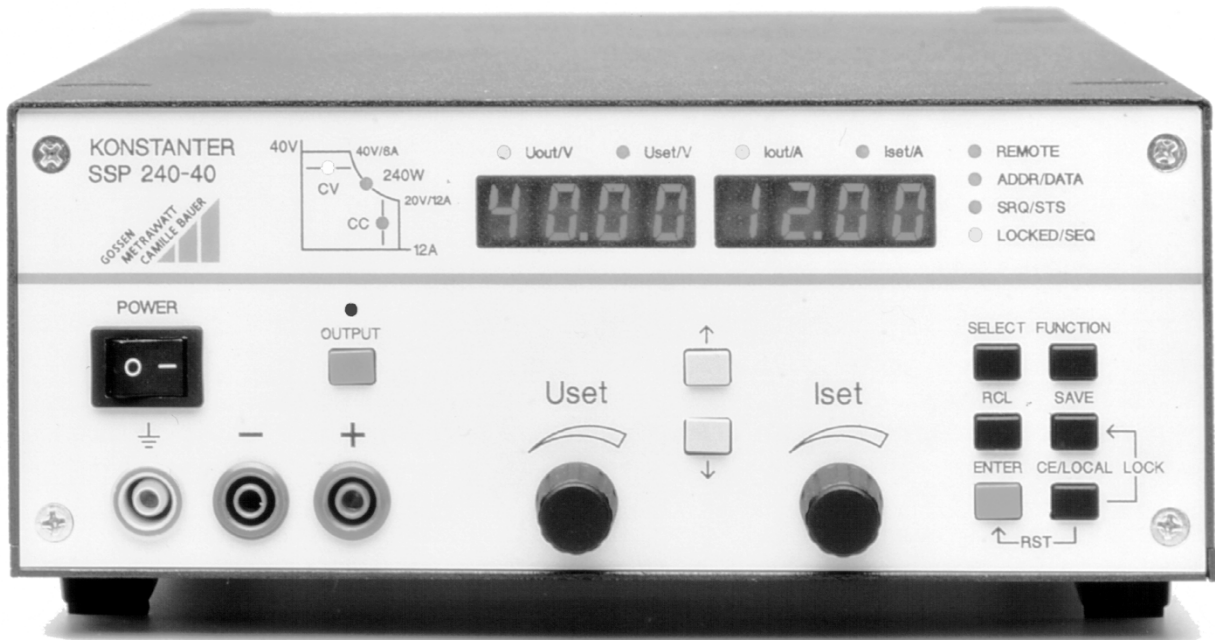


SSP-KONSTANTER

SSP 120 / SSP 240 / SSP 320 Series
Programmable Power Supplies

13024
6/5.00



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I Initial Inspection

Immediately after receipt, remove the KONSTANTER and all included accessories from the packaging and inspect for completeness and damage.

Removing from the Packaging

The electronic instrument must be removed from its packaging with great care.

- ☞ Pull the KONSTANTER from its packaging.
- ☞ Do not pull on rotary knobs, terminals or sockets in order to avoid mechanical damage.
- ☞ Do not allow the KONSTANTER to fall from its packaging: control elements, displays, terminals or internal components might otherwise be damaged.
- ☞ Do not under any circumstances touch the electrical terminals at the KONSTANTER before equipotential bonding has been established via the housing. Sensitive electronic circuits might otherwise be damaged due to electrostatic discharge.
- ☞ The KONSTANTER is shipped in recyclable packaging which has been tested to assure that it provides for adequate protection during transport. If the instrument needs to be re-packaged, the original or equivalent packaging must be used.

Visual Inspection

- ☞ Compare the order number or type designation indicated on the packaging and/or the serial plate with the data included in the shipping documents.
- ☞ Make sure that all accessories have been included (→1.3 Options and Accessories).
- ☞ Inspect the packaging and the physical condition of the instrument and accessories for possible transport damage.

Claims for Damage

If damage is apparent, file a claim for damage with the freight forwarder immediately (save the packaging!). In the event of other defects or if service is required, please contact the service representative responsible for your region, or contact us directly at the address included on the last page.

II Warnings and Safety Precautions

The KONSTANTER has been designed and tested as a safety class I device in accordance with the safety regulations listed in the technical data section, and has been shipped from the factory in flawless technical safety condition. In order to maintain this condition and to assure hazard-free operation, the user must observe all of the notes and warnings included in these operating instructions. Notes and warnings are identified with the following headings:

ATTENTION!

A note concerning operation or a practical application etc., which must be observed in order to prevent damage to the KONSTANTER and to assure correct operation.

WARNING!

An operating procedure or a practical application etc., which must be observed in order to maintain safe operation of the KONSTANTER and to prevent bodily injury. The most important warnings are summarized in the following paragraphs. Reference is made to these warnings at appropriate points within these operating instructions.

III Important Warnings:

WARNING I – Protective Earthing

The KONSTANTER may only be operated after connecting the protective conductor. Any interruption of the protective conductor, either inside or outside of the KONSTANTER or disconnection of the cable from the protective conductor terminal, may transform the instrument into a potential source of danger. Intentional interruption is prohibited. Connection to the mains is accomplished with a 3-conductor cable and plug. The plug may only be inserted into an appropriate mains outlet with earthing contact. Extension cables without protective conductor may not be used.

WARNING II – Impaired Safety Protection

If it may be assumed that safe operation is no longer possible, the KONSTANTER must be removed from service and secured against unintentional 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 long periods of storage under conditions which do not comply with specified storage conditions
- ☞ After extraordinary stress due to transport

WARNING III – Opening Housing Panels

When housing panels are opened, voltage conducting components may be exposed if the KONSTANTER is connected. Touching these exposed voltage conducting components is extremely life endangering. For this reason, housing panels may only be opened by trained personnel who are familiar with the dangers involved.

WARNING IV – Repair by Trained Personnel

When housing panels are opened, voltage conducting components may be exposed if the KONSTANTER is connected. Maintenance and repair work, as well as internal device balancing, may only be conducted by trained personnel who are familiar with the dangers involved. In as far as this is possible, the KONSTANTER must be disconnected from all external voltage sources before work of this type is performed. A waiting period of 5 minutes must be observed after disconnection in order to allow internal capacitors to discharge themselves to a safe voltage level.

WARNING V – Fuse Replacement

When replacing blown fuses, use only fuses of the specified type with the specified current rating (see Technical Data and specifications included on the serial plate). Any tampering with fuses or the fuse holder ("repairing" or short-circuiting fuses etc.) is prohibited.

1 Technical Description

1.1 Range of Applications and Equipment

Depending upon local conditions, electrical and electronic devices may be subjected to substantial mains fluctuations if stabilization or backup supply power has not been provided for.

Automotive electrical system characteristics which are observed when the starter motor is cranked is a typical example.

R&D, production and testing departments must therefore assure that electrical equipment reliably fulfills all of the required functions at any point in time under adverse conditions.

The SSP-KONSTANTER series SSP 120 / SSP 240 / SSP 320 from GOSSEN-METRAWATT provides the user with support for solutions to these problems.

SSP-KONSTANTERs are capable of **high throughput rates** for routine testing, especially in **automatic test systems**. **Short response time** assures **highly accurate simulation** of rapidly changing voltage and current profiles.

The performance of consuming devices as related to **dynamic supply power** can thus be easily tested and simulated.

An **integrated calibration procedure** and the **included calibration certificate** are especially important for **use in ISO 9000 certified production and testing facilities**.

SSP-KONSTANTERs (**S**ingle-**O**utput **S**ystem **P**ower Supplies) are programmable, voltage and current controlled DC power supplies with 120 W, 240 W or 320 W output power.

They feature microprocessor controlled operation and include an addressable, RS 232C serial interface as standard equipment. Up to 30 KONSTANTERs can thus be controlled from a PC port.

An IEEE 488 interface is available as an option. Control of all device functions and querying of measurement values, parameter settings and device status is possible with both PC interfaces.

Manual adjustment of voltage and current is accomplished by means of two rotary pulse generators with adjustable sensitivity.

Two 4-digit multifunction displays allow for precision read-out of measurement values (V, A, W), as well as for menu driven configuration of numerous additional functions such as setting range limits, overvoltage protection, delayable overcurrent shutdown or programmable digital signal inputs and outputs.

Up to 243 settings can be saved to memory and queried sequentially, for example for the generation of specific voltage or current characteristics. Innovative circuit technology allows for practically load independent response times of less than 1 ms.

Output parameters can thus be superimposed with AC signals up into the kHz range via the analog interface which is included as standard equipment.

The measuring function includes an extreme value memory, limit value indicating signals and a hold function.

1.2 Functional Characteristics

Adjustable functions

- Voltage and current setpoints
- Voltage and current limit values (soft-limits)
- Output activation and deactivation
- Overvoltage protection trigger value
- Overcurrent protection (limiting with or without shutdown)
- Delay time for overcurrent shutdown
- Power-on status
- Reset device configurations
- Save / recall device configurations to / from memory
- Save / recall setting sequences
- Sequence definition
- Select trigger input function
- Select function for digital control outputs
- Operating parameters for measuring function (save extreme values to memory, limit value signalling, display resolution)
- Start calibration procedure
- Start self-test
- Operating parameters for PC interfaces (device address, SRQ masks, baud rate etc.)

Display Functions

- Currently measured voltage, current and power values
- Min. and max. measured voltage and current values
- Current device settings (individual or complete)
- Current device status (control mode, overheated, busy)
- Occurred event (power failure, overtemperature, overvoltage, overload, program error)
- Memory contents
- Device ID
- Calibration date

Protective and Additional Functions

- Sensor terminals protected against polarity reversal with automatic activation (auto-sensing)
- Front panel controls can be disabled
- Output overvoltage protection
- Protection against output polarity reversal
- Protection against excessive temperature
- Battery backup for device settings memory
- Master-slave linking
- In-rush current limiting
- Temperature controlled fan (for 240 and 320 W models)

1.3 Options and Accessories

Options

(See last page for order information.)

The SSP-KONSTANTER can be equipped with an IEEE 488 interface adapter for integration into IEC bus controlled systems.

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

All device functions can be programmed, and measured values and selected parameters can be queried via the interface. A number of interface specific functions are provided for as well.

The interface option is shipped as a separate plug-in module and can be added to the KONSTANTER at any time.

Included Accessories:

The following accessories are included with the SSP-KONSTANTER:

- ❑ These operating instructions
- ❑ 1 power cable (approx. 1.5 m long) with earthing contact plug

Additionally Available Accessories:

(See last page for order information.)

- ❑ 19" adapter, 1 x 32 N
Required for installation of one series SSP 32 N / SLP 32 N KONSTANTER to a 19" rack
- ❑ 19" adapter, 2 x 32 N
Required for installation of two series SSP 32 N / SLP 32 N KONSTANTERs to a 19" rack
- ❑ Mains jumper cable, 0.4 m long
The cable is equipped with a 10 A plug and a 10 A socket for non-heating apparatus. It is used to loop through mains power when several KONSTANTERs are mechanically combined into a multi-channel unit. The multi-channel unit thus requires only one power cable.
- ❑ RS 232 bus cable, 0.4 m long
Used to loop through the RS 232 data transmission line when several series SSP 32 N KONSTANTERs are mechanically combined into a multi-channel unit (extension cable, 9-pin socket / 9-pin plug).
- ❑ RS 232 bus cable, 2 m long
For connecting one KONSTANTER to an RS 232 interface (extension cable, 9-pin socket / 9-pin plug).
- ❑ IEEE-IEEE bus cable, 2 m long
For connecting one KONSTANTER to the IEEE 488 bus system

1.4 Technical Data

1.4.1 General

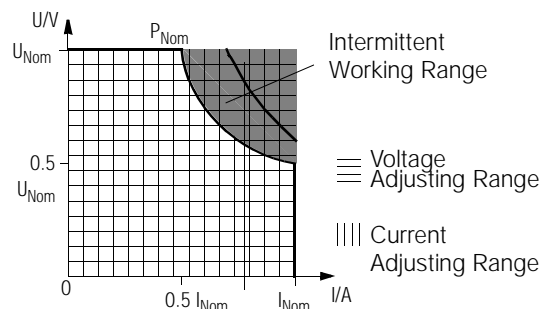
Power Supply

Connection	Input: 10 A IEC plug Output: 10 A IEC socket, no switch, no fuse
Line Voltage	230 V ~, + 10 /- 15%, 47 ... 63 Hz
Power Consumption	see 1.4.3
In-Rush Current	max. 50 A _S
Mains Fuse	1 x T 4 A / 250 V (6.3 x 32 mm, UL) internal: 1 x T 5 H 250 V (5 x 20 mm)

Output

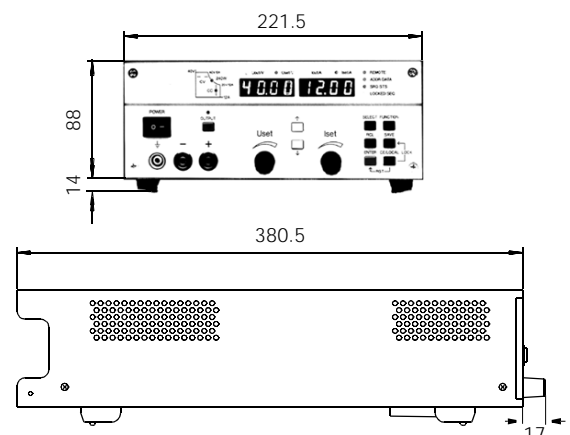
Connection	front panel, 2 ea. 4 mm safety socket
Output	rear panel, 6-pole plug-in screw terminal block
Sensor	rear panel, 6-pole plug-in screw terminal block
Analog Interface	rear panel, 11-pole plug-in screw terminal block
Regulator Type	primary switched mode with BET technology
Operating Modes	adjustable constant voltage / constant current source with automatic sharp transition
Output Isolation	Floating output with protective isolation from the mains input and computer interfaces, max. allowed potential output-earth: 120 V, capacitive output-earth (housing): 60 nF

Output Working Range



Intermittent Working Range:

Overtemperature protection may be triggered, and the output deactivated, if operated for lengthy periods of time in the intermittent working range (see also intermittent power under 1.4.3).



All dimensions in mm

Figure 1.4 Dimensional Drawing (benchtop model)

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), isolated
4	TRG IN +	
5	+15 V	Auxiliary voltage +15 V / max. 50 mA, reference point connected to – output
6	AGND	
7	U _{set} –	Analog, negated voltage control input (0 ... –5 V corresponds to 0 ... U _{nom} , R _i = 10 kΩ)
8	U _{set} +	Analog voltage control input (0 ... +5 V corresponds to 0 ... U _{nom} , R _i = 10 kΩ)
9	I _{set} +	Analog current control input (0 ... +5 V corresponds to 0 ... I _{nom} , R _i = 10 kΩ)
10	U-MON	Measurement output for output voltage (0 ... 10 V corresponds to 0 ... U _{nom} , R _i = 9.8 kΩ)
11	I-MON	Measurement output for output current (0 ... 10 V corresponds 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/s

Device Address adjustable from 0 to 30 or UNL (unlist)

Max. Setting Speed approx. 15 settings/s

Max. Sampling Rate approx. 7 measurements/s

IEC 625 / IEEE 488 Interface (optional)

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

Interface SH1 SOURCE HANDSHAKE
Functions handshake source function

AH1 ACCEPTOR HANDSHAKE
handshake sink function

T6 TALKER
talker function with series polling
and automatic unlisting function,
without secondary address and
without talker-only operation

L4 LISTENER
listener function with automatic unlisting,
without secondary address and
without listener-only operation

SR1 SERVICE REQUEST
service request function

RL1 REMOTE / LOCAL
switching between remote and manual
operation with disabling

DC1 DEVICE CLEAR
reset function with selected
device clearing

PP1 PARALLEL POLL
parallel polling function with remote
configuration

DT1 DEVICE TRIGGER
triggering function

C0 No controller function

E1/2 Open collector drive

Codes / Formats in accordance with IEEE488.2

Device Address adjustable from 0 to 30 or UNL (unlist)

Max. Setting Speed approx. 40 settings/s

Max. Sampling Rate approx. 15 measurements/s

Electrical Safety

IEC 1010-1 +A1 ('92) EN 61010-1 ('93)	Safety requirements for electrical equipment for measurement, control and laboratory use
VDE 0411-1 ('94)	Safety class I, Overvoltage category: II for mains input, I for output and interfaces, Fouling factor: 2, Earth leakage current: 2.5 mA typical
IEC 950+A1+A2 ('93) EN 60950+A1+A2('93) VDE 0805+A2 ('94)	Safety requirements for data processing systems and office machinery
IEC 529 ('89) EN 60529 ('91) VDE 0470-1 ('92)	Protection provided by enclosures (IP 20 for housing, terminals for mains power, output and analog interface, IP 00 for PC interfaces)
Electrical Isolation	Test voltage
Mains / Output – PE	1.35 kV ~
Mains – Output	2.7 kV ~ (type test, 3.7 kV ~)

Electromagnetic Compatibility (EMC)

Interference Emission

EN 50081-2 ('94) VDE 0839-81-2 ('94)	Generic standard for interference emission - industrial
CISPR 11 ('90) EN 55011 ('91) VDE 0875-11 ('92)	Limit values and measuring methods for transmitted interference from ISM devices

Interference Immunity

EN 50082-2 ('96) VDE 0839-82-2 ('96)	Generic standard for interference immunity - industrial
IEC 1000-4-2 ('95) EN 61000-4-2 ('95) VDE 0847-4-2 ('96)	Electrostatic discharge (severity level 2 for contact discharge, severity level 3 for atmospheric discharge)
IEC 1000-4-3 ('95) ENV 50140 ('95) VDE 0847-3 ('95)	Electromagnetic RF fields (10 V / m, no influence)
IEC 1000-4-4 ('95) EN 61000-4-4 ('95) VDE 0847-4-4 ('96)	Transient interference - burst (severity level 3)

Ambient Conditions

IEC 68-2-6 ('90)	Resistance to Vibration 10 ... 55 Hz, 0.3 mm, 1 octave / min, 3 x 30 min
IEC 68-2-27 ('89)	Impact Resistance (15 g, 11 ms, half-sine, 3 x 6 shocks)
Temperature Range	Operation: 0 ... 50 °C, current derating at > 40 °C (see also 1.4.3.) Storage: -25 ... +75 °C
Atmospheric Humidity	Operation: ≤ 75% relative humidity, no condensation
Cooling	With integrated fan Air Inlet: at side panels Air Outlet: at rear panel

1.4.2 Design Data

Type	Benchtop device, suitable for rack mounting
Dimensions	See also dimensional drawing, figure 1.4, page 8
(W x H x D)	Benchtop: 221.5 x 102 x 397.5 mm 19" Rack: ½19" x 2 standard height units x 400 mm
Weight	approx. 2.8 kg IEEE 488 interface (optional): approx. 0.1 kg

1.4.3 Electrical Data

Electrical Data, Series 120 W

- If not otherwise specified, all indicated values are absolute values and are valid for an operating temperature range of 0 to 50 °C, nominal power range and a line voltage range of 230V ±10% after a warm-up period of 30 minutes.
- Percentage values are relative to the respective setting value or measured value.

Description (abbreviated designation)		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 where $T_u \leq 40$ °C	max. 1200 W	max. 120 W	max. 120 W
	Intermittent power where $t < 90$ s / $T_u \leq 25$ °C	max. 200 W	max. 240 W	max. 240 W
	Current derating where $T_u > 40$ °C	- 0.25 A / K	- 0.15 A / K	- 0.07 A / K
Output Operating Characteristics				
Setting resolution [display (< 10.00 / ≥ 10.00), remote]	Voltage	5 mV / 10 mV, 5 mV	10 mV	20 mV
	Current	2.5 mA	2 mA	1 mA
Overall setting accuracy at 23 ± 5 °C including system deviation, load / mains	Voltage	0.15% + 30 mV	0.15% + 40 mV	0.15% + 80 mV
	Current	0.4% + 35 mA	0.5% + 20 mA	0.5% + 10 mA
Static system deviation ¹⁾ at 100% load variation ¹⁾	Voltage	15 mV	10 mV	10 mV
	Current	20 mA	10 mA	10 mA
Static system deviation ¹⁾ at 10% line voltage variation ¹⁾	Voltage	5 mV	5 mV	5 mV
	Current	8 mA	5 mA	5 mA
Residual ripple ¹⁾	Voltage (10 Hz ... 10 MHz)	10 mV _{eff}	10 mV _{eff}	10 mV _{eff}
	Current (10 Hz ... 1 MHz)	25 mA _{eff}	20 mA _{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 sudden load variation of 10 ... 90% I _{nom}	Tolerance	40 mV	80 mV	160 mV
	Δ I = 80%	200 μs	200 μs	200 μs
Under and overshooting with sudden load variation of 50 A / ms		400 mV	400 mV	800 mV
Settling time (voltage) with setpoint jump: 0 → 100% with setpoint jump: 100% → 0	Tolerance no load / nominal load	40 mV 1 ms / 1 ms	80 mV 1 ms / 1 ms	160 mV 4 ms / 4ms
	no load / nominal load	1 ms / 1 ms	1 ms / 1 ms	4 ms / 4ms
Settling time (current) with setpoint jump: 0 → 100% with setpoint jump: 100% → 0	Tolerance short-circuit / nominal load	100 mA < 5 ms / < 5 ms	60 mA < 5 ms / < 5 ms	30 mA < 10 ms / < 10 ms
	short-circuit / nominal load	< 5 ms / < 5 ms	< 5 ms / < 5 ms	< 10 ms / < 10 ms
Measured Value Displays (4-digit)				
Measurement resolution [display (< 10.00 / ≥ 10.00), query]	Voltage	2 mV / 10 mV, 2 mV	10 mV, 4 mV	10 mV, 8 mV
	Current	1 mA, 1 mA	1 mA, 0.6 mA	1 mA, 0.5 mA
	Power	0.1 W, 0.1 W	0.1 W, 0.1 W	0.1 W, 0.1 W
Measuring accuracy at 23 ± 5 °C for values > 0.1% nominal value	Voltage	0.15% + 30 mV	0.15% + 40 mV	0.15% + 80 mV
	Current	0.4% + 25 mA	0.5% + 15 mA	0.5% + 10 mA
	Power	0.55% + 0.5 W	0.65% + 0.6 W	0.65% + 0.8 W
Protective Functions				
Output overvoltage protection, trigger value	Setting range	0 ... 25 V	0 ... 50 V	0 ... 100 V
	Setting resolution	0.1 V	0.2 V	0.4 V
	Setting accuracy	2% + 0.2 V	2% + 0.4 V	2% + 0.8 V
Reversed polarity protection – overload capacity	Continuous	10 A	6 A	3 A
Reverse flow resistance	Continuous	40 V	80 V	100 V
General				
Power supply ¹⁾	Line voltage	230 V~ +10 / -15%	230 V~ +10 / -15%	230 V~ +10 / -15%
		47 ... 63 Hz	47 ... 63 Hz	47 ... 63 Hz
Power Consumption	At nominal load	280 VA, 180 W	280 VA, 170 W	280 VA, 170 W
	In standby mode	45 VA, 15 W	45 VA, 15 W	45 VA, 15 W
	At max. intermittent power	450 VA	500 VA	500 VA
Efficiency	At nominal load	> 70%	> 80%	> 80%
Switching frequency	Typical	200 kHz	200 kHz	200 kHz
Article number		K320A	K321A	K322A

1) Typical values are increased by a factor of approximately 1.2 in the functional line voltage input range of -10% to -15%.

Electrical Data, Series 240 / 320 W

- If not otherwise specified, all indicated values are absolute values and are valid for an operating temperature range of 0 to 50 °C, nominal power range and a line voltage range of 230V ±10% after a warm-up period of 30 minutes.
- Percentage values are relative to the respective setting value or measured value

SSP 240-20 32 N 20 RU 20 P	SSP 240-40 32 N 40 RU 12 P	SSP 240-80 32 N 80 RU 6 P		SSP 320-32 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 ... 18 A
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 mA 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}
0.5 mA _{eff}	0.5 mA _{eff}	0.5 mA _{eff}		0.5 mA _{eff}
40 mV 400 μs	80 mV 200 μs	160 mV 200 μs		64 mV 200 μs
400 mV	400 mV	800 mV		400 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 / 4ms 4 ms / 4ms		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 mA 2 mA, 10 mA, 2 mA	10 mV, 4 mV 2 mA / 10 mA, 1.2 mA	10 mV, 8 mV 1 mA, 0.6 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) Typical values are increased by a factor of approximately 1.2 in the functional line voltage input range of -10% to -15%.

2 Initial Start-Up

2.1 Preparation

2.1.1 Mains Connection

Observe **WARNING !**

ATTENTION!

Before switching the KONSTANTER on, make sure that your local mains voltage corresponds with the operating voltage specified on the device's rear panel at the recessed connector plug.

The KONSTANTER requires 230 V ~ supply power. Connect the recessed plug at the back of the device to a mains outlet with earthing contact with the included power cable.

Power consumption is specified on the serial plate at the back of the KONSTANTER.

A mains outlet socket is located above the recessed plug and can be used for looping mains power through to an additional KONSTANTER.

This mains outlet is neither switched nor fused.

WARNING!

If mains power is looped through, make sure that overall power consumption does not exceed 10 A at the point from which power is drawn from the mains!

Suitable "mains jumper cables" are available as an accessory (see order information on last page).

2.1.2 Connection to the Consuming Device

Supply power to the consuming device is connected either at the front panel with 4 mm safety plugs to the safety jacks identified with the "+" and "-" markings, or to the "+" and "-" outputs at the 6-pole screw terminal block at the rear panel.

If connections are made simultaneously at the front and the rear panel (not permitted for 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 "-" at the rear panel.

Load currents of greater than 10 A must be connected in parallel due to contact ratings.

Be certain to use conductors with an adequate cross-section and observe correct polarity. It is advisable to twist the power leads to the consuming device, and to identify polarity with markings at their ends.

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

2.1.3 Sensing Mode Operation

In order to take advantage of highly constant output voltage, even if long leads are used for connection to the consuming device, voltage drops at the power leads can be compensated for with additional sensing leads.

Function

- Sensing terminals: +SENSE / -SENSE
- Output voltage, which is decisive for the voltage measuring and regulating circuits, is acquired **directly at the consuming device** (instead of at the output terminals).
- Sensing mode operation (**remote sensing**) offers the following advantages:

- Voltage at the consuming device remains largely **uninfluenced** by **current dependent voltage drops** at the power supply leads during **constant voltage operation**.
- Voltage drops are **compensated for** by automatically increasing voltage as required at the output jacks.
- **Voltage limiting** remains **uninfluenced** by **output voltage** as well during **constant current operation**.
- The **voltage value** determined by the measuring function corresponds to **voltage acquired by the sensing leads**. **Load parameters** such as **power consumption** and **load impedance** can thus be precisely determined.
- The **parameters** and **limit values** listed in figure 5.2 and in the section entitled **Electrical Data** apply for operation with the sensing leads.

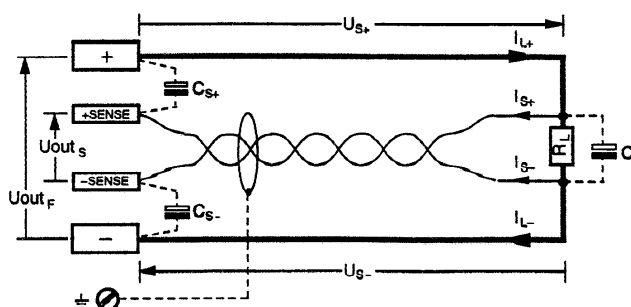


Figure 2.1.3 Connection to Consumer for Sensing Mode Operation

$$C_{S+}, C_{S-} \quad 10 \mu\text{F} \dots 220 \mu\text{F}$$

$$U_{S+}, U_{S-} \quad \leq 1 \text{ V}$$

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

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

Connection

- The +SENSE and -SENSE leads from the plug connector at the rear panel should be connected **as close as possible** to the power consuming device.
- Each of the SENSE leads must be assigned to the corresponding output terminal (+SENSE to + terminal, -SENSE to - terminal).
- Interference injection can be minimized as follows:
 - Twist the sensing leads and/or
 - Shield the sensing leads (connect shield to ground/housing or minus output terminal)
- Impedance resulting from long power and sensing leads may lead to control oscillation at the output. Capacitance at the consumer promotes this problem as well.
- Control oscillation can be counteracted by connecting capacitors (C_{S+} , C_{S-}) between the SENSE and the output terminals (see figure 2.1.3). Twisting the power leads reduces their impedance as well.
- Incorrect connection of the sensing leads does not cause any damage to the KONSTANTER, although it leads to the following reversible events:
 - Sensing lead polarity reversal or power lead interruption
If output voltage from the KONSTANTER is not limited with the current regulator, it rises to well above the setpoint value. Overvoltage protection is thus immediately triggered and the output is deactivated.
 - Sensing lead interruption
If one of the sensing leads is interrupted, the device is switched automatically to local sensing for the corresponding

output terminal.

- If the sensing leads are connected incorrectly, the measuring function is unable to detect rising voltage between the output terminals.

Activating Sensing Mode Operation

- Sensing mode operation is activated **automatically after connecting** the SENSE terminal to the consumer which has been connected to the output terminals.
- Sensing mode operation is deactivated as soon as this connection has been **interrupted**.

2.1.4 Connection to PC Interfaces

If the KONSTANTER is to be utilized within computer controlled systems, one of the connections described below must be established via the corresponding interface.

Comments

- The KONSTANTER cannot be simultaneously remote controlled via both interfaces. The interface at which activity is first initiated after power-up remains active, and the other interface remains inactive.
- In order to prevent interference to any current bus activities, all affected KONSTANTERs should be switched off when the bus connection is established.
- Both interfaces share a common ground (GND), and are isolated from the output in accordance with the specified electrical safety regulations.
- Interface configuration is described in chapter 4.2.4.

RS 232C Interface

Most controllers are equipped with **two serial ports**. These are frequently designated "COM1" and "COM2" and include a 25-pin or a 9-pin subminiature plug connector.

A suitable cable with a length of approximately 2 m is available as an accessory for connecting the KONSTANTER to the controller. Cables with other lengths are commercially available, as is the adapter which is required if your controller is equipped with a 25-pin plug connector.

If you prefer to fabricate the cable yourself, you will need a 3 strand shielded cable in order to establish the connection as shown in figure 2.1.4 a.

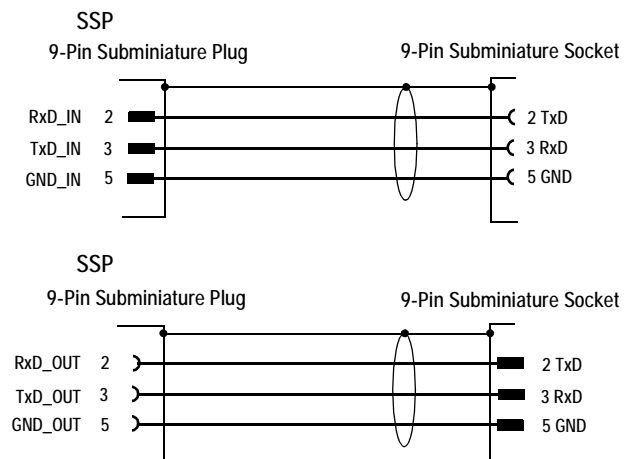


Figure 2.1.4 a Pin Assignments for 9-Pin Plug / Socket

KONSTANTER series power supplies are equipped with an **addressable serial interface**. Up to 30 KONSTANTERs can be queried via this interface.

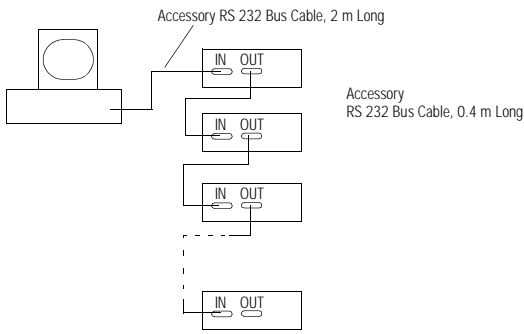


Figure 2.1.4 b Interconnection via Serial Interface

If several KONSTANTERs are to be interconnected via the RS 232 interface, additional factors regarding data protocols must also be taken into consideration.

Addressing

An individual address is assigned to each of the interconnected KONSTANTERs. If a KONSTANTER receives its own address, it is switched to the "addressed" status and accepts all subsequent commands and data until it is unlisted upon receipt of an extraneous address.

In compliance with IEEE488, an address range of 0 to 31 is used, and address 31 is reserved as well as a general unlisting command (UNL). The device address for the serial interface is thus identical with the address of an existing, optional IEEE 488 interface.

Universal Commands

In addition to the command

Addr xxdevice address,

other general commands are useful, which are accepted without previous addressing.

*TRG trigger command, synchronization

DCL device clear

IFC interface clear

Explanations and syntax for these commands are included in chapter 6.

Data Query

If a device (slave) is requested to return data to the controller, it may not be unlisted before it has completed this task. The controller must therefore wait until all requested data have been received before transmitting data to any other device.

Good timing is essential for "serial multi-device operation". Data collisions are avoided in this way which may otherwise lead to aborted data read-outs and to deletion of the output buffer memory.

If the device does not respond within a specified period of time (timeout period), the controller can attempt to re-synchronize or reset the device with a universal command, and request the data again.

IEEE 488 Interface

- Up to 15 IEC bus controlled devices including controllers can be incorporated into a system.
- Bus connections are established with appropriate, commercially available cables with 24-pin plug connectors. If the formerly common 25-pin subminiature plug connectors are utilized in your system, a suitable adapter cable is required. In order to assure reliable data transmission, the cable length between any two devices should not exceed 2 m, and total cable length should not exceed 15 m. If the KONSTANTER is operated in proximity to strong sources of interference or their power cables, double-shielded connector leads are recommended.

2.1.5 Installing the IEEE 488 Interface Assembly

Warning!

The KONSTANTER must be disconnected from the mains before installing the interface assembly. First 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 allow the capacitors to discharge voltage to a safe level. Capacitors may otherwise be charged with life endangering voltage levels and contact may cause severe bodily injury.

Attention!

The interface assembly may be damaged by electrostatic discharge. Observe guidelines for the handling of electrostatic sensitive devices. Do not touch electrical contacts and individual components.

- ① Disconnect the KONSTANTER from the mains and pull the mains plug from the outlet. Wait for approximately 5 minutes in order to allow the capacitors to discharge.
- ② Loosen the 4 housing cover screws, and remove the cover.
- ③ Unscrew the blanking plate at the left side of the housing rear panel. Keep the screws in a safe place.

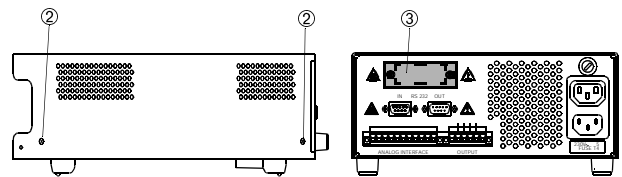


Figure 2.1.5 a Opening the KONSTANTER Housing

- ④ Interface Assembly: Insert the interface assembly, ribbon cable first, through the housing rear panel and into the device. Screw the cover plate at the back of the interface assembly to the housing rear panel from the outside. Use the screws which were removed in step ③ to this end.
- ⑤ Insert the plug from the interface assembly into the plug connector on the primary printed circuit board. Do not twist the ribbon cable.

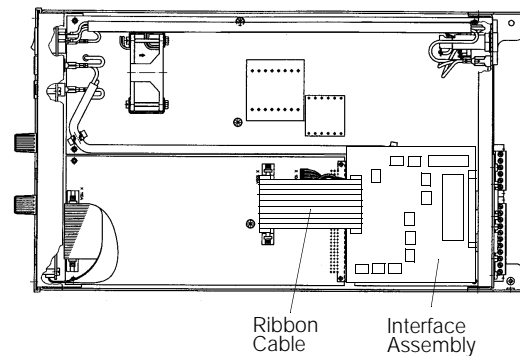


Figure 2.1.5 b Installing the Interface Assembly

- ⑥ Set the housing cover back into place and secure with the 4 housing cover screws. The KONSTANTER can now be connected as usual.

2.1.6 Installation to a 19" Rack

The housing included with the SSP-KONSTANTER has been designed for use as a benchtop device, as well as for installation to a 19" rack. Two KONSTANTERs can be installed next to one another, or a single device can be installed along with a blanking plate.

A benchtop device can be quickly converted for installation to a 19" rack.

Converting a Single Device for Rack Installation

Use the accessory kit: "19" Adapter 1 x 32 N".

It includes an 19" limit stop and a 19" blanking plate.

- ① Loosen the 4 screws at the front panel of the KONSTANTER.
- ② Pull out the two filler strips from the left and right-hand sides at the front of the side panels.

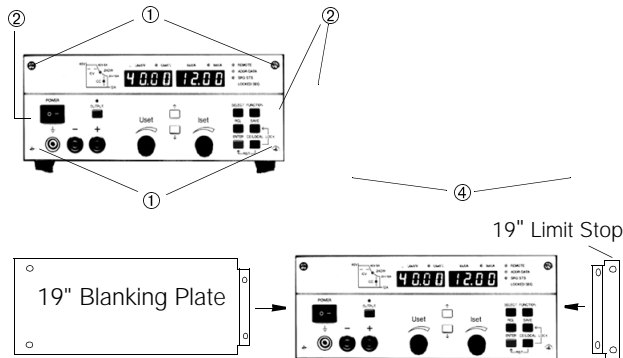


Figure 2.1.6 a Rack Conversion for a Single KONSTANTER

- ③ Replace the filler strips with the 19" limit stop on one side, and the 19" blanking plate on the other side. Fasten the limit stop and the blanking plate with the 4 screws.
- ④ Unscrew the feet from the bottom of the device. Remove the rubber inserts from the feet first, behind which the screws are concealed.
- ⑤ Install the KONSTANTER into the rack. Keep all remaining parts in a safe place for possible future use.

The KONSTANTER must be supported in the rack at one side with slide rails. The slide rails, as well as the screws required for securing the KONSTANTER's front panel are rack-specific, and must thus be procured from your rack supplier.

Conversion for Installing Two KONSTANTERs to a Rack

Use the accessory kit: "19" Adapter 2 x 32 N".

It includes two 19" limit stops and one 19" joiner.

- ① Loosen the 8 screws from the KONSTANTER front panels.
- ② Pull out the two filler strips from the left and right-hand sides of the front of the side panels at each device.

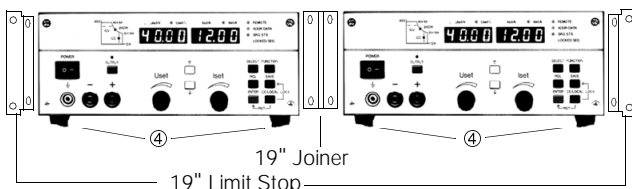


Figure 2.1.6 b Rack Conversion for Two KONSTANTERs

- ③ Replace the filler strips with the 19" limit stops at the right and left-hand sides, and with the 19" joiner in the middle. Fasten the limit stops and the joiner with the 8 screws. Screw the housings together at the threaded through-holes in the cable spacers at the back of the devices.

- ④ Unscrew the feet from the bottom of the devices. Remove the rubber inserts from the feet first, behind which the screws are concealed.
- ⑤ If the two KONSTANTERs are to be electrically connected to one another, use the accessory "mains jumper cable" and the "RS 232 bus cable".
- ⑥ Install the devices into the rack. Keep all remaining parts in a safe place for possible future use.

The KONSTANTERs must be supported in the rack at one side with slide rails. The slide rails, as well as the screws required for securing the KONSTANTERs' front panels are rack-specific, and must thus be procured from your rack supplier.

