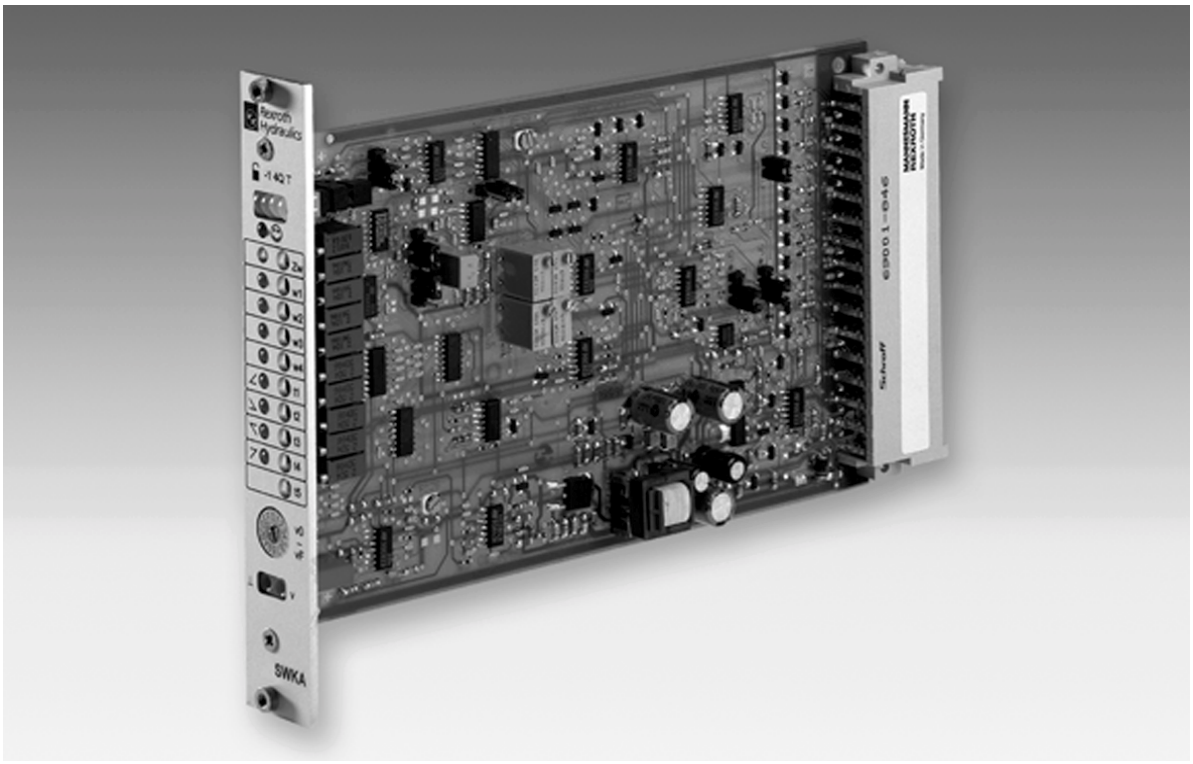
engineering
mannesmann
Rexroth



Analog Command Value Card VT-SWKA-1

Product Description and Commissioning Instructions

RE 30 255-B/05.00

Rexroth
Hydraulics

Published by Mannesmann Rexroth AG
Rexroth Hydraulics
D-97813 Lohr am Main
Jahnstraße 3-5 • D-97816 Lohr am Main

Telephone 0 93 52/18-0
Telefax 0 93 52/18-23 58
Telex 6 89 418-0
eMail product.support@rexroth.de
Internet www.rexroth.com

