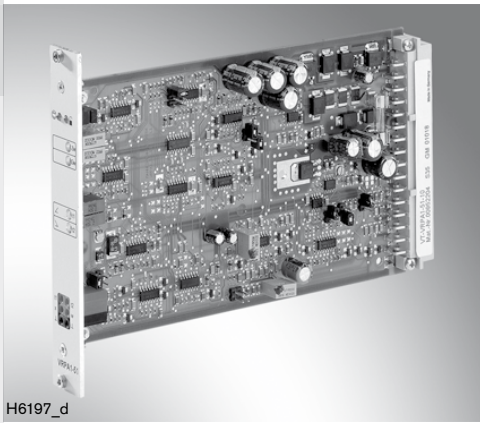
Analogue Amplifiers

RE 30117/07.06 1/8
Replaces: 05.06

Type VT-VRPA1-50 to VT-VRPA1-52

Series 1X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Features

- Suitable for controlling pilot operated proportional flow control valves (throttle valves) with electrical position feedback, types FE (sizes 16 and 25) and FES (sizes 25 to 63)
- In terms of plugs, compatible with amplifier types VT 5011, VT 5012 and VT 5062 to VT 5066 (depending on valve type and size)
- Power supply unit 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 (jumpers)
- Potentiometer adjustment for zero point and amplitude attenuation on the front panel
- Measuring sockets for ramp time
- Enable input and “ramp OFF” input
- Jumpers for changing over the maximum ramp time 0.02 s to 5 s or 0.2 s to 50 s
- Jumpers for adjustment to valve type and size
- Outputs for command value (0 to +6 V) and actual value (0 to −6 V)
- LED indicator lamp “ready for operation“
- Reverse polarity protection

Ordering code

VT-VRPA1 – –1X/ *

Amplifier for proportional valves with electrical position feedback, analogue, with 1 output stage

Amplifier for proportional flow control valves (throttle valves):
– Types FE 16, FE 25 and FES 25 (from series 2X each) **= 50**
– Types FES 32 and FES 40 (from series 3X each) **= 51**
– Types FES 50 and FES 63 (from series 3X each) **= 52**

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

Further details in clear text

Suitable card holders:

– 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, 70 VA

Further information:

– VT-PPV-1X, see RE 29687

When ordering spares for amplifiers VT 5011, VT 5012 and VT 5062 to VT 5066 for rack installation, a blind plate 4TE/3HE must be ordered separately.

Material no.: R900021004

Functional description

Power supply unit

After the operating voltage was applied, the internal power supply unit [6] generates a voltage of ±9 V as against measuring zero (M0). This is raised by +9 V when measured against load zero (L0). The voltages of +9 V and –9 V (–9 V corresponds to L0) are applied to terminal strip X1 and can be used externally (e.g. for a command value potentiometer). The max. load carrying capacity is 25 mA.

Readiness for operation

The amplifier card is ready for operation, when the following conditions are fulfilled:
– Operating voltage > 20 V
– No asymmetry of the internal supply voltages
– No cable break of position transducer cables
– No short-circuit in solenoid cables

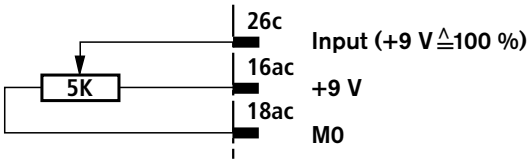
The green LED on the front panel lights up to signal readiness for operation.

Command value

The command value voltage is provided either directly via the regulated voltage of +9 V from the power supply unit [6] or via an external command value potentiometer. The following is valid for input “command value 1“: +9 V = +100 %, and for input “command value 2”: +6 V = +100 %. The reference point for 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 current input (0 to 20 mA or 4 to 20 mA) by plugging jumpers. If the command value is provided by external electronics with another reference potential, the differential input must be used.