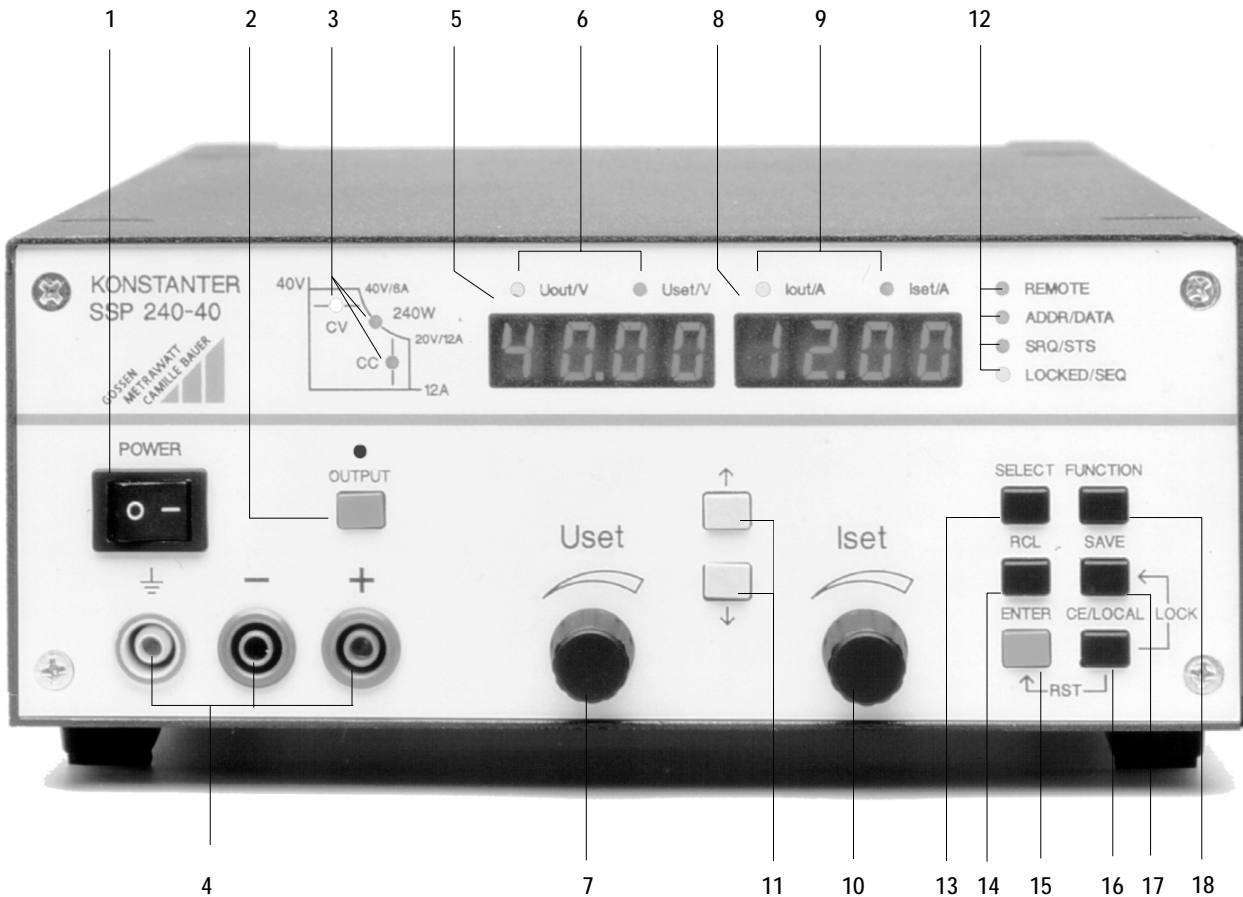
2.1.7 Multiple Benchtop Device Combination

Up to 3 KONSTANTERs can be stacked to create a multiple benchtop device combination (see also chapter 5 regarding possible electrical connections via the analog interface).

- ① Unscrew the feet from the bottom of the device. Remove the rubber inserts from the feet first, behind which the screws are concealed. Four large slotted holes are now visible at the bottom of the device.
- ② Turn the four collar screws from the device feet into the threads at the top of the other device housing. Keep the 4 lock washers and device feet in a safe place.
- ③ Set the KONSTANTER without feet on top of the other KONSTANTER. The screws from the KONSTANTER at the bottom must protrude through the large openings in the bottom of the KONSTANTER at the top. Push the top KONSTANTER back slightly, until the screws snap into place.
- ④ Screw the two KONSTANTERs together. The KONSTANTER at the top is thus secured against slipping.
- ⑤ If the two KONSTANTERs are to be electrically connected to one another, use the accessory "mains jumper cable".

3 Control Elements, Displays and Connector Terminals

Note: The numbers in brackets make reference to the photograph below.



[1] Mains Switch <POWER>

For switching the KONSTANTER on and off. After mains power has been switched on, the KONSTANTER performs a self-test (duration: approx. 8 s). After successful completion of the self-test, the KONSTANTER briefly displays its interface address and the version number of the installed firmware. It is then switched to the standby mode and is ready for operation. When the mains switch is set to the off position, the KONSTANTER is disconnected from the mains and the output is immediately deactivated. The most recent device settings and any stored settings remain in the settings memory with backup battery.

[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 lights up when the output is active. No significant output voltage overshooting occurs during activation and deactivation of the power output.

Start-Up Performance:

If the power output is activated, current and voltage are set to a value of "0" for 2 ms during the transition from the high impedance condition. Setpoint values are resumed thereafter.

Shutdown Performance:

Current and voltage setpoint values are set to 0 A and 0 V for about 350 ms. This activates a sink which discharges the output capacitors as far as possible. 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 are lit: Output has not been activated.

LED is illuminated:

Indicates the current operating status (control mode) of the activated output:

"CV" - green LED Constant voltage mode ($U_{out} = U_{set}$)

"CC" - green LED Constant current mode ($I_{out} = I_{set}$)

Blinking LED:

Indicates the reason for automatic deactivation of the output.

"CV" - green LED OVP (overvoltage protection)
Overvoltage protection has been triggered, because output voltage has exceeded the selected threshold value **OVP / OVSET**.

Possible causes:

- ☛ The voltage setpoint value **USET** has been manually set too high, memory recall, programming command or Uset control signal to the analog interface
- ☛ **Voltage transients** during power-up at inductive consumers (difference between **USET** and **OVSET** may be too small).
- ☛ **Unipolar feedback** from connected consumer (e.g. with DC motors).

⚠ During sensing mode operation: The sensing leads were connected with **reversed polarity**, or a **power conductor** is/was **interrupted** or was not taken into consideration in determining OVSET, which means that the voltage at the output terminals which is **relevant for the OVP function** is **higher** than USET voltage, which is regulated by the sensing function, by an amount equal to the **voltage drop to be compensated for at both power conductors** (difference between USET and OVSET is too small).

⚠ Parallel Connected Voltage Sources

“CC” - green LED OCP (overcurrent protection)
Overcurrent protection is active:
OCP ON has been selected and the output has been operated for a given period of time ($t > \text{DELAY}$) with current regulation, the output has been deactivated.

Possible causes:

⚠ The current setpoint value ISET has been manually **set too low**, memory recall, programming command or Iset control signal to the analog interface

⚠ **Current transients** during power-up at capacitive consumers (DELAY time setting may be too low)

“Pmax” - yellow LED OTP (overtemperature protection)
Electronic power limiting has been triggered (overload! $P_{out} > P_{nom}$)

Possible causes:

⚠ **Impaired cooling**, e.g. due to blocked air intake or exhaust slots.

⚠ **Ambient temperature is too high.** The KONSTANTER is capable of delivering nominal power during continuous operation at an ambient temperature of up to 50 °C (measured at air intake). Approximately 120 to 130% nominal power can be delivered intermittently (threshold level for electronic power limiting). Continuous demand for power at these levels may trigger overtemperature protection.

⚠ The fan has **malfunctioned**.

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

The output can be reactivated after the cause of triggering has been acknowledged.

[4] Output

The selected constant voltage or constant current is made available at the safety jacks at the front panel.

– blue Negative output terminal

+ red Positive output terminal

⚡ yellow-green The output can be grounded here if desired, or the shield can be connected here if shielded power leads are used. The ground terminal is connected to the housing and the mains connection earthing contact.

The 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)

The **measured value** for output voltage U_{out} in volts appears as the **standard display value** at the left-hand display.

The **currently selected voltage setpoint value** U_{set} can be displayed by **briefly turning the voltage adjuster** [5], or by pressing the <ENTER> key.

The LEDs assigned to the display indicate which value is currently being displayed (green LED = measured value, yellow LED = setpoint value).

- U_{out} / V (gr) = measured output voltage value in volts
- U_{set} / V (ye) = setpoint output voltage value in volts (blinking indicates that the displayed value has not yet been set)

If no control elements are activated for a period of 10 seconds during display of the setpoint value, the measured output voltage value reappears automatically.

Additional KONSTANTER functions can be selected with the <SELECT>, <FUNCTION>, <RCL> and <SAVE> keys. In this case, the function code or the parameter name appears at the left-hand display.

[7] Rotary Knob for Voltage Setpoint Adjustment <Uset>

Output voltage is set in the usual way with this rotary knob. However, a rotary pulse encoder with 24 pulses per revolution is used instead of a potentiometer. Setting resolution (increment per pulse) can be selected with the <SELECT> function, and three different levels are available: coarse, medium and fine. On the one hand, this allows for easy accurate settings, and at the same time it assures that the selected value is not changed during switching between remote control and manual operation.

As soon as the rotary knob is turned, the voltage setpoint value U_{set} appears at the left-hand display. About 0.4 seconds later, one of the decimal places in the display starts to blink in order to indicate the selected control resolution. As of this point in time, the display and the setpoint value can be changed at the selected decimal place by turning the knob.

The value is increased by turning the knob clockwise, and is decreased by turning the knob counterclockwise.

If no control elements are activated for a period of 10 seconds, the measured output voltage value U_{out} reappears automatically. If the <CE/LOCAL> key is activated, the measured output voltage value U_{out} immediately reappears at the display.

⚠ Refer to chapter 4.1 for detailed information.

[8] Right-Hand Display with [10]

[9] Display Parameter Indicators (LEDs)

The **measured value** for **output current Iout** in amperes appears as the **standard display value** at the right-hand display.

The **currently selected current setpoint value Uset** can be displayed by **briefly turning the current adjustor [8]**, or by pressing the **<ENTER>** key.

The LEDs assigned to the display indicate which value is currently being displayed (**green LED** = measured value, **yellow LED** = setpoint value).

- Iout / A (gr) = measured output current value in amperes
- Iset / A (ye) = setpoint output current value in amperes (blinking indicates that the displayed value has not yet been set)

If no control elements are activated for a period of 10 seconds during display of the setpoint value, the measured output current value reappears automatically.

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

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

This rotary knob functions just like the rotary knob for voltage setpoint adjustment [5].

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

The **<↑>** and **<↓>** keys (increase and decrease) are used for selecting and setting all KONSTANTER functions and their parameters.

☞ Refer to chapter 4.1, 4.2 and 4.8 for detailed information.

[12] Interface Indicator LEDs: REMOTE, ADDR, SRQ, LOCKED

The respectively illuminated LED indicates the current operating status of the PC interfaces:

- REMOTE on:** The KONSTANTER is being remote controlled, control elements are disabled.
- ADDR/DATA on:** The KONSTANTER has been addressed and is receiving or sending data (only applies for IEC bus operation).
- SRQ/STS on:** The KONSTANTER is transmitting a service request (only applies for IEC bus operation).
- LOCKED/LOCAL on:** The controls at the front panel have been disabled in order to prevent unauthorized or inadvertent operation. This display applies only to front panel disabling which has been activated manually, or with a control signal at the **TRIGGER** input (**T_MODE LLO**). It does not indicate disabling which has been activated with the IEC bus command **"LOCAL LOCKOUT"**.

[13] Function Selector Key <SELECT>

- Select displayable measurement values
- Display and setpoint value resolution

☞ Refer to chapter 4.1, 4.2 and 4.8 for detailed information.

[14] Memory Recall Key <RCL>

This key is used to recall KONSTANTER settings which have been saved to memory, value pairs (Uset and Iset) and corresponding setting dwell times for possible changes.

☞ Refer to chapter 4.5 for detailed information.

[15] <ENTER> Key

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

- Execute a selected function.
 - Acknowledge selected text parameters.
 - Jump down one level within the functions menu.
 - Switch display from **Uout / Iout** to **Uset / Iset** with active cursor. Changes to the setpoint value are acknowledge with the **<ENTER>** key in this mode.
 - Move cursor back and forth between Uset / Iset in Uset / Iset display mode.
 - Activate recalled memory content.
- ☞ Refer to chapters 4.1, 4.2 and 4.6 for detailed information.

[16] <CE/LOCAL> Key

This key is used for various functions:

- Interrupt an operating sequence.
 - Switch from remote control to local operation.
 - Disable the control elements.
 - Other tasks in combination with special functions
- ☞ Refer to chapter 4.7 for detailed information.

[17] Save Key <SAVE>

- Save device settings, value pairs (Uset and Iset) and corresponding setting dwell times to memory. During manual operation, this key can also be used to execute the PC **"STORE"** command.
- Prevents inadvertent or unauthorized changes to settings via front panel controls (only possible in combination with the **<CE/LOCAL>** key).

☞ Refer to chapter 4.4 for detailed information.

[18] Function Selector Key <FUNCTION>

Device functions which are seldom configured or used are not assigned to their own special key. These functions are activated with the help of a menu.

☞ A description of the menu and procedures used for configuring all functions and parameters is included in chapter 4.2.

[19] RS 232 Interface

☞ Detailed information concerning remote control of KONSTANTER functions via the serial RS 232 interface is included in chapter 2.1.7.

☞ Interface-specific commands are included in chapter 6.2.2.

[20] IEEE 488 Bus Interface

Interface for remote control of KONSTANTER functions

☞ Refer to chapter 2.1.5 for detailed information.

☞ Interface-specific commands are included in chapter 6.2.2.

ATTENTION!

The contacts at all interfaces are connected to electronic components which may be damaged by electrostatic discharge. Before touching any contacts, neutralize the potential difference between yourself and the device by touching the housing!

[21] Analog Interface

The analog interface provides for the following functions:

- Remote setting of output voltage and current with analog control voltages ranging from 0 to 5 V or –5 to 0 V.
- 🔧 See chapters 5.3 and 5.4.
- External measurement or recording of output voltage and current by means of monitor signals ranging from 0 to 10 V
- 🔧 See chapters 5.4 and 5.5.
- +15 V auxiliary power supply to external control devices
- Linking of several devices for master-slave operation
- 🔧 See chapters 5.8 and 5.9.
- For varying internal output resistance
- 🔧 See chapter 5.3.
- For controlling a selected device function via the floating TRIGGER input
- 🔧 See chapter 5.7.

ATTENTION!

The contacts at this interface are connected to electronic components which may be damaged by electrostatic discharge. Before touching any contacts, neutralize the potential difference between yourself and the device by touching the housing!

ATTENTION!

All of the control leads connected to the analog interface should be shielded. Ground the shield directly to the device with the shortest possible conductor. This connection may be established at the threaded hole in one of the cable spacers located at the back of the device. Fasten the shield with a screw and a toothed lock washer to assure good contact.

[22] OUTPUT Interface

The OUTPUT interface can be used for two different functions:

- Pick off constant voltage or constant current from the rear panel of the KONSTANTER via the terminal strip
- Connect the sensing leads for the compensation of voltage drops at the power leads
- 🔧 See chapter 5.2.

[23] Air Outlet

The air outlet vents regulate temperature inside the device. Warm air generated during operation is exhausted via the air outlet vents with the help of a temperature controlled fan.

ATTENTION!

The air outlet may not be closed off. It must be possible for warm air to be exhausted freely via the air outlet vents, because overheating might otherwise lead to malfunctioning, failure or damage to the KONSTANTER.

[24] Mains Power Input

Mains power input with looped through mains outlet for connection to inlet connectors for non-heating apparatus. The looped through mains outlet allows for direct connection of up to three devices with two short power cables with inlet connectors for non-heating apparatus. Only one power cable (device to mains) is thus required for operation of three devices.

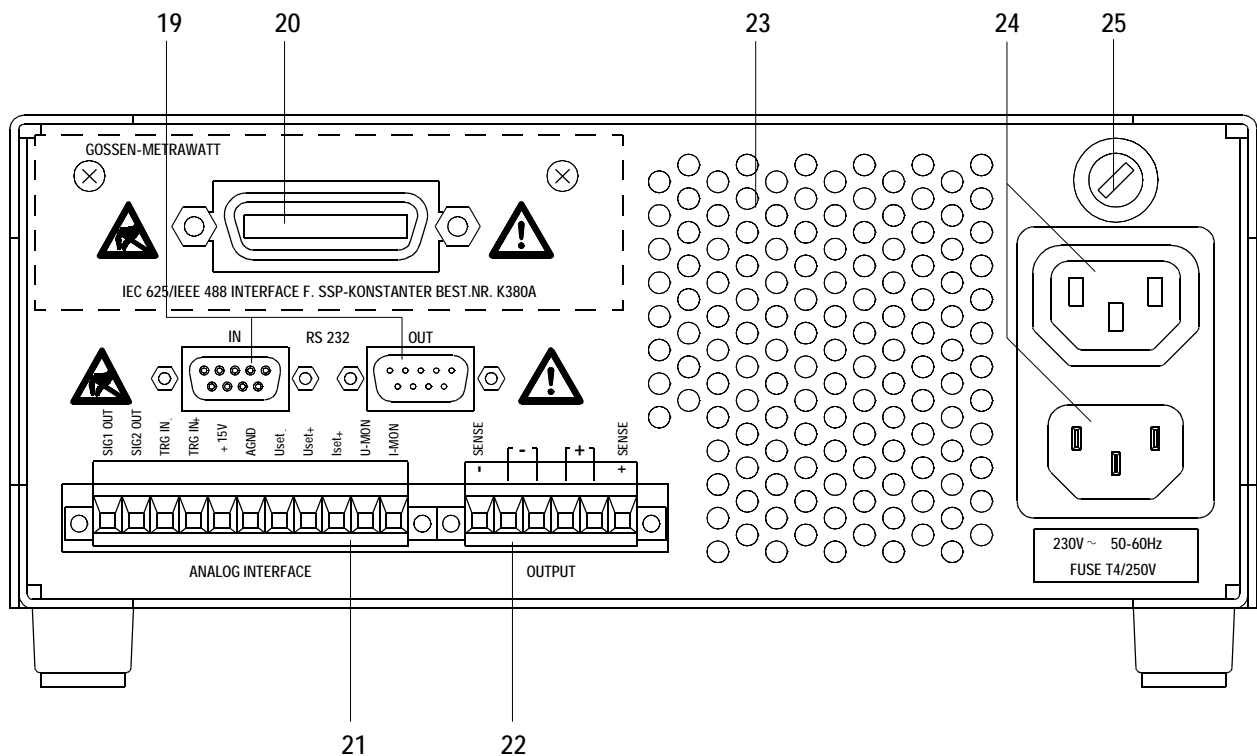
[25] Mains fuse

Fusing at the 230 V mains power input

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

WARNING!

When replacing blown fuses, use only fuses of the specified type with the specified current rating. Any tampering with fuses or the fuse holder ("repairing" fuses or short-circuiting the fuse holder etc.) is strictly prohibited.



4 Manual Settings, Querying Functions and Parameters

4.1 Output Voltage and Current

4.1.1 Uout – Currently Measured Voltage Value

- Appears at the left-hand display [5].
- The green Uout/V LED [6] is illuminated and indicates display of the currently measured voltage value.
- Measured voltage is automatically displayed once again approximately 10 seconds after the last setting has been made.
- The currently measured voltage value is displayed immediately if the device function set-up mode is exited by pressing the <CE/LOCAL> key [16].

4.1.2 Uset – Output Voltage

- No settings can be made with the Uset rotary knob [7] until 0.4 s after the digital display [5] has switched to the setpoint value. This delay assures that Uset cannot be changed inadvertently during activation of the Uset display. The rotary knob must be turned after this period has expired in order to change Uset.
- After the delay period with activated output, output voltage is changed directly by turning the rotary knob. The currently selected setpoint value is always indicated at the display [5].
- If no control elements are activated for a period of 10 seconds, the measured voltage value Uout automatically reappears at the display. If the <ENTER> key [5] or the <CE/LOCAL> key [5] is activated, Uout is displayed immediately.
- There are two different ways to select Uset manually.

Selected Value Becomes Immediately Effective

- ☞ Briefly turn (1) the Uset rotary knob [7].
 - The display [5] changes from Uout (measured voltage value) to Uset (voltage setpoint). The decimal place representing the selected control 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 the values become immediately effective during adjustment.
- Control Resolution:
 - 3 increments are possible: 0.01 V, 0.1 V, and 1 V
 - The blinking decimal place [5] indicates the control resolution increment.
 - ☞ Repeatedly press the <SELECT> key [13] until the desired decimal place blinks at the display [5].
- Output Voltage:
 - ☞ Adjustment (2) with the Uset rotary knob [7]:
 - Turn clockwise → increases value
 - Turn counterclockwise → reduces value
 - All intermediate values are cycled in a quasi-linear fashion and are forwarded to the output (if active).

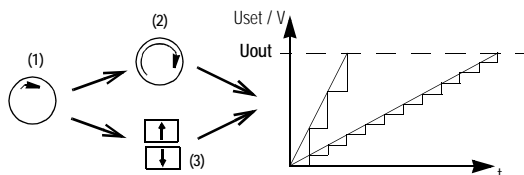


Figure 4.1.2 a Continuous Adjustment of Uset

- ☞ Adjustment (3) with the <↑> or the <↓> key [11],
 - <↑> (increment) → increases value
 - <↓> (decrement) → decreases value
- Each time the key is pressed, output voltage is changed by an amount equal to the selected control resolution value.
- Pressing and holding the key causes an automatic sweep dependent upon the selected increment.

Attention! Uset may not be set to a higher value than Ulim!

Fixed Value Setting

- ☞ Press the <ENTER> key [15].
 - The display [5] changes from Uout (measured voltage value) to Uset (setpoint voltage value). The decimal place representing the selected control resolution 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, a value can be selected with the rotary knob [7] which becomes immediately effective).
- Control Resolution:
 - 3 increments are possible: 0.01 V, 0.1 V, and 1 V
 - ☞ Repeatedly press the <SELECT> key [13] until the desired decimal place (increment) blinks at the display [5].
- Output Voltage:
 - ☞ Press the <↑> or the <↓> key [11].
 - <↑> (increment) → increases value
 - <↓> (decrement) → decreases value
 - The yellow Uset/V LED [5] starts blinking.
 - The blinking Uset/V LED indicates that the new value is displayed, but does not become effective during adjustment. The old Uset value remains active.
 - ☞ Press the <↑> or <↓> key [11] until the desired value appears at the display [5].
 - Each time the key is pressed, output voltage is changed by an amount equal to the selected control resolution value.
 - Pressing and holding the key causes an automatic sweep dependent upon the selected increment.
 - ☞ Acknowledge the selected value with the <ENTER> key [15]. The selected value is read out to the output [4], and the yellow Uset/V LED [6] is continuously illuminated.
 - ☞ Uset and Iset can be alternately selected by pressing the <ENTER> key [15] again.

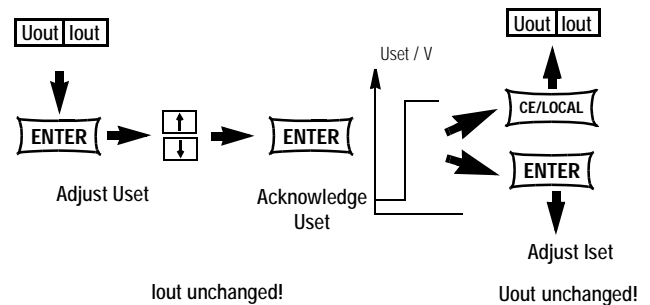


Figure 4.1.2 b Adjusting Uset with Fixed Value Entry

- Output voltage is changed from the old to the new value in a single jump (no intermediate values).

Attention: Uset may not be set to a higher value than Ulim!

4.1.3 Iout – Currently Measured Current Value

- Appears at the left-hand display [8].
- The **green Iout/A LED** [6] is illuminated and indicates display of the currently measured current value.
- Measured current is automatically displayed once again approx. 10 seconds after the last setting has been made.
- The currently measured current value is displayed immediately if the device function set-up mode is exited by pressing the **<CE/LOCAL>** key [16].

4.1.4 Iset – Output Current

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

Only the following setting and display elements are different:

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

Attention: Iset may not be set to a higher value than Ilim!

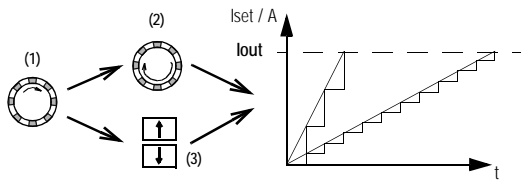


Figure 4.1.4 a Continuous Adjustment of Iset

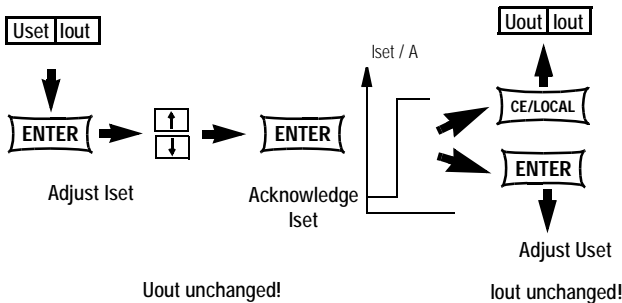


Figure 4.1.4 b Adjusting Iset with Fixed Value Entry

4.1.5 OUTPUT – Switching the Power Output On and Off

The function of the **<OUTPUT>** key (chapter 3/[2]) depends upon the current operating status of the KONSTANTER. Details concerning control mode, protective function and status displays which provide information regarding the operating status of the output can be found in chapter 3/[3].

Control Mode

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

- OUTPUT OFF → OUTPUT ON
- OUTPUT ON → OUTPUT OFF

REMOTE Status (remote control)

(chapter 3/[12], chapter 4.7)

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

LOCAL LOCKED Status (control panel elements disabled)

(chapter 3/[12], chapter 4.7)

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

trG out (T_MODE OUT) and External Trigger Active

If the power output has been disabled with an **external trigger signal** applied to the analog interface, neither a command nor a key operation can be used for reactivation. The corresponding command is not executed and bit 4 in event register B (output on error) is set. "Err 25" is also briefly displayed in the manual operating mode.

The status of the power output (chapter 3/[4/22]) is indicated with the **red LED** above the **<OUTPUT>** key [2]:

- LED on = output is active
- LED off = output is inactive

If the output is switched off, the control mode displays are inactive as well (chapter 3/[3]).

If the output has been deactivated by means of **overtemperature protection**, the **yellow "240 W" LED** [3] blinks at the control mode display. The output cannot be reactivated until the KONSTANTER has returned to normal operating temperature.

The output is automatically reactivated after return to normal operating temperature, if the **Pon RCL** function is active.

The following functions may influence the output switching status:

- OVP (OVSEt)** overvoltage protection chap. 4.2.1.3, 6.2.1.15
- OCp** overcurrent protection chap. 4.2.1.4, 6.2.1.13
- Pon (POWER_ON)** function chap. 4.2.1.6, 6.2.1.17
- SEq** function chap. 4.2.4, 6.2.1.22
- trG-** (T_MODE) function chap. 4.2.2.1, 6.2.1.29

4.1.6 Additional Measured Values

Pout / U⁻ / U₋ / I⁻ / I₋

Settings for querying currently measured values including output power and minimum and maximum voltage and current can be found in chapter 4.3.1 (description of the **<SELECT>** key [13]).

4.2 Setting Device Parameters in the FUNCTION Menu

The **FUNCTION** menu includes the following functions for configuring the KONSTANTER:

Function Group	Function	Parameter (numeric / text)
■ Setup		
SEt	Ulim	NP: xx.xx
	llim	NP: xx.xx
	OVP	NP: xxx.x
	OCP	TP: oFF / on
	dLY	NP: xx.xx
	pon	TP: rSt / SbY / rcL
	UL ₋	TP: oFF / on / rSt
	Rnd	TP: 0 / -1 / -2
■ Analog Interface		
AnIF	trG	TP: oFF / out / rcL / SEq / LLO / UL ₋
	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	TP: xx.xx
	Strt	NP: xxx (11 ... 252)
	StoP	NP: xxx (12... 253)
	reP	NP: xxx (continuous or 1 ... 255)
SEq	TP: Go	
■ 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
	■ Calibration (chapter 7)	
CAL	dAtE	TP: mm.yy/last/next date of calibration
	CAL	TP: Strt
	MEAS	UoFF
	UoFF	NP: x.xxxenter externally measured value U
	MEAS	UFS
	UFS	NP: xx.xxenter externally measured value U
	MEAS	IoFF
	IoFF	NP: x.xxxenter externally measured value I
	MEAS	IFS
	IFS	NP: xx.xxenter externally measured value I
	CAL	End

NP: Numeric parameters

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

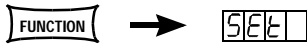
TP: Text parameters (alpha parameters)

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

Procedure

☞ Press the <FUNCTION> key [14] at the front panel of the KONSTANTER.

If no settings have been entered to the FUNCTION menu since the device has been switched on, the display always jumps to the "SEt" group when the <FUNCTION> key is activated.



If settings have already been entered to the FUNCTION menu, the display automatically jumps to the last configured function group or to Function.

• **Jumping to last configured function:**

- ☞ In order to configure a function from the currently selected function group, select the desired function by pressing the <FUNCTION> key. Detailed information is included in the respective sections of this chapter.
- ☞ In order to configure a function from a different function group, first press the <CE/LOCAL> key in order to return to the Function Group menu.

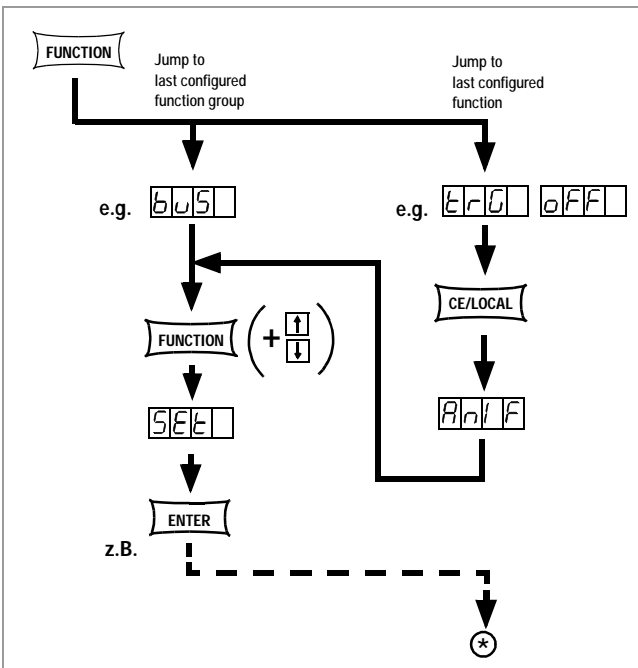
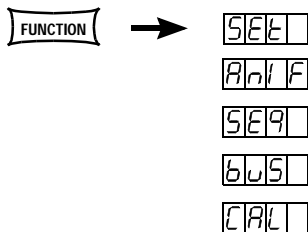


Figure 4.2 a Path to Functions Sub-Menu

☞ The following function groups can be queried from within the function group menu:



☞ 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 the above example)!

- **Scrolling forward** through the function groups in this menu:
 - ☞ Repeatedly press the <FUNCTION> key or
 - ☞ Press and hold the <FUNCTION> key and simultaneously press the <↓> key repeatedly.
- **Scrolling backwards** through the function groups in this menu:
 - ☞ Press and hold the <FUNCTION> key and simultaneously press the <↑> key repeatedly.
- **Jumping to the functions within the selected function group:**
 - ☞ Press the <ENTER> key

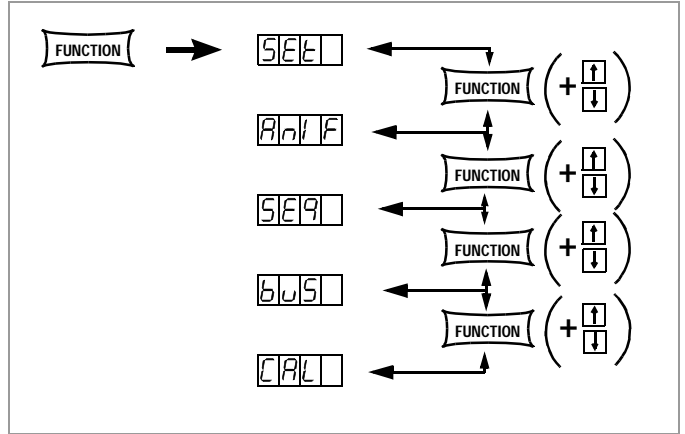


Figure 4.2 b Scrolling Amongst the Individual Function Groups

COMMENT

The order in which the commands are explained in the following sections corresponds to their actual sequence during manual operation of the SSP-KONSTANTER. This is intended to allow for minimal scrolling and time-saving configuration of device settings and parameters!

4.2.1 The "Setup" Function Group SEt

4.2.1.1 Ulim – Upper Voltage Setting Limit

Function

- Upper setting limit (soft-limit) for Uset
- Prevents inadvertent exceeding of a maximum voltage value when setting Uset.
- Protection for the connected power consumer
- Ulim has higher priority than Uset.
- Manual and computer controlled Uset settings are prevented from exceeding the Ulim value.
- Ulim cannot be set below a value which has already been assigned to Uset. In this case, Uset must first be reduced in order to allow for the selection of a new Ulim value.

Procedure (see also figure 4.2.1.1)

- ☞ Press the <FUNCTION> key [18] at the front panel.
 - ! The display jumps automatically to the last configured function group or function.
- ☞ If the "SEt" function group does not appear immediately at the left-hand display, repeatedly press the <FUNCTION> key until "SEt" appears at the left-hand display (figure 4.2.1).
- ☞ Press the <CE/LOCAL> key [16] to jump from the functions menu back to the function groups menu and then to SEt.
- Scrolling forward through the function groups in this menu:
 - ☞ Repeatedly press the <FUNCTION> key or
 - ☞ Press and hold the <FUNCTION> key and simultaneously press the <↓> [11] key repeatedly.
- Scrolling backwards through the function groups in this menu:
 - ☞ Press and hold the <FUNCTION> key and simultaneously press the <↑> [11] key repeatedly.
- Jumping to the setup menu:
 - ☞ Press the <ENTER> key.
 - ! The display jumps automatically to the last configured setup function.
- Scrolling forward through the setup functions in this menu:
 - ☞ Repeatedly press the <FUNCTION> key or
 - ☞ Press and hold the <FUNCTION> key and simultaneously press the <↓> [11] key repeatedly.
- Scrolling backwards through the setup functions in this menu:
 - ☞ Press and hold the <FUNCTION> key and simultaneously press the <↑> [11] key repeatedly.
- Resolution (cursor position) of the numeric parameter [V]:
 - ☞ Repeatedly press the <SELECT> key [13].
 - The cursor travels through the parameter in a continuous loop from right to left.
 - ☞ The decimal place at which the cursor is currently positioned blinks.
- Set Ulim value:
 - ☞ With the <↑> key [11] (increase value) or the <↓> key (decrease value), depending upon selected resolution.
 - ! The last selected value automatically becomes effective.
- Selecting additional SETUP functions:
 - ☞ Repeatedly press the <FUNCTION> key or press and hold the <FUNCTION> key while simultaneously pressing the <↓> or the <↑> key repeatedly.
- Jumping back to the function groups menu:
 - ☞ Press the <CE/LOCAL> key.
 - A new function group can now be chosen and selected with the <ENTER> key.
- Exit the functions menu:
 - ☞ Press the <CE/LOCAL> key once again.
 - ! Uout and Iout reappear at the display.

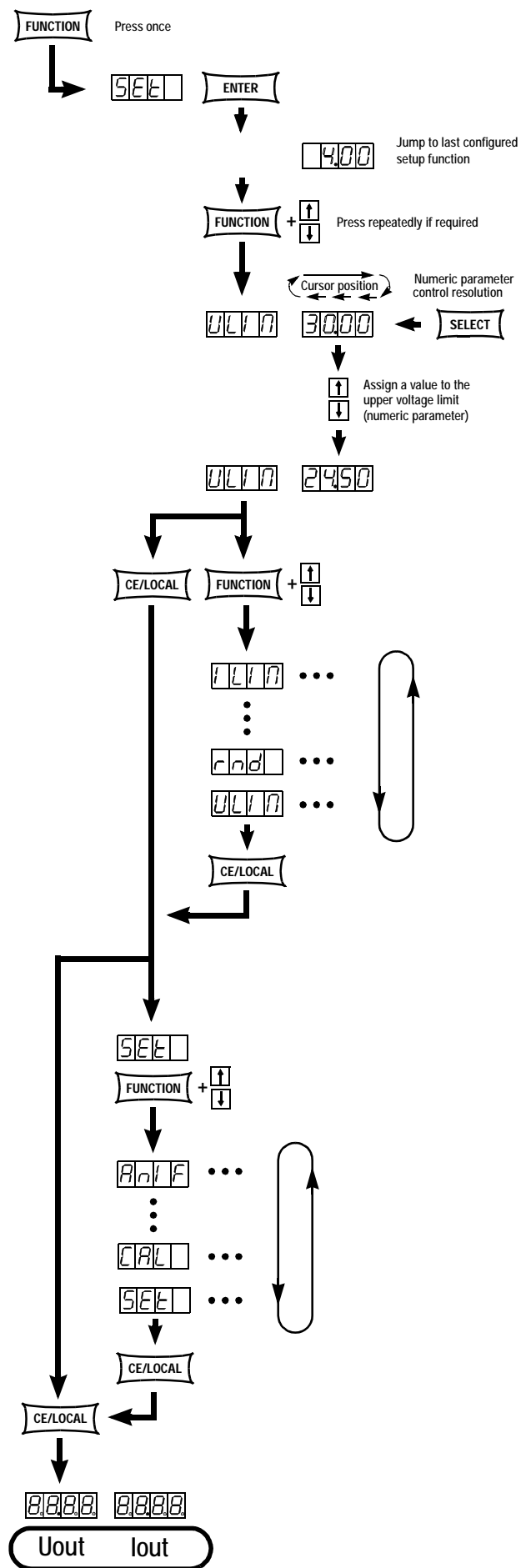


Figure 4.2.1.1 Path to Ulim Setting

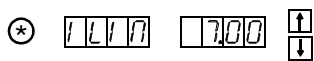
4.2.1.2 Ilim – Upper Current Setting Limit

Function

- **Upper setting limit** (soft-limit) for **Iset**
- Prevents inadvertent exceeding of a maximum current value when setting **Iset**.
- **Protection** for the connected power consumer
- **Ilim** has higher priority than **Iset**.
- Manual and computer controlled **Iset** settings are prevented from exceeding the **Ilim** value.
- **Ilim** cannot be set below a value which has already been assigned to **Iset**. In this case, **Iset** must first be reduced in order to allow for the selection of a new **Ilim** value.

Procedure

- ☞ The procedure for adjusting **Ilim** is identical to the procedure used for adjusting **Ulim** (see also 4.2.1.1, figure 4.2.1.1).
- ! However, **Ilim** and the corresponding numeric parameter [A] appear in the setup function display.



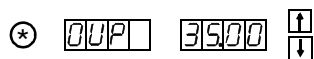
4.2.1.3 OVP – Overvoltage Protection Threshold Value

Function

- **Threshold value** for the **overvoltage protection function**
- **Protection** for the connected power consumer
- If voltage at the output terminal exceeds the selected **OVP** value, the power output is switched off.
- When overvoltage protection is triggered, the output is deactivated (**OUTPUT OFF**) immediately (< 200 μs). The HF power transformer is immediately disabled and the electronic sink used for discharging the output capacitors is activated for a period of approximately 350 ms. In addition to this, bit 4 (OVPA) in events register A is set, and remains set until voltage no longer exceeds the threshold value.
- The “**CV**” LED blinks as soon as **OVP** is triggered (see also chapter 3 [3]) and the red “**OUTPUT**” LED goes out.
- After the condition which caused shutdown no longer exists, the power output can be reactivated by pressing the <OUTPUT> key, with a **trigger signal** to the analog interface or via **remote computer control** (“**OUTPUT ON**” ⇔ red “**OUTPUT**” LED lights up).

Procedure

- ☞ The procedure for adjusting **OVP** is identical to the procedure used for adjusting **Ulim** (see also 4.2.1.1, figure 4.2.1.1).
- ! However, **OVP** and the corresponding numeric parameter [V] appear in the setup function display.



- ☞ In order to prevent undesired **OVP** triggering caused by overshooting during sudden load reducing at the output, the **OVP** threshold value should be set approximately 1 V higher than the desired output voltage **USET** (see minimum values under 1.4.3, Electrical Data).
- ☞ The **OVP** threshold value makes reference to prevailing voltage between the output terminals at the SSP. This value is increased to greater than **USET** during sensing mode operation (remote sensing) by an amount equal to voltage drop at the power leads. The prescribed difference between **OVP** and **USET** must thus be increased during sensing mode operation!
- ☞ The newly adjusted **parameter** becomes effective automatically as soon as the **OCP** function is exited with the <FUNCTION>, the <CE/LOCAL> or the <ENTER> key.

Note

- Overvoltage protection response time is less than 200 μs. Output voltage generated by the device may continue to climb above and beyond **OVSET** during this time. Maximum possible overshooting can be approximated as follows.

$$U_{out} = ISET [A] \times 200 [\mu s] / C_{out} [\mu F]$$

$$ISET = \text{current setpoint value}$$

$$C_{out} = \text{output capacitor capacitance}$$
 Subsequent discharging time for the output capacitor depends upon load and corresponds to the response time values specified in chapter 1.4.3 (Unom → >1 volt).
- Possible causes for overvoltage protection triggering are included in chapter 3 [3], Control Mode Displays.

4.2.1.4 OCP – Overcurrent Protection

Function

- Determines **performance of the power output**, i.e. the output is switched to the **current regulating mode** when load current has reached the value **Iset**.
- **Protects** consumers from continuous overcurrent.
- Intermittent, higher current values for a defined period of time (**dents**, chapter 4.2.1.5) are nevertheless possible, e.g.
 - ! Start-up current for electric motors
 - ! Inrush current for capacitive consumers
 - ! For testing breaking characteristics of circuit breakers, motor protecting switches, fuses etc.
 - ! For determining intermittent overload capacity at contacts, conductors and electric and electronic components
 - ! For short response times when the output voltage setpoint value is increased
- **OCP** responds after expiration of a selected delay time (see also chapter 4.2.1.5).
- The “**CC**” LED blinks as soon as **OCP** has been 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 applying a **trigger signal** to the analog output or via **remote computer control** (“**OUTPUT ON**” ⇔ red “**OUTPUT**” LED lights up).

