GOSSEN METRAWATT

SSP-KONSTANTER 32 N
Series SSP 120, SSP 240 and SSP 320
Programmable Power Supplies

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I   Initial Inspection

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

Unpacking

Great care must be exercised when removing the electronic device from the package.

☞ Pull the **KONSTANTER** from its package.

☞ In doing so, do not grasp rotary knobs, terminals or jacks in order to avoid damage.

☞ Do not allow the **KONSTANTER** to fall out of the packaging. Controls, displays, terminals and internal components might otherwise be damaged.

☞ Do not, under any circumstances, touch the **KONSTANTER**'s electrical terminals before grounding yourself to the housing in order to neutralize potential differences. Sensitive electronic circuitry might otherwise be damaged as a result of electrostatic discharge.

☞ 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

(see chapter 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 under "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:

ATTENTION!

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 it into a source of danger. Intentional interruption is prohibited.

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.

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 voltage sources before work of this type is performed, in as far as this is possible. A five 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

CE   Indicates EC conformity

Observe EGB directives

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

1 Technical Description

1.1 Features and Range of Applications

Depending upon where they are used and prevailing local conditions, electrical and electronic devices may be subject to significant supply power fluctuation in the absence of stabilizing and back-up systems.
Automotive electrical system voltage characteristics during starter motor operation offer a typical example.
R&D, production and test departments must be able to assure that electrical equipment is capable of executing all required functions under these types of conditions.

Type SSP 120, SSP 240 and SSP 320 KONSTANTER power supplies from **GMC-I Messtechnik GmbH** support users in fulfilling this objective.

In particular in **automated test systems** for routine testing, SSP KONSTANTERs are capable of **high throughput rates**. **Short response times** assure **accurate emulation** of rapidly changing voltage and current characteristics.
Power consumer characteristics relative to **dynamic supply power** can thus be tested and simulated very easily.

The **integrated calibration procedure** and the **included calibration certificate** are especially important for **use in production and testing departments which are certified in accordance with ISO 9000**.

SSP KONSTANTERs (**s**ingle output **s**ystem **p**ower supplies are programmable, voltage and current regulated DC power supplies with 120, 240 or 320 W of output power.

They are microprocessor controlled, and are furnished with an addressable RS 232C serial interface as standard equipment. Up to 30 KONSTANTERs can thus be controlled from a single PC port.

An IEEE 488 interface can be integrated as an option. Complete control of all device functions, as well as querying of measured values, setting parameters and device statuses is possible via both interfaces.

Manual adjustment of voltage and current is accomplished by means of two rotary pulse encoders with selectable adjusting sensitivity.

Two 4-place multifunction displays are used for precision read-out of measured values (V, A and W), as well as for menu-driven configuration of numerous additional functions such as limiting setting ranges, overvoltage protection, overcurrent shutdown delay and programmable, digital signal inputs and outputs.

Up to 243 settings can be saved to memory and recalled either individually or sequentially, for example in order to generate specific voltage or current characteristics. And innovative circuit technology allows for nearly load independent response times of less than 1 ms.
Output parameters can thus be superimposed with AC signal right up into the kHz range via the analog interface which is furnished as standard equipment.

The measuring function includes a Min-Max value memory, limit monitoring signals and a HOLD function.

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 shutdown
- ❑ Start-up performance (power-on status)
- ❑ Reset device settings
- ❑ Save / recall device settings
- ❑ Save / recall setting sequences
- ❑ Sequence definition
- ❑ Trigger input function selection
- ❑ Function selection for digital control inputs
- ❑ Operating parameters for the measuring function (Min-Max value memory, limit monitoring, display resolution)
- ❑ Initialize calibration procedure
- ❑ Initialize self-test
- ❑ Operating parameters for computer interfaces (device address, SRQ masks, transmission speed etc.)

Display functions:

- ❑ Momentary measured voltage, current and power values
- ❑ Minimum and maximum measured voltage and current values
- ❑ Current device settings (individual or complete)
- ❑ Current operating status (control mode, overtemperature, busy)
- ❑ Occurred events (mains or phase failure, overtemperature, overvoltage, overload, programming error)
- ❑ Memory contents
- ❑ Device ID
- ❑ Calibration date

Protective Functions and Additional Functions

- ❑ Sensing terminals protected against polarity reversal and automatic switching to auto-sensing
- ❑ Control panel disabling
- ❑ Output overvoltage protection
- ❑ Output protected against reverse polarity
- ❑ Overtemperature protection
- ❑ Backup battery for device settings memory
- ❑ Master-slave series operation
- ❑ Inrush current limiting
- ❑ Temperature controlled fans (with 240 and 320 W models)

1.3 Options and Accessories

Options

(See order information on last page.)

Devices can be equipped with an IEEE 488 plug-in interface module for integration of SSP KONSTANTERs into IEC bus controlled systems.

The interface is in compliance with requirements set forth in the IEEE488.2 standard (IEC 625-2), and is frequently designated as a GPIB (general purpose interface bus) or an HP-IB (Hewlett Packard interface bus).

Programming of all device functions, as well as querying measured and configured parameters, is possible via the interface. Several specific interface functions are also provided.

The interface option is supplied as a separate plug-in module for easy, subsequent installation to the KONSTANTER.

Included accessories:

The following accessories are included with the SSP KONSTANTER:

- ❏ These operating instructions
- ❏ 1 mains power cable with earthing contact plug (approx. 1½ meters)

Additionally available accessories:

(See order information on last page.)

- ❏ 19" rack adapter, 1 x 32 N
  required for installation of one series SSP 32 N or SLP 32 N KONSTANTER to a 19" rack
- ❏ 19" rack adapter, 2 x 32 N
  required for installation of two series SSP 32 N or SLP 32 N KONSTANTERs to a 19" rack
- ❏ Mains jumper cable, 0.4 meters
  The cable is equipped with a 10 A inlet plug and a 10 A inlet socket. It is used for looping mains power through when several KONSTANTERs are mechanically combined into a multi-channel unit. In this way, the complete unit requires only one mains power cable.
- ❏ RS 232 bus cable, 2 meters
  For connecting one KONSTANTER to an RS 232 interface. (extension cable, 9-pin socket / 9-pin plug connector)

1.4 Functional Principle

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.

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

Operation

Generally speaking, all of the functions of the SSP KONSTANTER can be controlled with the adjusting elements at the front panel, via the RS 232 interface or via the optional IEEE 488 plug-in interface module.

Displays and Control Panel

Both 4-place 7-segment displays and the individual LEDs are controlled statically by the processor via the registers. Front panel key operations are processed by means of a group interrupt and subsequent direct querying. The rotary pulse encoders control the increment and decrement counters depending upon the direction of rotation. Each time an adjusting element is activated, an interrupt occurs at the CPU which then causes an appropriate response.

Interface Option

The SSP KONSTANTER with installed interface module allows for control via the IEEE 488 bus in addition to serial operation.

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 I/O controller of the respective function unit. 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 sensing terminals.

Actual output current is acquired as a voltage drop at a shunt situated 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 15 W continuous power). The sink function is implemented by means of BET technology (bidirectional energy transfer). This technology assures charging and discharging of the output capacitor within an equally short period of time, even at no-load operation. The sink function is activated as soon as, and for 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 functions are enabled when the output On / Off status is set to ON, and the source function is disabled when the status is set to Off, in which case the sink function is deactivated after approximately 300 ms (highly resistive output).

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 converter, controlled directly by the CPU, functions in accordance with the dual-slope principle and traces measured value acquirement back to a time measurement (meter reading). The actually measured decimal value is calculated based upon this data, and is stored to RAM. 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 interfaces' 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 operation 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
After bypassing the voltage monitor, 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 ("CV" LED blinks, status and events registers).

– Overcurrent Monitoring
Overcurrent monitoring can be activated and deactivated. Response time is defined with the delay parameter. If, with activated OCP function, the device is in the current regulating mode for at least the duration of the selected delay time ("CC" LED is illuminated), the power output is switched off and an OCP message is generated ("CC" LED blinks, status and events registers).

– Temperature Monitoring
Temperature is acquired by means of PTC resistors at representative points (circuit breaker heat sink), and is converted into a proportional electrical signal. As of an initial threshold temperature of approximately 70° C, fan voltage is increased in a linear fashion as temperature increases. The device can be operated at any output load up to the maximum specified operating temperature after the fan has been activated. If ventilation is impeded, or at excessive ambient temperatures, temperature at the sensor may reach the upper threshold of approximately 90° C. If this is the case, an overtemperature message is entered to the status and event registers. The output is deactivated by the CPU after 5 seconds, and OTP triggering is indicated by the blinking "Pmax" LED. 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

Power Supply

Connection	Input:	10 A IEC inlet plug
	Output:	10 A IEC inlet socket, without switch, without fuse

Line voltage 230 V ~ +10 -15%, 47 to 63 Hz

Power consumption See chapter 1.4.3

Inrush Current Max. 50 A_S

Mains fuse 1 ea. T 4 A / 250 V (6.3 x 32 mm, UL)
internal: 1 ea. T 5 A 250 V (5 x 20 mm)

Output

Connection

Output Front panel, 2 ea. 4 mm safety jacks
Rear , 6-pole plug-in screw terminal block

Sensor Rear panel, included in 6-pole plug-in screw terminal block

Analog interface Rear, 11-pole plug-in screw terminals

Regulator type Primary switched-mode regulator with BET technology

Operating modes Adjustable constant voltage / constant current source with automatic sharp transition

Output isolation Floating output with "safe electrical separation" from the mains input and computer interfaces
Max. allowable potential, output–ground: 120 V, capacitance, output–ground (housing) 60 nF

Output operating range
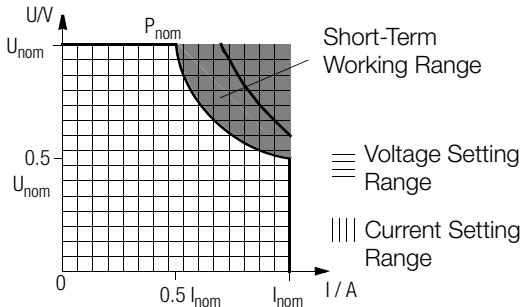
Short-term range:

If lengthy operation in the short-term range occurs, overtemperature protection may be triggered resulting in output shutdown (see also short-term power in chapter 1.5.3).

Dimensions in millimeter
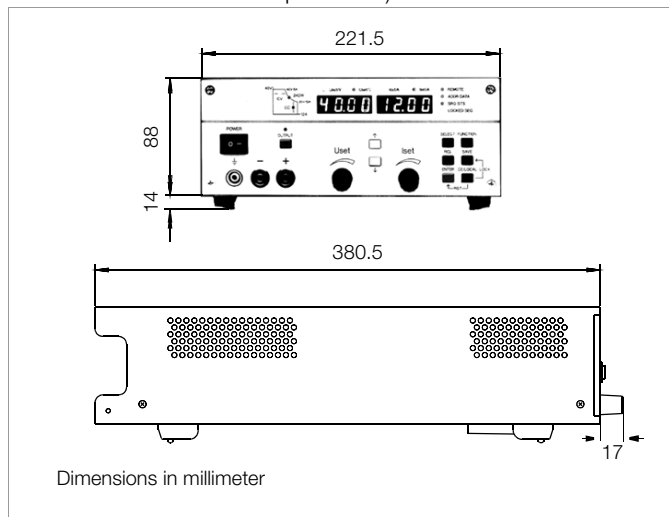
Figure 1.5 Dimensional Drawing (benchtop device)

Analog Interface

Connection 11-pole plug-in screw terminal block

Reference potential Output minus pole, floating TRG input

Connector pin assignments:

Pin	Designation	Function
1	SIG1 OUT	Digital, programmable, open-collector outputs (max. 30 V – / 20 mA)
2	SIG2 OUT	
3	TRG IN –	Digital, programmable control input (low: < 1.0 V, high: 4 ... 26 V), potential-free
4	TRG IN +	
5	+15 V	Auxiliary voltage, +15 V / max. 50 mA reference point, connected to -output
6	AGND	
7	U_{set} –	Analog, inverting voltage control input (0 ... –5 V correspond to 0 ... U_{nom}, $R_i = 10$ kΩ)
8	U_{set}+	Analog voltage control input (0 ... +5 V correspond to 0 ... U_{nom}, $R_i = 10$ kΩ)
9	I_{set}+	Analog current control input (0 ... +5 V correspond to 0 ... I_{nom}, $R_i = 10$ kΩ)
10	U-MON	Output voltage measuring output (0 ... 10 V correspond to 0 ... U_{nom}, $R_i = 9.8$ kΩ)
11	I-MON	Output current measuring output (0 ... 10 V correspond to 0 ... I_{nom}, $R_i = 9.4$ kΩ)

Addressable V.24 – RS 232C Interface

Input 9-pin subminiature socket connector

Output 9-pin subminiature plug connector

Operating mode half-duplex, asynchronous, XON / XOFF

Transmission speed adjustable from 50 to 19,200 bits per second

Device address selectable from 0 to 30 or UNL (unlist)

Max. Setting Rate approx. 15 settings per second

Max. Sampling Rate approx. 7 measurements per second

IEC 625 – IEEE 488 Interface (optional)

Connection 24-pin socket connector per IEC 625.1, IEEE488.1

Interface functions SH1 SOURCE HANDSHAKE handshake source function

AH1 ACCEPTOR HANDSHAKE handshake sink function

T6 TALKER talker function with serial polling and automatic unlisting, no secondary address and no talk-only operation

L4 LISTENER listener function with automatic unlisting, no secondary address and no listen-only operation

SR1 SERVICE REQUEST service request function

RL1 REMOTE / LOCAL remote to local switching function with disabling

DC1 DEVICE CLEAR reset 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

Codes / formats Per IEEE 488.2

Device address Selectable from 0 to 30 or UNL (unlist)

Max. setting rate Approx. 40 settings per second

Max. sampling rate Approx. 15 measurements per second

Electrical Safety

Safety class	I
Overvoltage category	II for mains input I for output and interfaces
Fouling factor	2
Earth leakage current	2.5 mA, typ.

IEC 61010-1:1990 + A1:1992 / DIN EN 61010-1: 1993 / VDE 0411-1:1994

DIN VDE 0160:1988 + A1:1989 class W1

EN 60950:1992 / VDE 0805:1990

Protection	IP 20 for housing per IEC 529:1989, EN 60529:1991, VDE 0470-1:1992
Electrical isolation	Test voltage
Mains/output–PE	1.35 kV~
Mains–output	2.7 kV~ (type test: 3.7 kV ~)

Electromagnetic Compatibility (EMC)

Product standard	EN 61326-1:1997 + A1: 1998
Interference emission	EN 55022:1998 class A
Interference immunity	EN 61000-4-2:1995, feature A EN 61000-4-3:1996 + A1:1998, feature B EN 61000-4-4:1995, feature B EN 61000-4-5:1995, feature B EN 61000-4-6:1996, feature B EN 61000-4-11:1994, feature B

Ambient Conditions

IEC 68-2-6 ('90)	Vibration resistance 10 ... 55 Hz, 0.3 mm, 1 octave / min., 3 x 30 min.
IEC 68-2-27 ('89)	Impact resistance (15 g, 11 ms, semi-sinusoidal, 3 x 6 shocks)
Temperature range	Operation: 0 to 50° C, current derating at > 40° C (see also chapter 1.5.3) Storage: -25 to +75° C
Relative humidity	Operation: ≤ 75%, no condensation allowed
Cooling	With integrated fan Inlet vent: side panel Outlet vent: rear panel

1.5.2   Mechanical Data

Type	Benchtop device, suitable for rack mounting
Dimensions	See also dimensional drawing in Figure 1.5
(W x H x D)	Benchtop device: 221.5 x 102 x 397.5 mm For 19" rack: ½19" x 2 standard height units x 400 mm
Weight	Approx. 2.8 kg IEEE 488 interface (optional): approx. 0.1 kg

1.5.3 Electrical Data

Electrical Data for 120 W Models

- Unless otherwise specified, all entries are maximum values and apply within an operating temperature range of 0 to 50° C, within the nominal power range and the nominal line voltage range of 230 V ±10% after a warm-up period of 30 minutes.

- Percentages make reference to the respective setting value or measured value.

Description (abbreviated name)		SSP 120-20	SSP 120-40	SSP 120-80
Type		32 N 20 RU 10 P	32 N 40 RU 6 P	32 N 80 RU 3 P
Nominal Output Data	Voltage setting range	0 … 20 V	0 … 40 V	0 … 80 V
	Current setting range	0 … 10 A	0 … 6 A	0 … 3 A
	Continuous power at $Tu \leq 40°$ C	max. 120 W	max. 120 W	max. 120 W
	Short-term power where t < 90 s / $Tu \leq 25°$ C	max. 200 W	max. 240 W	max. 240 W
	Current derating where $Tu > 40°$ C	-0.25 A / K	-0.15 A / K	-0.07 A / K
Output Characteristics				
Setting resolution [display (< 10.00 / ≥ 10.00), remote]	Voltage Current	5 mV / 10 mV, 5 mV 2.5 mA	10 mV 2 mA	20 mV 1 mA
Overall setting accuracy at 23 ± 5° C including system deviation (load / mains)	Voltage Current	0.15% +30 mV 0.4% +35 mA	0.15% +40 mV 0.5% +20 mA	0.15% +80 mV 0.5% +10 mA
Static system deviation [1] with 100% load fluctuation [1]	Voltage Current	15 mV 20 mA	10 mV 10 mA	10 mV 10 mA
Static system deviation [1] with 10% line voltage fluctuation [1]	Voltage Current	5 mV 8 mA	5 mV 5 mA	5 mV 5 mA
Residual ripple [1] $Ua > 5\% U_{nom}$	Voltage (10 Hz … 10 MHz) Current (10 Hz … 1 MHz)	$10 mV_{eff}$ $25 mA_{eff}$	$10 mV_{eff}$ $20 mA_{eff}$	$10 mV_{eff}$ $10 mA_{eff}$
Common mode noise (10 Hz … 1 MHz)		$0.5 mA_{eff}$	$0.5 mA_{eff}$	$0.5 mA_{eff}$
Settling time (voltage) with load step of 10 … 90% I_{nom}	Tolerance (Typical values) $\Delta I = 80\%$	40 mV 200 µs	80 mV 200 µs	160 mV 200 µs
Under and overshooting with load step of 50 A / ms	(Typical values) $\Delta I = 80\%$	400 mV	400 mV	800 mV
Response time (voltage) with setpoint jump from 0 → 100% with setpoint jump from 100% → 0	Tolerance No-load / nominal load No-load / nominal load	40 mV 1 ms / 1 ms 1 ms / 1 ms	80 mV 1 ms / 1 ms 1 ms / 1 ms	160 mV 4 ms / 4 ms 4 ms / 4 ms
Response time (current) with setpoint jump from 0 → 100% with setpoint jump from 100% → 0	Tolerance short-circuit / nominal load short-circuit / nominal load	100 mA < 5 ms / < 5 ms < 5 ms / < 5 ms	60 mA < 5 ms / < 5 ms < 5 ms / < 5 ms	30 mA < 10 ms / < 10 ms < 10 ms / < 10 ms
Measured Value Displays (4-place)				
Measuring resolution [display (< 10.00 / ≥ 10.00), query]	Voltage Current Power	2 mV / 10 mV, 2 mV 1 mA, 1 mA 0.1 W, 0.1 W	10 mV, 4 mV 0.6 mA, 1 mA 0.1 W, 0.1 W	10 mV, 8 mV 0.5 mA, 1 mA 0.1 W, 0.1 W
Measuring accuracy at 23 ± 5° C for values > 0.1% of the nominal value	Voltage Current Power	0.15% + 30 mV 0.4% + 25 mA 0.55% + 0.5 W	0.15% + 40 mV 0.5% + 15 mA 0.65% + 0.6 W	0.15% + 80 mV 0.5% + 10 mA 0.65% + 0.8 W
Protective Functions				
Output overvoltage protection, trigger value	Setting Range Setting resolution Setting accuracy	0 … 25 V 0.1 V 2% + 0.2 V	0 … 50 V 0.2 V 2% + 0.4 V	0 … 100 V 0.4 V 2% + 0.8 V
Reverse polarity protection load capacity	Continuous	10 A	6 A	3 A
Reverse voltage withstand capacity	Continuous	40 V	80 V	100 V
General				
Power supply [1]	Line voltage	230 V~ +10 / −15% 47 … 63 Hz	230 V~ +10 / −15% 47 … 63 Hz	230 V~ +10 / −15% 47 … 63 Hz
Power consumption	At nominal load In standby mode With maximum short-term power	280 VA, 180 W 45 VA, 15 W 450 VA	280 VA, 170 W 45 VA, 15 W 500 VA	280 VA, 170 W 45 VA, 15 W 500 VA
Efficiency	At nominal load	> 70%	> 80%	> 80%
Switching frequency	Typical	200 kHz	200 kHz	200 kHz
Article Number		**K320A**	**K321A**	**K322A**

[1] Specified values are increased by a factor of approximately 1.2 within the functional range for line voltage, namely -10% to -15%.

Electrical Data for 240 and 320 W Models

- Unless otherwise specified, all entries are maximum values and apply within an operating temperature range of 0 to 50 °C, within the nominal power range and the nominal line voltage range of 230 V $\pm$10 % after a warm-up period of 30 minutes.

- Percentages make reference to the respective setting value or measured value.

SSP 240-20	SSP 240-40	SSP 240-80		SSP 320-32
32 N 20 RU 20 P	32 N 40 RU 12 P	32 N 80 RU 6 P		32 N 32 RU 18 P
0 ... 20 V	0 ... 40 V	0 ... 80 V		0 ... 32 V
0 ... 20 A	0 ... 12 A	0 ... 6 A		0 ... 18A
max. 240 W	max. 240 W	max. 240 W		max. 320 W
max. 320 W	max. 360 W	max. 360 W		max. 430 W
-0.5 A / K	-0.3 A / K	-0.15 A / K		-0.5 A / K
5 mV / 10 mV, 5 mV 5 mA / 10 mA, 5 mA	10 mV 3.33 mA / 10 mA, 3.33 mA	20 mV 2 mA		10 mV 5 mA / 10 mA, 5 mA
0.15% +40 mV 0.5% +70 mA	0.15% +45 mV 0.5% +45 mA	0.15% + 80 mV 0.5% +25 mA		0.15% +50 mV 0.5% +70 mA
25 mV 30 mA	18 mV 30 mA	18 mV 15 mA		30 mV 40 mA
5 mV 8 mA	5 mV 8 mA	5 mV 5 mA		10 mV 20 mA
15 mV$_{eff}$ 50 mA$_{eff}$	15 mV$_{eff}$ 25 mA$_{eff}$	15 mV$_{eff}$ 20 mA$_{eff}$		30 mV$_{eff}$ 50 mA$_{eff}$ (Ua > 10%U$_{nom}$)
0.5 mA$_{eff}$	0.5 mA$_{eff}$	0.5 mA$_{eff}$		0.5 mA$_{eff}$
40 mV 600 μs	80 mV 300 μs	160 mV 200 μs		64 mV 500 μs
450 mV	450 mV	800 mV		450 mV
40 mV 1 ms / 1 ms 1 ms / 1 ms	80 mV 1 ms / 1 ms 1 ms / 1 ms	160 mV 4 ms / 4 ms 4 ms / 4 ms		64 mV 1 ms / 1 ms 1 ms / 1 ms
200 mA < 5 ms / < 5 ms < 5 ms / < 5 ms	120 mA < 5 ms / < 5 ms < 5 ms / < 5 ms	60 mA < 10 ms / < 10 ms < 10 ms / < 10 ms		180 mA < 5 ms / < 5 ms < 5 ms / < 5 ms
2 mV / 10 mV, 2 mV 2 mA, 10 mA, 2 mA	10 mV, 4 mV 2 mA / 10 mA, 1.2 mA	10 mV, 8 mV 0.6 mA, 1 mA		10 mV, 4 mV 2 mA, 10 mA, 2 mA 0.1 W, 0.1 W
0.15% +40 mV 0.5% +70 mA 0.65% +1.4 W	0.15% +40 mV 0.5% +25 mA 0.65% +1 W	0.15% + 80 mV 0.5% +15 mA 0.65% +1.2 W		0.15% +40 mV 0.5% +70 mA 0.65% +1.4 W
0 ... 25 V 0.1 V 2% +0.2 V	0 ... 50 V 0.2 V 2% +0.4 V	0 ... 100 V 0.4 V 2% + 0.8 V		0 ... 40 V 0.2 V 2% +0.4 V
20 A	12 A	6 A		18 A
40 V	80 V	100 V		64 V
230 V~ +10 / −15% 47 ... 63 Hz	230 V~ +10 / −15% 47 ... 63 Hz	230 V~ +10 / −15% 47 ... 63 Hz		230 V~ +10 / −15% 47 ... 63 Hz
510 VA, 350 W 45 VA, 15 W 620 VA	500 VA, 340 W 45 VA, 15 W 690 VA	500 VA, 340 W 45 VA, 15 W 690 VA		650 VA, 460 W 50 VA, 15 W 770 VA
> 68%	> 70%	> 70%		> 69%
200 kHz	200 kHz	200 kHz		200 kHz
K330A	**K331A**	**K332A**		**K334A**

[1] Specified values are increased by a factor of approximately 1.2 within the functional range for line voltage, namely -10% to -15%.

2 Initial Start-Up

2.1 Preparing for Operation

2.1.1 Installing the IEEE 488 Interface Module

⚡ **Warning!**
The KONSTANTER must be disconnected from the mains before installing the interface module. Switch the KONSTANTER off, and then pull the mains plug from the outlet. Wait at least 5 minutes before opening the KONSTANTER, in order to assure that the capacitors have been discharged to a safe voltage level. Capacitors may otherwise be charged with life endangering voltage, and coming into contact with them may result in severe injury.

⚠ **Attention!**
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 Disconnect the KONSTANTER from the mains, and pull the mains plug from the outlet. Wait for at least 5 minutes in order to assure that the capacitors have been adequately discharged.

② Loosen the 4 screws in the housing cover and lift the cover off.

③ Unscrew the cover plate at the left-hand side of the rear housing panel. Save the screws for use in the next step..
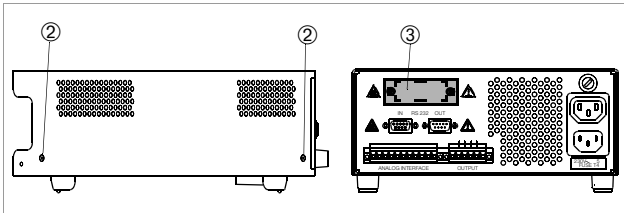

Figure 2.1.1 a   Opening the KONSTANTER Housing

④ The interface module:

With the ribbon cable facing forward, push the interface module through the housing rear panel and into the device interior.

Securely screw the sheet metal cover on the interface module to the housing rear panel from the outside. Use the two screws referred to in step③.

⑤ Insert the plug connector from the interface module into the connector strip on the primary printed circuit board. Do not twist the ribbon cable.
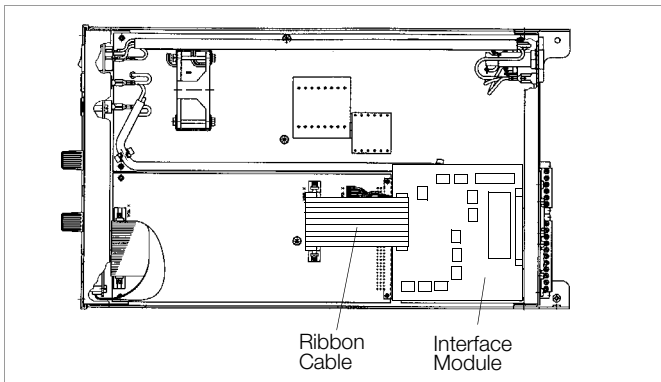

Ribbon Cable   Interface Module

Figure 2.1.1 b   Installing the Interface Module

⑥ Return the housing cover and secure it with the four screws. The KONSTANTER can now be connected as usual.

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. One KONSTANTER and a cover plate, or two devices next to each other can be installed to the rack.
The benchtop instrument can be quickly retrofitted for rack mounting.

Retrofit for Rack Mounting a Single Device

Use the accessory adapter: 19'' adapter 1 x 32 N.
This accessory components includes a 19'' abutment and a 19'' blanking plate.

① Loosen the 4 screws at the KONSTANTER front panel.

② Pull out the filler strips from the left and right sides.
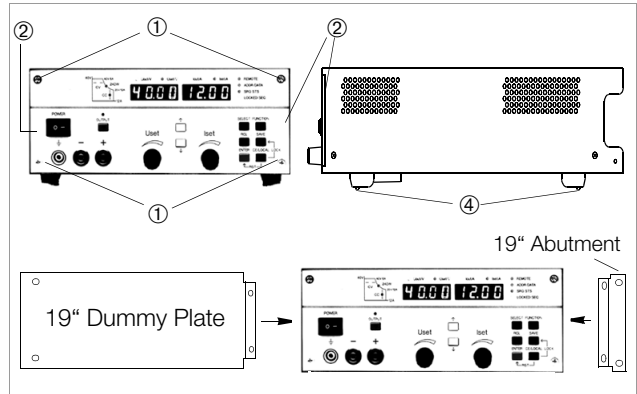
Figure 2.1.2 a Rack Installation of a Single KONSTANTER

③ Replace the filler strips with the 19'' abutment on one side, and with the 19'' blanking plate on the other side, and secure them with the four screws.

④ Unscrew the feet from the bottom of the housing. Remove the rubber inserts from the feet to this end. The screws are then exposed.

⑤ Now install the KONSTANTER to the rack. Save all loose parts for possible future use.

The KONSTANTER must be attached to guide rails at one side of the rack. The guide rails, as well as the front panel mounting screws used to secure the KONSTANTER, are rack-specific and must be procured from your rack supplier.

Retrofit for Rack Mounting Two KONSTANTERs

Use the accessory adapter: 19'' adapter 2 x 32 N.
This accessory component includes two 19'' abutments and one 19'' connector plate.

① Loosen the 8 screws at the KONSTANTER front panels.

② Pull out the filler strips from the left and right sides of each device.
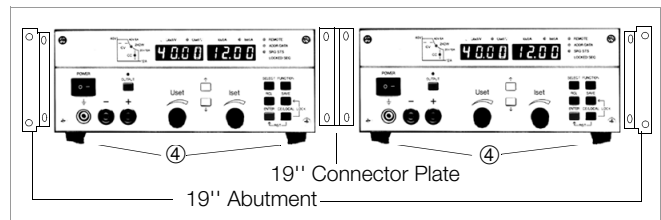

19'' Connector Plate
19'' Abutment

Figure 2.1.2 b   Rack Installation for Two KONSTANTERs

③ Replace the filler strips with the 19'' abutments at the far left and far right, and with the 19'' connector plate in the middle, and secure them with the eight screws.

Screw both housings to the through-holes and threads in the plug protector at the rear.

④ Unscrew the feet from the bottom of the housing. Remove the rubber inserts from the feet to this end. The screws are then exposed.

⑤ If you would like to electrically connect the two KONSTANTERs, use the "mains jumper cable" and "RS 232 bus cable" accessories.

⑥ Install the two devices to the rack. Save all loose parts for possible future use.

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

2.1.3 Combining Benchtop Devices

Up to 3 benchtop KONSTANTERs can be stacked in combination (see also chapter 5 for electrical connection options via the analog interface).

① Unscrew the feet from the bottom of the housing. Remove the rubber inserts from the feet to this end. The collar screws are then exposed.
Four oblong slots now become visible at the bottom of the housing.

② Turn the 4 collar screws from the feet into the 4 threaded holes on the top of the other device housing. Save the 4 retaining washers and feet for possible future use.

③ Set the KONSTANTER without feet onto the top of the other KONSTANTER. The screws from the bottom KONSTANTER must protrude through the oblong slots in the base of the other KONSTANTER. Carefully push the top KONSTANTER back until the screws snap into place.

④ Screw the two KONSTANTERs together via the through-holes and threads in the plug protector at the back. The top KONSTANTER is thus secured against shifting.

⑤ If you would like to electrically connect the two KONSTANTERs, use the "mains jumper cable" and "RS 232 bus cable" accessories.

2.1.4 Connection to the Mains

Observe WARNING I!

⚠ **Attention!**
Before switching the KONSTANTER on, is must be assured that available mains power complies with the supply power values specified at the mains connection on the back of the device.

The KONSTANTER requires **230 V ~ supply power**. Connect the mains inlet plug at the rear panel to a mains outlet with earthing contact using the included power cable.
Rated power consumption is specified on the serial plate at the bottom of the KONSTANTER.

A mains outlet is included above the mains inlet plug for looping mains power through to an additional KONSTANTER.
This mains outlet can neither be switched on and off, nor is it protected with a fuse.

⚡ **Warning!**
If mains power is looped through, make sure that overall current consumption does not exceed 10 A at the incoming supply lines!
Suitable "mains jumper cables" are available as accessories (see order information on last page).

2.1.5 Connecting Power Consumers

The output leads are connected either at the front panel with 4 mm safety plugs to the "+" and "–" safety jacks, or at the rear panel to the "+" and "–" outputs at the 6-pole screw terminal. If loads are connected to both the front and the rear panel (not allowed in the event of parallel connection due to danger of overload!), constant voltage regulation applies to the terminals at the rear panel. There are two terminals each for "+" and "–" for load connection at the rear panel.

> In the case of load current of greater than 10 A, these terminals must be parallel connected due to the specified contact rating.
> 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.

The yellow-green safety jack at the front panel is connected to PE, and can be used to connect ground cables or cable shield, or can be used as an earth connection point for one of the output poles.

2.1.6 Connection to Computer Interfaces

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

Comments

- The KONSTANTER 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 KONSTANTERs 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.

- Interface configuration is described in chapter 4.7.4.

RS 232C Interface

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.
A suitable cable with a length of approximately 2 meters is available as an accessory for connecting the KONSTANTER and the controller. Cables with other lengths are commercially available. Appropriate adapters are available as well, in the event that your controller is equipped with a 25-pin plug connector.
If you would like to fabricate the connector cable yourself, you'll need a 3-conductor shielded cable in order to establish connection as shown in Figure 2.1.6 a.
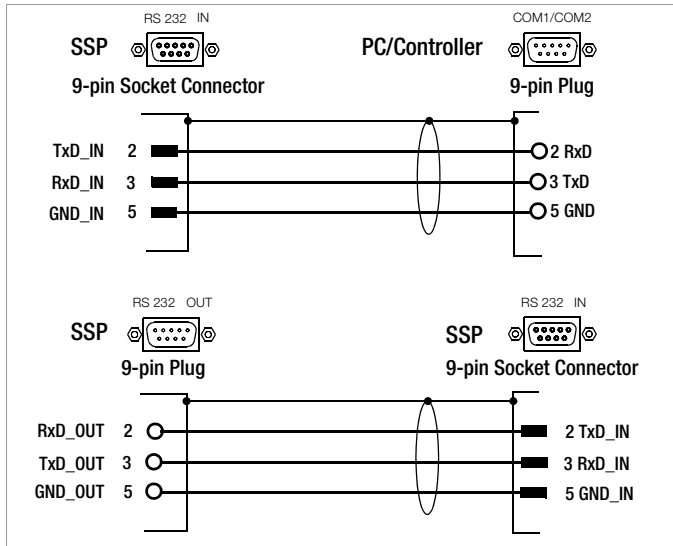
Figure 2.1.6 a   Pin Assignments for 9-Pin Plug and Socket Connectors

The **serial interface** furnished with this KONSTANTER series is **addressable**. Up to **30 KONSTANTERs** can be addressed via this interface.
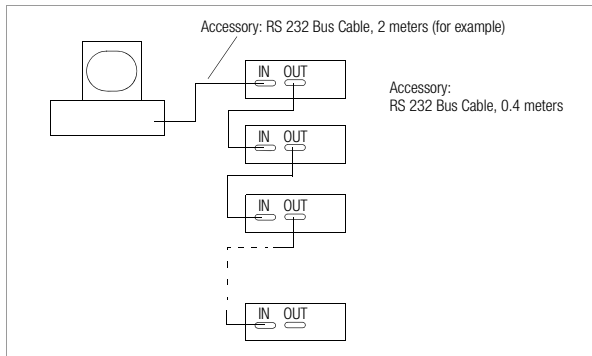

Figure 2.1.6 b   Interconnection via the Serial Interface

If RS 232 communication is to be expanded to several KONSTANTERs, additional arrangements must be made regarding data protocols.

Addressing

A separate address is assigned to each interconnected KONSTANTER. If the KONSTANTER receives its own address, it is switched to the "addressed" status after which it accepts all subsequent commands and data, until it is unlisted upon receipt of a different device address.

In compliance with IEEE 488, an address range of 0 to 31 is used, although address 31 is reserved as a general unlist command (UNL). The serial interface's device address is thus identical to the address of the optional IEEE 488 interface (if included).

