Electrical amplifier

RE 30112/05.05 1/12
Replaces: 02.03

Type VT-VSPA2-1

Series 1X

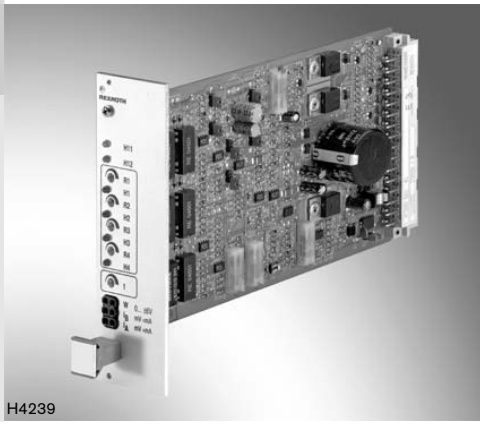

H4239

Table of contents

Contents	Page
Features	1
Ordering code	2
Preferred types	2
Functional description	2 and 3
Block circuit diagram / pin assignment VT-VSPA2-1-1X/T1	4
Block circuit diagram / pin assignment VT-VSPA2-1-1X/T5	5
Technical data	6 and 7
Output characteristic curves	7
Indicator / adjustment elements	8
Unit dimensions	9
Engineering / maintenance notes / supplementary information	9

Information about available spare parts:
www.boschrexroth.com/spc

Features

- Suitable for controlling direct operated proportional directional valves without electrical position feedback (type 4WRA, sizes 6 and 10, from series 2X)
- Four command values that can be adjusted by means of potentiometers
- Four command value call-ups with LED indicator lamp
- Differential input, can be changed over to current input
- Enable input with LED indicator lamp
- Indication of “ready for operation” by LED
- Step function generator
- Ramp generator with one or five ramp times
- Two clocked current output stages
- Reverse polarity protection for voltage supply

Card holder: – Type VT 3002-2X/32, see RE 29928 single card holder without power supply unit

Power supply unit: – Type VT-NE30-1X, see RE 29929 (VT-NE30-2X) compact power supply unit, 115/230 VAC → 24 VDC, 70 VA

Ordering code

VT-VSPA2 – 1 – 1X/ *

Amplifier for controlled proportional valves, analogue, with 2 output stages

Amplifier for proportional directional valve types 4WRA 6 and type 4WRA 10 (from series 2X) **= 1**

Production code and further details in clear text

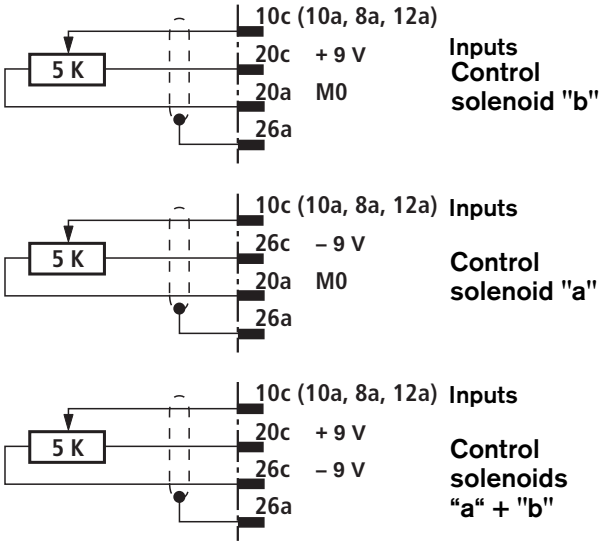
T1 = 1 ramp time
T5 = 5 ramp times

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

Functional description

With command value inputs 1 to 4, command values [1] can be called up by controlling associated relays (K1 to K4). The command value voltage is applied either directly through regulated ±9 V voltages of the power supply unit [9] or via an external command value potentiometer. For these inputs, ±9 V ≙ ±100 % [1] is valid. If these four command value inputs are connected directly to the regulated voltages of ±9 V, then four different command values can be set using potentiometers R1 to R4. When using external command value potentiometers at these inputs the internal potentiometers act as attenuators or limiters, unless they are set to maximum.

External command value potentiometers



Which command value is momentarily called up is indicated by LEDs "H1" to "H4". If more than one command value is called up at a time, then the input with the highest number has priority. Example: If command values 1 and 3 are called up simultaneously, then command value 3 becomes active.

