

The Drive & Control Company

Rexroth
Bosch Group

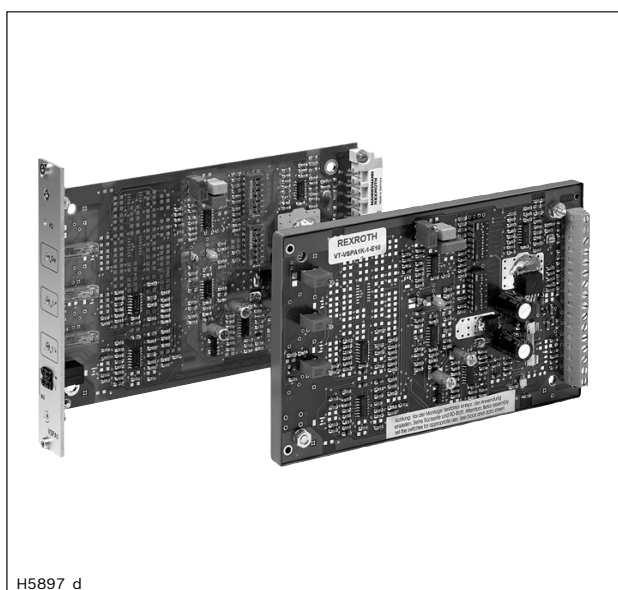
Valve amplifiers for proportional pressure valves

Type VT-VSPA1-1, VT-VSPA1K-1

RE 30111

Edition: 2013-11

Replaces: 10.10



- ▶ Component series 1X
- ▶ Suitable for the control of all direct and pilot operated proportional pressure valves without electrical position feedback and only one solenoid as actuating element available at the time of the data sheet publication

Features

- ▶ Differential input, switchable from voltage to current input
- ▶ Additional command value input 0 to +9 V
- ▶ Ramp generator, separately adjustable for upwards and downwards direction
- ▶ Clocked power output stage
- ▶ "Ready for operation" message (VT-VSPA1K-1 only with LED display)
- ▶ Reverse polarity protection for voltage supply
- ▶ Cable break detection for current input 4 to 20 mA
- ▶ Short-circuit protection of the solenoid conductor
- ▶ Cable break detection of the solenoid conductor

Contents

Features	1
Ordering code	2
Function	2
Block diagram/pin assignment: VT-VSPA1-1	4
Block diagram/pin assignment: VT-VSPA1K-1	5
Technical data	6
Characteristic curves	7
Display/adjustment elements	8
Meaning of the DIL switches	10
Dimensions	11
Project planning/maintenance instructions/ additional information	11
Troubleshooting	12

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2/12 **VT-VSPA1-1, VT-VSPA1K-1** | Valve amplifiers

Ordering code

01	02	03	04	05
VT-VSPA1		-	1	-
			1X	/
				*

01	Amplifier for controlled proportional pressure valves, analog, with one solenoid	VT-VSPA1
02	With 32-pole male multipoint connector and front plate	no code
	With 16-pole terminal strip; without front plate	K
03	For pressure valves	1
04	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	1X
05	Further details in the plain text	*

Suitable card holders for VT-VSPA1-1:

- ▶ Type VT 3002-1-2X/32D, see data sheet 29928
Single card holder without power supply unit

When replacing amplifiers VT 2000 (up to component series 4X), VT 2010, VT 2013 or VT 2023, the blind plate 4TE/3HE must be ordered separately for the rack mounting.

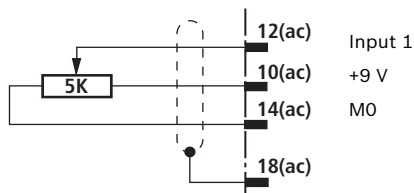
Material no. R900021004

Function

The command value voltage is specified at the command value input 1 either directly or via an external command value potentiometer by means of the regulated voltage +9 V of the power supply unit [14].

To this input, the following applies: +9 V \pm +100 % ¹⁾.

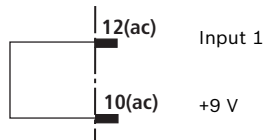
External command value presetting



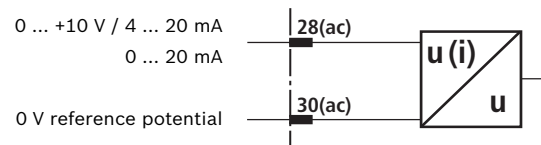
Notice:

If an external command value potentiometer is used, the internal potentiometer "Gw" [3] must be set to maximum or to the desired maximum pressure.

