Электроника

Технические характеристики

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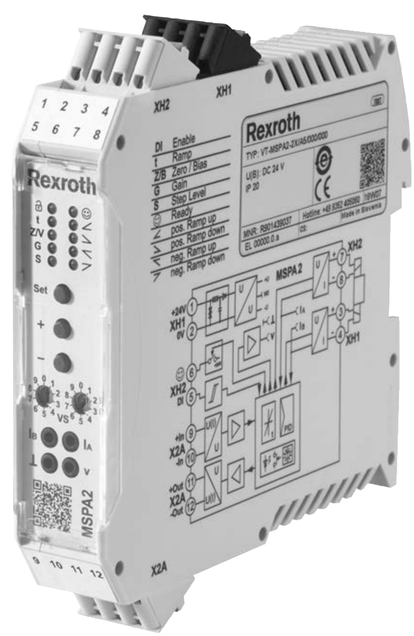
RE 30232
Edition: 2020-09
Replaces: 2020-04

rexroth
A Bosch Company

Valve amplifier for proportional valves without electrical position feedback

Type VT-MSPA



H8134

- Component series 2X
- Suitable for controlling proportional valves and pump controls without electrical position feedback
- Easy valve selection of the Rexroth valves for the industrial hydraulics
- Characteristic curves of the valves stored in the device
- Valve optimization via push-buttons
- All valve parameters adjustable

Features

- Command value input 0 ... ±10 V or 4 ... 20 mA
- Reverse polarity protection of the operating voltage
- Ramp generator up and down is separately adjustable
- Zero point setting
- Command value adjustment
- Characteristic curve generator
- Clocked power output stage
- Output short-circuit-proof
- LED status displays
- Measuring sockets for: Actual current value, internal current command/setting

Contents

Ordering code

01	02		03		04					05
VT-MSPA		–	2X	/		/	000	/	000	*

01	Valve amplifier for proportional valves without position feedback, analog, modular design	**VT–MSPA**
02	For proportional valves with 1 solenoid	**1**
	For proportional valves with 2 solenoids	**2**
03	Component series 20 ... 29 (20 ... 29: unchanged technical data and connections)	**2X**
04	Command value voltage (1 solenoid 0 ... +10 V / 2 solenoids 0 ... ±10 V)	**A5**
	Command value current (4 ... 20 mA)	**F5**
05	Further details in the plain text	*

Available variants

Type	Material no.
VT-MSPA1-2X/A5/000/000	R901439034
VT-MSPA1-2X/F5/000/000	R901439036
VT-MSPA2-2X/A5/000/000	R901439037
VT-MSPA2-2X/F5/000/000	R901439038

Function

General
The amplifier modules are intended for assembly on top hat rails. The electrical connection is established via 3 tension spring plug-in connectors. The supply voltage is 24 VDC.

Power supply unit (1)
The internal power supply unit has a making current limiter to prevent current peaks. Additionally, inverse-polarity protection is integrated.

Command value, command value summing device (3)
The "internal command value" comprises:
- "External command value", connected at the input of the differential amplifier (2)
- Zero point offset (4), "Z/B" adjustable in the standard setup

For pressure valves, a positive command value results in a pressure increase at the valve.
For valve types 4W...[1]), the following applies:
- Via solenoid B, a command value of 0 ... +10 V or 12 ... 20 mA results in a flow in the valve from P to A and from B to T.
- Via solenoid A, a command value of 0 ... -10 V or 12 ... 4 mA results in a flow in the valve from P to B and from A to T. In the expert setup, you can invert the command value (5) (see operating instructions 30232-B).
- In normal operation, the "internal command value" can be measured at the "v" measuring socket.

Ramps
A ramp limits the incline of the command value.
You can choose between a single ramp (6) (one time for all ramps, default value) and a 4Q/2Q ramp (7) (different times for the possible ramps). The 4Q/2Q ramp times are set in the expert setup. The characteristic curve generator (9) does not influence the ramp time.

Command value attenuator "G" (8)
By means of the command value attenuator, the command value can be reduced.

Characteristic curve generator (9)
In the characteristic curve generator, the pre-set valve characteristic curve can be adjusted to the actual hydraulic and control-technical conditions.
The following can be adjusted in the expert setup:
- Pilot current "B"
- Step "S"
- Maximum current "G" (with VT-MSPA2 separately possible for solenoid A and B)

Current controller (10)
The solenoid current is recorded, compared to the command value in the current controller and the difference is compensated.

Clock generator (11)
The clock generator creates the clock frequency "f" of the output stage. With Rexroth valves, the clock frequency sometimes changes dependent on the command value and/or the operating voltage.

Power output stage (12)
The power output stage creates the clocked solenoid current for the proportional valve. The solenoid current is limited to the maximum admissible current per output, depending on the set valve. The output stages are short-circuit-proof. With an internal interference signal or in case enable is missing, the output stage will be switched off.

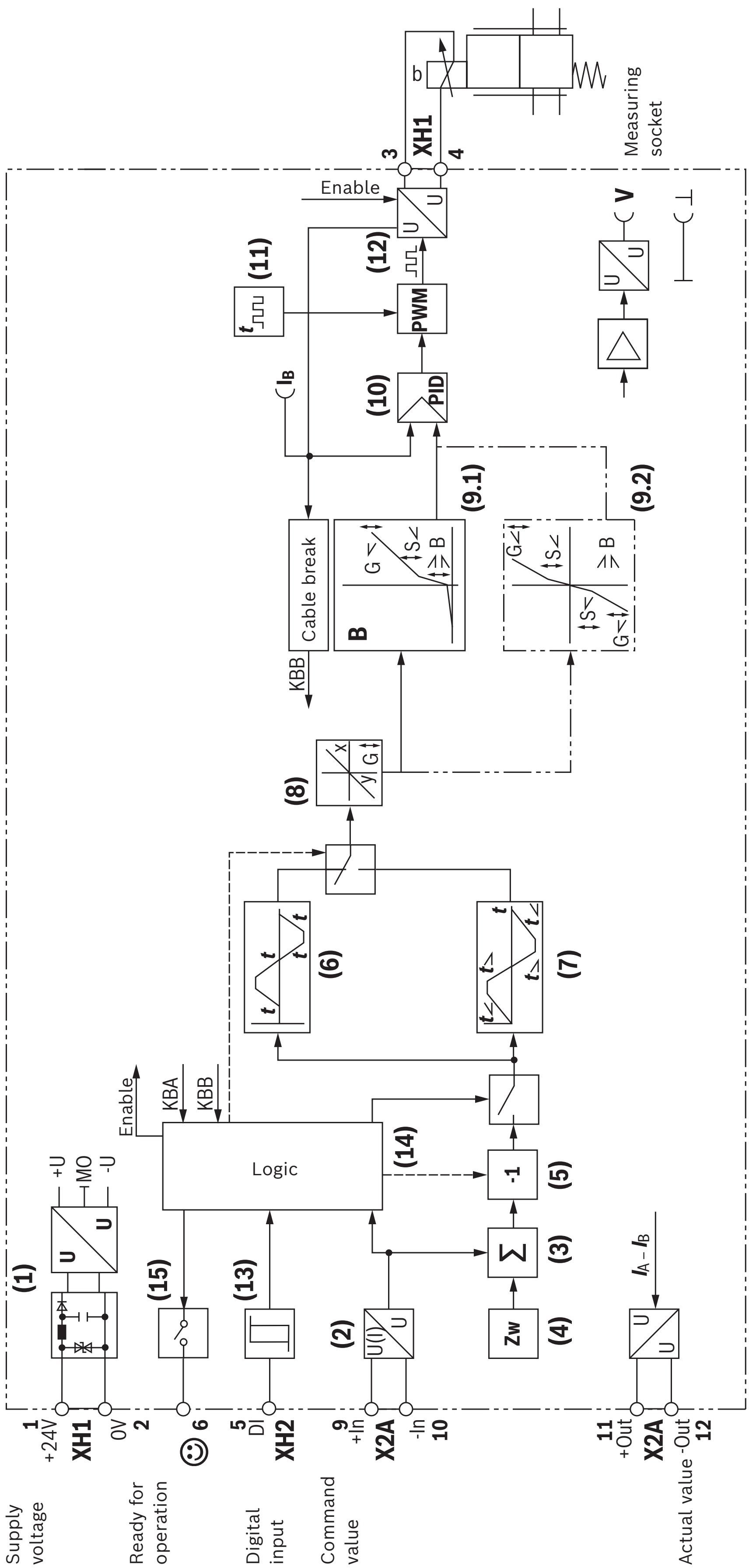
Digital input (13)
The input DI can be set to four different functions:
- 1 Enable (factory setting)
- 2 VT-MSPA1 [1]) without function (permanent enable)
- 2 VT-MSPA2 command value inversion (permanent enable)
- 3 Ramp on/off (permanent enable)
- 4 Single or quadrant ramp (permanent enable)

Digital output (15)
Device notifies ready for operation if there is no cable break, no internal error and $\boldsymbol{U}_{\mathrm{B}} \geq \boldsymbol{U}_{\mathrm{B\,min}}$.

See also "block diagram" on page 4 and 5.

[1]) Valve type 4WRPH6...SO855, switch position 0-5:
- Command value ±10 V
- Digital input 2, command value inversion (permanent enable)

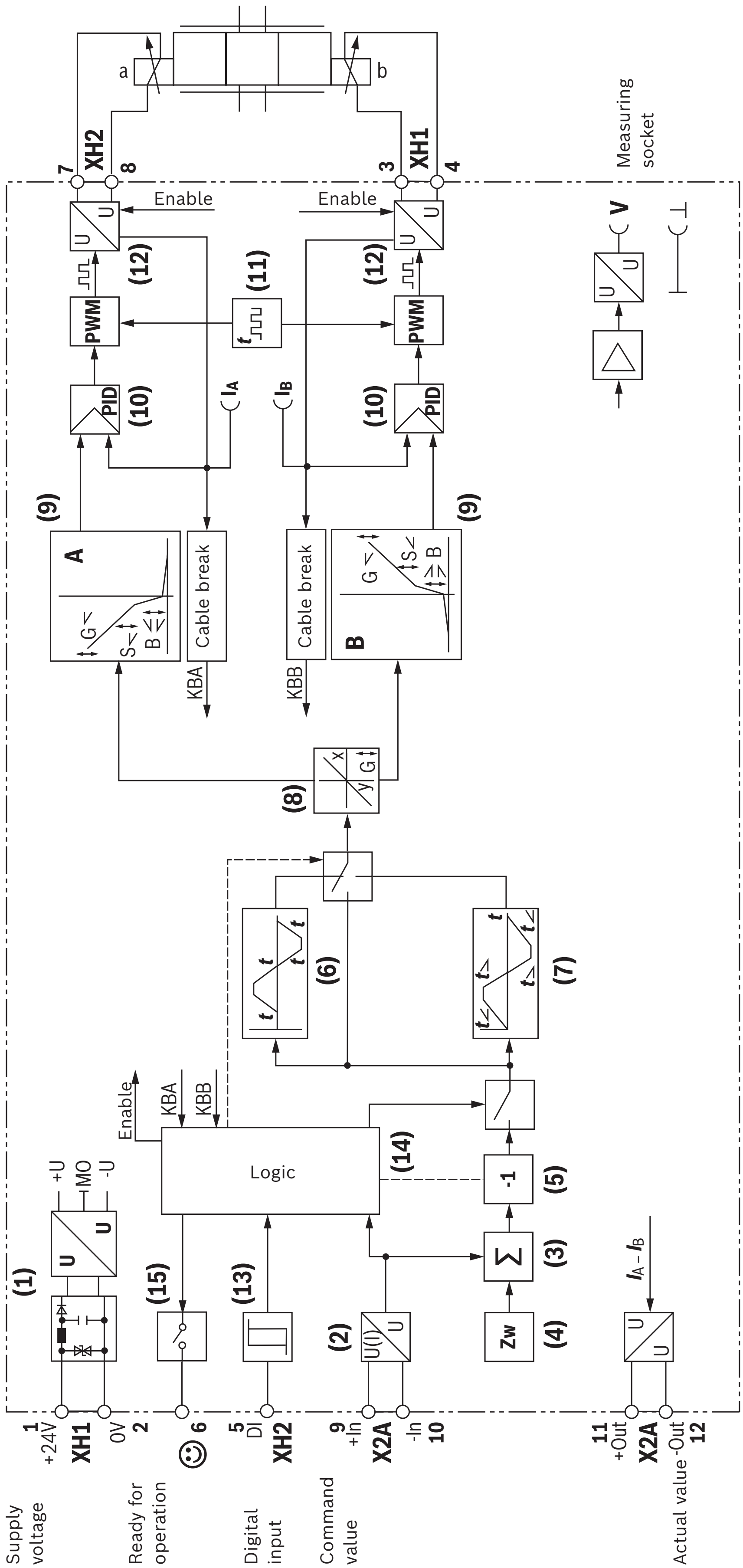
Block diagram: VT-MSPA1...



1 Power supply unit
2 Differential amplifier
3 Command value summing device
4 Zero point setting
5 Inverter
6 Single ramp
7 4-quadrant ramp
8 Command value attenuator
9.1 Characteristic curve generator (standard)
9.2 Characteristic curve generator ("4WRPH 6 ...SO855" version)
10 Current controller
11 Clock generator
12 Output stage
13 Enable or inverter or ramp off or 4Q ramp
14 Switching logics/fault recognition
15 Digital output

See also "Function" on page 3.

Block diagram: VT-MSPA2...



1 Power supply unit
2 Differential amplifier
3 Command value summing device
4 Zero point setting
5 Inverter
6 Single ramp
7 4-quadrant ramp
8 Command value attenuator
9 Characteristic curve generator
10 Current controller
11 Clock generator
12 Output stage
13 Enable or inverter or ramp off or 4Q ramp
14 Switching logics/fault recognition
15 Digital output

See also "Function" on page 3.

Technical data

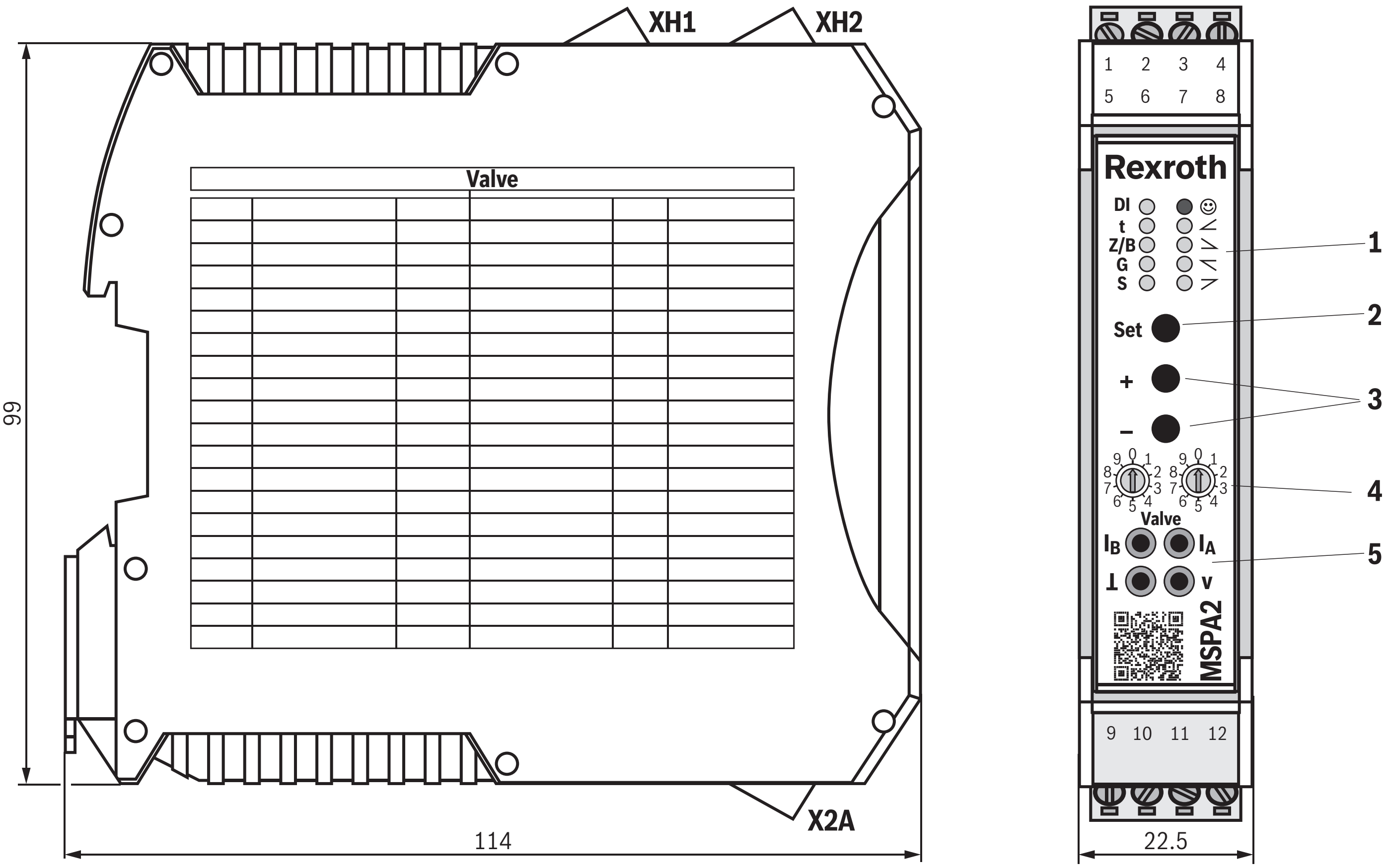
General			
Component series			2X
Design			Module
Voltage supply			
Operating voltage	▶ Nominal	V	24; +40% ... −20%
	▶ Lower limit value [1]	V	18
	▶ Upper limit value	V	36
	▶ Maximum admissible residual ripple (40 ... 400 Hz)	Vpp	2.5 (observe the admissible limits)
Maximum power consumption		W	< 48
Maximum current consumption		A	< 2
Maximum switch-on current		A	< 4
External fuse		A	3.15 time-lag
Analog input			
Command value	▶ 1 solenoid (0 ... 100%)	**mA**	4 ... 20
		V	0 ... +10
	▶ 2 solenoids (0 ... ±100%)	**mA**	4 ... 20
		V	0 ... ±10
	▶ Voltage (differential input)	kΩ	200 (input resistance)
	▶ Current input	Ω	100 (load resistance)
Analog output			
Solenoid current [2]	▶ Solenoid current I_A	V	0 ... -2.5 (mV ≙ mA)
	I_B	V	0 ... 2.5 (mV ≙ mA)
	▶ Minimum load impedance	Ω	1000
Digital input			
On (active) [3]		V	11 ... U_B
Off (inactive)		V	-3 ... 5
Solenoid outputs			
Maximum solenoid current		A	2.7
Clock frequency-setting range [4]		Hz	95 ... 505
Other properties, solenoid output			Short-circuit-proof, clocked
Cable length for 1.5 mm^2		m	50
Adjustment options			
Zero point calibration		%	±10
Command value attenuator [5]		%	70 ... 110
Ramp time up / down		s	0.01 ... 30
Step level		%	0 ... 50
Measuring sockets			
Command value/setting	▶ "v"	V	0 ... ±10
Actual current value	▶ I_A	V	0 ... ±2.5 (mV ≙ mA)
	▶ I_B	V	0 ... ±2.5 (mV ≙ mA)
Reference potential	▶ "⊥"		
Additional notes			See operating instructions 30232

1) With valves with a maximum solenoid current of 0.8 A, the lower limit value is 21 V
2) Maximum value depending on the selected valve
3) R_E > 50 k
4) Depending on the selected valve
5) Applies to a command value of 100%

Technical data

Supplementary information			
Start-up time		s	< 1
Type of connection			12 spring-type terminals, detachable
Protection class according to EN 60529			IP 20
Ambient temperature range		°C	0 ... +60
Weight		kg	0.14
Maximum admissible temperature change		°C/min	5
Transport temperature range		°C	–40 ... +70
Recommended storage temperature with UV protection		°C	+5 ... +40
Relative air humidity (without condensation)		%	10 ... 95
Maximum altitude for use		m	2000
UV resistance			Housing is only partly UV resistant. Extended exposure to radiation may cause color changes.
Transport shock according to DIN EN 60068-2-27			15 g / 11 ms / 3 axes
Sine test according to DIN EN 60068-2-6		Hz	10 ... 500 (maximum 2 g / 10 cycles / 3 axes)
Noise test according to DIN EN 60068-2-64		Hz	20 ... 500 (2.2 g RMS / 6.6 g peak / 30 min. / 3 axes)
Free fall (in original packaging)		m	1
Installation position			Vertical. For breathing of the assembly, the ventilation slots of the top and bottom side must be at least 2 cm away from covers, walls, etc. With an ambient temperature of more than 50°C, the clearance to the next assembly must be 1 cm.
Top hat rail assembly			TH35-7.5 or TH35-15 according to EN 60715
Housing material			Glass-fiber reinforced polyamide plastic
Resistance against aggressive media			Contact with conductive dusts is not admissible. Avoid contact with hydraulic fluids.
Conformity			CE according to the EMC directive CE according to the RoHS directive
Electro-magnetic compatibility (EMC)	▶ EN 61000-6-2 – EN 61000-4-2 ESD	kV	4 CD / 8 AD with BWK B
	– EN 61000-4-3 HF radiated	V/m	10 (80 ... 6000 MHz) with BWK A
	– EN 61000-4-4 Burst	kV	2 (5 kHz and 100 kHz) with BWK B
	– EN 61000-4-5 Surge	kV	0.5 (2 Ω/12 Ω) to operating voltage, 1 kV (42 Ω) to signal with BWK B
	– EN 61000-4-6 HF conducted	V_{eff}	10 (150 kHz ... 80 MHz) with BWK A
	– EN 61000-4-8 Magnetic field 50/60 Hz	A/m	100 with BWK A
	▶ EN 61000-6-3 / EN 61000-6-4 – EN 55016-2-1 Interference voltage	MHz	0.15 ... 30 (class A, EN 55022)
	– EN 55016-2-3 Radio interference field strength	MHz	30 ... 6000 (class B, EN 55022)

Dimensions
(dimensions in mm)



1. **Status LEDs**
   Display the current operating state, menu levels and error conditions
2. **SET key**
   Editing the selected parameters, selection of work operation, selection of the "expert mode"
3. **+ / - keys**
   Selection of the parameters and adjustment of the parameter values
4. **Rotary switch**
   Valve type selection
5. **Measuring sockets for connecting a measuring instrument**

Terminal assignment

Assignment		Connector	Terminal
Operating voltage	$+U_B$	XH1	1
	0 V	XH1	2
+ solenoid B		XH1	3
– solenoid B		XH1	4
Digital input		XH2	5
Ready		XH2	6
+ solenoid A [1)]		XH2	7
– solenoid A [1)]		XH2	8
+ command value		X2A	9
– command value		X2A	10
+ actual value		X2A	11
– actual value		X2A	12

[1)] Only VT-MSPA2

Status description LEDs

Indicator light	Operating state	Display mode	Meaning
"Digital input" LED (yellow)	Normal operation	Permanent light on/off	Digital input status
	Setup	Flashing	Standard setup active
	Setup	Off	Expert setup active
	Setup	On/flashing/flickering	Expert setup: Digital input setting
"Ready" LED (red/green)	Normal operation	Permanent light, green	Module ready for operation
	Normal operation	Permanent light, red	Error
	Normal operation and setup	Flashing light, red-green	Valve setting changed
	Normal operation and setup	Flashing light, red	Inadmissible valve number
	Normal operation	Off	Module not ready for operation
	Setup	Flashing light, green	Expert setup active

Description of the LED display [1]	
DI	Enable [2]
t	Ramp
Z/B	Zero point / pilot current
G	Command value attenuator
S	Step level command value
☺	Ready for operation
	1st quadrant (positive command value rising)
	2nd quadrant (positive command value falling)
	3rd quadrant (negative command value rising)
	4th quadrant (negative command value falling)

[1] A detailed description is contained in the operating instructions 30232-B

[2] Function of the digital input can be adjusted in the setup

Accessories (separate order)

	Material no.
Shield set for the installation with shielded lines	**R961011117**

Assignment: Switch position/valve type

TYPE VT-MSPA1

Switch position	**Valve type** (1 solenoid)
0-0	no valve
0-1	4WRA6...-2X
0-2	4WRA10...-2X
0-3	4WRZ...-7X
0-4	3DREP6...-2X
0-5	4WRPH6...-2X (SO855)
0-6	DBEP6...-1X
0-7	DBET-6X...G24...
0-8	DBET-6X...G24-8...
0-9	DBETX-1X...G24-25...
1-0	DBETX-1X...G24-8...
1-1	(Z)DBE6-2X...
1-2	DBEM10...-7X...G24...
1-3	DBEM10...-7X...G24-8...
1-4	DBEM20...-7X...G24...
1-5	DBEM20...-7X...G24-8...
1-6	DBEM30...-7X...G24...
1-7	DBEM30...-7X...G24-8...
1-8	(Z)DRE6...-1X...
1-9	ZDRE10...-2X...G24...
2-0	ZDRE10...-2X...G24-8...
2-1	DRE...10...-6X...G24...
2-2	DRE...10...-6X...G24-8...
2-3	DRE...20...-6X...G24...
2-4	DRE...20...-6X...G24-8...
2-5	DRE...30...-6X...G24...
2-6	DRE.30...-6X...G24-8...
2-7	3DRE...-7X...G24...
2-8	3DRE...-7X...G24-8...
2-9	3FREX6...-1X...G24-25...
3-0	3FREX10...-1X...G24-25...
3-1	3DREP6...-2X... (SO674)
3-2	Z3DRE10..-1X...G24...[1)]
3-3	DBE6X-1X...G24-25...[1)]
3-4	DBE6X-1X...G24-8...[1)]
3-5	DRE6X-1X---G24-8...[1)]
3-6	DBET-1X..HG24-8...[1)]
3-7	Pump control 1 (0.7 A) EP2 (A7VO)
3-8	Pump control 2 (0.6 A) ED72 (A10VSO/31) ER72 (A10VSO/31)
3-9	Pump control 3 (0.6 A) EP2 (A10VSO/52, 53) EK2 (A10VSO/52, 53) L4 (A15VSO...) E2 (A15VSO...) EP2,6(A6VM)

Switch position	**Valve type** (1 solenoid)
4-0	DBE10Z-1X..G24-8..[1)]
4-1	DRE10Z-1X...G24-8...[1)]
4-2	(Z)3DRE6...-2X/...G24... [2)]
4-3	(Z)3DRE6...-2X/...G24-8... [2)]
9-6	Universal (0.8 A)
9-7	Universal (1.6 A)
9-8	Universal (2.5 A)

1) Available from series 21
2) Available from series 22

Assignment: Switch position/valve type

Type VT-MSPA2

Switch position	**Valve type** (2 solenoids)
0-0	no valve
0-1	4WRA6...-2X
0-2	4WRA10...-2X
0-3	4WRZ...-7X
0-4	3DREP6...-2X
0-5	3DREP6...-2X (SO674)
0-6	DBEP6...-1X
0-7	–
0-8	–
0-9	–
1-0	–
1-1	–
1-2	–
1-3	–
1-4	–
1-5	–
1-6	–
1-7	–
1-8	–
1-9	–
2-0	–
2-1	–
2-2	–
2-3	–
2-4	–
2-5	–
2-6	–
2-7	–
2-8	–
2-9	–
3-0	–
3-1	–
3-4	–
3-5	–
3-6	–
3-7	Pump control 1 (0.74 A) EP (A4CSG)
3-8	–
3-9	–
9-6	Universal (0.8 A)
9-7	Universal (1.6 A)
9-8	Universal (2.5 A)

Project planning and maintenance instructions

☞ **Maintenance instructions:**

- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices can be repaired.
- Repaired devices are returned with default settings. User-specific settings must be made by the machine end-user once again.

☞ **Notice:**

- In especially EMC-sensitive environments, additional measures must be taken (depending on the application, e.g. shielding, filtration)
- **Wiring information**
  - Maximum possible spatial separation between signal and load lines.
  - Do not lead signal lines through magnetic fields.
  - If possible, install signal lines without intermediate terminals.
  - Do not install signal lines in parallel to the load lines.
  - Connect cable shields (see the operating instructions 30232-B)
  - For digital inputs and outputs as well as command and actual value, the max. admissible cable length for unshielded cables is 30 m. For longer cable lengths, shielded cables must be used.
  - The distance to radios must be sufficient (> 1 m).
  - With a strongly fluctuating operating voltage, in individual cases, it may 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.
- The upper and lower ventilation slots must not be concealed by adjacent devices in order to provide for sufficient cooling.

Further information

▶ Valve amplifier for proportional valves without electrical position feedback	Operating instructions 30232-B
▶ CE Declaration of Conformity	upon request
▶ Installation, commissioning and maintenance of proportional valves	Data sheet 07800
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900

RE 30232-01
Edition: 2019-09

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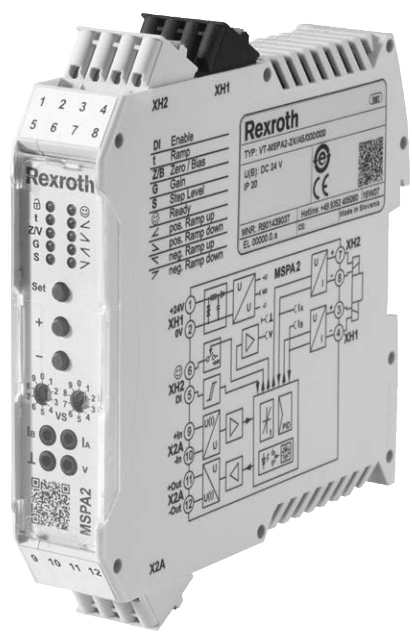
A Bosch Company

Valve amplifier for proportional valves without electrical position feedback; Maximum current limitation 1 A

Type VT-MSPA2...1A0



H8134

- Component series 2X
- Easy valve selection of the Rexroth valves for industrial hydraulics
- Characteristic curves of the valves stored in the device
- Valve optimization via push-buttons
- All valve parameters adjustable
- For explosion-protected valves with one or two solenoids

Features

- Not in accordance with the Explosion Protection Directive 2014/34/EU
- Command value input 0 ... ±10 V
- Reverse polarity protection of the operating voltage
- Ramp generator up and down is separately adjustable
- Zero point setting
- Command value adjustment
- Characteristic curve generator
- Clocked power output stage
- Output short-circuit-proof
- LED status displays
- Measuring sockets for actual current value, internal current command/setting

Contents

Ordering codes

01	02		03		04		05			06
VT-MSPA	**2**	**–**	**2X**	**/**	**A5**	**/**	**1A0**	**/**	**000**	*****

01	Valve amplifier for proportional valves without position feedback, analog, modular design	**VT–MSPA**
02	For proportional valves with 1 or 2 solenoids	**2**
03	Component series 20 ... 29 (20 ... 29: unchanged technical data and connections)	**2X**
04	Command value voltage (1 solenoid 0 ... +10 V / 2 solenoids 0 ... ±10 V)	**A5**
05	Maximum current limitation 1.0 A	**1A0**
06	Further details in the plain text	*****

Available variant

Type	Material no.
VT-MSPA2-2X/A5/1A0/000	R901505407

Function

General
The valve amplifiers are intended for assembly on top hat rails. The electrical connection is established via 3 tension spring plug-in connectors. The supply voltage is 24 VDC.

Power supply unit (1)
The internal power supply unit has a making current limiter to prevent current peaks. Additionally, inverse-polarity protection is integrated.

Command value, command value summing device (3)
The "internal command value" comprises:
- "External command value", connected at the input of the differential amplifier (2)
- Zero point offset (4), "Z/B" adjustable in the standard setup

For pressure valves, a positive command value results in a pressure increase at the valve.
For valve types 4W..., the following applies:
- Via solenoid B, a command value of 0 ... +10 V results in a flow in the valve from P to A and from B to T.
- Via solenoid A, a command value of 0 ... -10 V results in a flow in the valve from P to B and from A to T. In the expert setup, you can invert the command value (5) (see operating instructions 30232-01-B).
- In normal operation, the "internal command value" can be measured at the "v" measuring socket.

Ramps
A ramp limits the incline of the command value.
You can choose between a single ramp (6) (one time for all ramps, default value) and a 4Q/2Q ramp (7) (different times for the possible ramps). The 4Q/2Q ramp times are set in the expert setup. The characteristic curve generator (9) does not influence the ramp time.

Command value attenuator "G" (8)
By means of the command value attenuator, the command value can be reduced.

Characteristic curve generator (9)
In the characteristic curve generator, the pre-set valve characteristic curve can be adjusted to the actual hydraulic and control-technical conditions.
The following can be adjusted in the expert setup:
- Pilot current "B"
- Step "S"
- Maximum current "G" (separately possible for solenoid A and B)

Current controller (10)
The solenoid current is recorded, compared to the command value in the current controller and the difference is compensated.

Clock generator (11)
The clock generator creates the clock frequency "f" of the output stage. With Rexroth valves, the clock frequency sometimes changes dependent on the command value and/or the operating voltage.

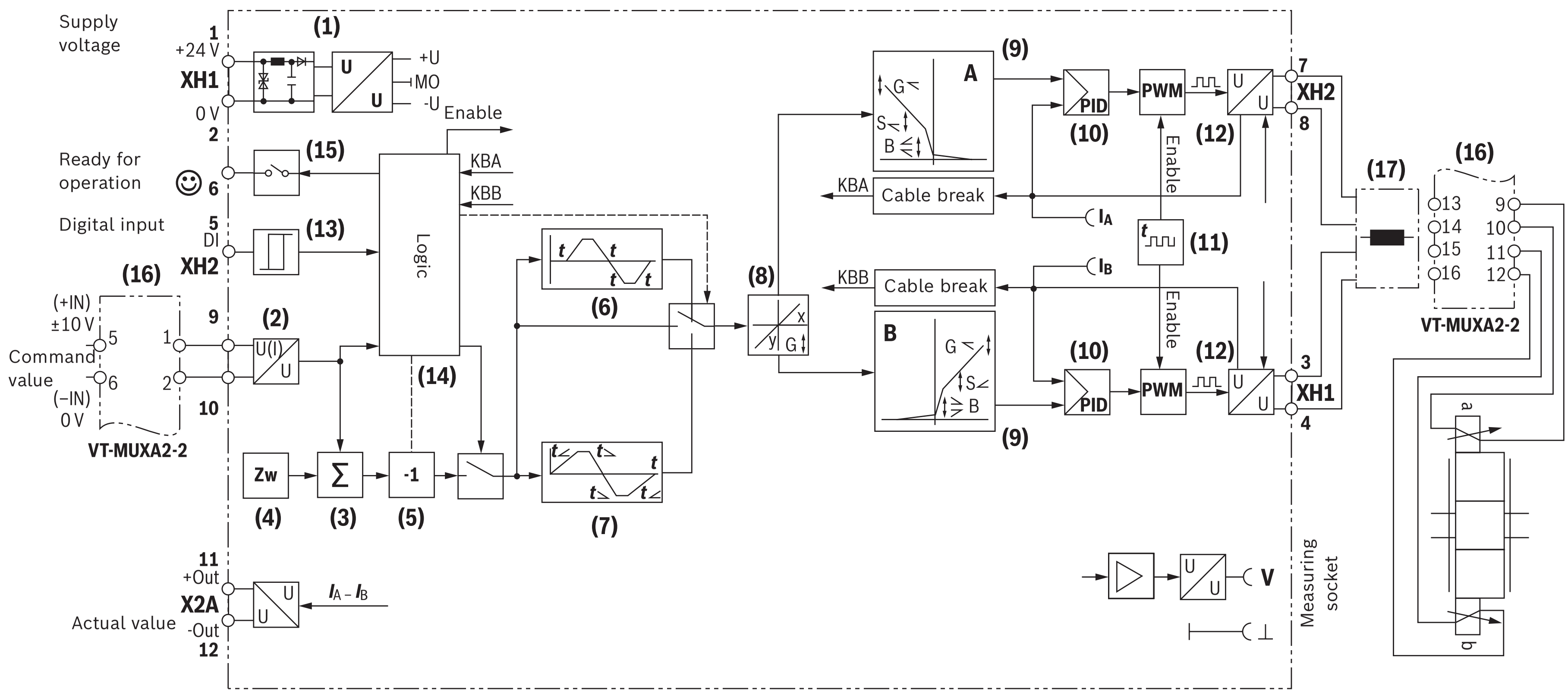
Power output stage (12)
The power output stage creates the clocked solenoid current for the proportional valve. The solenoid current is limited to the maximum admissible current per output, depending on the set valve. The output stages are short-circuit-proof. With an internal interference signal or in case enable is missing, the output stage will be switched off.

Digital input (13)
The input DI can be set to four different functions:
- 1. Enable (factory setting)
- 2. Command value inversion (permanent enable)
- 3. Ramp on/off (permanent enable)
- 4. Single or quadrant ramp (permanent enable)

Digital output (15)
Device notifies ready for operation if there is no cable break, no internal error and $\boldsymbol{U}_B \geq \boldsymbol{U}_{B\,min}$.

See also "block diagram", on page 4.

Block diagram



1 Power supply unit
2 Differential amplifier
3 Command value summing device
4 Zero point setting
5 Inverter
6 Single ramp
7 4-quadrant ramp
8 Command value attenuator
9 Characteristic curve generator
10 Current controller
11 Clock generator
12 Output stage
13 Enable or inverter or ramp off or 4Q ramp
14 Switching logics/fault recognition
15 Digital output
16 Monitoring module VT-MUXA2-2 (separate order)
17 Two ferrite sleeves (included in the scope of delivery of the monitoring module only)

See also "Function" on page 3.

Technical data

General			
Component series			2X
Design			Module
Voltage supply			
Operating voltage	▶ Nominal	V	24; +40% ... −20%
	▶ Lower limit value [1]	V	18
	▶ Upper limit value	V	36
	▶ Maximum admissible residual ripple (40 ... 400 Hz)	Vpp	2.5 (observe the admissible limits)
Maximum power consumption		W	< 48
Maximum current consumption		A	< 2
Maximum switch-on current		A	< 4
External fuse		A	3.15 time-lag
Analog input			
Command value	▶ 2 solenoids (0 ... ±100%)	**mA**	0 ... ±10
	▶ Voltage (differential input)	kΩ	200 (input resistance)
Analog output			
Solenoid current [2]	▶ $\mathbf{I}_A$	V	0 ... -2.5 (mV ≙ mA)
	▶ $\mathbf{I}_B$	V	0 ... 2.5 (mV ≙ mA)
	▶ Minimum load impedance	**Ω**	1000
Digital input			
On (active) [3]		V	11 ... $\boldsymbol{U}_B$
Off (inactive)		V	-3 ... 5
Solenoid outputs			
Maximum solenoid current		A	1.0
Clock frequency-setting range [4]		Hz	95 ... 505
Other properties, solenoid output			Short-circuit-proof, clocked
Cable length for 1.5 mm^2		m	50
Adjustment options			
Zero point calibration		%	± 10
Command value attenuator [5]		%	70 ... 110
Ramp time up / down		s	0.01 ... 30
Step level		%	0 ... 50
Measuring sockets			
Command value/setting	▶ "v"	V	0 ... ±10
Actual current value	▶ $\mathbf{I}_A$	V	0 ... ±2.5 (mV ≙ mA)
	▶ $\mathbf{I}_B$	V	0 ... ±2.5 (mV ≙ mA)
Reference potential	▶ "⊥"		
Additional notices			See operating instructions 30232-01

1) For valves with a maximum solenoid current of 0.8 A, the lower limit value is 21 V

2) Maximum value depending on the selected valve

3) $\boldsymbol{R}_E$ > 50 k

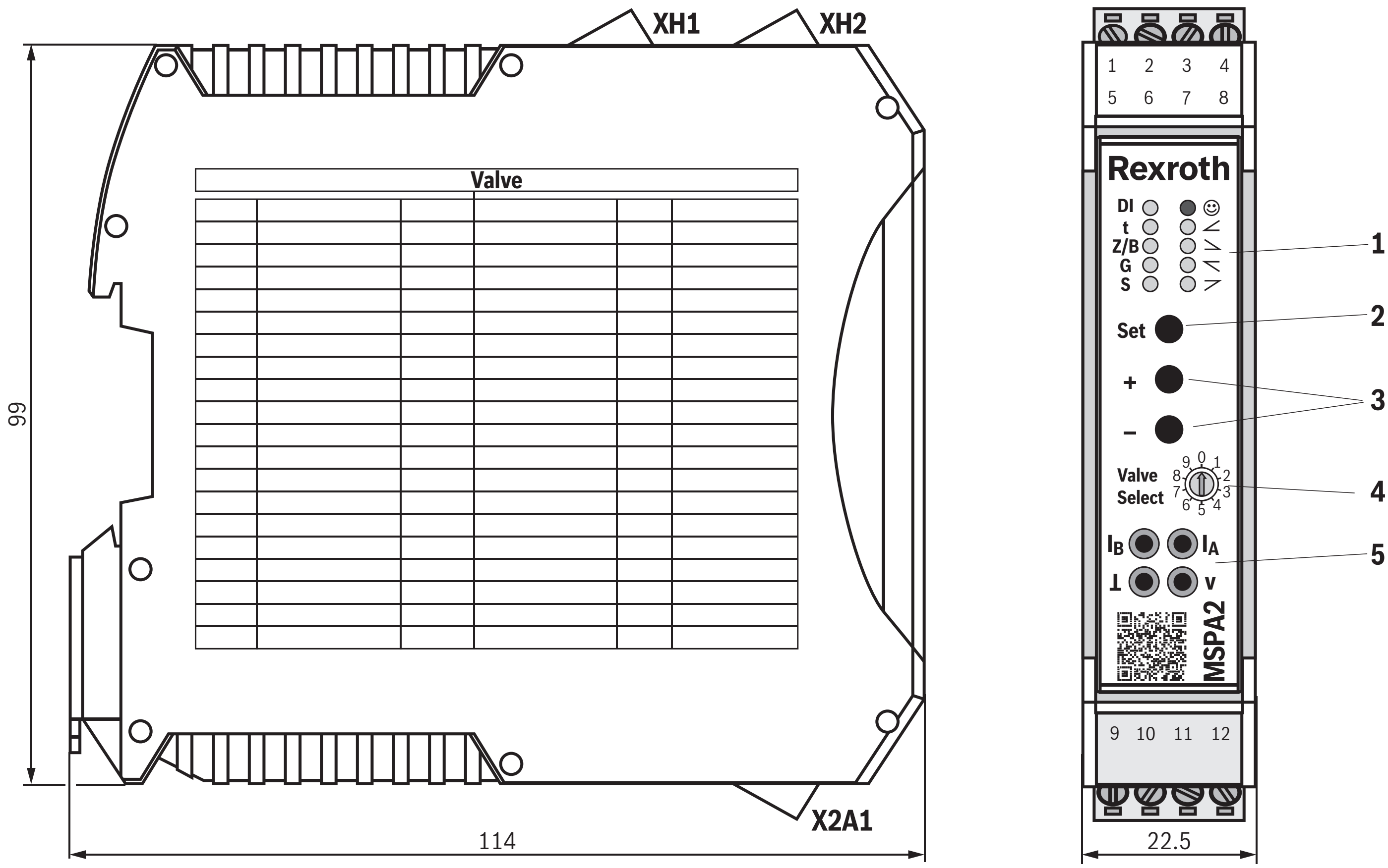
4) Depending on the selected valve

5) Applies to a command value of 100%

Technical data

Supplementary information			
Start-up time		s	< 1
Type of connection			12 spring-type terminals, detachable
Protection class according to EN 60529			IP 20
Ambient temperature range		°C	0 ... +60
Weight		kg	0.14
Maximum admissible temperature change		°C/min	5
Transport temperature range		°C	-40 ... +70
Recommended storage temperature with UV protection		°C	+5 ... +40
Relative air humidity (without condensation)		%	10 ... 95
Maximum altitude for use		m	2000
UV resistance			Housing is only partly UV resistant. Extended exposure to radiation may cause color changes.
Transport shock according to DIN EN 60068-2-27			15 g / 11 ms / 3 axes
Sine test according to DIN EN 60068-2-6		Hz	10 ... 500 (maximum 2 g / 10 cycles / 3 axes)
Noise test according to DIN EN 60068-2-64		Hz	20 ... 500 (2.2 g RMS / 6.6 g peak / 30 min. / 3 axes)
Free fall (in original packaging)		m	1
Installation position			Vertical. For breathing of the assembly, the ventilation slots of the top and bottom side must be at least 2 cm away from covers, walls, etc. With an ambient temperature of more than 50°C, the clearance to the next assembly must be 1 cm.
Top hat rail assembly			TH35-7.5 or TH35-15 according to EN 60715
Housing material			Glass-fiber reinforced polyamide plastic
Resistance against aggressive media			Contact with conductive dusts is not admissible. Avoid contact with hydraulic fluids.
Conformity			CE according to the EMC directive CE according to the RoHS directive
Electro-magnetic compatibility (EMC)	▶ EN 61000-6-2		
	– EN 61000-4-2 ESD	kV	4 kV CD / 8 kV AD with BWK B
	– EN 61000-4-3 HF radiated	V/m	10 (80 ... 6000 MHz) with BWK A
	– EN 61000-4-4 Burst	kV	2 (5 kHz and 100 kHz) with BWK B
	– EN 61000-4-5 Surge	kV	0.5 (2 **Ω**/**12 Ω**) to operating voltage, 1 kV (42 **Ω)** **to signal with** BWK B
	– EN 61000-4-6 HF conducted	V_{eff}	10 (150 kHz ... 80 MHz) with BWK A
	– EN 61000-4-8 Magnetic field 50/60 Hz	A/m	100 with BWK A
	▶ EN 61000-6-3 / EN 61000-6-4		
	– EN 55016-2-1 Interference voltage	MHz	0.15 ... 30 (class A, EN 55022)
	– EN 55016-2-3 Radio interfer-ence field strength	MHz	30 ... 6000 (class B, EN 55022)

Dimensions
(dimensions in mm)



1 **Status LEDs**
Display the current operating state, menu levels and error conditions

2 **SET key**
Editing the selected parameters, selection of work operation, selection of the "expert mode"

3 **+ / - keys**
Selection of the parameters and adjustment of the parameter values

4 **Rotary switch**
Valve type selection

5 **Measuring sockets for connecting a measuring instrument**

Assignment: Switch position/valve type

Switch position	Valve type
0	No valve
1	DBET...6X...XE
2	4WRA 6...XE
3	3DREP 6...XE
4	4WRZ...XE
9	Universal

Terminal assignment

Assignment		Connector	Terminal
Operating voltage	$+U_B$	XH1	1
	0 V	XH1	2
+ solenoid B		XH1	3
– solenoid B		XH1	4
Digital input		XH2	5
Ready		XH2	6
+ solenoid A		XH2	7
– solenoid A		XH2	8
+ command value		X2A	9
– command value		X2A	10
+ actual value		X2A	11
– actual value		X2A	12

Status description LEDs

Indicator light	Operating state	Display mode	Meaning
"Digital input" LED (yellow)	Normal operation	Permanent light on/off	Digital input status
	Setup	Flashing	Standard setup active
	Setup	Off	Expert setup active
	Setup	On/flashing/flickering	Expert setup: Digital input setting
"Ready" LED (red/green)	Normal operation	Permanent light, green	Module ready for operation
	Normal operation	Permanent light, red	Error
	Normal operation and setup	Flashing light, red-green	Valve setting changed
	Normal operation and setup	Flashing light, red	Inadmissible valve number
	Normal operation	Off	Module not ready for operation
	Setup	Flashing light, green	Expert setup active

Description of the LED display [1]	
DI	Enable [2]
t	Ramp
Z/B	Zero point / pilot current
G	Command value attenuator
S	Step level command value
☺	Ready for operation
∠	1st quadrant (positive command value rising)
	2nd quadrant (positive command value falling)
	3rd quadrant (negative command value rising)
	4th quadrant (negative command value falling)

[1] A detailed description is contained in the operating instructions 30232-01-B

[2] Function of the digital input can be adjusted in the setup

Accessories (separate order)

	Material no.
Shield set for the installation with shielded lines	**R961011117**

Project planning and maintenance instructions

☞ **Project planning information:**

- To comply with the safety requirements for the operation of the valve in potentially explosive atmospheres, it must be ensured that the solenoid current does not exceed 1 A. For monitoring and limitation of the valve flow, we recommend using the Rexroth monitoring module VT-MUXA2-2, see data sheet 30290.
- The VT-MSPA2-2X...1A0 valve amplifier and the VT-MUXA2-2 monitoring module may only be installed outside the potentially explosive atmosphere.
- The VT-MSPA2-2X...1A0 valve amplifier and the VT-MUXA2-2 monitoring module are not subject to directive 2014/34/EU.

☞ **Maintenance instructions:**

- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices can be repaired.
- Repaired devices are returned with default settings. User-specific settings must be made by the machine end-user once again.

☞ **Notice:**

- In especially EMC-sensitive environments, additional measures must be taken (depending on the application, e.g. shielding, filtration)
- **Wiring information**
  - Maximum possible spatial separation between signal and load lines.
  - Do not lead signal lines through magnetic fields.
  - If possible, install signal lines without intermediate terminals.
  - Do not install signal lines in parallel to the load lines.
  - Connect cable shields (see operating instructions 30232-01-B)
  - For digital inputs and outputs as well as command and actual value, the max. admissible cable length for unshielded cables is 30 m. For longer cable lengths, shielded cables must be used.
  - The distance to radios must be sufficient (> 1 m).
  - With a strongly fluctuating operating voltage, in individual cases, it may 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.
- The upper and lower ventilation slots must not be concealed by adjacent devices in order to provide for sufficient cooling.

Further information

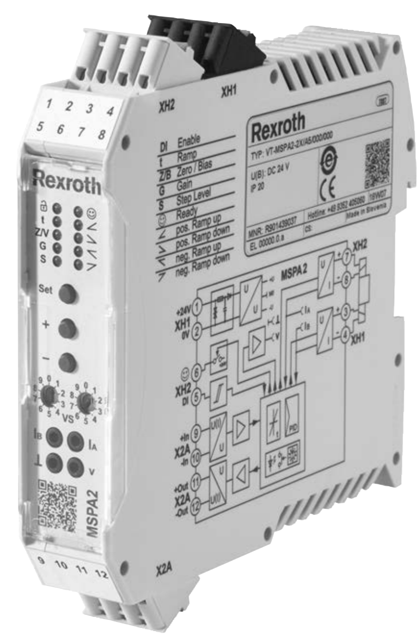
▶ Valve amplifier for proportional valves without electrical position feedback	Operating instructions 30232-01-B
▶ CE Declaration of Conformity	upon request
▶ Installation, commissioning and maintenance of proportional valves	Data sheet 07800
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900

RE 30232-02
Edition: 2021-04

rexroth
A Bosch Company

Valve amplifier for proportional valves without electrical position feedback Maximum current limitation 1.5 A

Type VT-MSPA2...1A5



H8134

- Component series 2X
- Easy valve selection of the Rexroth valves for industrial hydraulics
- Characteristic curves of the valves stored in the device
- Valve optimization via push-buttons
- All valve parameters adjustable
- For valve with one or two solenoids and 24 V nominal voltage

Features

- Command value input 0 ... ±10 V
- Maximum ambient temperature range 70 °C
- Reverse polarity protection of the operating voltage
- Ramp generator up and down is separately adjustable
- Zero point setting
- Command value adjustment
- Characteristic curve generator
- Clocked power output stage
- Output short-circuit-proof
- LED status displays
- Measuring sockets for actual current value, internal current command/setting

Contents

Ordering code

01	02		03		04		05			06
VT-MSPA	**2**	**–**	**2X**	**/**	**A5**	**/**	**1A5**	**/**	**000**	*****

01	Valve amplifier for proportional valves without position feedback, analog, modular design	**VT–MSPA**
02	For proportional valves with 1 or 2 solenoids	**2**
03	Component series 20 ... 29 (20 ... 29: unchanged technical data and connections)	**2X**
04	Command value voltage (1 solenoid 0 ... +10 V / 2 solenoids 0 ... ±10 V)	**A5**
05	Maximum current limitation 1.5 A	**1A5**
06	Further details in the plain text	*****

Available variant

Type	**Material no.**
VT-MSPA2-2X/A5/1A5/000	R901505408

Function

General
The valve amplifiers are intended for assembly on top hat rails. The electrical connection is established via 3 tension spring plug-in connectors. The supply voltage is 24 VDC.

Power supply unit (1)
The internal power supply unit has a making current limiter to prevent current peaks. Additionally, inverse-polarity protection is integrated.

Command value, command value summing device (3)
The "internal command value" comprises:
- "External command value", connected at the input of the differential amplifier (2)
- Zero point offset (4), "Z/B" adjustable in the standard setup
- Via solenoid B, a command value of 0 ... +10 V results in a flow in the valve from P to A and from B to T.
- Via solenoid A, a command value of 0 ... -10 V results in a flow in the valve from P to B and from A to T. In the expert setup, it is possible to invert the command value (5) (see operating instructions 30232-02-B).
- In normal operation, the "internal command value" can be measured at the "v" measuring socket.

Ramps
A ramp limits the incline of the command value.
You can choose between a single ramp (6) (one time for all ramps, default value) and a 4Q/2Q ramp (7) (different times for the possible ramps). The 4Q/2Q ramp times are set in the expert setup. The characteristic curve generator (9) does not influence the ramp time.

Command value attenuator "G" (8)
By means of the command value attenuator, the command value can be reduced.

Characteristic curve generator (9)
In the characteristic curve generator, the pre-set valve characteristic curve can be adjusted to the actual hydraulic and control-technical conditions.
The following can be adjusted in the expert setup:
- Pilot current "B"
- Step "S"
- Maximum current "G" (separately possible for solenoid A and B)

Current controller (10)
The solenoid current is recorded, compared to the command value in the current controller and the difference is compensated.

Clock generator (11)
The clock generator creates the clock frequency "f" of the output stage. With Rexroth valves, the clock frequency sometimes changes dependent on the command value and/or the operating voltage.

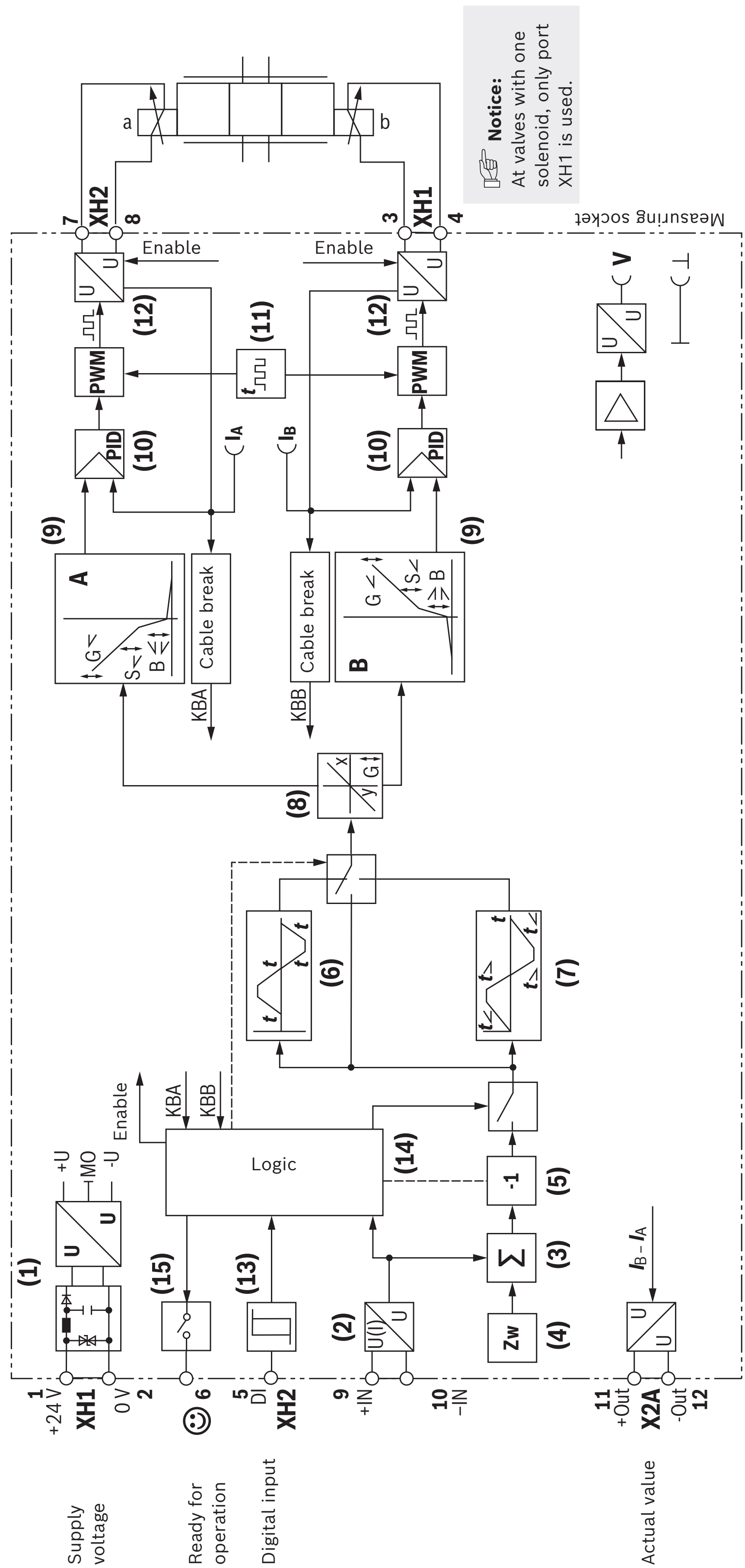
Power output stage (12)
The power output stage creates the clocked solenoid current for the proportional valve. The solenoid current is limited to the maximum admissible current per output, depending on the set valve. The output stages are short-circuit-proof. With an internal interference signal or in case enable is missing, the output stage will be switched off.

Digital input (13)
The input DI can be set to four different functions:
- 1. Enable (factory setting)
- 2. Command value inversion (permanent enable)
- 3. Ramp on/off (permanent enable)
- 4. Single or quadrant ramp (permanent enable)

Digital output (15)
Device notifies ready for operation if there is no cable break, no internal error and $\boldsymbol{U}_\mathrm{B} \geq \boldsymbol{U}_\mathrm{B\,min}$

See also "block diagram", on page 4.

Block diagram



1 Power supply unit
2 Differential amplifier
3 Command value summing device
4 Zero point setting
5 Inverter
6 Single ramp
7 4-quadrant ramp
8 Command value attenuator
9 Characteristic curve generator
10 Current controller
11 Clock generator
12 Output stage
13 Enable / inverting / ramp off / 4Q ramp
14 Switching logics / fault recognition
15 Digital output

See also "Function" on page 3.

Technical data

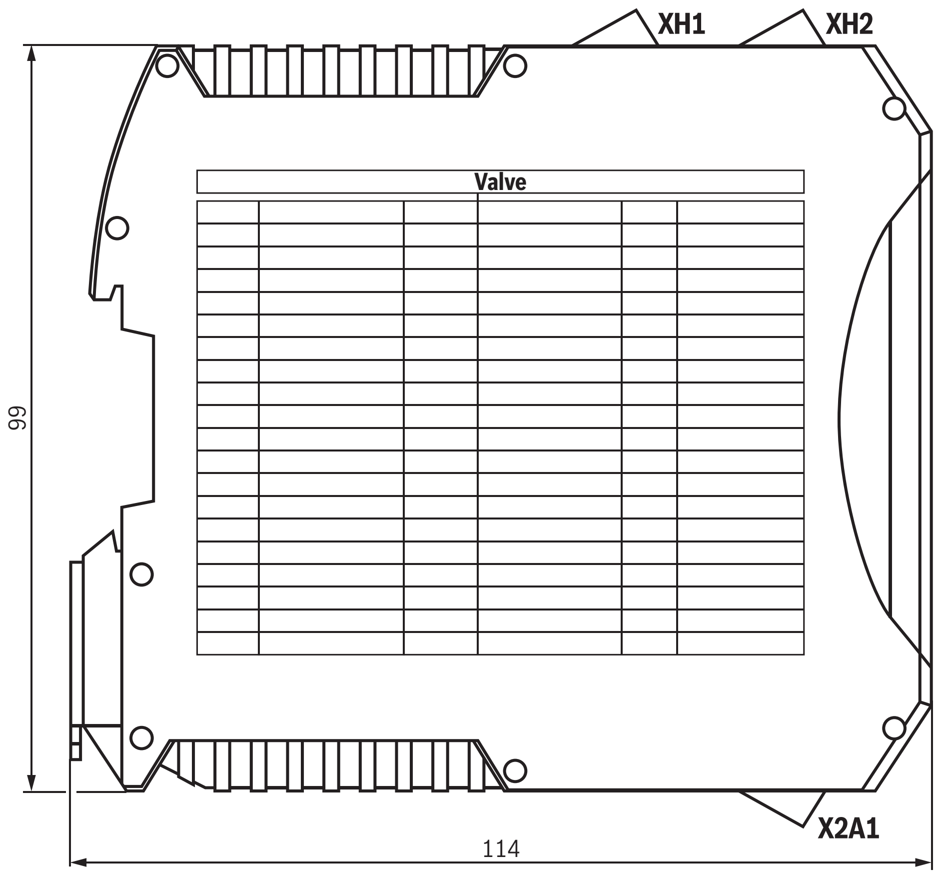
General			
Component series			2X
Design			Module
Voltage supply			
Operating voltage	▶ Nominal	V	24; +40% ... –20%
	▶ Lower limit value	V	18
	▶ Upper limit value	V	36
	▶ Maximum admissible residual ripple (40 ... 400 Hz)	Vpp	2.5 (observe the admissible limits)
Maximum power consumption		W	< 48
Maximum current consumption		A	< 2
Maximum switch-on current		A	< 4
External fuse		A	3.15 time-lag
Analog input			
Command value	▶ 2 solenoids (0 ... ±100%)	V	0 ... ±10
	▶ Voltage (differential input)	kΩ	200 (input resistance)
Analog output			
Solenoid current as voltage	▶ $\mathbf{I}_A$	V	0 ... -1.5 (V ≙ A)
	▶ $\mathbf{I}_B$	V	0 ... 1.5 (V ≙ A)
	▶ Minimum load impedance	Ω	1000
Digital input			
On (active) 1)		V	11 ... U_B
Off (inactive)		V	-3 ... 5
Solenoid outputs			
Maximum solenoid current		A	1.5
Clock frequency setting range 2)		Hz	95 ... 505
Other properties, solenoid output			Short-circuit-proof, clocked
Cable length for 1.5 mm^2		m	50
Adjustment options			
Zero point calibration		%	±10
Command value attenuator 3)		%	70 ... 110
Ramp time up / down		s	0.01 ... 30
Step level		%	0 ... 50
Measuring sockets			
Command value/setting	▶ "v"	V	0 ... ±10
Actual current value	▶ $\mathbf{I}_A$	V	0 ... 1.5 (V ≙ A)
	▶ $\mathbf{I}_B$	V	0 ... 1.5 (V ≙ A)
Reference potential	▶ "⊥"		
Additional information			See operating instructions 30232-02-B

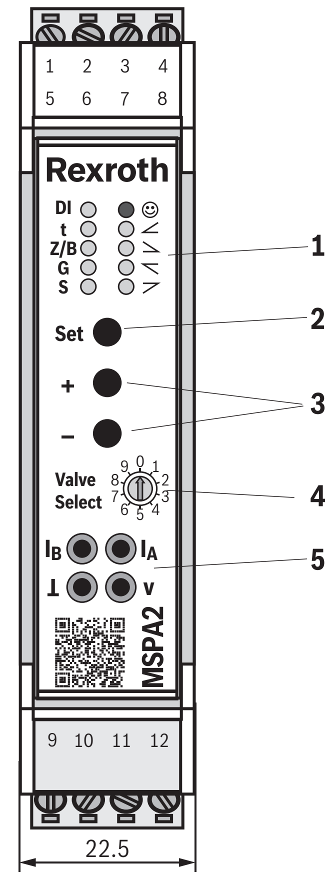
1) R_E > 50 k
2) Depending on the selected valve
3) Applies to a command value of 100%

Technical data

Supplementary information			
Start-up time		s	< 1
Type of connection			3 tension spring plug-in connectors, detachable
Protection class according to EN 60529			IP 20
Ambient temperature range		°C	0 … +70
Weight		kg	0.14
Maximum admissible temperature change		°C/min	5
Transport temperature range		°C	–40 … +70
Recommended storage temperature with UV protection		°C	+5 … +40
Relative air humidity (without condensation)		%	10 … 95
Maximum altitude for use		m	2000
UV resistance			Housing is only partly UV resistant. Extended exposure to radiation may cause color changes.
Transport shock according to DIN EN 60068-2-27			15 g / 11 ms / 3 axes
Sine test according to DIN EN 60068-2-6		Hz	10 … 500 (maximum 2 g / 10 cycles / 3 axes)
Noise test according to DIN EN 60068-2-64		Hz	20 … 500 (2.2 g RMS / 6.6 g peak / 30 min. / 3 axes)
Free fall (in original packaging)		m	1
Installation position			Vertical. For breathing of the assembly, the ventilation slots of the top and bottom side must be at least 2 cm away from covers, walls, etc. With an ambient temperature of more than 50 °C, the clearance to the next assembly must be 1 cm.
Top hat rail assembly			TH35-7.5 or TH35-15 according to EN 60715
Housing material			Glass-fiber reinforced polyamide plastic
Resistance against aggressive media			Contact with conductive dusts is not admissible. Avoid contact with hydraulic fluids.
Electro-magnetic compatibility (EMC)	▶ EN 61000-6-2		
	– EN 61000-4-2 ESD	kV	4 kV CD / 8 kV AD with BWK B
	– EN 61000-4-3 HF radiated	V/m	10 (80 … 6000 MHz) with BWK A
	– EN 61000-4-4 Burst	kV	2 (5 kHz and 100 kHz) with BWK B
	– EN 61000-4-5 Surge	kV	0.5 (2 **Ω/12 Ω**) to operating voltage, 1 kV (42 **Ω) to signal with** BWK B
	– EN 61000-4-6 HF conducted	V_{eff}	10 (150 kHz … 80 MHz) with BWK A
	– EN 61000-4-8 Magnetic field 50/60 Hz	A/m	100 with BWK A
	▶ EN 61000-6-3 / EN 61000-6-4		
	– EN 55016-2-1 Interference voltage	MHz	0.15 … 30 (class A, EN 55022)
	– EN 55016-2-3 Radio interference field strength	MHz	30 … 6000 (class B, EN 55022)

Dimensions
(dimensions in mm)





1 **Status LEDs**
Display the current operating state, menu levels and error conditions

2 **SET key**
Editing the selected parameters, selection of work operation, selection of the "expert mode"

3 **+ / - keys**
Selection of the parameters and adjustment of the parameter values

4 **Rotary switch**
Valve type selection

5 **Measuring sockets for connecting a measuring instrument**

Assignment: Switch position/valve type

Switch position	Valve type
0	No valve
1	4WRA 6 WA15...2X...K10 4WRA 6 XA00...K10
2	4WRA 6 W30...2X...K10 4WRA 6 E00 ...2X ...K10
3	4WRZ ...7X...K10
9	Universal (1.5 A)

Terminal assignment

Assignment		Connector	Terminal
Operating voltage	$+U_B$	XH1	1
	0 V	XH1	2
+ solenoid B		XH1	3
– solenoid B		XH1	4
Digital input		XH2	5
Ready		XH2	6
+ solenoid A		XH2	7
– solenoid A		XH2	8
+ command value		X2A	9
– command value		X2A	10
+ actual value		X2A	11
– actual value		X2A	12

Status description LEDs

Indicator light	Operating state	Display mode	Meaning
"Digital input" LED (yellow)	Normal operation	Permanent light on/off	Digital input status
	Setup	Flashing	Standard setup active
	Setup	Off	Expert setup active
	Setup	On/flashing/flickering	Expert setup: Digital input setting
"Ready" LED (red/green)	Normal operation	Permanent light, green	Module ready for operation
	Normal operation	Permanent light, red	Error
	Normal operation and setup	Flashing light, red-green	Valve setting changed
	Normal operation and setup	Flashing light, red	Inadmissible valve number
	Normal operation	Off	Module not ready for operation
	Setup	Flashing light, green	Expert setup active

Description of the LED display [1]	
DI	Enable [2]
t	Ramp
Z/B	Zero point / pilot current
G	Command value attenuator
S	Step level command value
☺	Ready for operation
∠	1. quadrant (positive command value rising)
⦣	2. quadrant (positive command value falling)
⦤	3. quadrant (negative command value rising)
⦥	4. quadrant (negative command value falling)

[1] A detailed description is contained in the operating instructions 30232-02-B

[2] Function of the digital input can be adjusted in the setup

Accessories (separate order)

	Material no.
Shield set for the installation with shielded lines	**R961011117**

Project planning and maintenance instructions

☞ **Maintenance instructions:**

- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices can be repaired.
- Repaired devices are returned with default settings. User-specific settings must be made by the machine end-user once again.

☞ **Notices:**

- In especially EMC-sensitive environments, additional measures must be taken (depending on the application, e.g. shielding, filtration)
- **Wiring information**
  - Maximum possible spatial separation between signal and load lines.
  - Do not lead signal lines through magnetic fields.
  - If possible, install signal lines without intermediate terminals.
  - Do not install signal lines in parallel to the load lines.
  - Connect cable shields (see operating instructions 30232-02-B)
  - For digital inputs and outputs as well as command and actual value, the max. admissible cable length for unshielded cables is 30 m. With longer cable lengths, shielded cables are to be used.
  - The distance to radios must be sufficient (> 1 m).
  - With a strongly fluctuating operating voltage, in individual cases, it may 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.
- The upper and lower ventilation slots must not be concealed by adjacent devices in order to provide for sufficient cooling.

Further information

▶ Valve amplifier for proportional valves without electrical position feedback; maximum current limitation 1.5 A	Operating instructions 30232-02-B
▶ Installation, commissioning and maintenance of proportional valves	Data sheet 07800
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900

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

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

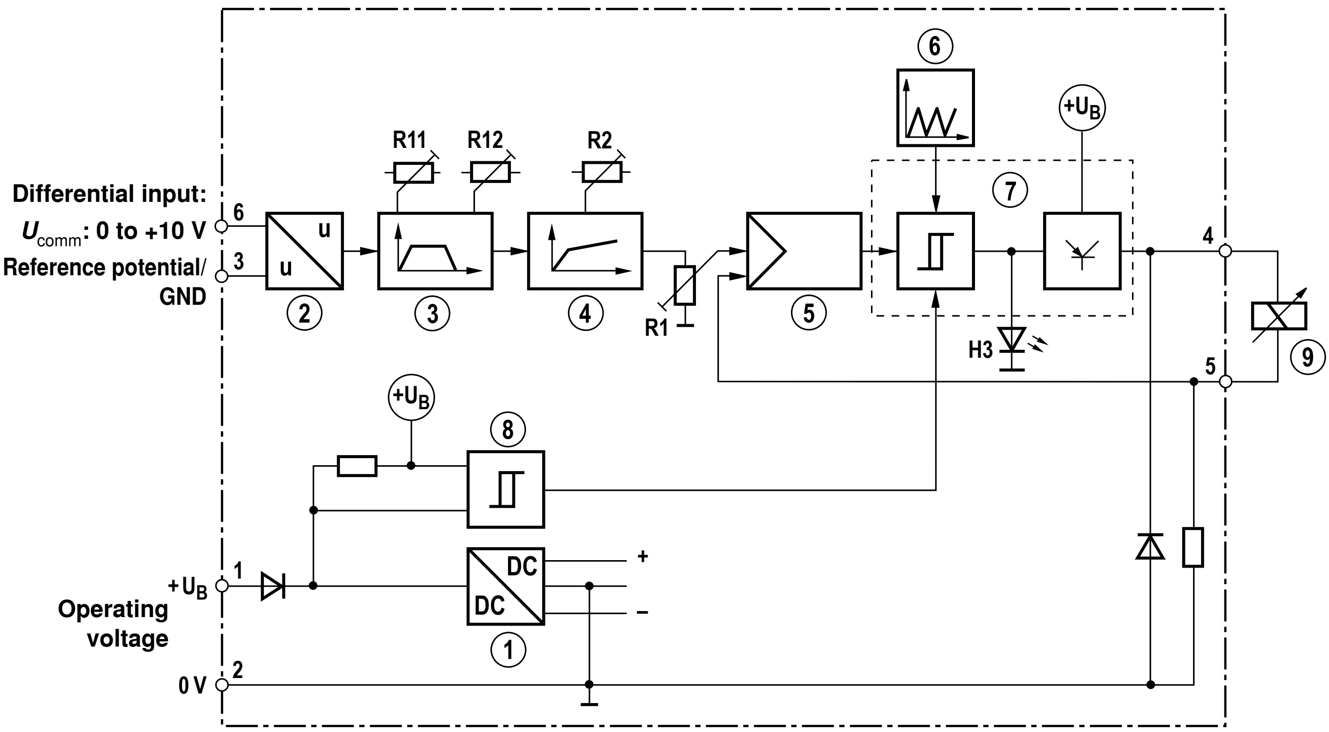
These amplifier modules are suitable for controlling a proportional solenoid. The amplifier modules are to be snapped onto carrier rails according to EN 60715. The electrical connections are made by means of screw terminals. The modules are operated using 24 V DC.

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		

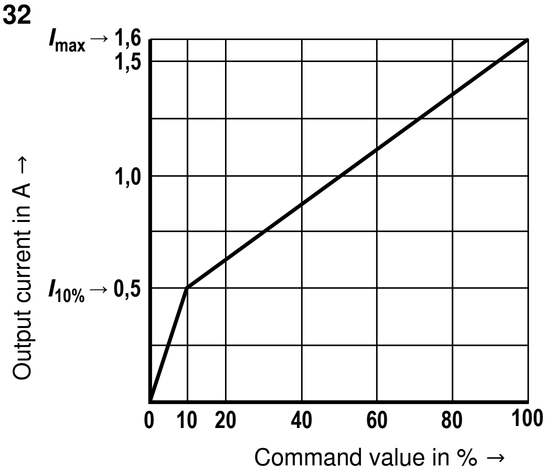
Technical data (for applications outside these parameters, please consult us!)

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

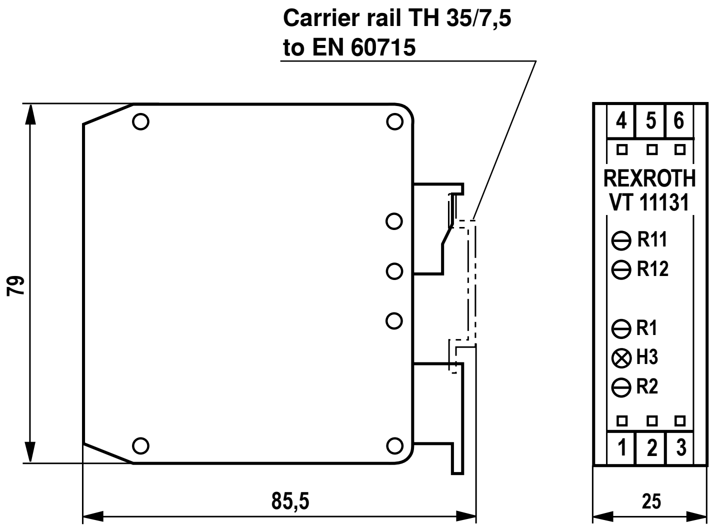


Terminal assignment

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.

Rexroth
Bosch Group

Plug-in amplifier

RE 30264/07.12
Replaces: 03.10

Type VT-SSPA1

Component series 2X

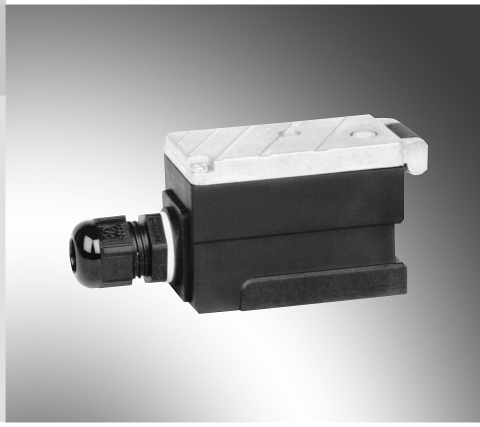


Table of contents

Contents **Page**

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**

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

Customer version
V0 = Catalog version

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

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

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

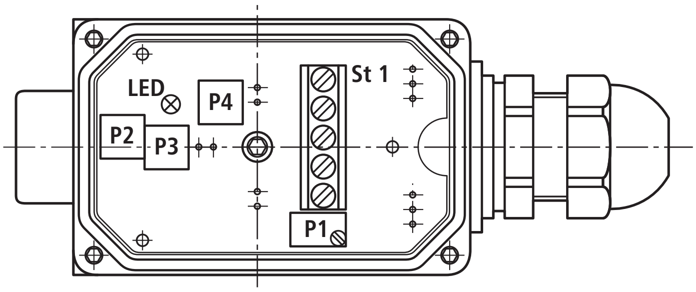
– Current measurement adapter VT-PA-5 (see data sheet 30073).

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.

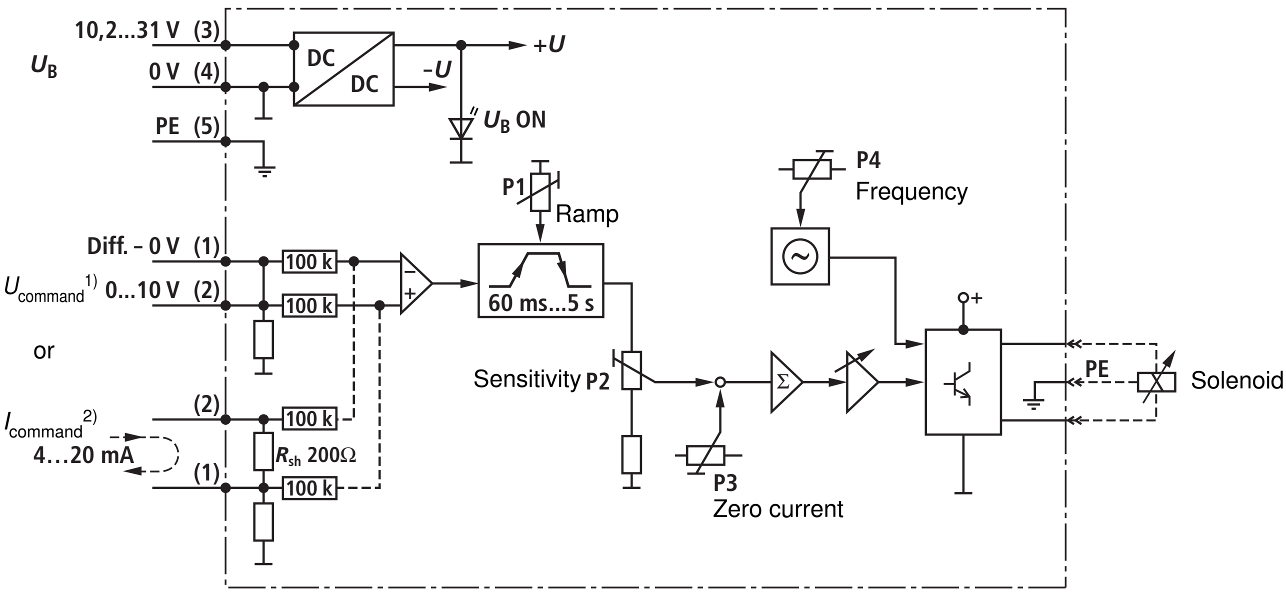
The command value can be adjusted with regard to **zero point** and **sensitivity**. In case of voltage specification, a **differential input** is available.
Apart from that, the command value can be led via a **ramp**.
In order to allow for adjustment to special applications, the **dither amplitude** 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



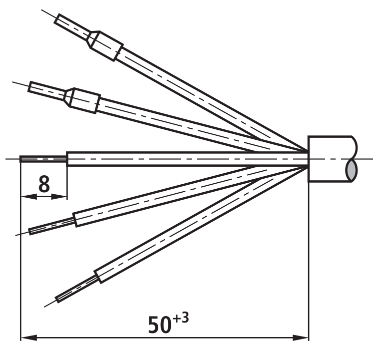
1) 0 811 405 143; 0 811 405 144
2) 0 811 405 145; 0 811 405 162

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 mm², 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.



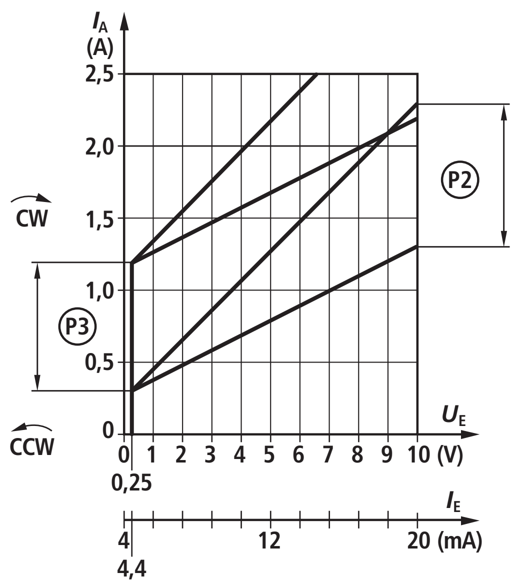
Crimp the wire end ferrules shortly (5x)

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!

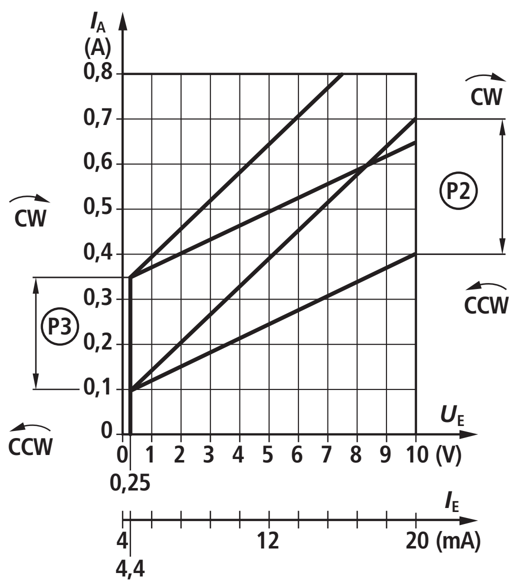
3. Apply the supply voltage
↓
LED (green) is illuminated.

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

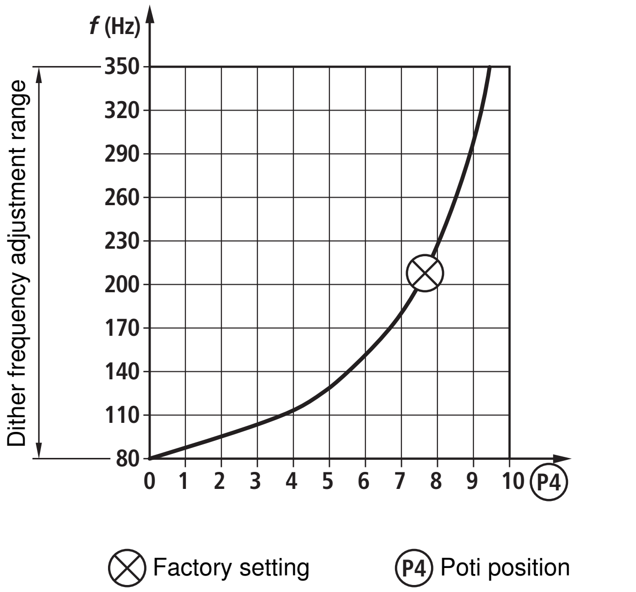


P2 Sensitivity range
P3 Zero current range

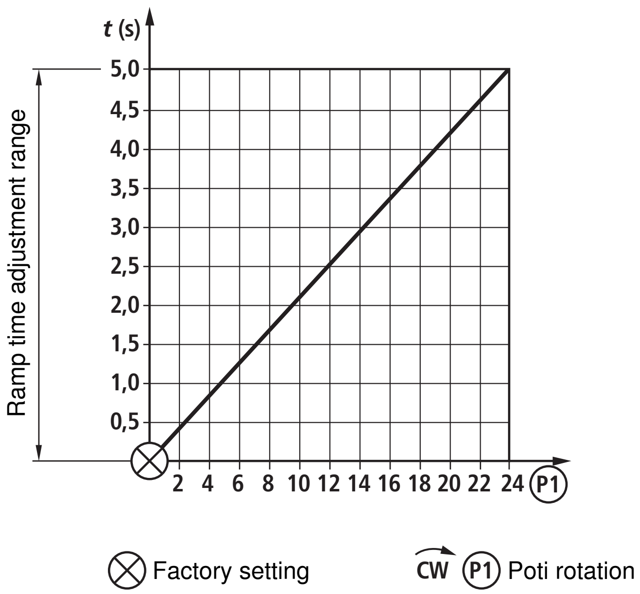
Commissioning and adjustment

6. Dither frequency adjustment
   → Poti (P4).

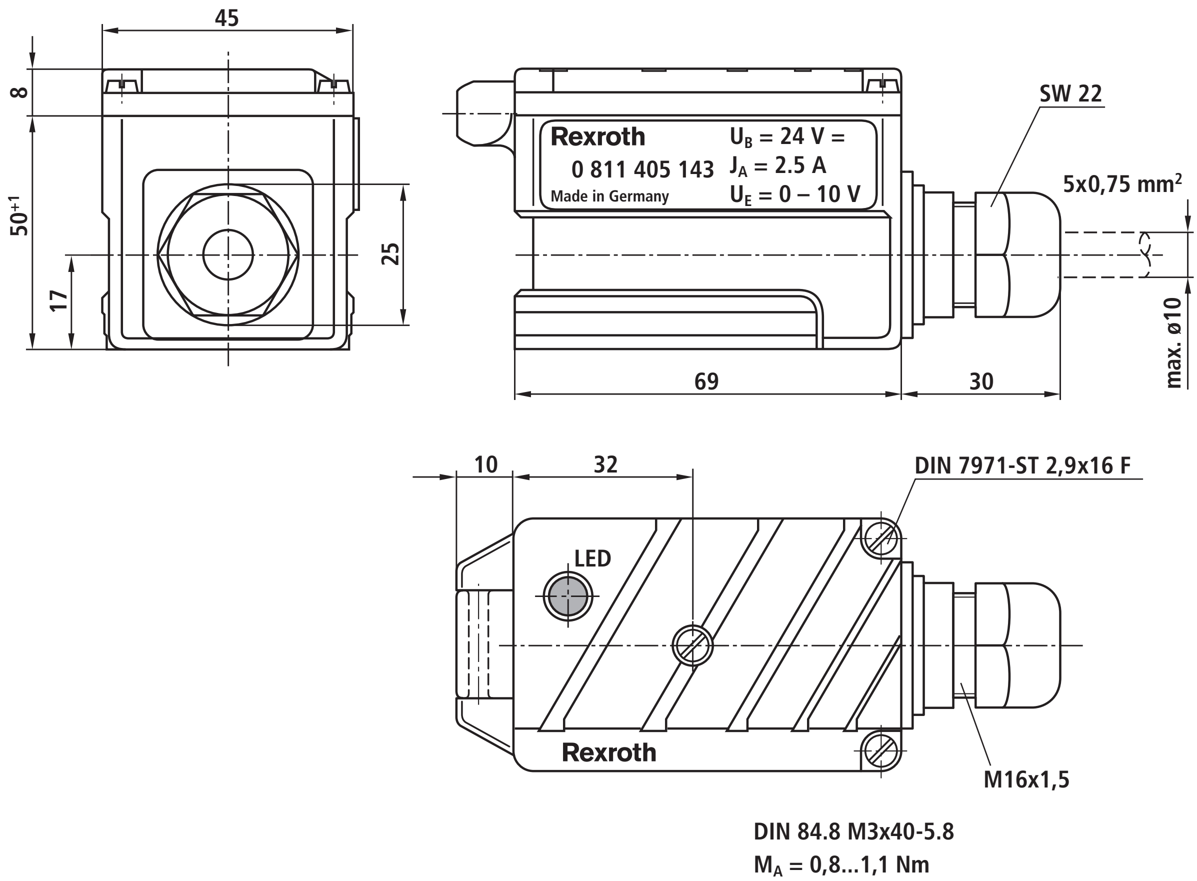
The dither frequency has already been correctly adjusted upon delivery. For special applications, correction may be necessary. in this connection, please contact DC-IA/PRM12.



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



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.

Valve amplifier for proportional valves

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

RE 30116
Edition: 2015-12
Replaces: 2015-03

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 / KBVS / KTVS	**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**
07	Cable gland PG11	**no code**
	Conector, 4-pole, M12x1 [1)]	**K24**

1) Contact box, separate order, see accessories

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 300 Hz [1)]	0…10 V/24 V	KBPS.BA / KBVS.BA / KTVS.BA KBPS.AA / KBVS.AA / KTVS.AA	4.77 Ω
VT-SSPA1-5-1X/V0/0-24/K24	R901238530	24 V	1.2 A	200 Hz 300 Hz [1)]	0…10 V/24 V	KBPS.BA / KBVS.BA / KTVS.BA KBPS.AA / KBVS.AA / KTVS.AA	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	KKDS / KUDS	7.2 Ω
VT-SSPA1-100-1X/V0/0-24/K24	R901238528	24 V	1.2 A	150 Hz	0…10 V/24 V	KKDS / KUDS	7.2 Ω
VT-SSPA1-150-1X/V0/0-24	R901104644	24 V	0.8 A	150 Hz [2)]	0…10 V	universal	19.5 Ω
VT-SSPA1-150-1X/V0/0-24/K24	R901263782	24 V	0.8 A	150 Hz [2)]	0…10 V	universal	19.5 Ω

1) The clock frequency of the output stage must be set to 300 Hz using the potentiometer „f“.
2) With a solenoid resistance of R = 19.5 Ω and a solenoid current of I = 100 mA

Ordering code (continued)

Accessories for type .../K24

Cable set (VT-SSPA1) [1]	Connector	Length in m	Material number
4-pole, A coding, PVC, M12 connector, free line end, line cross-section 0.75 mm²	straight	5	R901241656
	straight	10	R901148443
	angled	5	R901241651

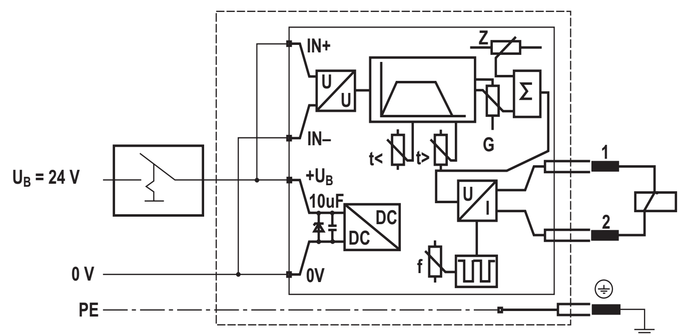
[1] For more information see RD08006

Applications

2-conductor technology (only with differential input)

- Switching application with fixed flow control
- Ramp function upon switch-on

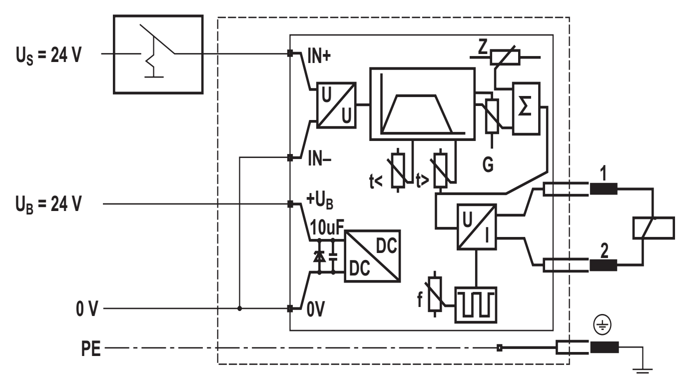
The “IN+” input is bridged with supply voltage (+U_B) in the connector, the IN− input is bridged with supply voltage (0 V) in the connector.
The maximum current must generally be adjusted according to the solenoid information using potentiometer “G”.
The ramp time “ramp up” (t <) can be set within the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



3-conductor technology (only with differential input)

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

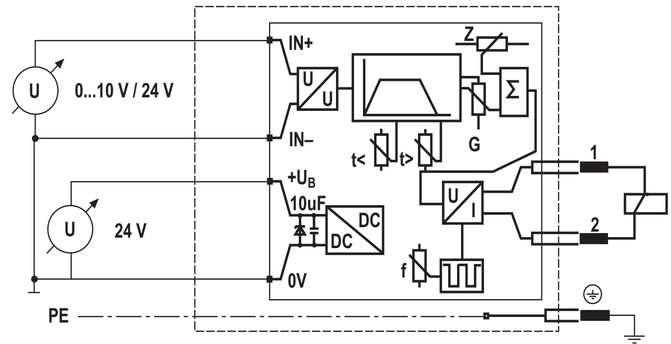
The “IN+” input is connected to the control voltage (Us = 24 V), the “IN−” input is bridged with supply voltage (0 V) in the connector.
The maximum current must generally be adjusted according to the solenoid information using potentiometer “G”.
When switched off (“IN+” = 0 V or “IN+” = open) a pilot 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 page 5).



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 toU_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”.

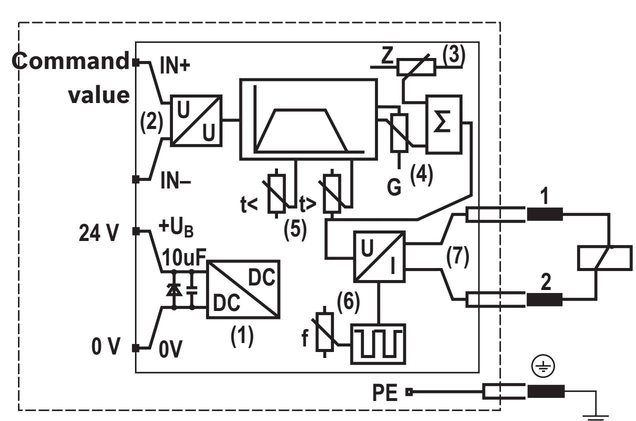
Power output stage

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.

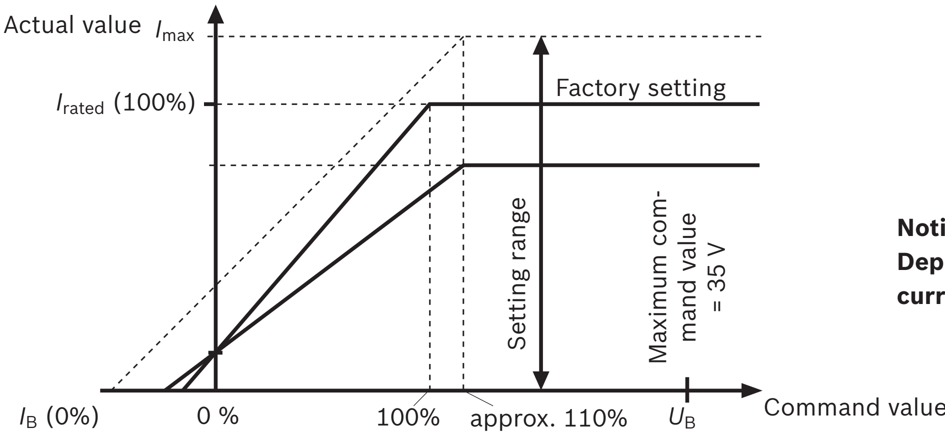
( )= Assignment to the block diagram

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



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) [3]						
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, A codification				
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)	°C	−25 ... +70	−25 ... +70	−25 ... +60	−25 ... +70	−25 ... +70
Admissible operating temperature range (amplifier with M12 connector)	°C	−25 ... +70	−25 ... +70	−25 ... +50	−25 ... +70	−25 ... +70
Storage temperature range	°C	−25 ... +85				
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

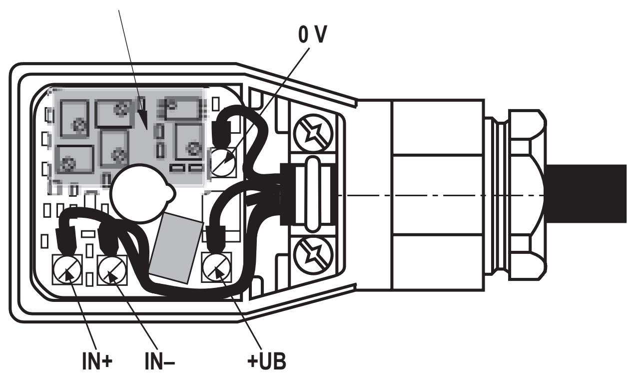
[3] The minimum ramp time depends on the valve solenoid. The values indicated here should be considered as a guideline only and may vary

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!

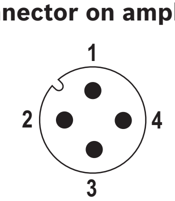


The connection for the protective earthing conductor is accessible after the electronic printed-circuit board has been removed.

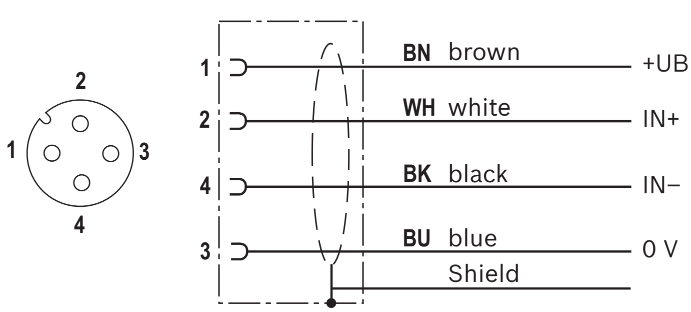
Connection cross-section:
4 x 0.75 mm² shielded or
5 x 0.5 mm² shielded (connect shield in control cabinet)
For VT-SSPA1-50:
4 x 1.5 mm² shielded (connect shield in control cabinet)
Cable diameter: 4.5 ... 11 mm

M12 plug-in connector port

Connector on amplifier



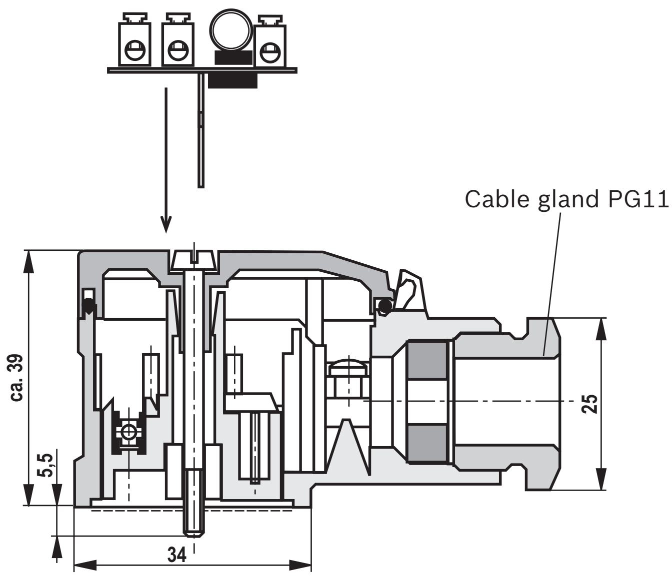
Mating connector and wire colors with pre-assembled cable set
Please order the cable set separately, see page 3

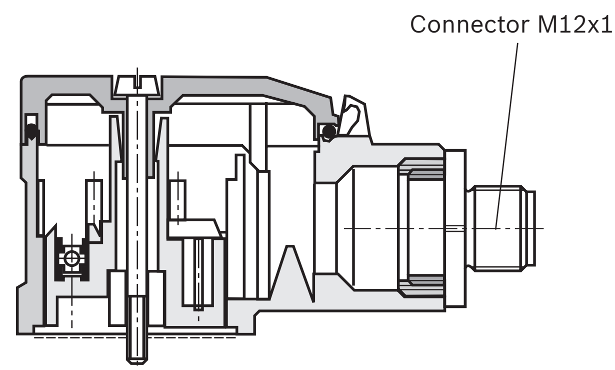


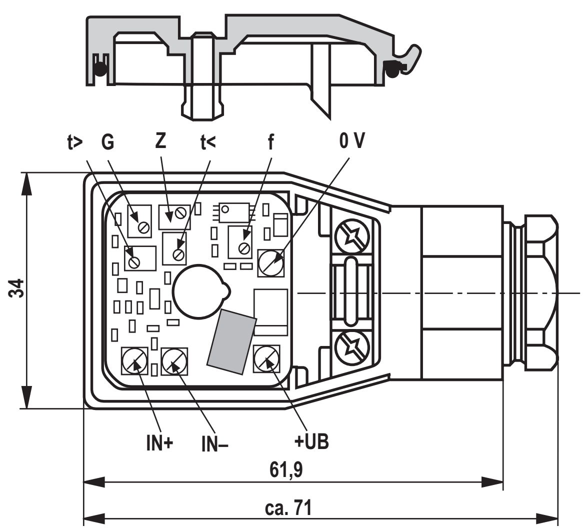
The connection for the protective earthing conductor is not provided

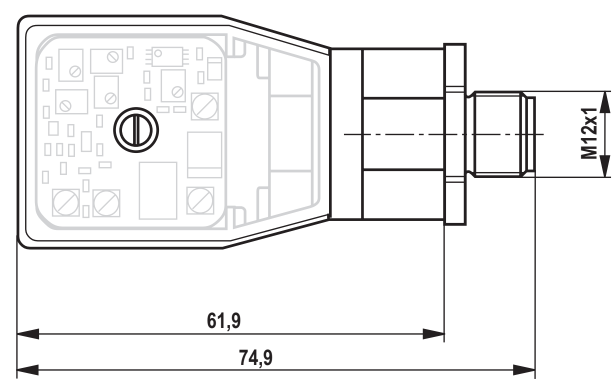
Connection cross-section:
4 x 0.75 mm² shielded
(connect shield in control cabinet)

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 insert can be rotated in 90° steps in compliance with ESD protective measures.
- 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

Further information

Notice:
For general information regarding safety, assembly and commissioning see operation manual:

07602-B Electronics for industrial applications

Rexroth
Bosch Group

Declaration on environmental compatibility in the field of EMC[1], climate and mechanical stress

RE 30116-U/06.10
Replaces: 03.07

Type VT-SSPA1, series 1X

Plug-in proportional amplifier

Product types

– VT-SSPA1-...-1X... according to data sheet RE 30116

Description of the products

– Compact variant of plug-in design
– Suitable for controlling proportional valves without electrical position feedback
– Proportional command value / current characteristic curves for command values from 0 % to 100 %
– Differential input

[1] In the sense of the EMC directive 2004/108/EC and the EMVG (act on the electromagnetic compatibility of operating media) dated 02/26/2008

The above products comply with the following standards:

1. EMC (electromagnetic compatibility)

Testing according to specialized basic standard EN 61000-6-2:2001, VDE 0839 part 6-2

EN 61000-4-2:1995 +A1:1998 +A2:2000 IEC 1000-4-2	VDE 0847-4-2	ESD (electrostatic discharge)	Air discharge: Severity 4 / assessment criterion A Contact discharge: Severity 4 / assessment criterion A
EN 61000-4-4:1995 +A1:2001 +A2:2001 IEC 1000-4-4	VDE 0847-4-4	BURST (transient discharge)	Supply voltage: Severity 3 / assessment criterion B Data cable: Severity 4 / assessment criterion B
EN 61000-4-5:1995 +A1:2001 IEC 1000-4-5	VDE 0847-4-5	SURGE (surge voltages)	Supply voltage: Severity 1 / assessment criterion A
EN 61000-4-6:1996 +A1:2001 IEC 1000-4-6	VDE 0847-4-6	RF fields, conducted interference	Severity 3 / assessment criterion A

Note:

To adhere to the above limit values, signal cables must be routed past the capacitor!

Please observe our notes in data sheet RE 30116.