Parameter Settings

- ☞ **OFF**
OCP function inactive
 Continuous current limiting (current regulation)!
- ☞ **ON**
OCP function active
 The output is deactivated as soon as current limiting has been active for the entire duration of the predefined **DELAY** period.
- ☞ The selected text parameter only becomes effective after the <ENTER> key has been activated.

Procedure

- ☞ The procedure for adjusting **OCP** is in principle identical to the procedure used for adjusting **Ulim** (see 4.2.1.1, figure 4.2.1.1).
- ! However, **OCP** and the corresponding text parameter appear in the setup function display.



- ☞ Select the desired text parameter [**ON** or **OFF**] with the <↓> or the <↑> key.
- ! Parameter selections can be displayed in a continuous loop with the <↓> and <↑> keys.

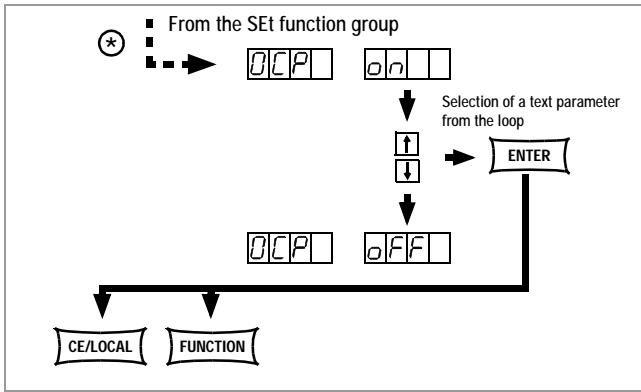


Figure 4.2.1.4 Path to OCP Text Parameter Settings

Note

Charging current from the output capacitor is acquired by the current regulator and is limited to the value: $I_{set} - I_{load}$. If the OCP function has been activated and low values have been selected for ISET and DELAY, the output may be deactivated if output voltage is set to an increased value. For this reason, DELAY must first be set somewhat higher than the response time which results from the selected output voltage value.

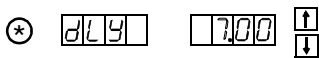
4.2.1.5 dLY – Shutdown Delay for OCP

Function

- Delay time until the power output is deactivated after current regulation has been activated ($I_{out} = I_{set}$).
- Can only be enabled if the OCP function has been activated (OCP ON).
- If output current I_{out} is reduced to a value below I_{set} before DELAY time has expired, the shutdown routine is aborted.
- If current regulation is activated again, the entire procedure is started again (at 00.00).
- Default value after a RESET (*RST) is 00.00.

Procedure

- ☞ The procedure for adjusting DELAY is identical to the procedure used for adjusting U_{lim} (see 4.2.1.1, figure 4.2.1.1).
- ! However, DELAY and the corresponding numeric parameter [t] appear in the setup function display.



4.2.1.6 Pon – Select a Power-On Condition

Function

- Determines the default KONSTANTER setting after power has been switched on.

Parameter Settings:

- ☞ rSt
RESET: The device is reset to the factory default settings.
- ☞ SbY
STANDBY: Same device settings as prior to disconnection from the mains, power output remains inactive (OUTPUT OFF).
- ☞ rcl
RECALL: Same device settings as prior to disconnection from the mains.

Procedure

- ☞ The procedure for setting PON is in principle identical to the procedure used for adjusting U_{lim} (see 4.2.1.1, figure 4.2.1.1).
- ! However, Pon and the corresponding text parameter appear in the setup function display.
- ☞ Select the desired parameter setting with the <↓> or the <↑> key.
- ! Parameter selections can be displayed in a continuous loop with the <↓> and <↑> keys.

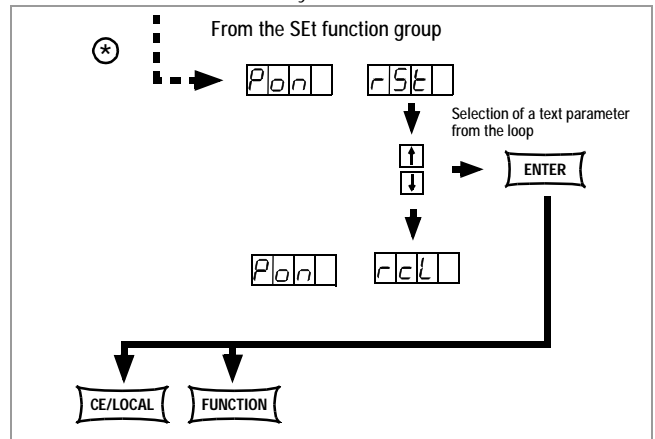


Figure 4.2.1.6 Path to Pon Text Parameter Settings

Note

- The Pon function status cannot be saved as a device setting to the SETUP registers with the <SAVE> key.
- Depending upon how the KONSTANTER is used, the following settings are recommended (examples only):
 - ! Pon rSt: For use in computer controlled systems
 - ! Pon SbY: Common laboratory use
 - ! Pon rcl: Applications which should resume in an unchanged fashion after power failure

4.2.1.7 UI₋ – U/I Extreme Value Memory (MIN-MAX)

Function

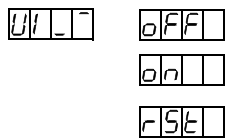
- Stores **minimum** and **maximum** measured voltage and current values.
- Reads out stored values for **Umin**, **Umax**, **Imin** and **Imax** to the display or via a PC interface.
- The MIN-MAX function can be temporarily deactivated (**OFF**), e.g. before deactivating the output in order to connect a new device under test. Extreme values are no longer updated after temporary deactivation, nor are they automatically reset.
- The selected status of the **MIN-MAX** function has no influence on the read-out of stored extreme values.
- Extreme values can be reset at any time with **UI₋ RST**.
- Extreme values can also be reset with the ***RST** command or with the key combination **<CE/LOCAL> & <ENTER>**.
- The **MIN-MAX** function status can also be saved to the **SETUP** registers with the **"SAVE"** key.
- The **Pon** function re-initializes the MIN-MAX function in the **"SbY"** and the **"rcl"** status, although extreme values acquired before the KONSTANTER was switched off are lost.
- The **MIN-MAX** function can also be controlled via the **trigger input** at the analog interface.

Parameter Settings

- ☞ **OFF**
Extreme value storage is deactivated.
- ☞ **ON**
Extreme value storage is activated.
- ☞ **RST**
The contents of the extreme value memory are reset, or are replaced with currently measured values:
Umin = Uout Umax = Uout
Imin = Iout Imax = Iout

Procedure

- ☞ The **procedure** for setting **UI₋** is in principle identical to the procedure used for adjusting **Ulim** (see 4.2.1.1, figure 4.2.1.1).
- ! However, **UI₋** and the corresponding text parameter appear in the setup function display.



- ☞ Select the desired parameter setting with the **<↓>** or the **<↑>** key.
- ! Parameter selections are displayed in a continuous loop.
- ☞ Default setting after a **RESET (*RST)**: **OFF**

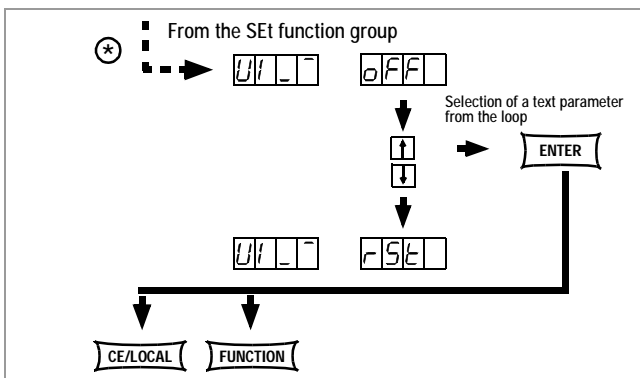


Figure 4.2.1.7 Path to **UI₋** Text Parameter Settings

4.2.1.8 rnd – Rounding the Displayed Value

Function

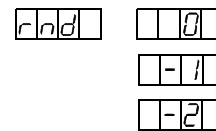
- Applies to **Uout** and **Iout** measuring function only
- Determines number of decimal places at the display.
- Stabilizes the display if fluctuations are anticipated at the last decimal place within the measured value.

Parameter Settings

- ☞ **0**
No rounding
- ☞ **-1**
Round to one decimal place
- ☞ **-2**
Round to two decimal places

Procedure

- ☞ The **procedure** for setting the **UI₋** parameter is in principle identical to the procedure used for adjusting **Ulim** (see 4.2.1.1, figure 4.2.1.1).
- ! However, **rnd** and the corresponding text parameter appear in the setup function display.



- ☞ Select the desired parameter setting with the **<↓>** or the **<↑>** key.
- ! Parameter selections can be displayed in a continuous loop with the **<↓>** and **<↑>** keys.
- ☞ Press the **<ENTER>** key in order to save the text parameter.

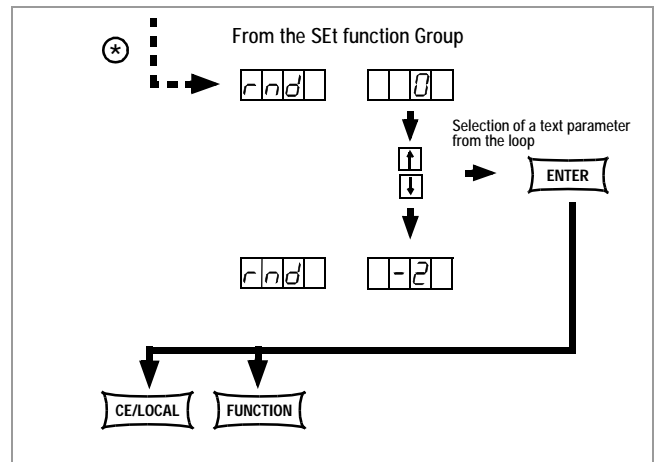


Figure 4.2.1.8 Path to **rnd** Text Parameter Settings

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

4.2.2 "Analog Interface" Group AniF

The analog interface allows for remote operation of the KONSTANTER. Digital control inputs (TRG IN+ / TRG IN-) and outputs (SIG1 / SIG2) have been made available to this end.

This facilitates control of other devices (such as meters, alarms, SSP-KONSTANTER and much more). In combination with a second or several SSP-KONSTANTERs, a master-slave network can be created (see chapter 5).

Please observe that only certain **maximum current and voltage values** can be used for the signal outputs.

4.2.2.1 trG – Selecting a Trigger Input Function

Function

- Floating optocoupler input "TRG IN" at the analog interface
- The trigger input is controlled with a digital signal (low: 0 V, high: 4 to 26 V).

Parameter Settings

OFF

Trigger input function is deactivated. Signals applied to the trigger input have no effect.

OUT

Trigger input influences the **OUTPUT**: output ON / OFF

TRIGGER Signal	Effect on OUTPUT Status
LOW	Status depends upon manual setting or programming command
LOW \uparrow HIGH	OUTPUT remains OFF or OUTPUT OFF after max. 1 ... 15 ms
HIGH	OUTPUT is OFF and cannot be activated, neither manually nor with a programming command
HIGH \downarrow LOW	OUTPUT is activated after 1 ... 15 ms, exception: OTP

RCL

RECALL: memory recall (single step)¹⁾, displays Iset/Usset values from the respective memory locations. The **SEQUENCE** function group must be set to "SEQUENCE ON" for this function, and the corresponding **START** address must be designated (see also chapter 4.2.3). The required trigger is a high level pulse with a length of $11 \text{ ms} < t_{\text{High}} < 800 \text{ ms}$.

Recall begins at the designated **START** address. The address is increased by 1 with each trigger signal until the **STOP** address has been reached. The contents of the **START** address appear after the next pulse. A pulse with a duration of $t_{\text{High}} > 1.0 \text{ s}$ can be used to reset the counter to the **START** address at any time.

SEQ

Controls execution of the **SEQUENCE** function¹⁾
SEQUENCE: sequential series of predefined values for Iset, Usset and dwell time (see also chapter 4.2.3). The **SEQUENCE** function group must be set to "SEQUENCE ON" for this function.

TRIGGER Signal	Effect on SEQUENCE Status
LOW \uparrow HIGH	SEQUENCE function is started, "SEQUENCE GO" delay approx. 1 ... 15 ms
HIGH \downarrow LOW	SEQUENCE function is stopped at its current position

¹⁾ If the **SEQUENCE** function has not already been started, an

active trigger signal generates the error message "Err 27", which appears at the display for about 1 s. Additionally, bit 5 ("SEQE") is set in events register B (ERB). The **SEQUENCE** function must be fully initialized in order to execute the settings "RCL" or "SEQ".

LLO

LOCAL LOCKED: Front panel controls are disabled.

TRIGGER Signal	Effect on Front Panel Controls
LOW	All front panel controls are enabled
HIGH	All front panel controls are disabled, except for the mains switch, enabling is not possible with the "LOCAL" key

UI_

MIN-MAX function: Storage of U and I extreme values to memory is controlled with the trigger.

TRIGGER Signal	Effect on MIN-MAX Function Status
LOW	ON/OFF/RST : Status is dependent upon manual setting or programming.
LOW \uparrow HIGH	MINMAX RST : The contents of the memory locations are reset.
HIGH	MINMAX ON : Extreme values are updated.
HIGH \downarrow LOW	MINMAX OFF : The extreme value memory cannot be activated.

- The **trG** function status cannot be saved as a device setting with the **SAVE** key!

Procedure

- Procedure for setting **trG** parameter → see chapter 4.2
- ! **trG** and a corresponding text parameter appear at the **AniF** function display.

```

Err0  OFF
      OUE
      rcl
      SEQ
      LLO
      UI_
  
```

- Select the desired parameter setting with the $\langle \downarrow \rangle$ or the $\langle \uparrow \rangle$ key.
- ! Parameter selections can be displayed in a continuous loop with the $\langle \downarrow \rangle$ and $\langle \uparrow \rangle$ keys.
- Press the **<ENTER>** key in order to save the text parameter.
- Default setting after a **RESET** ("RST"): **unchanged**

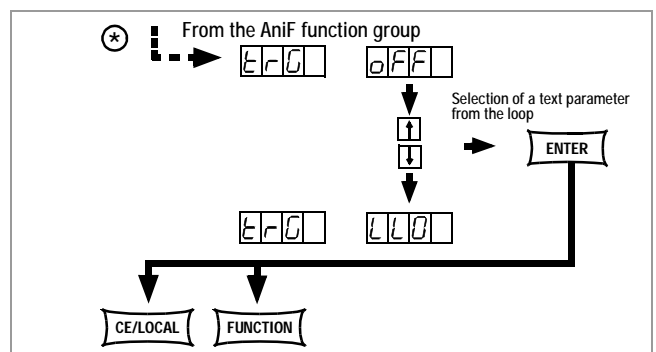


Figure 4.2.2.1 Path to trG Text Parameter Settings

4.2.2.2 SiG1 – Signal Output 1 SiG1

Function

- Digital open collector output with reference to AGND, max. switching voltage min. 30 V DC, max. switching current min. 20 mA (e.g. external load relay), indicates status of the power output
- If an event occurs which is relevant to the selected parameter, a corresponding signal is generated at the output.
- For parallel or series connection (master-slave) of several SSP-KONSTANTERs allowing for coupling of the OUTPUT function via the TRIGGER INPUT.
- Control of an external output relay is possible.
- As a message signal to monitoring equipment
- As a freely usable switching output

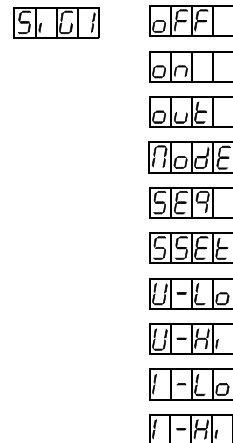
Parameter Settings	SIG1 OUT Status
OFF	cont. passive, high
ON	cont. active, low
OUT Power output: OUTPUT ON OUTPUT OFF	passive, high active, low
ModE Control mode signal: Constant current regulation Overload (Pmax) Constant voltage, output OFF	active, low active, low passive, high
SEq Status during SEQUENCE execution	active, low
SSEt If SSEt is set to ON in SEQUENCE for special memory location SSEt ¹⁾ Otherwise	active, low passive, high
U_LO Umeas < Uset (see value memory 254) Umeas ≥ Uset	active, low passive, high
U_HI Umeas < Uset (see value memory 254) Umeas ≥ Uset	active, low passive, high
I_LO I meas < Iset (see value memory 254) I meas ≥ Iset	active, low passive, high
I_HI I meas < Iset (see value memory 254) I meas ≥ Iset	active, low passive, high

1) The SSEt parameter must be set to ON in the SEQUENCE function group for a specified memory location.

- When the SEQUENCE is run, a signal is additionally generated which causes read-out of Uset and Iset when the specified memory location is reached.
- The signal is made available at the outputs of the analog interface (SiG1 / SiG2 / SiG1 + SiG2) for the selected dwell time tSEt or tdEF of the memory location.
- However, this signal can only be picked off of the outputs if the SSEt parameter has been activated for the SiG1 and SiG2 functions in the AniF function group (see also chapter 3.3.14).

Procedure

- ☞ Procedure for setting Sig1:
See chapter 3.2 - Procedure.
- ! Sig1 and a corresponding text parameter (status) appear at the AniF function display.



- ☞ Select the desired parameter setting with the <↓> or the <↑> key.
- ! Parameter selections can be displayed in a continuous loop with the <↓> and <↑> keys.

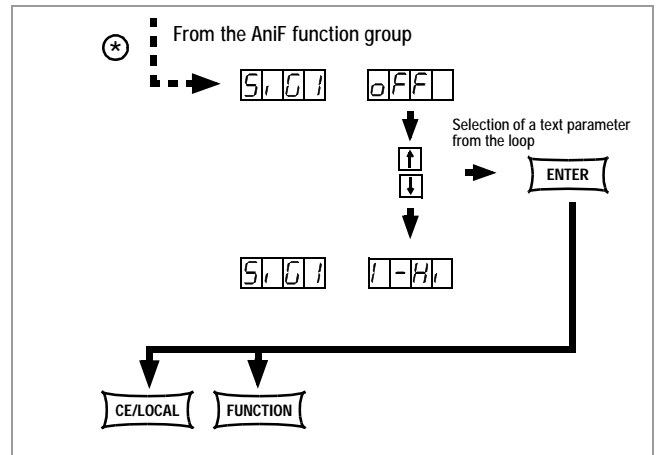


Figure 4.2.2.2 Path to SiG1 Text Parameter Settings

- ☞ Press the <ENTER> key in order to save the text parameter.

4.2.2.3 SiG2 – Signal Output 2

Function and Parameters

- ☞ Identical to SiG1, chapter 4.2.2.2

Procedure

- ☞ Identical to SiG1, chapter 4.2.2.2

4.2.3 Sequence Function Group SE9

Special test sequences can be created with the **SEQUENCE** function group (in accordance with DIN as well) by entering specific values for **Uset**, **Iset** and **tset** at certain vertices.

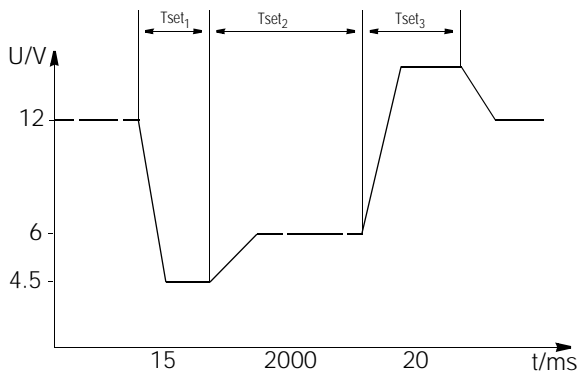


Figure 4.2.3 Path to SEq Parameter Settings

The sequences can be set up in accordance with respective test requirements for specific devices under test. The **SEQUENCE** automatically executes all of the specified values from the start address to the stop address. Furthermore, a signal can be read out for any desired test step for further external processing.

4.2.3.1 tSEt – Memory Location Specific Dwell Time

Function

- Special dwell time (see also figure 4.2.3)
For the voltage and current value pair from a given memory location of a given **SEQUENCE**
- For a message signal generated for this memory location

Setting Range

00.00 s	tdEF value is selected
00.01 s ... 99.99 s	Max. resolution: 0.01 s
99.99 s	Distribution of time entries to several consecutive SEQUENCE registers with identical current and voltage values

The values include **rise** and **decay times** (see figure 4.2.3). These slope times are only assured within a **limited load impedance range** (see **Technical Data**).

Procedure (see setting up and running a **SEQUENCE**, chapter 4.2.3.8)

- ☞ **Procedure** for setting **tSEt**:
See chapter 4.2 - **Procedure**.
- ! **tSEt** and a corresponding numeric parameter [s] appear at the **SEq** function display.

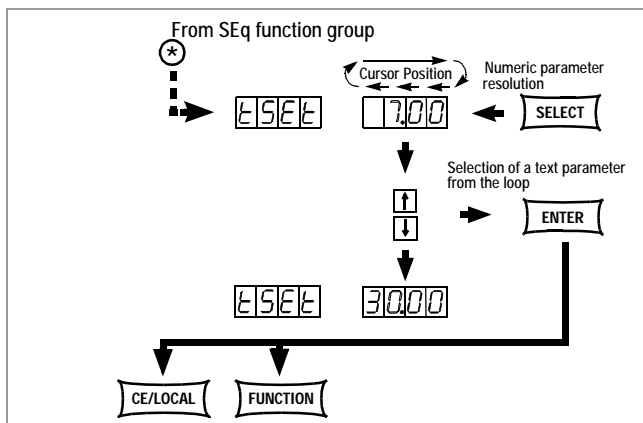


Figure 4.2.3.1 Path to tSEt Setting

- ☞ Set resolution, i.e. the decimal place (cursor position) of the numeric parameter by repeatedly pressing the **<SELECT>** key.
- ☞ Enter the dwell time value with the **<↓>** key or the **<↑>** key based upon the previously selected resolution.
- ☞ After selecting the value, jump to the next, or to the previous sequence function by pressing the **<Function>** key, or by pressing and holding the **<Function>** key and activating the **<↓>** key or the **<↑>** key.
- ☞ The last value selected and displayed for the dwell time parameter becomes automatically effective.

4.2.3.2 SSEt – Setting a Digital Switching Function

Function

- **Preparation** of the SSP-KONSTANTER for read-out of a message signal from a specified memory location.
- The duration of the signal depends upon the dwell time, **tSEt** or **tdEF**, which has been selected for the memory location.
- The signal is read-out via analog interface outputs **SIG1** and/or **SIG2**.
- **Prerequisite**: The desired output (**SIG1 / SIG2 / SIG1 + SIG2**) must be enabled accordingly with the **SSEt** parameter in the **AniF** function menu (see chapters 4.2.2.2 and 4.2.2.3).

Parameter Settings

- ☞ **OFF**
No message signal is read out.
- ☞ **ON**
Signal outputs are enabled for message signal read-out.

Procedure (see setting up and running a **SEQUENCE**, chapter 4.2.3.8)

- ☞ **Procedure** for selecting **SSEt**:
See chapter 4.2 - **Procedure**.
- ! **SSEt** and a corresponding text parameter appear at the **SEq** function display.

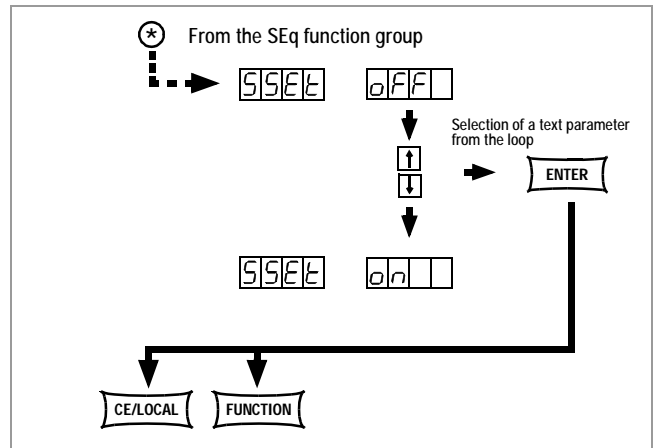


Figure 4.2.3.2 Path to SSEt Text Parameter Settings

- ☞ Select the desired parameter setting with the **<↓>** or the **<↑>** key.
- ☞ Acknowledge with the **<ENTER>** key.
- ! Parameter selections can be displayed in a continuous loop with the **<↓>** and **<↑>** keys.
- ☞ Continue to the next parameter in the **SEq** functions menu by pressing the **<FUNCTION>** key, or by pressing and holding the **<Function>** key and activating the **<↓>** key or the **<↑>** key, or return to the **FUNCTION** menu with the **<CE/LOCAL>** key.

4.2.3.3 tdEF – Memory Location Specific Dwell Time

Function

- Default dwell time
 - For all voltage and current value pairs of a given sequence to whose memory locations **no special dwell time (tSEt = 00.00)** has been assigned
 - For all message signals generated at these memory locations
- **tdEF** is primarily used as a tool for quick programming, if the duration of a specific dwell time is repeated frequently within a given **SEQUENCE**.

Setting Range

0.01 s ... 99.99 s Max. resolution: 0.01 s

Procedure (see setting up and running a SEQUENCE, chapter 4.2.3.8)

- ☞ Do not enter **tdEF** until all **Uset**, **Iset** and **tset** values have been allocated to all of the necessary memory locations!
- ☞ **Procedure** for selecting **tdEF**:
See chapter 4.2 - **Procedure**.
- ! **tdEF** and a corresponding numeric parameter [s] appear at the **SEq** function display.

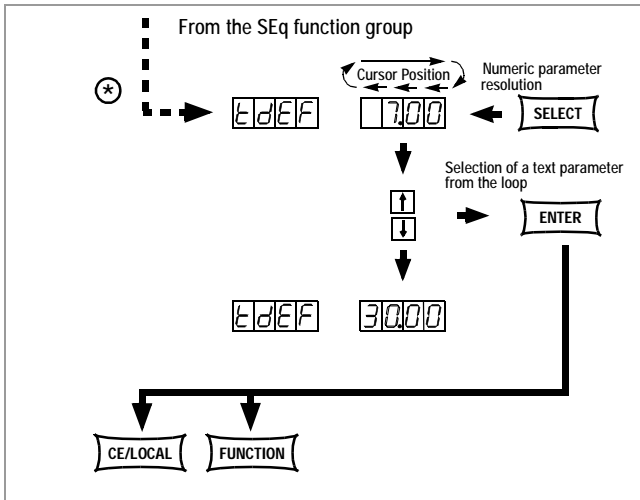


Figure 4.2.3.3 Path to **tdEF** Setting

- ☞ Set resolution, i.e. the decimal place (cursor position) of the numeric parameter by repeatedly pressing the **<SELECT>** key.
- ☞ Enter the dwell time value with the **<↓>** key or the **<↑>** key based upon the previously selected resolution.
- ☞ After selecting the value, jump to the next, or to the previous sequence function by pressing the **<FUNCTION>** key, or by pressing and holding the **<FUNCTION>** key and activating the **<↓>** key or the **<↑>** key.
- ! The last value selected and displayed for the dwell time parameter becomes automatically effective.

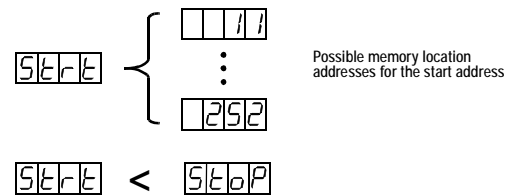
4.2.3.4 Strt – SEQUENCE Start Address

Function

- The **SEQUENCE** is always defined with a **start address** and a **stop address**.
- Memory address at which the **SEQUENCE** is to begin
- The **start address** can be **any memory address between 11 and 252**.
- The **start address** is selected immediately **before a new SEQUENCE is started for the first time**.
- The **last selected start address** is always valid for the **SEQUENCE**, regardless of when the **SEQUENCE** is started.
- The start address can be reselected independent of the stop address in the event of a **SEQUENCE change**.
- ! The content of the memory location selected with the **Strt** parameter is executed as the first function.
- ! The power output is automatically activated (**OUTPUT ON**) when the start address is reached, if the "SEQ ON" parameter setting has been selected.
- ! If no executable data have been stored to the memory location with the **Strt** address (see also Err 22), the previous setting remains unchanged (including **OUTPUT**).

Parameter Settings

- 11 lowest selectable memory location address for **Strt**
- 252 highest selectable memory location address for **Strt**



- ! The **Strt** address must always have a value of **at least 1 whole number less than the Stop address** (see also Err 23).

Procedure (see setting up and running a SEQUENCE, chapter 4.2.3.8)

- ☞ **Procedure** for selecting a **Strt** address:
See chapter 4.2 - **Procedure**.
- ! **Strt** and a corresponding numeric parameter appear at the **SEq** function display.

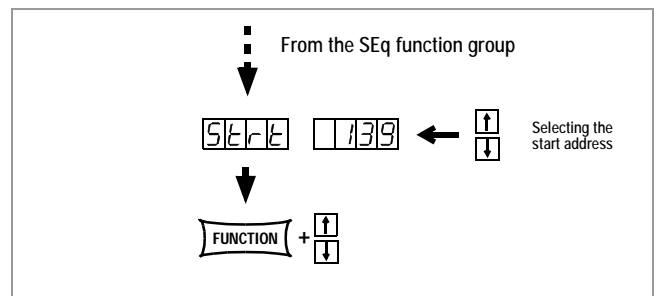


Figure 4.2.3.4 Path to the Start Address Setting

- ☞ Select the memory location address with the **<↓>** or the **<↑>** key.
- ☞ After selecting the value, jump to the next, or to the previous sequence function by pressing the **<FUNCTION>** key, or by pressing and holding the **<FUNCTION>** key and activating the **<↓>** key or the **<↑>** key.
- ! The last value selected and displayed for the **Strt** address parameter becomes automatically effective.

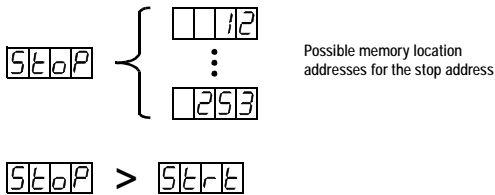
4.2.3.5 StoP – SEQUENCE Stop Address

Function

- SEQUENCES are always defined with **start and stop addresses**.
 - Memory address at which the SEQUENCE is to be ended
 - The **stop address** can be **any memory address between 12 and 253**.
 - The **stop address** is selected immediately **before a new SEQUENCE is started for the first time**.
 - The **last selected stop address** is always valid for the SEQUENCE, regardless of when the SEQUENCE is started.
 - The start address can be reselected independent of the stop address in the event of a SEQUENCE change.
- ! The content of the memory location selected with the Stop parameter is executed as the last function (reP ≠ ∞).
- ! If the **memory location** assigned to the stop address is **not empty**, the output remains active at the last value after the sequence has been run (OUTPUT ON).
- ! If the **memory location** assigned to the stop address is **empty**, the output is switched off automatically (OUTPUT OFF).

Parameter Settings

- 12 lowest selectable memory location address for Stop
- 253 highest selectable memory location address for Stop



- ! The **Strt** address must always have a value of **at least 1 whole number** less than the **Stop** address.
- The contents of the memory location assigned to the **StoP** address are executed as the last function, after which the SEQUENCE can be ended, or repeated beginning at the **Strt** address.
- If the SEQUENCE has been set up for automatic repetition (reP, see chapter 4.2.3.6, page 32), the pointer jumps directly to the memory location with the **Strt** address after the contents of the memory location with the **StoP** address have been executed, and the SEQUENCE starts again.

Procedure (see setting up and running a SEQUENCE, chapter 4.2.3.8)

- ☞ Procedure for selecting a **StoP** address:
See chapter 4.2 - Procedure.
- ✓ **StoP** and a corresponding numeric parameter appear at the SEq function display.

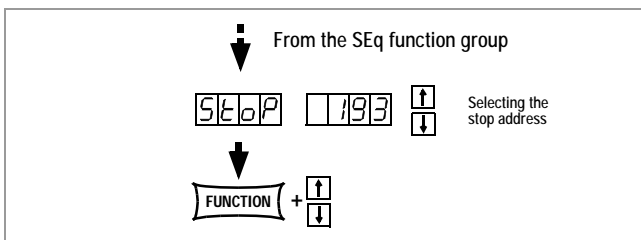


Figure 4.2.3.5 Path to the Stop Address Setting

- ☞ Select the memory location address with the <↓> or the <↑> key.
- ☞ After selecting the value, jump to the next, or to the previous sequence function by pressing the <Function> key, or by pressing and holding the <Function> key and activating the <↓> key or the <↑> key.
- ! The last value selected and displayed for the **Stop** address parameter becomes automatically effective.

4.2.3.6 reP – SEQUENCE Repetition

Function

- Defines the number of SEQUENCE repetitions from the selected **START** address to the selected **STOP** address.
- The SEQUENCE is run from the selected start address to the selected stop address. If repeats have been programmed, the pointer jumps automatically from the stop address back to the start address, and the SEQUENCE begins again.
- The value entered for the reP parameter is stored to the SETUP memory as a device setting with the **SAVE** key.

Parameter Settings

- cont Continuous repetition until the SEQUENCE is ended manually (chapters 4.2.3.11 & 12) or with the PC (chapter 6.2.1.17)
- 1 ... 255 Number of possible repetitions

Procedure (see setting up and running a SEQUENCE, chapter 4.2.3.8)

- ☞ Procedure for setting reP:
See chapter 4.2 - Procedure.
- ! reP and a corresponding numeric parameter [s] appear in the SEq function display.

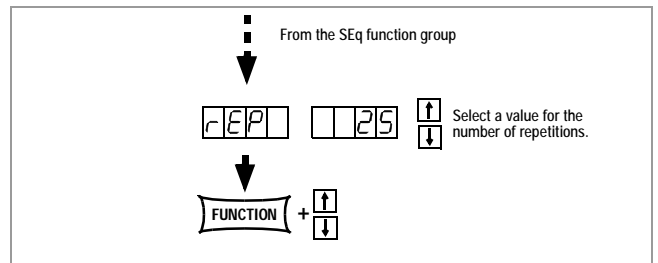


Figure 4.2.3.6 a Path to reP Setting

- ☞ Select the number of repetitions with the <↓> or the <↑> key.
- ☞ After selecting the value, jump to the next, or to the previous sequence function by pressing the <Function> key, or by pressing and holding the <Function> key and activating the <↓> key or the <↑> key.
- ! The last value selected and displayed for the numeric parameter becomes automatically effective.

Interrupting a Running SEQUENCE

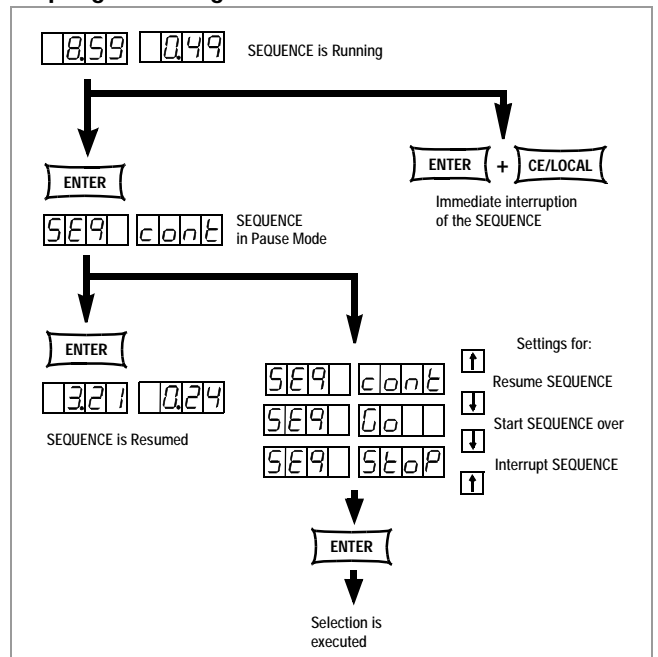


Figure 4.2.3.6 b Interrupting a Running SEQUENCE

4.2.3.7 SEq – Sequence, Automatic Memory Recall

Function

- Allows for automatic, reproducible execution of a series of **USet**, **ISet**, **tSet** and **SSEt** values which have been stored to memory with the **<SAVE>** key.
- A **SEQUENCE** consists of a series of memory locations to which values have been written (**Uset**, **Iset**, **tSet** / **tdEF** and sometimes **SSEt**).
- The series may also contain empty memory locations, which are skipped over by the sequence.
- A start and a stop address must be assigned in order to start a **SEQUENCE** (see chapters 4.2.3.4 and 4.2.3.5).
- The **SEQUENCE** cannot be started if the **start** or the **stop address** is missing.
- A **SEQUENCE** can be repeated 1 to 255 times, or indefinitely until it is stopped manually (see chapter 4.2.3.6).
- The **SEQUENCE** cannot be started if the **start** or the **stop address** is missing.
- A **SEQUENCE** can be repeated 1 to 255 times, or indefinitely until it is stopped manually (see chapter 4.2.3.6).
- **Memory locations 11 through 253** are reserved for **SEQUENCE** commands and contents.
- This entire memory location range can be occupied by a single **SEQUENCE** if desired.
- New sequences can be created using portions of the occupied memory range by redefining the start and stop addresses accordingly.

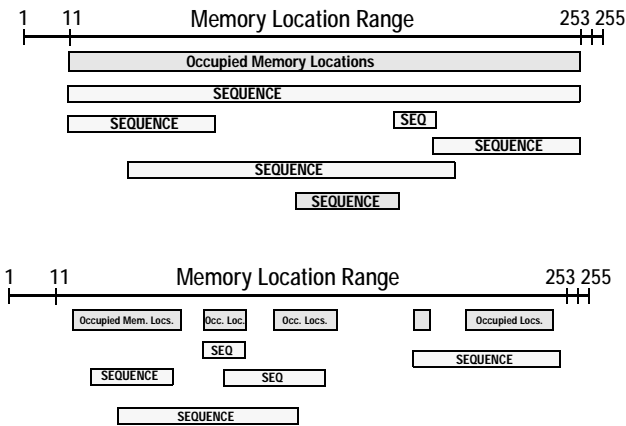


Figure 4.2.3.7 a Memory Location Range and Sequences

- Several smaller **SEQUENCES** can also be generated and distributed over the entire memory location range.
- However, a start and a stop address must be assigned to each individual **SEQUENCE** before it can be started.
- The power output is automatically activated (**OUTPUT ON**) when the **SEQUENCE** function is initialized.
- The power output at the KONSTANTER can be controlled with the **OUTPUT** function at any time while the **SEQUENCE** is running, or during a pause.
- The current condition of a **SEQUENCE** can be queried with bit 7 **SEQB** (= **SEQ**uence **B**usy) in condition register A (**CRA**). The end of the **SEQUENCE** is indicated with bit 7 **SEQI** in event register A (**ERA**).
- Ending the **SEQUENCE** has no influence on the **SEQUENCE** parameter settings **TdEF**, **rEP** etc., or on the contents of the **SEQUENCE** memory locations.

Parameter Settings

- ☞ **GO**
Prepare to start **SEQUENCE**, start with the **<ENTER>** key.

Procedure (see setting up and running a **SEQUENCE**, chapter 4.2.3.8)

- ☞ Procedure for selecting **SEq**:
See chapter 4.2 - **Procedure**.
- ! **SEq** appears in the **SEq** function display.
- ☞ Press the **<ENTER>** key in order to open the **SEQUENCE** menu.
- ☞ Press the **<FUNCTION>** repeatedly (max. 6 times) until "**SEq Go**" appears.

SEq 0000

- ☞ Acknowledge with the **<ENTER>** key.

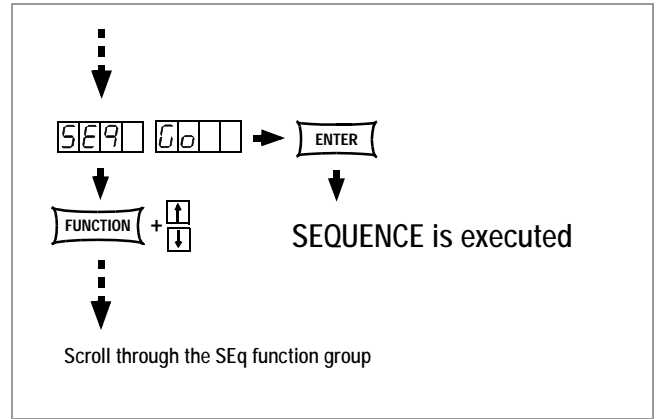


Figure 4.2.3.7 b Preparing to Start a **SEQUENCE**

- ! All of the memory locations from the start address to the stop address are now executed one after the other, and the stored values are read out to the power output (**Uset**, **Iset**, **tdEF** / **tset**, **SSEt**).

Note

- ! Automatic execution and single step control (external trigger or regulating commands) are **not mutually exclusive**.
- ! Various **error messages** may occur after the **SEQUENCE** has been started. These are displayed for approximately 1 second (see chapter 4.2.3.9 and appendix).
- ! If an error occurs during the execution of the **SEQUENCE**, bit 5 **SEQE** (**SEQ**uence **E**rror) is set in event register B (**ERB**).
- ☞ The preparation procedure shown in figure 4.2.3.7. c applies to the execution of the **SEQUENCE** for **SSP-KONSTANTERs with software versions prior to REL. 003**.
In this case, a **SEQUENCE** can only be set up or started if the text parameter "**SEQ ON**" is selected upon entering the **SEq** menu.