Universal Commands

In addition to the command

　　Addr xxDevice address,

other general commands can be used which are accepted without previous addressing.

　*TRG　Trigger command, synchronization

　DCL　Device clear

　IFC　Interface clear

Explanations of these commands and their syntax are included in chapter 6.

Data Queries

If a device (slave) is requested to return data to the controller, it may not be addressed in the interim. In other words, the controller must wait until all requested data have been fully received. No data may be transmitted to any other devices during this period of time.

In the case of **multiple device serial operation**, **good timing** must be assured. Data collision is thus avoided, which may result in interruption of data transfer and deletion of output buffer contents.

If the slave does not respond within a specified period of time (TIMEOUT), the controller can try to synchronize the device with a universal command, or execute a reset and request the required data once again.

IEEE 488 Interface

- Up to 15 IEC bus controlled devices (including the controller) 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'll need a suitable adapter cable.

  In order to assure reliable data transfer, the cable length between any two devices should not exceed 2 meters, and overall length should not exceed 15 meters.

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

2.2　Switching the Instrument On

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

- Press the mains switch [1] at the front panel until it snaps into place in order to turn the device on.

Power-Up Test

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 setup memory)

– ROM test

– RAM test

– Initialize computer interfaces if installed

– Ascertain device type

– Check the A-D converter timer

– Recall last settings if required

The "LOCKED/SEQ" LED [12] 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 optional "IEEE 488 computer interface", the selected IEC bus device address then appears briefly at the display (e.g. "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 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	25 V (for 20 V models)
	50 V (for 40 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 69):

- Default settings or
- Last used device settings or
- Last used device settings with 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 one 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-back configuration 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

Note: Numbers in brackets make reference to the figures included below.
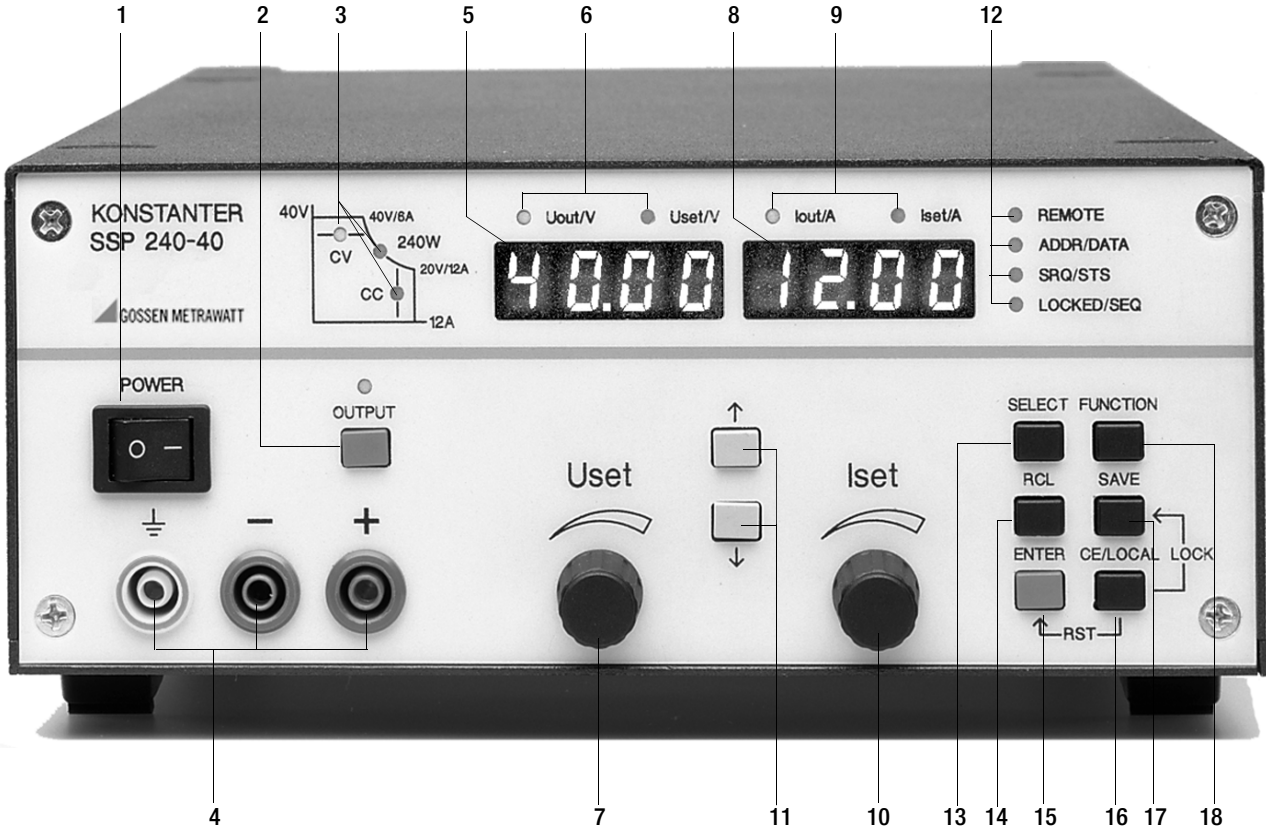
[1]   Mains Switch <POWER>

For turning the KONSTANTER on and off
After switching the KONSTANTER on, a self-test is performed with a duration of approximately 8 seconds. After successful completion of the self-test, the KONSTANTER briefly displays its interface address and the version number of the installed firmware, one after the other. The **POWER-ON** function then configures the device with predetermined settings and the device is ready for use.

When the KONSTANTER 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 setup memory, are retained.

[2]   Output On-Off Key <OUTPUT>

The power output can be activated and deactivated by pressing the <OUTPUT> key. The **red LED** above the <OUTPUT> key is illuminated as long as the output is active.
No significant output voltage overshooting occurs when the output is activated and deactivated.

Activation sequence:
If the power output is activated, current and voltage are initially set to "0" for transition from the "highly resistive" state. Setpoints do not become active until after this transition has been completed.

Deactivation sequence:
Current is set to 0 A and voltage to 0 V for approximately 350 ms. A sink is thus activated which discharges the output capacitors to the greatest possible extent. The sink is then deactivated and the output becomes highly resistive. However, the output terminals are not electrically isolated.

[3]   Control Mode, Protective Function and Status Displays

No LEDs light up: Output has not been activated

LEDs lights up:

Indicates the output's operating status (control mode) if it has been activated:

Green CV LED   Constant voltage regulation (Uout = Uset)

Green CC LED   Constant current regulation (Iout = Iset)

Blinking LED:

Indicates the reason for automatic deactivation of the output

Green CV LED   OVP (overvoltage protection)
                          Overvoltage protection has been triggered, because output voltage has exceeded the selected trigger value **OVP / OVSET**.

Possible causes:

☞ **Voltage setpoint USET** has been **set too high** manually, 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)

☞ **Unipolar power recovery** from the connected consumer (e.g. DC motor)

☞ 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).

☞ Parallel connected voltage sources

Green CC LED   OCP (overcurrent protection)
Overcurrent protection is active.
If the **OCP ON** function has been activated, the output was operated for a duration of **t > DELAY** in the current limiting mode (current regulation). The output has been deactivated.

Possible causes:

☞ **Current setpoint ISET** has been **set too low** manually, memory recall, programming error or Iset control signal to the analog interface

☞ **Current transients** caused by switching inductive consumers (**DELAY** time may be set too low)

Yellow Pmax LED   OTP (overtemperature protection)
Electronic power limiting has been triggered (overload! Pout > Pnom).

Possible causes:

☞ **Impaired cooling**, e.g. air inlet or exhaust vents are obstructed.

☞ **Excessive ambient temperature**
The KONSTANTER 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.

☞ The **fan** has **failed**.

☞ A **device error** or **defect** has occurred.

After the cause of triggering has been eliminated, the output can be reactivated.

[4] Output

Selected constant voltage or constant current is available from the safety jacks at the front panel.

– blue	Negative output pole
+ red	Positive output pole
⏚ yellow-green	Earth connection point for the output or shield terminal if shielded output leads are used. The ground terminal is connected to the housing and the earthing contact at the mains connection.

The power consumer can also be connected to the OUTPUT interface **[22]** at the rear panel.

[5] Left-Hand Display with [7]

[6] Display Parameter Indicators (LEDs)

As a **default setting**, the **measured output voltage value Uout** appears in volts at the left-hand display.
The display can be switched to the **momentary measured voltage value Uset** by **slightly turning** the **voltage adjusting knob** [5], or by pressing the **<ENTER>** key.
The LEDs allocated to the display indicate which value is being displayed (**green** LED = measured value, **yellow** LED = setting value).

• Uout / V (gr) =   Measured output voltage value in V

• Uset / V (ye) =   Output voltage setpoint in V (blinking indicates that the displayed value has not yet been set)

If no adjustment is made for a period of 10 seconds during the display of a setting value, the display returns to Uout automatically.
Additional KONSTANTER functions can be selected with the **<SELECT>**, **<FUNCTION>**, **<RCL>** and **<SAVE>** keys. The function code or the parameter name appears at the left-hand display in this case.

[7] Rotary Knob for Voltage Adjustment <Uset>

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, whose setting resolution (step size per pulse) can be set to either coarse, medium or fine with the **<SELECT>** function. 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 **Uset** 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 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 the measured voltage value **Uout**. The display can be immediately switched to the **Uout** value by pressing the **<CE/LOCAL>** key.

☞ Detailed explanations are included in chapter 4.6.

[8] Right-Hand Display with [10]

[9] Display Parameter Indicators (LEDs)

As a **default setting**, the **measured output current value Iout** appears in amperes at the right-hand display.
The display can be switched to the **momentary current setpoint Iset** by **slightly turning** the **current adjusting knob** [8], or by pressing the **<ENTER>** key twice.
The LEDs allocated to the display indicate which values are being displayed (**green** LED = measured value, **yellow** LED = setting value).

• Iout/A (gr) =   Measured current value in A

• Iset / A (ye) =   Current setpoint in A (blinking indicates that the displayed value has not yet been set)

If no adjustment is made for a period of 10 seconds during the display of a setting value, the display returns to Iout automatically.

Additional KONSTANTER functions can be selected with the **<SELECT>**, **<FUNCTION>**, **<RCL>** and **<SAVE>** keys. The respective measured value or setting parameter appears at the right-hand display in this case.

[10] Rotary Knob for Adjusting Current <Iset/A>

The same applies to this rotary knob, with reference to output current, as is also the case with the voltage adjusting knob [5].

[11] Parameter Adjusting Keys <↑> and <↓>

The <↑> (increment) and <↓> (decrement) keys are used to select or adjust all KONSTANTER functions and their parameters.

☞ Detailed explanations are included in chapters 4.6, 4.7 and 4.14.

[12] Interface Displays: REMOTE, ADDR, SRQ, LOCKED

The respectively illuminated LED indicates the current operating state of the computer interface:

REMOTE on: The KONSTANTER is being remote controlled, front panel controls are disabled.

ADDR/DATA on: The KONSTANTER has been addressed and is receiving or transmitting data (applies to IEC bus operation only).

SRQ/STS on: The KONSTANTER is transmitting a service request.

LOCKED/SEQ on: **Indicates that manual controls are disabled:** Front panel controls are disabled and protected against unauthorized or inadvertent change. This display only applies to disabling of the front panel controls by means of manual operation or a control signal applied to the **TRIGGER** input (for **T_MODE LLO**). It does not indicate disabling of manual switching to local control by means of the IEC bus **LOCAL LOCKOUT** command.

blinking: **Sequence mode display in disabled and enabled state:** – Slow blinking: sequence in hold status – Fast blinking: sequence in run status **Sequence mode display** and disabling: LLO is displayed when any key or rotary knob is activated (local lockout).

[13] Function Selection Key <SELECT>

• Selection of displayable measured values

• Resolution of display values and setting values

☞ Detailed explanations are included in chapters 4.6, 4.7 and 4.8.

[14] Recall Key <RCL>

Recall of stored KONSTANTER settings, value pairs (Uset and Iset) and any associated dwell time setting for possible readjustment.

☞ Detailed explanations are included in chapter 4.10.

[15] <ENTER> Key

The **<ENTER>** key is used for several functions:

• Execute selected functions

• Acknowledge selected text parameters

• Go to the next lowest function menu level

• Switch the display from **Uout / Iout** to **Uset / Iset** with active cursor

  Setpoint changes are acknowledged with the **<ENTER>** key in this mode.

• Move cursor back and forth between Uset and Iset in the Uset / Iset display

• Activate the recalled memory location

☞ Detailed explanations are included in chapters 4.6, 4.7 and 4.12.

[16] <CE/LOCAL> Key

This key has several functions:

• Abort an operation

• Switching from remote to local control

• Disable front panel controls

• In combination with special functions

☞ Detailed explanations are included in chapter 4.13.

[17] Save Key <SAVE>

• Saves device settings, value pairs (Uset and Iset) and any associated dwell time. In the manual mode, this key also fulfills the function of the **STORE** computer command.

• Disabling of front panel controls in order to prevent inadvertent or unauthorized changes to settings is only possible in combination with the <**CE/LOCAL**> key.

☞ Detailed explanations are included in chapter 4.9.

[18] Function Selection Key <FUNCTION>

No special key is assigned to device functions which are normally seldom adjusted or used. These functions are controlled in a menu-driven fashion.

☞ A description of the menu and the procedure for setting all functions and parameters is included in chapter 4.7.

[19] RS 232 Interface

☞ Detailed explanations regarding remote control of KONSTANTER functions via the RS 232 serial interface are included in chapter 2.1.3.

☞ Interface-specific commands are included in chapter 6.4.

[20] IEEE 488 Bus Connection

Connection for remote control of KONSTANTER functions:

☞ Detailed explanations are included in chapter 2.1.1.

☞ Interface-specific commands are included in chapter 6.4.

⚠ **Attention!**
The electrical contacts of all interfaces are connected to components which may be damaged by electrostatic discharge. Neutralize potential differences between yourself and the device by grasping the housing before touching these contacts!

[21] 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, or –5 to 0 V

☞ chapter 5.8 / chapter 5.4

- External measurement or recording of output voltage and current based on monitor signals, 0 to 10 V

☞ chapter 5.4 / chapter 5.5

- Supply external controllers with +15 V auxiliary power
- Linking of several devices for master-slave operation

☞ chapter 5.9 / chapter 5.10

- Varying the internal output resistance value

☞ chapter 5.8

- Control of a selected device function via the floating trigger input

☞ chapter 5.7

⚠ **Attention!**
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!

⚠ **Attention!**
All of the control cables connected to the analog interface should be shielded. Ground the shield directly to the device using the shortest possible connection lead. One of the threaded holes for the plug protector at the rear panel can be used for this connection. Use a suitable screw and washer to secure the connection and assure good contact.

[22] OUTPUT Interface

The output interface offers two options:

- Take constant voltage or constant current from the terminal strip at the rear panel of the KONSTANTER.
- Connect sensing leads for compensation of voltage drops in the output leads

☞ chapter 5.3

[23] Exhaust Vents

The exhaust vents are required for regulating the temperature inside the device. Warm air generated during operation of the device is discharged via these vents with the help of a temperature controlled fan.

⚠ **Attention!**
The exhaust vents may not be closed or obstructed, because heat accumulation inside the device may result in malfunctioning, failure or damage to the KONSTANTER.

[24] Mains Input

Mains input with looped through mains outlet for inlet plug. The looped through mains outlets make it possible to directly connect up to three devices using two short power cables with inlet plugs. In this way, only one mains power cable is required to operate all three devices.

[25] Mains Fuse

Fusing for the 230 V mains power input

All devices: T 4.0 A / 250 V (6.3 x 32 mm)

⚡ **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 absolutely prohibited ("repairing" fuses, short-circuiting fuse holders etc.).
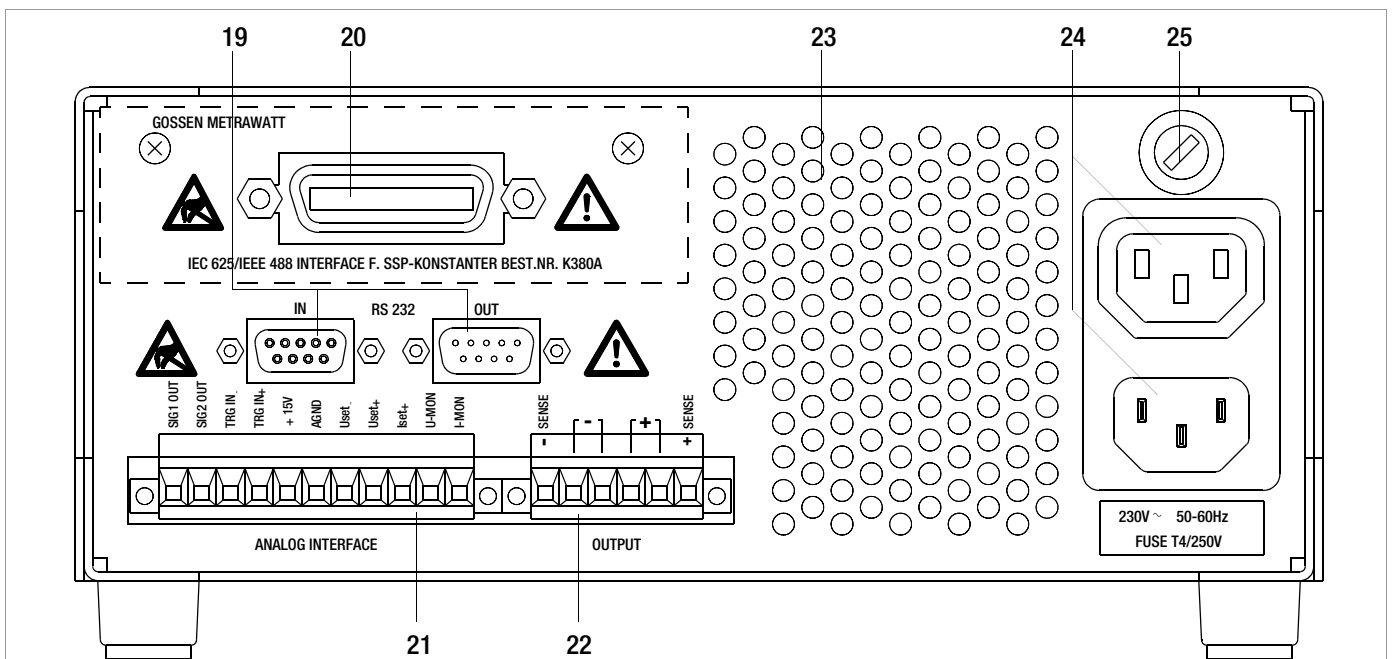
4 Manual Operation and Device Functions

4.1 Menu Structure

After the power-up sequence has been completed, the device is switched to the basic operating mode 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 protection and overcurrent shutdown

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

- SEt   (setup) extended   Setup functions
- AnlF   (analog interface)   Analog interface settings
- SEq   (sequence function)   Sequence function settings
- bUS   (computer interface)   Interface configuration settings
- CAL   (calibration menu)   Balance the KONSTANTER

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 and Output Current

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 scroll 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 scroll 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, current 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 above 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 state. Depending upon the selected output quantities and the load situation, either output voltage or output current is regulated. CV (constant voltage) indicates voltage regulation, and CC (constant current) indicates 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 above the display. The blinking decimal place indicates the resolution with which adjustment will take place. Resolution can be adjusted with the <SELECT> 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 scroll keys, in which case resolution can also be pre-selected.

- **Initializing the Procedure**
  - ☞ **Slightly turn** (1) the **Uset** knob [7].
  - ! 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** [6] goes out and the **yellow Uset/V LED** [6] lights up. **Continuous illumination of** the **Uset/V LED** indicates that values are activated immediately during adjustment.

- **Selecting Resolution**
  - ! **3 step widths** are possible: **0.01 V**, **0.1 V** or **1 V**.
  - ! The **blinking decimal place** [5] indicates which **step width** will be used for setpoint adjustment.
  - ☞ Repeatedly press the **<SELECT>** key [13] 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 [7]:
    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).
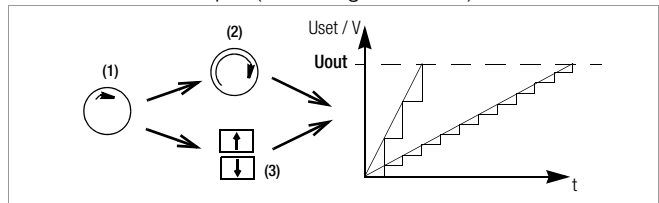
Figure 4.2.1 a   Continuous Adjustment of Uset

- ☞ Adjust (3) with the <↑> key or the <↓> key [11]
  <↑> (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 – Output Voltage

- Adjustment with the **Uset rotary knob** [7] is not enabled until 0.4 seconds after the digital display [5] 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 value always appears at the display [5].

- If no adjustment is made for a period of 10 seconds, the display automatically returns to the measured voltage value Uout. The display can be **immediately switched** to the Uout value by pressing the **<CE/LOCAL>** key [16].

- 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 enabling.

Iset – Output Current

The procedure for selecting output current **Iset** is identical to the procedure for selecting output voltage **Uset** (4.1.2).

However, the following controls and displays must be substituted:

- Iset rotary knob (chapter 3 [10]
- Right-hand display (chapter 3 [8])
- Yellow Iset/A LED (chapter 3 [9])
- **Setting resolution**:
  4 step widths are possible: 0.001 A / 0.01 A / 0.1 A / 1 A

Attention: Iset may not be set to a value which exceeds **Ilim**!
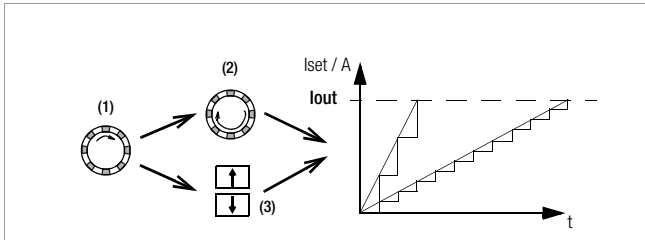
4.2.2 Pre-selected Setting (ENTER, scroll keys)

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 with 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 LEDs above 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 scroll keys (and only with the scroll 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] starts blinking.
  ! **A blinking Uset/V LED** 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, 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.

☞ 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**.
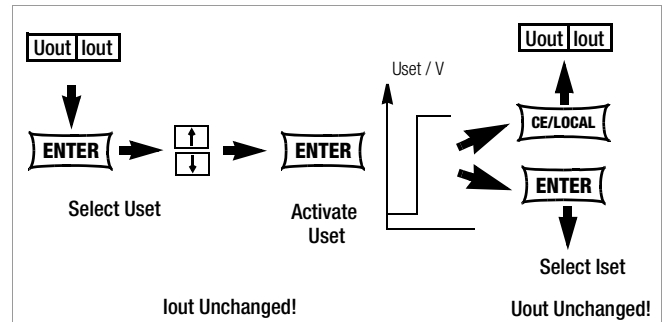
Figure 4.2.2 a   Adjusting Uset with a Specified Fixed Value

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

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

4.3 Switching the Power Output On and Off

The <**OUTPUT**> key (chapter 3 [2]) functions independently of the current operating state of the KONSTANTER.

Details regarding control mode, protective function and status displays which provide information concerning the output's operating mode are included in chapter 3 [3].

Closed Loop Control Mode

The power output can be activated or deactivated by pressing the <**OUTPUT**> **key [2]**.

OUTPUT OFF ↔ OUTPUT ON

REMOTE status (remote control)

(chapter 3 [12], chapter 4.13)

The <**OUTPUT**> key [2] is disabled and has no function.

LOCAL LOCKED status (front panel controls disabled)

(chapter 3 [12], chapter 4.13)

The <**OUTPUT**> key [2] is disabled and has no function.

trG out (T_MODE OUT) and External Trigger Active

The output can be activated an 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 [4/22]) is indicated by the **red LED** above the <**OUTPUT**> **key [2]**:
   LED on   = output activated
   LED off   = output deactivated

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

If the output has be deactivated as a result of **overtemperature protection**, the **yellow "240 W" LED [3]** in the control mode display blinks. 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 25	page 69
OCP	Overcurrent protection	page 26	page 68
Pon (POWER_ON)		page 26	page 69
SEq	Sequence	chapter 4.7.4	page 70
trG (T_MODE)		page 28	page 74

4.4 Limiting the Allowable Working Range: Ulim, Ilim

Allowable setting limits for voltage and current can be restricted 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 scroll keys. New settings become immediately active.

Attention!

These settings represent so-called soft limits. This means that values can be selected both manually and via the computer interface which lie within these limit values, 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

Functions

- **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

See description on page 25.

Ilim – Setting the Upper Current Limit Value

Functions

- **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

See description on page 25.

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

Functions

- **Protection** for the connected power consumer
- If voltage at the output terminals exceeds the selected **OVP** 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 for 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 **CV** LED blinks as soon as overvoltage protection **OVP** is triggered (see also chapter 3 **[3]**), 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" ⑥ red **OUTPUT** LED lights up).

Settings

See description on page 25.

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 **CC** LED blinks as soon as overvoltage protection **OCP** is triggered (see also chapter 3 **[3]**), 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 ⑥ red **OUTPUT** LED lights up).

Settings

See description on page 26.

dLY – Output Off Delay for OCP

Functions

- Delay time prior to deactivation of the power output after current regulation has been triggered (**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 over (at 00.00).
- The default setting after **RESET** (***RST**) is 00.00.

Settings

See description on page 26.

4.6 Display of Momentary Output Values Uout, Iout and Pout

Uout – Momentary Measured Voltage Value

- Appears at the **left-hand display** [5].
- The **green Uout/V** LED [6] 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 [16].

Iout – Momentary Measured Current Value

- Appears at the **right-hand display** [8].
- The green **Iout/A** LED [9] 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 [16].

Pout – Display Momentary Output Power

Calculated internally based upon momentary measured values Uout and Iout.

Settings

See description in chapter 4.8.1.

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 in chapter 4.8.1.

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	Ulim	NP: xx.xx
	Ilim	NP: xx.xx
	OVP	NP: xxx.x
	OCP	TP: **oFF** / on
	dLY	NP: xx.xx
	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_¯
	SiG1	TP: oFF / on / out / Mode / SEq / SSEt / U-Lo / U-Hi / I-Lo / I-Hi
	SiG2	TP: oFF / on / out / Mode / SEq / SSEt / U-Lo / U-Hi / I-Lo / I-Hi
■ Sequence Function		
SEq*	tSEt	NP: xx.xx
	SSEt	NP: **oFF** / on
	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
■ Adjustment (calibration, chapter 7)		
CAL	dAtE	TP: mm.yylast/new adjustment date
	CAL	TP: Strt
	MEAS	UoFF
	UoFF	NP: x.xxxentry of ext. measured value U
	MEAS	UFS
	UFS	NP: xx.xxentry of ext. measured value U
	MEAS	IoFF
	IoFF	NP: x.xxxentry of ext. measured value I
	MEAS	IFS
	IFS	NP: xx.xxentry of ext. measured value I
	CAL	End

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 **<SELECT>** key.
- Select with the **<↑>** key or the **<↓>** key.
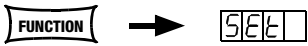- Displayed value = selected value.

TP: Text Parameters

- Select parameter with the **<↑>** key or the **<↓>** key.
- Acknowledge the selected value by pressing the **<ENTER>** key.

Settings

☞ Press the <FUNCTION> key [14] 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 upon pressing the **<FUNCTION>** key.

FUNCTION ➡ SEt

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 groups menu** by pressing the **<CE/LOCAL>** key.
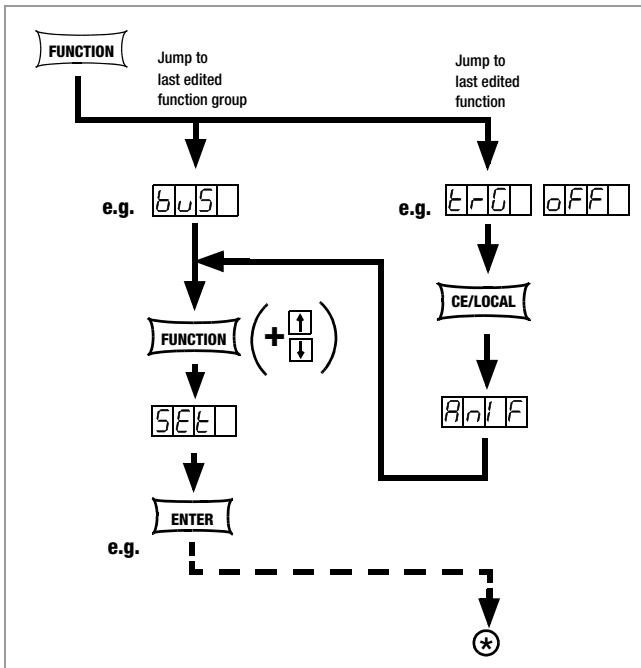
Figure 4.7 a   Accessing the Functions Submenu

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

FUNCTION ➡ SEt
AnIF
SE9
buS
CAL
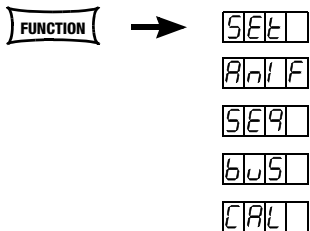
☞ If the desired function group does not appear immediately at the left-hand display, repeatedly press the **<FUNCTION>** key until the name of the desired function group appears at the **left-hand display** (SEt in this example).

- **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.
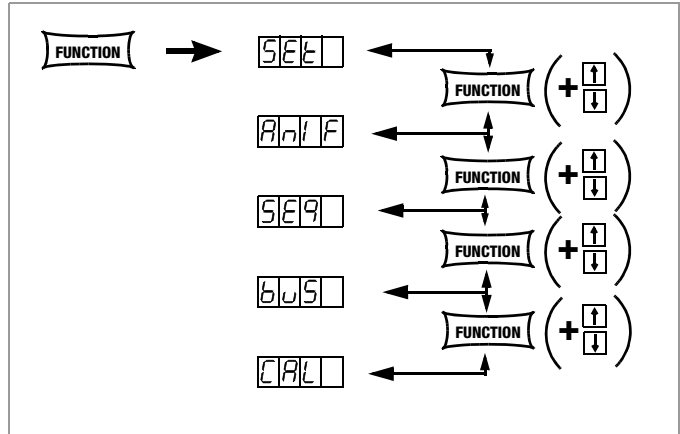
Figure 4.7 b   Switching Amongst Individual Function Groups

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 should make it easy to configure device functions and parameters without leafing back and forth through the instructions.

4.7.1 SET – "Setup" Function Group
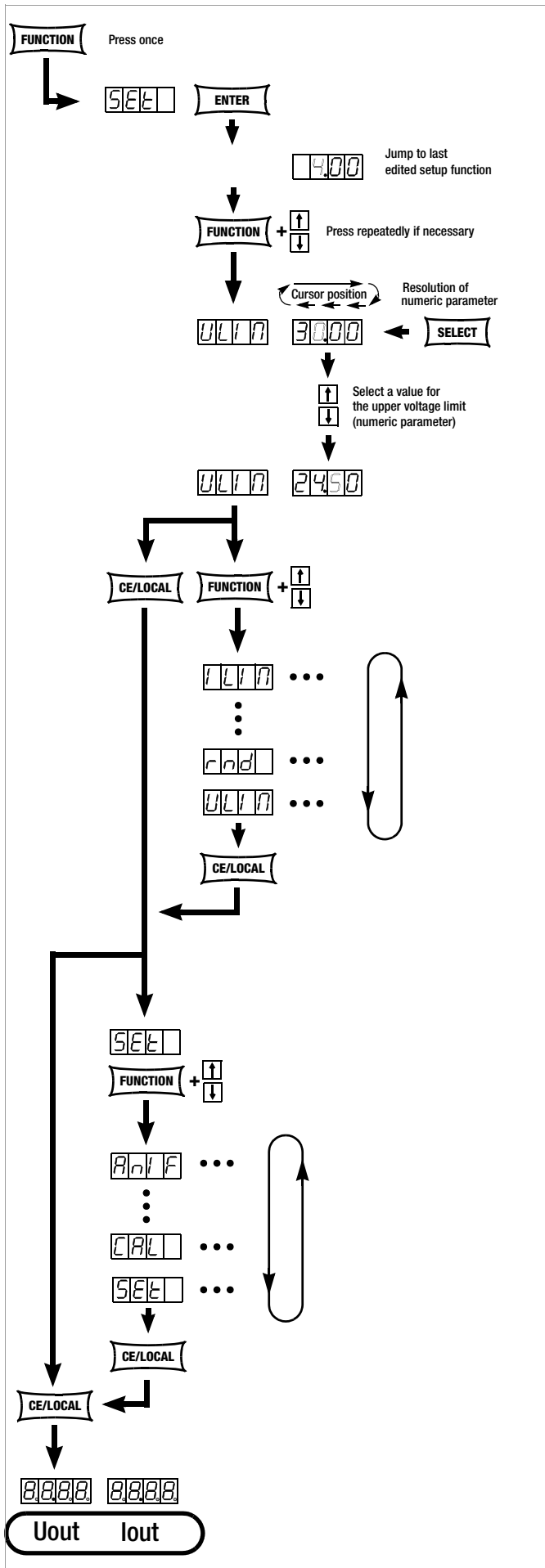
Figure 4.7.1 a   Path to Ulim Settings

Ulim – Upper Voltage Setting Limit

Functions

See functions description on page 22.

Settings

The procedure is described in principle in chapter 4.7.

! The Ulim display appears in the window for the setup function, along with a related numeric parameter [V].

Ilim – Upper Current Setting Limit

Functions

See functions description on page 22.

Settings

The procedure is described in principle in chapter 4.7.

! The Ilim display appears in the window for the setup function, along with a related numeric parameter [A].

OVP – Overvoltage Protection Trigger Value

Functions

See functions description on page 22.

Settings

The procedure is described in principle in chapter 4.7.

! The **OVP** display appears in the window for the setup function, along with a related numeric parameter [V].
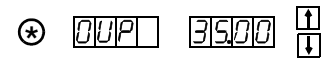
☞ The **OVP** trigger value should be set at least 1 V higher than the desired **USET** output voltage in order to prevent undesired triggering of the **OVP** function resulting from overshooting due to sudden output discharging (minimum values: chapter 1.5.3, "Electrical Data")!

☞ 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 **OVP** and **USET** must be correspondingly increased during sensing mode operation.

☞ The selected **parameter** becomes immediately active!

Note

• 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:

Uout = ISET [A] x 200 [μs] / Cout [μF]

ISET = selected current setpoint

Cout = 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 Unom = 1 V included in chapter 1.5.3.

• Possible causes for triggering overvoltage protection are listed in chapter 3 [3], "Control Modes".

OCP – Overcurrent Protection

Functions

See functions description on page 22.

Setting Parameter

☞ **OFF: OCP** function **is 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.

☞ The selected text parameter does not become active until the <**ENTER**> key is pressed!

Settings

The procedure is described in principle in chapter 4.7.

! The **OCP** display and a related text parameter appear in the setup function window.
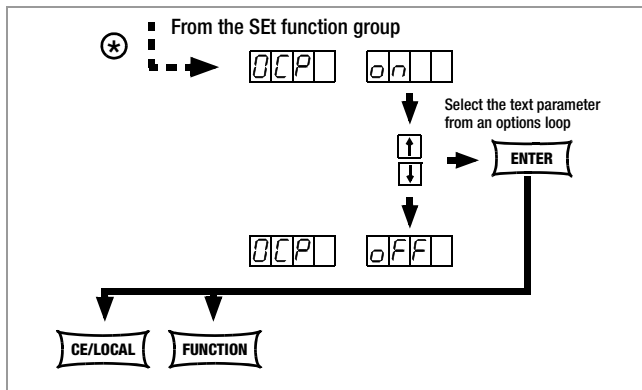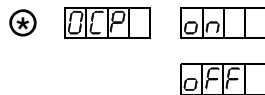
Figure 4.7.1 b   Path to Selection of the OCP Text Parameter

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.

## dLY – Output Off Delay for OCP

Functions

See functions description on page 23.

Settings

The procedure is described in principle in chapter 4.7.

! The **DELAY** display appears in the window for the setup function, along with a related numeric parameter [t].
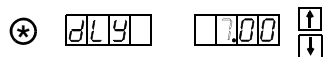
Pon – Specifying a Power-On Status

Functions

• Use automatic 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 panel controls are re-enabled after mains ON.
From firmware version 4.003 onwards:
Disabled panel controls remain blocked even after mains ON.

☞ **rcl (RECALL)** Same settings as prior to shutdown.
Disabled panel controls remain blocked even after mains ON.

Settings

The procedure is described in principle in chapter 4.7.

! 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 KONSTANTERs 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_⁻ – 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 the **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.

Setting Parameter

- ☞ **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 the momentary measured value:

Umin	= Uout	Umax	= Uout
Imin	= Iout	Imax	= Iout

Settings

The procedure is described in principle in chapter 4.7.