Internal command value presetting



Differential input (input 2)



The amendment of the connection designations in brackets only applies to type VT-VSPA1-1.

The command value input 2 is a differential input [1] (0 to +10 V). By means 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 specified by external electronics with a different reference potential (e.g. by a PLC), this input has to be used. When disconnecting or connecting the command value voltage, it has to be ensured that both signal lines are in each case separated from or connected with the input.

Before they are forwarded, both command values are summed up [2] and then reach a potentiometer [3] accessible at the front plate of the card which acts as attenuator and thus limits the maximum command value.

Function (continued)

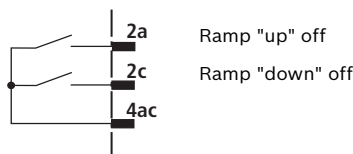
The down-stream ramp generator [4] generates a ramp-shaped output signal from a given stepped input signal. The time constant of this signal can be separately adjusted for the upwards and downwards direction by means of two potentiometers. The specified ramp time refers to a command value step of 100 % and may be approx. 1 s or 5 s, depending on the setting by means of a DIL switch ²⁾. If a command value step of less than 100 % is switched to the ramp generator input or if the attenuator [3] is effective, the ramp time will be correspondingly shorter.

To type **VT-VSPA1-1**, the following applies: By means of the external "ramp up/down off" contacts, the upwards and downwards ramp times can be separately set to their minimum value (approx. 30 ms).

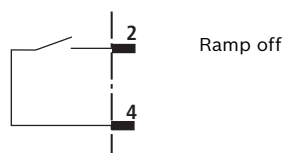
To type **VT-VSPA1K-1**, the following applies: By means of the external "ramp off" contact, the upwards and downwards ramp times can be set to their minimum value (approx. 30 ms) together.

Ramp "up/down" off

VT-VSPA1-1



VT-VSPA1K-1



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

In the summing amplifier [5], the output signals of the characteristic curve generators [6 or 7] are added 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 be filtered by means of a connectible low pass. The current output stage [9] is controlled using the current controller [8]. In the current controller, the current command value is moreover modulated with the clock generator signal [10] (frequency can be programmed using the DIL switch ²⁾). In the valve solenoid, the clocked actual current value acts like a constant current with superimposed dither signal. Type VT-VSPA1-1 has measuring sockets for the internal command value and the actual value.

The following is true for the command value: +6 V $\hat{=}$ 100 %

The following is true for the actual value: 1 mV $\hat{=}$ 1 mA

The "ready for operation" signal is output and the "H2" LED on the front plate (with VSPA1-1) or the "H2" LED (with VSPA1K-1) is illuminated if:

- there is no short-circuit of the solenoid conductors and no overload of the output stage,
- a command value is available (cable break detection),
- there is no cable break of the solenoid conductor.

In case of a fault, the following applies:

	Output	LED
Short-circuit	Low	Off
Cable break	Clocking	Flashing

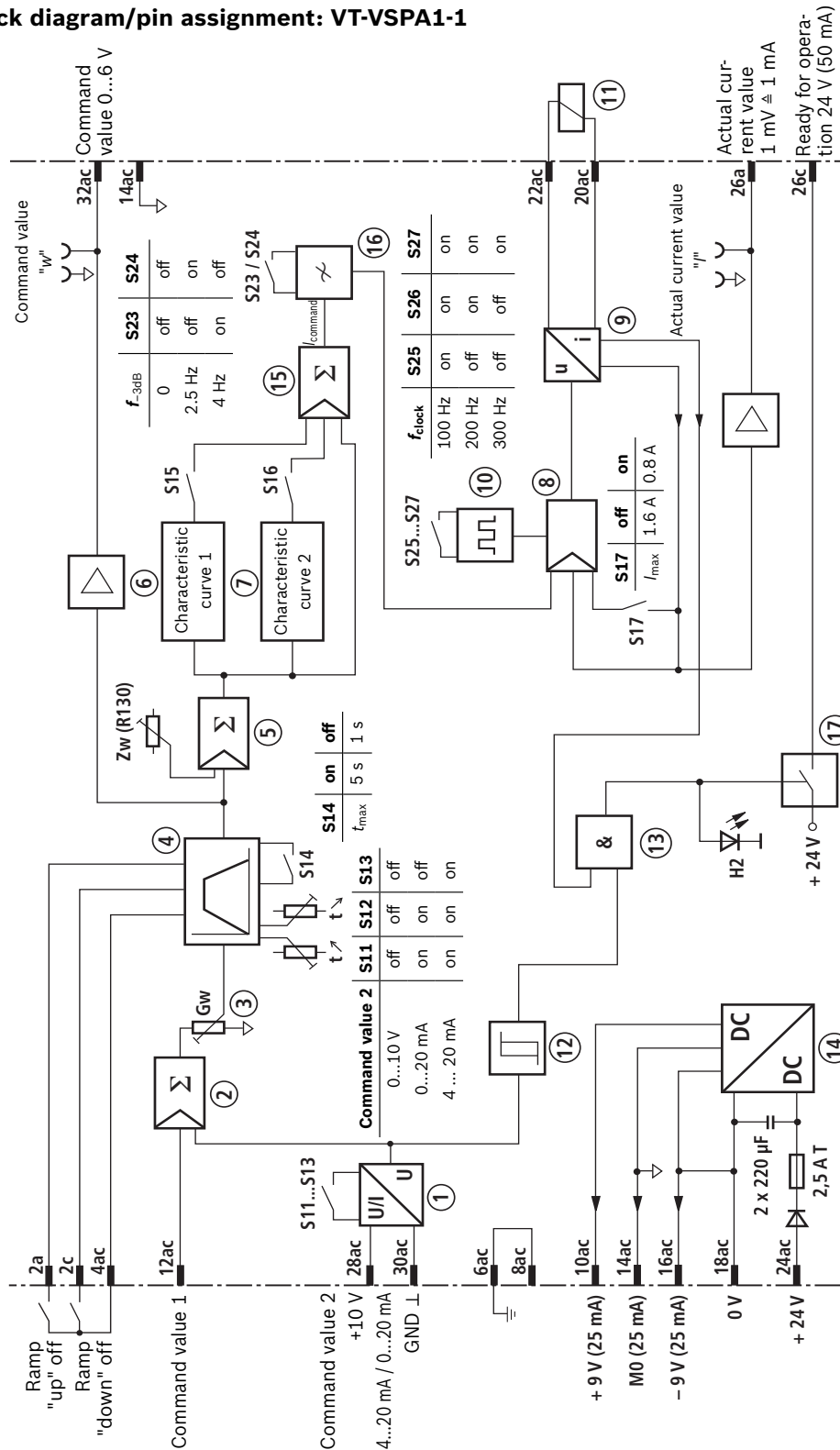
¹⁾ The reference potential for command value 1 is M0 (measurement zero).

²⁾ For the DIL switch settings see page 8 to 10

[] ... assignment to the block diagrams on page 4 and 5

Block diagram/pin assignment: VT-VSPA1-1

Notice: Measurement zero (M0) is increased by 9 V as compared to the 0 V operating voltage.