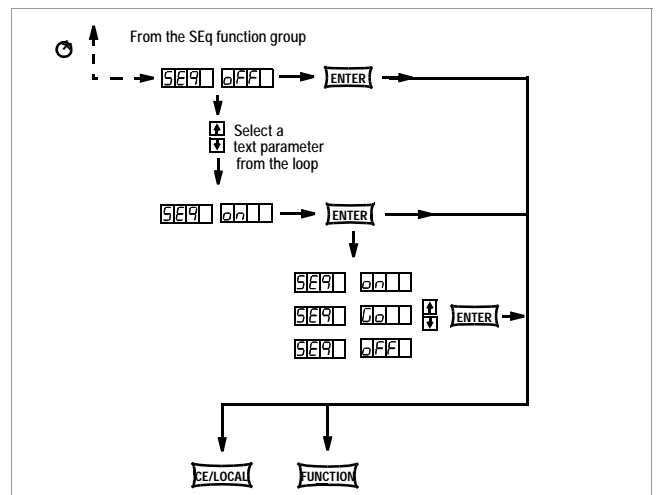


Figure 4.2.3.7 c **SEQUENCE** Preparation for Software < REL. 003

4.2.3.8 Setting All Required Values for a SEQUENCE

Read detailed instructions in chapters 4.1 and 4.2.3 first.

- ① Press the <FUNCTION> key.
- ② The function groups or functions menu is now active.
- ③ If the functions menu is not active, press the <CE/LOCAL> key to jump back to the function groups menu.
- ④ If the function groups menu is now active, repeatedly press the <FUNCTION> key until **SEq** appears at the left-hand display. The right-hand display is empty.
- ⑤ Press the <ENTER> key to open the **SEQUENCE** function menu. **tSEt** appears in the left-hand display.
- ⑥ If required, set **Uset** and **Iset** values with the rotary knob and/or with the <↓> or the <↑> key.
[Uset and Iset values can be selected at any time and assigned to a memory location with the <SAVE> - <ENTER> keys.]
The display is immediately returned to the previous parameter (in this case **tSEt**) by pressing the <FUNCTION> key.
- ⑦ If required, select a value for **tSEt** with the <↓> or the <↑> key, and continue by pressing the <FUNCTION> key.
- ⑧ Set **SSEt** to **on** or **off** with the <↓> or the <↑> key.
- ⑨ Press the <SAVE> key. The memory location (**Sto**) is displayed.
- ⑩ Select the desired memory location address with the <↓> or the <↑> key (11 to 253).
- ⑪ Press the <ENTER> key. The settings are saved to the memory location and the **memory address is automatically increased by 1**.
- ⑫ Enter the next desired values for **Uset**, **Iset**, **tset** and **SSEt**, and continue until all of the values for the **SEQUENCE** have been entered.
- Use rotary knobs only for setting **Uset / Iset**.
Use the <FUNCTION> key and the <↑> key for setting **tset**.
Use only the <FUNCTION> key for setting **SSEt**.
- ⑬ After saving the last step of the **SEQUENCE loop** ⑬a with the <SAVE> - <ENTER> keys, continue to the **tdEF** parameter with the <FUNCTION> key.
- ⑭ Enter a **tdEF** value if required, acknowledge with the <FUNCTION> key and/or continue to the next function.
- ⑮ **Strt** - a **SEQUENCE** start address is requested.
- ⑯ If required, select a start address with the <↓> or the <↑> key, acknowledge with the <FUNCTION> key and/or continue to the next function.
- ⑰ **StoP** - a **SEQUENCE** stop address is requested.
- ⑱ If required, select a stop address with the <↓> or the <↑> key, acknowledge with the <FUNCTION> key and continue to the next function.
- ⑲ **rEP** - Number of **SEQUENCE** repetitions is requested.
- ⑳ If required, select the number of repetitions with the <↓> or the <↑> key, acknowledge with the <FUNCTION> key and continue to the next function.
- ㉑ **Seq Go** blinks at the display and indicates that the **SEQUENCE** can now be started.
- ㉒ Press the <ENTER> key. The sequence is run with the selected values.

The display can always be returned from the **Uset / Iset** setting to the previously configured parameter by pressing the <FUNCTION> key. Otherwise, pressing the <FUNCTION> key advances the display from one function to the next.

The key combination <FUNCTION> and <↑> returns the display to the previous function.

The **LOKked/SEQ** LED blinks during execution of the **SEQUENCE**.

The example shown here is only one possible procedure for the reliable creation of a **SEQUENCE**. The user is free to use other procedures which may be easier for his specific application.

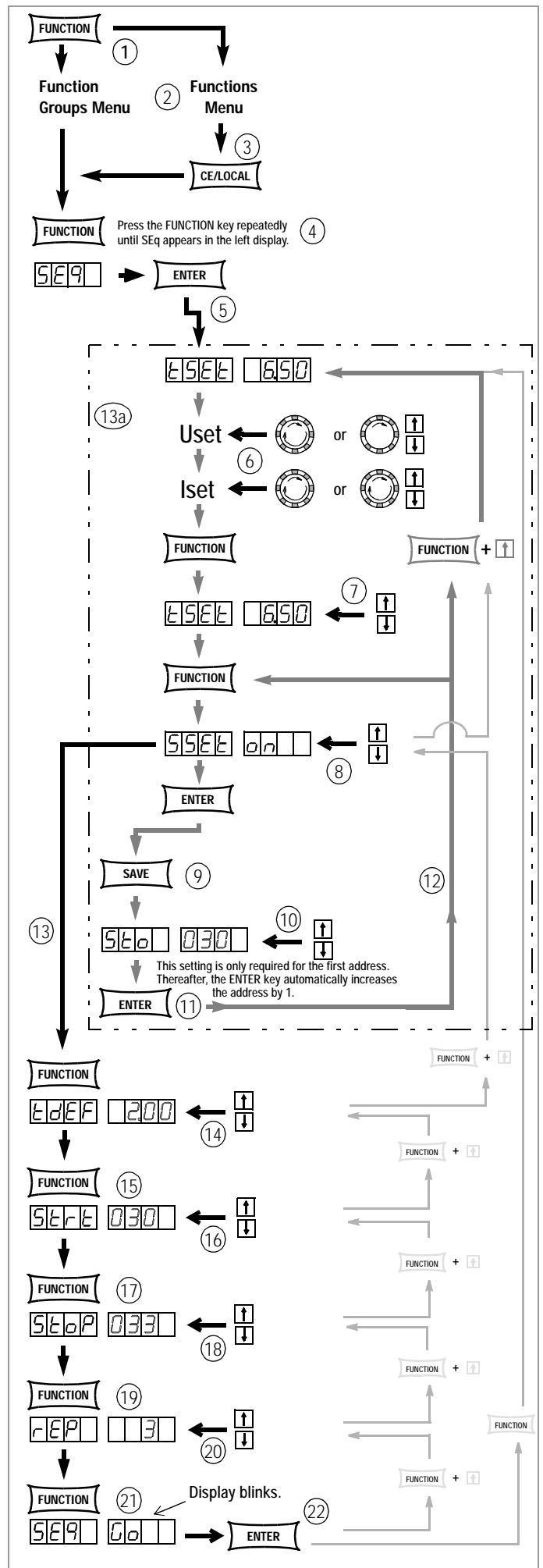


Figure 4.2.3.8 Setting all Required Values for a SEQUENCE

4.2.3.9 Possible Error Messages after SEQUENCE Start

After the SEQUENCE has been started, various error messages may occur, which are displayed for approximately 1 second.

Err 21: Selected **Uset** and **Iset** values exceed their currently valid soft-limits **Ulim** or **Ilim** at least once within the sequence from start to stop address. SEQUENCE execution is aborted.

Err 22: The range of addresses from the start to the stop address contains empty locations only. SEQUENCE execution is aborted.

Err 20: Warning: The SEQUENCE will be started, but automatic activation of the power output with a trigger signal from the analog interface in the **T_MODE OUT** operating mode is disabled.

If an error occurs, bit 5 (SEQE, SEquence Error) is set in event register B (ERB) (see chapter 6.3).

4.2.3.10 SEQUENCE Monitoring

Function

! The following parameters can be viewed in the display menu while the SEQUENCE is running, or during a pause:

- > **Pout** = max. output power
- > **U₋** = min. output voltage
- > **U₊** = max. output voltage
- > **I₋** = min. output current
- > **I₊** = max. output current
- > **rcl** = current memory location address
- > **reP** = number of remaining repetitions
- > **Uset** = current output voltage
- > **Iset** = current output current
- > **tSet** = execution time for the current address (**tSet** or **tdEF**), remaining time is not displayed
- > **SSEt** = SSEt switching function output level

Monitoring the SEQUENCE

- ☞ Press the <SELECT> key and scroll through the display menu.
- ☞ See chapter 4.3 for additional information.

4.2.3.11 Premature SEQUENCE Abort (StoP)

Function

- ! A SEQUENCE can be aborted at any time while it is running, or during a pause.
- ! The abort function jumps immediately to the stop address.
- ! The output status is determined by the contents of the stop address, i.e. **OUTPUT ON** with output values or **OUTPUT OFF**.

Aborting the SEQUENCE

- ☞ Simultaneously press the <ENTER> and the <CE/LOCAL> keys!

4.2.3.12 Interrupting the SEQUENCE (pause)

Function

- ! A running SEQUENCE can be interrupted for an indeterminate period of time.
- The overall device settings maintain the values which are defined by the contents of the current memory address.
- The output may be active or inactive depending upon settings.
- During interruption, the SEQUENCE can be **resumed** as of the next memory location, **aborted** or **restarted**.

Interrupting the SEQUENCE (Pause)

- ☞ Press the <ENTER> key during SEQUENCE execution.
- ! No reaction occurs until the key is released.
- ! The SEQUENCE is **interrupted** at the corresponding location.
- ! "SEq cont" blinks at the display during the pause.

Resuming the SEQUENCE after a Pause

- ! The SEQUENCE is in the pause mode: **SEq cont**.
- ☞ Press the <ENTER> key.
- ! No reaction occurs until the key is released.
- ! The SEQUENCE is now resumed at the next location.
- ! Selected dwell time is not taken into consideration.
- ! In the case of very long dwell times, premature advancing to the next memory location can be achieved by **activating the <ENTER> key twice**.

Aborting the SEQUENCE (SEq StoP)

- ! The SEQUENCE is in the pause mode: **SEq cont**.
- ☞ Press the <↑> key. "SEq StoP" blinks at the display.
- ☞ Press the <ENTER> key.
- ! The SEQUENCE is **aborted**. The output status is determined by the contents of the stop address.

Restarting the SEQUENCE (SEq Go)

- ! The SEQUENCE is in the pause mode: **SEq cont**.
- ☞ Press the <↓> key. "SEq Go" blinks at the display.
- ☞ Press the <ENTER> key.
- ! The SEQUENCE is restarted.

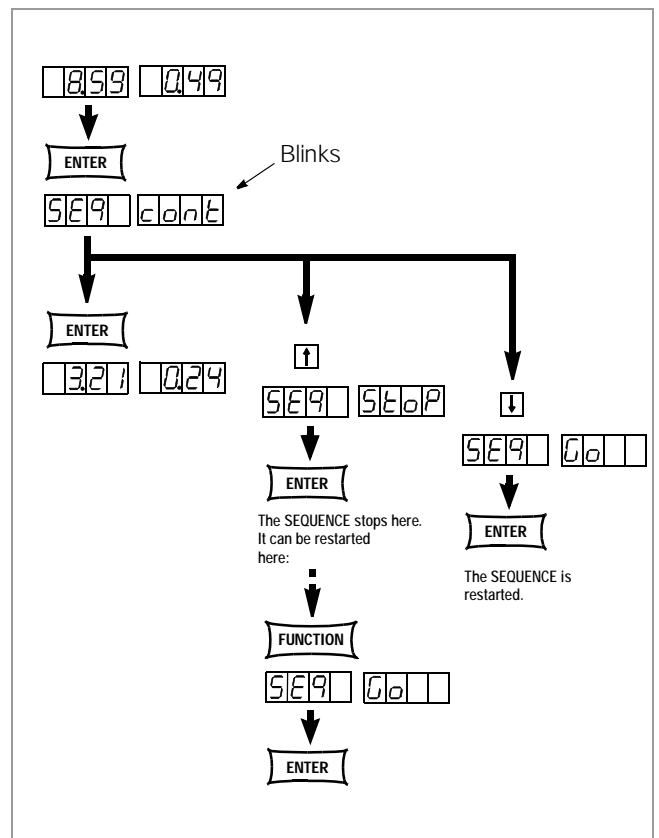


Figure 4.2.3.12 SEQUENCE Pause Mode Settings

4.2.3.13 Inserting New Settings to an Existing SEQUENCE

Function

- ! SEQUENCES can be **expanded** with memory locations 11 through 200.
- ! Insert the corresponding number of memory locations with the respective data.
- ! The addresses of previously programmed memory locations are increased by 1 as of the selected location.
- ! All **data** from locations **beyond address 200** are **lost**.
- ! No insertion is possible within the memory location range of **201 to 253**: the contents of these locations can only be **overwritten**.

Procedure

- ☞ Select all of the necessary settings for **Uset**, **Iset**, **tSet** and **SSet**.
- ☞ Press the **<SAVE>** key.
- ! **Sto** and the last selected address appear at the display.
- ☞ Select the desired address with the **<↓>** or the **<↑>** key.
- ☞ Press and **hold** the **<SAVE>** key, and press the **<↑>** key **simultaneously**.
- ! An **i** for **insert** appears in the right-hand display next to the selected register number.

SEb 0300 ← i

- ☞ Press the **<ENTER>** key in order to insert the new settings.
- ! The data are stored to the currently selected memory location.

4.2.3.14 Deleting an Individual SEQUENCE Register

Function

- ! A complete data record can be deleted from a memory location.
- ! The **SEQUENCE** is thus shortened by one memory location.
- ! Data as of the selected address are overwritten by data from the following address (#11 to #200).
- ! Empty memory locations are thus created at the corresponding position.

Procedure

- ☞ Activate the **SEQUENCE** function.
- ☞ Press the **<SAVE>** key.
- ! **Sto** and the last selected address appear at the display.
- ☞ Select the desired address with the **<↓>** or the **<↑>** key.
- ☞ Simultaneously press the **<SAVE>** and the **<↓>** keys.
- ! A **d** for **delete** appears in the right-hand display next to the selected register number.

SEb 030d

- ☞ Press the **<ENTER>** key to delete.
- ! The address number of all registers as of the selected position are reduced by 1.

4.2.4 Interface Configuration Function Group

buS

The KONSTANTER can be set up for data transmission to a PC with the interface configuration function group. All of the settings which had previously been selected with DIP switches are made via software in this case. Communication is accomplished via the serial interface (RS 232), or with the (optional) parallel interface (IEEE 488).

4.2.4.1 Addr – Setting the Device Address

- In order to assure correct functioning of the SSP-KONSTANTER at the IEC bus in combination with other devices and the computer, an address must be assigned.
- If the KONSTANTER receives its own address from the computer, it interprets subsequent data and executes the commands.
- If the computer transmits an extraneous address, all of the following data are ignored until the KONSTANTER once again receives its own address.

Procedure

- ☞ **Procedure** for selecting an **Addr**:
See chapter 4.2 - **Procedure**.
- ☞ Press the **<FUNCTION>** key to display the **FUNCTION** menu.
- ! The display automatically jumps to the last configured function or function group.
- ☞ If required, select **buS** interface configuration by pressing the **<FUNCTION>** key, or the **<FUNCTION>** key and the **<↓>** or **<↑>** key.
- ! **buS** appears at the left-hand display.
- ☞ Press the **<ENTER>** key in order to acknowledge.
- ! The **buS** functions menu is now active.
- ☞ Select the **Addr** function by pressing the **<FUNCTION>** key, or the **<FUNCTION>** key and the **<↓>** or **<↑>** key.
- ! **Addr** appears at the left-hand display, and the last configured parameter appears at the right-hand display.
- ☞ Select an address for the SSP-KONSTANTER with the **<↓>** or the **<↑>** key.
- ! Any address between 0 and 31 can be selected.
- ! The selected address must coincide with the address selected at the computer for the SSP-KONSTANTER.
- ! Address 0 is usually used for the controller.
- ! Address 31 means unL (unlist).
- ☞ Acknowledge the setting with the **<ENTER>** key.
- ! After acknowledgement with the **<ENTER>** key, the display is returned to the functions menu.

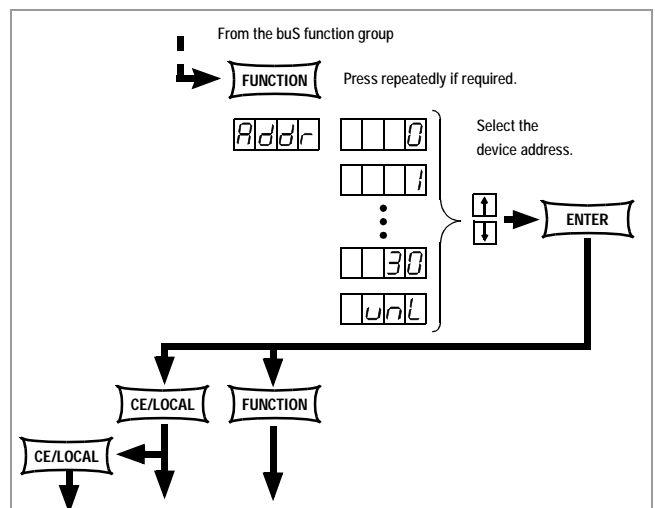


Figure 4.2.4.1 Path to Device Address Setting

4.2.4.2 bAud – Selecting a Transmission Speed

- Indicates transmission speed in bits per second.
- The baud rate is a serial interface operating parameter.
- A low baud rate should be selected if communicating devices are separated by great distances, and in EMC critical environments.
- Settings at the SSP-KONSTANTER and the controller must be identical.
- One of the following baud rates can be selected:
50, 75, 150, 200, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600 or 19,200 bits per second.

Procedure

- ☞ Procedure for setting the **bAud** rate:
See chapter 4.2 - Procedure.
- ! **bAud** and a corresponding parameter (transmission speed) appear in the **buS** function display.

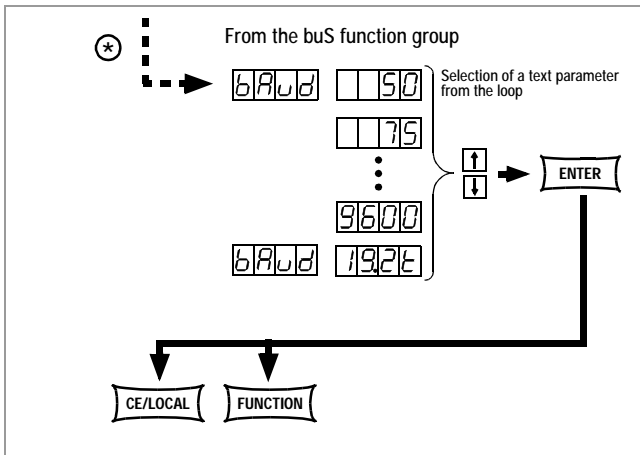


Figure 4.2.4.2 Path to **bAud** Text Parameter Settings

- ☞ Select the desired parameter setting with the <↓> or the <↑> key.
- ! Parameter selections are displayed in a continuous loop.
- ☞ Acknowledge your selection with the <ENTER> key.
- ☞ Continue to the next parameter in the **buS** functions menu by pressing the <FUNCTION> key, or by pressing and holding the <Function> key and activating the <↓> or the <↑> key, or return to the **FUNCTION** menu with the <CE/LOCAL> key.

4.2.4.3 dbit – Selecting the Number of Data Bits

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

Procedure

- ☞ Procedure for selecting **dbit**:
See chapter 3.2 - Procedure.
- ! **dbit** and a corresponding parameter (data bits) appear at the **buS** function display.
- ☞ Select the desired parameter setting with the <↓> or the <↑> key.
- ! Parameter selections are displayed in a continuous loop
- ☞ Acknowledge your selection with the <ENTER> key.
- ☞ Continue to the next parameter in the **buS** functions menu by pressing the <FUNCTION> key, or by pressing and holding the <Function> key and activating the <↓> key or the <↑> key, or return to the **FUNCTION** menu with the <CE/LOCAL> key.

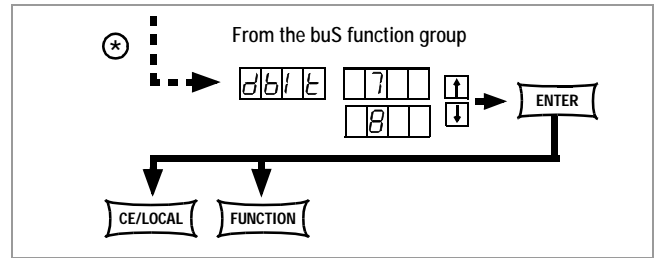


Figure 4.2.4.3 Path to **dbit** Text Parameter Settings

4.2.4.4 Pbit – Configuring the Parity Bit

- Parity bits are used to recognize transmission errors.
- They are added to the characters so that the sum of H or L is even or odd, depending upon definition.
- One of the following configurations can be used for the parity bit:

nonE	no parity bit
ZErO	always 0
EVEn	even parity
odD	odd parity
onE	always 1

- ! A parity bit should be used in any event in EMC critical environments.
- ! Settings at the SSP-KONSTANTER and the controller must be identical.

Procedure

- ☞ Procedure for configuring the **Pbit**:
See chapter 4.2 - Procedure.
- ✓ **Pbit** and a corresponding parameter (parity bit) appear at the **buS** function display.
- ☞ Select the desired parameter setting with the <↓> or the <↑> key.
- ! Parameter selections are displayed in a continuous loop.
- ☞ Acknowledge your selection with the <ENTER> key.
- ☞ Continue to the next parameter in the **buS** functions menu by pressing the <FUNCTION> key, or by pressing and holding the <Function> key and activating the <↓> or the <↑> key, or return to the **FUNCTION** menu with the <CE/LOCAL> key.

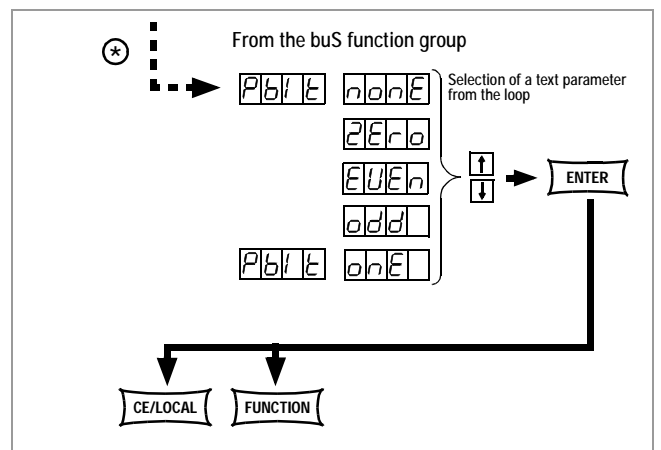


Figure 4.2.4.4 Path to **Pbit** Text Parameter Settings

4.2.4.5 Sbit – Selecting the Number of Stop Bits

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

Procedure

- ☞ Procedure for selecting Sbit:
See chapter 4.2 - Procedure.
- ! Sbit and a corresponding parameter (stop bit) appear at the buS function display.
- ☞ Select the desired parameter setting with the <↓> or the <↑> key.
- ! Parameter selections are displayed in a continuous loop
- ☞ Acknowledge your selection with the <ENTER> key.
- ☞ Continue to the next parameter in the buS functions menu by pressing the <FUNCTION> key, or by pressing and holding the <Function> key and activating the <↓> or the <↑> key, or return to the FUNCTION menu with the <CE/LOCAL> key.

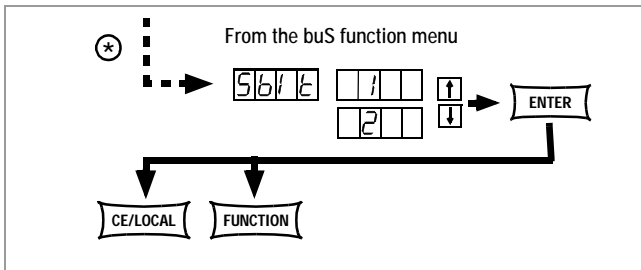


Figure 4.2.4.5 Path to Sbit Text Parameter Settings

4.3 Settings with the <SELECT> Key

The <SELECT> key is located on the front panel next to the <FUNCTION> key. It can be used to activate various functions, depending upon the setting in FUNCTION menu 3:

4.3.1 Basic Functions (Uout and Iout displays)

The 7 segment display can be switched 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

- The first time the **SELECT** key is activated, the last selected parameter name appears at the left-hand display, and the corresponding value appears at the right-hand display.
- The second time the **SELECT** key is activated, the next parameter name is displayed along with its corresponding value etc.
- The **SELECT** key display mode can be interrupted:
 - ☞ By briefly turning one of the rotary pulse encoders [5] or [8]
 - ☞ By pressing the **CE/LOCAL**, **SAVE**, **RCL** or the **FUNCTION** key

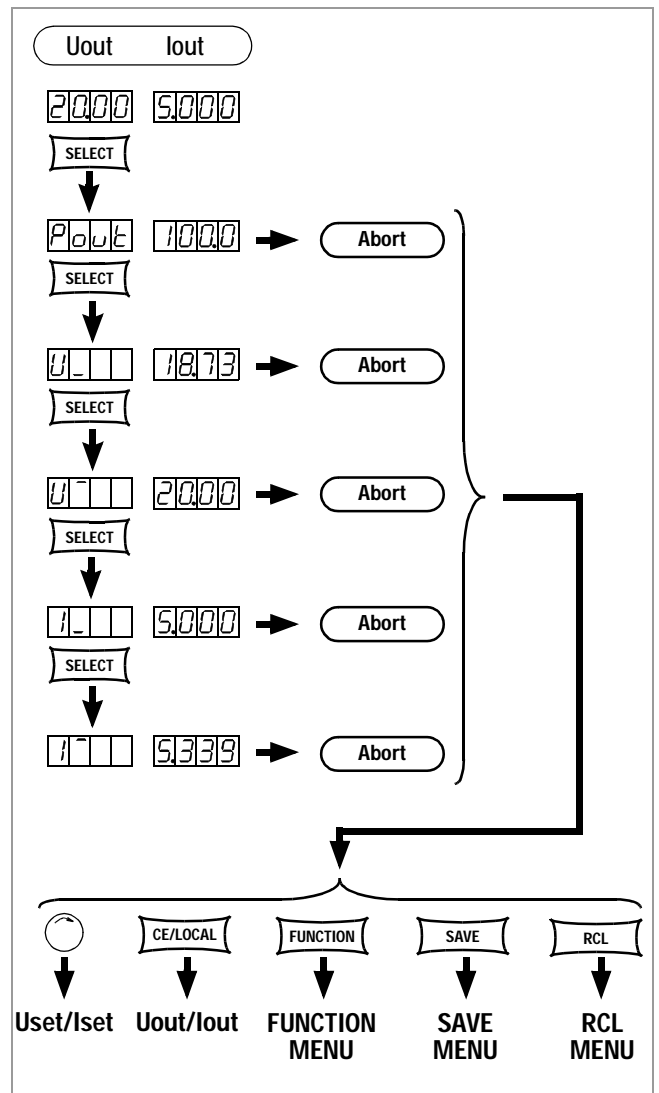


Figure 4.3.1 Setting Basic Functions with the SELECT Key

4.3.2 With Active SEQUENCE Function

The **SELECT** menu is expanded when the **SEQUENCE** function is active. It makes no difference whether the **SEQUENCE** is **running** or in the **PAUSE** mode.

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
rclL	Exzeß	current address, memory location no.
reP	Exzeß	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 the current address, no remaining time
Sset	txt	Sset switching function output level

Otherwise, the same functions can be executed as described in chapter 3.3.1.

4.3.3 Resolution

Numeric parameters can be set with varying degrees of accuracy. Shift the cursor position within the display as desired to this end. The current cursor position is indicated by blinking at the respective decimal place.

Resolution can be set for the following parameters:

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

Procedure

- ☞ Select the parameter.
- ! The parameter value display blinks at the last selected decimal place.
- ☞ Press the **<SELECT>** key. The cursor (blinking decimal place) is shifted one position to the left.
- ☞ Repeatedly press the **<SELECT>** key until the cursor is situated at the desired position (resolution).
- ☞ Set the parameter value to the selected resolution with the **<↓>** or the **<↑>** key.!

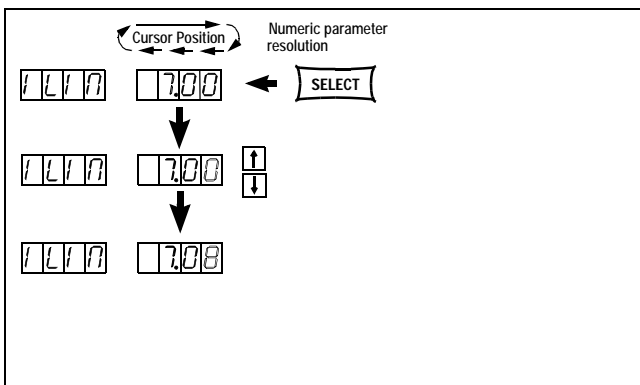


Figure 4.3.3 Setting Control Resolution with the SELECT Key

4.4 Settings with the <SAVE> Key

The **<SAVE>** key is located at the left side the front panel in the second row of the keypad underneath the **<FUNCTION>** key. It makes the following functions available:

- Save device settings to memory
- Save data to a memory location
- Delete all data from memory locations 11 through 200
- Insert additional data to a SEQUENCE
- Delete an individual SEQUENCE register

4.4.1 Saving Device Settings to Memory

- Device settings can be stored to memory locations 1 through 10, from which they can be recalled at any time.
 - Settings are stored to battery-backed memory.
- All settings for the following parameters can be saved to these locations:

Uset/Iset	OVset	Tset
OCp	Tdef	Sset
DELAY	START	OUTPUT
MINMAX	STOP	Ulim
REPETITION	Ilim	SEQ

Procedure

- ☞ Select values for the desired parameters.
- ☞ Press the **<SAVE>** key.
- ! Sto appears at the left-hand display, and the last selected register number appears at the right-hand display.
- ☞ Select the desired memory location address (from 1 to 10) with the **<↓>** or the **<↑>** key.
- ☞ Press the **<ENTER>** key in order to acknowledge.
- ☞ Exit the **SAVE** function by pressing the **<CE/LOCAL>** key.
- ☞ Activate the desired function by pressing the **<FUNCTION>**, the **<SELECT>** or the **<RCL>** key, or by briefly turning the current or the voltage rotary pulse encoder.

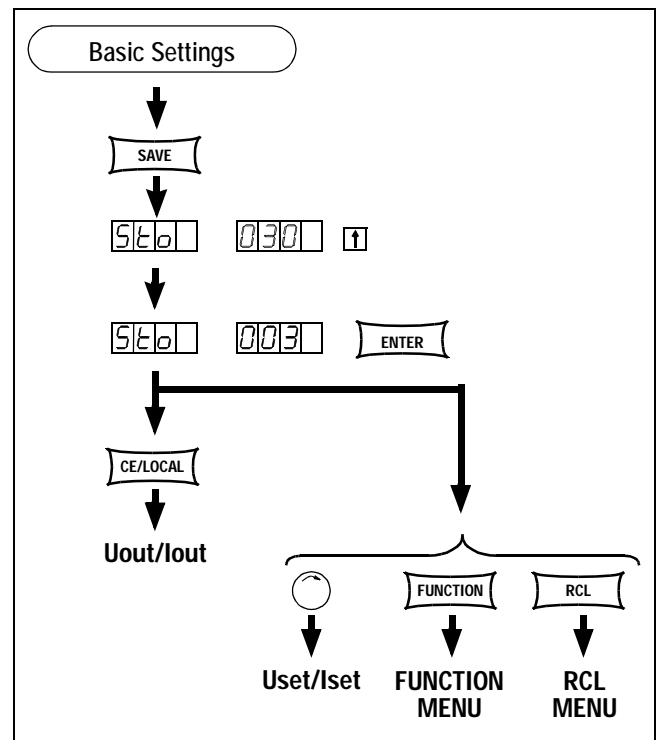


Figure 4.4.1 Saving Device Settings

4.4.2 Saving Data to a Memory Location

Function

- SEQUENCE data can be stored to memory locations 11 through 253.
- Data are stored to battery-backed memory.
- Data can be saved for the parameters Uset, Iset, Tset and Sset.

Procedure (see chapter 4.2.3.8)

- ☞ Activate the SEQUENCE function.
- ☞ Select values for the desired parameters.
- ☞ Press the <SAVE> key.
- ! Sto appears at the left-hand display, and the last selected register number appears at the right-hand display.
- ☞ Select the desired memory location address (from 11 to 253) with the <↓> or the <↑> key.
- ☞ Press the <ENTER> key in order to acknowledge.

4.4.3 Deleting All Data from Locations 11 to 200

Function

- All SEQUENCE data is entirely deleted.

Procedure

- ☞ Press the <SAVE> key.
- ☞ Select memory location 0 (clr) with the <↓> or the <↑> key.
- ☞ Press the <ENTER> key.
- ! clr dAtA blinks at the display.
- ☞ Press the <ENTER> key in order to acknowledge.
- ! Memory locations 11 through 200 are cleared.
- ! The following default parameters are also set automatically: REPETITION = 0, START = 011, STOP = 011
- ! The deletion process can be aborted at any time by pressing the <CE/LOCAL> key.

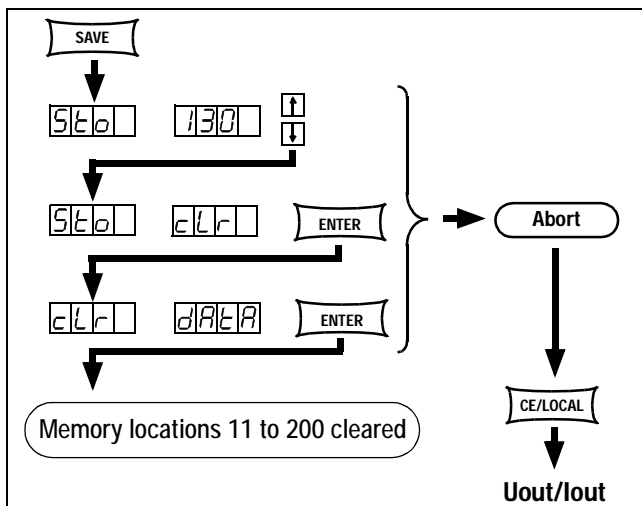


Figure 4.4.3 Deleting All Data from Memory Locations 11 to 200

4.4.4 Inserting Additional Data to a SEQUENCE

Function

- Insertion is only possible to memory locations 11 through 200.
- Existing SEQUENCES can be expanded as desired.
- Insert the appropriate number of memory locations along with the respective data to this end.
- The addresses of previously programmed memory locations are increased by 1 as of the selected location.
- All data from locations beyond address 200 are lost.

Procedure

- ☞ Activate the SEQUENCE function as described in chapter 4.2.3.7.
- ☞ Select all necessary values for Uset, Iset, tSet and SSet.
- ☞ Press the <SAVE> key.
- ! Sto and the last selected address appear at the display.
- ☞ Select the desired address with the <↓> or the <↑> key.
- ☞ Simultaneously press the <SAVE> and the <↑> keys.
- ! An i for insert appears next to the selected register number in the right-hand display.
- ☞ Press the <ENTER> key in order to insert the new data.
- ! The data are stored to the currently selected memory location.
- ! All location addresses above the selected position are increased by 1.

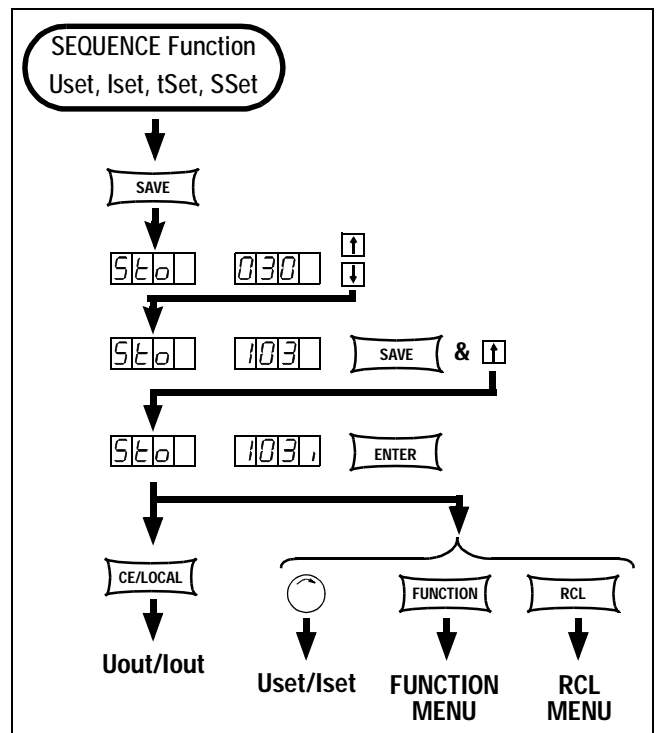


Figure 4.4.4 Inserting Additional Data to a Sequence

4.4.5 Deleting an Individual SEQUENCE Register

Function

- Entire memory locations can be deleted along with their data content (locations 11 through 200).
- The **SEQUENCE** is shortened accordingly.
- Data as of the selected address are overwritten by data from the following address.
- Empty memory locations are thus created at the corresponding position.

Procedure

- ☞ Activate the **SEQUENCE** function as described in chapter 4.2.3.7.
- ☞ Press the **<SAVE>** key.
- ! **Sto** and the last selected address appear at the display.
- ☞ Select the desired address with the **<↓>** or the **<↑>** key.
- ☞ Simultaneously press the **<SAVE>** and the **<↓>** keys
- ! A **d** for delete appears next to the selected register number in the right-hand display.
- ☞ Press the **<ENTER>** key in order to delete the location.
- ! The address numbers of all registers as of the selected position within the range of 11 to 200 are reduced by 1.

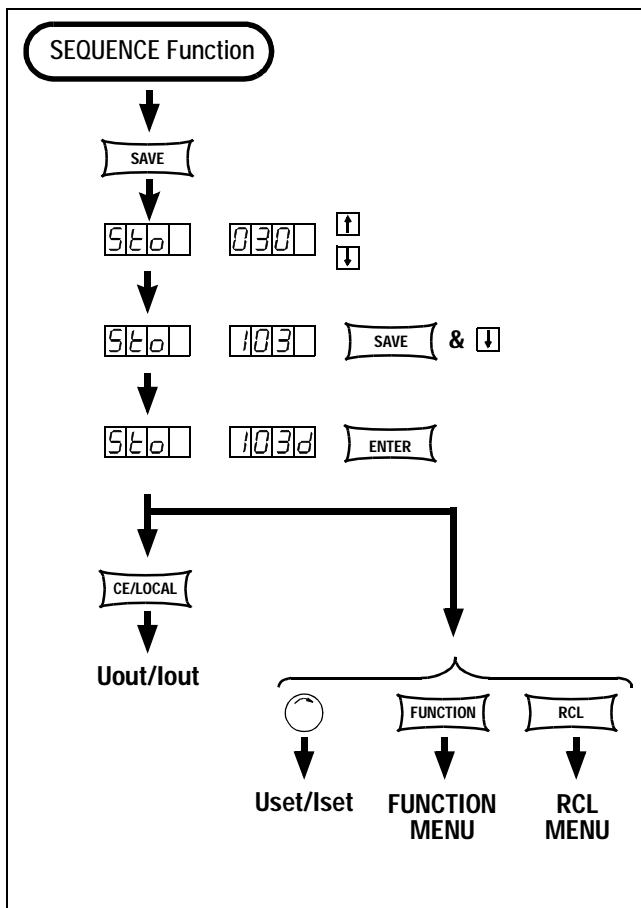


Figure 4.4.5 Deleting an Individual SEQUENCE Register

4.4.6 Disabling the Front Panel

The control elements at the front panel can be disabled in order to prevent inadvertent modification of configured parameters and values.

Procedure

- ☞ Simultaneously press the **<CE/LOCAL>** and **<SAVE>** keys.
- ! The control elements at the front panel are now disabled.
- ! The yellow **"LOCKED/SEQ"** LED is illuminated.
- ☞ Press the **<CE/LOCAL>** key three time to enable the controls.
- ☞ The **<CE/LOCAL>** key can also be disabled by applying a signal to the trigger input at the analog interface, and with appropriate configuration of the **T_MODE** function. Reactivation of the front panel controls can thus be prevented.

4.5 Settings with the <RCL> Key

- All of the device settings saved with **<SAVE>** or **"STORE"** can be recalled with the **<RCL>** key, e.g. in order to configure a new device.
- The memory is battery-backed and is thus capable of **configuring** new devices.
- Empty registers are identified as follows: **"----" "-----"**: no data can be loaded to these registers. **"ERR 24"** appears briefly at the display, and bit 5 in event register B is set.
- RCL** can also be controlled via the analog interface (see chapters 4.2.2.1 and 5.7).

4.5.1 Recall from the SETUP Memory

Addresses 1 to 10, each with complete basic device settings.

