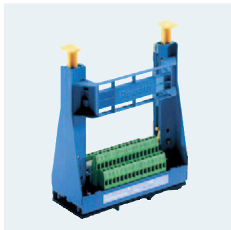
The Drive & Control Company

Rexroth
Bosch Group

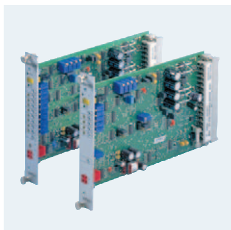
Product catalog
Industrial hydraulics

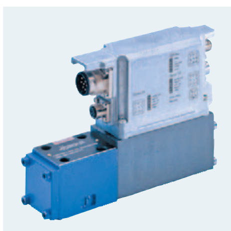
Part 6: Electronics










Product catalog Industrial hydraulics

Part 6: Electronics

Product catalogs Industrial hydraulics of Bosch Rexroth at a glance:

Part 1:	Pumps	RE 00112-01
Part 2	Motors	RE 00112-02
Part 3:	Cylinders	RE 00112-03
Part 4:	On/off valves	RE 00112-04
Part 5:	Proportional servo valves	RE 00112-05
Part 6:	Electronics	RE 00112-06
Part 7:	Systems	RE 00112-07
Part 8:	Power units, Manifolds and plates, Accumulators	RE 00112-08
Part 9:	Filters	RE 00112-09
Part 10:	ATEX units for potentially explosive atmospheres	RE 00112-10

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Should you have queries with regard to the products in this catalog, please contact the Rexroth sales partner in your vicinity.

www.boschrexroth.com/contact

Contents

Electronics

Suitable analog or digital amplifier cards in Euro-card format and analog amplifiers in modular design or connector design that have been adapted to the valve technology are available to realize controlled or regulated drives. Rexroth provides a unique complete, scalable portfolio of digital control electronics and motion controllers – from 1-axis controllers to high-performance multi-axis control – which are able to connect almost any number of axes via crosscommunication. Integrated software is adapted to the particularities of the hydraulics and enables commissioning, parameterization and diagnosis.

Valve amplifiers

Valve amplifiers

Rexroth
Bosch Group

Plug-in amplifier

RE 30264/07.12
Replaces: 03.10

Type VT-SSPA1

Component series 2X

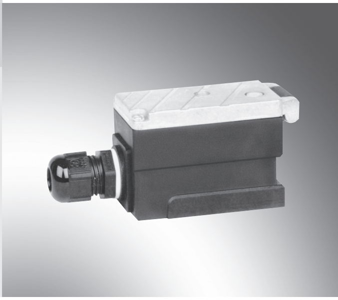


Table of contents

Features

- Analog amplifier for controlling proportional valves (pressure and directional valves) without position control
- Differential input
- Ramp time adjustable (60 ms...5 s)
- Sensitivity, valve zero point, dither frequency adjustable
- Operating voltage 24 V

Notice:

The photo is an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT – S | S | P | A | 1 – | – 2X / V0 /

Design
Plug-in amplifier **= S**

Hydraulic component
for valves without electrical feedback **= S**

Valve type
Proportional valve **= P**

Control
Analog **= A**

Output stages
1 output stage **= 1**

Serial number for types
508 = 0.8 A solenoid
525 = 2.5 A solenoid

Component series 20 to 29
(20 to 29: Unchanged technical data and pin assignment)
2X =

Customer version
V0 = Catalog version

Control
0 = Voltage 0...10 V
I = Current 4...20 mA

Preferred types

Amplifier type	Material number	For proportional valves, without position control
VT-SSPA1-525-20/V0/0	0811405143	DBETX-1X...-25...
		DBE6X-1X...-25...
		3(2)FREX...-1X...-25...
VT-SSPA1-525-20/V0/I	0811405145	DBETX-1X...-25...
		DBE6X-1X...-25...
		3(2)FREX...-1X...-25...
VT-SSPA1-508-20/V0/0	0811405144	DBETX-1X...-8...
		DRE10Z-1X...-8...
		DRE6X-1X...-8...
		DBE6X...1X...-8...
		DBE10Z-1X...-8...
VT-SSPA1-508-20/V0/I	0811405162	DBETX-1X...-8...
		DRE10Z-1X...-8...
		DRE6X-1X...-8...
		DBE6X...1X...-8...
		DBE10Z-1X...-8...

Test and service device

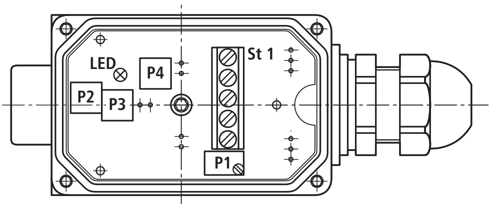
– Current measurement adapter VT-PA-5 (see data sheet 30073).

Function

The active connector is used for **controlling** proportional valves without position control.
It is directly attached to the solenoid plug of the valve. The **connection cable** on the control side (U_B, command value) is led through a gland fitting and connected.
An **LED** signals the available supply voltage. Depending on the type of the active connector, the **command value is specified** as voltage 0...10 V or as current 4...20 mA.

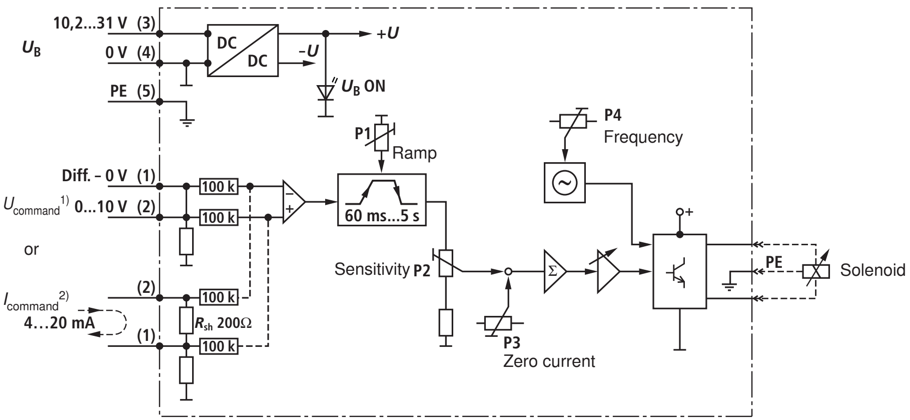
The command value can be adjusted with regard to **zero point** and **sensitivity**. In case of voltage specification, a **differential input** is available.
Apart from that, the command value can be led via a **ramp**.
In order to allow for adjustment to special applications, the **dither amplitude** was designed variably.
Upon delivery, the dither amplitude has already been set to a perfect value so that another adjustment is only necessary in the above-mentioned special cases.

Connections and adjustment



P1 – Ramp time
P2 – Sensitivity
P3 – Zero point
P4 – Dither frequency
St 1 – Connection terminal
LED – Display U_B

Block diagram and pin assignment



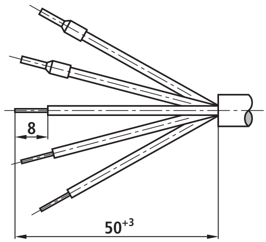
[1] 0811 405 143; 0811 405 144
[2] 0811 405 145; 0811 405 162

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

Supply voltage nom. 24 V =			
	Solenoid 2.5 A		Battery voltage 10.2...31 V Rectified voltage 10.2...27 V
	Solenoid 0.8 A		Battery voltage 21...31 V Rectified voltage 21...27 V
	Residual ripple		< 2 V_{SS}
Power consumption max.		VA	55 (see valve data)
Command value	0 811 405 143 0 811 405 144		0...10 V =
	0 811 405 145 0 811 405 162		4...20 mA
Output	0 811 405 145 0 811 405 143		I_{max} = 2.5 A (rectangular voltage, pulse-modulated)
	0 811 405 144 0 811 405 162		I_{max} = 0.8 A (rectangular voltage, pulse-modulated)
Ramp time			60 ms...5 s
Dither frequency range		Hz	95...340
Zero point calibration range			See characteristic curves, page 5
Sensitivity adjustment range			
Special features			LED (green): Supply voltage is available, Clocked output stage, Fast energization for short actuating times, Adjustments via trimming potentiometer
Protection class			IP 65, in plugged condition
Electro-magnetic compatibility tested according to			EN 61000-6-2: 2002-08 EN 61000-6-3: 2002-08
Design:			Connector housing
Connections	– Solenoid – U_B, command value		DIN 43650 Cable 5x0.75 mm^2, shielded (incl. PE)
Ambient temperature		°C	–20...+70
Storage temperature range		°C	–20...+85
Weight		*m*	0.23 kg

Commissioning and adjustment

1. Preparation of the connection cable.



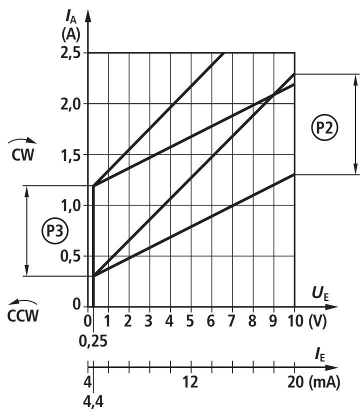
Crimp the wire end ferrules shortly (5x)

2. Lead the cable through the gland fitting and connect to terminal St 1.
   Notice
   Supply voltage and command value must not yet be applied to the cable!

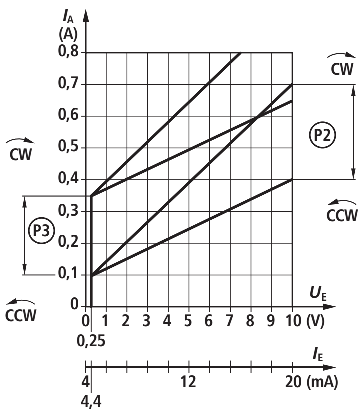
3. Apply the supply voltage
   ↓
   LED (green) is illuminated.

4. Zero point adjustment → Poti P3, with minimum command value specification.
5. Sensitivity adjustment → Poti P2, with maximum command value specification.

0 811 405 143
0 811 405 145



0 811 405 144
0 811 405 162

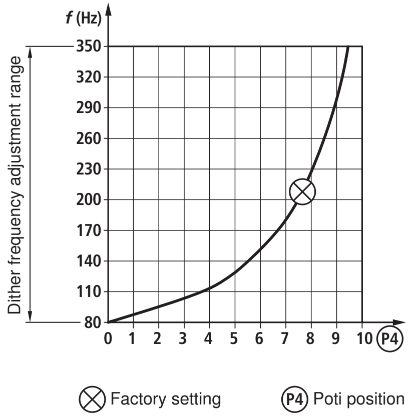


P2 Sensitivity range
P3 Zero current range

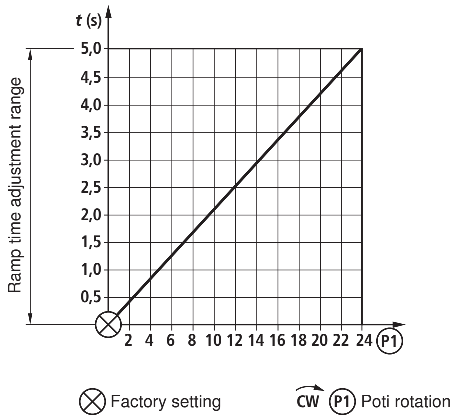
Commissioning and adjustment

6. Dither frequency adjustment
   → Poti P4.

The dither frequency has already been correctly adjusted upon delivery. For special applications, correction may be necessary. in this connection, please contact DC-IA/PRM12.

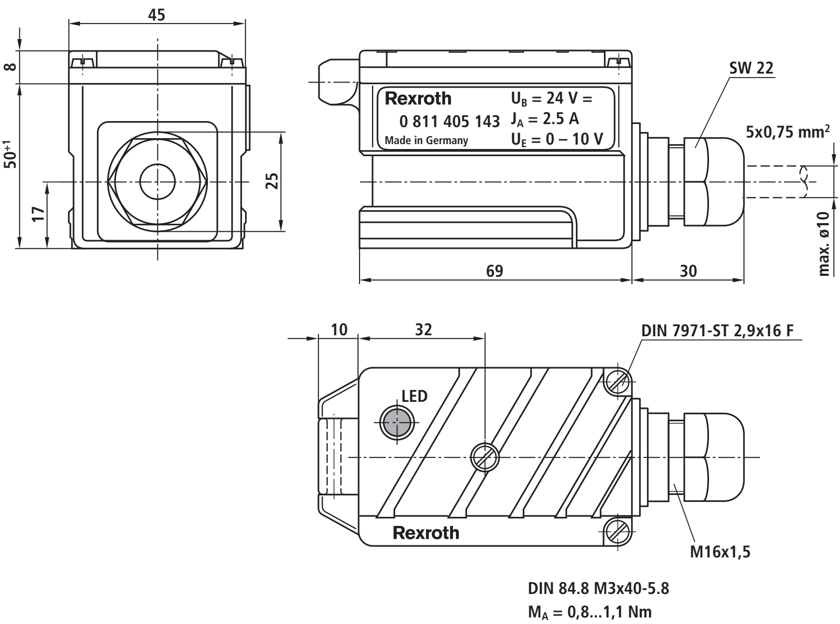


7. Ramp time adjustment
   (accelerations and braking)
   → Poti P1.



1

Device dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

– The plug-in amplifier may only be unplugged and plugged when de-energized.
– The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
– Do not lay solenoid and signal lines near power cables.
– For signal lines and solenoid conductors, we recommend using shielded cables.
The cable shield must be connected to the control cabinet extensively and as short as possible.

Notes

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The Drive & Control Company **Rexroth** Bosch Group

Valve amplifier for proportional valves

Type VT-SSPA1-1(5, 50, 100, 150)

RE 30116
Edition: 2013-04
Replaces: 12.12

H7072+7645

- Component series 1X
- Analog, connector design
- Suitable for controlling solenoid-actuated pressure and directional valves without position control (see page 2)

Features

- Proportional command value/current characteristic curve for command values between 0 and 100 %
- Regulated adjustable maximum current for command values greater than approx. 120 % (for differential input only)
- Differential input
- Separate up/down ramp generator
- Zero potentiometer/pilot current
- Command value attenuator/maximum current
- Dither frequency potentiometer
- 24 V operating voltage

Contents

Ordering code

01		02		03		04		05		06		07
VT-SSPA1	**–**		**–**	**1X**	**/**		**/**	**0**	**–**	**24**	**/**	

01	Valve amplifier for proportional valves, analog, connector design	**VT-SSPA1**
02	For DBET / DRE / DBEM...7x	**1**
	For KBPS...8	**5**
	Universal, 2.5 A	**50**
	For KKDSR	**100**
	Universal, 0.8 A	**150**
03	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	**1X**
04	Version: Standard	**V0**
	Version: Ramp time: 10 ms to 2 s (only for variant VT-SSPA1-50-1X)	**V002**
05	Voltage input	**0**
06	24 V operating voltage	**24**
06	With cable gland	**no code**
	With M12 connector	**K24**

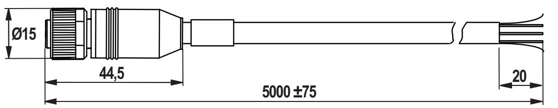
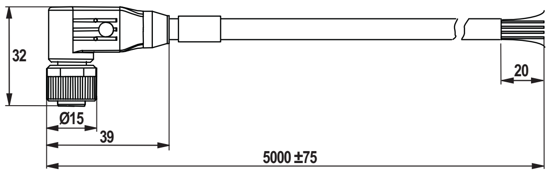
Type overview

Type	Mat. no.	U_B	I_{rated}	f with I_{rated}	Command value	For valve	Solenoid
VT-SSPA1-1-1X/V0/0-24	R900779643	24 V	1.6 A	340 Hz	0...10 V/24 V	DBET / DRE / DBEM...7x	5.5 Ω
VT-SSPA1-1-1X/V0/0-24/K24	R901238534	24 V	1.6 A	340 Hz	0...10 V/24 V	DBET / DRE / DBEM...7x	5.5 Ω
VT-SSPA1-5-1X/V0/0-24	R901024331	24 V	1.2 A	200 Hz	0...10 V/24 V	KBPS...8	4.77 Ω
VT-SSPA1-5-1X/V0/0-24/K24	R901238530	24 V	1.2 A	200 Hz	0...10 V/24 V	KBPS...8	4.77 Ω
VT-SSPA1-50-1X/V0/0-24	R901005414	24 V	2.5 A	305 Hz	0...10 V/24 V	Universal	> 2 Ω
VT-SSPA1-50-1X/V002/0-24	R901336728	24 V	2.5 A	305 Hz	0...10 V/24 V	Universal	> 2 Ω
VT-SSPA1-50-1X/V0/0-24/K24	R901238532	24 V	2.5 A	305 Hz	0...10 V/24 V	Universal	> 2 Ω
VT-SSPA1-100-1X/V0/0-24	R901030116	24 V	1.2 A	150 Hz	0...10 V/24 V	KKDSR1	7.2 Ω
VT-SSPA1-100-1X/V0/0-24/K24	R901238528	24 V	1.2 A	150 Hz	0...10 V/24 V	KKDSR1	7.2 Ω
VT-SSPA1-150-1X/V0/0-24	R901104644	24 V	0.8 A	150 Hz [1)]	0...10 V	Universal	19.5 Ω
VT-SSPA1-150-1X/V0/0-24/K24	R901263782	24 V	0.8 A	150 Hz [1)]	0...10 V	Universal	19.5 Ω

[1)] With a solenoid resistance of R = 19.5 Ω and a solenoid current of I = 100 mA

Ordering code (continued)

Accessories for type .../K24

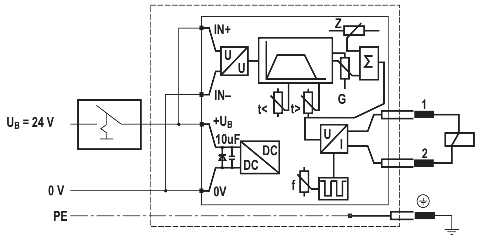
Description	Designation	Mat. no.
Assembled cable with straight mating connector	KABELSATZ VT-SSPA1-1X/M12/1/V00	R901241656
		Cable sheath: PVC, black Cable sheath Ø: 6.4 mm Wire cross-section: 4 x 0.75 mm² Cable and mating connector shielded Connection see page 6
Assembled cable with angular mating connector	KABELSATZ VT-SSPA1-1X/M12/2/V00	R901241651
		Cable sheath: PVC, black Cable sheath Ø: 6.4 mm Wire cross-section: 4 x 0.75 mm² Cable and mating connector shielded Connection see page 6

Applications

2-conductor technology (only with differential input)

- Switching application with constant-current control
- Ramp function upon switch-on

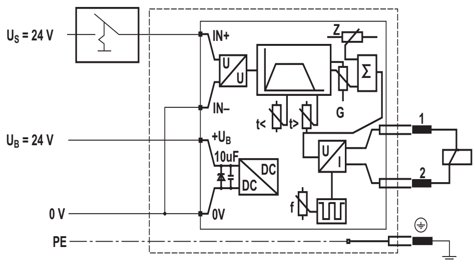
The "IN+" input is bridged with supply voltage (+U_B) in the connector, the IN- input is bridged with supply voltage (0 V) in the connector.
The maximum current must generally be adjusted according to the solenoid information using potentiometer "G".
The ramp time "ramp up" (t <) can be set within the range of t_{min} to 5 s.



3-conductor technology (only with differential input)

- Switching application with constant-current control
- Switching with low control power
- Ramp function can be adjusted separately when switching on and off the control voltage

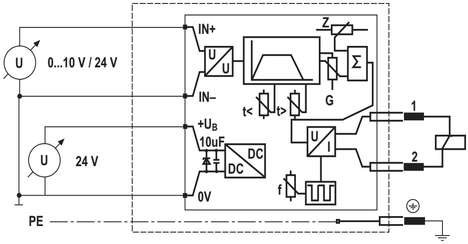
The "IN+" input is connected to the control voltage (Us = 24 V), the "IN–" input is bridged with supply voltage (0 V) in the connector.
The maximum current must generally be adjusted according to the solenoid information using potentiometer "G".
When switched off ("IN+" = 0 V or "IN+" = open) a pilot current can be set at "Z". This serves to reduce the switch-on delay, particularly with ramp. If required, this value can be adjusted between approx. 0 mA and approx. 15 % of the rated current. The ramp times "ramp up" (t <) and "ramp down" – (t >) can be set within the range of t_{min} to 5 s.



Applications (continued)

4-conductor technology

The "IN+" input is connected to the control signal (Us = 0... 10 V/24 V), the "IN–" input is connected to the reference potential of the control voltage.
Pilot current and maximum current are set using potentiometers "Z" and "G" prior to commissioning. The current can now be proportionally adjusted according to the control voltage between the set pilot current and the set maximum current. The pilot current can be set in the range of approx. 0 mA to approx. 15 % of the rated current, the maximum current can be set in the range of 0 to I_{max} (see technical data page5).



Function

The plug-in amplifier is suitable for installation on a valve connection base according to EN 175301-803. By turning the plug insert and the electronics in the housing, the plug-in amplifier can be mounted on the solenoid in 90° increments.

Command value presetting

The command value range is between 0 and U_B. In the command value range 0... 10 V the solenoid current is proportional to the command value. Starting with a command value of 12 V up to U_B the solenoid current is almost constant according to the I_{max} setting (switching application).

Ramp generator

The ramp generator (5) limits the rise of the control output. The up and down ramp times can be adjusted separately. In switching applications, the ramps can be used to dampen the switch-on and switch-off impulse (When switching off only with 3-conductor connection, i.e. switching signal and supply are connected separately). This behavior also depends on the valve and solenoid type. The downstream command value attenuator (4) has no influence on the ramp time.

Characteristic curve

Up to a command value of approx. 110 % the transfer characteristic curve rises linearly. The zero point can be corrected using potentiometer "Z", the maximum value can be corrected using potentiometer "G".

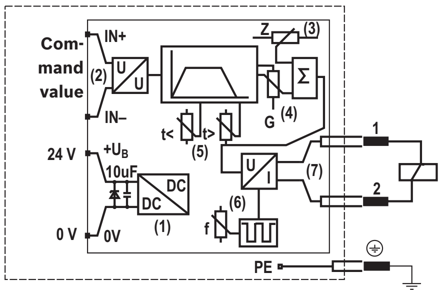
Power output stage

Output stage (7) is freely clocking. The clock frequency depends on the current level, the operating voltage and the impedance of the controlled solenoid. The clock frequency can be re-adjusted using potentiometer "f". The current output stage generates a regulated current signal according to the control output provided by the summing device (3). If the clock frequency is too high, the valve hysteresis is increased. If the clock frequency is too low, the noise level of the hydraulic system is increased.

( ) = references to the block diagram

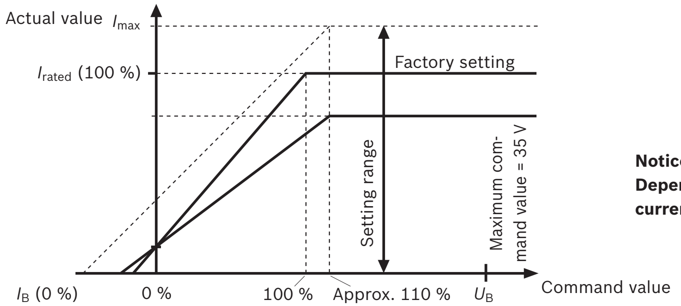
Block diagram

(1) Internal voltage adjustment
(2) Command value input
(3) Zero point potentiometer "Z" / pilot current I (IN = 0 %)
(4) Command value attenuator "G" / maximum current I (IN = 100 %)
(5) Ramp time potentiometers "t <" and "t >"
(6) Frequency range correction "f"
(7) Power output stage



1

Characteristic curve



Notice:
Depending on the type, the pilot current can also be "0".

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

Type		VT-SSPA1-1	VT-SSPA1-5	VT-SSPA1-50	VT-SSPA1-100	VT-SSPA1-150
24 V operating voltage	U_B	24 VDC				
	$u(t)_{max}$	35 V				
	$u(t)_{min}$	18 V				
Maximum cable inductance [1]	L_{max}	100 µH				
Current and power consumption (dependent on solenoid data)	I / A	< 1.7	< 1.7	< 2.6	< 1.7	< 1.2
	P_{max} / VA	< 40	< 40	< 60	< 40	< 30
Recommended pre-fuse	I / A	2; time-lag	2; time-lag	3.15; time-lag	2; time-lag	1.5; time-lag
Minimum coil inductivity	L_{min} / mH	15	15	10	15	15
Pilot current (setting range)	I_B / mA	0...300	0...300	0...350	0...250	0...200
Pilot current (factory setting)	I_B / mA	100	0	100	0	100
Rated current (factory setting)	I / A	1.6	1.2	2.5	1.2	0.8
Maximum current (setting range)	I_{max} / A	I_B...1.7	I_B...1.8	I_B...2.6	I_B...1.7	I_B...0.8
Clock frequency at I_{max}	f / Hz	340	200	305	150	150 [2]
Command value input (voltage)						
Proportional range	U	0...10 V				
Switching range	U	12 V...U_B				
Resistance	R	20 kΩ				
Ramp time (setting range)						
Variant V0	t	100 ms...5 s	60 ms...5 s			
Variant V002	t			10 ms...2 s		
Type of connection (cable gland)		4 screw terminals				
Cable diameter		4.5 ... 11 mm				
Type of connection (M12 connector)		Connector, 4-pole, M12x1				
Type of connection (solenoid)		Base according to EN 175301-803				
Number of poles (solenoid)		2 + PE				
Dimensions		See page 7				
Type of mounting		M3 x 40 mm				
Admissible operating temperature range (amplifier with cable gland)	ϑ / °C	–25 ... +70	–25 ... +70	–25 ... +60	–25 ... +70	–25 ... +70
Admissible operating temperature range (amplifier with M12 connector)	ϑ / °C	–25 ... +70	–25 ... +70	–25 ... +50	–25 ... +70	–25 ... +70
Storage temperature range	ϑ	–25 ... +85 °C				
Protection class according to EN 60529		IP65 with mounted cable/mounted mating connector				
Weight	m	0.125 kg				

[1] Usually corresponds to a cable length < 100 m

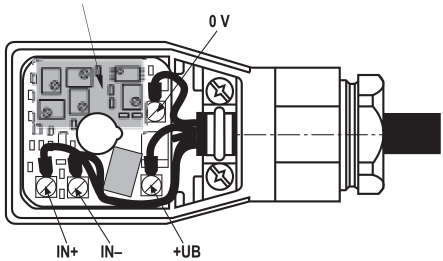
[2] With a solenoid resistance of R = 19.5 Ω and a solenoid current of I = 100 mA

Electrical connection

Terminal/pin		Terminal/pin	
+UB / 1	Operating voltage U_B 24 V	IN+ / 2	Command value input 24 V; 0...10 V
0 V / 3	0 V ground	IN– / 4	Reference potential for the command value

Terminal connection

Risk of malfunctions in case of EMC/ESD interference on the connection cable
Do not route command value connection lines through this section!

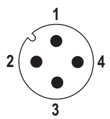


The connection for the protective grounding conductor is accessible after the electronic printed-circuit board has been removed.

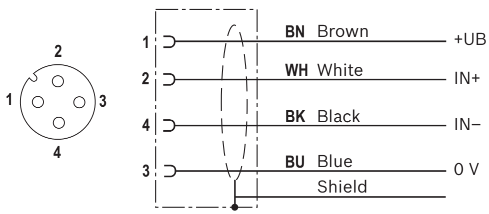
Connection cross-section:
4 x 0.75 mm² shielded or
5 x 0.5 mm² shielded (connect shield in control cabinet)
For VT-SSPA1-50:
4 x 1.5 mm² shielded (connect shield in control cabinet)
Cable diameter: 4.5 ... 11 mm

M12 plug-in connector port

Connector on amplifier



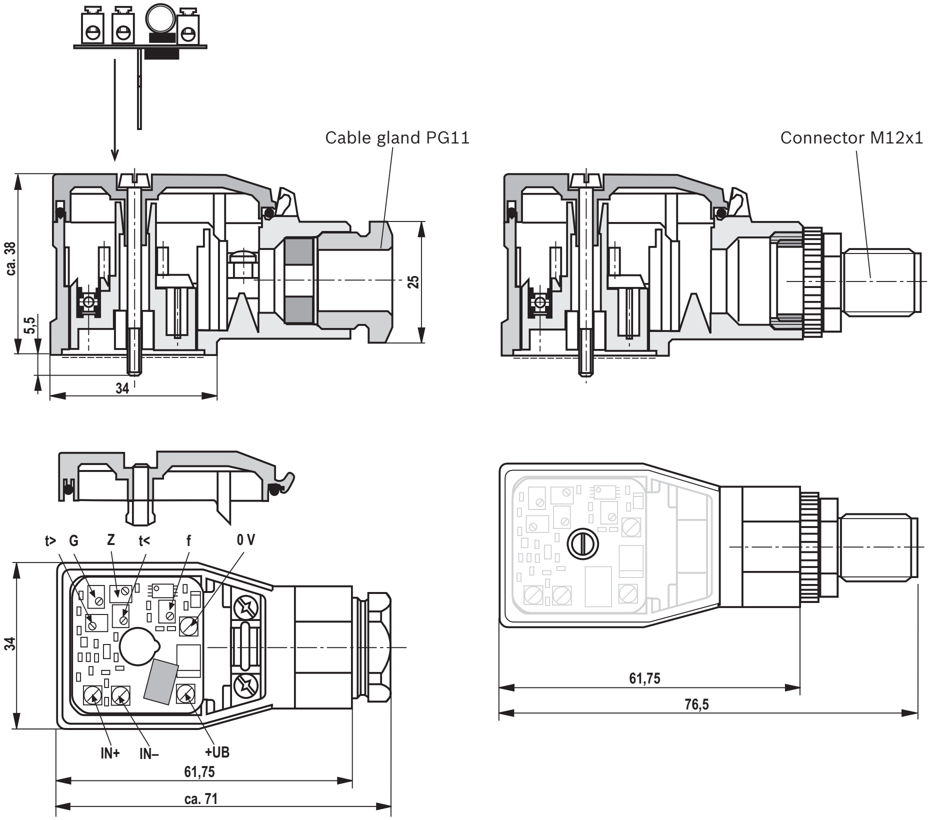
Mating connector and wire colors with pre-assembled cable set
Please order the cable set separately, see page 3



The connection for the protective grounding conductor is not provided

Connection cross-section:
4 x 0.75 mm² shielded
(connect shield in control cabinet)

Adjustment elements / dimensions (dimensions in mm)



Top view on open housing:

G	Command value attenuator/maximum current
Z	Zero point potentiometer/pilot current
t <	Ramp time "up"
t >	Ramp time "down"
f	Frequency range

Project planning / maintenance instructions / additional information

- The plug-in amplifier may only be wired when de-energized.
- Do not lay lines close to power cables!
- The distance to aerial lines, radios, and radar systems has to be 1 m at least.
- To set the potentiometers and to check the current values, use the measuring adapter and measure the currents in a potential-free manner.
- The specified maximum solenoid currents must not be exceeded.
- Do not use solenoids with integrated free-wheeling diodes.
- The supply voltage is to be protected by means of a fuse – see "Technical data".

Notice:
The solenoids are controlled with a clocked voltage. The solenoid voltage impulse level corresponds to the applied operating voltage ($+U_B$).
Solenoids with integrated EMC protection circuit may only be used if the response voltage of the protection circuit - both, for positive and negative voltage - is greater than the actual operating voltage.
The specifications of the valve manufacturers are to be observed.

Notice:
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of approx. 470 μF to 2200 μF.
- The line length should not exceed 50 m. For longer lines, a capacitor with C ≥ 100 μF has to be connected between U_B and 0 V. The line between capacitor and plug-in amplifier must not be longer than 50 m.

Recommendation: Capacitor module VT 11110 (see data sheet 30750); sufficient for up to 5 plug-in amplifiers.

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Plug-in proportional amplifier

Type VT-SSPA1-525-1X/V0

Component series 1X

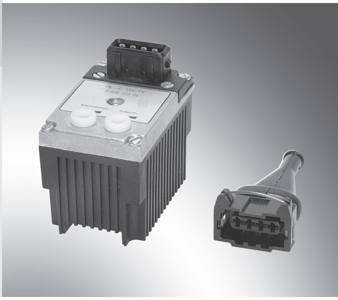


Table of contents

Features

Analog amplifier for controlling proportional valves (pressure and directional valves) without position control

- Differential input
- Adjustable sensitivity and valve zero point
- Connection via 4-pole connector
- Operating voltage 12/24 V

Notice:

The photo is an example configuration.
The delivered product differs from the figure.

Ordering code

VT-	S	S	P	A	1	–525–1X/V0

Plug-in proportional amplifier **= S**

Hydraulic component
For valves without electrical feedback **= S**

Valve type
Proportional valve **= P**

Control
Analog **= A**

Output stages
1 output stage **= 1**

525 = Serial number for type 2.5 A solenoid

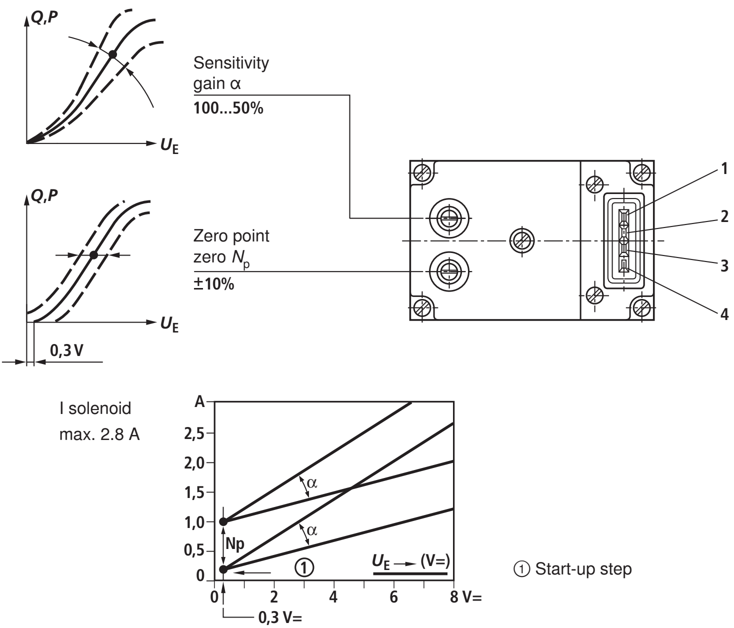
1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

Customer version
V0 = Catalog version

Preferred types

Type	Material number	For valves
VT-SSPA1-525-10/V0	0811405041	All proportional valves without position control with solenoid 2.5 A/25 W
Connector socket 4-pole	1834484098	

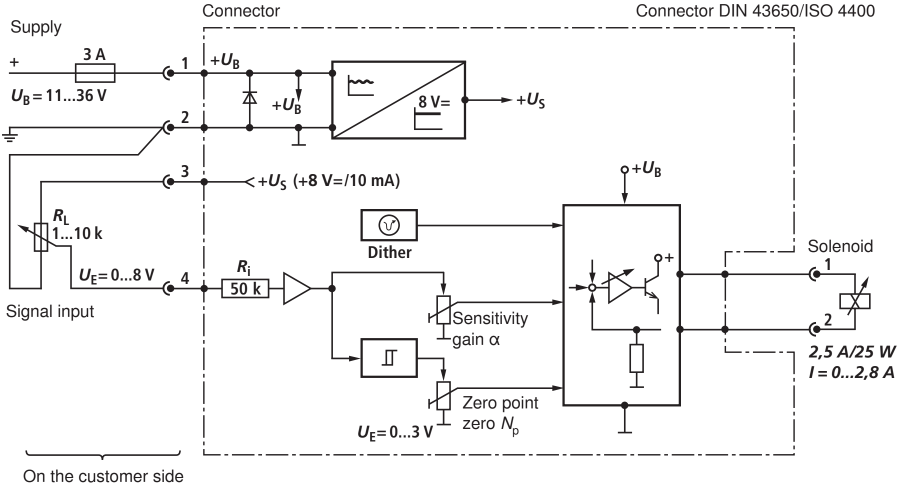
Adjustment, pin assignment



Zero point with 0.3...0.5 V = U_E adjustable

1

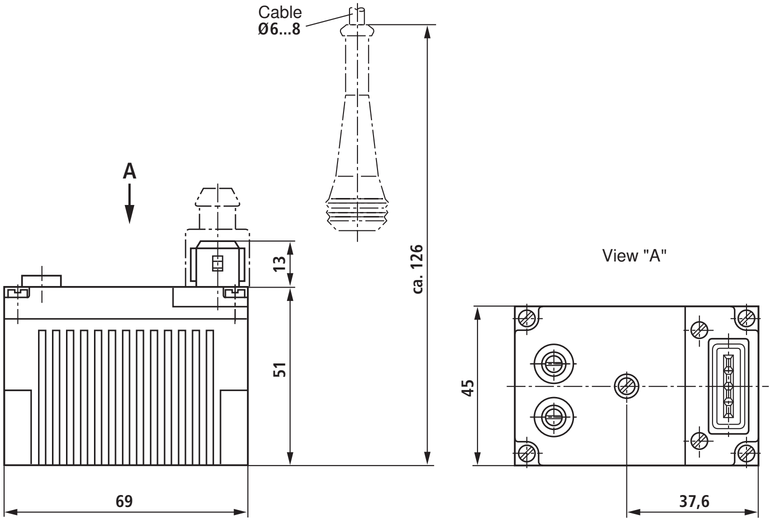
Block diagram with pin assignment



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

Design:		Connector housing
Plug-in connection		Solenoid: DIN 34 650 Cable: 4-pole
Ambient temperature	°C	–20...+70
Storage temperature min.	°C	–20
Protection class		IP 65 including connector socket, cable Ø 6...8 mm
Supply voltage		12 V/24 V battery voltage (11...36 V, < 10 % ripple)
Max. power consumption	W	< 30
Input signal (command value)	V	0.3...8 < 0.3 V, solenoid de-energized
Signal source		Potentiometer 1...10 kΩ Supply +8 V from (3)
Output proportional solenoid		Rectangular voltage, pulse-modulated I_{max} = 2.5 A
Cable lengths and cross-sections		Supply < 20 m 1.5 mm² 20...40 m 2.5 mm²
Special features		– Inputs and outputs short-circuit proof – Clocked output stage – Fast energization for short actuating time
Adjustment via trimming potentiometer		1. Zero point 2. Sensitivity

Device dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The plug-in proportional amplifier may only be wired in de-energized condition.
- Do not lay lines close to power cables!
- The distance to aerial lines, radios, and radar systems has to be 1 m at least.
- To set the potentiometers and to check the current values, use the measuring adapter and measure the currents in a potential-free manner.
- The specified maximum solenoid currents must not be exceeded.
- Do not use solenoids with integrated free-wheeling diodes.
- The supply voltage is to be secured by means of a fuse – see "Technical data".

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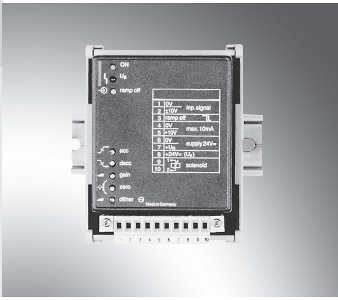
Electric amplifier modules

RE 30222/07.12 **1**/6
Replaces: 01.09

Type VT-MSPA1-5...



Component series 1X

Table of contents

Features

- Suitable for controlling direct operated proportional valves without electrical feedback
- Design: Module for snapping onto carrier rails
- Differential input for command value voltage 0...+10 V
- Ramp generator up and down can be set separately
- Zero point potentiometer
- Clocked output stage
- LED display:
  - Supply voltage
  - Ready for operation
  - Ramp "Off"
- Removable connector strip

Notice:

The photo is an example configuration.
The delivered product differs from the figure.

Ordering code

VT– M	S	P	A	1 –	– 1X / V0

Hydraulic component
For valves without electrical feedback **= S**

Valve type
Proportional valve **= P**

Control
Analog **= A**

Output stages
1 output stage **= 1**

Customer version
V0 = Catalog version

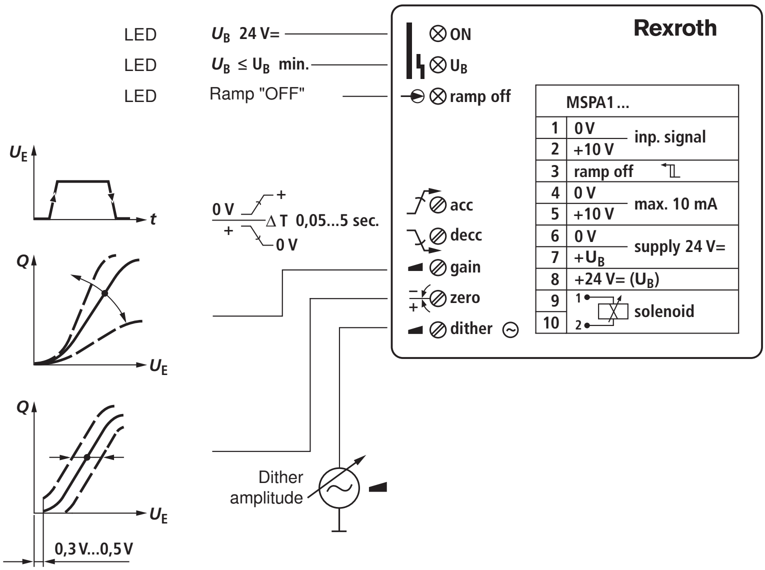
1X = Component series 10 to 19
(10 to 19: Unchanged technical data and pin assignment)

Serial number for types
508 = 0.8 A solenoid
525 = 2.5 A solenoid

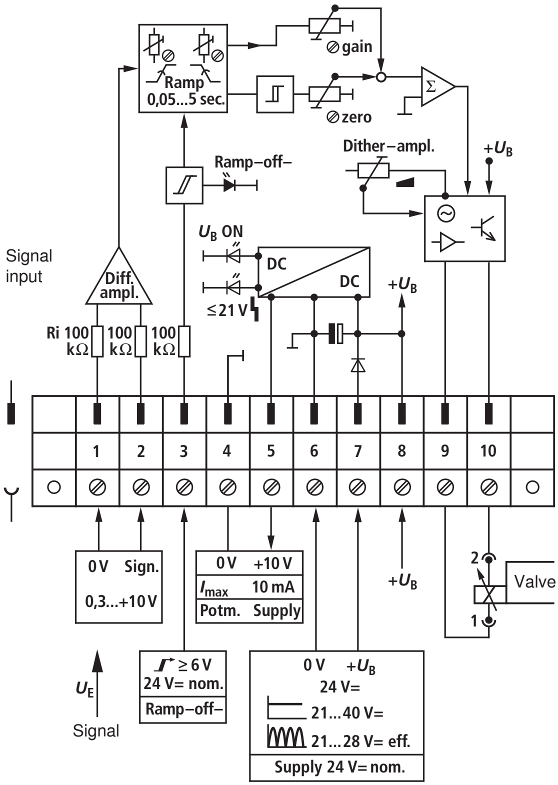
Preferred types

Amplifier type	Material number	For proportional valves, direct operated, without electrical feedback
VT-MSPA1-525-10/V0	0811405127	DBETX-1X...-25...
		DBE6X-1X...-25...
		(3)2FREX...-1X...-25...
VT-MSPA1-508-10/V0	0811405126	DBETX-1X...-8...
		DRE10Z-1X...-8...
		DRE6X-1X...-8...
		DBE6X-1X...-8...
		DBE10Z-1X...-8...

Front plate



Block diagram with pin assignment

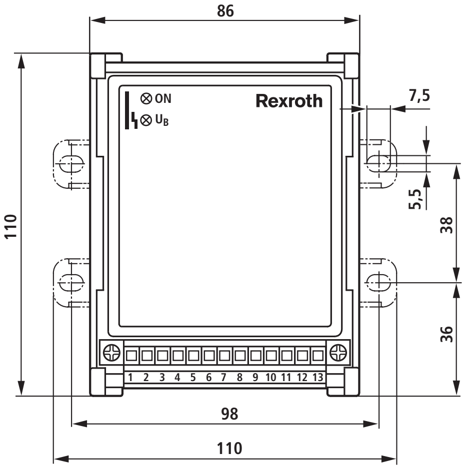


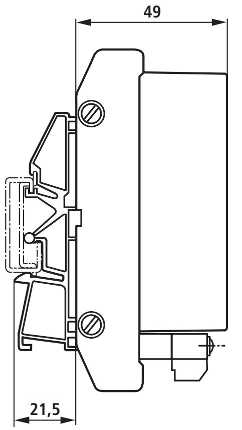
Technical data (For applications outside these parameters, please consult us!)

		VT-MSPA1-508-10/V0	VT-MSPA1-525-10/V0
Supply voltage U_B at (7) – (6)		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Valve solenoid	A/VA	0.8/25	2.5/55
Current consumption max.	A	1.25	2.5
		The current consumption may increase with min. U_B and an extreme cable length to the control solenoid	
Max. power consumption	VA	30	60
Command value		(2): 0...+10 V } Differential input (1): 0 V (R_i = 100 kΩ)	
Command value source		Potentiometer 10 kΩ Supply +10 V from (5) (10 mA) or external signal source	
Solenoid output		Clocked current controller	
(9) – (10)	A	I_{max} = 0.8	I_{max} = 2.5
Cable lengths between amplifier and valve		Solenoid cable: up to 20 m 1.5 mm² 20 to 50 m 2.5 mm²	
LED displays		green: Enable yellow: Ramp off red: Undervoltage (U_B too low)	
External ramp switch-off		(3): 6...40 V = (24 V_{nom})	
Ramp times	s	0.05...5	
Adjustment possibilities		Zero point valve, Ramp times, Sensitivity, Dither amplitude	
Special features		Inputs and outputs short-circuit-proof, Clocked output stage, Fast energization for short actuating time	
Format (W x L x H)	mm	(86 x 110 x 70.5)	
Design		Module	
Mounting		Top hat rail TH35-7,5 or G rail G32 according to EN 60715	
Plug-in connection		Connector, 10-pole (screw terminal)	
Ambient temperature	°C	0...+70	
Storage temperature range	°C	–20...+70	
Weight	*m*	0.31 kg	

Information for the use of ramps
Setting of ramp UP (acceleration) and ramp DOWN (braking) via 1 trimming potentiometer each.
Ramp ON, if (3) = 0 V (open). **Ramp OFF,** if (3) = 24 V_{nom} (min.: ≧ 6 V high).
With **ramp OFF**, a previously started ramp is canceled.
Transition to the signal end value is effected as step.
Setting zero: With 0.5 V signal (min. 0.3 V).
Max. setting: With +10 V signal.

Device dimensions (dimensions in mm)





Wall mounting (86 x 110 x 70.5) mm

Carrier rail assembly (snap-in)

Project planning / maintenance instructions / additional information

– The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
– Do not lay solenoid and signal lines near power cables.
– For signal lines and solenoid conductors, we recommend using shielded cables.
The cable shield must be connected to the control cabinet extensively and as short as possible.
– The cable lengths and cross-sections specified on page 4 must be complied with.

Notes

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Electric amplifier module

RE 30229/07.12
Replaces: 09.05

Type VT-MSPA2-525...

Component series 1X

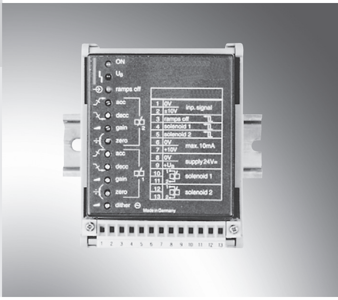


Table of contents

Contents | **Page**

Features

- Suitable for controlling
  two 1-solenoid proportional directional valves
  or
  one 2-solenoid proportional directional valve
- Design: Module for snapping onto carrier rails
- Differential input for command value voltage 0...+10 V
- Ramp generator up and down can be set separately
- Zero point potentiometer
- Clocked output stage
- LED display:
  - Supply voltage
  - Ready for operation
  - Ramp "Off"
- Removable connector strip

Notice:
The photo is an example configuration.
The delivered product differs from the figure.

Ordering code

VT–M | S | P | A | 2 – 525 –1X / V0

Hydraulic component
For valves without electrical feedback **= S**

Valve type
Proportional directional valve **= P**

Control
Analog **= A**

Output stages
2 output stages **= 2**

525 = Serial number for types 2.5 A solenoid

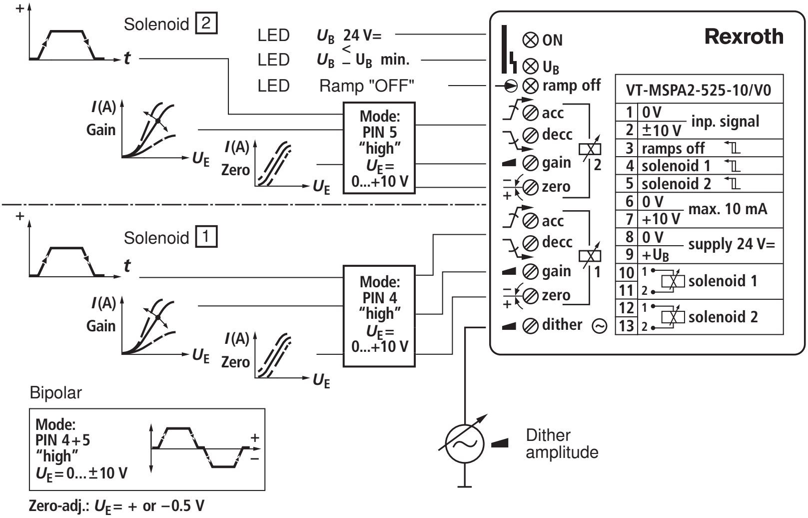
1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

V0 = Customer version
Catalog version

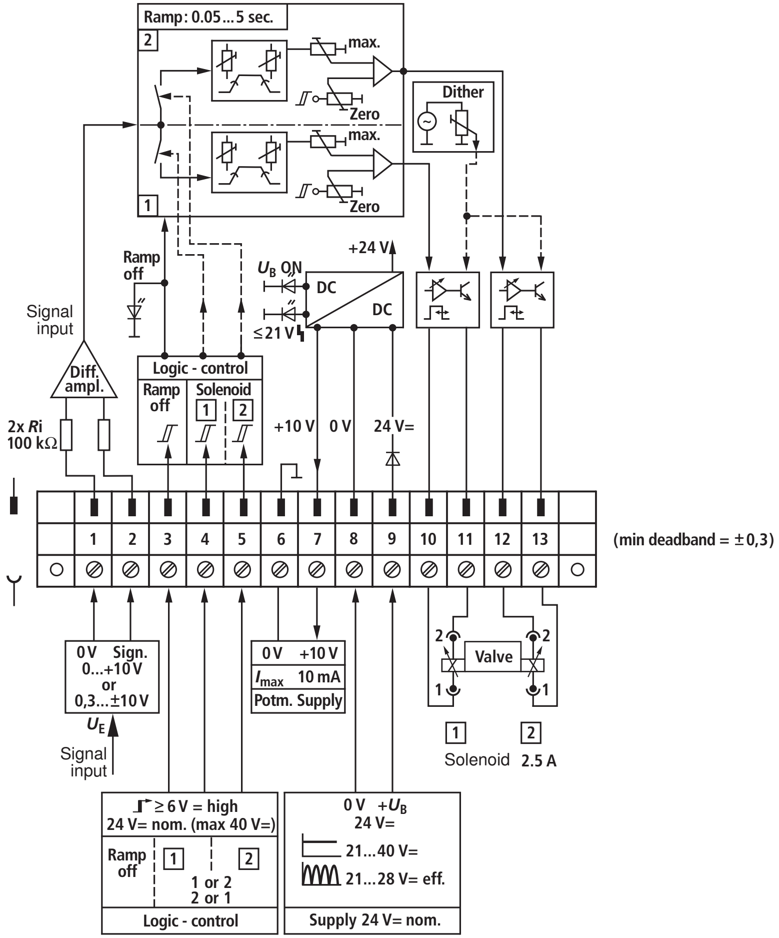
Preferred types

Amplifier type	Material number	For proportional directional valve, direct operated, with two solenoids
VT-MSPA2-525-10/V0	0811405106	4WRBA..E../..W..-2X...

Front plate



Block diagram with pin assignment



Notices on terminal 4 and 5

4	5	Solenoid	Command value	
Low	Low	–	–	—
High	Low	1	0...+10 V	UNIPOLAR mode 0...+10 V U_E Zero adjustment 0 V
Low	High	2	0...+10 V	
High	High	1 / 2	±10 V	BIPOLAR mode U_E 0...+10 V Zero adjustment ±0.5 V

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

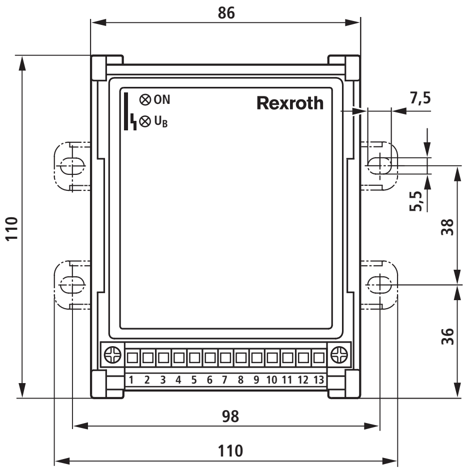
Supply voltage U_B at (9)		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Valve solenoid	A/VA	2.5/60
Current consumption max.	A	2.5
		The current consumption may increase with min. U_B and an extreme cable length to the control solenoid
Max. power consumption	VA	60
Command value: Signal (2) 0 V (1)		0...+10 V or ±0.3...±10 V (see mode) Differential amplifier (R_i = 100 kΩ)
Command values and logic	Mode ±10 V	(4) and (5) +24 V (>6 V...max. 40 V) Command value ±0.3...±10 V
	Mode +10 V	(4) +24 V → Command value 0...+10 V 1 (5) +24 V → Command value 0...+10 V 2
Command value source		Potentiometer 10 kΩ Supply +10 V from (7) Max. (10 mA) or external signal source
Output solenoids 1 and 2		Clocked current controller
	A	I_{max} = 2.5
Cable lengths between amplifier and valve		Solenoid cable: up to 20 m 1.5 mm² 20 to 50 m 2.5 mm²
LED displays		green: U_B Enable yellow: Ramp off red: Undervoltage (U_B too low)
External ramp switch-off		(3): 6...40 V = (24 V_{nom})
Ramp times	s	0.05...5
Adjustment possibilities for solenoids 1 and 2		Zero point valve, Ramp times, Sensitivity, Dither amplitude
Special features		Inputs and outputs short-circuit-proof, Clocked output stage, Fast energization for short actuating time
Format (W x L x H)	mm	(86 x 110 x 95.5)
Design		Module
Mounting		Top hat rail TH35-7,5 or G rail G32 according to EN 60715
Plug-in connection		Connector, 13-pole (screw terminal)
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	*m*	0.43 kg

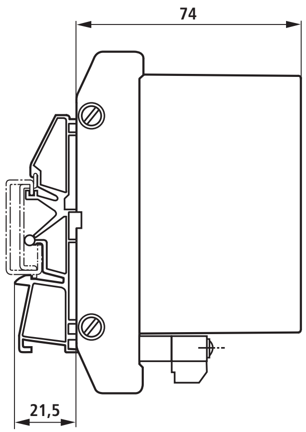
Setting information

Information for the use of ramps
Setting of ramp UP (acceleration) and ramp DOWN (braking) via 1 trimming potentiometer each.
Ramp ON, if (3) is open.
Ramp OFF, if at (3) $U > 6$ V e.g. 10 V from (7) or 24 V = $_{nom}$
With ramp OFF, any ramp started before will be canceled. Transition to the signal end value is effected by means of a step.

Setting zero/max. gain
1. With mode (4) and (5) = high (24 V =)
   Command value U_E (1) (2) ±10 V
   Zero: From 0.3 V, usually 0.5 V
   + adjustment = solenoid 1
   – adjustment = solenoid 2
   Gain: Set in case of +10 V
   + = solenoid 1
   – = solenoid 2
2. With mode (4) or (5) = high
   Command value U_E (1) (2) 0...+10 V
   Zero: With 0 V command value
   Gain: With +10 V command value.
   The logic signal determines:
   4 = solenoid 1
   5 = solenoid 2.

Device dimensions (dimensions in mm)





Wall mounting (86 x 110 x 74) mm Carrier rail assembly (snap-in)

Project planning / maintenance instructions / additional information

- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protection circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

Notes

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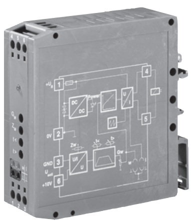
The Drive & Control Company

Rexroth
Bosch Group

Analog amplifier module

Type VT-MSPA1-1, VT-MSPA1-10, VT-MSPA1-11

RE 30223
Version: 2013-01
Replaces: 02.12



H6833_d

▶ Component series 1X

Features

▶ Suitable for controlling direct operated proportional pressure valves:
  – DBET-6X,
  – DBEM...-7X,
  – (Z)DRE 6...-1X,
  – 3DRE(M) 10...-7X,
  – 3DRE(M) 16...-7X,
  – ZDRE 10...-2X,
  – (Z)DBE6...-2X,
  – DRE(M) 10, 25, 32-6X
▶ Inverse-polarity protection of the operating voltage
▶ Differential input for command value voltage +10 V
▶ Ramp generator up and down can be set separately
▶ Zero point potentiometer
▶ 1 command value attenuator
▶ Characteristic curve generator
▶ Clocked power output stage
▶ LED display: • Ready for operation (green)
▶ Measuring sockets for: • Pressure command value
  • Actual current value
▶ Dither generator with command value- and operating voltage-dependent frequency

Contents

Ordering code

01		02		03		04		05
VT-MSPA1	–		–	1X	/	V0	/	*

01	Analog amplifier module	**VT-MSPA1**

02	For controlling direct operated proportional pressure valves:	
	DBET-6X, DBEM...-7X	**1**
	(Z)DRE 6...-1X	**10**
	3DRE(M) 10...-7X, 3DRE(M) 16...-7X, ZDRE 10...-2X, (Z)DBE6...-2X, DRE(M) 10, 25, 32-6X	**11**

03	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	**1X**

04	Standard version	**V0**

05	Further details in the plain text	*

Functional description

Analog amplifier for controlling pressure valves without electrical feedback. The modular design allows for simple top hat rail mounting as is usual in control cabinets.

Command value input: 4
The module amplifier is controlled by means of a standard command value signal 0 to +10 V. By means of the zero point trimmer (Zw) (6), a zero point offset can be corrected.

Ramp generator: 5
In the ramp generator (5), the control output rise is limited. Using the trimmer "t <" (7), the time for the increasing command value signal is set and using trimmer "t >" (8), the time for the decreasing command value voltage is set. The adjustable time is part of the technical data.

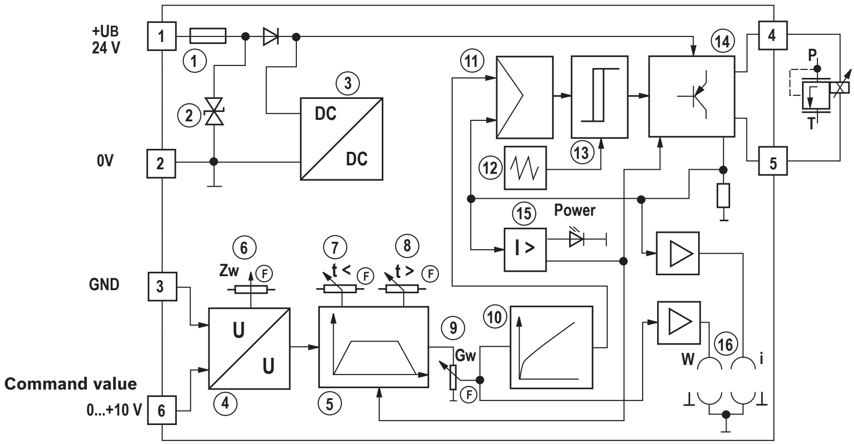
Characteristic curve generator: 10
Using the trimmer "Gw" (9), the rated current of 1.6 A for the solenoid is set. In the characteristic curve generator (10), the command value signal is changed so that a linear command value pressure characteristic curve results.

Clock generator: 12
In the clock generator (12), a frequency for the output stage adjusted to the command value is generated.

Power output stage: 11-14
Using the control output coming from the characteristic curve generator (10) and the clock frequency, the power output stage generates a PWM signal that is fed into the solenoid. The solenoid current is recorded and, in the current controller (11), compared with the control output and the difference is compensated.

Fault recognition: 15
Monitors the solenoid conductors with regard to cable break and short circuit as well as over-current of the output stage. If there is an error, the green ready for operation display goes out.

Block diagram



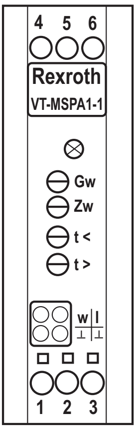
1 Fuse
2 Suppressor diode
3 Power supply unit
4 Command value input
5 Ramp generator
6 Potentiometer zero point
7 Potentiometer ramp up
8 Potentiometer ramp down
9 Potentiometer I_{max}
10 Characteristic curve generator
11 Current controller
12 Clock generator
13 Schmitt trigger
14 Output stage
15 Fault recognition
16 Measuring socket
Ⓕ On front side

Terminal assignment/device view

Terminal assignment

Terminal	
1	$+U_B$
2	Ground
3	$-U_{command}$
4	Solenoid +
5	Solenoid –
6	$+U_{command}$

Device view



Potentiometer: "Gw" Pressure command value
"Zw" Zero point
"t <" Ramp time up
"t >" Ramp time down

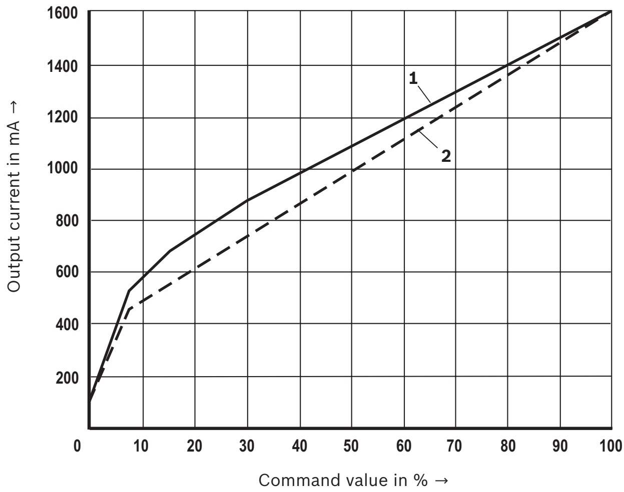
Sockets: "w" Pressure command value
"I" Actual current value
"⊥" Measurement zero

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

		VT-MSPA1-1	VT-MSPA1-10	VT-MSPA1-11
Operating voltage	U_B	24 VDC +40 % −10 %		
Operating range:				
– Upper limit value	$u_B(t)_{max}$	35 V		
– Lower limit value	$u_B(t)_{min}$	21 V		
Power consumption	P_{max}	< 50 VA		
Current consumption	I_{max}	< 1.3 A		
Fuse	I_s	Electronic overload protection and SMD fuse (soldered in)		
Inputs:				
– Command value (differential input)	$U_{command}$	0 to +10 V; R_e = 100 kΩ		
Outputs:	I_{min}			
– Solenoid current/solenoid resistance	I_{max}	1.9 A; R_{20} = 5.5 Ω	1.9 A; R_{20} = 5.2 Ω	1.9 A; R_{20} = 5.5 Ω
– Frequency	f	180 to 450 Hz	330 Hz ± 10 %	180 to 450 Hz
Setting ranges:				
GW: Solenoid current	I	100 mA...1.9 A		
ZW: Zero point		±25 %		
t >: / t <: } Ramp	t	80 ms...5 s	210 ms...5 s	160 ms...5 s
Measuring sockets:				
– Command value "w"	U	0 to 10 V		
– Actual current value "I"	U	1 mV ≙ 1 mA solenoid current		
Type of connection		6 screw terminals		
Type of mounting		Top hat rail TH 35–7.5 according to EN 60715		
Protection class according to EN 60529		IP 20		
Dimensions (W x H x D)		25 x 79 x 85.5 mm		
Admissible operating temperature range	ϑ	0 to +50 °C		
Storage temperature range	ϑ	−25 to +85 °C		
Ground	m	0.15 kg		

Notice:
For information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30223-U.

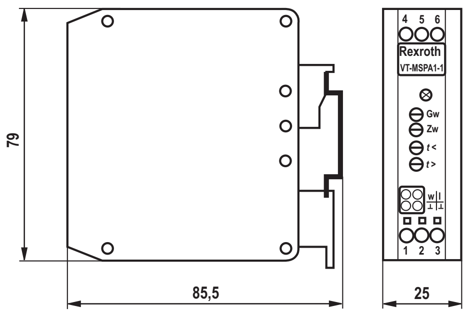
Output characteristic curve



1 = VT-MSPA1-1 and VT-MSPA1-11

2 = VT-MSPA1-10

Device dimensions (dimensions in mm)



Project planning/maintenance instructions/additional information

- The amplifier module may only be wired when de-energized.
- The distance to radios must be sufficient (>> 1 m).
- Screen command value lines, do not lay them close to power cables, screen solenoid conductors.
- **Do not use free-wheeling diodes** in the solenoid conductors.
- With a strongly fluctuating operating voltage, it may in individual cases be necessary to use an external smoothing capacitor with a capacity of at least 2200 μF.
- Recommendation: Capacitor module VT 11110 (see data sheet 30750); sufficient for up to 3 amplifier modules.

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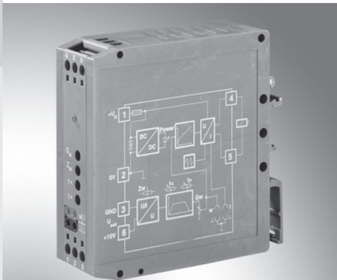
Analog amplifier module

RE 30224/12.10 1/6
Replaces: –.–

Type VT-MSPA1-30, VT-MSPA1-150

Component series 1X



H6833_d

Table of contents

Contents	**Page**

Features

- Suitable for controlling direct operated proportional pressure valves:
  - DBE(M) 30-3X
  - DRE(M) 30-4X
- Inverse-polarity protection of the operating voltage
- Differential input for command value voltage +10 V
- Ramp generator up and down can be set separately
- Zero point potentiometer
- 1 command value attenuator
- Characteristic curve generator
- Synchronized power output stage
- Output short-circuit-proof
- LED display: • Ready for operation (green)
- Measuring sockets for: • Pressure command value
  • Actual current value
- Dither generator with fixed frequency

Ordering code

VT-MSPA1– –1X/V0/ *

Analog amplifier module	
For controlling the valves DBE(M) 30-3X and DRE(M) 30-4X	**= 30**
For controlling the valves DBE(M) 30-3X and DRE(M) 30-4X in connection with hydraulic pumps	**= 150**
Component series 10 to 19 (10 to 19: Identical technical data and pinout)	**= 1X**
Standard version	V0
Further details in the plain text	*

Functional description

Analog amplifier for controlling pressure valves without electric return. The modular design allows for simple top hat rail assembly as is usual in control cabinets.

Command value input: 4

The module amplifier is controlled by means of a standard command value signal 0 to +10 V. By means of the zero point trimmer (Zw) (6), a zero point offset can be corrected.

Ramp generator: 5

In the ramp generator (5), the actuating variable rise is limited. Using the trimmer "t <" (7), the time for the increasing command value signal is set and using trimmer "t >" (8), the time for the decreasing command value voltage is set. The adjustable time is contained in the technical data.

Characteristic curve generator: 10

Using the trimmer "Gw" (9), the rated current for the solenoid is set. In the characteristic curve generator (10), the command value signal is changed so that a linear command value current characteristic curve results.

Clock generator: 12

In the clock generator (12), a fixed frequency for the output stage is generated.

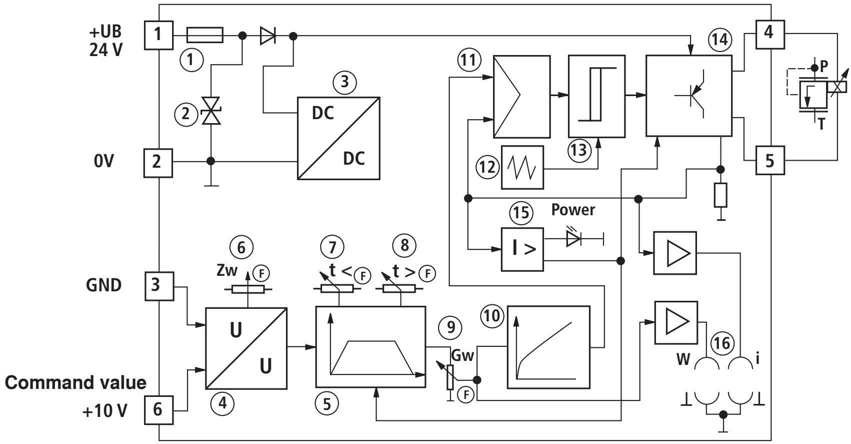
Power output stage: 11-14

Using the actuating variable coming from the characteristic curve generator (10) and the clock frequency, the power output stage generates a PWM signal that is fed into the solenoid. The solenoid current is recorded and in the current controller (11) compared with the actuating variable and the difference is compensated.

Fault recognition: 15

Monitors the solenoid lines with regard to cable break and short circuit as well as overcurrent of the output stage. If there is an error, the green Ready for operation display goes out.

Block diagram



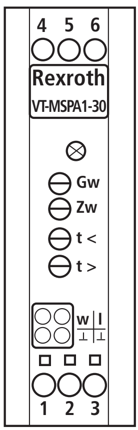
1	Fuse	**7**	Potentiometer ramp up	**13**	Schmitt trigger
2	Suppressor diode	**8**	Potentiometer ramp down	**14**	Output stage
3	Power supply	**9**	Potentiometer I_{max}	**15**	Fault recognition
4	Command value input	**10**	Characteristic curve generator	**16**	Measuring socket
5	Ramp generator	**11**	Current controller		
6	Potentiometer zero point	**12**	Clock generator	**F**	On front side

Terminal assignment / device view

Terminal assignment

Terminal	
1	$+U_B$
2	Ground
3	$-U_{command}$
4	Solenoid +
5	Solenoid –
6	$+U_{command}$

Device view



Potentiometer:	"Gw"	Pressure command value
	"Zw"	Zero point
	"t <"	Ramp time up
	"t >"	Ramp time down
Sockets:	"w"	Pressure command value
	"I"	Actual current value
	"⊥"	Measurement null

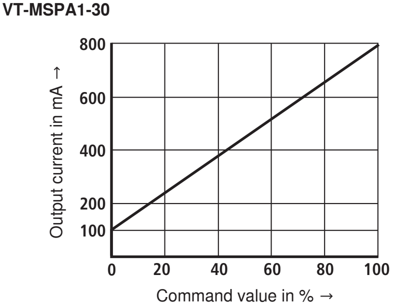
Technical Data (For applications outside these parameters, please consult us!)

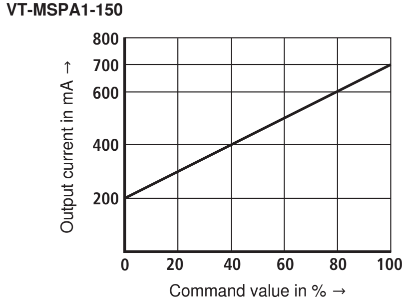
		VT-MSPA1-30	VT-MSPA1-150
Operating voltage	U_B	24 VDC +40 % –10 %	
Operating range:			
– Upper limit value	$u_B(t)_{max}$	35 V	
– Lower limit value	$u_B(t)_{min}$	21 V	
Power consumption	P_{max}	< 25 VA	
Current consumption	I_{max}	< 1 A	
Fuse	I_s	Electronic overload protection and SMD fuse (soldered in)	
Inputs			
– Command value (differential input)	$U_{command}$	0 to +10 V; R_e = 100 kΩ	
Outputs			
– Bias current (factory setting)	I_V	100 mA	200 mA
– Solenoid current / resistance	I_{max}	800 mA; R_{20} = 19.5 Ω	700 mA; R_{20} = 19.5 Ω
– Frequency	f	200 Hz	100 Hz ±10 %
Setting ranges			
GW: Solenoid current	I	100 mA…800 mA	200 mA…700 mA
ZW: Zero point		±25 %	±25 %
t >: / t <: Ramp	t	60 ms…5 s	60 ms…5 s
Measuring sockets			
– Command value "w"	U	0 to 10 V	
– Actual current value "I"	U	1 mV ≙ 1 mA solenoid current	
Type of connection		6 screw terminals	
Mounting type		Top hat rail TH 35-7.5 according to EN 60715	
Protection class according to EN 60529		IP 20	
Dimensions (W x H x D)		25 x 79 x 85.5 mm	
Admissible operating temperature range	ϑ	0 to +50 °C	
Storage temperature range	ϑ	–25 to +85 °C	
Weight	m	0.15 kg	

Important:

Information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load see 30223-U (declaration on environmental compatibility).

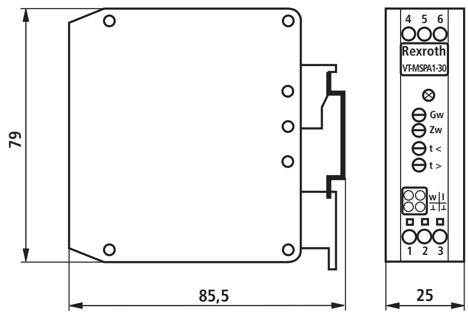
Output characteristic curve





1

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier module may only be wired when de-energized!
- The distance to radios must be sufficient (>> 1 m)!
- Screen command value lines, do not lay them close to power cables, screen solenoid lines!
- Do not use **free-wheeling diodes** in the solenoid lines!
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of at least 2200 μF.

  Recommendation: Capacitor module VT 11110 (see RE 30750); sufficient for up to 3 amplifier modules.

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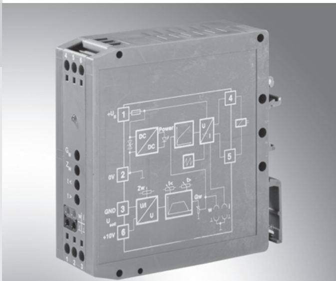
Amplifier module for controlling the explosion-proof proportional pressure valve DBET-6X...XE [1)]

RE 30223-200/03.11 1/6
Replaces: 02.07

Type VT-MSPA1-200

Component series 1X



H6833

Table of contents

Contents	**Page**

Features

- Amplifier module is not subject to the directive 94/9/EC (ATEX directive)
- In connection with the Rexroth monitoring module [1)] VT-MUXA2-2 suitable for controlling the proportional pressure valve of type DBET-6X...XE
- Inverse-polarity protection of the operating voltage
- Differential input for command value voltage +10 V
- Ramp generator up and down can be set separately
- Zero point potentiometer
- 1 command value attenuator
- Characteristic curve generator
- Synchronized power output stage
- Output short-circuit-proof
- LED display: • Ready for operation (green)
- Measuring sockets for: • Pressure command value
  • Actual current value
- Dither generator with command value- and operating voltage-dependent frequency

[1)] **For the operation of the valve in the explosive area, additional safety measures are required. Here, we recommend using the Rexroth monitoring module VT-MUXA2-2.
In this connection, observe data sheet 30290.**

Ordering code

VT-MSPA1 – 200 – 1X / V0 / *

Analog amplifier module	
For controlling the valve DBET-6X...XE	**= 200**
Component series 10 to 19 (10 to 19: Identical technical data and pinout)	**= 1X**
V0 = Standard version	
Further details in the plain text	

Functional description

Analog amplifier for controlling pressure valves without electric return. The modular design allows for simple top hat rail assembly as is usual in control cabinets.

( ) = Assignment to the block diagram on page 3

Command value input (4)

The module amplifier is controlled by means of a standard command value signal 0 to +10 V. By means of the zero point trimmer (Zw) (6), a zero point offset can be corrected.

Ramp generator (5)

In the ramp generator (5), the actuating variable rise is limited. Using the trimmer "t <" (7), the time for the increasing command value signal is set and using trimmer "t >" (8), the time for the decreasing command value voltage is set. The adjustable time is in each case 30 ms to > 5 s.

Characteristic curve generator (10)

Using the trimmer "Gw" (9), the rated current of 1.0 A for the solenoid is set. In the characteristic curve generator (10), the command value signal is changed so that a linear command value/pressure characteristic curve results.

Clock generator (12)

In the clock generator (12), a frequency for the output stage adjusted to the command value is generated.

Power output stage (11) to (14)

Using the actuating variable coming from the characteristic curve generator (10) and the clock frequency, the power output stage generates a PWM signal that is fed into the solenoid. The solenoid current is recorded and in the current controller (11) compared with the actuating variable and the difference is compensated.

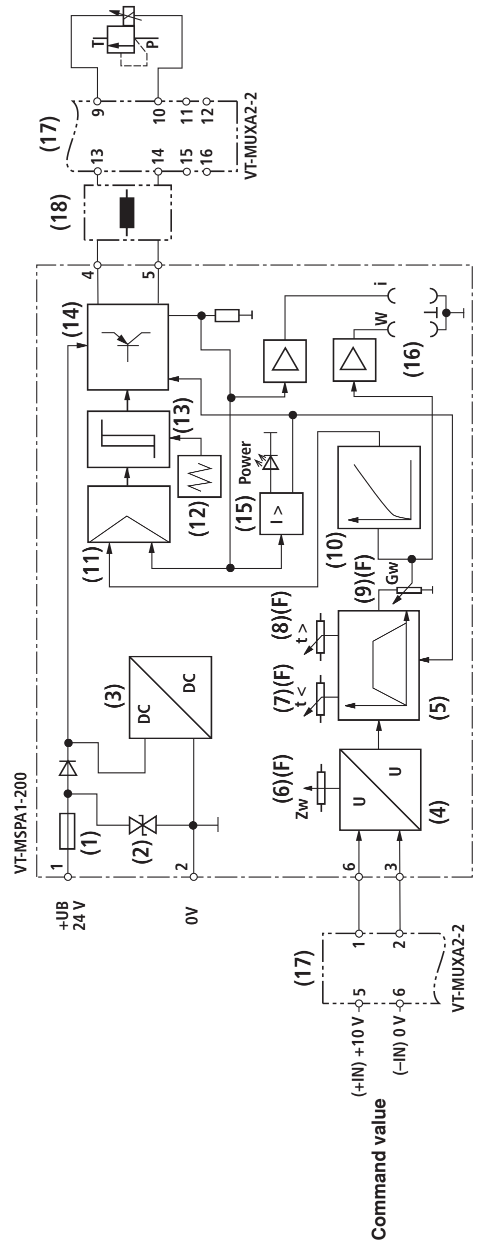
Fault detection (15)

Monitors the solenoid lines with regard to cable break and short circuit as well as overcurrent of the output stage. If there is an error, the green Ready for operation display goes out.

Monitoring and limitation of the solenoid current (17)

The VT MUXA2-2 module provides for the monitoring and limitation of the solenoid current. The functioning is described in data sheet 30290.

Block diagram



(1) Fuse
(2) Suppressor diode
(3) Power supply
(4) Command value input
(5) Ramp generator
(6) Potentiometer zero point
(7) Potentiometer ramp up
(8) Potentiometer ramp down
(9) Potentiometer I_{max}
(10) Linearization
(11) Current controller
(12) Oscillator
(13) Schmitt trigger
(14) Output stage
(15) Fault recognition
(16) Measuring socket
(F) On front side
(17) VT-MUXA2-2 monitoring module (order separately)
(18) Ferrite sleeve (only included in the delivery of the monitoring module)

1

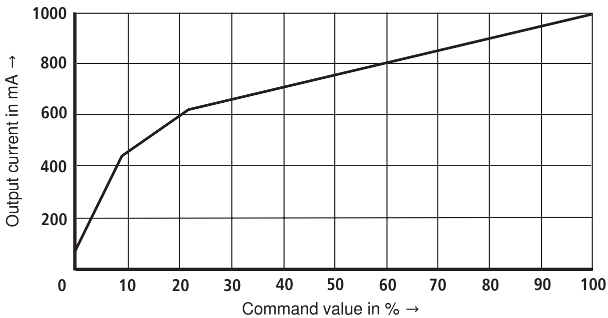
Technical Data (For applications outside these parameters, please consult us!)

Operating voltage	U_B	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V
– Lower limit value	$u_B(t)_{min}$	21 V
Power consumption	P_{max}	< 50 VA
Current consumption	I_{max}	< 1.3 A
Fuse	I_s	Electronic overload protection and SMD fuse (soldered in)
Inputs:		
– Command value (differential input)	$U_{command}$	0 to +10 V; R_e = 100 kΩ
Outputs:		
– Solenoid current / resistance	I_{max}	1.0 A; R_{20} = 8.3 Ω
– Frequency	f	180 to 450 Hz
Setting ranges:		
– GW: Solenoid current	I	60 mA…1000 mA
– ZW: Zero point		±25 %
– t >: / – t <: Ramp	t	60 ms…5 sec
Measuring sockets:		
– Command value "w"	U	0 to 10 V
– Actual current value "I"	U	1 mV ≙ 1 mA solenoid current
Type of connection		6 screw terminals
Mounting type		Top hat rail TH 3-7.5 according to EN 60715
Protection class		IP 20 according to EN 60529
Dimensions (W x H x D)		25 x 79 x 85.5 mm
Admissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–25 to +85 °C
Weight	m	0.15 kg

Note!

For information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30223-U.

Output characteristic curve

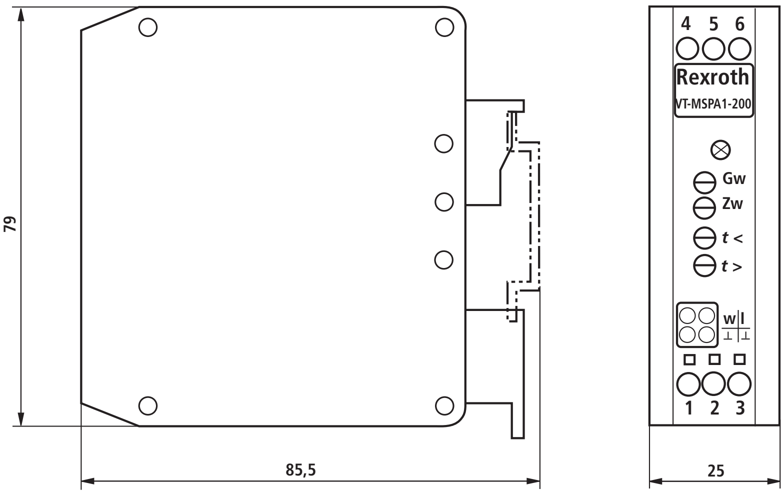


1

Terminal assignment

Terminal	
1	$+U_B$
2	Ground
3	$-U_{command}$
4	Solenoid +
5	Solenoid –
6	$+U_{command}$

Device view/unit dimensions (dimensions in mm)



Potentiometer:	"Gw"	Pressure command value
	"Zw"	Zero point
	"t <"	Ramp time up
	"t >"	Ramp time down
Sockets:	"w"	Pressure command value
	"I"	Actual current value
	"⊥"	Measurement null

Important notes

Explosion hazard caused by incorrect assembly!

For achieving the prescribed safety when operating the valve in the explosive area, it has to be ensure that the solenoid current does not exceed 1 A. For monitoring and limiting the valve current, we recommend using the Rexroth monitoring module VT-MUXA2-2. In this connection, observe data sheet 30290.

The VT-MSPA1-200 amplifier module and the VT-MUXA2-2 monitoring module may only be installed outside the explosive area!

The VT-MSPA1-200 amplifier module and the VT-MUXA2-2 monitoring module are not subject to the directive 94/9/EC (ATEX directive)!

More information:

- The amplifier module may only be wired when de-energized!
- Do not lay signal lines close to power cables and lines!
- Do not use free-wheeling diodes in the solenoid lines!
- The distance to aerial lines, radios, and radar systems has to be 1 m at least!
- Always shield command value lines, connect shielding to protective earthing (PE) on the module side!
  • Also shield the solenoid lines!
  • For solenoid lines up to 50 m in length, use the line type LiYCY 1.5 mm^2!
  • With greater lengths please consult us!
  • In applications in connection with the VT-MUXA2-2 monitoring module, please observe the wiring specified in the block diagram of data sheet 30290.
- For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents)!
- Only carry out measurements at the module using instruments with R_i > 100 kΩ.
- For setting the potentiometers, use a screwdriver with a blade width of 4 mm!
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of at least 2200 µF.
  Recommendation: Capacitor module VT 11110 (see data sheet 30750), sufficient for up to 3 amplifier modules

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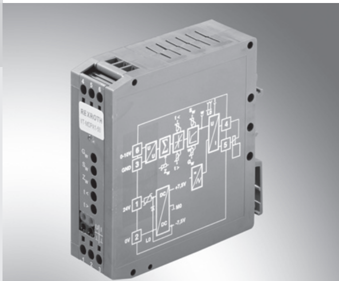
Analogue amplifier module

RE 30225/02.07
Replaces: 01.04

Type VT-MSPA1-50

Component Series 1X



HAD6785_d

Table of contents

Suitable power supply unit:
– Type VT-NE30-2X, see RE 29929
compact power supply unit 115/230 VAC → 24 VDC, 108 W

Features

– Suitable for controlling of one proportional solenoid; especially of direct operated proportional directional valves in screw-in cartridge valve technology
– Differential input
– One pulsed output stage
– Ramp generator; ramp times „up" and „down" separately adjustable
– Reverse polarity protection for power supply
– Adjustable maximal current
– Adjustable current step
– Zero point potentiometer
– Measuring sockets for actual value and command value of current
– LED lamp „Ready for operation" (green)

Ordering code

VT–MSPA1–50–1X/V0/ *

Analogue amplifier in modular design for controlling of one proportional solenoid

for proportional solenoids with one solenoid for 2.5 A

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

Further details in clear text

Basic version

Functional description

General

The amplifier module is to be snapped onto top hat rail according to EN 60715. The electrical connection is by means of screw terminals. The module is operated using 24 VDC.

The internal power supply unit provides all internally required positive and negative supply voltages. As soon as the power supply unit is in operation, the green LED („Ready for operation“) lights up.

Command value preselection

The internal command value signal is generated by the sum [3] of the external command value signal applied to differential input [2] and the zero point offset (zero point potentiometer „Zw”).

Ramp generator [4]

The ramp generator limits the gradient of the control variable. Due to the characteristic curve generator connected downstream, the ramp time is not extended or shortened. The ramp time can be set separately for “up” and “down” ramps with the help of potentiometers (“t <“ and “t >“).

Characteristic curve generator [5]

The adjustable characteristic curve generator can be used to adjust the step-change height and maximum values to the hydraulic requirements.

Clock-pulse generator [6]

The clock pulse generator generates the clock frequency and feeds it to the output stage.

Current output stage [7]

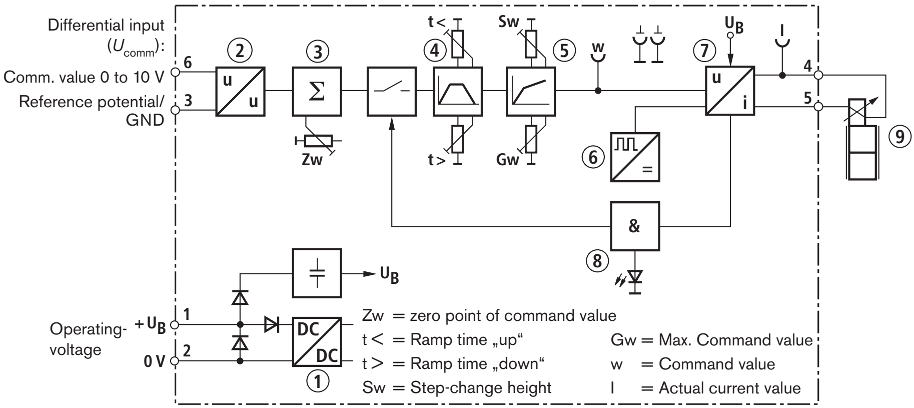
The current output stage generates the pulsed solenoid current for the proportional valve. The solenoid current is 2.5 A. The output stage output is short-circuit-proof.

Fault detection [8]

The solenoid cables are monitored for cable break and short-circuit and the output stage for overcurrent. In the case of an error, the green LED flashes.

[ ] = Cross-reference to the block circuit diagram

Block circuit diagram / Pin assignment



1	Power supply unit	**4**	Ramp generator	**7**	Current output stage
2	Differential amplifier	**5**	Characteristics curve generator	**8**	Command detection
3	Command value summator	**6**	Clock-pulse generator	**9**	Proportional valve

Terminal assignment

Operating-voltage	$+U_B$	1	4		Proportional solenoid
	0 V	2	5		
	Reference potential	3	6	$\pm U_{comm}$	

Terminals 3 and 6: Differential input

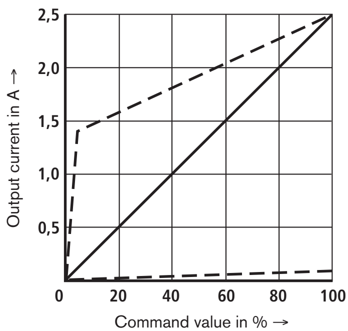
Technical Data (For applications outside these parameters, please consult us!)

Operating voltage	U_B	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V
– Lower limit value	$u_B(t)_{min}$	21 V
Current consumption (at U_B= 24 V)	I_{max}	2 A
Power consumption	P_S	max. 50 VA
Fuse		Electronic overload protection of the output stage
Inputs:		
– Command value (differential input)	U_{Comm}	0 to +10 V; R_e approx. 100 kΩ
Adjustment ranges:		
– Zero point of command value (potentiometer „Zw“)		±10 %
– Max. command value (potentiometer „Gw“)		0 to 110 %
– Ramp times (potentiometer „t <“ and „t >“)		approx. 50 ms to ca. 5 s
– Step-change height (potentiometer „Sw“)		0 to 50 %
Outputs:		
– Current output stage		
• Solenoid current / resistance	I_{max}	2.5 A; $R_{(20)}$ = 2 Ω
• Clock-pulse frequency	f	360 Hz ±15%
– Measuring socket		
• Command value „w“	U	0 to 10 V
• Actual current value „I“	U	0 to 2.5 V (mV $\triangleq$ mA)
Type of connection		6 threaded terminals
Type of mounting		Top hat rail TH 35 – 7.5 to EN 60715
Insulation		IP 20 to EN 60529
Dimensions (W x H x D)		25 x 79 x 85.5 mm
Permissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight	m	0.13 kg

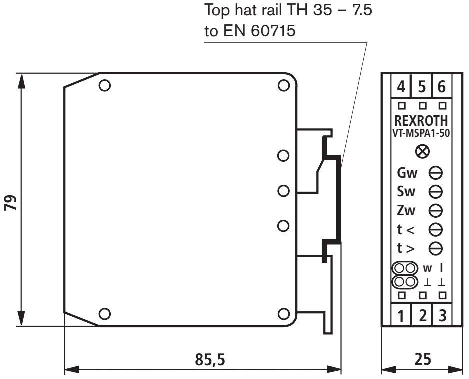
Note!

For details on environment simulation tests in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30225-U (declaration on environmental compatibility).

Output curve



Unit dimensions (in mm)



Potentiometer:

Gw Max. command value

Sw Step-change height of internal command value

Zw Zero point of command value

t < Ramp time for increasing command values

t > Ramp time for decreasing command values

Measuring socket:

w Command value

I Actual current value

⊥ Reference potential

Engineering notes / Maintenance notes / Supplementary information

- The amplifier module may only be wired when disconnected from the power supply!
- The distance to radio sources must be adequate (>> 1 m)!
- Shield command value cables, do not lay in the vicinity of power cables!
- Do not connect freewheel diodes in the solenoid lines!
- In the case of heavy fluctuations in the operating voltage, it may become necessary to install an external smoothing capacitor having a capacitance of at least 2200 µF.
  Recommendation: Capacitor module type VT 11073 (see RE 29750); sufficient for up to 3 amplifier modules
- For solenoid cables up to 50 m long, use cable type LiYCY 1.5 mm^2. In the case of greater lengths, please consult us!
- The inputs of the differential amplifier must always be switched on or off simultaneously!
- Use relays with gold-plated contacts for passing on command values (small voltages, small currents)!
- Use only instruments $R_i > 100$ kΩ for taking measurements on the module!
- For adjusting the potentiometers, use a screw driver with a blade width of 2.5 mm to 3.5 mm!
- Adjustment of step-change heights:
  1. Turn potentiometer “Sw“ to the left-hand limit stop
  2. Preselect a command value of 0.5 V using zero point potentiometer “Zw” (measuring socket “w“)
  3. Set the required step-change height using potentiometer ”Sw”; check the value in measuring socket “w”
  4. Apply 0 V to the differential input
  5. Set 0 V in measuring socket “w” using the “Zw” potentiometer (zero point balancing)

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Rexroth
Bosch Group

Analog amplifier module

RE 30228/04.11 1/8
Replaces: 07.04

Type VT-MSPA2-1

Component series 1X

H 7282

Table of contents

Features

– Suitable for controlling direct operated proportional directional valves without electric position feedback (type 4WRA, size 6 and 10, component series 2X)
– Command value input ±10 V (differential input)
– Ramp generation with separately adjustable ramp time "up/down"
– Characteristic curve correction by means of separately adjustable step heights and separately adjustable maximum values
– Release input
– Reverse polarity protection for the voltage supply
– Power supply with DC/DC converter without raised zero point
– LED displays: • Ready for operation (green)
• Release (yellow)
– Mode selector switch "S"

Ordering code

VT-MSPA2 – 1 – 1X / V0 / 0 | *

Analog amplifier in modular design	
For controlling the valves 4WRA6 (component series 2X) and 4WRA10 (component series 2X)	**= 1**
Component series 10 to 19 (10 to 19: Identical technical data and ports)	**= 1X**
V0 =	Basic version
0 =	Basic version
*	Further details in the plain text

Functional description

General

The amplifier modules are snapped onto top hat rails. The electrical connection is established via screw terminals. The modules are operated with 24 V direct voltage.

Power supply unit [1]

The amplifier modules have a power supply unit with switch-on current limitation. This unit supplies all internally required positive and negative supply voltages. The switch-on current limitation prevents high switch-on current peaks.

Command value provision

The internal command value signal is calculated from the total [3] of the external command value signal available at the differential input [2] and the zero point offset (zero point potentiometer "Zw").

A positive command value results in a current increase in the solenoid "b" and thus a flow in the valve from P to A and from B to T.

A negative command value results in a current increase in the solenoid "a" and thus a flow in the valve from P to B and from A to T.

Release function [11]

The release function enables the power output stage and forwards the internal command value signal to the ramp generator. The release signal is displayed by an LED on the front plate. If the release 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.

Ramp generator [4]

The ramp generator limits the rise of the actuating variable. The downstream step functions and amplitude attenuators do not extend or shorten the ramp time.

Notes for setting and measuring the ramp time:

Value at measuring socket "t <" or "t >"	U_t in V	5	3	2
Current ramp time (±20 %)	t in ms	20	33	50

U_t in V	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
t in ms	100	200	333	500	1000	2000	3333	5000

The following applies: $t = \dfrac{100\text{ V ms}}{U_t}$

Example: Measured $U_t = 5\text{ V}$

Results in $t = \dfrac{100\text{ V ms}}{5\text{ V}} = 20\text{ ms}$

Characteristic curve generator [5]

Using the adjustable characteristic curve generator, step height and maximum values for positive and negative signals can be set separately, adjusted to the hydraulic requirements. The actual development of the characteristic curve through the zero point is not stepped but linear.

Amplitude limiter [6]

The internal command value is limited to ca. ±110 % of the nominal range.

Current controller [7]

Power output stage [8]

The power output stage 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.

Clock generator [9]

The clock generator creates the clock frequency "f" of the output stages. Using the mode selector switch, three basic frequencies can be set:

S = 1: f = 150 Hz … 400 Hz adjustable

S = 2: f = 380 Hz … 180 Hz ±15 % (WRA 10)

S = 3: f = 350 Hz … 240 Hz ±15 % (WRA 6)

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

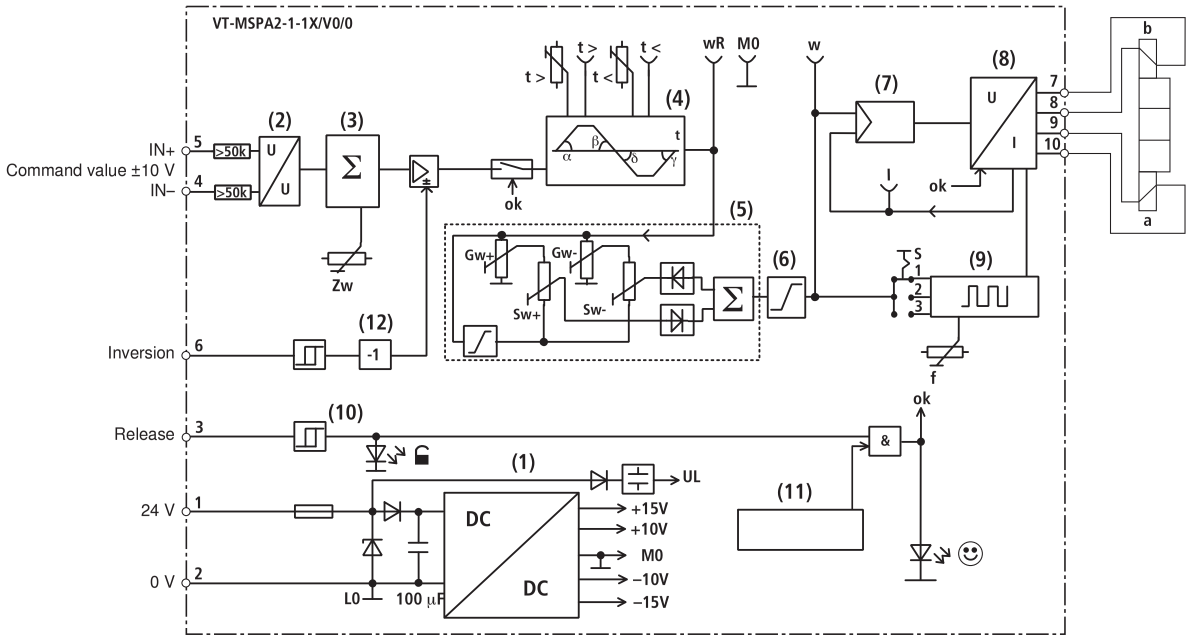
Fault detection [11]

The solenoid line is monitored for cable break as well as overcurrent of the output stage.

Command value inversion [12]

The command value created internally from the input signal and the zero point offset signal can be inverted by an external signal.

Block diagram



Zw	Zero point command value	**w**	Command value	**2**	Differential amplifier	**8**	Power output stage
t<	Ramp time "up"	**wR**	Command value after ramp	**3**	Command value summing device	**9**	Clock generator
t<	Ramp time "down"	☺	Ready for operation	**4**	Ramp generator	**10**	Release function
Sw	Step height	🔓	Release	**5**	Characteristic curve generator	**11**	Fault recognition
Gw	Amplitude attenuator	**1**	Power supply	**6**	Amplitude limiter	**12**	Inversion
				7	Current controller		

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

Operating voltage	U_B	24 VDC +40 % –20 %
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V
– Lower limit value	$u_B(t)_{min}$	18 V
Power consumption	S	< 48 VA
Current consumption	I	< 2 A
Fuse		Thermal overload protection (with restart if the value falls below the temperature threshold)
Inputs:		
– Analog		
• Command value (differential input)	U_e	0 to ±10 V; R_e > 50 kΩ (current input on request)
– Digital		
• Release ON	U	8.5 V to U_B; R_e > 100 kΩ
OFF	U	0 to 6.5 V; R_e > 100 kΩ
• Inversion ON	U	8.5 V to U_B; R_e > 100 kΩ
OFF	U	0 to 6.5 V; R_e > 100 kΩ
Setting ranges:		
– Clock frequency "f"	S = 1	150 Hz … 400 Hz adjustable
	S = 2	380 Hz … 180 Hz ±15 % (WRA 10)
	S = 3	350 Hz … 240 Hz ±15 % (WRA 6)
– Zero point command value (potentiometer "Zw")		±30 %
– Ramp times (potentiometer "t <" and "t >")		20 ms to 5 s
– Step heights (potentiometer "Sw+" and "Sw–")		0 to 50 %
– Amplitude attenuator (potentiometer "G+" and "G–")		0 to 110 % (applies to the step height setting of 0 %)
Outputs:		
– Power output stages	I	0 to 2.5 A; short-circuit-proof; clocked
– Measuring sockets		
• Ramp time "t <"	U	20 mV to 5 V
• Ramp time "t >"	U	20 mV to 5 V
• Actual value "I"	U	0 to ±2.5 V (mV ≙ mA)
• Command value "w"	U	0 to ±10 V
• Command value after ramp "wR"	U	0 to ±10 V
Type of connection		12 screw terminals
Mounting type		Top hat rail TH 35-7.5 according to EN 60715
Protection class according to EN 60529		IP 20
Dimensions (W x H x D)		40 x 79 x 85.5 mm
Admissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–25 °C to +70 °C
Weight	m	0.14 kg

Important:

For information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30228-U.

Terminal assignment

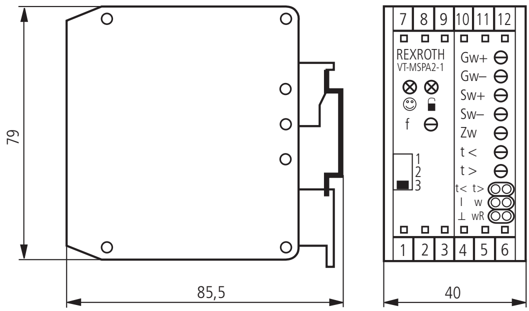
Operating voltage	$+U_B$	1	7	Solenoid "b"
	0 V	2	8	
Release	U_F	3	9	Solenoid "a"
Differential input	–IN	4	10	
	+IN	5	11	n.c.
Inversion	INV	6	12	n.c.

Unit dimensions (dimensions in mm)

LED displays:

Ready for operation (green)

Release (yellow)



Potentiometer:

Gw+ Amplitude attenuator for positive command values

Gw– Amplitude attenuator for negative command values

Sw+ Step height for positive direction

Sw– Step height for negative direction

Zw Zero point command value

t < Ramp time for increasing command values

t > Ramp time for decreasing command values

f Frequency setting

Measuring sockets:

t < Ramp time "up"

t > Ramp time "down"

I Actual current value

w Command value

wR Command value after ramp

⊥ Measurement null

Mode selector switch

1: General use with $I_{\mathbf{max}}$ = 2.5 A; f = 150 Hz … 400 Hz
2: Frequency optimized for WRA 10
3: Frequency optimized for WRA 6

Project planning / maintenance instructions / additional information

- The amplifier module may only be wired when de-energized!
- Do not lay lines close to power cables!
- Do not use free-wheeling diodes in the solenoid lines!
- The distance to aerial lines, radios, and radar systems has to be 1 m at least!
- Always shield command value lines; connect shielding to protective earthing (PE) on the module side!
  Recommendation: Also shield solenoid lines!
  For solenoid lines up to a length of 50 m, use the cable type LiYCY 1.5 mm^2!
  With greater lengths please contact us!
- For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents)!
- Only carry out measurements at the module using instruments with Ri > 100 kΩ.
- For setting the potentiometers, use a screwdriver with a blade width of 4 mm!
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of at least 2200 μF.
  Recommendation: Capacitor module VT 11110 (see data sheet 30750); sufficient for up to 3 amplifier modules
- In the condition as supplied, the setting of the clock frequency corresponds to the requirements of the WRA 6 and WRA 10 valves. Rotating the "f" potentiometer changes the valve hysteresis and may lead to disturbing noise developments.

Setting recommendation

The system-specific wiring must have been completed.

Signal	Setting
Command value zero point	– Set the external command value specification to zero – Set the internal command value to zero using the "Zw" potentiometer and carry out a check at the "wR" measurement socket
Ramp times	– Set ramp time according to formula or table (see functional description "Ramp generator) and check it at the "t >" and "t <" measurement sockets
Step height	– Apply the release signal – Using the "Zw" zero point potentiometer, set the measurement signal at "wR" to +0.3 V – Using the "Sw+" potentiometer, set the necessary positive step height – Using the "Zw" zero point potentiometer, set the measurement signal at "wR" to –0,3 V – Using the "Sw–" potentiometer, set the necessary negative step height – Set the zero point Note: With an external command value provision, it must at least result in +0.3 V / –0.3 V at the "wR" measuring socket.
Maximum values	Important: Before adjusting the maximum values, zero point and step heights must be set correctly. The maximum current must not exceed the nominal solenoid current! – Set the step heights first; create the command value ±100 % externally – Using the "Gw+"/"Gw–" potentiometers, set the required maximum actuating variable and carry out a check at the "wR" and "w" measurement sockets
Clock frequency:	Condition as supplied: S = 1: *f* = 170 Hz S = 2 and "w" = 0: f = 380 Hz S = 3 and "w" = 0: f = 350 Hz

Note: The new setting of the frequency can be carried out with a digital multimeter that is able to measure frequencies. Measure at solenoid terminals 7 against 2 and/or 9 against 2.

Notes

Notes

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Amplifier module for controlling [1)] the explosion-proof proportional directional valves 4WRA...XE, 3DREP 6...XE and 4WRZ...XE

RE 30228-200/03.11 1/8
Replaces: 07.05

Type VT-MSPA2-200

Component series 1X

H 7282

Table of contents

Content	Page

Features

- Amplifier module is not subject to the directive 94/9/EC (ATEX directive)
- In connection with the Rexroth monitoring module [1)] VT-MUXA2-2 suitable for controlling proportional directional valves without electric position feedback, types 4WRA...XE, 3DREP 6...XE and 4WRZ...XE
- Command value input ±10 V (differential input)
- Ramp generation with separately adjustable ramp time "up/down"
- Characteristic curve correction by means of separately adjustable step heights
- Release input
- Reverse polarity protection for the voltage supply
- Power supply with DC/DC converter without raised zero point for the internal supply
- LED displays: • Ready for operation (green)
  • Release (yellow)

[1)] **For the operation of the valve in the explosive area, additional safety measures are required. Here, we recommend using the Rexroth monitoring module VT-MUXA2-2. In this connection, observe data sheet 30290.**

Ordering code

VT-MSPA2 – 200 – 1X / V0 / 0 | *

Analog amplifier in modular design

For controlling the explosion-protected valves
4WRA...XE (component series 2X),
3DREP 6...XE (component series 2X)
and 4WRZ...XE (component series 7X) **= 200**

Component series 10 to 19 **= 1X**
(10 to 19: Identical technical data and ports)

V0 = Basic version

0 = Basic version

Further details in the plain text

Functional description

General

The amplifier modules are snapped onto top hat rails according to EN 60715. The electrical connection is established via screw terminals. The modules are operated with 24 V direct voltage.

( ) = Assignment to the block diagram on page 3

Power supply unit (1)

The amplifier modules have a power supply unit with switch-on current limitation. This unit supplies all internally required positive and negative supply voltages. The switch-on current limitation prevents high switch-on current peaks.

Command value provision

The internal command value signal is generated from the external command value signal available at the differential input (2).

A positive command value results in a current increase in the "b" solenoid and thus a flow in the valve from P → A and from B → T.

A negative command value results in a current increase in the "a" solenoid and thus a flow in the valve from P → B and from A → T.

Release function (10)

The release function enables the power output stage and forwards the internal command value signal to the ramp generator. The release signal is displayed by an LED on the front plate. If the release 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.

Ramp generator (3)

The ramp generator limits the rise of the actuating variable. The downstream step functions do not extend or shorten the ramp time.

Notes for setting and measuring the ramp time:

Value at measuring socket "t <" or "t >"	U_t in V	5	3	2
current ramp time (±20 %)	t in ms	20	33	50

U_t in V	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
t in ms	100	200	333	500	1000	2000	3333	5000

The following applies: $t = \dfrac{100\ \text{Vms}}{U_t}$

Example: Measured $U_t = 5\ \text{V}$

Results in $t = \dfrac{100\ \text{Vms}}{5\ \text{V}} = 20\ \text{ms}$

Characteristic curve generator (4)

Using the adjustable characteristic curve generator, the step height for positive and negative signals can be set separately, adjusted to the hydraulic requirements. The actual development of the characteristic curve through the zero point is not stepped but linear. (Characteristic curve see page 5)

Amplitude limiter (5)

The command value is limited to ca. ±110 % of the nominal range.

Current controller (6)

The current is controlled according to the command value.

Power output stage (7)

The power output stage creates the clocked solenoid current for the proportional valve. The rated solenoid current is 1000 mA 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.

Clock generator (8)

The clock generator creates the clock frequency *f* of the output stages.

f = 150 Hz … 400 Hz, adjustable by means of the potentiometer "f" (preset to 240 Hz)

Fault detection (10)

The solenoid line is monitored for cable break as well as overcurrent of the output stage.

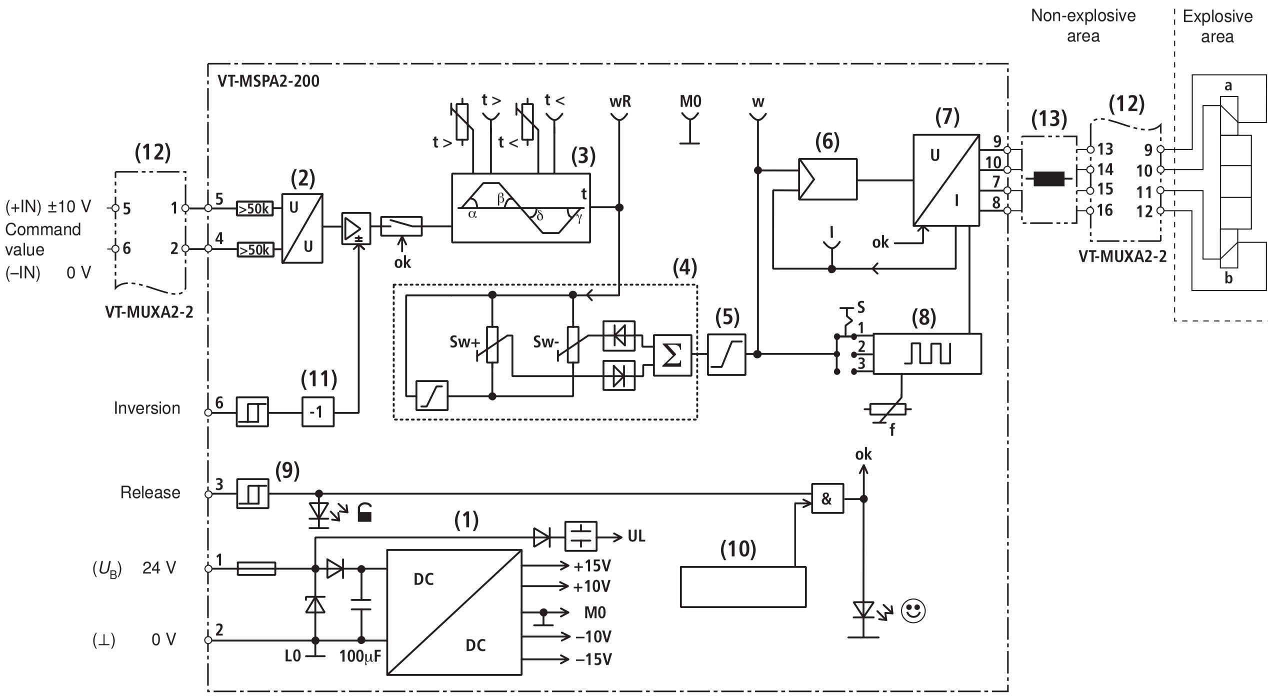
Command value inversion (11)

The command value created internally from the input signal and the zero point offset signal can be inverted by an external signal.

Monitoring and limitation of the solenoid current (12)

The VT MUXA2-2 module provides for the monitoring and limitation of the solenoid current. The functioning is described in data sheet 30290.

Block diagram



t >	Ramp time "down"	☺	Ready for operation	(1)	Power supply	(9)	Release function
t <	Ramp time "up"	🔓	Release	(2)	Differential amplifier	(10)	Fault recognition
Sw	Step height			(3)	Ramp generator	(11)	Inversion
w	Command value			(4)	Characteristic curve generator	(12)	Monitoring module VT-MUXA2-2 (order separately)
wR	Command value after ramp			(5)	Amplitude limiter	(13)	Two ferrite sleeves (only included in the delivery of the monitoring module)
				(6)	Current controller		
				(7)	Power output stage		
				(8)	Clock generator		

1

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

Operating voltage	Nominal value		U_B	24 VDC
	Maximum value		$u_B(t)_{max}$	35 V
	Minimum value		$u_B(t)_{min}$	18 V
Power consumption			P	< 24 VA
Current consumption			I	< 1 A
Fuse				Thermal overload protection (with restart if the value falls below the temperature threshold)
Inputs				
Analog	Command value (differential input)		U_e	0 … ±10 V; R_e > 50 kΩ
Digital	Release	ON	U	8.5 V … U_B; R_e > 100 kΩ
		OFF	U	0 … 6.5 V; R_e > 100 kΩ
	Inversion	ON	U	8.5 V … U_B; R_e > 100 kΩ
		OFF	U	0 … 6.5 V; R_e > 100 kΩ
Setting ranges				
Clock frequency			f	150 Hz … 400 Hz, adjustable, preset to 240 Hz
Ramp times (potentiometer "t <" and "t >")			t <, t >	20 ms…5 s
Step heights (potentiometer "Sw+" and "Sw–")				0 % … 50 %
Outputs				
Power output stages			I	0 … 1000 mA, short-circuit-proof; clocked
Measuring sockets	Ramp time "t <"		U	20 mV…5 V
	Ramp time "t >"		U	20 mV…5 V
	Actual value "I"		U	0 … ±1000 mV (measured value in mV ≙ solenoid current in mA)
	Command value "w"		U	0 … ±10 V
	Command value after ramp "wR"		U	0 … ±10 V
Type of connection				Screw terminals
Connection cross-section			A	0.5 … 2.5 mm^2
Mounting type				Top hat rail TH 35-7.5 according to EN 60715
Protection class				IP 20 according to EN 60529
Dimensions (W x H x D)				See unit dimensions
Admissible operating temperature range			ϑ	0 … +50 °C
Storage temperature range			ϑ	–25 °C … +70 °C
Weight			m	0.14 kg

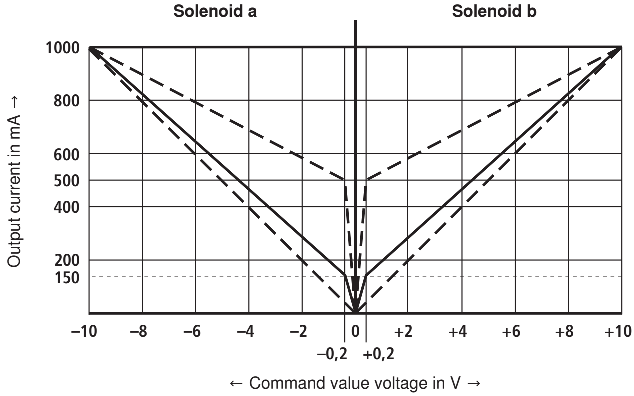
Note!

For information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30228-U.

1

Characteristic curves

Dependency of the output current from the command value voltage

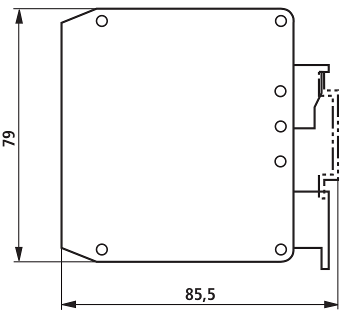


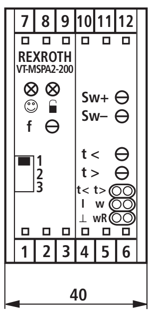
Setting range of the step height of the output current: 0 … 500 mA
Pre-setting ex works: 150 mA

Terminal assignment

Operating voltage	$+U_B$	1	7	Solenoid "b"
	0 V	2	8	
Release	U_F	3	9	Solenoid "a"
Command value input	0 V (–IN)	4	10	
	±10 V (+IN)	5	11	n.c.
	Inversion	6	12	n.c.

Device view / unit dimensions (dimensions in mm)





LED displays:

☺ Ready for operation (green)

Release (yellow)

Potentiometer:

Sw+ Step height for positive direction

Sw– Step height for negative direction

t < Ramp time for increasing command values

t > Ramp time for decreasing command values

f Frequency setting, 240 Hz pre-set, 150 Hz …400 Hz adjustable

Mode selector switch: without function

Measuring sockets:

t < Ramp time "up"

t > Ramp time "down"

I Actual current value

w Command value

wR Command value after ramp

⊥ Measurement null

1

Important notes / setting information

Explosion hazard caused by incorrect assembly!

For achieving the prescribed safety when operating the one of the specified valves in the explosive area, it has to be ensure that the solenoid current does not exceed 1 A. For monitoring and limiting the valve current, we recommend using the Rexroth monitoring module VT-MUXA2-2. In this connection, observe data sheet 30290.
The VT-MSPA2-200 amplifier module and the VT-MUXA2-2 monitoring module may only be installed outside the explosive area!

The VT-MSPA2-200 amplifier module and the VT-MUXA2-2 monitoring module are not subject to the directive 94/9/EC (ATEX directive)!

More information:

- The amplifier module may only be wired when de-energized!
- Do not lay signal lines close to power cables and lines!
- Do not use free-wheeling diodes in the solenoid lines!
- The distance to aerial lines, radios, and radar systems has to be 1 m at least!
- Always shield command value lines, connect shielding to protective earthing (PE) on the module side!
  • Also shield the solenoid lines!
  • For solenoid lines up to 50 m in length, use the line type LiYCY 1.5 mm^2!
  • With greater lengths please consult us!
  • In applications in connection with the VT-MUXA2-2 monitoring module, please observe the wiring specified in the block diagram of data sheet 30290.
- For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents)!
- Only carry out measurements at the module using instruments with R_i > 100 kΩ.
- For setting the potentiometers, use a screwdriver with a blade width of 4 mm!
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of at least 2200 µF.
  Recommendation: Capacitor module VT 11110 (see data sheet 30750), sufficient for up to 3 amplifier modules
- In connection with the VT-MUXA2-2 monitoring module, the operating voltage has to be fed in via a capacitor module.
  The solenoid current connections to the VT-MUXA2-2 monitoring module must be led via ferrite sleeves. The ferrite sleeves are included in the scope of delivery of the VT-MUXA2-2 monitoring module.
- In the condition as supplied, the clock frequency is set to 240 Hz. Rotating the "f" potentiometer changes the valve hysteresis and may lead to disturbing noise developments.

Setting information

Prerequisite: The system-specific wiring must have been completed.

Signal	Setting
Ramp times:	– Set ramp time according to formula or table (see functional description "Ramp generator) and check it at the measuring sockets "t >" or "t <"
Step height:	– Apply the release signal – with an external command value provision of +0.3 V, set the measuring signal at "wR" to +0.3 V – using the "Sw+" potentiometer, set the necessary positive step height – with an external command value provision of –0,3 V, set the measuring signal at "wR" to –0,3 V – using the "Sw–" potentiometer, set the necessary negative step height Note: With an external command value provision, it must at least result in +0.3 V / –0.3 V at the "wR" measuring socket.
Clock frequency:	Condition as supplied: f = 240 Hz **Note:** The new setting of the frequency can be carried out with a digital multimeter that is able to measure frequencies. Measure at connection terminals 7 or 9 against 2 (ground).

Notes

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Rexroth
Bosch Group

Analog amplifier modules

RE 29865/12.12
Replaces: 10.12

Types VT 11131 and VT 11132

Series 1X


H3786

Table of contents

Contents	Page

Features

– Suitable for controlling proportional pressure control valves without electrical position feedback
– Differential input
– One clocked output stage
– Function generator
– Ramp generator with adjustable ramp time (up and down ramp can be adjusted separately)
– Adjustable current regulator
– Reverse voltage protection for voltage supply
– Indication of solenoid energisation by LED (brightness of LED proportional to solenoid current)

Ordering code

VT 1113_ – 1X / *

Amplifier modules for controlling proportional pressure control valves:	
– Types (Z)DBE 6-1X, DBE(M) 10-3X, DBE(M) 10-5X, DBE(M) 20-3X, DBE(M) 20-5X and ZDRE 10-1X	**= 1**
– Type (Z)DRE 6-1X	**= 2**
Series 10 to 19 (10 to 19: unchanged technical data and pin allocation)	**= 1X**
Further details in clear text	*

Functional description

These amplifier modules are suitable for controlling a proportional solenoid. The amplifier modules are to be snapped onto carrier rails according to EN 60715. The electrical connections are made by means of screw terminals. The modules are operated using 24 V DC.

The solenoid current (actual value) is measured and compared with the externally provided command value. Any differences occurring between actual and command value, caused e.g. by changes in the solenoid temperature or operating voltage, are balanced.

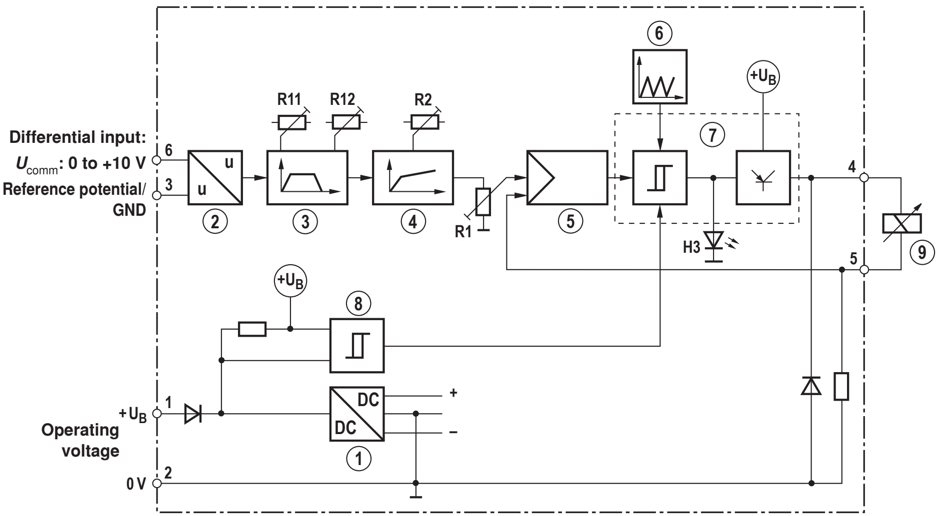
The activation of solenoid control is indicated by LED ”H3“, the brightness of which is proportional to the solenoid current.

The following values can be adjusted from outside by means of assigned trimming potentiometers:

– Ramp time, separately for up and down ramp (by means of R11, R12 → t_{max} approx. 5 s)

– Gradient of the output characteristic curve (by means of R1, R2)

Block circuit diagram / pin assignment



1	Power supply unit	**6**	Clock-pulse generator
2	Differential amplifier	**7**	Output stage
3	Ramp generator	**8**	Switching stage
4	Function generator	**9**	Proportional solenoid
5	Current regulator		

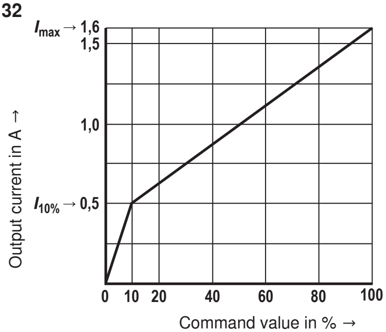
Technical data (for applications outside these parameters, please consult us!)

Operating voltage	U_O	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V
– Lower limit value	$u_B(t)_{min}$	21 V
Power consumption	$P_{S\ max}$	28 VA
Current consumption	I_{max}	1.3 A
Fuse		Electronic short-circuit protection of the solenoid
Inputs:		
– Command value (differential input)	U_{comm}	0 to +10 V; R_i approx. 10 kΩ
Adjustment ranges:		
– Output current	I	$I_{10\%}$ to I_{max}
– Ramp time	t	approx. 50 ms to approx. 5 s
Outputs:		
– Solenoid current / resistance		
• with VT 11131	I_{max}	1.6 A; $R_{(20)}$ = 5.4 Ω
• with VT 11132	I_{max}	1.6 A; $R_{(20)}$ = 5.4 Ω
– Clock-pulse frequency of output stage		
• with VT 11131	f	300 Hz ±15 %
• with VT 11132	f	360 Hz ±15 %
Type of connection		6 screw terminals
Type of mounting		Carrier rail TH 35/7.5 to EN 60715
Type of protection		IP 20 to EN 60529
Dimensions (W x H x D)		25 x 79 x 85.5 mm
Permissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–25 to +85 °C
Weight	m	0.13 kg

Note:
For details regarding **environment simulation tests** in the field of climate, see data sheet 30309-U (declaration on environmental compatibility).

Output characteristic curve

VT 11131 and VT 11132



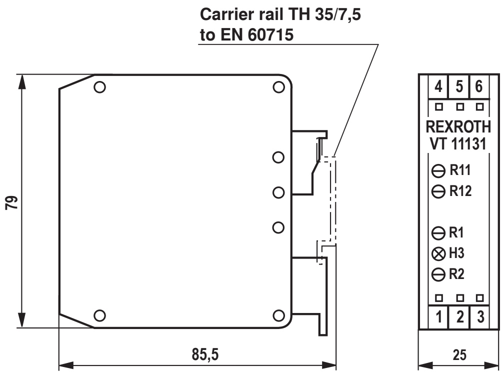
1

Terminal assignment

Operating voltage	$+U_O$	**1**	**4**		Proportional solenoid
	0 V	**2**	**5**		
	Reference potential	**3**	**6**	$+U_{comm}$	

Terminals 3 and 6: Differential input

Unit dimensions (Dimensions in mm)



Adjustment/indication element			set to
Potentiometers:			
R1	→	I_{max}	1,6 A
R2	→	$I_{10\,\%}$	0,5 A
R11	→	Up ramp	min
R12	→	Down ramp	min
LED Lamp:			
H3	→	Solenoid current	

Engineering / maintenance notes / supplementary information

– The amplifier module may only be wired when disconnected from the power supply.
– The distance to radio equipment must be sufficiently large (>> 1 m).
– Command value cables must always be shielded and **not** laid near power cables; shield solenoid cables.
– Do not use free-wheeling diodes in the solenoid cables.
– In the case of heavy fluctuations in the operating voltage, it may become necessary to install an external smoothing capacitor having a capacitance of at least 2200 μF.
Recommendation: Capacitor module type VT 11110 (see data sheet 30750); sufficient for up to 3 amplifier modules.

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Analog amplifier module

RE 30218/04.12 1/6
Replaces: 02.11

Type VT 11118

Component Series 1X

HD20489_d

Table of contents

Contents	**Page**

Note:

When using VT 11118 as substitute for VT 11011, VT 11012, VT 11013, VT 11090 or VT 11114, observe the configuration and adjustment notes given in supplementary information 30218-Z.

Features

- Suitable for controlling direct operated proportional directional valves (type 4WRA, Component Series 1X only), pilot operated proportional directional valves (type .WRZ, from Component Series 5X) and proportional pressure reducing valves (type 3DREP 6) without electrical position feedback
- Selection of the valve type by means of change-over switch at the front
- Differential input for command value voltage ±10 V
- Enable inputs
- Polarity effect of command value voltage can be controlled via enable inputs
- Adjustable ramp generator
- 2 command value attenuators
- 2 output stages with fixed-frequency clocking
- DC/DC converter (L0 = M0)
- Reverse polarity protection for operating voltage
- Short-circuit-proof outputs
- LEDs: “power“ – internal supply voltage (green)
  “H1“ – Enable logic mode 1 (yellow)
  “H2“ – Enable logic mode 2 (yellow)

Ordering code

VT 11118 – 1X / *

Amplifier module for direct operated proportional directional valves (type 4WRA, Component Series 1X only), pilot operated proportional directional valves (type .WRZ, from Component Series 5X) and proportional pressure reducing valves (type 3DREP 6)	VT 11118
Component Series 10 to 19 (10 to 19: unchanged technical data and pin assignment)	**= 6**
Further Details in clear text	*

Functional description

The amplifier module is to be snapped onto top hat rail according to EN 60715. The electrical connection is by means of screw terminals. The module is operated using 24 V DC. A power supply unit [1] provides internally required positive and negative supply voltages. As soon as the power supply unit is in operation, the green LED ("power") lights up.

One of the two solenoids ("a" or "b") of the valve is controlled by applying a command value voltage to the differential input and a positive enable voltage to one of the enable inputs. The solenoid current depends on the amount of the command value (see output characteristic curves) and on the position of the selector switch [13] for the valve type. Which of the two solenoids is controlled depends on the polarity of the command value and the activation of the enable inputs (see function table).

The solenoid current (actual value) is measured and compared with the externally provided command value; any differences caused e.g. by changes in temperature of the solenoid or changes in the supply voltage are corrected. Potentiometers "GW1" and "GW2" are used to set the maximum current of the solenoids and thus the maximum valve opening. Which of the potentiometers is activated by the enable inputs is indicated by the yellow LED. Potentiometer "S" (jump height) can be used to compensate for tolerances of valve overlap. However, care must be taken that the nominal voltage of the solenoids is not exceeded.

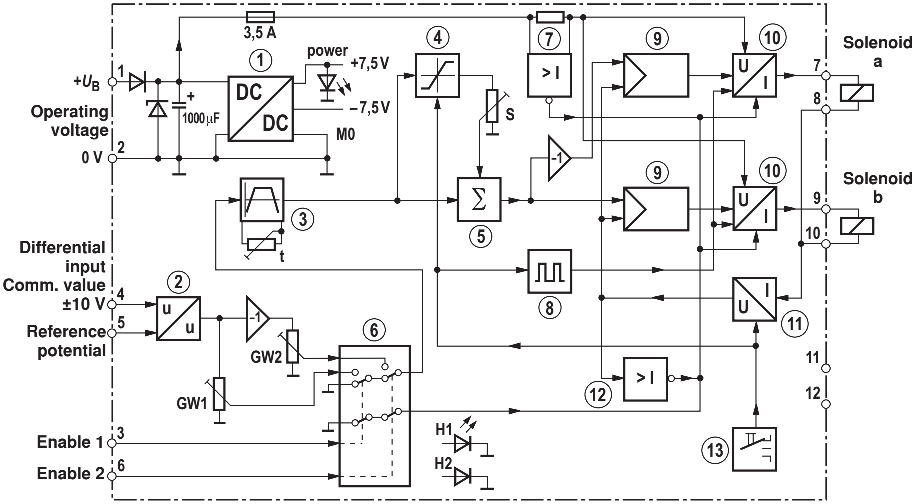
The amplifier module comprises a ramp generator [3]; the associated potentiometer "t" can be used to adjust the rise and fall time of the solenoid current.

The presettings for the valve type to be controlled can be selected at the front of the module.

Function table of enable inputs and solenoid control

Enable inputs		Command value voltage U_{Comm}	Active solenoid	Active LED	Mode
Enable 1, U_{F1} active	Enable 2, U_{F1} active				
Yes	No	> 0 V < 0 V	b a	H1	1
No	Yes	> 0 V < 0 V	a b	H2	2
Yes	Yes	> 0 V < 0 V	a b	H2	2
No	No	> 0 V < 0 V	– –	–	–

Block circuit diagram / Pin assignment



1	Power supply
2	Differential amplifier
3	Ramp generator
4	Step function generator
5	Summator
6	Command value changeover and output stage enable
7	Short-circuit detector
8	Clock-pulse generator
9	Current regulator
10	Output stage
11	Solenoid current measurement
12	Overcurrent detector
13	Valve type selector switch
GW1	Command value attenuator 1
GW2	Command value attenuator 2
t	Ramp time setting
S	Jump height at U_{Comm} = ±10 V
H1	Enable logic mode 1
H2	Enable logic mode 2

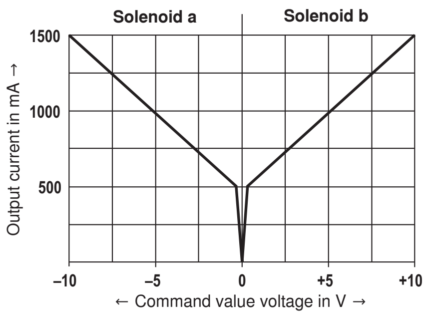
Technical Data (for applications outside these parameters, please consult us!)

Operating voltage	U_O	24 VDC + 40% (– 10%)
Operating range		
Upper limit value	$u_O(t)_{max}$	35 V
Lower limit value		
for 4WRA (Component Series 1X), .WRZ (Component Series 7X), 3DREP 6, (Component Series 2X)	$u_O(t)_{min}$	21 V
for .WRZ (Component Series 5X and 6X) and 3DREP 6 (Component Series 1X)	$u_O(t)_{min}$	24 V
Power consumption	P_S	approx. 30 VA
Current consumption	I	< 1,3 A
Fuse	I_S	3,5 A F (soldered in)
Inputs		
Command value (differential input)	U_{Soll}	0 to ±10 V; R_e > 50 kΩ
Enable		
active	U_{F1}; U_{F2}	10 V < U_F < 35 V; R_i > 3 kΩ
not active	U_{F1}; U_{F2}	< 8 V
Adjustment ranges		
Jump height		0 to approx. 50 % of I_{max}
Ramp time		approx. 50 ms to approx. 5 s
Outputs		
Solenoid current/resistance		
for 4WRA 6 (Component Series 1X)	I_{max}	1,75 A; $R_{(20)}$ = 5,4 Ω
for 4WRA 10 (Component Series 1X)	I_{max}	1,75 A; $R_{(20)}$ = 10 Ω
for .WRZ (Component Series 5X and 6X) and 3DREP 6 (Component Series 1X)	I_{max}	1 A; $R_{(20)}$ = 19,5 Ω
for .WRZ (Component Series 7X) and 3DREP 6 (Component Series 2X)	I_{max}	1,75 A; $R_{(20)}$ = 4,8 Ω
Clock-pulse frequency of the output stage		
for 4WRA 6 (Component Series 1X), .WRZ (Component Series 5X to 7X), 3DREP 6 (Component Series 2X)	f	175 Hz ± 10 %
for 4WRA 10 (Component Series 1X) and 3DREP 6 (Component Series 1X)	f	100 Hz ± 10 %
Type of connection		12 screw terminals
Type of mounting		Top hat rail TH 35-7.5 to EN 60715
Type of protection to EN 60529		IP 20
Dimensions (W x H x D)		40 x 79 x 85,5 mm
Operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	– 25 to +85 °C
Weight	m	0,14 kg

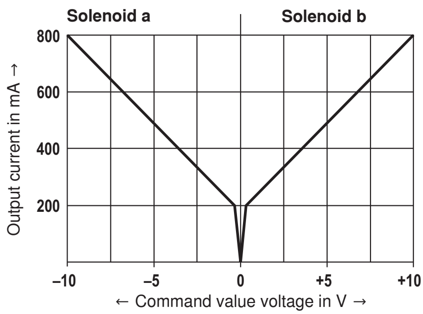
1

Output characteristic curves (valid at enable voltage U_{F1} >10 V)

Switch position 1 for valves
– 4WRA 6 (Component Series 1X),
– .WRZ (Component Series 7X)
– 3DREP 6 (Component Series 2X)
Switch position 2 for valves
– 4WRA10 (Component Series 1X)



Switch position 3 for valves
– .WRZ (Component Series 5X und 6X)
– 3DREP 6 (Component Series 1X)

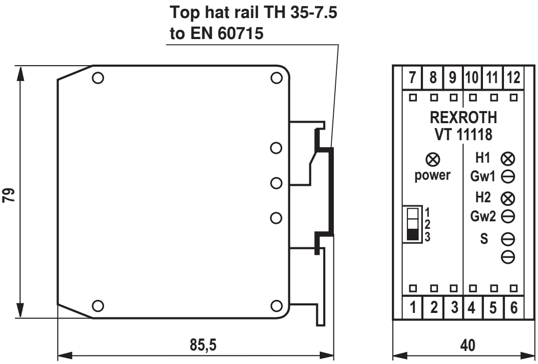


Terminal assignment

Operating voltage	$+U_O$	1	7		Solenoid a
	0 V	2	8		
Enable 1	$+U_{F1}$	3	9		Solenoid b
Differential input	$\pm U_{Comm}$	4	10		
	Reference-potential	5	11	n. c. [1]	
Enable 2	$+U_{F2}$	6	12	n. c. [1]	

[1] These terminals must not be used!

Unit dimensions (Dimensions in mm)



Potentiometer:

Gw1	I_{max} at Mode 1
Gw2	I_{max} at Mode 2
S	jump height
t	ramp time

LED-lamps:

power	operating voltage ON
H1	Enable logic mode 1
H2	Enable logic mode 2

Switch positions:

1	for valves 4WRA6 (Component Series 1X), .WRZ (Component Series 7X) and 3DREP 6 (Component Series 2X)
2	for valves 4WRA10 (Component Series 1X)
3	for valves .WRZ (Component Series 5X and 6X) and 3DREP 6 (Component Series 1X)

Engineering / maintenance notes / supplementary information

- The amplifier module may only be wired when disconnected from the power supply.
- Ensure a sufficient distance to radio sources (>> 1 m).
- Shield solenoid cables, never lay solenoid cables near power cables; shield solenoid cables in pairs.
- Do not use free-wheeling diodes in solenoid cables.
- In the case of heavy fluctuations in the operating voltage, it may be required to use an external smoothing capacitor having a capacitance of at least 2200 μF.
  Recommended: Capacitor module VT 11110 (see data sheet 30750); sufficient for up to 3 amplifier modules

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Rexroth
Bosch Group

Analog amplifier module

RE 30227/02.12
Replaces: 10.08

Type VT-MSRA1-1-1X

Component series 1X

H 7282

(Similar figure)

Table of contents

Contents	Page

Features

– Suitable for controlling direct operated proportional directional valves without electric position feedback (type 4WRPH6...-2X...-855)
– Command value input ±10 V (differential input)
– Characteristic curve correction by means of separately adjustable step levels and separately adjustable maximum values
– Enable input
– Reverse polarity protection for the voltage supply
– Power supply with DC/DC converter without raised zero point
– LED displays:
  • Ready for operation (green)
  • Enable (yellow)
– Ready for operation output

Ordering code

VT-MSRA1 – 1 – 1X / V0 / 0 | *

Analog amplifier in modular design	
For valve type 4WRPH6...-2X...-855	**= 1**
Component series 10 to 19 (10 to 19: unchanged technical data and ports)	**= 1X**
V0 =	Basic version
0 =	Basic version
Further details in the plain text	*****

Functional description

General

The amplifier module is snapped onto top hat rails according to EN 60715. The electrical connection is established via screw terminals. The modules are operated with 24 V direct voltage.

Power supply [1]

The amplifier modules have a power supply unit with making current limiter. This unit supplies all internally required positive and negative supply voltages. The making current limiter prevents high making current peaks.

Command value provision

The internal command value signal is calculated from the total [3] of the external command value signal available at the differential input [2] and the zero point offset (zero point potentiometer "Zw").

Characteristic curve generator [4]

Using the adjustable characteristic curve generator, step level and maximum values for positive and negative signals can be set separately, adjusted to the hydraulic requirements. The actual development of the characteristic curve through the zero point is not stepped but linear.

Amplitude limiter [5]

The internal command value is limited to ca. ±110 % of the nominal range.

Current controller [6]

The solenoid current is recorded, in the current controller compared with the actuating variable and the difference is compensated.

Power output stage [7]

The power output stage 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 enable is missing.

Clock generator [8]

The clock generator creates the clock frequency "f" of the output stages depending on command value and operating voltage.

Enable function [9]

The enable function enables the power output stage and forwards the internal command value signal. The enable signal is displayed by an LED on the front plate.

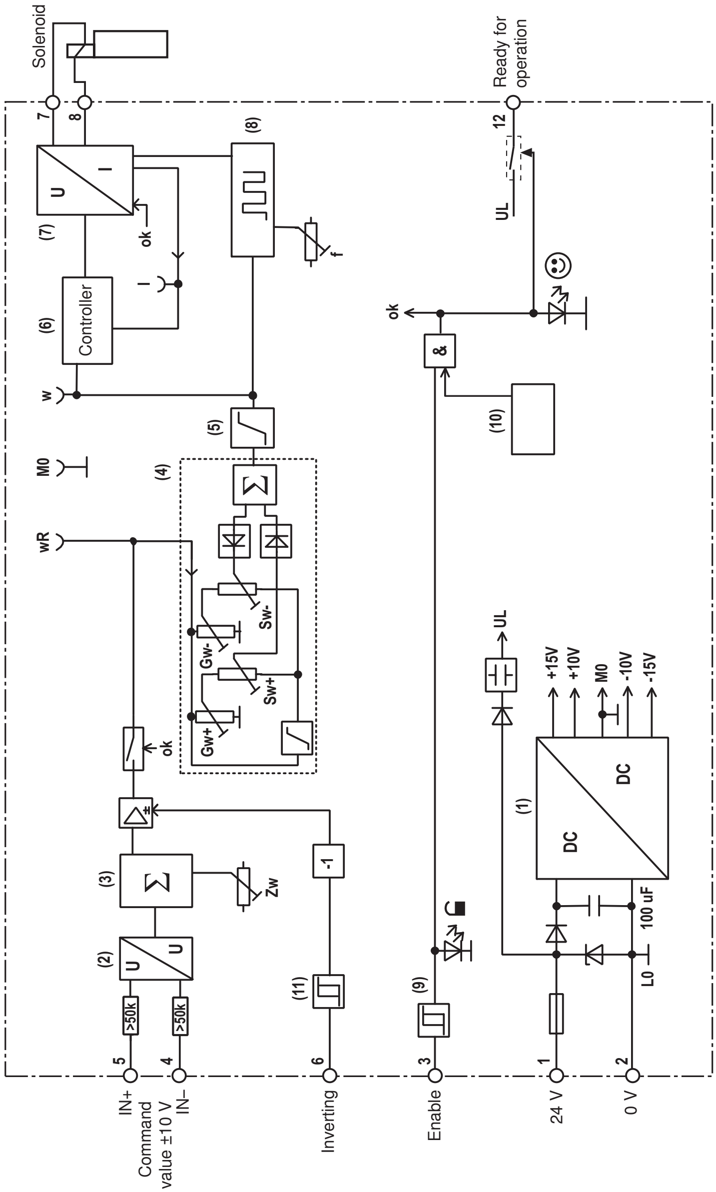
Fault recognition [10]

The solenoid conductor is monitored for cable break as well as over-current of the output stage.

Command value inversion [11]

The command value created internally from the input signal and the zero point offset signal can be inverted by an external signal.

Block diagram



Zw	Zero point command value
Sw	Step level
Gw	Amplitude attenuator
w	Command value
wR	Command value before attenuator
☺	Ready for operation
	Enable
1	Power supply
2	Differential amplifier
3	Command value summing device
4	Characteristic curve generator
5	Amplitude limiter
6	Current controller
7	Power output stage
8	Clock generator
9	Enable function
10	Fault recognition
11	Inverting

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

Operating voltage	U_B	24 VDC +40 % –20 %
Operating range:		
– Upper limit	$u_B(t)_{max}$	35 V
– Lower limit	$u_B(t)_{min}$	18 V
Power consumption	S	< 48 VA
Current consumption	I	< 2 A
Fuse		Thermal overload protection (with restart if the value falls below the temperature threshold)
Inputs:		
– Analog		
• Command value (differential input)	U_e	0 to ±10 V; R_e > 50 kΩ (current input on request)
– Digital		
• Enable ON	U	8.5 V to U_B; R_e > 100 kΩ
OFF	U	0 to 6.5 V; R_e > 100 kΩ
• Inverting ON	U	8.5 V to U_B; R_e > 100 kΩ
OFF	U	0 to 6.5 V; R_e > 100 kΩ
Setting ranges:		
– Clock frequency "f"		170 to 430 Hz (see last notice on page 6)
– Zero point command value (potentiometer "Zw")		±30 %
– Step level (potentiometer "Sw+" and "Sw–")		0 % to 50 %
– Amplitude attenuator (potentiometer "G+" and "G–")		0 % to 110 % (applies to the step level setting of 0 %)
Outputs:		
– Power output stages	I	0 to 2.7 A; short-circuit-proof; clocked
– Ready for operation (on request)	U	> 16 V, 50 mA (in case of fault U < 1 V, R_i = 10 kΩ)
– Measurement sockets		
• Actual value "I"	U	0 to ±2.5 V (mV ≙ mA)
• Command value "w"	U	0 to ±10 V
Type of connection		12 screw terminals
Type of mounting		Top hat rail TH 35-7.5 according to EN 60715
Protection class according to EN 60529		IP 20
Dimensions (W x H x D)		45 x 79 x 85.5 mm
Admissible operating temperature range	ϑ	0 to +60 °C
Storage temperature range	ϑ	–25 °C to +70 °C
Weight	m	0.14 kg

Terminal assignment

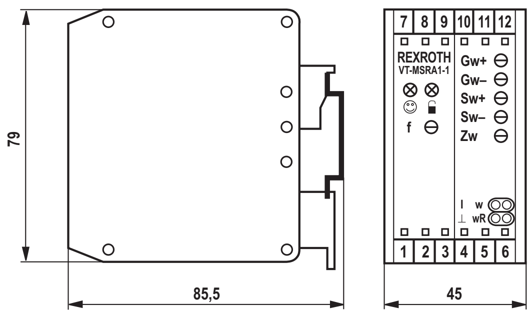
Operating voltage	$+U_B$	1	7	Solenoid
	0 V	2	8	
Enable	U_F	3	9	n. c.
Differential input	Reference potential	4	10	
	$\pm U_{Command}$	5	11	n. c.
	Inverting	6	12	Ready for operation

Unit dimensions (dimensions in mm)

LED displays:

Ready for operation (green)

Enable (yellow)



Potentiometer:

Gw+ Amplitude attenuator for positive command values

Gw– Amplitude attenuator for negative command values

Sw+ Step level for positive direction

Sw– Step level for negative direction

Zw Zero point command value

f Frequency setting

Measurement sockets:

I Actual current value

w Command value

wR Command value before attenuator

⊥ Measurement zero

Project planning / maintenance instructions / additional information

- The amplifier module may only be wired in de-energized condition.
- Do not lay lines close to power cables.
- Do not use free-wheeling diodes in the solenoid lines.
- The distance to aerial lines, radios, and radar systems has to be 1 m at least.
- Always shield command value lines; connect shield to protective earth (PE) on the module side.
  Recommendation: Also shield the solenoid lines.
  For solenoid lines up to a length of 50 m, use the cable type LiYCY 1.5 mm^2.
  With greater lengths, please contact us.
- For switching command values, relays with gold contacts have to be used (low voltages, low currents).
- Only carry out measurements at the module using instruments with R_i > 100 kΩ.
- For setting the potentiometers, use a screwdriver with a blade width of 4 mm.
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of at least 2200 μF.
  Recommendation: Capacitor module VT 11110 (see data sheet 30750); sufficient for up to 3 amplifier modules
- In the condition as supplied, the setting of the clock frequency corresponds to the requirements of the valve 4WRPH6...-2X...-855. Rotating the "f" potentiometer changes the valve hysteresis and may lead to disturbing noise developments.

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Electric amplifiers

RE 30109/07.12
Replaces: 07.05

Type VT-VSPA1-5..-1X/V0/RTP

Component series 1X

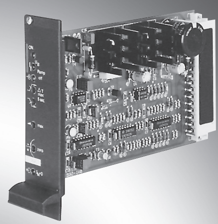


Table of contents

Features

– Suitable for controlling direct operated proportional valves without electrical feedback
– Analog amplifiers in Europe format for installation in 19 " racks
– Differential input for command value voltage 0...+10 V
– Ramp generator up and down can be set separately
– Zero point potentiometer
– Controlled output stage
– LED display:
  • Supply voltage
  • Ready for operation
  • Ramp "Off"
  • Solenoid current I_M = 0

Notice:

The photo is an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	S	P	A	1 –	–1X /	V0 /	RTP

Hydraulic component
For valves without electrical feedback **= S**

Valve type
Proportional valve **= P**

Control
Analog **= A**

Output stages
1 output stage **= 1**

Options
RTP = Ramp setting via potentiometer

Customer version
V0 = Catalog version

1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

Serial number for types
508 = 0.8 A solenoid
525 = 2.5 A solenoid

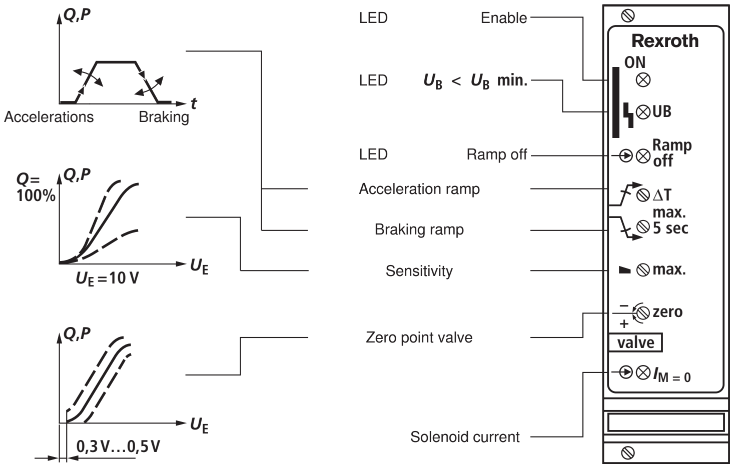
Preferred types

Amplifier type	Material number	For proportional valves, direct operated, without electrical feedback
VT-VSPA1-525-10/V0/RTP	0811405079	DBETX-1X...-25...
		DBE6X-1X...-25...
		3(2)FREX...-1X...-25...
VT-VSPA1-508-10/V0/RTP	0811405081	DBETX-1X...-8...
		DRE10Z-1X...-8...
		DRE6X-1X...-8...
		DBE6X-1X...-8...
		DBE10Z-1X...-8...

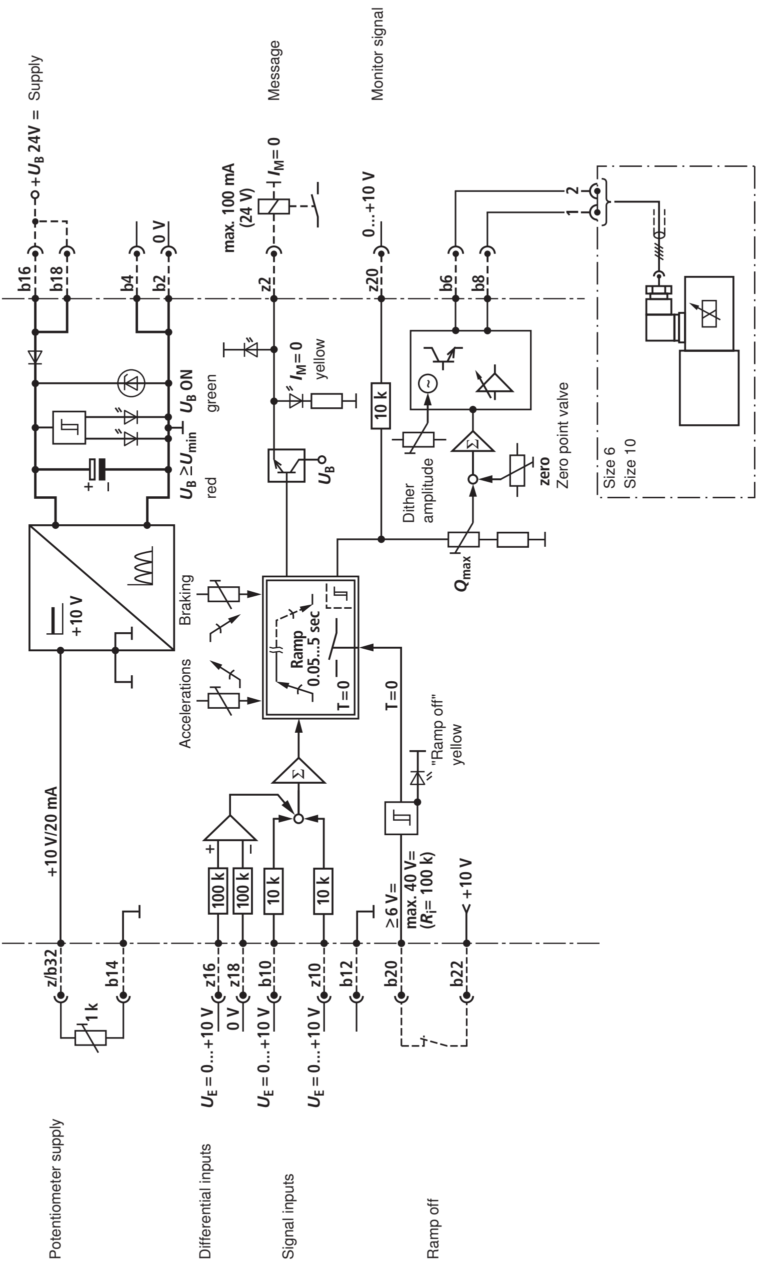
Suitable card holder:

– Open card holder VT 3002-1-2X/32F (see data sheet 29928). Only for control cabinet installation.

Front plate



Block diagram with pin assignment



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

Supply voltage		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor, separately		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10%)
Current consumption, max.	0811405079	1.5 A (size 6) 2.5 A (size 10)
	0811405081	1.25 A
Power consumption, max.	0811405079	35 VA (size 6) 60 VA (size 10)
	0811405081	30 VA
Command value potentiometer		$R_L \geqq 1$ kΩ Supply: b/z 32, +10 V/20 mA
Input signals		b10: +10 V z10: +10 V z16: +10 V } Differential input z18: Diff. 0 V
External ramp switch-off		b20: 6...40 V = (nom. 10 V =)
Monitor signal ramp		z20: 0...10 V
Cable lengths between amplifier and valve		Solenoid cable: up to 20 m 1.5 mm² 20 to 60 m 2.5 mm²
Special features		Inputs and outputs short-circuit-proof Clocked output stage Fast energization for short actuating time
LED displays		yellow: Ramp OFF yellow: Solenoid current I_M = 0 green: U_B ON red: $U_B < U_B$ min
Valve setting time		50 ms with 100 signal step
Valve hysteresis	%	< 4
Ramp times	s	0.05...5
Adjustment		Zero point valve, sensitivity, ramp times, dither amplitude
Format of the printed circuit board	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE
Plug-in connection		Connector DIN 41612 – F32
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	*m*	0.32 kg

Notice:
Power zero b2 and control zero b12 are to be bridged.
If the power supply unit is < 1 m away, directly to DIN connector.
In case of distances > 1 m, lead the control zero separately to the ground.

Adjustment of the cards

Zero point: For the adjustment, a command value U_E ~ 300 mV is specified.

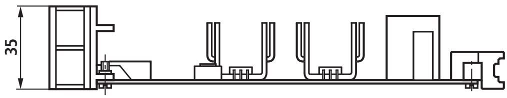
Sensitivity (max.): For the adjustment, a command value U_E = 10 V is specified.

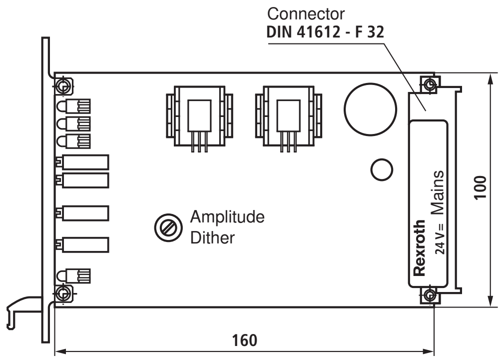
Use of ramps

Setting of ramp UP (accelerations) and ramp DOWN (braking) via 1 trimming potentiometer each.
Ramp ON if open at b20. **Ramp OFF** if b20 U > 6 V.

With **ramp OFF**, a previously started ramp is canceled.
Transition to the signal end value is effected as step.

Device dimensions (dimensions in mm)





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Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protection circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

Notes

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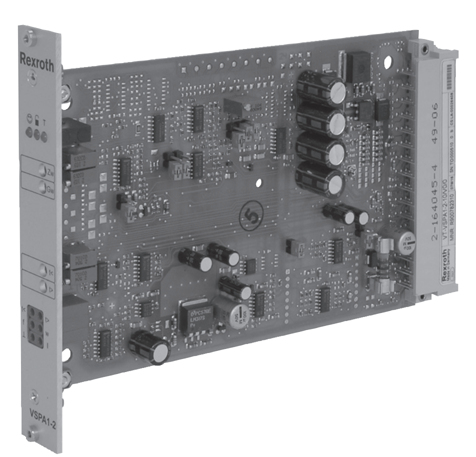
The Drive & Control Company **Rexroth Bosch Group**

Valve amplifiers for proportional pressure valves

RE 30100
Edition: 2013-04
Replaces: 03.11

Type VT-VSPA1-10, VT-VSPA1-11



tb0185_d

- Component series 1X
- Analog, euro-card format
- Suitable for controlling proportional pressure valves:
  – (Z)DRE 6...-1X,
  – ZDRE 10...-2X,
  – 3DRE(M) 10...-7X,
  – 3DRE(M) 16...-7X,
  – DRE(M) 10...-6X,
  – DRE(M) 25...-6X,
  – DRE(M) 32...-6X,
  – Z)DBE6...-2X

Features

- Differential input (0 to +10 V)
- Current input (4 to 20 mA)
- Ramp generator with separately adjustable ramp times "up/down"
- External ramp time setting
- Enable input
- Clocked power output stage
- "Ready for operation" message
- Reverse polarity protection of the supply voltage
- Short-circuit protection and cable break detection of the solenoid conductor

Contents

Ordering code

01		02		03		04		05	06
VT-VSPA1	**–**		**–**	**1X**	**/**	**V0**	**/**	**0**	*****

01	Valve amplifier for proportional pressure valves, analog, euro-card format	**VT-VSPA1**
02	For controlling the valve (Z)DRE 6...-1X	**10**
	For controlling the valves: ZDRE 10...-2X, 3DRE(M) 10...-7X, 3DRE(M) 16...-7X, DRE(M) 10...-6X, DRE(M) 25...-6X, DRE(M) 32...-6X, (Z)DBE6...-2X,	**11**
03	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	**1X**
04	Version: Standard	**V0**
05	Standard option	**0**
06	Further details in the plain text	*****

Accessories

- Open card holder VT 3002-1-2X/48F (see data sheet 29928)

Function

Power supply unit (1)
The amplifier has a power supply unit with making current limiter. This unit supplies all internally required positive and negative supply voltages.

Command value specification (2), (3), (4), (5)
The internal command value signal is calculated from the total (5) of the external command value signal available at the differential input (2) or at the current input (3) and the zero point offset (4) (zero point potentiometer "Zw").
The following applies:

Standard values	Current input	Differential input	Command value socket
0 %	4 mA	0 V	0 V
+100 %	20 mA	+10 V	+10 V

There is no switch-over between current and voltage input. The inputs are permanently available (see block diagram).

Enable function (6)
The enable function (6) enables the power output stage and forwards the internal command value signal to the ramp generator (7). The enable signal is indicated by an LED. If enable is connected (via 24 V input or jumper J1), 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.

Ramp generator (7)
The ramp generator (7) limits the rise of the control output. The downstream amplitude limiter (11) does not extend or shorten the ramp time. Using the jumper J3, the ramp time is changed by the factor 10.
The following applies:

J3	U_{socket} /V	1	0.2	0.1	0.02
Open*	t/ms	100	500	1000	5000
Closed	t/s	1	5	10	50

* Basic setting (condition as supplied)

Formula:

$$t = \frac{100\text{ ms}}{U_{socket} / V}$$

Ramp on/off (8)
Using jumper J2 or the "Ramp on/off" input (8) (see terminal assignment), the ramp time is set to a minimum (< 50 ms).

An activated ramp is indicated by an LED.

"Ramp on/off" input	J2	LED "T"	Ramp
0 V	Open	**On**	**On**
+24 V	Open	**Off**	**Off**
0 V	Closed	**Off**	**Off**
+24 V	Closed	**On**	**On**

External ramp time setting (9)

Using an external potentiometer or external voltage specification (according to the formula specified in section "Ramp generator"), the internally set ramp time can be extended. The setting can be verified by means of the measuring sockets. In case of a cable break, the internal default setting will be valid automatically.

The following applies to the external potentiometer:

	Setting range*	
R	**Min. ramp time (potentiometer at left turn)**	**Max. ramp time (rotary angle of the potentiometer at approx. 95 %)**
1 kΩ	100 ms	1 s
100 Ω	1 s	10 s

* 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 turn. The specified ramp times are true for J3 = open.

Characteristic curve generator (10)

Using the "Gw" potentiometer (11), the maximum current for the solenoid is set. In the characteristic curve generator (10), the command value signal is changed so that a linear command value pressure characteristic curve is created. For this purpose, the characteristic curve generator (10) has to be activated using jumper J4 and jumper J5 has to be opened.
In order to deactivate the characteristic curve, jumper J4 has to be opened and jumper J5 has to be closed.

Amplitude limiter (11)

The internal command value is limited to approx. +120 % of the nominal range.

Command value output (12)

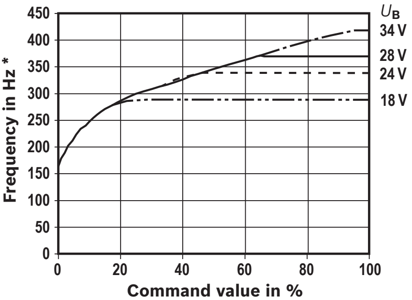
0 % ≙ 0 V +100 % ≙ +10 V

Clock generator (13)

In the clock generator (13), a frequency for the output stage is generated. The frequency is influenced by the supply voltage.
Via the jumper J6, a frequency depending on the command value signal is generated. For a universal use, jumper J6 is to be opened.
A frequency adjustment via the "frequency" potentiometer can be realized by means of jumper J7.

Example 1:
(Frequency adjustment via "frequency" potentiometer – without command value dependancy; J6 = open, J7 = closed)
Setting range for VT-VSPA1-10: 180 Hz ... 400 Hz ± 15 %
Setting range for VT-VSPA1-11: 210 Hz ... 310 Hz ± 15 %

Example 2:
(command value-dependent frequency – J6 = closed)



* Tolerance: ±15 %

Via the "frequency" potentiometer, the frequency can be corrected by > ±10 % (J6 and J7 closed).

Power output stage (14)

The power output stage creates a clocked solenoid current for the proportional valve.
The output stage output is de-energized in case of an internal fault signal or iif it has not been enabled. The output stage output is short-circuit-proof.

Actual value output (15)

1 mA ($I_{solenoid}$) ≙ 1 mV (actual value output)

Fault recognition (16)

The solenoid conductor is monitored for cable break and short-circuits. If there is no fault, a voltage > 16 V is output at the "ready-for-operation" output and the "ready-for-operation" LED is illuminated. In case of a fault, the voltage is < 1 V and the LED flashes.

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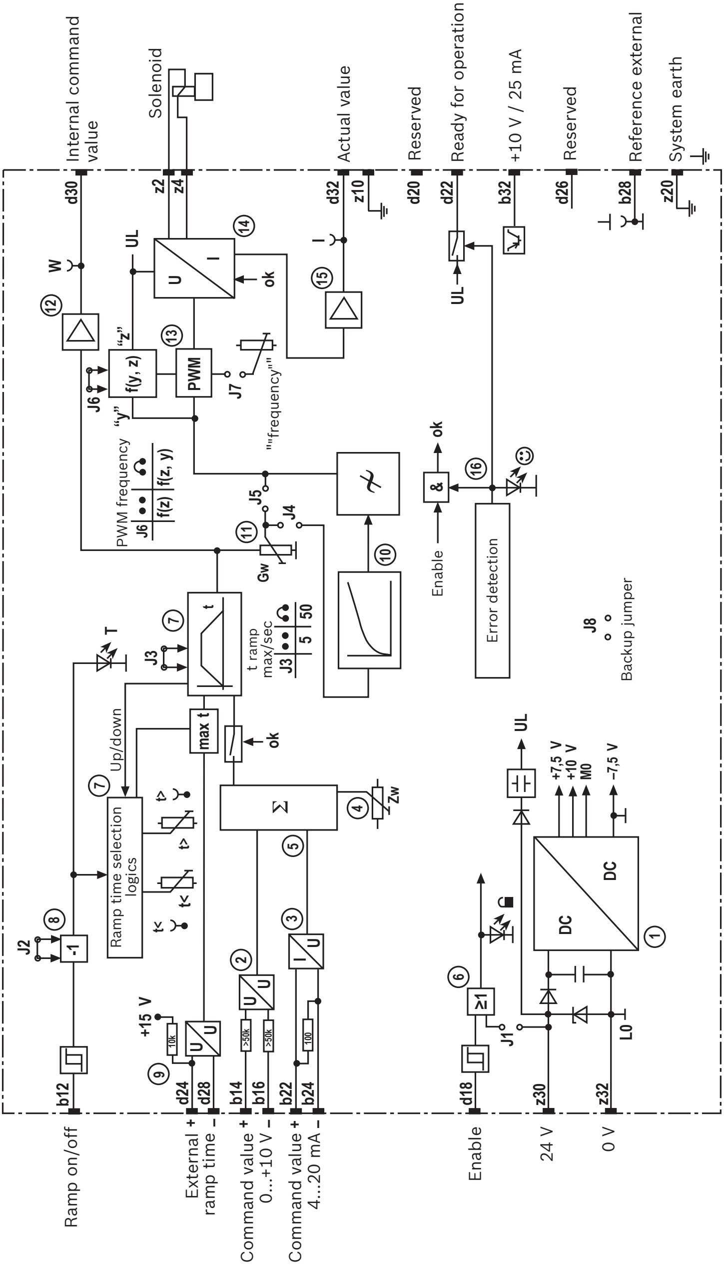
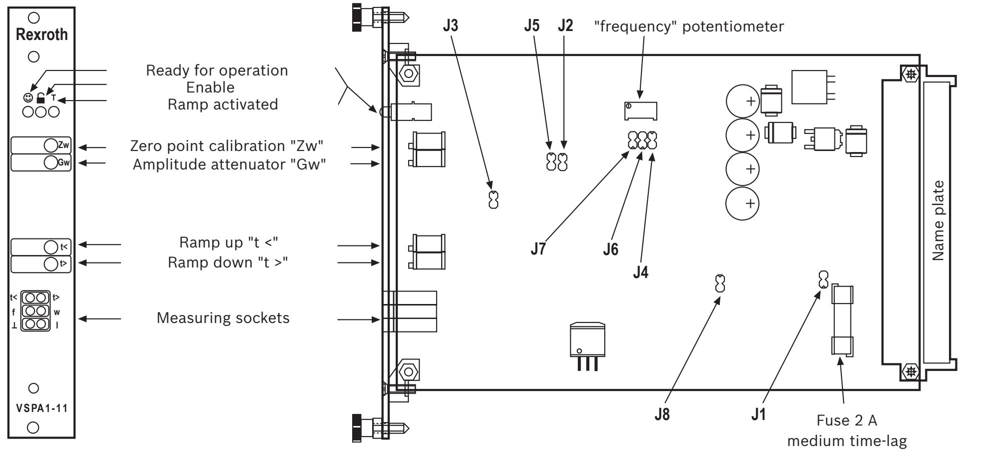
Block diagram



1 Power supply unit
2 Differential input
3 Current input
4 Zero point setting
5 Command value summation
6 Enable
7 Ramp generator
8 Ramp on/off
9 External ramp time
10 Characteristic curve generator
11 Amplitude limiter
12 Command value output
13 Clock generator
14 Power output stage
15 Actual value output
16 Fault recognition

1

Setting and operating controls



Measuring sockets

t <	Ramp time "Ramp up"
t >	Ramp time "Ramp down"
w	Command value output (0...10 V)
I	Actual value (1 mV ≙ 1 mA)
f	Clock frequency of the output stage
⊥	Reference for outputs

Additional potentiometer

"frequency"	Frequency setting (to be activated using J7)

LED

☺	Ready-for-operation LED
🔓	Enable LED ("enable")
T	"Ramp on active" LED
w1-w4	"Command value call-up active" LEDs (only with A4 variant)

Jumpers

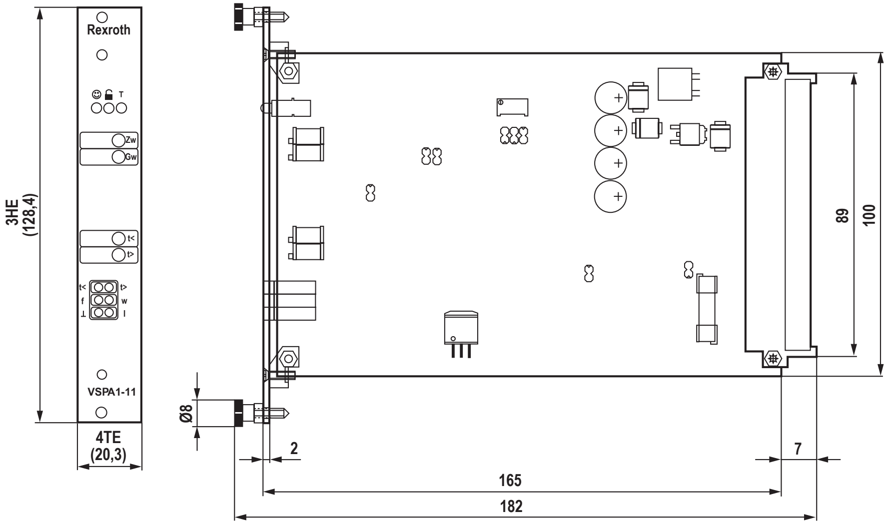
			VT-VSPA1-10	VT-VSPA1-11
J1	Open	Not enabled	•	•
	Closed	Enabled		
J2		Ramp function on/off (• = open) (see table under "Ramp on/off" on page 3)		
J3	Open	Ramp time 20 ms ... 5 s	•	•
	Closed	Ramp time 200 ms ... 50 s		
J4	Open	Command value pressure characteristic curve correction inactive		
	Closed	Command value pressure characteristic curve correction active	•	•
J5	Open	Command value pressure characteristic curve correction active	•	•
	Closed	Command value pressure characteristic curve correction inactive		
J6	Open	Command value-dependent frequency deactivated	•	
	Closed	command value-dependent frequency activated (ZDRE 10, 3DRE(M) size 10 and size 16)		•
J7	Open	Frequency adjustment via "frequency" potentiometer deactivated		•
	Closed	Frequency adjustment via "frequency" potentiometer activated	•	
J8	Closed	Reserve jumper	•	•

• = Jumper condition as supplied

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

			VT-VSPA1-10	VT-VSPA1-11
Operating voltage		U_B	24 VDC + 40 % – 20 %	
Operating range	Upper limit value	$u_B(t)_{max}$	35 V	
	Lower limit value	$u_B(t)_{min}$	18 V	
Power consumption		P_S	< 24 VA	
Current consumption		I	< 2 A	
Fuse		I_S	2 A medium time-lag, exchangeable	
Inputs				
Analog	Differential input	U_e	0 ... +10 V, R_e > 50 kΩ	
	Current input	I_e	4 ... 20 mA, load R_B = 100 kΩ	
	Ramp time external	U_e	0 V ... +5 V, R_e > 10 kΩ	
Digital	Ramp call-ups	U	8.5 V ... U_B → call-up operated, R_e > 100 kΩ 0 ... 6.5 V → no call-up, R_e > 100 kΩ	
	Ramp on/off	U	8.5 V ... U_B → ramp on, R_e > 100 kΩ 0 ... 6.5 V → ramp off , R_e > 100 kΩ	
	Enable	U	8.5 V ... U_B → ON, R_e > 100 kΩ 0 ... 6.5 V → OFF, R_e > 100 kΩ	
Clock frequency		f	330 Hz ± 10 %, with J6 = open and J7 = closed	250 Hz ± 10 % with J6 and J7 = open
Setting ranges				
Zero adjustment (potentiometer "Zw")			+30 %	
Ramp times (potentiometer "t <" and "t >")		t	20 ms ... 5 s, switchable to 0.2 s ... 50 s	
Amplitude attenuator (potentiometer "Gw")			0 ... +120 %	
Frequency adjustment with potentiometer "frequency" (J7 operated)		f	See explanation: Clock generator, page 3	
Outputs				
Command value signal		U	0 ... +10 V ± 2 %, I_{max} = 2 mA	
Actual value signal		U	0 ... +10 V ± 2 %, I_{max} = 2 mA	
Ready for operation		U	> 16 V, I_{max} = 50 mA (in case of a fault: U < 1 V, R_i = 10 kΩ)	
Regulated voltage		U	+10 V ± 2 %, I_{max} = 25 mA, short-circuit-proof	
Ramp signals measuring socket		U	+100 mV ... +5 V ± 10 %, +10 mV ... +100 mV ± 50 %	
Power output stage		I	0 ... 1.9 A, short-circuit-proof, clocked	
Type of connection			48 pin male multipoint connector, DIN 41612, design F	
Card dimensions			Euro-card 100 x 160 mm, DIN 41494	
Admissible operating temperature range		ϑ	0 ... 50 °C	
Storage temperature range		ϑ	–25 ... +85 °C	
Weight		m	0.15 kg (net)	

Dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be assembled when de-energized.
- No connectors with free-wheeling diodes or LED displays must be used for the solenoid connection.
- Only carry out measurements at the card using instruments R_i > 100 kΩ.
- For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents).
- Always shield command value lines, connect shielding to earth on the card-side, other side open. If no system earth exists, connect 0 V operating voltage.
- Recommendation:
  Also shield the solenoid conductors. For solenoid conductors up to 50 m in length, use the line type LiYCY 1.5 mm^2. With greater lengths, please contact us.
- The distance to aerial lines, radios, and radar systems must at least be 1 m.
- Do not lay solenoid conductors and signal lines near power lines.
- If the differential input is used, both inputs must always be connected or disconnected at the same time.

Notes

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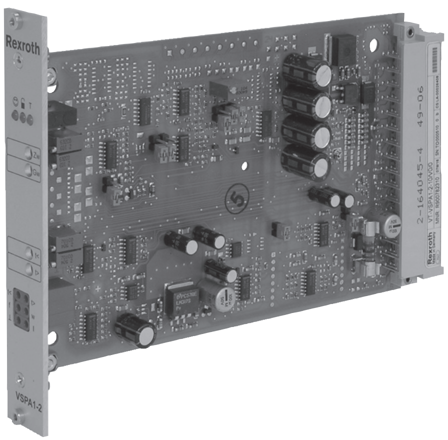
The Drive & Control Company

Rexroth
Bosch Group

Valve amplifier for proportional pressure valves

Type VT-VSPA1-2

RE 30115
Edition: 2013-02
Replaces: 02.06



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- Component series 1X
- Analog, Euro-card format
- Suitable for controlling proportional pressure valves:
  – DBET-6X,
  – DBEM...-7X

Features

- Differential input (0 ... +10 V)
- Current input (4 ... 20 mA)
- Ramp generator with separately adjustable ramp times "up/down"
- External ramp time presetting
- Enable input
- Clocked power output stage
- "Ready for operation" message
- Reverse polarity protection of the supply voltage
- Short-circuit protection and cable break detection of the solenoid conductor

Contents

Ordering code

01		02		03		04		05		06
VT-VSPA1	**–**	**2**	**–**	**1X**	**/**	**V0**	**/**		**/**	*****

01	Valve amplifier for proportional pressure valves, analog, Euro-card format	**VT-VSPA1**
02	For controlling direct operated proportional pressure valves DBET-6X and DBEM...-7X	**2**
03	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	**1X**
04	Version: Standard	**V0**
05	Option: Standard	**0**
	Option: 4 command value call-ups	**A4**
06	Further details in the plain text (additional functions on request)	*****

Accessories

- Open card holder VT 3002-1-2X/48F
  (see data sheet 29928)

Function

Power supply unit (1)
The amplifier has a power supply unit with making current limiter. This unit supplies all internally required positive and negative supply voltages.

Command value specification (2), (3), (4) [1], (5), (6)
The internal command value signal is calculated from the total (6) of the external command value signal or the called-up signal (4) [1] available at the differential input (2) or at the current input (3) and the zero point offset (5) (zero point potentiometer "Zw").
The following applies:

Standard values	Current input	Differential input	Command value socket
0 %	4 mA	0 V	0 V
+100 %	20 mA	+10 V	+10 V

There is no switch-over between current and voltage input. The inputs are permanently available (see block diagram).

Command value call-ups (4) [1]
Four command value call-ups "w1" to "w4" can be called up. The external voltages (command values 1 to 4) are either defined directly by the voltage output +10 V or by external potentiometers. If these command value inputs are directly connected to the regulated voltage, 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 "w1" has the lowest priority and call-up "w4" has the highest priority. The active call-up is indicated by a yellow LED.

Enable function (7)
The enable function (7) enables the power output stage and forwards the internal command value signal to the ramp generator (8). The enable signal is indicated by an LED. If the release is connected (via 24 V input or jumper J1), 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.

Ramp generator (8)
The ramp generator (8) limits the rise of the control output. The downstream amplitude limiter (12) does not extend or shorten the ramp time. Using the jumper J3, the ramp time is changed by the factor 10.

The following applies:

J3	U_{socket} **/V**	**2**	**1**	**0.2**	**0.1**	**0.02**
Open*	t/ms	50	100	500	1000	5000
Closed	t/s	0.5	1	5	10	50

* Basic setting (condition as supplied)

[1] Only with option A4

Formula:

$$t = \frac{100\ \text{ms}}{U_{\text{socket}} / V}$$

Ramp on/off (9)

Using jumper J2 or the "Ramp on/off" input (9) (see terminal assignment), the ramp time is set to a minimum (< 50 ms). An activated ramp is indicated by an LED.

"Ramp on/off" input	J2	LED "T"	Ramp
0 V	Open	**On**	**On**
+24 V	Open	**Off**	**Off**
0 V	Closed	**Off**	**Off**
+24 V	Closed	**On**	**On**

Ramp time setting external (10)

Using an external potentiometer or an external voltage presetting (according to the formula in section "Ramp generator"), the internally set ramp time can be extended. The setting can be verified at the measuring sockets. In case of a cable break, the internal default setting will be valid automatically.

The following applies to the external potentiometer:

	Setting range*	
R	**Min. ramp time (potentiometer at left turn)**	**Max. ramp time (rotary angle of potentiometer at approx. 95 %)**
1 kΩ	100 ms	1 s
100 Ω	1 s	10 s

* 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 turn. The specified ramp times are true for J3 = open.

Characteristic curve generator (11)

The maximum current for the solenoid is set using the "Gw" (12) potentiometer. In the characteristic curve generator (11), the command value signal is changed so that a linear command value pressure characteristic curve (correction characteristic curve for DBET-6X and DBEM...-7X) results. For this purpose, jumper J4 has to be closed and jumper J5 has to be opened.
In order to deactivate the correction characteristic curve, jumper J4 has to be opened and jumper 5 has to be closed.

Amplitude limiter (12)

The internal command value is limited to approx. +120 % of the nominal range.

Command value output (13)

0 % ≙ 0 V +100 % ≙ +10 V

Clock generator (14)

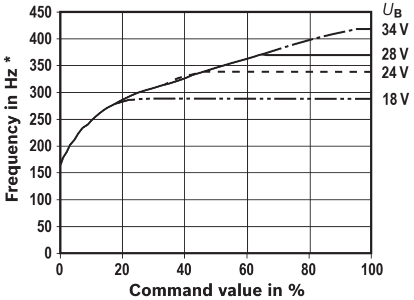
In the clock generator (14), a frequency for the output stage is generated. The frequency is influenced by the supply voltage.

A frequency dependent on the command value signal is generated using the jumper J6 (for DBET-6X and DBEM...-7X). For a universal use, jumper J6 is to be opened. A frequency adjustment via the "frequency" potentiometer can be realized by means of jumper J7.

1

Example 1:
(frequency adjustment via "frequency" potentiometer – without command value dependency; J6 = open, J7 = closed)
Setting range: 210 Hz ... 310 Hz ± 15 %

Example 2:
(command-value dependent frequency – J6 closed)



* Tolerance: ±15 %

Via the "frequency" potentiometer, the frequency can be corrected by > ±10 % (J6 and J7 closed).

Power output stage (15)

The power output stage creates a clocked solenoid current for the proportional valve.
The output stage output is de-energized in case of an internal fault signal or if the release is missing. The output stage output is short-circuit-proof.

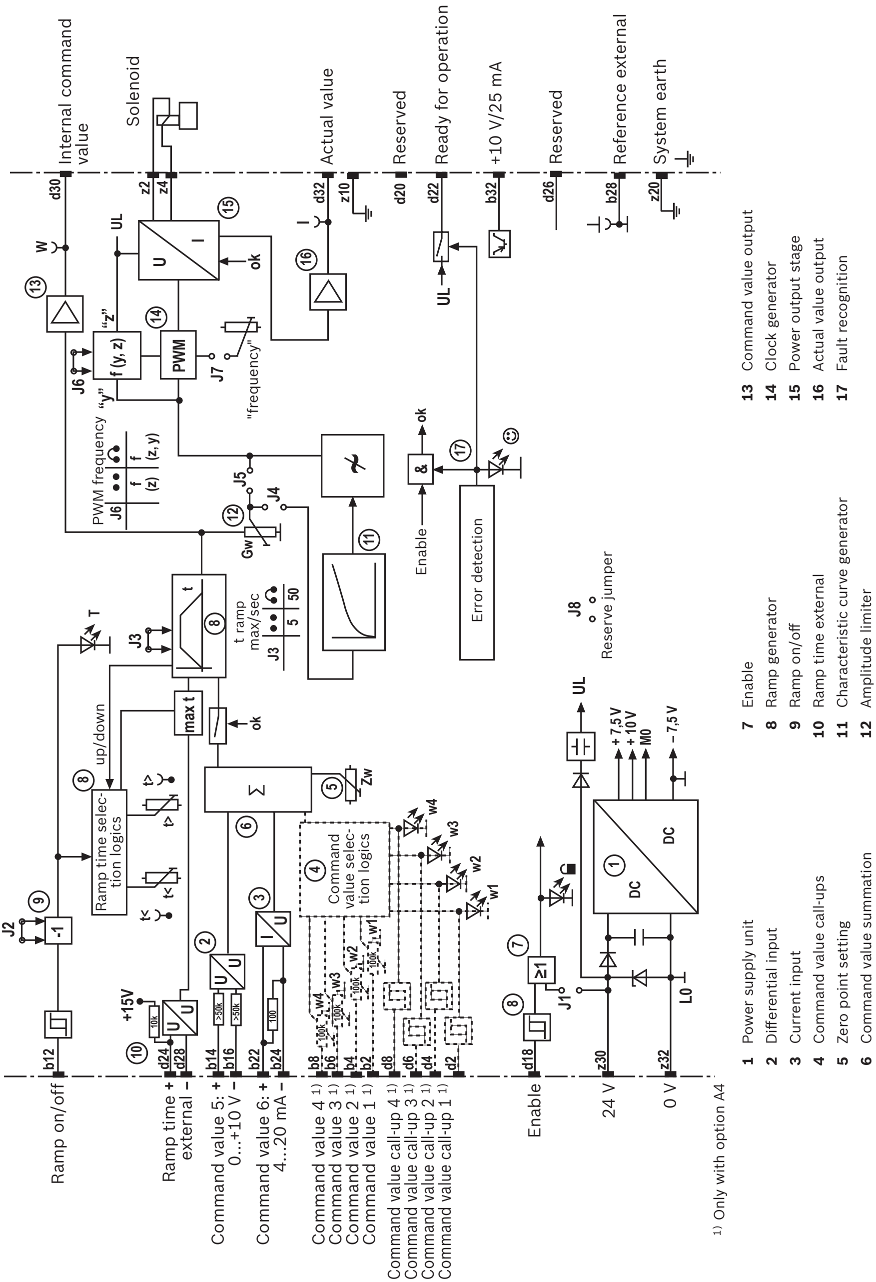
Actual value output (16)

1 mA (I_{solenoid}) ≙ 1 mV (actual value output)

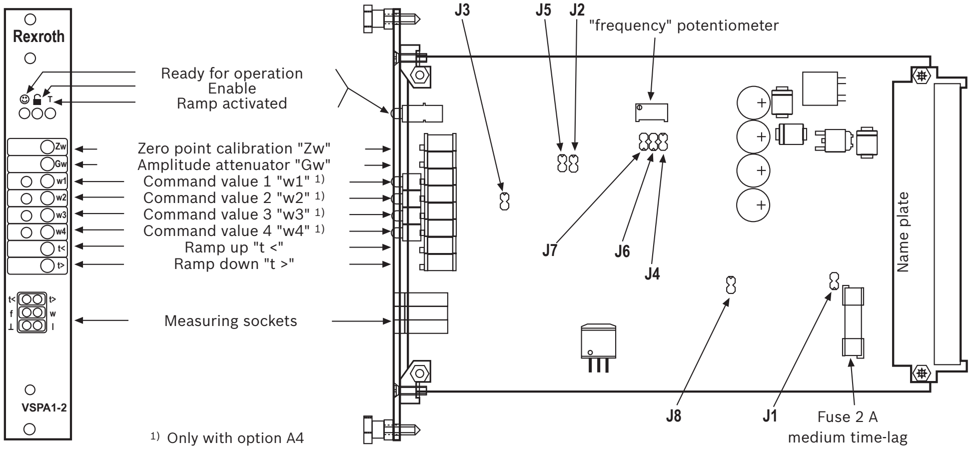
Fault recognition (17)

The solenoid conductor is monitored for cable break and short-circuits. If there is no fault, a voltage > 16 V is output at the "ready-for-operation" output and the "ready-for-operation" LED is illuminated. In case of a fault, the voltage is < 1 V and the LED flashes.

Block diagram



Setting and operating controls



Measuring sockets

t <	Ramp time "Ramp up"
t >	Ramp time "Ramp down"
w	Command value output (0...10 V)
I	Actual value (1 mV ≙ 1 mA)
f	Clock frequency of the output stage
⊥	Reference for outputs

Additional potentiometer

"frequency"	Frequency setting (to be activated using J7)

LED

☺	Ready-for-operation LED
🔓	Enable LED ("enable")
T	"Ramp on active" LED
w1-w4	"Command value call-up" LEDs (only with A4 variant)

Jumpers

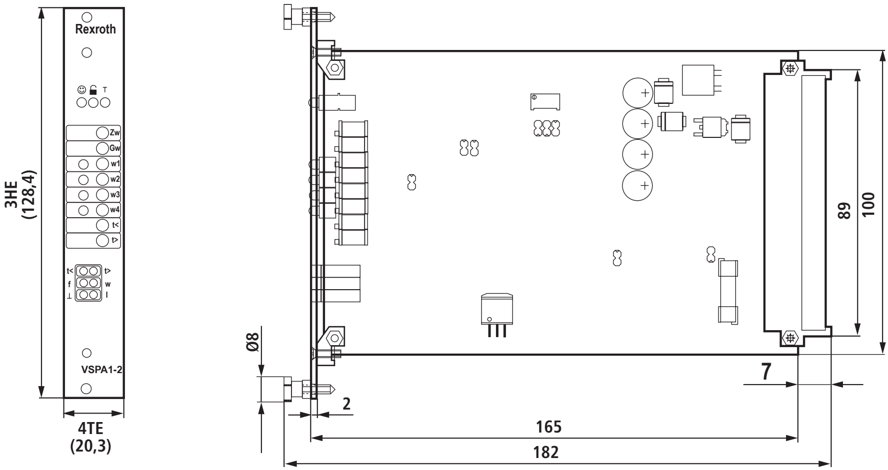
J1	Open Closed	• 	No enabled Enable activated	
J2			Ramp function on/off (• = open) (see table under "Ramp on/off" on page 3)	
J3	Open Closed	• 	Ramp time 20 ms ... 5 s Ramp time 200 ms ... 50 s	
J4	Open Closed	 •	Command value pressure characteristic curve correction inactive Command value pressure characteristic curve correction active	J4 and J5 must not be simultaneously closed.
J5	Open Closed	• 	Command value pressure characteristic curve correction active Command value pressure characteristic curve correction inactive	
J6	Open Closed	 •	Command value-dependent frequency deactivated Command value-dependent frequency activated (for DBET-6X and DBEM...-7X)	
J7	Open Closed	• 	Frequency adjustment via "frequency" potentiometer deactivated Frequency adjustment via "frequency" potentiometer activated	
J8	Closed	•	Reserve jumper	

• = Jumper condition as supplied

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

Operating voltage	U_B	24 VDC + 40 % – 20 %
Operating range		
Upper limit value	$u_B(t)_{max}$	35 V
Lower limit value	$u_B(t)_{min}$	18 V
Power consumption	P_S	< 24 VA
Current consumption	I	< 2 A
Fuse	I_S	2 A medium time-lag, exchangeable
Inputs, analog		
Command values 1 to 4 (potentiometer inputs) *	U_e	0 ... +10 V, R_e > 100 kΩ
Differential input	U_e	0 ... +10 V, R_e > 50 kΩ
Current input	I_e	4 ... 20 mA, load R_B = 100 Ω
Ramp time external	U_e	0 ... +5 V, R_e > 10 kΩ
Inputs, digital		
Command value call-ups (only with option A4)	U	8.5 V ... U_B –> call-up operated, R_e > 100 kΩ
	U	0 ... 6.5 V –> no call-up, R_e > 100 kΩ
Ramp on/off	U	8.5 V ... U_B –> ramp on, R_e > 100 kΩ
	U	0 V ... 6.5 V –> ramp off, R_e > 100 kΩ
Release	U	8.5 V ... U_B –> ON, R_e > 100 kΩ
	U	0 ... 6.5 V –> OFF, R_e > 100 kΩ
Clock frequency	f	250 Hz ± 10 % (J6 and J7 = open)
Setting ranges		
Zero adjustment (potentiometer "Zw")		+30 %
Command values (potentiometers "w1" to "w4")		0 ... 100 %
Ramp times (potentiometer "t <" and "t >")	t	20 ms ... 5 s, switchable to 0.2 s ... 50 s
Amplitude attenuator (potentiometer "Gw")		0 ... +120 %
Frequency adjustment with "frequency" potentiometer (J7 operated)	f	See explanation: Clock generator, page 3
Outputs		
Command value signal	U	0 ... +10 V ± 2 %, I_{max} = 2 mA
Actual value signal	U	0 ... +10 V ± 2 %, I_{max} = 2 mA
Ready for operation	U	> 16 V, I_{max} = 50 mA
		(in case of faults: U < 1 V, R_i = 10 kΩ
Regulated voltage	U	+10 V ± 2 %, I_{max} = 25 mA, short-circuit-proof
Ramp signals measuring socket	U	+100 mV ... +5 V ± 10 %,
		+10 mV ... +100 mV ± 50 %
Power output stage	I	0 ... 1.9 A, short-circuit-proof, clocked
Type of connection		48-pin male multipoint connector, DIN 41612, design F
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Operating temperature range	ϑ	0 ... 50 °C
Storage temperature range	ϑ	–25 ...+85 °C
Weight	m	0.15 kg (net)

Unit dimensions (dimensions in mm)



Project planning information/maintenance instructions/additional information

- In the condition as supplied the parameters are set as follows: Correction characteristic curve and command value-dependent frequency = active (for valves DBET-6X and DBEM...-7X), max. ramp time = 5 s, pilot current = 100 mA, max. output current = 1.6 A.
- The amplifier card may only be assembled when de-energized.
- No connectors with free-wheeling diodes or LED displays must be used for the solenoid connection.
- Only carry out measurements at the card using instruments R_i > 100 kΩ.
- For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents).
- Always shield command value lines, connect shielding to earth on the card-side, other side open. If no system earth exists, connect 0 V operating voltage.
  Recommendation:
  Shield solenoid conductors as well. For solenoid conductors up to 50 m in length, use the line type LiYCY 1.5 mm^2. With greater lengths, please contact us.
- The distance to aerial lines, radios, and radar systems has to be 1 m at least.
- Do not lay solenoid conductors and signal lines near power lines.
- If the differential input is used, both inputs must always be connected or disconnected at the same time.

Notes

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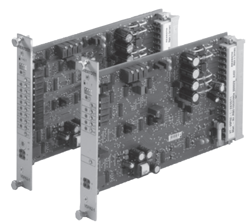
The Drive & Control Company

Rexroth
Bosch Group

Valve amplifier for proportional directional valves and proportional pressure valves

Type VT-VSPA2-1

RE 30110
Edition: 2013-04
Replaces: 05.12



H7299

- Component series 2X
- Analog, euro-card format
- Suitable for controlling proportional directional valves:
  – 4WRA 6...-2X, 4WRA 10...-2X,
  – 4WRZ...-7X,
  and proportional pressure valves:
  – 3DREP 6..2X

Features

- Differential input (±10 V)
- Four callable command value inputs (±10 V)
- Current input (4 ... 20 mA)
- Inversion 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) with 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 with option T5
- Reverse polarity protection for the voltage supply
- Power supply with DC/DC converter without raised zero point

Contents

Notice:
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/..., make sure to observe the configuration and setting information according to the 30110-Z additional information.

Ordering code

01		02		03		04		05		06
VT-VSPA2	**–**	**1**	**–**	**2X**	**/**	**V0**	**/**		**/**	*****

01	Valve amplifier for proportional directional valves and proportional pressure valves, analog, Euro-card format	**VT-VSPA2**
02	For controlling proportional directional valves 4WRA 6...-2X, 4WRA 10...-2X and 4WRZ...-7X as well as proportional pressure valves 3DREP 6..2X	**1**
03	Component series 20 to 29 (20 to 29: Unchanged technical data and pin assignment)	**2X**
04	Version: Standard	**V0**
05	Option: With one ramp time	**T1**
	Option: With five ramp times	**T5**
06	Further details in the plain text	*****

Accessories

- Open card holder VT 3002-1-2X/48F (see data sheet 29928)

Function

Power supply unit [1]

The amplifier card has a power supply unit with making current limiter. This unit supplies all internally required positive and negative supply voltages.

Command value specification

The internal command value signal is calculated from the total (summation [6]) of the external command value signal available at the differential input [2] and at the current input [3], the called-up signal [4] and the zero point offset [5] (zero point potentiometer "Zw").

The following applies:

Standard values	Current input	Differential input	Command value measuring socket	Flow direction
–100 %	4 mA	–10 V	–10 V	P to B, A to T
0 %	12 mA	0 V	0 V	
100 %	20 mA	10 V	10 V	P to A, B to T
0 %	< 1 mA [1)]		0 V	

1) 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 switch-over between current and voltage input. The inputs are permanently available (see block diagram).

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 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". 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.

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 indicated by an LED ("–1") on the front plate.

Enable function [8]
The enable function enables the power output stages and forwards the internal command value signal to the ramp generator. The enable signal is indicated 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.

Ramp generator [9]
The ramp generator limits the rise of the control output. The downstream step functions and amplitude attenuators do not extend or shorten the ramp time.
Using the "Ramp on/off" signal or the jumper J2, the ramp time is set to a minimum (< 2 ms) (ramp off).
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.

Note for setting and measuring the ramp time:

Value at measuring socket "t" (T1) / "v" (T5)	U_t **/ V**	5	3	2
Current ramp time (±20 %)	***t* / ms**	20	33	50

U_t **/ V**	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
***t* / ms**	100	200	333	500	1000	2000	3333	5000

By closing the jumper J3, the ramp times specified above can be increased tenfold.

Characteristic curve generator [10]
Using the adjustable characteristic curve generator, the step level and maximum values for positive and negative signals can be set separately according to the hydraulic requirements. The actual development of the characteristic curve through the zero point is not stepped but linear.

Amplitude limiter [11]
The internal command value is limited to approx. ±110 % of the nominal range.

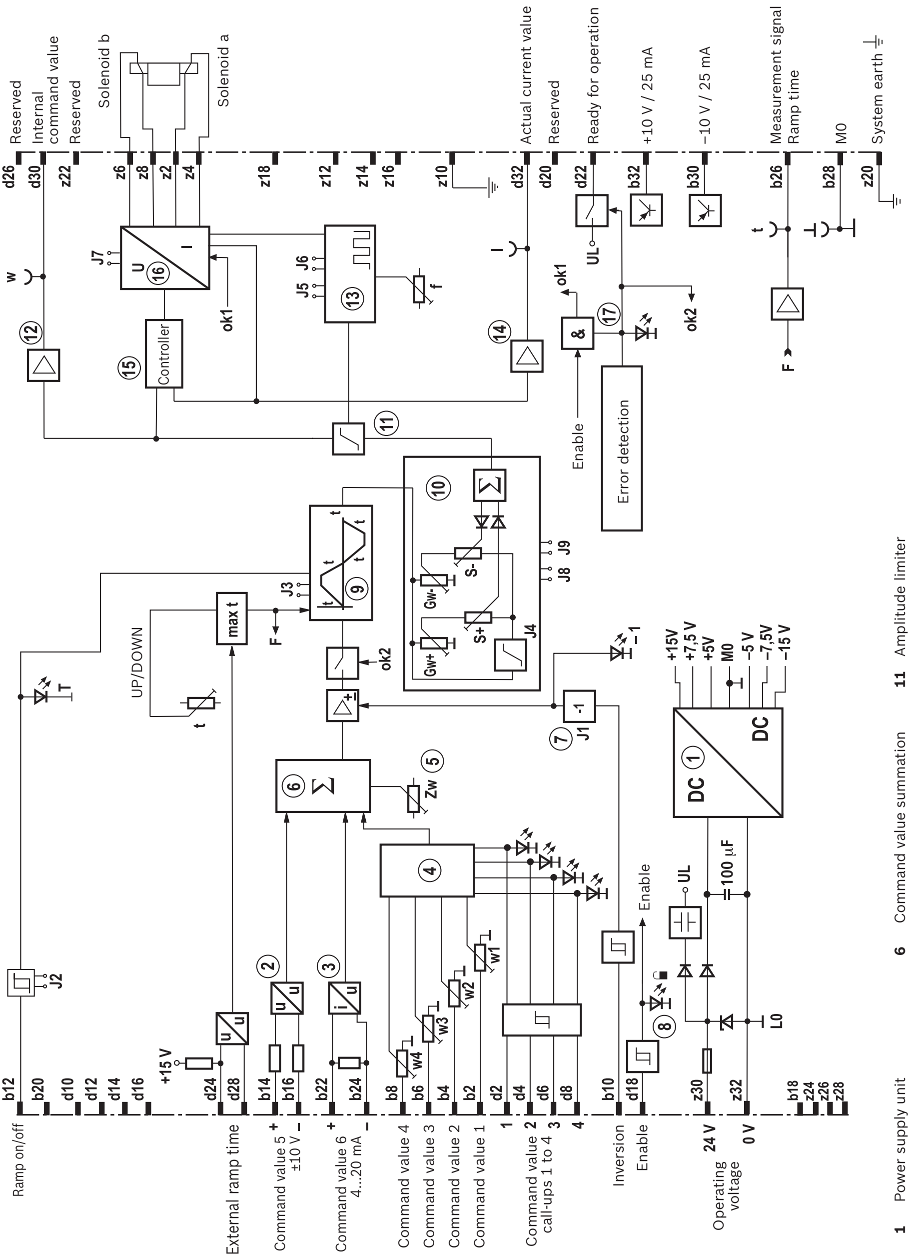
Clock generator [13]
The clock generator creates the clock frequency of the output stages. The clock signal can be switched in three basic frequency ranges using jumpers.

Power output stage [16]
The power output stage creates the clocked solenoid current for the proportional valve. The solenoid current is limited to 2.5 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 they have not been enabled.

Fault recognition [17]
Monitors over-current of the output stage.