- **!** The **UI_⁻** display and a related text parameter appear in the setup function window.
- ☞ Default setting after **RESET** (*RST): **OFF!**
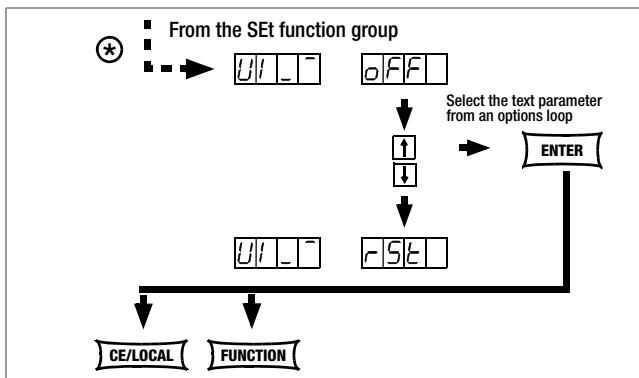
Figure 4.7.1 d   Path to Selection of the Pon Text Parameter

rnd – Rounding Off the Displayed Measured Value

Functions

- Only effective for Uout and Iout measuring function
- Number of decimal places which appear at the display
- Stabilizes the display when fluctuation is expected at the last decimal place of the measured value

Setting Parameter

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

Settings

The procedure is described in principle in chapter 4.7.

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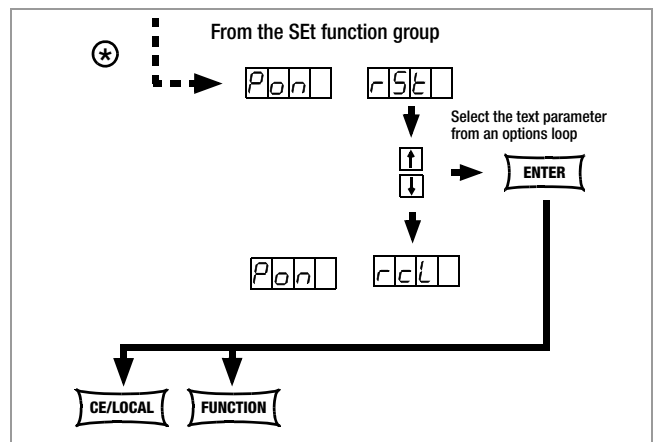

Figure 4.7.1 e   Path to Selection of the rnd Text Parameter

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

4.7.2 AnIF – "Analog Interface" Function Group

The analog interface allows for remote control of the KONSTANTER.
An isolated digital control input (**TRG IN+ / TRG IN-**) and digital signal outputs (**SIG1 / SIG2**) are available in addition to analog setting options.
Other devices can be controlled in this way (e.g. counters, alarms, SSP KONSTANTERs and many more). A **master-slave** system can be set up in combination with a second or several SSP KONSTANTERs (see also chapter 5).
Observe specified **maximum current and voltage values** for signal outputs.

---

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 Parameter

☞ **OFF:** Trigger input function is deactivated, signals at the trigger input are ignored.

☞ **OUT:** Trigger input influences the **OUTPUT**: output on / off

TRIGGER Signal	Influence on OUTPUT Status
LOW	Status depends upon manual setting or programming command
LOW _↑⁻ HIGH	OUTPUT remains OFF or OUTPUT is switched OFF
HIGH	OUTPUT in the OFF state, cannot be switched on – neither manually nor with a programming command
HIGH ⁻↓_ 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 → High	Start trigger signal
HIGH	• 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 → 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 increasers 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:** Controlling 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 _↑⁻ HIGH	The SEQUENCE function is started beginning with the start address, **SEQUENCE GO**
HIGH ⁻↓_ 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, no activation 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⁻ ON)

TRIGGER Signal	Influence on Min-Max Status
LOW	The Min-Max function is active.
LOW _↑⁻ HIGH	The Min-Max function is deactivated. Levels in the in Min-Max memories remain unchanged.
HIGH	The Min-Max function is inactive.
HIGH ⁻↓_ LOW	Values in the Min-Max memories are 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** ② see also chapter 4.7

! The **trG** display and a related text parameter appear in the **AnIF** function window.
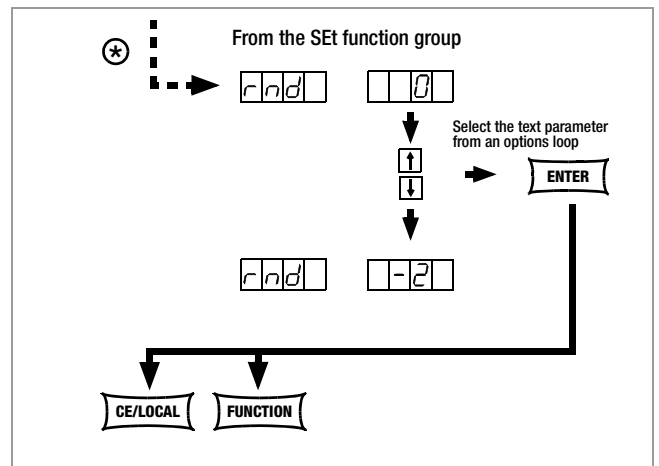
☞ Default setting after RESET (*RST): **unchanged**

![trG]	oFF
	out
	rcL
	SEQ
	LLO
	UI_⁻
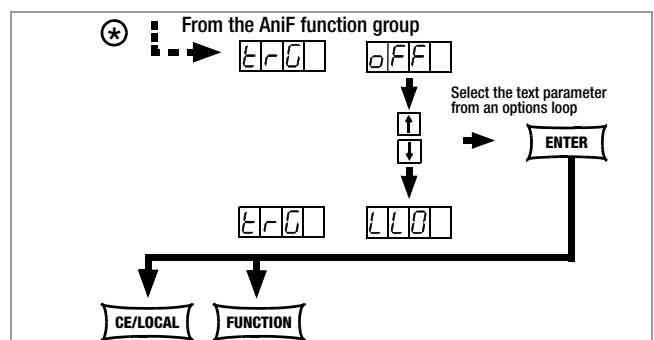
Figure 4.7.2 a   Path to Selection of the trG Text Parameter

SiG1 – Signal Output 1

Functions

- Digital open collector output with reference to AGND, max. switching voltage min. 30 V DC, max. switching current min. 20 mA (e.g. ext. load shedding relay).
  Indicates the status of the power output.

- If an event occurs which is associated with the selected parameter, a corresponding signal is generated at the output.

- Used to link the OUTPUT function via the trigger input in the case of parallel or series (master-slave) connection of several SSP KONSTANTERs.

- Control of an external output relay is possible.

- As a status signal for monitoring devices

- As a freely assignable switching output

Setting Parameters	SIG1 OUT Status
☞ OFF	Always passive high
☞ ON	Always active low
☞ OUT	
Power output:	
OUTPUT ON	Passive high
OUTPUT OFF	Active low
☞ ModE	
Control mode signal:	
Constant current regulation	Active low
Overload (Pmax)	Active low
Constant voltage, output Off	Passive high
☞ SEq	
Status with running sequence	Active low
☞ SSEt	
If SSEt is set to ON for special memory location in the SEQUENCE [1], otherwise	Active low Passive high
☞ U_LO	
Umeas < Uset (reference value memory Umeas ≥ Uset254)	Active low Passive high
☞ U_HI	
Umeas > Uset (reference value memory Umeas ≤ Uset255)	Active low Passive high
☞ I_LO	
Imeas < Iset (reference value memory Imeas ≥ Iset254)	Active low passive high
☞ I_HI	
Imeas > Iset (reference value memory Imeas ≤ Iset255)	Active low Passive high

[1] The SSEt parameter must be set to ON for a certain memory location in the SEQUENCE function group.

☞ When the SEQUENCE is run, an signal is additionally generated for the read-out of Uset and Iset when this particular memory location is executed.

☞ The signal is available at the outputs of the analog interface (SiG1 / SiG2 / SiG1 + SiG2) for the respectively selected dwell time tSEt or tdEF.

Setting

☞ **Procedure** for selecting **Sig1:** see also chapter 4.7, "Settings".

! The **Sig1** display and a related text parameter (status) appear in the **AnIF** function window.

Si.G1	oFF
	on
	out
	ModE
	SEq
	SSEt
	U-Lo
	U-Hi
	I-Lo
	I-Hi
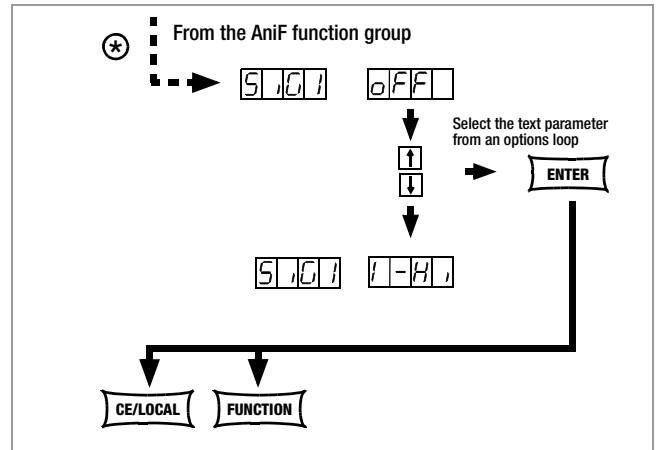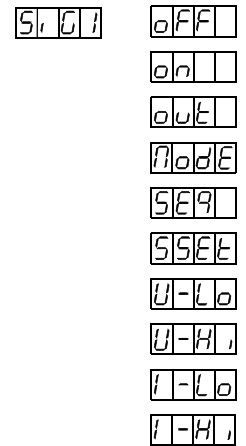
Figure 4.7.2 b   Path to Selection of the SiG1 Text Parameter

SiG2 – Signal Output 2

Function and Parameters

☞ Identical to **SiG1**, page 29

Settings

☞ Identical to **SiG1**, page 29

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. In addition, a signal for external processing can be specified for each test step (**Sset**).

.
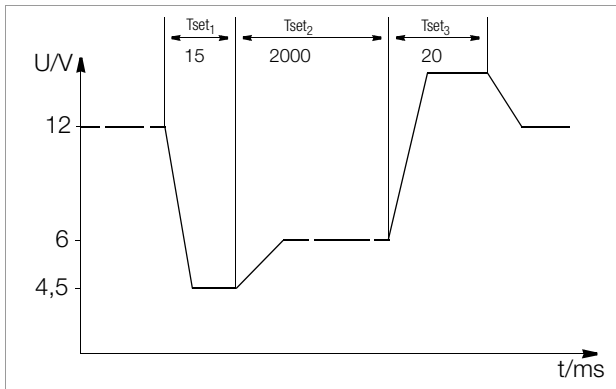
Figure 4.7.3 a   Test Signal to Electrical System Simulation during Start-Up

Test sequences can be saved, and changed as required.

The test 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, tSEt and SSEt values which have been stored to memory with the <SAVE> function.

Memory Occupancy

- A defined memory location (addresses 11 through 255) is assigned to each test step which contains specified setpoints for USEt, ISEt, tSEt and SSEt.
- 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.
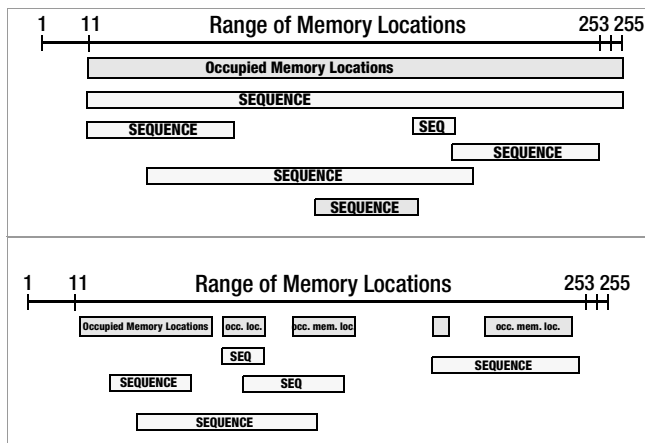
Figure 4.7.3 b   Range of Memory Locations and Sequences

Responses to Sequence Start and Stop

- 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 contains 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 bit 7 SEQI in event register A (ERA).

Number of Repetitions and Remaining Repetition Counters

- 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, (rEP = 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.

tSEt – Memory Location-Specific Dwell Time

Functions

Special dwell time (see also Figure 4.7.3 a):

- For the voltage-current value pair at a specific memory location within a **SEQUENCE**
- For all status signals generated for these memory locations

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.

Values include **rise time** and **decay time** (see also Figure 4.7.3 a). Edge times are only assure 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):

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

Figure 4.7.3 c   Path to tSEt Settings

☞ Set resolution, i.e. the decimal place (cursor position) of the numeric parameter, by repeatedly pressing the **<SELECT>** 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.

SSEt – Setting a Digital Switching Function

Functions

- **Preparation** of the SSP KONSTANTER for the read-out of a status signal from a specific memory location.
- The duration of the signal depends upon the dwell time, **tSEt** or **tdEF**, selected for the memory location.
- The signal is read out to the analog interface's **SiG1 and/or SiG2** outputs.
- **Prerequisite**: The desired output (SiG1, SiG2 or SiG1 and SiG2) must be prepared with the **SSEt** parameter in the **AniF** function menu (see also page 29).

Setting Parameter

☞ **OFF:** No status signal

☞ **ON:** Signal outputs prepared for read-out of a status signal

Settings (see sequence settings and execution on page 35)

☞ **Procedure** for selecting **SSEt, (**see also chapter 4.7 **"Settings"**):

! The **SSet** display and a related text parameter appear in the **SEq** function window.
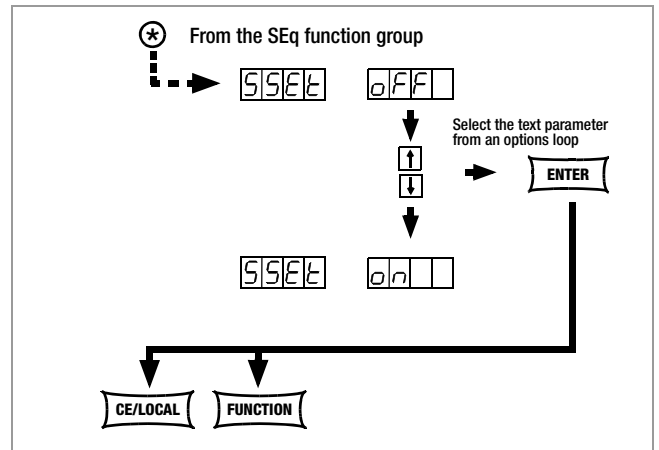
Figure 4.7.3 d   Path to Selection of the SSEt Text Parameter

☞ Select the desired parameter with the <↓> key or the <↑> key.

☞ Acknowledge your selection with the **<ENTER> key.**

! Parameters can be scrolled through in a loop with the <↓> key or the ↑> key.

☞ Advance through the **SEq** functions menu by pressing the **<FUNCTION>** key or the <**FUNCTION**>+<↓> and <↑> keys, or press the <**CE/LOCAL**> key to jump back to the function group menu (**FUNCTION**).

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)**
  – For all status signals generated for these memory locations

- **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**, **Iset** 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].
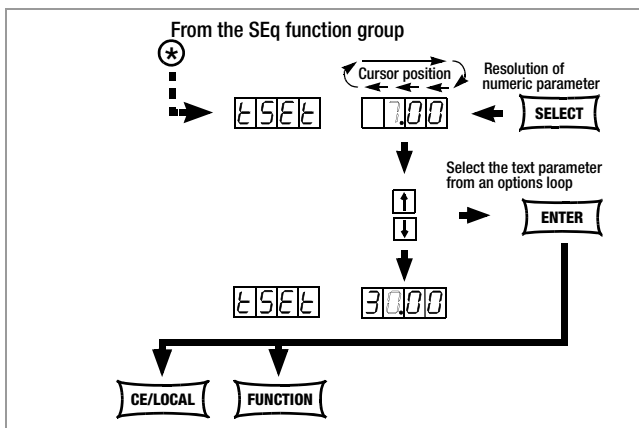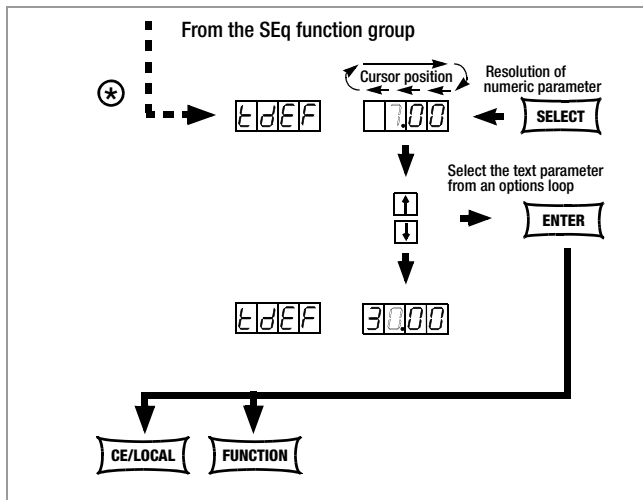

Figure 4.7.3 e   Path to tdEF Settings

☞ Set resolution, i.e. the decimal place (cursor position) of the numeric parameter by repeatedly pressing the **<SELECT>** 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 **before initially starting a new SEQUENCE**.

- The **last selected start** address is always valid for any given **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 Parameter

11	Lowest possible memory location **Strt** address
255	Highest possible memory location **Strt** address
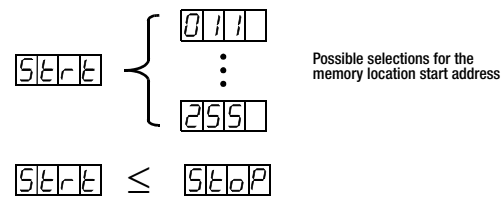
Settings (see sequence settings and execution on page 35)

☞ **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.
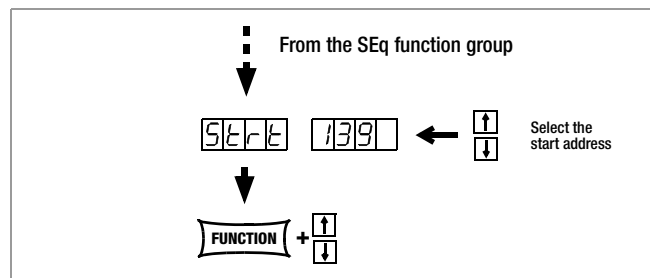
Figure 4.7.3 f   Path to Start Address Selection

☞ 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 **before 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 stop address.
- ! The contents of the memory location with the **stop** address are executed as the last function (reP $\neq \infty$).

Setting Parameter

11	Lowest possible memory location **stop** address
255	Highest possible memory location **stop** address

Possible selections for the memory location stop address

$$StoP \geq Strt$$
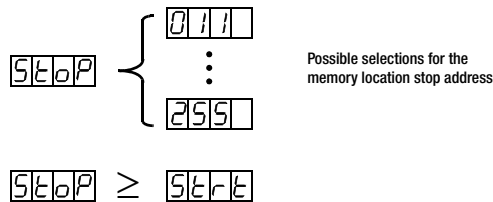
Settings (see sequence settings and execution on page 35)

☞ **Procedure** for selecting **StoP,** see also chapter 4.7:

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

From the SEq function group

Select the stop address
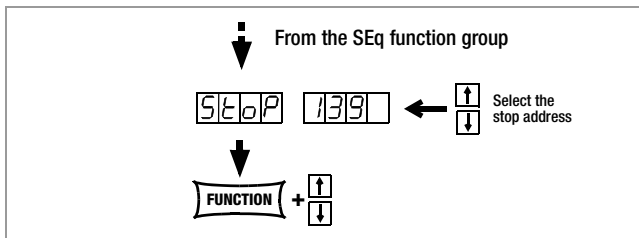
Figure 4.7.3 g   Path to Stop Address Selection

☞ Select the memory location with 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 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 the **setup** memory as a device setting with the **SAVE** key.

Setting Parameter

cont	Continuous repetition until the **sequence** is stopped manually (page 36 ff,) or by means of computer control (page 70)
1 ... 255	Number of possible repetitions

Settings (see sequence settings and execution on page 35)

☞ **Procedure** for selecting **rEP, (**see also chapter 4.7**):**

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

From the SEq function group

Select a value for number of repetitions
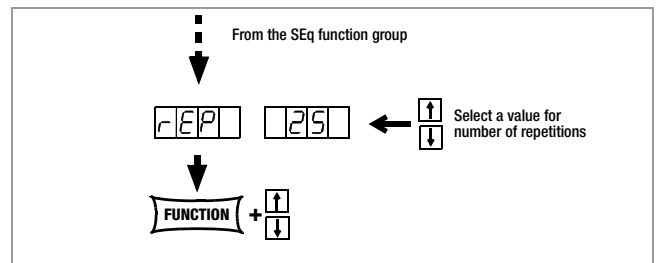
Figure 4.7.3 h   Path to rEP Setting

☞ Select the desired number of repetitions 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 numeric parameter (number of repetitions) is used as a default setting.

SEq – Sequence, Automatic Memory Recall

Functions

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

Setting Parameter

☞ **Strt: select step-by-step control** , jump to start address (status: RDY → HOLD), execute command with the **<ENTER>** key.

☞ **GO: select SEQUENCE**, jump to start address and start (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** runs 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 start (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**):**

! 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.
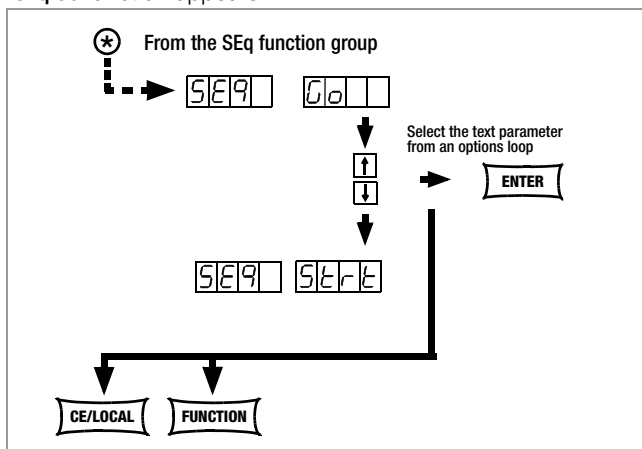
Figure 4.7.3 i   Preparing a **SEQUENCE**

☞ Acknowledge the sequence with the **<ENTER>** key.
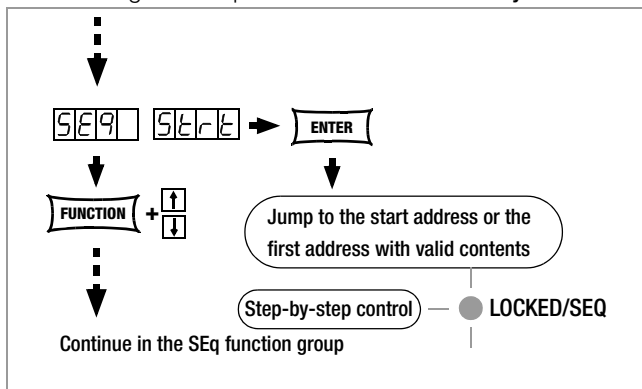
Figure 4.7.3 j   Preparing for **Step-by-Step Control**

! The first valid memory location is now executed, and the values saved to this location (**Uset**, **Iset** and **SSEt**) are read out to the power output and the signal output.
The LOCKED/SEQ LED blinks slowly ⎯⏺ LOCKED/SEQ .
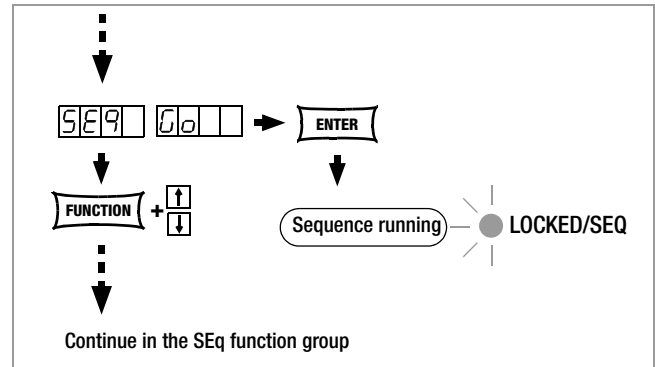
Figure 4.7.3 k   Preparing for Automatic **SEQUENCE** Control

! 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**, **tdef/tset** and **SSEt**) are read out to the power output and the signal output.
The LOCKED/SEQ LED blinks rapidly. ⎯⏺ LOCKED/SEQ .

Note

! Automatic and step-by-step sequence control (external trigger or setting command) are **not interlocked**.

! After the SEQUENCE run 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).

☞ The procedure shown in Figure 4.7.3 l must be used for setting up and starting **sequences** for **SSP KONSTANTERs** with software version < REL. 003.

In this case, **sequences** can only be set up and started if the **SEQ ON** test parameter has been selected after entering the **SEq** menu.
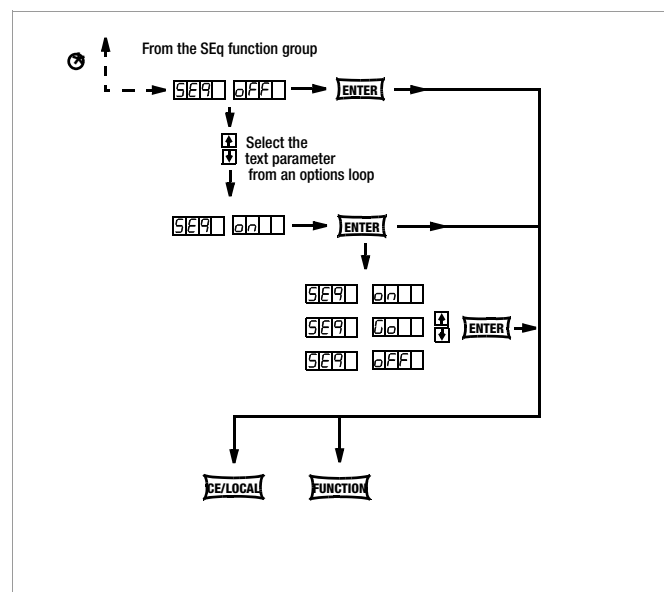
Figure 4.7.3 l   SEQUENCE preparation with software version < REL. 003

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 groups** or **functions** menu appears.

3. If the functions 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 value 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 <↓> or the <↑> key if necessary, and continue by pressing the <FUNCTION> key.

8. Set **SSEt** to **on** or **oFF** with the <↓> key or the <↑> key.

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, tset** and **SSEt** , and continue until all values have been entered for the entire **sequence**. Use rotary knobs only for **Uset and Iset** settings. Press the <FUNCTION> and <↑> keys for **tset** settings. Press the <FUNCTION> key only for **SSEt** 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 display, indicating that the **sequence** can now be started.

22. Press the <ENTER> key. The sequence is run using the selected values.

Jump from the Uset / Iset settings to the last edited function, or from a 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 LOCKED/SEQ 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.
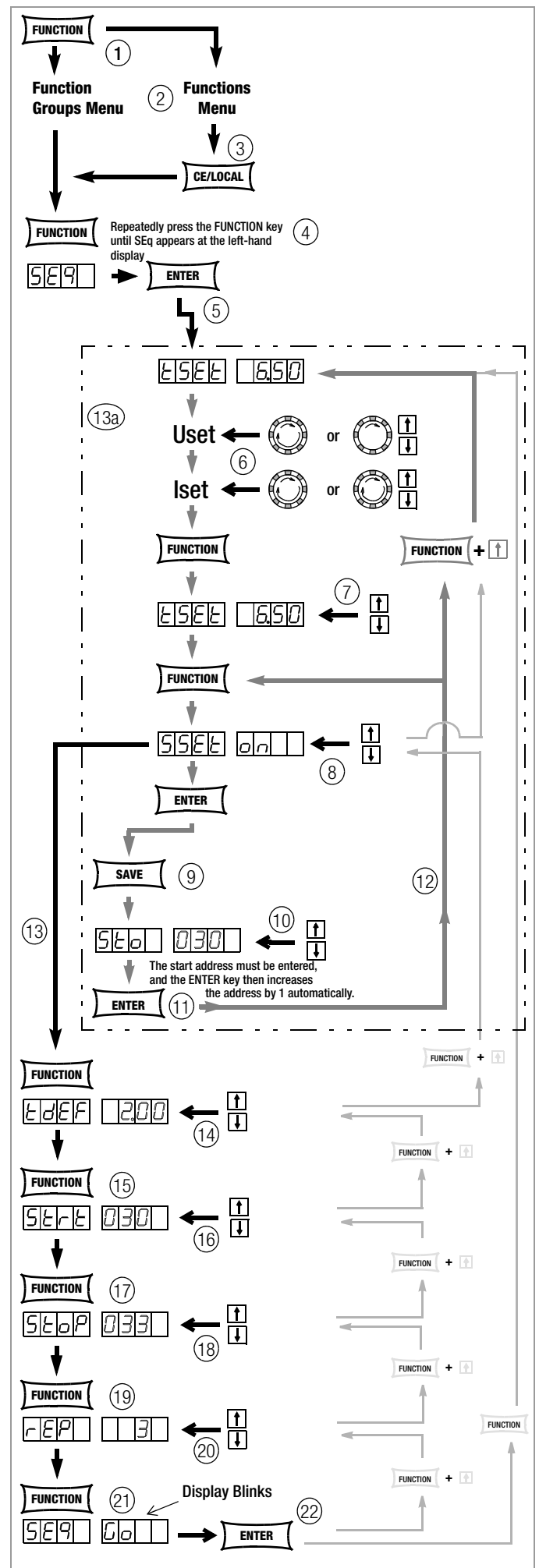
Figure 4.7.3 m   Setting all Required Values for a **SEQUENCE**

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
> **U_** = min. output voltage
> **U¯** = max. output voltage
> **I_** = min. output current
> **I¯** = max. output current
> **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
> **SSEt** = output level for **SSEt** switching function

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 70).
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, Iset and Sset 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. The selected dwell time of the exited and the new memory address is 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 output on status.

Procedure:

☞ With **interrupted** or **running sequence,**
– press the <FUNCTION> key and then browse with the <↑> key, the <↓> 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 LOCKED/SEQ LED blinks slowly in the HOLD status**.**

Execute 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. The selected dwell time of the exited and the new memory address is not taken into consideration.

• The output retains its switching status (output On or Off).

• When jumping from the stop address to the start 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 <↓> 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 LOCKED/SEQ 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 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, Iset and Sset 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 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.

Stop Sequence at Current Address (status: RUN → HOLD)

Functions

! A running **SEQUENCE** can be suspended for an indefinite period of time.

• Uset, Iset and Sset 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 <↓> or the <FUNCTION> key
until SEq **hold** appears
and execute the command with the <**ENTER**> key.

! The command is executed when the key is released.

! The **SEQUENCE** stops at the current address.

! The LOCKED/SEQ 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 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**, **tdef/tset** and **SSEt**) are read out to the power and signal outputs.

! 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 <↓> or the <FUNCTION> key
until SEq **cont** appears
and execute the command with the <**ENTER**> key.

! The command is executed when the key is released.

! The **SEQUENCE** is resumed starting with the next memory location.

! The LOCKED/SEQ LED blinks rapidly in the run status.

End 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, Iset and Sset 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 of the current location is not taken into consideration.

• The output status is determined by the content 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 <↓> 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 content of the stop address.

! The LOCKED/SEQ LED does not blink in the RDY status.

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

Functions

! A suspended **SEQUENCE** can be ended at the current address at any time.

• Uset, Iset and Sset retain the values specified in the current memory location. Selected dwell time Tset of the 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 LOCKED/SEQ 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**, **tdef/tset** and **SSEt**) are read out to the power and signal outputs.

Procedure:

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

! The **SEQUENCE** is restarted.
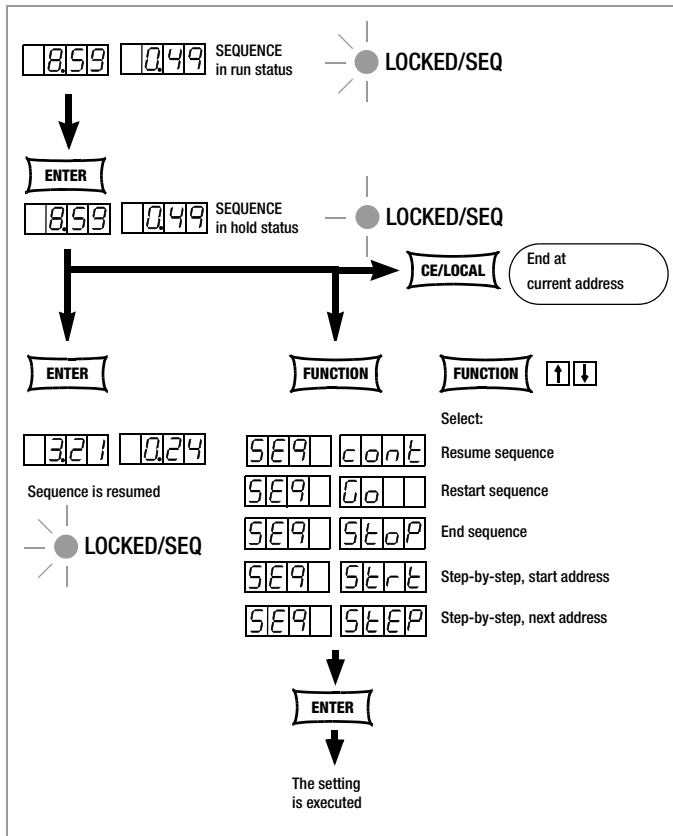
Figure 4.7.3 n   Suspending and Resuming a Sequence

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. The selected dwell time of the exited and the new memory address is 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 start address to the stop address, the remaining repetitions counter (rrep) remains unchanged.

Procedure:

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

! The **SEQUENCE** executes the next address.

! The selected dwell time of the new and the exited memory address is not taken into consideration.

! The LOCKED/SEQ 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 a suspended or a running **SEQUENCE**. The setpoints saved to the start address are executed. The selected dwell time of the exited and the new memory address is 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 <↓> or the <FUNCTION> key until SEq **start** appears and execute the command with the **<ENTER>** key.

! The **SEQUENCE** executes the start address.

! The selected dwell time of the new and the exited memory address is not taken into consideration.

! The LOCKED/SEQ LED blinks slowly in the HOLD status.

Adding New Settings to an Existing SEQUENCE

See chapter 4.9.4, page 43.

Deleting an Individual SEQUENCE Memory Location

See chapter 4.9.5, page 44.

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 (optional) parallel port (IEEE 488) is used for communication.

Addr – Setting the Device Address

• 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**, and setting the desired parameter (see chapter 4.7):

☞ 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 simultaneously the <↓> key or the <↑> key.

! **buS** appears at the left-hand display.

☞ Acknowledge by pressing the <ENTER> key.

! The **buS** functions menu appears.

☞ Select the **Addr** function by pressing the <**FUNCTION**> key, or the <**FUNCTION**> and simultaneously the <↓> key or the <↑> key.

! **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 <↓> 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.

! The display is returned to the functions menu after acknowledging with the <**ENTER**> key.
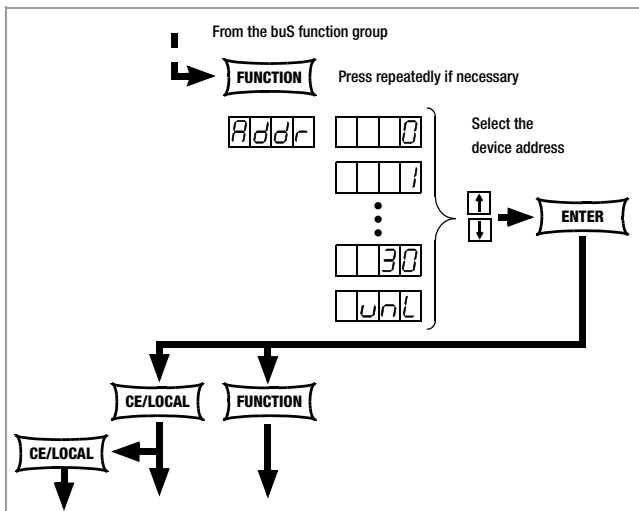
Figure 4.7.4 a   Path to Device Address Selection

bAud – Setting Transmission Speed

• 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 SSP KONSTANTER 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.
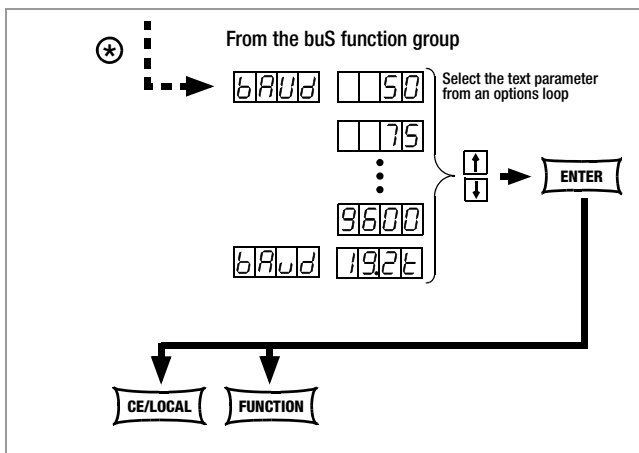
Figure 4.7.4 b   Path to Selection of the bAud Text Parameter

Settings

☞ **Procedure** for selecting **bAud** and setting the desired parameter (see chapter 4.7):

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

dbit – Selecting the Number of Data Bits

• Either 7 or 8 data bits can be used.