USET	OVset	OCp	START
ISET	Ulim	DELAY	STOP
Tset	Ilim	MINMAX	REPETITION
Sset	OUTPUT	Tdef	

Procedure

- ☞ Press the **<RCL>** key
- ! **rcl** appears in the left-hand display, and the last selected register number appears in the right-hand display.
- ☞ Select the desired address (between 1 and 10) by pressing the **<↓>** or the **<↑>** key.
- ☞ Press the **<ENTER>** key.
- ! The **Iset** and **Uset** values stored to this address blink at the display.
- ☞ Scroll through the register with the **<SELECT>** key.
- ☞ All of the data from the register can be loaded as a basic device setting by pressing the **<ENTER>** key a second time.
- ☞ The recall function can be aborted by pressing the **<CE/LOCAL>** key
- ☞ Press the **<RCL>** key to return to the register selection function.
- ☞ **RECALL** can be exited by activating any other key, or either of the rotary pulse encoders.

4.5.2 Recall from the SEQUENCE Memory

Addresses 11 to 253: Uset, Iset, tSEt and SSEt values for the SEQUENCE function

- ! Data from locations 11 through 253 can be recalled at any time during programming.
- ☞ rcl appears in the left-hand display, and the last selected register number appears in the right-hand display.
- ☞ Select the desired address (between 11 and 253) by pressing the <↓> or the <↑> key.
- ☞ Press the <ENTER> key after the desired register has been selected
- ! The Iset and Uset values stored to this address blink at the display.
- ☞ Scroll through the register with the <SELECT> key.
- ☞ All of the data from the register can be loaded by pressing the <ENTER> key a second time.
- ! If one of the recalled parameter settings (Uset or Iset) exceeds currently valid soft-limits (Ulim or Ilim), 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.
- ☞ A new memory location can be selected immediately with the <↓> or the <↑> key, while the previous function is being executed!
- ☞ The **RECALL** function can be aborted with the <CE/LOCAL> key.
- ☞ Press the <RCL> key to return to the register selection function.
- ☞ **RECALL** can be exited by activating any other key, or either of the rotary pulse encoders.

4.6 The <ENTER> Key

The <ENTER> key executes specific functions depending upon the respectively selected operating mode.

4.6.1 <ENTER> Key Functions

Uout/Iout

Switch to **Uset/Iset** display and data entry. Entered data must be acknowledged by pressing the <ENTER> key a second time.

Uset/Iset

Uset and Iset LEDs are continuously illuminated:
Shift cursor back and forth between Uset and Iset, e.g. in order to set resolution.

Uset or Iset LED blinks:

The selected value becomes effective as the Uset or Iset setpoint value (EXECUTE).

<SAVE> Function

Save data to the selected address.

<RCL> Function

Recall data which has been stored to the selected address. The respective data blink at the display after pressing the <ENTER> key once, and are executed after pressing the <ENTER> key a second time.

<FUNCTION> Groups

Function group selection:

Switch from function group selection to function selection.

Text parameter

Acknowledge the selected text parameter.

<SEQUENCE>

Status RUN: --> Pause

Status PAUSE: --> Run

4.6.2 RESET Device Settings

Most device functions can be restored to defined default values with the reset command.

- ☞ First press the <CE/LOCAL> key, and then the <ENTER> key.

4.7 The <CE/LOCAL> Key

The <CE/LOCAL> key executes specific functions depending upon the respectively selected operating mode.

4.7.1 Status

RESET Device Settings

- ✎ <CE/LOCAL> and <ENTER> keys:
The KONSTANTER is reset to its basic configuration.

Disable Front Panel

- ✎ <CE/LOCAL> and <SAVE> keys: (LOCKED/SEQ LED lights up).

Enable Front Panel

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

Switch from REMOTE to LOCAL

- ✎ <CE/LOCAL> key
Switch from REMOTE control to LOCAL (manual operation).

Switch Display to Uout / Iout

Uset / Iset Data Entry

- ✎ <CE/LOCAL> key
Switch to measured value display for Uout and Iout.

<SELECT> Display

- ✎ <CE/LOCAL> key
Switch to measured value display for Uout and Iout.

<SAVE> / <RCL> Function

- ✎ <CE/LOCAL> key
Exit <SAVE> or <RCL> function, switch to measured value display for Uout and Iout.

4.7.2 FUNCTION

Function Group Selection:

- ✎ <CE/LOCAL> key
Return from function group selection to measured value display for Uout and Iout.

Function Selection

- ✎ <CE/LOCAL> key
Exit function selection, return to higher level function group selection.

Text Parameter

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

4.8 INCR <↑> and DECR <↓> Keys

The INCREMENT and DECREMENT keys execute various functions depending upon settings.

Text Parameter

- <↑> display next parameter
- <↓> display previous parameter

The selected text parameter is acknowledged with the <ENTER> key.

Abort with <CE/LOCAL>, <RCL>, <SAVE>, <FUNCTION>

Numeric Parameter

- <↑> increase parameter value at current cursor position
- <↓> decrease parameter value at current cursor position

The cursor position can be changed with the <SELECT> key. The selected text parameter is acknowledged automatically.

Exception:

If selection of Uset and Iset with the <↑> and <↓> keys has been initiated with the <ENTER> key, the selected values must also be acknowledged with the <ENTER> key.

Display Function

The next or previous display function can be selected from within the SELECT menu. Only the <↑> or the <↓> key needs to be activated.

Address

- <↑> select the next memory address
- <↓> select the previous memory address

This operation may also be executed in the background, if an address has been selected via RCL.

<FUNCTION> and <↑> / <↓>

Switch to the next, or the previous function or function group.

<SELECT> and <↑> / <↓>

Select the next or the previous display function.

5 Control via the Analog Interface

5.1 Connector 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

See chapter 5.2 for detailed description.

TRG IN+, TRG IN- (input)

- Floating digital control input for the control of a device function defined by trG txt.
- Low signal: $-26\text{ V} \leq U_s \leq +1\text{ V}$
- High signal: $+4\text{ V} \leq U_s \leq +26\text{ V}$,
 $I_s = (U_s - 2\text{ V}) / 1.5\text{ k}\Omega$

See chapter 5.3 for detailed description.

+ 15 V (output)

- This auxiliary voltage output (15 ... 17 V DC with reference to AGND) can be used to control the trigger input or to supply external consumers with power (e.g. reference element for the generation of 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 analog control inputs and outputs
- This terminal is internally connected to the minus pole of the power output via an automatically reversing fuse (110 mA rating).

Uset-, Uset+ (Input)

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

$$U_{out} = U_{SET} + U_{su} \cdot k_u$$

U_{out} = output voltage during constant voltage operation

U_{SET} = manually selected voltage setpoint value

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

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

R_{su} = input impedance
Uset +: 10 k Ω
Uset -: 15 k Ω

See chapter 5.4 for detailed description.

Iset+ (input)

- Analog voltage input, with reference to AGND, for controlling output current. The following applies when the output is active:

$$I_{out} = I_{SET} + U_{si} \cdot k_i$$

I_{out} = output current during constant current operation

I_{SET} = manually selected current setpoint value

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

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

R_{si} = input impedance: 10 k Ω

See chapter 5.5 for detailed description.

U-MON (output)

- Analog voltage output, proportional to output voltage U_{out} which is acquired by the sensing leads.
(0 ... 10 V \triangleq 0 ... $U_{out_{nom}}$).
- The output, with reference to AGND, has an internal resistance of 9.8 k Ω and is short-circuit proof.

See chapter 5.6 for detailed description.

I-MON (output)

- Analog voltage output proportional to actual output current I_{out}
(0 ... 10 V \triangleq 0 ... $I_{out_{nom}}$).
- The output, with reference to AGND, has an internal resistance of 9.4 k Ω and is short-circuit proof.

See chapter 5.7 for detailed description.

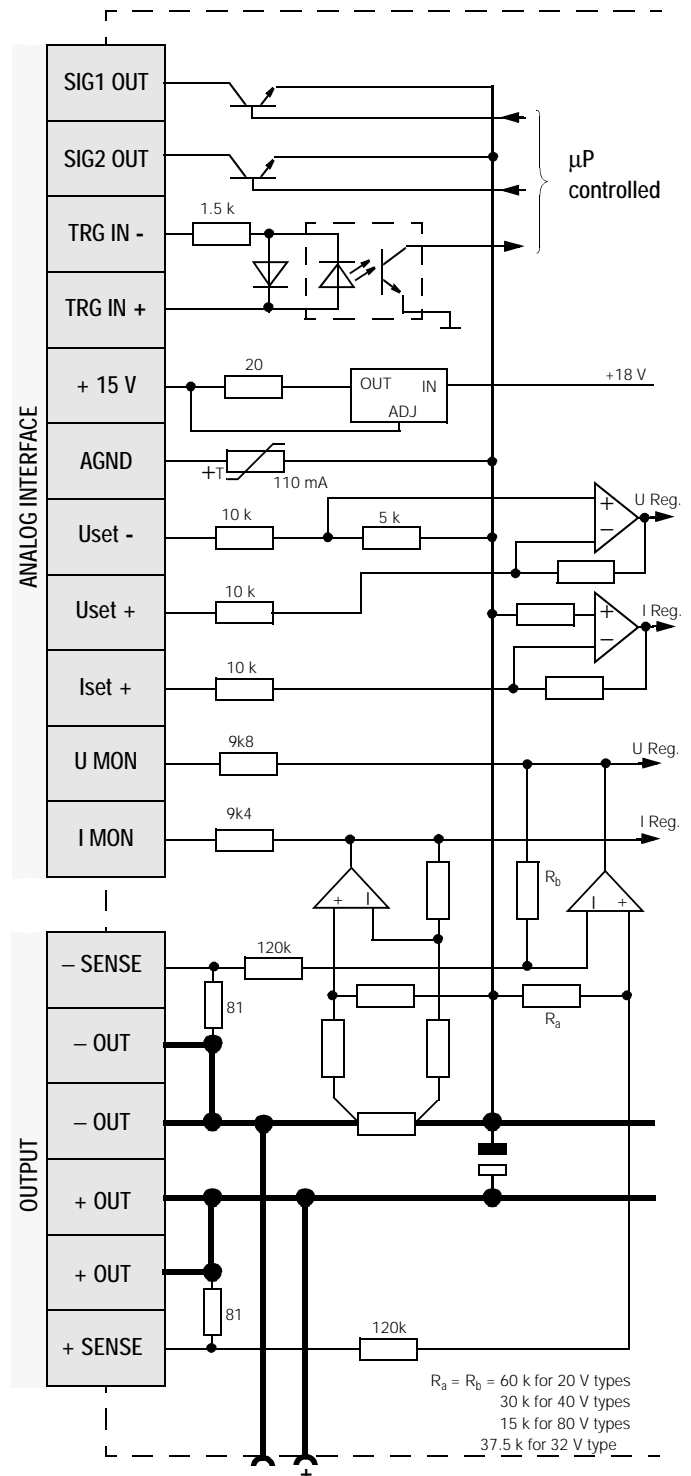


Figure 5.1 Internal connection of the analog interface and the output (simplified schematic)

5.2 Status Signal Outputs

Function

- The KONSTANTER includes two digital open collector outputs with reference to AGND for the generation of status signals: SIG1OUT, SIG2OUT.
- The two signal outputs are independent of one another as regards the device status or the event to be signalled. Selection is accomplished with the function settings for SIG1 and SIG2.

A detailed description is included in chapters 4.2.2.2 and 4.2.2.3 (for manual operation), as well as 6.2.1.18 (for programming).

- As a **message signal** for transmission to monitoring equipment
- For the **control** of external **output relays**

Application

- Triggering of certain device functions can be synchronized by means of connection to the trigger inputs TRG IN of additional KONSTANTERs (see also chapter 5.8.2).

Connection

- Connected load values
Max. switching voltage 30 V DC
Max. switching current 20 mA
- If the signal outputs are to be used for transmitting **message signals** to external monitoring equipment, **pull-up resistors** must be used to generate the required signal levels.

In order to generate an "active high" signal of + 15 V, the status signal outputs can be connected to the +15 V terminal with pull-up resistors with a value of at least 1 k Ω (see figure 5.2).

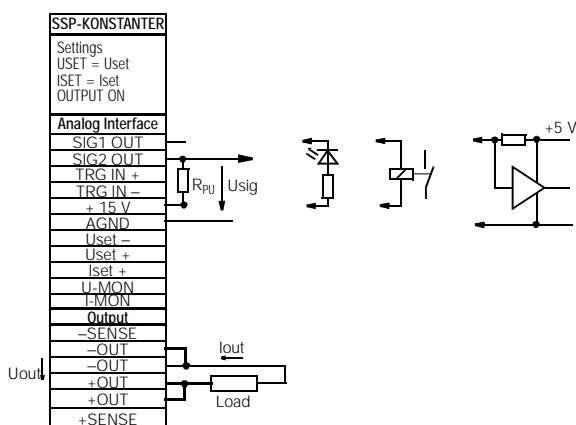


Figure 5.2
Wiring Examples for the
Status Signal Outputs

5.3 Trigger Input

Function

- The **floating optocoupler input TRG IN** allows for **remote control** of a device function with a binary signal.
- Selection of the function to be controlled is accomplished with the **T-MODE** setting (in the trG display).

A detailed description is included in chapters 4.2.2.1 and 6.2.1.22.

Connection

- Connect the control signal between **TRG IN +** and **TRG IN -**. Appropriate signal levels are listed in the following table.

Output	Signal	U_s	I_s
OFF	High	4 ... 26 V DC	$(U_s - 2 \text{ V}) / 1.5 \text{ k}\Omega$
ON	Low	0 ... 1 V DC	0 mA

- The **TRIGGER** can be controlled with the **+ 15 V output** at the analog interface via any desired switch (see figure 5.3 a).

Warning!

Trigger input TRG IN is a floating input and is functionally isolated from the output current circuit. This functional isolation is not to be construed with "protective separation" as set forth in electrical safety regulations.

Note

- The trigger input is sampled by the digital controller approximately every 10 ms. After a signal change has been recognized, repeated sampling ensues at a shorter interval (suppression of contact chatter and spurious pulses). Thus:
 - Trigger signal pulses must have a duration of at least 14 ms in order to be reliably recognized.
 - A delay with a duration of 1 to 15 ms may occur between application of the control signal and triggering of the controlled function.

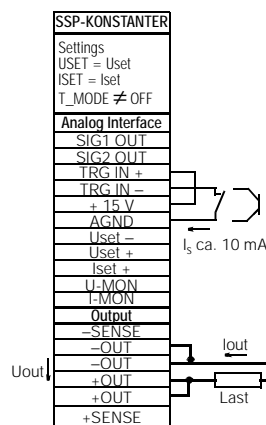


Figure 5.3 a
Controlling the
Trigger Input with
a Switching Element

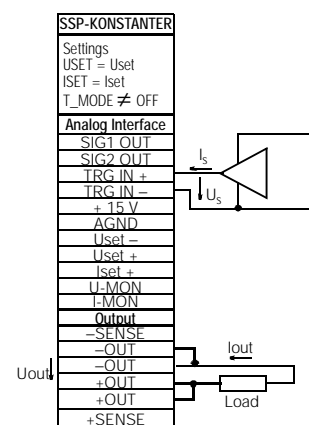


Figure 5.3 b
Controlling the
Trigger Input with
an External Signal

5.4 Controlling Output Voltage

Function

- Output voltage U_{out} can be controlled via control inputs U_{set+} (non-negated) and U_{set-} (negated) with an external control voltage U_{su} .

- The following applies during constant voltage operation:

$$U_{out} = U_{SET} + U_{su} \cdot k_{su}$$

U_{SET} = selected voltage setpoint value

k_{su} = voltage control coefficient = $U_{out_{nom}} / 5 \text{ V}$

Max. setting error: $\pm 0.05\%$ of $U_{nom} \pm 2\%$ of setting value

- The voltage control input is laid out as a differential voltage input:

U_{set+} = non-negated input:

$U_{su} = 0 \dots + 5 \text{ V}$ for $U_{out} = 0 \text{ V} \dots U_{out_{nom}}$,
input impedance: $10 \text{ k}\Omega$

U_{set-} = negated input:

$U_{su} = 0 \dots - 5 \text{ V}$ for $U_{out} = 0 \text{ V} \dots U_{out_{nom}}$,
input impedance $15 \text{ k}\Omega$

Notes

- The **control inputs** are **not floating inputs**, the reference point **AGND** is connected to the **minus pole** of the power output.
- Connecting **grounded current circuits** to the control input may lead to **erroneous settings** due to leakage current or earth loops.
- If control voltage U_{su} is applied to the **output's minus pole** with its **reference point at the load side**, the negated input must be connected to this point (**connection b** in figure 5.4 a).

Influences caused by voltage drops at the load conductor are thus avoided.

- If **control voltage** is electrically **isolated from the output**, connect U_{set-} to **AGND** (**connection a** in figure 5.4 a).
- If **remote control of output voltage** is to be accomplished by means of a **potentiometer**, wiring can be implemented in accordance with figure 5.4 b.
- U_{su} can be applied as an **alternating voltage**, e.g. in order to superimpose the selected direct voltage **USET** with **fault signals**.

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

However, the cut-off frequency remains largely independent of load and the selected current limit thanks to special circuit technology.

Connection

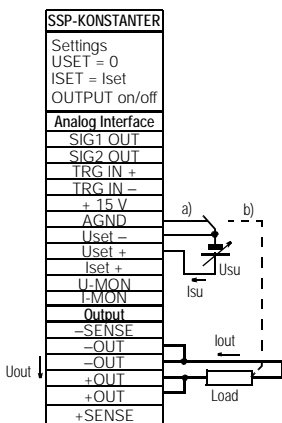


Figure 5.4 a
Wiring for Control of Output Voltage with an External Voltage

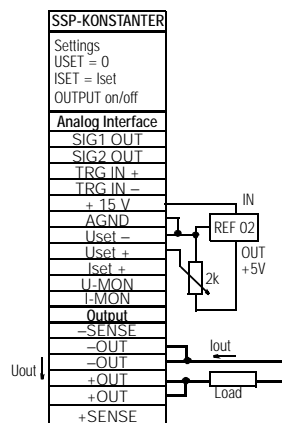


Figure 5.4 b
Wiring for Control of Output Voltage with an External Potentiometer

5.5 Controlling Output Current

Function

- Output current I_{out} can be controlled with an external control voltage U_{si} via the control input I_{set+} .

- The following applies during constant current operation:

$$I_{out} = ISET + U_{si} \cdot k_{si}$$

$ISET$ = selected current setpoint value

k_{si} = current control coefficient = $I_{out_{nom}} / 5 \text{ V}$

Max. setting error: $\pm 0.1\%$ of $I_{nom} \pm 2\%$ of setting value

- Current Control Input

I_{set+} = non-negated input:

$U_{si} = 0 \dots + 5 \text{ V}$ for $I_{out} = 0 \text{ A} \dots I_{out_{nom}}$,

- Input impedance is equal to $10 \text{ k}\Omega$.

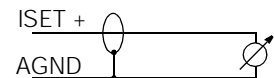
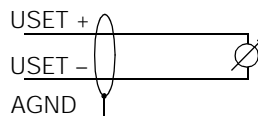
Notes

- The **control input** is **not a floating input**, the reference point **AGND** is connected to the **minus pole** of the power output.
- Connecting **grounded current circuits** to the control input may lead to **erroneous settings** due to leakage current or earth loops.
- Control voltage U_{si} may **not** be connected to the **input's minus pole at the load side**. (see figure 5.5 a)
- If **remote control of output current** is to be accomplished by means of a **potentiometer**, wiring can be implemented in accordance with figure 5.5 b.
- U_{si} can be applied as an **alternating voltage**, e.g. in order to superimpose the selected direct current **ISET** with **fault signals**.

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

Attention!

Control inputs U_{set+} , U_{set-} and I_{set+} should only be connected with shielded cable. Connect the shield to reference point AGND.



Connection

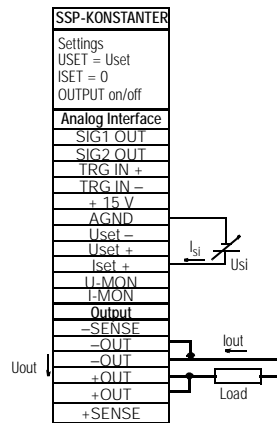


Figure 5.5 a
Wiring for Control of Output Current with an External Voltage

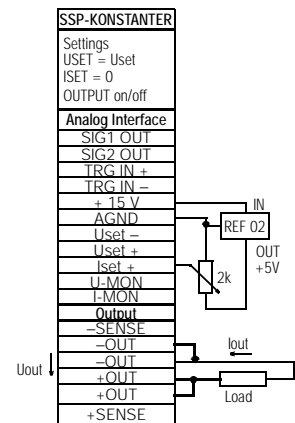


Figure 5.5 b
Wiring for Control of Output Current with an External Potentiometer

5.6 Voltage Monitoring Output

Function

- The U-MON terminal supplies a voltage U_{MU} which is proportional to U_{out} , with reference to AGND.
- U-MON is used as a control voltage for series master-slave connection (see 5.9.2).
- U-MON can also be used for external measuring, monitoring and recording purposes.
- The following applies:

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

$$k_{MU} = 10 \text{ V} / U_{out_{nom}}, \text{ U monitor coefficient}$$

$$R_i (\text{U-MONITOR}) = 9.8 \text{ k}\Omega, \text{ U monitor internal resistance}$$

$$k_{Load} = \frac{R_{Load}}{R_{Load} + 9.8 \text{ k}\Omega} ; \text{ load coefficient}$$

$$R_{Load} = \text{load resistance}$$

Max. error, U_{MU} : $\pm 5 \text{ mV} \pm 1\%$ actual value (where $R_{Load} > 10 \text{ M}\Omega$)

Notes

- U-MON is not a floating output, its reference point AGND is connected to the minus pole of the output.
- Connecting grounded current circuits to the monitoring output may lead to erroneous measurements due to leakage current or earth loops.
- The voltage monitoring output makes reference to output voltage acquired by the sensing leads (see chapter 2.1.3).
- The monitoring output is short-circuit proof. Internal resistance is equal to 9.8 k Ω .

Connection

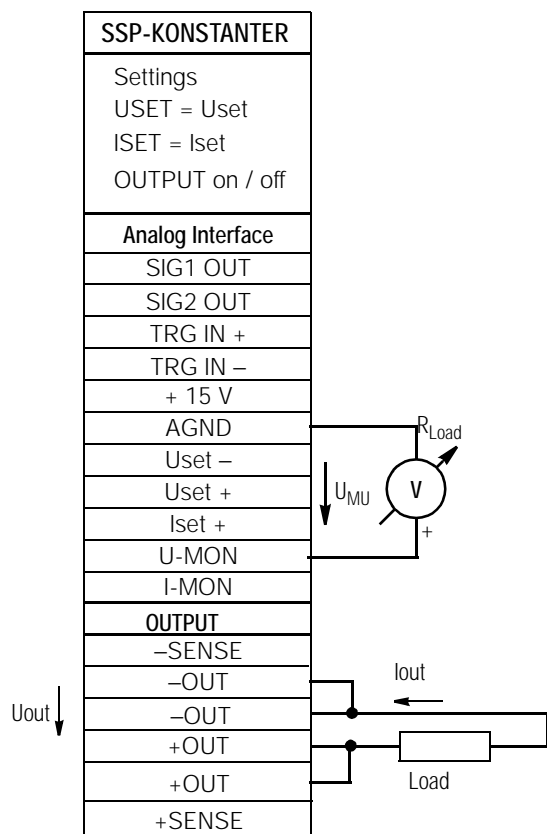


Figure 5.6
Voltage Monitor Wiring

5.7 Current Monitoring Output

Function

- The I-MON terminal supplies a current U_{MI} which is proportional to I_{out} , with reference to AGND.
- I-MON is used as a control voltage for parallel master-slave connection (see 5.8.2).
- I-MON can also be used for external measuring, monitoring and recording purposes.
- The following applies:

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

$$k_{MI} = 10 \text{ V} / I_{out_{nom}}, \text{ I monitor coefficient}$$

$$R_i (\text{I-MONITOR}) = 9.4 \text{ k}\Omega; \text{ I monitor internal resistance}$$

$$k_{Load} = \frac{R_i}{R_i + 9.4 \text{ k}\Omega} ; \text{ load coefficient}$$

$$R_{Load} = \text{load resistance}$$

Max. error, U_{MI} : $\pm 5 \text{ mV} \pm 1\%$ actual value (where $R_{Load} > 10 \text{ M}\Omega$)

Notes

- I-MON is not a floating output, its reference point AGND is connected to the minus pole of the output.
- Connecting grounded current circuits to the monitoring output may lead to erroneous measurements due to leakage current or earth loops.
- The monitoring output is short-circuit proof. Internal resistance is equal to 9.4 k Ω .

Connection

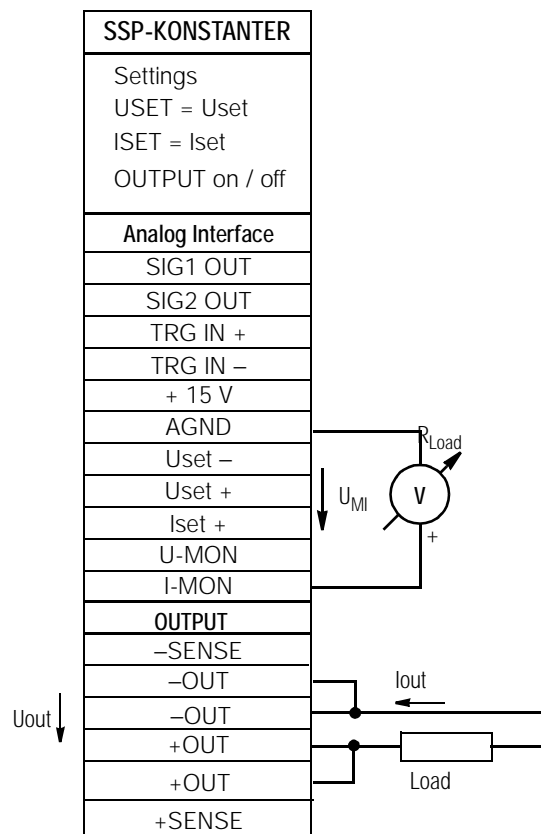


Figure 5.7
Current Monitor Wiring

5.8 Parallel Connection

The outputs of **any number** of KONSTANTERs can be parallel connected if output current from a single KONSTANTER is insufficient for your application.

Attention!

If outputs with different nominal voltage values are parallel connected, all of the outputs must be limited to the lowest nominal voltage value within the system. This setting is accomplished with the ULM parameter.

5.8.1 Direct Parallel Connection

Function

- Simplest way to increase current to the consumer to a level greater than that provided by a single KONSTANTER
- KONSTANTERs with different nominal output voltages can be used. However, all voltage setpoints must be limited to the same value.
- Less suitable for constant voltage operation

Wiring

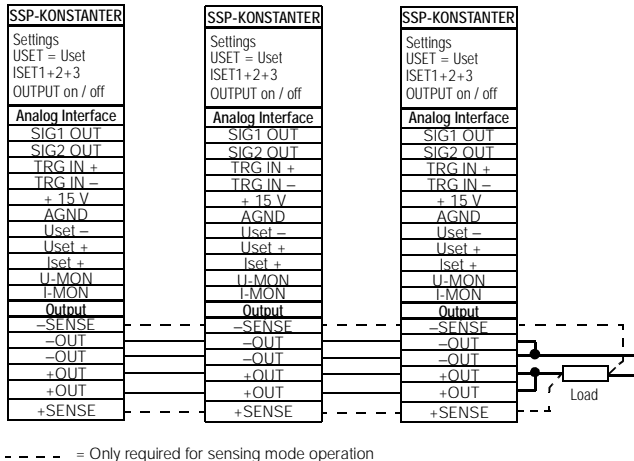


Figure 5.8.1 a
Wiring for Direct Parallel Connection

Procedure

- Deactivate all outputs.
- Adjust voltage setpoint values USET for all parallel connected KONSTANTERs to approximately the same value:
 $USET1 = USET2 = USET3 = USETn$
- Adjust current setpoint values ISET such that the desired cumulative current setpoint value Iset is achieved:
 $Iset = ISET1 + ISET2 + ISET3 + \dots + ISETn$
- Activate the outputs.

Functional Principle

- Immediately after power-up, the KONSTANTER with the highest voltage setting provides the consumer with load current.
- If load resistance is continuously reduced, load current is consistently increased.
- When load current at the initially loaded output reaches the selected setpoint value ISET, current regulating is activated for this output.
- If load resistance is further reduced, current regulating reduces output voltage until the voltage value for the output with the next lowest setting has been reached.
- As of this point in time, the corresponding KONSTANTER supplies a portion of the load current.
- This process continues until load current triggers current regulating at the output with the lowest voltage setting when the cumulative current setpoint value is reached.
- This output maintains constant load current until the load resistor is short-circuited.

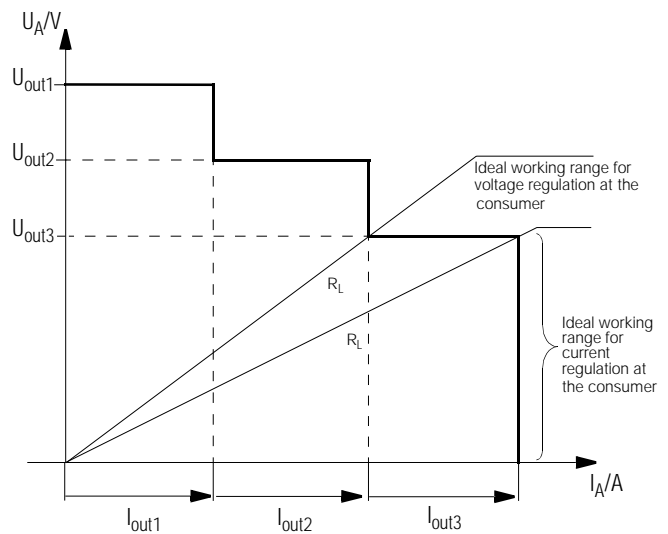


Figure 5.8.1 b
U/I Diagram for Direct Parallel Connection

Notes

- Slightly varying voltages result at the individual outputs due to setting tolerance.
If large voltage differences prevail, an electronic sink becomes active at the outputs with the lower voltage settings. The sink attempts to achieve the lower voltage value - possibly in pulsating mode.
Neither the KONSTANTER nor the consumer are damaged by this process.
- If load current measurement problems should occur as a result, the KONSTANTERs should be master-slave parallel connected (see also chapter 5.8.2).
- The outputs can be activated and deactivated simultaneously by connecting the SIG1 outputs to the TRG inputs (see also chapter 5.8.2).

5.8.2 Parallel Master-Slave Connection

Function

Parallel master-slave connection provides for significant **advantages** as opposed to direct parallel connection:

- Equally suitable for **voltage** and **current regulation**
- **Output parameters** (output voltage, cumulative current limiting, output on / off) are **fully** controlled by the **master**.
- **All** interconnected KONSTANTERs are **equally loaded**.

Wiring

- Define one device as the **master**.
- Connect master and slave devices as shown in **figure 5.8.2**.
- Connect the **power leads** (observe instruction in **chapter 2.2**).
- **Balance** the individual **current outputs**. Keep the connector cables as **short** as possible, and use the **largest possible** conductor cross section. Perform balancing with R_{match} .

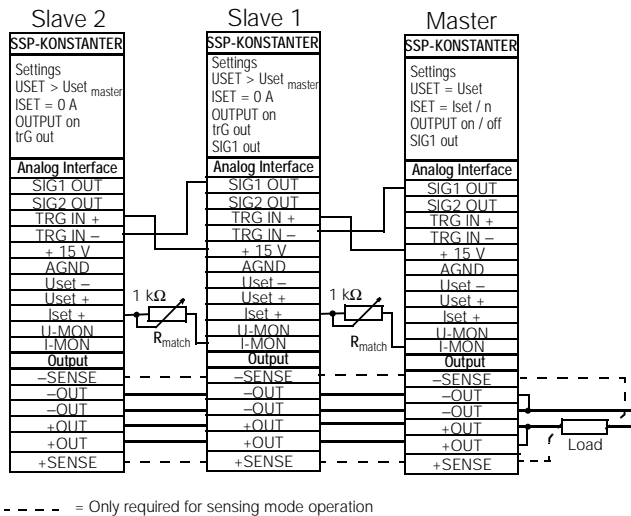


Figure 5.8.2
Wiring for Parallel Master-Slave Connection

Procedure

Initial Start-Up:

- Short circuit the load.
- Switch on **master** (mains switch) and set:

SIG1 out

Pon rcl

OUTPUT off

USET = Uset desired output voltage

ISET = Iset / n Iset: desired cumulative output current,
n: number of devices

Only valid if **nominal values** for all devices are **identical**, see notes as well

- Switch on **slave 1** (mains switch) and set:

trG out

SIG1 out

Pon rcl

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

ISET = 0 A ISET rotary knob can be deactivated by setting ILIM to 0 A.

- Proceed as described above for all slaves.
- Press the **OUTPUT ON** key at the master. **All slave** outputs are switched on and set **simultaneously** in this way.
- Check output current levels at the slave device displays.
- **Output current for each individual slave** can be precisely set to match output current at the master by adjusting R_{match} . Changes appear immediately at the respective display.
- Eliminate short-circuiting of the load.
- From now on, (cumulative) output parameters are set and regulated **entirely** by the master.

Repeat Start-Up (after initial start-up):

- The **order** in which devices are switched off and back on again is **irrelevant**.

Functional Principle

- The master controls output current at the downstream device (slave 1) via its **current control input** with the **current monitor signal**.
- **Slave 1** functions as a **master** for **slave 2** and so forth.

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

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

NOTES

KONSTANTERs with Different Nominal Values

- The KONSTANTER with the **lowest nominal voltage** must be used as the **master**.
- The **voltage setting range** for all other KONSTANTERs must be **limited** to the lowest nominal value with the **ULIM** parameter.
- $I_{out,slave}$ is only equivalent to $I_{out,Master}$ as a percentage with reference 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 conductor** can be used instead of R_{match} , if an **exact setpoint value is not** required for cumulative output current. In this case, each of the **slaves** always supplies somewhat **more current** than the master.
- If the **connector leads** to the analog interface and the sensing leads are **longer than 1 m**, use **shielded** cable. Connect the **shield** to **ground / housing** or **- OUT**.
- The measuring function at the master device acquires **cumulative generated output voltage** from all interconnected KONSTANTERs, but **only its own output current**. **Current values** from all of the interconnected KONSTANTERs must be **added together** in order to calculate **cumulative output current**.

5.9 Series Connection

The outputs of several KONSTANTERs can be connected in series if output voltage from a single KONSTANTER is insufficient, or if a \pm voltage needs to be generated.

WARNING

Maximal allowable cumulative output voltage for series connection is 120 V (or 240 V with grounded neutral).

5.9.1 Direct Series Connection

ATTENTION!

When outputs with different nominal values are series connected, the highest selected current flows at all outputs in the event of short-circuit. However, the internal reverse voltage protection diode is only rated for nominal current at a single device (see reverse voltage withstand under Technical Data).

All current setpoint values must therefore be set to the lowest nominal current value of all interconnected devices.

This setting is accomplished with the ILIM parameter.

A diode can also be connected in the reverse direction between the output terminals at the device with lower nominal values (D_{e1} , see figure 5.9.1 a). The diode must be capable of conducting nominal current from the output with the highest nominal value.

Function

- Simplest way to increase voltage to the consumer to a level greater than that provided by a single KONSTANTER
- Easy wiring
- Less suitable for constant current operation

Wiring

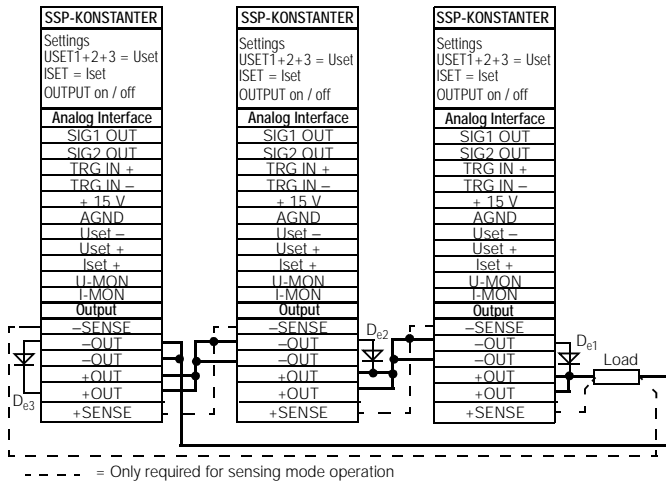


Figure 5.9.1 a

Wiring for Direct Series Connection

Procedure

- Deactivate all outputs.
- Adjust current setpoint values ISET for all series connected KONSTANTERs to approximately the same value:
 $ISET1 = ISET2 = ISET3 = ISETn$
- Adjust voltage setpoint values USET such that the desired cumulative voltage setpoint value Uset is achieved:
 $Uset = USET1 + USET2 + USET3 + \dots + USETn$
- Activate the outputs.

Functional Principle

- The sum of the individual output voltages is made available to the consumer.
- If connected load resistance is continuously reduced, all outputs deliver the same load current at first.
- If 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 a constant load current until its output voltage has dropped to 0 V.
- Further reduction of load resistance results in negative voltage at the respective output caused by the other outputs.
- The respective internal reverse voltage protection diode is conductive as of approximately -0.5 V.
- Load current can now rise again until current regulating is triggered at the output with the next highest current setpoint value.
- This process continues until load current triggers current regulating at the output with the highest current setpoint value.
- Constant current is maintained by this final output until short-circuiting occurs.

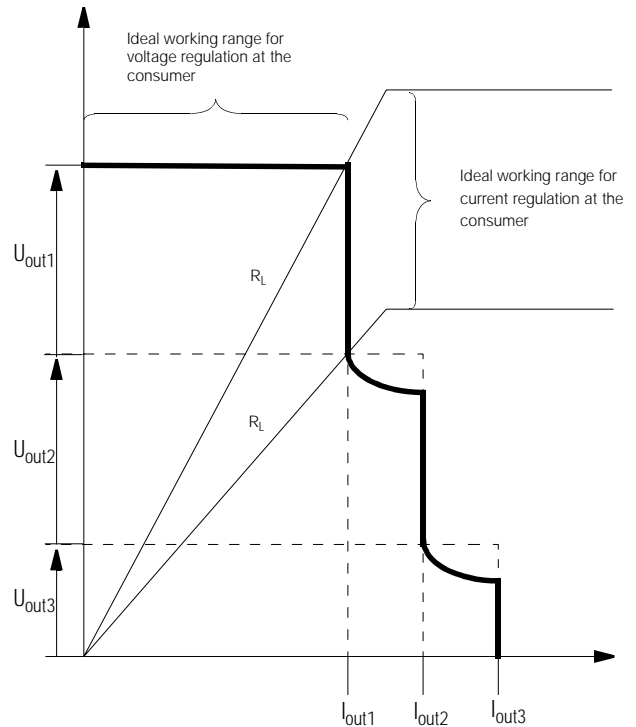


Figure 5.9.1 b
U/I Diagram for Direct Series Connection

Note

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

5.9.2 Series Master-Slave Connection

Function

Series master-slave connection provides for significant advantages as opposed to direct series connection:

- Equally suitable for **voltage** and **current regulation**
- Output parameters** (cumulative output voltage, current limiting, output on / off) are **fully** controlled by the **master**.
- All interconnected KONSTANTERs are **equally loaded**.

Wiring

- Define one device as the **master**.
- Connect master and slave devices as shown in **figure 5.9.2**.
- Connect the **power leads** to the **external points** in the series circuit.
- Balance the individual output voltages with R_{match} .
- Balancing and optimization** can be **simplified** by combining a fixed-value resistor (metal film resistor, $T_k \leq 50$ ppm / K) and a trimming resistor for R_{match} .

Slave Nominal Voltage	R_{match} Nominal Value	R_{match} Combination
20 V	40 k Ω / 0.2 W	36 k Ω + 10 k Ω potentiometer
40 V	80 k Ω / 0.2 W	75 k Ω + 10 k Ω potentiometer
80 V	160 k Ω / 0.2 W	150 k Ω + 20 k Ω potentiometer

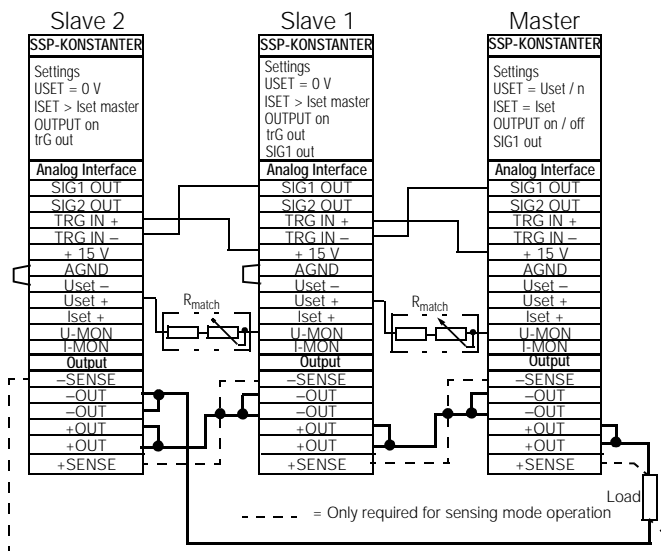


Figure 5.9.2 Wiring for Series Master-Slave Connection

Procedure

Initial Start-Up:

- Do not load outputs (no-load operation).
- Switch on **master** (mains switch) and **set**:

SIG1 out

Pon rcl

OUTPUT off

$USET = Uset / n$ Uset: cumulative output voltage
n: number of devices

Only valid if **nominal values** for all devices are **identical**, see notes as well

ISET = Iset Current limiting value

- Switch on **Slave 1** and **set**:

trG out

SIG1 out

Pon rcl

$USET = 0$ V USET rotary knob can be deactivated by setting ULIM to 0 V.

