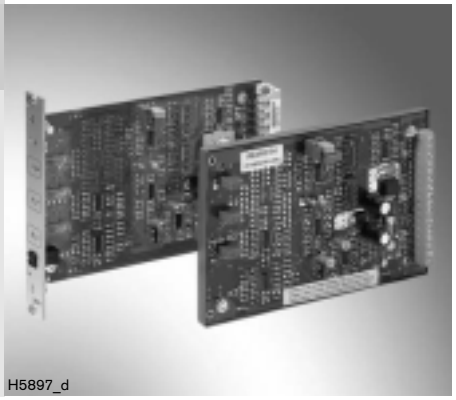
Electrical amplifiers

RE 30111/09.05 1/12
Replaces: 02.03

Type VT-VSPA1-1 and VT-VSPA1K-1

Component series 1X



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Features

- Suitable for controlling all direct and pilot operated proportional pressure control valves without electrical position feedback and only one solenoid as actuator that are available at the time of publication of this data sheet
- Differential input, can be switched between voltage and current input
- Additional command value input, 0 to +9 V
- Ramp generator, can be adjusted separately for up and down ramps
- Clocked output stage
- Signal "ready for operation" (VT-VSPA1K-1 only with LED indicator lamp)
- Reverse polarity protection for voltage supply
- Cable break detection of current input 4 to 20 mA
- Short-circuit protection of solenoid cable
- Cable break detection of solenoid cable

Suitable card holders for VT-VSPA1-1:
- Type VT 3002-2X/32, see RE 29928
  Single card holder without power supply unit

Suitable power supply unit:
- Type VT-NE30-1X, see RE 29929
  Compact power supply unit 115/230 VAC → 24 VDC, 108 W

Ordering code

VT-VSPA1 | – 1 – 1X / *

Amplifiers for controlled proportional pressure control valves, analogue, with one solenoid

With 32-pin male connector and front panel **= No code**
With 16-pin terminal strip; without front panel **= K**

1X = Component series 10 to 19 (10 to 19: unchanged technical data and pin assignment)

Further details in clear text

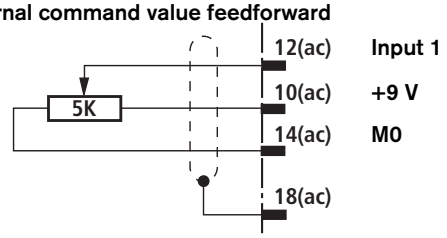
For substitutes for amplifier types VT 2000 (up to component series 4X), VT 2010, VT 2013 or VT 2023 for rack installation, blind plate 4TE/3HE must be ordered separately. **Material no. R900021004**

Functional description

The command value voltage is applied to command value input 1 either directly or via an external command value potentiometer with the help of the regulated + 9V voltage from the power supply unit [14].

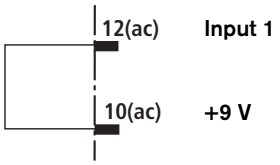
The following is valid for this input: +9 V +100 % [1].

External command value feedforward

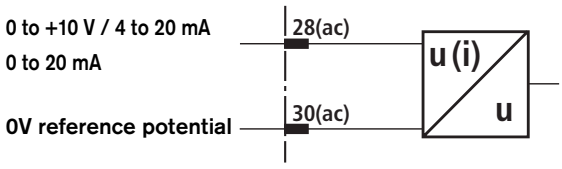


Note:
When an external command value potentiometer is used, internal potentiometer "Gw" [3] must be set to maximum or the required maximum pressure.

Internal command value feedforward



Differential input (input 2)



Additions to the pin designations in brackets are only valid for type VT-VSPA1-1.

Command value input 2 is a differential input [1] (0 to + 10 V). With the help of DIL switches [2] it can be configured as current input (4 to 20 mA or 0 to + 20 mA). If the command value is fed forward by external electronics with a different reference potential (e.g. by a PLC), this input must be used. When the command value voltage is applied or withdrawn, care must be taken that both signal cables are disconnected from or connected to the input.

Before being passed on, both command values are summated [2] and then fed to a potentiometer [3] that is accessible on the front panel and acts as attenuator and limits the maximum command value.

The downstream ramp generator [4] generates a ramp-shaped output signal from a stepped input signal. The time constant of this signal can be adjusted separately for “up” and “down” ramps with the help of two potentiometers. The specified ramp time refers to a command value step-change of 100% and can be approx. 1 s or 5 s, depending on the setting of a DIL switch [2]. If a command value step-change of less than 100 % is fed to the input of the ramp generator or when attenuator [3] is effective, the ramp time shortens accordingly

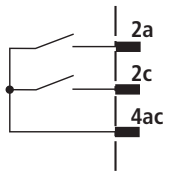
The following is valid for type **VT-VSPA1-1**: The up and down ramp times can be set separately to their minimum value (approx. 30 ms) with the help of the external contacts “ramp up/down OFF”.

