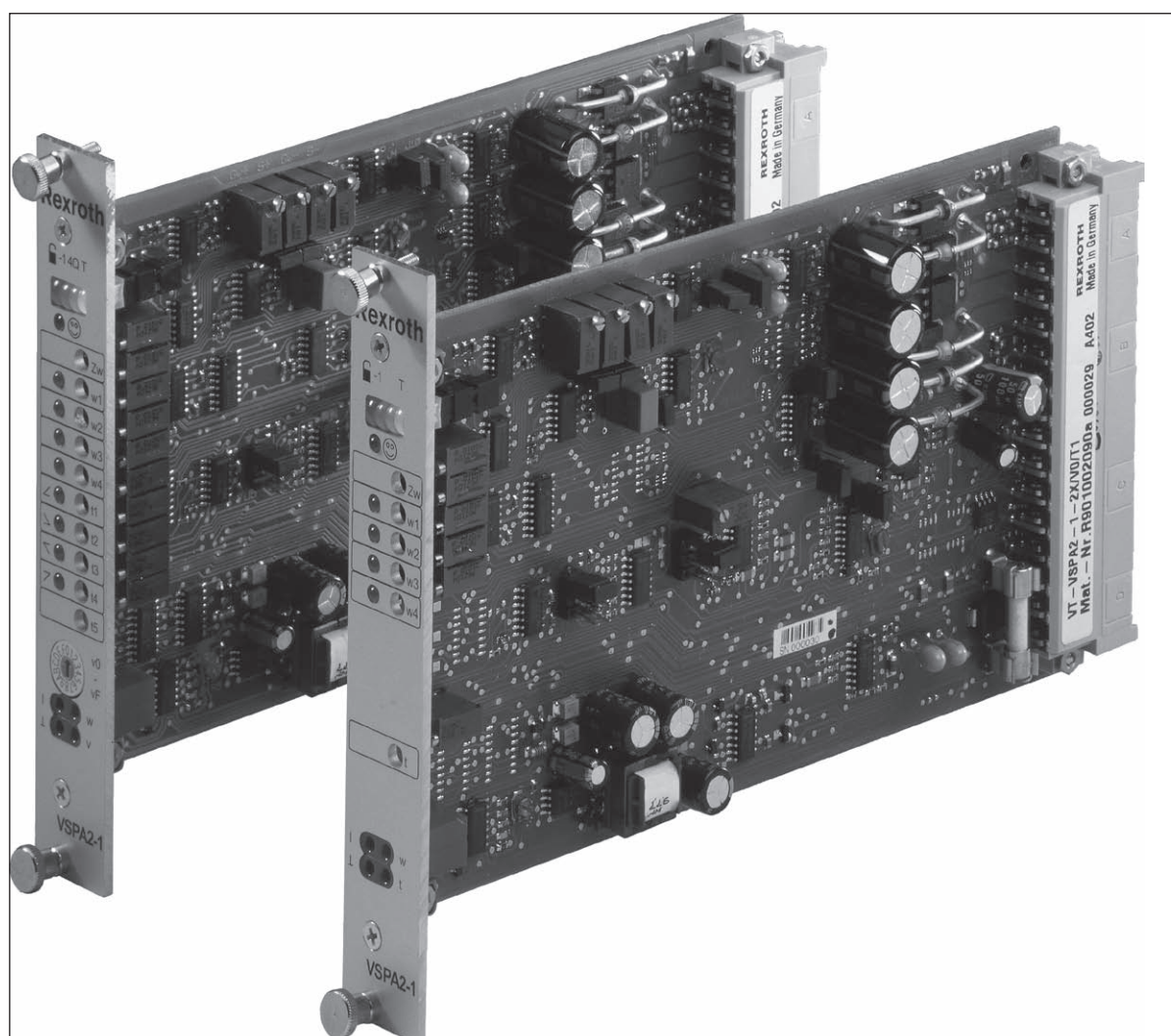


# VT-VSPA2-1-2X/V0/T.

Analog amplifier card component series 2X

**Operating instructions**  
**RE 30110-B/11.12**

Replaces: **10.10**  
English



The data specified above serve to describe the product. If there is also information on the use, it is only to be regarded as application examples and proposals. Catalogue information does not constitute warranted properties. The information given does not release the user from the obligation of own judgment and verification. Our products are subject to a natural process of wear and aging.

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The cover page shows an example configuration. The product supplied may therefore differ from the photo shown.

The original operating instructions were prepared in German.

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# 1 About this documentation

## 1.1 Validity of the documentation

This documentation applies to the following products:


- VT-VSPA2-1-2X/V0T1 mat. no.: 901002090
- VT-VSPA2-1-2X/V0T5 mat. no: 901002095

This documentation is intended for assembly fitters, operators, service engineers and system end users.




This documentation contains important information on the safe and proper assembly, transport, commissioning, operation, use, maintenance, disassembly and simple troubleshooting of the product

- You should read this documentation thoroughly, and in particular chapter 2 "Safety instructions" on page 7 and chapter 3 "General information on damage to property and damage to the product" on page 11, before working with the product.

## 1.2 Required and amending documentation

- The product must not be commissioned until you have been provided with the documentation marked with the book symbol  and you have understood and observed it.
- Observe the configuration and setting instructions according to the 30110-Z additional information when using the VT-VSPA2-1-2X amplifier card as replacement for VT 3000-3X, VT 3006-3X, VT 3013-3X, VT 3014-3X, VT 3017-3X, VT 3018-3X, VT 3026-3X, VT-VSPA2-1-1X/... or VT-VSPA2-50-1X/...

**Table 1: Required and amending documentation**

	<b>Title</b>	<b>Document number</b>	<b>Document type</b>
	Analog amplifier card	30110	Data sheet
	Analog amplifier card	30110-U	Environmental statement
	Analog amplifier card	30110-Z	Additional information

## 1.3 Representation of information

Consistent safety instructions, symbols, terms and abbreviations are used in this documentation so that you can quickly and safely work with your product. For a better understanding, they are explained in the following sections.

### 1.3.1 Safety instructions




In this documentation, safety instructions are indicated in chapter 2.6 "Product-specific safety instructions" on page 9 and in chapter 3 "General information on damage to property and damage to the product" on page 11 and whenever sequences of actions or instructions are explained which bear the danger of personal injury or damage to property. The measures described for preventing these hazards must be observed.

Safety instructions are set out as follows:

 <b>SIGNAL WORD</b>
<b>Type and source of danger!</b> Consequences in case of non-compliance <ul style="list-style-type: none"> <li>► Measures for the hazard avoidance</li> <li>► &lt;Enumeration&gt;</li> </ul>

- **Warning sign:** Draws attention to the danger
- **Signal word:** Identifies the degree of danger
- **Type and source of danger:** Specifies the type and source of danger
- **Consequences:** Describes the consequences in case of non-compliance
- **Precaution:** Specifies how the danger can be prevented


Table 2: Risk classes according to ANSI Z535.6-2006

Warning sign, signal word	Meaning
 <b>DANGER</b>	Indicates a dangerous situation which will cause death or severe personal injuries if not avoided.
 <b>WARNING</b>	Indicates a dangerous situation which may cause death or severe personal injuries if not avoided.
 <b>CAUTION</b>	Indicates a dangerous situation which may cause minor or medium personal injuries if not avoided.
<b>NOTICE</b>	Damage to property: The product or the environment could be damaged.

### 1.3.2 Symbols

The following symbols indicate notes which are not safety-relevant but increase the comprehensibility of the documentation.

Table 3: Meaning of the symbols

Symbol	Meaning
	If this information is not observed, the product cannot be used and/or operated optimally.
►	Individual, independent action
1.	Numbered instruction:
2.	The numbers indicate that the steps must be carried out one after the other.
3.	

### 1.3.3 Designations

The following designations are used in this documentation:

Table 4: Designations

Designation	Meaning
U <sub>B</sub>	Operating voltage
VT-VSPA2	Analog amplifier card

### 1.3.4 Abbreviations

The following designations are used in this documentation:

**Table 5: Abbreviations**

Designation	Meaning
EMC	Electromagnetic compatibility
PELV =	Protective Extra Low Voltage

## 2 Safety instructions

### 2.1 General information on this chapter

The product has been manufactured according to the generally accepted code of practice. However, there is still the risk of personal injury and damage to property if you do not observe this chapter and the safety instructions in this documentation.

- ▶ Read this documentation completely and thoroughly before working with the product.
- ▶ Keep this documentation in a location where it is accessible to all users at all times.
- ▶ Always include the required documentation when you pass the product on to third parties.

### 2.2 Intended use

The product is an electric component.

The VT-VSPA2-1-2X/V0/T\* analog amplifier card is used for generating, linking or standardizing command value signals and subsequent amplification of the generated signals. You may use the product as follows:

- For controlling the valves specified in the data sheet 30110.