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

Settings

☞ **Procedure** for selecting **dblt** and setting the desired parameter (see chapter 4.7):

! **dblt** appears in the **buS** display along with the related parameter (number of data bits).
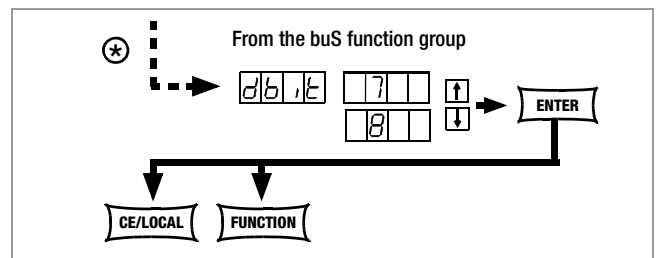
Figure 4.7.4 c   Path to Selection of the dblt Text Parameter

Pbit – Setting the Parity Bit

• 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 (**see also chapter 4.7**):**

! **Pbit** appears in the **buS** display along with the related parameter (parity bit).
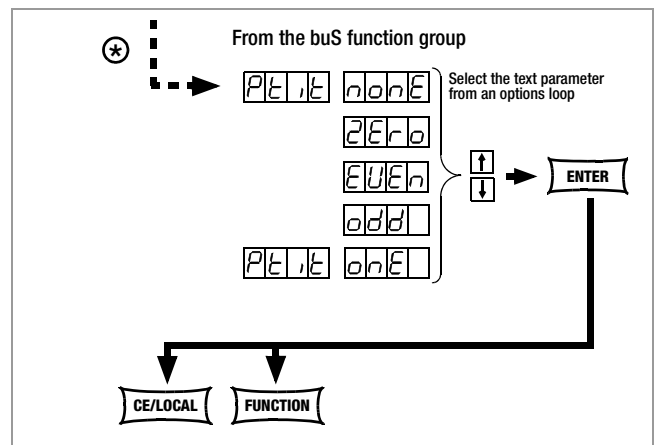
Figure 4.7.4 d   Path to Selection of the Pblt Text Parameter

SbIt – Selecting the Number of Stop Bits

- 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 desired parameter (see chapter 4.7):

! **Sbit** appears in the **buS** display along with the related parameter (number of stop bits).
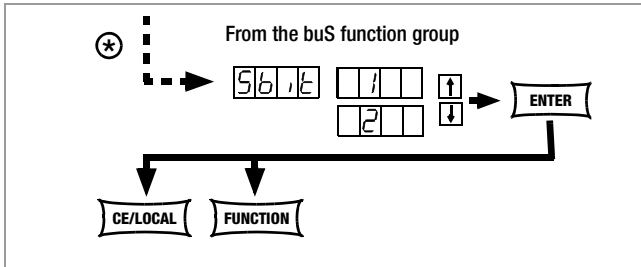
Figure 4.7.4 e Path to Selection of the SbIt Text Parameter

4.8 Settings with the <SELECT> Key

The <**SELECT**> key is located on the front panel next to the <**FUNCTION**> key. Depending upon settings in the **FUNCTION** menu, it makes 3 different functions available:

4.8.1 In the Basic Function
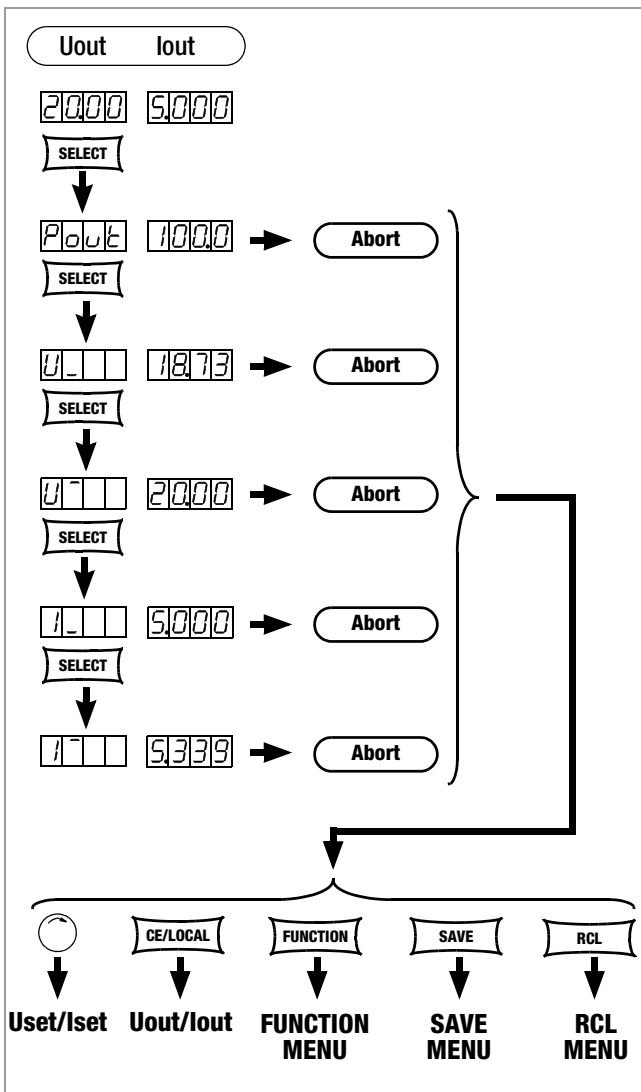
Figure 4.8.1 Setting Basic Functions with the SELECT Key

Switching the 7-segment display from Uout and Iout to the following measured values:

Pout	xxx.x	Max. output power
U_	xx.xx	Min. output voltage
U=	xx.xx	Max. output voltage
I_	x.xxx	Min. output current
I=	x.xxx	Max. output current

- When the <**SELECT**> key is pressed the first time, the last selected parameter name appears at the left-hand display, and the respective parameter values appears at the right-hand display.
- When the <**SELECT**> key is pressed again, the next parameter name with value is displayed, and so forth.
- Display with the <**SELECT**> key is exited:
  - ☞ By slightly turning rotary knob [5] or [8].
  - ☞ By pressing the <**CE/LOCAL**>, <**SAVE**>, <**RCL**> or <**FUNCTION**> key.

4.8.2 During a Sequence Run and with Step-by-Step Control

The LOCKED/SEQ 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.

Pout	xxx.x	Max. output power
U_	xx.xx	Min. output voltage
U=	xx.xx	Max. output voltage
I_	x.xxx	Min. output current
I=	x.xxx	Max. output current
rcL	xxx	Current address, memory location number
rrEP	xxx	Number of remaining sequence repetitions
USEt	xx.xx	Programmed voltage value
ISEt	x.xxx	Programmed current value
tSEt	xx.xx	Programmed dwell time (tSEt or tdEF) for current address, no remaining time
SSEt	txt	Output level for SSEt switching function

Otherwise, the same functions can be executed as listed in chapter 4.8.1.

4.8.3 Display of Stored Data Upon Execution of <RCL>

Display of 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
tSEt		Programmed dwell time
SSEt		Signal output status
outP		Output switching status after power on
Ulim		Voltage setting limit
Ilim		Current setting limit
OVP		Overvoltage setpoint
OCP		Overcurrent protection
dLY		Overcurrent delay
UI_		Min-Max value recording
tdEF		Dwell time independent of memory location
Strt		Start address
StoP		Stop address
rEP		Number of repetitions

Display of 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
SSEt		Signal output status

4.8.4 Setting Resolution with the <SELECT> Key

The numeric parameter 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 <**SELECT**> key. The cursor (blinking decimal place) is moved one place to the right.

☞ Repeatedly press the <**SELECT**> 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.
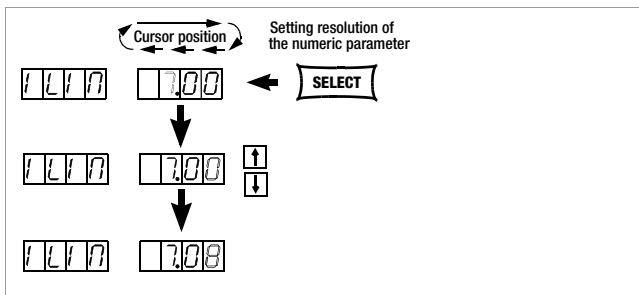
Figure 4.8.4 Setting Resolution with the SELECT Key

4.9 Storing Data with the <SAVE> Key

The <**SAVE**> key is located at the left-hand side of the front panel in the second row of keys underneath the <**FUNCTION**> key.

It makes the following functions available:

• 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

4.9.1 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	SSET
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.
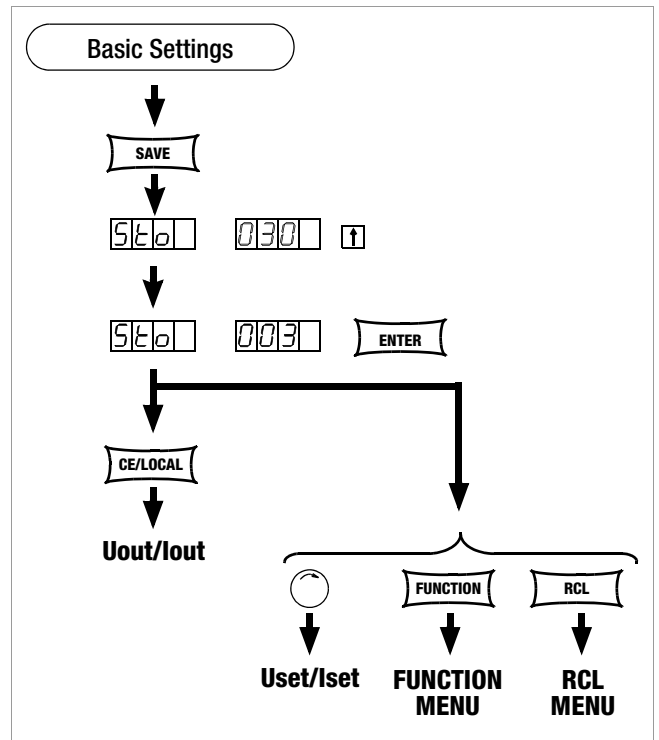
Figure 4.9.1 Saving Device Settings

4.9.2 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, Tset and Sset 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 <↓> or the <↑> key.

☞ Acknowledge by pressing the <**ENTER**> key.

4.9.3 Clearing the Contents of a Defined Memory Range

Functions

- **All** data are deleted from memory locations from the current start address to the current stop address.

Settings

☞ Press the <**SAVE**> key.

☞ Select **memory location 0** (clr) with the <↓> key or the <↑> key.

☞ Press the <**ENTER**> key.

! **clr dAtA** and **start stop** blink alternately at the display in order to identify the range to be deleted.

☞ Acknowledge by pressing the <**ENTER**> key.

! The range of memory locations from the start address to the stop address is cleared.

! Deletion of data can be aborted at any time by pressing the <**CE/LOCAL**> key.
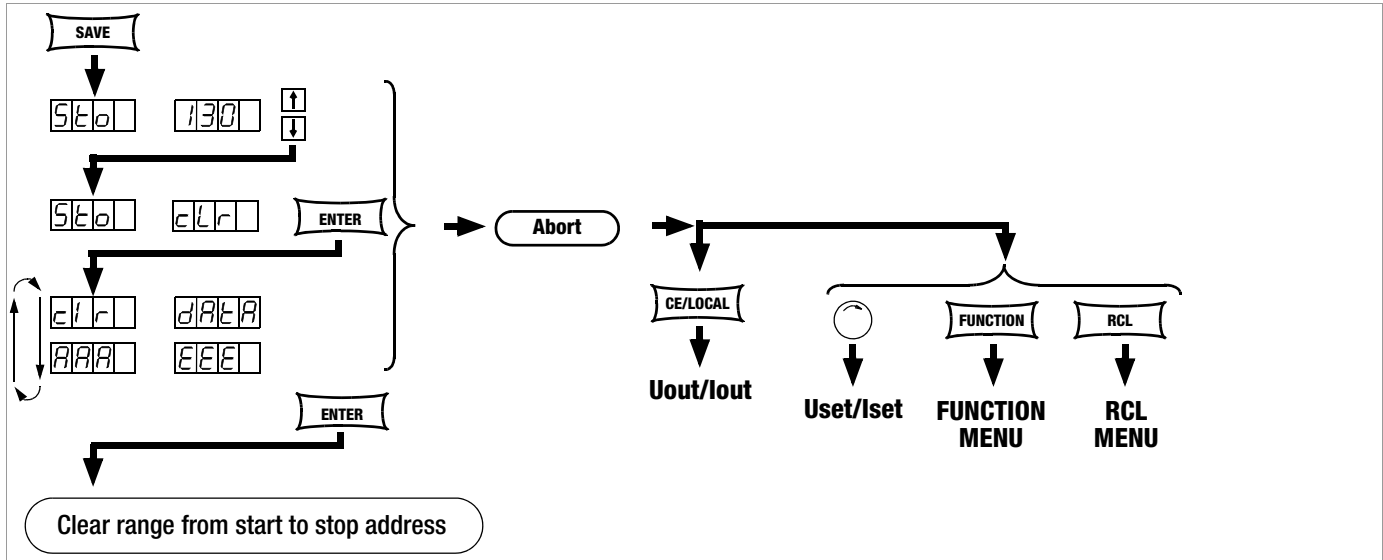
Figure 4.9.3 Clearing all Content from the Start to the Stop Address

Example of clearing all content from start to stop address:
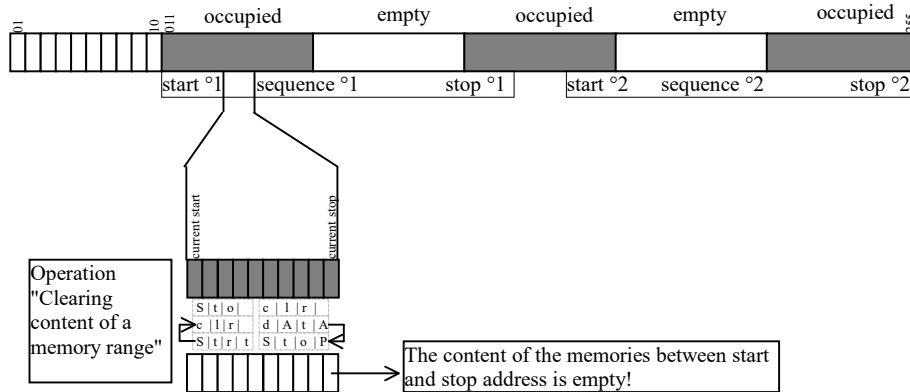
4.9.4 Inserting a Memory Location

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 the command is executed. Each time a memory location is inserted, the content of the previous stop address is lost.

Functions

- Starting with the target address, previously saved data are shifted to higher address numbers.
- 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 <↓> or the <↑> key.
- ☞ Simultaneously press the **<SAVE>** and <↑> keys.
- ! An **i** (for insert) appears in the right-hand display next to the selected memory 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.
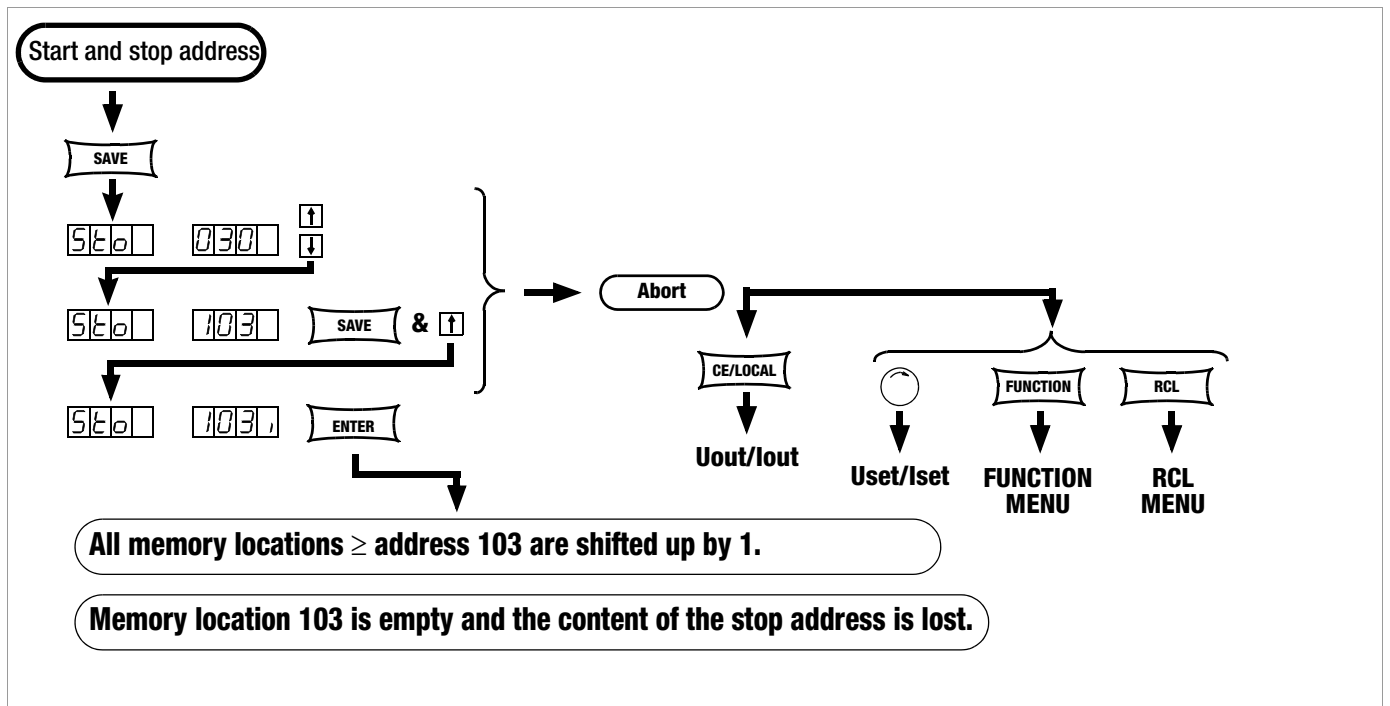
Figure 4.9.4   Inserting a Memory Location Within a Given Range

Example of inserting an empty memory location within a given memory range:
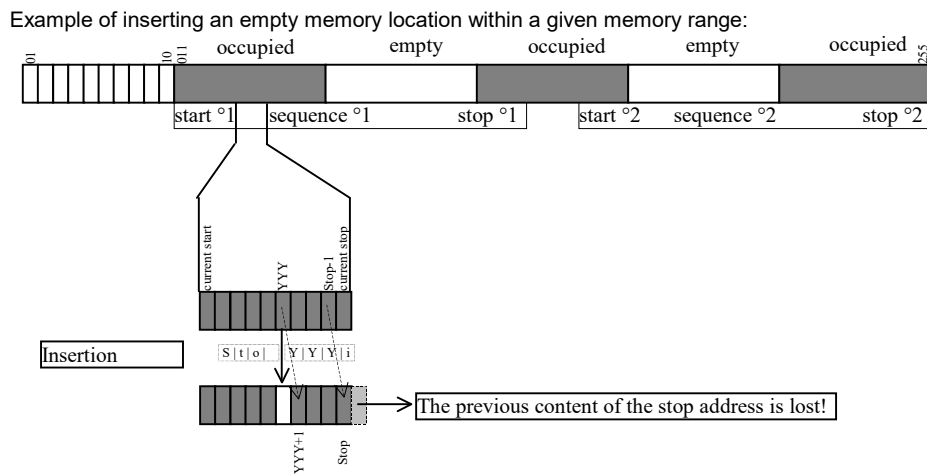
4.9.5 Deleting a Memory Location

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 the command is executed. 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 <↓> or the <↑> key.

☞ Simultaneously press the <**SAVE**> and <↓> keys.

! A **d** (for delete) appears in the right-hand display next to the selected memory location address number.

☞ 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.
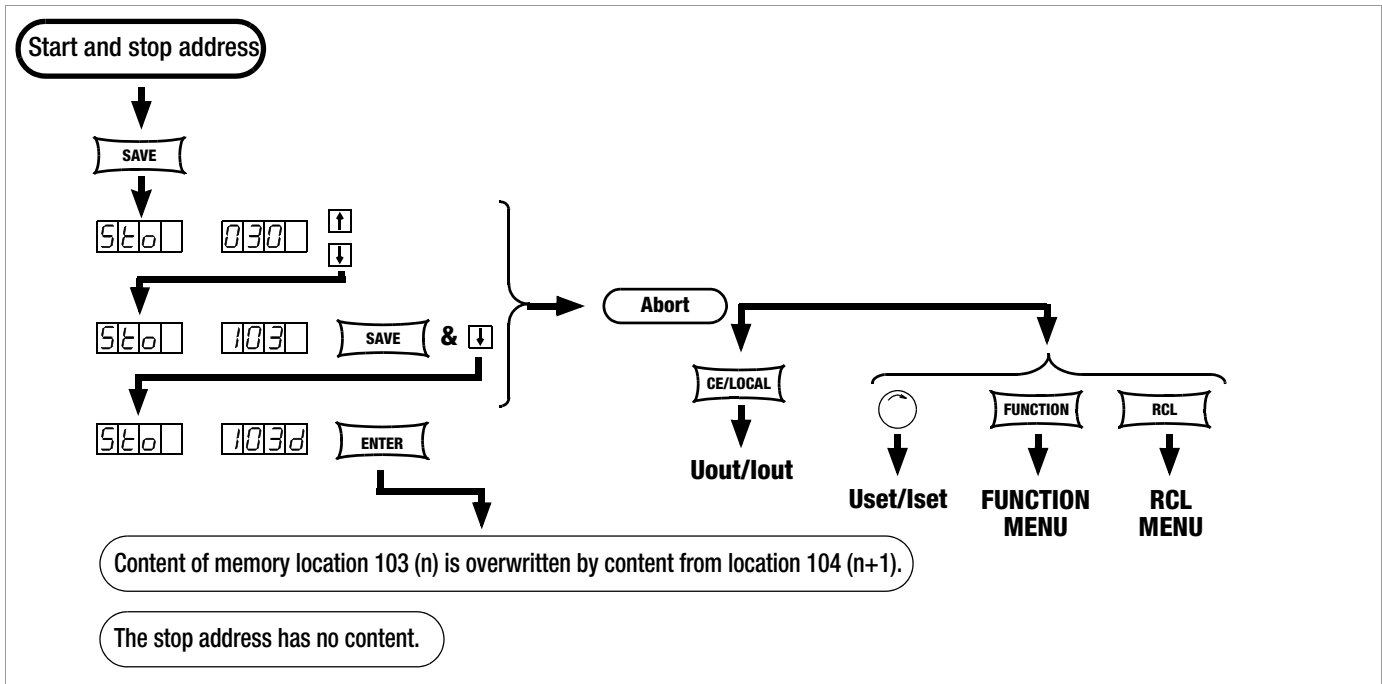
Figure 4.9.5   Deleting an Individual SEQUENCE Memory Location

Example of deleting an individual SEQUENCE memory location:
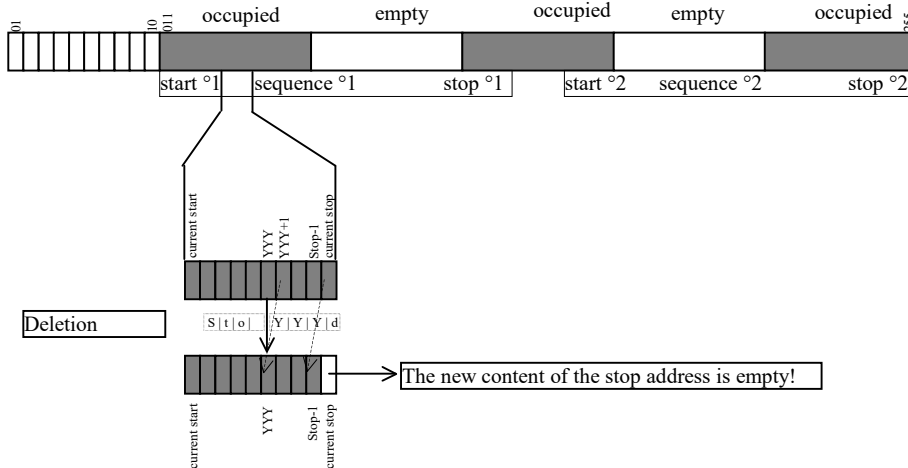
4.9.6 Deleting the Contents of a Memory Location

Functions

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

☞ Press the <**SAVE**> and <**CE/LOCAL**> keys simultaneously.

! 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.
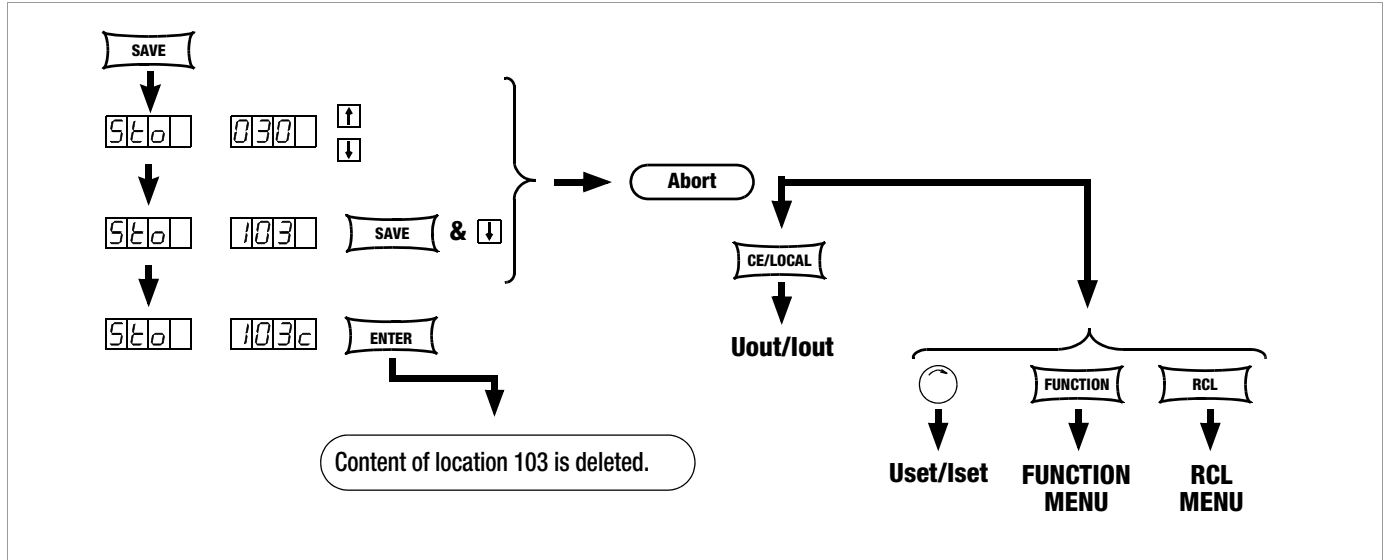
Figure 4.9.6   Deleting the Contents of an Individual Memory Location

Example of deleting the content of an individual memory location:
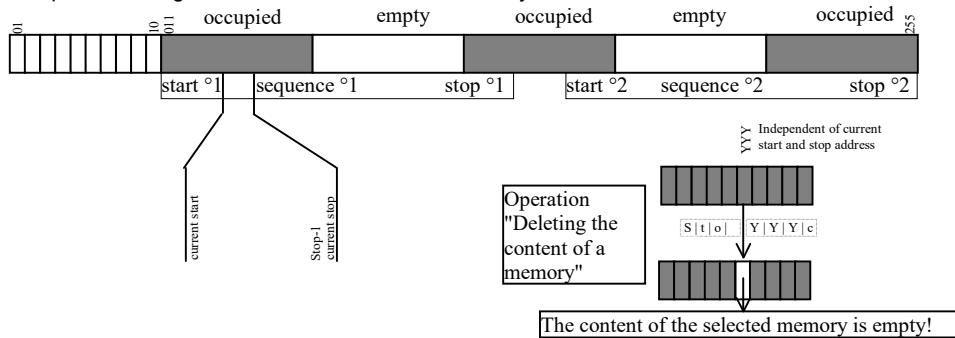
4.10 Memory Recall with the <RCL> Key

- 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. **ERR 24** appears briefly at the display, and bit 5 is set in event register B.
- **RCL** can also be controlled via the analog interface (see page 28 and chapter 5.8).

4.10.1 Recall from SETUP Memory

Addresses 1 through 10: complete basic device settings

USET	OVset	OCP	START
ISET	Ulim	DELAY	STOP
Tset	Ilim	MINMAX	REPETITION
Sset	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.

4.10.2 Recall from SEQUENCE Memory

Addresses 11 to 255: Uset, Iset, tSEt and SSEt 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** is displayed briefly and bit 5 is set in event register B.

! Only Uset, Iset and SSEt are executed: tset is loaded as a current setting value but 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.

4.11 Disabling Front Panel Controls

The front panel controls can be disabled against inadvertent changes to selected values and settings.
The behaviour during mains ON is also influenced by the selected power-on status Pon parameter (page 26).

Disabling

☞ Simultaneously press the <**CE/LOCAL**> and <**SAVE**> keys.

! The front panel controls are now disabled.

! The yellow **LOCKED/SEQ** LED lights up.

Enabling

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

Note: While key is pressed and sequence is in progress, „LLO" is shown in the display.

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.

4.12 <The ENTER> Key

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

<ENTER> Key Functions

Pre-Selecting Setpoints (fixed value selection)

1) <**ENTER**>: Change display from Uout/Iout 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 decimal place which can be adjusted with the <**SELECT**> function blinks.

See also page 21, "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.

4.13 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

☞ <**CE/LOCAL**> key + <**ENTER**>: The KONSTANTER's factory default settings are used.

Disable and Enable Front Panel Controls

See chapter 4.11.

Switch from REMOTE to LOCAL

See chapter 4.16.

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**>
    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.

4.14 INCR <↓> and DECR <↑> Keys

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

- **Parameter Selection**

  ### Text parameters

  <↑>/<↓>: Display next or previous parameter.

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

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

  ### Numeric parameters

  <↑>/<↓>: Increase / 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 <↑> or the <↓> key must also be acknowledged with the <ENTER> key.

- **Memory Location Selection**

  After Pressing <RCL> or <SAVE>:

  <↑>/<↓>: Select next or previous memory location.

  ### Address by Address Preview of Stored Setpoints:

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

  Blinking display of USET, ISET, TSET and SSET setpoints, can be selected with <SELECT>, browse though 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.

  ### Select Menu

  <SELECT> + <↑>/<↓>:

  Select the next or the previous display function.

- **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 <↓>.

4.15 Device RESET

Most device functions can be returned to a defined default value with the reset command, see page 63.

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

4.16 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.

LOCAL —> REMOTE
– Switching from manual to remote control

Switching to remote control occurs:
At the IEC bus when the REN line is activated by the controller and the device is addressed as a listener.
At the serial interface as soon as data are transmitted to the device.

a) **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**

LOCAL LOCKOUT
– Disabling manual switching to manual 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 switching to the manual operating mode (remote state with lock).
Programming example (HP Basic): **LOCAL LOCKOUT 7**

Comments
The "REMOTE" LED indicates the momentary control mode:
LED on = remote control
LED off = manual control

Switching back and forth between the two control modes does not cause any changes to current device settings or stored parameters.
Exception: If the display has been switched off it is reactivated when switching from REMOTE to LOCAL (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 Connector Pin Assignments

SIG1 OUT, SIG2 OUT (output)

- Digital status signal outputs with reference to AGND
- **SIG1 OUT** indicates the status defined by **SIG1** *txt*.
- **SIG2 OUT** indicates the status defined by **SIG2** *txt*.
- Signal type   Open collector
- Max. switching voltage 30 V DC
- Max. switching current 20 mA
  - ☞ For a detailed description refer to chapter 5.3.

TRG IN+, TRG IN- (input)

- Floating, digital control input for controlling a device function assigned with **trG** *txt*.
- Low signal: $-26\,V \le U_s \le +1\,V$
- High signal: $+4\,V \le U_s \le +26\,V$,
  $I_s = (U_s - 2\,V) / 1.5\,k\Omega$
  - ☞ For a detailed description refer to chapter 5.8.

+15 V (output)

- This auxiliary voltage output (15 to 17 V DC with reference to AGND) can be used to control the trigger input, or to supply power to external components (e.g. reference element for generating control voltages).
- The output is equipped with electronic current limiting to approximately 60 mA, and is short-circuit proof to AGND.

AGND (analog ground = reference point)

- Reference point for analogue 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.

Uset-, Uset+ (input)

- Analog (differential) **voltage input** with reference to **AGND** for controlling output voltage. The following applies when the output is activated:
- $U_{out} = U_{SET} + U_{su} \cdot k_u$

  U_{out} = **Output voltage** in constant voltage regulating mode

  U_{SET} = **Voltage setpoint** selected in **manual mode**

  U_{su} = **External control voltage** (0 to 5 V $\triangleq$ 0 ... $U_{out_{nom}}$)

  k_u = **Control coefficient** = $U_{out_{nom}}$ / 5 V

  R_{su} = **Input resistance** (Uset +: 10 kΩ)

         Uset–: 15 kΩ
  - ☞ For a detailed description refer to chapter 5.4.

Iset+ (input)

- Analog **voltage input** with reference to **AGND** for controlling output current. The following applies when the output is activated:
- $I_{out} = I_{SET} + U_{si} \cdot k_i$

  I_{out} = **Output current** in constant current regulating mode

  I_{SET} = **Current setpoint** selected in manual mode

  U_{si} = **External control voltage** (0 to 5 V $\triangleq$ 0 ... $I_{out_{nom}}$)

  k_i = **Control coefficient** = $I_{out_{nom}}$ / 5 V

  R_{si} = **Input resistance**: 10 kΩ
  - ☞ For a detailed description refer to chapter 5.5.

U-MON (output)

- Analog voltage output signal, proportional to output voltage Uout acquired by the sensing leads.

  (0 ... 10 V $\triangleq$ 0 ... $U_{out_{nom}}$).
- The short-circuit proof output is referenced to **AGND**, has an internal resistance of 9.8 kΩ and is **short-circuit proof**.
  - ☞ For a detailed description refer to chapter 5.6.

I-MON (output)

- Analog voltage output signal, proportional to output current (0 to 10 V $\triangleq$ 0 ... $I_{out_{nom}}$).
- The short-circuit proof output is referenced to **AGND**, has an internal resistance of 9.4 kΩ and is **short-circuit proof**.
  - ☞ See detailed description in chapter 5.7.
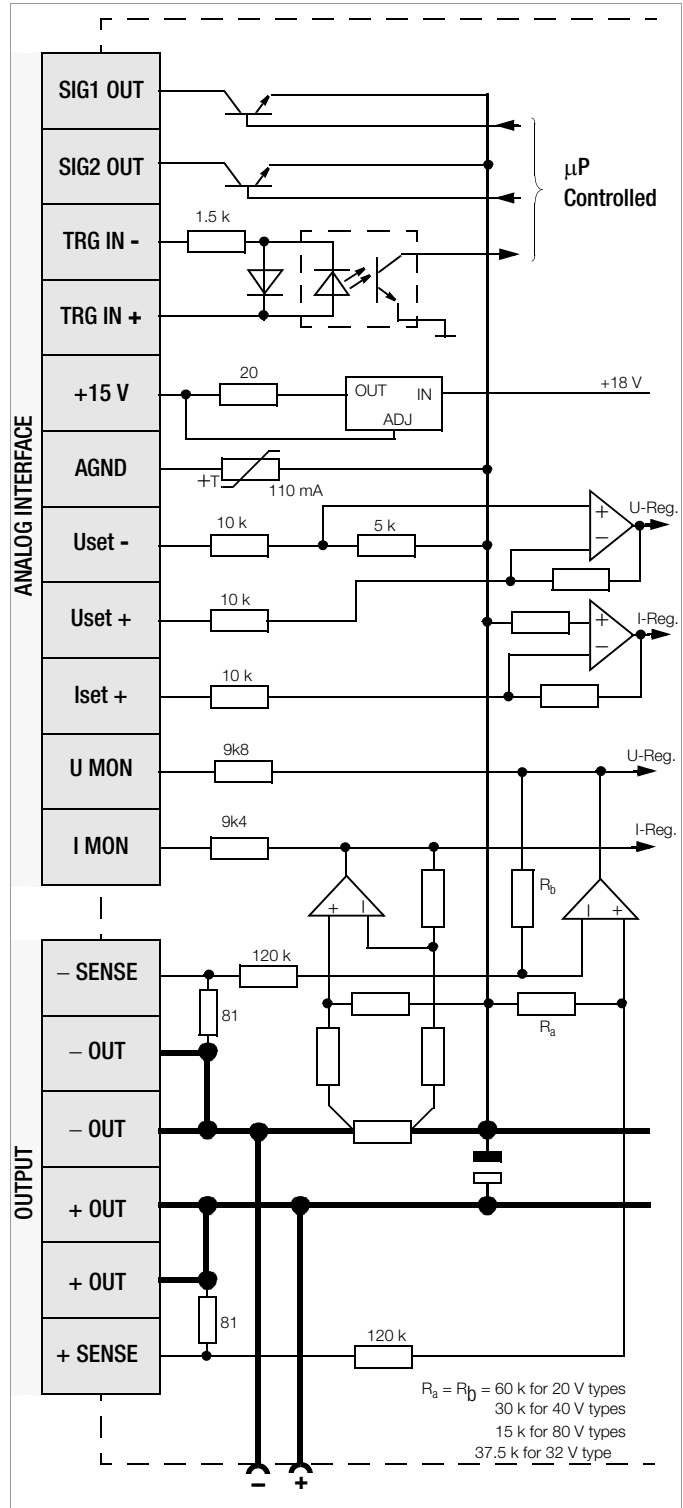
Figure 5.1   Internal Wiring of Analog Interface and Output (simplified representation)

5.2 Auto-Sensing Mode

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

Functions

- Sensing lead terminals **+SENSE and –SENSE**

- Acquirement of output voltage, which decisively influences the voltage measuring and control circuits, **directly at the power consumer** (instead of at the output terminals).