A further output of the card provides a supply voltage for the command value call-ups which can be switched over from +9 V to –9 V using relay K6 [1].

With the amplifier variant with 5 ramp times (ordering code **T5**) an adjustable ramp time ("t1" to "t4") is assigned to each of the four call-up command values. If no command value is called up, then time "t5" is effective with this unit.

All relays on the card are operated with 24 VDC (smoothed).

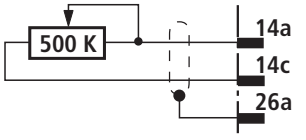
Additionally, direct command value input 5 is available for the input voltage of 0 to ±6 V. The following is valid: ±6 V = ±100 % [1].

The command value input is a differential input (0 to ±10 V). It can be configured as a current input (4 to 20 mA or 0 to ±20 mA) (see "adjustment elements" on page 6) by setting jumpers [2]. If the command value is applied by separate electronics with a different reference potential, this input must be used. When applying or withdrawing the command value voltage, care must be taken to ensure that both signal cases are either disconnected from or connected to the input.

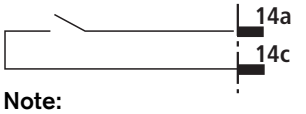
Before being passed on, all command values are summated with the correct amount and sign [3].

The downstream ramp generator [4] generates a ramp-shaped output signal from a stepped input signal. The time constant of the output signal can be adjusted using potentiometers "t" or "t1" to "t5". The given ramp time refers to a command value step-change of 100 % and can be ca. 1 s or 5 s, depending on the jumper setting (J5, J6). If a command value step-change of less than 100 % is fed to the input of the ramp generator, the ramp time shortens accordingly.

External ramp time potentiometer and ramp "off"



Ramp "regulatable"
Time: min. = 0 Ω
Time: max. = 500 kΩ



Ramp "On/Off"

Note:

When an external time potentiometer is used, the internal ramp time potentiometer must be set to maximum. The maximum ramp time shortens, because the resistance of the external potentiometer is connected in parallel to that of the internal potentiometer (ca. 500 kΩ)!

Functional description

By operating relay K5 or by plugging an external jumper, the ramp time is set to its minimum value (ca. 30 ms).

The output signal of the ramp generator [4] is fed in parallel to the summator [6] and the step function generator [5]. At command value voltages > ±1 % the step function generator generates a polarity-dependent step-change signal that is added to the output signal of the ramp generator. This step function results in the fact that the overlap section of the valve spool is passed quickly. At higher command value voltages, the step function generator outputs a constant output signal.

The output signal of the summator [6] is the command value current value that is fed to the two current regulators [7] and to measuring socket "w" on the front panel of the card. A voltage of 6 V at the command value measuring socket corresponds to a command value of 100 %. A positive command value signal at the input of the amplifier controls the output stage of solenoid "b", and a negative signal controls the output stage of solenoid "a". When the command value signal is less than ±1% (step function still ineffective), a biasing current of 50 mA flows through both solenoids. The actual values of the currents through both solenoids can be measured separately at sockets "I_A" (solenoid "a") and "I_B" (solenoid "b"). Here, a voltage of 2.5 V is the equivalent to a current of 2.5 A.

[1] = Reference potential for the command values 1 to 5 is M0 (measuring zero).