2. Climate

Testing according to EN 60068-2 / IEC 68-2 (Environmental test)

Testing with solenoid current 2 A			
EN 60068-2-1:1994		Cold test	2 cycles –30 °C dwell time 2 hours
EN 60068-2-2:1993		Dry heat test	2 cycles +85 °C dwell time 2 hours
EN 60068-2-1:1994 EN 60068-2-2:1993		Storage temperature	–30 °C, dwell time 16 hours +85 °C, dwell time 16 hours
	IEC 68-2-14:1986	Temperature cycle	2 cycles –30 °C to +85 °C dwell time 3 hours at min./max. temperature
	IEC 68-2-30:1985	Damp heat, cyclical	Variant 2 +25 °C to +55 °C 93 % to 97 % relative humidity 2 cycles, 24 hours each
Additional test with solenoid current 2.5 A			
	IEC 68-2-14:1986	Temperature cycle	2 cycles –30 °C to +70 °C dwell time 3 hours at min./max. temperature

The above products comply with the following standards (continued):

3. Mechanical stress

Vibration and shock test according to EN 60068-2 / IEC 68-2 / DIN 40046 (Environmental test)
Tests were carried out in three axes (X/Y/Z)

prEN60068-2-6:1994		Vibration, sinusoidal	10 cycles, 5 to 2000 bis 5 Hz at a logarithmic frequency change rate of 1 Oct./Min. 5 to 57 Hz, amplitude 1.5 mm (p-p) 57 to 2000 Hz, amplitude 10 g
	IEC 68-2-36:1973 DIN 40046-24:1977	Random vibration Broadband noise	20 to 2000 Hz, amplitude 0.1 g^2/Hz (14 g_{RMS}), testing time 24 h
EN 60068-2-27:1993		Shock	Half sine 15 g / 11 ms, 3 x in positive direction 3 x negative direction (in total, 6 individual shocks)
	IEC 68-2-29	Bumping	Half sine 15 g / 11 ms 1000 x in positive direction 1000 x negative direction (in total, 2000 individual shocks)

Plug-in proportional amplifier

Type VT-SSPA1-525-1X/V0

Component series 1X

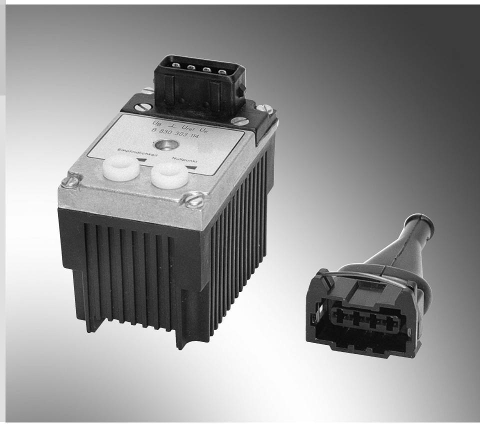


Table of contents

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

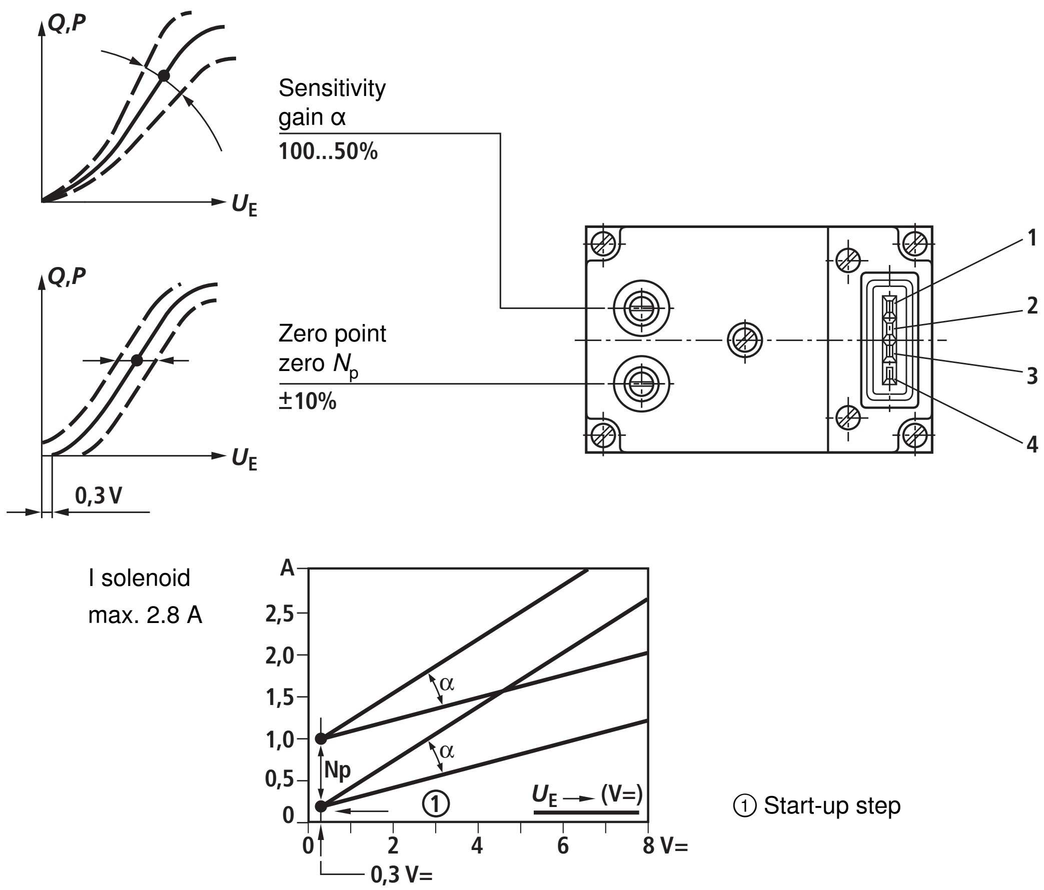
1X = Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

Customer version
V0 = Catalog version

Preferred types

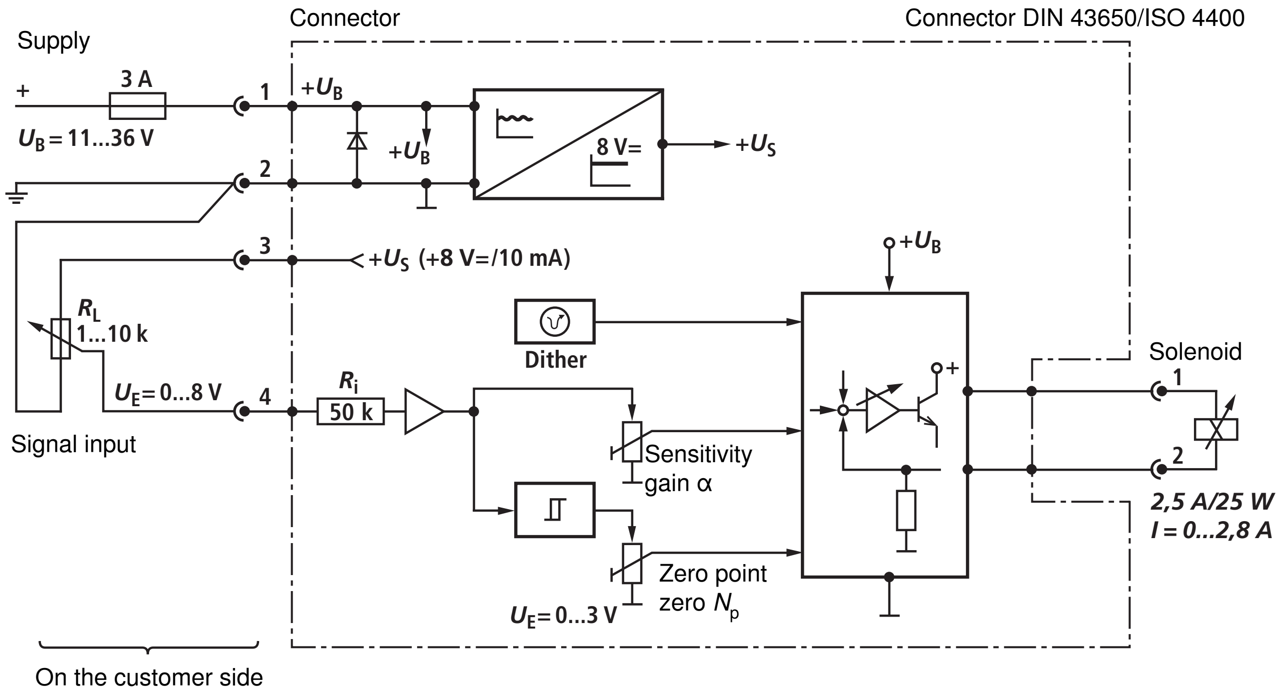
Type	Material number	For valves
VT-SSPA1-525-10/V0	0811405041	All proportional valves without position control with solenoid 2.5 A/25 W
Connector socket 4-pole	1834484098	

Adjustment, pin assignment



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

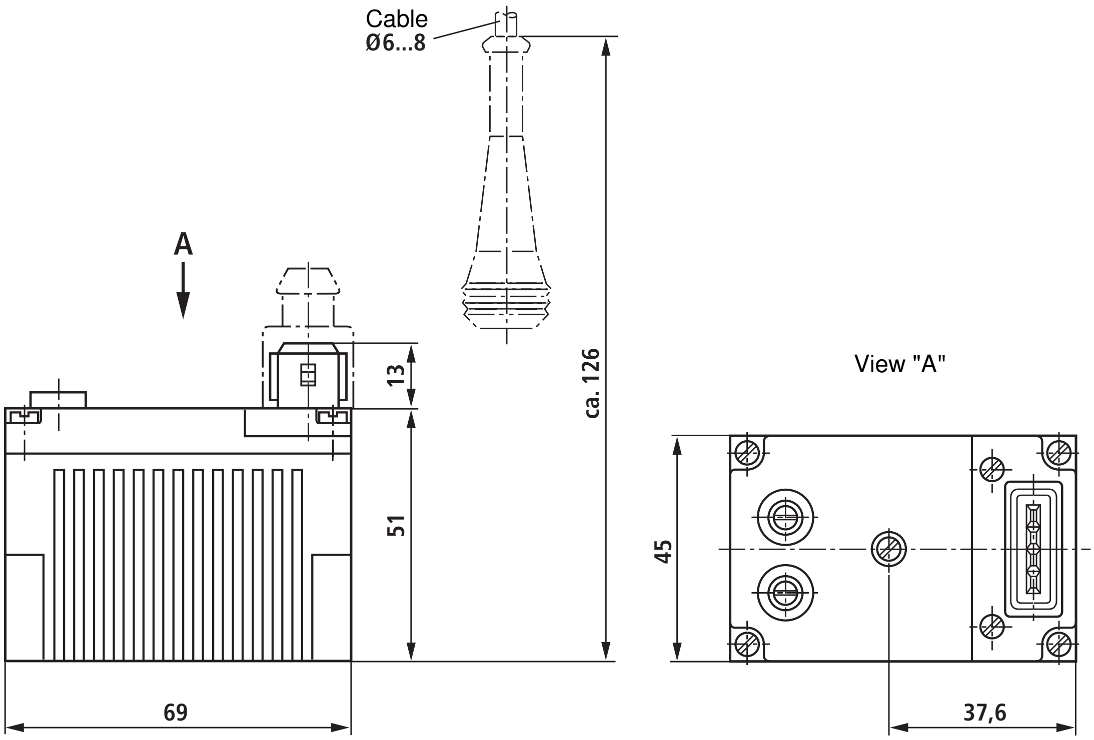
Block diagram with pin assignment



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".

The Drive & Control Company

Valve amplifier for proportional pressure valves

Type VT-MRMA1-1

RE 30214
Edition: 2017-03
Replaces: 04.13

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:

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

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 %.

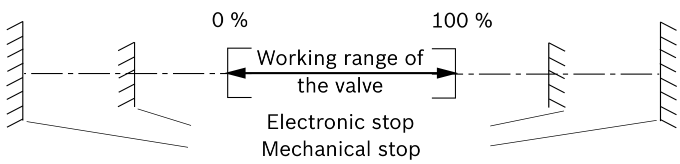
Actual valve position value acquisition [12]

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.

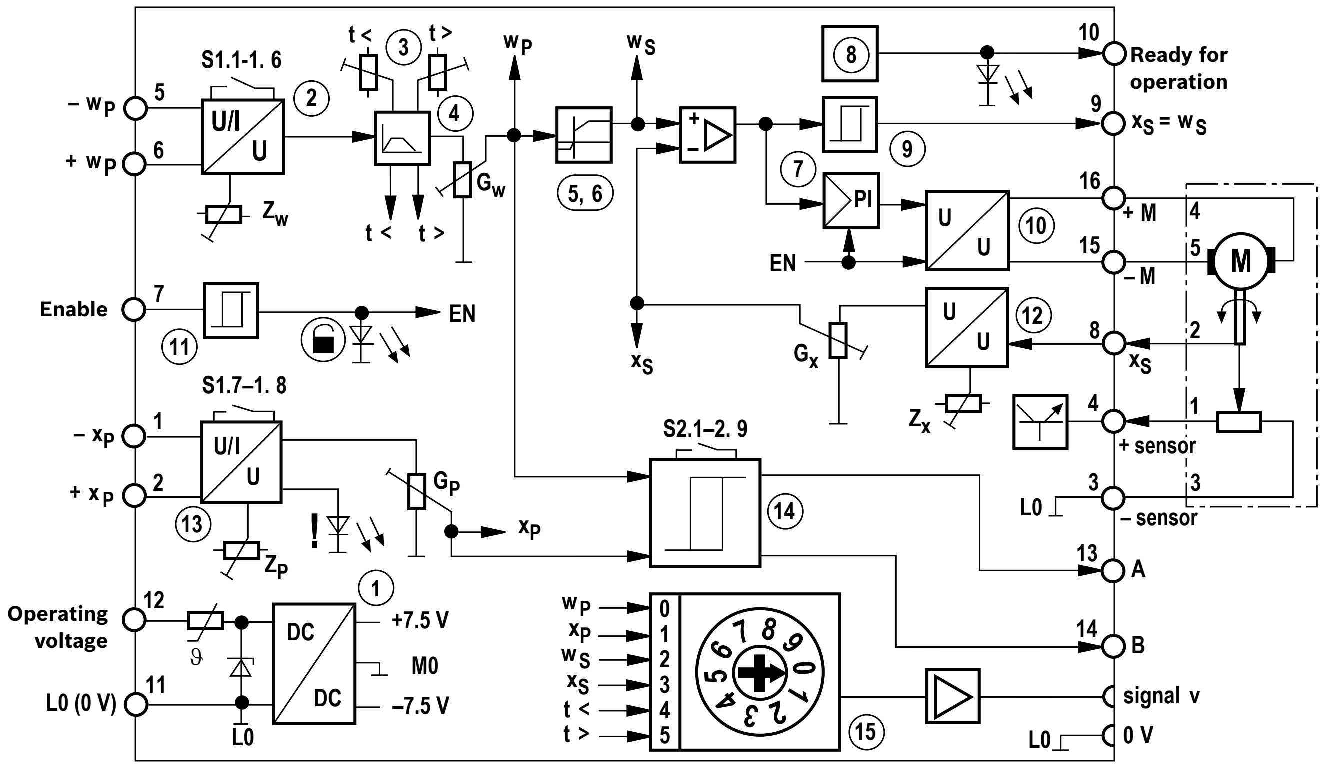
Measuring point		Switch position	Measurement signal v (⊥ is reference)
Pressure command value	w_P	0	0 % ≙ 0 V and 100 % ≙ 10 V
Actual pressure value	x_P	1	0 % ≙ 0 V and 100 % ≙ 10 V
Valve command value	w_S	2	0 % ≙ 0 V and 100 % ≙ 10 V
Actual valve value	x_S	3	0 % ≙ 0 V and 100 % ≙ 10 V
Ramp time "up"	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!)

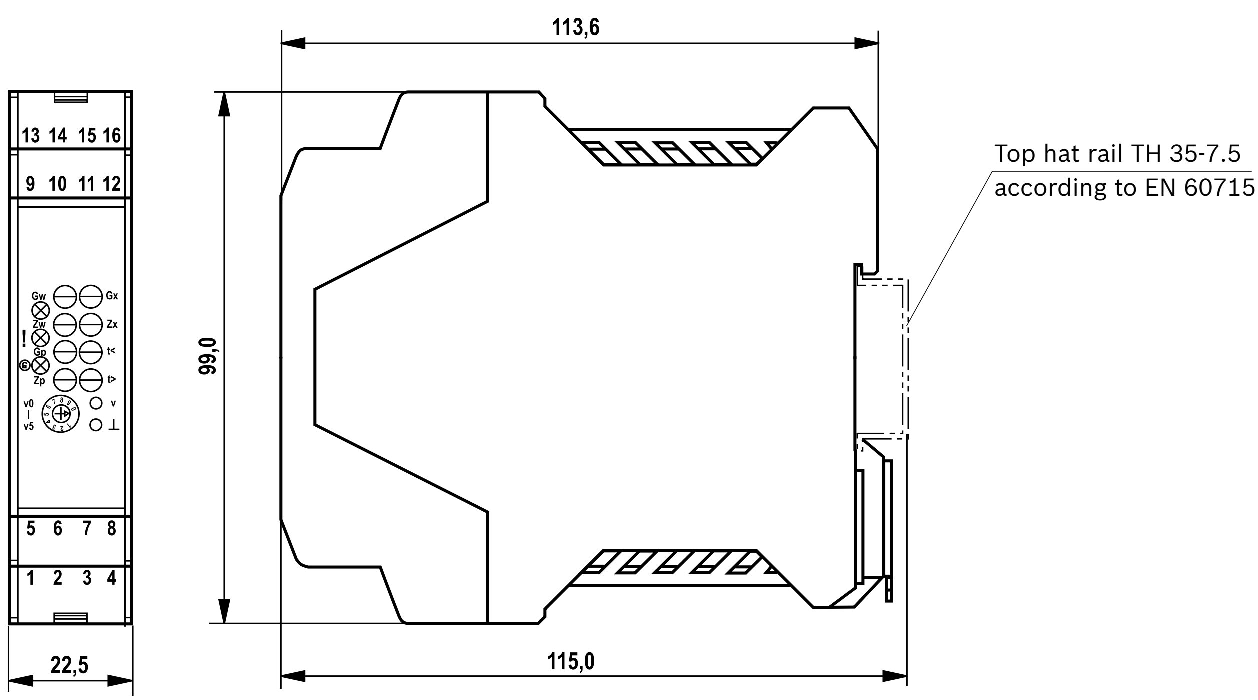
Operating voltage		U_B	24 VDC + 40 % – 20 %
Operating range	Upper limit value	$u_B(t)_{max}$	35 V
	Lower limit value	$u_B(t)_{min}$	21 V
Power consumption		P_S	< 50 VA
Current consumption	$i(t)_{max}$ (switching on the motor)		< 3.5 A
	I_{max} (during the actuating process)		< 1 A
	I_{min} (when output 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.

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

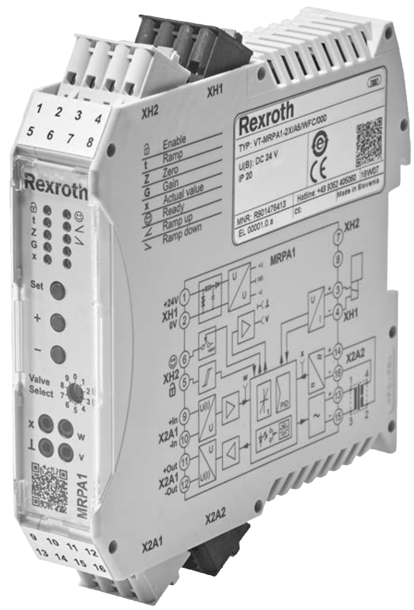
<table>
<tr><th></th><th>Signal</th><th>Setting</th></tr>
<tr><td>5</td><td>Maximum actual pressure value</td><td>Notice:
Before adjusting the maximum value, the 100 % actual pressure value must be adjusted accord-ing to step 4.
▶ Set external pressure command value provision to 100 %.
▶ Externally connect 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 (100 %)</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>

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

Valve amplifier for proportional directional cartridge valve of type 2WFC

Type VT-MRPA1...WFC

RE 30220
Edition: 2019-05
Replaces: 2019-02



H8144

- Component series 2X
- Suitable to control the pilot-operated proportional directional cartridge valve type 2WFC
- One amplifier for all valves of type 2WFC-1X
- Easy selection of the valves to be controlled according to sizes
- Characteristic curves of the valves stored in the device
- Valve optimization via push-buttons

Features

- Command value input 0 ... +10 V or 4 ... 20 mA
- Reverse polarity protection of the operating voltage
- Ramp generator up and down is separately adjustable
- Zero point setting
- Command value adjustment
- Position control
- Clocked power output stage
- Output short-circuit-proof
- LED status displays
- Measuring sockets for position actual value, internal command value and parameters to be set

Contents

Ordering code

01	02		03		04		05		06	07
VT-MRPA	1	–	2X	/		/	WFC	/	000	*

01	Valve amplifiers	**VT–MRPA**
02	For proportional directional cartridge valves with 1 solenoid	**1**
03	Component series 20 ... 29 (20 ... 29: unchanged technical data and ports)	**2X**
04	Voltage command value (0 ... +10 V)	**A5**
	Command value, current (4 ... 20 mA)	**F5**
05	Valve amplifier for proportional directional valve type 2WFC	**WFC**
06	Standard	**000**
07	Further details in the plain text	*

Available variants

Type	Material no.
VT-MRPA1-2X/A5/WFC/000	R901476413
VT-MRPA1-2X/F5/WFC/000	R901476414

Function

General
The amplifier module is intended for the assembly on top hat rails. The electrical connection is established via 4 tension spring plug-in connectors. The supply voltage is 24 VDC.

Power supply unit (1)
The internal power supply unit has a making current limiter to prevent current peaks. Additionally, inverse-polarity protection is integrated.

Command value, command value summing device (3)
The "internal command value" comprises:
- the "external command value", connected at the input of the differential amplifier (2)
- the zero point offset (4), "Z" adjustable in the standard - set-up

The "internal command value" can be measured at the "w" measuring socket and, in normal operation, at the "v" measuring socket.

Ramps
Ramps limit the incline of the command values.
You can choose between a single ramp (5) (one time for all ramps, default value) and a 2-quadrant ramp (2Q) (6) (different times for the ramps up and down). The 2Q ramp times are set in the expert setup.

Command value attenuator "G" (7)
By means of the command value attenuator, the command value can be reduced.

Position controller (8)
The valve position is recorded, compared to the command value in the current controller and the difference is compensated.

Power output stage (9)
The power output stage creates the clocked solenoid current for the directional control valve. The solenoid current is limited to the maximum admissible current, depending on the set valve size. The output stage is short-circuit-proof. With an internal interference signal or in case enable is missing, the output stage will be switched off.

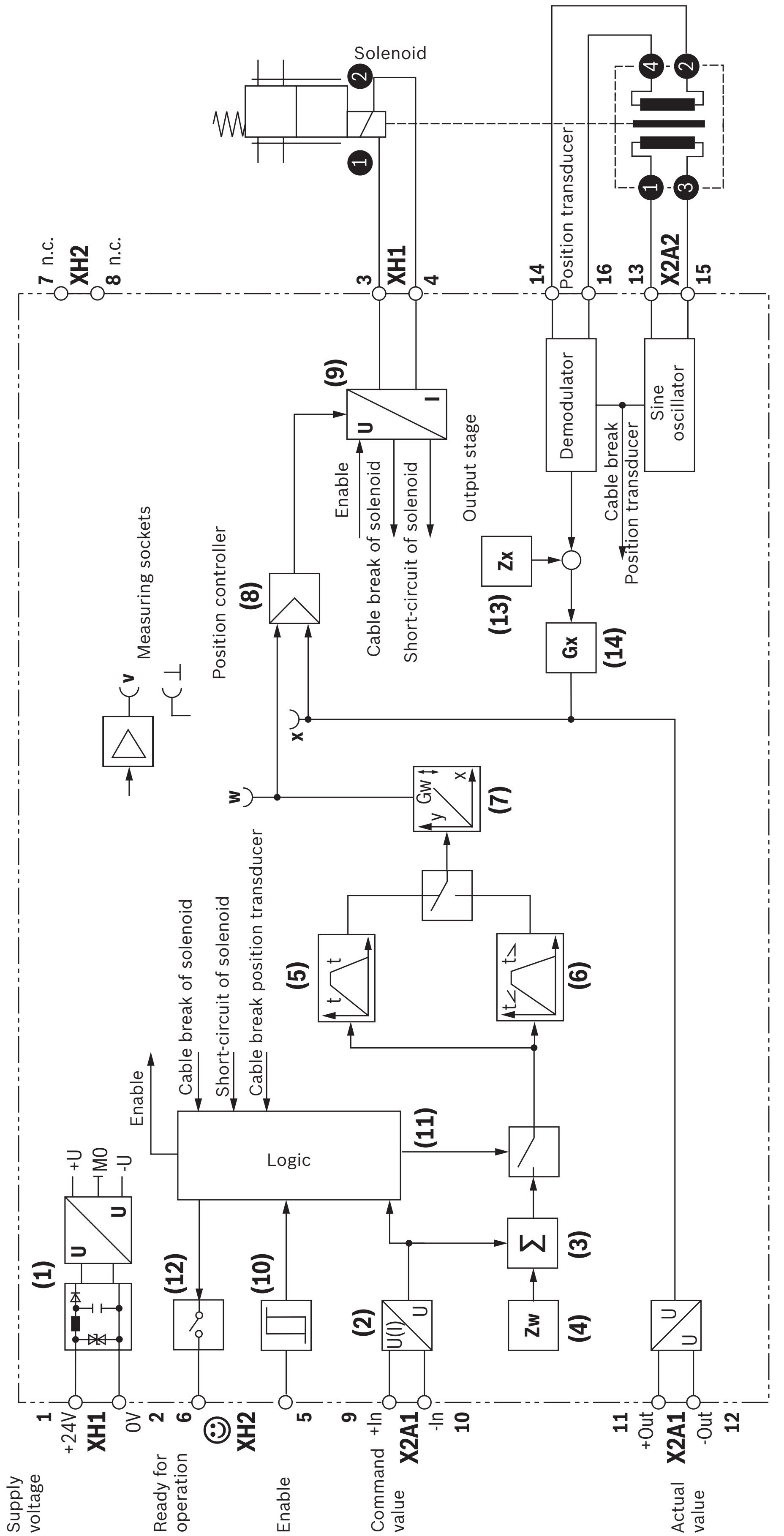
Enable input (10)
The enable input enables the output stage. The terminal has to be connected.

Logic (11)
Internal logic to enable output stage, internal command value and ready for operation output.

Ready for operation output (12)
Device notifies ready for operation if there is no cable break, no internal error and $\boldsymbol{U}_\mathrm{B} \geq \boldsymbol{U}_\mathrm{B\,min}$.

See also "block diagram" on page 3.

Block diagram



1 Power supply unit
2 Differential amplifier
3 Command value summing device
4 Zero point setting
5 Single ramp
6 2-quadrant ramp
7 Command value attenuator
8 Position controller
9 Output stage
10 Enable input
11 Switching logics/fault recognition
12 Ready for operation output
13 Actual value zero point trimming
14 Sensitivity adjustment actual value position

See also "Function" on page 2.

Technical data

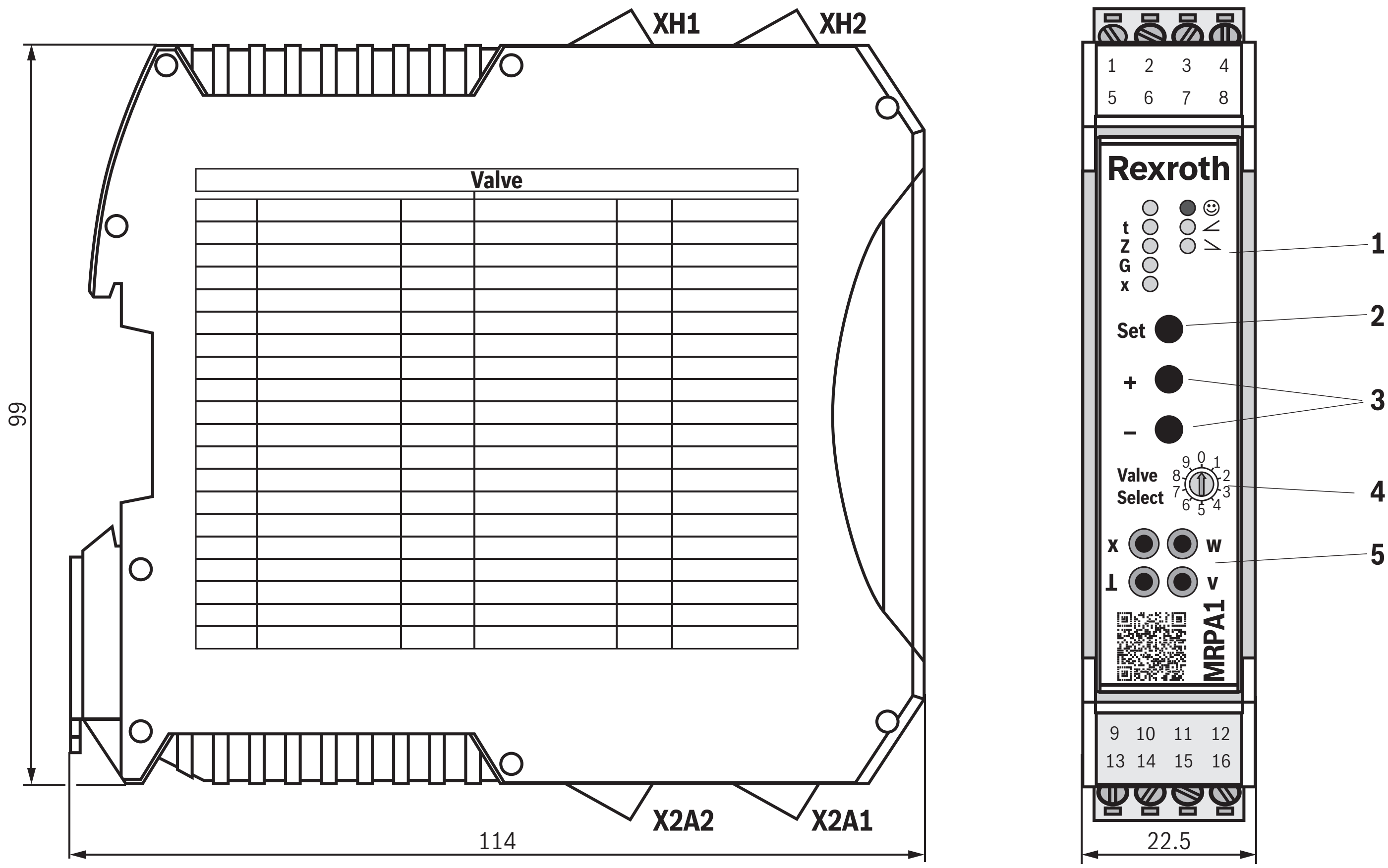
general			
Component series			2X
Design			Module
Voltage supply			
Operating voltage	▶ Nominal	V	24; +16% ... −20%
	▶ Lower limit value [1]	V	18
	▶ Upper limit value	V	28
	▶ Maximum admissible residual ripple (40 ... 400 Hz)	Vpp	2.5 (observe the admissible limits)
Maximum power consumption		W	< 48
Maximum current consumption		A	< 2
Maximum switch-on current		A	< 4
External fuse		A	3.15 time-lag
Analog input			
Command value	▶ Voltage (differential input) "A5"	V	0 ... +10
		kΩ	200 (input resistance)
	▶ Current input "F5"	mA	4 ... 20
		Ω	100 (load resistance, with overload protection!)
Analog output			
Position actual value	▶ Output range	V	0 ... 10
	▶ Minimum load impedance	Ω	1000
Digital input			
Enable	▶ On (active) [1]	V	11 ... U_B
	▶ Off (inactive)	V	-3 ... 5
Solenoid outputs			
Maximum solenoid current		A	2.7
Other properties, solenoid output			Short-circuit-proof, clocked
Cable length for 1.5 mm²		m	50
Adjustment options			
Zero point calibration		%	±10
Command value attenuator [2]		%	70 ... 110
Ramp time up / down		s	0.01 ... 30
Measuring sockets			
Actual value	▶ "x"	V	±10
Command value	▶ "w"	V	0 ... 10
Edition	▶ "v"	V	±10
Reference potential	▶ "⊥"		
Additional notes			See operating instructions 30220-B

1) R_E > 50 k Ohm
2) Applies to a command value of 100%

Technical data

Supplementary information			
Start-up time		s	< 1
Type of connection			16 spring-type terminals, detachable
Protection class according to EN 60529			IP 20
Ambient temperature range		°C	0 ... +60
Weight		kg	0.14
Maximum admissible temperature change		°C/min	5
Transport temperature range		°C	–40 ... +70
Recommended storage temperature with UV protection		°C	+5 ... +40
Relative air humidity (without condensation)		%	10 ... 95
Maximum altitude for use		m	2000
UV resistance			Housing is only partly UV resistant. Extended exposure to radiation may cause color changes.
Transport shock according to DIN EN 60068-2-27			15 g / 11 ms / 3 axes
Sine test according to DIN EN 60068-2-6		Hz	10 ... 500 (maximum 2 g / 10 cycles / 3 axes)
Noise test according to DIN EN 60068-2-64		Hz	20 ... 500 (2.2 g RMS / 6.6 g peak / 30 min. / 3 axes)
Free fall (in original packaging)		m	1
Installation position			Vertical. For breathing of the assembly, the ventilation slots of the top and bottom side must be at least 2 cm away from covers, walls, etc. With an ambient temperature of more than 50 °C, the clearance to the next assembly must be 1cm.
Top hat rail assembly			TH35-7.5 or TH35-15 according to EN 60715
Housing material			Glass-fiber reinforced polyamide plastic
Resistance against aggressive media			Contact with conductive dusts is not admissible. Avoid contact with hydraulic fluids.
Conformity			▶ CE according to the EMC directive 2014/30/EU ▶ CE according to the RoHS directive 2011/65/EU
Electro-magnetic compatibility (EMC)	▶ EN 61000-6-2		
	– EN 61000-4-2 ESD	kV	4 kV CD / 8 kV AD with evaluation criterion (BWK) B
	– EN 61000-4-3 HF radiated	V/m	10 (80 ... 6000 MHz) with BWK A
	– EN 61000-4-4 Burst	kV	2 (5 kHz and 100 kHz) with BWK B
	– EN 61000-4-5 Surge	kV	0.5 (2 Ω/12 Ω) to operating voltage, 1 kV (42 Ω) to signal with BWK B
	– EN 61000-4-6 HF conducted	V_{eff}	10 (150 kHz ... 80 MHz) with BWK A
	– EN 61000-4-8 Magnetic field 50/60 Hz	A/m	100 with BWK A
	▶ EN 61000-6-3 / EN 61000-6-4		
	– EN 55016-2-1 Interference voltage	MHz	0.15 ... 30 (class A, EN 55022)
	– EN 55016-2-3 Radio interference field strength	MHz	30 ... 6000 (class B, EN 55022)

Dimensions
(dimensions in mm)



1 **Status LEDs**
Display the current operating state, menu levels and error conditions

2 **SET key**
Editing the selected parameters, selection of work operation, selection of the "expert mode"

3 **+ / - keys**
Selection of the parameters and adjustment of the parameter values

4 **Rotary switch**
Selection of the valve sizes

5 **Measuring sockets**
for connecting a measuring instrument

Assignment: switch position/size

Switch position	Valve type/size
0	no valve
1	2WFC 16 ...-1X
2	2WFC 25 ...-1X
3	2WFC 32 ...-1X
4	2WFC 40 ...-1X
5	2WFC 50 ...-1X

Terminal assignment

Assignment		Connector	Terminal
Operating voltage	$+U_B$	XH1	1
	0 V	XH1	2
+ Solenoid B		XH1	3
– Solenoid B		XH1	4
Enable		XH2	5
Ready		XH2	6
n.c.		XH2	7
n.c.		XH2	8
+ Command value		X2A1	9
– Command value		X2A1	10
+ Actual value		X2A1	11
– Actual value		X2A1	12
+ OSC		X2A2	13
+ SIG		X2A2	14
– OSC		X2A2	15
– SIG		X2A2	16

Status description LEDs

Indicator light	Operating state	Display mode	Meaning
"Enable" LED (yellow) 🔓	Normal operation	Permanent light on/off	Enable input status
	Setup	Flashing	Standard setup active
	Setup	Off	Expert setup active
"Ready" LED (red/green) ☺	Normal operation	Permanent light, green	Module ready for operation
	Normal operation	Permanent light, red	Error
	Normal operation and setup	Flashing light, red-green	Valve setting changed
	Normal operation and setup	Flashing light, red	Inadmissible valve number
	Normal operation	Off	Module not ready for operation
	Setup	Flashing light, green	Expert setup active

Description of the LED display [1)]

🔓	Enable
t	Ramp
Z/B	Zero point / pilot current
G	Command value attenuator
x	Actual value
☺	Ready for operation
∠	1st quadrant (positive command value rising)
⦣	2nd quadrant (positive command value falling)

[1)] A detailed description is contained in the operating instructions 30220-B

Accessories (separate order)

	Material no.
Shield set for the installation with shielded lines	**R961011117**

Project planning and maintenance instructions

☞ **Maintenance instructions:**

- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices can be repaired.
- Repaired devices are returned with default settings. User-specific settings must be made by the machine end-user once again.

☞ **Notice:**

- In especially EMC-sensitive environments, additional measures must be taken (depending on the application, e.g. shielding, filtration)
- **Wiring information**
  - Maximum possible spatial separation between signal and load lines.
  - Do not lead signal lines through magnetic fields.
  - If possible, install signal lines without intermediate terminals.
  - Do not install signal lines in parallel to the load lines.
  - Connect cable shields (see the operating instructions 30220-B)
  - Lines for digital inputs and outputs can be laid in an unshielded manner.
  - Lines for command and actual values as well as the solenoid conductors must generally be laid in a shielded and/or twisted shielded manner.
  - The distance to radios must be sufficient (> 1 m).
  - With a strongly fluctuating operating voltage, in individual cases, it may 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.
- The upper and lower ventilation slots must not be concealed by adjacent devices in order to provide for sufficient cooling.

Further information

▶ Valve amplifier for proportional directional valve type 2WFC	Operating instructions 30220-B
▶ CE Declaration of Conformity	upon request
▶ Installation, commissioning and maintenance of proportional valves	Data sheet 07800
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900

The Drive & Control Company

Valve amplifier for proportional valves with electrical position feedback

Type VT-MRPA1-...

RE 30221
Edition: 2015-02
Replaces: 2013-08

H7076

- Component series 1X
- Analog, modular design
- Intended for controlling direct operated proportional pressure relief valves with electrical position feedback (type DBETR-1X) or proportional flow control valves with electrical position feedback (type 2FRE...)

Features

- Command value input +10 V (differential input)
- Ramp generator with separately adjustable ramp time "up/down"
- Zero point potentiometer
- Amplitude attenuator
- Enable input
- Reverse polarity protection for voltage supply
- Power supply unit with DC/DC converter without raised zero point
- Cable break detection in the position transducer branch
- LED indicators:
  - Ready for operation (green)
  - Enable (yellow)
- Measuring sockets for:
  - Command value "w"
  - Actual value "x"
  - Ramp times "t <", "t >"

Contents

Ordering codes

01		02		03		04		05		06
VT-MRPA1	**–**	**100**	**–**	**1X**	**/**	**V0**	**/**	**0**	**/**	*****

01	Analog amplifier in modular design	**VT-MRMA1**
02	For controlling the valve DBETR-1X	**100**
	For controlling the valve 2FRE6-2X	**150**
	For controlling the valves 2FRE10-4X and 2FRE16-4X	**151**
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	*****

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 at 24 V direct voltage.

Power supply unit [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 presetting
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 and thus a pressure increase in the valve.

Enable function [11]
The enable function enables the power output stages and forwards the internal command value signal to the ramp generator. The enable signal is displayed by an LED on the front plate. If enable is connected, the internal command value is changed (with any kind of command value presetting) by the set ramp time. Thus, a controlled valve does not open abruptly.

Ramp generator [4]
The ramp generator limits the rise of the control output. The amplitude attenuator does not extend or shorten the ramp time.
Notice 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 $t = \dfrac{100 \text{ V ms}}{5 \text{ V}} = 20 \text{ ms}$

Amplitude attenuator [5]
By means of the amplitude attenuator "Gw", the maximum value can be adjusted to the hydraulic requirements in a range between 0 and 100%.

Amplitude limiter [6]
The internal command value is limited to 0% and 110%.

Oscillator [9]
The oscillator creates the control signal for the inductive position transducer.

Demodulator [10]
The demodulator supplies the actual value signal of the valve spool position from the position transducer signal: +100% ≙ +10 V at the measuring socket "x".

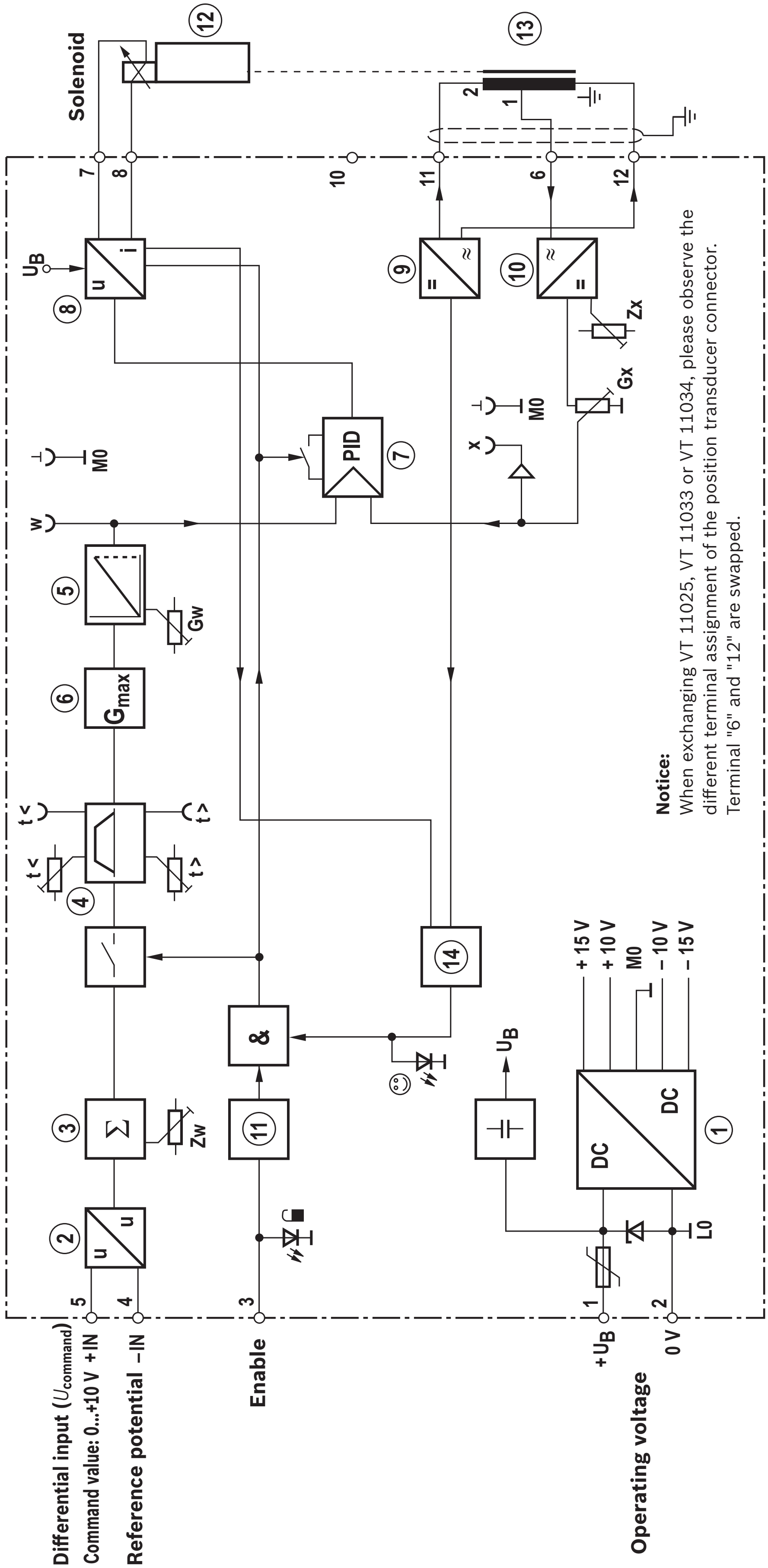
Controller for the valve spool position [7]
The position controller is intended to minimize the valve hysteresis and is optimized in a valve-specific manner.

Power output stage [8]
The power output stage creates the clocked solenoid current for the proportional valve. The solenoid current is limited to approx. 1.85 A. The output stage output is short-circuit-proof. The output stage is de-energized in case of an internal fault signal or if the enable signal is missing.

Fault recognition [14]
The position transducer cable is monitored for cable break and over-current at the output stage.

[ ] = References to the block diagram on page 4

Block diagram/pin assignment



Notice:
When exchanging VT 11025, VT 11033 or VT 11034, please observe the different terminal assignment of the position transducer connector. Terminal "6" and "12" are swapped.

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

Zw Zero point command value
Zx Zero point actual value
t < Ramp time "up"
t > Ramp time "down"
Gw Amplitude attenuator
Gx Sensitivity actual value
w Command value
x Actual value
☺ Ready for operation
Enable

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

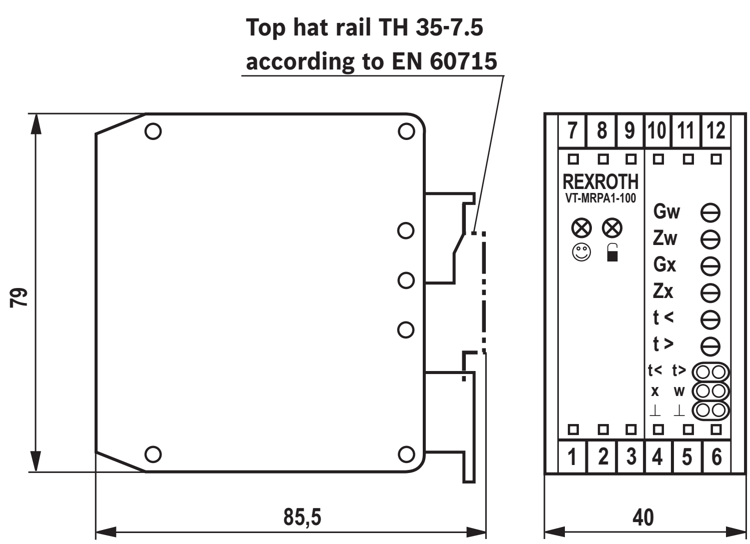
Operating voltage	U_B	24 VDC + 40% – 20%
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V
– Lower limit value	$u_B(t)_{min}$	18 V
Power consumption	P_S	< 24 VA
Current consumption	I	< 2 A
Fuse		Thermal overload protection (with restart if the value falls below the temperature threshold)
Inputs:		
– Analog		
• 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
Setting ranges:		
– Zero point command value (potentiometer "Zw")		±10%
– Zero point actual value (potentiometer "Zx")		±10%
– Ramp times (potentiometer "t <" and "t >")	t	20 ms to 5 s
– Amplitude attenuator (potentiometer "Gw")		0% to 110% (applies to the zero point setting = 0%)
Outputs:		
– Power output stages	I	0 to 1.85 A; short-circuit-proof; clocked 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
Type of connection		12 screw terminals
Type of mounting		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)		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

Notice:
For information on the **environment simulation testing** for the areas EMC (electro-magnetic compatibility), climate and mechanical load, see data sheet 30221-U.

Terminal assignment

Operating voltage	$+U_B$	**1**	**7**		Solenoid	Connection cable (recommendation): 2-wire cable, single shielded, 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-wire cable, single shielded, cross-section 1.5 mm^2 max.
Position transducer return feed	1	**6**	**12**	⏚		

Dimensions (dimensions in mm)



LED indicators:

☺	Ready for operation (green)
🔓	Enable (yellow)

Potentiometer:

Gw	Amplitude attenuator for positive command values
Gx	Sensitivity adjustment of positional transducer (pre-set)
Zw	Zero point command value
Zx	Zero point actual value
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
⊥	Measurement zero

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 conductors.
- The distance to aerial lines, radios, and radar systems has to be 1 m at least.
- Always shield command value and position transducer lines; connect shielding to protective earthing (PE) on the module side.
  In some cases (e.g. if PE is subject to strong interference) it can be necessary to connect the shield of the position transducer line directly to the LO of the amplifier module; other side open (risk of ground loops).
- Recommendation:
  Also shield solenoid conductors!
  For solenoid lines up to a length of 50 m, use cable type LiYCY 1.5 mm^2.
  For longer lines, please consult us.
- Do not connect terminal "⏚" of the position transducer connector to "PE".
- For switching command values, relays with gold-plated contacts have to be used (low voltages, low currents).
- Only carry out measurements at the module using instruments with R_i > 100 kΩ
- 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
- **Notice:**
  When exchanging VT 11025, VT 11033 or VT 11034, please observe the different terminal assignment of the position transducer connector. Terminals "6" and "12" are swapped.

Setting recommendation

The system-specific circuitry must have been completed.

Signal	**Setting MRPA1**
Command value zero point	Apply enable signal
	Preset the external command value to zero
	Set the internal command value to zero using the "Zw" zero point potentiometer and carry out a check at measuring socket "w"
Actual value zero point	Enable signal "OFF" or pull solenoid plug (valve moves to mechanical end position)
	For all settings, observe polarity of measuring device → measuring sockets
Ramp times	Set ramp time according to formula or table (see functional description "Ramp generator") and check it at the "t >" and "t <" measuring sockets
Maximum value (amplitude attenuator "Gw")	Notice: Before comparing the maximum value, the zero point must have been set correctly.
	Preset command value = 100%
	Set maximum control output using the "Gw" potentiometer and carry out a check at measuring socket "w"

Declaration on environmental compatibility in the fields of EMC[1], climate and mechanical stress

Type VT-MRPA1-1..-1X/V0/0

Analog amplifier modules

Product types

– VT-MRPA1-100-1X/V0/0 according to data sheet RE 30221
– VT-MRPA1-150-1X/V0/0 according to data sheet RE 30221
– VT-MRPA1-151-1X/V0/0 according to data sheet RE 30221

Description of the product family

Analog amplifier modules 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...)

[1] in the sense of the EMC law of 30th August 1995 and Directive 89/336/EEC

The products comply with the following standards:

1. EMC (electromagnetic compatibility)

Testing in accordance with generic standard EN 61000-6-2:2001, VDE 0839 part 6-2

EN 61000-4-2:1995 +A1:1998 +A2:2000 IEC 1000-4-2	VDE 0847-4-2	ESD (electrostatic discharge)	Air discharge: Severity 3 / Assessment criterion B Contact discharge: Severity 2 / Assessment criterion B
EN 61000-4-4:2004 IEC 1000-4-4	VDE 0847-4-4	BURST (transient discharge)	Repetition rate 5 kHz Supply voltage: Severity 2 / Assessment criterion A Severity 3 / Assessment criterion B Data cable: Severity 4 / Assessment criterion A Repetition rate 100 kHz Supply voltage: Severity 3 / Assessment criterion A Data cable: Severity 4 / Assessment criterion A
EN 61000-4-5:1995 +A1:2001 IEC 1000-4-5	VDE 0847-4-5	SURGE (surge voltages)	Supply voltage: Severity 1 / Assessment criterion A
EN 61000-4-6:1996 +A1:2001 IEC 1000-4-6	VDE 0847-4-6	HF fields, conducted interference	Severity 3 / Assessment criterion A

2. Climate

Testing in accordance with EN 60068-2 / IEC 68-2 (environmental test)

EN 60068-2-1:1994		Cold test	2 cycles –5 °C Dwell time 2 hours
EN 60068-2-2:1993		Dry heat test	2 cycles +55 °C Dwell time 2 hours
EN 60068-2-1:1994 EN 60068-2-2:1993		Storage temperature	–25 °C, dwell time 16 hours +85 °C, dwell time 16 hours
	IEC 68-2-14:1986	Temperature cycle	2 cycles –5 °C to +55 °C Dwell time 3 hours each at min. / max. temperature
	IEC 60068-2-30:1999	Damp heat, cyclical	Variant 2 +25 °C to +40 °C 93 % to 97 % elative humidity 2 cycles of 24 hours each

The products comply with the following standards (continued):

3. Mechanical stress

Vibration and shock test in accordance with EN 60068-2 / IEC 68-2 / DIN 40046 (environmental test)
Testing in three axes (X/Y/Z)

EN 60068-2-6:1996			Sine test	10 cycles at, 5…500 Hz…5 Hz at a logarithmic frequency change rate of 1 oct./min. 5 to 57 Hz, amplitude 0.3 mm (p-p) 57 to 500 Hz, amplitude 2 g
	IEC 68-2-36:1973	DIN 40046-24:1977	Random test Wide band noise	20 to 500 Hz, amplitude 0,01 g^2/Hz ($2,2\ g_{RMS}$) Testing time 30 min
EN 60068-2-27:1993			Shock test	Half sine 15 g / 11 ms, 3 x in positive/ 3 x in negative direction per axis; 18 individual shocks in total

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

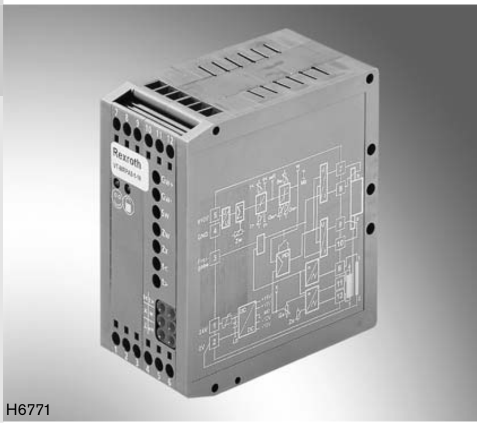


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Table of contents

Contents	**Page**

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

Further details in clear text

V0 = Basic version

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]

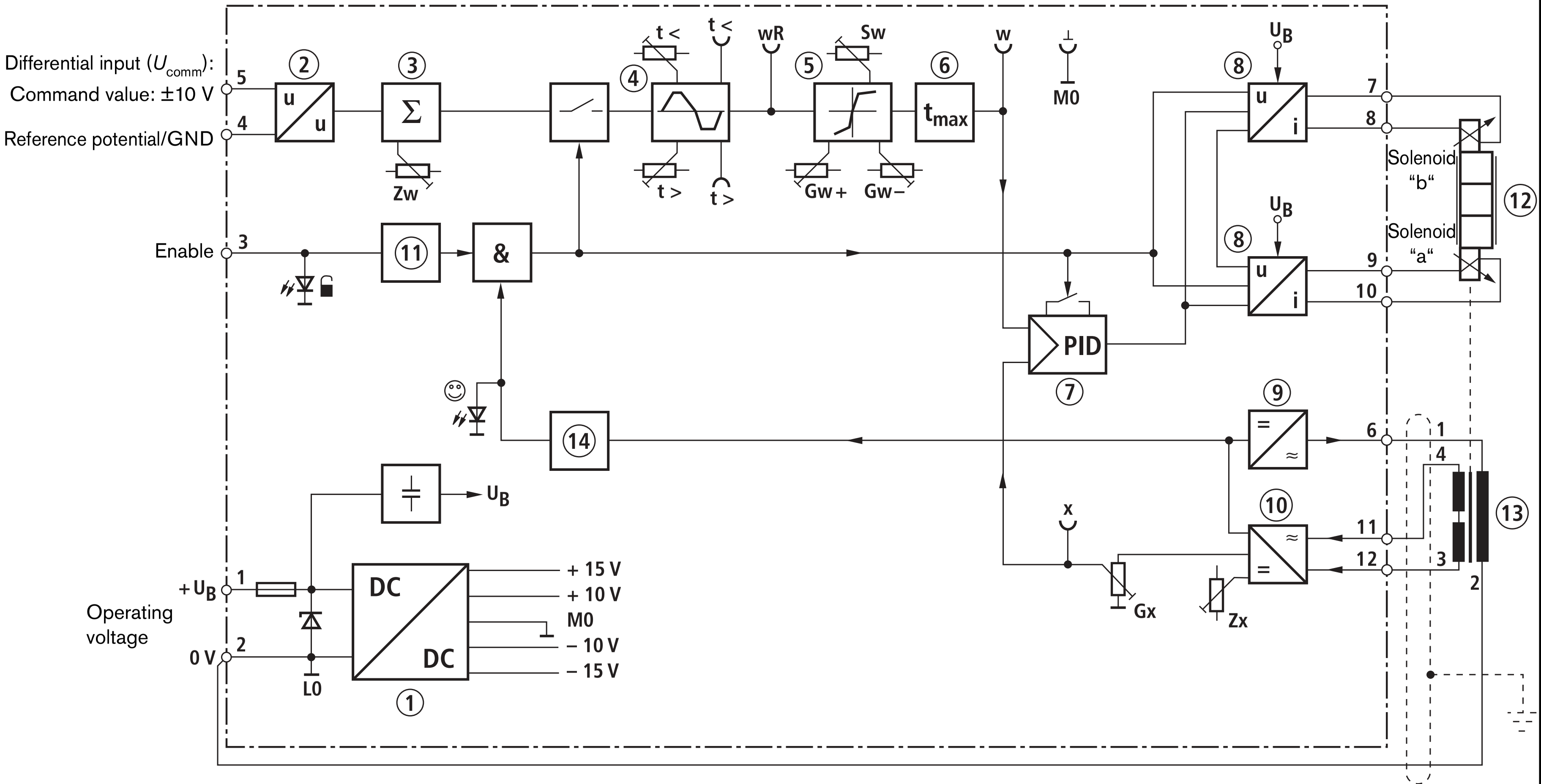
The position transducer cable is monitored for cable break and primary-sided short-circuit, and the output stage for overcurrent.

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

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.

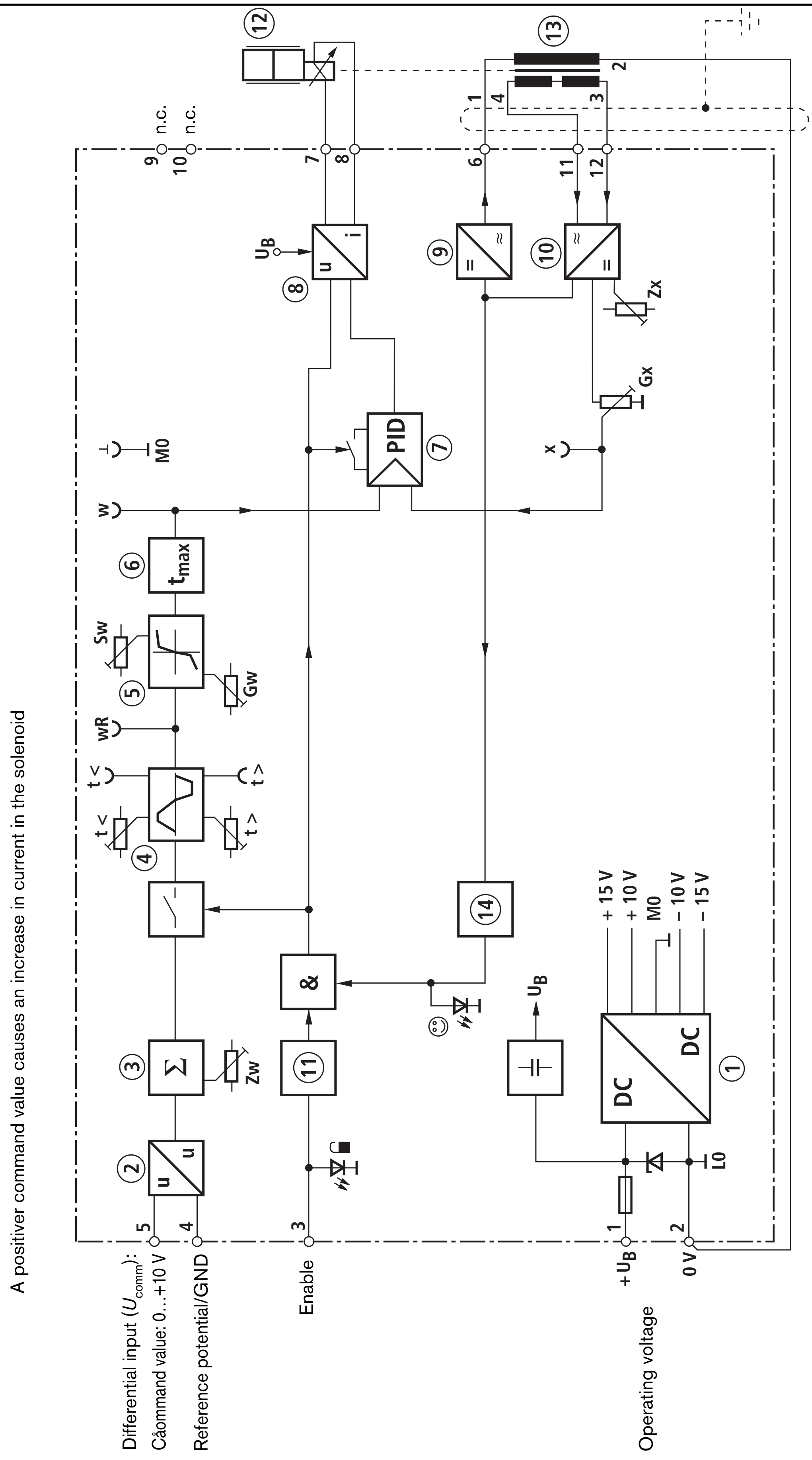
A negative command value causes an increase in current in solenoid "a" and hence a flow in the valve from P to B and from A to T.



Zw	=	Command value zero point	**Gx**	=	Actual value sensitivity
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
2 Differential amplifier
3 Command value summator
4 Ramp generator
5 Characteristic curve generator
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

Block circuit diagram / pin assignment VT-MRPA1



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

1 Power supply unit
2 Differential amplifier
3 Command value summator
4 Ramp generator
5 Characteristic curve generator
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

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!**

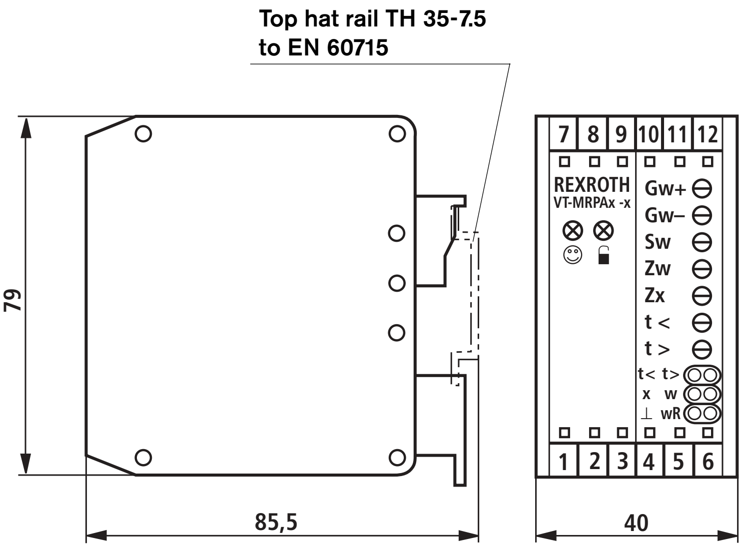
Details with regard to **environment simulation testing** in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 30219-U (declaration on environmental compatibility).

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 $R_i > 100\ k\Omega$.
- 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"

Rexroth
Bosch Group

Electric amplifiers

RE 30052/02.12
Replaces: 01.09

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

Component series 1X

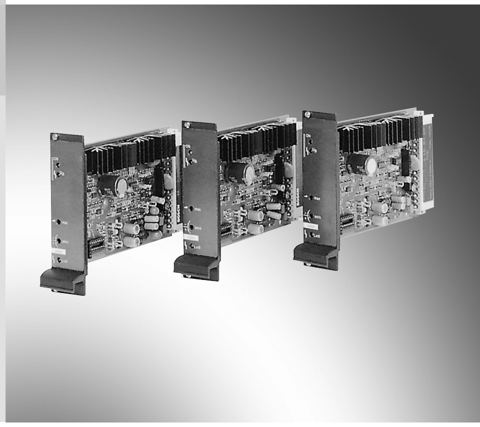


Table of contents

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**
- 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 valves

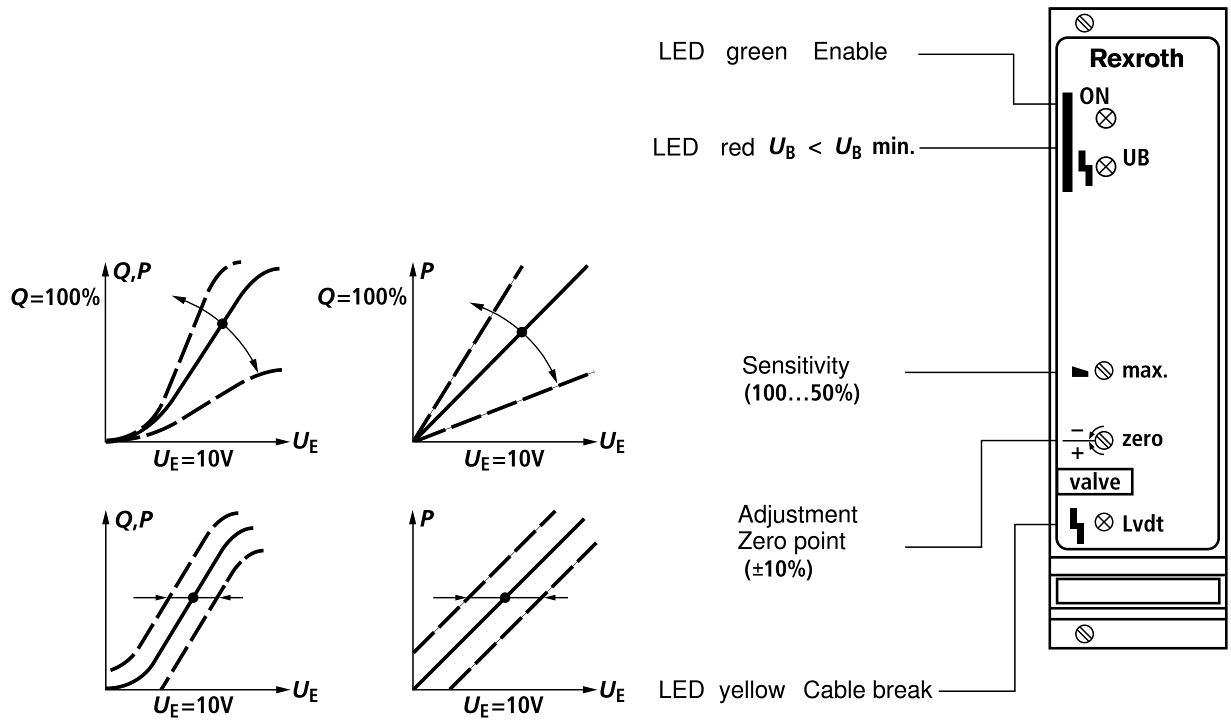
Preferred types

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

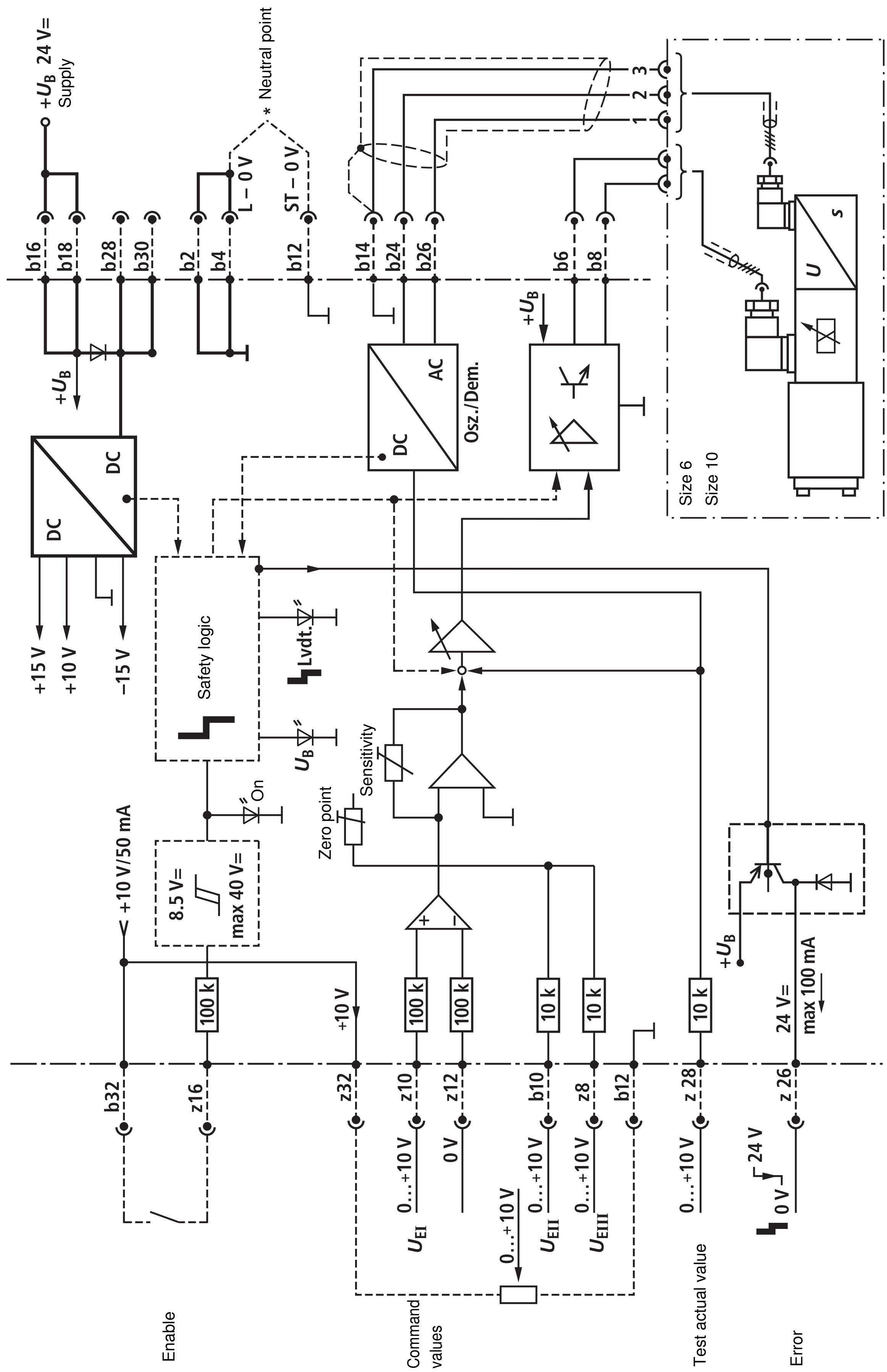
Suitable card holder:

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

Front plate



Block diagram with pin assignment



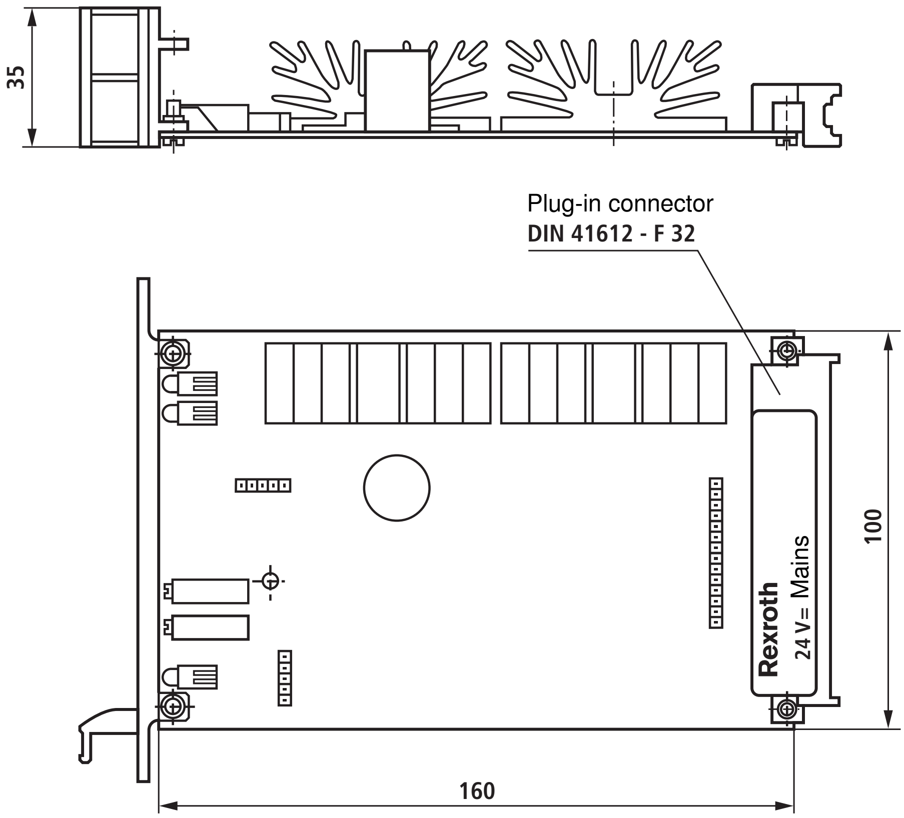
Technical data

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 mm² 20 to 60 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 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.

Electric amplifiers

RE 30054/03.12
Replaces: 01.09

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

Component series 1X

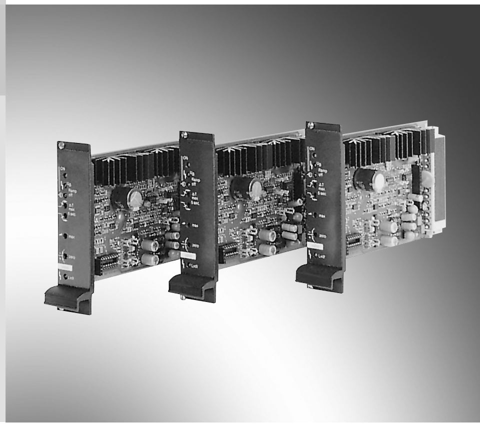


Table of contents

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
– 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)

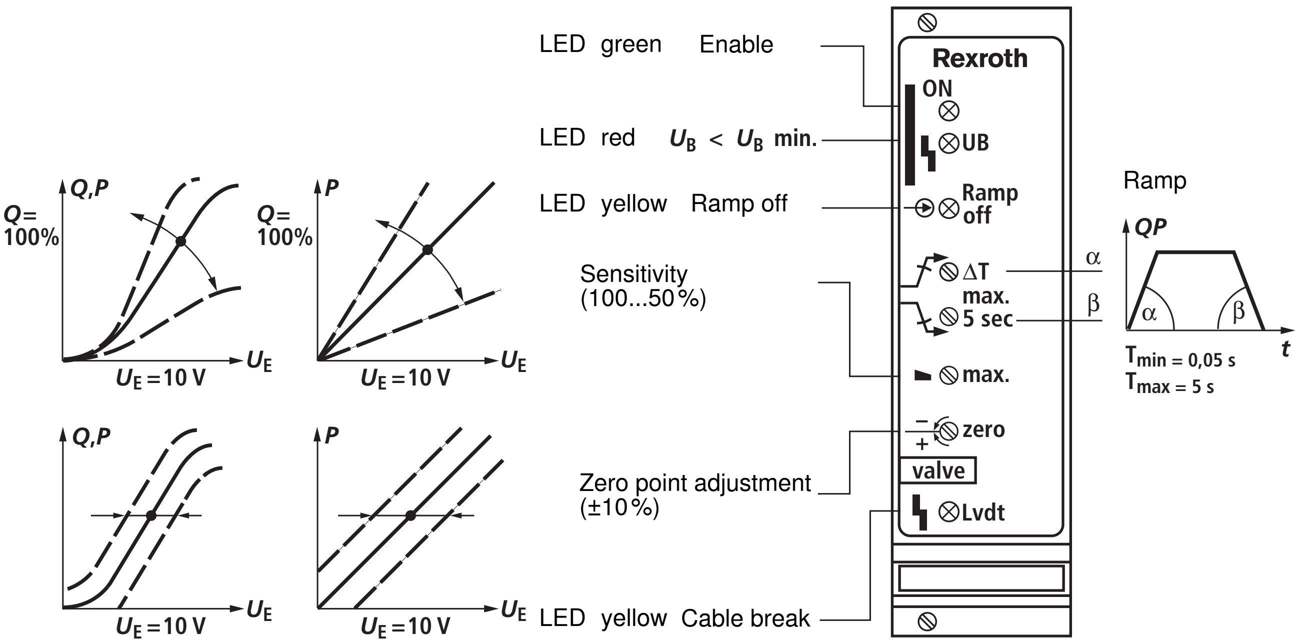
Preferred types

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

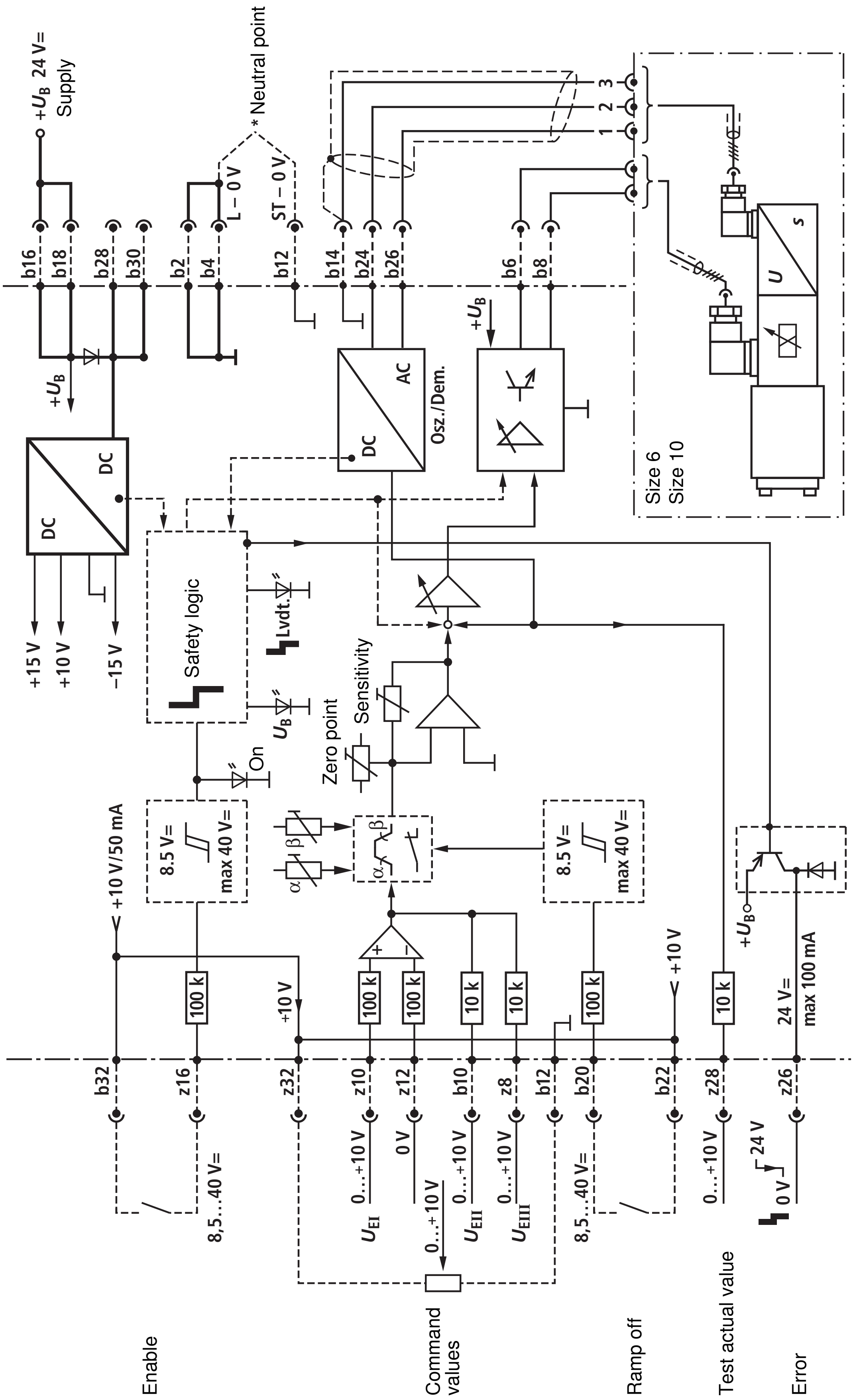
Suitable card holder:

– 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

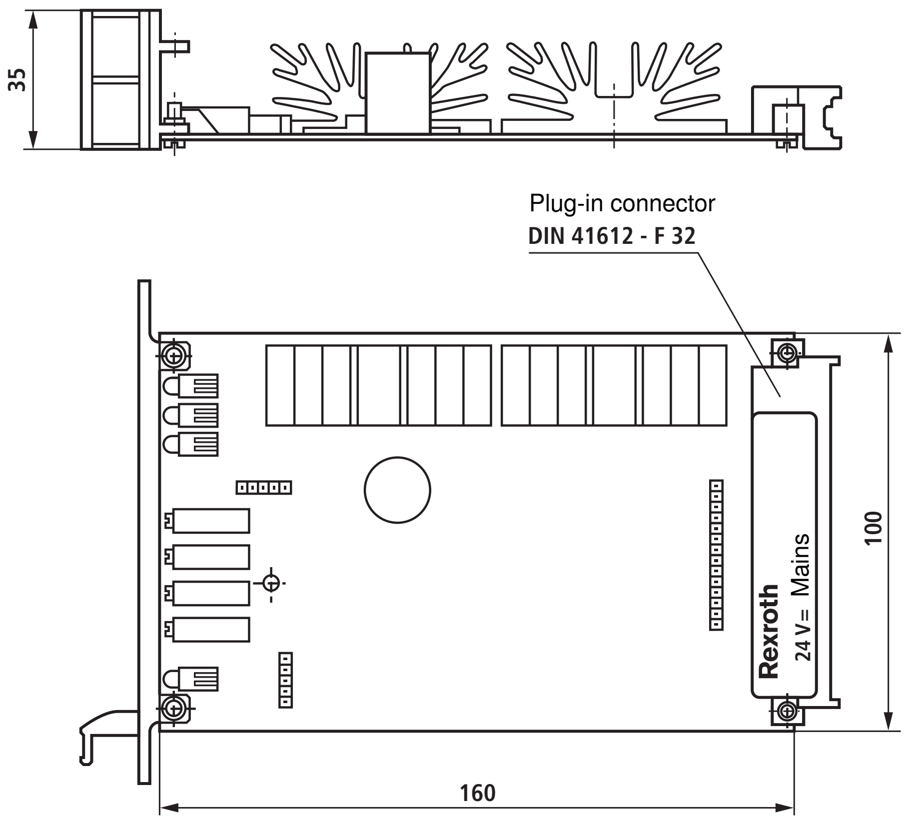
Information for the use of ramps

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.

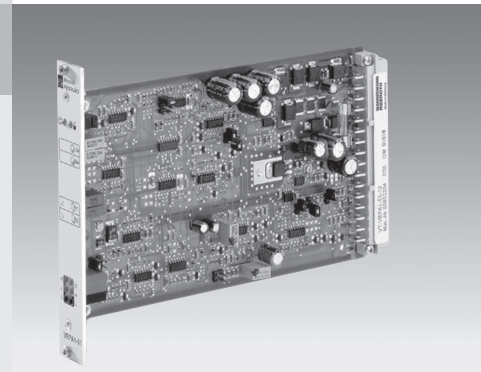
Rexroth
Bosch Group

Analogue amplifier

RA 30118/11.04
Replaces: 04.04

Model VT-VRPA1-...

Component series 1X



H/A/D 6197/99

Table of contents

Card holder:

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

Power supply:

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

Features

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

Ordering details

VT-VRPA1 – –1X / V0 / 0 / *

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

Amplifier for proportional pressure valves	
DBETR–1X	**= 100**
2FRE 6	**= 150**
2FRE 10 and 16	**= 151**

Further details in clear text

1X = Component series 10 to 19 (10 to 19: unchanged 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

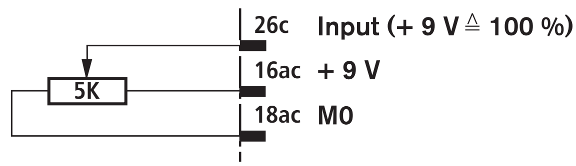
Functional description

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.

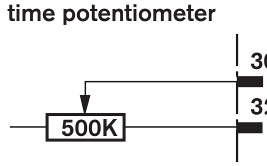
Command value
The command value signal is applied either directly from the regulated +9 V of the power supply [6] or via an external command value potentiometer. For the input „command value 1“ +9 V = +100 % applies and for the input „command value 2“ +6 V = +100 % applies. The reference point for the 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.

Functional description (continued)

Calculating the ramp times

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

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

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

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

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

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

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

Limiting and position controller

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

Position sensing

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

Note

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

Enable input

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

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

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

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

Continued on next page

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

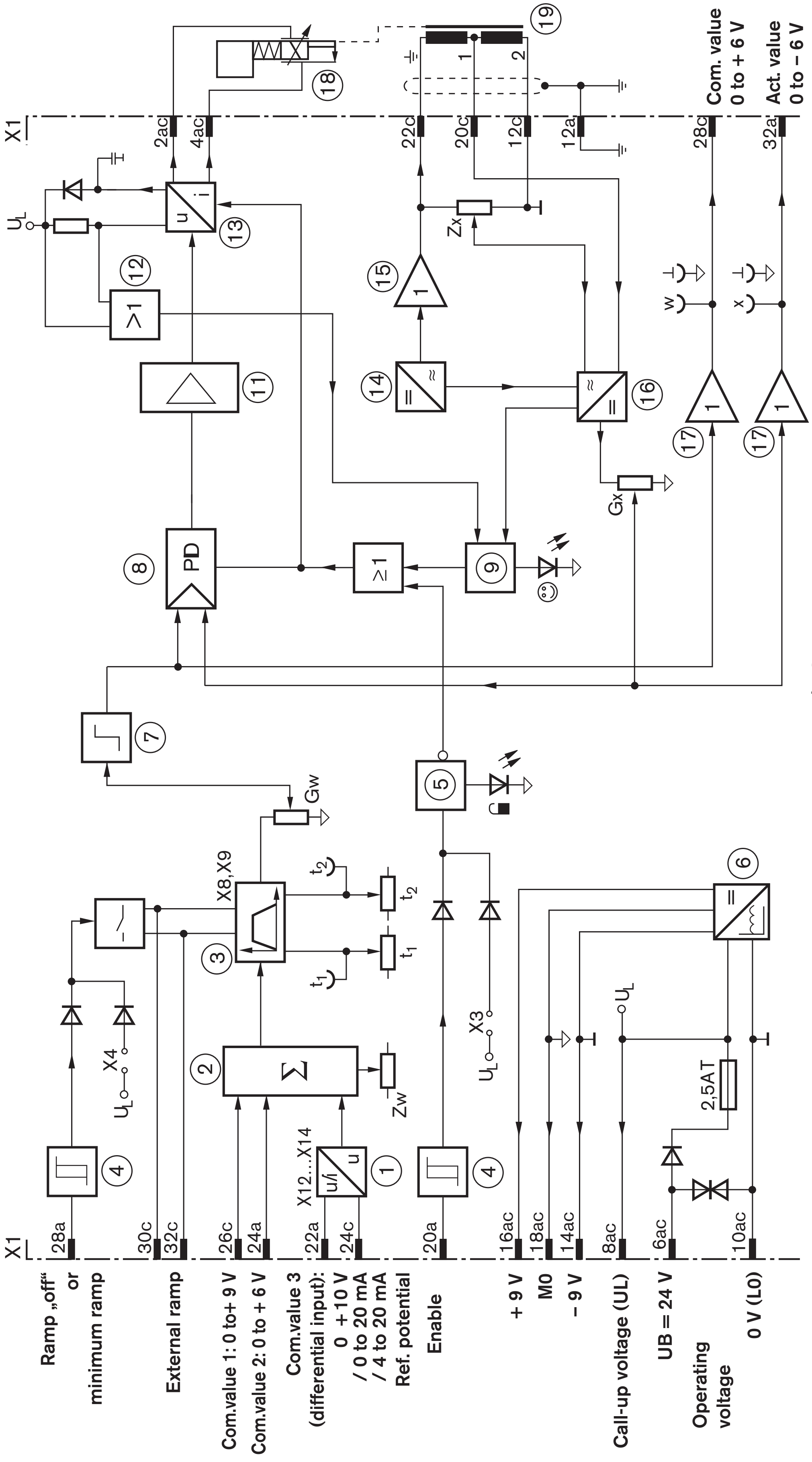
Continued from previous page

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

Note!

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

Block circuit diagram / connection allocation



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

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

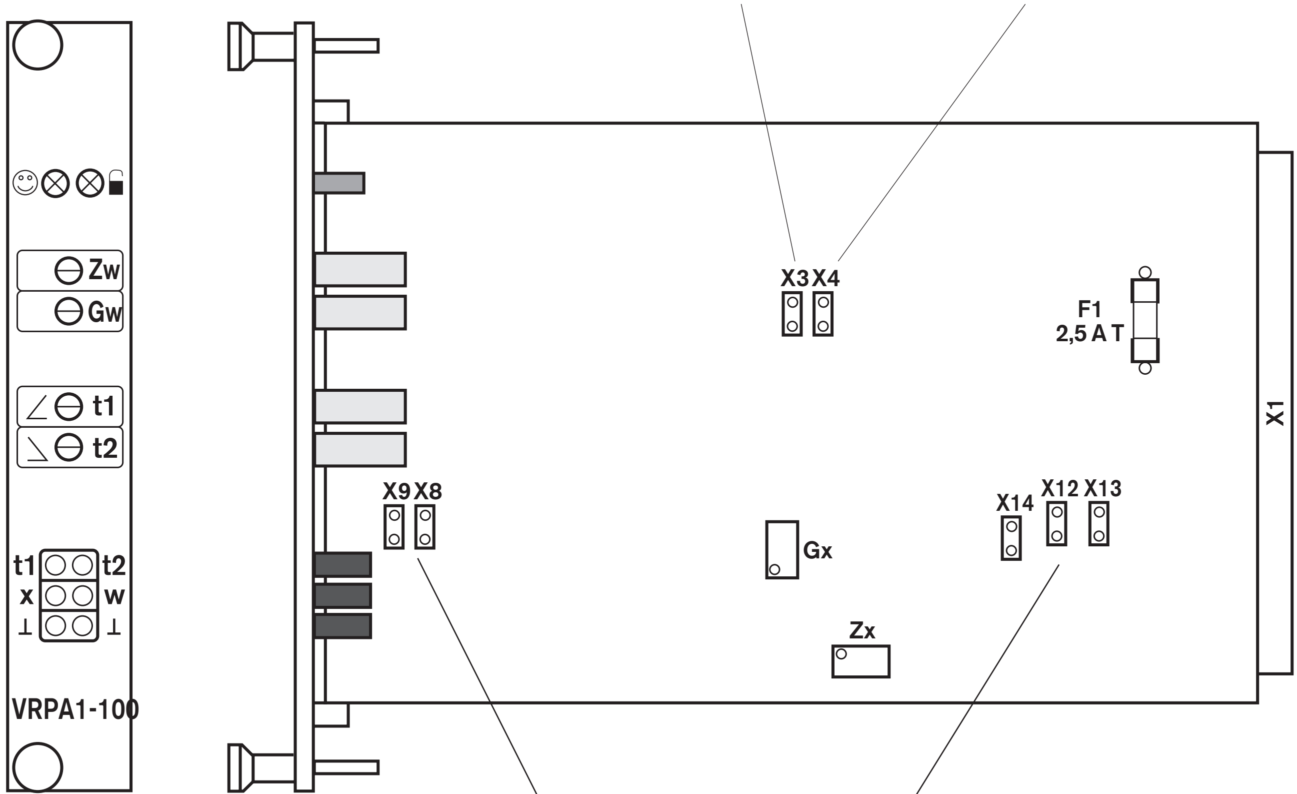
11 Summator controller
12 Over-current recognision
13 Clocked output stage
14 Oscillator
15 Position transducer driver
16 Demodulator
17 Output stage
18 Proportional valve
19 Position transducer

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

Display / adjustment elements

Enable [1]	**X3**
Permanently ON •	▬
Externally controlable	○○

Ramp	**X4**
Permanently OFF •	▬
Externally controlable	○○



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

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

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

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:

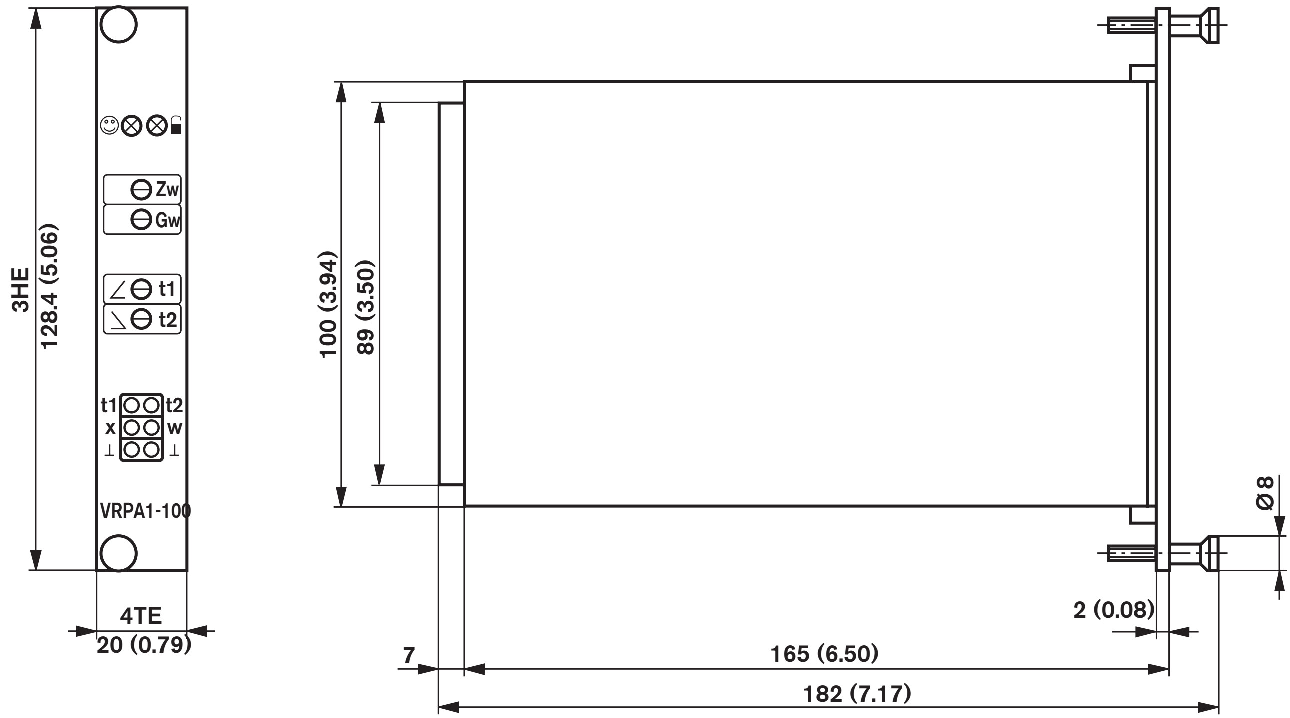
- **Zx** Zero point actual value
- **Gx** Actual value

Measurement sockets:

- **t1** Ramp time „up"
- **t2** Ramp time „down"
- **x** Actual value
- **w** Command value
- ⊥ Measurement zero

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

Unit dimensions - nominal dimensions in mm (inches)



Engineering / maintenance guidelines / additional information

– The amplifier card must be configured to match the application; see display/adjustment elements on page 6!
– The amplifier card may only be unplugged or plugged when switched off!
– For the solenoid connection, plugs fitted with free-wheeling diodes or LED displays must not be used!
– Measurements at the card may only be caried out with instruments $R_i > 100$ 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 mm^2.
For longer lengths please consult us!
– The distance to antenna lines, radio sources and radar equipment must be at least 1 m!
– Do not lay solenoid and signal lines near power lines!
– Because of the loading current of the smoothing capacitor on the card, the pre-fuses must have slow blowing characteristics!
– The connection of the inductive position transducer that is marked with the ground symbol must not be connected to ground! (Precondition for the compatibility with amplifier types VT 5003, VT 5004 and VT 5010)
– **Attention:** When using the **differential input, both inputs** must always be switched on or off **simultaneously**!

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

Standard types

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

Rexroth
Bosch Group

Analogue Amplifiers

RE 30117/07.06
Replaces: 05.06

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

Series 1X

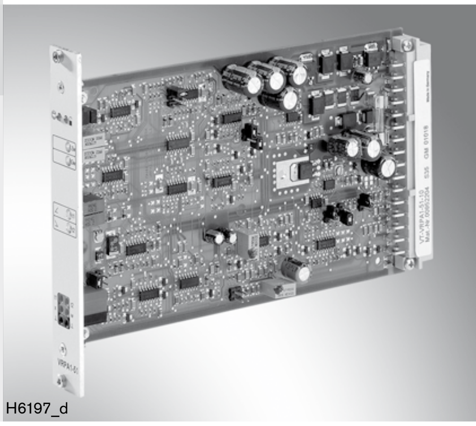


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Table of contents

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**

Further details in clear text

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

Suitable card holders:

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

Suitable power supply unit:

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

Further information:

– VT-PPV-1X, see RE 29687

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

Material no.: R900021004

Functional description

Power supply unit

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

Readiness for operation

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

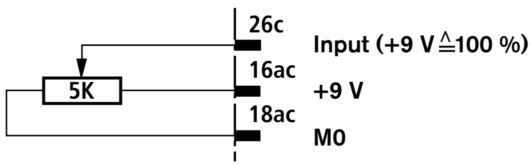
The green LED on the front panel lights up to signal readiness for operation.

Command value

The command value voltage is provided either directly via the regulated voltage of +9 V from the power supply unit [6] or via an external command value potentiometer. The following is valid for input "command value 1": +9 V = +100 %, and for input "command value 2": +6 V = +100 %. The reference point for command value inputs 1 and 2 is always M0 (18ac). Command value input 3 is a differential input [1] (0 to +10 V). It can be configured as current input (0 to 20 mA or 4 to 20 mA) by plugging jumpers. If the command value is provided by external electronics with another reference potential, the differential input must be used.

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

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



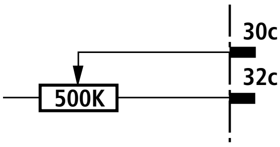
Ramp function

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

For details, see "Technical data"

Functional description (continued)

External time potentiometer



Note:

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

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

Calculation of the ramp times

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

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

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

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.

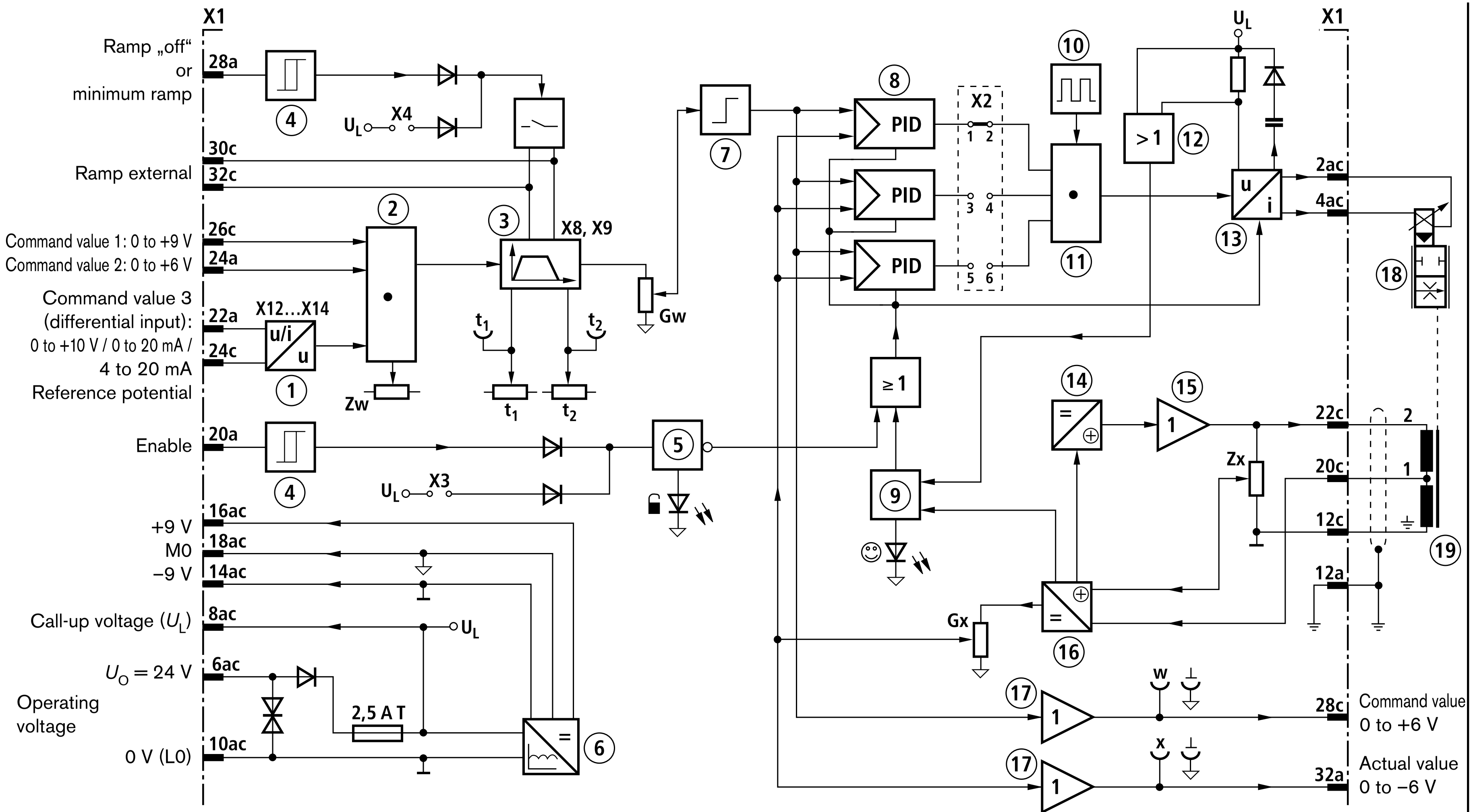
[ ] = Cross-reference to block circuit diagram on page 4

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

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)

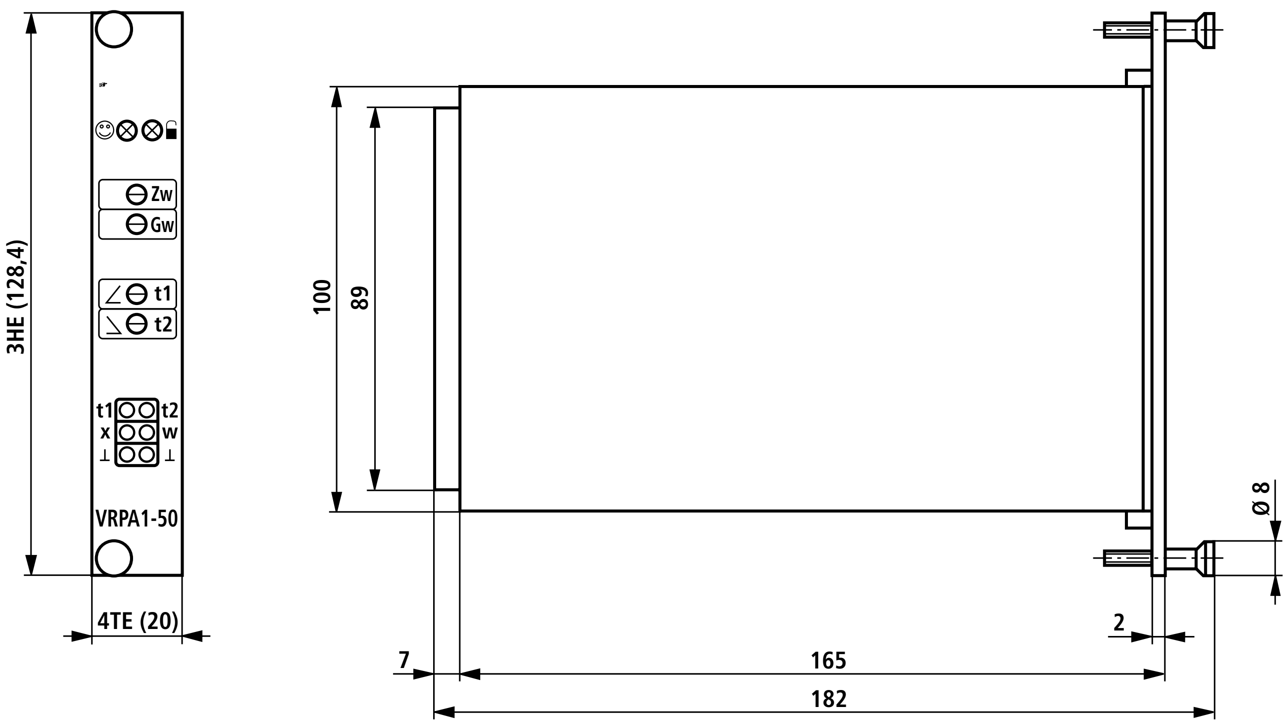
Technical data (for applications outside these parameters, please consult us!)

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).

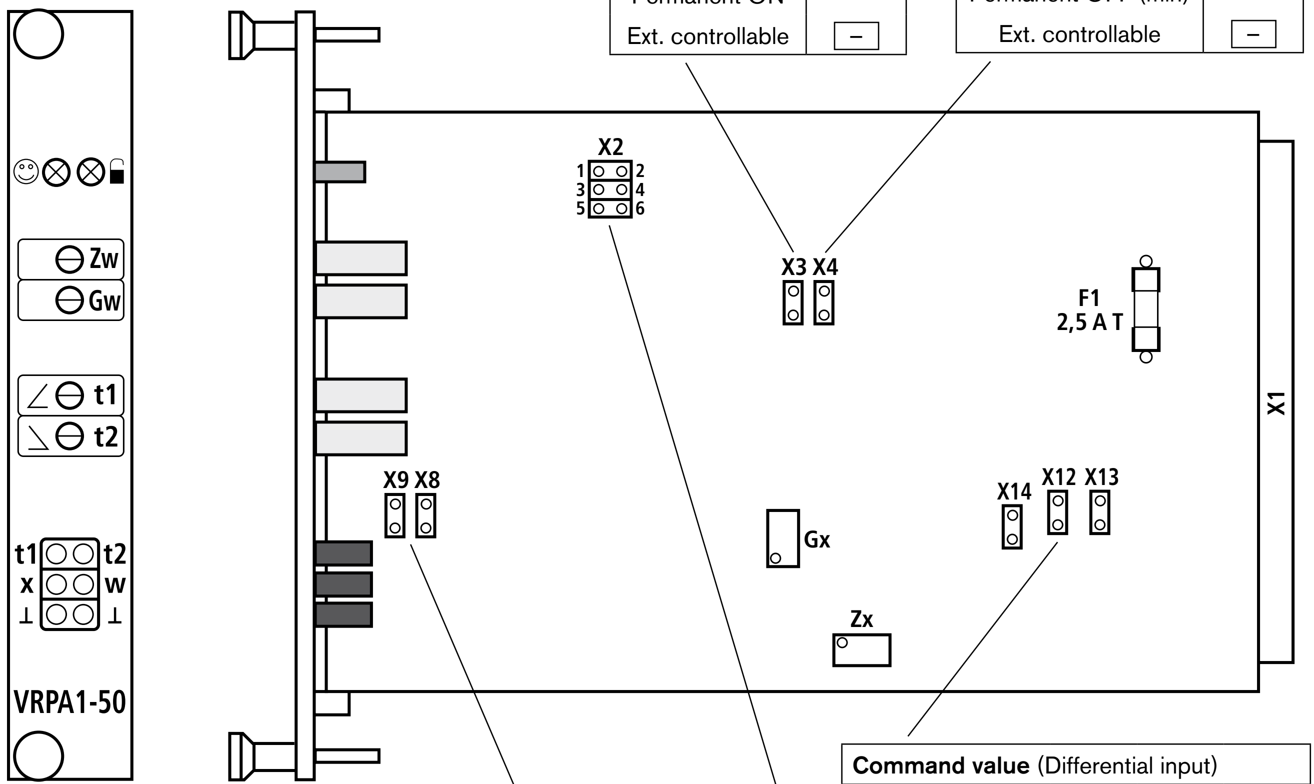
Unit dimensions (Dimensions in mm)



Indicator / adjustment elements

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

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



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

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)

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)

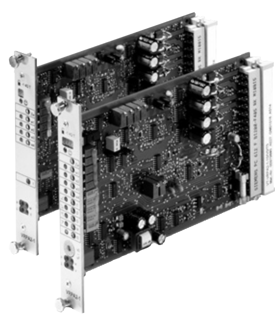
The Drive & Control Company

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

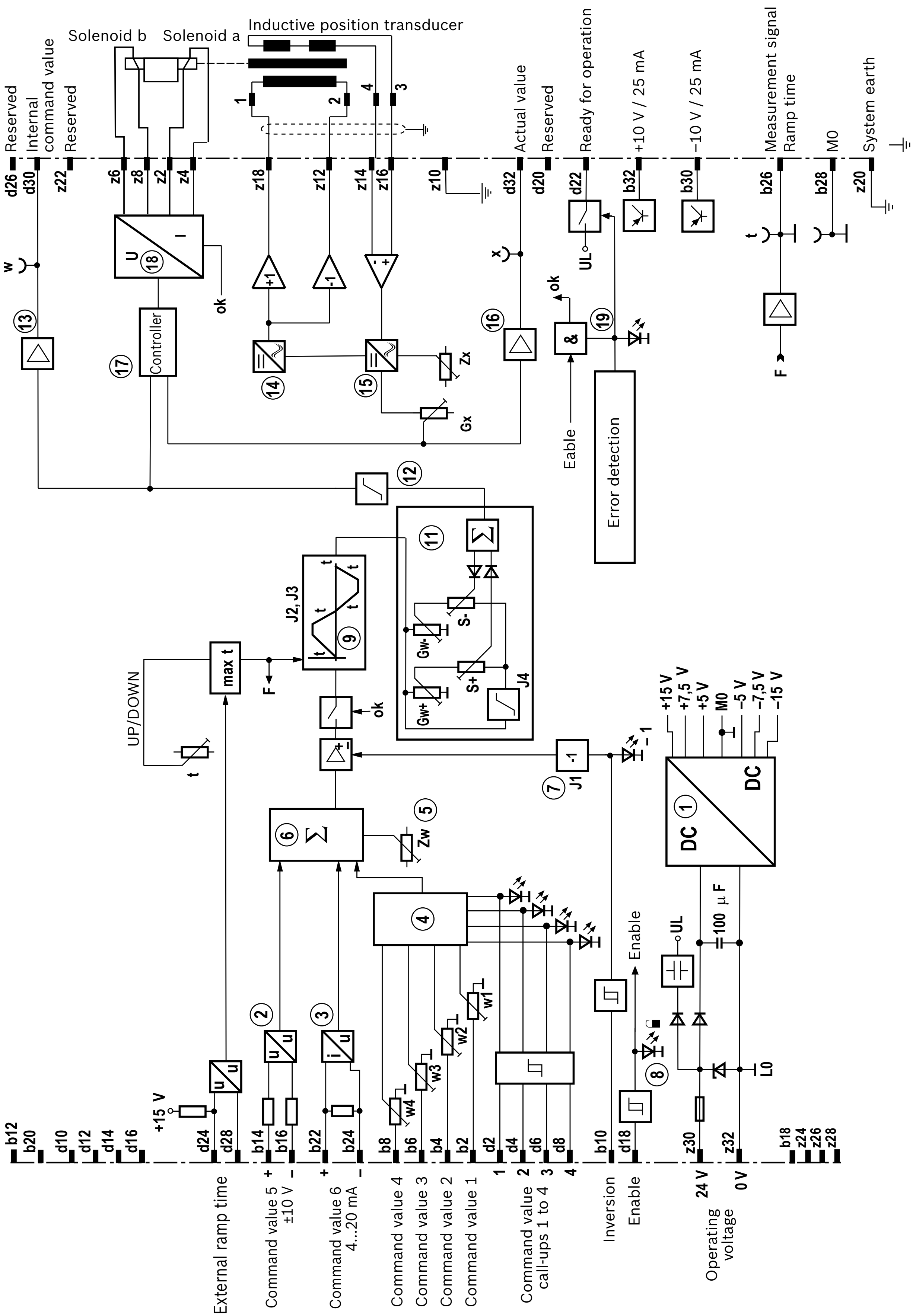
Position controller [17]
The position controller is optimized in a valve-specific manner.