$ISET > ISET_{master}$ Current limiting for the slaves must be set at least 1% higher than it is at the master, e.g. to max.

- Proceed as described above for all slaves.
- Press the **OUTPUT ON** key at the master. **All slave outputs** are switched on and set **simultaneously** in this way.
- Check output voltage levels at the device displays.
- Output voltage for each individual slave** can be precisely set to match output voltage at the master by adjusting R_{match} . Changes appear immediately at the respective display.
- Connect the consumer.
- From now on, (cumulative) output parameters are **set and regulated entirely** by the **master**.

Repeat Start-Up (after initial start-up):

- The **order** in which devices are switched off and back on again is **irrelevant**.

Functional Principle

- The master controls output voltage at the downstream KONSTANTER (slave 1) via its **voltage control output** with the **voltage monitoring signal**.
- Slave 1** functions as a **master** for **slave 2** and so forth.

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

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

Notes

KONSTANTERs with Different Nominal Values

- The KONSTANTER with the **lowest nominal current** must be used as the **master**.
- The **current setting range** for all other KONSTANTERs must be **limited** to the lowest nominal value with the **ILIM** parameter.
- $U_{out,Slave}$ is only equivalent to $U_{out,Master}$ as a percentage with reference 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 the **connector leads** to the analog interface and the sensing leads are **longer than 1 m**, use **shielded cable**.

Connect the **shield** to **ground / housing** or **- OUT**.

- The same current flows through all KONSTANTERs.

The **measured current value** from the **master** is thus sufficient for the measurement of **load current**.

Voltage values from all interconnected KONSTANTERs must be **added together** in order to calculate **cumulative output voltage**.

5.10 Varying Internal Output Resistance

Function

- In the voltage regulating mode, internal resistance at the output is equal to practically 0 Ω.
- Internal resistance can be increased at the output for some applications, e.g. for the **simulation of long power leads or weak automotive batteries**.

The selected (open-circuit) output voltage drops proportionately as load increases (figure 5.10 a).

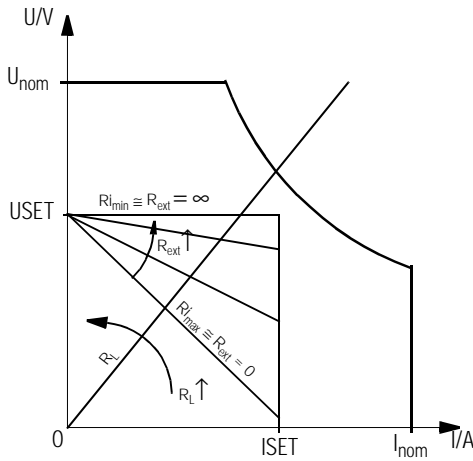


Figure 5.10 a
Output Voltage Relative to Load

Connection

- Wire the analog interface in accordance with figure 5.10 c.
- When wired as shown, the following relationship of internal resistance R_i to control resistance R_{ext} applies:

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

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

====> $R_{ext} = 376 \text{ k}\Omega$

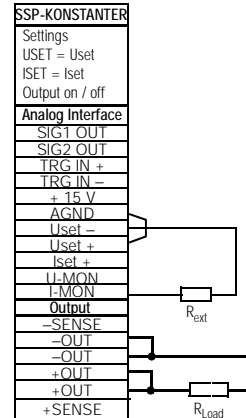


Figure 5.10 c
Wiring for Varying Internal Resistance

Standardization

- The standardized curve shown in figure 5.10 applies to all KONSTANTER types.
- It is plain to see from the characteristic curve, which internal output resistance R_i results from which control resistance R_{ext} :

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

$$\frac{R_i}{R_{imax}} = \frac{24.4 \text{ k}\Omega}{R_{ext} + 24.4 \text{ k}\Omega} ; R_{imax} = 1,23 \cdot \frac{U_{nom}}{I_{nom}}$$

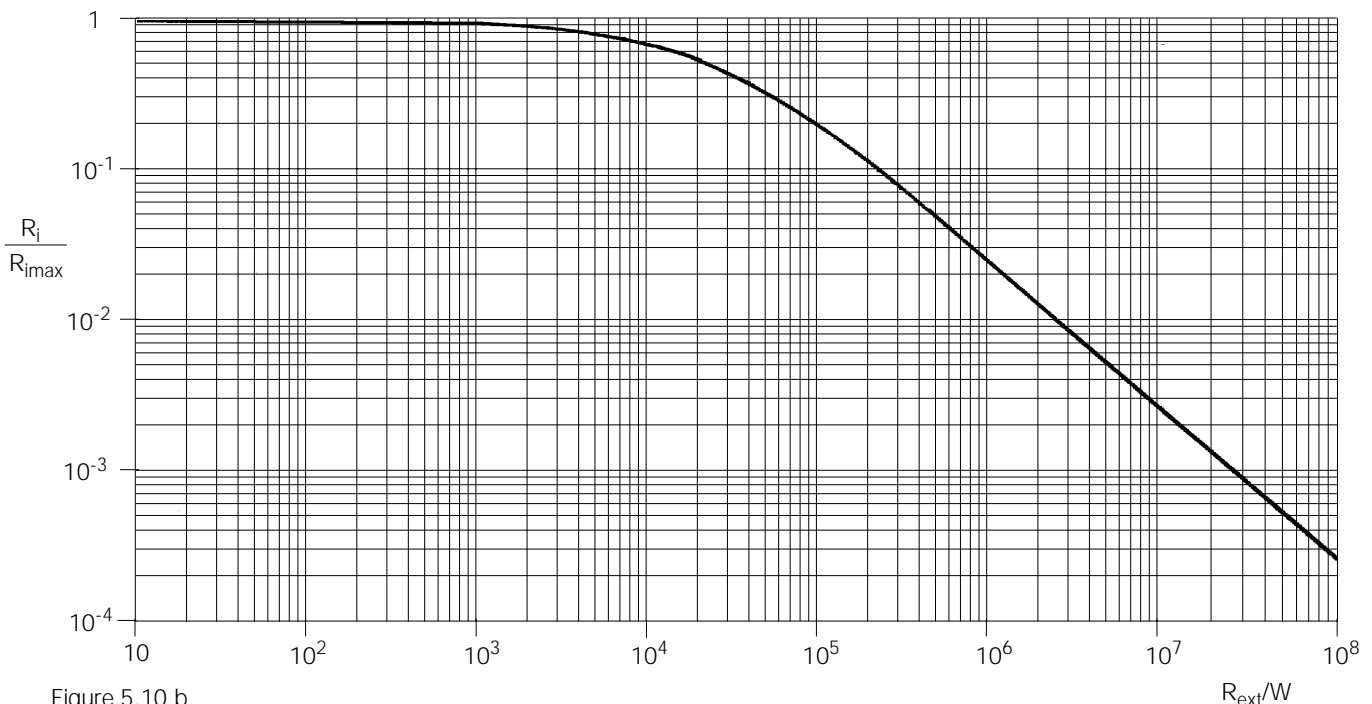


Figure 5.10 b
Standardized curve for the determination of internal output resistance based upon a predefined control resistance

- Table of R_{imax} Values for all KONSTANTER Types

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

6 Program Controlled Configuration of Device Functions, Parameters and Interfaces

6.1 Explanations

- Almost all **SSP-KONSTANTER** device functions 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**.
Several IEC bus-specific functions are the only exceptions.
- Device messages are transmitted as follows:
 - **IEC-Bus: byte-serial** transmission with the help of a special 3-wire handshake
 - **RS 232C interface: bit-serial** transmission under consideration of selected operating parameters
- Please refer to the corresponding **standards** or to the **interface description** included with your controller for detailed information concerning **data transmission functions**.
- In general, the layout of the device messages is in compliance with **"Agreements regarding Coding, Formats, Protocols and Common Commands"** in accordance with **IEEE488.2** and IEC 625-2.
- The standardized function commands used by some manufacturers of computer controlled devices (SCPI, standard commands for programmable instruments) are **not used for the KONSTANTER**.

6.1.1 General Command Layout

- The command names reflect the designations of the corresponding functions.
- For example, the command

```
USET 12
```

is used to set the output to a voltage value of 12 V.
- A command consists of a **header**, and **one or several parameters** as required.
- Both **numeric** and **text (alpha)** parameters are used.
- **Headers** and **text parameters** can be entered as **upper** and/or **lower case** letters in a mixed fashion.
- **At least one blank must be inserted between the header and the parameters.**
- If more than one parameter is included, they are delimited with commas (","), and a blank may be entered in front of and after each parameter.

Examples:

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

6.1.2 Abbreviated Commands

- Commands can be abbreviated.
- **Maximum possible abbreviation** of commands is highlighted throughout chapter 6 with boldface type.
- The portions of the commands which are not printed in boldface can be omitted.
- Make sure to always include a "?" for query commands, even if they are abbreviated.

Example 1:

The following abbreviations are permissible for the configuring command **"OUTPUT"**:

OUTPUT / OUTPUTU / OUTP / OUT / OU

Example 2:

The following abbreviations are permissible for the query command **"DELAY?"**:

DELAY? / DELA? / DEL? / DE?

6.1.3 Text Parameters

- Text parameters generally **begin** with a **letter**.
- For each command which contains **text parameters**, there exists a given **number of possible texts** which can be used to define the parameter.

Example:

```
Command:  DISPLAY txt
Selections: OFF
           ON
```

- **"DISPLAY"** is the **header** in this example, and **"ON"** and **"OFF"** are the permissible **text parameters**.

6.1.4 Numeric Parameters

- Numeric parameters can be entered as **whole numbers**, **fixed point numbers** or **floating point numbers with or without exponent**.
- The exponent may include up to two digits.
- The entire parameter may not exceed 30 places.
- The exponent symbol **"E"** can be entered in **upper or lower case**.
- A **blank** may be include in front of and after the exponent symbol.
- The plus sign (+) need not be included.
- Several parameters are **delimited with commas**.
- A **blank** may be included in front of and after each parameter.

Example: parameter 12.5 (twelve + decimal fraction)

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

6.1.5 Query Commands

- Query commands are used to **query device settings** and **measured values**.
- They are always followed by a **"?"**.
- The queried device sends a **response** to the master computer.
- If an **IEEE 488** interface is used, it can be determined whether or not a message is available for the device by querying the status byte or by means of serial polling.
- If this is the case, bit 4 (MAV, message available) is set in the status byte register.

Example:

```
USET?
Determines which voltage setpoint value
has been selected.
```

6.1.6 Commands with an Asterisk "*"

- Commands used for SSP-KONSTANTER device and interface functions which correspond to the functions defined in IEEE488.2 (or IEC 625-2), comply with the standards.
- These commands are identified with an "*" (2A_{hex}) at the beginning of the header.
- The asterisk is a part of the header and must be transmitted with the command.
- Please refer to the above mentioned standard for detailed information concerning these commands.

6.1.7 Setting Commands in a Row

- Several commands can be set together in a row and transmitted as a string.
- These commands are delimited with semicolons ";".
- Blanks may be entered in front of and after the semicolons.

Example:

USET 10; OUTPUT ON; IOU?

Comments

- Execution of the individual commands is performed in the order in which they were received.
- Configuration and query commands can be mixed within a single string.
- If a data string includes several query commands, semicolons ";" are used to delimit the requested parameters in the response string.
- If a data string contains a faulty command, the corresponding error bit is set in the standard event register (ESR), and the commands interpreted successfully up to that point are executed.

6.1.8 Terminating Device Messages

IEEE 488 Controls

- The following end-of-text characters are accepted for data receipt:

NL	new line = line feed = (0A _{hex})
NL & EOI	EOI = end or identify
DAB & EOI	DAB = last data byte
- The end-of-text combination CR LF (0D_{hex} followed by 0A_{hex}), which is still frequently utilized, should no longer be used according to the standard.
- However, CR LF is accepted by the device for data receipt, but should be only be used in combination with EOI.
- The following end-of-text characters are added to the response for data transmission:

NL & EOI

RS 232 Controls

- The following end-of-text characters are accepted for data receipt:

NL	(0A _{hex}) = new line = line feed
CR	(0D _{hex}) = carriage return
ETB	(17 _{hex})
ETX	(03 _{hex})
- The following end-of-text characters are added to the response for data transmission:

Last received end-of-text character

6.1.9 Tables with Device-Specific, General and Interface Commands

- The tables in the appendix provide an overview of device-specific, and general configuration and query commands, functions, and interface commands.
- The precise syntax descriptions for the respective device functions are included in chapter 6.2.

Corresponding general explanations for the device settings are included in chapter 4, "Manual Configuration of Device Functions and Parameters".

6.2 Configuration and Query Commands

6.2.1 Device Functions and Parameters

6.2.1.1 ADDRESS – Interface Addressing



Configuration

Function and Manual Operation

See explanations in chapter 4.2.

Programming

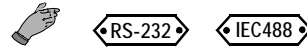
Config. command: **ADDRESS** *n*
Parameter: *n* (address number)
Parameter type: integer (whole number)
Setting range: $0 \leq n \leq 30, 31$ (= UNL → unlist)

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 IEEE 488 interface**, sub-addressing is ignored.

6.2.1.2 DELAY – Shutdown Delay for OCP



Configuration

Function and Manual Operation

See explanations in chapter 4.2.1.5.

Programming

Config. command: **DELAY** *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"
{10.7 second shutdown delay}



Query

Displays the selected delay period from the time current regulating is triggered until the power output is deactivated.

Programming

Query command: **DELAY?**
Response string: DELAY *v*
Length: always 11 characters
Parameter: *v* (*value*)
Format *w*: nn.nn

Example (HP Basic):
OUTPUT 713; "DELAY?"
ENTER 713; A\$
DISP A\$
→ Display: DELAY 10.70

6.2.1.3 DISPLAY – Activate / Deactivate 7 Segment Displays



Configuration

Function

- Activation / deactivation of 7 segment displays during remote control operation.
- When the display is deactivated, it need not be continuously refreshed.
- This results in somewhat shorter measuring and response times during interface operation.

Programming

Config. command: **DISPLAY 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}

Comments

If the remote control mode "REMOTE" is exited, the 7 segment display is automatically switched back on.

Query

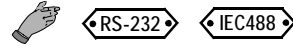
Activation status of the 7 segment display

Programming

Query command: **DISPLAY?**
 Response string: DISPLAY *txt*
 Length: always 11 characters
 Parameter: *txt (status)*

Example (HP Basic):
 OUTPUT 713;"DISPLAY?"
 ENTER 713;A\$
 DISP A\$
 → Display: DISPLAY OFF

6.2.1.4 ILIM – Current Setting Limit Value



Configuration

Function and Manual Operation

See explanations in chapter 4.2.1.2.

Programming

Config. command: **ILIM V**
 Parameter: *v (value)*
 Parameter Type: real number
 Setting range: $0 \leq v \leq \text{ILIM}_{\text{max}}$

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
Increment [mA]	1.0	1.0	1.0	1.0	1.0	1.0

If the programmed value is not a whole number multiple of the increment, it is rounded accordingly.

The numeric value is rounded again if necessary for the 4 place digital display.

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

Example (HP Basic):
 OUTPUT 713; "ILIM 20"
 {current setting limit value = 20 A}

Comments

- **ILIM may not be set to a value less than ISET!**
- If it is, the respective command is not executed.
- **Bit 1** in event register B (**limit error**) and **bit 4** in the standard event register (**execution error**) would be set in this case.
- The ILIM function is not effective for configuring ISET with a control signal via the analog interface.

Query

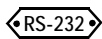
Displays the **upper limit** for the **current setpoint value ISET**.

Programming

Query command: **ILIM?**
 Response string: ILIM *v*
 Length: always 13 characters
 Parameter: *v (value)*
 Format *v*: +nnn.nnn

Example (HP Basic):
 OUTPUT 713;"ILIM?"
 ENTER 713;A\$
 DISP A\$
 → Display: ILIM +020.000

6.2.1.5 IMAX? – Maximum Measured Current Value



Query

Function and Manual Operation

See explanations in chapter 4.3.1.

Programming

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

Example (HP Basic):

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

→ Display: IMAX +02.8550

6.2.1.6 IMIN? – Minimum Measured Current Value



Query

Function and Manual Operation

See explanations in chapter 4.3.1.

Programming

Query command: **IMIN?**
 Response string: IMIN *v*
 Length: always 13 characters
 Parameter: *v (value)*
 Format: +nn.nnnn

Example (HP Basic):

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

→ Display: IMIN +02.7300

6.2.1.7 IOUT? – Currently Measured Current Value



Query

Function and Manual Operation

See explanations in chapter 4.1.2.

Programming

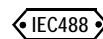
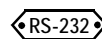
Query command: **IOUT?**
 Response string: IOUT *v*
 Length: always 13 characters
 Parameter: *v (value)*
 Format: +nn.nnnn

Example (HP Basic):

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

→ Display: IOUT +02.7350

6.2.1.8 ISET – Current Setpoint Value



Configuration

Function and Manual Operation

See explanations in chapter 4.1.2.

Programming

Config. command: **ISET *v***
 Parameter: *v (value)*
 Parameter type: real number
 Setting range: $0 \leq w \leq \text{ILIM}$

Device Type	2	3	6	10	12	20
Nom. Current [A]	2.0	3.0	6.0	10.0	12.0	20.0
ISET _{max} [A]	2.0	3.0	6.0	10.0	12.0	20.0
Increment [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 increment, it is rounded dependent upon control resolution.

The numeric value is rounded again if necessary for the 4 place digital display.

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

Example (HP Basic):

```
OUTPUT 713;"ISET 11.3"
{current setpoint value = 11.3 ampere}
```

Comments

- ISET may not be set to a value greater than ILIM.
- If it is, the respective command is not executed.
- Bit 1 in event register B (limit error) and bit 4 in the standard event register (execution error) would be set in this case.



Query

Displays the selected output current setpoint value.

Programming

Query command: **ISET?**
 Response string: ISET *v*
 Length: always 13 characters
 Parameter: *v (value)*
 Format: +nn.nnnn

Example (HP Basic):

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

→ Display: ISET +03.0000

6.2.1.9 MIN-MAX – Extreme Value Memory for Measured U and I Values



Configuration

Function and Manual Configuration

See explanations in chapter 4.2.1.7.

Programming

Config. command: **MINMAX** *txt*
Parameter: *txt (status)*
Parameter type: text (character)
Setting range: **OFF** extreme value memory deactivated
ON extreme value memory activated
RST Contents of the extreme value memory are reset, i.e. replaced with the currently measured value for the respective parameter.
Default setting: **OFF** (after RESET (*RST))

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



Query

Displays the functional status of the extreme value memory.

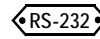
Programming

Query command: **MINMAX?**
Response string: MINMAX *txt*
Length: always 10 characters
Parameter: *txt (status)*

Example (HP Basic):
OUTPUT 713; "MINMAX?"
ENTER 713; A\$
DISP A\$

→ Display: MINMAX OFF

6.2.1.10 MODE? – Query Current Control Mode



Query

Function and Manual Configuration

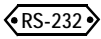
- Displays the control mode for the power output
- Evaluates the condition register **CRA**
- Direct querying of the current control mode
- See explanations in chapter 3 [3].

Programming

Query command: **MODE?**
Response string: MODE *txt*
Length: always 8 characters
Parameter: *txt (operating mode)*
Range of queries: **OFF** output deactivated
CV constant voltage operation
CC constant current operation
OL overload (power limiting)

Example (HP Basic):
OUTPUT 713; "MODE?"
ENTER 713; A\$
DISP A\$
→ Display: MODE CV

6.2.1.11 OCP – Overcurrent Protection



Configuration

Function and Manual Operation

See explanations in chapter 4.2.1.4.

Programming

Config. command: **OCP** *txt*
Parameter: *txt (status)*
Parameter type: text (character)
Setting range: **OFF** Function inactive, continuous current limiting (current regulation).
ON Function active, the output is deactivated as soon as current limiting has been active for the duration of the predefined DELAY period.
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

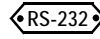
Query command: **OCP?**
Response string: OCP *txt*
Length: always 7 characters
Parameter: *txt (status)*

Example (HP Basic):

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

→ Display: OCP ON

6.2.1.12 OUTPUT – Activate / Deactivate the Output



Configuration

Function and Manual Configuration

See explanations in chapter 3 [3].

Programming

Config. command: **OUTPUT** *txt*
Parameter: *txt (status)*
Parameter type: text (character)
Setting range: **OFF** deactivates the output
ON activates the output

Example (HP Basic):

```
OUTPUT 713;"OUTPUT ON"  
{activate output}
```



Query

Displays the selected status of the power output.

Programming

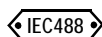
Query command: **OUTPUT?**
Response string: OUTPUT *txt*
Length: always 10 characters
Parameter: *txt (status)*

Example (HP Basic):

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

→ Display: OUTPUT ON

6.2.1.13 OVSET – Overvoltage Protection Threshold



Configuration

Function and Manual Operation

See explanations in chapter 4.2.1.3 - OVP.

Programming

Config. command: **OVSET** *v*

Parameter: *v* (*value*)

Parameter type: real number

Setting range $0 \leq w \leq OVSET_{max}$

Device Type				
Nominal Voltage [V]	20	40	80	360
OVSET_{max} [V]	25	50	100	450
Increment [mV]	100	200	400	2000

Format: +nnn.n

Example (HP Basic):

```
OUTPUT 713;"OVSET 35.0"
{threshold value: 35 V}
```

Query

Programming

Query command: **OVSET?**

Response string: OVSET *v*

Length: always 12 characters

Parameter: *v* (*value*)

Format: +nnn.n

Example (HP Basic):

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

→ Display: OVSET +035.0

6.2.1.14 POUT? – Query Current Output Power



Query

Function and Manual Operation

- The **POUT** function determines current actual values for **output voltage** and **output current**.
- These two **measured quantities** are multiplied to arrive at the power value **Pout**.
- Measurement and processing of the values takes about 90 ms.
- See explanations in chapter 4.3.1.

Programming

Query command: **POUT?**

Response string: POUT *v*

Length: always 12 characters

Parameter: *v* (*value*)

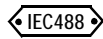
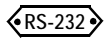
Format: +nnnn.n

Example (HP Basic):

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

→ Display: POUT +0074.2

6.2.1.15 POWER_ON – Determine Device Power-On Status



Configuration

Function and Manual Configuration

See explanations in chapter 4.2.1.6.

Programming

Config. command: **POWER_ON** *txt*
Parameter: *txt (status)*
Parameter type: text (character)
Setting range: **RST** RESET: device default setting
RCL RECALL: last device setting
SBY STANDBY: last device setting, although the power output remains inactive (OUTPUT OFF).

Example (HP Basic):

```
OUTPUT 713;"POWER_ON RST"  
{The KONSTANTER is returned to the  
default setting after mains power is  
switched on.}
```



Query

Displays the device setting which determines device status after mains power has been switched on.

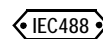
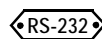
Programming

Query command: **POWER_ON?**
Response string: **POWER_ON** *txt*
Length: always 12 characters
Parameter: *txt (status)*

Example (HP Basic):

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

6.2.1.16 REPETITION – Number of Repetitions for the SEQUENCE Function



Configuration

Function and Manual Operation

See explanations in chapter 4.2.3.6.

Programming

Config. command: **REPETITION** *n*
Parameter: *n (number)*
Parameter type: integer
Setting range: 0 continuous repetition
1 to 255 number of sequence repetitions
Format: nnn
Default setting: unchanged (after RESET (*RST))

Example (HP Basic):

```
OUTPUT 713;"REPETITION 100"  
{100 repetitions}
```



Query

Displays the number of repetitions for the SEQUENCE function.

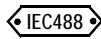
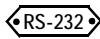
Programming

Query command: **REPETITION?**
Response string: **REPETITION** *n*
Length: always 14 characters
Parameter: *n (number)*
Format: nnn

Example (HP Basic):

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

6.2.1.17 SEQUENCE – Recall Stored Settings (automatic/sequential)



Configuration

Function and Manual Operation

See explanations in chapter 4.2.3.7.

Programming

Config. command: **SEQUENCE** *txt*

Parameter: *txt (status)*

Parameter type: text (character)

Setting range: **GO** start SEQUENCE at **STRT**
ON open SEQUENCE
as of Rel. 003¹⁾ SEQUENCE always open
OFF close / exit SEQUENCE

as of Rel. 003¹⁾ same as **SEQUENCE STOP**

HOLD²⁾ pause

CONT²⁾ resume auto-run, control panels

STRT³⁾ single step operation

STEP³ (→ operating concept (remote))

STOP³⁾

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

Example (HP Basic):

OUTPUT 713; "SEQUENCE GO"

Notes

- 1) This function has been modified as of **software release 003**.
- 2) **HOLD** and **CONT** were first implemented in **software release 003**. The software release included in your KONSTANTER appears at the display in the following format after the device is switched on: **rel 00x**.
- 3) **Single step operation**, similar to ext. trig. function / **T_MODE RCL**
STRT Executes all data stored to the **STRT** address. If no executable data are available, the last setting remains active, **OUTPUT** is activated.
STEP Executes data at next memory location, sequence resumes at **STRT** after **STOP** address.
STOP Executes all data stored to the **STOP** address. If no executable data are available, the last setting remains active, **OUTPUT** is deactivated.

Attention: Automatic execution and single step operation (ext. trigger / configuration commands) are not mutually exclusive.



Query

Only for compatibility of older devices with existing programs, response is always "SEQUENCE ON".

Programming

Query command: **SEQUENCE?**

Response string: SEQUENCE *txt (status: on)*

Length: always 12 characters

Example (HP Basic):

OUTPUT 713; "SEQUENCE?"

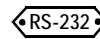
ENTER 713; A\$

DISP A\$

→ Display: SEQUENCE ON

Indicates whether or not SEQUENCE is active via **CRA-D7 (SEQB)** bit or **SEQ** parameter (level) in **SIG1_SIG2** signal

6.2.1.18 SIG1_SIG2 – Analog Interface Signal Outputs



Configuration

Function and Manual Operation

- As opposed to manual operation, the computer generated **SIG1_SIG2** command simultaneously addresses both signal outputs.
- **Signal output 1:** depends upon status of the power output.
- **Signal output 2:** depends upon current output operating mode.
- The status of the **SIG1_SIG2** function **cannot** be saved as a device setting with the **SAVE** key.
- See explanations in chapter 4.2.2.2 and 4.2.2.3.

Programming

Config. command: **SIG1_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 oder CV		passive, high
	CC oder 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 function setting for the signal outputs at the analog interface.

Programming

Query command: **SIG1_SIG2?**

Response string: **SIG1_SIG2** *txt1,txt2*

Length: always 19 characters

Parameter: *txt1, txt2 (selection)*

Example (HP Basic):

OUTPUT 713; "SIG1_SIG2?"

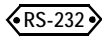
ENTER 713; A\$

DISP A\$

→ Display:

SIG1_SIG2 OUT,MODE

6.2.1.19 SSET – Switching Function Signal Level



Configuration

Function and Manual Operation

See explanations in chapter 4.2.3.2.

Programming

Config. command: **SSET** *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 high signal.
```



Query

Queries the functional status of the sequence.

Programming

Query command: **SSET?**
Response string: SSET *txt*
Length: always 8 characters
Parameter: *txt (status)*

Example (HP Basic):

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

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



Configuration

Function and Manual Operation

- As opposed to manual operation, memory location start and stop addresses are entered with a command in this case.
- See explanations in chapter 4.2.3.4 and 4.2.3.5.

Programming

Config. command: **START_STOP** *n1, n2*
Parameter: *n1, n2 (start address, stop address)*
Parameter type: integer
Setting range: start address: 11 through 252
stop address: 12 through 253
Conditions: start address < stop address
Default setting: after RESET (*RST →): unchanged

Example (HP Basic):

```
OUTPUT 713;"STA 20, 115"  
{beginning of sequence = register 20}  
{end of sequence = register 115}
```



Query

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

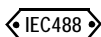
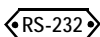
Programming

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

Example (HP Basic):

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

6.2.1.21 TDEF – Default Dwell Time for the SEQUENCE Function



Configuration

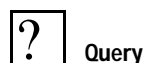
Funktion

See explanations in chapter 4.2.3.3.

Programming

Config. command: **TDEF** *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

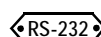
Recalls the default value for dwell time.

Programming

Query command: **TDEF?**
Response string: TDEF *v*
Length: always 10 characters
Parameter: *v (value)*

Example (HP Basic):
OUTPUT 713;"TDEF?"
ENTER 713; A\$
DISP A\$
→ Display: TDEF 12.34

6.2.1.22 T_MODE – Function Selection for the Trigger Input



Configuration

Funktion

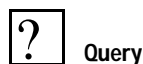
- The status of the **T_MODE** function **cannot** be saved as a device setting with the **SAVE** key.
- See explanations in chapter 4.2.2.1 - **trG**.

Programming

Config. command: **T_MODE** *txt*
Parameter: *txt*
Parameter type: influence (character)
Setting range: **OFF** trigger input deactivated
OUT trigger input influence on **OUTPUT**:
output on / off
RCL **RECALL**: memory recall (single step)¹⁾
SEQ **SEQUENCE**: sequential memory recall
(**SEQUENCE GO**)¹⁾
LLO **LOCAL LOCKED**: front panel controls
disabled, indicated with "LOCKED /
SEQ" LED at front panel
MIN **MIN-MAX**: extreme value memory for
measured values
Default setting: unchanged (after RESET (*RST))

Example (HP Basic):
OUTPUT 713;"T_MODE LLO"
{trigger input influences front panel
controls}

- 1) If the SEQUENCE function has not been previously initialized, an active trigger signal generates error message "Err 27", which is displayed for approximately 1 second. Additionally, bit 5 ("SEQE") is set in event register B (ERB). The SEQUENCE function must be fully initialized in order to execute the "RCL" or the "SEQ" setting.



Query

Displays the function which has been assigned to the trigger input.

Programming

Query command: **T_MODE?**
Response string: T_MODE *txt*
Length: always 10 characters
Parameter: *txt (influence)*

Example (HP Basic):
OUTPUT 713;"T_MODE?"
ENTER 713; A\$
DISP A\$
→ Display: T_MODE LLO

6.2.1.23 TSET – Memory Location Specific Dwell Time for the SEQUENCE Function



Configuration

Function and Manual Operation

- See explanations in chapter 4.2.3.1.
- The selected value for TSET is saved to the SETUP register as a device setting with the SAVE key.

Programming

Config. command: TSET *value*
 Parameter type: real number
 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

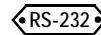
Displays memory location specific dwell time.

Programming

Query command: TSET?
 Response string: TSET *v*
 Length: always 10 characters
 Parameter: *v (value)*
 Format: nn.nn

Example (HP Basic):
 OUTPUT 713; "TDEF?"
 ENTER 713; A\$
 DISP A\$
 → Display: TDEF 00.02

6.2.1.24 ULIM – Limit Value for Voltage Setting Range



Configuration

Function and Manual Operation

See explanations in chapter 4.2.1.1.

Programming

Config. command: ULIM *v*
 Parameter: *v (value)*
 Parameter Type: real number
 Setting range: $0 \leq w \leq ULIM_{max} I$

Device Type				
Nominal Voltage [V]	20	40	80	360
ULIM _{max} [V]	20	40	80	360
Increment [mV]	1.0	1.0	1.0	1.0

Default setting: after RESET (*RST) → nominal voltage

Example (HP Basic):
 OUTPUT 713; "ULIM 20"
 {limit value for voltage setting range: 20 V}

Comments

- ULIM may not be set to a value less than USET.
- If it is, the respective command is not executed.
- Bit 1 in event register B (limit error) and bit 4 in the standard event register (execution error) would be set in this case.
- If the programmed value is not a whole number multiple of the increment, it is rounded accordingly.
- The numeric value is rounded again if necessary for the 4 place digital display.
- The ULIM function is not effective for configuring USET with a control signal via the analog interface.



Query

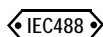
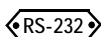
Displays the selected upper limit for the voltage setpoint value USET.

Programming

Query command: ULIM?
 Response string: ULIM *w*
 Length: always 13 characters
 Parameter: *v (value)*
 Format *w*: +nnn.nnn

Example (HP Basic):
 OUTPUT 713;"ULIM?"
 ENTER 713;A\$
 DISP A\$
 → Display: ULIM +020.000

6.2.1.25 UMAX? – Maximum Measured Voltage Value



Query

Function and Manual Operation

See explanations in chapter 4.3.1.

Programming

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

Example (HP Basic):

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

→ Display: UMAX +028.125

6.2.1.26 UMIN? – Minimum Measured Voltage Value



Query

Function and Manual Operation

See explanations in chapter 4.3.1.

Programming

Query command: **UMIN?**
Response string: UMIN *v*
Length: always 13 characters
Parameter: *v* (*value*)
Format: +nnn.nnn

Example (HP Basic):

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

→ Display: UMIN +027.350

6.2.1.27 UOUT? – Currently Measured Voltage Value



Query

Function and Manual Operation

See explanations in chapter 4.1.2.

Programming

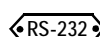
Query command: **UOUT?**
Response string: UOUT *v*
Length: always 13 characters
Parameter: *v* (*value*)
Format: +nnn.nnn

Example (HP Basic):

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

→ Display: UOUT +027.350

6.2.1.28 USET – Voltage Setpoint Value



Configuration

Function and Manual Operation

See explanations in chapter 4.1.1.

Programming

Config. command: **USET** *v*
Parameter: *v* (*value*)
Parameter Type: real number
Setting range: $0 \leq v \leq \text{ULIM}$

Device Type

Nominal Voltage [V]	20	40	80	360
ULIM _{max} [V]	20	40	80	360
Increment [mV]	5	10	20	100

Default setting: after RESET (*RST) → 0.00 V

Example (HP Basic):

```
OUTPUT 713;"USET 12.5"  
{voltage setpoint value = 12.5 Volt}
```

Comments

- USET may not be set to a value greater than ULIM.
- If it is, the configuration command is not executed.
- Bit 1 in event register B (**limit error**) and bit 4 in the standard event register (**execution error**) would be set in this case.
- If the programmed value is not a whole number multiple of the increment, it is rounded accordingly.
- The numeric value is rounded again if necessary for the 4 place digital display.



Query

Displays the output voltage which has been defined with the USET parameter.

Programming

Query command: **USET?**
Response string: USET *v*
Length: always 13 characters
Parameter: *v* (*value*)
Format: +nnn.nnn

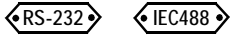
Example (HP Basic):

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

→ Display: USET +012.500

6.2.2 General Commands and Queries

6.2.2.1 DCL, SDC – Device Clear Function



Configuration

Function

- Deletes input and output buffers at PC interfaces.
- E.g. requested data which have not been picked up
- Eliminates interface-internal queues and lockouts.
- The KONSTANTER is ready to receive data.
- Manual operation is not possible.

Programming

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

Influence

Addressing status	unchanged
Input and output buffers	deleted
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
Configured and stored parameters	unchanged

Example (HP Basic):

- OUTPUT 713;"DCL"
- CLEAR 713
- CLEAR 7

6.2.2.2 *DDT – Define Device Trigger



Configuration

Function

- A command list with a maximum of 80 characters can be saved to a register with the **DDT** command.
- The command list is executed upon receipt of the ***TRG** command.

Programming

Config. command: ***DDT** *command* [/command]/[command] ..
 Parameter: *Command*
 Parameter type: All specified device commands and queries except for the ***TRG** command
 Setting range: Maximum 80 characters
 Default setting: **DDT** memory is deleted (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 causing immediate execution.
- An empty **DDT** register responds with a blank.
- Command list syntax and limit values are not checked until a trigger command is received.
- ***TRG may not be included** as part of the ***DDT** command. If it is, bit 4 (EXE, execution error) in the standard event register and bit 3 (DDTE, define device trigger error) in event register B are set.
- If maximum string length is exceeded, extra characters are ignored and an execution error is generated.
- If "EXE" occurs, the **DDT** register can be read out with the **DDT?** query, but its content cannot be executed (repeated "EXE" message).



Query

Reads out the contents of the **DDT** register.

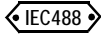
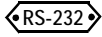
Programming

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

Example (HP Basic):

```
OUTPUT 713; "DDT?"
ENTER 713; A$
DISP A$
→ Display: USET 10; ISET 5.6; OUT ON
```

6.2.2.3 *IDN? – Querying Device ID



Query

Function

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

Programming

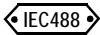
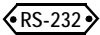
Query command: ***IDN?**

Response string: *Manufacturer, type, serial no., hardware revision, software revision*

Length: always 46 characters

Example for KONSTANTER 120 W / 40 V:
 GOSSSEN-METRAWATT,SSP32N040RU006P,
 XXXXXXXX,01.001

6.2.2.4 *LRN – Querying Overall Configuration



Query

Function

- Complete list of all configurable functions
- Complete list of all respective parameter settings

Programming

Query command: ***LRN?**

Response string: LRN *list*

Length: always 215 characters

Parameter: *List of all configurable functions including current parameter settings*

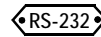
Example (HP Basic):

```
OUTPUT 713; "LRN?"
ENTER 713; A$
DISP A$
→ Display: ULIM +035.000;ILIM +050.000;OVSET
+050.0; OCP OFF;DELAY 12.00;USET
+21.300;ISET +048.000;OUTPUT ON;
POWER_ON RST;MINMAX ON;
SEQUENCE ON;TSET 00.10;TDEF 10.00;
REPETITION 000;START_STOP 020,115;
T_MODE OUT;DISPLAY OFF
```

Comments

- The controller determines the status of current device settings.
- This information can be used for the purpose of analysis, or for computer controlled configuration.
- Test system sequences can be executed manually for all interconnected KONSTANTERs.
- Existing device settings for each of the individual test sequence steps are queried by the controller with *LRN?.
- The response string can be forwarded to the test program as is, and is then transmitted as a data string to the respective KONSTANTER.

6.2.2.5 *RCL – Recalling Stored Settings



Configuration

Function and Manual Configuration

See explanations in chapter 4.5.

Programming

Config. command: ***RCL n**

Parameter: *n (register number)*

Parameter type: integer (from 1 to 255)

Setting range **1 ... 10** parameter set from **SETUP** memory

11 ... 253 parameter set from **SEQUENCE** memory

254 ... 255 comparative values memory

Format: n, nn, nnn

Example (HP Basic):

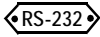
```
OUTPUT 713; "*"RCL 11"
{displays all parameters stored to memory
location 11}
```

Comments

- Registers 11 through 253 can be recalled via interface programming even if **no SEQUENCE has been opened**.
- If an **invalid (empty) register** is accessed from within the SEQUENCE memory, **execution** of the command is **aborted**. "Err 21" appears at the display, and **bit 5** in event register B (**SEQE**, SEQUENCE error) is set.
- If **USET** or **ISET** exceed one of the limit values **ULIM** or **ILIM** during recall, "Err 21" appears at the display and **bit 5** in event register B (**SEQE**, SEQUENCE error) is set.

As is also the case with all other memory locations with addresses greater than 10, memory locations 254 and 255 can be stored with *SAV and used as device settings with *RCL.

6.2.2.6 REMOTE/LOCAL – Remote and Local Control



Configuration

Function and Manual Configuration

- After power up: always manual operation (local state)
- All front panel control elements are enabled.
- The KONSTANTER can be operated manually.
- See chapter 4.7.1 regarding manual configuration.

Switching from LOCAL to REMOTE

- Switches from manual operation to remote control
- **at the serial interface**
as soon as data are transmitted to the device.
- **at the IEC bus**
when the REN line from the controller is activated and the device is addressed as a listener.

Switching from REMOTE to LOCAL

- Switches from remote control to manual operation
- **at the IEC bus**
upon transmission of the addressed interface command GTL (go to local) to the device (selective switching).

Example (HP Basic):

LOCAL 712

- Deactivation of the REN line with the controller (all devices are switched to manual operation)

Example (HP Basic):

LOCAL 7

LOCAL LOCKOUT

- Disables manual switching to manual operation (applies to IEC bus control only)
- Universal interface command LLO (LOCAL LOCKOUT)
- The controller disables the LOCAL key at the KONSTANTER.
- Lockable remote status

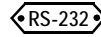
Example (HP Basic):

LOCAL LOCKOUT 7

Comments

- The "REMOTE" LED indicates the respective control status:
LED on = remote control
LED off = manual operation
- Switching from one control status to the other has no influence on current device settings or stored parameters.
- Exception when switching from REMOTE to LOCAL:
If the display has been deactivated, it is switched back on. (DISPLAY OFF → DISPLAY ON).
- With IEC bus control
The KONSTANTER is capable of receiving programming data in the manual operating mode, but they are not executed.

6.2.2.7 *RST – Reset Device Settings



Configuration

Functions and Manual Operation

See explanations in chapter 4.7.1.

Programming

Config. command: *RST

Example (HP Basic):

OUTPUT 713;*"RST"

Default settings:

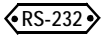
OUTPUT OFF	output inactive
USET 0	voltage setpoint value = 0
ISET 0	current setpoint value = 0
OVSET max	max. overvoltage protection threshold
ULIM unom	USET limit value = nominal voltage
ILIM inom	ISET limit value = nominal current
OCP OFF	current limiting with current regulation
DELAY 0	immediate output deactivation in the event of CC
TSET 0 (= tdef)	SEQUENCE dwell time = default time
SEQUENCE OFF	SEQUENCE function inactive
DISPLAY ON	display active
MINMAX OFF	no extreme value recording
TDEF	0.01
REPETITION	0 (= cont)
START_STOP	011, 011
POWER ON	unchanged
T_MODE	unchanged

Stored parameters:

SETUP register 1 ... 10	unchanged
SEQUENCE register	unchanged
DDT register	deleted
MIN-MAX memory	reset
Configured parameters	reset to default

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

6.2.2.8 *SAV – Saving Device Settings



Configuration

Functions and Manual Operation

See explanations in chapter 4.4.

Programming

Config. command: ***SAV** *n*

Parameter: *n* (register number)

Parameter type: Integer

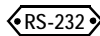
Setting range:	0	*SAV 0 (display in manual operating mode: "Sto clr ") deletes the contents of SEQUENCE registers 11 through 200.
	1 to 10	The current device setting is stored to the specified SETUP register.
	11 to 253	The current setting for the SEq parameter is stored to the specified SEQUENCE register.
	254	Comparative values U_Lo, I_Lo
	255	Comparative values U_Hi, I_Hi

Default setting: after RESET (*RST)
 Register number: omitted
 Register contents: unchanged

Example (HP Basic):

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

6.2.2.9 STORE – Saving a Parameter Directly to Memory



Configuration

Function

- The **STORE** command and its parameters can only be addressed by means of programming via an interface.
- It immediately overwrites old memory location values with new parameter data.
- The contents of the memory locations are **not** shifted.

Programming

Config. command: **STORE** *n, v1, v2, v3, txt*

Parameter: *n, v1, v2, v3, txt* (memory location address, USET, ISET TSET, SSET)

Parameter type: integer, real, real, real, character

Setting range:

<i>n</i>	11 ... 255
<i>w1</i>	$0 \leq w1 \leq USET_{max}$
<i>w2</i>	$0 \leq w2 \leq ISET_{max}$
<i>w3</i>	$00.01 [s] \leq v2 \leq 99.99 [s]$
<i>txt</i>	OFF, ON, CLR (deletes the entire memory 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 upon execution}

Comments

- As compared with ***SAV**, the **STORE** command provides for a substantially faster more direct method of programming the memory locations required for a sequence.



Query

Reads out data from address *n* from the SEQUENCE memory / limit value memory.

Programming

Query command: **STORE?** *n*

Response string: STORE *n, v1, v2, v3, txt*

Length: always 38 characters

Parameter: *n, v1, v2, v3, txt*
 (*nnn, +000.000, +00.0000, 00.00, CLR*)
 (memory location address, USET, ISET TSET, SSET)

Is returned in response to SSET CLR if the queried memory location is empty.

Example (HP Basic):

OUTPUT 713; "STORE? 14"
 ENTER 713; A\$
 DISP A\$

→ Display: STORE 14,15.5,3,9.7,ON

6.2.2.10 *TRG – Device Trigger Function



Configuration

Funktion

Triggers functions specified by *DDT (see also chapter 6.2.2.2).

Programming

Config. command: *TRG

Example (HP Basic):