The following is valid for type **VT-VSPA1K-1**: The up and down ramp times can be set collectively to their minimum value (approx. 30 ms) with the help of the external contact “ramp OFF”.

Functional description (continued)

Ramp "up/down" OFF

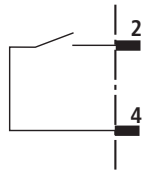
VT-VSPA1-1



Ramp "up" OFF

Ramp "down" OFF

VT-VSPA1K-1



Ramp OFF

The output signal of ramp generator [4] is fed as current command value to the summing amplifier [5]. Here, a command value of 100 % corresponds to a voltage of +6 V.

Summing amplifier [5] adds the output signals of the characteristic curve generators [6 or 7] to the command value (can be selected by means of DIL switches [2] depending on the valve to be controlled). The current command value can also be filtered through a low-pass filter that can be cut in. Current output stage [9] is controlled via current regulator [8]. In addition, the current regulator modulates the current command value with clock-pulse encoder signal [10] (the frequency can be programmed with the help of DIL switches [2]). The clocked actual current value acts in the solenoid of the valve like a constant current with overlaid dither signal. Type VT-VSPA1-1 is provided with measuring sockets for the internal command value and the actual value.

The following is valid for the command value: +6 V 100 %

The following is valid for the actual value: 1 mV 1 mA

The signal "ready for operation" is output and LED "H2" on the front panel (with VSPA1-1) or LED "H2" (with VSPA1K-1) is lit, when:

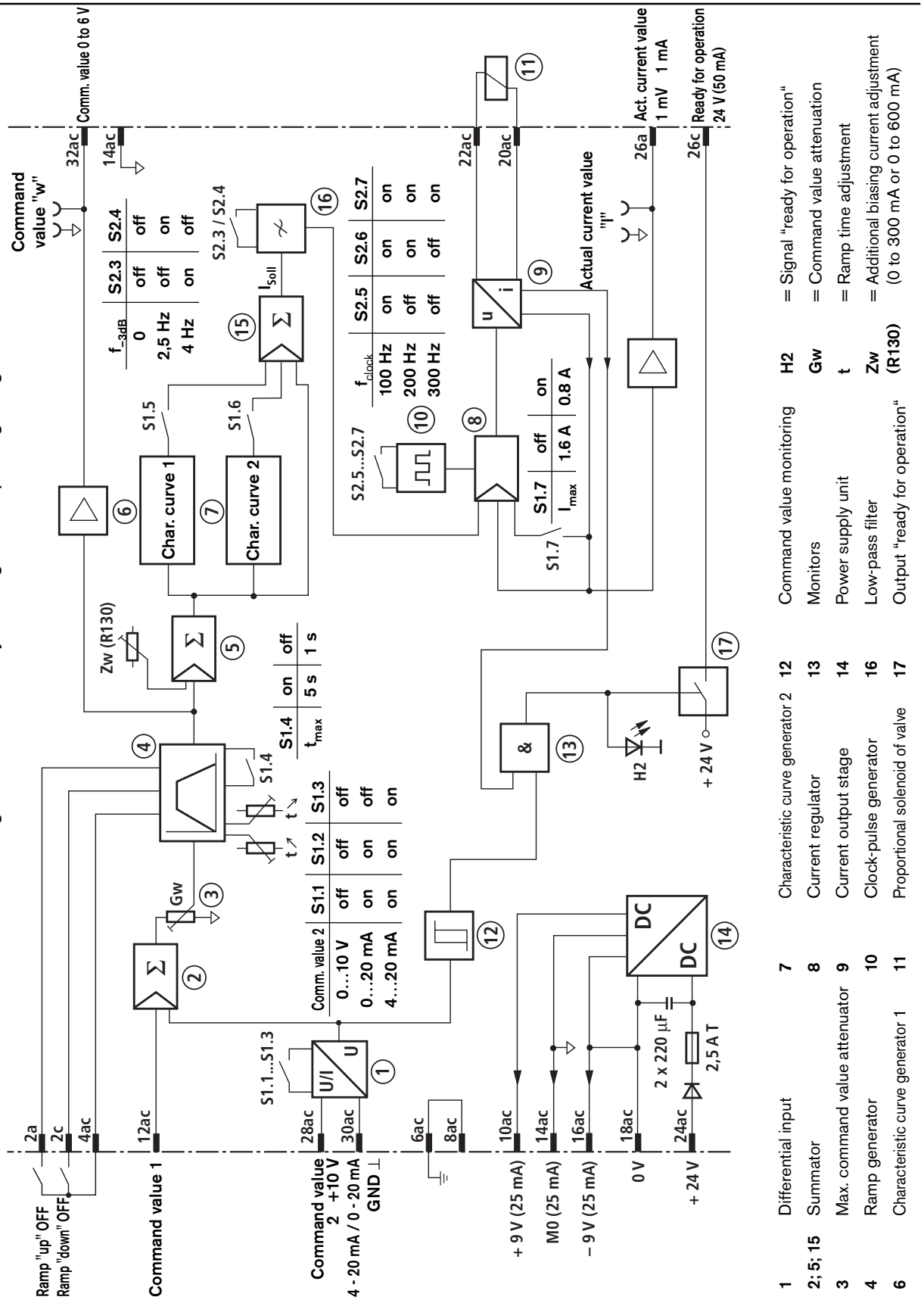
– The solenoid cables are not short-circuited and the output stage is not overloaded,
– a command value is applied (cable break detection),
– there is no cable break present on the solenoid cable.