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.

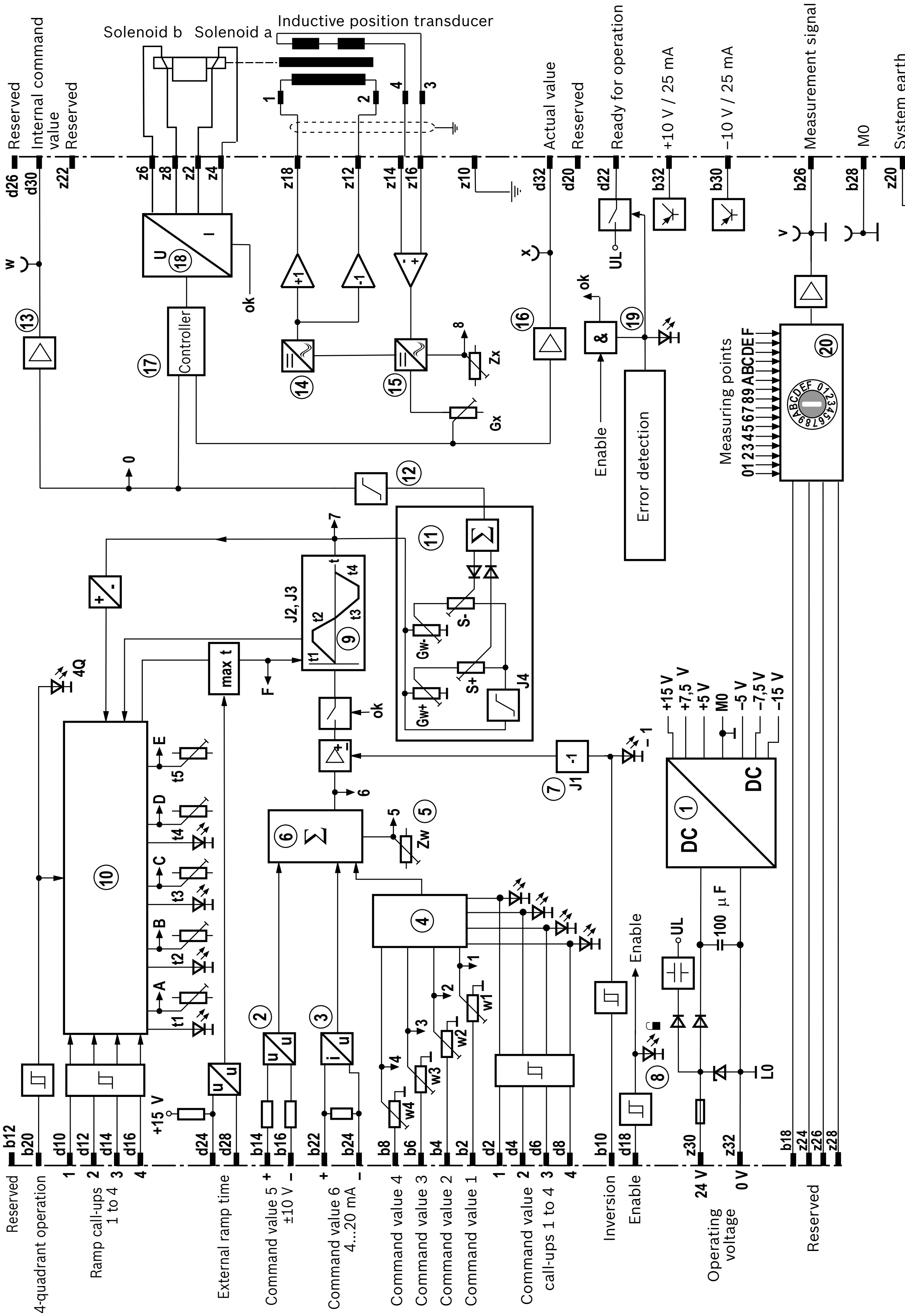
[ ] = Attribution to the block diagrams on pages 4 and 5

Block diagram/pin assignment, option T1



1 Power supply unit
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
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

Block diagram/pin assignment, option T5



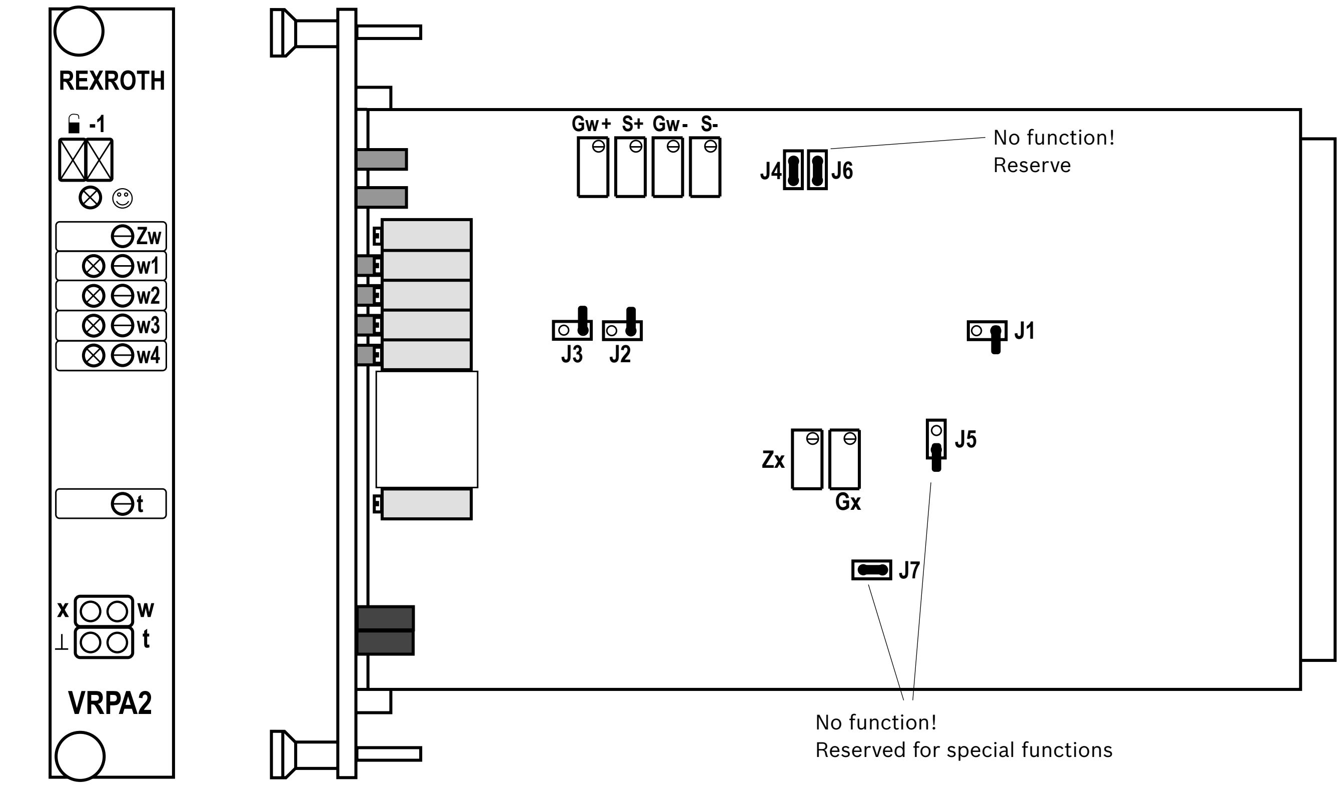
1 Power supply unit
2 Differential input
3 Current input
4 Command value selection logic
5 Zero point setting
6 Command value summation
7 Command value inversion
8 Enable function
9 Ramp generator
10 Ramp time selection logic
11 Characteristic curve generator
12 Amplitude limiter
13 Command value output
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):

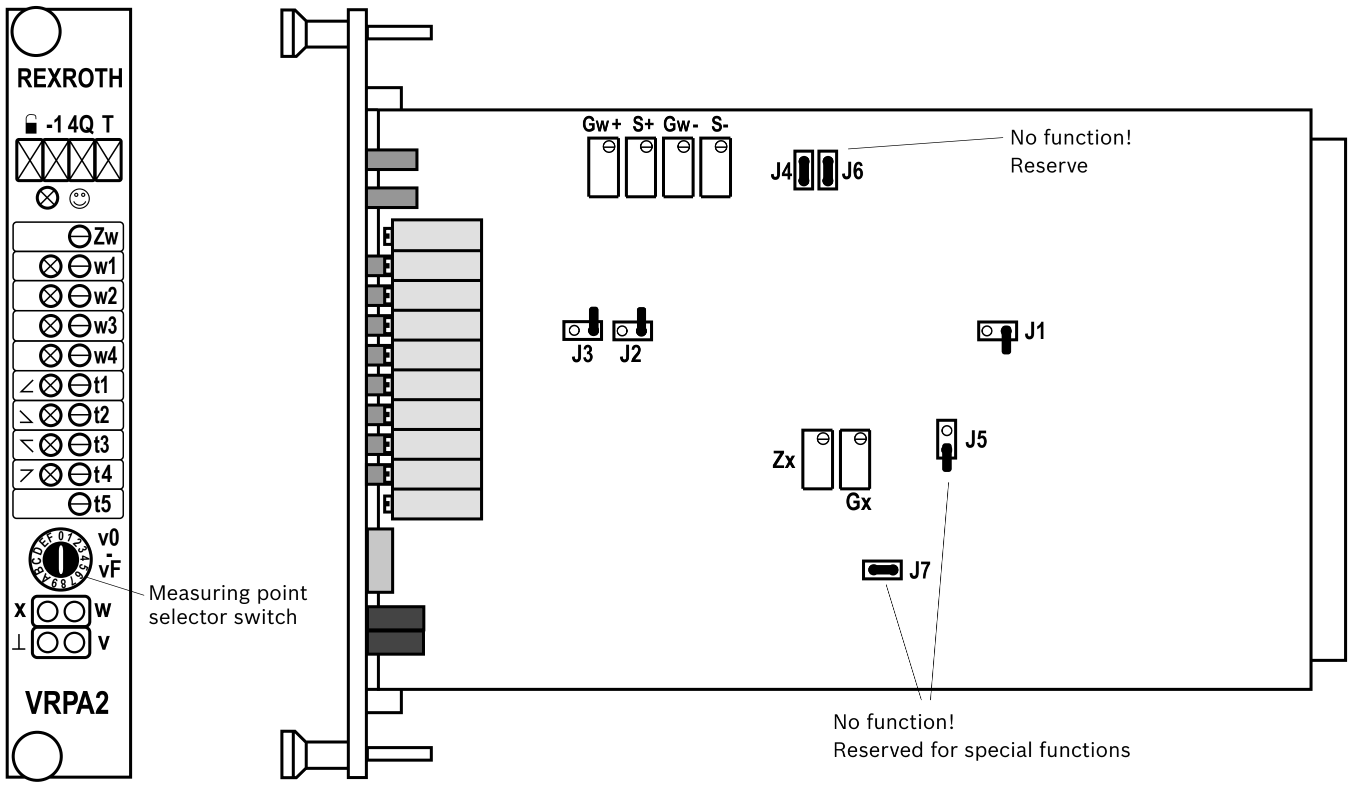
Zw Zero point calibration
w1 Command value 1
w2 Command value 2
w3 Command value 3
w4 Command value 4
t Ramp time

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.

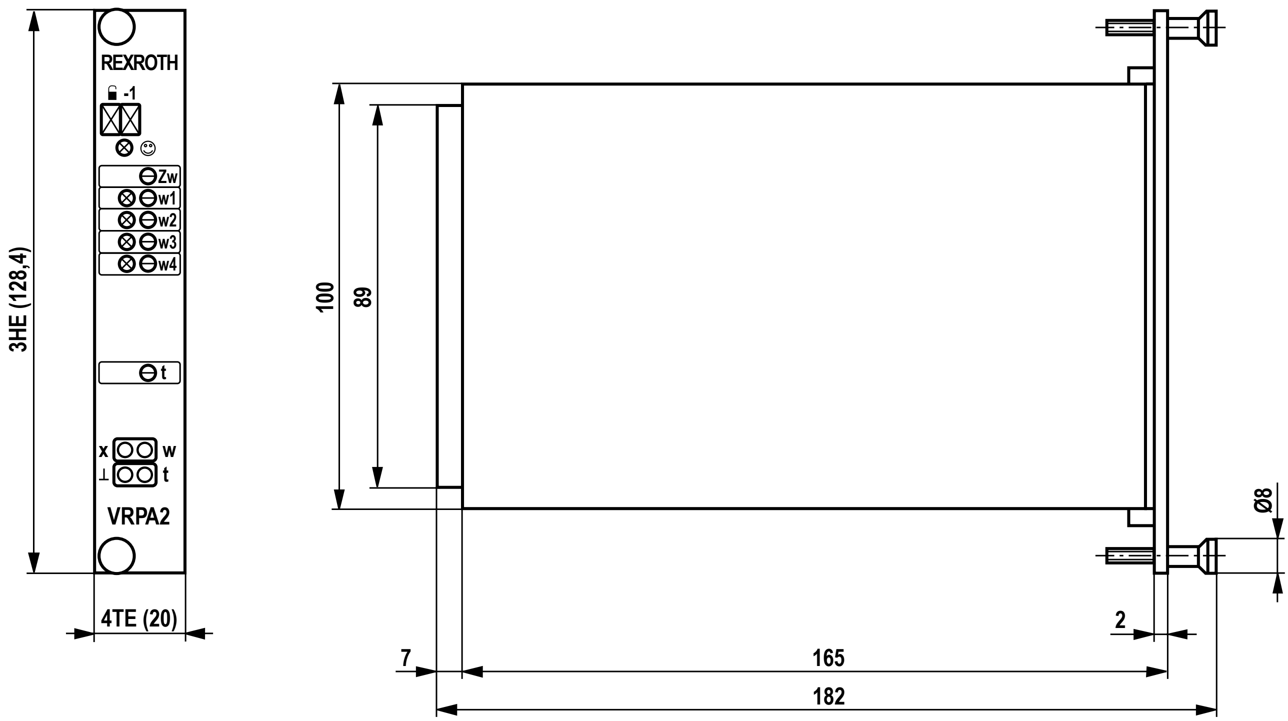
Display/adjustment elements, option T5 (continued)

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.

Dimensions (dimensions in mm)



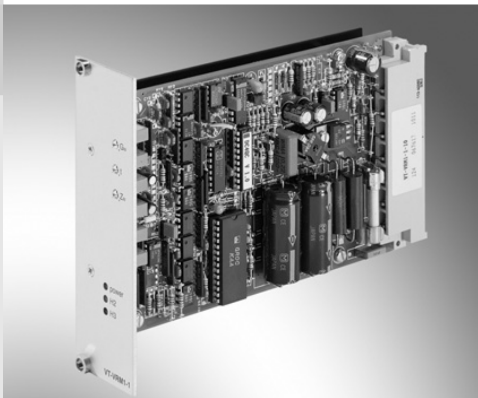
Project planning / maintenance instructions / additional information

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

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

Type VT-VRM1-1

Component series 1X



H5758

Table of contents

Content **Page**

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

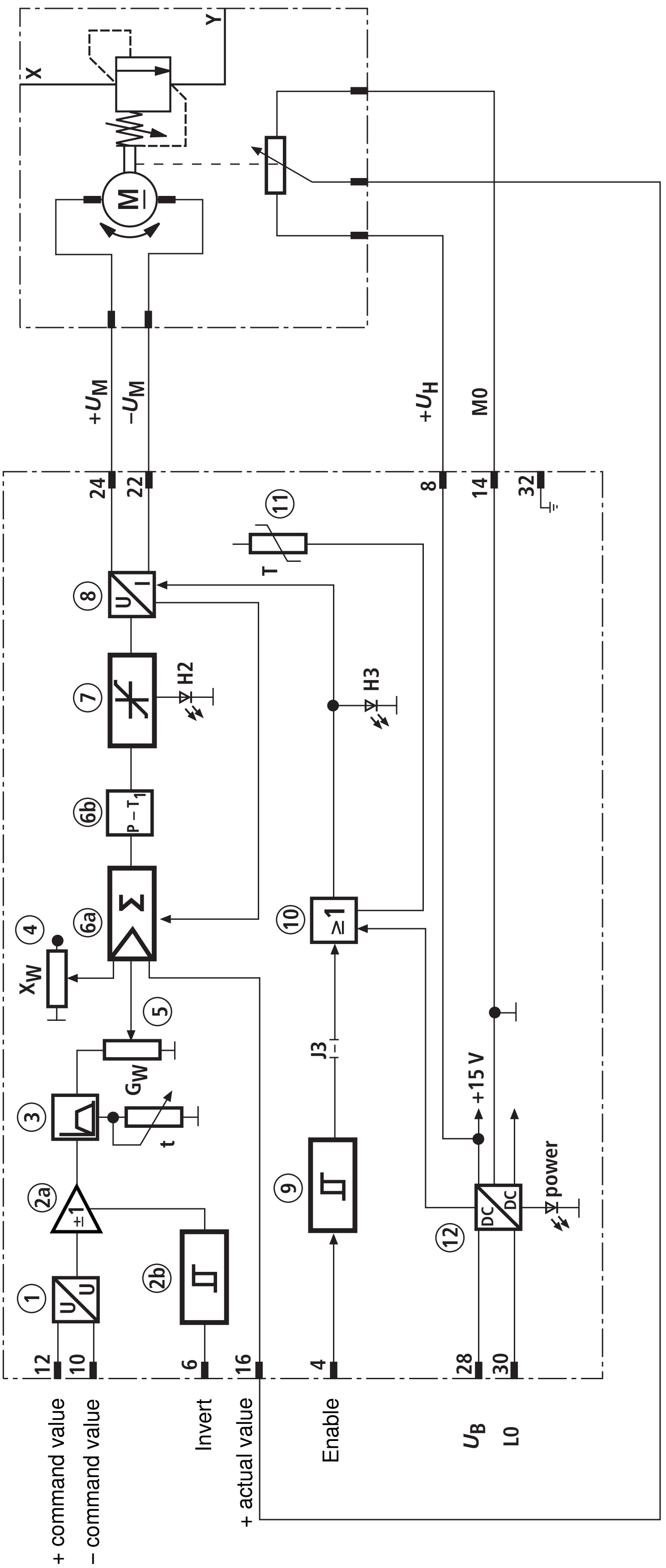
Item	Comp. names	Description (lettering on printed-circuit board)	Setting	Front panel designation
1	P1	n_{max} (command value attenuator)	Right-hand limit stop (maximum)	G_w
2	P2	t_{int} (ramp time)	Left-hand limit stop (minimum)	t
3	P3	n_{offs} (zero point)	Right-hand limit stop (minimum)	Z_x
4	P4	X_p (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

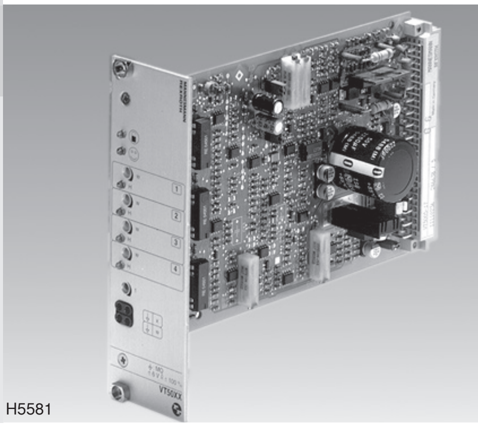
Rexroth
Bosch Group

Electric amplifier for flow control with proportional valves

RE 29955/07.14
Replaces: 09.11

Type VT 5035

Component series 1X



H5581

Table of contents

Content	**Page**

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:

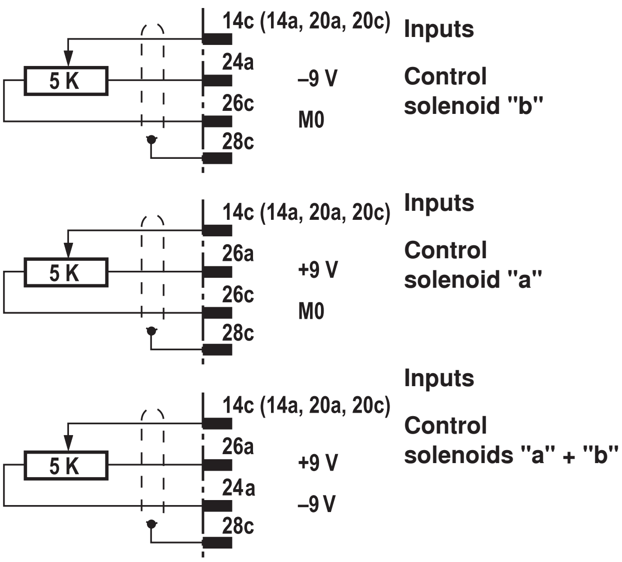
Type VT 3002-1-2X/32D, see data sheet 29928

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).

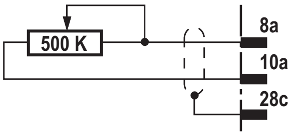
The command value input 5 is a differential input (0 to ±10 V). If the command value is specified by external electronics with a different reference potential, this input has to be used. When disconnecting or connecting the command value voltage, it has to be ensured that both signal lines are in each 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].

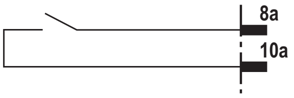
The down-stream ramp generator [4] generates a ramp-shaped output signal from a given step-shaped input signal. The time constant of the output signal can be adjusted using the "t" potentiometer. The specified ramp time refers to a command value step of 100 % and may - depending on the jumper setting (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"



Ramp "controllable"



Ramp "On/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

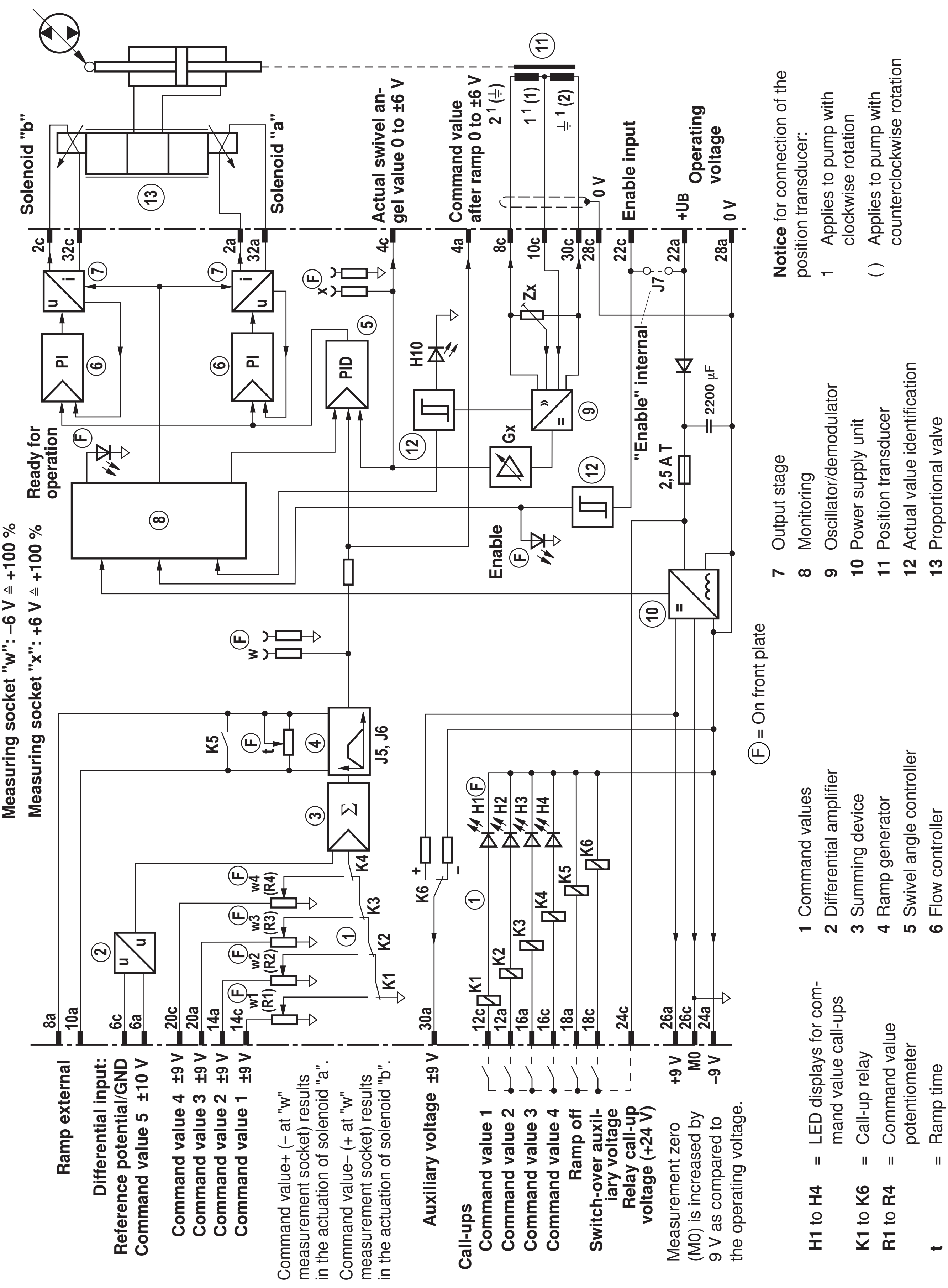
In the position transducer lines exists.

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

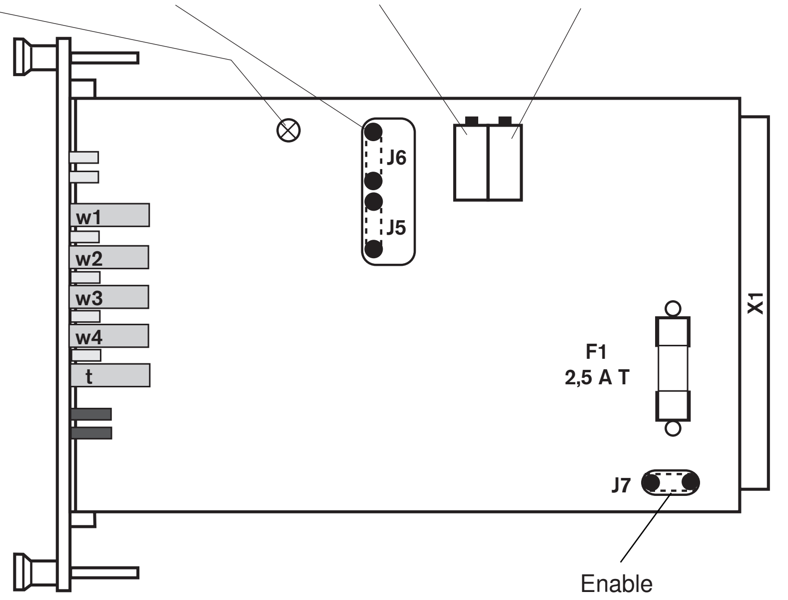
Block diagram / pinout (from series 17)



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



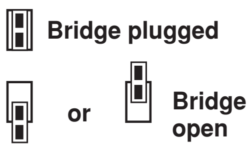
LED display "Enable" (yellow)
LED display "Ready for operation" (green)

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		Jx = bridge
◯ • 5 s	J5	J6	◯ •	int. J7	Jx = open
◯ 1 s	J5	J6	◯	ext. J7	• = delivery state

Ramp time Enable

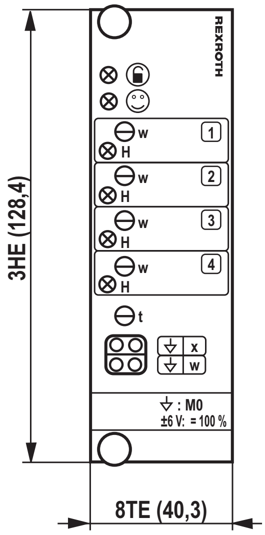


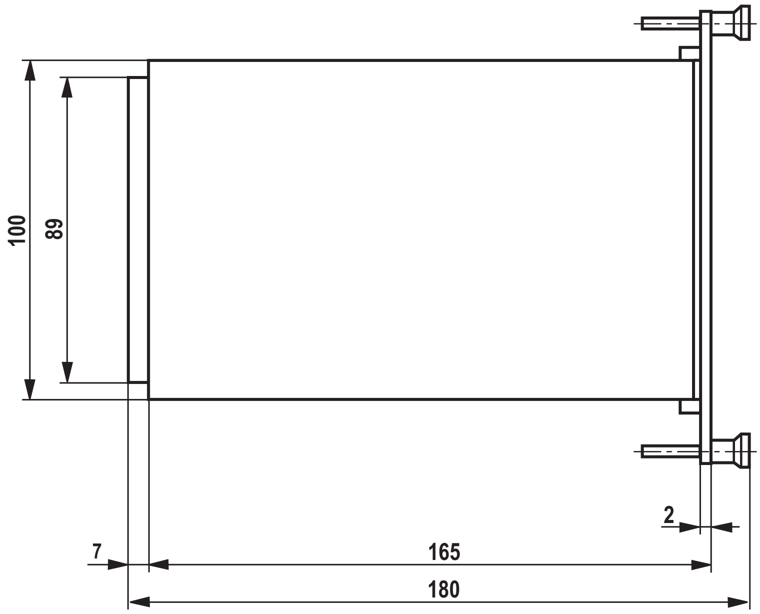
Notice:

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

The condition as supplied is marked with "•".

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)

Rexroth
Bosch Group

Electric amplifiers

RE 30047/03.12
Replaces: 11.02

Type VT-VRPA2-5...-1X/V0/RTS

Component series 1X

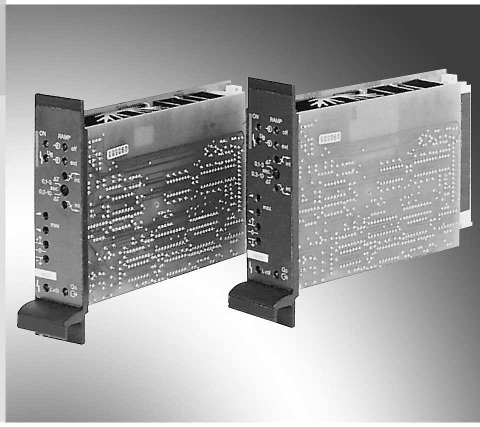


Table of contents

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

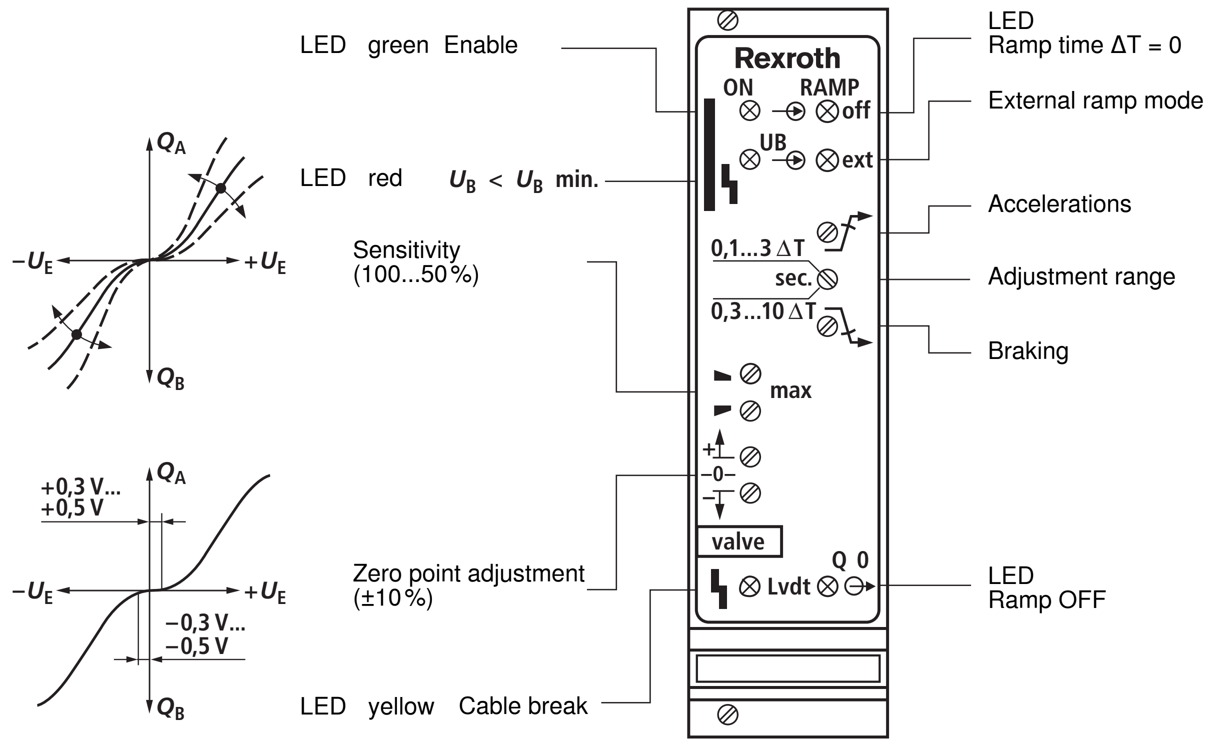
Preferred types

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...

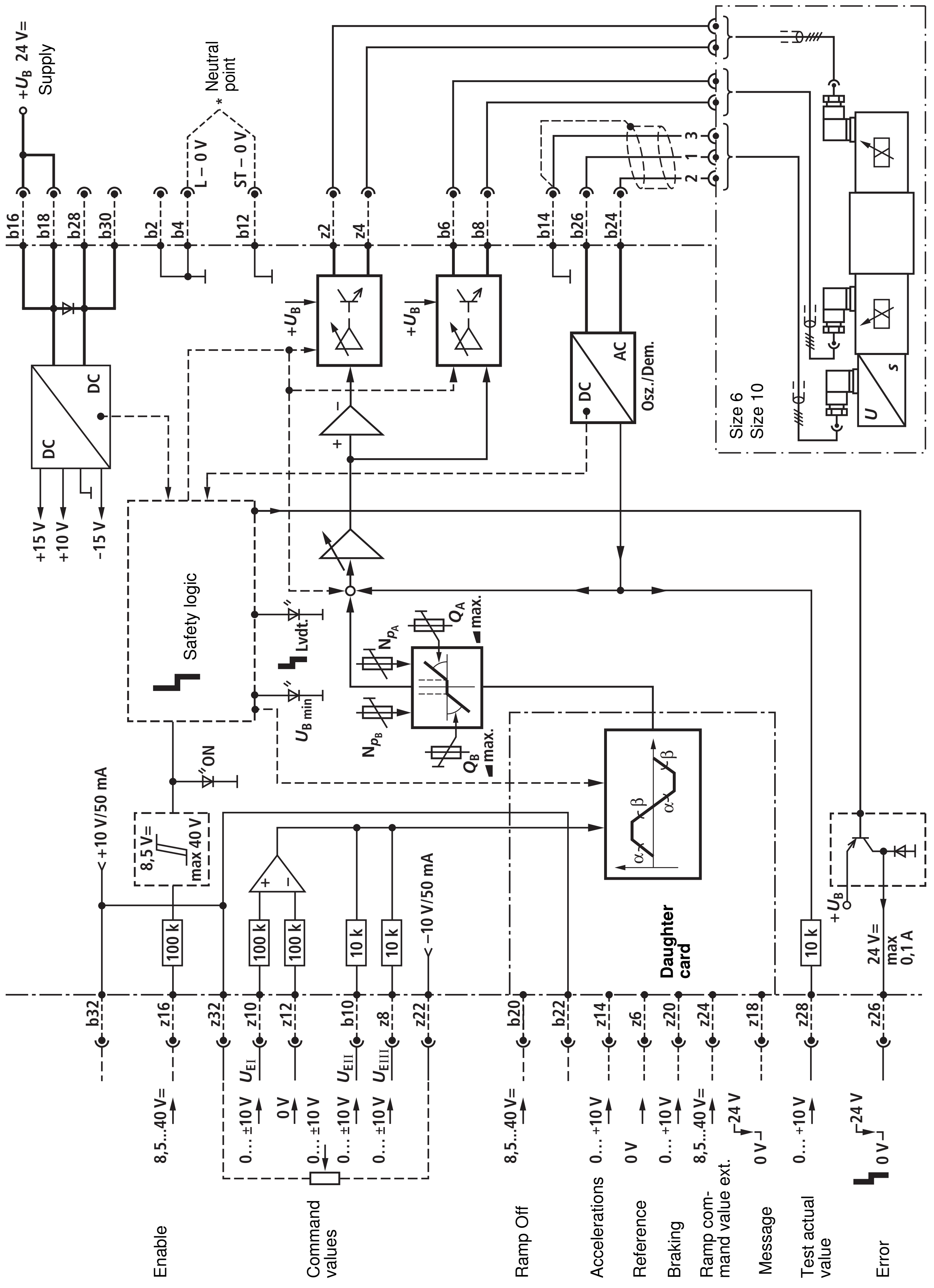
Suitable card holder:

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

Front plate



Block diagram with pin assignment



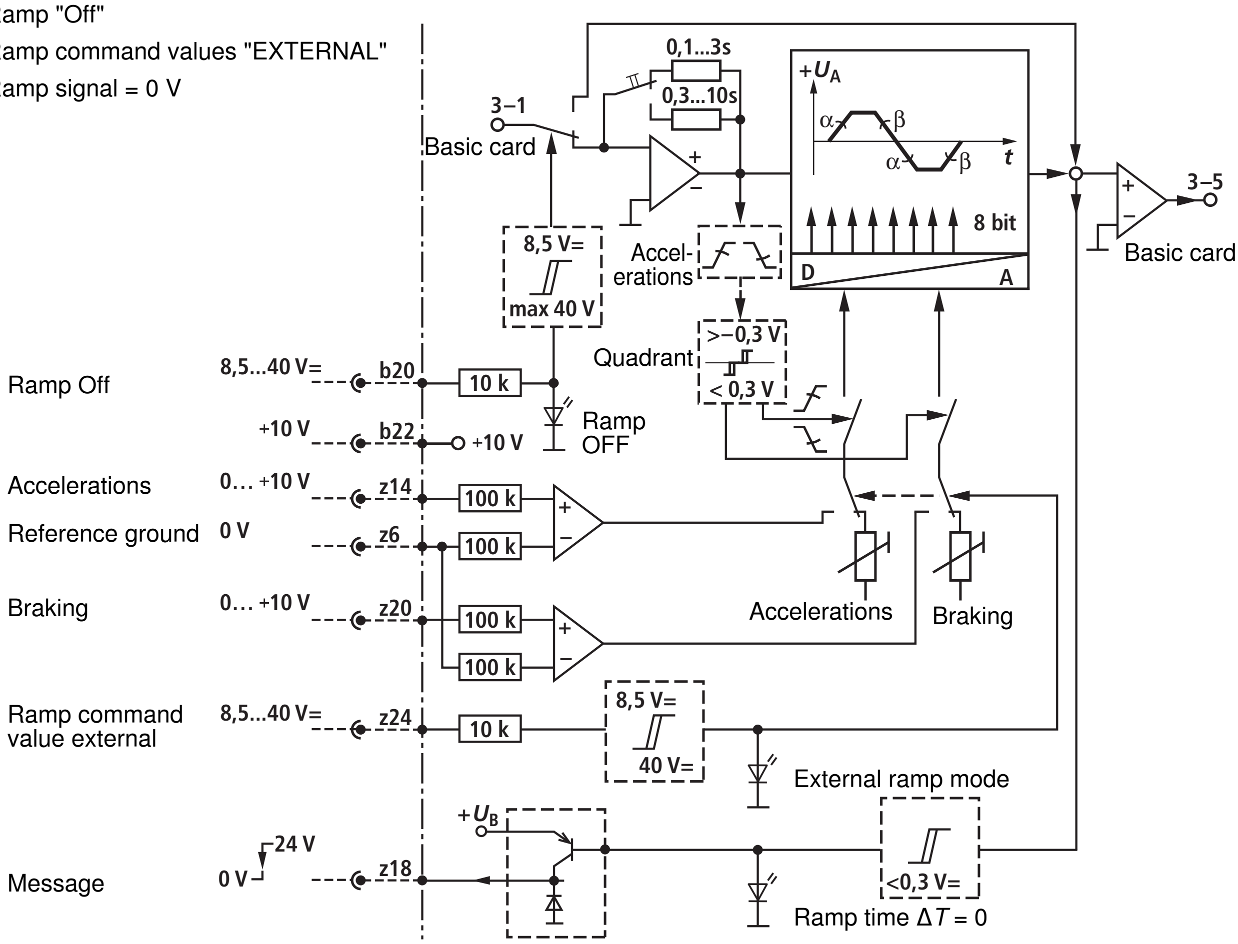
Block diagram with pin assignment daughter card

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 Δ*T* = 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.

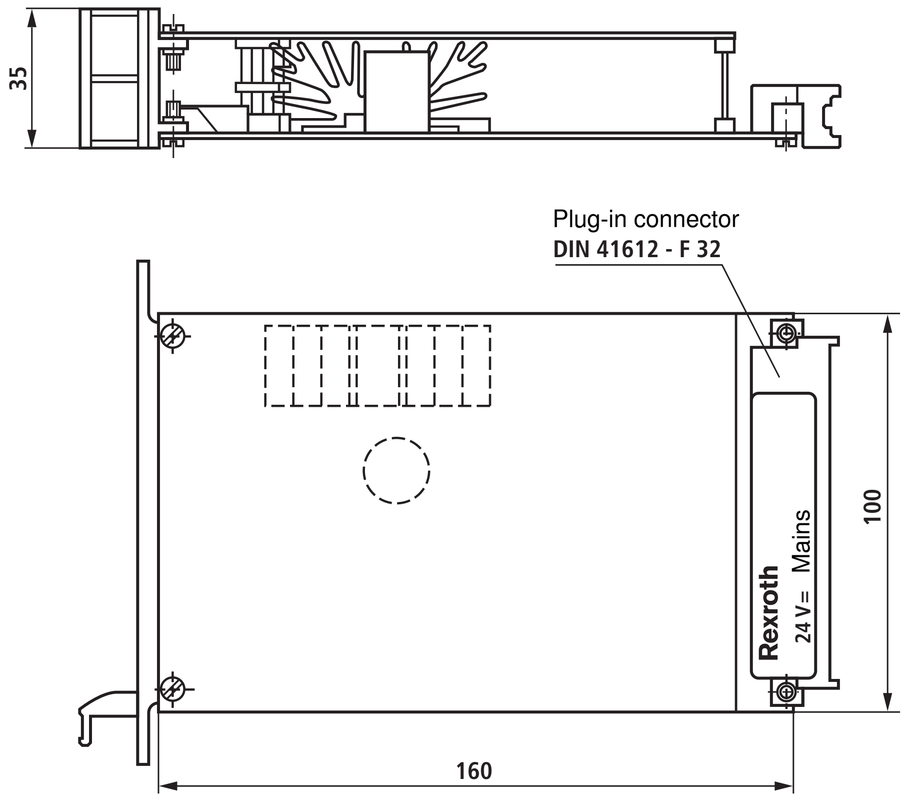
Technical data (For applications outside these parameters, please consult us!)

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.

Rexroth
Bosch Group

Electric amplifiers

Type VT-VRPA2-5...-1X/V0/RTP

Component series 1X

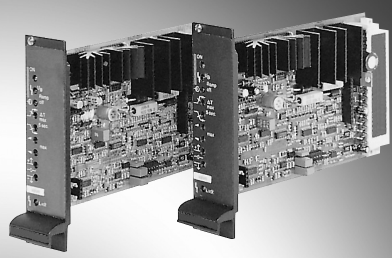


Table of contents

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**

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
RTP = Ramp function can be set manually

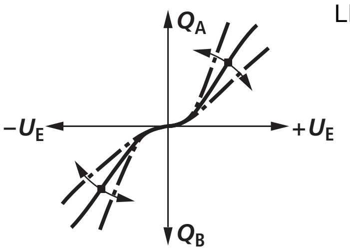
Preferred types

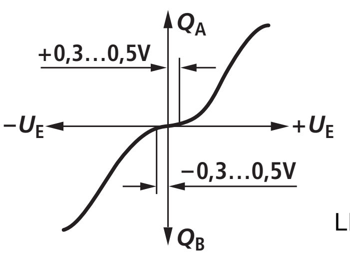
Amplifier type	Material number	For high-response valves with electric position feedback and positive overlap
VT-VRPA2-527-10/V0/RTP	0811405119	4WRP 6...S-1X...
VT-VRPA2-537-10/V0/RTP	0811405120	4WRP 10...S-1X...

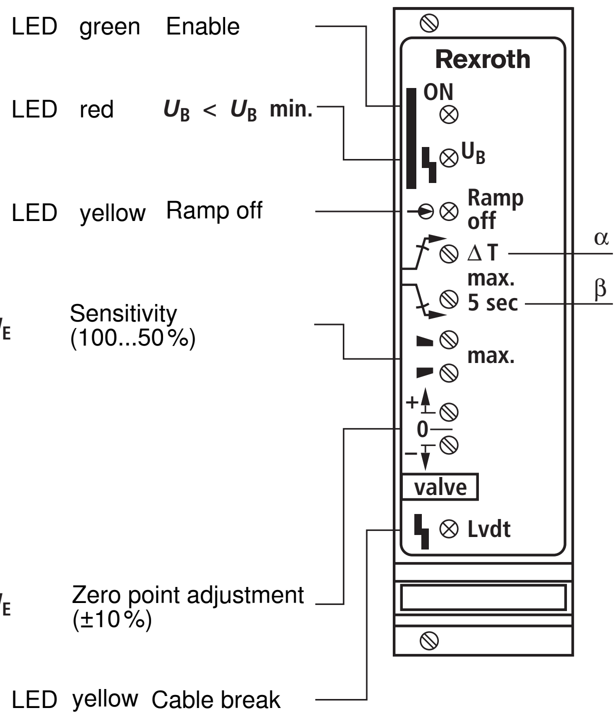
Suitable card holder:

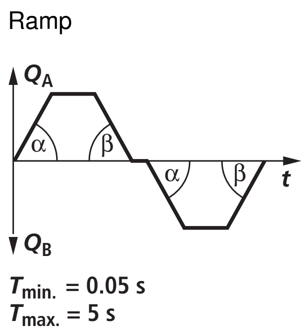
– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate

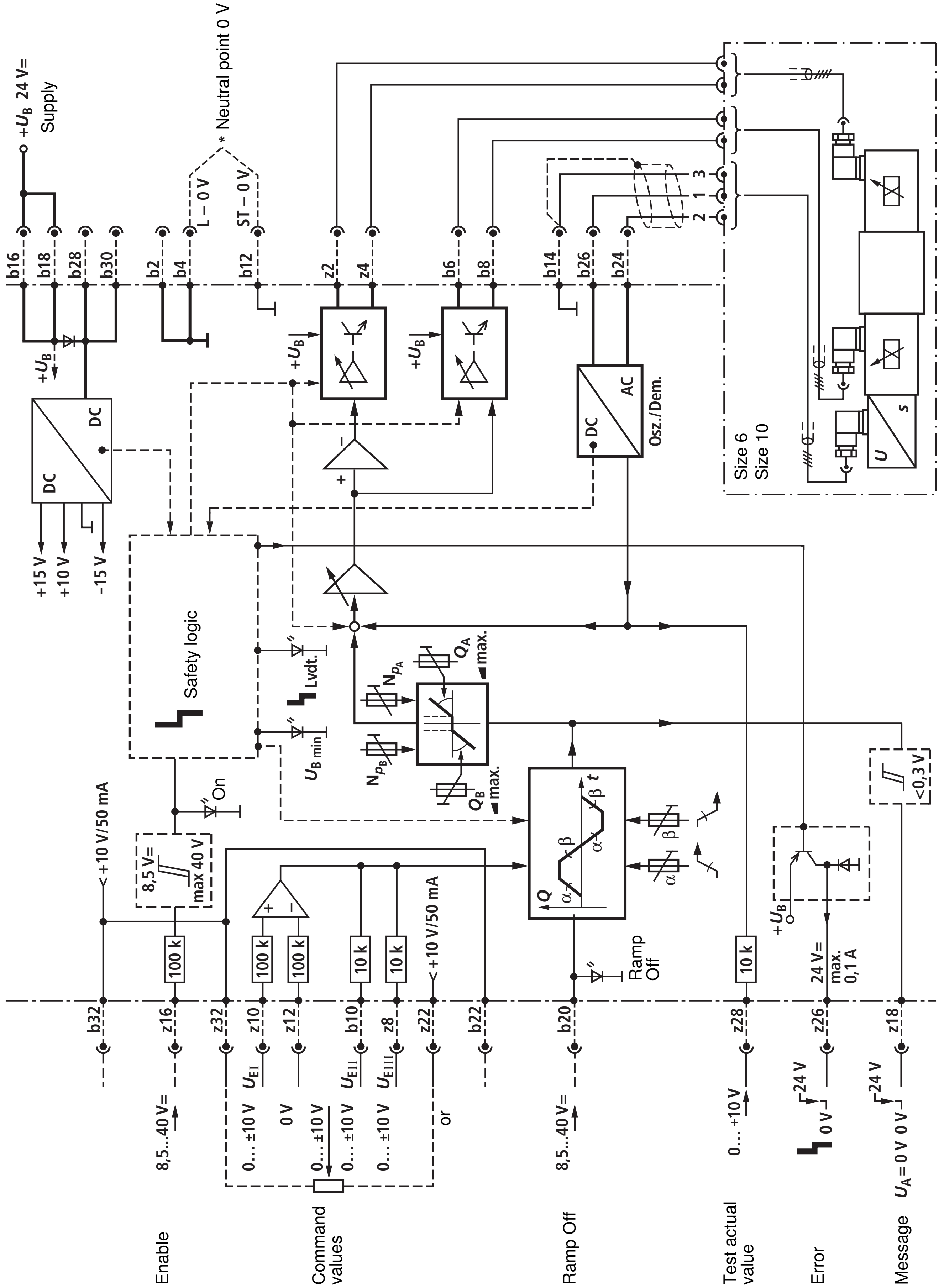








Block diagram with pin assignment



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.

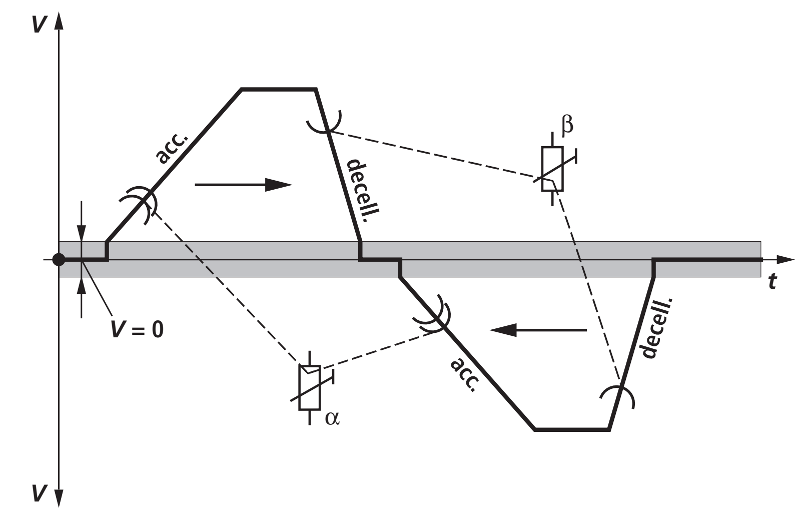
Compensation of the dead zone in central valve position B

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.

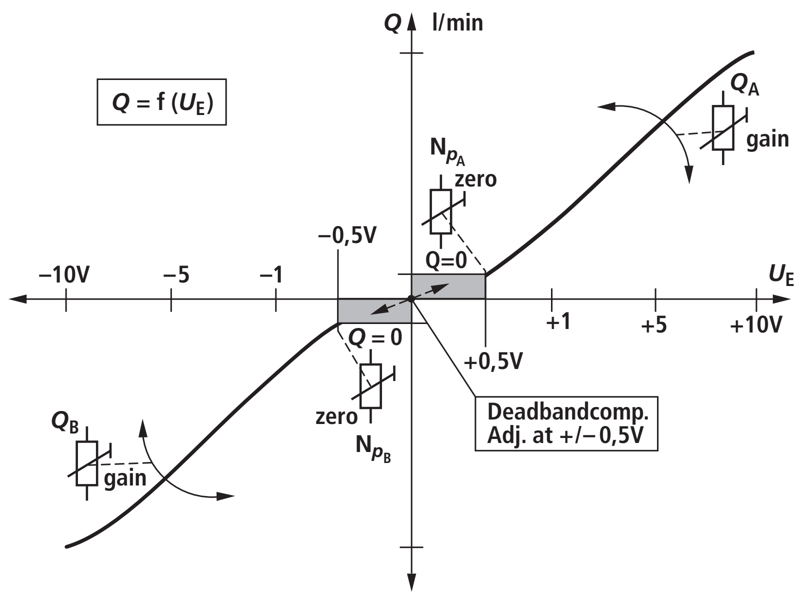
Zero point calibration

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.

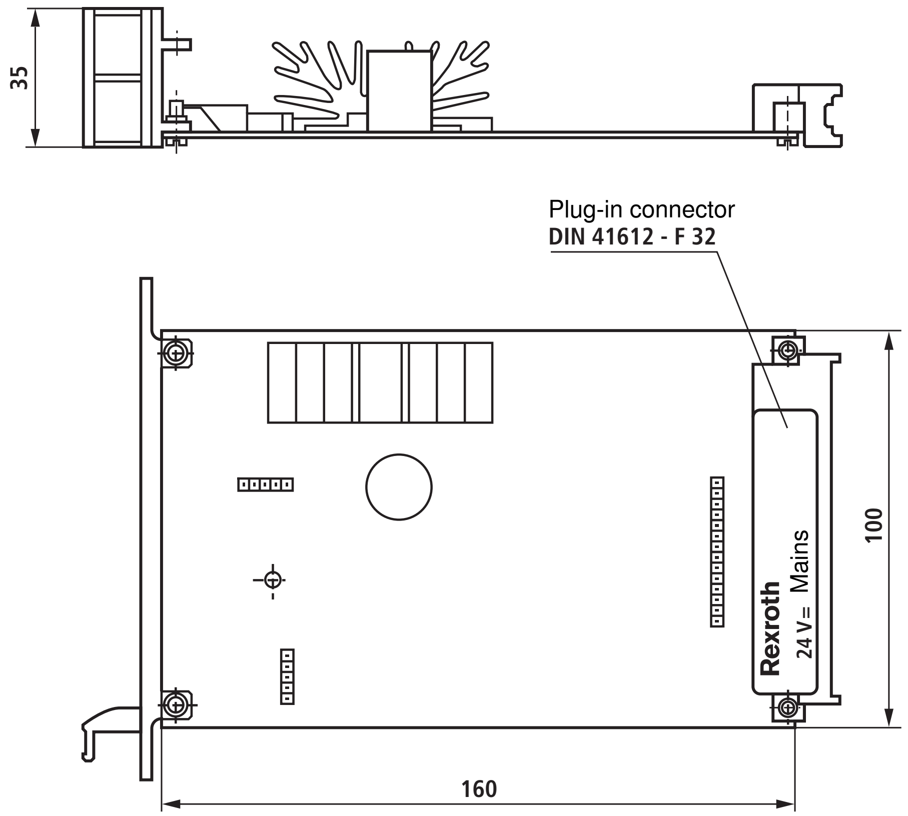
A



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.

Rexroth
Bosch Group

Electric amplifiers

RE 30042/02.12
Replaces: 11.02

Type VT-VRRA1-527-1X/V0/...

Component series 1X

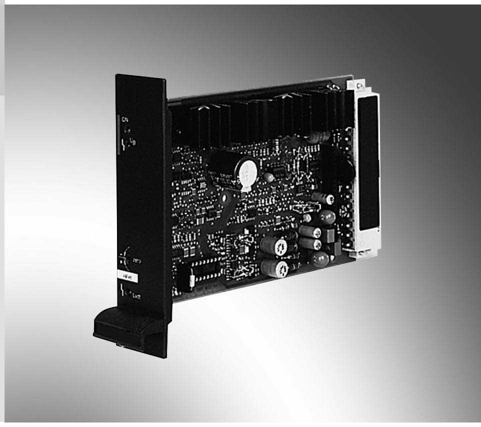


Table of contents

Contents **Page**

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**

Serial number for types
527 = Size 6

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

Customer version
V0 = Catalog version

Option
no code = High-response valve with control 0...±10 V
RV = High-response valve with control +3.5...6.5...9.5 V

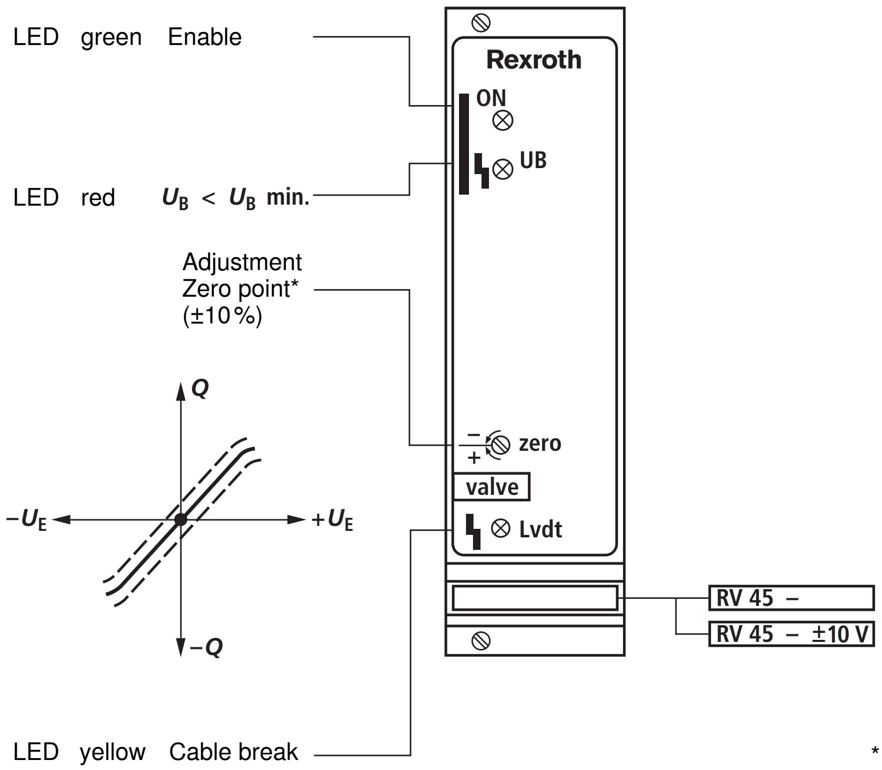
Preferred types

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:

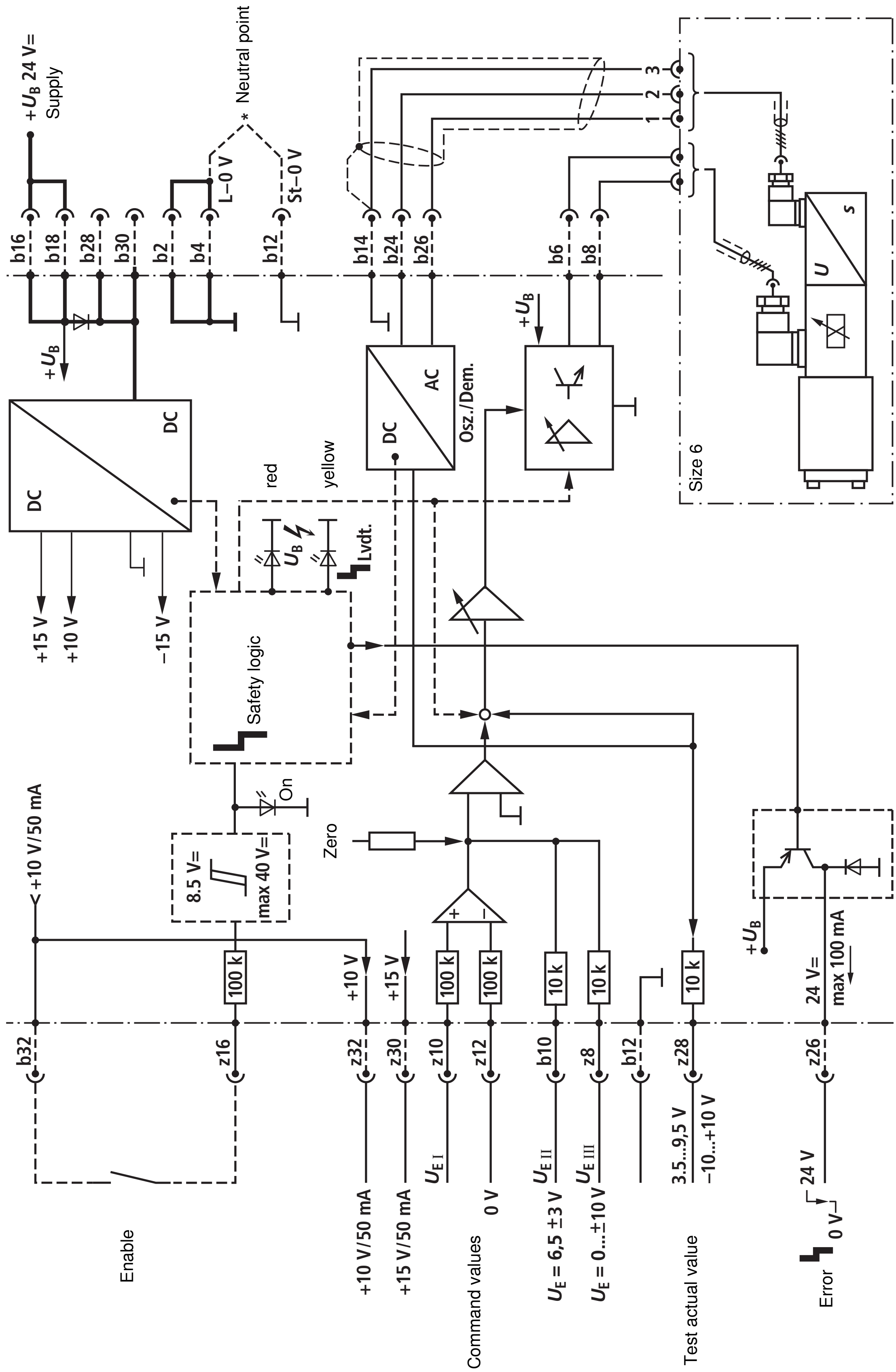
– Open card holder VT 3002-1-2X/32F
(see data sheet 29928).
Only for control cabinet installation!

Front plate



* 0811405148 without

Block diagram with pin assignment

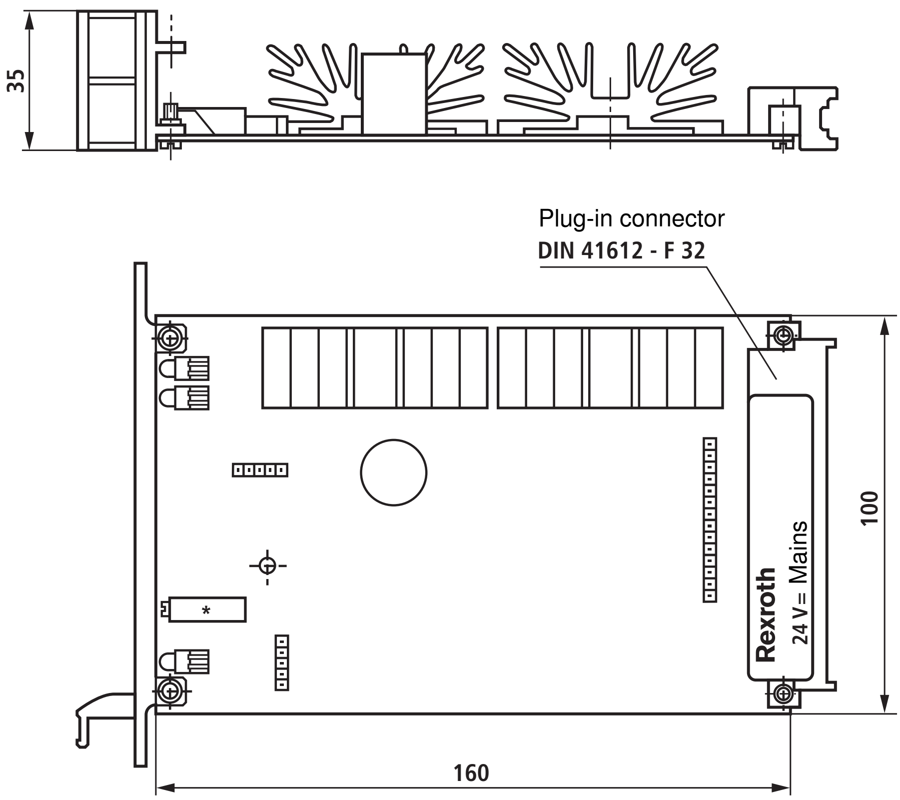


Technical data (For applications outside these parameters, please consult us!)

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 pF/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).

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.

Electric amplifiers

RE 30041/02.12
Replaces: 01.11

Type VT-VRRA1-5...-2X/V0
Type VT-VRPA1-5...-2X/V0

Component series 2X

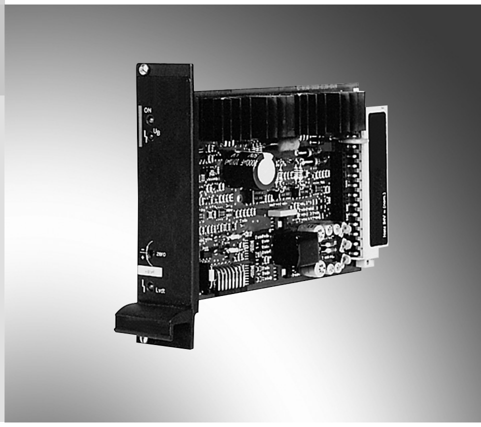


Table of contents

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**

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

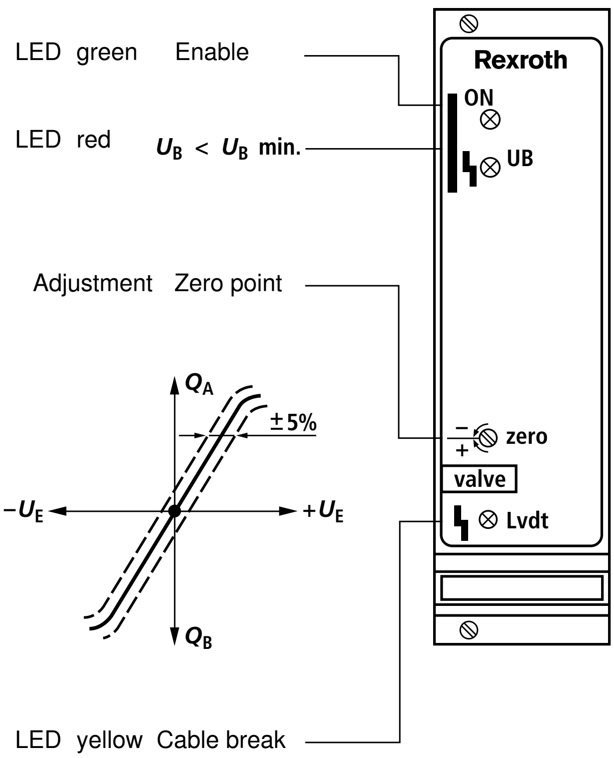
Preferred types

Amplifier type	Material number	For high-response valves with electrical position feedback
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

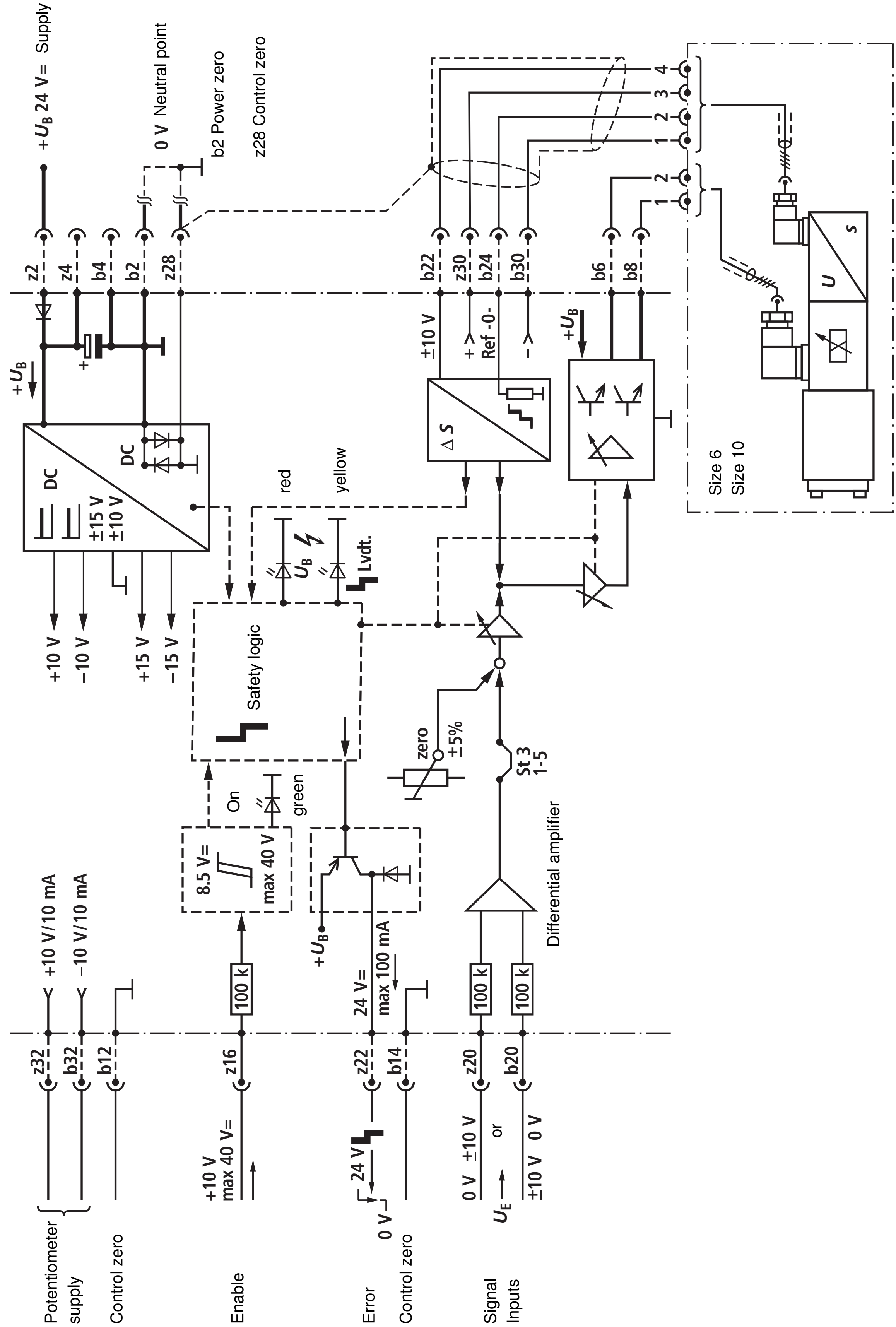
Suitable card holder:

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

Front plate



Block diagram with pin assignment



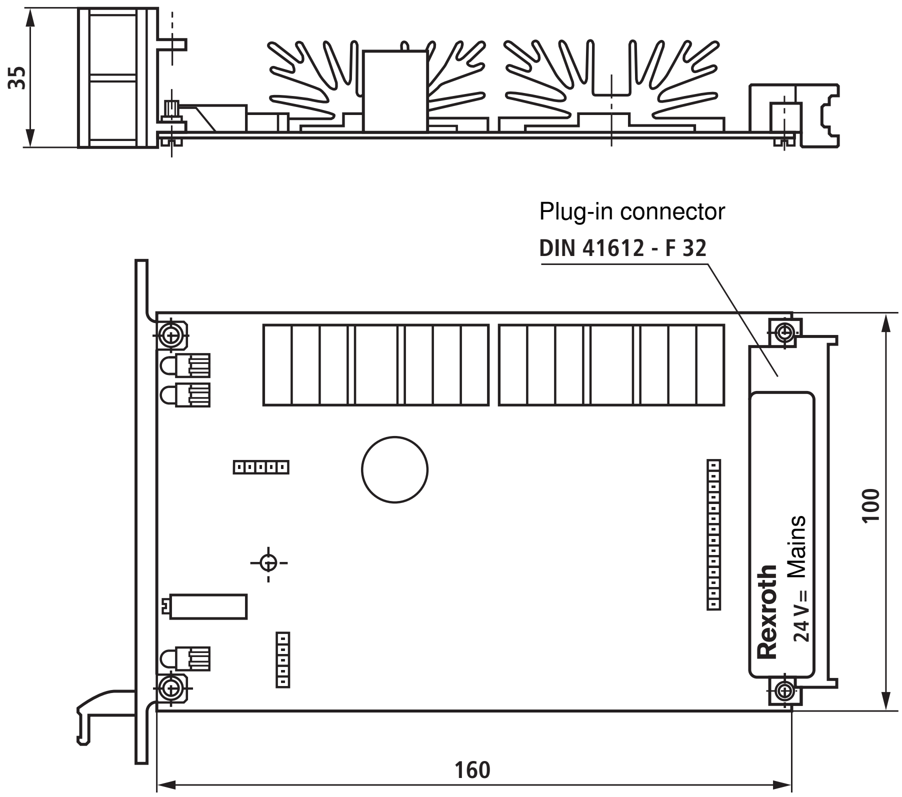
Technical data (For applications outside these parameters, please consult us!)

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 z20: 0...±10 V } Differential amplifier (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	
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 %	
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.

Rexroth
Bosch Group

Electric amplifiers

RE 30040/02.12
Replaces: 11.02

Type VT-VRRA1-5...-2X/V0/K...-AGC

Component series 2X

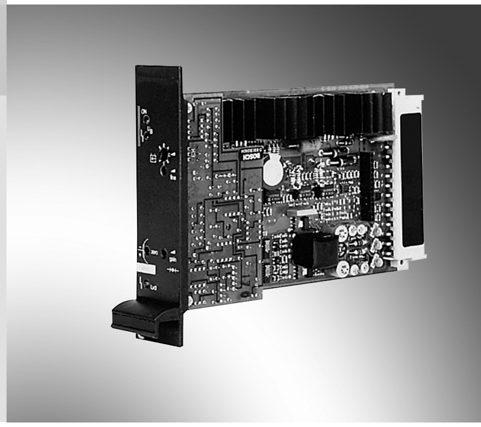


Table of contents

Contents	**Page**
Features	1
Ordering code, accessories	2
Front plate	2
Block diagram with pin assignment	3
Technical data	4
Commissioning	5
Unit dimensions	6
Project planning / maintenance instructions / additional information	6

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**

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

Option
K40-AGC = High-response valve with 40 % inflection
K60-AGC = High-response valve with 60 % inflection

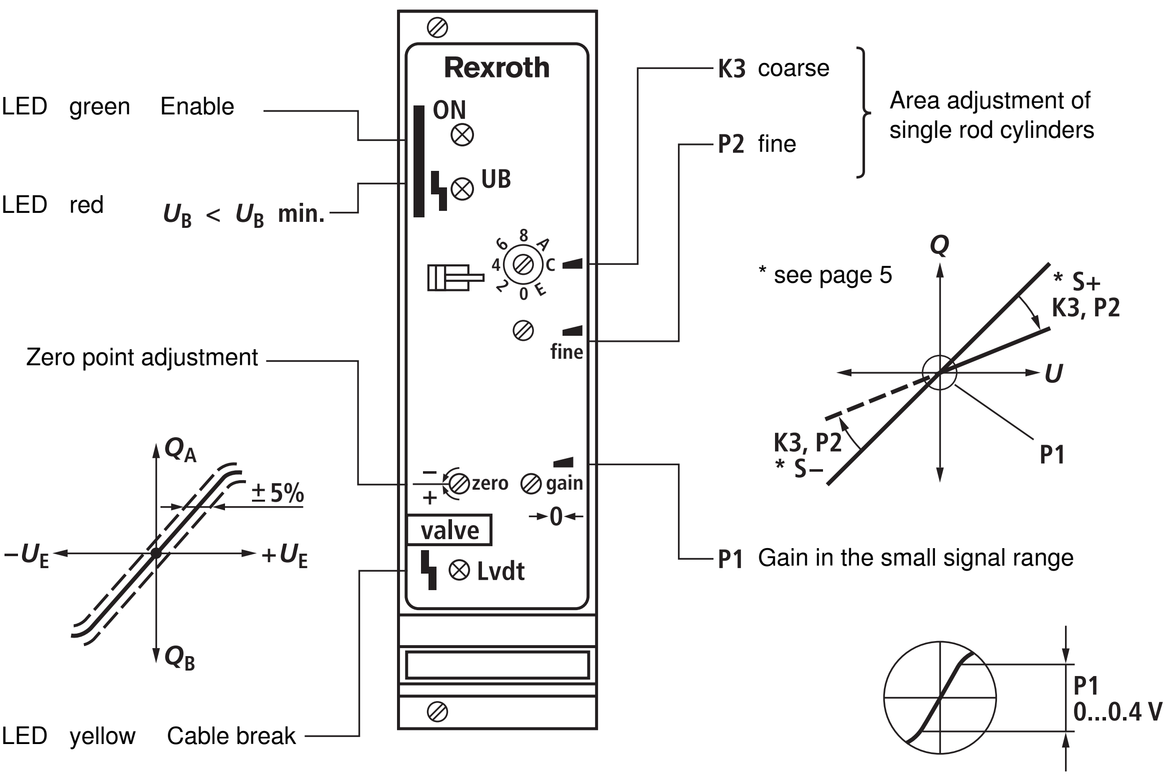
Preferred types

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...

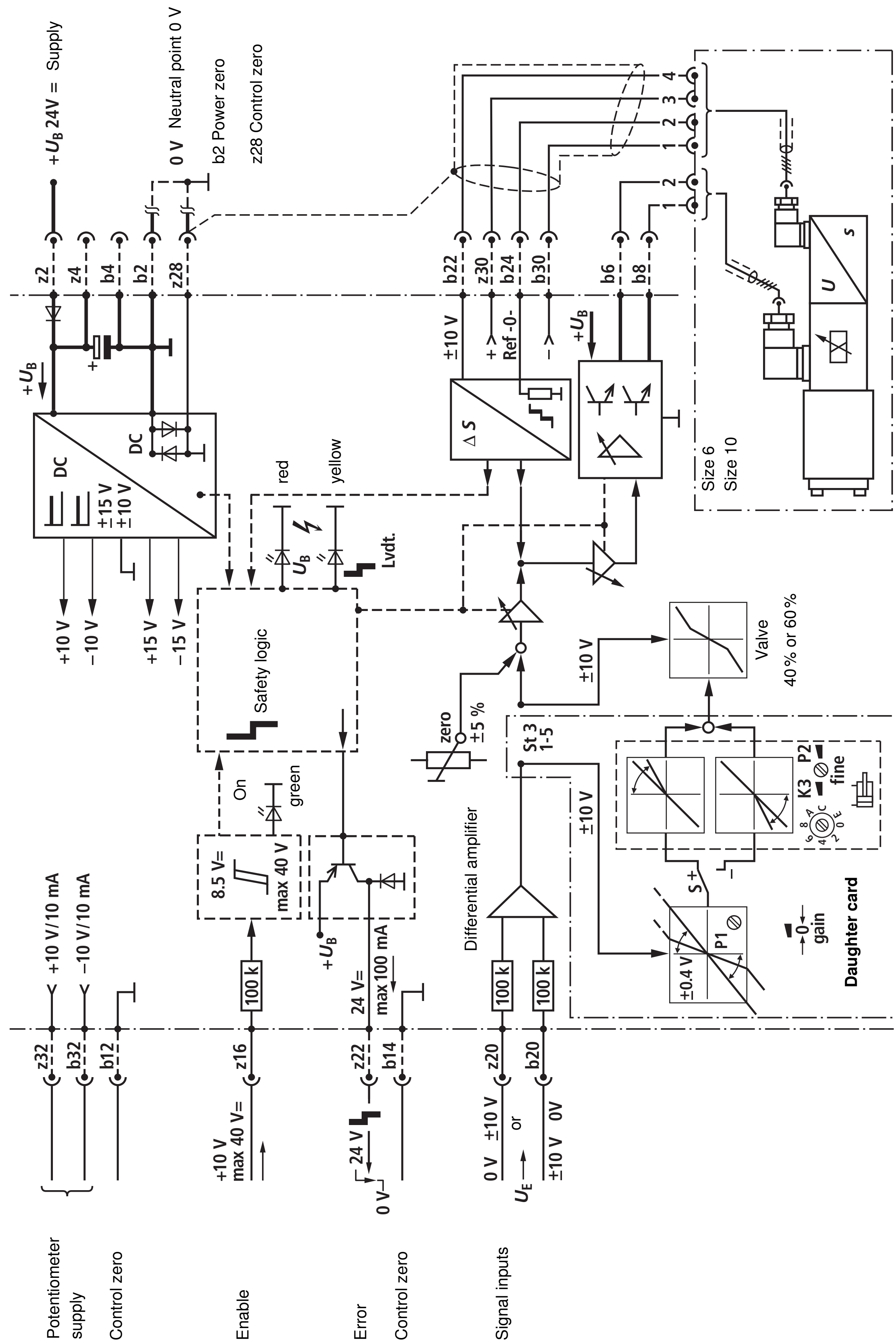
Suitable card holder:

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

Front plate



Block diagram with pin assignment



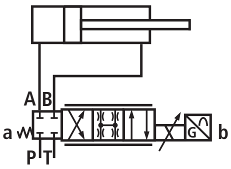
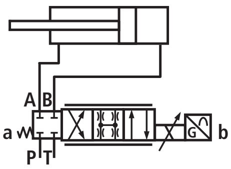
Technical data (For applications outside these parameters, please consult us!)

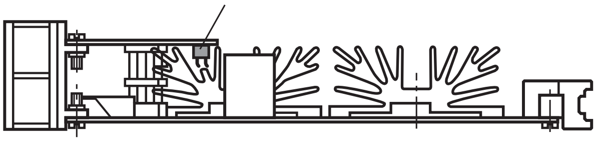
Supply voltage U_B at z2 – b2		Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 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).

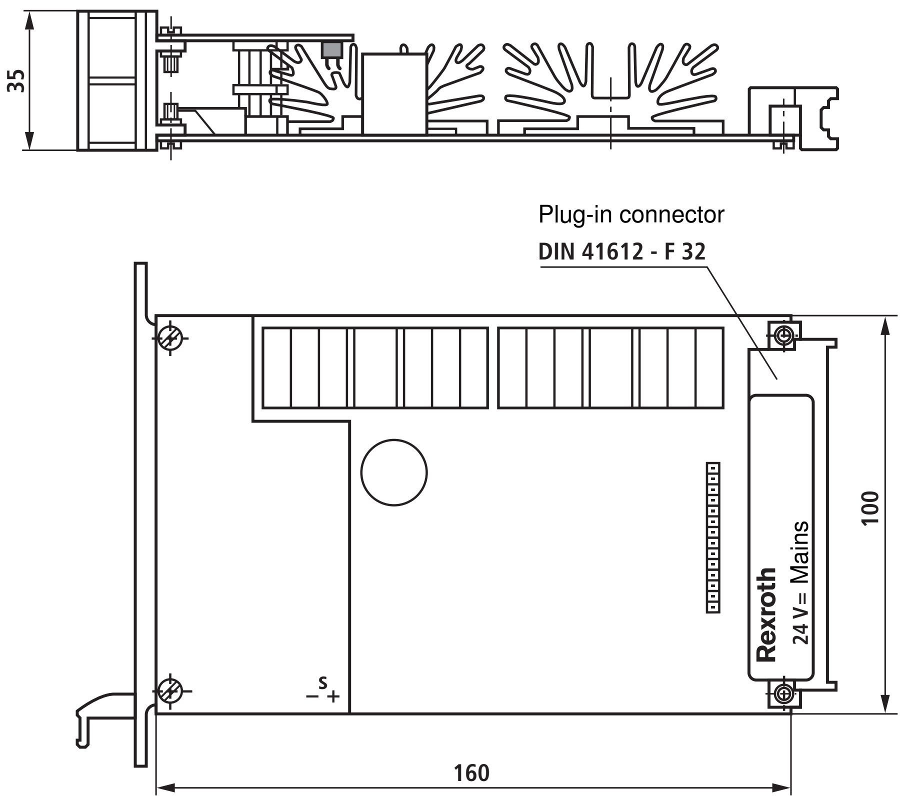
Commissioning

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" +



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.

Rexroth
Bosch Group

Electric amplifiers

RE 30046/03.12
Replaces: 11.02

Type VT-VRRA1-5...-2X/V0/KV-AGC

Component series 2X

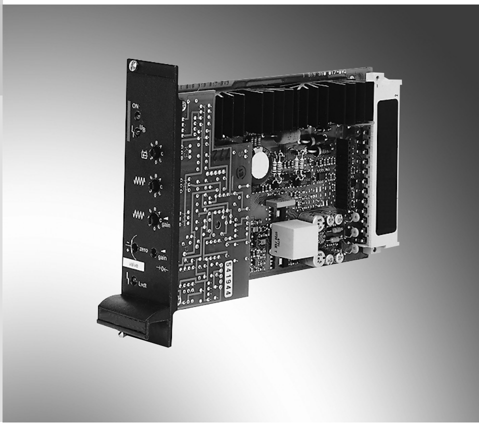


Table of contents

Contents	**Page**

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)

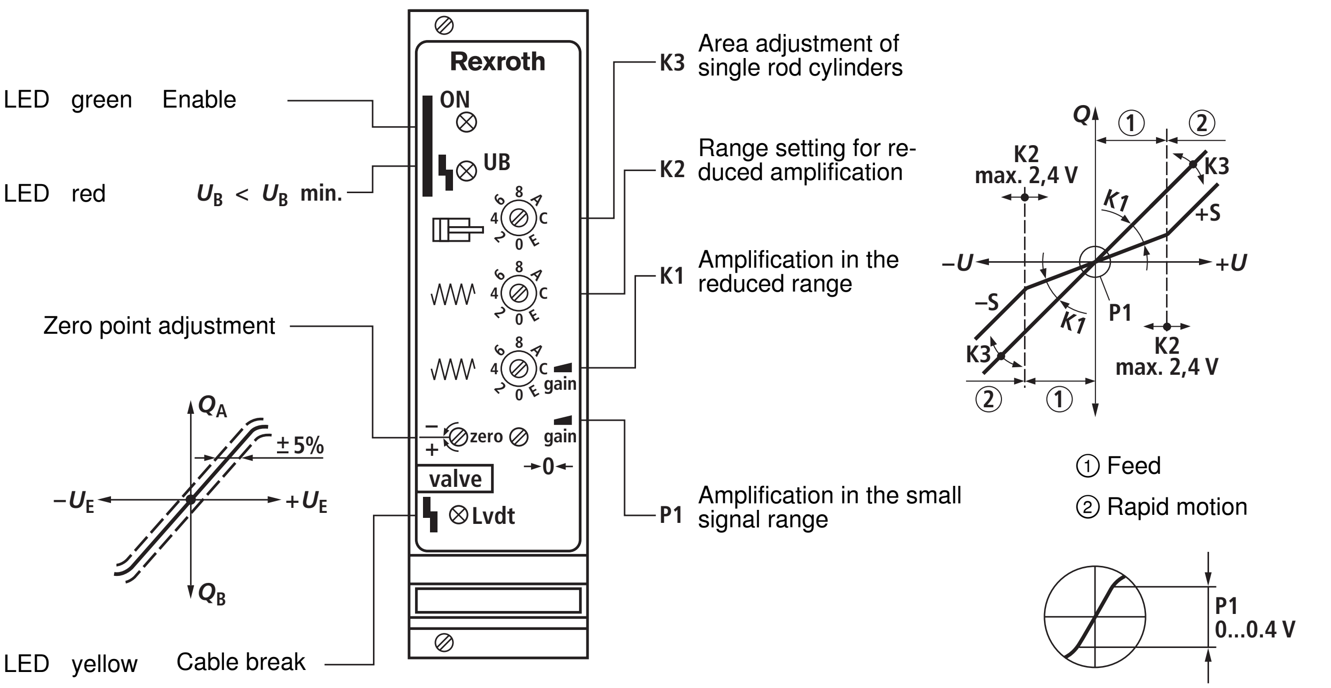
Serial number for types
527 = Size 6
537 = Size 10

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...

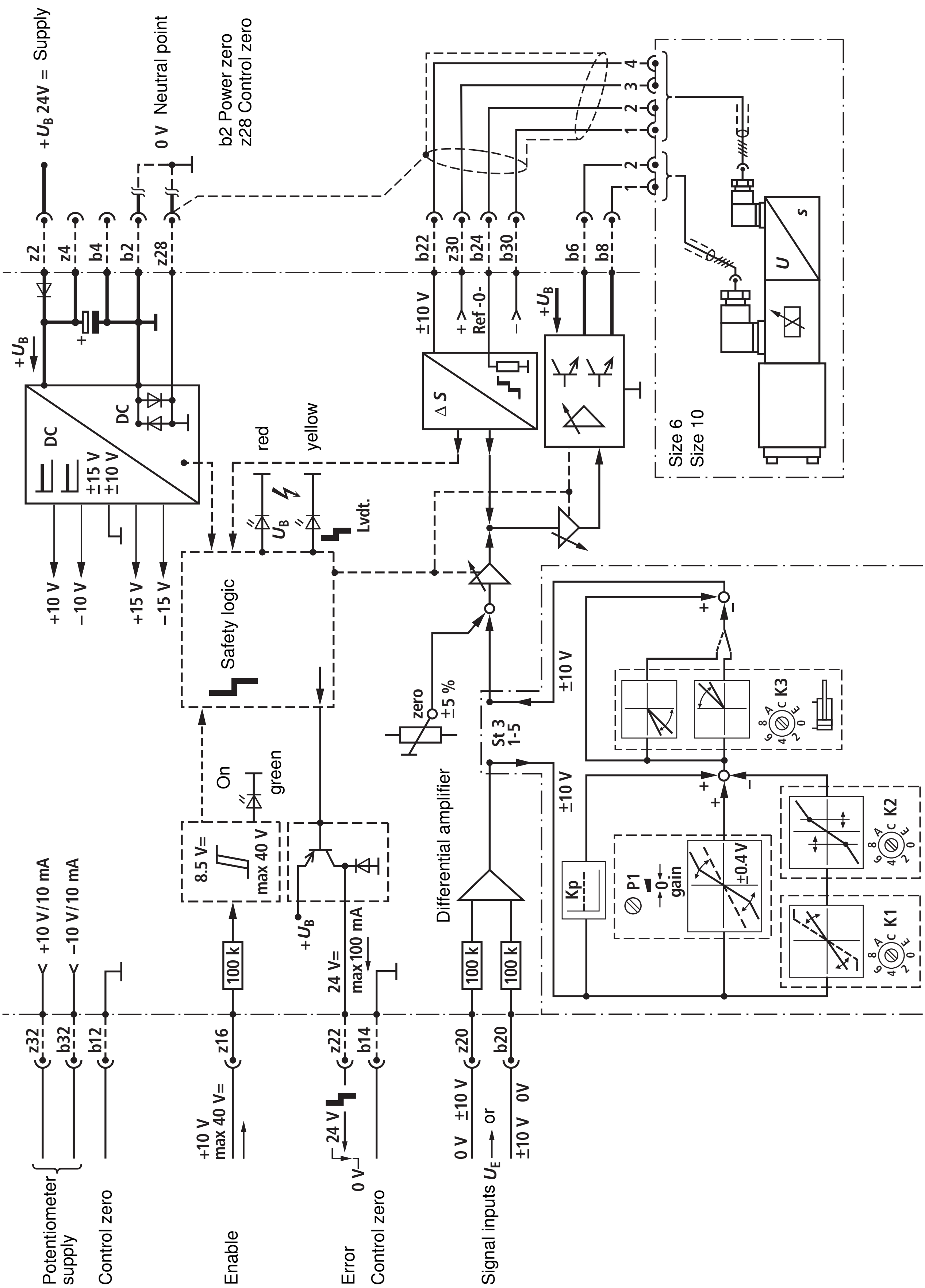
Suitable card holder:
- Open card holder VT 3002-1-2X/32F (see data sheet 29928). Only for control cabinet installation!

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



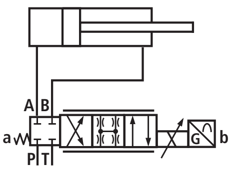
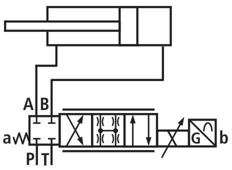
Technical data (For applications outside these parameters, please consult us!)

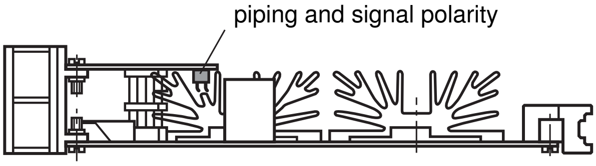
Supply voltage U_B at z2 – b2		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at z2 – b2		Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 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).

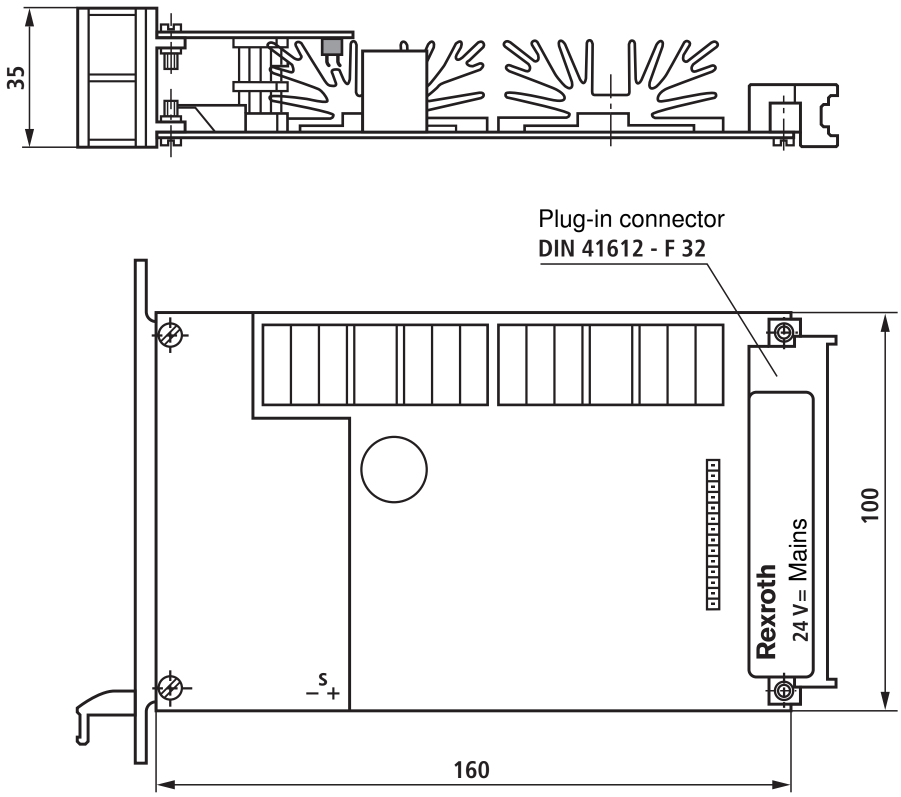
Commissioning

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.

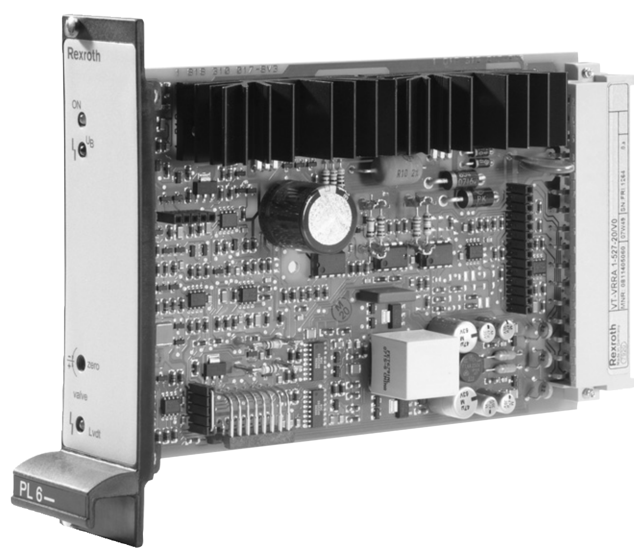
The Drive & Control Company

Rexroth
Bosch Group

Valve amplifier for high-response valves

Type VT-VRRA1-527-2X/V0/2STV, VT-VRRA1-527-2X/V0/PO-IS

RE 30045
Edition: 2013-04
Replaces: 02.12



Actual product may differ

- Component series 2X
- Analog, euro-card format
- Suitable for controlling pilot operated directional control valves, progressive with linear fine control
  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...

Features

- Controlled output stage
- Enable input
- Short-circuit proof outputs
- Adjustment possibilities – zero point of valve
- Cable break detection for actual value cable
- Position control with PID behavior

Contents

Ordering code

			01	02	03			04		05		06		07
VT	–	V	R	R	A	1	–	527	–	2X	/	V0	/	

01	Hydraulic component for valves with electrical feedback	**R**
02	Valve type: Directional control valve	**R**
03	Control: Analog	**A**
04	Serial number for types: Pilot control valve, size 6	**527**
05	Component series 20 to 29 (20 to 29: Unchanged technical data and pin assignment)	**2X**
06	Catalog version	**V0**
07	Option: Pilot operated directional control valve, progressive with linear fine control	**2STV**
	Option: Block installation valve control A → X	**PO-IS**

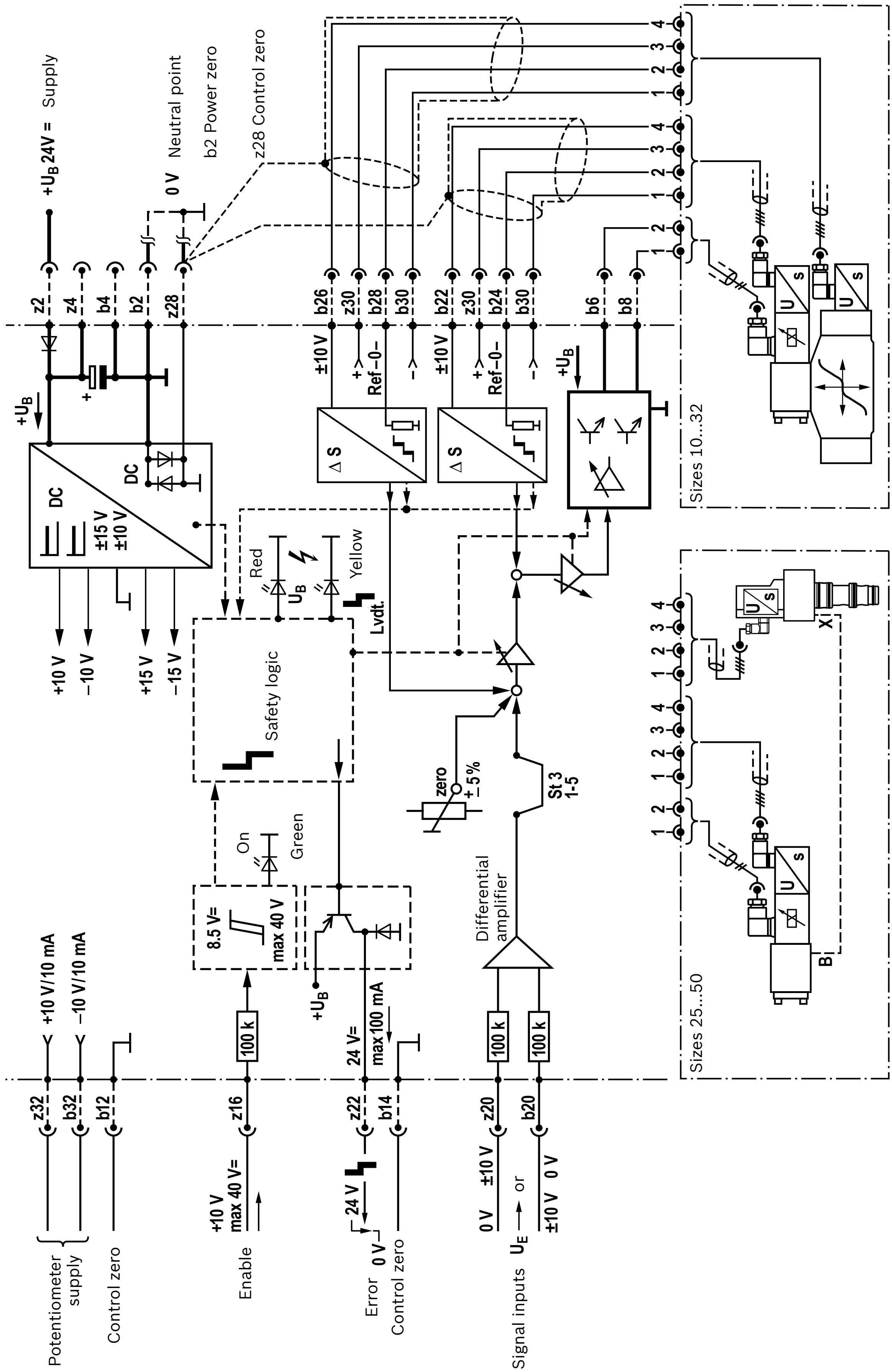
Preferred types

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...
VT-VRRA1-527-20/V0/PO-IS	0811405064	3WRCB 25...50...M-1X...

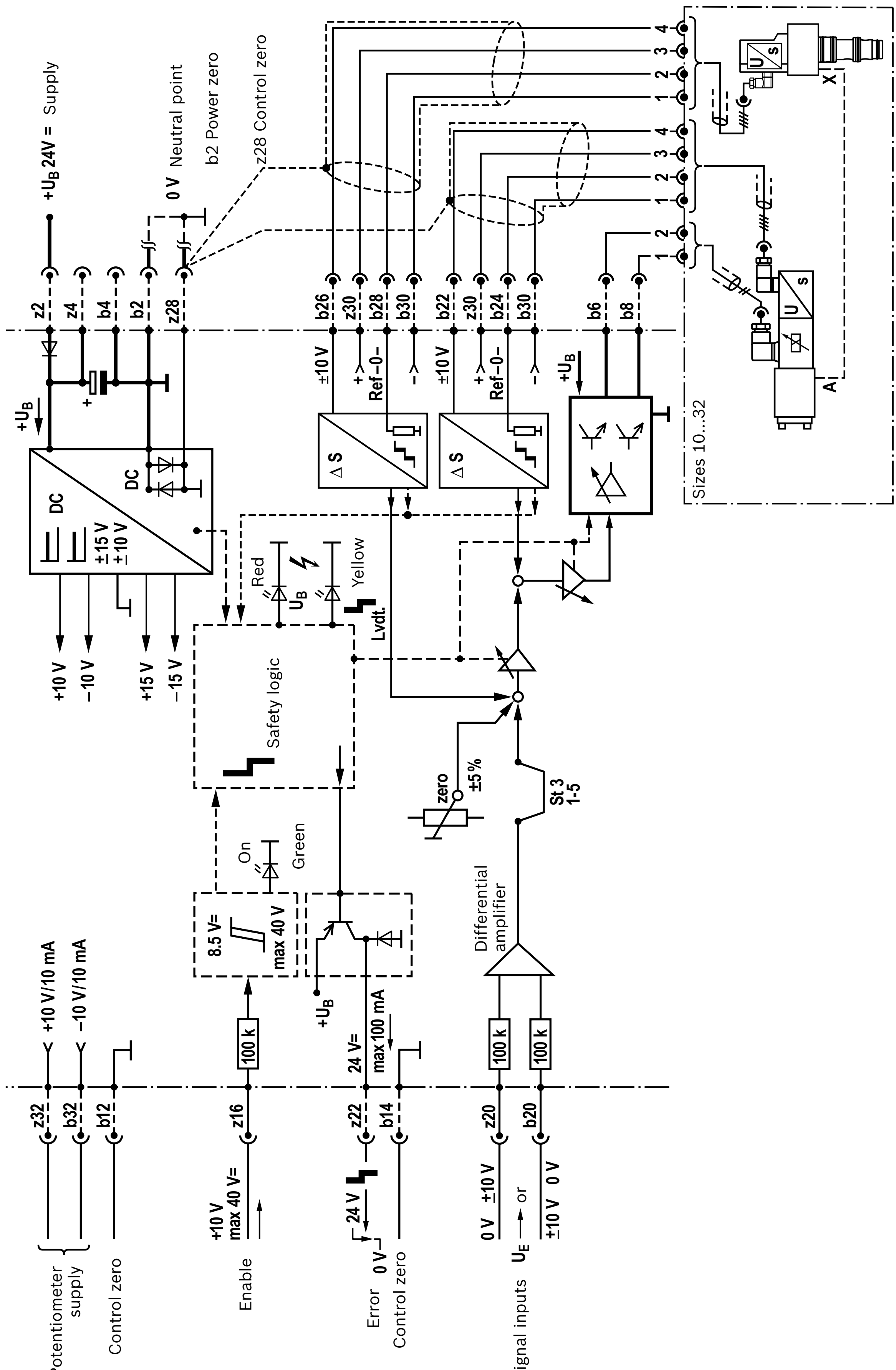
Suitable card holder:

- Open card holder T 3002-1-2X/32F (see data sheet 29928)

Block diagram with pin assignment, option 2STV



Block diagram with pin assignment, option PO-IS

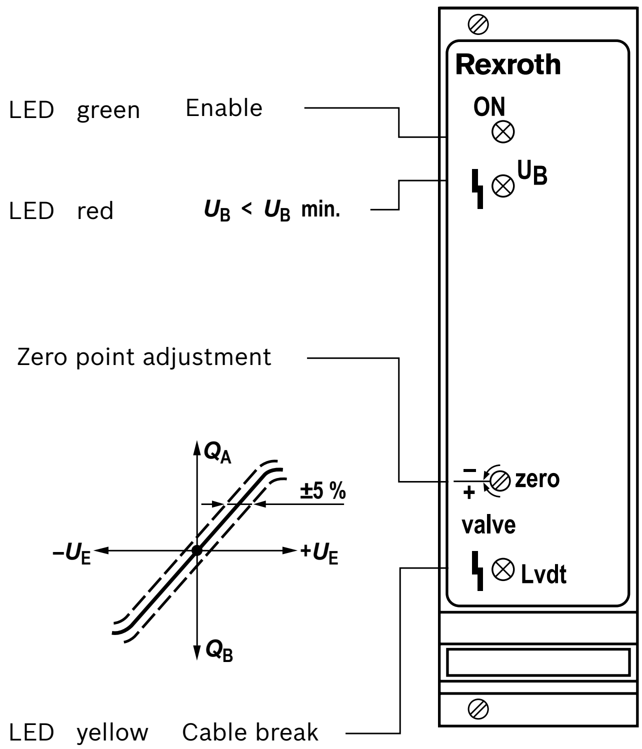


Technical data (For applications outside these parameters, please consult us)

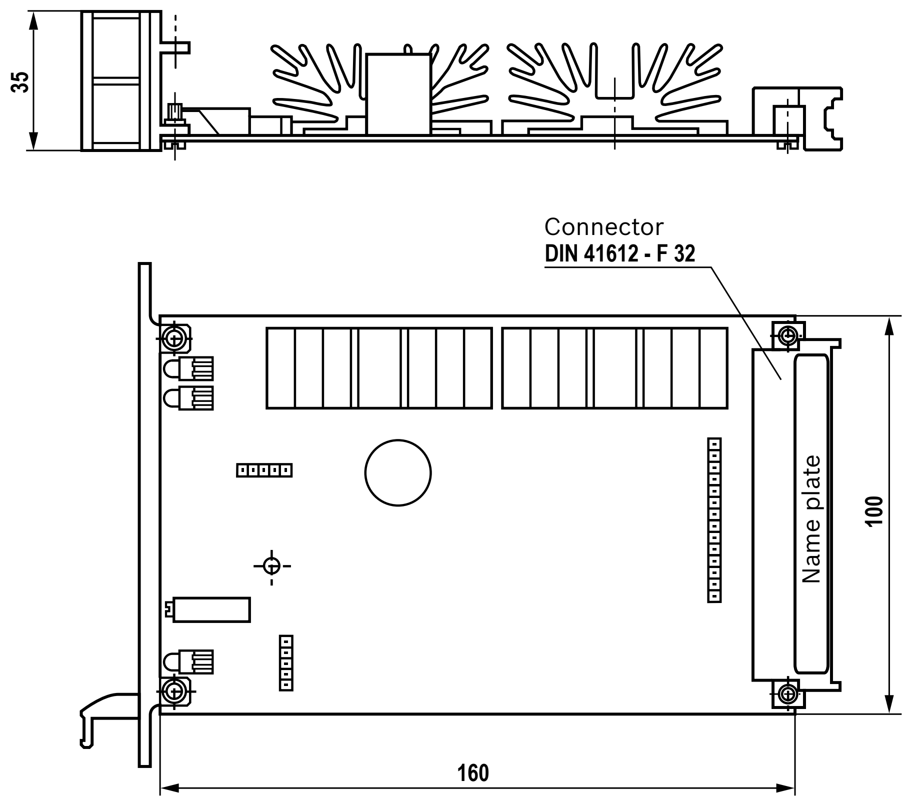
Supply voltage U_B at z2 – b2		Nominal 24 V = battery voltage 21...40 V, rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor, separately at z2 – b2		Recommendation: capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)
Valve solenoid, max.	A/VA	2.7/40 (pilot control valve, size 6)
Current consumption, max.	A	1.7
		Current consumption may increase with min. U_B and extreme cable lengths 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 panel
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		Clocked current controller
	I_{max}	2.7 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)
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 indicators		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 panel 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).