- 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 consumer is **independent** of **output current**.
  - The **voltage value** read out by the measuring function indicates **voltage acquired at the sensing leads**. **Load parameters** such as **power consumption** and **load resistance** can thus be determined more accurately.

- The **parameters** and **limit values** included in figure **in figure 5.2** and in the section entitled **Electrical Data** apply for operation with the sensing leads.
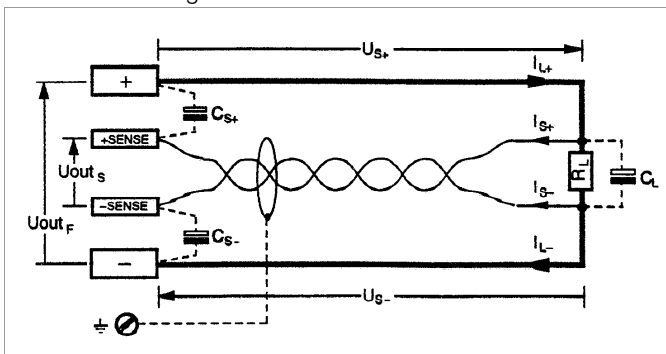
Figure 5.2   Connecting the Power Consumer for Sensing Mode Operation

C_{S+}, C_{S-} 10 µF ... 220 µF

U_{S+}, U_{S-} ≤ 1 V

I_{S+} $\approx -U_{S+} / 81 \ \Omega$

I_{S-} $\approx U_{S-} / 81 \ \Omega$

Connection

- The **+SENSE** and **–SENSE** sensing leads from the output connector plug at the rear panel should be connected **as close as possible** to the power consumer.

- Connect each respective **sensing lead** to the appropriate **output pole** (+SENSE: **+, –SENSE: –**).

- **Interference** can be minimized by:
  - **Twisting** the sensing leads and/or
  - **Shielding** the sensing leads (connect shield to ground, the housing or the negative output pole)

- Long **output and sensing lead impedances** may result in control fluctuations at the output.
  This problem is of course worsened by **capacitive consumers**.

- Control fluctuations can be counteracted with one capacitor each (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 KONSTANTER**, although it results in the following reversible events:**
  - **Polarity reversal at sensing leads or interrupted output lead**
    If output voltage is not being limited at the KONSTANTER by means of current regulation, it climbs to well above the selected value.
    This condition immediately triggers overvoltage protection and deactivates the output.
  - **Interruption of a sensing lead**
    Automatic reset to local sensing for the respective output pole.

- If the sensing leads have been connected incorrectly, increasing voltage between the output terminals is not acquired by the measuring function.

Activation

- The remote sensing mode function is activated **automatically after** the SENSE terminals have been connected to the power consumer at the respective output poles.

- The function is deactivated by once again **interrupting** this connection.

5.3 Status Signal Outputs

Functions

- The KONSTANTER is equipped with two open collector outputs with reference to AGND for reading out status signals, namely **SIG1OUT** and **SIG2OUT.**

- The device status or event to be signaled is independent for both signal outputs.

  Selection is made by setting the SIG1 and SIG2 functions.

  A detailed description is included on page 29 for manual operation, and on page 71 for programming.

- As a **status signal** for monitoring devices

- For **controlling** external **output relays**

Applications

- Triggering of certain device functions can be synchronized by means of connection to the trigger inputs of other KONSTANTERs (see also chapter 5.9.2).

Connection

- Values for connection:
  Max. switching voltage: 30 V DC
  Max. switching current: 20 mA

- If you want to use the signal outputs to send **status signals** to external monitoring devices, **pull-up resistors** must be used in order to generate appropriate levels.

  The status signal outputs can be connected to the +15 V terminal with pull-up resistors (at least 1 kΩ), in order to generate an active high signal of +15 V.
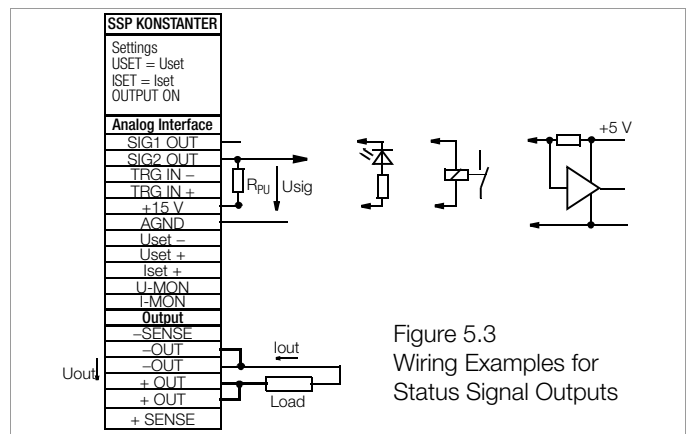
Figure 5.3
Wiring Examples for Status Signal Outputs

5.4 Regulating Output Voltage

Functions

- Output voltage **Uout** can be set by means of an external control voltage U_{su} via control inputs **Uset+** (non-inverting) and **Uset–** (inverting).

- The following applies in the constant voltage regulating mode:
  Uout = USET + U_{su} · k_{su}

  USET = selected voltage setpoint
  k_{su} = voltage control coefficient = $Uout_{nom}$ / 5 V
  Max. adjusting error: $\pm$ 0.05% v. U_{nom} $\pm$ 2% of the setting value

- The voltage control input functions as a differential voltage input:
  Uset+ = non-inverting input:
      U_{su} = 0 ... + 5 V for Uout = 0 V ... $Uout_{nom}$
      input resistance: 10 kΩ
  Uset– = inverting input:
      U_{su} = 0 ... – 5 V for Uout = 0 V ... $Uout_{nom}$,
      input resistance: 15 kΩ

Notes:

- The **control inputs** are **not floating inputs**: Their reference point, **AGND**, is connected to the **negative pole** of the power output.

- Connecting **grounded circuits** to the control input may result in **erroneous settings** due to leakage current or ground loops.

- If the **reference point** of control voltage U_{su} is connected to the negative output pole at the load side, the inverting input must be connected to this point (**connection b** in Figure 5.4).

  Influences resulting form voltage drops in the output lead are thus avoided.

- If **control voltage** is isolated from the **output**, connect **Uset–** to **AGND** (**connection a** in Figure 5.4).

- If **remote adjustment** of **output voltage** is to be accomplished by means of a **potentiometer**, wiring can be laid out as shown in Figure 5.4.

- U_{su} can be applied as an **alternating voltage**, for example in order to superimpose the selected direct voltage **USET** with **interference signals**.

  The **cut-off frequency** of the modulated output voltage **depends** upon **voltage amplitude**.

  To a great extent, cut-off frequency remains independent of the magnitude of the load and selected current limiting thanks to a special circuit design.

Connection
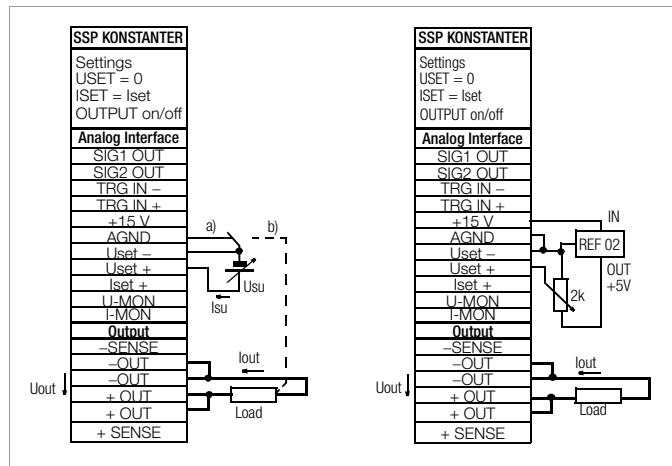
Figure 5.4   Wiring for Controlling Output Voltage with External Voltage / External Potentiometer

5.5 Regulating Output Current

Functions

- Output current **Iout** can be set with an external voltage U_{si} via the control input **Iset+**.

- The following applies in the constant current regulating mode:
  Iout = ISET + U_{si} · k_{si}
  ISET = selected current setpoint
  k_{si} = current control coefficient= $Iout_{nom}$ / 5 V
  Max. adjusting error: $\pm$ 0.1% of I_{nom} $\pm$ 2% of setting value

- Current control input
  Iset + = non-inverting input:
  U_{si} = 0 ... + 5 V for Iout = 0 A ... $Iout_{nom}$

- Input resistance is 10 kΩ.

Notes:

- The **control input** is **not a floating input**: Its reference point, **AGND**, is connected to the **negative pole** of the power output.

- Connecting **grounded circuits** to the control input may result in **erroneous settings** due to leakage current or ground loops.

- Control voltage U_{si} may **not** be connected to the **negative output pole** at the **load side**. (Figure 5.5)

- If **remote adjustment** of **output current** is to be accomplished by means of a **potentiometer**, wiring can be laid out as shown in Figure 5.5.

- U_{si} can be applied as an **alternating voltage**, for example in order to superimpose the selected direct current **ISET** with **interference signals**.

  The **cut-off frequency** of the modulated output current depends upon the **voltage amplitude** which results from load.

⚠ **Attention!**
Control inputs Uset+, Uset– and Iset+ should only be connected with shielded cable.
Connect the shield to the AGND reference point.
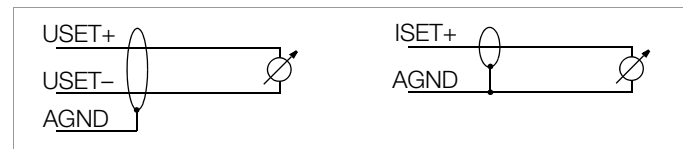
Connection
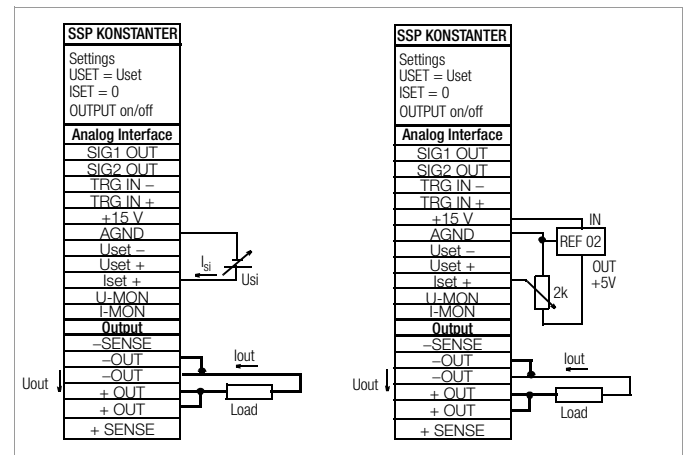
Figure 5.5   Wiring for Controlling Output Current with External Voltage / External Potentiometer

5.6 Voltage Monitoring Output

Functions

- The **U-MON** terminal reads out a voltage U_{MU} with reference to **AGND**, which is **proportional** to output voltage Uout.

- **U-MON** serves as a control voltage for **master-slave** series connection (see chapter 5.10.2).

- However, **U-MON** can also be used for external **measuring**, **monitoring** and **recording**.

- The following applies:

  $U_{MU} = Uout \cdot k_{MU} \cdot k_{Bel} = 0 \dots 10\ V$

  $k_{MU} = 10\ V\ /\ Uout_{nom}$, U-Monitor coefficient

  $R_{i\ (U\text{-}MONITOR)} = 9.8\ k\Omega$, U-Monitor internal resistance

  $k_{load} = \dfrac{R_{load}}{R_{load} + 9.8\ k\Omega}$, load coefficient

  R_{load} = load resistance

  Max. error for U_{MU}: ± 5 mV ± 1% of actual value (where $R_{load} >$ 10 MΩ)

Notes:

- **U-MON** 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 chapter 5.2).

- The monitor output is **short-circuit proof**. **Internal resistance** is 9.8 kΩ.

Connection
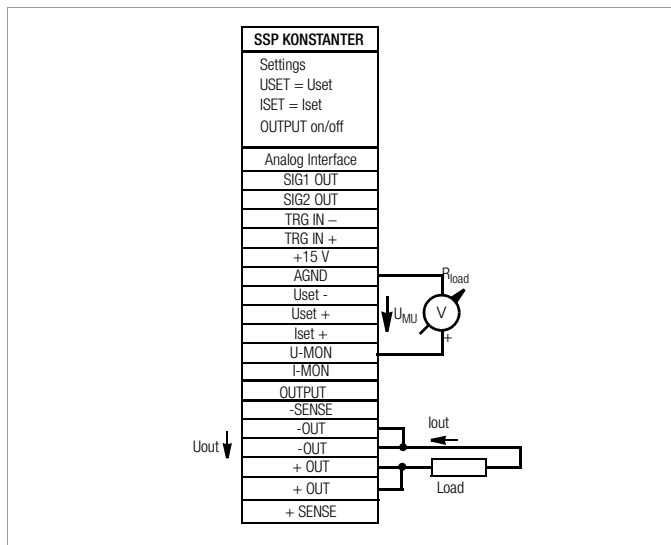
Figure 5.6   Voltage Monitor Wiring

5.7 Current Monitoring Output

Functions

- The **I-MON** terminal reads out a voltage U_{MI} with reference to **AGND**, which is **proportional** to output current Iout.

- **I-MON** serves as a control voltage for **master-slave** parallel connection (see chapter 5.9.2).

- However, **I-MON** can also be used for external **measuring**, **monitoring** and **recording**.

- The following applies:

  $U_{MI} = Iout \cdot k_{MI} \cdot k_{load} = 0 \dots 10\ V$

  $k_{MI} = 10\ V\ /\ Iout_{nom}$, I-Monitor coefficient

  $R_{i\ (I\text{-}MONITOR)} = 9.4\ k\Omega$; I-Monitor internal resistance

  $k_{load} = \dfrac{R_i}{R_i + 9.4\ k\Omega}$, load coefficient

  R_{load} = load resistance

  Max. error for U_{MI}: ± 5 mV ± 1% of actual value (where $R_{load} >$ 10 MΩ)

Notes:

- **I-MON** 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 monitor output is short-circuit proof.

  Internal resistance is 9.4 kΩ.

Connection
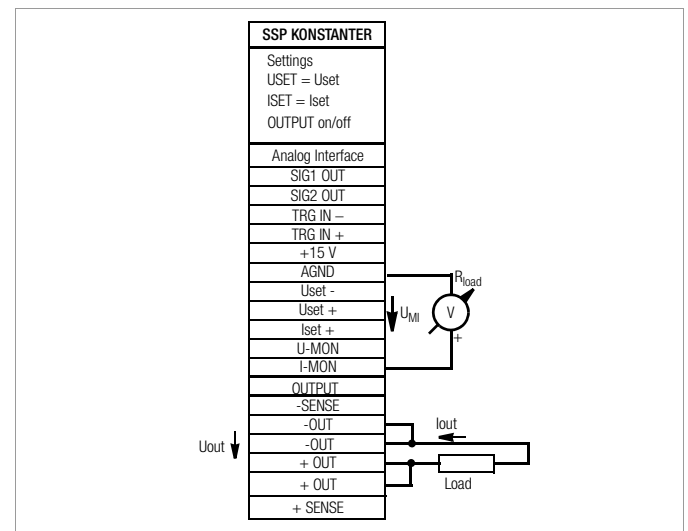
Figure 5.7   Current Monitor Wiring

5.8 Trigger Input

Functions

- The **TRG IN floating optocoupler input** allows for **remote control** of a device function using 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 28 and page 74.

Connection

- Connect the control signal between **TRG IN+** and **TRG IN-**. Refer to the table below for the respective signal level.

Output	Signal	U_s	I_s
OFF	High	4 ... 26 V DC	$(U_s - 2\ V) / 1.5\ k\Omega$
ON	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 5.8).

⚡ **Warning!**
The TRG IN 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

- The trigger input is scanned roughly every 10 ms by the digital control unit. After a signal change has been detected, repeated querying ensues at short time intervals (suppression of switch bouncing and interference pulses). This means that:
  - 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.
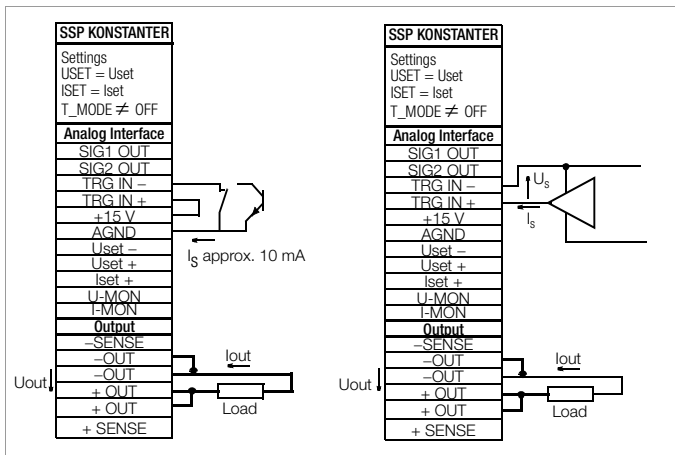
Figure 5.8   Controlling the Trigger Input with a Switching Element / External Signal

5.9 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.

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

5.9.1 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**.
- Less suitable for **constant voltage regulating mode**

Connection

- - - - = Only required for sensing mode operation
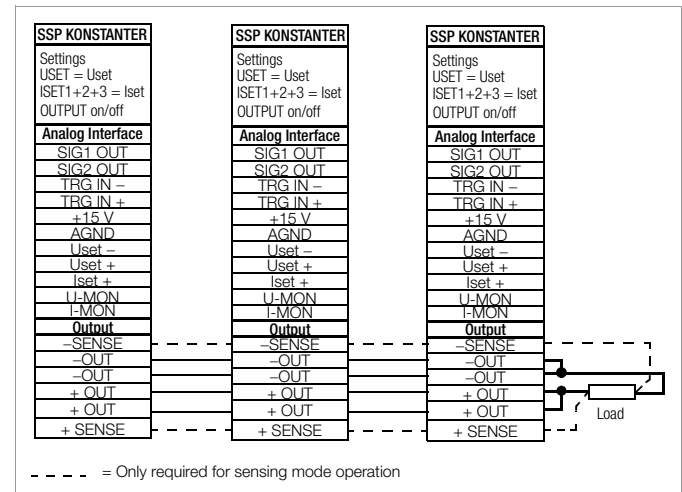
Figure 5.9.1 a   Wiring for Direct Parallel Connection

Settings

- **Deactivate** all outputs.
- Adjust **voltage setpoint USET** of all parallel connected KONSTANTERs **to approximately the same value**:

  Uset   = USET1 = USET2 = USET3 = USETn

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

  Iset   = ISET1 + ISET2 + ISET3 + ... + 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.
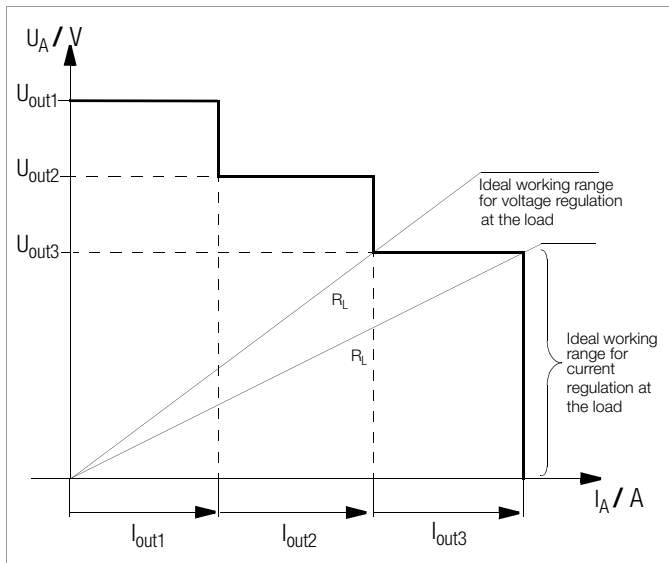
Figure 5.9.1 b   U/I Diagram for Direct Parallel Connection

Notes:

- 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 attempts – **in some cases in pulse mode** – to reach the lower voltage value.

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

  If problems occur with **measurement of load current**, the KONSTANTERs should be linked by means of **master-slave parallel connection** (see also chapter 5.9.2).

- The **outputs** can be activated and deactivated **commonly** by connecting the **SIG1** outputs to the **TRG** inputs (see also chapter 5.9.2).

5.9.2 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, output on/off) are set **entirely** by the **master device**.
- **All** interconnected KONSTANTERs are **equally loaded**.

Connection

- **Define** one power supply as a **master device**.
- **Connect master** and **slave** devices as shown in Figure 5.9.2.
- Connect the **output leads** (**refer to** chapter 2.1.5).
- **Balance** the individual **output current values**. Keep connector cable as **short** as possible, and use the **largest** possible conductor cross-section. Perform balancing with R**R$_{sym}$**.
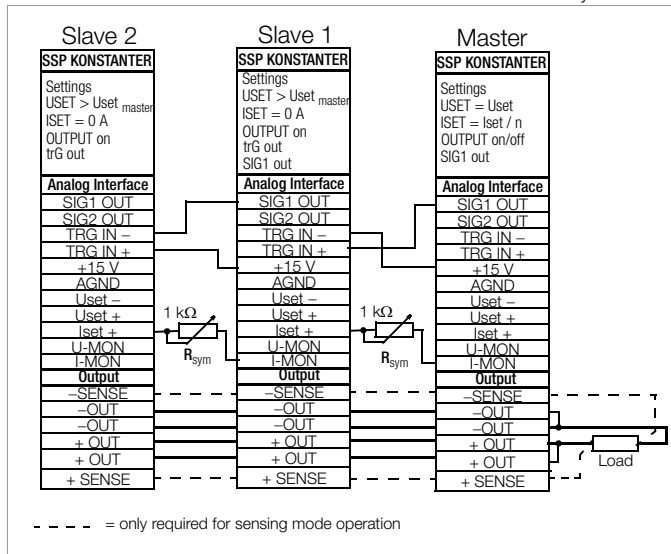
Figure 5.9.2 Wiring for Master-Slave Parallel Connection

Settings

Initial power-up:

- Short circuit the load.
- Switch the **master** on (mains) and **configure** settings:

  SIG1 out

  Pon rcl

  OUTPUT off

  USET   = Uset   Desired output voltage

  ISET   = Isoll / n   Iset: 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**:

  trG out

  SIG1 out

  Pon rcl

  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 master. **All slave** outputs are **switched on simultaneously** and configured.

- 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:

- 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.

  The master controls the **output on / off status** of the slave devices via the **connection** from the **master SIG1** output (**SIG1 out setting**) to the **Slave TRG** input (**trG out setting**).

Notes:

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 **Iout** corresponds to master output current **Iout** as a percentage only, relative to I$_{nom}$.

  Example:

Master:	SSP 120-20	U$_{nom}$	20 V	I$_{nom}$	10 A	
	Settings:	**USET** :	12 V	**ISET** :	3 A	(30%)
Slave 1:	SSP 120-20	U$_{nom}$	20 V	I$_{nom}$	10 A	
	Results in	**Uout** :	12 V	**Iout** :	3 A	(30%)
Slave 2:	SSP 120-40	U$_{nom}$	40 V	I$_{nom}$	6 A	
	Results in	**Uout** :	12 V	**Iout** :	1.8 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**.

5.10 Series Connection

If **output voltage** from a **single KONSTANTER** is insufficient, or if you want to generate a ± **voltage**, the outputs of several **KONSTANTERs can be connected in series**.

⚠️ **Warning!**
Maximum allowable cumulative voltage for series connection is 120 V (or 240 V with grounded neutral point).

5.10.1 Direct Series Connection

⚠️ **Attention!**
If outputs with differing nominal values are series connected, the highest selected current value is present at all outputs in the event of short-circuit. However, the internal reverse-voltage protection diode is only rated for nominal current of the respective device (see reverse voltage withstand under Technical Data). For this reason, all current setpoints must be set to the lowest nominal current value of all interconnected devices.
The **ILIM** parameter is used to select this setting.
You can also connect a diode (D_e, **Figure 5.10.1 a)** in reverse direction between the terminals of the outputs with low nominal values. The diode must be capable of conducting nominal current from the output with the highest current value.

Functions

- **Easiest way** to supply the power consumer with **more voltage** than is available from a single KONSTANTER
- Easy wiring
- Less suitable for **constant current regulating mode**
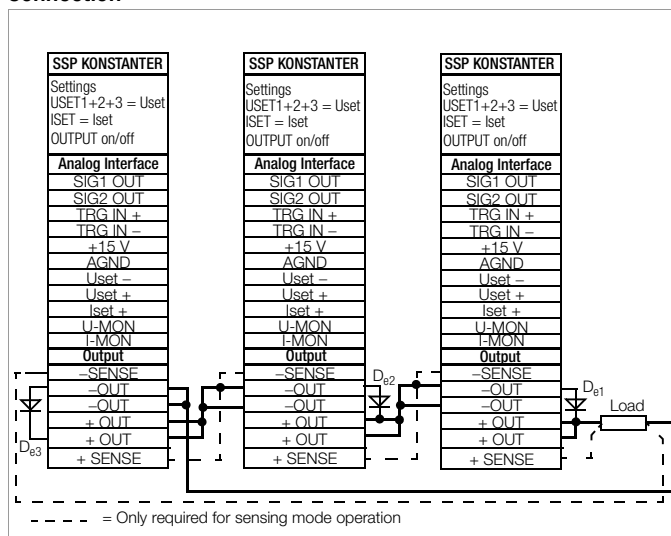
Connection

Figure 5.10.1 a   Wiring for Direct Series Connection

Settings

- **Deactivate** all outputs.
- Adjust **current setpoint ISET** of all series connected KONSTANTERs **to approximately the same value**:

  Iset   = ISET1 = ISET2 = ISET3 = ISETn

- **Adjust voltage setpoints USET** such that they add up to the desired **cumulative voltage value Uset**:

  Uset   = USET1 + USET2 + USET3 + ... + USETn

- **Activate** the outputs.

Functional Principle

- The **sum of all individual output voltages** is made available to the power consumer.
- If load resistance is continuously reduced, all of the outputs deliver the **same load current at first**.
- When load current reaches the lowest **selected current setpoint value**, **current regulating** is triggered at the respective output.
- If load resistance is further reduced, this output maintains **constant load current** until its **output voltage has dropped to 0 V**.
- If even **further reduction** of load current occurs, the affected output is forced by the other outputs to generate a **negative voltage**.
- As of approximately –**0.5 V**, the internal **reverse-voltage protection diode** becomes conductive.
- **Load current** can once again **climb**, until **current regulation** is activated at the output with the **next highest current setpoint value**.
- This procedure is continued until load current triggers current regulating at the **output** with the **highest current setpoint value**.
- Current is held constant by this last output **until short-circuiting** occurs.
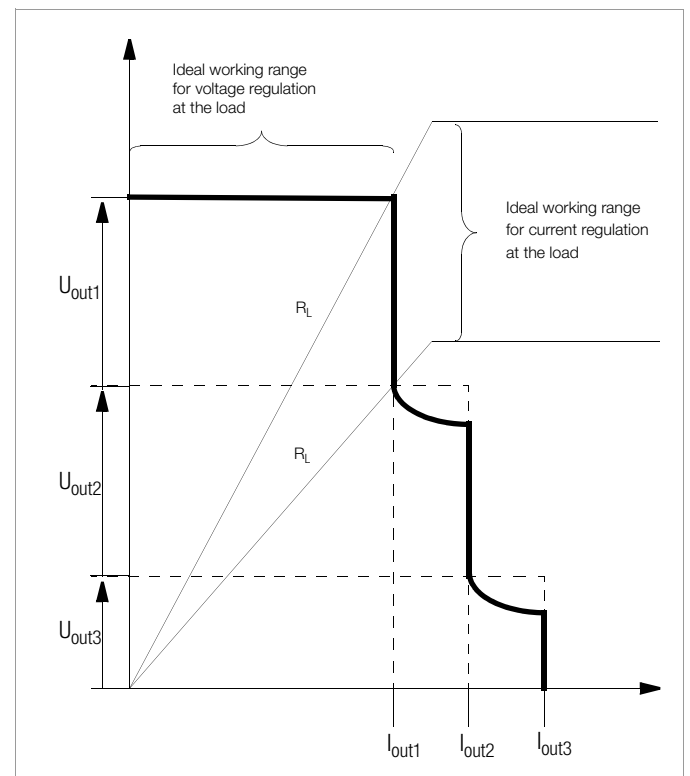
Figure 5.10.1 b   U/I Diagram for Direct Series Connection

Note

- The **outputs** can be activated and deactivated **commonly** by connecting the **SIG1** outputs to the **TRG** inputs (see also chapter 5.10.2).

5.10.2 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, output on/off) are set **entirely** by the **master device**.
- All interconnected KONSTANTERs are **equally loaded**.

Connection

- **Define** one power supply as a **master device**.
- **Connect master** and **slave** devices as shown in Figure 5.10.2.
- Connect the **output leads** to the **series circuit phase terminals**.
- **Balance** the individual **output voltage values** with R_{sym}.
- **Balancing** can be **simplified** and **optimized** by combining a fixed resistor (metallic layer, $T_k \leq 50$ ppm / K) and a trimming resistor for R_{sym}.

Slave, Nominal Voltage	R_{sym}, Nominal Value	R_{sym}, Combination
20 V	40 kΩ / 0.2 W	36 kΩ + 10 kΩ pot
40 V	80 kΩ / 0.2 W	75 kΩ + 10 kΩ pot
80 V	160 kΩ / 0.2 W	150 kΩ +20 kΩ pot
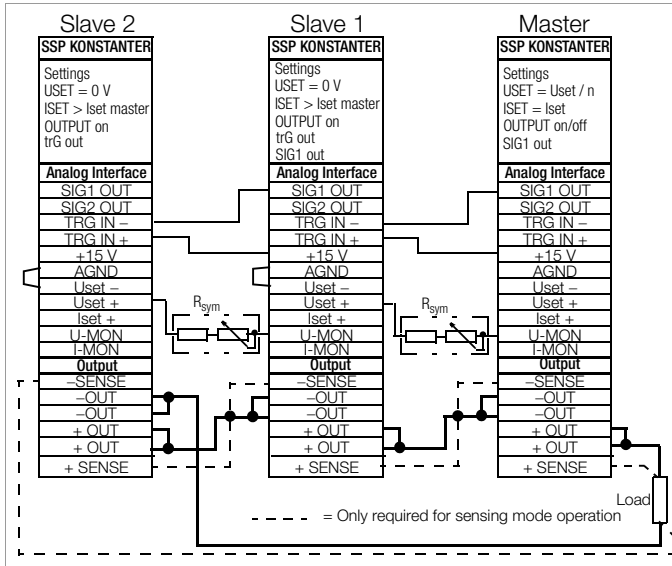
Figure 5.10.2   Wiring for Master-Slave Series Connection

Settings

Initial power-up:

- Do not load the outputs (idle).
- Switch the **master** on (mains) and **configure** settings:

  SIG1 out

  Pon rcl

  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**:

  trG out

  SIG1 out

  Pon rcl

  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. **All slave** outputs are **switched on simultaneously** and **configured**.
- Check output voltage at the KONSTANTER 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:

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

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

  The master controls the **output on/off status** of the slave devices via the **connection** from the **master SIG1 output** (SIG1 out setting) to the **Slave TRG** input (**trG out setting**).

Notes:

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 KONSTANTER must be **limited** to this lowest value with the **ILIM** parameter.
- Slave output voltage **Uout** corresponds to master output current **Uout** as a percentage only, relative to U_{nom}.

  Example:

Master:	SSP 120-40	U_{nom}	40 V	I_{nom}	6 A
	Settings:	**USET** :	12 V (30%)	**ISET** :	3 A
Slave 1:	SSP 120-20	U_{nom}	20 V	I_{nom}	10 A
	Results in	**Uout** :	6 V (30%)	**Iout** :	3 A
Slave 2:	SSP 120-40	U_{nom}	40 V	I_{nom}	6 A
	Results in	**Uout** :	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** 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**.

5.11 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 5.11 a).
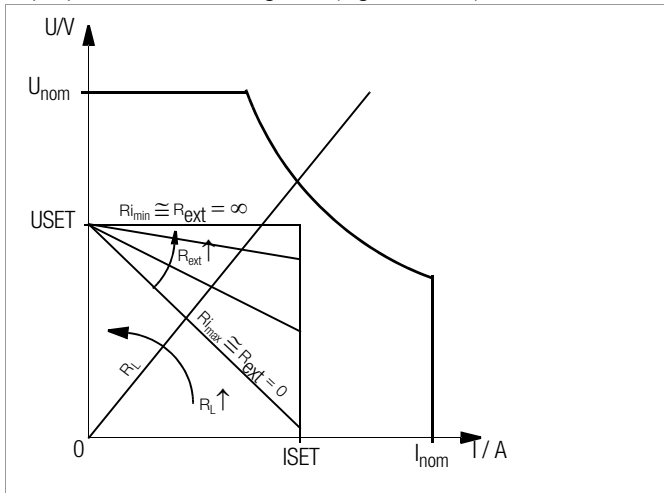
Figure 5.11 a   Dependence of Output Voltage on Load

Standardization

- The standard characteristic curve shown in Figure 5.11 c 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.

$$R_i = R_{imax} \cdot \text{display value}$$

Connection

- Connect the analog interface as shown in Figure 5.11 b.

- The following relationship between internal resistance R_i and control resistance R_{ext} applies with this wiring configuration:

$$R_{ext} = \frac{30 \text{ k}\Omega \cdot U_{nom}}{R_i \cdot I_{nom}} - 24.4 \text{ k}\Omega$$

Example: $U_{nom} = 40$ V, $I_{nom} = 6$ A, R_i is 0.5 Ω

$$===> R_{ext} = 376 \text{ k}\Omega$$
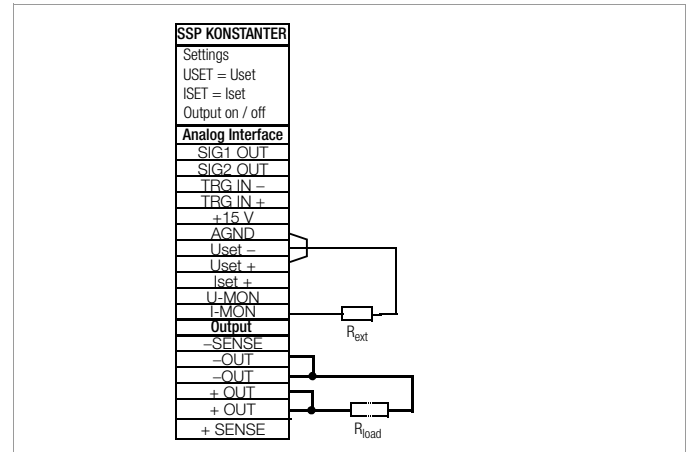
Figure 5.11 b   Wiring for Varying Internal Resistance

- Table of R_{imax} Values for All KONSTANTER Models

Device Type	120-20	120-40	120-80
R_{imax} / Ω	2.46	8.2	32.8
Device Type	240-20	240-40	240-80
R_{imax} / Ω	1.23	4.1	16.4

$$\frac{R_i}{R_{imax}} = \frac{24.4 \text{ k}\Omega}{R_{ext} + 24.4 \text{ k}\Omega} \; ; \; R_{imax} = 1.23 \cdot \frac{U_{nom}}{I_{nom}}$$

Figure 5.11 c   Standardized Curve for Determining Internal Output Resistance for a Specified Control Resistance

6 Operating Commands

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

- **Device settings** and **device responses** are triggered by **character strings**, which are transmitted in **ASCII code**.