```
OUTPUT 713;”*TRG”
```

Comments

If DDT memory is empty, the trigger function is undefined. If the *TRG command is received, bit 4 (EXE, execution error) in the standard event register is set immediately.

The *TRG command may not be included in the *DDT command.

Execution of the *TRG command does not change the DDT register.

6.2.2.11 *TST? – Trigger Self-Test



Query

Function

- Command for triggering the **device self-test**
- **Test results** are written to the **data output buffer** in response to this command.
- The device self-test **does not cause any changes** to current **device settings** or stored **parameters**.
- The self-test begins immediately after receipt of the corresponding query command and lasts approximately **6 seconds**.

Programming

Query command: *TST?

Response string: 0 = test passed
1 = error detected

Length: always 1 character

Comments

- As long as the test is running, no data should be transmitted to the device, and no manual operations should be executed.
- Do not transmit *TST? together with other configuring or query commands in a single data string.
- Insert a waiting period of approximately 6 seconds between transmission of the self-test query command and read-out of the response string.
- **IEC bus control:** Completion of the self-test can be recognized by cyclically querying and analyzing 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 in **ERB** (event register B) is set.
- An **SRQ message** can be generated by means of appropriate **masking** with the **ERDE** and **SRE** enable registers.

6.2.2.12 *WAI – Wait to Continue



Function

The *WAI command has no significance as regards programming the KONSTANTER.

It serves to synchronize the interface protocol in accordance with IEC 488.2.

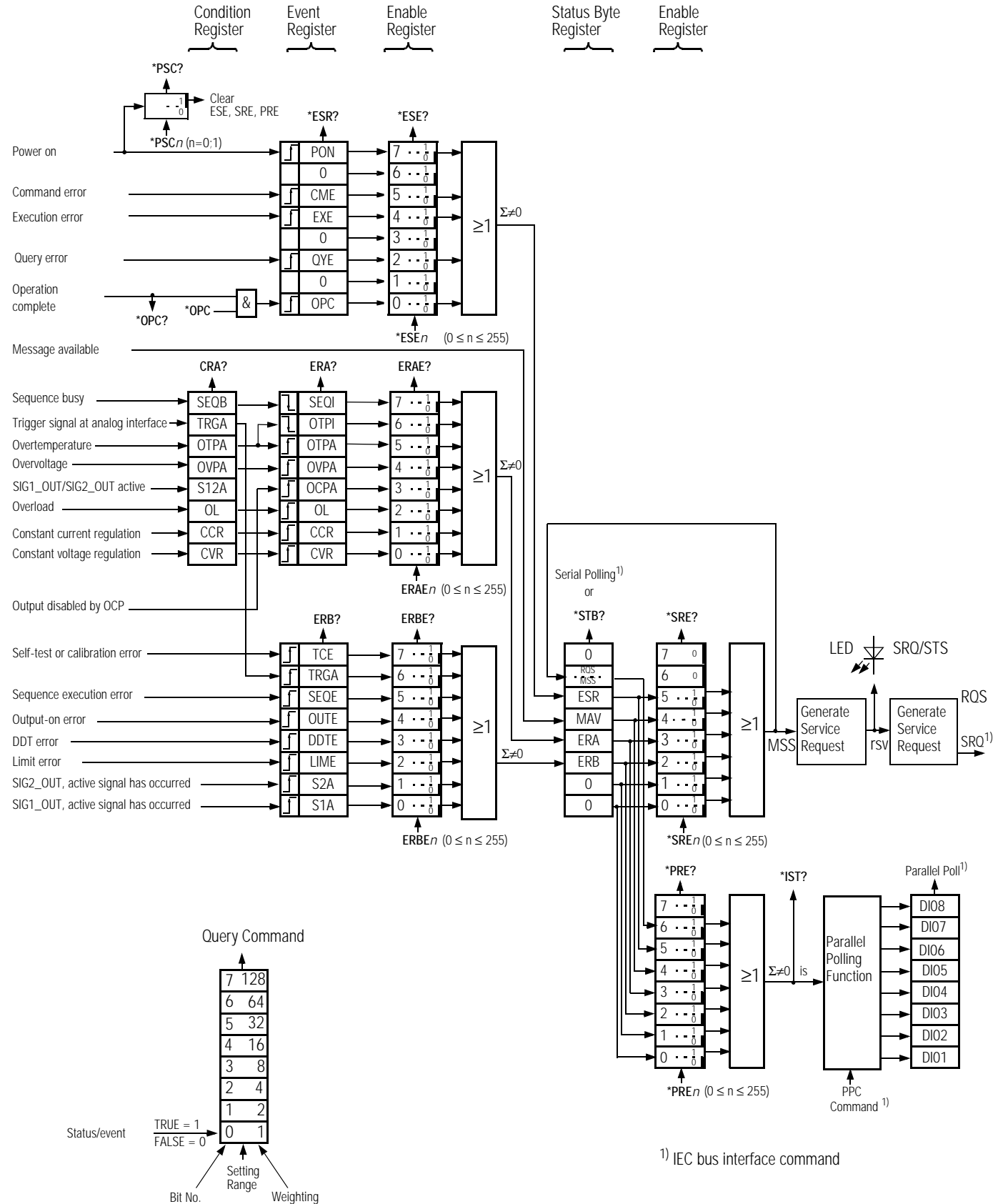
6.3 Status and Events Management

The device is equipped with special registers for the recognition of:

- Programming errors (e.g. receipt of a faulty command)
 - Device status (e.g. current regulating output mode)
 - Events (e.g. output deactivated by OCP function)
- These can be queried by the controller.

The status and event registers can **only** be **configured** and **queried** via the

serial or the parallel interface!



6.3.1 Overview – Significance of Register Contents

- TCE Self-test error or error during calibration**
- An error was detected during the self-test.
 - An error occurred during device calibration.
 - Calibration was not completed successfully.
 - At least 1 calibration value could not be used because it was outside of the calibration range.
- CCR Constant current regulation**
Output is (was) in current regulating mode.
- CVR Constant voltage regulation**
Output is (was) in voltage regulating mode.
- CME Command error**
- Unknown command
 - Syntax error
 - Parameter is not within the setting range.
- DDTE Define device trigger error**
- *DDT command string is longer than 80 characters.
 - *TRG command included in the *DDT command string
- EXE Execution error**
- Command-specific parameter limits have been exceeded.
 - A command or a parameter is incompatible with a current operating status.
- LIME Limit error**
Limit error after **USET**, **ISET**, **ULIM** or **ILIM** configuration command
- Voltage or current setpoint was set higher than allowed by the selected limit value.
 - A limit value has been selected which is less than the currently selected voltage or current setpoint.
- MAV Message available**
Ready message after query command
- Requested information is available at the data output buffer.
 - **MAV bit query** is only sensible via serial polling if IEC bus control is used.
- OCPA Overcurrent protection active**
- The output has been deactivated by the OCP function.
 - Reactivate with **OUTPUT ON**.
- OL Overload**
Overload message
- Power limiting has been activated.
- OPC Operation complete**
- The commands which preceded the ***OPC** command have been executed (time synchronization).
- OTPA Overtemperature protection active**
- The device has overheated, e.g. due to insufficient ventilation.
 - The **OUTPUT ON** configuration command is ignored as long as this condition exists and results in renewed setting of the **OTPA bits** in the event register.
- OTPI Overtemperature protection inactive**
Ready message after overtemperature message **OTPA**
- The device has cooled back down.
 - The output remains inactive if the **POWER-ON** function is set to **SBY** or **RST**.
 - The output is reactivated automatically if the device is set to **RCL**.
- OUTE Output error**
This error message follows the **OUTPUT ON** configuration command.
- Activation of the output is disabled with the **OUTPUT OFF Signal** at the analog interface trigger input.
 - Display: "Err 25"
- OVPA Overvoltage protection active**
- The output has been deactivated.
 - Reactivate with **OUTPUT ON**.
- PON Power on**
- Device was previously switched off.
- QYE No message in the output queue**
Error message after addressing as talker
- No message is available at the output buffer (yet).
- SEQB Sequence busy**
Status message: **SEQUENCE** function is running
- SEIQ Sequence inactive**
Completion message
- **SEQUENCE** function has been completed or interrupted.
- SEQE Sequence error**
This error message is generated after **SEQUENCE GO**.
- The voltage or current value recalled from the **SEQUENCE memory** is **greater than** the selected limit value (**USET > ULIM** or **ISET > ILIM**), display: "Err 21".
 - Memory locations between the start and stop addresses do not contain any executable values, display: "Err 22".
 - The **SEQUENCE** function is aborted when this error message occurs.
- S1A SIG1_OUT, an active signal has occurred.**
- S2A SIG2_OUT, an active signal has occurred.**
- S12A SIG1_OUT or SIG2_OUT active**
- TRGA Trigger at analog interface**
A trigger signal has been detected at the analog interface.

6.3.2 Decimal Equivalent of Register Contents

- Querying data registers always results in a decimal number.
- The decimal number indicates the content of the register.
- This number is between 0 and 255 for 8 bit registers.
- The number indicates which register bits are set.
- The number must be converted to a binary value to this end.

Example:

The query **CRA?** results in a response of **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 in condition register A (CRA)** are set.
 - 3 (OL = overload)
 - 5 (OVPA = overvoltage)
 - 6 (OTPA = overtemperature)
- These bits may trigger an SRQ (service request).

6.3.3 Command and Queries

6.3.3.1 *CLS – Clear Status Command



Configuration

Function

- Deletes event registers **ESR**, **ERA**, **ERB**.
- Deletes the status byte register (except for the MAV bit).
- Any existing service request **SRQ** is cancelled.
- Manual operation is not possible.

Programming

Config. command: ***CLS**

Example (HP Basic):

OUTPUT 713; "CLS"

Influence

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

6.3.3.2 CRA? – Condition Register



Query

Function

- Condition Register A.
- 8 bit condition register
- Current status of certain device functions at the point in time the query was made
- Direct writing or deletion is not possible.
- Example
 - Output is in current regulating mode (**CCR**):
Status bit 1 "**CCR**" in the **CRA** is set to "= 1".
 - Status bit remains set for the duration of current regulation.
 - The **CRA** can be queried as often as desired.
 - The contents of the **CRA** are not influenced by the query.
 - Output exits current regulating mode:
Status bit 1 "**CCR**" in the **CRA** is reset to "= 0".

Programming

Query command: **CRA?**

Response string: *n* (decimal equivalent)

Value: $0 \leq n \leq 255$

Length: always 3 characters

Example (HP Basic):

OUTPUT 713; "CRA?"
ENTER 713; A\$; DISP A\$

→ Display: 002 {002₁₀ = 0000 0010₂}
(CCR, constant current regulation)

6.3.3.3 ERA?, ERB?, *ESR? – Event Registers



Query

Function

- Event register (see also figure, chapter).
- The device is equipped with **3 event registers**.
- Each event register has its own **enable register**.
- The registers can be **queried separately**.
- Acquisition and storage to memory of **status changes** to specific device functions
- Information concerning **device events** since the last query
- Inputs react in an **edge-triggered** fashion.
- A **bit is set** if the corresponding function changes:
 - from the **FALSE** to the **TRUE** condition (input \uparrow),
 - from the **TRUE** to the **FALSE** condition (input \downarrow).
- The registers are reset by the query.
- The ***CLS** configuration command clears all event registers.
- Example:
 - Faulty program command occurs.
 - Command error bit 5 "**CME**" in the **ESR** is set to "= 1".
 - Bit 5 remains set, even if correct commands follow.
 - After querying the **ESR**, the **CME** bit is reset.

Programming

Query command: ***ESR?** standard event register

ERA? event register A

ERB? event register B

Response string: *n* (decimal equivalent)

Value: $0 \leq n \leq 255$

Length: always 3 characters

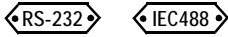
Example (HP Basic):

OUTPUT 713; "*ESR?"
ENTER 713; A\$; DISP A\$
→ Display: 032 {032₁₀ = 0010 0000₂}
(CME, command error)

Note

Please refer to chapter 6.3.2 regarding conversion of the decimal equivalent for representation of set bits.

6.3.3.4 ERAE, ERBE, ESE, SRE, PRE – Enable Registers



Configuration

Function

- **Enable register** (see also figure, chapter).
- The device is equipped with **5 enable registers**.
- **Mask** for forwarding **messages** from the event registers and the status byte register
- Correct **masking** is only possible after the required **bits** have been **set** in the corresponding enable register.
- **Event information** is only forwarded by set registers.
- **Selective** enabling or disabling of **SRQ** or **IST** for event messages
- Registers can be written **separately**.
- Register contents are **non-volatile**.
- Register contents are not deleted by queries, the ***CLS** command or device functions.
- **Deletion** only occurs if the device is switched off when the non-volatile PSC flag is set to “= 1”.
- **Deletion** is possible by entering the value “0”.

Programming

Config. 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 polling 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"
ERAE bits 4 and 7 are prepared for forwarding $\{1001\ 0000_2 = 144_{10}\}$



Query

Function

- The **query** results in read-out of the configured register value.
- Registers can be queried **separately**.
- **Queries** have no influence on register contents.

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 polling enable register

Response string: *n* (decimal equivalent)

Value: $0 \leq n \leq 255$

Length: always 3 characters

Example (HP Basic):

OUTPUT 713; "ERAE?"
ENTER 713; A\$; DISP A\$

→ Display: 144 $\{144_{10} = 1001\ 0000_2\}$

6.3.3.5 IST? – Individual Status Query



Query

Function

- Command for directly querying parallel poll information
- Current status of the IEEE488.1 IST message at the device
- Content is not influenced by the query.
- An ASCII coded byte is returned in response.

Programming

Query command: ***IST?**

Response string: 0 : "local message is false"

1 : "local message is true"

Length: always 1 character

Example (HP Basic):

OUTPUT 713; "**IST?"

→ Display: 0

6.3.3.6 OPC – Operation Complete Flag



Configuration

Function

- Allows for **synchronization** of the controller and the device.
- **OPC** results from the command which is supposed to generate a signal.
- After completion of the command, the “0” **OPC** bit is set in the standard event register **ESR**.
- Depending upon masking in the **ESE**, an **SRQ** can be generated in this way.
- Messaging takes places via the parallel interface only.

Programming

Config. command: ***OPC**

Example (HP Basic):

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



Query

Function

- Are the controller and the device **synchronized**?
- ***OPC?** follows the command which is supposed to generate a message.
- A signal is transmitted to the controller after the command has been completed.
- Messaging may take place via the **serial** and the **parallel** interface.

Programming

Query command: ***OPC?**

Example (HP Basic):

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

6.3.3.7 PSC/POC – Power-On Status Clear Flag



Configuration

Function

- Performance relative to the contents of non-volatile enable registers when the device is switched off

Programming

Config. command: ***PSC** *n*

Parameter: *n* (value)

Setting range: "0": enable registers are not deleted
"1": enable registers are deleted

Example (HP Basic):

```
OUTPUT 713;"*PSC 1"
```



Query

Function

- Status display for PSC flag
- Indication regarding performance relative to the contents of non-volatile enable registers when the device is switched off
PSC flag remains unchanged after the device is switched off.
PSC flag remains unchanged after the *CLR command.

Programming

Query command: ***PSC?**

Response string: "0" enable registers are not deleted
"1" enable registers are deleted

6.3.3.8 STB – Status Byte Register



Query

Function

- Reads out register contents:
 - Status of group signals from all three event registers: ESR, ERA and ERB (bits 2, 3 and 5).
 - Status of data output buffer (not empty → bit 4 MAV = 1, empty → bit 4 MAV = 0).
 - Status of MSS group message masked with the SRE enable register resulting from its own bits 2 through 5
 - Bits 0, 1 and 7 are not used and are always set to "0".

Programming

Query command: ***STB?**

Response string: *n* (decimal equivalent)

Value: $16 \leq n \leq 124$

Length: always 3 characters

Example (HP Basic):