[ ] = Cross-reference to block circuit diagram on pages 3 and 4

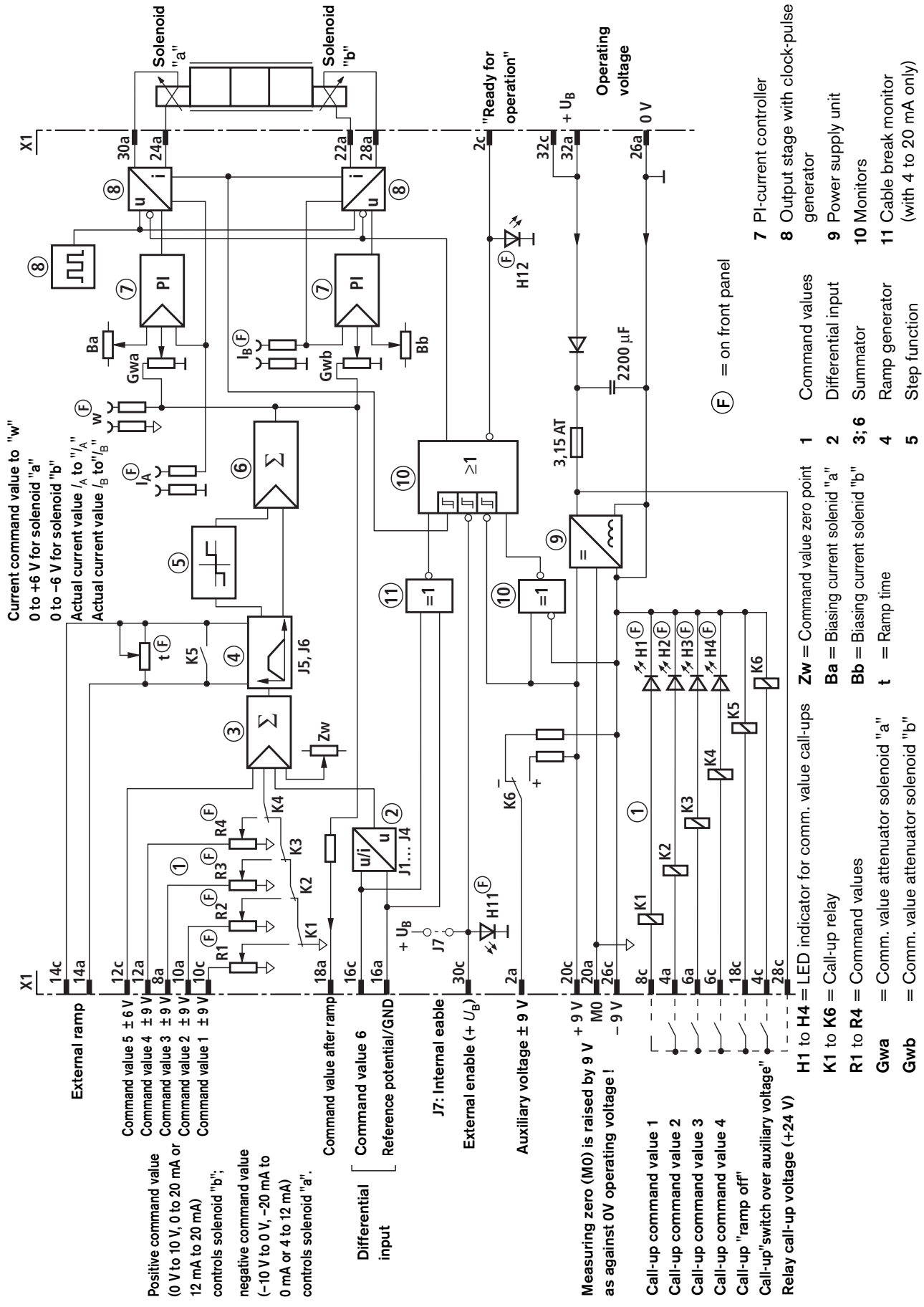
The output stages are enabled with a signal of > 8.5 V at the enable input (indicated by yellow LED "H11" on the front panel). The output stages can be permanently enabled independently of the state of the enable input by setting jumper J7. In this case, the switching input is ineffective.

The signal "ready for operation" is output [10] and the green LED "H12" on the front panel lights up, if:

- The enable signal is applied
- The internal ±9 V voltage supply is operable (amplitude and symmetry)
- There is no short-circuit of the solenoid cables
- The current input (with circuitry of the input amplifier [2] for 4 to 20 mA) does not signal any faults [10]

In case of a fault, both output stages are immediately switched off and the messages "ready for operation" is reset. After elimination of the fault, the card is immediately operable; "ready for operation", however, is only signalled after a delay of 75 ms (±30 %) so that even short-time malfunction can be acquired by a PLC.