When cutting the command value voltage in or out, care must be taken that always both signal lines are disconnected from or connected to the input. Before being passed on, all command values are summated correctly in terms of amount and sign [2]. Offset voltages in the command value branch can be compensated for by means of potentiometer “Zw“.

External command value potentiometer (for 9V command value input)



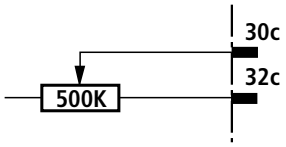
Ramp function

The ramp generator [3] connected downstream generates a ramp-shaped output signal from a stepped input signal. The time constants of the output signal (ramp times) can be adjusted by means of potentiometers “t1” (“up” ramp) and “t2” (“down” ramp) that are accessible on the front panel. The maximum ramp time given refers to a command value step-change of 100 % and can be approx. 5 s or 50 s depending on the jumper configuration (X8, X9). If a command value step-change of less than 100 % is applied to the input of the ramp generator [3], the ramp time shortens accordingly. The current ramp time can be checked at measuring sockets “t1” (“up” ramp) and “t2” (“down” ramp).

For details, see “Technical data“

Functional description (continued)

External time potentiometer



Note:

When an external time potentiometer is used, the internal potentiometers for the ramp times must be set to maximum (voltages at measuring sockets “t1“ and “t2“ approx. 20 mV). The maximum ramp time decreases, since the resistance of the external potentiometer is connected in parallel to that of the internal potentiometer (approx. 500 kΩ). In this case, the ramp time for the “up” and “down” ramp cannot be adjusted separately.

By applying a voltage > 10 V to the switching input “ramp OFF” or by plugging jumper X4, the ramp time is set to its minimum value (approx. 15 ms). The switching input then becomes ineffective. In this case the minimum value is valid for both directions.

Calculation of the ramp times

Jumper **X9** plugged (ramp time “short“)

$$t_{up} = \frac{0{,}1}{U_{t1}} \text{ (in s)} \qquad t_{down} = \frac{0{,}1}{U_{t2}} \text{ (in s)}$$

Jumper **X8** plugged (ramp time “long“)

$$t_{up} = \frac{1}{U_{t1}} \text{ (in s)} \qquad t_{down} = \frac{1}{U_{t2}} \text{ (in s)}$$

U_{t1}; U_{t2} … voltage at measuring socket “t_1“ or “t_2“ (in V)

Limiter and position controller

The command value voltage is fed from the output of the ramp generator [3] to potentiometer “Gw”, which is accessible on the front panel and acts as attenuator. It can be used to adjust the maximum flow through the valve. The downstream limiter [7] limits the command value to +105 % or –5 % (e.g. in the case of an excessively high command value voltage or maladjustment of the potentiometers for zero point “Zw” and basic value “Gw”) in order to prevent the valve spool from hitting the mechanical end positions. The output signal of the limiter [7] is the position command value and is fed to the PID-controllers [8] and, via output stage [17], to measuring socket ”w“ on the front panel of the card as well as to connection 28c on terminal strip X1 (command value after ramp and limiter). A voltage of +6 V at command value measuring socket “w“ corresponds to a command value of +100 %. The PID-controllers are optimised to the individual valves. Before the card is installed, the plug-in jumpers X2 have to be plugged at the position provided for the valve type to be controlled (see also tags at the back of the printed circuit board). The controllers compare the position command values and actual position values; in the case of a difference, a corresponding control variable is output. The downstream summator [11] adds to the control output a square-wave voltage generated by the dither generator [10]; the resulting signal is passed on to the current output stage [13], whose output signal controls the proportional solenoid of the throttle valve.

Position acquisition

The position transducer electronics consists of an oscillator [14] with downstream 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 must be connected in a reactance circuit with central pick-off. The position transducer electronics is matched in the factory. In the case of very long or capacitive position transducer cables, delays resulting from the signal running time and line attenuation may require a re-adjustment of the zero point (using potentiometer “Zx“) and the gain (using potentiometer “Gx“). The actual value (corresponds to the position of the valve spool) can be measured at the measuring socket.