Display/adjustment elements



Dimensions (dimensions in mm)



Project planning information / 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 must be 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 5 must be complied with.

Electric amplifiers

RE 30043/02.12
Replaces: 11.02

Type VT-VRRA1-527-2X/V0/K40-AGC-2STV

Component series 2X

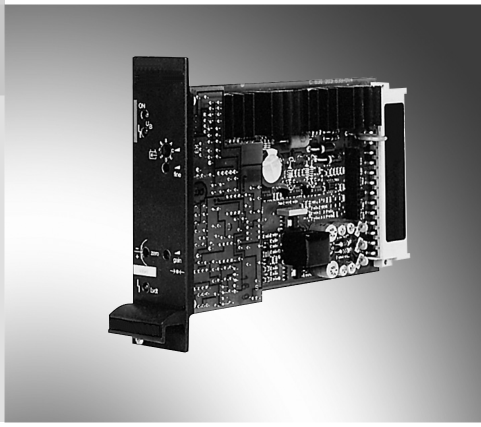


Table of contents

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

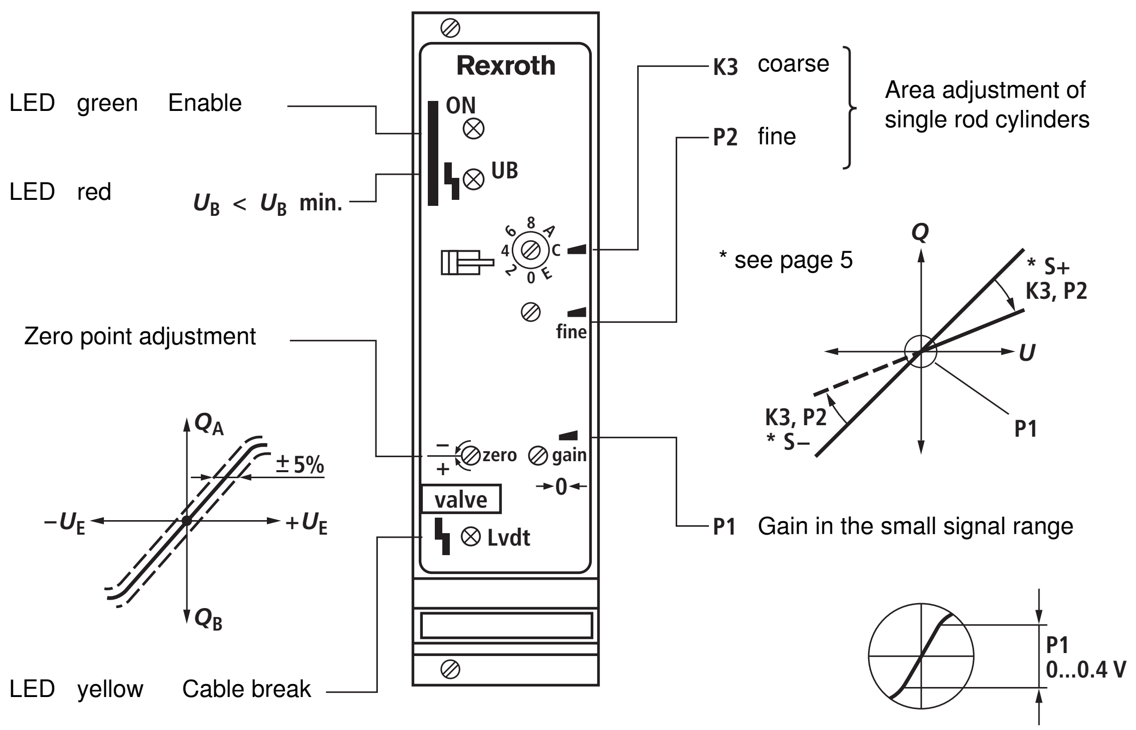
Preferred types

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

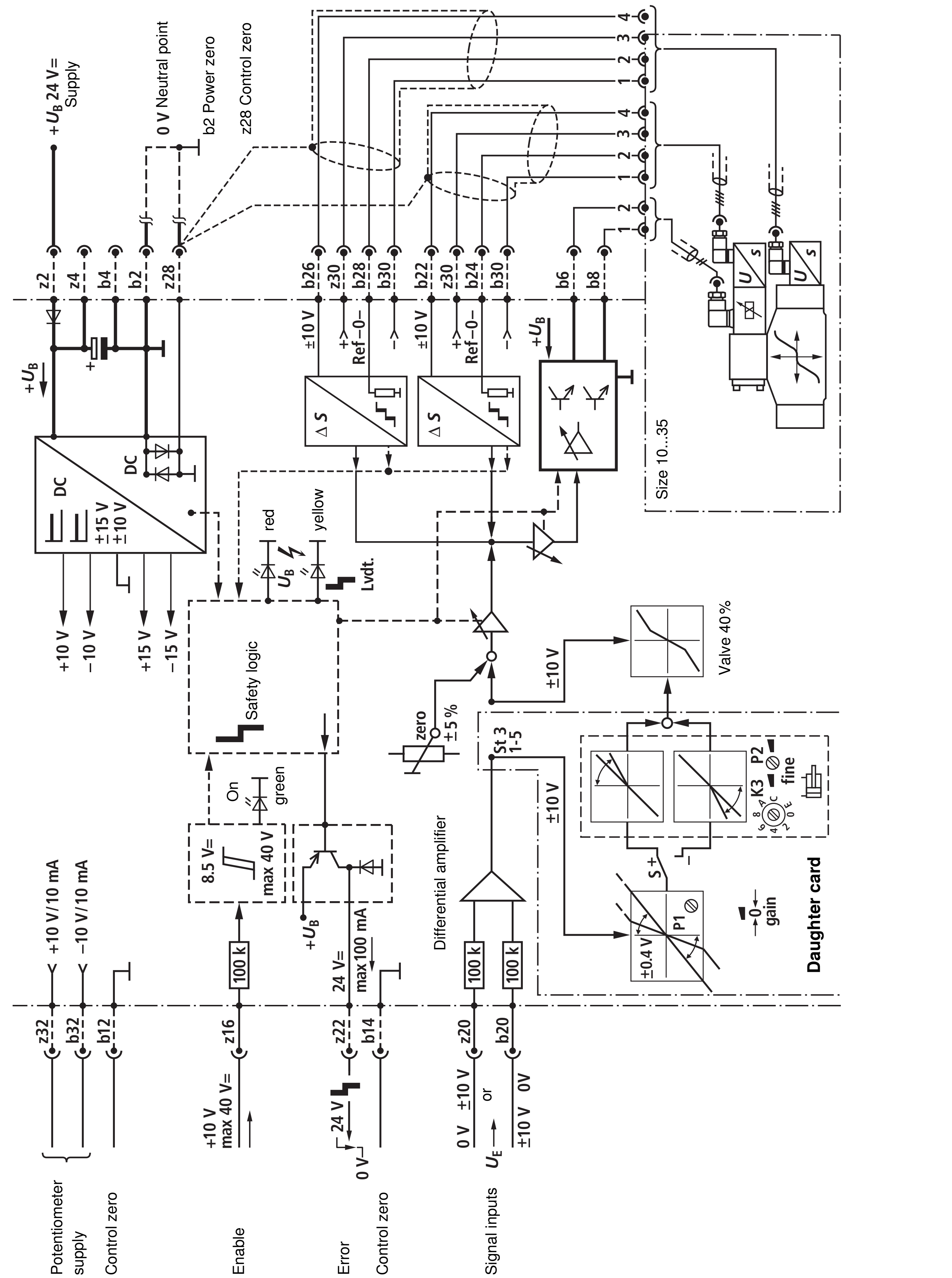
Suitable card holder:

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

Front plate



Block diagram with pin assignment



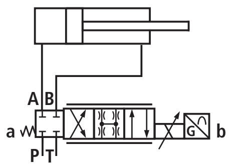
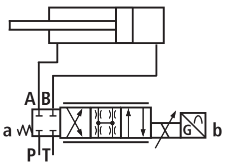
Technical data (For applications outside these parameters, please consult us!)

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 mm^2 20 to 60 m 2.5 mm^2 Position transducer: 4 x 0.5 mm^2 (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

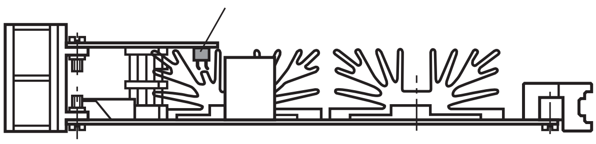
Notice:
Power zero b2 and control zero b12 or b14 or z28 must be separately led to the central ground (neutral point).

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



Rexroth
Bosch Group

Electric amplifiers

RE 30049/07.14
Replaces: 03.12

Type VT-KRRA2-5...-2X/...

Component series 2X

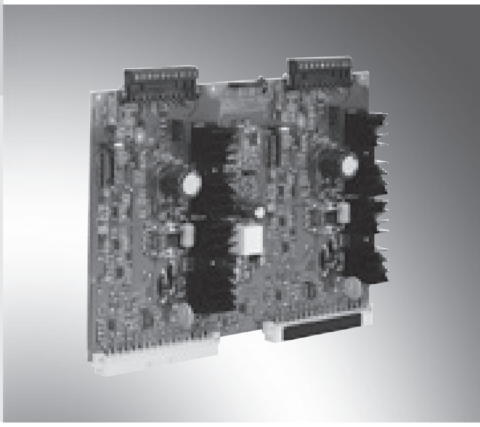


Table of contents

Contents	**Page**

Features

- Suitable for controlling direct operated high-response valves
- Double card for simultaneous operation of 2 high-response valves size 6 or size 10
- Controlled output stage
- Enable input
- Outputs short-circuit-proof
- Adjustment possibilities – zero point valve
- Cable break detection for actual value cable

Notice:

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

Ordering code, accessories

VT-	K	R	R	A	2 –	–	2X /	V0 /	2CH

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

Valve type
High-response valve **= R**

Control
Analog **= A**

Output stage
2 output stages **= 2**

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

Option
2CH = High-response valve with 2-channel variant

Preferred types

Amplifier type	Material number	For high-response valves with electric position feedback
VT-KRRA2-527-20/V0/2CH	0811405083	4WRPH 6...L-2X...
VT-KRRA2-537-20/V0/2CH	0811405082	4WRPH 10...L-2X...

Suitable card holder:

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

Function

Applications

2-axis control in presses, forming machines and machine tools.

Plug-in connections

- 2 x DIN 41612, 32-pole, for low-power signals (command value, enable, etc.).
- Bolted plug-in connection to the valve and for supply voltage on handle side (ST 4, 5 and ST 9, 10) included in the scope of delivery.

Test points

IC base on handle side for control measurements and signal inputs.

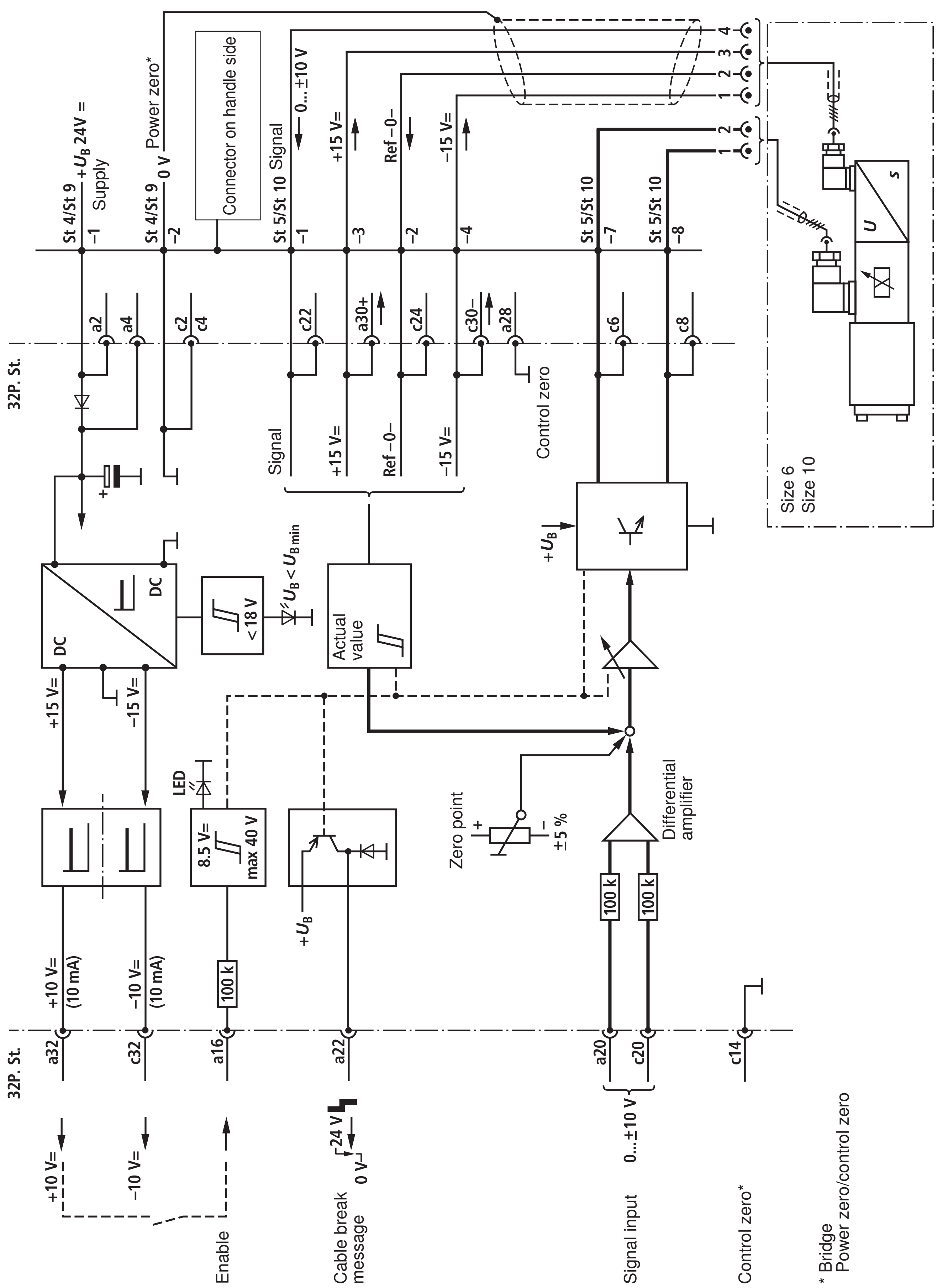
Displays

For cable break, enable and undervoltage.

Direct voltage controller (DC/DC converter)

For the supply of command value encoders, position transducers and internal supply together for both channels.

Block diagram with pin assignment



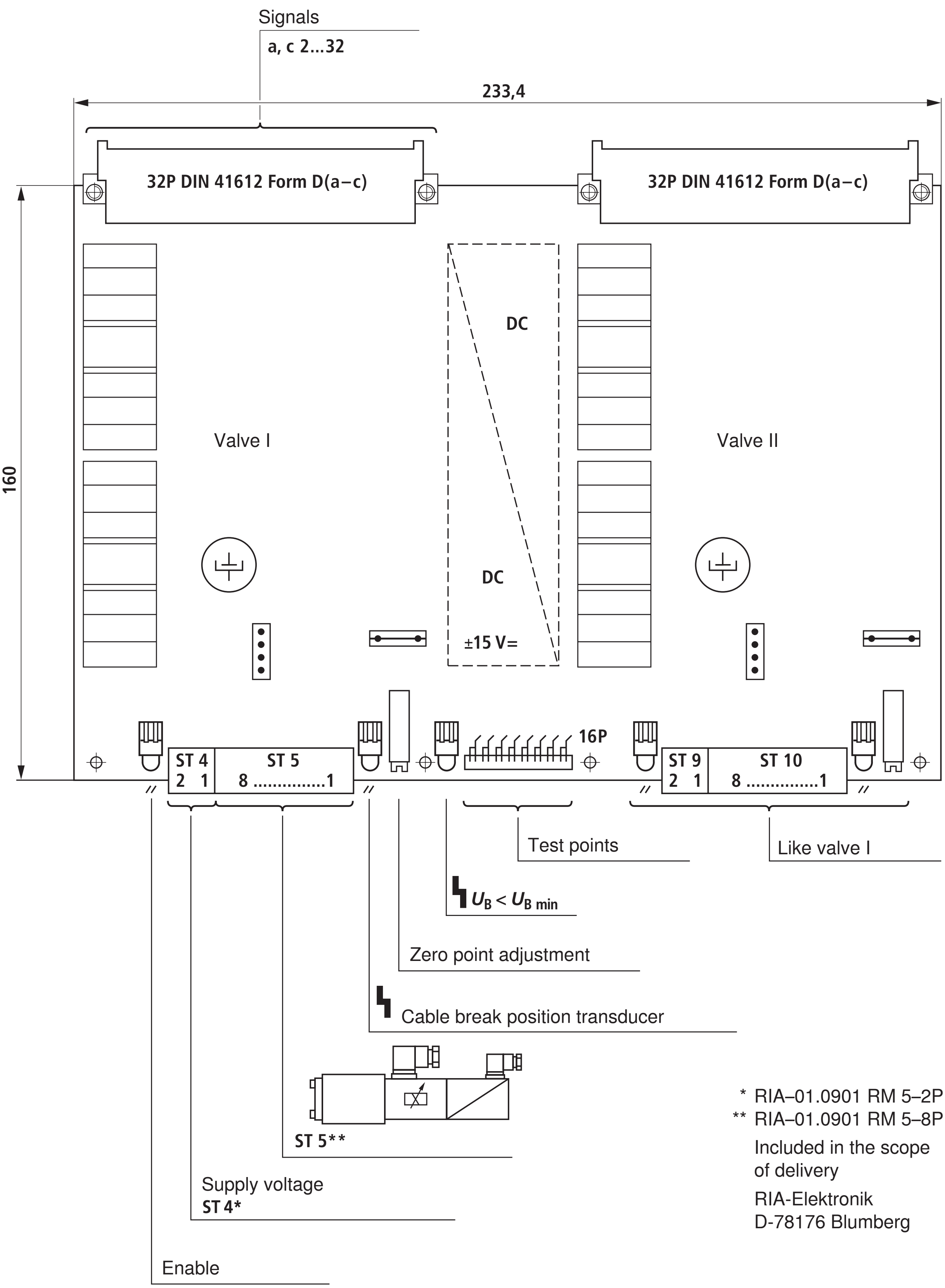
Technical data (For applications outside these parameters, please consult us!)

Supply voltage U_B at ST 4 and ST 9			Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor			Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 10 %)
Undervoltage UB > 18 V			LED (red) on handle side is illuminated
Current consumption – printed circuit board	VT-KRRA2-527		Max. 1.5 A per valve, the current consumption may increase up to 2.5 A with min. U_B and extreme cable length
	VT-KRRA2-537		Max. 2.7 A per valve, the current consumption may increase up to 3.5 A with min. U_B and extreme cable length
Power consumption – solenoid max.	VT-KRRA2-527		37 VA, nominal, per valve
	VT-KRRA2-537		55 VA, nominal, per valve (typical)
Command value at a20/c20			0...±10 V; R_i = 100 kΩ (differential amplifier), overload capacity < ±20 V
Signal source			External electronic control system, reference ±10 V from b32, z32
Enable output stage			At a16 U = 8.5...40 V; R_i = 100 kΩ, LED on handle side lights up (green)
Position transducer at ST 5 and ST 10	Supply		Cl. 4: –15 V/200 mA, short-circuit-proof
	Supply		Cl. 3: +15 V/200 mA, short-circuit-proof
	Signal		Cl. 1: 0 ... ±10 V; RL ≧ 10 kΩ
Reference voltage for external electronics			c32: –10 V/10 mA, short-circuit-proof a32: +10 V/10 mA, short-circuit-proof
Solenoid current max.	VT-KRRA2-527	A	2.9
	VT-KRRA2-537	A	3.7
Fault message a22 cable break			Error: 0 V; no errors: 24 V, max. 100 mA ϟ : LED (yellow) on handle side is illuminated
Cable between amplifier and valve			Solenoid cable: to 20 m Ø 1.5 mm^2 20 to 60 m Ø 2.5 mm^2 Position transducer: 4 x 0.5 mm^2 (shielded)
Circuit board format		mm	(233.4 x 160 x approx. 30) / (W x L x H), double Europe format
Plug-in connection	Signals		Connector DIN 41612, design D (a–c)
	Valve and supply		Screw-plug-in connection on handle side
Ambient temperature		°C	0...+70
Storage temperature range		°C	–20...+70
Weight		m	0.54 kg

Notice:
Power zero and control zero c14/c12 must be bridged.
If the distance to the power supply unit is < 1 m, directly onto the DIN connector at c2/c4.
With larger distances, lead the control separately to the ground.
Connect the supply voltage to connectors ST 4 and ST 9.

Adjustment
Zero point adjustment via trimming potentiometer.

Disposition, unit dimensions (dimensions in mm)



* RIA–01.0901 RM 5–2P
** RIA–01.0901 RM 5–8P
Included in the scope of delivery
RIA-Elektronik
D-78176 Blumberg

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.

Electric amplifiers

RE 30044/02.12
Replaces: 11.02

Type VT-VRPA1-527-2X/V0/RTS-2STV

Component series 2X

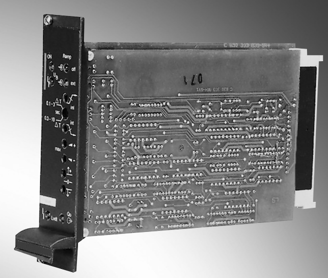


Table of contents

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**
527 =	Serial number for types Pilot control valve size 6
2X =	Component series 20 to 29 (20 to 29: Unchanged technical data and pin assignment)
V0 =	Customer version Catalog version
RTS-2STV =	Option Directional control valve, pilot operated RTS = Ramp function

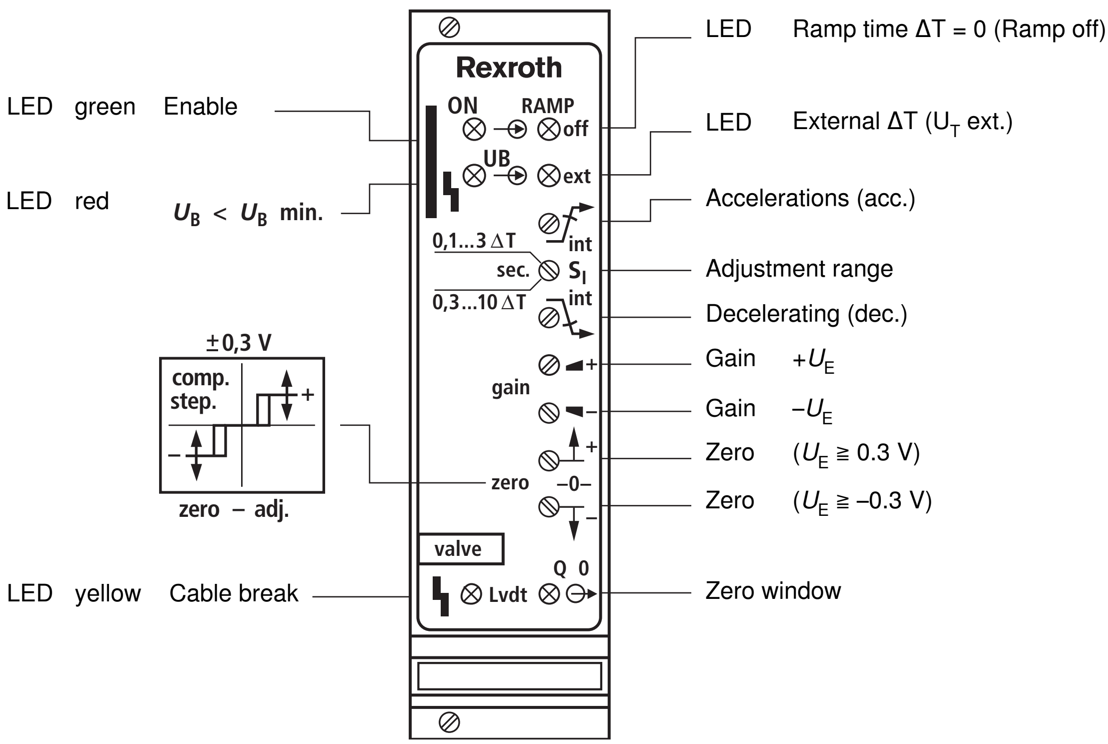
Preferred types

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...

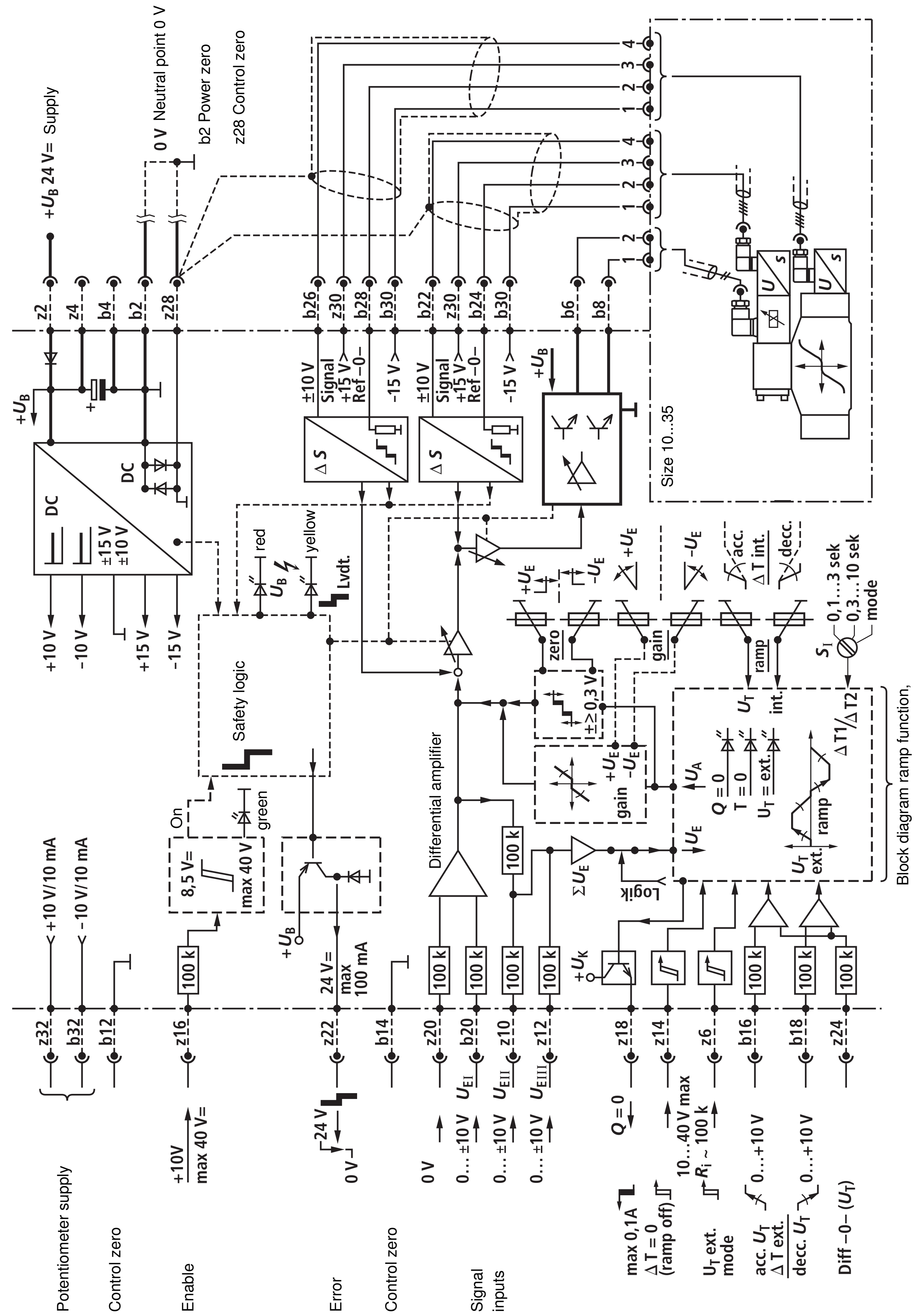
Suitable card holder:

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

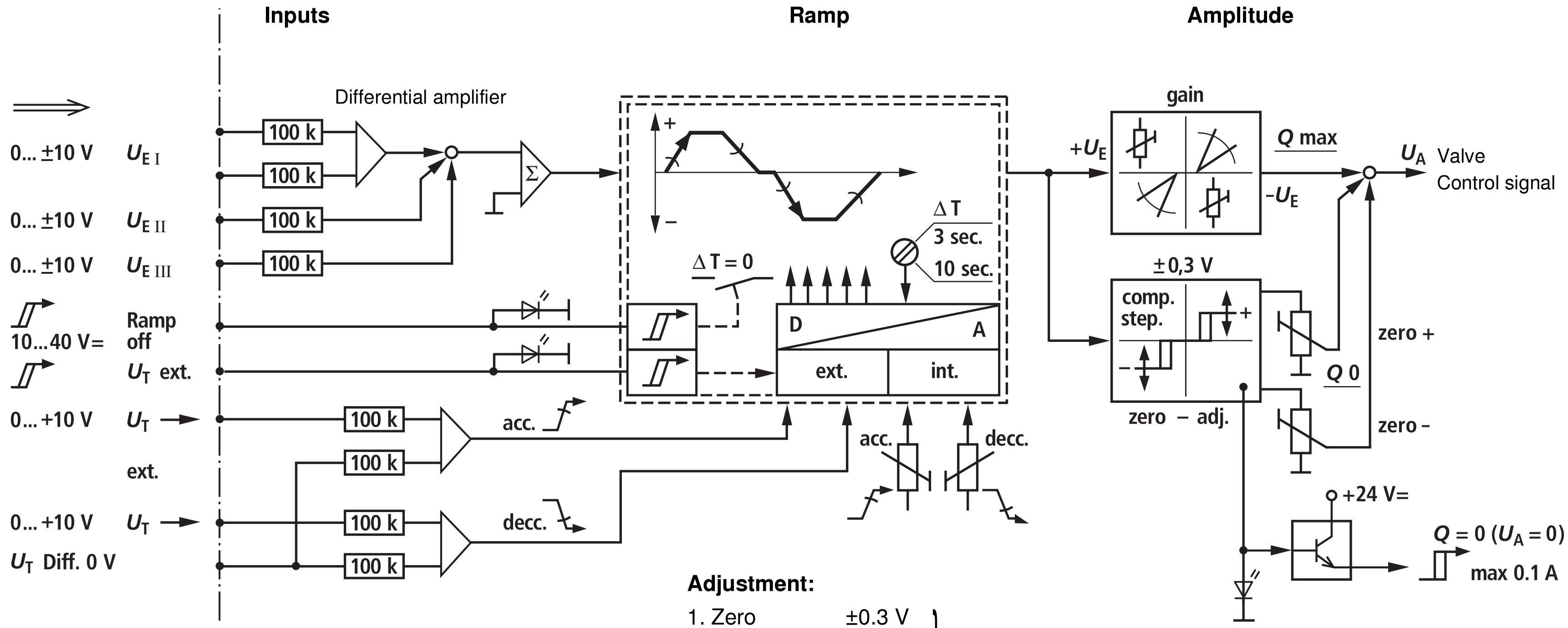
Front plate



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!)

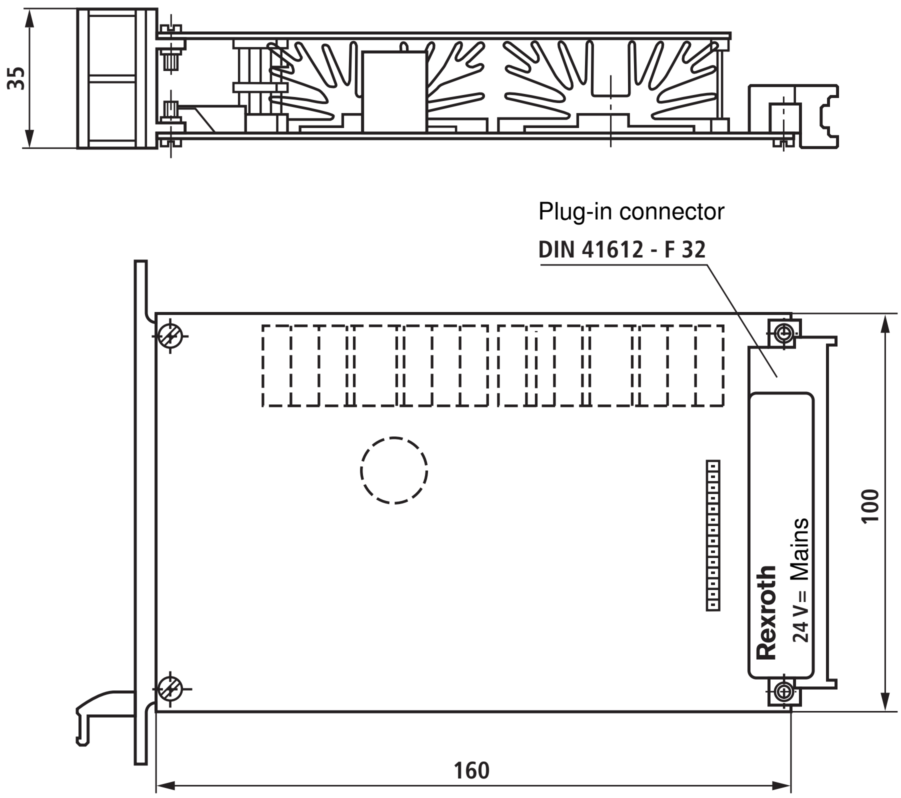
Supply voltage U_B at z2 – b2			Nominal 24 V =, Battery voltage 21…40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Smoothing capacitor, separately at z2 – b2			Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 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
	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	0.44 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.

Rexroth
Bosch Group

Electric amplifiers

RE 30041/02.12 **1**/6
Replaces: 01.11

Type VT-VRRA1-5...-2X/V0
Type VT-VRPA1-5...-2X/V0

Component series 2X

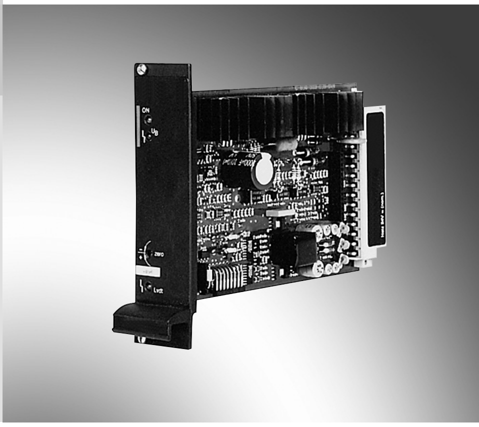


Table of contents

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

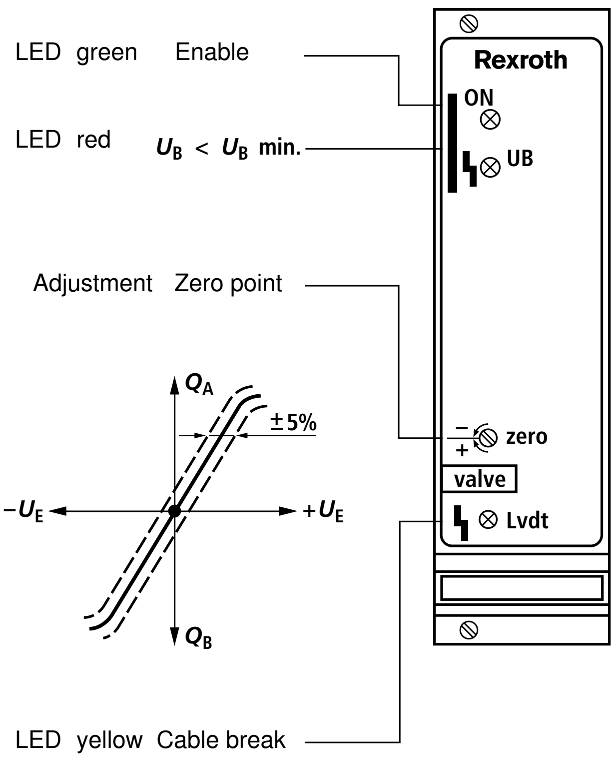
Preferred types

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

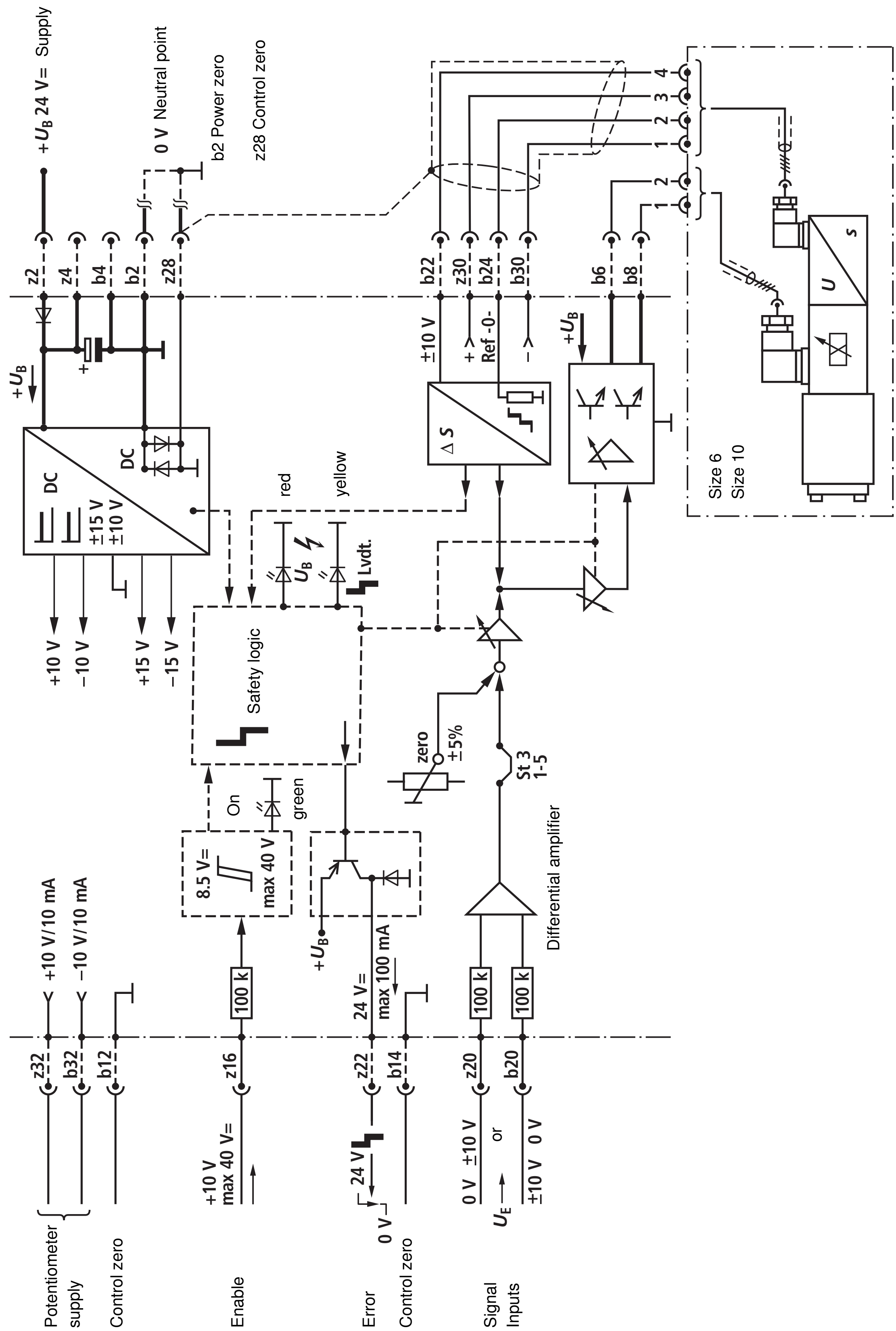
Suitable card holder:

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

Front plate



Block diagram with pin assignment

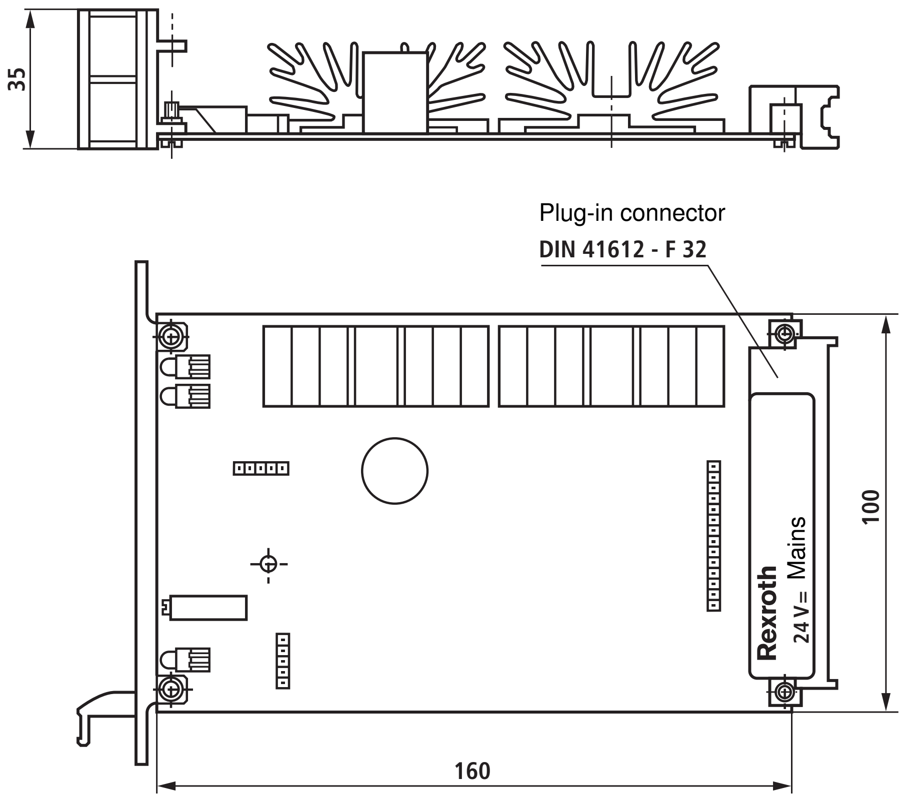


Technical data (For applications outside these parameters, please consult us!)

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	
	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 %	
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.

Valve amplifier for high-response valves with servo valve pilot control

Type VT-SR31 to VT-SR38

RE 29931
Edition: 2013-07
Replaces: 12.10

H5657

- Component series 1X
- Analog, euro-card format
- Suitable for actuation of high-response valves (flow control valves) with servo valve pilot control and electric position feedback (cartridge valves, type .WRC...1X)

Features

- Controller for valve flow
- Controller for main control spool position
- Dither signal generator
- Push-pull output stage
- Oscillator/demodulator
- Enable circuit mit relay
- Measuring instrument for display of servo valve flow
- Reverse polarity protection for 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 only affects the actual value (velocity feedback).

Contents

Ordering codes

01		02		03		04	05
VT-SR ...	**–**	**1X**	**/**		**–**		

01	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**

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

03	Without ±15 V voltage regulator	**0**
	With ±15 V voltage regulator	**1**

04	For valves with 2/2-way function	**2**
	For valves with 3/2-way function	**3**

05	Further details in the plain text [1]	**no code**

Accessories (separate order)

Card holder

- ► Type VT 3002-1-2X/32D, 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

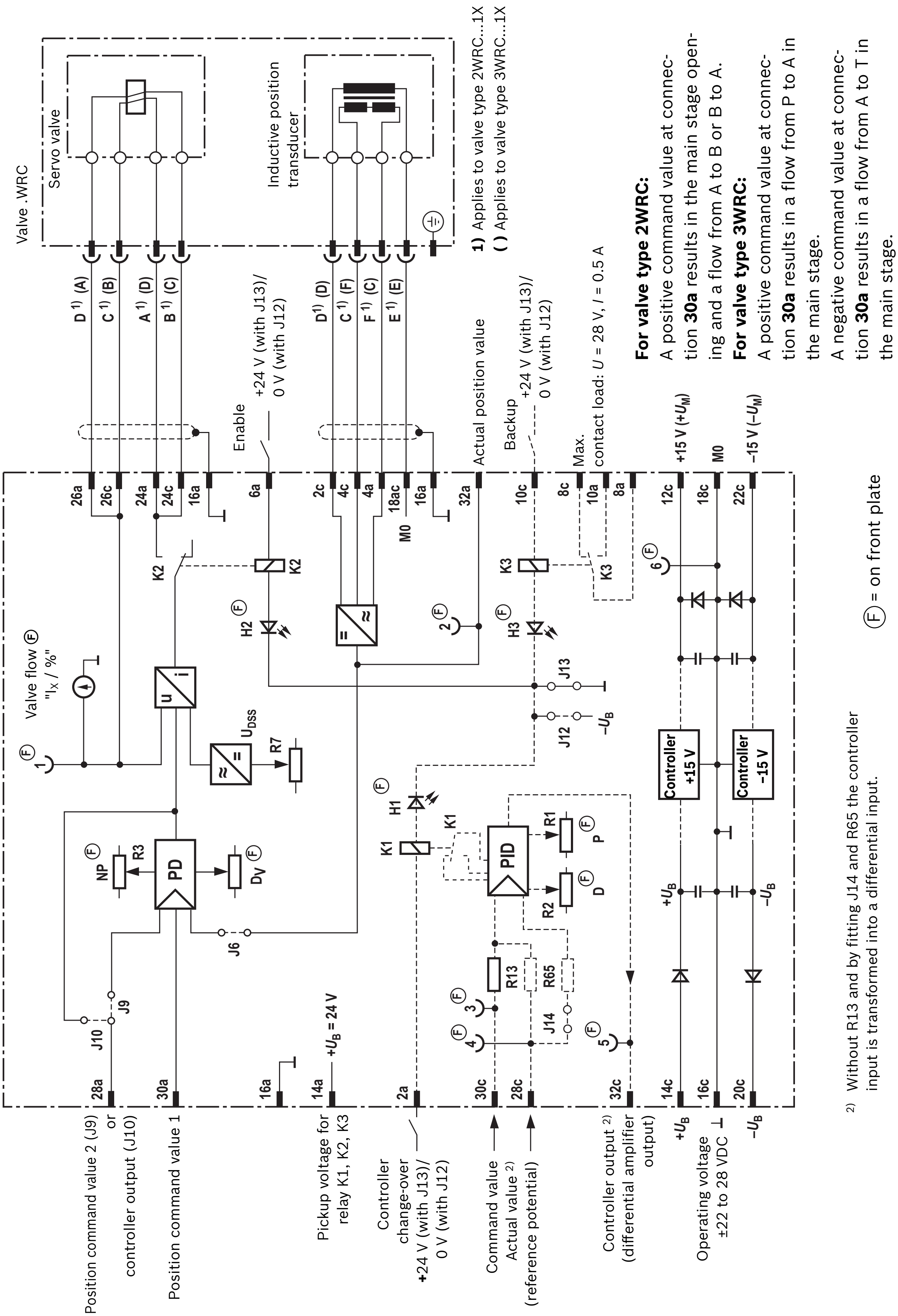
[1] E.g. with/without PID controller, with/without backup relay K3
The controller characteristics for the additional PID controller need to be specified.

Function

The amplifiers VT-SR31 to VT-SR38 operate with a push-pull output stage with bipolar transistors. The output of this output stage can be connected or disconnected by means of an enable circuit (relay K2). The enable is indicated by the LED "H2" on the front plate being illuminated.
The switching voltage of all relays is defined by means of bridges J12 and J13 to either 0 V or $+U_B$ (factory $+U_B$).
The output stage 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 (command current value) is made via a PD controller. The actual current value returned is simultaneously displayed by the instrument on the front plate.
The oscillator/demodulator senses the spool valve 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 command value and the actual position 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 plate.

The required symmetric operating voltage $\pm U_B$ is protected against reversed 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 reversed 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 a switchable PI share and a backup relay with potential-free changeover contact. This controller can be used to superimpose a further control loop (e.g. for drive control).
The P and D share can be set at the front plate. 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 be specified in the order in 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/pin assignment



1) Applies to valve type 2WRC...1X
( ) Applies to valve type 3WRC...1X

For valve type 2WRC:
A positive command value at connection **30a** results in the main stage opening and a flow from A to B or B to A.

For valve type 3WRC:
A positive command value at connection **30a** results in a flow from P to A in the main stage.
A negative command value at connection **30a** results in a flow from A to T in the main stage.

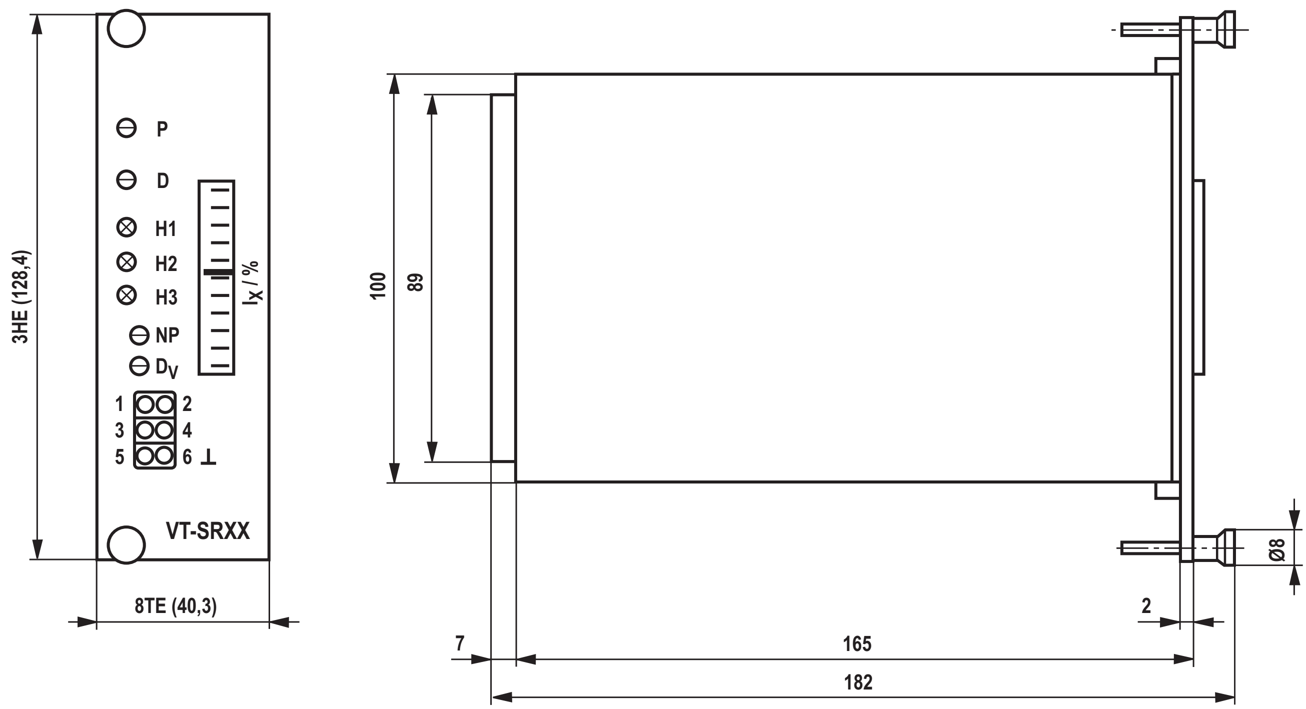
2) Without R13 and by fitting J14 and R65 the controller input is transformed into a differential input.

Technical data (for applications outside these values, 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) when U_B = ±24 V [1]			I	< 150 mA
Inputs	Command value 1 (main control spool position)		U_e	0 to ±10 V (R_e = 50 kΩ)
	Command value 2 (main control spool position) with J9		U_e	0 to ±10 V (R_e = 50 kΩ)
	Actual value (main control 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 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	Regulated output voltage [1]		U_M	±15 V ± 2%; 150mA
	Valve flow		I_{max}	±60 mA
	Valve flow command value (with J10)		U_A	±10 V ≙ ±60 mA (measuring 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
	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		I	0.5 A
Type of connection				32-pole male multipoint connector, DIN 41612, design D
Card dimensions				Euro-card 100 x 160 mm, DIN 41494
Front dimensions	Height			3 HE (128.4 mm)
	Width soldering side			1 TE (5.08 mm)
	Component side width			7 TE
Adm. ambient temperature range			J	0 to +50 °C
Storage temperature range			J	−20 to +70 °C
Weight			m	0.3 kg

[1] For design **with** voltage regulator

Dimensions (dimensions in mm)



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-plated 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 cables; connect shielding to ground (⊥) on the card-side, open at one side.
- Do not lay signal lines close to power lines.
- Recommendation: 1. Also shield the solenoid conductors (to ⊥ on one side).
  2. Up to 50 m length, use cable type LiYCY 1.5 mm^2, for longer lengths please ask.

Notice: The K2 relay may only be de-activated if the servo valve is trimmed so that main stage of the WRC valve moves the actuator into a secure end position.
With non-trimmed servo valves, the position of the control spool in the main stage is not defined when relay K2 is off.

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

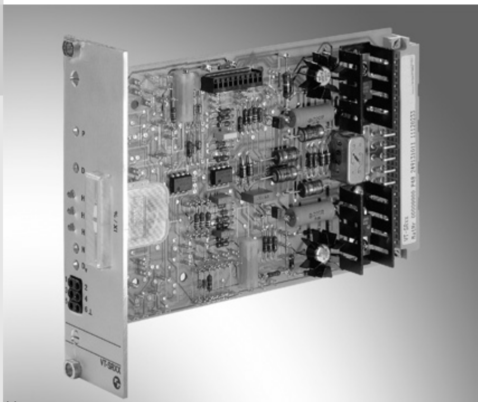


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Table of contents

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.

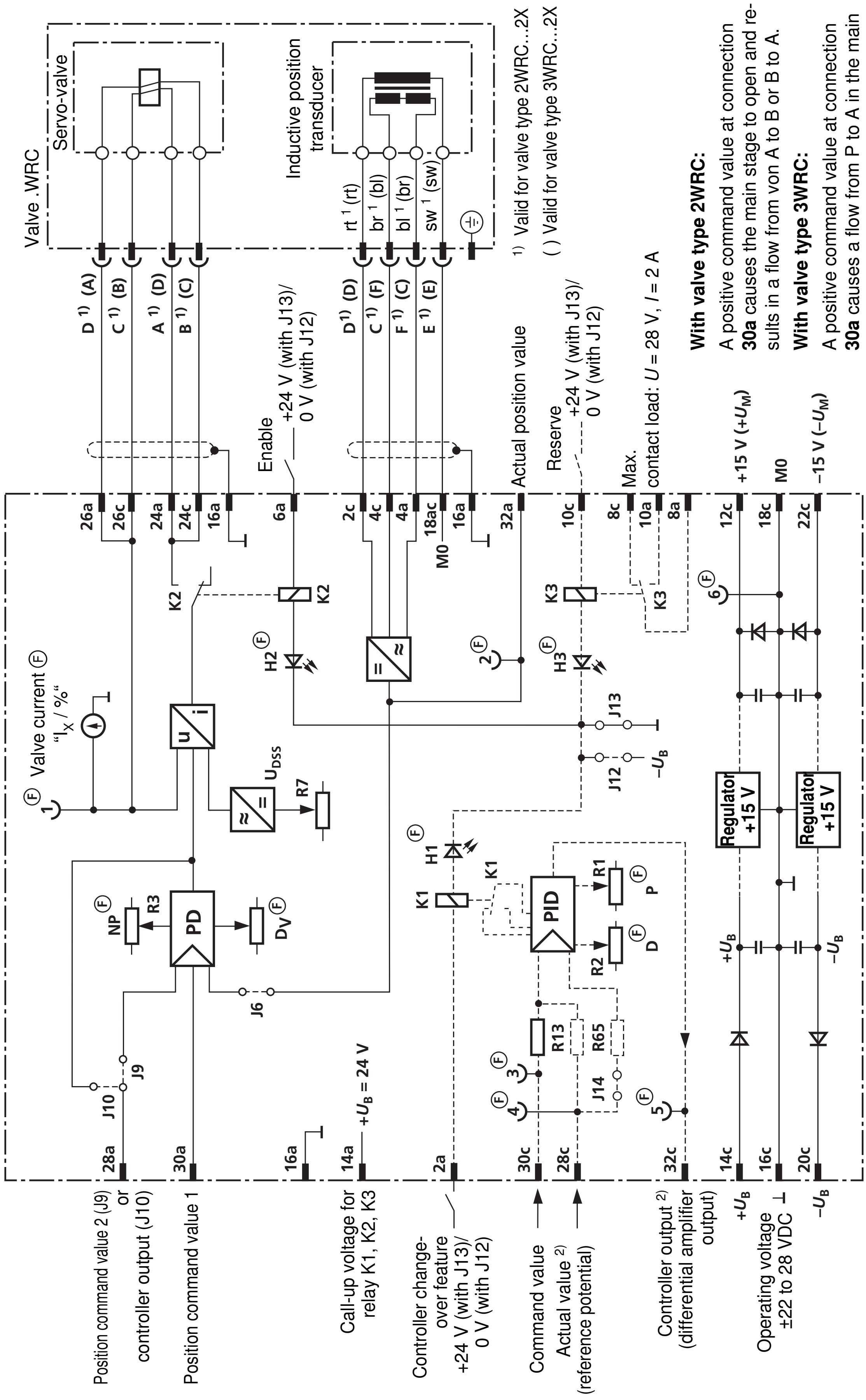
The PD-controller receives the position command value and the actual position value, with the D-component being effective **exclusively** on the actual value (velocity feedback).

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



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.

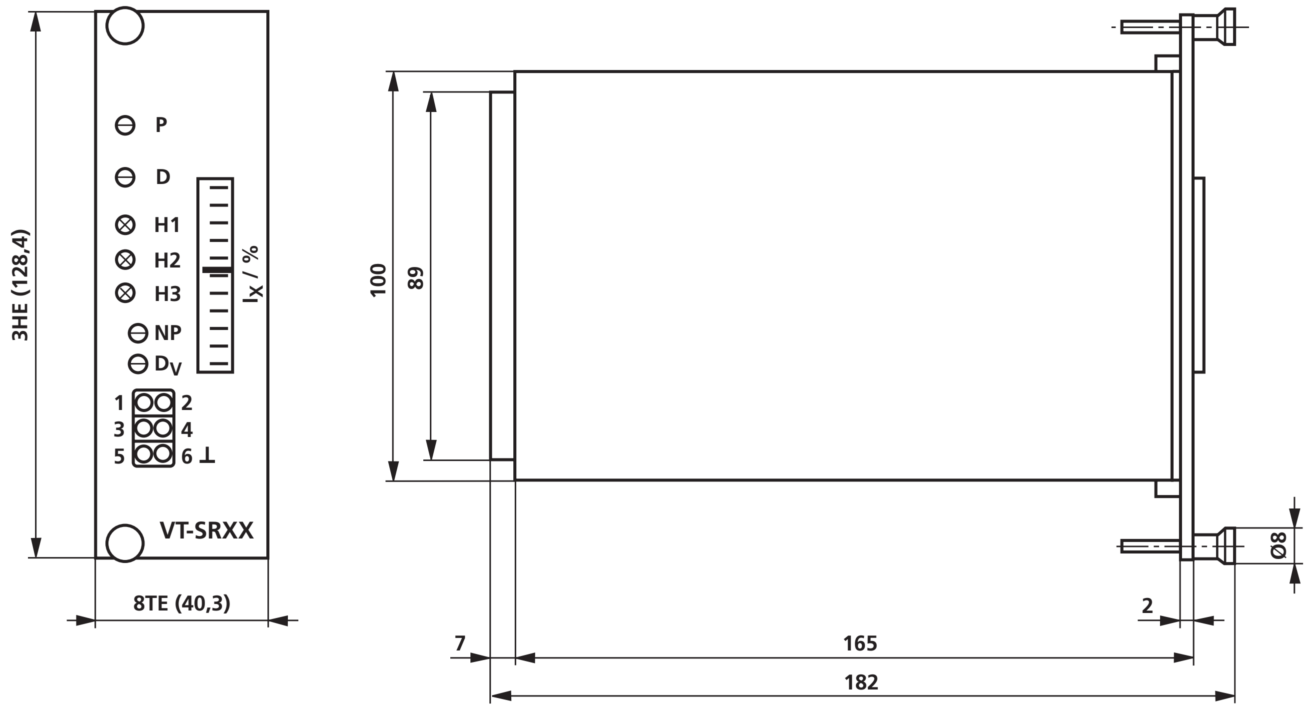
A negative command value at connection **30a** causes a flow from A to T in the main stage.

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!

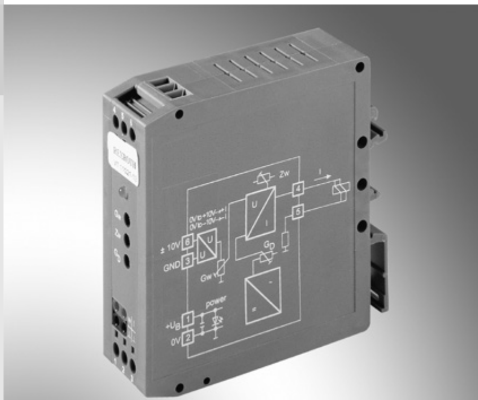
Note: Electrical signals (e.g. actual value) brought out via control electronics must not be used for switching safety-relevant machine functions!
(See also European standard “Safety requirements for fluid power systems and components - hydraulics“, EN 928.)

Analog amplifier module

RE 29743/07.10
Replaces: 06.05

Type VT 11021

Component series 1X



H6507_d

Table of contents

Contents	**Page**

Features

- Suitable for controlling servo-valves with mechanical feedback, 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

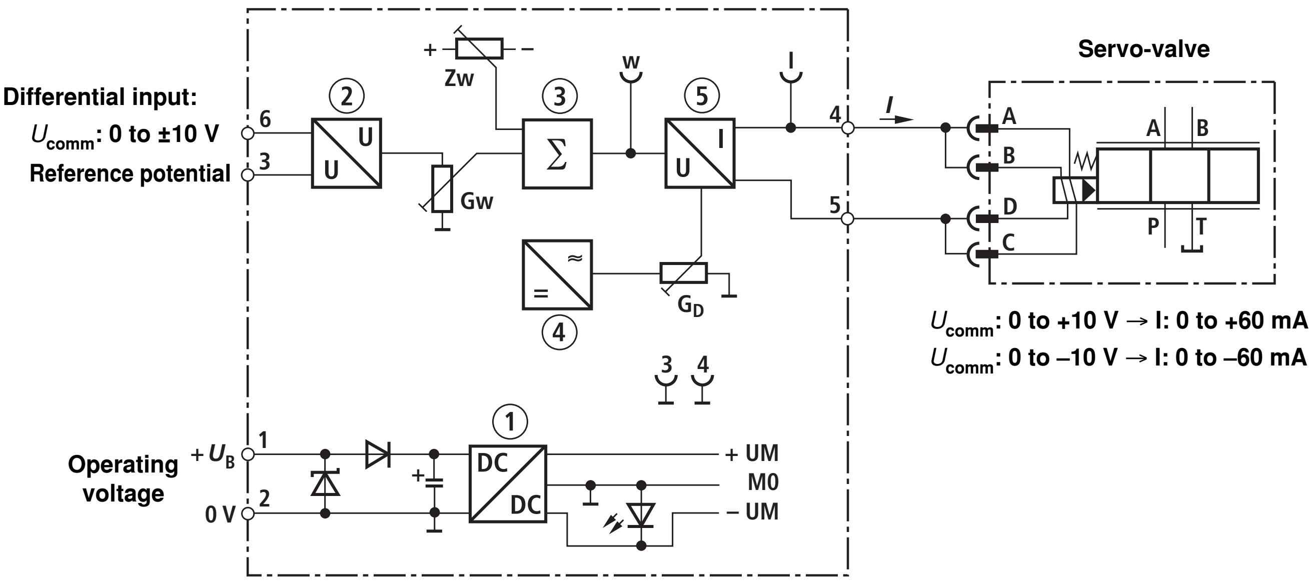
The amplifier module is to be snapped onto a hat rails according to EN 60715. It is electrically connected by means of screw terminals. The module is powered by 24V DC voltage.

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		

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

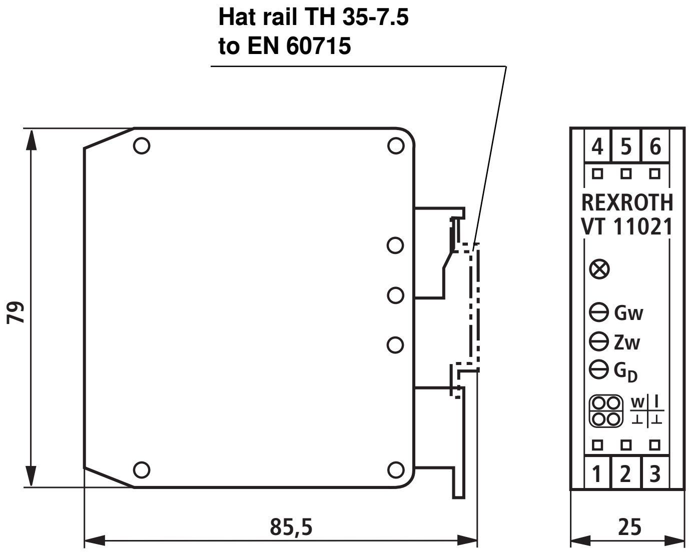
Operating voltage	U_O	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_O(t)_{max}$	35 V
– Lower limit value	$u_O(t)_{min}$	21 V
Current consumption (without valve) at U_O = ±24 V	I_{max}	300 mA
Power consumption	P_S	approx. 8 VA
Fuse		Thermal overload fuse (with reactive function when temperature 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

Analog amplifier module

RE 29743-03/07.10 1/4
Replaces: 05.10

Type VT 11021-1X/V002

Component series 1X

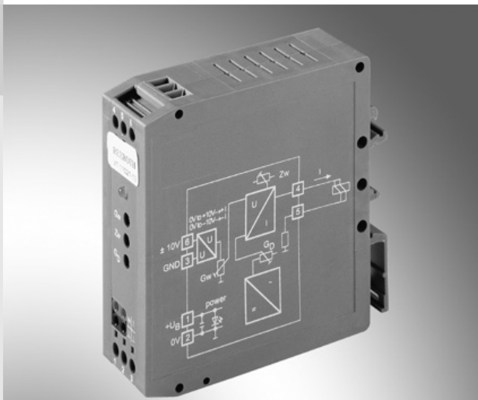

H6507_d

Table of contents

Features

– Suitable for controlling servo-valves with mechanical feedback, type 4WS2EM… (sizes 6 and 10)
– Change as compared to the basic unit:
Input ±50 mA instead of ±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

Type VT 11021-1X/V002

Mat. no. R901272388

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 ±50 mA command value is applied to the differential input. The output current of the downstream U/I transformer controls the servo-valve.

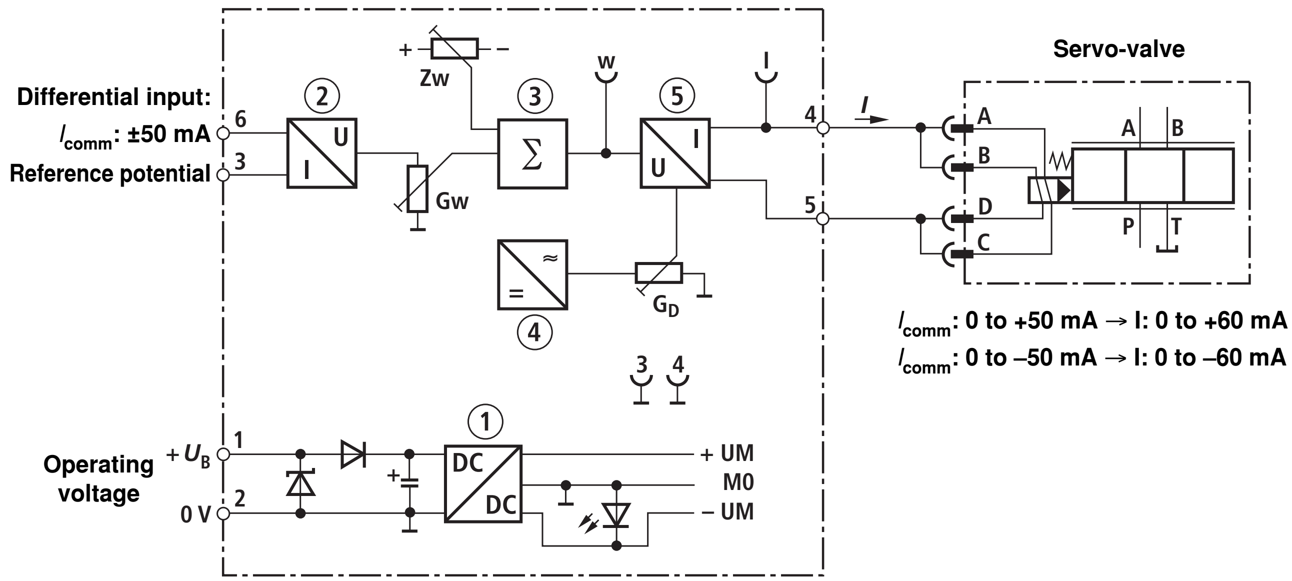
The following parameters can be adjusted externally using trimming potentiometers Gw, Zw and G_D:

– 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	$\mathbf{G_D}$	Amplitude of dither signal
4	Dither signal generator		
5	U/I transformer		

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

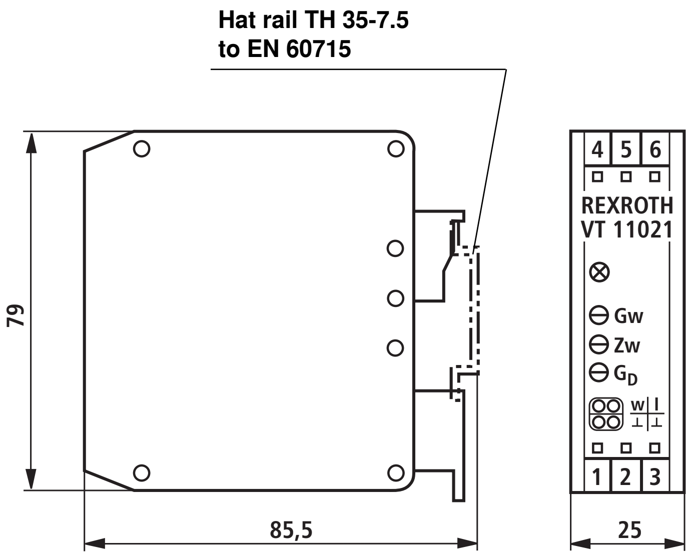
Operating voltage	U_O	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_O(t)_{max}$	35 V
– Lower limit value	$u_O(t)_{min}$	21 V
Current consumption (without valve) at U_O = ±24 V	I_{max}	300 mA
Power consumption	P_S	approx. 8 VA
Fuse		Thermal overload fuse (with reactive function when temperature falls below the threshold)
Inputs:		
– Command value	I_{comm}	0 to ±50 mA (R_e = 100 Ω)
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		Top 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
Operating voltage	0 V	2	5	Servo-valve	Connection C, D
	Reference potential	3	6	$\pm I_{comm}$	

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

Analog amplifier module

RE 29743-02/07.10
Replaces: 04.08

Type VT 11021-1X/V001

Component series 1X

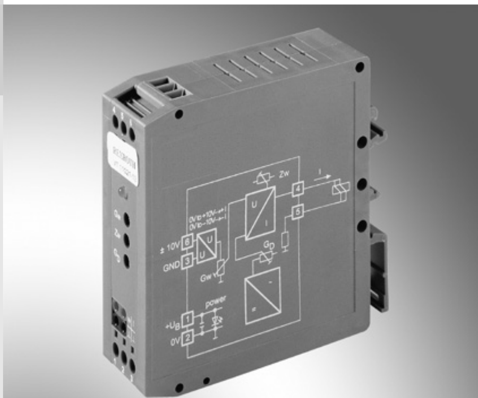


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Table of contents

Features

- Suitable for controlling servo-valves with mechanical feed-back, type 4WS2EM… (sizes 6 and 10)
- Changes when compared with the basic device:
  Maximum current ±20 mA
- Differential input ±10 V
- Dither signal generator
- U/I converter (short-circuit-proof against 0 V)
- DC/DC converter
- Reverse polarity protection
- Internal supply voltage is signaled by LED

Ordering code

Type VT 11021-1X/V001

Mat. no. R901167581

Functional description

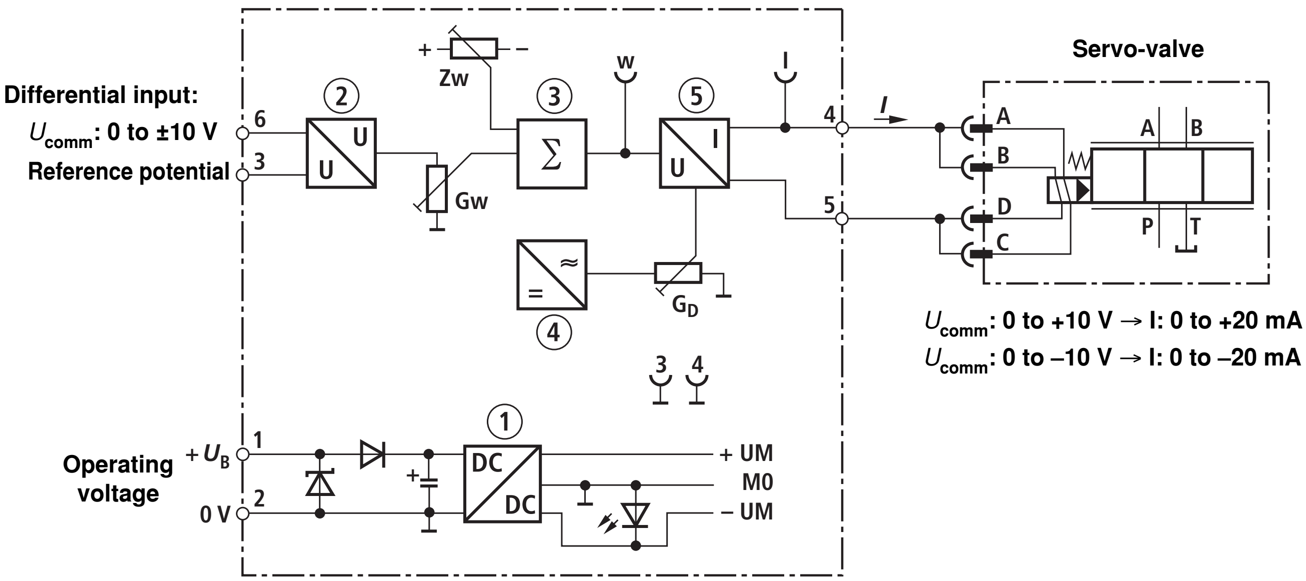
The amplifier module is to be snapped onto hat rails in accordance with EN 60715. The electrical connection is made by means of screw-type terminals. The module is operated with 24V DC voltage.

The command value of ±10 V is applied to the differential input. The output current of the downstream U/I converter controls the servo-valve.

The following parameters can be adjusted externally by means of trimming potentiometers Gw, Zw and G_D:

- Max. output current by means of “Gw“ from ca. 10 % to 110 %
- Offset current by means of “Zw“ between +10 % and –10 % of max. output current
- Amplitude of the dither signal by means of “G_D“ between 0 % and 10 % of max. output current

Block circuit diagram / pinout



1	Power supply unit	**Gw**	Max. output current
2	Differential amplifier	**Zw**	Offset current
3	Summator	**G_D**	Dither signal amplitude
4	Dither signal generator		
5	U/I converter		

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

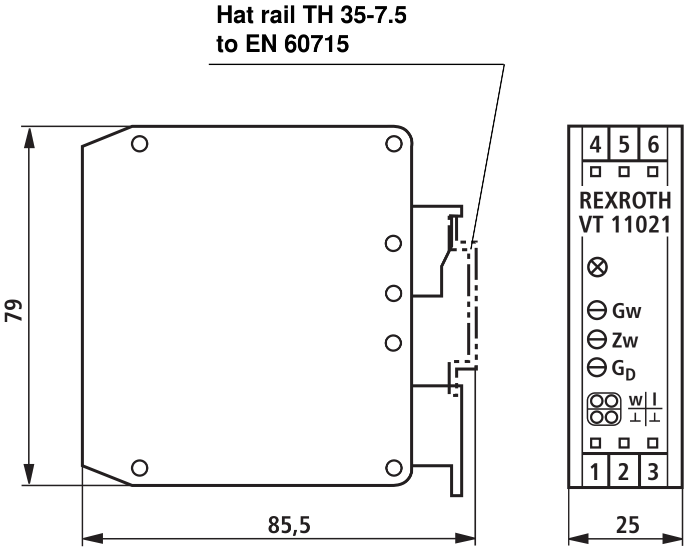
Operating voltage	U_B	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V
– Lower limit value	$u_B(t)_{min}$	21 V
Current consumption (without valve) at U_B = ±24 V	I_{max}	300 mA
Power consumption	P_S	ca. 8 VA
Fuse		Thermal overload protection (with reclosing when temperature falls below the threshold)
Inputs:		
– Command value	U_{comm}	0 to ±10 V ($R_i \geq$ 20 kΩ)
Outputs:		
– Valve current	I_{max}	±20 mA +10 %
– Measuring sockets		
• Current command value “w“	U_w	0 to ±10 V
• Actual current value “I“	U_{act}	0 to ±200 mV (10 mV ≙ 1 mA)
Dither signal:		
– Frequency	f	100 Hz ±10 %
– Amplitude	I_{SS}	0 to 2 mA (factory setting 1 mA)
Type of connection		6 screw-type terminals
Type of mounting		Hat rails 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	–20 to +70 °C
Weight	m	0.13 kg

Terminal assignment

Operating voltage	$+U_B$	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	20 mA (100 %)
Zw	→ Offset current	0 mA
G_D	→ Dither signal amplitude	1 mA
LED indicator lamp:		
Green	→ Internal supply voltage	
Measuring socket:		
w	→ Current command value (10 V ≙ 100 %)	
I	→ Actual current value (10 mV ≙ 1 mA)	
⊥	→ Measurement 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 sufficient (>> 1m)!
- Shield command value cables, do **not** install command value cables near power cables!
- Do not use free-wheeling diodes in solenoid cables!
- In the case of a strongly fluctuating operating voltage, it may be required to install an external smoothing capacitor having a capacitance of at least 2200 μ.

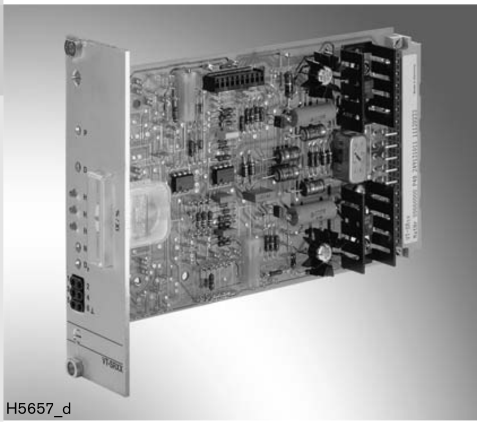
  Recommendation: Capacitor module VT 11110 (see RE 30750); sufficient for up to 3 amplifier modules

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.

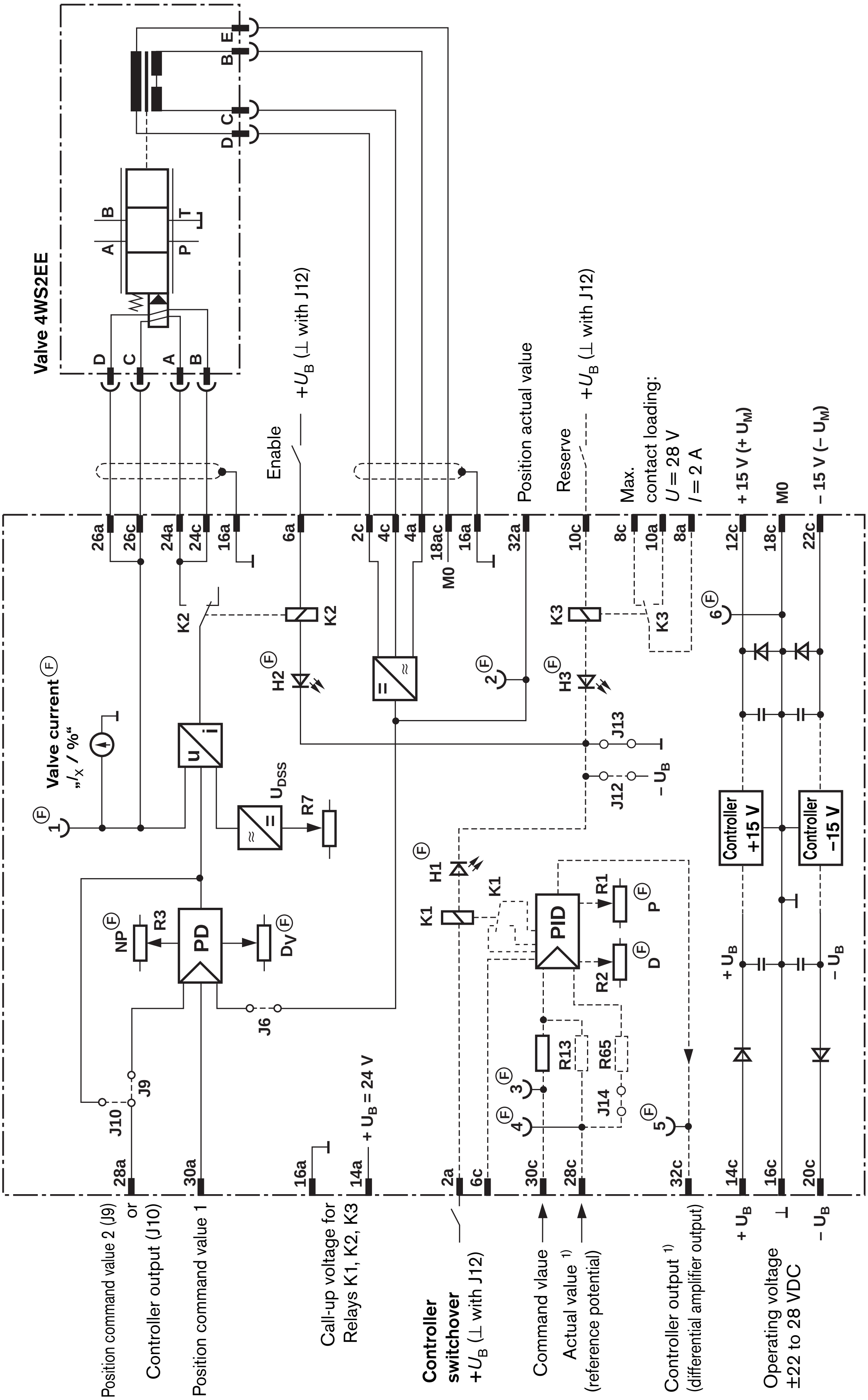
The amplifier may be optionally equiped with a PID controller (the D component **only** effects the actual value signal) with selectable PI component and a reserve relay with a potential free 2-way switch. Using this controller, an additional closed loop control circuit (e.g. for a closed loop drive 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.

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 $U_B = \pm 24$ 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 ≙ +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



1) Without R13 and by fitting J14 and R65 the controller input becomes a differential input.

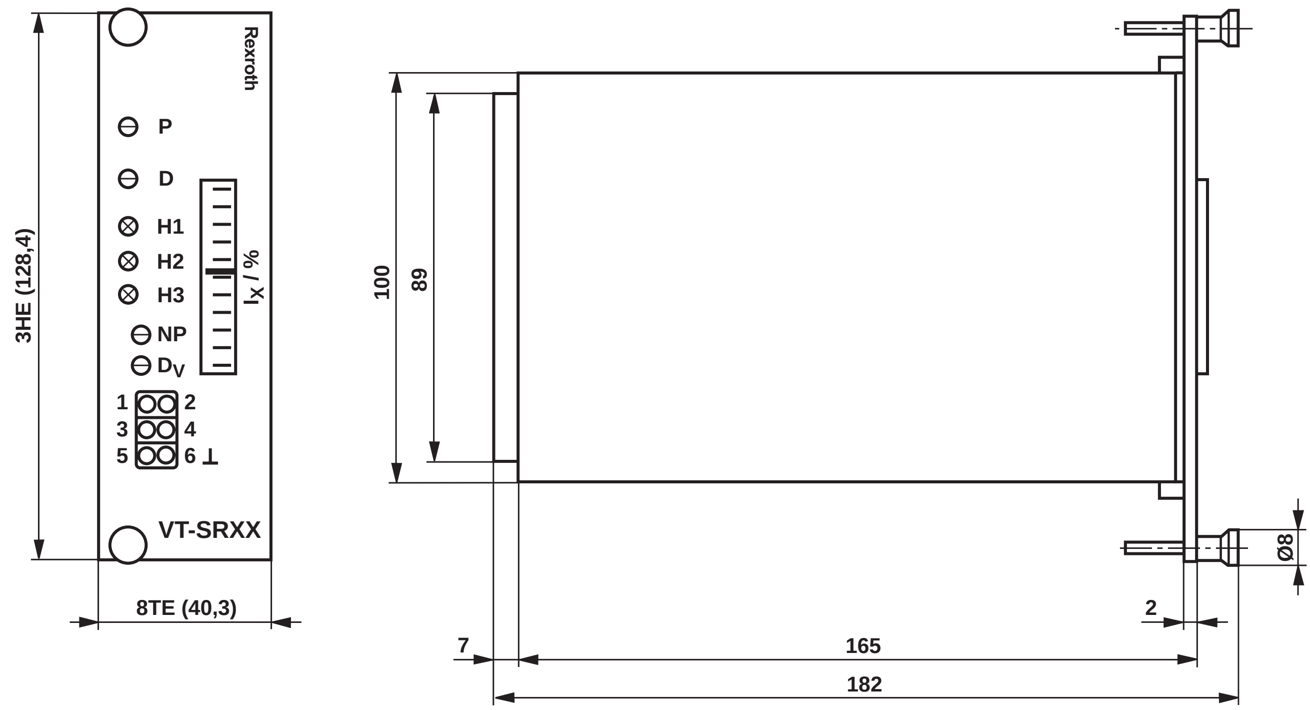
F = On front panel

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)



Rexroth
Bosch Group

Analogue amplifier

RE 29980/09.05
Replaces: 02.03

Type VT-SR2

Series 1X

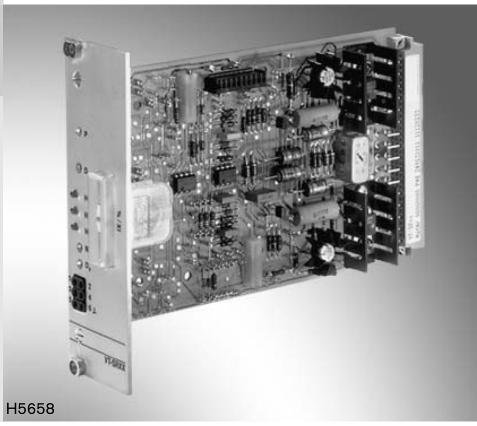

H5658

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.

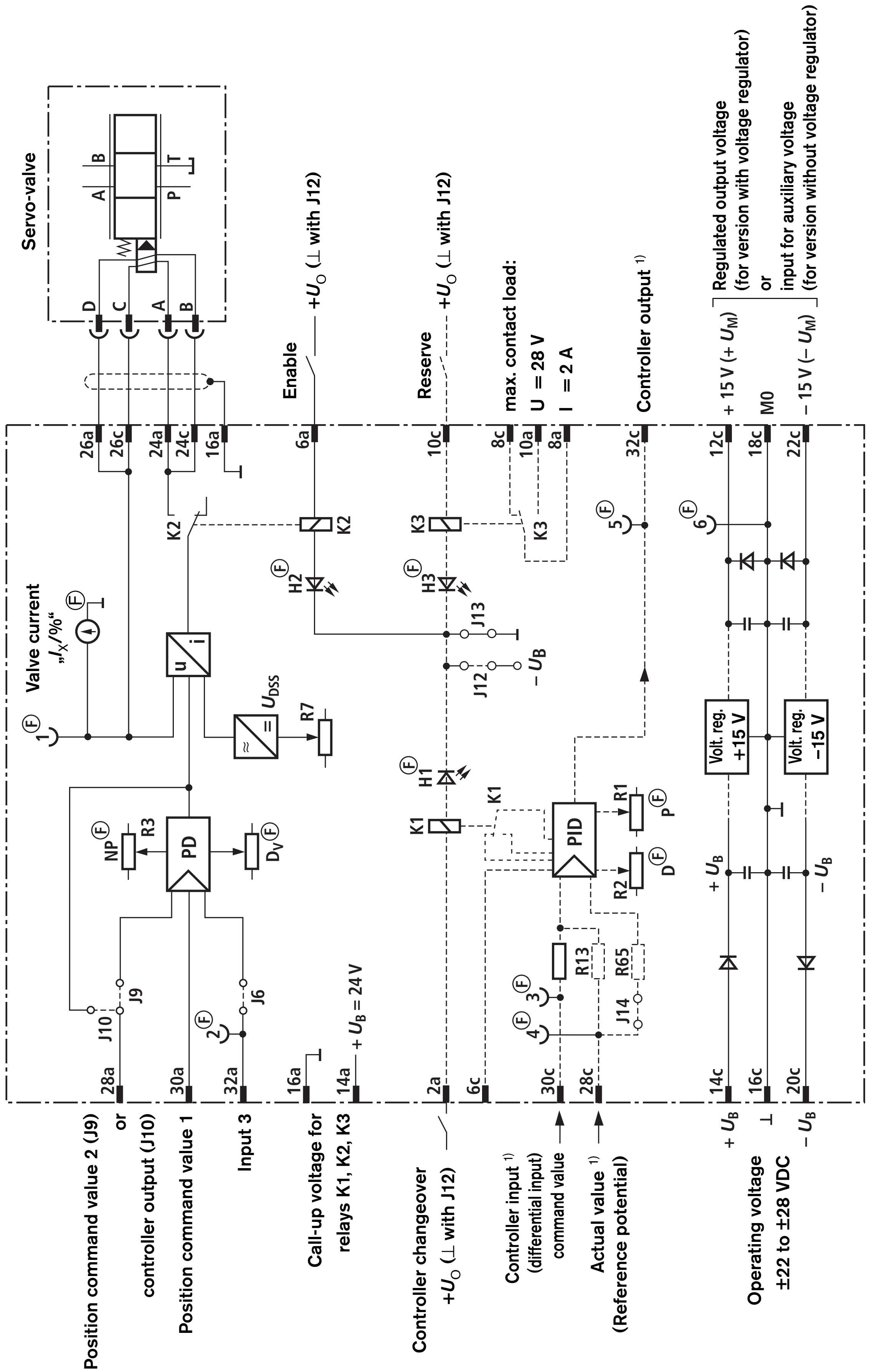
Optionally, the amplifier can be fitted with a PID-controller (D-component acts **only** on the actual value), with the PI-component being able to be changed over, and a reserve relay with potential-free changeover contact. This controller can be used to superimpose a further closed control loop (e.g. 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.

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

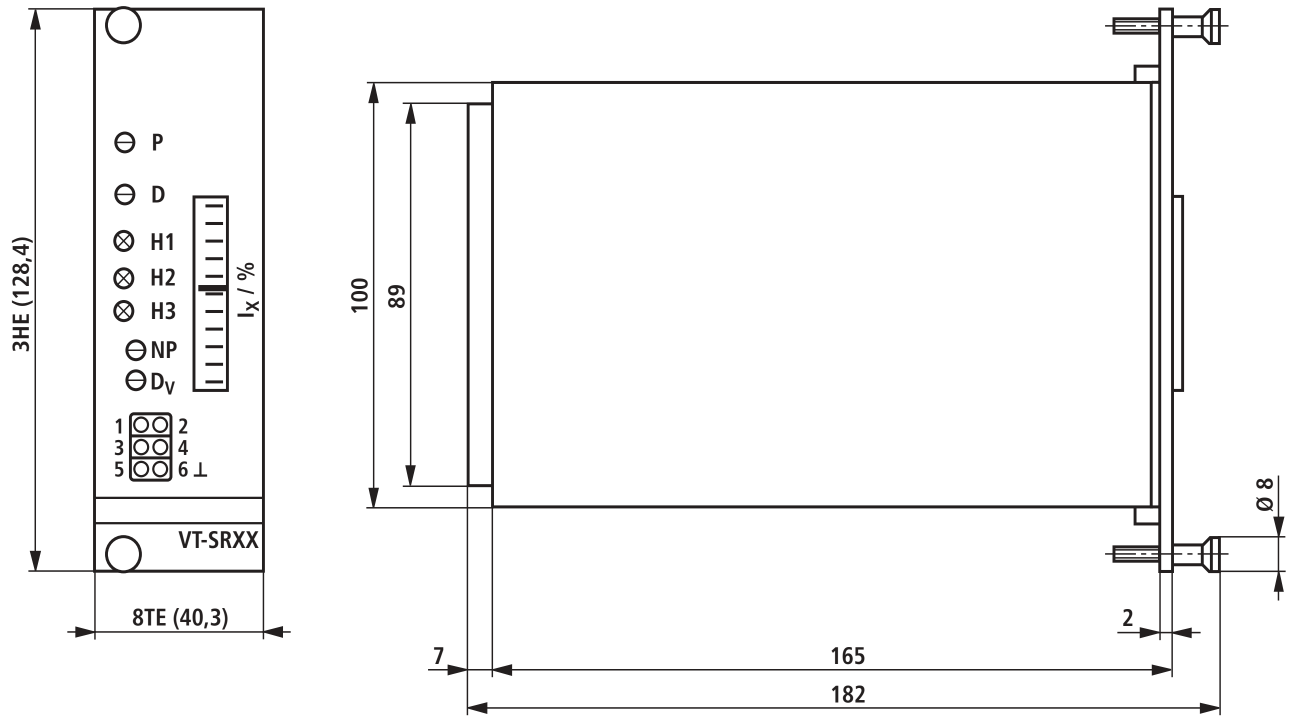
Block circuit diagram / pin assignment



Ⓕ = 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!

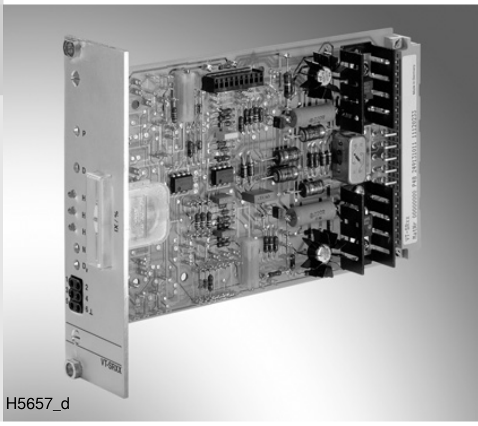
Rexroth
Bosch Group

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 **= 1X**
(10 to 19: unchanged technical data and pinout)

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.

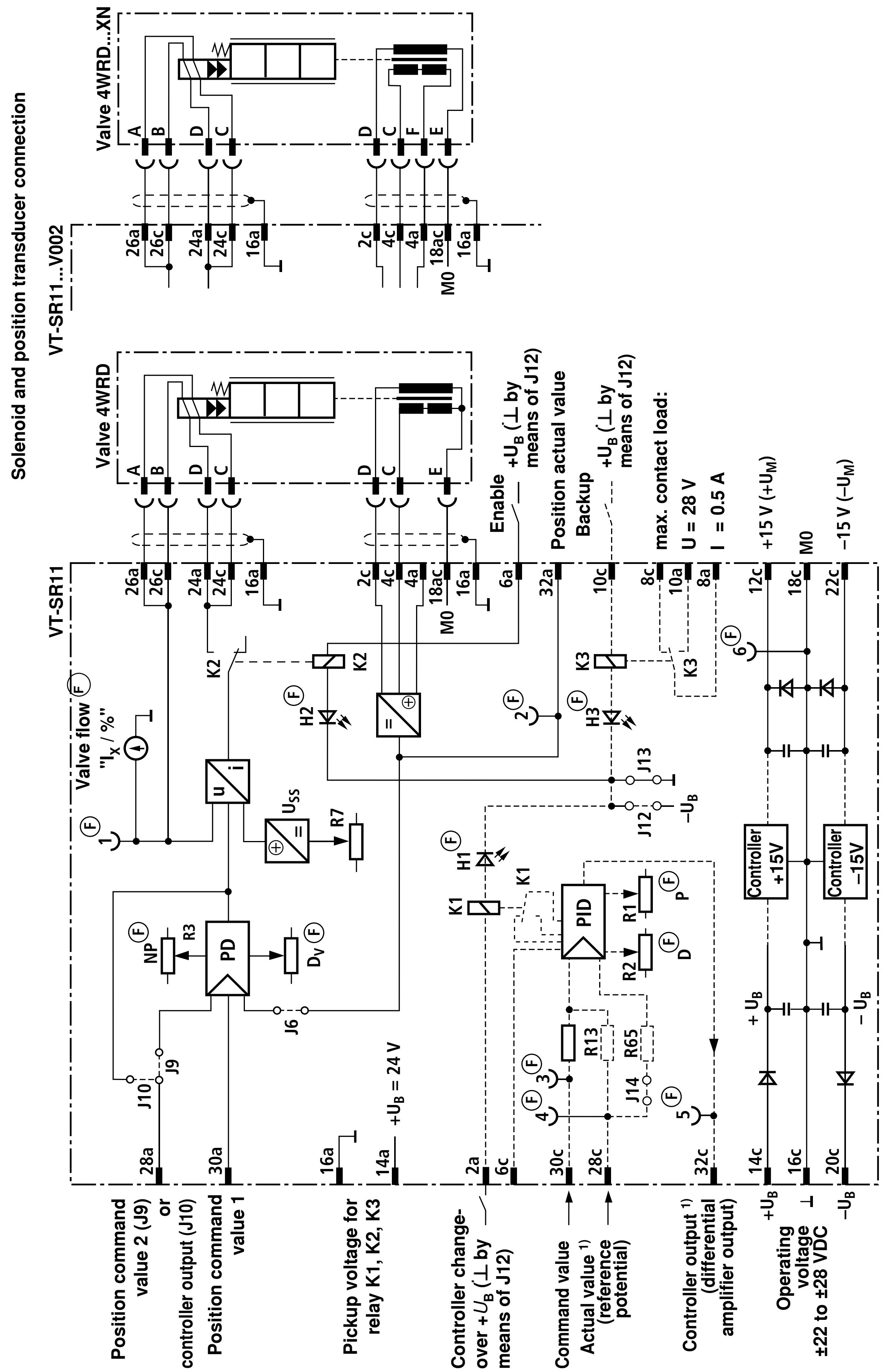
The PD controller is supplied the position command value and the position actual value with the D share of the controller **only** affecting the actual value (velocity feedback).

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

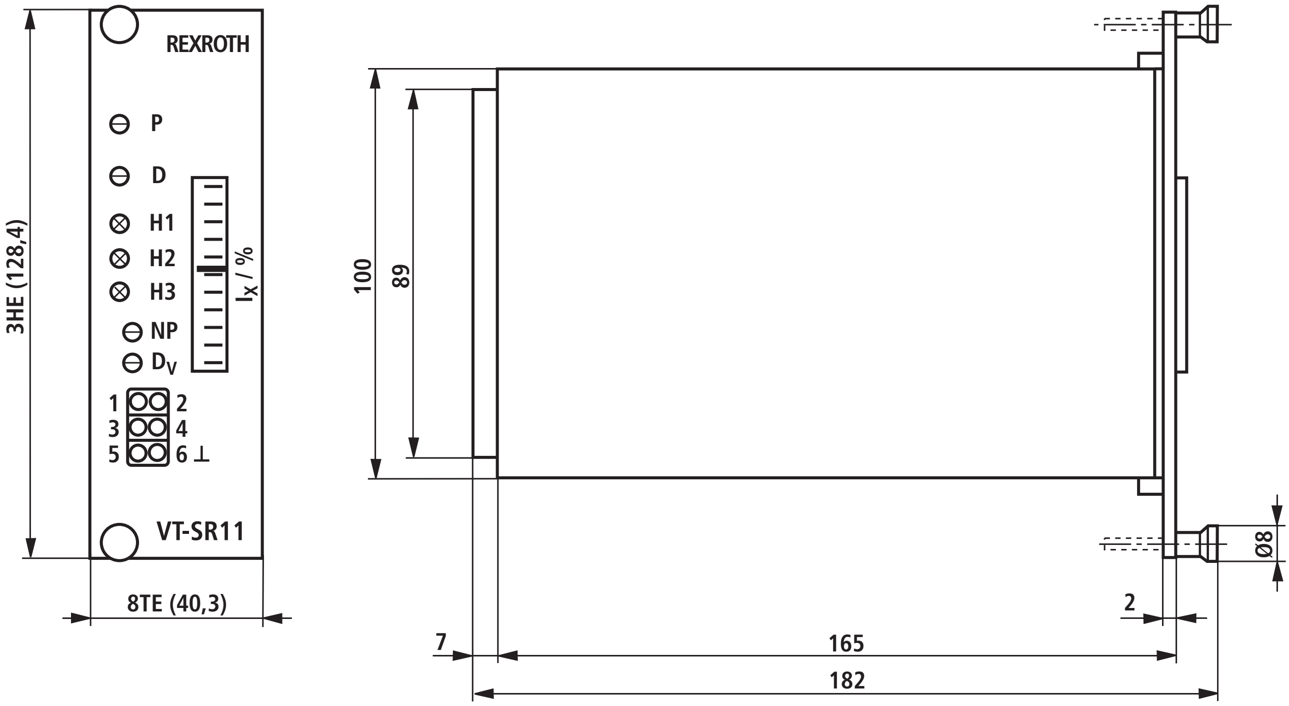
1) Without R13 and by fitting of J14 and R65 the controller input is transformed into a differential input.

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 mm^2, 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.

Rexroth Bosch Group

Plug-in switching amplifier

RE 30262/06.05
Replaces: 07.99

Type VT-SSV-1

Series 2X

H 6138_d

Table of contents

Contents	**Page**
Features	1
Ordering code	2
Block circuit diagram / pin allocation	2
Technical data	3
Unit dimensions	4
Project / maintenance instructions / additional information	4

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

Ordering code

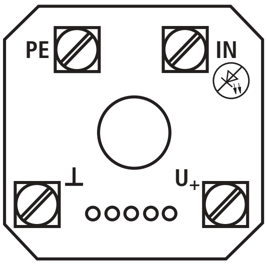
VT-SSV-1 –2X / *

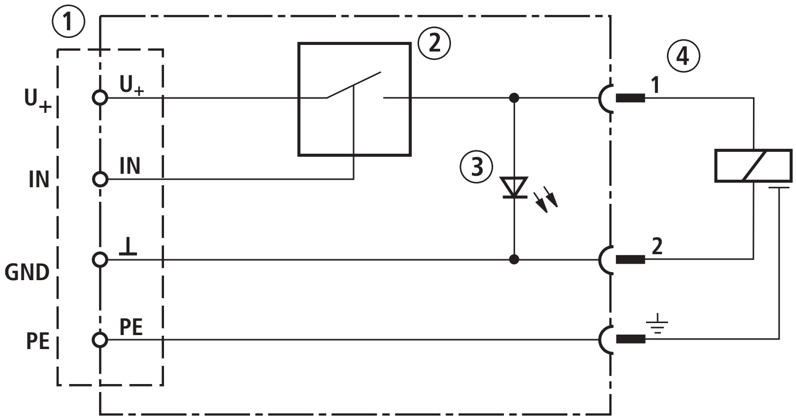
Plug-in switching amplifier

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”

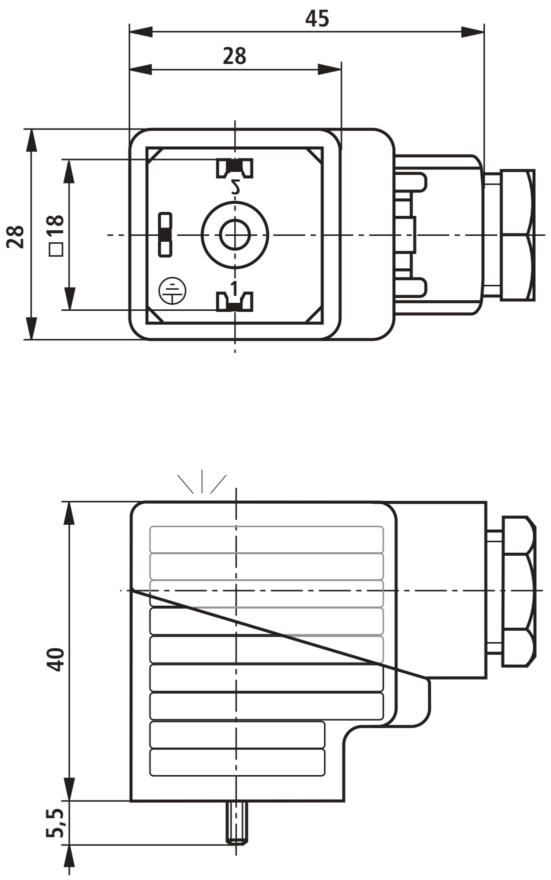
1 Connecting terminals
2 Electronic switch
3 LED for status indication
4 Solenoid contacts

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.