Block circuit diagram / pin assignment VT-VSPA2-1-1X/T1

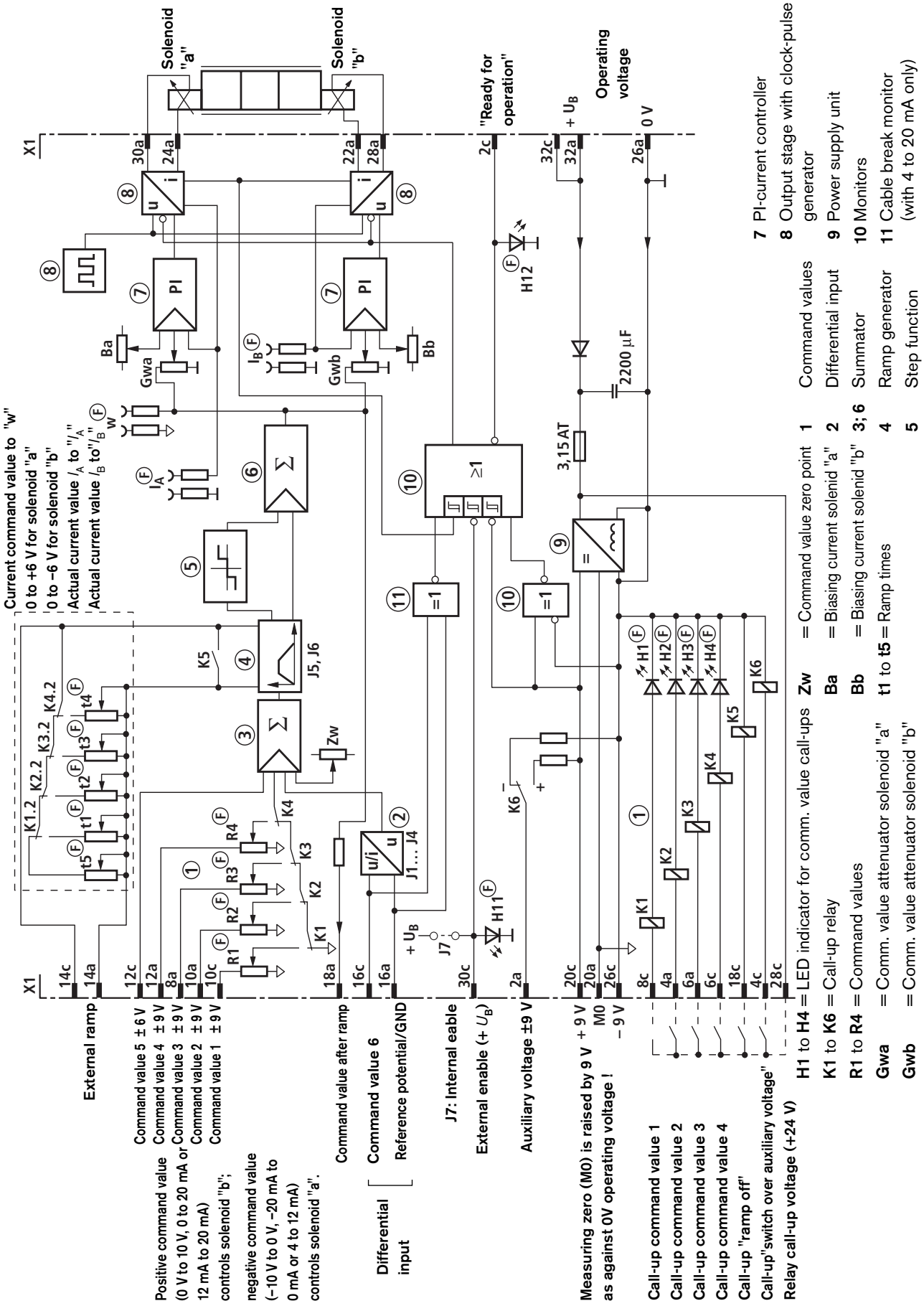


H1 to **H4** = LED indicator for comm. value call-ups
K1 to **K6** = Call-up relay
R1 to **R4** = Command values
Gwa = Comm. value attenuator solenoid "a"
Gwb = Comm. value attenuator solenoid "b"
Zw = Command value zero point
Ba = Biasing current solenid "a"
Bb = Biasing current solenid "b"
t = Ramp time

1 Command values
2 Differential input
3; 6 Summator
4 Ramp generator
5 Step function
7 PI-current controller
8 Output stage with clock-pulse generator
9 Power supply unit
10 Monitors
11 Cable break monitor (with 4 to 20 mA only)