[1] Reference potential for command value 1 is M0 (measuring zero).

[2] For DIL switch settings, see "adjustment elements" on page 8

[ ] … Cross-reference to block circuit diagrams on pages 4 and 5

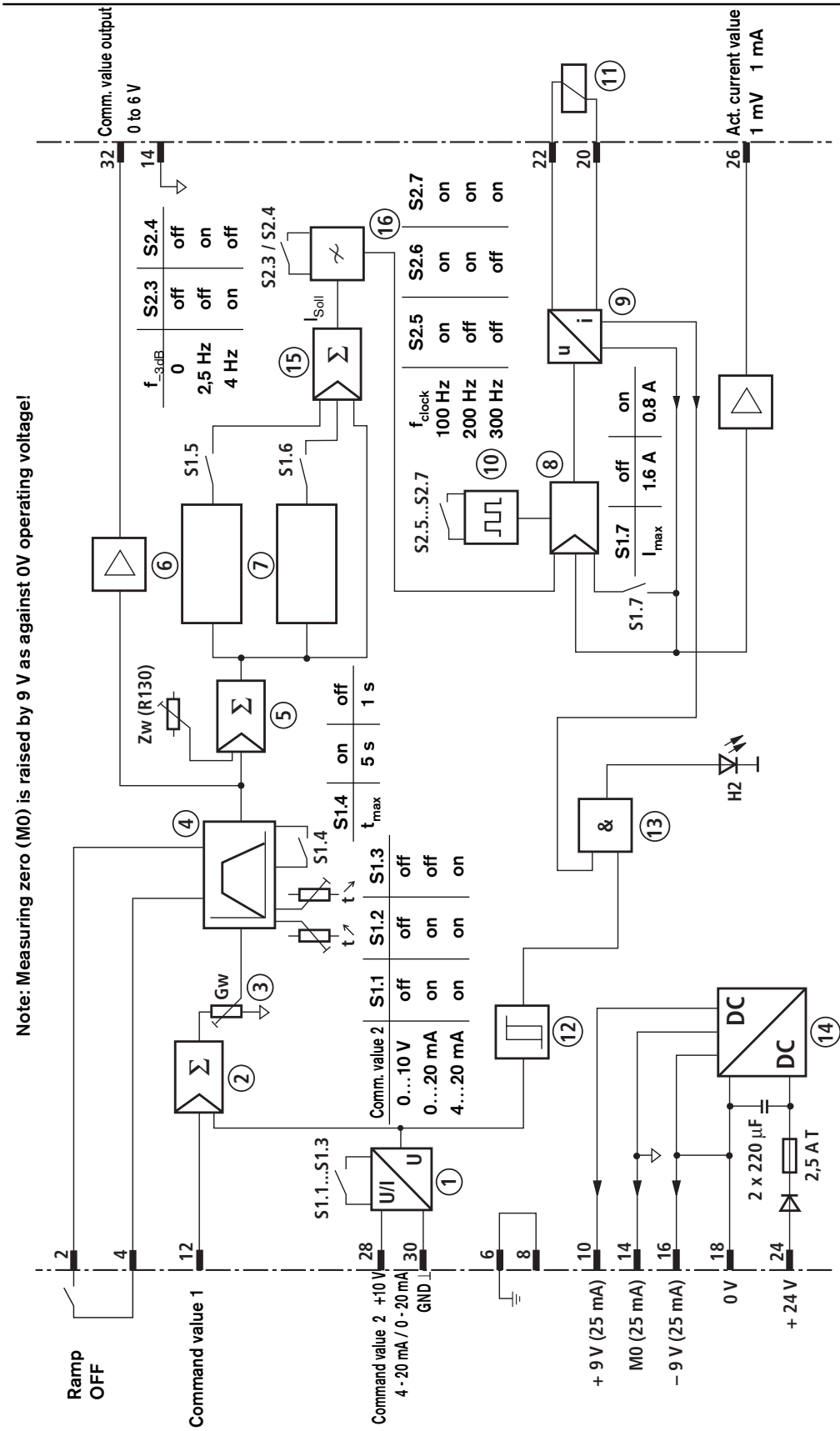
Block circuit diagram / pin assignment: VT-VSPA1-1