The product is only intended for professional use and not for private use.

Intended use includes having read and understood this documentation, especially chapter 2 "Safety instructions" on page 7.

### 2.3 Improper use

Any use deviating from the intended use is improper and thus not admissible.

Bosch Rexroth AG does not assume any liability for damage caused by improper use.

The user assumes all risks involved with improper use.

The following cases of foreseeable misuse are also regarded as being improper:

- Using the analog amplifier card outside the specified performance limits and operating conditions and in particular the specified environmental conditions.

- Using the analog amplifier card in explosion-protected areas or in safety-related parts of control systems (functional safety).

## 2.4 Qualification of personnel

The activities described in this documentation require basic knowledge of electrics and hydraulics as well as knowledge of the appropriate technical terms. For transporting and handling the product, additional knowledge of dealing with lifting tools and the related attachment devices is required. In order to ensure safe use, these activities may only be carried out by a corresponding expert or an instructed person under the direction and supervision of an expert.

Experts are those who can recognize potential hazards and apply the appropriate safety measures due to their professional training, knowledge and experience, as well as their understanding of the relevant conditions pertaining to the work to be undertaken. An expert must observe the relevant specific professional rules and have the necessary hydraulic expert knowledge.

Hydraulic expert knowledge means, amongst others:

- reading and completely understanding hydraulic schemes,
- in particular completely understanding the correlations regarding the safety equipment and
- having knowledge of the function and set-up of hydraulic components.



Bosch Rexroth offers measures supporting the training in specific fields. An overview of the training contents is available on the Internet via the following link:

<http://www.boschrexroth.de/didactic>.

## 2.5 General safety instructions

- Observe the valid regulations on accident prevention and for environmental protection.
- Observe the safety regulations and provisions of the country where the product is implemented/used.
- Exclusively use Rexroth products in technically perfect condition.
- Observe all notices on the product.
- Persons assembling, operating, disassembling or maintaining Rexroth products must not be under the influence of alcohol, other drugs or medications influencing the ability to react.
- Only use original Rexroth accessories and spare parts in order to exclude hazards to persons due to unsuitable spare parts.
- Comply with the technical data and environmental conditions specified in the product documentation.
- The installation or use of inappropriate products in safety-relevant applications could result in unintended operating conditions when being used which in turn could cause personal injuries and/or damage to property. Therefore please only use a product for safety-relevant applications if this use is expressly specified and permitted in the documentation of the product, e.g. in explosion-protected areas or in



safety-related parts of control systems (functional safety). The VT-VSPA2-1-2X/V0/T\* analog amplifier card itself does not contain any safety functions for personal safety and is not a safety-relevant component. The amplifier card is solely used for the generation of the solenoid currents for on/off valves.

- Do not commission the product until you can be sure that the end product (for example a machine/system) where the Rexroth products are installed comply with the country-specific provisions, safety regulations and standards of the application.

## 2.6 Product-specific safety instructions

### **WARNING**

#### **Dangerous movement!**

Risk of injury due to incorrect control of the valve via the amplifier card and unforeseeable machine movements caused in this way.

- The amplifiers may only be operated with the valve/coil combinations released in the type key.
- If persons must access the danger zone during active control, monitoring or measures must be provided for personal safety which are superior to the system. These measures must be provided according to the specific data of the system and on the basis of the risk and error analysis of the system manufacturer/user. In this connection, the safety provisions applied for the system must be taken into account.

The electronics always causes interference on other electronics lying within the limit values. Thus, malfunctions in the control are possible.

- Only use electronics under the EMC limit values or provide for corresponding screening.

The electronics of the VT-VSPA2-1-2X/V0/T\* analog amplifier card reacts to electromagnetic interference of unshielded, incorrectly laid or incorrectly connected signal lines. If the limit values specified in the data sheet are exceeded, malfunctions or uncontrolled movements are possible.

- Comply with the limit values specified in the data sheet; use only electronics under the EMC limit values or provide for corresponding screening.

Electrostatic processes, an incorrect earthing concept or missing equipotential bonding may lead to damage to the electronics and thus cause malfunctions or uncontrolled movements at the machine.

- Provide for correct earthing and for equipotential bonding.

If the product is used outside the specified IP protection class, short-circuits and malfunctions and thus uncontrolled machine movements may result.

- You may therefore only use the product within the IP protection class and environment specified in the data sheet.

#### **High pressure!**

Risk of injury!

- Depressurize the relevant part of the system before performing any work on the control electronics.



## WARNING

### **High electrical voltage by incorrect connection!**

Danger to life, risk of injury caused by electric shock.

- ▶ All connections and terminals with voltages between 0 and 50 Volt may only be connected with devices, electric components and lines with a protective extra-low voltage (PELV).
- ▶ Only connect voltages and electric circuits provided with a safe isolation from dangerous voltages. Safe isolation can be achieved for example with isolation transformers, safe optocouplers or mains-free battery operation.

### **High voltage!**

Risk of injury.

- ▶ Only wire and plug the analog amplifier card in de-energized state.

### **Stroke of lightning!**

Risk of uncontrolled machine movements.

- ▶ An incorrect earthing concept or lack of equipotential bonding may lead to damage to the electronics. Provide for equipotential bonding for the device.

### **Failures and errors in the control circuits or the energy supply!**

Risk of uncontrolled machine movements.

- ▶ Comply with safety instructions according to EN ISO 13849 or IEC 62061.



## CAUTION

### **Hot surfaces!**

Risk of burning.

- ▶ System parts may become hot during operation. Allow the system parts to cool down before touching them or wear protective gloves.

### **Fault currents and short-circuits!**

Impairment of safety and malfunctions.

- ▶ The environment must be free from electrically conductive contamination (acids, bases, corrosive agents, salts, metal vapors, etc.) and the device must not be exposed to these substances. Rule out any deposits according to protection class IP.

### 3 General information on damage to property and damage to the product

#### **NOTICE**

##### **High voltage!**

Possible damage to the analog amplifier card.

- ▶ Only wire the amplifier card in de-energized state.

##### **High temperatures!**

Possible damage to the amplifier card.

- ▶ Comply with the environmental conditions according to the data sheet.
- ▶ Do not use free-wheeling diodes in the solenoid conductors.
- ▶ Provide for sufficient air circulation.

##### **Voltage loss or melting of the cable.**

- ▶ For solenoid lines up to 50 m in length, use the cable type LIYCY 1.5 mm<sup>2</sup>. Greater line lengths on request.

##### **Overload!**

Risk of overload and damage to the supply line in case of insufficient design and/or operation with several electric devices.

- ▶ Provide for current limitation by means of overload protection.
- ▶ Dimension power supply unit and cable sufficiently.

##### **Short-circuit!**

Risk of overload and damage to the supply line in case of defects at the electric device.

- ▶ Provide for current limitation by means of overload protection.

##### **Inadmissible temperature range!**

Danger due to overheating. Device might be thermally destroyed.

- ▶ Comply with the specifications in the data sheet.

##### **Electrostatic discharge!**

Possible damage to the components of the analog amplifier card.

- ▶ Provide for equipotential bonding to discharge electrostatic charges from your body.
- ▶ Work in a safe environment
- ▶ Do not use devices causing or having static discharges into the work environment.
- ▶ Do not work on the amplifier card in environments which might cause an electrostatic charge.
- ▶ Handle the amplifier card with care. Do not touch exposed connection pins and sensitive electronic components.
- ▶ Transport and store the amplifier card carefully in the original packaging intended for this purpose.

NOTICE

**Wrong cables! Voltage loss, melting of the cable!**

Risk of product damage.

- ▶ For solenoid lines up to 50 m in length, use the cable type LiYCY 1.5 mm<sup>2</sup>. With greater lengths, please contact us.

**Cables lying around!**

Risk of stumbling and possible damage.

- ▶ Lay the cables and lines so that they cannot be damaged and no one can trip over them.

The warranty only applies to the delivered configuration.

The claim to warranty expires if the product is incorrectly assembled, commissioned and operated, not used as intended and/or handled improperly.

4
Scope of delivery

The scope of delivery includes:

- Analog amplifier card

Accessories such as cable and power supply unit and cable sets are not included in the scope of delivery and must be ordered separately. See below.

4.1
Recommended accessories

Denomination	Material number
Closed card holder VT 12302 with use of a blind plate	R900021004
Open card holder VT 3002-2X/48F	R900020154

## 5 Information on this product

### 5.1 Performance description

The VT-VSPA2-1-2X/V0/T\* analog amplifier card is used for generating, linking or standardizing command value signals and subsequent amplification of the generated signals.

### 5.2 Product description

The amplifier card can be used for the following proportional directional valves (hydraulic valves).

- 4WRA6-2X
- 4WRA10-2X
- 4WRZ...-7X
- 3DREP...2X

By means of digital command value call-ups and ramp time call-ups (option T5) the amplifier card can, for example, also be controlled via a PLC.