Ⓕ = on front panel

Block circuit diagram / pin assignment VT-VSPA2-1-1X/T5



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

Operating voltage		U_B	24 VDC +40 % –5 %
Operating range:			
– Upper limit value		$u_O(t)_{max}$	35 V
– Lower limit value		$u_O(t)_{min}$	22 V
Current consumption		I	< 2 A
Power consumption		P_s	< 50 VA
Fuse		I_F	3.15 AT
Inputs:			
– Command values 1 to 4		U_i	±9 V (reference potential is M0)
– Command value 5		U_i	±6 V (reference potential is M0)
– Command value input 6 (differential input)		U_i	0 to ±10 V; R_i = 100 kΩ
	or	I_i	4 to 20 mA; load R_i = 100 Ω
			(4 mA ≙ –100 %; 12 mA ≙ 0 %; 20 mA ≙ +100 %)
	or	I_i	0 to ±20 mA
– Enable			
• active		U_E	> 8.5 V
• inactive		U_E	< 6.5 V
Relay data to 20 °C			
– Nominal voltage		U	Operating voltage U_O
– Response voltage		U	16.8 V
– Release voltage		U	2.4 V
– Coil resistance		R	2150 Ω
Ramp time (adjustment range)		t	30 ms to ca. 1 s or 5 s
Outputs:			
– Output stage			
• solenoid current / resistance		I_{max}	2.5 A; $R_{(20)}$ = 2 Ω
• biasing current		I	50 mA ±25 %
• lock-pulse frequency	• for valve size 6	f	300 Hz ±10 %] set by means of jumper J8
	• for valve size 10	f	180 Hz ±10 %]
– Signal „ready for operation“			
Series 10	• when ready for operation	U	ca. U_O] load resistance > 10 kΩ
	• in the case of a fault	U	< 1 V]
from series 11	• when ready for operation	U	> 16 V, 50 mA
	• in the case of a fault	U	< 1 V, R_i = 10 kΩ
– Regulated voltage		U	±9 V ±1 %; ±25 mA externally loadable
– Measuring sockets (reference potential is M0)			
• command value „w“		U	0 to ±6 V; R_i = 1 kΩ
• actual current value „I_A” and “I_B”		U_A; U_B	0 to 2500 mV ≙ 0 to 2500 mA ±50 mA; R_i = 1 kΩ

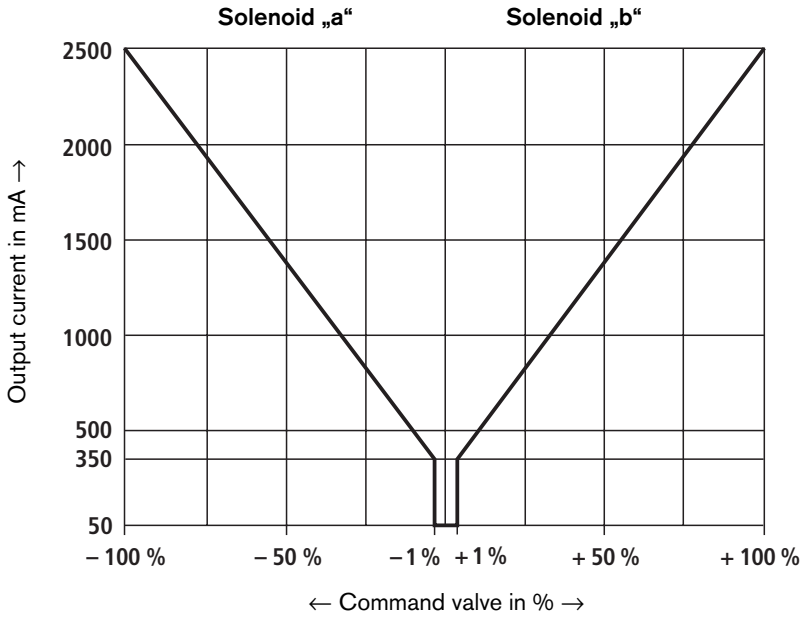
Technical data (for applications outside these parameters, please consult us!)