1	Differential input	**7**	Characteristic curve generator 2	**12**	Command value monitoring
2; 5; 15	Summator	**8**	Current regulator	**13**	Monitors
3	Max. command value attenuator	**9**	Current output stage	**14**	Power supply unit
4	Ramp generator	**10**	Clock-pulse generator	**16**	Low-pass filter
6	Characteristic curve generator 1	**11**	Proportional solenoid of valve	**17**	Output "ready for operation"

H2	= Signal "ready for operation"
Gw	= Command value attenuation
t	= Ramp time adjustment
Zw (R130)	= Additional biasing current adjustment (0 to 300 mA or 0 to 600 mA)

Block circuit diagram / pin assignment: VT-VSPA1K-1



1	Differential input	7	Characteristic curve generator 2	12	Command value monitoring **Gw** = Command value attenuation
2; 5; 15	Summator	8	Current regulator	13	Monitors **t** = Ramp time adjustment
3	Max. command value attenuator	9	Current output stage	14	Power supply unit **Zw** = Additional biasing current adjustment
4	Ramp generator	10	Clock-pulse generator	16	Low-pass filter **(R130)** (0 to 300 mA or 0 to 600 mA)
6	Characteristic curve generator 1	11	Proportional solenoid of valve	**H2**	= Signal "ready for operation"

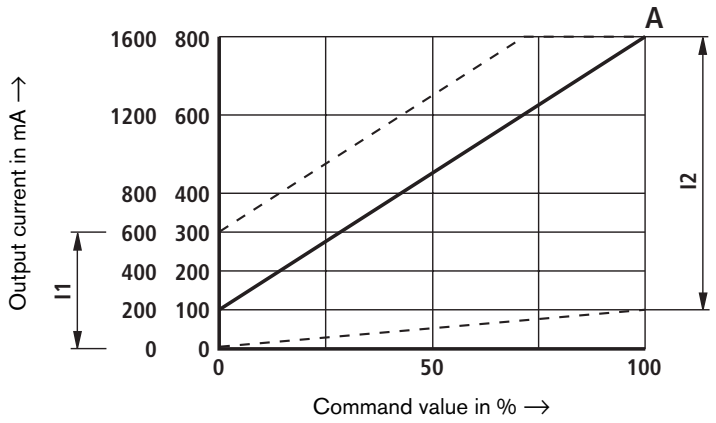
Technical data (for applications outside these parameters, please consult us!)

