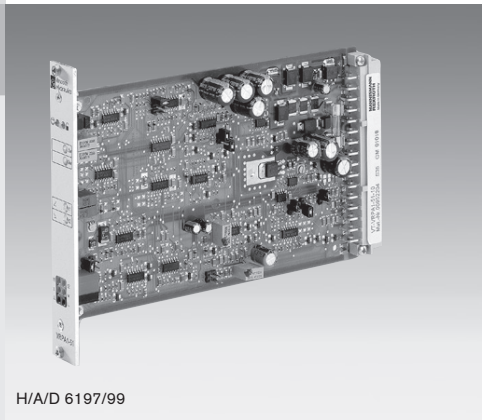
Analogue amplifier

RA 30118/11.04 1/8
Replaces: 04.04

Model VT-VRPA1-...



H/A/D 6197/99

Component series 1X

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Card holder:

– Type VT 3002-2X/32, see RE 29928
Single card holder without power supply

Power supply:

– Type VT-NE30-1X, see RE 29929
Compact power supply 115/230 VAC → 24 VDC, 70 VA

Features

– Suitable for controlling direct operated proportional pressure control valves with electrical position feedback, type DBETR, and proportional flow control valves with electrical position feedback, type 2FRE.
– Plug-in connections compatible with those of amplifier types VT 5003, VT 5004 and VT 5010
– Power supply with raised zero point
– Command value signal inputs:
• 0 to + 6 V; 0 to + 9 V; 0 to + 10 V
• 0 to 20 mA; 4 to 20 mA (plug-in bridges)
– Potentiometer adjustment on the front plate for the zero point and amplitude attenuation
– Measurement sockets for the ramp time
– Enable input and “ramp off“ input
– Plug-in bridges for switching the maximum ramp times 0.02 to 5 s or 0.2 to 50 s
– Outputs for command value (0 to + 6 V) and actual value (0 to – 6 V)
– LED display “operational“
– Polarity protection

Ordering details

VT-VRPA1 – –1X / V0 / 0 / *

Amplifier for proportional valves with electrical feedback, analogue, with one output stage

Amplifier for proportional pressure valves

DBETR–1X	= 100
2FRE 6	= 150
2FRE 10 and 16	= 151

Further details in clear text

1X = Component series 10 to 19 (10 to 19: unchanged technical data and connection allocation)

When replacing amplifier types VT 5003, VT 5004 or VT 5010 for rack installation, a 4TE/3HE dummy plate must be ordered separately.
Material no.: R900021004

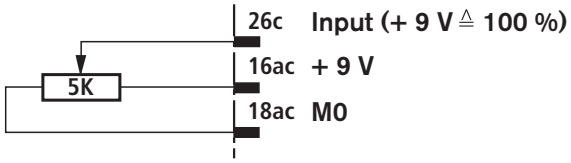
Functional description

Power supply
After the operating voltage has been applied the internal power supply [6] supplies a voltage of ±9 V compared to the measurement zero (M0). This is compared to the load zero (L0) raised by +9 V. The voltages +9 V and –9 V (–9 V relates to L0) are fed to the plug strip X1 and can thereby be externally (e.g. for a command value potentiometer) used. The maximum loading is 25 mA.

Operational
The amplifier card is operational when the following conditions have been fulfilled:
– Operating voltage > 20 V
– There is no unsymmetry in the internal supply voltages
– No cable break in the position transducer cables
– No short circuit in the solenoid cables
That the unit is operational is indicated by a green LED lighting up on the front plate.