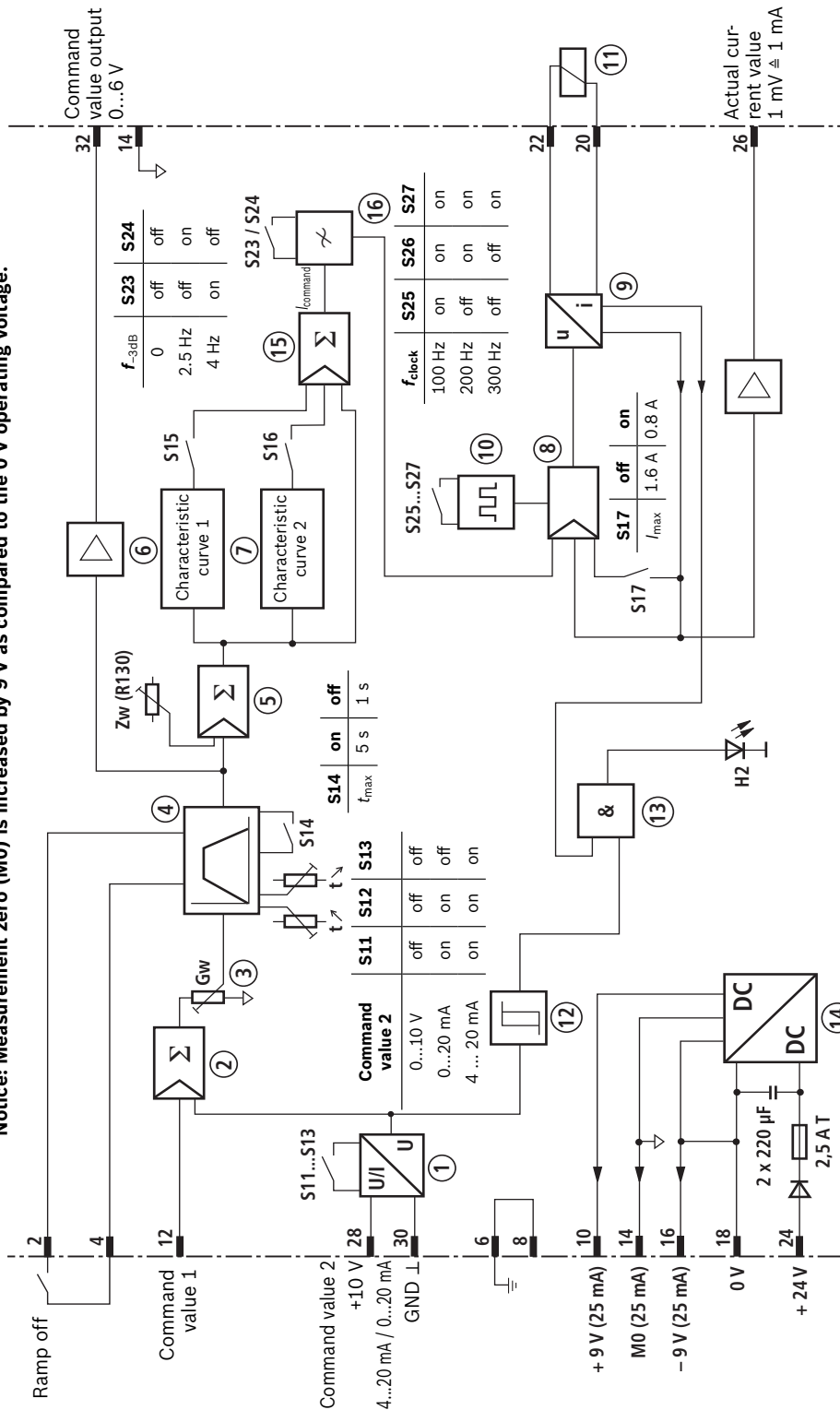


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- | | | | | | |
|-----------------|----------------------------------|-----------|------------------------------------|---------------|----------------------------------|
| 1 | Differential input | 9 | Power output stage | 17 | "Ready for operation" output |
| 2; 5; 15 | Summing device | 10 | Clock generator | H2 | "Ready for operation" display |
| 3 | Attenuator max. command value | 11 | Proportional solenoid of the valve | Gw | Command value attenuation |
| 4 | Ramp generator | 12 | Command value monitoring | t | Ramp time setting |
| 6 | Characteristic curve generator 1 | 13 | Monitoring | Zw | Additional pilot current setting |
| 7 | Characteristic curve generator 2 | 14 | Power supply unit | (R130) | (0 to 300 mA or 0 to 600 mA) |
| 8 | Current controller | 16 | Low pass filter | | |

Block diagram/pin assignment: VT-VSPA1K-1

Notice: Measurement zero (M0) is increased by 9 V as compared to the 0 V operating voltage.



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6/12 **VT-VSPA1-1, VT-VSPA1K-1** | Valve amplifiers

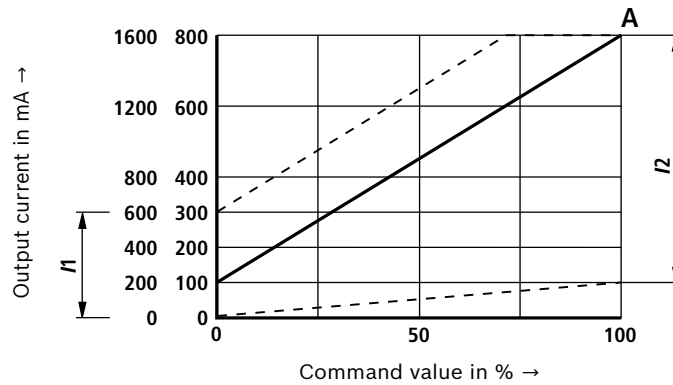
Technical data (For applications outside these parameters, please consult us!)