Type of connection		32-pin male connector, DIN 41612, form D
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 mm)
– Width component side		7 TE
Permissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–25 to +85 °C
Weight	m	0.13 kg

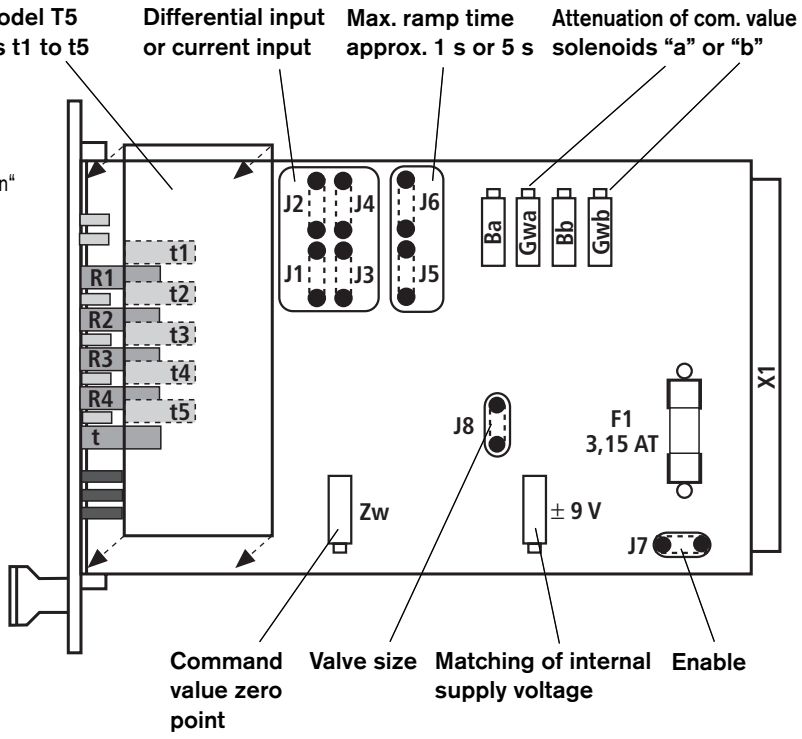
Note:

For details regarding **environment simulation tests** covering EMC (electro-magnetic compatibility), climate and mechanical loading see RE 30112-U (declaration on environmental compatibility).

Output characteristic curves



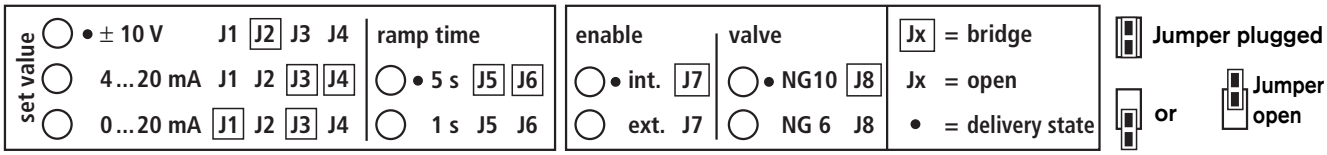
Indicator / adjustment elements



H11	-	Yellow LED indicator lamp „enable“
H12	-	Green LED indicator lamp „ready for operation“
R1/H1	-	Com. value 1 with LED
R2/H2	-	Com. value 2 with LED
R3/H3	-	Com. value 3 with LED
R4/H4	-	Com. value 4 with LED
t	-	Ramp time (with VT-VSPA2…/**T1**)
t1 to **t5**	-	Ramp times (with VT-VSPA2…/**T5**)
w	-	Solenoid current command value
I_B	-	Actual current value solenoid „b“
I_A	-	Actual current value solenoid „a“

Meaning of the jumpers on the card for the settings

(labels on the back of the front panel)