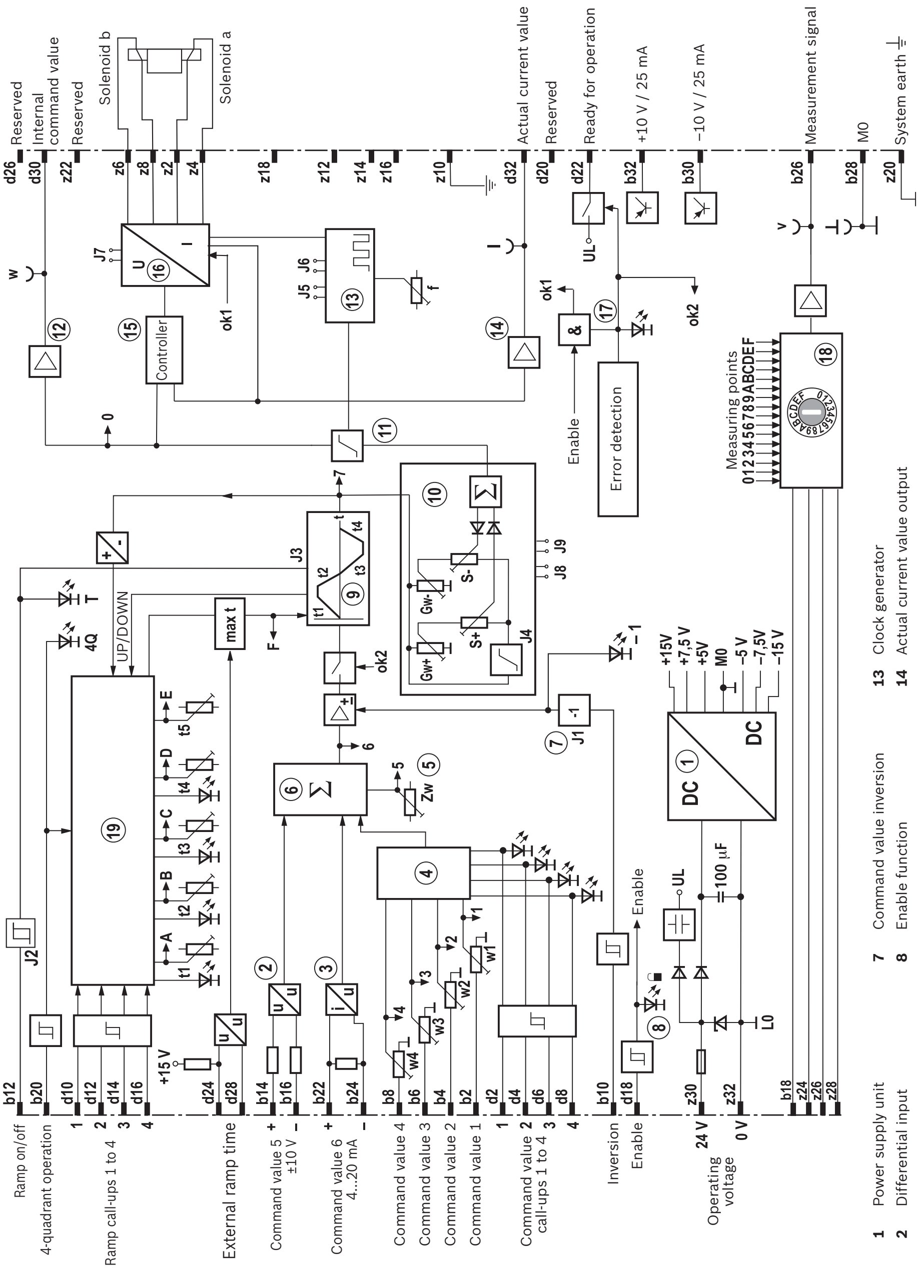
[ ] = Assignment to the block diagrams on pages 4 and 5

Block diagram/pin assignment, option T1



1 Power supply unit
2 Differential input
3 Current input
4 Command value selection logic
5 Zero point setting
6 Command value summation
7 Command value inversion
8 Enable function
9 Ramp generator
10 Characteristic curve generator
11 Amplitude limiter
12 Command value output
13 Clock generator
14 Actual current value output
15 Current controller
16 Power output stage
17 Fault recognition
ok1 Output stage enable signal
ok2 Card monitoring

Block diagram/pin assignment, option T5



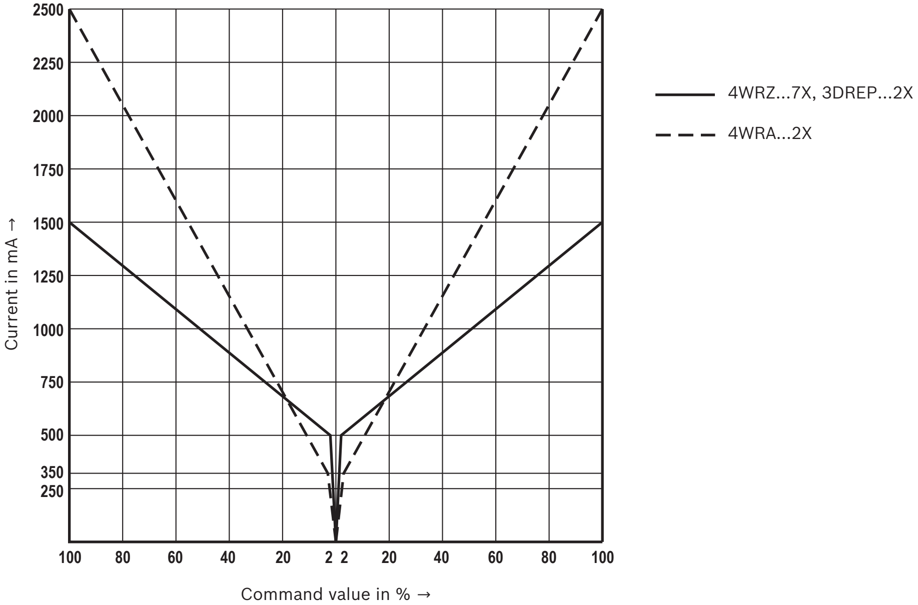
1 Power supply unit
2 Differential input
3 Current input
4 Command value selection logic
5 Zero point setting
6 Command value summation
7 Command value inversion
8 Enable function
9 Ramp generator
10 Characteristic curve generator
11 Amplitude limiter
12 Command value output
13 Clock generator
14 Actual current value output
15 Current controller
16 Power output stage
17 Fault recognition
18 Measuring point switch-over
19 Ramp time selection logics
ok1 Output stage enable signal
ok2 Card monitoring

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

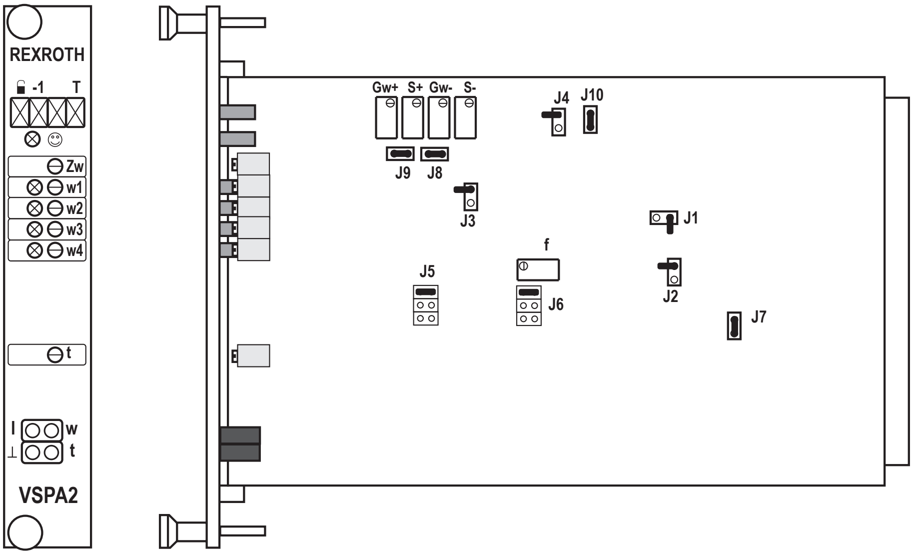
Operating voltage	U_B	24 VDC + 40 % – 20 %
Operating range:		
Upper limit value	U_B (t)$_{max}$	35 V
Lower limit value	U_B (t)$_{min}$	18 V
Power consumption	P_S	< 50 VA
Current consumption	I	< 2 A
Fuse	I_S	2 A medium time-lag, exchangeable
Inputs, analog		
Command values 1 to 4 (potentiometer inputs)	U_e	0 ... ±10 V, R_e > 100 kΩ (M0 is reference)
Command value 5 (differential input)	U_e	0 ... ±10 V, R_e > 50 kΩ
Command value 6 (current input)	I_e	4 ... 20 mA, load R_B = 100 Ω
External ramp time	U_e	0 ... +10 V, R_e = 10 kΩ (internally increased to +15 V, M0 is reference)
Inputs, digital		
Command value call-ups, Command value inversion, Enable, Ramp on/off, Ramp call-ups (option T5), 4-quadrant operation (option T5)	U U	8.5 V ... U_B –> ON, R_e > 100 kΩ 0 ... 6.5 V –> OFF, R_e > 100 kΩ
Setting ranges		
Zero adjustment (potentiometer "Zw")		±30 %
Command values (potentiometers "w1" to "w4")		0 ... 110 %
Ramp times (potentiometer "t1" to "t5")		20 ms ... 5 s, switchable to 0.2 ... 50 s
Step level (potentiometer "S+" and "S–")		0 ... 50 %
Amplitude attenuator (potentiometer "G+" and "G–")		0 ... 110 % (applies to the step level setting of 0 %)
Outputs		
Internal command value	U	±10 V ± 2 %, I_{max} = 2 mA
Actual current value	U	±2,5 V ± 2 %, I_{max} = 2 mA (mV ≙ mA)
Measurement signal (option 5)	U	±10 V ± 2 %, I_{max} = 2 mA
Ready for operation	U	> 16 V, 50 mA (in case of a fault: U < 1 V, R_i = 10 kΩ)
Regulated voltages	U	±10 V ± 2 %, 25 mA, short-circuit-proof
Power output stage	I	0 ... 2.5 A, short-circuit-proof
Measuring sockets		
Command value "w"		±10 V ± 2 %, I_{max} = 2 mA
Actual current value signal "I"		±2.5 V ± 2 %, I_{max} = 2 mA (mV ≙ mA)
Ramp time "t"		See description on page 3
Socket "v" (option T5)		See description on page 3 and table on page 10
Clock frequency		
WRA6...2X	f	300 ... 370 Hz (at U_B = 24 V and $U_{command}$ = 0 V: 370 Hz)
WRA10...2X	f	180 ... 410 Hz (at U_B = 24 V and $U_{command}$ = 0 V: 410 Hz)
WRZ...7X	f	170 Hz
3DREP 6...2X	f	170 Hz
Type of connection		48 pin male multipoint connector, DIN 41612, design F
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Admissible operating temperature range	ϑ	0 ... 50 °C
Storage temperature range	ϑ	–25 °C ... +85 °C
Weight	m	0.17 kg (net)

Notice:
For information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30110-U.

Characteristic curves



Display/adjustment elements, option T1



Ramp time	J3
0.2 ... 50 sec.	▬
0.02 ... 5 sec. ●	○○

Step level	J8	J9
4WRA 6...2X, 4WRA 10...2X	○○	○○
4WRZ...7X, 3DREP 6...2X ●	▬	▬

Step function	J4
Off	▬
On ●	○○

Inversion	J1
Inverting	▬
Not inverting ●	○○

LED displays:

☺ Ready for operation (green)

🔓 Enable (yellow)

–1 External inverting

T Ramp on

Clock frequency	J5	J6
4WRA 6...2X	○○ ○○ ▬	○○ ○○ ▬
4WRA 10...2X	○○ ▬ ○○	○○ ○○ ▬
Universal, 4WRZ...7X 3DREP 6...2X	▬ ○○ ○○	▬ ○○ ○○

Ramp function	J2
Off	▬
On ●	○○

Maximum current setting	J7
4WRZ...7X, 3DREP 6...2X ●	▬
4WRA 6...2X, 4WRA 10...2X	○○

●	=	Factory setting of the jumpers
▬	=	Jumper closed
○○	=	Jumper open

Measuring sockets:

I, w, t Measurement signal (see page 6)

⊥ Measurement zero

Potentiometers (some with LED display):

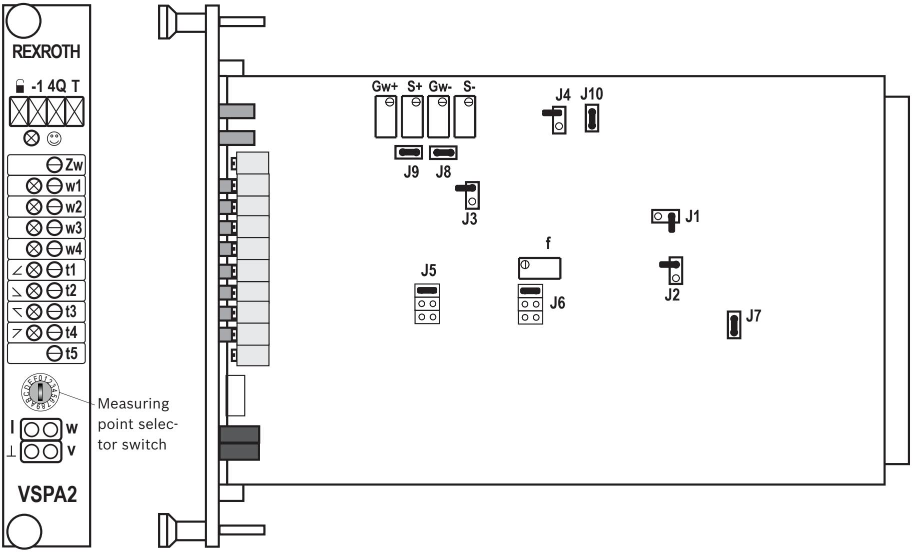
Zw Zero point calibration
w1 Command value 1
w2 Command value 2
w3 Command value 3
w4 Command value 4
t Ramp time

Adjustable on the board:

Gw+ Amplitude attenuator for positive command values
Gw– Amplitude attenuator for negative command values
S+ Step level for positive direction
S– Step level for negative direction
f Clock frequency output stage

The warranty expires if the sealed potentiometer is adjusted.

Display/adjustment elements, option T5



Ramp time	J3
0.2 ... 50 sec.	▬
20 ms ... 5 sec. ●	o o

Step level	J8	J9
4WRA 6...2X, 4WRA 10...2X	o o	o o
4WRZ...7X, 3DREP 6...2X ●	▬	▬

Step function	J4
Off	▬
On ●	o o

Inversion	J1
Inverting	▬
Not inverting ●	o o

Clock frequency	J5	J6
4WRA 6...2X	o o o o ▬	o o o o ▬
4WRA 10...2X	o o ▬ o o	o o o o ▬
Universal, 4WRZ...7X 3DREP...2X	▬ o o o o	▬ o o o o

Ramp function	J2
Off	▬
On ●	o o

Maximum current setting	J7
4WRZ...7X, 3DREP 6...2X ●	▬
4WRA 6...2X, 4WRA 10...2X	o o

●	=	Factory setting of the jumpers
▬	=	Jumper closed
o o	=	Jumper open

LED displays:

☺ Ready for operation (green)

🔓 Enable (yellow)

–1 External inverting

4Q 4-quadrant operation

T Ramp on

Measuring sockets:

I, w, v Measurement signal (see page 6)

⊥ Measurement zero

Potentiometers (some with LED display):

Zw Zero point calibration
w1 Command value 1
w2 Command value 2
w3 Command value 3
w4 Command value 4
t1 Ramp time 1
t2 Ramp time 2
t3 Ramp time 3
t4 Ramp time 4
t5 Ramp time 5

Adjustable on the board:

Gw+ Amplitude attenuator for positive command values
Gw– Amplitude attenuator for negative command values
S+ Step level for positive direction
S– Step level for negative direction
f Clock frequency output stage

The warranty expires if the sealed potentiometer is adjusted.

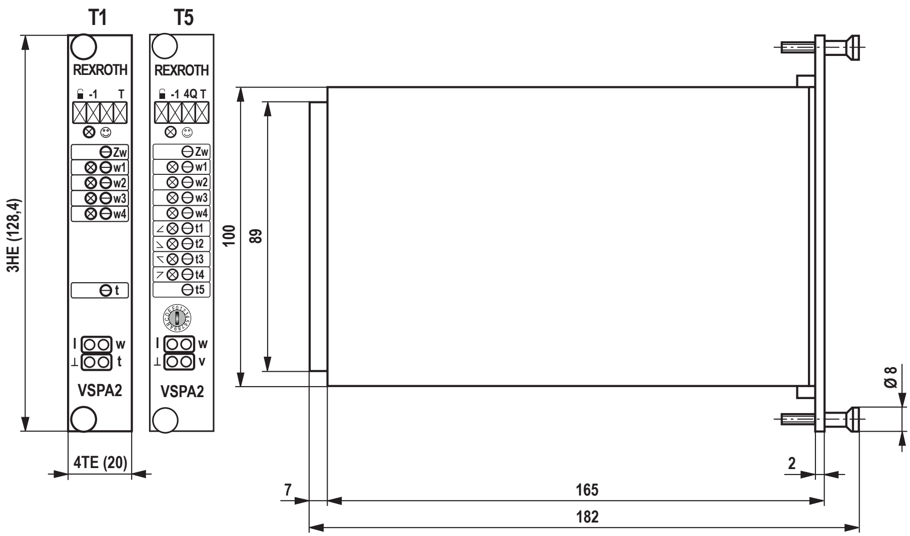
Display/adjustment elements, option T5 (continued)

Measuring socket "v"

Signal designation	Measuring point selector switch	Measurement signal "v"
Internal command value	0	±100 % ≙ ±10 V
Command value call-up 1	1	±100 % ≙ ±10 V
Command value call-up 2	2	±100 % ≙ ±10 V
Command value call-up 3	3	±100 % ≙ ±10 V
Command value call-up 4	4	±100 % ≙ ±10 V
Zero point offset "Zw"	5	±30 % ≙ ±3 V
1 composite signal of the command values	6	±100 % ≙ ±10 V
Ramp output signal	7	±100 % ≙ ±10 V
Not connected	8	
Clock frequency	9	Rectangular signal ±15 V
Ramp time "t1"	A	10 mV ... 10 V [1]
Ramp time "t2"	B	10 mV ... 10 V [1]
Ramp time "t3"	C	10 mV ... 10 V [1]
Ramp time "t4"	D	10 mV ... 10 V [1]
Ramp time "t5"	E	10 mV ... 10 V [1]
Current ramp time "t"	F	10 mV ... 10 V [1]

[1] The allocations of voltage and ramp time specified in the table on page 3 shall apply.

Dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- For more information, refer to document 30110-B.

Notes

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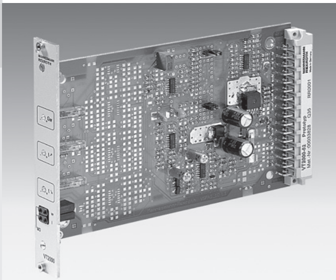
Electrical amplifiers

RE 29904/09.04
Replaces: 05.02

Type VT 2000

Component series 5X



H/A/D 5896/97

Table of contents

Features

- Suitable for controlling direct and pilot operated proportional pressure control valves without electrical position feedback
- Differential input
- Additional command value input, 0 to +9 V
- Ramp generator, separately adjustable for up and down ramps
- Clocked current output stage
- Reverse polarity protection for voltage supply
- Short-circuit protection of solenoid cable

Card holder:

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

Power supply unit:

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

Ordering code

VT 2000 – 5X / *

Amplifier for proportional pressure control valves without electrical position feedback

Component series 50 to 59 **= 5X**
(50 to 59: unchanged technical data and pin assignment)

Further details in clear text

When ordering spares for amplifier type VT 2000 up to series 4X, a 4TE/3HE blind plate must be ordered separately.

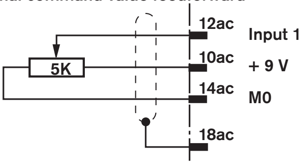
Material no. R900021004

Functional description

The command value voltage can be applied to command value input 1 either directly or via an external command value potentiometer using the regulated + 9 V voltage from the power supply unit [8].

The following is valid for this input: + 9 V = + 100 % [1)].

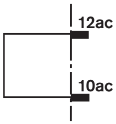
External command value feedforward



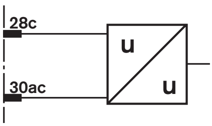
Note:

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

Internal command value feedforward



Differential input (input 2)



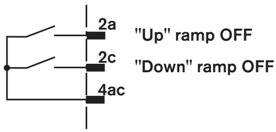
Command value input 2 is a differential input [1] (0 to + 10 V). If the command value is fed forward by external electronics with another reference potential (e.g. from a PLC), this input must be used. When cutting the command value voltage in or out, take care that both signal cables are connected to or disconnected from the input.

Before being passed on, both command values are summated [2] and fed to a potentiometer [3] that is accessible at the front panel of the card and acts as attenuator for limiting the maximum command value.

The downstream ramp generator [4] generates a ramp-shaped output signal from a stepped input signal. The time constant of this signal can be adjusted separately for up and down ramps by means of two potentiometers. The specified ramp time refers to a command value step-change of 100% and can be approx. 1 s or 5 s, depending on the jumper setting. If a command value step-change of less than 100 % is applied to the input of the ramp generator or when the attenuator [3] is active, the ramp time shortens accordingly.

With the help of the external contacts "ramp up/down" the up and down ramp times can be set separately to their minimum value (approx. 30 ms).

Ramp "up/down" OFF



The output signal of the ramp generator [4] is the internal current command value and is fed to measuring socket "w" at the front panel of the card. Here, a command value of 100 % corresponds to a voltage of + 6 V. In addition, the command value is passed on via the current regulator [5] to the current output stage [6]. The current regulator [5] adds the value of potentiometer "Zw" (R130) for the biasing current to the value from the ramp generator. The current command value is modulated with the clock pulse encoder signal [7]. The clocked actual current value acts like a constant current with superimposed dither signal in the solenoid of the valve. The actual current value through the solenoid can be measured at socket "I". Here, a voltage of 800 mV corresponds to a current of 800 mA.

[1)] Reference potential for command value 1 is M0 (measurement zero).

[ ] ... Cross-reference to block circuit diagram on page 3

Troubleshooting

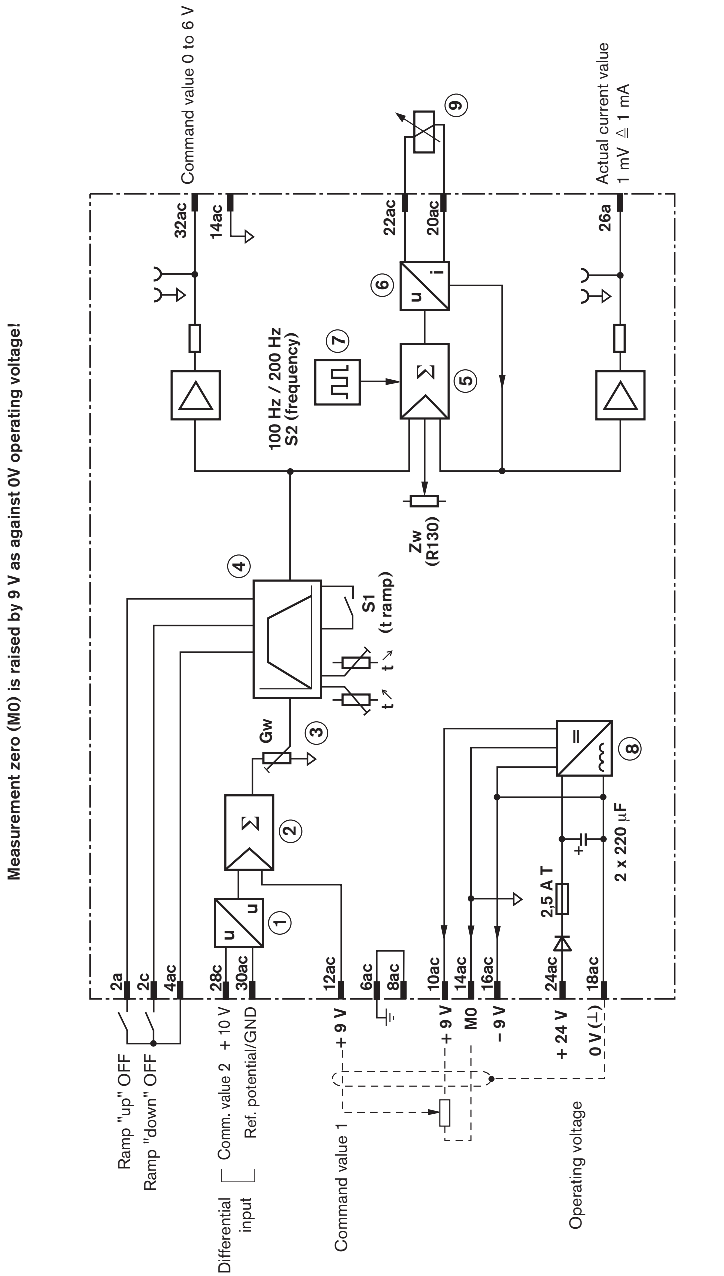
If the VT 2000 amplifier card is not operable, follow the steps below for troubleshooting:

1. Is the operating voltage applied?
   Measure contacts 24ac against 18ac
2. Is the fuse on the card defective?
3. Is the internal operating voltage of ± 9 V available on the card?
4. If the internal command value potentiometer is used, is the jumper from 10ac to 12ac plugged?
5. Is the external potentiometer correctly connected?
   (for the connection, see top left)
6. Is the differential input properly connected?
   Check: Reference potential at 30ac
   0 to + 10 V at 28c
7. Is the solenoid properly connected?
   When the card is unplugged, a resistance of approx. 20 to 30 Ω must be measurable between contacts 22ac and 20ac.
8. The internal command value potentiometer "Gw" must not be turned to the left-hand limit stop ("zero").

Note:

In the case of excessive temperatures (e.g. caused by overloading), the output stage shuts down. This fault is not signalled separately!

Block circuit diagram / pin assignment



1 Differential input
2 Summator
3 Max. command value attenuator
4 Ramp generator
5 Current regulator with summator
6 Current output stage
7 Clock-pulse generator
8 Power supply unit
9 Proportional solenoid of the valve

Gw = Command value attenuation
t = Ramp time adjustment
Zw (R130) = Additional biasing curernt setting (0 to 300 mA)

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

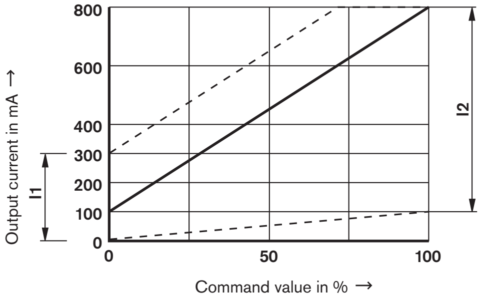
Operating voltage	U_O	24 VDC + 40 % – 5 %
Operating range:		
– Upper limit value	$u_O(t)_{max}$	35 V
– Lower limit value	$u_O(t)_{min}$	22 V
Power consumption	P_S	< 25 VA
Current consumption	I	< 1 A
Fuse	I_F	2.5 A T
Inputs:		
– Command value 1	U_i	0 to + 9 V (reference potential is M0)
– Command value 2 (differential input)	U_i	0 to + 10 V; R_i = 100 kΩ
Ramp time (adjustment range)	t	30 ms to approx. 1 s or 5 s (depending on setting of S1)
Outputs:		
– Output stage		
• Solenoid current / resistance	I_{max}	800 mA [1)] + 10 % – 5 %; $R_{(20)}$ = 19.5 Ω
• Biasing current	I_V	0 mA to 300 mA;
		adjustable using potentiometer “Zw (R130)“ on the printed circuit board
• Clock frequency	f	100 Hz or 200 Hz; ± 10 % each;
		depending on the setting with jumper S2 (“frequency“)
– Regulated voltage	U	± 9 V ± 1 %; ± 25 mA, externally loadable
– Measuring sockets		
• Command value "w"	U	0 to + 6 V (+ 6 V ≙ 100 %); R_i = 1 kΩ
• Actual current value "I"	U	0 to 800 mV ≙ 0 to 800 mA ± 10 mA
Type of connection		32-pin male connector, DIN 41 612, form D
Card dimensions		Euro-card 100 x 160 mm, DIN 41 494
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 to + 85 °C
Weight	m	0.1 kg

1) The maximum current I_{max} can be adjusted to the required value using the command value attenuator (potentiometer "Gw" on the front panel).

Note:

For details regarding **environment simulation testing** in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30111-U (declaration on environmental compatibility).

Output characteristic curve



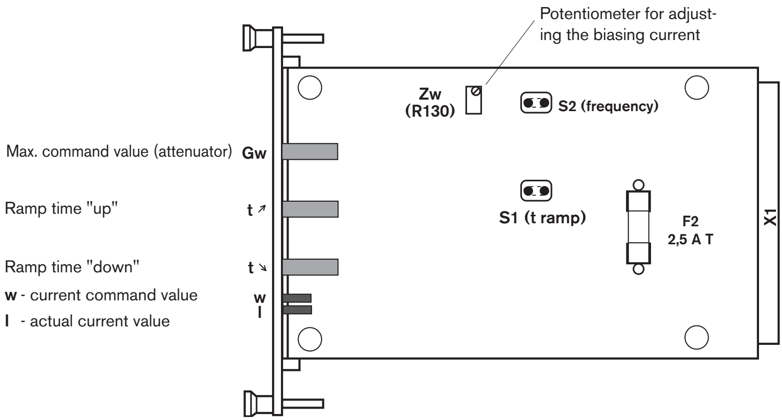
I1 Adjustment range of the biasing current (0 to approx. 300 mA) with potentiometer "Zw (R130)" on the printed circuit board

I2 Adjustment range of the maximum command value with potentiometer "Gw" on the front panel

A Output characteristic curve with factory setting

1

Indicator / adjustment elements



Meaning of the jumpers on the card for the settings
(nameplate on the printed circuit board)

ramp time			frequency			
◯	• 5 s	$\boxed{S1}$	◯	100 Hz	$\boxed{S2}$	$\boxed{Sx}$ = bridge
◯	1 s	S1	◯	• 200 Hz	S2	Sx = open
						• = delivery state

Jumper plugged

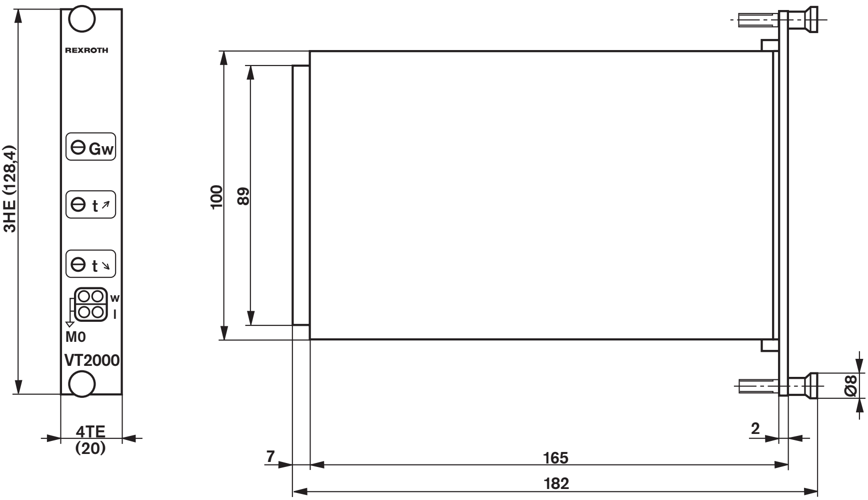
or Jumper open

Note:

The circles (◯) serve for marking the settings made by the customer.

The factory setting is identified with "•".

Unit dimensions (dimensions in mm)



Engineering / maintenance notes / supplementary information

- Before commissioning the amplifier, make sure that the jumpers on the printed circuit board are plugged according to the relevant application.
- With the factory setting, an amplifier of series 5X is interchangeable with series 4X with a ramp time of 5 s and a clock frequency of 200 Hz.
  If a series 5X amplifier is to be used as substitute for a device of series 4X, a blind plate having a width of 4TE must be ordered separately (see ordering code on page 1).
- The amplifier may only be installed when disconnected from the power supply!
- Do not use plug-in connectors with free-wheeling diodes or LED lamps for connecting the solenoids!
- Measurements on the card may only be taken using instruments with $R_i > 100$ kΩ!
- The measurement zero (M0) is raised by + 9 V as against the 0V operating voltage and is not electrically isolated,
  i.e. – 9 V regulated voltage ≙ 0V operating voltage.
  The measurement zero (M0) must therefore not be connected to the 0V operating voltage!
- Use relays with gold-plated contacts for passing on command values (small voltages, small currents)!
- Always shield command value cables; connect the shield to ground on the card side and leave the other end open. The card must be connected to ground at connection 6 or 8. If no system ground is available, connect 0V operating voltage.
  Recommendation: Also shield solenoid cables!
  For solenoid cable lengths up to 50 m, use cable type LiYCY 1.5 mm^2.
  For greater lengths, please consult us!
- The distance to aerial lines, radio sources and radar equipment must be at least 1 m!
- Do not lay solenoid and signal cables near power cables!
- Because of the charging current of the smoothing capacitors on the card, back-up fuses must be of the slow-blowing type!
- **Caution:** When using the differential input, both inputs must always be activated or deactivated simultaneously!

  Note: Electrical signals (e.g. actual value) brought out via control electronics must not be used for switching safety-relevant machine functions!
  (See also European standard "Safety requirements for fluid power systems and components – hydraulics", prEN 982)

Notes

Notes

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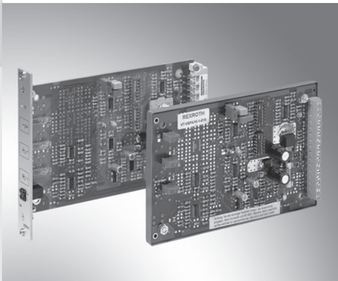
Electrical amplifiers

RE 30111/10.10
Replacses: 09.05

1/12

Type VT-VSPA1-1 and VT-VSPA1K-1

Component series 1X



H5897_d

Table of contents

Features

– Suitable for controlling all direct and pilot operated proportional pressure control valves without electrical position feedback and only one solenoid as actuator that are available at the time of publication of this data sheet
– Differential input, can be switched between voltage and current input
– Additional command value input, 0 to +9 V
– Ramp generator, can be adjusted separately for up and down ramps
– Clocked output stage
– Signal "ready for operation" (VT-VSPA1K-1 only with LED indicator lamp)
– Reverse polarity protection for voltage supply
– Cable break detection of current input 4 to 20 mA
– Short-circuit protection of solenoid cable
– Cable break detection of solenoid cable

Ordering code

VT-VSPA1		1	–1X	/ *

Amplifiers for controlled proportional pressure control valves, analogue, with one solenoid

With 32-pin male connector and front panel = No code
With 16-pin terminal strip; without front panel = K

Further details in clear text

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

Suitable card holders for VT-VSPA1-1:
– Type VT 3002-2X/32, see RE 29928
Single card holder without power supply unit

Suitable power supply unit:
– Type VT-NE30-2X, see RE 29929
Compact power supply unit 115/230 VAC → 24 VDC, 108 W

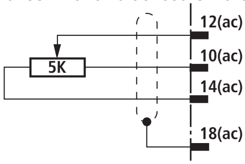
For substitutes for amplifier types VT 2000 (up to component series 4X), VT 2010, VT 2013 or VT 2023 for rack installation, blind plate 4TE/3HE must be ordered separately.
Material no. R900021004

Functional description

The command value voltage is applied to command value input 1 either directly or via an external command value potentiometer with the help of the regulated + 9V voltage from the power supply unit [14].

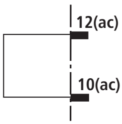
The following is valid for this input: +9 V ≙ +100 % [1].

External command value feedforward

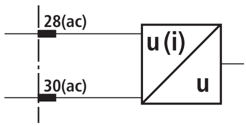


Note:
When an external command value potentiometer is used, internal potentiometer "Gw" [3] must be set to maximum or the required maximum pressure.

Internal command value feedforward



Differential input (input 2)



Additions to the pin designations in brackets are only valid for type VT-VSPA1-1.

Command value input 2 is a differential input [1] (0 to + 10 V). With the help of DIL switches [2] it can be configured as current input (4 to 20 mA or 0 to + 20 mA). If the command value is fed forward by external electronics with a different reference potential (e.g. by a PLC), this input must be used. When the command value voltage is applied or withdrawn, care must be taken that both signal cables are disconnected from or connected to the input.

Before being passed on, both command values are summated [2] and then fed to a potentiometer [3] that is accessible on the front panel and acts as attenuator and limits the maximum command value.

The downstream ramp generator [4] generates a ramp-shaped output signal from a stepped input signal. The time constant of this signal can be adjusted separately for “up” and “down” ramps with the help of two potentiometers. The specified ramp time refers to a command value step-change of 100% and can be approx. 1 s or 5 s, depending on the setting of a DIL switch [2]. If a command value step-change of less than 100 % is fed to the input of the ramp generator or when attenuator [3] is effective, the ramp time shortens accordingly

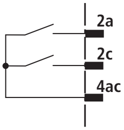
The following is valid for type **VT-VSPA1-1**: The up and down ramp times can be set separately to their minimum value (approx. 30 ms) with the help of the external contacts “ramp up/down OFF”.

The following is valid for type **VT-VSPA1K-1**: The up and down ramp times can be set collectively to their minimum value (approx. 30 ms) with the help of the external contact “ramp OFF”.

Functional description (continued)

Ramp "up/down" OFF

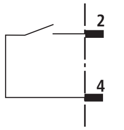
VT-VSPA1-1



Ramp "up" OFF

Ramp "down" OFF

VT-VSPA1K-1



Ramp OFF

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

Summing amplifier [5] adds the output signals of the characteristic curve generators [6 or 7] to the command value (can be selected by means of DIL switches [2)] depending on the valve to be controlled). The current command value can also be filtered through a low-pass filter that can be cut in. Current output stage [9] is controlled via current regulator [8]. In addition, the current regulator modulates the current command value with clock-pulse encoder signal [10] (the frequency can be programmed with the help of DIL switches [2)]). The clocked actual current value acts in the solenoid of the valve like a constant current with overlaid dither signal. Type VT-VSPA1-1 is provided with measuring sockets for the internal command value and the actual value.

The following is valid for the command value: +6 V ≙ 100 %

The following is valid for the actual value: 1 mV ≙ 1 mA

The signal "ready for operation" is output and LED "H2" on the front panel (with VSPA1-1) or LED "H2" (with VSPA1K-1) is lit, when:

– The solenoid cables are not short-circuited and the output stage is not overloaded,

– a command value is applied (cable break detection),

– there is no cable break present on the solenoid cable.

[1)] Reference potential for command value 1 is M0 (measuring zero).

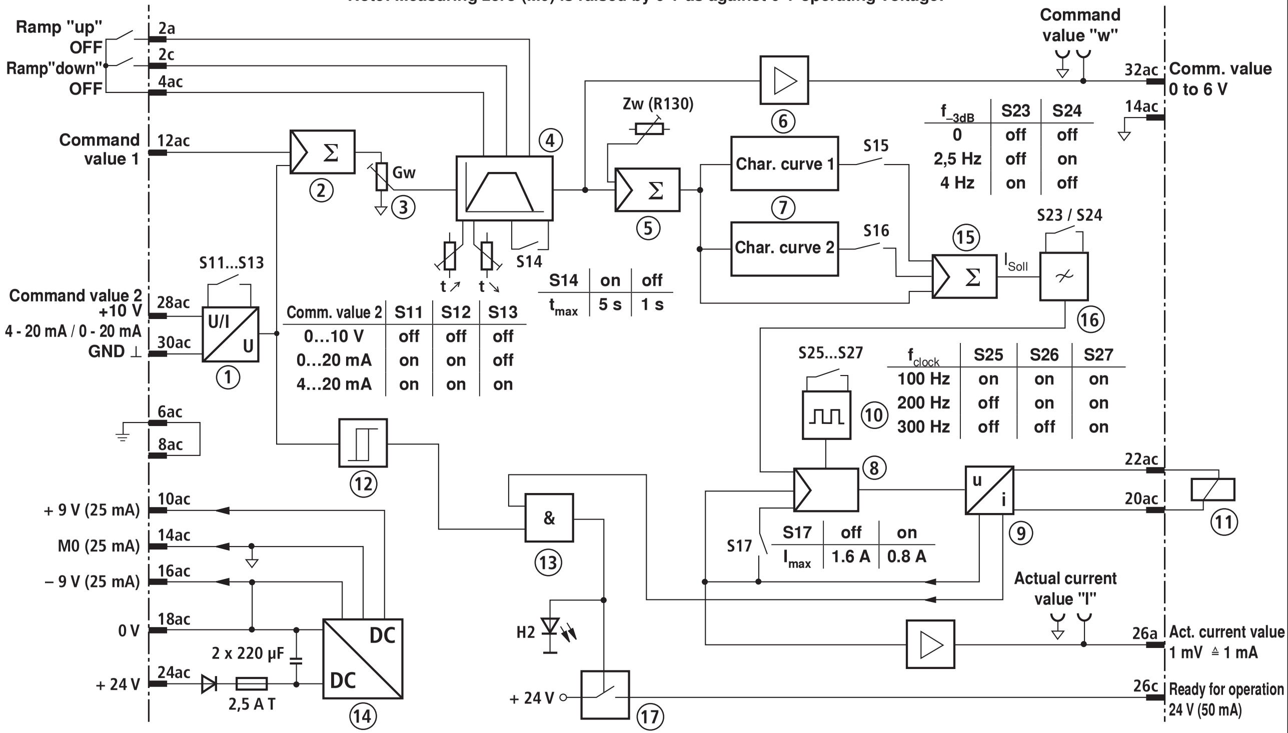
[2)] For DIL switch settings, see page 8 to 10

[ ] … Cross-reference to block circuit diagrams on pages 4 and 5

1

Block circuit diagram / pin assignment: VT-VSPA1-1

Note: Measuring zero (M0) is raised by 9 V as against 0 V operating voltage!



Comm. value 2	S11	S12	S13
0…10 V	off	off	off
0…20 mA	on	on	off
4…20 mA	on	on	on

S14	on	off
t_{max}	5 s	1 s

f_{-3dB}	S23	S24
0	off	off
2,5 Hz	off	on
4 Hz	on	off

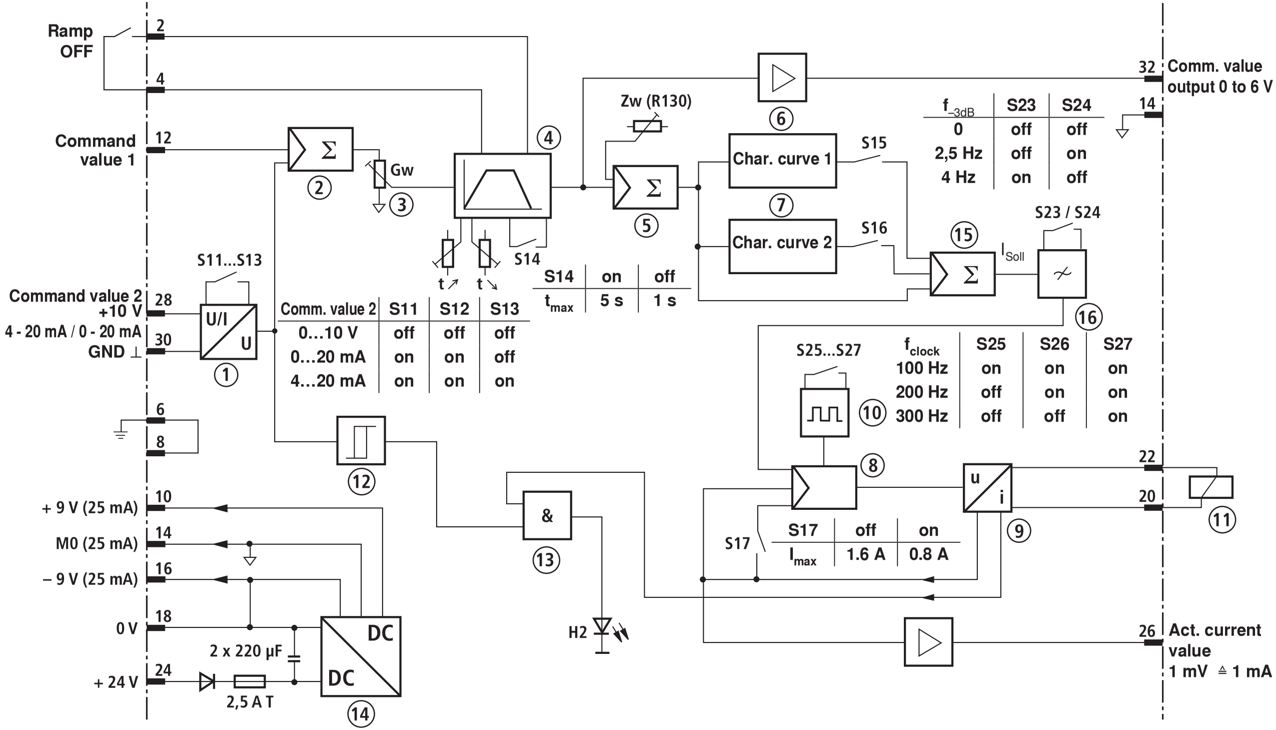
f_{clock}	S25	S26	S27
100 Hz	on	on	on
200 Hz	off	on	on
300 Hz	off	off	on

S17	off	on
I_{max}	1.6 A	0.8 A

1	Differential input
2; 5; 15	Summator
3	Max. command value attenuator
4	Ramp generator
6	Characteristic curve generator 1
7	Characteristic curve generator 2
8	Current regulator
9	Current output stage
10	Clock-pulse generator
11	Proportional solenoid of valve
12	Command value monitoring
13	Monitors
14	Power supply unit
16	Low-pass filter
17	Output “ready for operation“
H2	Signal “ready for operation“
Gw	Command value attenuation
t	Ramp time adjustment
Zw (R130)	Additional biasing current adjustment (0 to 300 mA or 0 to 600 mA)

Block circuit diagram / pin assignment: VT-VSPA1K-1

Note: Measuring zero (M0) is raised by 9 V as against 0 V operating voltage!



1	Differential input	6	Characteristic curve generator 1	11	Proportional solenoid of valve	H2	Signal "ready for operation"
2; 5; 15	Summator	7	Characteristic curve generator 2	12	Command value monitoring	Gw	Command value attenuation
3	Max. command value attenuator	8	Current regulator	13	Monitors	t	Ramp time adjustment
4	Ramp generator	9	Current output stage	14	Power supply unit	Zw (R130)	Additional biasing current adjustment (0 to 300 mA or 0 to 600 mA)
		10	Clock-pulse generator	16	Low-pass filter		

1

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

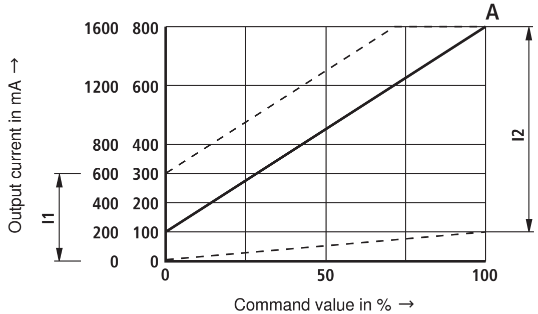
Operating voltage	U_O	+24 VDC +40 % –5 %
Operating range:		
– Upper limit value	$u_O(t)_{max}$	+35 V
– Lower limit value	$u_O(t)_{min}$	+22 V
Max. power consumption	P_s	50 VA
Max. current consumption	I	1.8 A
Fuse	I_s	2.5 A T
Inputs:		
– Command value 1	U_i	0 to +9 V (reference potential is M0)
– Command value 2 (differential input)	U_i	0 to +10 V; R_i = 100 Ω — depending on setting with S11 to S13
or	I_i	4 to 20 mA (load R_L = 100 Ω) — depending on setting with S11 to S13
or	I_i	0 to 20 mA (load R_L = 100 Ω) — depending on setting with S11 to S13
Ramp time (adjustment range)	t	30 ms to approx. 1 s or 5 s (depending on setting with S14)
Outputs:		
– Output stage		
• Solenoid current/resistance	I_{max}	800 mA +20 %, R_{20} = 19,5 Ω — depending on setting with S17 [1]
or	I_{max}	1600 mA +20 %, R_{20} = 5,4 Ω — depending on setting with S17 [1]
• Biasing current at I_{max} = 800 mA	I_b	50 mA or 100 mA — depending on setting with S17 and “Zw“ (R130)
at I_{max} = 1600 mA	I_b	100 mA — depending on setting with S17 and “Zw“ (R130)
additionally at I_{max} = 800 mA	I_b	0 to 300 mA +20 % — Adjustable by means of “Zw“ (R130) on the printed-circuit board
at I_{max} = 1600 mA	I_b	0 to 600 mA +20 % — Adjustable by means of “Zw“ (R130) on the printed-circuit board
• Clock frequency	f	100 Hz, 200 Hz, 300 Hz or 370 Hz ±10 % each (depending on setting with S25 to S27)
– Signal “ready for operation“ (only with VT-SPA1-1)		
• Component series 10 when ready for operation	U	approx. U_O
in the case of a fault	U	< 1 V
• From component series 11 when ready for operation	U	approx. U_O, 50 mA — Load resistance > 10 kΩ
in the case of a fault	U	0 V, R_i = 10 kΩ — Load resistance > 10 kΩ
– Regulated voltage	U	±9 V ±1 %, ±25 mA externally laodable
– Measuring sockets		
• Command value “*w*“	U	0 to +6 V (+6 V ≙ 100 % solenoid current), R_i = 1 kΩ
• Actual current value *“I“*	U	0 to 1600 mV ≙ 0 to 1600 mA ±20 mA
Type of connection:		
– VT-VSPA1-1		32-pin male connector, DIN 41612, form D
– VT-VSPA1K-1		16-pin terminal strip
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)
– Width component side		3 TE
Permissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–25 to +85 °C
Weight	m	0.1 kg

[1] The maximum current I_{max} can be set to the required value by means of command value attenuator potentionmeter “Gw“.

1

Output characteristic curves

Linear output characteristic curve (basic characteristic curve)

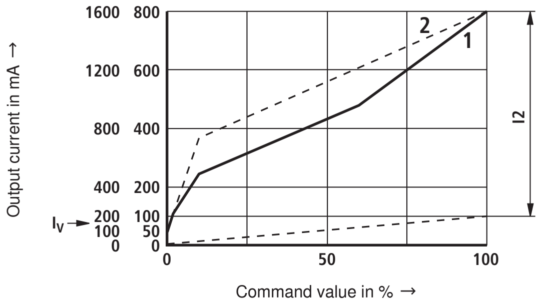


I1 Adjustment range of biasing current I_b by means of potentiometer "Zw" (R130) on the printed-circuit board

I2 Adjustment range of maximum command value by means of potentiometer "Gw"

A Characteristic curve with factory setting

Output characteristic curve with firmly set characteristics
(see adjustment instructions on pages 9 and 10)



I_v Biasing current curve 2 (qualitative representation)

I2 Adjustment range of maximum command value by means of potentiometer "Gw"

1 Characteristic curve 1 (qualitative representation)

2 Characteristic curve 2 (qualitative representation)

Indicator / adjustment elements

VT-VSPA1-1, component series 10

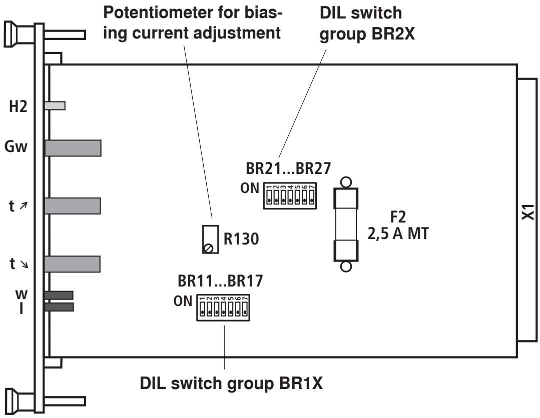
LED indicator lamp "ready for operation"

Max. command value (attenuator)

Ramp time "up"

Ramp time "down"

w - Current command value
I - Actual current value



VT-VSPA1-1, from component series 11

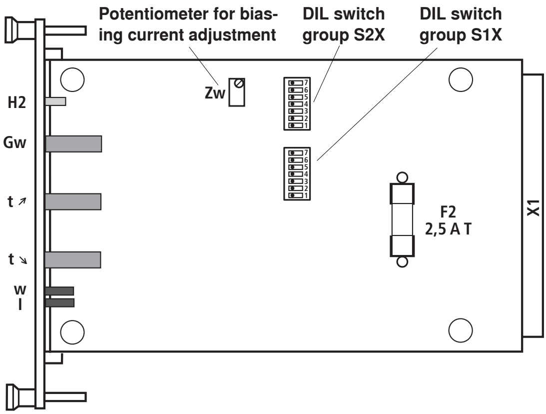
LED indicator lamp "ready for operation"

Max. command value (attenuator)

Ramp time "up"

Ramp time "down"

w - Current command value
I - Actual current value

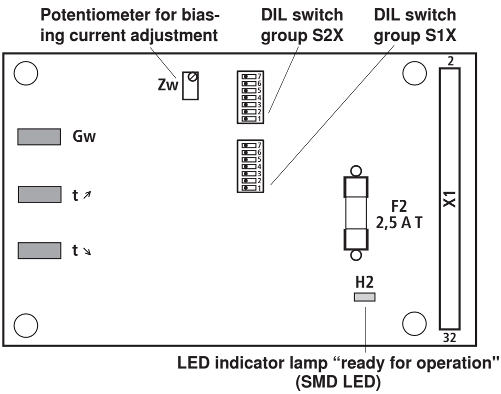


VT-VSPA1K-1

Max. command value (attenuator)

Ramp time "up"

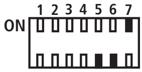
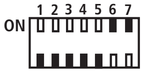
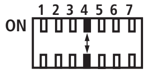
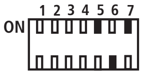
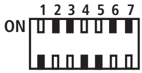
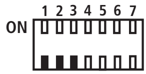
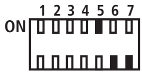
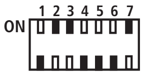
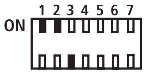
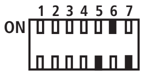
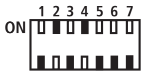
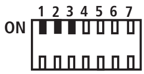
Ramp time "down"



1

Indicator / adjustment elements (continued)

Assignment of DIL switch settings on the card to the valve types (see also label on the printed-circuit board)

Setting for valve types:	S15 ... S17 (BR15 ... BR17)	S21 ... S27 (BR21 ... BR27)	Setting valid for all valve types:	S11 ... S14 (BR11 ... BR14)
DBE(M)T, DBE(M)30, DRE(M)30, 3DRE(M)10 1), 3DRE(M)16 1), DBEP6A, DBEP6B, 3DREP6A, 3DREP6B, pumps			**Ramp time** 5 s ↕ 1 s	
DRE(M)10-5X, DRE(M)20-5X		 X	**Command value 2** +10 V	
DBE(M)10-5X, DBE(M)20-5X, 3DRE(M)10P-6X, 3DRE(M)16P-6X, ZDRE10, (Z)DBE6		 X	0 … 20 mA	
DRE6, ZDRE6		 X	4 … 20 mA	

1) Up to component series 5X

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

– Adjustment of biasing current by means of potentiometer "Zw" (R130)
  - Turning clockwise → increase in biasing current
  - Turning counter-clockwise → reduction of biasing current
– Adjustment of the max. command value by means of potentiometer "Gw"
  - Turning clockwise → increase in command value
  - Turning counter-clockwise → reduction of command value

Note (X):

With type VT-VSPA1-1 (component series 10) switch BR22 must be set to “ON” and potentiometer “R130” turned to “left-hand limit stop” before the correct characteristic curve can be set.

With type VT-VSPA1-1 (from component series 11) and type VT-VSPA1K-1, the switches S21 and S22 are ineffective. Potentiometer "Zw" needs not to be operated.

Meaning of the DIL switches

Note (X):

Before commissioning the amplifiers, make sure that the DIL switches on the printed-circuit board are set according to the relevant application.

Switch positions with reference to the current valve types or previous amplifier cards

Switch	Valve types/amplifier cards			
	DBE(M)T, DBE(M)30 DRE(M)30, DRE(M)10 [3)] DRE(M)16 [3)] DBEP6A, DBEP6B 3DREP6A, 3DREP6B pumps	DRE(M)10-5X DRE(M)20-5X	DBE(M)10-5X DBE(M)20-5X ZDRE10 (Z)DBE6 3DRE(M)10P-6X 3DRE(M)16P-6X	DRE, ZDRE6
	VT 2000	VT 2010	VT 2013	VT 2023
	Characteristic curves			
	Basic characteristic curve	Characteristic curve 1	Characteristic curve 1	Characteristic curve 2
S15 (BR15)	OFF	ON	ON	OFF
S16 (BR16)	OFF	OFF	OFF	ON
	Command value filters			
		f_{-3dB} = 4 Hz	f_{-3dB} = 4 Hz	f_{-3dB} = 2.5 Hz
S23 (BR23)	OFF	ON	ON	OFF
S24 (BR24)	OFF	OFF	OFF	ON
	Max. output current [1)]			
	I_{max} = 800 mA	I_{max} = 800 mA	I_{max} = 1,6 A	I_{max} = 1.6 A
S17 (BR17)	ON	ON	OFF	OFF
	Clock frequency [2)]			
	f = 200 Hz	f = 200 Hz	f = 300 Hz	f = 370 Hz
S25 (BR25)	OFF	OFF	OFF	OFF
S26 (BR26)	ON	ON	OFF	OFF
S27(BR27)	ON	ON	ON	OFF
	Basic biasing current setting			
“Zw“ (R130)	100 mA	50 mA	100 mA	100 mA

1) Doubling of the maximum output current doubles the adjustment range and the set biasing current.

2) For f = 100 Hz, DIL switches S25, S26 and S27 must be set to the “ON“ position.

3) Up to component series 5X

Adjustment range of biasing current using potentiometer “Zw“ (R130):

I_{max} = 800 mA → I_b = 0 to 300 mA

I_{max} = 1600 mA → I_b = 0 to 600 mA

( ) valid for VT-VSPA1-1, component series 10

When switch BR22 is operated, the biasing current increases by 50 mA or 100 mA.

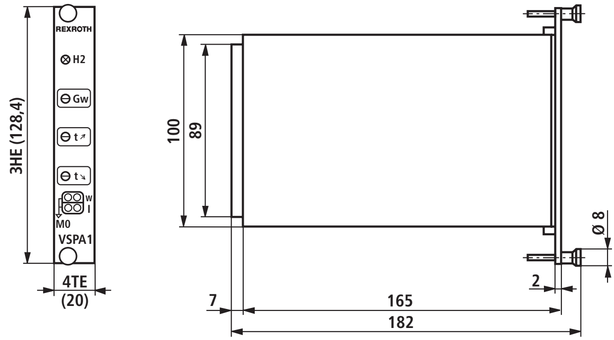
Adjustment options inedependent of the valve type (command value 2 and ramp time)

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

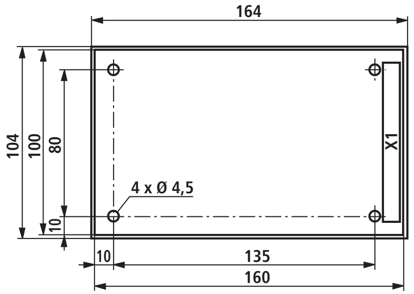
[grey box] = Factory setting (corresponds to the configuration of a VT 2000 amplifier)

Unit dimensions (dimensions in mm)

VT-VSPA1-1



VT-VSPA1K-1



Engineering / maintenance notes / supplementary information

- Before commissioning the amplifiers, make sure that the DIL switches on the printed-circuit board are set according to the relevant application.
- The factory setting of the parameters is as follows (for the adjustment of parameters, see pages 8 to 10):
  max. ramp time = 5 s, biasing current = 100 mA, max. output current = 800 mA, clock frequency = 200 Hz
- The amplifier card may only be installed when disconnected from the power supply!
- Do not use plugs with free-wheeling diodes or LED lamps for connecting the solenoids!
- Measurements on the card may only be taken with instruments R_i > 100 kΩ !
- Measuring zero (M0) is raised by +9 V as against 0 V operating voltage and not electrically isolated, i.e. –9 V regulated voltage ≙ 0 V operating voltage. For this reason, do not connect measuring zero (M0) to 0 V operating voltage!
- Use relays with gold-plated contacts for passing on command values (small voltages, small currents)!
- Always shield command value cables; connect the shield to ground on the card side and leave the other end open. Connect the card to ground at terminal 6 or 8. If no system ground is provided, connect 0 V operating voltage.
  Recommendation: Also shield solenoid cables!
  For solenoid cables of up to 50 m length, use cable type LiYCY 1.5 mm^2. For greater lengths, please consult us!
- The distance to aerial lines, radio sources and radar equipment must be at least 1 m!
- Do not lay solenoid and signal cables near power cables!
- Due to the charging current of the smoothing capacitor on the card, fuses must feature slow-blowing characteristics!

⚠ **Caution!** When the differential input is used, both inputs must always be switched on or off simultaneously!

Note! Electrical signals (e.g. signal “ready for operation”) brought out via control electronics must not be used for switching safety-relevant machine functions!
(See also European standard “Safety requirements for fluid power systems and components - hydraulics“, EN 928.)

Troubleshooting

If the amplifier cards are not operable, follow the steps below for troubleshooting:

1. Is the operating voltage applied?
   Measurement of contacts 24(ac) against 18 (ac)
2. Fuse on the card defective?
3. Internal ±9 V operating voltage available on the card?
4. When the internal command value potentiometer is used, is the jumper from 10(ac) to 12(ac) plugged?
5. Is the external potentiometer properly connected?
6. Is the differential input properly connected?
   Check: Reference potential to 30(ac)
   0 to +10 V to 28(ac)
7. Is the solenoid properly connected?
   When the card is unplugged, a resistance of approx. 20 Ω to 30 Ω or 5 Ω to 8 Ω, depending on the valve, must be measurable between contacts 22ac and 20ac.

The additions to the contact designations are only valid for type VT-VSPA1-1.

Note:

The output stage shuts down in the case of excessive temperatures (e.g. caused by overloading). This fault is signalled by LED "H2" going out!

In the event of a cable break of the "4 to 20 mA" input, the signal "ready for operation" is reset and LED "H2" also goes out.

The following is valid from component series 11 onwards:

In the case of a short-circuit or cable break of the solenoid cable, the output “ready for operation” is switched and LED "H2" flashes at a frequency of 0.5 to 2 Hz as soon as the command value is > 2 % at the same time.

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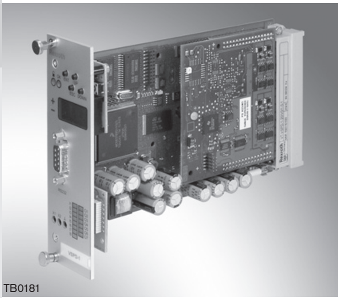
Bosch Group

Digital valve amplifier for proportional valves without electrical position feedback

RE 30523/09.07
Replaces: 08.06

Type VT-VSPD-1

Component series 2X



TB0181

Table of contents

Features

– Suitable for controlling proportional valves without electrical position feedback, types:
  4WRA 6 and 10, component series 2X
  4WRZ 10 to 52, component series 5X to 7X
  (Z)DBE 6, component series 1X
  DBE(M)T, component series 5X
  DBE(M) 10 and 25, component series 5X
  DBE(M) 32, component series 3X
  DBEP 6, component series 1X
  DRE 4 K, component series 3X
  DRE(M) 10 and 25, component series 5X
  (Z)DRE 6, component series 1X
  ZDRE 10, component series 1X, 2X
  3DRE(M) 10 P and 16 P, component series 6X, 7X
  DRE(M) 32, component series 4X
  3DREP 6, component series 1X and 2X
  DBET 6, component series 6X

Continued on page 2

Features (continued)

- User-specific data can be exactly reproduced and are protected against unintended or unauthorized changing
- Use of a powerful microcontroller
- Valve selection by means of BODAC operator software
- Command value input, optionally as voltage or current interface
- Voltage input as differential input
- For optional applications, free programmability of output stage frequency, biasing, surge and final current, or characteristic curve correction with a maximum of 8 supporting points
- Command value input with variable input adjustment
- Ramp generator
- Digital inputs for calling up pre-set command value parameters
- Enable input and fault output
- Switched-mode power supply unit for internal supply voltages
- Freely configurable measuring socket X2
- Display (optional) for diagnostics purposes and complete configuration and parameterization
- Configuration and parameterization via serial interface with PC software BODAC (CD:SYS-HACD-BODAC-01)
- Up to 32 amplifiers can be interconnected via local bus for parameterization and diagnostics

Ordering code

VT-VSPD – 1 – 2X / V0 / 0 – 0 – 1

Digital amplifier for proportional valves without electrical position feedback	VT-VSPD	
Amplifier for valve types (see page 1, Features)	= 1	
Component series 20 to 29 (20 to 29: unchanged technical data and pin assignment)	= 2X	
V0 =		Basic device
0 =		Without display
1 =		With display
0 =		Basic device
1 =		With valve output stage

Standard types	Material number
VT-VSPD-1-2X/V0/0-0-1	R901077297
VT-VSPD-1-2X/V0/1-0-1	R901161533

Required accessories:

- PC program BODAC: Ordering code for CD: SYS-HACD-BODAC-01 (R900777335) or free download on the Internet at www.boschrexroth.com/hacd
- Interface cable: Cable set VT-HACD-1X/03.0/HACD-PC (R900776897) or commercial 1:1 cable

Suitable card holders:

- 19" racks VT 19101, VT 19102, VT 19103 and VT 19110, see RE 29768
- Enclosed card holder VT 12302, (standard), Mat. no. R900784153, see RE 30103
- Open card holder VT 3002-2X/48F, Mat. no. R900020154) or VT 3002-2X/64G, Mat. no. R900991843), see RE 29928 Only for installation in control cabinet!
- Connection adapter VT 10812-2X/64G, Mat. no. R900713826, see RE 30105

Functional description

The amplifier card is designed as double-sided printed-circuit board of Euro-card format 100 x 160 mm with daughter board.

The central unit of the amplifier is a microcontroller that controls the entire sequence. Data for configuration, command values, and parameters are saved in a non-volatile FLASH.

Four binary-coded, digital inputs can be used for calling up parameter sets (command values) from the memory, in which a maximum of 16 sets can be saved. A call-up activates the command value for the valve spool position with the associated ramp times.

Further control inputs assume the following functions:

"Comm. valid":	Enable of the parameter set addressed by the current call-up (H-active)
"Enable":	Activation of outputs (acknowledgement of fault message with Low→High edge)

The command value can be provided in the form of digital command value call-ups [5] and/or via analog inputs [1]. Analog input AI4 (b14/b16) must be used for command values of ±10 V, analog input AI6 (b22/b24) for command values of 4 to 20 mA.

Command values of 0 to +10 V (12...20 mA) control solenoid "B".

Command values of 0 to –10 V (4...12 mA) control solenoid "A".

The digital command value is added to the analog command value with the correct sign in accordance with the set call-up.

The signal level of the command value inputs can be varied by means of the software.

Apart from the possibility of generating ramps internally, the ramps for "up" and "down" can be influenced by external signals with the correct amount and sign with the help of analog inputs AI2 (b6/b8) and AI5 (b18/b20).

When a spool with overlap is selected for valves, a step function generator [8] can be configured by means of the software to implement an overlap jump.

Enable and fault messages

Closed-loop controlling is activated by an H-level at the enable input. If no command value call-up is active, digital call-up "0" is set.

A fault logic [13] recognizes a cable break of the command value input for 4 to 20 mA and an inactive enable input. When a fault is present, a fault message is output by means of a "low" signal at (d22) and the fault signaled visually by the LED "OK" (OK goes out) on the front panel. It is possible to configure the enable so that an inactive enable input is not signaled as a fault.

Parameterization and diagnosis

The selection of the valve to be controlled and the selection and configuration of the command value input, the ramp generator and the enable input, and the setting of parameters of the command value call-ups meter are made via the serial interface at the D-SUB sockets at the front. Up to 32 valve amplifiers can be interconnected via the local bus. Each valve amplifier is assigned a bus address via BODAC. Re-plugging of the serial interface cable is not required. For further information, please see RE 30523-01-B.

On the version with display, configuration, parameterization, and diagnostics can be carried out directly on the display without a PC.

Digital outputs

DO 1	(d20)	Solenoid A active
DO 2	(d26)	Solenoid B active
DO 3	(z22)	Freely configurable
DO 4	(z24)	Freely configurable
DO 5	(z26)	Freely configurable
DO 6	(z28)	Freely configurable
DO 7	(f2)	Not assigned

Indicator elements and measuring sockets

The front panel of the command value card is fitted with measuring sockets for the two analog outputs:

Measuring socket "X1":	Valve current
Measuring socket "X2":	Valve command value (default)
Measuring socket "⊥":	Reference potential (corresponds to connection z32)

The following states are signaled by LEDs:

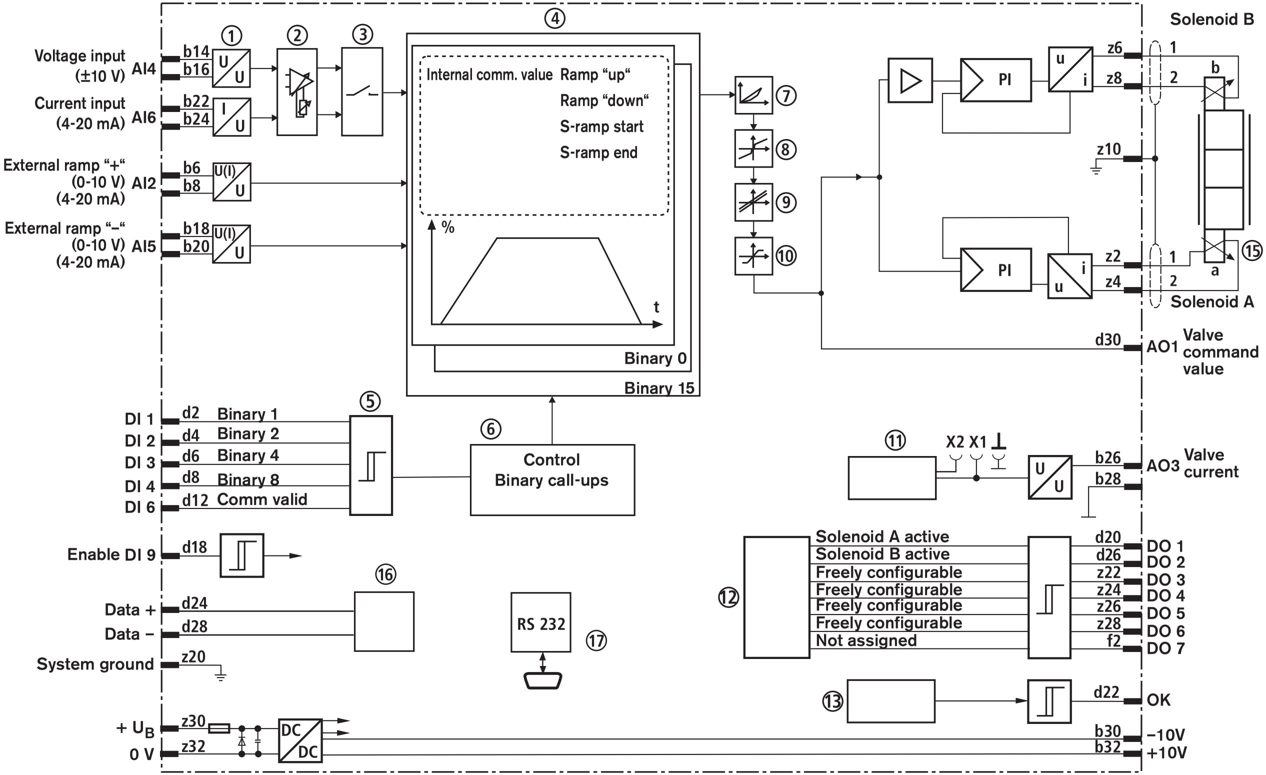
LED "🔓" (green):	Enable active
LED "OK" (green):	OK ready for operation
LEDs "I1"..."I4" (yellow):	Binary-coded command value call-ups
LED "I6" (yellow)	Command valid
LED "I5, I7" (yellow)	Not assigned

Display functions:

Display, 4 characters	Configuration, parameterization and diagnosis in conjunction with the keys above

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

Block circuit diagram



1 U/U or I/U converter
2 Analog input adjustment
3 Switching matrix
4 Command value generation
5 Binary command value call-ups
6 Control of binary call-ups
7 Characteristic curve adjustment
8 Step function generator
9 Offset
10 Limitation
11 Measuring sockets
12 Digital outputs
13 Fault logic
14 Switched-mode power supply unit
15 Connection for valve with one solenoid
16 Local bus
17 Serial interface

Measuring sockets:

X1 Valve current (default)

X2 Freely configurable Output ±10 V

⊥ Reference potential (0 V)

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

Operating voltage	U_B	24 VDC + 40 % – 10 %
Operating range:		
Upper limit value	$u_B(t)_{max}$	35 V
Lower limit value	$u_B(t)_{min}$	21 V
Current consumption	I_{max}	1.5 A; stand-by current 270 mA
Fuse	I_S	4 A slow-blowing
Digital inputs	Signal	log 0 = 0 to 5 V log 1 = 16 V to U_B
Digital outputs	Signal	log 0 = 0 to 5 V log 1 = U_B – 3 V I_{max} = 30 mA, short-circuit-proof
Analog inputs		
Voltage inputs AI4, AI2 and AI5		
Range	U	±10 V
Input resistance	R_e	100 kΩ, > 10 MΩ for input AI2
Resolution		5 mV for range ±10 V 2.5 mV for range 0...10 V
Non-linearity		< 10 mV
Current inputs AI6, AI2 and AI5		
Range	I	4...20 mA
Input resistance	R_e	100 Ω
Current loss		0.15 % (at 500 Ω between Pin b24, b8, b20 and 0 V)
Resolution	I	5 µA
Analog outputs		
Voltage outputs AO1 and AO3		
Output voltage	U	±10 V
Load	R_{Lmin}	1 kΩ
Resolution	U	1,25 mV (14 bit)
Residual ripple content		±15 mV (without noise)
Ramp time	s	max. 300
Valve output stage		
Solenoid current per solenoid	I_{max}	2.5 A
Reference voltage	U	±10 V, 30 mA, short-circuit-proof
Residual ripple content		< 20 mV
Sample time for command value conditioning	t	2 ms
Serial interface		RS 232 (front panel), D-Sub socket
Type of connection		64-pin connector strip, DIN 41612, form G
Local bus, distance to the most distant station	l	max. 280 m cable length
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Front panel dimensions:		
Height		3 HE (128.4 mm)
Width soldering side		1 TE (5.08 mm)
Width component side		7 TE
Permissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight	m	0.2 kg

Note:

For details regarding **environment simulation testing** in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30523-U (declaration on environmental compatibility).

Pin assignment of multiple plug

Row d		
Pin	Short designation	Description
2	DI 1	Binary 1
4	DI 2	Binary 2
6	DI 3	Binary 4
8	DI 4	Binary 8
10	DI 5	n. c.
12	DI 6	Command valid
14	DI 7	n. c.
16	DI 8	n. c.
18	DI 9	Enable
20	DO 1	Solenoid A active
22	OK	OK output
24	Data+	Local bus
26	DO 2	Solenoid B active
28	Data–	Local bus
30	AO 1	Valve command value
32	n. c.	n. c.

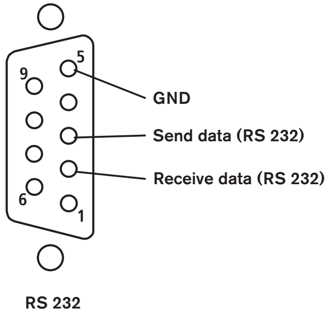
Row b		
Pin	Short designation	Description
2	n. c.	n. c.
4	n. c.	n. c.
6	AI 2+	Ramp + (U/I) +
8	AI 2–	Ramp + (U/I) –
10	n. c.	n. c.
12	n. c.	n. c.
14	AI 4+	Command value (U) +
16	AI 4–	Command value (U) –
18	AI 5+	Ramp – (U/I) +
20	AI 5–	Ramp – (U/I) –
22	AI 6+	Command value (I) +
24	AI 6–	Command value (I) –
26	AO 3	Valve current ±10V
28	AGND	Analog GND
30	REF–	–10 V
32	REF+	+10 V

Row z		
Pin	Short designation	Description
2	MA+	Solenoid A+ [1]
4	MA–	Solenoid A– [1]
6	MB+	Solenoid B+
8	MB–	Solenoid B–
10	Shield	Shield
12	n. c.	n. c.
14	n. c.	n. c.
16	n. c.	n. c.
18	n. c.	n. c.
20	System ground	System ground
22	DO 3	Freely configurable
24	DO 4	Freely configurable
26	DO 5	Freely configurable
28	DO 6	Freely configurable
30	UB	Supply voltage
32	LO	Ground

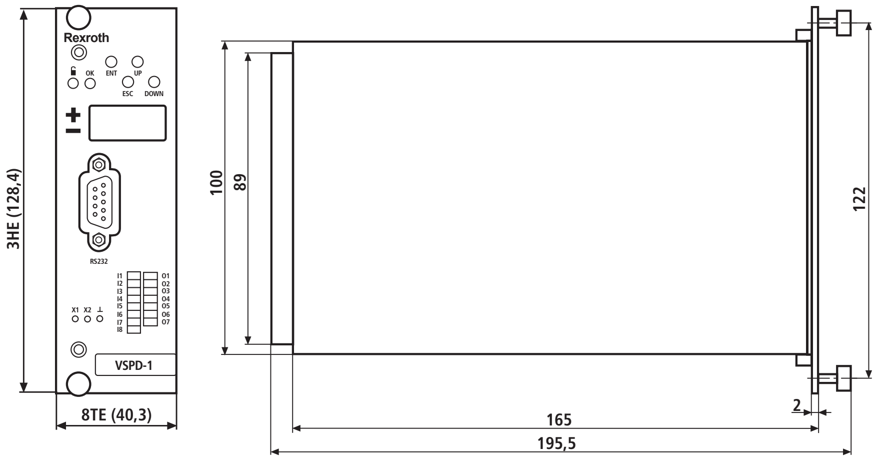
Row f		
Pin	Short designation	Description
2	DO 7	n. c.
4	n. c.	n. c.
6	n. c.	n. c.
8	n. c.	n. c.
10	n. c.	n. c.
12	n. c.	n. c.
14	n. c.	n. c.
16	n. c.	n. c.
18	n. c.	n. c.
20	n. c.	n. c.
22	n. c.	n. c.
24	n. c.	n. c.
26	n. c.	n. c.
28	n. c.	n. c.
30	n. c.	n. c.
32	n. c.	n. c.

[1] Connection for valve with one solenoid

Pin assignment of D-SUB socket



Unit dimensions (dimensions in mm)



Engineering / maintenance notes / supplementary information

Product documentation for valve amplifier VT-VSPD-1-2X/

- RE 30523
  Technical data sheet (the present document)
- RE 30523-B
  Installation and operating instructions
- RE 30523-01-B
  Commissioning and operating instructions
- RE 30523-U
  Declaration on environmental compatibility
- RE 30523-Z
  Supplementary information on the replacement of VT-VSPD-1-1X by VT-VSPD-1-2X

– 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 $R_i > 100$ kΩ!
– Use relays with gold-plated contacts for passing on command values (small voltages, small currents)!
– Command value cables must always be shielded; connect the shield to connection z10 on the card side and leave the other end open (risk of earth loops)!
– 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! Also shield solenoid cables!
– Use a highly flexible Cu conductor (min. 2.5 mm^2) for connecting the system ground!
The system ground is an integral part of EMC protection of the amplifier card. It is used to discharge interference that is transported via the data and supply cables. This is only possible when the system ground itself does not inject in interference into the command value card.
– 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!
– **Attention:** When using the **differential input, both inputs** must always be switched on or off **simultaneously**!

Note: Electrical signals brought out via control electronics (e.g. signal "OK") 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)

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The Drive & Control Company

Rexroth
Bosch Group

Valve amplifier for proportional pressure valves

Type VT-MRMA1-1

RE 30214
Edition: 2013-04
Replaces: 06.05

H7125

- Component series 1X
- Analog, modular design
- Suitable for controlling a direct current motor-operated pressure reducing valve with electric position feedback of the type (Z)DRS, size 6, component series 1X

Features

- Snap-in module housing with detachable plug-in screw connectors
- Configurable actual pressure value input
- Ramp times (up and down) can be separately adjusted
- Linearization
- Electronic limit stops for the actuator
- Position controller with "position command value reached" detection
- Enable input
- "Ready for operation" output
- "Position command value reached" output
- Configurable actual pressure value input
- Integrated pressure switch function with adjustable switching thresholds
- Switchable measuring socket
- Fault recognition (cable breaks, short-circuits etc.)
- LED indicators:
  - Ready for operation (green)
  - Enable (yellow)
  - Error detection of actual pressure value input (red)

Contents

Ordering code

01		02		03		04		05		06
VT-MRMA1	–	1	–	1X	/	V0	/	0	/	*

01	Analog amplifier in modular design	**VT-MRMA1**
02	For direct current motor-operated pressure reducing valve (Z) DRS, size 6, component series 1X	**1**
03	Component series 10 to 19 (10 to 19: unchanged technical data and pin assignment)	**1X**
04	Version: Standard	**V0**
05	Standard option	**0**
06	Further information in the plain text	*

Suitable pressure transducer:
- HM20-1X/..-C-K35
  (see data sheet 30270)

Functional description

General
The amplifier module is snapped onto top hat rails according to EN 60715. It is electrically connected via 4 plug-in screw connectors with 4 ports each. The module is operated with 24 V direct voltage.

Power supply unit [1]
An internal power supply unit supplies all internally required positive and negative supply voltages.

Pressure command value provision [2]
The internal pressure command value signal is generated from the external pressure command value signal available at input [2] and the zero point offset [2] (Zw zero point potentiometer on the front side). If the pressure command value increases/decreases, the pressure rises/falls. The differential input can be configured into a 4 to 20 mA current input via DIL switches S1.1 to S1.6 (see commissioning instructions).

Standard values	Current input	Differential input	Pressure command value at measuring socket v (position 0)
0 %	4 mA	0 V	0 V
100 %	20 mA	10 V	10 V

A cable break in a pressure command value line will be detected ("ready for operation" output) and deactivate the output stage.

Ramp generator [3]
In the ramp generator [3], a provided step signal is turned into a ramp-shaped output signal. The ramp time relates to a pressure command value modification of the input signal of 100 %. The ramp time is not extended or shortened by the downstream pressure command value attenuator [4].

The ramp times for pressure increase or pressure reduction can be adjusted separately on the front side of the module using potentiometers "t <" and "t >". The current ramp time values can also be checked or pre-set via the switchable measuring socket (also located on the front side).
Information on ramp time adjustment:

Value at measuring socket (position 4 or 5) U_t in V	10	5	3	2	1	0.5	0.1	0.05	0.03	0.02	0.01
Current ramp time t in s (±20 %)	0.1	0.2	0.33	0.5	1	2	10	20	33.3	50	100

The following applies: Example measured:

$$t = \frac{1\ \text{Vs}}{U_t} \quad \text{Measurement: } U_t = 5\ \text{V} \;\Rightarrow\; t = \frac{1\ \text{Vs}}{5\ \text{V}} = 0.2\ \text{s}$$

Gw pressure command value attenuator [4]
The Gw potentiometer acts as an attenuator [4] and determines the maximum internal pressure command value. The setting range lies between 0 % and 130 %.

Linearization of the valve characteristic curve [5]
The linearization [5] is used to compensate the non-linear valve characteristic curve. The required valve position command value is generated from the pressure command value.

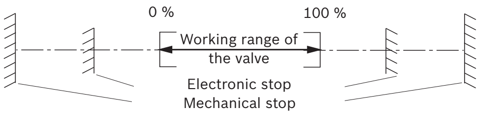
Amplitude limiter [6]
The amplitude limiter [6] limits the internal valve position command value to +110 % and –5 %.

Actual valve position value acquisition [12]
A voltage output is used to supply the position transducer. The actual valve position value fed back by the position transducer can be corrected using the Zx zero point potentiometer and the Gx sensitivity potentiometer. The internal

Functional description (continued)

actual position value signal generated this way is provided to the valve position controller [7] for further processing. Cable breaks in the position transducer lines are detected via the fault recognition [8].

Electronic limit stop
The electronic limit stops are a functional part of the actual value position acquisition [12].
The adjustable stroke of the valve is mechanically limited. The used working range is within these mechanical stops. To prevent the valve from moving into the mechanical stops when this is not intended (e.g. during setting), so-called "electronic stops" which are within these limits have been realized for safety purposes. The valves are prevented from moving beyond these limits by deactivation of the output stage. The electronic stops are only effective if sensor and motor are correctly wired.



Valve position controller [7]
The valve position controller [7] generates the control output for the clocked output stage on the basis of the position control deviation. The position controller has been optimized for a special valve type.

Output stage [10]
The output stage [10] generates the clocked control voltage for the DC motor acting as actuating element in the pressure reducing valve. The output stage output is short-circuit-proof. The output stage is de-energized in case of an internal fault signal [8] or if not enabled [11].

"Position command value reached" detection [9]
A "position command value reached" output is provided for as auxiliary process variable. This output is connected with 24 V operating voltage when the control deviation from the valve position command value and the regulated actual valve position value are ≤ **5 %** of the nominal stroke **and** the internal ramp output signal corresponds to the provided pressure command value.

Fault detection [8]
The following is monitored:
- Cable break of pressure command value lines
- Inversion of the pressure command value lines
- Cable break of the position transducer connecting lines
- Short-circuit of the position transducer supply at L0 (0 V)
- Thanks to the integrated motor protection the following is detected:
- Inversion of the motor lines (positive feedback)
- Jammed valve actuator
- Cable break of the motor lines

If there is **no** error, the green "ready for operation" LED on the front side is lit and the "ready for operation" output is connected to 24 V operating voltage.

Motor protection
The motor protection is a functional part of the fault recognition [8]. To ensure the correct functioning of the valve actuator, the adjustment time required for each pressure adjustment process is monitored. If an internally set maximum adjustment time (approx. 4 s) is exceeded, the output stage is deactived to prevent the motor from being damaged by continuous application of current.
The "ready for operation" output is connected to 0 V and the green LED on the front side goes out. After the cause of error has been eliminated, the electronics can be reactivated by resetting and enabling it.
The motor protection detects the following:
- Inversion of the motor lines (positive feedback)
- Cable break of the motor lines
- Jammed valve actuator

Enable function [11]
The enable function [11] can be used to activate both the position controller and the output stage via the external control. The enable signal is indicated by a yellow LED on the front side of the module.

Internal controller and output stage enable
The controller and the output stage are enabled if the external enable [11] has been set and the electronics is "ready for operation", i.e. the fault recognition [8] does not diagnose any error.

Actual pressure value input [13]
The internal actual pressure value signal is generated from the signal available at actual pressure value input [13] and the zero point offset (Zp zero point potentiometer on the front side). The Gp sensitivity potentiometer can be used to compensate tolerance-related variations of the pressure transducer. The input can be configured either as 0.5 to 5 V voltage input or 4 to 20 mA current input via the DIL switches S1.7 and S1.8 (see commissioning instructions) and a corresponding adjustment using the Zp zero point potentiometer and Gp sensitivity.
Notice: If the input is configured as 4 to 20 mA input and if the actual pressure value input is connected in series with another separate external current input, the module electronics supplies an offset current at terminal 1. This must be taken into account when adjusting the external current input.
The following is monitored at the actual pressure value

Functional description (continued)

input (depending on the property of the pressure transducer electronics):
- Cable break of the actual pressure value lines
- Inversion of the actual pressure value lines
- Cable break of the pressure transducer's operating voltage
- Cable break of the pressure transducer's ground

If one of these errors is detected at the actual pressure value input, **both** pressure switch signals A and B are connected with 0 V and the red LED (!) on the front side of the amplifier module is lit.

Pressure switch function [14]

The integrated pressure switch [14] compares the internal actual pressure value to a window which can be individually adjusted by the pressure command value (DIL switches S2.1 to S2.9). Depending on whether the actual pressure value falls below the lower limit or exceeds the upper limit, the corresponding pressure switch signal A or B falls to 0 V. If the actual pressure value is within the pressure command value window, both pressure switch signals are connected to 24 V operating voltage. Exception: In case of a cable break of one of the two actual pressure value lines **both** signals A and B fall to 0 V. (Adjustment of the pressure switch thresholds via DIL switch S2, see commissioning instructions)

Measuring point switch-over [15]

The measuring sockets v and ⊥ on the module front side can be used to check various internal measuring points (v0 to v5). The measuring points are selected via the measuring point selector switch [15] on the housing front panel.

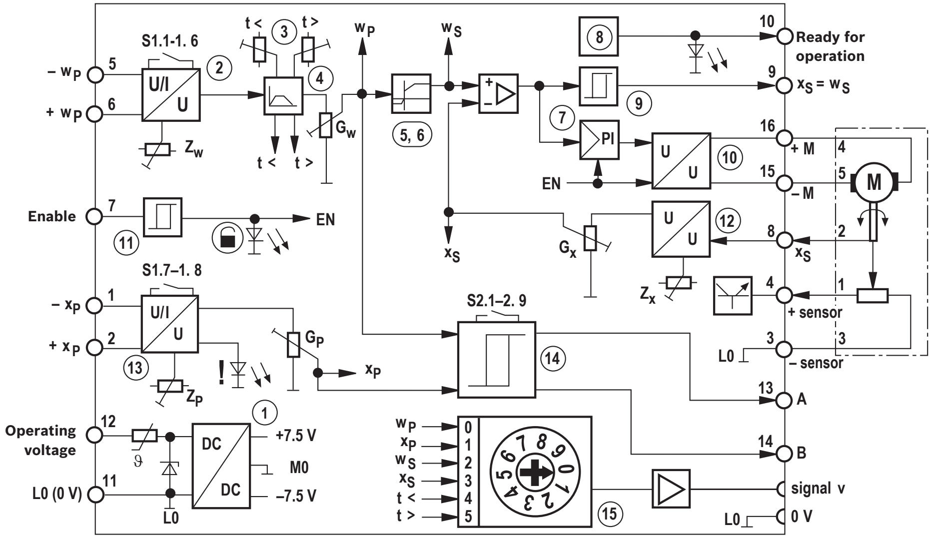
Measuring point	Switch position	Measurement signal v (⊥ is reference)
Pressure command value w_P	0	0 % ≙ 0 V and 100 % ≙ 10 V
Actual pressure value x_P	1	0 % ≙ 0 V and 100 % ≙ 10 V
Valve command value w_S	2	0 % ≙ 0 V and 100 % ≙ 10 V
Actual valve value x_S	3	0 % ≙ 0 V and 100 % ≙ 10 V
Ramp time "up" t <	4	10 mV to 10 V
Ramp time "down" t >	5	10 mV to 10 V
Without function	6	0 V
Without function	7	< −10 V
Without function	8	< −10 V
Without function	9	< −10 V

Notice:

Switch positions 6 to 9 have no function. They only serve to determine the switch position in case the arrow mark of the measuring point selector switch is no longer visible due to damage.

[ ] = references to the block diagram on page 5

Block diagram/pin assignment



1 Power supply unit
2 Pressure command value provision
3 Ramp generator
4 Pressure command value attenuator
5 Linearization of the valve characteristic curve
6 Amplitude limiter
7 Valve controller
8 Fault recognition
9 Position command value reached – detection
10 Output stage
11 Enable function
12 Actual valve position value acquisition
13 Actual pressure value input
14 Pressure switch function
15 Measuring point switch-over

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

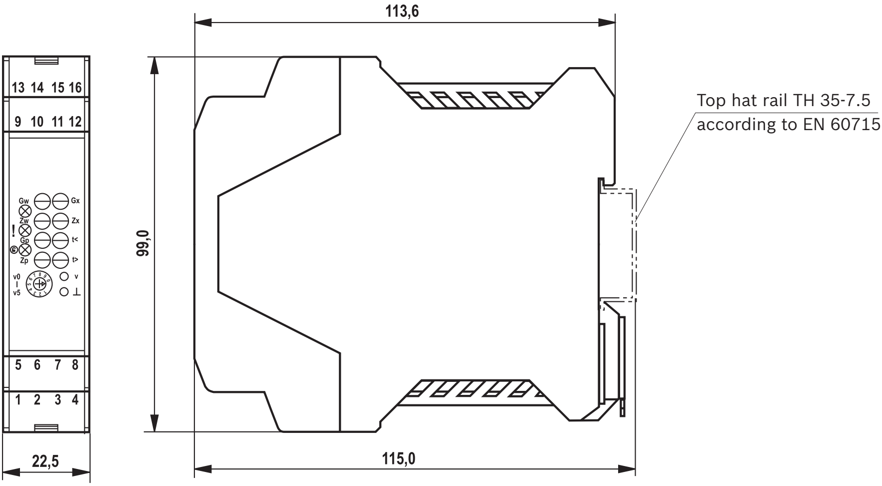
Operating voltage		U_B	24 VDC + 40 % – 20 %
Operating range	Upper limit value	$u_B(t)_{max}$	35 V
	Lower limit value	$u_B(t)_{min}$	21 V
Power consumption		P_S	< 50 VA
Current consumption	$i(t)_{max}$ (switching on the motor)		< 3.5 A
	I_{max} (during the actuating process)		< 1 A
	I_{min} (when output stage is switched off)		< 120 mA
Fuse			1.6 A, self-healing (thermal overload protection)
Inputs			
– Analog			
Pressure command value (differential input)		U_e	0 to +10 V; R_e > 100 kΩ
Pressure command value (current input)		I_e	4 to 20 mA; load R_B = 100 Ω
Actual pressure value (differential input)		U_e	0.5 to +5 V; R_e > 100 kΩ
Actual pressure value (current input)		I_e	4 to 20 mA; load R_B = 100 Ω
– Digital			
Enable	ON	U	+8.5 V to U_B; R_e > 100 kΩ
	OFF	U	0 to +6.5 V; R_e > 100 kΩ
Setting ranges			
Zero point pressure command value (Zw potentiometer)			±30 %
Pressure command value attenuator (Gw potentiometer)			0 to 130 % [1]
Actual pressure value sensitivity (Zp potentiometer)			±5 %
Actual pressure value amplification (Gp potentiometer)			90 to 120 % [1]
Sensitivity of actual valve position value (Zx potentiometer)			±15 %
Actual valve position value amplification (Gx potentiometer)			90 to 120 % [1]
Ramp times (potentiometer *t* < and *t* >)			0.1 to 100 s
Outputs			
Output stage		U_{eff}	0 V_{eff} to $U_{B,eff}$
Sensor supply voltage		U	0 V and +10 V ± 3 %
Measuring socket		U	0 V to +10 V ± 2 %; I_{max} = 2 mA
Ready for operation	"Ready for operation"	U	> 16 V (R_i = 10 kΩ; 50 mA)
	"Not ready for operation"	U	< 1 V (R_i = 10 kΩ; 50 mA)
Position command value	"Reached"	U	> 16 V (R_i = 10 kΩ; 50 mA)
	"Not reached"	U	< 1 V (R_i = 10 kΩ; 50 mA)
Pressure switch signal A			
Actual pressure value > lower pressure switch threshold		U	> 16 V (R_i = 10 kΩ; 50 mA)
Actual pressure value < lower pressure switch threshold		U	< 1 V (R_i = 10 kΩ; 50 mA)
Pressure switch signal B			
Actual pressure value < upper pressure switch threshold		U	> 16 V (R_i = 10 kΩ; 50 mA)
Actual pressure value > upper pressure switch threshold		U	< 1 V (R_i = 10 kΩ; 50 mA)
Type of connection			4 plug-in screw connectors with 4 ports each
Mounting type			Top hat rail TH 35-7.5 according to EN 60715
Protection class according to EN 60529			IP 20
Admissible operating temperature range		ϑ	0 to +50 °C
Storage temperature range		ϑ	–25 °C to +70 °C
Weight		m	0.15 kg

[1] Provided that the zero point has been correctly set

Terminal assignment

Actual pressure value input	– x_p	**1**	**9**	$x_s = w_s$	Position command value reached
	+ x_p	**2**	**10**		Ready for operation
Position transducer supply	– sensor Valve connector contact 3	**3**	**11**	0 V	Operating voltage
	+ sensor Valve connector contact 1	**4**	**12**	+ U_B	
Pressure command value input	– w_P	**5**	**13**	A	Pressure switch signals
	+ w_P	**6**	**14**	B	
Enable	Enable	**7**	**15**	– M Valve connector contact 5	Valve motor connection
Actual position value input	x_s Valve connector contact 2	**8**	**16**	+ M Valve connector contact 4	

Dimensions (Dimensions in mm)



Potentiometers

Gw Pressure command value attenuator
Zw Zero point of pressure command value
Gp Amplification of actual pressure value
Zp Zero point of actual pressure value
Gx Actual valve position value amplification
Zx Zero point of actual valve position value
t < Ramp time "up"
t > Ramp time "down"

LED indicators

	Ready for operation	(green)
	Enable	(yellow)
!	Cable break in pressure load cell	(red)

Measuring sockets

v Measurement signal
⊥ Load zero

Project planning/maintenance instructions/additional information

- Prior to installation and commissioning it must be ensured that the DIL switches on the printed circuit board of the amplifier module have been correctly set (for function of the DIL switches, see commissioning instructions).
- DIL switches on the printed circuit board of the amplifier module may only be adjusted when de-energized.
- The amplifier module may only be wired or connected and opened when de-energized.
- The distance to aerial lines, radios, and radar systems has to be 1 m at least.
- Do not lay motor and signal lines near power cables.
- The valve is connected with a 5-wire line. For lines up to 50 m in length, use the line type LiYCY 0.5 mm^2. For greater lengths, please contact us.
- If the valve line has to be shielded, the shield must be connected to protective earth ("PE") on the module side. In some cases (e.g. if PE is subject to strong interference) it can be useful to connect the shield directly to the L0 of the amplifier module, other side open (risk of ground loops).
- If a differential input is used, both inputs must always be connected or disconnected at the same time.
- Cable ends should not be too short, so as to ensure that the module can still be opened when connected (e.g.: to adjust the DIL switches).
- Ensure that the ground of the pressure command value ("$-w_P$", terminal 5), has the same potential (→ equipotential bonding busbar) as the ground ("L0", terminal 11) of the power supply unit. This allows for a better suppression of interferences.
- For setting the potentiometers and the measuring point selector switch, use a screwdriver with a blade width of 4 mm.

1

Setting recommendation

Condition as supplied

The condition as supplied of the electronics is characterized by the following features:

- Minimum ramp times.
- Gw attenuator is set to 100 %.
- The linearity of the overall system (module electronics and valve) is subject to deviations in series production.

Fine adjustment of the overall system

Prerequisites:

- The system-specific wiring must have been completed.
- Set DIL switches on printed circuit board of module electronics according to individual requirements.
- Turn on the hydraulic system.

It must be ensured that the hydraulic fluid already has the (regulated) operating temperature for fine-adjustment.

<table>
<tr><th></th><th>Signal</th><th>Setting</th></tr>
<tr><td>1</td><td>Pressure command value zero point</td><td>▶ Set external pressure command value provision to 0 %.
▶ Set measuring point selector switch to "0".
▶ Use the zero point potentiometer Zw to adjust the measurement signal at v: 0 V ± 5 mV (= 0 %).</td></tr>
<tr><td>2</td><td>Maximum pressure command value</td><td>Notice:
Before adjusting the maximum value, the zero point must be adjusted according to step 1.
▶ External pressure command value provision = 100 %.
▶ Set measuring point selector switch to "0".
▶ Use the potentiometer Gw to adjust the measurement signal at v: 10 V ± 5 mV (= 100 %).</td></tr>
<tr><td>3</td><td>Ramp times</td><td>▶ Use the measuring point selector switch to select the potentiometer that is to be set:
▶ Position 4 for ramp "up" t < and position 5 for ramp "down" t >.
▶ Set ramp time according to formula or table (see functional description "Ramp generator") and check at measuring socket v.</td></tr>
<tr><td>4</td><td>20 %-actual pressure value</td><td>Notice:
Prior to the 20 % actual pressure value adjustment the pressure command value must be adjusted according to steps 1 and 2.
▶ Electrically connect the valve.
▶ Measure sensor supply voltage on the module side between terminals 4 and 3: +10.0 V ± 300 mV
▶ Set external pressure command value provision to 20 %.
▶ Externally connect enable signal.
▶ Set actual pressure value signal (= voltage between terminals 2 and 1) using Zx to 20 % of the nominal pressure value:
→ Actual pressure value signal dependent on the pressure transducer used:
<table>
<tr><th>Used pressure transducer</th><th>Output signal (20 %)</th><th>Voltage between terminals 2 and 1</th></tr>
<tr><td>"0.5 ... 5 V" output</td><td>+1.40 V</td><td>+1.40 V</td></tr>
<tr><td>"4 ... 20 mA" output</td><td>+7.2 mA</td><td>+0.72 V (R_{load} = 100 Ω)</td></tr>
</table>
▶ Set measuring point selector switch to "1".
▶ Use the potentiometer Zp to adjust the measurement signal at v: +2.00 V ± 5 mV.</td></tr>
</table>

Continued on page 10

<table>
<tr><th></th><th>Signal</th><th>Setting</th></tr>
<tr><td>5</td><td>Maximum actual pressure value</td><td>Notice:
Before adjusting the maximum value, the 20 % actual pressure value must be adjusted according to step 4.
▶ Set external pressure command value provision to 100 %.
▶ Externally connect enable signal.
▶ Set actual pressure value signal (= voltage between terminals 2 and 1) using Gx to 100 % of the nominal pressure value:
→ Actual pressure value signal dependent on the pressure transducer used:
<table>
<tr><th>Used pressure transducer</th><th>Output signal (20 %)</th><th>Voltage between terminals 2 and 1</th></tr>
<tr><td>"0.5 ... 5 V" output</td><td>+5.00 V</td><td>+5.00 V</td></tr>
<tr><td>"4 ... 20 mA" output</td><td>+20 mA</td><td>+2.00 V (R_{load} = 100 Ω)</td></tr>
</table>
▶ Set measuring point selector switch to "1".
▶ Use the potentiometer Gp to adjust the measurement signal at v: +10.00 V ± 5 mV.</td></tr>
<tr><td>6</td><td>Actual pressure value</td><td>▶ Check both working points (steps 4 and 5).
Repeat steps 4 and 5 if required.</td></tr>
<tr><td>7</td><td>Individually adjust the maximum pressure command value</td><td>Set external pressure command value provision according to individual requirements.
Example:
Reduce 100 % external pressure command value to 80 %.
▶ Set external pressure command value provision to 100 %.
▶ Set measuring point selector switch to "0".
▶ Use the potentiometer Gw to set the measurement signal at the measuring socket v according to the requirements: adjustment according to example: 8.0 V ± 5 mV (= 80 %).</td></tr>
</table>

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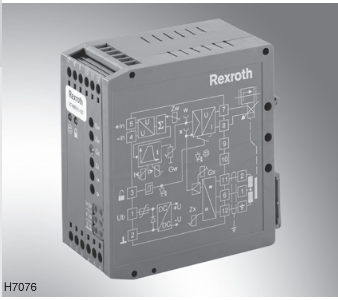
Analog amplifier module

RE 30221/01.12
Replaces: 02.09

Type VT-MRPA1-...

Series 1X



H7076

Table of contents

Contents	**Page**

Note:
When replacing a VT 11025, VT 11033 and VT 11034 the changed terminal allocation of position transducer connections has to be taken into account!

Features

- Suitable for controlling direct operated proportional relief valves with electrical position feedback (type DBETR-1X) or for proportional flow control valves with electrical position feedback (type 2FRE...)
- Command value input +10 V (differential input)
- Ramp generator with separately adjustable ramp times "up/down"
- Zero point potentiometer
- Amplitude attenuation
- Enable input
- Reverse polarity protection for the power supply
- Power supply with a DC/DC converter without a raised zero point
- Cable break recognition in the position transducer branch
- LED indicators:
  - Operational (green)
  - Enable (yellow)
- Measuring sockets for:
  - Command value "w"
  - Actual valve "x"
  - Ramp times "t<", "t>"

Ordering details

VT-MRPA1– –1X / V0 / 0 / *

Analog amplifier of modular design		
For controlling a DBETR-1X valve	**= 100**	
For controlling a 2FRE6-2X valve	**= 150**	
For controlling a 2FRE10 and 16-4X valve	**= 151**	
Series 10 to 19 (10 to 19: unchanged technical data and pinout)	**= 1X**	
		Basic version
		Basic version
		Further details in clear text

Functional description

General

These amplifier modules can be snapped onto top hat rails to EN 60715. The electrical connections are are established by means of screw terminals. The modules are operated using 24 VDC.

Power supply unit [1]

The amplifier modules comprise a power supply unit with an inrush current limiter. It provides all the internally required positive and negative supply voltages. The inrush current limiter prevents high inrush current peaks.

Command value preselection

The internal command value signal is generated from the sum [3] of the external command value signal applied to differential input [2] and the zero point offset (zero point potentiometer "Zw").

A positive command value results in a current increase in the solenoid and, thereby an increase in pressure at the valve.

Enable function [11]

The enable function is used to enable the current output stages and to pass the internal command value signal on to the ramp generator. A LED on the front panel indicates the enable signal. When the enable is activated, the internal command value (an applied optional command value) changes according to the set ramp time. As a result of this, the valve does not open suddenly when activated.

Ramp generator [4]

The ramp generator limits the gradient of the control variable. Due to the amplitude attenuator, the ramp time is not extended or shortened.

Notes on the adjustment and measurement of the ramp time:

Value at measuring socket "t <" or "t >"	U_t in V	5	3	2
Actual ramp time (±20 %)	t in ms	20	33	50

U_t in V	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
t in ms	100	200	333	500	1000	2000	3333	5000

The following is valid: $t = \dfrac{100\text{ V ms}}{U_t}$

Example: Measured $U_t = 5\text{ V}$

Results in $t = \dfrac{100\text{ V ms}}{5\text{ V}} = 20\text{ ms}$

Amplitude attenuation [5]

The amplitude attenuator "Gw" can be used to adjust the maximum value, within the range of 0 - 100 %, to the hydraulic requirements.

Amplitude limiter [6]

The internal command value is limited to 0 % and 110 %.

Oscillator [9]

The oscillator generates the control signal for the inductive position transducer.

Demodulator [10]

The demodulator uses the position transducer signal to provide the actual value signal of the valve spool position: +100 % ≙ +10 V at measuring socket "x".

Controller for the valve spool position [7]

The position controller is used to minimize the valve hysteresis and is optimised to meet the individual valve's requirements.

Current output stages [8]

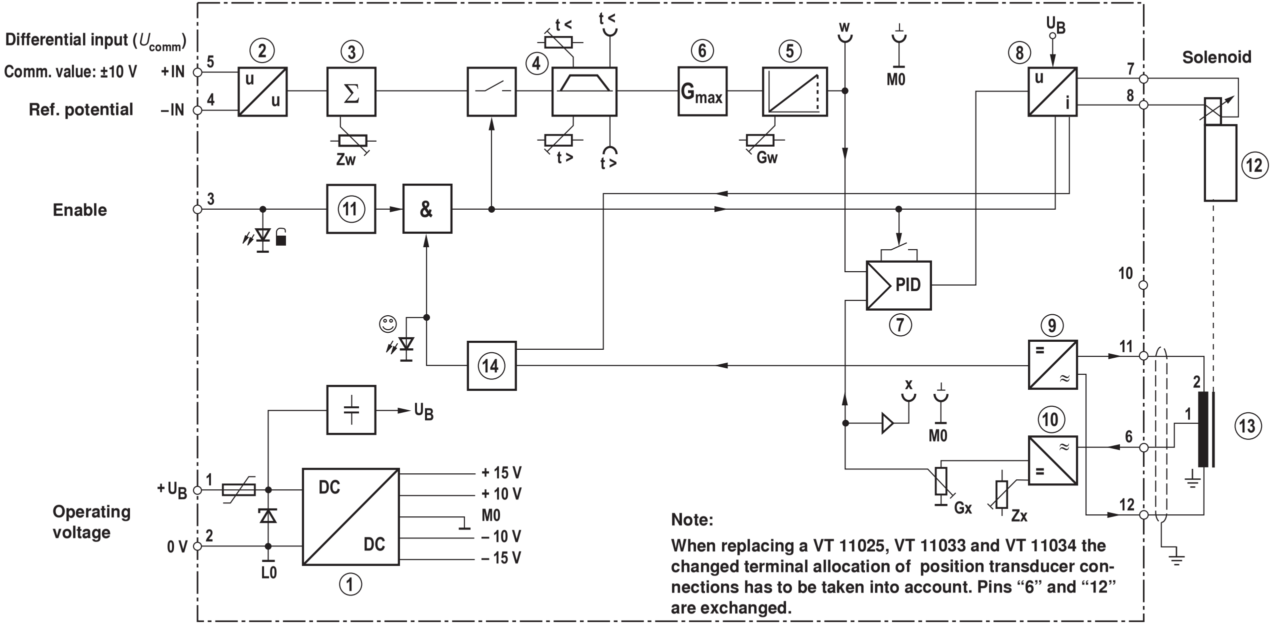
The current output stage generates the clocked solenoid current for the proportional valve. The solenoid current is limited to approx. 1.85 A. The output stage outputs are short-circuit-proof. The output stages are de-energized in the case of an internal fault signal or missing enable.

Fault detection [14]

The position transducer cable is monitored for cable break and short circuits and the output stage for overcurrent.

[ ] = Cross-reference to the block circuit diagram on page 3

Block circuit diagram / connection allocation



Note:
When replacing a VT 11025, VT 11033 and VT 11034 the changed terminal allocation of position transducer connections has to be taken into account. Pins "6" and "12" are exchanged.

Zw	Zero point com. value
Zx	Zero point actual value
t <	Ramp time "up"
t >	Ramp time "down"
Gw	Amplitude attenuator
Gx	Actual value sensitivity
w	Command value
x	Actual value

☺ Operational
🔒 Enable

1	Power supply unit
2	Differential amplifier
3	Command value summator
4	Ramp generator
5	Amplitude attenuator
6	Amplitude limiter
7	Controller for valve spool position
8	Current output stage
9	Oscillator
10	Demodulator
11	Enable function
12	Proportional valve
13	Inductive position transducer
14	Fault detection

1

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

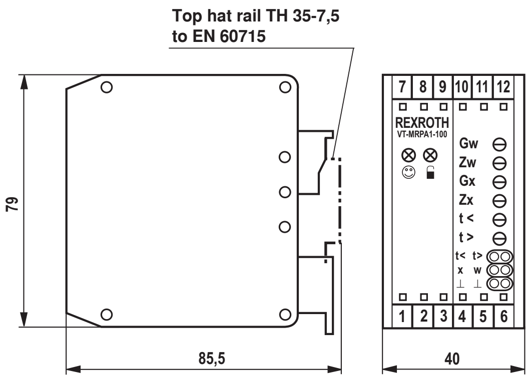
Operating voltage	U_B	24 VDC +40 % –20 %
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V
– Lower limit value	$u_B(t)_{min}$	18 V
Power consumption	P_S	< 24 VA
Current consumption	I	< 2 A
Fuse		Thermal overload protection (with reclosing feature when the temperture falls below the threshold)
Inputs:		
– Analogue		
• Command value (differential input "±IN")	U_e	0 to +10 V; R_e > 50 kΩ
– Digital		
• Enable ON	U	8.5 V to U_B; R_e > 100 kΩ
OFF	U	0 to 6.5 V; R_e > 100 kΩ
Adjustment ranges:		
– Command value zero point (potentiometer "Zw")		±10 %
– Actual value zero point (potentiometer "Zx")		±10 %
– Ramp times (potentiometer "t <" and "t >")		20 ms to 5 s
– Amplitude attenuator (potentiometer "Gw")		0 % to 110 % (valid for setting the zero point = 0 %)
Outputs:		
– Current output stages	I	0 to 1.85 A; short-circuit-proof; clocked to approx. 5 kHz
– Oscillator	U_{SS}	2 V; 10 mA per output
	f	5.6 kHz ±10 %
– Measuring sockets		
• Ramp time "t <"	U	20 mV to 5 V
• Ramp time "t >"	U	20 mV to 5 V
• Actual value "x"	U	0 to +10 V
• Command value "w"	U	0 to +10 V
Connection type		12 screw terminals
Mounting style		Top hat rail TH 35-7.5 to EN 60715
Protection type		IP 20 to EN 60529
Dimensions (W x H x D)		40 x 79 x 85.5 mm
Permissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–25 °C to +70 °C
Weight	m	0.14 kg

Note:
For details regarding **environmental simulation tests** covering EMC (electro-magnetic compatibility), climate and mechanical loading see data sheet 30221-U.

Terminal allocation

Operating voltage	$+U_B$	1	7		Solenoid	Connection cable (recommendation): 2-core cable, single screen, cross-section 1.5 mm^2
	0 V	2	8			
Enable	U_F	3	9		Free	
Differential input	–IN	4	10			
	+IN	5	11	2	Position transducer control	3-core cable, single screen, max. cross-section 1.5 mm^2
Position transducer, primary	1	6	12	⏚		

Unit dimensions (dimensions in mm)



LED-indicators:

☺ Operational (green)

🔓 Enable (yellow)

Potentiometer:

Gw Amplitude attenuator for positive com. values

Gx Position transducer sensitivity (pre-set)

Zw Command value zero point

Zx Actual value zero point

t < Ramp time for increasing command values

t > Ramp time for decreasing command values

Measuring sockets:

t < Ramp time “up”

t > Ramp time “down”

x Actual value

w Command value

$\perp$ Measuring zero

Engineering notes / maintenance guidelines / additional information

The amplifier module may only be wired when disconnected from the power supply.

- Do not lay cables in the vicinity of power cables.
- Do not use free-wheeling diodes in solenoid cables.
- The distance to antenna cables, radio devices and radar systems must be at least 1 meter.
- Always shield command value and position transducer cables; connect the shield to protective earth (PE) on the module side. In individual cases (e.g. PE subject to strong interference), it may be required to connect the shield of the position transducer cable directly to the LO of the amplifier module; leave the other end open (risk of earth loops).

  Recommendation: Also shield solenoid cables.
  For solenoid cables up to 50 m long, use cable type LiYCY 1.5 mm^2.
  In case of longer lengths, please consult us.
- Do not connect terminal "⏚" of the position transducer to "PE"
- Use relays with gold-plated contacts for passing on command values (small voltages, small currents).
- Use only instruments R_i > 100 kΩ for taking measurements on the module.
- In the case of strongly fluctuating operating voltages, it may be required in individual cases to use an external smoothing capacitor with a capacitance of at least 2200 μF.
  Recommendation: Capacitor module VT 11110 (see data sheet 30750); sufficient for up to 3 amplifier modules
- Note: When replacing a VT 11025, VT 11033, VT 11034 the changed terminal allocation of position transducer connections has to be taken into account. Pins "6" and "12" are exchanged.

Setting recommendations

The system-specific circuits must be provided.

Signal	**Setting MRPA1**
Com. value zero point	– Apply the enable signal – Set the externally applied command value to zero – Set the internal command value to zero using the zero point potentiometer "Zw" and check at measuring socket "w"
Act. value zero point	– Set enable signal to "OFF" or disconnect the solenoid plug (the valve moves to its mechanical limit stop) When making any adjustments, pay attention to the polarity of the measuring instrument → measuring sockets.
Ramp times	– Adjust the ramp time according to the formula or table (see functional description of the "ramp generator") and check this at measuring sockets "t >" and "t <"
Maximum values (amplitude attenuator "Gw")	Note: Before the maximum values can be matched the zero point must be correctly set – Command value = apply 100 %. – Use potentiometer "Gw" to set the maximum control variable and check at the measuring socket "w"

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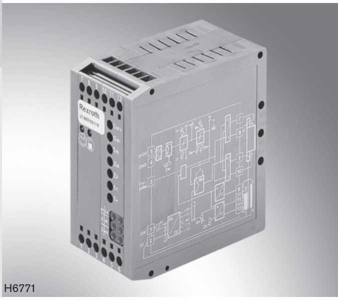
Analogue amplifier modules for 4/3 and 4/2 proportional directional valves 4WRE

RE 30219/06.05
Replaces: 12.04

Types VT-MRPA2 and VT-MRPA1

Component series 1X



H6771

Table of contents

Features

– Suitable for controlling direct operated 4/3 and 4/2 proportional directional valves with electrical position feedback, type 4WRE, sizes 6 and 10, component series 2X
– Command value input ±10 V (VT-MRPA2), 0 to 10 V (VT-MRPA1)
– Ramp generator with separately adjustable “up/down” ramp times
– Characteristic curve correction with symmetrically (with VT-MRPA2 only) adjustable step-change heights and separately (with VT-MRPA2 only) adjustable maximum values
– Enable input
– Reverse polarity protection of power supply
– Power supply unit with DC/DC converter without raised zero point
– Cable break detection in the position transducer branch
– LED indicator lamps:
  • Readiness for operation (green)
  • Enable (yellow)

Ordering code

VT-MRPA		–		–1X	/	V0	/	*

Analogue amplifier of modular design	
For 4/2 proportional directional valves 4WRE (with one solenoid)	= 1
For 4/3 proportional directional valves 4WRE (with two solenoids)	= 2
For controlling valve 4WRE 6 (component series 2X)	= 1
For controlling valve 4WRE 10 (component series 2X)	= 2
Component series 10 to 19 (10 to 19: unchanged technical data and pin assignment)	= 1X
V0 = Basic version	
Further details in clear text	

Suitable power supply unit:

– Type VT-NE30-2X, see RE 29929
  compact power supply unit 115/230 VAC –> 24 VDC,
  108 VA

Functional description

General

The amplifier modules are to be snapped onto top hat rails according to EN 60715. The electrical connection is made by means of screw terminals. The modules are operated at 24V DC.

Power supply unit [1]

The amplifier modules are provided with a power supply unit with switch-on current limiter. The power supply unit provides all internally required positive and negative supply voltages. The switch-on current limiter prevents high switch-on current peaks.

Command value feedforward

The internal command value signal is generated from the sum [3] of the external command value signal applied to differential input [2] and the zero point offset (zero point potentiometer “Zw”).

The following is valid for VT-MRPA2:
A positive command value causes an increase in current in solenoid “b“ and hence a flow in the valve from P to A and from B to T.
A negative command value causes an increase in current in solenoid “a“ and hence a flow in the valve from P to B and from A to T.

The following is valid for VT-MRPA1:
A positive command value causes an increase in current in the solenoid.

Enable function [11]

The enable function is used to enable the current output stages and to pass the internal command value signal on to the ramp generator. The enable signal is indicated by an LED on the front panel. When the enable is granted, the internal command value changes over the set ramp time (with any command value selection). The valve does therefore not open suddenly when activated.

Ramp generator [4]

The ramp generator limits the gradient of the control output. The downstream step functions and amplitude attenuators do not shorten or extend the ramp time.

Note on the adjustment and measurement of the ramp time:

Value at measuring socket "t <" or "t >"	U_t in V	5	3	2
Current ramp time (± 20 %)	t in ms	20	33	50

U_t in V	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
t in ms	100	200	333	500	1000	2000	3333	5000

The following is valid: $t = \frac{100 \text{ V ms}}{U_t}$

Example: Measured $U_t = 5 \text{ V}$

results in $t = \frac{100 \text{ V ms}}{5 \text{ V}} = 20 \text{ ms}$

Characteristic curve generator [5]

The adjustable characteristic curve generator can be used to adjust step-change heights symmetrically (with VT-MRPA2 only) and maximum values for positive and negative signals separately (with VT-MRPA2 only) to suit the hydraulic requirements. The actual line of the characteristic curve through the zero point is not stepped, but linear.

Amplitude limiter [6]

The internal command value is limited to approx. ±110 % (with VT-MRPA2) or +110 % (with VT-MRPA1) of the nominal range.

Oscillator [9]

The oscillator generates the control signal for the inductive position transducer.

Demodulator [10]

The demodulator generates the actual value signal of the valve spool position from the position transducer signal:
±100 % ±10 V (with VT-MRPA2) or
+100 % +10 V (with VT-MRPA1), respectively

Controller for valve spool position [7]

The position controller is optimised specifically to the valve.

Current output stage [8]

The current output stage generates the clocked solenoid current for the proportional valve. The solenoid current is limited to 2.4 A to 2.6 A per output. The output stage outputs are short-circuit-proof. In the event of an internal fault signal or missing enable, the output stages are de-energised.

Fault detection [14]

The position transducer cable is monitored for cable break and primary-sided short-circuit, and the output stage for overcurrent.

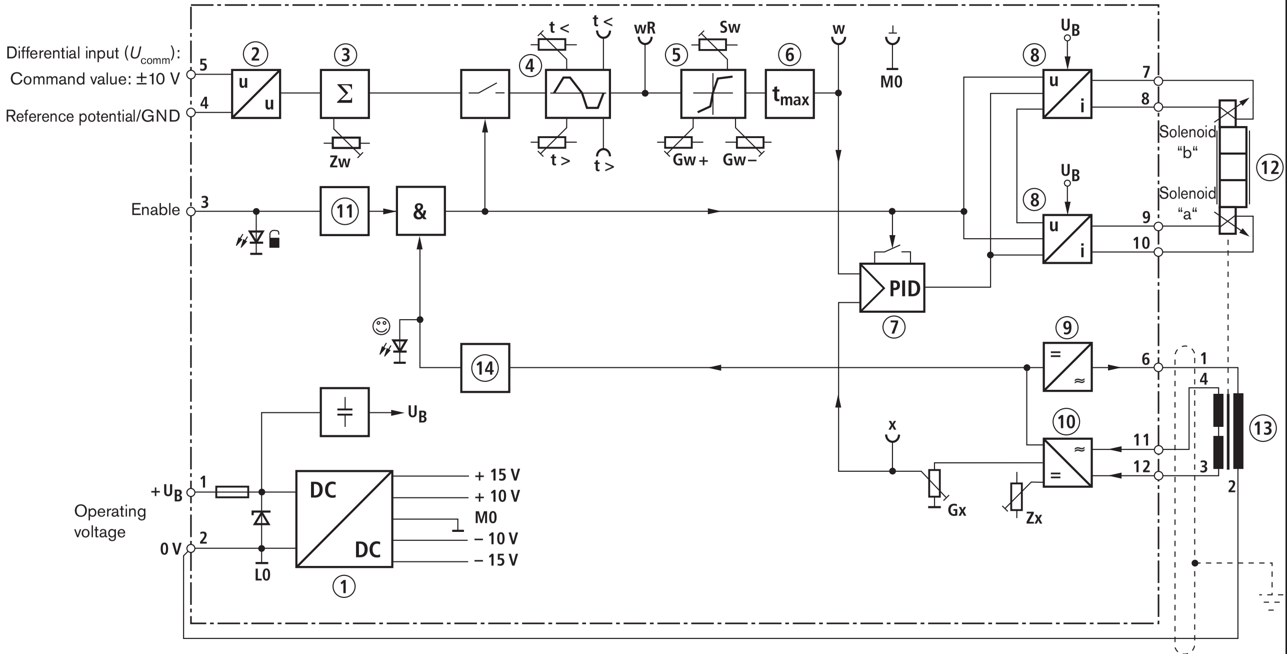
[ ] = Cross-reference to block circuit diagrams on pages 4 and 5

1

Block circuit diagram / pin assignment VT-MRPA2

A positive command value causes an increase in current in solenoid "b" and hence a flow in the valve from P to A and from B to T.

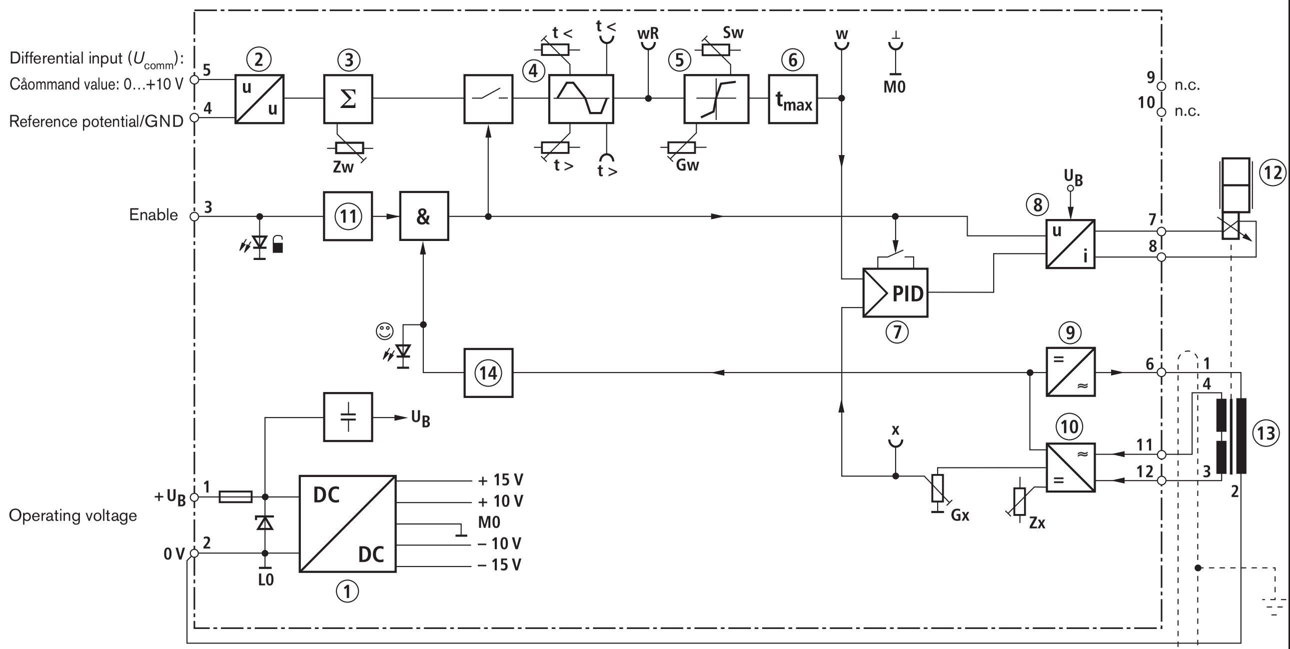
A negative command value causes an increase in current in solenoid "a" and hence a flow in the valve from P to B and from A to T.



Zw = Command value zero point	**Gx** = Actual value sensitivity	**1** Power supply unit	**8** Current output stage
Zx = Actual value zero point	**w** = Command value	**2** Differential amplifier	**9** Oscillator
t < = Ramp time "up"	**x** = Actual value	**3** Command value summator	**10** Demodulator
t > = Ramp time "down"	**wR** = Command value after ramp	**4** Ramp generator	**11** Enable function
Sw = Step-change height	☺ = Readiness for operation	**5** Characteristic curve generator	**12** Proportional valve
Gw = Amplitude attenuator	🔓 = Enable	**6** Amplitude limiter	**13** Inductive position transducer
		7 Controller for valve spool position	**14** Fault detection

Block circuit diagram / pin assignment VT-MRPA1

A positiver command value causes an increase in current in the solenoid



Zw	= Command value zero point	**Gx**	= Actual value sensitivity
Zx	= Actual value zero point	**w**	= Command value
t <	= Ramp time “up“	**x**	= Actual value
t >	= Ramp time “down“	**wR**	= Command value after ramp
Sw	= Step-change height	☺	= Readiness for operation
Gw	= Amplitude attenuator	🔓	= Enable

1	Power supply unit	**8**	Current output stage
2	Differential amplifier	**9**	Oscillator
3	Command value summator	**10**	Demodulator
4	Ramp generator	**11**	Enable function
5	Characteristic curve generator	**12**	Proportional valve
6	Amplitude limiter	**13**	Inductive position transducer
7	Controller for valve spool position	**14**	Fault detection

1

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

Operating voltage		U_O	24 VDC + 40 % – 20 %
Operating range:			
– Upper limit value		$u_O(t)_{max}$	35 V
– Lower limit value		$u_O(t)_{min}$	18 V
Power consumption		P_S	< 24 VA
Current consumption		I	< 2 A
Fuse protection			Thermal overload protection (reclosing when the temperature falls below the threshold)
Inputs:			
– Analogue			
• Command value (differential input)	VT-MRPA2	U_i	0 to ±10 V, R_i > 50 kΩ (current input on enquiry)
	VT-MRPA1	U_i	0 to +10 V, R_i > 50 kΩ (current input on enquiry)
– Digital			
• Enable ON		U	8.5 V to U_O, R_i > 100 kΩ
OFF		U	0 to 6.5 V, R_i > 100 kΩ
Adjustment ranges:			
– Command value zero point (potentiometer “Zw“)			±30 %
– Actual value zero point (potentiometer “Zx“)			±10 %
– Ramp times (potentiometers “t <“ and “t >“)			20 ms to 5 s
– Step-change height (potentiometer “Sw“)			0 % to 50 %
– Amplitude attenuator (potentiometers “G+“ and “G–“)			0 % to 110 % (valid for a step-change height setting of 0 %)
Outputs:			
– Current outputs		I	0 to 2.5 A; short-circuit-proof; clocked, approx. 5 kHz
– Oscillator		U_{SS}	10 V; 10 mA
		f	5.6 kHz ± 10 %
– Measuring sockets			
• Ramp time “t <“		U	20 mV to 5 V
• Ramp time „t >“		U	20 mV to 5 V
• Actual value “x“	VT-MRPA2	U	0 to ±10 V
	VT-MRPA1	U	0 to +10 V
• Command value “w“	VT-MRPA2	U	0 to ±10 V
	VT-MRPA1	U	0 to +10 V
• Command value after ramp “wR“	VT-MRPA2	U	0 to ±10 V
	VT-MRPA1	U	0 to –10 V
Type of connection			12 screw terminals
Type of mounting			Top hat rail TH 35-7.5 to EN 60715
Type of protection			IP 20 to EN 60529
Dimensions (W x H x D)			40 x 79 x 85.5 mm
Permissible operating temperature range		ϑ	0 to +50 °C
Storage temperature range		ϑ	–25 to +70 °C
Weight		m	0.14 kg

☞ **Note!**

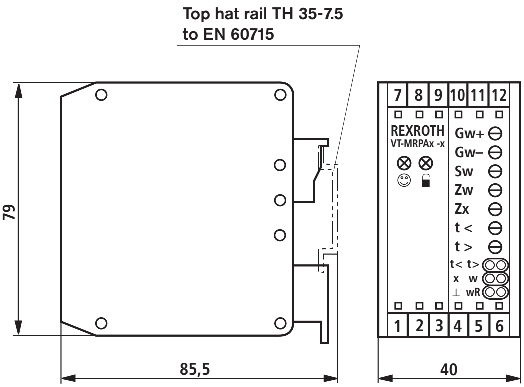
Details with regard to **environment simulation testing** in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30219-U (declaration on environmental compatibility).

Terminal assignment

				VT-MRPA2	VT-MRPA1
Operating voltage	$+U_O$	1	7	Solenoid "b"	Solenoid
	0 V[1)]	2	8		
Enable	U_E	3	9	Solenoid "a"	n.c.
Differential input	Reference potential	4	10		
	$\pm U_{comm}$	5	11	4 Position transducer, secondary	4 Position transducer, secondary
Position transducer, primary	1	6	12	3	3

1) and position transducer, primary (connection 2)

Unit dimensions (nominal dimensions in mm)



LED indicator lamps:

☺ Readiness for operation (green)

🔓 Enable (yellow)

Potentiometers:

Gw+ Amplitude attenuator for positive command values

Gw– Amplitude attenuator for negative command values (only with VT-MRPA2)

Sw Step-change height for negative and positive direction

Zw Command value zero point

Zx Actual value zero point

t < Ramp time for rising command values

t > Ramp time for falling command values

Measuring sockets:

t < Ramp time "up"

t > Ramp time "down"

x Actual value

w Command value

wR Command value after ramp

⊥ Measuring zero

Engineering / maintenance notes / supplementary information

- The amplifier module may only be wired when disconnected from the power supply!
- Do not lay cables near power cables!
- Do not use free-wheeling diodes in solenoid cables!
- The distance to aerial lines, radio sources and radar equipment must be at least 1 m!
- Always shield command value and position transducer cables; connect the shield to the protective earth (PE) on the module side!
  In individual cases (e.g. in the case of PE with severe interference) it may be required to connect the shield of the position transducer cable directly to L0 of the amplifier module; leave the other end open (risk of earth loops).
  Recommendation: Also shield solenoid cables!
  For solenoid cables up to 50 m length, use cable type LiYCY 1.5 mm^2!
  For greater lengths, please consult us!
- For passing on command values, use relays with gold-plated contacts (small voltages, small currents)!
- Measurements on the module may only be taken with instruments $R_i > 100$ kΩ.
- To adjust the potentiometers, use a screw driver with a blade width of 4 mm!
- In the case of strongly fluctuating operating voltages, it may be required to install an external smoothing capacitor having a capacitance of at least 2200 µF .
  Recommendation: Capacitor module VT 11073 (see RE 29750), sufficient for up to 3 amplifier modules

Adjustment recommendation

The system-specific circuitry must be completed.

Signal	Setting for VT-MRPA2	Setting for VT-MRPA1
Command value zero point	– Set external command value feedforward to zero – Set the internal command value to zero using zero point potentiometer "Zw" and check the setting at measuring socket "wR"	– Set external command value feedforward to zero – Set the internal command value to zero using zero point potentiometer "Zw" and check the setting at measuring socket "wR"
Actual value zero point	– Set enable signal to "OFF" or disconnect solenoid plug-in connector (Valve moves to the mechanical centred position) – Set the actual value at measuring socket "x" to zero using potentiometer "Zx" Recommendation: In the case of valves with V-spools, adjust the zero point during operation with the hydraulic drive, i.e. – Apply enable signal and check at measuring sockets "wR" and "w" – Use potentiometer "Zx" to bring the hydraulic drive to a standstill	– Set enable signal to "OFF" or disconnect solenoid plug-in connector (Valve moves to end position) – Set the actual value at measuring socket "x" to zero using potentiometer "Zx" Recommendation: In the case of valves with V-spools, adjust the zero point during operation with the hydraulic drive, i.e. – Apply enable signal and check at measuring sockets "wR" and "w" – Use potentiometer "Zx" to bring the hydraulic drive to a standstill
Ramp times	– Set ramp time according to formula or table (see functional description "Ramp generator") and check at measuring sockets "t >" and "t <"	– Set ramp time according to formula or table (see functional description "Ramp generator") and check at measuring sockets "t >" and "t <"
Step-change height	– Apply enable signal – Set the measuring signal at "wR" to +0.3 V using zero point potentiometer "Zw" – Set the required step-change height using potentiometer "Sw" – Set the measuring signal at "wR" to –0.3 V using zero point potentiometer "Zw" – Check the required step-change height, adjust zero point Note: In the case of an external command value feedforward, at least +0.3 V / –0.3 V must be measured at measuring socket "wR".	– Apply enable signal – Set the measuring signal at "wR" to –0.3 V using zero point potentiometer "Zw" – Set the required step-change height using potentiometer "Sw" – Check the required step-change height, adjust zero point Note: In the case of an external command value feedforward, at least –0.3 V must be measured at measuring socket "wR"
Maximum values	Note: Before the maximum values are matched, the zero point and step-change heights must have been correctly set. – Adjust step-change heights first; generate ±100 % command value externally – Use potentiometers "Gw+"/"Gw–" to adjust the required maximum control output and check the settings at measuring sockets "wR" and "w"	Note: Before the maximum values are matched, the zero point and step-change heights must have been correctly set. – Adjust step-change heights first; generate +100 % command value externally – Use potentiometer "Gw" to adjust the required maximum control output and check the settings at measuring sockets "wR" and "w"

1

Notes

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Electric amplifiers

RE 30052/02.12
Replaces: 01.09

Type VT-VRPA1-5...-1X/V0/...

Component series 1X

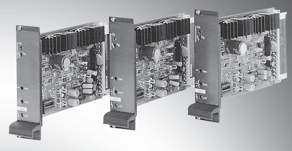


Table of contents

Contents	**Page**

Features

– Suitable for controlling proportional valves
– Analog amplifiers in Europe format for installation in 19" racks
– Controlled output stage
– Position control with PID behavior
– Fast energization and fast deletion for short actuating times
– Enable input
– Cable break detection for actual value cable
– Inputs and outputs short-circuit-proof
– Adjustment possibilities for zero point and sensitivity

Notice:
The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	P	A	1 –		–1X /	V0 /	

Hydraulic component
For valves with electrical feedback = **R**

Valve type
4/2 high-response valve with positive overlap = **P**

Control
Analog = **A**

Output stages
1 output stage = **1**

Option
PV = Pressure valves
QV = Throttle/flow control valves

Customer version
V0 = Catalog version

1X = Component series 10 to 19
(10 to 19: Unchanged technical data and pin assignment)

Serial number for types
527 = 2.7 A solenoid
537 = 3.7 A solenoid

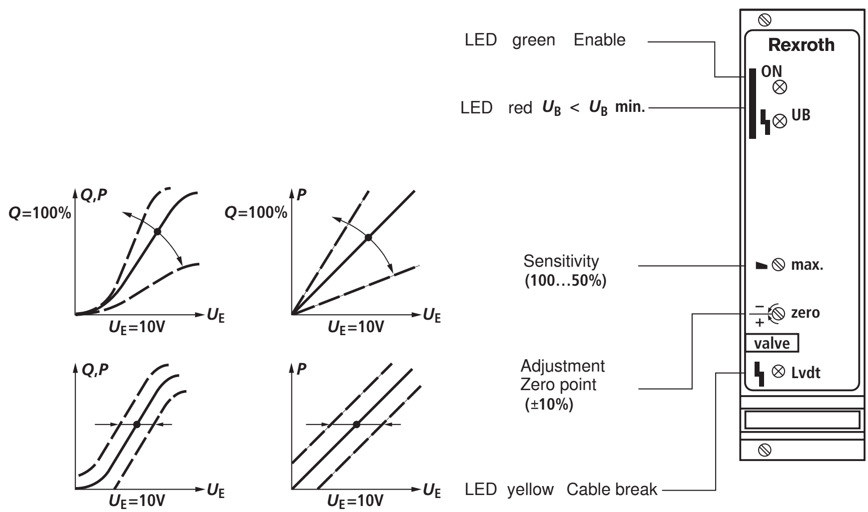
Preferred types

Type	Material number	For proportional valves
VT-VRPA1-527-10/V0	0811405095	DBETFX
VT-VRPA1-527-10/V0/PV	0811405096	DREB6X
VT-VRPA1-537-10/V0/PV	0811405097	DBEB10Z / DREB10Z / DBETBX
VT-VRPA1-527-10/V0/QV	0811405098	4WRP6EA / 3FREZ
VT-VRPA1-537-10/V0/QV	0811405099	4WRP10EA

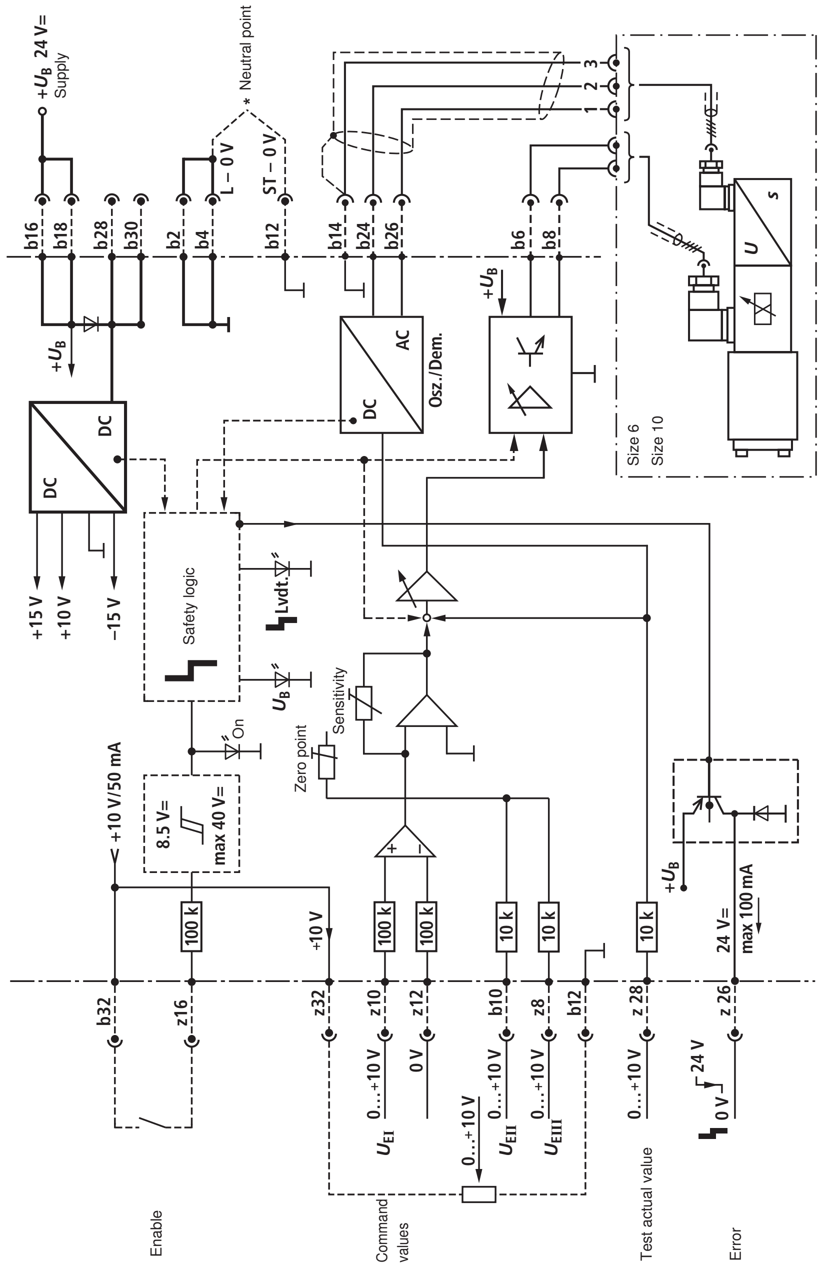
Suitable card holder:

– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



Block diagram with pin assignment



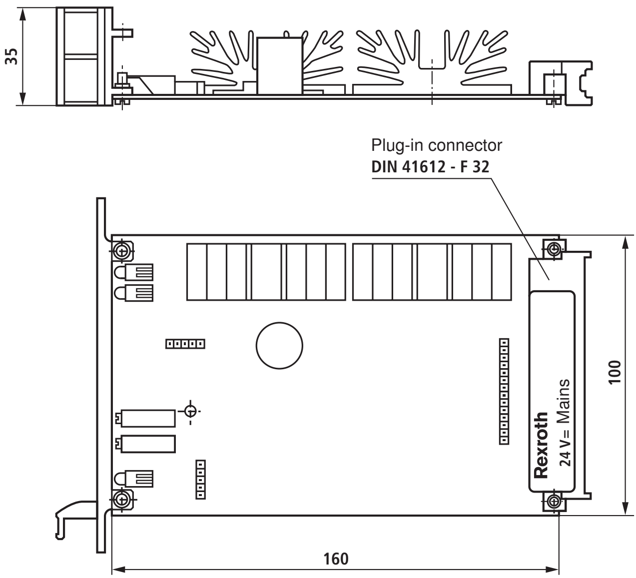
Technical data

Supply voltage U_B at b16 – b2		Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at b16 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)	
Valve solenoid, max.	A/W	**2.7/25 (size 6)**	**3.7/50 (size 10)**
Power consumption, max.	W	35	60
Current consumption, max.	A	1.5	2.5
Solenoid output b6–b8		Rectangular voltage, pulse-modulated $I_{max.}$ = 2.7 A	 $I_{max.}$ = 3.7 A
Command value		$U_{E\ I}$: 0...+10 V (z10) } Difference : 0 V (z12) } input $U_{E\ II}$: 0...+10 V $U_{E\ III}$: 0...+10 V	
Signal source (command value)		Potentiometer R_i = 1 kΩ Supply with +10 V from b32 (10 mA) or external source	
Actual value feedback		Osci b26	Test point z28 [1]
0811405095		10.2 V_{eff}/7.8 kHz	0...+10 V =
0811405096		10.2 V_{eff}/7.8 kHz	0...+10 V =
0811405097		10.8 V_{eff}/7.8 kHz	0...+10 V =
0811405098		10.2 V_{eff}/7.8 kHz	0...+10 V =
0811405099		10.8 V_{eff}/7.8 kHz	0...+10 V =
Enable output stage		At z16, U = 8.5...40 V; e.g. 10 V from z32 LED (green) on front plate lights up	
Cable lengths between amplifier and valve		Solenoid cable: < 20 m 1.5 mm^2 20 to 60 m 2.5 mm^2 Position transducer: Max. 50 m with 100 pF/m Supply and capacitor 1.5 mm^2	
LED displays		green: Enable yellow: Cable break actual value red: $U_B < U_{B\ min.}$ (approx. 21 V)	
Error message – Cable break actual value – U_B too low – ±15 V stabilization		 z26: Switching output No error +24 V (max. 100 mA) Error 0 V	
Short-circuit-proof outputs		Output stage to the solenoid Signal to the positional transducer Supply voltage for potentiometer	
Special features		Cable break protection for actual value cable Position control with PID behavior Pulsed output stage Fast energization and fast deletion for short actuating times	
Adjustment via trimming potentiometer		1. Zero point 2. Sensitivity	
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE	
Plug-in connection		Connector DIN 41612 – F32	
Ambient temperature	°C	0...+70	
Storage temperature range	°C	–20...+70	
Weight	m	0.37 kg	

Notice:
Power zero b2 and control zero b12 must be bridged. If the distance to the power supply unit is < 1 m, directly onto the DIN connector.
With larger distances, lead the control zero separately to the ground.

[1] 0 V with I_m = 0 V (enable OFF)
+10 V with I_m = max. (U_E = 10 V, potentiometer = c_W)

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

Notes

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Rexroth
Bosch Group

Electric amplifiers

RE 30054/03.12
Replaces: 01.09

Type VT-VRPA1-5...-1X/...-RTP

Component series 1X

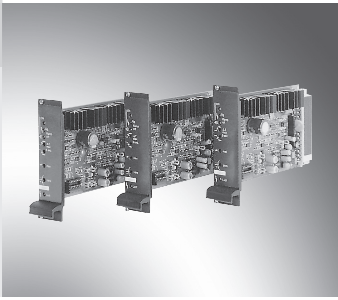

Table of contents

Contents	Page

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– Enable input
– Adjustable ramp that can be switched off
– Cable break detection for actual value cable
– Inputs and outputs short-circuit-proof
– Adjustment possibilities for zero point and sensitivity, acceleration and braking ramp

Notice:
The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	P	A	1 –	–1X/V0/	–RTP

Hydraulic component
For valves with electric feedback **= R**

Valve type
4/2 high-response valve with positive overlap **= P**

Control
Analog **= A**

Output stages
1 output stage **= 1**

Serial number for types
527 = 2.7 A solenoid
537 = 3.7 A solenoid

1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

Customer version
V0 = Catalog version

Option
PV = Pressure valves
QV = Throttle/flow control valve

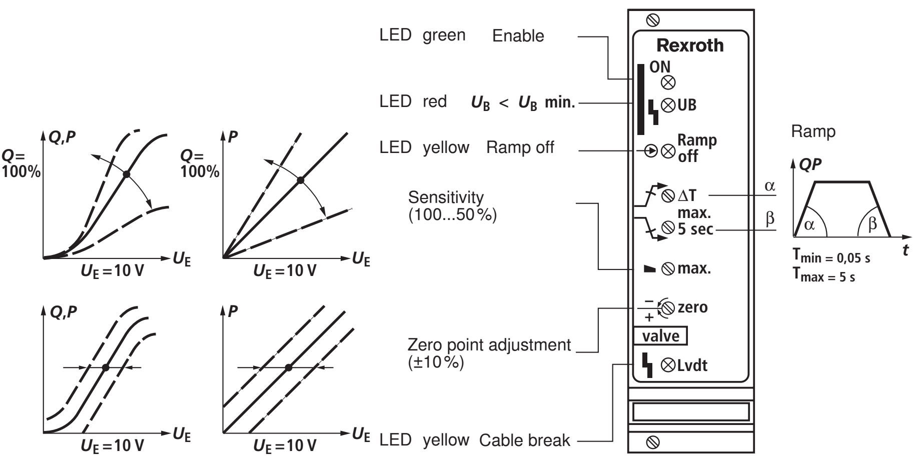
Option
RTP = Adjustable ramp that can be switched off (potentiometer)

Preferred types

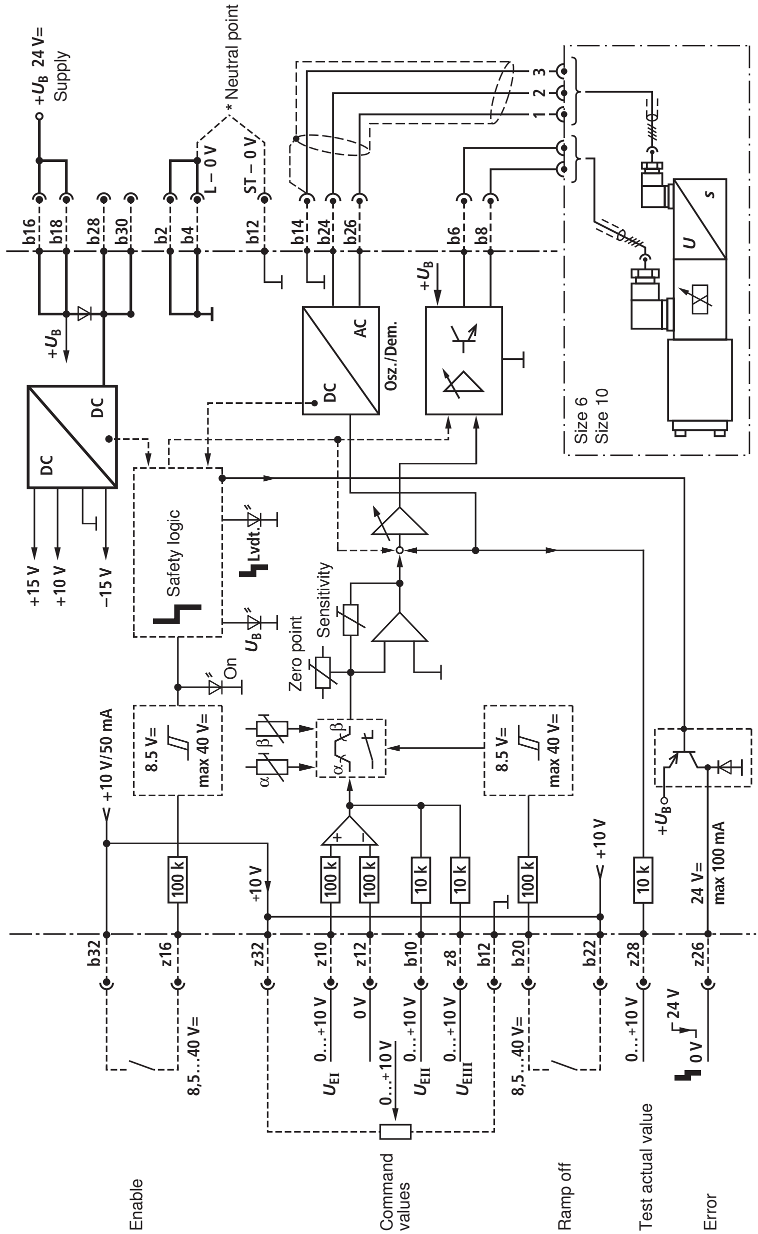
Type	Material number	For proportional valves
VT-VRPA1-527-10/V0/RTP	0811405100	DBETFX
VT-VRPA1-527-10/V0/PV-RTP	0811405101	DREB6X
VT-VRPA1-537-10/V0/PV-RTP	0811405102	DBEB10Z / DREB10Z / DBETBX
VT-VRPA1-527-10/V0/QV-RTP	0811405103	4WRP6EA / 3FREZ
VT-VRPA1-537-10/V0/QV-RTP	0811405104	4WRP10EA

Suitable card holder:
– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



Block diagram with pin assignment



Technical data

Supply voltage U_B at b16/b18	Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at b16 – b2	Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10%	
Valve solenoid max. A/W	**2.7/25 (size 6)**	**3.7/50 (size 10)**
Power consumption, max. W	35	60
Current consumption, max. A	1.5	2.5
Solenoid output b6 – b8	Rectangular voltage, pulse-modulated $I_{max.}$ = 2.7 A	 $I_{max.}$ = 3.7 A
Command value	$U_{E\ I}$: 0...+10 V (z10) } Difference : 0 V (z12) } input $U_{E\ II}$: 0...+10 V $U_{E\ III}$: 0...+10 V	
Signal source (command value)	Potentiometer R_i = 1 kΩ Supply with +10 V from b32 (10 mA) or external source	
Actual value feedback	Osci b26	Test point z28 [1]
0811405100	10.2 V_{eff}/7.8 kHz	0...+10 V =
0811405101	10.2 V_{eff}/7.8 kHz	0...+10 V =
0811405102	10.8 V_{eff}/7.8 kHz	0...+10 V =
0811405103	10.2 V_{eff}/7.8 kHz	0...+10 V =
0811405104	10.8 V_{eff}/7.8 kHz	0...+10 V =
Enable output stage	At z16, U = 8.5...40 V; e.g. 10 V from z 32 LED (green) on front plate lights up	
Ramp OFF	At b20; U = 8.5...40 V	
Cable lengths between amplifier and valve	Solenoid cable: < 20 m 1.5 mm² 20...50 m 2.5 mm² Position transducer: Max. 50 m with 100 pF/m Supply and capacitor 1.5 mm²	
LED displays	green: Enable yellow: Cable break actual value / ramp OFF red: $U_B < U_{B\ min.}$ (approx. 21 V)	
Error message – Cable break actual value – U_B too low – ±15 V stabilization	 z26: Switching output No error +24 V (max. 100 mA) Error 0 V	
Short-circuit-proof outputs	Output stage to the solenoid, Signal to the positional transducer Supply voltage for potentiometer	
Special features	Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Adjustable ramp that can be switched off	
Adjustment via trimming potentiometer	1. Zero point 2. Sensitivity	3. Acceleration ramp 4. Braking ramp
Circuit board format mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE	
Plug-in connection	Connector DIN 41612 – F32	
Ambient temperature °C	0...+70	
Storage temperature range °C	–20...+70	
Weight m	0.36 kg	

Notice:
Power zero b 2 and control zero b 12 must be bridged. If the distance to the power supply unit is < 1 m, directly onto the DIN connector. With larger distances, lead the control zero separately to the ground.

[1] 0 V with I_m = 0 V (enable OFF), +10 V with I_m = max. (U_E = 10 V, potentiometer = c_W)

Setting information

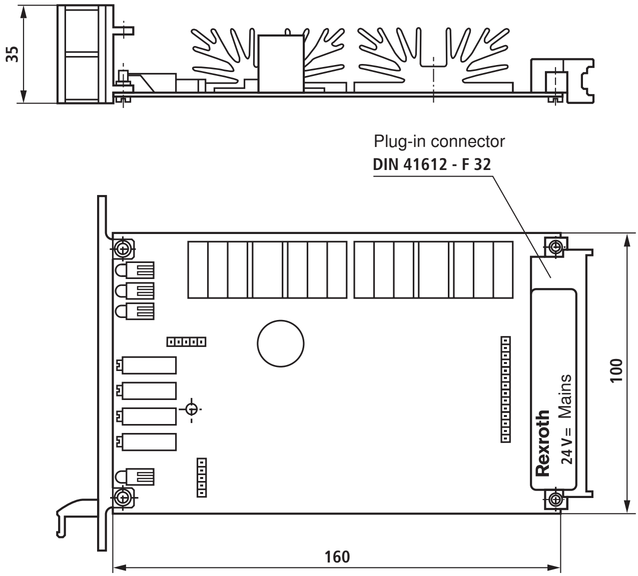
Information for the use of ramps

Ramp ON: No signal at b20.

Ramp OFF: 8.5...40 V at b20 or connection between b22 and b20.

In case of **Ramp OFF** or **Cable break,** any ramp started before will be canceled. Transition to the signal end value is effected by means of a step.

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

Notes

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Analogue amplifier

RE 30118/11.04 1/8
Replaces: 04.04

Type VT-VRPA1-…

Component series 1X

H/A/D 6197/99

Overview of contents

Contents	Page
Overview of contents	1
Features	1
Ordering details	2
Functional description	2
Technical data	3
Block circuit diagram / connection allocation	5
Display/adjustment elements	6
Engineering/maintenance guidelines, additional information	7
Unit dimensions	7

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(G)
– 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 techncial 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

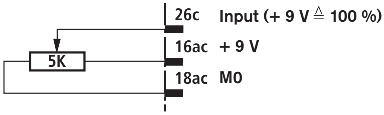
That the unit is operational is indicated by a green LED lighting up on the front plate.

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)

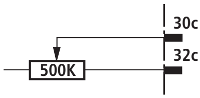


Ramp function

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.

1

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 capasitive 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
	Or	I_e	0 mA to 20 mA (R_i = 100 Ω)
	Or	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!)

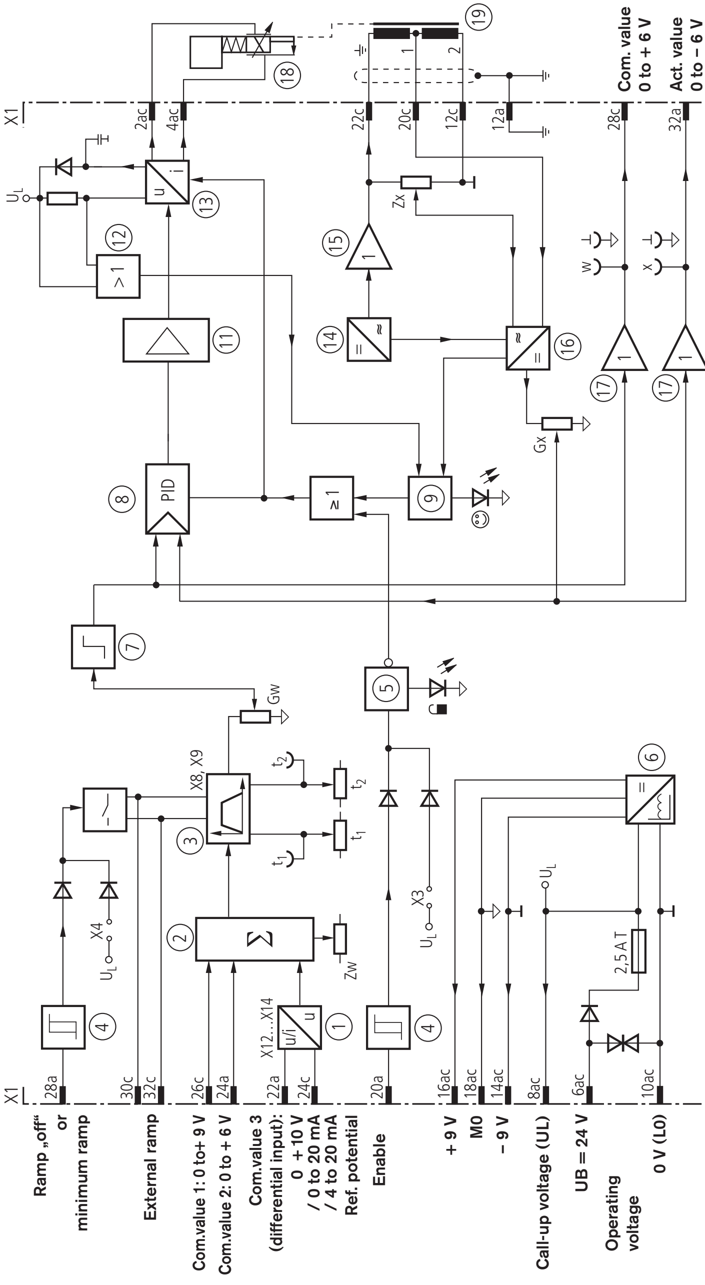
Continued from page 3

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



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

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

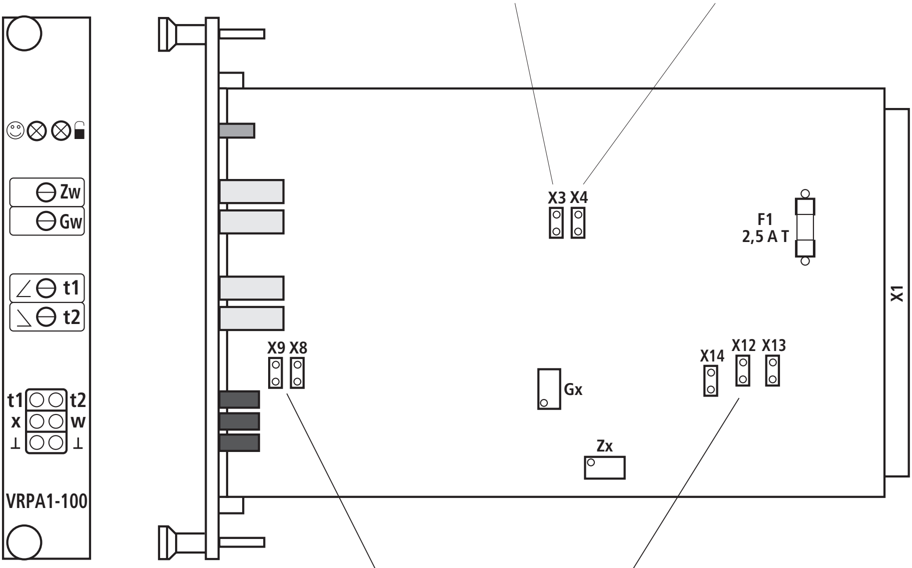
1 Differential amplifier
2 Command value summator
3 Ramp generator
4 Threshold value switch
5 Enable circuit
6 Power supply
7 Command value limiter
8 PID-controller
9 Fault recognision

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

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

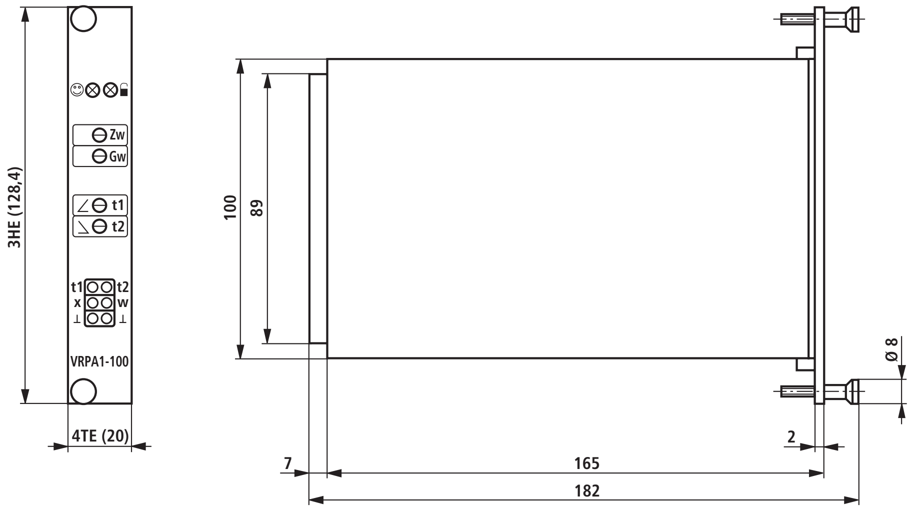
▬ = Bridge fitted

○○ = 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 (in mm)



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 $R_i > 100$ kΩ!
- 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)

Preferred 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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Analogue Amplifiers

RE 30117/07.06
Replaces: 05.06

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

Series 1X

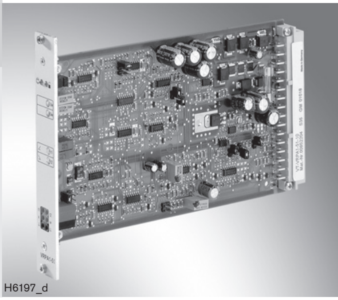

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Table of contents

Contents	**Page**

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

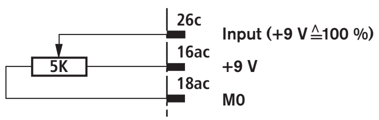
The green LED on the front panel lights up to signal readiness for operation.

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

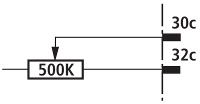
The ramp generator [3] connected downstream generates a ramp-shaped output signal from a stepped input signal. The time constants of the output signal (ramp times) can be adjusted by means of potentiometers "t1" ("up" ramp) and "t2" ("down" ramp) that are accessible on the front panel. The maximum ramp 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"

1

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")

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

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

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

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

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

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.

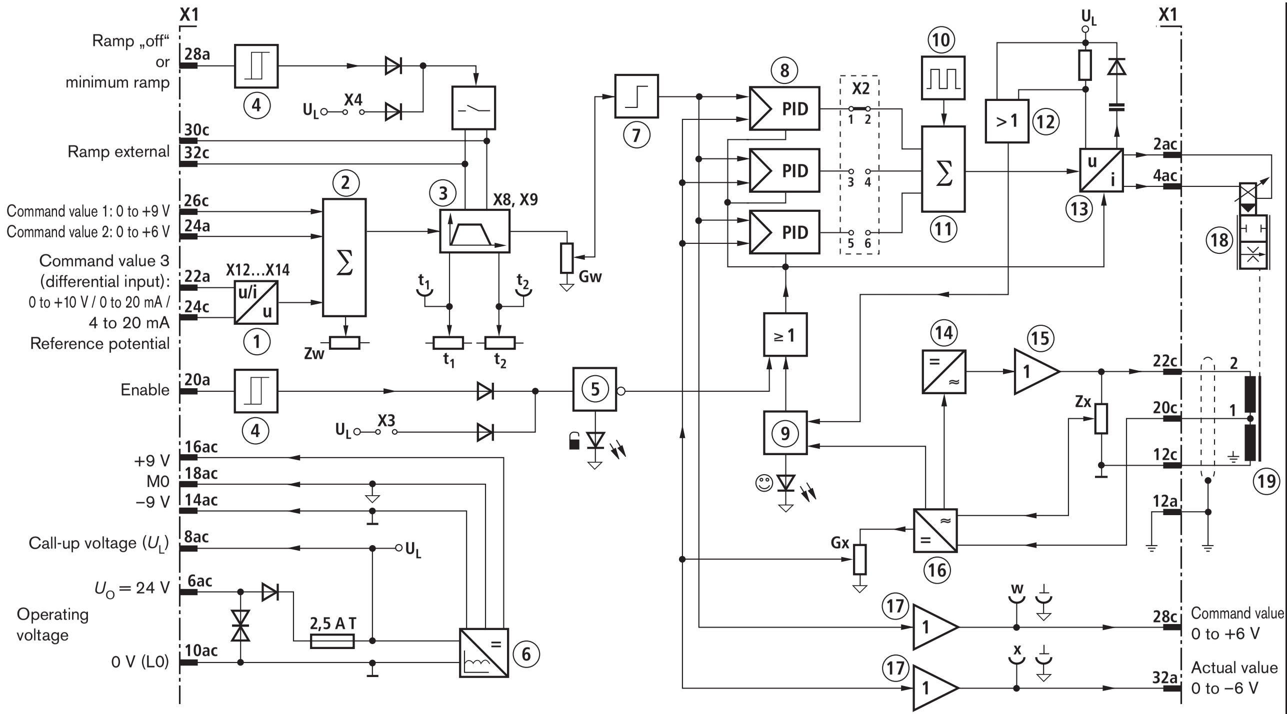
[ ] = Cross-reference to block circuit diagram on page 4

☞ **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	**1**	Differential amplifier	**9**	Fault detector	**17**	Output stage
Gw	= Command value attenuator	**2**	Command value summator	**10**	Dither generator	**18**	Proportional valve
Zx	= Actual value zero point	**3**	Ramp generator	**11**	Summator, controller	**19**	Position transducer
Gx	= Actual value	**4**	Trigger	**12**	Overcurrent detector		
☺	= Readiness for operation	**5**	Enable circuit	**13**	Clocked output stage		
	= Enable	**6**	Power supply unit	**14**	Oscillator		
t1	= Ramp time “up“	**7**	Command value limiter	**15**	Position transducer driver		
t2	= Ramp time “down“	**8**	PID-controller	**16**	Demodulator		

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

1

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)

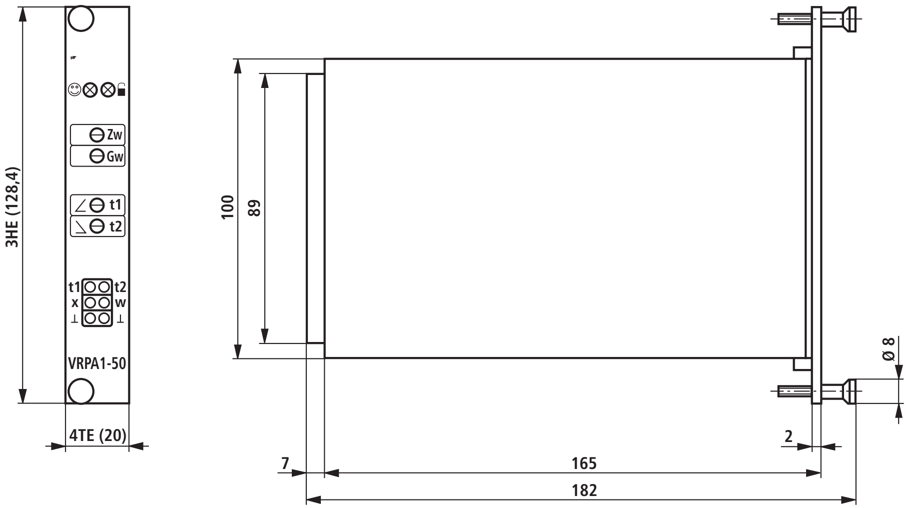
Technical data (for applications outside these parameters, please consult us!)

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 – Width soldering side – Width component side		 3 HE (128.4 mm) 1 TE (5.08 mm) 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).

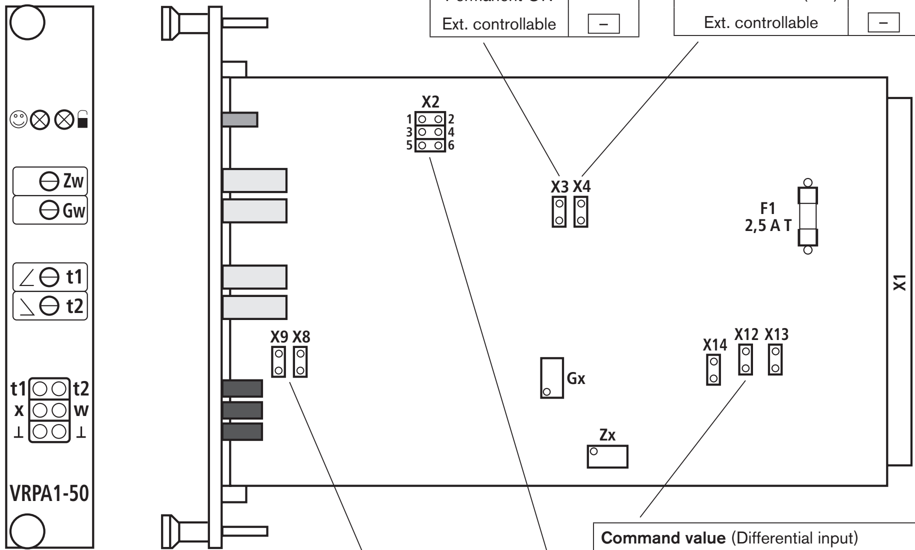
Unit dimensions (Dimensions in mm)



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 Δp < 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 $R_i > 100$ kΩ!
- 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)

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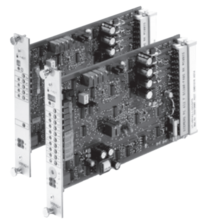
The Drive & Control Company

Rexroth
Bosch Group

Valve amplifier for proportional directional valves

Type VT-VRPA2

RE 30119
Edition: 2013-04
Replaces: 07.05



H6641

- Component series 1X
- Analog, Euro-card format
- Suitable for controlling 4/3 proportional directional valves with electrical position feedback:
  – 4WRE 6...-2X,
  – 4WRE 10...-2X

Features

- Differential input (±10 V)
- Four callable command value inputs (±10 V)
- Current input (4 ... 20 mA)
- Inversion 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) with 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
- "Ready for operation" output signal
- Switchable measuring socket with option T5
- Reverse polarity protection for the voltage supply
- Power supply with DC/DC converter without raised zero point

Contents

Ordering code

01		02		03		04		05		06
VT-VRPA2	**–**		**–**	**1X**	**/**	**V0**	**/**		**/**	*****

01	Valve amplifier for proportional directional valves and proportional pressure valves, analog, euro-card format	**VT-VRPA2**
02	For controlling 4/3 proportional directional valves 4WRE 6...-2X	**1**
	For controlling 4/3 proportional directional valves 4WRE 10...-2X	**2**
03	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	**1X**
04	Version: Standard	**V0**
05	Option: With one ramp time	**T1**
	Option: With five ramp times	**T5**
06	Further details in the plain text	*****

Accessories

- Open card holder VT 3002-1-2X/48F (see data sheet 29928)

Function

Power supply unit [1]
The amplifier card has a power supply unit with making current limiter. This unit supplies all internally required positive and negative supply voltages.

Command value specification
The internal command value signal is calculated from the total (summation [6]) of the external command value signal available at the differential input [2] and at the current input [3], the called-up signal [4] and the zero point offset [5] (zero point potentiometer "Zw").

The following applies:

Standard values	Current input	Differential input	Command value measuring socket	Flow direction
–100 %	4 mA	–10 V	–10 V	P to B, A to T
0 %	12 mA	0 V	0 V	
100 %	20 mA	10 V	10 V	P to A, B to T
0 %	< 1 mA [1)]		0 V	

1) 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 switch-over between current and voltage input. The inputs are permanently available (see block diagram).

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 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". 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.

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 indicated by an LED ("–1") on the front plate.

Enable function [8]
The enable function enables the power output stages and forwards the internal command value signal to the ramp generator. The enable signal is indicated 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.

Ramp generator [9]
The ramp generator limits the rise of the control output. The downstream step functions and amplitude attenuators do not extend or shorten the ramp time.
Using jumper J2, the ramp time is set to a minimum (< 2 ms) (ramp off).
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.

Note for setting and measuring the ramp time:

Value at measuring socket "t" (T1) / "v" (T5)	***U_t* / V**	5	3	2
Current ramp time (±20 %)	***t* / ms**	20	33	50

***U_t* / V**	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
***t* / ms**	100	200	333	500	1000	2000	3333	5000

By closing the jumper J3, the ramp times specified above can be increased tenfold.

Characteristic curve generator [11]
Using the adjustable characteristic curve generator, the step level and maximum values for positive and negative signals can be set separately according to the hydraulic requirements. The actual development of the characteristic curve through the zero point is not stepped but linear.

Amplitude limiter [12]
The internal command value is limited to approx. ±110 % of the nominal range.

Oscillator [14]
The oscillator creates the control signal for the inductive position transducer.

Demodulator [15]
The demodulator supplies the actual value signal of the valve spool position from the position transducer signal.
100 % ≙ 10 V

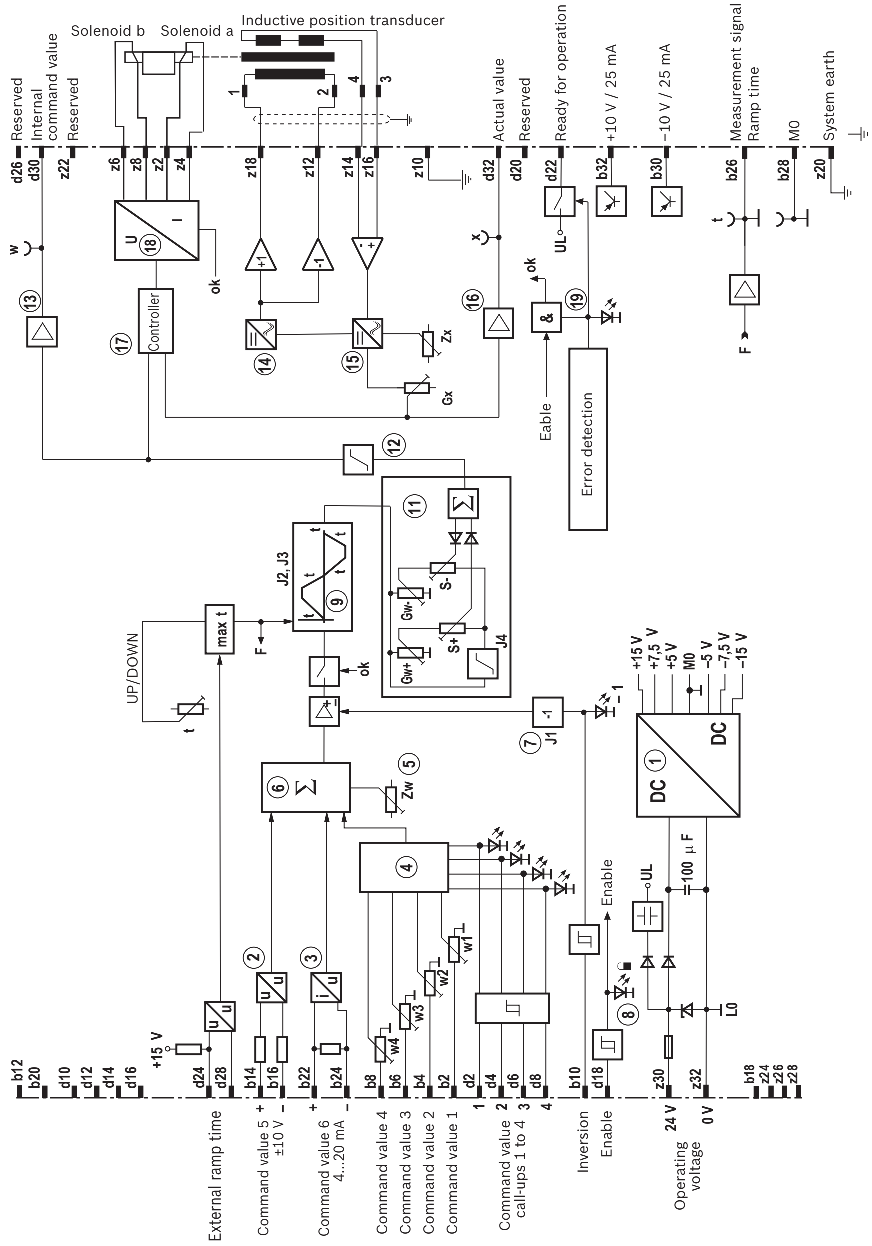
Position controller [17]
The position controller is optimized in a valve-specific manner.

Power output stage [18]
The power output stage creates the clocked solenoid current for the proportional valve. The solenoid current is limited to 2.5 A to 2.8 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 they have not been enabled..

Fault recognition [19]
The position transducer cable is monitored for cable break and short-circuits on the primary side as well as for over-currents at the output stage.

[ ] = Attribution to the block diagrams on pages 4 and 5

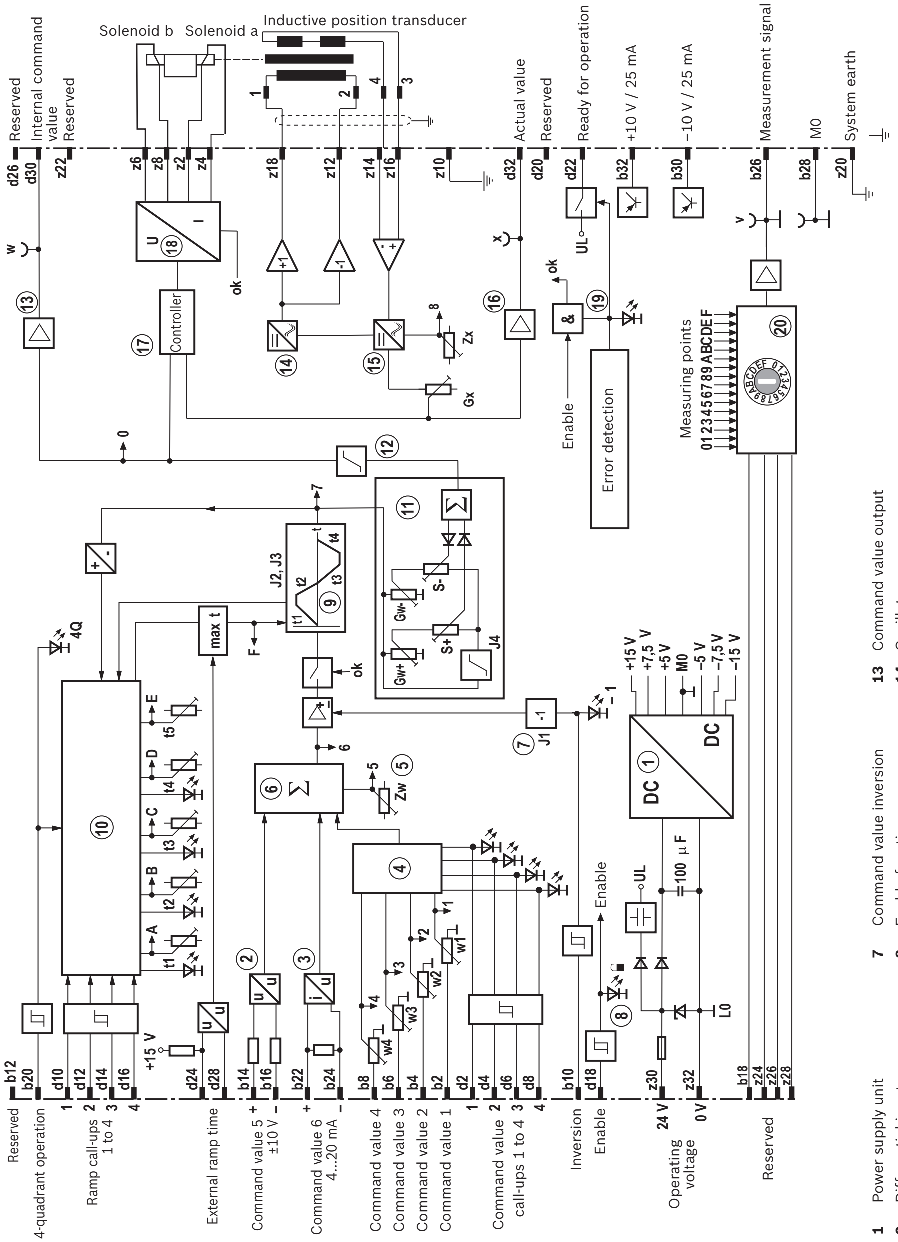
Block diagram/pin assignment, option T1



1	Power supply unit	**6**	Command value summation	**12**	Amplitude limiter
2	Differential input	**7**	Command value inversion	**13**	Command value output
3	Current input	**8**	Enable function	**14**	Oscillator
4	Command value selection logic	**9**	Ramp generator	**15**	Demodulator
5	Zero point setting	**11**	Characteristic curve generator	**16**	Actual value output
				17	Position controller
				18	Power output stage
				19	Fault recognition

1

Block diagram/pin assignment, option T5



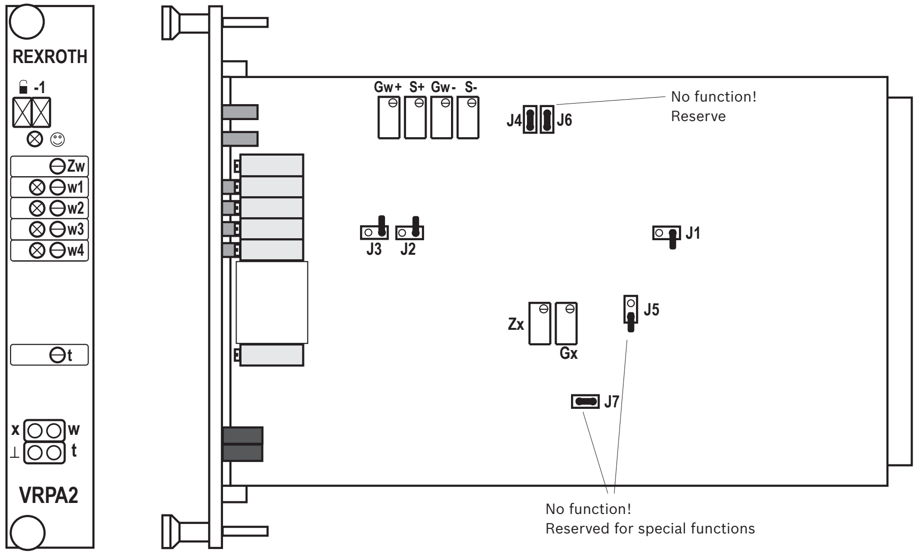
1 Power supply unit
2 Differential input
3 Current input
4 Command value selection logic
5 Zero point setting
6 Command value summation
7 Command value inversion
8 Enable function
9 Ramp generator
10 Ramp time selection logic
11 Characteristic curve generator
12 Amplitude limiter
13 Command value output
14 Oscillator
15 Demodulator
16 Actual value output
17 Position controller
18 Power output stage
19 Fault recognition
20 Measuring point switch-over

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

Operating voltage	U_B	24 VDC + 40 % – 20 %
Operating range:		
Upper limit value	$U_B\ (t)_{max}$	35 V
Lower limit value	$U_B\ (t)_{min}$	18 V
Power consumption	P_S	< 24 VA
Current consumption	I	< 2 A
Fuse	I_S	2 A medium time-lag, exchangeable
Inputs, analog		
Command values 1 to 4 (potentiometer inputs)	U_e	0 … ±10 V, R_e > 100 kΩ (M0 is reference)
Command value 5 (differential input)	U_e	0 … ±10 V, R_e > 50 kΩ
Command value 6 (current input)	I_e	4 … 20 mA, load R_B = 100 Ω
External ramp time	U_e	0 … +10 V, R_e = 10 kΩ (internally increased to +15 V, M0 is reference)
Inputs, digital		
Command value call-ups, Command value inversion, Enable, Ramp call-ups (option T5), 4-quadrant operation (option T5)	U U	8.5 V … U_B –> ON, R_e > 100 kΩ 0 … 6.5 V –> OFF, R_e > 100 kΩ
Setting ranges		
Zero adjustment (potentiometer "Zw")		±30 %
Command values (potentiometers "w1" to "w4")		0 … 110 %
Ramp times (potentiometer "t1" to "t5")		20 ms … 5 s, switchable to 0.2 … 50 s
Step level (potentiometer "S+" and "S–")		0 … 50 %
Amplitude attenuator (potentiometer "G+" and "G–")		0 … 110 % (applies to the step level setting of 0 %)
Outputs		
Command value signal	U	±10 V ± 2 %, I_{max} = 2 mA
Actual value signal	U	±2,5 V ± 2 %, I_{max} = 2 mA
Measurement signal (option 5)	U	±10 V ± 2 %, I_{max} = 2 mA
Ready for operation	U	> 16 V, 50 mA (in case of a fault: U < 1 V, R_i = 10 kΩ)
Regulated voltages	U	±10 V ± 2 %, 25 mA, short-circuit-proof
Power output stage	I	0 … 2.5 A, short-circuit-proof, clocked with approx. 5 kHz
Oscillator	U	±5 V_{SS} per output, 10 mA
	f	5.6 kHz ± 10 %
Measuring sockets		
Command value "w"		±10 V ± 2 %, I_{max} = 2 mA
Actual value signal "x"		±10 V ± 2 %, I_{max} = 2 mA
Ramp time "t"		See description on page 3
Socket "v" (option T5)		See description on page 3 and table on page 9
Type of connection		48-pin male multipoint connector, DIN 41612, design F
Card dimensions		Euro card 100 x 160 mm, DIN 41494
Admissible operating temperature range	ϑ	0 … 50 °C
Storage temperature range	ϑ	–25 °C … +85 °C
Weight	m	0.17 kg (net)

Notice:
For information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30119-U.

Display/adjustment elements, option T1



Inversion	J1
Inverting	
Not inverting ●	

Ramp function	J2
Off	
On ●	

Ramp time	J3
0.2 ... 50 sec.	
0.02 ... 5 sec. ●	

Step function	J4
Off ●	
On	

LED displays:

☺ Ready for operation (green)

🔒 Enable (yellow)

–1 External inverting

●	=	Factory setting of the jumpers
	=	Jumper closed
	=	Jumper open

Measuring sockets:

x, w, t Measurement signal (see page 6)

⊥ Measurement zero

Potentiometers (some with LED display):

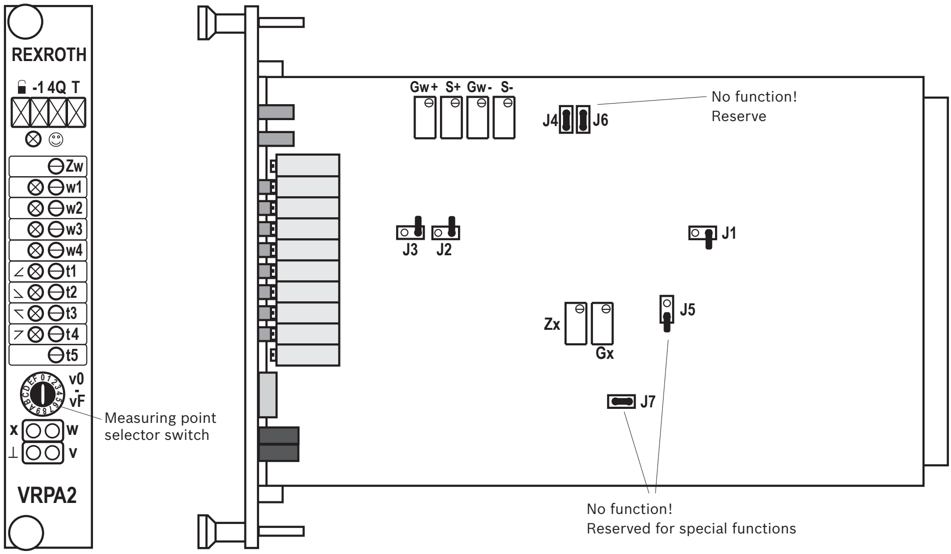
Zw Zero point calibration
w1 Command value 1
w2 Command value 2
w3 Command value 3
w4 Command value 4
t Ramp time

Adjustable on the board:

Gw+ Amplitude attenuator for positive command values
Gw– Amplitude attenuator for negative command values
S+ Step level for positive direction
S– Step level for negative direction

The warranty expires if the sealed potentiometer is adjusted.

Display/adjustment elements, option T5



Inversion	J1
Inverting	▬
Not inverting ●	○ ○

Ramp function	J2
Off	▬
On ●	○ ○

Ramp time	J3
0.2 ... 50 sec.	▬
0.02 ... 5 sec. ●	○ ○

Step function	J4
Off	▬
On ●	○ ○

●	=	Factory setting of the jumpers
▬	=	Jumper closed
○ ○	=	Jumper open

LED displays:

☺ Ready for operation (green)

🔓 Enable (yellow)

–1 External inverting

4Q 4-quadrant operation

T Reserved

Measuring sockets:

x, w, v Measurement signal (see page 6)

⊥ Measurement zero

Potentiometers (some with LED display):

Zw Zero point calibration

w1 Command value 1

w2 Command value 2

w3 Command value 3

w4 Command value 4

t Ramp time

Adjustable on the board:

Gw+ Amplitude attenuator for positive command values

Gw– Amplitude attenuator for negative command values

S+ Step level for positive direction

S– Step level for negative direction

The warranty expires if the sealed potentiometer is adjusted.

Display/adjustment elements, option T5 (continued)

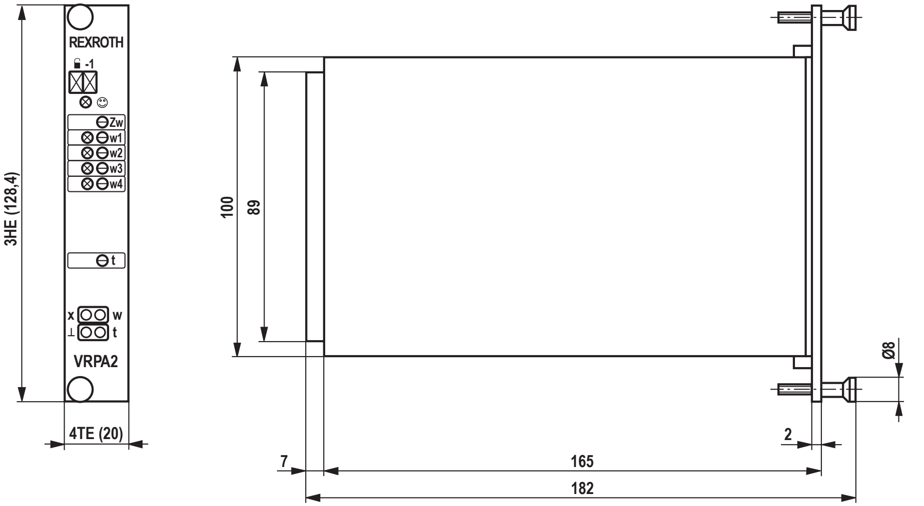
Measuring socket "v"

Signal designation	Measuring point selector switch	Measurement signal "v"
Internal command value	0	±100 % ≙ ±10 V
Command value call-up 1	1	±100 % ≙ ±10 V
Command value call-up 2	2	±100 % ≙ ±10 V
Command value call-up 3	3	±100 % ≙ ±10 V
Command value call-up 4	4	±100 % ≙ ±10 V
Zero point offset "Zw"	5	±30 % ≙ ±3 V
Composite signal of the command values	6	±100 % ≙ ±10 V
Ramp output signal	7	±100 % ≙ ±10 V
Zero point offset "Zx"	8	±30 % ≙ ±10 V
Not connected	9	
Ramp time "t1"	A	10 mV ... 10 V [1)]
Ramp time "t2"	B	10 mV ... 10 V [1)]
Ramp time "t3"	C	10 mV ... 10 V [1)]
Ramp time "t4"	D	10 mV ... 10 V [1)]
Ramp time "t5"	E	10 mV ... 10 V [1)]
Current ramp time "t"	F	10 mV ... 10 V [1)]

[1)] The allocations of voltage and ramp time specified in the table on page 3 shall apply.

1

Dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- For more information, refer to document 30119-B.

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Electrical amplifier for controlling DC motor-actuated pressure control valves with electrical feedback

RE 30405/04.08

Type VT-VRM1-1

Component series 1X

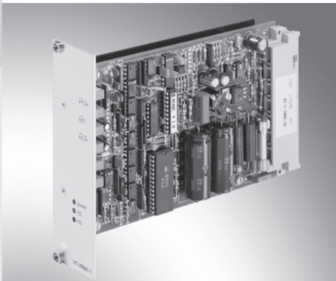

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Table of contents

Content	Page

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

Features

The amplifier card is used for controlling DC motor-actuated pressure control valves with electrical feedback (DBGx...1X, DRG...1X).

- PWM output stage with 4-quadrant operation
- Rotary angle controller of actual value potentiometer
- Differential input for command value provision
- Enable circuit
- Command value inversion
- DC/DC converter
- Offset adjustment for command value
- Command value attenuation
- Ramp generator
- LED indicator lamps:
  power
  H2 for maximum current indication
  H3 for fault and missing enable

Ordering code

Type VT-VRM1-1-1X
Material number: R900067617

Accessories (can be ordered separately)
Card holder:
– VT 3002-1-2X/15H, Material number: R900209648
Power supply unit:
– VT-NE30-2X, Material number: R901082348

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

Operating voltage	U_B	24 VDC –20 % +40 % Residual ripple content: 8 %
Current consumption	I (idle) I_{max}	0.2 A 6 A
Inputs		
Command value	U	0 V to +10 V (R_i > 100 kΩ)
Actual value	U	0 V to +15 V
Enable	U	log 0: 0 to 3 V log 1: 10 to 30 V
Invert (command value inversion)	U	log 0: 0 to 3 V log 1: 10 to 30 V
Adjustment ranges		
Offset adjustment for command value		0 to 50 %
Command value attenuation		20 to 100 %
Ramp time	t	40 ms to 1.6 s
Note: Valve can be overcontrolled. Before adjusting the offset, turn the command value attenuator to minimum and apply a command value of 0 V!		
Outputs		
Motor connection – Maximum output current – Minimum motor inductivity	 I_{max} L_{min}	 8 A 1 mH
Auxiliary voltage for potentiometer connection	U	15 V, 30 mA
Type of connection		15-pin male connector, DIN 41615, form H
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Front panel dimensions		
Height		3 HE
Width soldering side		3 TE
Width component side		5 TE (1 TE = 5,08 mm)
Permissible ambient temperature	T	0° to 45°C (temperature of output stages is monitored)
Weight	m	0.4 kg

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

Basic settings of potentiometers

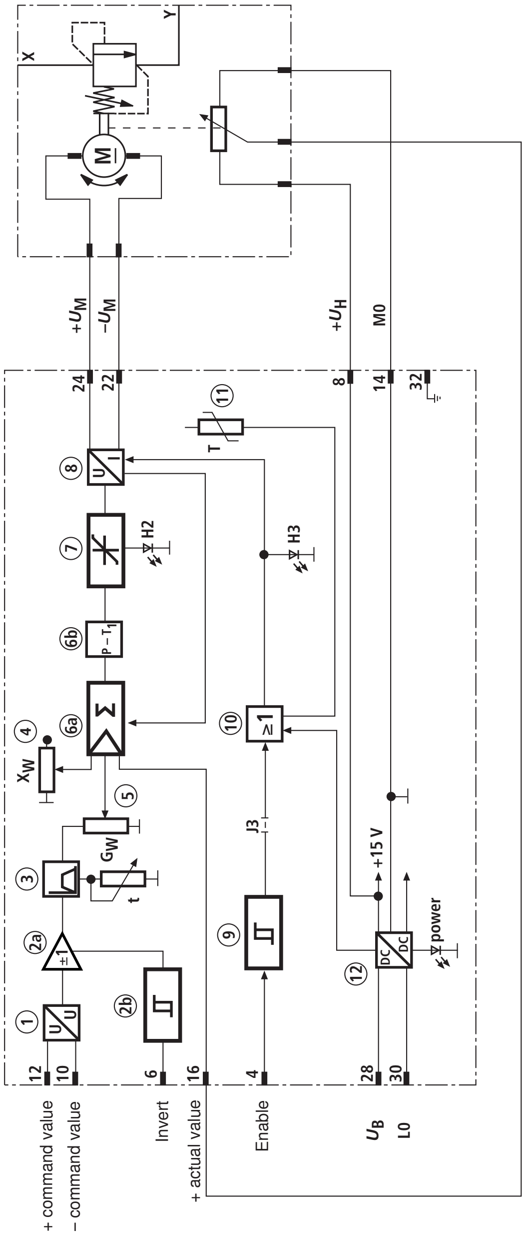
Item	Comp. names	Description (lettering on printed-circuit board)	Setting	Front panel designation
1	P1	n_{max} (command value attenuator)	Right-hand limit stop (maximum)	G_w
2	P2	t_{int} (ramp time)	Left-hand limit stop (minimum)	t
3	P3	n_{offs} (zero point)	Right-hand limit stop (minimum)	Z_x
4	P4	X_p (controller adjustment)	Right-hand limit stop	
5	P5	I_xR	Left-hand limit stop	
6	P6	I_A (current limitation)	Right-hand limit stop (no current limitation)	

Jumper settings

The jumpers are firmly pre-set and must not be changed. This information is provided purely for checking purposes.

Jumper	Factory setting	Remark
J1	Open	Not available
J2	Plugged between jumper pins 2 and 3	Differential input activated
J3	Plugged	Controller and output stage enable
J4	Plugged between jumper pins 1 and 2	Position controller activated
J5	Open	Armature voltage regulation deactivated

Block circuit diagram



1 Differential input
2 Command value inversion
3 Ramp generator
4 Zero point potentiometer

5 Command value attenuator
6 Rotary angle controller
7 Maximum current limitation
8 Clocked and regulated motor current outpupt stage

9 Enable input
10 Output stage enable circuit
11 Temperature sensor
12 Internal power supply

Electrical connection

Connector pinout of amplifier card			Connector pinout of valve	
Pin	**Designation**	**Value**	**DBG...1X**	**DRG...1X**
4	Enable OFF	0 V < U < 3 V		
	ON	10 V < U < 30 V		
6	Invert OFF	0 V < U < 3 V		
	ON	10 V < U < 30 V		
8	+15 V		3	3
10	–command value	Reference potential	⏚	⏚
12	+command value	0 V < U < 10 V		
14	M0/0 V		1	1
16	+actual value		2	2
18	I_{Mmax}	n.c.		
20		n.c.		
22	$-U_{Motor}$		5	5
24	$+U_{Motor}$		6	6
26		n.c.		
28	$+U_B$	24 VDC		
30	L0/ground	0 V		
32	GND	GND/ground		

Installation and connection

- Connection according to block circuit diagram and table above
  Incorrect connection (polarity reversal) can destroy the device !
- Shield command value, control and actual value cables / connect shield on one end - only to Pin 14
- Shield motor cable / connect shield on one end to system ground and to Pin 32
- Connect L0 on power supply unit to system ground

Notes

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Digital valve amplifier for valve types 4WRE 6 ..., component series 2X 4WRE 10 ..., component series 2X

RE 30126/09.07
Replaces: 09.05

Typ VT-VRPD-2

Component series 2X

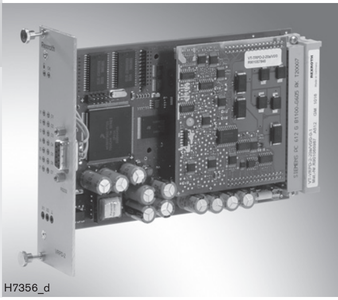

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Table of contents

Features

– Suitable for controlling proportional valves with electrical position feedback, types:
  4WRE 6, component series 2X
  4WRE 10, component series 2X
– User data can be exactly reproduced and are protected against unintended or unauthorized changes
– Use of a powerful microcontroller
– Valve selection using operating software BODAC
– Command value input, optional as voltage or current interface
– Voltage input as differential input
– Command value input with variable input adjustment
– Ramp generator
– Digital inputs for calling pre-set command value parameters
– Enable input and fault output
– Switched-mode power supply unit for internal supply voltages
– Freely configurable measuring sockets X2 (X1 positively assigned to actual valve value)
– Configuration and parameterization via serial interface using PC software BODAC (CD:SYS-HACD-BODAC-01)
  Connection cable for BODAC
– Up to 32 valve amplifiers can be interconnected via local bus for parameterization and diagnostics purposes

Ordering code

VT-VRPD – 2 – 2X / V0 / 0 – 0 – 1

Digital amplifier for proportional valves with electrical position feedback	VT-VRPD
Amplifier for valve types 4WRE 6 …-2X and 4WRE 10 …-2X	**= 2**
Component series 20 to 29 (20 to 29: unchanged technical data and pin assignment)	**= 2X**
V0 =	Basic device
0 =	Without display
0 =	Basic device
1 =	With valve output stage (Attention: Suitable only for valve with two solenoids!)