Operating voltage	U_B	+24 VDC + 40 % – 5 %	
Upper limit value	$u_B(t)_{ma}$	+35 V	
Lower limit value	$u_B(t)_{min}$	+22 V	
Max. power consumption	P_s	50 VA	
Max. current consumption	I	1.8 A	
Fuse	I_s	2.5 A slow-blow	
Inputs	Command value 1	U_e	0 to +9 V (reference potential is M0)
	Command value 2 (differential input)	U_e	0 to +10 V; $R_e = 100 \Omega$
	or	I_e	4 to 20 mA (load $R_B = 100 \Omega$)
	or	I_e	0 to 20 mA (load $R_B = 100 \Omega$)
Ramp time (setting range)		t	30 ms to approx. 1 s or 5 s (depending on the setting by means of S14)
Outputs			
Output stage			
Solenoid current/resistance		I_{max}	800 mA + 20 %, $R_{20} = 19.5 \Omega$
	or	I_{max}	1600 mA + 20 %, $R_{20} = 5.4 \Omega$
Pilot current	with $I_{max} = 800$ mA	I_v	50 mA or 100 mA
	with $I_{max} = 1600$ mA	I_v	100 mA
Additionally	with $I_{max} = 800$ mA	I_v	0 to 300 mA + 20 %
	with $I_{max} = 1600$ mA	I_v	0 to 600 mA + 20 %
Clock frequency		f	100 Hz, 200 Hz, 300 Hz or 370 Hz in each case ± 10 % (depending on the setting by means of S25 to S27)
"Ready for operation" signal (only with VT-VSPA1-1)			
High		U	Approx. U_B , 50 mA
Low		U	0 V, $R_i = 10 \text{ k}\Omega$
Regulated voltage		U	$\pm 9 \text{ V} \pm 1 \%$, ± 25 mA externally loadable
Measuring sockets			
Command value "w"		U	0 to +6 V (+6 V ± 100 % solenoid current), $R_i = 1 \text{ k}\Omega$
Actual current value "I"		U	0 to 1600 mV ± 0 to 1600 mA ± 20 mA
Type of connection			
VT-VSPA1-1			32-pole male multipoint connector, DIN 41612, design D
VT-VSPA1K-1			16-pole terminal strip
Card dimensions			Euro-card 100 x 160 mm, DIN 41494
Front plate dimensions			
Height			3 HE (128.4 mm)
Width soldering side			1 TE (5.08)
Width component side			3 TE
Admissible 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 the "Gw" command value attenuator potentiometer.

Characteristic curves

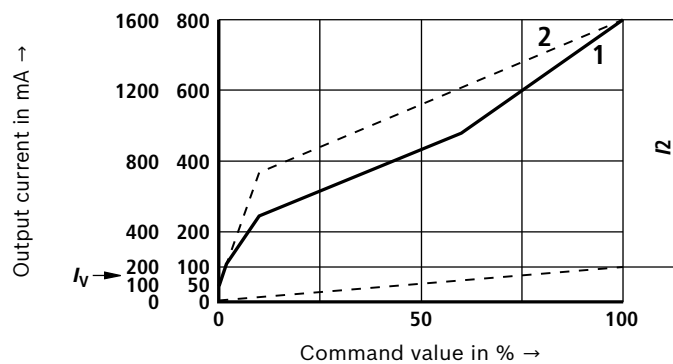
Linear output characteristic curve (basic characteristic curve)



- /1 Pilot current setting range I_V with potentiometer "Zw" (R130) on the printed circuit board
- /2 Setting range of the maximum command value with potentiometer "Gw"
- A Characteristic curve in the condition as supplied

Output characteristic curve with fixedly set characteristic

(see setting instructions on page 9 and 10)