**Options** The standard version (VT-VSPA2-1-2X/V0/...) is generally available with the following options:

- VT-VSPA2.../**T1**: Amplifier card with one adjustable ramp time.
- VT-VSPA2.../**T5**: Amplifier card with five adjustable ramp times. If this option is chosen, the ramp time can also be selected via ramp time call-ups (24 V inputs) or in 4-quadrant operation. In addition, a switchable measuring socket is integrated.

### Features of the amplifier card

For the technical data of the analog amplifier card, please refer to the associated data sheet 30110.

- Set up as printed circuit board in Euro-card format, 100 x 160 mm, and suitable for installation in a rack.
- Command value inputs:
  - Differential input  $\pm 10$  V
  - Four callable command value inputs  $\pm 10$  V
  - Current input 4 to 20 mA
- Inverting of the internal command value signal via 24 V input or jumper
- Selection of ramp time via quadrant recognition (24 V input) or ramp time call-ups (24 V inputs) (option T5)
- Selection of the ramp time range via jumper
- Characteristic curve correction by means of separately adjustable step levels and maximum values
- Enable input
- "Ramp on/off" input
- "Ready for operation" output signal
- Switchable measuring socket (option T5)
- Reverse polarity protection for the voltage supply
- Power supply with DC/DC converter without raised zero point

## 5.2.1 Block diagrams/pin assignments of the amplifier card

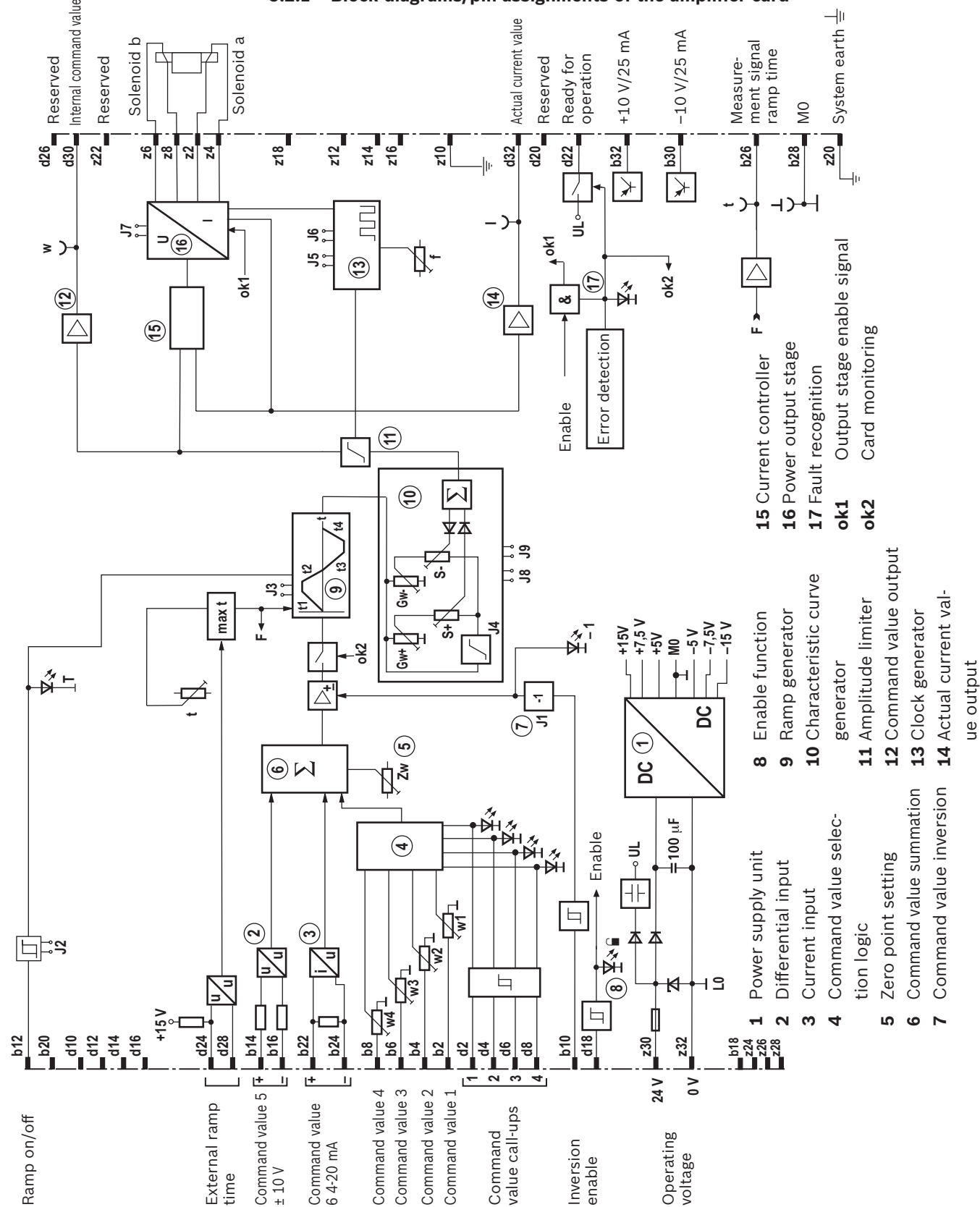
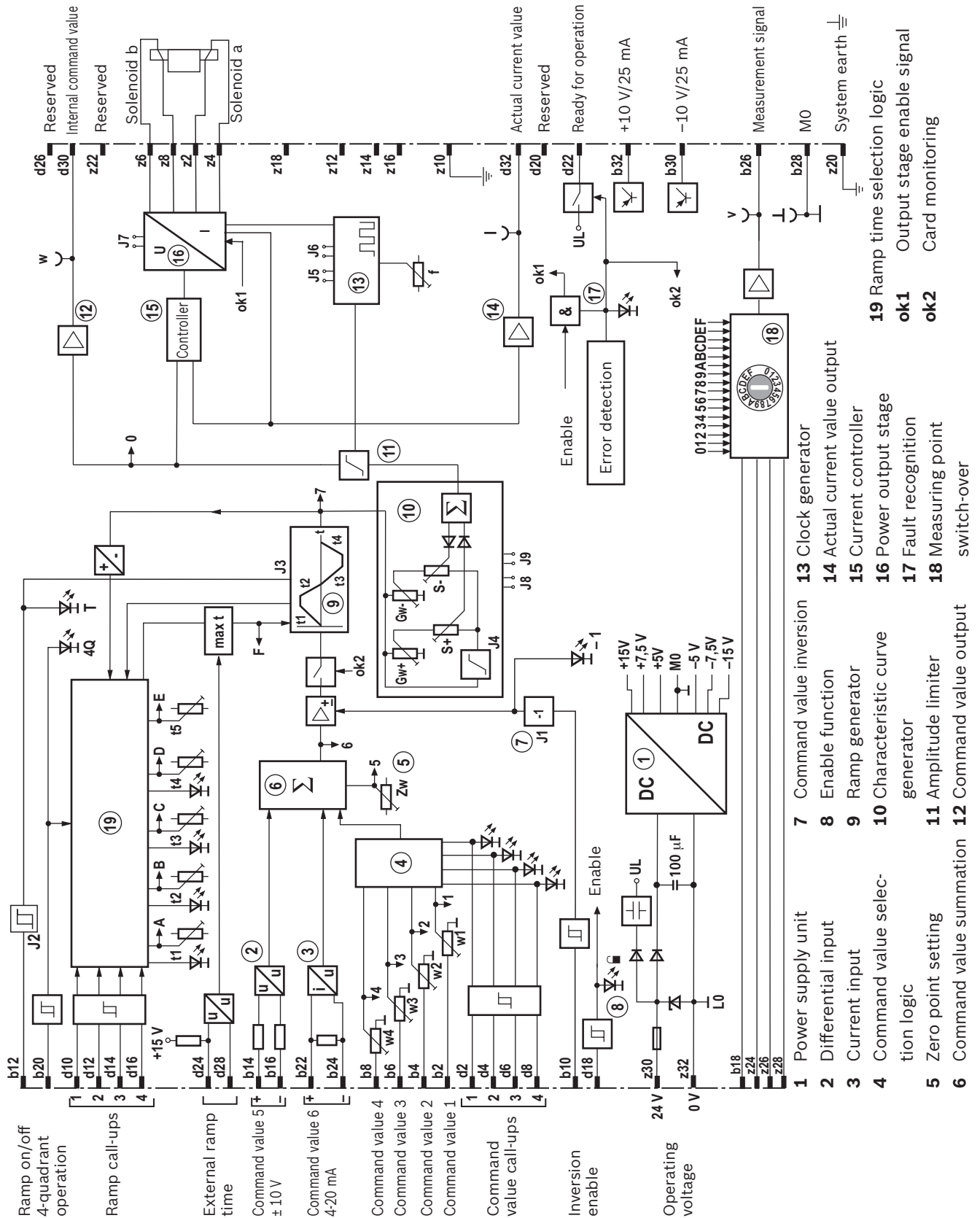
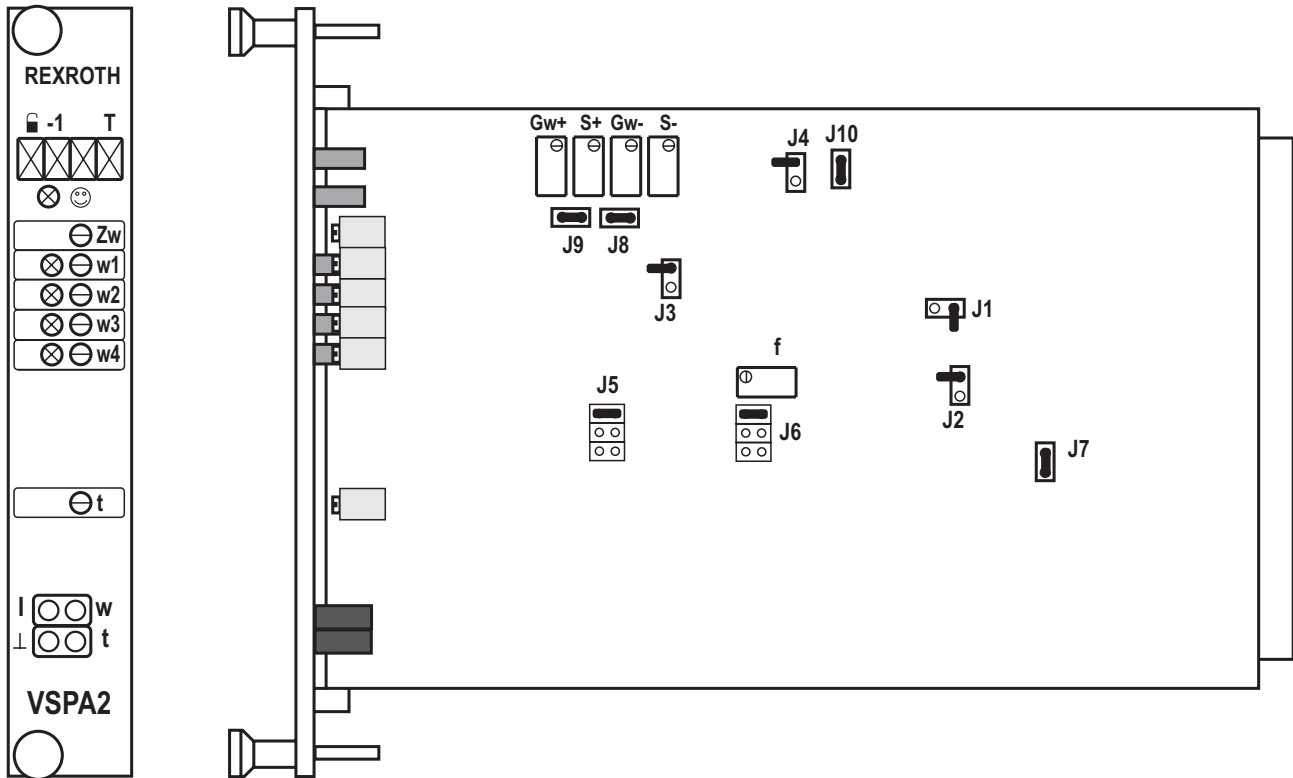




