RE 30362
Edition: 2021-06
Replaces: 2015-07

rexroth
A Bosch Company

Connector switching amplifier with pulse width modulation (PWM)

Type VT-SSBA1

- Component series 1X

CE

Features

- Fast switching: Control of hydraulic on/off valves with 12 V solenoids
- Energy savings: Power reduction in the control of hydraulic on/off valves with 24 V solenoids
- Reduction in the coil temperature of at least 30°K with 100% duty cycle (with energy savings)
- Suitable for the control of on/off valves of the type WE 6 and WE 10 with 12 V and/or 24 V direct current solenoids with the control spools described in the data sheet.
- For valves with connector K4 according to EN 175301-803
- Potted-in cable with open end
- 3-conductor connection, power supply and enable input separated
- Short-circuit-proof output
- Status display of the switching status with LED

Contents

Ordering code

01		02		03		04	05
VT-SSBA1-PWM	**–**	**1X**	**/**		**/**		*****

01	Connector switching amplifier with pulse width modulation (PWM)	**VT-SSBA1-PWM**

02	Component series 10 ... 19 (10 ... 19: unchanged technical data and pin assignment)	**1X**

03	Power reduction to 100 ms for fast switching for 12 V solenoids	**V001**
	Power reduction to 300 ms for energy savings for 24 V solenoids	**V002**

Cable length

04	5 m	**5**
	10 m	**10**
	15 m	**15**

05	Further details in the plain text	*****

Function

The connector switching amplifier type VT-SSBA1 is directly mounted at the K4 connector of the valve.
It is supplied with 24 V direct voltage. If at wire 2 (enable "IN"), a high-signal is applied, the voltage profile is applied at the valve according to the functional diagram. If the enable input is switched, the status display LED is flashing yellow.

Fast switching ("V001")
As fast switching amplifier, the connector switching amplifier type VT-SSBA1 considerably reduces the switching time of standard directional valves in connection with 12 V solenoids.
On switching on, the solenoid is overexcited with 24 V by 100%. Afterwards, the voltage is reduced and the required holding current is set via pulse width modulation.

Energy savings ("V002")
If 24 V standard directional valves are used, the connector switching amplifier considerably reduces the continuous current to save energy.
After a defined power supply time and the connected hydraulic switching of the valve, the system switches to pulse width modulation and the power is considerably reduced. This leads to a holding power under the power of a 24 V valve at 24 V supply voltage.

Assignment of valves with their voltage version to versions "V001" and "V002", see page 6 and 7.

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

General			
Weight (incl. cable), approx.		g	350
Housing			Valve connector K4 according to DIN EN 175301-803
Ambient temperature range		°C	−20 ... +60
Storage temperature range		°C	−20 ... +60

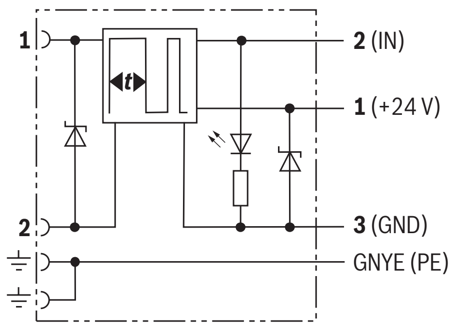
Electric [1]			
Voltage type			Direct voltage
Operating voltage		V	24 ±10%
Holding current		A	2
Control voltage (enable "IN")	▶ ON	V	10 ... 30
	▶ OFF	V	<3.5
Galvanic separation			no
Control current (enable "IN")		mA	2.5 ... 12
Maximum switching frequency		Hz	≤1
PWM frequency		Hz	PWM operation 300 ... 500
Protection class according to EN 60529			IP65, IP67
Cable connection			Potted-in cable with open end
Cable type			See table below
Duty cycle	▶ "V001" (fast switching)	ms	100 ... 115
	▶ "V002" (energy savings)	ms	300 ... 330
PWM duty factor	▶ "V001" (fast switching)	%	40 ±5 on
	▶ "V002" (energy savings)	%	60 ±5 on
Conformity	▶ CE according to EMC directive 2014/30/EU, tested according to		EN 61000-6-2:2005, EN 61000-6-3:2007 + A1:2011

[1] The specified values refer to an operating voltage of 24 V

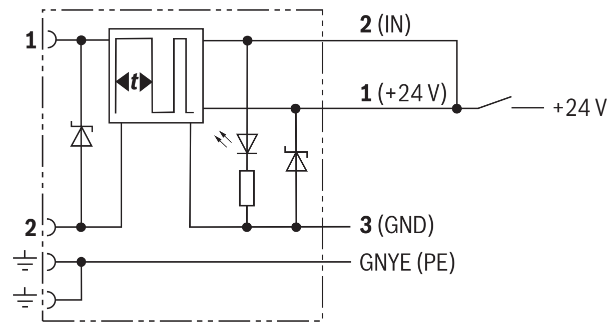
Cable type

Jacket material	**Jacket color**	**Lead insulation**	**Wire color**	**Wires** in mm^2	**Jacket diameter** in mm
PUR-JZ	Black	PP	BK, GNYE	4 x 0.75	6.5

Block diagram / pin assignment



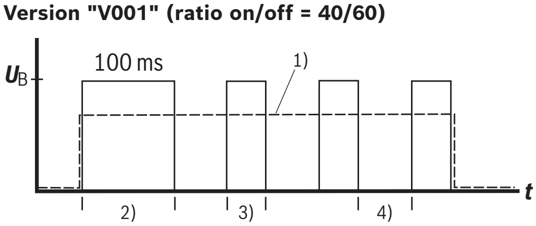
2-conductor port



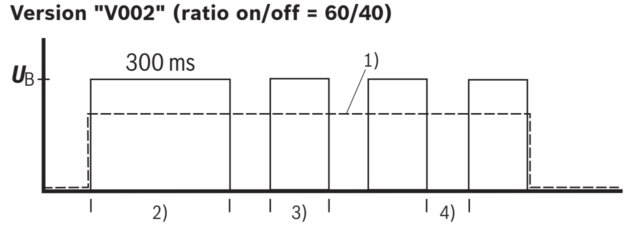
1	Operating voltage "+U_B" (+24 V)
2	Enable “IN”
3	Operating voltage "GND"
GNYE	Protective grounding conductor "PE"

Functional diagram

Version "V001" (ratio on/off = 40/60)

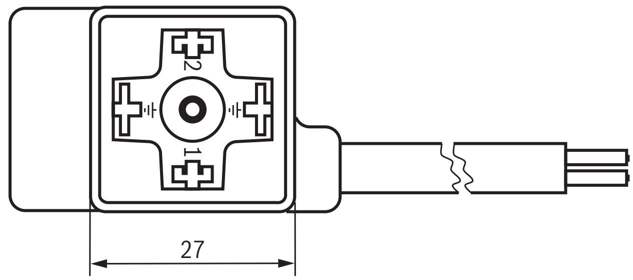


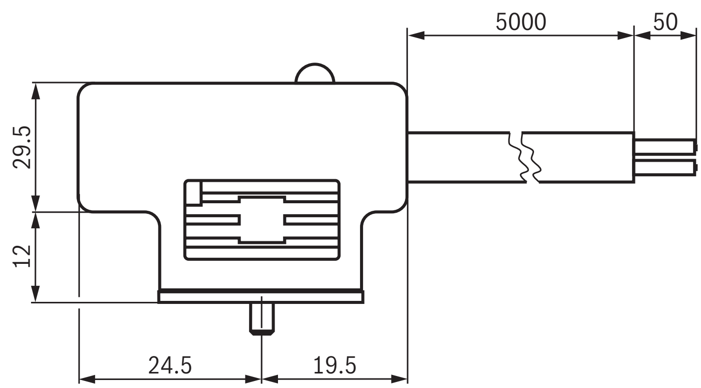
Version "V002" (ratio on/off = 60/40)



1) Enable signal
2) Duty cycle
3) On time
4) Off time

Dimensions (dimensions in mm)





- M3 mounting screw, tightening torque $\boldsymbol{M}_A$ = 0.4 Nm
- Contacting according to DIN EN 175301-803

Switching times: Version "V001"

Comparison of 24 V coil (control standard 24 V signal) **with 12 V coil** (control via VT-SSBA1...V001)

Directional spool valves type 4WE 10 ... (3 chambers)

Symbol	Coil	Switching time in ms	
		ON	OFF
C	24 V	58	48
	12 V; "V001"	26	48
D	24 V	78	28
	12 V; "V001"	29	28
E	24 V	55	35
	12 V; "V001"	22	35
E67	24 V	84	31
	12 V; "V001"	24	31
J	24 V	63	51
	12 V; "V001"	28	51
J2	24 V	47	31
	12 V; "V001"	24	31
Y	24 V	57	31
	12 V; "V001"	23	31
Y11	24 V	46	50
	12 V; "V001"	28	50

Directional spool valves type 4WE 6 ...

Symbol	Coil	Switching time in ms	
		ON	OFF
C	24 V	27	14
	12 V; "V001"	17	14
D	24 V	42	11
	12 V; "V001"	25	11
E	24 V	32	11
	12 V; "V001"	22	11
E67	24 V	39	12
	12 V; "V001"	21	12
G	24 V	33	11
	12 V; "V001"	28	11
J	24 V	37	17
	12 V; "V001"	17	17
L	24 V	36	15
	12 V; "V001"	21	15
M	24 V	47	26
	12 V; "V001"	33	26
X7	24 V	62	13
	12 V; "V001"	47	13

Directional spool valves type 5-4WE 10 ... (5 chambers)

Symbol	Coil	Switching time in ms	
		ON	OFF
J2	24 V	170	23
	12 V; "V001"	44	23
X84	24 V	39	67
	12 V; "V001"	20	67

Shut-off valves type Z-4WE 6 ...

Symbol	Coil	Switching time in ms	
		ON	OFF
E63	24 V	27	14
	12 V; "V001"	15	14
E68	24 V	27	14
	12 V; "V001"	15	14
X250	24 V	31	20
	12 V; "V001"	16	20
X252	24 V	47	13
	12 V; "V001"	17	13

Notices:

- Additional valves on request.
- If the connector switching amplifier is used, the power limit may be improved. The degree of improvement depends on the respective symbol of the valve. Further information on request.
- When switching on and off, an additional dead time of approx. 2 ms must be taken into account (applies at signal level 24 V).
- The specified switching times correspond to the time of signaling until a pressure change of 5%.
- The switching times are specified for the same power limits as documented in data sheets (see 23178, 23340 and 23352) and for a horizontal installation position.
- The use of version "V001" is not possible in connection with valves with amplified spring.

Energy savings: Version "V002"

Energy savings with valves with 24 V coils using connector amplifier VT-SSBA1..V002

Directional spool valves type 4WE 10 … (3 chambers)

Symbol	Energy consumption in W	
	24 V coil (standard)	**24 V coil with "V002"**
C; D; E; E67; J; J2; Y; Y11	40	24

Directional spool valves type 4WE 6 …

Symbol	Energy consumption in W	
	24 V coil (standard)	**24 V coil with "V002"**
C; D; E; E67; G; J; L; M; X7	30	18

Directional spool valves type 5-4WE 10 … (5 chambers)

Symbol	Energy consumption in W	
	24 V coil (standard)	**24 V coil with "V002"**
J2; X84	40	24

Shut-off valves type Z-4WE 6 …

Symbol	Energy consumption in W	
	24 V coil (standard)	**24 V coil with "V002"**
E63; E68; X250; X252	30	18

Notices:
- Additional valves on request.
- If the connector switching amplifier is used, the power limit may be improved. The degree of improvement depends on the respective symbol of the valve. Further information on request.
- The use of version "V001" is not possible in connection with valves with amplified spring.
- Reduction of the coil temperature by at least 30 K.

Project planning and maintenance instructions

- The connector switching amplifier may only operated in accordance with the limits and applications defined in the data sheet.
- Sufficient distance to radios and mobile phones is required (>1 m).
- In case of overload or short-circuit, the output is de-energized. Before switching it on again, enable signal "IN" has to be switched to "OFF" (<3.5 V).
- There is no galvanic separation between the input and output.
- If used as power reducer, the power in PWM operation is not sufficient for repeated switching of the valve after exceeding the power limit in switched state.
- In an error case, the temperature of the valve solenoid may increase. Take external monitoring measures to ensure that the maximum surface temperature of the solenoid is complied with.
- The connector switching amplifier type VT-SSBA1 is no safety-relevant part of a control system according to EN ISO 13849-1:2006.
  To comply with safety requirements, the following points must be observed:
  - In case the safety function is required, the voltage supply and the enable input of the connector switching amplifiers type VT-SSBA1 is to be switched off by a suitable switching element with appropriate reliability.
  - If persons have to enter the danger zone with activated connector switching amplifier type VT-SSBA1, additional measures for guaranteeing their safety have to be taken for the reasons specified above.

Further information

▶ Mating connectors and cable sets for valves and sensors	Data sheet 08006
▶ Hydraulic valves for industrial applications	Operating instructions 07600-B
▶ Information on available spare parts	

Rexroth
Bosch Group

Analogue command value module

RE 29902-01/08.06 1/6
Replaces: RE 29902-D/01.01

Type VT-SWMA-1/002 (mod. VT-SWMA-1)

Series 1X

H5999
Basic amplifier VT -SWMA-1

Table of contents

Contents	**Page**

Features

– Change compared with base:
  maximum ramp time changed from 50 s to 10 s
– 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	– 1	– 1X	002	*

Analogue command value module = VT-SWMA-1

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

002

* = Further datails 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	+	Maximum value	0 % ↗ Maximum value (+)
t2	+	0 %	Maximum value (+) ↘ 0 %
t3	–	Maximum value	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

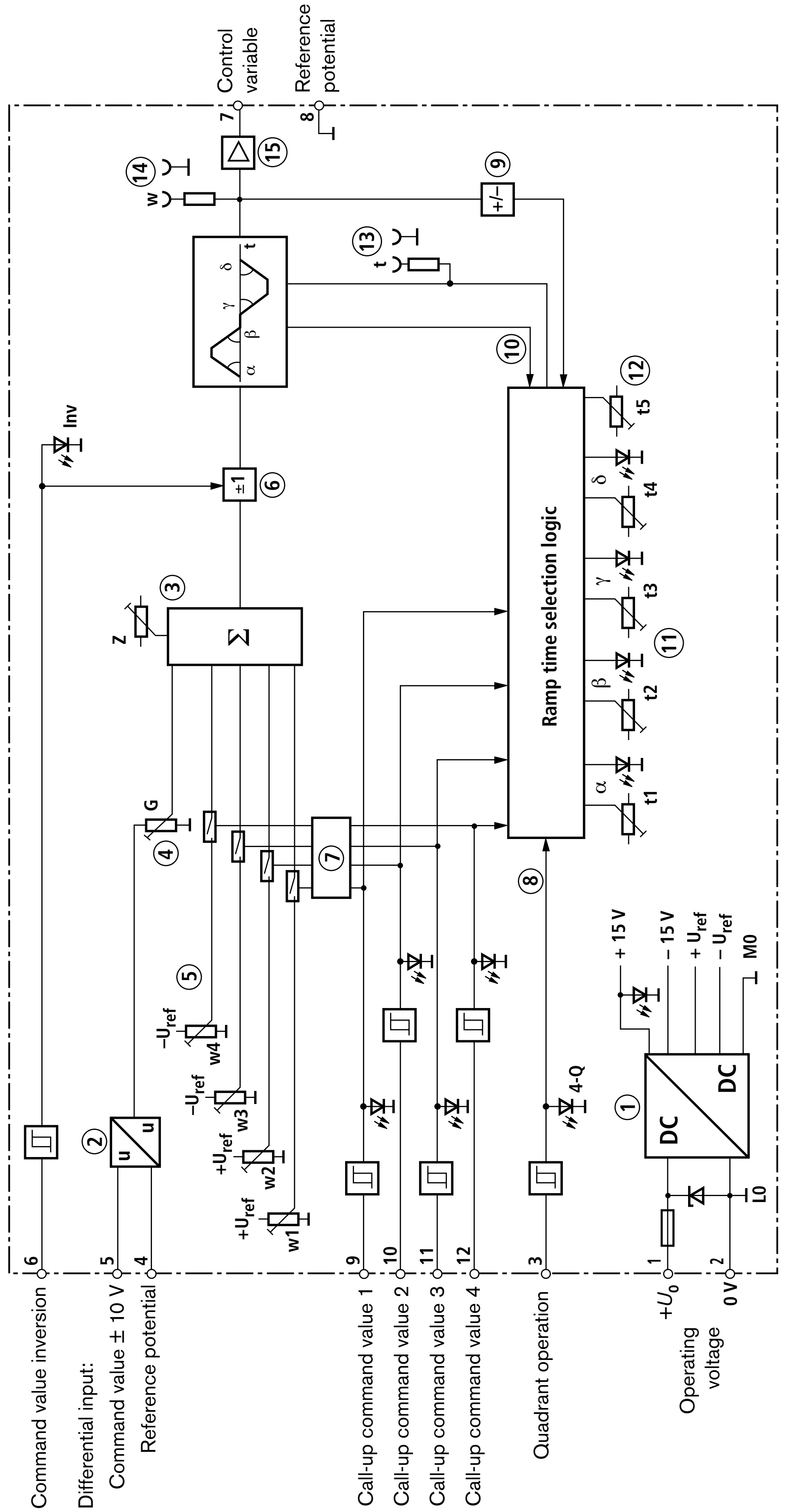
The current ramp time can be checked at measuring socket "t" [13]. Ramp times "t1" to "t4" can be adjusted with the help of the ramp time potentiometers. Through activation of a call-up signal, ramp time signal "t" at the measuring socket is clearly assigned to one of the ramp times t1 to t4. t5 is assigned 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 approx. 110 %
– Command values (potentiometers “w1“ to “w4“)		0 % to approx. 110 % (factory setting 100 %)
– Ramp times (potentiometers “t1“ to “t5“)		100 ms to 50 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} = approx. 50 s); 10 V (t_{min} = approx. 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).

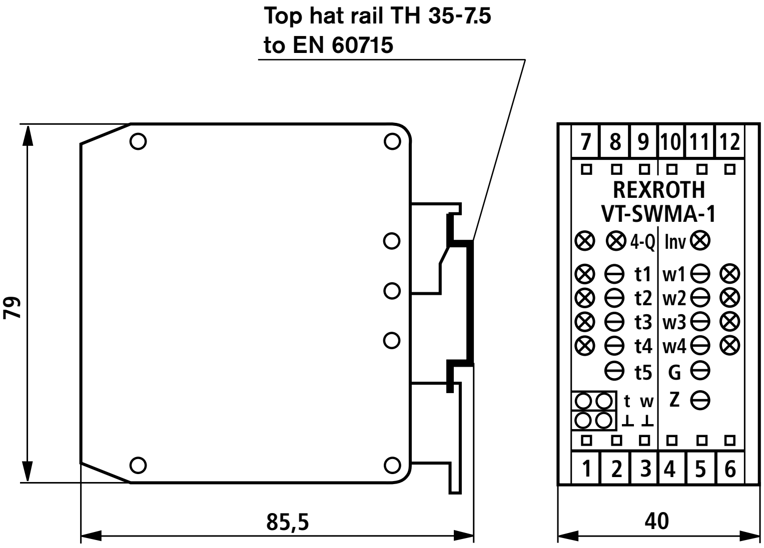
Note on the adjustment and measurement of the ramp time
For adjusting the ramp time potentiometers we recommend that 4-quadrant recognition be switched off and call-ups be activated.

Value at measuring socket “t“	U_t in V	5	0,02
Current ramp time (± 20 %)	t in ms	100	50000

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)

Analogue command value module

RE 29902/2017-04
Replaces: 05.14

Type VT-SWMA-1

Series 1X

H5999

Table of contents

Contents	**Page**

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

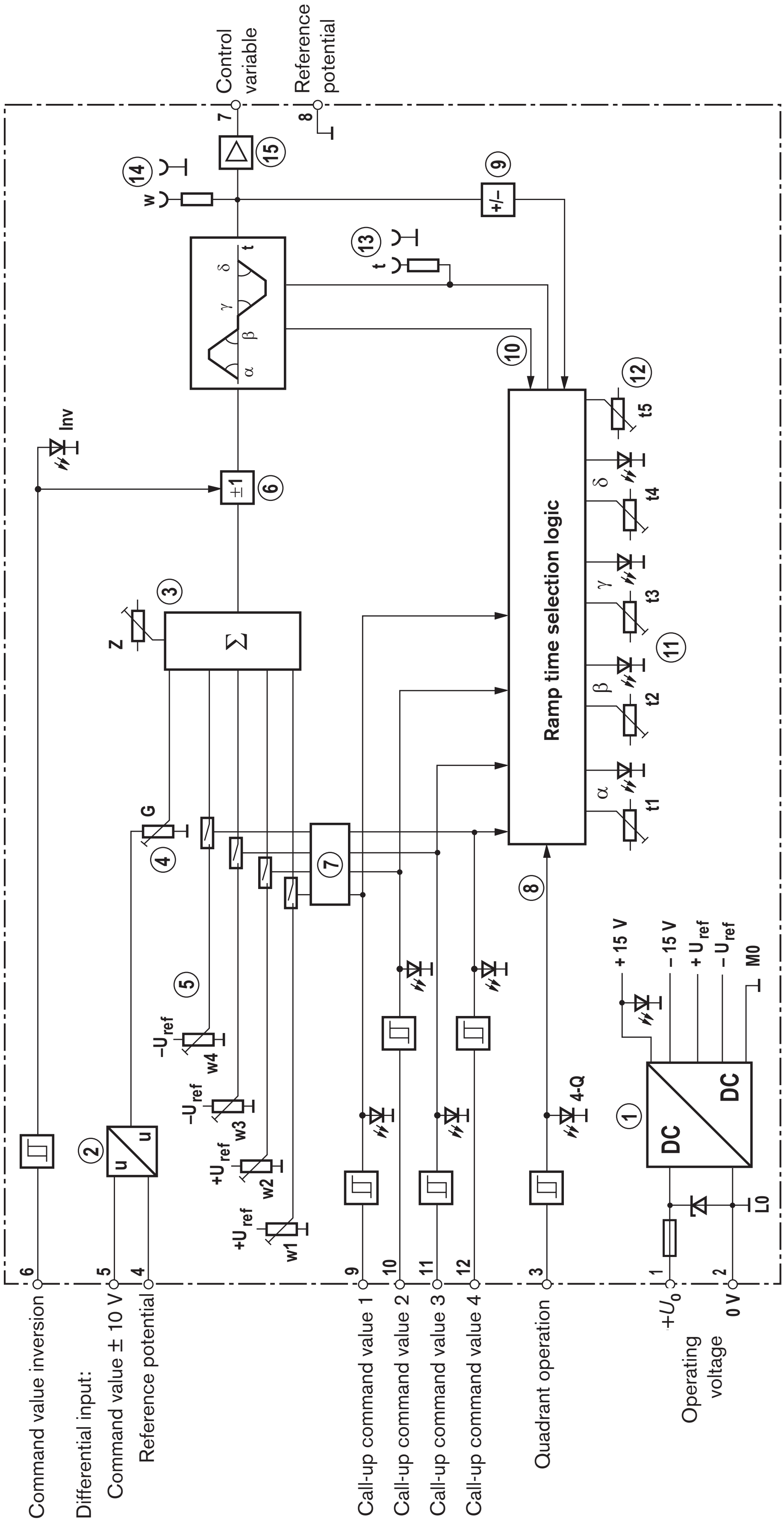
The current ramp time can be checked at measuring socket "t" [13]. Ramp times "t1" to "t4" can be adjusted with the help of the ramp time potentiometers. Through activation of a call-up signal, ramp time signal "t" at the measuring socket is clearly assigned to one of the ramp times t1 to t4. t5 is assigned 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



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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; ±6 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: $t = \frac{100\ \text{V ms}}{U_t}$

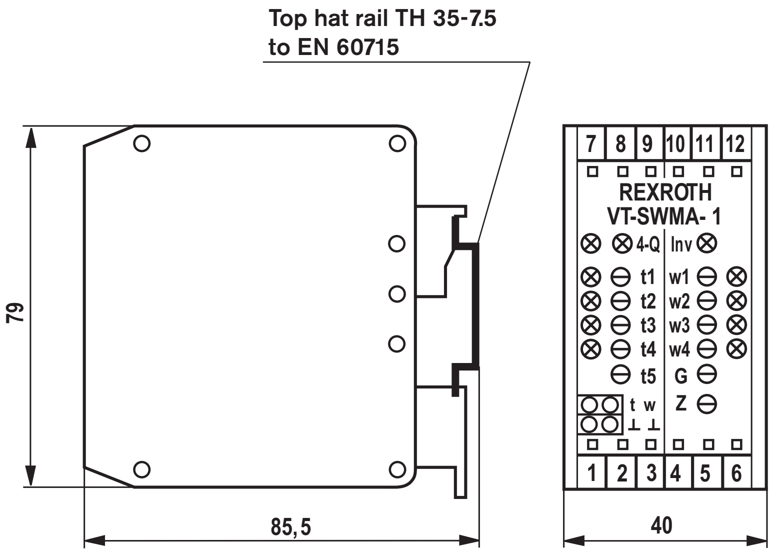
Example: Measured $U_t = 5$ V

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
	Reference potential	4	10	Call-up command value 2
Differential input	$\pm U_{comm}$	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**!

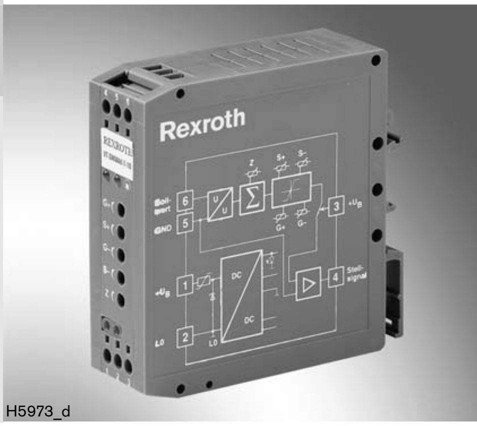
Note: Electrical signals (e.g. control variable) brought out via control electronics must not be used for switching safety-relevant machines functions!
(See also the European standard "Safety requirements for fluid power systems and components – hydraulics", EN 982)

Analogue command value module

RE 29903/06.05
Replaces: 02.03

Type VT-SWMAK-1

Series 1X



H5973_d

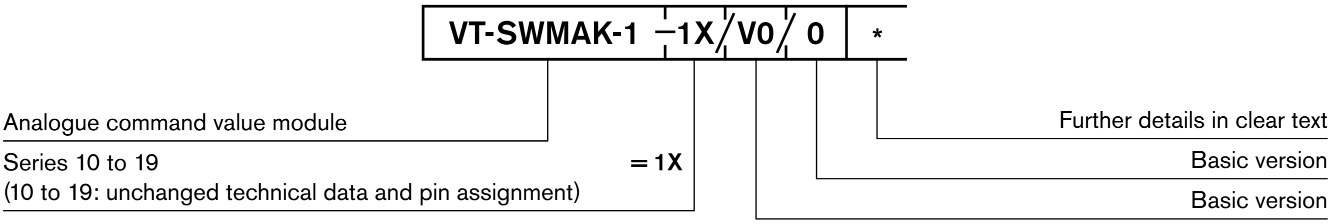
Table of contents

Contents	**Page**

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



Functional description

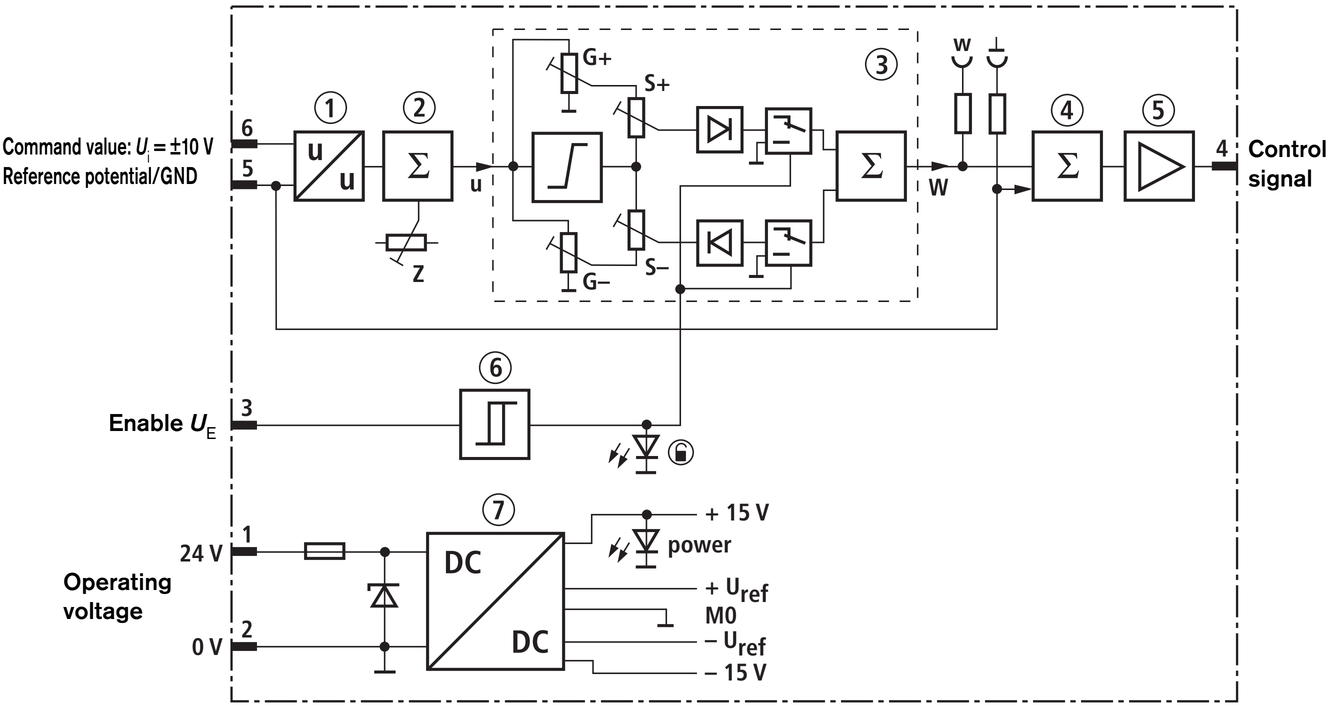
The command value module requires 24V DC voltage. A power supply unit [7] provides the internally required positive and negative supply voltage. As soon as the power supply unit is in operation, the green LED ("power") lights up. The control signal can be cut in or out by applying a signal at the enable 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).

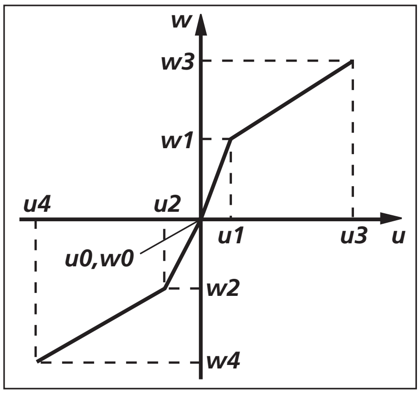
The control signal has the same reference potential/GND as the command value. In the case of fluctuations in the reference potential, the summator [4] corrects the control signal as required.

Block circuit diagram



1 Differential input
2; 4 Summator
3 Characteristic curve generator
5 Output amplifier
6 Trigger
7 Power supply unit

Output characteristic curve



Points of inflection of characteristic curves:

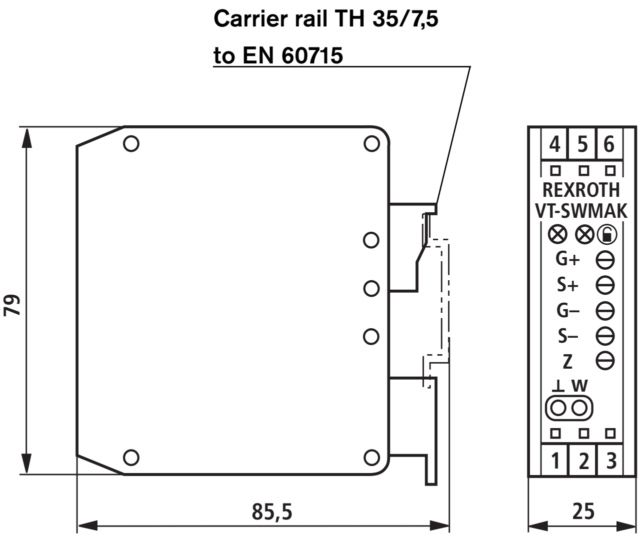
u0	0 %		
w0	0 %		
u1	+2 % = +200 mV		
w1	0 % to +50 % **(S+)**	=	0 V to +5 V
u2	–2 % = –200 mV		
w2	0 % to –50 % **(S–)**	=	0 V to –5 V
u3	+100 % = +10 V		
w3	w1 up to +110 % **(G+)**	=	w1 up to +11 V
u4	–100 % = –10 V		
w4	w2 up to –110 % **(G–)**	=	w2 up to –11 V

The minimum value of *w3* and *w4* corresponds to the setting of *w1* and *w2*.

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

Command value and ramp module

Type VT-SWMA3-...

Component series 1X

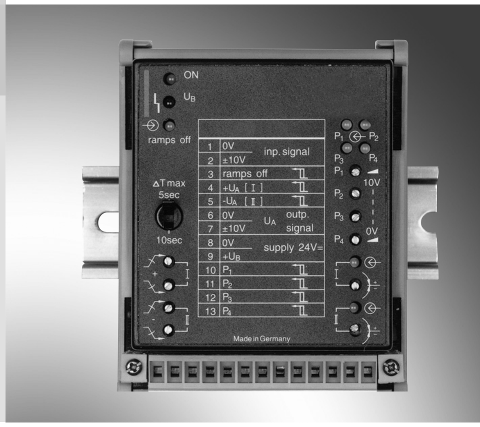


Table of contents

Contents	**Page**

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

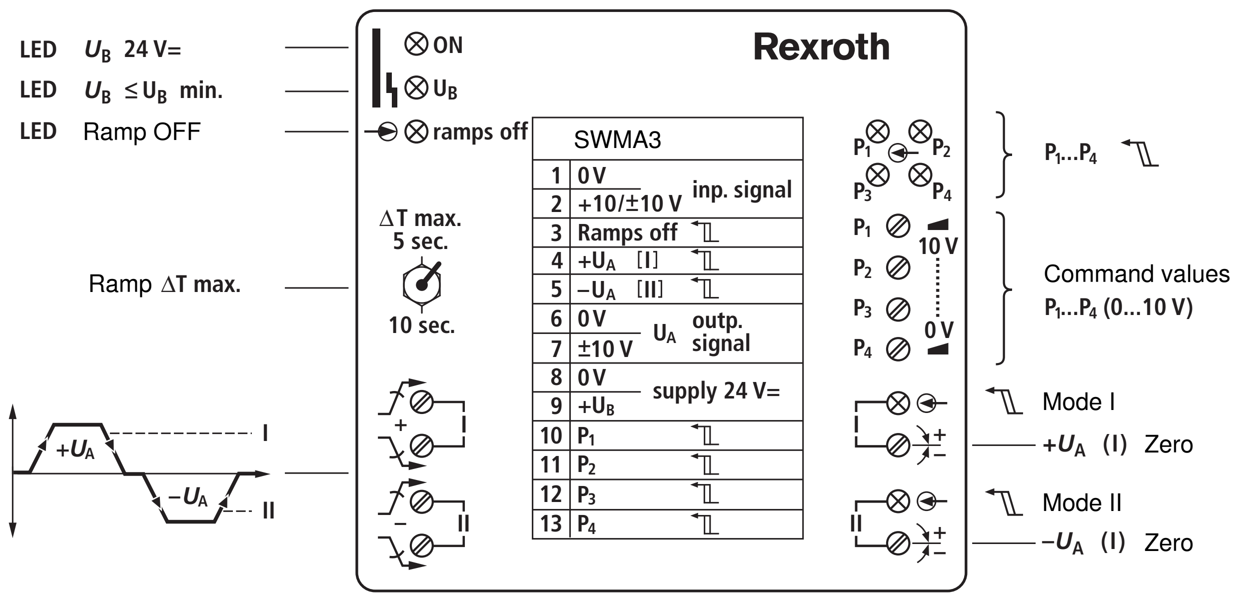
Command value and ramp module

0 =	Standard option
	Customer version
V0 =	Catalog version
1X =	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)

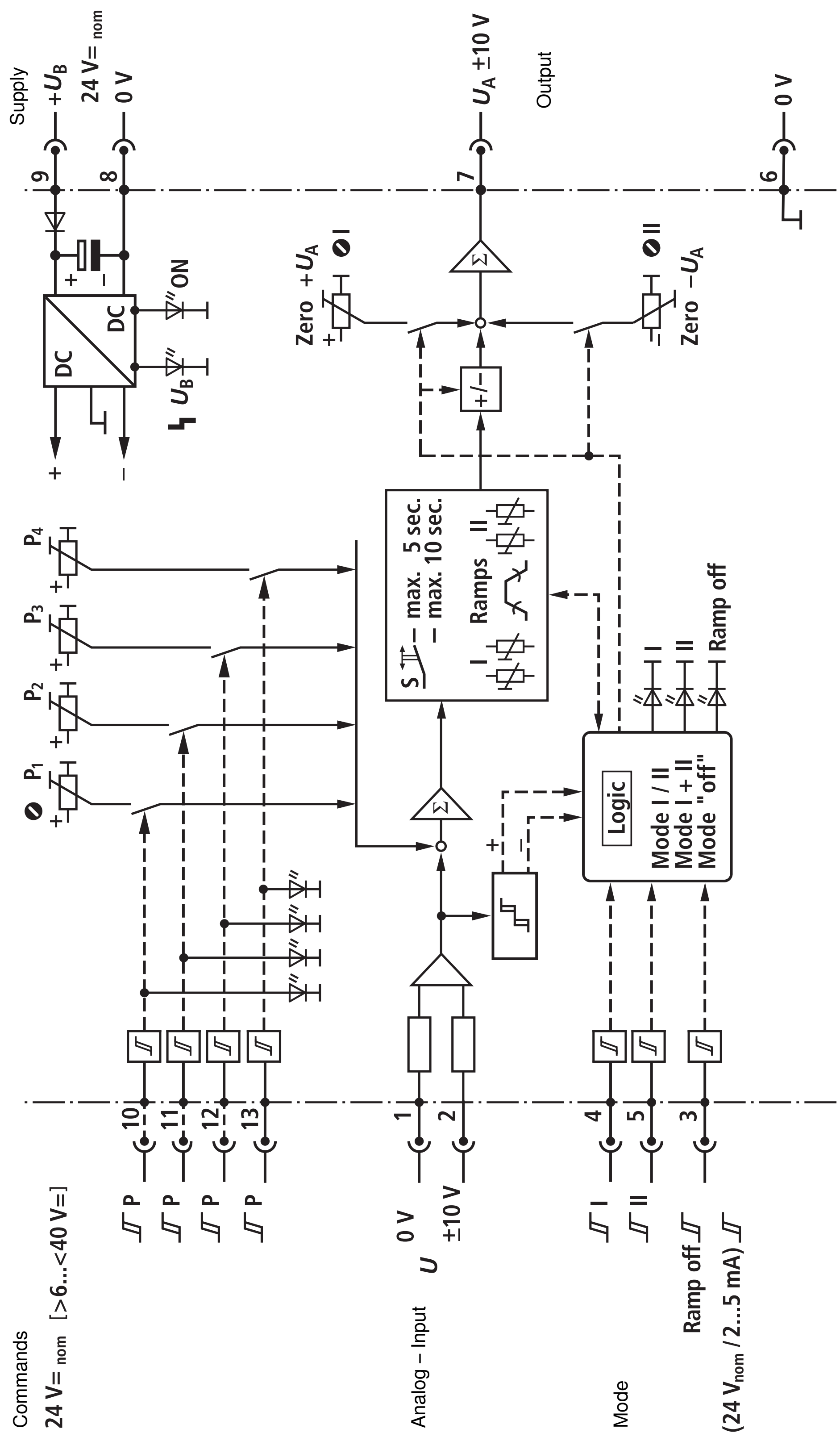
Preferred type

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!)

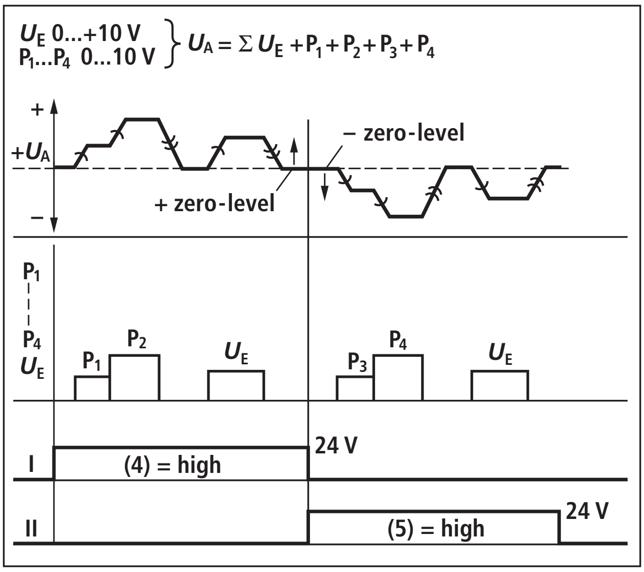
Supply voltage		Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)
Current consumption	A	≦ 0.2
Signal input "U_E" analog		Mode I or II: 0...+10 V Mode I + II: 0...±10 V
Logic commands "commands"		24 V = $_{nom}$, loaded: 2...5 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

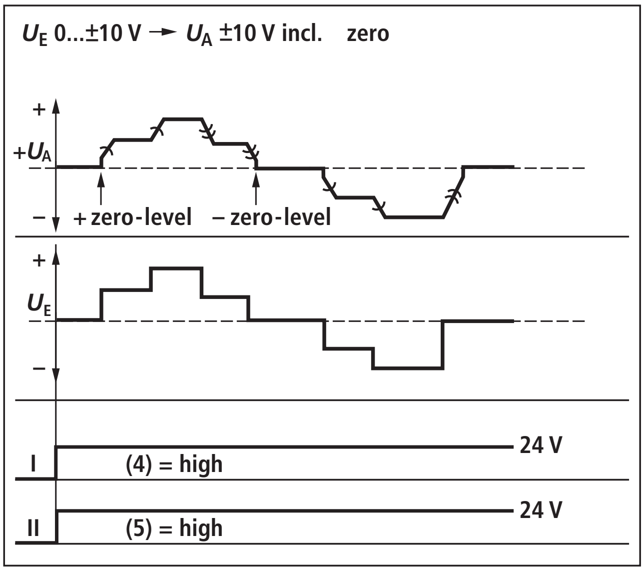
Commissioning

MODE/SIGNAL: I → +U_A
II → –U_A

or

MODE/SIGNAL: I + II → ±U_A

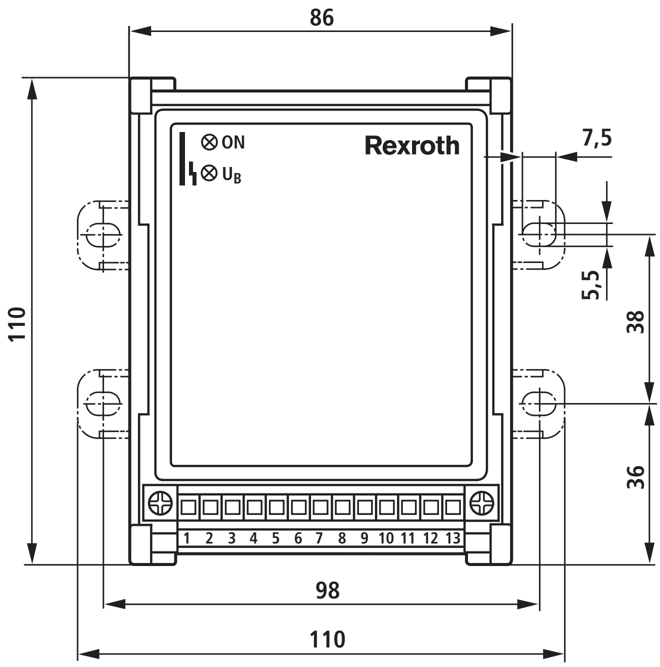


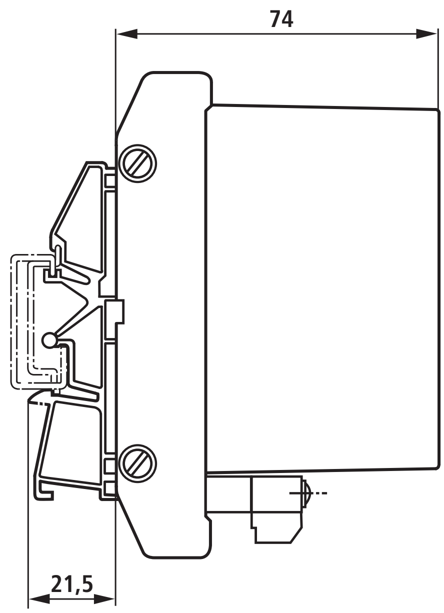


- Selection mode I or II
- Zero point with U_E = 0 V
- Examination of the signals U_E (P_1...P_4)
- Ramp adjustment I or II

- 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.

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.

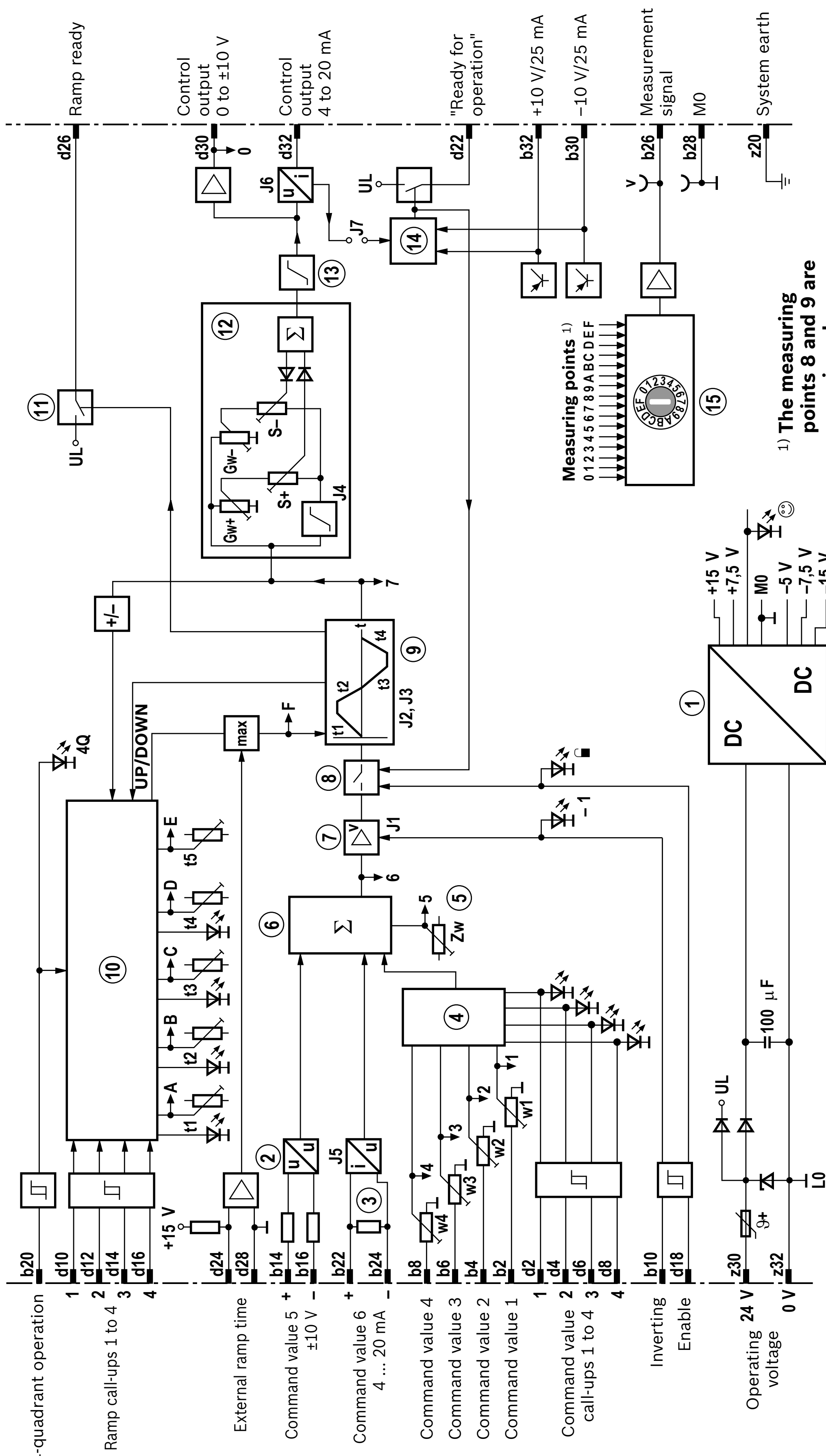
Amplitude limiter [13]
The control outputs (current output and voltage output) are limited to approx. ±110 % of the nominal range.

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!)

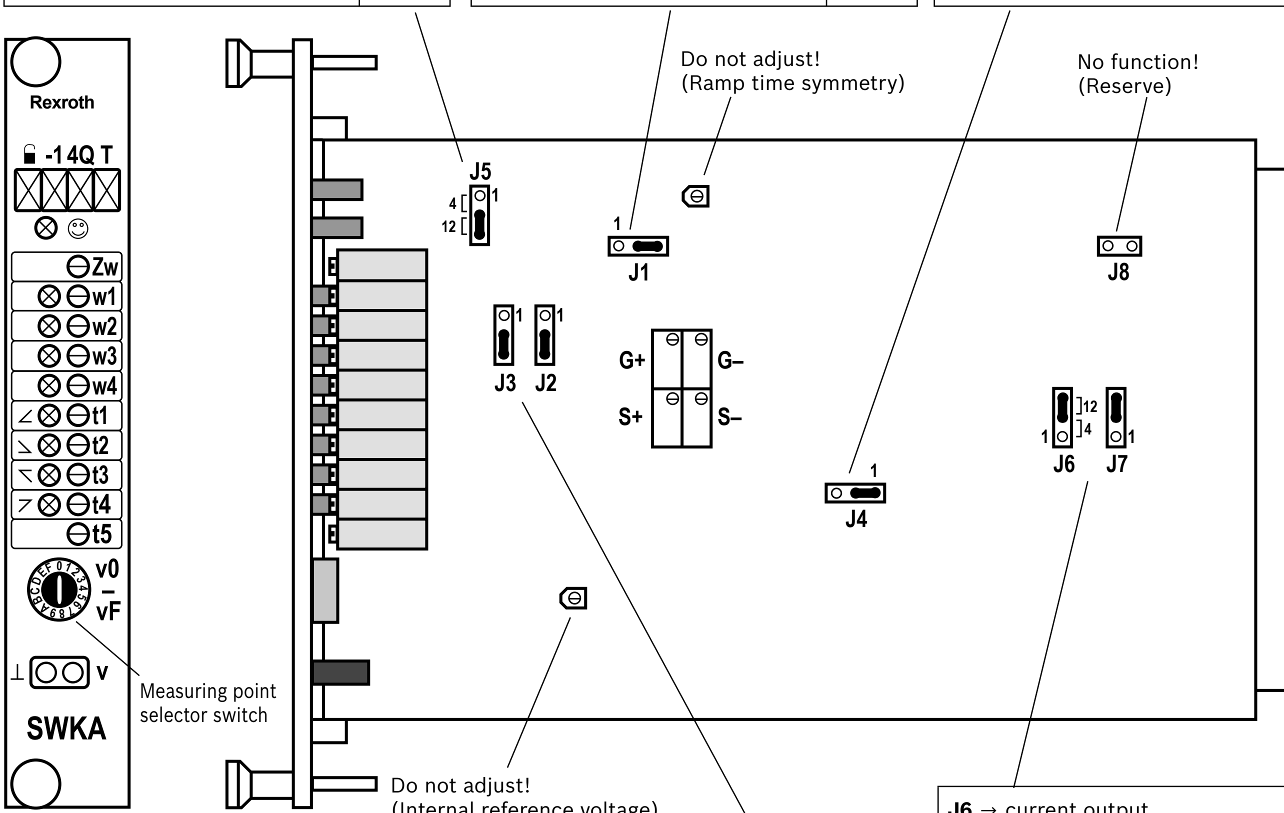
Operating voltage	U_B	24 VDC + 40 % – 20 %
Operating range:		
Upper limit value	U_B (t)$_{max}$	35 V
Lower limit value	U_B (t)$_{min}$	18 V
Power consumption	P_S	< 7 VA
Current consumption	I	< 0.3 A
Fuse	I_S	Thermal overload protection; self-activating after tripping
Inputs, analog		
Command values 1 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

$\boxed{}$ ... Factory setting of the jumpers

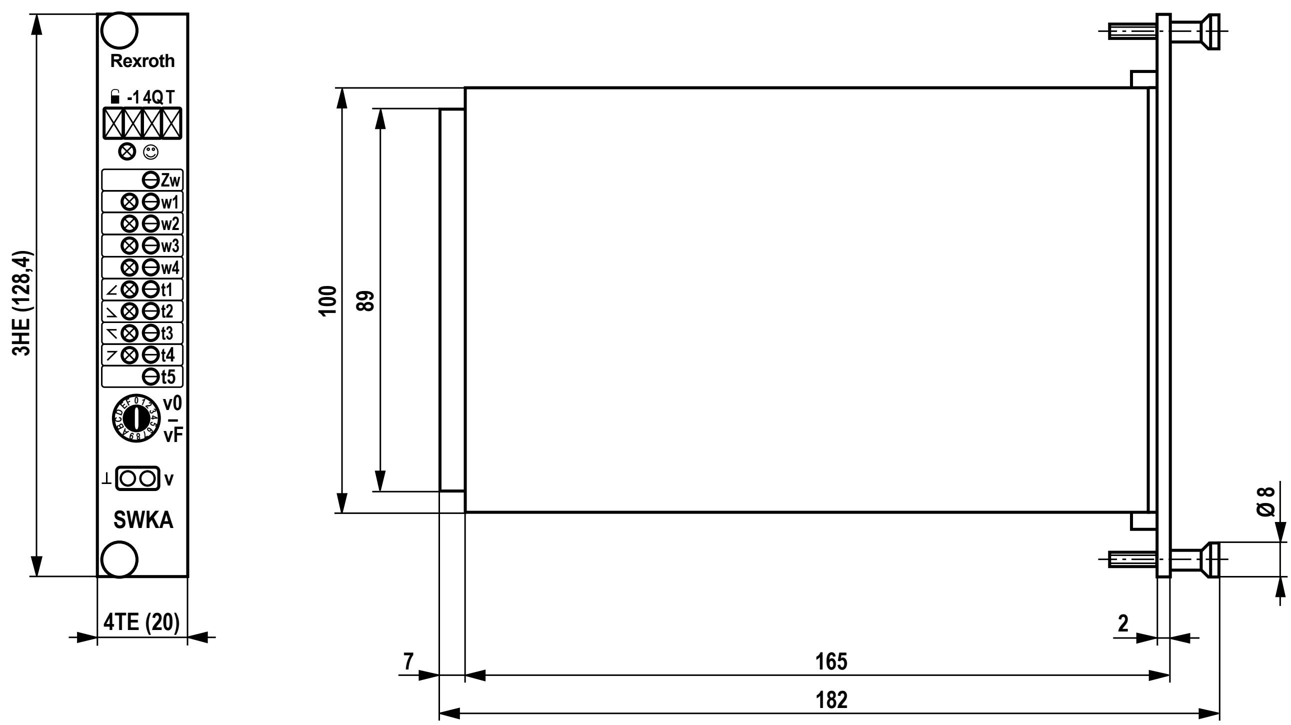
For further information and important notices see product description and commissioning instructions 30255-B.

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).

Command value and ramp card

Type VT-SWKA2-5-...

Component series 1X

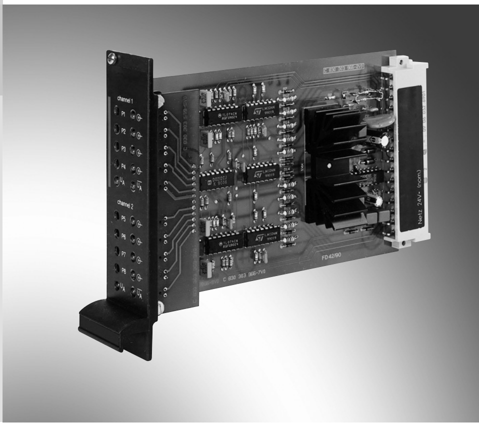


Table of contents

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

Customer version

V0 = Catalog version

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

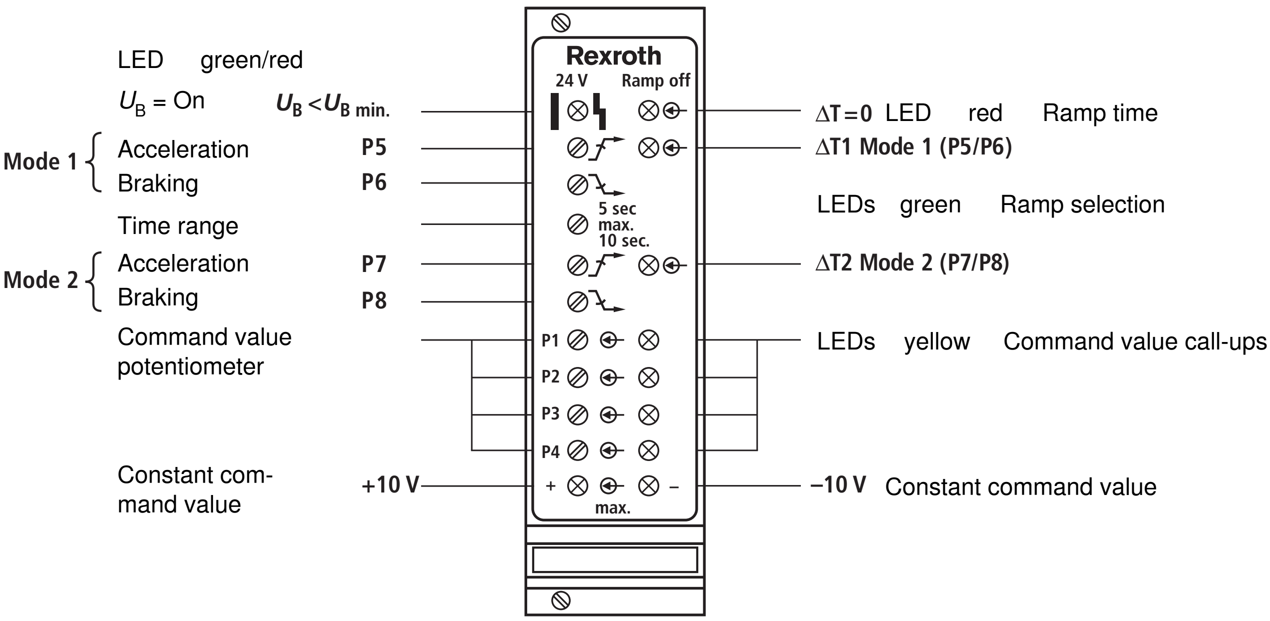
Preferred types

Amplifier type	**Material number**
VT-SWKA2-5-1X/V0/0	0811405094

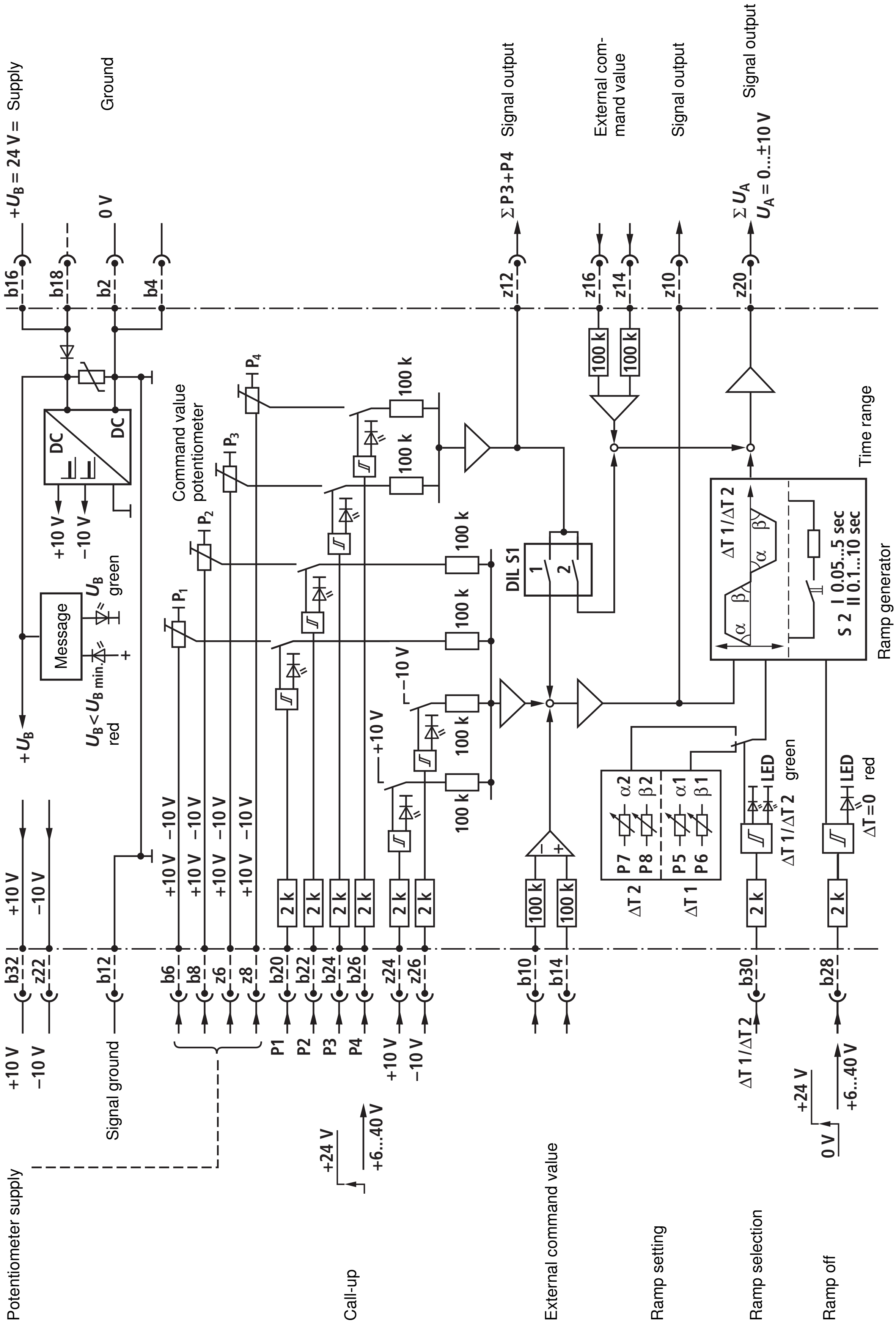
Suitable card holder:

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

Front plate



Block diagram with pin assignment



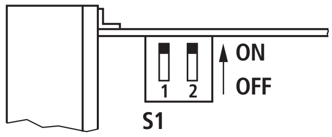
Technical data (For applications outside these parameters, please consult us!)

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

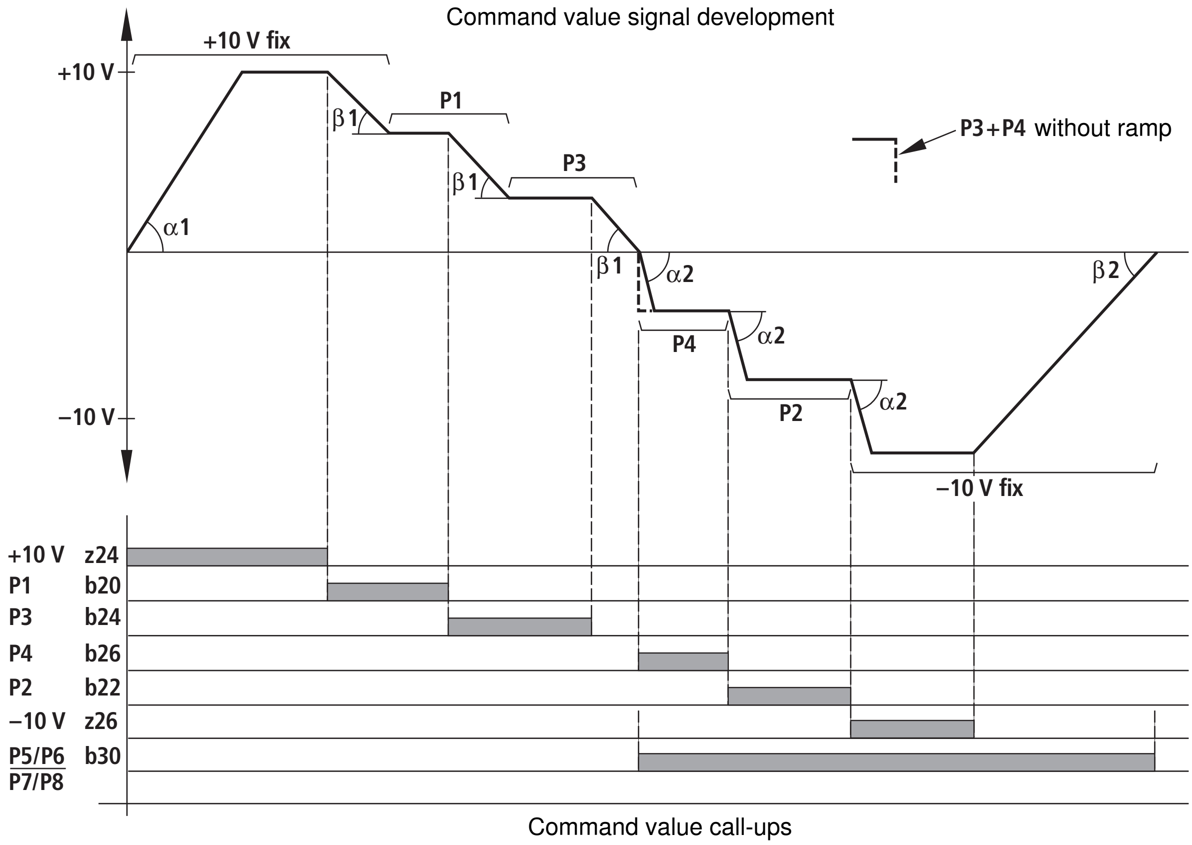
Applications

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.

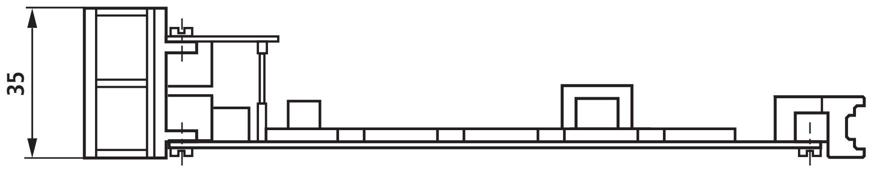
DIL S1. __		Ramp
.1	.2	.P3/P4
1	0	EIN/ON
0	1	AUS/OFF

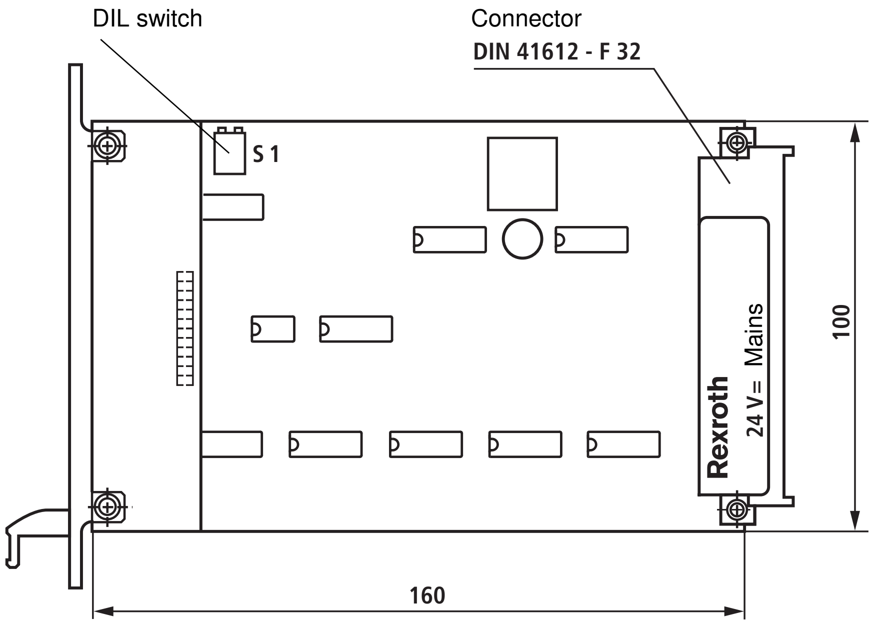


Command value run program
Example



Device dimensions (dimensions in mm)





Project planning / maintenance instructions / additional information

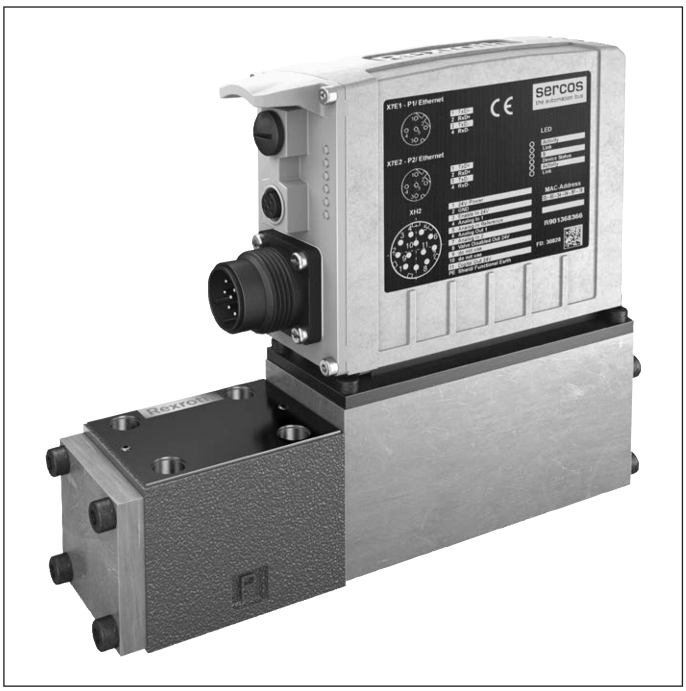
- The amplifier card may only be unplugged and plugged when de-energized.
- The distance to aerial lines, radios and radar systems must be sufficient (> 1 m).
- Do not lay solenoid and signal lines near power cables.
- For signal lines and solenoid conductors, we recommend using shielded cables.
  The 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.

RE 29391
Edition: 2021-05
Replaces: 2016-02

rexroth
A Bosch Company

Directional control valve, direct operated, with integrated digital axis controller (IAC-Multi-Ethernet)

Type 4WRPDH



- Sizes 6 and 10
- Component series 2X
- Maximum operating pressure 350 bar
- Maximum flow 100 l/min (***Δp*** = 70 bar)

Features

- Open
  - Integrated digital axis control functionality (IAC Multi Ethernet)
  - Bus connection/service interface (sercos, EtherCAT, EtherNet/IP, PROFINET RT, POWERLINK, VARAN)
- Scalable
  - 2 configurable analog sensor inputs
  - 1 input for linear position measurement system (SSI, 1Vpp or EnDat 2.2)
- Safe
  - 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
- Precise
  - Best-in-class hydraulic controller
  - High response sensitivity and low hysteresis

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	Directional control valve	**WRP**
03	With integrated digital axis controller	**D**
04	Control spool/sleeve	**H**
05	Size 6	**6**
	Size 10	**10**
06	Symbols; possible version see page 3	
07	Installation side of the inductive position transducer	**B**

Rated flow at 70 bar pressure differential (35 bar/control edge)

08		Flow characteristic			
		"L"	**"P"** (inflection 40%)	**"P"** (inflection 60%)	
	– Size 6				
	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**
	– Size 10				
	50 l/min	✓	✓	–	**50**
	100 l/min	✓	✓	–	**100**

Flow characteristic

09	Linear	**L**
	Inflected characteristic curve (inflection 60% for NG6 with rated flows "**15**" and "**25**", otherwise inflection 40%)	**P**
10	Component series 20 … 29 (20 … 29: unchanged installation and connection dimensions)	**2X**

Seal material (observe compatibility of seals with hydraulic fluid used, see page 7)

11	NBR seals	**M**
	FKM seals	**V**
12	Supply voltage 24 V	**24**

Ethernet interface

13	EtherNET/IP	**E**
	PROFINET RT	**N**
	Sercos	**S**
	EtherCAT (CANopen profile)	**T**
	POWERLINK (CANopen profile)	**W**
	VARAN	**V**

Electrical interface

14	±10 VDC or 4 … 20 mA	**D6**

Ordering code

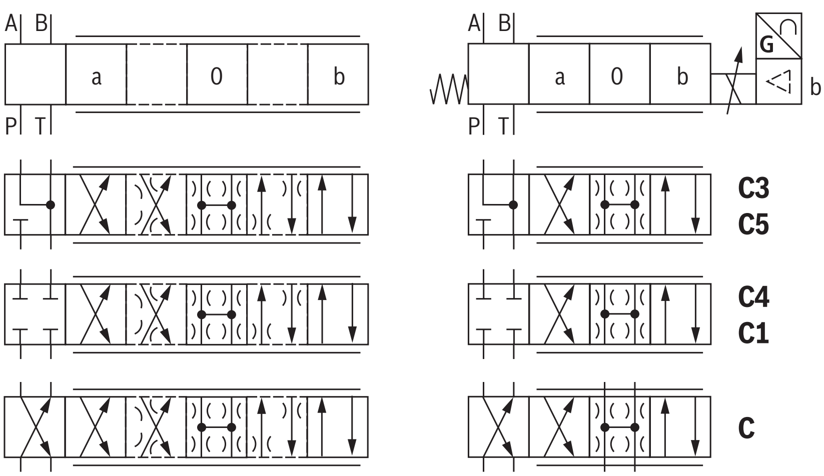
01	02	03	04	05	06	07	08	09		10		11		12	13	14	15	16
4	**WRP**	**D**	**H**			**B**			**–**	**2X**	**/**		**/**	**24**		**D6**		

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/1Vpp	**U**

16	Further details in the plain text	*****

Symbols



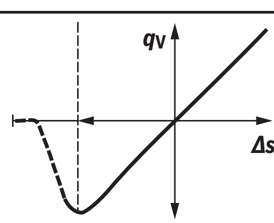
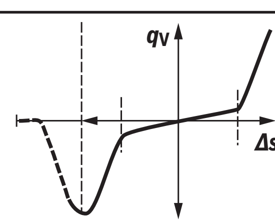
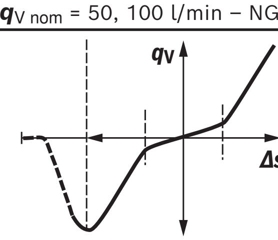
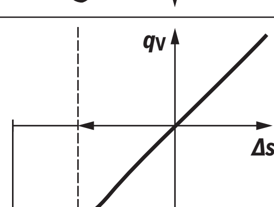
With symbols C5 and C1: [1)]

P → A: $q_{V\,nom}$ B → T: $q_{V\,nom}/2$
P → B: $q_{V\,nom}/2$ A → T: $q_{V\,nom}$

> **Notice:**
> Representation according to DIN ISO 1219-1.
> Hydraulic interim positions are shown by dashes.

1) Standard = 1:1, , $q_{V\,nom}$ 2:1 from rated flow = 40 l/min (version "40")

Flow characteristic

Symbol	**Linear characteristic curve** (version "L")	**Inflected characteristic curve** (version "P") Inflection 60% ($q_{V\,nom}$ = 15, 25 l/min)	Inflection 40% ($q_{V\,nom}$ = 4, 40 l/min – NG6) ($q_{V\,nom}$ = 50, 100 l/min – NG10)
C3, C5 **C4, C1**			
C		–	–

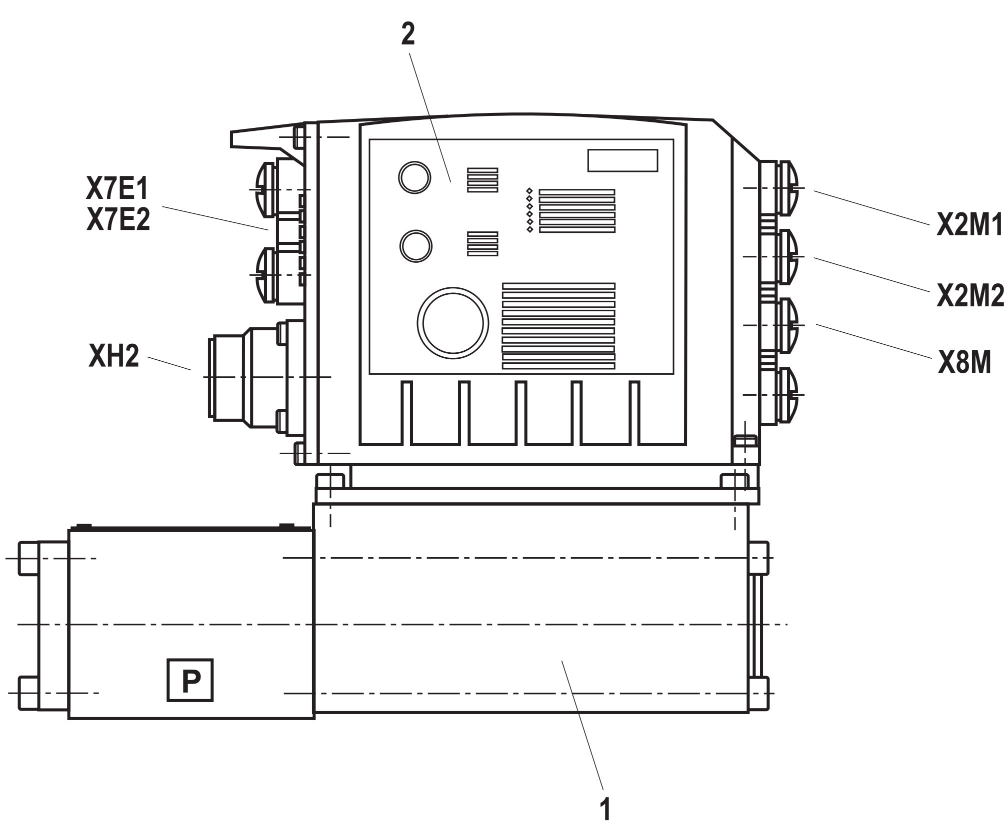
Function, section

Set-up

The directional control valve with IAC-Multi-Ethernet electronics mainly consists of:

- Direct operated directional control valve (1) with control spool and sleeve 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)

Directional control 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 directional control valves) is a digital directional control valve with integrated axis controller and the following functionalities:

- Position control
- Pressure/force control
- Closed-loop speed control
- Substitutional closed-loop control (position - pressure/force)
- Substitutional control (flow - pressure/force)
- pQ function (flow-controlled)

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 preset 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 controller parameters are set via the Ethernet interface (X7E1 or X7E2)

Monitoring

The digital control electronics enable comprehensive monitoring functions/error 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 DS PC program

To implement the project planning task and to parameterize the IAC-Multi-Ethernet valves, the user may use the IndraWorks DS engineering tool (see accessories):

- Project planning
- Parameterization
- Commissioning
- Diagnosis
- Comfortable administration of all data on a PC
- PC operating systems: Windows XP (SP3), Windows 7

Safety function
The integrated control electronics of the valve enables the additional shut-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).

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

General				
Size		NG	6	10
Type of connection			Plate connection, porting pattern according to ISO 4401	
Weight		kg	3.2	7.2
Installation position			any	
Ambient temperature range		°C	–20 ... +60	
Storage temperature range		°C	+5 ... +40	
Maximum solenoid surface temperature		°C	150	
$MTTF_d$ value according to EN ISO 13849	▶ Hydraulic (category 1)	Years	150 (for further details, see operating instructions 29391-B)	
Vibration resistance	▶ Sine test according to DIN EN 60068-2-6		10 ... 2000 Hz / maximum of 10 g / 10 cycles / 3 axes	
	▶ Noise test according to DIN EN 60068-2-64		20 ... 2000 Hz / 10 g_{RMS} / 30 g peak / 30 min / 3 axes	
	▶ Transport shock according to DIN EN 60068-2-27		15 g / 11 ms / 3 axes	
Maximum relative humidity (no condensation)		%	95	

Hydraulic											
Maximum operating pressure	▶ Ports A, B, P	bar	350							315	
	▶ Port T	bar	250								
Hydraulic fluid			see table page 7								
Hydraulic fluid temperature range (flown-through)		°C	–20 ... +60								
Viscosity range	▶ Recommended	mm²/s	20 ... 100								
	▶ Maximum admissible	mm²/s	10 ... 800								
Maximum admissible degree of contamination of the hydraulic fluid; cleanliness class according to ISO 4406 (c)			Class 18/16/13 [2)]								
Rated flow (***Δp*** = 35 bar per edge [1)])		l/min	2	4	12	15	24/25	40	50	100	
Leakage flow (at 100 bar)	▶ Linear characteristic curve "L"	cm³/min	< 150	< 180	< 300	–	< 500	< 900	< 1200	< 1500	
	▶ Inflected characteristic curve "P"	cm³/min	–	–	–	< 180	< 300	< 450	< 600 (1:1) < 500 (2:1)	< 600	
Limitation of use (transition in fail safe position)	▶ Symbol C3, C5	bar	350	350	350	350	350	160	315	160	
	▶ Symbols C4, C1	bar	350	350	350	280	250	100	250	100	

1) Flow for deviating ***Δp***:

$$q_x = q_{Vnom} \times \sqrt{\frac{\Delta p_x}{35}}$$

2) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and simultaneously increases the life cycle of the components.

Technical data

(For applications outside these values, please consult us!)

Hydraulic fluid		Classification	Suitable sealing materials	Standards	Data sheet
Mineral oils		HL, HLP, HLPD, HVLP, HVLPD	NBR, FKM	DIN 51524	90220
Bio-degradable	▶ Insoluble in water	HETG	FKM	ISO 15380	90221
		HEES	FKM		
	▶ Soluble in water	HEPG	FKM	ISO 15380	
Flame-resistant	▶ Water-free	HFDU (glycol base)	FKM	ISO 12922	90222
		HFDU (ester base)	FKM		
		HFDR	FKM		
	▶ Containing water	HFC (Fuchs: Hydrotherm 46M, Renosafe 500; Petrofer: Ultra Safe 620; Houghton: Safe 620; Union: Carbide HP5046)	NBR	ISO 12922	90223

Important information on hydraulic fluids:

- For further information and data on the use of other hydraulic fluids, please refer to the data sheets above or contact us.
- There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.).
- The ignition temperature of the hydraulic fluid used must be 50 K higher than the maximum surface temperature.
- **Bio-degradable and flame-resistant – containing water:** If components with galvanic zinc coating (e.g. version "J3" or "J5") or parts containing zinc are used, small amounts of dissolved zinc may get into the hydraulic system and cause accelerated aging of the hydraulic fluid. Zinc soap may form as a chemical reaction product, which may clog filters, nozzles and solenoid valves – particularly in connection with local heat input.
- **Flame-resistant – containing water:**
  - Due to the increased cavitation tendency with HFC hydraulic fluids, the life cycle of the component may be reduced by up to 30% as compared to the use with mineral oil HLP. In order to reduce the cavitation effect, it is recommended – if possible specific to the installation – backing up the return flow pressure in ports T to approx. 20% of the pressure differential at the component.
  - Dependent on the hydraulic fluid used, the maximum environment and hydraulic fluid temperature must not exceed 50 °C. In order to reduce the heat input into the component, the command value profile is to be adjusted for proportional and high-response valves.

Static/dynamic		
Hysteresis	%	≤ 0.2
Manufacturing tolerance q_{Vmax}	%	≤ 10
Temperature drift	%/10 K	Zero shift < 0.25
Pressure drift	%/100 bar	Zero shift < 0.15
Zero compensation		ex plant ±1%

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

Electrical, integrated electronics (OBE)				
Size		NG	6	10
Supply voltage [3; 4]	▶ 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)	
Current consumption	▶ Maximum [5]	A	2.5	
	▶ Impulse current	A	4	
Maximum power consumption		W	40	60
Relative duty cycle		%	100 (continuous operation)	
Protection class according to EN 60529			IP 65 with mounted and locked plug-in connectors	
Required fuse protection, external		A	4, time-lag	
Protective grounding conductor and screening			see connector pin assignment (CE-compliant installation) page 12 and 13	
Adjustment			calibrated in the plant, see characteristic curves page 15 ... 18	
Booting time		s	< 15	
Scan time pressure and force controller (minimum)		ms	0.5	
Scan time position controller (minimum)		ms	1	
AD/DA resolution	▶ Analog inputs	Bit	12	
	▶ Analog output	Bit	10	
Parameterization interface			Ethernet	
Conformity			CE according to EMC directive 2004/108/EC tested according to EN 61000-6-2 and EN 61000-6-3	

3) Supply voltage is used directly for sensor connections X2M1, X2M2 and X8M (no internal voltage limitation)

4) Voltage limit values must be observed directly at the connector of the valve (observe line length and cable cross-section!)

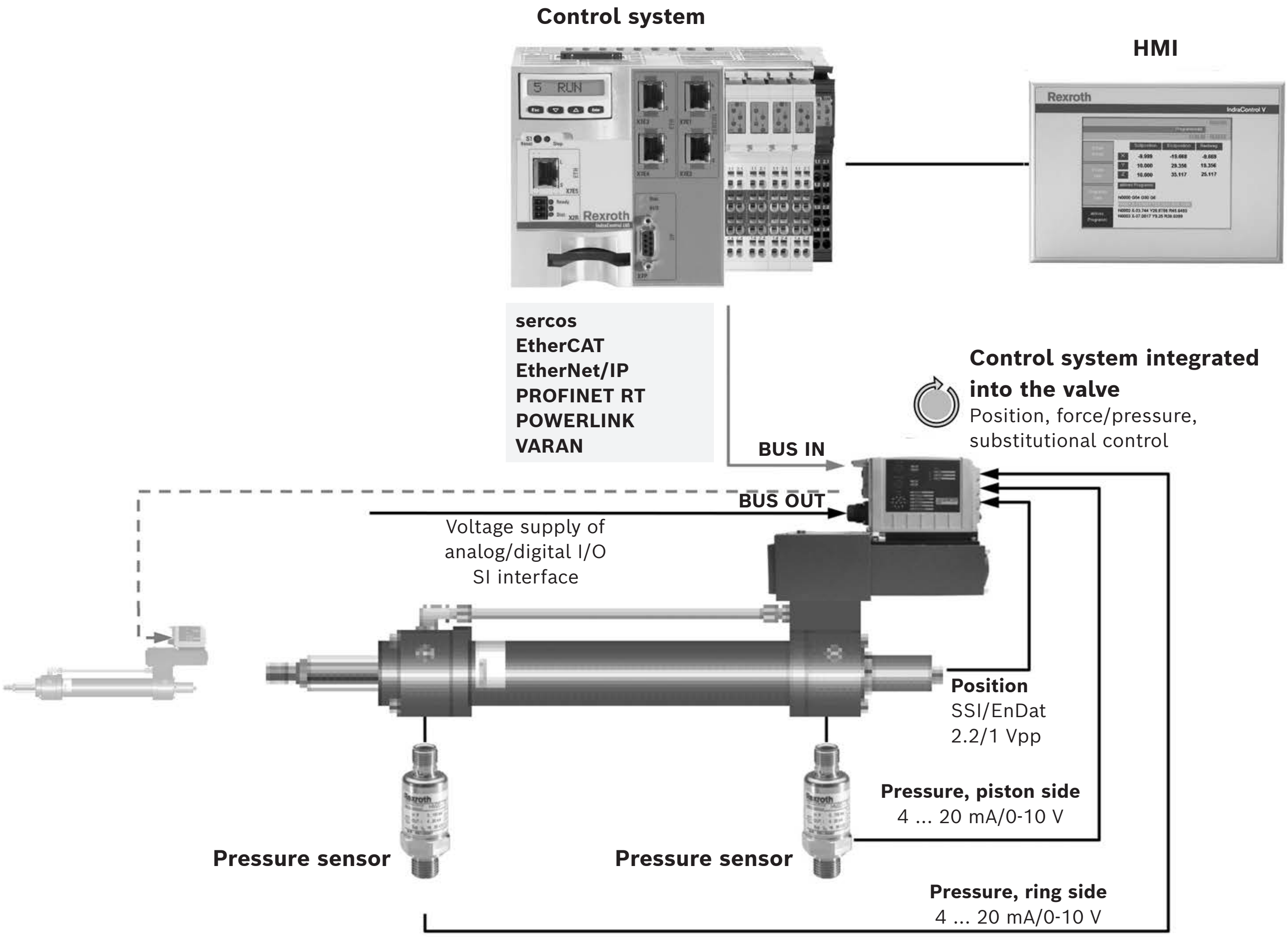
5) When using the sensor inputs or the switching output, the maximum current consumption will increase according to the external load

Electrical, integrated electronics (OBE)			
Digital inputs XH2	▶ Quantity		optionally up to 2, configurable (analog inputs are omitted)
	▶ Low level	V	–3 ... 5
	▶ High level	V	15 ... $\boldsymbol{U}_{\mathrm{B}}$
	▶ Current consumption at high level	mA	< 1
	▶ Reference potential		Pin 5
Digital outputs XH2	▶ Quantity		1
	▶ Low level	V	0 ... 3
	▶ High level	V	15 ... $\boldsymbol{U}_{\mathrm{B}}$
	▶ Current carrying capacity	A	1.5 (short-circuit-proof)
	▶ Signal delay time	msec	< 2 (depending on set scan time)
	▶ Reference potential		GND

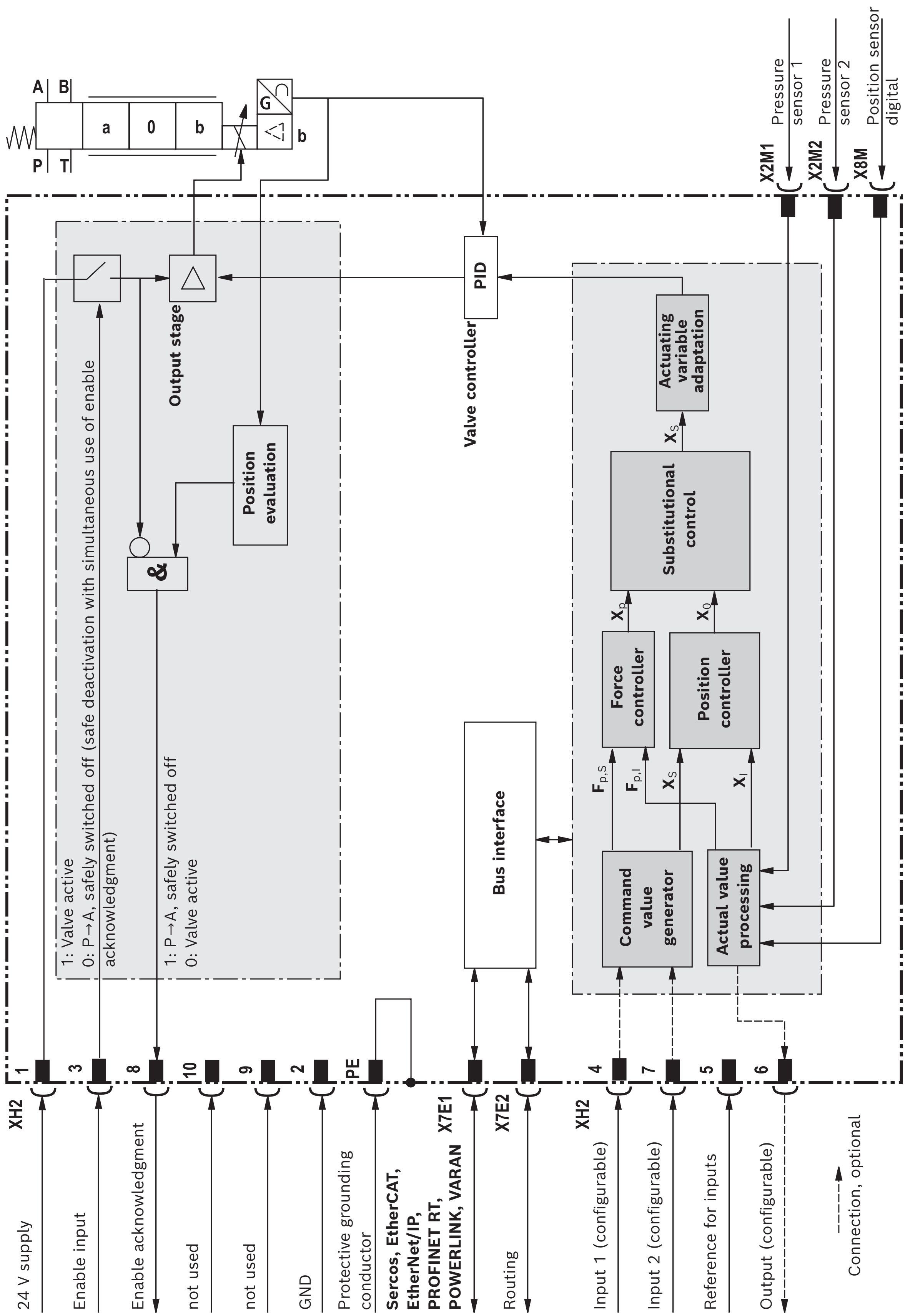
Technical data
(For applications outside these values, please consult us!)

Analog inputs XH2	▶ Number (current and voltage input parameterizable)		optionally up to 2, configurable (digital inputs are no longer required)
	▶ AD resolution	bit	12
	▶ Voltage inputs (differential inputs)		
	– Measurement range	V	–10 … +10
	– Input resistance	kΩ	80 +10%
	– Temperature drift		< 14 mV / 10 K
	▶ Current inputs (reference to AGND)		
	– Input current		4 … 20 (0 … 20 physically)
	– Input resistance	Ω	200, measuring resistance plus FET
	– Temperature drift		< 25 µA / 10 K
Analog outputs XH2	▶ Number (current and voltage input parameterizable)		1
	▶ DA resolution	bit	14
	▶ Voltage outputs		
	– Output range	V	–10 … +10 (0 … 10 by software)
	– Minimum load impedance	kΩ	10
	– Temperature drift		< 5 mV / 10 K
	▶ Current outputs		
	– Output range	mA	0 … 20 (4 … 20 by software)
	– Maximum load	Ω	200
Analog sensors X2M1, X2M2	▶ Number (current and voltage input configurable)		1 per connector
	▶ Supply voltage	V	24 (corresponding to supply voltage applied to XH2)
	▶ Maximum supply current	mA	350 (sum X2M1, X2M2 and X8M)
	▶ AD resolution	bit	12
	▶ Voltage inputs		
	– Measurement range	V	0 … 10
	– Input resistance	kΩ	80 +10%
	– Temperature drift		< 15 mV / 10 K
	▶ Current inputs (reference to AGND)		
	– Input current		4…20 (0…20 physically)
	– Input resistance	Ω	200, measuring resistance plus PTC
	– Temperature drift		< 10 µA / 10 K
Digital sensor X8M	▶ Supply voltage		24 V or 5 V
	▶ Maximum supply current – 24 V	mA	350 (sum X2M1, X2M2 and X8M)
	– 5 V	mA	250
	▶ SSI transducer		
	– Coding		Gray
	– Data width		12 … 28 bit
	– Transfer frequency		80 kHz … 1 MHz
	– Line receiver / driver		RS485
	▶ Endat encoder		2.2
	– Line receiver / driver		RS485
	– Resolution		minimum 10 nm and multiple
	▶ 1Vpp-encoder		
	– Transfer frequency	kHz	250

Representation of the axis controller in the system network



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 acknowledgment will only be activated after the safe valve spool position has been achieved. For a detailed description of the safety function, refer to the operating instructions 29391-B.

Electrical connections, assignment

Connector pin assignment XH2, 11-pole + PE according to EN 175201-804

	Core marking		
Pin	Cable, one-part [1]	Cable, split [2]	**Interface D6 assignment**
1	1	1	24 V DC supply voltage
2	2	2	GND
3	3	white	Enable input 24 V DC (high ≥ 15 V; low < 2 V)
4	4	yellow	Command values 1 (4 ... 20 mA/±10 V) [3]
5	5	green	Reference for command values
6	6	violet	Actual value (4 ... 20 mA/±10 V) [3; 4]
7	7	pink	Command value 2 (4 ... 20 mA/±10 V) [3]
8	8	red	Enable acknowledgment 24 V DC (I_{max} 50 mA) [5]
9	9	brown	not used
10	10	black	not used
11	11	blue	Switching output 24 V, configurable (fault-free operation (24 V)/error (0V) or power circuit signal), maximum 1.5 A [3; 5]
PE	green-yellow	green-yellow	Functional ground (connected directly to metal housing)

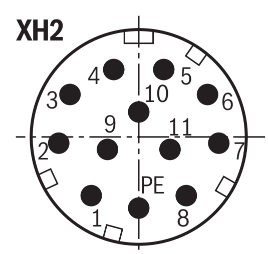
1) Core marking of the connection lines for mating connector with cable set (see accessories, page 22, material numbers R901268000, R901272854, R901272852)

2) Core marking of the connection lines for mating connector with cable set (see accessories, page 22, material numbers R900884671, R900032356, R900860399)

3) Selection via commissioning software

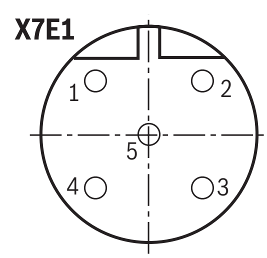
4) For diagnostic purposes, precise actual value response via Ethernet interface

5) A load increases the current consumption on pin 1



Connector pin assignment for Ethernet interfaces "X7E1" and "X7E2" (coding D), M12, 4-pole, socket

Pin	Assignment
1	TxD +
2	RxD +
3	TxD –
4	RxD –
5	not used



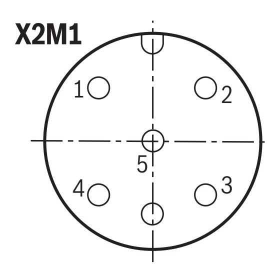
Analog configurable sensor interfaces, connections "X2M1", "X2M2" (coding A), M12, 5-pole, socket

Pin	Assignment
1	+24 V voltage output (sensor supply) [1; 2]
2	Sensor signal input current (4 ... 20 mA) [3]
3	GND
4	Sensor signal input voltage (0 ... 10 V) [3]
5	Negative differential amplifier input to pin 4 (optional)

1) Voltage output same as voltage supply connected to input XH2. (Maximum load capacity see page 13)

2) A load increases the current consumption of the valve (pin 1 on the connector XH2)

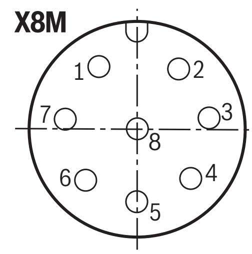
3) Only one signal input per interface, configurable



Electrical connections, assignment

Digital sensor interface SSI, EnDat 2.2 or 1Vpp 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 3)	+5 V 3)	+5 V 3)
3	Data +	Data +	A +
4	Data –	Data –	A –
5	GND	GND	B +
6	Clock –	Clock –	B –
7	Clock +	Clock +	R +
8	+24 V 3)	+5 V 3)	R –

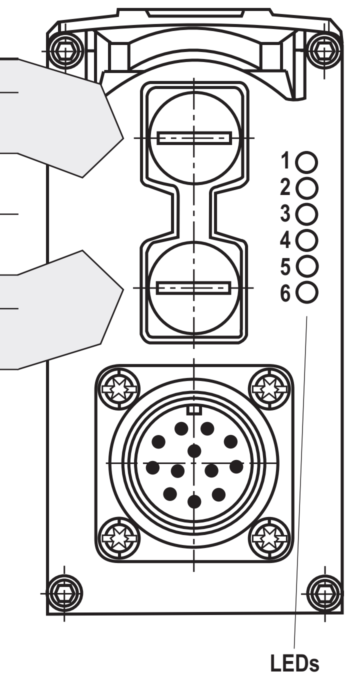


1) Pins 2, 8 and 1, 5 have the same assignment each
2) Supported resolution ≥ 10 nm
3) A load increases the current consumption of the valve (pin 1 on the connector XH2)

Notices:
- Reference potential for all signals: GND
- 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.

LED displays

LED	Interface	Sercos	EtherNET/IP	EtherCAT	PROFINET RT	POWERLINK	VARAN
1	**X7E1**	Activity	Activity	not used	Activity	not used	Active
2		Link	Link	Link/activity	Link	Link/data activity	Link
3	**Electronics module**	S	Network status	Network status	Network status	Status/error	Network status
4		Module status	Module status	Module status	Module status	Module status	Module status
5	**X7E2**	Activity	Activity	not used	Activity	not used	not used
6		Link	Link	Link/activity	Link	Link/data activity	not used



Displays of the status LEDs

Module status LED (LED 4)	Display status
Aus	No voltage supply
Green-red, flashing	Initialization
Green, flashing	Drive ready for operation
Green	Drive active
Orange, flashing	Warning
Red, flashing	Error

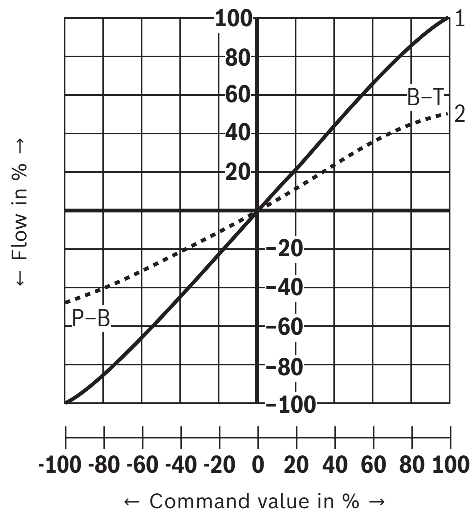
Network status LED (LED 3)	Display status
Aus	No voltage supply
Green	Operation

☞ **Notices:**
- LEDs 1, 2, 5 and 6 relate to interfaces "X7E1" and "X7E2"
  - Link: Cable plugged in, connection established (permanently lit)
  - Activity: Data sent/received (flashing)
- Module status LEDs 3 and 4 relate to the electronics module
- For a detailed description of the diagnosis LEDs, please refer to the functional description Rexroth HydraulicDrive HDx.