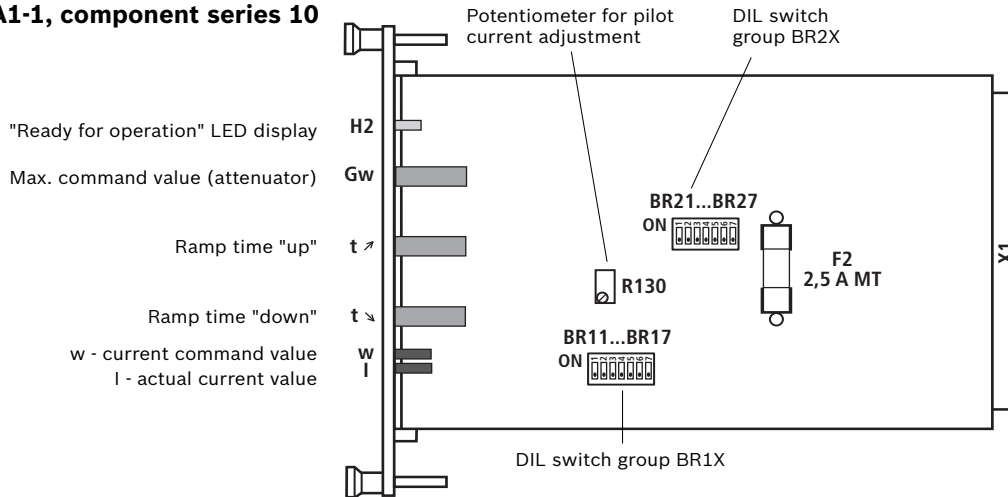


- I_V Pilot current characteristic curve 2 (qualitative representation)
- /2 Setting range of the maximum command value with potentiometer "Gw"
- 1 Characteristic curve 1 (qualitative representation)
- 2 Characteristic curve 2 (qualitative representation)

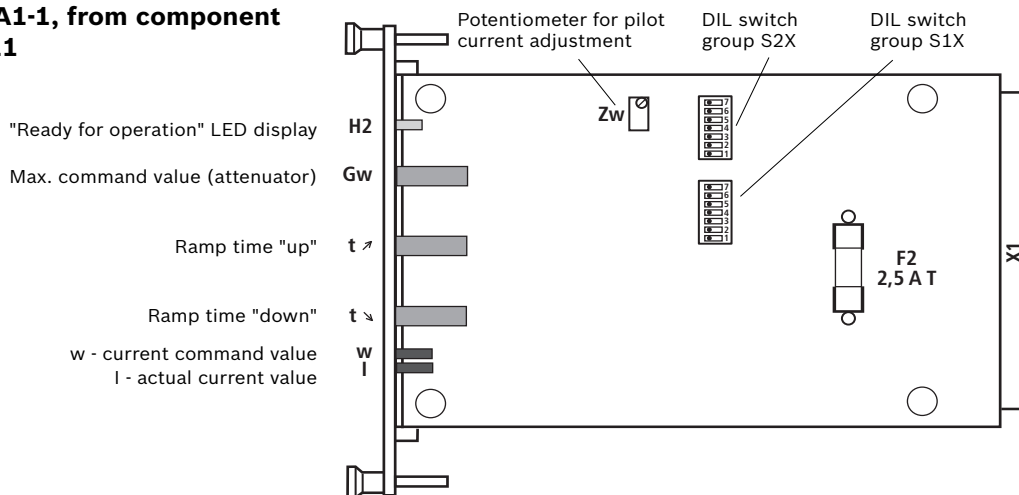
8/12 **VT-VSPA1-1, VT-VSPA1K-1** | Valve amplifiers

Display/adjustment elements

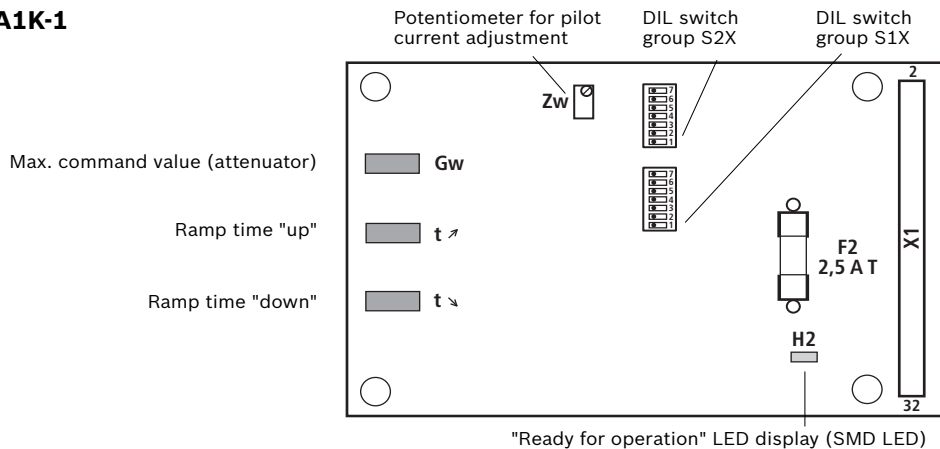
VT-VSPA1-1, component series 10



VT-VSPA1-1, from component series 11



VT-VSPA1K-1



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Display/adjustment elements (continued)