Standard types	**Material number**
VT-VRPD-2-2X/V0/0-0-1	R901066987

Required accessories:

– PC program BODAC: Ordering code of CD: SYS-HACD-BODAC-01 (R900777335) or free download on the Internet at www.boschrexroth.com/hacd

– Interface cable: Cable set VT-HACD-1X/03.0/HACD-PC (R900776897) or commercial 1:1 cable

Suitable card holders:

– 19“ racks VT 19101, VT 19102, VT 19103 and VT 19110 (see RE 29768)

– Enclosed card holder VT 12302 (see RE 30103) (standard), Mat. no. R900784153

– Open card holder VT 3002-2X/64G (see RE 29928), Mat. no. R900991843 (only for installation into control cabinet!)

– Connection adapter VT 10812-2X/64G (see RE 30105), Mat. no. R900713826

1

Functional description

The amplifier card is designed as double-sided printed-circuit board in Euro-format 100 x 160 mm with daughterboard.

A microcontroller is the central unit of the amplifier. It controls the entire sequence and implements closed-loop position control. Data for the configuration, command value feedforward, and parameters are saved in a non-volatile FLASH.

Four binary-coded, digital inputs are used for calling up parameter sets (command values) from the memory, in which a maximum of 16 sets can be saved. A call-up activates the command value for the valve spool position with the associated ramp times.

Further control inputs have the following function:

"Command valid":	Enable of the parameter set addressed by the current call-up (H-active)
"Enable":	Activation of outputs (fault message acknowledgement by Low→High edge)

The amplifier card includes a controller for the spool position of a proportional valve.

The command value can be provided via digital command value call-ups [5] and/or via analog inputs [1]. Analog input AI4 (b14/b16) must be used for command values of ±10 V, analog input AI6 (b22/b24) for command values of 4 to 20 mA.

Command values of 0 to +10 V (12...20 mA) control solenoid B.

Command values of 0 to –10 V (4...12 mA) control solenoid A.

The digital command value is added to the analog command value with the correct sign in accordance with the set call-up.

The signal level of the command value inputs can be varied by means of the software.

Apart from the possibility of generating ramps internally, it is possible to influence "up" and "down" ramps of external signals with correct sums and signs via analog inputs AI2 (b6/b9) and AI5 (b18/b20).

For 4WRE valves, a step function generator [9] is provided by the software to realize an overlap jump when a spool with overlap is selected. The command value sum is fed to the controller [12].

The actual valve value (b26) is generated by means of an oscillator/demodulator stage from the valve position measuring system and also fed to the controller [12]. The controller output controls the current-regulated output stages.

Enable and fault messages

The closed-loop control is activated by a H-level at the enable input. If no command value call-up is active, digital call-up 0 is set.

A fault logic [14] recognizes control deviations, a cable break of actual value cables and of the command value input for 4 to 20 mA as well as an inactive enable input. In the case of a fault, a fault message is output to (d22) by a Low signal and signaled visually by LED "OK" (OK goes out) on the front panel. It is possible to configure the enable so that an inactive enable input is not signaled as a fault.

Parameterization and diagnosis

The selection of the valve to be controlled and the selection and configuration of the command value input, the ramp generator, the enable input, and the setting of the command value call-up parameters are made via the serial interface [6] at the front D-SUB socket [7]. Up to 32 valve amplifiers can be interconnected via the local bus. A bus address is assigned to each valve amplifier via BODAC. Re-plugging of the serial interface cable is not required.
For further information, see RE 30126-01-B.

Digital outputs

DO 1	(d20)	Solenoid A active
DO 2	(d26)	Solenoid B active
DO 3	(z22)	System deviation ≥ window
DO 4	(z24)	Freely configurable
DO 5	(z26)	Freely configurable
DO 6	(z28)	Freely configurable
DO 7	(f2)	Not assigned

Indicator elements and measuring sockets

The front panel of the command value card is provided with measuring sockets for the two analog outputs.

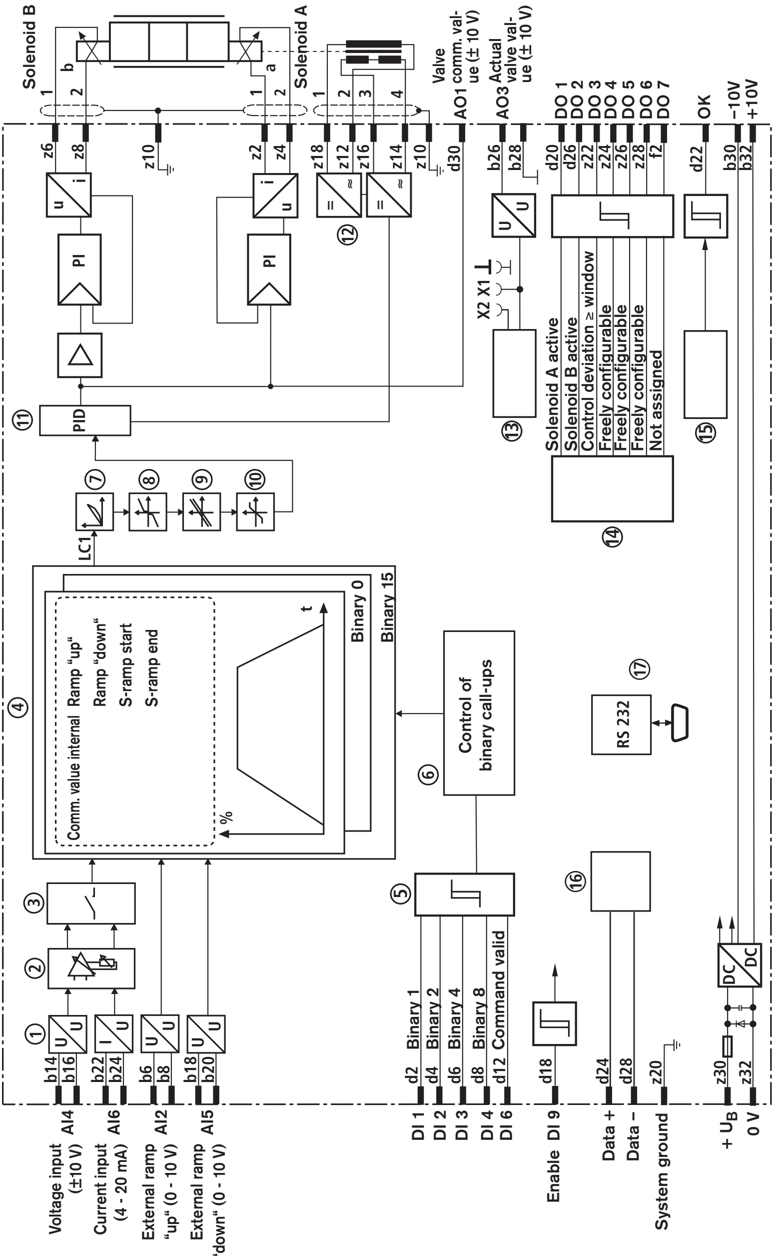
Measuring socket "X1":	Actual valve value (b26)
Measuring socket "X2":	Valve command value (default)
Measuring socket "⊥":	Reference potential (corresponds to connection z32)

The following states are signaled by LEDs:

LED "🔓" (green):	Enable active
LED "OK" (green):	OK ready for operation
LEDs "I1"..."I4" (yellow):	Binary-coded command value call-ups
LED "I6" (yellow)	Command valid
LED "I5, I7" (yellow)	Not assigned

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

Block circuit diagram



1 U/U or I/U converter
2 Analog input adjustment
3 Switching matrix
4 Switched-mode power supply unit
5 Binary command value call-ups
6 Control of binary call-ups
7 Characteristic curve adaptation
8 Step function generator
9 Offset
10 Limitation
11 PID controller
12 Oscillator / demodulator
13 Measuring sockets
14 Digital outputs
15 Fault logic
16 Local bus
17 Serial interface

Measuring sockets:

X1 Actual valve value
X2 Valve command value (default)
⊥ Reference potential (0 V)

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

Valve amplifier VT-VRPD-2-2X/V0/0-0-1		
Operating voltage	U_B	24 VDC + 40 % – 10 %
Operating range		
Upper limit value	$u_B(t)_{max}$	35 V
Lower limit value	$u_B(t)_{min}$	21 V
Current consumption	I_{max}	1.5 A; stand-by current 270 mA
Fuse	I_S	4 A slow-blowing
Digital inputs	Signal	log 0 = 0 to 5 V log 1 = 16 V to U_B
Digital outputs	Signal	log 0 = 0 to 5 V log 1 = U_B – 3 V I_{max} = 30 mA, short-circuit-proof
Analog inputs		
Voltage input AI4, AI2 and AI5		
Range	U	±10 V
Input resistance	R_e	100 kΩ, > 10 MΩ for input AI2
Resolution		5 mV for range ±10 V 2.5 mV for range 0...10 V
Non-linearity		< 10 mV
Current input (AI6 only)		
Range	I	4...20 mA
Input resistance	R_e	100 Ω
Current loss		0.15 % (at 500 Ω between Pin b24 and 0 V)
Resolution	I	5 μA
Analog outputs		
Voltage outputs AO1 and AO3		
Output voltage	U	±10 V
Load	R_{Lmin}	1 kΩ
Resolution	U	1.25 mV (14 bit)
Residual ripple content		±15 mV (without noise)
Ramp time	s	max. 300
Valve output stage		
Solenoid current per solenoid	I_{max}	2.5 A
Reference voltage	U	±10 V, 30 mA, short-circuit-proof
Residual ripple content		< 20 mV
Oscillator frequency	f	5.7 kHz
Scan time for command value conditioning	t	2 ms
Serial interface		RS 232 (front panel), D-Sub socket
Type of connection		64-pin multi-point connector, DIN 41612, form G
Local bus, distance to most distant station	l	max. 280 m cable length
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Front panel dimensions		
Height		3 HE (128.4 mm)
Width soldering side		1 TE (5.08 mm)
Width component side		7 TE
Permissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight	m	0.2 kg

Note:

For details regarding **environment simulation testing** in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30126-U (declaration on environmental compatibility).

1

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

Valve 4WRE…-2X (not included in the scope of supply)		
Solenoid		
Current consumption per solenoid	I_{max}	2.5 A
Solenoid coil resistance		
Cold value at 20 °C	R	2.7 Ω
Max. warm value	R	4.5 Ω
Electrical connection		Plug-in connection to DIN EN 175301-803
Type of protection to EN 60529		IP 65 with mating connector correctly mounted and locked
Position transducer		
Carrier frequency	f	5 kHz
Coil resistance (at 20 °C):		
Between connections 1 and 2	R	113 Ω
Between connections 3 and 4	R	101 Ω
Electrical connection		Plug-in connection to DIN 43650-BFZ-Pg9
Type of protection to EN 60529		IP 65 with mating connector correctly mounted and locked

1

Pin assignment of multi-point connector

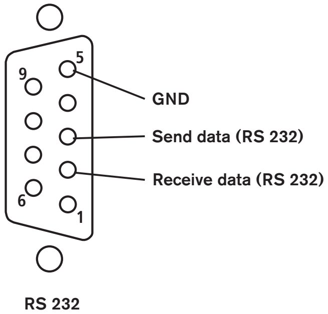
Row d		
Pin	Code	Description
2	DI 1	Binary 1
4	DI 2	Binary 2
6	DI 3	Binary 4
8	DI 4	Binary 8
10	DI 5	n. c.
12	DI 6	Command valid
14	DI 7	n. c.
16	DI 8	n. c.
18	DI 9	Enable
20	DO 1	Solenoid A active
22	OK	OK output
24	Data+	Local bus
26	DO 2	Solenoid B active
28	Data–	Local bus
30	AO 1	Valve command value
32	AO 2	n. c.

Row b		
Pin	Code	Description
2	n. c.	n. c.
4	n. c.	n. c.
6	AI 2+	Ramp + (U)+
8	AI 2–	Ramp + (U)–
10	n. c.	n. c.
12	n. c.	n. c.
14	AI 4+	Command value (U)+
16	AI 4–	Command value (U)–
18	AI 5+	Ramp – (U)+
20	AI 5–	Ramp – (U)–
22	AI 6+	Command value (I)+
24	AI 6–	Command value (I)–
26	AO 3	Actual valve value ±10V
28	AGND	Analog GND
30	REF–	–10 V
32	REF+	+10 V

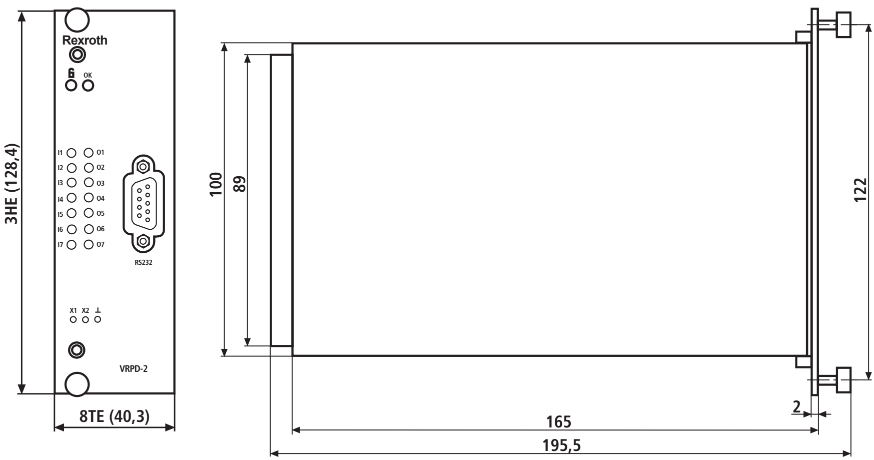
Row z		
Pin	Code	Description
2	MA+	Solenoid A+
4	MA–	Solenoid A–
6	MB+	Solenoid B+
8	MB–	Solenoid B–
10	Shield	Shield
12	L 1O–	LVDT supply –, Pin 2
14	L 1I–	LVDT signal –, Pin 4
16	L 1I+	LVDT signal +, Pin 3
18	L 1O+	LVDT supply +, Pin 1
20	System ground	System ground
22	DO 3	System deviation ≥ window
24	DO 4	Freely configurable
26	DO 5	Freely configurable
28	DO 6	Freely configurable
30	UB	Supply voltage
32	LO	Ground

Row f		
Pin	Code	Description
2	DO 7	n. c.
4	n. c.	n. c.
6	n. c.	n. c.
8	n. c.	n. c.
10	n. c.	n. c.
12	n. c.	n. c.
14	n. c.	n. c.
16	n. c.	n. c.
18	n. c.	n. c.
20	n. c.	n. c.
22	n. c.	n. c.
24	n. c.	n. c.
26	n. c.	n. c.
28	n. c.	n. c.
30	n. c.	n. c.
32	n. c.	n. c.

Pin assignment of D-SUB socket



Unit dimensions (dimensions in mm)



Engineering / maintenance notes / supplementary information

Product documentation for valve amplifier VT-VRPD-2-2X/V0/0-0-1

- RE 30126
  Technical data sheet (the present document)
- RE 30126-B
  Installation and operating instructions
- RE 30126-01-B
  Commissioning and operating instructions
- RE 30126-U
  Declaration on environmental compatibility
- RE 30126-Z
  Supplementary information for the replacement of VT-VRPD-2-1X by VT-VRPD-2-2X

– The amplifier card may only be plugged or withdrawn when disconnected from the power supply!
– Do not use plugs with free-wheeling diodes or LED indicator lamps for connecting the solenoids!
– Measurements on the card may only be taken using instruments $R_i > 100$ kΩ!
– Use relays with gold-plated contacts for passing on command values (small voltages, small currents)!
– Route command value cables separately and always shield them; connect shield to connection z10 on the card side and leave the other end open (risk of earth loops)!
– For solenoid cables up to 50 m length, use cable type LiYCY 1.5 mm^2. In the case of greater lengths, please consult us!
Recommendation: Also shield solenoid cables!
– Use highly flexible Cu cables (min. 2.5 mm^2) for connecting the system ground!
The system ground is an integral part of EMC protection of the valve amplifier. It is intended to discharge interference that is transported via the data and supply cables. This is only possible, when the system ground itself does not inject interference into the command value card.
– The distance to aerial lines, radio sources and radar equipment must be at least 1 m!
– Do not lay solenoid and signal cables near power cables!
– Due to the charging current of the smoothing capacitor on the card, back-up fuses must have slow-blowing characteristics!
– **Caution:** When the **differential input** is used, **both inputs** must always be switched on or off **simultaneously.**

Note: Electrical signals brought out via control electronics (e.g. signal “OK”) must not be used for switching safety-relevant machine functions!
(See also European standard “safety requirements for fluid power systems and components - hydraulics”, EN 982)

Notes

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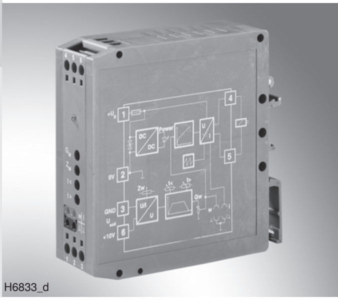
Rexroth
Bosch Group

Analog amplifier module

RE 30224/12.10 1/6
Replaces: –.–

Type VT-MSPA1-30, VT-MSPA1-150

Component series 1X



H6833_d

Table of contents

Contents	**Page**

Features

- Suitable for controlling direct operated proportional pressure valves:
  - DBE(M) 30-3X
  - DRE(M) 30-4X
- Inverse-polarity protection of the operating voltage
- Differential input for command value voltage +10 V
- Ramp generator up and down can be set separately
- Zero point potentiometer
- 1 command value attenuator
- Characteristic curve generator
- Synchronized power output stage
- Output short-circuit-proof
- LED display: • Ready for operation (green)
- Measuring sockets for: • Pressure command value
  • Actual current value
- Dither generator with fixed frequency

Ordering code

VT-MSPA1– –1X / V0 / *

Analog amplifier module	
For controlling the valves DBE(M) 30-3X and DRE(M) 30-4X	**= 30**
For controlling the valves DBE(M) 30-3X and DRE(M) 30-4X in connection with hydraulic pumps	**= 150**
Component series 10 to 19 (10 to 19: Identical technical data and pinout)	**= 1X**
Standard version	
Further details in the plain text	

Functional description

Analog amplifier for controlling pressure valves without electric return. The modular design allows for simple top hat rail assembly as is usual in control cabinets.

Command value input: 4

The module amplifier is controlled by means of a standard command value signal 0 to +10 V. By means of the zero point trimmer (Zw) (6), a zero point offset can be corrected.

Ramp generator: 5

In the ramp generator (5), the actuating variable rise is limited. Using the trimmer "t <" (7), the time for the increasing command value signal is set and using trimmer "t >" (8), the time for the decreasing command value voltage is set. The adjustable time is contained in the technical data.

Characteristic curve generator: 10

Using the trimmer "Gw" (9), the rated current for the solenoid is set. In the characteristic curve generator (10), the command value signal is changed so that a linear command value current characteristic curve results.

Clock generator: 12

In the clock generator (12), a fixed frequency for the output stage is generated.

Power output stage: 11-14

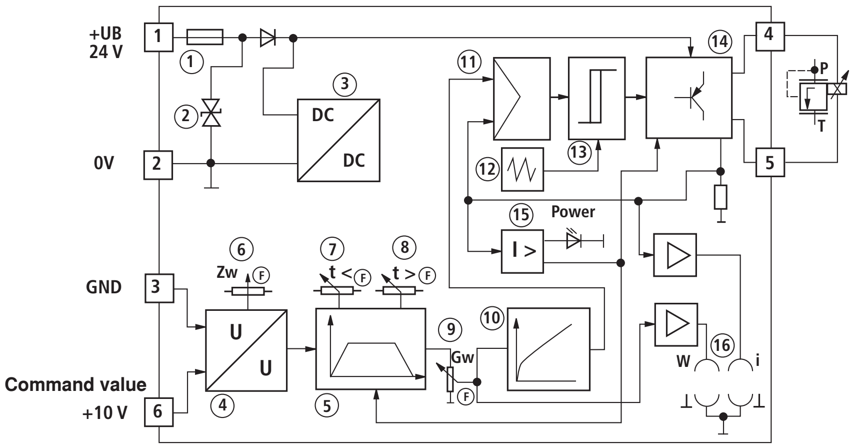
Using the actuating variable coming from the characteristic curve generator (10) and the clock frequency, the power output stage generates a PWM signal that is fed into the solenoid. The solenoid current is recorded and in the current controller (11) compared with the actuating variable and the difference is compensated.

Fault recognition: 15

Monitors the solenoid lines with regard to cable break and short circuit as well as overcurrent of the output stage. If there is an error, the green Ready for operation display goes out.

1

Block diagram



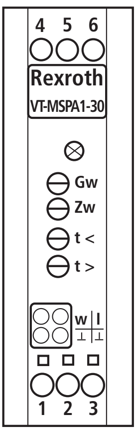
1	Fuse	**7**	Potentiometer ramp up	**13**	Schmitt trigger
2	Suppressor diode	**8**	Potentiometer ramp down	**14**	Output stage
3	Power supply	**9**	Potentiometer I_{max}	**15**	Fault recognition
4	Command value input	**10**	Characteristic curve generator	**16**	Measuring socket
5	Ramp generator	**11**	Current controller		
6	Potentiometer zero point	**12**	Clock generator	(F)	On front side

Terminal assignment / device view

Terminal assignment

Terminal	
1	$+U_B$
2	Ground
3	$-U_{command}$
4	Solenoid +
5	Solenoid –
6	$+U_{command}$

Device view



Potentiometer:	"Gw"	Pressure command value
	"Zw"	Zero point
	"t <"	Ramp time up
	"t >"	Ramp time down
Sockets:	"w"	Pressure command value
	"I"	Actual current value
	"⊥"	Measurement null

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

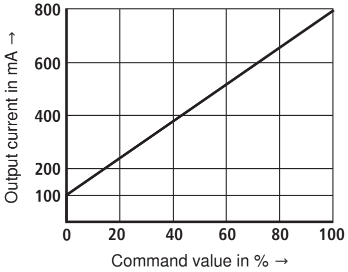
		VT-MSPA1-30	VT-MSPA1-150
Operating voltage	U_B	24 VDC +40 % –10 %	
Operating range:			
– Upper limit value	$u_B(t)_{max}$	35 V	
– Lower limit value	$u_B(t)_{min}$	21 V	
Power consumption	P_{max}	< 25 VA	
Current consumption	I_{max}	< 1 A	
Fuse	I_s	Electronic overload protection and SMD fuse (soldered in)	
Inputs			
– Command value (differential input)	$U_{command}$	0 to +10 V; R_e = 100 kΩ	
Outputs			
– Bias current (factory setting)	I_V	100 mA	200 mA
– Solenoid current / resistance	I_{max}	800 mA; R_{20} = 19.5 Ω	700 mA; R_{20} = 19.5 Ω
– Frequency	f	200 Hz	100 Hz ±10 %
Setting ranges			
GW: Solenoid current	I	100 mA…800 mA	200 mA…700 mA
ZW: Zero point		±25 %	±25 %
t >: / t <: } Ramp	t	60 ms…5 s	60 ms…5 s
Measuring sockets			
– Command value "w"	U	0 to 10 V	
– Actual current value "I"	U	1 mV ≙ 1 mA solenoid current	
Type of connection		6 screw terminals	
Mounting type		Top hat rail TH 35-7.5 according to EN 60715	
Protection class according to EN 60529		IP 20	
Dimensions (W x H x D)		25 x 79 x 85.5 mm	
Admissible operating temperature range	ϑ	0 to +50 °C	
Storage temperature range	ϑ	–25 to +85 °C	
Weight	m	0.15 kg	

Important:

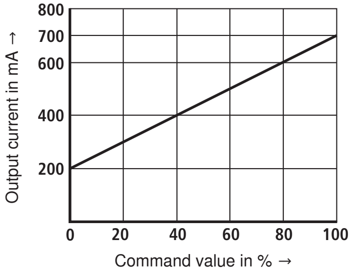
Information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load see 30223-U (declaration on environmental compatibility).

Output characteristic curve

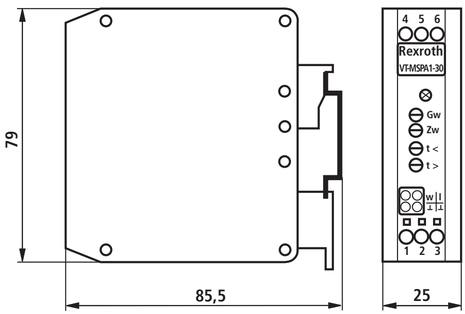
VT-MSPA1-30



VT-MSPA1-150



Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier module may only be wired when de-energized!
- The distance to radios must be sufficient (>> 1 m)!
- Screen command value lines, do not lay them close to power cables, screen solenoid lines!
- Do not use **free-wheeling diodes** in the solenoid lines!
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of at least 2200 μF.
  Recommendation: Capacitor module VT 11110 (see RE 30750); sufficient for up to 3 amplifier modules.

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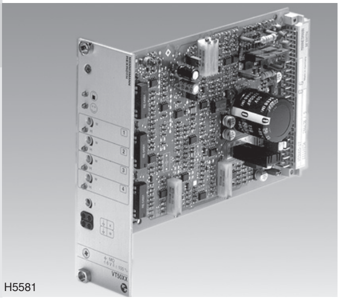
Electric amplifier for flow control with proportional valves

RE 29955/09.11
Replaces: 09.04

Type VT 5035

Component series 1X



H5581

Table of contents

Content	**Page**
Features	1
Ordering code	2
Functional description	2
Block diagram / pinout	4
Technical data	5
Display / adjustment elements	6
Unit dimensions	7
Project planning / maintenance instructions / additional information	7

Features

- Suitable for the flow control of the axial piston variable displacement pumps A4VSO and A4VSG with EO1 or EO2 control or A4CSG with EO2 control (see data sheets 92050, 92076 and 92100).
- Differential input
- Enable input with LED display
- "Ready for operation" message by LED display
- Ramp time adjustable by means of the potentiometer
- Four command values adjustable by means of the potentiometer, call-ups indicated by LEDs
- Controller for the pump swivel angle
- Two synchronized power output stages
- Oscillator and demodulator for inductive position measurement with cable break detection
- Reverse polarity protection for the voltage supply

Ordering code

VT 5035 – 1X / *

Amplifier for the flow control of the axial piston variable displacement pumps A4VSO and A4VSG with EO1 or EO2 control or A4CSG with EO2 control

1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pinout)

* Further details in the plain text

Accessories (not included in the scope of delivery)

Card holder:

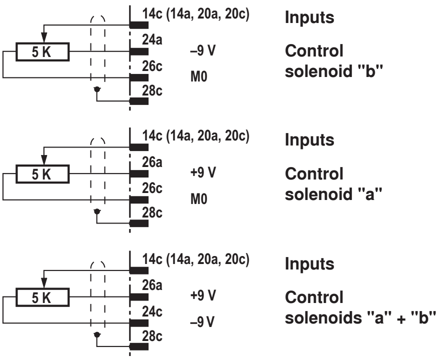
Type VT 3002-1-2X/32D, see data sheet 29928

Functional description

The printed circuit board is used for the electric flow control of an AV4VSO and AV4SG with EO1 and EO2 control or an AVCSG with EO2 control.

The amplifier controls the proportional valve of the swivel angle actuating cylinder and controls its position analogously to the specified command value. The swivel angle position is recorded as actual value.

Using the command value inputs 1 to 4, command values can be retrieved [1] by actuating the related relays (K1 to K4). The command value voltage is either specified directly, by the regulated voltages ±9 V of the internal power supply [10] or via an external command value potentiometer. For these inputs, ±9 V ≙ 100 % 1). If these four command value inputs are directly connected to the regulated voltages ±9 V, four different command values can be set at the "w1" to "w4" potentiometers. When external command value potentiometers are used at these inputs, the internal potentiometers function as attenuators or limiters unless they have been set to the maximum.



External command value potentiometers

The LEDs "H1" to "H4" indicate which command value is just being called. If more than one command value is called at a time, the input with the highest number will take priority.

Example: If command value 1 and command value 3 are activated simultaneously, command value 3 will take effect.

Another output of the card supplies a supply voltage for the command value call-ups which can be switched from +9 V to –9 V by means of the relay K6 1).

All relays on the card are switched with 24 VDC (smoothened).

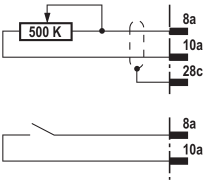
The command value input 5 is a differential input (0 to ±10 V). If the command value is specified by external electronics with a different reference potential, this input has to be used. When disconnecting or connecting the command value voltage, it has to be ensured that both signal lines are in each case separated from or connected with the input.

Before they are forwarded, all command values will be added up according to their absolute value and their sign [3].

The down-stream ramp generator [4] generates a ramp-shaped output signal from a given step-shaped input signal. The time constant of the output signal can be adjusted using the "t" potentiometer. The specified ramp time refers to a command value step of 100 % and may - depending on the jumper setting (J5, J6), be approx. 1 s or 5 s. If a command value step of less than 100 % is switched to the ramp generator input, the ramp time will be correspondingly shorter.

Functional description

External time potentiometer and ramp "Off"



Notice:

When using an external time potentiometer, the internal potentiometer for the ramp time must be set to maximum. The maximum ramp time is reduced as the resistance value of the external potentiometer is switched in parallel to that of the internal one (ca. 500 kΩ).

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

The output signal of the ramp generator [4] is the swivel angle command value and is supplied to the PID controller [5], the "w" measurement socket on the front panel of the card and port 4a (command value after ramp/external limiting potential). A voltage of –6 V at the "w" command value measurement socket corresponds to a command value of +100 %.

The PID controller has been especially optimized for the specified pump types. The power output stages are controlled depending on the difference between swivel angle command value and actual swivel angle value. A positive command value signal at the amplifier input actuates the output stage for solenoid "a", a negative command value signal the output stage for solenoid "b".

The inductive position transducer [11] detects the actual swivel angle value. The AC voltage signal of the position transducer is converted in the oscillator/demodulator [9] and returned to the PID controller as actual swivel angle value.

The zero point of the position transducer (actual value zero point) can be adjusted by means of the "Zx" potentiometer (on the printed circuit board). The amplification of the actual swivel angle value has been calibrated in the factory and must not be changed (±6V ≙ max. swivel angle position).

With a signal of > 8.5 V at the enable input, the output stages are enabled (indication by the yellow "H11" LED on the front plate). By setting jumper J7, the output stages are permanently enabled irrespective of the enable input status. The enable input will then be ineffective.

In case of failure-free operation, the "H12" LED (ready for operation) is illuminated; in detail if:

- The enable signal is applied,
- The internal ±9 V voltage supply functions (amplitude and symmetry),
- No short-circuit of the solenoid lines and
- No cable break

In the position transducer lines exists.

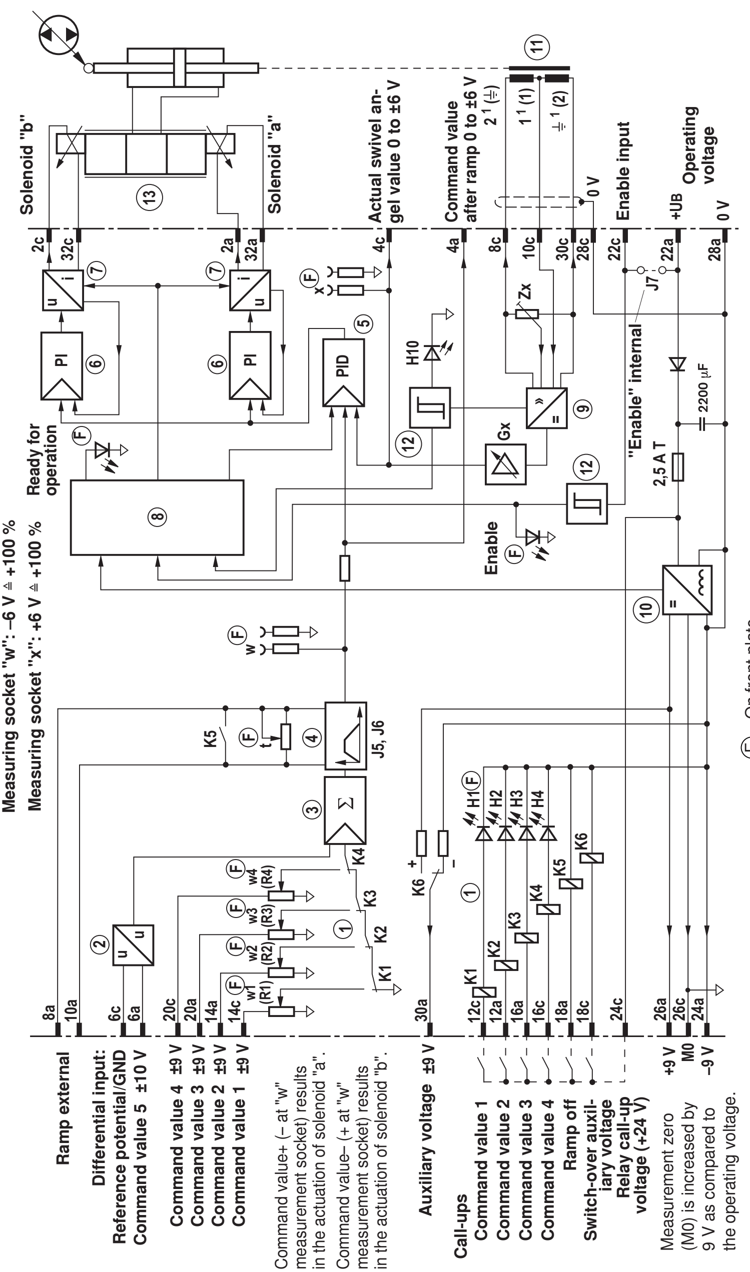
In case of failure, the two output stages are immediately de-energized, the controller is switched off and the "Ready for operation" message is reset. After remedy of the failure, the card is immediately functional again; the "H12" LED lights up again.

[1] The reference potential for the command values 1 to 4 is M0 (measurement zero).

[ ] = Assignment to the block diagram

1

Block diagram / pinout (from series 17)



Ⓕ = On front plate

1 Command values
2 Differential amplifier
3 Summing device
4 Ramp generator
5 Swivel angle controller
6 Flow controller
7 Output stage
8 Monitoring
9 Oscillator/demodulator
10 Power supply unit
11 Position transducer
12 Actual value identification
13 Proportional valve

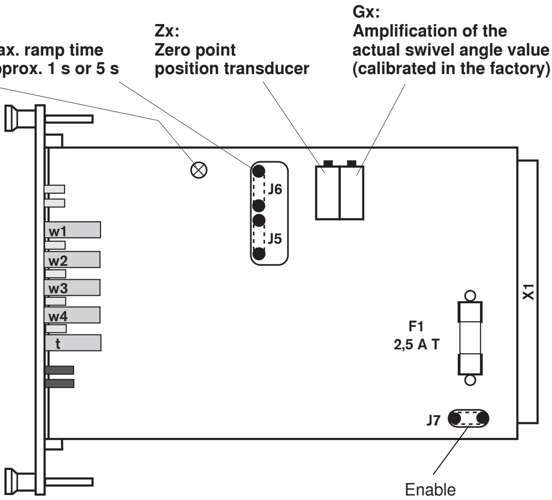
H1 to **H4** = LED displays for command value call-ups
K1 to **K6** = Call-up relay
R1 to **R4** = Command value potentiometer
t = Ramp time

Notice for connection of the position transducer:
1 Applies to pump with clockwise rotation
( ) Applies to pump with counterclockwise rotation

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

Operating voltage	U_B	24 VDC + 40 % – 5 %
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V including superimposed residual ripple
– Lower limit value	$u_B(t)_{min}$	22 V
Power consumption	P_S	< 50 VA
Current consumption	I	< 2 A
Fuse	I_S	2.5 A slow-blow
Inputs:		
– Command values 1 to 4	U_e	±9 V (reference potential is M0)
– Command value 5	U_e	0 to ±10 V
– Enable		
• Active	U_F	> 8.5 V
• Not active	U_F	< 6.5 V
Relay data:		
– Nominal voltage	U	Operating voltage U_B
– Response voltage	U	16.8 V
– Step-back voltage	U	2.4 V
– Coil resistance	R	2150 Ω
Ramp time (setting range)	t	30 ms to approx. 1 s or 5 s (in each case ±20 %)
Outputs:		
– Output stage		
• Solenoid current/resistance	I_{max}	1.8 A ± 20 %; $R_{(20)}$ = 5.4 Ω
• Clock frequency	f	Self-clocking up to ca. 1.5 kHz
– Driver for the inductive position transducer		
• Oscillator frequency	f	2.5 kHz ± 10 %
• Max. load capacity	I	30 mA
• Voltage amplitude (U_{ss})	U_a	5 V per output
– Regulated voltage	U	±9 V ± 1 %; 25 mA externally loadable
– Measuring sockets		
• Swivel angle command value "w"	U_w	0 to ±6 V (–6 V ≙ +100 %; +6 V ≙ –100 %); R_i = 100 Ω
• Actual swivel angle value "x"	U_x	0 to ±6 V (+6 V ≙ +100 %; –6 V ≙ –100 %); R_i = 100 Ω
Type of connection		32-pole male multipoint connector, DIN 41612, design D
Card dimensions		European card 100 x 160 mm, DIN 41494
Front plate dimensions:		
– Height		3 HE (128.4 mm)
– Width soldering side		1 TE (5.08 mm)
– Width component side		7 TE
Admissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–25 to +85 °C
Weight	m	0.15 kg

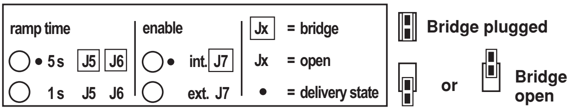
Display / adjustment elements



LED display "Enable" (yellow)
LED display "Ready for operation" (green)

w1/**H1** Command value 1 with LED display
w2/**H2** Command value 2 with LED display
w3/**H3** Command value 3 with LED display
w4/**H4** Command value 4 with LED display
t Ramp time (in the condition as supplied set to the minimum value)
x Measuring sockets for actual swivel angle value
w Measuring sockets for swivel angle command value

Meaning of the jumpers on the card for the settings
(Plate on the back side of the front plate)

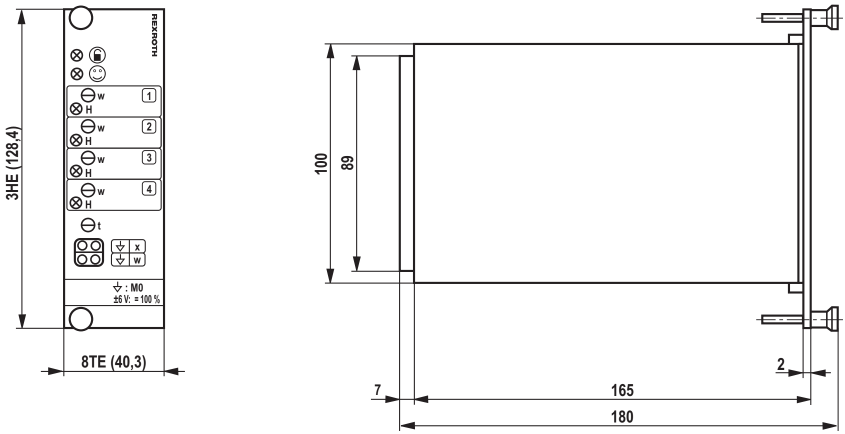


Ramp time Enable

Notice:
The circles (◯) serve the marking of the settings made by the customer.
The condition as supplied is marked with "•".

1

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

– The amplifier card may only be unplugged and plugged when de-energized.

– No plug-in connectors with free-wheeling diodes or LED indicators must be used for solenoid connection.

– Only carry out measurements at the card using instruments R_i > 100 kΩ.

– Measurement zero (M0) is increased by +9 V as compared to the operating voltage and not potentially isolated, i.e. –9 V regulated voltage ≙ 0 V operating voltage. Thus, do not connect measurement zero (M0) to 0 V operating voltage.

– For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents).

– For switching the card relays, only switching contacts with a load capacity of approx. 40 V, 50 mA may be used. In case of external control, the residual ripple of the control voltage may maximally be 10 %.

– Always shield command value lines and lines of the inductive position transducer separately; connect shielding to 0 V operating voltage on the card-side, other side open (risk of ground loops).
Recommendation: Also shield the solenoid conductors.
For solenoid lines up to 50 m in length, use cables with a wire cross-section of 1.5 mm^2.
With greater lengths, please contact us.

– The distance to aerial lines, radios, and radar systems has to be 1 m at least.

– Do not lay solenoid and signal lines near power cables.

– The charging current of the smoothing capacitor on the card requires the pre-fuses to be of a slow-blowing nature.

– Do not connect the ground sign at the inductive position transducer with the ground.
(Prerequisite for the compatibility with previous component series.)

Notices:

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

– Electric signals taken out via control electronics (e.g. actual value) must not be used for switching safety-relevant machine functions. (also see the European standard "Safety requirements on fluid-powered systems and components - Hydraulics", EN ISO 13849)

Notes

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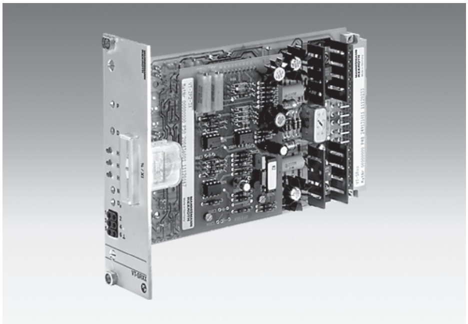
RE 29 993/02.03

Replaces: 06.97

Electrical amplifier for flow control with servo-valves
Type VT- SR7

Series 1X

H/A/D 5657/97



Type VT-SR7-1X/...

Table of contents

Features

VT-SR7 amplifiers are used to control axial piston units of type A4VS…HS.

The assembly is fitted with an oscillator/demodulator for inductive position feedback and a PID-controller for controlling the swivel angle of the pump. The parameters for the controller are matched to the individual size of the axial piston unit.

The valve current is enabled by means of a relay call-up. The command value can be fed forward via the differential input or the command value input.

A measuring instrument installed in the front panel indicates the servo-valve current; ± 100 % corresponds to ± 60 mA.

Card holder:

– Type VT 3002-2X/32, see RE 29 928, single card holder without power supply unit

Power supply unit:

– Type VT-NE31-1X, see RE 29 929 compact power supply unit 115/230 VAC Æ ± 24 VDC, 7 VA

Ordering code

VT-SR7 – 1X / / *

Amplifier for flow control with servo-valves

Series 10 to19 **= 1X**
(10 to 19: unchanged technical data and pin assignment)

Without ± 15 V voltage regulator **= 0**
With ± 15 V voltage regulator **= 1**

Further details in clear text 1)

A4VS40HS =	Axial piston unit size	40
A4VS71HS =	Axial piston unit size	71
A4VS125HS =	Axial piston unit size	125
A4VS180HS =	Axial piston unit size	180
A4VS250HS =	Axial piston unit size	250
A4VS355HS =	Axial piston unit size	355
A4VS500HS =	Axial piston unit size	500
A4VS750HS =	Axial piston unit size	750
A4VS1000HS =	Axial piston unit size	1000

1) For example: with/without PID-controller
For the additional PID-controller, the technical controller data must be specified.

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

Operating voltages:		
With voltage regulator	U_B	± 24 VDC
– Upper limit value	$u_O(t)_{max}$	± 28 VDC
– Lower limit value	$u_O(t)_{min}$	± 22 VDC
Without voltage regulator	U_O; U_M	± 24 VDC and ± 15 VDC (stabilised)
– Upper limit values	$u_O(t)_{max}$; $u_M(t)_{max}$	± 28 VDC; ± 15.2 VDC
– Lower limit values	$u_O(t)_{min}$; $u_M(t)_{min}$	± 22 VDC; ± 14.8 VDC
Power consumption (without valve) at U_O = ± 24 V [1)]	I	< 150 mA
Inputs:		
– Command value 1	U_i	0 to ± 10 V (R_i= 50 kΩ)
– Command value 2 (with J9)	U_i	0 to ± 10 V (R_i= 50 kΩ)
– Actual position value	U_i	0 to ± 10 V (R_i= 50 kΩ)
– Enable	U_i	+ 24 V with J13; 0 V with J12 (R_i= 700 Ω; relay circuit)
– Controller changeover	U_i	+ 24 V with J13; 0 V with J12 (R_i= 700 Ω; relay circuit)
– Reserve relay	U_i	+ 24 V with J13; 0 V with J12 (R_i= 700 Ω; relay circuit)
Outputs:		
– Regulated output voltage [1)]	U_M	± 15 V ± 2 %; 150 mA
– Valve current	I_{max}	± 60 mA
– Valve current command value (with J10)	U_o	– 10 V ≙ + 60 mA (measuring output)
– Relay call-up voltage	U	+ 24 V (+ U_O)
Dither signal	f	340 Hz (I_{SS} = 3 mA)
Relay data:		
– Nominal voltage	U	+ 26 V
– Response voltage	U	> 13 V
– Release voltage	U	1.3 V to 6.5 V
– Switching time	t	< 4 ms
– Coil resistance (at 25 °C)	R	700 Ω
Type of connection		32-pin male connector, DIN 41 612, form D
Card dimensions		Euro-card 100 x 160 mm, DIN 41 494
Front panel dimensions:		
– Height		3 HE (128,4 mm)
– Width soldering side		1 TE (5.08 mm)
– Width component side		7 TE
Permissible ambient temperature range	J	0 to + 50 °C
Storage temperature range	J	– 20 to + 70 °C
Weight	m	0.3 kg

1) for version **with** voltage regulator

Functional description

VT-SR7 amplifiers operate with a push-pull output stage with bipolar transistors. The output of this output stage can be activated or deactivated using an enable circuit (relay K2). The enable is indicated by lighting up of LED "H2" on the front panel. The switching voltage of all relays is set to either 0 V or + U_O by means of jumpers J12 and J13 (factory setting + U_O).

The output stage consists of an I-controller with connected dither signal generator. The amplitude of the dither signal can be adjusted using R7. The input stage (current command value) is controlled via a PD-controller. The actual current value fed back is indicated by the instrument on the front panel.

The oscillator/demodulator is used for acquiring the position. It is designed as plug-in board, the parameters of which are adapted to the relevant size of the axial piston unit.

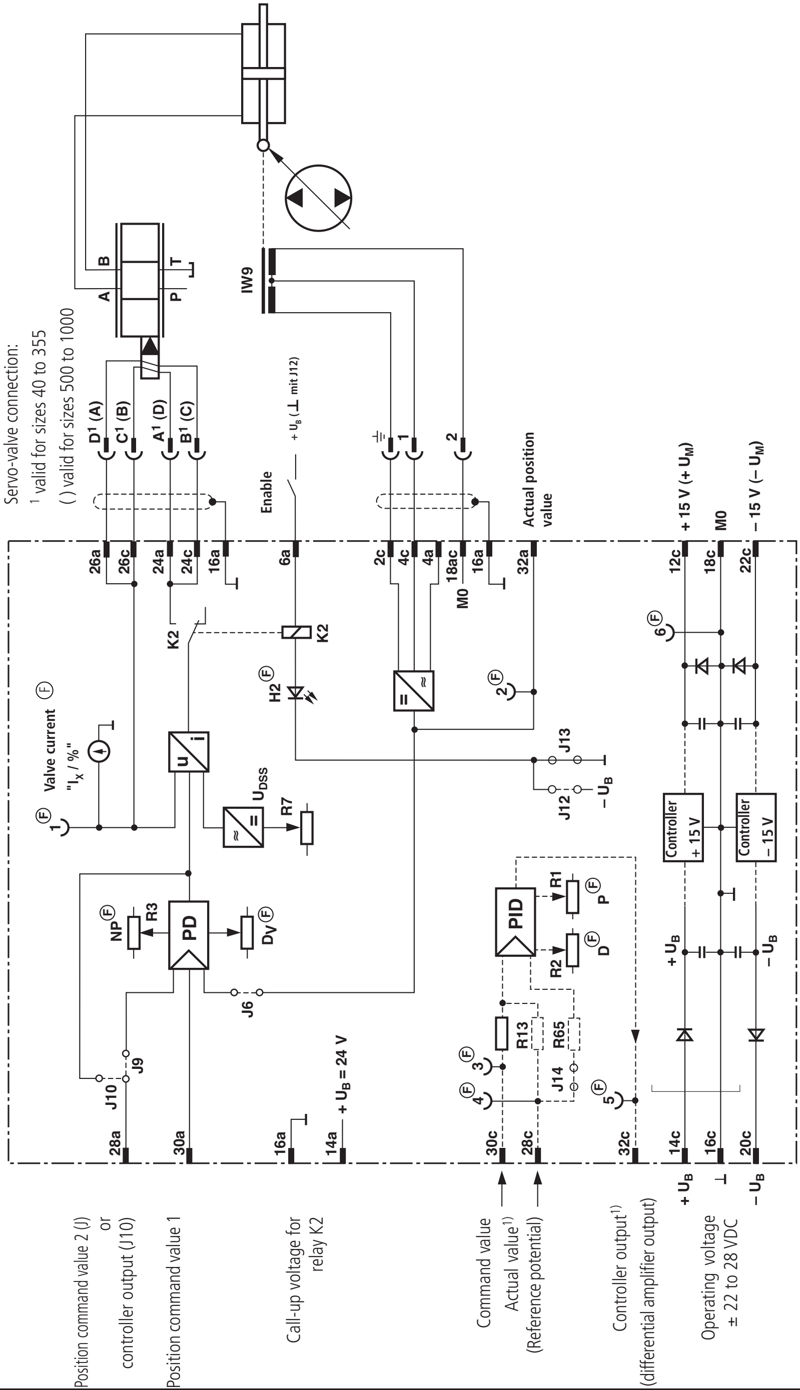
The position command value and actual position value are fed to the PD-controller, with the D-component acting **only** on the actual value (velocity feedback).

The zero point can be adjusted from the front panel using R3 ("NP").

The required symmetric operating voltage ± U_O is protected against reverse polarity. If the printed circuit board is not fitted with a voltage regulator for supplying the controller and displacement transducer electronics, an additional, stabilised auxiliary voltage ± U_M must be provided. The auxiliary voltage connection is protected against reverse polarity up to a maximum current of 1 A.

Optionally, the amplifier can be provided with a PID-controller (D-component acts **only** on the actual value). This controller can be used to superimpose a further closed control loop (e.g. for drive control). The P- and D-component can be adjusted on the front panel. The PID-controller configuration is customised and must therefore be indicated in clear text on the order. When dispatched, a special type designation is assigned to the amplifiers.

Block circuit diagram / pin assignment



1) The controller input can be converted into a differential input by removing R13 and plugging in J14 and R65.

F = On front panel

Preferred types

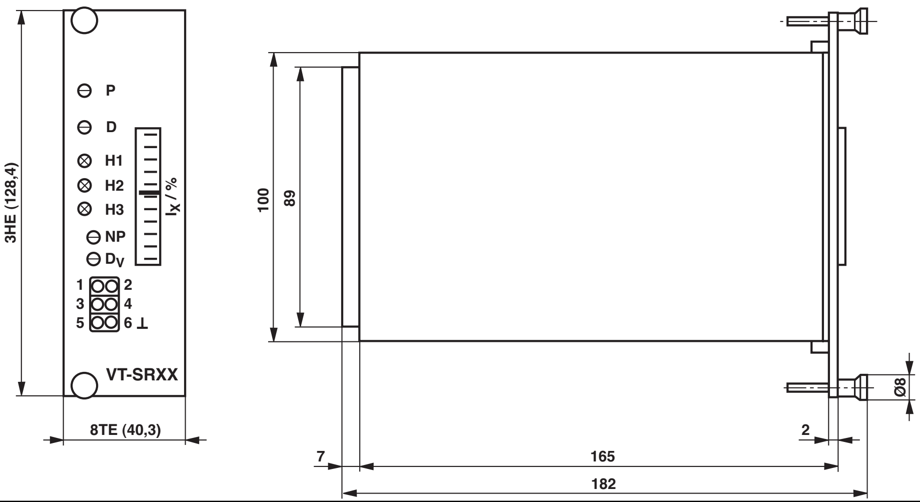
Material no.	Type
R900035612	VT-SR7-1X/0/A4VS.355HS
R900030717	VT-SR7-1X/0/A4VS.500HS
R900557769	VT-SR7-1X/1/A4VS.180HS
R900029274	VT-SR7-1X/1/A4VS.250HS
R900579280	VT-SR7-1X/1/A4VS.355HS
R900029181	VT-SR7-1X/1/A4VS.500HS

Engineering / maintenance notes / supplementary information

- The amplifier may only be plugged or unplugged when disconnected from the power supply!
- Command values may only be switched via relays with gold-plated contacts (small voltages, small currents)!
- For switching card relays (enable, controller changeover, reserve) use only contacts with a load-carrying capacity of ca. 40 V/ 50 mA.
- Always shield command value and actual value cables; leave one end of shield open and connect the card-sided end to the ground (⊥)!
- Do not lay signal cables near power cables!
- Recommendation: 1. Also shield solenoid cables (one end to ⊥)!
  2. For lengths up to 50 m use cable type LiYCY 1.5 mm^2 , for greater lengths, please consult us!
- **Caution:** When pilot pressure is applied to the actuating equipment and relay K2 is deactivated or the voltage supply is disconnected, the pump may swivel to its maximum position!

Note: Electrical signals brought out via control electronics (e.g. actual value) must not be used for switching safety-relevant machine functions! (See also the European standard "Safety requirements for fluid power systems and components - Hydraulics", prEN 982.)

Unit dimensions (dimensions in mm)



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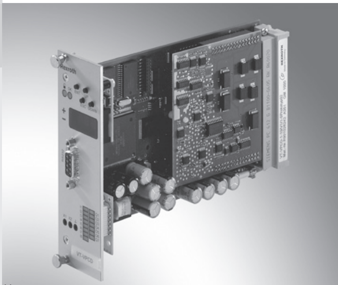
Digital control electronics for the axial piston pumps A4VS… with HS4 control and A2V… with EO4 control

RE 30028/06.12
Replaces: 03.09

Type VT-VPCD

Component series 1X



H7190

Table of contents

Contents	**Page**

Features of the control systems

The HS4 or EO4 control is used for the electro-hydraulic swivel angle and pressure control as well as for the power limitation of variable displacement axial piston pumps.

The control system with HS4 control consists of the following assemblies:

- A4VS…HS4 axial piston pump with attached 4WRE6-2X/822 proportional valve including position transducer for swivel angle and valve position sensing
- Recommended pressure transducer HM17 for recording the system pressure
- VT-VPCD control electronics to realize all electrical functions necessary for the HS4 control

The control system with EO4 control consists of the following assemblies:

- A2V...EO4 axial piston pump (housing and/or installation pump) with attached proportional valve including position transducer for swivel angle and valve position sensing
- Recommended pressure transducer HM17 for recording the system pressure
- VT-VPCD control electronics to realize all electrical functions necessary for the EO4 control

Features of the digital control electronics VT-VPCD

The parameterization is effected via a serial interface. The user-specific data can be exactly reproduced and is protected against unintended or unauthorized adjustment.

- Digital inputs for calling up pre-set parameters [1)]
- Ramp times for swivel angle and pressure command values [1)]
- Analog inputs for command and actual values [1)]
- Enable input and collective fault output [1)]
- Oscillators/demodulators for two inductive measuring systems
- Clocked, flow-controlled output stage
- Switching power supply unit for the internal supply voltages
- Function and status display LEDs
- 2 measuring sockets configurable via display and/or Bodac

[1)] Please also observe the corresponding bus documentation.

- Serial interface RS 232
- Up to 32 control electronics can be interconnected for parameterization and diagnosis via the local bus
- Size selection (size 40 to 1000 for A4VS…HS4, size 500 to 1000 for A2V…EO4) and parameterization via BODAC
- New: Parameterization for pump A4VHO 450 HS4
- Valve position controller
- Pressure controller with subordinate swivel angle controller
- Parameterizable power limitation
- Leakage compensation
- Master/slave capacity
- Mooring capacity
- Oscilloscope function
- Parameterizable test output
- Diagnosis display

Ordering code

VT–VPCD – 1 – 1X /   / 1 –   – 1

Digital control electronics for controlling variable displacement axial piston pumps

Component series 10 to 19 **= 1X**
(10 to 19: Unchanged installation and connection dimensions)

For axial piston pump A4VS…HS4 with swivel angle sensor AWX F004 D01 and for axial piston pump A2V…EO4 (housing pump) with swivel angle sensor MCP-40/4742 **= V0**

For axial piston pump A2V…EO4 (installation pump) with swivel angle sensor DK 100
(only available without bus connection) **= V100**

1 = with display

0 = without bus connection
P = PROFIBUS DPV0
D = DeviceNet
C = CANopen

1 = with valve output stage

Preferred types	Material number
VT-VPCD-1-1X/V0/1-0-1	R901044346
VT-VPCD-1-1X/V0/1-P-1	R901089559

PC system requirements:

- Windows XP, Windows Vista, Windows 7
- RAM (recommendation 256 MB)
- 250 MB of available hard disk capacity

Required accessories:

- BODAC PC program: CD ordering information: SYS-HACD-BODAC-01 (R900777335) or free download on the Internet at www.boschrexroth.com/vpcd
- Interface cable: Cable set VT-HACD-1X/03.0/HACD-PC (R900776897) or standard 1:1 cable

Suitable card holder:

- 19 inch racks VT 19101, VT 19102, VT 19103 and VT 19110 (see data sheet 29768)
- Closed card holder VT 12302 (see data sheet 30103) (preferred), mat. no. R900784153
- Open card holder VT 3002-2X/64G (see data sheet 29928), mat. no. R900991843 (Only for control cabinet installation!)
- Connection adapter VT 10812-2X/64G (see data sheet 30105), mat. no. R900713826

Functional description using the A4VS axial piston pump with HS4 control as example

The swivel angle and pressure control as well as the power limitation of the A4VS… variable displacement pump are effected by an electrically controlled proportional valve (1). Via the actuating piston (2) of the pump, this valve determines the position of the swash plate (3).

If the pump does not rotate, in case of depressurized high-pressure and actuating system and if enable is not operated, the swash plate is held in the "Zero" swivel angle position by the spring centering.

The position of the swash plate is determined by an inductive position transducer (4), the actual pressure value is recorded by a pressure transducer. Both actual values are supplied to the VT-VPCD control electronics and linked with each other by the software.

The actual power value is calculated from the product of actual pressure value and actual swivel angle value. The controller software ensures by means of a minimum value generator that the controller corresponding to the working point is always active.

In the static condition, i.e. swivel angle command value equals actual swivel angle value, power command value equals actual power value or pressure command value equals actual pressure value, the valve control spool is in central position.

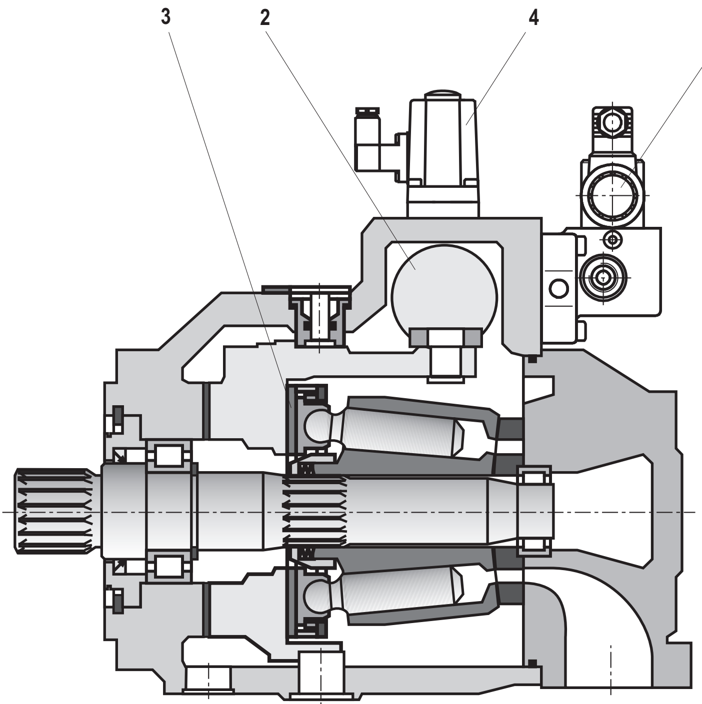
If the superior controllers demand e.g. an increase in the swivel angle (corresponds to an increase in the flow), the valve spool must be deflected out of the central position until the swivel angle has achieved the necessary value.

The sectional drawing shows the A4VS… variable displacement pump with HS4 control; the proportional valve (1) is controlled using the VT-VPCD control electronics.

Notice for the HS4 control:

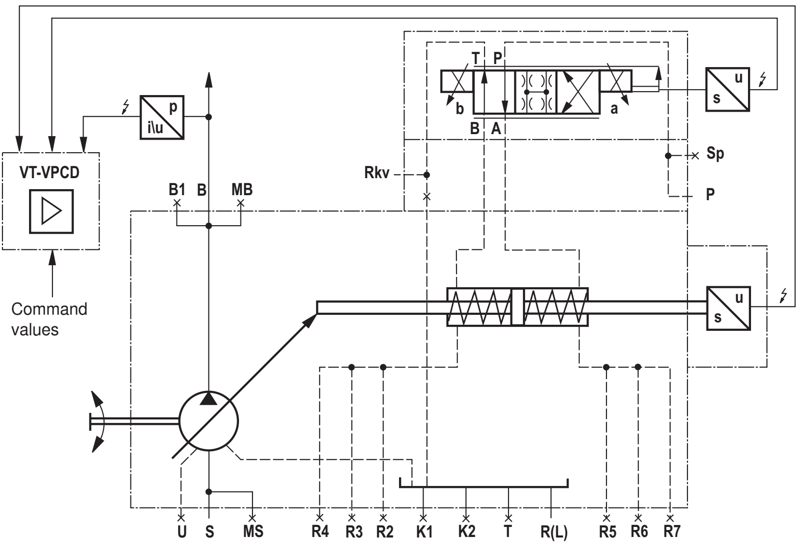
With de-energized proportional valve and pump with clockwise rotation and if the actuating pressure is available, the pump swivels to swivel angle $\alpha = 0$ (A4VSO design) or $\alpha = -100$ % (A4VSG design).

1



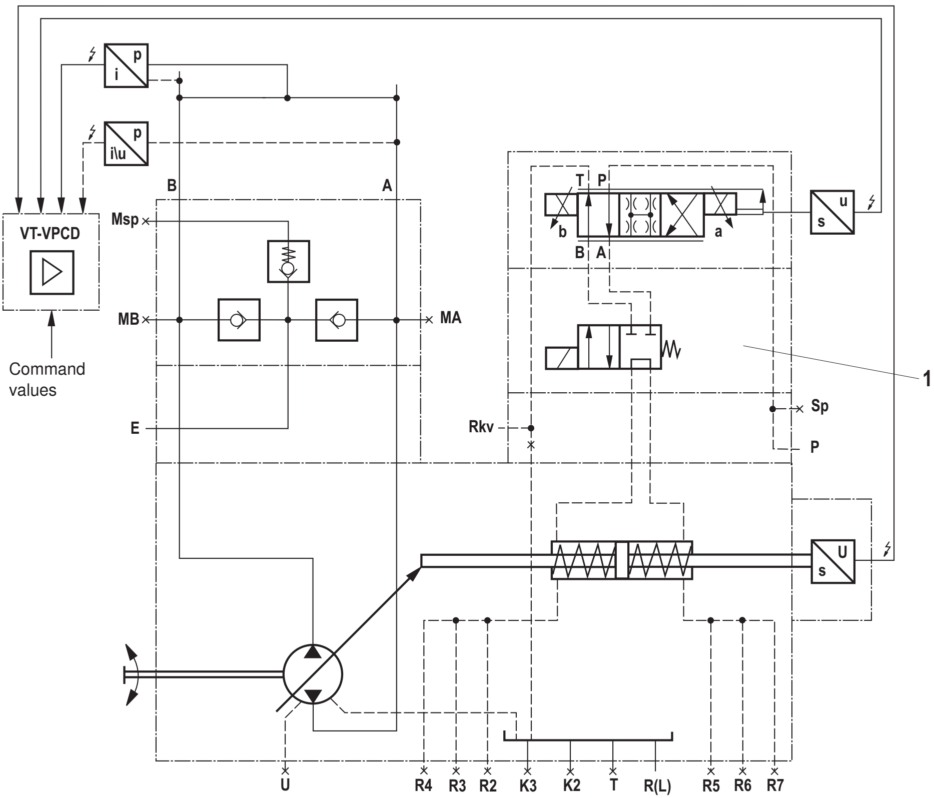
Circuit variations of the HS4 control

A4VSO – open circuit



Circuit variations of the HS4 control

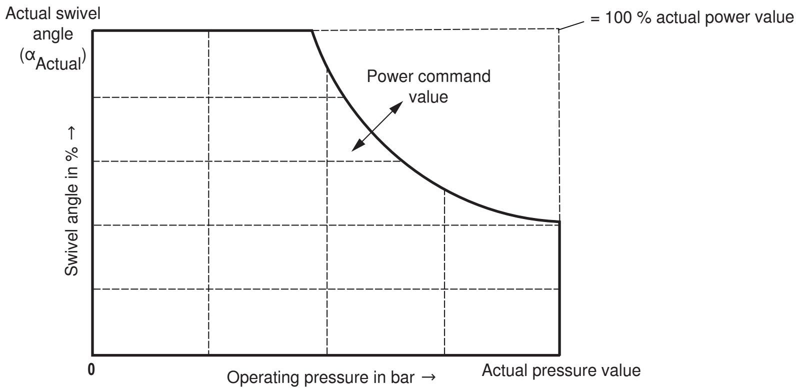
A4VSG – closed circuit



Notice:

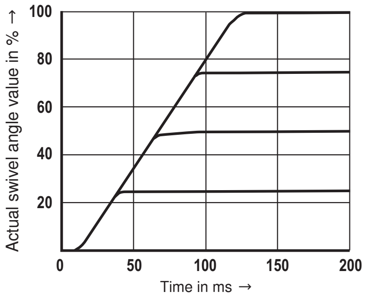
With de-energized valve and pending actuating pressure, the A4VSG... pump type without short-circuit valve (1) swivels to swivel angle right (Q_{max}).

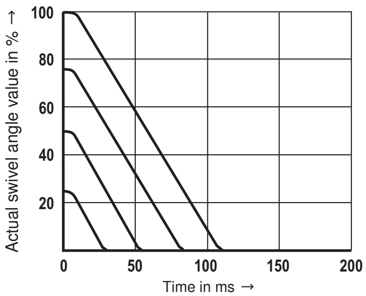
Static characteristic curve



Transition function with swivel angle command value step

Example A4VS with HS4 control, size 250, actuating pressure p = 125 bar





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Functional description of the control electronics

The control electronics is set-up as printed circuit board in Europe format 100 x 160 mm, fitted on both sides. It comprises a switching power supply unit [1] creating all internally required voltages.

The central unit is a microcontroller controlling the entire process and realizing the controller functions. Data for configuration, command values and parameters are stored in a FLASH in a non-volatile form.

Four binarily coded digital inputs are used to call up parameter sets (command values) from the memory in which you can store a maximum of 16 sets. A call-up activates a command value for the swivel angle, the pressure and the power limitation as well as ramp times for swivel angle and pressure.

More control inputs have the following functions:

"Command value valid":	Release of the parameter set addressed by the current call-up (H active)
"Enable":	Activation of the control (H active)
Comment:	H active = High active (level 16 V to U_B) L active = Low active (level 0 V to 5 V) L/H edge = Low High edge

Via the differential inputs AI7, AI5 and AI4[3], the analog command value for the swivel angle, the pressure and the maximum power is specified. With a positive swivel angle command value, the pump swivels in "counterclockwise" swivel direction (= flow direction P → B). The digital call-up command values are added to the analog command values; the total of both command values is supplied to the controller input via the relevant ramp generators.

The controller output signal controls the output stage [6] depending on the command/actual value differences.

The position of the valve spool [11], the swivel angle of the variable displacement pump [12a, 12b or 12c] and the system pressure [13] are measured and supplied to the control loop via evaluation electronics [7].

For the pressure control, different modes are provided:

Depending on the configuration, the pressure controller works with one or two pressure sensors.
Open circuit:
1 sensor, optionally current or voltage

Closed circuit:
2 sensors, optionally current or voltage

In the closed circuit, both pressure sensors are evaluated. As soon as the control electronics is in pressure control, the larger of the two pressures determines the control behavior. To compensate control deviations (pressure command value-actual pressure value), the pressure controller can also swivel the pump to the opposite side as well as beyond its specified swivel angle command value.

The switching outputs are configured via BODAC. You can select the following functions:

– Swivel angle control active	DO1
– Pressure control active	DO2
– Power limitation active	DO3
– Slave mode active	DO4
– Swivel angle in the accuracy window	DO5
– Pressure in the accuracy window	DO6
– Rectangular 32 Hz	DO7

The test output (b26 or measuring socket X1) is also configured via BODAC. It is used for the analog output of internal variables.

Enable and error messages

Setting the enable input activates the control. If no command value call-up is activated, parameter set 0 is set.

Error logics identify the following faults:

- Cable brake or short circuit in the actual valve value sensing
- Cable brake or short circuit in the actual swivel value sensing
- Cable break at the pressure transducer (only current interface)
- Closed-loop control errors (i.e. control deviations between swivel angle command value and actual swivel angle value)

An error is displayed at output d22. The "OK" message goes out, signal level is 0 V.
Errors are also shown at the display.

Parameterization and diagnosis

Using the serial interface [2], the pump size is selected and the leakage oil correction and the sequence control are activated or deactivated and switching outputs and the test output are configured via BODAC at the front-side D-Sub socket. Via the local bus, up to 32 control electronics can be connected. Via BODAC, every control electronics is assigned a bus address. Reconnection of the serial interface cable is omitted. More information in document 30028-01-B.

Display elements and measuring sockets

The freely configurable measuring sockets X1/X2 located at the front plate serve to display the process signals. Configuration see online help.

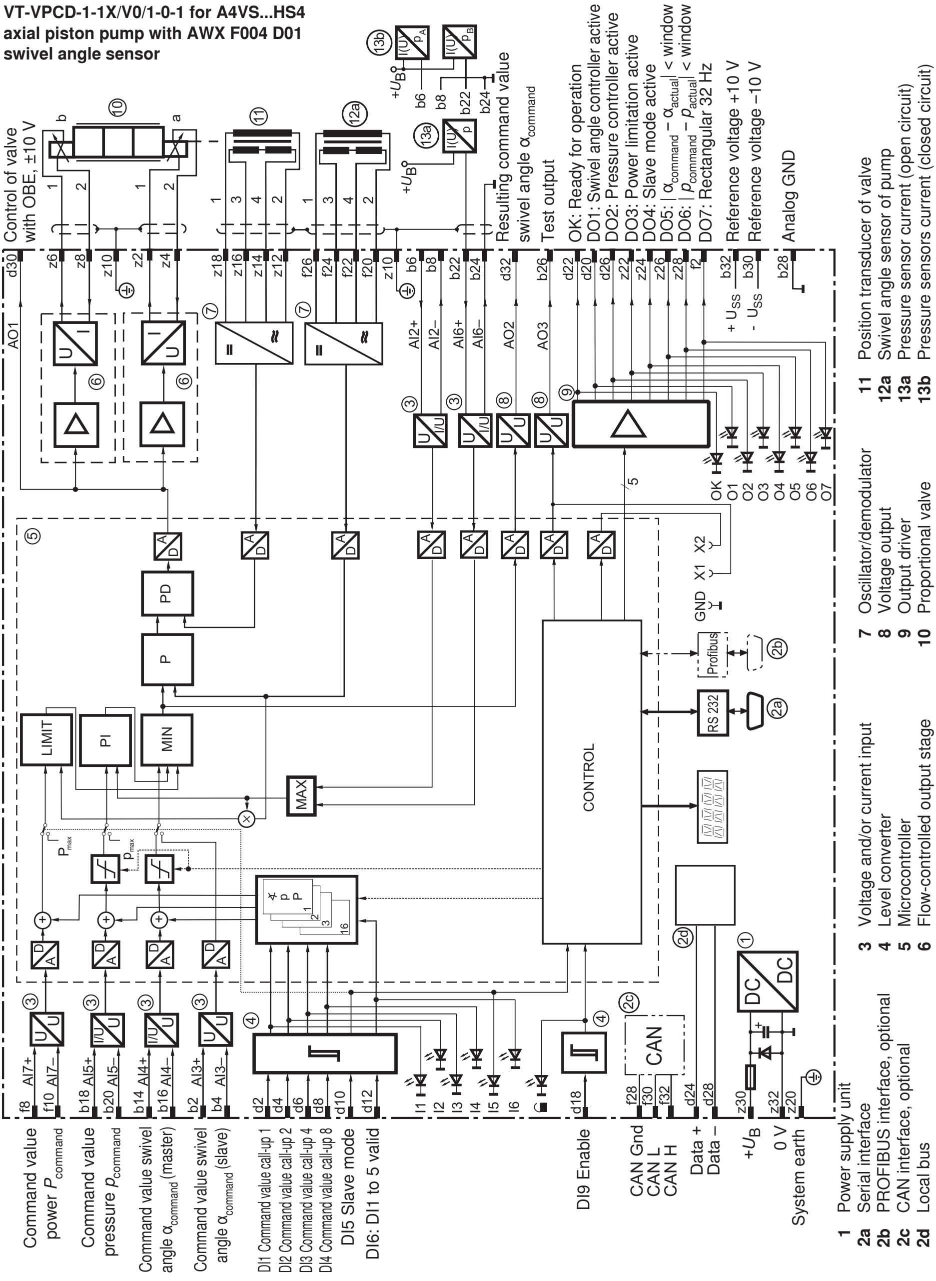
LEDs display the following states:

LED "🔓" (green):	Enable active
LED "OK" (green):	OK ready for operation
LEDs "I1"..."I4" (yellow):	Binarily coded command value call-ups
LED "I5" (yellow)	Slave mode
LED "I6" (yellow)	Command value valid
LED "I7" (yellow)	Not assigned

[ ] = Assignment to the block diagrams on pages 8 to 10

Block diagram

VT-VPCD-1-1X/V0/1-0-1 for A4VS...HS4 axial piston pump with AWX F004 D01 swivel angle sensor



Pin assignment of the male multipoint connector

VT-VPCD-1-1X/V0/1-0-1 for A4VS...HS4 axial piston pump with AWX F004 D01 swivel angle sensor

Row d

Pin	Short denomination	Description
2	DI1	Command value call-up 1, H active
4	DI2	Command value call-up 2, H active
6	DI3	Command value call-up 4, H active
8	DI4	Command value call-up 8, H active
10	DI5	Slave mode, H active
12	DI6	DI1 to DI5 valid, H active
14		n.c.
16		n.c.
18	DI9	Enable, H active
20	DO1	Swivel angle controller active, H active
22	OK	OK output, H active
24	Data +	Local bus
26	DO2	Pressure controller active, H active
28	Data –	Local bus
30	AO1	Control of valve with OBE, ±10 V
32	AO2	Resulting swivel angle command value for master/slave operation

Row b

Pin	Short denomination	Description
2	AI3+	Command value swivel angle slave (in case of slave operation)
4	AI3–	Command value swivel angle slave, reference
6	AI2+	Actual value pressure p_A, (I or U)
8	AI2–	Actual value pressure $p_{A,}$ reference
10		n.c.
12		n.c.
14	AI4+	Command value swivel angle
16	AI4–	Command value swivel angle, reference
18	AI5+	Command value pressure
20	AI5–	Command value pressure, reference
22	AI6+	Actual value pressure p_B, (I or U)
24	AI6–	Actual value pressure p_B, reference
26	AO3	Test output (measuring socket X1)
28	AGND	Analog GND
30	REF–	Reference voltage –10 V
32	REF+	Reference voltage +10 V

Row z

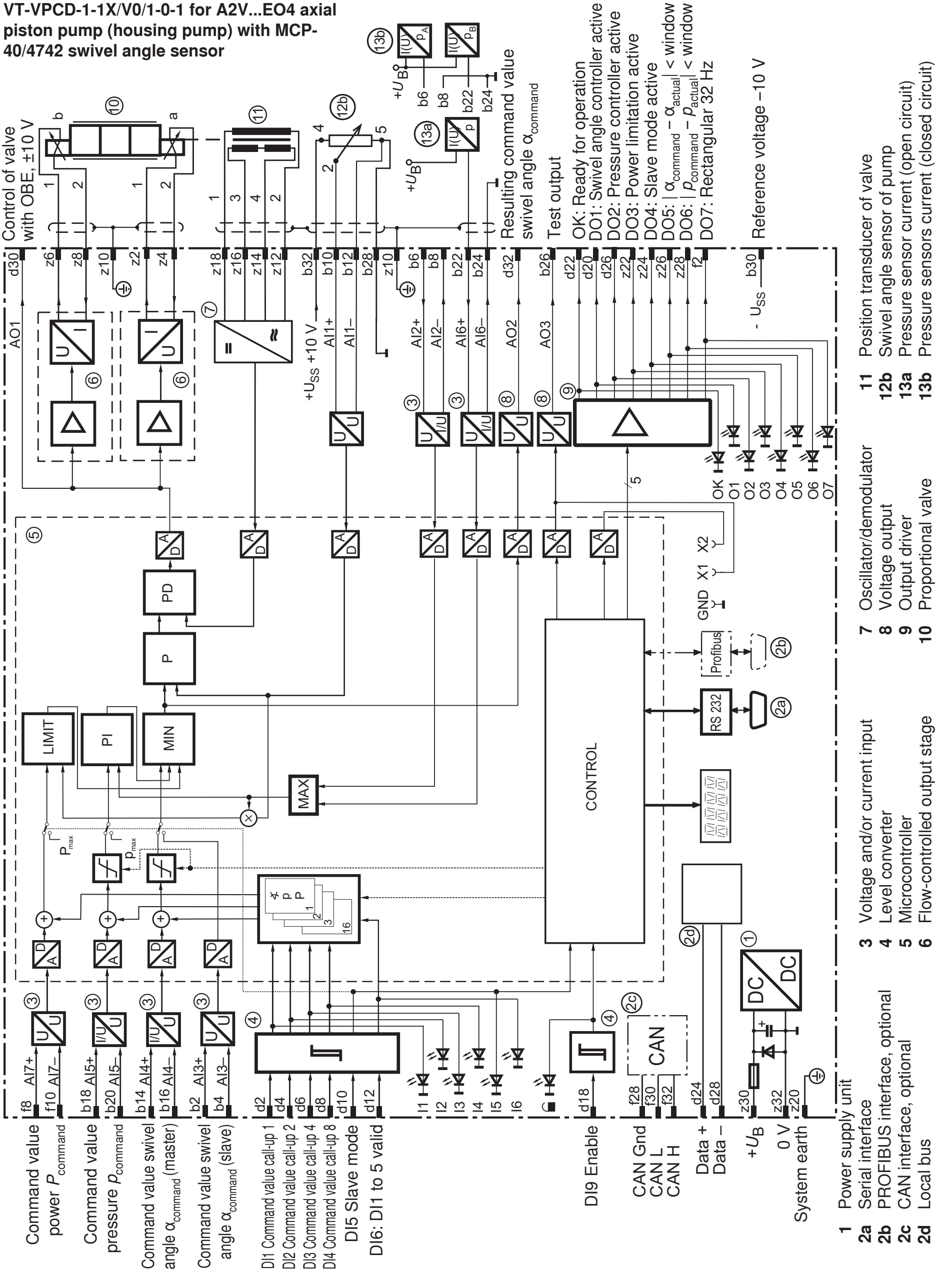
Pin	Short denomination	Description
2	MA+	Solenoid A +
4	MA–	Solenoid A –
6	MB+	Solenoid B +
8	MB–	Solenoid B –
10	Shield	Shield
12	L1O–	Position transducer of valve feed –, pin 2
14	L1I–	Position transducer of valve actual value –, pin 4
16	L1I+	Position transducer of valve actual value +, pin 3
18	L1O+	Position transducer of valve feed +, pin 1
20	System earth	System earth
22	DO3	Power limitation active, H active
24	DO4	Slave mode active, H active
26	DO5	$\lvert \alpha_{command} - \alpha_{actual} \rvert$ < window, H active
28	DO6	$\lvert p_{command} - p_{actual} \rvert$ < window, H active
30	UB	Supply voltage $+U_B$
32	LO	Supply voltage 0 V

Row f

Pin	Short denomination	Description
2	DO7	Rectangular 32 Hz
4		n.c.
6		n.c.
8	AI7+	Command value power
10	AI7–	Command value power, reference
12		n.c.
14		n.c.
16		n.c.
18		n.c.
20	L2O–	Swivel angle sensor of pump, feed –, pin 2
22	L2I–	Swivel angle sensor of pump, actual value –, pin 4
24	L2I+	Swivel angle sensor of pump, actual value +, pin 3
26	L2O+	Swivel angle sensor of pump, feed +, pin 1
28	CAN Gnd	CAN bus reference
30	CAN L	CAN bus input/output
32	CAN H	CAN bus input/output

Block diagram

VT-VPCD-1-1X/V0/1-0-1 for A2V...EO4 axial piston pump (housing pump) with MCP-40/4742 swivel angle sensor



Pin assignment of the male multipoint connector

VT-VPCD-1-1X/V0/1-0-1 for A2V...EO4 axial piston pump (housing pump) with MCP-40/4742 swivel angle sensor

Row d

Pin	Short denomination	Description
2	DI1	Command value call-up 1, H active
4	DI2	Command value call-up 2, H active
6	DI3	Command value call-up 4, H active
8	DI4	Command value call-up 8, H active
10	DI5	Slave mode, H active
12	DI6	DI1 to DI5 valid, H active
14		n.c.
16		n.c.
18	DI9	Enable, H active
20	DO1	Swivel angle controller active, H active
22	OK	OK output, H active
24	Data +	Local bus
26	DO2	Pressure controller active, H active
28	Data –	Local bus
30	AO1	Control of valve with OBE, ±10 V
32	AO2	Resulting swivel angle command value for master/slave operation

Row b

Pin	Short denomination	Description
2	AI3+	Command value swivel angle slave (in case of slave operation)
4	AI3–	Command value swivel angle slave, reference
6	AI2+	Actual value pressure p_A, (I or U)
8	AI2–	Actual value pressure $p_{A,}$ reference
10	AI1+	Swivel angle sensor of pump, pin 2
12	AI1–	Swivel angle sensor of pump, pin 5
14	AI4+	Command value swivel angle
16	AI4–	Command value swivel angle, reference
18	AI5+	Command value pressure
20	AI5–	Command value pressure, reference
22	AI6+	Actual value pressure p_B, (I or U)
24	AI6–	Actual value pressure p_B, reference
26	AO3	Test output (measuring socket X1)
28	AGND	Analog GND and swivel angle sensor of pump, pin 5
30	REF–	Reference voltage –10 V
32	REF+	Reference voltage +10 V and swivel angle sensor of pump, pin 4

Row z

Pin	Short denomination	Description
2	MA+	Solenoid A +
4	MA–	Solenoid A –
6	MB+	Solenoid B +
8	MB–	Solenoid B –
10	Shield	Shield
12	L1O–	Position transducer of valve feed –, pin 2
14	L1I–	Position transducer of valve actual value –, pin 4
16	L1I+	Position transducer of valve actual value +, pin 3
18	L1O+	Position transducer of valve feed +, pin 1
20	System earth	System earth
22	DO3	Power limitation active, H active
24	DO4	Slave mode active, H active
26	DO5	$\lvert \alpha_{command} - \alpha_{actual} \rvert$ < window, H active
28	DO6	$\lvert p_{command} - p_{actual} \rvert$ < window, H active
30	UB	Supply voltage $+U_B$
32	LO	Supply voltage 0 V

Row f

Pin	Short denomination	Description
2	DO7	Rectangular 32 Hz
4		n.c.
6		n.c.
8	AI7+	Command value power
10	AI7–	Command value power, reference
12		n.c.
14		n.c.
16		n.c.
18		n.c.
20		n.c.
22		n.c.
24		n.c.
26		n.c.
28	CAN Gnd	CAN bus reference
30	CAN L	CAN bus input/output
32	CAN H	CAN bus input/output

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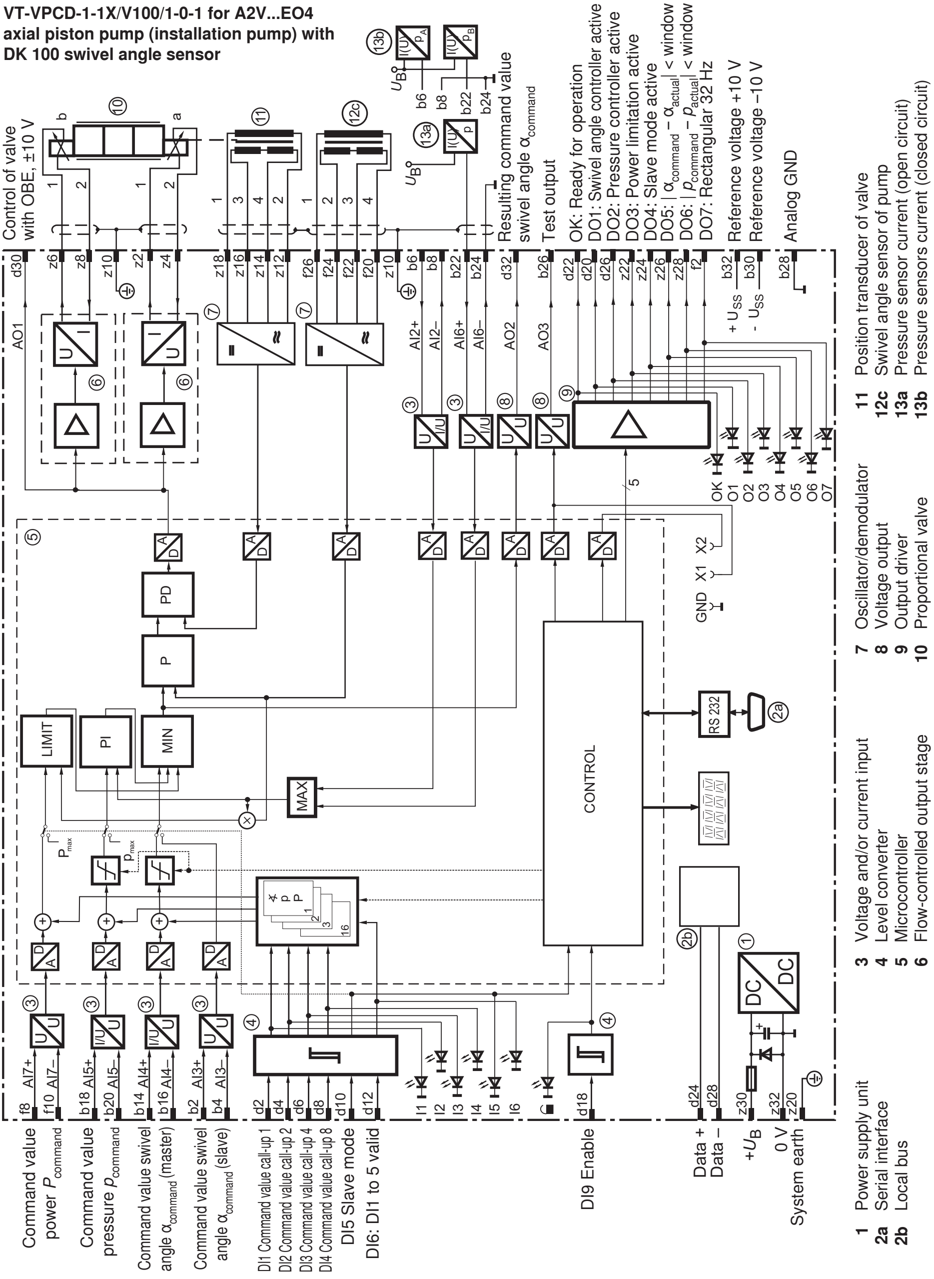
Block diagram

VT-VPCD-1-1X/V100/1-0-1 for A2V...EO4 axial piston pump (installation pump) with DK 100 swivel angle sensor



Pin assignment of the male multipoint connector

VT-VPCD-1-1X/V100/1-0-1 for A2V...EO4 axial piston pump (installation pump) with DK 100 swivel angle sensor

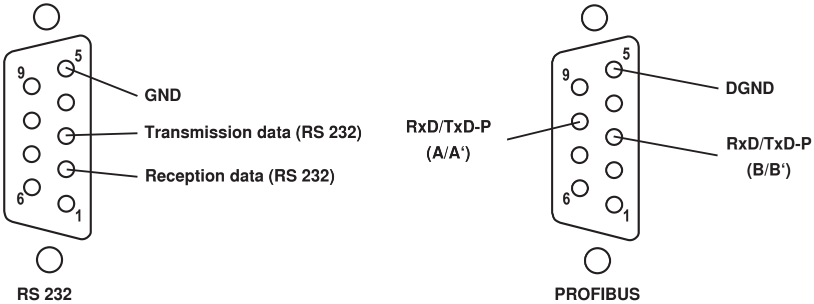
Row d		
Pin	**Short denomination**	**Description**
2	DI1	Command value call-up 1, H active
4	DI2	Command value call-up 2, H active
6	DI3	Command value call-up 4, H active
8	DI4	Command value call-up 8, H active
10	DI5	Slave mode, H active
12	DI6	DI1 to DI5 valid, H active
14		n.c.
16		n.c.
18	DI9	Enable, H active
20	DO1	Swivel angle controller active, H active
22	OK	OK output, H active
24	Data +	Local bus
26	DO2	Pressure controller active, H active
28	Data –	Local bus
30	AO1	Control of valve with OBE, ±10 V
32	AO2	Resulting swivel angle command value for master/slave operation

Row b		
Pin	**Short denomination**	**Description**
2	AI3+	Command value swivel angle slave (in case of slave operation)
4	AI3–	Command value swivel angle slave, reference
6		n.c.
8		n.c.
10		n.c.
12		n.c.
14	AI4+	Command value swivel angle
16	AI4–	Command value swivel angle, reference
18	AI5+	Command value pressure
20	AI5–	Command value pressure, reference
22	AI6+	Actual value pressure p_B, (I or U)
24	AI6–	Actual value pressure p_B, reference
26	AO3	Test output (measuring socket X1)
28	AGND	Analog GND
30	REF–	Reference voltage –10 V
32	REF+	Reference voltage +10 V

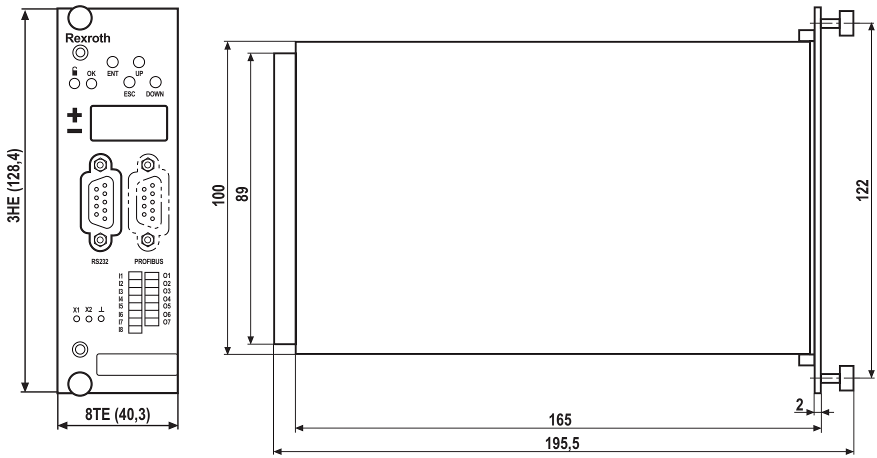
Row z		
Pin	**Short denomination**	**Description**
2	MA+	Solenoid A +
4	MA–	Solenoid A –
6	MB+	Solenoid B +
8	MB–	Solenoid B –
10	Shield	Shield
12	L1O–	Position transducer of valve feed –, pin 2
14	L1I–	Position transducer of valve actual value –, pin 4
16	L1I+	Position transducer of valve actual value +, pin 3
18	L1O+	Position transducer of valve feed +, pin 1
20	System earth	System earth
22	DO3	Power limitation active, H active
24	DO4	Slave mode active, H active
26	DO5	$\lvert \alpha_{command} - \alpha_{actual} \rvert$ < window, H active
28	DO6	$\lvert p_{command} - p_{actual} \rvert$ < window, H active
30	UB	Supply voltage $+U_B$
32	LO	Supply voltage 0 V

Row f		
Pin	**Short denomination**	**Description**
2	DO7	Rectangular 32 Hz
4		n.c.
6		n.c.
8	AI7+	Command value power
10	AI7–	Command value power, reference
12		n.c.
14		n.c.
16		n.c.
18		n.c.
20	L2O–	Swivel angle sensor of pump, feed –, pin 4
22	L2I–	Swivel angle sensor of pump, actual value –, pin 3
24	L2I+	Swivel angle sensor of pump, actual value +, pin 2
26	L2O+	Swivel angle sensor of pump, feed +, pin 1
28		n.c.
30		n.c.
32		n.c.

Pin assignment of the D-Sub sockets on the front plate



Unit dimensions (dimensions in mm)



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

Valve 4WRE6-2X/822 for HS4 control		
Current consumption per solenoid	I_{max}	2.5 A
Control current with constant swivel angle	I_a I_b	Solenoid a: 450 mA Solenoid b: 700 mA
Solenoid coil resistance: – Cold value at 20 °C – Max. hot value	 R R	 2.7 Ω 4.05 Ω
Electrical connection		Plug-in connection according to DIN EN 175301-803
Protection class according to EN 60529		IP 65
Position transducer to the valve 4WRE6-2X/822		
Carrier frequency	f	5 kHz
Coil resistance (at 20 °C): – Between port 1 and 2 – Between port 3 and 4	 R R	 113 Ω 101 Ω
Electrical connection		Plug-in connection according to DIN 43650-BFZ-Pg9
Protection class of the plug-in connection according to EN 60529		IP 65
Swivel angle sensor type AWX F004 D01		
Carrier frequency	f	5 kHz
Coil resistance (at 20 °C): – Between port 1 and 2 – Between port 3 and 4	 R R	 110 Ω 560 Ω
Electrical connection		Plug-in connection according to DIN 43650-BFZ-Pg9
Protection class of the plug-in connection according to EN 60529		IP 65
Closed-loop control quality of the HS4 control		
Hysteresis	%	≤ 0.2
Repeatability	%	≤ 0.2
Linearity deviation of the swivel angle	%	≤ 1.0
Linearity deviation of the pressure	%	≤ 1.5 of the maximum measuring pressure of the pressure transducer

1

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

VT-VPCD-1-1X/.../1-0-1 control electronics		
Operating voltage	U_B	24 VDC
Operating range		
Upper limit value	$U_B(t)_{max}$	30 V
Lower limit value	$U_B(t)_{min}$	21 V
Current consumption	I_{max}	< 2 A
Oscillator frequency (position transducer valve spool, swivel angle)	f	Approx. 5 kHz at 10 V_{SS}
Digital inputs	Signal	log 0 = 0 to 5 V log 1 = 16 V to U_B
Digital outputs	Signal	log 0 = 0 to 5 V log 1 = U_B – 3 V I_{max} = 30 mA, short-circuit-proof load resistance ≤ 10 kΩ
Analog inputs AI1… AI7 can be configured as voltage input		
AI3, AI4	U	±10 V
AI1, AI2, AI5, AI6, AI7	U	0 to 10 V
Input resistance	R_e	100 kΩ
Resolution	U	5 mV for range ±10 V, 2.5 mV for range 0 to 10 V
Non-linearity	U	< 10 mV
Analog inputs AI2, AI4, AI5 and AI6 can be configured as current input		
Range	I	4 to 20 mA
Input resistance	R_e	100 Ω (voltage drop across actual value input pressure at 4 mA approx. 1.7 V, at 20 mA approx. 3.5 V)
Leakage current		0.15 % (with 500 Ω between pin AI x - and 0 V)
Resolution	I	5 μA [12 bit]
Analog outputs AO1, A02 and A03		
Output voltage	U	±10 V
Load	R_{Lmin}	1 kΩ
Resolution	U	10 mV (11 bit)
Residual ripple	U	±25 mV (without noise)
Reference voltage		
Voltage	U	±10 V
Current	I_{max}	30 mA
Residual ripple	U	< 20 mV
Scan time	T	2 ms
Serial interface		RS 232 (front plate), D-Sub socket 9-pole
Type of connection		64-pole male multipoint connector, DIN 41612, design G
Local bus, distance to the furthermost participant	l	Max. 280 m line length
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Front plate dimensions:		
Height		3 HE (128.4 mm)
Width soldering side		1 TE (5.08 mm)
Width component side		7 TE (35.56 mm)
Admissible ambient temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight	m	0.2 kg

Notice:

For information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30028-U.

Project planning / maintenance instructions / additional information

Product documentation for the VT-VPCD

- 30028
  Technical data sheet (this document)
- 30028-B
  Installation and operating instructions
- 30028-01-B
  Commissioning and operating instructions
- 30028-U
  Environmental compatibility statement
- 30028-01-Z
  Commissioning instructions PROFIBUS interface
- 30028-02-Z
  Commissioning instructions CANopen interface
- 30028-03-Z
  Commissioning instructions DeviceNet interface

– The control electronics may only be unplugged and plugged when de-energized!
– Only carry out measurements at the card using instruments with R_i > 100 kΩ!
– For switching analog command values and digital call-ups, relays with gold-plated contacts have to be used (small voltages, low currents)!
– Always shield command and actual value lines; connect shielding to system earth on the card-side, open at one side!
– Recommendation: Up to a length of 50 m, use the line type LiYCY 1.5 mm^2 for solenoid line, for position transducer line use cable type LiYCY 0.5 mm^2, shielded. With greater lengths, please contact us!
– The distance to aerial lines or radios must be at least 1 m!
– Do not lay solenoid and signal lines near power cables!
– Commissioning and programming of the control electronics are described in detail in the operating instructions 30028-B.
– For perfect control results, the quality of the sensors is important.

Notice: Electric signals taken out via control electronics (e.g. "Fault message" signal) must not be used for switching safety-relevant machine functions!
(see also the European standard "Safety requirements for fluid power systems and their components – Hydraulics", EN ISO 4413)

Notes

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Electric amplifiers

RE 30047/03.12
Replacies: 11.02

Type VT-VRPA2-5...-1X/V0/RTS

Component series 1X

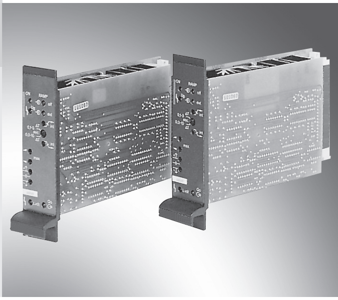


Table of contents

Contents	Page

Features

- Suitable for controlling direct operated high-response valves with positive overlap
- Amplifier with additional electronics (daughter card)
- Analog amplifiers in Europe format for installation in 19" racks
- Adjustment possibilities
  - Zero point valve
  - Sensitivity
  - Ramp times
- Controlled output stage
- Enable input
- Ramp generator that can be switched off
- Compensation step
- Inputs and outputs short-circuit-proof
- External ramp switch-off
- External voltage-controlled ramp setting via differential inputs
- Cable break detection for actual value cable
- Position control with PID behavior

Notice:

The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	P	A	2 –		–1X /	V0 /	RTS

Hydraulic component
For valves with electric feedback **= R**

Valve type
High-response valve **= P**

Control
Analog **= A**

Output stage
2 output stages per high-response valve **= 2**

Serial number for types
527 = Size 6
537 = Size 10

1X = Component series 10 to 19
(10 to 19: Unchanged technical data and pin assignment)

Customer version
V0 = Catalog version

Option
RTS = Ramp function set via signal

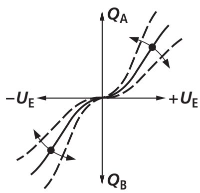
Preferred types

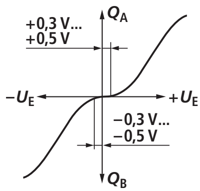
Amplifier type	Material number	For high-response valves with electric position feedback and inflected characteristic curve
VT-VRPA2-527-10/V0/RTS	0811405137	4WRP 6...S-1X...
VT-VRPA2-537-10/V0/RTS	0811405138	4WRP 10...S-1X...

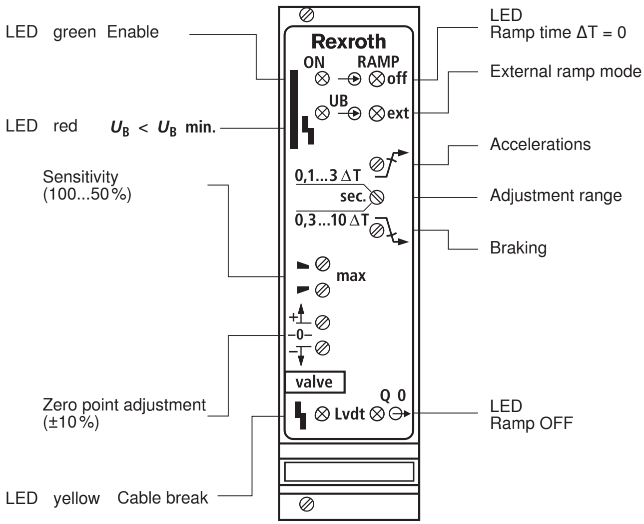
Suitable card holder:

– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

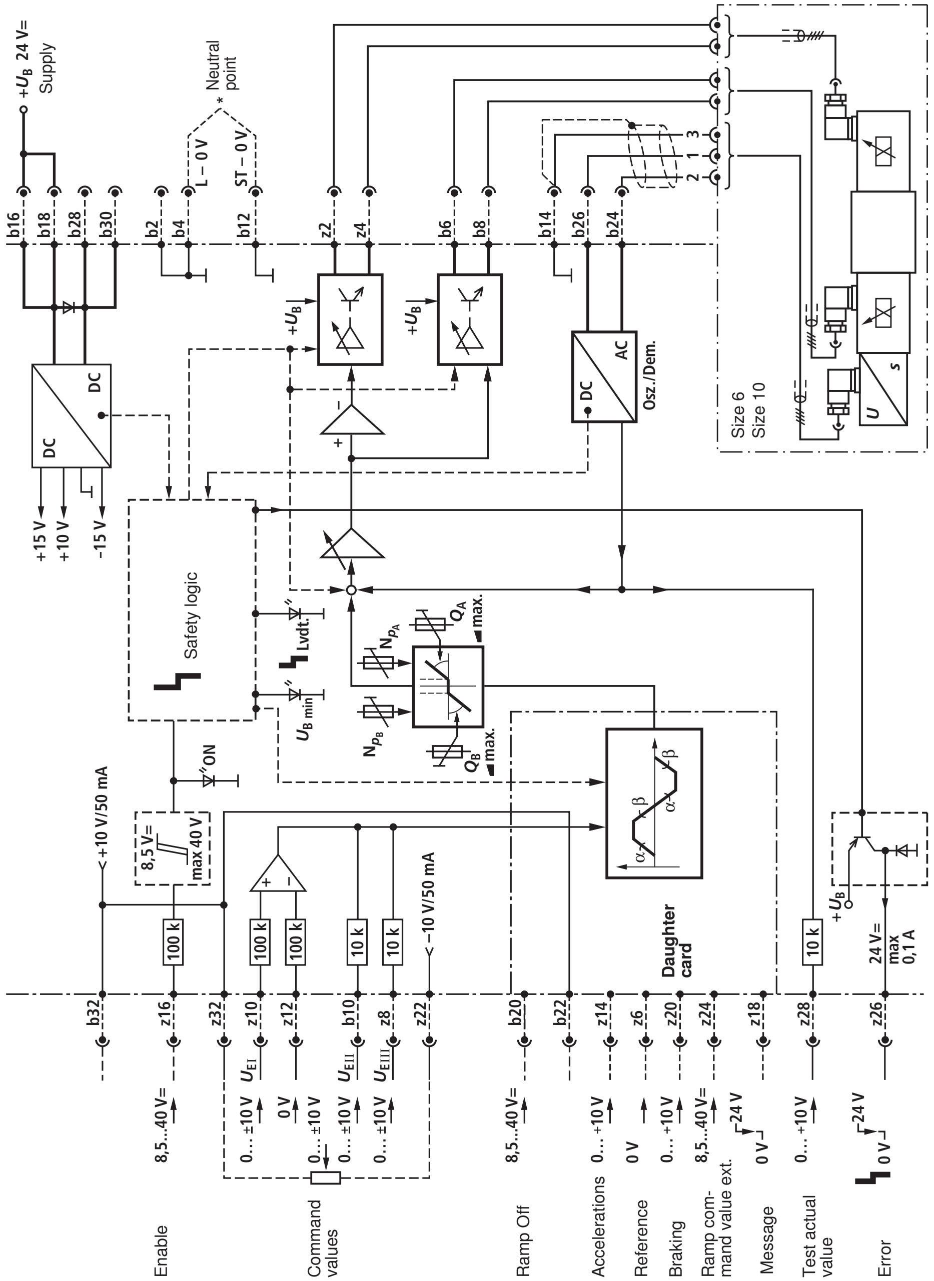
Front plate







Block diagram with pin assignment



1

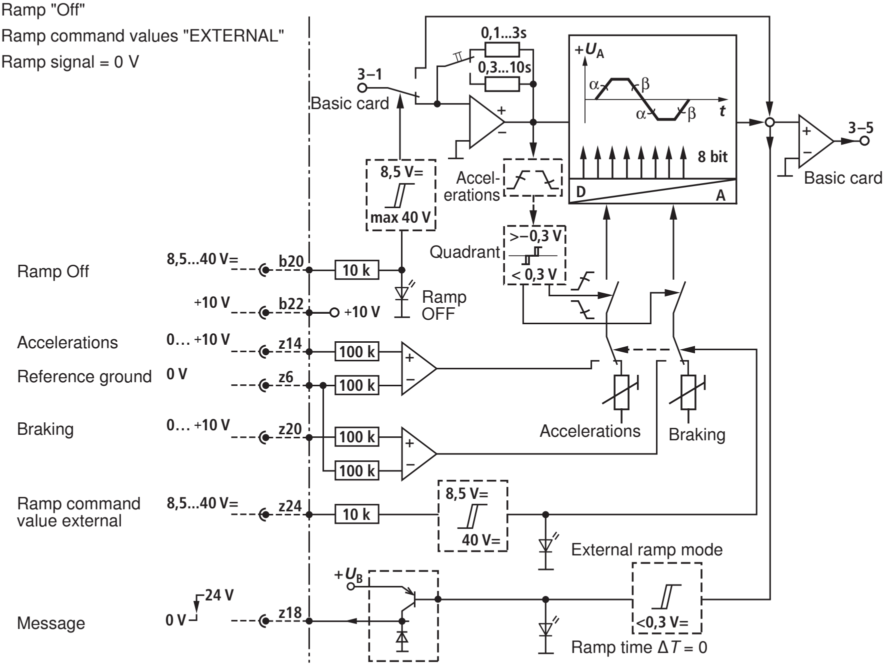
Block diagram with pin assignment daughter card

Operating range: Ramp generator

– Internal/external specification 0...+10 V for the ramp time

Logic signals

– Ramp "Off"
– Ramp command values "EXTERNAL"
– Ramp signal = 0 V



Additional information

Information for the use of ramps

1. Quadrant recognition
   There is automatic quadrant recognition of the ramps for positive and negative valve command values.

2. Switch-over INTERNAL/EXTERNAL ramp command value specification
– Switch-over is effected by means of voltage signal at z24 to external specification
– This renders the setting potentiometers ineffective
– "EXTERNAL" state is displayed by LED.

3. INTERNAL ramp setting
– Set potentiometer to desired ramp behavior
– Prerequisite: No command at z24 and/or b20.

4. EXTERNAL ramp setting
– Voltage specification at z14
  and z20 (joint reference point z6)
– Max. resolution: 75 mV
  Prerequisite: Command at z24 and no command at b20.

5. Ramp time range
– You can set 2 ramp time ranges (front plate selector). They are valid for internal and external command value specification.

6. Ramp OFF
– Ramp switch-off by means of command at b20
– If the ramp has already been started, transition to the signal end value is effected by means of a step
– "Ramp Off" state is displayed by LED.

7. Ramp time ΔT = 0
– If the ramp output voltage U_A = 0 V, the signal output z18 is switched to 24 V
– The state is also displayed by an LED
– If the ramp function is switched off, there is no message.

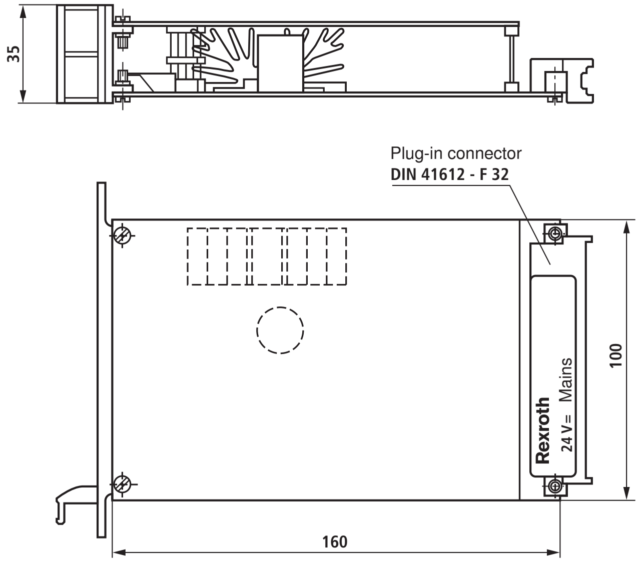
Technical data (For applications outside these parameters, please consult us!)

Supply voltage U_B at b16 – b2		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at b16 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10%)	
Valve solenoid, max.	A/VA	**2.5/25 (size 6)**	**3.7/50 (size 10)**
Current consumption, max.	A	1.5	2.5
		The current consumption may increase with min. U_B and extreme cable length to the control solenoid	
Solenoid output b6 – b8/z2 – z4	A	Rectangular voltage, pulse-modulated $I_{max.}$ = 2.7	$I_{max.}$ = 3.7
Power consumption (typical)	W	35	60
Input signal (command value)		0...±10 V optionally at b10, z8, z10, z12, z14/b14 summing (R_i = 100 kΩ)	
Signal source		Potentiometer 1 kΩ Supply ±10 V from b32 (50 mA) – 10 V from z22 (50 mA) or external signal source	
Actual value feedback		Osci b26	Test point z28[1]
0811405137		10.2 V_{eff}/7.8 kHz	0...±10 V =
0811405138		10.2 V_{eff}/7.8 kHz	0...±10 V =
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ, LED (green) on front plate lights up	
Ramp internal/external		At z24, U = 8.5...40 V external ramp command values	
Ramp OFF		At b20 U = 8.5...40 V	
Cable lengths between amplifier and valve		Solenoid cable: to 20 m 1.5 mm² 20 to 50 m 2.5 mm² Position transducer: Max. 50 m with 100 pF/M Supply and capacitor 1.5 mm²	
Short-circuit-proof outputs		Output stage to the solenoid, signal to the positional transducer, Supply voltage for potentiometer	
Special features		Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Ramps with quadrant recognition, Compensation of the dead zone in central valve position, Ramps that can be switched off, Ramp command values can be specified internally (potentiometers) or externally (voltage)	
Adjustment via trimming potentiometer		1. Zero point N_{PA} and N_{PB} 2. Sensitivity Q_A and Q_B 3. Ramps for acceleration and braking, depending on setting 0.1...3 sec and/or 0.3...10 sec 4. Switch-over ramp setting range	
LED displays		green: Enable ON / ramp external yellow: Cable break actual value / ramp OFF / Q_0 = 0 V red: $U_B > U_{B\,min.}$ (approx. 21 V)	
Error message – Cable break actual value – U_B too low – ±15 V stabilization		Switching output No error: +24 V (max. 100 mA) Error 0 V	
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE	
Plug-in connection		Connector DIN 41612 – F32	
Ambient temperature	°C	0...+70	
Storage temperature range	°C	–20...+70	
Weight	*m*	0.43 kg	

Notice: Power zero b2 and control zero b12 must be separately led to the central ground (neutral point).

[1] Values for potentiometer in end position (cw) and for "zero potentiometer" in central position.

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 5 must be complied with.

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Electric amplifiers

RE 30048/08.12
Replaces: 03.12

Type VT-VRPA2-5...-1X/V0/RTP

Component series 1X

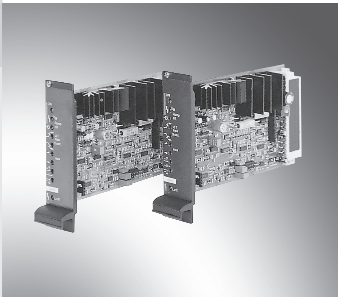


Table of contents

Features

- Suitable for controlling direct operated high-response valves
- Analog amplifiers in Europe format for installation in 19" racks
- Ramp generator that can be switched off
- Compensation step
- Controlled output stage
- Enable input
- Inputs and outputs short-circuit-proof
- External ramp switch-off
- Adjustment possibilities
  • Zero point valve
  • Sensitivity
  • Ramp times
- Cable break detection for actual value cable
- Position control with PID behavior

Notice:
The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	P	A	2 –	–1X	/ V0	/ RTP

Hydraulic component
For valves with electric feedback **= R**

Valve type
High-response valve **= P**

Control
Analog **= A**

Output stages
2 output stages per valve **= 2**

Option
RTP = Ramp function can be set manually

Customer version
V0 = Catalog version

1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

Serial number for types
527 = Size 6
537 = Size 10

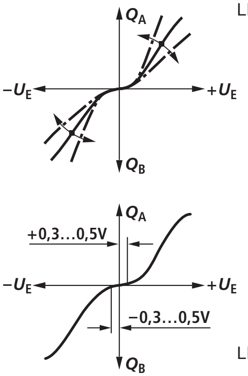
Preferred types

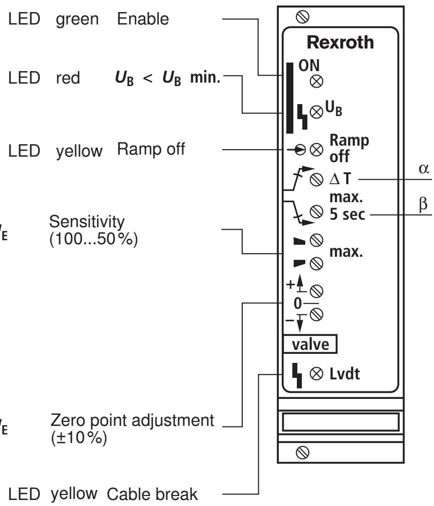
Amplifier type	**Material number**	**For high-response valves with electric position feedback and positive overlap**
VT-VRPA2-527-10/V0/RTP	0811405119	4WRP 6...S-1X...
VT-VRPA2-537-10/V0/RTP	0811405120	4WRP 10...S-1X...

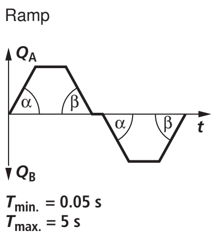
Suitable card holder:

– Open card holder VT 3002-1-2X/32F
  (see data sheet 29928).
  Only for control cabinet installation!

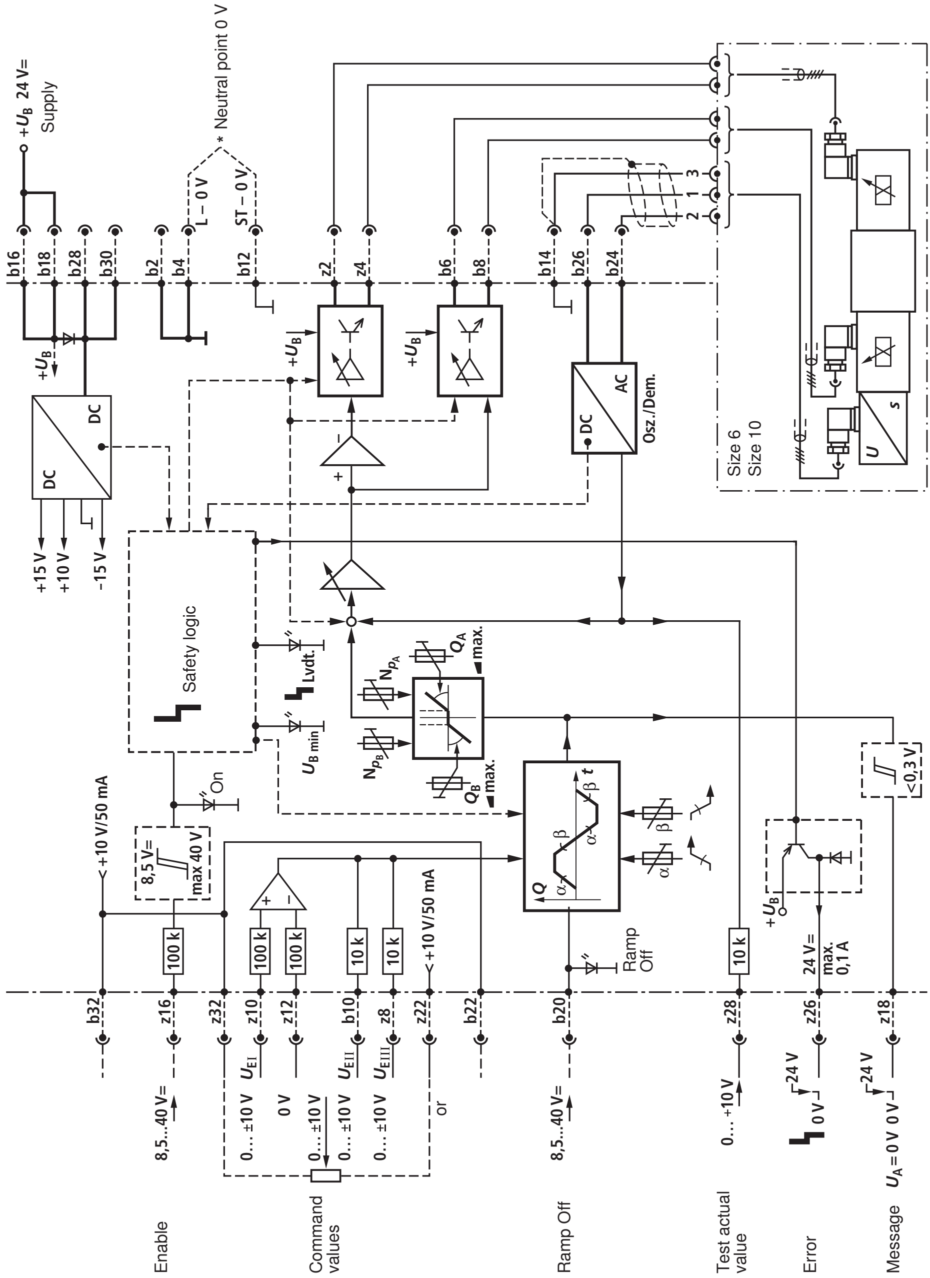
Front plate







Block diagram with pin assignment



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

Supply voltage U_B at b16/b18 and b2/b4		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at b16 – b4		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)	
Solenoid, max.	A/VA	**2.7/25 (size 6)**	**3.7/50 (size 10)**
Current consumption	A	1.5	2.5
		The current consumption may increase with min. U_B and extreme cable length to the control solenoid	
Power consumption (typical)	W	35	60
Input signal (command value)		0...±10 V optionally at b10, z8, z10, z12, z14/b14 summing (R_i = 100 kΩ)	
Signal source		Potentiometer 10 kΩ Supply with +10 V from b32 (50 mA) –10 V from z22 (50 mA) or external signal source	
Actual value feedback		Osci b26	Test point z28 [1]
	0 811 405 119	10.2 V_{eff}/7.8 kHz	0...±10 V =
	0 811 405 120	10.2 V_{eff}/7.8 kHz	0...±10 V =
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ, LED (green) on front plate lights up	
Ramp OFF		At b20, U = 8.5...40 V	
Solenoid output		Output stage to the solenoid Signal to the positional transducer Supply voltage for potentiometer	
Cable lengths between amplifier and valve		Solenoid cable: to 20 m 1.5 mm² 20 to 50 m 2.5 mm² Position transducer: Max. 50 m with 100 pF/m Supply 1.5 mm²	
Special features		Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Ramps with quadrant recognition, Compensation of the dead zone in central valve position, Ramp that can be switched off	
Adjustment via trimming potentiometer		Zero point N_{PA} and N_{PB} Sensitivity Q_A and Q_B Ramps for accelerations and braking t = 0.05...5 sec	
LED displays		green: Enable ON red: $U_B < U_{B\,min.}$ (approx. 21 V) yellow: Ramp OFF yellow: Cable break actual value	
Error message – Cable break actual value – U_B too low – ±15 V stabilization		z22: Open collector output to $+U_B$ Max. 100 mA; no error: $+U_B$	
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE	
Plug-in connection		Connector DIN 41612 – F32	
Ambient temperature	°C	0...+70	
Storage temperature range	°C	–20...+70	
Weight	m	0.35 kg	

Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

[1] Values for potentiometers in end position (cw) and for "zero potentiometer" in central position.

Use of ramps

Information for the use of ramps

Ramp ON, if b20 open.

Ramp OFF, if b20 connected to b22 or U = 8.5...40 V at b20.

With **Ramp OFF, Enable OFF** or **Cable break,** any ramp started before will be canceled. Transition to the signal end value is effected by means of a step.

Quadrant recognition A

When passing through the central position, the direction of movement of the valve spool remains the same, however the cylinder changes its direction. So that the acceleration values for both directions of movement remain the same, the ramp is switched by means of quadrant recognition when the valve passes from one quadrant to the next.

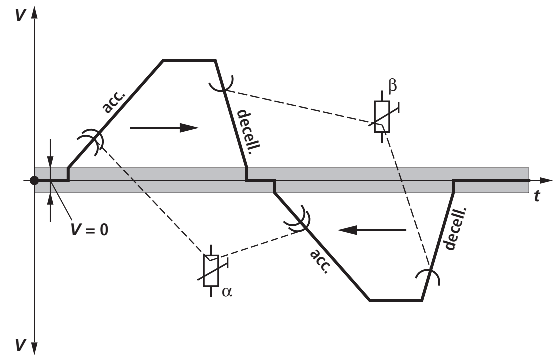
Compensation of the dead zone in central valve position B

The positive overlap of ±20 % of the spool travel is skipped by means of an electronic compensation circuit in the range ±15 % of the spool travel.

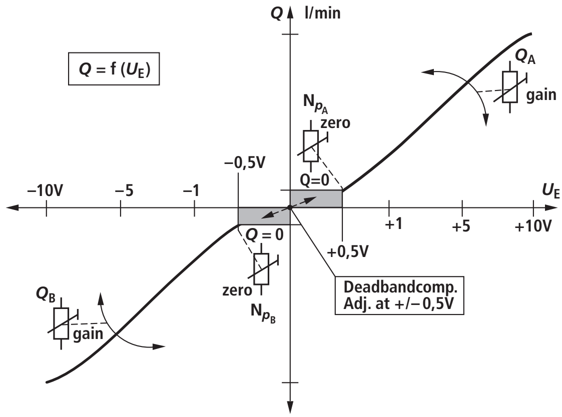
Zero point calibration

For the calibration, a small command value (U_E = 0.3...0.5 V) must be specified in order to ensure that the dead zone has been left.

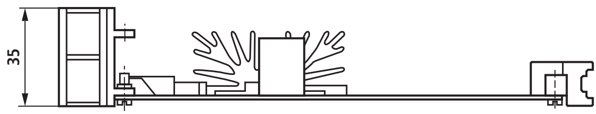
A

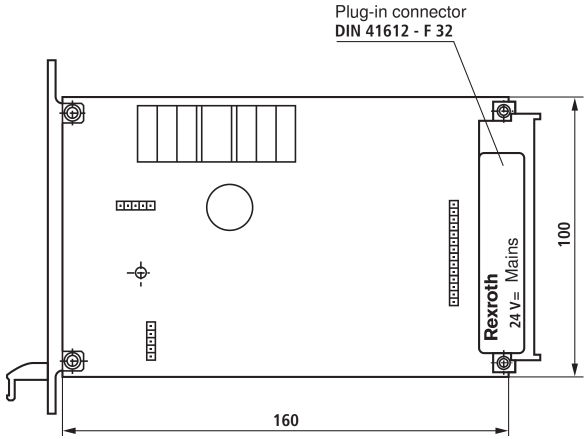


B



Unit dimensions (dimensions in mm)





Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

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Electric amplifiers

RE 30042/02.12
Replaces: 11.02

Type VT-VRRA1-527-1X/V0/...

Component series 1X

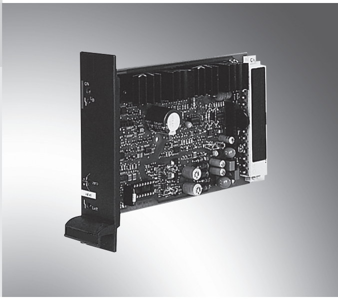


Table of contents

Features

- Suitable for controlling direct operated high-response valves with linear characteristic curve and electrical position feedback
- Analog amplifiers in Europe format for installation in 19" racks
- Controlled output stage
- Enable input
- Outputs short-circuit-proof
- Adjustment possibilities – Zero point valve
- Cable break detection for actual value cable
- Position control with PID behavior

Notice:

The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	R	A	1 –	–1X	/V0	/

Hydraulic component
For valves with electrical feedback **= R**

Valve type
High-response valve **= R**

Control
Analog **= A**

Option
no code = High-response valve with control 0...±10 V
RV = High-response valve with control +3.5...6.5...9.5 V

Customer version
V0 = Catalog version

1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

Serial number for types
527 = Size 6

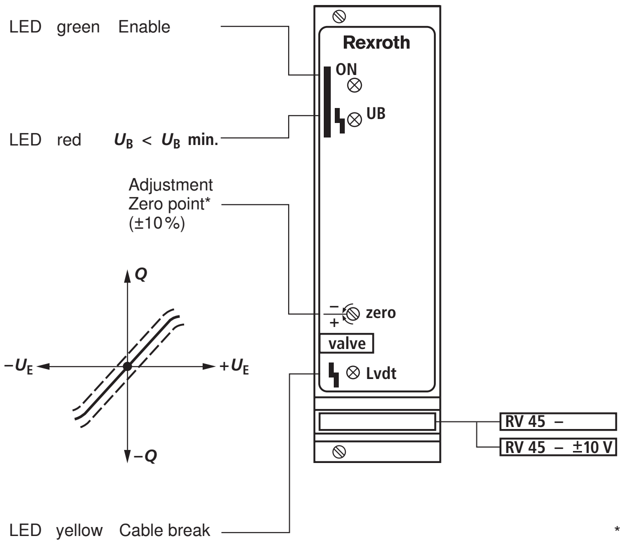
Preferred types

Amplifier type	Material number	For high-response valves LVDT-AC
VT-VRRA1-527-10/V0	0811405123	4WRPH 6..L-1X...
VT-VRRA1-527-10/V0/RV	0811405148	4WRPH 6..L-1X...

Suitable card holder:

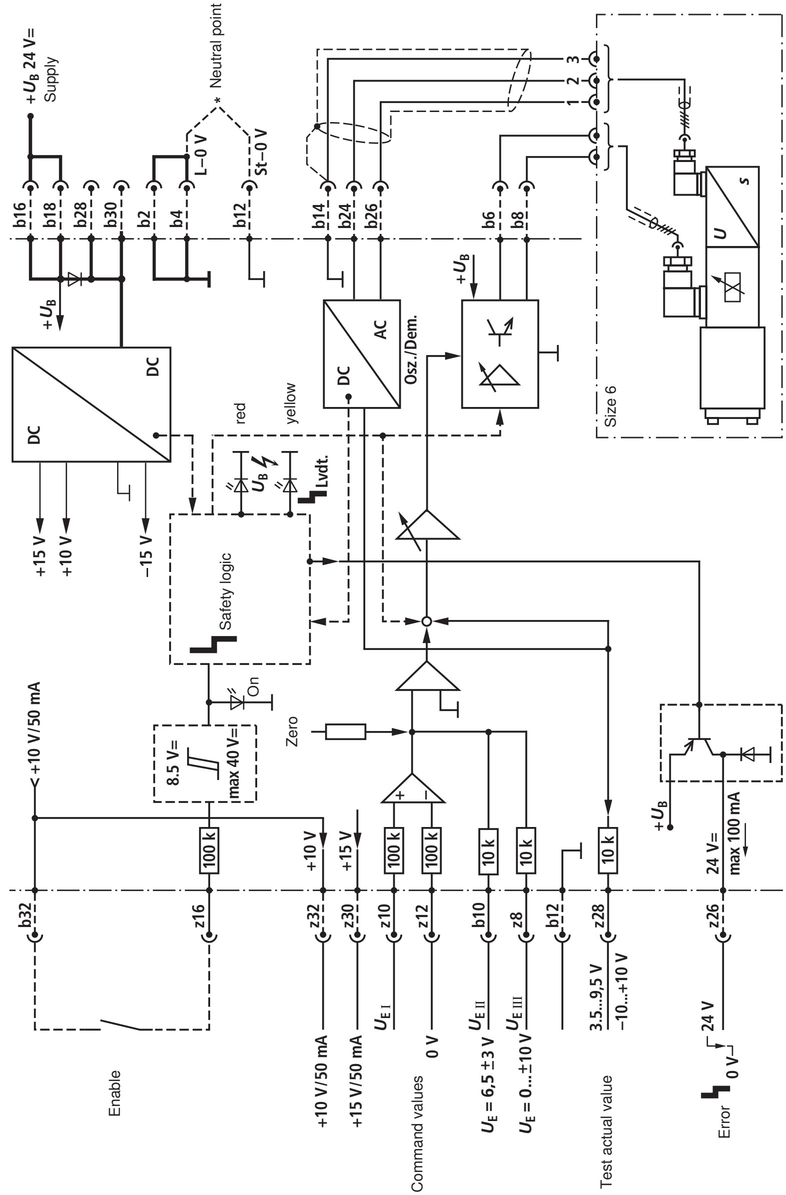
– Open card holder VT 3002-1-2X/32F (see data sheet 29928). Only for control cabinet installation!

Front plate



* 0811405148 without

Block diagram with pin assignment



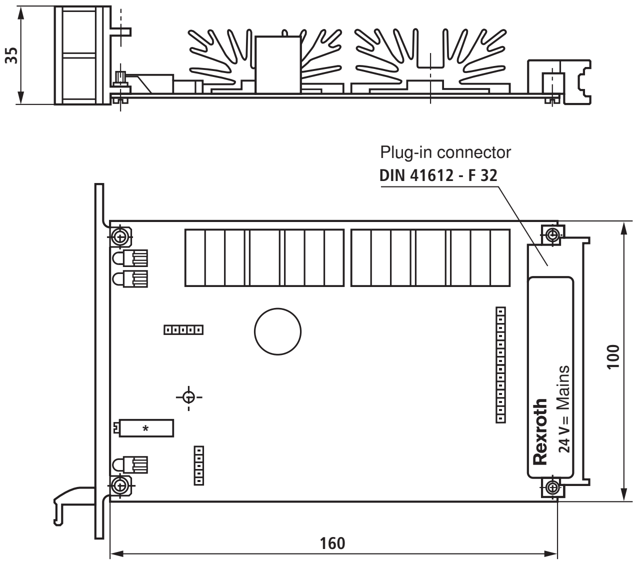
Technical data (For applications outside these parameters, please consult us!)

Supply voltage U_B at b16/b18 and b2/b 4 (0 V)		Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor, separately at b16 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)
Valve solenoid, max.	A/VA	**2.7/25 (size 6)**
Current consumption, max.	A	1.5
		The current consumption may increase with min. U_B and extreme cable length to the control solenoid
Power consumption (typical)	VA	35
Input signal (command value)		z10: U_E } Differential amplifier z12: 0 V } z8 b10
0811405148		U_E = +3.5...6.5...9.5 V
0811405123		U_E = 0...±10 V
Actual value feedback		Osci b26: 10.4 V/8 kHz
0811405148		Testp. z28: U_E = +3.5...6.5...9.5 V
0811405123		Testp. z28: U_E = 0...±10 V
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ , LED (green) on front plate lights up
Cable lengths between amplifier and valve		Solenoid cable: to 20 m 1.5 mm² 20 to 50 m 2.5 mm² Actual value: Max. 50 m with 100 p^F/m
Short-circuit-proof outputs		Output stage to the solenoid Signal to the positional transducer Supply voltage for potentiometer
Special features		Cable break protection for actual value cable, Position control with PID behavior, Fast energization and fast deletion for short actuating times
LED displays		green: Enable yellow: Cable break actual value red: $U_B < U_{B\,min}$ (≦ 21 V)
Error message – Cable break actual value – U_B too low		z26: No error +24 V/0.1 A Error: 0 V
Zero point adjustment		
0811405148		Fixedly set
0811405123		Via trimming potentiometer
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE
Plug-in connection		Connector DIN 41612 – F32
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	m	0.35 kg

Notice:
Power zero b2 and control zero b12 must be separately led to the central ground (neutral point).

1

Unit dimensions (dimensions in mm)



* Potentiometer only with 0811405123

Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

Notes

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Electric amplifiers

RE 30041/02.12
Replaces: 01.11

Type VT-VRRA1-5...-2X/V0
Type VT-VRPA1-5...-2X/V0

Component series 2X

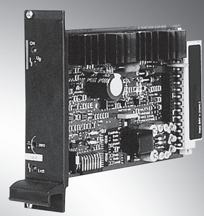


Table of contents

Contents	Page

Features

- Suitable for controlling direct operated high-response valves with linear characteristic curve and position feedback (Lvdt-DC/DC)
- Analog amplifiers in Europe format for installation in 19" racks
- Controlled output stage
- Enable input
- Outputs short-circuit-proof
- Adjustment possibilities – Zero point valve
- Cable break detection for actual value cable
- Position control with PID behavior

Notice:

The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R		A	1 –	–2X/V0

Hydraulic component
For valves with electrical feedback = R

Valve type
p/Q high-response valve = P
High-response valve = R

Control
Analog = A

Serial number for types
527 = Size 6
537 = Size 10

2X = Component series 20 to 29
(20 to 29: Unchanged technical data and pin assignment)

Customer version
V0 = Catalog version

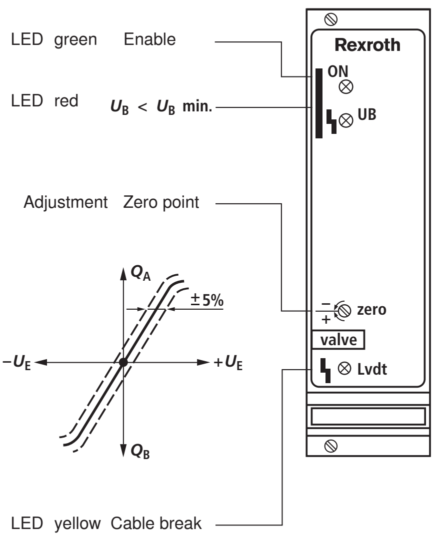
Preferred types

Amplifier type	Material number	For high-response valves with electrical position feedback
VT-VRRA1-527-20/V0	0811405060	4WRPH6...L-2X
VT-VRRA1-537-20/V0	0811405061	4WRPH10...L-2X
VT-VRPA1-537-20/V0	0811405062	5WRP10...L-2X

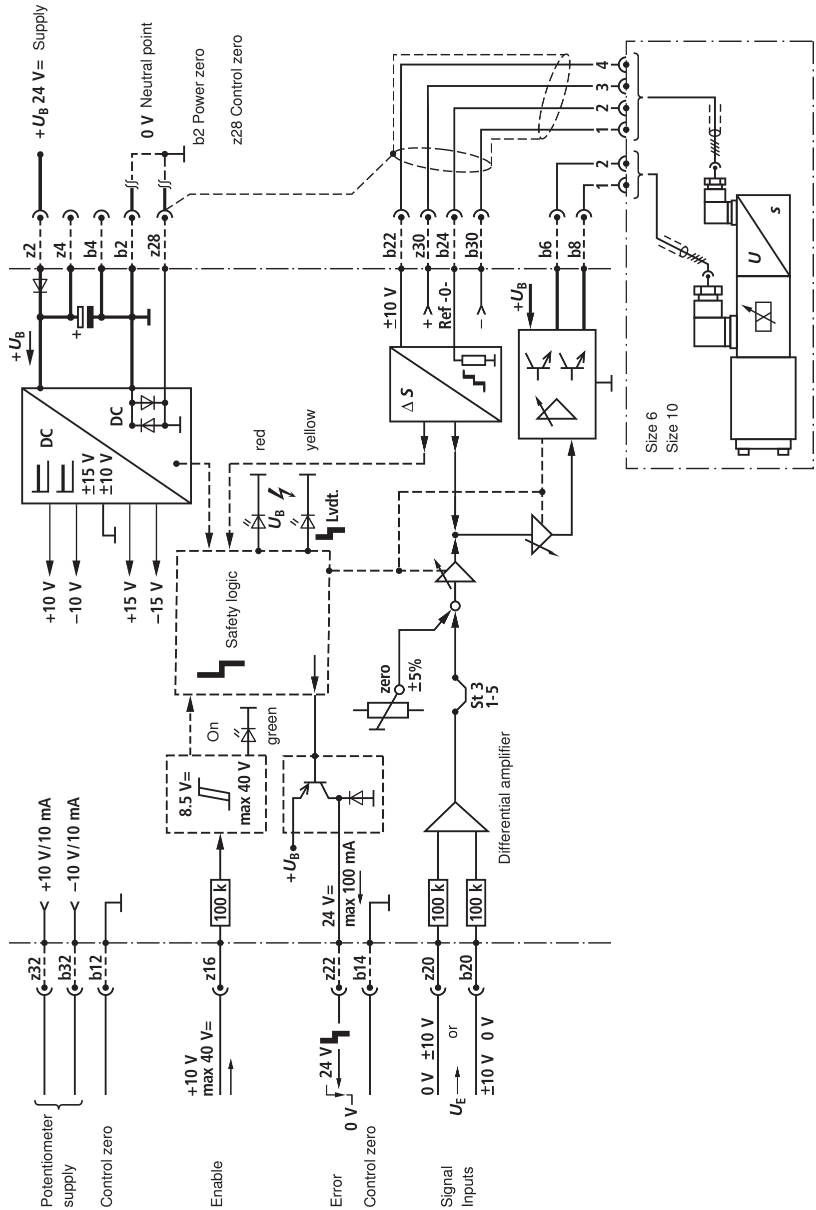
Suitable card holder:

– Open card holder VT 3002-1-2X/32F
  (see data sheet 29928).
  Only for control cabinet installation!

Front plate



Block diagram with pin assignment

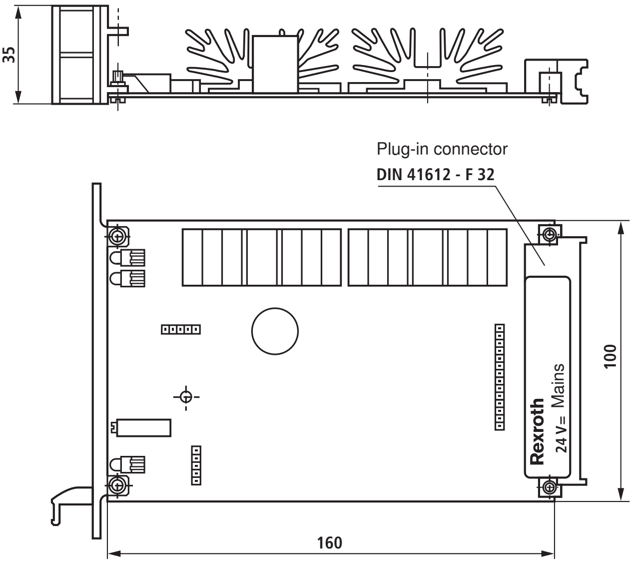


Technical data (For applications outside these parameters, please consult us!)

Supply voltage U_B at z2 – b2		Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B >10 %)	
Valve solenoid, max.	A/VA	**2.7/40 (size 6)**	**3.7/60 (size 10)**
Current consumption, max.	A	1.7	2.7
		The current consumption may increase with min. U_B and extreme cable length to the control solenoid	
Power consumption (typical)	W	37	55
Input signal (command value)		b20: 0...±10 V } Differential amplifier z20: 0...±10 V } (R_i = 100 kΩ)	
Signal source		Potentiometer 10 kΩ, Supply ±10 V from b32, z32 (10 mA) or external signal source	
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ, LED (green) on front plate lights up	
Position transducer – Supply		b30: –15 V z30: +15 V	
Position transducer – Actual value signal		b22: 0...±10 V, R_i = 20 kΩ	
Position transducer – Actual value reference		b24	
Solenoid output b6 – b8		Clocked current controller	
	I_{max}	2.7 A	3.7 A
Cable lengths between amplifier and valve		Solenoid cable: to 20 m 1.5 mm² 20 to 60 m 2.5 mm² Position transducer: 4 x 0.5 mm² (shielded)	
Special features		Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Short-circuit-proof outputs	
Adjustment		Zero point via trimming potentiometer ±5 %	
LED displays		green: Enable yellow: Cable break actual value red: Undervoltage (U_B too low)	
Error message – Cable break actual value – U_B too low – ±15 V stabilization		z22: Open collector output to +U_B max. 100 mA; no error: +U_B	
Circuit board format	mm	(100 x 160 x approx. 35) (W x L x H) Europe format with front plate 7 TE	
Plug-in connection		Connector DIN 41612 – F 32	
Ambient temperature range	°C	0...+70	
Storage temperature range	°C	–20...+70	
Weight	m	0.37 kg	

Notice
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

1

Notes

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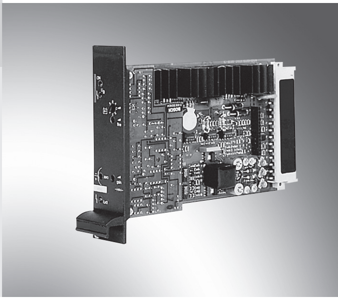
Rexroth
Bosch Group

Electric amplifiers

RE 30040/02.12
Replaces: 11.02

Type VT-VRRA1-5...-2X/V0/K...-AGC



Component series 2X

Table of contents

Contents	**Page**

Features

- Suitable for controlling direct operated high-response valves with inflected characteristic curve
- Amplifier with additional electronics (daughter card)
- Linearization of inflected valve characteristic curves
- Area adjustment of single rod cylinders
- Analog amplifiers in Europe format for installation in 19" racks
- Controlled output stage
- Enable input
- Outputs short-circuit-proof
- Adjustment possibilities – Zero point valve
- Cable break detection for actual value cable
- Position control with PID behavior
- Gain in the small signal range

Notice:
The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	R	A	1 –		–2X / V0 /	

Hydraulic component
For valves with electrical feedback **= R**

Valve type
High-response valve **= R**

Control
Analog **= A**

Option
K40-AGC = High-response valve with 40 % inflection
K60-AGC = High-response valve with 60 % inflection

Customer version
V0 = Catalog version

2X = Component series 20 to 29 (20 to 29: Unchanged technical data and pin assignment)

Serial number for types
527 = Size 6
537 = Size 10

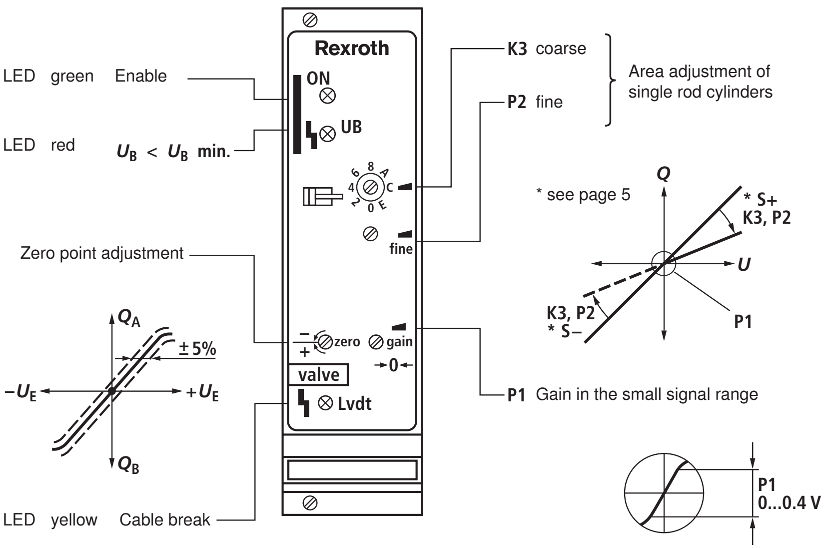
Preferred types

Amplifier type	Material number	For high-response valves with electrical position feedback and inflected characteristic curve
VT-VRRA1-527-20/V0/K40-AGC	0811405065	4WRPH 6...P-2X...
VT-VRRA1-527-20/V0/K60-AGC	0811405066	4WRPH 6...P-2X...
VT-VRRA1-537-20/V0/K40-AGC	0811405067	4WRPH 10...P-2X...

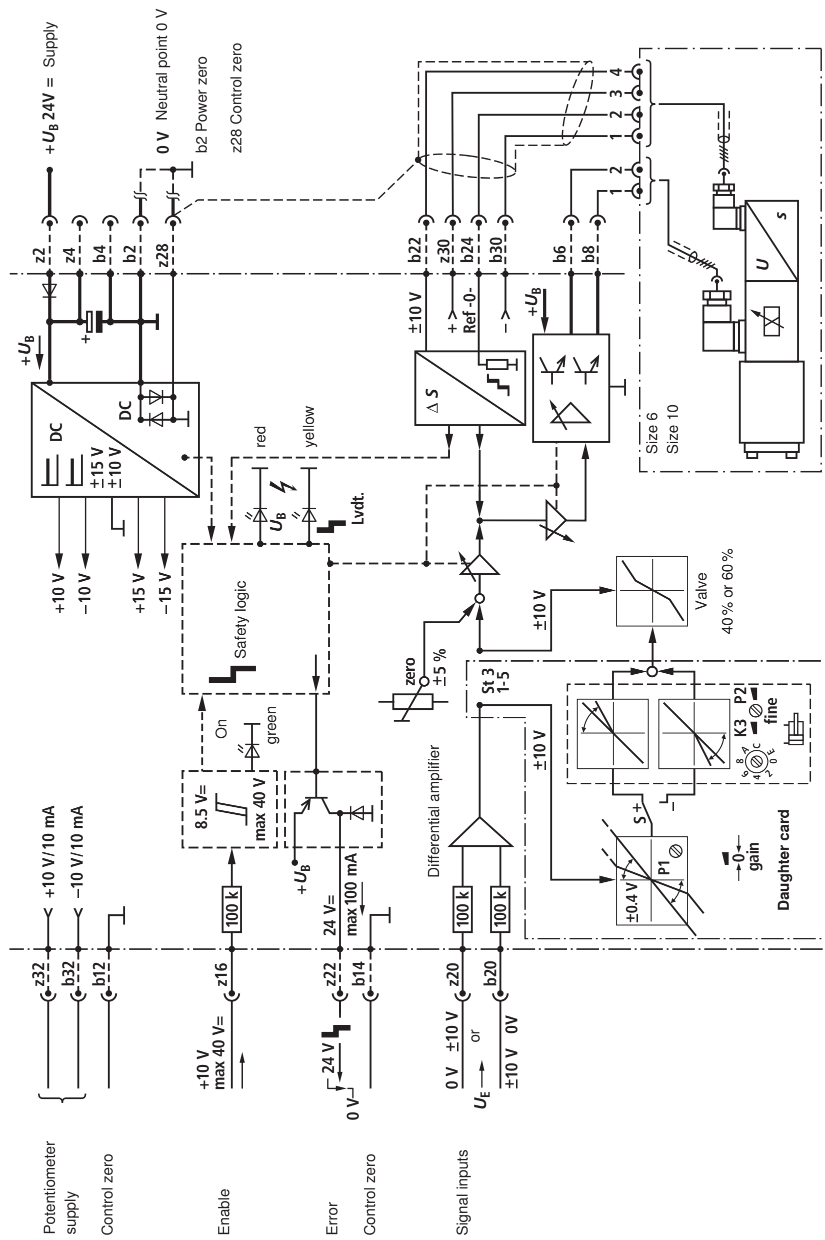
Suitable card holder:

– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



Block diagram with pin assignment



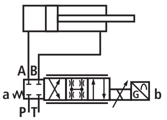
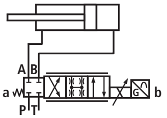
Technical data (For applications outside these parameters, please consult us!)

Supply voltage U_B at z2 – b2		Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)	
Valve solenoid, max.	A/VA	**2.7/40 (size 6)**	**3.7/60 (size 10)**
Current consumption, max.	A	1.7	2.7
		The current consumption may increase with min. U_B and extreme cable length to the control solenoid	
Power consumption (typical)	W	37	55
Input signal (command value)		b20: 0...±10 V } Differential amplifier z20: 0...±10 V (R_i = 100 kΩ)	
Signal source		Potentiometer 10 kΩ Supply with ±10 V from b32, z32 (10 mA) or external signal source	
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ , LED (green) on front plate lights up	
Position transducer	Supply	b30: –15 V z30: +15 V	
	Actual value signal	b22: 0...±10 V, R_i = 20 kΩ	
	Actual value reference	b24	
Solenoid output b6 – b8		Clocked current controller	
	I_{max}	2.7 A	3.7 A
Cable lengths between amplifier and valve		Solenoid cable: to 20 m 1.5 mm² 20 to 60 m 2.5 mm² Position transducer: 4 x 0.5 mm² (shielded)	
Special features		Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Short-circuit-proof outputs, Linearization of the inflected flow characteristic curve	
Adjustment		Zero point via trimming potentiometer ±5 %, Area adjustment of single rod cylinders, Gain in the small signal range	
LED displays		green: Enable yellow: Cable break actual value red: Undervoltage (U_B too low)	
Error message – Cable break actual value – U_B too low – ±15 V stabilization		z22: Open collector output to +U_B max. 100 mA; no error: +U_B	
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE	
Plug-in connection		Connector DIN 41612 – F32	
Ambient temperature	°C	0...+70	
Storage temperature range	°C	–20...+70	
Weight	m	0.39 kg	

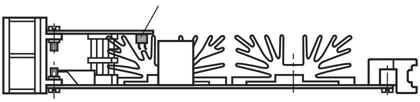
Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

Commissioning

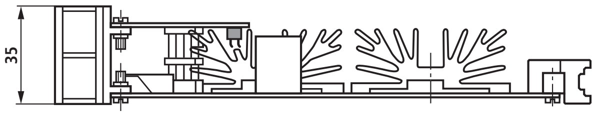
1. Setting the electric and hydraulic zero point using the "zero" potentiometer.
   With closed control loop, the following error displayed by the CNC is then controlled to 0.
2. Adjustment single rod cylinder
   – "S" selector switch setting on daughter card
   – Comparison with direction-dependant command value attenuator with step switch K3 (coarse), with potentiometer P2 (fine).
3. Optimization of the gain in the small signal range with potentiometer P1.

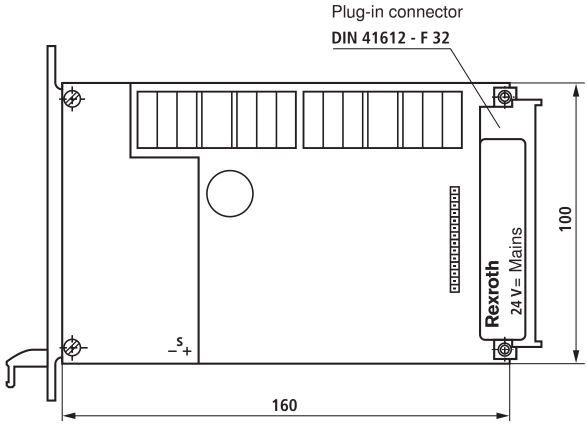
Valve ←→ Cylinder	Selector switch
	"S" –
	"S" +

"S" selector switch
Position depending on
piping and signal polarity



Unit dimensions (dimensions in mm)





Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

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Electric amplifiers

RE 30046/03.12
Replaces: 11.02

Type VT-VRRA1-5...-2X/V0/KV-AGC

Component series 2X

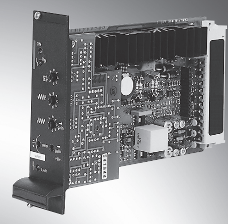


Table of contents

Features

- Suitable for controlling direct operated high-response valves with linear characteristic curve
- Area adjustment of single rod cylinders
- Analog amplifiers in Europe format for installation in 19" racks
- Controlled output stage
- Enable input
- Outputs short-circuit-proof
- Adjustment possibilities – zero point valve
- Cable break detection for actual value cable
- Position control with PID behavior
- Gain in the small signal range

Notice:
The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	R	A	1 –	– 2X	/ V0	/ KV-AGC

Hydraulic component
For valves with electric feedback **= R**

Valve type
High-response valve **= R**

Control
Analog **= A**

Option
KV-AGC = Function for variable inflection
Small signal amplification
Area adjustment

Customer version
V0 = Catalog version

2X = Component series 20 to 29
(20 to 29: Unchanged technical data
and pin assignment)

Serial number for types
527 = Size 6
537 = Size 10

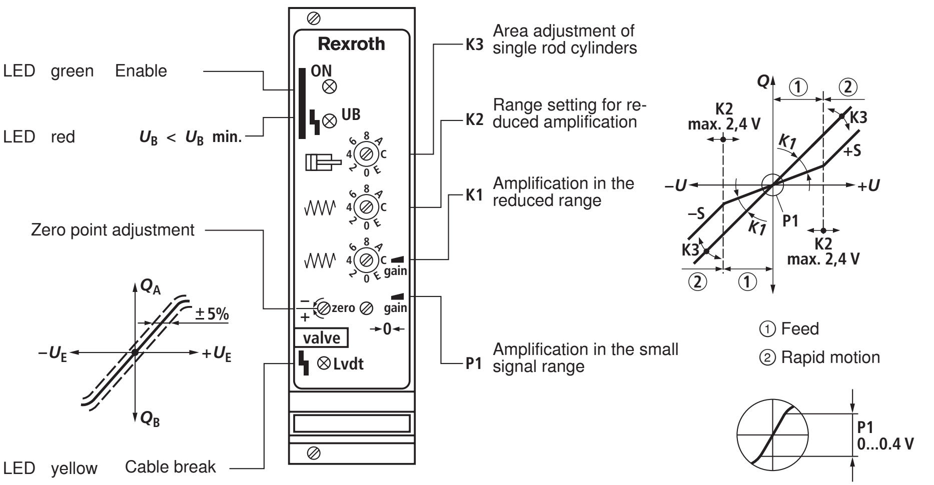
Preferred types

Amplifier type	Material number	For high-response valves with electric position feedback and linear characteristic curve
VT-VRRA1-527-20/V0/KV-AGC	0811405069	4WRPH 6...P-2X...
VT-VRRA1-537-20/V0/KV-AGC	0811405070	4WRPH 10...P-2X...

Suitable card holder:

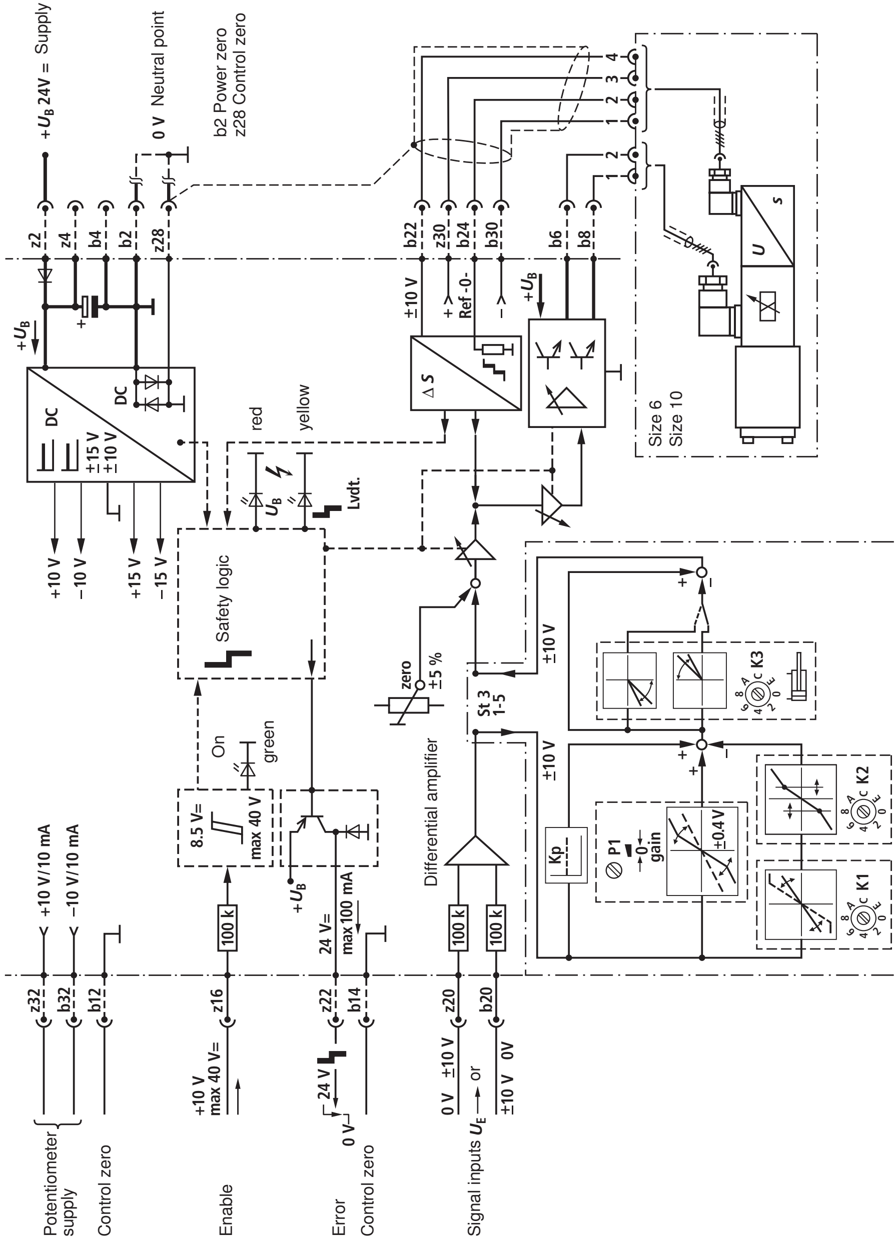
– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



Position	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Amplification K3	1:1	1.06:1	1.15:1	1.23:1	1.33:1	1.44:1	1.56:1	1.70:1	0.733	0.7	0.666	0.633	0.6	0.566	0.533	0.5
Area ratio	1	0.97	0.934	0.9	0.867	0.834	0.8	0.766	1.86:1	2.04:1	2.23:1	2.50:1	2.77:1	3.12:1	3.52:1	4:1

Block diagram with pin assignment



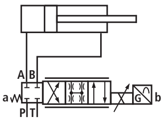
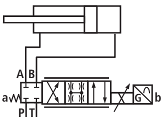
Technical data (For applications outside these parameters, please consult us!)

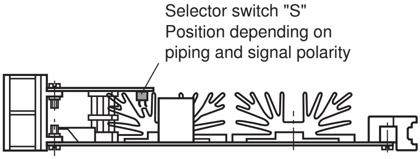
Supply voltage U_B at z2 – b2		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10%)	
Valve solenoid, max.	A/VA	**2.7/40 (size 6)**	**3.7/60 (size 10)**
Current consumption, max.	A	1.7	2.7
		The current consumption may increase with min. U_B and extreme cable length to the control solenoid	
Power consumption (typical)	W	37	55
Input signal (command value)		b20: 0...±10 V } Differential amplifier z20: 0...±10 V } (R_i = 100 kΩ)	
Signal source		Potentiometer 10 kΩ Supply with ±10 V from b32, z32 (10 mA) or external signal source	
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ, LED (green) on front plate lights up	
Position transducer	Supply	b30: –15 V z30: +15 V	
	Actual value signal	b22: 0...±10 V, R_i = 20 kΩ	
	Actual value reference	b24	
Solenoid output b6 – b8		Clocked current controller	
	I_{max}	2.7 A	3.7 A
Cable lengths between amplifier and valve		Solenoid cable: to 20 m 1.5 mm² 20 to 60 m 2.5 mm² Position transducer: 4 x 0.5 mm² (shielded)	
Special features		Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Short-circuit-proof outputs	
Adjustment		Zero point via trimming potentiometer ±5% Area adjustment of single-rod cylinders (K3) Amplification in the small signal range (P1) Variable adjustment of the loop gain in the feed speed range (K1) Range setting of feed speed range (K2)	
LED displays		green: Enable yellow: Cable break actual value red: Undervoltage (U_B too low)	
Error message – Cable break actual value – U_B too low – ±15 V stabilization		z22: Open collector output to +U_B Max. 100 mA; no error: +U_B	
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE	
Plug-in connection		Connector DIN 41612 – F32	
Ambient temperature	°C	0...+70	
Storage temperature range	°C	–20...+70	
Weight	m	0.40 kg	

Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

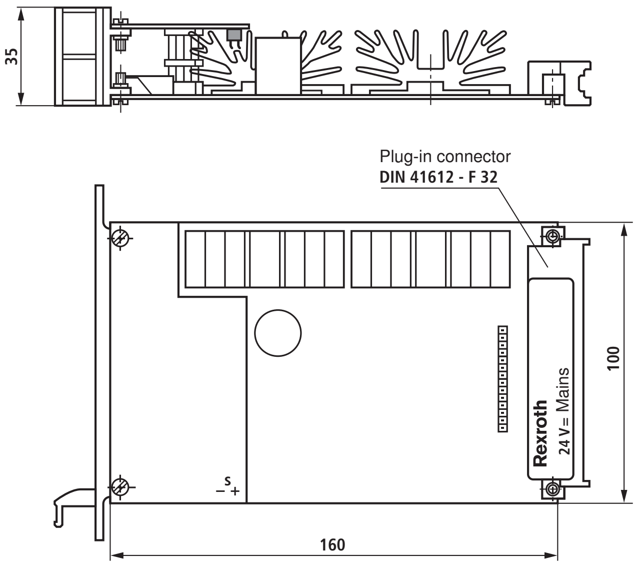
Commissioning

1. Setting the electric and hydraulic zero point using the „zero“ potentiometer.
   With closed control loop, the following error displayed by the CNC is then controlled to 0.
2. Setting of the range of minimum valve modulation by means of the rotary encoding switch K2.
3. Reduction of the amplification by means of the rotary encoding switch K1 so that the drive stabilizes in the area of minimum valve modulation.
4. Carry out point 2 and 3 in several steps, if necessary.
5. Adjust different forward and backward speeds (area adjustment of single rod cylinders) using switch S and rotary encoding switch K3.
6. Adjust the optimization of the amplification in the small signal range by means of P1 (complete reduction of the following error).

Valve ←→ Cylinder	Selector switch
	"S" –
	"S" +



Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

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Electric amplifiers

RE 30045/02.12
Replaces: 11.02

Type VT-VRRA1-527-2X/V0/2STV

Component series 2X

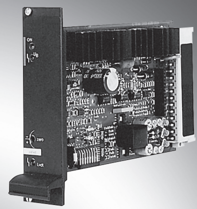


Table of contents

Features

- Suitable for controlling pilot operated directional control valves, progressive with linear fine control
- Analog amplifiers in Europe format for installation in 19" racks
- Controlled output stage
- Enable input
- Outputs short-circuit-proof
- Adjustment possibilities – Zero point valve
- Cable break detection for actual value cable
- Position control with PID behavior

Notice:

The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	R	A	1	–527	–2X	/ V0	/ 2STV

Hydraulic component
For valves with electrical feedback **= R**

Valve type
Directional control valve **= R**

Control
Analog **= A**

Option
2STV = Directional control valve pilot operated, progressive with linear fine control

Customer version
V0 = Catalog version

2X = Component series 20 to 29 (20 to 29: Unchanged technical data and pin assignment)

Serial number for types
527 = Pilot control valve size 6

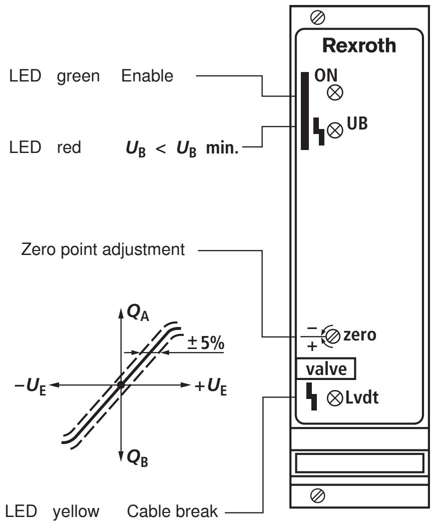
Preferred types

Amplifier type	**Material number**	**For directional control valves, pilot operated, with electrical position feedback**
VT-VRRA1-527-20/V0/2STV	0811405063	4WRL 10...35 V/V1...M-3X...
		4WRL 10...35 E/W...S-3X...
		4WRL 10...25 V/V1...M-3X...-750
		3WRCB 25...50...M-1X...

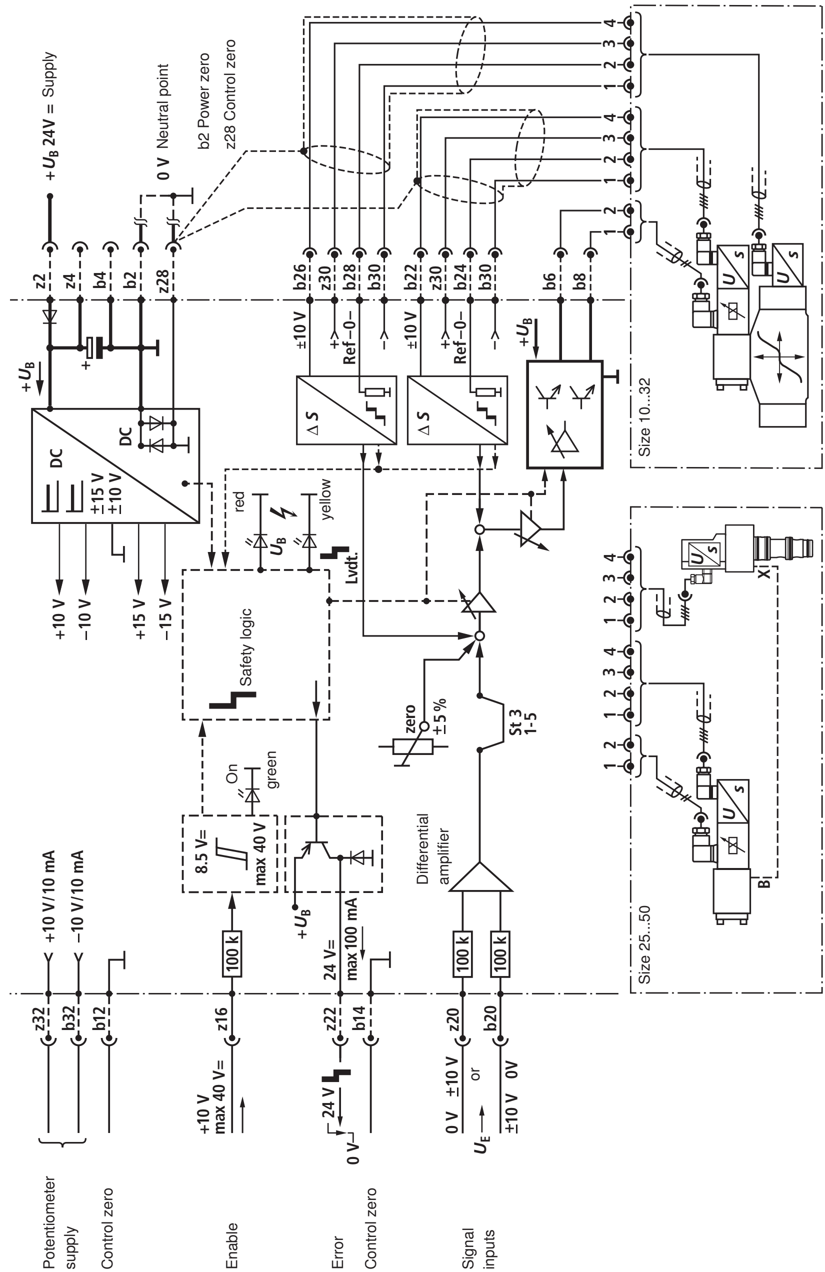
Suitable card holder:

– Open card holder VT 3002-1-2X/32F
  (see data sheet 29928).
  Only for control cabinet installation!

Front plate



Block diagram with pin assignment

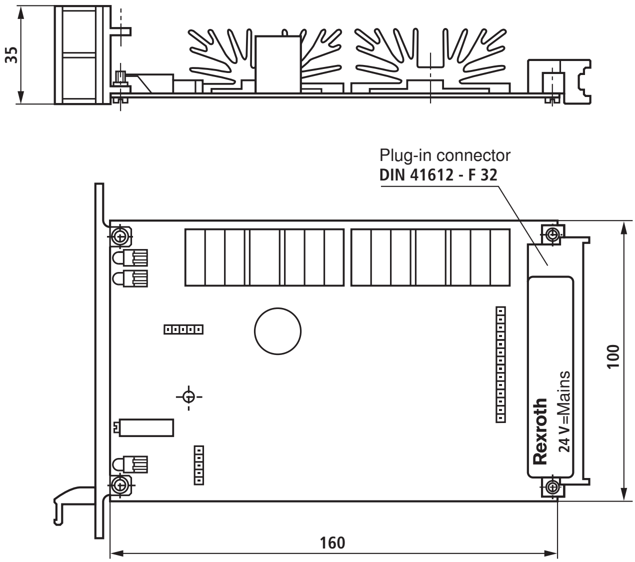


Technical data (For applications outside these parameters, please consult us!)

Supply voltage U_B at z2 – b2		Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)
Valve solenoid, max.	A/VA	**2.7/40 (pilot control valve size 6)**
Current consumption, max.	A	1.7
		The current consumption may increase with min. U_B and extreme cable length to the control solenoid
Power consumption (typical)	W	37
Input signal (command value)		b20: 0...±10 V } Differential amplifier z20: 0...±10 V } (R_i = 100 kΩ)
Signal source		Potentiometer 10 kΩ Supply with ±10 V from b32, z32 (10 mA) or external signal source
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ , LED (green) on front plate lights up
Position transducer	Supply	b30: –15 V z30: +15 V
Pilot control valve	Actual value signal	b22: 0...±10 V
	Actual value reference	b24
Main stage	Actual value signal	b26: 0...±10 V
	Actual value reference	b28
Solenoid output		Clocked current controller
b6 – b8	I_{max}	2.7 A
Cable lengths between amplifier and valve		Solenoid cable: to 20 m 1.5 mm² 20 to 60 m 2.5 mm² Position transducer: 4 x 0.5 mm² (shielded)
Special features		Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Short-circuit-proof outputs
Adjustment		Zero point via trimming potentiometer ±5 %
LED displays		green: Enable yellow: Cable break actual value red: Undervoltage (U_B too low)
Error message – Cable break actual value – U_B too low – ±15 V stabilization		z22: Open collector output to +U_B max. 100 mA; no error: +U_B
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE
Plug-in connection		Connector DIN 41612 – F32
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	m	0.36 kg

Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

Notes

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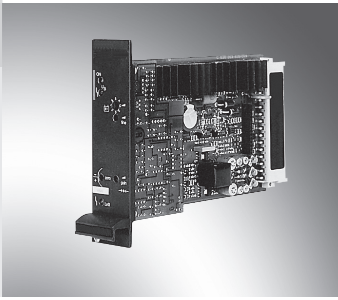
Rexroth
Bosch Group

Electric amplifiers

RE 30043/02.12 1/6
Replaces: 11.02

Type VT-VRRA1-527-2X/V0/K40-AGC-2STV



Component series 2X

Table of contents

Contents	Page

Features

- Suitable for controlling pilot operated directional control valves with inflected characteristic curve
- Linearization of inflected valve characteristic curves
- Area adjustment of single rod cylinders
- Analog amplifiers in Europe format for installation in 19" racks
- Controlled output stage
- Enable input
- Outputs short-circuit-proof
- Adjustment possibilities – Zero point valve
- Cable break detection for actual value cable
- Position control with PID behavior
- Gain in the small signal range

Notice:
The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	R	A	1	– 527	– 2X	/ V0	/ K40-AGC-2STV

Hydraulic component
For valves with electrical feedback **= R**

Valve type
Directional control valve **= R**

Control
Analog **= A**

Option
K40-AGC-2STV = Directional control valve, pilot operated, with 40 % inflection

Customer version
V0 = Catalog version

2X = Component series 20 to 29 (20 to 29: Unchanged technical data and pin assignment)

Serial number for types
527 = Pilot control valve size 6

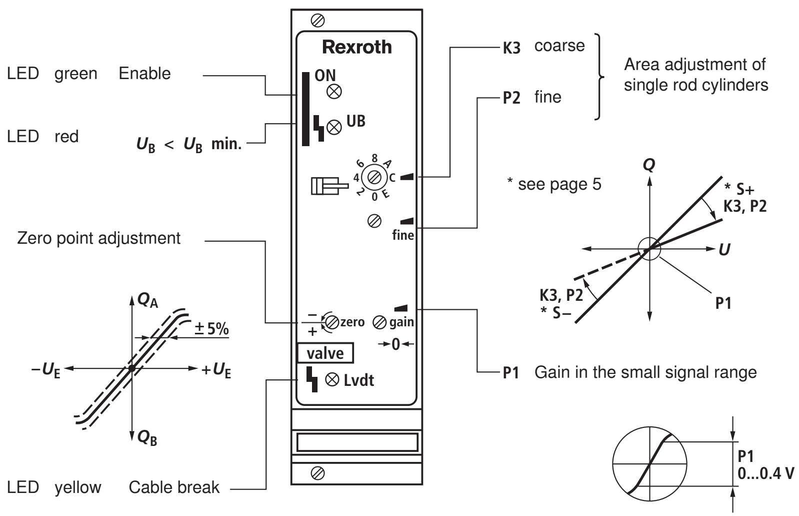
Preferred types

Amplifier type	Material number	For directional control valves, pilot operated, with electrical position feedback and inflected characteristic curve
VT-VRRA1-527-20/V0/K40-AGC-2STV	0811405068	4WRL 10...35 V/V1...P-3X...
		4WRL 10...25 V/V1...P-3X...-750

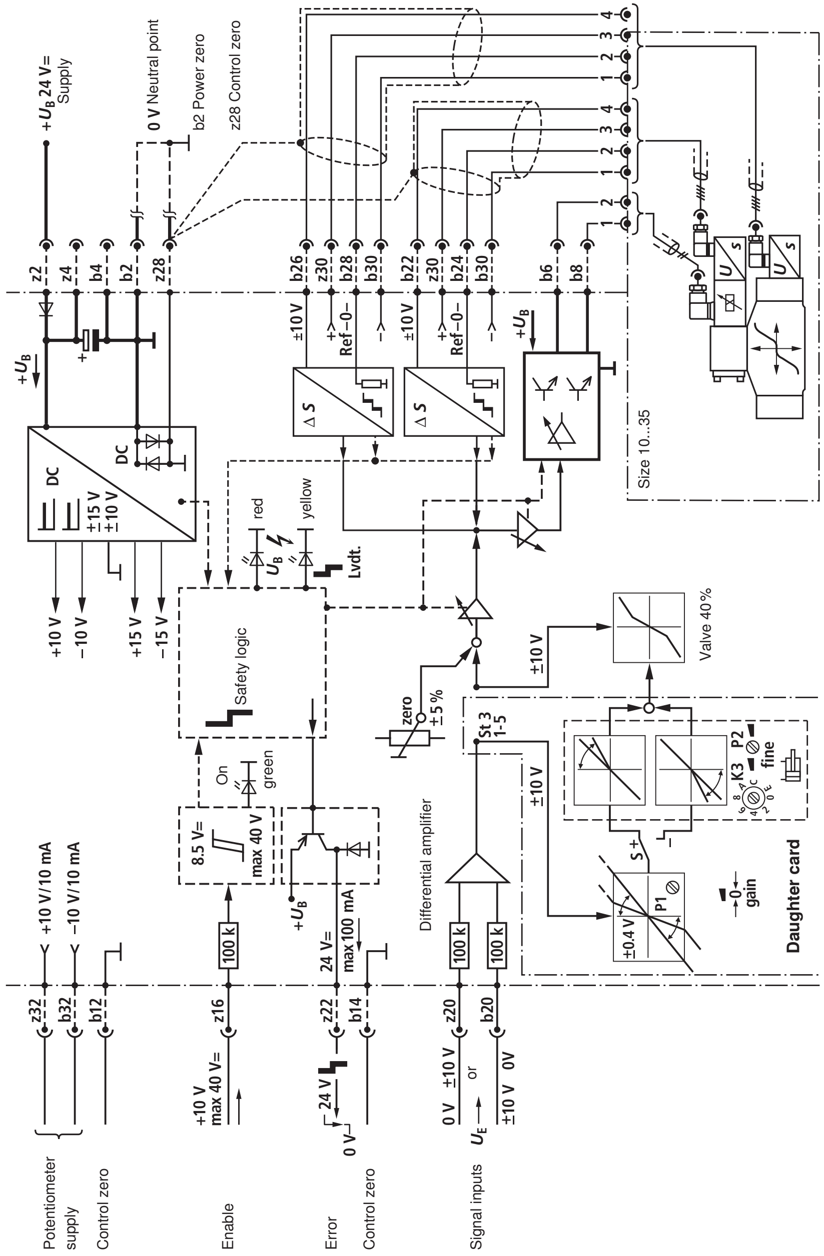
Suitable card holder:

– Open card holder VT 3002-1-2X/32F (see data sheet 29928). Only for control cabinet installation!

Front plate



Block diagram with pin assignment



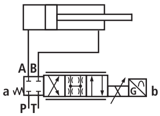
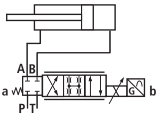
Technical data (For applications outside these parameters, please consult us!)

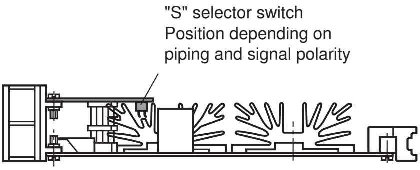
Supply voltage U_B at z2 – b2			Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor, separately at z2 – b2			Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10%)
Valve solenoid, max.		A/VA	**2.7/40 (pilot control valve size 6)**
Current consumption, max.		A	1.7 The current consumption may increase with min. U_B and extreme cable length to the control solenoid
Power consumption (typical)		W	37
Input signal (command value)			b20: 0...±10 V } Differential amplifier z20: 0...±10 V } (R_i = 100 kΩ)
Signal source			Potentiometer 10 kΩ Supply with ±10 V from b32, z32 (10 mA) or external signal source
Enable output stage			At z16, U = 8.5...40 V, R_i = 100 kΩ , LED (green) on front plate lights up
Position transducer	Supply		b30: –15 V z30: +15 V
Pilot control valve	Actual value signal		b22: 0...±10 V
	Actual value reference		b24
Main stage	Actual value signal		b26: 0...±10 V
	Actual value reference		b28
Solenoid output b6 – b8		I_{max}	Clocked current controller 2.7 A
Cable lengths between amplifier and valve			Solenoid cable: to 20 m 1.5 mm² 20 to 60 m 2.5 mm² Position transducer: 4 x 0.5 mm² (shielded)
Special features			Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Short-circuit-proof outputs, Linearization of the inflected flow characteristic curve
Adjustment			Zero point via trimming potentiometer ±5 % Area adjustment of single rod cylinders, Gain in the small signal range
LED displays			green: Enable yellow: Cable break actual value red: Undervoltage (U_B too low)
Error message – Cable break actual value – U_B too low – ±15 V stabilization			z22: Open collector output to +U_B max. 100 mA; no error: +U_B
Circuit board format		mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE
Plug-in connection			Connector DIN 41612 – F32
Ambient temperature		°C	0...+70
Storage temperature range		°C	–20...+70
Weight		m	0.39 kg

Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

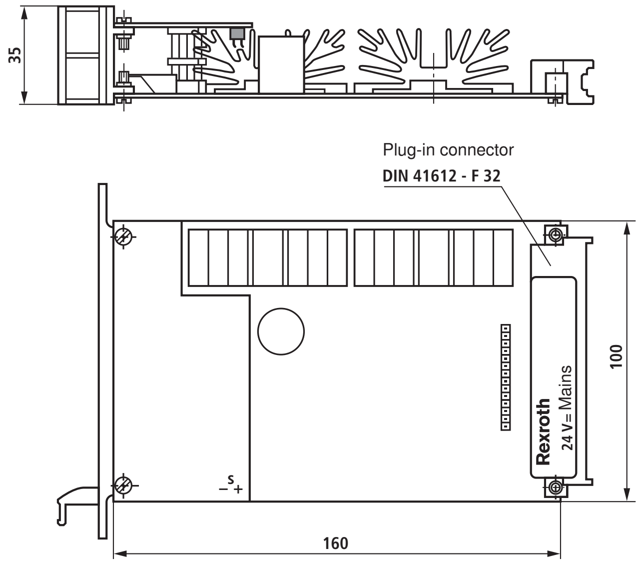
Commissioning

1. Setting the electric and hydraulic zero point using the "zero" potentiometer.
   With closed control loop, the following error displayed by the CNC is then controlled to 0.
2. Adjustment single rod cylinder
   – "S" selector switch setting on daughter card
   – Comparison with direction-dependant command value attenuator with step switch K3 (coarse), with potentiometer P2 (fine).
3. Optimization of the gain in the small signal range with potentiometer P1.

Valve ←→ Cylinder	Selector switch
	"S" –
	"S" +



Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

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Electric amplifiers

RE 30044/02.12 1/8
Replaces: 11.02

Type VT-VRPA1-527-2X/V0/RTS-2STV

Component series 2X

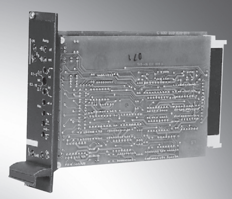


Table of contents

Contents **Page**

Features

– Suitable for controlling directional control valves, pilot operated, with positive overlap
– Amplifier with additional electronics (daughter card)
– Analog amplifiers in Europe format for installation in 19" racks
– Controlled output stage
– Enable input
– Outputs short-circuit-proof
– Adjustment possibilities – Zero point valve
– Cable break detection for actual value cable
– Position control with PID behavior
– Ramp function
  • External voltage-controlled ramp setting via differential inputs
  • Ramp function that can be switched off

Notice:

The photo shows an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	R	P	A	1	–527	–2X	/ V0	/ RTS-2STV

Hydraulic component
For valves with electrical feedback **= R**

Valve type
Directional control valve **= P**

Control
Analog **= A**

Option
RTS-2STV = Directional control valve, pilot operated
RTS = Ramp function

Customer version
V0 = Catalog version

2X = Component series 20 to 29
(20 to 29: Unchanged technical data and pin assignment)

Serial number for types
527 = Pilot control valve size 6

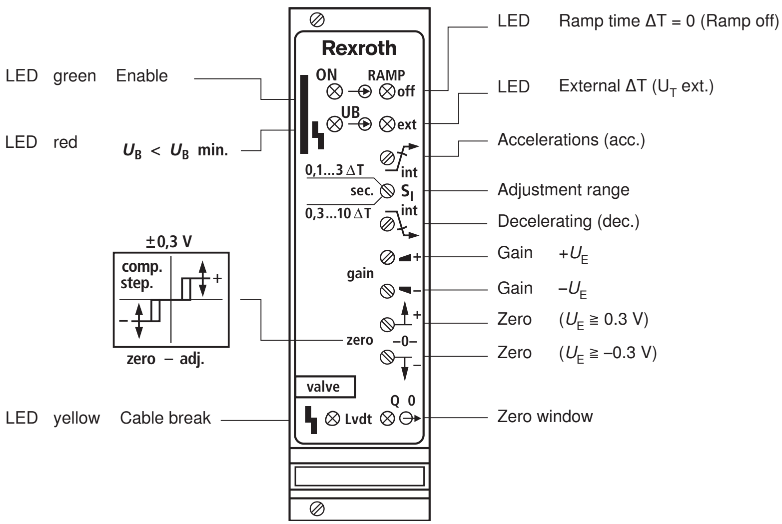
Preferred types

Amplifier type	Material number	For directional control valves, pilot operated, with electrical position feedback and positive overlap
VT-VRPA1-527-20/V0/RTS-2STV	0811405073	4WRL 10...35 E/W...-3X...

Suitable card holder:

– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



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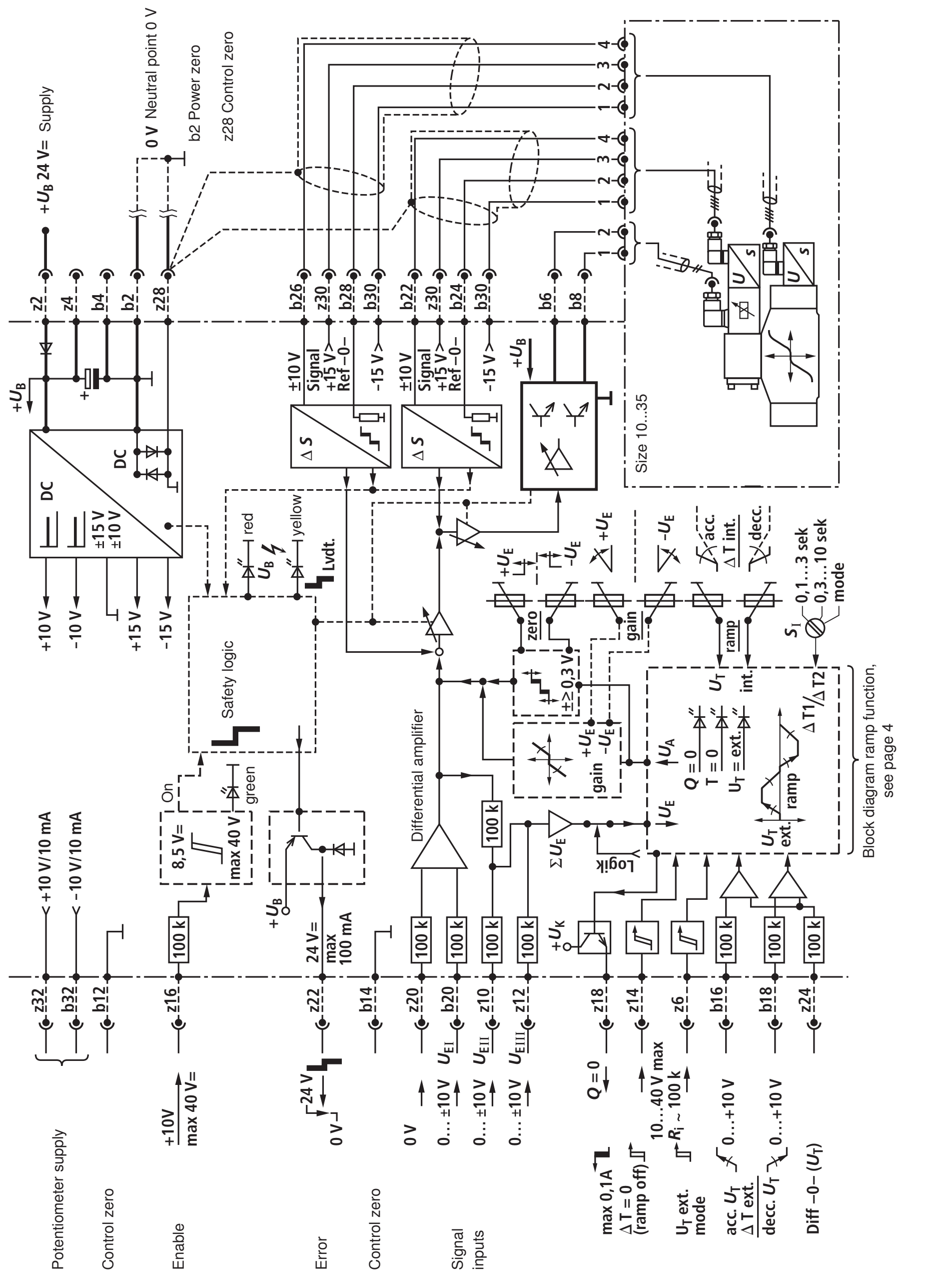
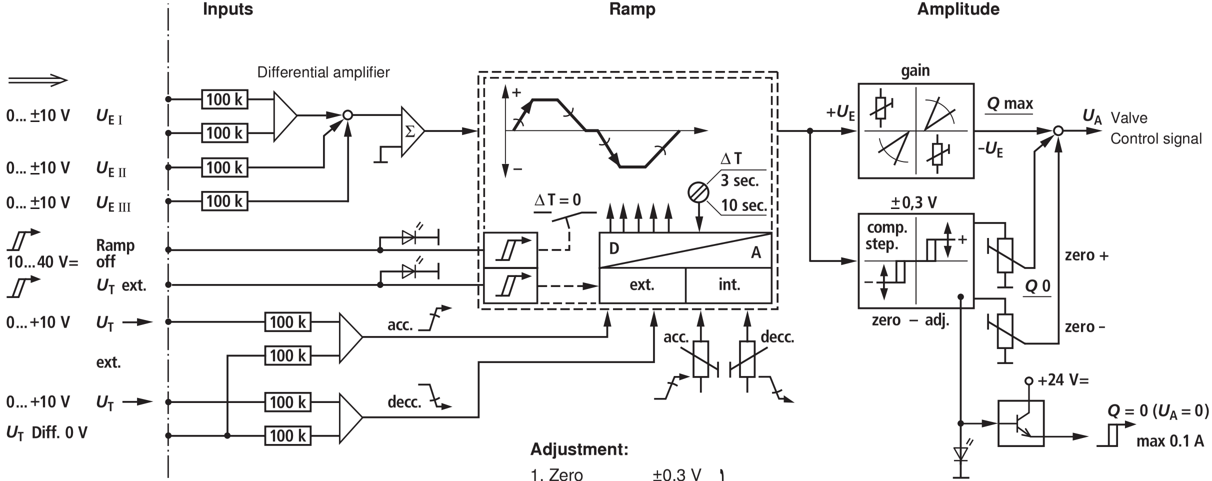
Block diagram with pin assignment



Block diagram ramp function



Adjustment:

1. Zero	±0.3 V	U_E
2. Max/gain	±10 V	
3. Ramp time	±10 V	

Functions of the daughter ramp card

- Three command value inputs
  $U_{E\,I}$ Differential input
  (b20 = 0...±10 V, z20 = 0 V)
- $U_{E\,II}$ } Referred to control zero (z10)
- $U_{E\,III}$ } With summing effect (z12)
- Selection of internal and external ramp time setting via control input $U_{Text.}$ (z6), LED display on front plate
- Ramp increase time can be set by means of switch at front plate in ΔT 0.1...3 sec. or ΔT 0.3...10 sec.
- Connection and shut-off of the ramp function via control input Ramp off (z14), LED display of operating mode on the front plate
- Internal ramp time setting via potentiometer on the front plate
  Acceleration – Deceleration
- External ramp time setting via voltage-controlled differential inputs U_T
  Acceleration (b16) – Deceleration (b18)
- Signal output "Ramp timeout“ in case of $U_E = 0$
  (z18; open collector output to $+U_A$)
  LED display on front plate
- Setting: Sensitivity
  Q_A/Q_B – Limitations in the range 100...50 % $Q_{max.}$
- Automatic quadrant recognition in the transmission of the valve from one quadrant to the other one – thus only one setting potentiometer and/or one control voltage for the ramp time specification for acceleration and deceleration each.

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

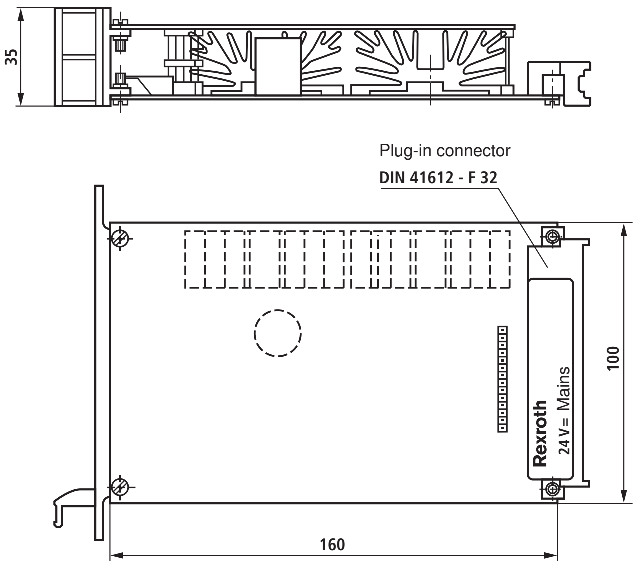
Supply voltage U_B at z2 – b2		Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)
Valve solenoid, max.	A/VA	**2.7/40 (pilot control valve size 6)**
Current consumption, max.	A	1.5 The current consumption may increase with min. U_B and extreme cable length to the control solenoid
Power consumption (typical)	W	37
Input signal (command value)		b20: 0...±10 V } Differential amplifier z20: 0...±10 V } (R_i = 100 kΩ)
Signal source		Potentiometer 10 kΩ Supply with ±10 V from b32, z32 (10 mA) or external signal source
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ , LED (green) on front plate lights up
Position transducer – Supply		b30: –15 V z30: +15 V
Pilot control valve – Actual value signal		b22: 0...±10 V
Pilot control valve – Actual value reference		b24
Main stage – Actual value signal		b26: 0...±10 V
Main stage – Actual value reference		b28
Solenoid output b6 – b8	I_{max}	Clocked current controller 2.7 A
Cable lengths between amplifier and valve		Solenoid cable: to 20 m 1.5 mm² 20 to 60 m 2.5 mm² Position transducer: 4 x 0.5 mm² (shielded)
Special features		Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Short-circuit-proof outputs
Adjustment		Zero point via trimming potentiometer ±5 %
LED displays		green: Enable yellow: Cable break actual value red: Undervoltage (U_B too low)
Error message – Cable break actual value – U_B too low – ±15 V stabilization		z22: Open collector output to +U_B max. 100 mA; no error: +U_B
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE
Plug-in connection		Connector DIN 41612 – F32
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	m	0.44 kg

Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

Setting information

1. Before setting the ramps "Acceleration/Deceleration", you must first of all align $Q = 0$ and $Q_{max.}$.
   For that purpose, the ramp function can be switched on or off.
2. Q 0 is to be set in case of 0 V = U_E.
   $Q_{max.}$ is to be set in case of ±10 V = U_E.
3. Zero point calibration: For the calibration, a small command value (U_E = 0.3...0.5 V) must be specified in order to ensure that the dead zone has been left.
4. Now, by means of command value changes 0 → 0+U_E and +U_E → 0, you can set the desired ramp behavior
   Prerequisite: **No command at z14.**

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

– The amplifier card may only be unplugged and plugged when de-energized.
– The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
– Do not lay solenoid and signal lines near power cables.
– For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
– The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
– The cable lengths and cross-sections specified on page 5 must be complied with.

Notes

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Electrical amplifiers for controlling high-response valves with servo-valve pilot control

RE 29931/12.10
Replaces: 05.10

Types VT-SR31 to VT-SR38

Component series 1X

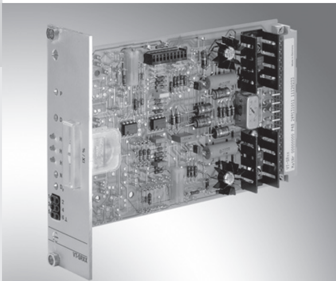

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Table of contents

Content	**Page**

Features

Amplifiers VT-SR31 to VT-SR38 are suitable for controlling high-response valves (flow control valves) with servo-valve pilot control and electrical position feedback (cartridge valves, type .WRC…1X).

- Regulator for valve current
- Controller for main spool position
- Dither signal generator
- Push-pull output stage
- Oscillator/demodulator
- Enable circuit with relay
- Measuring instrument for indicating the servo-valve current
- Reverse polarity protection for voltage supply

Optional extensions:

- PID-controller [1] with controller changeover feature
- Relay with isolated changeover contact (28 V / 0.5 A)
- Voltage regulator ±15 V for supplying the controller and position transducer electronics

[1] The D-component acts only on the actual value (velocity feedback).

Ordering code

VT–SR_ _–1X/ | | |

Amplifier for high-response valves (flow control valves) with servo-valve pilot control

Type .WRC 32…1X	**= 31**
Type .WRC 40…1X	**= 32**
Type .WRC 50…1X	**= 33**
Type .WRC 63…1X	**= 34**
Type .WRC 80…1X	**= 35**
Type .WRC 100…1X	**= 36**
Type .WRC 125…1X	**= 37**
Type .WRC 160…1X	**= 38**

F =	With fail-safe function [1]
No code =	Further details in clear text [2]
2 =	For valves with 2/2 directional function
3 =	For valves with 3/2 directional function
0 =	Without ±15 V voltage regulator
1 =	With ±15 V voltage regulator
1X =	Component series 10 to 19 (10 to 19: unchanged technical data and pinout)

Accessories (separate order)

Card holder

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

Power supply unit

– Type VT-NE31-1X, see data sheet 29929
  Compact power supply unit 115/230 VAC → ±24 VDC, 6 W

[1] only with 2WRC...1X SO56/ SO60, size 63 to 160 and 3WRC...1X SO56/ SO60, size 63 to 160

[2] E.g. with/without PID-controller, with/without backup relais K3

The controller data for the additional PID controller. must be specified

Function

Amplifiers VT-SR31 to VT-SR38 operate with a push-pull output stage with bipolar transistors. The output of this output stage can be cut in or out using an enable circuit (relay K2). The enable is indicated by illuminated LED "H2" on the front panel. The switching voltage of all relays is set to 0 V or $+U_B$ with jumpers J12 and J13 (factory setting: $+U_B$).

The output stage consists of an I-controller with connected dither signal generator. The amplitude of the dither signal is adjusted by means of R7. The pilot stage (current command value) is controlled using a PD-controller. The actual current value fed back is also signaled by the instrument on the front panel.

The oscillator/demodulator serves to acquire the spool position. It is designed as a plug-on printed-circuit board, the parameters of which are matched to the relevant valve type.

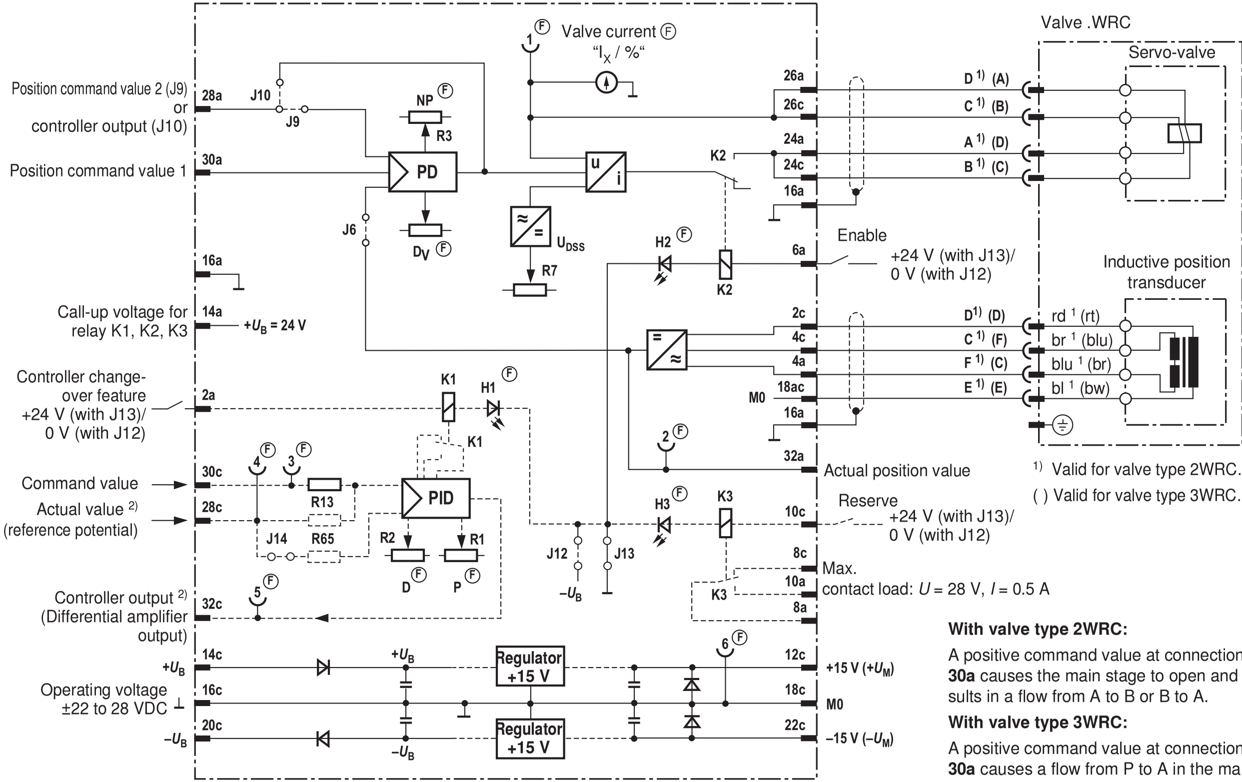
The position command value and the actual position value are fed to the PD-controller, with the D-component acting **exclusively** on the actual value (velocity feedback).

The zero point can be adjusted by means of R3 ("NP") on the front panel.

The required symmetrical operating voltage $\pm U_B$ is protected against polarity reversal. If the printed-circuit board does not contain a voltage regulator for the supply of controller and position transducer electronics, an additional, stabilized auxiliary voltage $\pm U_M$ must be provided. The auxiliary voltage connection is protected against polarity reversal up to a maximum current of 1 A.