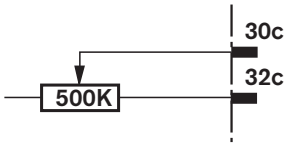
Command value
The command value signal is applied either directly from the regulated +9 V of the power supply [6] or via an external command value potentiometer. For the input „command value 1“ +9 V = +100 % applies and for the input „command value 2“ +6 V = +100 % applies. The reference point for the command value inputs 1 and 2 is always M0 (18ac). Command value input 3 is a differential input [1] (0 to +10 V). It can be configured as a current input (0 to 20 mA or 4 to 20 mA) via plug-in bridges. If the command value signal comes from external electroncis with a different reference potential then the differential input is to be used.
When the command value voltage is applied or withdrawn care has to be taken to ensure that both of the signal lines are separated from the input or connected with it. All of the command values are, before being switched, summated [2] with regard to the value and pre-sign. With potentiometer „Zw“ it is possible to compensate for off-set voltages in the command value branch.

External command value potentiometer (with a 9 V command value input)



Ramp function
The subsequent ramp generator [3] produces from a jump form of applied input signal an output signal in the form of a ramp. The time constants of the output signal (ramp times) can be adjusted by potentiometers „t1“ (upwards ramp) and „t2“ (downwards ramp) which are accessible via the front panel. The maximum ramp time stated relates to a command value jump of 100 % and can, dependent on the plug-in bridge settings (X8, X9), be either approx. 5 s or 50 s. If a command value signal is applied onto the input of the ramp generator [3] that is less than 100 % then the ramp time is reduced accordingly. The actual ramp time can be checked at the measurement sockets „t1“ (upwards ramp) and „t2“ (downwards ramp).
For details see „Technical data“

External time potentiometer



Note
When using an external time potentiometer the internal potentiometers for the ramp times must be set to their maximum (voltages at the measurement sockets „t1“ and „t2“ are approx. 20 mV). The maximum ramp time reduces as the resistance value of the external potentiometer (approx. 500 kΩ) is switched in parallel to the internal potentiometers. In this case it is not possible to separately adjust the ramp times for the up and down ramps.
By applying a voltage >10 V at the switched input „ramp off“ or by setting the plug-in bridge X4 the ramp time is set to its minimum value (approx. 15 ms). The switched input is then ineffective. The minimum value then applies to both directions.

Functional description (continued)

Calculating the ramp times

Plug-in bridge **X9** is fitted („short“ ramp time)

$$t_{up} = \frac{0.1}{U_{t1}} \text{ (in s)}$$

$$t_{down} = \frac{0.1}{U_{t2}} \text{ (in s)}$$

Plug-in bridge **X8** is fitted („long“ ramp time)

$$t_{up} = \frac{1}{U_{t1}} \text{ (in s)}$$

$$t_{down} = \frac{1}{U_{t2}} \text{ (in s)}$$

U_{t1}; U_{t2} … voltages at the measurement sockets „t1“ or „t2“ (in V)

Limiting and position controller

From the output of the ramp generator [3] the command value signal is passed to potentiometer „Gw“, which is accessible via the front panel, which acts as an attenuator. The maximum flow of the valve can be thereby adjusted. The subsequent limiter [7] limits the command value to + 105 % or – 5 % (e.g. with a command value that is too high or by adjusting the zero point „Zw“ potentiometer and the basic value „Gw“) so that the valve spool is prevented from hitting the mechanical end position. The output signal of the limiter [7] is the actual position signal and is connected to the PID controllers [8] and via an output stage [17] to the measurement socket „w“ on the front plate of the card as well as connection 28c on the plug strip X1 (command value to ramp and limiter). A voltage of +6 V at the command value measurement socket „w“ relates to a command value of + 100 %. The PID controller is optimised specifically to the requirements of DBETR and FRE valves. The controller compares the position command value and the actual position value; in the case of differences, a corresponding control output is fed to the current output stage [13], the output signal of which controls the proportional solenoid of the valve.

Position sensing

The position transducer electronics comprise of an oscillator [14] with a subsequent driver [15] for controlling the inductive position transducer and a demodulator [16] for evaluating the position transducer signal (actual value). The oscillator frequency is approx. 2.5 kHz. The inductive position transducer has to be connected as a throttle circuit with mid sensing. The position transducer electronics are factory pre-set. Very long or capacitive position transducer cables can result in the zero point having to be re-adjusted (via potentiometer „Zx“). The actual value (relates to the position of the valve spool) can be measured at the actual value measurement socket.