Assignment of the DIL switch settings on the card to the valve types (see also sign 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	ON	ON	Ramp time 5 s ↑ 1 s	ON
DRE(M)10-5X, DRE(M)20-5X	ON	ON X	Command value 2 +10 V	ON
DBE(M)10-5X, DBE(M)20-5X, 3DRE(M)10P-6X, 3DRE(M)16P-6X, ZDRE10, (Z)DBE6	ON	ON X	0 ... 20 mA	ON
DRE6, ZDRE6	ON	ON X	4 ... 20 mA	ON

¹⁾ To component series 5X

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

- Pilot current setting by means of the "Zw" (R130) potentiometer
 - Clockwise rotation → increase in pilot current
 - Counterclockwise rotation → reduction of pilot current
- Setting of the max. command value using the "Gw" potentiometer
 - Clockwise rotation → increase in command value
 - Counterclockwise rotation → reduction of command value

Notice (X):

With type VT-VSPA1-1 (component series 10), the BR22 switch must be set to "ON" and the "R130" potentiometer must be rotated to the left stop in order to set the correct characteristic curve.

With type VT-VSPA1-1 (from component series 11) and type VT-VSPA1K-1, switches S21 and S22 do not have any effect. The "Zw" potentiometer does not have to be operated.

10/12 VT-VSPA1-1, VT-VSPA1K-1 | Valve amplifiers

Meaning of the DIL switches

Notice:

It has to be ensured before commissioning of the amplifiers that the DIL switches on the printed circuit board are set according to the relevant application.

Switch settings with regard to 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 filter			
		$f_{-3dB} = 4 \text{ Hz}$	$f_{-3dB} = 4 \text{ Hz}$	$f_{-3dB} = 2.5 \text{ Hz}$
S23 (BR23)	OFF	ON	ON	OFF
S24 (BR24)	OFF	OFF	OFF	ON
	Max. output current ¹⁾			
	$I_{max} = 800 \text{ mA}$	$I_{max} = 800 \text{ mA}$	$I_{max} = 1.6 \text{ A}$	$I_{max} = 1.6 \text{ A}$
S17 (BR17)	ON	ON	OFF	OFF
	Clock frequency ²⁾			
	$f = 200 \text{ Hz}$	$f = 200 \text{ Hz}$	$f = 300 \text{ Hz}$	$f = 370 \text{ Hz}$
S25 (BR25)	OFF	OFF	OFF	OFF
S26 (BR26)	ON	ON	OFF	OFF
S27 (BR27)	ON	ON	ON	OFF
	Pilot current basic setting			
"Zw" (R130)	100 mA	50 mA	100 mA	100 mA

¹⁾ Any doubling of the maximum output current will double the setting range and the set pilot current.

²⁾ For $f = 100 \text{ Hz}$, the DIL switches S25, S26 and S27 must be brought into "ON" position.

³⁾ To component series 5X

Pilot current setting range by means of the "Zw" (R130) potentiometer:

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

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

() applies to VT-VSPA1-1, component series 10

Upon operation of switch BR22, the pilot current is increased by 50 mA or 100 mA.

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

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

☐ = Condition as supplied (corresponds to the configuration of an amplifier VT 2000)