Operating voltage	U_O	+24 VDC +40 % –5 %
Operating range:		
– Upper limit value	$u_O(t)_{max}$	+35 V
– Lower limit value	$u_O(t)_{min}$	+22 V
Max. power consumption	P_s	50 VA
Max. current consumption	I	1.8 A
Fuse	I_s	2.5 A T
Inputs:		
– Command value 1	U_i	0 to +9 V (reference potential is M0)
– Command value 2 (differential input)	U_i	0 to +10 V; $R_i = 100\ \Omega$] depending on setting with S11 to S13
or	I_i	4 to 20 mA (load $R_L = 100\ \Omega$)
or	I_i	0 to 20 mA (load $R_L = 100\ \Omega$)
Ramp time (adjustment range)	t	30 ms to approx. 1 s or 5 s (depending on setting with S14)
Outputs:		
– Output stage		
• Solenoid current/resistance	I_{max}	800 mA +20 %, $R_{20} = 19{,}5\ \Omega$] depending on setting with S17 [1]
or	I_{max}	1600 mA +20 %, $R_{20} = 5{,}4\ \Omega$
• Biasing current at I_{max} = 800 mA	I_b	50 mA or 100 mA] depending on setting with S17 and "Zw" (R130)
at I_{max} = 1600 mA	I_b	100 mA
additionally at I_{max} = 800 mA	I_b	0 to 300 mA +20 %] Adjustable by means of "Zw" (R130) on the printed-circuit board
at I_{max} = 1600 mA	I_b	0 to 600 mA +20 %
• Clock frequency	f	100 Hz, 200 Hz, 300 Hz or 370 Hz ±10 % each (depending on setting with S25 to S27)
– Signal "ready for operation" (only with VT-SPA1-1)		
• Component series 10 when ready for operation	U	approx. U_O
in the case of a fault	U	< 1 V
• From component series 11 when ready for operation	U	approx. U_O, 50 mA] Load resistance > 10 kΩ
in the case of a fault	U	0 V $R_i = 10$ kΩ
– Regulated voltage	U	±9 V ±1 %, ±25 mA externally laodable
– Measuring sockets		
• Command value "*w*"	U	0 to +6 V (+6 V 100 % solenoid current), $R_i = 1$ kΩ
• Actual current value "*I*"	U	0 to 1600 mV 0 to 1600 mA ±20 mA
Type of connection:		
– VT-VSPA1-1		32-pin male connector, DIN 41612, form D
– VT-VSPA1K-1		16-pin terminal strip
Card dimensions:		Euro-card 100 x 160 mm, DIN 41494
Front panel dimensions		
– Height		3 HE (128.4 mm)
– Width soldering side		1 TE (5.08)
– Width component side		3 TE
Permissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–25 to +85 °C
Weight	m	0.1 kg

[1] The maximum current I_{max} can be set to the required value by means of command value attenuator potentionmeter "Gw".

Output characteristic curves

Linear output characteristic curve (basic characteristic curve)



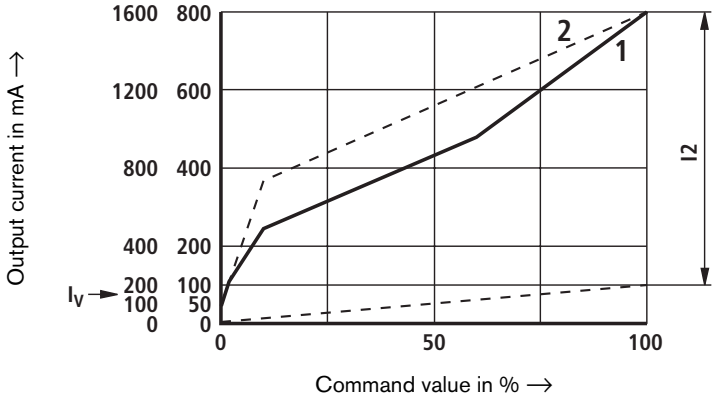
I1 Adjustment range of biasing current I_b by means of potentiometer "Zw" (R130) on the printed-circuit board

I2 Adjustment range of maximum command value by means of potentiometer "Gw"

A Characteristic curve with factory setting

Output characteristic curve with firmly set characteristics

(see adjustment instructions on pages 8 and 9)



I_v Biasing current curve 2 (qualitative representation)

I2 Adjustment range of maximum command value by means of potentiometer "Gw"

1 Characteristic curve 1 (qualitative representation)

2 Characteristic curve 2 (qualitative representation)

Indicator / adjustment elements

VT-VSPA1-1, component series 10

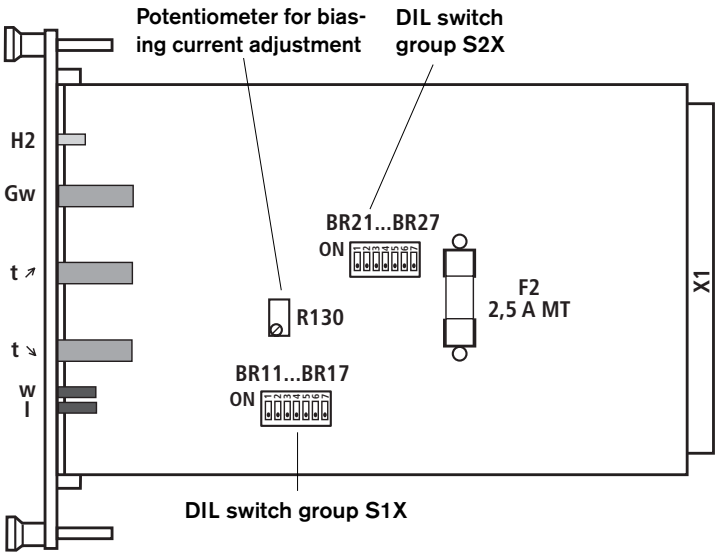
LED indicator lamp “ready for operation"

Max. command value (attenuator)