Issue number RE 30 255-B/05.00

Table of contents

1. General

1.1 Features

- Analog command value card (without power part) for controlling valves with integral electronics
  → For controlling valves without integral electronics, a suitable additional amplifier is required.
- Suitable for generating, combining and normalizing command value signals
- Configuration and parameterization of the command value card by means of potentiometers
- Command value inputs:
  - Differential input ± 10 V
  - 4 callable command value inputs ± 10 V
  - Current input 4 to 20 mA (standard 0 to 100 %; can be changed over ± 100 %)
- Control variable output:
  - Voltage ± 10 V
  - Current 4 to 20 mA (standard 0 to 100 %; can be changed over ± 100 %)
- Inversion of internal command value signal using 24V input or jumper
- Ramp time selection by quadrant recognition (24V input) or ramp time call-ups (24V inputs)
- Ramp time range can be changed over by means of jumpers
- Characteristic curve correction by means of separately adjustable step-change heights and maximum values
- Enable input
- Output signal "ramp ready" as auxiliary process variable
- Output signal "ready for operation"
- Switchable measuring socket
- Reverse voltage protection for voltage supply

Suitable card holders:
- 19" rack types VT 19101, VT 19102, VT 19103 and VT 19110 (see RE 29 768)
- Closed card holder VT 12302 (see RE 30 103) with blind plate insert 4TE/3HE (material no. 00021004)
- Open card holder VT 3002-2X/48 (see RE 29 928)
  For control cabinet installation only!

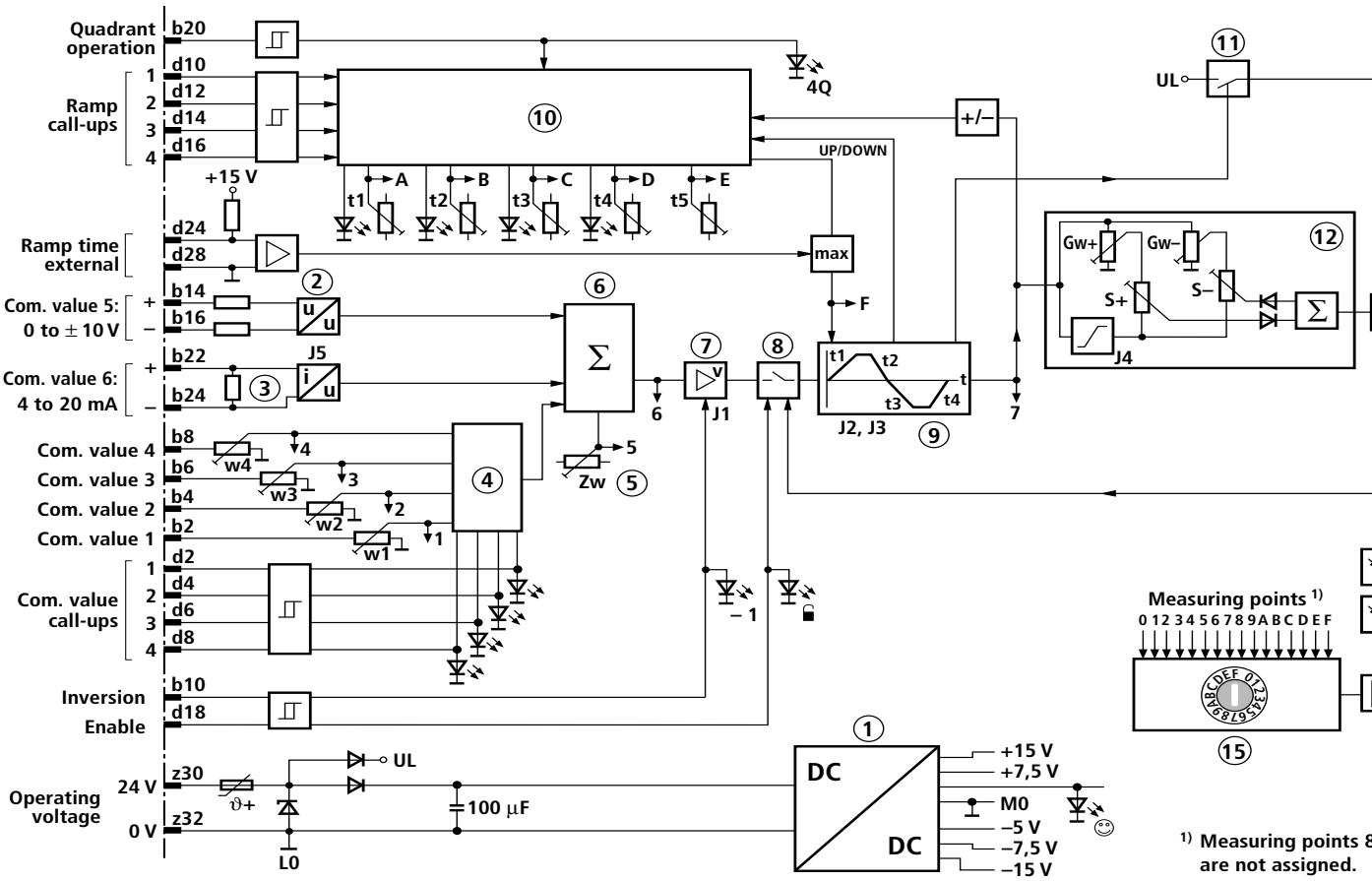
Power supply units:
- Type VT-NE30-1X, see RE 29 929
  Compact power supply unit 115/230 VAC → 24 VDC, 70 VA
- Type VT-NE31-1X, see RE 29 929
  Compact power supply unit 115/230 VAC → 24 VDC, 7 VA
- Type VT-NE32-1X, see RE 29 929
  Compact power supply unit 115/230 VAC → 24 VDC, 60 VA (smoothed) and 24 VDC, 25 VA (regulated)