Fig. 1: Block diagrams/pin assignments of the amplifier card VT-VSPA../T1



### 5.2.2 Setting and display elements of the amplifier card VT-VSPA../T1



J3 ramp time	J8, J9 step level	J8	J9	J4 step function	J1 inverting
0.2 to 50 sec. 	4WRA6 and 10...2X			Off 	Off 
0.02 to 5 sec. • 	4WRZ...7X, 3DREP...2X			On • 	On • 

LED displays		J5, J6 clock frequency	J5	J6	J2 ramp function	J7 maximum current setting
☺	Ready for operation (green)	4WRA6...2X			Off 	4WRZ...7X • 
☹	Enable (yellow)				On • 	3DREP...2X
−1	External inverting	4WRA10...2X				4WRA...2X 
<b>Measuring sockets</b>					• = factory setting of the jumpers	
l, w, t	Ready for operation (green)	Universal, 4WRZ...7X			 = jumper closed	
⊥	Enable (yellow)	3DREP...2X			 = jumper open	
−1	External inverting					

Potentiometer (some of which with LED display)		Potentiometer adjustable on the board	
zw	Zero point calibration	Gw+	Amplitude attenuator for positive command values
w1	Command value 1	Gw−	Amplitude attenuator for negative command values
w2	Command value 2	S+	Step level for positive direction
w3	Command value 3	S−	Step level for negative direction
w4	Command value 4	f	Clock frequency output stage
t	Ramp time		



The warranty expires if the sealed potentiometer is adjusted.





5.2.4
Description of the functions and components of the analog amplifier card

The assemblies described in this documentation are shown in the block diagrams (data sheet 30110). The numbers in brackets used in the following description are cross-references to the block diagrams in Fig. 1 and Fig. 2 on page 14 and page 15.

5.2.4.1
Power supply unit [1]

The amplifier card is equipped with a power supply unit with a making current limiter. It supplies all positive and negative supply voltages required internally. The making current limiter prevents high start-up peaks caused by the smoothing capacitors in the power output stage.

5.2.4.2
Command value specification

Internal command value signal

The internal command value signal is calculated from the total (summation [6]) of the following signals:

- The external command value signal at the differential input [2]
- The external command value signal at the current input [3]

The zero point offset [5] (zero point potentiometer "Zw")

The zero-point offset (command value zero point setting) is used to correct the zero signal at the input and can be used as command value specification for step setting by means of targeted trimming (compensation of hydraulic valve overlap).

- The called up signal

The following applies:

Standard values	Input signals		Command value measuring socket	Flow direction
	Current input	or	Differential input	
−100 %	4 mA		−10 V	P to B; A to T
0 %	12 mA		0 V	
100 %	20 mA		10 V	P to A; B to T
0 %	< 1 mA <sup>1)</sup>		0 V	

<sup>1)</sup> If the current input is not wired-up or if the cable of the current command value is broken, the resulting internal command value signal is 0 %.

There is no switching between current and voltage input. The inputs are permanently available (see terminal assignment).

Command value call-ups [4]

Four command value signals "w1" to "w4" can be called up. The external command value voltages (command values 1 to 4) are either defined directly by the regulated voltage outputs +10 V and −10 V or external potentiometers. If these command value inputs are directly connected to the regulated voltages, the command values are set at the potentiometers "w1" to "w4". When using external potentiometers, the internal potentiometers will function as attenuators or limiters.

Only one call-up can be operated at the same time. If several call-ups are operated simultaneously, call-up "1" has the lowest priority and call-up "4" has the highest priority.

The respective active call-up is indicated via a yellow LED on the front plate.

### 5.2.4.3 External command value voltages

The external command value voltages are either defined directly by regulated voltages (+10 V, -10 V; connection b30, b32) or via external potentiometers:

- If these command value inputs are directly connected to the regulated voltages, the command values are set at the potentiometers "w1" to "w4".
- If you are using external potentiometers, the internal potentiometers will function as attenuators or limiters.

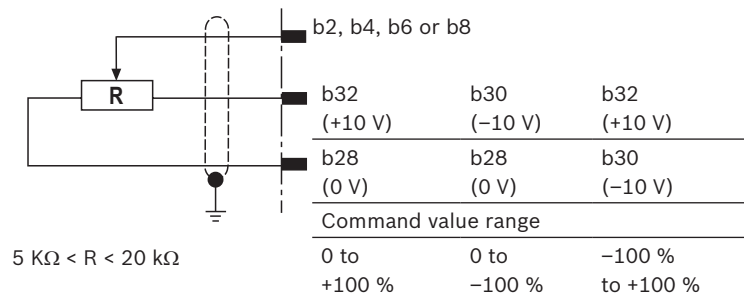


Fig. 3: Command value setting via external potentiometer

### 5.2.4.4 Command value inversion [7]

The command value created internally from the input signals, the command value call-ups and the zero point offset signal can be inverted by an external signal or jumper J1. The inversion is displayed by an LED ("1") on the front plate.

### 5.2.4.5 Enable function [8]

The enable function enables the power output stage and forwards the internal command value signal to the ramp generator. The enable signal is displayed by an LED on the front plate. If enable is connected, the internal command value is changed (with any kind of command value specification) by the set ramp time. Thus, a controlled valve does not open abruptly.