Note:

The actual value signal is output **inverted** against the command value. A travel of 100 % corresponds to –6 V at the actual value measuring socket and connection 32a of terminal strip X1.

Enable input

A signal > 10 V at enable input 20a enables the output stage and the I-controller (indicated by yellow LED on the front panel). By plugging jumper X3 they are permanently enabled independently of the signal at the enable input. The switching input becomes ineffective.

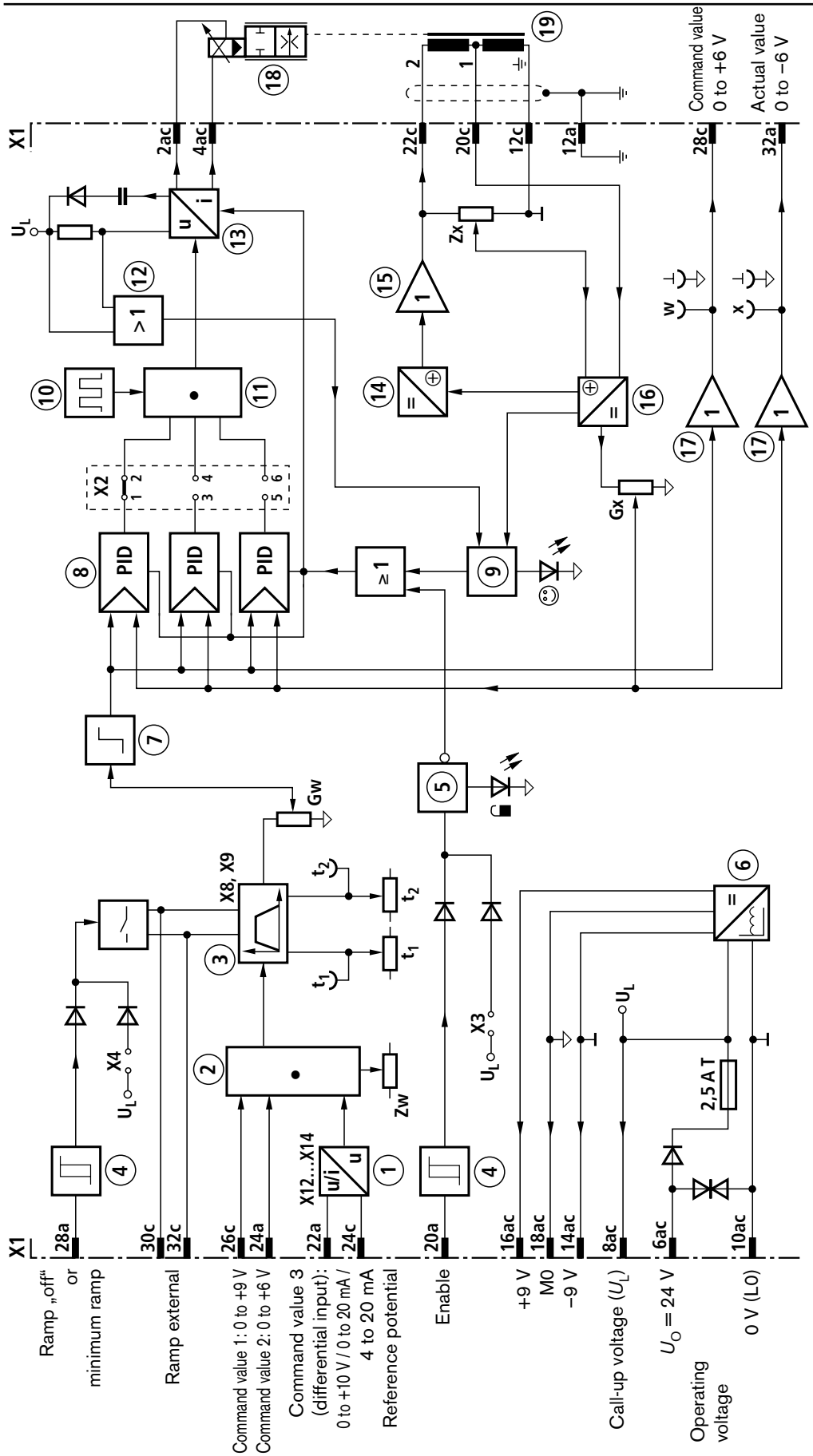
[ ] = Cross-reference to block circuit diagram on page 4