1.2 Technical data

For applications outside these parameters, please consult us!

Operating voltage	U_B	24 VDC + 40 % – 20 %
Operating range: – Upper limit value	$U_B(t)_{max}$	35 V
– Lower limit value	$U_B(t)_{min}$	18 V
Power requirement	P_S	< 7 VA
Current consumption	I	< 0.3 A
Fuse		Thermal overload protection; auto-activating when triggered
Inputs:		
– Analog		
• command values 1 to 4 (potentiometer inputs)	U_e	0 to ± 10 V; R_e = 100 kΩ (reference is M0)
• command value 5 (differential input)	U_e	0 to ± 10 V; R_e > 50 kΩ
• command value 6 (current input)	I_e	4 to 20 mA; load R_B = 100 Ω (zero point can be changed over)
• ramp time external	U_e	0 to +10 V; R_e = 10 kΩ (internally raised to +15 V; reference is M0)
– Digital		
• command value call-ups	U	8.5 V to U_B → call-up activated
	U	0 to 6.5 V → no call-up
• ramp call-ups	U	8.5 V to U_B → call-up activated
	U	0 to 6.5 V → no call-up
• quadrant recognition	U	8.5 V to U_B → ON
	U	0 to 6.5 V → OFF
• command value inversion	U	8.5 V to U_B → ON
	U	0 to 6.5 V → OFF
• enable	U	8.5 V to U_B → ON
	U	0 to 6.5 V → OFF
Adjustment ranges:		
– Zero point adjustment (potentiometer "Zw")		± 30 %
– Command values (potentiometers "w1" to "w4")		0 to 110 %
– Ramp times (potentiometers "t1" to "t5")		20 ms to 5 s (can be changed over using J3)
– Step-change height (potentiometers "S+" and "S–")		0 % to 50 % (step-change height reached at ca. 2 % command value injection)
– Amplitude attenuator (potentiometers "G+" and "G–")		0 % to 110 % (valid when step-change height is set to 0 %)
Outputs:		
– Analog signals		
• control variable voltage	U	± 10 V ± 2 %; I_{max} = 2 mA
current	I	4 mA to 20 mA ± 2 %; $R_{B\ max}$ = 500 Ω (zero point can be changed over)
• measuring signal	U	± 10 V ± 2 %; I_{max} = 2 mA
– Digital signals		
• ramp ready	U	> 16 V; 50 mA → ready
	U	< 1 V; R_i = 10 kΩ → ramp active
• ready for operation	U	> 16 V; 50 mA (in the event of a fault: U < 1 V; R_i = 10 kΩ)
– Regulated voltages	U	±10 V ± 2 %; 25 mA
– Measuring sockets		
• measur. signal "v" (dep. on position of measur. point selector switch)	U	± 10 V ± 2 %; I_{max} = 2 mA
Type of connection		48-pin blade connector, DIN 41 612, form F
Card dimensions		Euro-card 100 x 160 mm, DIN 41 494
Front panel dimensions: – Height		3 HE (128.4 mm)
– Width soldering side		1 TE (5.08 mm)
– Width component side		3 TE
Permissible operating temperature range	ϑ	0 to + 50 °C
Storage temperature range	ϑ	– 25 °C to + 85 °C
Weight	m	0.15 kg