### 5.2.4.6 Ram generator [9]

The ramp generator limits the rise of the input signal. A ramp-shaped output signal develops from a specified step signal. The ramp time relates to a command value modification of the input signal of 100 %.

The ramp time is not increased or shortened in the downstream characteristic curve generator.

Using the ramp "on/off" signal or the jumper J2 the ramp time is set to a minimum (< 2 ms) (ramp off).

### Adjustment options

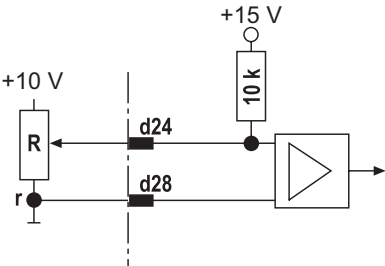
You can use jumper "J3" to select the possible setting range of the ramp time: 0.02 - 5 sec. or 0.2 - 50 sec.

- The following applies to the amplifier card VT-VSPA2.../T5:

- 5 different ramp times can be set and enabled (see chapter "Ramp time selection logic").
- The ramp times can be set using the potentiometers "t1" to "t5" and they can be read and checked by means of the test socket "v".
- The following applies to the amplifier card VT-VSPA2../T1:
  - Only one ramp time can be set. This time is the same for all command value modifications (increase, decrease, positive and negative).
  - The ramp time can be set using the potentiometer "t" and read and checked on the measuring socket "t" (selection via measuring point selector switch).

**External ramp time setting**

Using an external potentiometer the internally set ramp time can be extended. The setting can be verified by means of the measuring socket. In case of a cable break, the internal default setting will be valid automatically.



**Fig. 4: Ramp time setting via external potentiometer**

The setting range is dependent on the resistance "R".

**Table 6: Ramp time setting**

R	Setting range <sup>1)</sup>	
	Minimum ramp time potentiometer angle of rotation = left turn	Maximum ramp time potentiometer angle of rotation = 95 %
1 kΩ	80 msec	1 sec
500 Ω	150 msec	2 sec
100 Ω	0.8 sec	10 sec

<sup>2)</sup> The minimum ramp time can only be reached if the internally set ramp time is lower, i.e. the corresponding potentiometer is at the left stop.

The specified ramp times are true for jumper "J3" = open.

**5.2.5 Ramp on/off**

The ramp time can be set to a minimum (< 2 msec) via an external signal or a jumper (J2) (= ramp off). This is true irrespective of the specified ramp times. If both measures are set simultaneously, they cancel each other out. If the jumper (J2) is plugged, the 24 V input functions as ramp "on" input. If the ramp is active, this is indicated by an LED "T".

### 5.2.6 Ramp time selection logic [19] (only for VT-VSPA2.../T5)

The ramp time selection logic enables 3 operating modes:

- 4-quadrant operation
- Ramp time call-ups
- Ramp time "t5"

#### 4-quadrant operation

If the 4-quadrant operation is active (external 24 V input signal "4Q"), the electronics automatically detects the command value polarity and the command value modification and attributes a ramp time to the current signal state.

Dependent on the signal state, one out of 4 ramp times is selected:

- Ramp up, positive (ramp potentiometer "t1")
- Ramp down, positive (ramp potentiometer "t2")
- Ramp up, negative (ramp potentiometer "t3")
- Ramp down, negative (ramp potentiometer "t4")

The 4-quadrant operation has a higher priority than all ramp time call-ups. While a signal change is taking place, the LED attributed to the current ramp time is on. The LEDs are on the front plate directly next to the associated potentiometer.



If the ramp times are very short, you will not be able to perceive the flashing of the LEDs.

#### Ramp time call-ups

If the 4-quadrant operation is active, the LED "4Q" on the front plate is illuminated.

If the 4-quadrant operation is not active, 4 ramp times can be called up with any call-up signal (24 V input). Only 1 call-up can be operated at the same time. If several call-ups are operated simultaneously, call-up "1" has the lowest priority and call-up "4" has the highest priority.

Each called-up ramp time is indicated via a yellow LED. The LED is on the front plate, directly next to the associated potentiometer.

#### Ramp time "t5"

Ramp time "t5" is always valid, if neither the 4-quadrant operation nor a ramp time call-up are enabled.

### 5.2.7 Characteristic curve generator [10]

After the ramp generator the command value signal is sent to the characteristic curve generator. You can use this feature to separately adjust the step level and the maximum values for positive and negative signals to meet the hydraulic requirements. The actual development of the characteristic curve through the zero point is not stepped but linear.

In the condition as supplied, the characteristic curve generator is pre-set. If the jumpers J7, J8 and J9 are plugged, the output characteristic curve is set to the 4WRZ-7X. To control the 4WRA-2X valves, the jumpers J7, J8 and J9 must be unplugged.

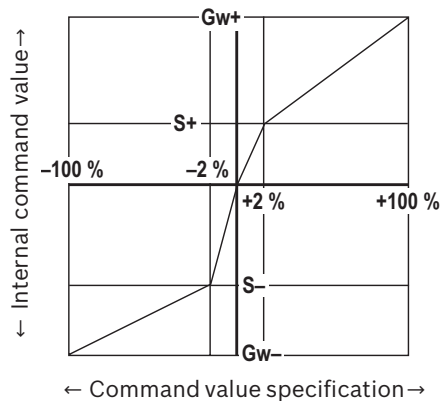
#### Adjustment options

- You can use the jumper "J4" to switch the step function on (J4 = open) or off (J4 = closed).



To prevent a residual step ( $< 1\%$ ), you have to switch off the step function (= jumper "J4" closed) and turn the potentiometers "S+" and "S-" to the left stop.

- You can set/correct the step level "S" separately for positive and negative signals using the potentiometers "S+" and "S-".
- You can set the maximum internal command value separately for positive and negative signals. The potentiometers "Gw+" and "Gw-" have been installed for this purpose. The setting range lies between 0 % and 110 %.



**Fig. 5: Correcting the characteristic curve using the characteristic curve generator**

#### 5.2.8 Amplitude limiter [11]

From the characteristic curve generator the signal is sent to the amplitude limiter [12]. Here, the internal command value is limited to approx.  $\pm 110\%$  of the nominal range.

#### 5.2.9 Power output stage [16]

The power output stage [18] creates the clocked solenoid current for the proportional valve. The solenoid current is limited to 2.7 A per output. The output stage outputs are short-circuit-proof. The output stages are de-energized in case of an internal fault signal or if the release is missing.

#### 5.2.10 Clock generator [13]

The clock generator creates the clock frequency of the output stages. The clock signal can be switched in three basic frequency ranges using jumpers (J5, J6).

- Clock frequency for 4WRA6-2X, correctable via potentiometer "f".
- Clock frequency for 4WRA10-2X, correctable via potentiometer "f".
- Clock frequency for 4WRZ-7X, correctable via potentiometer "f", also suitable for universal applications.

When setting the WRA valves, the frequency changes depending on the command value and on the operating voltage.

#### 5.2.11 Measuring sockets

A measuring socket for the command value (w) and the actual current value (I) is installed on the front plate. The following applies: Command value  $\pm 100\% = \pm 10\text{ V}$   
Actual value  $\pm 100\% = \pm 2.5\text{ V}$

In addition, a measuring socket (v) is intended for setting the command values. The measuring points are selected via the measuring point selector switch on the front plate. The signal of the measuring socket (v) is also connected to the male multi-point connector.

**Table 7: Measuring points and measurement signals**

Measuring point	Switch position	Measurement signal "v"
Internal command value	0	$\pm 100\% = \pm 10\text{ V}$
Command value call-up 1	1	$\pm 100\% = \pm 10\text{ V}$
Command value call-up 2	2	$\pm 100\% = \pm 10\text{ V}$
Command value call-up 3	3	$\pm 100\% = \pm 10\text{ V}$
Command value call-up 4	4	$\pm 100\% = \pm 10\text{ V}$
Zero point offset "Zw"	5	$\pm 30\% = \pm 3\text{ V}$
1 composite signal of the command values	6	$\pm 100\% = \pm 10\text{ V}$
Ramp output signal	7	$\pm 100\% = \pm 10\text{ V}$
Not connected	8	
Clock frequency	9	Rectangular signal $\pm 15\text{ V}$
Ramp time "t1"	A	10 mV to 10 V
Ramp time "t2"	B	10 mV to 10 V
Ramp time "t3"	C	10 mV to 10 V
Ramp time "t4"	D	10 mV to 10 V
Ramp time "t5"	E	10 mV to 10 V
Current ramp time "t"	F	10 mV to 10 V

## 6 Transport and storage

There are no special transport instructions for this product. You must, however, observe the notes in chapter 2 "General safety instructions" and comply with the environmental conditions for storage and transport which are detailed in the technical data of the data sheet.