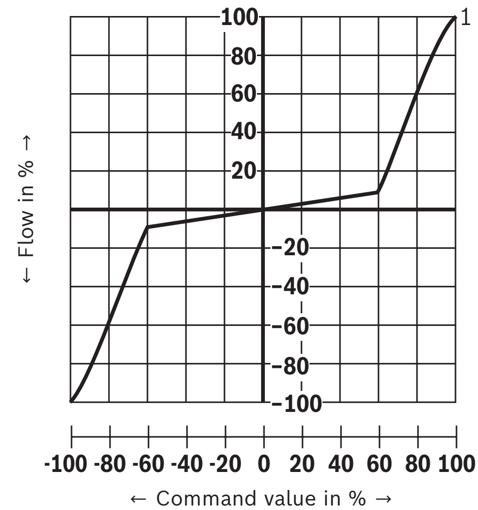
Characteristic curves: Size 6 – Flow characteristic (measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/signal function

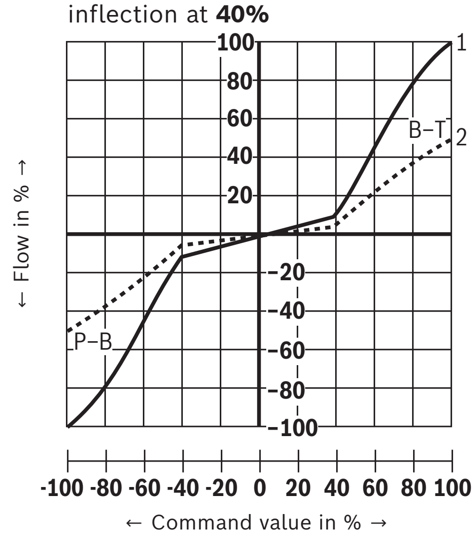
Linear characteristic curve "L"



Inflected characteristic curve "P", inflection at **60%**

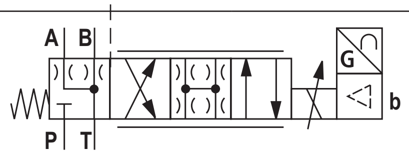
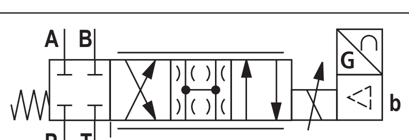


Inflected characteristic curve "P", inflection at **40%**



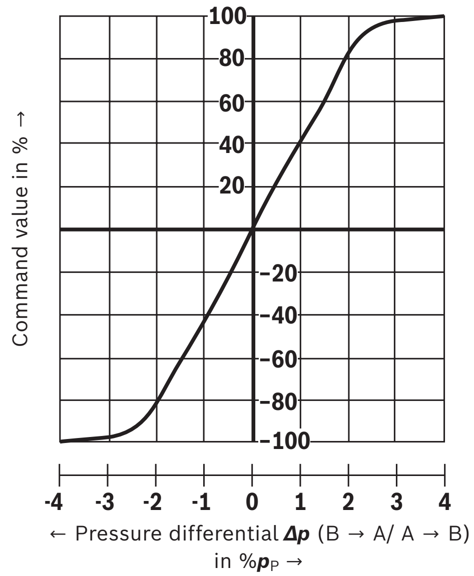
1 $q_{vA} : q_{vB}$ = 1:1
2 $q_{vA} : q_{vB}$ = 2:1

Fail-safe position

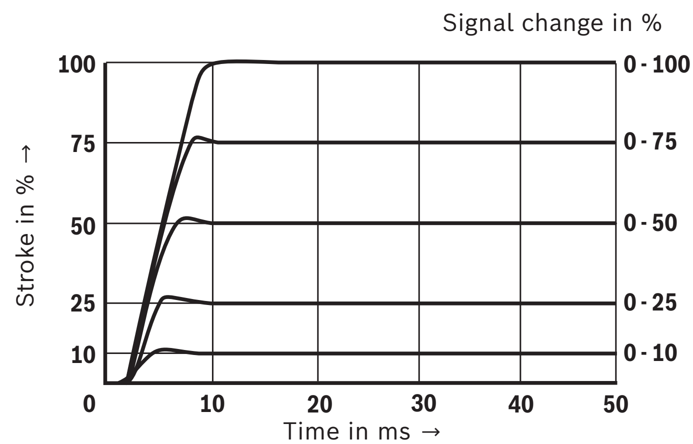
	Leakage flow at 100 bar	P→A P→B	50 cm³/min 70 cm³/min
	Flow at Δp = 35 bar	A→T B→T	10 ... 20 l/min 7 ... 20 l/min
	Leakage flow at 100 bar	P→A P→B	50 cm³/min 70 cm³/min
		A→T B→T	70 cm³/min 50 cm³/min
Fail-safe	p = 0 bar → 7 ms p = 100 bar → 10 ms	Enable "off" or internal shut-off if an error has occurred U_B ≤ 18 V or I ≤ 2 mA (with 4 ... 20 mA signal, cable break detection: current threshold configurable)	

Characteristic curves: Size 6
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

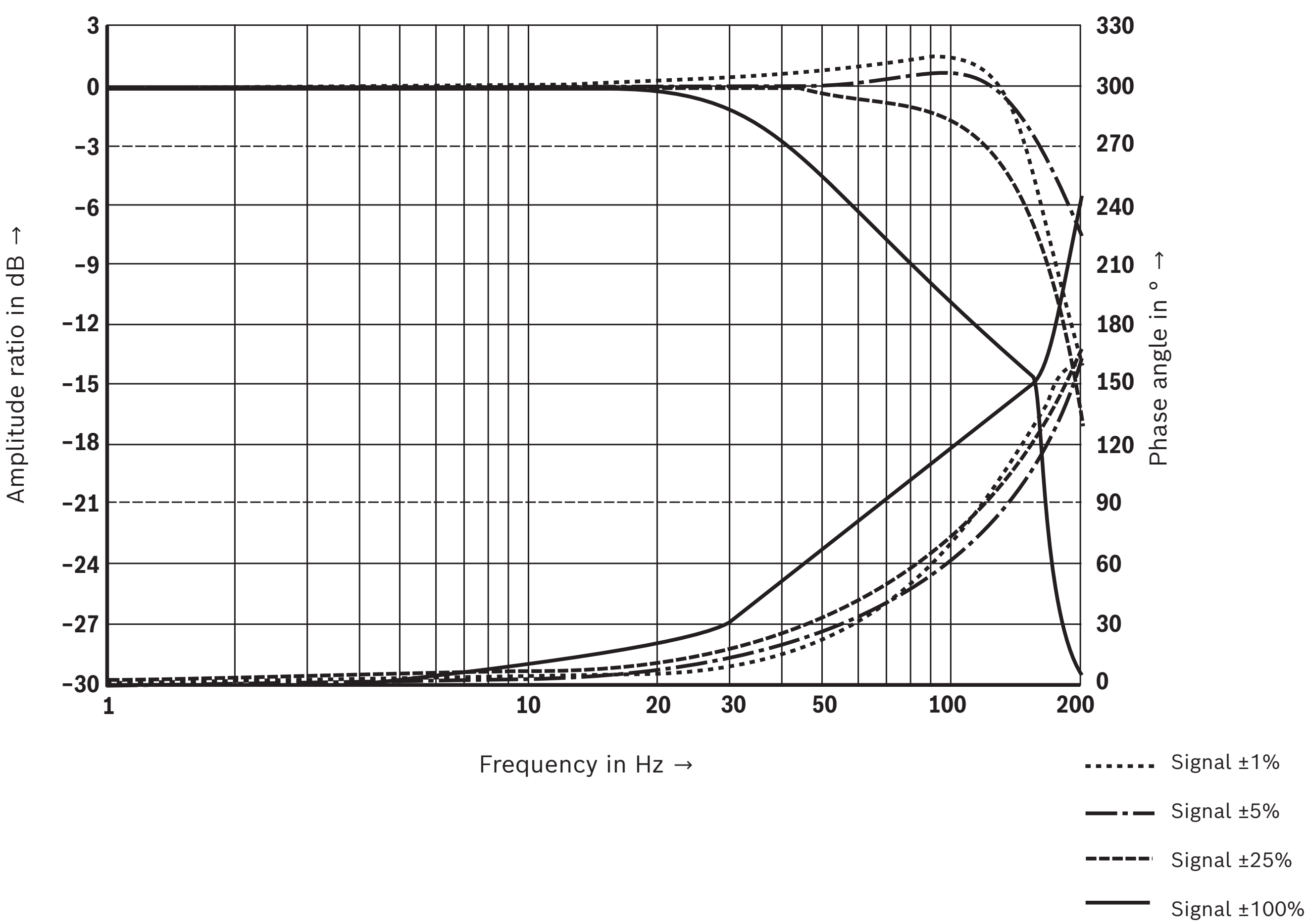
Pressure/signal characteristic curve



Transition function with stepped electric input signals



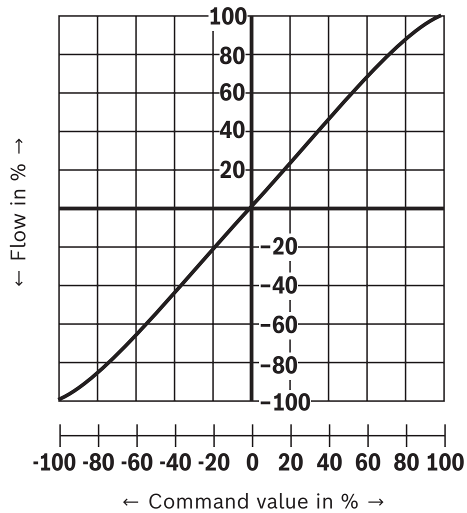
Frequency response



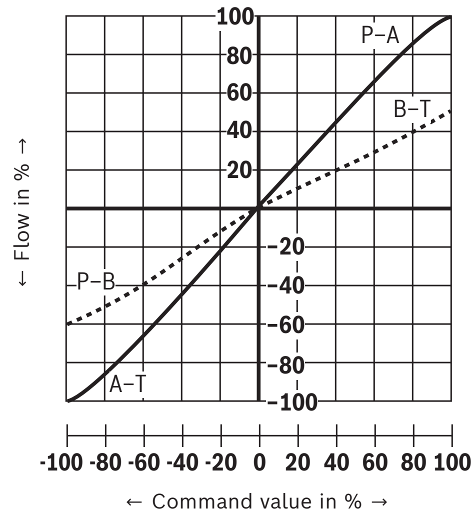
Characteristic curves: Size 10 – Flow characteristic (measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/signal function

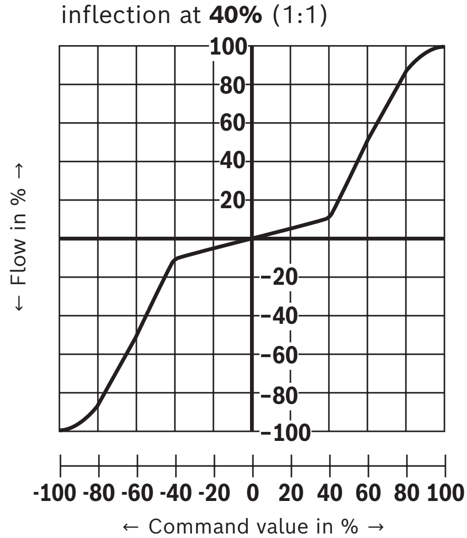
Linear characteristic curve "L" (1:1)



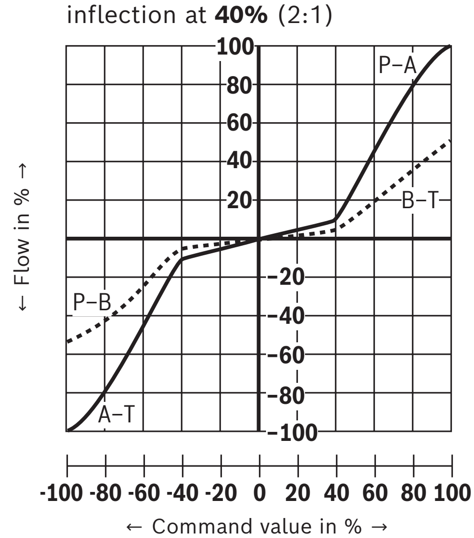
Linear characteristic curve "L" (2:1)



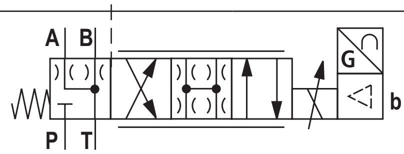
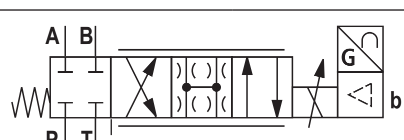
Inflected characteristic curve "P", inflection at **40%** (1:1)



Inflected characteristic curve "P", inflection at **40%** (2:1)

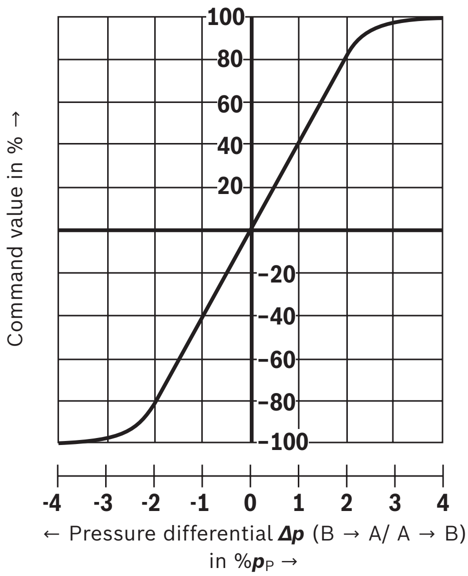


Fail-safe position

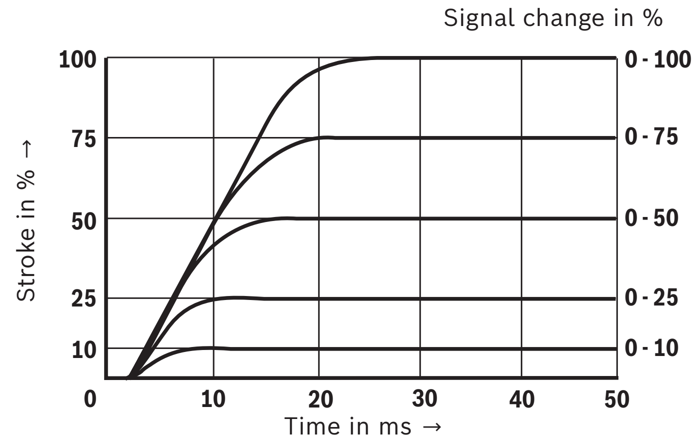
	Leakage flow at 100 bar	P→A P→B	50 cm³/min 70 cm³/min
	Flow at Δp = 35 bar	A→T B→T	100 ... 110 l/min 10 ... 25 l/min
	Leakage flow at 100 bar	P→A P→B	50 cm³/min 70 cm³/min
		A→T B→T	70 cm³/min 50 cm³/min
Fail-safe	p = 0 bar → 12 ms p = 100 bar → 16 ms	Enable "off" or internal shut-off if an error has occurred 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)

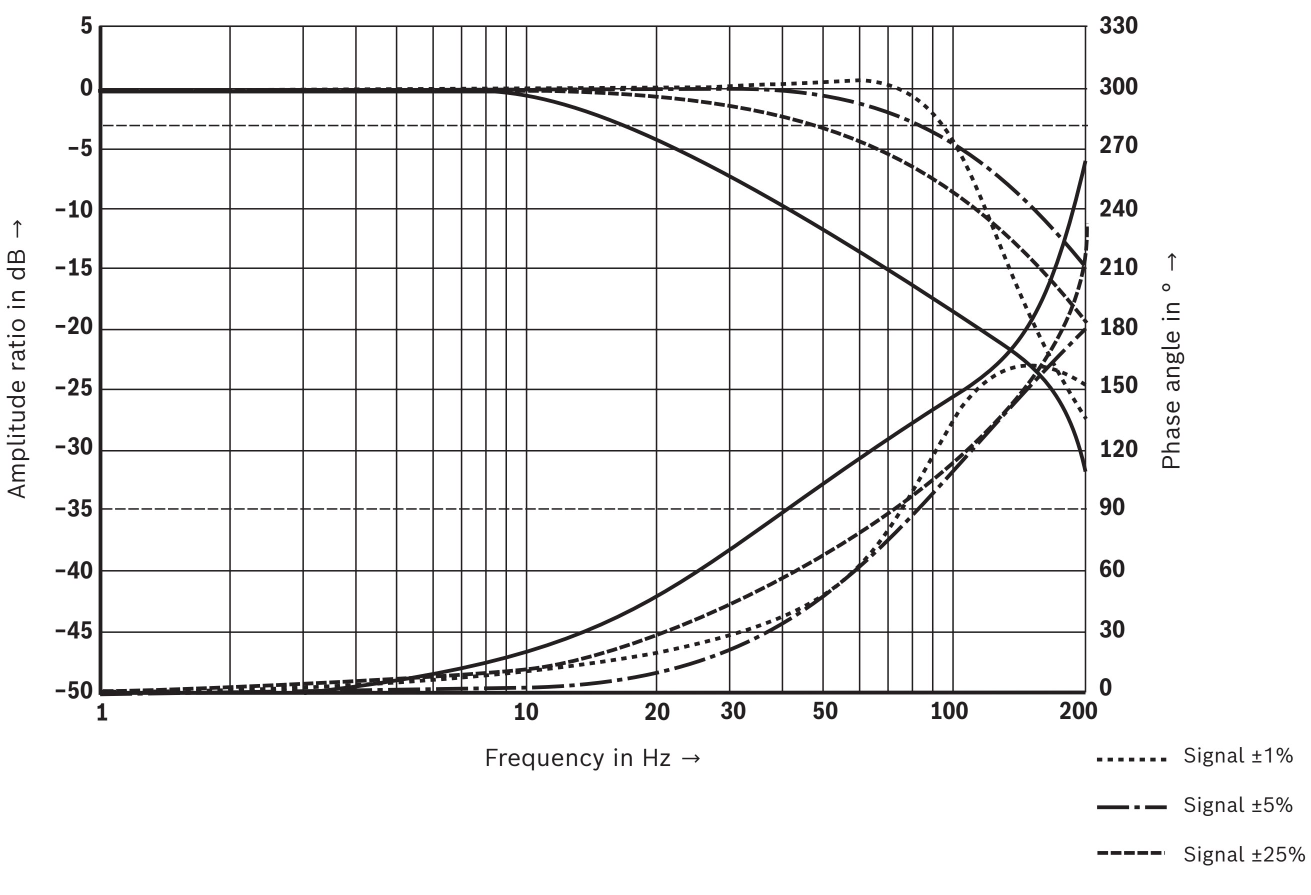
Pressure/signal characteristic curve



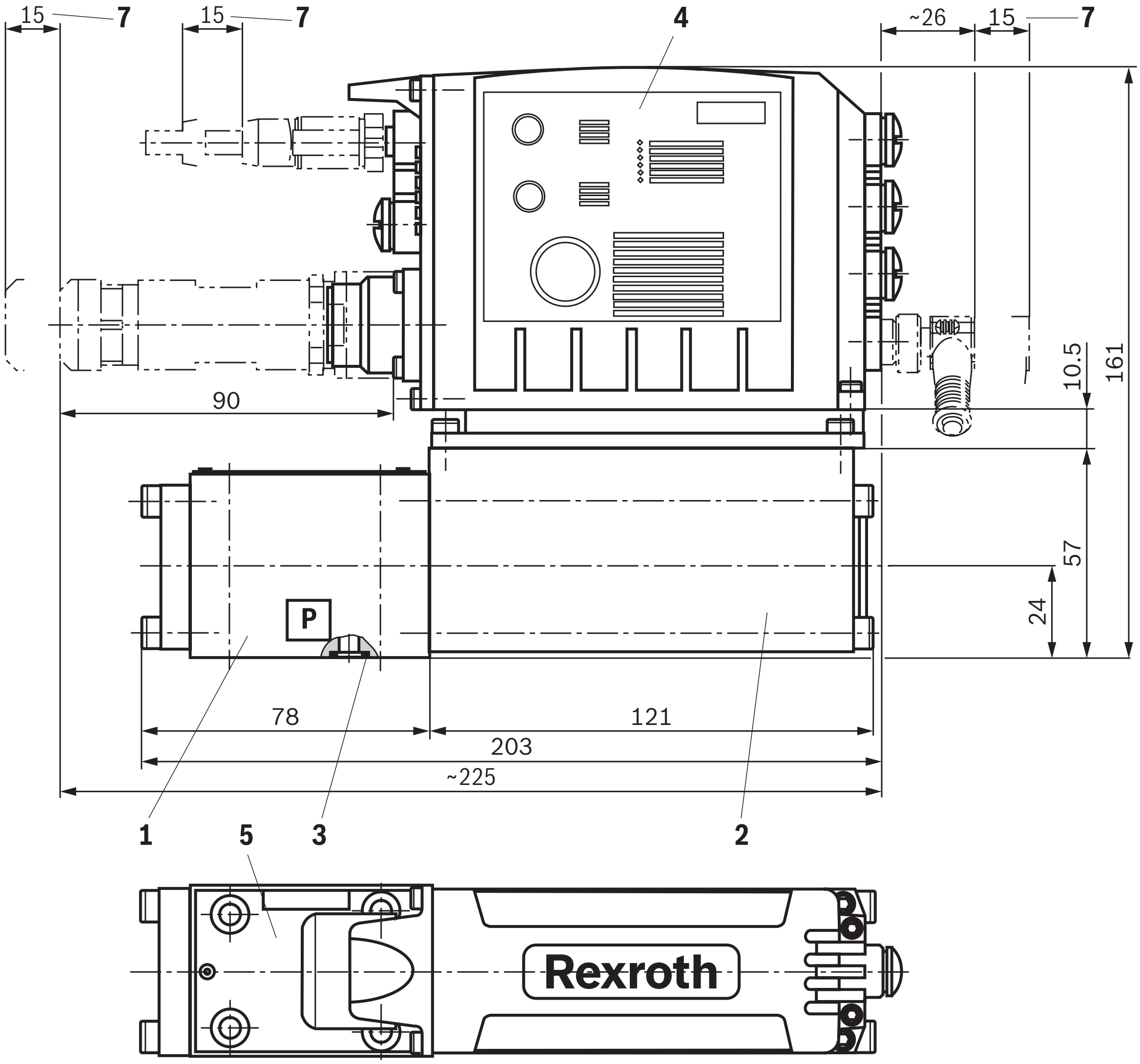
Transition function with stepped electric input signals

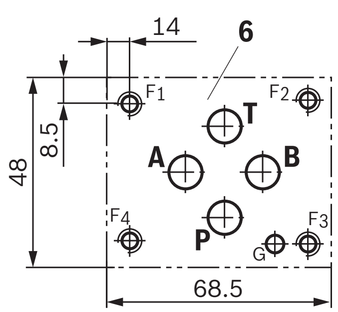


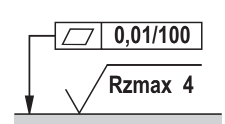
Frequency response



Dimensions: Size 6
(dimensions in mm)







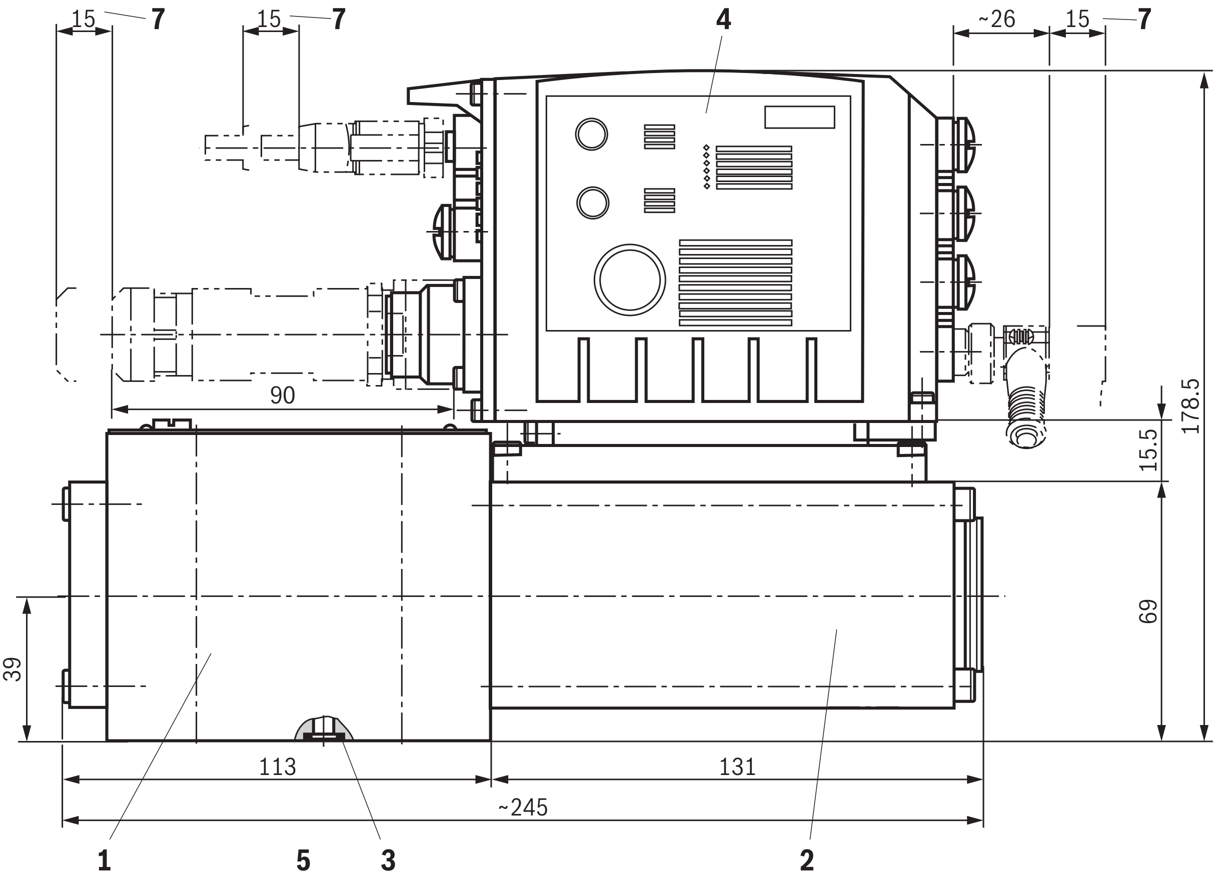
Required surface quality of the
valve contact surface

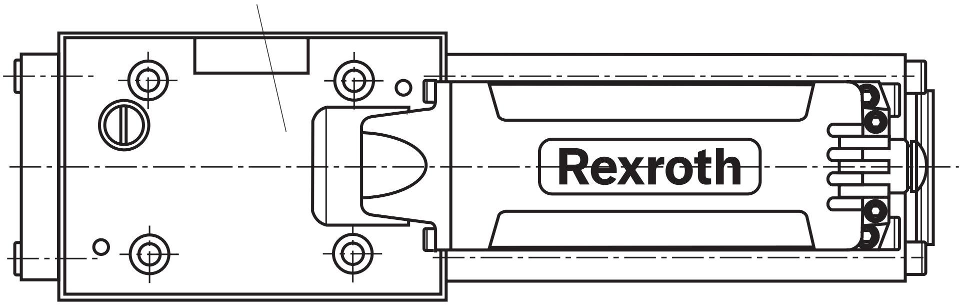
- **1** Valve housing
- **2** Control solenoid with position transducer
- **3** Identical seal rings for ports A, B, P, T
- **4** Integrated digital control electronics
- **5** Name plate
- **6** Machined valve contact surface, porting pattern according to ISO 4401-03-02-0-05
- **7** Space required to remove the mating connectors

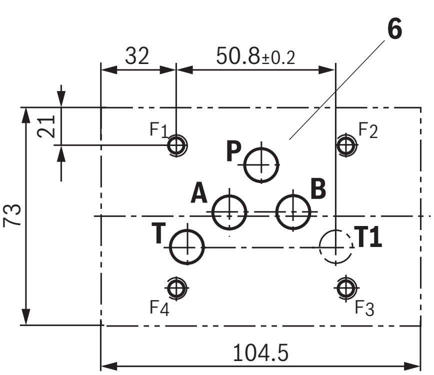
Notices:
The dimensions are nominal dimensions which are subject to tolerances.

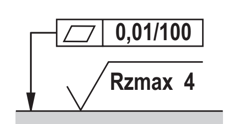
Valve mounting screws see page 21.

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 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 exists additionally
7 Space required to remove the mating connectors

Notices:
The dimensions are nominal dimensions which are subject to tolerances.

Valve mounting screws see page 21.

Dimensions

Valve mounting screws (separate order)

Size	Hexagon socket head cap screws	Material number
6	**4 hexagon socket head cap screws ISO 4762 - M5 x 30 - 10.9-N67F 821 70** (galvanized according to Bosch standard N67F821 70) Tightening torque M_A = 6^{+2} Nm	**2910151166**
10	**4 hexagon socket head cap screws ISO 4762 - M6 x 40 - 10.9-N67F 821 70** (galvanized according to Bosch standard N67F821 70) Tightening torque M_A = 11^{+3} Nm	**2910151209**

☞ **Notice:**
The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.

Accessories (separate order)

Mating connectors and cable sets

Port	Designation	Version	Short designation	Material number	Data sheet
XH2	Mating connector; for valves with round connector, 11-pole + PE	Metal, shielded	12PN11... EMC	**R901268000**	08006
		Plastic, two cable outlets	12PN11...2XD8	**R900884671**	
	Cable sets; for valves with round connector, 11-pole + PE	Metal, shielded, 5 m	12PN11REFS EMV...BG	**R901272854**	
		Metal, shielded, 20 m		**R901272852**	
		Plastic, shielded, 5 m	12PN11REFF 2X...	**R900032356**	
		Plastic, shielded, 20 m		**R900860399**	
X7E1, X7E2	Cable set; shielded, 4-pole, D coding	Straight connector M12, on straight connector M12, line cross-section 0.25 mm², CAT 5e, length freely selectable (= xx.x)	–	**R911172111** 1)	–
	Cable set; shielded, 4-pole	Straight connector M12, on straight connector RJ45, line cross-section 0.25 mm², CAT 5e, length freely selectable (= xx.x)	–	**R911172135** 2)	–
X2M1, X2M2	Cable set; shielded, 5-pole, for connecting Rexroth pressure sensors, type HM20, A coding	PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm², 0.6 m	–	**R901111709**	–
		PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm², 1.0 m	–	**R901111712**	–
		PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm², 2.0 m	–	**R901111713**	–
	Cable set; shielded, 5-pole, A coding	Straight connector M12, on free line end, line cross-section 0.34 mm², 1.5 m	–	**R901111752**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm², 3.0 m	–	**R901111754**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm², 5.0 m	–	**R901111756**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm², 10.0 m	–	**R913005147**	–
	Plug-in connector; 5-pole, M12 x 1, pins, A-coding	Metal (cable diameter 4 ... 6 mm2)	–	**R901075542**	–
X8M	Cable set; Shielded, 8-pole, A-coding (only SSI, 1Vss) 3)	Straight connector M12, on free line end, line cross-section 0.25 mm², 10 m	–	**R913002641**	–

1) Additional indication of type designation RKB0040/xx.x

2) Additional indication of type designation RKB0044/xx.x

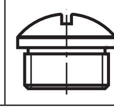
3) **Recommendation:** If an EnDat 2.2 sensor is used, please refer to the sensor manufacturer Heidenhain with respect to a cable set.

☞ **Notices:**

- Tighten the M12 connector with a manual torque wrench by 1 Nm.
- Self-locking M12 cables must be used.
- It must be ensured that cables are secured without radial forces.
- All cables connected to XH1, X7E1 and X7E2 must be bundled in a wire harness after 20cm the latest. The wire harness must be fixed after further 20 ... 30cm. Make sure that there is no relative motion between the fixation and the valve.
- Before the fixation point, there must not be any cable loops.
- In general, the information on installation provided by the cable manufacturers must be observed.
- Respectively, the cables of X2M1, X2M2 and X8M, if used, are also fixed as described above.
- For further information, see operating instructions 29391-B

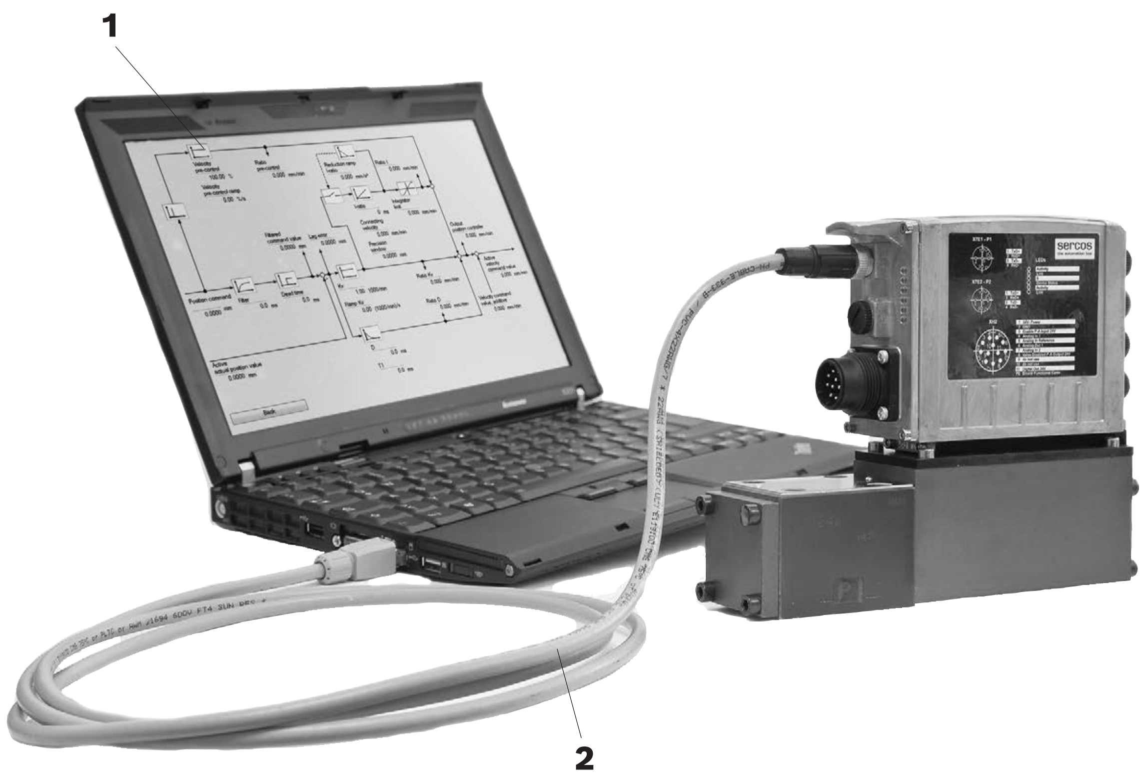
Accessories (separate order)

Protective cap

Protective cap M12	**Version**	**Material number**
		**R901075563**

Parameterization

The following is required for the parameterization with PC		**Material number/download**
1 Commissioning software	IndraWorks, Indraworks D, Indraworks DS	
2 Connection cable, 3 m	Shielded, M12 on RJ45, length can be freely selected (= xx.x)	**R911172135** (additional indication of type designation RKB0044/xx.x)



Project planning and maintenance instructions

- The supply voltage must be permanently connected; otherwise, bus communication is not possible.
- If electro-magnetic interference is to be expected, take appropriate measures to ensure the function (depending on the application, e.g. shielding, filtration).
- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices 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.

Further information

▶ Directional control valves, direct operated, with electrical position feedback and integrated electronics (OBE)	Data sheet 29035 and 29037
▶ Directional control valve with integrated digital axis controller (IAC-R) and field bus interface	Data sheet 29191
▶ Directional control valve with integrated digital axis controller (IAC-R) and clock synchronized PROFIBUS DP/V2 (PROFIdrive profile)	Data sheet 29291
▶ Directional control valve with integrated digital axis controller	Operating instructions 29391-B
▶ CE Declaration of Conformity	Upon request
▶ Subplates	Data sheet 45100
▶ Hydraulic fluids on mineral oil basis	Data sheet 90220
▶ Environmentally compatible hydraulic fluids	Data sheet 90221
▶ Flame-resistant, water-free hydraulic fluids	Data sheet 90222
▶ Hydraulic valves for industrial applications	Operating instructions 07600-B
▶ General product information on hydraulic products	Data sheet 07008
▶ Installation, commissioning and maintenance of servo valves and high-response valves	Data sheet 07700
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900
▶ Operation IAC-Multi-Ethernet electronics (xx = software version): – Functional description Rexroth HydraulicDrive HDx-xx – Parameter description Rexroth HydraulicDrive HDx-xx – Description of diagnosis Rexroth HydraulicDrive HDx-xx	
▶ Commissioning software and documentation on the Internet	
▶ Selection of filters	
▶ Information on available spare parts	

RE 29289
Edition: 2021-05
Replaces: 2017-09

rexroth
A Bosch Company

Directional control valve, pilot-operated, with integrated digital axis controller (IAC-Multi-Ethernet)

Type 4WRLD


H8073

- Sizes 10 ... 35
- Component series 4X
- Maximum operating pressure of 350 bar (ports P, A, B)
- Rated flow 60 ... 1500 l/min (***Δp*** = 10 bar)

Features

- Open
  - Integrated digital axis control functionality (IAC-Multi-Ethernet)
  - Bus connection/service interface (Sercos, EtherCAT, EtherNet/IP, PROFINET RT, POWERLINK, VARAN)
- Scalable
  - 2 configurable analog sensor inputs
  - 1 input for linear position measurement system (SSI, 1Vpp or EnDat 2.2)
- Precise
  - Best-in-class hydraulic controller
  - High response sensitivity and low hysteresis
- Safe
  - Internal safety function (can be used up to category 4/PL e according to EN 13849-1)
  - CE conformity according to EMC Directive 2014/30/EU

Contents

Ordering code

01	02	03	04	05	06	07	08		09		10	11		12	13	14	15	16
4	WRL	D						–	4X	/			/	24		D6		*

01	4 main ports	**4**
02	Directional control valve, pilot-operated	**WRL**
03	With integrated digital axis controller	**D**
04	Size 10	**10**
	Size 16	**16**
	Size 25	**25**
	Size 27	**27**
	Size 35	**35**
05	Symbols; possible version see page 4	

Rated flow at 10 bar pressure differential (5 bar/control edge)

06	**– Size 10**	
	60 l/min (only symbol E, E1-, W6-, W8-, V and V1-)	**60**
	100 l/min	**100**
	– Size 16	
	200 l/min (only symbol W6- and W8-)	**200**
	250 l/min (only symbol E, E1-, V, V1- and Q3)	**250**
	– Size 25	
	350 l/min (only symbol W6- and W8-) [1)]	**350**
	400 l/min (only symbol E, E1-, V, V1- and Q3)	**400**
	– Size 27	
	430 l/min (only symbol W6- and W8-) [1)]	**430**
	600 l/min (only symbol E, E1-, V, V1- and Q3)	**600**
	– Size 35	
	1000 l/min (only symbol E, E1-, V and V1-)	**1000**
	1200 l/min (only symbol W6- and W8-) [1)]	**1200**
	1500 l/min (only symbol E, E1-, V, V1- and Q3-)	**1500**

Flow characteristic

07	Linear	**L**
	Linear with fine control range (only NG10; other sizes on request)	**P**
	Progressive with linear fine control range (only symbols Q3-)	**M**
08	**Without** overlap jump (only symbols V, V1- and Q3)	**no code**
	With overlap jump (opening point 5% with covered valve; only symbols E, E1-, W6-, W8-)	**J**
09	Component series 40 … 49 (40 … 49: unchanged installation and mounting dimensions)	**4X**

Seal material (observe compatibility of seals with hydraulic fluid used, see page 10)

10	NBR seals	**M**
	FKM seals	**V**

Pilot oil flow

11	External pilot oil supply, external pilot oil return	**XY**
	Internal pilot oil supply, external pilot oil return	**PY**
	Internal pilot oil supply; internal pilot oil return	**PT**
	External pilot oil supply, internal pilot oil return	**XT**
12	Supply voltage 24 V	**24**

1) Higher rated flow upon request

Ordering code

01	02	03	04	05	06	07	08		09		10	11		12	13	14	15	16
4	**WRL**	**D**						**–**	**4X**	**/**			**/**	**24**		**D6**		*****

Ethernet interface

13	EtherNET/IP	**E**
	PROFINET RT	**N**
	Sercos	**S**
	EtherCAT (CANopen profile)	**T**
	POWERLINK (CANopen profile)	**W**
	VARAN	**V**

Electrical interface

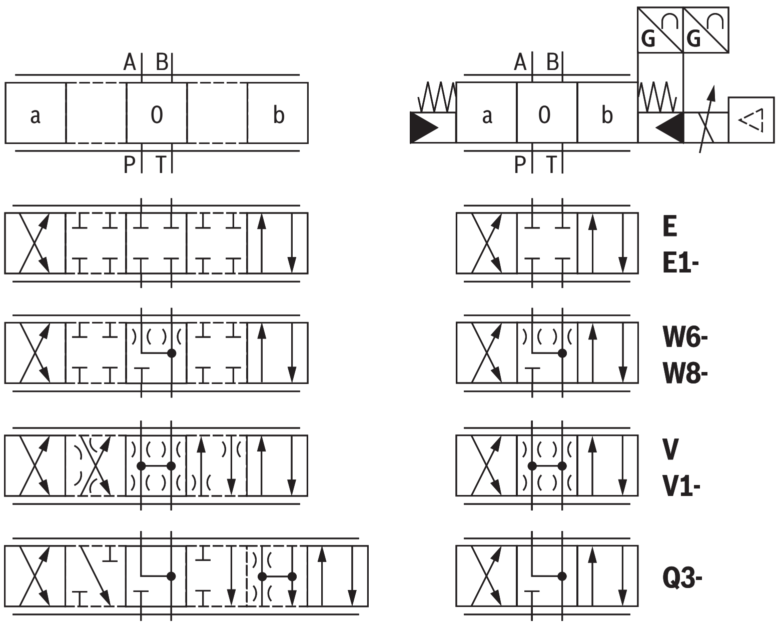
14	±10 VDC or 4 ... 20 mA	**D6**

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/1Vpp	**U**

16	Further details in the plain text	*****

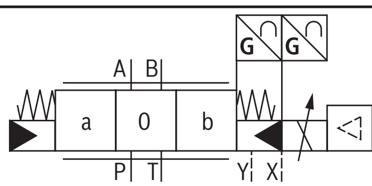
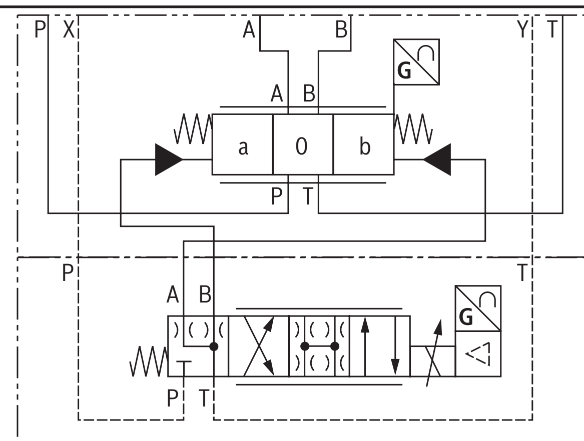
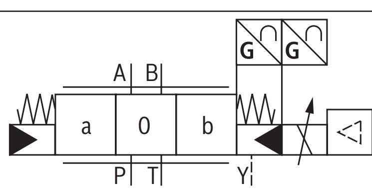
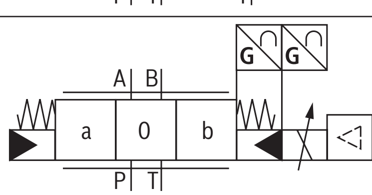
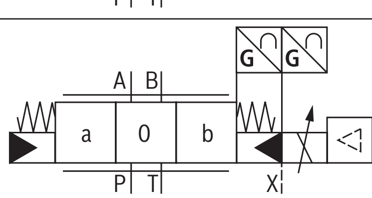
Symbols



With symbol E1–, V1– and W8–:

P → A: $q_{V\,max}$ B → T: $q_V/2$

P → B: $q_V/2$ A → T: $q_{V\,max}$

Version	simple	detailed
"XY"		
"PY"		
"PT"		
"XT"		

Notice:
- Representation according to DIN ISO 1219-1.Hydraulic interim positions are shown by dashes.
- For information on the "switch-off behavior", refer to "Technical data" on page 10.
- Symbols V and V1 are not suitable for use in safety applications (no overlap).

Function

General

The pilot-operated **IAC-Multi-Ethernet** valve (**I**ntegrated **A**xis **C**ontroller based on directional control valves) is a digital directional control valve with integrated axis controller and the following functionalities:

- Position control
- Pressure/force control
- Closed-loop speed control
- Substitutional closed-loop control (position - pressure/force)
- Substitutional control (flow - pressure/force)
- pQ function (flow-controlled)

Among others, the following operating modes are possible:

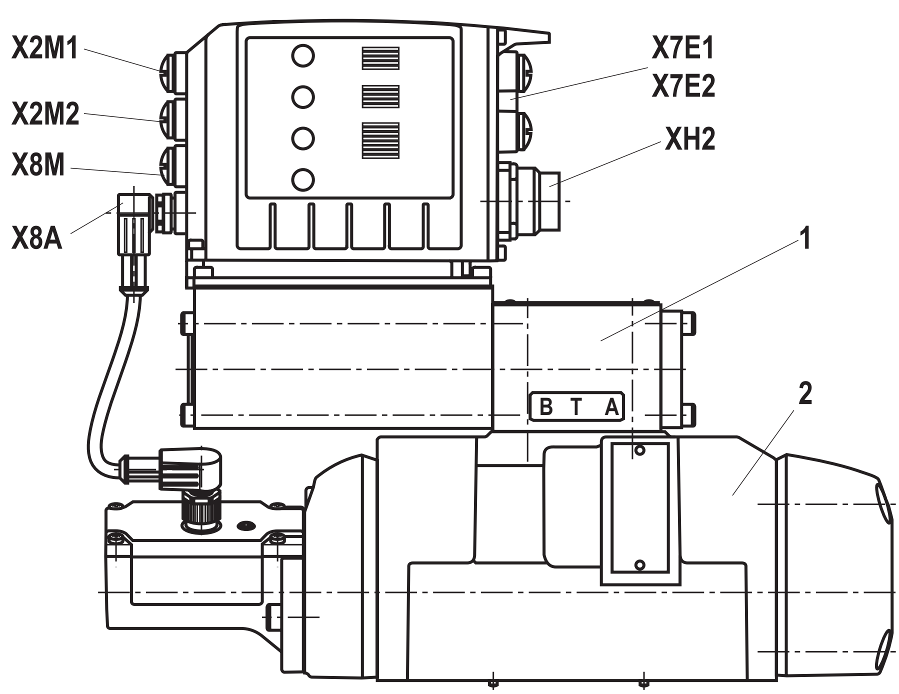
- Valve direct control
- Drive-controlled position control
- Drive-controlled positioning
- Positioning block operation

- The command values are preset 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 controller parameters are set via the Ethernet interface (X7E1 or X7E2)

Set-up

The directional control valve with IAC-Multi-Ethernet electronics mainly consists of:

- Pilot control valve (1) with control spool and sleeve in servo quality
- Main stage (2) with centering springs and position feedback
- Integrated digital axis controller (3) with:
  – analog/digital interface (XH2)
  – Ethernet interfaces (X7E1, X7E2)
  – analog sensor interfaces (X2M1, X2M2)
  – digital sensor interface (X8M)
  – interface for the position transducer of the main stage (X8A)



Function

Function (symbol V, V1- and Q3)
When the control solenoid of the pilot control valve is de-energized, its spring-operated control spool is in the "fail safe" position. The control spool of the main valve is in the spring-centered offset position at approx. 6% of the stroke in direction P→B/A→T.
The integrated electronics (OBE) compare the specified command value to the position actual value of the control spool of the main stage. In case of a control deviation, the control solenoid of the pilot control valve is activated and its control spool is adjusted.
The flow which is activated via the control cross-sections at the pilot control valve leads to an adjustment of the control spool of the main valve. The stroke/control cross-section of the main valve is regulated proportionally to the command value. In case of a command value presetting of 0%, the electronics adjust the control spool of the main valve to central position.
The pilot oil supply in the pilot control valve is either internal via port P or external via port X. The feedback can be internal via port T or external via port Y to the tank.

Switching off the release (symbol V and V1-)
If the supply voltage fails or in case of cable break, the integrated electronics will de-energize the control solenoid, the pilot control spool will move to the fail-safe position and will unload the pilot oil chambers of the main valve. Operated by the spring, the main valve control spool will move to the offset position (approx. 6% P→B/A→T).

Function (symbol E. and W.)
When the control solenoid of the pilot control valve is de-energized, its spring-operated control spool is in the "fail safe" position. The control spool of the main valve is in spring-centered central position.
The integrated electronics (OBE) compare the specified command value to the position actual value of the control spool of the main stage. In case of a control deviation, the control solenoid of the pilot control valve is activated and its control spool is adjusted.
The flow which is activated via the control cross-sections at the pilot control valve leads to an adjustment of the control spool of the main valve. The stroke/control cross-section of the main valve is regulated proportionally to the command value.
The pilot oil supply in the pilot control valve is either internal via port P or external via port X. The feedback can be internal via port T or external via port Y to the tank.

Switching off the release (symbol E. and W.)
If the supply voltage fails or in case of cable break, the integrated electronics will de-energize the control solenoid, the pilot control spool will move to the fail-safe position and will unload the pilot oil chambers of the main valve. Operated by the spring, the main valve control spool will move to the central position.

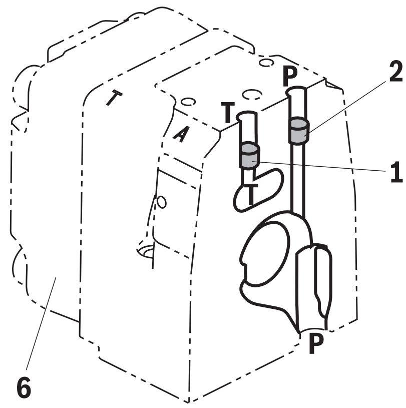
Monitoring
The digital control electronics enable comprehensive monitoring functions/error detection including:
- Undervoltage
- Communication error
- Cable break for analog sensor inputs and digital position measurement system
- Short-circuit monitoring for analog/digital outputs
- Monitoring of the microcontroller (watchdog)
- Temperature of the integrated electronics

IndraWorks DS PC program
To implement the project planning task and to parameterize the IAC-Multi-Ethernet valves, the user may use the IndraWorks DS engineering tool (see accessories):
- Project planning
- Parameterization
- Commissioning
- Diagnosis
- Comfortable administration of all data on a PC
- PC operating systems: Windows XP (SP3), Windows 7-10

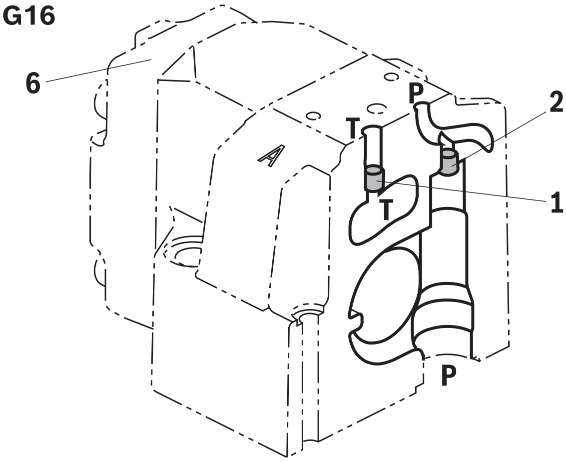
☞ **Notices:**
- Symbol V and V1-:
  Pilot-operated 4/3 directional control valves are only functional in the active control loop and do not have a locking basic position when deactivated.
  Consequently, "external isolator valves" are required in many applications and must be taken into account regarding the switch-on/switch-off order.
  While the electrical supply voltage is being switched off, the drive may be accelerated for a short time in functional direction P → B.
- Symbol E. and W.:
  Pilot-operated 4/3 directional control valves with positive overlap are functional in controlled or regulated axes. The overlap in the de-energized state is approx. 20% of the control spool stroke.
  While the release is being switched off, the drive may be accelerated for a short time in functional direction P → B. (For further details, please refer to operating instructions 29391-B)

Pilot oil supply (schematic illustration)

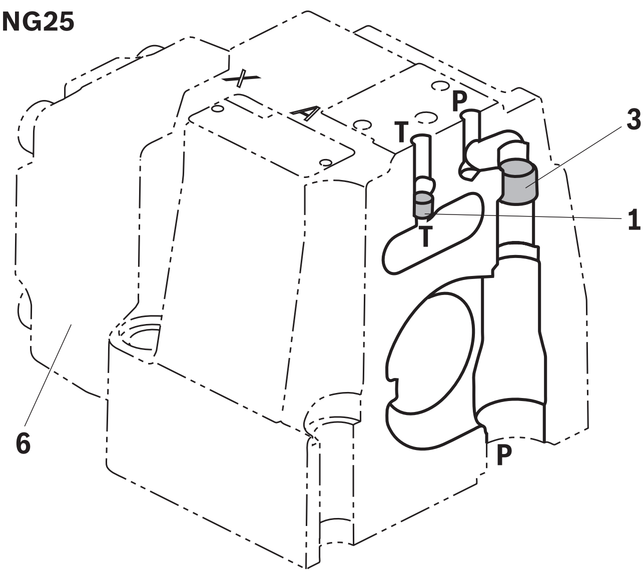
NG10



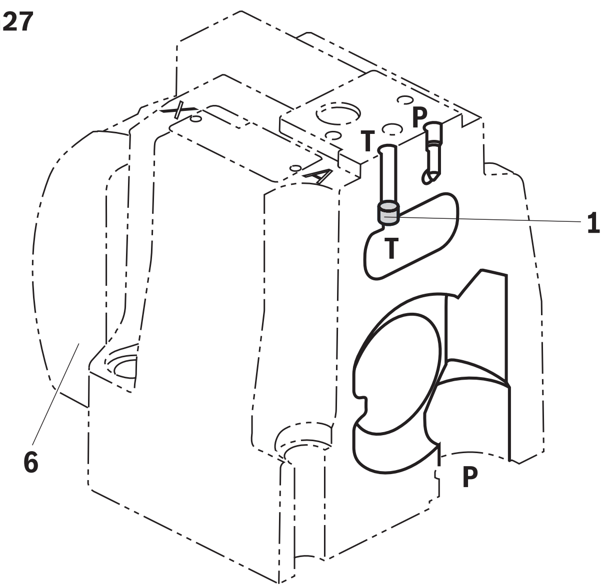
NG16



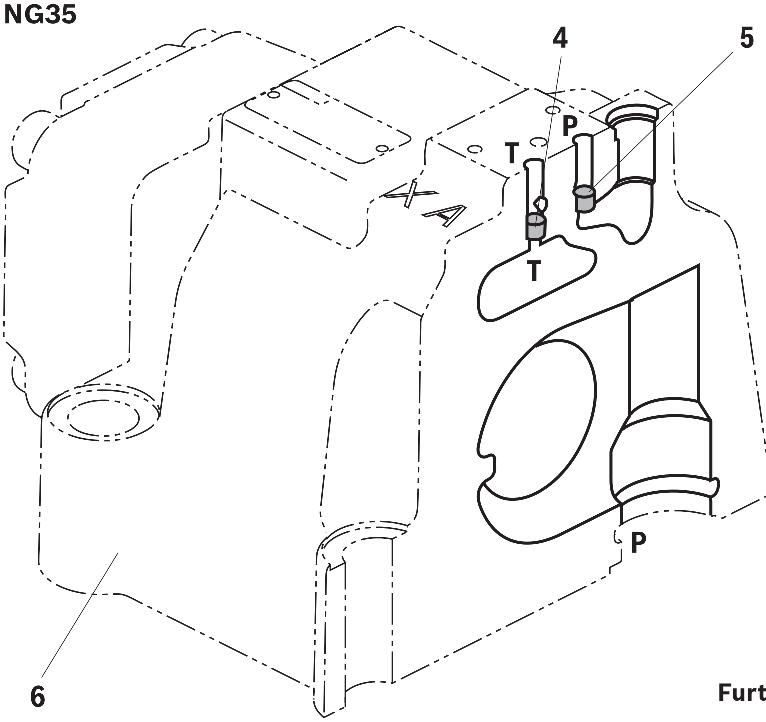
NG25



NG27



NG35



1 Plug screw M6 according to DIN 906, wrench size 3 – pilot oil return

2 Plug screw M6 according to DIN 906, wrench size 3 –pilot oil supply

3 Plug screw M12 x 1.5 according to DIN 906, wrench size 6 –pilot oil supply

4 Plug screw 1/16-27 NPTF, SW4 – pilot oil return

5 Plug screw 1/16-27 NPTF, SW4 –pilot oil supply

6 Housing cover main stage (position transducer side)

Pilot oil supply

External: **2, 3, 5** closed

Internal: **2, 3, 5** open

Pilot oil return

External: **1, 4** closed

Internal: **1, 4** open

Further explanations on page 8.

Pilot oil supply

Version "XY"
External pilot oil supply
External pilot oil return
In this version, the pilot oil is supplied from a separate control circuit (external).
The pilot oil return is not directed into channel T of the main valve but is separately directed to the tank via port Y (external).

Version "PY"
Internal pilot oil supply
External pilot oil return
With this version, the pilot oil is supplied from channel P of the main valve (internal).
The pilot oil return is not directed into channel T of the main valve but is separately directed to the tank via port Y (external).
In the subplate, port X is to be closed.

Version "PT"
Internal pilot oil supply
Internal pilot oil return
With this version, the pilot oil is supplied from channel P of the main valve (internal).
The pilot oil is directly returned to channel T of the main valve (internal).
In the subplate, ports X and Y are to be closed.

Version "XT"
External pilot oil supply
Internal pilot oil return
In this version, the pilot oil is supplied from a separate control circuit (external).
The pilot oil is directly returned to channel T of the main valve (internal).
In the subplate, port Y is to be closed.

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

General							
Size		NG	10	16	25	27	35
Weight		kg	9	12	19	21	80
Installation position			any				
Ambient temperature range		°C	–20 ... +60				
Maximum solenoid surface temperature		°C	120 (individual operation)				
Maximum storage time		Years	1 (if the storage conditions are observed; refer to the operating instructions 07600-B)				
$MTTF_d$ value according to EN ISO 13849	▶ Hydraulic (category 1)	Years	75 (for further details, see operating instructions 29391-B)				
	▶ Hydraulic and electric (category 3 and 4, without power supply unit)	Years	70 (for further details, see operating instructions 29391-B)				
Vibration resistance	▶ Sine test according to DIN EN 60068-2-6		10 ... 2000 Hz/maximum of 10 g/10 cycles/3 axes				
	▶ Noise test according to DIN EN 60068-2-64		20 ... 2000 Hz / 10 g_{RMS} / 30 g peak / 30 min. / 3 axes				
	▶ Transport shock according to DIN EN 60068-2-27		15 g / 11 ms / 3 axes				
Maximum relative humidity (no condensation)		%	95				

Technical data

(For applications outside these values, please consult us!)

Hydraulic							
Size		NG	10	16	25	27	35
Maximum operating pressure	▶ Ports A, B, P						
	– External pilot oil supply	bar	350			270	350
	– Internal pilot oil supply	bar	280			270	280
	▶ Port X	bar	280			270	280
	▶ Ports T, Y	bar	250			210	250
Hydraulic fluid			see table page 10				
Hydraulic fluid temperature range (flown-through)		°C	−20 ... +70				
Viscosity range	▶ recommended	mm^2/s	30 ... 45				
	▶ maximum admissible	mm^2/s	20 ... 380				
Rated flow (***Δp*** = 5 bar/control edge) [1]		l/min	60/100	200/250	350/400	430/600	1000/1200/1500
Maximum flow		l/min	300	800	1250	1850	4700
Maximum leakage flow (inlet pressure 100 bar)	▶ Symbol E, E1-						
	– Main valve	l/min	0.06	0.13	0.17		0.61
	– Main valve + pilot control valve	l/min	0.14	0.28	0.42		1.01
	▶ Symbol W6-, W8-						
	– Main valve	l/min	0.12	0.26	0.35		1.23
	– Main valve + pilot control valve	l/min	0.2	0.41	0.6		1.63
Maximum zero flow (inlet pressure 100 bar)	▶ Symbol V, V1-						
	– Main valve	l/min	1.7	2.3	2.8	3.3	7.2
	– Main valve + pilot control valve	l/min	1.85	2.6	3.2	3.7	7.65
	▶ Symbol Q3-						
	– Main valve	l/min	0.4	1.6	1.8	2.2	1.6
	– Main valve + pilot control valve	l/min	0.55	1.9	2.2	2.6	2.05
Minimum pilot pressure (pilot control valve)		bar	10				
Pilot flow [2]	▶ Symbol E, W	l/min	2.4	3.5	7.5		23
	▶ Symbol V, Q3-	l/min	4.5	11.5	22		29
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [3]				

Flow unloading central position Δ***p*** = 5 bar/control edge			A→T	B→T	A→T	B→T	A→T	B→T	A→T	B→T	A→T	B→T
	▶ Symbol W6-	l/min	2.8	2.8	4	4	6	6	6	6	25	25
	▶ Symbol W8-	l/min	2.8	1.4	4	2	6	3	6	3	25	12.5

1) Flow for deviating ***Δp*** (valve pressure differential):

$$\boxed{q_x = q_{Vnom} \times \sqrt{\frac{\Delta p_x}{10}}}$$

2) At port X and Y with stepped input signal from 0 ... 100% (100 bar)

3) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and simultaneously increases the life cycle of the components.

Technical data

(For applications outside these values, please consult us!)

Hydraulic fluid		Classification	Suitable sealing materials	Standards	Data sheet
Mineral oils		HL, HLP, HLPD, HVLP, HVLPD	NBR, FKM	DIN 51524	90220
Bio-degradable	▶ Insoluble in water	HETG	FKM	ISO 15380	90221
		HEES	FKM		
	▶ Soluble in water	HEPG	FKM	ISO 15380	
Flame-resistant	▶ Water-free	HFDU (glycol base)	FKM	ISO 12922	90222
		HFDU (ester base)	FKM		
		HFDR	FKM		
	▶ Containing water	HFC (Fuchs: Hydrotherm 46M, Renosafe 500; Petrofer: Ultra Safe 620; Houghton: Safe 620; Union: Carbide HP5046)	NBR	ISO 12922	90223

Important information on hydraulic fluids:

- For further information and data on the use of other hydraulic fluids, please refer to the data sheets above or contact us.
- There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.).
- The ignition temperature of the hydraulic fluid used must be 50 K higher than the maximum surface temperature.
- **Bio-degradable and flame-resistant – containing water:** If components with galvanic zinc coating (e.g. version "J3" or "J5") or parts containing zinc are used, small amounts of dissolved zinc may get into the hydraulic system and cause accelerated aging of the hydraulic fluid. Zinc soap may form as a chemical reaction product, which may clog filters, nozzles and solenoid valves – particularly in connection with local heat input.
- **Flame-resistant – containing water:**
  - Due to the increased cavitation tendency with HFC hydraulic fluids, the life cycle of the component may be reduced by up to 30% as compared to the use with mineral oil HLP. In order to reduce the cavitation effect, it is recommended – if possible specific to the installation – backing up the return flow pressure in ports T to approx. 20% of the pressure differential at the component.
  - Dependent on the hydraulic fluid used, the maximum environment and hydraulic fluid temperature must not exceed 50 °C. In order to reduce the heat input into the component, the command value profile is to be adjusted for proportional and high-response valves.

Static/dynamic							
Size		NG	10	16	25	27	35
Hysteresis		%	< 0.1				
Range of inversion		%	< 0.08				
Response sensitivity		%	< 0.05				
Manufacturing tolerance q_{Vmax}		%	≤ 10				
Temperature drift (temperature range 20 °C ... 80 °C)		%/10 °C	Zero shift < 0.25				
Zero compensation (ex plant)		%	±1				
Actuating time for 0 ... 100% at X=100 bar	▶ Symbols E, E1-, W6-, W8-	ms	40	60	60	60	90
Switch-off behavior (after electric shut-off)	▶ Symbols E, E1-, W6-, W8-		Pilot control valve in fail-safe position, main valve moves to overlapped spring-centered central position				
	▶ Symbol V, V1-		Pilot control valve in fail-safe position, main valve moves to spring-centered "offset position" (approx. 6%, P→B/A→T)				
	▶ Symbol Q3		Pilot control valve in fail-safe position, main valve moves to spring-centered "offset position" (P blocked, A/B to port T open)				

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

Electrical, integrated electronics (OBE)			
Supply voltage [4; 5]	▶ 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)
Current consumption	▶ Maximum [6]	A	2.5
	▶ Impulse current	A	4
Maximum power consumption		W	40
Relative duty cycle		%	100 (continuous operation)
Protection class according to EN 60529			IP 65 with mounted and locked plug-in connectors
Required fuse protection, external		A	4, time-lag
Protective grounding conductor and screening			see connector pin assignment (CE-compliant installation) page 15 and 16
Adjustment			calibrated in the plant, see characteristic curves page 18 ... 30
Booting time		s	< 15
Scan time pressure and force controller (minimum)		ms	0.5
Scan time position controller (minimum)		ms	1
AD/DA resolution	▶ Analog inputs	Bit	12
	▶ Analog output	Bit	12
Parameterization interface			Ethernet
Conformity			CE according to EMC directive 2004/108/EC tested according to EN 61000-6-2 and EN 61000-6-3
Digital inputs XH2	▶ Quantity		optionally up to 2, configurable (analog inputs are omitted)
	▶ Low level	V	–3 ... 5
	▶ High level	V	15 ... U_B
	▶ Current consumption at high level	mA	< 1
	▶ Reference potential		Pin 5
Digital outputs XH2	▶ Quantity		1
	▶ Low level	V	0 ... 3
	▶ High level	V	15 ... U_B
	▶ Current carrying capacity	A	1.5 (short-circuit-proof)
	▶ Signal delay time	ms	< 2 (depending on set scan time)
	▶ Reference potential		GND
Analog inputs XH2	▶ Number (current and voltage input parameterizable)		optionally up to 2, configurable (digital inputs are no longer required)
	▶ AD resolution	bit	12
	▶ Voltage inputs (differential inputs) – Measurement range	V	–10 ... +10
	– Input resistance	kΩ	80 +10%
	– Temperature drift		< 14 mV / 10 K
	▶ Current inputs (reference to AGND) – Input current		4 ... 20 (0 ... 20 physically)
	– Input resistance	Ω	200, measuring resistance plus FET
	– Temperature drift		< 25 µA / 10 K

4) Supply voltage is used directly for sensor connections X2M1, X2M2 and X8M (no internal voltage limitation)

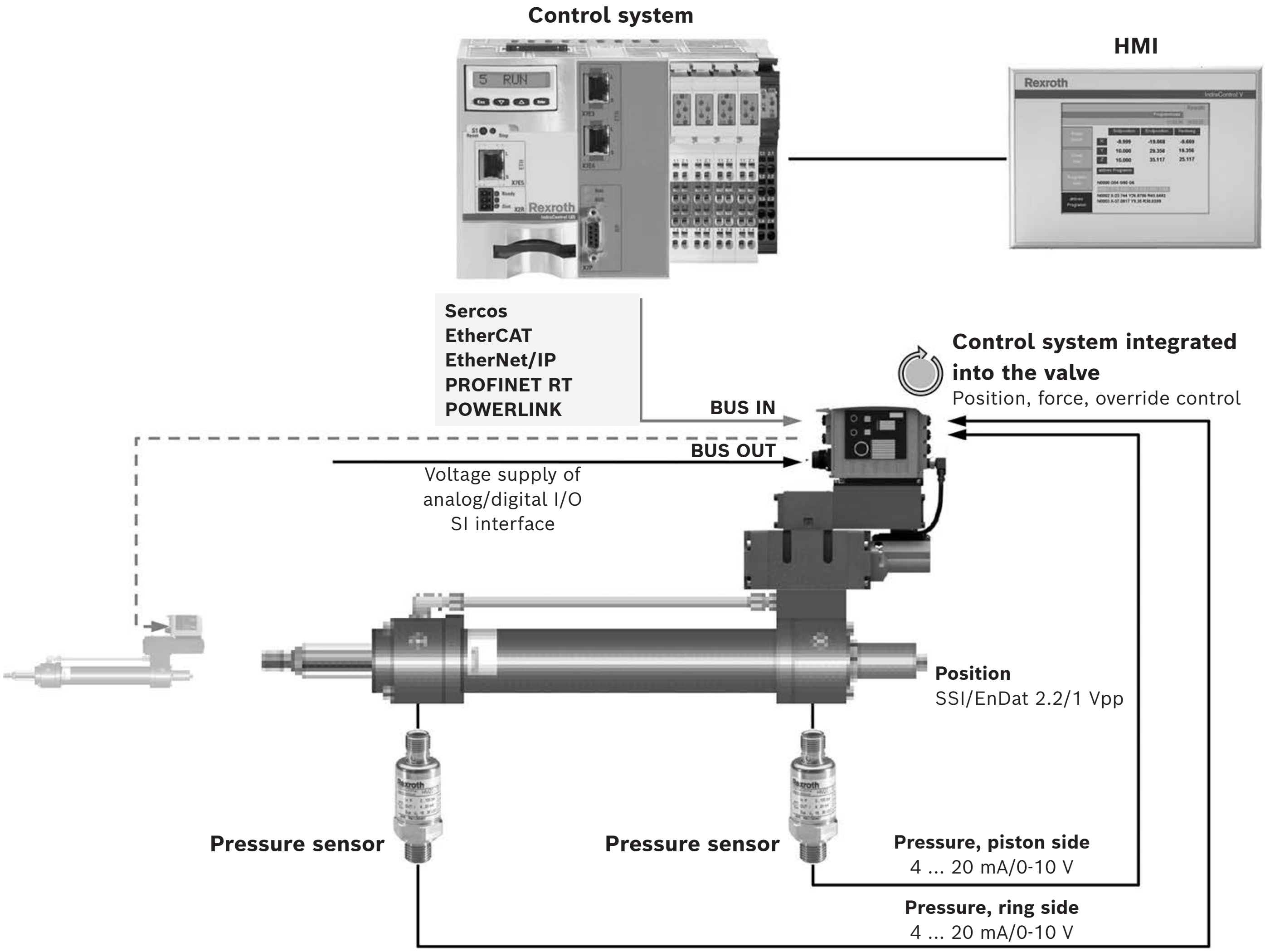
5) Voltage limit values must be observed directly at the connector of the valve (observe line length and cable cross-section!)

6) When using the sensor inputs or the switching output, the maximum current consumption will increase according to the external load

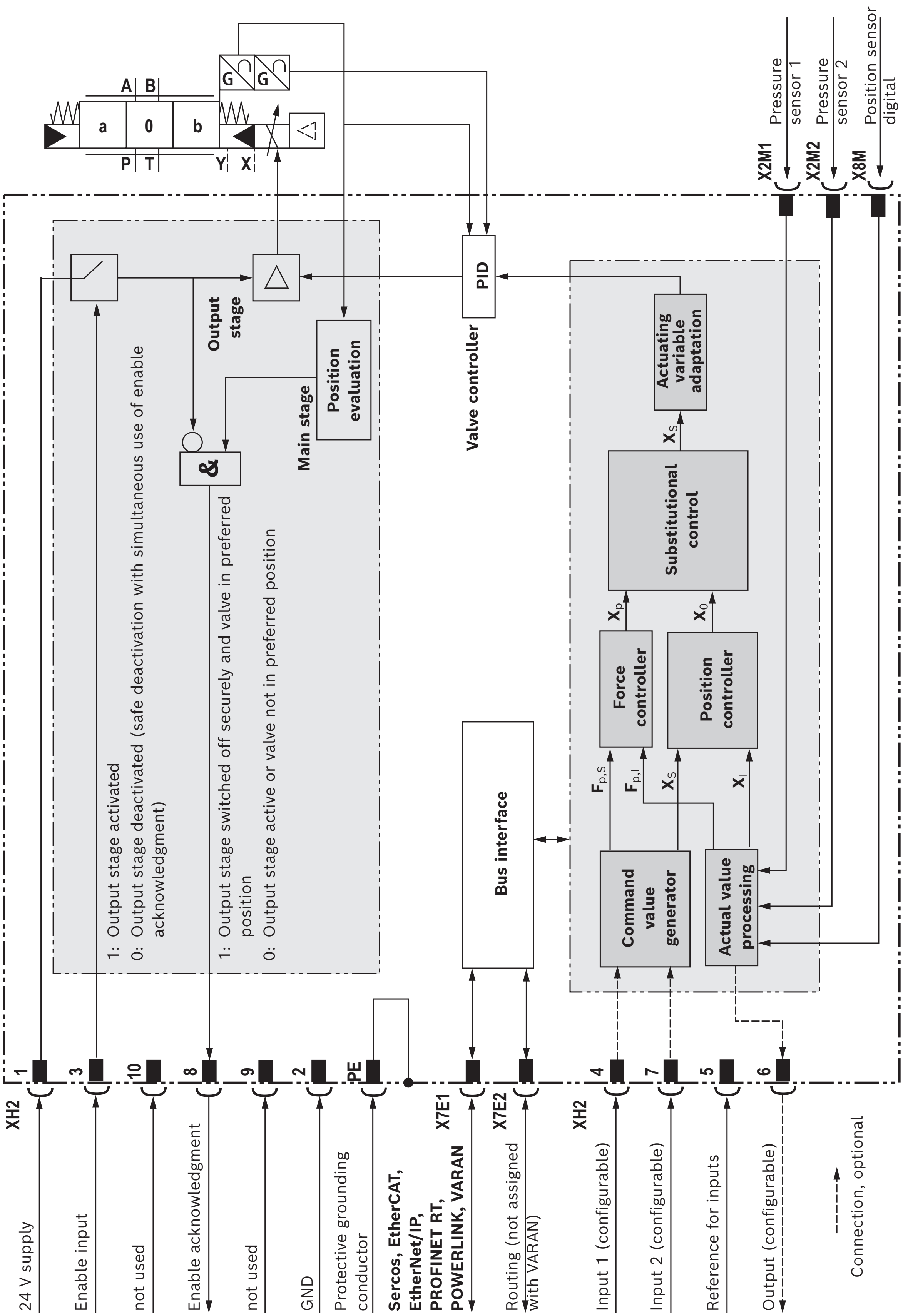
Technical data
(For applications outside these values, please consult us!)

Analog outputs XH2	▶ Number (current and voltage input parameterizable)		1
	▶ DA resolution	bit	12
	▶ Voltage outputs – Output range	V	−10 ... +10 (0 ... 10 by software)
	– Minimum load impedance	kΩ	10
	– Temperature drift		< 5 mV / 10 K
	▶ Current outputs – Output range	mA	0 ... 20 (4 ... 20 by software)
	– Maximum load	Ω	200
Analog sensors X2M1, X2M2	▶ Number (current and voltage input configurable)		1 per connector
	▶ Supply voltage	V	24 (corresponding to supply voltage applied to XH2)
	▶ Maximum supply current	mA	350 (sum X2M1, X2M2 and X8M)
	▶ AD resolution	bit	12
	▶ Voltage inputs – Measurement range	V	0 ... 10
	– Input resistance	kΩ	80 +10%
	– Temperature drift		< 15 mV / 10 K
	▶ Current inputs (reference to AGND) – Input current		4...20 (0...20 physically)
	– Input resistance	Ω	200, measuring resistance plus PTC
	– Temperature drift		< 10 µA / 10 K
Digital sensor X8M	▶ Supply voltage		24 V or 5 V
	▶ Maximum supply current – 24 V	mA	350 (sum X2M1, X2M2 and X8M)
	– 5 V	mA	250
	▶ SSI transducer – Coding		Gray
	– Data width		12 ... 28 bit
	– Transfer frequency		80 kHz ... 1 MHz
	– Line receiver / driver		RS485
	▶ Endat encoder		2.2
	– Line receiver / driver		RS485
	– Resolution		minimum 10 nm and multiple
	▶ 1Vpp-encoder – Transfer frequency	kHz	250

Representation of the axis controller in the system network



Block diagram/controller function block



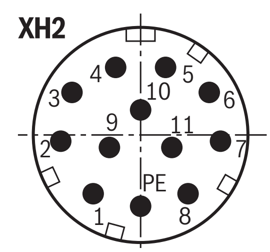
Detailed description of the safety function:
After the signal at the enable input has been removed, the output stage, and thus the solenoid of the valve, are internally separated from the available supply voltage. The enable acknowledgment will only be activated after the safe valve spool position has been achieved. For a detailed description of the safety function, refer to the operating instructions 29391-B.

Electrical connections, assignment

Connector pin assignment XH2, 11-pole + PE according to EN 175201-804

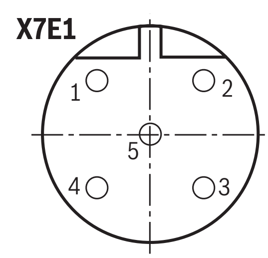
Pin	Core marking		Interface D6 assignment
	Cable, one-part [1]	Cable, split [2]	
1	1	1	24 V DC supply voltage
2	2	2	GND
3	3	white	Enable input 24 V DC (high ≥ 15 V; low < 2 V)
4	4	yellow	Command values 1 (4 ... 20 mA/±10 V) [3]
5	5	green	Reference for command values
6	6	violet	Actual value (4 ... 20 mA/±10 V) [3; 4]
7	7	pink	Command value 2 (4 ... 20 mA/±10 V) [3]
8	8	red	Enable acknowledgment 24 V DC (I_{max} 50 mA) [5]
9	9	brown	not used
10	10	black	not used
11	11	blue	Switching output 24 V, configurable (fault-free operation (24 V)/error (0V) or power circuit signal), maximum 1.5 A [3; 5]
PE	green-yellow	green-yellow	Functional ground (connected directly to metal housing)

1) Core marking of the connection lines for mating connector with cable set (see accessories, page 37, material numbers R901268000, R901272854, R901272852)
2) Core marking of the connection lines for mating connector with cable set (see accessories, page 37, material numbers R900884671, R900032356, R900860399)
3) Selection via commissioning software
4) For diagnostic purposes, precise actual value response via Ethernet interface
5) A load increases the current consumption on pin 1



Connector pin assignment for Ethernet interfaces "X7E1" and "X7E2" (coding D), M12, 4-pole, socket

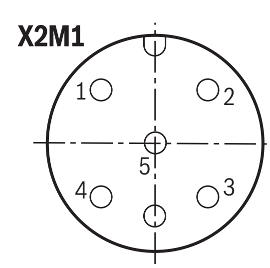
Pin	Assignment
1	TxD +
2	RxD +
3	TxD –
4	RxD –
5	not used



Analog configurable sensor interfaces, connections "X2M1", "X2M2" (coding A), M12, 5-pole, socket

Pin	Assignment
1	+24 V voltage output (sensor supply) [1; 2]
2	Sensor signal input current (4 ... 20 mA) [3]
3	GND
4	Sensor signal input voltage (0 ... 10 V) [3]
5	Negative differential amplifier input to pin 4 (optional)

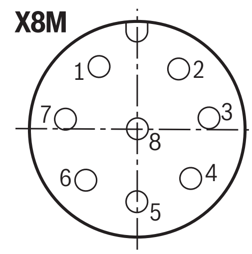
1) Voltage output same as voltage supply connected to input XH2. (Maximum load capacity see page 16)
2) A load increases the current consumption of the valve (pin 1 on the connector XH2)
3) Only one signal input per interface, configurable



Electrical connections, assignment

Digital sensor interface SSI, EnDat 2.2 or 1Vpp 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 3)	+5 V 3)	+5 V 3)
3	Data +	Data +	A +
4	Data –	Data –	A –
5	GND	GND	B +
6	Clock –	Clock –	B –
7	Clock +	Clock +	R +
8	+24 V 3)	+5 V 3)	R –

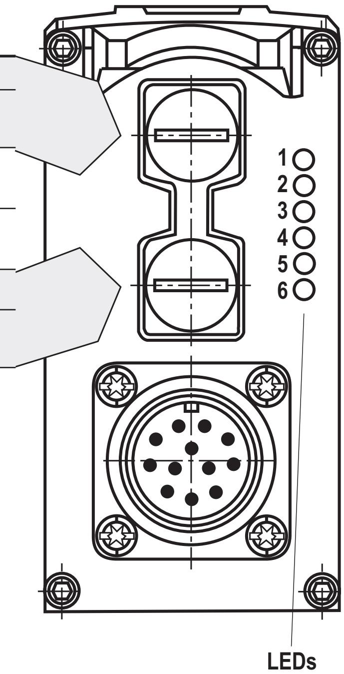


1) Pins 2, 8 and 1, 5 have the same assignment each
2) Supported resolution ≥ 10 nm
3) A load increases the current consumption of the valve (pin 1 on the connector XH2)

Notices:
- Reference potential for all signals: GND
- 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.

LED displays

LED	Interface	Sercos	EtherNET/IP	EtherCAT	PROFINET RT	POWERLINK	VARAN
1	**X7E1**	Activity	Activity	not used	Activity	not used	Active
2		Link	Link	Link/activity	Link	Link/data activity	Link
3	**Electronics module**	S	Network status	Network status	Network status	Status/error	Network status
4		Module status	Module status	Module status	Module status	Module status	Module status
5	**X7E2**	Activity	Activity	not used	Activity	not used	not used
6		Link	Link	Link/activity	Link	Link/data activity	not used



Displays of the status LEDs

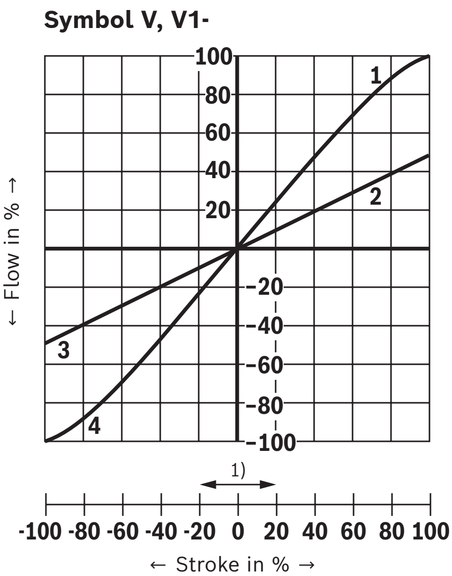
Module status LED (LED 4)	Display status
Aus	No voltage supply
Green-red, flashing	Initialization
Green, flashing	Drive ready for operation
Green	Drive active
Orange, flashing	Warning
Red, flashing	Error

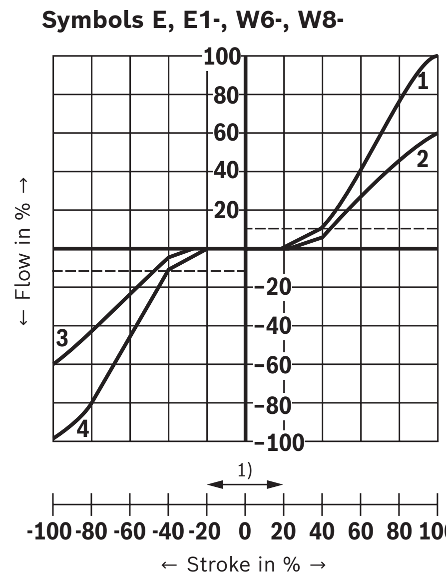
Network status LED (LED 3)	Display status
Aus	No voltage supply
Green	Operation

Notices:
- LEDs 1, 2, 5 and 6 relate to interfaces "X7E1" and "X7E2"
  - Link: Cable plugged in, connection established (permanently lit)
  - Activity: Data sent/received (flashing)
- Module status LEDs 3 and 4 relate to the electronics module
- For a detailed description of the diagnosis LEDs, please refer to the functional description Rexroth HydraulicDrive HDx.

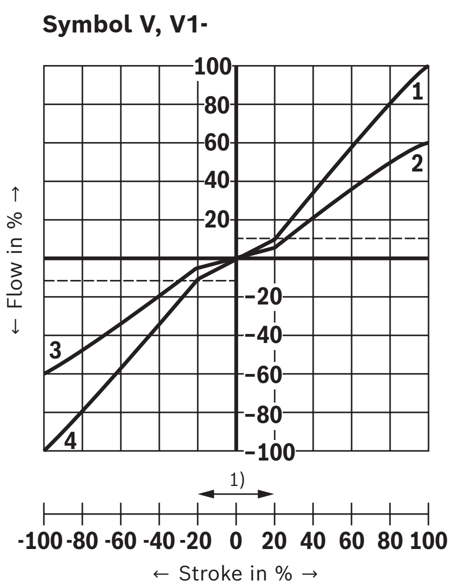
Characteristic curves: Flow characteristic "L" and "P" (measured with HLP46, ϑ_{oil} = 40 ±5 °C)

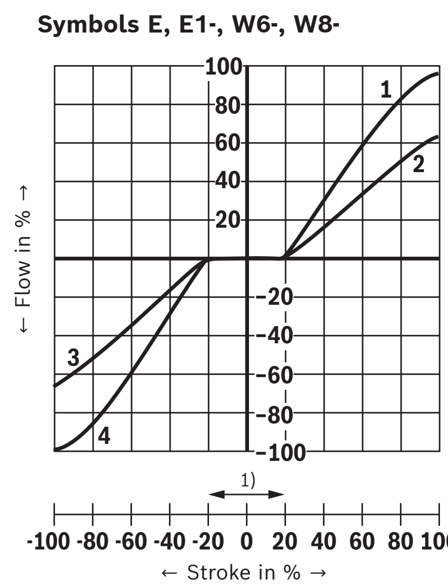
Flow/signal function – Version "L"





Flow/signal function – Version "P"



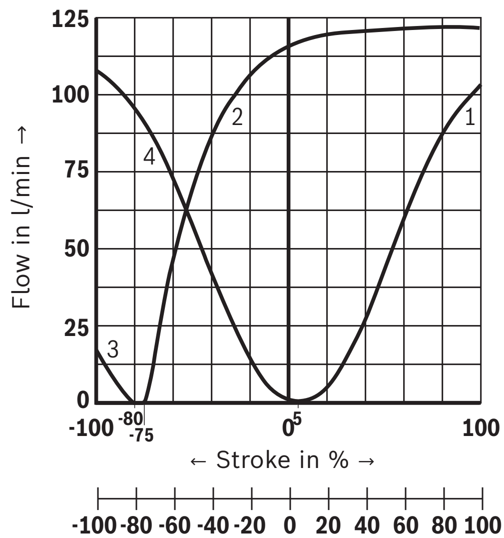


1 P–A; B–T (1:1)
2 B–T (2:1)
3 P–B (2:1)
4 P–B; A–T (1:1)
––– 10 % q_V

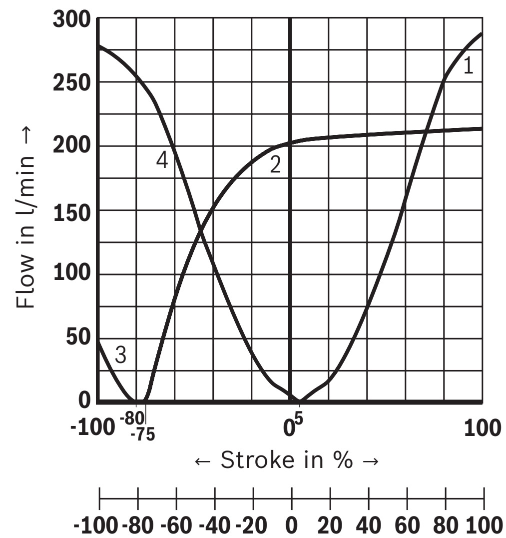
1) Step compensation (opening at 5%)

Characteristic curves: Flow characteristic "M"
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

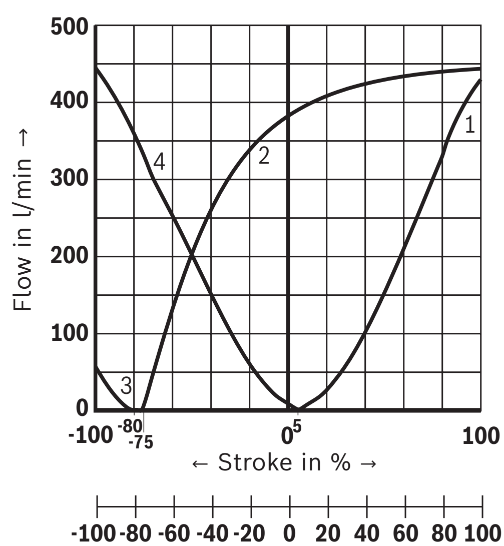
Symbol Q3, version "100"



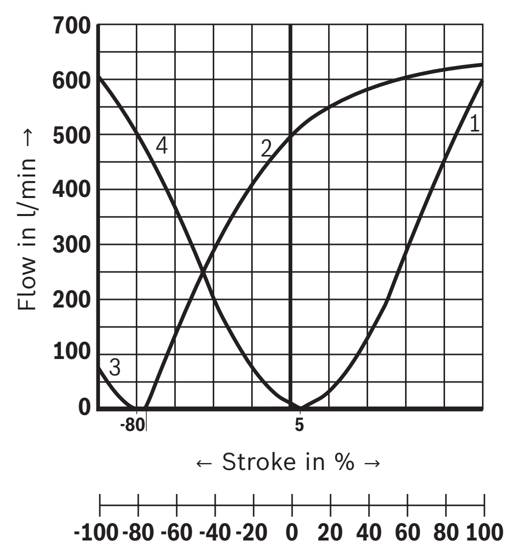
Symbol Q3, version "250"



Symbol Q3, version "400"



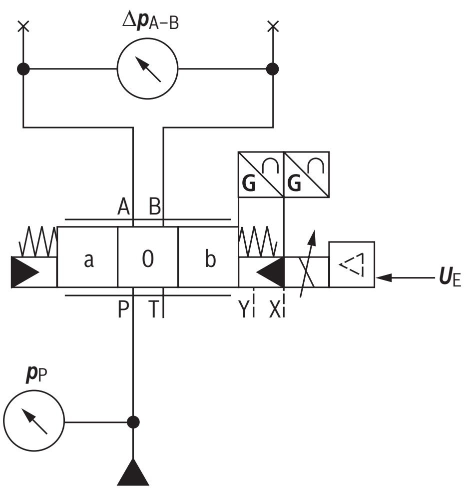
Symbol Q3, version "600"

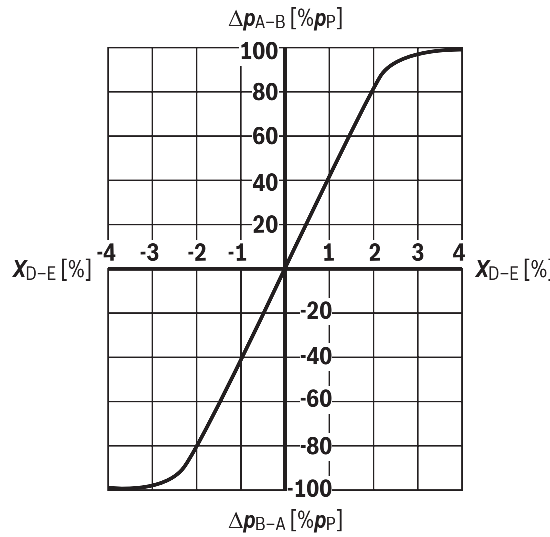


1 P–A
2 B–T
3 P–B
4 A–T

Characteristic curves
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Pressure amplification

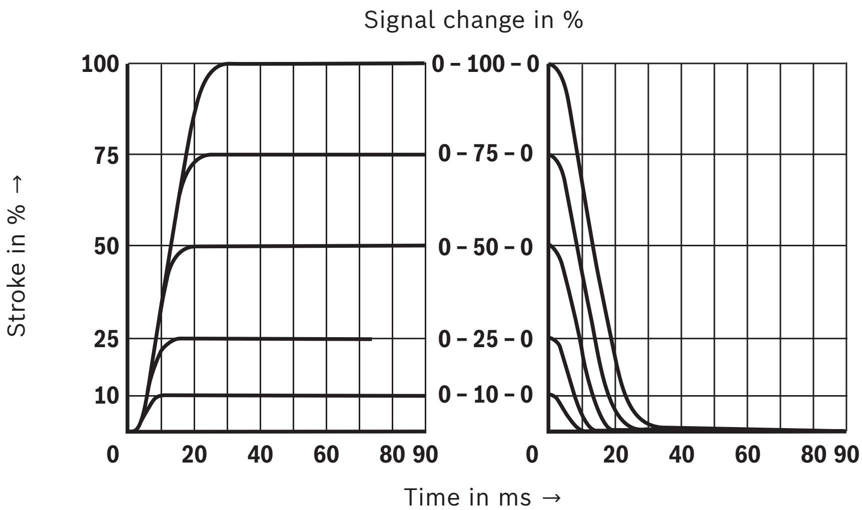




Characteristic curves: Size 10
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals

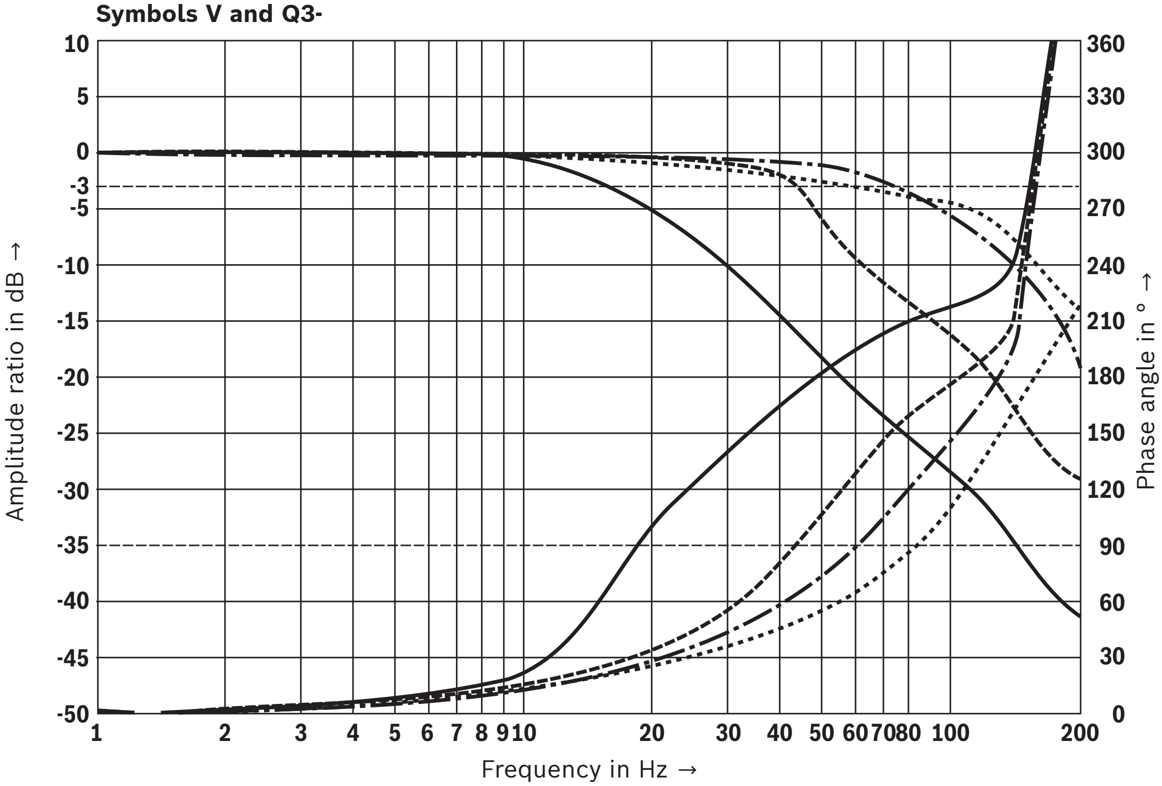
Symbols V and Q3-



- Pilot control valve, port X = 100 bar
- Main valve, port P = 10 bar

Frequency response

Symbols V and Q3-



Signal ±1%

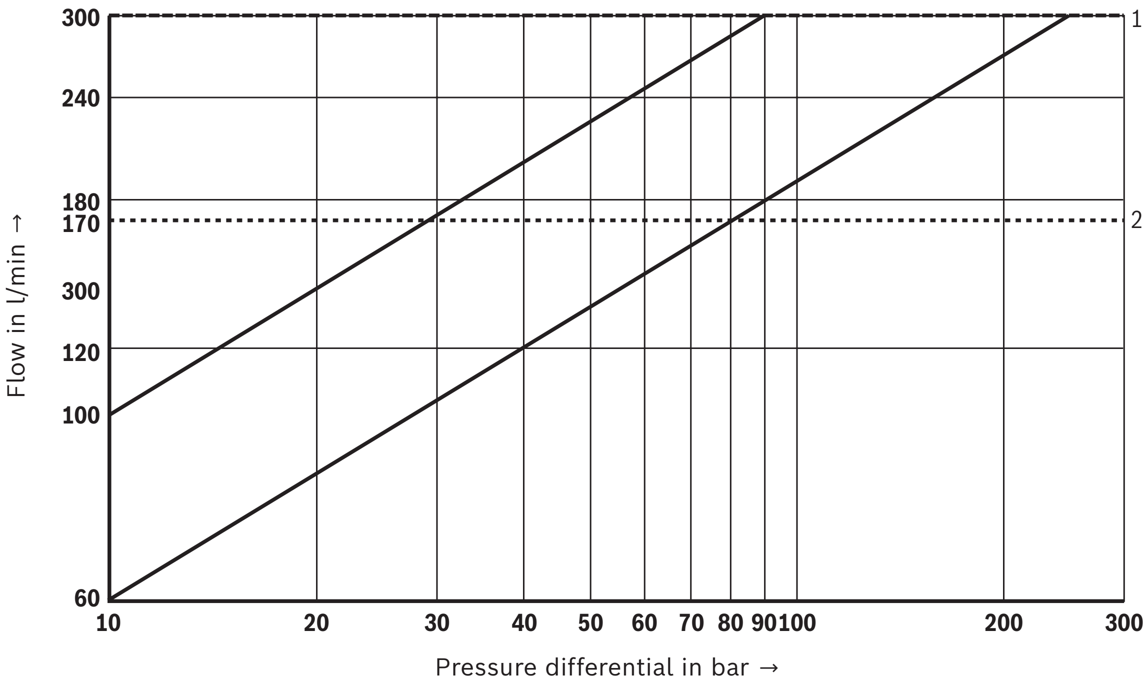
Signal ±5%

Signal ±25%

Signal ±100%

Characteristic curves: Size 10
(valid for HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/load function (with maximum valve opening; tolerance ±10%)

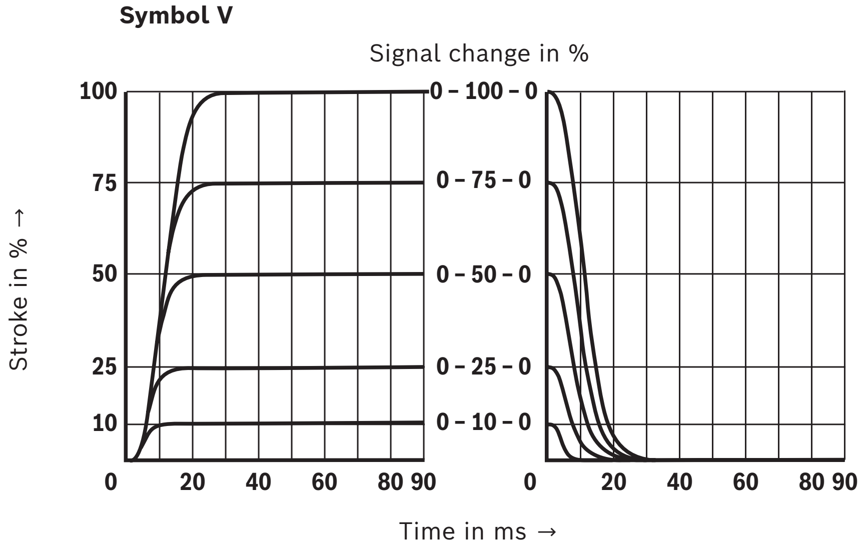


1 Maximum flow

2 Recommended flow
(flow velocity 30 m/s)

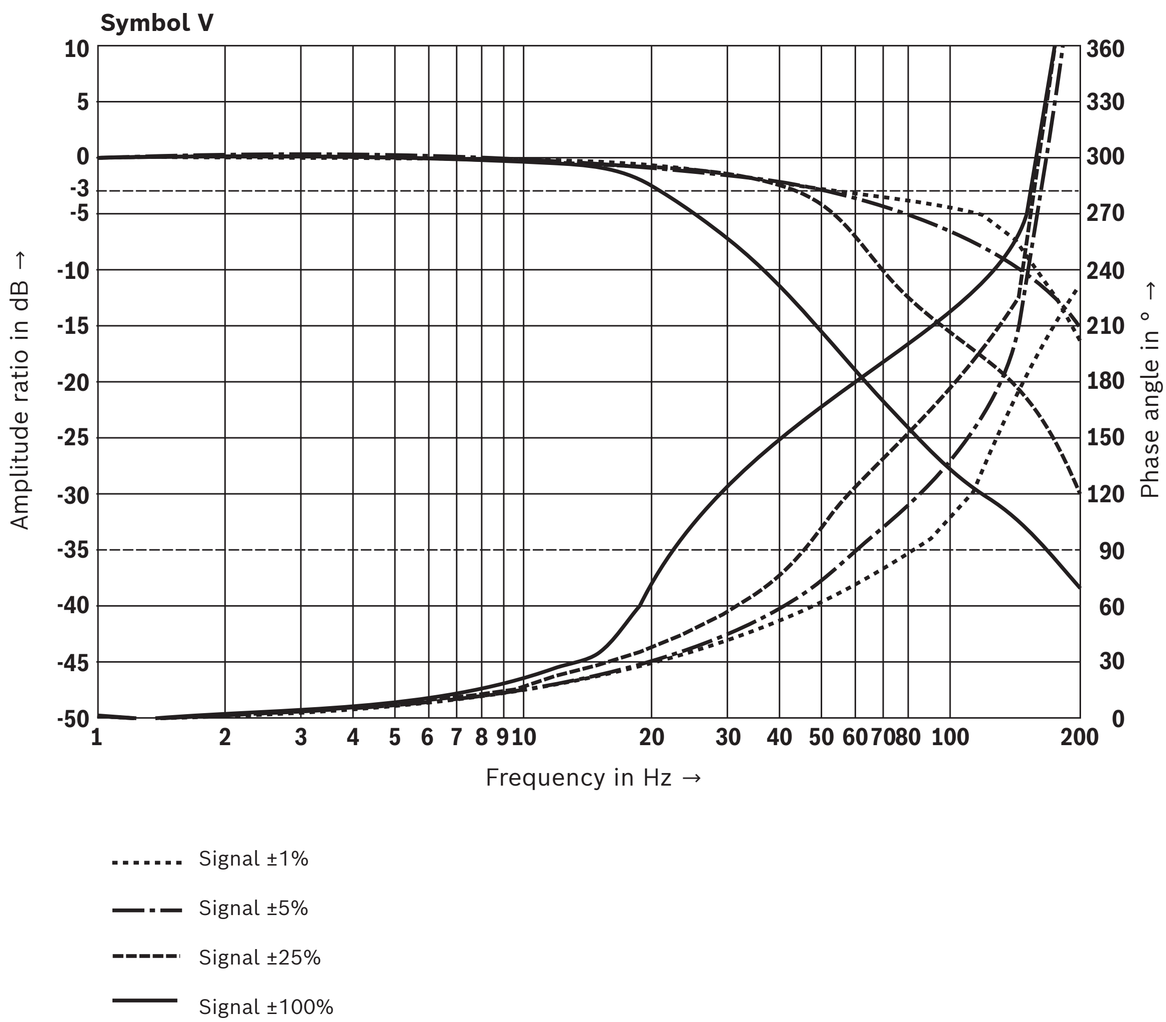
Characteristic curves: Size 16
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals



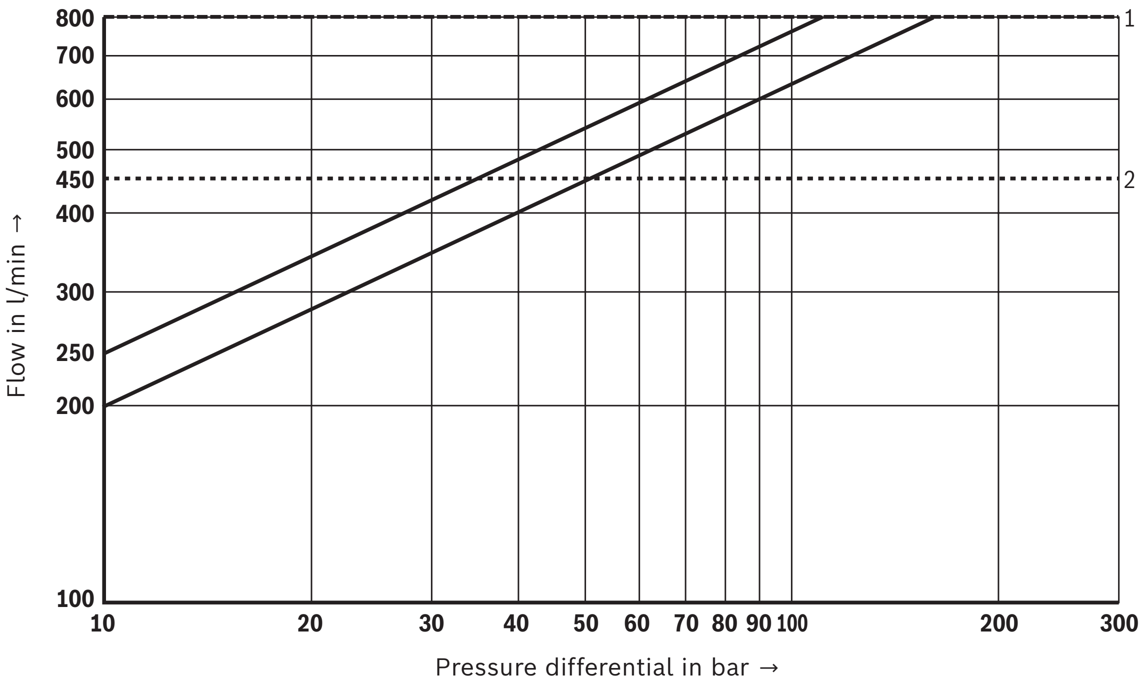
- Pilot control valve, port X = 100 bar
- Main valve, port P = 10 bar

Frequency response



Characteristic curves: Size 16
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/load function (with maximum valve opening; tolerance ±10%)

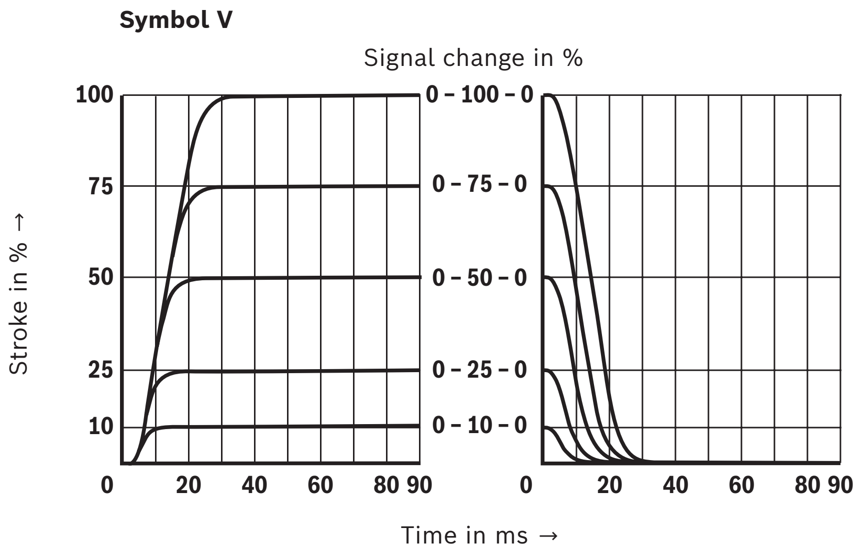


1 Maximum admissible flow

2 Recommended flow limitation (flow velocity 30 m/s)

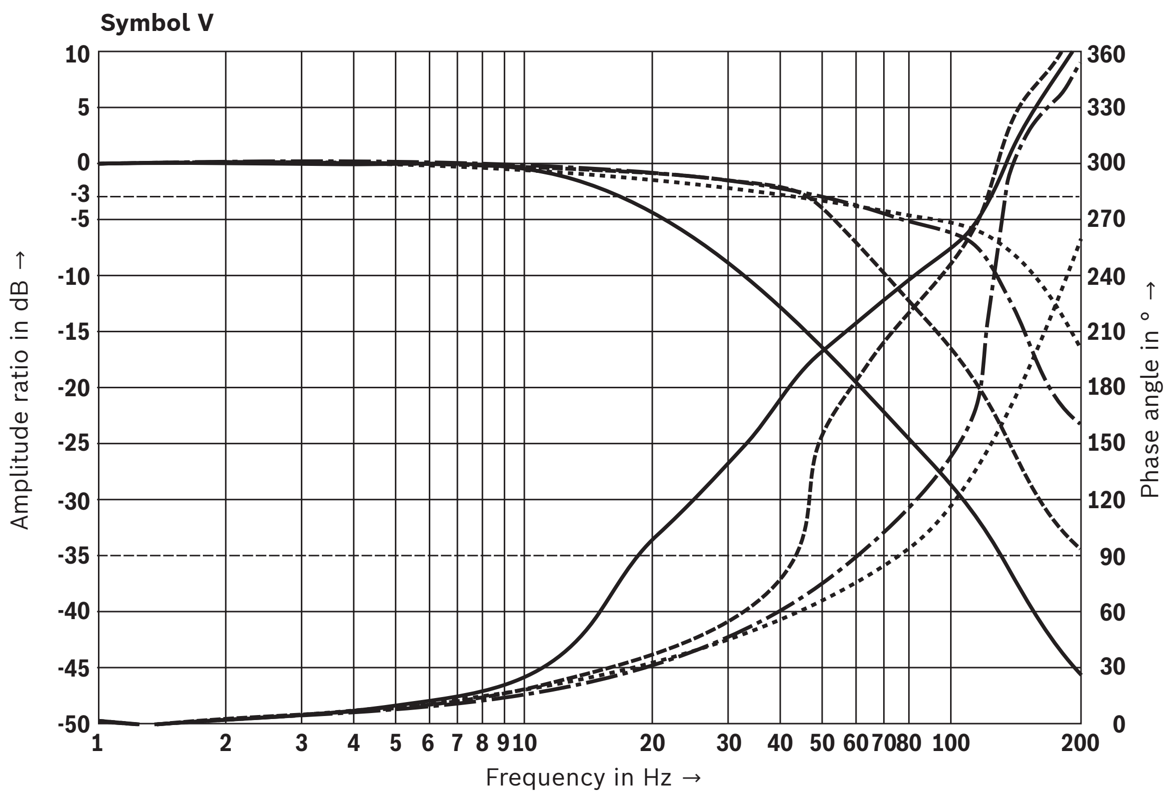
Characteristic curves: Size 25
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals



- Pilot control valve, port X = 100 bar
- Main valve, port P = 10 bar

Frequency response



Signal ±1%

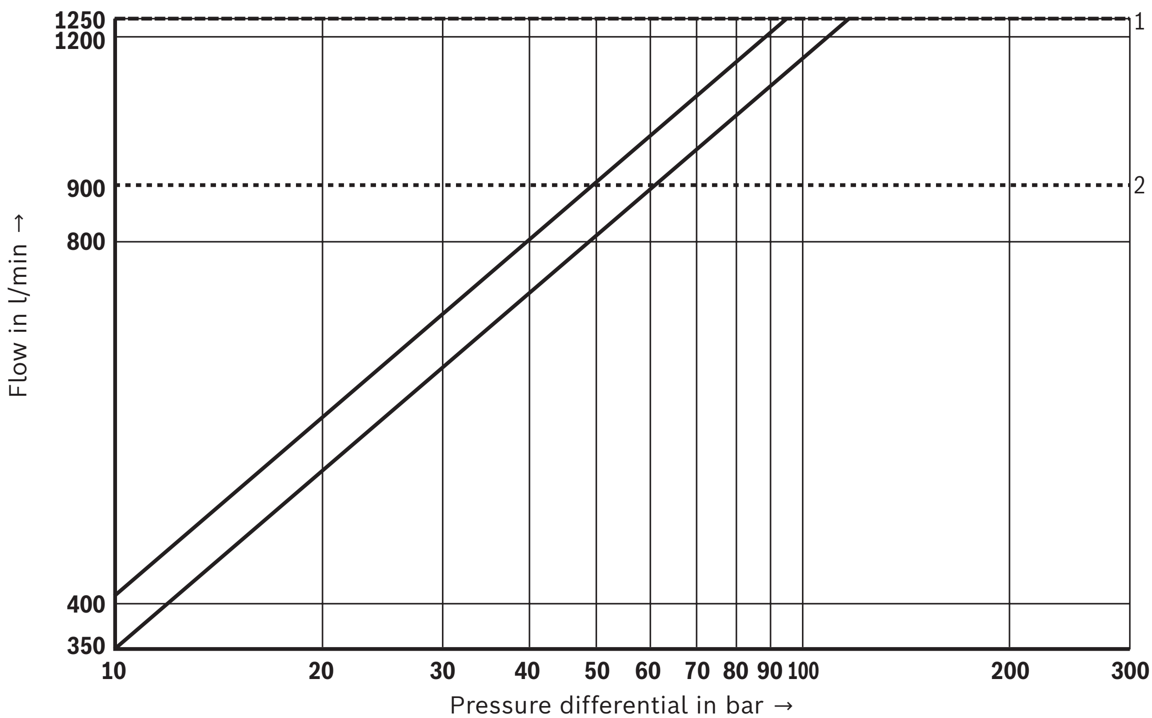
Signal ±5%

Signal ±25%

Signal ±100%

Characteristic curves: Size 25
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/load function (with maximum valve opening; tolerance ±10%)