Note:
For details regarding **environment simulation tests** in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30 255-U (declaration on environmental compatibilty).



1) Measuring points 8 are not assigned.

1	Power supply unit	**6**	Command value summation	**11**	Ramp status function
2	Differential amplifier	**7**	Command value inversion	**12**	Characteristic curve generator
3	Current input	**8**	Enable function	**13**	Amplitude limiter
4	Command value selection logic	**9**	Ramp generator	**14**	Fault recognition
5	Zero point adjustment	**10**	Ramp time selection logic	**15**	Measuring point changeover

For explanations re ers as well as the p ment of indicator a elements, see page

3. Functional description / commissioning notes

[ ] = Reference to the block circuit diagram

3.1 General

The command value card is designed as printed circuit board in Euro-format 100 x 160 mm and is suitable for installation in a rack. A power supply unit [1] provides the internally required positive and negative supply voltages. As soon as the power supply unit is in operation and no error is present, the green LED on the front panel lights up and the "ready for operation" signal is set.

3.2 Command value preselection

The internal command value signal is generated from the sum (command value summation [6]) of the external command value signal applied to differential input [2] and to current input [3], called-up signal [4] and zero point offset [5] (zero point potentiometer "Zw").

3.3 Current input [3]

There is no changeover between current and voltage input. Both inputs are permanently available (see terminal allocation). The input signals are internally normalized and added. The zero point and the range of values of the current input can be changed over by means of jumper J5.

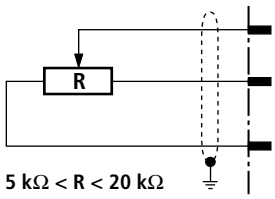
3.4 Command value call-ups [4]

Four command value signals, "w1" to "w4", can be called up. External command value voltages (command values 1 to 4) are preselected either directly via the regulated voltage inputs + 10 V and – 10 V or via external potentiometers. If the command value inputs are connected directly to the regulated voltages, the command values are adjusted by means of potentiometers "w1" to "w4". If external potentiometers are used, the internal potentiometers act as attenuators or limiters.

Only one call-up is possible at a time. If several call-ups are selected simultaneously, call-up "1" has lowest priority, call-up "4" highest priority.

A yellow LED on the front panel indicates, which call-up is active.

3.5 External command value potentiometer



b2, b4, b6 or b8		
b32 (+10V)	b30 (–10V)	b32 (+10V)
b28 (0V)	b28 (0V)	b30 (–10V)
Range of command values		
0 to +100%	0 to –100%	–100% to +100%

3.6 Command value inversion [7]

The command value that is generated internally from input signals, command value call-ups and zero point offset signals can be inverted by means of an external signal or jumper J1. An LED ("– 1") on the front panel signals whether an external inversion signal is applied.