Optionally, the amplifier can be fitted with a PID-controller (D-component acts **only** on the actual value) with change-over PI-component and a back-up relay with isolated change-over contact. This controller can also be used to superimpose a further closed control loop (e.g. for the closed-loop control of a drive). The P- and D-component can be adjusted on the front panel. The state of the controller is signaled by LED "H1", that of the relay by LED "H3" (LEDs are ON when the relays have picked up). The component placement of the PID-controller is customer-specific and must therefore be specified in clear text in the order. These amplifiers are assigned special type designations before being shipped. The back-up relay can be loaded up to 28 V and 0.5 A.

Block circuit diagram / pinout



1) Valid for valve type 2WRC…1X

( ) Valid for valve type 3WRC…1X

2) Without R13 and by placing J14 and R65 the controller input beomes a differential input.

Ⓕ = on front panel

With valve type 2WRC:

A positive command value at connection **30a** causes the main stage to open and results in a flow from A to B or B to A.

With valve type 3WRC:

A positive command value at connection **30a** causes a flow from P to A in the main stage.

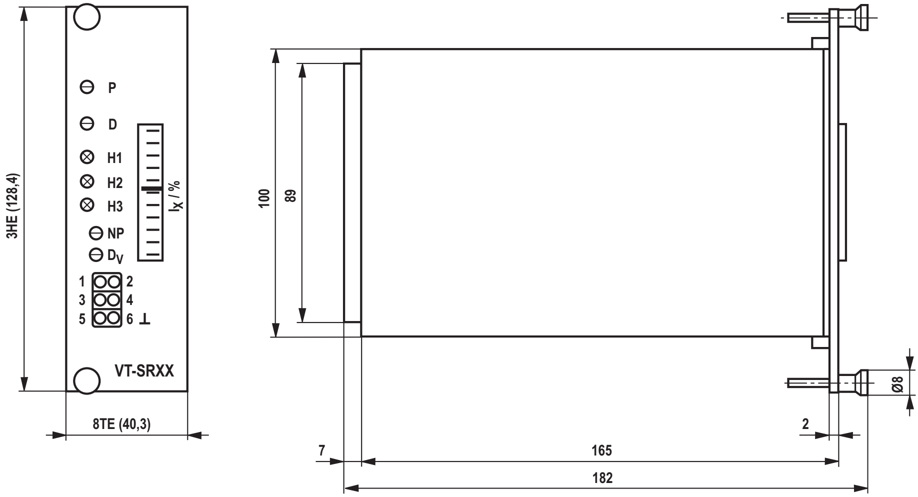
A negative command value at connection **30a** causes a flow from A to T in the main stage.

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

Operating voltages	**With** voltage regulator	U_B	±24 VDC
	Upper limit value	$u_B(t)_{max}$	±28 VDC
	Lower limit value	$u_B(t)_{min}$	±22 VDC
	Without voltage regulator	U_B; U_M	±24 VDC; ±15.0 VDC
	Upper limit values	$u_B(t)_{max}$; $u_M(t)_{max}$	±28 VDC; ±15.2 VDC
	Lower limit values	$u_B(t)_{min}$; $u_M(t)_{min}$	±22 VDC; ±14.8 VDC
Current consumption (without valve) at U_B= ±24 V [1]		I	< 150 mA
Inputs	Command value 1 (main spool position)	U_i	0 to ±10 V (R_i = 50 kΩ)
	Command value 2 (main spool position) with J9	U_i	0 to ±10 V (R_i = 50 kΩ)
	Actual value (main spool position)	U_i	0 to ±10 V (R_i = 50 kΩ)
	Enable	U_i	+24 V (with J13); 0 V (with J12), R_i = 700 Ω (relay circuit)
	Controller changeover feature	U_i	+24 V (with J13); 0 V (with J12), R_i = 700 Ω (relay circuit)
	Back-up relay	U_i	+24 V (with J13); 0 V (with J12), R_i = 700 Ω (relay circuit)
Outputs	Regulated output voltage [1]	U_M	±15 V ±2 %; 150 mA
	Valve current	I_{max}	±60 mA
	Valve current command value (with J10)	U_o	±10 V ≙ ±60 mA (measurement output at Pin 28a)
	Relay call-up voltage	U	+24 V (+U_B)
Dither signal		f	340 Hz ±5 % (I_{SS} = 3 mA)
Oscillator frequency		f	5 kHz
Relay data	Nominal voltage	U	+26 V
	Response voltage	U	> 13 V
	Release voltage	U	1.3 V to 6.5 V
	Switching time	t	< 4 ms
	Coil resistance (at 25 °C)	R	700 Ω
	Contact load	I	0.5 A
Type of connection			32-pin male connector, DIN 41612, form D
Card dimensions			Euro-card 100 x 160 mm, DIN 41494
Front panel dimensions	Height		3 HE (128.4 mm)
	Width soldering side		1 TE (5.08 mm)
	Width component side		7 TE
Permissible ambient temperature range		J	0 to +50 °C
Storage temperature range		J	–20 to +70 °C
Weight		m	0.3 kg

[1] Variant **with** voltage regulator

Unit dimensions (dimensions in mm)



Engineering / maintenance notes / supplementary information

- The amplifier card may only be plugged or withdrawn when disconnected from the power supply!
- Use only relays with gold-plated contacts for passing on command values (small voltages, small currents)!
- For switching card relays (enable, controller changeover, reserve) use only contacts with a load carrying capacity of ca. 40 V; 50 mA.
- Always shield command value cables; connect the shield to ground (⊥) on the card side and leave the other end open!
- Do not lay signal cables near power cables!
- Recommendation: 1. Shield also solenoid cables (connect one end to ⊥)!
  2. Up to 50 m length, use cable type LiYCY 1.5 mm^2 ; for greater lengths, please consult us!
- **Attention:** Relay K2 may only be switched off, when the servo-valve is adjusted by means of a trimming potentiometer to ensure that the main stage of the WRC valve brings the actuator to a safe end position!
  If the servo-valve is not appropriately adjusted, the position of the main stage control spool is not defined when relay K2 is switched off!

Note: Electrical signals (e.g. actual value) brought out via control electronics must not be used for switching safety-relevant machine functions!
(See also European standard “Safety requirements for fluid power systems and components - hydraulics“, EN 928.)

1

Notes

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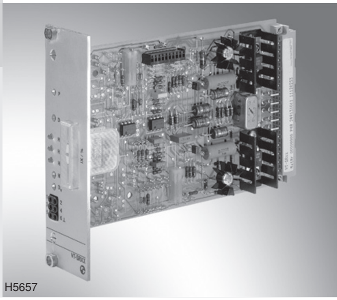
Electrical amplifiers for controlling high-response valves with servo-valve pilot control

RE 30209/03.08
Replaces: 07.04

Types VT-SR41 to VT-SR43

Component series 1X



H5657

Table of contents

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

Features

Amplifiers VT-SR41 to VT-SR43 are suitable for controlling high-response valves (flow control valves) with servo-valve pilot control and electrical position feedback (cartridge valves, type .WRC…2X).

- Regulator for valve current
- Controller for main spool position
- Dither signal generator
- Push-pull output stage
- Oscillator/demodulator
- Enable circuit with relay
- Measuring instrument for indication of the servo-valve current
- Reverse polarity protection for voltage supply

Optional extensions:

- PID-controller [1] with controller changeover feature
- Relay with isolated changeover contact (28 V / 2 A)
- Voltage regulator ±15 V for supplying the controller and position transducer electronics

[1] The D-component acts only on the actual value (velocity feedback).

Ordering code

VT–SR _ _–1X / – | *

Amplifier for high-response valves (flow control valves) with servo-valve pilot control

Type .WRC 32…2X	**= 41**
Type .WRC 40…2X	**= 42**
Type .WRC 50…2X	**= 43**
Component series 10 to 19 (10 to 19: unchanged technical data and pinout)	**= 1X**
0 = Without ±15 V voltage regulator	
1 = With ±15 V voltage regulator	
2 = For valves with 2/2 directional function	
3 = For valves with 3/2 directional function	
Further details in clear text [1]	

[1] E.g. with/without PID-controller, with/without back-up relay K3

Controller data must be specified for the additional PID-controller.

Accessories (separate order)

Card holder

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

Power supply unit

– Type VT-NE31-1X, see RE 29929
  Compact power supply unit 115/230 VAC → ±24 VDC, 7 VA

Function

Amplifiers VT-SR41 to VT-SR43 operate with a push-pull output stage with bipolar transistors. The output of this output stage can be cut in and out with an enable circuit (relay K2). The enable is signaled by LED “H2“ on the front panel. The switching voltage of all relays is set to 0 V or $+U_B$ by means of jumpers J12 and J13 (factory setting: $+U_B$).

The output stage consists of an I-controller with connected dither signal generator. The amplitude of the dither signal can be adjusted by means of R7. The pilot stage (current command value) is controlled via a PD-controller. The actual value fed back is indicated by the instrument on the front panel.

The oscillator/demodulator serves to acquire the spool position. It is designed as a plug-on printed-circuit board, the parameters of which are adapted to the relevant valve type.

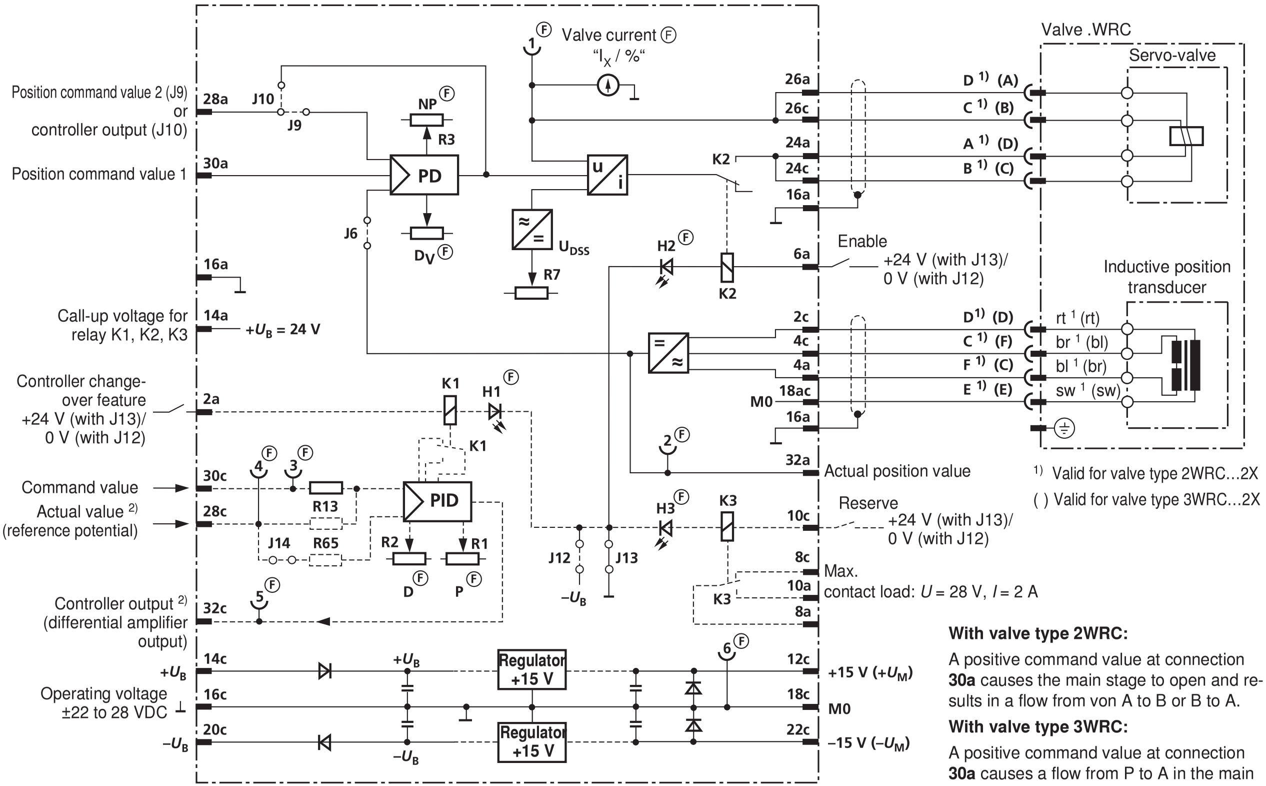
The PD-controller receives the position command value and the actual position value, with the D-component being effective **exclusively** on the actual value (velocity feedback).

The zero point can be adjusted by means of R3 (“NP“) on the front panel.

The required symmetrical operating voltage $\pm U_B$ is protected against polarity reversal. If the printed-circuit board does not include a voltage regulator for supplying the controller and the position transducer electronics, an additional, stabilized auxiliary voltage $\pm U_M$ must be made available. The auxiliary voltage connection is protected against polarity reversal up to a maximum current of 1 A.

Optionally, the amplifier can be fitted with a PID-controller (D-component acts **only** on the actual value) with PI-component that can be changed over and a back-up relay with isolated changeover contact. This controller can be used for superimposing a further control loop (e.g. for closed-loop drive control). The P- and D-component can be adjusted on the front panel. The state of the controller is signaled by LED “H1“, that of the relay by LED “H3“ (LEDs are ON when the relays have picked up). The component placement of the PID-controller is customer-specific and must therefore be specified in clear text in the order. A special type designation is assigned to these amplifiers before shipment. The back-up relay can be loaded up to 28 V and 2 A.

Block circuit diagram / pinout



2) Without R13 and by placing J14 and R65 the controller input beomes a differential input.

Ⓕ = on front panel

With valve type 2WRC:

A positive command value at connection **30a** causes the main stage to open and results in a flow from von A to B or B to A.

With valve type 3WRC:

A positive command value at connection **30a** causes a flow from P to A in the main stage.

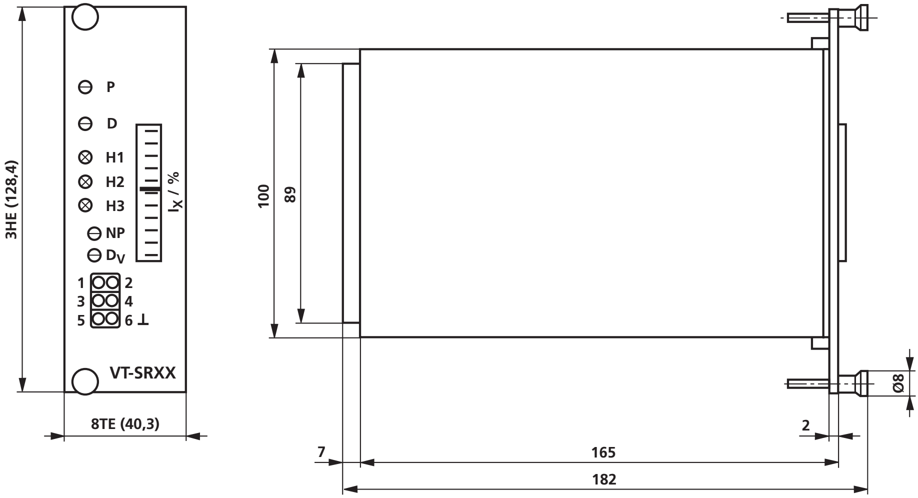
A negative command value at connection **30a** causes a flow from A to T in the main stage.

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

Operating voltages:	With voltage regulator	U_B	±24 VDC
	Upper limit value	$u_B(t)_{max}$	±28 VDC
	Lower limit value	$u_B(t)_{min}$	±22 VDC
	Without voltage regulator	U_B; U_M	±24 VDC; ±15.0 VDC
	Upper limit values	$u_B(t)_{max}$; $u_M(t)_{max}$	±28 VDC; ±15.2 VDC
	Lower limit values	$u_B(t)_{min}$; $u_M(t)_{min}$	±22 VDC; ±14.8 VDC
Current consumption (without valve) at U_B= ±24 V [1]		I	< 150 mA
Inputs:	Command value 1 (main spool position)	U_i	0 to ±10 V (R_i = 50 kΩ)
	Command value 2 (main spool position) with J9	U_i	0 to ±10 V (R_i = 50 kΩ)
	Actual value (main spool position)	U_i	0 to ±10 V (R_i = 50 kΩ)
	Enable	U_i	+24 V (with J13); 0 V (with J12), R_i = 700 Ω (relay circuit)
	Controller changeover feature	U_i	+24 V (with J13); 0 V (with J12), R_i = 700 Ω (relay circuit)
	Back-up relay	U_i	+24 V (with J13); 0 V (with J12), R_i = 700 Ω (relay circuit)
Outputs:	Regulated output voltage [1]	U_M	±15 V ±2 %; 150 mA
	Valve current	I_{max}	±60 mA / ±100 mA (depending on valve size)
	Valve current command value (with J10)	U_o	–10 V ≙ +60 mA / +100 mA (measurement output)
	Relay call-up voltage	U	+24 V (+U_B)
Dither signal		f	380 Hz ±5 % (I_{SS} = 0.42 mA)
Oscillator frequency		f	5 kHz
Relay data:	Nominal voltage	U	+26 V
	Response voltage	U	> 13 V
	Release voltage	U	1.3 V to 6.5 V
	Switching time	t	< 4 ms
	Coil resistance (at 25 °C)	R	700 Ω
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)
	With component side		7 TE
Permissible ambient temperature range		J	0 to +50 °C
Storage temperature range		J	–20 to +70 °C
Weight		m	0.3 kg

[1] Variant **with** voltage regulator

Unit dimensions (dimensions in mm)



Engineering / maintenance notes / supplementary information

- The amplifier card may only be plugged or withdrawn when disconnected from the power supply!
- Use only relays with gold-plated contacts for passing on command values (small voltages, small currents)!
- For switching card relays (enable, controller changeover, reserve) use only contacts with a load carrying capacity of ca. 40 V; 50 mA.
- Always shield command and actual value cables; connect the shield to ground (⊥) on the card side and leave the other end open!
- Do not lay signal cables near power cables!
- Recommendation: 1. Shield also solenoid cables (connect one end to ⊥)!
  2. Up to 50 m length, use cable type LiYCY 1.5 mm^2 ; for greater lengths, please consult us!
- **Attention:** Relay K2 may only be switched off, when the servo-valve is adjusted by means of a trimming potentiometer to ensure that the main stage of the WRC valve brings the actuator to a safe end position!
  If the servo-valve is not appropriately adjusted, the position of the main stage control spool is not defined when relay K2 is switched off!

Note: Electrical signals (e.g. actual value) brought out via control electronics must not be used for switching safety-relevant machine functions!
(See also European standard “Safety requirements for fluid power systems and components - hydraulics“, EN 928.)

Notes

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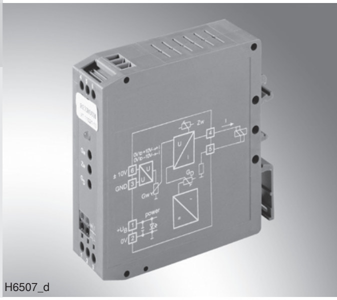
Analog amplifier module

RE 29743/07.10 1/4
Replaces: 06.05

Type VT 11021

Component series 1X



H6507_d

Table of contents

Features

- Suitable for controlling servo-valves with mechanical feed-back, type 4WS2EM… (sizes 6 and 10)
- Differential input ±10 V
- Dither signal generator
- U/I transformer (short-circuit-proof against 0 V)
- DC/DC converter
- Reverse voltage protection
- Signalling of internal supply voltage by LED

Ordering code

VT 11021 – 1X / *

Amplifier module for servo-valves without electrical position feedback;
types 4WS2EM 6 and 4WS2EM 10

Component series 10 to 19 **= 1X**
(10 to19: unchanged technical data and pin assignment)

Further details in clear text

Functional description

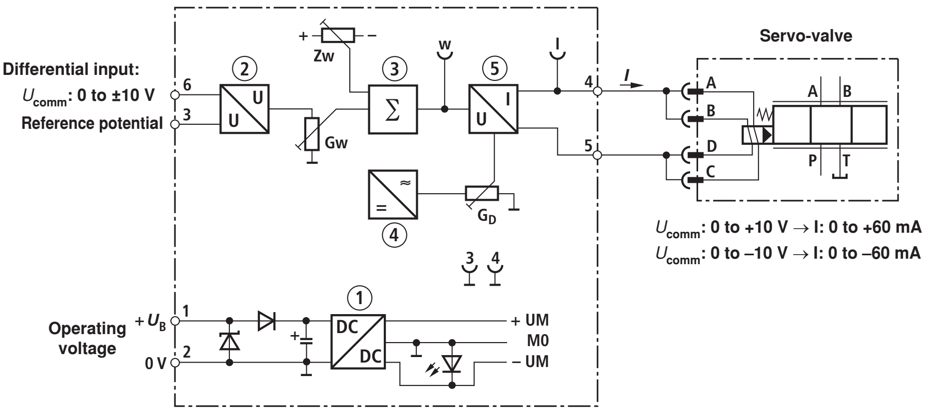
The amplifier module is to be snapped onto a hat rails according to EN 60715. It is electrically connected by means of screw terminals. The module is powered by 24V DC voltage.

The ±10 V command value is applied to the differential input. The output current of the downstream U/I transformer controls the servo-valve.

The following parameters can be adjusted externally using trimming potentiometers Gw, Zw and G_D:

- The max. output current between approx. 10 and 110 % by means of “Gw“
- The offset current between +10 % and –10 % of the max. output current by means of “Zw”
- The amplitude of the dither signals between 0 and 10 % of the maximum output current by means of “G_D“

Block circuit diagram / pin assignment



1	Power supply unit	**Gw**	Max. output current
2	Differential amplifier	**Zw**	Offset current
3	Summator	**G_D**	Amplitude of dither signal
4	Dither signal generator		
5	U/I transformer		

1

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

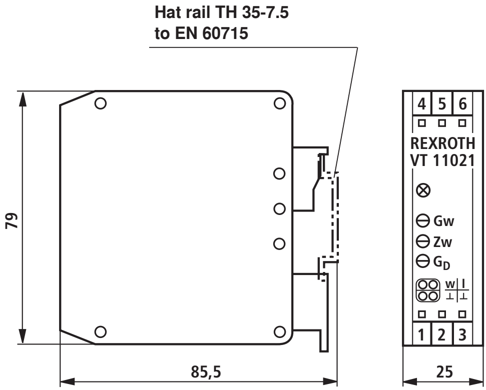
Operating voltage	U_O	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_O(t)_{max}$	35 V
– Lower limit value	$u_O(t)_{min}$	21 V
Current consumption (without valve) at U_O = ±24 V	I_{max}	300 mA
Power consumption	P_S	approx. 8 VA
Fuse		Thermal overload fuse (with reactive function when temperature falls below the threshold)
Inputs:		
– Command value	U_{comm}	0 to ±10 V ($R_e \geq$ 20 kΩ)
Outputs:		
– Valve current	I_{max}	±60 mA +10 %
– Measuring sockets		
• Current command value “w“	U_w	0 to ±10 V
• Actual current value “I“	U_{act}	0 to ±600 mV (10 mV ≙ 1 mA)
Dither signal:		
– Frequency	f	340 Hz ±10 %
– Amplitude	I_{SS}	0 to 6 mA (factory setting 3 mA)
Type of connection		6 screw terminals
Type of mounting		Hat rail TH35-7.5 according to EN 60715
Type of protection		IP 20 to EN 60529
Dimensions (W x H x D)		25 x 79 x 85.5 mm
Permissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight	m	0.13 kg

Terminal assignment

Operating voltage	$+U_O$	1	4	Servo-valve	Connection A, B
	0 V	2	5	Servo-valve	Connection C, D
	Reference potential	3	6	$\pm U_{comm}$	

Terminals 3 and 6: Differential input

Unit dimensions



Adjustment / indicator element	Factory setting
Potentiometers:	
Gw → max. output current	60 mA (100 %)
Zw → offset current	0 mA
G_D → amplitude of dither signal	3 mA
LED indicator lamp:	
green → internal supply voltage	
Measuring sockets:	
w → current command value (10 V ≙ 100 %)	
I → actual current value (10 mV ≙ 1 mA)	
⊥ → measuring zero	

Engineering / maintenance notes / supplementary information

- The amplifier module may only be wired when disconnected from the power supply!
- The distance to radio equipment must be sufficiently large (>> 1m)!
- Shield command value cables; do **not** lay them near power cables!
- Do not use free-wheeling diodes in the solenoid cables!
- In the case of a strong fluctuations in the operating voltage, it may become necessary to install an external smoothing capacitor having a capacitance of at least 2200 μF.
  Recommendation: Capacitor module VT 11110 (see RE 30750); sufficient for up to 3 amplifier modules

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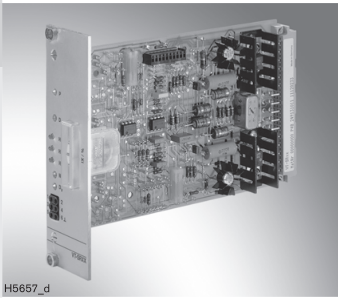
Electrical amplifier for the control of servo valves with electrical position feedback

RE 29979/07.05
Replaces: 11.02

Type VT-SR1

Series 1X



H5657_d

Table of contents

Contents	**Page**

Features

The amplifier VT-SR1 is suitable for the control of 2-stage servo valves with electrical position feedback (type 4WS2EE …).

- Valve current controller
- Main spool position controller
- Dither signal generator
- Inverse pulsed output stage
- Oscillator/demodulator
- Enable circuit using relays
- Measuring instrument for displaying the servo valve current
- Polarity protection for the supply voltage

Optional accessories:

- PID controller [1] with controller switching
- Relay with a potential free 2-way contact (28 V / 2 A)
- Voltage controller ±15 V for the controller and position transducer electronics

[1] The D component only acts on the actual value (velocity feedback).

Ordering code

VT – SR1 – 1X / [ ] [ ] *

Amplifier for servo valves with electrical position feedback; type 4WS2EE (all nominal sizes)

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

0 = Without ±15 V voltage controller
1 = With ±15 V voltage controller

Valve type code

Further details in clear text [2)]

2) E.g. With/without PID controller, with/without reserve relay K3
For the additional PID controller, the controller technical data must be stated.

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

Suitable power supply:
- Type VT-NE31-1X, see RE 29929
  Compact power supply unit 115/230 VAC → ±24 VDC, 7 VA

Function

The amplifier VT-SR1 operates using an inverted pulse output stage with bipolar transistors. The output from this output stage may be switched on and off by means of an enable circuit (relay K2). The enable is indicated by the lighting up of LED „H2“ on the front plate. The switching voltage for all relays is set to either 0 V or $+U_B$ using jumpers J12 and J13 (works setting $+U_B$).

The output stage comprises of an I controller with connected dither signal generator. The amplitude of the dither signal is set using R7. A PD controller is used to control the pilot stage (command value current). The actual value current feedback is displayed at the same time by the instrument on the front plate.

The oscillator/demodulator is used to determine the spool position. It is designed as a plug-in card. The parameters of which are matched to the corresponding valve type.

The command value position and the actual value position are fed to the PD controller. The D component **only** effects the actual value (velocity feedback).

The zero point may be set on the front plate by means of R3 (“NP”).

The necessary symmetrical operating voltage $\pm U_B$ is protected against reverse polarity. If the card does not include a voltage controller to supply the closed loop controller and position transducer electronics, then an additional stabilised auxiliary voltage $\pm U_M$ must be available. The auxiliary voltage connection is protected against reverse polarity up to a maximum current of 1 A.

The amplifier may be optionally equiped with a PID controller (the D component **only** effects the actual value signal) with selectable PI component and a reserve relay with a potential free 2-way switch. Using this controller, an additional closed loop control circuit (e.g. for a closed loop drive control) may be superimposed. The P and D components may be set on the front plate. The switched status of the controller is displayed by LED “H1” and the relay by LED “H3” (the LED‘s lights up when the relay is closed). The PID controller is set up in accordance with the customer specifications and hence must be stated in clear text on the order. These amplifiers are allocated a special type code on delivery. The reserve relay may be loaded up to 28 V and 2 A.

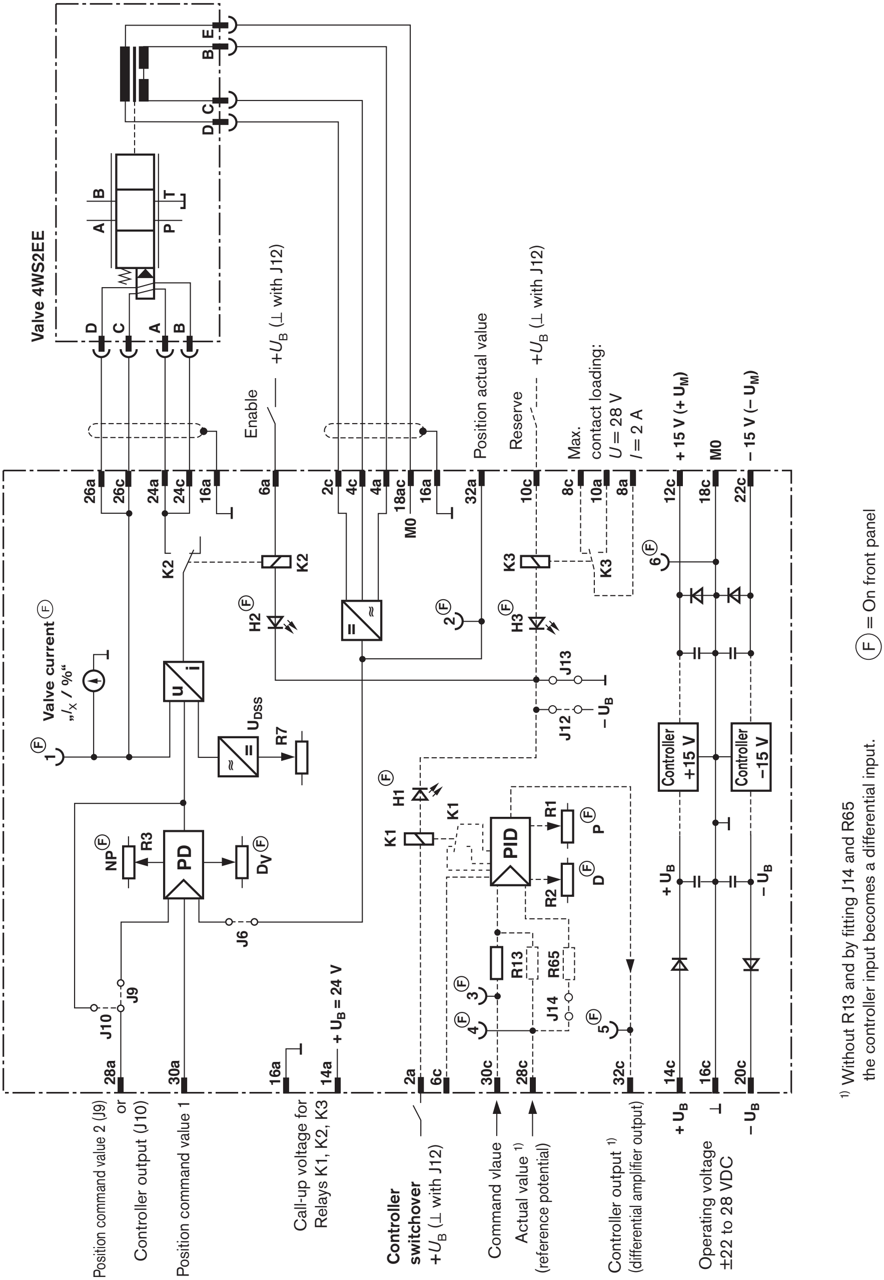
1

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

Operating voltages:		
With voltage controller	U_B	±24 VDC
– Upper limiting value	$u_B(t)_{max}$	±28 VDC
– Lower limiting value	$u_B(t)_{min}$	±22 VDC
Without voltage controller	U_B; U_M	±24 VDC; ±15.0 VDC
– Upper limiting value	$u_B(t)_{max}$; $u_M(t)_{max}$	±28 VDC; ±15.2 VDC
– Lower limiting value	$u_B(t)_{min}$; $u_M(t)_{min}$	±22 VDC; ±14.8 VDC
Current consumption (without valve) at $U_B = ±24$ V [1]	I	< 150 mA
Inputs:		
– Command value 1 (main spool position)	U_e	0 to ±10 V ($R_e = 50$ kΩ)
– Command value 2 (main spool position) with J9	U_e	0 to ±10 V ($R_e = 50$ kΩ)
– Actual value (main spool position)	U_e	0 to ±10 V ($R_e = 50$ kΩ)
– Enable	U_e	+24 V with J13; 0 V with J12 ($R_e = 700$ Ω; relay circuit)
– Controller switching	U_e	+24 V with J13; 0 V with J12 ($R_e = 700$ Ω; relay circuit)
– Reserve relay	U_e	+24 V with J13; 0 V with J12 ($R_e = 700$ Ω; relay circuit)
Outputs:		
– Stabilised output voltage [1]	U_M	±15 V ±2 %; 150 mA
– Valve current	I_{max}	±60 mA
– Command value valve current (with J10)	U_a	–10 V $\triangleq$ +60 mA (measuring output)
– Relay selection voltage	U	+24 V (+U_B)
Dither signal	f	340 Hz ±5 % ($I_{SS} = 3$ mA)
Oscillator frequency	f	2.5 kHz / 5 kHz (dependent on the valve type)
Relay data:		
– Nominal voltage	U	+26 V
– Response voltage	U	> 13 V
– Release voltage	U	1.3 V to 6.5 V
– Switching time	t	< 4 ms
– Coil resistance (at 25 °C)	R	700 Ω
Connection type		32-pin blade 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, conductor side		1 TE (5.08 mm)
– Width, component side		7 TE
Permissible ambient temperature range	J	0 to +50 °C
Storage temperature range	J	–20 to +70 °C
Weight	m	0.3 kg

[1] In version **with** voltage controller

Block circuit diagram / connection allocation

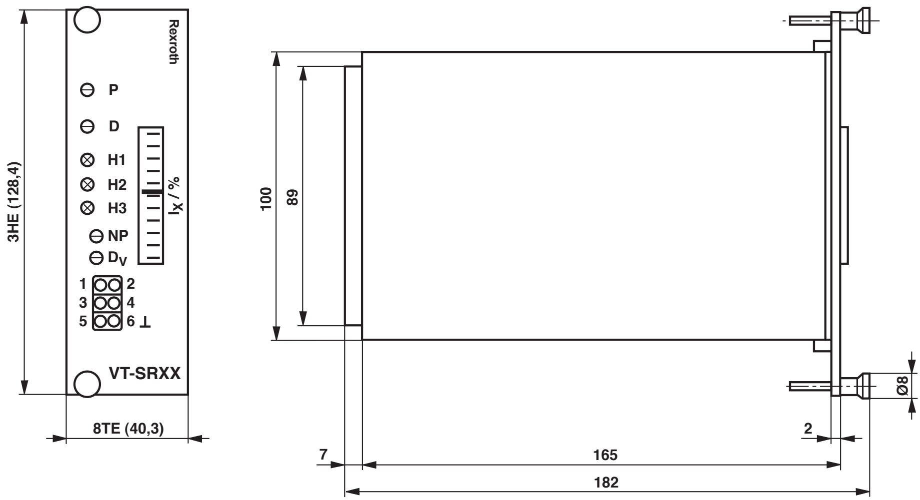


Engineering / maintenance guidelines / additional information

– The amplifier card must only be removed or inserted when de-energised!
– Command value signals must only be switched using relays with gold plated contacts (small voltages, small currents)!
– Only use contacts with a loadability of approx. 40 V; 50 mA for switching card relays (enable, controller switching, reserve).
– Always screen the command and actual value cables; leave one end of the screen open, connect on the card side to ground (⊥)!
– Do not lay signal cables in the vicinity of power cables!
– Recommendations: 1. Also screen the solenoid cables (connect one end to ⊥)!
2. Use cable type LiYCY 1.5 mm^2 for lengths up to 50 m long. Longer lengths on request!

Note: Electrical signals (e.g. actual value) taken via valve electronics must not be used to switch off the machine safety functions!
(This is in accordance with the regulations to the European standard “Safety requirements of fluid technology systems and components - hydraulics”, prEN 982.)

Unit dimensions (dimensions in mm)



Notes

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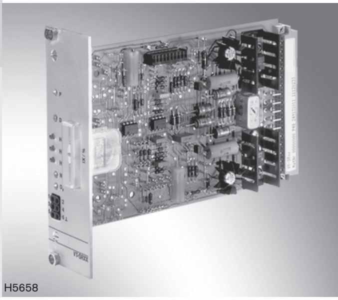
Rexroth
Bosch Group

Analogue amplifier

RE 29980/09.05
Replaces: 02.03

Type VT-SR2

Series 1X



H5658

Table of contents

Contents	Page

Features

- Suitable for controlling single and two-stage servo-valves without electrical position feedback (types 4WS2EM 6, 4WS2EM 10., 4WS2EM 16., 4WS2EB 10., 4DS1EO 2 and 3DS2EH 10)
- Regulator for valve current
- Dither signal generator
- Push-pull output stage
- Enable circuit with relay
- Measuring instrument for displaying servo-valve current
- Reverse polarity protection for voltage supply
- Optional extensions:
  • PID-controller[1] with controller changeover
  • Relay with potential-free changeover contact (28 V / 2 A)
  • Voltage regulator ±15 V for supplying the closed-loop control electronics

[1] The D-components act on the actual value only.

Suitable Card holders:

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

Suitable Power supply unit:

- Type VT-NE31-1X, see RE 29929
  Compact power supply unit 115/230 VAC → ±24 VDC, 7 VA

Ordering code

VT-SR2 – 1X / – *

Amplifier for servo-valves without electrical position feedback; types 4WS2EM 6, 4WS2EM 10., 4WS2EM 16., 4WS2EB 10., 4DS1EO 2 and 3DS2EH 10

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

Without voltage regulator ±15 V **= 0**
With voltage regulator ±15 V **= 1**

Valve current:
60 = ±60 mA
100 = ±100 mA

Further details in clear text

Functional description

VT-SR2 amplifiers operate with a push-pull output stage with bipolar transistors. The output of this output stage can be activated or deactivated using an enable circuit (relay K2). The enable is indicated by lighting up of the LED “H2“ on the front panel. The switching voltage of all relays is set to either 0 V or $+U_O$ (factory setting $+U_o$) by means of jumpers J12 and J13.

The output stage consists of an I-controller with connected dither signal generator. The amplitude of the dither signal can be adjusted using R7. The input stage (current command value) is controlled by a PD-controller. The actual current value fed back is indicated on an instrument on the front panel.

The position command value is fed to the PD-controller, with the D-component acting **only** on input 3.

The valve zero point can be adjusted from the front panel using R3 (“NP”).

The required symmetric operating voltage $\pm U_O$ is protected against reverse polarity. For the version **without voltage regulator**, an **additional stabilised auxiliary voltage** ($\pm U_M$) must be provided to supply the controller electronics. The auxiliary voltage connection is protected against reverse polarity up to a maximum current of 1 A.

Optionally, the amplifier can be fitted with a PID-controller (D-component acts **only** on the actual value), with the PI-component being able to be changed over, and a reserve relay with potential-free changeover contact. This controller can be used to superimpose a further closed control loop (e.g. for drive control). The P- and D-component can be adjusted on the front panel. The control state of the controller is signalled by LED “H1”, that of the relay by LED “H3” (LEDs light up when relays are picked up). The PID-controller configuration is customised and must therefore be indicated in clear text on the order. When dispatched, a special type designation is assigned to the amplifier. The reserve relay may be loaded up to 28 V and 2 A.

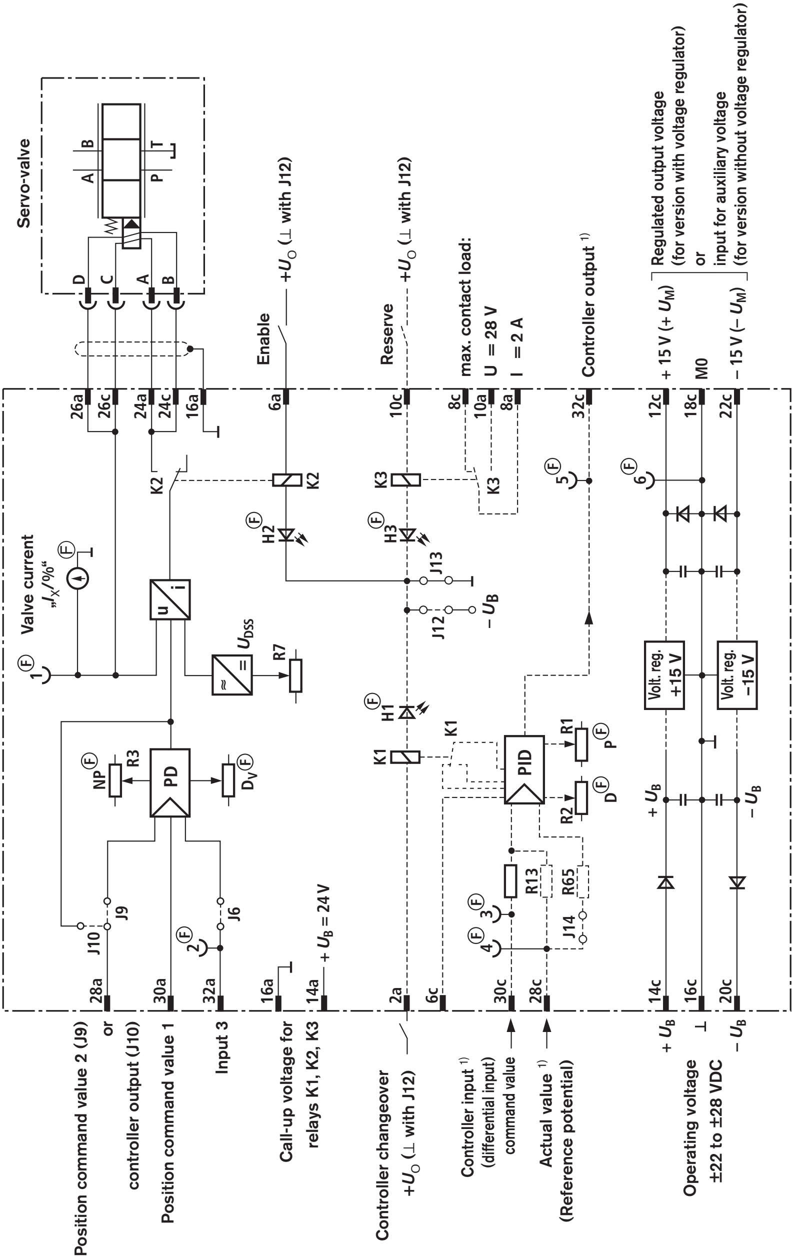
1

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

Operating voltages		
With voltage regulator	U_B	±24 VDC
– Upper limit value	$u_O(t)_{max}$	±28 VDC
– Lower limit value	$u_O(t)_{min}$	±22 VDC
Without voltage regulator (operating and auxiliary voltage)	U_O U_M	±24 VDC ±15.0 VDC
– Upper limit values	$u_O(t)_{max}$ $u_M(t)_{max}$	±28 VDC ±15.2 VDC
– Lower limit values	$u_O(t)_{min}$ $u_M(t)_{min}$	±22 VDC ±14.8 VDC
Power consumption (without valve) at U_O= ±24 V [1)]	I	<150 mA
Inputs		
– Command value 1 (main spool position)	U_e	0 to ±10 V (R_i = 50 kΩ)
– Command value 2 (main spool position) with J9	U_e	0 to ±10 V (R_i = 50 kΩ)
– Enable	U_e	+24 V with J13 0 V with J12 (R_i = 700 Ω, relay circuit)
– Changeover of controller	U_e	+24 V with J13 0 V with J12 (R_i = 700 Ω, relay circuit)
– Reserve relay	U_e	+24 V with J13 0 V with J12 (R_i = 700 Ω, relay circuit)
Outputs		
– Regulated output voltage [1)]	U_M	±15 V ±2 %, 150 mA
– Valve current	I_{max}	±60 mA / ±100 mA
– Valve current command value (with J10)	U_a	−10 V +60 mA / +100 mA (measurement output)
– Relay call-up voltage	U	+24 V (+U_O)
Dither signal	f	340 Hz ±5 % (I_{SS} = 3 mA)
Relay data		
– Nominal voltage	U	+26 V
– Response voltage	U	>13 V
– Release voltage	U	1.3 V to 6.5 V
– Switching time	t	<4 ms
– Coil resistance (at 25 °C)	R	700 Ω
Type of connection		32-pin male connector, DIN 41612, form D
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Front panel dimensions		
– Height		3 HE (128.4 mm)
– Width soldering side		1 TE (5.08 mm)
– Width component side		7 TE
Permissible ambient temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	−20 to +70 °C
Weight	m	0.2 kg

[1)] Only for version **with** voltage regulator

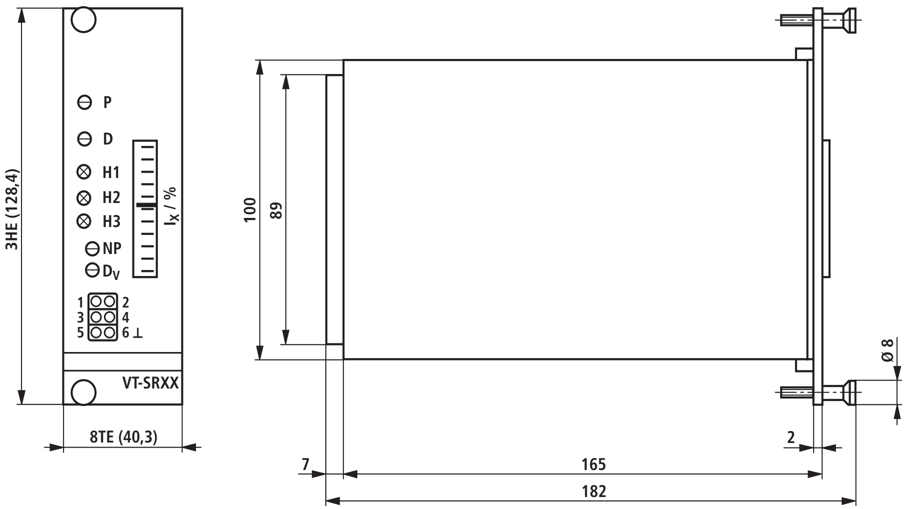
Block circuit diagram / pin assignment



Ⓕ = on front panel

[1] The controller input can be converted into a differential input by removing R13 and plugging in J14 and R65.

Unit dimensions (Dimensions in mm)



Engineering / maintenance notes / supplementary information

- The amplifier may only be plugged or unplugged when disconnected from the power supply!
- Command values may only be switched via relays with gold-plated contacts (small voltages, small currents)!
- For switching card relays (enable, controller changeover, reserve) use only contacts with a load-carrying capacity of ca. 40 V, 50 mA.
- Always shield command value and actual value cables; leave one end of shield open and connect the card-sided end to the ground (⊥)!
- Do not lay signal cables near power cables!
- Recommendation: Also shield solenoid cables!
  For solenoid cable lengths up to 50 m, use cable type LiYCY 1.5 mm^2.
  For greater lengths, please consult us!

Notes

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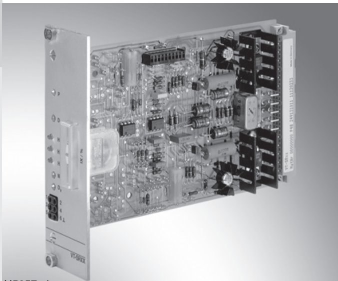
Analog amplifier

RE 30211/06.11
Replaces: 12.10

Type VT-SR11

Component series 1X



H5657_d

Table of contents

Features

- Suitable for actuation of control valves with servo-valve pilot control and electric position feedback (type 4WRD)
- Controller for valve flow, controller for main spool position
- Dither signal generator and push-pull output stage
- Oscillator/demodulator
- Release circuit with relay
- Measuring instrument fro display of servo valve flow
- Reverse polarity protection for the voltage supply

Optional extensions:

- PID controller [1] with controller change-over
- Relay with potential-free changeover contact (28 V/0.5 A)
- Voltage regulator ±15 V for supply of controller and position transducer electronics

[1] The D share of the controller only affects the actual value (velocity feedback).

Ordering code

VT-SR11 – 1X / / / *

Amplifier for type 4WRD control valves, component series 5X, with servo valve pilot control and electric position feedback	
Component series 10 to 19 (10 to 19: unchanged technical data and pinout)	**= 1X**
Without voltage regulator ±15V	**= 0**
With voltage regulator ±15V	**= 1**
No code =	Standard
V002 =	For 4WRD...XN valves
Type designation of the valve	e.g. 4WRD10-5X
Further details in the plain text [1)]	

[1)] E.g. with/without PID controller, with/without backup relay K3
The controller characteristics for the additional PID controller need to be specified.

Accessories

Card holder

– Type VT 3002-2X/32, see data sheet 29928 single card holder without mains adapter

Functional description

The amplifier VT-SR11 operates with a push-pull output stage with bipolar transistors. The output of this output stage can be connected or disconnected by means of a release circuit (relay K2). The release is indicated by the LED "H2" on the front panel being illuminated. The switching voltage of all relays is defined by means of the jumpers J12 and J13 to either 0 V or $+U_B$ (factory setting $+U_B$).

The output level consists of an I controller with connected dither signal generator. The amplitude of the dither signal is set by means of R7. The actuation of the pre-stage (current command value) is made via a PD controller. The current actual value returned is at the same time displayed by the instrument on the front panel.

The oscillator/demodulator serves for sensing of the spool position. It is designed as pluggable board the parameters of which are adapted to the respective valve type.

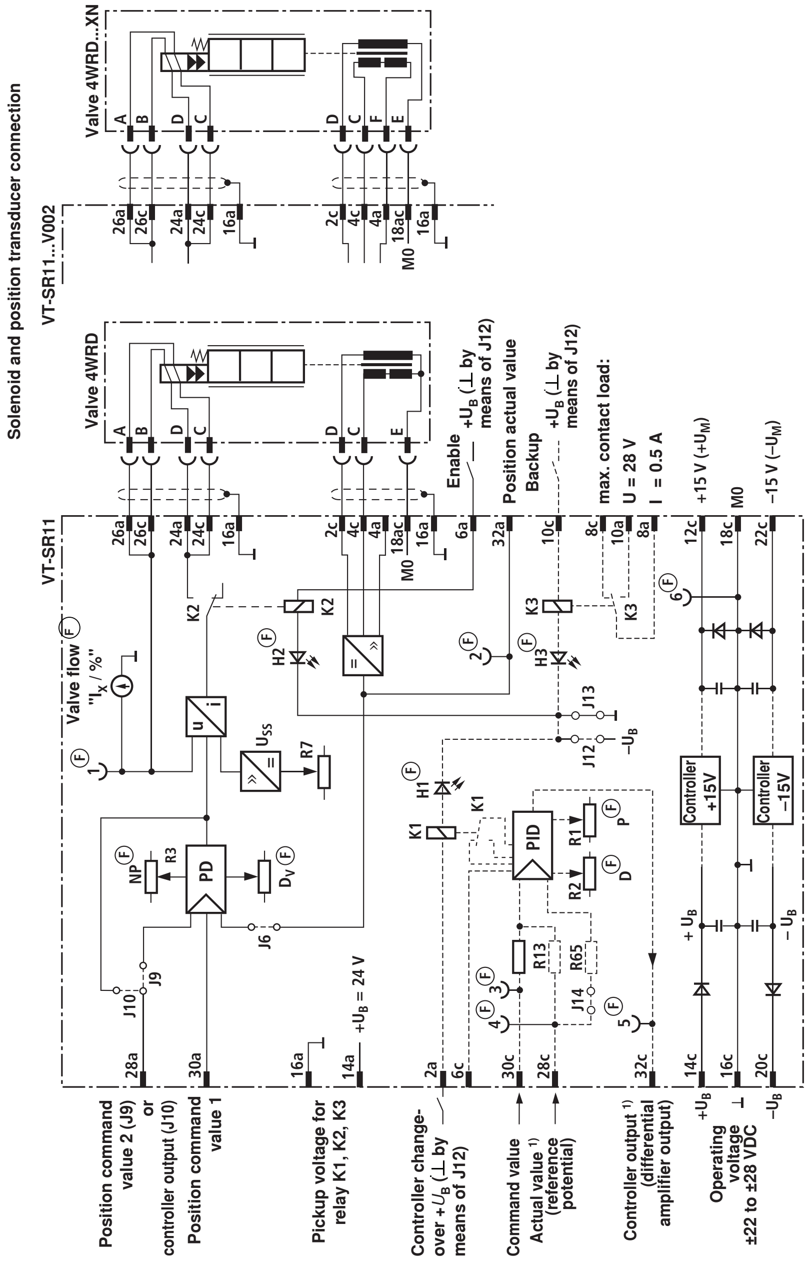
The PD controller is supplied the position command value and the position actual value with the D share of the controller **only** affecting the actual value (velocity feedback).

The zero point can be set via R3 ("NP") from the front panel.

The required symmetric operating voltage $\pm U_B$ is protected against reverse polarity. If the board does not have any voltage regulators for supply of the controller and position transducer electronics, an additional stabilized auxiliary voltage $\pm U_M$ has to be provided. The auxiliary voltage port is protected against reverse polarity up to a maximum current of 1 A.

As an option, the amplifier can be equipped with a PID controller (D share **only** affects the actual value) with selectable PI share and a backup relay with potential-free changeover contact. This controller can be used to superimpose a further control circuit (e.g. for drive control). The P and D share can be set at the front panel. The controller switching status is indicated by the LED "H1", the relay at LED "H3" (LEDs illuminated if relays are applied). The PID controller fitting is customer specific and therefore has to specified in the order in the plain text. These amplifiers receive a special type designation upon delivery. The backup relay is loadable up to 28 V and 0.5 A.

Block diagram/Pinout



Ⓕ = on front plate

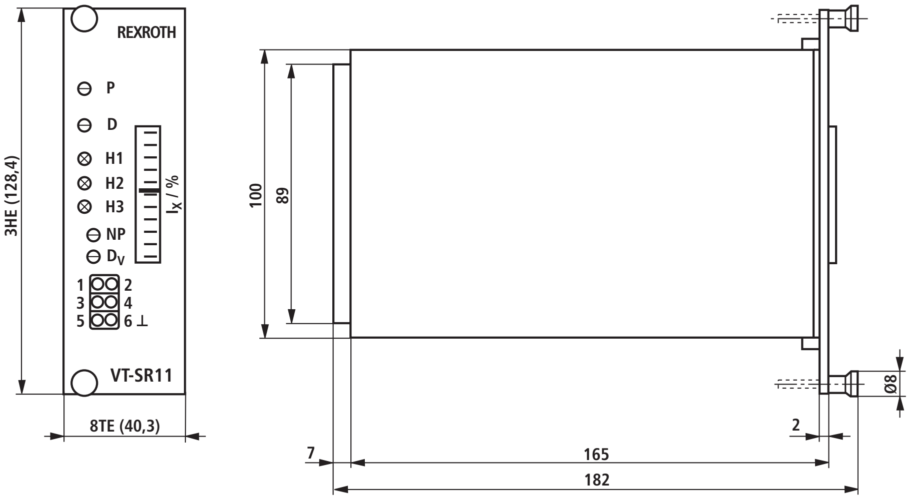
[1] Without R13 and by fitting of J14 and R65 the controller input is transformed into a differential input.

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

Operating voltages		
with voltage regulator	U_B	±24 VDC
upper limit value	$u_B(t)_{max}$	±28 VDC
lower limit value	$u_B(t)_{min}$	±22 VDC
without voltage regulator	U_B; U_M	±24 VDC; ±15.0 VDC
upper limit values	$u_B(t)_{max}$; $u_M(t)_{max}$	±28 VDC; ±15.2 VDC
lower limit values	$u_B(t)_{min}$; $u_M(t)_{min}$	±22 VDC; ±14.8 VDC
Current consumption (without valve) for U_B= ±24 V [1]	I	< 150 mA
Inputs		
Command value 1 (main spool position)	U_e	0 to ±10 V (R_e = 50 kΩ)
Command value 2 (main spool position) by means of J9	U_e	0 to ±10 V (R_e = 50 kΩ)
Actual value (main spool position)	U_e	0 to ±10V (R_e = 50 kΩ)
Enable	U_e	+24 V with J13; 0 V with J12 (R_e = 700 Ω; relay circuit)
Controller change-over	U_e	+24 V with J13; 0 V with J12 (R_e = 700 Ω; relay circuit)
Backup relay	U_e	+24 V with J13; 0 V with J12 (R_e = 700 Ω; relay circuit)
Outputs		
controlled output voltage [1]	U_M	±15 V ±2 %; 150 mA
Valve flow	I_{max}	±60 mA
Valve flow command value (by means of J10)	U_a	–10 V ≙ +100 mA (measuring output)
Relay pickup voltage	U	+24 V (+U_B)
Dither signal	f	470 Hz ±5 %
Oscillator frequency	f	5 kHz
Relay data		
Nominal voltage	U	+26 V
Response voltage	U	> 13 V
Step-back voltage	U	1.3 V to 6.5 V
Switching time	t	< 4 ms
Coil resistance (for 25°C)	R	700 Ω
Contact load	A	0.5
Type of connection		32-pole male multipoint connector, DIN 41612, design D
Card dimensions		Euro board 100 x 160 mm; DIN 41494
Front plate dimensions		
Height		3 HE (128.4mm)
Broad soldering side		1TE (5.08mm)
Broad component side		7 TE
admissible ambient temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight	m	0.3 kg

[1] For design **with** voltage regulator

Unit dimensions



Project Planning/Maintenance Instructions/Additional Information

- The amplifier card may only be unplugged and plugged when de-energized!
- Command values may only be switched via relays with gold contacts (low voltage, low currents)!
- Card relays may only be switched (enable, controller change-over, reserve) using contacts with a load capacity of approx. 40 V; 50 mA.
- Always shield command and actual value lines; Connect shielding to ground (⊥) on the card-side, open at one side!
- Do not lay signal lines close to power cables!
- **Recommendation** 1. Do also shield solenoid lines (one-sided to ⊥)!
  2. Up to 50 m length, use cable type LiYCY 1.5 mm², for higher lengths please ask!

Note Electric signals taken out via control electronics (e.g. actual value) must not be used for switching of safety-relevant machine functions! (See also the European standard "Safety requirements for fluid power systems and their components - Hydraulics", EN 982.)

Note for V002 version
The project planning information in data sheet 29094-XN-B2 must be complied with.

Notes

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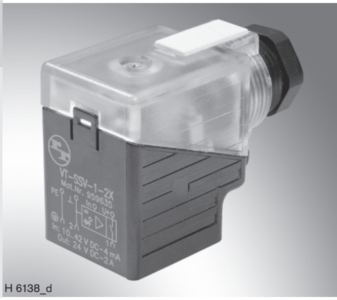
Plug-in switching amplifier

RE 30262/06.05
Replaces: 07.99

Type VT-SSV-1

Series 2X



H 6138_d

Table of contents

Features

- Suitable for control of switching valves with direct current solenoid operation through signals with low control power
- Activation can carried out direct with the switch output signals of an open loop control
- Output with constant short circuit protection
- Status indication of switching condition with LED

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

Ordering code

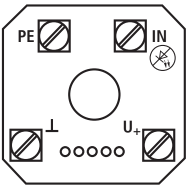
VT-SSV-1 –2X / *

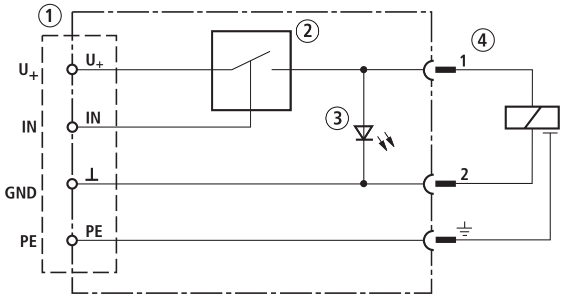
Plug-in switching amplifier

Series 20 bis 29 **= 2X**
(20 to 29: technical data and terminal connection unchanged)

Further details in clear text

Block circuit diagram / pin allocation





Operating voltage on terminal „U_+“ (24 V) and „⊥“ (GND)
Control voltage on terminal „IN“ and „⊥“ (GND)
Protective ground on terminal „PE”

1 Connecting terminals
2 Electronic switch
3 LED for status indication
4 Solenoid contacts

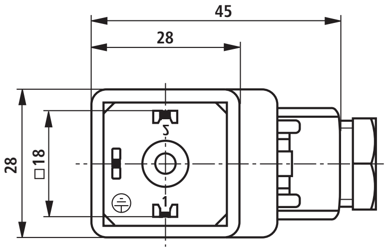
1

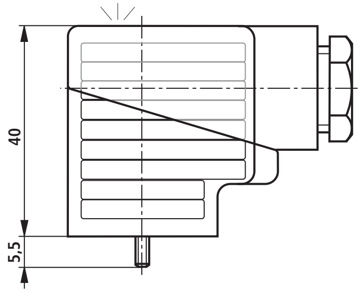
Technical Data (For application outside these parameters please consult us!)

Operating voltage	U_+	24 VDC +20 % –10 % (residual ripple < 15 %)
Output current	I_{max}	2 A (at 100 % duty)
Output voltage	U_{max}	U_+ – 0.2 V (typical at 2 A)
Control voltage:		
–ON	U_{IN}	10 to 35 VDC
–OFF	U_{IN}	0 to 6 VDC
Control current	I_{IN}	≤ 3 mA
Switching frequency	f_{max}	approx. 4 Hz
Cable connection:		Screw-type terminals max. 1.5 mm^2
–Fitting		Pg 11
–External cable diameter	d	4 to max. 10 mm
Solenoid connection		Plug-in connector 2-pin + PE, EN 175301-803 (Z5L)
Connection cable (recommendation)		H05VV-F 4G1,5 (not included in delivery)
Permisible operating temperature range	ϑ	–25 to +70 °C
Storage temperature range	ϑ	–25 to +70 °C
Weight	m	ca. 45 g

Note:
For details regarding **environmental simulation test** for the areas of EMC (electro-magnetic compatibility), climate and mechanical loading see RE 30 262-U (explanation regarding environmental compatibility).

Unit dimensions (dimensions in mm)





Project / maintenance instructions / additional information

- The amplifier is integrated into a plug-in connector Z5L to EN 175301-803 with transparent cover. For the operation a terminal lead with 3 wires is necessary. With a lead with four wires the protective conductor can also be connected.
  Cable recommendation: H05VV-F 4G1,5
- On mounting the housing can be rotated by 90° steps.
- When overloading or short circuit occurs the output is switched off. Before switching back on the control signal U_{IN} must be switched to “OFF” (≤ 6 V).
- The switching off times may be doubled or trebled because of the limitation of the negative switching off voltage peak.

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The Drive & Control Company **Rexroth** Bosch Group

Plug-in switching amplifier

Type VT-SSBA1

RE 30362
Edition: 2013-01
Replaces: 2011-08

- Component series 1X

CE

Features

- Control of hydraulic on/off valves with 12 V solenoids which are to be switched fast (fast switching amplifier)
- Energy saving due to power reduction when controlling hydraulic on/off valves with 24 V solenoids (power reducer)
- Suitable for controlling on/off valves of type WE6 and WE10 with 12 V or 24 V DC solenoids
- Potted-in cable with open end
- 3-conductor connection, power supply and release separated
- Short-circuit proof output
- Status display of the switching status by LED

Table of contents

Bestellangaben

01		02		03		04	
VT-SSBA1–PWM	–	1X	/		/	5	*

01	Plug-in switching amplifier with pulse width modulation (PWM)	**VT-SSBA1-PWM**
02	Component series 10 to 19 (10 to 19: Unchanged installation and connection dimensions)	**1X**
03	Variant	
	Power reduction after 100 ms	**V001**
	Power reduction after 300 ms	**V002**
04	Cable length in m	**5**
05	Further details in the plain text	*

Allocation of the ampifier varaiants to the valves types

Valve type WE6...6X					
Control spool	**24 V solenoid (power saving)**		**12 V solenoid (fast switching)**		
	Ampifier variant	**Power consumption**	**Ampifier variant**	**Switching time "on"**	**Switching time "off"**
E	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	23 ms	20 ms
D (Y)	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	24 ms	17 ms
C (Y11)	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	24 ms	17 ms
G	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	20 ms	14 ms
J	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	19 ms	17 ms
L	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	19 ms	23 ms
M	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	29 ms	29 ms
X7	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	64 ms	16 ms
E67	VT-SSBA1-PWM-1X/V002	18 W	VT-SSBA1-PWM-1X/V001	17 ms	13 ms

Weitere Ventile auf Anfrage.

The use of a plug-in switching amplifier may, in dependence on the individual control spool, result in an improvement with regard to the performance limit. Further information on request.

Functional description

The VT-SSBA1 switching amplifier is directly mounted on the valve's K4 connector.
It is supplied with 24 V direct voltage. If a high signal is applied to wire no. 2 (release "IN"), the voltage profile is applied to the valve according to the functional diagram.
As soon as the release input is switched, the "yellow" status display LED lights up.

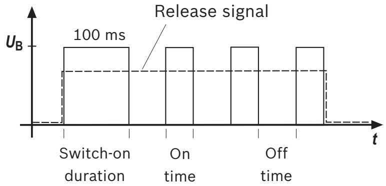
Fast switching amplifier
As fast switching amplifier, the VT-SSBA1 considerably reduces the switching time of standard directional valves in connection with 12 V solenoid coils.

Upon activation, there is an overexcitation of the solenoid by 100 % with 24 V. Then, the voltage is reduced and the necessary holding current is set via the pulse width modulation.

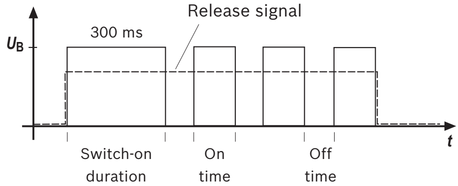
Power reducer (Power saving)
As power reducer, the switching amplifier considerably reduces the holding current when using 24 V standard directional valves.
After activation, the rated voltage of 24 V for switching the valve is changed to pulse width modulation and in this way, the power is considerably reduced.
The above table contains the allocation of the valves to the VT-SSBA1-PWM-1X/V001 and VT-SSBA1-PWM-1X/V002 switching amplifiers.

Functional diagram

PWM with V001: Ratio on/off = 40/60



PWM with V002: Ratio on/off = 60/40



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

General		
Weight	m	Approx. 350 g (incl. cable)
Housing		Valve connector for K4 connector
Ambient temperature range	ϑ	–25 to +70 °C
Max. operating temperature	ϑ	–20 to +60 °C
Storage temperature range	ϑ	–20 to +60 °C

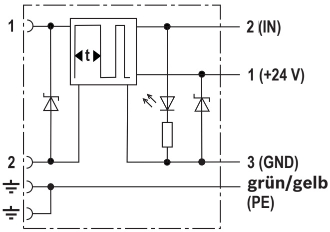
Electric 1)		
Voltage type		Direct voltage
Operating voltage (nominal voltage)	U_B	24 V ± 10 %
Holding current	I_{max}	2 A
Control voltage (release "IN") – ON – OFF	 U_{IN} U_{IN}	 10 to 30 V < 3.5 V
Galvanic separation		No
Control current (release)	I_{IN}	2.5 to 12 mA
Switch-on repetition rate	f	≤1 Hz
Switching frequency	f_{max}	PWM operation 300 to 500 Hz
Protection class according to EN 60529		IP 65, IP 67
Cable connection		Potted-in cable with open end
Cable type		See table below
Switch-on duration – V001 – V002	 t t	 100 to 115 *ms* 300 to 315 *ms*
Pulse width modulation – V001 – V002	 % %	 40 ±5 on 60 ±5 on
CE conformity		According to EMC directive 2004/108/EEC Applied harmonized standards: EN 61000-6-2:2005, EN 61000-6-3:2007

1) Die angegeben Werte beziehen sich auf eine Betriebsspannung von 24 V

Information on the cable type:

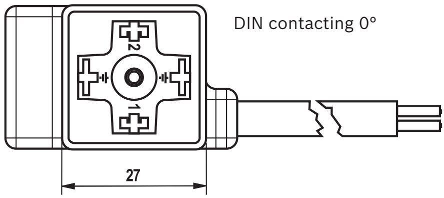
Jacket material	Jacket color	Wire insulation	Wire color	Wires	Jacket diameter
PUR-JZ	black	PP	black, green/yellow	4 x 0.75 mm²	6.5 mm

Block diagram / pinout

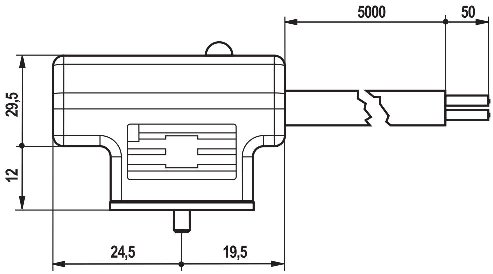


Wire no. 2: Release "IN"
Wire no. 1: Operating voltage "+U_B" (24 V)
Wire no. 3: Operating voltage "GND"
Wire green/yellow: Protective earthing "PE"

Unit dimensions (dimensions in mm)



DIN contacting 0°



Mounting screw M3,
tightening torque M_A = 0.4 Nm

Project planning / maintenance instructions / additional information

- The plug-in switching amplifier may only be operated within the limits and applications defined in the data sheet.
- The distance to radios and mobile phones must be sufficient (>> 1 m).
- In case of overload or short-circuit, the output will be de-energized. Before another switch-on, release "IN" must be switched to "OFF" (< 3.5 V).
- Between input and output, there is no galvanic separation.
- If the operating voltage connections +U_B and GND are interchanged, the current is not limited. This may lead to destruction of the connector or the solenoid. Please make sure that the current is limited by means of external measures.
- In applications as power reducer, the power in PWM operation is not sufficient for switching the valve through a second time if the performance limit is exceeded in the switched condition.

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Command value preparation

Analogue command value module

RE 29902/07.05
Replaces: 02.03

Type VT-SWMA-1

Series 1X

H5999

Table of contents

Features

– Suitable for controlling valves with integral electronics
– Possibility of realising simple hydraulic functions via digital controlling
– Adjustment elements:
  1 potentiometer for zero point adjustment (command value offset)
  1 potentiometer for command value attenuation (for differential input)
  4 potentiometers for command value preselection
  5 potentiometers for ramp time adjustment
– LED lamps: Command value call-up (4 x)
  Active ramp time (4 x)
  Quadrant recognition
  Polarity reversal
  Power
– Measuring sockets for command value and ramp time
– Differential input
– 4 call-up possibilities each for command value and ramp time
– Ramp generator with 5 ramp times; 4-quadrant recognition
– Control signal output
– Power supply unit without raised zero point
– Without power part

Ordering code

VT-SWMA-1	–	1X	/	V0	/	0	*

Analogue command value module

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

V0 = Basic version

0 = Basic version

Further details in clear text

Functional description

General

The command value module is to be snapped onto top hat rails to EN 60715. The electrical connection is made using screw-type terminals. The module is operated with 24V DC voltage. A power supply unit [1] provides the internally required positive and negative supply voltages. The green LED (power) lights up as soon as the power supply unit is in operation.

Internal command value

The internal command value is generated from the external command value signal applied to differential input [2], a called up signal and an offset signal (zero point potentiometer "Z" [3]).

The external command value signal can be changed from 0 % to approx. 110 % by means of potentiometer "G" (amplitude attenuator [4]).

Command value call-ups

Call-up signals w1 to w4 [5] can also be adjusted between 0 % and 110 %. Call-up signals w1 and w2 have a positive, call-up signals w3 and w4 a negative polarity. This allows the realisation of two forward and two reverse movements of the hydraulic drive without requiring any additional circuitry. For applications that require more than two signals of the same polarity, command value inversion is provided [6]. If this is activated, for example, together with call-up 3, call-up signal w3 also provides a positive control variable.

Only 1 call-up is possible at a time. If several call-ups are activated simultaneously, the following is valid: Call-up "1" has the lowest priority, call-up "4" has the highest priority [7].

Quadrant recognition

When quadrant recognition [8] is activated, the electronics automatically recognises the polarity [9] and any changes (up/down) [10] in the control variable and assigns a ramp time to the current signal state.

Ramp time	Polarity of-control output	Signal changes in direction of…	
t1	+	Maximalwert	0 % → Maximum value (+)
t2	+	0 %	Maximum value (+) → 0 %
t3	–	Maximalwert	0 % → Maximum value (–)
t4	–	0 %	Maximum value (–) → 0 %

As long as the signal is being changed, the LED assigned to the current ramp is alight.

Ramp time call-ups [11]

When quadrant recognition is not activated, a separate ramp time "t1" to "t4" is assigned to each command value call-up "w1" to "w4".

As long as a signal is being changed, the LED assigned to the current ramp time is alight.

Ramp time "t5" [12]

If neither quadrant recognition nor a call-up is activated, ramp time "t5" is always valid. This ramp time can be used, among others, for an emergency stop function. The valve can be closed with the defined ramp time "t5".

Ramp time adjustment

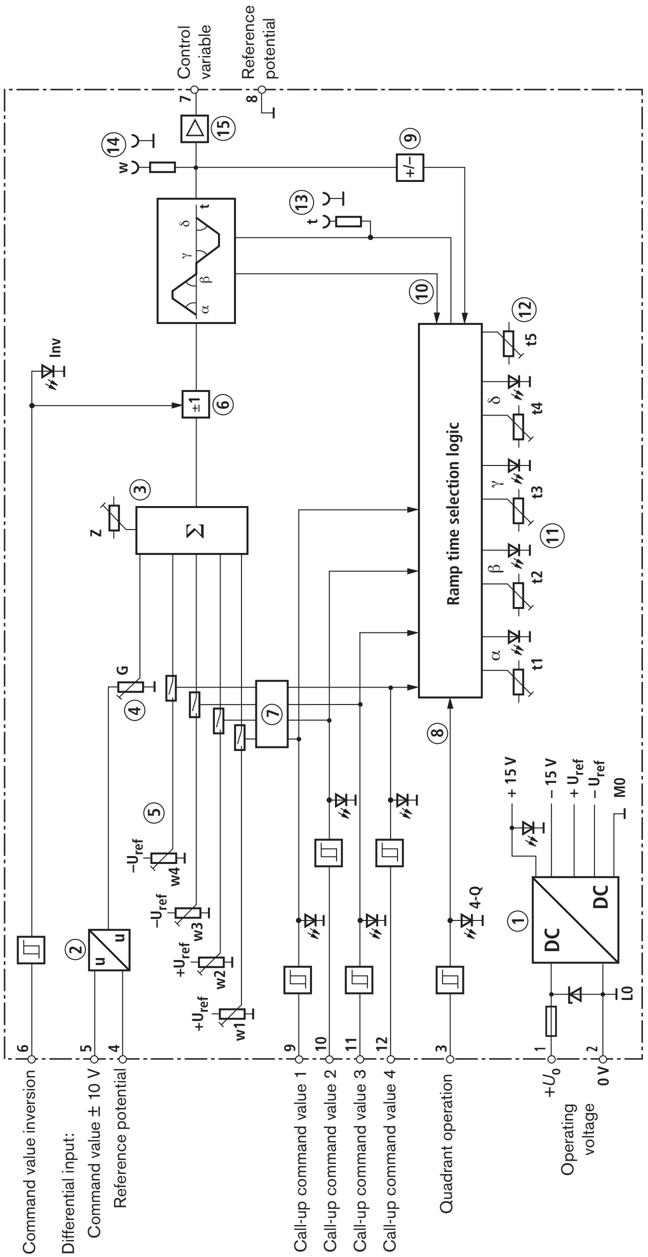
The current ramp time can be checked at measuring socket "t" [13]. Ramp times "t1" to "t4" can be adjusted with the help of the ramp time potentiometers. Through activation of a call-up signal, ramp time signal "t" at the measuring socket is clearly assigned to one of the ramp times t1 to t4. t5 is assigned to the ramp time signal at the measuring socket, if neither a call-up nor quadrant recognition is activated. The adjustment range of the ramp time is selected so that these can be set reproducibly (for details, see "Technical data").

Output

The output signal of the ramp generator can be checked at measuring socket "w" [14]. The downstream matching amplifier [15] provides the control signal for the valve via output "control variable" [16].

[ ] = Cross-reference to block circuit diagram on page 3

Block circuit diagram / pin assignment



1 Power supply unit
2 Differential amplifier
3 Summator with zero point potentiometer
4 Amplitude attenuator
5 Call-up signals
6 Command value inversion
7 Priority logic
8 Quadrant recognition
9 Polarity recognition
10 Recognition of changes in the contol variable (up/down)
11 Ramp time call-ups
12 Ramp time potentiometer “t5“
13 Measuring socket “ramp time signal“
14 Measuring socket “internal command value“
15 Matching amplifier

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

Operating voltage	U_o	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_o(t)_{max}$	35 V
– Lower limit value	$u_o(t)_{min}$	18 V
Power consumption	P_S	12 VA
Current consumption	I_{max}	0.5 A
Fuse		Thermal overload protection (reactivation when temperature falls below threshold)
Inputs		
– Command value (differential input with attenuator)	U_i	0 to ±10 V; $R_i > 50$ kΩ
– Quadrant operation “4-Q“		
• active	$U_{4\text{-}Q}$	8.5 V to 35 V; $R_i > 50$ kΩ
• inactive	$U_{4\text{-}Q}$	0 to 6.5 V
– Command value inversion “Inv“		
• active	U_{Inv}	8.5 V to 35 V; $R_i > 50$ kΩ
• inactive	U_{Inv}	0 to 6.5 V
– Command value call-ups 1 to 4		
• active	U	8.5 V to 35 V; $R_i > 50$ kΩ
• inactive	U	0 to 6.5 V
Adjustment ranges:		
– Zero balancing (potentiometer “Z“)		±30 %
– Amplitude attenuator (potentiometer “G“)		0 % to ca. 110 %
– Command values (potentiometers “w1“ to “w4“)		0 % to ca. 110 % (factory setting 100 %)
– Ramp times (potentiometers “t1“ to “t5“)		20 ms to 5 s
Outputs:		
– Control variable	U	0 to ±10 V; ±2 mA; $R_L > 5$ kΩ
– Measuring socket for control variable “w“	U_w	0 to ±10 V (+100 % = +10 V; –100 % = –10 V)
– Measuring socket for ramp time “t“	U_t	0,01 V to +10 V 0,01 V(t_{max} = ca. 10 s); 10 V(t_{min} = ca. 10 ms)
Type of connection		12 screw terminals
Type of mounting		Top hat rail TH 35/7.5 to EN 60715
Type of protection		IP 20 to EN 60529
Dimensions (W x H x D)		40 x 79 x 85,5 mm
Permissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–25 to +85 °C
Weight	m	0.3 kg

Note:
For details regarding **environment simulation tests** in the field of EMC (electro-magnetic compatibility), climate and mechanical stress, see RE 29902-U (declaration on environmental compatibility).

Note on the adjustment and measurement of the ramp time
For adjusting the ramp time potentiometers we recommend that 4-quadrant recognition be switched off and call-ups be activated.

Value at measuring socket “t“	U_t in V	5	3	2	1	0,5	0,3	0,2	0,1	0,05	0,03	0,02
Current ramp time (± 20 %)	*t* in ms	20	33	50	100	200	333	500	1000	2000	3333	5000

The following is valid: $t = \frac{100 \text{ V ms}}{U_t}$

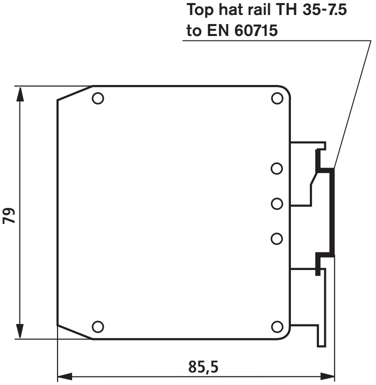
Example: Measured $U_t = 5$ V

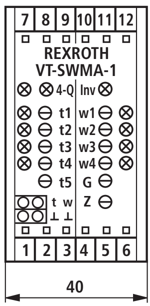
Results in $t = \frac{100 \text{ V ms}}{5 \text{ V}} = 20$ ms

Terminal assignment

Operating voltage	$+U_0$	1	7	Control variable output
	0 V	2	8	Reference potential
Quadrant operation	$+U_{4\text{-Q}}$	3	9	Call-up command value 1
Differential input	Reference potential	4	10	Call-up command value 2
	$\pm U_{comm}$	5	11	Call-up command value 3
Command value inversion	$+U_{Inv}$	6	12	Call-up command value 4

Unit dimensions (Dimensions in mm)





Potentiometers (some with LED lamps):
“t1“ to “t5“ → Ramp times
“w1“ to “w4“ → Command value call-ups
“G“ → Amplitude attenuator for differential input
“Z“ → Zero point balancing

LED lamps:
“4-Q“ → Quadrant recognition
“Inv“ → Inversion active
green → Ready for operation “power“ (no lettering)

Measuring sockets:
“t“ → Current ramp time
“w“ → Internal control variable
“⊥“ → Reference potential / ground

Engineering / maintenance notes / supplementary information

- The amplifier module may only be unplugged when disconnected from the power supply!
- Ensure a sufficient distance to aerial lines, radio sources and radar equipment (>> 1 m)!
- Shield command value lines, do **not** lay near power cables!
- **Caution:** When the **differential input** is used, **both inputs** must be activated or deactivated **simultaneously**!

Note: Electrical signals (e.g. control variable) brought out via control electronics must not be used for switching safety-relevant machines functions!
(See also the European standard "Safety requirements for fluid power systems and components – hydraulics", EN 982)

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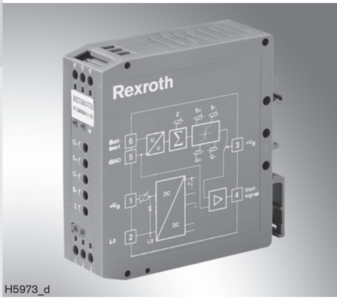
Bosch Group

Analogue command value module

RE 29903/06.05
Replaces: 02.03

Type VT-SWMAK-1

Series 1X



H5973_d

Table of contents

Contents	Page

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

Features

– Suitable for controlling valves with integral electronics
– For valve spool overlap compensation
– Possibility of adjusting the maximum valve opening and the hydraulic zero point; convenient correction of zero point shifts
– Adjustment elements:
  1 potentiometer for zero point adjustment (command value offset)
  2 potentiometers for command value attenuation for positive and negative signals
  2 potentiometers for jump adjustment for positive and negative signals
– LED lamps: Enable
  Power
– Measuring socket for command value
– Differential input; enable input
– Control signal output
– Power supply unit without raised zero point
– Without power part
– Reverse voltage protection for voltage supply

Ordering code

VT-SWMAK-1 – 1X / V0 / 0 *

Analogue command value module		
Series 10 to 19 (10 to 19: unchanged technical data and pin assignment)	= 1X	
	V0	Basic version
	0	Basic version
	*	Further details in clear text

Functional description

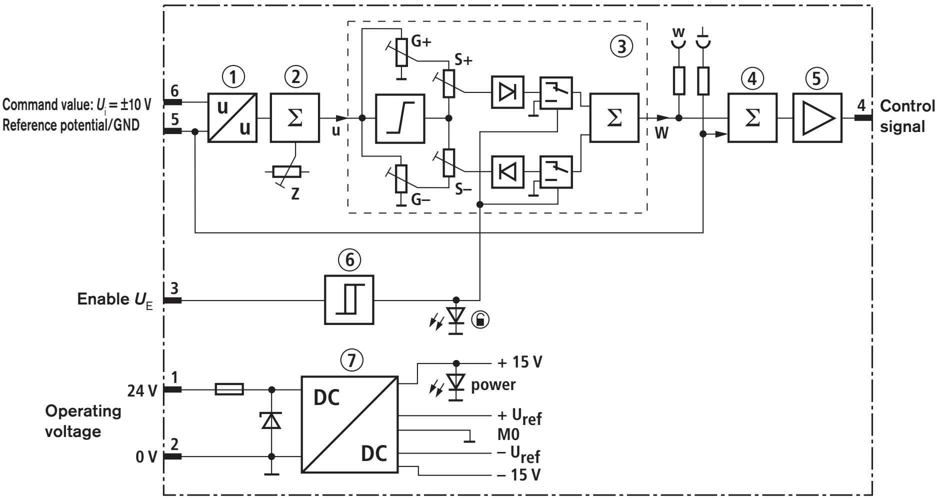
The command value module requires 24V DC voltage. A power supply unit [7] provides the internally required positive and negative supply voltage. As soon as the power supply unit is in operation, the green LED ("power") lights up. The control signal can be cut in or out by applying a signal at the enable input (connection 3). If no enable signal is applied, the control signal is 0 % (with reference to the reference potential "GND" of the command value).

The summator [2] adds an offset, which can be adjusted by means of potentiometer "Z", to the externally provided command value. Thus, zero point drifts from the control side can be compensated for and the hydraulic zero point can be exactly adjusted. The adjustable characteristic curve generator [3] can be used to adjust the jump height and maximum values independently of each other for positive and negative signals in accordance with the hydraulic requirements.

The potentiometers "S+" and "S–" serve to compensate for the valve overlap; the potentiometers "G+" and "G–" are used for adjusting the maximum flow of the servo- or proportional valve (see output characteristic curve and adjustment recommendation).

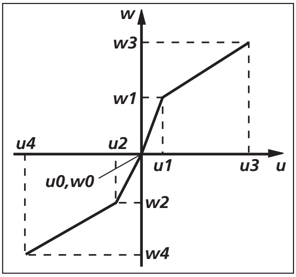
The control signal has the same reference potential/GND as the command value. In the case of fluctuations in the reference potential, the summator [4] corrects the control signal as required.

Block circuit diagram



1	Differential input	**5**	Output amplifier
2; 4	Summator	**6**	Trigger
3	Characteristic curve generator	**7**	Power supply unit

Output characteristic curve



Points of inflection of characteristic curves:

u0	0 %		
w0	0 %		
u1	+2 % = +200 mV		
w1	0 % to +50 % **(S+)**	=	0 V to +5 V
u2	−2 % = −200 mV		
w2	0 % to −50 % **(S–)**	=	0 V to −5 V
u3	+100 % = +10 V		
w3	w1 up to +110 % **(G+)**	=	w1 up to +11 V
u4	−100 % = −10 V		
w4	w2 up to −110 % **(G–)**	=	w2 up to −11 V

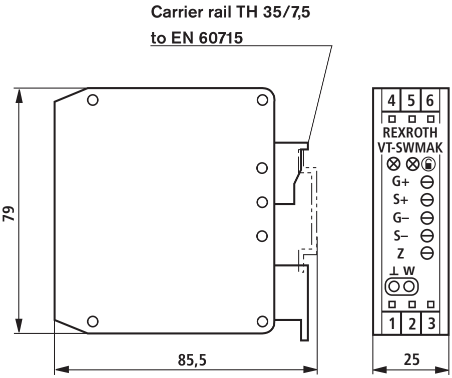
The minimum value of *w3* and *w4* corresponds to the setting of *w1* and *w2*.

2

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

Operating voltage	U_O	24 VDC
Operating range:		
– Upper limit value	$u_O(t)_{max}$	35 V
– Lower limit value	$u_O(t)_{min}$	18 V
Power consumption	P_C	1.2 VA
Current consumption	I_{max}	50 mA
Fuse		Electronic protection
Inputs:		
– Command value (differential input)	U_e	0 to ±10 V; Re = 100 kΩ (common reference potential with control signal output)
– Enable		
• active	U_F	> 8.5 V
• inactive	U_F	< 6.5 V
Adjustment range:		
– Jump function		0 to 50 %; jump height achieved at U_{comm} = 2 % (can be adjusted separately for positive and negative signals)
– Amplitude attenuator		0 % to 110 %; this is valid for a jump height setting = 0 % (can be adjusted separately for positive and negative signals)
– Balance		±10 %
Outputs:		
– Actuating signal	U	0 to ±10 V
– Measuring socket for command value “w“	U_w	0 to ±10 V (±10 V = ±100 %)
Type of connection		6 screw-type terminals
Type of mounting		Carrier rail NS 35/7.5 to DIN 50022
Type of protection		IP 20 to DIN 40050
Dimensions (W x H x D)		25 x 79 x 85.5 mm
Permissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	−25 to +85 °C
Weight	m	0.08 kg

Unit dimensions (Dimensions in mm)



G+ Amplitude attenuator for positive command values
S+ Jump height for positive direction
G– Amplitude attenuator for negative command values
S– Jump height for negative direction
Z Balancing
w Internal command value
⊥ Reference potential

LED lamps:

green → power
yellow → enable „ “

Terminal assignment

Operating voltage	$+U_O$	1	4		**Control signal output**
	0 V	2	5	GND	**Reference potential**
Enable	U_E	3	6	U_i	**Command value input**

Engineering / maintenance notes

– The command value module may only be wired when disconnected from the power supply!
– Do **not** lay lines near power cables!
– The distance to aerial lines, radio equipment and radar systems must be at least 1 m!
– Always connect the reference potential of the differential input “GND“ to the earth of the control!

Adjustment recommendations

With external command value feedforward:

1. • Apply operating voltage
   - Turn potentiometers “S+“ and “S-“ to the left-hand limit stop (Min)
   - Turn amplitude attenuators “G+“ and “G-“ to the righthand limit stop (Max)
   - Preselect command value 0 %
   - Apply enable signal
2. Zero point adjustment
   Attention! Terminal 5 is the reference potential for the command value input and the actuating signal output and must be connected to 0 V (earth) at the control.
   - Set 0 V at measuring socket “w” using potentiometer “Z“
3. Jump height adjustment
   - Preselect command value +2 %
     → the measuring socket signal is now approx. 0.19 V to 0.23 V
   - Adjust the positive jump height using potentiometer “S+“; check the control variable at measuring socket “w“ (10 V = 100 %)
   - Preselect command value –2 %
     → the measuring socket signal is approx. –0.19 V to –0.23 V
   - Adjust the negative jump height using potentiometer “S-“; check the control variable at measuring socket “w“ (–10 V = –100 %)

   For an exact hydraulic adjustment, the valve and the hydraulics must also be in operation. The jump height must be adjusted according to the required min. drive speed (creep speed).
4. Maximum value adjustment
   - Preselect command value +100 %
     → the measuring socket signal is now approx. 10 V to 11 V
   - Set the positive max. control variable using potentiometer “G+“; check the control variable at measuring socket “w“ (10 V = 100 %)
   - Preselect command value –100 %.
     → the measuring socket signal is now approx. –10 V to –11 V
   - Set the negative max. control variable using potentiometer “G-”; check the control variable at measuring socket “w“ (–10 V = –100 %)

Without external command value feedforward:

1. • Apply operating voltage
   - Turn potentiometers “S+“ and “S-“ to the left-hand limit stop (Min)
   - Turn amplitude attenuators “G+“ and “G-“ to the right-hand limit stop (Max)
   - Preselect command value 0 % (input open or short-circuited)
   - Apply enable signal
2. Step height adjustment
   - Set an internal command value of +2 % using potentiometer “Z“ → the measuring socket signal is now 0.2 V
   - Adjust the positive jump height using potentiometer “S+“; check the control variable at measuring socket “w“ (10 V = 100 %)
   - Set an internal command value of –2 % using zero point potentiometer “Z“
     → the measuring socket signal is now –0.2 V
   - Adjust the negative jump height using potentiometer “S-“; check the control variable at measuring socket “w“ (–10 V = –100 %)
3. Zero point adjustment
   - Set 0 V at measuring socket “w” with the help of potentiometer “Z“
4. Maximum value adjustment
   - Only possible with external command value feedforward

Notes

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Command value and ramp module

Type VT-SWMA3-...

Component series 1X

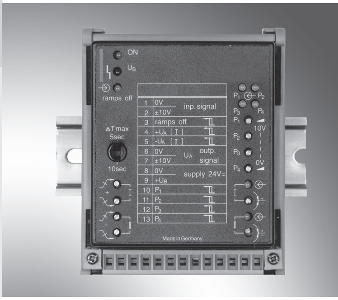


Table of contents

Features

- Design: Module for snapping onto carrier rail
- Suitable for controlling proportional valves with installed electronics
- 4 internal command values
- Command value input U_E
- Direction logic (+/–)
- Adjustable ramps
  I for $+U_A$
  II for $-U_A$
- Selector switch for ΔT_{max}
- Input for "Ramps OFF"

Notice:
The photo is an example configuration.
The delivered product differs from the figure.

Ordering code

VT-SWMA3-5 – 1X / V0 / 0

Command value and ramp module

0 = Standard option

Customer version

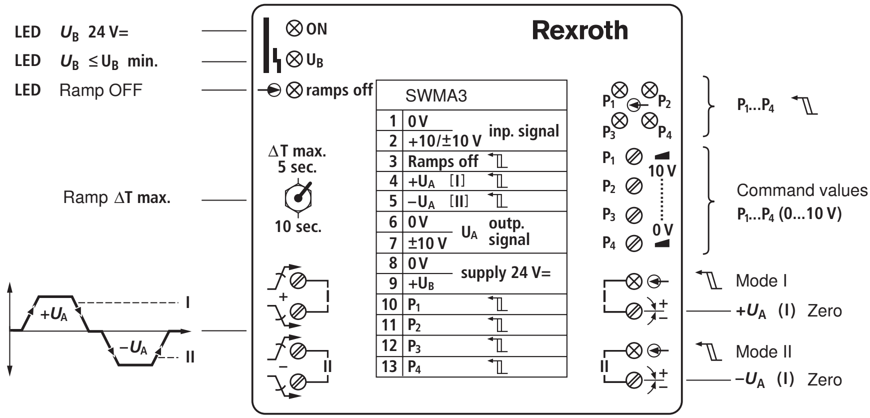
V0 = Catalog version

1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

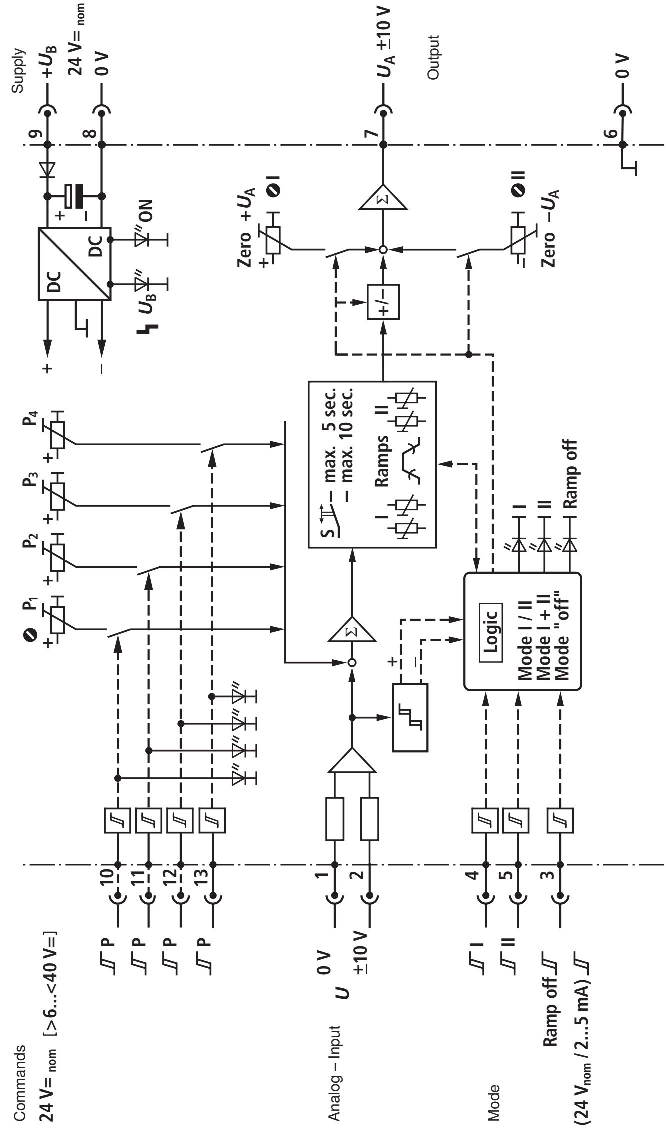
Preferred type

Amplifier type	Material number
VT-SWMA3-5-10/V0/0	0811405108

Front plate



Block diagram with pin assignment

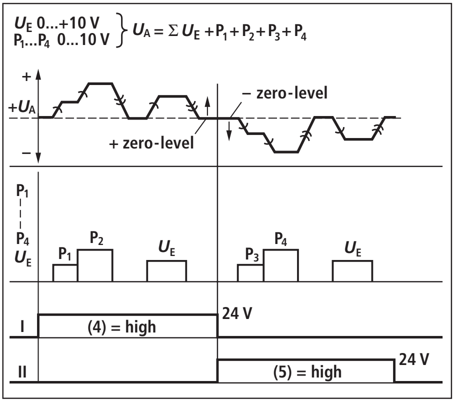


Technical data (For applications outside these parameters, please consult us!)

Supply voltage		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Current consumption	A	≦ 0.2
Signal input "U_E" analog		Mode I or II: 0...+10 V Mode I + II: 0...±10 V
Logic commands "commands"		24 V = $_{nom}$, loaded: 2...5 mA (> 6 V max. 40 V =)
Operating state (mode) 1. Unipolar 2. Bipolar		 Mode I (cl. 4) for U_A = + or Mode II (cl. 5) for U_A = – Mode I + II for $\pm U_E \rightarrow \pm U_A$
Note		Zero point Mode I or zero point → 0 V Mode I + II zero point with +0.5 V or adjust –0.5 V U_E
Miscellaneous		P_1...P_4 may sum up (up to a max. of 10 V)
Format / design	mm	860 x 110 x 95.5/module
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	*m*	0.39 kg

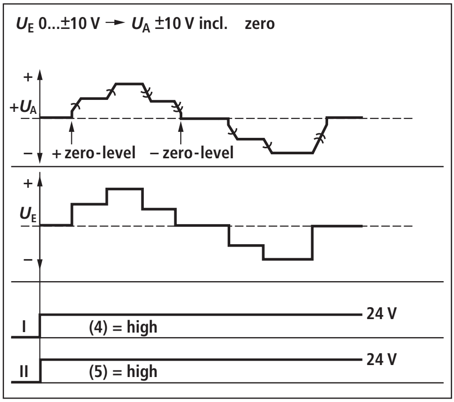
Commissioning

MODE/SIGNAL: I → +U_A
II → –U_A



or

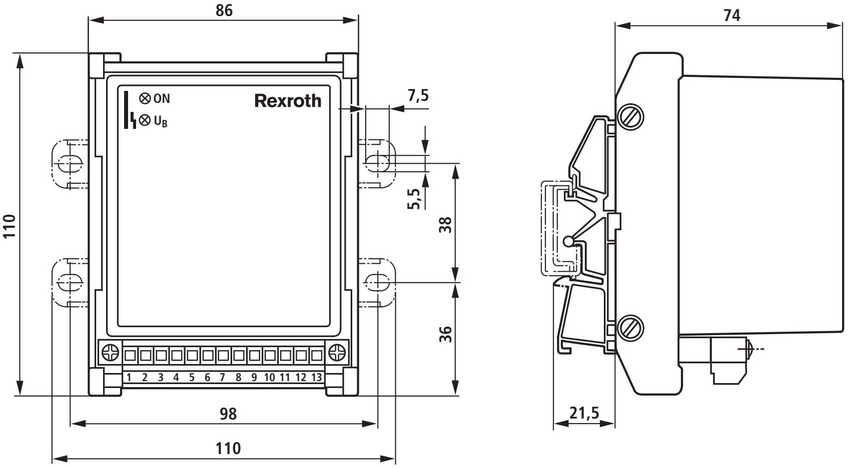
MODE/SIGNAL: I + II → ±U_A



- Selection mode I or II
- Zero point with U_E = 0 V
- Examination of the signals U_E (P_1...P_4)
- Ramp adjustment I or II

- Selection mode I or II (bipolar)
- Zero point with U_E = +0.5 V and/or –0.5 V
- Examination of the signal ± U_E
- Ramp adjustment I or II

Device dimensions (dimensions in mm)



Wall mounting (86 x 110 x 95.5) mm Carrier rail assembly (snap-in)

Project planning / maintenance instructions / additional information

- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protection circuits.

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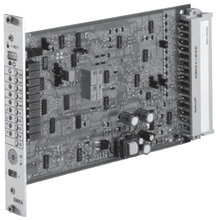
The Drive & Control Company

Rexroth
Bosch Group

Command value and ramp card

Type VT-SWKA-1

RE 30255
Edition: 2013-04
Replaces: 06.05



H6538

- Component series 1X
- Analog, Euro-card format
- Suitable for controlling valves with integrated electronics. For controlling valves without integrated electronics, an additional suitable amplifier is necessary.
- Suitable for generating, linking and standardizing command value signals

Features

- Configuration and parameterization of the command value card using potentiometers
- Command value inputs:
  • Differential input ±10 V
  • 4 callable command value inputs ±10 V
  • Current input 4 to 20 mA
  (standard 0 to 100 %; switchable ±100 %)
- Actuating variable outputs:
  • Voltage ±10 V
  • Current 4 to 20 mA
  (standard 0 to 100 %; switchable ±100 %)
- 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)
- Switching of the ramp time range via jumper
- Characteristic curve correction by means of separately adjustable step levels and maximum values
- Enable input
- "Ramp ready" output signal as auxiliary process variable
- "Ready for operation" output signal
- Switchable measuring socket
- Reverse polarity protection for the voltage supply

Contents

More information:

- Product description and commissioning instructions VT-SWKA-1, see 30255-B

Ordering code

01		02		03		04		05
VT-SWKA-1	**–**	**1X**	**/**	**V0**	**/**	**0**	**/**	*****

01	Analog command value card	**VT-SWKA-1**
02	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	**1X**
04	Version: Standard	**V0**
05	Standard option	**0**
06	Further details in the plain text	*****

Suitable card holder:

- Open card holder VT 3002-1-2X/48F
  (see data sheet 29928)

Functional description

General

The command value card is set up as printed circuit board in Euro format, 100 x 160 mm, and suitable for installation in a rack. An internal power supply unit [1] supplies all internally required positive and negative supply voltages. If the power supply unit is in operation and no error is detected, the green LED on the front plate is lit and the "ready for operation" signal is set.

Current input [3]

There is no switching between current and voltage input. Both inputs are permanently available (see terminal assignment). The input signals are internally standardized and added up. The zero point and the value range of the current input can be switched using jumper J5.

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 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". 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.

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. If an external inverting signal is connected, this is indicated by an LED ("–1") on the front plate.

Enable function [8]

The enable function switches the input signal of the ramp generator on or off. If enable is switched on or off, the control output changes with the set ramp time irrespective of the command value. Thus, a controlled valve does not open or close abruptly. If an error signal occurs, the ramp generator input signal is also set to 0 %. The enable signal is indicated by an LED on the front plate.

Ramp generator [9]

The ramp generator limits the rise of the control output. The downstream step functions and amplitude attenuators do not extend or shorten the ramp time.
Using jumper J2, the ramp time is set to a minimum (< 2 ms) (ramp off).

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.
Note for setting and measuring the ramp time:

Functional description (continued)

Value at measuring socket "v"	***U***$_t$ **/ V**	5	3	2
Current ramp time (±20 %)	***t* / ms**	20	33	50

U$_t$ **/ V**	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
***t* / ms**	100	200	333	500	1000	2000	3333	5000

By reconnecting the jumper J3, the ramp times specified above can be increased tenfold.

Ramp status signal [11]
The "ramp ready" status signal indicates that the control output has reached the desired end value. By means of this signal (24 V output), superior sequence controls can be more easily synchronized with the valve function or the controlled hydraulic function.

Characteristic curve generator [12]
Using the adjustable characteristic curve generator, step level and maximum values for positive and negative signals can be set separately, adjusted to the hydraulic requirements. The actual development of the characteristic curve through the zero point is not stepped but linear.

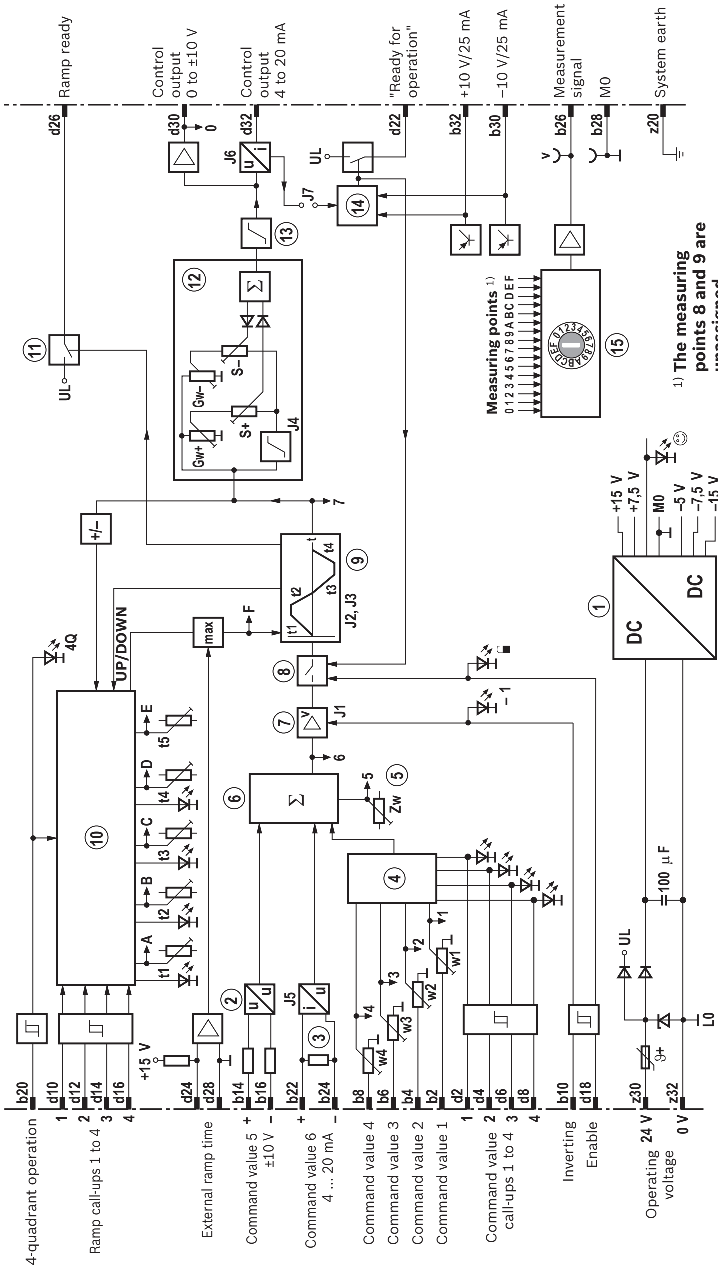
Amplitude limiter [13]
The control outputs (current output and voltage output) are limited to approx. ±110 % of the nominal range.

Fault recognition [14]
The internal operating voltages and the voltage outputs are monitored and, if the jumper J7 (1-2) is connected, the current output is checked for cable break. If there is no error, the green "ready for operation" LED is lit and the "ready for operation" output is switched to 24 V (operating voltage).

Measuring points [15]
A measuring socket on the front plate is provided for verifying the settings of the command value call-up, the ramp times and further internal signals. The measuring points are selected via the measuring point selector switch which is also located on the front plate. The signal of the measuring socket is also connected to the male multipoint connector (b26).

[ ] = references to the block diagram on page 4

Block diagram / pin assignment



1) **The measuring points 8 and 9 are unassigned.**

1 Power supply unit
2 Differential amplifier
3 Current input
4 Command value selection logic
5 Zero point setting
6 Command value summation
7 Command value inverting
8 Enable function
9 Ramp generator
10 Ramp time selection logic
11 Ramp status function
12 Characteristic curve generator
13 Amplitude limiter
14 Fault recognition
15 Measuring point switch-over

Explanations regarding the jumpers and position and meaning of the display and adjustment elements see page 6.

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

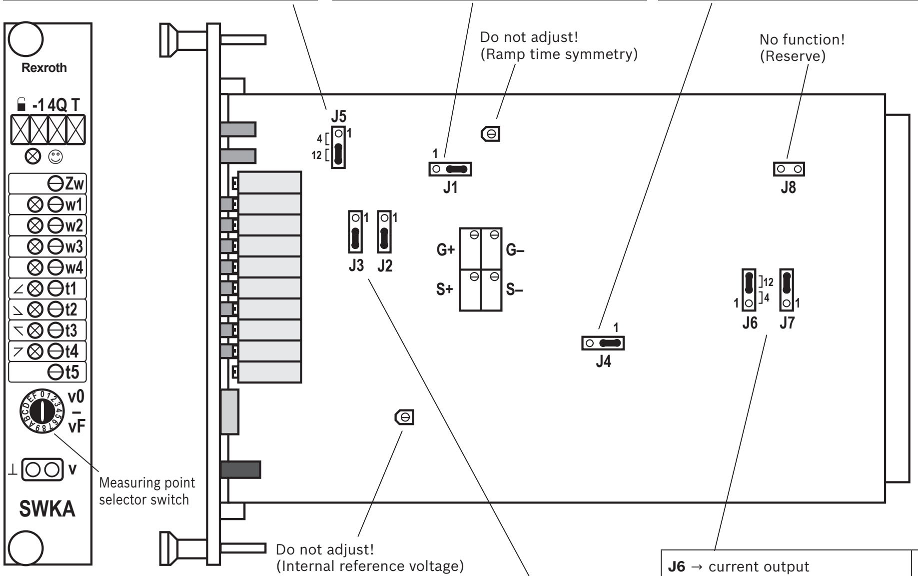
Operating voltage	U_B	24 VDC + 40 % – 20 %
Operating range:		
Upper limit value	U_B (t)$_{max}$	35 V
Lower limit value	U_B (t)$_{min}$	18 V
Power consumption	P_S	< 7 VA
Current consumption	I	< 0.3 A
Fuse	I_S	Thermal overload protection; self-activating after tripping
Inputs, analog		
Command values 1 to 4 (potentiometer inputs)	U_e	0 ... ±10 V, R_e > 100 kΩ (M0 is reference)
Command value 5 (differential input)	U_e	0 ... ±10 V, R_e > 50 kΩ
Command value 6 (current input)	I_e	4 ... 20 mA, load R_B = 100 Ω (zero point switchable)
External ramp time	U_e	0 ... +10 V, R_e = 10 kΩ (internally increased to +15 V, M0 is reference)
Inputs, digital		
Command value call-ups, Command value inversion, Enable, Ramp call-ups, 4-quadrant operation	U U	8.5 V ... U_B –> ON, R_e > 100 kΩ 0 ... 6.5 V –> OFF, R_e > 100 kΩ
Setting ranges		
Zero adjustment (potentiometer "Zw")		±30 %
Command values (potentiometers "w1" to "w4")		0 ... 110 %
Ramp times (potentiometer "t1" to "t5")		20 ms ... 5 s, switchable to 0.2 ... 50 s using J3
Step level (potentiometer "S+" and "S–")		0 ... 50 % (step level reached at approx. 2 % of specified command value)
Amplitude attenuator (potentiometer "G+" and "G–")		0 ... 110 % (applies to the step level setting of 0 %)
Outputs, analog		
Control output voltage	U	±10 V ± 2 %, I_{max} = 2 mA
Control output current	U	4 mA ... 20 mA ± 2 %; $R_{B\ max}$ = 500 Ω (zero point switchable)
Measurement signal	U	±10 V ± 2 %, I_{max} = 2 mA
Outputs, digital		
Ramp ready		> 16 V, 50 mA → ramp ready < 1 V; R_i = 10 kΩ → ramp on
Ready for operation	U	> 16 V, 50 mA (in case of a fault: U < 1 V, R_i = 10 kΩ)
Regulated voltages	U	±10 V ± 2 %, 25 mA, short-circuit-proof
Measuring sockets		
Measurement signal "v" (depending on the position of the measuring point switch-over)	U	±10 V ± 2 %, I_{max} = 2 mA
Type of connection		48-pin male multipoint connector, DIN 41612, design F
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Admissible operating temperature range	ϑ	0 ... 50 °C
Storage temperature range	ϑ	–25 °C ... +85 °C
Weight	m	0.15 kg (net)

Display / adjustment elements

J5 → current input	1-2	2-3
0 % ≙ 4 mA	•	–
0 % ≙ 12 mA	$\boxed{–}$	$\boxed{\bullet}$

J1 → inverting	1-2	2-3
Inverting	•	–
Not inverting	$\boxed{–}$	$\boxed{\bullet}$

J4 → step function	1-2	2-3
Off	$\boxed{\bullet}$	$\boxed{–}$
On	–	•



J6 → current output	1-2	2-3
0 % ≙ 4 mA	•	–
0 % ≙ 12 mA	$\boxed{–}$	$\boxed{\bullet}$

J7 → cable break monitoring	1-2	2-3
On	•	–
Off	$\boxed{–}$	$\boxed{\bullet}$

J2 → ramp function	1-2	2-3
Off	•	–
On	$\boxed{–}$	$\boxed{\bullet}$
J3 → ramp time		
Tenfold	•	–
Simple	$\boxed{–}$	$\boxed{\bullet}$

LED indicators:

☺	Ready for operation (green)
🔒	Enable (yellow)
–1	External inverting
4Q	Quadrant recognition
T	Reserved

Potentiometers (some with LED indicator):

Zw	Zero point calibration
w1	Command value 1
w2	Command value 2
w3	Command value 3
w4	Command value 4
t1	Ramp time 1
t2	Ramp time 2
t3	Ramp time 3
t4	Ramp time 4
t5	Ramp time 5

Cannot be set via front plate:

G+	Amplitude attenuator for positive command values
G–	Amplitude attenuator for negative command values
S+	Step level for positive direction
S–	Step level for negative direction

Measuring sockets:

v	Measurement signal (see page 7)
⊥	Measurement zero

• ... Connection activated
– ... Connection open
☐ ... Factory setting of the jumpers

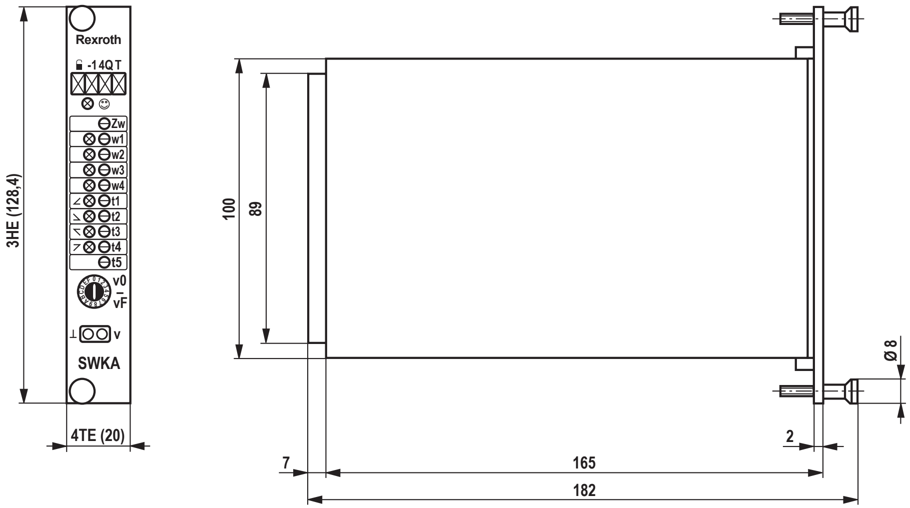
For further information and important notices see product description and commissioning instructions 30255-B.

Display / adjustment elements (continued)

Measuring socket "v"

Signal designation	Measuring point selector switch	Measurement signal "v"
Internal command value	0	±100 % ≙ ±10 V
Command value call-up 1	1	±100 % ≙ ±10 V
Command value call-up 2	2	±100 % ≙ ±10 V
Command value call-up 3	3	±100 % ≙ ±10 V
Command value call-up 4	4	±100 % ≙ ±10 V
Zero point offset "Zw"	5	±30 % ≙ ±3 V
1 composite signal of the command values	6	±100 % ≙ ±10 V
Ramp output signal	7	±100 % ≙ ±10 V
Not connected	8	
Not connected	8	
Ramp time "t1"	A	10 mV ... 10 V
Ramp time "t2"	B	10 mV ... 10 V
Ramp time "t3"	C	10 mV ... 10 V
Ramp time "t4"	D	10 mV ... 10 V
Ramp time "t5"	E	10 mV ... 10 V
Current ramp time "t"	F	10 mV ... 10 V

Dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The command value card may only be unplugged and plugged when de-energized.
- Do not lay lines close to power cables.
- The distance to aerial lines, radios, and radar systems has to be 1 m at least.
- For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents).
- Always shield command value lines, connect shielding to protective earth (PE) on the card side.

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

For further information see "Product description and commissioning instructions VT-SWKA-1" (30255-B).

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Rexroth
Bosch Group

Command value signal card

RE 30282/10.12
Replaces: 07.12

Type VT-SWKA1-5-...

Component series 1X

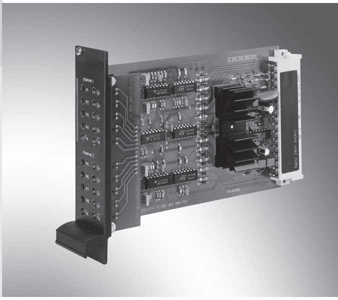


Table of contents

Contents	**Page**
Features	1
Ordering code, accessories	2
Front plate	2
Block diagram with pin assignment	3
Technical data	4
Application	4
Device dimensions	5
Project planning / maintenance instructions / additional information	5

Features

– Suitable for controlling valves with integrated or external electronics
– Analog amplifiers in Europe format for installation in 19 " racks
– Used for the command value preparation
  • 4 internal, variable command values
  • Command value call-ups using digital signals
  • 2 signal inputs for inversion

Notice:

The photo is an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-SWKA1-5 – /V0/ 0

Command value signal card

0 = No option

Customer version

V0 = Catalog version

1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

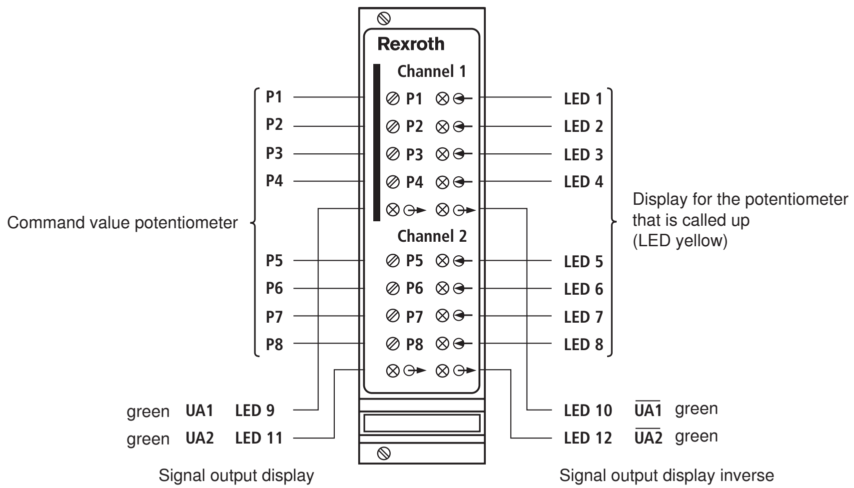
Preferred types

Amplifier type	Material number
VT-SWKA1-5-1X/V0/0	0811405093

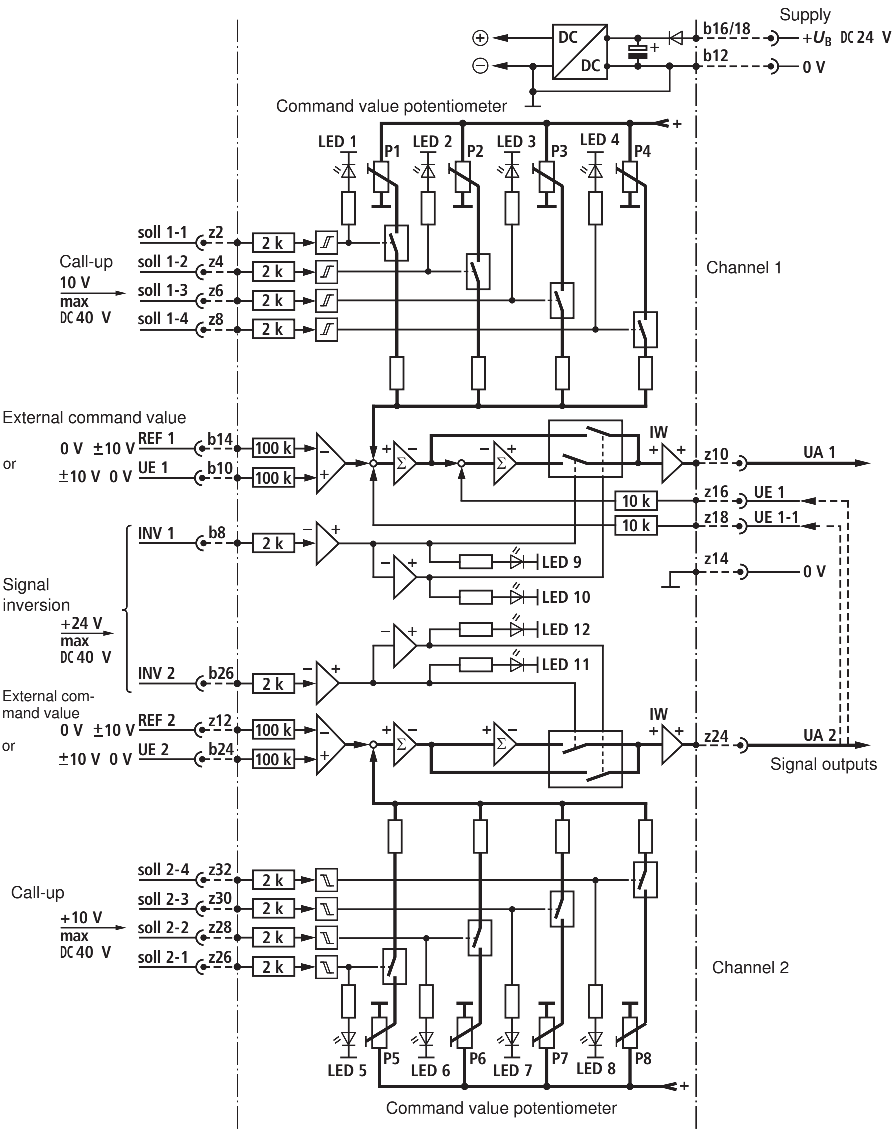
Suitable card holder:

– Open card holder VT 3002-1-2X/32F (see data sheet 29928). Only for control cabinet installation.

Front plate



Block diagram with pin assignment



Addition channel 1 and channel 2 z24 → z18; Σ P1...P8 = + U_A1

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

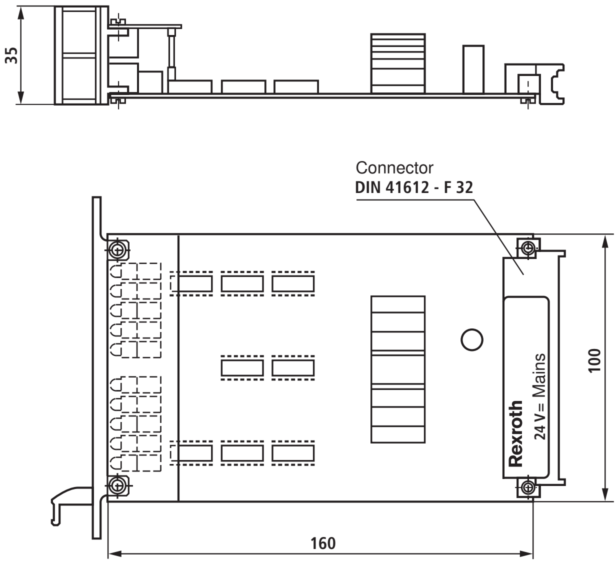
Supply voltage U_B at z2 – b2		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Current consumption	mA	Max. 150
Signal preparation		8 trimming potentiometers for 0...10 V Negative output signals by means of the external command IN_{V1} (b8) or IN_{V2} (b 26)
Signal call-up z2...z8/z26...z32		8 signal inputs +24 V (max. 40 V =) R_i = 2 kΩ P1...P4 and/or P5...P8 individually or summing
Display		Yellow LED for the potentiometer that is called up Green LED for true output signal and for inverted output signal
Summary P1...P8 via channel 1		Bridge z24–z18: P1...P4 +P5...P8 z24–z16: P1...P4 –P5...P8
Format of the printed circuit board	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE
Plug-in connection		Connector DIN 41612 – F32
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	*m*	0.33 kg

Application

Two-channel command value card for the preparation and call-up of four internal signal voltages ($U_{command}$ = 0...±10 V) per channel.

- By means of its output signals U_{A1} (channel 1) and/or U_{A2} (channel 2), the command value signal card usually controls a proportional amplifier.
- In two separate channels, you can set eight command values from 0 to +10 V, using in each case four internal potentiometers:
  P1 to P4 (channel 1)
  P5 to P8 (channel 2).
- The individual command values are called up via the external enable signals (switching signals +24 V) that are allocated to the potentiometers:
  Command 1–1 to command 1–4 (channel 1)
  Command 2–1 to command 2–4 (channel 2).
- The selected call-up is signalized by means of yellow LED displays: LED 1 to LED 8.
- Two differential inputs U_{E1} (channel 1) and U_{E2} (channel 2) allow for the feed-in of additional external command values 0 to ±10 V.
- The output signal U_{A1} (channel 1) or U_{A2} (channel 2) can be inverted by means of an external input signal IN_{V1} or IN_{V2}; i.e. positive command values U_{E1}, U_{E2} and/or the internal command values P1 to P8 result in a negative output U_{A1} or U_{A2}.
  Green LED displays at the front plate signalize that there is an inverse output signal.
- Command value signal linking. If more than four internal command values are necessary, up to eight command values can be processed by feeding in the output U_{A2} (channel 2) into channel 1.

Device dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protection circuits.

Notes

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Command value and ramp card

Type VT-SWKA2-5-...

Component series 1X

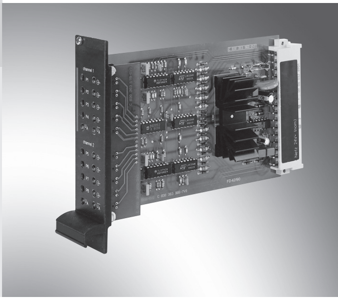


Table of contents

Features

– Analog amplifiers in Europe format
– Preparation and call-up of signal voltages
– Generation of voltage ramps via potentiometers
– Accessory card for electric amplifiers

Notice:
The photo is an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-SWKA2-5 – 1X / V0 / 0

Command value and ramp card

0 = No option

V0 = Customer version
Catalog version

1X = Component series 10 to 19
(10 to 19: Unchanged technical data and pin assignment)

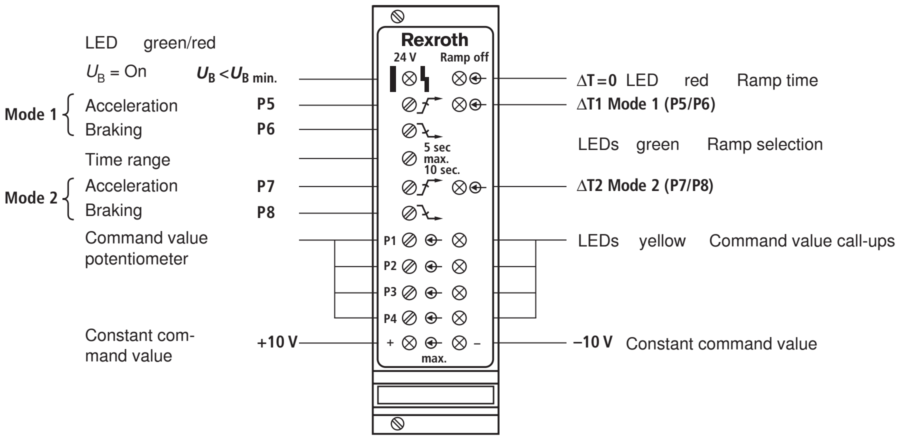
Preferred types

Amplifier type	Material number
VT-SWKA2-5-1X/V0/0	0811405094

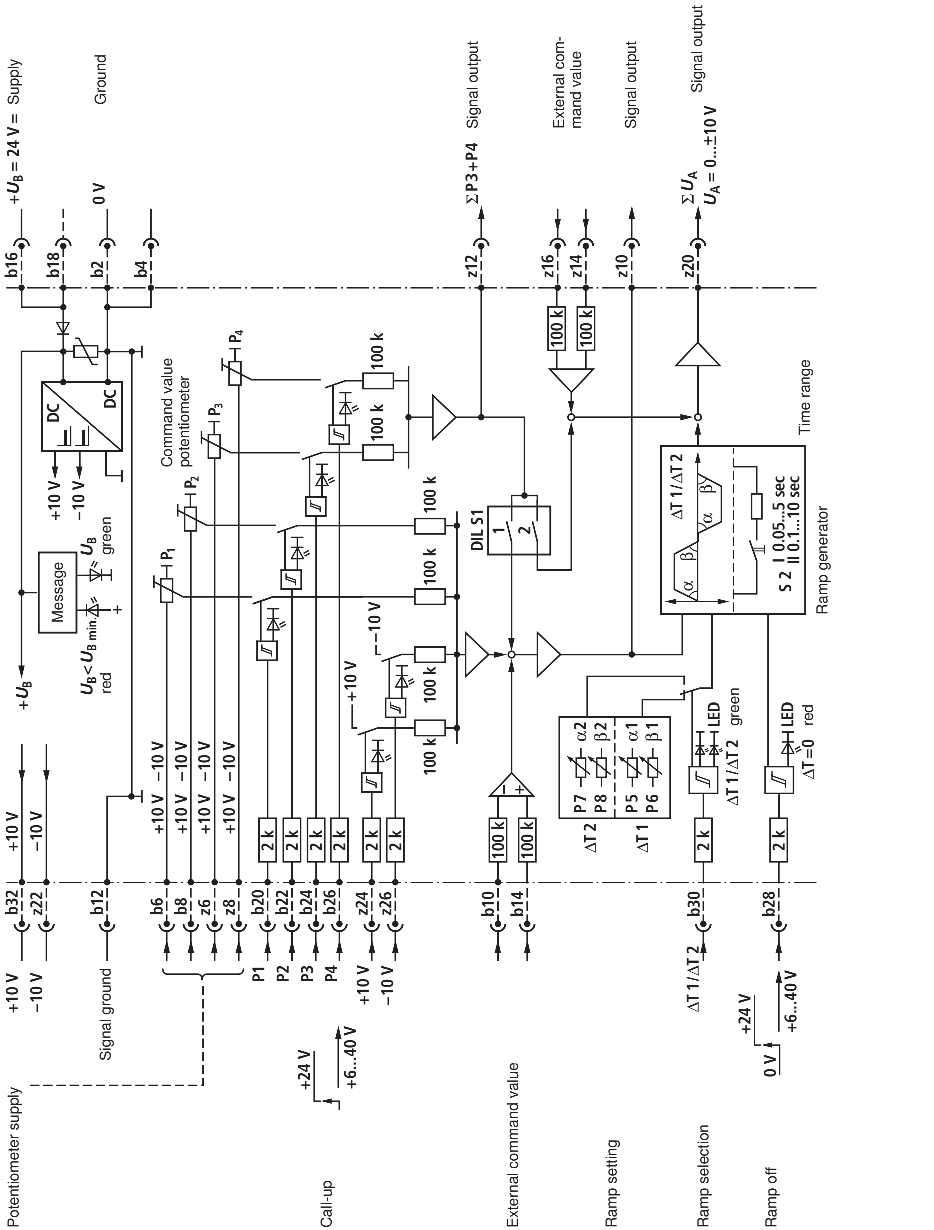
Suitable card holder:

– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



Block diagram with pin assignment



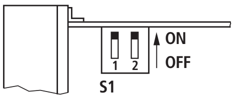
Technical data (For applications outside these parameters, please consult us!)

Supply voltage U_B at b16 – b18 and b2 – b4		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Max. current consumption	mA	350
Command value preparation		– **2 internal, fixed command values:** +10 V and –10 V, can be called via digital signals (+24 V) at z24 and z26 (e.g. use as input command values) – **4 internal, variable command values:** Adjustable via potentiometers P1...P4 on the front plate Supply from internal, stabilized voltage source b32 = +10 V and/or z22 = –10 V (can in each case be loaded with 100 mA) Command value call-up via digital signals (+24 V) at the terminals b20, b22, b24 and b26 – **1 input for external command value specification:** Designed as differential amplifier Input voltage 0...±10 V at terminals b10 and b14 Input impedance R_i = 100 kΩ – **1 input for external command value specification:** Designed as differential amplifier Input voltage 0...±10 V at terminals z14 and z16 Input impedance R_i = 100 kΩ Additional command value input without ramp function, can be added to the ramp command value as bypass signal
Ramp generation		– **Selection of two ramp time ranges** t1 = 0.05...5 s, t2 = 0.1...10 s – **Separate** ramps which can be adjusted **at potentiometers** for acceleration α1, α2 (P5 and P7) and braking β1, β2 (P6 and P8) – Selection of **two ramp time combinations** α1, β1 or α2, β2. Selection via digital signal (+24 V) at terminal b30 High level (+24 V) ≙ α2, β2 (P7/P8), low level (0 V) and/or open input ≙ α1, β1 (P5/P6) – **Automatic quadrant recognition** of the ramps for positive and negative command values – **"Ramps Off" control** with digital signal (+24 V) at b28 High level (+24 V) ≙ ramp Off, low level (0 V) and/or open input ≙ with ramps
Signal outputs		– Main output (z20), signal ground (b12) – Additional output (z12) total command value from P3 and P4 without ramp control, see block diagram – Additional output (z10) total command value without ramp control. Is formed from Σ P1...P4 and external command value b10/b14. Can be measured as input signal for ramp generator – Every output can be loaded with 10 mA (load = 10 kΩ)
Digital inputs (control inputs)		– Signal voltage U_E = +6...+40 V, $U_{E\,nom.}$ = +24 V High signal ≧ +6 V, low signal ≦ +6 V Input impedance R_i = 2 kΩ (input current approx. 10...15 mA)
Displays/messages (see page 2)		– LED displays for active command values P1...P4 and/or fixed command values +10 V and –10 V – LED display for ramp combination (α1, β1) or (α2, β2) – LED display with "Ramp Off" mode – LED operating messages with 2-color LED green: Operating voltage U_B = On red: Operating voltage too small
Format of the printed circuit board	mm	(100 x 160 x ca. 35) / (W x L x H) Europe format with front plate 7 TE
Plug-in connection		Connector DIN 41612 – F32
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	*m*	0.33 kg

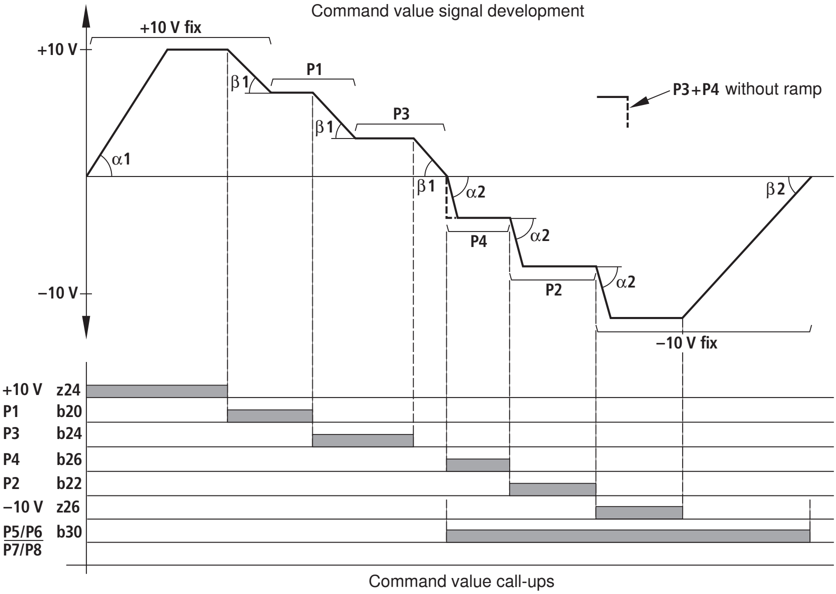
Applications

1. Preparation and call-up of signal voltages U_E = 0...±10 V.
2. Generation of voltage ramps t = 0.05...10 s via potentiometer settings on the front side.
3. By means of the DIL switch S1, the command values P3/P4 can be connected with or without ramp function.

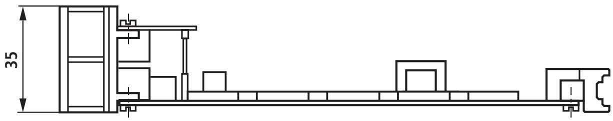
DIL S1. __		Ramp
.1	.2	.P3/P4
1	0	EIN/ON
0	1	AUS/OFF

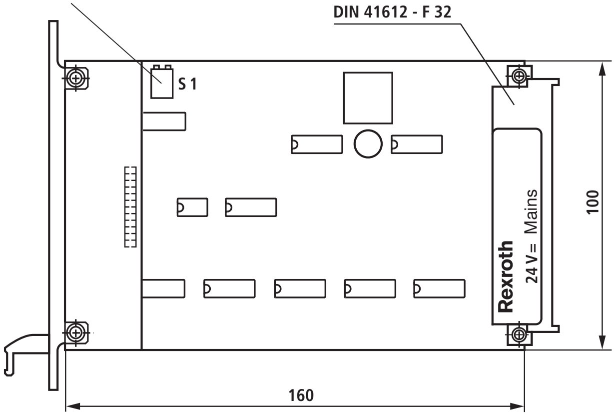


Command value run program
Example



Device dimensions (dimensions in mm)





Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protection circuits.

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Motion

Designation	Type	Component series	Data sheet	Page
Analog				
Analog positioning module	VT-MACAS	1X	30050	413
p/Q closed-loop control amplifier	VT-VARAP1	2X	30058	425
p/Q closed-loop control amplifier	VT-VACAP	2X	30134	439
Δp/Q controller	VT-VACAF	1X	30136	451
Integrated				
4/3 proportional directional valve with integrated digital electronics and field bus interface (IFB-P)	4WREF	2X	29048	467
4/3-proportional directional valve direct operated, with pQ functionality	STW 0195, STW 0196	2X, 1X	29014	489
4/3-proportional directional valve direct operated, with pQ functionality	4WREQ	2X	29050	507
High-response valve with integrated digital axis controller (IAC-Multi-Ethernet)	4WRPDH	2X	29391	533
High-response valve with integrated digital axis controller (IAC-R) and field bus interface	4WRPNH.../24	2X	29191	555
High-response valve with integrated digital axis controller (IAC-R) and clock-synchronized PROFIBUS DP/V2 (PROFIdrive profile)	4WRPNH.../24F	2X	29291	577
Standard				
Digital closed-loop control electronics	VT-HACD-3	2X	30543	595
Digital command value and controller card	VT-HACD-1	1X	30143	611
Digital Controller for electro-hydraulic Injection Molding Machines	VT-HACD-DPQ	2X	30146	625
Programmable				
Digital axis control	VT-HNC100	3X	30139	635
Digital drive controller for hydraulic axes with sercos interface	VT-HNC100.../S	3X	30159	655
Digitale Reglerbaugruppe HNC100-SEK zur Sekundärregelung von Axialkolbeneinheiten	SYHNC100-SEK	3X	30162	669
Digital axis control	VT-HNC100-1, VT-HNC100-2	2X	30131	689
Advanced				
Digital multi-axis NC control	VT-MAC8	1X	30156	703
Motion-Logic System IndraMotion MLC, controller-based	See catalog “Automation Systems and Control Components, 72604			

3

Analog positioning module

RE 30050/07.12
Replaces: 03.04

Type VT-MACAS-...

Component series 1X

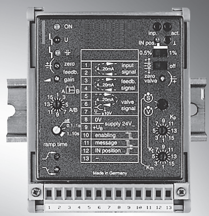


Table of contents

Contents	**Page**

Features

- Suitable for controlling valves with installed electronics for position and velocity control
- Design: Module for snapping onto carrier rails
- Enable input
- Cable break detection for actual value cable
- Interfaces short-circuit-proof
- Test points on front plate
- Compensation step that can be switched off
- Position: PT1 control
- Velocity control possible in connection with tachometer (speed indicator): PI control
- Area adjustment cylinder

Notice:

The photo is an example configuration.
The delivered product differs from the figure.

Ordering code

VT-	M	A	C	A	S	– 500	– 1X	/ V0	/

Hydraulic component
Axis control **= A**

Type
Controller **= C**

Control
Analog **= A**

Function
Position control **= S**

Option
Marking
without = Variant with voltage input
I = Variant with current input

Customer version
V0 = Catalog version

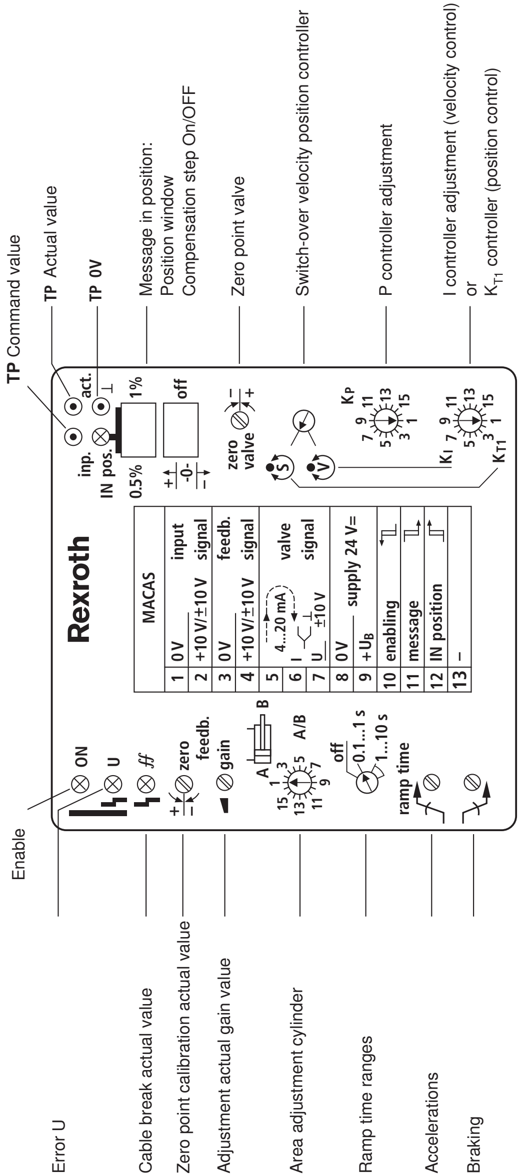
1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

Serial number for types
500 = Standard variant without valve amplifier function

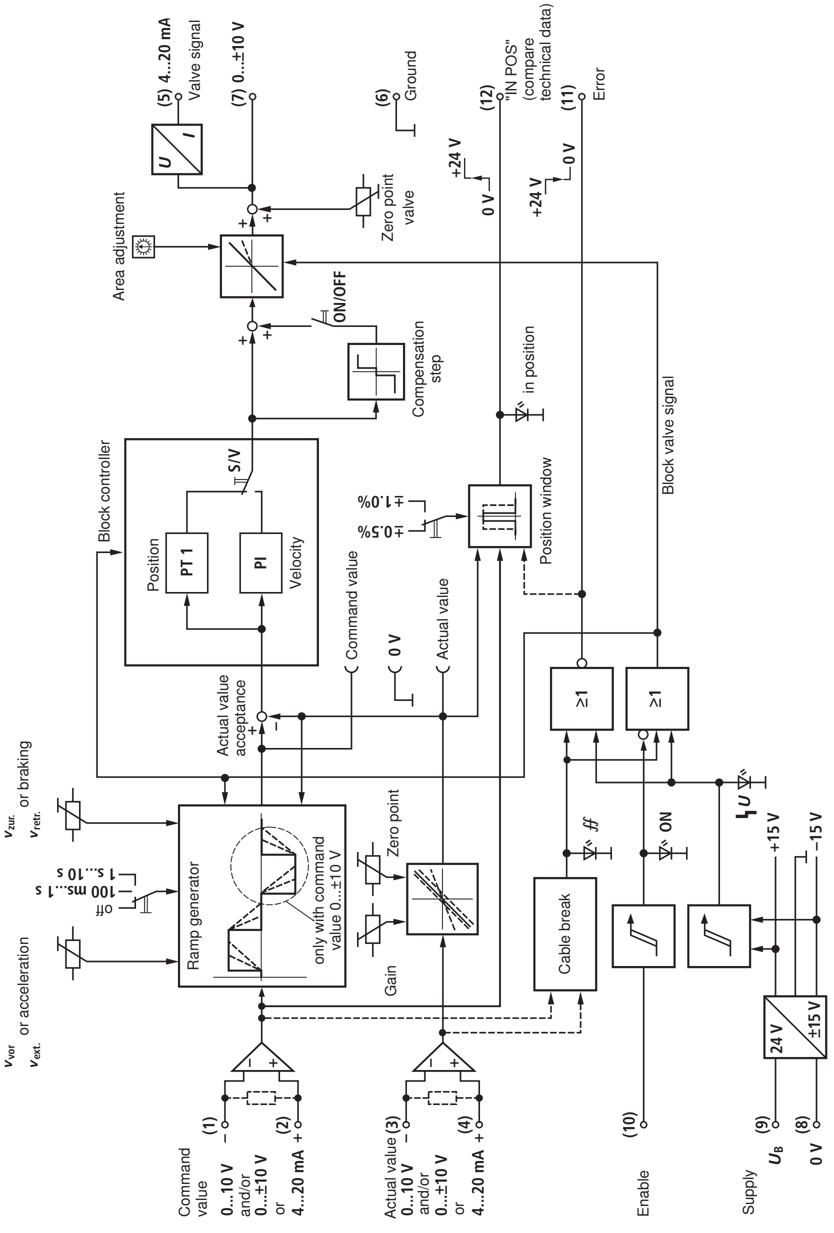
Preferred types

Amplifier type	Material number
VT-MACAS-500-10/V0	0811405139
VT-MACAS-500-10/V0/I	0811405140

Front plate


TP Command value
TP Actual value
TP 0V
Message in position:
Position window
Compensation step On/OFF
Zero point valve
Switch-over velocity position controller
P controller adjustment
I controller adjustment (velocity control)
or
K T1 controller (position control)
Enable
Error U
Cable break actual value
Zero point calibration actual value
Adjustment actual gain value
Area adjustment cylinder
Ramp time ranges
Accelerations
Braking
Rexroth
MACAS
1 0V input
2 +10 V/±10 V signal
3 0V feedb.
4 +10 V/±10 V signal
5 4...20 mA valve
6 I signal
7 U ±10 V
8 0V
9 +UB supply 24 V=
10 enabling
11 message
12 IN position
13 –
inp.
act.
IN pos.
0.5%
1%
off
-0-
zero valve
KP
KI
KT1
ON
U
zero feedb.
gain
A/B
A
B
off
0.1...1 s
1...10 s
ramp time

Block diagram with pin assignment



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

Supply voltage (8), (9)			Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Current consumption, max.		mA	200
Signal input (1), (2)	VT-MACAS-500-10/V0		$U_{command}$: ±10 V, differential amplifier R_i = 100 kΩ
	VT-MACAS-500-10/V0/I		$I_{command}$: 4...20 mA R_{sh} = 200 Ω
Actual value signal (3), (4)	VT-MACAS-500-10/V0		U_{actual}: ±10 V, differential amplifier R_i = 100 kΩ
	VT-MACAS-500-10/V0/I		I_{actual}: 4...20 mA R_{sh} = 200 Ω
Valve signal (5), (6, (7))			U_V = ±10 V (max. 10 mA) or I_V = 4...20 mA (middle 12 mA)
Compensation step			Can be switched off; effective in a range of ± 4 %
Enable signal (10)		V=	8.5...40
Error message (11)			No error: 24 V_{nom} (U_B) max. 50 mA Error: < 2 V
IN POS message (12)			IN POS: 24 V_{nom} (U_B) max. 50 mA Not IN POS: < 2 V
Ramp ranges			I: 0.1 ... 1 s II: 1 ... 10 s
Area adjustment $A_K : A_R$			Min. 1:1; max. 1:4
Actual value adjustment			Zero point: –5...10 % Gain: 50...110 %
Controller type			Position: PT_1 Velocity: PI
Zero point valve		%	±5
Special features			– Switchable from position to velocity control – Switchable position window – Test points on front plate – Interfaces short-circuit-proof
Format/design		mm	(86 x 110 x 95.5) / module
Mounting			Top hat rail TH35-7,5 or G rail G32 according to EN 60715
Connection			Connectors + terminals
Ambient temperature		°C	0...+70
Storage temperature range		°C	–20...+70
Weight		*m*	0.38 kg

3

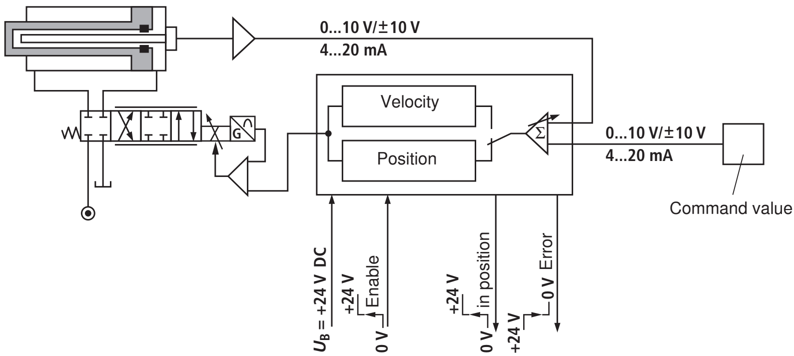
Function

Applications

By means of this controller module, simple position or velocity controls can be represented in connection with Bosch Rexroth servo cylinders with analog position measurement systems (potentiometer). As the entire signal processing is analog and the module is only equipped with the necessary features for the set-up of controls, the costs for the drive can be kept low. There is moreover the particularity that the module can be internally switched to velocity control (front plate) and one version is in each case offered for voltage interface and current interface, referring to the command and actual values.

Position control

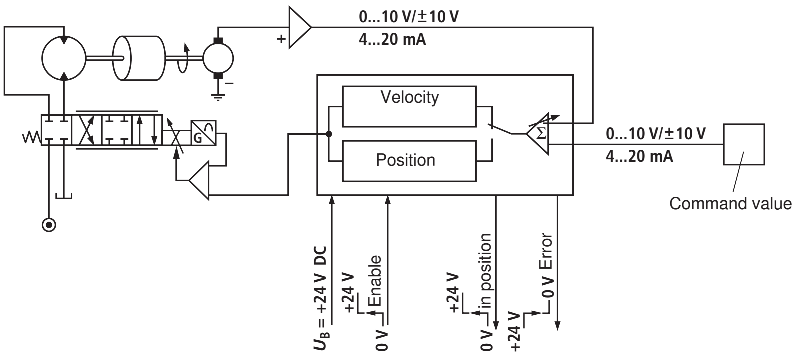
Command and actual value of the position are compared and the deviation is forwarded to the valve amplifier. In case of an abrupt change of the input signal, the system will react with maximum dynamics. The times for accelerating or braking a load are either limited by the available power or the system gain. With a ramp function as input value, the load is moved with a constant velocity.



Velocity control*

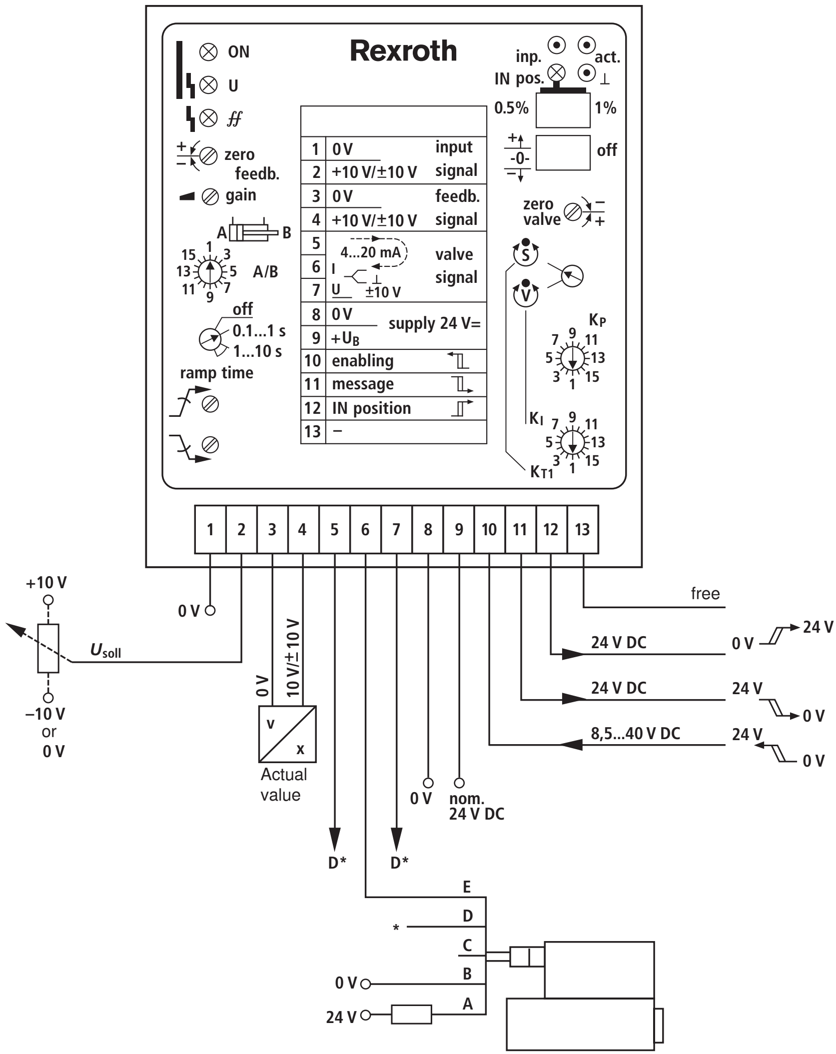
Command and actual value of the velocity are compared and the deviation is forwarded to the valve amplifier. The signal is amplified by integration so that even smallest errors are compensated.

With a ramp function as input signal, there is a gradual acceleration and/or deceleration with a constant value.
* Only possible with tachometer (speed indicator).



Electrical connection

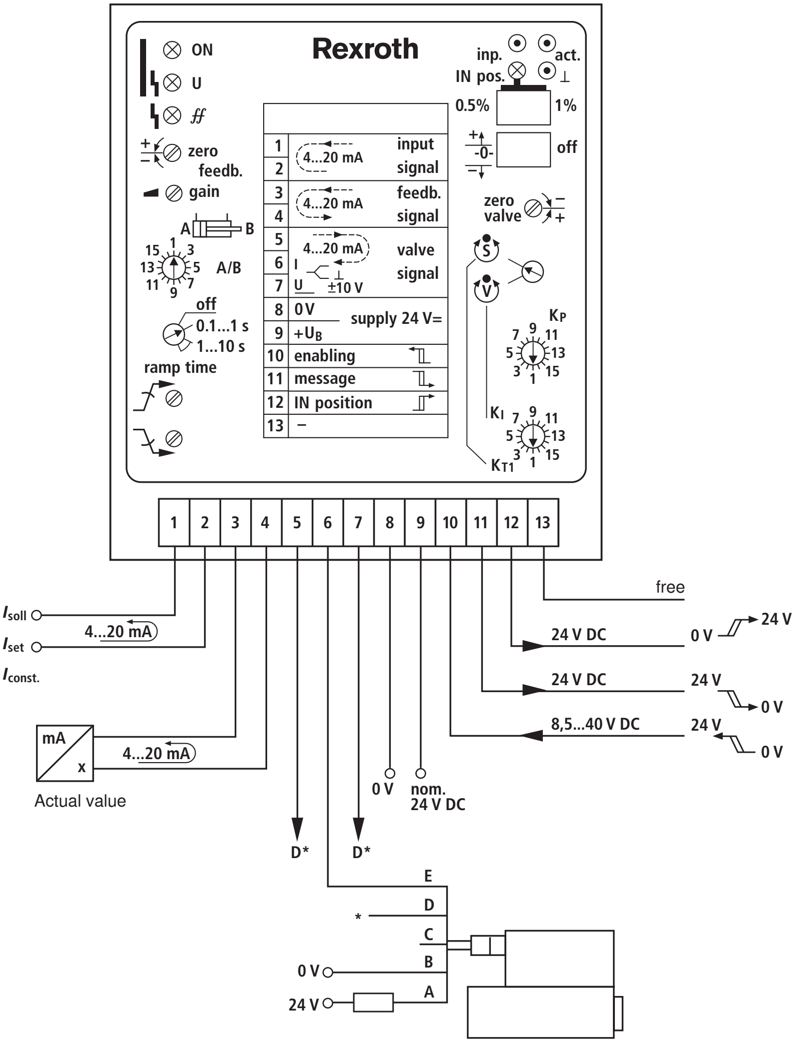
Wiring diagram
AVPC-V



D* valve signal for valve with voltage or current interface

Electrical connection

Wiring diagram
AVPC-mA



D* valve signal for valve with voltage or current interface

Adjustment and commissioning

The entire adjustment of the module is carried out at the front plate with operating pressure.

Checking the wiring (page 6)	
↓ Mode settings	– Velocity controller/position controller – Compensation step ON / OFF – Position window 0.5 % / 1 % – Ramp ON / OFF
↓ Controller default setting	– K_P = 1 with position control – K_I = 2 / K_{TI} = 1 with velocity control (K_I = 1 forbidden)
↓ Area ratio default setting	– Hex switch "A / B"; according to the area ratio of the cylinder
↓ Supply voltage ON Enable ON (cl. 10)	– LED "ON" is illuminated – LED "ϟU" and LED "ϟ∫∫" are not illuminated → otherwise, see error reactions, page 10
↓ Adjustment of the actual value transducer	– Specification of the command value minimum → by means of "zero feedb." potentiometer actual value adjustment to 0 V (TP "act." against TP "⊥") – Specification of the command value maximum (e.g. + 10 V; 20 mA) → by means of "gain" potentiometer actual value adjustment to 10 V (TP "act." against TP "⊥") **Notice** At the 13-pin connection terminal of the module, no measuring devices must be connected in order to perform voltage measurements of the actual or command value.
↓ Adjustment of the valve signal	– Enable OFF – Specification of the command value for valve zero position → By means of "zero valve" potentiometer adjustment of the valve signal (e.g. cylinder standstill; 0 V at the valve)
↓ Controller adjustment	– Gradual increase in the K_P share, then – Gradual increase in the K_{TI} /K_I share – Adjustment aid, page 10
↓ Ramp adjustment	– If ramp function required: Ramp ON → time range pre-selection – Specification of the command value step (e.g. 20%...60%) Setting of the velocity ramps (position) and/or acceleration ramps (velocity) by means of the potentiometer
↓ Fine adjustment area adjustment	– Comparison of the chronological sequence s(t) and/or v(t) of both directions of movement by means of an oscilloscope → by means of hexcode switch "A / B" compensation of differences

3

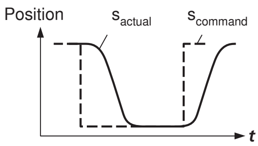
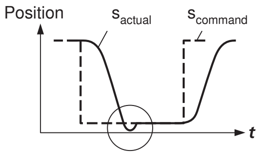
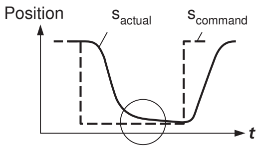
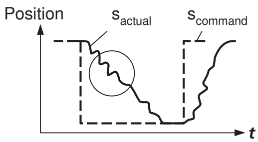
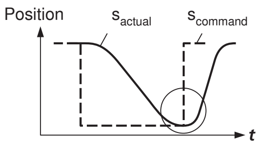
Error reactions

ϟ U: Tripping if the value falls below the minimum internal supply voltage
⇒ Valve signal 0 V and/or 12 mA;
⇒ Message LED "ϟ U" and (11)

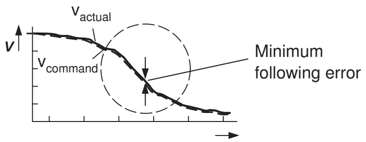
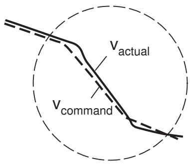
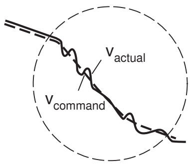
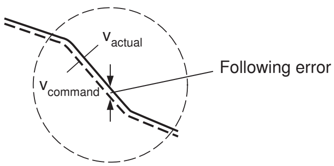
Possible causes: External supply voltage too low (< 16 V) or internal error (→ repair).

ϟ ∫∫: **Tripping** if the actual value or command value lines break
⇒ Valve signal 0 V and/or 12 mA;
⇒ Message LED "∫∫" and (9)

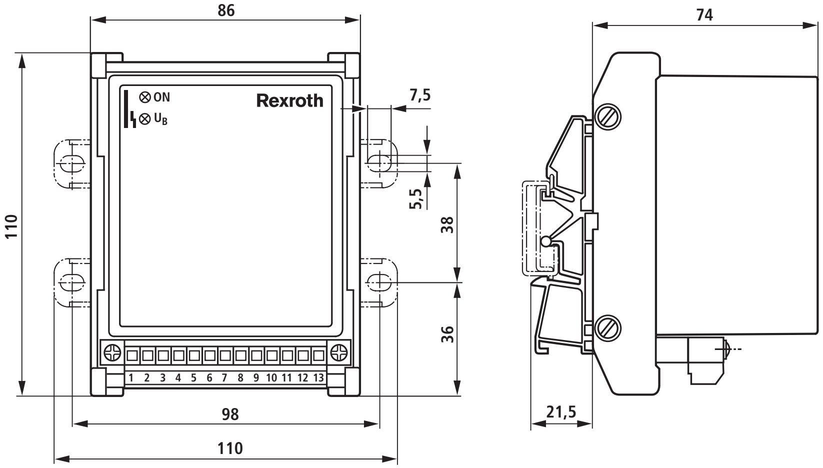
The error is stored.
Deletion of the error by switching the enable signal or the supply voltage off and on again.

	Ideal development (without command value ramps)
	"Overshooting", P gain too high, → rotate switch K_P against 1
	"Creeping into the position", P gain too low, → rotate switch K_P against 16
	"Vibrations", time constant too small, → rotate switch K_{T1} against 16
	"Area ratio wrong"; set symmetric motion sequence by means of switch A/B

Velocity controller adjustment

	Ideal development (without command value ramps)
	P gain too small, → rotate switch K_P against 16
	P gain too large, → rotate switch K_P against 1
	P gain correct, however following error too large, minimization of the following error by means of the I controller → rotate switch K_I until the min. following error is reached

Device dimensions (dimensions in mm)



Wall mounting (86 x 110 x 95.5) mm Carrier rail assembly (snap-in)

Project planning / maintenance instructions / additional information

- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protection circuits.

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Rexroth
Bosch Group

p/Q closed-loop control amplifier

RE 30058/06.12
Replaces: 03.04

Type VT-VARAP1-...-2X/...

Component series 2X

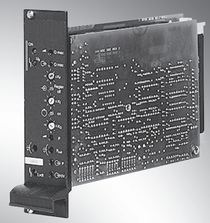


Table of contents

Contents	**Page**

Features

- Suitable for controlling direct and pilot operated control valves
- Amplifier with additional electronics (daughter card)
- Analog amplifiers in Europe format for installation in 19" racks
- Valve position control with PID behavior
- Pressure control with external pressure load cell
- Controlled output stage
- Enable input
- Outputs short-circuit-proof
- Adjustment possibilities – Zero point valve
- Cable break detection for actual value cable and pressure sensor
- Fast energization and fast deletion for short actuating times
- External controller shut-off
- Suitable for pressure sensors (1...6 V, 0...10 V, 4...20 mA), see data sheet 30271

Notice:

The photo is an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT-	V	A	R	A	P	1 –	– 2X /	V0 /	

Hydraulic component (control)
Axis control **= A**

Valve type
High-response valve **= R**

Control
Analog **= A**

Function
p/Q control **= P**

Output stages
1 output stage **= 1**

Serial number for types
527 = 2.7 A solenoid
537 = 3.7 A solenoid

2X = Component series 20 to 29 (20 to 29: Unchanged technical data and pin assignment)

Customer version
V0 = Catalog version

Option
no code = High-response valve size 6/10 direct operated
5/3V = *p/Q* valve size 10 direct operated
2STV = High-response valve pilot operated
3/2V = High-response valve pilot operated Control line A → X

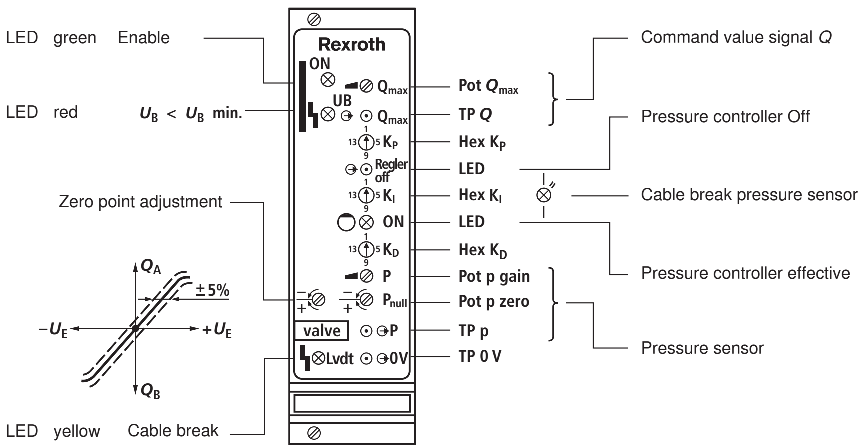
Preferred types

Amplifier type	Material number	For high-response valves with electrical position feedback
VT-VARAP1-527-20/V0	0811405152	4WRPH6...
VT-VARAP1-537-20/V0	0811405153	4WRPH10...
VT-VARAP1-537-20/V0/5/3V	0811405154	5WRP10...
VT-VARAP1-527-20/V0/2STV	0811405155	4WRL...
VT-VARAP1-527-20/V0/3/2VAX	0811405156	3WRCBH25...50...

Suitable card holder:

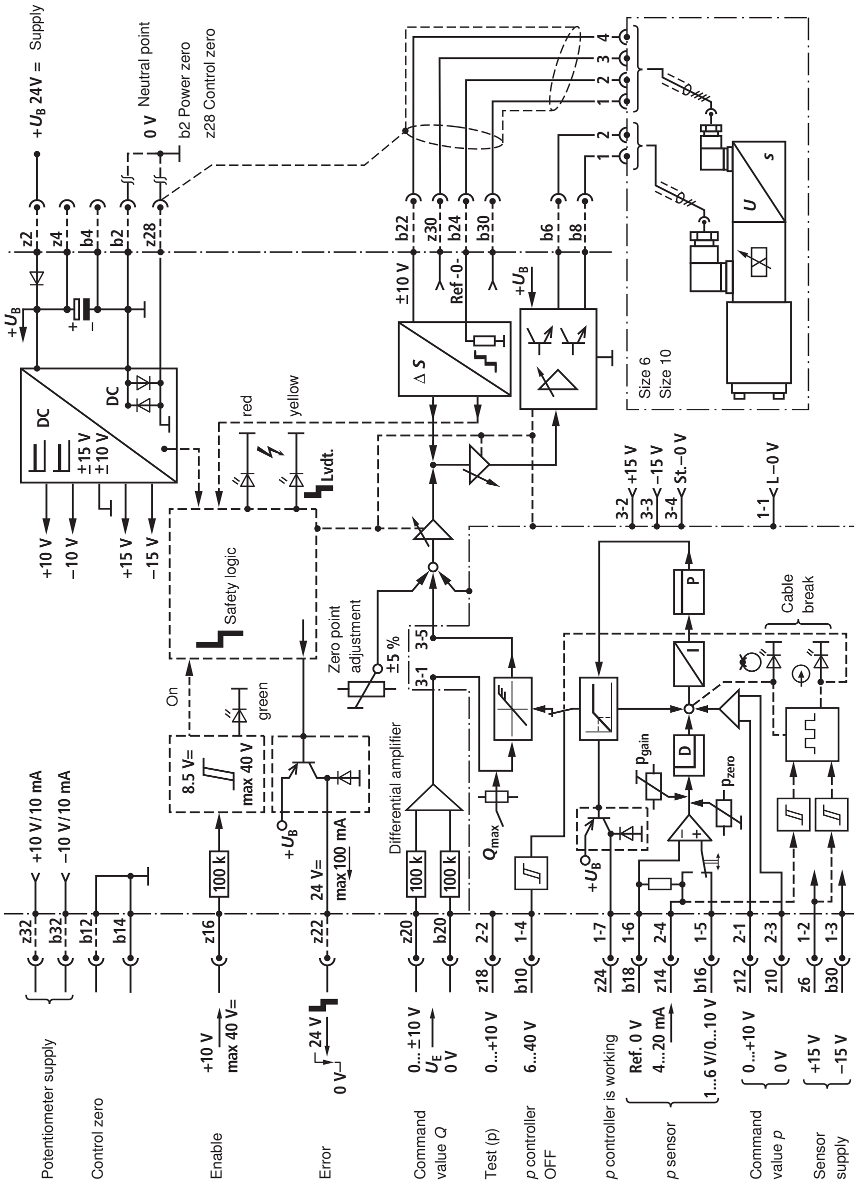
– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



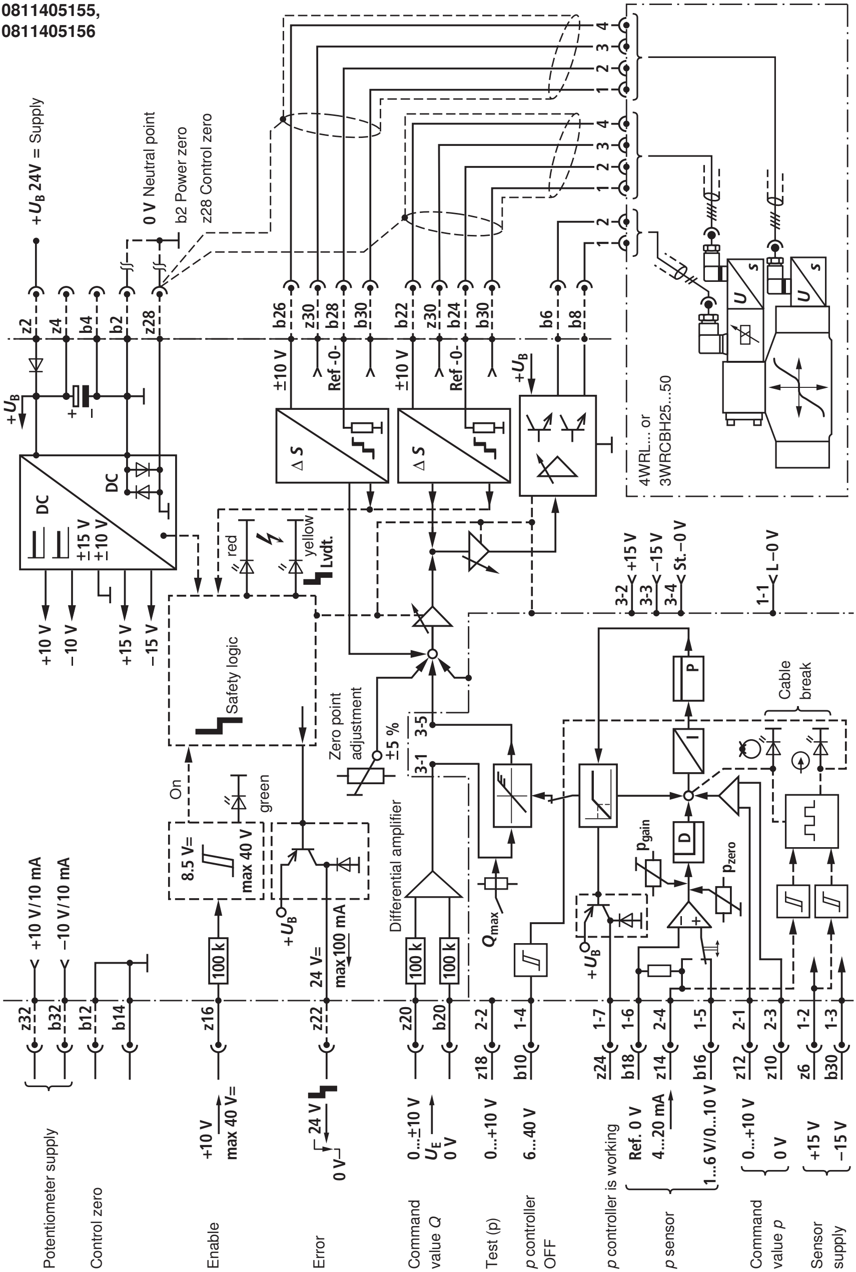
Block diagram with pin assignment

0811405152, 0811405153, 0811405154



Block diagram with pin assignment

0811405155, 0811405156



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

Supply voltage U_B at z2 – b2		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)	
Valve solenoid, max.	A/VA	**2.7/40 (size 6)**	**3.7/60 (size 10)**
Current consumption, max.	A	1.7	2.7
		The current consumption may increase with min. U_B and extreme cable length to the control solenoid	
Power consumption (typical)	W	37	55
Input signal (command value)		b20: 0...±10 V } Differential amplifier z20: 0...±10 V (R_i = 100 kΩ)	
Input signal (command value *p*)		z12: 0...10 V } Differential amplifier z10: 0 V	
Actual value from the pressure sensor		z14: 4...20 mA – Current input b16: 0...+10 V/1...+6 V – Voltage input b18: 0 V – Reference	
Pressure controller OFF		b10: 6...40 V =	
External enquiry pressure controller active		z24: 24 V/0.1 A max.	
Limit frequency		For applications ≦ 30 Hz	
Signal source		Potentiometer 10 kΩ Supply with ±10 V from b32, z32 (10 mA) or external signal source	
Enable output stage		At z16, U = 8.5...40 V, R_i = 100 kΩ, LED (green) on front plate lights up	
Sensor supply		z6: +15 V/35 mA, R_i ~ 25 Ω	
Position transducer	Supply	b30: –15 V (25 mA) z30: +15 V (35 mA)	
Pilot control valve	Actual value signal	b22: 0...±10 V, R_L = 10 kΩ/Ref. b24	
Main stage	Actual value reference	b26: 0...±10 V, R_L = 10 kΩ/Ref. b28	
Solenoid output b6 – b8		Clocked current controller	
	I_{max}	2.7 A	3.7 A
Cable lengths between amplifier and valve		Solenoid cable: up to 20 m 1.5 mm² 20 to 60 m 2.5 mm² Position transducer: 4 x 0.5 mm² (shielded) Pressure sensor: 4 x 0.5 mm² (shielded)	
Special features		Cable break protection for actual value cable, Position control with PID behavior, Pulsed output stage, Fast energization and fast deletion for short actuating times, Short-circuit-proof outputs, Controller shut-off	
Adjustment		Zero point via trimming potentiometer ±5 % Command value attenuator *Q* Pressure controller K_P, K_I and K_D Sensitivity pressure load cell Zero point pressure load cell	
LED displays		green: Enable yellow: Cable break position transducer red: Supply voltage (U_B too low) yellow: Pressure controller OFF yellow: Pressure controller is working both yellow LEDs are flashing: Cable break pressure sensor	

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

Error message – Cable break actual value – U_B too low – ±15 V stabilization		z22: Open collector output to $+U_B$ Max. 100 mA; no error: $+U_B$
Circuit board format	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front panel 7 TE
Plug-in connection		Connector DIN 41612 – F32
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	*m*	0.49 kg

Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

Additional information

Applications

The *p/Q* closed-loop control amplifiers consist of a basic card with front plate containing the valve amplifier with position control as well as an attached daughter card on which the actual pressure control has been realized.
These amplifiers are only supplied as complete combinations. In connection with the corresponding high-response valves (see table page 2) and pressure sensors (sensor signal 1...6 V, 0...10 V or 4...20 mA), flows can be controlled and pressures in closed control loops can be regulated.
The input variables are the pressure *p* and flow *Q* command values. Pressure and valve spool path are fed back as actual values.

The combination of valve amplifier and *p/Q* controller takes effect:

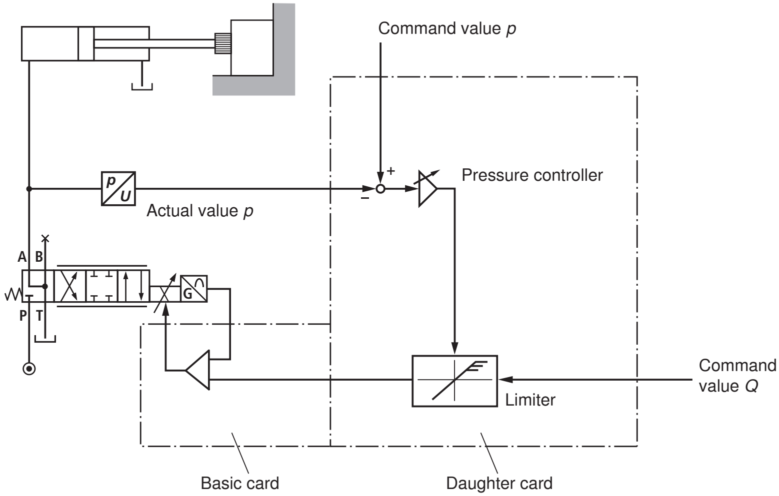
a) As long as $p_{command} < p_{actual}$ as flow control, i.e. the pressure control does not take effect, yet.
b) With $p_{command} \geqq p_{actual}$ as pressure control, i.e. the flow is reduced until $p_{actual} = p_{command}$. The pressure control works only with a positive command value voltage at z20.

The command value *Q* corresponds to the spool path as long as the pressure control does not take effect, yet, i.e. $p_{command} > p_{actual}$ or if the pressure controller is switched off (DIL 4 OFF). The command value *Q* may range between U_E = 0...±10 V. For the dynamic pressure control there should, however, in addition to the command value *p* also be a command value Q_1 $U_E \geqq$ 2...+10 V.

Examples

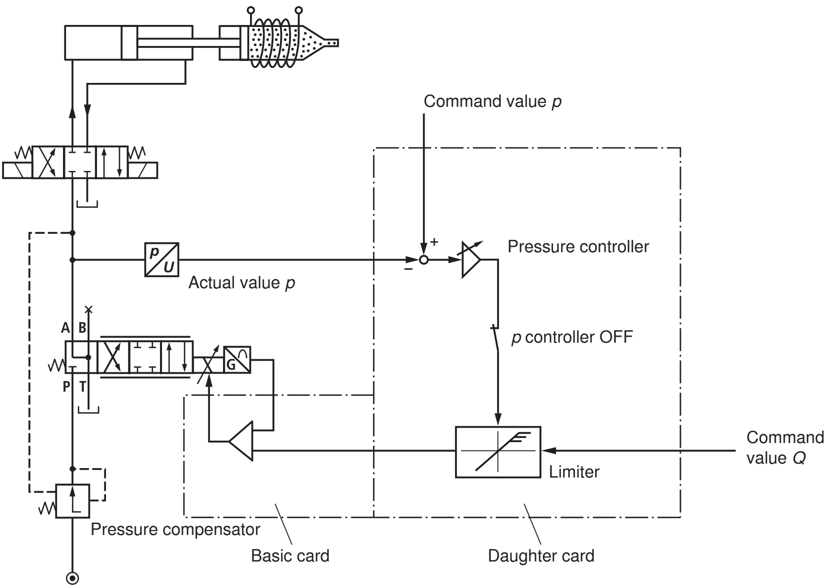
Example 1

Pressure control in a cylinder chamber for achieving a constant clamping force.



Example 2

Flow with load compensation controlled via pressure compensator and the pressure regulated in the closed control loop (pressure cut off).

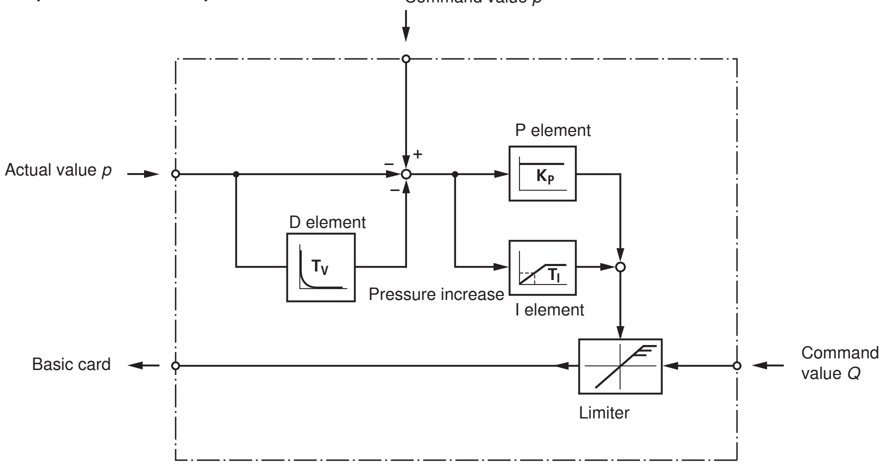


Function

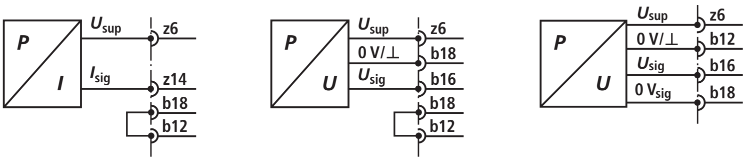
The combination of basic card and daughter card is shown in the block diagrams on page 3 and 4. Details of the daughter card, i.e. the pressure control, result from a detailed block diagram on page 9.
The command value *p* (z12) is specified by the user by a voltage 0...+10 V, e.g. by means of a potentiometer which can be supplied from z32/b12 (z10 to 0 V).
The actual value *p* is supplied by a pressure sensor. Optionally, sensors with current signal interface 4…20 mA or voltage signal interface 1…6 V and/or 0…10 V can be used.
Zero point and sensitivity of the sensor can be set at the front plate. Cable break of the pressure sensor is signalized (LEDs flash) if the sensor is supplied at z6.
Command and actual value are compared in the summing point which is moreover affected by a differentiated actual value.

The control deviation is amplified by a PID controller and reaches a limiter superimposing the command value *Q* with the pressure controller signal if $p_{command} \leqq p_{actual}$.
As long as $p_{command} > p_{actual}$ or if the command value *Q* ranges between 0…–10 V, the limiter and thus the pressure control do not take effect and there is simple flow control.
The characteristic of the PID controller and the D element can be roughly set by means of the DIL switch on the daughter card and finely by means of the HEXCODE switch on the front plate. If the pressure is regulated, this condition is displayed on the front plate (LED) and can be used for switching purposes via an acknowledgement output (z24).
However, the pressure control can also be switched off so that there is only flow control, independent of p_{actual}.

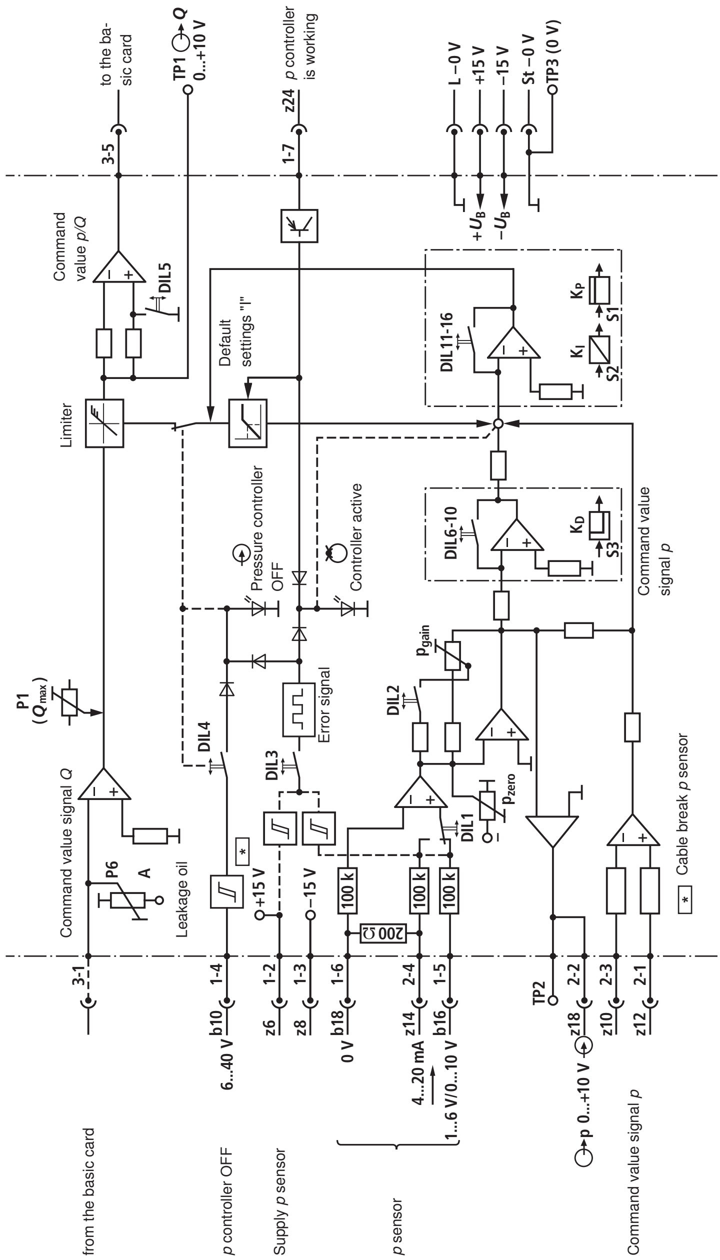
Principle of the control loop



Pressure sensor connection versions



Block diagram daughter card



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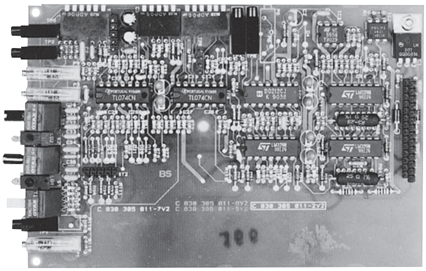
Mode setting (DIL switch, daughter card)

DIL 16...0



DIL no.	Status	Function		
0	–	without function		
1	ON	Pressure sensor signal		1...6 V/0...10 V
	OFF			4...20 mA
2	ON	Pressure sensor amplification		p_{SYS}[2] $\triangleq\sim$ p_{NOM}[3]
	OFF			$p_{SYS} \triangleq\sim 0.5\ p_{NOM}$
3	ON	Cable break monitoring pressure sensor		On
	OFF			Off
4	ON	Pressure controller		On
	OFF			Off
5	ON	Valve output signal		not inverted
	OFF			inverted
6	ON	D	Pressure build-up	normal
	OFF			reduced [1]
7	ON		Pressure reduction	normal
	OFF			reduced [1]
8	ON		Share high	(9, 10 = OFF)
9	ON		Share medium	(8, 10 = OFF)
10	ON		Share low	(8, 9 = OFF)
11	ON	I	Share = 0	(12 = OFF)
12	ON		Share available	(11 = OFF)
13	ON	P	Reduced pressure reduction	Valve opening in case of pressure reduction < approx. 15%
	OFF			ineffective
14	ON		Share low	(16 = ON/15 = OFF)
15	ON		Share medium	(14, 16 = OFF)
16	ON		Share high	(14, 15 = OFF)

[1] With DIL 6 and 7 = OFF, DIL 8...10 is ineffective

[2] p_{SYS} = System pressure

[3] p_{NOM} = Nominal sensor pressure

General notes:

Setting during the commissioning is effected using potentiometers and HEXCODE switches on the front plate as well as using DIL switches on the daughter card bottom side. Test points for voltage measurements as well as LED displays are located on the front plate. The measured values generally refer to the test point 0 V. The test points may only be loaded with measuring instruments $R_L \geqq 10\ k\Omega$. Overload impairs the control function and/or the printed circuit board is damaged.

Before the commissioning, the basic settings of the as-delivered state are to be checked.
In the card comparison, proceed in the order of the points shown:

A: Adjustment of the valve zero point (basic card front plate)

1) DIL 4 OFF (pressure controller OFF)
2) Applying the voltage and pressure supply
3) Command value specification Q = 0 V
4) Use the "Zero" potentiometer to bring the cylinder to a standstill

B: Pressure sensor comparison

1) Sensor type selection
   DIL 1 ON ≙ U_A = 1...6 V/0...10 V
   OFF ≙ U_A = 4...20 mA
2) Sensor amplification selection
   DIL 2 ON if $p_{SYS} \sim p_{NOM}$
   OFF if $0.5 \cdot p_{NOM} \leqq p_{SYS} \leqq p_{NOM}$
3) Hydraulic supply OFF
4) Zero point calibration with potentiometer "P_{Zero}" (at TP "" = 0 V)
5) Hydraulic supply ON – max. system pressure
6) Sensitivity adjustment with potentiometer " P" (at TP " P" = 10 V)

C: Comparison – command value Q

1) Specification $Q_{command}$ = 10 V
2) Limitation of the max. valve opening (50...100% opening) by potentiometer "Q_{max}". Control of the voltage value at TP "Q_{max}":
   10 V ≙ 100% Valve opening (with $Q_{command}$ = 10 V)
   5 V ≙ 50% Valve opening (with $Q_{command}$ = 10 V)

D: Controller adjustment

The P, I and D shares of the closed-loop control amplifier are to be optimized according to the properties of the control distance, the disturbance variables and the static and dynamic requirements on the control result.

1) Pressure controller ON – DIL 4 ON
2) Connection of an oscilloscope at terminals z18 and b12 (0 V) → p_{actual}
3) Usefully connection of a 2nd oscilloscope channel at z2 and z10 (0 V) → $p_{command}$
4) DIL 6 and DIL 7 serve to compensate dynamic differences in the pressure build-up and reduction in the system
   DIL 6 ON = Normal application
   OFF = Special application
   DIL 7 ON = Normal application
   OFF = Special application
5) DIL 13 – reduces the pressure reduction by means of a valve opening < approx. 15%
   ON = Special application
   OFF = Normal application
6) **Aim of the controller optimization**
   An optimum between change over characteristic (overshooting tendency with excessive static amplification) and static accuracy (control error with starting pressure cut off) is to be achieved (a).

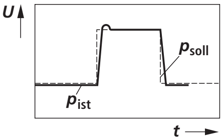
Procedure (see table, page 12)

An increase in the P share of the controller increases the dynamic of the control behavior (b). In case of excessive gain, the tendency to oscillate increases (c). Limitation of the I share reduces the static gain. With increasing static gain, the control deviation is reduced (d).
The D share can be used to influence the transition behavior (minimization of the tendency to oscillate); thus, the command value is only reached after a longer transition time (f).

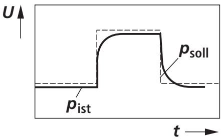
3

Ideal development

a



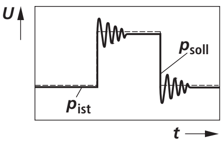
b



Problem:
P share too small
Solution:
→ Rotate K_P against 13 (fine adjustment)
→ P gain >

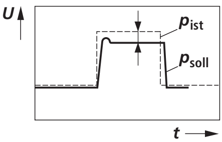
DIL 14	ON
DIL 15	OFF
DIL 16	ON

c



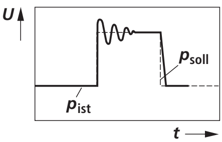
Problem:
P share too large
Solution:
→ Rotate K_P against 0 (fine adjustment)
→ use DIL 14 –16 to reduce the P gain according to the table

d



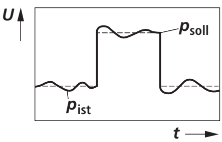
Problem:
P share correct, control deviation too large
Solution:
→ Increase the I gain share
→ DIL 11 ON = I share = 0
DIL 12 ON = I share connected
→ Rotate K_I against 13

e



Problem:
Time constant of the I share too low
Solution:
→ Rotate K_I against 13 until control deviation and vibration are perfect
→ If K_I = 13 is not sufficient, the P share must also be reduced

f



Problem:
D share too low
Solution:
→ Rotate K_D against 13
→ D share >

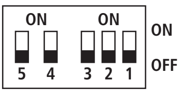
DIL 8	ON
DIL 9	OFF
DIL 10	OFF

Adjustment protocol

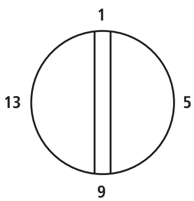
Created by:

Date:

DIL switch



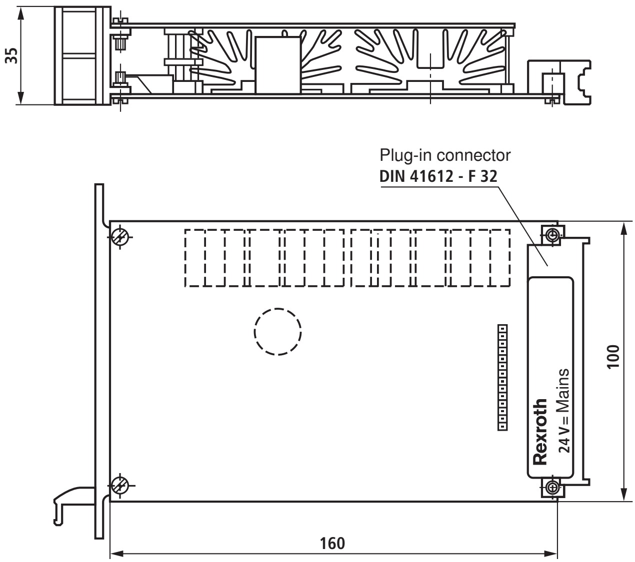
HEXCODE switch



Switches	As-delivered state		
DIL 1	OFF		
DIL 2	ON		
DIL 3	ON		
DIL 4	ON		
DIL 5	OFF		
DIL 6	OFF		
DIL 7	OFF		
DIL 8	OFF		
DIL 9	OFF		
DIL 10	OFF		
DIL 11	OFF		
DIL 12	OFF		
DIL 13	OFF		
DIL 14	OFF		
DIL 15	ON		
DIL 16	OFF		
HEX K_P	3		
HEX K_I	9		
HEX K_D	5		

3

Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 5 must be complied with.

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p/Q closed-loop control amplifier

RE 30134/06.12
Replaces: 12.05

Type VT-VACAP-500-2X/V0/...

Component series 2X

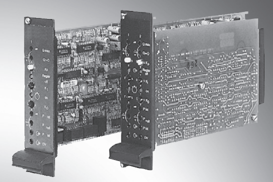


Table of contents

Contents	**Page**
Features	1
Ordering code, accessories	2
Front plate	2
Block diagram with pin assignment	3
Technical data	4
Connection scheme	5
Additional information	5
Examples	6
Functional presentation	7
Special function	7
Setting instructions	8
Controller adjustment	9
Ideal development	10
Adjustment table	11
Unit dimensions	12
Project planning / maintenance instructions / additional information	12

Features

- Suitable for controlling high-response valves with installed electronics
- Amplifier with additional electronics (daughter card)
- Analog amplifiers in Europe format for installation in 19" racks
- Valve position control with PID behavior
- Outputs short-circuit-proof
- External shut-off for pressure controller
- Suitable for pressure sensors (1...6 V, 0...10 V, 4...20 mA), see data sheet 30271
- Supply for pressure sensors
- Cable break detection for pressure sensor

Notice:
The photo is an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT– V | A | C | A | P – 500 – 2X / V0 /

Hydraulic component (control)
Axis control = A

Valve type
High-response valve = C

Control
Analog = A

Function
p/Q control = P

Serial number for types
500 = Standard variant without valve amplifier function

2X = Component series 20 to 29 (20 to 29: Unchanged technical data and pin assignment)

Customer version
V0 = Catalog version

Option
no code = 1 channel
2CH = 2 channels

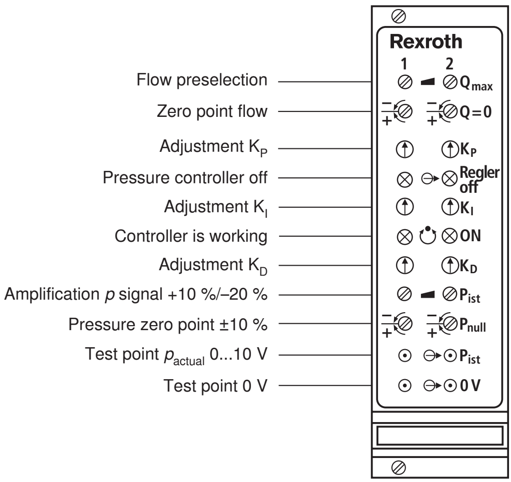
Preferred types

Amplifier type	Material number	For high-response valves
VT-VACAP-500-20/V0	0811405157	All valve types with installed electronics
VT-VACAP-500-20/V0/2CH	0811405158	

Suitable card holder:

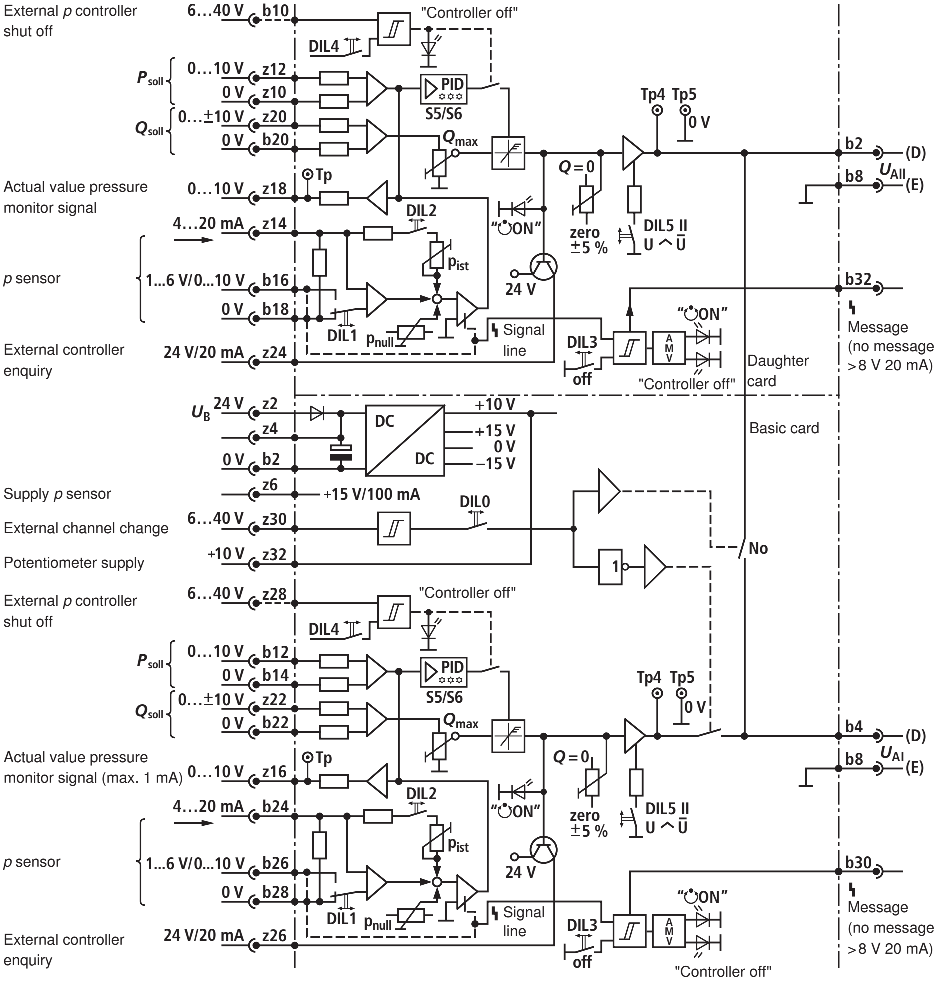
– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



1 and 2 with 0811405157
1 only with 0811405158

Block diagram with pin assignment



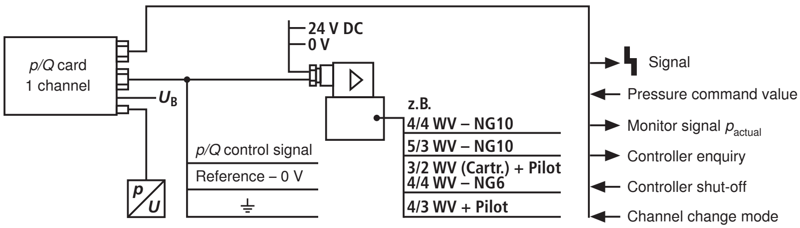
* Daughter card only attached with 2-channel variant

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

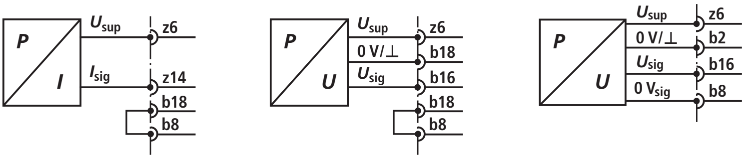
Supply voltage U_B at z2 – b2	Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at z2 – b2	Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)	
Current consumption, max. 0811405157	160 mA	
0811405158	220 mA	
	Basic card	**Daughter card**
Pressure sensor (1...6 V/0...10 V) Pressure sensor (4...20 mA)	b26 – Ref. b28 b24 – Ref. b28	b16 – Ref. b18z14 – Ref. b18
Pressure sensor supply – V	z6 (+15 V)/b8 (0 V)	
Pressure command value (0...10) V	b12/b14 (0 V)	z12/z10 (0 V)
External controller shut off	z28: 6...40 V =	b10: 6...40 V =
External controller enquiry	z26: 24 V =, max. 20 mA	z24: 24 V =, max. 20 mA
Monitor signal p_{actual}	z16: 0...10 V =	z18: 0...10 V =
External channel change mode	z30: 6...40 V =	
Flow command value	z22: 0...±10 V = b22: 0 V	z20: 0...±10 V = b22: 0 V
Potentiometer supply	z32: +10 V, max. 10 mA	
Output	U_{AI}; b4/b8 (0 V): 0...±10 V Load R_L > 1 kΩ	U_{AII}; b6/b8 (0 V): 0...±10 V Load R_L > 1 kΩ
Cable: Pressure sensor Valve PLC signals	4 x 0.5 mm^2 (shielded) 5 x 0.5 mm^2 (shielded) 0.5 mm^2 (shielded)	
LED displays/channel	Pressure controller OFF Controller is working Cable break pressure transducer (both a.-m. LEDs are flashing)	
Special features	Cable break monitoring for pressure sensor Test points for important characteristics External pressure controller shut-off External channel change mode Different pressure sensors possible	
Circuit board format mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front panel 7 TE	
Plug-in connection	Connector DIN 41612 – F32	
Ambient temperature °C	0...+70	
Storage temperature range °C	–20...+70	
Weight *m*	0811405157 – 0.35 kg, 0811405158 – 0.44 kg	

Connection scheme

Amplifier – Valve



Pressure sensor connection: Example channel II



3

Additional information

Applications

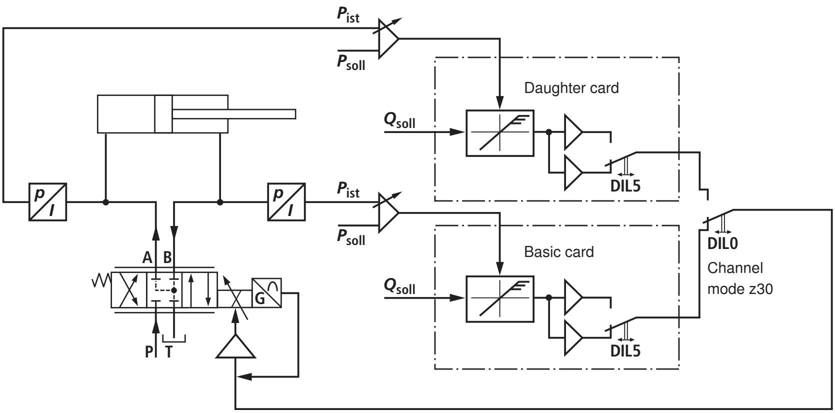
The "1-channel *p/Q* control card" consists of the basic card in Europe format with DC/DC converter and front plate. With the "2-channel *p/Q* control card", this basic card contains a *p/Q* daughter card with identical circuit and a joint front plate. The supply voltage is 24 V =. The voltage of the valve to be regulated is not supplied via this card.
Input variables for the cards are the valve position command value, the pressure command value, the actual pressure value and possible control mode signals. The pressure sensors with voltage interface receive their voltage supply from the card (z6/z8). At the card, pressure sensors with voltage and current signal can be connected.