  The only exceptions to this rule are several IEC bus-specific functions.

- Transmission of device messages is accomplished as follows:
  - **Byte-serial via the IEC bus** with the help of a special 3-wire handshake
  - **Bit-serial via the RS 232C interface** in consideration of selected operating parameters

- 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 the KONSTANTER.

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.

- 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 can be abbreviated.

- The **greatest possible extent of abbreviation** is **highlighted** for each command throughout all of chapter 6.

- The portion of the header which is not highlighted can be omitted.

- Make sure to include question marks (?) in query commands, even where abbreviations are used.

Example 1:

The following abbreviations can be used for the **OU**TPUT setting command:

OUTPUT / OUTPU / OUTP / OUT / OU

Example 2:

The following abbreviations can be used for the **DE**LAY**?** query command:

DELAY? / DELA?/ DEL?/ DE?

Query Commands

- Result in **querying of a device setting** or **measured values.**

- Query commands always end with a question mark (?).

- The device transmits a **response** to the control computer.

- 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 is set in the status byte register (MAV: message available).

  Example:

  USET?

  is used to query the voltage setpoint.

Text Parameters

- Text parameters generally **begin with a letter**.

- Selection can be made from a **group of texts** for all commands which use **text parameters**.

  Example:

Command:	**DI**SPLAY txt
Range:	**OFF**
	ON

- 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 may occupy up to two places.

- The entire parameter may not exceed a length of 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.

- Leading plus signs can be omitted.

- If several parameters are included they are separated by **commas**.

- **Blanks** can be entered to the left and to the right of parameters.

  Example: 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 (*) ($2A_{hex}$) 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

- You can **string several commands together** and transmit them as a single unit.

- In this case, the individual commands are separated with **semicolons** (;).

- **Blanks** can be entered to the **left** and to the **right** of the semicolons.

    Example:

    USET 10; OUTPUT ON; IOUT?

Comments

- 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**, this part of the command is ignored and the corresponding **error bit** is set in the event standard register (ESR), while the remaining commands are nevertheless executed.

Terminating Device Messages

a) IEEE 488 control:

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

NL	New line = line feed = (0Ahex)
NL & EOI	EOI = end or identify
DAB & EOI	DAB = last data byte

- The still common end-of-message character combination CR LF ($0D_{hex}$ followed by $0A_{hex}$) should no longer be used according to the standard.

- Although CR LF is accepted by the device for data receive, it should be used in combination with EOI.

- In the case of **transmission**, the following **end-of-message character** is used in the response string

    NL + EOI

b) RS 232 control:

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

NL	(0Ahex) = new line = line feed
CR	(0Dhex) = carriage return
CR LF	carriage return and line feed
ETB	(17 hex)
ETX	(03 hex)

- In the case of **transmission**, the following **end-of-message character** is used in the response string

NL	(0Ahex) = 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 settings 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 • USET • ISET • OUTPUT • POWER_ON **Measured Value Query** • UOUT • IOUT • POUT	• *RST • *SAV • *RCL • *LRN • T_MODE • SIG1_SIG2 • DISPLAY • WAIT	• ULIM • ILIM • OVSET • MINMAX • UMIN • UMAX • IMIN • IMAX • OCP • DELAY • MODE • SIG1_SIG2 • CRA • ERA • ERB	
SEQUENCE and STEP-BY-STEP CONTROL FUNCTIONS	**Time Dependent FUNCTIONS, External CONTROL**	**Special COMMANDS**	**STATUS and EVENT MANAGEMENT**
Sequence Control • SEQUENCE • START_STOP • REPETITION • SSET • TDEF • TSET **Memory management** • STORE • *SAV • *RCL	• T_MODE • OCP • DELAY • *DDT • *TRG • WAIT	• *TST • CAL • ADDRESS • IFC • SDC • DCL • *WAI	• *CLS • *STB, *SRE • *ESR, *ESE • *IST, *PRE • *OPC • *PSC **Condition and event register** • 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

Settings

Functions

- Clears all event registers: **ESR, ERA and ERB.**
- Clears the status byte register (except for the MAV bit).
- Any service requests SRQ are cleared.
- Manual operation is not possible.

Programming

    Setting command: ***CLS**

Example (HP Basic):

        OUTPUT 713; "*CLS"

Action

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

*DDT, *DDT? – Define Device Trigger

Functions

- A command list with **up to 80 characters** can be saved to a **register** with the help of the **DDT** command.
- The command list is executed after receiving the ***TRG** command.

Programming

    Setting command: ***DDT** command [/command][/command] ...

Parameter:	*Command*
Parameter type:	All specified device commands and queries except for the *TRG command
Setting range:	Max. 80 characters
Default setting:	**DDT** memory cleared (after RESET, *RST)

Example (HP Basic):

        OUTPUT 713; "*DDT USET 10 / ISET 5.6 / TSET 05.00 / OUT ON"
        OUTPUT 713; "USET 2"
        :
        OUTPUT 713;"*TRG"

Comments

- The slash in the command defines the command only, without executing it immediately.
- An **empty DDT register** returns a blank as a response.
- The command list is not checked for correct syntax and limit values until a trigger command is received.
- ***TRG** may **not** be included in the ***DDT** command. Otherwise, bit 4 (EXE, execution error) would be set in the standard event register, and bit 3 (DDTE, define device trigger error) would be set in event register B.
- If the maximum string length is exceeded, all characters in excess of the allowable number are ignored and an execution error message is generated as well.
- In the case of "EXE", the DDT register can be read out with DDT?, but its content cannot be executed ("EXE" error message).

Query

Read out content of the **DDT** register.

Programming

Query command:	***DDT?**
Response string:	*DDT *command [;command][;command]* ...
Length:	Max. 80 characters
Parameter:	*Command*

Example (HP Basic):

	OUTPUT 713; "***DDT?**"
	ENTER 713; A\$
	DISP A\$
→Display:	USET 10;ISET 5.6;TSET 0.5.00; OUT ON

*IDN? – Device Identification Query

Functions

- The KONSTANTER identifies itself.
- Manufacturer, type designation, serial number, hardware revision and software (firmware) revision.

Programming

Query command:	***IDN?**
Response string:	*manufacturer,type,serial no.,hardware revision.software revision*
Length:	46 characters, fixed

Example for KONSTANTER 120 W / 40 V:

        GOSSEN-METRAWATT,SSP32N040RU006P, XXXXXXXXX,04.001

*IST? – Individual Status Query

Functions

- Command for directly querying parallel poll information (see also chapter 6.3 on page 60 and table: "Query Commands for Status and Events Management" on page 86).
- 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

- Complete list of all configurable functions.
- Complete list of all current parameter settings.

Programming

Query command:	***LRN?**
Response string:	LRN *list*
Length:	202 characters, fixed
Parameter:	*List all configurable functions including current parameter settings*

Example (HP Basic):

OUTPUT 713; "LRN?"
ENTER 713; A$
DISP A$

→ Display:

ULIM +035.000;ILIM +10.0000;OVSET +
050.0;OCP OFF;DELAY 12.00;USET +02
1.3000;ISET +09.5000;OUTPUT ON;
POWER_ON RST;MINMAX ON;
TSET 00.10;TDEF 10.00;
REPETITION 000;START_STOP 020,115;
T_MODE OUT;DISPLAY OFF

Note

- The controller determines the status of a current device setting.
- This information can then be used for evaluation, or for computer controlled configuration.
- A check system test sequence can first be executed manually for all interconnected KONSTANTERs.
- The device settings required for the individual test steps are queried by the controller with the *LRN? command.
- The response string can be transferred to the test program in an unchanged fashion, and then serves as the string which will be sent to the respective KONSTANTER.

*OPC, *OPC? – Operation Complete Flag

Settings

Functions

- Allows for **synchronization** of the controller and the device (see also chapter 6.3 on page 60 and the table: "Query Commands for Status and Events Management" on page 86).
- **OPC** follows the command which will generate a message.
- After completion of the command, bit "0" **OPC** is set in the standard event register **ESR**.
- An **SRQ** can be generated in this way, depending upon **ESE** masking.
- The message is read out via the parallel interface only.

Programming

Setting command: ***OPC**

Example (HP Basic):

OUTPUT 713; "USET 5; ISET 3; *OPC"

Query

Functions

- Are the controller and the device **synchronized**?
- ***OPC?** follows the command which will generate a message.

- After completion of the command, a signal is transmitted to the controller.
- The message can be read out via the **serial** and the **parallel** interface.

Programming

Query command: ***OPC?**

Example (HP Basic):

OUTPUT 713; "USET 5; ISET 3; *OPC?"

*PSC/POC, *PSC/POC? – Power-On Status Clear Flag

Settings

Functions

- Response to the contents of non-volatile enable registers when the device is switched off (see also chapter 6.5 on page 77 and the table: "Query Commands for Status and Events Management" on page 86).

Programming

Setting command:	***PSC** *n*
Parameter:	*n (value)*
Setting range:	"**0**": Enable registers will not be cleared.
	"**1**": Enable registers will be cleared.

Example (HP Basic):

OUTPUT 713; "*PSC 1"

Query

Functions

- Status display for the **PSC flag**
- Indicates response to the contents of non-volatile enable registers when the device is switched off.
  The PSC flag remains unchanged after switching the device off.
  The PSC flag remains unchanged after the *CLR command.

Programming

Query command:	***PSC?**
Response string:	"**0**": Enable registers will not be cleared.
	"**1**": Enable registers will be cleared.

*RCL – Recalling Stored Settings

Function and manual operation:

See explanation in chapter 4.10.

Programming

Setting command:	***RCL** *n*	
Parameter:	*n (memory location number)*	
Parameter type:	Integer (1 ... 255)	
Setting range	**1 ... 10**	Parameter set from S**ETUP** memory
	11 ... 253	Parameter set from **SEQUENCE** memory
	254 ... 255	Reference value memory
Format:	n, nn, nnn	

Example (HP Basic):

OUTPUT 713;"*RCL 11"
{display of all parameters saved to memory location 11}

Note

- **Memory locations 11 through 253** can be recalled by means of interface programming, even if the **sequence has not been opened**.
- If an **invalid (empty) memory location** is accessed in sequence memory, command **execution** is **aborted**.
  Err 21 appears at the display, and **bit 5** is set in event register B (**SEQE**, SEQuence error).
- If a **USET** or **ISET** parameter exceeds the **ULIM** or **ILIM** limit value during recall, **Err 21** appears at the display and **bit 5** is set in event register B (**SEQE**, SEQuence error).

  As is the case with all other memory locations with an address of greater than 10, addresses 254 and 255 can be stored with *SAV and used for device configuration with *RCL.

---

*RST – Reset Device Settings

Function and manual operation:

See explanation on page 47.

Programming

Setting command: *****RST

Example (HP-Basic):   **OUTPUT 713;"*RST"**

Default settings:

OUTPUT OFF	Output deactivated
USET 0	Voltage setpoint = 0
ISET 0	Current setpoint = 0
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	Output is deactivated immediately in event of CC
TSET 0 (=tdef)	Sequence dwell time = default duration
SEQUENCE OFF	Sequence function deactivated
DISPLAY ON	Display activated
MINMAX OFF	No Min-Max value recording
TDEF	0.01
REPETITION	0 (= cont.)
START_STOP	011, 011
POWER ON	Unchanged
T_MODE	Unchanged

Stored parameters:

SETUP memory locations 1 ... 10	Unchanged
SEQUENCE memory	Unchanged
DDT register	Cleared
MINMAX memory	Reset
Parameter settings	Reset to 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

---

*SAV – Saving Device Settings

Function and manual operation:

See explanation in chapter 4.9.

Programming

Setting command: ***SAV** *n*
Parameter: *n (memory location number)*
Parameter type: Integer

Setting range:	**0**	*SAV 0 (display for manual operation: Sto clr) clears contents of the sequence memory from the start address to the stop address.
	1 to 10	Current device settings are saved to the selected SETUP register.
	11 to 253	Current SEq parameter settings are saved to the selected sequence memory location.
	254	Reference value U_Lo, I_Lo
	255	Reference value U_Hi, I_Hi

Default setting: After RESET (*RST)
Memory location number: n/a
Memory location contents: unchanged

Example (HP Basic):

OUTPUT 713;"*SAV 3"
{current device setting is saved to memory location 3}

---

*STB? – Status Byte Register Query

Functions

- Read out **register contents** (see also chapter 6.3 on page 60 and table: "Query Commands for Status and Events Management" on page 86)**:**
  - The **status of group messages** from the three event registers **ESR**, **ERA** and **ERB** (bits 2, 3 and 5)
  - The **status of the output buffer** (not empty ⇨ bit 4 **MAV** = 1, empty ⇨ bit 4 **MAV** = 0)
  - The **status** of the **MSS** group message masked with the **SRE** enable register from internal bits 2 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 value 1 is generally returned as a response.

Programming

Query command: ***STB?**
Response string: *n* (decimal equivalent)
Value: $16 \le n \le 124$
Length: 3 characters, fixed

Example (HP Basic):

OUTPUT 713; "*IST"
ENTER 713; A$; DISP A$
→ Display: 034 {$034_2 = 0001\ 1000_{10}$}

Note

- A message is always made available as a result of the query.
- The response string is stored to the output buffer.
- The **MAV** bit is set for this reason.
- The value of *n* is always ≥ 16 in this case.
- The ***CLS** command clears the status byte register.
- However, the **MAV** bit is not cleared.

- **SRQ** is also reset.

*TRG – Device Trigger Function

Functions
Triggering of functions specified with ***DDT** (see also page 61)

Programming
Setting command: ***TRG**

Example (HP Basic**):**

OUTPUT 713;"*TRG"

Note
If DDT memory is empty, the trigger function is considered undefined. When the *TRG command is received, bit 4 (EXE, execution error) is immediately set in the standard event register. The *TRG command may not be used as part of the *DDT command. Execution of the *TRG command does not change the DDT register.

*TST? – Starting the Self-Test

Functions
- Command for a **device self-test**
- **Test results** are written to the **output buffer** as a response.
- The self-test has **no effect** on current **device settings** or stored **parameters.**
- The self-test is started immediately after receipt of the corresponding query command and has a duration of approximately **6 seconds**.

Programming
Query command: ***TST?**

Response string: 0 = test passed
1 = error detected
Length: 1 character, fixed

Notes:
- **As long as the test is running, no data can be transmitted to the device and manual operation is disabled.**
- **Do not transmit the *TST? command together with other setting and/ or query commands in a single string.**
- **Enter a waiting period of approximately 6 seconds between transmission of the query command and read-out of the response string.**
- **IEC bus control:** Completion of the self-test can be recognize 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 **ERB** (event register B).
- If appropriate **masking** is implemented with event registers **ERDE** and **SRE**, an **SRQ message** is triggered.

*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.

ADDRESS – Interface Addressing

Function and manual operation:
See explanation in chapter 4.7.

Programming
Setting command: **ADDR**ESS *n*
Parameter: *n* (address number)
Parameter type: Integer (whole number)
Setting range: $0 \le n \le 30$, 31 (= UNL → unlist)

Example:

"ADDRESS 13"

Comments
- If the SSP KONSTANTER is operated at the **serial interface** only, sub-addressing can be omitted.
- If the SSP KONSTANTER is operated at the **optional IEEE488 interface**, sub-addressing is ignored.

CRA? – Condition Register Query

Query

Functions
- Condition register A (see also chapter 6.3 on page 60 and the table: "Query Commands for Status and Events Management" on page 86).
- 8 bit status register
- Current status of a certain device function at the point in time of the query
- Direct writing and clearing is not possible.
- Example
  - Output in current regulating mode (**CCR**):
    CCR status bit 1 is set (= 1) in the **CRA**.
  - The status bit remains set for the duration of current regulation.
  - CRA can be queried as often as desired.
  - The contents of the CRA are not changed by the query.
  - The current regulating mode is exited:
    CCR status bit 1 is reset (= 0) in the **CRA**.

Programming
Query command: **CRA?**

Response string: *n (decimal equivalent)*
Value: $0 \le n \le 255$
Length: 3 characters, fixed

Example (HP Basic):

OUTPUT 713; "CRA?"
ENTER 713; A$; DISP A$
→ Display: 002 {002_{10} = 0000 0010_2}
(CCR, constant current regulation)

DCL, SDC – Device Clear Function

Functions

- **Clears input and output buffers** at the computer interfaces.
- e.g. requested data which have not been picked up
- Clears internal interface **waiting times** or **disabling**.
- The KONSTANTER is ready to receive data.
- Manual operation is not possible.

Programming

Setting command:	**DCL** (= device clear)
	SDC (= selected device clear)
Used for:	Both interfaces
Setting command:	**CLEAR 713** ($\hat{=}$ SDC)
Used for:	One IEC interface only, command for specified bus user, fast
Setting command:	**CLEAR 7** ($\hat{=}$ DCL)
Used for:	IEC interface only, universal command for all bus users, fast

Action

Addressing status	Unchanged
Input and output buffers	Cleared
Service request **SRQ**	Unchanged
Status byte register **STB**	MAV bit = 0, otherwise Unchanged
Event registers **ESR, ERA, ERB**	Unchanged
Enable registers **ESE, ERAE, ERBE, SRE, PRE**	Unchanged
Set and stored parameters	Unchanged

Example (HP Basic):

a) OUTPUT 713;"DCL"
b) CLEAR 713
c) CLEAR 7

DELAY, DELAY? – Output Off Delay for OCP

Settings

Function and manual operation:

See explanation on page 26.

Programming

Setting command:	**DE**LAY *v*
Parameter:	*v (value)*
Parameter type:	Real number
Setting range:	**00.00** [s] ... **99.99** [s]
Resolution:	10 ms
Default setting:	00.00 [s] (after RESET (*RST))

Example (HP Basic):

OUTPUT 713;"DELAY 10.7"
{output off delay: 10.7 seconds}

Query

Displays selected delay time from initialization of current regulation until the power output is deactivated.

Programming

Setting command:	**DE**LAY**?**
Response string:	DELAY *v*
Length:	11 characters, fixed
Parameter:	*v* (value)
Format *v*:	nn.nn

Example (HP Basic):

	OUTPUT 713; "**DE**LAY**?**"
	ENTER 713; A$
	DISP A$
→Display:	DELAY 10.70

DISPLAY, DISPLAY? – Activate / Deactivate Digital Displays

Settings

Functions

- Activate / deactivate the 7-segment displays during remote operation
- If the display has been deactivated, it need not be continuously refreshed.
- This results in somewhat shorter measuring and setting times during interface operation.

Programming

Setting command:	**DI**SPLAY *txt*
Parameter:	*txt (status)*
Parameter type:	Text (character)
Setting range:	**OFF** 7-segment display deactivated
	ON 7-segment display activated
Default setting:	ON (after RESET, *RST)

Example (HP Basic):

OUTPUT 713; "DISPLAY OFF"
{deactivate 7-segment display}

Comment

If the "REMOTE" operating mode is exited, the 7-segment display is automatically reactivated.

Query

On-off status of the 7-segment displays

Programming

Query command:	**DI**SPLAY**?**
Response string:	DISPLAY *txt*
Length:	11 characters, fixed
Parameter	*txt (status)*

Example (HP Basic):

	OUTPUT 713;"**DI**SPLAY**?**"
	ENTER 713; A$
	DISP A$
→Display:	DISPLAY OFF

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

Functions

- Event register (see also chapter 6.3 on page 60 and the table: "Query Commands for Status and Events Management" on page 86).
- The device is equipped with **3 event registers.**
- An **enable register** is assigned to each event register.
- The registers can be **queried separately**.
- Acquiring and saving **status changes** for specific device functions
- Information regarding **events** which have occurred at the device since the last query
- The inputs respond in an **edge controlled** fashion.
- A **bit** is **set** if the associated function:
  - Is changed from **FALSE** to **TRUE** (input ⌐),

– Is changed from **TRUE** to **FALSE** (input ⌐).

- The registers are reset as a result of querying.
- The ***CLS** setting command clears all event registers.
- Example
  - Incorrect programming command occurs.
  - Command error bit 5, **CME**, is set to 1 in the **ESR**.
  - Bit 5 remains set, even in the event of subsequent correct commands.
  - After querying **ESR**, the **CME** bit is reset.

Programming

Query command:	***ESR?**	event standard register
	ERA?	event register A
	ERB?	event register B
Response string:	n (decimal equivalent)	
Value:	$0 \leq n \leq 255$	
Length:	3 characters, fixed	

Example (HP Basic):

OUTPUT 713; "*ESR?"
ENTER 713; A\$; DISP A\$
→ Display: 032 {$032_{10} = 0010\ 0000_2$}
(CME, command error)

Note

Refer to chapter 6.5 regarding conversion of the decimal equivalent for representation of set bits.

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

Settings

Functions

- **Enable register** (see also chapter 6.3 on page 60 and the table: "Query Commands for Status and Events Management" on page 86).
- The device is equipped with **5 enable registers.**
- **Mask** for forwarding **messages** from the event registers or the status byte register
- The necessary **bits** must first be **set** in the respective enable register for corresponding **masking**.
- **Event information** is only forwarded by registers which have been set.
- **Selective** enabling or disabling of **SRQ** or **IST** for event messages
- The registers can be **written to separately**.
- The register contents are **non-volatile.**
- Queries, the ***CLS** command and device functions do not cause any changes to the register contents.
- **Cleared** only when the device is switched off, and if the non-volatile PSC flag is also set to 1.
- **Cleared** by entering a value of **0**.

Programming

Setting command:	***ESE** n	event standard enable register
	ERAE n	event enable register A
	ERBE n	event enable register B
	*SRE n	service request enable register
	*PRE n	parallel poll enable register
Parameter:	n (value) decimal equivalent, register content	
Parameter type:	Integer	
Setting range:	$0 \leq n \leq 255$	

Example (HP Basic):

OUTPUT 713; "ERAE144"
Bits 4 and 7 in the **ERAE** are prepared for forwarding {$1001\ 0000_2 = 144_{10}$}

Query

Functions

- The **query** results in the selected register value.
- The registers can be **queried separately**.
- Register content is not changed by the **query**.

Programming

Query command:	***ESE?**	event standard enable register
	ERAE?	event enable register A
	ERBE?	event enable register B
	*SRE?	service request enable register
	*PRE?	parallel poll enable register
Response string:	n (decimal equivalent)	
Value:	$0 \leq n \leq 255$	
Length:	3 characters, fixed	

Example (HP Basic):

OUTPUT 713; "ERAE?"
ENTER 713; A\$; DISP A\$
→ Display: 144 {$144_{10} = 1001\ 0000_2$ }

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

Settings

Function and manual operation:

See explanation on page 25.

Programming

Setting command: **IL**IM *v*
Parameter: *v (value)*
Parameter type: Real number
Setting range: $0 \le v \le ILIM_{max}$

Device Type Nom. current [A]	2	3	6	10	12	20
ILIM$_{max}$ [A]	2.0	3.0	6.0	10.0	12.0	20.0
Step size [mA]	1.0	1.0	1.0	1.0	1.0	1.0

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.

Default setting: Nominal current (after RESET, *RST)

Example (HP BASIC**):**

OUTPUT 713; "ILIM 20"
{current setting range limit: 20 A}

Comment

- **ILIM may not be set to a value of less than ISET!**
- Any setting command to this effect is not executed.
- **Bit 1** would otherwise be set in event register B (**limit error**) and **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.

Query

Displays the selected **final value** for **current setpoint ISET**.

Programming

Setting command: **IL**IM**?**

Response string: ILIM *v*
Length: 13 characters, fixed
Parameter *v (value)*
Format *v*: +nn.nnnn

Example (HP Basic)**:**

OUTPUT 713;"**IL**IM**?**"
ENTER 713; A$
DISP A$
→Display: ILIM +20.0000

IMAX? – Maximum Measured Current Value

Function and manual operation:

See explanation in chapter 4.8.1.

Programming

Query command: **IM**AX**?**
Response string: IMAX *v*
Length: 13 characters, fixed
Parameter: *v (value)*
Format: +nn.nnnn

Example (HP Basic):

OUTPUT 713; "IMAX?"
ENTER 713; A$
DISP A$
→ Display: IMAX +02.8550

IMIN? – Minimum Measured Current Value

Function and manual operation:

See explanation in chapter 4.8.1.

Programming

Query command: **IM**AX**?**
Response string: IMAX *v*
Length: 13 characters, fixed
Parameter: *v (value)*
Format: +nn.nnnn

Example (HP Basic):

OUTPUT 713; "IMIN?"
ENTER 713; A$
DISP A$
→ Display: IMIN +02.7300

IOUT? – Querying the Momentary Current Value

Function and manual operation:

See explanation on page 23.

Programming

Query command: **IO**UT**?**
Response string: IOUT *v*
Length: 13 characters, fixed
Parameter: *v (value)*
Format: +nn.nnnn

Example (HP Basic):

OUTPUT 713; "IOUT?"
ENTER 713; A$
DISP A$
→ Display: IOUT +02.7350

ISET, ISET? – Current Setpoint

Settings

Function and manual operation:

See explanation on page 21.

Programming

Setting command: **IS**ET *v*
Parameter: *v (value)*
Parameter type: Real number
Setting range: $0 \le v \le ILIM$

Device Type Nom. Current [A]	2	3	6	10	12	20
ISET$_{max}$ [A]	2.0	3.0	6.0	10.0	12.0	20.0
Step size [mA]	0.5	1.0	2.0	2.5	3.33	5.0

If the programmed value is not a whole number multiple of the step size, it is rounded off in accordance with selected setting resolution.

If necessary, the numeric value is rounded off once again for the 4-place digital display.

Default setting: 0.00 [A] (after RESET, *RST)

Example (HP BASIC):

OUTPUT 713;"ISET 11.3"
{current setpoint: 11.3 A}

Comment
- **ISET may not be set to a value of greater than ILIM.**
- Any setting command to this effect is not executed.
- **Bit 1** would otherwise be set in event register B (**limit error**), and **bit 4** in the standard event register (**execution error**).

Query
Displays the selected output current setpoint ISET.

Programming

Query command: **IS**ET**?**

Response string: ISET v

Length: 13 characters, fixed

Parameter: v (value)

Format: +nn.nnnn

Example (HP Basic):

OUTPUT 713; "ISET?"
ENTER 713; A$
DISP A$
→ Display: ISET +03.0000

MINMAX, MINMAX? – Min-Max Storage for Measured U and I Values

Function and manual operation:
See explanation on page 27.

Settings

Programming

Setting command: **MI**NMAX txt

Parameter: txt (status)

Parameter type: Text (character)

Setting range   **OFF**   Storage of Min-Max values is deactivated

ON   Storage of Min-Max values is activated

RST   Contents of Min-Max memory are reset, i.e. are replaced with the momentary measured value for the corresponding parameter.

Default setting: **OFF** (after RESET, *RST)

Example (HP Basic):

OUTPUT 713;"MINMAX RST"

Query
Displays Min-Max memory enable status.

Programming

Query command: **MI**NMAX**?**

Response string: MINMAX txt

Length: 10 characters, fixed

Parameter: txt (status)

Example (HP Basic):
OUTPUT 713; "MINMAX?"

ENTER 713; A$
DISP A$
→ Display: MINMAX OFF

MODE? – Querying the Momentary Control Mode

Function and manual operation:
- Displays the momentary output control mode.
- Evaluation of condition register **CRA**.
- Direct querying of the momentary control mode
- See explanation in chapter 3 [3].

Programming

Query command: **MO**DE**?**

Response string: MODE txt

Length: 8 characters, fixed

Parameter: txt (control mode)

Query range: **OFF**   output deactivated

CV   constant voltage regulation

CC   constant current regulation

OL   overload (power limiting)

Example (HP Basic):

OUTPUT 713; "MODE?"
ENTER 713; A$
DISP A$
→ Display: MODE CV

OCP, OCP? – Overcurrent Protection

Function and manual operation:
See explanation on page 26.

Settings

Programming

Setting command: **OC**P txt

Parameter: txt (status)

Parameter type: Text (character)

Setting range   **OFF**   Function inactive, continuous current limiting (current regulation).

ON   Function activated, the output is deactivated as soon as the specified DELAY period has elapsed.

Default setting: **OFF** (after RESET, *RST)

Example (HP Basic):

OUTPUT 713;"OCP ON"
{activate OCP function}

Query
Displays the selected status of the current limiting function.

Programming

Query command: **OC**P**?**

Response string: OCP txt

Length: 7 characters, fixed

Parameter: txt (status)

Example (HP Basic):

OUTPUT 713; "OCP?"
ENTER 713; A$
DISP A$
→ Display: OCP ON

OUTPUT, OUTPUT? – Activate / Deactivate the Output

Function and manual operation:

See explanation in chapter 3 [3].

Settings

Programming

Setting command:	**OU**TPUT *txt*	
Parameter:	*txt (status)*	
Parameter type:	Text (character)	
Setting command	OFF	Deactivate the output
	ON	Activate the output

Example (HP Basic):

OUTPUT 713;"OUTPUT ON"
{activate output}

Query
Displays the selected status of the power output.

Programming

Query command:	**OU**TPUT**?**
Response string:	OUTPUT *txt*
Length:	10 characters, fixed
Parameter:	*txt (status)*

Example (HP Basic):

OUTPUT 713; "OUTPUT?"
ENTER 713; A$
DISP A$
→ Display: OUTPUT ON

OVSET, OVSET? – Overvoltage Protection Trigger Value

Function and manual operation:

See explanation on page 25 - **OVP.**

Settings

Programming

Setting command:	**OVS**ET *v*
Parameter:	*v (value)*
Parameter type:	Real number
Setting range	$0 \le v \le OVSET_{max}$

Device Type				
Nom. voltage [V]	20	40	80	360
OVSET$_{max}$ [V]	25	50	100	450
Step size [mV]	100	200	400	2000

Format: +nnn.n

Example (HP Basic):

OUTPUT 713;"OVSET 35.0"
{trigger value 35 V}

Query

Programming

Query command:	**OVS**ET**?**
Response string:	OVSET *v*
Length:	12 characters, fixed
Parameter:	*v (value)*
Format:	+nnn.n

Example (HP Basic):

OUTPUT 713; "OVSET?"
ENTER 713; A$
DISP A$
→ Display: OVSET +035.0

POUT? – Querying the Momentary Power Value

Function and manual operation:

- Momentary values for **output voltage** and **output current** are acquired by means of the **POUT** function.
- The two **measured quantities** are **multiplied** to arrive at power value **Pout**.
- Approximately 90 ms are required to acquire and process the measured values.
- See explanations in chapter 4.8.1.

Programming

Query command:	**POU**T**?**
Response string:	POUT *v*
Length:	12 characters, fixed
Parameter:	*v (value)*
Format:	+nnnn.n

Example (HP Basic):

OUTPUT 713; "POUT?"
ENTER 713; A$
DISP A$
→ Display: POUT +0074.2

POWER_ON, POWER_ON? – Output Switching Status, Response After Power On

Function and manual operation:

See explanation on page 26.

Programming

Setting command:	**POW**ER_ON *txt*	
Parameter:	*txt (status)*	
Parameter type:	Text (character)	
Setting range	RST	RESET: device default settings
	RCL	RECALL: last used device settings
	SBY	STANDBY: last used device settings, but power output remains inactive (OUTPUT OFF).

Example (HP Basic):

OUTPUT 713;"POWER_ON RST"
{KONSTANTER is set to default settings after power-up}

Query
Displays device setting which determines status after power-up.

Programming

Query command:	**POW**ER_ON**?**
Response string:	POWER_ON *txt*
Length:	12 characters, fixed
Parameter:	*txt (status)*

Example (HP Basic):

OUTPUT 713; "POWER_ON?"
ENTER 713; A$
DISP A$
→ Display: POWER_ON RST

REPETITION, REPETITION? – Number of Repetitions for SEQUENCE Function

Function and manual operation:
See explanation on page 33.

Programming

Setting command:	**RE**PETITION *n*
Parameter:	*n (number)*
Parameter type:	Integer
Setting range	0 continuous repetition
	1 to 255 sequence repetitions
Format:	nnn
Default setting:	unchanged (after RESET, *RST)

Example (HP Basic):

OUTPUT 713;"REPETITION 100"
{100 repetitions}

Query
Display the number of sequence repetitions.

Programming

Query command:	**RE**PETITION**?**
Response string:	REPETITION *n*
Length:	14 characters, fixed
Parameter:	*n (number))*
Format:	nnn

Example (HP Basic):

OUTPUT 713; "REPETITION?"
ENTER 713; A$
DISP A$
→ Display: REPETITION 100

SEQUENCE, SEQUENCE? – Automatic Sequential Recall of Stored Settings

Function and manual operation:
See explanation on page 34.

Programming

Setting command:	**SEQ**UENCE *txt*
Parameter:	*txt (status)*
Parameter type:	Text (character)
Setting range:	**GO** SEQUENCE is started with **Strt** command
	HOLD[2] Pause, suspend sequence at current memory location
	CONT[2] Resume automatic sequence run with the next valid memory location
	STRT[3] Execute the first valid memory location, output is activated, step-by-step control
	STEP[3] Execute the next valid memory location
	STOP[3] Execute the stop address and end the automatic sequence run or step-by-step control

Example (HP Basic):

OUTPUT 713;"SEQUENCE GO"

Notes:

1) This function is modified as of **software release 003**.

     ON   Open SEQUENCE, as of **rel. 003**[1] SEQUENCE always open

     OFF   Close / exit SEQUENCE, as of **rel. 003**[1] same function as **SEQUENCE STOP**

     Default setting: **ON** (after RESET, *RST)

2) **HOLD** and **CONT** are only available as of **software release 003**. When you switch your KONSTANTER on, **rel 00x** appears at the display, indicating which software release you have.

3) **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.

Attention: Automatic and step-by-step sequence control (external trigger or setting command) are not interlocked.

Query
Through software release 10:
Only for compatibility with existing programs for older device versions. The response is always SEQUENCE ON.

Programming (as of software release 04.001)

Query command:	**SEQ**UENCE**?**
Response string:	SEQUENCE *txt,n1,n2*
Length:	21 characters, fixed
Parameter:	*txt (status)*
	n1,n2 (number of remaining 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 remaining 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)

SIG1_SIG2, SIG1_SIG2? – Analog Interface Signal Outputs

Function and manual operation:

- As opposed to manual operation, the computer generated SIG1_SIG2 command addresses both signal outputs simultaneously.
- **Signal output 1**: dependent upon power output status.
- **Signal output 2**: dependent upon current output control mode.
- The status of the **SIG1_SIG2** function is **not** saved as a device setting with the **SAVE** key.
- See explanations on page 29 ff.

Programming

Setting command:	**SI**G1_SIG2 *txt1,txt2*	
Parameter:	*txt1,txt2 (selection)*	
Parameter type:	Text (character)	

Setting range:		
OFF	SIG n	Passive high
ON		Active low
OUT	OUTPUT ON	Passive high
	OUTPUT OFF	Active low
MODE	OFF or CV	Passive high
	CC or OL	Active low
SEQ	GO	Active low
SSET	OFF	Passive high
	ON	Active low
U_LO	$U_{meas} \geq U_{min}$	Passive high
	$U_{meas} \leq U_{min}$	Active low
U_HI	$U_{meas} \leq U_{max}$	Passive high
	$U_{meas} \geq U_{max}$	Active low
I_LO	$I_{meas} \geq I_{min}$	Passive high
	$I_{meas} \leq I_{min}$	Active low
I_HI	$I_{meas} \leq I_{max}$	Passive high
	$I_{meas} \geq I_{max}$	Active low

Default setting: After RESET (*RST) → unchanged

Example (HP Basic):

OUTPUT 713; "SIG1_SIG2 OUT, MODE"

Query

Displays the selected function for the signal outputs at the analog interface.