3.7 Enable function [8]

The enable function cuts the enable signal of the ramp generator in or out. When the enable is cut in or out, the control variable changes at any command value according to the set ramp time. This prevents a controlled valve from opening or closing suddenly. If an error signal is present, the input signal of the ramp generator is also set to 0 %. An LED on the front panel signals that an enable signal is applied.

3.8 Ramp generator [9]

The ramp generator limits the increase of the control variable. Downstream step-functions and amplitude attenuators do not shorten or extend the ramp time.

Jumper J2 can be used to set the ramp time to minimum (< 2 ms) (ramp off).

The minimum/maximum ramp time can be changed between 20 ms/5 s or 0.2 s/50 s by means of jumper J3.

5 different ramp times can be set and activated. The ramp times can be pre-set or verified with the help of test socket "v".

The following is valid (with factory setting of jumper J3 → connection 2-3):

$$t = \frac{100}{U_{\text{test socket "v"}}\ (\text{in V})}\ (\text{in ms})$$

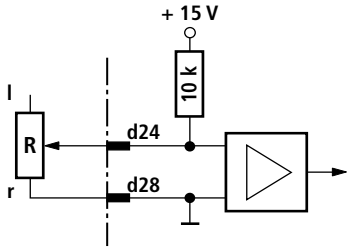
	$U_{\text{test socket "v"}}$ (in V)	5	3	2	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
J3 → connection **2-3** [1]	*t* (in ms; ± 20 %)	20	33	50	100	200	333	500	1000	2000	3333	5000
J3 → connection **1-2**	*t* (in s; ± 20 %)	0.2	0.33	0,50	1	2	3.33	5	10	20	33	50

[1] factory setting

3.9 External ramp time adjustment

The internally set ramp time can be extended by means of an external potentiometer. The setting can be verified with the help of the measuring socket. In the case of a cable break, the internal presetting will be validated automatically.

The adjustment range depends on "**R**".



The following is valid (with factory setting of jumper J3 → connection 2-3):

R	Adjustment range [2]	
	Minimum ramp time Potentiometer to left-hand stop	Maximum ramp time Potentiometer angle of rotation = 95 %
1 kΩ	80 ms	1 s
0,5 kΩ	150 ms	2 s
0,1 kΩ	800 ms	10 s

[2] The minimum ramp time can only be achieved, if the internally set ramp time is less, i.e. the relevant potentiometer is turned to the left-hand stop.

3.10 Ramp status signal [11]

The status signal "ramp ready" indicates that the control variable has reached the requested final value. This signal (24V output) facilitates the synchronization of higher-level sequence controls with the valve function or the controlled hydraulic function.

3.11 Ramp time selection logic [10]

a) Operating mode "4-quadrant operation"
When 4-quadrant operation is activated (24V signal "4Q"), the electronics automatically recognizes the command value polarity and the direction of change of the command value and assigns a ramp time to the current signal status. Depending on these signal states, one of the 4 ramp times is selected.

Ramp up, positive → Ramp potentiometer "t1"
Ramp down, positive → Ramp potentiometer "t2"
Ramp up, negative → Ramp potentiometer "t3"
Ramp down, negative → Ramp potentiometer "t4"

4-quadrant operation has a higher priority than all ramp time call-ups. As long as a signal changes, the LED (on the front panel, directly next to the associated potentiometer) assigned to the current ramp time lights up.

Note: In the case of very short ramp times, the LEDs' lighting up can no longer be noticed.

LED "4Q" on the front panel is on when quadrant recognition is active.

b) Ramp time call-ups

When operating mode "4-quadrant operation" is deactivated, 4 ramp times can be called up using an optional call-up signal (24V input). Only 1 call-up is possible at a time. If several call-ups are activated at the same time, call-up "1" has the lowest priority and call-up "4" has highest priority. Each called-up ramp time is signaled by a yellow LED (on the front panel, directly next to the associated potentiometer).

c) 5th ramp time
If neither quadrant recognition nor a call-up is activated, ramp time "t5" is always valid.