Ramp time “up”

Ramp time “down"

w - Current command value
I - Actual current value



VT-VSPA1-1, from component series 11

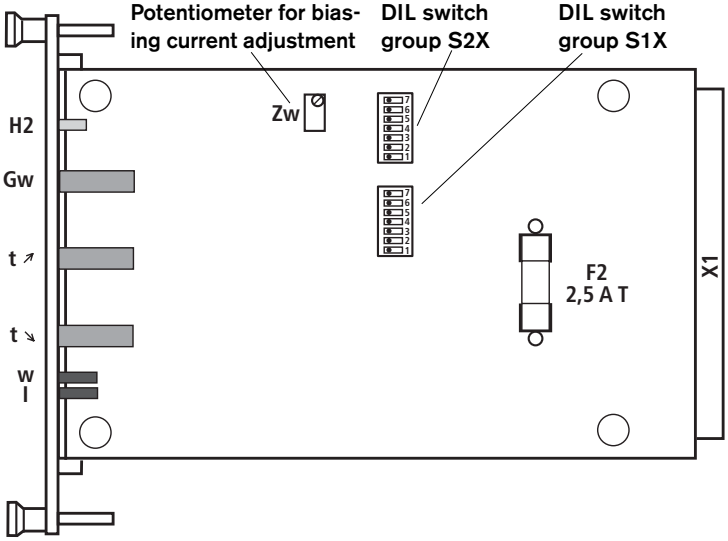
LED indicator lamp “ready for operation"

Max. command value (attenuator)

Ramp time “up”

Ramp time “down"

w - Current command value
I - Actual current value

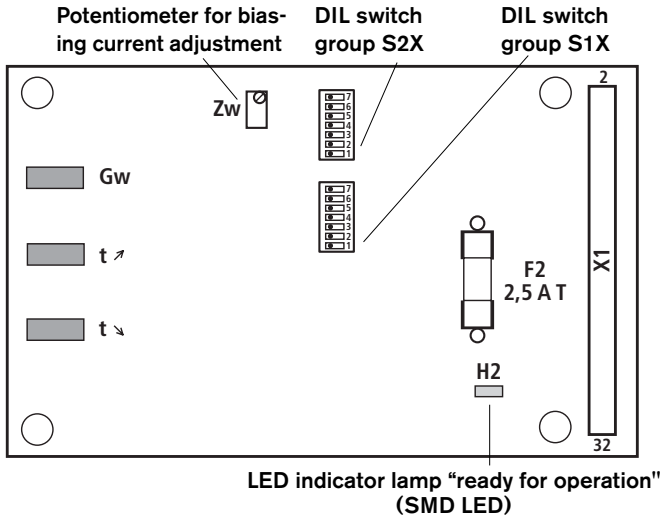


VT-VSPA1K-1

Max. command value (attenuator)

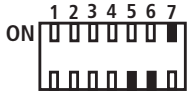
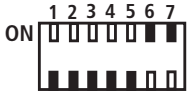
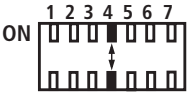
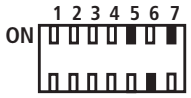
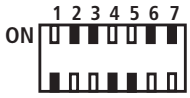
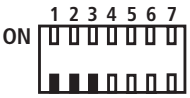
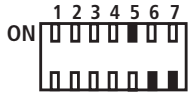
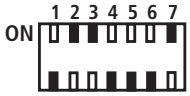
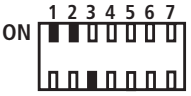
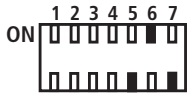
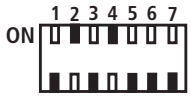
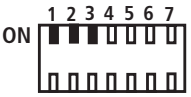
Ramp time “up"

Ramp time “down"



Indicator / adjustment elements (continued)

Assignment of DIL switch settings on the card to the valve types (see also label on the printed-circuit board)

Setting for valve types:	S15 … S17 (BR15 … BR17)	S21 … S27 (BR21 … BR27)	Setting valid for all valve types:	S11 … S14 (BR11 … BR14)
DBE(M)T, DBE(M)30, DRE(M)30, 3DRE(M)10 [1], 3DRE(M)16 [1], DBEP6A, DBEP6B, 3DREP6A, 3DREP6B, pumps			Ramp time 5 s ↕ 1 s	
DRE(M)10-5X, DRE(M)20-5X		 X	Command value 2 +10 V	
DBE(M)10-5X, DBE(M)20-5X, 3DRE(M)10P-6X, 3DRE(M)16P-6X, ZDRE10, (Z)DBE6		 X	0 … 20 mA	
DRE6, ZDRE6		 X	4 … 20 mA	