The pressure command value can be specified by means of a potentiometer. The potentiometers can be supplied from the card (z32/b12).
For control and comparison, the front plate and the circuit board comprise test points for the most important characteristics.
The circuit of the "2-channel card" is designed so that the controllers on basic and daughter card work in a completely independent manner. In this mode, the card is suitable for controlling 2 valves with integrated electronics (see example 2, page 6).
An additional channel mode circuit allows for the considerable extension of the possible applications of the described card (see example 1, page 6).

Examples

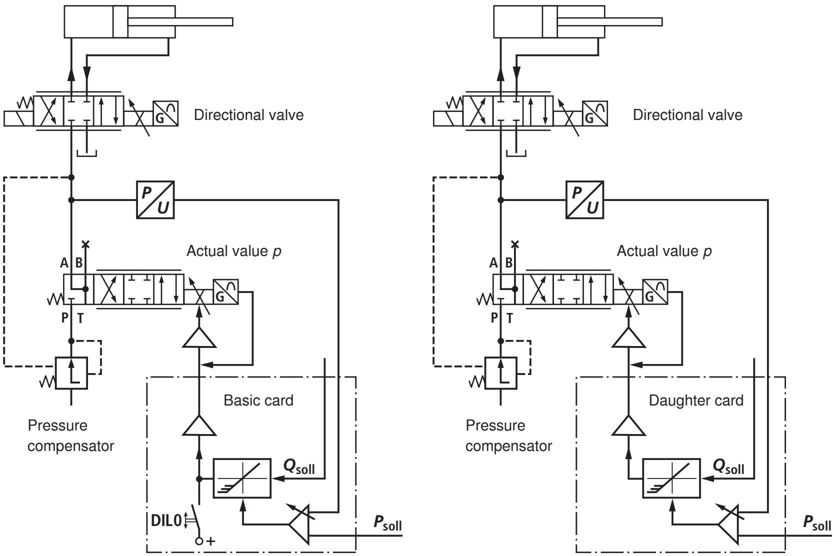
Example 1

Channel mode "joint output"



Example 2

Channel mode "separate outputs"



Functional presentation

Function and structure of the *p/Q* controller card are shown as block diagram (see page 3).
Pressure command value: It is specified by the user in the form of voltage (0...10 V; b12/b14 and/or z10/z12). You can do so by means of a potentiometer which can be supplied by the card (z32/b8).
Actual pressure value: It is optionally recorded by pressure sensors with voltage interface (1...6 V, 0...10 V) or current interface (4...20 mA) (which can be switched).
The actual pressure value can be tapped as monitor signal at z16 and/or z18. The command value is compared to the actual value. The variation and the differentiated actual value act on a PID controller. The controller output signal acts on the limiter circuit which influences the position command value. If the actual pressure value is smaller than the pressure command value, the controller signal is larger than the specified position command value. It is thus not influenced by the limiter; there is simple flow control of the valve.
If the pressure command value is reached, the limiter takes effect according to the actual pressure value so that the input signal for the valve position control is changed so that $p_{command} - p_{actual} = 0$ is maintained.
Controller characteristic: The PID controller and the derivative element can be roughly set by means of DIL switches (printed circuit board) and finely by means of front plate switches.
Controller display: The controller function is displayed by means of LED and can be used for switching purposes via an acknowledgement output.
Line break: Simultaneous flashing of the two yellow LEDs and the switching of output b30 and/or b32 signalizes a pressure sensor line break.
Controller shut-off: The controller can be shut off by means of an external signal (6...40 V =).
Channel selection: Is only possible for the 2-channel card. Detailed explanation (see below).

Special function "channel selection" of the "2-channel control card"

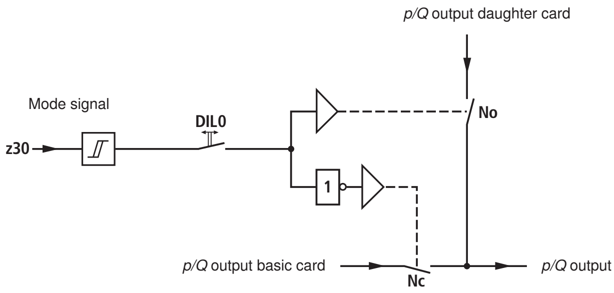
This special function can be used in all cases in which two actual pressure values have to act on one control distance via their two independent controllers. An external mode signal (z30/6...40 V =) is used to select basic or daughter *p/Q* control signal on the control distance. The DIL switch 0 must be ON; otherwise, this special function is blocked. The control signal of one channel must be inverted (DIL 5).

3

DIL 0	Mode signal z30	Basic card I	Daughter card II	DIL 5 I	DIL 5 II
ON	H	OFF	ON – out I (b4/b2)	ON	OFF
ON	L	ON – out I (b4/b2)	OFF	ON	OFF
OFF	X	ON – out I (b4/b2)	ON – out II(b6/b8)	X	X

X– without influence

Principle of the channel selection



Setting instructions

A: General instructions

- The measured values generally refer to the ground at the test point "0 V"
- Indication of the direction of rotation for potentiometers: cw – clockwise ccw – counterclockwise
- Before the commissioning, the position of the setting elements is to be checked according to the transfer condition (see adjustment table page 11)
- Proceed in the order b) to f) (page 10).

B: Mode settings

DIL no.	Status	Function
0	ON	Both controllers act on output 1
	OFF	Controller 1 and 2 act on output 1 and/or 2, irrespective of each other
1	ON	Pressure sensor 1...6 V/0...10 V
	OFF	Pressure sensor 4...20 mA
2	ON	Actual p value amplification p_{sys}[1] ≙ ~ p_{nom}[2]
	OFF	Actual p value amplification p_{sys} ≙ ~ 0.5 • p_{nom}
3	ON	Cable break detection active
	OFF	Cable break detection inactive
4	ON	*p* controller active
	OFF	*p* controller shut off, only the *Q* signal is analyzed
5	ON	*p/Q* output signal not inverted
	OFF	*p/Q* output signal inverted

1) p_{sys} = System pressure
2) p_{nom} = Nominal sensor pressure

C: Pressure sensor comparison

- Set the sensor type (DIL 1) and the gain factor (DIL 2)
- The zero point comparison is effected using the potentiometer p_{zero} in order to achieve 0 V (±10 mV) at the signal input with pressure-relieved pressure transducer
- The sensitivity is aligned using the potentiometer p_{actual} at system pressure (+10 %/–20 %).

D: Flow zero point

The zero position of the valve is set using the potentiometer Q_{zero} (±10 %). Due to the valve amplifier integrated in the valve, direct adjustment at the amplifier is not intended.

E: Comparison of the position signal

- Shut off the *p* controller (DIL 4)
- Set the command value amplification using the potentiometer $Q_{max.}$.

F: Optimization of the control characteristic

DIL no.	Status	Function		
6	ON	D	Pressure build-up	normal
	OFF			reduced [1]
7	ON		Pressure reduction	normal
	OFF			reduced [1]
8	ON		Share high	(9, 10 = OFF)
9	ON		Share medium	(8, 10 = OFF)
10	ON		Share low	(8, 9 = OFF)
11	ON	I	Share = 0	(12 = OFF)
12	ON		Share available	(11 = OFF)
13	ON	P	Reduced pressure reduction	Valve opening in case of pressure reduction < approx.15 %
	OFF			ineffective
14	ON		Share low	(16 = ON/15 = OFF)
15	ON		Share medium	(14, 16 = OFF)
16	ON		Share high	(14, 15 = OFF)

1) With DIL 6 and 7 = OFF, DIL 8 is ineffective

G: Test points

The test points of the card may only be loaded with a R_L > 10 kΩ. in case of overload, the function of the control is impaired and/or the card is destroyed. The test points are located on the front plate and laterally on the printed circuit board.

Basic card and daughter card have separate test points each, however the identical reference ground.

Controller adjustment

The P, I and D shares of the closed-loop control amplifier are to be optimized according to the properties of the control distance, the disturbance variables and the static and dynamic requirements on the control result.

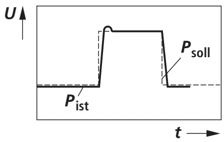
1) Pressure controller ON – DIL 4 ON
2) Connection of an oscilloscope at the test point "p_{actual}"
3) Usefully connection of a 2nd oscilloscope channel at the terminals "$p_{command}$"
4) DIL 6 and DIL 7 serve to compensate dynamic differences in the pressure build-up and reduction in the system
   DIL 6 ON = Normal application
   OFF = Special application
   DIL 7 ON = Normal application
   OFF = Special application
5) DIL 13 reduces the pressure reduction by means of a max. valve opening < approx. 15 %
   ON = Special application
   OFF = Normal application
6) **Aim of the controller optimization**

An optimum between change over characteristic (overshooting tendency with excessive static amplification) and static accuracy (control error with starting pressure cut off) is to be achieved (a).

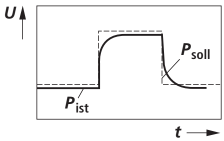
Procedure (see table, page 11):
An increase in the **P share** of the controller increases the dynamic of the control behavior (b). In case of excessive gain, the tendency to oscillate increases (c).
Limitation of the **I share** reduces the static gain. With increasing static gain, the control deviation is reduced (d). The **D share** can be used to influence the transition behavior (minimization of the tendency to oscillate); thus, the command value is only reached after a longer transition time (f).

Ideal development

a



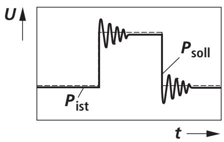
b



Problem:
P share too small
Solution:
→ Rotate K_p against F (fine adjustment)
→ P gain >

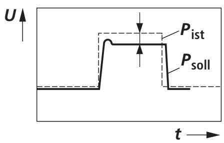
DIL 14	ON
DIL 15	OFF
DIL 16	ON

c



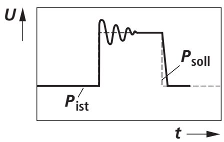
Problem:
P share too large
Solution:
→ Rotate K_p against 0 (fine adjustment)
→ use DIL 14–16 to reduce the P gain according to the table

d



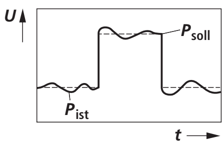
Problem:
P share correct
Control deviation too large
Solution:
→ Increase the I gain share
DIL 11 ON = I share = 0
DIL 12 ON = I share connected
→ Rotate K_i against F

e



Problem:
Time constant of the I share too low
Solution:
→ Rotate K_i against F until control deviation and vibration are perfect
→ If K_i = F is not sufficient, the P share must also be reduced

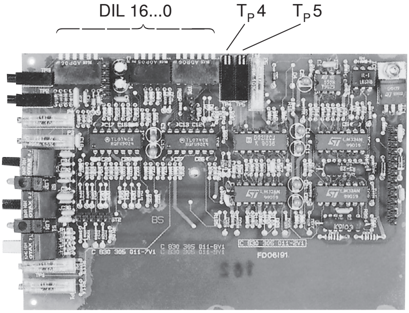
f



Problem:
D share too low
Solution:
→ Rotate K_D against F
→ D share >

DIL 8	ON
DIL 9	OFF
DIL 10	OFF

Adjustment table



$T_P 4$: U_A
$T_P 5$: 0 V

Basic card

Set by		Rexroth		
Date		As-delivered state		
DIL 0	DIL switch	OFF		
DIL 1		OFF		
DIL 2		ON		
DIL 3		ON		
DIL 4		ON		
DIL 5		OFF		
DIL 6		OFF		
DIL 7		OFF		
DIL 8		OFF		
DIL 9		OFF		
DIL 10		OFF		
DIL 11		OFF		
DIL 12		OFF		
DIL 13		OFF		
DIL 14		OFF		
DIL 15		ON		
DIL 16		OFF		
HEX K_P	HEX code	B		
HEX K_I		1		
HEX K_D		D		

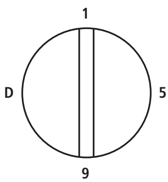
* Daughter card

Set by		Rexroth		
Date		As-delivered state		
DIL 0	DIL switch	OFF		
DIL 1		OFF		
DIL 2		ON		
DIL 3		ON		
DIL 4		ON		
DIL 5		OFF		
DIL 6		OFF		
DIL 7		ON		
DIL 8		OFF		
DIL 9		OFF		
DIL 10		OFF		
DIL 11		OFF		
DIL 12		OFF		
DIL 13		OFF		
DIL 14		OFF		
DIL 15		ON		
DIL 16		OFF		
HEX K_P	HEX code	3		
HEX K_I		9		
HEX K_D		5		

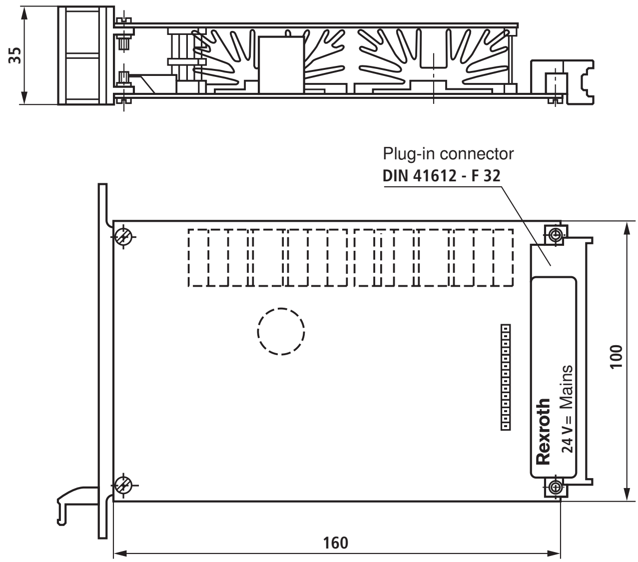
* Only with 2-channel variant

DIL switch

HEXCODE switch



Unit dimensions (dimensions in mm)



Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protective circuits.
- The cable lengths and cross-sections specified on page 4 must be complied with.

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Zum Eisengießer 1
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Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

Δp/Q controller

RE 30136/07.12
Replaces: 05.04

Type VT-VACAF

Component series 1X

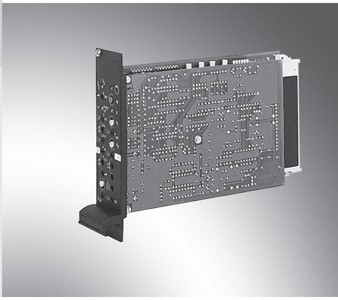


Table of contents

Contents	Page

Features

- Suitable for controlling high-response valves
- Amplifier with additional electronics (daughter card)
- Analog amplifiers in Europe format for installation in 19 " racks
- Pressure differential controller (force controller) with PID behavior
- Short-circuit-proof outputs
- External shut-off for pressure controller
- Monitor signal for controller
- Separate acceleration and braking ramp
- Ramps can be separately adjusted and switched off
- Adjustable area adjustment for cylinder
- Suitable for pressure sensors (0...10 V, 4...20 mA), see data sheet 30271
- Supply for pressure sensors
- Cable break detection for pressure sensor

Notice:

The photo is an example configuration.
The delivered product differs from the figure.

Ordering code, accessories

VT – V | A | C | A | F – 500 – 10 / V0

Hydraulic component (control)	
Axis control	**= A**
Valve type	
High-response valve	**= C**
Control	
Analog	**= A**
Function	
Δ*p*/*Q* control	**= F**
Serial number for types	
500 = Standard variant without valve amplifier function	
1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	
Customer version	
V0 = Catalog version	

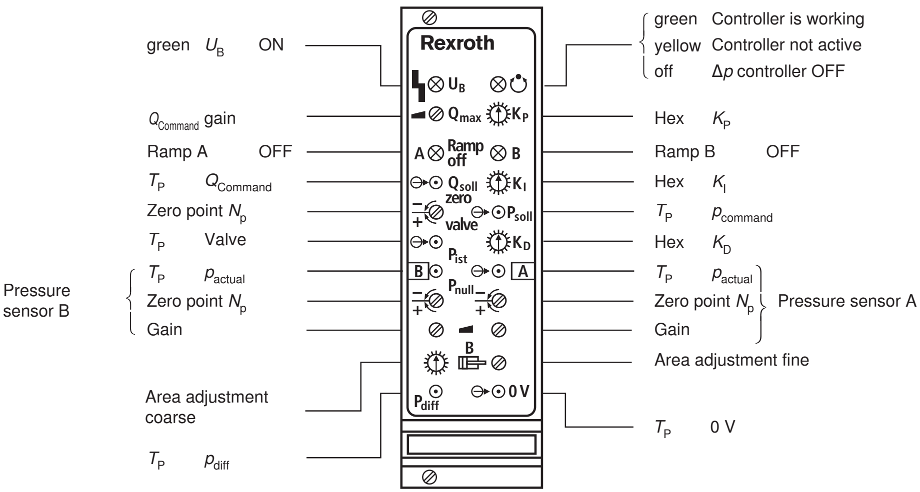
Preferred types

Amplifier type	Material number
VT-VACAF-500-10/V0	0811405147

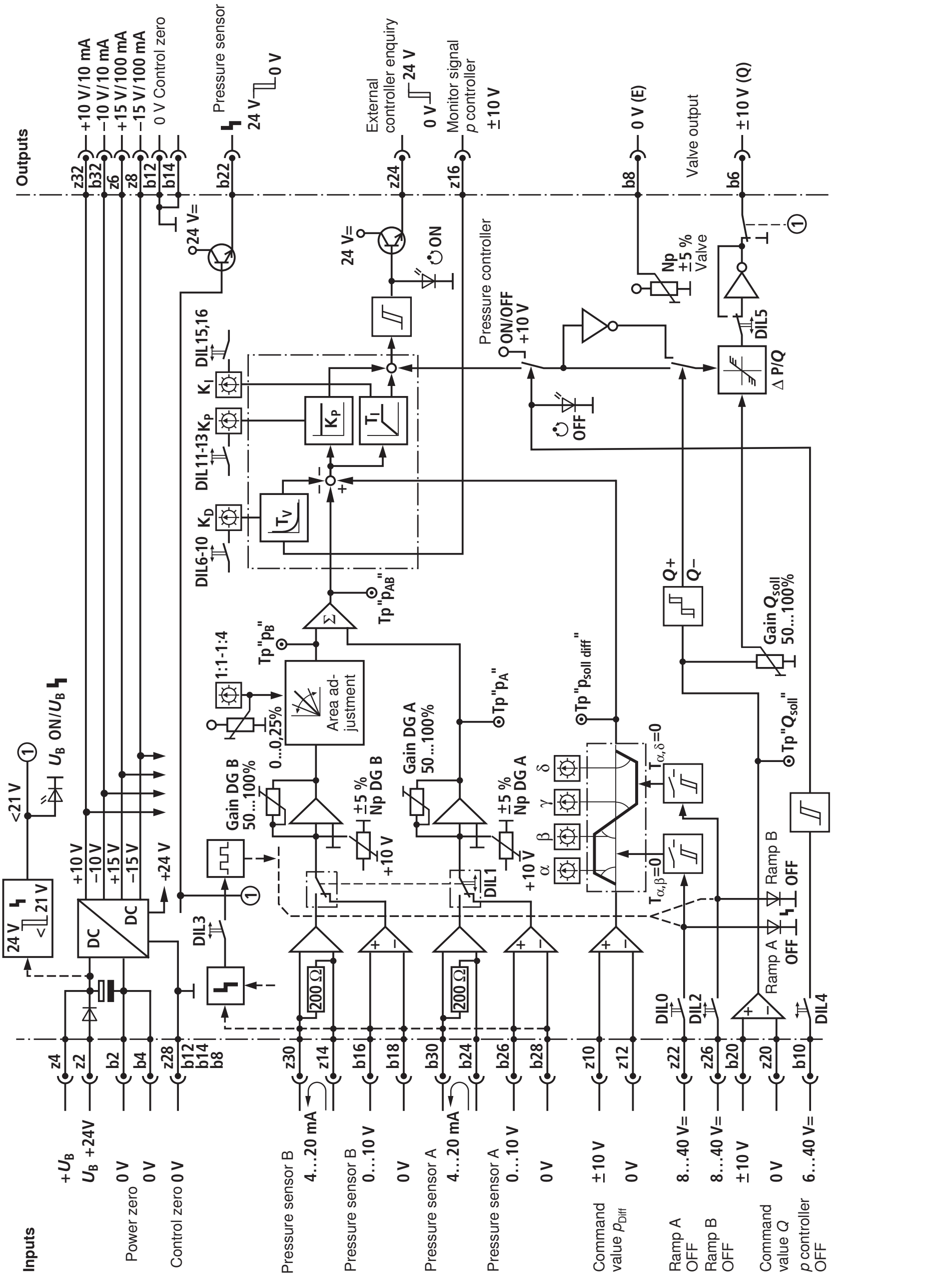
Suitable card holder:

– Open card holder VT 3002-1-2X/32F (see data sheet 29928). Only for control cabinet installation.

Front plate

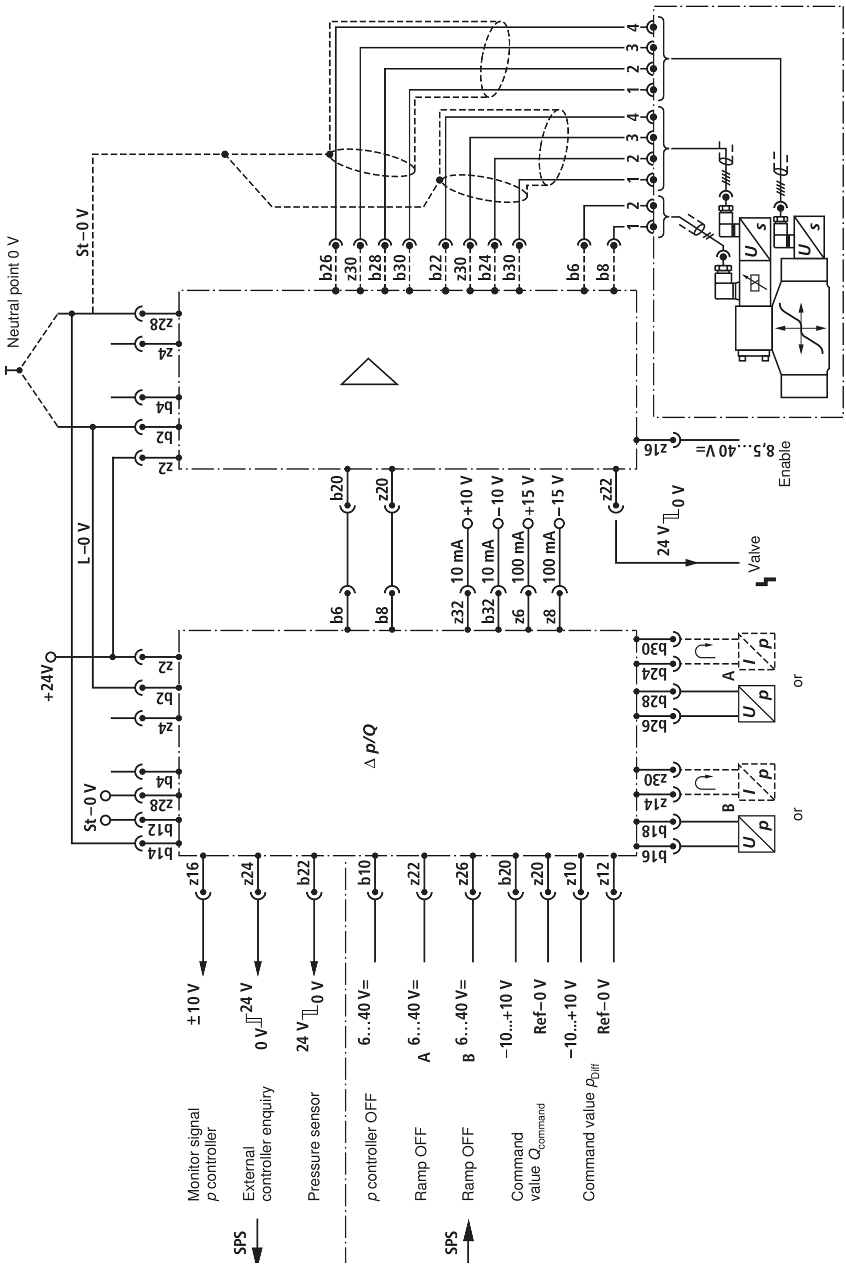


Block diagram with pin assignment

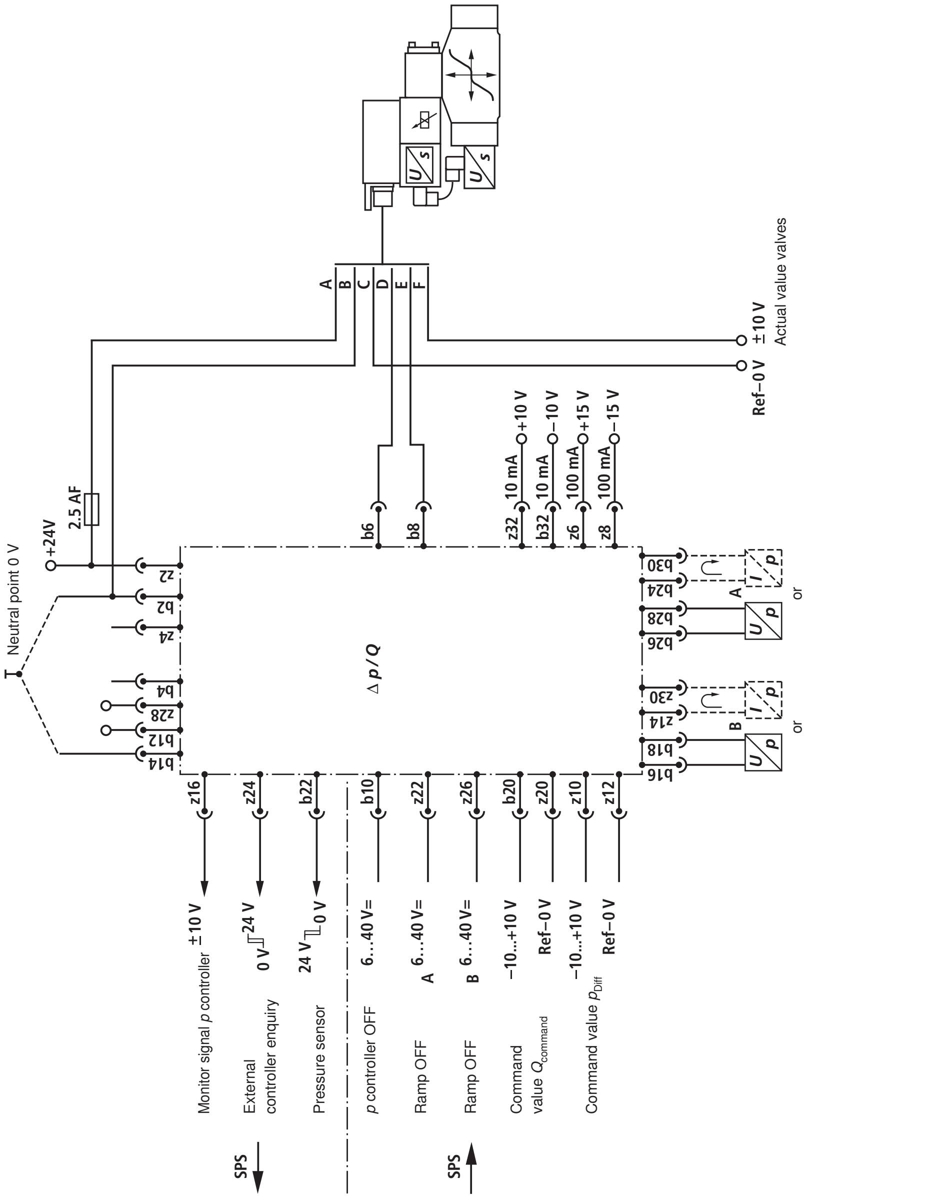


3

Wiring diagram with valve amplifier card



Wiring diagram – Valve with installed electronics



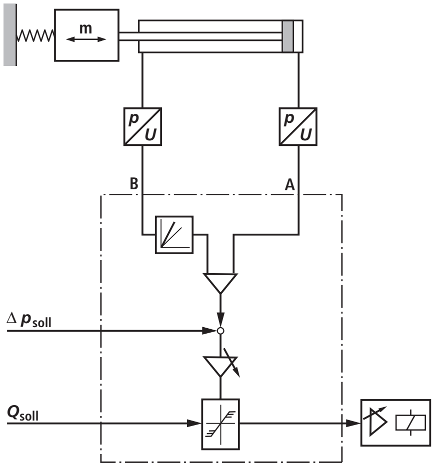
Technical data (For applications outside these parameters, please consult us!)

Supply voltage U_B at z2 – b2		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10%)
Current consumption, max.	mA	250
Command value Q		b20: 0...±10 V z20: 0...±10 V } Differential amplifier (R_i = 100 kΩ)
Command value p_{diff}		z10: 0...±10 V z12: 0 V } Differential amplifier
Actual value from the pressure sensor	A	b26: 0...+10 V b28: 0 V } Differential amplifier b24: b30: 4...20 mA
	B	b16: 0...+10 V b18: 0 V } Differential amplifier b14: b30: 4...20 mA
Pressure sensor supply		z6: +15 V, max. 100 mA z8: –15 V, max. 100 mA
Pressure controller OFF		b10: 6...40 V =
External controller enquiry		z24: 24 V/0.1 A max., if controller is not active
Signal source		Supply ±10 V from b32, z32 (10 mA) or external signal source
Monitor signal F_{actual}		z16: ±10 V
Error pressure sensor (cable break, signal lines)		b22: No error: +U_B; max. 100 mA Error: 0 V : LED "Ramp A OFF" and "Ramp B OFF" flash
Ramp times		Min. 350 ms (1) Max. 5.6 s (16) } 16 steps 350 ms/step
Ramp OFF	A	z22: 8...40 V =
	B	z26: 8...40 V =
Area adjustment cylinder		Min. 1:1 (1) Max. 1:4 (16) } 16 steps
LED displays		red: Error U_B red: Ramp A OFF red: Ramp B OFF green/yellow: green: Controller active yellow: Controller not active off: Controller OFF
Format of the printed circuit board	mm	(100 x 160 x approx. 35) / (W x L x H) Europe format with front plate 7 TE
Plug-in connection		Connector DIN 41612 – F32
Ambient temperature	°C	0...+70
Storage temperature range	°C	–20...+70
Weight	m	0.44 kg

Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

Functional principle

Force control



Additional information

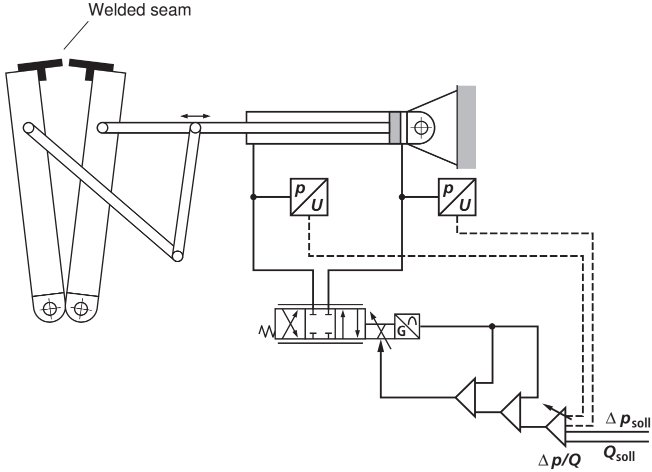
Applications

As opposed to *p/Q* control, pressure measurement in the A and B line of a hydraulic actuator by means of the "Pressure differential controller" printed circuit board can be used to allow for Δ*p/Q* control of the actuator.
Consequently, this control structure is used everywhere where you don't only have to control the pressure in one direction of motion of the actuator against a constant pressure but where there is also pressure control against a changing pressure, i.e. in all cases, in which force control is necessary.
The actual value adjustment allows for the connection of pressure sensors with 0...10 V and 4...20 mA output signal.

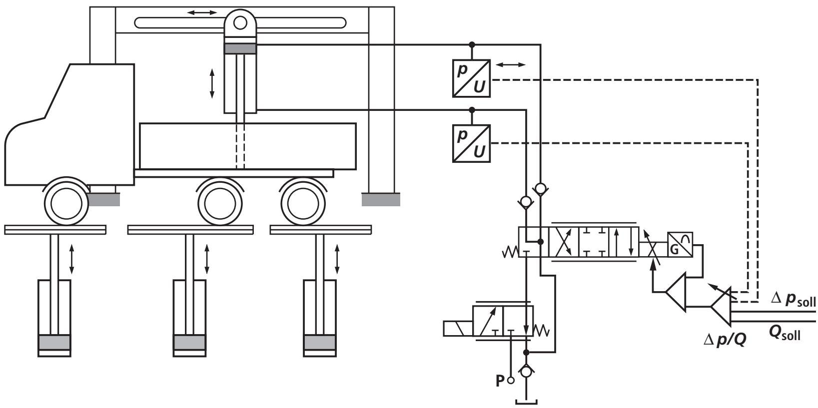
The command value ramps allow for the design of command value steps of $\Delta p_{command}$ as ramp function. The error monitoring logic detects cable break of the signal lines of the sensors and errors in the voltage supply. The pressure control circuit can also be switched off externally (flow control).
To control the actuator, this printed circuit board is to be coupled with a valve amplifier card or a valve with installed electronics.

Examples

Example 1
Welding machine



Example 2
Vehicle twisting test stand



Function

Input variables are the differential pressure Δp and flow Q command values. As actual values, pressure differential and valve spool path are fed back.

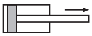
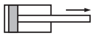
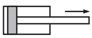
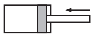
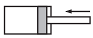
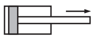
The $\Delta p/Q$ controller takes effect:

a) As long as $\Delta p_{command} > \Delta p_{actual}$ like a flow control, i.e. the pressure control does not yet take effect;

b) If $\Delta p_{command} = \Delta p_{actual}$, the pressure control takes effect, i.e. a limiter superimposes the command value Q.

The command value Q corresponds to the spool path as long as the pressure control does not take effect, yet, i.e. $\Delta p_{command} > \Delta p_{actual}$ or if the pressure controller is switched off. The command value Q may range between U_E = 0...±10 V.

Functional examples

$Q_{command}$	Direction	$p_{diff.\ command}$	Direction	Track traveling	Force control
+5.0 V		+3.5 V		with 50 % $v_{max.}$	After track traveling to 35 % of $p_{diff.\ max.}$
+7.5 V		–2.0 V		with 75 % $v_{max.}$	Not possible
–3.3 V		–4.8 V		with 33 % $v_{max.}$	After track traveling to 48 % of $p_{diff.\ max.}$
–10.0 V		+8.0 V		with $v_{max.}$	Not possible
↓	A command value of at least ±0.3 V must be specified!				

The numerical values listed in the table are examples, the signs of the values are decisive.

3

Settings DIL switch

DIL no.	Status		Function	
0	ON		External ramp control possible	A
	OFF		+ $p_{\text{diff. command}}$ via ramp	A
1	ON		4...20 mA pressure sensors	
	OFF		0...10 V pressure sensors	
2	ON		External ramp control possible	B
	OFF		+ $p_{\text{diff. command}}$ via ramp	B
3	ON		Cable break detection p sensor ON	
	OFF		Cable break detection OFF	
4	ON		External controller shut-off possible	
	OFF		External controller shut-off not possible	
5	ON/OFF		Inversion of the hydraulic direction of action → +Q_{Command} must extend the cylinder	
6	OFF	D share	Switch combinations, see table 1	
7	OFF	D share		
8	OFF	D share		
9	OFF	D share		
10	OFF	D share		
11	OFF	P share	Switch combinations, see table 2	
12	ON	P share		
13	OFF	P share		
14	ON	P share	Reduced pressure decrease with $p_{\text{diff. actual}} > p_{\text{diff. command}}$ Valve opening max. 20 %	
	OFF	P share	No reduced pressure reduction	
15	ON	I share	Switch combinations, see table 3	
16	OFF	I share		

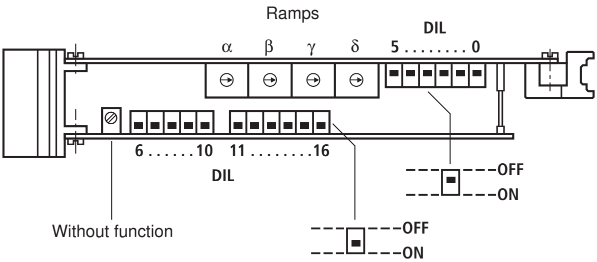


Table 1
Using the DIL switches 6 ... 10, the setting of the hex switch K_D (front plate) can be reduced.
The setting can be reduced in a direction-dependent form.
Step 1 is the lowest, step 8 the highest reduction.

	K_D					
	DIL 6	DIL 7	DIL 8	DIL 9	DIL 10	Effect
	OFF	OFF	OFF	OFF	OFF	No influence on the hex switch K_D
	OFF	OFF	ON	OFF	OFF	
	OFF	ON	OFF	OFF	OFF	
	OFF	ON	ON	OFF	OFF	
	ON	OFF	OFF	OFF	OFF	
	ON	OFF	ON	OFF	OFF	
	ON	ON	OFF	OFF	OFF	
	ON	ON	ON	OFF	OFF	
1	OFF	OFF	OFF	OFF	ON	Direction 1
	OFF	OFF	OFF	ON	OFF	Direction 2
	OFF	OFF	OFF	ON	ON	Direction 1 + 2
2	ON	OFF	OFF	OFF	ON	Direction 1
	ON	OFF	OFF	ON	OFF	Direction 2
	ON	OFF	OFF	ON	ON	Direction 1 + 2
3	OFF	ON	OFF	OFF	ON	Direction 1
	OFF	ON	OFF	ON	OFF	Direction 2
	OFF	ON	OFF	ON	ON	Direction 1 + 2
4	ON	ON	OFF	OFF	ON	Direction 1
	ON	ON	OFF	ON	OFF	Direction 2
	ON	ON	OFF	ON	ON	Direction 1 + 2
5	OFF	OFF	ON	OFF	ON	Direction 1
	OFF	OFF	ON	ON	OFF	Direction 2
	OFF	OFF	ON	ON	ON	Direction 1 + 2
6	ON	OFF	ON	OFF	ON	Direction 1
	ON	OFF	ON	ON	OFF	Direction 2
	ON	OFF	ON	ON	ON	Direction 1 + 2
7	OFF	ON	ON	OFF	ON	Direction 1
	OFF	ON	ON	ON	OFF	Direction 2
	OFF	ON	ON	ON	ON	Direction 1 + 2
8	ON	ON	ON	OFF	ON	Direction 1
	ON	ON	ON	ON	OFF	Direction 2
	ON	ON	ON	ON	ON	Direction 1 + 2

Direction 1 ≙ force reduction
Direction 2 ≙ force build-up

3

Table 2

DIL 11	DIL 12	DIL 13	Effect
OFF OFF	OFF OFF	OFF ON	No gain reduction to hex switch K_P
ON	OFF	ON	Low gain
OFF ON	ON ON	OFF OFF	Medium gain
ON	OFF	OFF	High gain
ON OFF	ON OFF	ON OFF	Forbidden

Table 3

DIL 15	DIL 16	Effect
OFF	OFF	No influence on the hex switch K_I
OFF ON	ON ON	I share = 0
ON	OFF	I max. (≙ K_I = 16) + K_I current

Commissioning and adjustment

General notes:

Setting during the commissioning is effected using potentiometers and HEXCODE switches on the front plate as well as using DIL switches on the printed circuit board.
Test points for voltage measurements as well as LED displays are located on the front plate. The measured values generally refer to the test point 0 V. The test points may only be loaded with measuring devices $R_L \geqq 10\ k\Omega$.

Overload impairs the control function and/or the printed circuit board is damaged. Before the commissioning, the basic settings of the as-delivered state are to be checked. In the card adjustment, proceed in the order of the points shown (see page 13).

Verification of the connections

– Electrical
According to connection diagram, page 4 and/or 5
– Hydraulic
Pressure sensor A for piston chamber
Pressure sensor B for annulus area.

↓

Default setting controller parameters

– According to the table, page 15, column as-delivered state.

↓

Mode settings DIL 0...5

– Carry out the settings according to the table, page 10.

↓

Pressure sensor adjustment

– Set an area ratio 1:1.
– **System depressurized:** Zero point adjustment
→ Potentiometer p_{zero} → $TP_{P\ actual}$ = 0 V.
– **Max. system pressure:** Gain adjustment
→ Potentiometer → $TP_{P\ actual}$ = 10 V.

↓

Setting of the cylinder area ratio

– Set the hex switch to the area ratio of the cylinder; potentiometer to ccw.
This potentiometer is used for the fine tuning during the controller adjustment.

↓

Adjustment $Q_{max.}$

– Specification of the max. command value (e.g. 7 V)
→ Potentiometer $Q_{max.}$ → Adjustment to 10 V at TP-$Q_{Command}$.

↓

Valve zero point adjustment

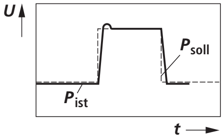
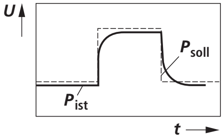
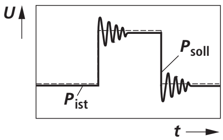
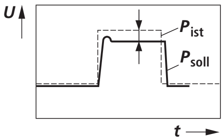
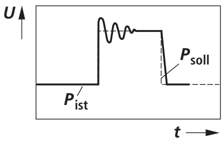
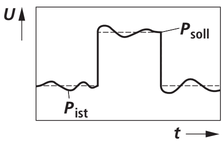
– Specification $Q_{Command}$ = 0 V → The forces at the cylinder must be balanced (i.e. pressure ratio p_K:p_R must correspond to the ratio A_K:A_R).

↓

Controller adjustment

– Working in the control loop
→ Specification of command value steps $p_{diff.}$
(e.g. 30 % → 70 % and –20 % → –60 %)
→ Comparison of command and actual value (see table, page 14)
→ Correction/adjustment of the parameters according to tables 1 to 3
→ Fine correction area ratio.

3

a 	**Ideal development** (only a square is shown)
b 	**Problem:** P share too low **Solution:** → Rotate K_p against 16 (fine adjustment) → P gain > see table 2, DIL 11–13
c 	**Problem:** P share too large **Solution:** → Rotate K_p against 1 (fine adjustment) → Use DIL 11–13 to reduce the P gain according to table 2
d 	**Problem:** P share correct, control deviation too large **Solution:** → Increase the I gain share according to table 3 → Rotate K_I against 16
e 	**Problem:** Time constant of the I share too low **Solution:** → Rotate K_I against 16 until control deviation and vibration are perfect → if K_I = 16 is not sufficient, the P share must also be reduced, see table 2
f 	**Problem:** D share too low **Solution:** → Rotate K_D against 16 → D share >, see table 1 (DIL 6–10)

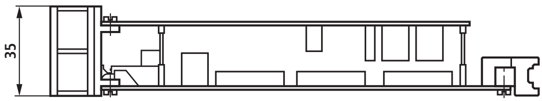
Adjustment protocol

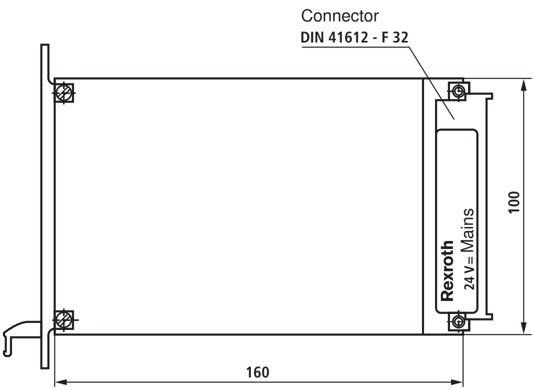
Created by

Date

Switches	As-delivered state ↓		
DIL 0	ON		
DIL 1	ON		
DIL 2	ON		
DIL 3	ON		
DIL 4	OFF		
DIL 5	ON		
DIL 6	OFF		
DIL 7	OFF		
DIL 8	OFF		
DIL 9	OFF		
DIL 10	OFF		
DIL 11	OFF		
DIL 12	ON		
DIL 13	OFF		
DIL 14	ON		
DIL 15	OFF		
DIL 16	ON		
HEX α	3		
HEX β	3		
HEX γ	3		
HEX δ	3		
HEX K_P	1		
HEX K_I	1		
HEX K_D	1		

Device dimensions (dimensions in mm)





Project planning / maintenance instructions / additional information

- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The cable shield must be connected to the control cabinet extensively and as short as possible.
- The valve solenoid must not be connected to free-wheeling diodes or other protection circuits.

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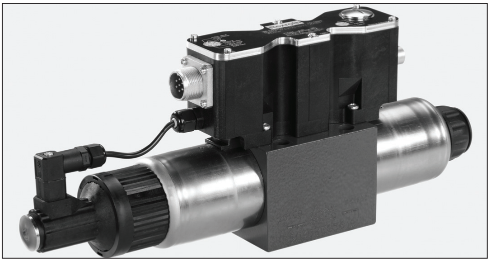
The Drive & Control Company

Rexroth
Bosch Group

4/3 proportional directional valve with integrated digital electronics and field bus interface (IFB-P)

Type 4WREF

RE 29048
Edition: 2013-02
Replaces: 12.12



- Sizes 6 and 10
- Component series 2X
- Maximum operating pressure 315 bar
- Maximum flow: 80 l/min (size 6)
- Maximum flow: 180 l/min (size 10)

Features

- Direct operated proportional directional valve with integrated digital electronics and field bus interface (Integrated Field Bus IFB-P)
- Operation by means of proportional solenoids with central thread and detachable coil
- Position-controlled valve control spool
- Analog interface for command and actual value
- Command value (flow) analog or via bus
- Design for CAN bus with CANopen protocol DS 408 or Profibus-DP
- Quick commissioning via PC and WIN-PED 6 commissioning software

Contents

Ordering code

01	02	03	04	05	06	07		08		09	10	11	12
4	**WRE**	**F**				**2X**	**/**	**V**	**–**	**24**			*****

01	4 main ports	**4**
02	Proportional directional valve	**WRE**
03	With integrated digital electronics and field bus interface	**F**
04	Size 6	**6**
	Size 10	**10**
05	Symbols e.g. E, E1, V etc.: possible design see page 3	

Rated flow for size 6

06	8 l/min	**08**
	16 l/min	**16**
	32 l/min	**32**

Rated flow for size 10

06	25 l/min	**25**
	50 l/min	**50**
	75 l/min	**75**
07	Component series 20 ... 29 (20 ... 29: Unchanged installation and connection dimensions)	**2X**
08	FKM seals	**V**
09	Supply voltage 24 V	**24**

Bus interface

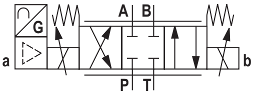
10	CANBus DS 408	**C**
	Profibus DP V0/V1	**P**

Electrical interface

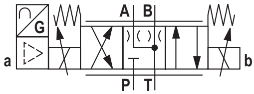
11	Command value ±10 V	**A1**
	Command value 4 to 20 mA	**F1**
12	Further details in the plain text	

Symbols

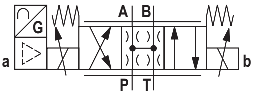
Type 4WREF...E...



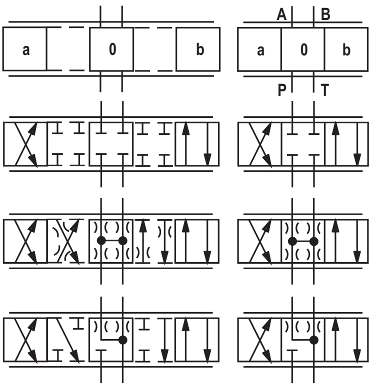
Type 4WREF...W...



Type 4WREF...V...



Control spool symbols



= E, E1

= V

= W, W1

With symbols E1 and W1:

P → A: $\boldsymbol{q}_{\text{vmax}}$ B → T: $\boldsymbol{q}_{\text{v}}/2$

P → B: $\boldsymbol{q}_{\text{v}}/2$ A → T: $\boldsymbol{q}_{\text{vmax}}$

Function, section

Set-up

The valve basically consists of:

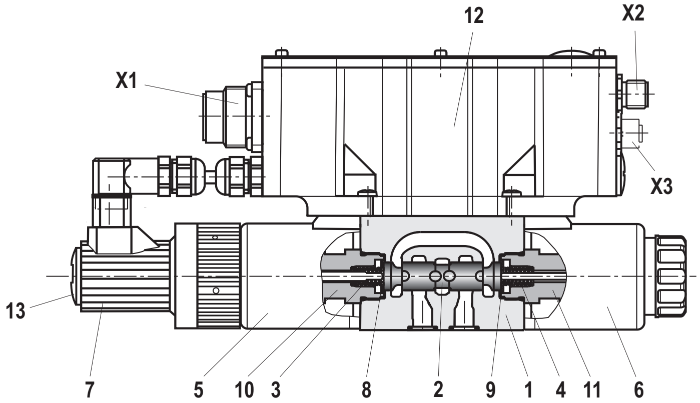
- Housing (1) with connection surface
- Control spool (2) with compression springs (3 and 4) and spring plates (8 and 9)
- Coils (5 and 6) and pole tubes (10 and 11) with central thread
- Position transducer (7)
- Integrated digital control electronics IFB-P (12)

Functional description

With de-energized solenoids (5 and 6), the control spool (2) is brought into the central position by the compression springs (3 and 4) between the spring plates (8 and 9) (with V control spool without spring plate). With V control spools, the mechanical zero position does not correspond to the hydraulic one.

Functions:

- Control of the valve spool position
- The command value can alternatively be specified via an analog interface (X1) or via the field bus interface (X2, X3).
- The actual value signals are provided via an analog interface (X1) and can additionally be read out via the field bus (X2, X3).
- The controller parameters are set via the field bus.



☞ **Notice!** The PG fitting (13) must not be opened. Mechanical adjustment of the adjustment nut located below is prohibited and damages the valve!

☞ **Notice!** Due to the design principle, internal leakage is inherent to the valves and may increase over the life cycle.
The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve is to be installed.

Function, section

The integrated digital electronics enables the following fault detection:
- Undervoltage
- Cable break in position transducer (7)
- Communication error
- Watchdog
- Cable break in command value input (only with current interface)

The following additional functions are available:
- Ramp generator
- Internal command value profile
- Enable function, digital
- Overlap compensation
- Zero point correction

WIN-PED PC program (version 6 or higher):
To implement the project planning task and to parameterize the IFB-P valves, the user may use the WIN-PED commissioning software.
- Parameterization
- Diagnosis
- Convenient data management on a PC

System requirements
- IBM PC or compatible system
- Windows 2000 or Windows XP
- RAM (recommendation: 256 MB)
- 150 MB of available hard disk capacity

Notice
The "WIN-PED" PC program is not included in the scope of delivery. It can be downloaded on the Internet free of charge! (See page 18)

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

general			**Size 6**	**Size 10**
Installation position			Any, preferably horizontal	
Storage temperature range		°C	–20 ... +80	
Ambient temperature range		°C	–20 ... +50	
Weight without sandwich plate		kg	2.4	6.5
MTTFd values according to EN ISO 13849		Years	150 (for further details see data sheet 08012)	
Climate			Environmental audit according to EN 60068-2	

hydraulic (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)				
Maximum operating pressure	– Ports A, B and P	bar	Up to 315	
	– Port T	bar	Up to 210	
Rated flow q_{Vnom} with Δp = 10 bar		l/min	8	25
			16	50
			32	75
Maximum admissible flow		l/min	80	180
Hydraulic fluid			See table page 6	
Hydraulic fluid temperature range		°C	–20 ... +70, preferably +40 ... +50	
Viscosity range		mm²/s	20 to 380, preferably 30 to 46	
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15 [1]	
Hysteresis (position control - valve control spool)		%	≤ 0.1	
Range of inversion (position control - valve control spool)		%	≤ 0.05	
Response sensitivity (position control - valve control spool)		%	≤ 0.05	
Zero shift valve control spool upon change of hydraulic fluid temperature and operating pressure		%/10K	< 0.15	
		%/100 bar	< 0.1	

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters, see www.boschrexroth.com/filter.

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

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oils and related hydrocarbons	HL, HLP	NBR, FKM	DIN 51524

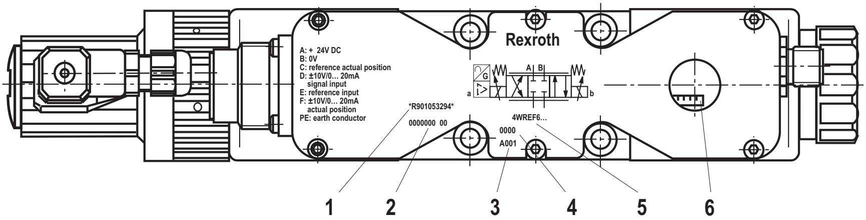
Important information on hydraulic fluids!
- For more information and data on the use of other hydraulic fluids, refer to data sheet 90220 or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.)!
- The flash point of the hydraulic fluid used must be 40 K higher than the maximum solenoid surface temperature.

electric			
Duty cycle [1]		%	100
Supply voltage	– Nominal voltage	VDC	24
	– Lower limit value	VDC	19.4
	– Upper limit value	VDC	35
	– Maximum admissible residual ripple	Vpp	2
Total current consumption	– I_{max}	A	2
	– Impulse current	A	3
Command and actual value signals	– Voltage "A1"	V	±10
	– Current "F1"	mA	4 to 20
Converter resolution (command/actual value signals)		Bit	10
Maximum coil temperature [2]		°C	Up to 150
Protection class of the valve according to EN 60529			IP 65 with mounted and locked plug-in connectors
EMC (electromagnetic compatibility)			Interference resistance prEN 50082-2:1994 Interference emission EN 50081-1:1992

[1] Connect the valve to the supply voltage only when this is required for the functional processes of the machine.

[2] Due to the temperatures occurring at the surfaces of the solenoid coils, the European standards ISO 13732-1 and EN ISO 4413 must be adhered to.

Integrated electronics (IFB-P), marking and adjustment elements



1 Material number
2 Production order number
3 Date of production
4 Serial number
5 Type designation
6 DIL switch for address and baud rate setting (position B0 on the right)

Electrical connection and allocation

Connector pin assignment X1, 6-pole + PE according to DIN EN 175201-804

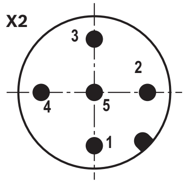
Pin	Signal	Interface A1 pin assignment	Interface F1 pin assignment
A	Supply voltage	24 VDC ($\boldsymbol{u}(\boldsymbol{t})$ = 19.4 to 35 V); $\boldsymbol{I}_{max}$ = 2 A	
B		0 V	
C	Reference potential actual value	Reference potential actual value	
D	Differential amplifier input	±10 V command value; $\boldsymbol{R}_e$ > 50 kΩ	4 to 20 mA command value; $\boldsymbol{R}_e$ = 100 Ω
E		Reference potential command value	
F	Measuring output	±10 V actual valve control spool value (limit load 5 mA)	4 to 20 mA actual valve control spool value (load resistance maximum 300 Ω)
PE		Protective earthing conductor (directly connected to cooling element and valve housing)	

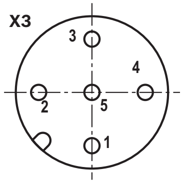
Connector pin assignment for CAN bus "X2"/"X3" (coding A), M12, 5-pole, pins/socket

Pin	Assignment
1	n. c.
2	n. c.
3	CAN_GND
4	CAN_H
5	CAN_L

Transmission rate kbit/s	20 to 1000
Bus address	1 to 127

CAN-specific settings:
Baud rate and identifier can be set via the bus system and/or the DIL switches.



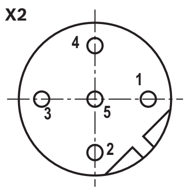


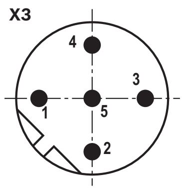
Connector pin assignment for Profibus DP "X2"/"X3" (coding B), M12, 5-pole, socket/pins

Pin	Assignment
1	+5 V
2	RxD/TxD-N (A line)
3	D GND
4	RxD/TxD-P (B line)
5	Shield

Transmission rate MBaud	up to 12
Bus address	1 to 126

Setting via DIL switch.
The +5 V voltage of the IFB-P serves to supply an external bus terminator (as required).





Integrated electronics (IFB-P), settings for CANopen and Profibus DP

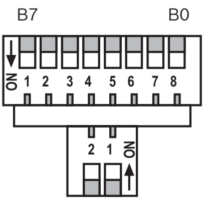
CANopen

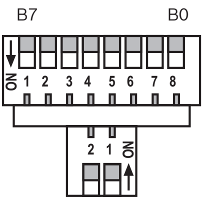
B7	B6	B5	B4	B3	B2	B1	B0	HEX	Baud rate: B7, B6	Address range: B5 to B0
0	0	0	0	0	0	0	0	00 [1]	Standard 20 kBaud or re-programmed	1 = Standard or re-programmed
0	0	0	0	0	0	0	1	01	20 kBaud	1 to 63
				to				to		
0	0	1	1	1	1	1	1	3F		
0	1	0	0	0	0	0	0	40	125 kBaud	1 = Standard or re-programmed
0	1	0	0	0	0	0	1	41	125 kBaud	1 to 63
				to				to		
0	1	1	1	1	1	1	1	7F		
1	0	0	0	0	0	0	0	80	250 kBaud	1 = Standard or re-programmed
1	0	0	0	0	0	0	1	81	250 kBaud	1 to 63
				to				to		
1	0	1	1	1	1	1	1	BF		
1	1	0	0	0	0	0	0	C0	500 kBaud	1 = Standard or re-programmed
1	1	0	0	0	0	0	1	C1	500 kBaud	1 to 62
				to				to		
1	1	1	1	1	1	1	0	FE		
1	1	1	1	1	1	1	1	FF	250 kBaud	Monitor mode/programming mode 1 = fixed

Profibus DP

B7	B6	B5	B4	B3	B2	B1	B0	HEX	Address range
0	0	0	0	0	0	0	0	00 [1]	125 = Standard or re-programmed
0	0	0	0	0	0	0	1	01	1 to 126 with parameter channel
				to				to	
0	1	1	1	1	1	1	0	7E	
1	0	0	0	0	0	0	0	80	1 to 126 with parameter channel
				to				to	
1	1	1	1	1	1	1	0	FE	
1	1	1	1	1	1	1	1	FF	Monitor operation address 125

[1] Factory setting



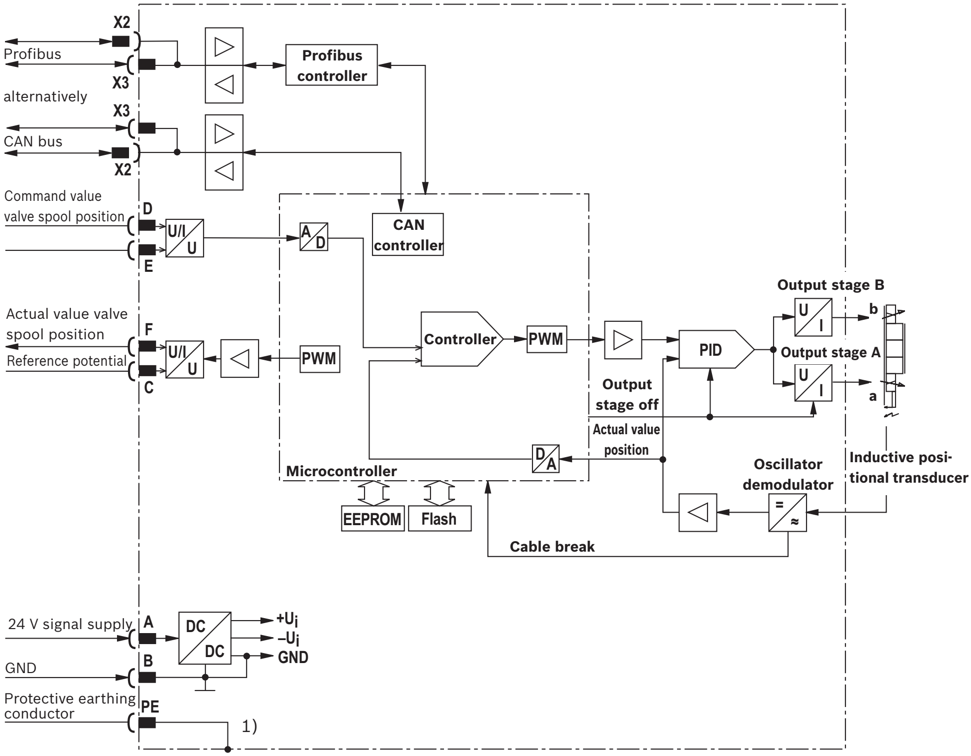


Connection of the bus terminator using the two lower switches (only with Profibus):

Left figure: Bus terminator not connected

Right figure: Bus terminator connected (both switches to "ON")

Integrated electronics (IFB-P), block diagram



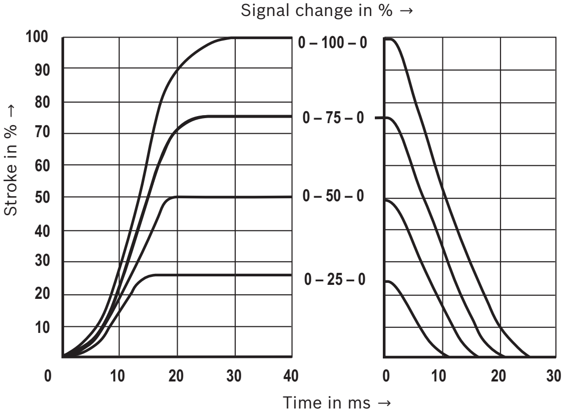
1) The protective earthing conductor (PE) is connected to cooling element and valve housing.

Command value	Positive command value 0 to +10 V (or 12 to 20 mA) at pin D and reference potential at pin E result in flow from P → A and B → T. Negative command value 0 to −10 V (or 12 to 4 mA) at pin D and reference potential at pin E result in flow from P → B and A → T.
Actual value	Positive actual value 0 to +10 V (or 12 to 20 mA) at pin F and reference potential at pin C result in flow from P → A and B → T.
Connection line	Recommendation: Up to 25 m line length type LiYCY 7 x 0.75 mm² Up to 50 m line lenght type LiYCY 7 x 1.00 mm² External diameter see sketch of mating connector

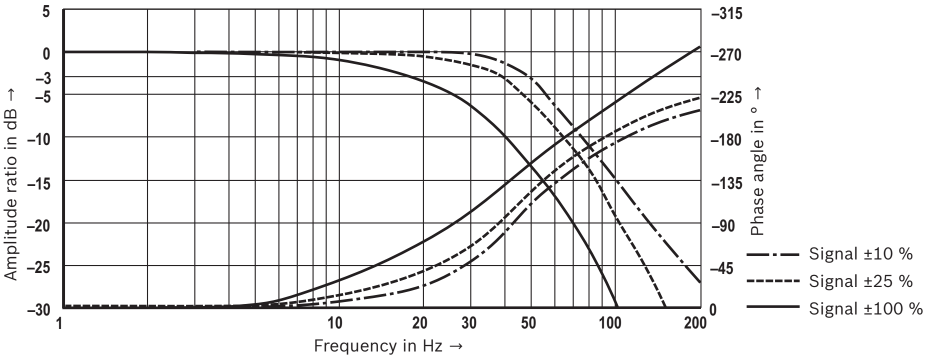
Characteristic curves size 6

(measured with HLP46, ϑ_{oil} = 40 ±5 °C) and p_s = 10 bar

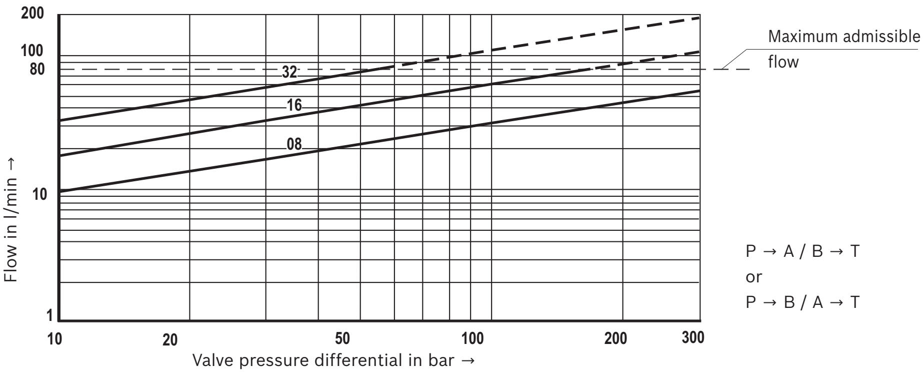
Transition function with stepped electric input signals (4/3 valve version; V control spool)



Frequency response (with V control spool)

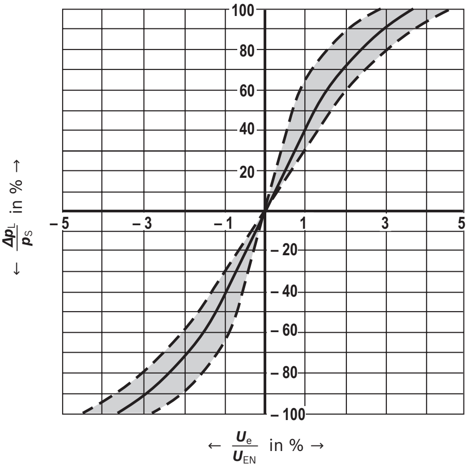


Flow/load function with maximum valve opening (with V control spool)

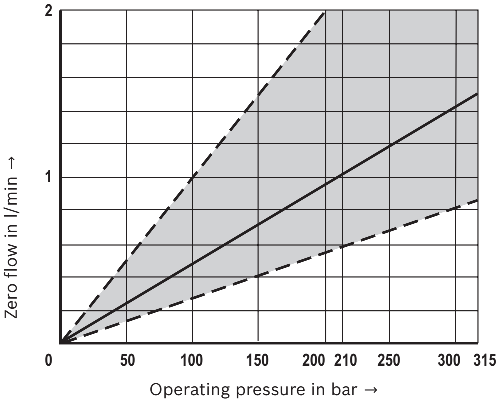


Characteristic curves size 6
(measured with HLP46, ϑ_{oil} = 40 ±5 °C) and p_s = 10 bar

Pressure/signal characteristic curve (V control spool), p_s = 100 bar

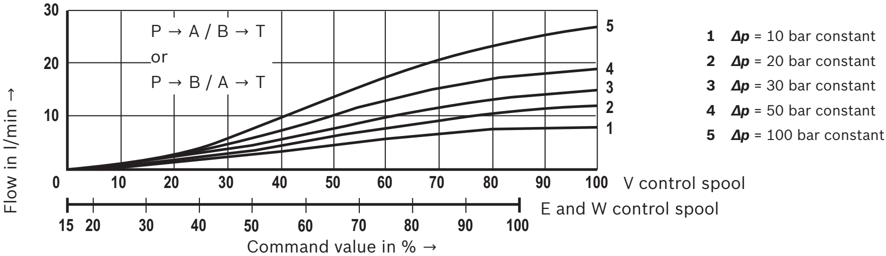


Zero flow (with central control spool position - V control spool)

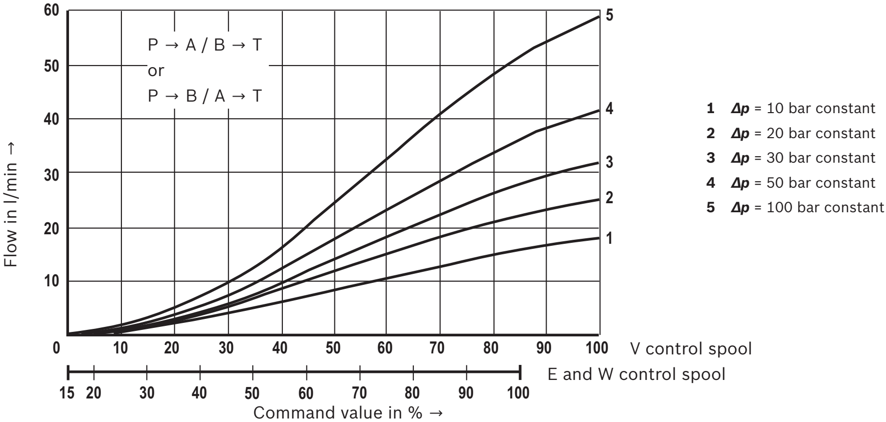


Characteristic curves size 6
(measured with HLP46, ϑ_{oil} = 40 ±5 °C and ***p*** = 100 bar)

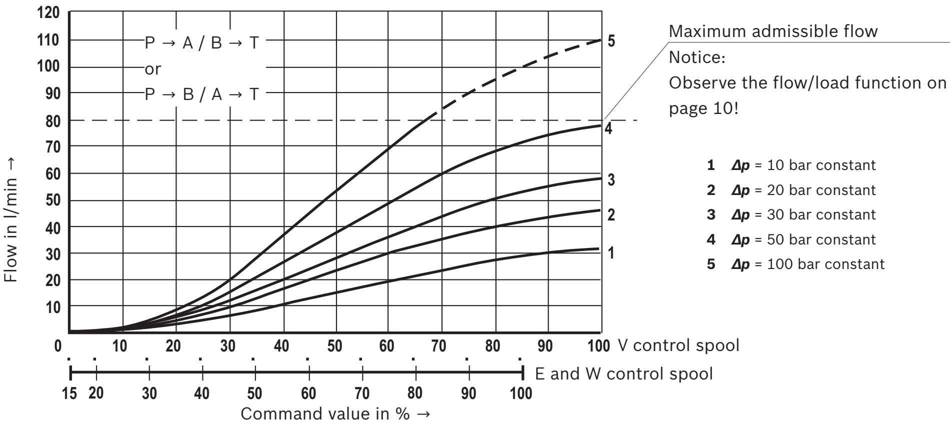
8 l/min rated flow



16 l/min rated flow



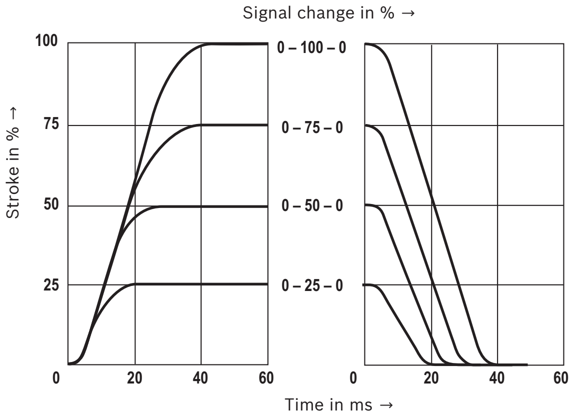
32 l/min rated flow



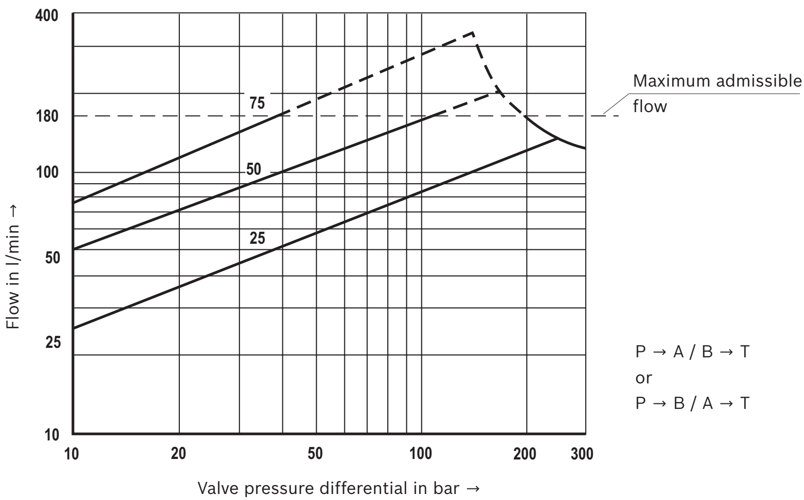
Characteristic curves size 10

(measured with HLP46, ϑ_{oil} = 40 ±5 °C) and p_s = 10 bar

Transition function with stepped electric input signals (4/3 valve version; V control spool)



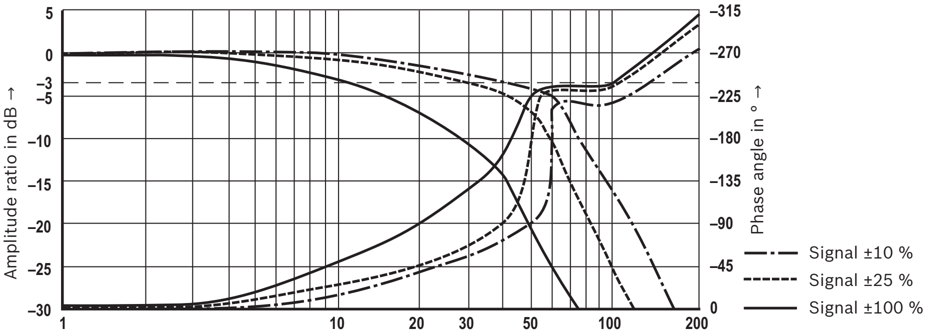
Flow/load function with maximum valve opening (with V control spool)



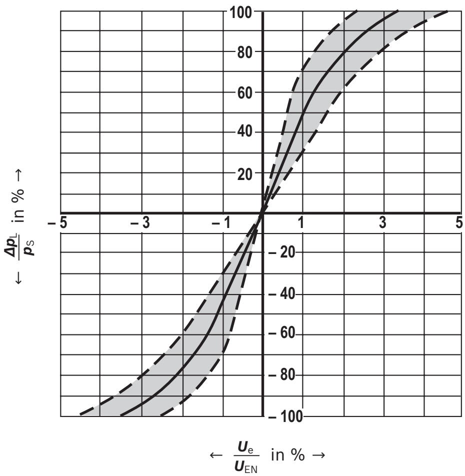
Characteristic curves size 10

(measured with HLP46, ϑ_{oil} = 40 ±5 °C) and p_s = 10 bar

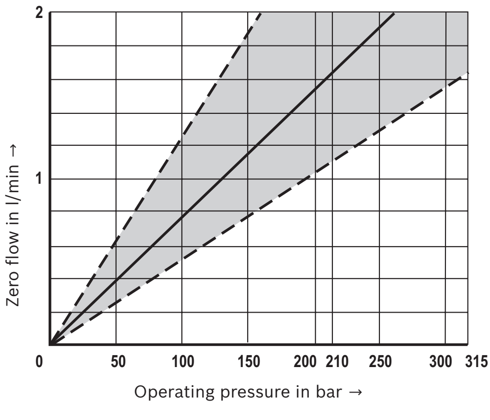
Frequency response (with V control spool)



Pressure/signal characteristic curve (V control spool), p_s = 100 bar



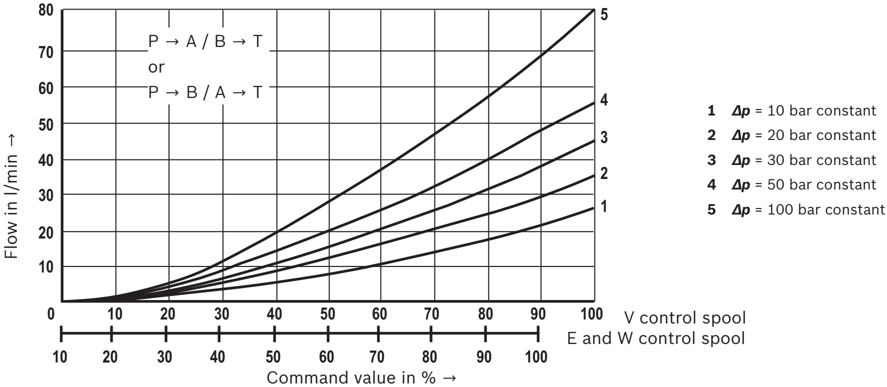
Zero flow (with central control spool position - V control spool)



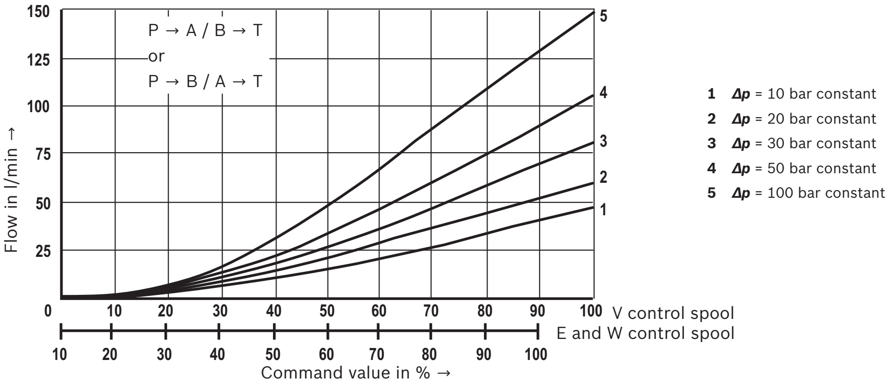
Characteristic curves size 10

(measured with HLP46, ϑ_{oil} = 40 ±5 °C and $\boldsymbol{p}$ = 100 bar)

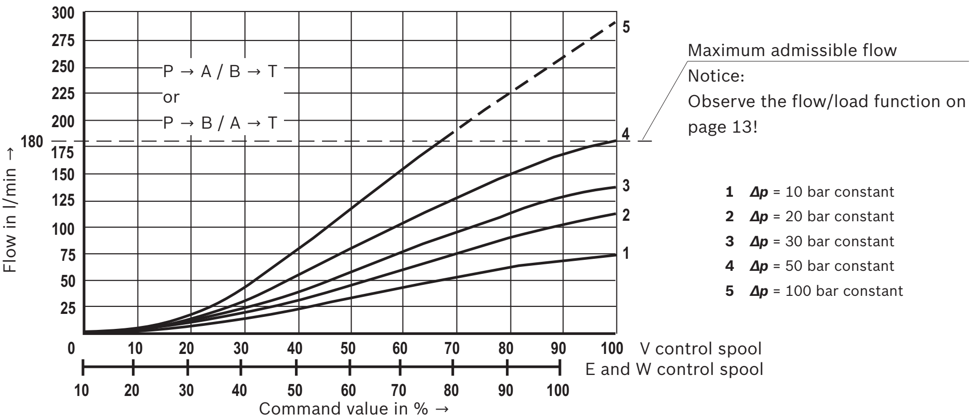
25 l/min rated flow



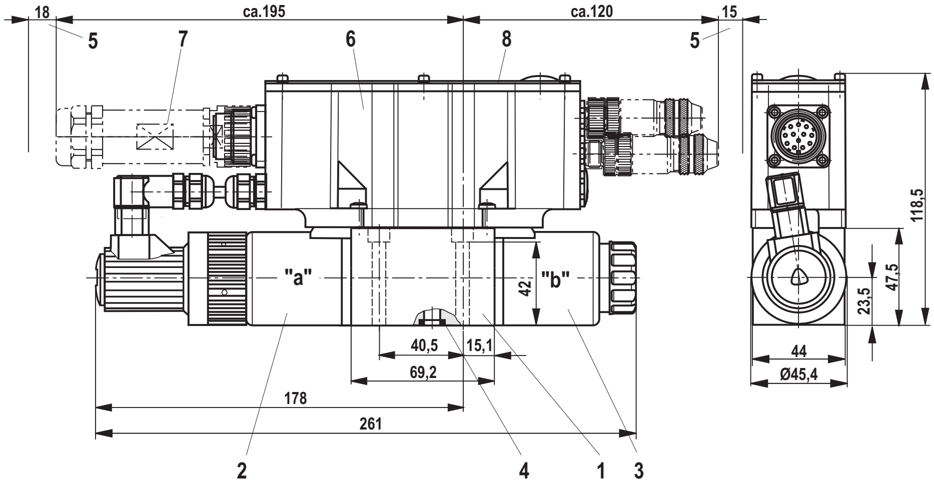
50 l/min rated flow

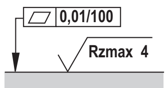


75 l/min rated flow

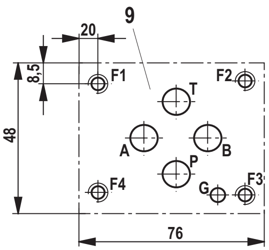


Unit dimension for size 6:
(dimensions in mm)





Required surface quality of
the valve connection surface

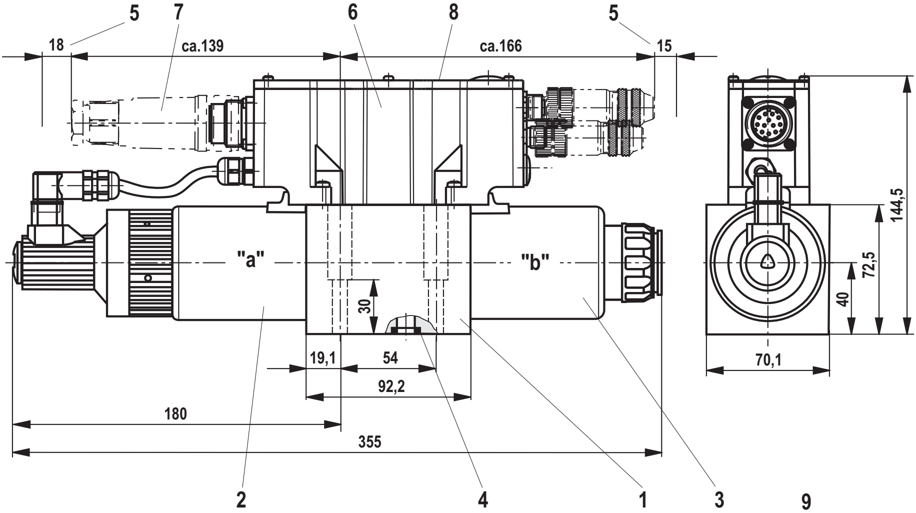


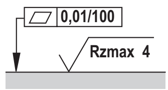
1 Valve housing
2 Proportional solenoid "a" with inductive position transducer
3 Proportional solenoid "b"
4 R-ring 9.81 x 1.5 x 1.78 for ports P, T, A and B
5 Space required to remove the mating connectors
6 Integrated digital control electronics
7 Mating connector according to DIN EN 175201-804; separate order, see page 19
8 Name plate
9 Machined valve contact surface, porting pattern according to ISO 4401-03-02-0-05
Deviating from the standard:
Ports P, A, B, T Ø8 mm
Bore G may not be required since there is no pin in the valve.

Notice!
The dimensions are nominal dimensions and subject to tolerances.

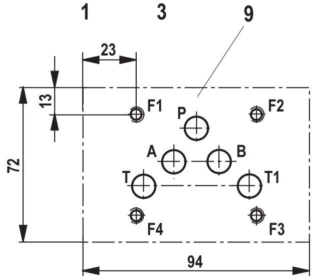
For valve mounting screws and **subplates,** see page 18.

Unit dimension for size 10:
(dimensions in mm)





Required surface quality of the valve connection surface



1 Valve housing
2 Proportional solenoid "a" with inductive position transducer
3 Proportional solenoid "b"
4 R-ring 13.0 x 1.6 x 2.0 for ports P, T, T1, A and B
5 Space required to remove the mating connectors
6 Integrated digital control electronics
7 Mating connector according to DIN EN 175201-804; separate order, see page 19
8 Name plate
9 Machined valve contact surface, porting pattern according to ISO 4401-05-04-0-05

Notice!
The dimensions are nominal dimensions and subject to tolerances.

For valve mounting screws and **subplates,** see page 18.

Unit dimensions

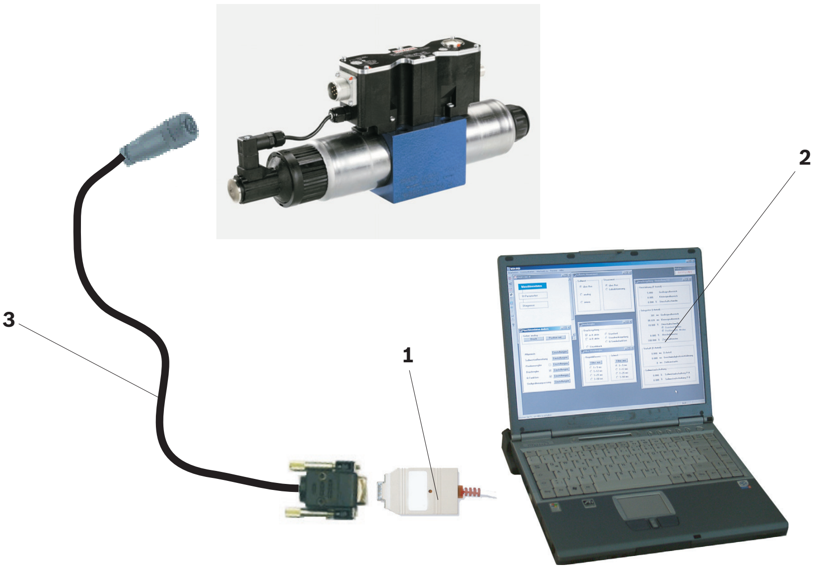
Hexagon socket head cap screws		**Material number**
Size 6	4x ISO 4762 - M5 x 50 - 10.9-flZn-240h-L Tightening torque $\boldsymbol{M_A}$ = 7 Nm ± 10 % or 4x ISO 4762 - M5 x 50 - 10.9 Tightening torque $\boldsymbol{M_A}$ = 8.9 Nm ± 10 %	R913000064
Size 10	4x ISO 4762 - M6 x 40 - 10.9-flZn-240h-L Tightening torque$\boldsymbol{M_A}$ = 12.5 Nm ± 10 % or 4x ISO 4762 - M6x 40 - 10.9 Tightening torque $\boldsymbol{M_A}$ = 15.5 Nm ± 10 %	R913000058

Notice: The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure!

Subplates	**Data sheet**
Size 6	45052
Size 10	45054

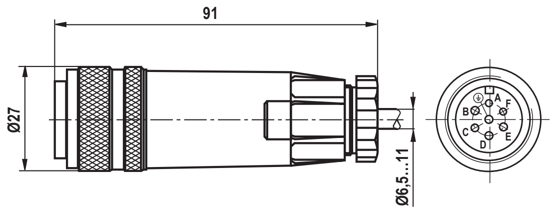
Accessories (not included in the scope of delivery)

	The following is required for the parameterization via PC:	**CANopen**	**Profibus DP**
1	Interface converter (USB)	VT-ZKO-USB/CA-1-1X/V0/0 Mat. no. R901071963	VT-ZKO-USB/P-1-1X/V0/0 Mat. no. R901071962
2	Commissioning software	WIN-PED 6 Download from www.boschrexroth.de/IAC	
3	Connection cable, 3 m	D-Sub / M12, coding A Mat. no. R900751271	D-Sub / M12, coding B Mat. no. R901078053

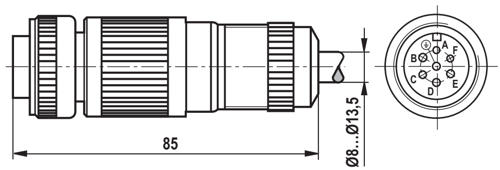


Accessories, port X1 (not included in the scope of delivery)

Mating connector for X1	**Version**	**Material number**
Mating connector according to DIN EN 175201-804 (6-pole)	Mating connector (plastic)	R900021267
	Mating connector (angular design)	R900217845

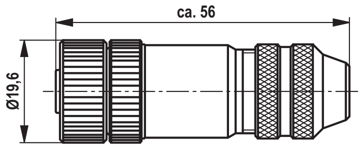
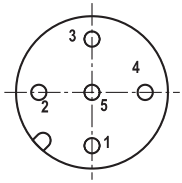
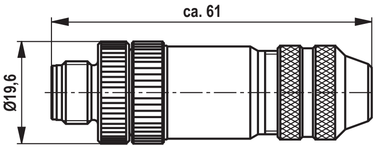
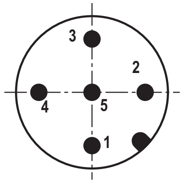
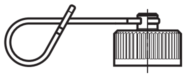


Mating connector for X1	**Version**	**Material number**
Mating connector according to DIN EN 175201-804 (6-pole)	Mating connector (metal)	R900223890

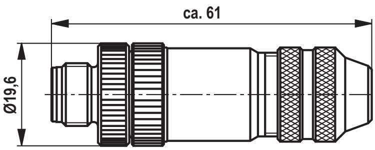
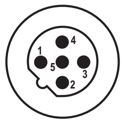
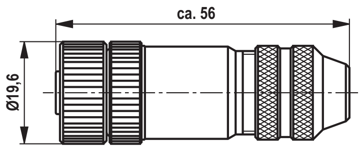
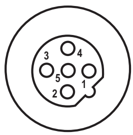
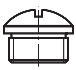


3

Accessories, CAN bus (A coding) (not included in the scope of delivery)

Description	**View, dimensions**	**Pole pattern, order details**
X2 Round connector, 5-pole, M12, can be assembled Straight mating connector in metal design		 Mat. no. R901076910 (cable diameter 6 to 8 mm)
X3 Round connector, 5-pole, M12, can be assembled Straight line connector in metal design		 Mat. no. R901076906 (cable diameter 6 to 8 mm)
M12 cap Dust protection (only for pins)		Mat. no. R901075564

Accessories, Profibus (B coding) (not included in the scope of delivery)

Description	**View, dimensions**	**Pole pattern, order details**
X2 Round connector, 5-pole, M12, can be assembled Straight line connector in metal design		 Mat. no. R901075545 (cable diameter 6 to 8 mm)
X3 Round connector, 5-pole, M12, can be assembled Straight mating connector in metal design		 Mat. no. R901075550 (cable diameter 6 to 8 mm)
M12 protective cap (only for socket)		Mat. no. R901075563

Project planning/maintenance instructions/additional information

Product documentation for IFB-P

- Data sheet 29048 (this data sheet)
- Operating manual 29015-B
- CAN bus protocol description data sheet 29015-01-Z
- Profibus protocol description data sheet 29015-02-Z
- General information on the maintenance and commissioning of hydraulic components 07800/07900
- General operating instructions: Hydraulic valves for industrial applications 07600-B

Commissioning software and documentation on the internet: www.boschrexroth.com/IAC

Maintenance instructions:

- The devices have been tested in the plant and are supplied with default settings.
- Only complete units can be repaired. Repaired devices are returned with default settings. User-specific settings will not be applied. The machine end-user will have to retransfer the corresponding user parameters.

Notices:

- Connect the valve to the supply voltage only when this is required for the functional processes of the machine.
- Do not use electrical signals provided via control electronics (e.g. "No error" signal) for switching safety-relevant machine functions (see also EN ISO 13849 "Safety of machinery – safety-related parts of control systems").
- If electro-magnetic interference is to be anticipated, suitable measures must be taken to ensure the function (depending on the application, e.g. shielding, filtration)!
- For more information, refer to the operating instructions and the WIN-PED online help.

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Proportional directional valve, direct operated, with *pQ* functionality

RE 29014/03.13
Replaces: 12.12

Type STW 0195, type STW 0196

STW 0195: Size 6
Component series 2X

STW 0196: Size 10
Component series 1X

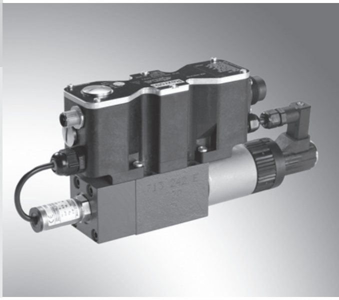


Table of contents

Contents	**Page**

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

Features

- Direct operated 3-way proportional valve with integrated IAC-P digital control electronics, for controlling a pressure in port A
- Completely adjusted unit consisting of position-controlled valve, pressure sensor and field bus connection
- Operation via a proportional solenoid with central thread and detachable coil
- Valve spool, position-controlled
- Integrated pressure sensor plate (optional)
- For subplate mounting: Porting pattern according to ISO 4401
- Analog interfaces for command and actual values
- Design for CAN bus with CANopen protocol DS 408 or Profibus DP
- Separate connectors for power supply and bus connection
- Quick commissioning via PC and WINPED commissioning software

Ordering code

STW	0195	–	2X	/		V		–	24			–	*

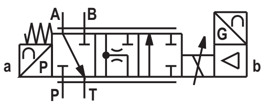
With integrated digital electronics and ***pQ*** functionality; size 6	
Component series 20 to 29 (20 to 29: Unchanged installation and connection dimensions)	**= 2X**
Rated flow	
P → A 10 l/min, A → T 20 l/min	**= 1**
P → A 20 l/min, A → T 20 l/min	**= 2**
Seal material	
FKM seals	**= V**
Pressure rating of the integrated pressure sensor	
3 =	Nominal pressure 50 bar
5 =	Nominal pressure 160 bar
8 =	Nominal pressure 250 bar
Supply voltage	
24 =	Direct voltage 24 V
Bus interface	
C =	CANBus DS - 408
P =	Profibus DP V0/V1
Interface A6 or F6	
A6 =	±10 VDC
F6 =	4 to 20 mA
Further details in plain text	*

STW	0196	–	1X	/	1	V		–	24			–	*

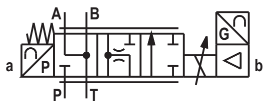
With integrated digital electronics and ***pQ*** functionality; size 10	
Component series 10 to 19 (10 to 19: Unchanged installation and connection dimensions)	**= 1X**
Rated flow	
P → A 65 l/min, A → T 60 l/min, B → T 60 l/min	**= 1**
Seal material	
FKM seals	**= V**
Pressure rating of the integrated pressure sensor	
3 =	Nominal pressure 50 bar
5 =	Nominal pressure 160 bar
8 =	Nominal pressure 250 bar
Supply voltage	
24 =	Direct voltage 24 V
Bus interface	
C =	CANBus DS - 408
P =	Profibus DP V0/V1
Interface A6 or F6	
A6 =	±10 VDC
F6 =	4 to 20 mA
Further details in plain text	*

Symbols

Type STW0195...



Type STW0196...



Set-up, function, section

Set-up

The IAC-P valve basically consists of:

– Housing (1) with connection surface
– Control spool (2) with compression spring (3)
– Solenoid and pole tube (4) with central thread
– Position transducer (5)
– Pressure sensor (6)
– Integrated IAC-P digital control electronics (7) with bus connection (X2) and central connector (X1).

Functional description

– If solenoids (4) are not operated, spool position A → T (with type STW 0196-1X/1 additionally B → T)
– Functions:
  • Flow control (***Q***)
  • Pressure control (***p***)
  • Substitutional closed-loop control ***p/Q***
– The command value can alternatively be specified via an analog interface (X1) or via the field bus interface (X2, X3).
– The actual value signals are provided via an analog interface (X1) and can additionally be read out via the field bus (X2, X3).
– The controller parameters are set via the field bus (X2, X3).
– Separate supply voltage for bus/controller and power part (output stage) for safety reasons.

The digital integrated control electronics enables the following fault detection: (diagnosis)

– Cable break of pressure sensor supply line (6)
– Undervoltage
– Cable break of position transducer (5)
– Communication error
– Watchdog
– Cable break of command value inputs

The following additional functions are available:

– Pressure ramp
– Internal command value profile
– Enable function analog/digital
– Error output 24 V

WINPED PC program

To implement the project planning task and to parameterize the IAC-P valves, the user may use the WINPED commissioning software (see accessories).

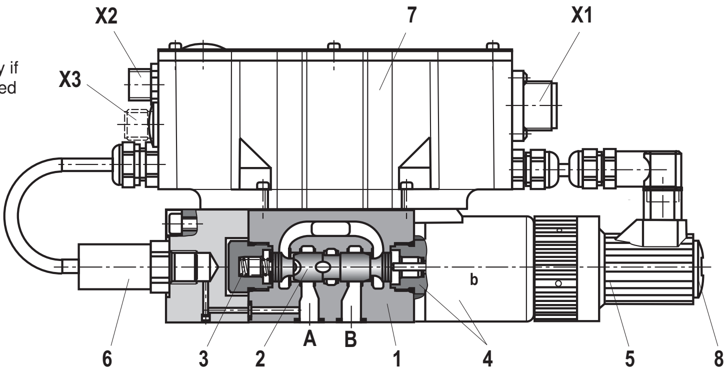
- Parameterization
- Diagnosis
- Comfortable data management on a PC
- PC operating systems: Windows 2000 or Windows XP

3

$Q_{command}$	***Q*** control	***p*** closed-loop control
< 12 mA	**A → T**	**Inactive**
> 12 mA	**Substitutional closed-loop control: (A → T or P → A) Q control ($Q_{command}$) with pressure limitation ($p_{command}$) if pressure limitation is active, the following applies: $Q_{actual} \leq Q_{command}$**	

Functional section of STW 0195–2X

X3 exists only if Profibus is used



Notice!

Due to the design principle, internal leakage is inherent to the valves, which may increase over the life cycle.

The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve is to be installed.

Important notice!

The PG fitting (8) must not be opened. Mechanical adjustment of the adjustment nut located below is prohibited and damages the valve!

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

general

Valve type		STW195	STW196
Weight	kg	2.4	6.5
Installation position		Any, preferably horizontal	
Ambient temperature range	°C	–20 … +50	
Storage temperature range	°C	–20 … +80	

hydraulic (measured using HLP 46; ϑ_{oil} = 40 °C ±5 °C and p = 100 bar)

Operating pressure [1] Ports P, A, B	with sensor 50 bar	bar	50		
	with sensor 160 bar	bar	160		
	with sensor 250 bar	bar	250		
Port T	with sensor 50 bar	bar	50		
	with sensor 160 bar	bar	160		
	with sensor 250 bar	bar	210		
Rated flow $q_{V\ rated}$ at Δp = 5 bar (see also flow characteristic curve from page 10 onwards)	From P → A	l/min	Spool **1**	Spool **2**	65
			10	20	
	From A → T	l/min	20	20	A → T, B → T 60
Maximum flow			See characteristic curves performance limit from page 11 onwards		
Hydraulic fluid			See table below		
Hydraulic fluid temperature range (at the valve's working ports)		°C	–20 to +80, preferably +40 to +50		
Viscosity range		mm^2/s	20 to 380, preferably 30 to 46		
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15 [2]		
Hysteresis		%	≤ 0.1		
Range of inversion		%	≤ 0.05		
Response sensitivity		%	≤ 0.05		
Zero shift		%10 K	≤ 0.15		
		%100 bar	≤ 0.1		

[1] Operating pressure, dependent on valve and sensor

[2] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components.
For the selection of the filters see www.boschrexroth.com/filter

Hydraulic fluid		Classification	Suitable sealing materials	Standards
Mineral oils and related hydrocarbons		HL, HLP	NBR, FKM	DIN 51524
Flame-resistant	– containing water	HFC (Fuchs HYDROTHERM 46M, Petrofer Ultra Safe 620)	NBR	ISO 12922

☞ **Important information on hydraulic fluids!**

- For more information and data on the use of other hydraulic fluids refer to data sheet 90220 or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.)!
- The flash point of the process and operating medium used must be 40 K greater than the maximum solenoid surface temperature.
- **Flame-resistant – containing water**: Maximum pressure differential per control edge 175 bar. Pressure pre-loading at the tank port > 20 % of the pressure differential; otherwise, increased cavitation.

  Life cycle as compared to operation with mineral oil HL, HLP 50 % to 100 %

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

electric

Supply voltage	Nominal voltage	VDC	24
	Lower limit value	VDC	19.4
	Upper limit value	VDC	35
Maximum admissible residual ripple		Vpp	2
Current consumption	I_{max}	A	2
	Pulse current	A	3
Command value signals		mA	4 to 20 or via CAN bus
Duty cycle [1]		%	100
Maximum coil temperature [2]		°C	Up to 150
Protection class of the valve according to EN 60529			IP 65 with mating connector correctly mounted and locked

[1] Connect the valve to the supply voltage only when this is required for the functional sequence of the machine.

[2] Due to the temperatures occurring at the surfaces of the solenoid coils, the European standards ISO 13732-1 and EN ISO 4413 need to be adhered to.

Sensor technology

Valve type			STW 195 (size 6) and STW 196 (size 10)		
Measurement range	p_N	bar	**50**	**160**	**250**
Overload protection	p_{max}	bar	120	320	500
Bursting pressure	p	bar	550	800	1200
Compensation error	Zero point		< 0.15 % of full scale		
	End value		< 0.3 %		
Temperature coefficient in nominal temperature range					
Greatest temperature coefficient of zero point			< 0.2 % / 10 K		
Greatest temperature coefficient of the range			< 0.2 % / 10 K		
Characteristic curve deviation			< 0.2 %		
Hysteresis			< 0.1 %		
Repetition accuracy			< 0.05 %		
Setting time (10 - 90 %)		t	< 2 ms		
Long-term drift (1 year) at reference conditions			< 0.2 %		
Conformity			CE according to EMC directive 89/336/EEC, 93/68/EEC, 93/44/EEC		

Electrical connections, allocation

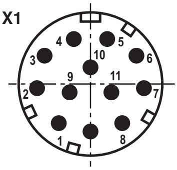
Connector allocation X1, 11-pole + PE according to DIN EN 175201-804

Pin	No. and/or litz wire color [1]	Interface A6 allocation	Interface F6 allocation
1	1	24 VDC (u(t) = 19.4 V … 35 V), I_{max} = 1.7 A (for output stage)	
2	2	0 V ≙ load zero, reference for pins 1 and 9	
3	White	Enable input 9 ... 35 V ≙ enable on	
4	Yellow	±10 V command value Q R_e > 50 kΩ	4...20 mA command value Q R_e = 100 Ω
5	Green	Reference for command values Q and p	
6	Purple	±10 V actual value Q	4...20 mA actual value Q (load resistance max. 300 Ω)
7	Pink	0 … 10 V command value p R_e > 50 kΩ	4...20 mA command value p R_e = 100 Ω
8	Red	0 … 10 V actual value p	4...20 mA actual value p (load resistance max. 300 Ω)
9	Brown	Control voltage, level same as pin 1, I_{max} = 0.3 A (for signal part and bus)	
10	Black	0 V reference potential for pins 3, 6, 8 and 11 (connected with pin 2 in valve)	
11	Blue	Error output 24 V (19.4 V … 35 V), 200 mA max. load	
PE	Green-yellow	Connected to cooling element and valve housing	

Connect shield on PE only on the supply side!

[1] Litz wire colors of connection line for mating connector with cable set (see accessories)

X1



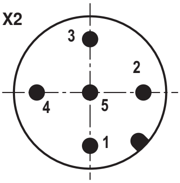
Connector allocation X2, CAN bus, (coding A), M12 x 1, 5-pole, pins

Pin	Allocation
1	n.c.
2	n.c.
3	CAN_GND
4	CAN_H
5	CAN_L

Transmission rate kbit/s 20 to 1000
Bus address 1 to 127

CAN-specific settings:
Baud rate and identifier must be set via the bus system.

X2



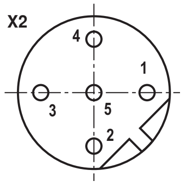
Connector allocation for Profibus DP, "X2"/"X3" (coding B), M12 x 1, 5-pole, socket/pins

Pin	Allocation
1	+5 V
2	RxD/TxD-N (A line)
3	D GND
4	RxD/TxD-P (B line)
5	Shield

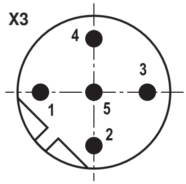
Transmission rate up to 12 MBaud
Bus address 1 to 126
Setting via DIL switch

The +5 V voltage of the IAC-P is available for an external terminating resistor.

X2



X3

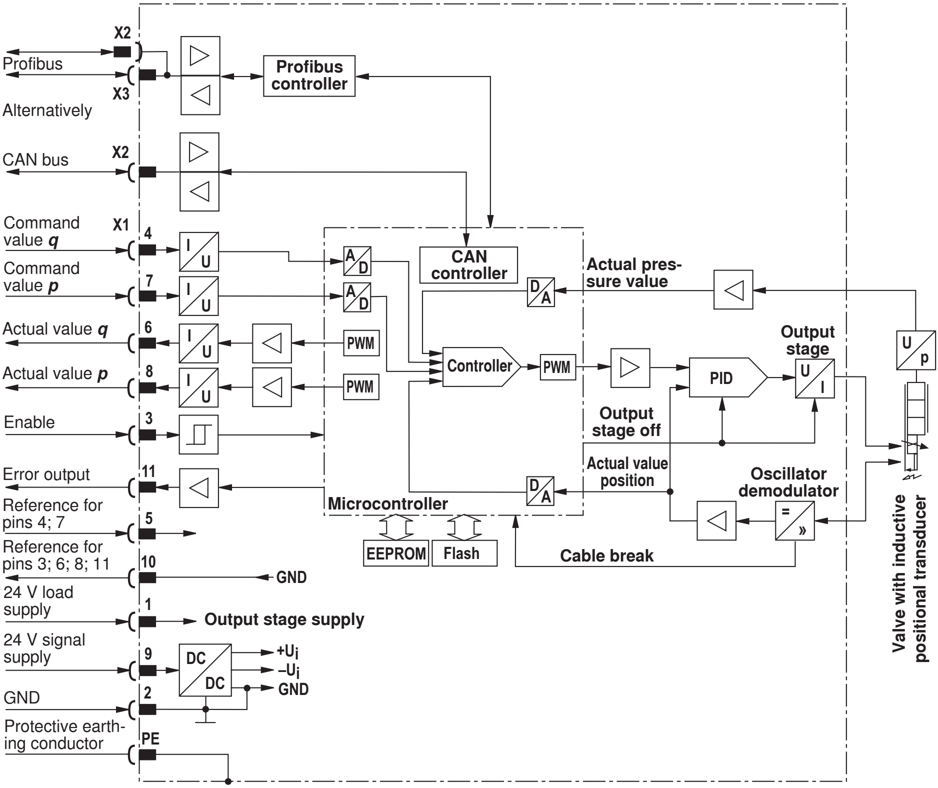


Notice:

We recommend connecting the shields on both sides via the metal housings of the plug-in connectors.
Using connector pins will affect the shielding effect!
Internal screens are not required.

Electrical connections, allocation

Block diagram, integrated control electronics



Command value: Command value 12 to 20 mA at pin 4 and reference potential at pin 5 result in flow from P → A.
Command value 4 to 12 mA at pin 4 and reference potential at pin 5 result in flow from A → T.

Actual value: Actual value 12 to 20 mA at pin 6 and reference potential at pin 10 result in flow from P → A.
Actual value 4 to 12 mA at pin 6 and reference potential at pin 10 result in flow from A → T.

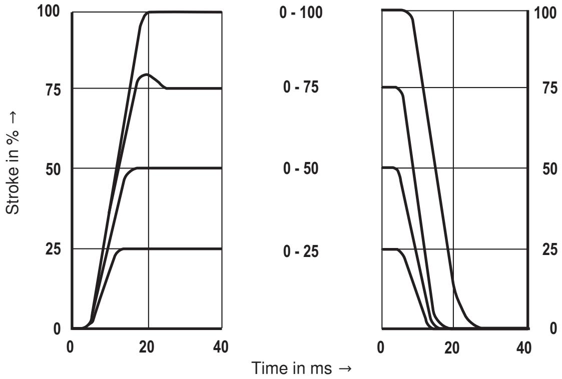
Connection line: Recommendation: – Up to 25 m line length for pins 1; 2 and PE: 0.75 mm^2, otherwise 0.25 mm^2
– Up to 50 m line length for pins 1; 2 and PE: 1.00 mm^2

External diameter see sketch of mating connector

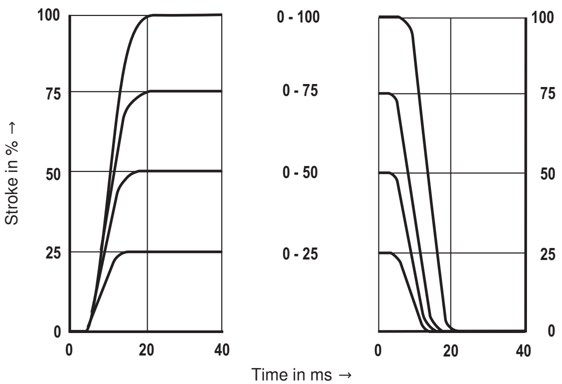
3

Characteristic curves: Type STW 0195-2X/1...

Transition function of type STW 0195-2X/1..., A → T

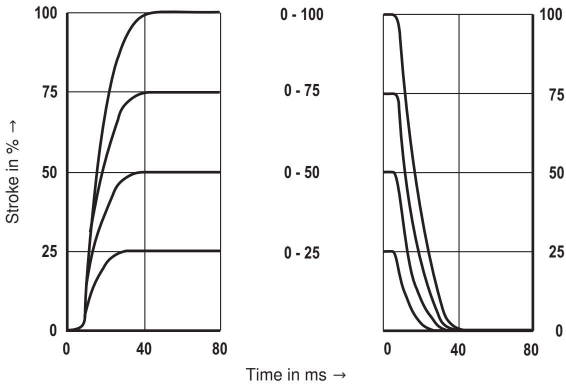


Transition function of type STW 0195-2X/1..., P → A

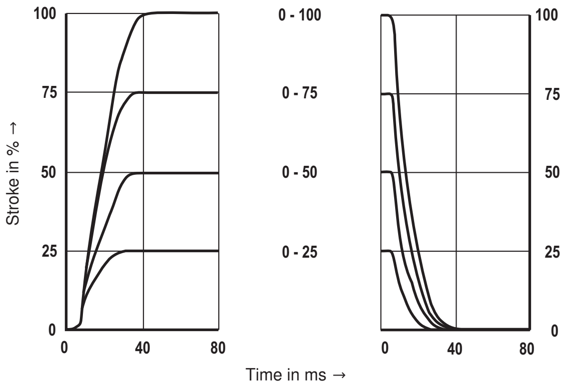


Characteristic curves: Type STW 0196-1X/1...

Transition function of type STW 0196-1X/1..., A → T, B → T

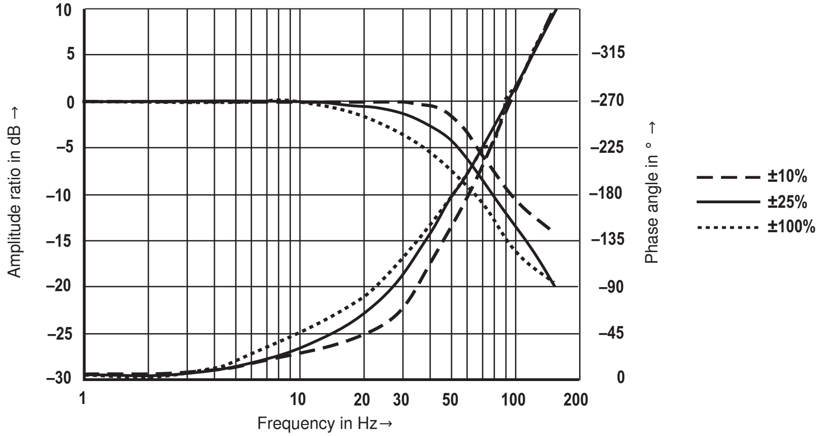


Transition function of type STW 0196-1X/1..., P → A

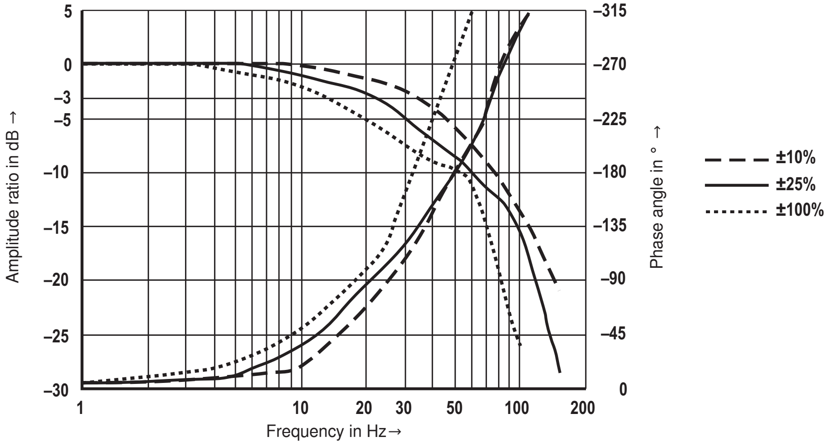


Characteristic curves: Type STW 0195-2X/1... and type STW 0196-1X/1...

Frequency response of type STW 0195-2X/1...

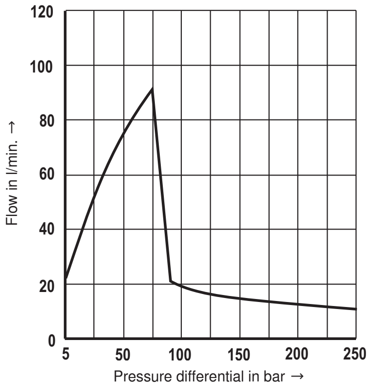


Frequency response of type STW 0196-1X/1...

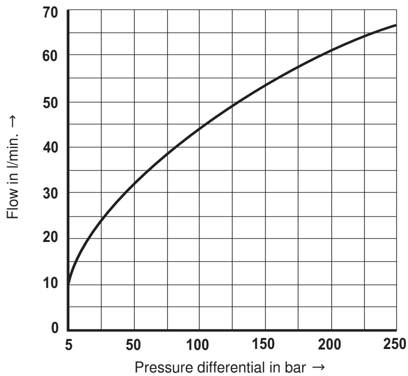


Characteristic curves: Type STW 0195-2X/1...

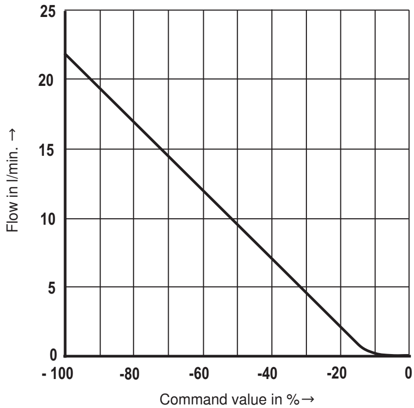
Performance limit A → T, position-controlled



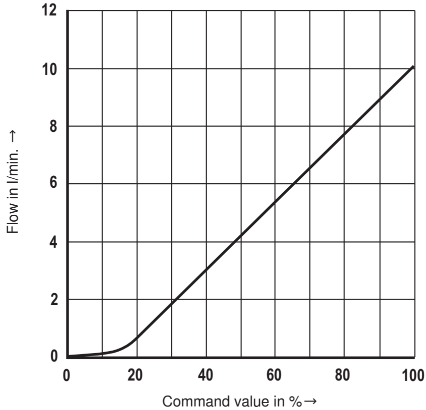
Performance limit P → A, position-controlled



Flow characteristic curve A → T, Δp = 5 bar

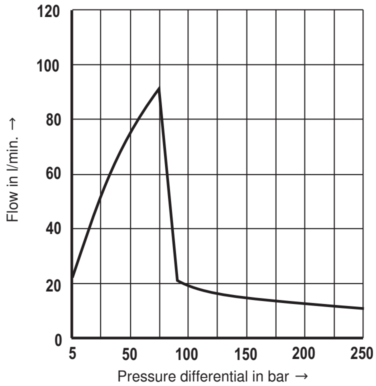


Flow characteristic curve P → A, Δp = 5 bar

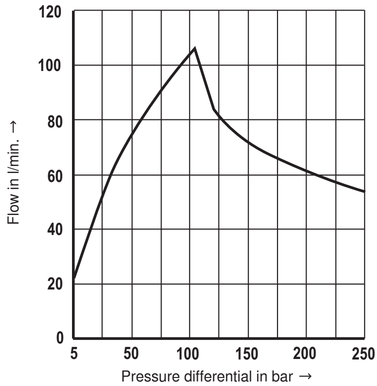


Characteristic curves: Type STW 0195-2X/2...

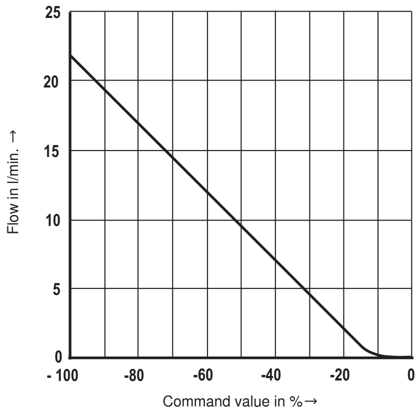
Performance limit A → T, position-controlled



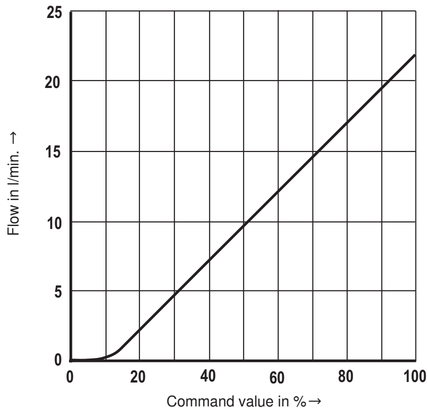
Performance limit P → A, position-controlled



Flow characteristic curve A → T, *Δp* = 5 bar

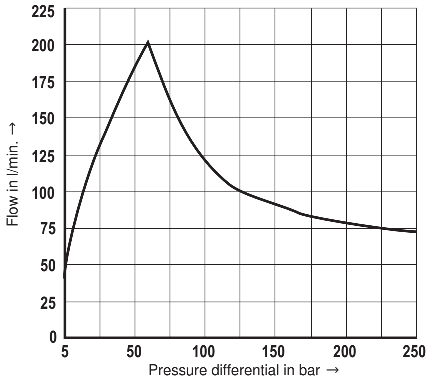


Flow characteristic curve P → A, *Δp* = 5 bar

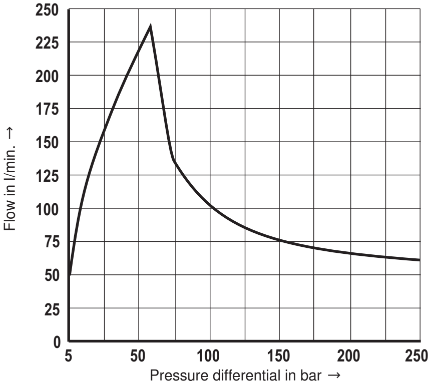


Characteristic curves: Type STW 0196-1X/1...

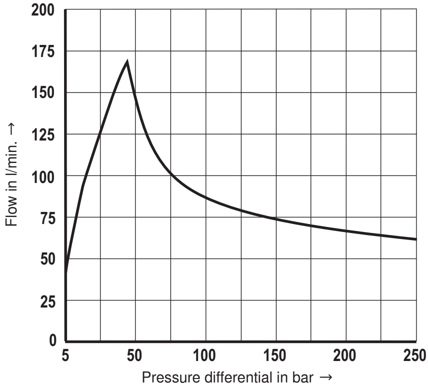
Performance limit A → T, position-controlled



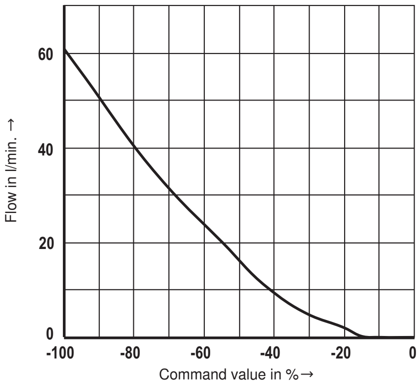
Performance limit P → A, position-controlled



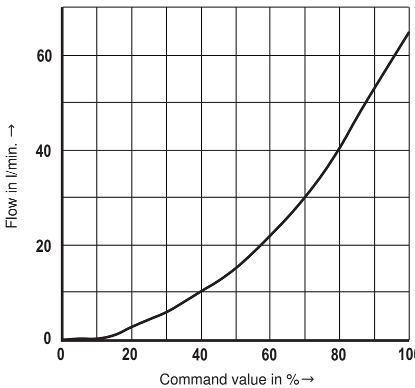
Performance limit B → T, position-controlled



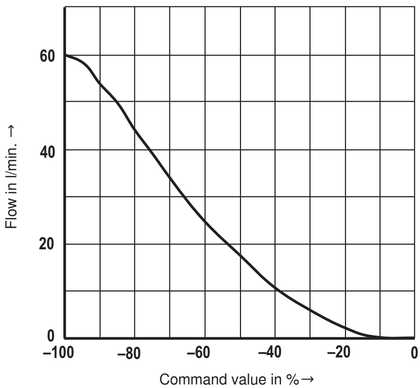
Flow characteristic curve A → T, *Δp* = 5 bar



Flow characteristic curve P → A, *Δp* = 5 bar

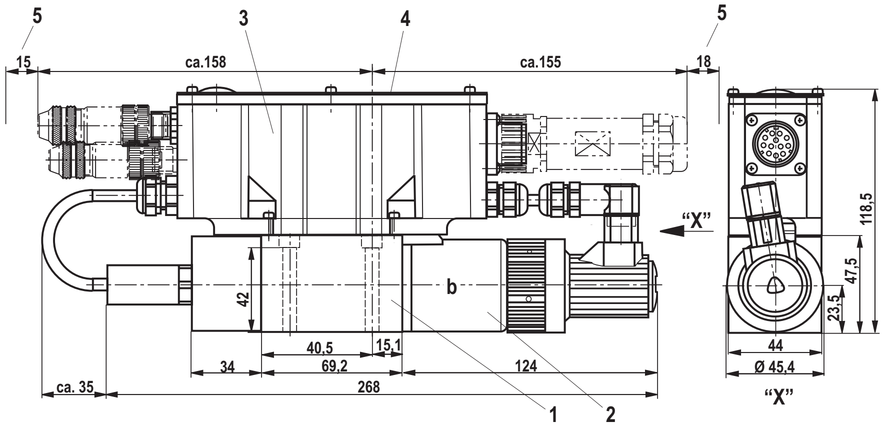


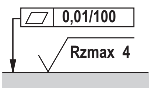
Flow characteristic curve B → T, *Δp* = 5 bar



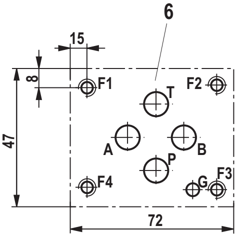
3

Dimensions: Type STW 0195-2X/1... (dimensions in mm)





Required surface quality of the valve contact surface



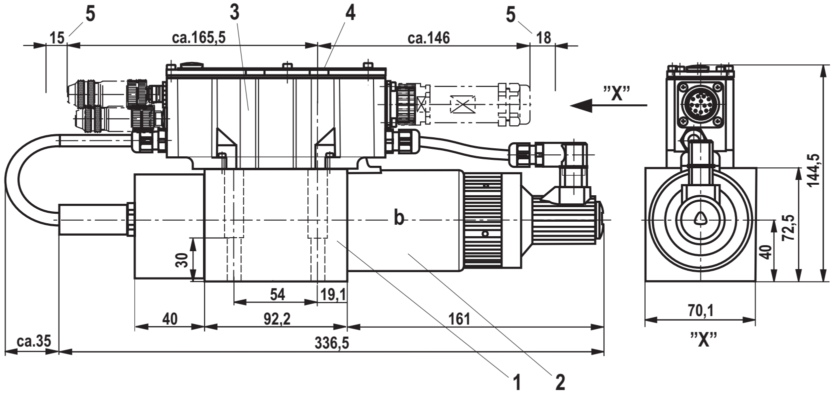
Notice!
The dimensions are nominal dimensions which are subject to tolerances.

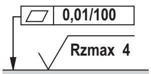
1. **1** Valve housing
2. **2** Proportional solenoid "b" with inductive position transducer
3. **3** Integrated digital control electronics
4. **4** Name plate
5. **5** Space required to remove the connector
6. **6** Machined valve contact surface, porting pattern according to ISO 4401-03-02-0-05

   Deviating from the standard:
   - Ports P, A, B and T with Ø 8 mm
   - Bore B may not be required since there is no pin in the valve.

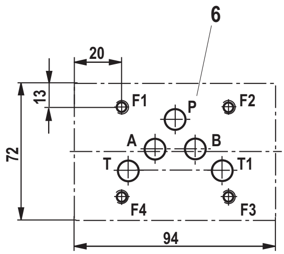
Subplates and valve mounting screws see page 16

Dimensions: Type STW 0196-1X/1... (dimensions in mm)





Required surface quality of the valve contact surface



3

Notice!
The dimensions are nominal dimensions which are subject to tolerances.

- **1** Valve housing
- **2** Proportional solenoid "b" with inductive position transducer
- **3** Integrated digital control electronics
- **4** Name plate
- **5** Machined valve contact surface,
  porting pattern according to ISO 4401-05-04-0-05
  Deviating from the standard:
  – Port T1 exists additionally

Subplates and valve mounting screws see page 16

Dimensions

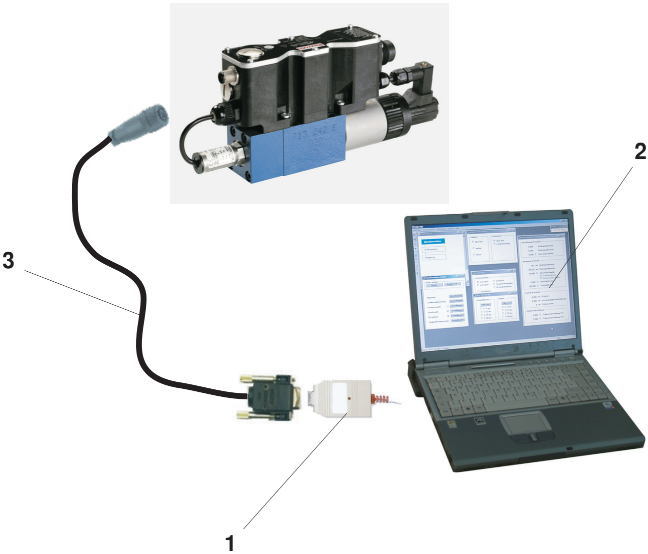
Hexagon socket head cap screws		**Material number**
Type STW0195	4x ISO 4762 - M5 x 50 - 10.9-flZn-240h-L Tightening torque M_A = 7 Nm ±10 % or 4x ISO 4762 - M5 x 50 Tightening torque M_A = 8.9 Nm ±10 %	R913000064
Type STW0196	4x ISO 4762 - M6 x 40 - 10.9-flZn-240h-L Tightening torque M_A = 12.5 Nm ±10 % or 4x ISO 4762 - M6 x 40 - 10.9 Tightening torque M_A = 15.5 Nm ±10 %	R913000058

Notice: The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure!

Subplates	**Data sheet**
Type STW0195	45052
Type STW0196	45054

Accessories (not included in the scope of delivery)

The following is required for the parameterization with PC:		CANopen	Profibus DP
1	Interface converter (USB)	VT-ZKO-USB/CA-1-1X/V0/0 Mat.no. **R901071963**	VT-ZKO-USB/P-1-1X/V0/0 Mat.no. **R901071962**
2	Commissioning software	WINPED Download via www.boschrexroth.de\IAC	
3	Connection cable, 3 m	D-Sub / M12, coding A Mat.no. **R900751271**	D-Sub / M12, coding B Mat.no. **R901078053**

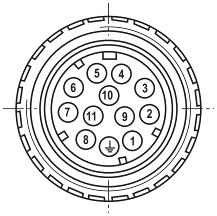


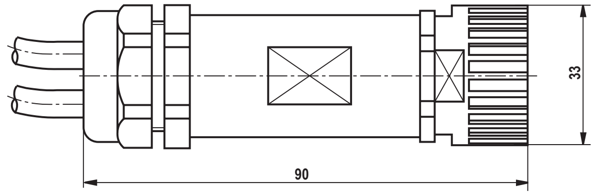
Accessories, port X1 (not included in the scope of delivery)

Mating connector for X1

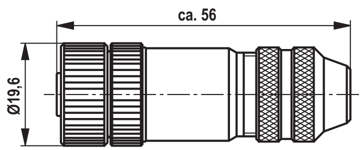
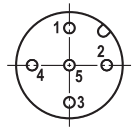
Mating connector according to DIN EN17520-804 (11-pole + PE), plastic variant

- Mating connector without cable (assembly kit) Material no. **R900884671**
- Mating connector with cable set 2 x 5 m 12-pole Material no. **R900032356**
- Mating connector with cable set 2 x 20 m 12-pole Material no. **R900860399**

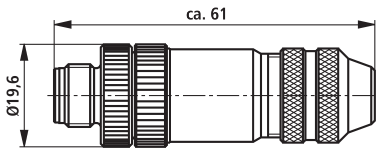
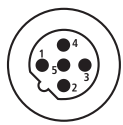
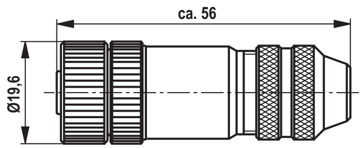
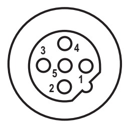
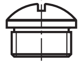




Accessories, CAN bus (A coding) (not included in scope of delivery)

Description	View, dimensions	Pole pattern, order details
X2 Round connector, can be assembled, 5-pole, M12x1 Straight mating connector in metal design.		 Mat no.: **R901076910** (line diameter 6 - 8 mm)

Accessories, Profibus (B coding) (not included in scope of delivery)

Description	View, dimensions	Pole pattern, order details
X2 Round connector, can be assembled, 5-pole, M12x1 Straight line connector in metal design.		 Mat no.: **R901075545** (line diameter 6 - 8 mm)
X3 Round connector, can be assembled, 5-pole, M12x1 Straight mating connector in metal design.		 Mat no.: **R901075550** (line diameter 6 - 8 mm)
M12 protective cap (for mating connector only)		Mat no.: **R901075563**

3

Project planning/maintenance instructions/additional information

Product documentation for types STW0195 and STW0196

Technical data sheet 29014 (this data sheet)

Operating manual 29015-B

CAN bus protocol description, data sheet 29015-01-Z
Profibus protocol description, data sheet 29015-02-Z

General information regarding the maintenance and commissioning of hydraulic components data sheet 07800/07900

WINPED commissioning software and documentation on the Internet: www.boschrexroth.com/IAC

Maintenance instructions:
- The devices have been tested in the factory and are supplied with default settings.
- Only complete devices can be repaired. Repaired devices are returned with default settings. User-specific settings are not accepted. The machine end-user will have to retransfer the corresponding user parameters.

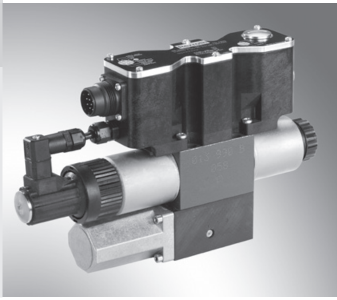
Notes:
- Connect the valve to the supply voltage only when this is required for the functional sequence of the machine.
- Do not use electrical signals led out of control electronics (e.g. "No error" signal) for switching safety-relevant machine functions (See also EN ISO 13849 "Safety of machinery – safety-related parts of control systems").
- If electro-magnetic interference must be expected, take appropriate measures to ensure the function (depending on the application, e.g. shielding, filtration)!

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

4/3-proportional directional valve direct operated, with *pQ* functionality

RE 29050/03.13
Replaces: 12.12

Type 4WREQ



Size 6 and 10
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 180 l/min

Table of contents

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

Features

- Direct operated proportional directional valve with integrated digital control electronics for the pressure, force and flow control (Integrated Axis Controller IAC-P)
- Completely adjusted unit consisting of valve, pressure sensor(s) (optional), digital control electronics and field bus connection
- Operation by means of proportional solenoids with central thread and detachable coil
- Valve spool position-controlled
- Integrated pressure sensor plate (optional)
- For subplate mounting: Porting pattern according to ISO 4401
- Analog interfaces for command and actual values
- Design for CAN bus with CANopen protocol DS 408 or PROFIBUS-DP V0/V1
- Quick commissioning via PC and commissioning software WIN-PED 6

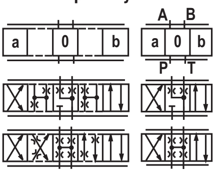
Ordering code

4WRE	Q			–2X/	V		–24				*

With integrated digital electronics and ***pQ*** functionality **= Q**

Size 6 **= 6**
Size 10 **= 10**

Control spool symbols



= Q5-

= V

Rated flow [1]

Size 6

8 l/min **= 08**
16 l/min **= 16**
32 l/min **= 32**

Size 10

25 l/min **= 25**
50 l/min **= 50**
75 l/min **= 75**

Component series 20 to 29 (20 to 29: Unchanged installation and connection dimensions) **= 2X**

Seal material
FKM seals **= V**

Pressure rating with internal sensors

100 bar [2] **= 4**
160 bar [2] **= 5**
250 bar [2] **= 8**
400 bar [3] **= B**
External sensor **= 0**

Position of the pressure sensors

0 = External sensor

Internal sensor in the channel

A = A
B = B
C = A + B
F = P + A + B

Application	Ordering code
Q control	F
p control only in A	A
p control only in B	B
p control in A + B or ***Δp*** control	C

Supply voltage
24 = Direct voltage 24 V

Bus interface
C = CANBus DS 408
P = PROFIBUS-DP V0/V1

Electronics interface [5]
A6 = ±10 VDC
F6 = 4 to 20 mA

Sensor interface with external pressure sensor [4]
2 = 4 to 20 mA
3 = 0 to 10 V
4 = 0 to 5 V
9 = 0.5 to 5 V
0 = Without external sensor interface

Further details in the plain text

[1] See flow characteristic curves from page 12.

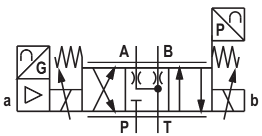
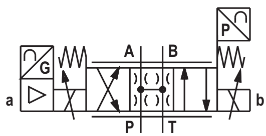
[2] The selected pressure rating limits the maximum valve pressure.

[3] Note: Maximum valve pressure is 315 bar.

[4] If internal pressure sensors are used, no external pressure sensor can be connected.

[5] With command value input "A6", only the sensor interfaces "3", "4" or "9" are possible.
With command value input "F6", only the sensor interface "2" is possible.

Symbols

Type 4WREQ.**Q5**-...	Type 4WREQ.**V**...
	

Set-up, function, section (valve with integrated sensors)

Set-up

The valve basically consists of:

- Housing (1) and pressure sensor plate (12) with connection surface
- Control spool (2) with compression springs (3 and 4) and spring plate (8 and 9)
- Coils (5 and 6) and pole tubes (14 and 15) with central thread
- Position transducer (7)
- Integrated pressure sensors (10)
- Integrated digital control electronics IAC-P (11)

Functional description

- With de-energized solenoids (5 and 6), the control spool (2) is brought into the central position by compression springs (3 and 4) between the spring plates (8 and 9) (with V spool valve without spring plate). With V spool valves, the mechanical zero position does not correspond to the hydraulic one.
- Depending on the valve type, the following functions result (some of them can be combined):
  - Flow control (***Q***)
  - Flow control (***Q***)
  - Pressure control in A and/or B (***p***)
  - Force control (***p***)
  - Substitutional control ***p/Q***
- The command value can alternatively be specified via an analog interface (X1) or via the field bus interface (X2, X3).
- The actual value signals are provided via an analog interface (X1) and can additionally be read out via the field bus (X2, X3).
- The controller parameters are set via the field bus
- Separate supply voltage for bus/controller and power part (output stage) for safety reasons

The digital integrated control electronics enables the following fault detection:

- Cable break pressure sensor (10)
- Undervoltage
- Cable break position transducer (7)
- Communication errors
- Watchdog
- Cable break command value inputs (only with current interface)

The following additional functions are available:

- Ramp generator
- Internal command value profile
- Enable function analog/digital
- Error output 24 V

PC program WIN-PED 6

To implement the project planning task and to parameterize the IAC-P valves, the user may use the commissioning software WIN-PED 6.

- Parameterization
- Diagnosis
- Comfortable data administration on the PC

System requirements

- IBM PC or compatible system
- Windows 2000 or Windows XP
- RAM (recommendation 256 MB)
- 150 MB of available hard disk capacity

Notice

- The "WIN-PED 6" PC program is not included in the scope of delivery. It can be downloaded on the Internet free of charge! (see page 26)

3

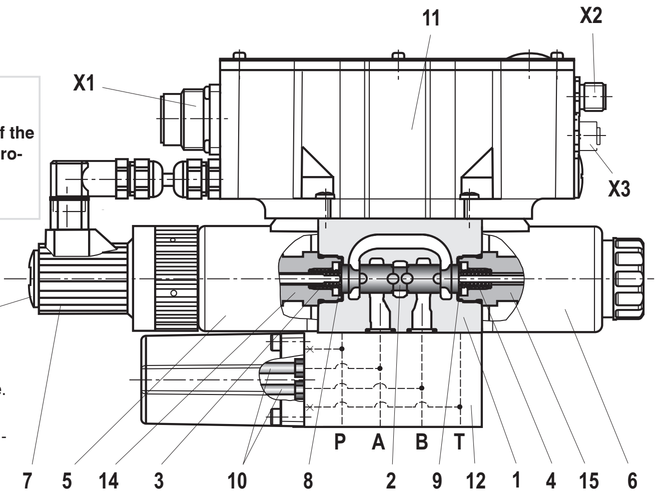
☞ **Important notice!**

The PG fitting (13) must not be opened. Mechanical adjustment of the adjustment nut located below is prohibited and damages the valve!

☞ **Notice!**

Due to the design principle, internal leakage is inherent to the valves, which may increase over the life cycle.

The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve is to be installed.



Set-up, function, section (valve for external sensor)

Set-up

The valve basically consists of:

- Housing (1) with connection surface
- Control spool (2) with compression springs (3 and 4) and spring plate (8 and 9)
- Coils (5 and 6) and pole tubes (14 and 15) with central thread
- Position transducer (7)
- Integrated digital control electronics IAC-P (11)
- Port (X4) for an external pressure sensor (12)

Functional description

- With de-energized solenoids (5 and 6), the control spool (2) is brought into the central position by compression springs (3 and 4) between the spring plates (8 and 9) (with V spool valve without spring plate). With V spool valves, the mechanical zero position does not correspond to the hydraulic one.
- Functions:
  - Flow control (***Q***)
  - Pressure control (***p***)
  - Substitutional control ***p/Q***
- The command value can alternatively be specified via an analog interface (X1) or via the field bus interface (X2, X3).
- The actual value signals are provided via an analog interface (X1) and can additionally be read out via the field bus (X2, X3).
- The controller parameters are set via the field bus
- Separate supply voltage for bus/controller and power part (output stage) for safety reasons

The digital integrated control electronics enables the following fault detection:

- Cable break pressure sensor (depending on sensor interface)
- Undervoltage
- Cable break position transducer (7)
- Communication errors
- Watchdog
- Cable break command value inputs (only with current interface)

The following additional functions are available:

- Ramp generator
- Internal command value profile
- Enable function analog / digital
- Error output 24 V

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To implement the project planning task and to parameterize the IAC-P valves, the user may use the commissioning software WIN-PED 6.

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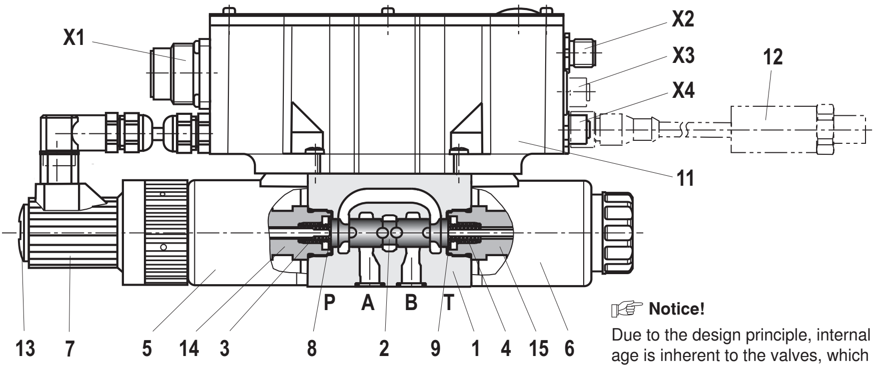

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The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve is to be installed.

☞ **Important notice!**

The PG fitting (13) must not be opened. Mechanical adjustment of the adjustment nut located below is prohibited and damages the valve!

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

general

Sizes		6	10
Weight with sandwich plate (3 sensors)	kg	3.6	8.5
Weight without sandwich plate	kg	2.4	6.5
Installation position		Any, preferably horizontal	
Ambient temperature range	°C	–20 to +50	
Storage temperature range	°C	–20 to +80	

hydraulic (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Operating pressure [1)] Ports P, A, B	with sensor	100 bar	bar	Up to 100	
		160 bar	bar	Up to 160	
		250 bar	bar	Up to 250	
		400 bar	bar	Up to 315	
Port T	with sensor	100 bar	bar	Up to 100	
		160 bar	bar	Up to 160	
		250 bar	bar	Up to 210	
		400 bar	bar	Up to 210	
Rated flow $q_{V\ nom}$ with Δp = 10 bar			l/min	8, 16, 32	25, 50, 75
Maximum admissible flow			l/min	80	180
Hydraulic fluid				See table below	
Hydraulic fluid temperature range			°C	–20 to +70, preferably +40 to +50	
Viscosity range			mm^2/s	20 to 380, preferably 30 to 46	
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)				Class 20/18/15 [2)]	
Hysteresis			%	≤ 0.1	
Range of inversion			%	≤ 0.05	
Response sensitivity			%	≤ 0.05	
Zero shift upon change of hydraulic fluid temperature and operating pressure			%/10 K	< 0.15	
			%/100 bar	< 0.1	

[1)] Operating pressure, determined by valve and sensor

[2)] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components.
For the selection of the filters see www.boschrexroth.com/filter

Hydraulic fluid		Classification	Suitable sealing materials	Standards
Mineral oils and related hydrocarbons		HL, HLP	NBR, FKM	DIN 51524
Flame-resistant	– containing water	HFC (Fuchs HYDROTHERM 46M, Petrofer Ultra Safe 620)	NBR	ISO 12922

☞ **Important information on hydraulic fluids!**

- For more information and data on the use of other hydraulic fluids refer to data sheet 90220 or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.)!
- The flash point of the process and operating medium used must be 40 K higher than the maximum solenoid surface temperature.
- **Flame-resistant – containing water**: Maximum pressure differential per control edge 175 bar. Pressure pre-loading at the tank port > 20 % of the pressure differential; otherwise, increased cavitation.
  Life cycle as compared to operation with mineral oil HL, HLP 50 % to 100 %.

3

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

electric

Supply voltage	Nominal voltage	VDC	24
	Lower limit value	VDC	19.4
	Upper limit value	VDC	35
	Maximum admissible residual ripple	Vss	2
Current consumption	I_{max}	A	2
	Impulse current	A	3
Command and actual value signals	Voltage "A6" U_Q	V	±10
	U_p	V	0 to 10
	Current "F6" I_Q and I_p	mA	4 to 20
Converter resolution (command/actual value signals)		Bit	10
Duty cycle [1]		%	100
Maximum coil temperature [2]		°C	Up to 150
Protection class of the valve according to EN 60529:1991+A1:2000			IP 65 with mounted and locked plug-in connectors

[1] Connect the valve to the supply voltage only when this is required for the functional sequence of the machine.

[2] Due to the temperatures occurring at the surfaces of the solenoid coils, the European standards ISO 13732-1 and EN ISO 4413 need to be adhered to.

Sensor technology

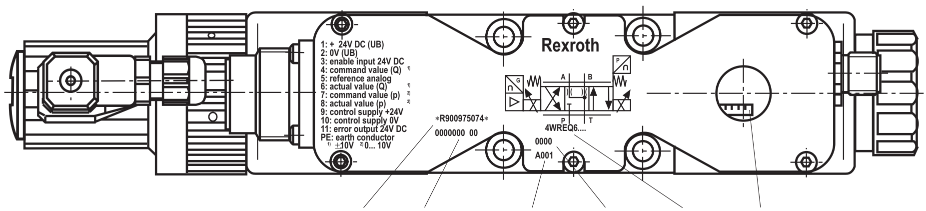
Measurement range	p_N	bar	**100**	**160**	**250**	**400**
Overload protection	p_{max}	bar	200	320	500	800
Bursting pressure	p	bar	400	640	1000	1600
Compensation error						
Zero point			< 0.25 % of the end value			
End value			< 0.5 %			
Temperature coefficients in the nominal temperature range						
Largest TK of the zero point			< 0.2 % / 10 K			
Largest TK of the range			< 0.2 % / 10 K			
Characteristic curve deviation			< 0.2 %			
Hysteresis			< 0.1 %			
Repeatability			< 0.05 %			
Long-term drift (1 year) with reference conditions			< 0.2 %			

With external pressure sensors, the accuracy of the pressure control depends on the accuracy class of the sensor used.

Notice!

Information on the environment simulation testing for the areas EMC (Electromagnetic compatibility), climate and mechanical load see RE 29050-U (declaration on environmental compatibility).

Control electronics (IAC-P), marking and adjustment elements



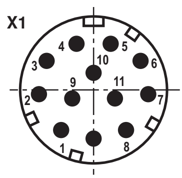
1 Material number
2 Production order number
3 Date of production
4 Serial number
5 Type designation, e.g. 4WREQ…-2X/…
6 DIL switch for address and baud rate setting (position B0 right), see page 10

Control electronics (IAC-P), Electrical connections and allocation

Connector pin assignment X1, 11-pin + PE according to DIN EN 175201-804

Pin	No. and/or litz wire color [1]	Allocation interface A6	Allocation interface F6
1	1	24 VDC (u(t) = 19.4 V to 35 V), I_{max} = 1.7 A (for output stage)	
2	2	0 V ≙ load zero, reference for pins 1 and 9	
3	White	Enable input 9 to 35 V ≙ enable on	
4	Yellow	±10 V command value ***Q*** R_e > 50 kΩ	4 to 20 mA command value ***Q*** R_e = 100 Ω
5	Green	Reference for command values ***Q*** and ***p***	
6	Purple	±10 V actual value ***Q*** (limit load 5 mA)	4 to 20 mA actual value ***Q*** (load resistance max. 300 Ω)
7	Pink	0 to 10 V command value ***p*** R_e > 50 kΩ	4 to 20 mA command value ***p*** R_e = 100 Ω
8	Red	0 to 10 V actual value ***p*** (limit load 5 mA)	4 to 20 mA actual value ***p*** (load resistance max. 300 Ω)
9	Brown	Control voltage, level as pin 1, I_{max} = 0.3 A (for signal part and bus)	
10	Black	0 V reference potential for pins 3, 6, 8 and 11 (in the valve connected to pin 2)	
11	Blue	Error output 24 V (19.4 V to 35 V), 200 mA max. load	
PE	Green-yellow	Connected to cooling element and valve housing	

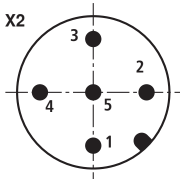
Connect shield to PE only on the supply side!



[1] Litz wire colors of the connection lines for mating connector with cable set (see accessories)

Control electronics (IAC-P), electrical connections and allocation

X2



Connector pin assignment for CAN bus "X2"/"X3" (coding A), M12, 5-pin, pins/sockets

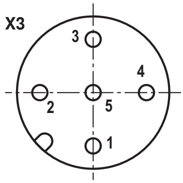
Pin	Allocation
1	n. c.
2	n. c.
3	CAN_GND
4	CAN_H
5	CAN_L

Transmission rate kbit/s	20 to 1000
Bus address	1 to 127

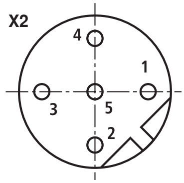
CAN-specific settings:

Baud rate and identifier can be set via the bus system and/or the DIL switches.

X3



X2



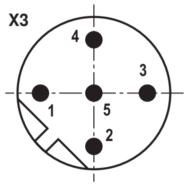
Connector pin assignment for PROFIBUS-DP, "X2"/"X3" (coding B), M12, 5-pin, socket/pins

Pin	Allocation
1	+5 V
2	RxD/TxD-N (A line)
3	D GND
4	RxD/TxD-P (B line)
5	Shield

Transmission rate	up to 12 MBaud
Bus address	1 to 126

Setting via DIL switches

X3

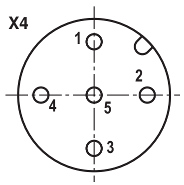


The +5 V voltage of the IAC-P is available for an external terminating resistor.

External pressure sensor port "X4" (coding A), M12, 5-pin, socket

Pin	Allocation of voltage interface	Allocation of current interface
1	Supply 24 VDC	Supply 24 VDC
2	Signal (0...+5 V)	Signal (4...20 mA)
3	Zero 0 V (GND)	Zero 0 V (GND)
4	n. c.	n. c.
5	n. c.	n. c.

X4



Notice:

We recommend connecting the shields on both sides over the metallic housings of the plug-in connectors.
Using connector pins will affect the shielding effect!
Internal screens are not required.

Control electronics (IAC-P), settings for CANopen and PROFIBUS-DP

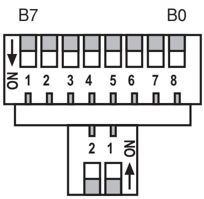
CANopen

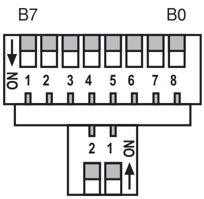
B7	B6	B5	B4	B3	B2	B1	B0	HEX	Baud rate: B7, B6	Address range: B5 to B0
0	0	0	0	0	0	0	0	00 [1)]	Standard 20 kBaud or re-programmed	1 = standard or re-programmed
0	0	0	0	0	0	0	1	01	20 kBaud	1 to 63
					to			to		
0	0	1	1	1	1	1	1	3F		
0	1	0	0	0	0	0	0	40	125 kBaud	1 = standard or re-programmed
0	1	0	0	0	0	0	1	41	125 kBaud	1 to 63
					to			to		
0	1	1	1	1	1	1	1	7F		
1	0	0	0	0	0	0	0	80	250 kBaud	1 = standard or re-programmed
1	0	0	0	0	0	0	1	81	250 kBaud	1 to 63
					to			to		
1	0	1	1	1	1	1	1	BF		
1	1	0	0	0	0	0	0	C0	500 kBaud	1 = standard or re-programmed
1	1	0	0	0	0	0	1	C1	500 kBaud	1 to 62
					to			to		
1	1	1	1	1	1	1	0	FE		
1	1	1	1	1	1	1	1	FF	250 kBaud	Monitor modus/ programming mode 1 = fixed

PROFIBUS-DP

B7	B6	B5	B4	B3	B2	B1	B0	HEX	Address range
0	0	0	0	0	0	0	0	00 [1)]	125 = standard or re-programmed
0	0	0	0	0	0	0	1	01	1 to 126 with parameter channel
					to			to	
0	1	1	1	1	1	1	0	7E	
1	0	0	0	0	0	0	0	80	1 to 126 without parameter channel
					to			to	
1	1	1	1	1	1	1	0	FE	
1	1	1	1	1	1	1	1	FF	Monitor operation address 125

[1)] Factory setting



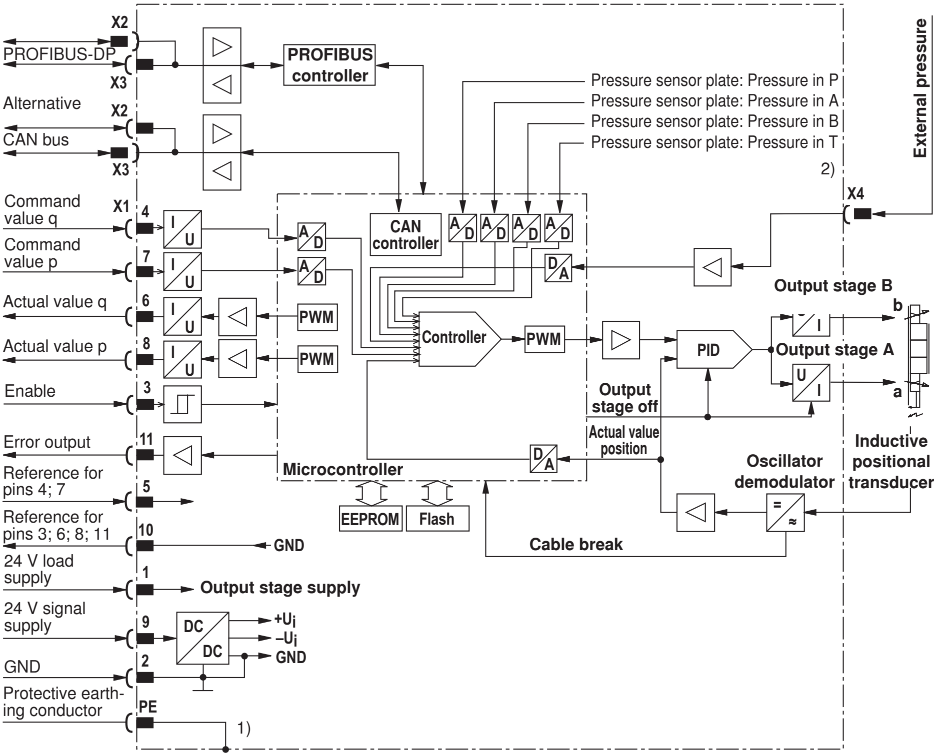


Connection of the bus terminator with the two lower switches (only with PROFIBUS-DP):

Left figure: Bus terminator not connected
Right figure: Bus terminator connected (both switches to "ON")

3

Control electronics (IAC-P), block diagram



Command value: Positive command value 0 to +10 V (or 12 to 20 mA) at pin 4 and reference potential at pin 5 result in flow from P → A and B → T.

Negative command value 0 to –10 V (or 12 to 4 mA) at pin 4 and reference potential at pin 5 result in flow from P → B and A → T.

Actual value: Positive actual value 0 to +10 V (or 12 to 20 mA) at pin 6 and reference potential at pin 10 result in flow from P → A and B → T.

Negative actual value 0 to –10 V (or 12 to 4 mA) at pin 6 and reference potential at pin 10 result in flow from P → B and A → T.

Connection line: Recommendation:
- Up to 25 m line length for pins 1; 2 and PE: 0.75 mm^2, otherwise 0.25 mm^2
- Up to 50 m line length for pins 1; 2 and PE: 1.00 mm^2

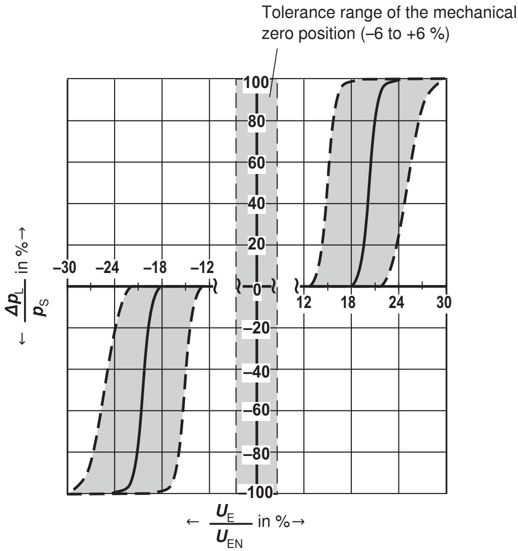
External diameter see sketch of mating connector

[1] The protective earthing conductor (PE) is connected to cooling element and valve housing

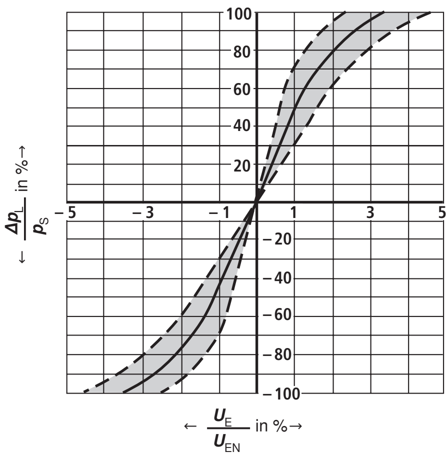
[2] Pressure transducer in P, A, B and T depending on ordering code or an external pressure sensor via the 5-pin M12 mating connector X4

Characteristic curves: Size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Pressure signal characteristic curve (Q5 control spool), p_s = 100 bar



Pressure signal characteristic curve (V control spool), p_s = 100 bar



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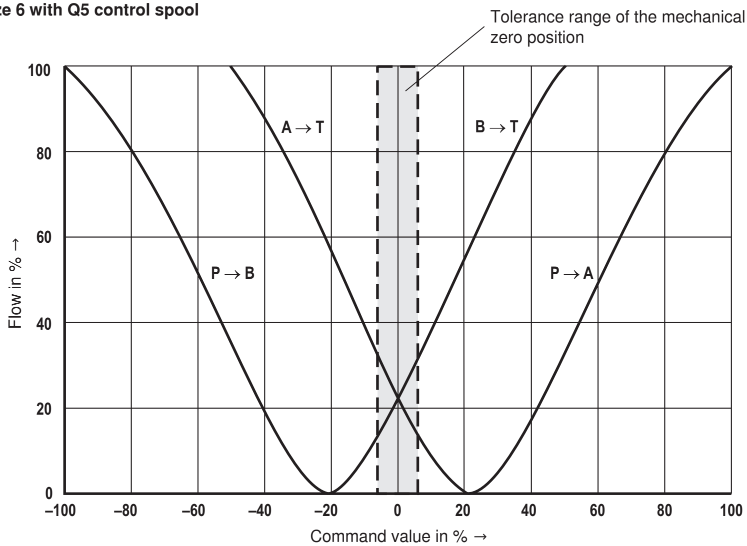
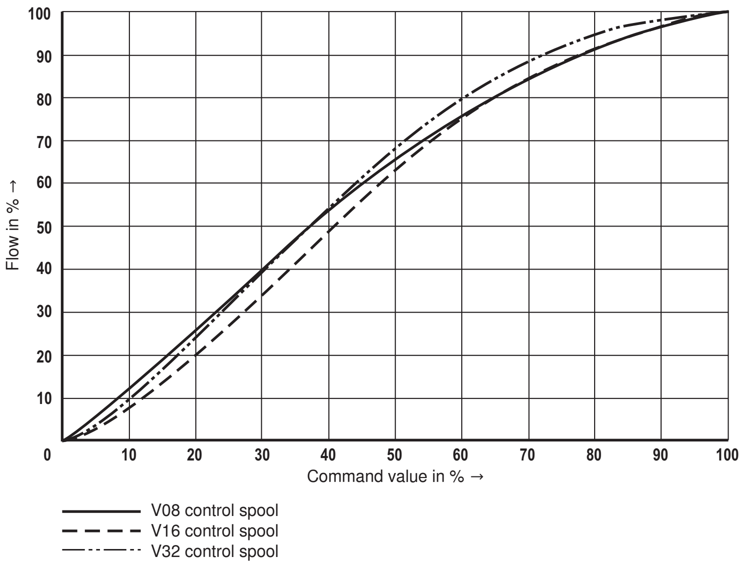
Characteristic curves: Size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow, size 6 with Q5 control spool

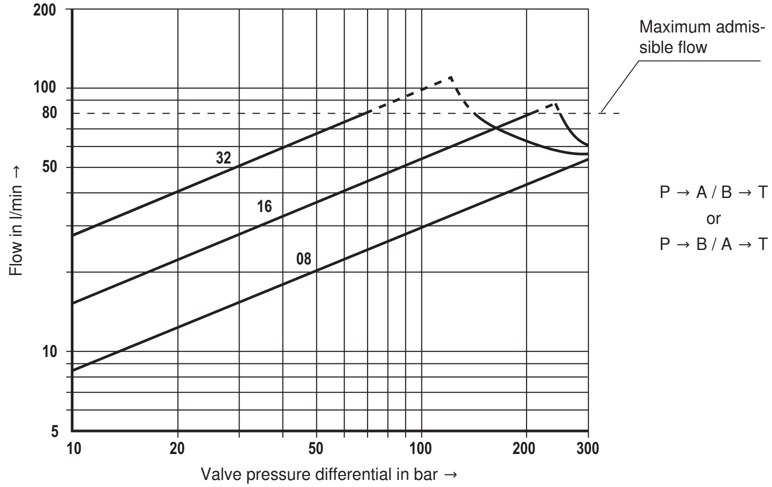


Flow, size 6 with V control spool

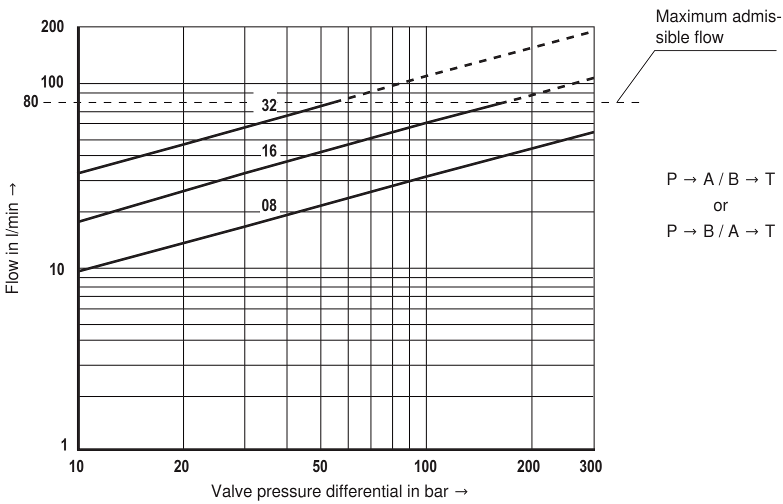


Characteristic curves: Size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function size 6 with Q5 control spool with maximum valve opening

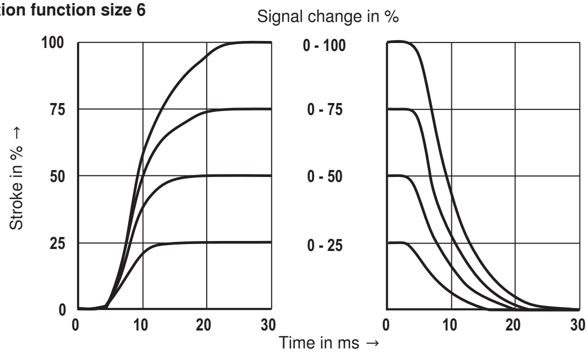


Flow/load function size 6 with V control spool with maximum valve opening

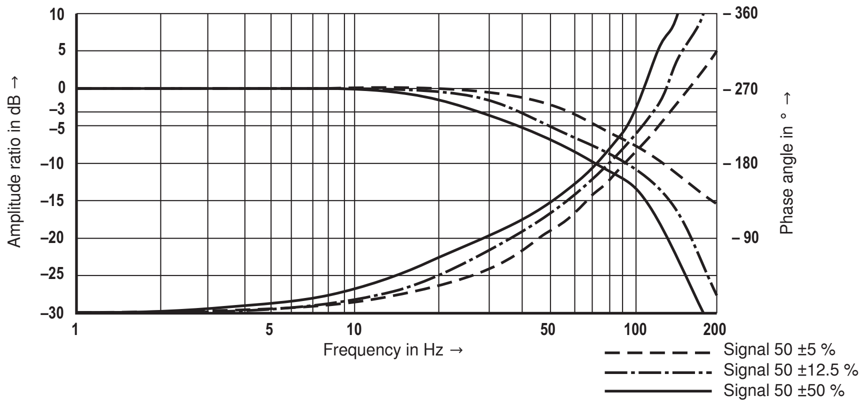


Characteristic curves: Size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

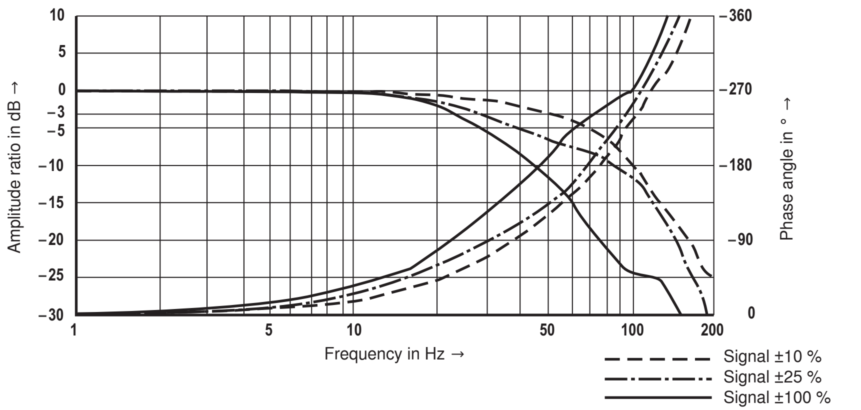
Transition function size 6



Frequency response size 6 with Q5 control spool, p_s = 10 bar

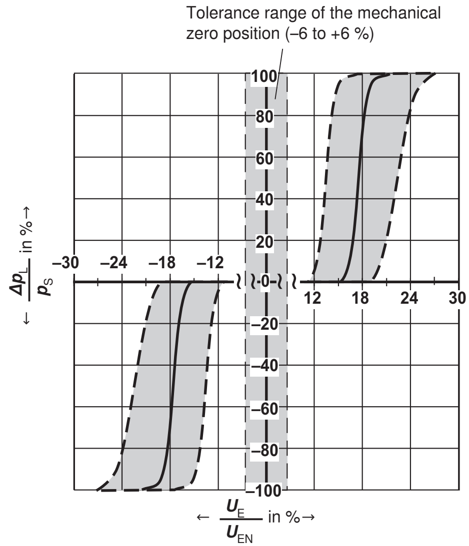


Frequency response size 6 with V control spool, p_s = 10 bar

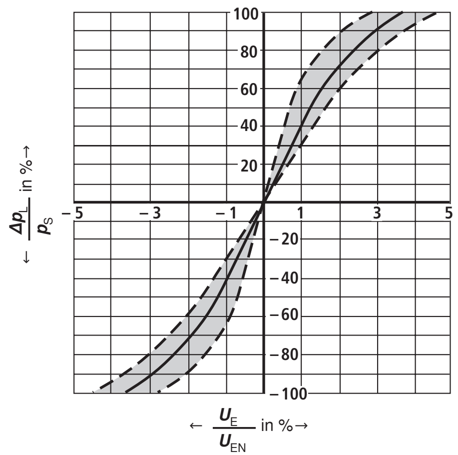


Characteristic curves: Size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Pressure signal characteristic curve (Q5 control spool), p_s = 100 bar

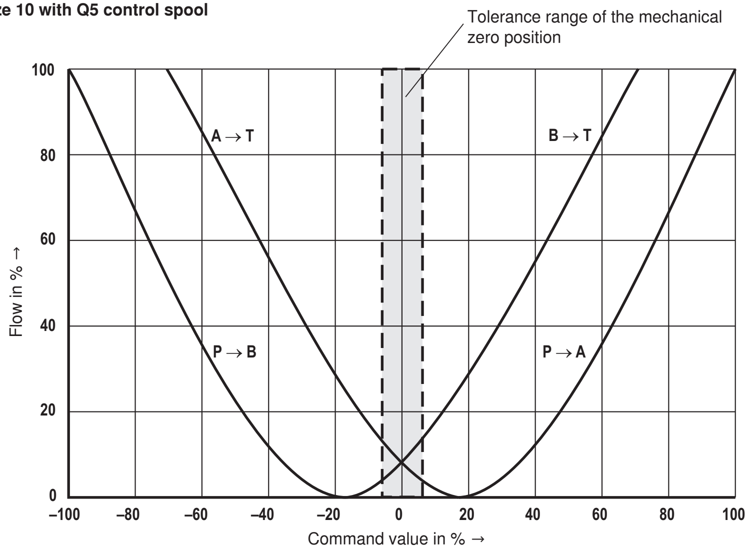


Pressure signal characteristic curve (V control spool), p_s = 100 bar

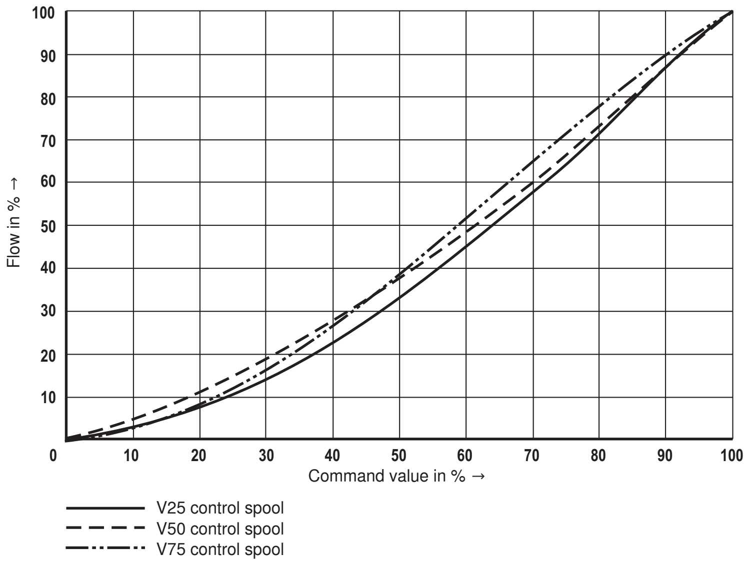


Characteristic curves: Size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow, size 10 with Q5 control spool

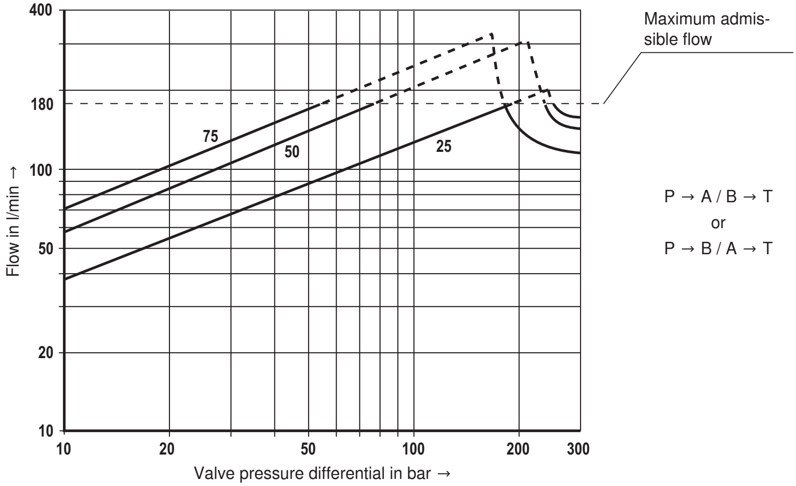


Flow, size 10 with V control spool

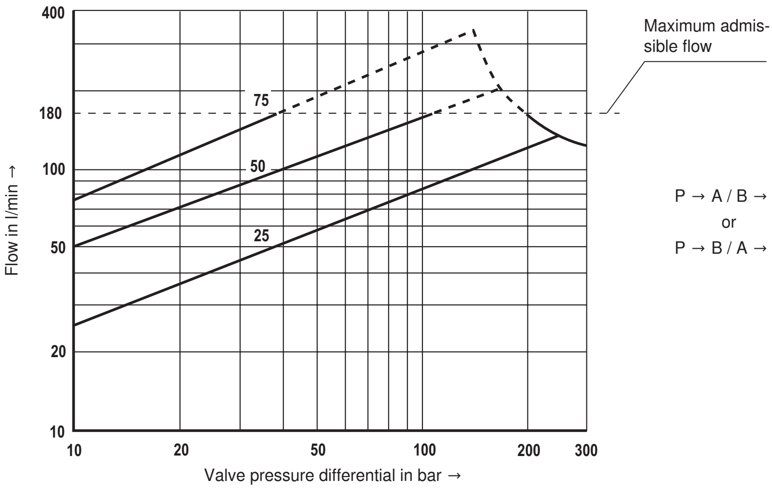


Characteristic curves: Size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function size 10 with Q5 control spool with maximum valve opening

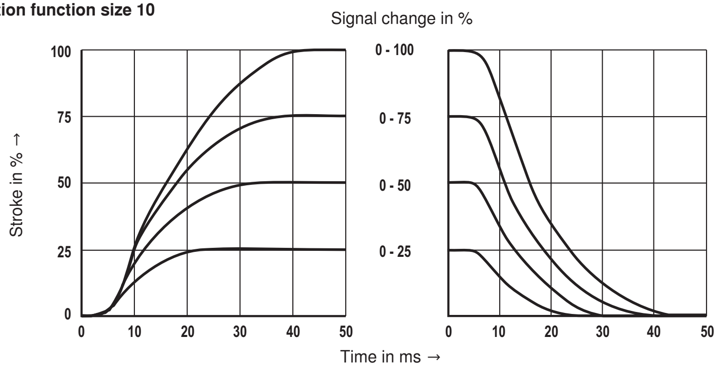


Flow/load function size 10 with V control spool with maximum valve opening

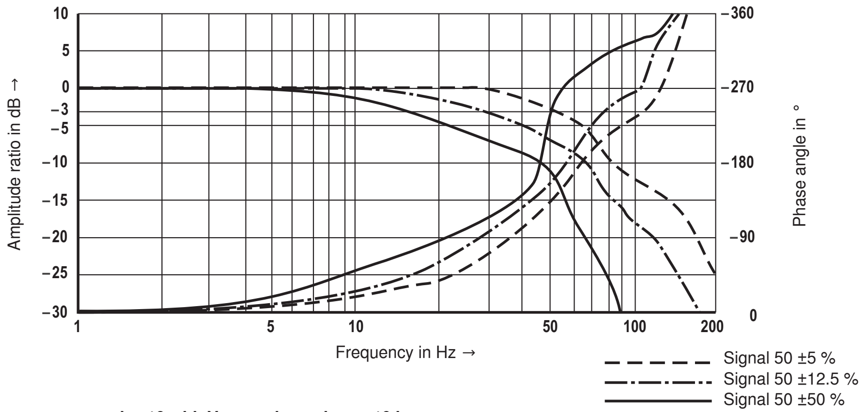


Characteristic curves: Size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

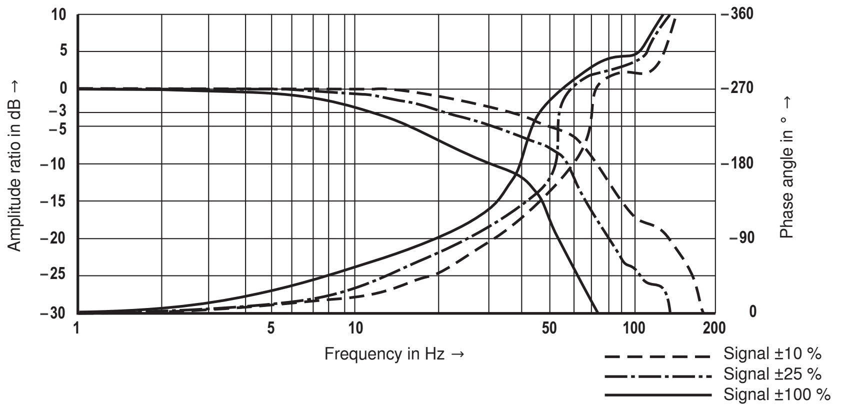
Transition function size 10



Frequency response size 10 with Q5 control spool, p_s = 10 bar

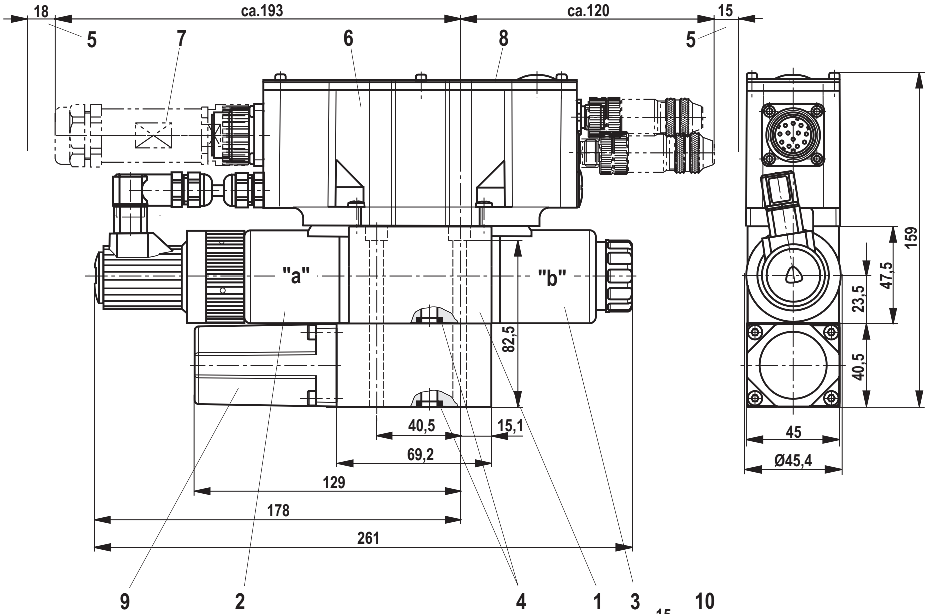


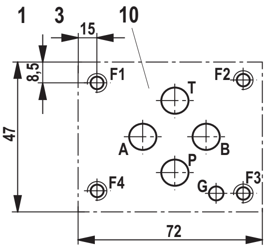
Frequency response size 10 with V control spool, p_s = 10 bar

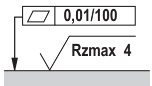


Dimensions: Size 6 (dimensions in mm)

Type 4WREQ with integrated pressure sensors







Required surface quality of the valve contact surface

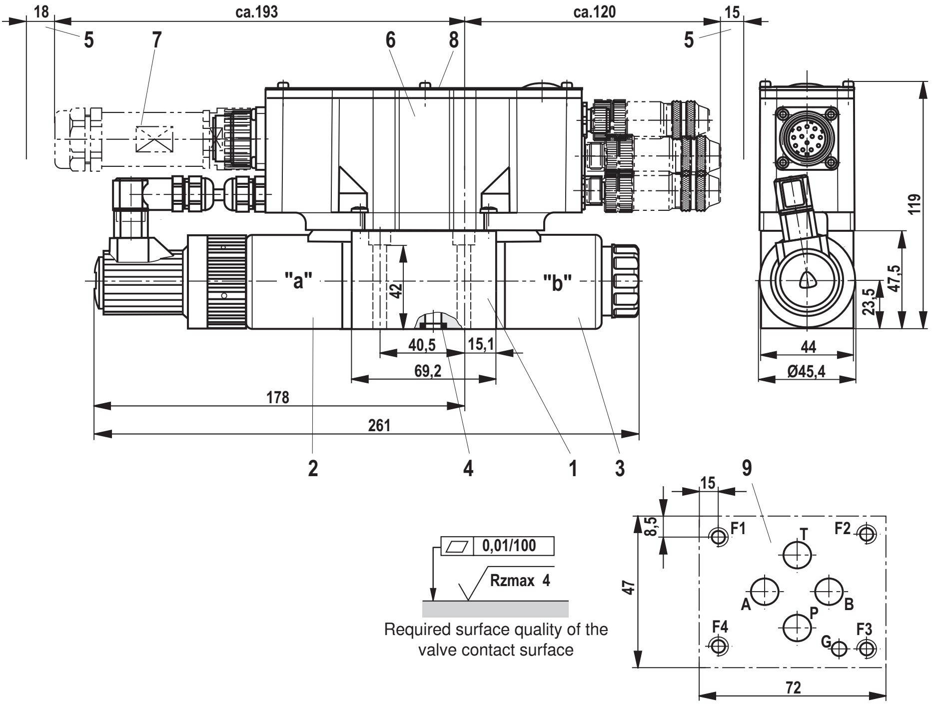
1 Valve housing
2 Proportional solenoid "a" with inductive position transducer
3 Proportional solenoid "b"
4 R-ring 9.81 x 1.5 x 1.78 (ports P, A, B, T)
5 Space required to remove the mating connector
6 Integrated digital control electronics
7 Mating connector according to DIN EN 175201-804; separate order, see page 25
8 Name plate
9 Integrated pressure transducer
10 Processed valve contact surface, porting pattern according to ISO 4401-03-02-0-05
Deviating from the standard:
– Ports P, A, B, T Ø 8 mm
– Bore G can be omitted as the valve does not have a pin.

Notice!
The dimensions are nominal dimensions which are subject to tolerances.

Subplates and valve mounting screws see page 23

Dimensions: Size 6 (dimensions in mm)

Type 4WREQ for external pressure sensor



Required surface quality of the valve contact surface

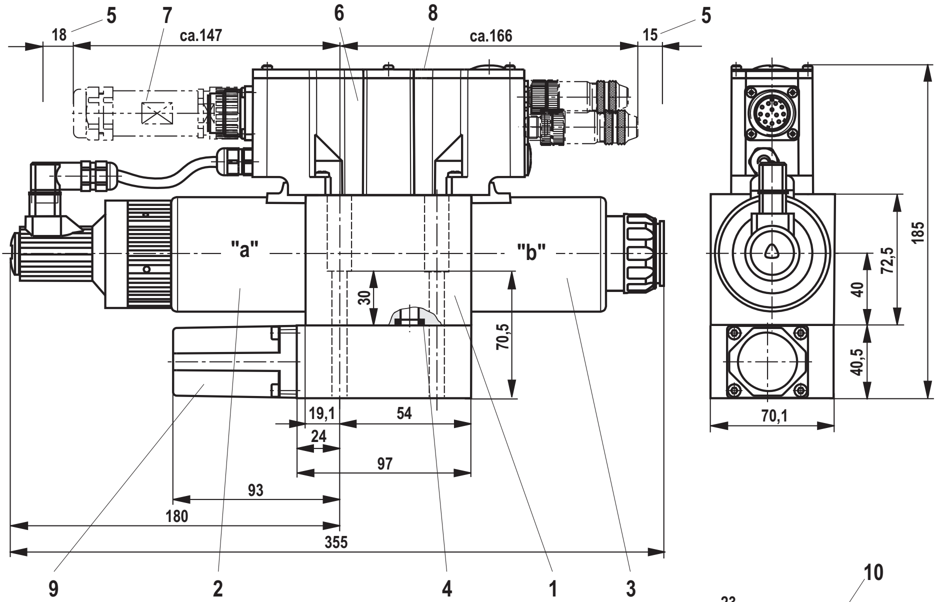
1 Valve housing
2 Proportional solenoid "a" with inductive position transducer
3 Proportional solenoid "b"
4 R-ring 9.81 x 1.5 x 1.78 (ports P, A, B, T)
5 Space required to remove the mating connector
6 Integrated digital control electronics
7 Mating connector according to DIN EN 175201-804; separate order, see page 25
8 Name plate
9 Processed valve contact surface, porting pattern according to ISO 4401-03-02-0-05
Deviating from the standard:
– Ports P, A, B, T Ø 8 mm
– Bore G can be omitted as the valve does not have a pin.

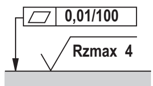
Notice!
The dimensions are nominal dimensions which are subject to tolerances.

Subplates and valve mounting screws see page 23

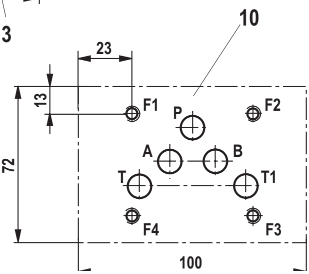
Dimensions: Size 10 (dimensions in mm)

Type 4WREQ with integrated pressure sensors





Required surface quality of the valve contact surface



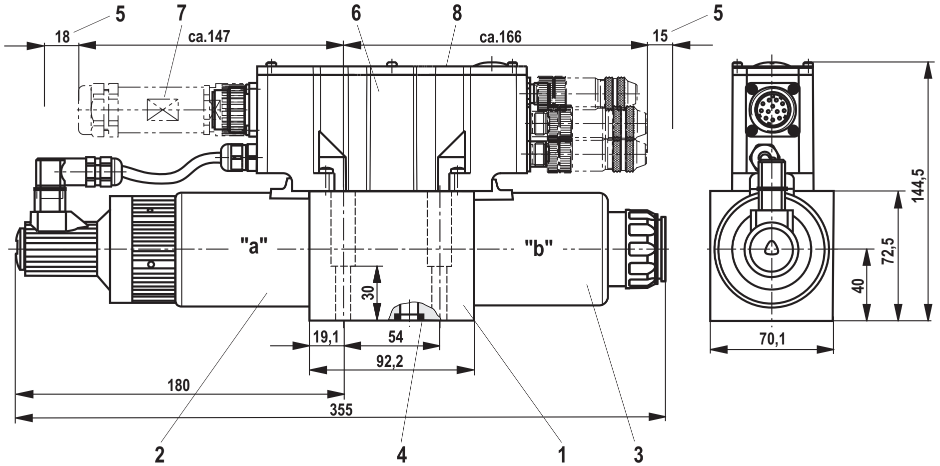
1 Valve housing
2 Proportional solenoid "a" with inductive position transducer
3 Proportional solenoid "b"
4 R-ring 13.0 x 1.6 x 2.0 (ports P, A, B, T1, T2)
5 Space required to remove the mating connector
6 Integrated digital control electronics
7 Mating connector according to DIN EN 175201-804; separate order, see page 25
8 Name plate
9 Integrated pressure transducer
10 Processed valve contact surface, porting pattern according to ISO 4401-05-04-0-05

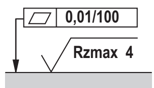
Notice!
The dimensions are nominal dimensions which are subject to tolerances.

Subplates and valve mounting screws see page 23

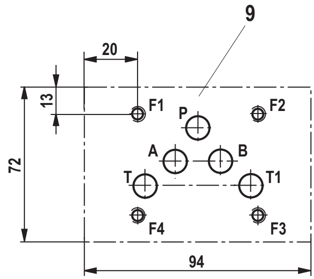
Dimensions: Size 10 (dimensions in mm)

Type 4WREQ for external pressure sensor





Required surface quality of the valve contact surface



1. **1** Valve housing
2. **2** Proportional solenoid "a" with inductive position transducer
3. **3** Proportional solenoid "b"
4. **4** R-ring 13.0 x 1.6 x 2.0 (ports A, B, P, T, T1)
5. **5** Space required to remove the mating connector
6. **6** Integrated digital control electronics
7. **7** Mating connector according to DIN EN 175201-804; separate order, see page 25
8. **8** Name plate
9. **9** Processed valve contact surface, porting pattern according to ISO 4401-05-04-0-05

Notice!
The dimensions are nominal dimensions which are subject to tolerances.

Subplates and valve mounting screws see page 23

Dimensions

Hexagon socket head cap screws		**Material number**
Size 6 with integrated pressure sensors	4x ISO 4762 - M5 x 90 - 10.9-flZn-240h-L Tightening torque M_A = 7 Nm ±10 %	R913000222
Size 6 with external pressure sensor	4x ISO 4762 - M5 x 50 - 10.9-flZn-240h-L Tightening torque M_A = 7 Nm ±10 % or 4x ISO 4762 - M5 x 50 - 10.9 Tightening torque M_A = 8.9 Nm ±10 %	R913000064
Size 10 with integrated pressure sensors	4x ISO 4762 - M6 x 80 - 10.9-flZn-240h-L Tightening torque M_A = 12.5 Nm ±10 % or 4x ISO 4762 - M6 x 80 - 10.9 Tightening torque M_A = 15.5 Nm ±10 %	R913000512
Size 10 with external pressure sensor	4x ISO 4762 - M6 x 40 - 10.9-flZn-240h-L Tightening torque M_A = 12.5 Nm ±10 % or 4x ISO 4762 - M6 x 40 - 10.9 Tightening torque M_A = 15.5 Nm ±10 %	R913000058

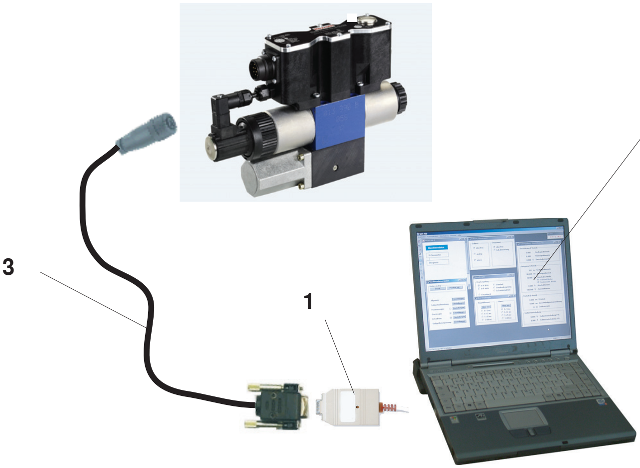
Notice: The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure!

Subplates	**Data sheet**
Size 6	45052
Size 10	45054

Accessories (not included in the scope of delivery)

The following is required for the parameterization with PC:		CANopen	PROFIBUS-DP
1	Interface converter (USB)	VT-ZKO-USB/CA-1-1X/V0/0 Mat.no. **R901071963**	VT-ZKO-USB/P-1-1X/V0/0 Mat.no. **R901071962**
2	Commissioning software	WIN-PED 6 Download from www.boschrexroth.de\IAC	
3	Connection cable, 3 m	D-Sub / M12, coding A Mat.no. **R900751271**	D-Sub / M12, coding B Mat.no. **R901078053**

3

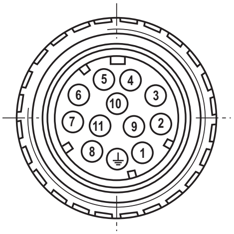


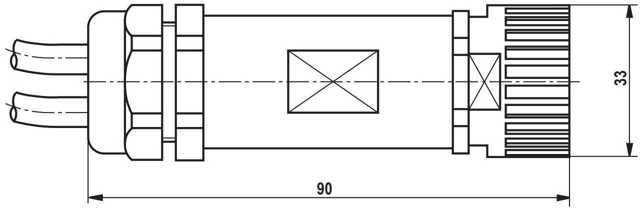
Accessories, port X1 (not included in the scope of delivery)

Mating connector for X1

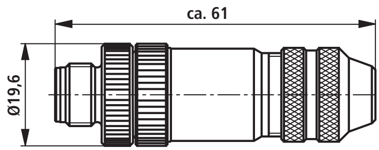
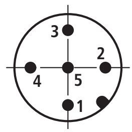
Mating connector according to DIN EN 175201 - 804 (11-pin + PE), plastic variant

- Mating connector without cable (assembly kit) Material no. **R900884671**
- Mating connector with cable set 2 x 5 m 12-pin Material no. **R900032356**
- Mating connector with cable set 2 x 20 m 12-pin Material no. **R900860399**

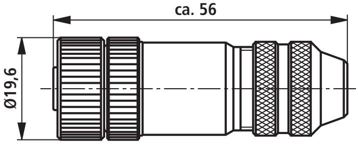
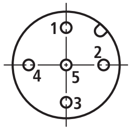
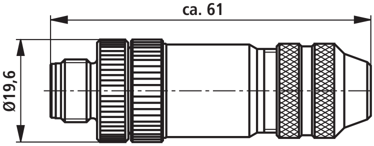
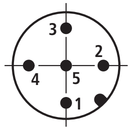
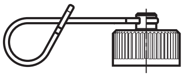




Accessories, sensor connection (not included in the scope of delivery)

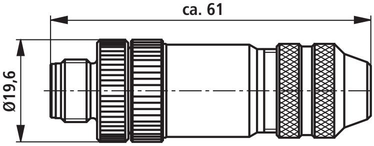
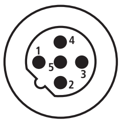
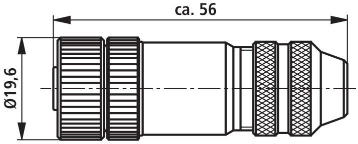
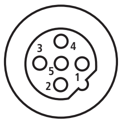
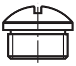
Description	View, dimensions	Pole pattern, order details
X4 (analog sensor) Plug-in connector, 5-pin, M12, pin, A coding, straight line connector in metal design		 Mat no.: **R901075542** (cable diameter 4 to 6 mm)

Accessories, CAN bus (A coding) (not included in the scope of delivery)

Description	View, dimensions	Pole pattern, order details
X2 Round plug-in connector, can be assembled, 5-pin, M12 Straight mating connector in metal design.		 Mat no.: **R901076910** (line diameter 6 to 8 mm)
X3 Round plug-in connector, can be assembled, 5-pin, M12 Straight line connector in metal design.		 Mat no.: **R901076906** (line diameter 6 to 8 mm)
M12 cap Dust protection only for line connector.		Mat no.: **R901075564**

3

Accessories, PROFIBUS (B coding) (not included in the scope of delivery)

Description	View, dimensions	Pole pattern, order details
X2 Round plug-in connector, can be assembled, 5-pin, M12 Straight line connector in metal design.		 Mat no.: **R901075545** (line diameter 6 to 8 mm)
X3 Round plug-in connector, can be assembled, 5-pin, M12 Straight mating connector in metal design.		 Mat no.: **R901075550** (line diameter 6 to 8 mm)
M12 protective cap (only for mating connector)		Mat no.: **R901075563**

Project planning/maintenance instructions/additional information

Product documentation for IAC-P

- **Product information data sheet 29015-P**
- **Technical data sheet** (this data sheet)
- **Operating manual 29015-B**
- **CAN bus protocol description data sheet 29015-01-Z**
  PROFIBUS protocol description data sheet 29015-02-Z
- **General information on the maintenance and commissioning of hydraulic components**
  Data sheet 07800/07900

Commissioning software WIN-PED 6 and documentation on the Internet: www.boschrexroth.com/IAC

Maintenance instructions:
- The devices have been tested in the factory and are supplied with default settings.
- Only complete devices can be repaired. Repaired devices are returned with default settings. User-specific settings are not accepted. The machine end-user will have to retransfer the corresponding user parameters.

Notices:
- Connect the valve to the supply voltage only when this is required for the functional sequence of the machine.
- Do not use electrical signals led out via control electronics (e.g. "No error" signal) for switching safety-relevant machine functions (In this connection also refer to EN ISO 13849 "Safety of machinery - Safety-related parts of control systems").
- If electro-magnetic interference must be expected, take appropriate measures to ensure the function (depending on the application, e.g. shielding, filtering)!

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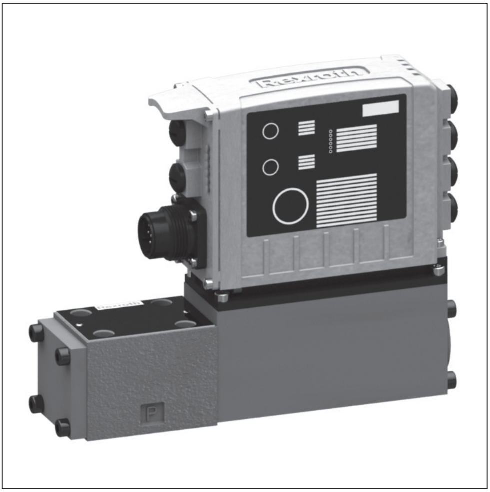
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

The Drive & Control Company **Rexroth** Bosch Group

High-response valve with integrated digital axis controller (IAC-Multi-Ethernet)

Type 4WRPDH

RE 29391
Edition: 2013-03



- Sizes 6 and 10
- Component series 2X
- Maximum operating pressure 315 bar
- Maximum flow 100 l/min

Features

- Direct operated servo quality high-response valves
- Integrated digital axis control functionality (IAC-Multi-Ethernet)
- Best-in-class hydraulic controller
- Bus connection/service interface (sercos, EtherCAT, EtherNet/IP, PROFINET RT)
- Actual value detection:
  2 x configurable analog sensors (current/voltage)
  1 x linear position measurement system (SSI, EnDat 2.2 or 1Vss)
- Internal safety function (can be used up to category 4/PL e according to EN 13849-1)
- CE conformity according to EMC Directive 2004/108/EC

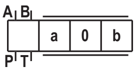
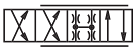
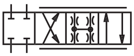
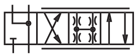
Contents

Ordering code

01	02	03	04	05	06	07	08	09	10		11		12	13	14	15	16
4	**WRP**	**D**	**H**			**B**			**2X**	**/**		**/**	**24**		**D6**		

01	4 main ports	**4**
02	High-response valve	**WRP**
03	With integrated digital axis controller	**D**
04	Control spool/bushing	**H**
05	Size 6	**6**
	Size 10	**10**

Control spool symbols (possible designs, characteristic curves see page 4)

06	Symbol	Characteristic curve L	Characteristic curve P			
			Inflection 60 % (size 6 only)	Inflection 40 %		
		●	●	●		**C**
			●	●	Rated flow 40 l/min or higher	**C1** [1]
		●	●	●		**C4**
		●	●	●		**C3**
			●	●	Rated flow 40 l/min or higher	**C5** [1]

● = available

[1] With symbols C1 and C5:
P → A: $\boldsymbol{q}_V$ B → T: $\boldsymbol{q}_V/2$
P → B: $\boldsymbol{q}_V/2$ A → T: $\boldsymbol{q}_V$

07	Installation side of the inductive position transducer	**B**

Rated flow of size 6 with 70 bar valve pressure differential (35 bar/control edge)

		Characteristic curve L	Characteristic curve P		
08	2 l/min	●			**02**
	4 l/min	●	●		**04**
	12 l/min	●			**12**
	15 l/min		●		**15**
	24 l/min	●			**24**
	25 l/min		●		**25**
	40 l/min	●	●		**40**

● = available

Rated flow of size 10 with 70 bar valve pressure differential (35 bar/control edge)

08	50 l/min	**50**
	100 l/min	**100**

Flow characteristics

09	Linear	**L**
	Inflected characteristic curve (inflection 60 % for size 6 with rated flows "**15**" and "**25**", otherwise inflection 40 %)	**P**

Ordering code

01	02	03	04	05	06	07	08	09	10		11		12	13	14	15	16
4	**WRP**	**D**	**H**			**B**			**2X**	**/**		**/**	**24**		**D6**		

10	Component series 20 ... 29 (20 ... 29: Unchanged installation and connection dimensions)	**2X**

Seal material

11	NBR seals	**M**
	FKM seals	**V**

12	Supply voltage 24 V	**24**

Field bus interface

13	EtherNET/IP	**E**
	PROFINET RT	**N**
	Sercos	**S**
	EtherCAT (CANopen profile)	**T**

Electrical interface

14	±10 VDC or 4 ... 20 mA	**D6**

Sensor interfaces

15	0 ... 10 V/4 ... 20 mA/EnDat 2.2	**S**
	0 ... 10 V/4 ... 20 mA/SSI	**T**
	0 ... 10 V/4 ... 20 mA/1Vss	**U**

16	Further details in the plain text	

3

☞ **Notice!** For ordering codes and technical information regarding high-response valves with integrated digital axis controller and additional bus profiles, please refer to:

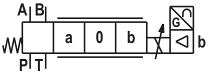
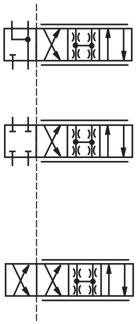
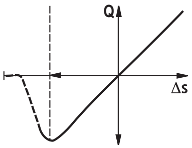
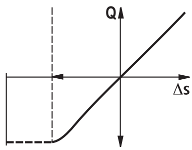
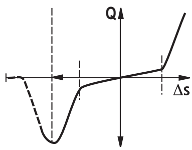
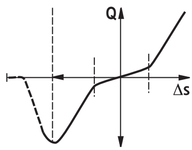
- Data sheet 29191: CANopen, Profibus DP V0/V1
- Data sheet 29291: Profibus DP/V2 (PROFIdrive profile)

☞ **Important notice!** Control spool versions that have been approved for the safety function:

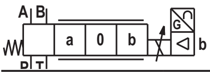
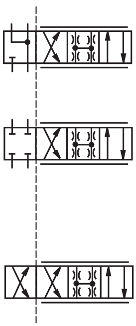
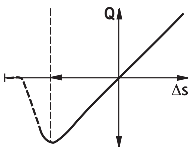
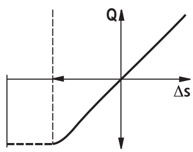
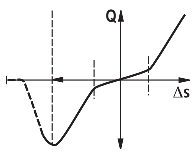
- C
- C1
- C3
- C4
- C5

Symbols

Size 6

	Linear	P: Inflection 60 % [q_n = 15.25 l/min]	P: Inflection 40 % [q_n = 40 l/min]
 C3, C5 C4, C1 C	 C3, C4  C	 C3, C5, C4, C1	
	Standard = 1:1, from q_n = 40 l//min also 2:1		

Size 10

	Linear	P: Inflection 40 %
 C3, C5 C4, C1 C	 C3, C4  C	 C3, C5, C4, C1

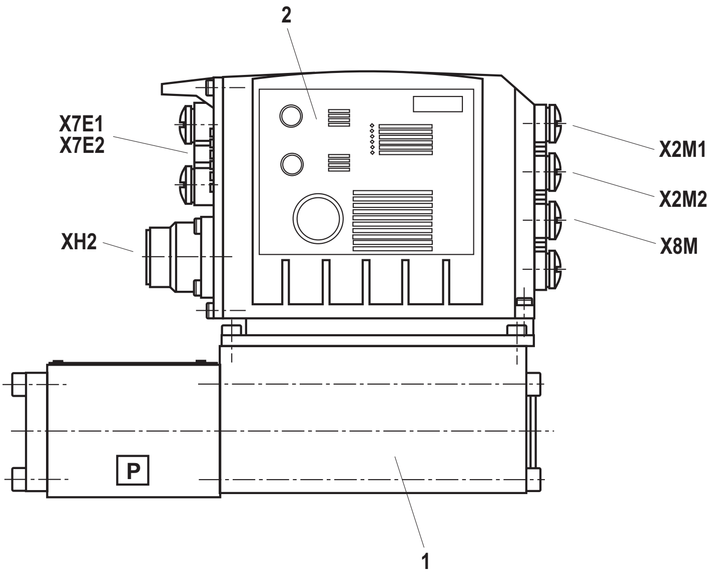
Function, section

Design

The high-response valve with IAC-Multi-Ethernet electronics mainly consists of:

- Direct operated high-response valve (1) with control spool and bushing in servo quality
- Integrated digital axis controller (2) with:
  – Analog/digital interface (XH2)
  – Ethernet interfaces (X7E1, X7E2)
  – Analog sensor interfaces (X2M1, X2M2)
  – Digital sensor interface (X8M)

High-response valve with integrated axis controller, analog interfaces (X2M1, X2M2), digital interfaces (XH2, X8M) and Ethernet interfaces (X7E1, X7E2)



Function, section

Functional description

The **IAC-Multi-Ethernet** valve (**I**ntegrated **A**xis **C**ontroller based on high-response valves) is a digital high-response valve with integrated axis controller and the following functionalities:

- Position control
- Pressure control
- Force control
- Override control (position/pressure)

This enables, amongst others, the following operating modes:

- Valve direct control
- Drive-controlled position control
- Drive-controlled positioning
- Positioning block operation

- The command values are specified via the Ethernet interface (X7E1 or X7E2) or, alternatively, via the analog/digital interface (XH2)
- The feedback information of the actual value signals to the superior control system is provided optionally either via the Ethernet interface (X7E1 or X7E2) or the analog/digital interface (XH2)
- The control parameters are set via the Ethernet interface (X7E1 or X7E2)

Safety function

The integrated control electronics of the valve enables the additional switch-off of a channel according to EN 13849-1 in the direction "P" to "A" (depending on the application, the fail-safe position must be adhered to).
For this purpose, a suitable control system must be provided to perform the plausibility check between the direction-dependent valve signals "enable input" and "enable acknowledgement" (signal fed back by the valve).
It is not possible to switch off direction "P" to "B" in a safety-relevant manner according to EN 13849-1 (depending on valve type).