### 6.1 Storing the VT-VSPA2-1-2X

Proceed as follows in order to prepare the amplifier card for storage and further use:

- Use the original packaging or an ESD-compliant packaging for storage.
- Comply with the maximum admissible transport temperature of  $-25\text{ °C}$  to  $+85\text{ °C}$  and the admissible storage temperature of  $5\text{ °C}$  to  $40\text{ °C}$  and ensure a relative air humidity of 0 % to 65 %.
- Protect the amplifier card from dust, humidity and direct sunlight (100 % UV protection).
- Additional ozone formation or condensation close to the storage area must be prevented.

## 7 Installation



### CAUTION

#### **Fault currents and short-circuits!**

Impairment of safety and malfunctions.

- ▶ The environment must be free from electrically conductive contamination (acids, bases, corrosive agents, salts, metal vapors, etc.) and the device must not be exposed to these substances.

#### **Cables lying around!**

Risk of stumbling.

- ▶ Lay the cables and lines so that they cannot be damaged and no one can trip over them.

### NOTICE

#### **Major potential differences!**

Danger of destroying the amplifier card by plugging or unplugging while energized.

- ▶ Always de-energize the relevant system part before plugging, unplugging or connecting the device. Damaged devices due to incorrect installation are not covered by the warranty!
- ▶ Observe protection class, voltage supply and environmental conditions according to data sheet RE 30110.

#### **Electrostatic discharge!**

Danger of destroying the analog amplifier card.

- ▶ Keep the amplifier card in its antistatic packaging until installation and comply with the instructions on the top of the packaging when unpacking the device.

#### **Interference!**

Risk of malfunctions.

- ▶ The distance to radios must be sufficient ( $>> 1\text{ m}$ ).
- ▶ Do not lay solenoid conductors and signal lines near power cables.
- ▶ Shield command and actual value cables. Shielding open at one side, connect to system earth on the card-side.

### 7.1 Work steps

Perform the steps in the following order:

1. Plug jumper
2. Install card
3. Set command value
4. Set command value zero point
5. Set ramp times (internal/external)
6. Set step level
7. Set maximum values



**Plug jumper**

Before commencing with the adjustment work, the system-specific wiring must have been completed.

Plug jumpers "J1" to "J10" according to the application in such a way that the associated bridge is either open or closed. Please refer to data sheet RE 30110 for setting information.

**7.2 Safety regulations**

- The amplifier card may only be installed by trained and qualified experts in accordance with the generally valid electrical engineering rules.
- You may only insert the amplifier card into a card holder/rack or remove the amplifier card out of a card holder/rack if the supply lines to the card are de-energized.
- Do not use silicone-containing sealing, adhesive, or insulating agents.

**7.3 Installation conditions****Power supply unit**

A suitable power supply unit for the amplifier card is the type VT-NE30-1X, see data sheet 29929.

**Important installation instructions**

- ▶ Prior to installing the card, ensure that all jumpers of the amplifier card are correctly plugged.
- ▶ Only use measuring instruments with an internal resistance ( $R_i$ ) > 100 k $\Omega$  for measurements.
- ▶ For the assembly, observe the notices regarding applied standards and application conditions in the data sheet.
- ▶ Use low-capacitance cables.
- ▶ If possible, design the cable connections without intermediate terminals.
- ▶ The distance from the place of installation of the card to aerial lines, radios, and radar systems has to be 1 m at least.
- ▶ Do not lay solenoid and signal lines near power cables.
- ▶ For solenoid lines up to a length of 50 m, use the cable type LiYCY 1.5 mm<sup>2</sup>. With greater lengths, please contact us!
- ▶ No plug-in connectors with free-wheeling diodes or LED indicators must be used for connecting the solenoid conductors to the valve.
- ▶ Always shield command value lines. Connect shielding to "PE" on the card-side.
- ▶ The system earth is a main component of the amplifier card's EMC protection. It is intended to eliminate interferences which are transported via the data and supply voltage lines. However, this is only possible if the system earth itself does not introduce interferences into the amplifier card. Recommendation: Also shield the solenoid lines.



If the **differential input is used**, both inputs **must always be connected or disconnected** at the same time.

- ▶ Use relays with gold-plated contacts for switching command values (low voltages, low currents).
- Electric signals taken out via control electronics (e. g. the "ready for operation" signal) must not be used for switching safety-relevant machine functions. (See also EN ISO 13849 "Safety of machinery - safety-related parts of control systems").

- The system earth is a main component of the control electronics' EMC protection. Here, interference is eliminated which is transported to the control electronics via the data and supply voltage lines. This function is only ensured if the system earth itself does not introduce interference into the control electronics. Bosch Rexroth recommends screening the solenoid lines as well.
- Ensure a maintenance-friendly installation, i.e. simple access to the connection lines. Free access to the connecting side must be guaranteed. The cable ends should be sufficiently long so that the amplifier card can also be dismantled in the wired condition.
- Before installation note down the information on the nameplates. If, after the installation, nameplates are no longer visible or legible, these data will be quickly available to you at any time.

## 7.4 Unpacking the amplifier card

- ▶ Only remove the card immediately before installing it at a protected workplace.
- ▶ Hold the amplifier card at the front plate taking care not to touch electrical components.

## 7.5 Installing the amplifier card

The amplifier card is set up as printed circuit board in europe format, 100 x 160 mm, and suitable for installation in a rack.

Suitable card holders are:

- Closed card holder VT12302 (see RE 30103)  
+ blind plate 4 TE/3 HE (mat.no.: R978009974)
- Open card holder VT3002-1-2X/48F (see RE 29928)

Proceed as follows when installing the amplifier card VT-VSPA2:

1. De-energize the rack or card holder used.
2. Only remove the card from its packaging at a protected workplace.
3. Open the packaging of the amplifier card and remove it by pulling it out by the front plate.
4. Insert the amplifier card into the guide rails of the rack without using force.
5. Gently press the amplifier card into the front plate until it locks in place.
6. Tighten the two mounting bolts on the front plate.

The amplifier card has now been correctly installed.



The open card holder may only be used if installed in a control cabinet. Contact protection can only be ensured in this case.



Make sure that the admissible operating temperature range of 0 to 50 °C is complied with at the place of installation .

**Table 8: Allocation of the male multipoint connector**

Pin	Row d	Row b	Row z
2	Command value call-up 1 (24 V input)	Command value 1 (potentiometer port connection $\pm 10$ V)	Solenoid a+
4	Command value call-up 2 (24 V input)	Command value 2 (potentiometer port connection $\pm 10$ V)	Solenoid a-
6	Command value call-up 3 (24 V input)	Command value 3 (potentiometer port connection $\pm 10$ V)	Solenoid b+
8	Command value call-up 4 (24 V input)	Command value 4 (potentiometer port connection $\pm 10$ V)	Solenoid b-
10	Ramp call-up 1 (24 V input) <sup>3)</sup>	Inverting of command value (24 V input)	Reserved
12	Ramp call-up 2 (24 V-C) <sup>3)</sup>	Ramp on/off (24 V input)	Reserved
14	Ramp call-up 3 (24 V input) <sup>3)</sup>	Command value 5+ (10 V)	Reserved
16	Ramp call-up 4 (24 V input) <sup>3)</sup>	Command value 5- (-10 V)	Reserved
18	Enable (24 V input)	Reserved	Reserved
20	Reserved	4-quadrant operation (24 V input) <sup>3)</sup>	System earth
22	Ready for operation signal (24 V, active high, 50 mA)	Command value 6+ (4 to 20 mA)	Reserved
24	Ramp external	Command value 6- (4 to 20 mA)	Reserved
26	Reserved	Measuring point signal	Reserved
28	Reference/ramp external	Reference potential for outputs (M0)	Reserved
30	Command value output $\pm 10$ V	-10 V/25 mA	Operating voltage (24 V)
32	Actual value output $\pm 10$ V	+10 V/25 mA	L0 (0 V)

# 8 Commissioning

## 8.1 Safety regulations

Commissioning of the amplifier card requires particular knowledge of electronics and hydraulic systems. Therefore, amplifier cards may only be commissioned by experts having knowledge of:

- The function of the card and the hydraulic system
- The properties of the amplifier card
- The function of the superior control system

The warranty expires if you change the setting of the sealed potentiometer ("ramp time symmetry" and "internal reference voltage").

- ▶ Prior to installing the card, ensure that the jumpers on the amplifier card are correctly plugged.
- ▶ Only use measuring instruments with an internal resistance ( $R_i$ ) > 100 kΩ for measurements.
- ▶ Use a screwdriver with a blade width of 4 mm for adjusting the potentiometers and selecting the measuring point selector switch (VT-.../T5).