☞ **Note!**

A command value preselection of 0V does not mean “orifice in seated position”. At an actual value of 0 V the orifice spool is in a positive overlap position. A command value of 0 V results in an actual value of 0 V. Depending on the pressure differential, a certain amount of leak-oil flows at any time. If no enable signal is applied or the output stage is blocked due to a failure, the orifice spool moves onto the seat and provides a leak-free closure.

In the seated position, the measurable actual value is > +0.5 V (depending on valve type)

Block circuit diagram / pin assignment



Zw = Command value zero point
Gw = Command value attenuator
Zx = Actual value zero point
Gx = Actual value
☺ = Readiness for operation
■ = Enable
t1 = Ramp time “up“
t2 = Ramp time “down“

1 Differential amplifier
2 Command value summator
3 Ramp generator
4 Trigger
5 Enable circuit
6 Power supply unit
7 Command value limiter
8 PID-controller
9 Fault detector
10 Dither generator
11 Summator, controller
12 Overcurrent detector
13 Clocked output stage
14 Oscillator
15 Position transducer driver
16 Demodulator
17 Output stage
18 Proportional valve
19 Position transducer

For explanations regarding jumpers (from X2) as well as position of the indicator and adjustment elements, see page 7

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
Power consumption	P_S	< 30 W
Current consumption	I	< 1.3 A
Fuse	I_F	2.5 A T
Inputs:		
– Command value 1	U_i	0 V to +9 V (reference potential is M0)
– Command value 2	U_i	0 V to +6 V (reference potential is M0)
– Command value 3 (differential input)	U_i	0 V to +10 V
or	I_i	0 mA to 20 mA (R_i = 100 Ω)
or	I_i	4 mA to 20 mA (R_i = 100 Ω)
– Enable		
• active	U_E	> 10 V
• not active	U_E	< 9 V
– External ramp deactivation		
• without ramp	U_R	> 10 V
• with ramp	U_R	< 9 V
Adjustment ranges:		
– Zero point “Zw“		–5 % to max. +30 %
– Command value attenuator “Gw“		0 % to 105 %
– Ramp time “up“		
• short (jumper X9 plugged)	$t_{up\ 1}$	< 20 ms to 5 s ±20 % (U_{t1}: –0.02 V ≙ ca. 5 s; –5 V ≙ ca. 20 ms)
• long (jumper X8 plugged)	$t_{up\ 2}$	< 0.2 s to 50 s ±20 % (U_{t1}: –0.02 V ≙ ca. 50 s; –5 V ≙ ca. 0.2 s)
– Ramp time “down“		
• short (jumper X9 plugged)	$t_{down\ 1}$	< 20 ms to 5 s ±20 % (U_{t2}: 0.02 V ≙ ca. 5 s; 5 V ≙ ca. 20 ms)
• long (jumper X8 plugged)	$t_{down\ 2}$	< 0.2 s to 50 s ±20 % (U_{t2}: 0.02 V ≙ ca. 50 s; 5 V ≙ ca. 0.2 s)
Outputs:		
– Output stage		
• solenoid current / resistance	I_{max}	1.2 A ±10 % / $R_{(20)}$ = 12.7 Ω
• biasing current VT-VRPA1-50, VT-VRPA1-52	I_V	550 mA
VT-VRPA1-51	I_V	400 mA
• clock-pulse frequency	f	freely clocking (ca. 1.5 kHz)
• superimposed dither frequency	f	300 Hz ±10 %
– Driver for inductive position transducer		
• oscillator frequency	f	2.5 kHz ±10 %
– Regulated voltage	U	±9 V ±1 % (with raised zero point); ±25 mA externally loadable
– Measuring sockets		
• command value “w“	U_w	0 V to +6 V (R_i = 1 kΩ)
• actual value “x“	U_x	0 V to –6 V (R_i = 1 kΩ)
• “up” ramp “t1“	U_{t1}	–0.02 V to ca. –5 V (cf. adjustment ranges)
• “down” ramp “t2“	U_{t2}	0.02 V to ca. 5 V (cf. adjustment ranges)