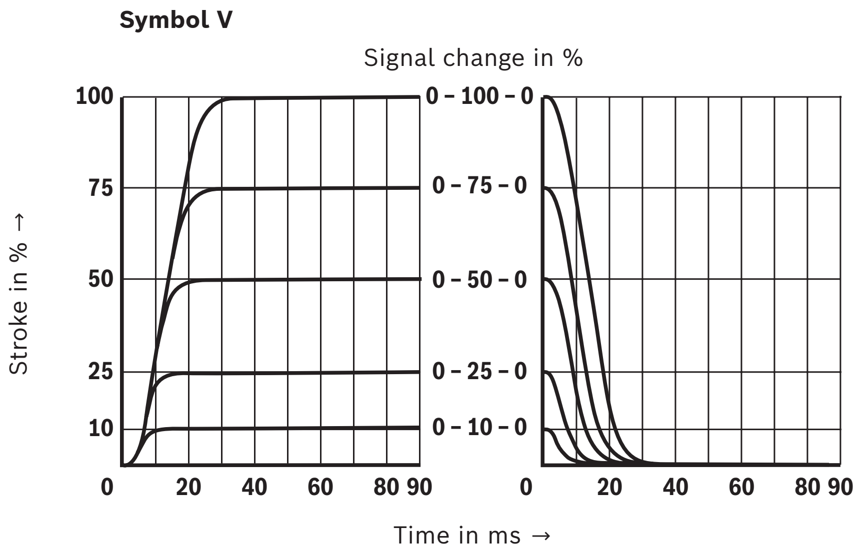


1 Maximum flow

2 Recommended flow limitation
(flow velocity 30 m/s)

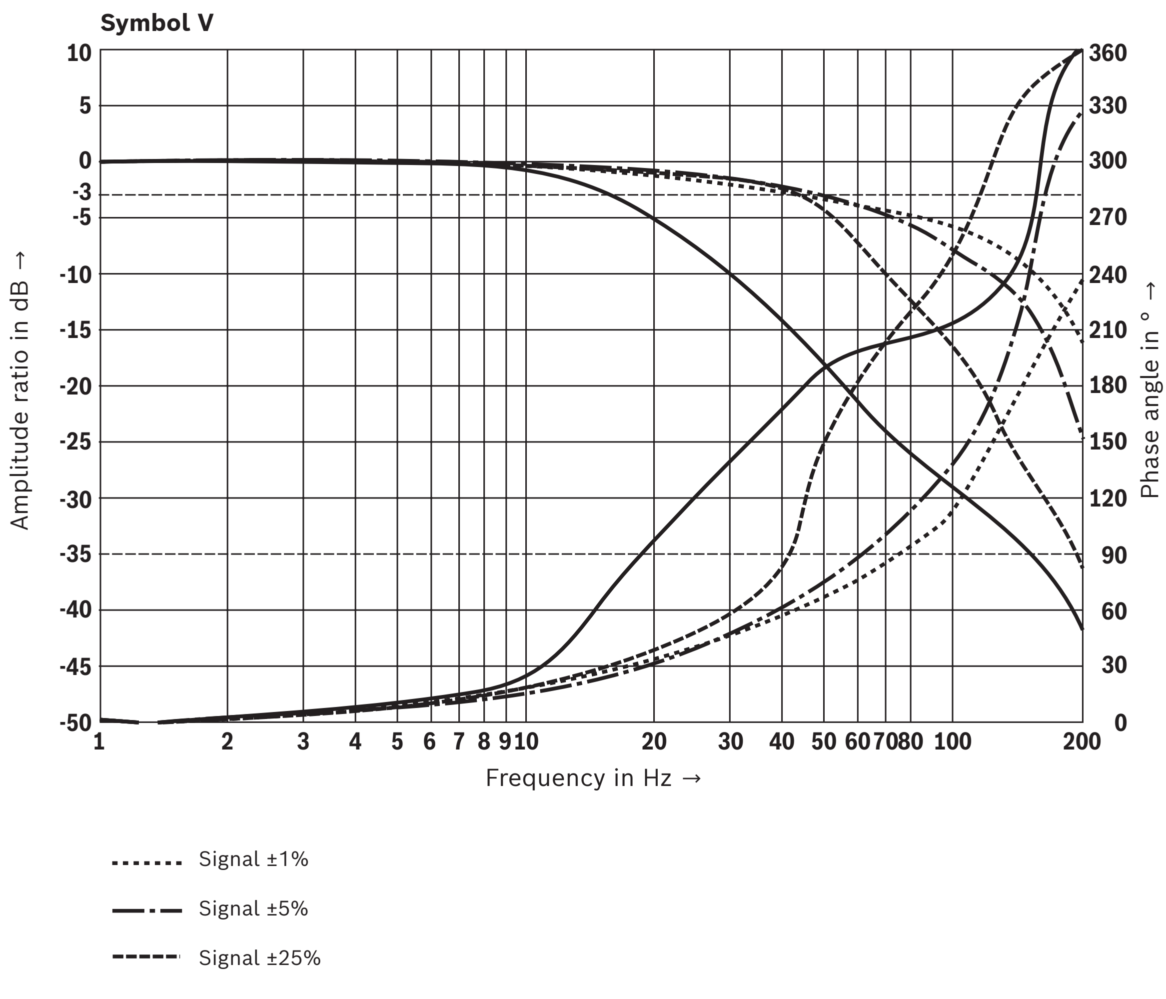
Characteristic curves: Size 27
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals



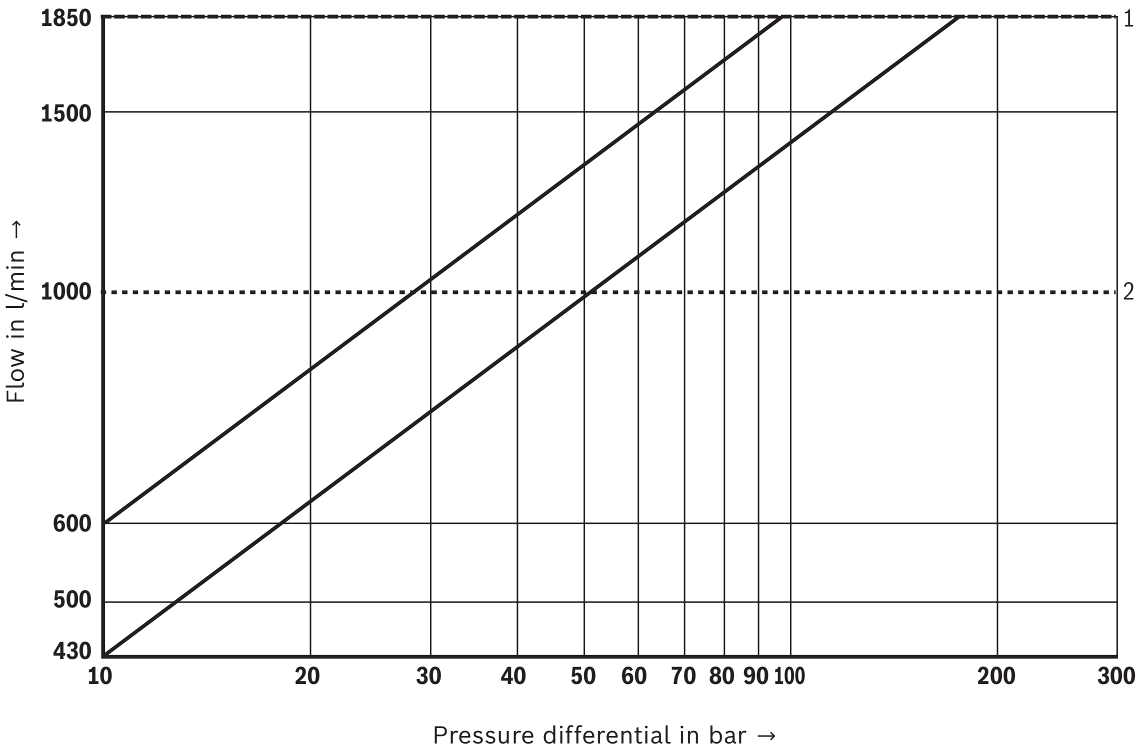
- Pilot control valve, port X = 100 bar
- Main valve, port P = 10 bar

Frequency response



Characteristic curves: Size 27
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Flow/load function (with maximum valve opening; tolerance ±10%)

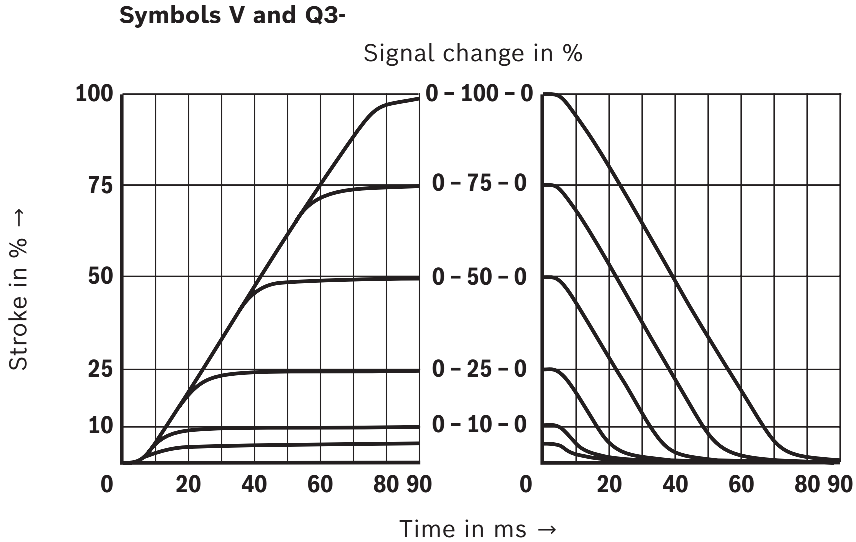


1 Maximum flow

2 Recommended flow limitation
(flow velocity 30 m/s)

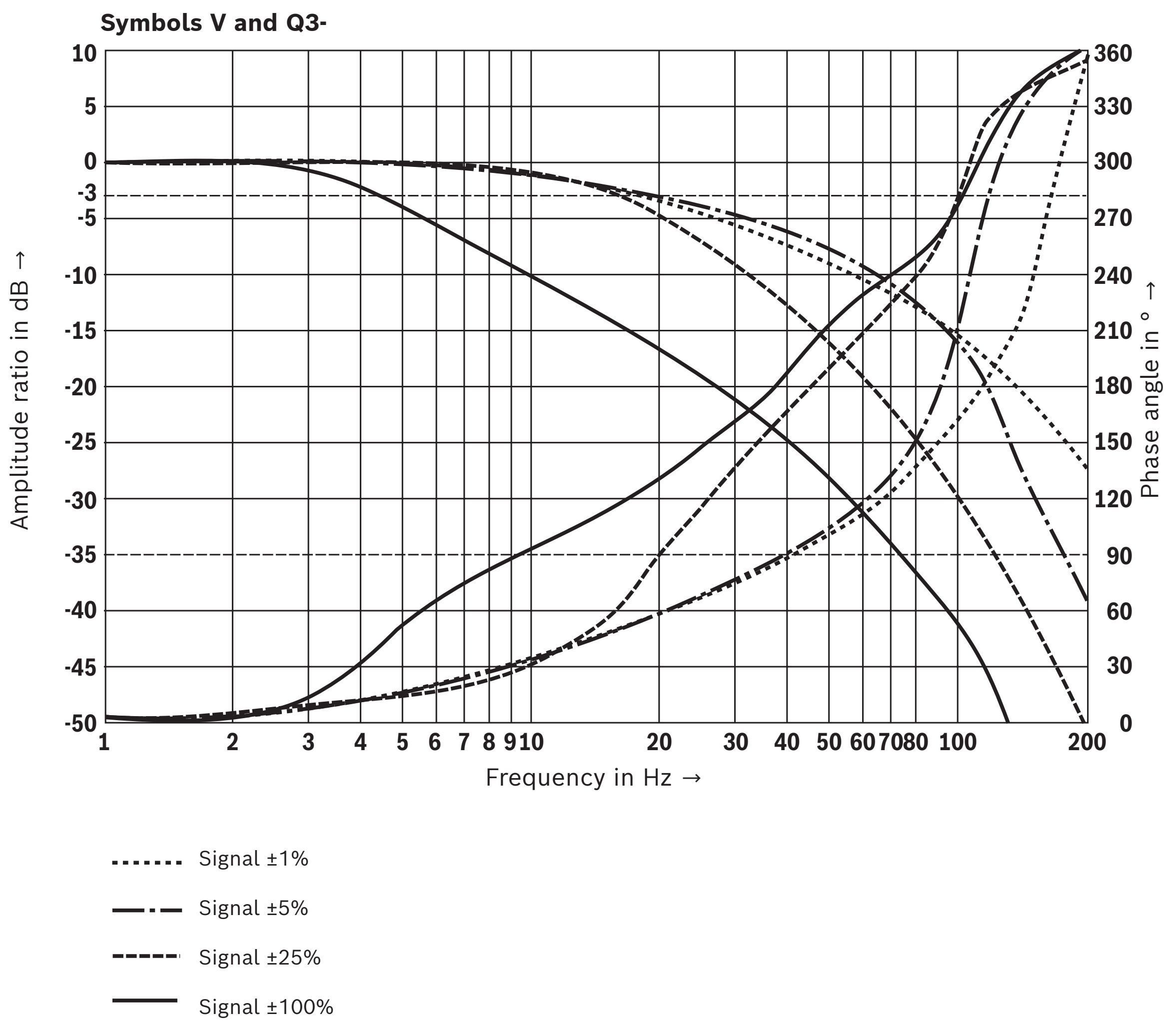
Characteristic curves: Size 35
(measured with HLP46, ϑ_{oil} = 40 ±5 °C)

Transition function with stepped electric input signals



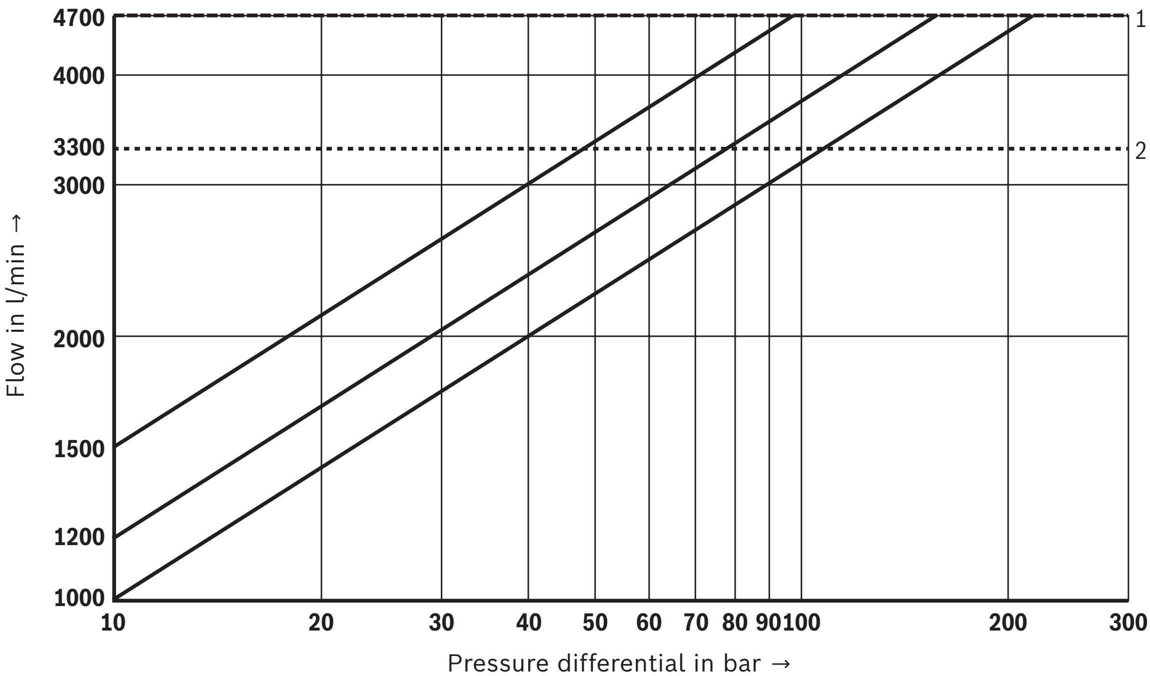
- Pilot control valve, port X = 100 bar
- Main valve, port P = 10 bar

Frequency response characteristic curves



Characteristic curves: Size 35
(valid for HLP46, ϑ_{oil} = 40 ±5 °C)

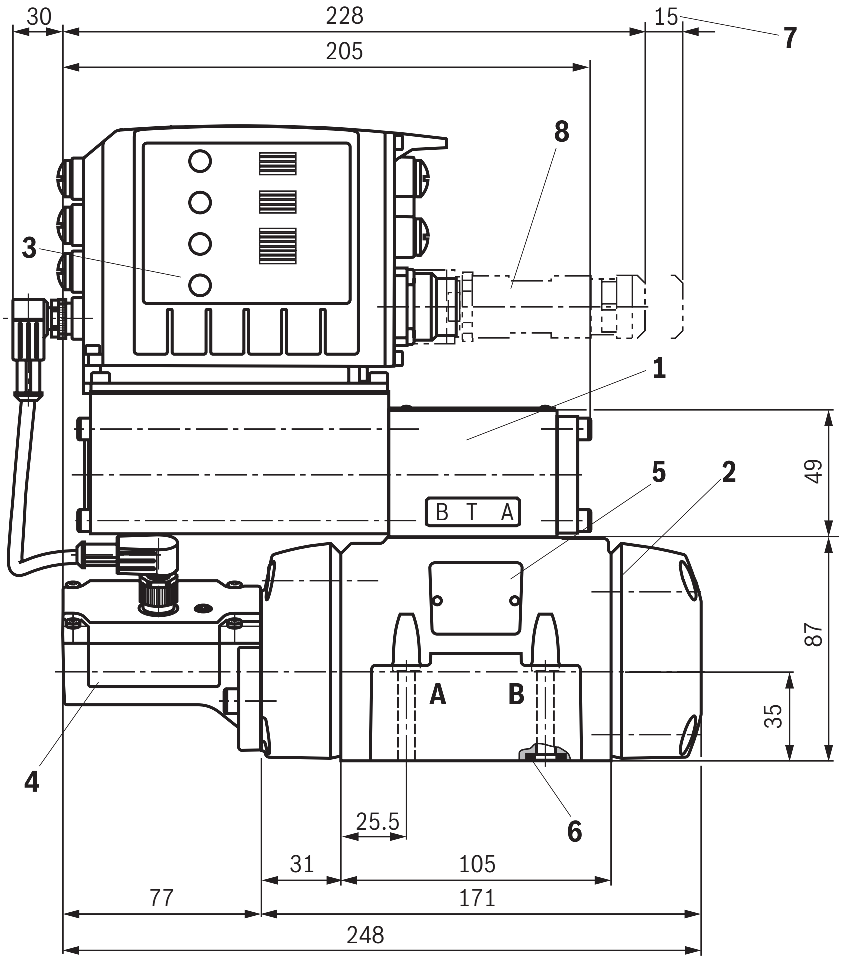
Flow/load function (with maximum valve opening; tolerance ±10%)

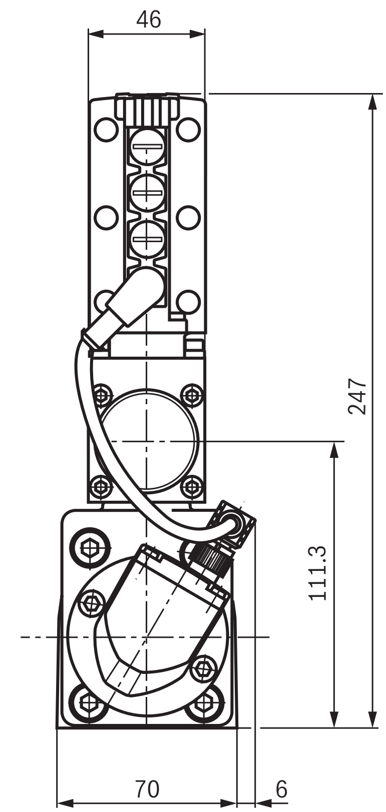


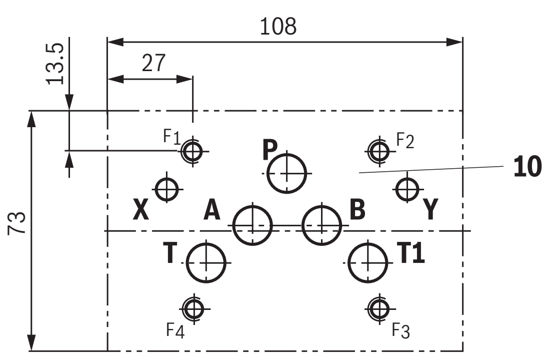
1 Maximum flow

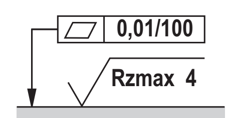
2 Recommended flow
(flow velocity 30 m/s)

Dimensions: Size 10 (dimensions in mm)









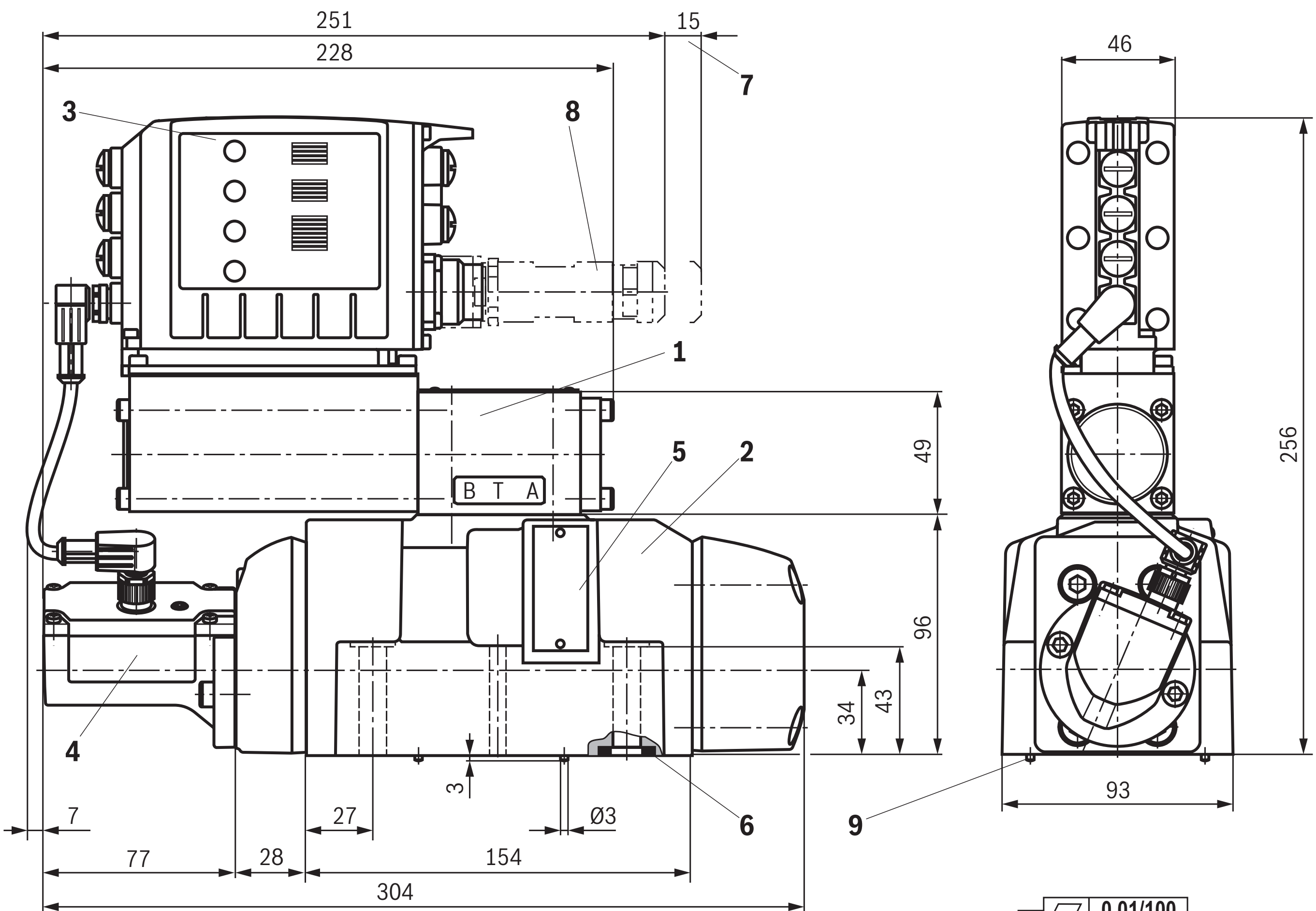
Required surface quality of the valve contact surface

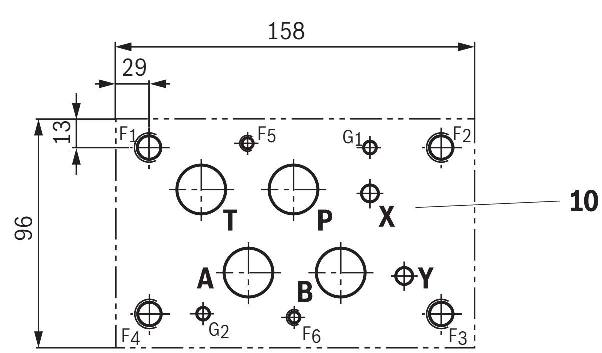
1. Pilot control valve
2. Main valve
3. Integrated electronics (OBE)
4. Inductive position transducer (main valve)
5. Name plate
6. Identical seal rings for ports P, A, B, T
   Identical seal rings for ports X, Y
7. Space required for removing the mating connector
8. Mating connectors, separate order, see page 37 and data sheet 08006.
9. Locking pin
10. Machined valve contact surface,
    Porting pattern according to ISO 4401-05-05-0-05

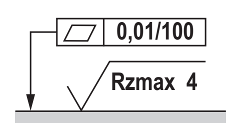
Valve mounting screws and **subplates,** see page 36.

Notice:
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 16
(dimensions in mm)







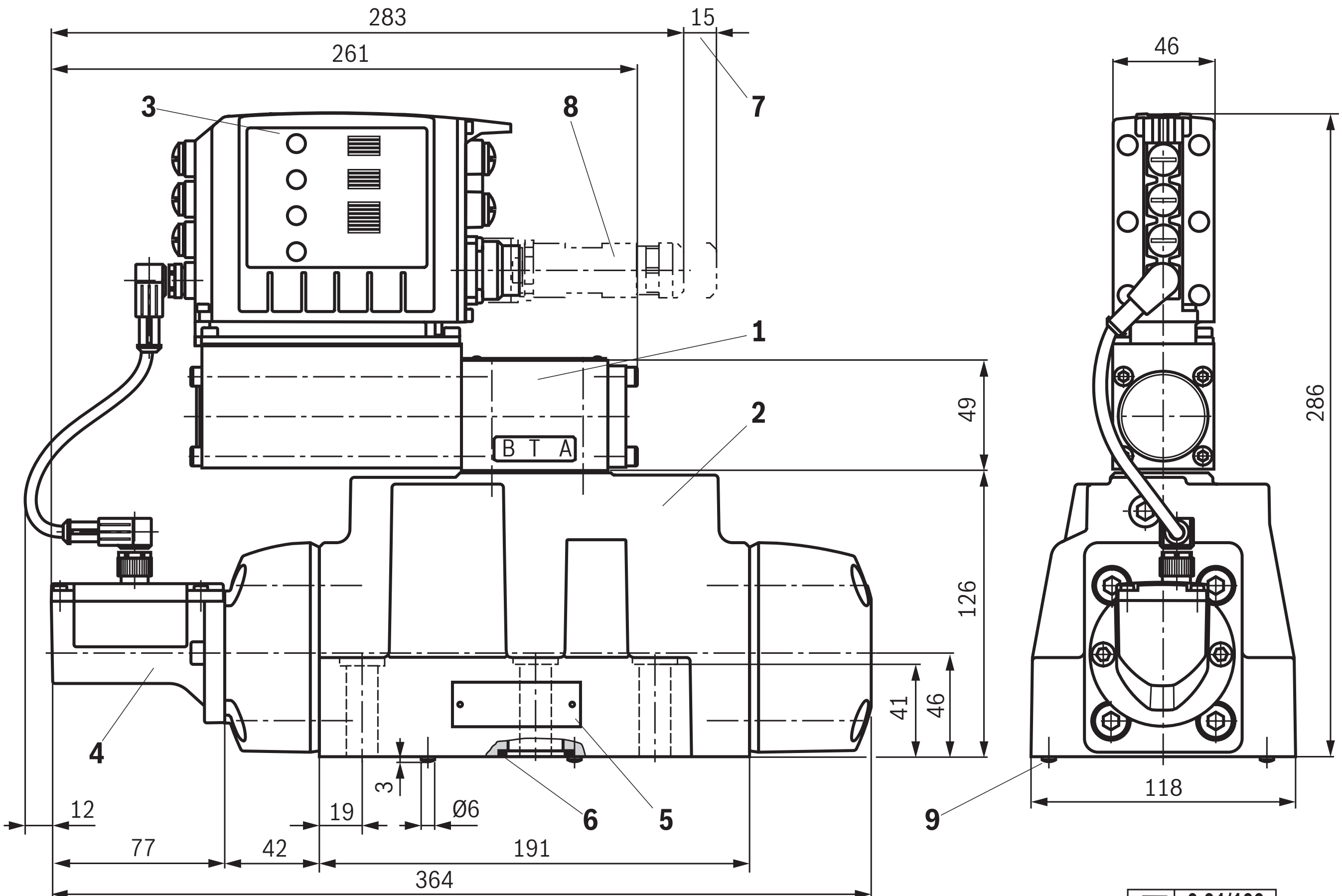
Required surface quality of the valve contact surface

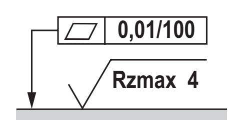
1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 37 and data sheet 08006.
9 Locking pin
10 Machined valve contact surface,
porting pattern according to ISO 4401-07-07-0-05
Deviating from the standard: Ports P, A, B, T – Ø20 mm
Minimum screw-in depth:
- Ferrous metal: 1.5 x Ø
- Non-ferrous metal: 2.0 x Ø

Valve mounting screws and **subplates,** see page 36.

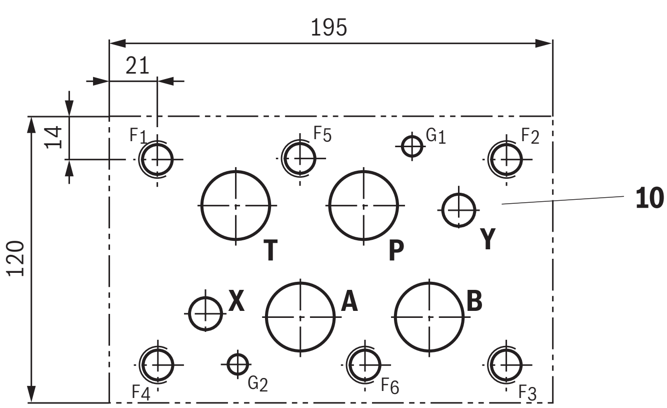
Notice:
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 25
(dimensions in mm)





Required surface quality of the valve contact surface



1 Pilot control valve

2 Main valve

3 Integrated electronics (OBE)

4 Inductive position transducer (main valve)

5 Name plate

6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y

7 Space required for removing the mating connector

8 Mating connectors, separate order, see page 37 and data sheet 08006.

9 Locking pin

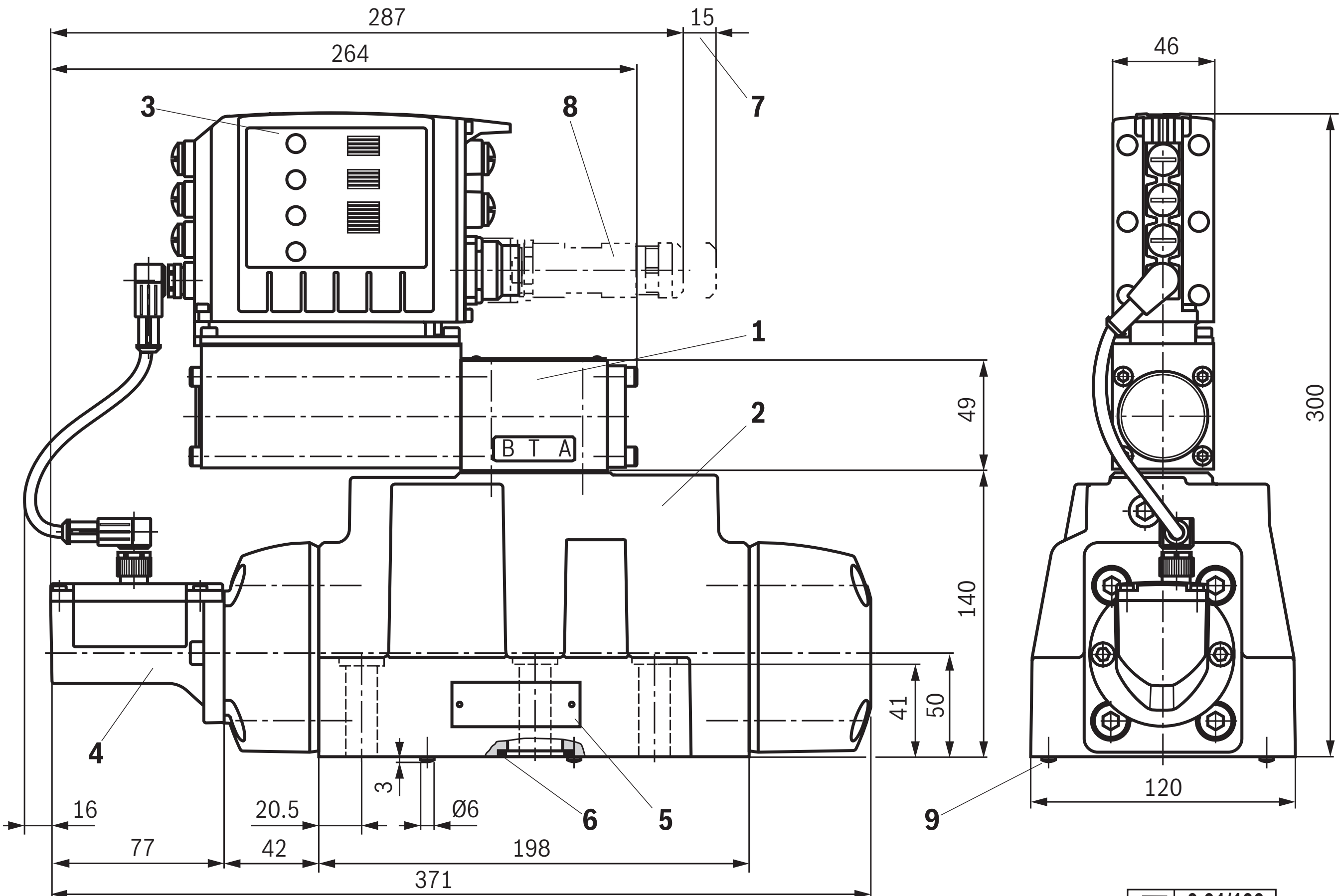
10 Machined valve contact surface,
Porting pattern according to ISO 4401-08-08-0-05
Deviating from the standard:
- Ports X, Y – Ø14 mm

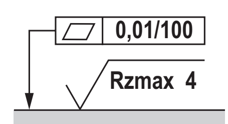
Minimum screw-in depth:
- Ferrous metal: 1.5 x Ø
- Non-ferrous metal: 2.0 x Ø

Valve mounting screws and **subplates,** see page 36.

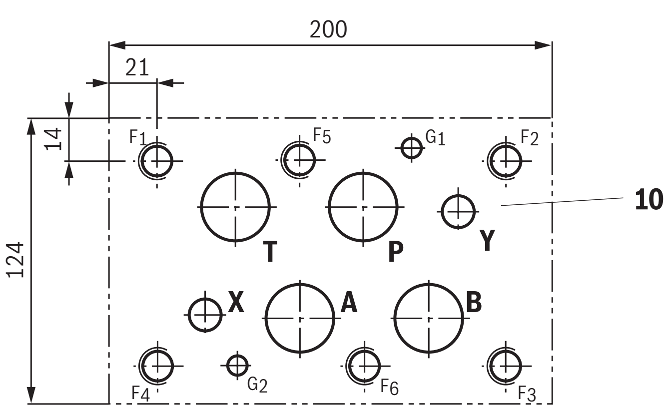
☞ **Notice:**
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 27
(dimensions in mm)





Required surface quality of the valve contact surface

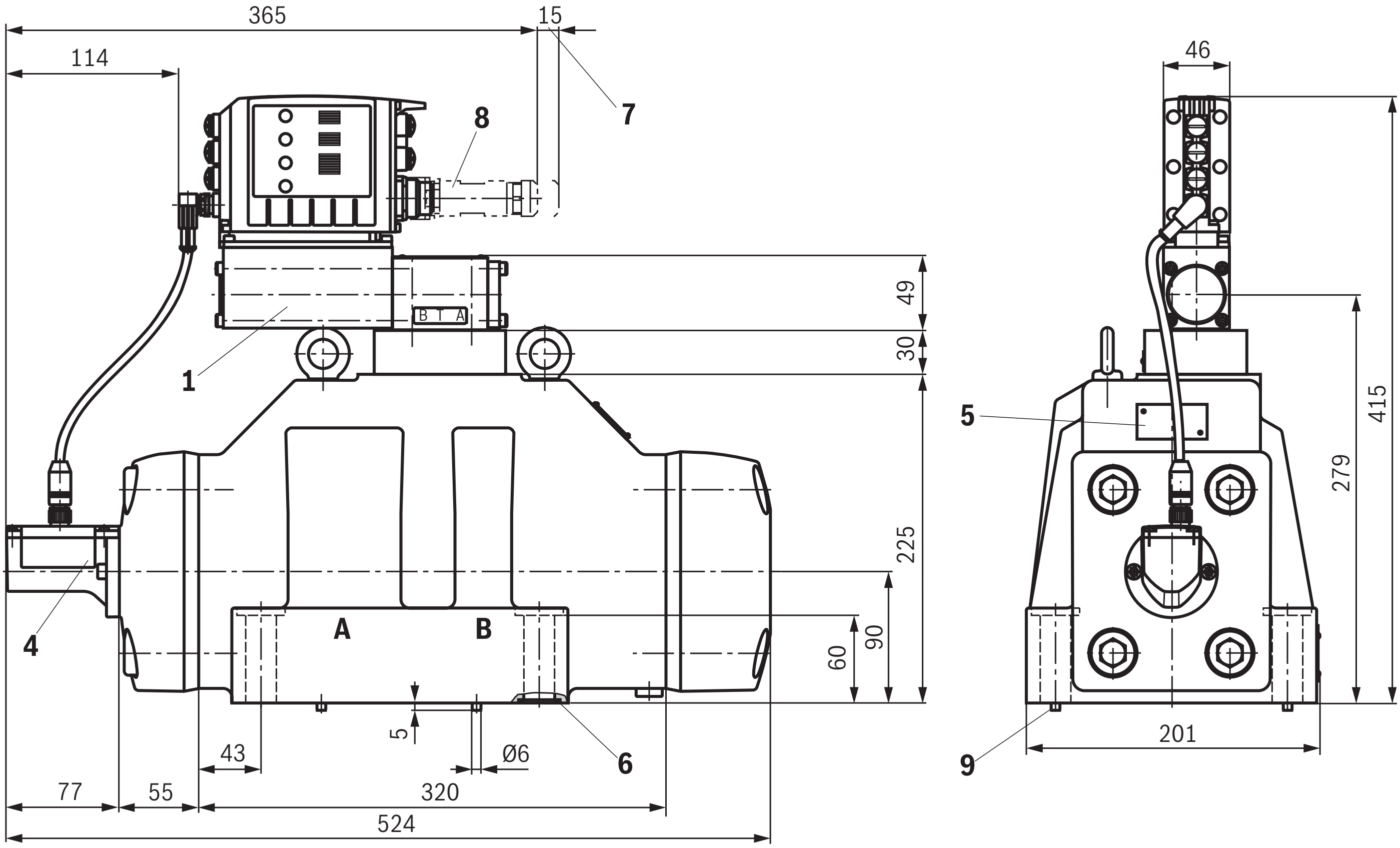


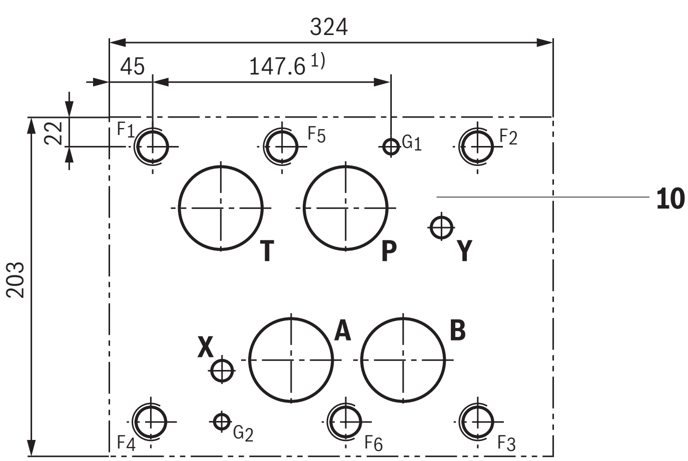
1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 37 and data sheet 08006.
9 Locking pin
10 Machined valve contact surface,
Porting pattern according to ISO 4401-08-08-0-05
Deviating from the standard:
▶ Ports P, A, B, T – Ø32 mm
Minimum screw-in depth:
▶ Ferrous metal: 1.5 x Ø
▶ Non-ferrous metal: 2.0 x Ø

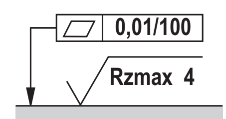
Valve mounting screws and **subplates,** see page 36.

☞ **Notice:**
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 35
(dimensions in mm)







Required surface quality of the
valve contact surface

1 Pilot control valve
2 Main valve
3 Integrated electronics (OBE)
4 Inductive position transducer (main valve)
5 Name plate
6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
7 Space required for removing the mating connector
8 Mating connectors, separate order, see page 37 and data sheet 08006.
9 Locking pin
10 Machined valve contact surface,
Porting pattern according to ISO4401-10-09-0-05
Deviating from the standard:
Ports P, A, B, T – Ø50 mm
1) Position G1 according to DIN 24340 Form A

Valve mounting screws and **subplates,** see page 36.

Notice:
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions

Valve mounting screws (separate order)

Size	Quantity	Hexagon socket head cap screws	Material number
10	4	**ISO 4762 - M6 x 45 - 10.9-CM-Fe-ZnNi-5-Cn-T0-H-B** Tightening torque M_A = 13.5 Nm ±10%	**R913043777**
	or		
	4	**ISO 4762 - M6 x 45 - 10.9** Tightening torque M_A = 15.5 Nm ±10%	Not included in the Rexroth delivery range
16	2	**ISO 4762 - M6 x 60 - 10.9-flZn-240h-L** Tightening torque M_A = 12.2 Nm ±10%	**R913000115**
	4	**ISO 4762 - M10 x 60 - 10.9-flZn-240h-L** Tightening torque M_A = 58 Nm ±20%	**R913000116**
	or		
	2	**ISO 4762 - M6 x 60 - 10.9** Tightening torque M_A = 15.5 Nm ±10%	Not included in the Rexroth delivery range
	4	**ISO 4762 - M10 x 60 - 10.9** Tightening torque M_A = 75 Nm ±20%	
25, 27	6	**ISO 4762 - M12 x 60 - 10.9-flZn-240h-L** Tightening torque M_A = 100 Nm ±20%	**R913000121**
	or		
	6	**ISO 4762- M12 x 60 - 10.9** Tightening torque M_A = 130 Nm ±20%	Not included in the Rexroth delivery range
35	6	**ISO 4762 - M20 x 90 - 10.9-flZn/nc/480h/C** Tightening torque M_A = 465 Nm ±20%	**R913009160**
	or		
	6	**ISO 4762 - M20 x 90 - 10.9** Tightening torque M_A = 610 Nm ±20%	Not included in the Rexroth delivery range

☞ **Notices:**
- The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.
- **When replacing component series 3X with 4X, only the valve mounting screws listed here may be used. Prior to assembly, check the existing mounting bore on the block for sufficient screw-in depth.**

Subplates (separate order) with porting pattern according to ISO 4401, see data sheet 45100.

Accessories (separate order)

Mating connectors and cable sets

Port	Designation	Version	Short designation	Material number	Data sheet
XH2	Mating connector; for valves with round connector, 11-pole + PE	Metal, shielded	12PN11... EMC	**R901268000**	08006
		Plastic, two cable outlets	12PN11...2XD8	**R900884671**	
	Cable sets; for valves with round connector, 11-pole + PE	Metal, shielded, 5 m	12PN11REFS EMV...BG	**R901272854**	
		Metal, shielded, 20 m		**R901272852**	
		Plastic, shielded, 5 m	12PN11REFF 2X...	**R900032356**	
		Plastic, shielded, 20 m		**R900860399**	
X7E1, X7E2	Cable set; shielded, 4-pole, D coding	Straight connector M12, on straight connector M12, line cross-section 0.25 mm^2, CAT 5e, length freely selectable (= xx.x)	–	**R911172111** [1]	–
	Cable set; shielded, 4-pole	Straight connector M12, on straight connector RJ45, line cross-section 0.25 mm^2, CAT 5e, length freely selectable (= xx.x)	–	**R911172135** [2]	–
X2M1, X2M2	Cable set; shielded, 5-pole, for connecting Rexroth pressure sensors, type HM20, A coding	PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm^2, 0.6 m	–	**R901111709**	–
		PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm^2, 1.0 m	–	**R901111712**	–
		PUR/PVC, straight connector M12, on straight socket M12, line cross-section 0.34 mm^2, 2.0 m	–	**R901111713**	–
	Cable set; shielded, 5-pole, A coding	Straight connector M12, on free line end, line cross-section 0.34 mm^2, 1.5 m	–	**R901111752**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm^2, 3.0 m	–	**R901111754**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm^2, 5.0 m	–	**R901111756**	–
		Straight connector M12, on free line end, line cross-section 0.34 mm^2, 10.0 m	–	**R913005147**	–
	Plug-in connector; 5-pole, M12 x 1, pins, A-coding	Metal (cable diameter 4 ... 6 mm2)	–	**R901075542**	–
X8M	Cable set; Shielded, 8-pole, A coding (only SSI, 1Vss) [3]	Straight connector M12, on free line end, line cross-section 0.25 mm^2, 10 m	–	**R913002641**	–

1) Additional indication of type designation RKB0040/xx.x

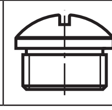
2) Additional indication of type designation RKB0044/xx.x

3) **Recommendation:** If an EnDat 2.2 sensor is used, please refer to the sensor manufacturer Heidenhain with respect to a cable set.

Notices:
- Tighten the M12 connector with a manual torque wrench by 1 Nm.
- Self-locking M12 cables must be used.
- It must be ensured that cables are secured without radial forces.
- All cables connected to XH1, X7E1 and X7E2 must be bundled in a wire harness after 20cm the latest. The wire harness must be fixed after further 20 ... 30cm. Make sure that there is no relative motion between the fixation and the valve.
- Before the fixation point, there must not be any cable loops.
- In general, the information on installation provided by the cable manufacturers must be observed.
- Respectively, the cables of X2M1, X2M2 and X8M, if used, are also fixed as described above.
- For further information, see operating instructions 29391-B

Accessories (separate order)

Protective cap

Protective cap M12	**Version**	**Material number**
		**R901075563**

Parameterization

The following is required for the parameterization with PC		**Material number/download**
1 Commissioning software	IndraWorks, Indraworks D, Indraworks DS	
2 Connection cable, 3 m	Shielded, M12 on RJ45, length can be freely selected (= xx.x)	**R911172135** (additional indication of type designation RKB0044/xx.x)

Project planning and maintenance instructions

- The supply voltage must be permanently connected; otherwise, bus communication is not possible.
- If electro-magnetic interference is to be expected, take appropriate measures to ensure the function (depending on the application, e.g. shielding, filtration).
- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices 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.

Further information

▶ Directional control valve with integrated digital axis controller (IAC-Multi-Ethernet, component series 2X)	Data sheet 29391 and 29391-B
▶ CE Declaration of Conformity	Upon request
▶ Subplates	Data sheet 45100
▶ Hydraulic fluids on mineral oil basis	Data sheet 90220
▶ Environmentally compatible hydraulic fluids	Data sheet 90221
▶ Flame-resistant, water-free hydraulic fluids	Data sheet 90222
▶ Flame-resistant hydraulic fluids - containing water (HFAE, HFAS, HFB, HFC)	Data sheet 90223
▶ Hexagon socket head cap screw, metric/UNC	Data sheet 08936
▶ Hydraulic valves for industrial applications	Data sheet 07600-B
▶ General product information on hydraulic products	Data sheet 07008
▶ Installation, commissioning and maintenance of servo valves and high-response valves	Data sheet 07700
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900
▶ Operation IAC-Multi-Ethernet electronics (xx = software version): – Functional description Rexroth HydraulicDrive HDx-xx – Parameter description Rexroth HydraulicDrive HDx-xx – Description of diagnosis Rexroth HydraulicDrive HDx-xx	
▶ Commissioning software and documentation on the Internet	
▶ Selection of filters	
▶ Information on available spare parts	

Rexroth
Bosch Group

Declaration on the environmental compatibility for EMC [1], climate and mechanical load

RE 29191-U/07.10
Replaces: 06.06

Type 4WRPNH...2X

High-response valve with integrated digital axis controller (IAC-R) and field bus interface

Product description

- Direct operated high-response valve with control spool and bushing in servo quality
- Integrated digital axis controller with analog and digital sensor interfaces and field bus connection

  Functionality:
  - Flow control
  - Position control
  - Pressure control
  - p/Q function
  - Substitutional position/pressure and position/force control
  - NC functionality

[1] The presumption of conformity in the sense of the EMC directive 2004/108/EC and EMVG dated February 26, 2008 is given.

The products comply with the following standards:

1. EMC (electromagnetic compatibility)

Test according to generic standard EN 61000-6-2: 2005

			Interference resistance
EN 61000-4-2: 2007	VDE 0847-4-2	ESD (electrostatic discharge)	Air discharge: Severity level 4 / evaluation criterion A Contact discharge: Severity level 4 / evaluation criterion A
EN 61000-4-3: 2006 + A1: 2008	VDE 0847-4-3	HF fields, freely beamed	Severity level 3 / evaluation criterion A 80…1000 MHz [1)] Severity level 3 / evaluation criterion A 1...2.7 GHz [1)]
EN 61000-4-4: 2004	VDE 0847-4-4	BURST (transient interference)	Repetition rate 5 kHz Supply voltage: Severity level 3 / evaluation criterion A Data lines: Severity level 4 / evaluation criterion A Repetition rate 100 kHz Supply voltage: Severity level 3 / evaluation criterion A Data lines: Severity level 4 / evaluation criterion A
EN 61000-4-5: 2006	VDE 0847-4-5	SURGE (surge voltage)	Supply voltage: Severity level 1 / evaluation criterion A Data line (asymmetric): Severity level 2 / evaluation criterion A
EN 61000-4-6: 2007	VDE 0847-4-6	HF fields, conducted	Severity level 3 / evaluation criterion A

Test according to generic standards EN 61000-6-3: 2007 and EN 61000-6-4: 2007

			Interference emissions
EN 55022: 2006 + A1: 2007	IEC/CISPR 16-2-3: 2006-07	Emission, radio interference field strength (housing, freely beamed)	Limits according to EN 61000-6-4: 2007 30…230…1000 MHz table 1 / line 1) [2)] Limits according to EN 61000-6-3:2007 40…230...1000 MHz table 1 / line 1) [3)]

[1)] Severity level X (20 V/m) continuously (80 MHz ... 2.7 GHz) satisfied;
Standard requirement: 80 … 1000 MHz: Severity level 3 (10 V/m); 1.4 … 2.0 GHz: Severity level 2 (3 V/m) and 2.0 GHz … 2.7 GHz: Severity level 1 (1 V/m)

[2)] Limit class A "Industry": The limit is always undershot by the specimens.

[3)] Limit class B "Small business and household": The limit is valid as of 40 MHz (up to 1 GHz) and is always undershot in this range. In the range from 30 to 40 MHz, the limit is exceeded, however by less than 3 dB.

The products comply with the following standards (continued):

2. Climate

Test according to EN 60068-2 / IEC 68-2 (environmental test)

EN 60068-2-1:1994		Cold test	2 cycles, –20 °C Duration 2 hours
EN 60068-2-2:1993		Dry heating test	2 cycles, +55 °C Duration 2 hours
EN 60068-2-1:1994 EN 60068-2-2:1993		Storage temperature	–25 °C duration 16 hours +85 °C duration 16 hours
	IEC 68-2-14:1986	Temperature change	2 cycles, –25 °C to +55 °C Duration 3 hours at min. / max. temperature
EN 60068-2-30:1999		Humid heat, cyclic	Variant 2 +25 °C to +55 °C 93 % to 97 % relative humidity 2 cycles à 24 hours each

3. Mechanical load

Vibration and shock test according to EN 60068-2 / IEC 68-2 / DIN 40046 (environmental test)
Tested on three axes (X/Y/Z)

EN 60068-2-6:1996		Vibrations, sinusoidal	10 cycles, 5 to 2000 to 5 Hz with logarithmic frequency changing speed of 1 octave/min. 5 to 57 Hz, amplitude 1.5 mm (p-p) 57 to 2000 Hz, amplitude 10 g
	IEC 68-2-36:1973 DIN 40046-24:1977	Vibrations (random) Broadband noise	20 to 2000 Hz, A) Spectral acceleration density 0.05 g^2 /Hz (10 g RMS / 30 g peak), testing time 30 min
EN 60068-2-27:1993		Shocking	Half sine 15 g / 11 ms, 3 x in positive / 3 x in negative direction (total of 6 individual shocks)

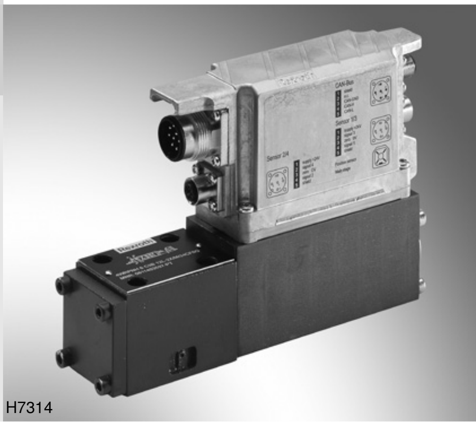
Rexroth
Bosch Group

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

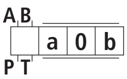
4WRP	N	H			B		– 2X / M / 24				*

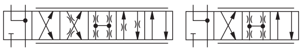
with integrated digital axis controller and NC functionality **= N**

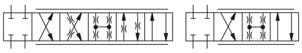
Control spools / sleeve **= H**

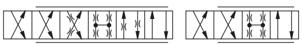
Size 6 **= 6**
Size 10 **= 10**

Spool symbols
4/4-directional design



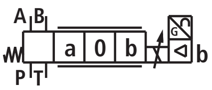
 **= C3, C5**

 **= 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

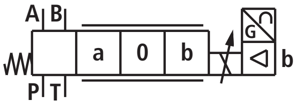
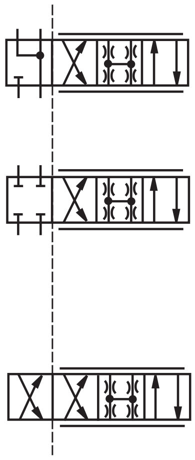
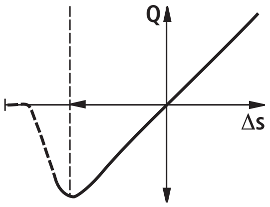
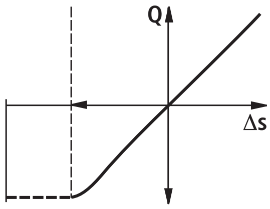
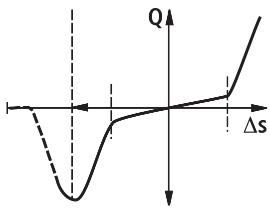
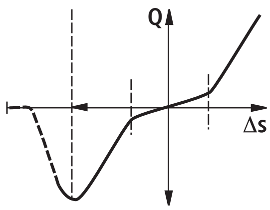
Material no.	Type
0811403552	4WRPNH 6 C3 B04L-2X/M/24PA6A
0811403575	4WRPNH 6 C3 B40L-2X/M/24PA6B
0811403550	4WRPNH 6 C3 B40L-2X/M/24PA6A
0811403573	4WRPNH 6 C3 B25P-2X/M/24PA6B
0811403559	4WRPNH 6 C3 B04L-2X/M/24PF6G
0811403531	4WRPNH 6 C3 B40L-2X/M/24PF6G
R901224758	4WRPNH 6 C1 B24L-2X/M/24PF6G

Size 10 with Profibus DP

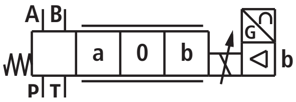
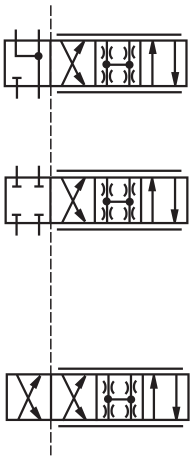
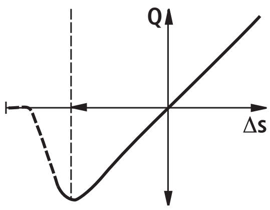
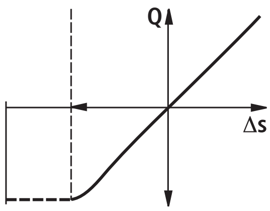
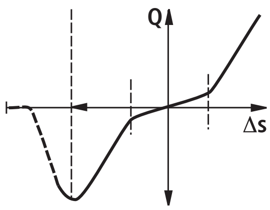
Material no.	Type
0811403358	4WRPNH 10 C3 B100L-2X/M/24PF6G
0811403359	4WRPNH 10 C4 B100L-2X/M/24PF6G
R901232766	4WRPNH 10 C4 B100P-2X/M/24PF6G

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		
	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

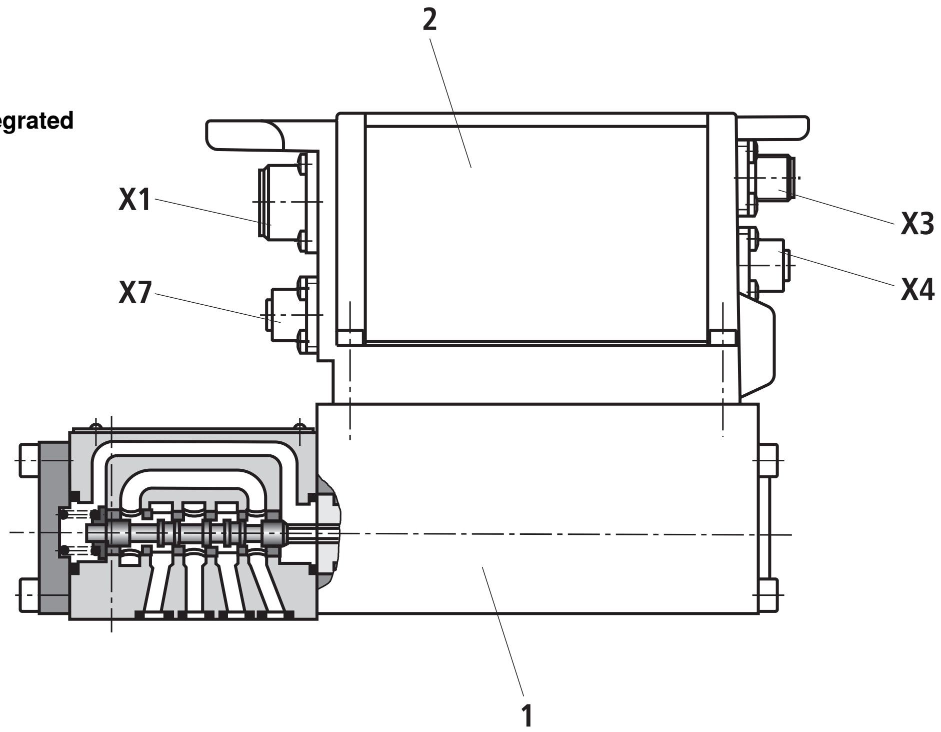
Function, section

Structure

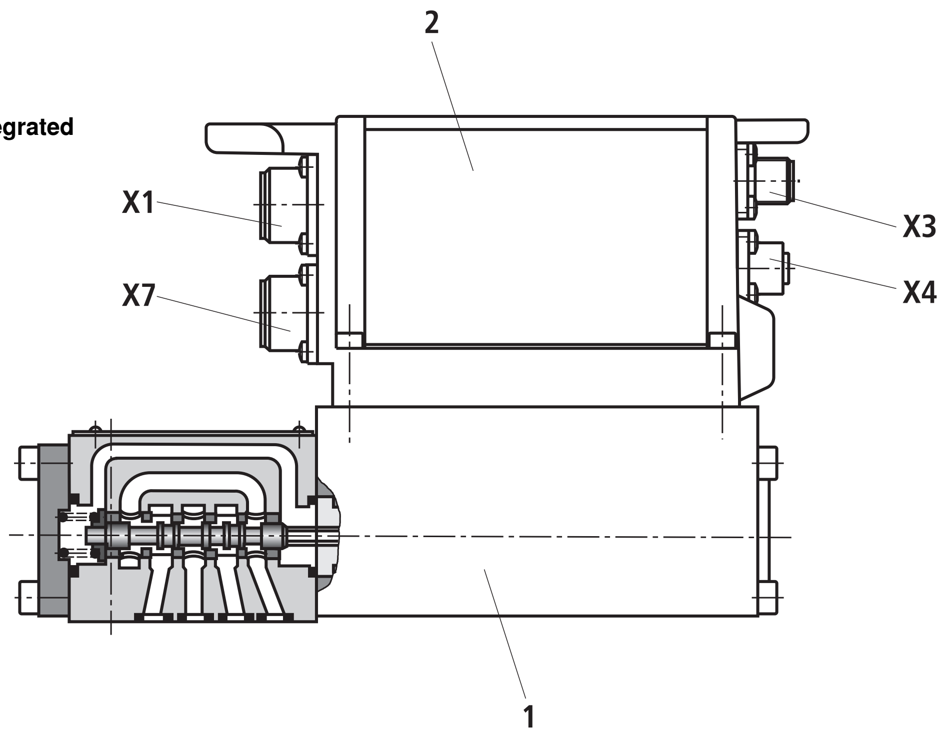
The IAC-R valve mainly consists of:

- 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 $\Delta\vartheta$ = 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!)

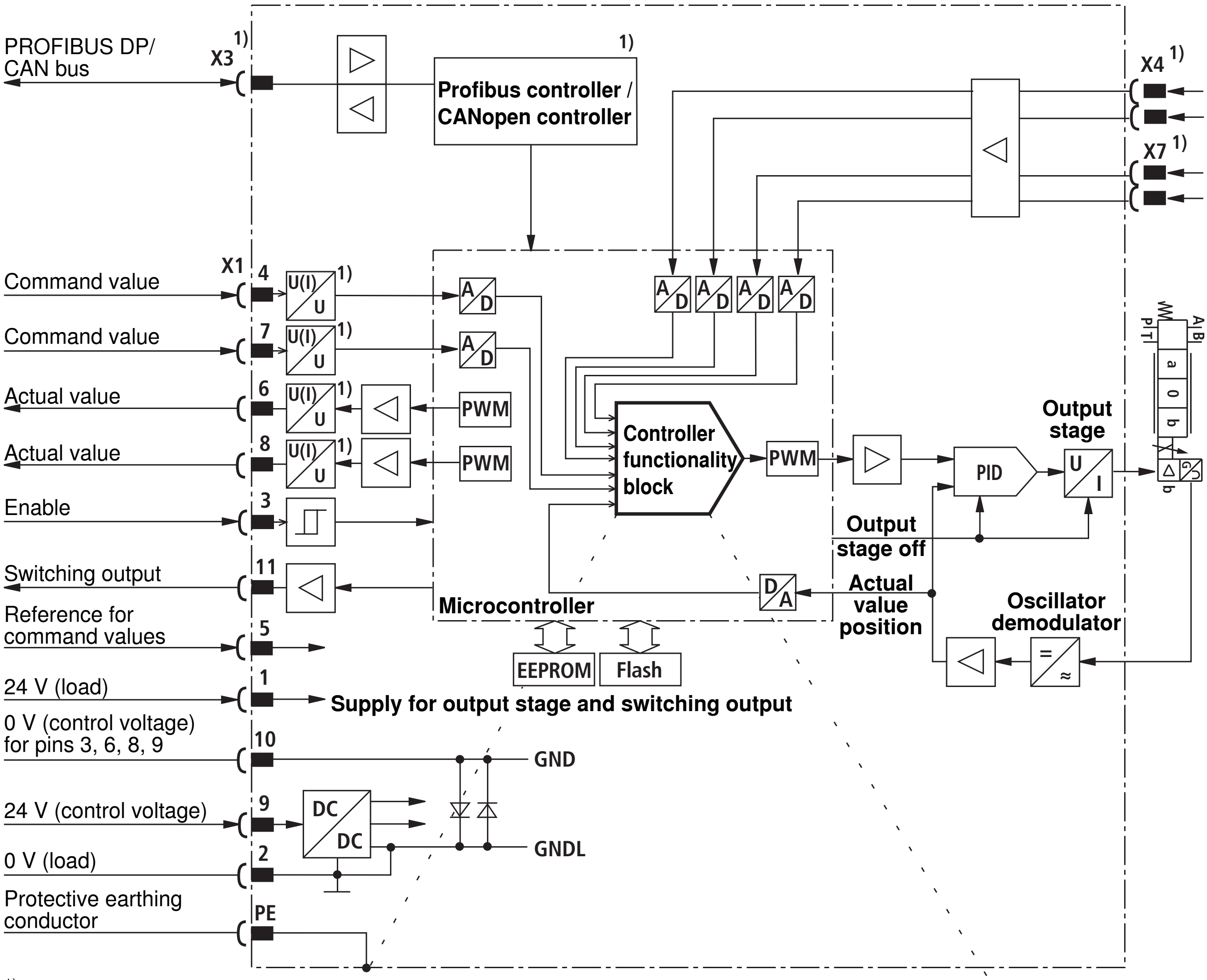
electric			
Relative duty cycle		%	100 (continuous operation)
Protection class according to EN 60529			IP 65 with mounted and locked plug-in connectors
Supply voltage	Nominal voltage	VDC	24
	Lower limit value	VDC	21
	Upper limit value	VDC	36
	Max admissible residual ripple	Vss	2 (at supply voltage of 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.

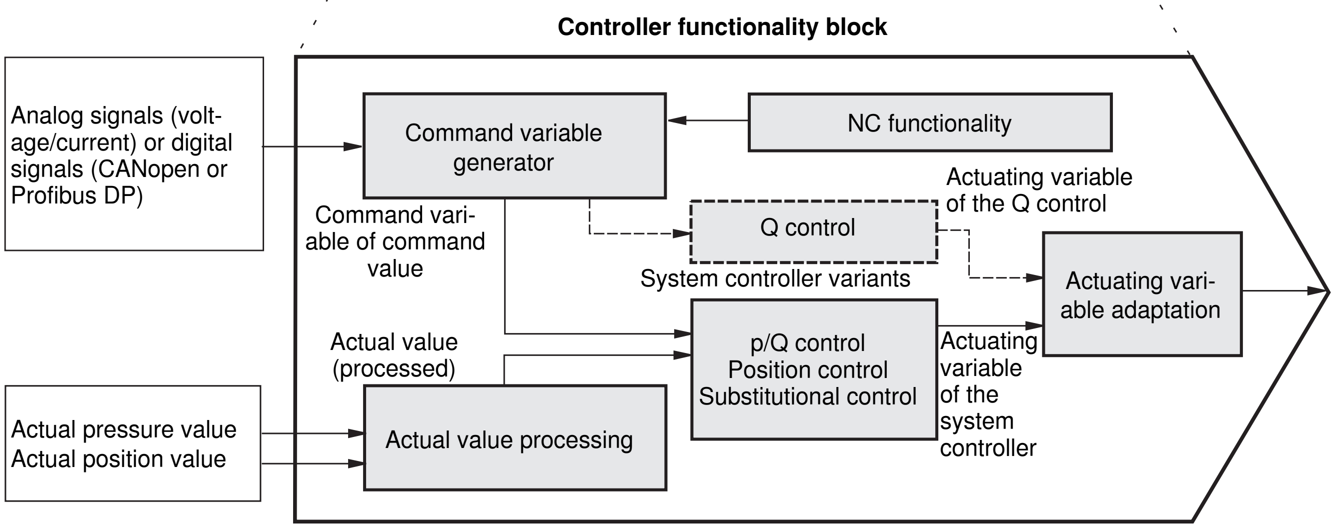
Effective filtration prevents faults and at the same time increases the service life of the components.

[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

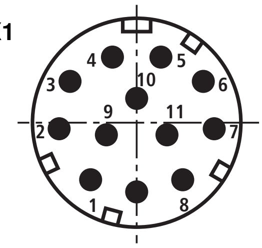
Unit connector pin assignment X1, 11-pole + PE according to EN 175201-804

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



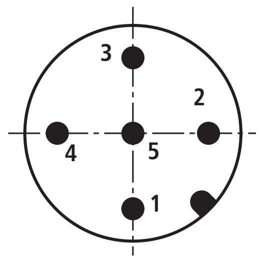
Unit connector pin assignment for CAN bus "X3" (code A), M12, 5-pole, pins

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.

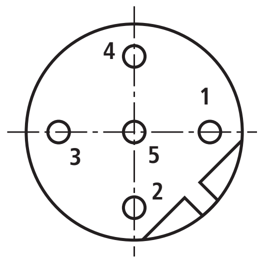
Transmission rate kbit/s	20 to 1000
Bus address	1 to 127



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

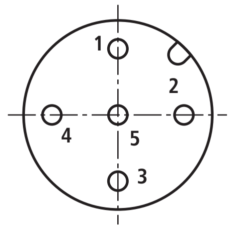


The galvanically separated voltage +5 V (pin 1 - VP) at the socket allows for passive termination of the profibus.

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

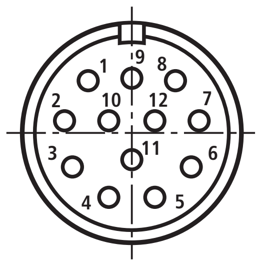


[1] Do not connect to 2-wire pressure transducer

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.



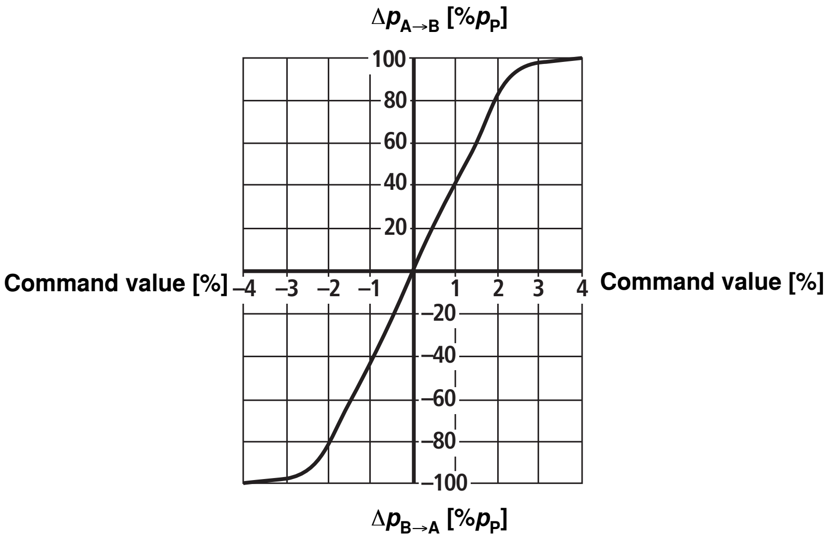
Note:
The sense signal is not analyzed.

[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.

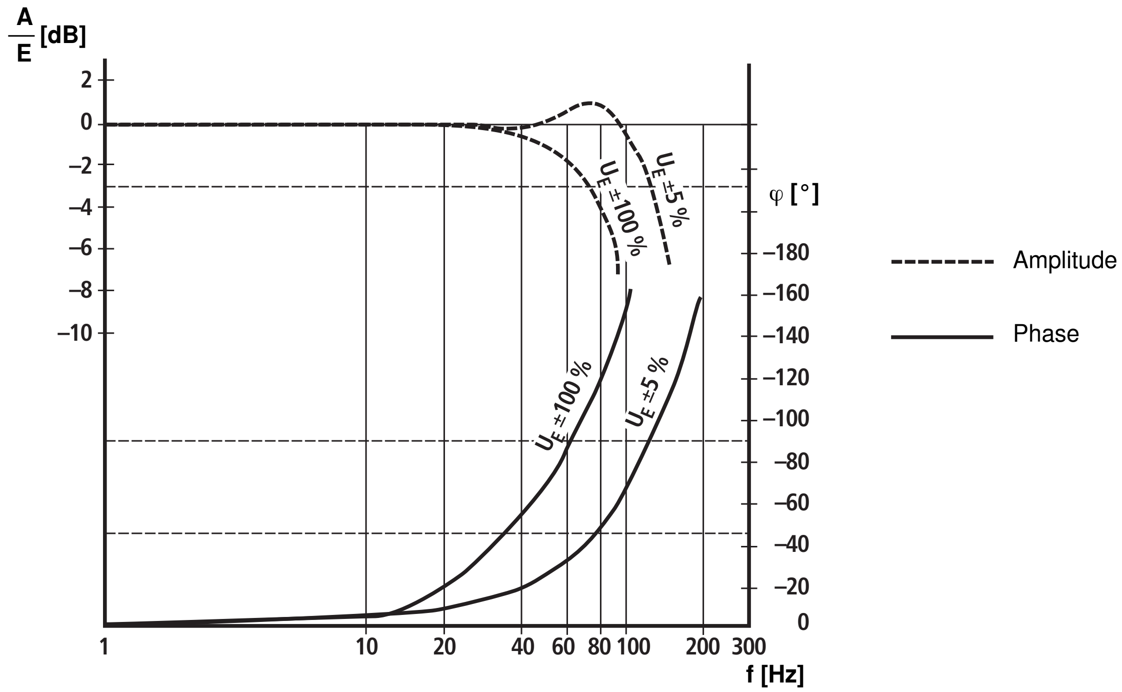
Note:
We recommend connecting the screens on both sides over the metallic housings of the plug-and-socket-connectors.
Using connector pins will affect the effectiveness of the screen!
Internal screens are not required.

Characteristic curves size 6 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Pressure gain



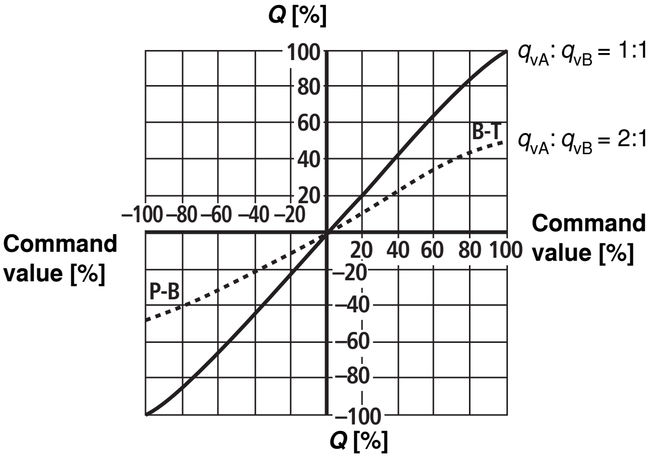
Bode diagram



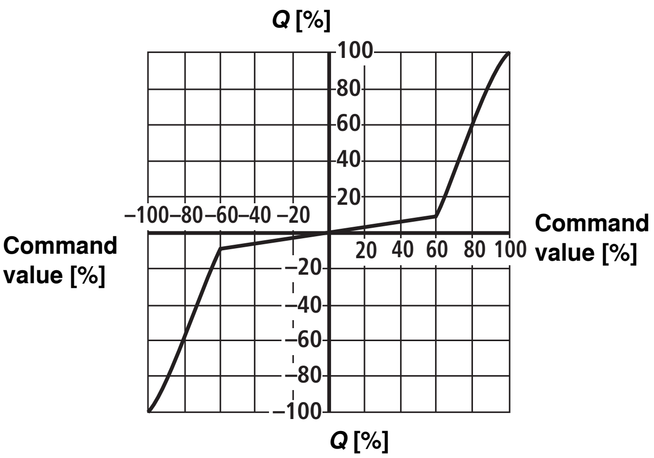
Characteristic curves size 6 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Flow - signal function

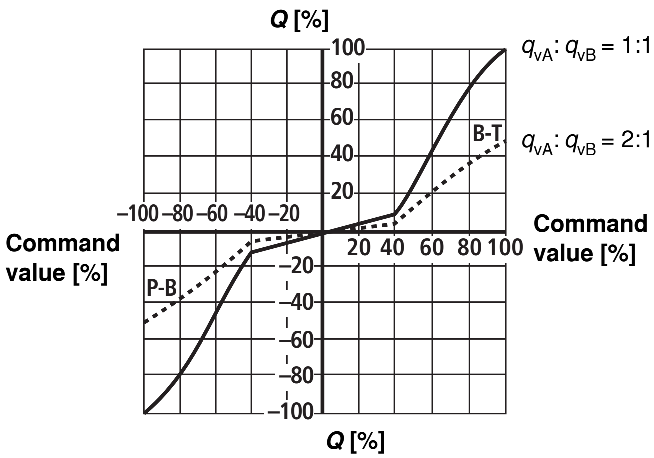
L: Linear



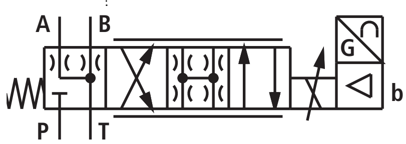
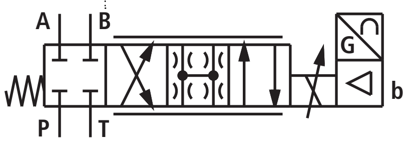
P: Inflection 60 %



P: Inflection 40 %



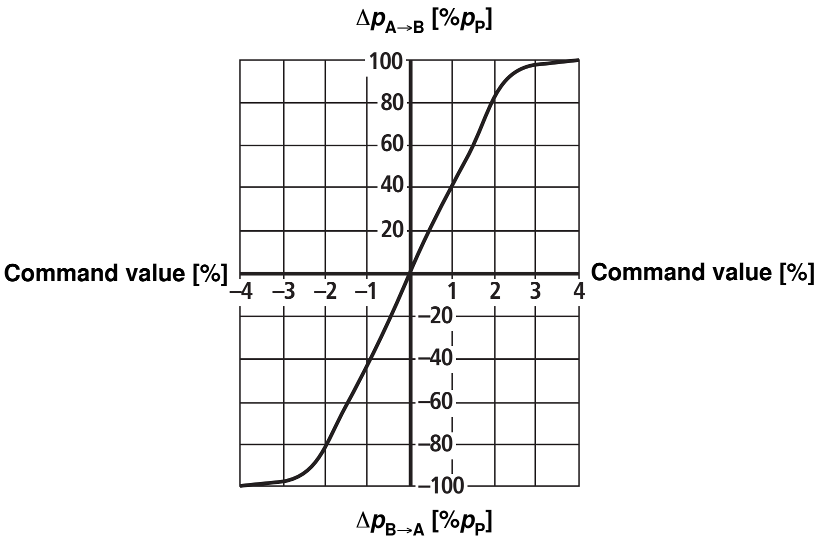
Fail-safe position

	Leakage oil at	100 bar	P → A	50 cm³/min
			P → B	70 cm³/min
	Flow at	Δp = 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

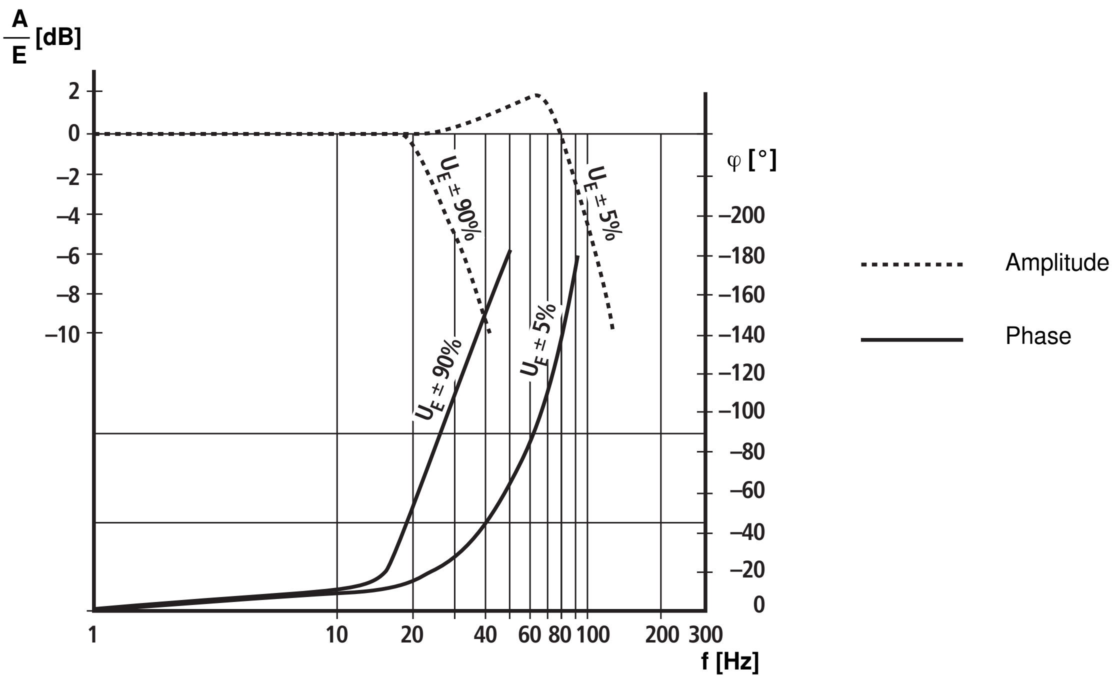
Fail-safe	p = 0 bar => 7 ms	Enable "off" or internal shut-off in case of error
	p = 100 bar => 10 ms	U_B ≤ 18 V or I ≤ 2 mA (at 4…20 mA signal)

Characteristic curves size 10 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Pressure gain



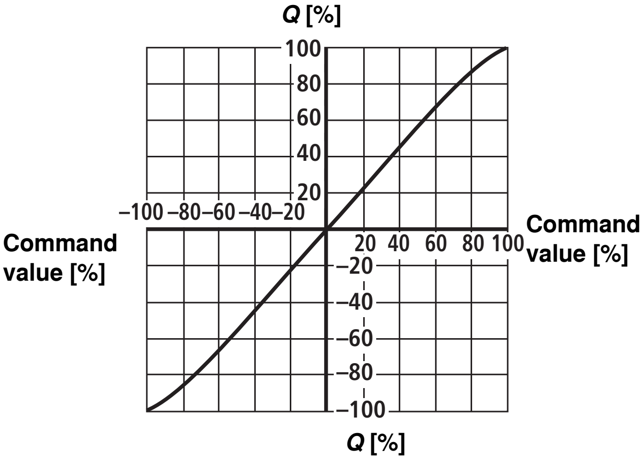
Bode diagram



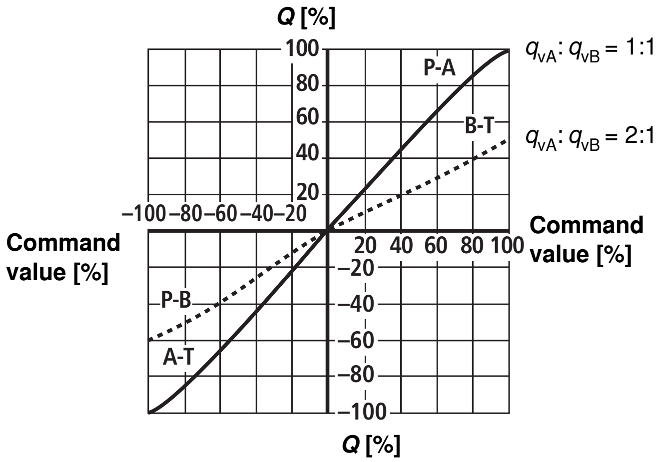
Characteristic curves size 10 (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Flow - signal function

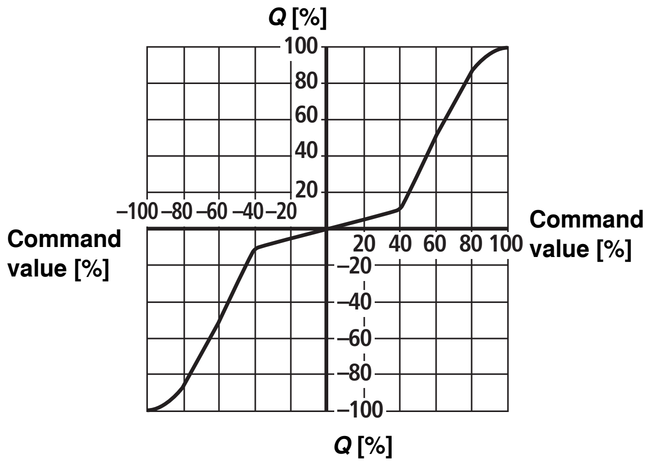
L: Linear 1:1



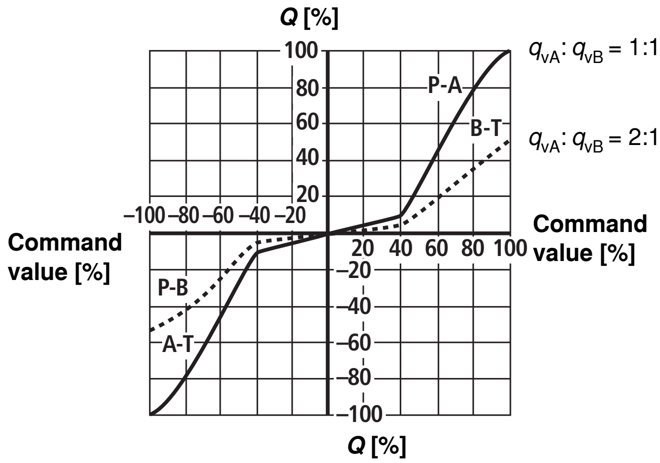
L: Linear 2:1



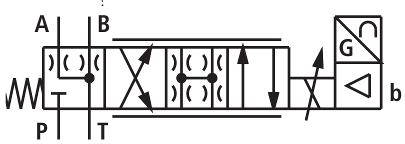
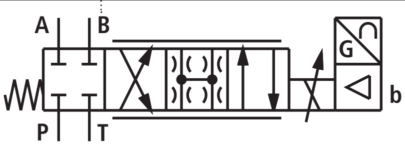
P: Inflection 40 % 1:1



P: Inflection 40 % 2:1

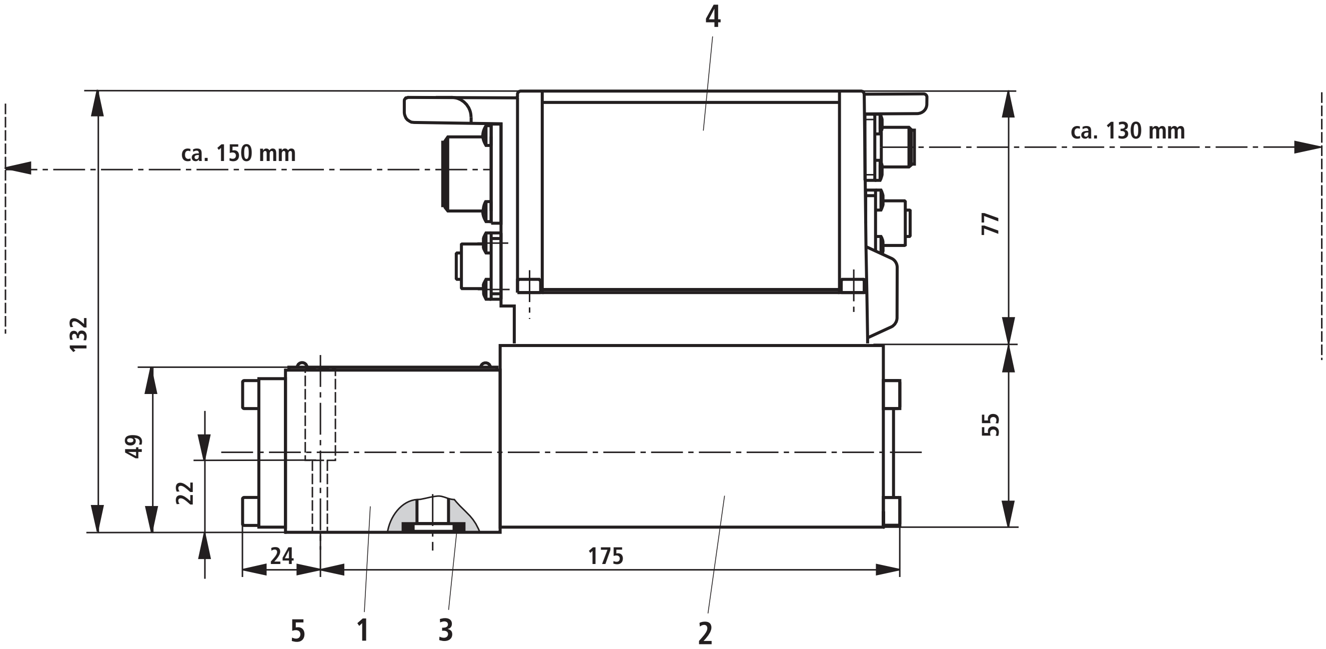


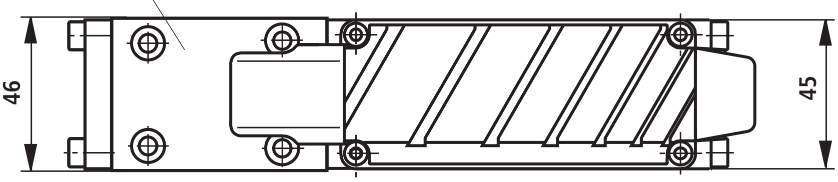
Fail-safe position

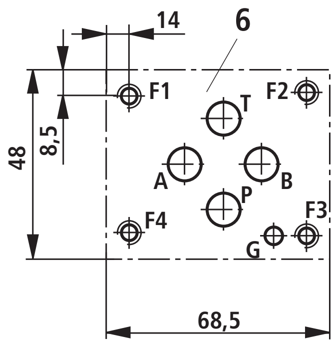
	Leakage oil at	100 bar	P → A	50 cm³/min
			P → B	70 cm³/min
	Flow at	Δp = 35 bar	A → T	10 ... 20 l/min
		q_n = 50/100 l/min	B → T	7 ... 20 l/min
	Leakage oil at	100 bar	P → A	50 cm³/min
			P → B	70 cm³/min
			A → T	70 cm³/min
			B → T	50 cm³/min

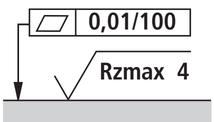
Fail-safe	p = 0 bar => 12 ms	Enable "off" or internal shut-off in case of error
	p = 100 bar => 16 ms	U_B ≤ 18 V or I ≤ 2 mA (at 4…20 mA signal)

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

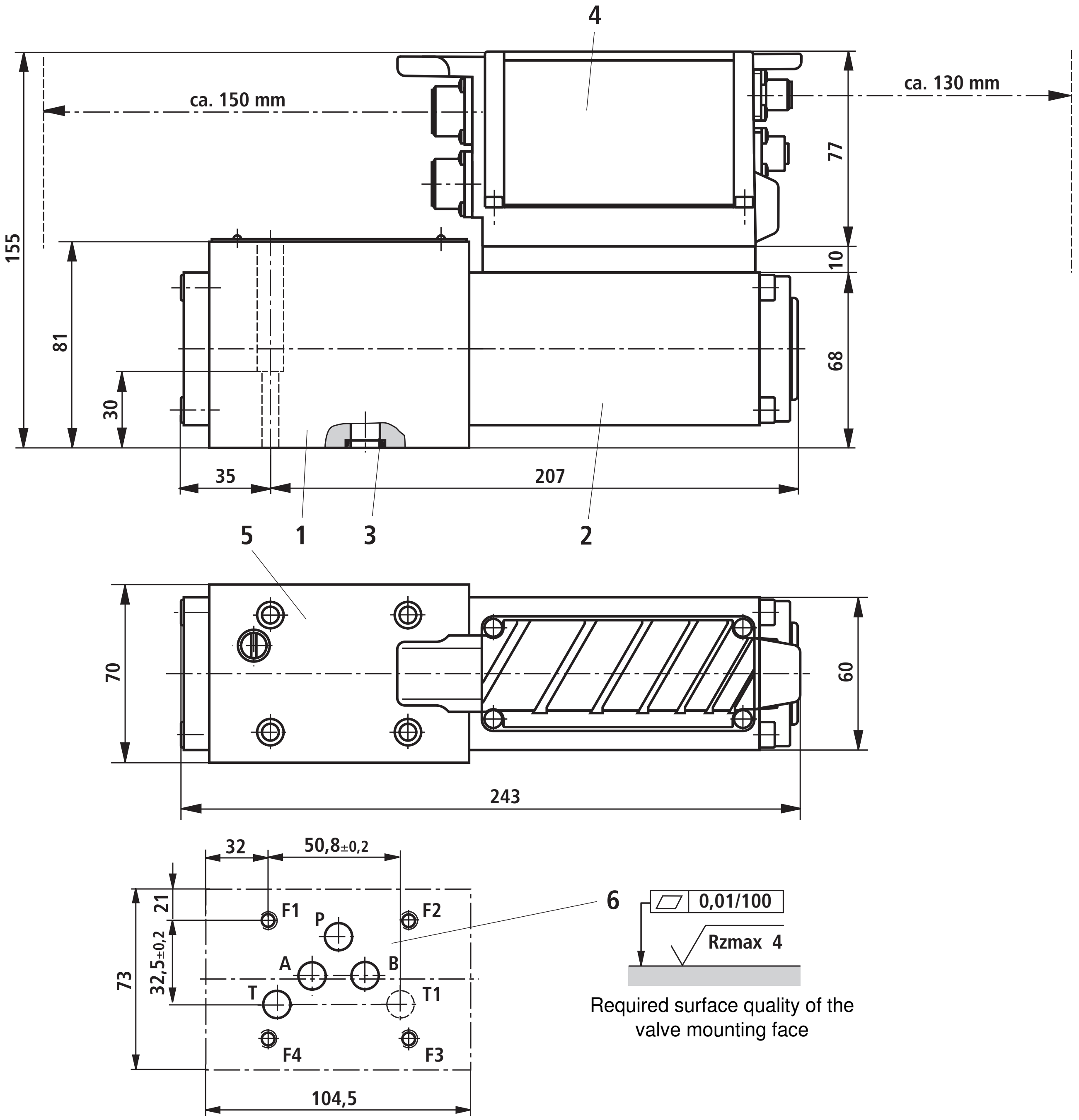
5 Name plate

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

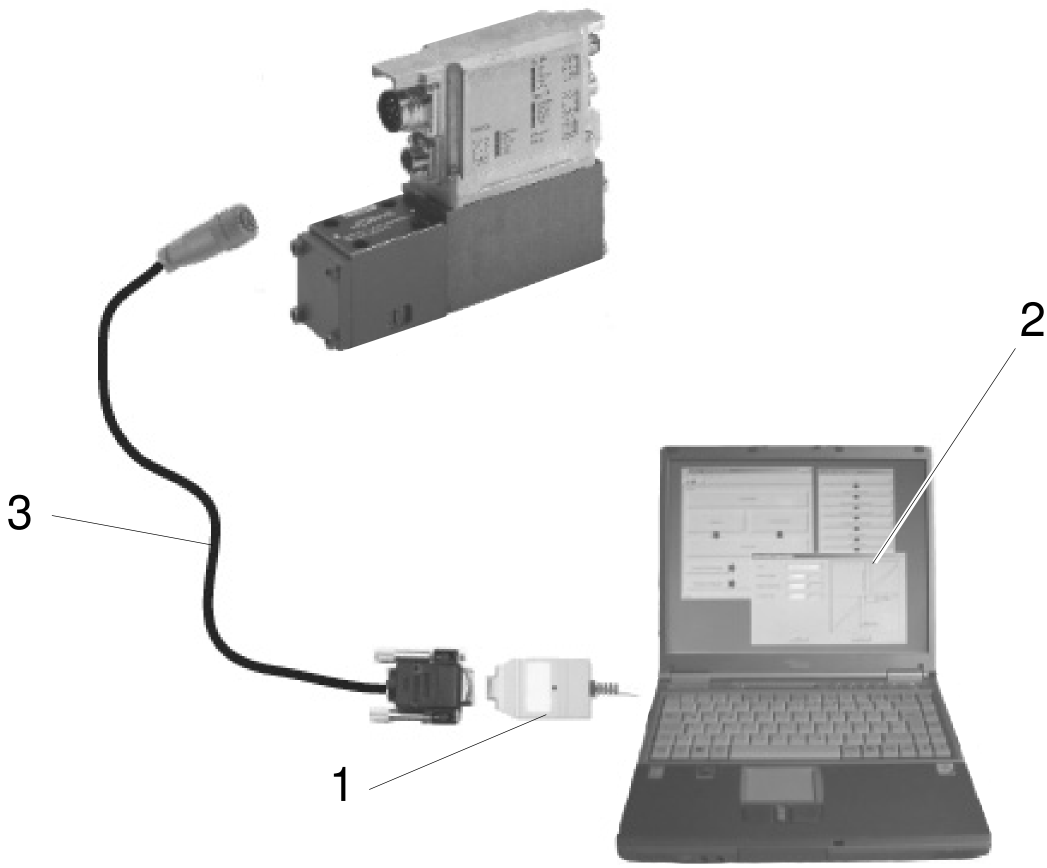
6 Machined valve mounting face, porting pattern according to ISO 4401-05-04-0-05

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	
3 Connecting cable, 3 m	D-Sub / M12 (coding A), Mat. no. **R900751271**	D-Sub / M12 (coding B), Mat. no. **R901078053**

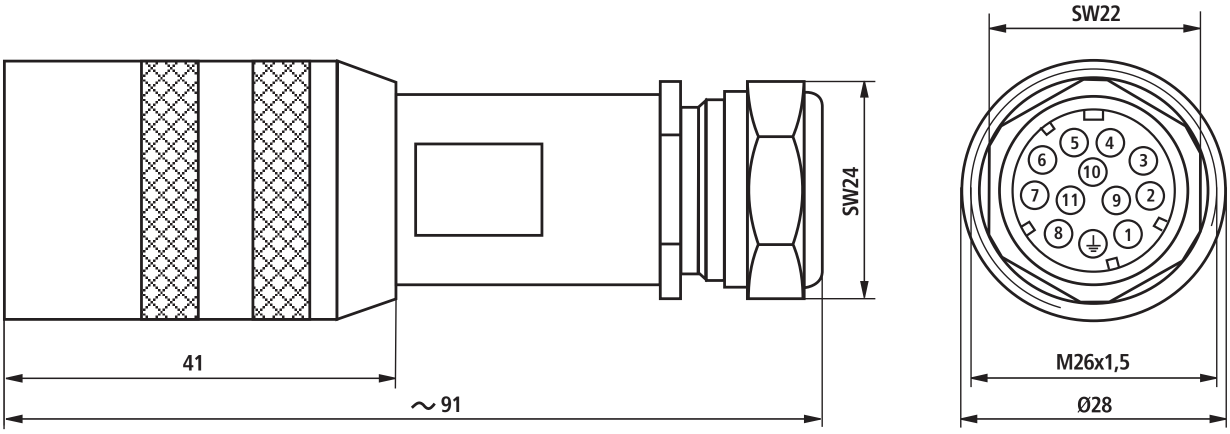


Accessories, port X1 (not included in scope of delivery)

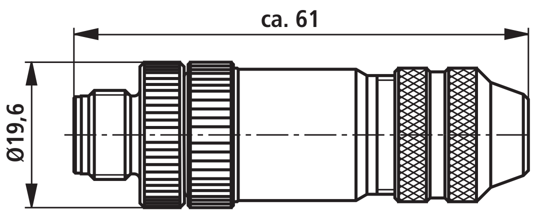
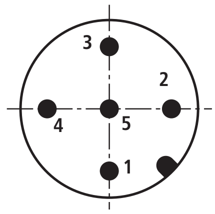
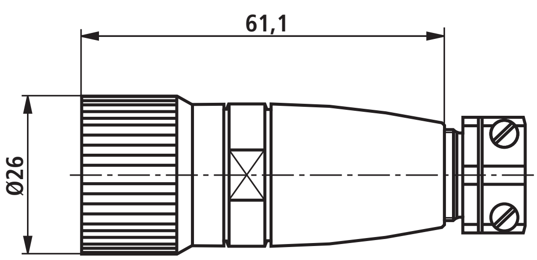
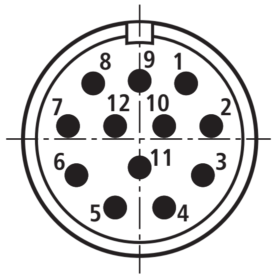
Mating connector for X1

Mating connector according to EN 175201-804 (12-pole, metal design)

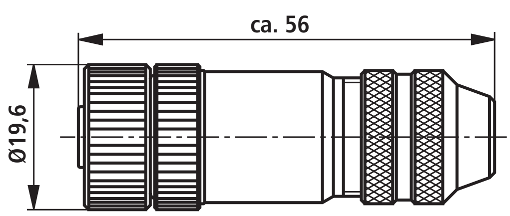
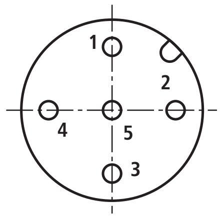
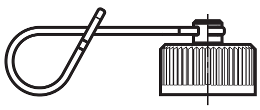
- Mating connector (construction set) for a cable diameter of 12-15 mm — Material no. **R901268000**
- Mating connector with 5 m cable, 12 x 0.75 mm^2 with cable shield, assembled — Material no. **R901272854**
- Mating connector with 20 m cable, 12 x 0.75 mm^2 with cable shield, assembled — Material no. **R901272852**



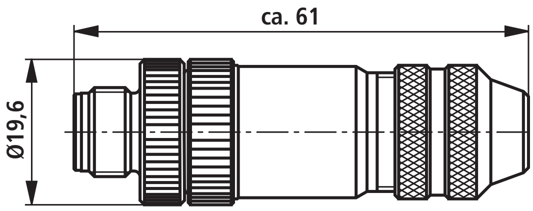
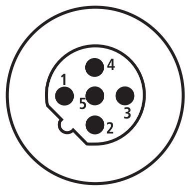
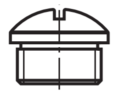
Accessories, sensor connections (not included in scope of delivery)

Description	View, dimensions	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

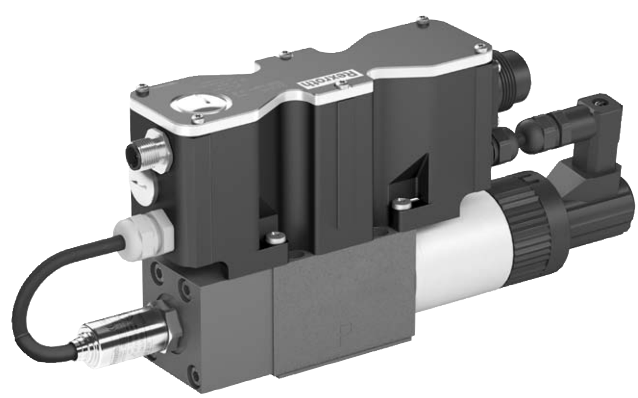
Maintenance instructions:
- The devices have been tested in the plant and are supplied with default settings.
- Only complete units can be repaired. Repaired devices are returned with default settings.
  User-specific settings are not maintained. The operator will have to retransfer the corresponding 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)!

Proportional directional valve, direct operated, with *pQ* functionality

Type STW 0195 and STW 0196

RE 29014
Edition: 2015-05
Replaces: 2013-03



H8064

- Sizes: 6 and 10
- Component series 1X, 2X

Features

- 3-way proportional directional valve with integrated IAC-P digital control electronics
- 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)
- ISO 4401 porting pattern
- Analog interfaces for command and actual values
- Design for CAN bus with DS 408 CANopen protocol or DP Profibus
- Quick commissioning via PC and WINPED commissioning software

Contents

Ordering codes

01	02		03		04	05	06		07	08	09		10
STW		–		/		V		–	24			–	*

01	3-way proportional directional valve with integrated IAC-P digital control electronics	**STW**

02	Size 6	**0195**
	Size 10	**0196**

03	Component series 10 ... 19 (10 ... 19: unchanged installation and connection dimensions) - size 10	**1X**
	Component series 20 ... 29 (20 ... 29: unchanged installation and connection dimensions) - size 6	**2X**

Rated flow

04	**– Size 6** (model “0195”)	
	P → A: 10 l/min, A → T: 20 l/min	**1**
	P → A: 20 l/min, A → T: 20 l/min	**2**
	– Size 10 (model “0196”)	
	P → A: 65 l/min, A → T: 60 l/min, B → T: 60 l/min	**1**

Seal material

05	FKM seals	**V**
	Observe compatibility of seals with hydraulic fluid used! (Other seals upon request)	

Pressure rating of the integrated pressure sensor

06	Nominal pressure: 50 bar	**3**
	Nominal pressure: 160 bar	**5**
	Nominal pressure: 250 bar	**8**

Supply voltage

07	Direct voltage 24 V	**24**

Bus interface

08	CANBus DS - 408	**C**
	Profibus DP V0/V1	**P**

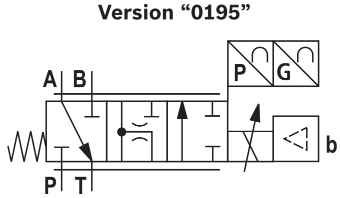
Interface

09	± 10 VDC	**A6**
	4 ... 20 mA	**F6**

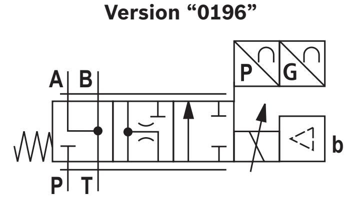
10	Further details in the plain text	*

Symbols

Version “0195”



Version “0196”



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***)
  - Override control ***p/Q***
- The command value can be defined either 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 may be read additionally 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 (diagnostics):

- Cable break of pressure sensor supply line (6)
- Undervoltage
- Cable break position transducer (5)
- Communication error
- Watchdog
- Cable break of command value inputs

The following additional functions are available:

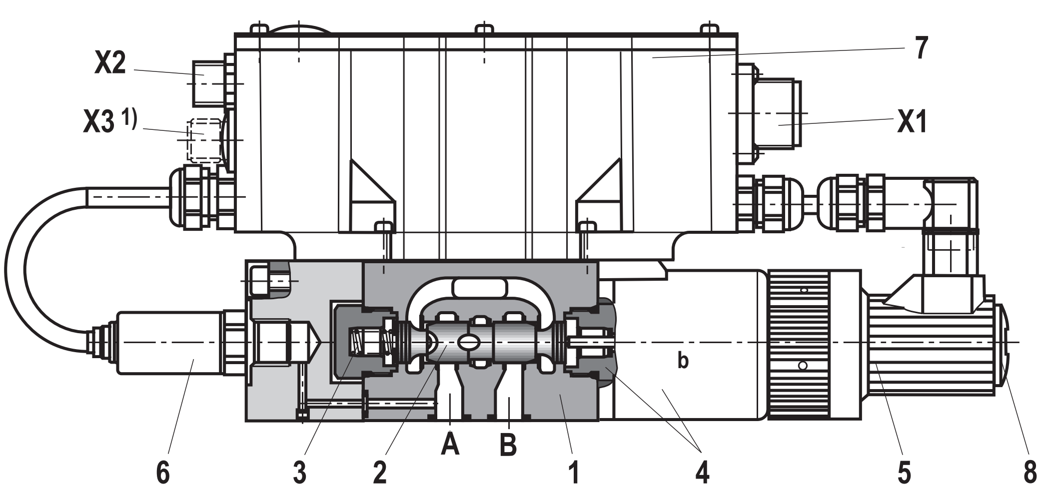
- Pressure ramp
- Internal command value profile
- Release function analog/digital
- Error output 24 V.