Note

The actual value signal is **inverted** when compared to the command value. A travel of 100 % relates to –6 V at the actual value measurement socket and at connection 32a on the plug strip X1.

Enable input

With a signal > 10 V at the enable input 20a the output stage and the I-controller are released (displayed via the yellow LED on the front plate). By setting the plug-in bridge X3 they are permanently released independent from the signal at the enable input. The switched input is thereby ineffective.

[ ] = Cross reference to the block circuit diagam see page 5

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

Operating voltage		U_B	24 VDC + 40 % – 5 %
Functional range	– Upper limiting value	$U_B(t)_{max}$	35 V
	– Lower limiting value	$U_B(t)_{min}$	22 V
Power consumption		P_s	< 35 W
Current consumption		I	< 1.5 A
Fuse		I_s	2.5 A T
Inputs	– Command value 1	U_e	0 V to + 9 V (ref. potential is M0)
	– Command value 2	U_e	0 V to + 6 V (ref. potential is M0)
	– Command value 3 (differential input)	U_e	0 V to + 10 V
		I_e	0 mA to 20 mA (R_i = 100 Ω)
		I_e	4 mA to 20 mA (R_i = 100 Ω)
	– Enable		
	• Active	U_F	> 10 V
	• Not active	U_F	< 9 V

Continued on next page

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

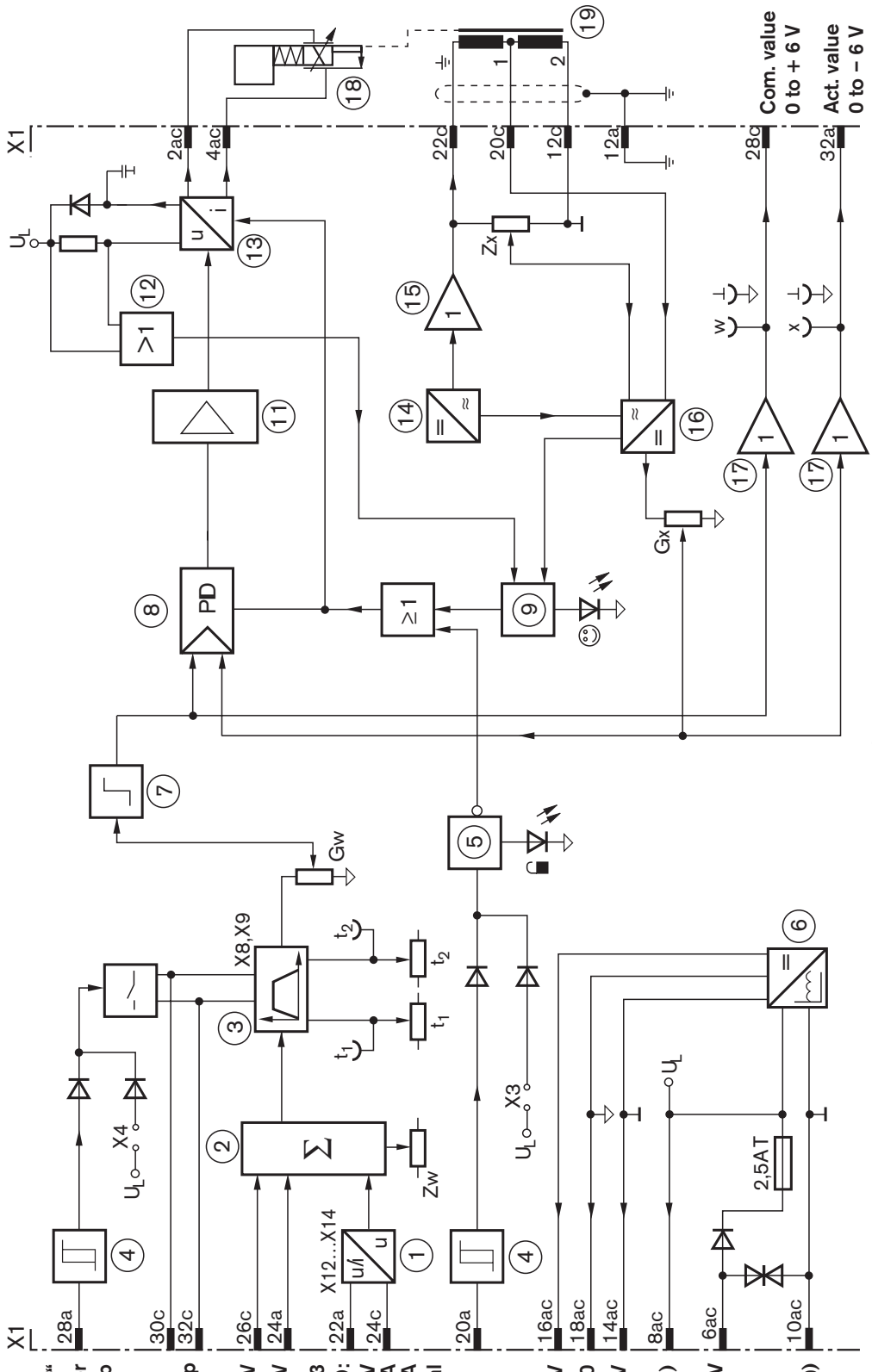
Continued from previous page

Inputs	– External ramp switch off		
	• Without ramp	U_R	> 10 V
	• With ramp	U_R	< 9 V
Adjustment ranges			
	– Zero point „Zw“		– 5 % up to max. + 30 %
	– Command value attenuation „Gw“		0 % to 105 %
	– Ramp time „up“		