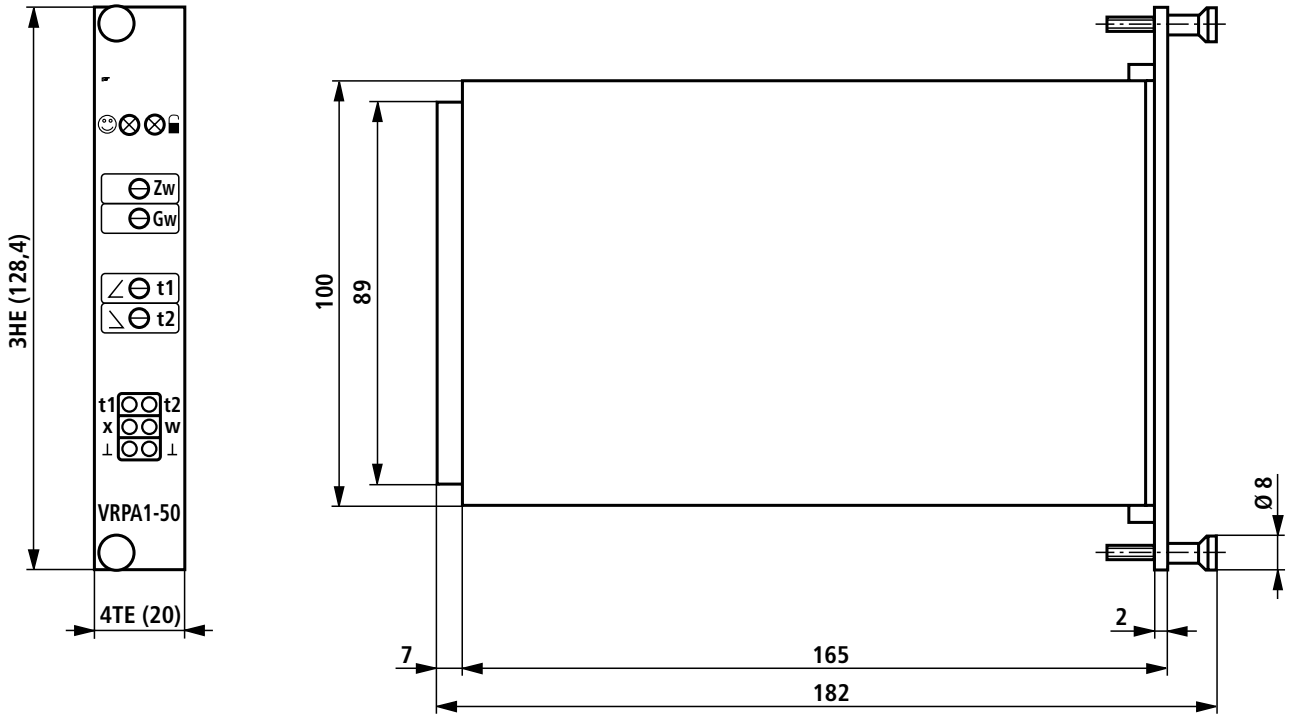
Technical data (for applications outside these parameters, please consult us!)