Programming

Query command:	**SI**G1_SIG2**?**
Response string:	SIG1_SIG2 *txt1,txt2*
Length:	19 characters, fixed
Parameter:	*txt1, txt2 (selection)*

Example (HP Basic):

OUTPUT 713; "SIG1_SIG2?"
ENTER 713; A$
DISP A$
→ Display: SIG1_SIG2 OUT,MODE

SRQ – SERVICE REQUEST

Functions

- The service request **SRQ** is only available via the **IEEE** parallel interface.
- **SRQ** can be activated by **any** device which is connected to the **IEC** bus.
- **SRQ** is **the only way for a device to trigger a specified action** at the controller.
- The **SRQ lead** is activated by the **KONSTANTER** when it **requests service from the controller**.
- **SRQ** allows for **simultaneous execution of several tasks** by the **controller**, and thus **increases** its **efficiency**.
- The controller can execute other tasks **until** it receives an **SRQ from the device**.
- In **response** to the **SRQ message** via the IEC bus, the control computer can start serial polling of the device status (**serial poll**).
- In this way, the **device which transmitted the SRQ** as well as the **reason** for the message, are both determined.
- If **only one device is connected to the IEC bus**, the controller can **read out the status byte directly** and trigger the desired function after receiving an SRQ.
- Primarily, the **controller** should read out information regarding device statuses and events.
- The service request is transmitted via the **common interrupt lead (SRQ)** at the IEC bus.
- **SRQ trigger conditions** can be **selected** from any of the messages which occur in the event registers (including MAV)**.**
- Which event message or messages result in an SRQ message is determined by **setting the enable registers** accordingly (**SRQ masking**).
- 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.

Example: SRQ triggering upon receipt of an incorrect command:

- Assuming all event registers have an initial value of 0.
- An incorrect command is received.
- The **ESR** (event standard register) sets bit 4 (**EXE**, execution error) or bit 5 (**CME**, command error).
- Did you previously set bits 4 and 5 in the **ESE** enable register (command: ***ESE 48**)?
- If so, the **ESR** group message is generated in the **STB** (status byte register).
- The associated **SRE** enable register must be set to bit 5 (command: ***SRE 32**).
- The **ESR** bit is now able to generate the **MSS** group message (master summary status).
- The **MSS** group message enters itself once again to bit 6 in the **STB** (status byte).
- In this way, a signal is generated indicating that there is **at least one reason** for generating 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 from the **MAV** message, are generated in the same way.

Comments

- We recommend **enabling** the **following events** at the corresponding **registers** for an SRQ message:

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
OUTE	OUTput Error	**SEQE**	Sequence Error
DDTE	Define Device Trigger Error		

- The **setting commands** required to this end read as follows:

  *ESE 52; **ERAE 56**; **ERBE 190**; ***SRE 52**.

- As soon as one of these events occurs, the KONSTANTER is no longer able to execute the desired setting.

RS 232C Serial Interface

- Use of the **SRQ** service request function is **not possible** via the RS 232 serial interface.
- **Similar results** can nevertheless be obtained.
- Set the **PRE** register (parallel poll enable) to the same value as the **SRE** register (status byte enable register).
- Now query and evaluate the **IST** individual status message.
- Query and evaluation can be executed cyclically, and/or each time data is transmitted to the KONSTANTER .

SSET, SSET? – Switching Function Signal Level

Function and manual operation:

See explanation on page 31.

Programming

Setting command: **SS**ET *txt*
Parameter: *txt (status)*
Parameter type: Text (character)
Setting range:
  OFF signal output n passive high
  ON signal output n active low

Example (HP Basic):

OUTPUT 713;"SSET OFF"
Signal output **SIG_OUT1/SIG_OUT2** at the analog interface generates a passive high signal.

Query

Queries the sequence's function status.

Programming

Query command: **SS**ET**?**
Response string: SSET *txt*
Length: 8 characters, fixed
Parameter: *txt (status)*

Example (HP Basic):

OUTPUT 713; "SSET?"
ENTER 713; A\$
DISP A\$
→ Display: SSET OFF

START_STOP, START_STOP? – Memory Location Start and Stop Addresses for the SEQUENCE Function

Function and manual operation:

- As opposed to manual operation, start and stop memory addresses are entered to a command.
- See explanations on page 32 ff.

Programming

Setting command: **STA**RT_STOP *n1, n 2*
Parameter: *n1, n2 (start address, stop address)*
Parameter type: Integer
Setting range: Start address: 11 to 255
  Stop address: 11 to 255
Condition: Start address < stop address
Default setting: after RESET (*RST) →: unchanged

Example (HP Basic):

OUTPUT 713;"STA 20, 115"
{sequence start = address 20}
{sequence end = address 115}

Query

Displays selected start and stop memory addresses for the SEQUENCE function.

Programming

Query command: **STA**RT_STOP**?**
Response string: START_STOP *n1, n2*
Length: 18 characters, fixed
Parameter: *n1, n2 (start address, stop address)*

Example (HP Basic):

OUTPUT 713; "STA?"
ENTER 713; A\$
DISP A\$
→ Display: START_STOP 020,115

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.

Programming

Setting command:	**STO**RE *n, v1, v2, v3, txt*	
Parameter:	*n, v1, v2, v3, txt (memory address, USET, ISET TSET, SSET)*	
Parameter type:	Integer, real, real, real, character	
Setting range:	*n*	11 ... 255
	w1	$0 \leq v1 \leq USET_{max}$
	w2	$0 \leq v2 \leq ISET_{max}$
	w3	00.01 [s] $\leq$ w3 $\leq$ 99.99 [s]
	txt	OFF, ON, CLR (deletes the entire memory location regardless of other data)

Example (HP Basic):

> OUTPUT 713;"STORE 14,15.5,3,9.7,ON"
> {overwrites memory location 14 with the following data:
> Uset = 15.5 V; Iset = 3 A; Tset = 9.7 sec; active low signal during execution}

Comments

- 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 in the future. 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, switching status remains unchanged
	Empty	New setpoints are transferred, switching status is set to OFF.
ON	Any	New setpoints are transferred, switching status is set to ON.
OFF	Any	New setpoints are transferred, switching status is set to OFF.
CLR	Any	Memory content is deleted.

Query

Recall data from address n from SEQUENCE memory / limit value memory:

Programming

	Command	Value Range	Meaning
a	**Sto**re?		Query contents of a memory range from the start address to the stop address (AAA and EEE)
b	**Sto**re? n	n = 11 ... 255	Query contents of memory location n
c	**Sto**re? n1,n2	n1, n2 = 11 ... 255 n2 ≥ n1	Query contents of a memory range from address n1 to address n2
d	**Sto**re? 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) **STO**RE**?**	
	b) **STO**RE**?** *n*	
	c) **STO**RE**?** *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): constant 37 characters	
	case a)/c): ((n2-n1+1)x38)-1 characters	
Parameter:	*n, v1, v2, v3, txt*	
	(nnn,+000.000,+00.0000,00.00,CLR)	
	(memory address, USET, ISET TSET, SSET)	
	If the response to SSET 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,+03.0000,09.70, ON

Example a)/c)
(HP Basic for 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,+03.0000,09.70, ON;
> STORE 012,+010.000,+04.0000,01.50,OFF;
> STORE 013,+020.000,+07.0000,02.30, ON

Example d) (HP Basic):

> OUTPUT 713; "STORE? 11,13,tab"
> ENTER 713; A$
> DISP A$
> → Display: STORE→011→+015,000→+03,0000→09,70→ ON↵
> STORE→012→+010,000→+04,0000→01,50→OFF↵
> STORE→013→+020,000→+07,0000→02,30→ ON↵

Significance of delineators:
→= ASCII 09h tabulator
↵ = ASCII 0Ah line feed

TDEF, TDEF? – Default Time for SEQUENCE Function

Functions:

See explanation on page 32.

Programming

Setting command:	**TD**EF *v*
Parameter:	*v (value)*
Parameter type:	Real
Setting range:	**00.01** [s] – **99.99** [s]
Resolution:	10 ms
Default setting:	after RESET (*RST): unchanged

Example (HP Basic):

OUTPUT 713;"TDEF 12.34"

Query

Recall the default value for standard dwell time.

Programming

Query command:	**TD**EF**?**
Response string:	TDEF *v*
Length:	10 characters, fixed
Parameter:	*v (value)*

Example (HP Basic):

OUTPUT 713; "TDEF?"
ENTER 713; A$
DISP A$
→ Display: TDEF 12.34

T_MODE, T_MODE? – Trigger Input Function Selection

Functions

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

- See explanations on page 28 - **trG.**

Programming

Setting command:	**T_M**ODE *txt*	
Parameter:	*txt*	
Parameter type:	Action (character)	
Setting range:	**OFF**	Trigger output deactivated
	OUT	Trigger input influences **OUTPUT**: output on/off
	RCL	**RECALL**: memory recall (step-by-step)[1]
	SEQ	**SEQUENCE**: sequential memory recall (**SEQUENCE GO**)[1]
	LLO	**LOCAL LOCKED**: Control panel disabling; indicated by LOCKED / SEQ LED at the front panel
	MIN	**MINMAX**: Min-Max memory control for measured values
Default setting:	Unchanged (after RESET, *RST)	

Example (HP Basic)**:**

OUTPUT 713;"T_MODE LLO"
{trigger input influences control panel disabling}

1 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 (SEQE) is set in event register B (ERB). "RCL" or "SEQ" settings can only be executed if the SEQUENCE function has been fully initialized.

Query

Displays selected trigger input function.

Programming

Query command:	**T_M**ODE**?**
Response string:	T_MODE *txt*
Length:	10 characters, fixed
Parameter:	*txt (action)*

Example (HP Basic):

OUTPUT 713; "T_MODE?"
ENTER 713; A$
DISP A$
→ Display: T_MODE LLO

TSET, TSET? Dwell Time Specific to Memory Location for the SEQUENCE Function

Function and manual operation:

- See explanations on page 31.
- Setting value **TSET** is saved to **SETUP** memory as a device setting with the **SAVE** command.

Programming

Setting command:	**TS**ET *value*
Parameter type:	Real
Setting range:	**00.01** [s] ... **99.99** [s]
Resolution:	10 ms
Format:	nn.nn
Default setting:	after RESET (*RST): 00.00 = TdEF

Example (HP Basic):

OUTPUT 713;"TSET 00.02"

Query

Recall memory location-specific dwell time.

Programming

Query command:	**TS**ET**?**
Response string:	TSET *v*
Length:	10 characters, fixed
Parameter:	*v (value)*
Format:	nn.nn

Example (HP Basic):

OUTPUT 713; "TDEF?"
ENTER 713; A$
DISP A$
→ Display: TDEF 00.02

ULIM, ULIM? – Voltage Setting Limit Value

Function and manual operation:
See explanation on page 25.

Programming

Setting command: **UL**IM *v*
Parameter: *v (value)*
Parameter type: Real number
Setting range: $0 \leq v \leq ULIM_{max}$ I

Device Type				
Nom. voltage [V]	20	40	80	360
$ULIM_{max}$ [V]	20	40	80	360
Step size [mV]	1.0	1.0	1.0	1.0

Default setting: after RESET (*RST) $\rightarrow$ nominal voltage

Example (HP BASIC):

OUTPUT 713;"ULIM 20"
{voltage setting range limit: 20 V}

Comment
- **ULIM may not be set to a value of less than USET!**
- Any setting command to this effect is not executed.
- **Bit 1** would otherwise be set in event register B (**limit error**), and **bit 4** in the standard event register (**execution error**).
- 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.
- The **ULIM** function does not effect the **USET** setting by means of a control signal via the analog interface.

Query
Displays the selected final value for voltage setpoint USET.

Programming

Query command: **UL**IM**?**

Response string: ULIM *v*
Length: 13 characters, fixed
Parameter *v (value)*
Format *v*: +nnn.nnn

Example (HP Basic):

OUTPUT 713;"**UL**IM**?**"
ENTER 713; A$
DISP A$
$\rightarrow$Display: ULIM +020.000

UMAX? – Maximum Measured Voltage Value

Function and manual operation:
See explanation in chapter 4.8.1.

Programming

Query command: **UM**AX**?**
Response string: UMAX *v*
Length: 13 characters, fixed
Parameter: *v (value)*
Format: +nnn.nnn

Example (HP Basic):

OUTPUT 713; "UMAX?"
ENTER 713; A$
DISP A$
$\rightarrow$ Display: UMAX +028.125

UMIN? – Minimum Measured Voltage Value

Function and manual operation:
See explanation in chapter 4.8.1.

Programming

Query command: **UM**AX**?**
Response string: UMAX *v*
Length: 13 characters, fixed
Parameter: *v (value)*
Format: +nnn.nnn

Example (HP Basic):

OUTPUT 713; "UMIN?"
ENTER 713; A$
DISP A$
$\rightarrow$ Display: UMIN +027.350

UOUT? – Querying the Momentary Voltage Value

Function and manual operation:
See explanation on page 23.

Programming

Query command: **UO**UT**?**
Response string: UOUT *v*
Length: 13 characters, fixed
Parameter: *v (value)*
Format: +nnn.nnn

Example (HP Basic):

OUTPUT 713; "UOUT?"
ENTER 713; A$
DISP A$
$\rightarrow$ Display: UOUT +027.350

USET, USET? – Voltage Setpoint Value

Function and manual operation:
See explanation on page 20.

Programming

Setting command: **US**ET *v*

Parameter:	*v (value)*
Parameter type:	Real number
Setting range:	$0 \leq v \leq ULIM$

Device Type				
Nom. voltage [V]	20	40	80	360
$ULIM_{max}$ [V]	20	40	80	360
Step size [mV]	5	10	20	100

Default setting: After RESET (*RST) → 0.00 V

Example (HP BASIC):

OUTPUT 713;"USET 12.5"
{voltage setpoint: 12.5 V}

Comments

- **USET cannot be set to a value of greater than ULIM.**
- Any setting command to this effect is not executed.
- **Bit 1** would otherwise be set in event register B (**limit error**), and **bit 4** in the standard event register (**execution error**).
- 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.

Query
Also displays the output voltage setpoint defined by means of USET.

Programming

Query command: **US**ET**?**

Response string:	USET *v*
Length:	13 characters, fixed
Parameter	*v (value)*
Format *v*:	+nnn.nnn

Example (HP Basic):

	OUTPUT 713;"**US**ET**?**"
	ENTER 713; A$
	DISP A$
→Display:	USET +012.500

WAIT – Additional Waiting Time

Function:
Additional waiting time between execution of two commands. This function can be used to add additional waiting time within a command string (linked commands) during processing / 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 millisecond range.

Programming

Setting command: **W**AIT *v*

Parameter:	*v (value)*
Parameter type:	Real number
Setting range:	0.001 <s> $\leq v \leq$ 9.999 <s>, resolution: 1 ms

Comments
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:
Data are not processed during waiting time, and the input buffer is disabled, which means that the display messages 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 equipped with **special registers** which can be queried by the controller in order to recognize:

- **Programming errors** (e.g. receipt of an incorrect command)
- **Device statuses** (e.g. output in voltage regulating mode)
- **Events** (e.g. output deactivated by OCP function)

Status and **event register settings** and **queries** are **only** possible via the

serial or the
parallel interface!
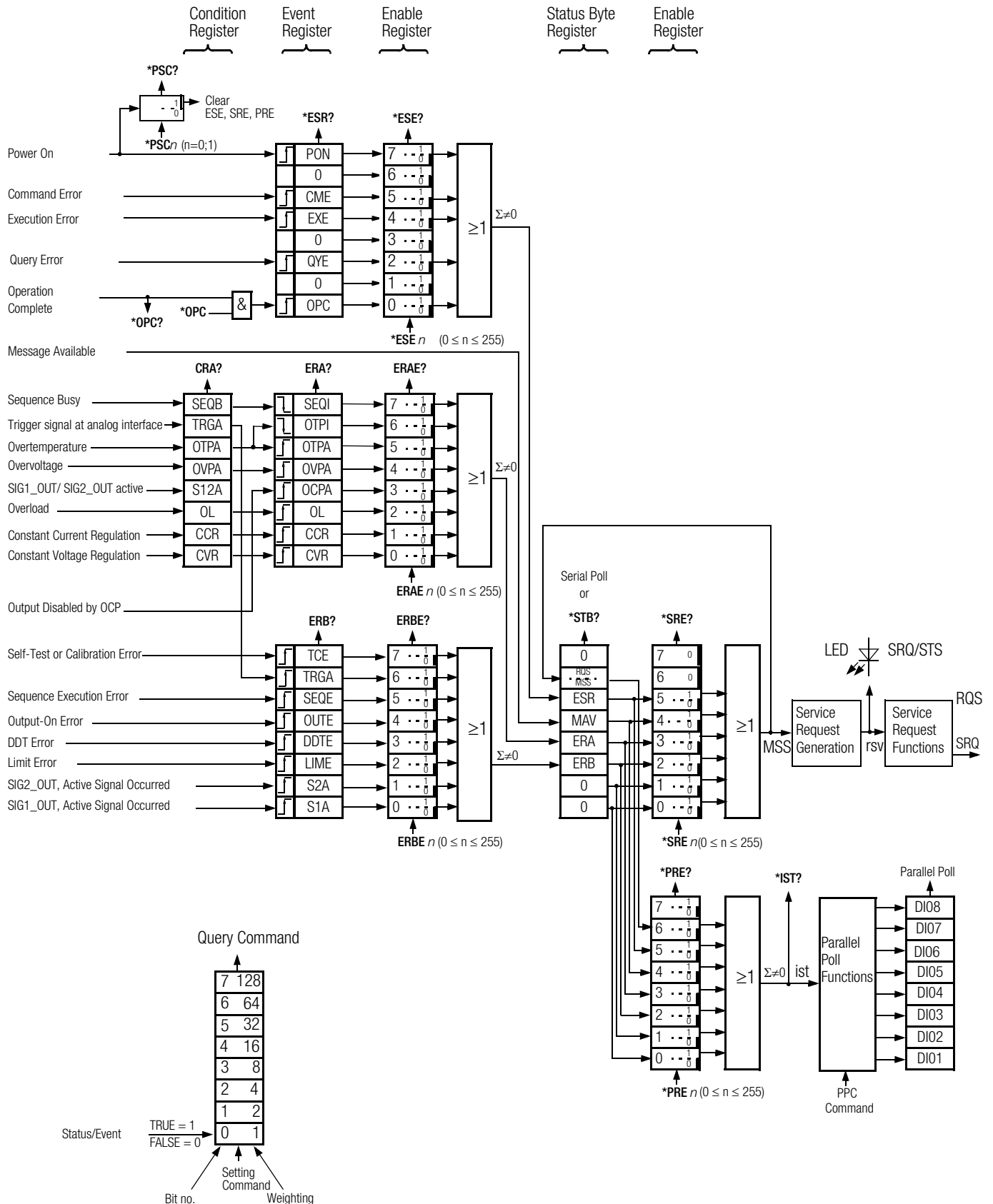
Overview – Significance of Register Contents

TCE Self-Test Error or Error During Calibration
- An error was recognized during the self-test.
- Device calibration error
- Calibration has not been completed successfully.
- At least one calibration value was not within the allowable range.

CCR Constant Current Regulation
Output is/was in the current regulating mode.

CVR Constant Voltage Regulation
Output is/was in the voltage regulating mode.

CME Command Error
Faulty command
- Unknown command
- Syntax error
- Parameter value is not within the setting range.

DDTE Define Device Trigger Error
Error message for the device trigger setting
- *DDT command string > 80 characters
- *TRG command included in *DDT command string

EXE Execution Error
- Command-specific parameter value limits have been exceeded.
- A command or a parameter is incompatible with the present operating state.

LIME Limit Error
Limit value error after setting command **USET, ISET, ULIM, ILIM**
- Voltage or current setpoint adjusted higher than the selected limit value
- A limit value has been selected which is less than the momentary voltage or current setpoint.

MAV Message Available
Ready message following a query command
- Requested data are in the output buffer.
- The **MAV bit** should only be queried by means of serial polling during IEC bus mode operation.

OCPA Overcurrent Protection Active
Overcurrent protection is active.
- Output deactivated by OCP function
- Reactivate with OUTPUT ON

OL Overload
Overload message
- Power limiting has been triggered.

OPC Operation Complete
Ready message
- Commands preceding the *OPC command have been executed (time synchronization).

OTPA Overtemperature Protection Active
Overcurrent protection is active.
- The device is overheated, e.g. due to obstructed vents.
- 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 Overtemperature Protection Inactive
Ready for operation message after **OTPA** overtemperature message:
- The device has cooled back down.
- If the **POWER-ON** function is set to **SBY** or **RST**, the output remains deactivated.
- If it has been set to **RCL**, automatic reactivation ensues.

OUTE Output Error
Error message after **OUTPUT ON** setting 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 Active
Overload protection has been triggered.
- The output has been deactivated.
- Reactivate with **OUTPUT ON**.

PON Power On
- The device was switched off for an interim period of time.

QYE Output **queue** without message
Error message after addressing as talker:
- No message is (yet) available at the output buffer.

SEQB Sequence Busy
The **SEQUENCE** function is running.

SEQI Sequence Inactive
Ready message
- **Sequence** run ended or aborted

SEQE Sequence Error
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".
- Memory range from the start address to the stop address does not contain any executable values, display: "Err 22".
- The sequence run is aborted when this error message appears.

S1A SIG1_OUT, Active Signal Occurred

S2A SIG2_OUT, Active Signal Occurred

S12A SIG1_OUT or SIG2_OUT active

TRGA Trigger at Analog Interface
Trigger signal detected at analog interface

Decimal Equivalent of Register Content

- Querying data registers always results in a decimal number.
- The decimal number designates the content of the register.
- For an 8-bit register, this number is within a range of 0 to 255.
- The number represents all set register bits.
- The number must be converted to a binary value to this end.

Example:

In response to the query **CRA?**, you receive the following response: **52**

Conversion:	52 : 2 =	26	rest 0	bit 0
	26 : 2 =	13	rest 0	bit 1
	13 : 2 =	6	rest 1	bit 2
	6 : 2 =	3	rest 0	bit 3
	3 : 2 =	1	rest 1	bit 4
	1 : 2 =	0	rest 1	bit 5
	0 : 2 =	0	rest 0	bit 6
	0 : 2 =	0	rest 0	bit 7

The binary representation of 52_{10} is thus: $0011\ 0100_2$

- The binary representation indicates which **bits** are **set** in **condition register A** (CRA).
    - 3 (OL = overload)
    - 5 (OVPA = overvoltage)
    - 6 (OTPA = overtemperature)
- These bits may have triggered an SRQ (service request).

7 Adjusting the SSP KONSTANTER CAL – "Calibration" Function Group

7.1 General Information and Definition of Terms

Adjustment

- Also known as **balancing**.
- **Adjust** (**balance**) a measuring instrument such that measuring deviation is as small as possible.
- **Adjustment** is a procedure which permanently changes the measuring instrument.

Calibration

- Determination of deviation at a finished measuring instrument
- **Indicating measuring instrument:**
  Deviation of the displayed value from the value determined as correct
- **Transmitting measuring instruments:**
  Deviation of the initial signal value from the value which this signal would demonstrate in the case of ideal transmission performance with a defined input value

Retracing

- A process by means of which measured values indicated by a measuring instrument can be compared with the national standard for the respective measured quantity, either in a single or in several steps

General

The adjusting routine integrated into the KONSTANTER (**CAL**) allows for the **elimination of deviation between actual value and setpoint** resulting from component ageing at user-specified intervals.
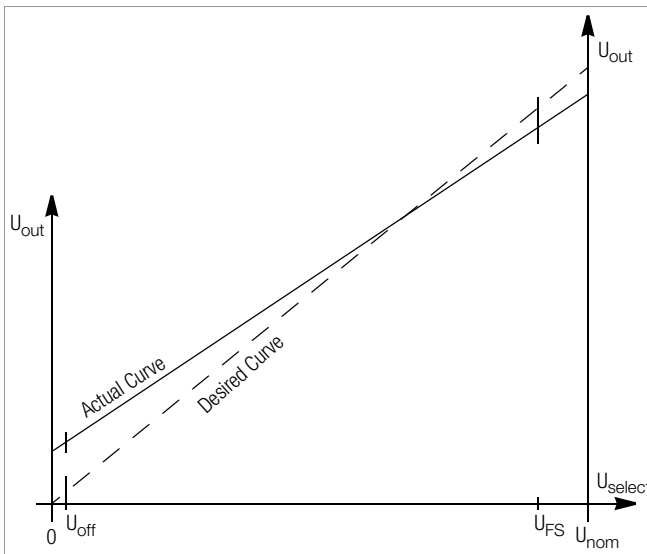
Figure 7.1 a   Continuous Adjustment of Uset

0:	Zero point
U_{nom}	Nominal voltage
U_{select}	Selected voltage value
U_{out}	Output voltage
U_{off}	Offset voltage = 0.5% of U_{nom}
U_{FS}	Full-scale voltage = 95% of U_{nom}

- In order to adjust the system, **2 fixed voltage values** (U_{off} and U_{FS}) are selected internally (**setpoints**), and a straight line (desired curve) is drawn between them.

- The associated external measured values (**actual values**) are entered to the system and compared with the setpoint values.
- A straight line is drawn between the actual values as well, and linear deviation from the setpoint curve (slope and ordinate segment) is saved to memory.
- These values are stored to the EEPROM, and are used for all adjustments.
- Each newly adjusted voltage value along the setpoint curve is calculated based upon the actual curve and deviation, for adjustment to the exact voltage value.
- The same applies to balancing current values.
- Adjustment can be executed manually, or automatically via the interfaces with the help of a PC.
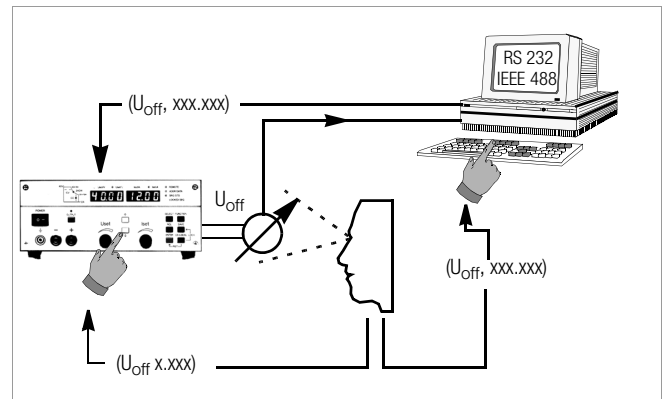
Figure 7.1 b   Adjusting the KONSTANTER Manually, or with a PC

7.2 Adjusting Procedure

Manual Balancing

Preparation

In order to adjust the KONSTANTER, you'll need a highly accurate measuring instrument whose resolution is roughly one class better than that of the KONSTANTER (see also Technical Data).

Connecting the Measuring Instrument for Output Voltage Adjustment

The KONSTANTER's **power output** must be **deactivated** (**OUTPUT OFF**).

Connect the **measuring instrument** directly (**parallel**) to the **power output** of the KONSTANTER. Adjustment accuracy can be further increased by additionally connecting the sensing leads.
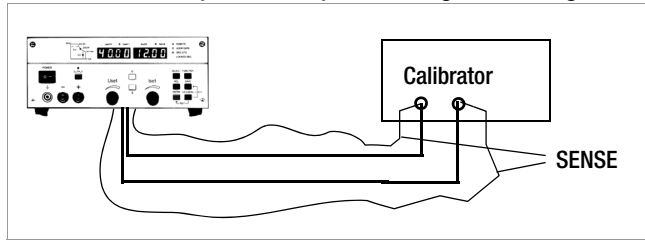
Figure 7.2 a Connection Schematic for Output Voltage Adjustment

Switch the measuring instrument on, and select the correct voltage range for the measurement. The upper range limit must be at least as great as nominal voltage of the KONSTANTER.

Select the voltage adjusting functions and then **activate** the KONSTANTER's **power output** (**OUTPUT ON**).

Connecting the Measuring Instrument for Output Current Adjustment

The KONSTANTER's **power output** must be **deactivated** (**OUTPUT OFF**).

Observe the measuring instrument's maximum current measuring range.

If the KONSTANTER's **maximum output current value** is **less** than the measuring instrument's **maximum current measuring range**, the measuring instrument can be connected **in series** directly to the **power output**.

If the **maximum output current value** is **greater** than the measuring instrument's **maximum current measuring range**, the measuring instrument must be connected to the KONSTANTER's power output via a properly dimensioned **shunt resistor**. Adjustment accuracy can be further increased by additionally connecting the sensing leads.

Figure 7.2 b Connection Schematic for Output Current Adjustment

Switch the measuring instrument on, and select the correct current range for the measurement. The upper range limit must be at least as great as nominal current of the KONSTANTER.

Select the current adjusting functions and then activate the KONSTANTER (**OUTPUT ON**).

Figure 7.2 c   Manual Device Adjustment

Selecting the Adjustment (calibration) Function

The KONSTANTER is operated in the standard operating mode.

23 Press the <FUNCTION> key once in order to access the function groups menu.
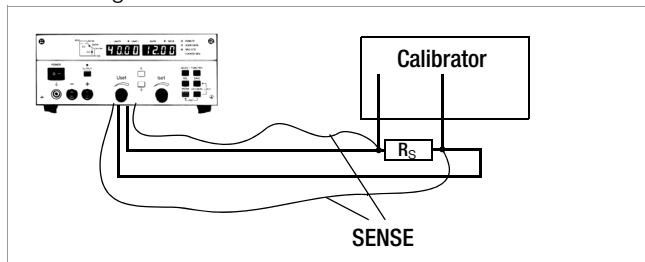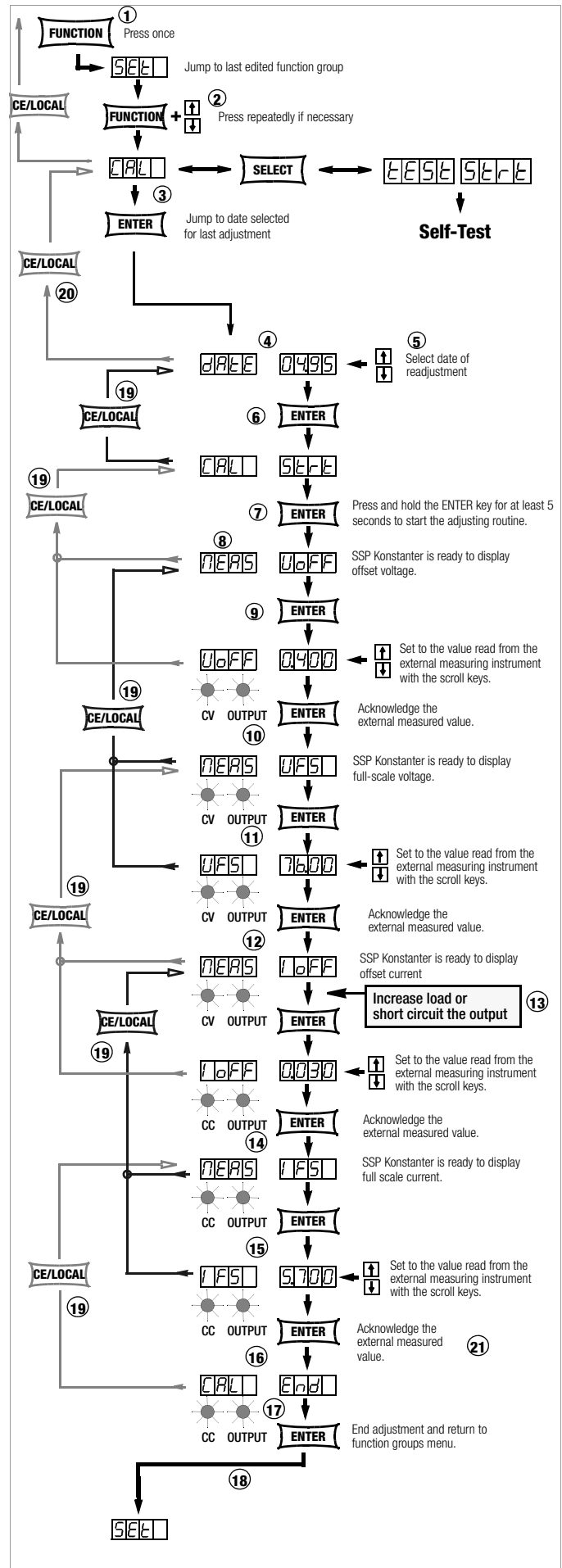
24 Repeatedly press the <FUNCTION> key until the **CAL** function group appears at the display.

25 If **CAL** appears at the left-hand display, press the <ENTER> key to access the adjustment (or calibration) function.

Setting the New Adjustment Date

26 At first, **date** appears at the left-hand display, and the date of last adjustment appears at the right-hand display.

27 Select today's date with the <↓> key or the <↑> key.

28 After setting the date, press the <ENTER> key.
    The date is saved and the following message appears at the display: **CAL Strt.** Strt blinks.

Starting the Adjustment (calibration) Routine

29 Press and hold the <ENTER> key for **at least 5 seconds** in order to start the adjusting (calibration) routine.

    If the <ENTER> key is held depressed for less than 5 seconds, the device is automatically returned to its default setting.

    If this is the case, press the <FUNCTION> key once again, in order to return to **CAL Strt**.

Adjusting Offset Voltage and Full-Scale Voltage

30 **MEAS UoFF** blinks at the display (measure offset voltage). The KONSTANTER is ready to display offset voltage.

31 Press the <ENTER> key.
    UoFF appears at the left-hand display, and the voltage value measured by the KONSTANTER appears at the right-hand display (0.5% of U_{nom}).
    The blinking digit indicates the smallest adjustable decimal .
    The **CV** and **OUTPUT** LEDs light up, and the output is active.

    Compare the **UoFF** value with the value displayed at the external measuring instrument.

    If these two values are different, set the KONSTANTER to the value measured by the external measuring instrument with the <↓> key or the <↑> key.

32 Save the corrected **UoFF** value to the KONSTANTER by pressing the <ENTER> key.

    After pressing the <ENTER> key, **MEAS UFS** blinks at the display (measure full-scale voltage).

33 Press the <ENTER> key.
    UFS appears at the left-hand display, and the voltage value measured by the KONSTANTER appears at the right-hand display (95% of U_{nom}).
    The blinking digit indicates the smallest adjustable decimal place.

    Compare this value with the value displayed at the external measuring instrument.

    If these two values are different, set the KONSTANTER to the value measured by the external measuring instrument with the <↓> key or the <↑> key.

34 Save the corrected **UFS** value to the KONSTANTER by pressing the <ENTER> key.

    MEAS IoFF appears at the display.

Adjusting Offset Current and Full-Scale Current

35 The KONSTANTER must be set to the **current regulating mode** in order to adjust **offset current and full-scale current**!
    Increase load to this end, or short circuit the output. The **CV** LED goes out, and the **CC** and **OUTPUT** LEDs light up.

MEAS IoFF blinks at the display (measure offset current). The KONSTANTER is ready to display offset current.

Press the <ENTER> key.
IoFF appears at the left-hand display, and the current value measured by the KONSTANTER appears at the right-hand display (0.5% of I_{nom}).
The blinking digit indicates the smallest adjustable decimal .

Compare this value with the value displayed at the external measuring instrument.

If these two values are different, set the KONSTANTER to the value measured by the external measuring instrument with the <↓> key or the <↑> key.

36 Save the corrected **IoFF** value to the KONSTANTER by pressing the <ENTER> key.

    After pressing the <ENTER> key, **MEAS IFS** blinks at the display (measure full-scale current).

37 Press the <ENTER> key.
    IFS appears at the left-hand display, and the current value measured by the KONSTANTER appears at the right-hand display (95% of I_{nom}).
    The blinking digit indicates the smallest adjustable place.

    Compare this value with the value displayed at the external measuring instrument.

    If these two values are different, set the KONSTANTER to the value measured by the external measuring instrument with the <↓> key or the <↑> key.

38 Save the corrected **IFS** value to the KONSTANTER by pressing the <ENTER> key.

Ending Adjustment of the KONSTANTER

39 **CAL End** appears at the display after acknowledging the last selected current value.

    Exit the adjusting function by pressing the <ENTER> key.

40 **All of the adjustment values are now stored to memory.**
    SEt appears at the left-hand display. The device is returned to the function groups menu.
    A new function group can now be selected with the <FUNCTION> key, or the menu can be exited by pressing the <CE/LOCAL> key in order to return to the standard display.

Manually Aborting the Adjusting Routine Prematurely

If, during one of the adjusting steps, you discover that deviation between the measured values from the KONSTANTER and the external measuring instrument will be too large (making adjustment impossible) adjustment can be aborted prematurely in order to retain the previous adjustment values.

41 Repeatedly press the <CE/LOCAL> key until **CAL** appears at the left-hand display.
    The display is returned to the beginning of the adjusting routine.

42 Press the <CE/LOCAL> key once again in order to exit the adjusting function and return to the function groups menu.

Automatic Adjustment Abort Triggered by the KONSTANTER

43 If the KONSTANTER is unable to execute adjustment because measured value deviation is too great, the adjustment values are not saved to memory in the last step of the adjusting routine.

    The KONSTANTER returns itself to the **UNCAL** status, activates default values (not previous adjustment values) and exits the adjusting function. In addition, each time the KONSTANTER is switched on the Cal error flag is set.

Computer-Aided Balancing

Preparation

Connect the bus cable to the interfaces at the PC and the KONSTANTER.

Further preparation for computer-aided adjustment of the KONSTANTER is identical to preparation for manual adjustment.