3.12 Characteristic curve generator [12]

The adjustable characteristic curve generator can be used to adjust step-change heights and maximum values separately for positive and negative signals according to the hydraulic requirements. The actual characteristic curve shape through the zero point is not step-like, but linear.

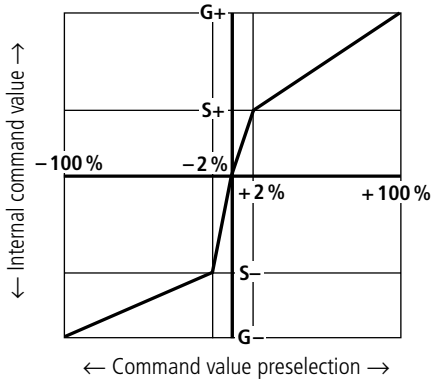
The step-change height can be adjusted by means of potentiometers "S+" and "S–".

Jumper J4 can be used to activate the step function. For this, the connection 2-3 of jumper J4 must be plugged (factory setting: connection 1-2 → step function OFF). To prevent a residual step-change (< 1 %) when the step function is deactivated, the potentiometers "S+" and S–" must be turned to the left-hand stop and the connection 1-2 of jumper J4 must be plugged.

The maximum command value can be adjusted by means of potentiometers "Gw+" and "Gw–". The adjustment range is between 0 % and 110 %.

3.13 Amplitude limiter [13]

The control variables (current output and voltage output) are limited to approx. ± 110 % of the nominal range.



3.14 Fault recognition [14]

This features monitors internal operating voltages, voltage outputs and, if jumper J7 (1-2) is plugged, the current output for cable break. When no fault is present, the green "ready for operation" LED lights up and the output "ready for operation" is set to 24 V (operating voltage).

3.15 Measuring points [15]

A measuring socket is provided on the front panel to allow the verification of the settings of command value call-ups, ramp times and further, internal signals. The measuring points can be selected using the measuring point selector switch that is also provided on the front panel. The signal of the measuring socket is also connected to the blade connector (b26).