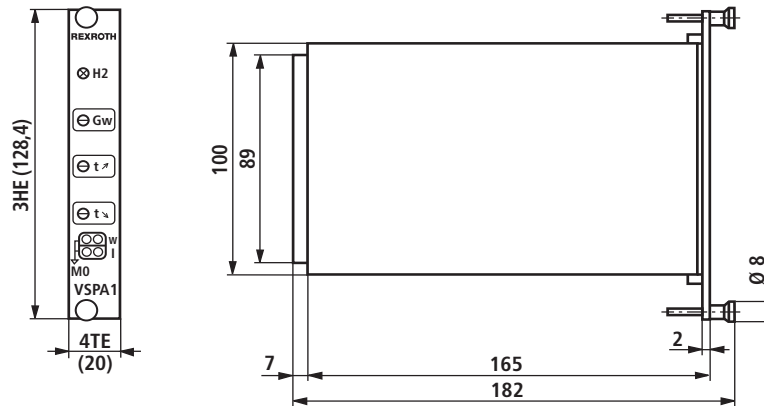
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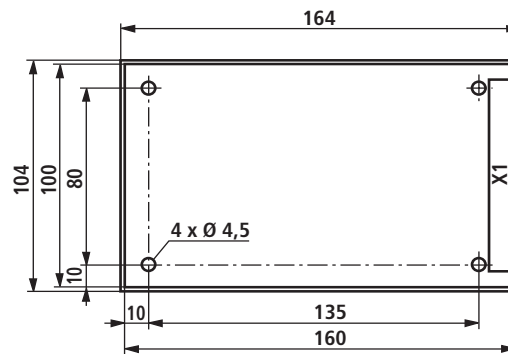
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Dimensions (dimensions in mm)

VT-VSPA1-1



VT-VSPA1K-1



Project planning/maintenance instructions/additional information

- ▶ It has to be ensured before commissioning of the amplifiers that the DIL switches on the printed circuit board are set according to the relevant application.
- ▶ In the condition as supplied the parameters are set as follows (for the parameter setting refer to pages 8 to 10):
Max. ramp time = 5 s, pilot current = 100 mA, max. output current = 800 mA, clock frequency = 200 Hz.
- ▶ The amplifier card may only be assembled when de-energized.
- ▶ No connectors with free-wheeling diodes or LED displays must be used for solenoid connection.
- ▶ Only carry out measurements at the card using instruments $R_i > 100 \text{ k}\Omega$.
- ▶ Measurement zero (M0) is increased by +9 V compared to 0 V operating voltage and not isolated, i.e. -9 V regulated voltage \neq 0 V operating voltage. Thus, do not connect measurement zero (M0) to 0 V operating voltage.
- ▶ For switching command values, relays with gold-plated contacts have to be used (low voltages, low currents).
- ▶ Always shield command value lines, connect shielding to earth on the card-side, other side open. The card has to be connected to the earth via terminal 6 or 8. If no system earth exists, connect 0 V operating voltage.
- ▶ Recommendation:
Also shield the solenoid conductor. For solenoid conductors up to 50 m in length, use the line type LiYCY 1.5 mm². For greater lengths, please contact us.
- ▶ The distance to aerial lines, radios, and radar systems has to be 1 m at least.
- ▶ Do not lay solenoid conductors and signal lines near power lines.
- ▶ The charging power of the smoothing capacitor on the card requires the pre-fuses to be of a slow-blowing nature.
- ▶ **Notice:**
If the differential input is used, both inputs must always be connected or disconnected at the same time.

12/12 VT-VSPA1-1, VT-VSPA1K-1 | Valve amplifiers

Troubleshooting

If the amplifier cards do not function, the following steps are required for troubleshooting:

1. Operating voltage available?
Measurement of contacts 24(ac) against 18(ac)
2. Fuse on the card faulty?
3. Internal ± 9 V operating voltage available on the card?
4. If the internal command value potentiometers are used, is the bridge from 10(ac) to 12(ac) available?
5. Is the external potentiometer correctly connected?
6. Is the differential input correctly connected?
Control: Reference potential to 30(ac)
0 to +10 V to 28(ac)
7. Is the solenoid correctly connected?
If the card is removed, a resistance of approx. $20\ \Omega$ to $30\ \Omega$ or $5\ \Omega$ to $8\ \Omega$ has to be measurable between contacts 22ac and 20ac depending on the valve type.

The amendment of the connection designations in brackets only applies to type VT-VSPA1-1.

Notice:

The output stage switches off at overtemperature (e.g. due to overload). This error is displayed by the "H2" LED going out.

In case of cable break of input "4 to 20 mA", the "ready for operation" signal is reset and the "H2" LED will go out, as well.

The following applies from component series 11:

In case of short-circuit or cable break of the solenoid conductor, the ready for operation output will clock and the "H2" LED will flash with a frequency of 0.5 to 2 Hz as soon as the command value is simultaneously $> 2\%$.

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