Computer-Aided Adjustment (manual)

In this case, you'll work interactively with the PC, the KONSTANTER and the measuring instrument. The following command is used to control the KONSTANTER via the PC:

| CAL | *txt, v* |
| Parameter | *txt, v* |

Alternatives for the *txt* and *v* parameters

txt, v	Description
Uoff	Start adjustment, U-Offset-Adj. setting
Uoff, xxx.xxx	U-Offset: externally measured voltage
Ufs	Setting: U-Upper-Limit-Adj.
Ufs, xxx.xxx	U-Upper-Limit: externally measured voltage
Ioff	I-Offset-Adj. setting
Ioff, xxx.xxx	I-Offset: externally measured current
Ifs	I-Upper-Limit-Adj. setting
Ifs, xxx.xxx	I-Upper-Limit: externally measured current
DATE, mm.yy	Adjustment date, exit adjustment

In order to implement this command, it must be translated into the language required by the interface. We use HP Basic for IEC bus systems, which results in the following syntax:

Output 713; "CAL Uoff"

Command	Description
Output	Command to the PC to transmit data to an external device via the interface
713	Address of the KONSTANTER (external device)
"CAL Uoff"	Command for the KONSTANTER, quotations define beginning and end

Example for adjustment with PC

Adjustment must be executed in the following manner and sequence.

OUTPUT 713; "CAL *Uoff*" ↵

    The start adjustment command is transmitted to the KONSTANTER. The KONSTANTER reads out the Uoff value. Read the measured value from the external measuring instrument.

OUTPUT 713; "CAL *Uoff, 0.478*" ↵

    0.478 is the value read from the external measuring instrument. It is entered as a numeric parameter value.

OUTPUT 713; "CAL *Ufs*" ↵

    The KONSTANTER reads out the Ufs value. Read the measured value from the external measuring instrument.

OUTPUT 713; "CAL *Ufs, 71.00*" ↵

    71.00 is the value read from the external measuring instrument. It is entered as a numeric parameter value.

OUTPUT 713; "CAL *Ioff*" ↵

    The KONSTANTER reads out the Ioff value. Read the measured value from the external measuring instrument.

OUTPUT 713; "CAL *Ioff, 0.048*" ↵

    0.048 is the value read from the external measuring instrument. It is entered as a numeric parameter value.

OUTPUT 713; "CAL *Ifs*" ↵

    The KONSTANTER reads out the Ifs value. Read the measured value from the external measuring instrument.

OUTPUT 713; "CAL *Ifs, 5.863*" ↵

    5.863 is the value read from the external measuring instrument. It is entered as a numeric parameter value.

OUTPUT 713; "CAL *date, 06.95*" ↵

    As opposed to direct computer adjustment, the adjustment date must be entered after the routine has been completed. However, the last adjustment date cannot be queried in this case. The adjusting routine is finished after the adjustment date has been entered.

Computer-Aided Adjustment (automatic)

Use an additional bus cable to connect the PC and the external measuring instrument to each other.

A program must be written for fully automated adjustment which is matched to the interface, allowing for data exchange amongst the PC, the system multimeter and the KONSTANTER, as well as data interpretation and translation.

The commands used for transmitting data correspond to those listed above for keyboard entry.

7.3 Self-Test Triggering

- The device tests itself for possible errors.
- Select the **CAL** function group from the function group menu.
- Press the **< SELECT>** key.
- **tESt Strt** appears at the display.
- Start the self-test by pressing the **<ENTER>** key.
- The LOCKED/SEQ LED blinks during testing.
- Any detected errors are indicated by briefly displaying the **Err 11** message (see error list).
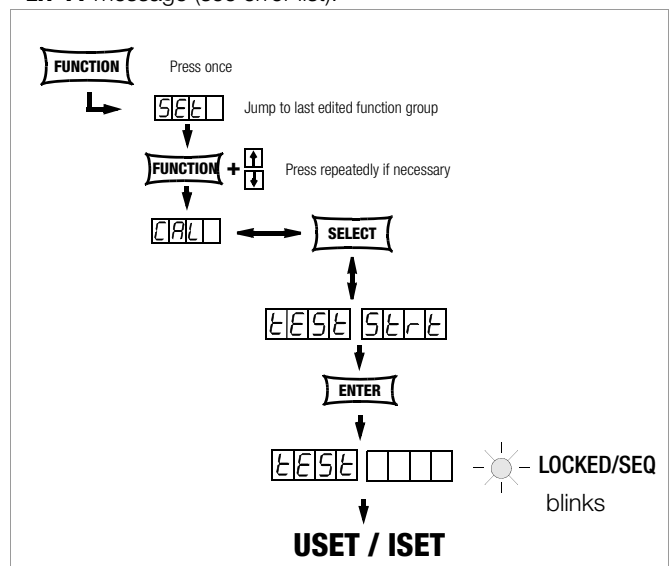

Figure 7.3   Triggering the Self-Test Manually

8 Appendix

8.1 Adjustable Functions and Parameters

Setting Command	Significance / Effect	Setting saved with *SAV n: Manual setting or via interface					Default setting after RESET *RST:	Explanation in Chapter on Page
		Manual	IEEE 488	RS 232C	n=1...10	n=11...255		
Addr *n*	Set device address for RS 232 or IEEE 488 (interface configuration)	X						p. 38
ADDRESS *n*	*n:* 0;1; ... ; 31 (device addresses)		X				unchanged	p. 64
bAUd *txt*	Set transmission speed (interface configuration)	X					unchanged	p. 39
	txt: 50; 75; 150; ... ; 4800; 9600; 19.2t (transmission speed in bits per sec.)							
CAL	Start "CAL" routine in accordance with chapter 7 of the operating instructions	X					unchanged	p. 80
CAL *txt, v*			X	X				p. 81
dbit *txt*	Set number of data bits (interface configuration)	X					unchanged	p. 39
	txt: 7; 8							
dly *v*	Output off delay for OCP (setup)	X			X			p. 26
DELAY *v*	*v:* 0; 0.1; ... 99.9 (delay time in seconds)		X	X	X		0.00 s	p. 65
DISPLAY *txt*	Activate / deactivate digital displays		X	X			ON	p. 65
	txt: off, on							
ILIM *v*	Current setting limit (setup) $0 \leq v \leq I_{nom}$	X	X	X	X		I_{nom}	p. 25 p. 67
	v: 12.00 (example: 12.00 A)							
ISET *v*	Current setpoint $0 \leq v \leq ILIM$	X	X	X	X	X	0.000	p. 21 p. 67
	v: 10.75 (example: 10.75 A)							
OCP *txt*	Response selection for current limiting (overcurrent protection), (setup)	X	X	X	X		oFF	p. 22 p. 68
	txt: oFF, on (current regulation / output off after expiration of delay time dLY)							
Output (key)	Activate / deactivate the output	X					oFF	p. 21
OUTPUT *txt*	*txt:* OFF, ON		X	X	X			p. 69
OVP *v*	Overvoltage protection trigger value (setup) $0 \leq v \leq 1.25 \times U_{nom}$	X			X		$1.25 \times U_{nom}$	p. 22
OVSET *v*	*v:* 32.5 (example: 32.5 V)		X	X	X			p. 69
Pbit *txt*	Set parity bit (interface configuration)	X					unchanged	p. 39
	txt: nonE — no parity bit; ZEro — always 0; EVEn — even numbered; odd — odd numbered; onE — always 1							
pon *txt*	Device setting selection after power-up (setup)	X						p. 26
POWER_ON *txt*	*txt:* rSt (default settings); SbY (last used settings, output deactivated); rcL (last used settings)		X	X			unchanged	p. 69
rEP *n*	Repetition, number of sequence repetitions (sequence)	X			X		cont or 0 = ∞	p. 33
REPETITION *n*	*n:* 1; ... ; 255 0 ≙ ∞		X	X	X			p. 70
rnd *txt*	Round off the displayed measured value (setup)	X					unchanged	p. 27
	txt: 0; −1; −2 (no rounding, round by one or two decimal places)							
Sbit *txt*	Set number of stop bits (interface configuration)	X					unchanged	p. 40
	txt: 1; 2							
SEq *txt*	Sequence, automatic memory recall	X					on [1]	p. 34
SEQUENCE *txt*	*txt:* Go (start); (off, on (close/end, open)) Hold (pause/suspend); cont (resume); strt, step, stop (step-by-step control)		X	X			running SEQ, "stop"	p. 70
SiG1 *txt*	Signal output 1 (analog interface)	X					unchanged	p. 29
SiG2 *txt*	Signal output 2 (analog interface)	X						p. 29
Sig1_Sig2 *txt1, txt2*	*txt:* oFF — SIG inactive (passive high); on — SIG active (active low)		X	X				p. 71
	out — Signal level depends upon the output's activation status. OUTPUT on: passive high. OUTPUT OFF: active low							
	ModE — Signal level depends upon momentary control mode. OFF or CV: passive high. CC or OL: active low							
	SEq — Signal level depends upon activated sequence run. Sequence being executed: active low							
	SSEt — Signal level depends upon SSET switching function ($\rightarrow$ SEQUENCE). OFF: passive high. ON: active low							
	U_Lo — Compare measured voltage value with USET from sequence memory location 254. Measured voltage value $\geq$ reference value: passive high. Measured voltage value < reference value: active low							
	U_Hi — Compare measured voltage value with USET from sequence memory location 255. Measured voltage value $\leq$ reference value: passive high. Measured voltage value > reference value: active low							
	I_Lo — Compare measured current value with ISET from sequence memory location 254. Measured current value $\geq$ reference value: passive high. Measured current value < reference value: active low							
	I_Hi — Compare measured current value with ISET from sequence memory location 255. Measured current value $\leq$ reference value: passive high. Measured current value > reference value: active low							

Setting Command	Significance / Effect	Manual setting or via interface			Setting saved with *SAV n:		Default setting after RESET *RST:	Explanation in Chapter on Page
		Manual	IEEE 488	RS 232C	n=1...10	n=11...255		

Function-Specific Commands and Device Settings

Setting Command	Significance / Effect	Manual	IEEE 488	RS 232C	n=1...10	n=11...255	Default	Page
SSEt txt	Set a message signal (sequence / analog interface)	X	X	X	X	X	oFF	p. 31
	txt: oFF, on (message signal off/on)							p. 72
StoP n	Stop address for the sequence	X			X		11	p. 33
	n: 11; ... ; 255							
Strt n	Start address for the sequence	X			X		11	p. 32
	n: 11; ... ; 255							
StART_STOP n1, n2	n: 11; ... ; 255		X	X	X		11; 11	p. 72
STORE n, v1, v2, v3, txt	Direct transfer of parameter data to memory		X	X			no effect	p. 73
	n: 11; 12; ... ; 253; 254; 255, memory address							
	v1: Voltage setpoint							
	v2: Current setpoint							
	v3: Memory location-specific dwell time							
	txt: Switching function, ON or OFF signal level, CLR: complete deletion of memory location data							
tdEF v	Dwell time independent of memory location (sequence)	X	X	X	X		0.01 s	p. 32
	v: 00.01; ... , 99.99 (in seconds)							p. 74
trG txt	Function selection for the trigger input (analog interface)	X					unchanged	p. 28
T_MODE txt	txt: oFF (trigger input deactivated)		X	X				p. 74
	out (trigger input influences the OUTPUT)							
	rcL (memory recall, step-by-step)							
	SEq (sequence execution control)							
	LLO (control panel disabling control)							
	UI_ (Min-Max measured value storage control) remote: "MIN"							
tSEt v	Memory location-specific dwell time (sequence)	X	X	X	X	X	tdef	p. 31
	v: 00.00; 00.01; ... , 99.99 (in seconds), at 00.00: value from tdEF automatically							p. 74
UI_ txt	Min-Max storage for measured U and I values (setup)	X			X		oFF	p. 27
MINMAX txt	txt: oFF; on; rSt (Min-Max value storage off/on/reset)		X	X	X			p. 68
ULIM v	Voltage setting limit (setup) $0 \le v \le U_{nom}$	X	X	X	X		U_{nom}	p. 25
	v: 15.0 (example: 15.0 V)							p. 75
USET v	Voltage setpoint $0 \le v \le ULIM$	X	X	X	X	X	0.000	p. 20
	v: 12.5 (example: 12.5 V)							p. 76
WAIT v	*Additional waiting time*		X	X				p. 76
	v: 0.001; 0.002 ... 9,999 (waiting time in seconds)							

General Commands and Settings

Setting Command	Significance / Effect	Manual	IEEE 488	RS 232C	n=1...10	n=11...255	Default	Page
*CLS	Clear status command		X	X			no effect	p. 61
DCL, SDC	Clear input and output buffers, all settings and register contents unchanged		X	X			no effect	p. 65
*DDT txt	Define device trigger		X	X			DDT memory cleared	p. 61
	txt: max. 80 characters, example: *DDT USET 10/ISET 3/OUT ON [2]							
ERAE n	Device dependent event register A enable command		X	X			no effect	p. 66
ERBE n	Device dependent event register B enable command		X	X			no effect	p. 66
*ESE n	Standard event enable command		X	X			no effect	p. 66
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. 62
*PRE n	Parallel poll enable register command		X	X			no effect	p. 66
*PSC n	Power-on status clear command		X	X			no effect	p. 62
*RCL n	Recall and set	X	X	X			no effect	p. 62
	n: 1 ... 10 a stored device setting							
	11 ... 255 stored parameters: USET, ISET TSET and SSET							
*RST	Reset device to default settings	X	X	X				p. 63
*SAV n	n: 0 *SAV 0 deletes the contents of memory locations n1 to n2 by using the address parameters of the sequence function defined by START_STOP n1, n2.	X	X	X			no effect	p. 63
	1 ... 10 Save current device settings							
	11 ... 253 Save momentary settings for USET, ISET TSET and SSET							
	254, 255 Reference values USET and ISET							
*SRE n	Service request enable command		X	X			no effect	p. 66
SRQ	Service request		X				no effect	p. 71
*TRG	Trigger: trigger the function specified with *DDT		X	X			no effect	p. 64
*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 omitted.

   Example: "**OU**TPUT 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 (;).

   Example: "USET 12; ISET 8.5; OUTPUT ON"

Formats for numeric parameters:

   n : Whole number (integer)

   v : Whole number, fixed or floating decimal point number with or without exponent

   Examples: "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	Expla-nation in Chapter on Page
			Front panel [3]	RS 232C	IEEE 488	10 characters	10 characters	10 characters		
Measured Value Query	IMAX?	Max. measured current value from Min-Max memory [A]	X	X	X	IMAX +15.4	400		13	p. 67
	IMIN?	Min. measured current value from Min-Max memory [A]	X	X	X	IMIN -00.0	100		13	p. 67
	IOUT?	Momentary measured current value [A]	X	X	X	IOUT +11.5	100		13	p. 67
	MODE?	Momentary output operating mode (control mode) CV = constant voltage, CC = constant current OL = overload, OFF = output deactivated	X[4]	X	X	MODE CV			8	p. 68
	POUT?	Momentary measured power value [W]	X	X	X	POUT +0662	.7		12	p. 69
	UMAX?	Max. measured voltage value from Min-Max memory [V]	X	X	X	UMAX +021.	310		13	p. 75
	UMIN?	Min. measured voltage value from Min-Max memory [V]	X	X	X	UMIN +021.	280		13	p. 75
	UOUT?	Momentary measured voltage value [V]	X	X	X	UOUT +021.	300		13	p. 75
Function-Specific Device Queries	DELAY?	Selected delay time for OCP function	X	X	X	DELAY 12.0	0		11	p. 65
	DISPLAY?	On-off status of the 7-segment displays	X	X	X	DISPLAY ON			11	p. 65
	ILIM?	Selected current setting range limit [A]	X	X	X	ILIM +20.0	000		13	p. 67
	ISET?	Selected current setpoint value [A]	X	X	X	ISET +18.0	000		13	p. 67
	MINMAX?	Min-Max memory enable status	X	X	X	MINMAX ON			10	p. 68
	OCP?	Selected current limiting function	X	X	X	OCP OFF			7	p. 68
	OUTPUT?	Output on-off status	X[4]	X	X	OUTPUT ON			10	p. 69
	OVSET?	Selected overvoltage protection trigger value [V]	X	X	X	OVSET +050	.0		12	p. 69
	POWER_ON?	Selected power-up status	X	X	X	POWER_ON R	ST		12	p. 69
	REPETITION?	Selected number of repetitions for the sequence function	X	X	X	REPETITION	000		14	p. 70
	SEQUENCE?	Sequence function status	[8]	X	X	SEQUENCE H	OLD,255,11	1	21	p. 70
	SIG1_SIG2?	Selected function for signal outputs at the analog interface	X[5]	X	X	SIG1_SIG2	OUT,MODE		19	p. 71
	SSET?	Selected switching signal for the sequence function	X	X	X	SSET OFF			8	p. 72
	START_STOP?	Selected start and stop memory addresses for the sequence function	X[6]	X	X	START_STOP	020,115		18	p. 72
	STORE?	Recall data from start address to stop address from sequence / limit value memory	[7]	X	X					p. 73
	STORE? n	Recall data from address n from sequence / limit value memory								
	STORE? n1,n2	Recall data from address n1 to address n2 from sequence / limit value memory								
	STORE? n1,n2,txt	Recall data from address n1 to address n2 from sequence / limit value memory with tab n, n1, n2: 11, 12, ... , 255 (memory address), n2 ≥ n1, optional txt: tab (optional)				STORE 014, .70, ON	+015.500,+	03.0000,09	37[9]	
	TDEF?	Selected default time for the sequence function	X	X	X	TDEF 10.00			10	p. 74
	T_MODE?	Selected trigger input function	X	X	X	T_MODE OUT			10	p. 74
	TSET?	Selected dwell time for the sequence function	X	X	X	TSET 00.10			10	p. 74
	ULIM?	Selected voltage setting range limit [V]	X	X	X	ULIM +035.	000		13	p. 75
	USET?	Selected voltage setpoint value [V]	X	X	X	USET +021.	300		13	p. 76
General Queries	*DDT?	DDT function memory content		X	X	USET +010.	000;ISET +	18.0000	1...80	p. 61
	*IDN?	Device ID		X	X	GOSSEN-MET 6P,XXXXXXX	RAWATT,SSP XX,04.001	32N040RU00	49	p. 61
	*LRN?	Complete settings		X	X	ULIM +020. SET +025.0 ;USET +019 UTPUT ON; ON;TSET 0 TITION 000 T_MODE OUT	000;ILIM + ;OCP OFF;D .300;ISET POWER_ON R 0.10;TDEF ;START_STO ;DISPLAY O	20.0000;OV ELAY 12.00 +18.0000;O ST;MINMAX 10.00;REPE P 020,115; FF	202	p. 62
	*TST?	Start self-test results query 0 = error-free, 1 = error		X	X	0			1	p. 64

[1] "off" as in "Stop", SEQ. function always open
[2] "/" instead of ";" within txt
[3] or front panel display selectable / possible
[4] LED
[5] 5ı9ı txt or 5ı92 txt
[6] 5trt n or 5toP n
[7] Manual: RCL n and scroll through parameters with [SELECT] key (indirect)
[8] Status indicated by blinking "LOCKED/SEQ" LED, rrep and rcl with <SELECT> key
[9] in general: length = ((n2-n1+1)x38)-1 characters, with n1, n2 also as start/stop address
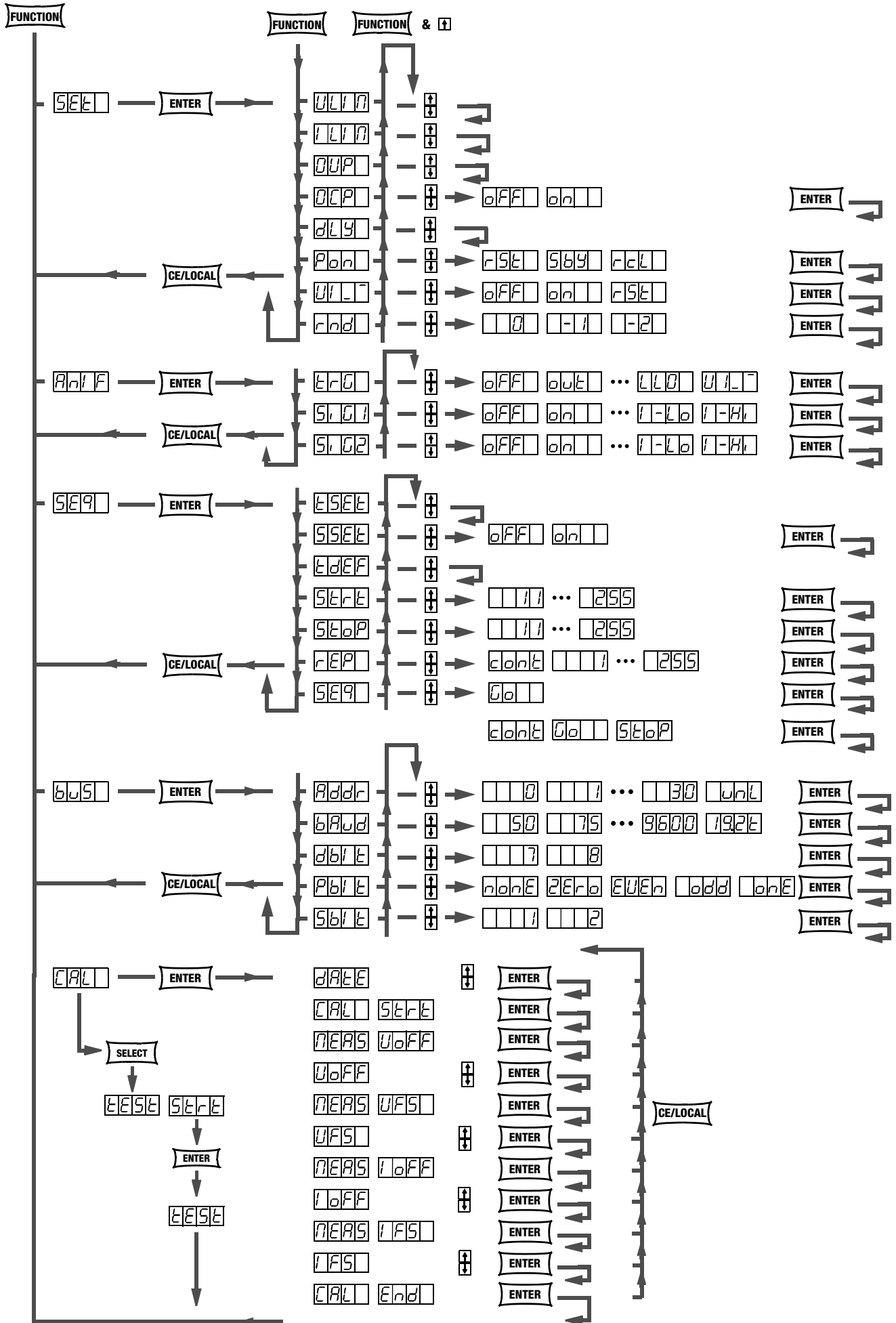
8.3 Query Commands for Status and Events Management

			RS 232C	IEEE 488	Response string for remote operation (example):	Resp. string length	Explanation in Chapter on Page
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 (excessive temperature)					
	D4: OVPA	Overvoltage protection triggered					
	D3: S12A	SIG1_OUT/SIG2OUT active					
	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. 65
	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. 66
ERB?		Device dependent event register B query	X	X	128	3	p. 65
	D7: TCE	Self-test error or error during adjustment					
	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: S2A	SIG2_OUT, active signal occurred					
	D0: S1A	SIG1_OUT, active signal occurred					
ERBE?		Device dependent event register B enable query	X	X	128	3	p. 66
*ESE?		Standard event status enable query	X	X	032	3	p. 66
*ESR?		Standard event status register query	X	X	144	3	p. 65
	D7: PON	Power On					
	D6: 0	(URQ user request)					
	D5: CME	Command error					
	D4: EXE	Execution error					
	D3: 0	(DDE device depend 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. 62
*PRE?		Parallel poll enable register enable query	X	X	012	3	p. 66
*PSC?		Power-on status clear query	X	X	0	1	p. 62
*SRE?		Status request enable query	X	X	012	3	p. 66
*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						

(Left margin vertical label: Query Status and Event Registers)

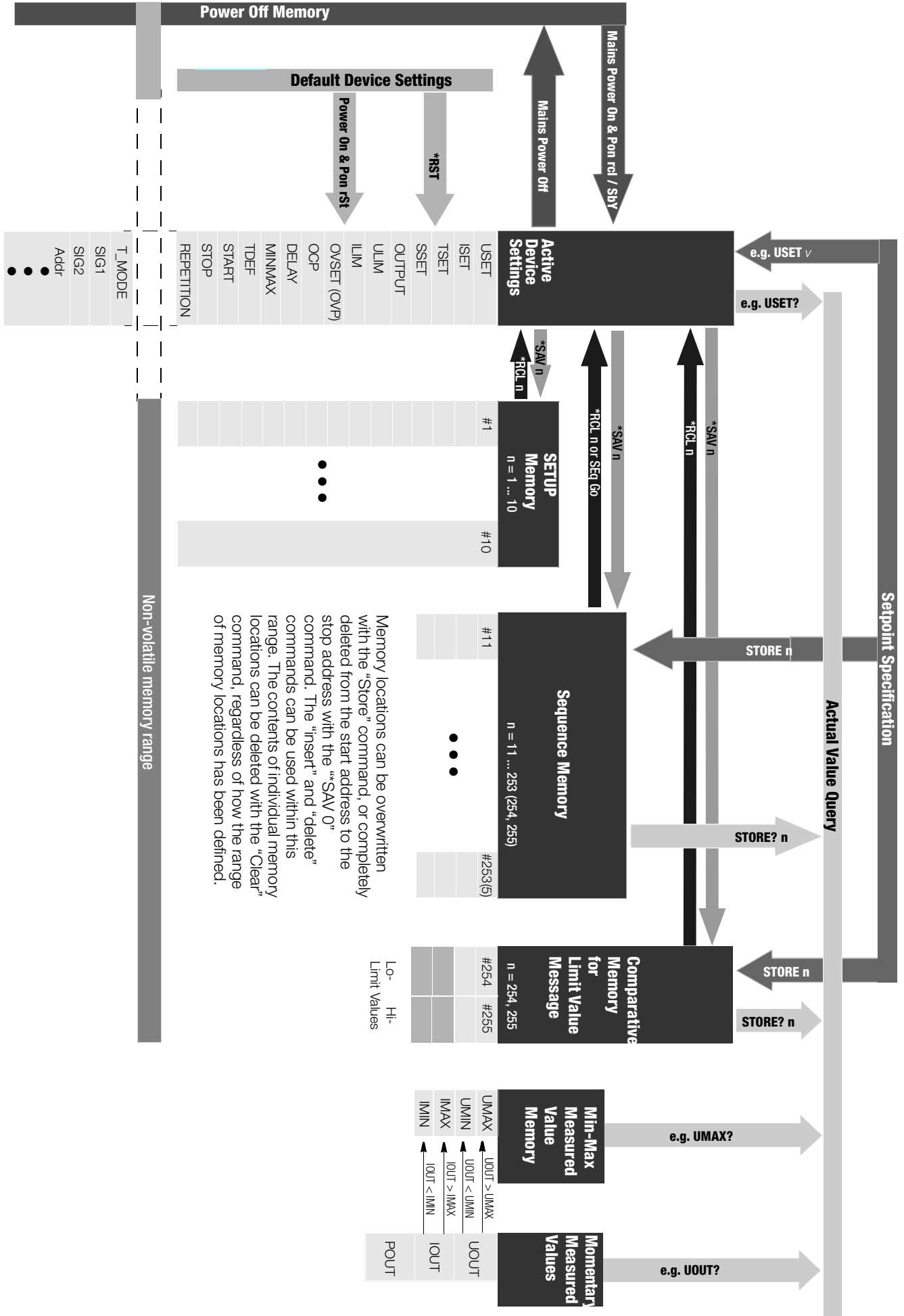*Column headers: Read out via interface — RS 232C / IEEE 488*

[1] When using RS232 interface **without** IEEE488 interface, value 1 is generally returned as a response.
[2] When using RS232 interface **without** IEEE488 interface, the invalid value 127 is generally returned as a response.

8.4 Overview of Menu Functions

8.5 Memory Structure

Power Off Memory

Default Device Settings

Mains Power On & Pon rcl / Sby

Mains Power Off

Power On & Pon rSt

*RST

Active Device Settings

USET
ISET
TSET
SSET
OUTPUT
ULIM
ILIM
OVSET (OVP)
OCP
DELAY
MINMAX
TDEF
START
STOP
REPETITION

T_MODE
Addr
SIG1
SIG2

Non-volatile memory range

*SAV n
*RCL n

SETUP Memory
n = 1 ... 10

#1

#10

*RCL n or SEq Go
*SAV n

*RCL n
*SAV n

e.g. USET ∨

e.g. USET?

Setpoint Specification

Actual Value Query

Sequence Memory
n = 11 ... 253 (254, 255)

#11

#253(5)

STORE n

STORE? n

Memory locations can be overwritten with the "Store" command, or completely deleted from the start address to the stop address with the "*SAV 0" command. The "insert" and "delete" commands can be used within this range. The contents of individual memory locations can be deleted with the "Clear" command, regardless of how the range of memory locations has been defined.

Comparative Memory for Limit Value Message
n = 254, 255

Lo-   Hi-
Limit Values

#254

#255

STORE n

STORE? n

Min-Max Measured Value Memory

IMIN
IMAX
UMIN
UMAX

e.g. UMAX?

IOUT < IMIN
IOUT > IMAX
UOUT < UMIN
UOUT > UMAX

Momentary Measured Values

POUT
IOUT
UOUT

e.g. UOUT?

8.6 Indication of Operating States

Control Mode / Operating State	Additional Linking	LED / Display	Color	Display Function Contin-uous	Blinking	Comment
Voltage regulation	OUTPUT ON	CV	green	∗	–	
Current regulation	OUTPUT ON	CC	green	∗	–	
OUTPUT ON		OUTPUT	red	∗	–	
OFF		OUTPUT	red	–	–	
OFF	In event of OTP	OUTPUT	red	–	∗	See OTP function
Primary overload, I limit	OUTPUT ON	P curve	yellow	∗	–	
OTP / Pon rcl	OUTPUT → OFF	P curve	yellow	–	∗	Retained after manual reset
		OUTPUT	red	–	∗	As long as OTP is active
		SRQ/STS	yellow	∗	–	Retained after manual reset
OTP / Pon	OUTPUT → OFF	P curve	yellow	–	∗	Retained after manual reset
stby, rst		OUTPUT	red	–	–	Remains latching OFF
		SRQ/STS	yellow	∗	–	Retained after manual reset
Overvoltage OVP		CV	green	–	∗	OUTPUT is latching in the OFF state
		OUTPUT	red	–	–	
		SRQ/STS	yellow	∗	–	Indicates reset
Overcurrent protection OCP selected in menu	OCP is on in the FUNCTION menu	Iset	yellow	–	∗	Brief blinking
OCP active		CC	green	–	∗	
		Iset	yellow	–	∗	Brief blinking
		SRQ/STS	yellow	∗	–	Indicates reset
		OUTPUT	red	–	–	Remains latching OFF
Display of						
Output voltage		Uout	green	∗	–	Activated output voltage appears at the display
Output voltage setpoint	SET function	Uset	yellow	∗	–	Uset appears at the display
Output current		Iout	green	∗	–	Activated output current appears at the display
Output current setpoint	SET function	Iset	yellow	∗	–	Iset appears at the display
Bus functions						
Remote programming		REMOTE	yellow	∗	–	
Addressing mode		ADR / DATA	yellow	∗	–	
Service request	In remote mode	SRQ / STS	yellow	–	∗	Indicates activated protective function
Front panel controls disabled	With activated function	LOCKED / SEQ	yellow	∗	–	
Sequence function		LOCKED / SEQ	yellow	–	∗ 1/1	With running sequence
		LOCKED / SEQ	yellow	–	∗ 1/3	With suspended sequence
Measured values, menu	Two 4-place numeric LED displays					

8.7 System Messages

Error messages may appear at the digital display immediately after the device is switched on, or after manual or remote control triggering of certain functions.

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 4	Write/read error. Initialization of the IEC bus interface failed: – Electrical isolation, optocoupler – Auxiliary power – Controller	The device must be tested at a service center and repaired if necessary.
Err 11	After execution of the self-test (manual). The measured value of the manipulated parameter was compared with the numeric setpoint at the momentary operating point with activated output and a deviation of > n ∗ resolution was detected (n is defined internally, U: 15 LSD; I: 30 LSD). ⤵ CAL	The device must be tested at a service center and repaired if necessary.
Err 3	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 deletion and insertion 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 run 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 memory range defined by the START and STOP addresses for the SEQUENCE run. The SEQUENCE run 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 trigger input action must be set to another function, after which the OUTPUT ON command must be re-executed.
Err 31	CMD error (remote)	
Err 32	CMD error (remote)	Adhere to calibration sequence
Err 33	Uoff, Ufs ⤵ Device must be in voltage regulating mode	e.g. eliminate short-circuit or reduce load
Err 34	Iff, Ifs ⤵ Device must be in current regulating mode	e.g. increase load or short circuit the output terminals
Err 35	Inadequate balancing range	– Check entered data – Hardware error?

Code	Meaning / Cause	Remedy
Err 36	Calibration error: An uncorrected error has occurred, no CAL data could be saved. Additional message(s): 40 U_offset setpoint 41 U_offset measured value 42 U_full-scale setpoint 43 U_full-scale measured value 44 I_offset setpoint 45 I_offset measured value 46 I_full-scale setpoint 47 I_full-scale measured value	
Err 99	POWERFAIL Voltage dip has occurred at auxiliary supply power ⤵ RE-START	
+OL or –OL	Display indicates measuring function over-ranging: If measured output voltage UOUT or output current IOUT 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: **UOUT indicates +OL:** e.g. caused by overdriving output voltage with an analog control signal applied to the analog interface. **UOUT indicates –OL:** due to incorrectly connected sensing leads. **IOUT 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 UOUT and IOUT, it can be assumed that one of the above listed causes is responsible for this message.	

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8.6 Index

9 Order Information

Description (abbreviated name)	Type	Article No.
SSP-KONSTANTER 120-20	32 N 20 RU 10 P	K320A*
SSP-KONSTANTER 120-40	32 N 40 RU 6 P	K321A*
SSP-KONSTANTER 120-80	32 N 80 RU 3 P	K322A*
SSP-KONSTANTER 240-20	32 N 20 RU 20 P	K330A*
SSP-KONSTANTER 240-40	32 N 40 RU 12 P	K331A*
SSP-KONSTANTER 240-80	32 N 80 RU 6 P	K332A*
SSP-KONSTANTER 320-32	32 N 32 RU 18 P	K334A*
IEEE 488 interface	for SSP KONSTANTER types 32 N ... Weight: 172 g, Dimensions: 150 x 100 x 60 (L x W x H)	K380A

* 115 V variant available with appendix -S001

Mounting

Description	Note	Article No.
19" rack adapter, 1 x 32 N	Required for mounting one type 32 N ... device to a 19" rack Weight: 214 g (packed in plastic bag)	K990A
19" rack adapter, 2 x 32 N	Required for mounting two type 32 N ... device to a 19" rack Weight: 50 g (packed in plastic bag)	K990B
Mains jumper cable, 0.4 m	The cable is equipped with a 10 A inlet plug and a 10 A inlet socket. It is used for looping mains power through when several devices are mechanically combined into a multi-channel unit. In this way, the complete unit requires only one mains power cable. Weight: 102 g (packed in plastic bag)	K991A
RS 232 bus cable, 2 m	For connecting a device to an RS 232 interface (extension cable with 9-pin socket and 9-pin plug connector). Weight: 232 g (packed in plastic bag)	GTZ3241000 R0001

10 Repair and Replacement Parts Service, Calibration Center* and Rental Service

If required please contact:

GMC-I Service GmbH
Service Center
Beuthener Straße 41
90471 Nürnberg • Germany
Phone   +49 911 817718-0
Fax   +49 911 817718-253
E-Mail   service@gossenmetrawatt.com
www.gmci-service.com

This address is only valid in Germany. Please contact our representatives or subsidiaries for service in other countries.

* DAkkS Calibration Laboratory for Electrical Quantities
D-K-15080-01-01 accredited per DIN EN ISO/IEC 17025

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 and temperature

Competent Partner

GMC-I Messtechnik GmbH is certified in accordance with DIN EN ISO 9001:2008.

Our DAkkS calibration laboratory is accredited by the Deutsche Akkreditierungsstelle GmbH (National accreditation body for the Federal Republic of Germany) in accordance with DIN EN ISO/IEC 17025 under registration number D-K-15080-01-01.

We offer a complete range of expertise in the field of metrology: from **test reports** and **factory calibration certificates**, right on up to **DAkkS calibration certificates**.

Our spectrum of offerings is rounded out with free test equipment management.

Our service department includes an **on-site DAkkS 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
Phone   +49 911 8602-0
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E-Mail   support@gossenmetrawatt.com