## 8.2 Setting the amplifier card

### Setting ranges

The analog amplifier card offers the following setting ranges:

Denomination	Potentiometer	Setting range
Zero adjustment	"Zw"	±30 %
Command values	"w" to "w4"	0 to 110 %
Ramp times	"t1" to "t5" (option T5) „t" (option T1)	0.02 to 5 sec.; switchable 0.2 to 50 sec
Step level	"S+" and "S–"	0 to 50 %
Amplitude attenuator	"Gw+" and "Gw–"	0 to 110 % (applies to the step level setting of 0 %)
Clock frequency	"t"	J5, J6 ≙ 4WRA6: f = 300 Hz...370 Hz
		J5, J6 ≙ 4WRA10: f = 180 Hz...410 Hz
		J5, J6 ≙ 4WRZ: f = 170 Hz
		J5, J6 ≙ 3DREP: f = 170 Hz

### 8.2.1 Setting the command value zero point

The command value zero point setting is used to:

- Correct the zero signal at the input
- Set the step function for command value specification if no internal command value is available

#### Option VT-.../T1

##### Procedure:

Prerequisite: No command value call-up must be operated.

1. Set external command value specifications to 0 V.
2. Set internal command value to 0 V using the potentiometer "Zw". Check the setting of the measuring socket "w".

#### Option VT-.../T5

##### Procedure:

Prerequisite: No command value call-up must be operated.

1. Set external command value specifications to 0 V.

2. Set measuring point selector switch to "6".
3. Set internal command value to 0 V using the potentiometer "Zw". Check the setting of the measuring socket "w".

### 8.2.2 Setting the command value

#### Option VT-.../T1

##### Procedure:

1. Select the command value that is to be set (1, 2, 3, or 4) using a call-up signal (command value call-up 1 to 4).
2. Set the desired command value using the associated potentiometer "w1"... "w4" (or the connected external potentiometer). Check the setting of the measuring socket "w".

You can now set the next command value.

#### Option VT-.../T5

##### Procedure:

1. Select the command value that is to be set (1, 2, 3, or 4) using a call-up signal (command value call-up 1 to 4).
2. Switch the measuring point selector switch to the command value that is to be set (switch position 1, 2, 3 or 4 = command value call-up 1 to 4).
3. Set the desired command value using the associated potentiometer "w1"... "w4" (or the connected external potentiometer). Check the setting of the measuring socket "v".

### 8.2.3 Setting the ramp time

#### Setting ramp

#### times internally

#### Conversion table

You can use the ramp time setting to limit the stop of the hydraulic drive.

The table below lists the ramp time corresponding to the measured test voltage.

The conversion formula is:  $t = 100 \text{ msec} / U_{\text{test socket}} / \text{V}$

**Table 9: Ramp times and test voltages**

J3	$U_{\text{test socket}} / \text{V}$	5	3	2	1	0,5	0,3	0,2	0,1	0,05	0,03	0,02
Open (= basic setting)	t/msec $\pm 20 \%$	20	33	50	100	200	333	500	1000	2000	3333	5000
Plugged	t/sec $\pm 20 \%$	0.2	0.33	0.50	1	2	3.33	5	10	20	33	50

#### Option VT-.../T1

##### Procedure:

- Set the ramp time using the potentiometer "t" according to the conversion formula or conversion table. Check the setting of the measuring socket "t".

#### Option VT-.../T5

##### Procedure:

1. Switch the measuring point selector switch to the ramp time that is to be set (t1 to t5).
2. Set the ramp time using the associated potentiometer (t1 to t5) according to the conversion formula or conversion table. Check the setting of the measuring socket "v".

You can now set the next ramp time (repeat procedure).

### 8.2.4 Externally setting the ramp time

If you use an additional potentiometer, you have the following options:

- Increasing the internally set ramp time
- Remote control of the ramp time
- Changing the ramp time by means of analog step specification of an external control

**Conversion table** The table below lists the ramp time corresponding to the measured test voltage.

The conversion formula is:  $t = 100 \text{ msec} / U_{\text{test socket}} / V$

**Table 10: Ramp times and test voltages**

J3	$U_{\text{test socket}}/V$	5	3	2	1	0,5	0,3	0,2	0,1	0,05	0,03	0,02
Open (= basic setting)	t/msec $\pm 20\%$	20	33	50	100	200	333	500	1000	2000	3333	5000
Plugged	t/sec $\pm 20\%$	0.2	0.33	0.50	1	2	3.33	5	10	20	33	50

#### Option VT-.../T1 Procedure:

1. Turn ramp potentiometer "t" to the left stop.
2. Set the ramp time using the external potentiometer according to the conversion formula or conversion table. Check the setting of the measuring socket "t".

#### Option VT-.../T5 Procedure:

Prerequisite: No ramp call-up must be operated.

1. Turn potentiometer "t5" to the left stop.
2. Switch measuring point selector switch to "F" (= current ramp time "t").
3. Set the ramp time using the external potentiometer according to the conversion formula or conversion table. Check the setting of the measuring socket "v".

You can now set the next ramp time (repeat procedure).

### 8.2.5 Setting the step level

By setting the step level, you can correct the characteristic curve of the command value signal and adjust it to the hydraulic requirements.

This adjustment option is used to:

- Compensate the hydraulic valve spool overlap
- Set the optimal creep speed for defined input signals

#### Option VT-.../T1 Procedure:

Prerequisite: Enable signal is connected, jumper J4 is open.

1. Read all settings on the measuring socket "w".
2. Turn potentiometers "S+" and "S-" to the left stop.
3. Use potentiometer "Zw" to set the measurement signal to +0.3 V.
4. Use potentiometer "S+" to set the required step level.
5. Use potentiometer "Zw" to set the measurement signal to -0.3 V.
6. Use potentiometer "S-" to set the required step level.
7. Use potentiometer "Zw" to set the zero point.



If command values are externally specified, the value at the measuring socket "w" (with S+/S- at left turn) must be at least +0.3 V/-0.3 V.

#### Option VT-.../T5

##### Procedure:

Prerequisite: Enable signal is connected, jumper J4 is open.

1. Read all settings on the measuring socket "v".
2. Set measuring point selector switch to "7".
3. Use potentiometer "Zw" to set the measurement signal to 0.3 V.
4. Set measuring point selector switch to "0".
5. Use potentiometer "S+" to set the required step level.
6. Set measuring point selector switch to "7".
7. Use potentiometer "Zw" to set the measurement signal to -0.3 V.
8. Set measuring point selector switch to "0".
9. Use potentiometer "S-" to set the required step level.
10. Use potentiometer "Zw" to set the zero point.



If command values are externally specified, the value at the measuring socket "v" (measuring point switch position "7") must be at least +0.3 V/-0.3 V.

### 8.2.6 Setting the maximum values

By setting the maximum values for positive and negative signals, you can correct the characteristic curve of the command value signal and adjust it to the hydraulic requirements (e. g. to balance the forwards and return movement).

#### Option VT-.../T1

##### Procedure:

Prerequisite: Before comparing the maximum values, zero point and step levels must be set correctly.

1. Create the command value =  $\pm 100\%$  externally or by command value call-up.
2. Use the potentiometer "Gw+/"Gw-" to set the required maximum value. Check the setting of the measuring socket "w".

#### Option VT-.../T5

##### Procedure:

Prerequisite: Before comparing the maximum values, zero point and step levels must be set correctly.

1. Create the command value =  $\pm 100\%$  externally or by command value call-up.
2. Set measuring point selector switch to "7". Check at measuring socket "v" whether the measurement signal =  $10\text{ V} \pm 0.2\text{ V}$ .
3. Use the potentiometers "Gw+/"Gw-" to set the required maximum value. Check the setting of the measuring socket "w".

The clock frequency of the output stage can be reached using the potentiometer "f". The new setting can be carried out with a digital multimeter that is able to measure frequencies.

#### Option VT-.../T1

Measuring at male multipoint connectors pin Z2 to ground Z32 or pin Z6 to ground Z32

#### Option VT-.../T5

Measuring socket selector switch position "9"

In the condition as supplied, the setting of the clock frequency corresponds to the requirements of the valve WRZ. Rotating the "f" potentiometer changes the valve hysteresis and may lead to disturbing noise developments.

Condition as supplied:

WRZ:  $f = 170 \text{ Hz}$

WRA10 and "w"= 0:  $f = 380 \text{ Hz}$

WRA6 and "w"= 0:  $f = 350 \text{ Hz}$

## 9 Maintenance and repair

### 9.1 Cleaning and care (maintenance)

#### **NOTICE**

##### **Operating failures!**

Loss of functionality due to penetrating dirt and humidity

- ▶ Always provide for absolute cleanliness when working on the VT-VSPA2-1-2X amplifier card.
- ▶ Only use a dry and dust-free cloth for all cleaning works.

### 9.2 Maintenance

In order to ensure a long life cycle and functionality, include the following activities in your maintenance schedule for the VT-VSPA2-1-2X amplifier card:

- ▶ Check all clamping connections for correct seat and damage at least once per year. Check lines for break or squeezing.
- ▶ Have defective or damaged devices exchanged immediately.