Monitoring

The digital control electronics enables comprehensive monitoring functions/fault detection including:

- Undervoltage
- Communication error
- Cable break for analog sensor inputs and digital position measurement system
- Short-circuit monitoring for analog/digital outputs
- Monitoring of the microcontroller (watchdog)
- Temperature of the integrated electronics

IndraWorks PC program

To implement the project planning task and to parameterize the IAC-Multi-Ethernet valves, the user may use the IndraWorks engineering tool (see accessories).

- Project planning
- Parameterization
- Commissioning
- Diagnosis
- Comfortable management of all data on a PC
- PC operating systems: Windows XP (SP3), Windows 7

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

general		Size 6	Size 10
Design		Spool valve, direct operated, with steel sleeve,	
Operation		Proportional solenoid with position control, OBE	
Type of connection		Plate connection, porting pattern according to ISO 4401	
Installation position		Any	
Ambient temperature range	°C	–20 ... +60	
Storage temperature range	°C	–10 ... +50	
Sine test according to DIN EN 60068-2-6		10...2000 Hz / maximum of 10 g / 10 cycles / 3 axis	
Random test according to DIN EN 60068-2-64		20...2000 Hz / 10 g_{RMS} / 30 g peak / 30 min / 3 axis	
Transport shock according to DIN EN 60068-2-27		15 g / 11 ms / 3 axis	
Weight	kg	3.2	7.2
Maximum relative humidity (non-condensing)	%	97	

hydraulic			
Hydraulic fluid			See table page 8
Viscosity range	– recommended	mm^2/s	20 ... 100
	– maximum admissible	mm^2/s	10 ... 800
Hydraulic fluid temperature range		°C	–20 ... +60
Maximum admissible degree of contamination of the hydraulic fluid Cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]
Direction of flow			According to symbol

hydraulic, size 6								
Rated flow at Δp = 35 bar per edge [2]		l/min	2	4	12	15	24/25	40
Maximum operating pressure	– Ports A, B, P	bar	315					
	– Port T	bar	250					
Limitation of use with regard to the transition to failsafe	– Spool symbols C3, C5	bar	315	315	315	315	315	160
	– Spool symbols C1, C4	bar	315	315	315	280	250	100
Zero flow at 100 bar	– Linear characteristic curve L	cm^3/min	< 150	< 180	< 300	-	< 500	< 900
	– Inflected characteristic curve P	cm^3/min	-	-	-	< 180	< 300	< 450

hydraulic, size 10						
rated flow at Δp = 35 bar per edge [2]		l/min	50 (1:1)	50 (2:1)	100 (1:1)	100 (2:1)
Maximum operating pressure	– Ports A, B, P	bar	315			
	– Port T	bar	250			
Limitation of use with regard to the transition to failsafe	– Spool symbols C3, C5	bar	315	315	160	160
	– Spool symbols C1, C4	bar	250	250	100	100
Zero flow at 100 bar	– Linear characteristic curve L	cm^3/min	< 1200	< 1200	< 1500	< 1500
	– Inflected characteristic curve P	cm^3/min	< 600	< 500	< 600	< 600

1) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters, see www.boschrexroth.com/filter.

2) Flow with different Δp:
$$q_x = q_{rated} \cdot \sqrt{\frac{\Delta p_x}{35}}$$

3

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

static/dynamic			
Hysteresis	%	≤ 0.2	
Manufacturing tolerance q_{max}	%	< 10	
Actuating time for signal step 0 ... 100 %	ms	≤ 10	25
Temperature drift		Zero shift < 1 % with Δϑ = 40 °C	
Zero compensation		Ex factory ±1 %	

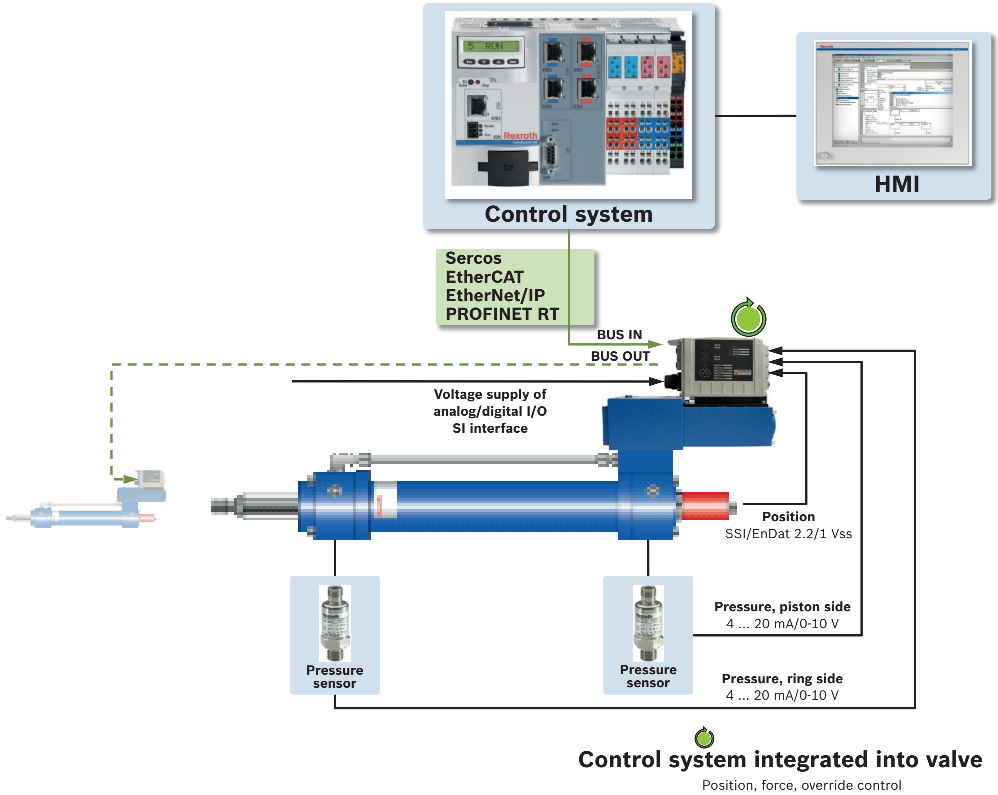
Hydraulic fluid		Classification	Suitable sealing materials	Standards
Mineral oils and related hydrocarbons		HL, HLP, HLPD, HVLP, HVLPD	NBR, FKM	DIN 51524
Bio-degradable	– insoluble in water	HETG	NBR, FKM	VDMA 24568
		HEES	FKM	
	– soluble in water	HEPG	FKM	VDMA 24568
Flame-resistant	– water-free	HFDU, HFDR	FKM	ISO 12922
	– containing water	HFC	NBR	ISO 12922

Important information on hydraulic fluids!
- For more information and data on the use of other hydraulic fluids, refer to data sheet 90220 or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.)!
- The flash point of the hydraulic fluid used must be 40 K higher than the maximum solenoid surface temperature.
- **Flame-resistant – containing water**: Maximum pressure differential per control edge 50 bar. Pressure pre-loading at the tank port > 20 % of the pressure differential; otherwise, increased cavitation. The pressure peaks should not exceed the maximum operating pressures!
  – If HFDU is used, data sheet 90222 must be complied with!

electrical, integrated electronics (OBE)			
Relative duty cycle		%	100 (continuous operation)
Protection class according to EN 60529			IP 65 with mounted and locked plug-in connectors
Supply voltage [1)]	– Nominal voltage	VDC	24
	– Lower limit value	VDC	18
	– Upper limit value	VDC	36
	– Maximum admissible residual ripple	Vpp	2.5 (Comply with absolute supply voltage limit values!)
Power consumption	– Size 6	W	Maximum of 40
	– Size 10	W	Maximum of 60
AD/DA resolution	– Analog inputs		12 bit
	– Analog output		10 bit
Protective earthing conductor and screening			See pin assignment (CE-compliant installation)
Required fuse protection, external		A	4, time-lag
Adjustment			Calibrated at plant, see valve characteristic curve
Conformity			CE according to EMC Directive 2004/108/EC tested according to EN 61000-6-2 and EN 61000-6-3

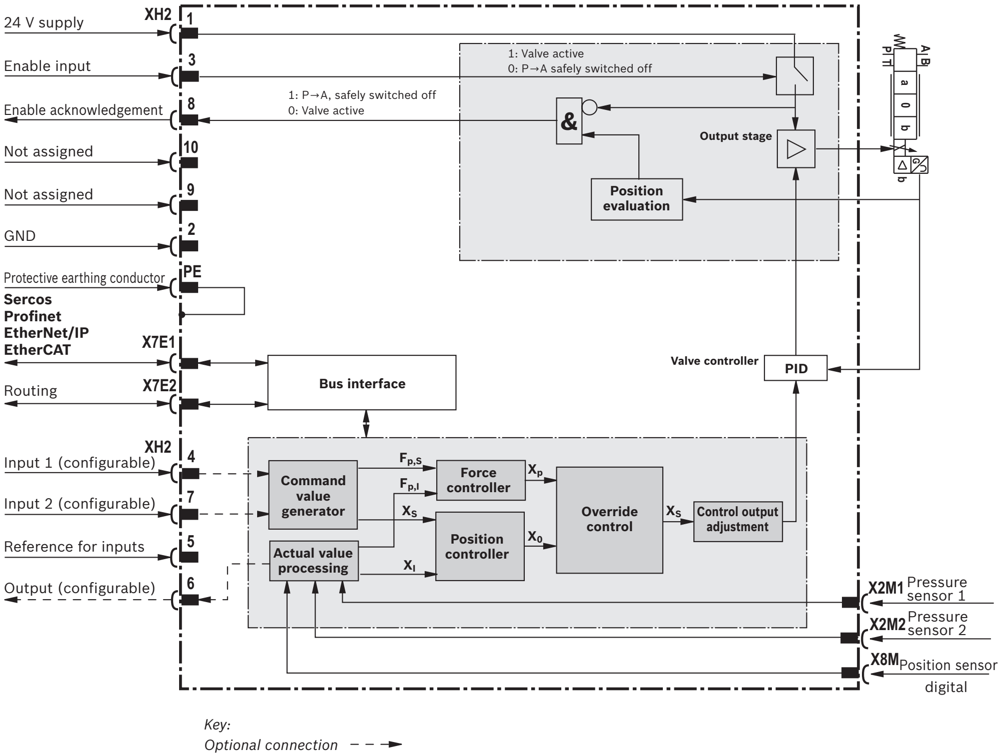
1) Supply voltage is used directly for sensor connections X2M1, X2M2 and X8M (no internal voltage limitation)

Representation of the axis controller in the system network



3

Block diagram/controller function block



Detailed description of the safety function:
After the signal at the enable input has been removed, the output stage, and thus the solenoid of the valve, are internally separated from the available supply voltage. The enable acknowlegement will only be activated after the safe valve control spool position has been achieved.

For a more detailed description of the safety function, please refer to the 29391-B operating instructions as well.

Electrical connections, assignment

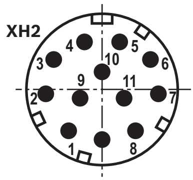
Connector pin assignment XH2, 11-pole + PE according to EN 175201-804

Pin	Core marking [1]	Interface D6 assignment
1	1	24 V DC supply voltage
2	2	GND
3	3	Enable input, output stage 24 V DC
4	4	Command value 1(4 ...20 mA/±10 V) [2]
5	5	Reference for command values
6	6	Actual value (4 ...20 mA/±10 V) [2, 3]
7	7	Command value 2(4 ...20 mA/±10 V) [2]
8	8	Enable acknowledgement, output stage 24 V DC
9	9	Not assigned
10	10	Not assigned
11	11	Switching output 24 V (error signal or power switching signal) max 1.5 A
PE	green-yellow	Protective earthing conductor (connected directly to metal housing)

1) Core marking of the connection lines for mating connector with cable set (see accessories)

2) Selection via commissioning software

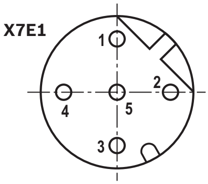
3) For diagnostic purposes, precise actual value response via Ethernet interface



3

Connector pin assignment for Ethernet interface "X7E1" and "X7E2" (coding D), M12, 4-pole, socket

Pin	Assignment
1	TxD +
2	RxD +
3	TxD –
4	RxD –
5	Not assigned

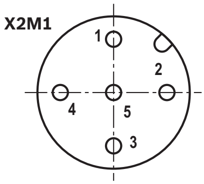


Analog configurable sensor interfaces, connections "X2M1", "X2M2" (coding A), M12, 5-pole, socket

Pin	Assignment
1	+24 V voltage output (sensor supply) [1]
2	Sensor signal input current (4 ... 20 mA) [2]
3	GND
4	Sensor signal input voltage (0 ... 10 V) [2]
5	Negative differential amplifier input to pin 4 (optional)

1) Maximum load capacity 50 mA, voltage output same as voltage supply connected to input XH2!

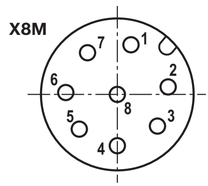
2) Only one signal input per interface, configurable



Electrical connections, assignment

Digital sensor interface SSI, EnDat 2.2 or 1 Vpp measurement system "X8M", M12, 8-pole, socket

Pin	SSI pin assignment [1]	EnDat 2.2 pin assignment [1)2)]	1Vpp pin assignment
1	GND	GND	GND
2	+24 V	+5 V	+5 V
3	Data +	Data +	A +
4	Data –	Data –	A –
5	GND	GND	B +
6	Clock –	Clock –	B –
7	Clock +	Clock +	R +
8	+24 V	+5 V	R –



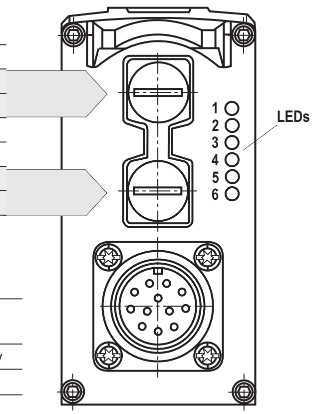
1) Pins 2, 8 and 1, 5 each with same assignment

2) Supported resolution ≥ 10 nm

Notice!
- Maximum load capacity at pin 2 (encoder supply):
  50 mA (SSI), 250 mA (EnDat 2.2, 1 Vpp)
- We recommend connecting the screens on both sides over the metallic housings of the plug-in connectors.
  Using connector pins will affect the shielding effect! Internal screens are not required.

LED displays

LED	Interface	Sercos	EtherNET/IP	EtherCAT	PROFINET
1	**X7E1**	Activity	Activity	Not used	Activity
2		Link	Link	Link/activity	Link
3	**Electronics module**	S	Network status	Network status	Network status
4		Module status	Module status	Module status	Module status
5	**X7E2**	Activity	Activity	Not used	Activity
6		Link	Link	Link/activity	Link



Displays of the Status LEDs

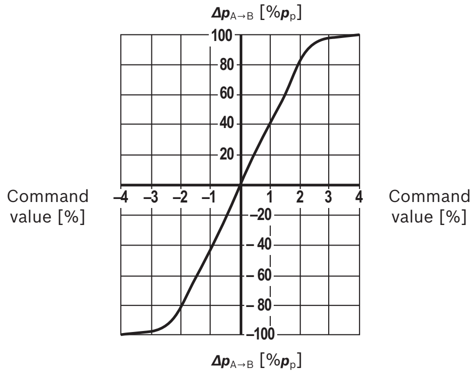
Module status LED (LED 4)	Display status
Off	No voltage supply
Green-red, flashing	Self-test
Green, flashing	Standby
Green	Operation
Red, flashing	Warning
Red	Error

Network status LED (LED 3)	Display status
Off	No voltage supply
Green	Operation

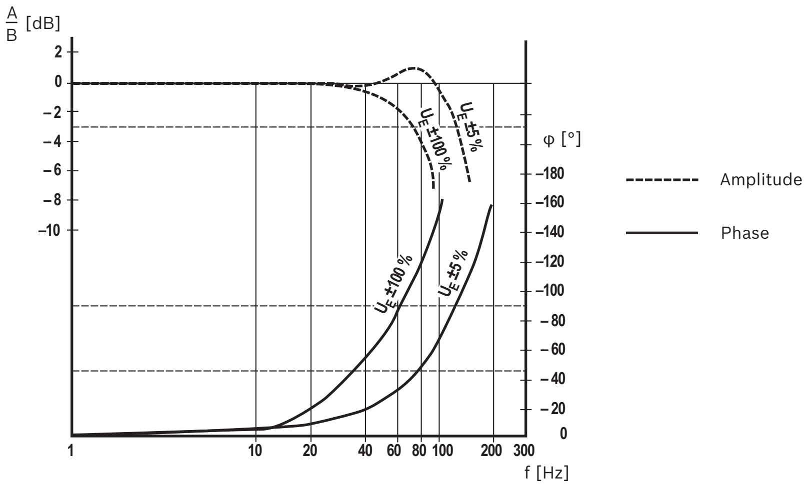
Notice!
- LEDs 1, 2, 5 and 6 refer to interfaces "X7E1" and "X7E2"
  - Link: Cable plugged in, connection established (permanently lit)
  - Activity: Data sent/received (flashing)
- Module status LEDs 3 and 4 refer to the electronics module
- For a detailed description of the diagnosis LEDs, please refer to the functional description Rexroth HydraulicDrive HDS-xx.

Characteristic curves size 6
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Pressure amplification



Bode diagram

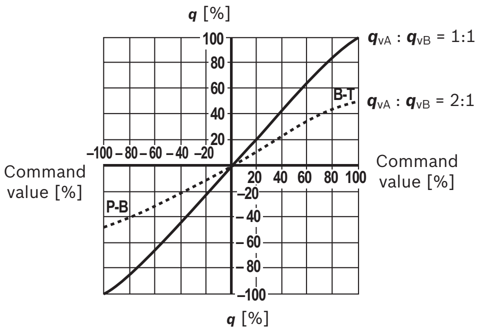


Characteristic curves size 6

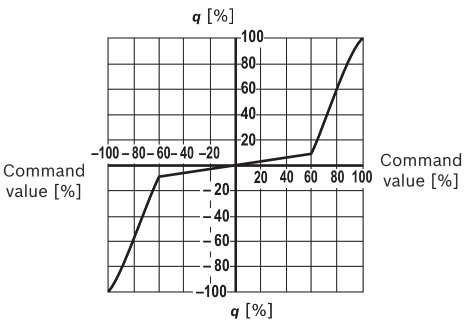
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/signal function

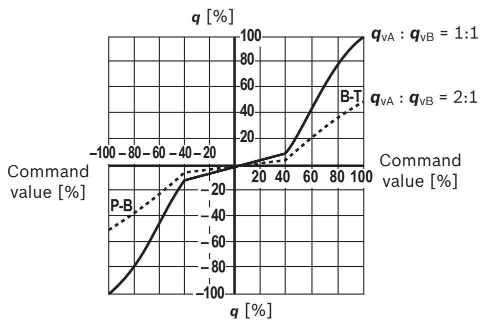
L: Linear



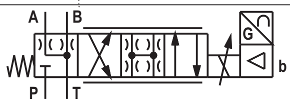
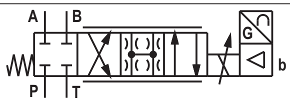
P: Inflection 60 %



P: Inflection 40 %



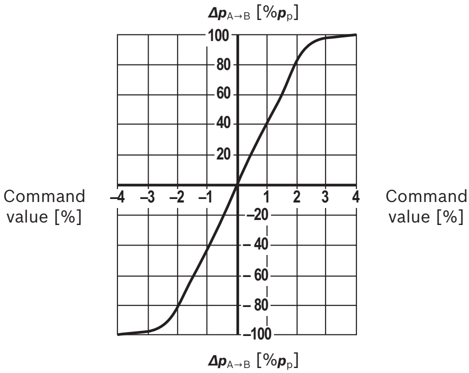
Fail-safe position

	Zero flow at	100 bar	P→A	50 cm³/min
			P→B	70 cm³/min
	Flow at	Δp = 35 bar	A→T	10 ... 20 l/min
			B→T	7 ... 20 l/min
	Zero flow at	100 bar	P→A	50 cm³/min
			P→B	70 cm³/min
			A→T	70 cm³/min
			B→T	50 cm³/min

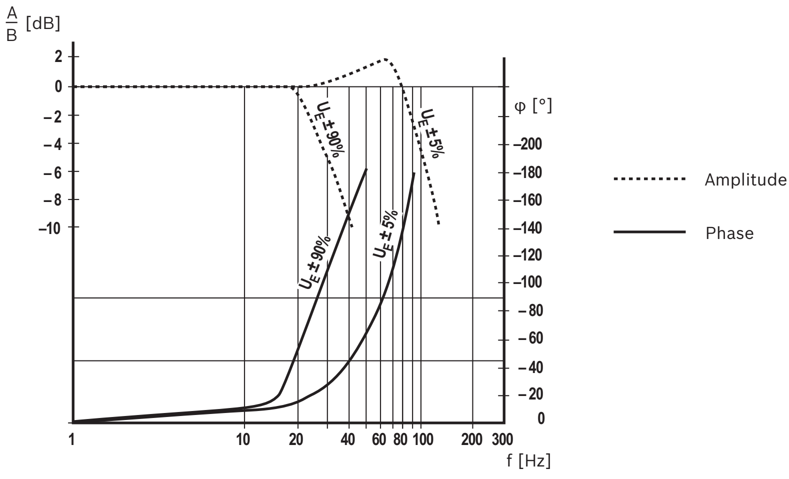
Fail-safe	***p*** = 0 bar => 7 ms	Enable "off" or internal shut-off if an error has occurred
	p = 100 bar => 10 ms	U_B ≤ 18 V or ***I*** ≤ 2 mA (with 4 ... 20 mA signal, cable break detection: Current threshold configurable)

Characteristic curves size 10
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Pressure amplification



Bode diagram

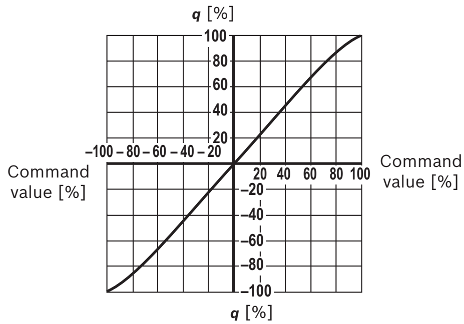


3

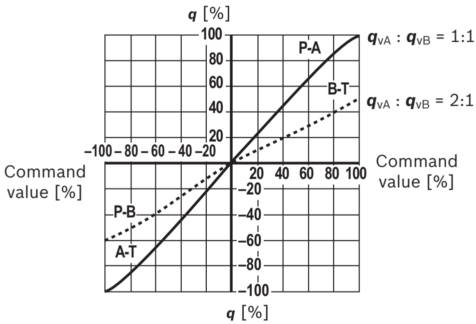
Characteristic curves size 10
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/signal function

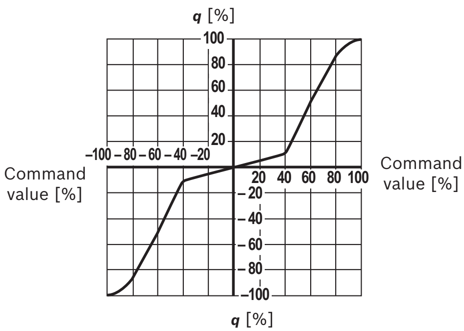
L: Linear 1:1



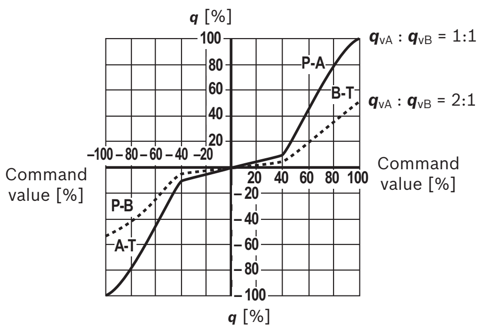
L: Linear 2:1



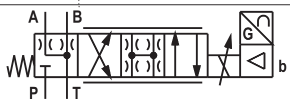
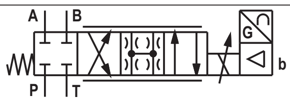
P: Inflection 40 % 1:1



P: Inflection 40 % 2:1

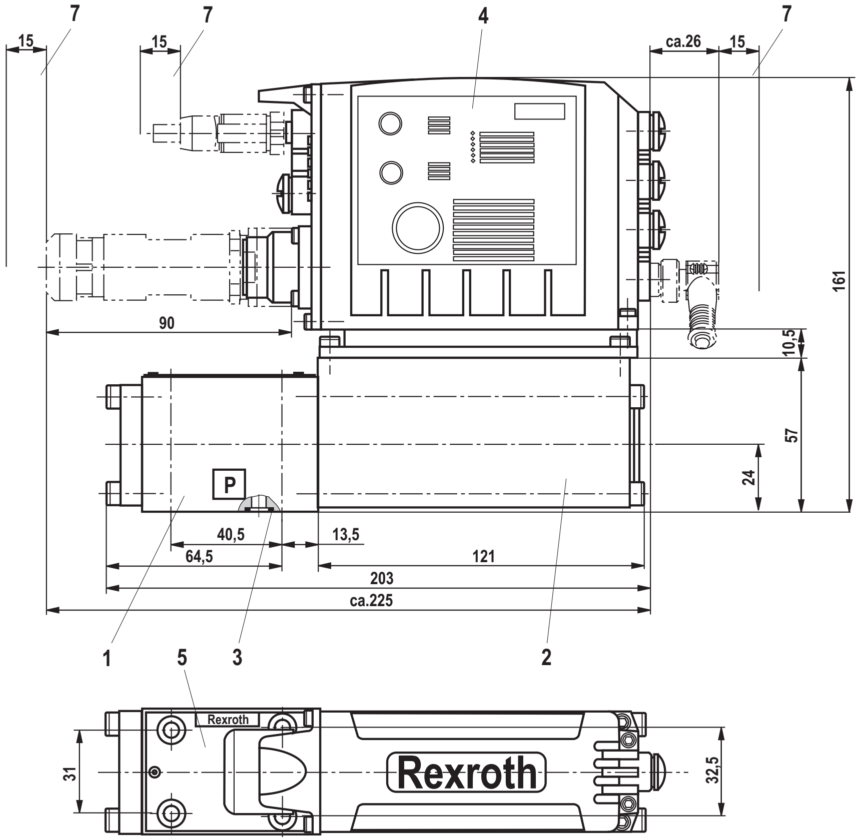


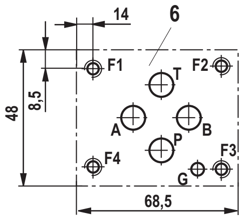
Fail-safe position

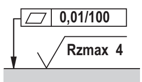
	Zero flow at	100 bar	P→A	50 cm³/min
			P→B	70 cm³/min
	Flow at	***Δp*** = 35 bar	A→T	10 ... 20 l/min
		q_n = 50/100 l/min	B→T	7 ... 20 l/min
	Zero flow at	100 bar	P→A	50 cm³/min
			P→B	70 cm³/min
			A→T	70 cm³/min
			B→T	50 cm³/min

Fail-safe	***p*** = 0 bar => 12 ms	Enable "off" or internal shut-off if an error has occurred
	p = 100 bar => 16 ms	U_B ≤ 18 V or ***I*** ≤ 2 mA (with 4 ... 20 mA signal, cable break detection: Current threshold configurable)

Dimensions, size 6 (dimensions in mm)







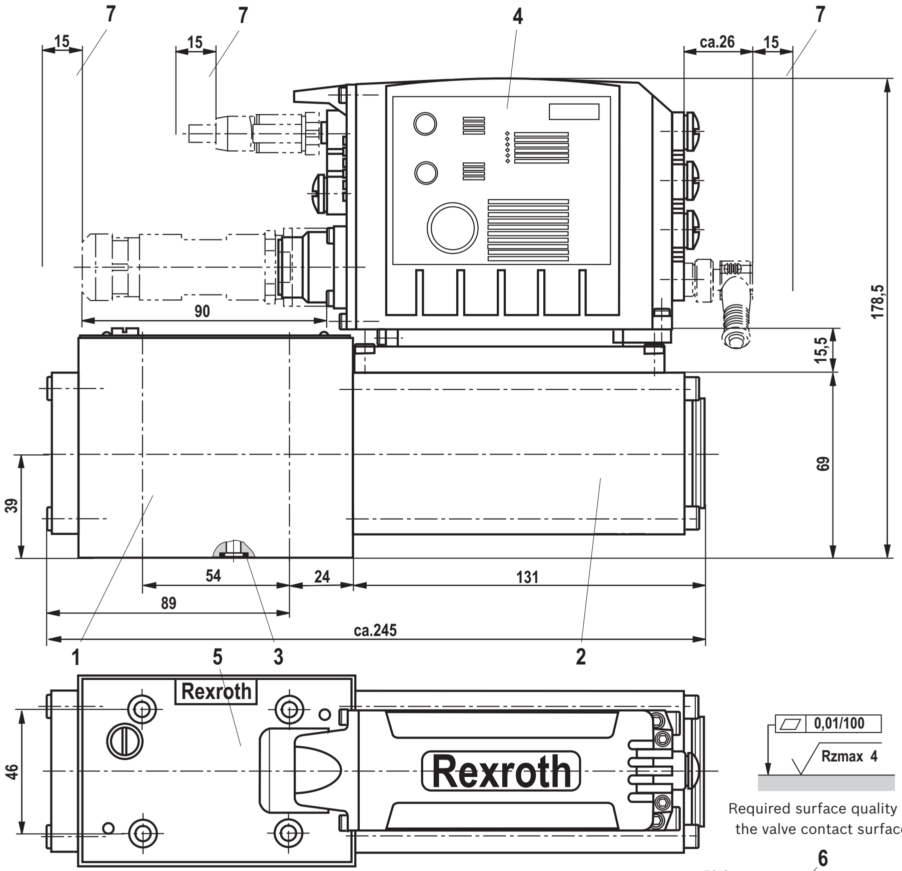
Required surface quality of the valve contact surface

1 Valve housing
2 Control solenoid with position transducer
3 Identical seal rings, 9.25 x 1.78, for ports A, B, P, T
4 Integrated digital control electronics
5 Name plate
6 Machined valve contact surface, porting pattern according to ISO 4401-03-02-0-05
7 Space required for removing the mating connectors

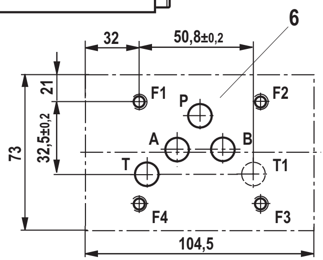
Notice!
The dimensions are nominal dimensions and subject to tolerances.

Valve mounting screws (separate order)
4 hexagon socket head cap screws, metric, ISO 4762 - M5 x 30 - 10.9-N67F 821 70
Tightening torque M_A = 6 + 2 Nm
Material no. 2910151166

Dimensions, size 10 (dimensions in mm)



Required surface quality of the valve contact surface



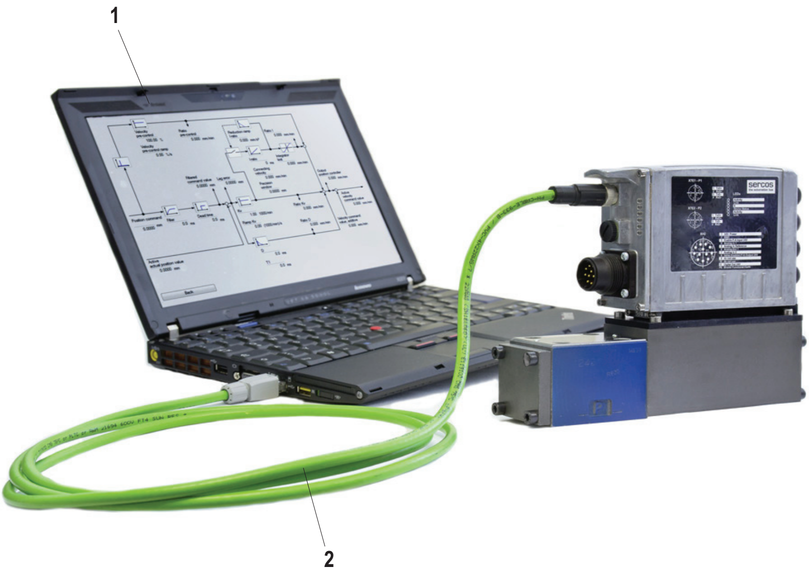
Notice!
The dimensions are nominal dimensions and subject to tolerances.

1 Valve housing
2 Control solenoid with position transducer
3 Identical seal rings, 12.0 x 2, for ports A, B, P, T, T1
4 Integrated digital control electronics
5 Name plate
6 Machined valve contact surface, porting pattern according to ISO 4401-05-04-0-05
Deviating from the standard:
Port T1 is additionally available
7 Space required for removing the mating connectors

Valve mounting screws (separate order)
4 hexagon socket head cap screws, metric, ISO 4762 - M6 x 40 - 10.9-N67F 821 70
Tightening torque M_A = 11 + 3 Nm
Material no. 2910151209

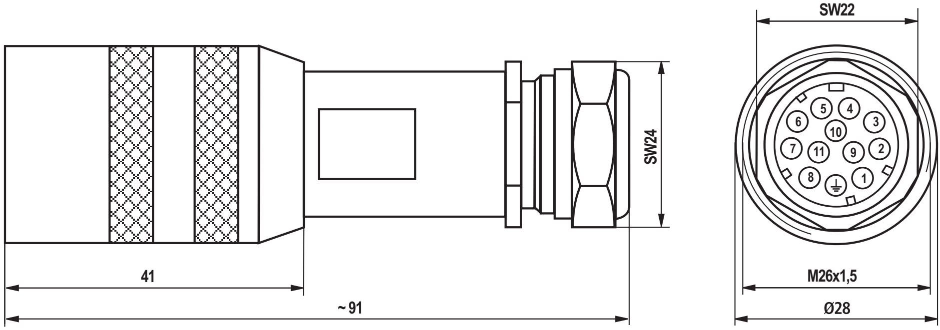
Accessories for parameterization (not included in scope of delivery)

For parameterization via PC, the following is required:	
1 Commissioning software	IndraWorks Indraworks D Indraworks DS, download from www.boschrexroth.com/IAC
2 Connection cable, 3 m	Shielded, M12 on RJ45, length can be freely chosen Mat. no. R911172135, type designation to be specified additionally RKB0044/xxx.x (length in meters)



Accessories, port XH2 (not included in the scope of delivery)

Mating connector for XH2	**Design**	**Material number**
Mating connector according to DIN EN 175201-804 (12-pole, metal design)	Mating connector (assembly kit) for cable diameters of 12-15 mm	R901268000
	Mating connector with 5 m cable, 12 x 0.75 mm² with cable shield, assembled	R901272854
	Mating connector with 20 m cable, 12 x 0.75 mm² with cable shield, assembled	R901272852



Accessories, sensor connections X2M1 and X2M2 (not included in the scope of delivery)

Cable set for X2M1, X2M2 (Analog sensors)	**Design**	**Material number**
Cable set for connecting Bosch Rexroth pressure sensors HM20, shielded, 5-pole, A coding, PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm²	Length 1.0 m	R901111712
	Length 2.0 m	R901111713

Accessories, sensor connection X8M (not included in the scope of delivery)

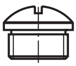
Cable set for X8M (SSI, 1Vss only) [1]	**Design**	**Material number**
Shielded, 8-pole, A coding, straight connector M12, on free line end, line cross-section 0.25 mm²	Length 10.0 m	R913002642

[1] **Recommendation**: If an EnDat 2.2 sensor is used, please refer to the sensor manufacturer Heidenhain with respect to a cable set.

Accessories, Ethernet connections X7E1 and X7E2 (not included in the scope of delivery)

Cable set for X7E1, X7E2 (Ethernet interface)	**Design**	**Material number**
Cable set, shielded, 4-pole, D coding, straight connector M12, on straight connector M12, line cross-section 0.25 mm^2	Length xx.x m	R911172111 (type designation RKB0040/xx.x to be specified additionally)
Cable set, shielded, 4-pole, straight connector M12, on straight connector RJ45, line cross-section 0.25 mm^2	Length xx.x m	R911172135 (type designation RKB0044/xx.x to be specified additionally)

Miscellaneous accessories (not included in scope of delivery)

Protective cap	**Design**	**Material number**
Protective cap M12		R901075563

Project planning/maintenance instructions/additional information

Product documentation for IAC-Multi-Ethernet

- Data sheet 29391 (this data sheet)
- Operating instructions 29391-B
- CE declaration of conformity (available from Bosch Rexroth upon request)
- Operation of IAC-Multi-Ethernet electronics (xx: Software version):
  - Functional description Rexroth HydraulicDrive HDS-xx
  - Parameter description Rexroth HydraulicDrive HDS-xx
  - Diagnosis description Rexroth HydraulicDrive HDS-xx
- General information on the maintenance and commissioning of hydraulic components 07800/07900
- General operating instructions: Hydraulic valves for industrial applications 07600-B

Product family

- 4-way analog valve, direct operated, sizes 6 and 10, with integrated electronics (see data sheets 29035 and 29037)
- 4-way bus valve, direct operated, sizes 6 and 10, in CANopen or Profibus version (see data sheet 29191)

Commissioning software and documentation on the internet: www.boschrexroth.com/IAC

Maintenance instructions:

- The devices have been tested in the plant and are supplied with default settings.
- Only complete units can be repaired. Repaired devices are returned with default settings. User-specific settings will not be applied. The machine end-user will have to retransfer the corresponding user parameters.

Notes:

- The supply voltage must be permanently connected, as otherwise bus communication is not possible.
- If electromagnetic interference is to be anticipated, suitable measures must be taken to ensure the function (depending on the application, e.g. shielding, filtration)!

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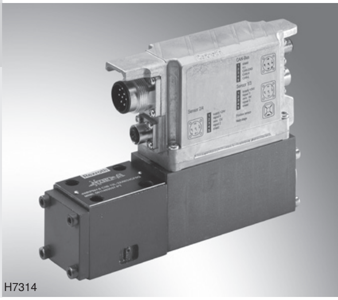
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

High-response valve with integrated digital axis controller (IAC-R) and field bus interface

RE 29191/09.10
Replaces: 06.05

Type 4WRPNH.../24C...
Type 4WRPNH.../24P...

Size 6 and 10
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 100 l/min (Δp = 70 bar)



H7314

Table of contents

Features

- Direct operated high-response valves size 6 and size 10 with control spool and sleeve in servo quality
- Single-side operated, 4/4 fail-safe position in deactivated state
- Integrated digital axis control functionality (IAC-R) for:
  - Flow control
  - Position control
  - Pressure control
  - p/Q function
  - Substitutional position/pressure and position/force control
  - NC functionality (stand-alone operation possible)
- Analog and digital interfaces for command and actual values
  - 4 x analog sensors (+/–10 V or 4..20 mA) or
  - 1 x length measurement system (1Vss or SSI) and 2 analog sensors
- Command value provision/actual value response analog (current or voltage) or via field bus
- Analog/digital inputs/outputs configurable
- Field bus connection
  - CAN bus with CANopen protocol DS408
  - Profibus-DP V0/V1
- Quick commissioning via PC and commissioning software

Ordering code

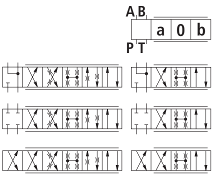
4WRP	N	H			B		– 2X /	M /	24				*

with integrated digital axis controller and NC functionality **= N**

Control spools / sleeve **= H**

Size 6 **= 6**
Size 10 **= 10**

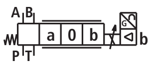
Spool symbols
4/4-directional design



= C3, C5
= C4, C1
= C

With symbols C5 and C1:
P → A: q_v B → T: $q_v/2$
P → B: $q_v/2$ A → T: q_v

Mounting side of the inductive position transducer



(standard) **= B**

Rated flow at 70 bar valve pressure differential (35 bar / control edge)

Size 6
2 l/min **= 02**
4 l/min **= 04**
12 l/min [8] **= 12**
15 l/min [1] **= 15**
24 l/min [8] **= 24**
25 l/min [1] **= 25**
40 l/min [2] **= 40**

Size 10
50 l/min **= 50**
100 l/min **= 100**

Flow characteristics
Linear **= L**
Inflected characteristic curve [3] **= P**

2X = Component series 20 to 29 (20 to 29: Identical installation and connection dimensions)

Seal material
M = NBR seals suitable for mineral oils (HL; HLP) according to DIN 51524

24 = Supply voltage 24 V

Field bus interface
C = CANopen [7]
P = Profibus DP V0/V1

Command value inputs
A6 = ±10 VDC
F6 = 4...20 mA

Sensor interfaces [4]
A = X4, M12-5, ±10 V
X7, M12-5, ±10 V
B = X4, M12-5, ±10 V
X7, M23-12, SSI [5]
C = X4, M12-5, ±10 V
X7, M23-12, 1 Vss [6]
G = X4, M12-5, 4...20 mA
X7, M12-5, 4...20 mA
H = X4, M12-5, 4...20 mA
X7, M23-12, SSI [5]

Further details in the plain text

1) Only in connection with flow characteristics **"P"**
2) q_v 2:1 only with rated flow = 40 l/min
3) Inflection 60 % at size 6 with rated flow **"15"** and **"25"**, otherwise inflection 40 %
4) For sensor interfaces **"A"**, **"B"** or **"C"** only command value input **"A6"** is possible.
For sensor interface **"G"** and **"H"** only command value input **"F6"** is possible.
5) Gray code or binary
6) Adjustable interpolation
7) Field bus interface CANopen with sensor interface **"B"**, **"C"**, **"G"** or **"H"** only upon request
8) Only in connection with flow characteristics **"L"**

Note:
Ordering codes for and technical information on the control valve with integrated digital axis controller (IAC-R) and clock-synchronized PROFIBUS DP/V2 (PROFIdrive profile) can be seen on data sheet 29291.

Standard types

Size 6 with CANopen

Material no.	Type
R901124262	4WRPNH 6 C4 B40P-2X/M/24CA6A
R901131590	4WRPNH 6 C4 B15P-2X/M/24CA6A
0811403540	4WRPNH 6 C3 B24L-2X/M/24CF6G
0811403548	4WRPNH 6 C4 B40L-2X/M/24CA6A
0811403541	4WRPNH 6 C3 B04L-2X/M/24CA6A

Size 10 with CANopen

Material no.	Type
R901125645	4WRPNH 10 C3 B100P-2X/M/24CA6A
0811403361	4WRPNH 10 C3 B100L-2X/M/24CA6A
R901243764	4WRPNH 10 C3 B100L-2X/M/24CA6B
R901243769	4WRPNH 10 C3 B100P-2X/M/24CA6B

Size 6 with Profibus DP

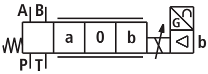
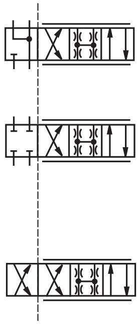
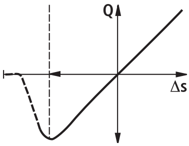
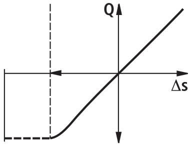
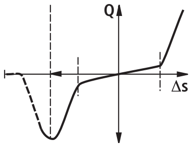
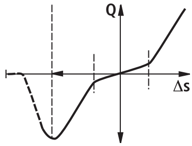
Material no.	Type
0811403552	4WRPNH 6 C3 B04L-2X/M/24PA6A
0811403575	4WRPNH 6 C3 B40L-2X/M/24PA6B
0811403550	4WRPNH 6 C3 B40L-2X/M/24PA6A
0811403573	4WRPNH 6 C3 B25P-2X/M/24PA6B
0811403559	4WRPNH 6 C3 B04L-2X/M/24PF6G
0811403531	4WRPNH 6 C3 B40L-2X/M/24PF6G
R901224758	4WRPNH 6 C1 B24L-2X/M/24PF6G

Size 10 with Profibus DP

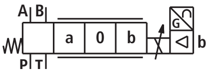
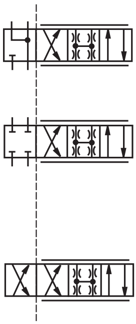
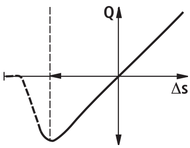
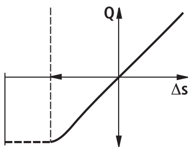
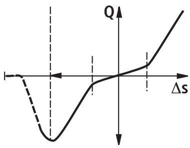
Material no.	Type
0811403358	4WRPNH 10 C3 B100L-2X/M/24PF6G
0811403359	4WRPNH 10 C4 B100L-2X/M/24PF6G
R901232766	4WRPNH 10 C4 B100P-2X/M/24PF6G

Symbols

Size 6

	Linear	*p*: Inflection 60 % [q_n 15.25 l/min]	*p*: Inflection 40 % [q_n 40 l/min]
 C3, C5 C4, C1 C	 C3, C5, C4, C1  C	 C3, C5, C4, C1	
	Standard = 1:1, from q_n = 40 l/min also 2:1		

Size 10

	Linear	*p*: Inflection 40 %
 C3, C5 C4, C1 C	 C3, C5, C4, C1  C	 C3, C5, C4, C1

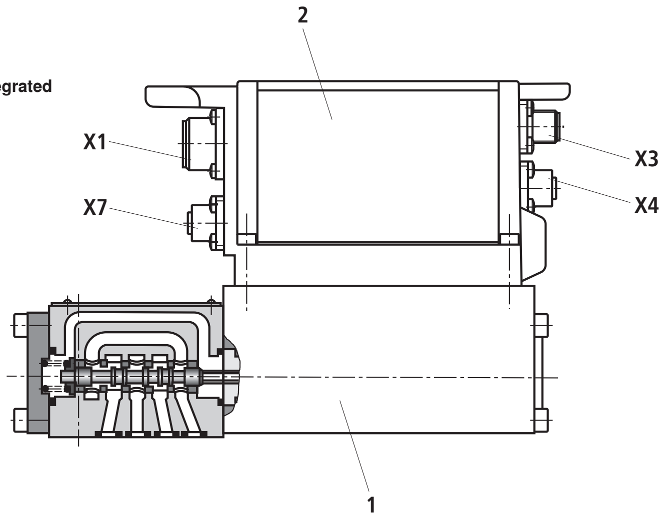
Function, section

Structure

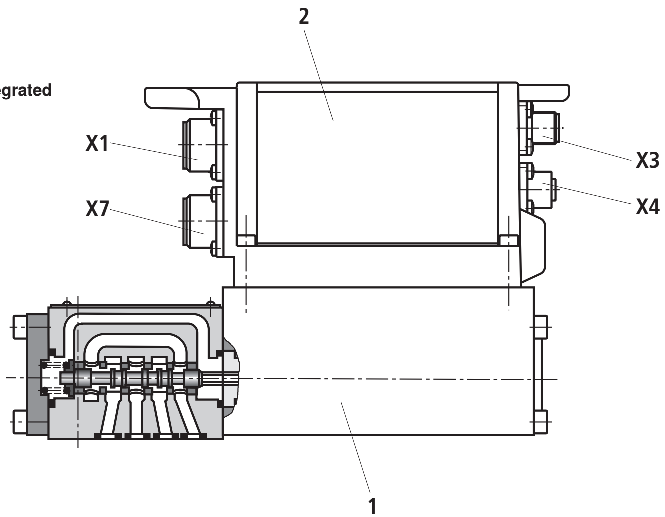
The IAC-R valve mainly consists of:

- Direct operated high-response valve (1) with control spool in servo quality
- Integrated digital axis controller (2) with analog and digital sensor interfaces and field bus connection (X3)

High-response valve with integrated axis controller with analog interfaces (X1, X4, X7)



High-response valve with integrated axis controller with analog interfaces (X1, X4) and digital sensor interface (X7)



Function, section

Functional description

The **IAC-**R valve (**I**ntegrated **A**xis **C**ontroller on the basis of high-response valves) is a digital high-response valve with integrated axis controller with the following functionalities:

- Flow control
- Position control
- Pressure control
- p/Q function
- Substitutional position/pressure and position/ force control
- NC functionality

- The command value can alternatively be provided via an analog interface (X1) or via the field bus interface (X3)
- The actual value signals are provided via an analog interface (X1) and can additionally be read out via the field bus (X3).
- The controller parameters are set via the field bus.
- Separate supply voltage for bus/controller and power part (output stage) for safety reasons

PC program WinHPT

To implement the project planning task and to parameterize the IAC-R valves, the user may use the commissioning software WinHPT (see accessories).

- Parameterization
- Programming of NC functionality
- Diagnosis
- Comfortable data management on a PC
- PC operating systems: Windows 2000 or Windows XP

The digital integrated control electronics enables the following fault detection:

- Cable break sensors
- Undervoltage
- Temperature of the integrated electronics
- Communication errors
- Watchdog

The following additional functions are available:

- Ramp generator
- Internal command value profile
- Release function analog/digital
- Error output 24 V (e.g. as switching signal to PLC/logic and further valves), max. 1.8 A
- Control output adjustment
  - Deadband compensation
  - Zero point correction
  - Valve inflection compensation
  - Friction compensation
  - Direction-dependent gain

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

general				Size 6			Size 10		
Type				Gate valve, directly operated, with steel sleeve					
Actuation				Proportional solenoid with position control, OBE					
Type of connection				Plate connection, porting pattern according to ISO 4401					
Installation position				Any					
Ambient temperature range			°C	–20 … +50					
Weight			kg	2.7			7.5		
hydraulic (measured with HLP46, $\vartheta_{ÖL}$ = 40 °C ± 5 °C)									
Hydraulic fluid				Hydraulic oil according to DIN 51524…535, other media upon request					
Viscosity range	Recommended		mm^2/s	20 … 100					
	Max admissible		mm^2/s	10 … 800					
Hydraulic fluid temperature range			°C	–20 … +60					
Maximum permitted degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)				Class 18/16/13 [1)]					
Direction of flow				According to symbol					
hydraulic, size 6									
Rated flow at Δp = 35 bar per edge [2)]			l/min	2	4	12	15	24/25	40
Max. operating pressure	Ports P, A, B		bar	315					
	Port T		bar	250					
Limitation of use with regard to the transition to failsafe	Spool symbols C3, C5		bar	315	315	315	315	315	160
	Spool symbols C1, C4		bar	315	315	315	280	250	100
Leakage oil at 100 bar	Linear characteristic curve L		cm^3/min	< 150	< 180	< 300	-	< 500	< 900
	Inflected characteristic curve P		cm^3/min	-	-	-	< 180	< 300	< 450

hydraulic, size 10							
Rated flow at Δp = 35 bar per edge [2)]			l/min	50 (1:1)	50 (2:1)	100 (1:1)	100 (2:1)
Max. operating pressure	Ports P, A, B		bar	315			
	Port T		bar	250			
Limitation of use with regard to the transition to failsafe	Spool symbols C3, C5			315	315	160	160
	Spool symbols C1, C4			250	250	100	100
Leakage oil at 100 bar	Linear characteristic curve L		cm^3/min	< 1200	< 1200	< 1500	< 1500
	Inflected characteristic curve P		cm^3/min	< 600	< 500	< 600	< 600

static / dynamic		Size 6	Size 10
Hysteresis	%	≤ 0.2	
Manufacturing tolerance q_{max}	%	< 10	
Actuating time for signal step 0 … 100 %	ms	≤ 10	25
Temperature drift		Zero shift < 1 % at Δϑ = 40 °C	
Zero compensation		ex factory ±1 %	
Conformity		CE according to EMC directive 2004/108/EC	

The footnotes are explained on the following page.

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

electric			
Relative duty cycle		%	100 (continuous operation)
Protection class according to EN 60529			IP 65 with mounted and locked plug-in connectors
Supply voltage	Nominal voltage	VDC	24
	Lower limit value	VDC	21
	Upper limit value	VDC	36
	Max admissible residual ripple	Vss	2 (at supply voltage of 23 V … 34 V)
Power consumption	Size 6	W	Max. 40
	Size 10	W	Max. 60
AD/DA resolution		Analog inputs Analog outputs	12 bit 10 bit
Protective earthing conductor and shielding			See pin assignment (CE-compliant installation)
Adjustment			Calibrated ex factory, see valve characteristic curve

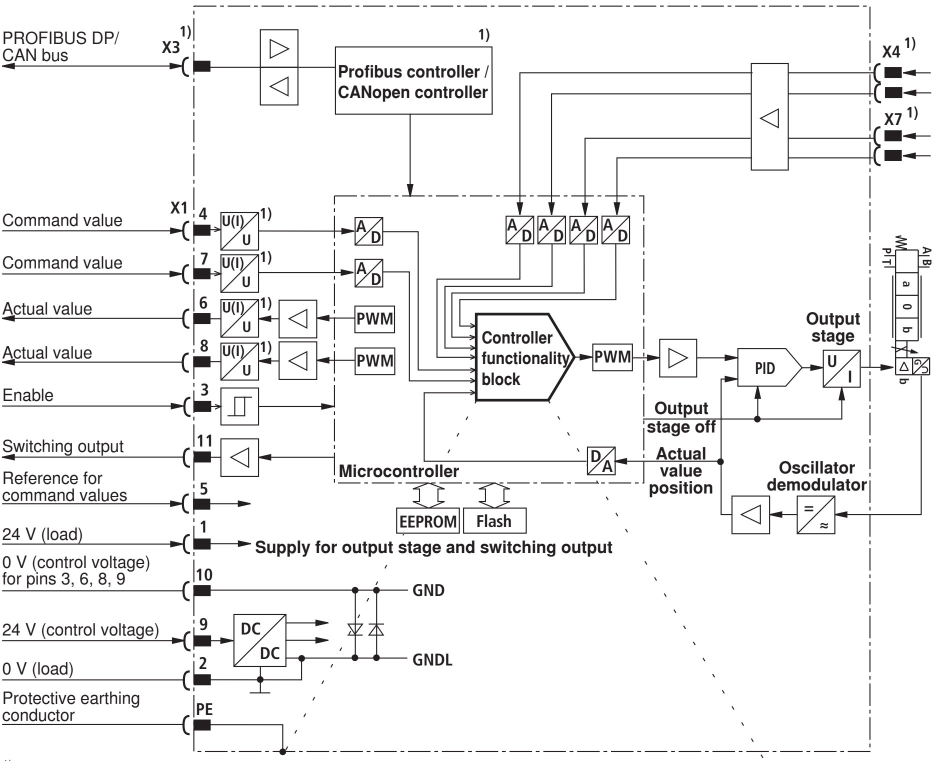
1) The cleanliness classes specified for the components must be adhered to in hydraulic systems.

Effective filtration prevents faults and at the same time increases the service life of the components.

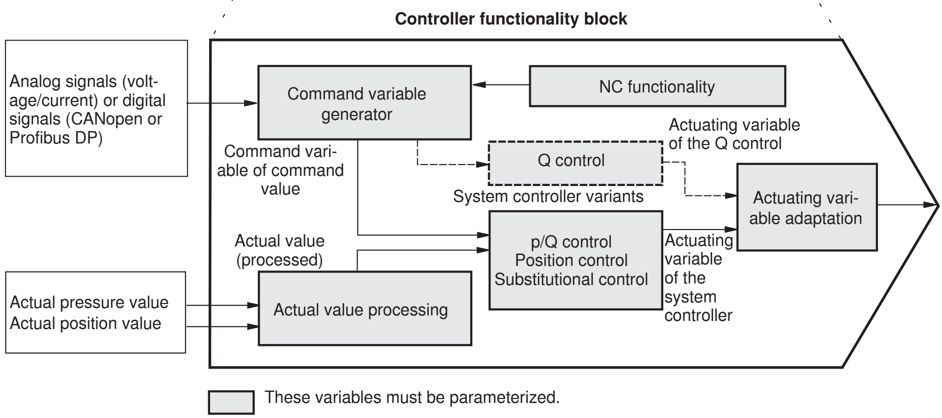
For the selection of the filters see www.boschrexroth.de/filter.

2) Flow at different Δp: $q_x = q_{nom} \cdot \sqrt{\frac{\Delta p_x}{35}}$

Block diagram/controller functionality



1) According to ordering code



These variables must be parameterized.

Electrical connections, assignment

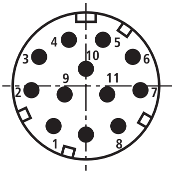
Unit connector pin assignment X1, 11-pole + PE according to EN 175201-804

Pin	Core marking [1]	Assignment of interface A6	Assignment of interface F6
1	1	24 VDC (supply for output stage and power switching signal)	
2	2	0 V ≙ load zero (for output stage)	
3	3	Release input 8.5 … 24 VDC = function, R_e ~10 kΩ	
4	4	Command value ±10 V; R_e ~130 kΩ or dig. Input (from PLC) [2]	4 … 20 mA command value; R_e = 200 Ω or dig. Input (from PLC) [2]
5	5	Reference for command values	
6	6	±10 V actual value or dig. Output (to PLC) [2]	4 … 20 mA actual value, load resistance ~330 Ω or dig. Output (to PLC) [2]
7	7	Command value ±10 V; R_e ~130 kΩ or dig. Input (from PLC) [2]	4 … 20 mA command value; R_e = 200 Ω or dig. Input (from PLC) [2]
8	8	±10 V actual value or dig. Output (to PLC) [2]	4 … 20 mA actual value, load resistance ~330 Ω or dig. Output (to PLC) [2]
9	9	24 VDC (control voltage for signal part and bus)	
10	10	0 V reference potential for pin 3, 6, 8 and 9	
11	11	Switching output 24 V (error signal or power switching signal) max 1.8 A	
PE	Green-yellow	Protective earthing conductor (connected directly to metal housing)	

[1] Core marking of the connection lines for line socket with cable set (see accessories)

[2] Selection via commissioning software

X1



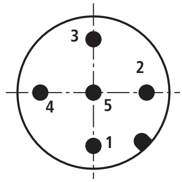
Unit connector pin assignment for CAN bus "X3" (code A), M12, 5-pole, pins

Pin	Assignment
1	n.c.
2	n.c.
3	CAN_GND
4	CAN_H
5	CAN_L

External screen on both sides of the metallic housing of the plug-in connection.

Internal screens are not required.

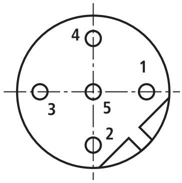
Transmission rate kbit/s	20 to 1000
Bus address	1 to 127



Unit connector pin assignment for Profibus DP "X3" (code B), M12, 5-pole, socket

Pin	Assignment
1	VP
2	RxD/TxD-N (A line)
3	D GND
4	RxD/TxD-P (B line)
5	Shield

Transmission rate	up to 12 MBaud
Bus address	1 to 126



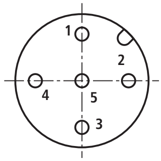
The galvanically separated voltage +5 V (pin 1 - VP) at the socket allows for passive termination of the profibus.

Electrical connections, assignment

Analog sensor interfaces, connection "X4" and "X7" (code A), M12, 5-pole, socket

Pin	Assignment of voltage interface	Assignment of current interface
1	Supply 24 VDC	Supply 24 VDC
2	Signal 3 (X4) / 4 (X7), (–10 … +10 V)	Signal 3 (X4) / 4 (X7), (4 … 20 mA)
3	Zero 0 V	Zero 0 V [1)
4	Signal 1 (X4) / 2 (X7), (–10 … +10 V)	Signal 1 (X4) / 2 (X7), (4 … 20 mA)
5	Shield	Shield

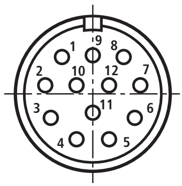
[1) Do not connect to 2-wire pressure transducer



Attention: The analog sensor interfaces at the connections X4 and X7 are not coded. Danger of confusing the same! The user has to ensure proper wiring!

Digital sensor interface 1Vss or SSI measurement system "X7", M23, 12-pole, socket

Pin	Assignment 1Vss	Assignment SSI
1	$\overline{B}$	0 V
2	Sense +5 V [1)	Data
3	R	Clock
4	$\overline{R}$	n.c.
5	A	n.c.
6	$\overline{A}$	n.c.
7	n.c.	n.c.
8	B	n.c.
9	n.c.	24 V
10	0 V [1)	$\overline{\text{Data}}$
11	Sense 0 V [1)	$\overline{\text{Clock}}$
12	+5 V [1)	n.c.



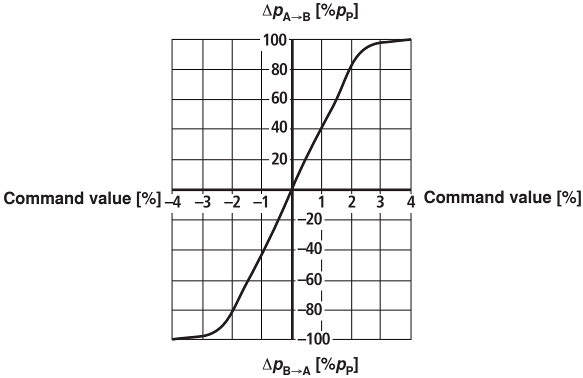
Note:
The sense signal is not analyzed.

[1) **Recommendation**:
Connect the voltages +5 V (pin 12) and +5 V-Sense (pin 2), as well as 0 V (pin 10) and 0 V-Sense (pin 11) for transducer supply.

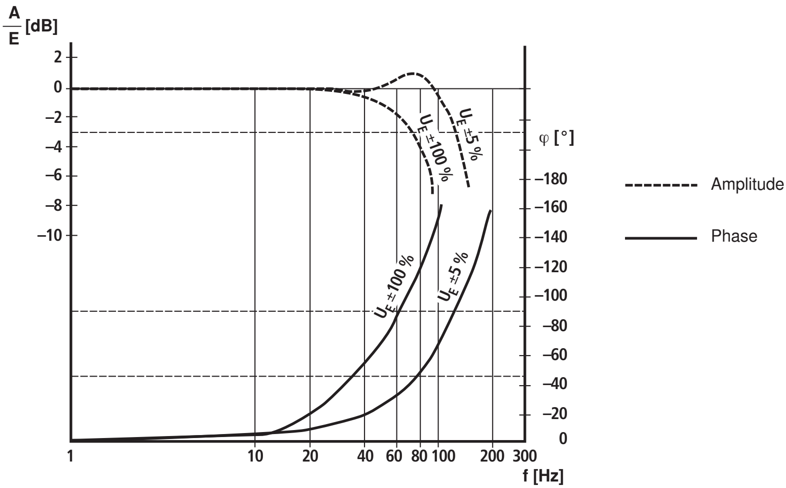
Note:
We recommend connecting the screens on both sides over the metallic housings of the plug-and-socket-connectors. Using connector pins will affect the effectiveness of the screen!
Internal screens are not required.

Characteristic curves size 6 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Pressure gain



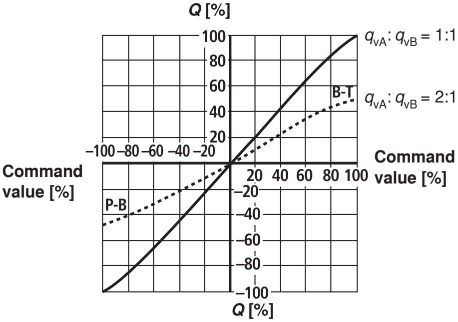
Bode diagram



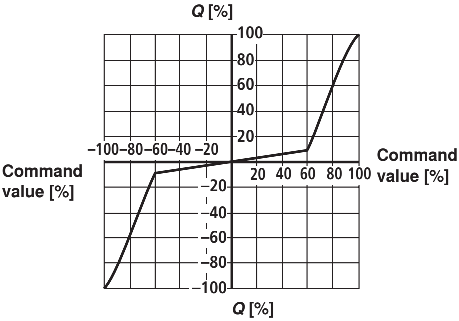
Characteristic curves size 6 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Flow - signal function

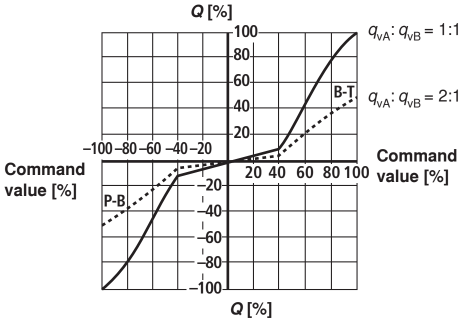
L: Linear



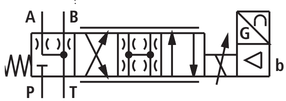
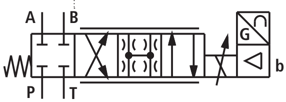
P: Inflection 60 %



P: Inflection 40 %



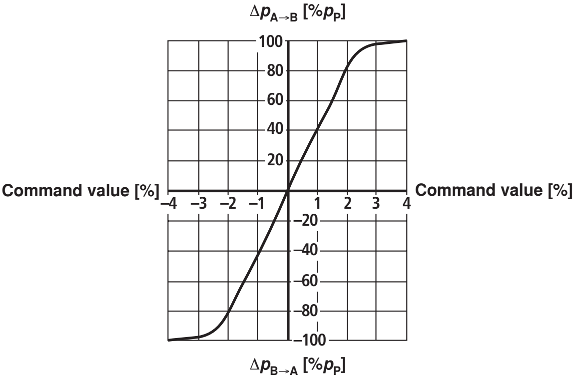
Fail-safe position

	Leakage oil at	100 bar	P → A	50 cm³/min
			P → B	70 cm³/min
	Flow at	Δ*p* = 35 bar	A → T	10 ... 20 l/min
			B → T	7 ... 20 l/min
	Leakage oil at	100 bar	P → A	50 cm³/min
			P → B	70 cm³/min
			A → T	70 cm³/min
			B → T	50 cm³/min

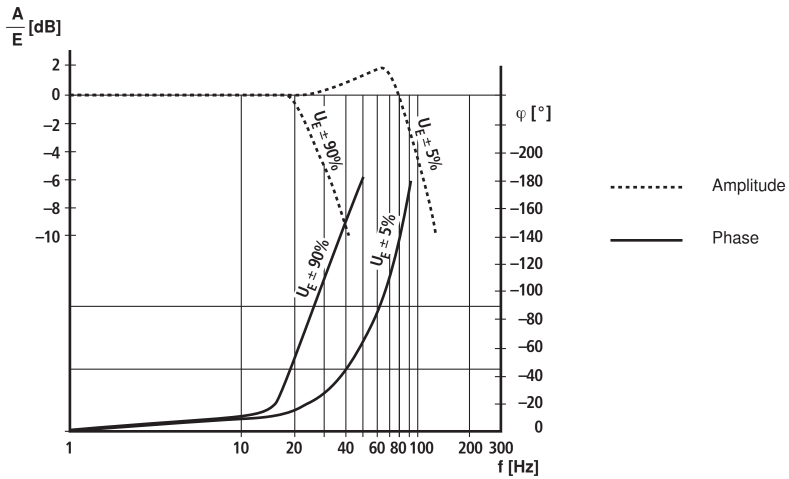
Fail-safe	*p* = 0 bar => 7 ms	Enable "off" or internal shut-off in case of error
	p = 100 bar => 10 ms	U_B ≤ 18 V or *I* ≤ 2 mA (at 4…20 mA signal)

Characteristic curves size 10 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Pressure gain



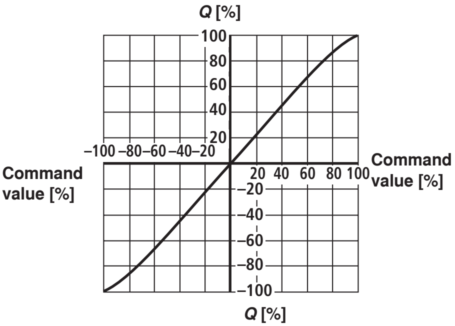
Bode diagram



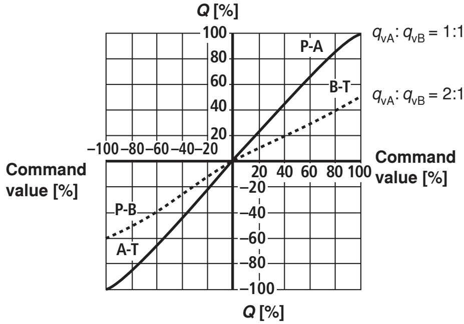
Characteristic curves size 10 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Flow - signal function

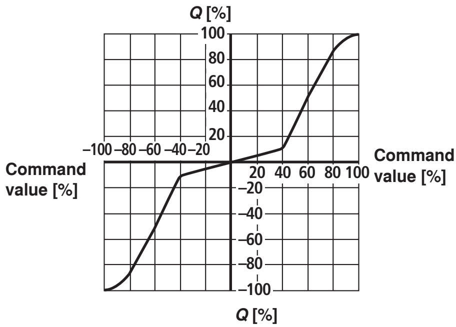
L: Linear 1:1



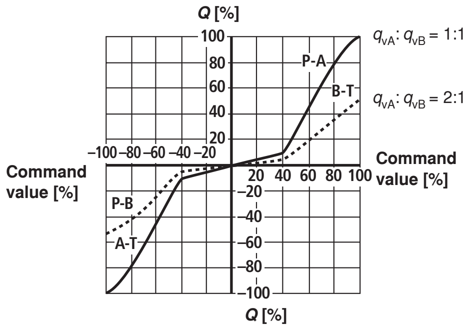
L: Linear 2:1



P: Inflection 40 % 1:1

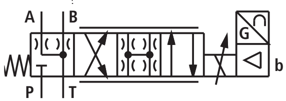
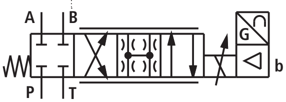


P: Inflection 40 % 2:1



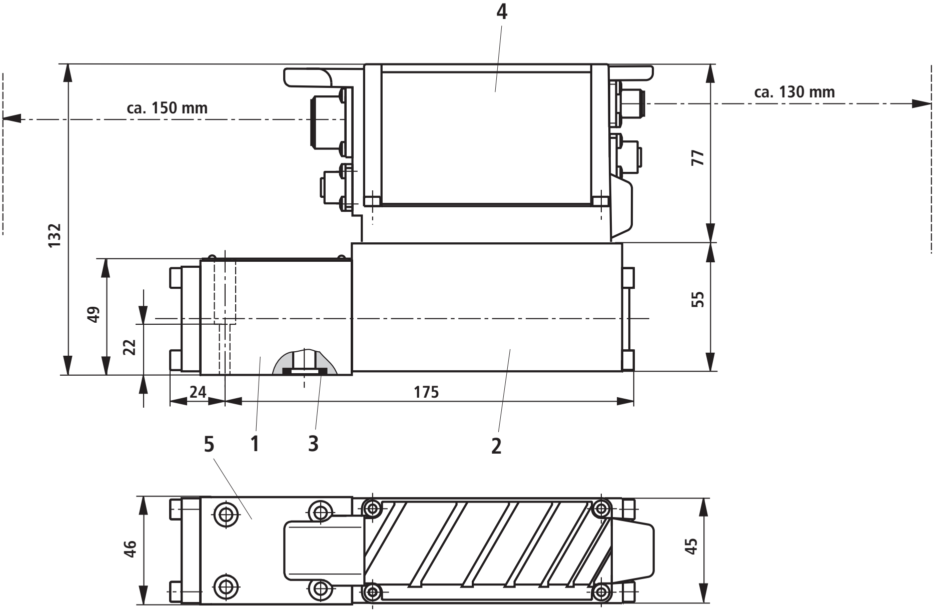
3

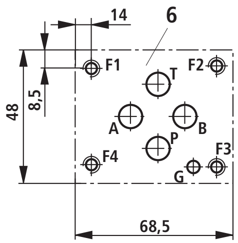
Fail-safe position

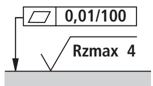
	Leakage oil at	100 bar	P → A	50 cm^3/min
			P → B	70 cm^3/min
	Flow at	Δp = 35 bar	A → T	10 ... 20 l/min
		q_n = 50/100 l/min	B → T	7 ... 20 l/min
	Leakage oil at	100 bar	P → A	50 cm^3/min
			P → B	70 cm^3/min
			A → T	70 cm^3/min
			B → T	50 cm^3/min

Fail-safe	p = 0 bar => 12 ms	Enable "off" or internal shut-off in case of error
	p = 100 bar => 16 ms	$U_B \leq$ 18 V or $I \leq$ 2 mA (at 4…20 mA signal)

Unit dimensions size 6 (dimensions in mm)





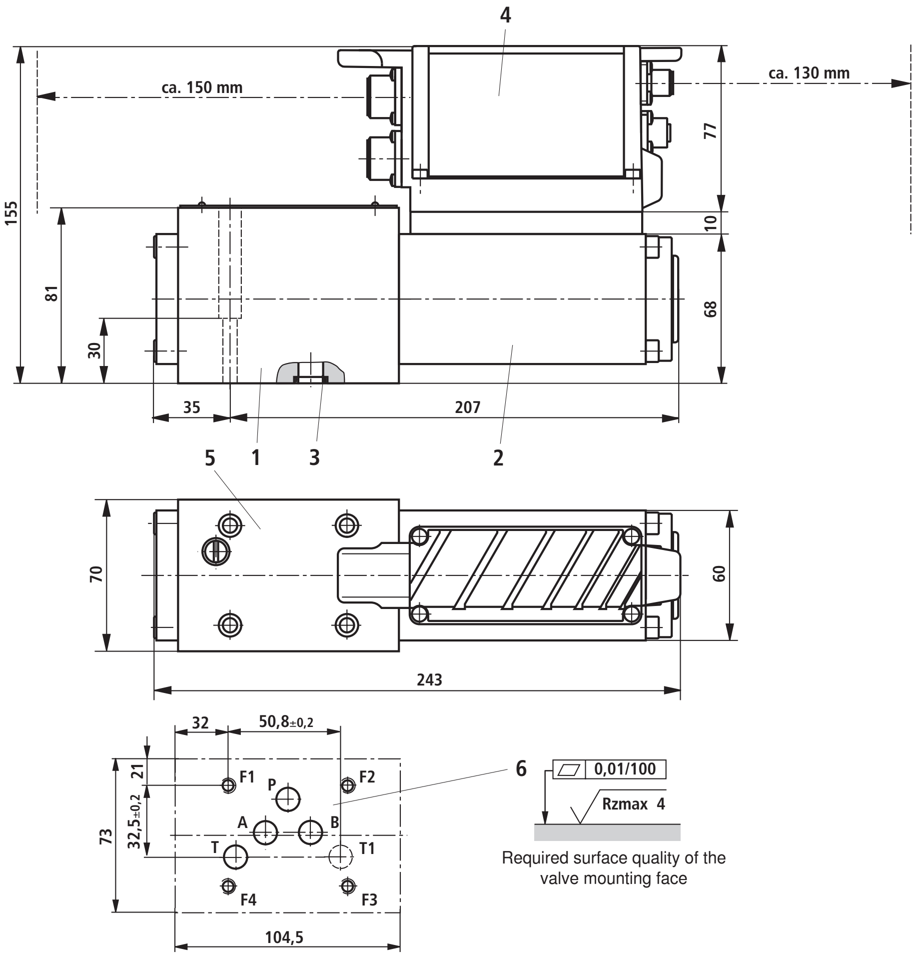


Required surface quality of the valve mounting face

1 Valve housing
2 Control solenoid with position transducer
3 O-ring 9.25 x 1.78 (ports P, A, B, T)
4 Integrated digital control electronics
5 Name plate
6 Machined valve mounting face, porting pattern according to ISO 4401-03-02-0-05

Valve mounting screws
(not included in scope of delivery)
4 units of hexagon socket head cap screws according to ISO4762-M5x30-10.9-N67F 821 70
(galvanized according to Bosch standard N67F 821 70)
M_A = 6+2 Nm
Mat. no. **2910151166**

Unit dimensions size 10 (dimensions in mm)



Required surface quality of the valve mounting face

1 Valve housing

2 Control solenoid with position transducer

3 O-ring 12.0 x 2.0 (ports P, A, B, T, T1)

4 Integrated digital control electronics

5 Name plate

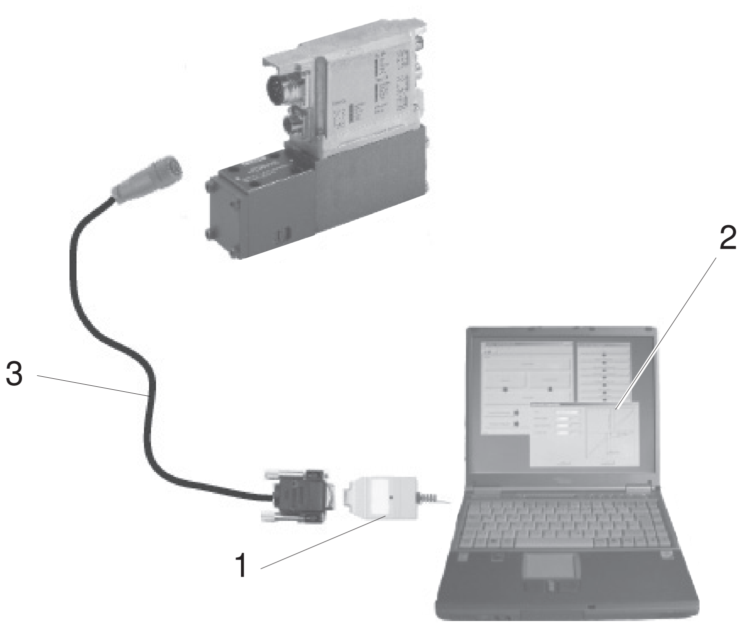
6 Machined valve mounting face, porting pattern according to ISO 4401-05-04-0-05

Deviating from the standard:
– Port T1 is provided additionally

Valve mounting screws
(not included in scope of delivery)
4 units of hexagon socket head cap screws according to ISO4762-M6x40-10.9-N67F 821 70
(galvanized according to Bosch standard N67F 821 70)
M_A = 11+3 Nm
Mat. no. **2910151209**

Accessories for parameterization (not included in scope of delivery)

The following is required for the parameterization with PC:	CANopen	Profibus DP
1 Interface converter (USB)	VT-ZKO-USB/CA-1-1X/V0/0 Mat. no. **R901071963**	VT-ZKO-USB/P-1-1X/V0/0 Mat. no. **R901071962**
2 Start-up software	WinHPT Download from www.boschrexroth.com/IAC	
3 Connecting cable, 3 m	D-Sub / M12 (coding A), Mat. no. **R900751271**	D-Sub / M12 (coding B), Mat. no. **R901078053**

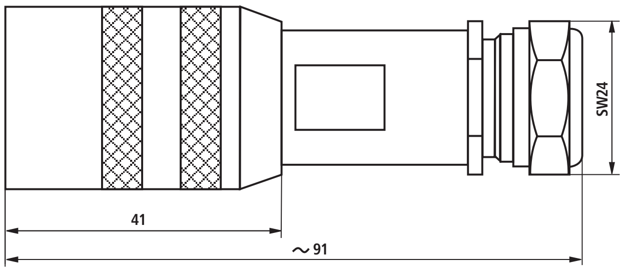


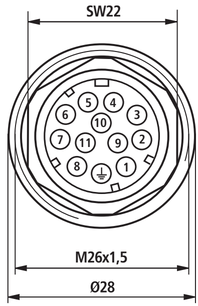
Accessories, port X1 (not included in scope of delivery)

Mating connector for X1

Mating connector according to EN 175201-804 (12-pole, metal design)

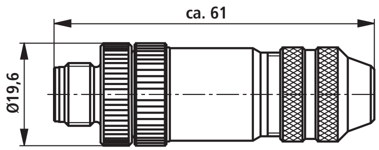
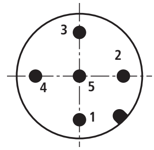
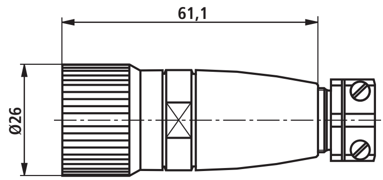
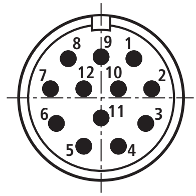
- Mating connector (construction set) for a cable diameter of 12-15 mm — Material no. **R901268000**
- Mating connector with 5 m cable, 12 x 0.75 mm² with cable shield, assembled — Material no. **R901272854**
- Mating connector with 20 m cable, 12 x 0.75 mm² with cable shield, assembled — Material no. **R901272852**



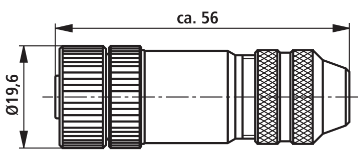
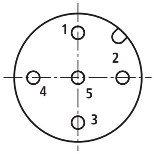
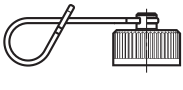


3

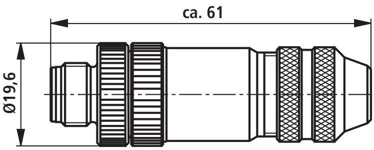
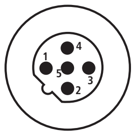
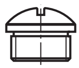
Accessories, sensor connections (not included in scope of delivery)

Description	View, dimensions	Pole image, order details
X4, X7 (analog sensors) Plug-in connector, 5-pole, M12 x 1, pins, A coding, metal design		 Mat. no.: **R901075542** (cable diameter 4 … 6 mm)
X7 (digital sensors, 1 Vss and SSI) Plug-in connector, 12-pole, M23, pins, soldered joint, metal design with cap nut		 Mat. no.: **R901076284** (cable diameter up to 10.5 mm)

Accessories, CAN bus (A coding) (not included in scope of delivery)

Description	View, Dimensions	Pole image, order details
X3 Round plug-in connector, processible, 5-pole, M12 x 1 Straight mating connector from metal.		 Mat. no.: **R901076910** (cable diameter 6-8 mm)
M12 cap Dust protection		Mat. no.: **R901075564**

Accessories, profibus (B code) (not included in scope of delivery)

Description	View, Dimensions	Pole image, order details
X3 Round plug-in connector, processible, 5-pole, M12 x 1 Straight line coupling plug from metal.		 Mat. no.: **R901075545** (cable diameter 6-8 mm)
Further profibus participants can be connected e.g. with a Y cable (can be ordered at HARTING, Mat. no. TB61042030039).		
M12 protective cap		Mat. no.: **R901075563**

Project Planning / Maintenance Instructions / Additional Information

Product documentation for IAC-R

Data sheet 29191 (this data sheet)

Declaration on environmental compatibility 29191-U

Operator's manual
CANopen 29090-B-01
Profibus 29090-B-02

General information on the maintenance and commissioning of hydraulic components 07800 / 07900

Commissioning software and documentation on the Internet: www.boschrexroth.com/IAC

Maintenance instructions:
- The devices have been tested in the plant and are supplied with default settings.
- Only complete units can be repaired. Repaired devices are returned with default settings.
  User-specific settings are not maintained. The operator will have to retransfer the corresponding user parameters.

Notes:
- Connect the valve to the supply voltage only when this is required for the functional processes of the machine.
- Electric signals taken out via control electronics (e.g. signal "ready for operation") may not be used for the actuation of safety-relevant machine functions! (See also the European standard "Safety requirements for fluid power systems and their components - Hydraulics", EN 982.)
- If electromagnetic interference is to be anticipated, suitable measures must be taken to ensure the function (depending on the application, e.g. shielding, filtration)!

Notes

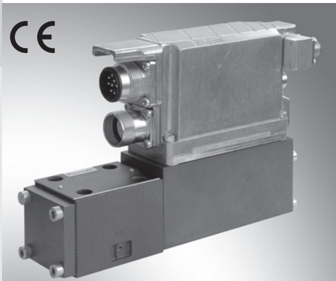
Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

High-response valve with integrated digital axis controller (IAC-R) and clock-synchro-nized PROFIBUS DP/V2 (PROFIdrive profile)

RE 29291/06.13
Replaces: 02.11

Type 4WRPNH.../24F..

Size 6 and 10
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 100 l/min (Δp = 70 bar)



TB0193

Type 4WRPNH 6 .../24F..

Table of contents

Features

– Direct operated high-response valves size 6 and size 10 with servo performance type control spool and sleeve
– Single-side operated, 4/4 fail-safe position in deactivated state
– Integrated digital axis control functionality (IAC-R) for:
  • position control with underlying velocity control
  • DSC functionality
– Analog sensor interfaces for
  • current and voltage
– Digital sensor interfaces for
  • 1 x length measurement system 1Vpp or
  • 1 x length measurement system SSI or
  • 1 x length measurement system EnDat 2.2
– Clock-synchronous command value provision according to PROFIdrive profile V4.0
  • telegram 5 or 105
– PROFIBUS DP/V1, DP/V2
– Quick commissioning via PC and commissioning software WinHPT from version 2.1

Ordering code

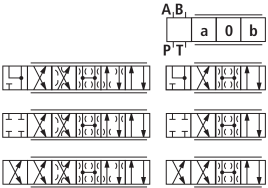
4WRP	N	H			B		–2X /	M /	24	F			*

With integrated digital axis controller for NC control systems **= N**

Control spool / sleeve **= H**

Size 6 **= 6**
Size 10 **= 10**

Spool symbols
4/4 directional design



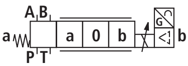
= C3, C5

= C4, C1

= C

With symbols C5 and C1:
P → A: q_v B → T: $q_v / 2$
P → B: $q_v / 2$ A → T: q_v

Mounting side of the inductive position transducer



(standard) **= B**

Rated flow at 70 bar valve pressure differential (35 bar / control edge)

Size 6
2 l/min [1] **= 02**
4 l/min **= 04**
12 l/min [5] **= 12**
15 l/min [2] **= 15**
24 l/min [5] **= 24**
25 l/min [2] **= 25**
40 l/min [3] **= 40**

Size 10
50 l/min **= 50**
100 l/min **= 100**

Flow characteristics
Linear **= L**
Inflected characteristic curve [4] **= P**

Further details in clear text

Sensor interfaces
A = X4, M12-5, ±10 V
X7, M12-5, ±10 V
B = X4, M12-5, ±10 V
X7, M23-12, SSI
C = X4, M12-5, ±10 V
X7, M23-12, 1 Vpp
G = X4, M12-5, 4-20 mA
X7, M12-5, 4-20 mA
T = X4, M12-5, ±10V
X7, M12-8, EnDat 2.2

Electronics interface
A6 = ±10 VDC
F6 = 4 to 20 mA

Drive bus
F = PROFIBUS DP/V2
PROFIdrive profile

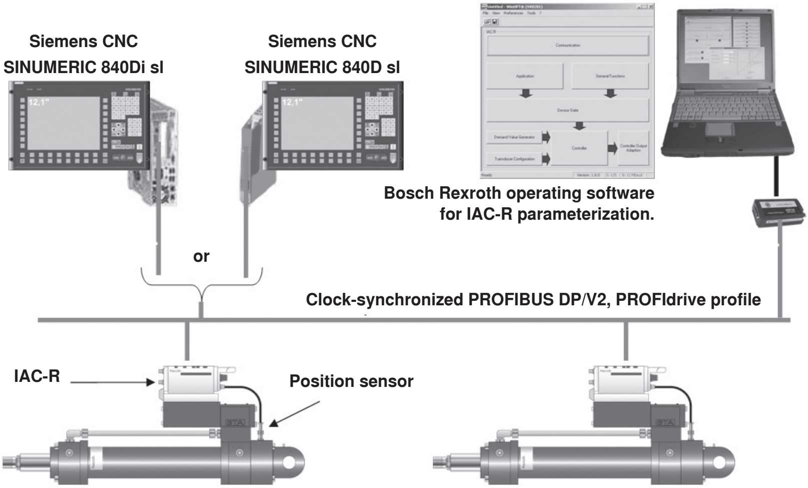
24 = Supply voltage 24 V

Seal material
M = NBR gaskets
suitable for mineral oils
(HL; HLP) according to DIN 51524

2X = Component series 20 to 29
(20 to 29: unchanged
mounting and connection dimensions)

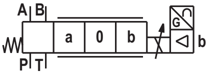
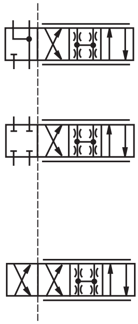
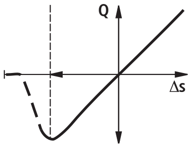
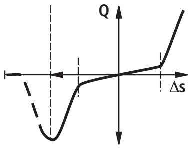
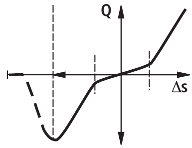
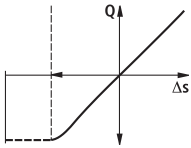
[1] Rated flow 2 l/min not with flow characteristics **"P"**
[2] Only in connection with flow characteristics **"P"**
[3] q_V 2:1 only with rated flow = 40 l/min
[4] Inflection 60% at size 6 with rated flow **"15"** and **"25"**, otherwise inflection 40%
[5] Only in connection with flow characteristics **"L"**

System overview

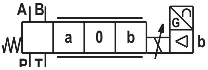
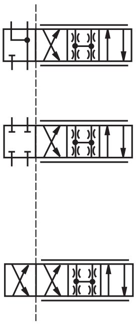
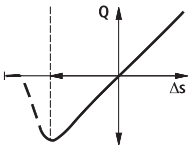
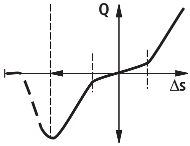
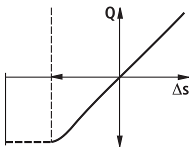


Symbols

Size 6

	Linear	*p*: Inflection 60 % [q_n 15.25 l/min]	*p*: Inflection 40 % [q_n 40 l/min]
 C3, C5 / C4, C1 / C	 C3, C5, C4, C1		
	 C	C3, C5, C4, C1	
	Standard = 1:1, from q_n = 40 l/min also 2:1		

Size 10

	Linear	*p*: Inflection 40 %
 C3, C5 / C4, C1 / C	 C3, C5, C4, C1	
	 C	C3, C5, C4, C1

Function, section

Construction

The IAC-R valve mainly consists of:

– Direct operated high-response valve (1) with servo performance type control spool
– Integrated digital axis controller (2) with analog (X4/X7) or digital (X7) sensor interface
– PROFIBUS interface (X3) with functionality according to DP/V1 with clock synchronization according to DP/V2

Functional description

The IAC-R valve is a digital high-response valve with integrated axis controller with the following functionalities:

– Position control
– DSC functionality
– Analog (X4/X7) or digital (X7) sensor interface
– Clock-synchronous command value specification according to PROFIdrive profile V4.0
  • telegram 5 or 105
– The controller parameters are set via the PROFIdrive parameter protocol.
– Separate supply voltage for bus/controller and power part (output stage) for safety reasons.

PC program WinHPT

To implement the project planning task and to parameterize the IAC-R valves, the user may use the commissioning software WinHPT (see accessories).

– Parameterization
– Diagnosis
– Comfortable data management on a PC
– PC operating systems: Windows 2000 or Windows XP

The digital integrated control electronics enables the following fault detection:

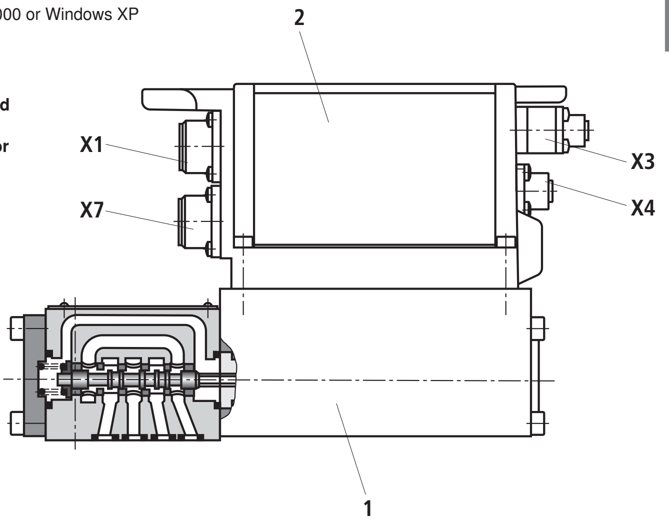
– Cable rupture of sensorics system
– Undervoltage
– Temperature of the integrated electronics
– Communication fault
– Watchdog
– Synchronous monitoring

The following additional functions are available:

– Fault output 24 V or control of an isolator valve
– Control output adjustment
  • deadband compensation
  • zero offset
  • valve inflection compensation
  • friction compensation
  • direction-dependent gain
– PIDT1 controller
– State controller
– Automatic/semi-automatic drive measurement for simple controller optimization

3

High-response valve with integrated axis controller and analog (X4/X7) or digital (X7) sensor interface



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

General		Size 6	Size 10
Type		Spool valve, directly operated, with steel sleeve	
Actuation		Proportional solenoid with position control, OBE	
Type of connection		Subplate mounting, porting pattern according to ISO 4401	
Installation position		any	
Ambient temperature range	°C	–20 … +50	
Weight	kg	2.7	7.5

hydraulic (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)			
Hydraulic fluid			Hydraulic oil according to DIN 51524…535, other media upon request
Viscosity range	recommended	mm^2/s	20 … 100
	max admissible	mm^2/s	10 … 800
Hydraulic fluid temperature range		°C	–20 … +60
Maximum admissible degree of contamination of the hydraulic fluid – cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]
Flow direction			according to symbol

Hydraulic, size 6								
Rated flow at Δp = 35 bar per edge [2]		l/min	2	4	12	15	24/25	40
Max operating pressure	Ports P, A, B	bar	315					
	Port T	bar	250					
Limitations of use Δp pressure drop across valve q_{Vnom}: > $q_{N\ valves}$	Spool symbols C, C3, C5	bar	315	315	315	315	315	160
	Spool symbols C1, C4	bar	315	315	315	280	250	100
Leakage oil at 100 bar	linear characteristic curve L	cm^3/min	< 150	< 180	< 300	–	< 500	< 900
	inflected characteristic curve P	cm^3/min	–	–	–	< 180	< 300	< 450

Hydraulic, size 10						
Rated flow at Δp = 35 bar per edge [2]		l/min	50 (1:1)	50 (2:1)	100 (1:1)	100 (2:1)
Max. operating pressure	Ports P, A, B	bar	315			
	Port T	bar	250			
Limitations of use Δp pressure loss at valve q_{Vnom}: > $q_{N\ valves}$	Spool symbols C, C3, C5	bar	315	315	160	160
	Spool symbols C1, C4	bar	250	250	100	100
Leakage oil at 100 bar	linear characteristic curve L	cm^3/min	< 1200	< 1200	< 1500	< 1500
	inflected characteristic curve P	cm^3/min	< 600	< 500	< 600	< 600

Static / dynamic		Size 6	Size 10
Hysteresis	%	≤ 0.2	
Manufacturing tolerance	%	< 10	
Acutating time for signal step 0 … 100 %	ms	≤ 10	25
Temperature drift		Zero point drift < 1% at $\Delta\vartheta$ = 40 °C	
Zero point calibration		ex factory ±1 %	
Conformity		CE according to EMC directive 2004/108/EC	

The footnotes are explained on the following page.

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

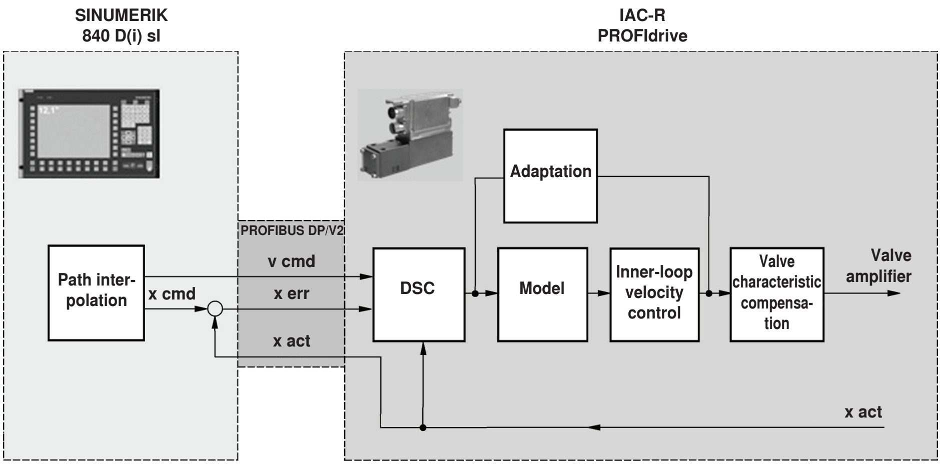
Electrical			
Relative duty cycle		%	100 (continuous operation)
Protection class			IP 65 according to EN 60529 with mounted and locked line connectors
Supply voltage	Nominal voltage	VDC	24
	Lower limit value	VDC	21
	Upper limit value	VDC	36
	Max. admissible residual ripple	Vpp	2 (at supply voltage of 23 V … 34 V)
Power consumption	Size 6	W	max. 40
	Size 10	W	max. 60
Protective earthing conductor and shielding			see pin assignment (CE-compliant installation)
Adjustment			Calibrated ex factory, see valve characteristic curve

[1] The cleanliness classes stated for the components need to be maintained in hydraulic systems.
Effective filtration prevents faults and at the same time increases the service life of the components.
For selecting the filters, see www.boschrexroth.de/filter

[2] Flow at different Δp: $q_x = q_{nom} \cdot \sqrt{\frac{\Delta p_x}{35}}$

3

Block diagram of the controller functionality



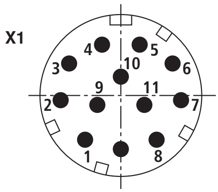
Electrical connections, assignment

Unit connector assignment X1, 11-pin + PE according to DIN EN 175201-804

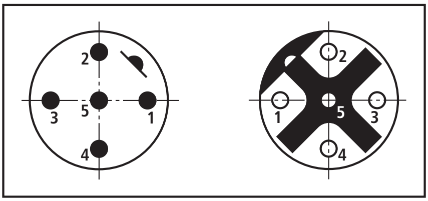
Pin	No. or Litz wire color[1]	Assignment interface A6/F6
1	1	24 VDC (supply for output stage and power switching signal)
2	2	0 V ≙ load zero (for output stage)
3	white	reserved
4	yellow	reserved
5	green	reserved
6	purple	reserved
7	pink	reserved
8	red	reserved
9	brown	24 VDC (supply for signal part and bus)
10	black	0 V reference potential for pin 9 (supply for signal part and bus)
11	blue	Switching output 24 V (error signal or power switching signal) max 1.8 A
PE	green-yellow	Protective earthing conductor (connected directly to metal housing)

Connect shield on PE only on the supply side!

[1] Litz wire colors of the connection lines for line socket (see accessories)



Unit connector assignment for PROFIBUS DP "X3" (code B), M12, 5-pin, socket / pins



Pin	Pinout of plug	Pinout of socket
1	n.c.	VP
2	RxD/TxD-N (A line)	RxD/TxD-N (A line)
3	DGND	DGND
4	RxD/TxD-P (B line)	RxD/TxD-P (B line)
5 [1]	Shield	Shield

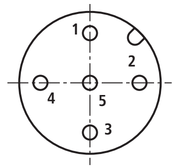
[1] We recommend connecting the shield on both sides via the metallic housing of the plug-and-socket-connectors. Using pin 5 will have adverse effects on the effectiveness of the shield!

The unit socket and the unit plug are equivalent as PROFIBUS connections.
The electrically isolated voltage +5 V (pin 1 - VP) at the socket allows for passive termination of the PROFIBUS.

Electrical connections, assignment

Analog sensor interfaces, connection "X4" and "X7" (code A), M12, 5-pin, socket

Pin	Pinout Voltage interface	Pinout Current interface
1	Supply 24 VDC	Supply 24 VDC
2	Signal 3 (X4) / 4 (X7), (–10 … +10 V)	Signal 3 (X4) / 4 (X7), (4 … 20 mA)
3	Zero 0 V	Zero 0V
4	Signal 1 (X4) / 2 (X7), (–10 … +10 V)	Signal 1 (X4) / 2 (X7), (4 … 20 mA)
5	Shield	Shield

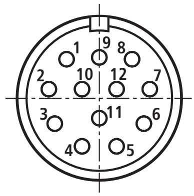


Note:

The analog sensor interfaces at the connections X4 and X7 are not coded. Danger of confusing the same! The user has to ensure proper wiring!

Digital sensor interface 1Vpp or SSI measurement system "X7", M23, 12-pin, socket

Pin	Pinout 1Vpp	Pinout SSI
1	$\overline{\text{B}}$	0 V
2	sense +5 V [1)]	Data
3	R	Clock
4	$\overline{\text{R}}$	n.c.
5	A	n.c.
6	$\overline{\text{A}}$	n.c.
7	n.c.	n.c.
8	B	n.c.
9	n.c.	24 V
10	0 V [1)]	$\overline{\text{Data}}$
11	Sense 0 V [1)]	$\overline{\text{Clock}}$
12	+5 V [1)]	n.c.

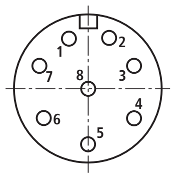


Note:

The sense signal is not evaluated.

Digitale Sensorschnittstelle EnDat 2.2 Messsystem „X7“, M12, 8-polig, Buchse

Pin	Belegung EnDat 2.2
1	0 V [2)]
2	+5 V [2)]
3	Data
4	$\overline{\text{Data}}$
5	0V [2)]
6	$\overline{\text{Clock}}$
7	Clock
8	supply +5 V [2)]



Note:

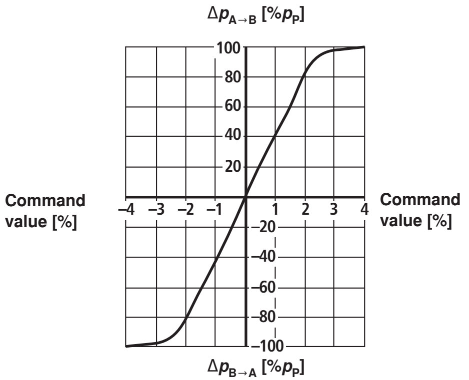
We recommend connecting the shields on both sides via the metallic housings of the plug-and-socket-connectors. Using connector pins will affect the effectiveness of the screen!
Internal shields are not required.

1) **Recommendation**: Connect the voltages +5 V (pin 12) and +5 V-Sense (pin 2), as well as 0 V (pin 10) and 0 V-Sense (pin 11) for transducer supply.

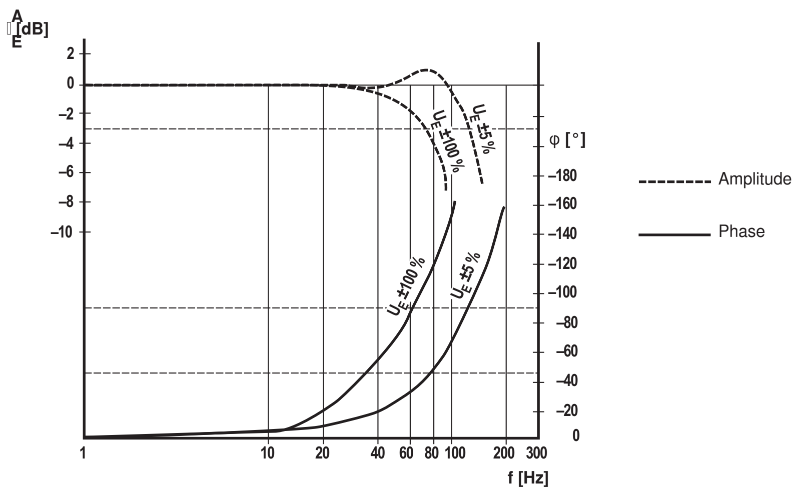
2) **Recommendation**: Connect the voltages +5 V (pin 2 and 8) as well as 0 V (pin 1 and 5) for transducer supply.

Characteristic curves size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Pressure gain



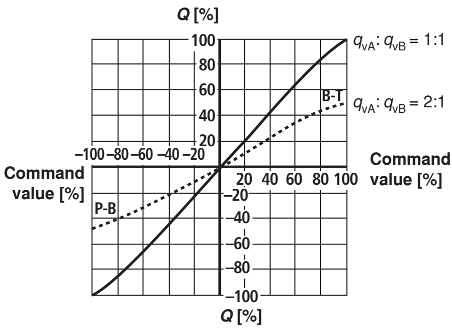
Bode diagram



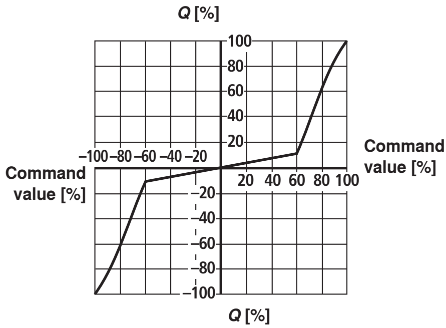
Characteristic curves size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow - signal function

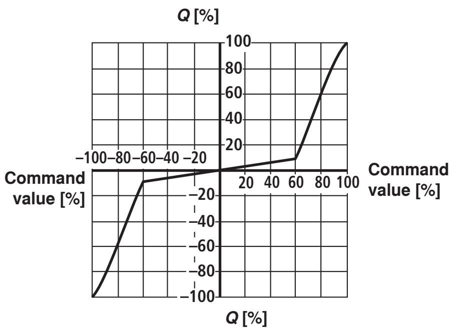
L: Linear



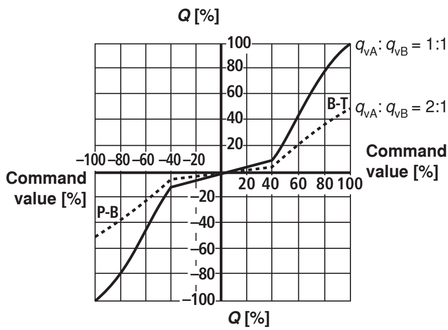
P: Inflection 60 %



P: Inflection 60 %



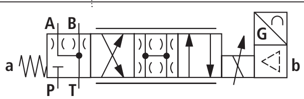
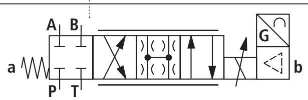
P: Inflection 40 %



Note:

Ex factory the inflection-compensation is activated at the valve electronics. In order that the P-characteristic curve appears linear.

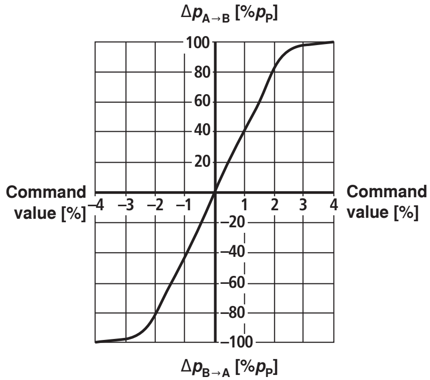
Fail-safe position

	Leakage oil at	100 bar	P → A	50 cm^3/min
			P → B	70 cm^3/min
	Flow at	Δp = 35 bar	A → T	10 ... 20 l/min
			B → T	7 ... 20 l/min
	Leakage oil at	100 bar	P → A	50 cm^3/min
			P → B	70 cm^3/min
			A → T	70 cm^3/min
			B → T	50 cm^3/min
Fail-safe	p = 0 bar => 7 ms	Shut-down U_B (output stage) X1 / pin 1+2		
	p = 100 bar => 10 ms			

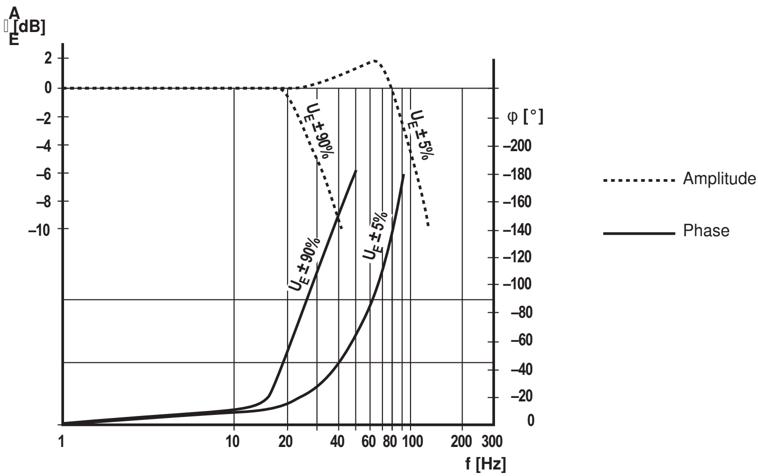
3

Characteristic curves size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Pressure gain



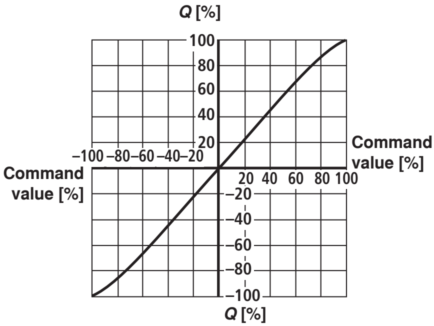
Bode diagram



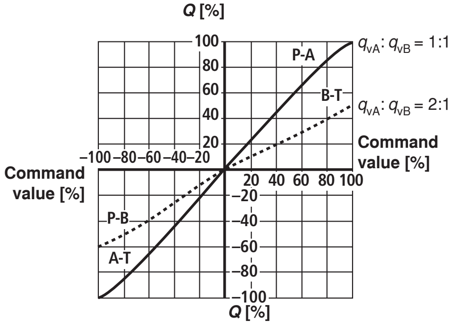
Characteristic curves size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow - signal function

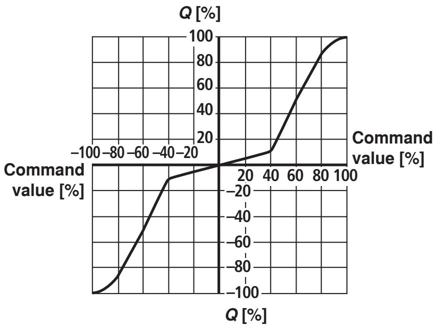
L: Linear 1:1



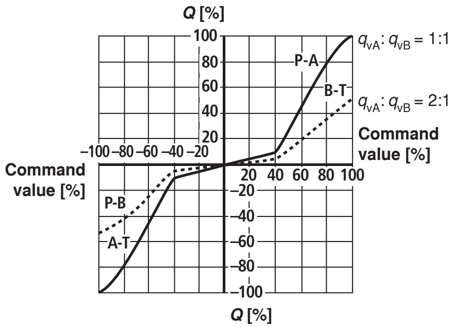
L: Linear 2:1



P: Inflection 40% 1:1

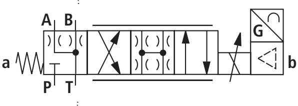
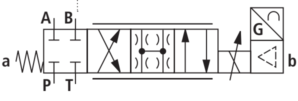


P: Inflection 40% 2:1



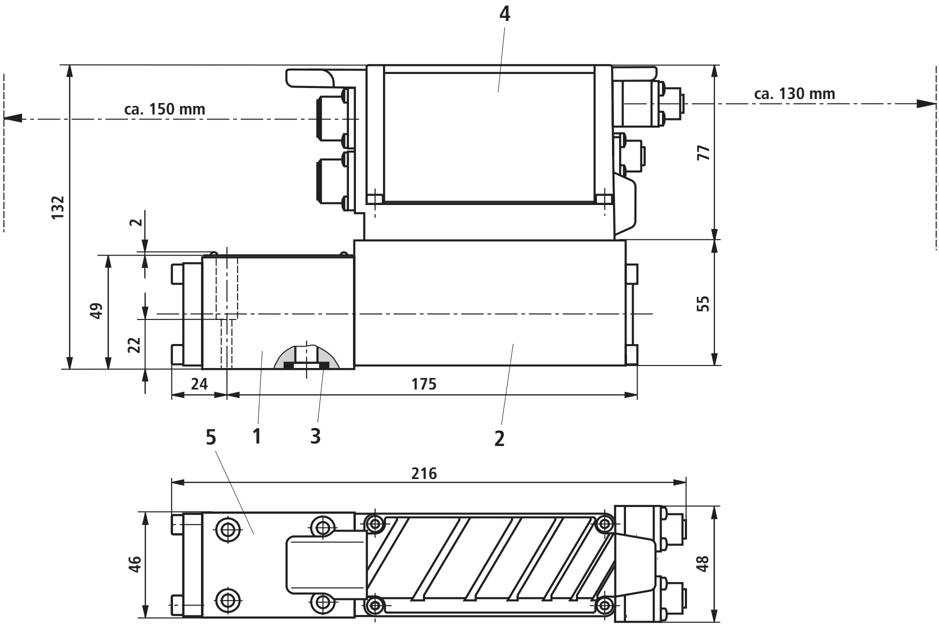
Note:
Ex factory the inflection-compensation is activated at the valve electronics. In order that the P-characteristic curve appears linear.

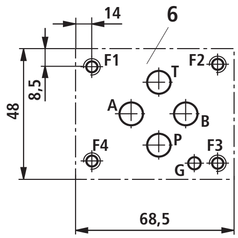
Fail-safe position

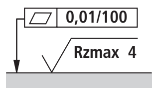
	Leakage oil at	100 bar	P → A	50 cm³/min
			P → B	70 cm³/min
	Flow at	Δp = 35 bar	A → T	10 ... 20 l/min
		q_n = 50/100 l/min	B → T	7 ... 20 l/min
	Leakage oil at	100 bar	P → A	50 cm³/min
			P → B	70 cm³/min
			A → T	70 cm³/min
			B → T	50 cm³/min

Fail-safe	p = 0 bar => 12 ms	Shut-down U_B (output stage) X1 / pin 1+2
	p = 100 bar => 16 ms	

Unit dimensions size 6 (dimensions in mm)







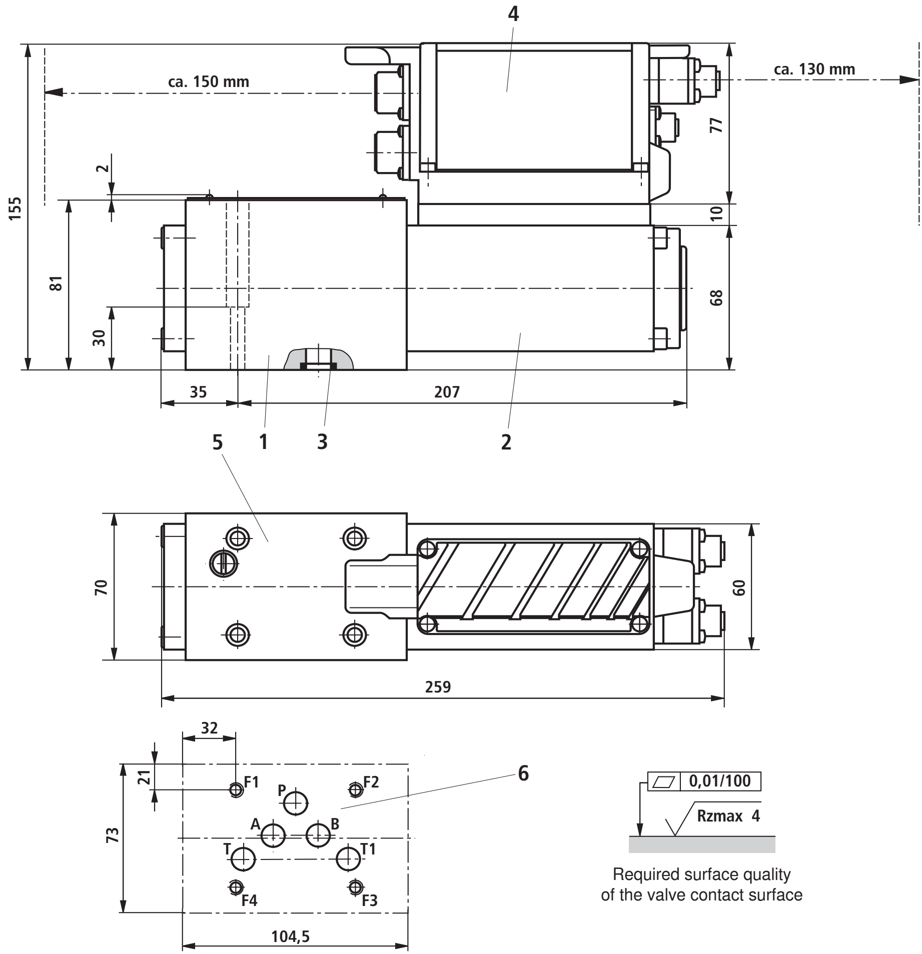
Required surface quality
of the valve contact surface

1. Valve housing
2. Control solenoid with position transducer
3. Identical seal rings for ports P, A, B, T
4. Integrated digital control electronics
5. Nameplate
6. Machined valve contact surface, position of the ports according to ISO 4401-03-02-0-05

Valve mounting screws
(not included in scope of delivery):

4 units of hexagon socket head cap screws according to ISO4762-M5x30-10.9-N67F 821 70
(galvanized according to Bosch standard N67F 821 70)
M_T = 6 +2 Nm
material no. **2910151166**

Unit dimensions size 10 (dimensions in mm)



Required surface quality
of the valve contact surface

1 Valve housing

2 Control solenoid with position transducer

3 Identical seal rings for ports P, A, B, T, T1

4 Integrated digital control electronics

5 Nameplate

6 Machined valve contact surface, position of the ports according to ISO 4401-05-04-0-05

Deviating from the standard:
– port T1 exists additionally

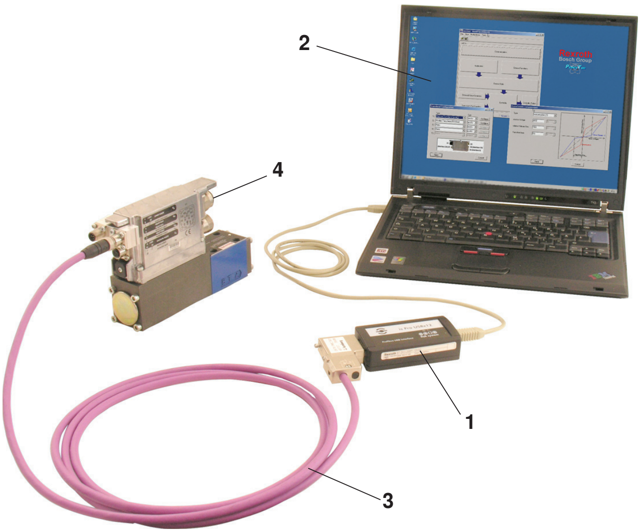
Valve mounting screws
(not included in scope of delivery):

4 units of hexagon socket head cap screws according to ISO4762-M6x40-10.9-N67F 821 70
(galvanized according to Bosch standard N67F 821 70)
M_T = 11 +3 Nm
material no. **2910151209**

3

Accessories for parameterization (not included in scope of delivery)

For parameterization using the PC, the following is required:	PROFIBUS DP (code B)
1 Interface converter (USB-PROFIBUS DP)	VT-ZKO-USB/P-1-1X/V0/0 Mat.no. **R901071962**
2 Start-up software	WinHPT (from version 2.1) Download at www.boschrexroth.com/IAC
3 Connecting cable, 3 m	D-Sub/M12, Mat.no. **R901078053**
4 24 V supply voltage	Mating connector for X1 (see below)

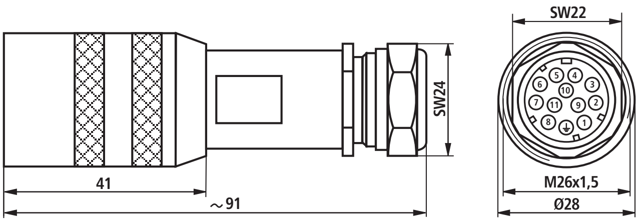


Accessories, port X1 (not included in the scope of delivery)

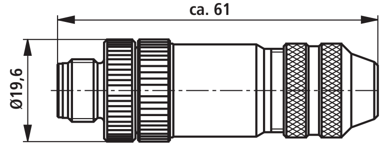
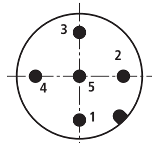
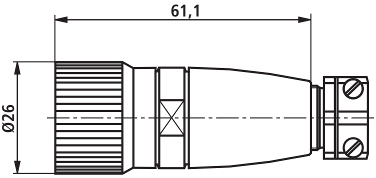
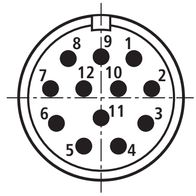
Mating connector for X1

Mating connector according to EN 175201-804 (12-pole, metal design)

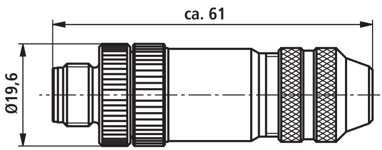
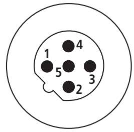
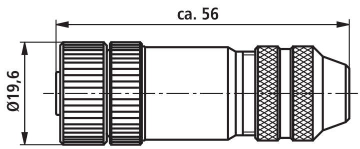
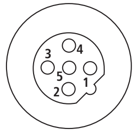
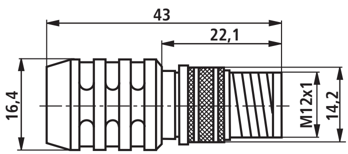
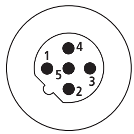
- Mating connector (construction set) for a cable diameter of 12-15 mm, Material no. **R901268000**
- Mating connector with 5 m cable, 12 x 0.75 mm^2 with cable shield, assembled, Material no. **R901272854**
- Mating connector with 20 m cable, 12 x 0.75 mm^2 with cable shield, assembled, Material no. **R901272852**



Accessories, sensor connections (not included in scope of delivery)

Description	View, dimensions	Pin pattern, order details
X4, X7 (analog sensors) Plug-in connector, 5-pole, M12 x 1, pins, A coding, metal design		 Mat. no.: **R901075542** (cable diameter 4 … 6 mm)
X7 (digital sensors, 1 Vpp and SSI) Plug-in connector, 12-pole, M23, pins, soldered joint, metal design with cap nut		 Mat. no.: **R901076284** (cable diameter up to 10.5 mm)

Accessories, PROFIBUS (B code) (not included in scope of delivery)

Description	Detail, dimensions	Pin pattern, order details
X3 Round connector, to be wired by user, 5-pin, M12 x 1 Straight line connector in metal design		 Material no.: **R901075545** (cable diameter 6 - 8 mm)
X3 Round connector, to be wired by user, 5-pin, M12 x 1 Straight mating connector from metal		 Material no.: **R901075550** (cable diameter 6 - 8 mm)
PROFIBUS terminating resistor Round plug-in connector, 5-pin, M12 x 1		 Material no.: **R901078086**

3

Project planning / maintenance instructions / additional information

Product documentation for IAC-R with clock-synchronized PROFIBUS DP/V2 (PROFIdrive profile)

- **Data sheet 29291** (this data sheet)
- **Declaration on environmental compatibility 29191-U**
- **Operating instructions 29291-B**
- **General Information on the Maintenance and Start-up of Hydraulic Components 07800 / 07900**

Commissioning software and documentation on the internet: www.boschrexroth.com/IAC

Mainenance notes:
- The devices have been tested in the factory and are supplied with default settings.
- Only complete units can be repaired. The repaired units will be supplied with default settings and current firmware. User-specific settings are not maintained. The operator will have to retransfer the corresponding user parameters.

Notes:
- Connect the valve to the supply voltage only when this is required for the functional processes of the machine.
- Electric signals brought out via control electronics (e.g. signal "ready for operation") may not be used for the actuation of safety-relevant machine functions! (see also the European standard "Safety requirements for fluid power systems and their components - Hydraulics", EN 982.)
- If electromagnetic interference must be expected, take appropriate measures to safeguard the function (depending on the application, e.g. shielding, filtering)!

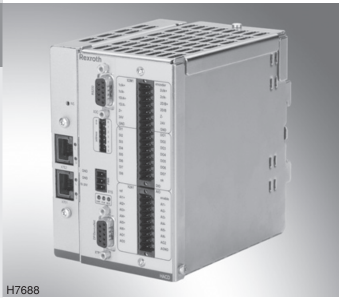
Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

Digital closed-loop control electronics

RE 30543/12.10
Replaces: 01.10

Type VT-HACD-3

Component series 2X



H7688

Table of contents

Features

- Use as **closed-loop control electronics** for closed control loops with PIDT1 controller and optional state feedback
- Substitutional closed-loop control (e.g. position control with superimposed pressure/force control) possible
- Use as **command value electronics** for generating, linking and standardizing signals
- Input for digital position measurement systems (2 x SSI or 1 x incremental)
- 6 analog inputs, voltage (±10 V, 0…10 V) and current (4…20 mA) selectable via software, input resistance of AI1 > 10 MΩ
- 3 analog outputs, 1x selectable voltage (±10 V, 0…10 V) or current (0…20 mA, 4…20 mA), 2x voltage (±10 V)
- Numerous possibilities of signal linking and switch-over
- Release input and OK output
- 8 digital inputs
- 7 digital outputs, configurable
- Parameterizable ramp function
- 32 blocks with command values, velocities and controller parameters
- Adjustment to hydraulic drive by means of area adjustment, characteristic curve correction, overlap compensation, residual velocity logic and zero point correction
- +10 V reference voltage output
- Serial interface RS232
- Up to 32 electronics can be interconnected for parameterization and diagnosis via the local bus

Fields of application

- Machine tools
- Plastics processing machines
- Special machines
- Presses
- Transfer systems

Technology functions

- Sequence parameterization
- Positioning
- Pressure control
- Force control
- Tables

Hydraulic axes

- Measurement system:
  • Incremental or absolute (SSI, Gray, Binary)
  • Analog 0 to ±10 V and 0(4) to 20 mA
- Actuating variable output voltage or current
- Freely configurable controller variants
  • Position/pressure/force/velocity controller
  • Substitutional closed-loop control (position/pressure)

Programming

- User programming using a PC

Operation

- Comfortable administration of the machine and measuring data on a PC

Process connection

- Digital inputs and outputs,
- Analog inputs and outputs,
- PROFIBUS DP to communicate with a superior control
- EtherNet/IP
- PROFINET RT

Installation

- Top hat rail 35 mm

CE conformity

- EMC directive 2004/108/EC
  Applied harmonized standards:
  EN 61000-6-2:2005
  EN 61000-6-3:2007

More information

www.boschrexroth.com/hacd

Ordering code

VT-HACD – 3 – 2X / 0 / I – 00 – 000

Digital closed-loop control electronics

Standard **= 3**

Component series 20 to 29 **= 2X**
(20 to 29: unchanged technical data and pinout)

Options

Hardware marking

Position transducer
I = Incremental/SSI

Bus system
0 = Without bus
P = PROFIBUS DP
Ethernet-based:
N = ROFINET RT
E = EtherNet/IP

Included within the scope of delivery:
Mating connector for
– Port X1S (Phoenix Mini Combicon 3-pole)
– Port X2A1 (Weidmüller B2L 3.5/18 LH SN SW)
– Port X2M1 (Weidmüller B2L 3.5/30 LH SN SW

Recommended accessories (can be ordered separately)

Description	Material number
Interface cable RS232, length 3 m	**R900776897**
USB-RS232 converter	**R901066684**
Plug-in connector type 6ES7972-0BA41-0XA0 for PROFIBUS DP	**R900050152**
CD with BODAC software SYS-HACD-BODAC-01/	**R900777335**

Software project planning

Project planning

The creation of a parameter file forms the basis for the function of the HACD. The parameter file contains the block structure of the HACD in which the links of the variables will be created. The parameter files are created in BODAC. The parameter file can be created offline and transferred to the HACD by means of a PC.

This software project planning is implemented according to the following steps:

1. Selection of the HACD.
2. Application is defined by means of the block structure.
3. Setting of the parameter values (sensors, controllers...).
4. The data is sent to the HACD.
5. Storage of the data in the flash.
6. The setting and the machine sequence are optimized at the machine.

PC program BODAC

For the implementation of the project planning tasks, the BODAC PC program is available to the user. It serves the programming, setting, and diagnosis of the HACD.

Scope of services:

– Comfortable dialog functions for setting the machine data online or offline
– Dialog window for setting the parameter values online
– Comprehensive options for displaying process variables, digital inputs, outputs, and flags
– Recording and graphical presentation of up to eight process variables with great selection of trigger options

PC-System requirements:

– Windows XP, Windows Vista, Windows 7
– Random access memory (256 MB recommended)
– 250 MB free hard disk capacity

Note:

The BODAC PC program is **not** included in the scope of delivery. It can be downloaded in the Internet free of charge!

Download in the Internet: www.boschrexroth.com/hacd

Inquiries: support.hacd@boschrexroth.de

Overview of the controller functions

Position controller:
- PDT1 controller
- Linear amplification characteristic curve
- Direction-dependent gain adaptation
- Gain modification via the program possible
- Adaptation of the valve characteristic curve
- Fine positioning
- Residual voltage principle
- Compensation of zero point errors
- State feedback via
  - Pressure
  - Pressure differential
  - Position
- Command value provision

Pressure/force controller:
- PIDT1 controller
- I component switchable via window
- Pressure differential analysis
- Command value provision

Velocity controller:
- PI controller
- I component switchable via window

Monitoring functions:
- Dynamic tracking error monitoring
- Cable break monitoring for incremental and SSI encoder
- Cable break monitoring for sensors
- Cable break monitoring for analog signals

Functional description

The VT-HACD-3-2X closed-loop control electronics is a module that is installed on a top hat rail.

A microcontroller controls the entire process, makes adjustments, establishes links and realizes the closed control loops. Data for configuration, command values and parameters are stored in a FLASH in a non-volatile form.

The entire configuration and the parameterization and diagnosis are carried out via the BODAC PC program. Apart from the switches for the address setting, the module does not contain any other hardware switches. For the configuration, the HACD has to be connected to a PC via a serial interface (RS 232, 1:1 cable).

The configuration and thus the creation of applications are very simple - you just have to link pre-defined functional components. For this purpose, no programming knowledge is necessary.

One mode is available:

- **Structural editor**
  Own motion sequences can be created. For this purpose, 32 blocks are available. Each block contains: Command value, ramp times (velocity ±, acceleration ±) and controller parameters.

  Blocks are activated by setting trigger conditions: Setting digital inputs, comparing signals with freely definable thresholds or expiry of waiting periods.

Signal links [6] [8] [17]

The HACD offers numerous possibilities for linking signals on the input and on the output side, whereas it is in each case possible to link 2 signals. This includes functions like addition, subtraction, multiplication, division as well as minimum/maximum value generator, area ratio and limiter:

+ = Addition: Z = X + Y

– = Subtraction: Z = X – Y

* = Multiplication: Z = X * Y / 100

/ = Division: Z = X / Y * 100

MIN = Minimum value generator: Z = MIN (X, Y)

MAX = Maximum value generator: Z = MAX (X, Y)

RATIO = Entry of a ratio:
for RATIO >1: Z = X * RATIO – Y
for RATIO <1: Z = X – Y / RATIO
(e.g. area ratio with pressure differential measurement)

LIMIT = Signal limiter: Z = MIN (|X|, |Y|) * sign (X)

JUMP = Jump generator: Z = MAX (|X|, |Y|) * sign (X)

with Z … Result
X … 1st signal
X … 2nd signal

T1 Lag = Low-pass filter

Analog I/O [1] [15]

For the 6 analog inputs, you can switch between ±10 V, 0…10 V, 0…20 mA by means of the software.

For the analog output AO1, you can switch between ±10 V, 0…10 V, 0…20 mA and 4...20 mA by means of the software.

AO2 and AO3 are fixedly set to ±10 V.

The switching is performed by utilizing the whole range of the analog-digital converter.

For all analog inputs, working range and error detection can be defined.

The analog outputs can be adjusted by means of amplification and offset.

Digital I/O [3] [16]

The HACD has 9 digital inputs and 8 digital outputs.

An input has the fix functionality Release, a digital output the fixed functionality OK.

The other digital inputs are used for triggering blocks (see blocks and triggering).

The function of each digital output can be determined by means of selection from a pre-defined list:

- Command value = Actual value
- Actual value larger or smaller than an adjustable threshold
- Waiting period expired
- Ramp active
- Internal flag set
- Error flag set
- Table ended
- Error status
- Block timeout
- Controller active
- Absolute value (actual value) < window
- Absolute value (command value) < window
- Incremental home position

[ ] = Assignment to the block diagram on page 8/9

Functional description (continued)

Digital position measurement system

When using the VT-HACD-3-2X as closed-loop control electronics, digital position measurement systems of type SSI or incremental can be used for recording the actual value.

Limitations of use incremental encoder

The maximum frequency of the incremental encoder input (f_G) of the HACD is 250 kHz. The maximum travel velocity of the drive, the resolution (res) of the encoder system used and the possible signal analysis by an EXE (interpolation and digitalization electronics) determine the frequency.

Determination formulae

Encoder resolution with given maximum velocity:

$$\text{Res } [\mu m] \geq \frac{v\left[\frac{m}{s}\right] \times 10^3}{f_G \text{ [kHz]} \times \text{EXE}}$$

Velocity with given encoder resolution:

$$v\left[\frac{m}{s}\right] \leq \frac{\text{Res } [\mu m] \times \text{EXE} \times f_G \text{ [kHz]}}{10^3}$$

Controller

If the HACD is used as closed-loop control electronics, the “Controller” entry has to be selected in the signal linking [8].

The LCx signals constitute the command value branch, the LFBx signals the actual value branch. [8]

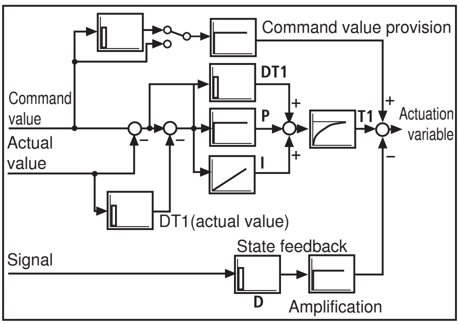
As actual value signal, you can use both, an SSI encoder or incremental encoder [2] digital measurement system or one or several analog sensors.

The controller structure is designed as PIDT1 controller, whereas each component can be activated or deactivated individually. In this way, you can, e.g. also realize a P or PT1 controller. The I component can moreover be controlled via a window (upper and lower limit).

Controller parameters can be set in a block-wise or in a block-independent form.

A state feedback can be used for dampening the controller output.

Controller structure:



Adjustment to hydraulic system

For the optimum adjustment to the particularities of hydraulic drives, the following functions are implemented upstream the analog output:

- Direction-dependent gain [10]
  For positive and negative values, the amplification can be set separately. In this way, adjustment to the area ratio of a single-rod cylinder is possible.
- Characteristic curve correction [11]
  In this way, the progressive flow characteristic of proportional directional valves is compensated or an inflected characteristic curve is realized.
- Overlap jump/residual velocity [12]
  When using valves with positive overlap, a fine positioning can be used in case of a PDT1 controller in order to increase the static accuracy. This fine positioning can be selected according to the residual voltage principle and as overlap jump.
- Zero point correction (offset) [13]
  Serves the correction of the zero point of the connected proportional servo valve.

Error detection and troubleshooting

The HACD supports numerous error monitoring possibilities:

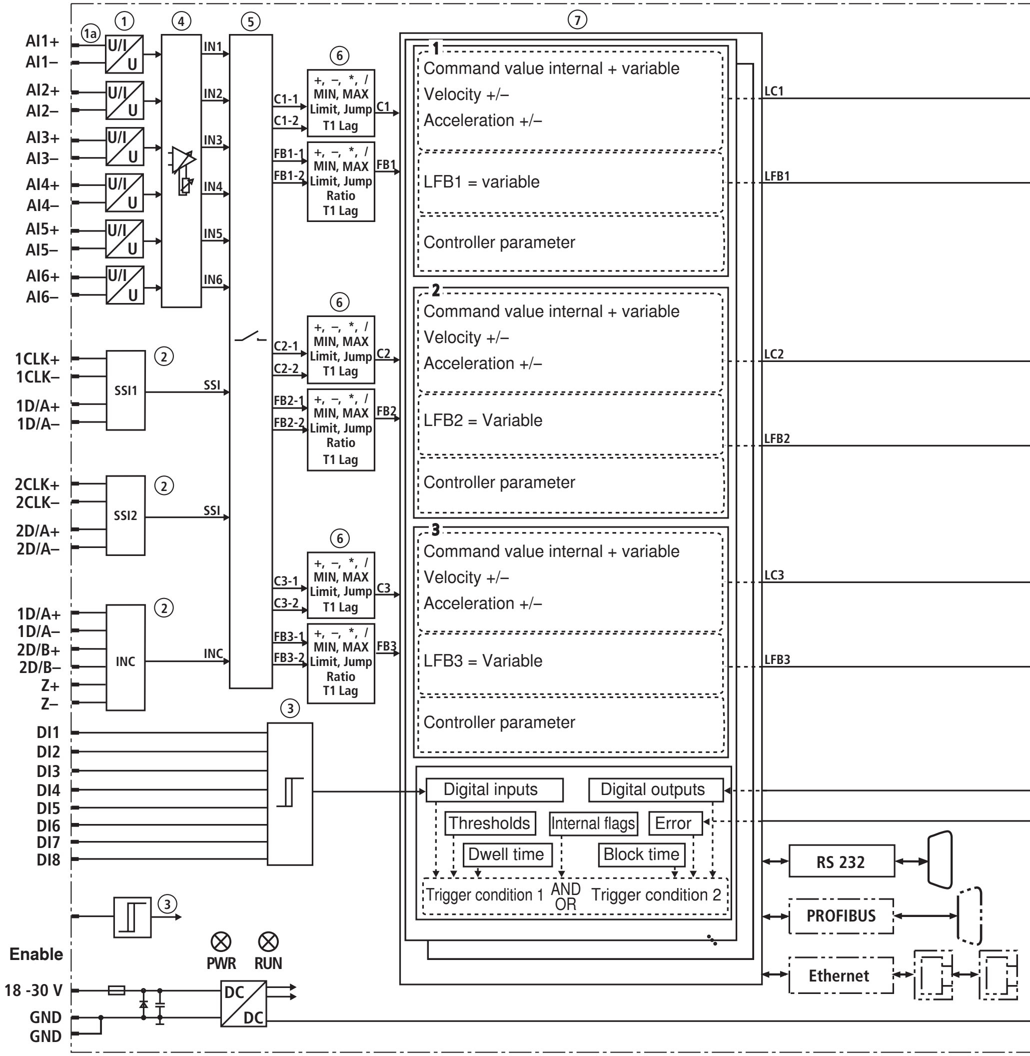
- Monitoring of the analog inputs for undershooting or exceedance of the range
- Monitoring of the sensors for cable break
- Control error monitoring in case of configuration of the HACD as controller
- Monitoring of the supply voltage, all internal voltages as well as of the +10 V reference voltage
- Monitoring of the microcontroller itself (watchdog) as well as of the accumulator (check sum)

The error monitors as well as their reaction can be configured, as well.

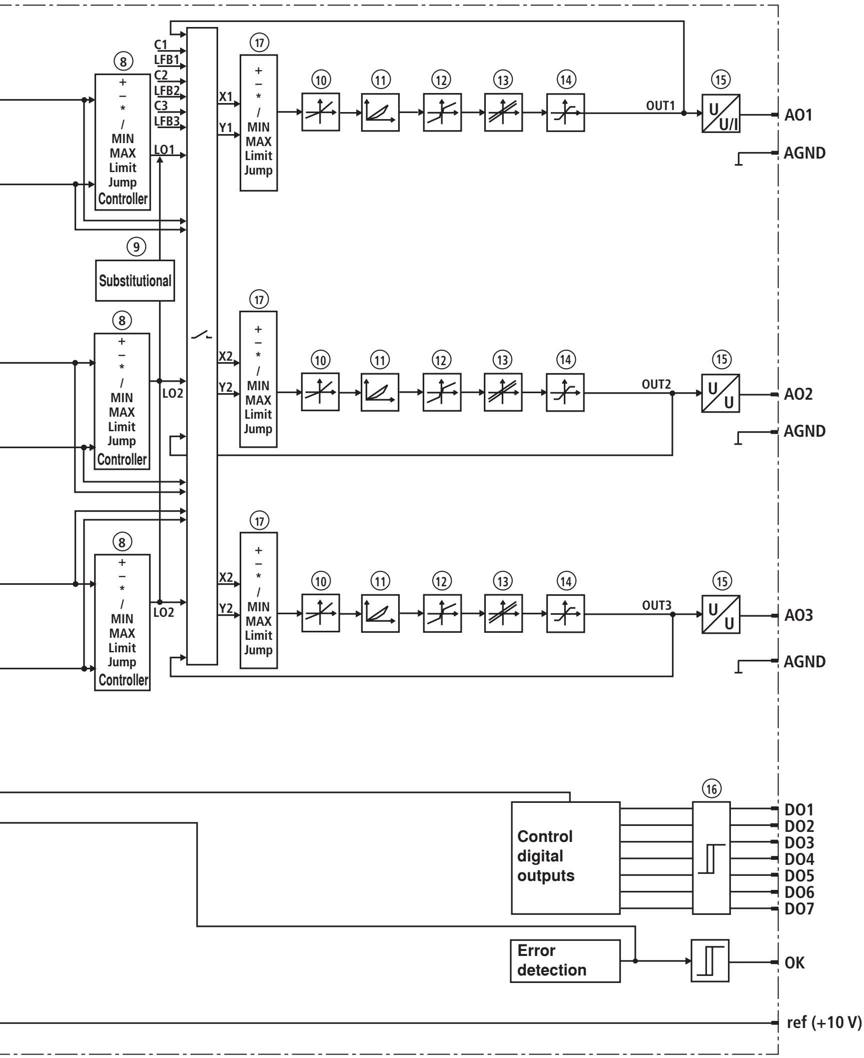
[ ] = Assignment to the block diagram on page 8/9

3

Block diagram: Mode 3 - structural editor



1 Analog inputs voltage or current
1a High-impedance input AI1
2 SSI or incremental
3 Release input and digital inputs
4 Adjustment analog inputs
5 Switching matrix
6 Math. linking of the inputs
7 32 blocks for command value generation, controller parameter switching
8 Math. linking and/or controller
9 Substitutional closed-loop control
10 Direction-dependent gain
11 Characteristic curve adjustment

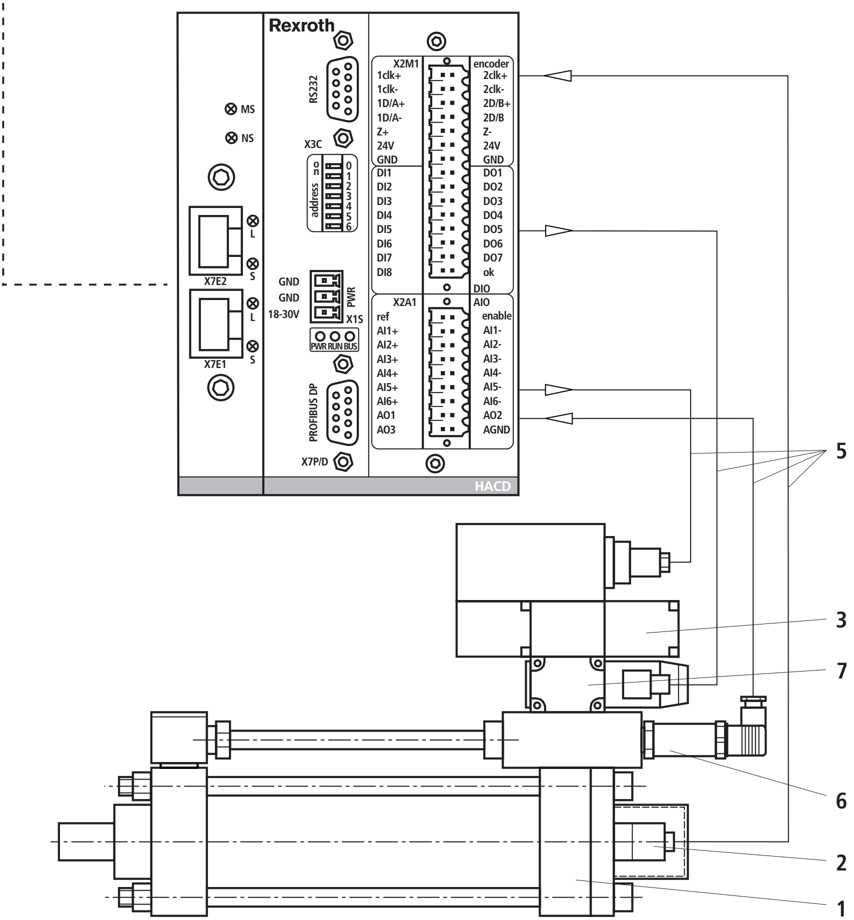


12 Residual velocity and overlap jump
13 Offset
14 Limitation
15 Analog outputs voltage or current
16 OK output and digital outputs
17 Math. linking of the outputs

System overview, interfaces

Superior control
Possible interfaces with the VT-HACD-3-2X:
- Analog signals
- Digital inputs / outputs
- Serial interface
- Bus systems

Example:
VT-HACD-3-2X/… with hydraulic cylinder axis



1 Single-rod cylinder
2 Integrated position measurement system
3 Proportional servo valve with integrated control electronics
4 VT-HACD-3-2X
5 Connection cable
6 Pressure transducer
7 Sandwich plate isolator valve (with plug-in switching amplifier)

Technical data

Operating voltage [1)]	U_B	18 to 30 VDC
Current consumption at 24 VDC		200 mA (observe additional power for connected sensors/actuators)
Processor		32 bit power PC
Analog inputs (AI)	Quantity	6
– Voltage inputs (differential inputs)		
• Channel number		max. 6 (selectable via software)
• Input voltage	U_E	max +15 V to –15 V (+10 V to –10 V analyzable)
• Input resistance	R_E	> 10 MΩ (AI1) 200 kΩ ±5 % /AI2 to AI6)
• Resolution		5 mV
• Non-linearity		±0.25 %
• Calibration tolerance		max. 40 mV (with factory settings)
– Current inputs		
• Channel number		max. 6 (selectable via software)
• Input current	I_E	0...20 mA
• Leakage current	I_V	0.1 to 0.4 %
• Resolution		5 μA
Analog outputs	Quantity	3
AO1 configuration as voltage output		
Output voltage	U	0…10 V or ±10 V (configurable)
Output current	I_{max}	10 mA
Load	R_{Lmin}	1 kΩ
Resolution		1.25 mV (14 bit)
Residual ripple		±15 mV (without noise)
AO1 configuration as current output		
Output current	I	0…20 mA or 4…20 mA (configurable)
Load	R_{max}	500 Ω
Resolution		1.25 μA
Residual ripple		±15 μA (without noise)
AO2 / AO3		
Output voltage	U	±10 V
Output current	I_{max}	10 mA
Load	R_{min}	1 kΩ
Resolution		1.25 mV (14 bit)
Residual ripple		±25 mV (without noise)

1) If a 24 V encoder supply is implemented directly via the VT-HACD-3-2X (supply voltage is looped in), the transducer specification has to be observed.

3

Technical data, (continued)

X3C, Interface for BODAC X7P, Bus interface X7E1(2), Ethernet interface		RS232 PROFIBUS DP (max. 12 MBaud according to IEC 61158) PROFINET RT, EtherNet/IP
Switching inputs (DI) and/or outputs (DO)		
	Quantity	DI = 9 / D0 = 8
Gate inputs (DI)	Logic level	log 0 (low) ≤ 5 V; log 1 (high) ≥ 10 V to U_B, I_e = 7 mA at U_B = 24 V
	Port	Flexible conductor up to 1.5 mm²
Gate outputs (DO)	Logic level	log 0 (low) ≤ 2 V; log 1 (high) ≤ U_B; I_{max} = 20 mA, Maximum load capacity C = 0.047μF
	Port	Flexible conductor up to 1.5 mm²
Reference potential for all signals		GND
Digital position transducer (encoder)		
– Incremental transducer (transducer with TTL output)		
• Input voltage	log 0	0 to 1 V
	log 1	2.8 to 5.5 V
• Input current	log 0	–0.8 mA (with 0 V)
	log 1	0.8 mA (with 5 V)
• max. frequency referring to Ua1	f_{max}	250 kHz
– SSI transducer (Due to the higher control quality, an SSI transducer with clock synchronization should be used.)		
• Coding		Gray code, binary code
• Data width		Adjustable up to max. 28 Bit
• Line receiver / line driver		RS485
– Voltage supply for SSI transducer via the VT-HACD-3-2X	*U, I*	U_B, **max. 200 mA**
Reference potential for all signals		GND
Reference voltage per axis electronics	U_{ref}	+10 V ±25 mV (20 mA)
Dimensions		See page 14
Installation		Top hat rail TH 35-7.5 or TH 35-15 according to EN 60715
Admissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Protection class according to EN 60529:1991		IP 20
Weight		
without EtherNet module	*m*	930 g
with EtherNet module	*m*	1162 g
CE conformity		See page 2

Further technical details upon request.

Note:

Information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load see data sheet 30543-U.

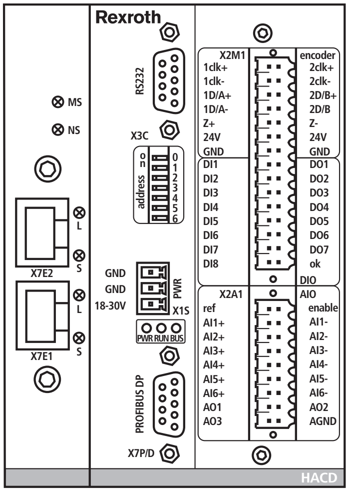
Pinout

X3C	RS232
Pin	
1	LCAN_H
2	TxD
3	RxD
4	Reserved
5	GND
6	Reserved
7	Reserved
8	Reserved
9	LCAN_L

X1S	Power
Pin	
1	GND
2	GND
3	18 – 30 V

X7P PROFIBUS DP	
Pin	
1	Reserved
2	Reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	Reserved
8	RxD/TxD-N
9	Reserved

X7E1, X7E2
Ethernet ports



X2M1	Encoder/DIO (digital)
1clk+	2clk+
1clk–	2clk–
1D/A+	2D/B+
1D/A–	2D/B–
Z+	Z–
24V	24V
GND	GND
DI1	DO1
DI2	DO2
DI3	DO3
DI4	DO4
DI5	DO5
DI6	DO6
DI7	DO7
DI8	ok

X2A1	AIO (analog)
Ref	Enable
AI1+	AI1–
AI2+	AI2–
AI3+	AI3–
AI4+	AI4–
AI5+	AI5–
AI6+	AI6–
AO1	AO2
AO3	AGND

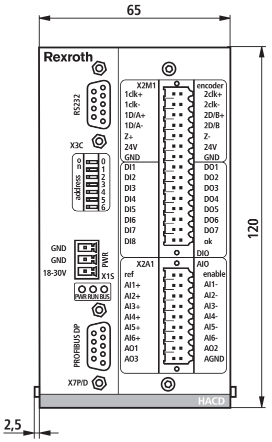
Notes:

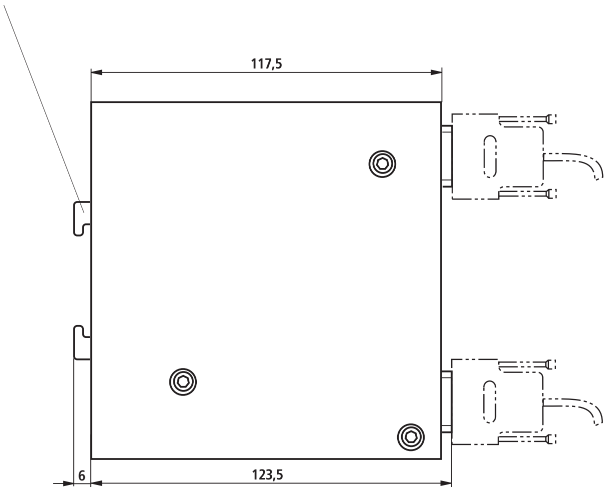
- The pins marked with **"reserved"** are reserved and must not be wired!
- PROFIBUS DP (port X7P/D) is not available with the Ethernet version.

Unit dimensions (dimensions in mm)

VT-HACD-3-2X/ (without Ethernet)

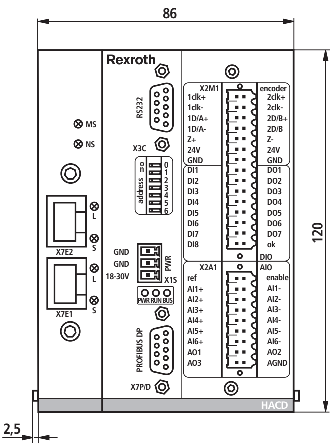
Installation on top hat rail TH 35-7.5 or TH 35-15 according to EN 60715

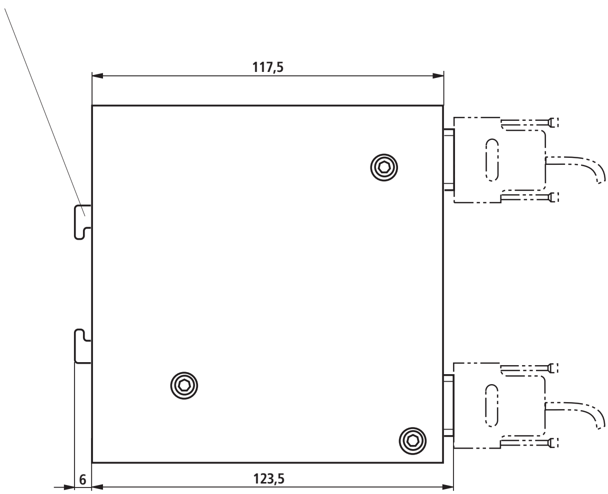




VT-HACD-3-2X/ (with Ethernet)

Installation on top hat rail TH 35-7.5 or TH 35-15 according to EN 60715





Project Planning / Maintenance Instructions / Additional Information

Product documentation for VT-HACD-3-2X

Data sheet 30543

Operating instructions 30543-B

Environmental compatibility statement 30543-U

BODAC software description 30543-01-B

Start-up PROFIBUS Interface 30543-01-Z

Start-up EtherNet/IP Interface 30543-04-Z

Start-up PROFINET RT Interface 30543-05-Z

General Information on the maintenance and commissioning of hydraulic components 07800/07900

Commissioning software and documentation on the Internet: www.boschrexroth.com/HACD

Maintenance instructions:

- The devices have been tested in the plant and are supplied with default settings.
- Only complete units can be repaired. The repaired units will be supplied with default settings. User-specific settings are not maintained. The operator will have to re-transfer the corresponding user parameters and programs.

Notes:

- Electric signals taken out via control electronics (e.g. signal “No error”) may not be used for the actuation of safety-relevant machine functions! (See also the European standard “Safety requirements for fluid power systems and their components - Hydraulics”, EN 982.)
- If electromagnetic interference must be expected, take appropriate measures to safeguard the function (depending on the application, e.g. screening, filtration)!
- For more information refer to the BODAC software description 30543-01-B and the 30543-B operating instructions
- The upper and lower ventilation slots must not be concealed by adjacent units in order to provide for sufficient cooling.

Notes

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Phone +49 (0) 93 52 / 18-0
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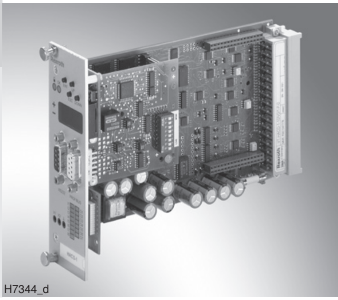
documentation@boschrexroth.de
www.boschrexroth.de

Digital command value and controller card

RE 30143/04.12
Replaces: 06.08

Type VT-HACD-1

Component series 1X



H7344_d

Table of contents

Features

- Use as **command value card** for generating, linking and standardizing signals
- Use as **controller card** for closed control loops with PIDT1 controller and optional state feedback
- Substitutional closed-loop (e.g. position control with superimposed pressure/force control) possible
- Input for digital measuring system SSI and incremental
- 6 analog inputs, voltage (±10 V, 0…10 V) and current (4…20 mA) selectable
- 3 analog outputs, 1x switchable voltage (±10 V, 0…10 V) or current (0…20 mA, 4…20 mA), 1x voltage (±10 V)
- Various possible signal linking and switch-over options
- Enable input and OK output
- 8 digital inputs
- 7 digital outputs, configurable
- Parameterizable ramp function
- 32 blocks with command values, velocities and controller parameters
- Adjustment to hydraulic drive by means of area adjustment, characteristic curve correction, overlap compensation, residual velocity logic and zero point correction.
- ±10 V reference voltage output
- Front display with keys for parameter display and modification as well as diagnosis
- Serial interface RS232
- Up to 32 cards can be interconnected for parameterization and diagnosis via the local bus
- Configurable analog output (A03) led onto connector strip
- PROFIBUS DP, PROFIBUS DP in Motorola format, DeviceNet or CANopen for the communication with a superior control (For CANopen, there is no standard EDS file available as the data is transmitted by the CANopen PDOs.)

Ordering code

VT-HACD – 1 – 1X / V0 / 1 – –

Digital command value and controller card

Standard command value and controller card **= 1**

Component series 10 to 19 **= 1X**
(10 to 19: Unchanged technical data and pin assignment)

0 = without valve output stage
1 = with valve output stage for 4WRE, component series 2X with two solenoids (only in connection with PROFIBUS)

0 = without bus connection
P = PROFIBUS DPV0
D = DeviceNet
C = CANopen

1 = with display

V0 = Basic device

Required accessories:

- PC program BODAC: CD ordering information: SYS-HACD-BODAC-01 (R900777335) or free download on the Internet at www.boschrexroth.com/hacd
- Interface cable: Cable set VT-HACD-1X/03.0/HACD-PC (R900776897) or standard 1:1 cable
- Optionally available USB adapter VT-ZKO-USB/S-1-1X/V0/0
- Plug-in connector type 6ES7972-0BA42-0XA0 for PROFIBUS DP, mat. no. R901312863

Suitable card holder:

- 19 inch racks VT 19101, VT 19102, VT 19103 and VT 19110 (see data sheet 29768)
- Closed card holder VT 12302 (see data sheet 30103), mat. no. R900784153
- Open card holder VT 3002-2X/64G (see data sheet 29928), mat. no. R900991843 (only for control cabinet installation)
- Connection adapter VT 10812-2X/64G (see data sheet 30105), mat. no. R900713826

Software project planning

Project planning

The creation of a parameter file forms the basis for the function of the HACD. The parameter file contains the block structure of the HACD in which the links of the variables will be created. The parameter files are created in BODAC. The parameter file can be created offline and transferred to the HACD by means of a PC.

Proceed as follows for this software project planning:

1. Selection of the HACD.
2. Application is defined by means of the block structure.
3. Setting of the parameter values (sensors, controllers...).
4. The data is sent to the HACD.
5. Storage of the data in the flash.
6. The setting and the machine sequence are optimized at the machine.

PC program BODAC

The user can use the BODAC PC program for the implementation of project planning tasks. BODAC can be used for the programming, setting and diagnosis of the HACD.

Scope of services

– Convenient dialog functions for the online or offline setting of the machine data
– Dialog window for the online setting of the parameter values
– Comprehensive options for displaying process variables, digital inputs, outputs, and flags
– Recording and graphical presentation of up to eight process parameters with a great choice of trigger options

PC system requirements

– Windows XP, Windows Vista, Windows 7
– Memory usage 64 MB typical
– 250 MB of available hard disk capacity

Notice:

The BODAC PC program is not included in the scope of delivery. It can be downloaded on the Internet free of charge.

Download on the Internet: www.boschrexroth.com/hacd

Enquiries: support.hacd@boschrexroth.de

Service interface

– RS 232

Process connection

– PROFIBUS DP, PROFIBUS DP in Motorola format, CANopen for the communication with a superior control (for CANopen, there is no standard EDS file available)

More information

www.boschrexroth.com/hacd

Functional description

The command value and controller card VT-HACD-1 is set up as printed circuit board in Europe format 100 x 160 mm, fitted on both sides.

A microcontroller controls the entire process, makes adjustments, establishes links and realizes the closed control loops. Data for configuration, command values and parameters are stored in a FLASH in a non-volatile form.

The complete configuration is made by means of software, the card does not comprise jumpers or the like. For the configuration, the VT-HACD has to be connected to a PC via a serial interface (RS 232, 1:1 cable). The BODAC user interface is used for the entire configuration and also for the parameterization and diagnosis.

The configuration and thus the creation of applications are very simple - you just have to link pre-defined functional components. For this purpose, no programming knowledge is necessary.

2 different modes are available:

- **Mode 1** (not bus-enabled) **– Block calls (condition as supplied)**
  The 32 blocks can be called via the binary combination of the digital inputs DI1…DI5 + DI6 as "binary enable". This mode is functionally compatible with VT-SWKD.
- **Mode 3** (bus-enabled) **– Structural editor**
  The structural editor is unlocked. Own motion sequences can be established. For this purpose, 32 blocks are available. Every block comprises: Command value, ramp times, (velocity +, velocity –, S share) and controller parameters.

  Blocks are activated by setting trigger conditions: Setting digital inputs, comparing signals with freely definable thresholds or expiry of waiting periods.

You can change to another mode by simply saving a corresponding parameter set which is included in the BODAC scope of delivery.

Signal linking

The VT-HACD has various signal linking options both for the input and the output side, whereas 2 signals each can be linked. These are functions such as addition, subtraction, multiplication, division as well as minimal/maximal value generator, area ratio and limiter:

+ = addition: Z = X + Y

– = subtraction: Z = X – Y

* = multiplication: Z = X * Y / 100

/ = division: Z = X / Y * 100

MIN = minimum value generator: Z = MIN (X, Y)

MAX = maximum value generator: Z = MAX (X, Y)

RATIO = ratio input:
For RATIO >1: Z = X * RATIO – Y
For RATIO <1: Z = X – Y / RATIO
(e.g. area ratio for differential pressure measurement)

LIMIT = signal limiter: Z = MIN (|X|, |Y|) * X / |X|

JUMP = jump generator: Z = MAX (|X|, |Y|) * X / |X|

with Z … result
X … 1st signal
Y … 2nd signal

Analog I/O

For the 6 analog inputs, you can switch between ±10 V, 0…10 V, 0…20 mA and 4...20 mA by means of the software.

For the analog output AO1, you can switch between ±10 V, 0…10 V, 0…20 mA and 4...20 mA by means of the software. AO2 is fixedly set to ±10 V. A03 can be configured by means of software and is e.g. suitable for diagnosis purposes.

The output is switched so that the whole range of the analog-digital connector is used.

Both working range and error identification can be defined for all analog inputs.

The analog outputs can be adjusted by means of amplification and offset.

Digital I/O

The VT-HACD has 9 digital inputs and 8 digital outputs.

An input has the fix functionality Enable, a digital output the fixed functionality OK.

Further digital inputs are used for the triggering of blocks (see blocks and triggering).

The function of each digital output can be determined by the selection from a predefined list:

- Command value = actual value
- Actual value higher or lower than the adjustable threshold
- Waiting time completed
- Ramp active
- Internal flag set
- Error flag set

Functional description (continued)

Digital position measurement system

If you use the VT-HACD as controller card, digital position measurement systems of type SSI or incremental can be used for actual value collection.

Limitations of use for the incremental encoder

The maximum frequency of the incremental encoder input (f_G) of the VT-HACD is 100 kHz. The maximum travel velocity of the drive, the resolution (res) of the encoder system used and the possible signal evaluation by EXE (interpolation and digitalization electronics) determine the frequency.

Determination formulas

Encoder resolution at given maximum velocity:

$$\text{Res}\ [\mu m] \geq \frac{v \left[\frac{m}{s}\right] \times 10^3}{f_G\ [kHz] \times EXE}$$

Velocity at specified encoder resolution:

$$v \left[\frac{m}{s}\right] \leq \frac{\text{Res}\ [\mu m] \times EXE \times f_G\ [kHz]}{10^3}$$

Controller

If the VT-HACD is used as controller card, you must select "Controller" for the signal connection [8].

The LCx signals indicate the command value branch, the LFBx signals indicate the actual value branch. [8]

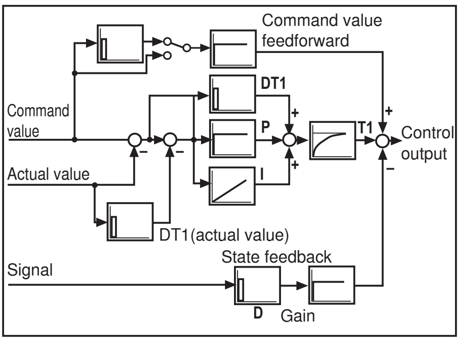
Both SSI encoder or incremental encoder [2] (digital measuring system) and one or more analog sensors can be used as actual value signal.

The controller structure is designed as PIDT1 controller, whereas each share can be activated or deactivated individually. Thus, also a P or PT1 controller can be implemented for example. The I share can additionally be controlled via a window (upper and lower limit).

Control parameters can be set in blocks or independently of blocks.

In mode 3, a state feedback can be used for dampening the controller output.

Controller structure:



Adjustment to hydraulic system

For the optimum adjustment to the particularities of hydraulic drives, the following functions are implemented upstream the analog output:

- Direction-dependent gain [10]

  For positive and negative values, the amplification can be set separately. In this way, adjustment to the area ratio of a single-rod cylinder is possible.
- Characteristic curve correction [11]

  In this way, the progressive flow characteristic of proportional directional valves is compensated or an inflected characteristic curve is realized.
- Overlap jump/residual velocity [12]

  When using valves with positive overlap, a fine positioning can be used in case of a PDT1 controller in order to increase the static accuracy. This fine positioning can be selected according to the residual voltage principle and as overlap jump.
- Zero point correction (offset) [13]

  Serves the correction of the zero point of the connected proportional servo valve.

Error identification and treatment

The VT-HACD supports numerous error monitoring possibilities:

- Monitoring of the analog inputs for lower deviation or exceedance of the range
- Monitoring of the position sensors for cable break
- Control error monitoring when configuring the HACD as controller
- Monitoring of the supply voltage, any internal voltage as well as the 10 V reference voltage
- Monitoring the microcontroller (watchdog) as well as the memory (checksum)

The error monitoring as well as its reaction can be configured as well.

3

Functional description (continued)

Front operation

In connection with the four keys, the front display is used to display and change parameters as well as for diagnosis purposes.

The VT-HACD parameters are accessed via a corresponding menu structure. The parameter values can be displayed and changed.

The following parameters can be accessed:

- Command value and ramp parameters
- Actual value
- Control parameters
- Output parameters
- Analog I/O
- Position sensors

Changes in the configuration, i.e. changes in the signal linking, trigger conditions, error monitoring, etc. are not possible via the front operation.

The display of command and actual values as well as the output of error messages are available as diagnosis options.

Valve output stage [18] (optional)

The following applies to the valve output stage:

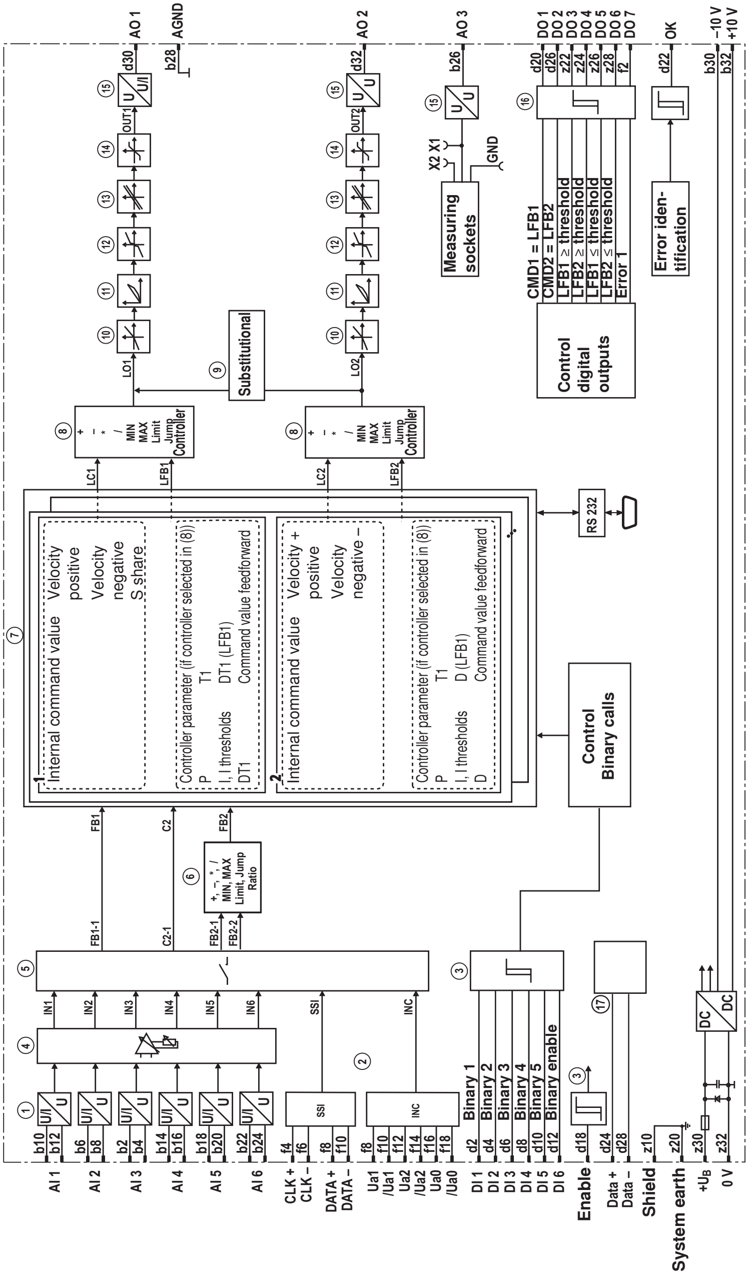
- Only available in connection with PROFIBUS
- Only for valves of type 4WRE…2X with two solenoids
- Can only be activated in mode 3

Error logics identify a cable break of the actual value line of the valve position sensor. Readiness for operation is removed, a low signal is output at connection d22 and the "OK" LED on the front plate goes out.

PC program BODAC

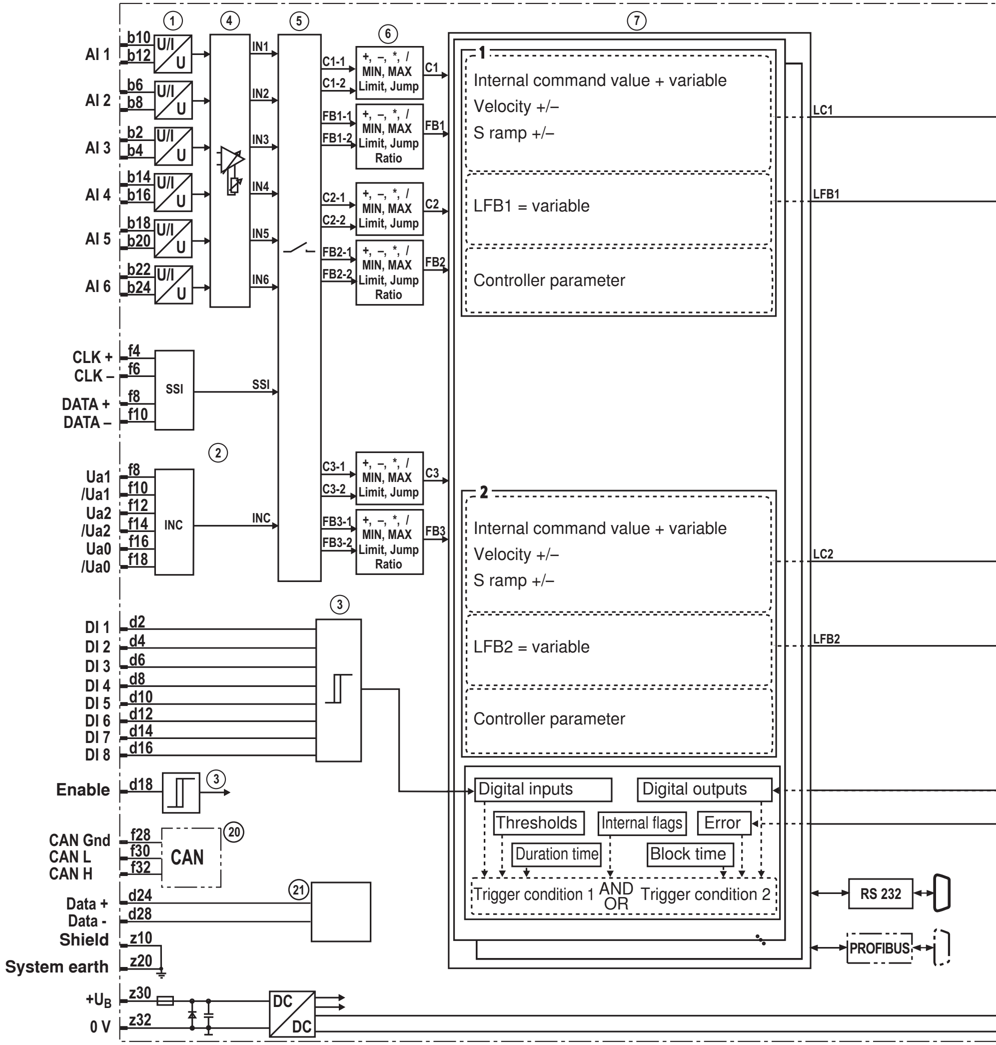
The BODAC PC program is used to configure, parameterize and diagnose the VT-HACD via a serial interface (RS 232). Via the local bus, up to 32 control electronics can be connected. Via BODAC, every control electronics is assigned a bus address. Reconnection of the serial interface cable is omitted. More information in document 30143-01-B.

Block diagram: VT-HACD-1, mode 1 - block calls

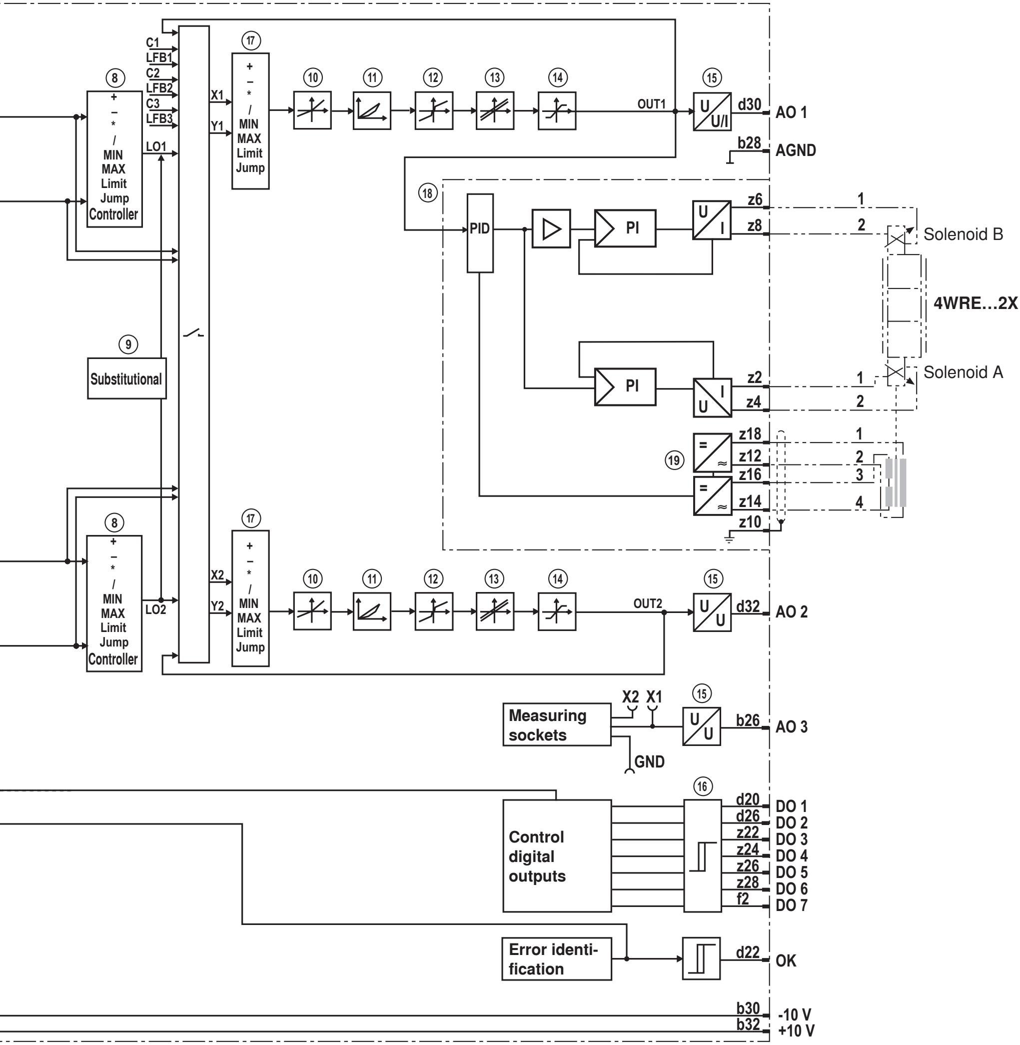


1 Analog voltage or current inputs
2 SSI or incremental
3 Enable input and digital inputs
4 Analog input adjustment
5 Switching matrix
6 Math. connection of the inputs
7 32 blocks for command value generation, controller parameter switching
8 Math. connection and/or controller
9 Substitutional control
10 Direction-dependent gain
11 Adjustment of the characteristic curve
12 Residual velocity and overlap jump
13 Offset
14 Limitation
15 Analog voltage or current outputs
16 OK output and digital outputs
17 Local bus

Block diagram: VT-HACD-1, mode 3 - structural editor



1 Analog voltage or current inputs
2 SSI or incremental
3 Enable input and digital inputs
4 Analog input adjustment
8 Math. connection and/or controller
9 Substitutional control
10 Direction-dependent gain
11 Adjustment of the characteristic curve
12 Residual velocity and overlap jump
13 Offset
14 Limitation



15 Analog voltage or current outputs
16 OK output and digital outputs
17 Math. connection of the outputs
18 Optional output stage
19 Oscillator/demodulator
20 CAN interface, optional
21 Local bus

3

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

Operating voltage	U_B	24 VDC
Operating range:		
Upper limit value	$u_B(t)_{max}$	30 V
Lower limit value	$u_B(t)_{min}$	21 V
Current consumption	I_{max}	Standby current consumption 250 mA
Fuse	I_S	4 A time-lag
Digital inputs	Signal	log 0 = 0 to 5 V log 1 = 16 V to U_B
Digital outputs	Signal	log 0 = 0 to 5 V log 1 = 16 V to (U_B – 3 V) I_{max} = 30 mA
Analog inputs AI 1...6		
Configuration as voltage input		
Range	U	0 to 10 V or ±10 V (configurable)
Input resistance	R_e	100 kΩ, > 10 MΩ for input AI 1
Resolution		5 mV for range ±10 V 2.5 mV for range 0...10 V
Non-linearity		< 10 mV
Configuration as current input		
Range	I	0…20 mA or 4…20 mA
Input resistance	R_e	100 Ω
Leakage current		0.15 % (with 500 Ω between pin AI x– and 0 V)
Resolution		5 μA
Analog outputs		
AO 1 configuration as voltage output		
Output voltage	U	0…10 V or ±10 V (configurable)
Output current	I_{max}	10 mA
Load	R_{Lmin}	1 kΩ
Resolution		1.25 mV (14 bit)
Residual ripple		±15 mV (without noise)
AO 1 configuration as current output		
Output current	I	0…20 mA or 4…20 mA (configurable)
Load	R_{max}	500 Ω
Resolution		1.25 μA
Residual ripple		±15 μA (without noise)
AO 2 / AO 3		
Output voltage	U	±10 V
Output current	I_{max}	10 mA
Load	R_{min}	1 kΩ
Resolution		10 mV (11 bit)
Residual ripple		±25 mV (without noise)
Reference voltage	U	±10 V
Load	I_{max}	30 mA
Residual ripple		< 20 mV
Scan time	t	2 ms

Technical data (continued)

Valve output stage (optional)		
Solenoid current per solenoid	I_{max}	2.5 A
Valve position sensor		
Oscillator amplitude	U	13 Vss
Oscillator frequency	f	5.7 kHz
Coil resistance	R_{20}	between coil connection 1 and 2: 130 to 164 Ω between coil connection 3 and 4: 21 to 24 Ω
For more technical data for valve 4WRE…2X see data sheet 29061		
Serial interface		RS 232 (front plate), D-Sub socket
Type of connection		64-pole male multipoint connector, DIN 41612, design G
Local bus, distance to the furthermost participant	l	max. 280 m line length
Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Front plate dimensions:		
Height		3 HE (128.4 mm) *[5.06 inches]*
Width soldering side		1 TE (5.08 mm) *[0.20 inches]*
Width component side		7 TE
Admissible operating temperature range	ϑ	0 to 50 °C *[0 to 122 °F]*
Storage temperature range	ϑ	–20 to +70 °C *[0 to 158 °F]*
Weight	m	0.2 kg

Notice:

For information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30143-U.

3

Pin assignment of the male multipoint connector

Pin	Row z	Row b	Row d	Row f
2 [5]	Solenoid A+ MA+	Analog input AI 3+	Digital input DI 1	Digital output DO 7
4 [5]	Solenoid A– MA–	Analog input AI 3–	Digital input DI 2	SSI clock +
6 [5]	Solenoid B+ MB+	Analog input AI 2+ [1]	Digital input DI 3	SSI clock –
8 [5]	Solenoid B+ MB–	Analog input AI 2– [1]	Digital input DI 4	SSI data +; Inc Ua1
10 [5]	Shield	Analog input AI 1+ [3]	Digital input DI 5	SSI data –; Inc /Ua1
12 [5]	Position transducer of valve feed – L1O–	Analog input AI 1– [3]	Digital input DI 6	Inc Ua2
14 [5]	Position transducer of valve actual value – L1I–	Analog input AI 4+ [1]	Digital input DI 7	Inc /Ua2
16 [5]	Position transducer of valve actual value + L1I+	Analog input AI 4– [1]	Digital input DI 8	Inc Ua0
18 [5]	Position transducer of valve feed + L1O+	Analog input AI 5+ [1]	Enable DI 9	Inc /Ua0
20	System earth	Analog input AI 5– [1]	Digital output DO 1	n.c.
22	Digital output DO 3	Analog input AI 6+ [1]	OK	n.c.
24	Digital output DO 4	Analog input AI 6– [1]	Local bus Data+	n.c.
26	Digital output DO 5	Analog output AO 3, ±10 V	Digital output DO 2	n.c.
28	Digital output DO 6	Analog GND [4]	Local bus Data–	CAN Gnd
30	U_B: +24 V	–10 V REF–	Analog output AO 1 [2]	CAN L
32	L0: 0 V	+10 V REF+	Analog output AO 2, ±10 V	CAN H

[1] By means of software, the inputs AI 2, 4, 5 and 6 can be set to 0…10 V, ±10 V, 0…20 mA or 4…20 mA.

[2] By means of software, the output AO 1 can be set to 0…10 V, ±10 V, 0…20 mA or 4…20 mA.

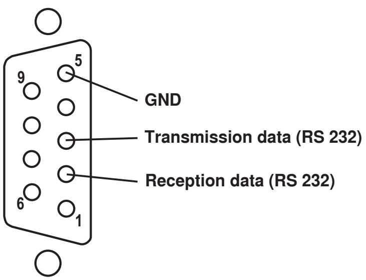
[3] This input has an input resistance R_e > 10 MΩ

[4] Reference potential for AO 1, AO 2, AO 3, +10 V and –10 V

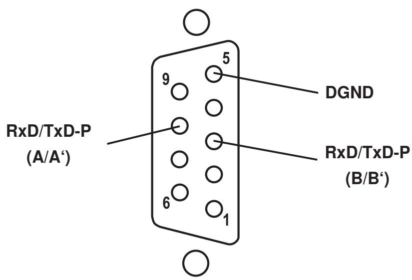
[5] Only for option with valve output stage

n.c. Not used in basic version, however reserved for extensions.

Pin assignment of the D-Sub sockets on the front plate

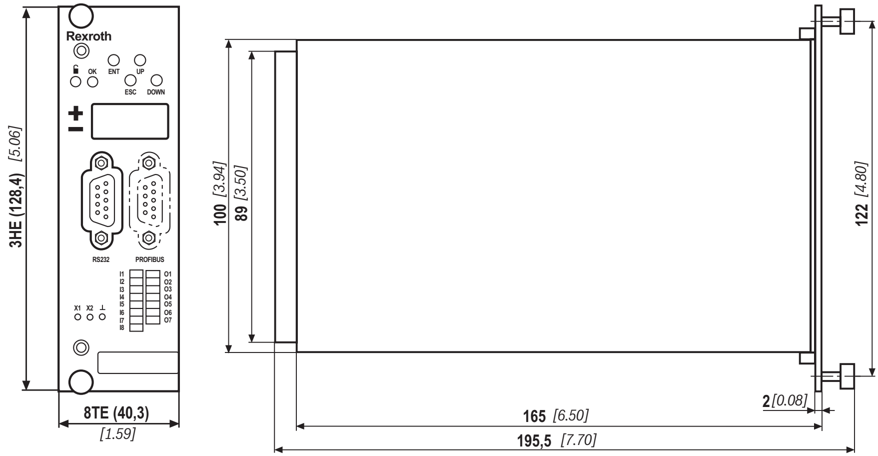


RS 232



PROFIBUS

Unit dimensions (dimensions in mm *[inch]*)



Project planning / maintenance instructions / additional information

Product documentation for VT-HACD-1

- 30143
  Technical data sheet (this document)
- 30143-B
  Installation and operating instructions
- 30143-01-B
  Commissioning and operating instructions
- 30143-U
  Environmental compatibility statement
- 30143-01-Z
  Commissioning instructions PROFIBUS DP interface
- 30143-02-Z
  Commissioning instructions CANopen interface
- 30143-03-Z
  Commissioning instructions DeviceNet interface
- 30143-Z
  Additional information for replacing the VT-SWKD by VT-HACD-1

- Use low-capacitance cables. If possible, design the cable connections without intermediate terminals.
- Electromagnetic sources of interference (e.g. frequency converters) must not be arranged in the immediate vicinity of the control electronics.
- Power cables must not be laid in the immediate vicinity of the controller card.
- Lines of the controller electronics must not be laid in the immediate vicinity of power cables.
- Pass the sensor lines separately.
- The distance to aerial lines, radios, and radar systems has to be 1 meter at least.
- Design the installation so that when the differential inputs are used, both inputs are always connected or disconnected at the same time.
- For switching command values, relays with gold contacts have to be used. (Low voltages, low currents)
- Always shield command value lines and actual value lines. Connect the shield to "Shield" on the card side and leave the other side open as otherwise, there is the risk of ground loops.
- Use highly flexible CU conductors (at least 2.5 mm^2) in order to connect the system earth
  The system earth is a main part of the EMC protection of the controller card. Here, interference is eliminated which is transported to the controller card via the data and supply voltage lines. This function is only ensured if the system earth itself does not introduce interference into the controller card. Rexroth recommends screening the solenoid lines as well.
- Do not use electrical signals led out via control electronics (e.g. the "OK" signal) for switching safety-relevant machine functions (In this connection, also observe EN ISO 13849 - "Safety of machinery - Safety-related parts of control systems").

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Rexroth
Bosch Group

Digital Controller for electro-hydraulic Injection Molding Machines

RE 30146/08.07
Replaces: 02.06

Type VT-HACD-DPQ

Component series 2X

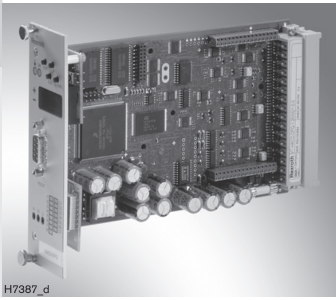

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Table of contents

Contents	**Page**

Features

– Actual value acquisition possible by means of SSI encoder, incremental or analogue position measuring system
– Free configuration for valve spool
– Loop tuning with ramps
– Jog mode
– Separate menus for Injection, “Pack and Hold“ and Back Pressure
– Pressure transfer by:
  – Position
  – Cavity pressure
  – Hydraulic pressure activated by position
  – Discrete input
– Enable input and OK output
– ±10 V reference voltage output
– Front display with keys for displaying and changing parameters as well as for diagnosis purposes
– RS232 serial interface
– Up to 32 control electronics for parameterization and diagnosis can be interconnected via local bus
– Internal or analogue profile
– I/O configuration

Ordering code

VT-HACD-DPQ – 1 – 2X / V0 / 1 – – 0

Digital controller card

Component series 20 to 29 (20 to 29: unchanged installation and connection dimensions) **= 2X**

Basic unit **= V0**

1 = With display

0 = Without bus interfacing
C = CANopen
D = DeviceNet

0 = Without valve output stage

Standard types	Material number
VT-HACD-DPQ-1-2X/V0/1-0-0	R901054664
VT-HACD-DPQ-1-2X/V0/1-C-0	R901119884

Required accessories:

– PC program BODAC: Ordering code of the CD: SYS-HACD-BODAC-01 (R900777335) or free download on the Internet at www.boschrexroth.com/hacd

– Interface cable: Cable set VT-HACD-1X/03.0/ HACD-PC (R900776897) or commercial 1:1 cable

– USB adapter optionally available VT-ZKO-USB/S-1-1X/V0/0

Suitable card holders:

– 19“ rack types VT 19101, VT 19102, VT 19103 and VT 19110 (see RE 29768)

– Enclosed card holder type VT 12302 (see RE 30103) (standard), mat. no. R900784153

– Open card holder type VT 3002-2X/64G (see RE 29928), mat. no. R900991843 (for installation in control cabinet only!)

– Connection adapter VT10812-2X/64G (see RE 30105), mat. no. R900713826

Suitable power supply unit

– Compact power supply unit type VT-NE30, see RE 29929

Functional description: Overview

Overview

The VT-HACD-DPQ is a digital controller card. It optimizes the control of a hydraulic injection axis.

– Injection velocity profiles are controlled completely by use of closed loop position control. An advanced position command profile is calculated automatically based on the operator input velocity profile.

– Because the VT-HACD-DPQ is a position control device it requires a position feedback transducer. Both, analogue (0...10 V; ±10 V; 0...20 mA; 4...20 mA) and digital types (SSI, INCR) are supported by the VT-HACD-DPQ.

– The VT-HACD-DPQ includes injection force-limiting control that can be configured to work with 1 or 2 pressure transducers or a load cell.

– The injection velocity and pressure profiles may be controlled with one proportional directional hydraulic valve or separate valves for flow and pressure.

– Motion profile command values are normally transferred into the VT-HACD-DPQ from a PLC (analogue). The profiles may also be entered into the card using the Bosch Rexroth BODAC software.

Function

The VT-HACD-DPQ is a complete hydraulic injection axis control solution. An injection profile is created from parameters that are entered by the machine operator. All injection cylinder process parameters are then stored on the card. Parameter changes may be individually loaded into the VT-HACD-DPQ, or the entire profile loaded at one time. The VT-HACD-DPQ maintains the last saved profile in a non-volatile flash memory. A single injection profile is stored on the card. A discrete input (enable) is required to enable the VT-HACD-DPQ .

Functional description: Injection control

Mould fill profile

A velocity profile of up to ten steps is provided to fill the mould cavity.

A maximum pressure/force limit may be set for each profile step. The injection cylinder is traversed under closed loop control on the basis of the velocity profile (closed-loop position control).

At the start of inject forward the internal position command value is set equal to the current cylinder position feedback and then ramped forward at a rate of movement corresponding to the velocity command in the current profile step. The steps are followed in subsequent order. Each step in the profile is initiated when the internal position command value has been reached. Repeatability of the profile is determined by adjusting the proportional gain as high as possible so the injection cylinder closely follows the internal position command value under varying load conditions. This type of system is used because it is relatively unaffected by changes in plastic material properties or temperature. Because the position control loop is a ramp of position command value over time, the change of velocity between the profile steps is seamless and does not require any extra ramp adjustments.

Transfer to Hold Pressure

The VT-HACD-DPQ begins the “hold pressure” profile when any of the predetermined transfer criteria are achieved. Transfer criteria available in the stored profile are hydraulic pressure, cylinder position, and mould cavity pressure or digital input 3 (DI3). All of the transfer criteria are continuously monitored, so any criteria not used must be set to a value that will not be reached during the mould fill velocity profile. The hydraulic pressure command value is enabled only if the injection cylinder position is less than the hydraulic transfer position parameter.

This allows the initial acceleration pressure to be higher than the transfer pressure without triggering the hold pressure profile. The machine control may also initiate the transfer on the basis of a digital input (DI3).

The completion of the process is signalled to the machine control via digital input DO1 .

Hold Pressure Profile

A pressure profile up to five steps long is available for pack and hold. Once the hold profile is initiated, the VT-HACD-DPQ changes mode into closed-loop pressure/force control with superimposed open loop velocity control. Any remaining steps in the velocity profile are ignored. In each step the pack and hold profile, pressure (force), time, and velocity limit can be adjusted.

Step 1 in the profile is started at the time of transfer. Each subsequent step in the pack and hold profile is initiated when the previous step timer is finished.

The velocity limit in step 1 of the pack and hold profile is typically used to prevent the injection cylinder from lunging forward to build up pressure/force when transfer by position is used. This also allows the DPQ to react faster when transfer by hydraulic mould cavity pressure is initiated, by closing down the flow control valve to a smaller opening within 2 msec of transfer, preventing pressure/force overshoots. The velocity limit in the subsequent pack and hold profile steps is typically set higher so it does not limit the dynamic response of the pressure/force control loop.

Pre-Decompress

After the last timer is completed in the hold pressure profile, the VT-HACD-DPQ automatically decompresses the screw. Pre-decompress is active if the pre-decompress position parameter is greater than the actual injection cylinder position at the end of the pressure hold profile. The pre-decompress velocity parameter is an open loop valve command. Pre-decompression is complete once the injection cylinder position is equal to or greater than the pre-decompress position parameter. At the end of pre-decompression the VT-HACD-DPQ raises a signal to the machine control that decompress is complete. The valve outputs are set to 0V at the end of pre-decompression.

Back pressure

To begin recovery the machine control raises the recovery discrete input DI. The VT-HACD-DPQ then controls the injection unit recovery based on the position, velocity, and pressure parameters in a 3-step recovery profile.

Back pressure is closed-loop controlled with an open loop velocity limit. The next step in the recovery profile is triggered by the increasing injection cylinder position as recovery continues. When applied to a single injection valve hydraulic circuit the velocity parameter for each back pressure step is set as a forward valve opening limit. When applied to a hydraulic circuit which uses a separate back pressure proportional relief valve the velocity parameter can be set to whatever valve command is necessary for the injection directional proportional valve, for example screw motor speed on some hydraulic systems.

Screw recovery mode is complete when the injection cylinder position is equal to or greater than the shot size parameter. The VT-HACD-DPQ signals to the machine control when shot size is reached. Back pressure control will be maintained until post decompress begins.

Post Decompress

When the post decompress discrete input (DI6) is raised by the machine control, the post decompress mode is started, if the injection cylinder position is equal to or greater than the shot size. The post decompress velocity parameter is an open loop valve command.

Post decompression is complete when the injection cylinder position is equal to or greater than the post decompress position parameter. When the post decompress position is reached, the VT-HACD-DPQ sets the valve outputs to 0V and signals this to the machine control.

Functional description: Injection control (continued)

Injection configuration options

The VT-HACD-DPQ can be applied in one of two injection configurations that depend on the hydraulic system.

1. Preferred configuration: closed-loop velocity profile and pressure control using one proportional injection valve and one analogue valve output. This type of system will control the injection velocity profile, pressure profile, back pressure, and screw decompress using a single proportional directional valve. The available dynamic response with this type of system is much better than with systems that use separate valves for flow and pressure control, which means that closed loop tuning can be adjusted for faster and more precise control.
2. Closed-loop velocity profile, and either closed or open-loop pressure control using one proportional directional or flow control valve for the velocity profile and one proportional pressure control valve for injection pressure control. There are two analogue valve outputs available for this configuration. This configuration does not require as high dynamic response from the proportional flow control valve as the single valve configuration. Overall system control will not be as dynamic or repeatable due to limitations of separating flow and pressure functions into multiple valves, and inherent dynamic limitations of proportional pressure control valves.

Additionally, the VT-HACD-DPQ may be configured so that the second valve output is controlled directly by a machine control instead of the internal pressure profile.

Applications

The VT-HACD-DPQ is configured to control injection moulding type applications, and all parameters are labelled to be recognizable in injection moulding applications. There are, however, many other applications that could benefit from the control quality afforded by the VT-HACD-DPQ.

– Transfer moulding
– Extrusion
– Broaching
– Rubber moulding
– Accumulator head blow moulding

Front panel operation

The front display is used in conjunction with the 4 push-buttons to display and change operator parameters.