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		3 TE
Permissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–25 °C to +70 °C
Weight	*m*	0.15 kg

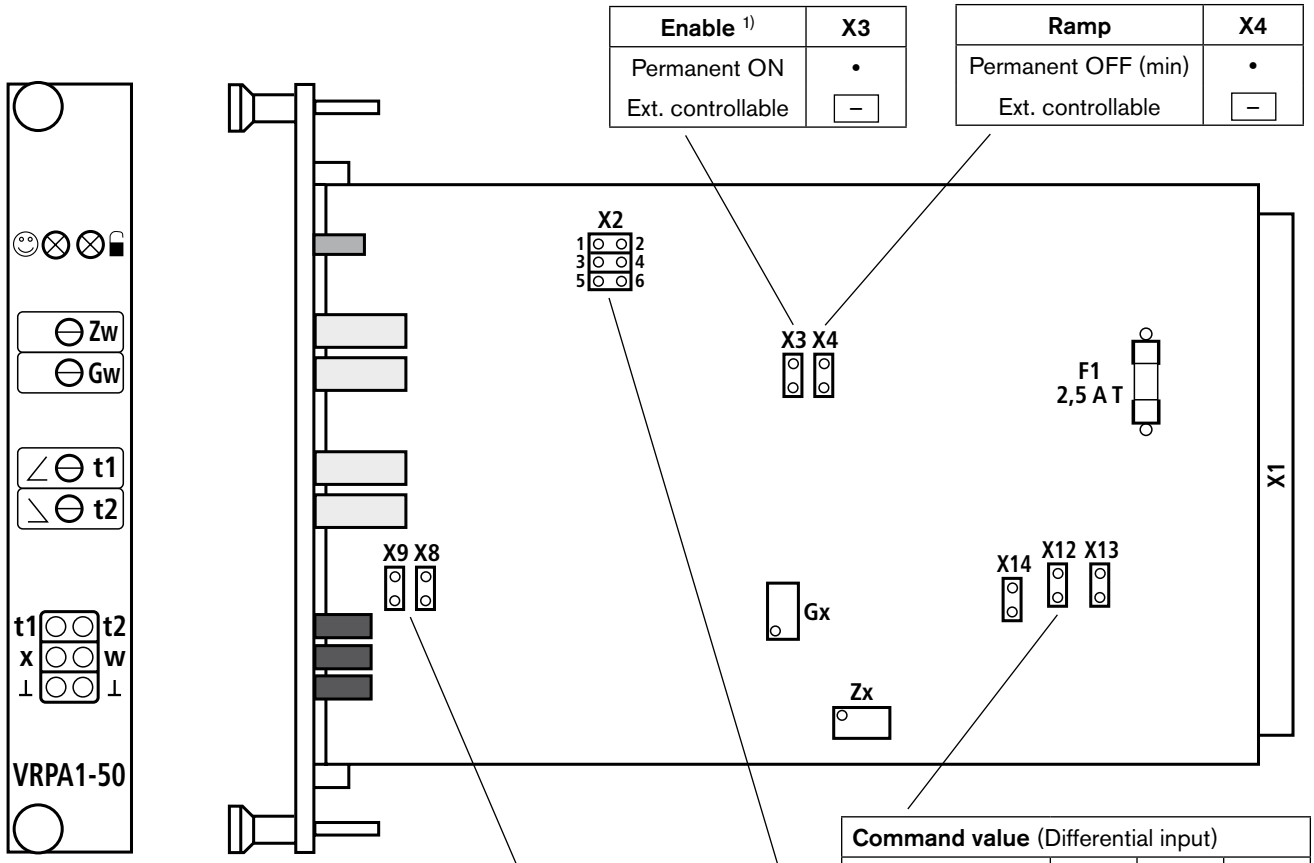
☞ **Note!**

For details regarding **environment simulation test** in the field of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30117-U (declaration on environmental compatibility).