[1] Up to component series 5X

Meaning of potentiometers "Zw" (R130) and "Gw":

- Adjustment of biasing current by means of potentiometer "Zw" (R130)
  - Turning clockwise → increase in biasing current
  - Turning counter-clockwise → reduction of biasing current
- Adjustment of the max. command value by means of potentiometer "Gw"
  - Turning clockwise → increase in command value
  - Turning counter-clockwise → reduction of command value

Note (X):

With type VT-VSPA1-1 (component series 10) switch BR22 must be set to “ON” and potentiometer “R130” turned to “left-hand limit stop” before the correct characteristic curve can be set.

With type VT-VSPA1-1 (from component series 11) and type VT-VSPA1K-1, switch S22 is ineffective. Potentiometer "Zw" needs not to be operated.

Meaning of the DIL switches

Note (X):

Before commissioning the amplifiers, make sure that the DIL switches on the printed-circuit board are set according to the relevant application.

Switch positions with reference to the current valve types or previous amplifier cards

Switch	Valve types/amplifier cards			
	DBE(M)T, DBE(M)30 DRE(M)30, DRE(M)10 [3] DRE(M)16 [3] DBEP6A, DBEP6B 3DREP6A, 3DREP6B pumps	DRE(M)10-5X DRE(M)20-5X	DBE(M)10-5X DBE(M)20-5X ZDRE10 (Z)DBE6 3DRE(M)10P-6X 3DRE(M)16P-6X	DRE, ZDRE6
	VT 2000	VT 2010	VT 2013	VT 2023
	Characteristic curves			
	Basic characteristic curve	Characteristic curve 1	Characteristic curve 1	Characteristic curve 2
S15 (BR15)	OFF	ON	ON	OFF
S16 (BR16)	OFF	OFF	OFF	ON
	Command value filters			
S23 (BR23)		$f_{-3dB} = 4$ Hz	$f_{-3dB} = 4$ Hz	$f_{-3dB} = 2.5$ Hz
S24 (BR24)	OFF	ON	ON	OFF
	OFF	OFF	OFF	ON
	Max. output current [1]			
	$I_{max} = 800$ mA	$I_{max} = 800$ mA	$I_{max} = 1{,}6$ A	$I_{max} = 1.6$ A
S17 (BR17)	ON	ON	OFF	OFF
	Clock frequency [2]			
	f = 200 Hz	f = 200 Hz	f = 300 Hz	f = 370 Hz
S25 (BR25)	OFF	OFF	OFF	OFF
S26 (BR26)	ON	ON	OFF	OFF
S27(BR27)	ON	ON	ON	OFF
	Basic biasing current setting			
"Zw" (R130)	100 mA	50 mA	100 mA	100 mA

[1] Doubling of the maximum output current doubles the adjustment range and the set biasing current.

[2] For f = 100 Hz, DIL switches S25, S26 and S27 must be set to the "ON" position.

[3] Up to component series 5X

Adjustment range of biasing current using potentiometer "Zw" (R130):

$I_{max} =$ 800 mA $\rightarrow I_b = 0$ to 300 mA

$I_{max} = 1600$ mA $\rightarrow I_b = 0$ to 600 mA

( ) valid for VT-VSPA1-1, component series 10

When switch BR22 is operated, the biasing current increases by 50 mA or 100 mA.

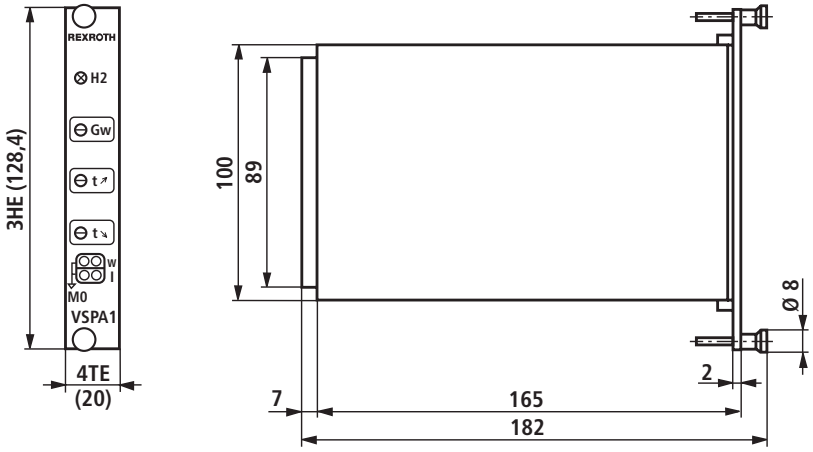
Adjustment options inedependent of the valve type (command value 2 and ramp time)