Access is given to the following operator parameters:

– Mould fill profile
– Transfer parameters
– Hold pressure profile
– Recovery profile
– Decompress parameters

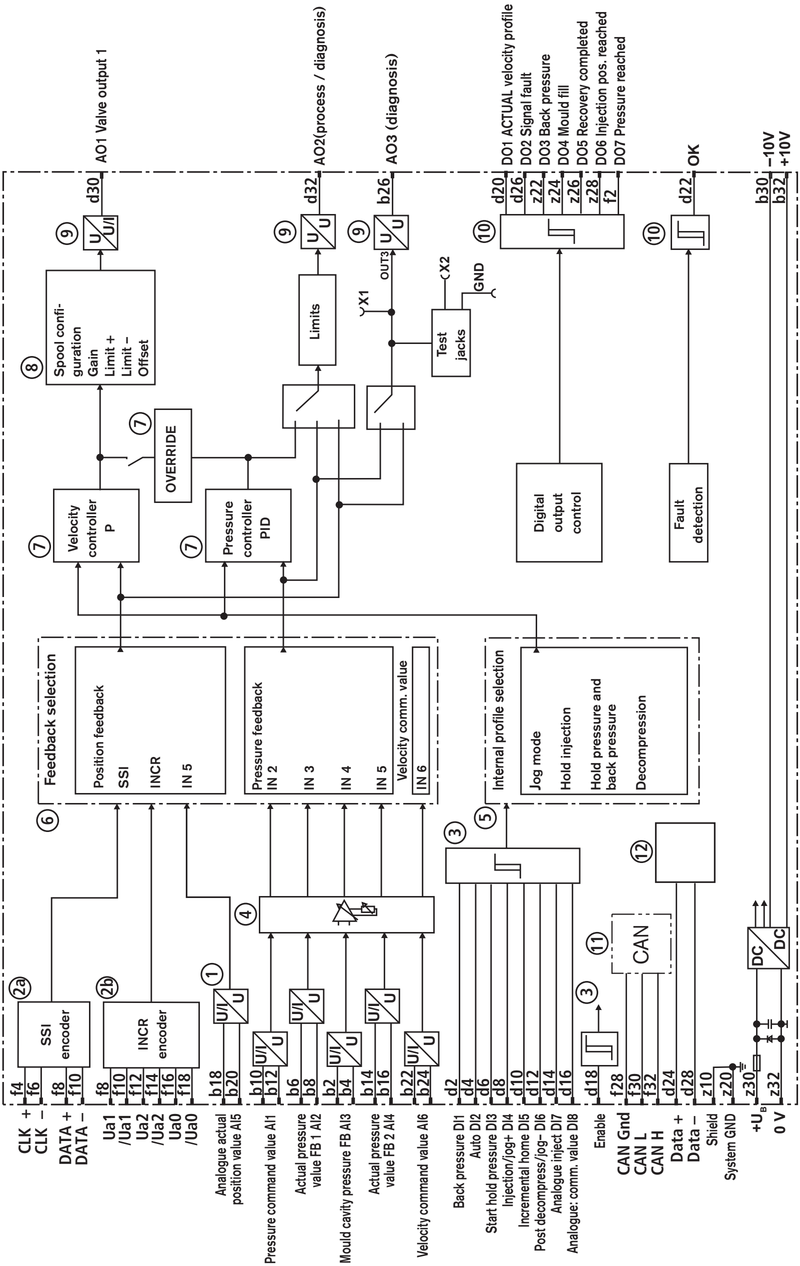
For safety reasons, set-up and configuration parameters are not accessible through the front panel.

Fault messages will be displayed when a fault occurs.

PC program BODAC

The PC program BODAC is used for the configuration, parameterisation and diagnosis of the VT-HACD-DPQ via a serial interface (RS 232). Up to 32 control electronics can be interconnected via the local bus. Each control electronics is assigned a bus address by means of BODAC. Re-plugging of the serial interface cable is not required. For further information, see RE 30146-01-B.

Block circuit diagram



1 Analogue inputs, voltage or current
2a SSI encoder
2b Incremental encoder
3 Enable and digital input
4 Setting of analogue inputs
5 Internal profile
6 Feedback selection
7 Controller
8 Valve spool configuration
9 Analogue outputs (voltage or current)
10 OK output and digital output
11 CAN interface, optional
12 Local bus

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

Operating voltage	U_O	24 VDC
Operating range:		
– Upper limit value	$u_O(t)_{max}$	35 V
– Lower limit value	$u_O(t)_{min}$	21 V
Current consumption	I_{max}	150 mA
Fuse	I_S	4 A slow-blowing
Digital inputs	Signal	log 0 = 0 to 5 V log 1 = 16 V to U_O
Digital outputs	Signal	log 0 = 0 to 5 V log 1 = 16 V to U_O I_{max} = 30 mA
Analogue inputs AI1…AI6		
Configuration as voltage input		
Range	U	0 to 10 V or ±10 V (configurable)
Input resistance	R_i	100 kΩ, > 10 MΩ for input AI 1
Resolution		5 mV for range ±10 V, 2.5 mV for range 0...10 V
Non-linearity		< 10 mV
Configuration as current input		
Range	I	0...20 mA or 4...20 mA (configurable)
Input resistance	R_i	100 Ω
Current loss		0.15 % (at 500 Ω between pin AI x– and 0 V)
Resolution	I	5 µA
Analogue outputs		
AO1 configuration as voltage output		
Output voltage	U	0...10 V or ±10 V (configurable)
Output current	I_{max}	10 mA
Load	R_{Lmin}	1 kΩ
Resolution		1.25 mV (14 bit)
Residual ripple content		±15 mV (without noise)
AO1 configuration as current output		
Output current	U	0...20 mA or 4...20 mA (configurable)
Load	R_{max}	500 Ω
Resolution		1.25 µA
Residual ripple content		±15 µA (without noise)
AO2 / AO3		
Output voltage	U	±10 V
Output current	I_{max}	10 mA
Load	R_{Lmin}	1 kΩ
Resolution		10 mV (11 bit)
Residual ripple content		±25 mV (without noise)
Reference voltage	U	±10 V
	I_{max}	30 mA
Residual ripple content		< 20 mV
Scanning rate	t	2 ms
Serial interface		RS232 (front panel), D-Sub socket
Type of connection		64-pin male connector, DIN 41612, form G
Local bus, distance to the farthest station	l	Max. 280 m cable length

Technical data (continued)

Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Front panel dimensions: – Height – Width soldering side – Width component side		 3 HE (128.4 mm) 1 TE (5.08 mm) 7 TE
Permissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight	m	0.2 kg

Pin assignment of male connector

PIN	Row z	Row b	Row d	Row f
2	n.c.	AI3+: Cavity pressure [1]	DI1: Back pressure	DO7: Pressure
4	n.c.	AI3–: Cavity pressure [1]	DI2: Auto	SSI clock+
6	n.c.	AI2+: Pressure FB 1 [1]	DI3: Start hold pressure	SSI clock–
8	n.c.	AI2–: Pressure FB 1 [1]	DI4: Injection/jog+	SSI data+; Inc. Ua1
10	n.c.	AI1+: Pressure command [1] [3]	DI5: Incremental Home	SSI data–; Inc. /Ua1
12	Shield	AI1–: Pressure command [1] [3]	DI6: Post Decomp./jog–	Inc. Ua2
14	n.c.	AI4+: Act. pressure FB 2 [1]	DI7: Analogue injection	/Inc. Ua2
16	n.c.	AI4–: Act. pressure FB 2 [1]	DI8: Analogue comm. value	Inc. Ua0
18	n.c.	AI5+: Analogue cyl. position [1]	Enable	/Inc. Ua0
20	System ground	AI5–: Analogue cyl. position [1]	DO1: Actual velocity profile	n.c.
22	DO3: Back Presuure	AI6+: Velocity command [1]	Card OK.	n.c.
24	DO4: Inject Forward	AI6–: Velocity command [1]	Data+: Local bus	n.c.
26	DO5: Decom. Achieved	AO3: Valve output	DO2: Signal fault	n.c.
28	DO6: At Shot Size	Analogue GND	Data–: Local bus	CAN Gnd
30	UB: +24 V	–10 V	AO1: Valve output 1 [2]	CAN L
32	LO: 0 V	10 V	AO2: Valve output 2	CAN H

[1] The inputs can be set to 0...10 V, ±10 V or 4...20 mA by means of software.

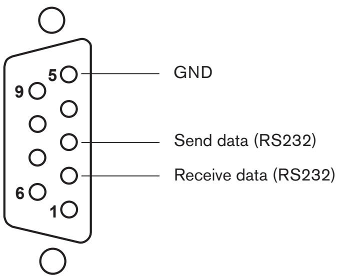
[2] Output AO 1 can be set to 0...10 V, ±10 V or 4...20 mA by means of software.

[3] This input has an input resistance of $R_i > 10\ \text{M}\Omega$

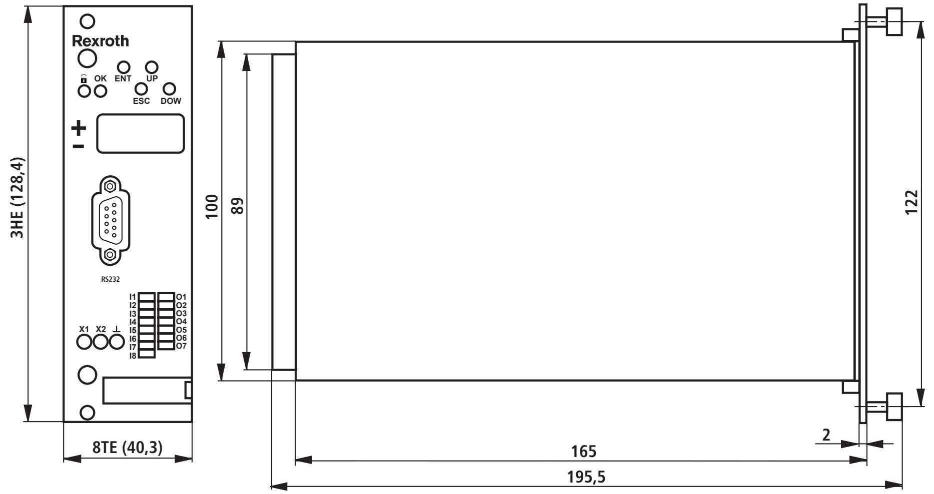
n.c. ... not assigned in the basic version, but reserved for extensions.

3

Pin assignment of D-sub socket on the front panel



Unit dimensions (dimensions in mm)



Engineering / maintenance notes / supplementary information

Product documentation for VT-HACD-DPQ

- RE 30146
  Technical data sheet (this document)
- RE 30146-B
  Installation and operating instructions
- RE 30146-01-B
  Commissioning and operating instructions
- RE 30146-U
  Declaration on environmental compatibility
- RE 30146-02-Z
  Start-up CANopen Interface
- RE 30146-03-Z
  Start-up DeviceNet Interface

– Use low-capacitance cables. Whenever possible, establish cable connections without intermediate terminals.
– The arrangement of electromagnetic sources of interference (e.g. frequency converter) in the direct vicinity of the closed-loop control electronics is not permitted.
– Do not lay power cables in the direct vicinity of the controller card.
– Do not lay cables of the control electronics in the direct vicinity of power cables.
– Lay sensor cables separately.
– The distance to aerial lines, radio sources and radar equipment must be at least 1 metre.
– Engineer the system so that when the differential inputs are used, both inputs are always activated or deactivated simultaneously.
– Use relays with gold-plated contacts for passing on command values (small voltages, small currents).
– Always shield command value and actual value cables. Connect the shield to “shield“ on the card side and leave the other end open, otherwise, there is a risk of earth loops.
– Use highly flexible CU conductors (min 2.5 mm^2) for connecting the system ground! The system ground is an essential part of EMC protection of the controller card. It discharges interference that is transported via data and supply voltage cables to the controller card. This function can only be ensured, if the system ground itself does not inject interference into the controller card. Rexroth recommends that solenoid cables be shielded as well.
– Electrical signals brought out via control electronics (e.g. the “OK“ signal) must not be used for switching safety-relevant machine functions!
(See also European Standard “Safety requirements for fluid power systems and components - hydraulics“ EN982:1996)

3

Notes

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Rexroth
Bosch Group

Digital axis control

RE 30139/08.12
Replaces: 10.11

Type VT-HNC100

Component series 3X

H7642

Table of contents

Features

The digital axis control VT-HNC100...3X is a programmable NC control for up to four controlled axes. It complies with the specific requirements for closed-loop control of hydraulic drives.

The VT-HNC100...3X is designed for being used in rough industrial environments as regards to interference immunity, mechanical vibration, shock, and climate resistance.

Fields of application
- Machine tools
- Plastics processing machines
- Special machines
- Presses
- Transfer systems

Technology functions
- Sequence programming
- Positioning
- Pressure/force control
- Differential pressure control
- Synchronization
- Curves
- Cams

Hydraulic axes
- Measurement system:
  - Incremental or absolute (SSI)
  - Analog 0 to ±10 V and 4 to 20 mA
- Actuating variable output voltage or current
- Freely configurable controller variants
  - Position/pressure/force/velocity controller
  - Path-dependent braking
  - Substitutional closed-loop control (position/force)
  - Synchronization control of up to 4 axes also in groups

Programming
- User programming using a PC
- NC language with subroutine technology and conditional jumps
- 1 NC program per axis for functional sequences
- 1 axes-spanning auxiliary routine
- Variable setting of the NC processing velocity
- Variable setting of the controller scan times
- Password protection

Operation
- Comfortable administration of the machine and measuring data on a PC

Service interface
- RS 232
- TCP/IP (not available with Version Compact)

Process connection
- Digital inputs and outputs,
- Analog inputs and outputs,
- PROFIBUS DP, PROFIBUS DP in Motorola format, CANopen for the communication with a superior control (for CANopen, there is no standard EDS file available)
- PROFINET RT
- EtherNet/IP

Assembly
- Top hat rail 35 mm

CE conformity
- CE conformity according to EMC directive 2004/108/EC and EMVG (Act on electro-magnetic compatibility of operating media) from February 26, 2008

  Applied harmonized standards:
  EN 61000-6-2:2005
  EN 61000-6-3:2007

More information

www.boschrexroth.com/hnc100

Ordering code

VT-HNC100 – – 3X / – – /

VT-HNC100	= Serial unit
Version Compact for 1 axis	**= C**
Version for 1 hydraulic axis	**= 1**
Version for 2 hydraulic axes	**= 2**
Version for 3 hydraulic axes	**= 3**
Version for 4 hydraulic axes	**= 4**
Component series 30 to 39 (30 to 39: unchanged technical data and pinout)	**= 3X**

Bus connection [2)]

P =	PROFIBUS DP
C =	CANopen
N =	PROFINET RT (not in connection with Compact version)
E =	EtherNet/IP (not in connection with Compact version)

Position transducer

I =	Incremental/SSI (not in connection with Compact version)
S =	SSI (only in connection with Compact version)

00 =	No fitting
E0 =	TCP/IP [1)]

Option

000 =	without synchronization
G02 =	Synchronization 2-axis version
G03 =	Synchronization 3-axis version
G04 =	Synchronization 4-axis version

1) Only specify "E0" if the Ethernet service interface is desired for "PROFIBUS DP"

2) Versions without bus connection are not available.

Included within the scope of delivery:

Mating connector for
- X1S (Type Phoenix Mini Combicon 3-pole),
- X2D (Type Phoenix Micro Combicon 8-pole or Phoenix Mini Combicon 12-pole),
- X2A (Type Phoenix Micro Combicon 8-pole or HD-SUB 15-pole),
- X8M (Type Phoenix Micro Combicon 8-pole or HD-SUB 15-pole)

Recommended accessories (can be ordered separately)

Description	Material number
Interface cable RS232 (1:1), length 3 m	**R900776897**
USB-RS232 converter	**R901066684**
Cable set VT17220-1X/HNC100-3X, length 2 m, for analog signals (connection X2A) or digital position measurement systems (connection X8M) with HD connector and open breakout cable for: VT-HNC100-1-3X, VT-HNC100-2-3X, VT-HNC100-3-3X, VT-HNC100-4-3X	**R901189300**
Cable set VT17220-1X/HNC100-3X length 2 m, for analog signals (connection X2A) or digital position measurement systems (connection X8M) with FK-MC connector and open breakout cable for VT-HNC100-C-3X	**R901189302**
Plug-in connector type 6ES7972-0BA42-0XA0 for PROFIBUS DP	**R901312863**

Software project planning

Project planning

Developing application-specific data sets forms the basis for the function of the VT-HNC100...3X. These data sets are generated on the PC and sent to VT-HNC100...3X. The connection of user program and data sets is called project. This software project planning is implemented according to fix steps:

1. The tasks of the VT-HNC100...3X are defined and recorded in a flow chart. In this connection, the meaning of the inputs and outputs and the used parameters is defined.
2. The functions of the flow chart are implemented in a series of NC commands.
3. The machine data (selection of transducers and controllers) and the parameters of the NC program are defined.
4. The data is sent to the VT-HNC100...3X.
5. The setting and the program sequence are optimized at the machine.

For detailed information on the generation of a project please refer to the document “First steps”.

PC programs “WIN-PED 7” and “WIN-PED 6”

For the implementation of the project planning tasks, two WIN-PED programs are available to the user.

WIN-PED 7 is suitable for all HNC variants mentioned in this document except for CANopen.

WIN-PED 6 is suitable for all HNC variants mentioned in this document except for the options PROFINET RT, EtherNet/IP and PROFIBUS DP with TCP/IP.

Projects generated with WIN-PED 6 are not compatible with WIN-PED 7 and vice-versa.

Scope of delivery for WIN-PED:

- Comfortable dialog functions for setting the machine data online or offline
- NC editor with integrated syntax test and program compiler
- Support for the definition of the parameters used in the NC program
- Dialog window for setting the parameter values online
- Comprehensive options for displaying process variables, digital inputs, outputs, and markers
- Recording and graphical presentation of up to 16 process variables with great selection of trigger options
- Dialog for the graphical definition of special functions (determination of the function via polygonal sequence)
- Bus manager for the configuration of data exchange (PROFIBUS DP, PROFINET RT, EtherNet/IP) with superior control

System requirements:

- IBM PC or compatible system
- Windows XP or Windows 7 for WIN-PED 6
- Windows XP or Windows 7 for WIN-PED 7
- Random access memory (512 MB recommended)
- 100 MB free hard disk capacity as per control type
- RS 232 interface for the connection of VT-HNC100...3X, for the PROFINET RT, EtherNet/IP or PROFIBUS DP, also the network interface TCP/IP can be used

Note:

The WIN-PED 6/WIN-PED 7 is **not** included in the scope of delivery. It can be downloaded from the Internet free of charge, or ordered as CD, Material number R900725471.

Download in the Internet: www.boschrexroth.com/hnc100

Inquiries: support.nc-systems@boschrexroth.de

Overview of the controller functions

Position controller:
- PDT1 controller
- Linear amplification characteristic curve
- Direction-dependent gain adaptation
- Gain modification via the NC program possible
- Adaptation of the valve characteristic curve
- Fine positioning
- Residual voltage principle
- Compensation of zero point errors
- State feedback via
  - Pressure,
  - Pressure differential
  - Position
- Command value provision
- Limitation of the actuating variable via the NC program
- “Path-dependent braking”
- Intermediate electronics when using commercially available NC controls
- Synchronization control

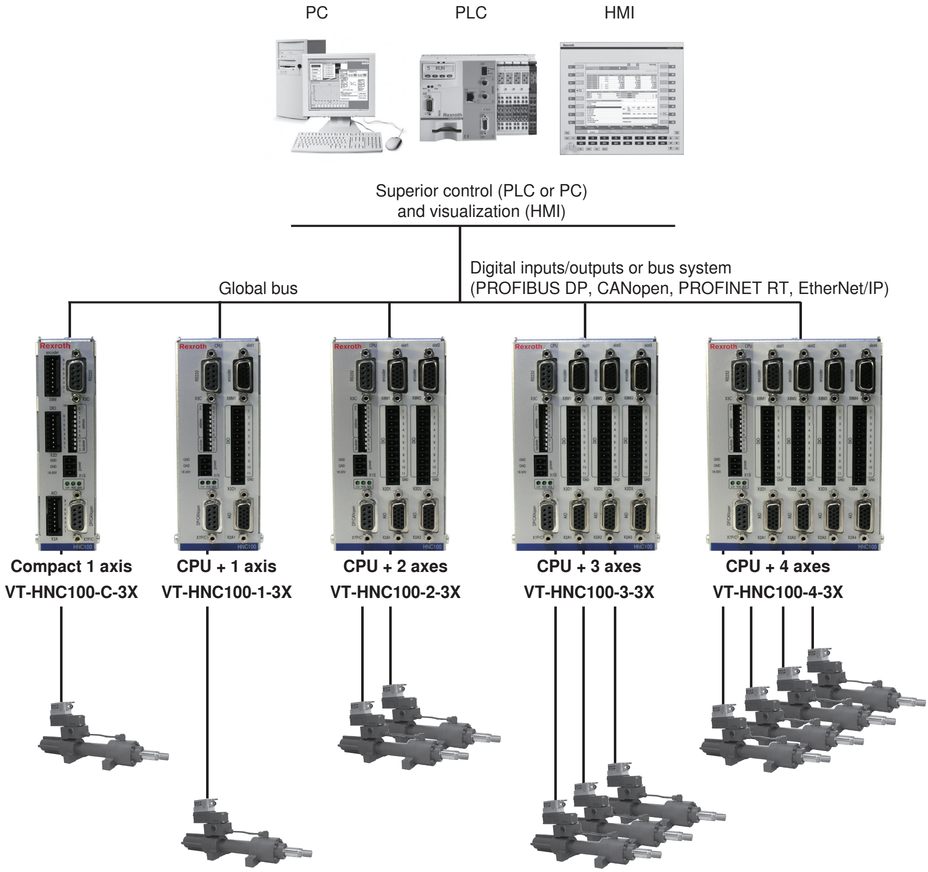
Pressure/force controller:
- PIDT1 controller
- I component switchable via window
- Pressure differential analysis
- Own scan time

Velocity controller:
- PI controller
- I component switchable via window

Synchronization controller (up to 4 axes):
- Master-slave principle
- Mean principle

Monitoring functions:
- Dynamic tracking error monitoring
- Traversing range limits (electronic limit switches)
- Cable break monitoring for incremental and SSI encoder
- Cable break monitoring for sensors with output 4 to 20 mA

System overview (example)



System overview, interfaces (example)

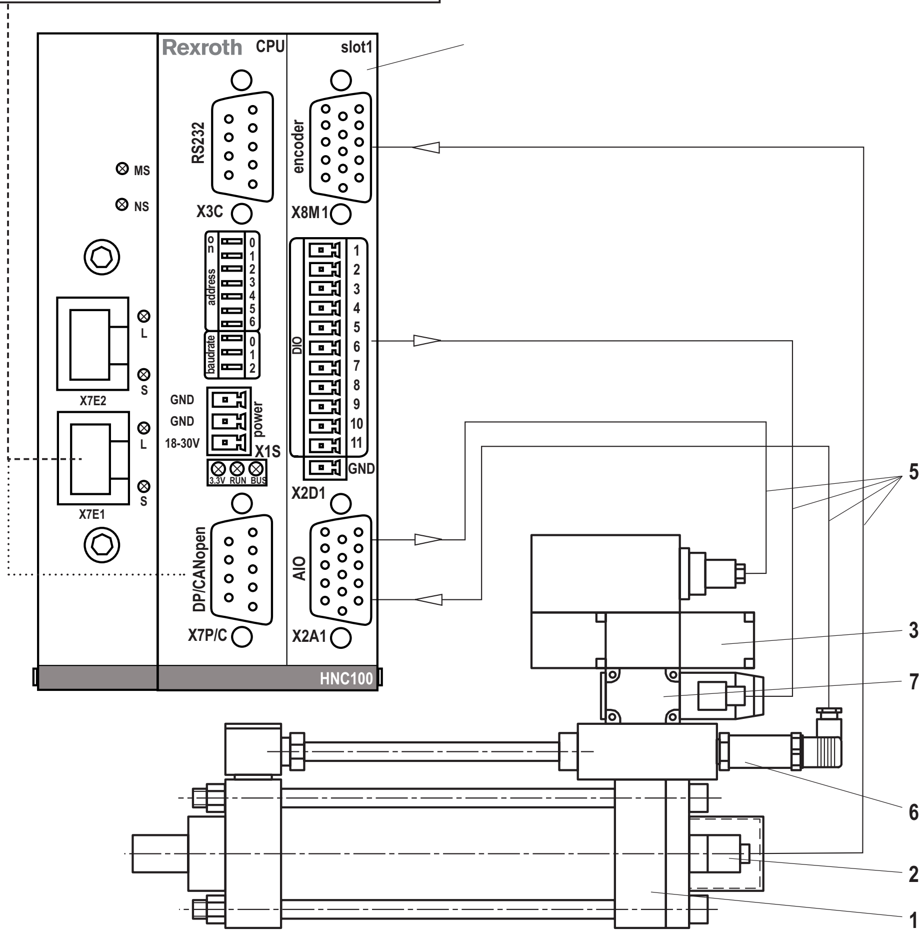
Superior control

Possible interfaces with VT-HNC100...3X:

- Analog signals
- Digital inputs / outputs
- Serial interface RS232
- Bus systems (PROFIBUS DP, CANopen, PROFINET RT, EtherNet/IP)
- Ethernet service interface

Example:

VT-HNC100-**1**-3X/N... / VT-HNC100-1-3X/E… with hydraulic cylinder axis



1 Single-rod cylinder

2 Integrated position measurement system

3 Proportional servo valve with integrated control electronics

4 VT-HNC100-1-3X/N...

5 Connection cable

6 Pressure transducer

7 Sandwich plate isolator valve (with plug-in switching amplifier)

Technical data VT-HNC100-C-3X (Compact)

Operating voltage [1]	U_B	18 to 30 VDC, residual ripple < 1.5 V_{pp}
Current consumption at 24 VDC	I	approx. 500 mA
Processor		32 bit power PC
Interface for WIN-PED 6, WIN-PED 7 Bus interface		RS232 PROFIBUS DP (max. 12 MBaud according to IEC 61158), CANopen
Analog inputs (AI):		
– Voltage input (reference to AGND - Analog ground)		
• Channel number		1
• Input voltage	U_E	max +12 V to –12 V (+10 V to –10 V measurable)
• Input resistance	R_E	200 kΩ ± 5 %
• Resolution		5 mV
• Non-linearity		< 0.2 %
• Calibration tolerance [2]		max. 40 mV (with factory settings)
– Current inputs		
• Channel number		2
• Input current	I_E	4 mA to 20 mA
• Input resistance	R_E	225 Ω at 20 °C (100 Ω measuring resistance)
• Leakage current	I_V	0.1 to 0.4 % (at 100 Ω between pin 2 or pin 3 (Cin1+ or Cin2+) and "AGND"
• Resolution		5 μA
– Voltage supply for analog sensors via the VT-HNC100-C-3X	U	U_B at X2A, Pin 7 (+24 Vsens)
Analog outputs (AO):		
– Voltage outputs		
• Channel number		2
• Output voltage	U_{nom}	–10 V to +10 V (max. –10.7 V to +10.7 V)
• Output current	I_{max}	±10 mA
• Load	R_{min}	1 kΩ
– Resolution		1.25 mV
– Non-linearity		
• In the range –9.5 V to +9.5 V		< 0,1 %
• In the range –10 V to –9.5 V and +9.5 V to +10 V		< 0,2 %

[1] If a 24 V transducer supply is implemented directly via the VT-HNC100...3X (supply voltage is looped in), the transducer specification has to be observed.

[2] If the factory settings are insufficient, the measurement technology can be calibrated on site via software in a system-specific way.

Technical data VT-HNC100-C-3X (Compact) continued

Gate inputs (DI)	Quantity	4
	Logic level	log 0 (low) ≤ 5 V; log 1 (high) ≥ 10 V to U_B, I_e = 20 mA at U_B = 24 V
	Port	Flexible conductor up to 1.5 mm^2
Gate outputs (DO)	Quantity	2
	Logic level	log 0 (low) ≤ 2 V; log 1 (high) ≤ U_B; I_{max} = 20 mA, Maximum load capacity C = 0.047 μF
	Port	Flexible conductor up to 1.5 mm^2
Reference potential for all signals		DGND
Digital position transducers (encoders):		
– SSI transducer (Due to the higher control quality, an SSI transducer with clock synchronization should be used.)		
• Coding		Gray-Code
• Data width		Adjustable up to max. 28 Bit
• Line receiver / line driver		RS485
• Voltage supply via the VT-HNC100-C-3X	U	U_B
– Reference potential for all signals		EGND
Dimensions		See page 16
Assembly		Top hat rail TH 35-7.5 or TH 35-15 according to EN 60715
Admissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Protection class according to EN 60529:1991		IP 20
Weight:	m	440 g
CE conformity		See page 2

Further technical details upon request.

Note:

Information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load see data sheet 30139-U.

Technical data VT-HNC100-...-3X (CPU + axis electronics)

Operating voltage [1]	U_B	18 to 30 VDC, residual ripple < 1.5 V_{pp}
Current consumption at 24 VDC	I	1 to 4 A (depending on the HNC variant and the additionally supplied components)
Processor		32 bit power PC
Interface for WIN-PED 6 interface for WIN-PED 7 Bus interface		RS232 RS232, optional TCP/IP PROFIBUS DP (max. 12 MBaud according to IEC 61158), CANopen, PROFINET RT, EtherNet/IP
PROFINET RT, EtherNet/IP		
• Minimum cycle time		2 ms
• Max. size of the cyclic I/O data		992 byte (max. 496 496 byte per direction)
• Transmission rate		100 Mbit/s, full-duplex
Analog inputs (AI) per axis electronics:		
– Voltage inputs (differential inputs)		
• Channel number		2
• Input voltage	U_E	max +12 V to –12 V (+10 V to –10 V measurable)
• Input resistance	R_E	200 kΩ ± 5 %
• Resolution		5 mV
• Non-linearity		< 0.2 %
• Calibration tolerance [2]		max. 40 mV (with factory settings)
– Current inputs		
• Channel number		2
• Input current	I_E	4 mA to 20 mA
• Input resistance	R_E	350 Ω at 20 °C (100 Ω measuring resistance)
• Leakage current	I_V	0.1 to 0.4 %
• Resolution		5 μA
– Voltage supply for analog sensors via the VT-HNC100...3X	U	U_B at X2A1 to X2A4, Pin 14 (+24 Vsens)
Analog outputs (AO) per axis electronics: [3]		2 (1)
– Non-linearity		
• In the range –9.5 V to +9.5 V		< 0.1 %
• In the range –10 V to –9.5 V and +9.5 V to +10 V		< 0.2 %
– Voltage output		
• Output voltage	U_{nom}	–10 V to +10 V (max. –10.7 V to +10.7 V)
• Output current	I_{max}	±10 mA
• Load	R_{min}	1 kΩ
• Residual ripple		±60 mV (without noise)
• Resolution		1.25 mV
– Current output		
• Output current Standardized	I_{nom}	4 mA to 20 mA
• Load	R_{max}	500 Ω
• Resolution		0,625 μA

[1] If a 24 V transducer supply is implemented directly via the VT-HNC100...3X (supply voltage is looped in), the transducer specification has to be observed.

[2] If the factory settings are insufficient, the measurement technology can be calibrated on site via software in a system-specific way.

[3] Configurable as current or voltage output.
Axis electronics slot 1 and axis electronics slot 2 have two voltage outputs Vout1 and Vout2. The axis electronics slot 3 and slot 4 only have one voltage output Vout1.

Technical data VT-HNC100-...-3X (CPU + axis electronics), continued

Gate inputs (DI) or outputs (DO) per axis electronics (settable via software)	Quantity	11 [1]
Gate inputs (DI)	Logic level	log 0 (low) ≤ 5 V; log 1 (high) ≥ 10 V to U_B, I_e = 20 mA at U_B = 24 V
	Port	Flexible conductor up to 1.5 mm²
Gate outputs (DO)	Logic level	log 0 (low) ≤ 2 V; log 1 (high) ≤ U_B; I_{max} = 20 mA, Maximum load capacity C = 0.047 µF
	Port	Flexible conductor up to 1.5 mm²
Reference potential for all signals		DGND
Digital position transducers (encoder) per axis electronics:		
– Incremental transducer (transducer with TTL output)		
• Input voltage	log 0	0 to 1 V
	log 1	2.8 to 5.5 V
• Input current	log 0	–0.8 mA (with 0 V)
	log 1	0.8 mA (with 5 V)
• Max. frequency referring to Ua1	f_{max}	250 kHz
• Voltage supply for incremental Transducer via the VT-HNC100...3X	U	5.25 V ±1 %, max. 400 mA total current across all axes at X8M1 to X8M4, pin 12 (+5 Venc)
– SSI transducer (Due to the higher control quality, an SSI transducer with clock synchronization should be used.)		
• Coding		Gray-Code
• Data width		Adjustable up to max. 28 Bit
• Line receiver / line driver		RS485
• Voltage supply for SSI encoders via the VT-HNC100...3X	U	U_B at X8M1 to X8M4, pin 14 (+24 Venc)
Reference potential for all signals		EGND
Reference voltage per axis electronics	U_{ref}	+10 V ± 25 mV (20 mA)
Dimensions		See page 16
Assembly		Top hat rail TH 35-7.5 or TH 35-15 according to EN 60715
Admissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Protection class according to EN 60529:1991		IP 20
Weight:		
– VT-HNC100-1-3X	m	585 g
– VT-HNC100-2-3X	m	690 g
– VT-HNC100-3-3X	m	850 g
– VT-HNC100-4-3X	m	960 g
with Ethernet	m	223 g more
CE conformity		See page 2

Further technical details upon request.

[1] Maximally, 20 digital outputs can be connected

Note:

Information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load see data sheet 30139-U.

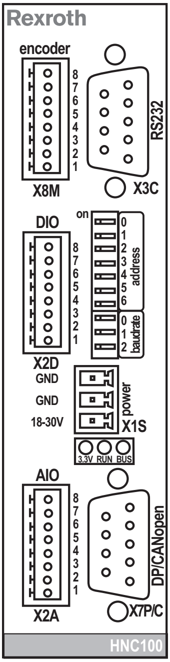
3

Pinout VT-HNC100-C-3X/... (Compact)

X8M	Encoder
Pin	
8	shield
7	24 Venc
6	+5 V
5	– Clk
4	+ Clk
3	– Data
2	+ Data
1	EGND

X2D	DIO (digital)
Pin	
8	shield
7	OUT2
6	OUT1
5	IN4
4	IN3
3	IN2
2	IN1
1	DGND

X2A	AIO (analog)
Pin	
8	shield
7	24 Vsens
6	Vout1 +
5	Vout2 +
4	Vin1
3	Cin2 +
2	Cin1 +
1	AGND



X3C	RS232
Pin	
1	
2	TxD
3	RxD
4	reserved
5	GND
6	reserved
7	reserved
8	reserved
9	

X1S	Power
Pin	
1	GND
2	GND
3	18 – 30 V

X7P	PROFIBUS DP
Pin	
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved

X7C	CANopen
Pin	
1	reserved
2	CAN_L
3	CAN_GND
4	reserved
5	reserved
6	reserved
7	CAN_H
8	reserved
9	reserved

Note:

The pins marked with **“reserved”** are reserved and must not be wired.

Pinout VT-HNC100-1-3X/... (1-axis version)

X3C	RS232
Pin	
1	
2	TxD
3	RxD
4	reserved
5	GND
6	reserved
7	reserved
8	reserved
9	

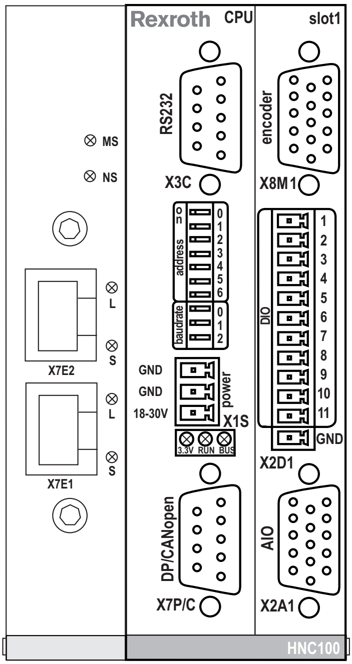
Slot 1 **X8M1**		**Encoder**	
		Incremental	SSI
Pin	1	– B (Inc)	
	2		+ CLK (SSI)
	3	+ R (Inc)	
	4	– R (Inc)	
	5	+ A (Inc)	
	6	– A (Inc)	
	7		– CLK (SSI)
	8	+ B (Inc)	
	9		– Data (SSI)
	10	EGND	
	11		+ Data (SSI)
	12	+5 Venc	
	13	+10 Vref	
	14	+24Venc	
	15	reserved	

X1S	Power
Pin	
1	GND
2	GND
3	18 – 30 V

Slot 1 **X2D1**		**DIO** (digital)
Pin	1	I/O 1
	2	I/O 2
	3	I/O 3
	4	I/O 4
	5	I/O 5
	6	I/O 6
	7	I/O 7
	8	I/O 8
	9	I/O 9
	10	I/O 10
	11	I/O 11
	12	DGND

X7E1, X7E2
Ethernet connection

X7P PROFIBUS DP	
Pin	
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved



Slot 1 **X2A1**		**AIO** (analog)
Pin	1	Vin1 +
	2	Vin1 –
	3	Vin2 +
	4	Vin2 –
	5	Cin1 +
	6	Cin1 –
	7	Cin2 +
	8	Cin2 –
	9	reserved
	10	AGND
	11	Vout1 +
	12	Vout2 +
	13	Cout1
	14	+24 Vsens
	15	reserved

X7C	CANopen
Pin	
1	reserved
2	CAN_L
3	CAN_GND
4	reserved
5	reserved
6	reserved
7	CAN_H
8	reserved
9	reserved

Note:
The pins marked with **"reserved"** are reserved and must not be wired.

Pinout VT-HNC100-2-3X/... (2-axis version)

X3C	**RS232**
Pin	
1	
2	TxD
3	RxD
4	reserved
5	GND
6	reserved
7	reserved
8	reserved
9	

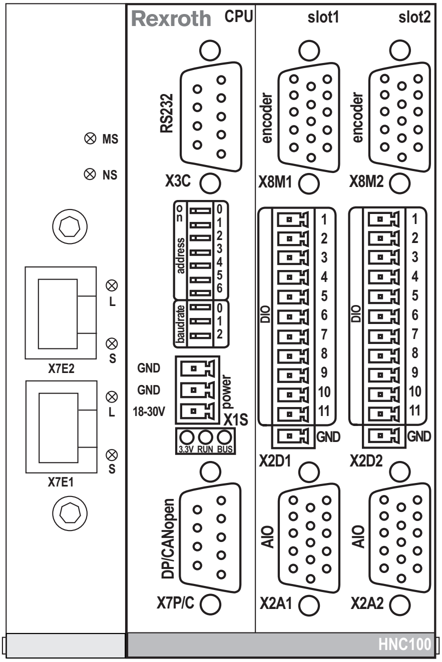
Slot 1 **X8M1** Slot 2 **X8M2**		**Encoder**	
		Incremental	SSI
Pin	1	– B (Inc)	
	2		+ CLK (SSI)
	3	+ R (Inc)	
	4	– R (Inc)	
	5	+ A (Inc)	
	6	– A (Inc)	
	7		– CLK (SSI)
	8	+ B (Inc)	
	9		– Data (SSI)
	10	EGND	
	11		+ Data (SSI)
	12	+5 Venc	
	13	+10 Vref	
	14	+24Venc	
	15	reserved	

X1S	**Power**
Pin	
1	GND
2	GND
3	18 – 30 V

Slot 1 **X2D1** Slot 2 **X2D2**		**DIO** [1] (digital)
Pin	1	I/O 1
	2	I/O 2
	3	I/O 3
	4	I/O 4
	5	I/O 5
	6	I/O 6
	7	I/O 7
	8	I/O 8
	9	I/O 9
	10	I/O 10
	11	I/O 11
	12	DGND

X7E1, X7E2
Ethernet connection

X7P PROFIBUS DP	
Pin	
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved



Slot 1 **X2A1** Slot 2 **X2A2**		**AIO** (analog)
Pin	1	Vin1 +
	2	Vin1 –
	3	Vin2 +
	4	Vin2 –
	5	Cin1 +
	6	Cin1 –
	7	Cin2 +
	8	Cin2 –
	9	reserved
	10	AGND
	11	Vout1 +
	12	Vout2 +
	13	Cout1
	14	+24 Vsens
	15	reserved

X7C	**CANopen**
Pin	
1	reserved
2	CAN_L
3	CAN_GND
4	reserved
5	reserved
6	reserved
7	CAN_H
8	reserved
9	reserved

[1] Maximally, 20 digital outputs can be connected.

Note:

The pins marked with **"reserved"** are reserved and must not be wired.

Pinout VT-HNC100-3-3X/... (3-axis version)

X3C	**RS232**
Pin	
1	
2	TxD
3	RxD
4	reserved
5	GND
6	reserved
7	reserved
8	reserved
9	

X1S	**Power**
Pin	
1	GND
2	GND
3	18 – 30 V

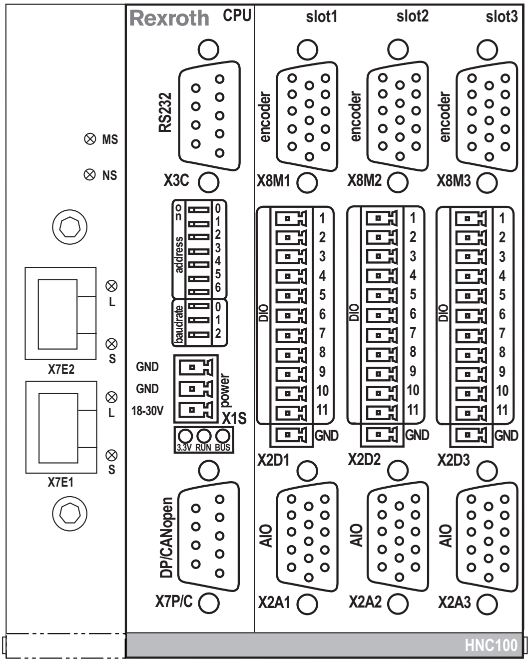
Slot 1 **X8M1** Slot 2 **X8M2** Slot 3 **X8M3**	**Encoder**	
	Incremental	SSI
Pin 1	– B (Inc)	
2		+ CLK (SSI)
3	+ R (Inc)	
4	– R (Inc)	
5	+ A (Inc)	
6	– A (Inc)	
7		– CLK (SSI)
8	+ B (Inc)	
9		– Data (SSI)
10	EGND	
11		+ Data (SSI)
12	+5 Venc	
13	+10 Vref	
14	+24Venc	
15	Reserved	

Slot 1 **X2D1** Slot 2 **X2D2** Slot 3 **X2D3**	**DIO** 1) (digital)
Pin 1	I/O 1
2	I/O 2
3	I/O 3
4	I/O 4
5	I/O 5
6	I/O 6
7	I/O 7
8	I/O 8
9	I/O 9
10	I/O 10
11	I/O 11
12	DGND

X7E1, X7E2
Ethernet connection

X7P PROFIBUS DP	
Pin	
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved

X7C	**CANopen**
Pin	
1	reserved
2	CAN_L
3	CAN_GND
4	reserved
5	reserved
6	reserved
7	CAN_H
8	reserved
9	reserved



Slot 1 **X2A1** Slot 2 **X2A2** Slot 3 **X2A3**	**AIO** (analog)
Pin 1	Vin1 +
2	Vin1 –
3	Vin2 +
4	Vin2 –
5	Cin1 +
6	Cin1 –
7	Cin2 +
8	Cin2 –
9	reserved
10	AGND
11	Vout1 +
12	Vout2 + 2)
13	Cout1
14	+24 Vsens
15	reserved

1) Maximally, 20 digital outputs can be connected.

2) Not available with slot 3 (reserved)

Note:

The pins marked with **"reserved"** are reserved and must not be wired.

3

Pinout VT-HNC100-4-3X/... (4-axis version)

X3C	**RS232**
Pin	
1	
2	TxD
3	RxD
4	reserved
5	GND
6	reserved
7	reserved
8	reserved
9	

Slot 1 **X8M1** Slot 2 **X8M2** Slot 3 **X8M3** Slot 4 **X8M4**		**Encoder**	
		Incremental	SSI
Pin	1	– B (Inc)	
	2		+ CLK (SSI)
	3	+ R (Inc)	
	4	– R (Inc)	
	5	+ A (Inc)	
	6	– A (Inc)	
	7		– CLK (SSI)
	8	+ B (Inc)	
	9		– Data (SSI)
	10	EGND	
	11		+ Data (SSI)
	12	+5 Venc	
	13	+10 Vref	
	14	+24Venc	
	15	reserved	

Slot 1 **X2D1** Slot 2 **X2D2** Slot 3 **X2D3** Slot 4 **X2D4**		**DIO** [1)] (digital)
Pin	1	I/O 1
	2	I/O 2
	3	I/O 3
	4	I/O 4
	5	I/O 5
	6	I/O 6
	7	I/O 7
	8	I/O 8
	9	I/O 9
	10	I/O 10
	11	I/O 11
	12	DGND

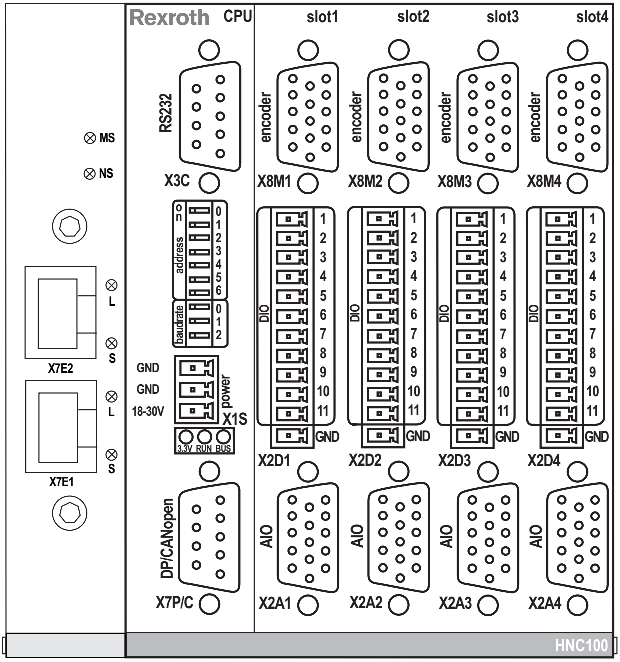
Slot 1 **X2A1** Slot 2 **X2A2** Slot 3 **X2A3** Slot 4 **X2A4**		**AIO** (analog)
Pin	1	Vin1 +
	2	Vin1 –
	3	Vin2 +
	4	Vin2 –
	5	Cin1 +
	6	Cin1 –
	7	Cin2 +
	8	Cin2 –
	9	reserved
	10	AGND
	11	Vout1 +
	12	Vout2 + [2)]
	13	Cout1
	14	+24 Vsens
	15	reserved

X1S	**Power**
Pin	
1	GND
2	GND
3	18 – 30 V

X7E1, X7E2
Ethernet connection

X7P PROFIBUS DP	
Pin	
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved

X7C	**CANopen**
Pin	
1	reserved
2	CAN_L
3	CAN_GND
4	reserved
5	reserved
6	reserved
7	CAN_H
8	reserved
9	reserved



1) Maximally, 20 digital outputs can be connected.

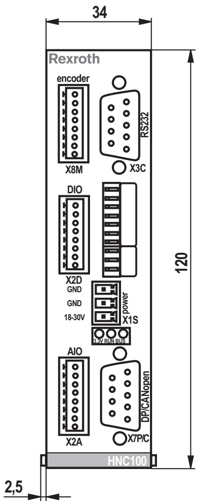
2) Not available with slot 3 and slot 4 (reserved)

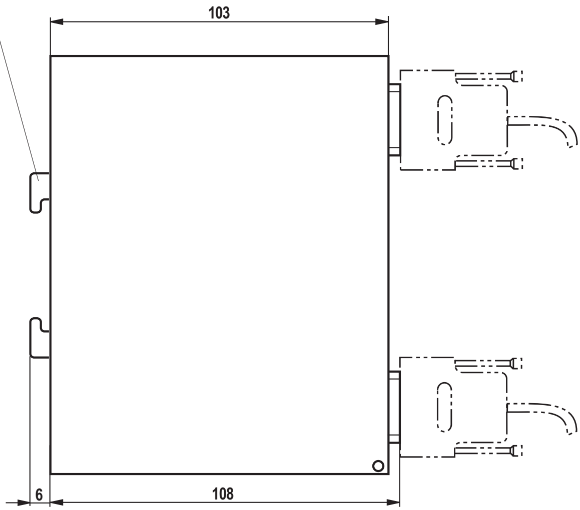
Note:

The pins marked with **"reserved"** are reserved and must not be wired.

Unit dimensions VT-HNC100-C-3X/… (dimensions in mm)

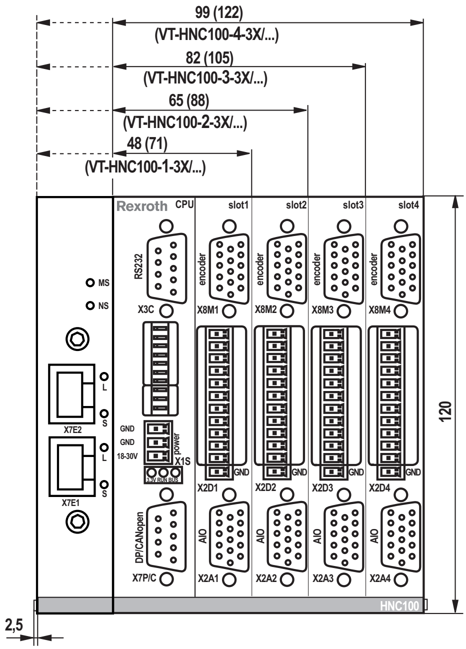
Installation on top hat rail TH 35-7.5 or TH 35-15 according to EN 60715





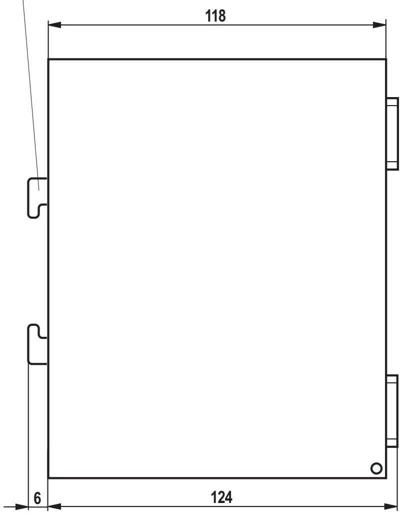
3

Unit dimensions of all axis versions (dimensions in mm)



Dimensions in ( ) apply for PROFINET RT version, EtherNet/IP version or TCP/IP version

Installation on top hat rail TH 35-7.5 or TH 35-15 according to EN 60715



Project Planning / Maintenance Instructions / Additional Information

Product documentation for VT-HNC100...3X

- **Product information 09956**
- **Data sheet 30139**
- **Operating instructions 30139-B**
- **Declaration on environmental compatibility 30139-U**
- **WIN-PED 6 / WIN-PED 7**
  - **First steps**
  - **Online help**
    - Machine data
    - NC commands
    - Parameter
    - CANopen (only with WIN-PED 6)
    - PROFIBUS DP (PROFIBUS DP with TCP/IP only with WIN-PED 7)
    - PROFINET RT (only with WIN-PED 7)
    - EtherNet/IP (only with WIN-PED 7)
- **General Information on the maintenance and commissioning of hydraulic components 07800 / 07900**

Commissioning software and documentation on the Internet: www.boschrexroth.com/HNC100

Maintenance instructions:

– The devices have been tested in the plant and are supplied with default settings.

– Only complete units can be repaired. The repaired units will be supplied with default settings. User-specific settings are not maintained. The operator will have to re-transfer the corresponding user parameters and programs.

Notes:

– Electric signals taken out via control electronics (e.g. signal “No error”) may not be used for the actuation of safety-relevant machine functions. (See also the European standard “Safety requirements for fluid power systems and their components - Hydraulics”, EN 982.)

– If electromagnetic interference must be expected, take appropriate measures to safeguard the function (depending on the application, e.g. screening, filtration).

– Wiring information
  · Largest spatial separation of signal and load lines possible
  · Don't lead signal lines through magnetic fields
  · If possibly, lay signal lines without intermediate terminals.
  · Don't lay signal lines parallelly to load lines

– For more information refer to the WIN-PED 6 and WIN-PED 7 online help and the 30139-B operating instructions

– The upper and lower ventilation slots must not be concealed by adjacent units in order to provide for sufficient cooling.

Notes

Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

Rexroth
Bosch Group

Digital drive controller for hydraulic axes with sercos interface

Type VT-HNC100.../S

RE 30159
Edition: 2012-03
Replaces: 09.11

H7644

▶ Component series 3X

Contents

Features

The VT-HNC100...3X/S digital drive controller complies with the specific requirements for closed-loop control of hydraulic linear drives.
It is designed for being used in rough industrial environments as regards interference immunity, mechanical vibration, shock, and climate resistance.

Areas of application
- Machine tools
- Bending machines

Technology functions
- Positioning
- Velocity controller:
  – Controlled
  – Regulated
- Force controller
- Substitutional closed-loop control
- Moving without following error
- Quadrant error correction

Hydraulic axes
- Measurement system:
  – Incremental TTL 5V
  – SSI transducer
  – EnDat 2.2
  – Analog 0 to ±10 V
- Actuating variable output voltage or current
- Freely configurable controller variants
  – Position / force / velocity controller
  – Substitutional closed-loop control (position/force)

Programming
- Via the control with IndraWorks

Operation
- IndraWorks

Process connection
- Digital inputs and outputs,
- Analog inputs and outputs,
- sercos II or sercos III to communicate with a superior control system

Assembly
- Top hat rail 35 mm

CE conformity
- CE conformity according to EMC Directive 2004/108/EC and EMVG (Act on electromagnetic compatibility of operating media) from February 26, 2008
  Harmonized standards used:
  EN 61000-6-2:2005
  EN 61000-6-3:2007

More information
www.boschrexroth.com/hnc100

Ordering code

VT-HNC100	–		–	3X	/	S	–		–		/	
01		02		03		04		05		06		07

01	Serial unit	**VT-HNC100**
02	Versions for an hydraulic axis	
	Compact	**C**
	Standard	**1**
03	Component series 30 to 39 (30 to 39: Unchanged technical data and pin assignment)	**3X**
04	Bus connection	
	sercos II / sercos III [1]	**S**
05	Position transducer	
	Incremental/EnDat 2.2/SSI (standard) [2]	**I**
	EnDat 2.2/SSI (only in connection with Compact version) [2]	**S**
06	sercos II (only in connection with Compact version)	**00**
	sercos III (only in connection with Standard version)	**30**
07	Option	**E**
	Without	**000**

Available variants

Type	Material number
VT-HNC100-C-3X/S-S-00/000	R901112919
VT-HNC100-1-3X/S-I-30/000	R901234133

[1] Ethernet service interface only in connection with sercos III

[2] Can be selected by means of the IndraWorks PC program

3

Included in the scope of delivery:

Mating connector for

- X1S (type Phoenix Mini Combicon 3-pole),
- X2D (type Phoenix Micro Combicon 8-pole and/or Phoenix Mini Combicon 12-pole),
- X2A (type Phoenix Micro Combicon 8-pole and/or HD-SUB 15-pole),
- X8M (type Phoenix Micro Combicon 8-pole and/or HD-SUB 15-pole)

Recommended accessories (can be ordered separately)

Denomination	Material number
Interface cable RS232, length 3 m	R900776897
USB RS232 converter	R901066684
Cable set VT17220-1X/HNC100-3X, length 2 m, for analog signals (connection X2A) or digital position measurement systems (connection X8M) with HD connector and open breakout cable for VT-HNC100-1-3X	R901189300
Cable set VT17220-1X/HNC100-3X length 2 m, for analog signals (connection X2A) or digital position measurement systems (connection X8M) with FK-MC connector and open breakout cable for VT-HNC100-C-3X	R901189302

Software project planning

Project planning

Developing application-specific data sets forms the basis for the function of the VT-HNC100...3X/S. These data sets are generated on the PC and sent to the VT-HNC100...3X/S using a serial Ethernet interface. This software parameterization is implemented according to fix steps:

1. Depending on the assignment, the inputs and outputs and the parameters used are defined.
2. The parameters (selection of transducers and controllers) are defined.
3. The data are sent to the VT-HNC100...3X/S.
4. The settings are optimized at the machine.

PC program "IndraWorks"

To implement the project planning tasks, the "IndraWorks" PC program is available to the user. It serves for parameterizing, setting, and diagnosing the VT-HNC100...3X/S.

Scope of service:

- Comfortable dialog functions for setting the parameters online or offline
- Dialog window for the online setting of the parameter values
- Various options for the display of the process variables

Notice:

The PC program "IndraWorks" is **not** covered by the scope of delivery.

Queries: support.nc-systems@boschrexroth.de

Overview of the controller functions

Position controller:

- PDT1 controller
- Linear amplification characteristic curve
- Direction-dependant gain adjustment
- Adaptation of the valve characteristic curve
- Valve characteristic diagram
- Fine positioning
- Residual voltage principle
- Compensation of zero point errors
- State feedback via:
  - Force,
  - Position
- Command value feedforward

Force controller:

- PIDT1 controller
- I share switchable via window
- Differential pressure evaluation
- Additive velocity addition

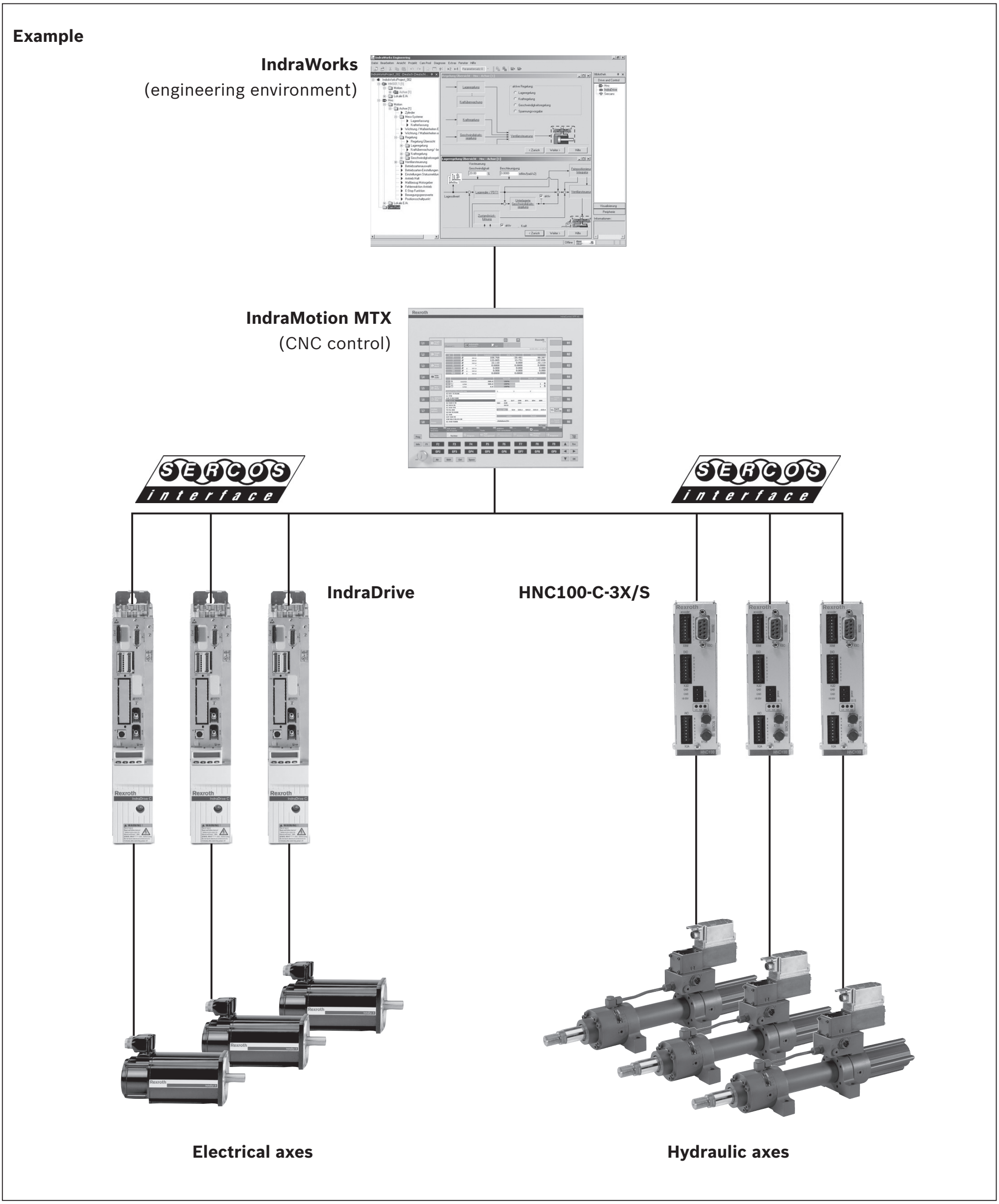
Velocity controller:

- PI controller
- I share switchable via window

Monitoring functions:

- Dynamic following error monitoring
- Traversing range limits (electronic end switches)
- Cable break monitoring for position transducers
- Cable break monitoring for sensors with output 4 to 20 mA

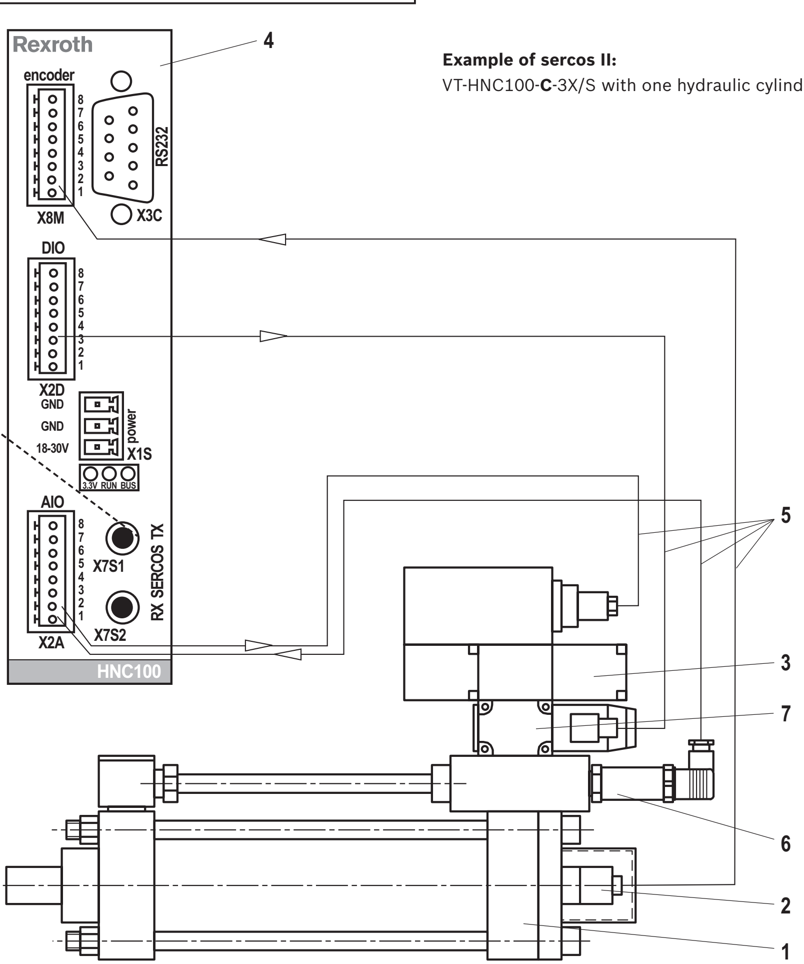
System overview



System overview, interfaces

Superior control system
Possible interfaces with the VT-HNC100...3X/S:
- Analog signals
- Digital inputs/outputs
- Serial interface
- Bus systems (sercos II or sercos III)

Example of sercos II:
VT-HNC100-**C**-3X/S with one hydraulic cylinder axis



1 Single-rod cylinder
2 Integrated position measurement system
3 Continuous control valve with integrated control electronics
4 VT-HNC100...3X/S
5 Connection cable
6 Pressure transducer
7 Sandwich plate shut-off valve (with connector switching amplifier)

Technical data VT-HNC100-C-3X/S (Compact)

Operating voltage [1)]	U_B	18 to 30 VDC
Current consumption at 24 VDC		Approx. 200 mA (observe additional current consumption for connected sensors/actuators)
Processor		32 bit power PC
Analog inputs (AI):		
– Voltage input (reference to AGND - Analog ground)		
• Channel number		1
• Input voltage	U_E	Max. +12 V to −12 V (+10 V to −10 V measurable)
• Input resistance	R_E	200 kΩ ± 5 %
• Resolution		5 mV
• Non-linearity		< 0.2 %
• Calibration tolerance [2)]		Max. 40 mV (with factory settings)
– Current inputs		
• Channel number		2
• Input current	I_E	4 mA to 20 mA
• Leakage current	I_V	0.1 to 0.4 % (with 100 Ω between pin 2 and/or pin 3 (Cin1+ and/or Cin2+) and "AGND"
• Resolution		5 µA
– Voltage supply for analog sensors via the VT-HNC100-C-3X/S	U, I	U_B, **max. 100 mA** at X2A, pin 7 (+24 Vsens)
Analog outputs (AO):		
– Voltage outputs		
• Channel number		2
• Output voltage	U_{nom}	−10 V to +10 V (max. −10.7 V to +10.7 V)
• Output current	I_{max}	±10 mA
• Load	R_{min}	1 kΩ
– Resolution		1.25 mV
– Non-linearity		
• In the range −9.5 V to +9.5 V		< 0.1 %
• In the range −10 V to −9.5 V and +9.5 V to +10 V		< 0.2 %

3

1) If a 24 V transducer supply is implemented directly via the VT-HNC100...3X/S (supply voltage is looped in), the transducer specification has to be observed.

2) If the factory settings are insufficient, the measurement technology can be calibrated on site via software in a system-specific way.

Technical data VT-HNC100-C-3X/S (Compact) continued

Bus interface		sercos II
Switching inputs (DI)	Quantity	4
	Logic level	log 0 (low) ≤ 5 V; log 1 (high) ≥ 10 V to U_B, I_e = 20 mA with U_B = 24 V
	Connection	Flexible conductor up to 1.5 mm²
Switching outputs (DO)	Quantity	2
	Logic level	log 0 (low) ≤ 2 V; log 1 (high) ≤ U_B; I_{max} = 20 mA, maximum load capacity C = 0.047 µF
	Connection	Flexible conductor up to 1.5 mm²
Reference potential for all signals		DGND
Digital position transducers (encoders):		
– **SSI transducer** (Due to the higher control quality, an SSI transducer with clock synchronization should be used.)		
• Coding		Gray-Code / binary code
• Data width		Adjustable 12 to 28 bits
• Line receiver / line driver		RS485
• Voltage supply via the VT-HNC100-C-3X/S	*U, I*	U_B, **max. 200 mA** at X8M, pin 7 (+24 Venc)
– **Position transducer, EnDat 2.2**		
• Interface (clock and data) according to RS485		
• Voltage supply via the VT-HNC100-C-3X/S	*U, I*	5.25 V ±1 %, **max. 400 mA** at X8M, pin 6 (+5 Venc) 3.6 to 5.25 V must be applied to the transducer.
• Resolution		Minimum 10 nm or higher
Reference potential for all signals		EGND
Dimensions		See page 13
Assembly		Top hat rail TH 35-7.5 or TH 35-15 according to EN 60715
Admissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Protection class according to EN 60529:1991		IP 20
Weight	*m*	440 g
CE conformity		See page 2

Further technical details upon request.

Notice:
For information on the environment simulation testing for the areas EMC (electro-magnetic compatibility), climate and mechanical load, see data sheet 30139-U.

Technical data VT-HNC100-1-3X/S (1-axis version)

Operating voltage [1)]	U_B	18 to 30 VDC
Current consumption at 24 VDC		CPU card approx. 200 mA Per axis approx. 100 mA (observe additional current consumption for connected sensors/actuators)
Processor		32 bit power PC
Analog inputs (AI) per axis electronics:		
– Voltage inputs (differential inputs)		
• Channel number		2
• Input voltage	U_E	Max. +12 V to −12 V (+10 V to −10 V measurable)
• Input resistance	R_E	200 kΩ ± 5 %
• Resolution		5 mV
• Non-linearity		< 0.2 %
• Calibration tolerance [2)]		Max. 40 mV (with factory settings)
– Current inputs		
• Channel number		2
• Input current	I_E	4 mA to 20 mA
• Leakage current	I_V	0.1 to 0.4 %
• Resolution		5 µA
– Voltage supply for analog sensors via the VT-HNC100-1-3X/S	U, I	U_B, **max. 200 mA** at X2A, pin 14 (+24 Vsens)
Analog outputs (AO) per axis electronics: [3)]		2
– Non-linearity		
• In the range −9.5 V to +9.5 V		< 0.1 %
• In the range −10 V to −9.5 V and +9.5 V to +10 V		< 0.2 %
– Voltage output		
• Output voltage	U_{nom}	−10 V to +10 V (max. −10.7 V to +10.7 V)
• Output current	I_{max}	±10 mA
• Load	R_{min}	1 kΩ
• Residual ripple		±60 mV (without noise)
• Resolution		1.25 mV
– Current output		
• Output current standardized	I_{nom}	4 mA to 20 mA
• Load	R_{max}	500 Ω
• Resolution		0.625 µA
Bus interface		sercos III
Switching inputs (DI) and/or outputs (DO) per axis electronics (adjustable via software)	Quantity	11
Switching inputs (DI)	Logic level	log 0 (low) ≤ 5 V; log 1 (high) ≥ 10 V to U_B, I_e = 20 mA with U_B = 24 V
	Connection	Flexible conductor up to 1.5 mm²
Switching outputs (DO)	Logic level	log 0 (low) ≤ 2 V; log 1 (high) ≤ U_B; I_{max} = 20 mA, maximum load capacity C = 0.047 µF
	Connection	Flexible conductor up to 1.5 mm²
Reference potential for all signals		DGND

1) If a 24 V transducer supply is implemented directly via the VT-HNC100-1-3X/S (supply voltage is looped in), the transducer specification has to be observed.

2) If the factory settings are insufficient, the measurement technology can be calibrated on site via software in a system-specific way.

3) Configurable as current or voltage output.

3

Technical data VT-HNC100-...-3X (1-axis version), continued

Digital position transducers (encoder) per axis electronics:		
– **Position transducer, incremental** (transducer with TTL output)		
• Input voltage	log 0	0 to 1 V
	log 1	2.8 to 5.5 V
• Input current	log 0	–0.8 mA (with 0 V)
	log 1	0.8 mA (with 5 V)
• Max. frequency referring to Ua1	f_{max}	250 kHz
• Voltage supply via the VT-HNC100...3X/S	*U, I*	5.25 V ±1 %, **max. 400 mA** at X8M1, pin 12 (+5 Venc)
– **SSI transducer** (Due to the higher control quality, an SSI transducer with clock synchronization should be used.)		
• Coding		Gray-Code / binary code
• Data width		Adjustable 12 to 28 bits
• Line receiver / line driver		RS485
• Voltage supply via the VT-HNC100...3X/S	*U, I*	U_B, **max. 500 mA** at X8M1, pin 14 (+24 Venc)
– **Position transducer, EnDat 2.2**		
• Interface (clock and data) according to RS 485		
• Voltage supply via the VT-HNC100...3X/S	*U, I*	5.25 V ±1 %, **max. 400 mA** at X8M1, pin 12 (+5 Venc) 3.6 to 5.25 V must be applied to the transducer.
• Resolution		Minimum 10 nm or higher
Analog position transducer (encoder):		
• Input voltage	U_E	Max. +12 V to –12 V (+10 V to –10 V measurable)
• Input resistance	R_E	> 10 MΩ
• Resolution		5 mV
• Non-linearity		< 0.2 %
• Calibration tolerance [1]		Max. 40 mV (with factory settings)
• Voltage supply via the VT-HNC100...3X/S	*U, I*	+10 V ± 25 mV, max. 20 mA at X8M1, pin 13 (+10 Vref)
Reference potential for all signals		EGND
Dimensions		See page 13
Assembly		Top hat rail TH 35-7.5 or TH 35-15 according to EN 60715
Admissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Protection class according to EN 60529:1991		IP 20
Weight	*m*	585 g
CE conformity		See page 2

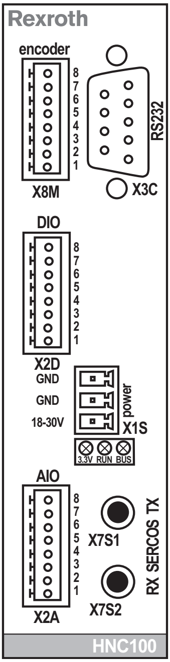
Further technical details upon request.

Notice:
For information on the environment simulation testing for the areas EMC (electro-magnetic compatibility), climate and mechanical load, see data sheet 30139-U.

[1] If the factory settings are insufficient, the measurement technology can be calibrated on site via software in a system-specific way.

Pin assignment VT-HNC100-C-3X/S... (Compact with sercos II)

X8M	Encoder	
Pin	SSI	EnDat 2.2
8	Shield	Shield
7	24 Venc	
6		+5 V
5	– Clk	– Clk
4	+ Clk	+ Clk
3	– Data	– Data
2	+ Data	+ Data
1	EGND	



X3C	RS232
Pin	
1	
2	TxD
3	RxD
4	Reserved
5	GND
6	Reserved
7	Reserved
8	Reserved
9	

X2D	DIO (Digital)
Pin	
8	Shield
7	OUT2
6	OUT1
5	IN 4
4	IN 3
3	IN 2
2	IN 1
1	DGND

X1S	Power
Pin	
1	GND
2	GND
3	18 – 30 V

X2A	AIO (Analog)
Pin	
8	Shield
7	24 Vsens
6	Vout1 +
5	Vout2 +
4	Vin 1
3	Cin2 +
2	Cin1 +
1	AGND

X7	sercos II
S1	TX
S2	RX

Notice:
The pins marked with **"reserved"** are reserved and must not be connected!

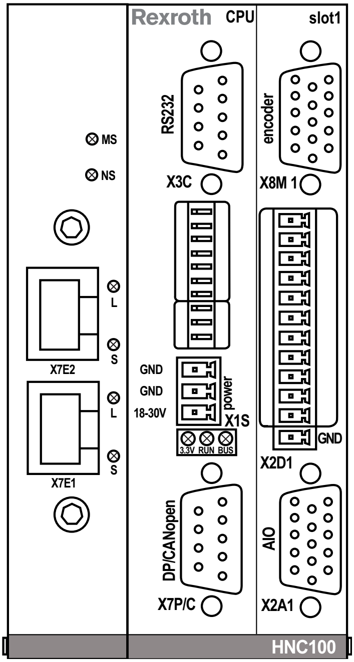
3

Pin assignment VT-HNC100-1-3X/S... (1-axis version with sercos III)

Slot 1 X8M1	Encoder			
	Incremental	**EnDat 2.2**	**SSI**	**Analog**
Pin				
1	– B (Inc)			
2		+ CLK	+ CLK	
3	+ R (Inc)			
4	– R (Inc)			
5	+ A (Inc)			
6	– A (Inc)			
7		– CLK	– CLK	
8	+ B (Inc)			
9		– Data	– Data	
10	EGND	EGND	EGND	EGND
11		+ Data	+ Data	
12	+5 Venc	+5 Venc		
13				+10 Vref
14			+24 Venc	
15				Vimp1

Slot 1 X2D1	DIO (Digital)
Pin	
1	I/O 1
2	I/O 2
3	I/O 3
4	I/O 4
5	I/O 5
6	I/O 6
7	I/O 7
8	I/O 8
9	I/O 9
10	I/O 10
11	I/O 11
12	DGND

X3C	RS232
Pin	
1	
2	TxD
3	RxD
4	Reserved
5	GND
6	Reserved
7	Reserved
8	Reserved
9	



Slot 1 X2A1	AIO (Analog)
Pin	
1	Vin1 +
2	Vin1 –
3	Vin2 +
4	Vin2 –
5	Cin1 +
6	Cin1 –
7	Cin2 +
8	Cin2 –
9	Reserved
10	AGND
11	Vout1 +
12	Vout2 +
13	Cout1
14	+24 Vsens
15	Reserved

X1S	Power
Pin	
1	GND
2	GND
3	18 – 30 V

X7E1, X7E2
sercos III connection

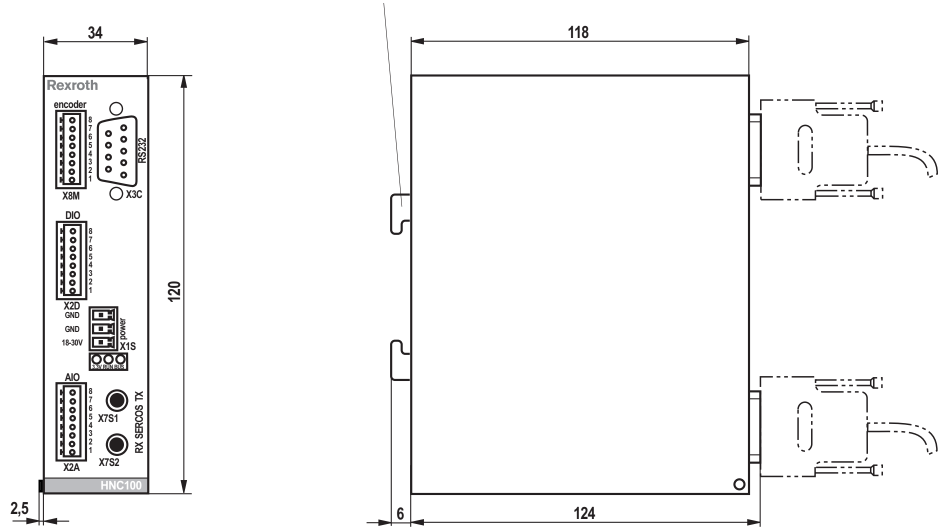
Notices:
The pins marked with **"reserved"** are reserved and must not be connected!

PROFIBUS DP or CANopen (connection X7P/C) are not available with the sercos version.

Unit dimensions (dimensions in mm)

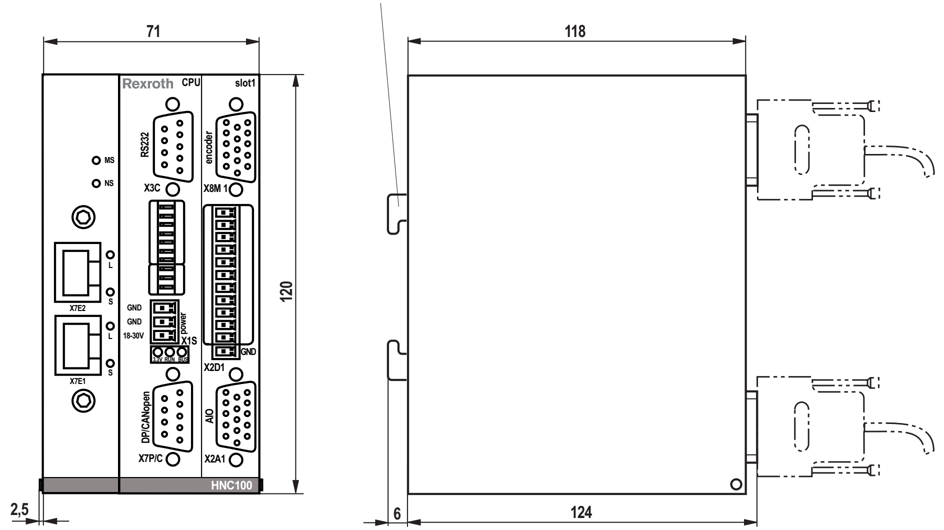
VT-HNC100-C-3X/S...

Assembly on top hat rail TH 35-7.5 or TH 35-15 according to EN 60715



VT-HNC100-1-3X/S...

Assembly on top hat rail TH 35-7.5 or TH 35-15 according to EN 60715



3

Project planning / maintenance instructions / additional information

Product documentation for VT-HNC100...3X/S

- **Product information 09956**
- **Data sheet 30159**
- **Operating instructions 30159-B**
- **Functional description 30159-FK**
- **Parameter description 30159-PA**
- **Environmental compatibility statement 30139-U**

Commissioning software and documentation on the Internet: www.boschrexroth.com/HNC100

Maintenance instructions:

- The devices have been tested in the plant and are supplied with default settings.
- Only complete units can be repaired. Repaired devices are returned with default settings. User-specific settings are not accepted. The user must transfer all appropriate user parameters and programs again.

Notices:

- The VT-HNC100...3X/S does not support rotary drives
- Electric signals taken out via control electronics (e.g. "No error" signal) must not be used for switching safety-relevant machine functions! (See also the European standard "Safety requirements for fluid power systems and their components - Hydraulics", EN 982.)
- If electro-magnetic interference is to be anticipated, suitable measures must be taken to ensure the function (depending on the application, e.g. shielding, filtration)!
  In order to satisfy the requirements of the CE mark, a cable of category 7 (cat. 7 according to ISO/IEC 11801) must be used for the sercos III communication.
- The upper and lower ventilation slots must not be concealed by adjacent units in order to provide for sufficient cooling.

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Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

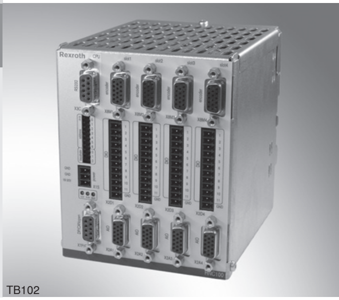
Rexroth
Bosch Group

Digital controller assembly HNC100-SEK for the secondary control of axial piston units

RE 30162/08.11
Replaces: 04.11

Type SYHNC100-SEK

Component series 3X



TB102

Table of contents

Features

The VT-HNC100-SEK digital controller assembly is suitable for the closed-loop speed control, the closed-loop torque control as well as the open-loop torque control of axial piston units Type A4VS..DS1(E) with secondary control.

It comprises interfaces for recording the swivel angle position of individual or tandem units as well as for the speed feedback with incremental encoders. The software contains closed-loop control, open-loop control and monitoring functions especially designed for the secondary control.

- Parameterization and process visualization with commercially available PC via serial interface
- Two modules with monitoring function for analyzing the signals from inductive swivel angle sensors
- Analog differential inputs (voltage or current)
- Up to 2 incremental or SSI inputs with monitoring function for the speed or rotary angle sensing
- 1 analog output ±10 V per I/O card (slot 3 and 4)
- 2 analog outputs ±10 V per LVDT card (slot 1 and 2)
- Digital inputs
- Profibus DP or CANopen for the communication with SPS
- Digital outputs (switching outputs)
- Configurable sequence routine for switch-on/switch-off order with signal output for isolator valve and a brake that might be available
- Monitoring functions with output of error codes for a better diagnosis

Note regarding the system structure:

In a secondary unit with servo valve 4WS2EM10 (standard version, see data sheet 92056), you moreover need an amplifier module VT 11021 (see data sheet 29743).

Assembly

- Top hat rail 35 mm

Ordering code

SYHNC100 – SEK – – 3X / – – 00 / S000

SYHNC100	**= Serial unit**
Version for secondary control	**= SEK**
Number of secondary units	**= 2** **= 4**
Component series 30 to 39 (30 to 39: Unchanged technical data and pinout)	**= 3X**

Bus connection

P =	PROFIBUS DP
C =	CANopen

Position transducer [2]

A =	2 x LVDT + 1 x Incremental/SSI (standard)
D =	4 x LVDT + 2 x Incremental/SSI (standard)

Hardware option

00 =	No fitting

Software option

S000 [1] **=**	Without

[1] Software functionality according to description on page 4

[2] With 2 secondary units, „A“ has to be selected; with 4 secondary units, „D“ has to be selected.

Standard types

Type	Material number
SYHNC100-SEK-2-3X/C-A-00/S000	R901293741
SYHNC100-SEK-2-3X/P-A-00/S000	R901293742
SYHNC100-SEK-4-3X/C-D-00/S000	R901267896
SYHNC100-SEK-4-3X/P-D-00/S000	R901278028

Included within the scope of delivery:

Mating connector for
- X1S (Type Phoenix Mini Combicon 3-pole)
- X2D (Type Phoenix Mini Combicon 12-pole)
- X2A (Type HD-SUB 15-pole)
- X8M (Type HD-SUB 15-pole)

Recommended accessories (can be ordered separately)

Description	Material number
Interface cable RS232 (1:1), length 3 m	**R900776897**
USB-RS232 converter	**R901066684**
Cable set VT17220-1X/HNC100-3X, length 2m, for analog signals (connection X2A) and digital position measurement systems (connection X8M) with HD connector and open breakout cable for SYHNC100-SEK-3X	**R901189300**
Plug-in connector Type 6ES7972-0BA41-0XA0 for PROFIBUS DP	**R900050152**

Software functionality

Software functionality

– Basically, the software contains the closed-loop control types closed-loop speed control, closed-loop torque control and open-loop torque control. It is possible to switch between the closed-loop control types during operation in a shock-free form.
– Adjustable ramp functions for speed and torque command value allow for an adjustment of external command values
– Software-based monitoring functions with parameterizable switching thresholds as well as hardware error messages analyzed by software
– Underlying closed-control loops per LVDT card for two swivel angle controllers
– Sequence program with defined signal sequence for switching a unit on and off
– Configuration, parameterization and diagnosis of an application by means of the WIN-PED PC program
– System-specific software extensions can be prepared upon request

PC program WIN-PED

For SYHNC100-SEK, only the version "WIN-PED 6.6" is used. It can be downloaded on the Internet from www.boschrexroth.de\hnc100.

Related enquiries: support.nc-systems@boschrexroth.de

System requirements:

– IBM PC or compatible system
– Windows XP or Windows 7
– Random access memory (512 MB recommended)
– 100 MB free hard disk capacity

Note:

The "WIN-PED 6.6" PC program is **not** included in delivery. It can be downloaded in the Internet free of charge!

Download in the Internet: www.boschrexroth.com/hnc100

Inquiries: support.nc-systems@boschrexroth.de

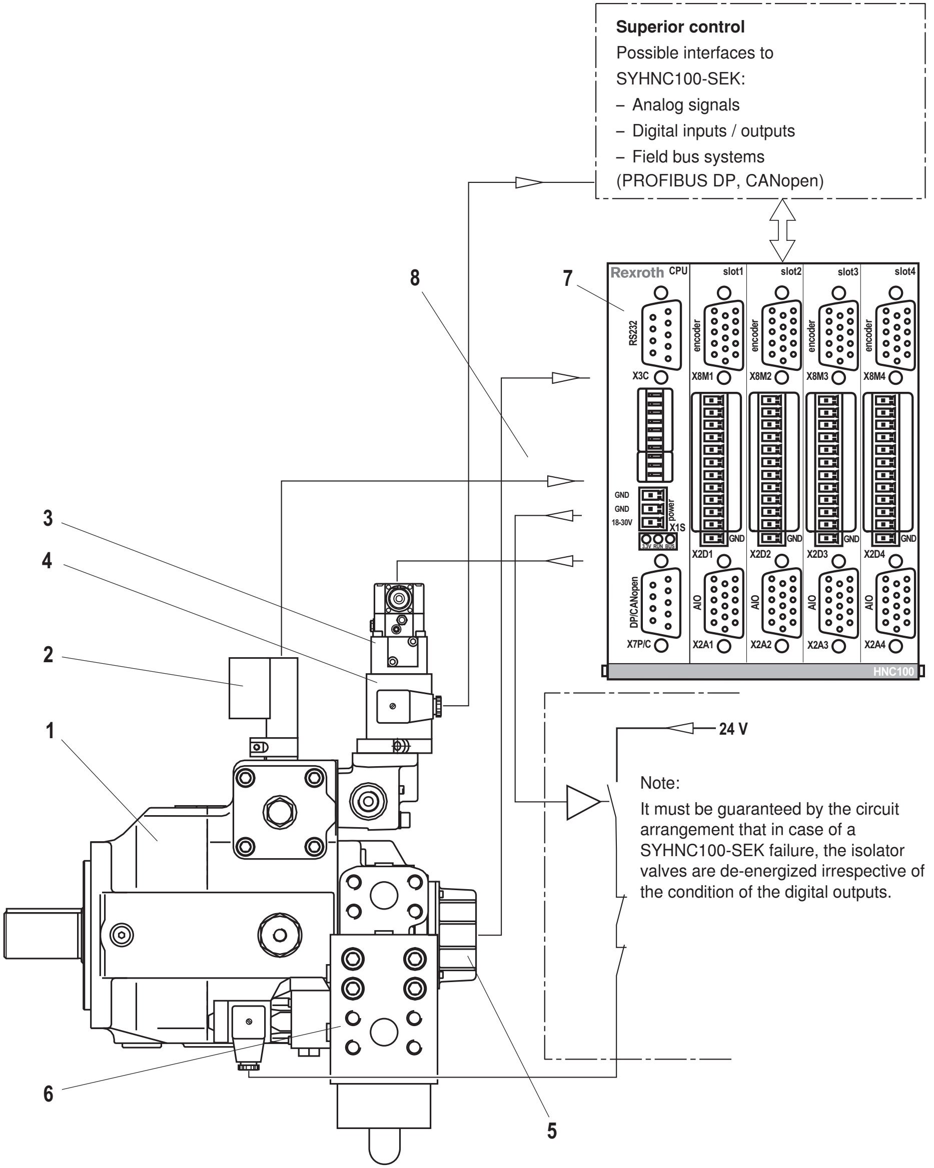
Overview of the controller functions

– Swivel angle controller
– Speed controller
– Closed-loop torque control
– Open-loop torque control

Monitoring functions:

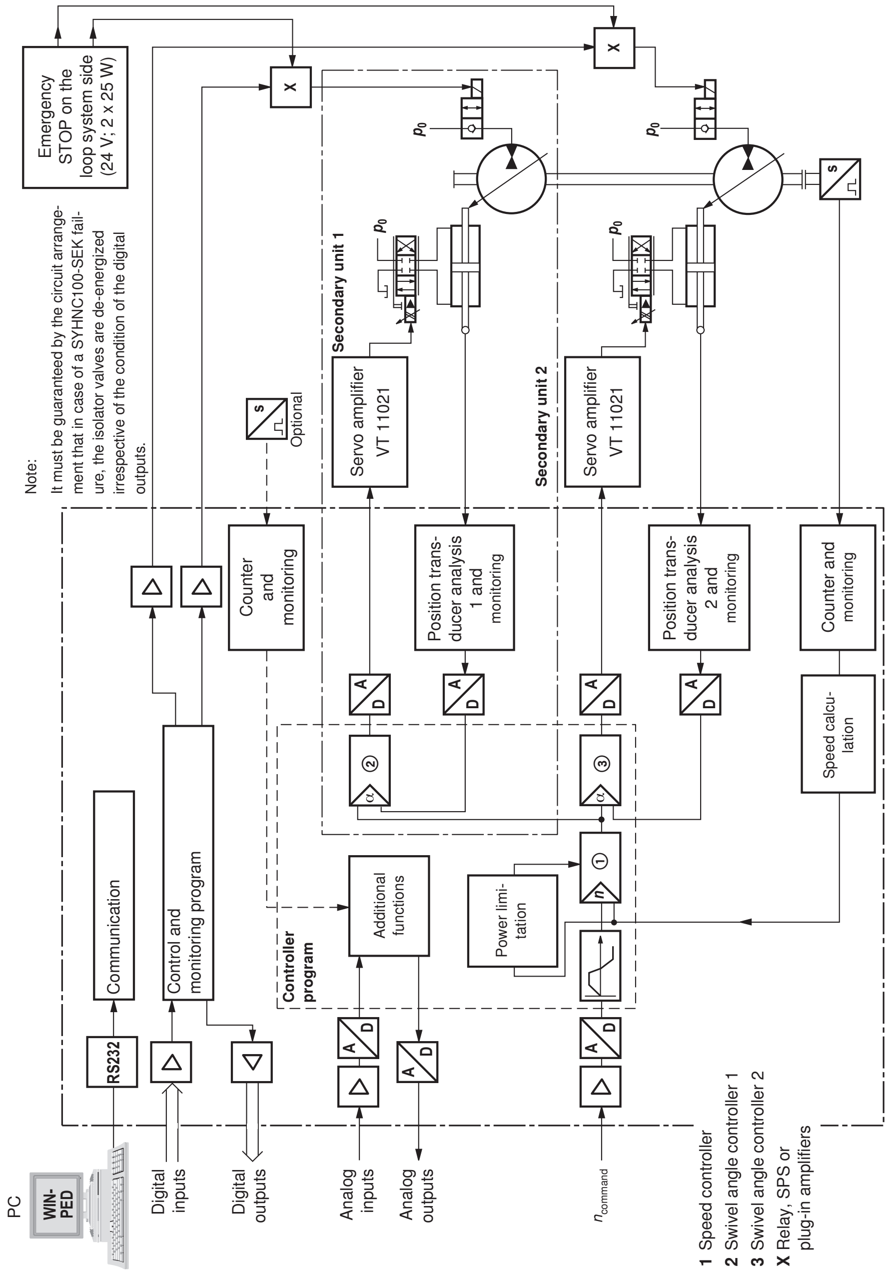
– Cable break monitoring for incremental and SSI encoder
– Cable break monitoring for swivel angle transducers
– Acceleration too high
– Overspeed (max. speed)
– Speed difference command / actual
– Swivel angle difference command / actual

System overview (example)



1 Secondary unit A4VS…
2 Swivel angle position transducer IW9 or AWX
3 Actuation of the servo valve by amplifier VT 11021
4 Sandwich plate filter
5 Incremental or SSI encoder
6 Electrically unlockable check valve (isolator valve)
7 SYHNC100-SEK
8 Connection cable

Block diagram (example with 2 drives)



Technical data

Operating voltage [1)]	U_B	18 to 30 VDC, residual ripple < 1.5 V_{pp}
Current consumption at 24 VDC		1 to 4 A (depending on the HNC variant and the additionally supplied components)
Processor		32 bit power PC
Analog inputs (AI) per axis electronics:		
– Voltage inputs (differential inputs)		
• Channel number		2
• Input voltage	U_E	max +12 V or –12 V (+10 V to –10 V measurable)
• Input resistance	R_E	200 kΩ ± 5 %
• Resolution		5 mV
• Non-linearity		< ±0,25 %
• Calibration tolerance		max. 40 mV (with factory settings)
– Current inputs		
• Channel number		2
• Input current	I_E	4 mA to 20 mA
• Input resistance	R_E	350 Ω at 20° (100 Ω measuring resistance)
• Leakage current	I_V	0.1 to 0.4 %
• Resolution		5 μA
– Voltage supply for analog sensors via SYHNC100-SEK	U	U_B at X2A1 to X2A4, Pin 14 (+24 Vsens)
Analog outputs (AO) per axis electronics:		
– with 4 drives		2 analog outputs each at X2A1 and X2A2 1 analog output each at X2A3 and X2A4
– with 2 drives		2 analog outputs at X2A1 1 analog output at X2A2
– Non-linearity		
• In the range –9.5 V to +9.5 V		< 0.1 %
• In the range –10 V to –9.5 V and +9.5 V to +10 V		< 0.2 %
– Voltage output		
• Output voltage	U_{nom}	–10 V to +10 V (max. –10.7 V to +10.7 V)
• Output current	I_{max}	±10 mA
• Load	R_{min}	1 kΩ
• Residual ripple		±60 mV (without noise)
• Resolution		1.25 mV
– Current output		
• Output current Standardized	I_{nom}	4 mA to 20 mA
• Load	R_{max}	500 Ω
• Resolution		0.625 μA

[1)] If a 24 V transducer supply is implemented directly via the SYHNC100-SEK (supply voltage is looped in), the transducer specification has to be observed.

3

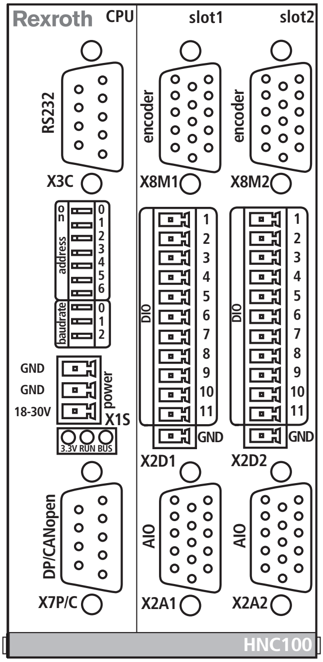
Technical data (continued)

Interface for WIN-PED 6		RS232
Bus interface		PROFIBUS DP (max. 12 MBaud according to IEC 61158), CANopen
Gate inputs (DI) or outputs (DO) per axis electronics (settable via software)	Quantity	11 [1)]
Gate inputs (DI)	Logic level	log 0 (low) ≤ 5 V; log 1 (high) ≥ 10 V to U_B, I_e = 20 mA at U_B = 24 V
	Port	Flexible conductor up to 1.5 mm²
Gate outputs (DO)	Logic level	log 0 (low) ≤ 2 V; log 1 (high) ≤ U_B; I_{max} = 20 mA, Maximum load capacity C = 0.047 μF
	Port	Flexible conductor up to 1.5 mm²
Reference potential for all signals		DGND
Digital position transducers (encoder) per axis electronics:		
– Incremental transducer (transducer with TTL output)		
• Input voltage	log 0	0 to 1 V
	log 1	2.8 to 5.5 V
• Input current	log 0	–0.8 mA (with 0 V)
	log 1	0.8 mA (with 5 V)
• Max. frequency referring to Ua1	f_{max}	250 kHz
• Voltage supply for incremental encoders via the HNC	*U, I*	5.25 V ±1 %, **max. 400 mA total current across all axes** at X8M3 to X8M4, pin 12 (+5 Venc)
– SSI transducer (Due to the higher control quality, an SSI transducer with clock synchronization should be used.)		
• Coding		Gray-Code
• Data width		Adjustable up to max. 28 Bit
• Line receiver / line driver		RS485
• Voltage supply for SSI encoders via SYHNC100-SEK	*U*	U_B at X8M3 to X8M4, Pin 14 (+24 Venc)
Reference potential for all signals		EGND
Reference voltage per axis electronics	U_{ref}	+10 V ± 25 mV (20 mA)
Dimensions		See page 18
Assembly		Top hat rail TH 35-7.5 or TH 35-15 according to EN 60715
Admissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Protection class according to EN 60529:1991		IP 20
Weight	*m*	960 g

[1)] Maximally, 20 digital outputs can be connected

Note:
Information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load see data sheet 30162-U.

Pinout (2-axis version)



X7C	CANopen
Pin	
1	reserved
2	CAN_L
3	CAN_GND
4	reserved
5	reserved
6	reserved
7	CAN_H
8	reserved
9	reserved

X7P PROFIBUS DP	
Pin	
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved

X1S	Power
Pin	
1	GND
2	GND
3	18 – 30 V

X3C	RS232
Pin	
1	LCAN_H
2	TxD
3	RxD
4	reserved
5	GND
6	reserved
7	reserved
8	reserved
9	LCAN_L

Note for all ports:

The pins marked with **“reserved”** are reserved and must not be wired!

Pinout (2-axis version, SLOT1)

SLOT 1 X8M1 - ENCODER | LVDT / port IW9 / AWX			
Signal	**Pin**	**Description of IW9**	**Description of AWX**
LVDT1	1	IW9 GND / axis 1	AWX1 Pin 1 / axis 1
LVDT1	2	IW9 Pin 2 / axis 1	AWX1 Pin 2 / axis 1
LVDT1	3	IW9 Pin 1 / axis 1	AWX1 Pin 3 / axis 1
LVDT1	4	Bridge to Pin 5	reserved
LVDT1	5	Bridge to Pin 4	AWX1 Pin 4 / axis 1
	6	reserved	reserved
LVDT2	7	IW9 Pin 1 / axis 2	AWX2 Pin 3 / axis 2
LVDT2	8	Bridge to Pin 9	reserved
LVDT2	9	Bridge to Pin 8	AWX2 Pin 4 / axis 2
	10	reserved	reserved
LVDT2	11	IW9 GND / axis 2	AWX2 Pin 1 / axis 2
	12	reserved	reserved
	13	reserved	reserved
	14	reserved	reserved
LVDT2	15	IW9 Pin 2 / axis 2	AWX2 Pin 2 / axis 2

SLOT 1 X2D1 - digital I/O		
Signal	**Pin**	**Description**
OUT 1	1	Ready for operation / axis 1 sum error
OUT 2	2	Ready for operation / axis 2 sum error
OUT 3	3	Axis 1 isolator valve control
OUT 4	4	Axis 2 isolator valve control
OUT 5	5	Open brake
OUT 6	6	Controller active
OUT 7	7	Speed = 0
OUT 8	8	Torque = 0
OUT 9	9	reserved
OUT 10	10	Operating mode “0” = n control “1” = MD open-loop/closed-loop control
OUT 11	11	Swivel angle control active

SLOT 1 X2A1 - analog I/O		
Signal	**Pin**	**Description**
Vin 1+	1	Torque command value ±10 V
Vin 1–	2	Torque command value voltage reference
Vin 2+	3	Actual torque value ±10 V
Vin 2–	4	Actual torque value voltage reference
Cin 1+	5	reserved
Cin 1–	6	reserved
Cin 2+	7	Actual torque value 4 to 20 mA / load cell
Cin 2–	8	Actual torque value current reference
n.c.	9	reserved
AGND	10	Analog GND
Vout 1	11	Analog OUT1 ±10 V / actuating variable 1 -> module amplifier
Vout 2	12	Analog OUT2 ±10 V / actuating variable 2 -> module amplifier
Cout1	13	reserved
+24V	14	24 V output voltage
n.c.	15	reserved

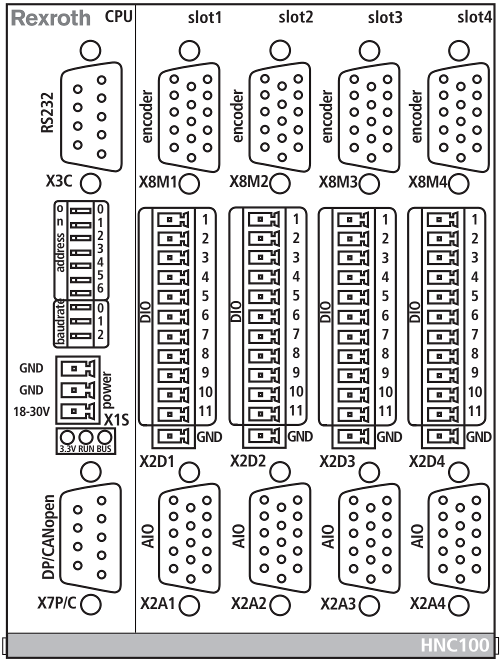
Pinout (2-axis version, SLOT2)

SLOT 2 X8M2 - ENCODER			
Signal	**Pin**	**INK description**	**SSI description**
–B	1	–Ua2 / GEL293 Pin G	
+Clk	2		+ CLK
+R	3	reserved	reserved
–R	4	reserved	reserved
+A	5	+Ua1 / GEL293 Pin C	
–A	6	–Ua1 / GEL293 Pin H	
–Clk	7		– CLK
+B	8	+Ua2 / GEL293 Pin B	
–DATA	9		– Data
GND	10	0 V / GEL293 Pin A	Ground
+DATA	11		+ Data
+5Venc	12	+5 V / GEL293 Pin F	
+10Vref	13	reserved	reserved
+24V enc	14		+24V
	15	reserved	reserved

SLOT 2 X2D2 - digital I/O		
Signal	**Pin**	**Description**
IN 1	1	Enable
IN 2	2	Start
IN 3	3	Error reset
IN 4	4	Open-loop torque control
IN 5	5	Closed-loop torque control
IN 6	6	Pressure OK
IN 7	7	Open brake
IN 8	8	reserved
IN 9	9	reserved
IN 10	10	reserved
IN 11	11	Select speed setpoint intern 2

SLOT 2 X2A2 - analog I/O		
Signal	**Pin**	**Description**
Vin 1+	1	Speed command value signal ±10 V
Vin 1–	2	Speed command value reference
Vin 2+	3	Actual pressure value signal 0 to 10 V / pressure cell
Vin 2–	4	Actual pressure value reference
Cin 1+	5	reserved
Cin 1–	6	reserved
Cin 2+	7	Actual pressure value current signal 0 to 20 mA / pressure cell
Cin 2–	8	Actual pressure value current reference
n.c.	9	reserved
AGND	10	AGND
Vout 1	11	Diagnosis 1
Vout 2	12	Diagnosis 2
Cout1	13	reserved
+24V	14	24 V output voltage
n.c.	15	reserved

Pinout (4-axis version)



X7C	CANopen
Pin	
1	reserved
2	CAN_L
3	CAN_GND
4	reserved
5	reserved
6	reserved
7	CAN_H
8	reserved
9	reserved

X7P PROFIBUS DP	
Pin	
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved

X1S	Power
Pin	
1	GND
2	GND
3	18 – 30 V

X3C	RS232
Pin	
1	LCAN_H
2	TxD
3	RxD
4	reserved
5	GND
6	reserved
7	reserved
8	reserved
9	LCAN_L

Note for all ports:

The pins marked with **"reserved"** are reserved and must not be wired!

Pinout (4-axis version, SLOT1)

SLOT 1 X8M1 - ENCODER | LVDT / port IW9 / AWX			
Signal	**Pin**	**Description of IW9**	**Description of AWX**
LVDT1	1	IW9 GND / axis 1	AWX1 Pin 1 / axis 1
LVDT1	2	IW9 Pin 2 / axis 1	AWX1 Pin 2 / axis 1
LVDT1	3	IW9 Pin 1 / axis 1	AWX1 Pin 3 / axis 1
LVDT1	4	Bridge to Pin 5	reserved
LVDT1	5	Bridge to Pin 4	AWX1 Pin 4 / axis 1
	6	reserved	reserved
LVDT2	7	IW9 Pin 1 / axis 2	AWX2 Pin 3 / axis 2
LVDT2	8	Bridge to Pin 9	reserved
LVDT2	9	Bridge to Pin 8	AWX2 Pin 4 / axis 2
	10	reserved	reserved
LVDT2	11	IW9 GND / axis 2	AWX2 Pin 1 / axis 2
	12	reserved	reserved
	13	reserved	reserved
	14	reserved	reserved
LVDT2	15	IW9 Pin 2 / axis 2	AWX2 Pin 2 / axis 2

SLOT 1 X2D1 - digital I/O		
Signal	**Pin**	**Description**
OUT 1	1	Ready for operation / axis 1 sum error
OUT 2	2	Ready for operation / axis 2 sum error
OUT 3	3	Axis 1 isolator valve control
OUT 4	4	Axis 2 isolator valve control
OUT 5	5	Open brake
OUT 6	6	Controller active
OUT 7	7	Speed = 0
OUT 8	8	Torque = 0
OUT 9	9	reserved
OUT 10	10	Operating mode “0” = n control “1” = MD open-loop/closed-loop control
OUT 11	11	Swivel angle control active

SLOT 1 X2A1 - analog I/O		
Signal	**Pin**	**Description**
Vin 1+	1	Torque command value ±10 V
Vin 1–	2	Torque command value voltage reference
Vin 2+	3	Actual torque value ±10 V
Vin 2–	4	Actual torque value voltage reference
Cin 1+	5	reserved
Cin 1–	6	reserved
Cin 2+	7	Actual torque value 4 to 20 mA / load cell
Cin 2–	8	Actual torque value current reference
n.c.	9	reserved
AGND	10	Analog GND
Vout 1	11	Analog OUT1 ±10 V / actuating variable 1 -> module amplifier
Vout 2	12	Analog OUT2 ±10 V / actuating variable 2 -> module amplifier
Cout1	13	Analog OUT1 ±20 mA
+24V	14	24 V output voltage
n.c.	15	reserved

Pinout (4-axis version, SLOT2)

SLOT 2 X8M2 - ENCODER | LVDT / port IW9 / AWX			
Signal	**Pin**	**Description of IW9**	**Description of AWX**
LVDT1	1	IW9 GND / axis 3	AWX1 Pin 1 / axis 3
LVDT1	2	IW9 Pin 2 / axis 3	AWX1 Pin 2 / axis 3
LVDT1	3	IW9 Pin 1 / axis 3	AWX1 Pin 3 / axis 3
LVDT1	4	Bridge to Pin 5	reserved
LVDT1	5	Bridge to Pin 4	AWX1 Pin 4 / axis 3
	6	reserved	reserved
LVDT2	7	IW9 Pin 1 / axis 4	AWX2 Pin 3 / axis 4
LVDT2	8	Bridge to Pin 9	reserved
LVDT2	9	Bridge to Pin 8	AWX2 Pin 4 / axis 4
	10	reserved	reserved
LVDT2	11	IW9 GND / axis 4	AWX2 Pin 1 / axis 4
	12	reserved	reserved
	13	reserved	reserved
	14	reserved	reserved
LVDT2	15	IW9 Pin 2 / axis 4	AWX2 Pin 2 / axis 4

SLOT 2 X2D2 - digital I/O		
Signal	**Pin**	**Description**
OUT 1	1	Ready for operation / axis 3 sum error
OUT 2	2	Ready for operation / axis 4 sum error
OUT 3	3	Axis 3 isolator valve control
OUT 4	4	Axis 4 isolator valve control
OUT 5	5	reserved
OUT 6	6	reserved
OUT 7	7	reserved
OUT 8	8	reserved
OUT 9	9	reserved
OUT 10	10	reserved
OUT 11	11	reserved

SLOT 2 X2A2 - analog I/O		
Signal	**Pin**	**Description**
Vin 1+	1	reserved
Vin 1–	2	reserved
Vin 2+	3	reserved
Vin 2–	4	reserved
Cin 1+	5	reserved
Cin 1–	6	reserved
Cin 2+	7	reserved
Cin 2–	8	reserved
n.c.	9	reserved
AGND	10	AGND
Vout 1	11	Analog OUT3 ±10 V / actuating variable 3 -> module amplifier
Vout 2	12	Analog OUT4 ±10 V / actuating variable 4 -> module amplifier
Cout1	13	reserved
+24V	14	24 V output voltage
n.c.	15	reserved

Pinout (4-axis version, SLOT3)

SLOT 3 X8M3 - ENCODER			
Signal	**Pin**	**INK description**	**SSI description**
–B	1	–Ua2 / GEL293 Pin G	
+Clk	2		+ CLK
+R	3	reserved	reserved
–R	4	reserved	reserved
+A	5	+Ua1 / GEL293 Pin C	
–A	6	–Ua1 / GEL293 Pin H	
–Clk	7		– CLK
+B	8	+Ua2 / GEL293 Pin B	
–DATA	9		– Data
GND	10	0 V / GEL293 Pin A	Ground
+DATA	11		+ Data
+5Venc	12	+5 V / GEL293 Pin F	
+10Vref	13	reserved	reserved
+24V enc	14		+24V
	15	reserved	reserved

SLOT 3 X2D3 - digital I/O		
Signal	**Pin**	**Description**
IN 1	1	Enable
IN 2	2	Start
IN 3	3	Error reset
IN 4	4	Open-loop torque control
IN 5	5	Closed-loop torque control
IN 6	6	Pressure OK
IN 7	7	Open brake
IN 8	8	reserved
IN 9	9	reserved
IN 10	10	reserved
IN 11	11	Select speed setpoint intern 2

SLOT 3 X2A3 - analog I/O		
Signal	**Pin**	**Description**
Vin 1+	1	Speed command value signal ±10 V
Vin 1–	2	Speed command value reference
Vin 2+	3	Actual pressure value signal 0 to 10 V / pressure cell
Vin 2–	4	Actual pressure value reference
Cin 1+	5	reserved
Cin 1–	6	reserved
Cin 2+	7	Actual pressure value current signal 0 to 20 mA / pressure cell
Cin 2–	8	Actual pressure value current reference
n.c.	9	reserved
AGND	10	AGND
Vout 1	11	Diagnosis 1
Vout 2	12	reserved
Cout1	13	reserved
+24V	14	24 V output voltage
n.c.	15	reserved

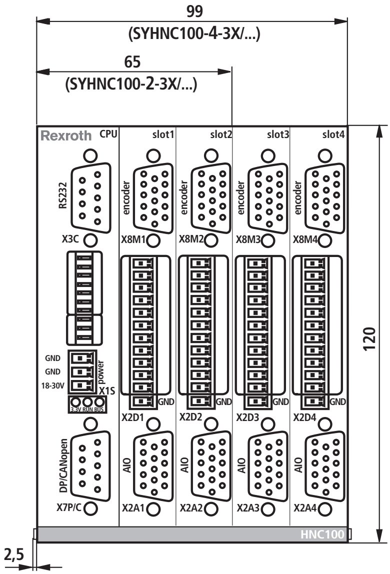
Pinout (4-axis version, SLOT4)

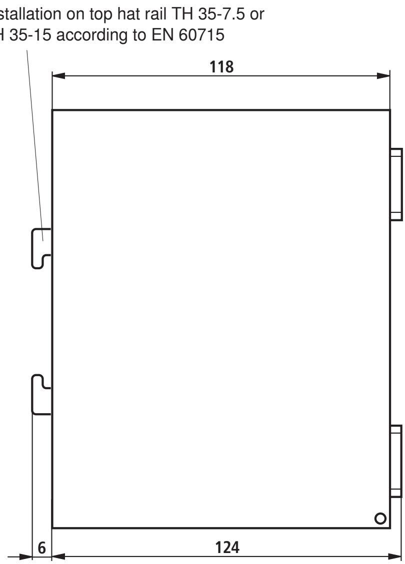
SLOT 4 X8M4 - ENCODER | INK2			
Signal	**Pin**	**INK description**	**SSI description**
–B	1	–Ua2 / GEL293 Pin G	
+Clk	2		+ CLK
+R	3	reserved	reserved
–R	4	reserved	reserved
+A	5	+Ua1 / GEL293 Pin C	
–A	6	–Ua1 / GEL293 Pin H	
–Clk	7		– CLK
+B	8	+Ua2 / GEL293 Pin B	
–DATA	9		– Data
GND	10	0 V / GEL293 Pin A	Ground
+DATA	11		+ Data
+5Venc	12	+5 V / GEL293 Pin F	
+10Vref	13	reserved	reserved
+24V enc	14		+24V
	15	reserved	reserved

SLOT 4 X2D4 - digital I/O		
Signal	**Pin**	**Description**
IN 1	1	reserved
IN 2	2	reserved
IN 3	3	reserved
IN 4	4	reserved
IN 5	5	reserved
IN 6	6	reserved
IN 7	7	reserved
IN 8	8	reserved
IN 9	9	reserved
IN 10	10	reserved
IN 11	11	reserved

SLOT 4 X2A4 - analog I/O		
Signal	**Pin**	**Description**
Vin 1+	1	reserved
Vin 1–	2	reserved
Vin 2+	3	reserved
Vin 2–	4	reserved
Cin 1+	5	reserved
Cin 1–	6	reserved
Cin 2+	7	reserved
Cin 2–	8	reserved
n.c.	9	reserved
AGND	10	AGND
Vout 1	11	Diagnosis 2
Vout 2	12	reserved
Cout1	13	reserved
+24V	14	24 V output voltage
n.c.	15	reserved

Unit dimensions (dimensions in mm)





Project Planning / Maintenance Instructions / Additional Information

Product documentation for SYHNC100-SEK

Data sheet 30162

Operating instructions 30162-B

Software description 30162-01-Z

Declaration on environmental compatibility 30162-U

WIN-PED 6

General Information on the maintenance and commissioning of hydraulic components 07800 / 07900

Commissioning software and documentation on the Internet: www.boschrexroth.com/HNC100

Maintenance instructions:
- The devices have been tested in the plant and are supplied with default settings.
- Only complete units can be repaired. The repaired units will be supplied with default settings. User-specific settings are not maintained. The operator will have to re-transfer the corresponding user parameters and programs.

Notes:
- Electric signals taken out via control electronics (e.g. signal “No error”) may not be used for the actuation of safety-relevant machine functions! (See also the European standard “Safety requirements for fluid power systems and their components - Hydraulics”, EN 982.)
- If electromagnetic interference must be expected, take appropriate measures to safeguard the function (depending on the application, e.g. screening, filtration)!
- For further notes see operating instructions 30162-B

Project Planning / Maintenance Instructions / Additional Information

Installation position

Don't install the SYHNC100-SEK next to power electronics (e.g. frequency converters); the power supply unit of the SYHNC100-SEK should be installed as close to the SYHNC100-SEK as possible.

Voltage supply

Keep the connection as short as possible, lay forward and return conductor (+24 V / GND) together.

When supplying an inductive position transducer via the interface of the SYHNC100-SEK, the provided voltage must comply with the required data of the position transducer.

Earthing of the housing

The necessary earthing of the SYHNC100-SEK housing is effected by connecting the mounting bolts with the control cabinet's rear panel.

Screening

Use only cables with a shield of copper braiding for signal lines. Usually, connect one side of the shield with the SYHNC100-SEK side. Connect the cable shield extensively with the metallized connector housing (push back the shield and clamp it under the pull relief).

Wiring

– Largest possible spatial separation of signal and load lines
– Don't lead signal lines through strong magnetic fields
– Pass signal lines without interruptions
– Twist load lines (e.g. voltage supply) passed as two individual wires
– Don't pass the signal lines parallely to load lines

System interference suppression

– Switched inductivities:
  • DC → Antiparallel free-wheeling diode via actuator winding
  • AC → Type-related R/C combination via actuator winding
– Electric motors:
  • Lead the R/C combinations of each motor winding to earth
– Frequency converter:
  • Provide an input filter in the voltage supply of the frequency converter
  • Pass control lines of the motor in a shielded form and separate from other lines and/or provide an output filter for motor lines
  • Extensive contact of the frequency converter housing with the rear panel of the control cabinet

Notes

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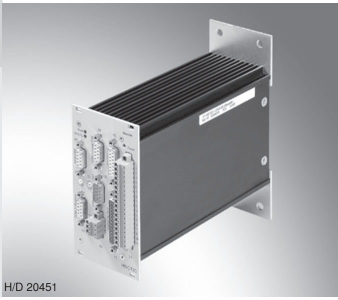
Digital axis control HNC100

RE 30131/04.10
Replaces: 05.08

Types VT-HNC100-1 and VT-HNC100-2

Component series 2X



H/D 20451

Table of contents

Features

The digital axis control HNC100 is a programmable NC control for a closed-loop controlled axis. It meets the specific requirements for controlling hydraulic drives and, in addition, offers the possibility of controlling electric drives.

With regard to immunity to interference, mechanical resistance to vibration and shock and climate-proofness, the HNC100 is designed for use in harsh industrial environments. It conforms with EC Directives (CE mark).

Fields of application:
- Machine tools, plastic processing machines, special machines
- Presses
- Transfer lines
- Rail-bound vehicles

Programming:
- User programming with PC
- NC language with subroutine technique and conditional jumps
- Separate NC program for function sequences
- Local CAN bus for parameterizing several HNC100

Operation:
- Comfortable administration of data on PC

Process interfacing:
- 8, 16 or 24 digital inputs and outputs each
- Comfortable configuration of field bus interfacing with the help of the WIN-PED 5 Bus Manager

Hydraulic axes:
- Measuring system:
  - Incremental or absolute (SSI)
  - Analog 0 to ±10 V and 4 to 20 mA
  - Reference voltage ±10 V
- Voltage or current control variable output
- Freely configurable controller variants
  - Position controller, pressure/force controller
  - Position-dependent braking
  - Alternating control (position/pressure)
  - Synchronization control for 2 axes

Ordering code

VT-HNC100 – – 2X / – – – 0 | *

Digital NC control HNC100

Variant for 1 hydraulic axis = 1
Variant for 2 hydraulic axes = 2

Component series 20 to 29 = 2X
(20 to 29: unchanged installation and connection dimensions)

Type of installation:
Housing for wall-mounting = W
Housing for rack installation = M

For single-axis version:
8 digital inputs/outputs = 08
24 digital inputs/outputs = 24
For 2-axis version:
16 digital inputs/outputs = 16

0 = Without bus interface
P = PROFIBUS DP [1)]
C = CANopen
I = INTERBUS-S

0 = Without evaluation electronics

Further details in clear text

Required accessories:
- Interface cable: Cable set VT15300-1X/03,0/, length 3 m, further lengths on request),
  Material no.: **R900842349**
- Optional USB adapter for the serial interface, VT-ZKO-USB/S-1-1X/V0/0,
  Material no.: **R901066684**

Standard types

Type	Material number
VT-HNC100–1–2X/W-08-0-0	R900955334
VT-HNC100–1–2X/W-08-P-0	R900958999
VT-HNC100–2–2X/W-16-P-0	R900724314

1) Additional plug-in connector, type 6ES7972-0BA41-0XA0 for PROFIBUS DP is not included in the scope of supply and must be ordered separately! Material no.: **R900050152**

Software project planning

Configuration

The operation of the HNC100 is based on the creation of application-specific data sets. These data sets are generated on a PC and sent via the serial interface to the HNC100. The combination of the user program and data sets is called “project”. The software configuration follows determined steps:

1. The tasks to be performed by the HNC100 are to be defined and in flowchart. The definition also refers to the meaning of inputs and outputs and the parameters used.
2. The functions of the sequence charts have to be implemented in the form of a sequence of NC commands.
3. The machine data (selection of transducers and controllers) and the parameters of the NC program have to be defined.
4. The data are sent to the HNC100.
5. Settings and program sequences are optimized on the machine.

PC program “WIN-PED 5“

The PC program “WIN-PED 5” helps the user perform configuration tasks. It is used for programming, setting and diagnostics of the HNC100.

Scope of functions:

- Convenient dialog functions for online or offline setting of machine data
- NC Editor with integrated syntax check and program compiler
- Support for the definition of parameters used in the NC program
- Dialog window for online setting of parameter values
- Comprehensive options for displaying process data, digital inputs, outputs and flags
- Recording and graphical representation of up to four process variables via a selection of trigger options
- Dialog for the graphical definition of special functions (determination of function via polygon)

System requirements:

- IBM PC or compatible system
- Windows 2000 or Windows XP
- RAM (recommended: 256 MB)
- 60 MB free hard disk space

Note for storing R parameters in the HNC100:

Damage to the internal memory (EEPROM) due to too high a number of write access!

When ticking the „Save in EEPROM“ checkbox (WIN-PED menu: R parameter), you write to the internal memory (EEPROM). As every EEPROM allows only for a limited number of write access before its cells are destroyed, you should make sure that the number of such write access is limited.

Information on the scope of supply:

The PC program “WIN-PED 5“ is **not** included in the scope of supply. It can be downloaded free of charge on the Internet!

Download on the Internet: www.boschrexroth.de/hnc100

Queries: support.nc-systems@boschrexroth.de

3

Overview of controller functions

Position controller:

- PDT1-controller
- Linear gain characteristic curve
- Direction-dependent gain adjustment
- "Inflected" gain characteristic curve
- Gain alteration possible via the NC program
- Fine positioning
- Residual voltage principle
- Zero point error compensation
- Active damping
- Command value feedforward
- Limitation of control output via the NC program
- “Position-dependent braking“
- Intermediate electronics for use with commercial NC controls
- Synchronization control (only in conjunction with VT-HNC100-2…)

Pressure/force controller:

- PIDT1-controller
- I-component can be cut in and out via window
- Differential pressure evaluation
- Own scan rate

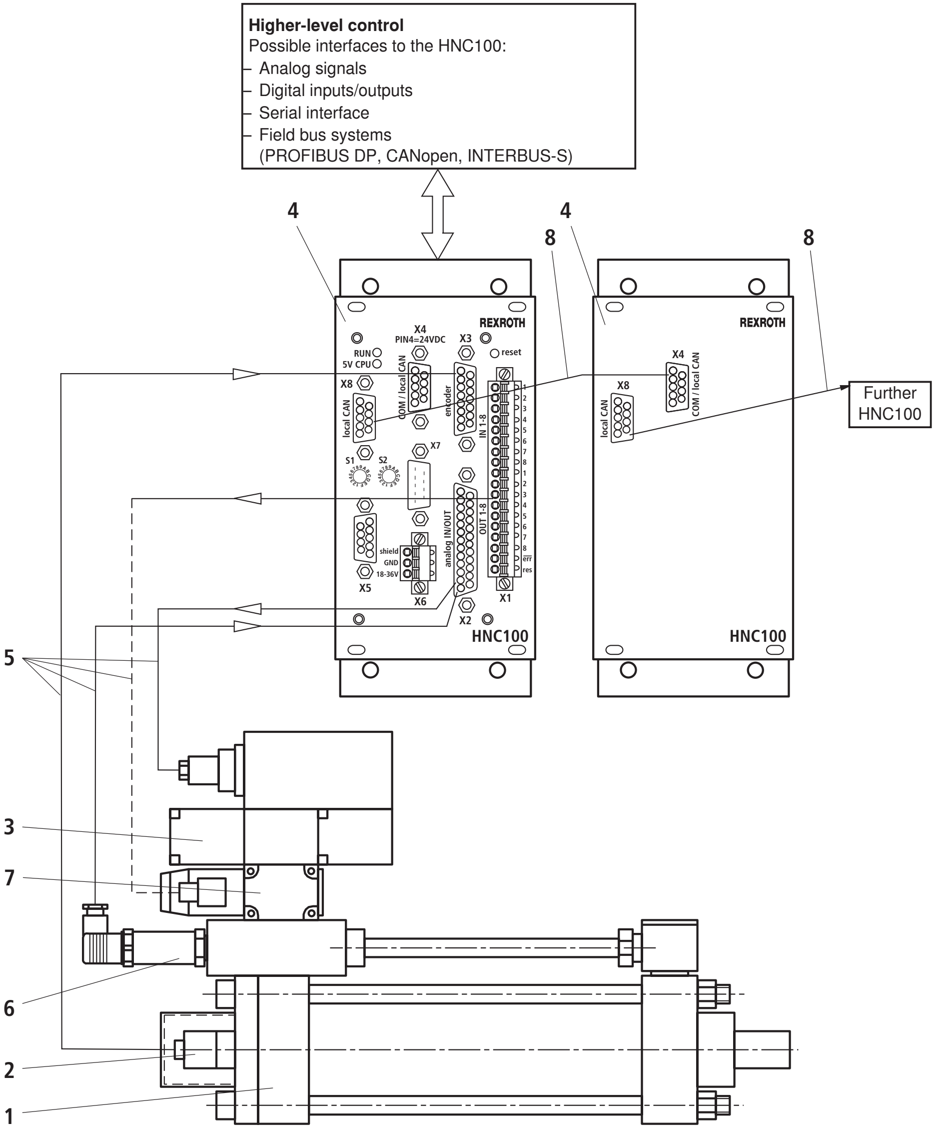
Velocity controller:

- PI-controller
- I-component can be cut in and out via window

Monitoring functions:

- Dynamic following error monitoring
- Traversing range limits (electronic limit switches)
- Cable break monitoring for incremental and SSI encoders
- Cable break monitoring for sensors with 4 to 20 mA output

System overview



1 Single-rod cylinder

2 Integrated position measuring system

3 Servo, proportional or high-response valve with integrated control electronics

4 HNC100

5 Connection cable

6 Pressure transducer

7 Sandwich plate shut-off valve (with plug-in switching amplifier)

8 Local CAN bus

Overview of NC commands for sequence control

For the programming of sequences, the following NC commands are available at the time of publication of this data sheet:

Definition part:	
/TRIG	Definition of a switching point
/E	Suppression of limit switches
/OVER	Override of velocity
/KD	Definition of a curve
/KT	Scan rate of a curve
/DFN	Normalization factor for curve polygon
/SE	Definition of system inputs
/SA	Definition of system outputs
NC Interpreter:	
KURVE	Start and stop of the curve function
K	Output of a voltage
KP	Alteration of controller gain
CLR	Resetting of output or flag
SET	Setting of output or flag
IF	Conditional branching
JMP	Jump to a flag (L000 to L1999)
JSR	Subroutine call
M17	End of subroutine
M02	End of main program
B	Variable for global variables
C	Variable for local variables
Lxxx	Jump flag
R	Value assignment for an R parameter
G64	Limitation of control output
BINE	Reading of binary-coded inputs
BINA	Output to binary-coded outputs
M22I	Setting of command value for position controller
G65/G66	Position monitoring in closed-loop pressure control “ON/OFF“
#define	Instruction
/EC	Definition of transducer monitoring
/ERROR	Definition of error response
/JMPSWITCH	Fast jump switch

Sequence control:	
G01	Point-to-point travel
G30	Point-to-point travel for oscillating movements
BREAK	Interruption of G01 or G30
STOP	Deceleration and completion, G01, G30
G53/G54	Zero point compensation “OFF/ON“
G70	Activation of closed-loop velocity control
G55	“Setting/reading” of values of zero point compensation
G63	Transition from closed-loop pressure/velocity control to closed-loop position control
M33/M34	Activation/deactivation” of position controller
M35/M36	Activation/deactivation” of synchronism
G26	Traversing to positive stop, closed-loop controlled
G25	Traversing to positive stop, open-loop controlled
G27, G28	Activation of pressure controller in dependence upon a position
G60	Activation of pressure controller
G61	Activation of pressure limitation
G62	Deactivation of pressure limitation
M22	Setting the actual and command value for the position controller
G04	Dwell time
M00	Waiting for input or flag
M90	Setting of output or flag
M91	Resetting of output or flag

3

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

Operating voltage	U_B	18 to 36 VDC
Power consumption	$P_{internal}$	8 W (additional power for connected sensors/actuators)
Processor		16/32 Bit MC68376
Memory		Flash EPROM 1 MB; EEPROM 8 KB; RAM 256 KB (main memory)
Analog inputs [1]:		
– Voltage inputs (differential inputs)		
• Number of channels		4
• Input voltage	U_I	+10 V to –10 V measurable (max. +15 V to –15 V)
• Input resistance	R_I	200 kΩ ±2 %
• Resolution		5 mV
• Non-linearity		< 10 mV
• Calibration tolerance [2]		max. 40 mV (with factory setting)
– Current inputs		
• Number of channels		4
• Input current	I_I	4 mA to 20 mA
• Input resistance	R_I	100 Ω ±0.2 %
• Resistance between pin "I_{in} 1 –" and "analog_GND"	R	0 to 500 Ω
• Current loss	I_L	0.1 to 0.4 % (at 500 Ω between pin "I_{in} 1 –" and "analog_GND")
• Resolution		5 µA
– Impedance inputs [3]		
• Number of channels		4
• Input voltage	U_{imp}	–10 V to +10 V
• Input resistance	R_{imp}	> 10 MΩ
• Resolution		5 mV
• Non-linearity		< 10 mV
• Calibration tolerance [2]		max. 40 mV (with factory setting)
Analog outputs:		
– Voltage outputs [4]		
• Number of channels		4
• Output voltage	U_{nom}	–10 V to +10 V (max. –10.7 V to +10.7 V)
• Output current	I_{max}	±10 mA
• Load	R_{min}	1 kΩ
– Current outputs [4]		
• Number of channels		2
• Output current — Normalized	I_{nom}	4 mA to 20 mA
Not normalized	I_{max}	±23 mA
• Load	R_{max}	500 Ω
– Residual ripple content		±60 mV (without noise)
– Resolution		1,25 mV
– Non-linearity		
• within the range of –9.5 V to +9.5 V		15 mV
• within the range of –10 V to –9.5 V and +9.5 V to +10 V		35 mV

[1] Not all of the channels can be used simultaneously. The voltage inputs and the current inputs are provided with a common pin so that either the voltage input **or** the current input can be used at a time. The current can be looped through several current measuring devices. Otherwise, a jumper must be plugged from pin "I_{in}" to pin "analog_GND".

[2] If the factory settings are not sufficient, the measuring equipment can be calibrated on site according to the system requirements.

[3] Due to the characteristics of these high-resistance inputs, **no internal protective circuits** with diodes or capacitors can be used. For this reason, when connecting analog signals to inputs $U_{imp}1$ to $U_{imp}4$, all required protective measures, EMC protection, signal filtration, must be connected **externally** in the incoming circuit.

[4] Outputs "U_{out} 1" and "I_{out} 1" as well as "U_{out} 2" and "I_{out} 2" are electrically coupled. Normalization can be set to voltage or current by means of software.

Technical data (continued)

Serial interfaces	Standard	RS232 (9,6 KBaud)
	Optional	PROFIBUS DP (max. 12 MBaud) CANopen, INTERBUS-S
Switching inputs	Number	8, 16 or 24
	Logic level	log 0 (low) ≤ 5 V; log 1 (high) ≥ 10 V to U_B; R_i = 3 kΩ ±10 %
	Connection	Flexible conductor up to 1.5 mm^2
Switching outputs	Number	8, 16 or 24
	Logic level	log 0 (low) ≤ 2 V; log 1 (high) ≤ U_B; I_{max} = 50 mA
	Connection	Flexible conductor up to 1.5 mm^2
Digital position transducers:		
– Incremental transducer (transducer with TTL output)		
• Input voltage	log 0	0 to 1 V
	log 1	2.8 to 5.5 V
• Input current	log 0	–0.8 mA (at 0 V)
	log 1	0.8 mA (at 5 V)
• Max. frequency referred to Ua 1	f_{max}	250 kHz
– SSI transducer		
• Coding		Gray code
• Data width		Adjustable up to max. 28 bits
• Line receiver (TTL)		
Input voltage	log 0	0 to 1 V
	log 1	2.8 to 5.5 V
Input current	log 0	–0.8 mA (at 0 V)
	log 1	0.8 mA (at 5 V)
• Line driver		
Output voltage	log 0	0 to 0.5 V (at 120 Ω)
	log 1	2.5 to 5.5 V (at 120 Ω)
Voltage supply to position transducers by the HNC100	U	U_B or +5 VDC ±5 %; max. 200 mA
Max. voltage for all input signals	U_{max}	U_B –1 V (signals are not opto-decoupled)
Inductive position transducers:		
– Number		2
– Power supply	U_{eff}	2 V (I_{max} = 30 mA / channel) Balanced to ground, short-circuit-proof, can be synchronized between 4.8 and 5.2 kHz, optional compensation capacitor 220 nF; amplitude stability ≤ 0.2 % /10 K; carrier frequency 5 Hz ± 2 %; inductive transducers in half- and full-bridge circuit and 3- and 4-conductor circuit; linearity error < 0.1 %
Reference voltage	U_{ref}	+10 V ±25 mV and –10 V ±25 mV (20 mA each)
Dimensions (W x H x D):		
– VT-HNC100-**1**-2X/.-**08**-.-.		71 x 155 x 204 mm
– VT-HNC100-**2**-2X/.-**16**-.-. and VT-HNC100-**1**-2X/.-**24**-.-.		106.5 x 155 x 204 mm
Permissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight:		
– VT-HNC100-**1**-2X/.-**08**-.-.	m	1.0 kg
– VT-HNC100-**2**-2X/.-**16**-.-. and VT-HNC100-**1**-2X/.-**24**-.-.	m	1.2 kg

☞ **Note!**

For details regarding **environment simulation testing** in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30131-U (declaration on environmental compatibility).

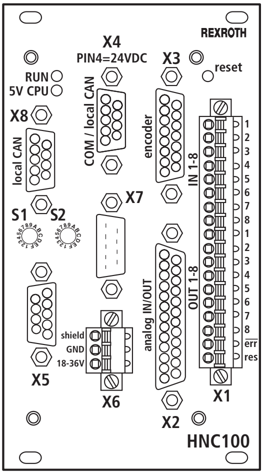
Connector pinout VT-HNC100-1-2X/.-08… (single-axis variant)

X8: Local CAN

Pin		
Pin	1	CAN_GND
	2	res
	3	res
	4	res
	5	res
	6	res
	7	res
	8	CAN_H
	9	CAN_L

X4: COM / local CAN

Pin	1	CAN_GND
	2	TxD
	3	CTS
	4	24 VN
	5	0 VN
	6	RxD
	7	RTS
	8	CAN_H
	9	CAN_L



S1, S2: Address, baud rate CAN

X3: Encoder

Pin	incremen-tal	SSI
1	/Ua 2	
2		Clocking
3	Ua 0	
4	/Ua 0	
5	Ua 1	Data
6	/Ua 1	/Data
7		/Clocking
8	Ua 2	
9	res	
10	0 VN	
11	res	
12	5 VTTL (max. 150 mA)	
13	res	
14	24 VN (max. 200 mA)	
15	res	

☞ **Note!**

The pins identified with “res“ are reserved and must not be connected.

X1: Digital I/O

Pin	1	IN1
	2	IN2
	3	IN3
	4	IN4
	5	IN5
	6	IN6
	7	IN7
	8	IN8
	9	OUT1
	10	OUT2
	11	OUT3
	12	OUT4
	13	OUT5
	14	OUT6
	15	OUT7
	16	OUT8
	17	/error
	18	res

X5: Communication with higher-level control

Pin	PROFIBUS DP	INTERBUS-S (OUT)
1	n.c.	DO 2
2	n.c.	DI 2
3	RxD/TxD-P	GND 2
4	CNTR-P	n.c.
5	DGND	U_{dd}
6	VP	/DO 2
7	n.c.	/DI 2
8	RxD/TxD-N	n.c.
9	n.c.	BCI

X6: Power supply

Pin	1	Shield
	2	GND
	3	18 - 36 VDC

X2: Analog IN / OUT

Pin	1	U_{in} 1 +	I_{in} 1 –
	2	U_{in} 1 –	
	3	U_{in} 2 +	I_{in} 2 –
	4	U_{in} 2 –	
	5	U_{in} 3 +	I_{in} 3 –
	6	U_{in} 3 –	
	7	U_{in} 4 +	I_{in} 4 –
	8	U_{in} 4 –	
	9	I_{out} 2	
	10	U_{out} 2	
	11	analog_GND	
	12	U_{ref} = + 10 V	
	13	U_{ref} = – 10 V	
	14	I_{out} 1	
	15	U_{out} 1	
	16	U_{out} 3	
	17	U_{out} 4	
	18		I_{in} 1 +
	19		I_{in} 2 +
	20		I_{in} 3 +
	21		I_{in} 4 +
	22	U_{imp} 1	
	23	U_{imp} 2	
	24	U_{imp} 3	
	25	U_{imp} 4	

X7: Communication with higher-level control

Pin	CANopen	inductive	INTERBUS-S (IN)
1	n.c.	Supply 1 +	DO1
2	CAN_L	Supply 1 –	DI1
3	CAN_GND	Signal 1 +	GND1
4	n.c.	Signal 1 –	n.c.
5	n.c.	Supply 2 +	n.c.
6	n.c.	Supply 2 –	/DO1
7	CAN_H	Signal 2 +	/DI1
8	n.c.	Signal 2 –	n.c.
9	n.c.	Sync IN/OUT	n.c.

Connector pinout VT-HNC100-2-2X/.-16… (2-axis variant)

Note!

The pins identified with “res“ are reserved and must not be connected.

X8: Local CAN		
Pin	1	CAN_GND
	2	res
	3	res
	4	res
	5	res
	6	res
	7	res
	8	CAN_H
	9	CAN_L

X4: COM / local CAN		
Pin	1	CAN_GND
	2	TxD
	3	CTS
	4	24 VN
	5	0 VN
	6	RxD
	7	RTS
	8	CAN_H
	9	CAN_L

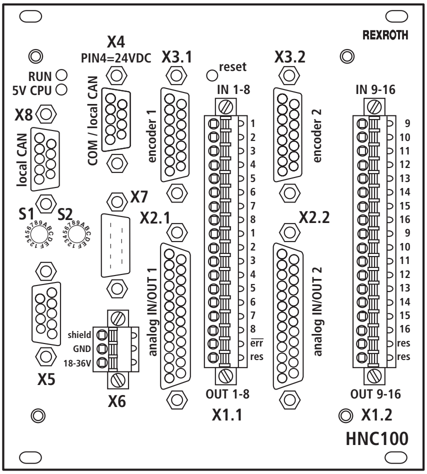
X1.1 and X1.2: Digital IN/OUT

Pin	X1.1	X1.2
1	IN1	IN9
2	IN2	IN10
3	IN3	IN11
4	IN4	IN12
5	IN5	IN13
6	IN6	IN14
7	IN7	IN15
8	IN8	IN16
9	OUT1	OUT9
10	OUT2	OUT10
11	OUT3	OUT11
12	OUT4	OUT12
13	OUT5	OUT13
14	OUT6	OUT14
15	OUT7	OUT15
16	OUT8	OUT16
17	/error	res
18	res	res

X3.1: Encoder 1

Pin	Incremental	SSI
1	/Ua 2	
2		Clocking
3	Ua 0	
4	/Ua 0	
5	Ua 1	Data
6	/Ua 1	/Data
7		/Clocking
8	Ua 2	
9	res	
10	0 VN	
11	res	
12	5 VTTL (max. 150 mA)	
13	res	
14	24 VN (max. 200 mA)	
15	res	

S1, S2: Address, baud rate CAN



X3.2: Encoder 2

Pin	Incremental	SSI
1	/Ub 2	
2		Clocking
3	Ub 0	
4	/Ub 0	
5	Ub 1	Dats
6	/Ub 1	/Dats
7		/Clocking
8	Ub 2	
9	res	
10	0 VN	
11	res	
12	5 VTTL (max. 150 mA)	
13	res	
14	24 VN (max. 200 mA)	
15	res	

X6: Voltage supply		
Pin	1	Shield
	2	GND
	3	18 - 36 VDC

X5: Communication with higher-level control

Pin	PROFIBUS DP	INTERBUS-S (OUT)
1	n.c.	DO 2
2	n.c.	DI 2
3	RxD/TxD-P	GND 2
4	CNTR-P	n.c.
5	DGND	U_{dd}
6	VP	/DO 2
7	n.c.	/DI 2
8	RxD/TxD-N	n.c.
9	n.c.	BCI

X7: Communication with higher-level control

Pin	CANopen	Inductive	INTERBUS-S (IN)
1	n.c.	Supply 1 +	DO1
2	CAN_L	Supply 1 –	DI1
3	CAN_GND	Signal 1 +	GND1
4	n.c.	Signal 1 –	n.c.
5	n.c.	Supply 2 +	n.c.
6	n.c.	Supply 2 –	/DO1
7	CAN_H	Signal 2 +	/DI1
8	n.c.	Signal 2 –	n.c.
9	n.c.	Sync IN/OUT	n.c.

X2.1: Analog IN / OUT1

Pin			
Pin	1	U_{in} 1 +	I_{in} 1 –
	2	U_{in} 1 –	
	3	U_{in} 2 +	I_{in} 2 –
	4	U_{in} 2 –	
	5	res	
	6	res	
	7	res	
	8	res	
	9	res	
	10	res	
	11	analog_GND	
	12	U_{ref} = + 10 V	
	13	U_{ref} = – 10 V	
	14	I_{out} 1	
	15	U_{out} 1	
	16	U_{out} 3	
	17	res	
	18		I_{in} 1 +
	19		I_{in} 2 +
	20	res	
	21	res	
	22	U_{imp} 1	
	23	U_{imp} 2	
	24	res	
	25	res	

X2.2: Analog IN / OUT2

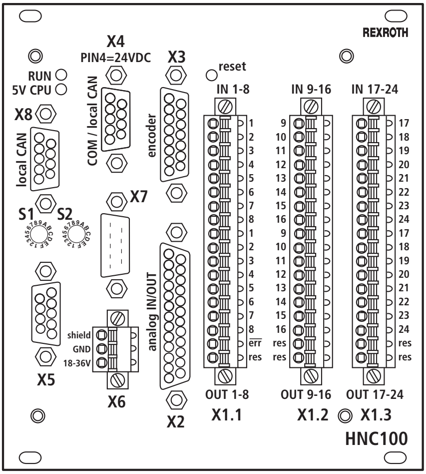
Pin	1	U_{in} 3 +	I_{in} 3 –
	2	U_{in} 3 –	
	3	U_{in} 4 +	I_{in} 4 –
	4	U_{in} 4 –	
	5	res	
	6	res	
	7	res	
	8	res	
	9	res	
	10	res	
	11	analog_GND	
	12	U_{ref} = + 10 V	
	13	U_{ref} = – 10 V	
	14	I_{out} 2	
	15	U_{out} 2	
	16	U_{out} 4	
	17	res	
	18		I_{in} 3 +
	19		I_{in} 4 +
	20	res	
	21	res	
	22	U_{imp} 3	
	23	U_{imp} 4	
	24	res	
	25	res	

3

Connector pinout VT-HNC100-1-2X/.-24… (single-axis variant)

Note!
The pins identified with “res“ are reserved and must not be connected..

S1, S2: Address, baud rate CAN



X3: encoder		
Pin	Incremen-tal	SSI
1	/Ua 2	
2		Clocking
3	Ua 0	
4	/Ua 0	
5	Ua 1	Daten
6	/Ua 1	/Daten
7		/Clocking
8	Ua 2	
9	res	
10	0 VN	
11	res	
12	5 VTTL (max. 150 mA)	
13	res	
14	24 VN (max. 200 mA)	
15	res	

X1.1 to X1.3: Digital IN/OUT			
Pin	X1.1	X1.2	X1.3
1	IN1	IN9	IN17
2	IN2	IN10	IN18
3	IN3	IN11	IN19
4	IN4	IN12	IN20
5	IN5	IN13	IN21
6	IN6	IN14	IN22
7	IN7	IN15	IN23
8	IN8	IN16	IN24
9	OUT1	OUT9	OUT17
10	OUT2	OUT10	OUT18
11	OUT3	OUT11	OUT19
12	OUT4	OUT12	OUT20
13	OUT5	OUT13	OUT21
14	OUT6	OUT14	OUT22
15	OUT7	OUT15	OUT23
16	OUT8	OUT16	OUT24
17	/error	res	res
18	res	res	res

X6: Power supply		
Pin	1	Shield
	2	GND
	3	18 - 36 VDC

X2: Analog IN / OUT			
Pin	1	U_{in} 1 +	I_{in} 1 –
	2	U_{in} 1 –	
	3	U_{in} 2 +	I_{in} 2 –
	4	U_{in} 2 –	
	5	U_{in} 3 +	I_{in} 3 –
	6	U_{in} 3 –	
	7	U_{in} 4 +	I_{in} 4 –
	8	U_{in} 4 –	
	9	I_{out} 2	
	10	U_{out} 2	
	11	analog_GND	
	12	U_{ref} = + 10 V	
	13	U_{ref} = – 10 V	
	14	I_{out} 1	
	15	U_{out} 1	
	16	U_{out} 3	
	17	U_{out} 4	
	18		I_{in} 1 +
	19		I_{in} 2 +
	20		I_{in} 3 +
	21		I_{in} 4 +
	22	U_{imp} 1	
	23	U_{imp} 2	
	24	U_{imp} 3	
	25	U_{imp} 4	

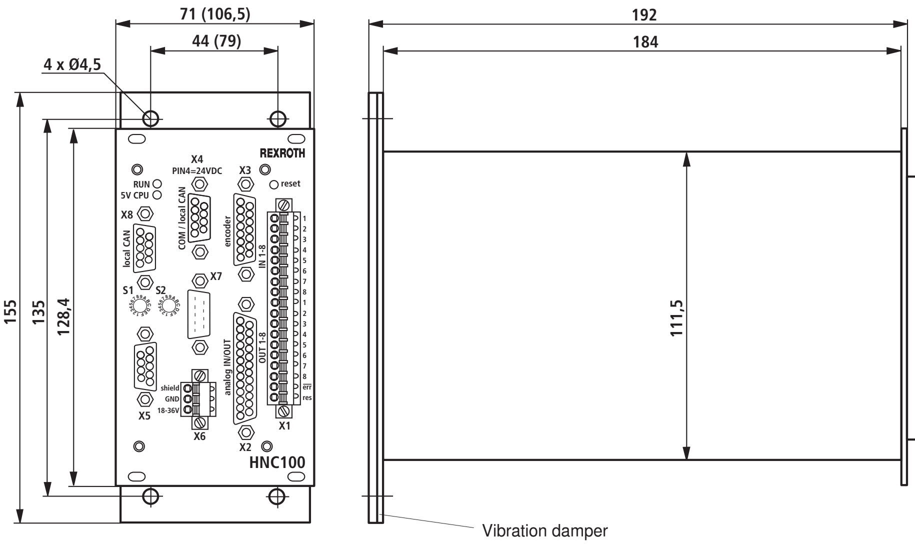
X5: Communication with higher-level control		
Pin	PROFIBUS DP	INTERBUS-S (OUT)
1	n.c.	DO 2
2	n.c.	DI 2
3	RxD/TxD-P	GND 2
4	CNTR-P	n.c.
5	DGND	U_{dd}
6	VP	/DO 2
7	n.c.	/DI 2
8	RxD/TxD-N	n.c.
9	n.c.	BCI

X4: COM / local CAN		
Pin	1	CAN_GND
	2	TxD
	3	CTS
	4	24 VN
	5	0 VN
	6	RxD
	7	RTS
	8	CAN_H
	9	CAN_L

X7: Communication with higher-level control			
Pin	CANopen	Inductive	INTERBUS-S (IN)
1	n.c.	Supply 1 +	DO1
2	CAN_L	Supply 1 –	DI1
3	CAN_GND	Signal 1 +	GND1
4	n.c.	Signal 1 –	n.c.
5	n.c.	Supply 2 +	n.c.
6	n.c.	Supply 2 –	/DO1
7	CAN_H	Signal 2 +	/DI1
8	n.c.	Signal 2 –	n.c.
9	n.c.	Sync IN/OUT	n.c.

X8: Local CAN		
Pin	1	CAN_GND
	2	res
	3	res
	4	res
	5	res
	6	res
	7	res
	8	CAN_H
	9	CAN_L

Unit dimensions (dimensions in mm)



( ) … dimensions are valid for VT-HNC100-2-2X/.-16-.-. and VT-HNC100-1-2X/.-24-.-.

Engineering / maintenance notes / supplementary information

Product documentation for VT-HNC100, component series 2X

- **Product information RE 30131-P**
- **Technical data sheet RE 30131**
- **Wiring diagrams RE 30131-Z**
- **Declaration on environmental compatibility RE 30131-U**
- **WIN-PED online help**
  - Machine data
  - NC commands (R parameters)
  - Curve function
  - Bus Manager
  - Diagnosis
- **General information on the maintenance and commissioning of hydraulic components RE 07800/RE 07900**

Commissioning software and documentation on the Internet: www.boschrexroth.com/HNC100

Notes on use:

The VT-HNC100...2X is exclusively intended for being integrated into a machine or system or assembled with other components to form a machine or system. The product may only be commissioned when it is integrated in the machine/system, for which it is intended.

Adhere to the operating conditions and performance limits specified in the technical data. The VT-HNC100...2X is used for the open and closed-loop control of position, pressure and velocity of electrohydraulic axes. For operation of the device an additional, higher-level control logic with corresponding I/O components is required, which, in conjunction with the VT-HNC100...2X, holistically control the motion sequence of the machine and also monitor it with regard to safety.

The VT-HNC100...2X must not be used in explosive atmospheres.

The VT-HNC100...2X is technical equipment that is not intended for private use.

Engineering / maintenance notes / supplementary information

Engineering notes:

- If electromagnetic interference has to be expected, take suitable measures for ensuring the function (depending on the application, e.g. shield, filtration)!
- Use low-capacitance cables; whenever possible, establish cable connections without intermediate terminals.
- Electromagnetic sources of interference (e.g. frequency converters) must not be installed in the direct vicinity of the control electronics.
- Power cables must not be routed in the direct vicinity of the controller card.
- Do not install cables of the control electronics in the direct vicinity of power cables.
- Install sensor cables separately.
- The distance to aerial lines, radio sources and radar equipment must be at least 1 meter.
- Use highly flexible CU conductors (min 2.5 mm^2) for connecting the system ground!
  The system ground is an essential, integral part of EMC protection of the controller card. It dissipates interference that is transported to the controller card via data and supply voltage cables. This function can only be ensured, if the system ground itself does not inject interference into the controller card. Rexroth recommends that also solenoid cables be shielded.
- Electrical signals brought out via control electronics (e.g. signal "no error") must not be used for switching safety-relevant machine functions (see also European standard "Safety requirements for fluid power systems and components - hydraulics", EN 982.)
- For further notes, see WIN-PED 5 online help

Maintenance notes

- The devices are tested in the factory and shipped with default settings.
- Only complete devices can be repaired. The repaired components will again be returned with default settings. User-specific settings are not retained. The operator is responsible for reloading the corresponding user parameters and programs.

Notes

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Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

Digital multi-axis NC control

RE 30156/03.12 1/16
Replaces: 04.05

Type VT-MAC8

Component series 1X

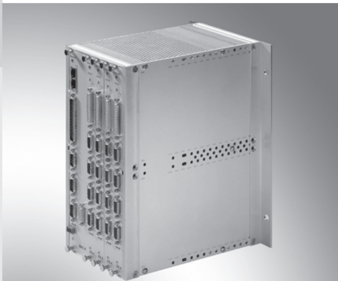

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Table of contents

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

Features

The MAC8 is the digital Rexroth multi-axis NC control in modular design. It consists of a master card with no, 2 or 4 axis controllers and can be extended with up to seven slave cards for four axes each, if necessary. It is thus the perfect solution for complex control tasks with up to 32 interpolatable axes. Using local Ethernet, more MAC8 can be connected. The MAC8 communicates with the superior PLC machine control via field bus (PROFIBUS DP or CAN) or via Ethernet. It has special hydraulic control characteristics and is able to control the movements of the machine or machine parts in a completely automatic manner and can thus also accept PLC tasks. Sensors and actuators can also be analyzed and/or activated via CAN bus.

Areas of application:

- Presses (tube forming, metal / ceramic, powder, plastic, deep drawing, glass presses, press brakes, die cushion controls, IHF (internal high pressure forming, etc.)
- Materials handling (container crane, balance crane, train/truck lift, belt drive, etc.)
- Steelworks and rolling mill technology (continuous caster, curved casting machine, mold oscillation, roll stand, 3-roll bending machine, turn over cooling bed, flying shears, ladle car, molding plants, etc.)
- Testing technology (weld testing machine, shock absorber testing system, tube testing press, etc.)
- Special machinery (coal distributors, thick sheet turning equipment, engine turning system, etc.)

Process connection

32 digital inputs, 24 digital outputs, PROFIBUS DP, CANopen, TCP-IP, UDP, PROFINET RT, EtherNet/IP

Connection / visualization

- By means of "OPC server"
- By means of "Active X" elements
- Interfaces: RS485 or Ethernet

Programming

- User programming with PC
- Extensive diagnosis and debugging tools
- Comfortable data administration on the PC
- High level language oriented
- 32 NC programs which can be executed in parallel
- High execution speed due to compiled programs
- Fast integer and real arithmetics
- Exponential and angle functions

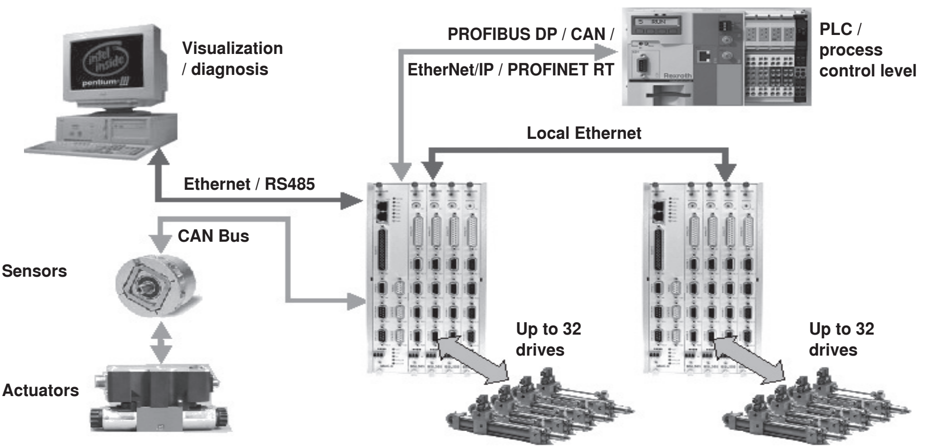
Hydraulic axes

– Measuring system	Incremental or absolute (SSI)
	Analog ±10 V and 4 to 20 mA, ±10 mA and ±20 mA
– Control output	Analog ±10 V and 4 to 20 mA, ±10 mA and ±20 mA

Closed-loop control

- Following controller
- State controller
- Path-dependant braking
- Synchronization controller up to 32 axes (different variants)
- Pressure / force controller

System overview



Ordering code for system

VT-MAC 8–1X/ S	–	M	–	AX4	*

System with
1 slot = 1
5 slots = 5
8 slots = 8

Bus variant
No field bus = A
PROFIBUS DP slave connection = P
PROFINET RT / EtherNET/IP slave connection = E

Master
1 = without axis module, with RS485
2 = 2-axis version, with RS485
4 = 4-axis version

4-axis slave
0 to 7 = Number

Further details in the plain text

Selection aid

Part Ordering code	Analog In	RS232 (V24) RS485	CANopen	PROFINET RT / EtherNet/IP	PROFIBUS DP	Analog I/O	Encoder plug
AM 1	X	X	X				
AM 2	X	X	X			X	2X
AM 4	X		X			X	4X
PM 1	X	X	X		X		
PM 2	X	X	X		X	X	2X
PM 4	X		X		X	X	4X
EM 4	X		X	X		X	4X

Components

Material no.	Type	Designation
R901075726	VT-MAC8-1X/K-AM1	Master card without axis controller
R901075728	VT-MAC8-1X/K-AM2	Master card with 2 axis controllers
R901075730	VT-MAC8-1X/K-AM4	Master card with 4 axis controllers
R901075732	VT-MAC8-1X/K-PM1	Master card with PROFIBUS DP, without axis controller
R901075734	VT-MAC8-1X/K-PM2	Master card with PROFIBUS DP, with 2 axis controllers
R901075738	VT-MAC8-1X/K-PM4	Master card with PROFIBUS DP, with 4 axis controllers
R901275171	VT-MAC8-1X/K-EM4	Master card with PROFIBUS RT / EtherNet/IP, with 4 axis controllers
R901075752	VT-MAC8-1X/K-AX4	Slave card with 4 axis controllers
R901075757	VT-MAC8-1X/K-DUMMY	Blank location cover for a slot
R901075714	VT-MAC8-1X/K-RACK1	Empty rack with one slot (master card)
R901075722	VT-MAC8-1X/K-RACK5	Empty rack with 5 slots (1 master, 4 slaves)
R901075725	VT-MAC8-1X/K-RACK8	Empty rack with 8 slots (1 master, 7 slaves)
R901052075	KABELSATZ MAC8/ABS/SF/3M	Cable absolute value encoder SSI (X2), 3 meters, open end
R901052153	KABELSATZ MAC8/INC/24V/SF3M	Cable incremental encoder 24V (X2), 3 meters, open end
R901052152	KABELSATZ MAC8/INC/5V/SF/3M	Cable incremental encoder 5V (X2), 3 meters, open end
R901052141	KABELSATZ MAC8/AE/SF/3M	Cable analog inputs (X4), 3 meters, open end
R901052069	KABELSATZ MAC8/AEA/SF/3M	Cable analog inputs/outputs (X1), 3 meters, open end
R901052150	KABELSATZ MAC8/DEA/SF/3M	Cable digital inputs/outputs (X5), 3 meters, open end
R901074828	KABELSATZ MAC8/PC/RS232/5M	Cable PC MAC8 RS232 interface (X3.4), 5 meters
R901269556	SYS-MAC8-2X-D/E	Installation CD for the MAC8 programming system

Software project planning

Program creation with MACpro
- Windows version with integrated editor with command highlighting
- Project group creation for managing the individual programs on the slots with automatic switch-over
- Global header files for joint definitions
- Programs can be organized in modules (files)
- Nesting depth for up to 50 subroutines
- Change-oriented compiling and transmission to the MAC8
- Reference list of the variables and subroutines used
- Automatic version comparison PC <-> MAC8
- Saving of different desktop settings
- Program stored in the flash

Debugging
- Online help for "Syntax", "Tools" and "Keys"
- Tracing of program execution (Trace)
- Process variable tracing by means of trend
- Program view (View) with search functions
- Function level display (call hierarchy)
- 5 break points are managed
- Stop / start / continue and single step (single, step, stepover) of individual or all programs
- Saving of the memory image (program with data)

View of variables
- All variable windows can be selected by means of "Hot keys" or the menu, flexible window size
- Configurable variable window (mix variables) with hexadecimal, decimal, binary and floating point representation. Easy transmission of any variable from the program view to the tracing window and structuring by means of comments
- Setup window with all axis-specific process variables
- System parameter assistant

Acquisition of measured data
- 64 recording channels with start and stop trigger
- Recording option for all process variables
- Graphical and numeric presentation (DBF format) of the recorded channels
- Endless data recording (trend)

Commissioning functions
- Inputs can be simulated
- Outputs can be set
- Analog output variables can be set
- Jog mode for controller optimization
- Activation / deactivation of individual controller components

Project-related management of the:
- Programs
- Configurable programming user interface
- System parameters
- Measured data

MACpro system requirements:
- IBM PC or compatible system
- Windows NT, Windows 2000, Win XP, Windows 7
- Processor from 300 MHz
- At least 256 MB RAM
- At least 100 MB of available hard disk capacity

The installation is effected from CD
(SYS-MAC8-2X-D/E with material no. **R901269556**)

Overview of the controller functions

Position controller:
- Following controller
- Substitutional closed-loop control (position / pressure)
- Force limitation in positive and negative direction
  Direction-dependent gain adjustment
- "Inflected" gain characteristic curve
- Fine positioning
- Residual voltage principle
- Compensation of zero point errors
- State feedback
- Command value feedforward
- Limitation of the control output via the NC program
- "Path-dependant braking"
- External controller function via NC program
- Following operation
- Velocity override
- Gain modification via the NC program possible
- Interpolation of up to 32 axes
- Pre-acceleration
- Force / path; force / time curves
- Position/ input value curves
- Coordinate transformation of the spatial axes

Overview of the controller functions (continued)

State controller:
- Velocity feedback
- Acceleration feedback
- Pressure feedback
- External feedback

Pressure / force controller:
- PID controller
- I share can be switched via window
- Differential pressure evaluation
- P / Q pilot control
- Different modes for transition from position to force controller

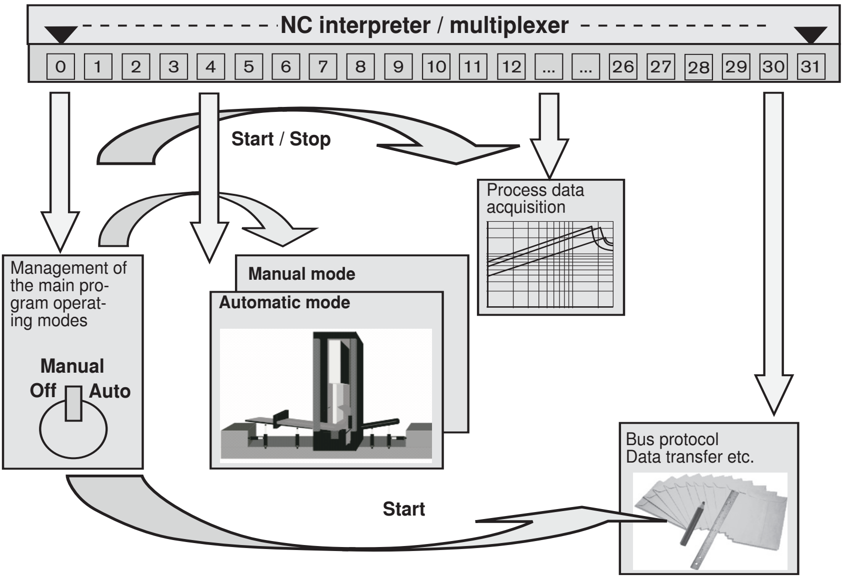
Velocity controller:
- PI controller
- I share switchable via window

Synchronization controller:
- Synchronization of any groups with up to 32 axes, which can be changed during runtime
- Active synchronization with force limitation and/or parallel making way
- Passive synchronization, tilt compensation control, with definable average counterforce
- Synchronization offsets of the axes can be changed dynamically
- Axes can be dynamically added to or removed from the synchronized group (also during operation)
- Relative synchronization, also in opposite direction

Monitoring functions:
- Dynamic following error monitoring
- Traversing range limits (electronic end switches)
- Cable break monitoring for incremental and SSI encoder
- Cable break monitoring for sensors with output 4 to 20 mA
- Valve monitoring
- Encoder voltage monitoring

NC interpreter

The NC interpreter organizes the execution of the 32 parallel NC programs. In this connection, each program works in a sequential manner. Switch-over between the parallel programs is in each case effected after processing of one program line. In case of commands waiting for an event (e.g.: "WAIT", "POS"), the next program is activated immediately after the event request in order not to hinder execution of the other programs. All system resources are available for all programs (I/O, axes, variables etc.). Programs can start, stop or delay each other. This concept allows for the perfect imaging of the sequence control of the machine in the NC program of the MAC8.



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ECL-Win programming language

The MAC8 data organization:

Numeric variables (integer):

V:	Standard variables
P:	Local variables
N:	Process variables

Fields (integer):

A:	User defined fields
S:	System parameters

Real variables:

R:	Floating point figures

Logic variables:

I:	Inputs
O:	Outputs
F:	Process flags

Signs and operators:

<num. signs> {"-" | "!" | "#"}

<num. operator> {"*" | "/" | "+" | "-" | "&" | "|" | "^" | "<<" | ">>"}

<num. real operator> {"sin" | "cos" | "tan" | "asin" | "acos" | "atan" | "sqrt"

<log. operator> {"&" | "|" | "^"}

<num. comp.operator> {"<=" | ">=" | "<>" |"<" | ">" | "="}

Compiler instructions:

";"	<Comment>
"#include"	<File name>
"#module"	<File name>
"#define"	<Name> <Text>
"#global"	<File name>

Acquisition of measured values:

TIMER	Timer
TRACE	Oscilloscope function

Dialog command (control box or terminal):

DIALOG	Start dialog
WINDOW	Define window
DISPLAY	Output variable or text
INPUT	Input definition
LEVEL	User level
READ_KEY	Softkey query
SSET	String assignment

Special commands:

CALL <Address>	Call C function
START/STOP TASK	Start C task

Program sequence control:

IF ELSE	Instruction
WHILE	Loop
{..}	Command block
[..]	Bundling of commands
BEGIN END	Program definition
Label	

JUMP <Label> or <Subroutine>

START/STOP/BREAK/CONT<Program>

WAIT <Time> or <Condition>

Data manipulation:

DIM	Field declaration
COPY	Field copying function
SET	Assign variable
MSET	Preset fields
PSET	Assign local variable

Axis/process functions:

AXINIT	Initialize axes
AXSET	Take over axis data
STOP	Cancel axis movement
HALT	Immediate halt of axis movement
POS HALT	Immediate halt of axis movement
BREAK	Interrupt axis movement
CONT	Resume axis movement
EQUIT	Acknowledge axis error
LOCK	Lock axis control
UNLOCK	Unlock control
OVER	Determine axis override
ACC	Axis acceleration (±)
VEL	Axis velocity
POS	Position axis
SYNCH	Define synchronized axes
LIN	Linear interpolation
FORCE	Force control
DAC	Voltage output
FUNC	Axis functions
SIMU	Simulation of axis
HOME	Referencing
TABLE	Process curve creation
VIRTUAL	Define virtual axes
REAL	Inverse calculation formula for VIRTUAL
FREEZE	Freeze axis velocity

For the operating parameters not listed here, you can usually enter a constant, a variable or a term!

Technical data

Operating voltage	U_B	18 to 36 VDC / max 3.6 A
Current consumption	Master without axis	500 mA
	Master with axes	800 mA
	Slave	400 mA
Processor		MPC860 and MPC555
Memory		16 MB SDRAM, 16 MB Flash, 8 KByte DPR
		4 MB Flash (MPC555)
		2 MB SRAM (MPC555)
Analog inputs:		
– Voltage inputs (differential inputs)		±10 V, 12 bits with 4-fold oversampling
• Input voltage	U_E	Max. +10 V to –10 V
• Input resistance	R_E	160 kΩ
• Resolution		5 mV
– Current inputs		
• Input current / input resistance	I_E / R_E	4 to 20 mA / 100 Ω ±20 mA / 500 Ω
• Leakage current	I_V	12 μA
• Resolution		4 μA
Analog outputs:		
– Voltage outputs		
• Output voltage	U_{nom}	±10 V PWM (pulse width modulation)
• Output current	I_{max}	10 mA
• Load	R_{min}	2 kΩ
– Current outputs		
• Output current normalized	I_{nom}	±20 mA
• Load	R_{max}	500 Ω
• Resolution		1 mV
Serial interfaces	Standard	RS232 (V 24) (19.2 KBaud)
		RS485 (115 KBaud)
	Optional	PROFIBUS DP (max. 12 MBaud)
		CANopen (max. 1 MBaud)
Switching inputs	Quantity	32
	Logic level	log 0 (low) 0 V to +5 V
		log 1 (high) +10 V to 36 V
	R_E	3 kΩ ±10 %
Switching outputs	Quantity	24
	Logic level	log 0 (low) 0 V to +5 V;
		log 1 (high) +10 V to 36 V;
		current carrying capacity up to 50 mA

Technical data (continued)

Digital position transducers		
– Incremental transducer • Transducer with TTL output		
Input voltage	log 0	0 to 1 V
	log 1	2.8 to 5.5 V
Input current	log 0	–0.8 mA (with 0 V)
	log 1	0.8 mA (with 5 V)
Max. frequency referring to Ua 1	f_{max}	250 kHz, 24 bit
SSI position transducers		
– Coding		Gray-Code
– Data width		Adjustable up to max. 28 bit
– Line receiver (TTL)	f_{max}	250 kHz
– Input voltage	log 0	0 to 1 V
	log 1	2.5 to 5.5 V
– Input current	log 0	–0.5 mA (with 0 V)
	log 1	0.5 mA (with 5 V)
– Line driver		
– Output voltage	log 0	0 to 0.5 V
	log 1	2.5 to 5.5 V
Admissible operating temperature range		0 to 50 °C
Storage temperature range		–20 to 70 °C
Weight:		
– Rack 1	m	1000 g
– Rack 5	m	1800 g
– Rack 8	m	2500 g
– Master card	m	400 g
– Slave card	m	350 g
– Blank cover	m	100 g

Pin assignment master card VT-MAC8

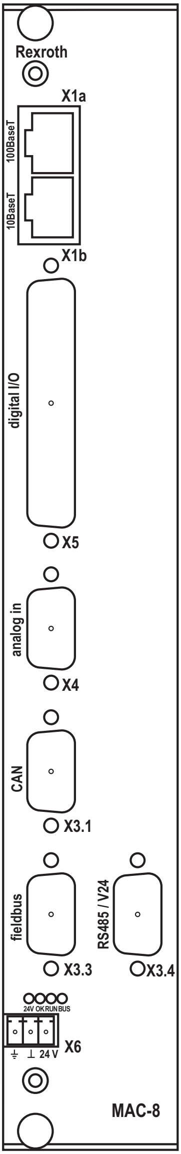
Front plate shows: VT-MAC8-1X/K-PM1

X1a	RJ-45; 100BaseT Ethernet
Pin	
1	TPO+
2	TPO–
3	TPI+
4	75K-GND
5	75K-GND
6	TPI–
7	75K-GND
8	75K-GND

X1b	RJ-45; 10BaseT Ethernet
Pin	
1	TPO+
2	TPO–
3	TPI+
4	n.c.
5	n.c.
6	TPI–
7	n.c.
8	n.c.

X4	Analog in	
Pin		**Pin**
1	$U_{in}1_C$	
	$U_{in}2_C$	6
2	$U_{in}3_C$	
	$U_{in}4_C$	7
3	AGND	
	$U_{in}1_D$	8
4	$U_{in}2_D$	
	$U_{in}3_D$	9
5	$U_{in}4_D$	

X6	Voltage supply
Pin	
1	Shield
2	GND
3	+24 V



X3.1	CANopen	
Pin		**Pin**
1	n.c.	
	n.c.	6
2	CAN_Lx	
	CAN_Hx	7
3	GNDCANx	
	n.c.	8
4	n.c.	
	n.c.	9
5	n.c.	

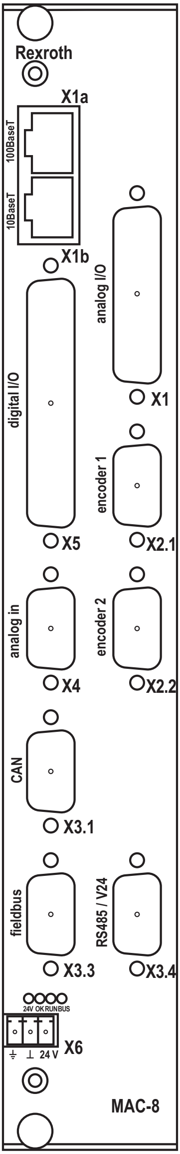
X3.3	PROFIBUS DP	
Pin		**Pin**
1	n.c.	
	VP	6
2	n.c.	
	n.c.	7
3	RxD/TxD -P	
	RxD/TxD -N	8
4	CNTR -P	
	n.c.	9
5	DGND	

Notice:
Please use straight Profibus connector

X3.4	RS232 (V24)	
Pin		**Pin**
1	GND	
	RxD	6
2	TxD	
	RS485	
	GND	7
3	5 V	
	RxD+	8
4	RxD–	
	TxD+	9
5	TxD–	

Pin assignment master card VT-MAC8

Front plate shows: VT-MAC8-1X/K-PM2

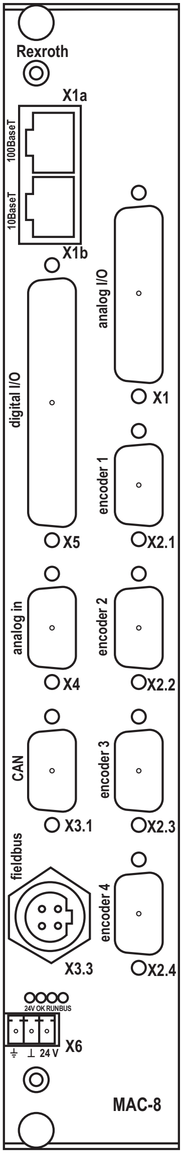


X5			Digital I/O		
Pin	**Description**	**Pin**	**Description**	**Pin**	**Description**
		22	Reserved		
43	Reserved			1	Reserved
		23	In0		
44	In2			2	In1
		24	In3		
45	In5			3	In4
		25	In6		
46	In8			4	In7
		26	In9		
47	In11			5	In10
		27	In12		
48	In14			6	In13
		28	In15		
49	In17			7	In16
		29	In18		
50	In20			8	In19
		30	In21		
51	In23			9	In22
		31	In24		
52	In26			10	In25
		32	In27		
53	In29			11	In28
		33	In30		
54	Out0			12	In31
		34	Out1		
55	Out3			13	Out2
		35	Out4		
56	Out6			14	Out5
		36	Out7		
57	Out9			15	Out8
		37	Out10		
58	Out12			16	Out11
		38	Out13		
59	Out15			17	Out14
		39	Out16		
60	Out18			18	Out17
		40	Out19		
61	Out21			19	Out20
		41	Out22		
62	0 V			20	Out23
		42	0 V		
				21	0 V

Notice:
The pins marked with "reserved" must not be connected.

Pin assignment master card VT-MAC8

Front plate shows: VT-MAC8-1X/K-EM4



X1			Analog I/O on master card
Pin		**Pin**	**Description**
1	n.c.		
	n.c.	14	
2	AGND		Analog ground
	n.c.	15	
3	n.c.		
	AGND	16	Analog ground
4	$IU_{in}1_A$		Current / voltage input 0.. 20 mA / ±10 V
	$IU_{in}1_B$	17	Current / voltage input 0.. 20 mA / ±10 V
5	$IU_{in}2_A$		Current / voltage input 0.. 20 mA / ±10 V
	$IU_{in}2_B$	18	Current / voltage input 0.. 20 mA / ±10 V
6	AGND		Analog ground
	$IU_{in}3_A$	19	Current / voltage input 0.. 20 mA / ±10 V
7	$IU_{in}3_B$		Current / voltage input 0.. 20 mA / ±10 V
	$IU_{in}4_A$	20	Current / voltage input 0.. 20 mA / ±10 V
8	$IU_{in}4_B$		Current / voltage input 0.. 20 mA / ±10 V
	AGND	21	Analog ground
9	$U_{out}1$		±10 V
	$U_{out}2$	22	±10 V
10	$U_{out}3$		±10 V
	$U_{out}4$	23	±10 V
11	AGND		Analog ground
	$I_{out}1$	24	±20 mA
12	$I_{out}2$		±20 mA
	$I_{out}3$	25	±20 mA
13	$I_{out}4$		±20 mA

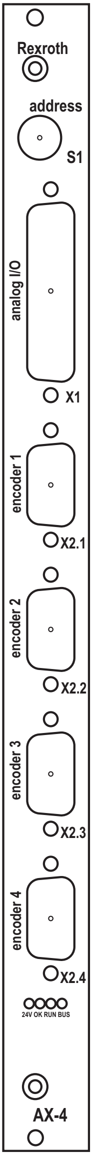
X2.x	Encoder plug	
Pin	**INC**	**SSI**
1	/Ua 2	
2		+Clk
3	Ua 0	
4	/ Ua 0	
5	Ua 1	
6	/ Ua 1	
7		–Clk
8	Ua 2	
9		–Data
10	0 V	0 V
11		+Data
12	Reserved	Reserved
13	n. c.	n. c.
14	Reserved	Reserved
15	n. c.	n. c.

X3.3	PROFINET RT / EtherNet/IP
Pin	
1	TPO+
2	TPI+
3	TPO–
4	TPI–

Notice:

The pins marked with "reserved" must not be connected.

Pin assignment slave card VT-MAC8-1X/K-AX4



X1			Analog I/O on slave card
Pin		**Pin**	**Description**
1	$I_{in}1_C$		Current / voltage input ±20 mA / ±10 V
	$I_{in}2_C$	14	Current / voltage input ±20 mA / ±10 V
2	AGND		Analog ground
	$I_{in}3_C$	15	Current / voltage input ±20 mA / ±10 V
3	$I_{in}4_C$		Current / voltage input ±20 mA / ±10 V
	AGND	16	Analog ground
4	$IU_{in}1_A$		Current / voltage input 0...20 mA / ±10 V
	$IU_{in}1_B$	17	Current / voltage input 0...20 mA / ±10 V
5	$IU_{in}2_A$		Current / voltage input 0...20 mA / ±10 V
	$IU_{in}2_B$	18	Current / voltage input 0...20 mA / ±10 V
6	AGND		Analog ground
	$IU_{in}3_A$	19	Current / voltage input 0...20 mA / ±10 V
7	$IU_{in}3_B$		Current / voltage input 0...20 mA / ±10 V
	$IU_{in}4_A$	20	Current / voltage input 0...20 mA / ±10 V
8	$IU_{in}4_B$		Current / voltage input 0...20 mA / ±10 V
	AGND	21	Analog ground
9	$U_{out}1$		±10 V
	$U_{out}2$	22	±10 V
10	$U_{out}3$		±10 V
	$U_{out}4$	23	±10 V
11	AGND		Analog ground
	$I_{out}1$	24	±20 mA
12	$I_{out}2$		±20 mA
	$I_{out}3$	25	±20 mA
13	$I_{out}4$		±20 mA

X2.x	Encoder plug	
Pin	**INC**	**SSI**
1	/Ua 2	
2		+Clk
3	Ua 0	
4	/ Ua 0	
5	Ua 1	
6	/ Ua 1	
7		–Clk
8	Ua 2	
9		–Data
10	0 V	0 V
11		+Data
12	Reserved	Reserved
13	n. c.	n. c.
14	Reserved	Reserved
15	n. c.	n. c.

S1	Address
	Slot
2	Slot 2
3	Slot 3
4	Slot 4
5	Slot 5
6	Slot 6
7	Slot 7
8	Slot 8
0 - 1	Not allowed
9 - F	Not allowed

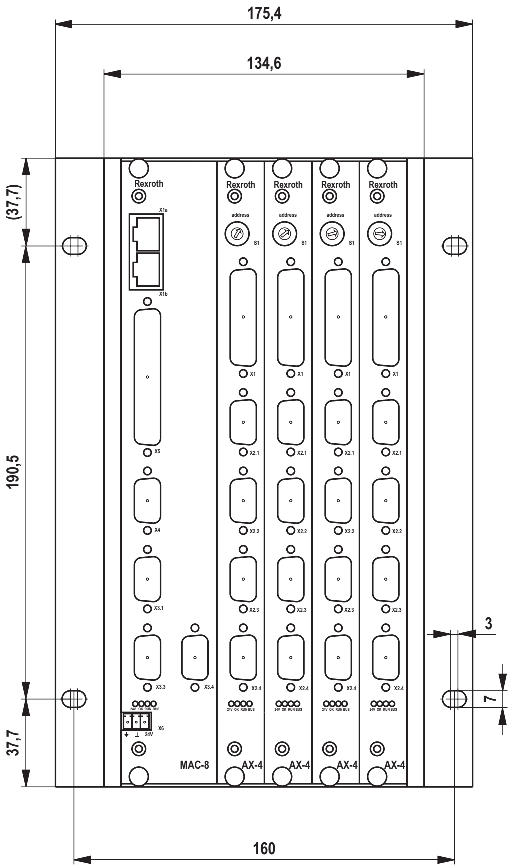
Notice:
Address the card according to the slot.

Notice:
The pins marked with "reserved" must not be connected.

Unit dimensions (dimensions in mm)

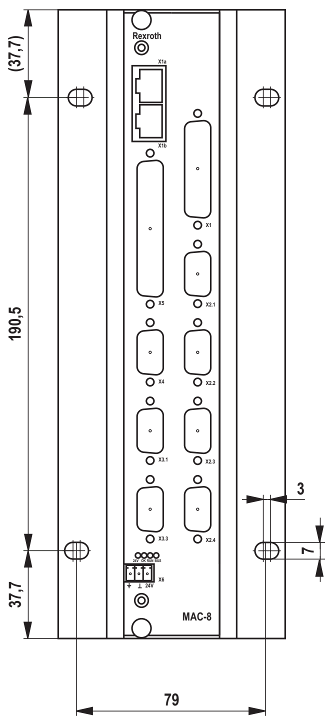
VT-MAC8-1X/K-RACK5

System with 5 slots



VT-MAC8-1X/K-RACK1

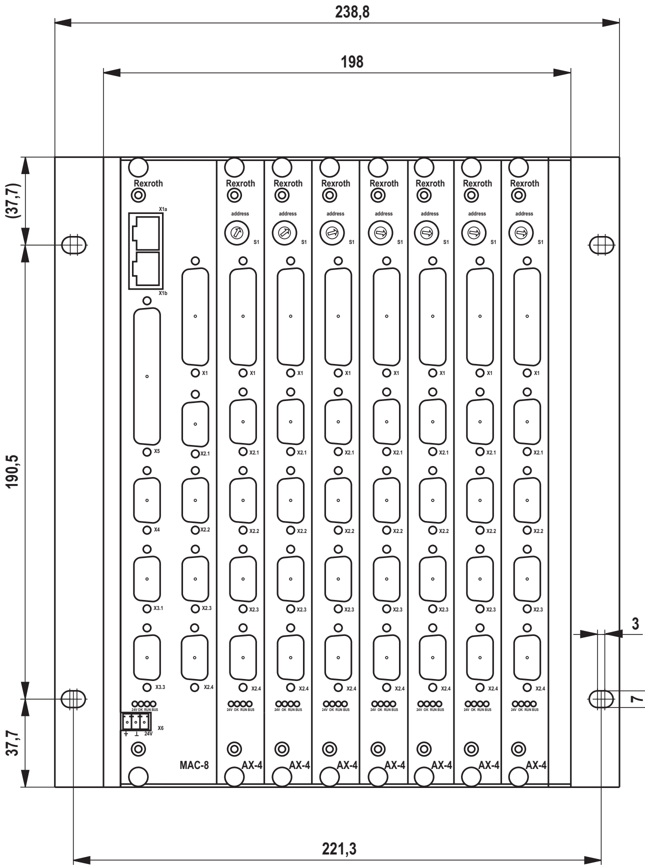
System with 1 slot



Unit dimensions (dimensions in mm)

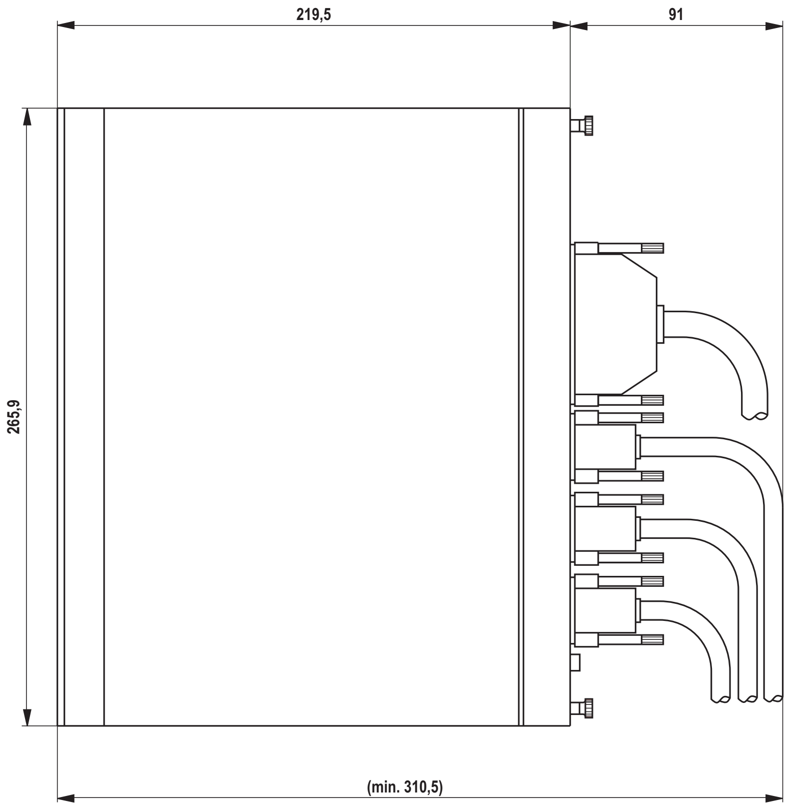
VT-MAC8-1X/K-RACK8

System with 8 slots



Unit dimensions (dimensions in mm)

VT-MAC8-1X/K-RACK1/5/8



Notes

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documentation@boschrexroth.de
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Sensors and signal transmitters

4

The Drive & Control Company **Rexroth** Bosch Group

Pressure transducers for hydraulic applications

Type HM20

RE 30272
Edition: 2013-03
Replaces: –.–

H8002

- Component series 2X

c UL US LISTED

Features

- Masurement of pressures in hydraulic systems
- 6 measurement ranges up to 630 bar
- Sensor with thin film measuring cell
- Components that are in contact with the media are made of stainless steel
- Operational safety due to high bursting pressure, reversed polarity, overvoltage and short-circuit protection
- Accuracy class 0.5
- Excellent non-repeatability < 0.05 %
- Wide operating temperature range –40 ... +85 °C

Contents

Ordering code

01		02		03		04		05
HM20	**–**	**2X**	**/**		**–**		**–**	**K35**

01	Pressure transducer	**HM20**
02	Component series 20 to 29 (20 to 29: Unchanged installation dimensions and pin assignments)	**2X**
03	50 bar	**50**
	100 bar	**100**
	250 bar	**250**
	315 bar	**315**
	400 bar	**400**
	630 bar	**630**
04	Current output 4 to 20 mA	**C**
	Voltage output 0.1 to 10 V	**H**
05	Connector, 4-pole, M12x1	**K35**

Replacement seal ring

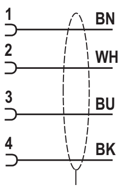
Designation	**Material no.**
Seal ring NBR	**R900012467**

Cable sets or mating connectors are not included in the scope of delivery; please order separately

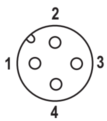
Cable sets and mating connectors

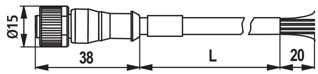
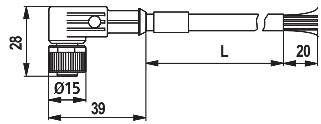
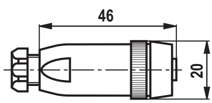
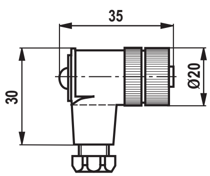
Technical data	
general	
Current carrying capacity	4 A
Temperature range	−25 ... +85 °C
Protection class	IP 67 according to EN 60529
Cable sets, shielded	
Cable diameter	5.9 mm
Jacket material	PUR-OB
Line cross-section	4 x 0.34 mm²
Mating connectors	
Cable diameter	4 to 6 mm
Line cross-section	4 x 0.75 mm²
Type of connection	Screw connection

Connection diagram
Cable set



Socket contacts,
view to the socket side



Unit dimensions (in mm)	**Designation**	**Material no.**
	4PM12 (L = 2 m) 4PM12 (L = 5 m)	**R900773031** **R900779498**
	4PM12 (L = 2 m) 4PM12 (L = 5 m)	**R900779504** **R900779503**
	4PE11508	**R900773042**
	4PE11509	**R900779509**

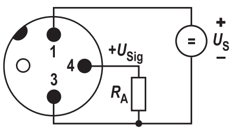
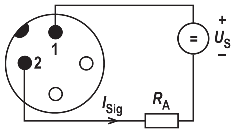
Technical data

Input variables							
Operating voltage	U_S	16 to 36 VDC [1]					
Residual ripple	U_{PP}	2.5 V (40 to 400 Hz)					
Current consumption	I_{max}	≤ 12 mA (with voltage output)					
Protection class		III					
Isolation resistance	R	> 100 (500 VDC)					
Measurement range	p_N [bar]	50	100	250	315	400	630
Overload protection	p_{max} [bar]	100	200	500	630	800	1000
Bursting pressure	p [bar]	200	400	1000	1260	1600	2520
Output parameters							
Output signal and admissible load R_A	I_{Sig}	4 to 20 mA $R_A = (U_S - 8.5\ V) / 0.0215\ A$ with R_A in Ω and U_S in V					
	U_{Sig}	0.1 to 10 V, R_A > 2 kΩ					
Setting time (10 to 90 %)	t	< 1 ms					
Accuracy (characteristic curve deviation)		< 0.5 % related to the complete measurement range, including non-linearity, hysteresis, zero point and end value deviation (corresponds to the measuring deviation according to IEC 61298-2)					
Temperature coefficient (TC) for zero point and range – within the nominal temperature range – outside of the nominal temperature range		 < 0.1 % / 10 K < 0.2 % / 10 K					
Hysteresis		< 0.15 % [2]					
Non-repeatability		< 0.05 % [2]					
Long-term drift (1 year) under reference conditions		< 0.1 %					
Environmental conditions							
Nominal temperature range	ϑ	–20 ... +80 °C					
Ambient temperature range	ϑ	–40 ... +85 °C					
Storage temperature range	ϑ	–40 ... +100 °C					
Hydraulic fluid temperature range	ϑ	–40 ... +90 °C					
Other characteristics							
Pressure port		G1/4 according to DIN 3852 form E, seal ring according to DIN 3869-14					
Housing materials Materials in contact with medium		V4A (1.4404), PEI, HNBR 1.4542, NBR					
Pressure media		HL, HLP, HFC, nitrogen [3], others upon request					
Tightening torque – Measurement ranges < 400 bar	M_A	20 ... 25 Nm					
Tightening torque – Measurement ranges ≥ 400 bar	M_A	25 ... 30 Nm					
Electrical connection		4-pole M12 connector on the housing [4]					
Protection class according to EN 60529		IP65/IP67 with mating connector correctly mounted and locked					
Weight	m	0.05 kg					
Life cycle		60 million load cycles or 60000 h					
Shock resistance, mechanical, IEC 60068-2-27		15 g / 11 ms (3 x positive / 3 x negative per axis)					
Vibration resistance under resonance, IEC 60068-2-6		10 ... 2000 Hz, 10 g (20 sweeps, 1 octave/min)					
Electromagnetic compatibility (EMC) – DIN EN 61000-4-2 ESD – DIN EN 61000-4-3 HF radiated – DIN EN 61000-4-4 burst – DIN EN 61000-4-5 surge – DIN EN 61000-4-6 HF cable-propagated		 4 kV CD / 8 kV AD 10 V/m (80 ... 2700 MHz) 4 kV clamp 1 kV signal for DC devices 10 V					
Conformity		CE					
Further tests		cULus-listed					

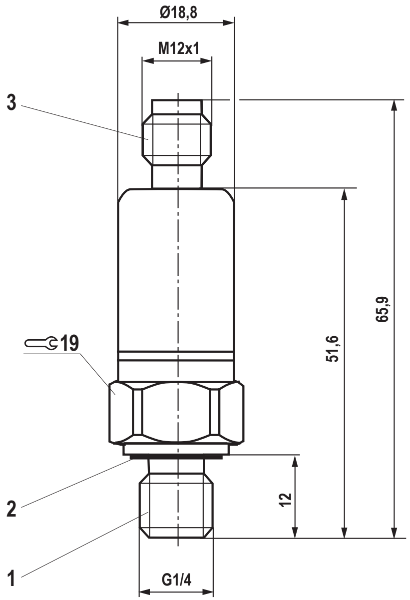
1) With cULus: Max. of 30 VDC is admissible
2) Related to nominal temperature range
3) Maximum of 300 bar is admissible
4) Recommendation: Use of shielded connection cable, see cable sets on page 2

Electrical connection

4-pole M12 connector, view to connection side

Voltage		Current (two-wire system)	
	Values for U_S, R_A and U_{Sig}, see page 3		Values for U_S, R_A and I_{Sig}, see page 3

Unit dimensions (dimensions in mm)



1 Pressure port G1/4 male thread
2 Seal ring
3 4-pole M12 connector

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Electronic pressure switch with integrated analogue output

RE 30276/03.06 1/6
Replaces: 01.06
RE 30275

Type HEDE 10…/1/

Component series 2X

tb0002

Table of contents

Features

– Suitable for measuring pressures and converting the measured values into electrical signal variables in hydraulic systems
– EMC properties allow the use of this pressure switch also in critical applications
– Ceramic / capacitive sensor
– Connecting cable with 4-pin M12 plug on housing
– Accuracy class 1.0
– Connection thread G1/4
– Parts in contact with media are made of stainless steel, ceramic and FKM
– Compact design
– One switching output and one analogue output

Ordering code

HED	E	10	A1	2X	/		K41	G24	/	1	/	V	/	*

- Hydraulic electrical pressure switch
- Integrated electronics = **E**
- Component type = **10**
- Hydraulic interface 1/4“ = **A1**
- Component series = **2X**
- Pressure stages
  - 100 bar = **100**
  - 250 bar = **200**
  - 400 bar = **400**
  - 600 bar = **600**
- **K41 =** Plug variant M12, 4-pin as standard
- **G 24 =** Supply voltage
- **1 =** One switching and one analogue output
- **V =** FKM seals
  ⚠ Caution! Observe compatibility of seals with hydraulic fluid used!
- Further details in clear text

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

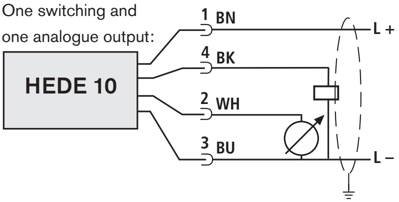
Input variables						
Auxiliary energy		U_O	18 to 36 VDC			
Current consumption		I	< 50 mA			
Measuring range		p_N in bar	100	250	400	600
Overload safety		p_{max} in bar	300	400	600	800
Burst pressure		p in bar	650	850	1000	1200
Output variables						
Analogue output		U	0 to 10 VDC minimum load 2000 Ω			
		I	4 – 20 mA (max. load (U_O – 10) x 50 Ω)			
	Rise time (10 to 90 %)	t	3 ms			
Switching output	Current carrying capacity	I	250 mA			
	Response time	t	< 3 ms (with response time set to dAP = 3)			
	Max. switching frequency	f	170 Hz (at dAP = 3)			
Characteristic curve deviation: (initial point setting according to DIN16086)			< ±0.5 %			
Temperature coefficient within nominal temperature range – Highest TC of zero point – Highest TC of span			 0.2 % / 10 k 0.2 % / 10 k			
Hysteresis			< ±0.1 %			
Repeatability			0.1 %			
Long-term drift under reference conditions (6 months)			0.05 %			
Ambient conditions						
Limit temperature range		ϑ	–20 to +80 °C			
Storage temperature range		ϑ	–40 to +100 °C			
Medium temperature range		ϑ	–25 to +80 °C			
Mechanical data						
Pressure port			G1/4			
Electrical connection			M12 plug-in connection			

Technical data (continued)

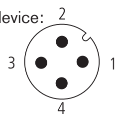
Programming options		Hysteresis / window; normally open / normally closed; pick-up, drop-out delay; attenuation; display unit / analogue output: voltage or current			
Pressure stages		100	250	400	600
Switching point SP	bar	1.0 ... 100	2 ... 250	4 ... 400	6 ... 600
Release position, rP	bar	0.5 ... 99.5	1 ... 249	2 ... 398	3 ... 597
In increments of	bar	0.5	1	2	3
Adjustable response time of a switching output and resulting switching frequency	Response time (dAP) ms Hz	3 ... 500 170 ... 1			
Adjustable delay time dS, dr	s	0.0; 0.2 ... 50.0			
Environmental compatibility					
Type of protection / housing to IEC 60529		IP67			
Class of protection EN 50178		III			
Insulation resistance	MΩ	> 100 (500 VDC)			
Resistane to shock to IEC 60068-2-27	g	50 g, 11 ms			
Resistance to vibration to IEC 60068-2-6	g	20 g, 10 ... 2000 Hz			
Switching cycles min.		100 million / 50 million with pressure stage 600 bar			
Approval		cULus			
EMC	EN 61000-4-2 ESD EN 61000-4-3 HF radiated EN 61000-4-4 burst EN 61000-4-5 surge EN 61000-4-6 HF cable-bound	4 / 8 kV 10 V/m 2 kV 0.5 / 1 kV 10 V			
Housing material		EPDM/X (Santoprene); FKM; PBTP (Pocan); PC (Macrolon); V2A (1.4301)			
Materials in contact with the medium		V2A (1.4305); ceramic; FKM			
Connection		M12 plug-in connection, gold-plated contacts			

Pin assignment K41

One switching and one analogue output:



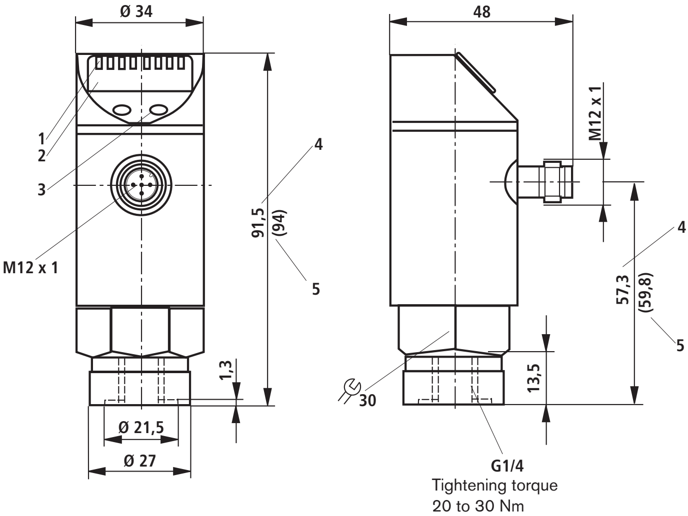
Detail of plug on the device:



1	BN	Brown
2	WH	White
3	BU	Blue
4	BK	Black

4

Unit dimensions (nominal dimensions in mm)



1 Status LEDs
2 4-digit alphanumerical display
3 Programming key
4 Dimension for pressure stage 100 bar and 250 bar
5 Dimension for pressure stage 400 bar and 600 bar

Recommended installation:
Vibration-free installation!