	• Short (bridge X9 fitted)	$t_{up\ 1}$	< 20 ms to 5 s ± 20 % (U_{t1}: – 0.02 V ≙ approx. 5 s; – 5 V ≙ approx. 20 ms)
	• Long (bridge X8 fitted)	$t_{up\ 2}$	< 0.2 s to 50 s ± 20 % (U_{t1}: – 0.02 V ≙ approx. 50 s; – 5 V ≙ approx. 0.2 s)
	– Ramp time „down“		
	• Short (bridge X9 fitted)	$t_{down\ 1}$	< 20 ms to 5 s ± 20 % (U_{t2}: 0.02 V ≙ approx. 5 s; – 5 V ≙ approx. 20 ms)
	• Long (bridge X8 fitted)	$t_{down\ 2}$	< 0.2 s to 50 s ± 20 % (U_{t2}: 0.02 V ≙ approx. 50 s; – 5 V ≙ approx. 0.2 s)
Outputs	– Output stage		
	• Solenoid current/resistance	I_{max}	2.2 A ± 10 % / $R_{(20)}$ = 10 Ω (VT-VRPA1-100) 2.2 A ± 10 % / $R_{(20)}$ = 5.4 Ω (VT-VRPA1-150) 2.2 A ± 10 % / $R_{(20)}$ = 10 Ω (VT-VRPA1-151)
	• Clock frequency	f	Free clocking (approx. 1.5 kHz)
	– Driver for the inductive position transducer		
	• Oscillator frequency	f	2.5 kHz ± 10 %
	– Regulated voltage	U	± 9 V ± 1% (with a raised zero point); ± 25 mA externally loadable
	– Measurement sockets		
	• Command value „w“	U_w	0 V to + 6 V (R_i = 1kΩ)
	• Actual value „x“	U_x	0 V to – 6 V (R_i = 1kΩ)
	• Upwards ramp „t1“	U_{t1}	– 0.02 V up to approx. – 5 V (delayed adjustment range)
	• Downwards ramp „t2“	U_{t2}	0.02 V up to approx. 5 V (delayed adjustment range)
Connection type			32-pin blade connection, DIN EN 60603-2, form D
Card dimensions	Euro card 100 x 160 mm, DIN 41494		
Front plate dimensions			
	– Height		3 HE (128.4 mm)
	– Width solder side		1 TE (5.08 mm)
	– Width component side		3 TE
Permissible operating temperature range		ϑ	0 up to 50 °C
Storage temperature		ϑ	– 25 °C up + 70 °C
Weight		m	0.15 kg

Note!