	Configuration of differential input			
S11 (BR11)	Command value 2: +10 V	Command value 2: 0 to 20 mA	Command value 2: 4 to 20 mA	DRE, ZDRE6
S12 (BR12)	OFF	ON	ON	
S13 (BR13)	OFF	ON	ON	
	OFF	OFF	ON	
	Max. ramp time			
S14 (BR14)	OFF 1 s		ON 5 s	

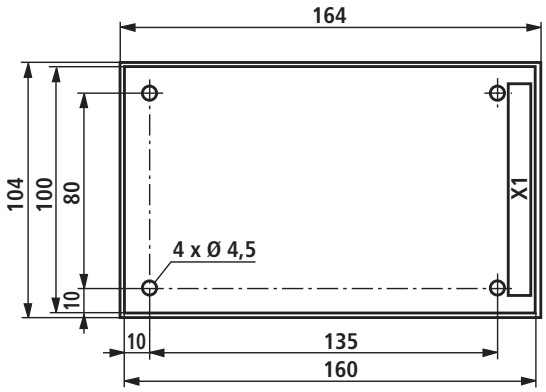
Factory setting (corresponds to the configuration of a VT 2000 amplifier)

Unit dimensions (nominal dimensions in mm)

VT-VSPA1-1



VT-VSPA1K-1



Engineering / maintenance notes / supplementary information

- Before commissioning the amplifiers, make sure that the DIL switches on the printed-circuit board are set according to the relevant application.
- The factory setting of the parameters is as follows (for the adjustment of parameters, see pages 8 to 10):
  max. ramp time = 5 s, biasing current = 100 mA, max. output current = 800 mA, clock frequency = 200 Hz
- The amplifier card may only be installed when disconnected from the power supply!
- Do not use plugs with free-wheeling diodes or LED lamps for connecting the solenoids!
- Measurements on the card may only be taken with instruments $R_i > 100\ k\Omega$!
- Measuring zero (M0) is raised by +9 V as against 0 V operating voltage and not electrically isolated, i.e. –9 V regulated voltage 0 V operating voltage. For this reason, do not connect measuring zero (M0) to 0 V operating voltage!
- Use relays with gold-plated contacts for passing on command values (small voltages, small currents)!
- Always shield command value cables; connect the shield to ground on the card side and leave the other end open. Connect the card to ground at terminal 6 or 8. If no system ground is provided, connect 0 V operating voltage.
  Recommendation: Also shield solenoid cables!
  For solenoid cables of up to 50 m length, use cable type LiYCY 1.5 mm^2. For greater lengths, please consult us!
- The distance to aerial lines, radio sources and radar equipment must be at least 1 m!
- Do not lay solenoid and signal cables near power cables!
- Due to the charging current of the smoothing capacitor on the card, fuses must feature slow-blowing characteristics!

⚠ **Caution!** When the differential input is used, both inputs must always be switched on or off simultaneously!

☞ **Note!** Electrical signals (e.g. signal “ready for operation”) brought out via control electronics must not be used for switching safety-relevant machine functions!
(See also European standard “Safety requirements for fluid power systems and components - hydraulics“, EN 928.)

Troubleshooting

If the amplifier cards are not operable, follow the steps below for troubleshooting:

1. Is the operating voltage applied?
   Measurement of contacts 24(ac) against 18 (ac)
2. Fuse on the card defective?
3. Internal ±9 V operating voltage available on the card?
4. When the internal command value potentiometer is used, is the jumper from 10(ac) to 12(ac) plugged?
5. Is the external potentiometer properly connected?
6. Is the differential input properly connected?
   Check: Reference potential to 30(ac)
   0 to +10 V to 28(ac)
7. Is the solenoid properly connected?
   When the card is unplugged, a resistance of approx. 20 Ω to 30 Ω or 5 Ω to 8 Ω, depending on the valve, must be measurable between contacts 22ac and 20ac.

The additions to the contact designations are only valid for type VT-VSPA1-1.

Note:

The output stage shuts down in the case of excessive temperatures (e.g. caused by overloading). This fault is signalled by LED "H2" going out!

In the event of a cable break of the "4 to 20 mA" input, the signal "ready for operation" is reset and LED "H2" also goes out.

The following is valid from component series 11 onwards:

In the case of a short-circuit or cable break of the solenoid cable, the output “ready for operation” is switched and LED "H2" flashes at a frequency of 0.5 to 2 Hz as soon as the command value is > 2 % at the same time.

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