Unit dimensions (Dimensions in mm)



Indicator / adjustment elements



Enable [1]	X3
Permanent ON	•
Ext. controllable	–

Ramp	X4
Permanent OFF (min)	•
Ext. controllable	–

LED indicator lamps:

☺ Readiness for operation (green)

🔓 Enable (yellow)

Potentiometers:

Zw Command value zero point

Gw Command value attenuator

t1 Ramp time “up“

t2 Ramp time “down“

Cannot be adjusted from front panel:

Zx Actual value zero point

Gx Actual value

Measuring sockets:

t1 Ramp time “up“

t2 Ramp time “down“

x Actual value

w Command value

⊥ Measuring zero

[1] In the case of spares for amplifier types VT 5011 and VT 5012, jumper X3 (enable) must be plugged to “permanently ON“.

[2] Optionally for FES25, jumper X2 on 5-6 with $\Delta p < 120$ bar of the hydraulic system (higher electrical gain)

Command value (Differential input)			
Input signal	**X14**	**X12**	**X13**
0 to +10 V	–	–	–
0 to 20 mA	–	•	•
4 to 20 mA	•	•	•

Selection of valve type			
Valve type	**X2**		
With VT-VRPA1-**50**	1-2	3-4	5-6
FE16; series 2X	•	–	–
FE25; series 2X	–	•	–
FES25; series 2X and 3X	–	•	–
FES25; series 2X and 3X [2]	–	–	•
With VT-VRPA1-**51**	1-2	3-4	5-6
FES32; series 3X	•	–	–
FES40; series 3X	–	•	–
With VT-VRPA1-**52**	1-2	3-4	5-6
FES50; series 3X	•	–	–
FES63; series 3X	–	•	–

Ramp time	**X9**	**X8**
0,02 s to 5s	•	–
0,2 s to 50 s	–	•

• … Jumper plugged

– … Jumper open

☐ … Factory setting of jumpers

Engineering / maintenance notes / supplementary information

- The amplifier card must be configured according to the relevant application; see “Indicator / adjustment elements“ on page 6!
- The amplifier card may only be plugged in or withdrawn when disconnected from the power supply!
- Do not use connectors with free-wheeling diodes or LED lamps for connecting the solenoids!
- Measurements on the cards may only be taken using instruments with $R_i > 100\ k\Omega$!
- The measuring zero (M0) is raised by +9 V as against the 0 V operating voltage and is **not electrically isolated**, i.e. –9 V regulated voltage = 0V operating voltage. The measuring zero (M0) must , therefore, **not** be connected with the 0 V operating voltage!
- Use relays with gold-plated contracts for passing on command values (small voltages, small currents)!
- Only use contacts with a loadability of approx. 40 V, 50 mA for switching relays!
  In the case of external controlling, the control voltage may have a maximum residual ripple content of 10 %!
- Command value cables must always be shielded; connect the shield to 0V operating voltage on the card side and leave the other end open (risk of earth loops)!

  Recommendation: Also shield solenoid cables!
  For solenoid cables of a length up to 50 m, use cable type LiYCY 1.5 mm^2.
  In the case of greater lengths, please consult us!
- The distance to aerial lines, radio equipment and radar systems must be at least 1 m!
- Do not lay solenoid and signal cables near power cables!
- Due to the charging current of smoothing capacitors on the card, back-up fuses must be of the slow-blowing type!
- The connection of the inductive position transducer identified with the ground symbol must not be connected to the ground! (Precondition for the compatibility with amplifier types VT 5011, VT 5012 and VT 5062 to VT 5066)
- **Attention:** When using the **differential input, both inputs** must always be switched on or off **simultaneously**!

Note: Electrical signals processed by control electronics (e.g. actual value) must not be used for activating safety-relevant machine functions! (See also European standard “Safety requirements for fluid power systems and components – Hydraulics“, EN 982)