For details regarding the **environmental simulation test** covering EMC (electro-magnetic compatibility), climate and mechanical loading see RE 30117-U (declaration regarding environmental compatibility).

Block circuit diagram / connection allocation

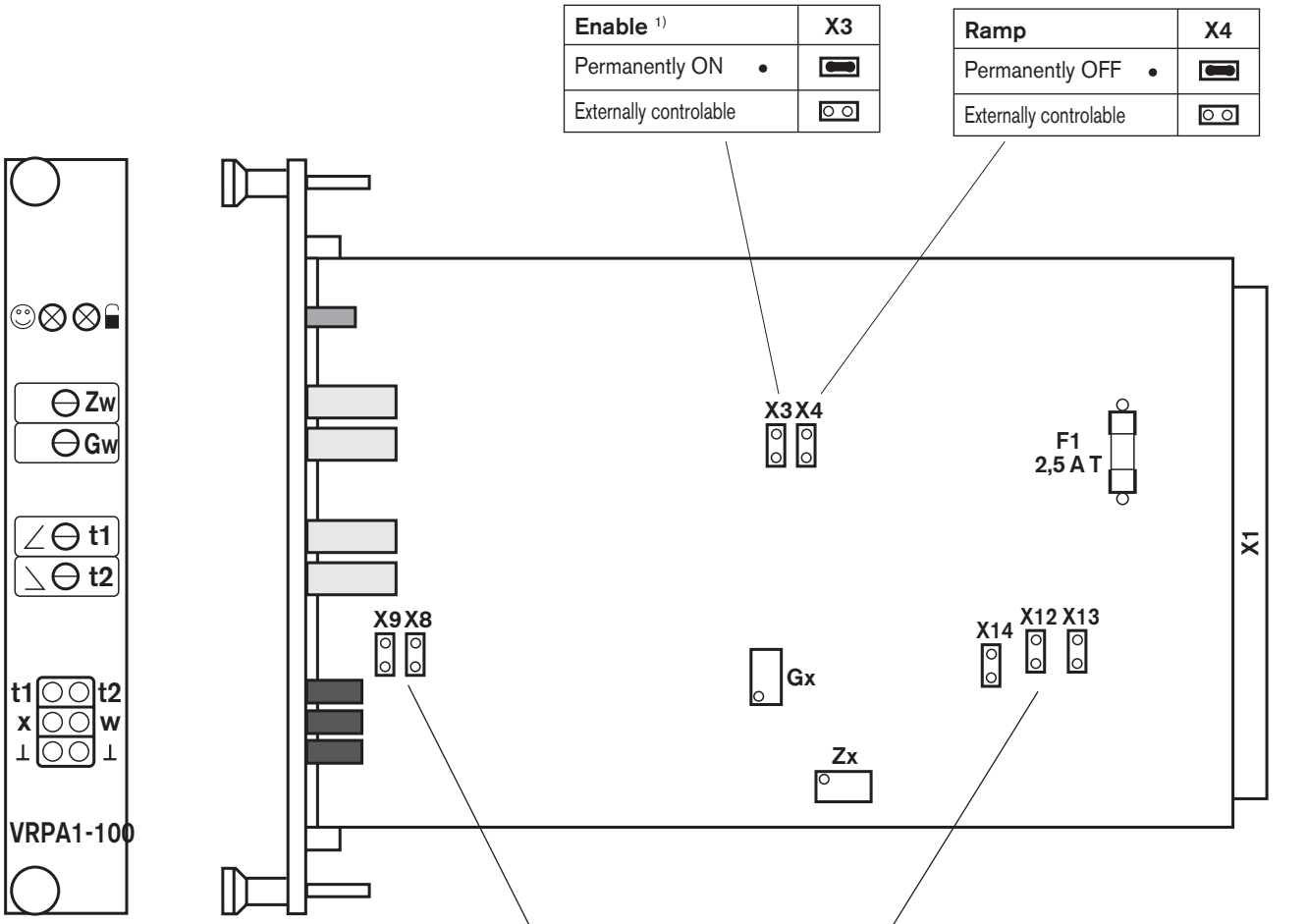


Zw = Zero point command value
Gw = Command value attentuator
Zx = Zero point actual value
Gx = Actual value
☺ = Operational
■ = Enable
t1 = Ramp time „up“
t2 = Ramp time „down“

1 Differential amplifier
2 Command value summator
3 Ramp generator
4 Threshold value switch
5 Enable circuit
6 Power supply
7 Command value limiter
8 PID-controller
9 Fault recognision
11 Summator controller
12 Over-current recognision
13 Clocked output stage
14 Oscillator
15 Position transducer driver
16 Demodulator
17 Output stage