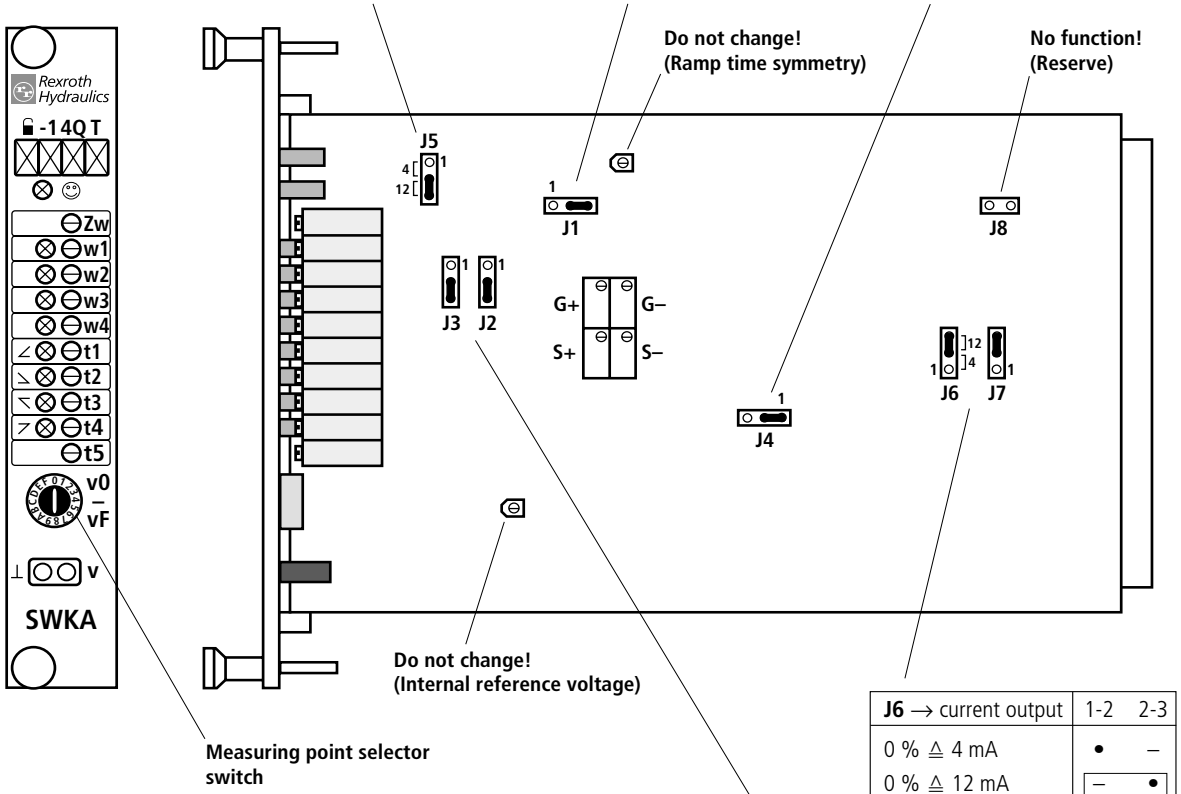
Switch position	Signal	Measuring signal at "v"
0	Internal command value	± 10 V ≙ 100 %
1	Command value call-up 1	± 10 V ≙ 100 %
2	Command value call-up 2	± 10 V ≙ 100 %
3	Command value call-up 3	± 10 V ≙ 100 %
4	Command value call-up 4	± 10 V ≙ 100 %
5	Zero point offset "Zw"	± 3 V ≙ ± 30 %
6	Summated signal of command values	± 10 V ≙ 100 %
7	Ramp generator output	± 10 V ≙ 100 %
8	free	
9	free	
A	Ramp time "t1"	10 mV to 10 V
B	Ramp time "t2"	10 mV to 10 V
C	Ramp time "t3"	10 mV to 10 V
D	Ramp time "t4"	10 mV to 10 V
E	Ramp time "t5"	10 mV to 10 V
F	Current ramp time "t"	10 mV to 10 V

4. Indicator / adjustment elements

J5 → current input	1-2	2-3
0 % ≙ 4 mA	•	–
0 % ≙ 12 mA	–	•

J1 → inversion	1-2	2-3
inverting	•	–
not inverting	–	•

J4 → step function	1-2	2-3
OFF	•	–
ON	–	•



J6 → current output	1-2	2-3
0 % ≙ 4 mA	•	–
0 % ≙ 12 mA	–	•

J7 → cable break monitor	1-2	2-3
ON	•	–
OFF	–	•

J2 → ramp function	1-2	2-3
OFF	•	–
ON	–	•

J3 → ramp time	1-2	2-3
Ten-fold	•	–
Single	–	•

• … Connection made
– … Connection broken
☐ … Factory setting of jumpers

LED lamps:

☺ Readiness for operation (green)
🔓 Enable (yellow)
–1 External inversion
4Q Quadrant recognition
T Reserved

Measuring sockets:

v Measuring signal
⊥ Measurement zero

Potentiometers (some with LED lamp):

Zw Zero point adjustment
w1 Command value 1
w2 Command value 2
w3 Command value 3
w4 Command value 4
t1 Ramp time 1
t2 Ramp time 2
t3 Ramp time 3
t4 Ramp time 4
t5 Ramp time 5

Cannot be adjusted on the front panel:

G+ Amplitude attenuator for positive command values
G– Amplitude attenuator for negative command values
S+ Step-change height for positive direction
S– Step-change height for negative direction

If the sealed potentiometers are misadjusted, the warranty will become void !

5. Adjustment recommendation

The system-specific circuit must be provided.