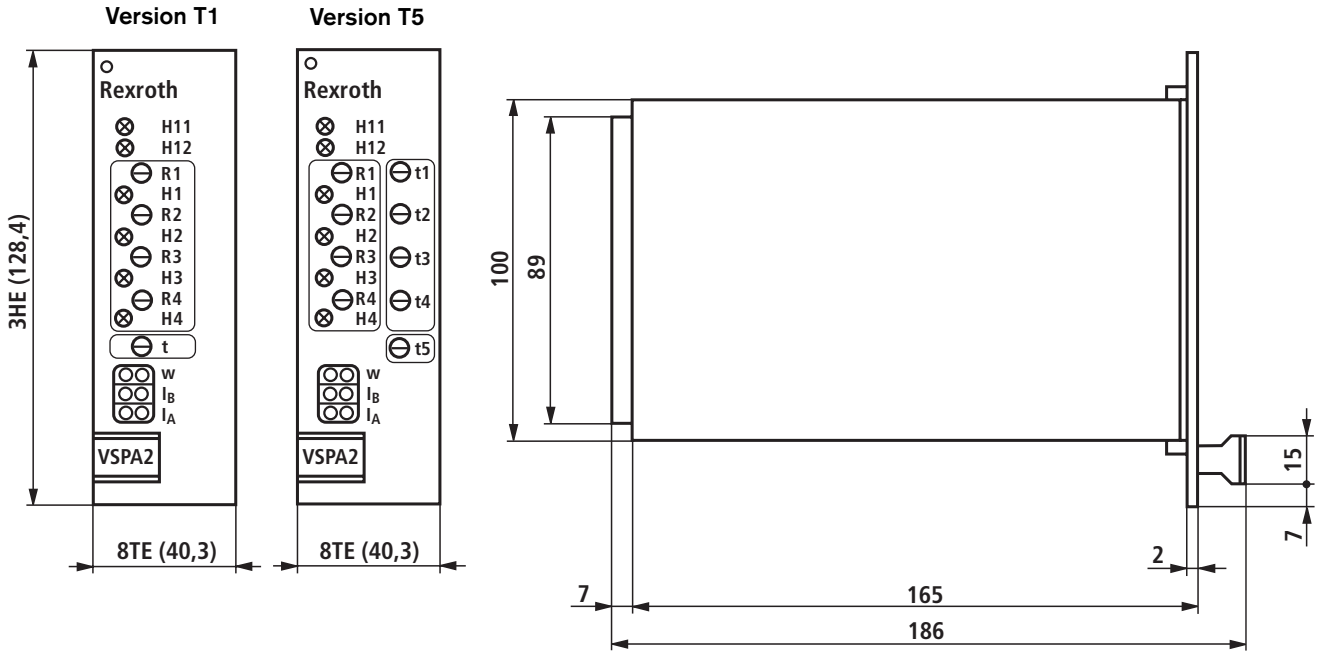
Command value **Ramp time** **Enable** **Valve size**

Note:

The circles (◯) are used for identifying settings carried out by the customer.

Factory setting is identified by “•”.

Unit dimensions (dimensions in mm)



Engineering / maintenance notes / supplementary information

- The amplifier card may only be unplugged or plugged when disconnected from the power supply!
- For the solenoid connection, plugs fitted with free wheeling diodes or LED lamps must not be used!
- Measurements on the card may only be taken using instruments $R_i > 100$ kΩ!
- Measuring zero (M0) is increased by +9 V as against 0V operating voltage and is **not electrically isolated**, i.e. –9 V regulated voltage≙ 0 V operating voltage. Therefore do **not** connect measuring zero (M0) with the 0 V operating voltage!
- For switching command values use relays with gold-plated contacts (small voltages, small currents)!
- For operating the card relay only use contacts with a load carrying capacity of approx. 40 V, 50 mA! When using an external control, the control voltage may have a maximum residual ripple content of 10 %!
- Always shield command value cables connect shield to 0 V operating voltage on the card side, leave the other end open (risk of earth loops)!
  Recommendation: Also shield solenoid cables!
  For solenoid cables of up to 50 m length, use cable type LiYCY 1.5 mm².
  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!
- Because of the loading current of the smoothing capacitor on the card, back-up fuses must have slow-blowing characteristics!
- The potentiometer can be adjusted using a screw driver with a 2 mm blade!

⚠ **Attention:**
- **Danger due to heat** – The cooling fins of the output stage transistors and the current measurement resistors heat up under full load!
- When using the **differential input, both inputs** must always be activated or deactivated **simultaneously**!
- When the 4-20 mA current input is used, the command value zero point may have to be slightly re-adjusted using the “Zw“ potentiometer (see indicator / adjustment elements)!

Note: Electrical signals generated via control electronics (e.g. signal "ready for operation") must not be used for switching safety-relevant machine functions!
(See also the European standard "Safety requirement for fluid power systems and components – Hydraulics", prEN 982)

Notes

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