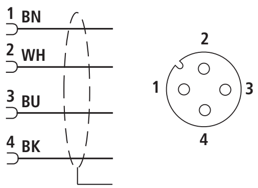
Accessories

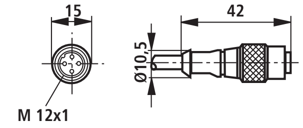
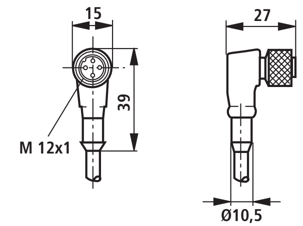
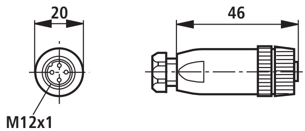
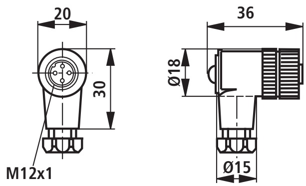
Cable sockets:

Technical data:

Current carrying capacity	4 A
Temperature range	–25...90 °C
Type of protection	IP 67
Contacts	CuZn
Contact surface	Gold-plated
Housing	TPU
Seal	FKM
Fitting	CuZn/Ni
Wire cross-section	4 x 0,34 mm
Sheath material	PUR
Shield	Not connected on plug side
Sheath diameter	Ø 5.0 mm
Sheath colour	Black
Bending radius for dyn. application	min. 50 mm

Connection:

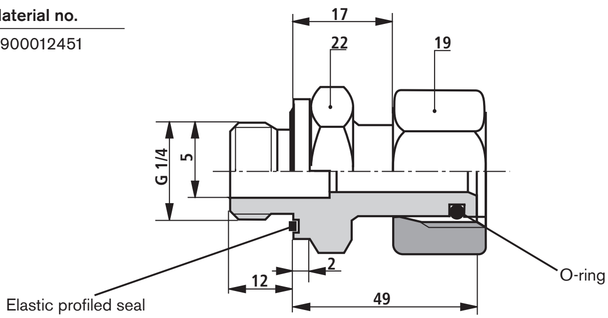


	Designation	Material no.
	04 POL (with 2 m cable)	R900773031
	04 POL (with 5 m cable)	R900779498
	04 POL (with 2 m cable)	R900779504
	04 POL (with 5 m cable)	R900779503
	04 POL (without cable)[1]	R900773042
	04 POL (without cable)[1]	R900779509

[1] Type of protection IP68

Hydraulic fitting:

Designation	Material no.
AB 20-28	R900012451

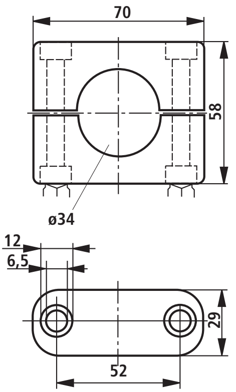


4

Accessories (continued)

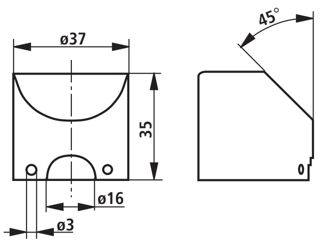
Mounting clamp for HEDE 10

Designation	Material no.
Mounting clamp	R900786138



Protective cap for HEDE 10

Designation	Material no.
Protective cap M12	R900786141



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Rexroth
Bosch Group

Electronic pressure switch with two switching outputs

RE 30278/03.06
Replaces: 01.06
RE 30275

Type HEDE 10…/2/

Component series 2X

tb0002

Table of contents

Features

– Suitable for measuring pressures and converting the measured values into electrical signal variables in hydraulic systems
– EMC properties allow the use also in critical applications
– Sensor ceramic / capacitive
– Connecting cable with 4-pin M12 plug on the housing
– Accuracy class 1.0
– Connection thread G1/4
– Parts that are in contact with the medium are made of stainless steel, ceramics or FKM
– Compact design
– Two switching outputs

Ordering code

HED	E	10	A1	2X	/		K41	G24	/	2	/	V	/	*

Hydraulic electrical pressure switch	**HED**
Integrated electronics	**= E**
Type of component	**= 10**
Hydraulic interface 1/4“	**= A1**
Component series	**= 2X**
Pressure stage	
100 bar	**= 100**
250 bar	**= 200**
400 bar	**= 400**
600 bar	**= 600**
K41 =	Plug-in variant M12, 4-pin as standard
G 24 =	Supply voltage
2 =	Two switching outputs
V =	FKM seals ⚠ **Caution!** Observe compatibility of seals with the hydraulic fluid used!
*	Further details in clear text

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

Input variables						
Auxiliary power		U_B	18 to 36 VDC			
Current consumption		I	< 50 mA			
Measuring range		p_N in bar	100	250	400	600
Overload safety		p_{max} in bar	300	400	600	800
Burst pressure		p in bar	650	850	1000	1200
Output variables						
Switching output	Current carrying capacity	I	250 mA			
	Response time	t	< 3 ms (with set response time dAP = 3)			
	Max. switching frequency	f	170 Hz (at dAP = 3)			
Characteristic curve deviation: (initial point setting to DIN16086)			< ±0.5 %			
Temperature coefficient in the nominal temperature range – Highest TC of the zero point – Highest TC of the range			 0.2 % / 10 k 0.2 % / 10 k			
Hysteresis			< ±0.25 %; 0.5 % for pressure stage 600 bar			
Repeatability			< ±0.1 %			
Long-term drift under reference conditions (6 months)			0.05 %			
Ambient conditions						
Limit temperature range		ϑ	–20 to +80 °C at U_B < 32 V –20 to +45 °C at U_B > 36 V			
Storage temperature range		ϑ	–40 to +100 °C			
Fluid temperature range		ϑ	–25 to +80 °C			
Mechanical data						
Pressure port			G1/4			
Electrical connection			M12 plug-in connection			

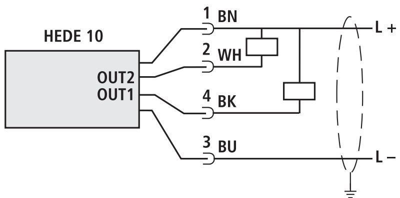
Technical data (continued)

Programming options		Hysteresis / window; n.o. / n.c; pick-up, drop-out delay; damping; unit of indication / diagnosis output			
Pressure stages		100	250	400	600
Switching point SP	bar	1.0 ... 100	2 ... 250	4 ... 400	6 ... 600
Resetting point, rP	bar	0.5 ... 99.5	1 ... 249	2 ... 398	3 ... 597
in increments of	bar	0.5	1	2	3
Adjustable response time of a switching output and resulting switching frequency	Response time (dAP) ms Hz	3 ... 500 170 ... 1			
Adjustable delay dS, dr	s	0.0; 0.2 ... 50.0			
Environmental compatibility					
Type of protection / housing to IEC 60529		IP67			
Protection class to EN 50178		III			
Insulation resistance	MΩ	> 100 (500 VDC)			
Resistance to shock to IEC 60068-2-27	g	50 g, 11 ms			
Resistance to vibration	g	20 g, 10 – 2000 Hz)			
Switching cycles min.		100 million / 50 million with pressure stage 600 bar			
Approval		cULus			
EMC	EN 61000-4-2 ESD EN 61000-4-3 HF radiated EN 61000-4-4 burst EN 61000-4-5 surge EN 61000-4-6 HF cable-bound	4 / 8 kV 10 V/m 2 kV 0,5 / 1 kV 10 V			
Housing material		EPDM/X (Santoprene); FKM; PBTP (Pocan); PC (Macrolon); V2A (1.4301)			
Materials in contact with the medium		V2A (1.4305); ceramics; FKM			
Connection		M12 plug-in connection, gold-plated contacts			

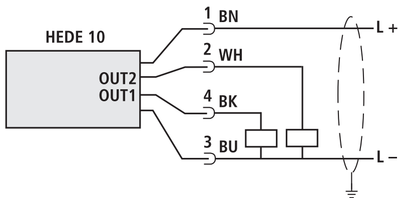
Pin assignment K41

Two switching outputs:

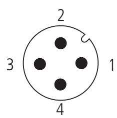
low-side switching (NPN)



high-side switching (PNP)



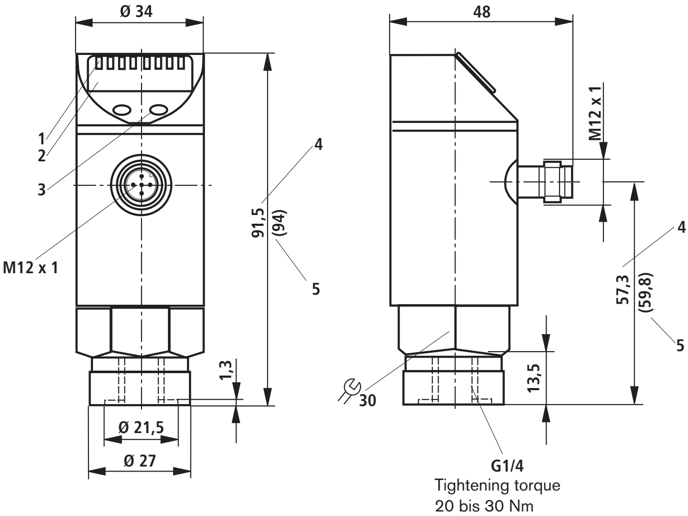
Detail view on the plug of the device:



1	BN	Brown
2	WH	White
3	BU	Blue
4	BK	Black

4

Unit dimensions (nominal dimensions in mm)



1 Status LEDs
2 4-digit alphanumerical display
3 Programming key
4 Dimension for pressure stages 100 bar and 250 bar
5 Dimension for pressure stages 400 bar and 600 bar

Installation recommendation:
Vibration-free installation!

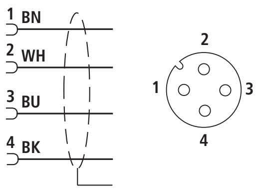
Accessories

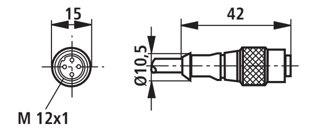
Cable sockets:

Technical data:

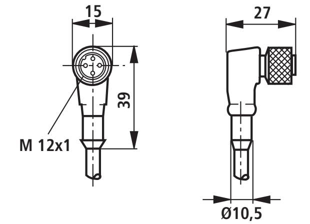
Current carrying capacity	4 A
Temperature range	–25...90°C
Type of protection	IP 67
Contacts	CuZn
Contact surface	Gold-plated
Housing	TPU
Seal	FKM
Fitting	CuZn/Ni
Wire cross-section	4 x 0.34 mm
Sheath material	PUR
Shield	Not connected on plug side
Sheath diam.	Ø 5.0 mm
Sheath colour	Black
Bending radius for dyn. application	min. 50 mm

Connection:

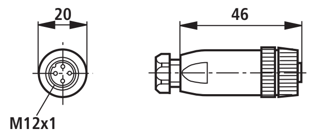




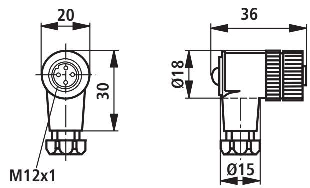
Designation	Material no.
04 POL (with 2 m cable)	R900773031
04 POL (with 5 m cable)	R900779498



Designation	Material no.
04 POL (with 2 m cable)	R900779504
04 POL (with 5 m cable)	R900779503



Designation	Material no.
04 POL (without cable)[1]	R900773042



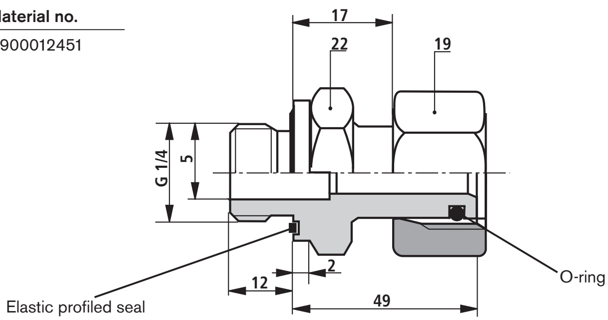
Designation	Material no.
04 POL (without cable)[1]	R900779509

[1] Type of protection IP68

4

Hydraulic fitting:

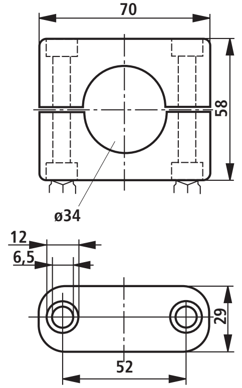
Designation	Material no.
AB 20-28	R900012451



Accessories (continued)

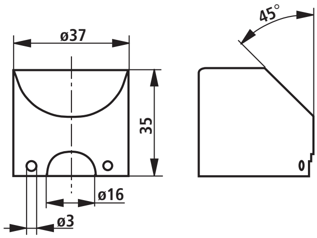
Fixing clamp for HEDE10

Designation	Material no.
Fixing clamp	R900786138



Protective cap for HEDE10

Designation	Material no.
Protective cap M12	R900786141



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Electronic pressure switch with two switching outputs

RE 30279/01.07

Type HEDE 11.../2/

Component series 1X
Maximum operating pressure 400 bar

TB0082

Table of contents

Contents	**Page**

Features

– Sensing of hydraulic pressures and their output as electrical switching signals
– 100 bar and 400 bar versions available
– High burst pressure range
– Simple adjustment of switching points by means of two, optimally readable adjustment rings
– Mechanical locking against unauthorised manipulations of the switching points
– Parts that come into contact with the medium are made of stainless steel or FPM
– Connection thread G1/4
– High long-term stability
– Electrical connection by means of 4-pin M12 connector
– Two exclusive-OR switching outputs
– Indication of switching status and readiness for operation
– Compact design

Ordering code

HED	E	11	A1	–	1X	/		K41	G24	/	2	/	V	/	*

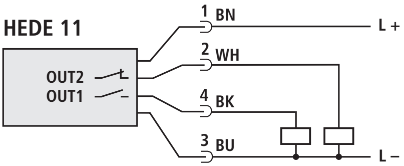
Hydraulic-electrical pressure switch	**= HED**
Integrated electronics	**= E**
Interface hydraulic G1/4	**= A1**
Component series 10 to 19 (10 to 19: unchanged installation and connection dimensions)	**= 1X**
Pressure setting	
100 bar	**= 100**
400 bar	**= 400**
Electrical connection	
Component plug M12, 4-pin as standard, without female connector	**= K41**
Supply voltage	
24 V DC voltage	**G24 =**
Electrical interface	
2 switching outputs	**2 =**
Seal material	
FPM seal	**V =**
Note: Observe compatibility of seals with hydraulic fluid used	
Further details in clear text	*

Function, electrical connection, adjustment

The electronic pressure switch senses the system pressure and switches the two outputs OUT1 (Pin 4) / OUT2 (Pin 2) according to the exclusive-OR principle.

– In the case of rising pressure, OUT1 closes / OUT2 opens, when the selected set value has been reached.

– In the case of falling presusre, OUT1opens / OUT2 closes, when the selected reset value has been reached.



Wire colours of Bosch Rexroth plug-in connectors:

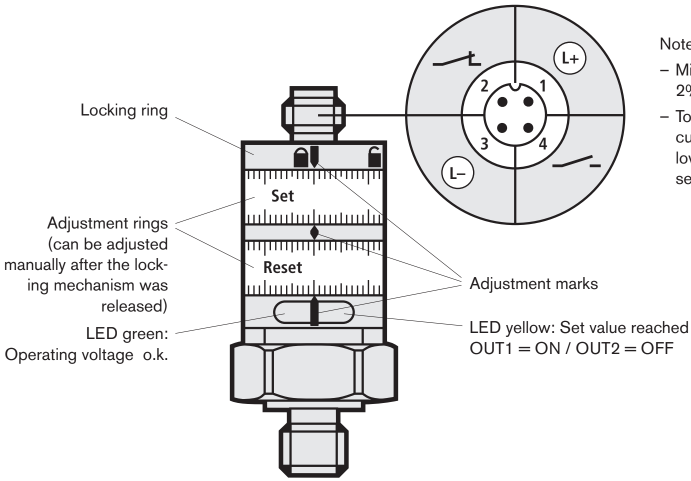
1 = BN (brown)

2 = WH (white)

3 = BU (blue)

4 = BK (black)

See also page 4, Accessories.



Notes on the adjustment:

– Minimum distance Set – Reset = 2% of final measuring range value

– To maintain the adjustment ac-curacy: First, set both rings to the lower mechanical limit stop, then set the desired values.

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

General

Weight	kg	Approx. 0.09
Installation position		Optional
Ambient temperature range	°C	–20 to +80
Storage temperature range	°C	–40 to +100

Hydraulic

HEDE 11A1-1X/...		...100	...400
Switching point Set	bar	5 to 100	20 to 400
Switching point Reset	bar	3 to 98	12 to 392
Maximum operating pressure	bar	100	400
Permissible overload pressure	bar	200	600
Burst pressure	bar	1000	1600
Hydraulic fluid temperature range	°C	–25 to +80	
Material in contact with medium		V4A (1 .4404), FPM	

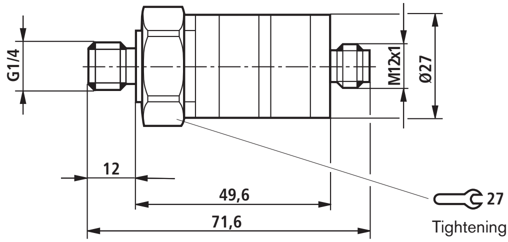
Electrical

Auxiliary power	VDC	18 to 36
Current consumption	mA	< 25
Current carrying capacity per switching output	mA	250 mA
Short-circuit protection		Clocked
Overload-proof		Yes
Reverse polarity protection		Yes
Voltage drop	V	< 2
Switching frequency	Hz	100
Adjustment accuracy	%	< ±2.5 of final measuring range value
Repeatability	%	< ±0.5 of final measuring range value
Temperature influence	%	< ±0.5 of final measuring range value / 10 K from 0 to +80 °C
Switching cycles, minimum		50 million
Type of protection to EN 60529		IP 67
Protection class to EN 50178		III
Insulation resistance	MΩ	> 100 (500 V DC)
EMC	EN 61000-4-2 ESD	4 kV CD / 8 kV AD
	EN 61000-4-3 HF radiated	10 V/m
	EN 61000-4-4 burst	2 kV
	EN 61000-4-6 HF conducted	10 V
UL approval		UL 508

Note:

To meet the “limited voltage current“ requirements according to UL, the device must be supplied from an electrically isolated source and an overcurrent protection feature must be provided.

Unit dimensions (nominal dimensions in mm)

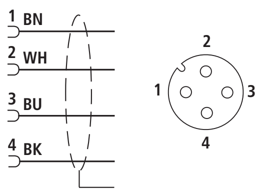


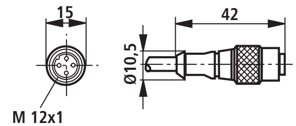
Tightening torque M_A = 25 to 30 Nm

Accessories: Plug-in Connectors

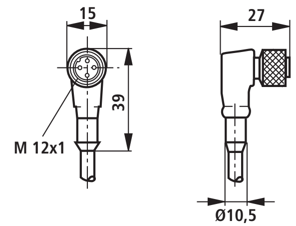
Technical data	
Ampacity	4 A
Temperature range	–25...90 °C
Type of protection	IP 67
Contacts	CuZn
Contact surface	Gold-plated
Housing	TPU
Seal	FPM
Fitting	CuZn/Ni
Wire cross-section	4 x 0,34 mm
Sheath material	PUR
Shield	Not connected on plug side
Sheath diameter	Ø5.0 mm
Sheath colour	Black
Bending radius for dyn. application	min. 50 mm

Connection:

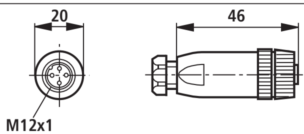




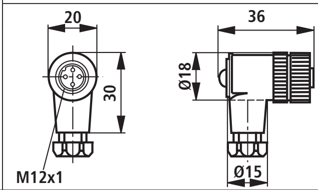
Designation	Material no.
04 POL (with 2 m cable)	**R900773031**
04 POL (with 5 m cable)	**R900779498**



Designation	Material no.
04 POL (with 2 m cable)	**R900779504**
04 POL (with 5 m cable)	**R900779503**



Designation	Material no.
04 POL (without cable)[1]	**R900773042**



Designation	Material no.
04 POL (without cable)[1]	**R900779509**

[1] Type of protection IP68

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Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

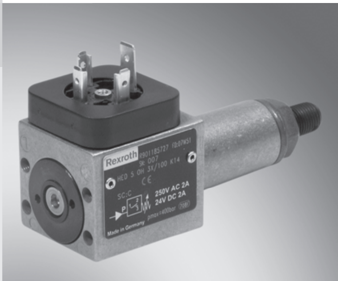
Rexroth
Bosch Group

Hydro-electric pressure switch

RE 50056/12.12
Replaces: 08.12

Type HED 5

Component series 3X
Maximum operating pressure 400 bar
CE, CCC, UL



tb0229

Table of contents

Features

- 4 pressure ratings
- Electrical connection
  - with large cubic connector
  - with M12 x 1 connector
- Micro switch with NC/NO contact function
- Potential-free switching of currents from 1 mA to 2 A
- UL approval
- CCC approval (except for MT version)

Ordering code

HED 5	OH – 3X /			*

Piston type pressure switch	**= HED 5**
Flange connection	**= OH**
Component series 30 to 39 (30 to 39: Unchanged installation and connection dimensions)	**= 3X**
Pressure rating maximum 50 bar	**= 50**
Pressure rating maximum 100 bar	**= 100**
Pressure rating maximum 200 bar	**= 200**
Pressure rating maximum 350 bar	**= 350**

Electrical connection

K14 = Individual connection with connector according to EN 175301-803, large cubic connector, without mating connector [1]

K35 = Individual connection with connector according to IEC 61076-2-101, M12 x 1, A coding, without mating connector [1]

Seal material

no code = NBR seals

V = FKM seals

MT = Low-temperature design (max. 315 bar)

(other seals upon request)

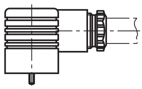
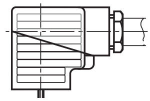
Notice:
Observe compatibility of seals with the hydraulic fluid used!

Further details in the plain text

[1] Mating connectors, separate order, see below

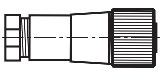
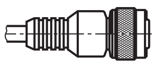
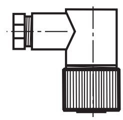
Mating connectors

For connection "K14"

For details and more mating connectors see data sheet 08006	Material no.					
	without circuitry	with circuitry (indicator light) AC/DC, –20....+60 °C				
	240 V, –40...+125 °C	6 … 14 V	16 … 30 V	36 … 60 V	90 … 130 V	180 … 240 V
Color black	**R901017012**	**R901017030**	**R901017048**	**R901017032**	**R901017035**	**R901017037**

For connection "K35"

For details and more mating connectors see data sheet 08006	Material no.		
	4-pole, M12 x 1 with screw connection, –40...+85 °C	4-pole, M12 x 1 with PUR cable, 3 m long, –25...+85 °C	4-pole, M12 x 1 with screw connection, angled, –40...+85 °C
Color black	**R900031155**	**R900064381**	**R900082899**

Function, section, symbol

Hydro-electric pressure switches of type HED 5 are piston type pressure switches.

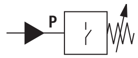
They basically consist of housing (1), installation kit with piston (2), compression spring (3), adjustment element (4) and micro switch (5).

The pressure to be monitored acts on the piston (2). The latter is supported by the spring plate (6) and acts against the continuously adjustable force of the compression spring (3). The spring plate (6) transmits the movement of the piston (2) onto the micro switch (5). This switches the electric circuit on or off, depending on the circuit set-up.

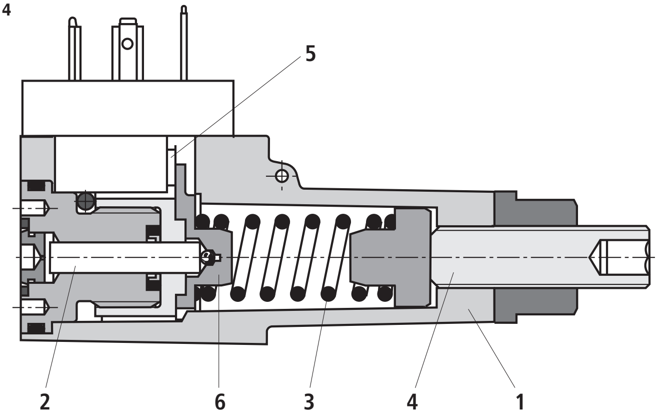
Installation information:

To increase the life cycle, pressure switches are to be mounted free of shocks and suitable measures are to be taken to dampen hydraulic pressure shocks.

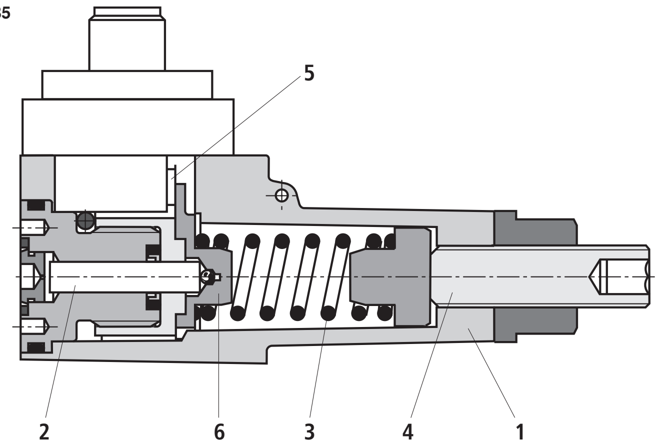
Symbol



Type HED 5…K14



Type HED 5…K35



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

general

Weight	kg	0.2
Installation position		Any
Ambient temperature range		–30 to +50 (NBR seals) –20 to +50 (FKM seals) –40 to +50 (MT version)
Sine test according to DIN EN 60068-2-6:1996-05		10...2000 Hz, max. 10 g, 10 double cycles
Transport shock according to DIN EN 60068-2-27:1995-03		Half-sine 15 g / 11 ms, 3 x in positive direction, 3 x negative direction (a total of 6 single shocks per axis)
Noise test according to DIN EN 60068-2-64:1995-08		20...2000 Hz, 14 g_{RMS}, 24 h
Conformity	CE	- DIN EN 61058-1:2008-09-05 - IEC 60947-5-1:2010-04 - DIN EN 60529:2000-09
	UL	UL 508 17th edition File No E223220
	CCC	- EN 61058-1:1993 - IEC 60947-5-1

hydraulic

Pressure rating		50	100	200	350
Maximum operating pressure					
NBR/FKM seals	bar	350	350	350	400
MT version	bar	315	315	315	315
Pressure adjustment range (decreasing)	bar	5...50	10...100	15...200	25...350
Pressure differential per rotation [1]	bar	≈10	≈17	≈38	≈60
Hydraulic fluid		Mineral oil (HL, HLP) according to DIN 51524 [2]; fast biodegradable hydraulic fluids according to VDMA 24568 (see also data sheet 90221); HETG (rape seed oil) [2]; HEPG (polyglycols) [3]; HEES (synthetic esters) [3]; HVLP [4]; HFC [5]; other hydraulic fluids upon request			
Hydraulic fluid temperature range	°C	–30 to +80 (NBR seals) –20 to +80 (FKM seals) –40 to +80 (MT version)			
Viscosity range	mm^2/s	10 to 800			
Maximum permitted degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)		Class 20/18/15 [6]			
Load cycles		≥ 4 millions			

[1] Direction of rotation:
– Clockwise → set pressure increase
– Counterclockwise → set pressure decrease

[2] Suitable for NBR and FKM seals and for MT version

[3] Only suitable for FKM seals

[4] Suitable for MT version

[5] Only suitable for NBR seals

[6] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components.

For the selection of the filters see www.boschrexroth.com/filter.

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

electric

Electrical connection / mating connector		K14	EN 175301-803, 3-pole + PE
		K35	IEC 61076-2-101, M12 x 1, A-coding, 4-pole
Maximum connection cross-section (mating connector)	mm²	K14	1.5
		K35	0.75
Line entry (mating connector)		K14	M16 x 1.5
		K35	M10 x 1.5
Protection class according to EN 60529		K14	IP 65 with mating connector mounted and locked
		K35	IP 67 with mating connector mounted and locked
Maximum switching frequency		1/h	4800
Switching accuracy (repetition accuracy)			< ± 1 % of the set pressure
Switch			According to VDE 0630-1/DIN EN 61058-1
Transition resistance		mΩ	< 50
Insulation coordination			Overvoltage category 3
Contamination			Degree of contamination 3
Bounce time	ON	ms	< 5
	OFF	ms	< 5
Minimum current		mA	1.0 with 24 V DC
Maximum current		A	0.5 with 50 V DC, inductive 0.2 with 125 V DC, inductive 0.1 with 250 V DC, inductive 2.0 with 250 V AC

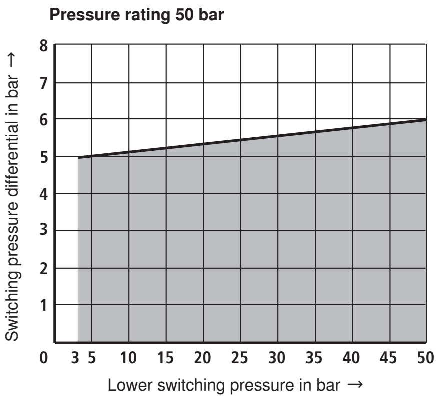
Switching power

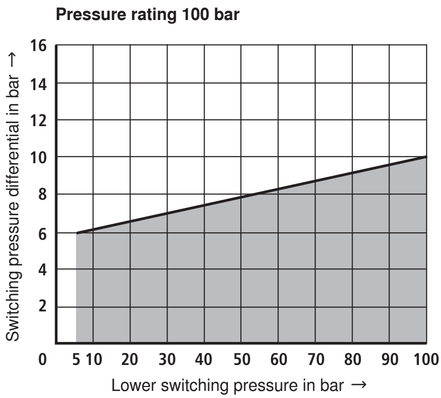
Switching cycles	Voltage *U* in V	Ohmic load max. in A	Inductive load, max. in A
2 million	250, AC	2 A for 2 million switching cycles	0.5 A, cos φ = 0.6 for 2 million switching cycles
2 million	24, DC	2 A for 2 million switching cycles	0.5 A for 2 million switching cycles
5 million	24, DC	5.0 mA for 5 million switching cycles	–

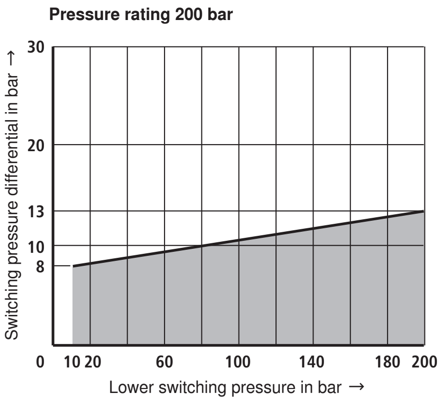
Notice:

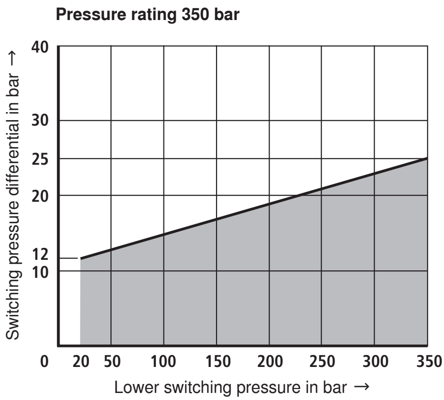
All variants can be unloaded to p_{min} = 0 bar.
(Observe the switching pressure differential!)

Switching pressure differential (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)





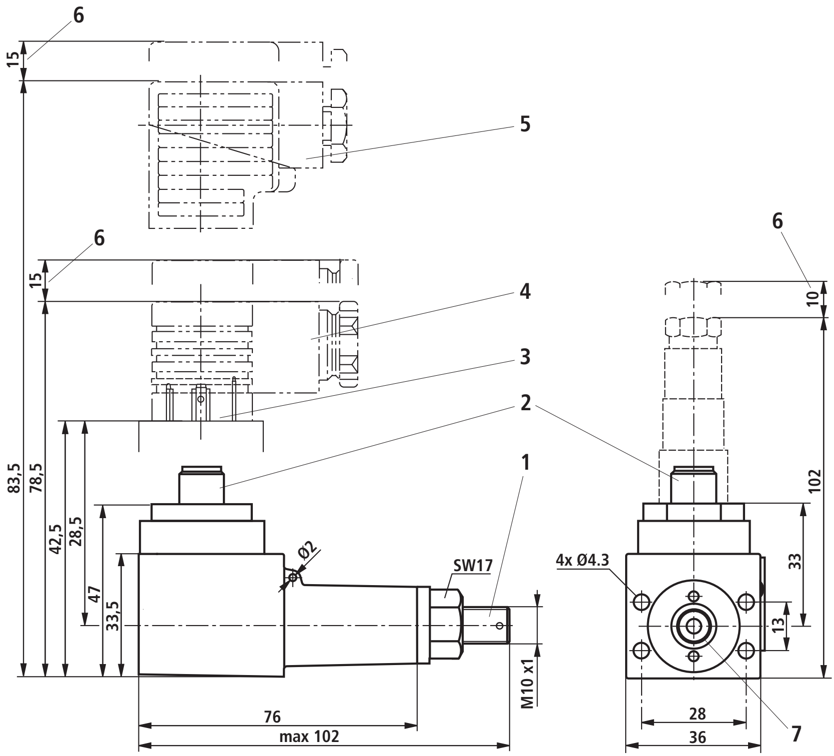


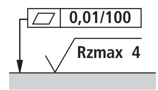


Notice:

The switching pressure differential may increase within the course of the life cycle due to the deterioration of the oil quality and the number of load cycles.

Device dimensions (dimensions in mm)





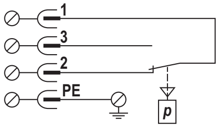
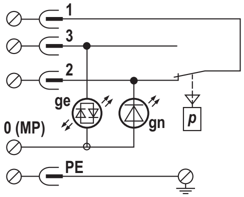
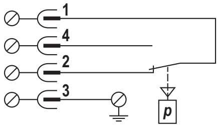
Required surface quality of the device contact surface

1 Adjustment element
2 Plug-in connection according to IEC 61076-2-101 (connection "K35")
3 Plug-in connection according to EN 175301-803 (connection "K14")
4 Mating connector without circuitry
5 Mating connector with circuitry
6 Space required to remove the mating connector
7 Seal ring (connection bore of the counterpart: max. Ø6)

Valve mounting screws (separate order)

4 hexagon socket head cap screws
ISO 4762-M4X45-10.9-flZn-240h-L
(friction coefficient μ_{total} = 0.09 to 0.14)
Tightening torque $\boldsymbol{M}_A$ = 2 Nm ± 10 %
Material no. **R913000370**

Electrical connection

"K14" without indicator light	**"K14" with** indicator light	**"K35"**
		
Switching function Terminals 1-2: Contact opens in case of pressure increase Terminals 1-3: Contact closes in case of pressure increase		Switching function Terminals 1-2: Contact opens in case of pressure increase Terminals 1-4: Contact closes in case of pressure increase

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Hydro-electric pressure switch

RE 50061/02.12 1/16
Replaces: 07.06

Type HED 8

Component series 2X
Maximum operating pressure 630 bar
CE, CCC, UL

TB0004+TB0040

Table of contents

Contents	Page
Features	1
Ordering code	2
Function, sections, symbol	3
Technical data	4
Characteristic curves Switching pressure differential	6
Unit dimensions	7
Installation information	10
Ordering code: Sandwich plate size 6	12
Symbols, variant no.: Sandwich plate size 6	12
Unit dimensions: Sandwich plate size 6	13
Ordering code: Sandwich plate size 10	14
Symbols, variant no.: Sandwich plate size 10	14
Unit dimensions: Sandwich plate size 10	15
Electrical connection	16
Mating connectors	16

Features

– For subplate mounting/pipeline installation
– For flange connection according to ISO 16873
– As vertical stacking element in connection with sandwich plates according to ISO 4401
– 5 pressure ratings
– 4 adjustment types:
  • Spindle with/without protective cap
  • Spindle with scale, with/without protective cap
  • Rotary knob with scale
  • Lockable rotary knob with scale
– Electrical connection
  • with large cubic connector
  • with M12 x 1 connector
– Micro switch with NC/NO contact function
– Potential-free switching of currents from 1 mA to 2 A
– UL approval for pressure ranges up to 350 bar

Ordering code

HED 8		–2X/				*

Piston type pressure switch

Flange connection (ISO 16873) [1)]	= OH
Subplate mounting	= OP
Pipeline installation	= OA
Component series 20 to 29 (20 to 29: Unchanged installation and connection dimensions)	= 2X
Pressure rating maximum 50 bar	= 50
Pressure rating maximum 100 bar	= 100
Pressure rating maximum 200 bar	= 200
Pressure rating maximum 350 bar	= 350
Pressure rating maximum 630 bar [2)]	= 630

Electrical connection

Individual connection with connector according to DIN EN 175301-803, large cubic connector without mating connector [3)]	= K14 [3)]
Individual connection with connector according to IEC 61076-2-101, M12 x 1, A-coding without mating connector [3)]	= K35 [3)]

Adjustment type

no code =	Spindle with internal hexagon, without scale, without protective cap
S =	Spindle with internal hexagon, without scale, with protective cap, can be sealed
A [5)] =	Spindle with scale, without protective cap
AS [5)] =	Spindle with scale, with protective cap
KS [4; 5)] =	Lockable rotary knob with scale
KW [5)] =	Rotary knob with scale

Seal material

no code =	NBR seals
V =	FKM seals
MT =	Low-temperature seals (max. 315 bar)

Notice:
Observe compatibility of seals with the hydraulic fluids used.

Further details in the plain text

1) Sandwich plate for vertical stacking, separate order see accessories

2) Not admissible for vertical stacking, not with low-temperature seals, without UL approval

3) Mating connectors, separate order, see accessories

4) H-key, material no. **R900008158**, is included in the scope of delivery

5) The exact setting of the switching pressure is only possible using a pressure gauge (scale is used as orientation)

Accessories

– Sandwich plates for the vertical stacking see page 12 and 14.

– Mating connectors for the electrical connection see page 16.

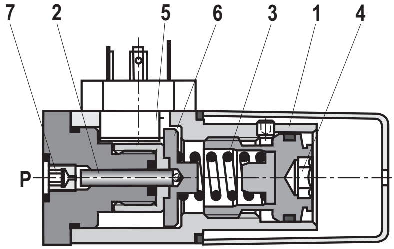
Function, sections, symbol

The hydro-electric pressure switch type HED 8 is a piston type pressure switch. It basically comprises of housing (1), installation kit with piston (2), compression spring (3), adjustment element (4) and micro switch (5).

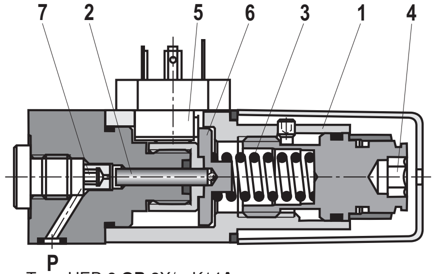
If the pressure to be monitored is below the set pressure, the micro switch (5) is operated. The pressure to be monitored is applied via the nozzle (7) at the piston (2). The piston (2) is supported by the spring plate (6) and acts against the continuously adjustable force of the compression spring (3). The spring plate (6) transmits the movement of the piston (2) onto the micro switch (5) and releases the latter when the set pressure is reached. This switches the electric circuit on or off, depending on the circuit set-up. The mechanical positive stop of the spring plate (6) protects the micro switch (5) in case of a sudden pressure drop from mechanical destruction and, in case of overpressure, prevents solid compression of the compression spring (3).

Notice:

In order to increase the service life, the pressure switch should be mounted with low vibrations and protected from hydraulic pressure surges.

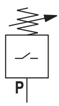


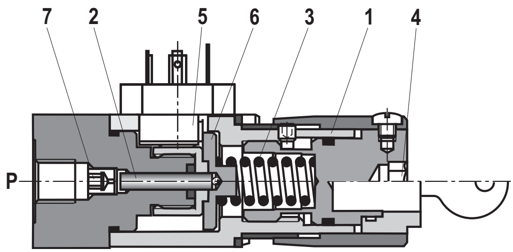
Type HED 8 **OH**-2X/…K14
Type HED 8 **OH**-2X/…K14**S**



Type HED 8 **OP**-2X/…K14**A**
Type HED 8 **OP**-2X/…K14**AS**

Symbol





Type HED 8 **OA**-2X/…K14**KW**
Type HED 8 **OA**-2X/…K14**KS**

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

general

Weight		kg	0.8
Installation position			Any
Ambient temperature range			–25 to +50 (NBR seals) –20 to +50 (FKM seals) –40 to +50 (low-temperature seals)
Sine test according to DIN EN 60068-2-6:1996-05			5...2000 Hz, max. 10 g, 10 double cycles
Transport shock according to DIN EN 60068-2-27:1995-03			15 g / 11 ms
Bump test according to DIN EN 60068-2-29:1995-03			25 g / 6 ms
Noise test according to DIN EN 60068-2-64:1996-05			20...2000 Hz, 10 g_{RMS}, 30 min
Conformity	CE		DIN EN 61058-1: 2008-09-05 IEC 60947-5-1: 2010-04 DIN EN 60529: 2000-09
	UL		UL 508 17th edition File No E223220
	CCC		EN 61058-1:1993 IEC 60947-5-1

hydraulic

Pressure rating	bar	50	100	200	350	630
Maximum operating pressure						
NBR/FKM seals	bar	350	350	350	400	630
MT version	bar	315	315	315	315	–
Pressure adjustment range (decreasing)	bar	5...50	10...100	15...200	25...350	40...630
Pressure differential per rotation [1]	bar	≈19	≈35	≈77	≈120	≈214
Hydraulic fluid		Mineral oil (HL, HLP) according to DIN 51524 [2]; fast biodegradable hydraulic fluids according to VDMA 24568 (see also RE 90221); HETG (rape seed oil) [2]; HEPG (polyglycols) [3]; HEES (synthetic esters) [3]; HVLP [4]; HFC [5]; other hydraulic fluids upon request				
Hydraulic fluid temperature range	°C	–25 to +80 (for NBR seals) –20 to +80 (for FKM seals) –40 to +80 (low-temperature seals)				
Viscosity range	mm^2/s	10 to 800				
Maximum permitted degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)		Class 20/18/15 [6]				
Load cycles		≥ 5 million				

[1] Direction of rotation:
– Clockwise → Set pressure increase
– Anticlockwise → Set pressure decrease

[2] Suitable for NBR and FKM seals

[3] Suitable only for FKM seals

[4] Suitable for low-temperature seals

[5] Suitable only for NBR seals

[6] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.

For the selection of the filters see www.boschrexroth.com/filter.

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

electric

Electrical connection / mating connector		K14	EN 175301-803, 3-pole + PE
		K35	IEC 61076-2-101, M12 x 1, A-coding, 4-pole
Protection class according to EN 60529		K14	IP 65 with mating connector mounted and locked
		K35	IP 67 with mating connector mounted and locked
Maximum switching frequency		1/h	7200
Switching accuracy (repetition accuracy)			< ±1 % of the set pressure
Switches			According to VDE 0630-1/DIN EN 61058-1
Transition resistance		mΩ	< 50
Insulation coordination			Overvoltage category 3
Contamination			Degree of contamination 3
Bounce time	ON	ms	< 5
	OFF	ms	< 5
Minimum current		mA	1.0 with 24 V DC
Maximum current		A	0.5 with 50 V DC, inductive 0.2 with 125 V DC, inductive 0.1 with 250 V DC, inductive 2.0 with 250 V AC

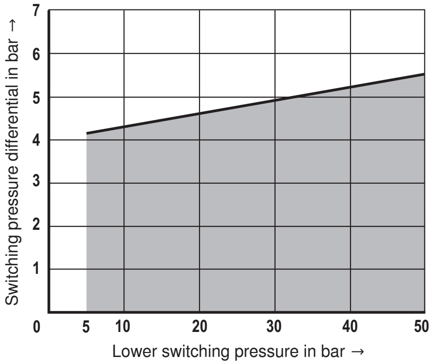
Switching power

Switching cycles	Voltage *U* in V	Ohmic load max. in A	Inductive load max. in A
2 million	250, AC	2 A for 2 million switching cycles	0.5 A, cos. φ = 0.6 for 2 million switching cycles
2 million	24, DC	2 A for 2 million switching cycles	0.5 A for 2 million switching cycles
5 million	24, DC	5.0 mA for 5 million switching cycles	–

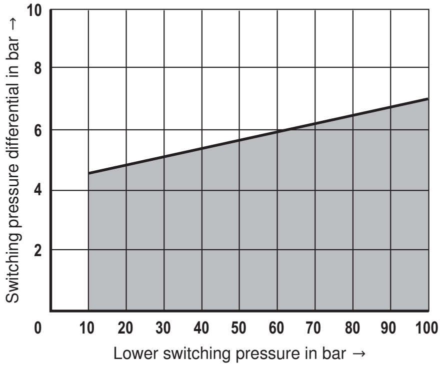
4

Characteristic curves Switching pressure differential

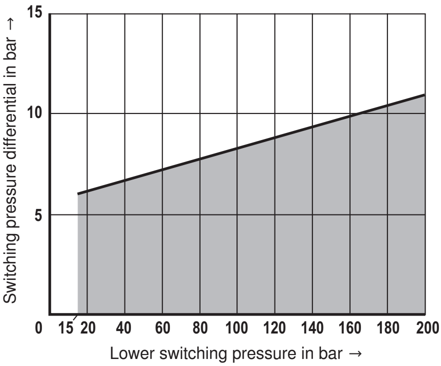
Pressure rating 50



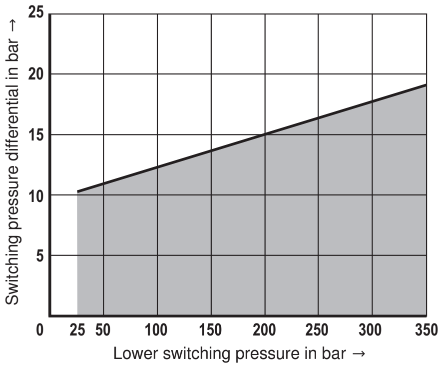
Pressure rating 100



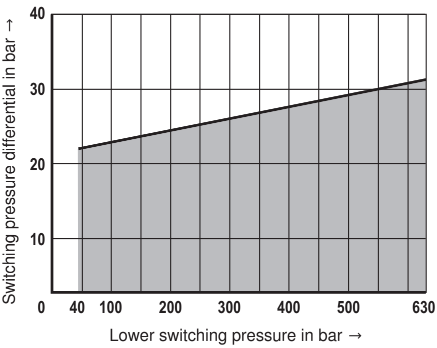
Pressure rating 200



Pressure rating 350



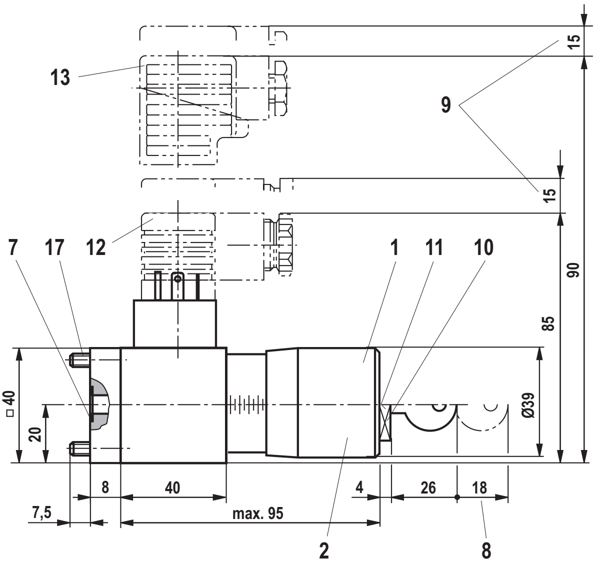
Pressure rating 630



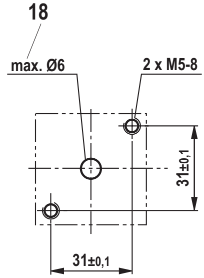
Notice:

The switching pressure differential may increase within the course of the service life due to the deterioration of the oil quality and the number of load cycles.

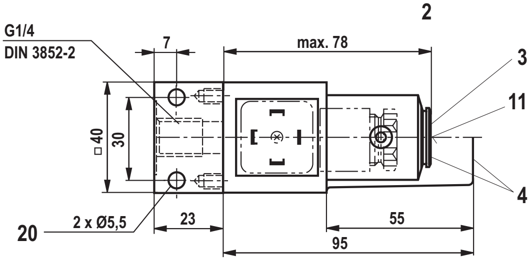
Unit dimensions: Type HED 8 …**K14** (dimensions in mm)



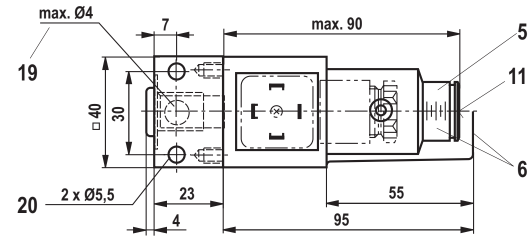
Type HED 8 **OH**…



Connection dimensions



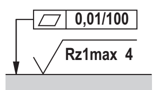
Type HED 8 **OA**…



Type HED 8 **OP**…

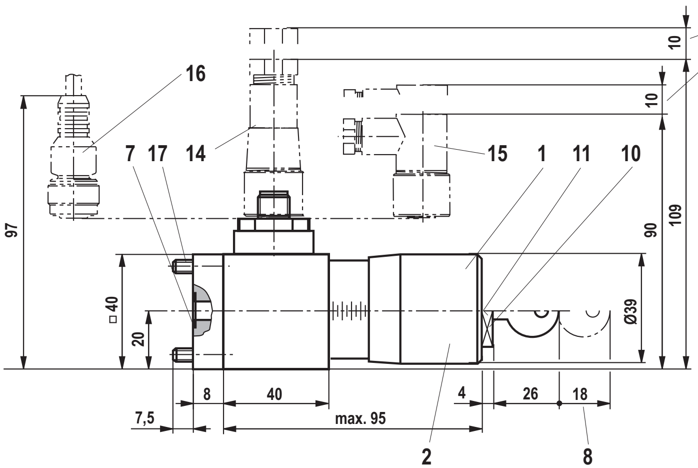
4

Item explanations see page 9

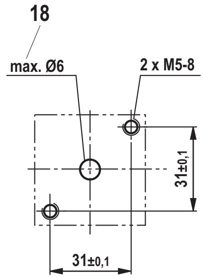


Required surface quality of the device contact surface (with version "OH" and "OP")

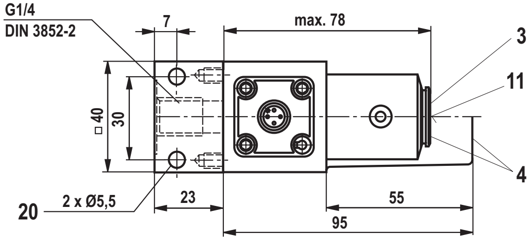
Unit dimensions: Type HED 8 …**K35** (dimensions in mm)



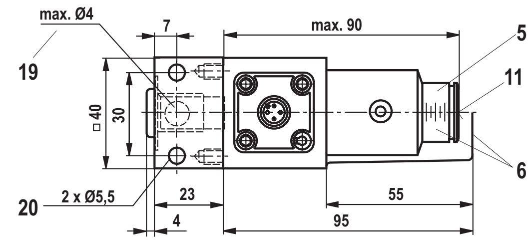
Type HED 8 **OH**…



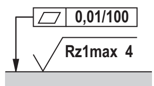
Connection dimensions



Type HED 8 **OA**…



Type HED 8 **OP**…



Required surface quality of
the device contact surface
(with version "OH" and "OP")

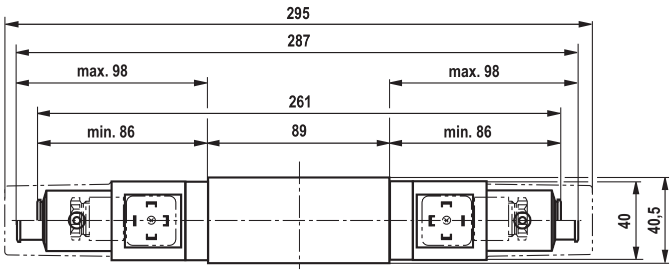
Item explanations see page 9

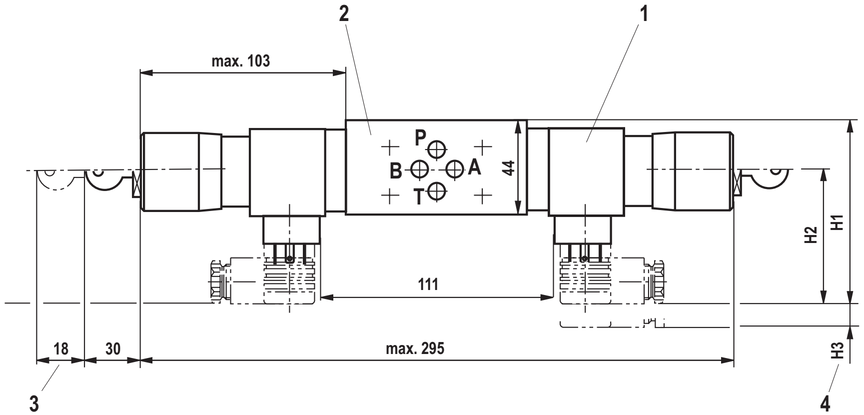
Unit dimensions

Item explanations:

1 Adjustment type "KW"
2 Adjustment type "KS"
3 Adjustment type "–"
4 Adjustment type "S"
5 Adjustment type "A"
6 Adjustment type "AS"
7 Seal ring
8 Space required to remove the key
9 Space required to remove the mating connector
10 Hexagon SW27 (with adjustment type "KS")
11 Internal hexagon SW10
12 Mating connector **without** circuitry for connection "K14" (separate order, see page 16)
13 Mating connector **with** circuitry for connection "K14" (separate order, see page 16)
14 Mating connector for connection "K35" (separate order see page 16)
15 Mating connector suitable for "K35", angled (separate order see page 16)
16 Mating connector for connection "K35", with cable (separate order see page 16)
17 **Valve mounting screws**
for type **HED 8 OH**… (separate order)
2 hexagon socket head cap screws
ISO 4762 - M5 x 55 - 10.9-flZn-240h-L
Friction coefficient μ_{total} = 0.09 to 0.14,
tightening torque $\boldsymbol{M}_A = 6^{+0.5}$ Nm,
material no. **R913000261**
18 Maximum diameter of the connection bore of the counterpart (type HED 8 **OH**…)
19 Maximum diameter of the connection bore of the counterpart (type HED 8 **OP**…)
20 **Valve mounting screws**
for type HED 8 **OA**… and …**OP**… (separate order)
2 hexagon socket head cap screws
ISO 4762 - M5 x 50 - 10.9-flZn-240h-L
Friction coefficient μ_{total} = 0.09 to 0.14,
tightening torque $\boldsymbol{M}_A = 7^{+0.5}$ Nm,
material no. **R913000064**

Installation information: Type HED 8 **OH**… in vertical stacking **size 6** (dimensions in mm)





1 Pressure switch HED 8 OH… for use in stacking assemblies (can be assembled staggered by 4 x 90°) The mounting option of the pressure switch depends on the set-up of the next stacking assembly subplate.

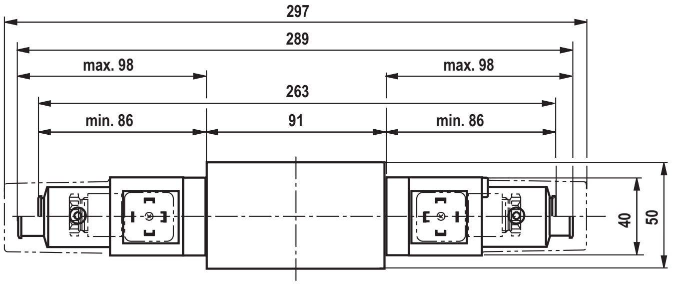
2 Sandwich plate type HSZ 06A... for use of the pressure switch as stacking element (see page 12)

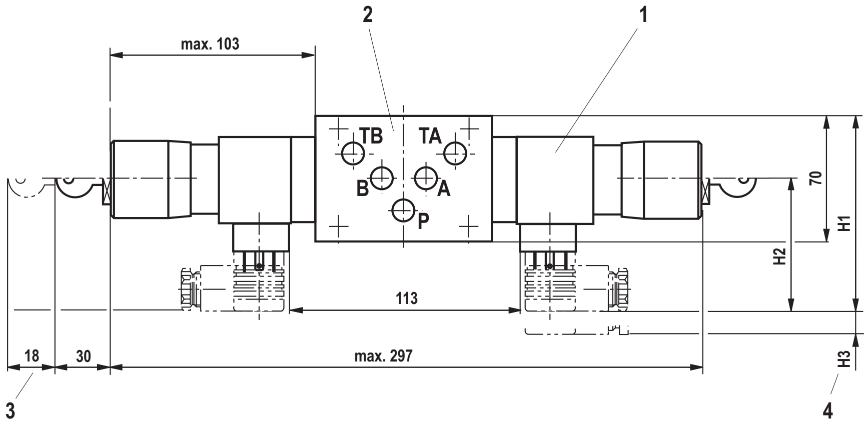
3 Space required to remove the key

4 Space required to remove the mating connector

Mating connector	**H1**	**H2**	**H3**
"K14" connection **without** circuitry	87	65	15
"K14" connection **with** circuitry	92	70	15
"K35" connection, angled	92	70	10
"K35" connection, straight	111	89	10

Installation information: Type HED 8 **OH**… in vertical stacking **size 10** (dimensions in mm)





1 Pressure switch HED 8 OH… for use in stacking assemblies (can be assembled staggered by 4 x 90°) The mounting option of the pressure switch depends on the set-up of the next stacking assembly subplate.

2 Sandwich plate type HSZ 10A... for use of the pressure switch as stacking element (see page 14)

3 Space required to remove the key

4 Space required to remove the mating connector

Mating connector	H1	H2	H3
"K14" connection **without** circuitry	100	65	15
"K14" connection **with** circuitry	105	70	15
"K35" connection, angled	105	70	10
"K35" connection, straight	124	89	10

Ordering code: Sandwich plate size 6 (separate order)

HSZ	06	A	–3X/	00	*

Sandwich plate

Size 6 **= 06**

Porting pattern according to ISO 4401-03-02-0-05 **= A**

Variant no. (see below) **= 6...**

Component series 30 to 39 **= 3X**
(30 to 39: Unchanged installation and connection dimensions)

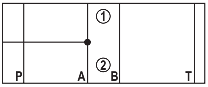
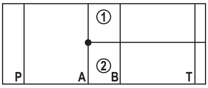
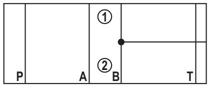
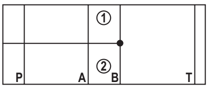
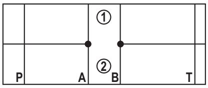
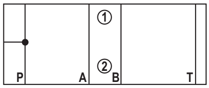
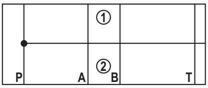
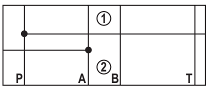
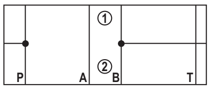
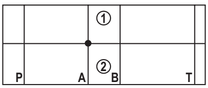
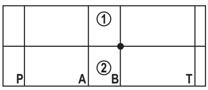
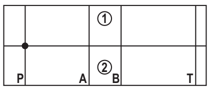
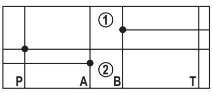
Further details in the plain text

Seal material

M = NBR seals
V = FKM seals
MT = Low-temperature seals (max. 315 bar)
(other seals upon request)

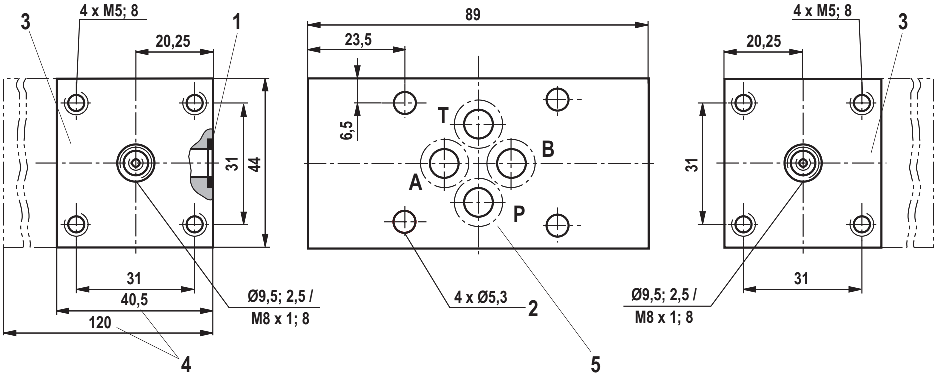
Notice:
Observe compatibility of seals with the hydraulic fluids used.

Symbols, variant no.: Sandwich plate size 6 (1 = component side, 2 = plate side)

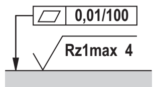
		Pressure switch effective in channel ...		
	Plate height in mm / weight in kg			
Variant number	40.5 / 0.8	**608**	**609**	**601**
	120 / 3	**627**	**628**	**620**
				
Variant number	40.5 / 0.8	**602**	**603**	**604**
	120 / 3	**621**	**622**	**623**
				
Variant number	40.5 / 0.8	**605**	**606**	**607**
	120 / 3	**624**	**625**	**626**
				
Variant number	40.5 / 0.8	**610**	**611**	**612**
	120 / 3	**629**	**630**	**631**
				
Variant number	40.5 / 0.8	**613**		
	–	**–**		

Unit dimensions: Sandwich plate size 6 (dimensions in mm)

Type HED 8 OH... as vertical stacking element (up to 350 bar)



1 Seal ring
2 Through hole for valve mounting
3 Screw-on surface for pressure switch
4 Plate height 40.5 mm or 120 mm, optional
5 Porting pattern according to ISO 4401-03-02-0-05



Required surface quality of the plate contact surface

Ordering code: Sandwich plate size 10 (separate order)

HSZ	10	A	–3X /	00	*

Sandwich plate

Size 10 **= 10**

Porting pattern according to ISO 4401-05-04-0-05 **= A**

Variant no. (see below) **= 6...**

Component series 30 to 39 **= 3X**
(30 to 39: Unchanged installation and connection dimensions)

Further details in the plain text

Seal material

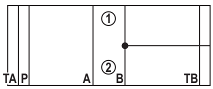
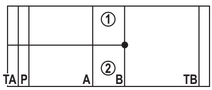
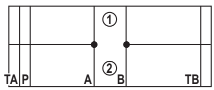
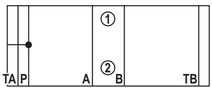
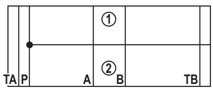
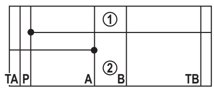
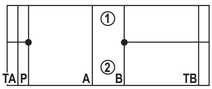
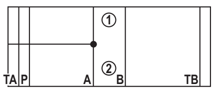
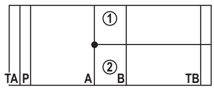
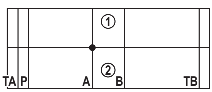
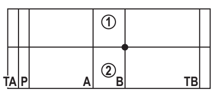
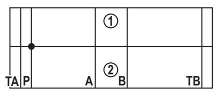
M = NBR seals

V = FKM seals

MT = Low-temperature seals (max. 315 bar)

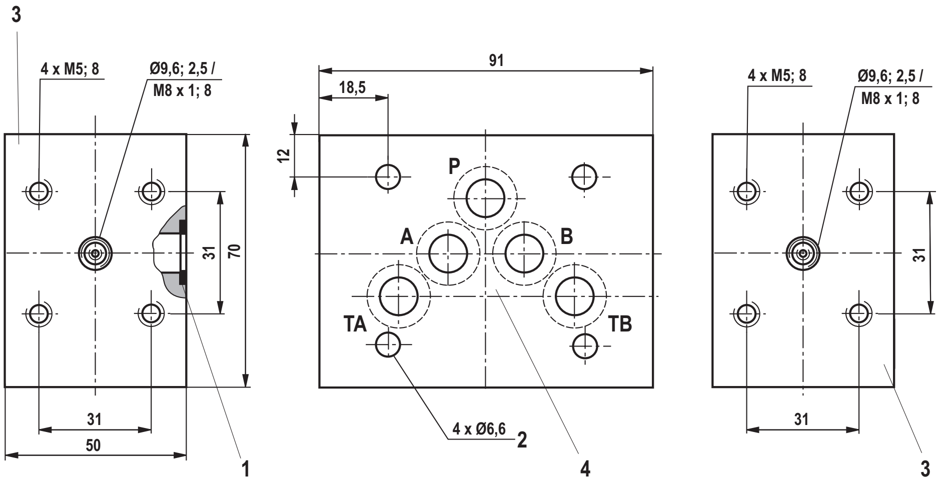
Notice:
Observe compatibility of seals with the hydraulic fluids used.

Symbols, variant no.: Sandwich plate size 10 (1 = component side, 2 = plate side)

		Pressure switch effective in channel ...		
	Weight in kg			
Variant number	2	**601**	**602**	**603**
				
Variant number	2	**604**	**605**	**606**
				
Variant number	2	**607**	**608**	**609**
				
Variant number	2	**610**	**611**	**612**

Unit dimensions: Sandwich plate size 10 (dimensions in mm)

Type HED 8 OH... as vertical stacking element (up to 350 bar)

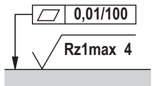


1 Seal ring

2 Through hole for valve mounting

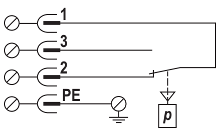
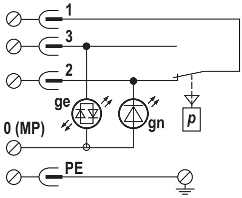
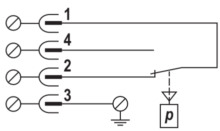
3 Screw-on surface for pressure switch

4 Porting pattern according to ISO 4401-05-04-0-05



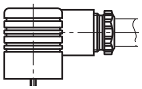
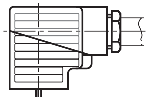
Required surface quality of the plate contact surface

Electrical connection

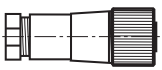
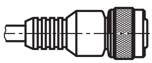
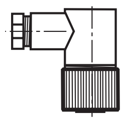
"K14" without indicator light	**"K14" with** indicator light	**"K35"**
		
Switching function Terminals 1-2: Contact opens in case of pressure increase Terminals 1-3: Contact closes in case of pressure increase		Switching function Terminals 1-2: Contact opens in case of pressure increase Terminals 1-4: Contact closes in case of pressure increase

Mating connectors

For connection "K14"

For details and more mating connectors see data sheet 08006						
	Material no.					
	without circuitry	with circuitry (indicator light) AC/DC, –20....+60 °C				
	240 V, –40...+125 °C	6 … 14 V	16 … 30 V	36 … 60 V	90 … 130 V	180 … 240 V
Color black	**R901017012**	**R901017030**	**R901017048**	**R901017032**	**R901017035**	**R901017037**

For connection "K35"

For details and more mating connectors see data sheet 08006			
	Material no.		
	4-pole, M12 x 1 with screw connection, –40...+85 °C	4-pole, M12 x 1 with PUR cable, 3 m long, –25...+85 °C	4-pole, M12 x 1 with screw connection, angled, –40...+85 °C
Color black	**R900031155**	**R900064381**	**R900082899**

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documentation@boschrexroth.de
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Rexroth
Bosch Group

Electronic signal transmitter

RE 29753/04.05
Replaces: 07.02

Type VT 10468

Series 3X
Single axis version

F 87015_d

Overview of contents

Contents	Page

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

Features

Contained within the VT 10468-3X electronic signal transmitter are the electronic and mechanical components which are used to convert the lever movement into a proportional electrical voltage.

– Sensitive control due to low operating forces
– Integrated evaluation electronics
– ±15 V DC supply voltage
– Replacable gaiter
– Switched off if there is a cable break in the supply cables
– Polarity protection

Options:
– Dead-man switch in the hand lever
– Additional controls possible via various switches fitted into the hand lever
– Can be held in any position by means of a friction brake
– The zero point may be mechanically locked
– Directional contacts for electrical monitoring of the hand lever movement

Ordering details

VT 10468 –3X / | – | *

Single axis signal transmitter

Series 30 bis 39 = 3X
(30 to 39: unchanged technical data and connection allocation)

Additional functions
Friction brake = B
Spring return = F

Lever form	Additional functions	Protection to EN 60529	
Hand lever	None	IP 65	= 0
Hand lever	Push button	IP 65	= 1
Hand lever	Rocker switch	IP 65	= 2
Hand lever	Pressure operated switch	IP 65	= 3
Hand lever	Rocker switch with detent	IP 65	= 4
Ball lever	None	IP 65	= 5
Ball lever	With dead-man contact	IP 53	= 6
Ball lever	With mech. pull detent	IP 65	= 7

Futher details in clear text

Direction contact
R0 = No contact
RX = Contact in the X axis

Function

Mechanics

The simple robust mechanism consists of a control lever mounted in a swivel bearing. By deflecting the lever, the setting of a plastic track potentiometer is changed. Dependent upon the model, the control lever is automatically spring returned to the neutral position or held in any position by a friction brake.
A mechanical detent can also be fitted into the hand lever. The mechanism is protected by a rubber gaiter.

Zero position, directional and dead-man contacts

In order to be able to electrically monitor the direction of lever movement and the zero position, a switch can be fitted per half axis. This switch closes when the lever is moved between ±5 % to ±10 % of the maximum travel (referred to the output signal of ±10 V).

The transducer can also be fitted with a dead-man switch. This is operated by pressing the upper half of the hand lever (at right angles to the plane of installation).

When these functions are required, they are connected via a 2nd non-screened cable.

Electronics

The plastic track potentiometer is connected in series with an impedance converter, which ensures that the control curve remains within the specified limits, even with varying loading on the control output. The electronics also carry out other protective functions. Should a cable break in the ±15V lines occur, then the supply to the electronics is automatically switched off internally. The electrical connection is via multi-core screened cable.

The combination of plastic track potentiometer and impedance converter ensures that a long service life is achieved.

Engineering guidelines

Attention: If the transmitter is installed in a fully isolated manner, then the transmitter housing must be earthed by a seperate cable!

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

Electronics		
Supply voltage	*U*	±15 VDC (± 1 %) stabilised
Current consumption	*I*	Approx. 30 mA
Control outputs – Output voltage – Output current	 *U* *I*	 Max. ±10 V Max. ±5 mA
Switched contacts		2 A, Max. 30 VDC (ohmic load)
Fuse	I_S	2 A, medium blowing characteristics
Mechanics		
Lever displacement angle	α	Approx. 20° from the spring centre position to the end position (when operated in the X direction)
Operating force	*F*	Start value approx. 6 N Final value approx. 10 N
Protection to EN 60529 – above the mounting plane: – below the mounting plane:		 See ordering details IP 65
Cable length	*l*	600 mm
Permissible ambient temperature	ϑ	–25 to +70 °C
Weight	*m*	Approx. 1.5 kg

Cable allocation

Colour of the connecting cables (cable 1 – screened):

Supply lines:	Red	+15 V
	Black	M0 (measured zero)
	Blue	–15 V
Signal lines:	White	M0 (measured zero)
	Pink	X axis
Screen:	Yellow/green	Housing transmitter
	Transparent	Screen

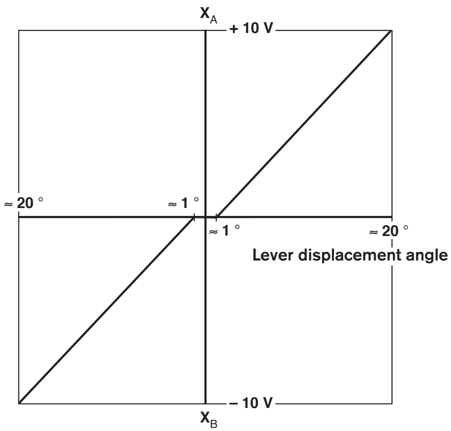
Notes:
- The cable screen is not connected internally!
- If the transmitter is installed in a fully isolated manner, then the transmitter housing must be connected to earth!

Colours of the connecting cables (cable 2 – non screened):

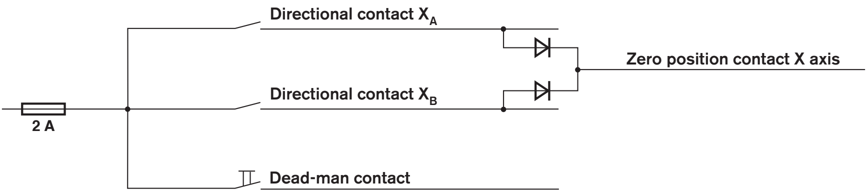
Feed cable:	Blue	
Directional contacts:	Grey/Pink	X_A
	Red/Blue	X_B
Dead-man contact:	Grey	
Zero position contact:	Black	X axis

Characteristic curves

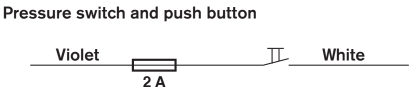
X axis

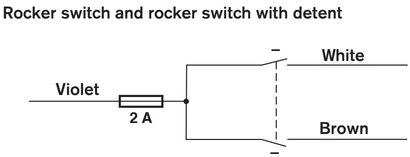


Zero position, directional and deadman contacts



Switch in the lever

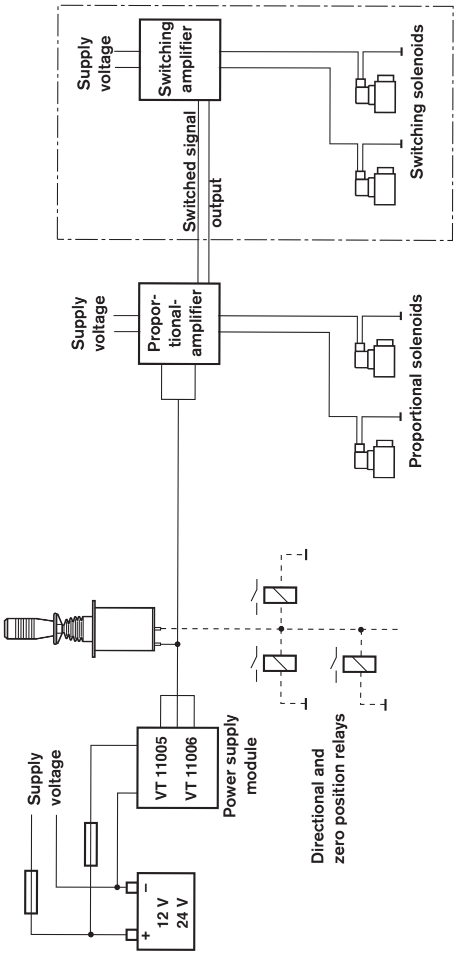




Colours of the connecting cable (cable 2 – non screened):

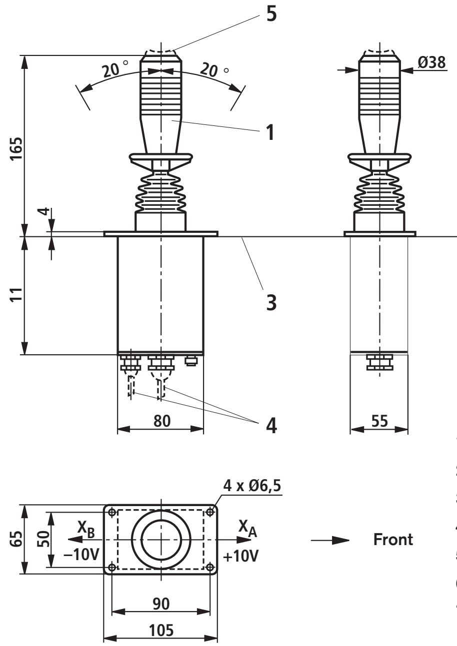
Feed cable:	Violet
Pressure operated switch and push button:	White
Rocker switch and rocker switch with detent:	Brown

Circuit example



4

Unit dimensions (dimensions in mm)



1 Hand lever
2 Ball lever
3 Mounting face
4 Connecting cables (length 600 mm)
5 Switch in lever (see ordering details)
6 Dead-man contact
7 Pull detent

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Electronic signal transmitter

RE 29754/04.05
Replaces: 07.02

1/8

Type VT 10406

Series 3X
Two axes version

F 87014_d

Overview of contents

Contents **Page**

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

Features

Contained within the VT 10406-3X electronic signal transmitter are the electronic and mechanical components which are used to convert the lever movement into two independent proportional signals. Due to the design of the lever joint safe operation of only one axis is also guaranteed.

– Sensitive control due to low operating forces
– Integrated evaluation electronics
– ±15 V DC supply voltage
– Replacable gaiter
– Switched off if there is a cable break in the supply cables
– Polarity protection

Options:
– Dead-man switch in the hand lever
– Additional controls are possible via various switches fitted into the hand lever
– Can be held in any position by means of friction brakes in the X and Y axes
– The zero point may be mechanically locked
– Directional contacts for electrical monitoring of the hand lever movement

Ordering details

VT 10406 – 3X / – – *

Two axes signal transmitter

Series 30 to 39	**= 3X**
(30 to 39: unchanged technical data and connection allocation)	
Additional functions	
Friction brakes on X and Y axes	**= BXY**
Friction brakes on X axis, spring return on Y axis	**= BX0**
Friction brakes on Y axis, spring return on X axis	**= B0Y**
Spring return on X and Y axes	**= FXY**

Lever form	Additional functions	Protection to EN 60529	
Hand lever	None	IP 65	**= 0**
Hand lever	Push button	IP 65	**= 1**
Hand lever	Rocker switch	IP 65	**= 2**
Hand lever	Pressure operated switch	IP 65	**= 3**
Hand lever	Rocker switch with detent	IP 65	**= 4**
Ball lever	None	IP 65	**= 5**
Ball lever	With dead-man contact	IP 53	**= 6**
Ball lever	With mech. pull detent	IP 65	**= 7**

	Further details in clear text
	Direction contact
R00 =	No contact
RXY =	Contact in X and Y axes
S =	Standard
K =	Cross-form limiting gate

Function

Mechanics

The simple robust mechanism consists of a control lever mounted in a swivel bearing. Two plastic track potentiometers are adjusted, these are orientated in relation to the associated axis. When the control lever is released, springs return to its neutral position. The mechanical components are protected by means of a gaiter. The transmitter can be fitted with a friction brake on both axes which makes it possible to hold the control lever in any position. When the actuation of only one axis is permissible a cross-form of gate can be fitted. (simultaneous actuation of both axes is thereby not possible).

Zero position, directional and dead-man contacts

In order to be able to electrically monitor the direction of lever movement and the zero position, a contact can be fitted per half axis. This contact closes when the lever is moved out of its neutral position within the range of ±5 % to ±10 % (referred to the output signal of ±10 V).

The transducer can also be fitted with a dead-man switch. This is operated by pressing the upper half of the hand lever (at right angles to the plane of installation).

When these functions are required, they are connected via a 2nd non-screened cable.

Electronics

The plastic track potentiometer is connected in series with an impedance converter, which ensures that the control curve remains within the specified limits, even with varying loading on the control output. The electronics also carry out other protective functions. Should a cable break in the ±15V supply lines occur, then the supply to the transducer is automatically switched off internally. The electrical connection is via a multi-core screened cable.

The combination of plastic track potentiometer and impedance converter ensures that a long service life is achieved.

Engineering guidelines

Attention: If the transmitter is installed in a fully isolated manner, then the transmitter housing must be earthed by a separate cable!

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

Elektronics		
Supply voltage	*U*	±15 VDC (± 1 %) stabilised
Current consumption	*I*	Approx. 40 mA
Control outputs – Output voltage – Output current	 *U* *I*	 Max. ±10 V Max. ±5 mA
Switched contact		2 A, max. 30 VDC (ohmic load)
Fuse	I_S	2 A, medium blowing characteristics
Mechanics		
Lever displacement angle	α	Approx. 20° from the spring centred position to the end position (when operated in the X or Y directions)
Operating force	*F*	Start value approx. 7 N Final value approx. 16 N
Protection to EN 60529 – Above the mounting plane – Below the mounting plane		 See ordering details IP 65
Cable length	*l*	600 mm
Permissible ambient temperature	ϑ	–25 to +70 °C
Weight	*m*	Approx. 1.8 kg

Cable allocation

Colour of the connecting cable (cable 1 – screened):

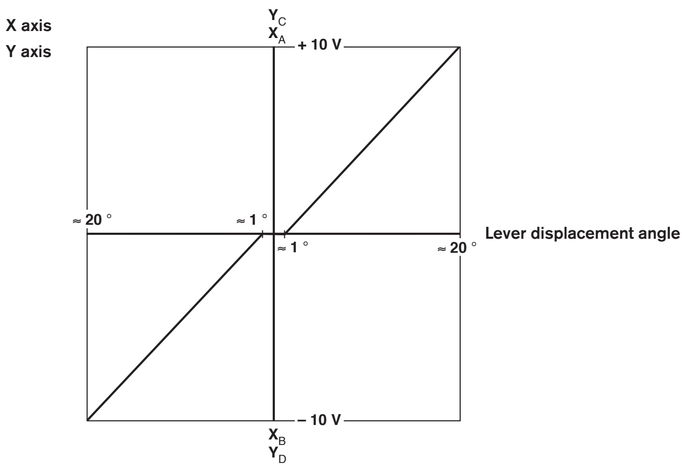
Supply lines:	Red	+15 V
	Black	M0 (measured zero)
	Blue	–15 V
Signal lines:	White	M0 (measured zero)
	Pink	X axis
	Green	Y axis
Screen:	Yellow/Green	Housing transmitter
	Transparent	Screen

Notes:
- The cable screen is not connected internally!
- If the transmitter is installed in a fully isolated manner, then the transmitter housing must be connected to earth!

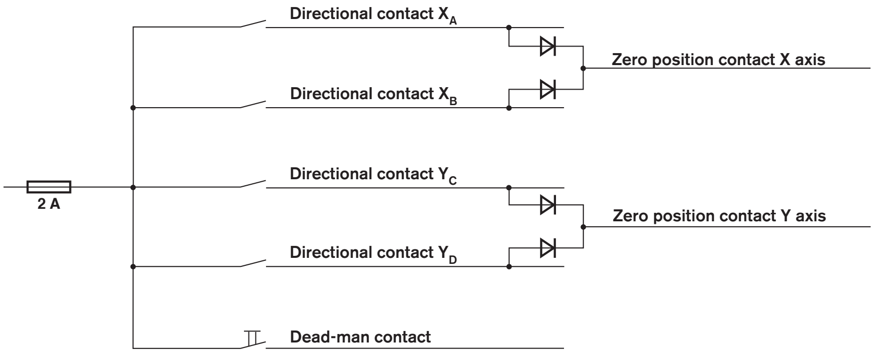
Colour of the connecting cable (cable 2 – non-screened):

Feed cable:	Blue	
Directional contacts:	Grey/Pink	X_A
	Red/Blue	X_B
	Yellow	Y_C
	Brown/Green	Y_D
Dead-man contact:	Grey	
Zero position contact:	Black	X-Achse
	Green	Y-Achse

Characteristic curves

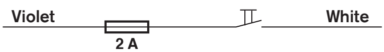


Zero position, directional and dead-man contacts

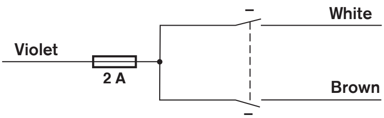


Switch in the lever

Pressure switch and push button:



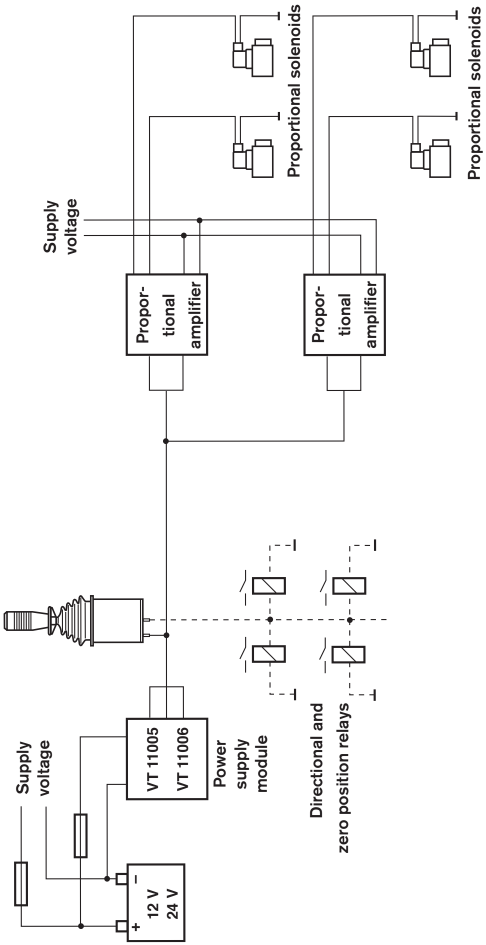
Rocker switch and rocker switch with detent:



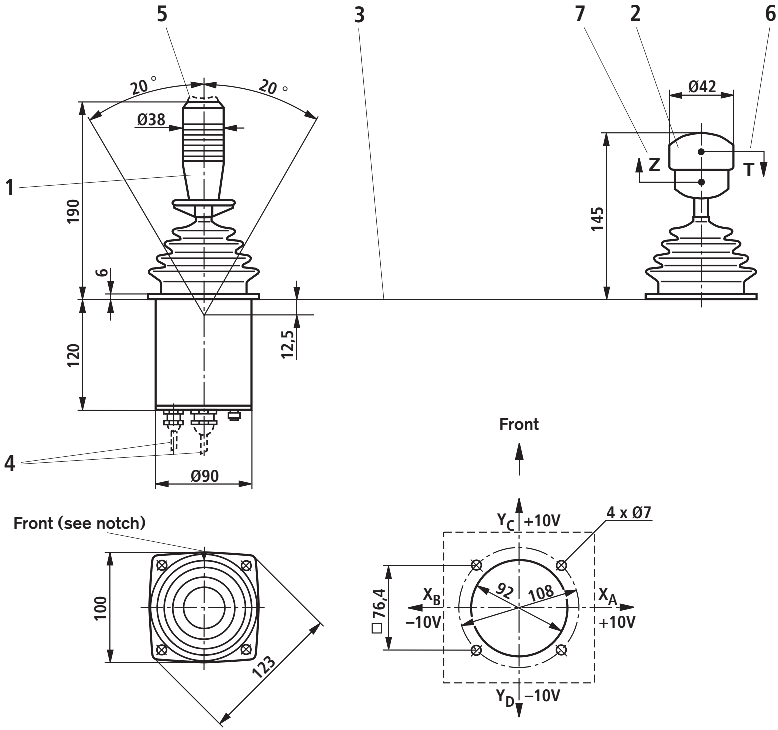
Colour of the connection cables (cable 2 – non-screened):

Feed cable:	Violet
Pressure operated switch and push button:	White
Rocker switch and rocker switch with detent:	Brown

Circuit example



Unit dimensions (dimensions in mm)



1 Hand lever

2 Ball lever

3 Mounting face

4 Connecting cables (length 600 mm)

5 Switch in lever (see ordering details)

6 Dead-man contact

7 Pull detent

Notes

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Electronic signal transmitter

RE 29755/04.05
Replaces: 07.02

Type VT 10399

Series 5X
Three axes version

F 87013_d

Overview of contents

Contents	Page
Features	1
Ordering details	2
Function	2
Engineering guidelines	3
Technical data	3
Cable allocation	4
Characteristic curves	4
Zero position, directional and dead-man contact	5
Circuit example	5
Unit dimensions	6

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

Features

Contained within the VT 10399-5X electronic signal transmitter are the electronic and mechanical components which are used to convert the lever movement and the operating elements contained within the ball grip into a proportional electrical voltage. Due to the design of the lever joint, safe operation of only one axis is also possible.

Features:

– Sensitive control due to low operating forces
– Integrated evaluation electronics
– ±15 V DC supply voltage
– Replacable gaiter
– Switched off if there is a cable break in the supply cables
– Polarity protection

Options:

– Dead-man switch in the hand lever
– The actuation pins of the Z axis are sealed (by means of a gaiter)
– The ball grip can be deflected by ±20 °
– Can be held in any position by means of a friction brake in the X and Y axes
– Directional contacts for electrical monitoring of the hand lever movement

Ordering details

VT 10399 – 5X / – – *

Three axes signal transmitter

Series 50 to 59 **= 5X**
(50 to 59: unchanged technical data and connection allocation)

Additional functions

Friction brakes on X and Y axes	**= BXY**
Friction brake X axis, spring return on Y axis	**= BX0**
Friction brake Y axis, spring return on X axis	**= B0Y**
Spring return on X and Y axes	**= FXY**

Lever form and additional functions	**Protection to EN 60529**	
Ball grip, adjustable ±20°	IP 53	**= B**
Ball grip, fixed	IP 53	**= C**
Ball grip, fixed with gaiter	IP 65	**= D**

Ball grip only with direction contacts	**= 80**
Ball grip with proportional output ±10 V	**= 90**
Ball grip with proportional output ±10 V and two direction contacts (can also be used as zero position contacts)	**= 9R**

T = ball grip **with** dead-man contact
A = ball grip **without** dead-man contact

Direction contact
R00 = No contact
RXY = Contact in the X and Y axes

Further details in clear text

Function

Mechanics

The simple robust mechanism consists of a control lever that is mounted in a swivel bearing. Two plastic track potentiometers are adjusted, these are orientated in relation to the associated axis. The actuation elements in the ball grip also adjusts the plastic track potentiometers, thereby sensitive control is also possible in the Z axis. On request the ball grip can be steplessly deflected (max. ±20°) in relation to the control lever. Spring centring returns the control lever and ball grip into the neutral position whn the lever is released. The mechanical components are protected by means of a gaiter.

Zero position, directional and dead-man contacts

In order to be able to electrically monitor the direction of lever movement and the zero position, a contact can be fitted per half axis. This contact closes when the lever is moved out of its neutral position within the range of ±5 % to ±10 % (referred to the output signal ±10 V).

The transducer can also be fitted with a dead-man switch. This is operated by pressing the upper half of the hand lever (at right angles to the plane of installation).

When these functions are required, they are connected via a 2nd non-screened cable.

Electronics

The plastic track potentiometer is connected in series with an impedance converter, which ensures that the control curve remains within the specified limits, even with varying loading on the control output. The electronics also carry out other protective functions. Should a cable break in the ±15V supply lines occur, then the supply to the transducer is automatically switched off internally. The electrical connection is via multi-core screened cable.

The combination of plastic track potentiometer and impedance converter ensures that a long service life is achieved.

Engineering guidelines

Attention: If the transmitter is installed in a fully isolated manner, then the transmitter housing must be earthed by a separate cable!

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

Elektronics		
Supply voltage	*U*	±15 VDC (±1 %) stabilised
Current consumption	*I*	Approx. 50 mA
Control outputs – Output voltage – Output current	 *U* *I*	 Max. ±10 V Max. ±5 mA
Switched contact		2 A, max. 30 VDC (ohmic load)
Fuse	I_S	2 A medium blowing characteristics
Mechanics		
Lever displacement angle	α	Approx. 20° from the spring centred position to the end position (when operated in the X or Y directions)
Operating force	*F*	Start value approx. 7 N Final value approx. 16 N
Protection to EN 60529 – Above the mounting plane: – Below the mounting plane:		 See ordering details IP 65
Cable length	*l*	600 mm
Permissible ambient temperature	ϑ	–25 to +70 °C
Weight	*m*	Approx. 2.0 kg

Cable allocation

Colour of the connecting cable (cable 1 – screened):

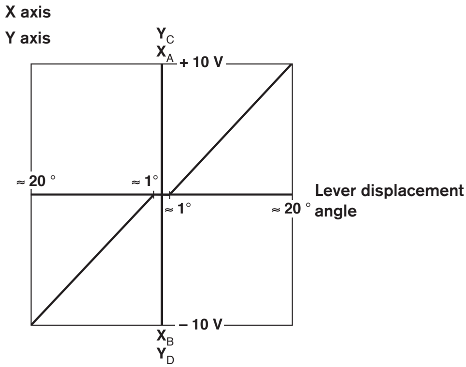
Supply lines:	Red	+15 V
	Black	M0 (measuring zero)
	Blue	–15 V
Signal lines:	White	M0 (measuring zero)
	Pink	X axis
	Green	Y axis
	Yellow	Z axis
Screen:	Yellow/Green	Housing transmitter
	Transparent	Screen

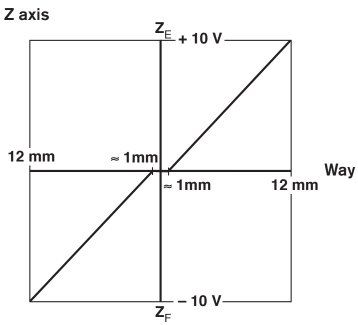
Colour of the connecting cable (cable 2 – non-screened):

Feed cable:	Blue	
Directional contacts:	Grey/Pink	X_A
	Red/Blue	X_B
	Yellow	Y_C
	Braun/Green	Y_D
	White/Yellow	Z_E
	Yellow/Brown	Z_F
Dead-man contact:	Grey	
Zero position contact:	Black	X axis
	Green	Y axis
	White/Green	Z axis

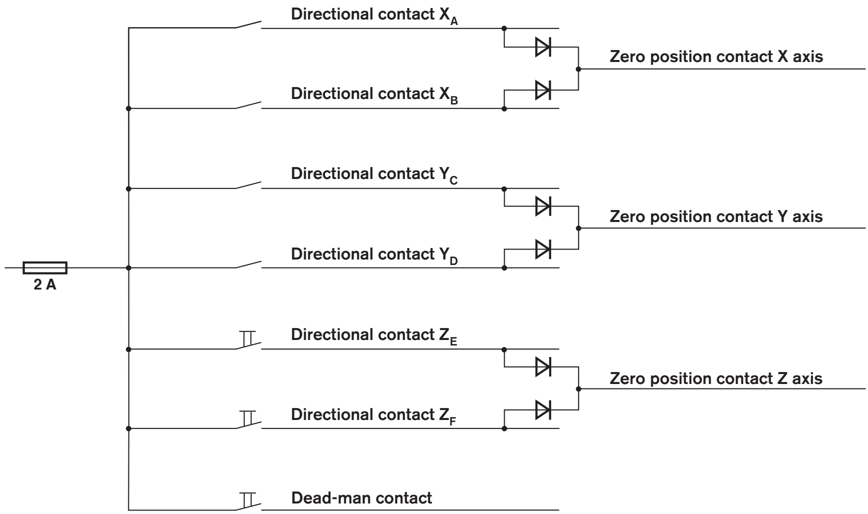
Notes:
- The cable screen is not connected internally!
- If the transmitter is installed in a fully isolated manner, then the transmitter housing must be connected to earth!

Characteristic curves

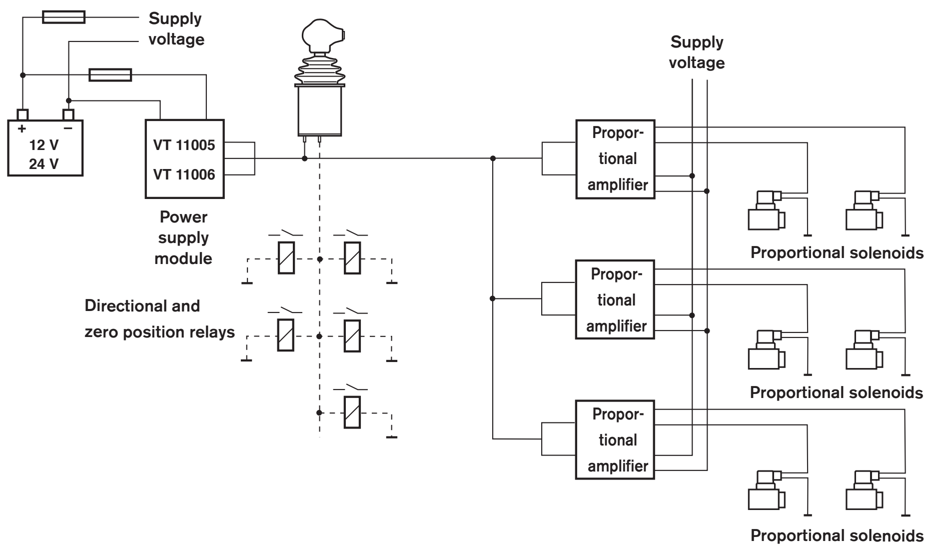




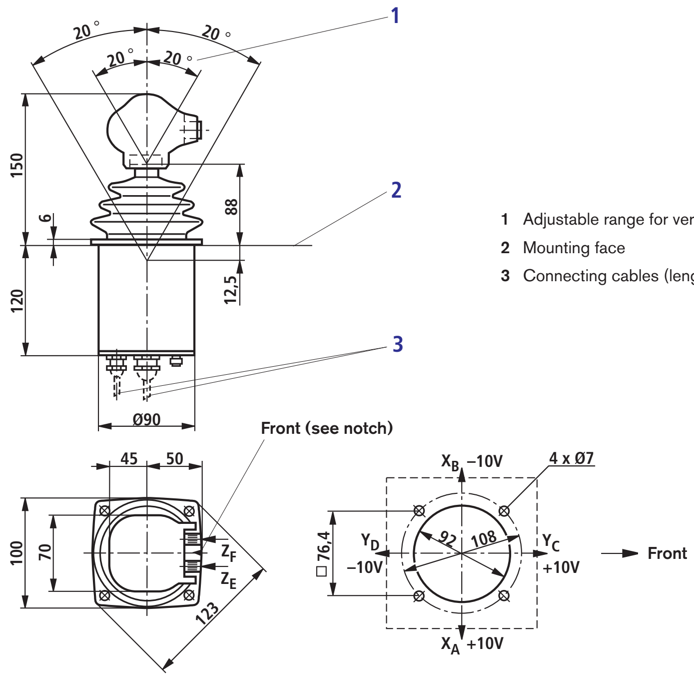
Zero position, directional and dead-man contacts



Circuit example



Unit dimensions (dimensions in mm)



1 Adjustable range for version „**B**“
2 Mounting face
3 Connecting cables (length 600 mm)

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Electronic accessories

5

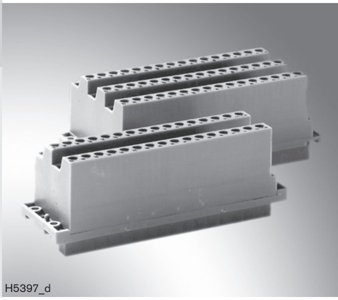
Rexroth Bosch Group

Connection adapter

RE 30105/06.05
Replaces: 08.03

Type VT 10812

Series 2X



H5397_d

Table of contents

Features

VT 10812 connection adapaters are used as connecting element between Euro-racks and electronic cards in Euro-format.

VT 10812-2X/32D connection adapters consist of:
– 32-pin female multi-point connector and
– 32-pin terminal strip (both a/c assigned; form D)

VT 10812-2X/48F connection adapters consist of:
– 48-pin female multi-point connector and
– 48-in terminal strip (b/d/z assigned; form F)

VT 10812-2X/64G connection adapters consist of:
– 64-pin female multi-point connector and
– 64-pin terminal strip (f/d/b/z assigned; form G)

Ordering code

VT 10812	–2X /	*

Connection adapter

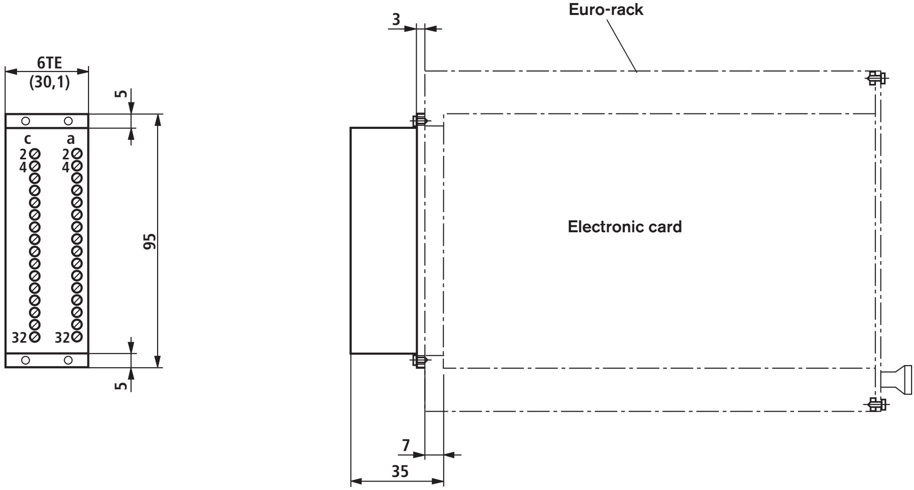
Series 20 to 29 = 2X
(20 to 29: unchanged installation dimensions and pin assignment)

32D =	32-pin, form D
48F =	48-pin, form F
64G =	64-pin, form G

Further details in clear text

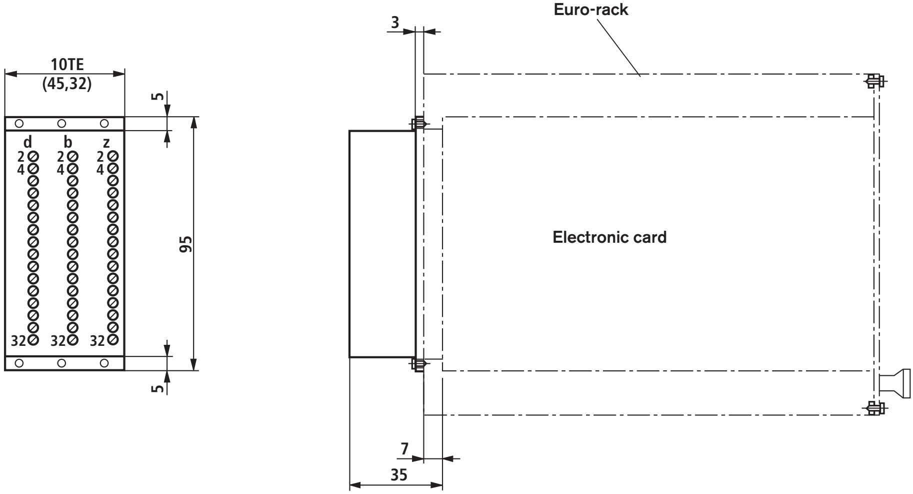
Unit dimensions (dimensions in mm)

Adapter, 32-pin, form D

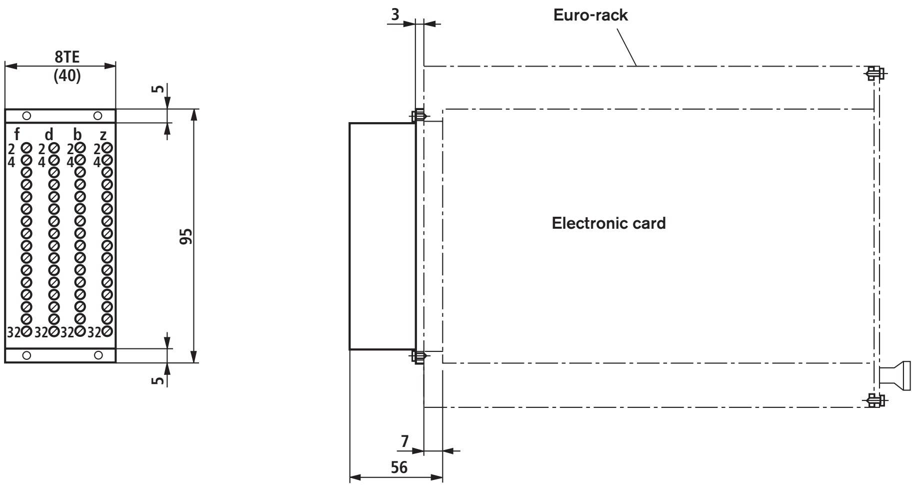


Unit dimensions (dimensions in mm)

Adapter, 48-pin, form F



Adapter, 64-pin, form G



Notes

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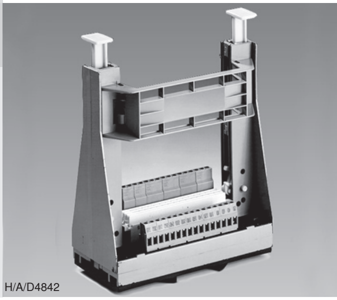
Rexroth
Bosch Group

Card holder

RE 29928/04.10
Replaces: 12.08

Type VT 3002

Component series 2X



H/A/D4842

Table of contents

Features

- The card holder allows for simple installation and wiring of individual electronics cards in Euro-card format , e.g. in control cabinets
- Screwable or snappable to hat rail
- With additional adapter (included in scope of supply) which can be mounted vertically on a hat rail
- Rugged base
- Card locking and releasing by lever actuation
- Connection via screw terminals

Ordering code

VT 3002 – – 2X / | *

Card holder	**= VT 3002**
Single Euro-format	**= 1**
Double Euro-format (only in version 32D)	**= 2**
Component series 20 to 29 (20 to 29: Unchanged mounting and connection dimensions)	**= 2X**

15H =	15-pin socket connector, form H
32D =	32-pin socket connector, form D
32F =	32-pin socket connector, form F
48F =	48-pin socket connector, form F
64G =	64-pin socket connector, form G

Further details in the clear text

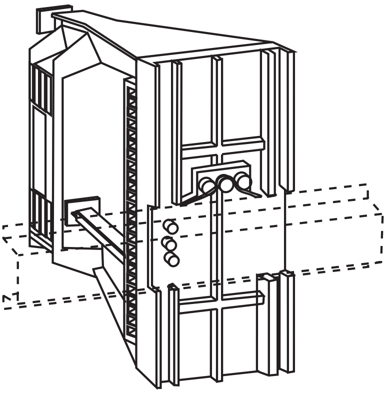
Technical data (For applications outside these parameters, please consult us!)

Terminal voltage according to VDE 0110 C		*U*	max. 48 VAC/DC
Current carrying capacity	VT 3002…15H	*I*	15 A
	VT 3002…32D	*I*	4 A
	VT 3002…32F	*I*	4 A
	VT 3002…48F	*I*	4 A
	VT 3002…64G	*I*	3 A
Connection cross-section		*A*	Plug-in screw terminals max 4 mm^2, form H = 6 mm^2
Type of connection (socket strip)	VT 3002…15H		15-pin socket connector, form H, DIN 41612
	VT 3002…32D		32-pin socket connector, form D, DIN 41612
	VT 3002…32F		32-pin socket connector, form F, DIN 41612
	VT 3002…48F		48-pin socket connector, form F, DIN 41612
	VT 3002…64G		64-pin socket connector, form G, DIN 41612
Pinout	VT 3002…15H		Even-numbered, rows d/z
	VT 3002…32D		Even-numbered, rows a/c
	VT 3002…32F		Even-numbered, rows b/z
	VT 3002…48F		Even-numbered, rows d/b/z
	VT 3002…64G		Even-numbered, rows f/d/b/z
Permissible ambient temperature range		ϑ	–20 to +70 °C
Weight single/double Euro-format		*m*	0.5 kg / 0.8kg

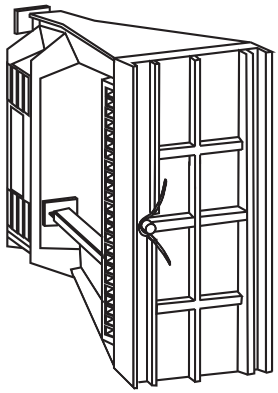
Notes on installation

Push down the yellow operating levers and insert card completely. The card can only be unlocked and withdrawn after repeated actuation of the locking lever.

For the connection of cables, the connection web between the two card guide rails can be removed or snapped in on the other side.



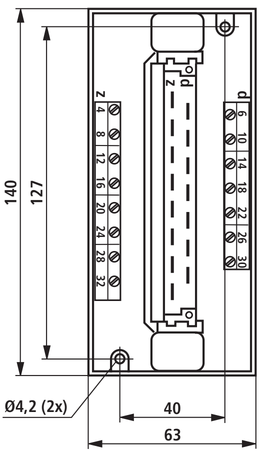
Card holder for forms H 15-pin, D 32-pin, F 32-pin, and F 48-pin



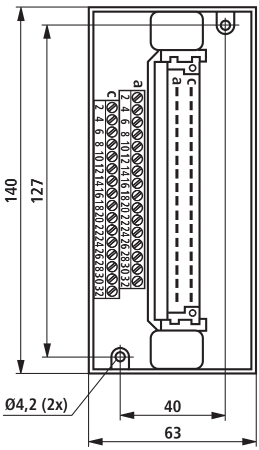
Card holder for designs double Europe format 32 D
as well as G 64-pole
Hat rail mounting only possible in vertical position

Unit dimensions (dimensions in mm)

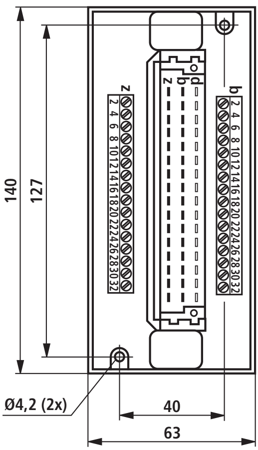
VT 3002-1-2X/15H



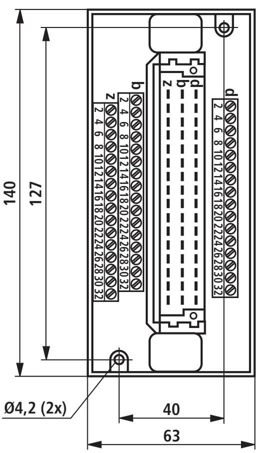
VT 3002-1-2X/32D



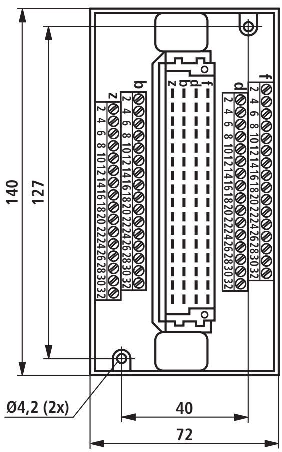
VT 3002-1-2X/32F

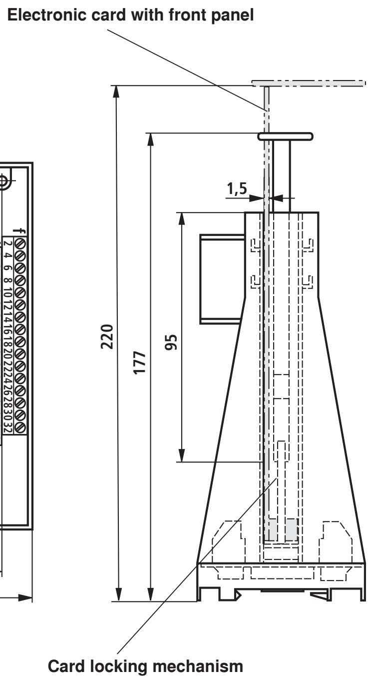


VT 3002-1-2X/48F



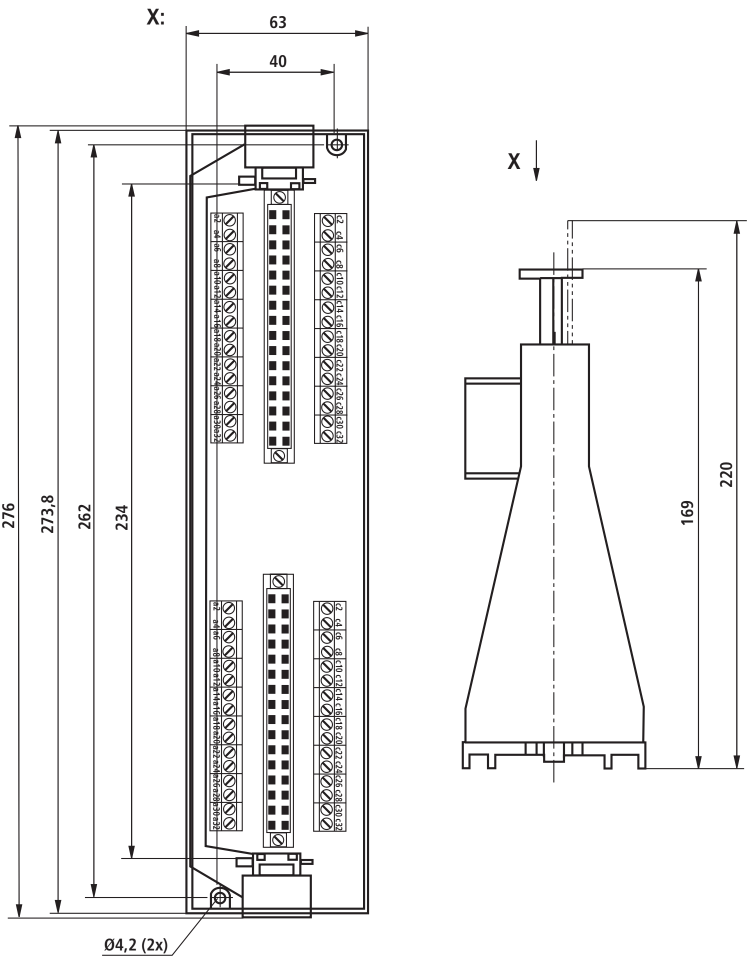
VT 3002-1-2X/64G





Unit dimensions (dimensions in mm)

VT 3002-2-2X/32D



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Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

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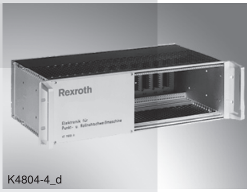
19´´racks

RE 29768/05.08 1/8
Replaces: 06.05

Type VT 19101, VT 19102, VT 19103

Component series 1X



19“ rack, VT 19101

19“ rack, VT 19101
(view: rear panel with plugs)

Overview of contents

Contents

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

Features

he 19“ racks, VT 19101, VT 19102 and VT 19103 accept electronic assemblies in Euro-card format and they can be fitted into 19“ electronic cabinets and housings.

They conform with DIN 41494 and IEC 297-3.

– Designed to VDE 0100/12.65-4

– Installation width; 84 pitch (TE) at 5.08 mm

– Designs of up to 3 x 3 height units (HE) at 44.45 mm for Euro-cards of 100 x 160 mm and 100 x 220 mm

– Electrical shock protection via a cover plate

– Sealed wiring space

– Vibration proof version (DB acceptance)

Optional outlets to cabinet wiring:

– Hinged rear panel with:

- 140 signal connection terminals on 10 plugs with 3 HE (max. connection cross-section 2.5 mm^2)
- Separate terminal block for the supply voltage with 10 terminals (max. connection cross section 6 mm^2)
- Standard connection plug coding
- Plug pre-assembly is possible

Or:

– VT 10812 connection adaptor (see RE 30105) for magazines without rear wall

Further options are:

– Rear panel with plugs instead of a blank rear wall for type VT 19102 and VT 19103

– Blank rear panel

Ordering details

VT 191 _ _ – 1X / | *

1 x 3 HE; card dimensions 100 x 160 mm	**= 01**
2 x 3 HE; card dimensions 100 x 160 mm	**= 02**
3 x 3 HE; card dimensions 100 x 160 mm	**= 03**

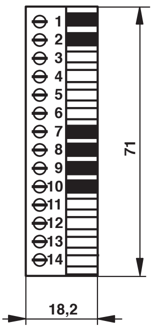
Series 10 to 19 **= 1X**
(10 to 19: unchanged installation and connection dimensions)

Magazine nominal depth
For VT 19101 to VT 19103
(card dimensions 100 x 160 mm):
1 = 160 mm (without rear panel)
2 = 220 mm (with rear panel)

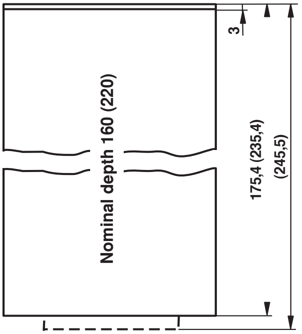
Further details (options) in clear text

Unit dimensions: terminal plug (dimensions in mm)

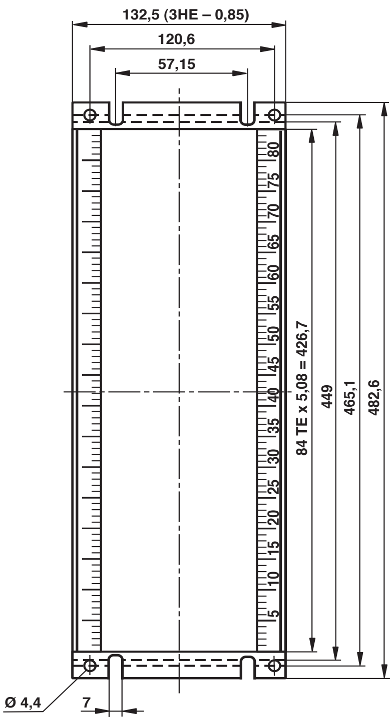
Coded terminal plug

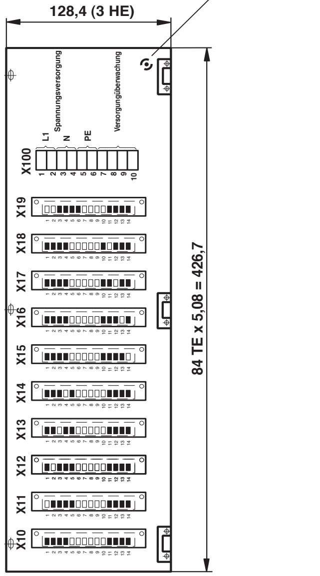


Unit dimensions: VT 19101-1X (dimensions in mm)



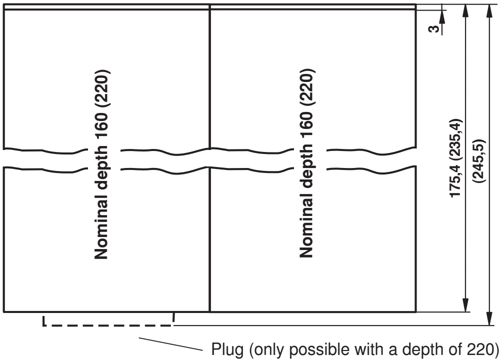
Plug (only possible with a depth of 220)

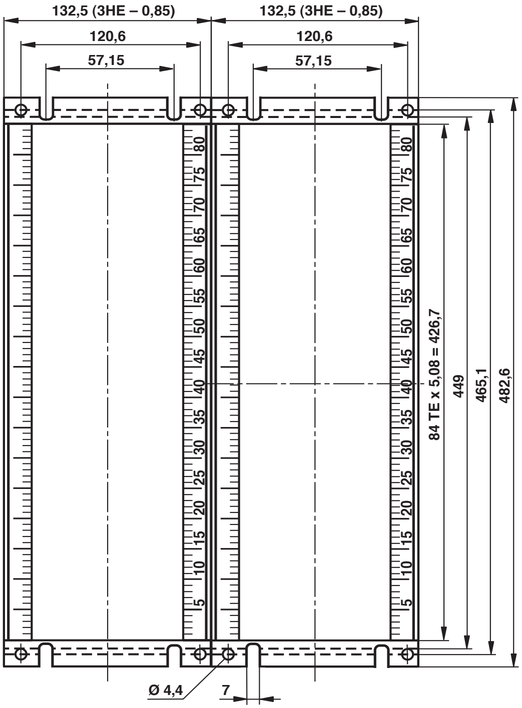


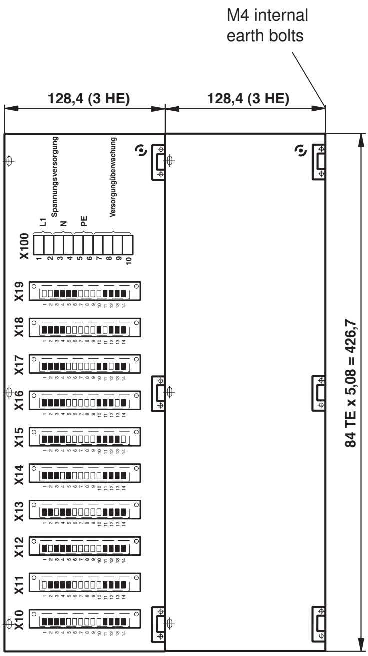


The „u“ numbers indicate the location of the cards within the magazine.
The first digit of the “u” number and the plug number gives the tier location.

Unit dimensions: VT 19102-1X (dimensions in mm)

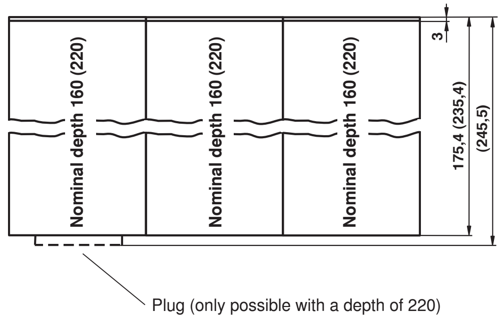


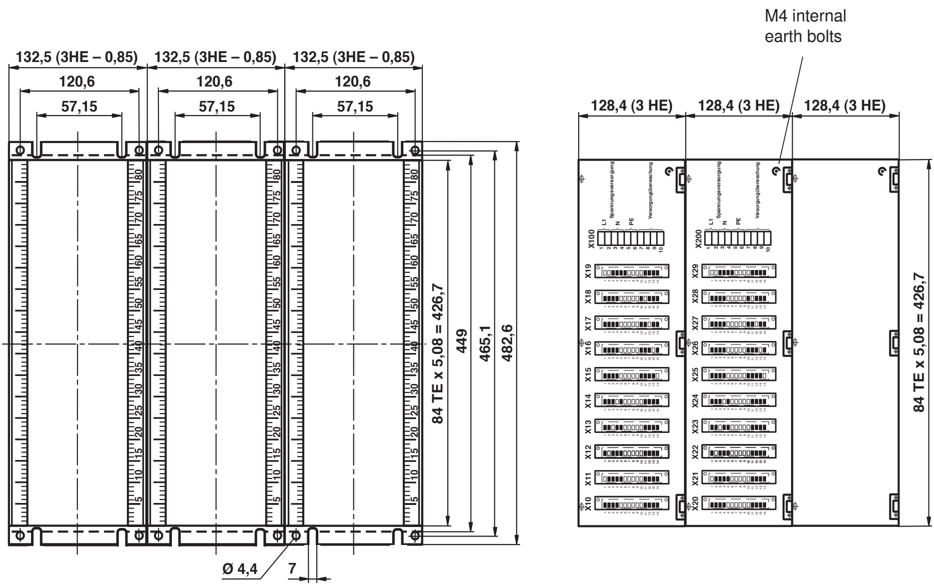




The „u“ numbers indicate the location of the cards within the magazine.
The first digit of the “u” number and the plug number gives the tier location.

Unit dimensions: VT 19103-1X (dimensions in mm)





The „u" numbers indicate the location of the cards within the magazine.
The first digit of the "u" number and the plug number gives the tier location.

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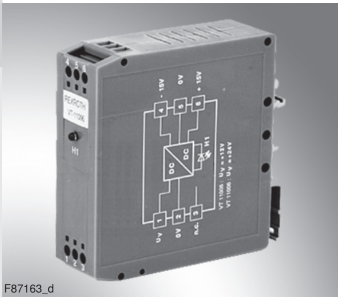
Power supply module

RE 29729/11.09
Replaces: 07.05

Type VT 11006, VT 11116

Series 1X



F87163_d

Table of contents

Features

The power supply module supplies two stabilised voltages. It is used to supply external, electrical consumers.

Special features:
- VT 11006-1X: 24 V / ±15 V
- VT 11116-1X: 24 V / ±10 V
- Switched-mode power supply unit
- Reverse voltage protection
- Function monitoring by means of LED lamps
- Output voltages electrically isolated from operating voltage

Ordering code

VT 11		–1X	*

24 V power supply module
Output voltage ±15 V **= 006**
Output voltage ±10 V **= 116**

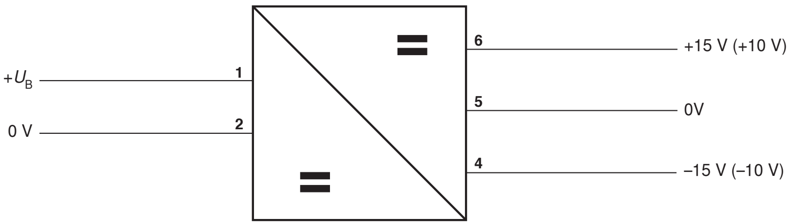
Further details in clear text

1X = Series 10 to 19
(10 to 19: unchanged installation and connection dimensions)

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

		VT 11006-1X	VT 11116-1X
Operating voltage	U_B	21.5 V_{eff} to 35 V_{eff}	21.5 V_{eff} to 35 V_{eff}
– Three-phase bridge (winding)	U	21.5 V to 35 V	21.5 V to 35 V
– Full bridge (winding)	U	20 V to 24 V	20 V to 24 V
(with external smoothing capacitor only, 2200 μF per module)			
Power consumption	P	≤10 VA	≤10 VA
Output voltage	U_O	±15 V (±1 %)	±15 V (±1 %)
Residual ripple content (referred to the nominal output voltage value)		<1 %	<1 %
Output current	I	max. ±200 mA	max. ±150 mA
Temperature range	t	–25 to +70° C	–25 to +70° C
Weight	m	~0.13 kg	~0.13 kg

Block circuit diagram



Terminal assignment

Operating voltage U_B

$+U_B$	1	4	–15 V (–10 V)
0 V	2	5	0 V
n. c.	3	6	+15 V (+10 V)

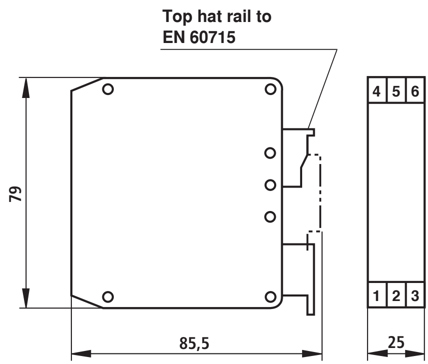
Notes

– The power supply module is not resistant to sustained short-circuit!

– In the case of overloading of one output voltage, the second output voltage is reduced as well!

– In the case of continuous operation of several adjacent modules and temperatures higher than 40 °C, a minimum space of ≥ 20 mm must be maintained between the modules!

Unit dimensions (dimensions in mm)



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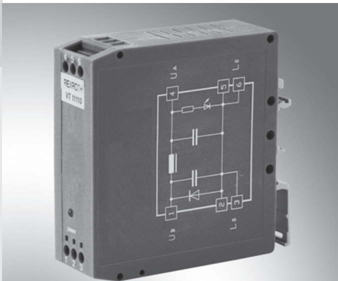
Capacitor module

RE 30750/04.10
Replaces: 29750

Type VT 11110

Series 1X



F88005_m

Table of contents

Features

This capacitor module is used for smoothing operating voltages for supplying various amplifier modules that control proportional and servo-valves.

Features:
- Capacitors
- Polarity reversal diode
- Overvoltage protector
- LED indicator for output voltage

Supplementary information

- The capacitor module may only be wired when disconnected from the power supply!
- In the case of polarity reversal of operating voltage → short-circuit!
- Do **not** install near power cables!

Ordering code

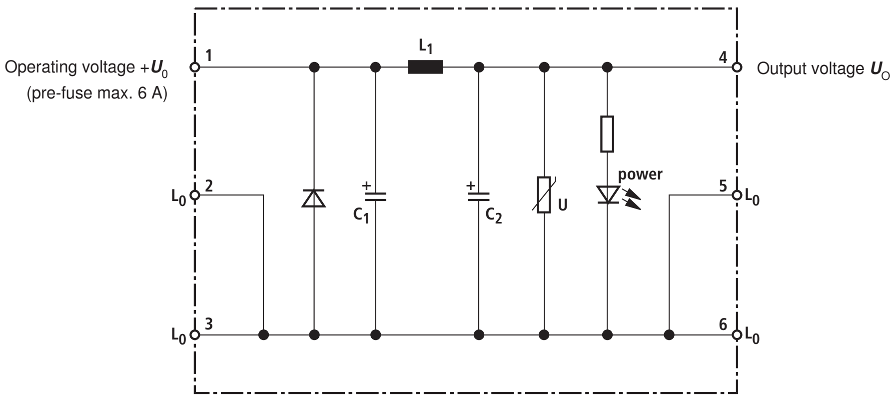
VT 11110 – 1X | *

Capacitor module
Series 10 to19 **= 1X**
(10 to 19: unchanged installation and connection dimensions)
Further details in clear text

Technical data

Operating voltage	U_0	≤ 36 V DC
Capacitance	$C_{1/2}$	2 x 3300 μF
Reactance coil	$L_{1/2}$	18 μH
Overvoltage protector		VDR 35 V / 1 mA
Permissible ambient temperature	t	–25° C bis +70° C
Weight	m	~0,13 kg

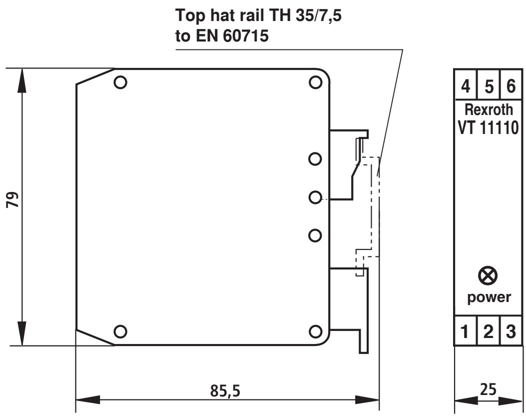
Pin assignment and block circuit diagram



Terminal assignment

Operating voltage	U_0	**1**	**4**	U_O	Output voltage
	0 V	**2**	**5**	0 V	
	0 V	**3**	**6**	0 V	

Unit dimensions (dimensions in mm)



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Service case with test unit for servo-valves without integrated electronics

RE 29681/05.11
Replaces: 06.10

Type VT-SVTSY-1

Series 1X

H6100_d

Table of contents

Features

– Service case contains test device as well as power supply and connection cable as option (see ordering code)
– The test unit is suitable for commissioning and servicing work on hydraulic systems that are fitted with servo-valves without integral electronics
– Allows functional testing and localisation of faults in the case of machinery malfunction without removal of the servo-valve
– Voltage supply by means of 9 V block battery (not included in the delivery) or 12 V power supply
– Service case:

• Dimensions (W x H x D)		450 x 100 x 350 mm
• Weight	empty	2 kg
	complete	3.2 kg

Note:
The unit may only be used by personnel who are familiar with the test unit, the valve and the hydraulic system. We will not assume liability for damage caused by wrongful operation!

Ordering code

VT-SVTSY-1 – 1X / 1 – – – – / *

Service case with test unit for servo-valves without integral electronics

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

Test unit type VT-SVT-1-1X **= 1**

Connecting cable for valves with electrical connection K31:
Without connecting cable **= 0**
With connecting cable type VT-SVTK-1-1X **= 1**

Connecting cable for valves with electrical connection K17:
Without connecting cable **= 0**
With connecting cable type VT-SVTK-2-1X **= 1**

Connecting cable for valves with electrical connection K8:
Without connecting cable **= 0**
With connecting cable type VT-SVTK-3-1X **= 1**

Power supply unit 12 V:
0 = Without power supply unit
1 = With power supply unit type VT-SVTNT-2-1X/G12 [1)]

Further details in clear text

[1)] The mains connector of the power supply unit is suitable for power sockets in Germany and many European countries.
In some countries, a country-specific adapter must be used which is not included in the delivery.

Ordering code for individual components

Designation	Type / ordering code	Material no.
Test unit for servo-valves without integral electronics	VT-SVT-1-1X	R900214710
Connecting cable with cable socket Z31	VT-SVTK-1-1X	R900939983
Connecting cable with cable socket Z17	VT-SVTK-2-1X	R900939984
Connecting cable with cable socket Z8	VT-SVTK-3-1X	R900939985
Power supply unit 12 V; 1.25 A	VT-SVTNT-2-1X/G12	R900946388

Test unit type VT-SVT-1-1X

The test unit is suitable for controlling and testing the function of servo-valves without integral electronics.

The voltage for the test device is provided by a 9 V block battery (not included in the delivery) or optionally by a 12 V power supply type VT-SVTNT-2-1X/G12.

H6101_d

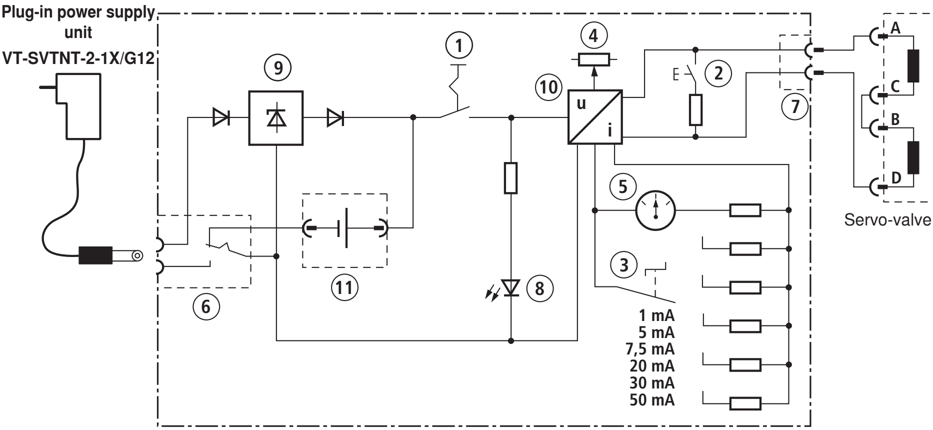
Functional description / operating instructions

Valve testing is carried out as follows:

- Connect the connecting cable of the power supply unit to the socket [6] of the test unit **or** insert battery [11]
- Set function switch [1] to “ON“ → LED “power“ [8] lights up
- For battery operation, carry out battery test:
  - Set selector switch [3] to “50 mA“
  - Set command value potentiometer [4] to “–100 %“
  - Actuate push-button [2] for battery test
  - The test unit indicates the battery charge in %
- Select coil type of the valve using selector switch [3] on the test unit
- Bring command value potentiometer [4] to the central position
- Use a suitable valve connecting cable (see ordering code) to connect the test unit (socket [7]) with the servo-valve (The valve connecting cables are to be wired so that the two coils of the servo-valve are connected in series.)
- Turn command value potentiometer [4] slowly anti-clockwise or clockwise and observe the movement of the motor or cylinder

  With a fully functional servo-valve, the motor or cylinder can be sensitively controlled and moved in the required direction or to the required position.

Block circuit diagram / pin assignment



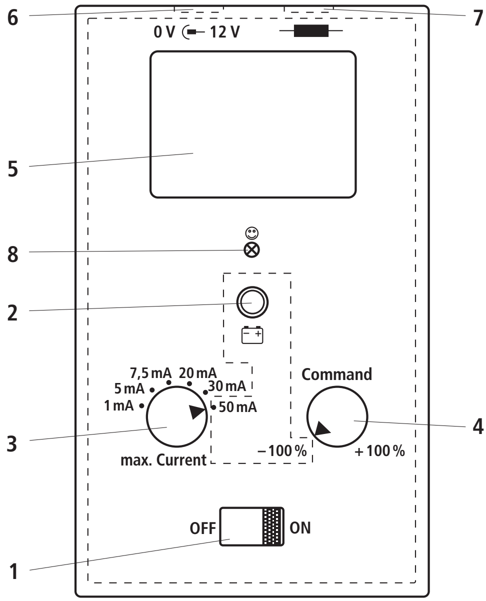
1	Function switch	**5**	Coil current indicator	**8**	“power“ LED
2	Pushbutton for battery test	**6**	Socket for power supply cable (with changeover switch)	**9**	Voltage regulator
3	Selector switch for type of coil			**10**	Output stage
4	Command value potentiometer	**7**	Socket for valve connecting cable	**11**	9 V block battery

Test unit type VT-SVT-1-1X:
Technical data (for applications outside these parameters, please consult us!)

Operating voltages:		
– Battery operation	U_O	9 V (E-block, not included in the delivery)
– Operation with power supply unit	U_O	12 V DC ± 5 %
Current consumption of the test unit	I	20 mA (plus valve current)
Dimensions (W x H x D)		95 x 158 x 45 mm
Weight	m	0.34 kg

Unit drawing

1 Function switch
2 Pushbutton for battery test
3 Selector switch for type of coil
4 Command value potentiometer
5 Coil current indicator (in %)
6 Socket for power supply unit cable
7 Socket for valve connecting cable
8 “power“ LED



Assignment of coil data to valve types:

5 mA / 500 Ω per coil 7.5 mA / 200 Ω per coil 20 mA / 80 Ω per coil 30 mA / 40 Ω per coil 50 mA / 28 Ω per coil	4WS2E.10-4X [1)] 4WS2E.10A-4X [1)] 4DS1EO2-1X [1)] 3DS2EH10-2X [1)]
30 mA / 85 Ω per coil	4WS2EM6-2X/... 4WS2EM10-5X/...
30 mA / 100 Ω per coil 50 mA / 80 Ω per coil	4WS2EM6-1X
50 mA / 85 Ω per coil	4WS2EM6-2X

Overview of servo-valves that are suitable for testing

At the time of publishing this data sheet, the following Rexroth servo-vavles can be tested with the VT-SVT-1 test unit:

Valve type	Electrical connection	Type of connecting cable
4WS2EM6-1X	K17	VT-SVTK-2-1X
4WS2EM6-2X	K17	VT-SVTK-2-1X
4WS2EM10-5X	K31	VT-SVTK-1-1X
4WS2EM10-4X [1)]	K8	VT-SVTK-3-1X
4WS2EB10-4X [1)]	K8	VT-SVTK-3-1X
4WS2EM10A-4X [1)]	K8	VT-SVTK-3-1X
4WS2EB10A-4X [1)]	K8	VT-SVTK-3-1X
4WS2EM16-2X	K8	VT-SVTK-3-1X
4DS1E02-1X [1)]	K8	VT-SVTK-3-1X
3DS2EH10-2X [1)]	K8	VT-SVTK-3-1X

[1)] Valves not available for new applications

Acccessories: Power supply unit type VT-SVTNT-2-1X/G12

Plug-in power supply unit 100 to 240 VAC → 12 VDC; 1.25 A

The mains connector of the power supply unit is suitable for power sockets in Germany and many European countries.

In some countries, a country-specific adapter must be used which is not included in the delivery.

H6102_d

Similar to photo

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

Operating voltage	*U*	100 to 240 VAC, 50 to 60 Hz
Current consumption	*I*	0.4 at 100 VAC
Fuse, secondary side	*I*	5 A
Output voltage	*U*	12 VDC; 1.25 A
Length of the connecting cable to the test unit	*l*	2 m
Dimensions (W x H x D)		77 x 42.5 x 26 mm
Weight	*m*	0.22 kg

Accessories: Valve connecting cable

Connecting cable type VT-SVTK-1-1X

Connecting cable between VT-SVT-1 test unit and servo-valves
without integral electronics (valves with ordering code **K31** for electrical connection)

The servo-valve coils are connected in series.

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

Valve connection		Plug-in connecor to DIN 43563-BF6-3/Pg11 (series circuit)
Test unit connection		Mono jack plug 2,5 mm
Cable length	*l*	3 m
Weight	*m*	0.16 kg

Connecting cable type VT-SVTK-2-1X

Connecting cable between the VT-SVT-1 test unit and servo-
valves without integral electronics (valves with ordering code **K17** for electrical connection)

The servo-valve coils are connected in series.

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

Valve connection		Plug in-connector VG 95328 (series circuit)
Test unit connection		Mono jack plug 2,5 mm
Cable length	*l*	3 m
Weight	*m*	0.3 kg

Connecting cable type VT-SVTK-3-1X

Connecting cable between the VT-SVT-1 test unit and servo-
valves without integral electronics (valves with ordering code **K8** for electrical connection)

The servo-valve coils are connected in series.

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

Valve connection		Plug in-connector 14S-2P (series circuit)
Test unit connection		Mono jack plug 2,5 mm
Cable length	*l*	3 m
Weight	*m*	0.16 kg

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Service case with test unit for servo and proportional valves with integral electronics (OBE)

RE 29685/03.11
Replaces: 07.10

Type VT-VETSY-1

Series 1X

H/A/D 5967/98

Table of contents

Features

– The service case comprises a test unit, power supply unit 24 V, connecting cables and adapter cables (see ordering code)

– The test unit can be used to control and carry out functional tests on servo and proportional valves with integral electronics and operating voltages of ±15 V or +24 V

– Simplifies commissioning and troubleshooting in hydraulic systems with servo and proportional valves

– Service case:

• Dimensions	(W x H x D)	450 x 100 x 350 mm
• Weight	empty	2 kg
	complete	4.3 kg

Caution:

The test unit may only be used by persons who are familiar with the unit, the valve and the hydraulic system. When set accordingly, the unit ignores control signals that come from the system. If safety features are provided on the control side, these are deactivated.

We assume no responsibility for damage caused by maloperation!

Ordering code

VT-VETSY-1 – 1X / 1 – 2 – 1 – 1 – 0 / *

Service case with test unit for servo and proportional valves with integral electronics

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

Test unit type VT-VET-1-1X **= 1**

Connecting cable to valve:
With 2 off 6-pin connecting cable type VT-VETK-1-1X **= 2**

Adapter cable for valve type 4WSE2EM6-1X:
Adapter cable type VT-VETAK-1-1X **= 1**

Power supply unit 115 / 220 V / ±15 VDC; 0.25 A:
0 = Without power supply unit (separate order, see page 10)

Power supply unit 90 - 265 VAC / +24 VDC; 3.75 A:
1 = Power supply unit type VT-VETNT-3-1X/G24 [1)]

Further details in clear text

[1)] The mains connector of the power supply unit is suitable for power sockets in Germany and many European countries.

In some countries, a country-specific adapter must be used which is not included in the delivery.

Test unit type VT-VET-1-1X

This test unit can be used to control and carry out functional tests on servo and proportional valves with integral electronics and an operating voltage of ±15 V or +24 V.

Operating modes:

- External operation → looping in of the operating voltage and the command values from the control cabinet to the valve
- Internal/external operation → command value feedforward via the test unit; operating voltage from the control cabinet
- Internal operation → operating voltage provided by a separate power supply unit; command value feedforward via the test unit
- Command value provided via the BNC socket → operating voltage optional

H/A 5315/95

Typ VT-VET-1-1X

Functional description and operating instructions

Voltage supply

The test unit can be supplied with +24 V or ±15 V, depending on the operating voltage required by the valve. To this end, the "power selector" switch must be set accordingly before commissioning.

An internal DC/DC converter generates the required auxiliary voltages of ±15 V for the internal command value signal.

The "power selector" switch connects, among other things, the internal reference potential L0 to the mass potential applied externally.

Switch position "+24 V" → input pin B = reference potential

Switch position "±15 V" → input pin C = reference potential

Connections

Input plug ES (item 1) and 4 mm input sockets:

Input plug ES on the left-hand side is used for connecting the cable coming from the control or the control cabinet. The 4 mm sockets on the left-hand side are connected directly with the pins of the ES input plug in accordance with the setting of the operating elements (see operating and indicator elements).

All signals coming from the control can therefore be measured at the sockets.

To operate the test unit and the valve the required operating voltages of +24 V or ±15 V (depending on valve type) must be available.

If the operating voltage is not provided from the control cabinet, an appropriate power supply unit can be connected to the ES input plug.

Output socket AB (item 16) and 4 mm output sockets:

Output socket AB on the right-hand side is used for connecting the valve. The 4 mm sockets on the right-hand side are directly connected to the pins of output socket AB.

All the signals to or from the valve can therefore be measured at the 4 mm sockets.

The short-circuit plugs can be used to separate each individual wire of the connecting cable to allow, for example, current measurements.

BNC socket:

An externally generated command value signal may be fed in via a standard 50 Ω cable at the BNC socket.

For this, the "setpoint selector" switch must be set to position "BNC".

PE socket:

The PE socket is directly connected to the PE connection of the ES input plug. Output socket AB does not have a PE connection.

Potentiometers / trimming potentiometers

Designation	Function	Preconditions
Setpoint intern	Command value signal to valve (AB - pin D). The output switches automatically between U_{comm} = ±10 V or I_{comm} = ±20 mA according to the load impedance of the valve command value input.	– Operating voltage present at input switch ES – power selector" switch position according to operating voltage – "setpoint selector" switch set to "intern – "stepfunction key" pushbutton not pressed
Stepfunction level	Adjustment of the step-input amplitude. The step function can be activated using the "stepfunction key" pushbutton.	– Operating voltage present at input switch ES – "power selector" switch position according to operating voltage – "setpoint selector" switch set to "intern" The step function is generated by pressing the "stepfunction key" pushbutton.

Functional description and operating instructions (continued)

LED-lamps

Designation	Function	Preconditions
power	Indication of internal voltage supply	– Operating voltage at input switch ES
enable indication control	Indication of enable signal coming from the control/ control cabinet (input socket ES - pin C)	– Operating voltage is +24 V – "power selector" switch to position “24 V“ – "power" LED lights up
enable indication valve	Indication of the enable signal going to the valve (output socket AB - pin C and measuring socket C). The LED also lights up, as soon as an enable signal is applied to the 4 mm measuring socket C. Without a short-circuit plug, this signal is not applied to output socket AB, but to the valve.	– Operating voltage is +24 V – "power selector" switch to position “24 V“ – "power" LED lights up – Enable signal is activated

Switches

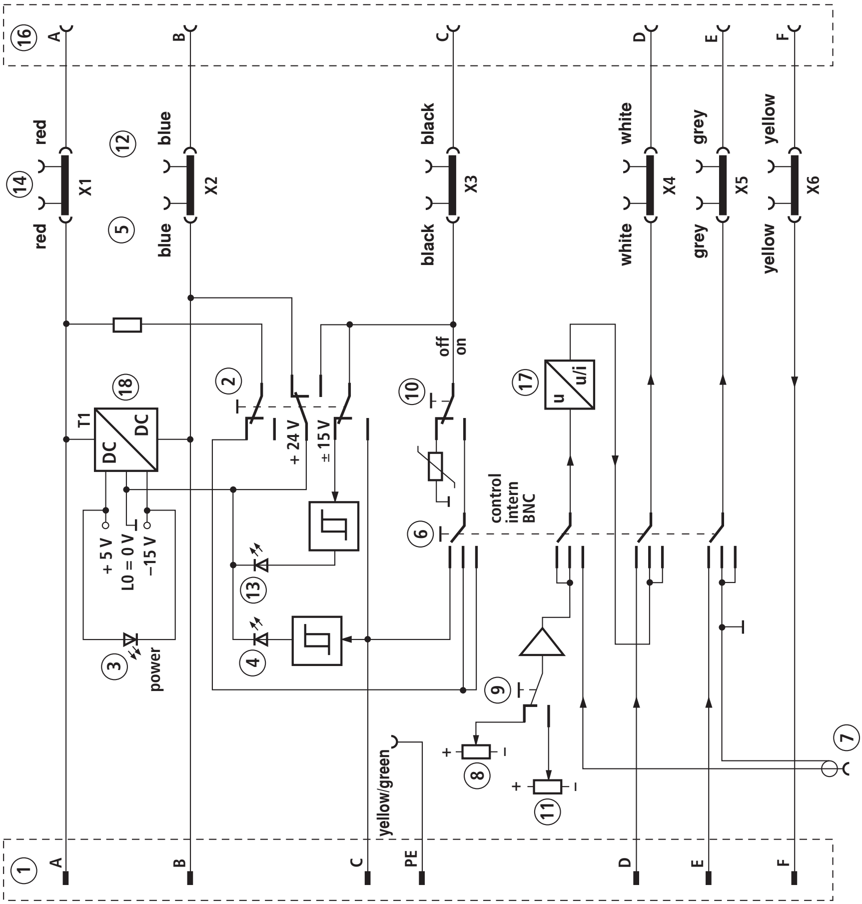
All the functions described are only valid as long as all short-circuit links are plugged!

Designation	Switch position	Function
power selector	+24 V	Internal reference potential is connected to ES - pin B (0 V to U_B = 24 V).
		The enable signal can be generated using switch "enable“ (“on“) or be switched off (“off“).
	±15 V	Internal reference potential is connected to ES - pin C (0 V to U_B = ±15 V).
		Enable signal generation deactivated.
		ES - pin C is directly connected to AB - pin C (short-circuit link).
enable (only with 24 V operation)	on	"setpoint selector" switch to position “control“→ an external enable signal applied by the control (ES - pin C) is switched through.
		"setpoint selector" switch to position “intern“ or „BNC“ → The enable signal for the valve is set.
	off	The enable signal output (AB - Pin C) is connected to the reference potential (0 V) at low resistance.
setpoint selector	control	The command value lines are connected directly from the control to the valve via pin D and pin E.
		If the "power selector" is at position “24 V“ and the "enable" switch is set to “on“ → then the enable signal is switched through from the control to the valve (pin C).
	intern oder BNC	"power selector" switch to position “24 V“ → The enable signal is fed to the valve as with the "enable" switch position.
		The reference potential for the command value (AB - pin E) corresponds to the internal reference potential (0 V).
	intern	If the "stepfunction key" pushbutton is not actuated → then the command value signal to the valve (AB - pin D) is as preselected by means of command value potentiometer "setpoint intern".
		If the "stepfunction key" pushbutton is actuated → then the command value signal to the valve (AB - pin D) is as preselected by means of trimming potentiometer "stepfunction level".
	BNC	The signal applied to the BNC socket is used as command value signal and fed to the valve (AB - pin D).

Pushbutton

Designation	Function	Preconditions
stepfunction key	Changeover between command value signals "setpoint intern" and "stepfunction level" (pushbutton actuated)	Operating voltage applied to input switch ES. "power selector" switch position according to the operating voltage type. "setpoint selector" switch to "intern"

Block circuit diagram / pin assignment

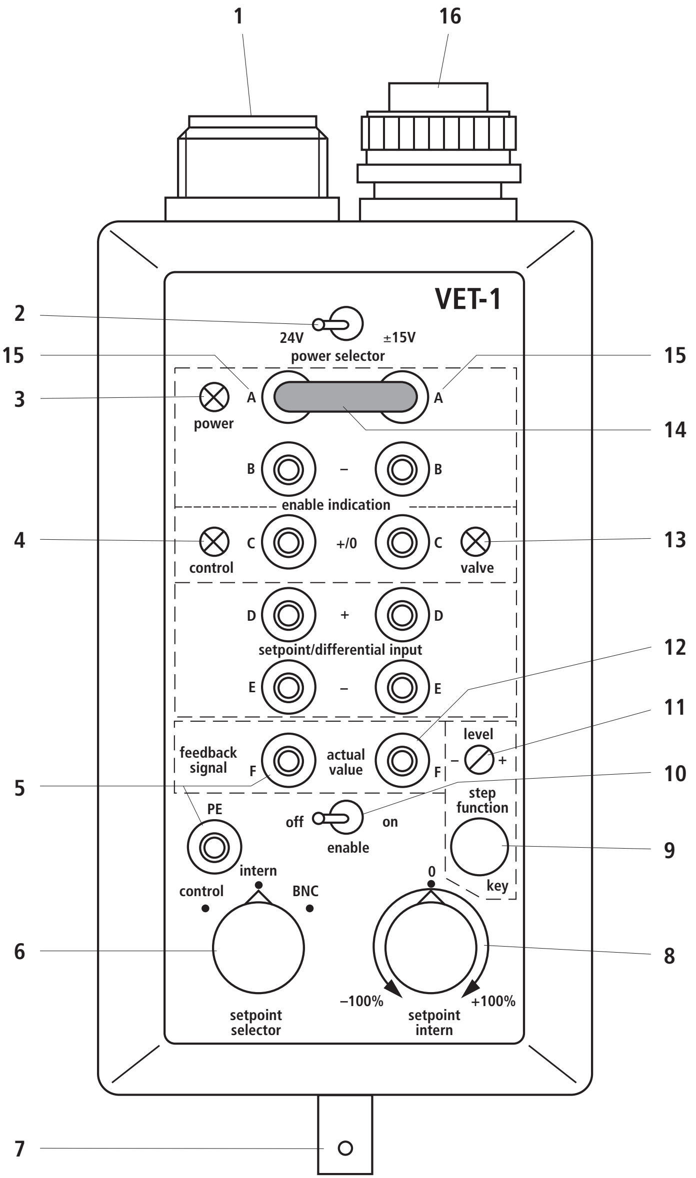


Pin	Pin assignment	
	Valve version with operating voltage **+24 V**	Valve version with operating voltage **±15 V**
A	+24 V	+15 V
B	0 V	−15 V
C	Enable or reference potential for actual valve value, e.g. with 4WRSE	0 V
PE	Protetctive earth	Protetctive earth
D	Command value +	Command value +
E	Command value –	Command value –
F	Actual value	Actual value

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

Operating voltages			
"power selector" switch:			
– Switch position "24 V"		U_B	24 V; – 20 % + 40 %
– Switch position "±15 V"		U_B	±15 V; ± 10 %
Current consumption of the test unit		I	0.1 A
Max. current carrying capacity of pins A and B of input plug ES and output socket AB when testing 24 V proportional or high-response control valves		I_{max}	6 A
Inputs:			
– Input plug ES			
Command values to pins E and D		U_i; I_i	according to valve details
Enable signal to pin C (24 V operation)	not active	U_E	0 to 10 V
	active	U_E	16 V to U_B
– Output socket AB			
Actual value to pin F		U_i; I_i	according to the actual value output of the valve
– BNC socket		U_i	0 bis ±10 V
Outputs (all short-circuiting links plugged):			
– Input plugES			
Actual value to pin in F		U_0; I_0	according to the actual value output of the valve
– Output socket AB			
Enable signal to pin C (24 V operation)			
• "setpoint selector" switch			
– Switch position "intern" or "BNC"			
"enable" switch to position "off"		U_E	0 V
"enable" switch to position "on"		U_E	U_B
– Switch position "control"			
"enable" switch to position "off"		U_E	0 V
"enable" switch to position "on"		U_E	according to pin C of input plug ES
Command values to pins D and E			
• "setpoint selector" switch			
– Switch position "intern" or "BNC"	pin E		Reference potential
	pin D	U_{comm}	0 to ±10 V, falls $R_{i\ valve}$ > 500 Ω
		I_{comm}	0 to ±20 mA, falls $R_{i\ valve}$ < 500 Ω
– Switch position "control"	pins E and D	U_{comm}	according to input plug ES (pins E and D)
Dimensions (W x H x D)			94 x 54 x 160 mm
Weight		m	0.36 kg

Unit drawing



For the item numbers, see page 8

Description of connections and indicator and adjustment elements

Functional element	Labelling	Position [1]
Input plug ES: Connection on the control side using component plug K31, CM02E14S-61P		**1**
Switch for selecting the operating voltage required by the valve	power selector	**2**
LED lamps: – Readiness for operation – Enable signal of input plug ES and from the external control to pin C – Enable signal to measuring sockets, output socket AB and pin C	 power enable indication control enable indication valve	 **3** **4** **13**
Input measuring sockets	A to F and PE	**5**
Marking of measuring sockets	A to F	**15**
Switch for selecting the command value signal source	setpoint selector	**6**
BNC socket for the connection of an external, independent command value encoder		**7**
Potentiometer for adjusting the internal command value signal	setpoint intern	**8**
Pushbutton for selecting between internal command value signals for the generation of a step-change signal	stepfunction key	**9**
Enable switch for the generation of an enable signal that is independent of an external control	enable	**10**
Trimming potentiometer for adjusting the amplitude of the internal step function generator	stepfunction level	**11**
Current / voltage output for the valve command value with automatic changeover between U_0 = 0 V to ±10 V or I_0 = 0 to ±20 mA		**17**
Short-circuiting links for the separation of individual cable strands in the connection from the control to the valve		**14**
Output measuring sockets for checking the signals in the valve connecting cable	A to F	**12**
Output socket AB: Connection on the valve side using an MS3108A-14S-6S flanged socket		**16**
Voltage converter DC/DC for the internal voltage supply		**18**

[1] The item numbers refer to the unit drawing and block circuit diagram

Notes:

Operating mode without enable input

Valves with integral electronics and an operating voltage of + 24 V without enable input use connection C as reference potential for the actual valve value. In this case, the "enable" switch must be set to "off".

Operating mode with enable input

Valves with integral electronics and an operating voltage of + 24 V with enable input use connection B as reference potential for the actual valve value. In this case, the "enable" switch must be set to "on”.

Overview of servo and proportional valves that can be tested

At the time of publicizing this data sheet, the following servo and proportional valves of Bosch Rexroth can be tested with the VT-VET-1-1X test unit:

Valve type	Operating voltage U_B
Servo-valve with integral electronics (OBE)	
4WSE2EM6 (without electrical position feedback)	±15 V
4WSE2EM10(A)-4X (without electrical position feedback)	±15 V
4WSE2EE10(A)-4X	±15 V
4WSE2EM10-5X (without electrical position feedback)	±15 V
4WSE2ED10-5X	±15 V
4WSE2EM16(A) (without electrical position feedback)	±15 V
4WSE2ED16(A)	±15 V
4WSE3EE16	±15 V
4WSE3EE25	±15 V
4WSE3EE32	±15 V
4DSE1EO2 (without electrical position feedback)	±15 V
3DSE2EH10 (without electrical position feedback)	±15 V
Proportional and high-response valves with integral electronics (OBE)	
4WRAE (without electrical position feedback)	+24 V
4WRBAE (without electrical position feedback)	+24 V
4WREE	+24 V
4WRPE	+24 V
4WRPEH	+24 V
4WRSE(H)	+24 V
4WRKE	+24 V
4WRBKE	+24 V
4WRLE	+24 V
4WRTE	+24 V
4WRGE	±15 V or +24 V
4WRDE	±15 V or +24 V
.WRCE	±15 V or +24 V
FESE (ab Serie 2X)	+24 V
3FERE	+24 V
.WRZE (without electrical position feedback)	+24 V
DBEE (without electrical position feedback)	+24 V
DBEME (without electrical position feedback)	+24 V
DBEMTE (without electrical position feedback)	+24 V
DBETE (without electrical position feedback)	+24 V
DBETRE (without electrical position feedback)	+24 V
ZDBEE (without electrical position feedback)	+24 V
STW on enquiry	±15 V or +24 V
DREE (without electrical position feedback)	+24 V

Power supply units

Included in delivery

Power supply unit type VT-VETNT-3-1X/G24

Desktop version 90-265 VAC → 24 VDC; 3.75 A

The mains connector of the power supply unit is suitable for power sockets in Germany and many European countries.

In some countries, a country-specific adapter must be used which is not included in the delivery.

Typ VT-VETNT-3-1X/G24

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

Operating voltage	*U*	90-265 VAC; 47-63 Hz
Current consumption	*I*	max. 1.5 A
Fuse		Electronic overload protection
Output voltage	*U*	24 VDC ± 1 V; 3.75 A
Supply cable length	*l*	approx. 1.5 m
Cable length to test unit	*l*	approx. 1.5 m
Dimensions (W x H x D)		135 x 65 x 41 mm
Weight	*m*	0.4 kg

Not included in delivery

Power supply unit type VT-VETNT-2-1X/G15

Plug version 115 VAC / 230 VAC → ±15 VDC; 0.25 A

(separate order, mat-no. R900576199)

The power supply unit is suitable for power sockets in Germany and many European countries.

In some countries, a country-specific adapter must be used which is not included in the delivery.

Typ VT-VETNT-2-1X/G15

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

Operating voltage	*U*	115 V / 230 V ± 5 % 50/60 Hz can be changed over
Current consumption	*I*	< 29 mA
Fuse		Thermal link 130°C
Output voltages	*U*	+15 VDC ± 0.2 V; 0.25 A –15 VDC ± 0.2 V; 0.25 A
Cable length to the test unit	*l*	2 m
Dimensions (W x H x D)		86 x 56 x 86 mm
weight	*m*	0.63 kg

Connecting and adapter cables

Included in delivery (2 parts)

Connecting cable type VT-VETK-1-1X

Connecting cable between the VT-VET-1-1X test unit and servo and proportional valves with integral electronics (valves with the electrical connection ordering codes K9 and K31)

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

Valve connection		Plug-in connector to DIN EN 175201-804
Test unit connection		Plug MS3101A 14S 6P
Connecting cable length	*l*	3 m
Weight	*m*	0.3 kg

Notes:

To achieve greater lengths, several cables can be joined together.

When operating valves with an electrical connection K31, the earth is interrupted.

Included in delivery

Adapter cable type VT-VETAK-1-1X

Adapter cable between the VT-VET-1-1X test unit and servo and proportional valves with integral electronics (valves with electrical connection ordering code K17).

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

Valve connection		Plug-in connector VG 95328
Test unit connection		Plug MS3101A 14S 6P
Connecting cable length	*l*	3 m
Weight	*m*	0.3 kg

Notes

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Rexroth
Bosch Group

Mating connectors and cable sets for valves and sensors in hydraulics

RE 08006/10.12
Replaces: 04.12

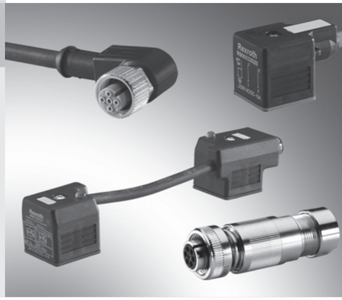


Table of contents

Features

- Mating connectors and cable sets for the electrical connection to
  - Valve solenoids
  - Valves with installed electronics
  - Position and pressure sensors
- Different designs and standards
- Plastic and metal versions

Table of contents

Table of contents

5

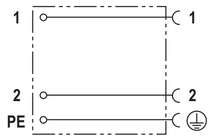
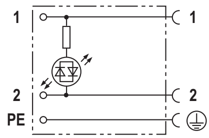
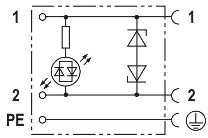
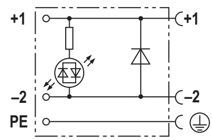
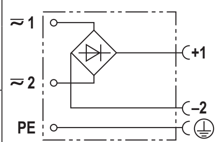
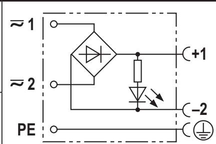
Table of contents

Table of contents

For valves with connector "K4" according to EN 175301-803 and ISO 4400, 2-pole + PE, "large cubic connector"

– Mating connectors for valves with one or two solenoids (individual connection)

Ordering code

Short designation	Voltage DC / AC U	Current I_{max}	Color	Valve side	Fitting	Material number	Circuit diagram
Without circuitry, standard							
Z4	12...240 V	16 A	Gray	A	M16 x 1.5	**R901017010**	
	12...240 V	16 A	Black	B	M16 x 1.5	**R901017011**	
Z45	12...240 V	16 A	Brown	A	NPT 1/2"	**R900004823**	
	12...240 V	16 A	Black	B	NPT 1/2"	**R900011039**	
With indicator light							
Z5L	12...240 V	3 A	Black	A/B	M16 x 1.5	**R901017022**	
Z55L	12...240 V	3 A	Black	A/B	NPT 1/2"	**R900057453**	
With indicator light and Zener diode suppression circuit							
Z5L1	24 V ± 10 %[1]	3 A	Black	A/B	M16 x 1.5	**R901017026**	
With indicator light and protective diode							
Z5L2	24 V ± 10 %[2] only DC	3 A	Black	A/B	M16 x 1.5	**R901017027**	
With rectifier							
RZ5	80...240 V[3]	0.75 A	Black	A/B	M16 x 1.5	**R901017025**	
RZ55	80...240 V[3]	0.75 A	Black	A/B	NPT 1/2"	**R900842566**	
With indicator light and rectifier							
RZ5L	80...240 V[3]	0.75 A	Black	A/B	M16 x 1.5	**R901017029**	
RZ55L	80...240 V[3]	0.75 A	Black	A/B	NPT 1/2"	**R900057455**	

1) Limitation of the switch-off voltage peak to 55 V

2) Limitation of the switch-off voltage peak to 1 V

3) Limitation of the switch-off voltage peak to 2 V

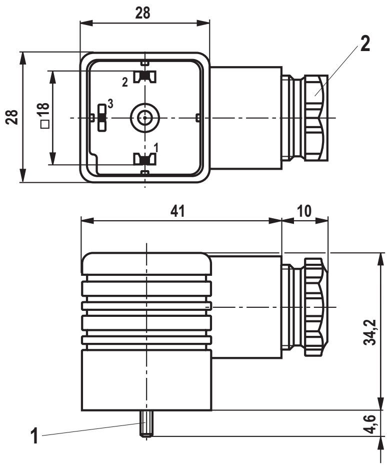
Technical Data (For applications outside these parameters, please consult us!)

Ambient temperature	Standard	°C	–40 to +125
	with indicator light/rectifier	°C	–20 to +60
Protection class according to EN 60529			IP 65 with mating connector mounted and locked
Indicator light			LED yellow
Number of poles			2 + PE
Terminal area for lines with external diameter		mm	5 to 10
Maximum line cross-section		mm^2	1.5 [1)]
Type of connection			Screw connection

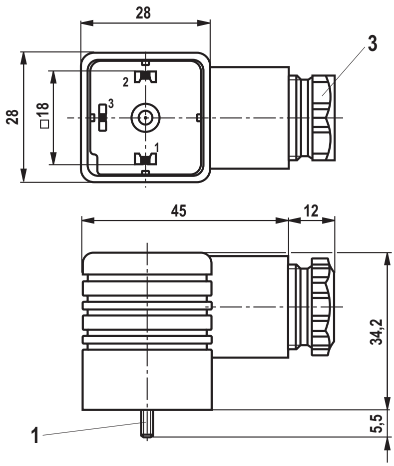
[1)] 2.5 mm^2 with special ferrule crimping pliers (e.g. Knipex 975314 or Weidmüller PZ 6/5)

Unit dimensions: Z4, Z45 (dimensions in mm)

Z4



Z45



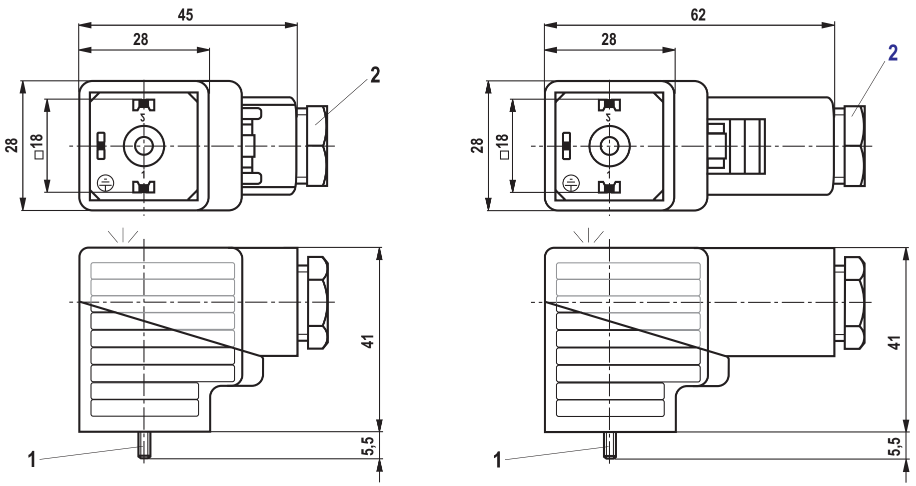
1 Mounting screw M3,
tightening torque M_A = 0.5 Nm

2 Fitting M16 x 1.5

3 Fitting NPT 1/2"

Unit dimensions: Z5..., RZ5... (dimensions in mm)

Z5L, Z5L1, Z5L2, RZ5, RZ5L, RZ55 **Z55L, RZ55L**



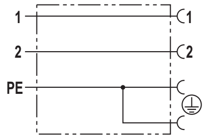
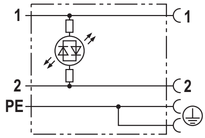
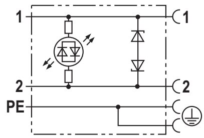
1 Mounting screw M3,
tightening torque M_A = 0.5 Nm

2 Fitting M16 x 1.5 / NPT 1/2"
(see table on page 6)

For valves with connector "K4" according to EN 175301-803 and ISO 4400, 2-pole + PE, "large cubic connector"

– Cable sets for valves with one or two solenoids (individual connection)

Ordering code

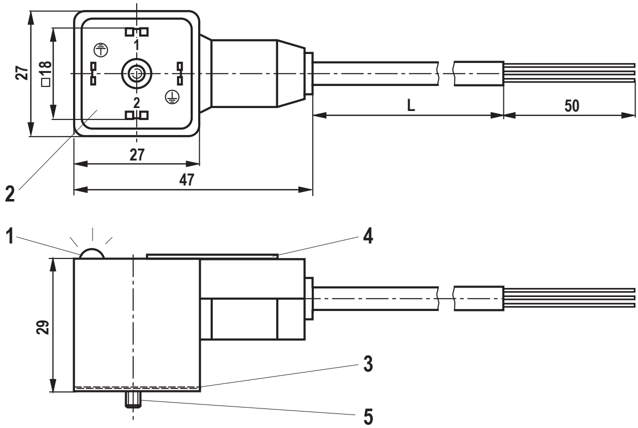
Short designation	Voltage DC / AC U	Current I_{max}	Color	Material number for cable length 3 m	5 m	10 m	Circuit diagram
Without circuitry, standard							
Z4	12...240 V	10 A	Black	**R900032020**	**R900032014**	**R900217134**	
With indicator light							
Z5L	24 V	4 A	Black	**R900032050**	**R900032018**	**R900217135**	
	90...130 V	1 A	Black	**R900032023**	**R900032012**	**R900217136**	
	180...240 V	0.5 A	Black	**R900032024**	**R900032010**	**R900217137**	
With indicator light and Zener diode suppression circuit							
Z5L1	24 V [1]	4 A	Black	**R900032021**	**R900032015**	**R900217138**	
Fast switching / Power reduction							
VT-SSBA1	24 V	4 A	Black	Types and technical data see data sheet 30362			

[1] Limitation of the switch-off voltage peak to 55 V

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

Ambient temperature	Cable fixedly laid	°C	–20 to +80
	Cable moveable	°C	–5 to +70
Protection class according to EN 60529			IP 67 with mating connector mounted and locked
Indicator light		Z4L...	LED yellow
Connection line			Ölflex 150 PVC, gray
Line cross-section		mm^2	3 x 1.0
Core marking	PE		Green/yellow
	Other wires		Black with numbers
Number of poles			2 + PE
Cable diameter		mm	Approx. 7

Unit dimensions (dimensions in mm)



1 LED

2 Contacting 0 + 180° rotatable

3 Flat seal (captive)

4 Name plate

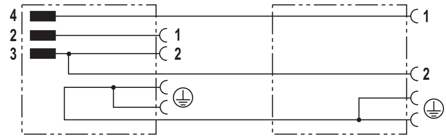
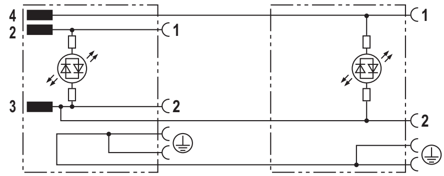
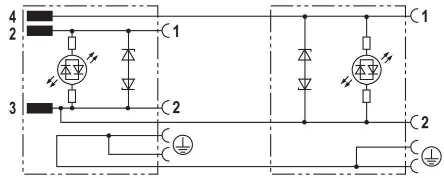
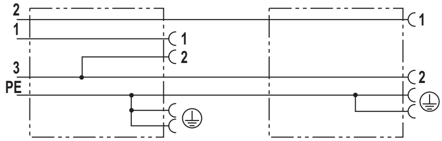
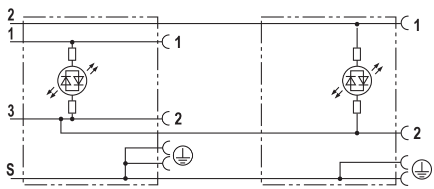
5 Mounting screw M3 (captive), tightening torque M_A = 0.5 Nm

L Cable length 3, 5 or 10 m (see "Ordering code")

For valves with connector "K4" according to EN 175301-803 and ISO 4400, 2-pole + PE, "large cubic connector"

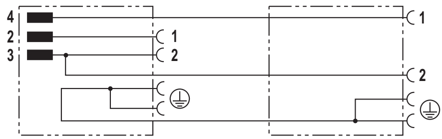
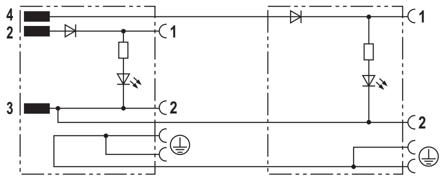
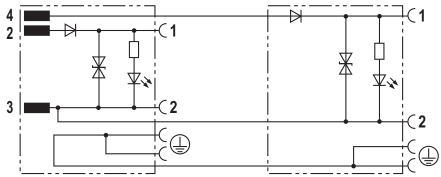
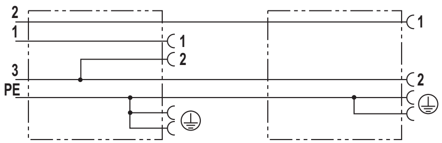
– Cable sets for valves with two solenoids (Double mating connectors)

Ordering code: For directional valves type WE **size 6**, SEC and pilot operated schwitching valves

Short designation	Voltage DC / AC U	Current I_{max}	Cable length	Material number	Circuit diagram
With connector M12 x 1					
Z60	24 V	4 A	–	**R901207820**	
With connector M12 x 1 and indicator light					
Z60L	24 V	4 A	–	**R901207819**	
With connector M12 x 1, indicator light and Zener diode suppression circuit					
Z60L8	24 V [1]	4 A	–	**R901205511**	
With breakout cable					
Z61	12...230 V	4 A	3 m	**R901207821**	
	12...230 V	4 A	5 m	**R901207822**	
With breakout cable, shielded, with indicator light					
Z61L	24 V	4 A	3 m	**R901286065**	S = Shield

[1] Limitation of the switch-off voltage peak to ≤ 50 V

Ordering code: For directional valves type WE size 10

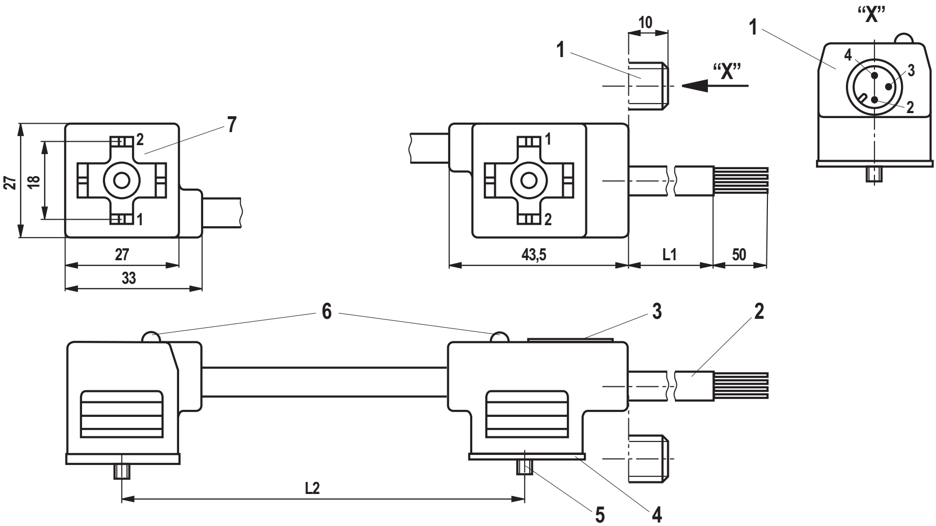
Short designation	Voltage DC / AC *U*	Current I_{max}	Cable length	Material number	Circuit diagram
With connector M12 x 1					
Z60	24 V	4 A	–	**R901207825**	
With connector M12 x 1 and indicator light					
Z60L	24 V only DC	4 A	–	**R901207824**	
With connector M12 x 1, indicator light and Zener diode suppression circuit					
Z60L8	24 V [1] only DC	4 A	–	**R901207823**	
With breakout cable					
Z61	12...230 V	4 A	3 m	**R901207826**	
	12...230 V	4 A	5 m	**R901207892**	

[1] Limitation of the switch-off voltage peak to ≤ 50 V

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

Ambient temperature	°C	–20 to +60
Protection class according to EN 60529		IP 67 with mating connector mounted and locked
Indicator light	Z60L..., Z61L...	LED yellow
Maximum operating current per contact	A	4 (at 40 °C), 3 (at 60 °C)
Connection line		PUR-JZ black, with UL / CSA approval
Line cross-section of the connection line	mm^2	3 x 0.75
Cable diameter of the breakout cable with "Z61"	mm	5.9 ± 0.2
Cable diameter of the breakout cable with "Z61L"	mm	6.5± 0.2
Overlap of shielding braid with “Z61L”		at least 85 %
Line cross-section of the breakout cable with "Z61"	mm^2	4 x 0.75
Line cross-section of the breakout cable with “Z61L”	mm^2	3 x 0.75
Core marking with "Z61"	PE	Green/yellow
	Other wires	Black with numbers
Connector M12		Thread in metal design, coding/pinout, design according to EN 61076-2-101:2003 + A1:2006

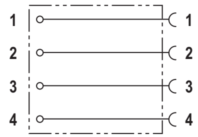
Unit dimensions (dimensions in mm)



1 Version "Z60…"
2 Version "Z61..."
3 Name plate
4 Flat seal (captive)
5 Mounting screw M3 (captive), tightening torque M_A = 0.5 Nm
6 LED (only versions "Z60L" and “Z61L”)
7 Contacting 0° (PE bridged)
L1 Cable length 3 or 5 m (see "Ordering code")
L2 113 mm (for valves size 6)
135 mm (for valves size 10)

For valves with "small cubic connector"
– Mating connector

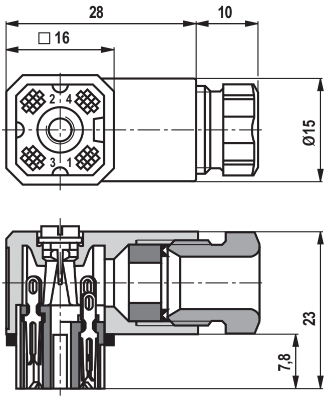
Ordering code

Short designation	Voltage DC / AC U_{max}	Current I_{max}	Color	Fitting	Material number	Circuit diagram
G4W1F	50	6	Black	PG 7	**R900023126**	

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

Ambient temperature	°C	–40 to +90
Protection class according to EN 60529		IP 65 with mating connector mounted and locked
Line cross-section	mm^2	0.14 to 0.5
Number of poles		4
Cable diameter	mm	4 to 7.5
Type of connection		Soldered joint

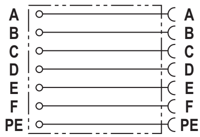
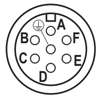
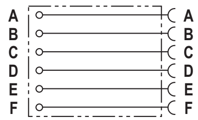
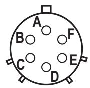
Unit dimensions (dimensions in mm)



For valves with round connector according to EN 175201-804, 6-pole + PE as well as 6-pole, compatible with VG 95328

– Mating connectors

Ordering code

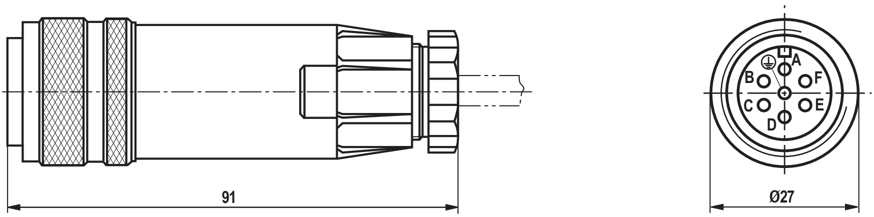
Short designation	Voltage DC / AC *U*	Current I_{max}	Fitting	Cable diameter Connection cross-section	Material number	Circuit diagram Pole pattern
6-pole + PE, plastic version						
7PZ31...K	24	3	PG 11	6.5...11 mm 0.5...1.5 mm²	**R900021267**	
6-pole + PE, metal version						
7PZ31...M	24	3	PG 11	8,0...13.5 mm 0.5...1.5 mm²	**R900223890**	
6-pole, metal version, compatible with VG 95328						
6P KPTC6	24	3	Special	4.5...7 mm 0.4...0.75 mm²	**R901043330**	

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

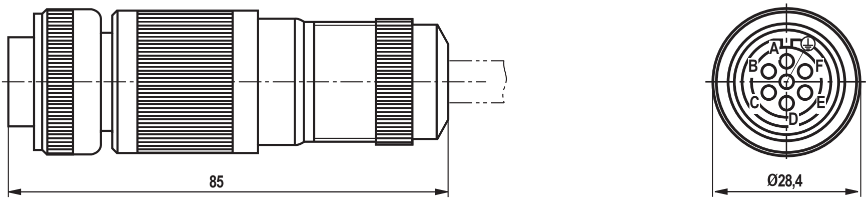
Ambient temperature	°C	–40 to +100
Protection class according to EN 60529		IP 67 with mating connector mounted and locked
Number of poles		6 (+ PE)
Type of connection	7PZ31...	Soldered joint
	6P KPTC6	Crimping connection (crimping contacts in the scope of delivery)

Unit dimensions (dimensions in mm)

6-pole + PE, plastic version, 7PZ31...K

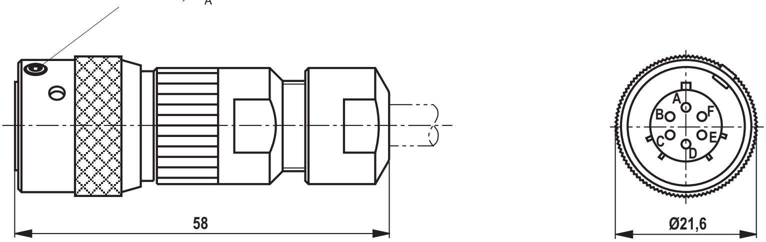


6-pole + PE, metal version, 7PZ31...M



6-pole, metal version, compatible with VG 95328, 6P KPTC6

Protection: Setscrew M3, M_A = 0.3 Nm



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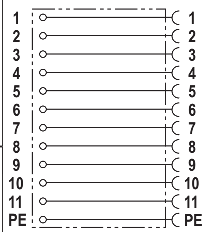
Accessories for "6P KPTC6" (not included in scope of delivery)

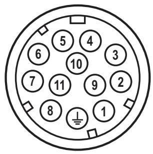
Company ITT Canon	Order number
Crimping pliers	M22520/1-01
Crimping insert	M22520/1-02
Installation tool	CiTG-20A
Installation pliers	CIT-KPTC-20

For valves with round connector according to EN 175201-804, 11-pole + PE
– Mating connectors

Ordering code

Short designation	Voltage DC / AC U	Current I_{max}	Fitting	Cable diameter Connection cross-section	Material number	Circuit diagram Pole pattern
11-pole + PE, metal version, shielded						
12PN11... EMV	24	3	PG 13.5	12...15 mm 0.5 mm^2	**R901268000**	
11-pole + PE, plastic version						
12P N11	24	3	PG 16	12...14 mm 0.5...1.5 mm^2	**R900752278**	
11-pole + PE, plastic version, two cable outlets						
12PN11...2XD8	24	3	PG 16	2 x 6...8 mm 3 x 0.5...1.5 mm^2 9 x 0.14...0.5 mm^2	**R900884671**	



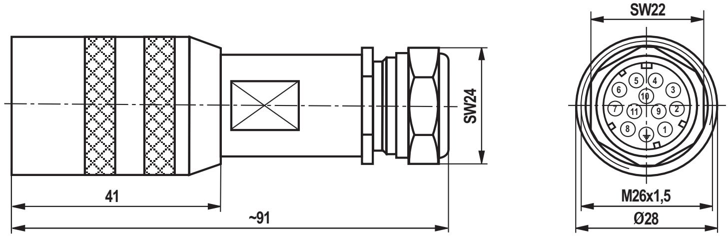


Technical data (For applications outside these parameters, please consult us!)

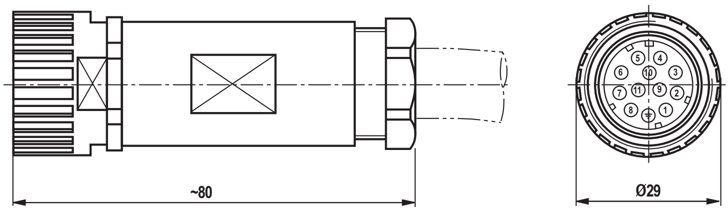
Ambient temperature	°C	–40 to +90
Protection class according to EN 60529		IP 65 with mating connector mounted and locked
Number of poles		11 + PE
Type of connection		Crimping connection (crimping contacts in the scope of delivery)

Unit dimensions (dimensions in mm)

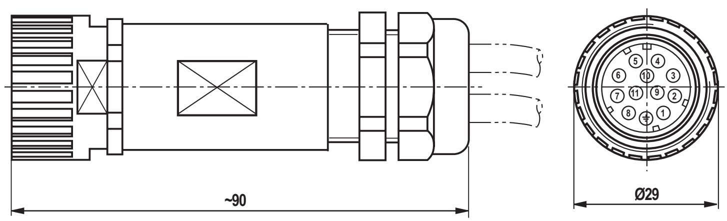
11-pole + PE, metal version, shielded, 12PN11... EMV



11-pole + PE, plastic version, 12PN11



11-pole + PE, plastic version, two cable outlets, 12PN11...2XD8



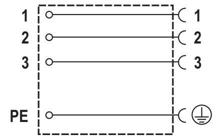
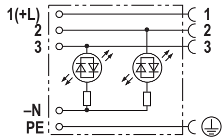
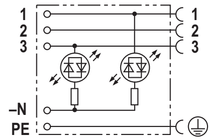
Accessories (not included in scope of delivery)

Company Hirschmann	Order number
Crimping pliers	XCZ 0701
Ejection tool	XWA 164

For mechanical pressure switches with connector "K14", according to EN 175301-803 and ISO 4400, 3-pole + PE, "large cubic connector"

– Mating connectors

Ordering code

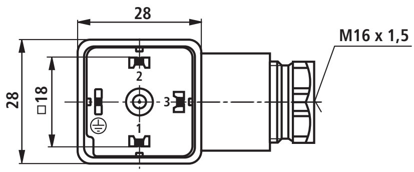
Short designation	Voltage DC / AC U	Current I_{max}	Color	Fitting	Material number	Circuit diagram
Without circuitry, standard						
Z14	12...240 V	16	Black	M16 x 1.5	**R901017012**	
With indicator lights at connections 2 and 3						
Z15L	6...14 V	4	Black	M16 x 1.5	**R901017030**	
	16...30 V	4	Black	M16 x 1.5	**R901017048**	
	36...60 V	4	Black	M16 x 1.5	**R901017032**	
	90...130 V	4	Black	M16 x 1.5	**R901017035**	
	180...240 V	4	Black	M16 x 1.5	**R901017037**	
With indicator lights at connections 1 and 3						
Z15L6	16...36 V	4	Black	M16 x 1.5	**R901017040**	

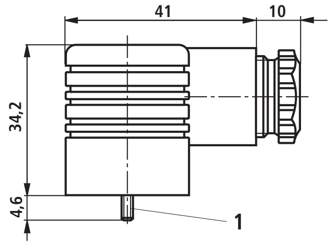
Technical data (For applications outside these parameters, please consult us!)

Ambient temperature	Standard	°C	–40 to +125
	with indicator light	°C	–20 to +60
Protection class according to EN 60529			IP 65 with mating connector mounted and locked
Indicator light		Z15L	Connection 2: LED green, connection 3: LED yellow
		Z15L6	Connection 1: LED green, connection 3: LED yellow
Number of poles			3 + PE
Terminal area for lines with external diameter		mm	5 to 10
Maximum line cross-section		mm^2	1.5 with conductor sleeve
Type of connection			Screw connection

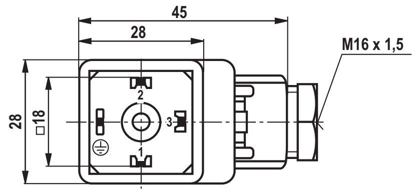
Unit dimensions: Z14, Z15L, Z15L6 (dimensions in mm)

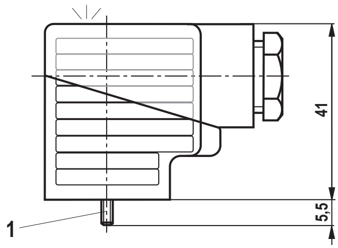
Z14





Z15L, Z15L6



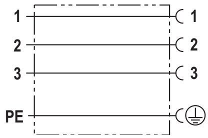
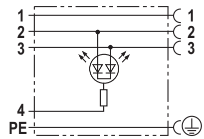


1 Mounting screw M3,
tightening torque M_A = 0.5 Nm

For mechanical pressure switches with connector "K14", according to EN 175301-803 and ISO 4400, 3-pole + PE, "large cubic connector"

– Cable sets

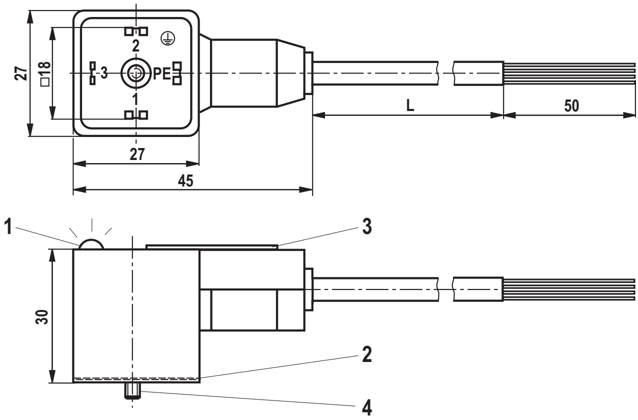
Ordering code

Short designation	Voltage DC / AC U	Current I_{max}	Color	**Material number** for cable length 5 m	10 m	Circuit diagram
Without circuitry, standard						
Z14	12 – 240	10 A	Black	**R900058528**	**R900217139**	
With indicator light						
Z14L	24 V only DC	4 A	Black	**R900210635**	**R900217140**	

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

Ambient temperature			–5 to +70
Protection class according to EN 60529			IP 67 with mating connector mounted and locked
Indicator light		Z14L	Connection 2: LED green, connection 3: LED yellow
Connection line			PUR-JZ, gray
Line cross-section	Standard	mm^2	4 x 0.75
	with indicator light	mm^2	5 x 0.5
Core marking	PE		Green/yellow
	Other wires		Black with numbers
Number of poles			3 + PE
Cable diameter		mm	Approx. 7

Unit dimensions (dimensions in mm)



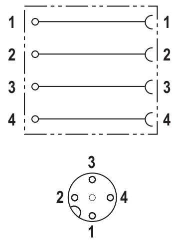
1 LED
2 Flat seal (captive)
3 Name plate
4 Mounting screw M3 (captive), tightening torque M_A = 0.5 Nm

L Cable length 5 or 10 m (see "Ordering code")

For sensors and valves with connector "K24", "K35" and "K72"

– Mating connectors M12, 4-pole, line cross-section 0.75 mm^2

Ordering code

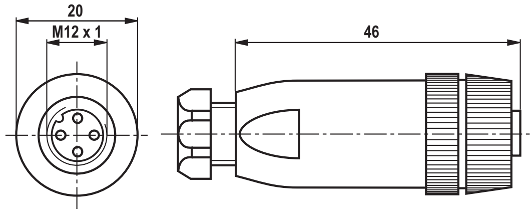
Short designation	Voltage DC U_{max}	Current I_{max}	Color	Fitting	Material number	Circuit diagram Pole pattern
M12 x 1, straight						
4PE11508	50	4	Black	PG 7	**R900773042**	
4PZ24	50	3	Black	PG 9	**R900031155**	
M12 x 1, angled						
4PE11509	50	4	Black	PG 7	**R900779509**	
4PZ24	50	3	Black	PG 9	**R900082899**	

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

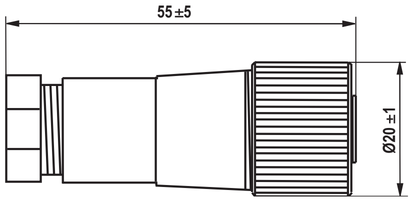
Ambient temperature	4PE1150...	°C	–25 to +85
	4PZ24	°C	–40 to +85
Protection class according to EN 60529			IP 67 with mating connector mounted and locked
Maximum line cross-section		mm^2	4 x 0.75
Number of poles			4
Cable diameter	4PE1150...	mm	4 to 6
	4PZ24	mm	6 to 8
Type of connection			Screw connection

Unit dimensions (dimensions in mm)

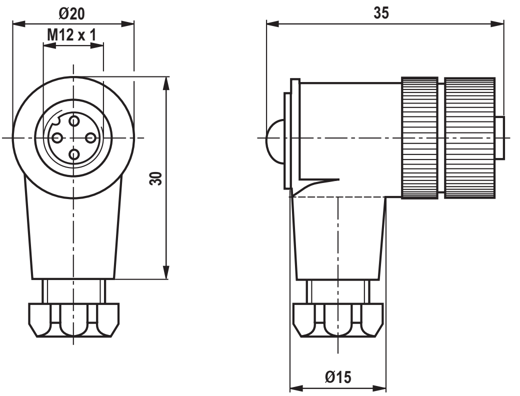
M12 x 1, straight, 4PE11508



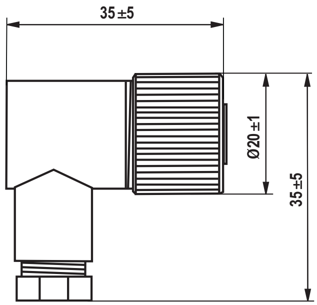
M12 x 1, straight, 4PZ24



M12 x 1, angled, 4PE11509



M12 x 1, angled, 4PZ24



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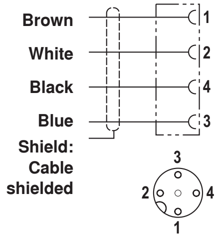
For sensors and valves with connector "K24", "K35" and "K72"

– Cable sets M12, 4-pole, line cross-section 0.34 mm²

Ordering code

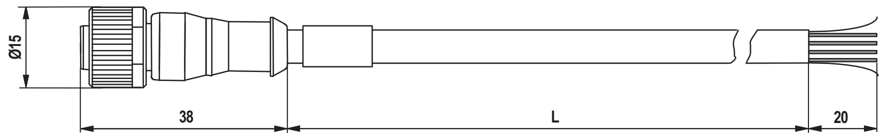
Short designation	**Voltage DC / AC** *U*	**Current** I_{max}	**Color**	**Material number** for cable length 2 m	3 m	5 m	**Circuit diagram Pole pattern**
M12 x 1, straight							
4PM12	250	4	Black	**R900773031**	–	**R900779498**	
4PZ24	50	3	Black	–	**R900064381**	–	
M12 x 1, angled							
4PM12	250	4	Black	**R900779504**	–	**R900779503**	

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

Ambient temperature		°C	–25 to +85
Protection class according to EN 60529			IP 67 with mating connector mounted and locked
Connection line			PUR-OB, black with approval: UL, CSA, CE
Line cross-section		mm²	4 x 0.34
Core marking			1: Brown; 2: White; 3: Blue; 4: Black
Number of poles			4
Cable diameter	4PM12	mm	5.9
	4PZ24	mm	6.5

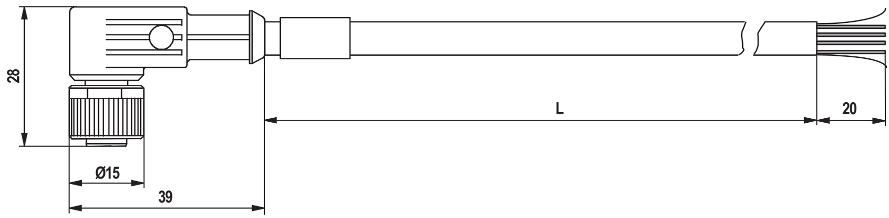
Unit dimensions (dimensions in mm)

M12 x 1, straight, 4PM12 and 4PZ24



R900773031 L = 2 m
R900064381 L = 3 m
R900779498 L = 5 m

M12 x 1, angled, 4PM12

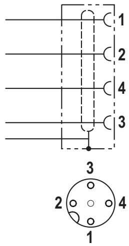


R900779504 L = 2 m
R900779503 L = 5 m

For sensors and valves with connector "K24", "K35" and "K72"

– Cable sets M12, 4-pole, line cross-section 0.75 mm²

Ordering code

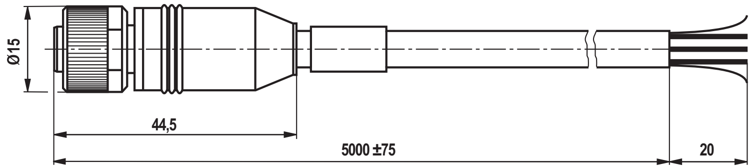
Denomination	Voltage DC / AC U	Current I_{max}	Color	Material number	Circuit diagram Pole pattern
M12 x 1, straight					**Brown** **White** **Black** **Blue** **Shield: Cable and mating connector shielded** 
KABELSATZ VT-SSPA1-1X/M12/1/V00	60	4	Black	**R901241656**	
M12 x 1, angled					
KABELSATZ VT-SSPA1-1X/M12/2/V00	60	4	Black	**R901241651**	

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

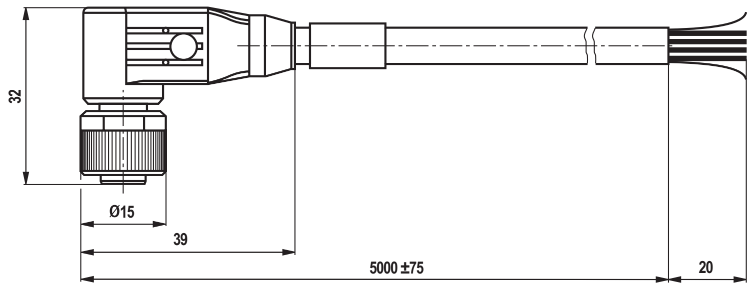
Ambient temperature	Fixedly laid	°C	–25 to +80
	Moveable	°C	–5 to +70
Protection class according to EN 60529			IP 67 with mating connector mounted and locked
Connection line			PVC, black
Line cross-section		mm²	4 x 0.75
Number of poles			4
Cable diameter		mm	6.4

Unit dimensions (dimensions in mm)

M12 x 1, straight, KABELSATZ VT-SSPA1-1X/M12/1/V00



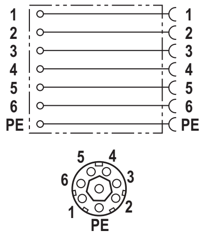
M12 x 1, angled, KABELSATZ VT-SSPA1-1X/M12/2/V00



For mechanical position switches, mechanical pressure switches and valves with central connection with connector "K6"

– Mating connectors

Ordering code

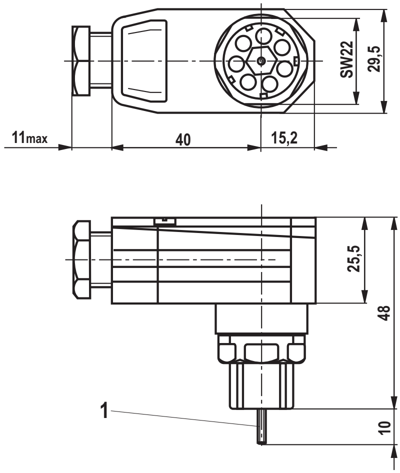
Short designation	Voltage DC / AC U	Current I_{max}	Color	Fitting	Material number	Circuit diagram Pole pattern
6-pole + PE						
7PZ6	250 V	10	Gray	PG 11	**R900002803**	

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

Ambient temperature	°C	–40 to +90
Protection class according to EN 60529		IP 65 with mating connector mounted and locked
Operating current, permanent	A	10
Number of poles		6 + PE
Terminal area for lines with external diameter	mm	7 to 9
Maximum line cross-section	mm^2	1.5
Type of connection		Crimping connection (crimping contacts in the scope of delivery)

Unit dimensions (dimensions in mm)

7PZ6



1 Mounting screw M3, tightening torque M_A = 0.5 Nm

Accessories (not included in scope of delivery)

Company HIRSCHMANN	Order number
Crimping pliers	XCZ 0701
Ejection tool	XWA 164

For directional valve with connector "C4" and "C4Z" (AMP Junior-Timer)

– Mating connectors

Ordering code

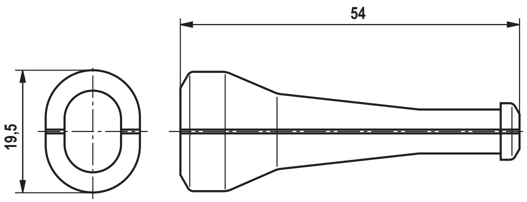
Short designation	**External line diameter** in mm	**Color**	**Material number**
2P JUNIOR D2 2	2.2 to 3.0	Black	**R901022127**
2P D1.2 JUNIOR	1.2 to 2.1	Black	**R900313533**

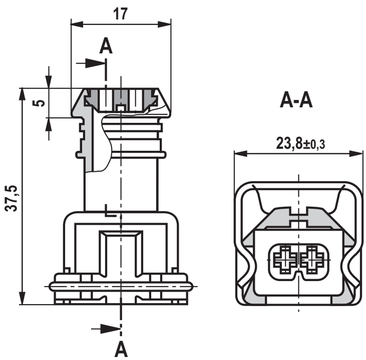
Technical data (For applications outside these parameters, please consult us!)

Ambient temperature range	°C	–20 to +125
Admissible operating voltage range	V DC	10 to 32
Protection class according to EN 60529		IP 66A (correctly mounted and locked)
Maximum operating current	A	5
Number of poles		2
Admissible external cable diameter	mm	5.2 to 7
Line cross-section	mm^2	0.5 to 1
Type of connection		Crimping connection
As-delivered state		1 connector housing, 2 contacts, 2 individual connector seals, 1 rubber bushing unmounted in pouch

Unit dimensions (dimensions in mm)

Housing AMP
Type 282189-1





Accessories (not included in scope of delivery)

Crimping tool	
Basic pliers	Type 539635-1, company TYCO
Die	Type 539737-2, company TYCO

For directional valves with connector "K40" (Deutsch plug)
– Mating connectors

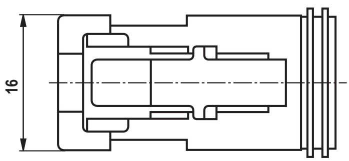
Ordering code

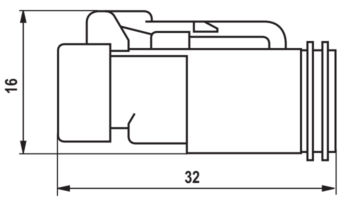
Short designation	Line cross-section	Color	Material number
2P DT06 K40AWG14	AWG14-16	Gray	**R900733451**
2P DT06 K40AWG16	AWG16-18	Gray	**R901017847**

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

Connector housing			DT06-2S-CE01
Ambient temperature range		°C	–20 to +125
Admissible operating voltage range		V DC	10 to 32
Protection class according to EN 60529			IP 69K (correctly mounted and locked)
Maximum operating current		A	5
Number of poles			2
Maximum line cross-section	AWG 14-16	mm^2	1.3 to 2.08
	AWG 16-18	mm^2	0.83 to 1.3
Admissible external diameter - individual conductor		mm	1.35 to 3.05
Type of connection			Crimping connection
As-delivered state			1 connector housing, 2 contacts, 1 locking wedge, unmounted in pouch

Unit dimensions (dimensions in mm)





Accessories (not included in scope of delivery)

Crimping tool	Type HDT-4800, company Deutsch

5

Notes

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