### 9.3 Repair

The VT-VSPA2-1-2X amplifier card can only be exchanged as whole unit. For safety reasons, modifications at the VT-VSPA2-1-2X performed to one's own authority are not admissible! Repair and maintenance works may only be performed by Bosch Rexroth AG. For repair and maintenance works, send the device to the service address specified in chapter 15.



## 10 Disassembly and exchange

### 10.1 Preparing for disassembly

#### ***NOTICE***

**Incorrectly performed disassembly!**

The device might be destroyed!

- ▶ Decommission the entire system as described in the overall system manual.
- ▶ De-energize the device and all connected components.

### 10.2 Disassembling the product

Disassemble the amplifier card performing the steps described in chapter 7 "Installation" from page 24 onwards in reverse order.

### 10.3 Preparing the components for storage/further use

Proceed as follows in order to prepare the VT-VSPA2-1-2X amplifier card for storage and further use:

- ▶ Only use the original packaging for storage.
- ▶ Comply with the admissible storage temperature range specified in RE 30110.
- ▶ Protect the amplifier card from dust and humidity.

# 11 Disposal

## 11.1 Environmental protection

Careless disposal of the VT-VSPA2-1-2X amplifier card and the packaging material could lead to pollution of the environment.

- Thus, dispose of the VT-VSPA2-1-2X amplifier card and the packaging material in accordance with the currently applicable national regulations in your country.

## 11.2 Return to Bosch Rexroth AG

The products manufactured by us can be returned to us for disposal purposes at no costs. However, the precondition is that there are no spurious adherences or any other contamination. Hydraulic products have to be drained before being returned. Furthermore, there must be no inappropriate foreign matter or third party components when products are returned.

The products have to be sent free to the door to the following address:

Bosch Rexroth AG  
Service Industriehydraulik [Industrial hydraulics]  
Bgm.-Dr.-Nebel-Straße 8  
97816 Lohr am Main  
Germany

## 11.3 Packaging

Upon request, reusable systems can be used for regular deliveries.

The materials for disposable packagings are mostly cardboard, wood, and styrofoam. They can be recycled without any problems. Due to ecological reasons, disposable packagings should not be used for returning products to us.

## 11.4 Materials used

Our products do not contain any hazardous materials that could be released during intended use. Normally, no adverse effects on human beings and on the environment have to be expected.

The products essentially consist of:

- Electronic components and assemblies

## 11.5 Recycling

Due to the high share of metal, the products can mostly be recycled. In order to achieve an ideal metal recovery, disassembly into individual assemblies is required. The metals contained in electric and electronic assemblies can be recovered by means of special separation procedures as well. If the products contain batteries or accumulators, these have to be removed before recycling and furnished to the battery recycling, if possible.

## 12 Extension and modification

The VT-VSPA2-1-2X amplifier card must neither be extended nor converted. If you convert the VT-VSPA2-1-2X amplifier card, warranty will expire.

## 13 Troubleshooting

### 13.1 How to proceed for troubleshooting

- Always work systematically and targeted, even when under time pressure. Random, thoughtless disassembly and changing of settings can, in the worst-case-scenario, result in the inability to determine the original error cause.
- First get a general idea of how your product works in conjunction with the overall system.
- Try to find out whether the product has worked properly in conjunction with the overall system before the error occurred first.
- Try to determine any changes of the overall system in which the product is integrated:
  - Were there any changes to the product's application conditions or area of application?
  - Were there any changes (e. g. refittings) or have repairs been carried out at the overall system (machine/system, electrical systems, control) or at the product?  
If so: What were they?
  - Was the product or machine used as intended?
  - How did the fault become apparent?
  - Try to get a clear idea of the cause of the error. Ask the direct (machine) operator.
  - If you could not remedy the occurred error, please contact one of the addresses you find at [www.boschrexroth.com](http://www.boschrexroth.com) or in the list of addresses in the appendix.

## 14 Technical data

In this connection, please refer to data sheet 30110 and the valid product-specific documentation.  
For the valid data sheets, please refer to:

[www.boschrexroth.com/medienverzeichnis](http://www.boschrexroth.com/medienverzeichnis)

Information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load see "environmental compatibility statement" (RE 30110-U).

**Table 11: Setting ranges**

Denomination	Potentiometer	Setting range
Zero adjustment	"Zw"	±30 %
Command values	"w" to "w4"	0 to 110 %
Ramp times	"t1" to "t5" (option T5) "t" (option T1)	0.02 to 5 sec.; switchable 0.2 to 50 sec
Step level	"S+" and "S–"	0 to 50 %
Amplitude attenuator	"Gw+" and "Gw–"	0 to 110 % (applies to the step level setting of 0 %)
Clock frequency	"t"	J5, J6 ≙ 4WRZ: f = 150 Hz...400 Hz
		J5, J6 ≙ 4WRA10: f = 180 Hz...380 Hz ±15 %
		J5, J6 ≙ 4WRA6: f = 240 Hz...350 Hz ±15 %

**Table 12: Specification of the inputs**

Denomination		Value
Command values 1 - 4 (potentiometer inputs)	U <sub>e</sub>	0 to ±10 V R <sub>e</sub> = 100 kΩ (M0 is reference)
Command value 5 (differential input)	U <sub>e</sub>	0 to ±10 V R <sub>e</sub> = 50 kΩ
Command value 6 (current input)	I <sub>e</sub>	0 to 20 mA; R <sub>B</sub> = 100 kΩ
Ramp time external	U <sub>e</sub>	0 to ±10 V R <sub>e</sub> = 10 kΩ (internally increased to +15 V; M0 is reference)
Command value call-ups	U	8.5 V to U <sub>B</sub> → call-up operated; R <sub>e</sub> > 100 kΩ
		0 to 6.5 V → no call-up; R <sub>e</sub> > 100 kΩ
Ramp call-ups (option T5)	U	8.5 V to U <sub>B</sub> → call-up operated; R <sub>e</sub> > 100 kΩ
	U	0 to 6.5 V → no call-up; R <sub>e</sub> > 100 kΩ
Quadrant recognition (option T1)	U	8.5 V to U <sub>B</sub> → ON; R <sub>e</sub> > 100 kΩ
		0 to 6.5 V → OFF; R <sub>e</sub> > 100 kΩ
Command value inversion	U	8.5 V to U <sub>B</sub> → ON; R <sub>e</sub> > 100 kΩ
		0 to 6.5 V → OFF; R <sub>e</sub> > 100 kΩ
Enable	U	8.5 V to U <sub>B</sub> → ON; R <sub>e</sub> > 100 kΩ
		0 to 6.5 V → OFF; R <sub>e</sub> > 100 kΩ
Ramp on/off	U	8.5 V to U <sub>B</sub> → ON; R <sub>e</sub> > 100 kΩ
		0 to 6.5 V → OFF; R <sub>e</sub> > 100 kΩ

**Table 13: Specification of the outputs**

Denomination		Value
Command value signal	U	$\pm 10 \text{ V} \pm 2 \%$ ; $I_{\text{max}} = 2 \text{ mA}$
Actual value signal	U	$\pm 2.5 \text{ V} \pm 2 \%$ ; $I_{\text{max}} = 2 \text{ mA}$ ; $1 \text{ mV} = 1 \text{ mA}$
Measuring point signal (option T5)	U	$\pm 10 \text{ V} \pm 2 \%$ ; $I_{\text{max}} = 2 \text{ mA}$
Ready for operation	U	$> 16 \text{ V}$ , $50 \text{ mA}$ ; (in case of fault $< 1 \text{ V}$ , $R_i = 10 \text{ k}\Omega$ )
Regulated voltages	U	$+10 \text{ V} \pm 2 \%$ ; $25 \text{ mA}$ ; short-circuit-proof
		$+10 \text{ V} \pm 2 \%$ ; $25 \text{ mA}$ ; short-circuit-proof
Power output stage	I	0 to $2.5 \text{ mA}$ ; short-circuit-proof, clocked
Measuring sockets		
Command value	U	$\pm 10 \text{ V} \pm 2 \%$ ; $I_{\text{max}} = 2 \text{ mA}$
Actual current value	U	$\pm 2.5 \text{ V} \pm 2 \%$ ; $I_{\text{max}} = 2 \text{ mA}$ ( $\text{mV} \triangleq \text{mA}$ )

## 15 Appendix

### 15.1 List of addresses

#### 15.1.1 Contacts for repairs and support

Bosch Rexroth AG  
 Service Industriehydraulik [Industrial hydraulics]  
 Bgm.-Dr.-Nebel-Straße 8  
 97816 Lohr am Main  
 Germany

Phone +49 (0) 9352 40 50 60  
<http://www.boschrexroth.com/service>  
 Email: [service@boschrexroth.de](mailto:service@boschrexroth.de)

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