18 Proportional valve
19 Position transducer

See page 6 for an explanation regarding the bridges (from X3) as well as the location of the display and adjustment elements

Display / adjustment elements



Enable [1]	X3
Permanently ON •	▬
Externally controlable	▭

Ramp	X4
Permanently OFF •	▬
Externally controlable	▭

Command value (differential input)			
Input signal	X14	X12	X13
0 to + 10 V •	▭	▭	▭
0 to 20 mA	▭	▬	▬
4 to 20 mA	▬	▬	▬

Ramp time	**X9**	**X8**
0.02 to 5 s •	▬	▭
0.2 to 50 s	▭	▬

LED display:

☺ Operational (green)
🔒 Enable (yellow)

Potentiometer:

Zw Zero point command value
Gw Command value attenuator
t1 Ramp time „up“
t2 Ramp time „down“

Not adjustable via the front planel:

Zx Zero point actual value
Gx Actual value

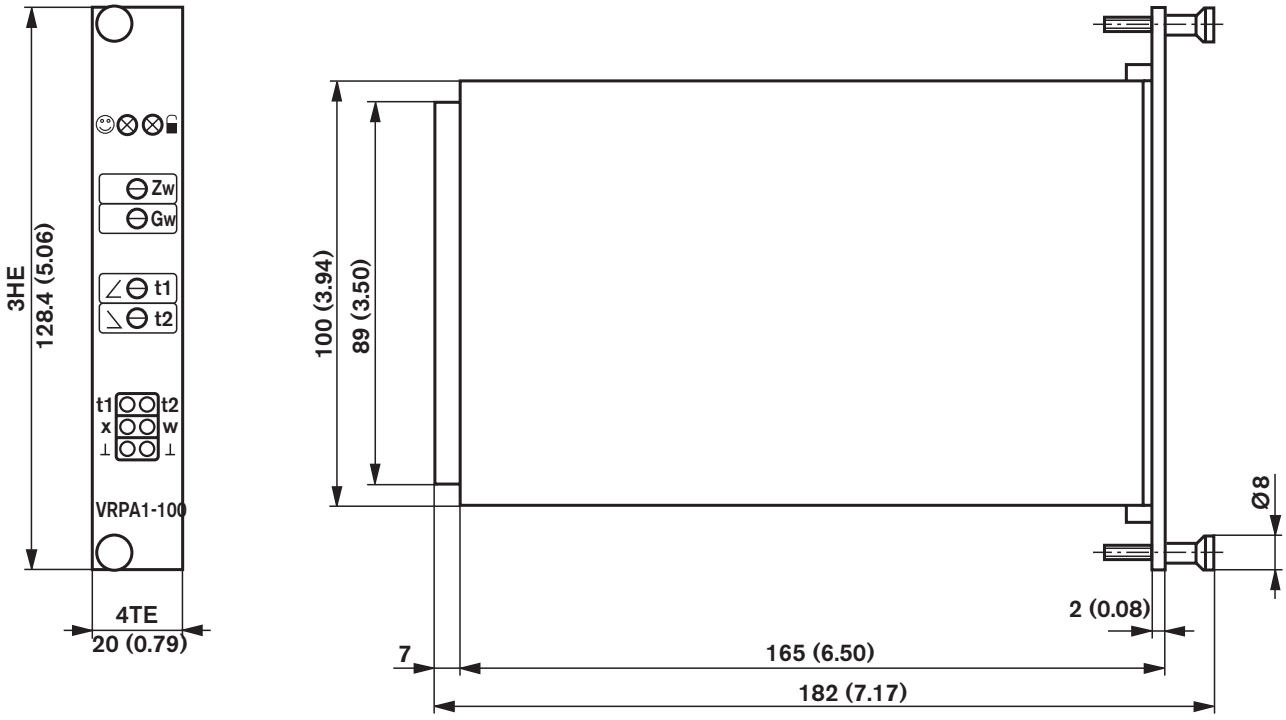
Measurement sockets:

t1 Ramp time „up“
t2 Ramp time „down“
x Actual value
w Command value
⊥ Measurement zero

▬ = Bridge fitted
▭ = Bridge open
• = Factory pre-set bridges

[1] When replacing amplifier types VT 5003, VT 5004 and VT 5010, jumper X3 (enable) must be set to “permanently ON“.

Unit dimensions - nominal dimensions in mm (inches)



Engineering / maintenance guidelines / additional information

- The amplifier card must be configured to match the application; see display/adjustment elements on page 6!
- The amplifier card may only be unplugged or plugged when switched off!
- For the solenoid connection, plugs fitted with free-wheeling diodes or LED displays must not be used!
- Measurements at the card may only be caried out with instruments $R_i > 100\ k\Omega$!
- Measuring zero (M0) is increased by + 9 V compared to the 0 V operating voltage and is **not potentially separated**, i.e. – 9 V controlled voltage ≙ 0 V operating voltage. Therefore do **not** connect measuring zero (M0) with the 0 V operating voltage!
- For switching the command values use relays with gold contancts (small voltages, small currents)!
- For switching the card relay only use contacts with a load capacity of approx. 40 V, 50 mA!
  When using an external control, the control voltage must only have a maximum residual ripple of 10 %!
- Always screen command value lines; screen to be connected to the 0 V operating voltage on the card side, leave other side open (danger of earth loops)!
  Recommendation: Also screen solenoid lines!
  For solenoid cables of up to 50 m length use cable type LiYCY 1.5 mm².
  For longer lengths please consult us!
- The distance to antenna lines, radio sources and radar equipment must be at least 1 m!
- Do not lay solenoid and signal lines near power lines!
- Because of the loading current of the smoothing capacitor on the card, the pre-fuses must have slow blowing characteristics!
- The connection of the inductive position transducer that is marked with the ground symbol must not be connected to ground! (Precondition for the compatibility with amplifier types VT 5003, VT 5004 and VT 5010)
- **Attention:** When using the **differential input, both inputs** must always be switched on or off **simultaneously**!

Note: Electrical signals generated via control electronics (e.g. actual value) must not be used for switching safety-relevant machine functions!
(Also see the European Standard „Safety requirement for fluid power systems and components – Hydraulics“, EN 982)

Standard types

Type	Material number
VT-VRPA1-100-1X/V0/0	R901009038
VT-VRPA1-150-1X/V0/0	R901057058
VT-VRPA1-151-1X/V0/0	R901057060

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