Signal	Adjustment
Command value call-up	– Select the potentiometer to be adjusted using the measuring point selector switch – Adjust the command value call-up and check it on measuring socket "v"
Command value zero point	– Do not activate a command value call-up! – Set external command value preselections to zero – Turn measuring point selector switch to "6" – Set the measured value to zero using zero point potentiometer "Zw"
Ramp times	– Select the potentiometer to be adjusted using the measuring point selector switch – Adjust the ramp time according to the formula or table (see "3.8 ramp generator") and check it on measuring socket "v"
External ramp potentiometer	– Do not activate a ramp time call-up! – Turn ramp potentiometer "t5" to the left-hand stop – Turn measuring point selector switch to "F" – Adjust the ramp time according to the formula or table (see "3.8 ramp generator") and check it on measuring socket "v"
Step-change height	– Apply enable signal – Turn measuring point selector switch to "7" – Adjust the measuring signal to + 0.3 V using zero point potentiometer "Zw" [1)] – Turn measuring point selector switch to "0" – Set the required step-change height using potentiometer "S+" – Turn measuring point selector switch to "7" – Adjust the measuring signal to – 0.3 V using zero point potentiometer "Zw" [1)] – Turn measuring point selector switch to "0" – Set the required step-change height using potentiometer "S–" – Adjust the zero point [1)] In the case of external command value preselection, this must result in at least + 0.3 V / – 0.3 V at measuring socket "v" (turn measuring point selector switch to "7").
Maximum values	Note: Before the maximum values are matched, the zero point and step-change heights must be correctly set. – Adjust the step-change heights first; generate command value ± 100 % externally or by means of a command value call-up – Turn measuring point selector switch to "7" – Check measuring signal 10 V ± 0.2 V – Adjust the required maximum control output using potentiometers "G+"/"G–"

6. Pin assignment

Pin	Row d	Row b	Row z
2	Command call-up 1 (24V input)	Command value 1 (Potentiometer connection ± 10 V)	Reserved
4	Command call-up 2 (24V input)	Command value 2 (Potentiometer connection ± 10 V)	Reserved
6	Command call-up 3 (24V input)	Command value 3 (Potentiometer connection ± 10 V)	Reserved
8	Command call-up 4 (24V input)	Command value 4 (Potentiometer connection ± 10 V)	Reserved
10	Ramp call-up 1 (24V input)	Command value inversion (24V input)	Reserved
12	Ramp call-up 2 (24V input)	Reserved	Reserved
14	Ramp call-up 3 (24V input)	Command value 5 + (+ 10V)	Reserved
16	Ramp call-up 4 (24V input)	Command value 5 – (– 10V)	Reserved
18	Enable (24V input)	Reserved	Reserved
20	Reserved	4-quadrant operation (24V input)	System ground
22	Signal "ready for operation" (24 V, H-active, 50 mA)	Command value 6 + (4 to 20 mA)	Reserved
24	Ramp external	Command value 6 – (4 to 20 mA)	Reserved
26	Ramp completed	Measuring signal	Reserved
28	Ramp external / reference	Reference potential for outputs (M0)	Reserved
30	Control output ± 10 V	– 10 V / 25 mA	Operating voltage (24 V)
32	Control output 4 to 20 mA	+ 10 V / 25 mA	L0 (0 V)

7. Engineering / maintenance notes / supplem. information

- The command value card may only be withdrawn or plugged in when disconnected from the power supply!
- Never install cables near power cables!
- The distance to antenna cables, radio equipment and radar systems must be at least 1 m!
- Use relays with gold-plated contacts for switching command values (small voltages, small currents)!
- Only carry out measurements on the cards with instruments $R_i > 100\ k\Omega$!
- Use a screw driver with a blade width of 4 mm for adjusting potentiometers and turning the measuring point selector switch.
- Always shield command value cables; connect shield to protective earth (PE) on the card side!
- **Caution:** When using the **differential input, both inputs** must always be switched on or off **simultaneously**!

If the sealed potentiometers are misadjusted, the warranty will become void !