```
OUTPUT 713;"*STB?"
```

```
ENTER 713; A$; DISP A$
```

```
→ Display: 034 {0342 = 0001 100010}
```

Comments

- A message is always made available by the query.
- This response string is made available at the data output buffer.
- The MAV bit is set as a result.
- Value *n* is always ≥ 16 in this case.
- The *CLS command clears the status byte register.
- The only exception is the MAV bit.
- SRQ is also reset.

6.3.3.9 SRQ – Service Request



Function

- The service request **SRQ** is only available via the **IEEE** interface.
- **SRQ** can be activated by **all** devices which are connected to the **IEC bus**.
- **SRQ** is the **only way** for a device to trigger a defined action at the controller.
- The **SRQ line** is activated by the **KONSTANTER**, when it requires service from the controller.
- **SRQ** allows for simultaneous execution of several tasks by the controller, and thus increases efficiency.
- The device is capable of processing **other tasks** until it transmits an **SRQ to the controller**.
- The master computer is capable of **responding to the SRQ message** at the IEC bus with a serial device status query (serial polling).
- The mast computer determines **which device has transmitted the SRQ message** and the reason for the message in this way.
- If **only one device has been connected to the IEC bus**, the controller is capable of **reading out the status byte directly** after an SRQ, and of initializing the desired function.
- In general, the **controller** should read out information concerning conditions and events at the device.
- The service request is transmitted via the **common interrupt line (SRQ)** at the IEC bus.
- The **trigger conditions** for the **SRQ** can be selected from all messages which occur in the event registers (including MAV).
- The **enable registers can be set correspondingly**, in order to determine which (one or several) event messages result in an SRQ message (**SRQ masking**).
- If **all interconnected SRQ compatible devices** are also equipped with the **parallel polling function**, determining which device transmitted the SRQ can be accomplished **more rapidly** by means of a **parallel status query**, as long as the required configuration has been previously implemented.

Example: SRQ generation upon receipt of a faulty command:

- Assuming: All event registers have a value of 0 to start with.
- A faulty command is received.
- The **ESR** standard event register sets bit 4 (**EXE** "execution error") or bit 5 (**CME** "command error").
- Have bits 4 and 5 in the **ESE** enable register been previously set? (***ESE 48** command).
- If so, the **ESR** group message is generated in the **STB** status byte register.
- The corresponding **SRE** enable register must be set to bit 5 (***SRE 32** command).

- The **ESR** bit is now capable of generating the **MSS** group message (master summary status).
- The **MSS** group message is once again entered at bit 6 in the status byte **STB**.
- This indicates that **at least one reason** for the read-out of an **SRQ** message exists.
- The **SRQ** message is triggered by the downstream **service request function**.
- The corresponding **commands** for **setting** the assumed **SRQ** conditions are thus: ***ESE 48; *SRE 32**.
- Service requests from the **ERA** and **ERB** event registers or from the **MAV** message are generated in the same way.

Comments

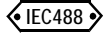
- We recommend enabling the **following events** at the corresponding **registers** for the SRQ message:

CME	command error	EXE	execution error
QYE	query error	OTPA	OTP activated
TSTE	self-test error	LIME	limit error
OVPA	OVP activated	OCPA	OCV activated
OUTE	OUTput error	SEQE	sequence error
DDTE	define device trigger error		
- The required **configuration commands** are as follows: ***ESE 52; ERAE 56; ERBE 190; *SRE 52**.
- As soon as just one of these events occurs, the **KONSTANTER** is no longer capable of executing the desired configuration.

RS 232C Serial Interface

- Use of the service request function **SRQ** 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).
- Query the individual status message **IST** and analyze the results.
- Query and analysis can be run at the **KONSTANTER** cyclically and/or after each data transmission.

6.3.3.10 SPOLL – Serial Status Query



Prerequisites

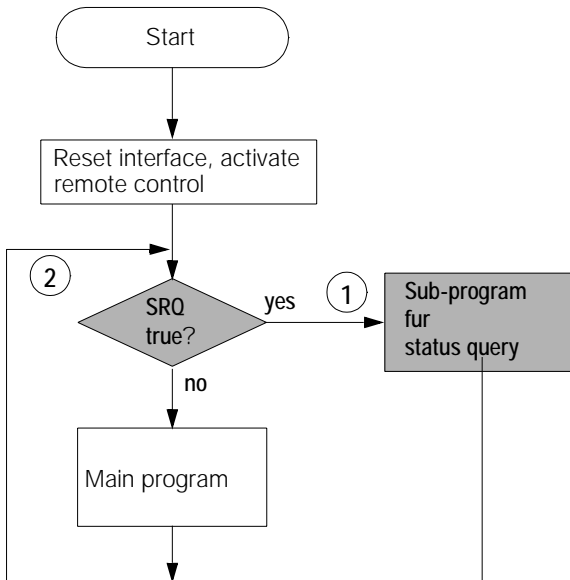
If a device is to be used for “serial polling”, it must fulfill the following prerequisites:

- The device interface must be equipped with an **SRQ function**: Sets the service request via the SRQ line at the IEC bus.
- **Talker function**
- Device must be able to read the **SPE** and **SPD** bus commands (SPE = serial poll enable, SPD = serial poll disable)

The KONSTANTER fulfills all of these requirements!

Function

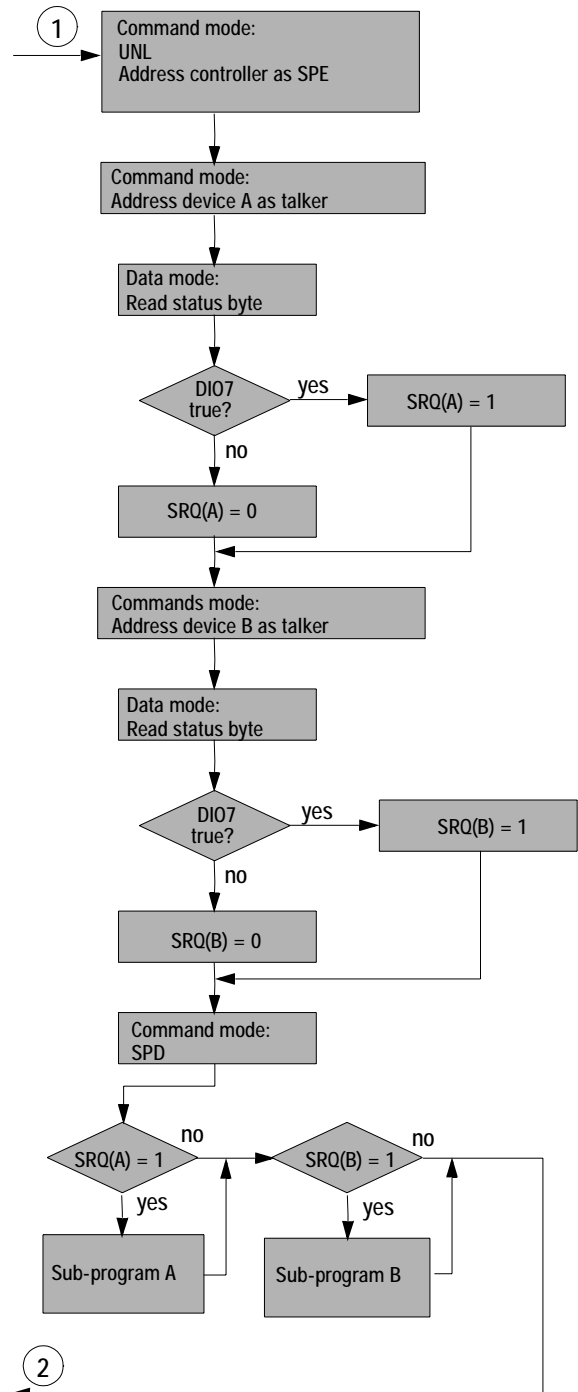
- The controller periodically checks the **SRQ line**.
- An **event** causes the KONSTANTER to generate a **service request**.
- The KONSTANTER **activates the SRQ line**, in order to make the controller aware of the anticipated activity.
- As soon as the controller reads this message, it starts an **interrupt service routine**.



Simplified Schematic of Query with Serial Polling

- Overall handling of the SRQ interrupt and subsequent operation of the SSP-Konstanter is dependent upon controller software.
- If several SRQ compatible devices have been connected to the system, the controller must determine **which device generated the SRQ**.
- The controller sets the entire system to the serial polling mode with the **SPE** command to this end.
- **All interconnected devices** are thus prepared for participation in the serial polling process.
- The controller then **checks all devices** for the **SRQ message**.
- One after the other, each interconnected **device is addressed as a talker**.
- **The status of the data transmission lines** (status byte) is checked at each **addressed device** in the data mode.
- If a **device expects service**, it sets the **DIO7 line to “true”** (RQS message, bit 6 in STB).

- All **other set data transmission lines** indicate the **type** of expected service (STB message).
- After all possible devices have been queried, the controller **ends serial polling** with the **SPD** interface command
- The controller now executes **all special tasks for each device** which has transmitted an **SRQ**.
- The type of service depends upon device software included in the device which transmitted the **SRQ**.



Example of an SRQ Processing Routine

Programming

Example (HP Basic):

Query **ST = SPOLL (713)**

The device with address number 13 transmits the value of its status byte. The value is assigned to the **ST variable** in the BASIC program.

Status Byte Register

The following table shows the **meanings** of the individual bits contained in the status byte register, and their decimal values.

Bit no.	Value	Meaning, when set
0	1	always "0"
1	2	always "0"
2	4	Message from event register B (query ERB!)
3	8	Message from event register A (query ERA!)
4	16	Requested message available (MAV, message available)
5	32	Message from standard event register (query ESE!)
6	64	SRQ message transmitted (RQS)
7	128	always "0"

Comments

- Querying the status byte registers with the serial polling command resets the **RQS bit** (bit 6) ("0").
- All other **STB bits** remain **unaffected**.
- Data stored to the **output buffer** is also **unaffected**.
- Alternatively, the **status byte register** can be read out via the **serial interface** with the ***STB?** query command.
- During this process, data in the **output buffer** are **overwritten with the value of the status byte**.
- Querying the respective event registers resets their **summation bits** (bits 2, 3 and 5).
- The ***CLS** command also resets the **summation bits**.
- The **MAV** bit (bit 4) is reset when the requested message which has been made available at the **data output buffer** is **read out**.
- IEC bus commands **DCL** and **SDC** reset the **MAV** bit as well.

Note

- The **command set** included with **IEC bus controller interfaces** in accordance with **IEC 625-2** (and **IEEE488.2**) contains commands, which significantly simplify the SRQ processing routine:
IEC 625-2 **ALLSPOLL** and **FINDRQS** functions

6.3.3.11PPOLL – Parallel Status Query



Prerequisites

If a device is to be used for “parallel polling”, it must fulfill the following prerequisites:

- Programming is only possible via the IEC interface.
- The device must be equipped with a parallel polling function for its IEC interface.
- The device's decoder must be capable of processing **bus and secondary commands** utilized during **parallel polling**.
- It must be possible to assign a data transmission line to the device (DIO1 ... DIO8).
- The device sets these lines to “true” during parallel polling, if activity is required.

The KONSTANTER fulfills all of these requirements!

Function

- **Simultaneous** status querying for up to **8 devices**.
- In response, the KONSTANTER makes **one bit** available at the **data bus line assigned to the device** by the controller.
- This bit is set in accordance with **STB masking** from the **PRE** (parallel poll enable register).
- The **value** of this bit only indicates whether or not one of the bits in the status byte register **STB has been set to (= “1”)**.
- The **contents** of the **STB** are independent of **masking** at the **event register**.
- These **maskings** and **SRQ masking** are of equal significance as regards **setting the value** of the **parallel polling bit**.

Configuring Parallel Polling

- Assign a **data transmission line** to the KONSTANTER (DIO1 ... DIO8).
- Tell the KONSTANTER to which value the **sense bit** should be set for this line in the event of an “IST” message.
TRUE ($\hat{=}$ sense bit = 1) or FALSE ($\hat{=}$ sense bit = 0)
- “IST” (individual status) is the **group signal** as masked by the **PRE**.
- **Execution** is accomplished with the addressed **IEC bus command PPC** (parallel poll configure).
- **Programming** (HP Basic)

Config. command: **PPOLL CONFIGURE 713**; w
Parameter: v (Integer)
Setting range: v = value (sense bit [0;1]) · 8 + DIO_n – 1
0 ≤ v ≤ 7 for value (sense bit) = 0
8 ≤ v ≤ 15 for value (sense bit) = 1

Example

PPOLL CONFIGURE 713;10
Data transmission line DIO 3 and a sense bit value of “1” have been selected.
{1 · 8 + 3 – 1 = 10}

Triggering Parallel Polling

- **All devices to be queried** must be configured with the **PPC** command.
- **Triggering** is accomplished with the **IEC bus command PPE** (parallel poll enable).
- **Programming** (HP Basic).

Example:

Query **P = PPOLL (7)**
The decimal equivalent of the 8 data transmission lines is stored to the **P variables** of the BASIC program.

Deleting the “Parallel Polling” Configuration

- The configuration required in order to respond to parallel polling can be deleted at each device.
- The **configuration** installed with the **PPC** command can be deleted with the **IEC bus command PPU** (parallel poll unconfigure).
- **Programming** (HP Basic).

Example:

Config. command: **PPOLL UNCONFIGURE 713**
Deletes the parallel polling configuration at the device with address 13.
Config. command: **PPOLL UNCONFIGURE 7**
Deletes the parallel polling configuration at all interconnected devices.

Configuring the PRE - Parallel Poll Enable Register

See chapter 6.3.3.4.

Querying the PRE - Parallel Poll Enable Register

See chapter 6.3.3.4.

Deleting the PRE - Parallel Poll Enable Register

- Write the value “0” to the register.
- The register is deleted when the device is switched off, if the power-on status clear flag **PSC** is set to **TRUE** (“1”).

Comments

- Neither the **SRQ** message, nor the contents of the status byte register or the data output buffer are affected by parallel polling.
- The device may not be addressed as a talker for parallel polling.
- If the parallel poll enable register **PRE** is set to the **same value** as the service request enable register **SRE**, the **same conditions** apply to the generation of the individual status message **IST** and to the master summary status message **MSS** which triggers the **SRQ**.
- If all **SRQ** compatible devices are also equipped with the parallel polling function, it may be possible to determine which **device has generated the SRQ more rapidly by means of parallel status polling** than would be the case with serial status polling.

7 Balancing the SSP-KONSTANTER



RS-232

IEC488

7.1 Definition of Terms and General Information

7.1.1 Adjustment

- Is also referred to as **balancing**.
- To **adjust (balance)** a measuring instrument such that measuring error is minimized to the greatest possible extent.
- **Balancing** is a procedure which changes the measuring instrument in a lasting fashion.

7.1.2 Calibration

- To determine the degree of error at an instrument.
- **Indicating measuring instruments:**
Deviation of the displayed value from the value deemed correct.
- **Signal transmitting measuring instruments:**
Deviation of the signal value from the value it would have demonstrated under ideal transmission conditions with a defined input value.

7.1.3 Retracing

- Retracing is a process by means of which the measured value indicated by a measuring instrument can be traced back, in one or several steps, and compared to the national standard for the measured quantity in question.

7.1.4 General Information

The balancing procedure integrated into the KONSTANTER (CAL) allows for the **elimination of deviation of the actual value from the setpoint** which may be caused by aging of device components at a user-defined interval to a great extent.

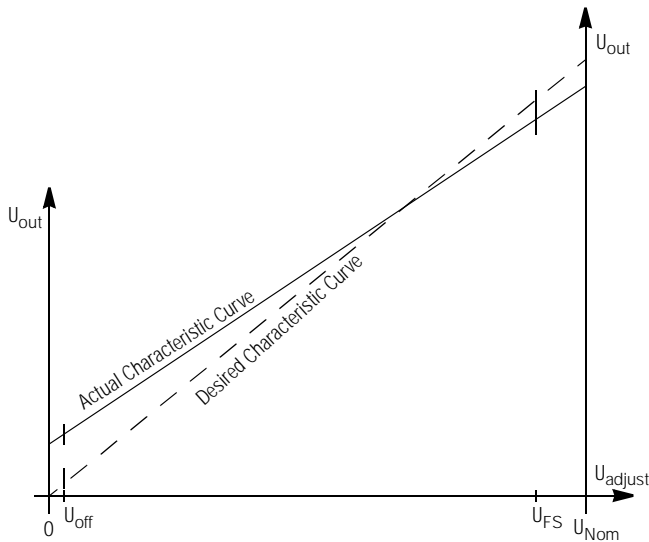


Figure 7.1.4 a Continuous Adjustment of Uset

0:	zero point
U_{Nom}	nominal voltage
U_{adjust}	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 balance the system, 2 **fixed voltage values** (U_{off} and U_{FS}) are selected (**setpoint values**), and a straight line is drawn between them (desired characteristic curve).
- The corresponding externally measured values (**actual values**) are entered to the system and compared with the setpoint values.
- The actual values are also connected with a straight line, and linear deviation from the setpoint line is saved to memory (slope and ordinates).
- These values are saved to the EEPROM and are taken into consideration for all adjustments.
- Each time a new voltage value is selected, its position along the desired characteristic curve is correlated to the corresponding position along the actual characteristic curve in order to allow for precision adjustment of the voltage value.
- The same applies to current value balancing.
- Adjustment can be performed manually or automatically with the help of a PC via the interfaces.

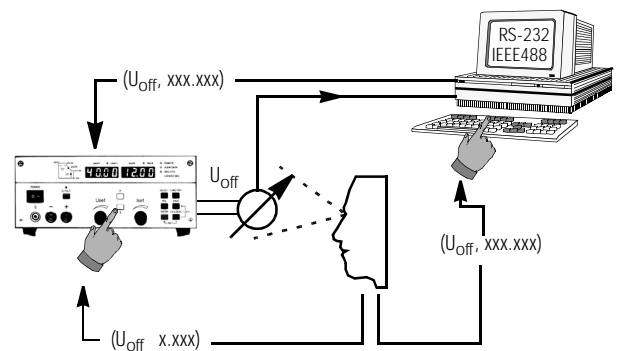


Figure 7.1.4 b Balancing the KONSTANTER Manually or with the PC

7.2 Manually Triggered Self-Test

- The device tests itself for possible error.
- Select the **CAL** function group from the function group menu.
- Press the **< SELECT >** key.
- "tEst" "Strt" appears at the display.
- Start the self-test with the **< ENTER >** key.
- The LED "LOCKED/SEQ" LED blinks for the duration of the self-test.
- Recognized errors are briefly indicated with the error message "Err" "11" (see error list).

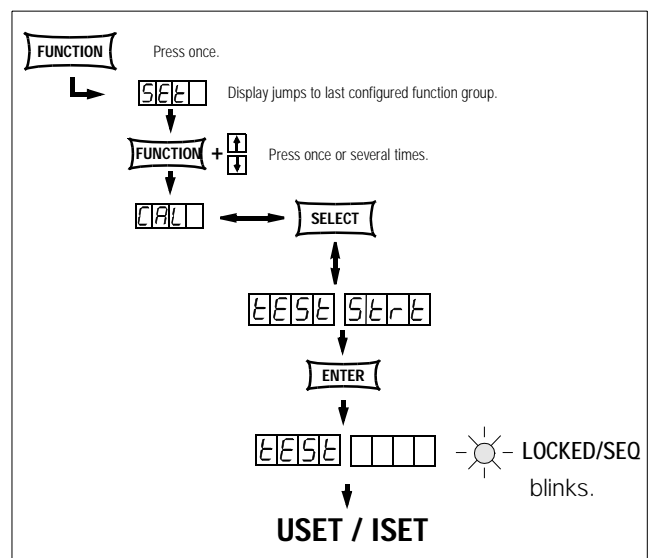


Figure 7.2 Triggering the Self-Test Manually

7.3 Balancing the KONSTANTER

7.3.1 Balancing the KONSTANTER Manually

Preparation

A highly accurate measuring instrument with a resolution which is approximately one class better than that of the KONSTANTER is required for balancing (see Technical Data).

For example, **METRAtop50** series benchtop multimeters are very well suited, and include an integrated RS 232 serial interface, an optional IEEE 488 interface and an optional calibrator.

Connecting the measuring instrument for output voltage balancing:

The **power output** at the KONSTANTER must be **deactivated (OUTPUT OFF)**.

Connect the **measuring instrument** directly (**parallel**) to the **power output** at the KONSTANTER. Balancing accuracy can be increased by additionally connecting the sensing leads.

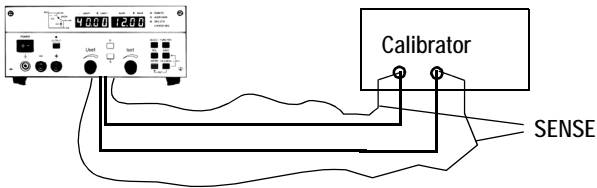


Figure 7.3.1 a Wiring Schematic for Balancing Output Voltage

Switch the measuring instrument on and select the voltage measuring range required for the measurement. The measuring range upper limit must be at least as high as nominal voltage at the KONSTANTER.

Select the voltage balancing function and then **activate the power output** at the KONSTANTER (**OUTPUT ON**).

Connecting the measuring instrument for output current balancing:

The **power output** at the KONSTANTER must be **deactivated (OUTPUT OFF)**.

Observe the maximum current range at your measuring instrument.

If the **maximum output current value** at the KONSTANTER is less than the **maximum current measuring range** of the measuring instrument, the measuring instrument may be connected directly **in series** to the **power output**.

If the **maximum output current value** is **greater than the maximum current measuring range** of the measuring instrument, connect the measuring instrument via a **shunt resistor** with an appropriate resistance value to the power output at the KONSTANTER. Balancing accuracy can be increased by additionally connecting the sensing leads.

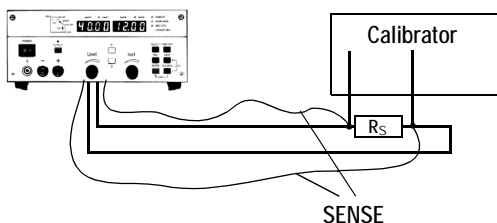


Figure 7.3.1 b Wiring Schematic for Balancing Output Current

Switch the measuring instrument on and select the current measuring range required for the measurement. The measuring range upper limit must be at least as high as nominal current at the KONSTANTER.

Select the current balancing function and then **activate the power output** at the KONSTANTER (**OUTPUT ON**).

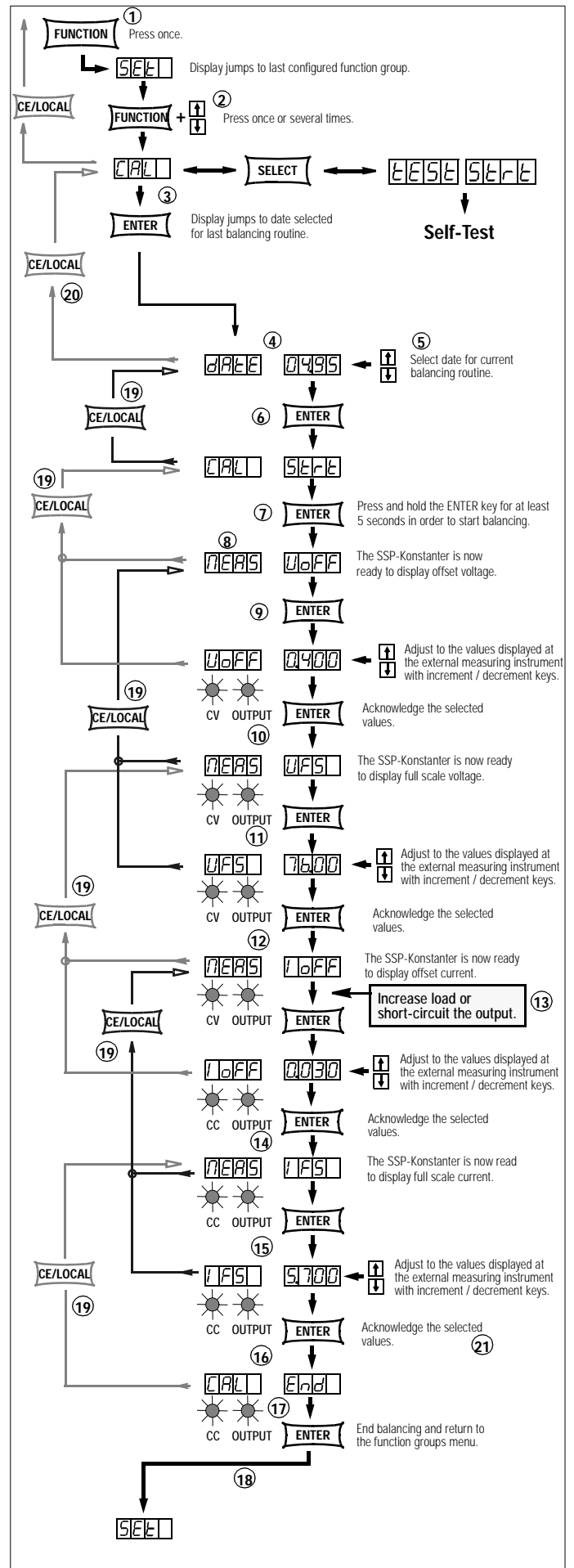


Figure 7.3.1 c Balancing the Device Manually

Selecting the Balancing (Calibration) Function

With the KONSTANTER in the standard functions mode:

- 23 Press the <FUNCTION> key once in order to open the function groups menu.
- 24 Now press the <FUNCTION> key repeatedly until the **CAL** function group appears at the display.
- 25 If **CAL** appears at the left-hand display, press the <ENTER> key. This opens the menu for the balancing (and calibration) function.

Entering the New Balancing Date

- 26 **date** appears first in the left-hand display, and the date of the last balancing routine appears at the right-hand display.
- 27 Set the display to today's date with the <↓> or the <↑> key.
- 28 After the date has been correctly set, press the <ENTER> key. The date is saved to memory and **CAL Strt** appears at the display. Strt blinks.

Starting the Balancing (Calibration) Routine

- 29 Press and hold the <ENTER> key for **at least 5 seconds** in order to start the balancing (calibration) routine.
If the <ENTER> key is depressed for less than 5 seconds, the device is automatically returned to the standard display.
In this case, press the <FUNCTION> key again in order to return to the **CAL Strt** function.

Balancing Offset 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 at the KONSTANTER appears at the right-hand display (0.5% of U_{Nom}).
The blinking digit shows the smallest adjustable decimal place.
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, adjust the value at the KONSTANTER to the value displayed at the measuring instrument with the <↓> or the <↑> key.
- 32 Save the corrected **UoFF** value to the KONSTANTER by pressing the <ENTER> key.
After the <ENTER> key has been pressed, **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 at the KONSTANTER appears at the right-hand display (95% of U_{Nom}).
The blinking digit shows the smallest adjustable decimal place.
Compare this value with the value displayed at the external measuring instrument.
If these two values are different, adjust the value at the KONSTANTER to the value displayed at the measuring instrument with the <↓> or the <↑> key.
- 34 Save the corrected **UFS** value to the KONSTANTER by pressing the <ENTER> key.
MEAS IoFF appears at the display.

Balancing Offset and Full Scale Current

- 35 The KONSTANTER must be in the **current regulating mode** in order to balance **offset and full scale current!**
Increase the load or short-circuit the output to this end. 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 at the KONSTANTER appears at the right-hand display (0.5% of I_{Nom}).
The blinking digit shows the smallest adjustable decimal place.
Compare this value with the value displayed at the external measuring instrument.
If these two values are different, adjust the value at the KONSTANTER to the value displayed at the measuring instrument with the <↓> or the <↑> key.
- 36 Save the corrected **IoFF** value to the KONSTANTER by pressing the <ENTER> key.
After the <ENTER> key has been pressed, **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 at the KONSTANTER appears at the right-hand display (95% of I_{Nom}).
The blinking digit shows the smallest adjustable decimal place.
Compare this value with the value displayed at the external measuring instrument.
If these two values are different, adjust the value at the KONSTANTER to the value displayed at the measuring instrument with the <↓> or the <↑> key.
- 38 Save the corrected **IoFF** value to the KONSTANTER by pressing the <ENTER> key.

End the Balancing Routine

- 39 **CAL End** appears at the display after the last changed value has been acknowledged.
Exit the balancing function by pressing the <ENTER> key.
- 40 **The entire balancing routine is now first saved to memory!**
SEt appears at the left-hand display. The device has been returned to the function groups menu.
A new function group can be selected with the <FUNCTION> key, or the menu can be exited entirely by pressing the <CE/LOCAL> key, which returns the device to the standard display.

Premature, Manual Interruption of the Balancing Routine

- If it is determined during balancing that deviation between the values from the KONSTANTER and the external measuring instrument are too great, and that balancing can no longer be performed, the balancing routine can be aborted and the device can be reset to the previous balancing parameters.
- 41 Repeatedly press the <CE/LOCAL> key until **CAL** appears at the left-hand display.
The device has been returned to the beginning of the balancing routine.
 - 42 Press <CE/LOCAL> again. The balancing function is exited and the display is returned to the function groups menu.

Automatic Interruption of the Balancing Routine

- 43 If the KONSTANTER cannot be balanced due to excessive measured value deviation, the balancing routine is rejected during the last step.
The KONSTANTER sets itself to the **UNCAL** status, resets the device to default values (not previous values) and exits the balancing function. The Cal error flag is set each time the KONSTANTER is switched on.

7.3.2 Computer-Aided Balancing of the KONSTANTER

Preparation

Connect the bus cable to the ports at the PC and the KONSTANTER.

Proceed as described under 7.2.1, manual balancing.

Computer-Aided Balancing (manual)

Balancing is performed interactively with the PC, the KONSTANTER and the measuring instrument. The command used for controlling the KONSTANTER with the PC is:

CAL *txt, v*
Parameter *txt, v*

Alternatives for the parameters *txt* and *v*:

<i>txt, w</i>	Beschreibung
Uoff	Start balancing, set U offset
Uoff, xxx.xxx	U offset: externally measured voltage
Ufs	Set U full scale value
Ufs, xxx.xxx	U full scale value: externally measured voltage
Ioff	Set I offset
Ioff, xxx.xxx	I offset: externally measured current
Ifs	Set I full scale value
Ifs, xxx.xxx	I full scale value: externally measured current
DATE, mm.yy	Balancing date, end balancing

In order to implement this command, it must be translated into a language which is supported by the interface. We use HP Basic for IEC bus systems, which results in the following syntax:

Output 713; "CAL Uoff"

Command Element	Description
Output	A command which instructs the PC to transmit data to an external device via the interface
713	The KONSTANTER's address (external device)
"CAL Uoff"	Command for the KONSTANTER, beginning and end are identified with " "

Example of Balancing Performed with the PC

Balancing must be performed as described below in the indicated order.

OUTPUT 713; "CAL Uoff" ↵

The command to start balancing is transmitted to the KONSTANTER. The KONSTANTER sets itself to the Uoff value.

Read the value displayed at the external measuring instrument.

OUTPUT 713; "CAL Uoff, 0.478" ↵

0.478 is the value displayed at the external measuring instrument. It is entered as a numeric parameter.

OUTPUT 713; "CAL Ufs" ↵

The KONSTANTER sets itself to the Ufs value.

Read the value displayed at the external measuring instrument.

OUTPUT 713; "CAL Ufs, 71.00" ↵

71.00 is the value displayed at the external measuring instrument. It is entered as a numeric parameter.

OUTPUT 713; "CAL Ioff" ↵

The KONSTANTER sets itself to the Ioff value.

Read the value displayed at the external measuring instrument.

OUTPUT 713; "CAL Ioff, 0.048" ↵

0.048 is the value displayed at the external measuring instrument. It is entered as a numeric parameter.

OUTPUT 713; "CAL Ifs" ↵

The KONSTANTER sets itself to the Ifs value.

Read the value displayed at the external measuring instrument.

OUTPUT 713; "CAL Ifs, 5.863" ↵

5.863 is the value displayed at the external measuring instrument. It is entered as a numeric parameter.

OUTPUT 713; "CAL date, 06.95" ↵

As opposed to balancing performed directly at the PC, the date of balancing is entered at the end of the balancing routine. However, the date of the last balancing routine cannot be queried.

Balancing is complete after the date has been entered.

Computer-Aided Balancing (automatic)

Use an additional bus cable in order to connect the PC and the external measuring instrument to one another.

A matching program must be created especially for the utilized interface for fully automated balancing. This program must allow for the exchange of data between the PC, the system multimeter and the KONSTANTER, and must provide for data interpretation and translation.

The above listed commands for the transmission of data are entered with the keyboard in this case.

Adjustable Functions and Parameters

		See following chapter for detailed explanation:				
		Default setting after RESET *RST				
		Save setting with *SAV n				
		Configure via IEEE 488 interface				
		Configure via RS 232C interface				
		Configure manually				
Config. Command	Significance / Influence			n=1...10	n=11...255	
Addr <i>n</i>	Sets the device address for the RS 232 or the IEEE 488 (interface configuration)	X				4.2.4.1
ADDRESS <i>n</i>	<i>n</i> : 0;1; ... ; 31 (device addresses)		X			6.2.1.1
bAUD <i>txt</i>	Sets transmission speed (interface configuration) <i>txt</i> : 50; 75; 150; ... ; 4800; 9600; 19.2t (transmission speed in bits per second)	X				4.2.4.2
CAL	Initialize "CAL" procedure in accordance with operating instructions, chapter 7	X				7.3.1
CAL <i>txt, v</i>			X	X		7.3.2
dbit <i>txt</i>	Select number of data bits (interface configuration) <i>txt</i> : 7; 8	X				4.2.4.3
dly <i>v</i>	Shutdown delay for OCP (setup)	X			X	4.2.1.5
DELAY <i>v</i>	<i>v</i> : 0; 0.1; ... 99.9 (delay time in seconds)		X	X	X	6.2.1.8
DISPLAY <i>txt</i>	Activate / deactivate the digital display <i>txt</i> : off; on		X	X		6.2.1.3
ILIM <i>v</i>	Current setting limit value (setup) <i>v</i> : 12.00 (example: 12.00 A)		X	X	X	4.2.1.2
	$0 \leq v \leq I_{Nom}$					6.2.1.4
ISET <i>v</i>	Current setpoint value <i>v</i> : 10.75 (example: 10.75 A)		X	X	X	4.1.4
	$0 \leq v \leq ILIM$				X	6.2.1.8
OCP <i>txt</i>	Current limiting reaction time (overcurrent protection), (setup) <i>txt</i> : oFF; on (current regulating / output shutdown after delay time dLY)	X	X	X	X	4.2.1.4
						6.2.1.11
Output (key)	Activate / deactivate the output	X				4.1.5
OUTPUT <i>txt</i>	<i>txt</i> : OFF; ON		X	X	X	6.2.1.12
OVP <i>v</i>	Overvoltage threshold value (setup)		X		X	4.2.1.3
OVSET <i>v</i>	<i>v</i> : 32.5 (example: 32.5 V)		X	X	X	6.2.1.13
Pbit <i>txt</i>	Configure parity bits (interface configuration) <i>txt</i> : nonE no parity bit ZEro always 0 EVEN even odd odd onE always 1	X				4.2.4.4
pon <i>txt</i>	Select power-on status (setup)	X				4.2.1.6
POWER_ON <i>txt</i>	<i>txt</i> : rSt (default setting) SbY (last setting, output active) rCL (last setting)		X	X		6.2.1.15
rEP <i>n</i>	Number of sequence repetitions (sequence)	X			X	4.2.3.6
REPETITION <i>n</i>	<i>n</i> : 1; ... ; 255 $0 \triangleq \infty$		X	X	X	6.2.1.16
rnd <i>txt</i>	Round displayed value (Setup) <i>txt</i> : 0; -1; -2 (no rounding: round to one or two decimal places)	X				4.2.1.8
Sbit <i>txt</i>	Configure the stop bit (interface configuration) <i>txt</i> : 1; 2	X				4.2.4.4
SEQ <i>txt</i>	Sequence, automatic memory recall	X				4.2.3.7
SEQUENCE <i>txt</i>	<i>txt</i> : Go (start); off, on (close / end, open) hold (pause); cont (continue); strt, step, stop (single step control in remote mode)		X	X		6.2.1.17
SIG1 <i>txt</i>	Signal output 1 (analog interface)	X				4.2.2.2
SIG2 <i>txt</i>	Signal output 2 (analog interface)	X				4.2.2.3
Sig1_Sig2 <i>txt1, txt2</i>	<i>txt</i> : oFF SIG inactive (passive, high) on SIG active (active, low) out Signal level dependent upon output activation status OUTPUT on: passive, high OUTPUT OFF: active, low ModE Signal dependent upon currently selected control mode OFF or CV: passive, high CC or OL: active, low SEq Signal dependent upon activation of the SEQUENCE function Function running: active, low SSEt Signal dependent upon SSET switching function (→ SEQUENCE) OFF: passive, high ON: active, low U_Lo Compare measured voltage value with USET from SEQUENCE memory location 254 Measured voltage value ≥ comparison value: passive, high Measured voltage value < comparison value: active, low U_Hi Compare measured voltage value with USET from SEQUENCE memory location 255 Measured voltage value ≤ comparison value: passive, high Measured voltage value > comparison value: active, low I_Lo Compare measured current value with ISET from SEQUENCE memory location 254 Measured voltage value ≥ comparison value: passive, high Measured voltage value < comparison value: active, low I_Hi Compare measured current value with ISET from SEQUENCE memory location 255 Measured voltage value ≤ comparison value: passive, high Measured voltage value > comparison value: active, low		X	X		6.2.1.18

Function-Specific Commands and Device Settings

		See following chapter for detailed explanation:						
		Default setting after RESET *RST						
		Save setting with *SAV n						
		Configure via IEEE 488 interface						
		Configure via RS 232C interface						
		Configure manually						
Config. Command	Significance / Influence				n=1...10	n=11...255		
SSEt <i>txt</i>	Set a message signal (sequence / analog interface) <i>txt</i> : oFF; on (message signal off / on)	X	X	X	X	X	oFF	4.2.3.2 6.2.1.19
StoP <i>n</i>	Sequence stop address <i>n</i> : 11; ...; 253	X			X		11	4.2.3.5 6.2.1.20
Strt <i>n</i>	Sequence start address <i>n</i> : 11; ...; 253	X			X		11	4.2.3.4
START_STOP <i>n1, n2</i>	<i>n</i> : 11; ...; 253		X	X	X		11; 11	6.2.1.20
tdEF <i>w</i>	Dwell time independent of memory location (sequence) <i>v</i> : 00.01; ...; 99.99 (in seconds)	X	X	X	X		0.01 s	4.2.3.3 6.2.1.21
trG <i>txt</i>	Function selection for trigger input (analog interface)	X					unchanged	4.2.2.1
T_MODE <i>txt</i>	<i>txt</i> : oFF (trigger input deactivated) out (trigger input influences OUTPUT) rcL (memory recall, single step) SEq (controls execution of the sequence) LLO (controls disabling of the front panel controls) UL_ (controls storage of extreme values) remote: "MIN"		X	X				6.2.1.22
TSEt <i>w</i>	Dwell time specific to memory location (sequence) <i>v</i> : 00.00; 00.01; ...; 99.99 (in seconds); tdEF value used automatically when set to 00.00	X	X	X	X	X	tdef	4.2.3.1 6.2.1.23
UL_ <i>txt</i>	Extreme value memory for measured U and I values (setup)	X			X		oFF	4.2.1.7
MINMAX <i>txt</i>	<i>txt</i> : oFF; on; rSt (extreme value memory off / on / reset)		X	X	X	X		6.2.1.9
ULIM <i>v</i>	Voltage setting limit value (setup) <i>v</i> : 15.0 (example: 15.0 V) $0 \leq v \leq U_{Nom}$	X	X	X	X		U_{Nom}	4.2.1.1 6.2.1.24
USET <i>v</i>	Voltage setpoint value <i>v</i> : 12.5 (example: 12.5 V) $0 \leq v \leq ULIM$	X	X	X	X	X	0.000	4.1.1 6.2.1.28
*CLS	Clear status command		X	X			no influence	6.3.3.1
DCL	Clear input and output buffers, all settings and register contents unchanged		X	X			no influence	6.2.2.1
SDC								
*DDT <i>txt</i>	Define device trigger <i>txt</i> : max. 80 characters, example: *DDT USET 10/ISET 3/OUT ON ²⁾		X	X			DDT memory deleted	6.2.2.2
ERAE <i>n</i>	Device-dependent event register A enable command		X	X			no influence	6.3.3.4
ERBE <i>n</i>	Device-dependent event register B enable command		X	X			no influence	6.3.3.4
*ESE <i>n</i>	Standard event enable command		X	X			no influence	6.3.3.4
*OPC	Operation complete command		X	X			no influence	6.3.3.5
*PRE <i>n</i>	Parallel poll enable register command		X	X			no influence	6.3.3.4
*PSC <i>n</i>	Power-on status clear command		X	X			no influence	6.3.3.6
*RCL <i>n</i>	Recall and set <i>n</i> : 1 ... 10 a saved device setting 11 ... 255 saved parameters USET, ISET, TSET and SSET	X	X	X			no influence	6.2.2.5
*RST	Reset device setting to default setting	X	X	X				6.2.2.7
*SAV <i>n</i>	<i>n</i> : 0 Clear memory locations 11 through 200 1 ... 10 Save current device setting 11 ... 253 Save current settings for USET, ISET, TSET and SSET 254, 255 Comparison values USET and ISET	X	X	X			no influence	6.2.2.8
*SRE <i>n</i>	Service request enable command		X	X			no influence	6.3.3.4
SRQ	Service request			X			no influence	6.3.3.9
STORE <i>n, v1, v2, v3, txt</i>	Store parameter data directly to memory <i>n</i> : 11; 12; ...; 253; 254; 255 memory location address <i>v1</i> : Voltage setpoint value <i>v2</i> : Current setpoint value <i>v3</i> : Dwell time specific to memory location <i>txt</i> : Switching function ON or OFF signal level, CLR: delete all data from memory locations		X	X			no influence	6.2.2.9
*TRG	Trigger the function defined by *DDT		X	X			no influence	6.2.2.10
*WAI	Wait to continue command		X	X			no influence	6.2.2.12

Abbreviating commands: Abbreviated commands appear in boldface.
The portion of the command which does not appear in boldface may be omitted.
Example: "OUTPUT ON" = "OU ON"
Generally speaking, large or small case letters can be used for alpha characters.

Setting commands into rows: If several commands are included in a single data string, they must be delimited with semicolons ";".
Example: "USET 12; ISET 8.5; OUTPUT ON"

Representation of numeric parameters:

n : whole number (integer);
v : whole number, fixed-point number or floating-point number with or without exponent

Examples: "12.5", "0012.5", "1.25E1", "+1.25 e+01"

Queryable Functions and Parameters

See following chapter for detailed explanation:										
Constant response string length										
Remote control response string (example)										
Read-out via IEC 488 interface										
Read-out via RS 232 interface										
Display at front panel ³⁾										
					10 characters	10 characters	10 characters			
Measured Value Queries	IMAX?	Max. current value from extreme value memory [A]	X	X	X	IMAX +045.	440		13	6.2.1.5
	IMIN?	Min. current value from extreme value memory [A]	X	X	X	IMIN -000.	010		13	6.2.1.6
	IOUT?	Currently measured current value [A]	X	X	X	IOUT +031.	510		13	6.2.1.7
	MODE?	Current output operating mode, control mode CV = constant voltage, CC = constant current OL = overload, OFF = output deactivated	X ⁴⁾	X	X	MODE CV			8	6.2.1.10
	POUT?	Currently measured power value [W]	X	X	X	POUT +0662	.7		12	6.2.1.14
	UMAX?	Max. voltage value from extreme value memory [V]	X	X	X	UMAX +021.	310		13	6.2.1.25
	UMIN?	Min. voltage value from extreme value memory [V]	X	X	X	UMIN +021.	280		13	6.2.1.26
UOUT?	Currently measured voltage value [V]	X	X	X	UOUT +021.	300		13	6.2.1.27	
Function-Specific Device Queries	DELAY?	Selected delay time for OCP function	X	X	X	DELAY 12.0	0		11	6.2.1.2
	DISPLAY?	Activation status of the 7 segment displays	X	X	X	DISPLAY ON			11	6.2.1.3
	ILIM?	Selected current setting range limit [A]	X	X	X	ILIM +050.	000		13	6.2.1.4
	ISET?	Selected current setpoint value [A]	X	X	X	ISET +048.	000		13	6.2.1.8
	MINMAX?	Enable status of the extreme value memory	X	X	X	MINMAX ON			10	6.2.1.9
	OCP?	Selected current limiting function	X	X	X	OCP OFF			7	6.2.1.11
	OUTPUT?	Output activation status	X ⁴⁾	X	X	OUTPUT ON			10	6.2.1.12
	OVSET?	Selected threshold value for overvoltage protection [V]	X	X	X	OVSET +050	.0		12	6.2.1.13
	POWER_ON?	Selected shutdown performance	X	X	X	POWER_ON R	ST		12	6.2.1.15
	REPETITION?	Selected number of repetitions for SEQUENCE function	X	X	X	REPETITION	000		14	6.2.1.16
	SEQUENCE?	SEQUENCE function status	X	X	X	SEQUENCE	ON		12	6.2.1.17
	SIG1_SIG2?	Selected function for signal outputs at the analog interface	X ⁵⁾	X	X	SIG1_SIG2	OUT,MODE		19	6.2.1.18
	SSET?	Selected switching signal for the SEQUENCE function	X	X	X	SSET OFF			8	6.2.1.19
	START_STOP?	Selected start and stop addresses for the SEQUENCE function	X ⁶⁾	X	X	START_STOP	020,115		18	6.2.1.20
	STORE? <i>n</i>	Recall data from address <i>n</i> from the SEQUENCE / limit value memory <i>n</i> : 11, 12, ..., 255 (memory location address)	X ⁷⁾	X	X	STORE 014, .70, ON	+015.500+ 03.0000,09		38	6.2.2.10
TDEF?	Selected default dwell time for the SEQUENCE function	X	X	X	TDEF 10.00			10	6.2.1.21	
T_MODE?	Selected function for the trigger input	X	X	X	T_MODE OUT			10	6.2.1.22	
TSET?	Selected dwell time for the SEQUENCE function	X	X	X	TSET 00.10			10	6.2.1.23	
ULIM?	Selected voltage setting range limit [V]	X	X	X	ULIM +035.	000		13	6.2.1.24	
USET?	Selected voltage setpoint value [V]	X	X	X	USET +021.	300		13	6.2.1.28	
General Queries	*DDT?	Memory content for the DDT function	X	X	X	USET +10.0	00; ISET +0	05.600	26	6.2.2.2
	*IDN?	Device ID	X	X	X	GOSSEN-MET 6P,XXXXXXXX	RAWATT,SSP XX,01.001	32N040RU00	49	6.2.2.3
	*LRN?	Overall settings	X	X	X	ULIM +035. SET +050.0 ;USET +021 UTPUT ON; ON;TSET 0 TITION 000 T_MODE OUT	000;ILIM + ;OCP OFF;D .300;ISET POWER_ON R ST;MINMAX 0.10;TDEF ;START_STO ;DISPLAY O	050.000;OV ELAY 12.00 +048.000;O 10.00;REPE P 020,115; FF	202	6.2.2.6
	*TST?	Trigger results query for the self-test 0 = error-free, 1 = faulty	X	X	X	0			1	6.2.2.12

See following chapter for detailed explanation:

Constant response string length

Remote control response string (example)

Read-out via IEC 488 interface

Read-out via RS 232 interface

Display at front panel

Condition and Event Register Queries	CRA?	Condition Register A Query		X	X	002	3	6.3.3.2
		D7: SEQB Status message: SEQUENCE function is active						
		D6: TRGA Signal at analog interface trigger input						
		D5: OTPA Overtemperature						
		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	6.3.3.3
		D7: SEQI SEQUENCE function ended						
		D6: OTPI Ready message to OTPA						
		D5: OTPA Overtemperature message						
		D4: OVPA Overvoltage protection triggered						
		D3: OCPA OCP function triggered						
		D2: OL Overload has occurred						
		D1: CCR Current regulating has occurred						
		D0: CVR Voltage regulating has occurred						
	ERAE?	Device-Dependent Event Register A Enable Query		X	X	032	3	6.3.3.4
	ERB?	Device-Dependent Event Register B Query		X	X	128	3	6.3.3.3
	D7: TCE Self-test error or error during balancing							
	D6: TRGA Signal at analog interface trigger input							
	D5: SEQE Error message from SEQUENCE function							
	D4: OUTE Error message after OUTPUT ON, lockout caused by analog interface trigger input							
	D3: DDTE Error message from define device trigger function							
	D2: LIME Limit error, ULIM < USET or ILIM < ISET							
	D1: S2A SIG2_OUT, active signal has occurred							
	D0: S1A SIG1_OUT, active signal has occurred							
ERBE?	Device-Dependent Event Register B Enable Query		X	X	128	3	6.3.3.4	
*ESE?	Standard Event Status Enable Query		X	X	032	3	6.3.3.4	
*ESR?	Standard Event Status Register Query		X	X	144	3	6.3.3.3	
	D7: PON Power on							
	D6: 0 (URO user request)							
	D5: CME Command error							
	D4: EXE Execution error							
	D3: 0 (DDE device depend error)							
	D2: OYE Query error							
	D1: 0 (RQC request control)							
	D0: OPC Operation complete							
*IST?	Individual Status Query		X	X	0	1	6.3.3.5	
*OPC?	Operation Complete Query		X	X	1	1	6.3.3.6	
*PRE?	Parallel Poll Enable Register Enable Query		X	X	012	3	6.3.3.4	
*PSC?	Power-On Status Clear Query		X	X	0	1	6.3.3.7	
*SRE?	Status Request Enable Query		X	X	012	3	6.3.3.4	
*STB?	Read Status Byte Query		X	X	034	3	6.3.3.8	
	D7: 0							
	D6: ROS MSS							
	D5: ESR Standard event register							
	D4: MAV Message available							
	D3: ERA Event register A							
	D2: ERB Event register B							
	D1: 0							
	D0: 0							

1) "off" in the sense of "stop", SEQ. function is always open

2) "/" instead of ":" in *txt*

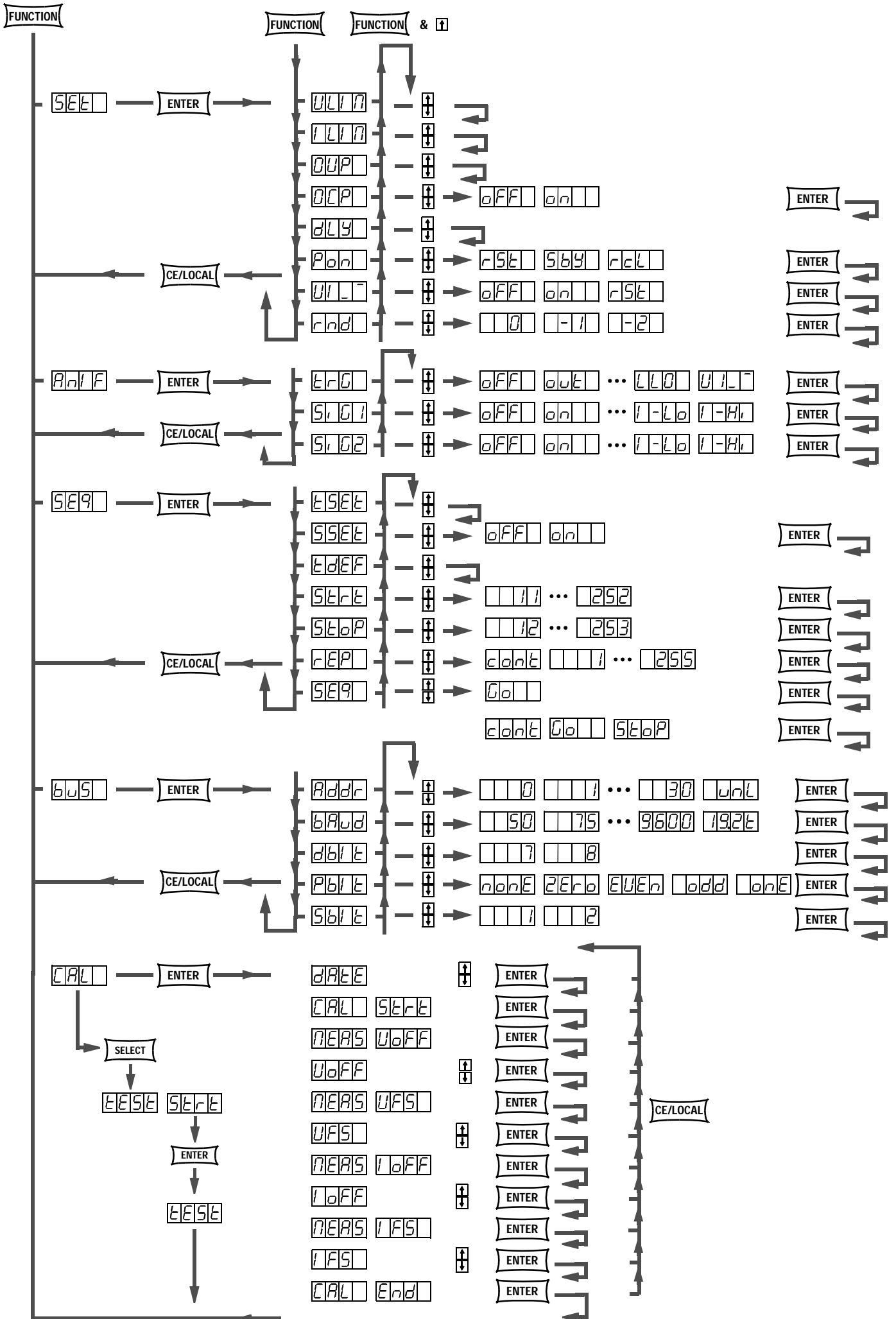
3) Front panel display can be selected / is possible

4) LED

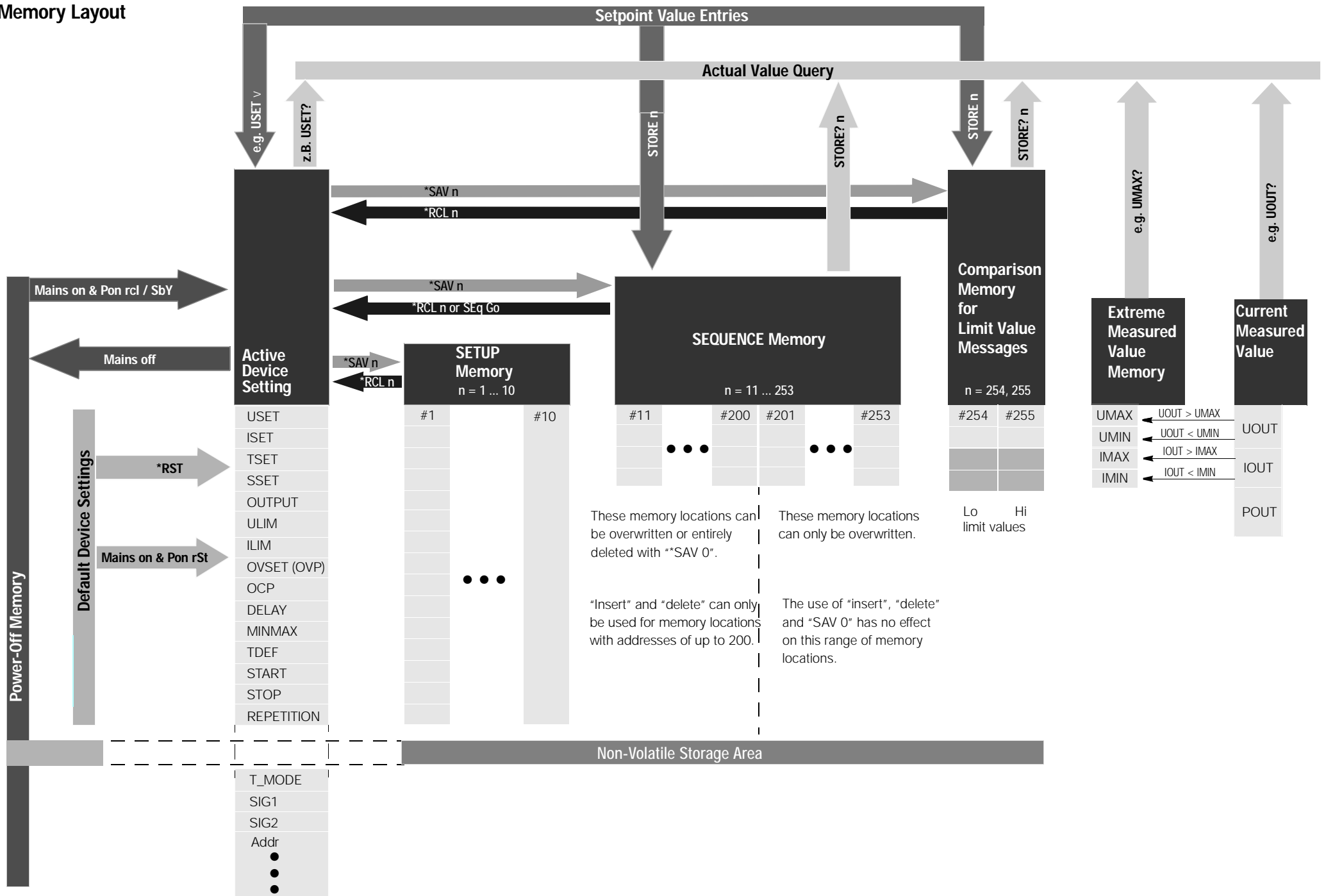
5) Si 91 *txt* or Si 92 *txt*

6) *Start n* or *Stop n*

7) Manual: RCL *n* and scroll through parameters with [SELECT] key (indirect)



Memory Layout



List of Error Messages

1	ROM test, EPROM checksum error
2	RAM test, WRITE / READ error
3	Error from self-test sub-function
4	"IEEE488 interface" option: → WRITE / READ IEEE 488 controller - Electrical isolation (optocoupler) - Auxiliary power - Controller component
7	Serial interface disabled, configuration not allowed: e.g. 8DB, PE, 2SB, or 7DB, PN, 1SB This error message is displayed during the power-on routine, and after each entry under menu item "BUS".
11	After execution of the self-test (manual query). If the output is active, the measured value of the controlled parameter is compared with the numeric setpoint at the current sequence step, and deviation > n * resolution is determined. (n is defined by the device (U: 15 LSD; I: 30 LSD)). → CAL
21	Sequence function, Uset > Ulim, Iset > Ilim
22	Sequence function, only invalid values throughout the range from start through stop address.
23	Sequence function, start address > stop address
24	Attempted recall of an invalid value (remote: *RCL xxx, where 011 ≤ xxx ≤ 255).
25	OUTPUT ON key is disabled by an external trigger signal.
99	POWERFAIL Power failure has occurred at auxiliary power supply → RE-START

CALIBRATION Errors

31	CMD error (remote)
32	SEQUENCE error (remote) Calibration sequence must be observed.
33	Uoff, Ufs → device must be in voltage regulating mode, e.g. eliminate short-circuiting or reduce load.
34	Iff, Ifs → device must be in current regulating mode, e.g. increase load or short-circuit output terminals.
35	Insufficient balancing range: - Check entered data - Hardware error?
36	CALIBRATION error A non-corrected error has occurred, unable to save CAL data. 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

Displays

Operating Mode / Status	Additional Link	LED / Display	Color	Display Function		Comment
				cont.	blinking	
Voltage regulation	OUTPUT ON	CV	green	*	–	
Current regulation	OUTPUT ON	CC	green	*	–	
OUTPUT ON OFF OFF		OUTPUT	red	*	–	
		OUTPUT	red	–	–	
	with OTP	OUTPUT	red	–	*	See OTP function
Primary overload, I limit OTP / Pon rcl OTP / Pon stby, rst	OUTPUT ON	P curve	yellow	*	–	
	OUTPUT → OFF	P curve	yellow	–	*	Manual reset remains
		OUTPUT	red	–	*	As long as OTP is active
		SRQ / STS	yellow	*	–	Manual reset remains
	OUTPUT → OFF	P curve	yellow	–	*	Manual reset remains
		OUTPUT	red	–	–	Remains latching OFF
SRQ / STS		yellow	*	–	Manual reset remains	
Overvoltage protection, OVP		CV	green	–	*	Output is latching in OFF condition
		OUTPUT	red	–	–	
		SRQ / STS	yellow	*	–	Indication of reset
Overcurrent protection, OCP set in menu	Menu: FUNCTION = OCP ON	Iset	yellow	–	*	Blinks briefly
OCP active		CC	green	–	*	
		Iset	yellow	–	*	Blinks briefly
		SRQ / STS	yellow	*	–	Indication of reset
		OUTPUT	red	–	–	Remains latching OFF
Displays for						
Output voltage		Uout	green	*	–	Activated Ua appears at display
Ua setpoint	with SET function	Uset	yellow	*	–	Uset appears at display
Output current		Iout	green	*	–	Activated Ia appears at display
Ia setpoint	with SET function	Iset	yellow	*	–	Iset appears at display
Bus functions						
Remote control		REMOTE	yellow	*	–	
Addressing mode		ADR / DATA	yellow	*	–	
Service request	in remote control mode	SRQ / STS	yellow	–	*	Reference to activated protective function
Front panel controls disabled	with activated function	LOCKED / SEQ	yellow	*	–	
Sequence function		LOCKED / SEQ	yellow	–	* 1/1	During running sequence
		LOCKED / SEQ	yellow	–	* 1/3	During sequence pause
Measured values, menu	2 four digit numeric LED displays					

Accessories

Installation

Description	Comment	Article No.
19" adapter 1 x 32 N	Required for installation of one type 32 N ... device to a 19" rack	K990A
19" adapter 2 x 32 N	Required for installation of two type 32 N ... devices to a 19" rack	K990B
Mains jumper cable, 0.4 m	The cable is equipped with one 10 A plug and one 10 A socket, both for non-heating apparatus. The cable is used for looping through mains power when several devices are mechanically combined into a multi-channel unit. This unit requires only one mains power cable.	K991A
RS 232 bus cable, 0.4 m	Used to loop through the RS 232 data transmission line when several series SSP 32 N devices are mechanically combined into a multi-channel unit (extension cable, 9-pin socket / 9-pin plug)	K931B
RS 232 bus cable, 2 m	For connecting one device to an RS 232 interface (extension cable, 9-pin socket / 9-pin plug)	GTZ 3241 000 R0001
IEEE-IEEE bus cable, 2 m	For connecting one device to the IEEE 488 bus	K931A

Software

Type	Designation	Article No.
K930D	LabView, device driver for SSP-KONSTANTER 120 / 240 / 320 Series and 500 / 1000 / 2000 / 3000 Series	K930D
K930E	LabWindows / CVI, device driver for SSP-KONSTANTER 120 / 240 / 320 Series and 500 / 1000 / 2000 / 3000 Series	K930E
K930F	HPVee / VXI PnP, device driver for SSP-KONSTANTER 120 / 240 / 320 Series and 500 / 1000 / 2000 / 3000 Series	K930F

Order Information

Description (abbreviated designation)	Type	Article No.
SSP 120-20	32 N 20 RU 10 P	K320A
SSP 120-40	32 N 40 RU 6 P	K321A
SSP 120-80	32 N 80 RU 3 P	K322A
SSP 240-20	32 N 20 RU 20 P	K330A
SSP 240-40	32 N 40 RU 12 P	K331A
SSP 240-80	32 N 80 RU 6 P	K332A
SSP 320-32	32 N 32 RU 18 P	K334A
IEEE 488 interface	for SSP-KONSTANTER type 32 N ...	K380A

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