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
- Diagnostics
- Comfortable data administration on a PC
- PC operating systems: Windows 2000 or Windows XP

$Q_{command}$	***Q*** control	***p*** closed-loop control
< 12 mA	A → T	inactive
> 12 mA	Override 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: $Q_{actual} \leq Q_{command}$	



Type STW0195-2X/...

1) Only available with Profibus

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. If required by the installation conditions, use a suitable preload valve.

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			
Size	S	6 (“0195”)	10 (“0196”)
Weight	kg	2.4	6.5
Installation position		any, preferably horizontal	
Ambient temperature range	°C	-20 ... +50	
Storage temperature range	°C	-20 ... +80	

Hydraulic [1]					
Operating pressure [2]	▶ Ports P, A, B (with sensor)	“3”	bar	50	
		“5”	bar	160	
		“8”	bar	250	
	▶ Port T (with sensor)	“3”	bar	50	
		“5”	bar	160	
		“8”	bar	210	
Rated flow $q_{V\ nom}$ (with Δp = 5 bar; see also characteristic curves starting on page 7)	▶ P → A	“1”	l/min	10	65
		“2”	l/min	20	–
	▶ A → T	“1”	l/min	20	–
		“2”	l/min	20	–
	▶ A → T, B → T	“1”	l/min	–	60
Max. flow			l/min	See performance limit starting on page 9	
Hydraulic fluid				See table below	
Hydraulic fluid temperature range (at the valve operating ports)			°C	-20 ... +80; preferably +40 ... +50	
Viscosity range			mm^2/s	20 ... 380; preferably 30 ... 46	
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)				Class 20/18/15 [3]	
Hysteresis			%	≤ 0.1	
Range of inversion			%	≤ 0.05	
Response sensitivity			%	≤ 0.05	
Zero shift			%10 K	≤ 0.15	
			%100 bar	≤ 0.1	

Hydraulic fluid		Classification	Suitable sealing materials	Standards	Data sheet
Mineral oils		HL, HLP, HLPD, HVLP, HVLPD	NBR, FKM	DIN 51524	90220
Bio-degradable	▶ Insoluble in water	HETG	NBR, FKM	ISO 15380	90221
		HEES	FKM		
	▶ Soluble in water	HEPG	FKM	ISO 15380	
Flame-resistant	▶ Water-free	HFDU, HFDR	FKM	ISO 12922	90222
	▶ Containing water	HFC (Fuchs Hydrotherm 46M, Petrofer Ultra Safe 620)	NBR	ISO 12922	90223

Important information on hydraulic fluids:
- For more information and data about the use of other hydraulic fluids, refer to data sheets above 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
  - Life cycle as compared to operation with mineral oil HL, HLP 50 to 100%
- **Bio-degradable and flame-resistant:** When using these hydraulic fluids that are simultaneously zinc-solving, zinc may accumulate (700 mg zinc per pole tube).

1) Measured using HLP 46; ϑ_{Oil} = 40 °C ± 5 °C and p = 100 bar

2) Operating pressure, dependent on valve and sensor

3) 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.

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

electrical			
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
	▶ Impulse current	A	3
Command value signals		mA	4 ... 20 (or via CAN bus)
Duty cycle [1]		%	100
Maximum coil temperature [2]		°C	150
Protection class according to DIN EN 60529			IP 65 with mating connector correctly mounted and locked

Sensor technology					
Measurement range	▶ p_N	bar	50	160	250
Overload protection	▶ p_{max}	bar	110	320	500
Bursting pressure	▶ p	bar	200	640	1000
Temperature coefficient for zero point and range within the nominal temperature range [3]			< 0.1% / 10 K		
Characteristic curve deviation			< 0.2%		
Hysteresis			< 0.1%		
Repetition accuracy			< 0.05%		
Setting time (10 ... 90%)		t	< 1 ms		
Long-term drift (1 year) under reference conditions			< 0.1%		
Conformity			CE according EMC directive EN 61000-6-2 / EN 61326-2-3 and EN 61000-6-3 / EN 61326-2-3		

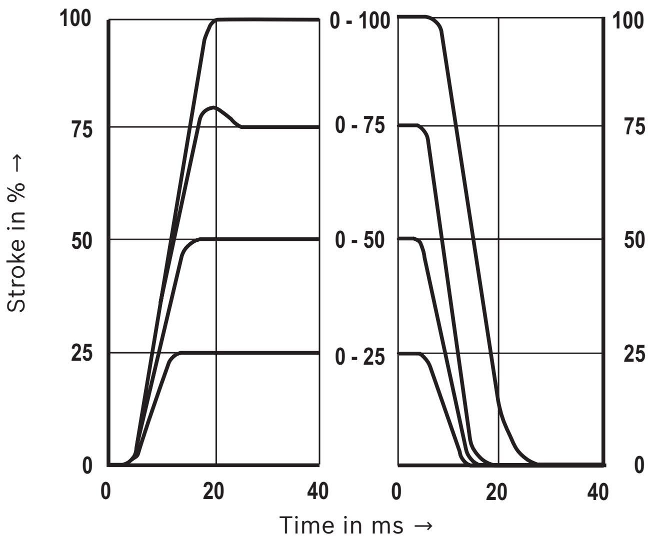
1) Connect the valve to the supply voltage only when this is required for the functional processes of the machine.

2) Due to the surface temperatures of the solenoid coils, the standards ISO 13732-1 and ISO 4413 need to be adhered to!

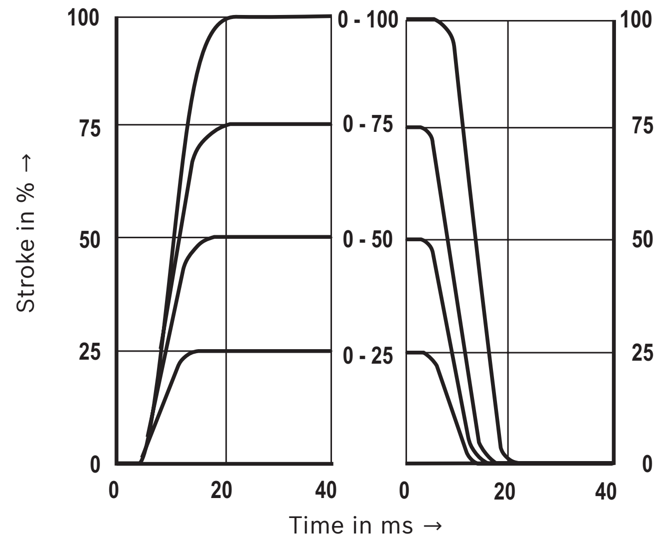
3) related to the complete measurement range, including non-linearity, hysteresis, zero point and end value deviation (corresponds to the measuring deviation according to IEC 61298-2)

Characteristic curves: Size 6 (“0195...1”) (measured with HLP46, ϑ_{Oil} = 40 ± 5 °C)

Transition function (A → T)

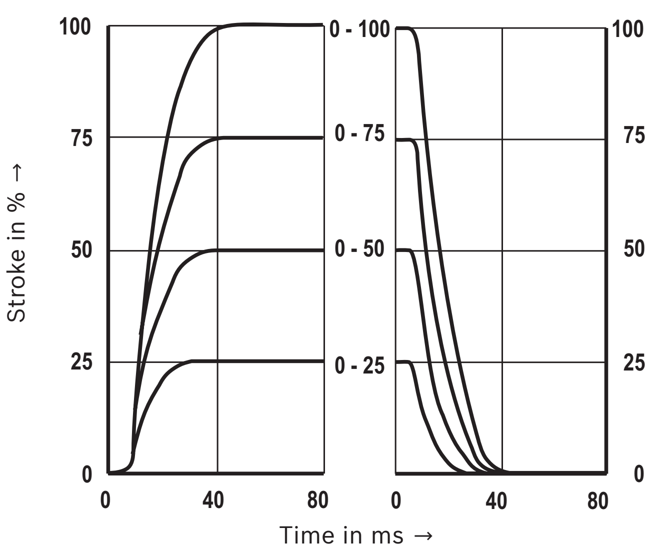


Transition function (P → A)

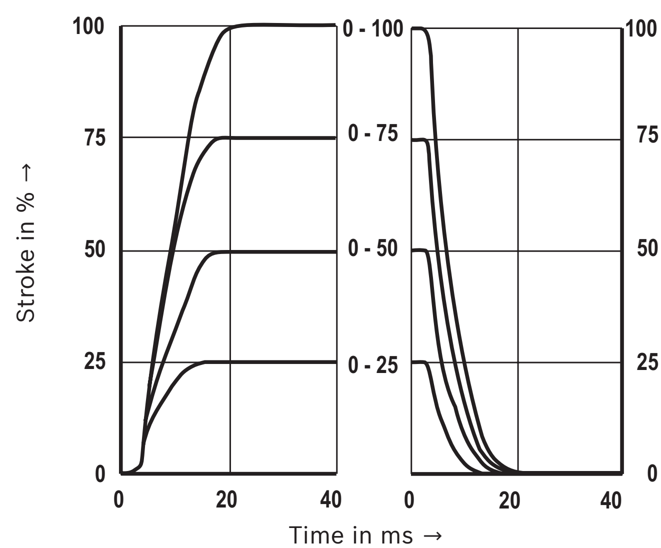


Characteristic curves: Size 10 (“0196...1”) (measured with HLP46, ϑ_{Oil} = 40 ± 5 °C)

Transition function (A → T and B → T)



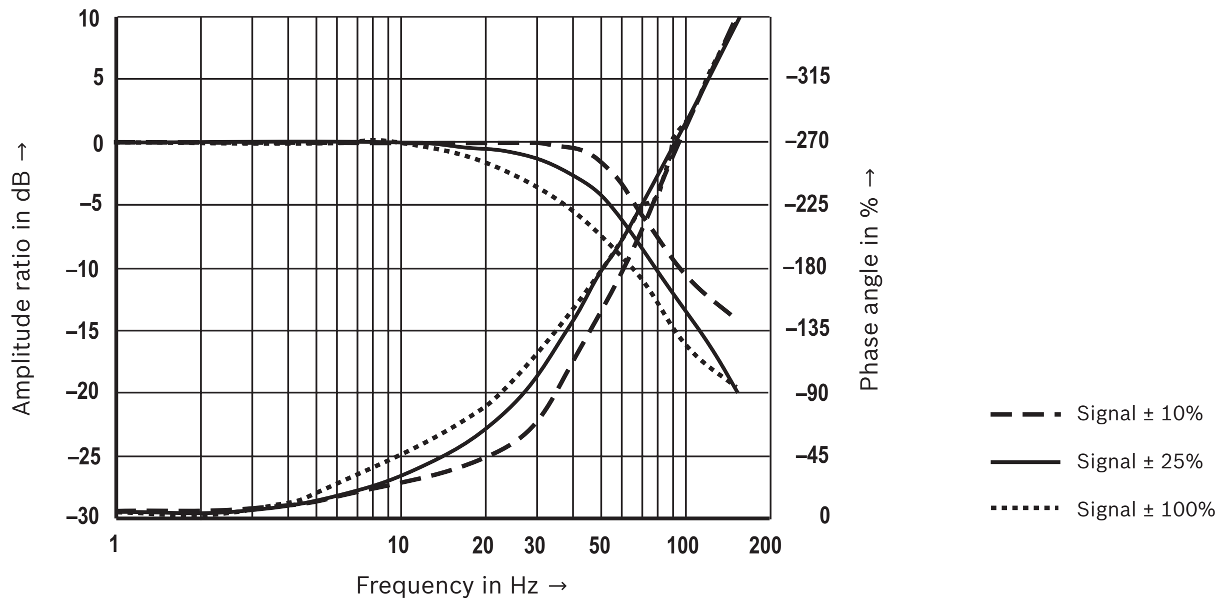
Transition function (P → A)



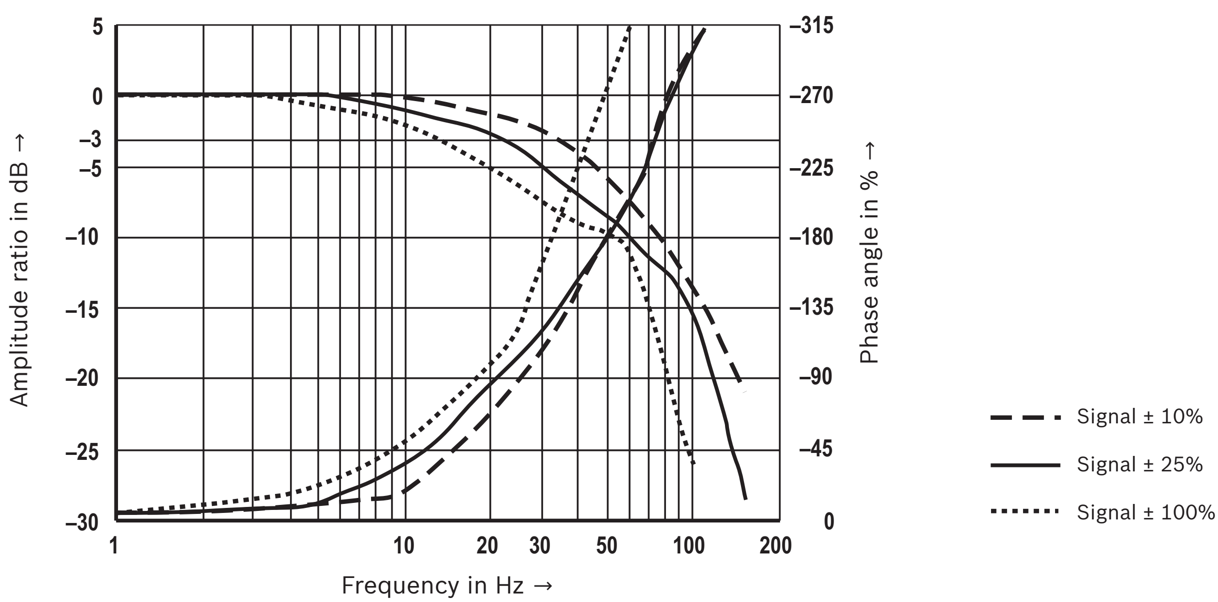
Characteristic curves

(measured with HLP46, ϑ_{Oil} = 40 ± 5 °C)

Frequency response, Size 6 (“0195...1”)

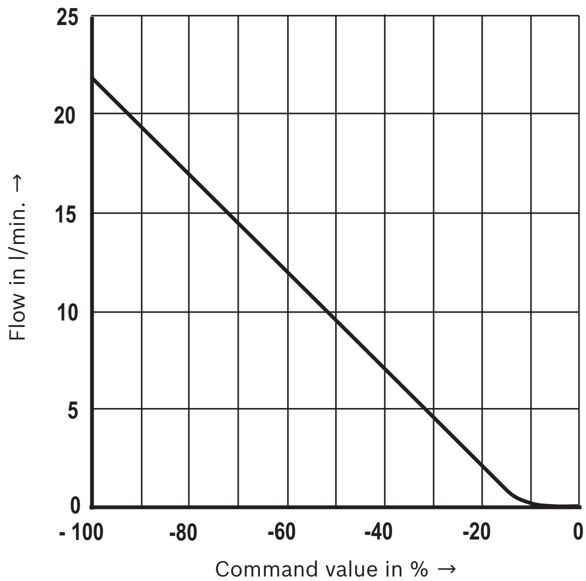


Frequency response, Size 10 (“0196...1”)

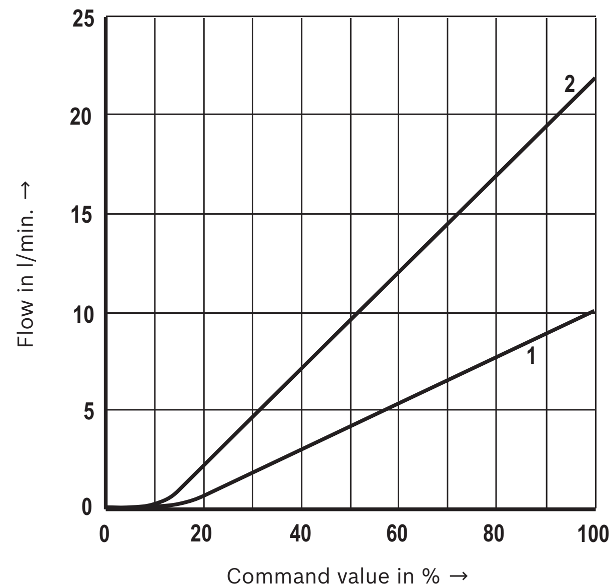


Characteristic curves: Size 6 ("0195...")
(measured with HLP46, ϑ_{Oil} = 40 ± 5 °C)

Flow characteristic curve (A → T, ***Δp*** = 5 bar)



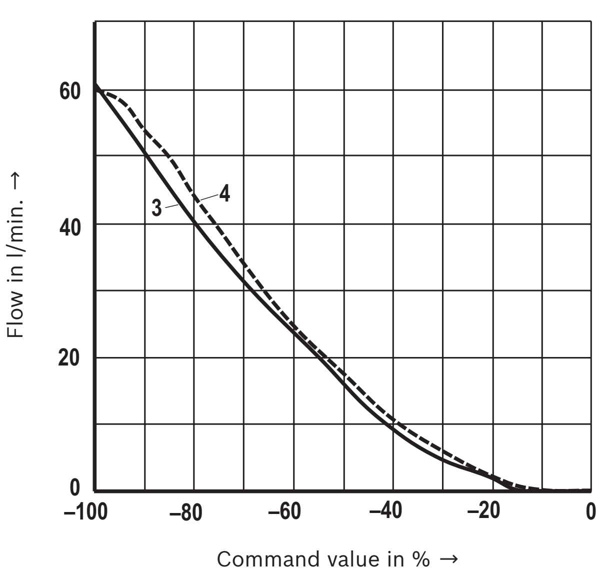
Flow characteristic curve (P → A, ***Δp*** = 5 bar)



1 Version "0195...1")
2 Version "0195...2")

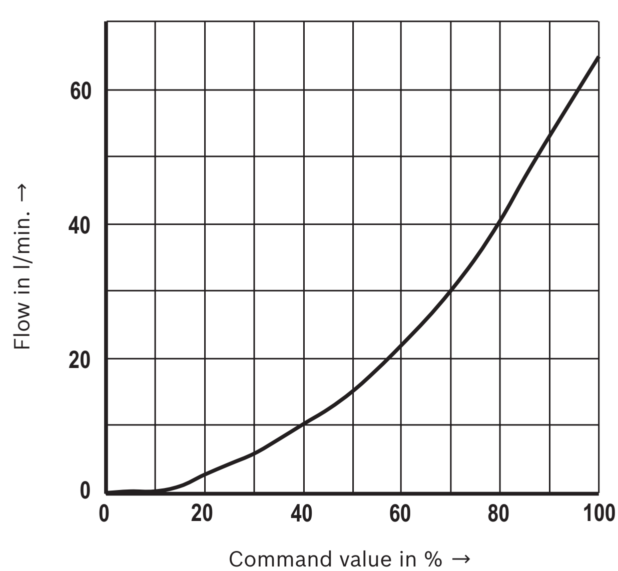
Characteristic curves: Size 10 ("0196")
(measured with HLP46, ϑ_{Oil} = 40 ± 5 °C)

Flow characteristic curve (A/B → T, ***Δp*** = 5 bar)



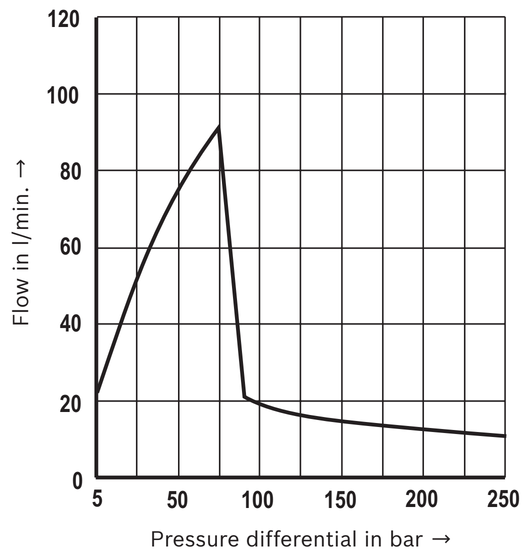
3 A → T
4 B → T

Flow characteristic curve (P → A, ***Δp*** = 5 bar)

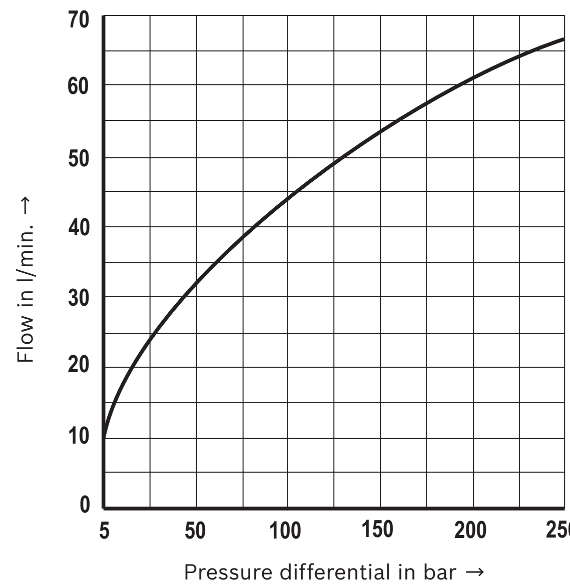


Performance limits: Size 6 (“0195...”)
(measured with HLP46, ϑ_{Oil} = 40 ± 5 °C)

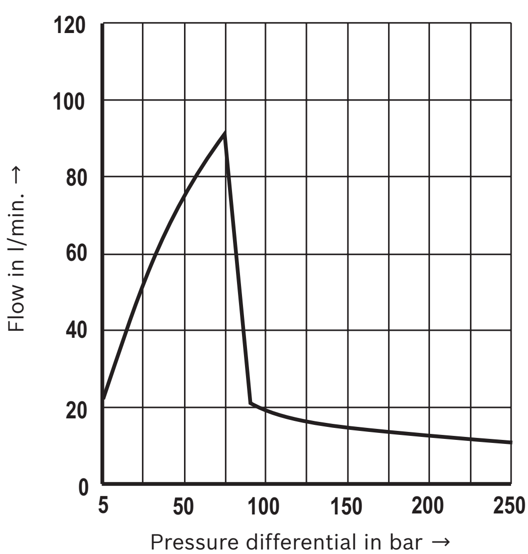
Position-controlled
(P → A: 10 l/min, A → T: 20 l/min – **A** → **T**)



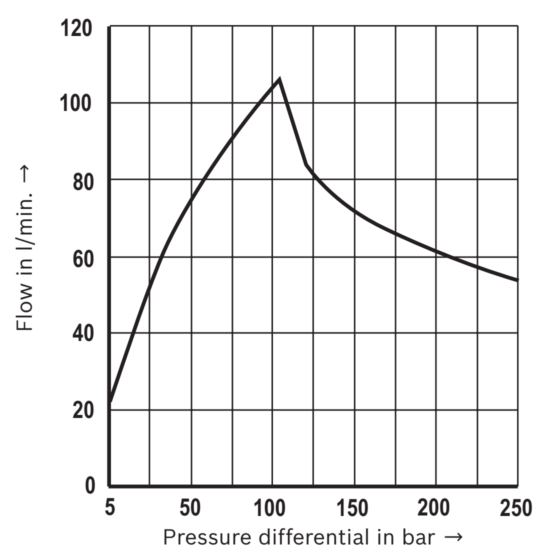
Position-controlled
(P → A: 10 l/min, A → T: 20 l/min – **P** → **A**)



Position-controlled
(P → A: 20 l/min, A → T: 20 l/min – **A** → **T**)

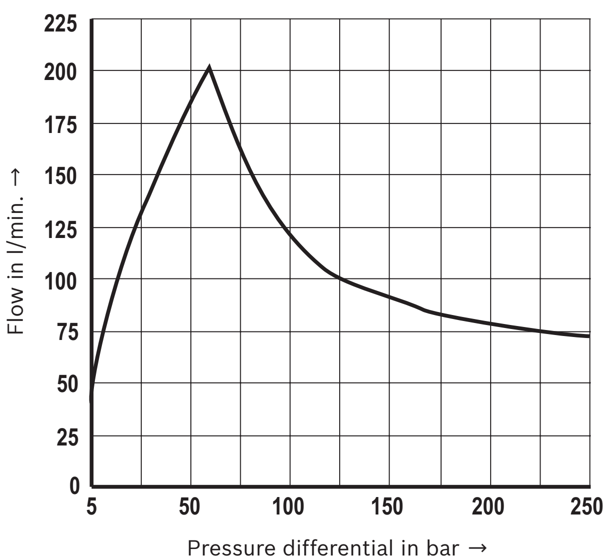


Position-controlled
(P → A: 20 l/min, A → T: 20 l/min – **P** → **A**)

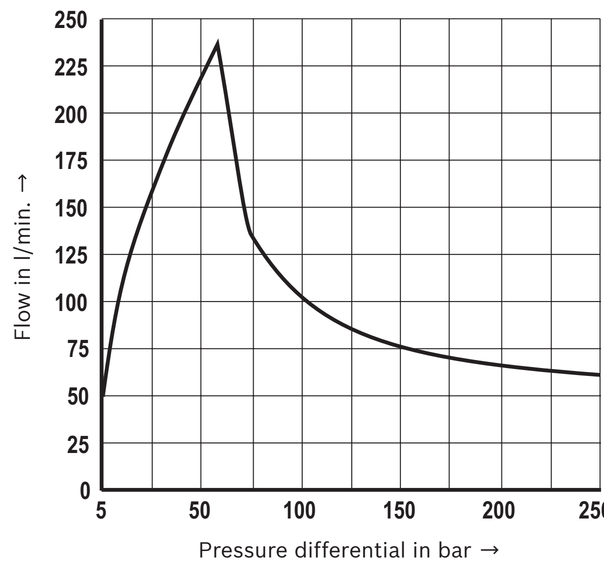


Performance limits: Size 10 (“0196”)
(measured with HLP46, ϑ_{Oil} = 40 ± 5 °C)

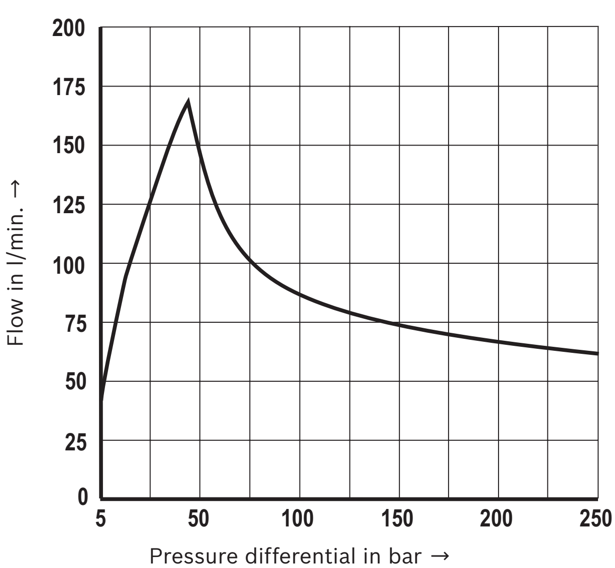
Position-controlled (A → T)



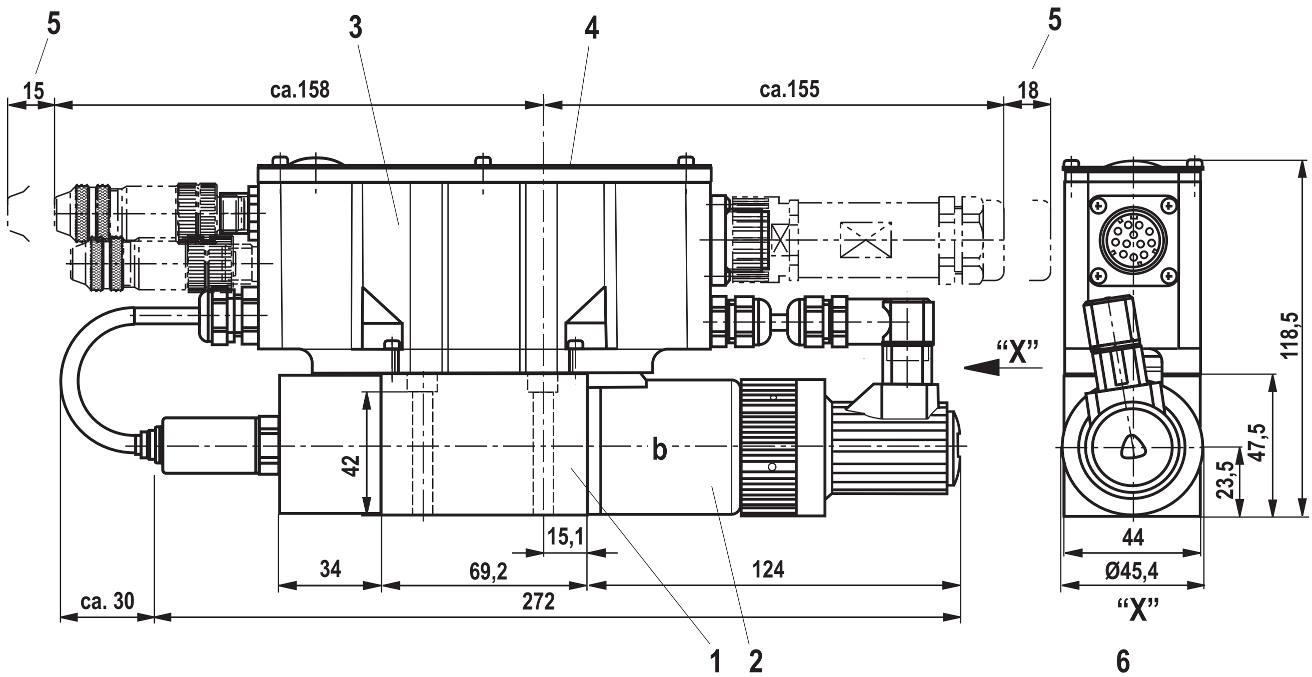
Position-controlled (P → A)

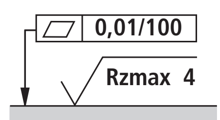


Position-controlled (B → T)

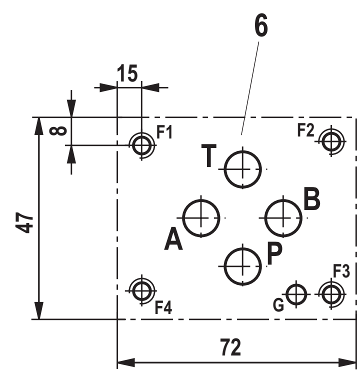


Dimensions: Size 6 (“0195”)
(dimensions in mm)





Required surface quality
of the valve contact surface

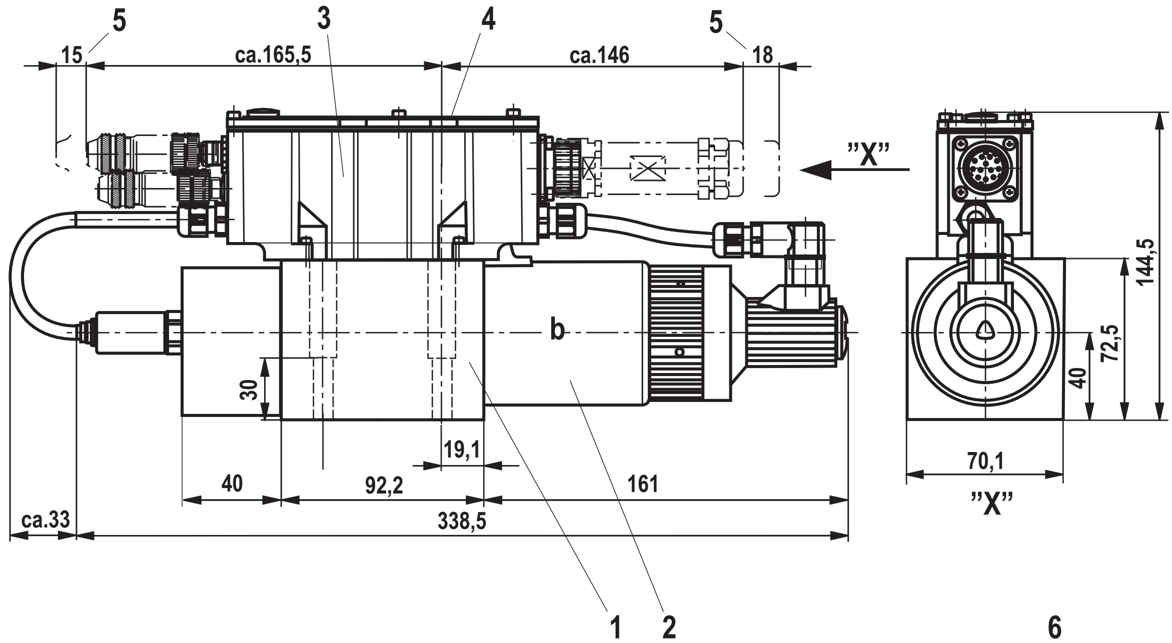


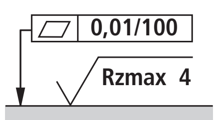
- **1** Valve housing
- **2** Proportional solenoid “b” with inductive position transducer
- **3** Integrated digital control electronics
- **4** Name plate
- **5** Space required to remove the connector
- **6** Machined valve contact surface
  porting pattern according to ISO 4401-03-02-0-05
  Deviating from the standard:
  - Ports P, A, B and T with Ø 8 mm
  - Locating pin not available

Note:
The dimensions are nominal dimensions which are subject to tolerances.

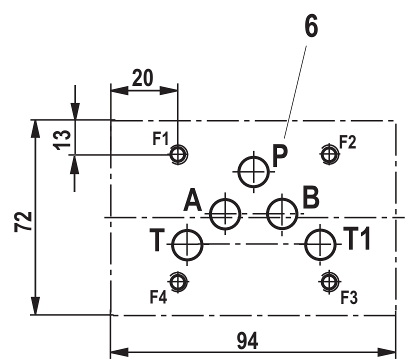
Subplates and valve mounting screws see page 13.

Dimensions: Size 10 (“0196”)
(dimensions in mm)





Required surface quality of the valve contact surface



- **1** Valve housing
- **2** Proportional solenoid “b” with inductive position transducer
- **3** Integrated digital control electronics
- **4** Name plate
- **5** Space required to remove the connector
- **6** Machined valve contact surface
  Porting pattern in accordance with ISO 4401-05-04-0-05
  Deviating from the standard:
  Port T1 exists additionally

Note:
The dimensions are nominal dimensions which are subject to tolerances.

Subplates and valve mounting screws see page 13.

Dimensions

Valve mounting screws (separate order)

Size	Hexagon socket head cap screws	Material number
6 ("0195")	**4 hexagon socket head cap screws ISO 4762 - M5 x 50 - 10.9-flZn-240h-L** tightening torque $\boldsymbol{M}_A$ = 7 Nm ± 10%	**R913000064**
	4 hexagon socket head cap screws ISO 4762 - M5 x 50 Tightening torque $\boldsymbol{M}_A$ = 8.9 Nm ± 10%	Not in the Rexroth delivery range
10 ("0196")	**4 hexagon socket head cap screws ISO 4762 - M6 x 40 - 10.9-flZn-240h-L** tightening torque $\boldsymbol{M}_A$ = 12.5 Nm ± 10%	**R913000058**
	4 hexagon socket head cap screws ISO 4762 - M6 x 40 - 10.9 tightening torque $\boldsymbol{M}_A$ = 15.5 Nm ± 10%	Not in the Rexroth delivery range

☞ **Notice:**
The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.

Subplates (separate order)

Size	Data sheet	Material number
6 ("0195")	45052	–
10 ("0196")	45054	–

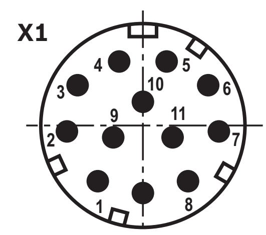
Electrical connections, assignment

Connector pin assignment X1, 11-pole + PE according to DIN EN 175201-804

Pin	Core marking [1]	Interface A6 allocation	Allocation Interface F6
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 kΩ
8	red	0 ... 10 V actual value p	4 ... 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 (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	

☞ **Notice:**
Connect shield to PE only on the supply side.

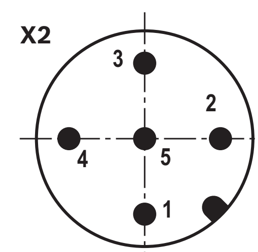
[1] Litz wire colors of the connection line for mating connector with cable set (see accessories page 17)



Connector pin assignment X2, CAN bus, (coding A), M12 x 1, 5-pole, pins

Pin	Assignment
1	n.c.
2	n.c.
3	CAN_GND
4	CAN_H
5	CAN_L

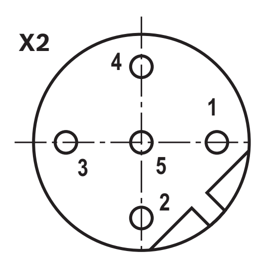
Transmission rate 20 ... 1000 kBit/s
Bus address 1 ... 127
CAN-specific settings:
Baud rate and identifier must be set via the bus system.



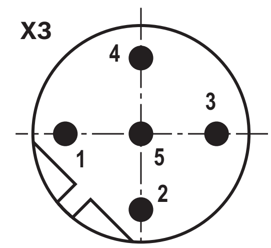
Connector pin assignment for Profibus DP, "X2" / "X3" (coding B), M12 x 1, 5-pole, socket / pins

Pin	Assignment
1	+5V
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 ... 126
Setting via DIL switch



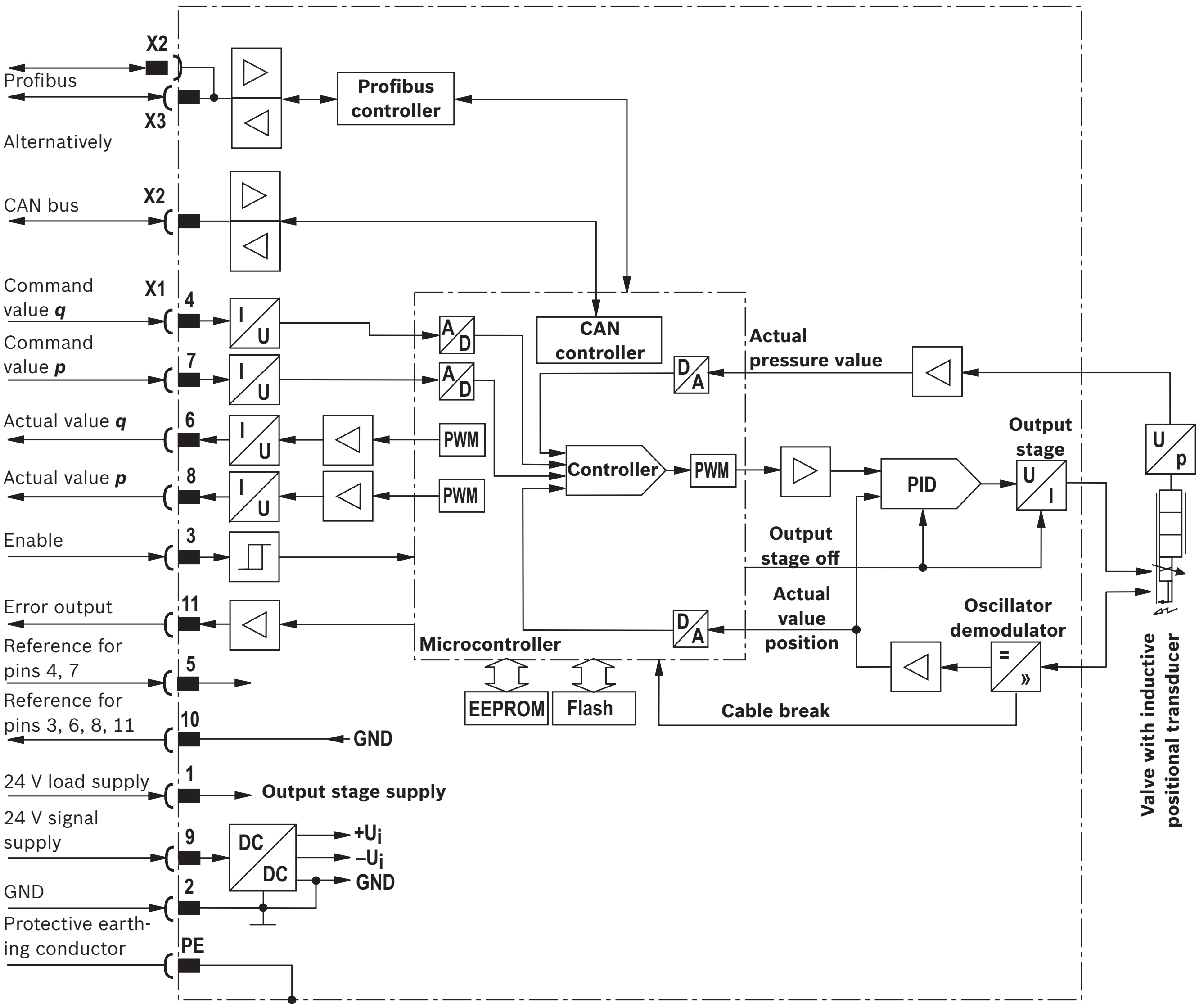
The +5V voltage of the IAC-P is available for an external terminating resistor.



☞ **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, assignment

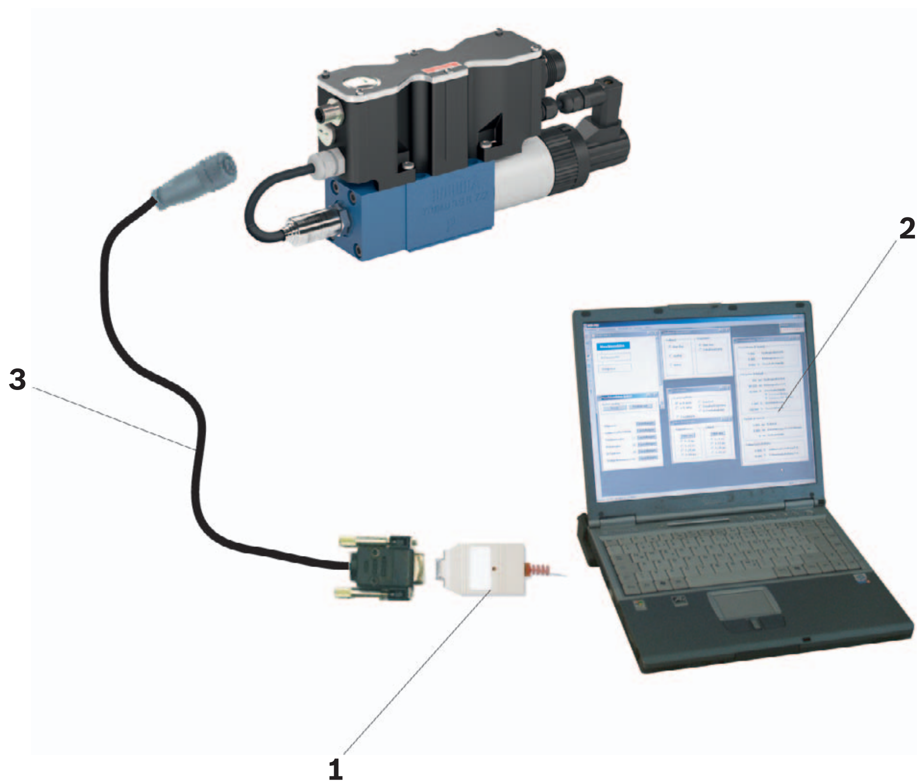
Block diagram, integrated control electronics



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 (recommended):	▶ 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

Accessories (separate order)

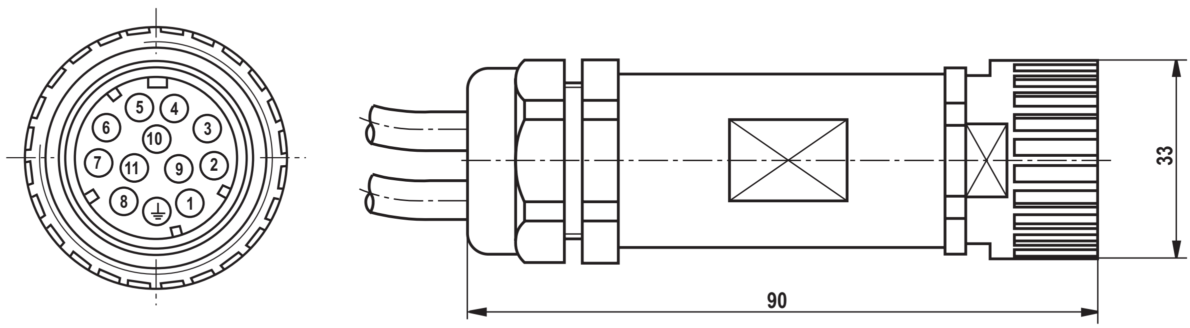
The following is required for the parameterization via PC:	**CANopen**	**Profibus DP**
1 interface converter (USB)	VT-ZKO-USB/CA-1-1X/V0/0 Material no.: **R901071963**	VT-ZKO-USB/P-1-1X/V0/0 Material no.: **R901071962**
2 Commissioning software	WINPED	
3 Connection cable, 3 m	D-Sub / M12, coding A Material no.: **R900751271**	D-Sub / M12, coding B Material no.: **R901078053**



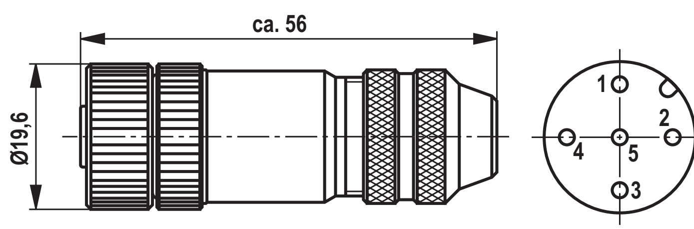
Accessories (separate order)

Port X1

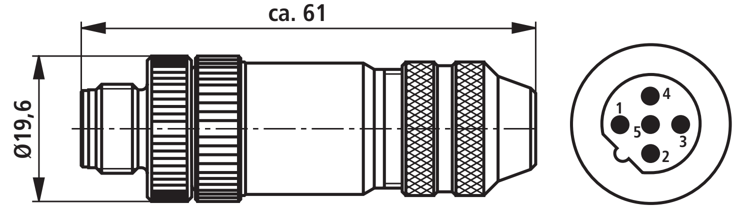
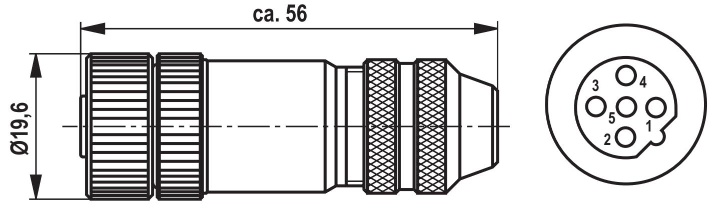
Mating connector for X1	Dimensions	Material number
Mating connector according to DIN EN 17520-804 (11-pole + PE), plastic variant	Without cable (assembly kit)	**R900884671**
	With cable set 2 x 5 m 12-pole	**R900032356**
	With cable set 2 x 20 m 12-pole	**R900860399**



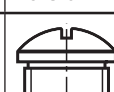
CAN bus (A coding)

Plug-in connector for X2	View, dimensions	Material number
Round connector, processable, 5-pole, M12 x 1 Straight mating connector in metal design	 (line diameter 6 ... 8 mm)	**R901076910**

Profibus (B coding)

Plug-in connector for X2 and X3	View, dimensions	Material number
X2 Round connector, processable, 5-pole, M12 x 1 Straight mating connector in metal design	 (line diameter 6 ... 8 mm)	**R901075545**
X3 Round connector, processable, 5-pole, M12 x 1 Straight mating connector in metal design	 (line diameter 6 ... 8 mm)	**R901075550**

Protective cap

Protective cap M12	Version	Material number
		**R901075563**

Project planning and maintenance instructions

- 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 must be expected, take appropriate measures to ensure the function (depending on the application, e.g. shielding, filtration).
- 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 machine end-user will have to retransfer the corresponding user parameters.

Further information

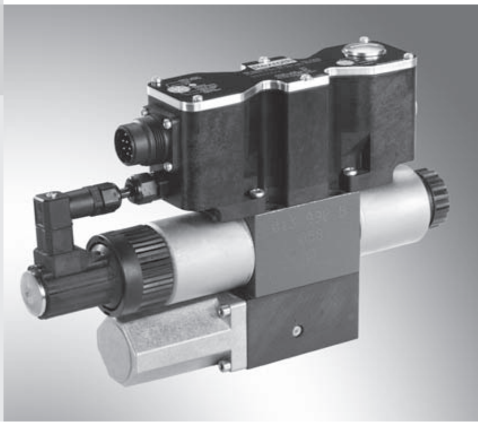
▶ Subplates	Data sheets 45052, 45054
▶ Hydraulic fluids on mineral oil basis	Data sheet 90220
▶ Environmentally compatible hydraulic fluids	Data sheet 90221
▶ Flame-resistant, water-free hydraulic fluids	Data sheet 90222
▶ Hydraulic valves for industrial applications	Data sheet 07600-B
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900
▶ CANopen protocol for IFB-P and IAC-P valves, protocol description	Data sheet 29015-01-Z
▶ Profibus protocol for IFB and IAC-P valves, protocol description	Data sheet 29015-02-Z
▶ Proportional directional valves with field bus interface, with and without integrated axis controller (IAC-P and IFB-P), operating instructions	Data sheet 29015-B
▶ Commissioning software and documentation on the Internet	
▶ Selection of the filters	

Rexroth
Bosch Group

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

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

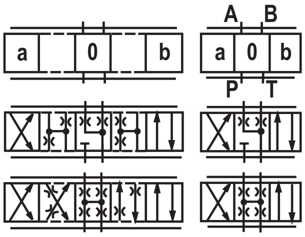
Ordering code

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 **= 2X**
(20 to 29: Unchanged installation and connection dimensions)

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

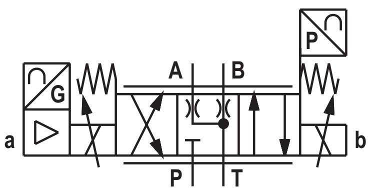
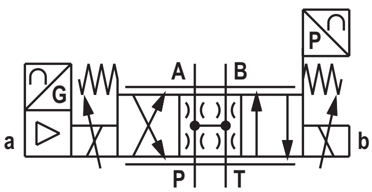
Electronics interface [5)]
A6 = ±10 VDC
F6 = 4 to 20 mA

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)

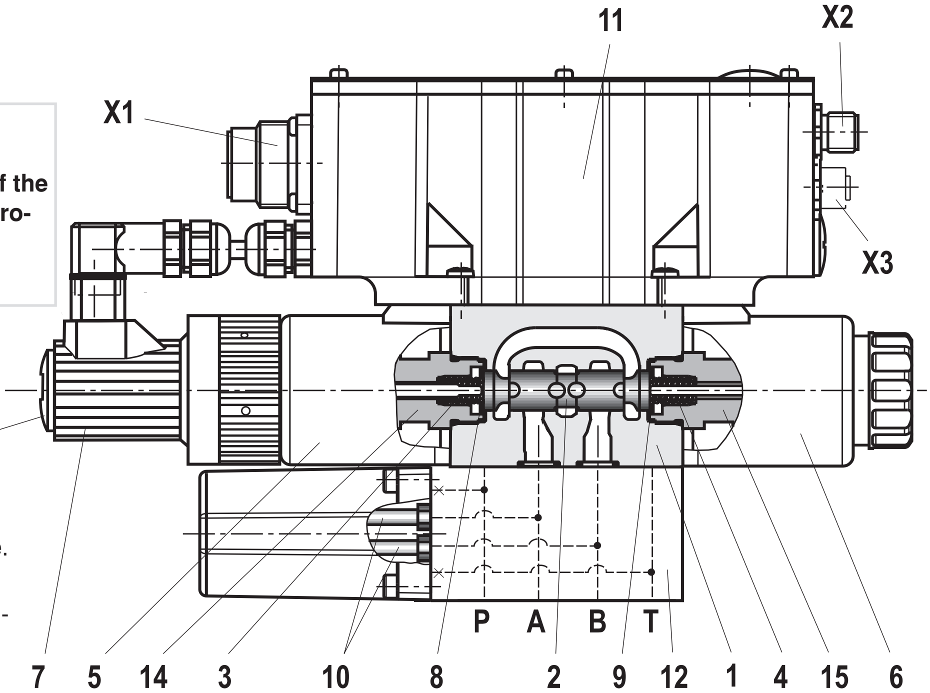
☞ **Important notice!**

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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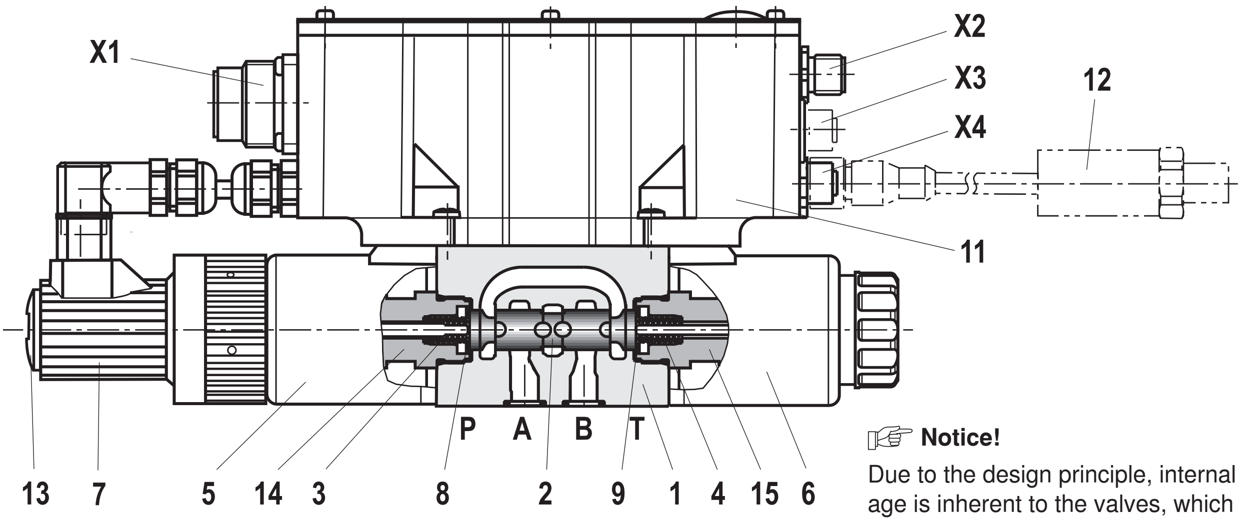

☞ Important notice!

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☞ 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.

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.

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 %.

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

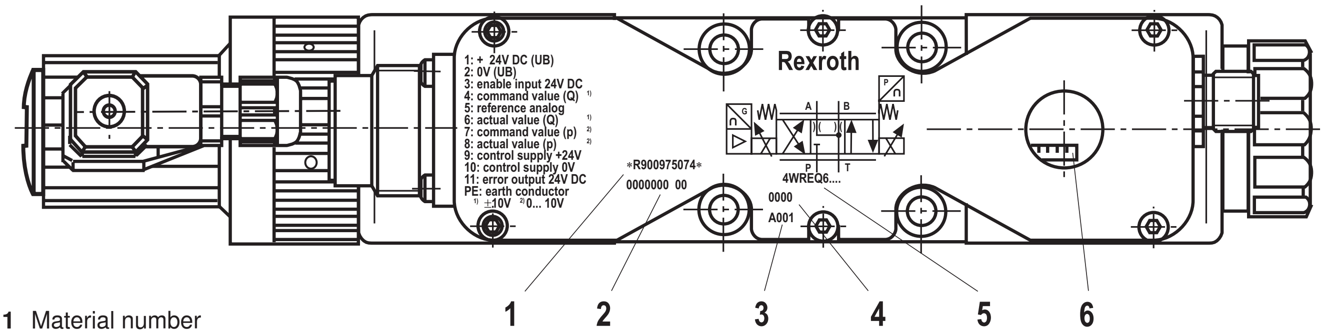
Measurement range	p_N	bar	**100**	**160**	**250**	**400**
Overload protection	p_{max}	bar	200	320	500	800
Bursting pressure	p	bar	400	640	1000	1600
Compensation error						
Zero point			< 0.25 % of the end value			
End value			< 0.5 %			
Temperature coefficients in the nominal temperature range						
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

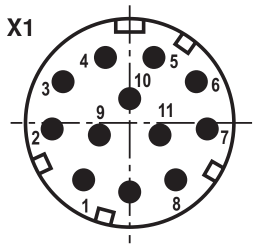
Control electronics (IAC-P), Electrical connections and allocation

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

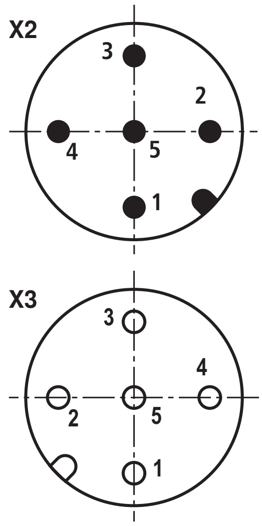
Connector pin assignment for CAN bus "X2"/"X3" (coding A), M12, 5-pin, pins/sockets

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.



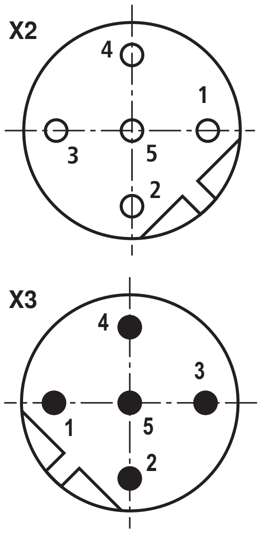
Connector pin assignment for PROFIBUS-DP, "X2"/"X3" (coding B), M12, 5-pin, socket/pins

Pin	Allocation
1	+5 V
2	RxD/TxD-N (A line)
3	D GND
4	RxD/TxD-P (B line)
5	Shield

The +5 V voltage of the IAC-P is available for an external terminating resistor.

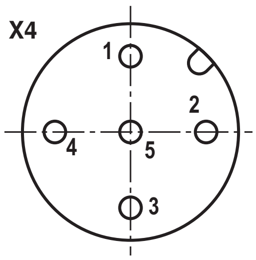
Transmission rate	up to 12 MBaud
Bus address	1 to 126

Setting via DIL switches



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.



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

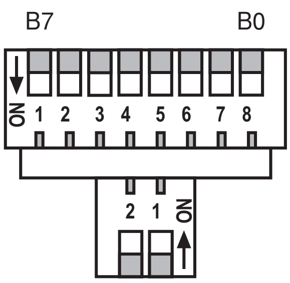
CANopen

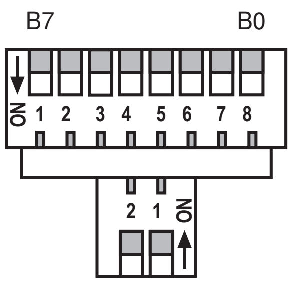
B7	B6	B5	B4	B3	B2	B1	B0	HEX	Baud rate: B7, B6	Address range: B5 to B0
0	0	0	0	0	0	0	0	00 [1]	Standard 20 kBaud or re-programmed	1 = standard or re-programmed
0	0	0	0	0	0	0	1	01	20 kBaud	1 to 63
					to			to		
0	0	1	1	1	1	1	1	3F		
0	1	0	0	0	0	0	0	40	125 kBaud	1 = standard or re-programmed
0	1	0	0	0	0	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

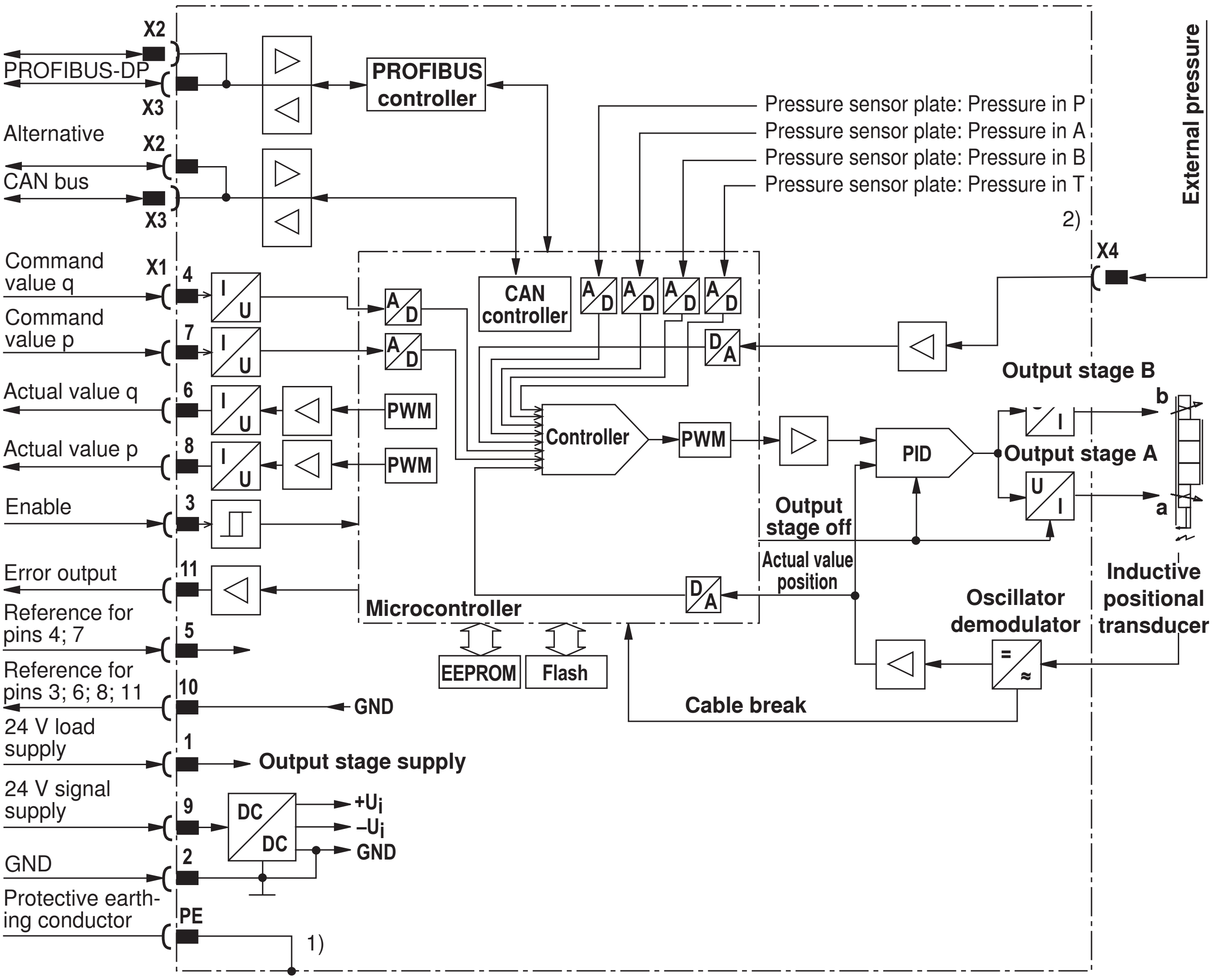




Connection of the bus terminator with the two lower switches (only with PROFIBUS-DP):

Left figure: Bus terminator not connected
Right figure: Bus terminator connected (both switches to "ON")

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

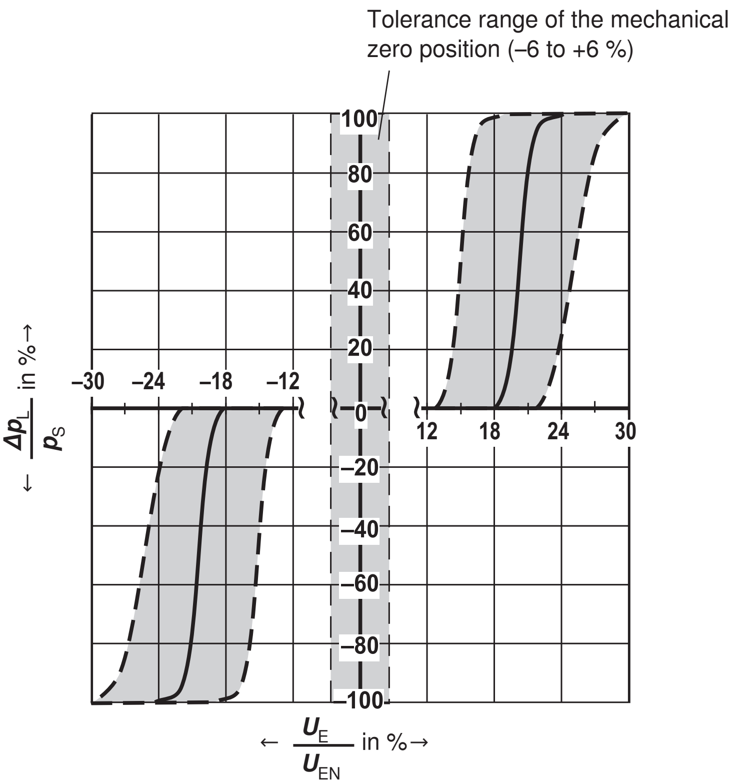
External diameter see sketch of mating connector

[1] The protective earthing conductor (PE) is connected to cooling element and valve housing

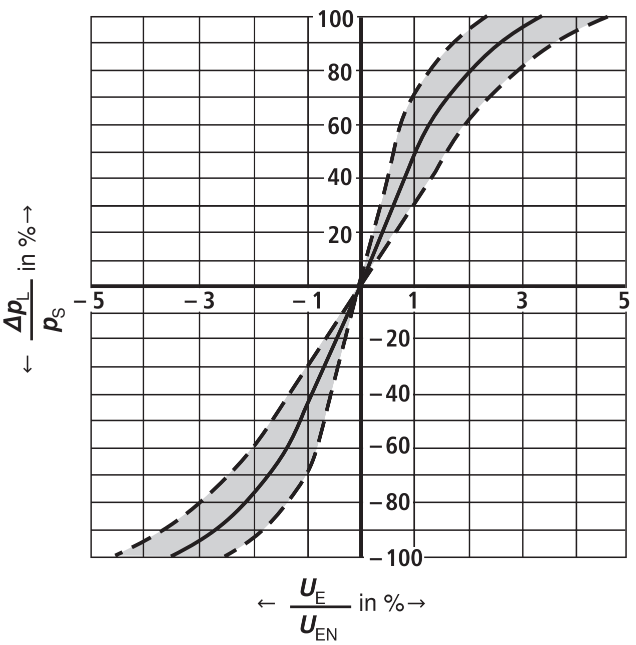
[2] Pressure transducer in P, A, B and T depending on ordering code or an external pressure sensor via the 5-pin M12 mating connector X4

Characteristic curves: Size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Pressure signal characteristic curve (Q5 control spool), p_s = 100 bar

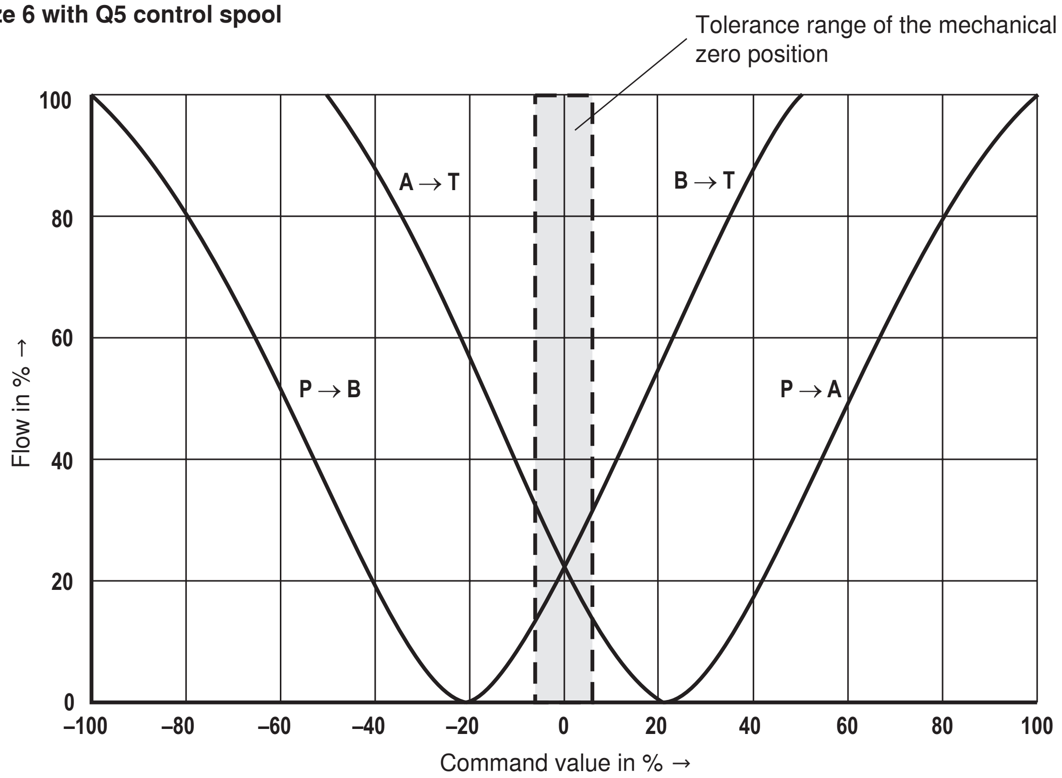


Pressure signal characteristic curve (V control spool), p_s = 100 bar

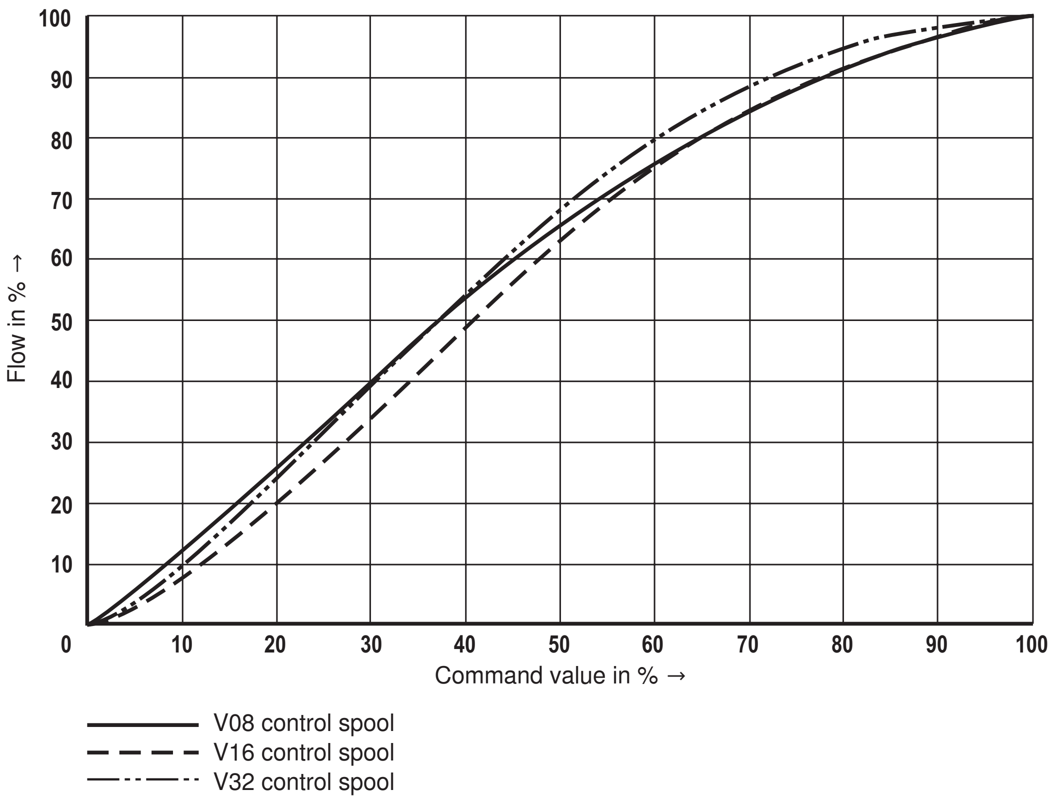


Characteristic curves: Size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow, size 6 with Q5 control spool

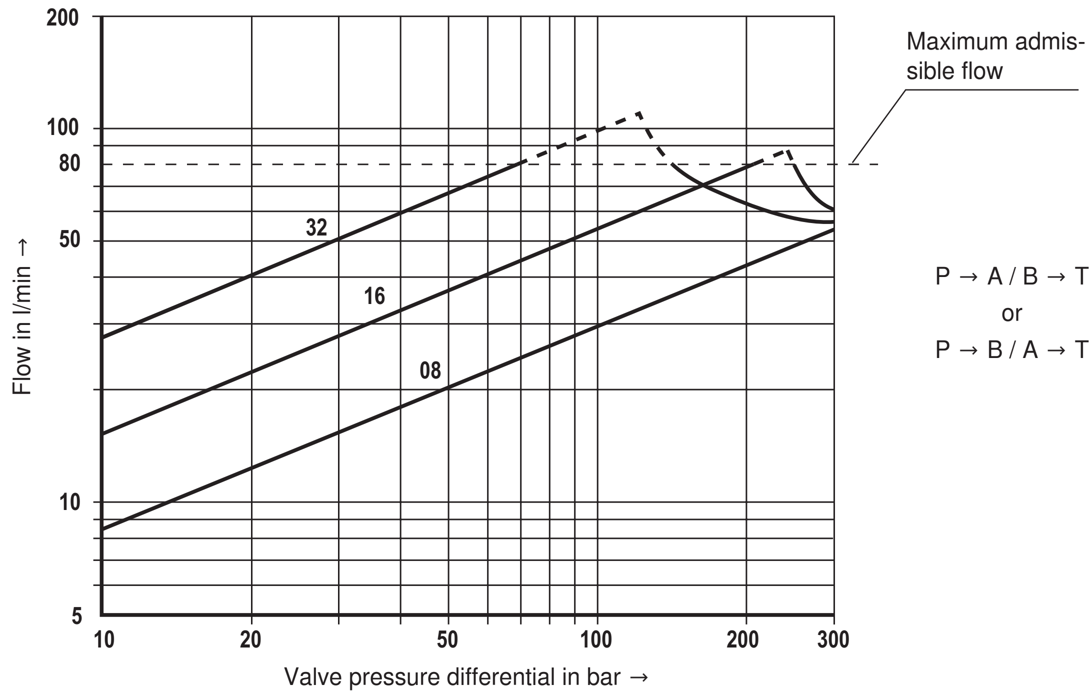


Flow, size 6 with V control spool

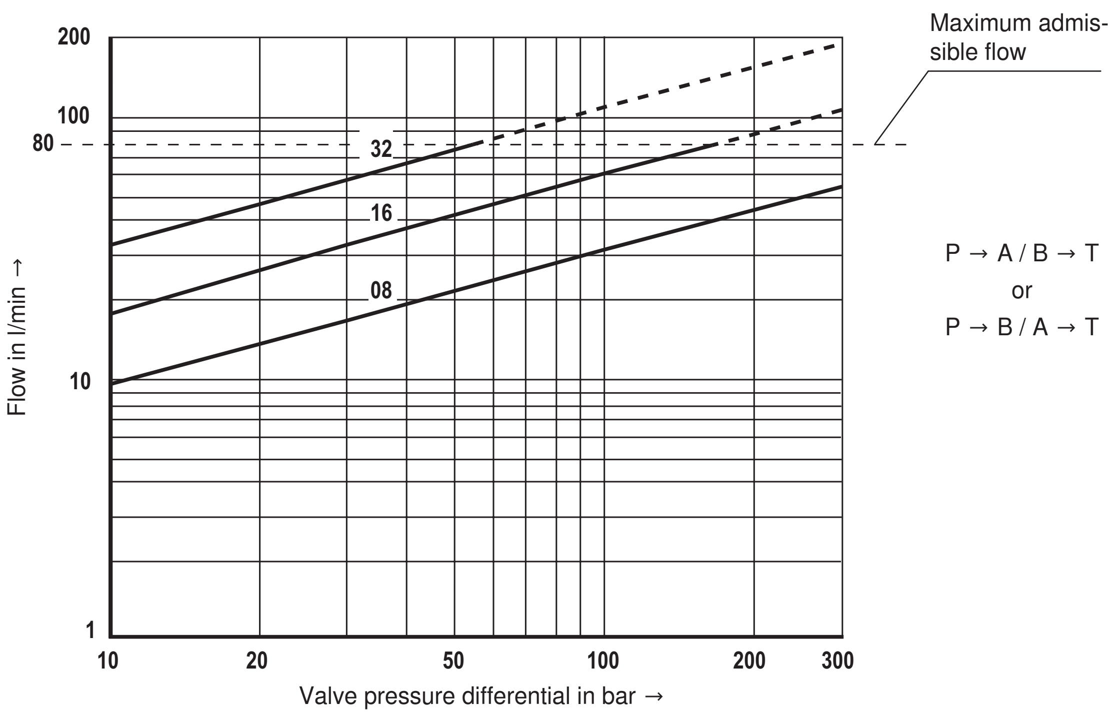


Characteristic curves: Size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function size 6 with Q5 control spool with maximum valve opening

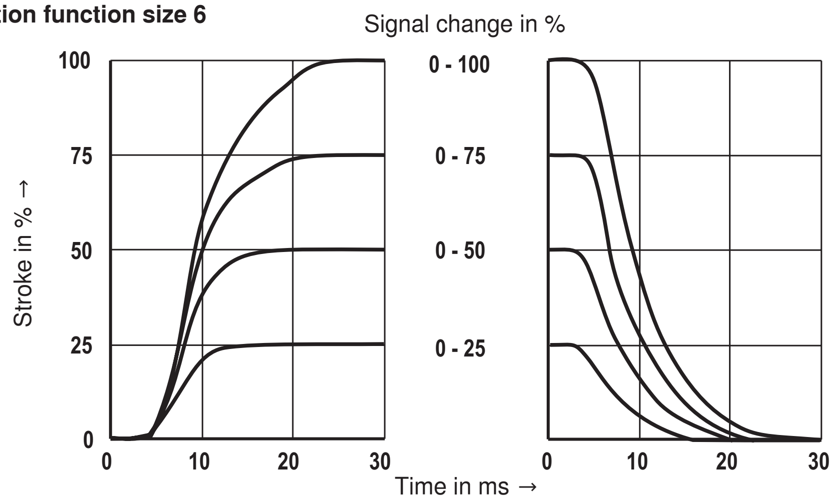


Flow/load function size 6 with V control spool with maximum valve opening

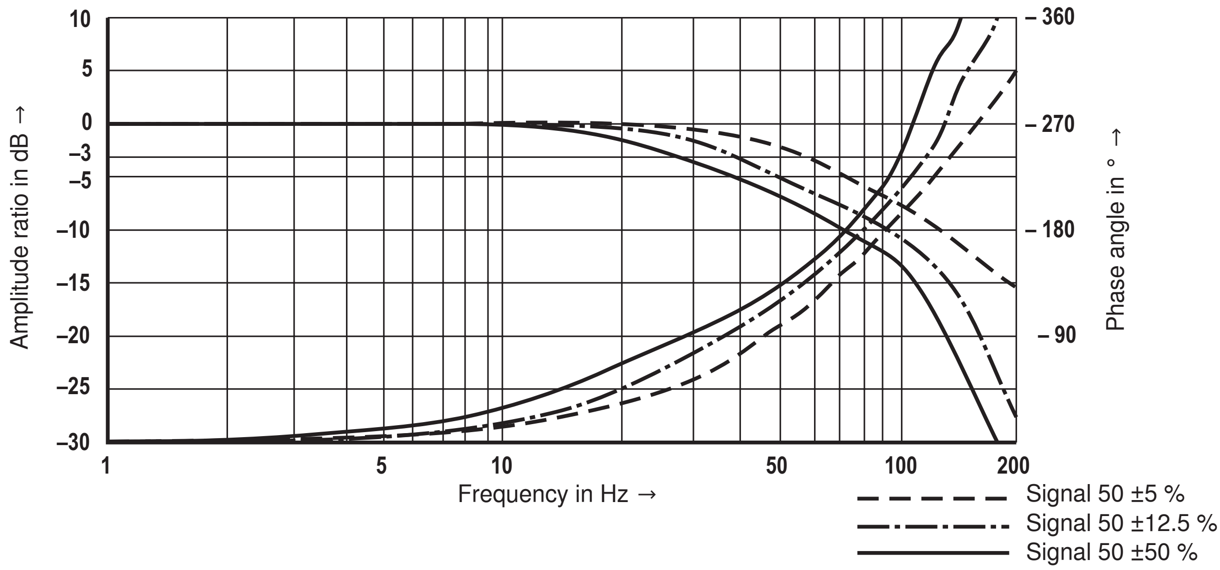


Characteristic curves: Size 6 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

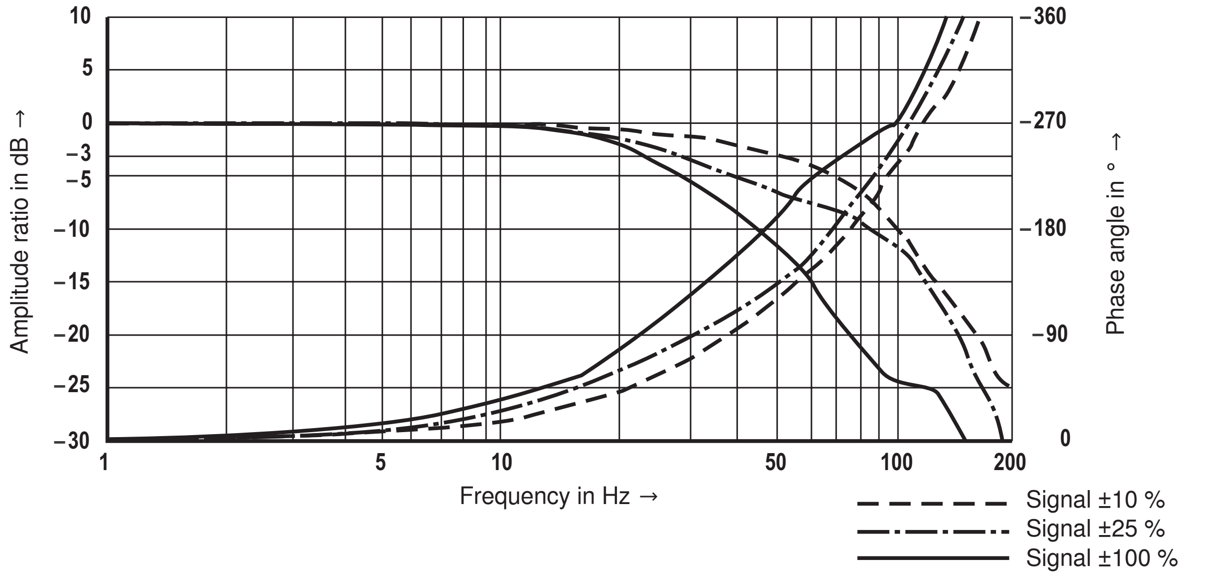
Transition function size 6



Frequency response size 6 with Q5 control spool, p_s = 10 bar

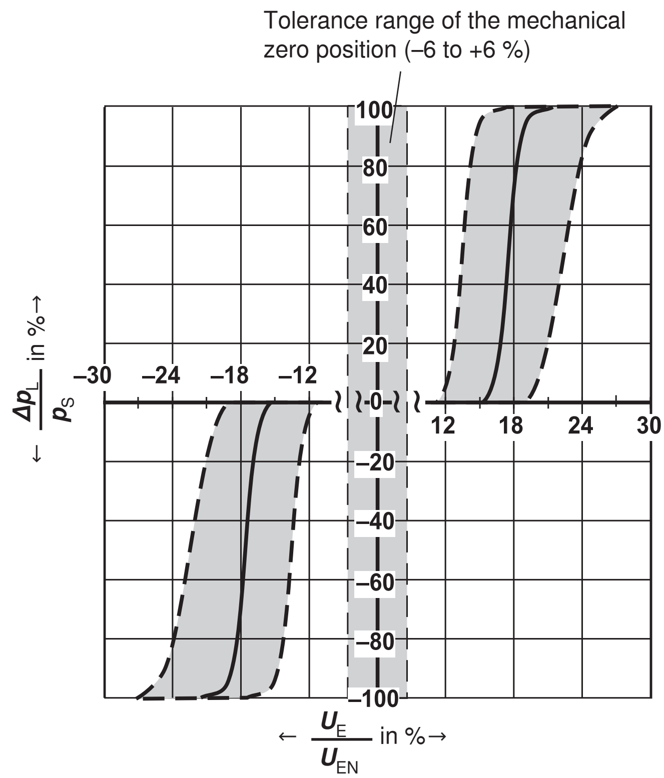


Frequency response size 6 with V control spool, p_s = 10 bar

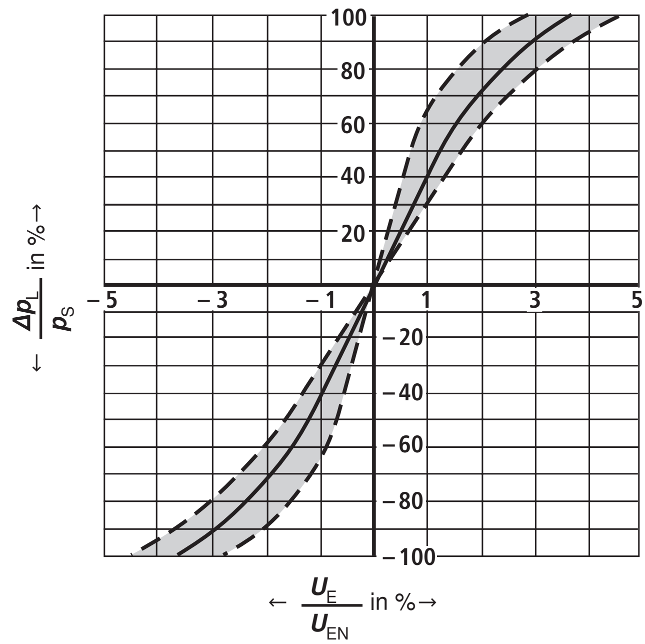


Characteristic curves: Size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Pressure signal characteristic curve (Q5 control spool), p_s = 100 bar

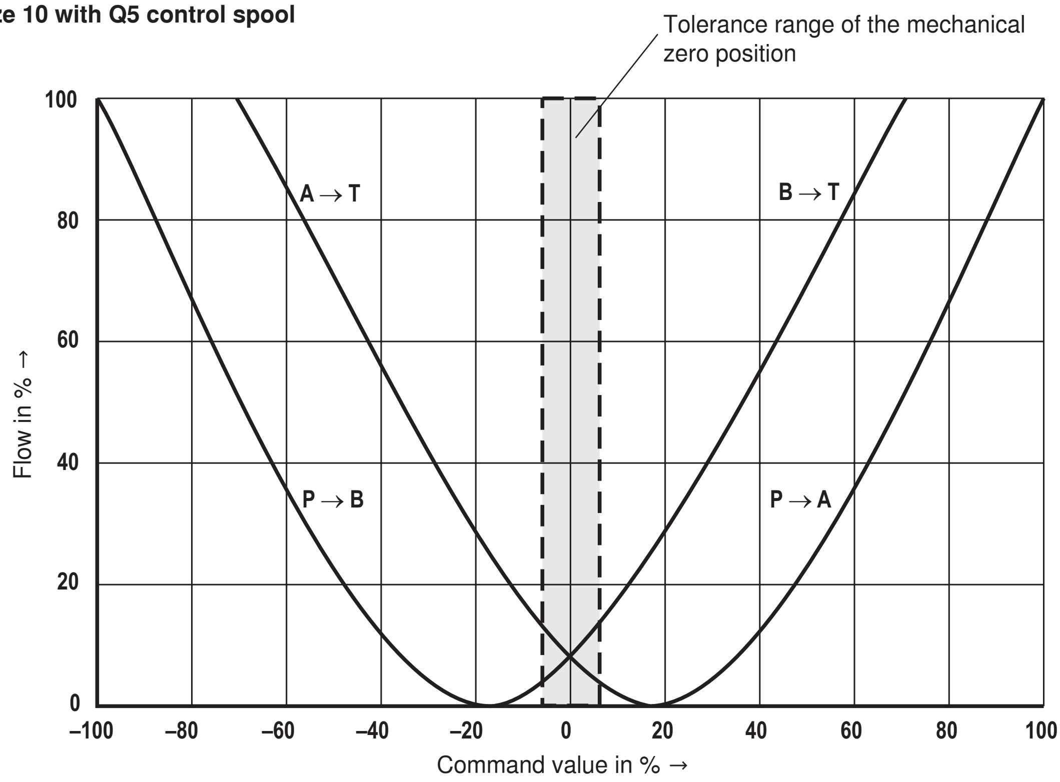


Pressure signal characteristic curve (V control spool), p_s = 100 bar

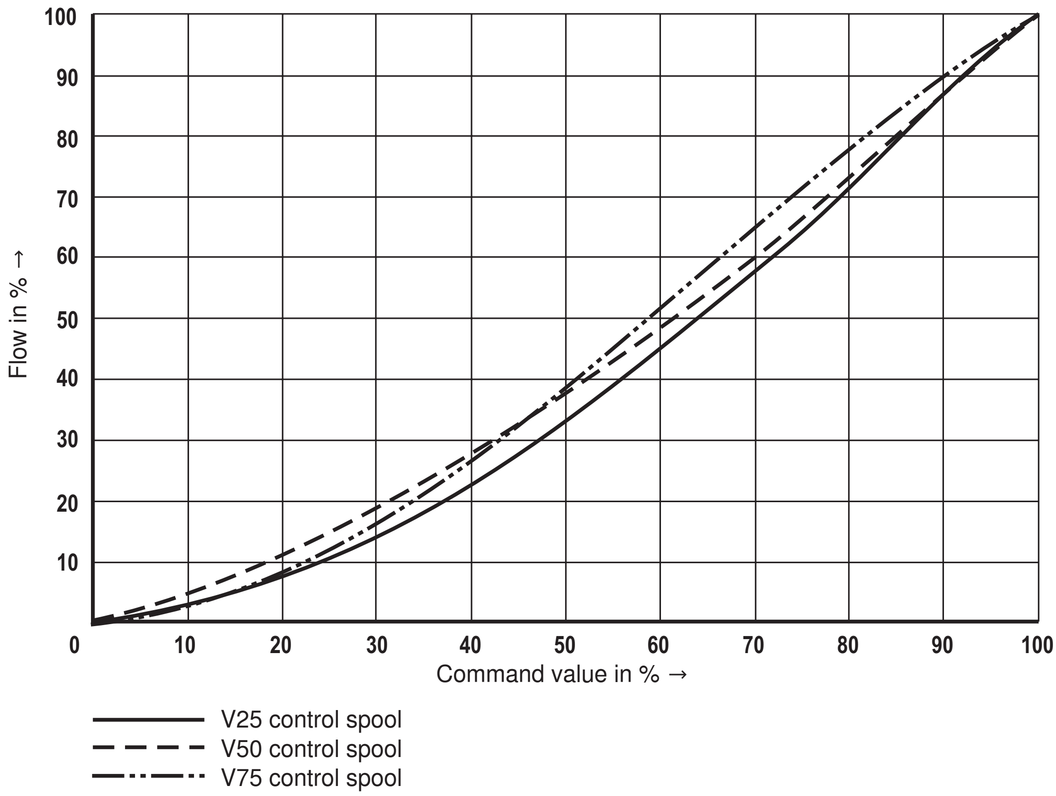


Characteristic curves: Size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow, size 10 with Q5 control spool

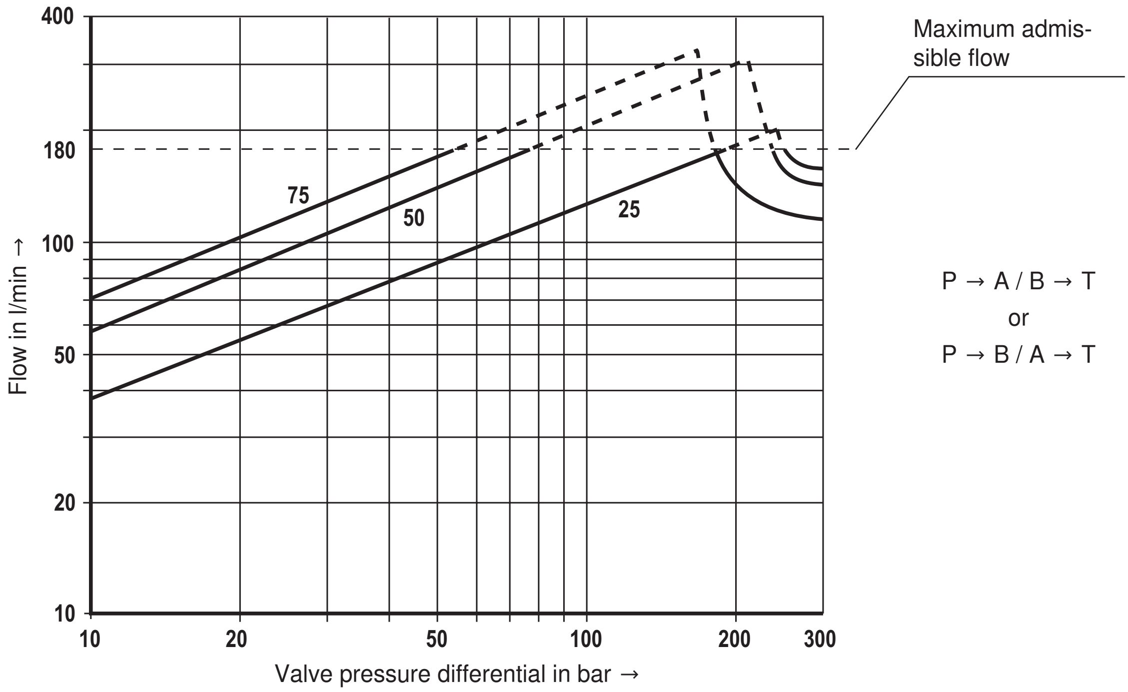


Flow, size 10 with V control spool

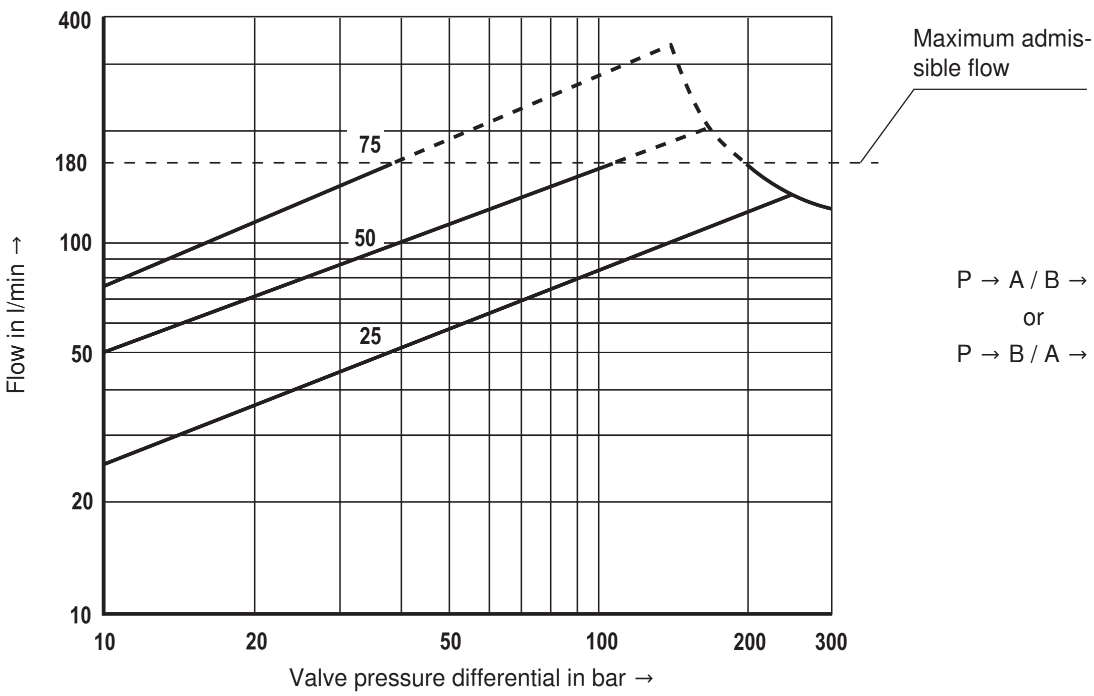


Characteristic curves: Size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function size 10 with Q5 control spool with maximum valve opening

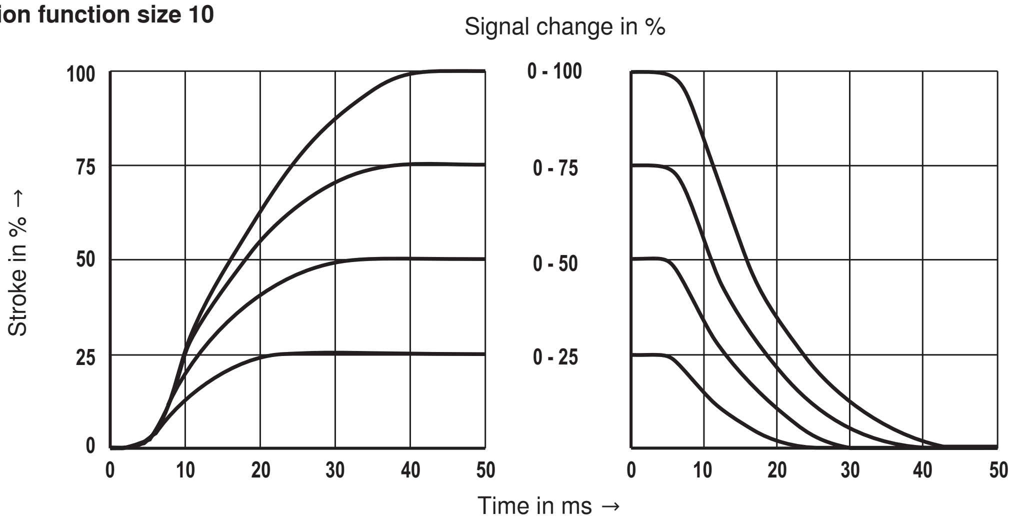


Flow/load function size 10 with V control spool with maximum valve opening

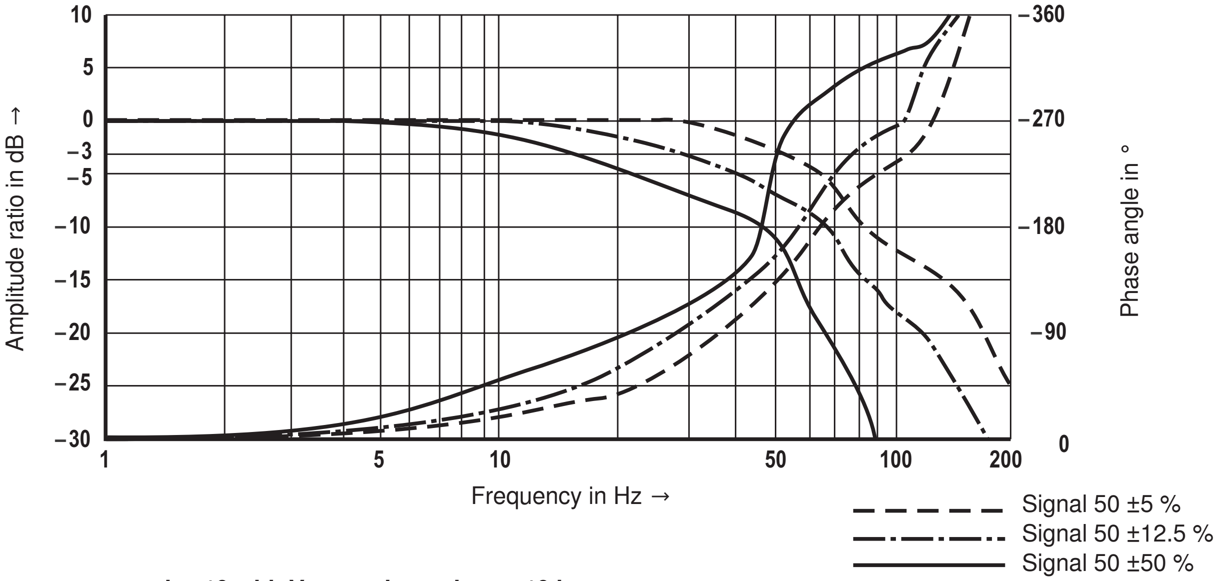


Characteristic curves: Size 10 (measured with HLP46, ϑ_{oil} = 40 °C ±5 °C)

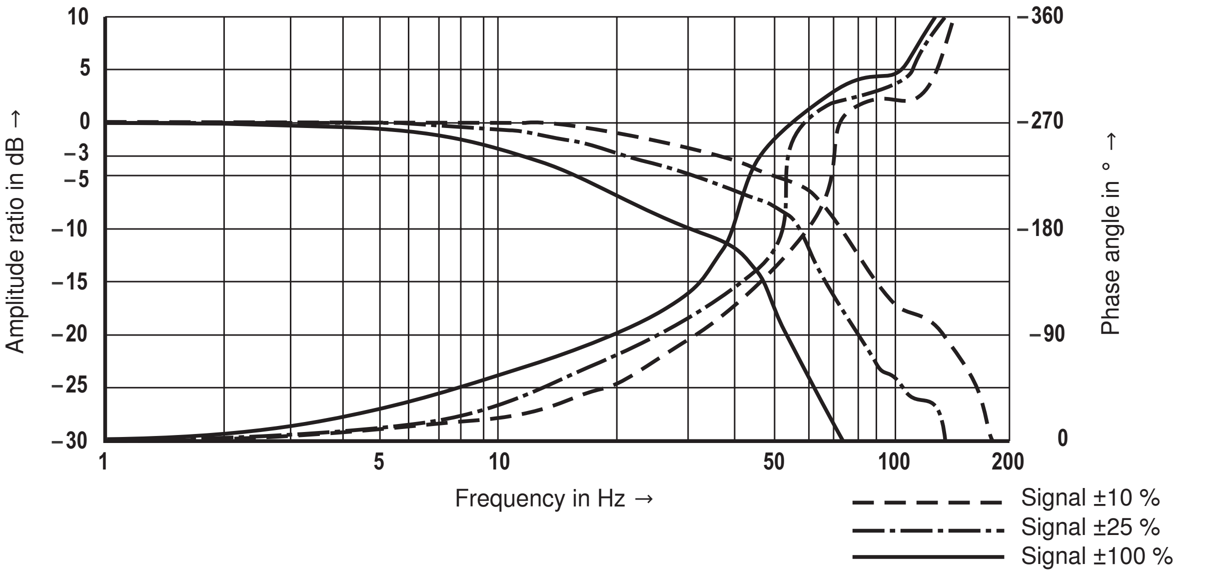
Transition function size 10



Frequency response size 10 with Q5 control spool, p_s = 10 bar

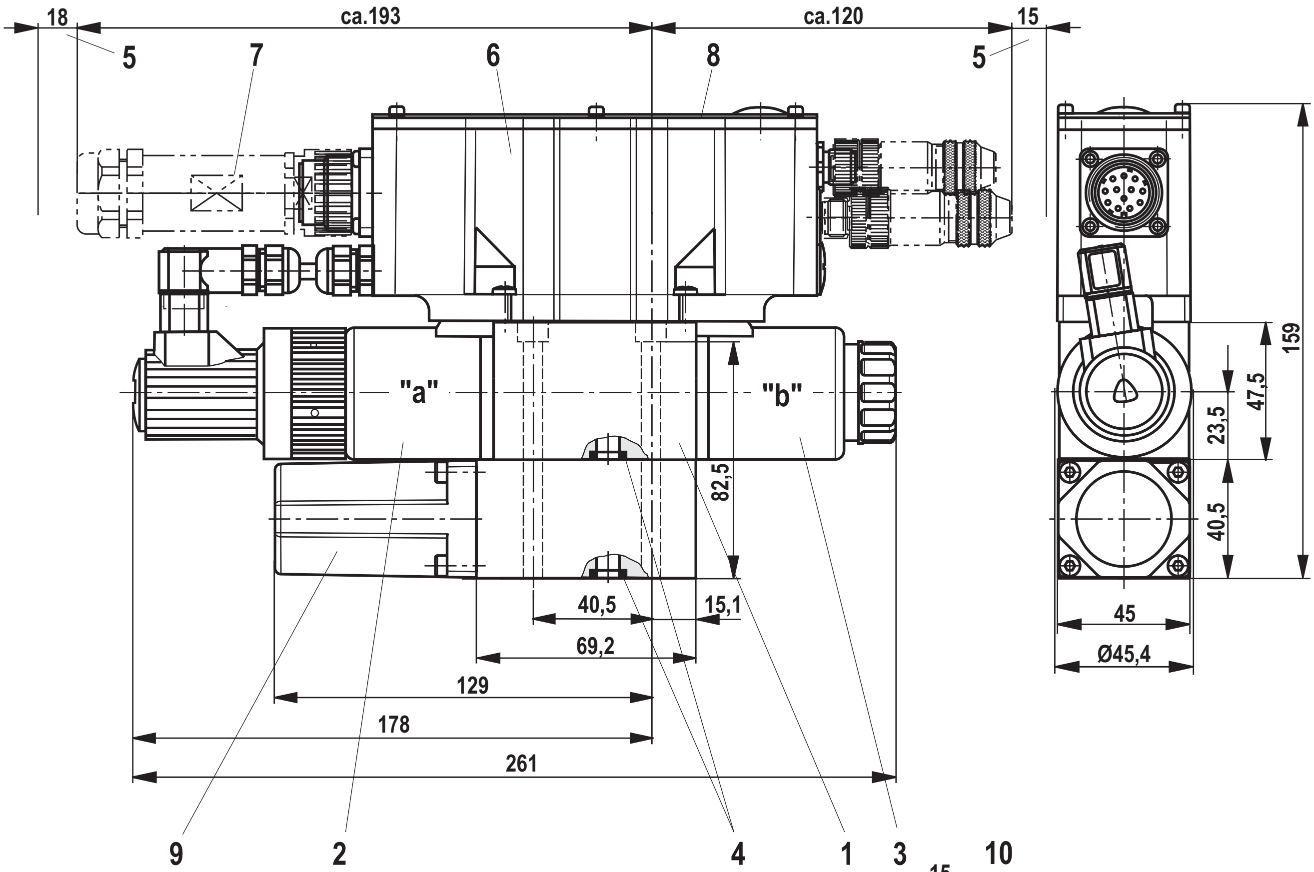


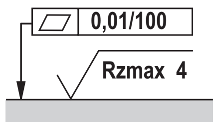
Frequency response size 10 with V control spool, p_s = 10 bar



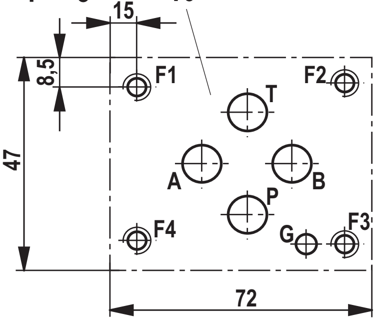
Dimensions: Size 6 (dimensions in mm)

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

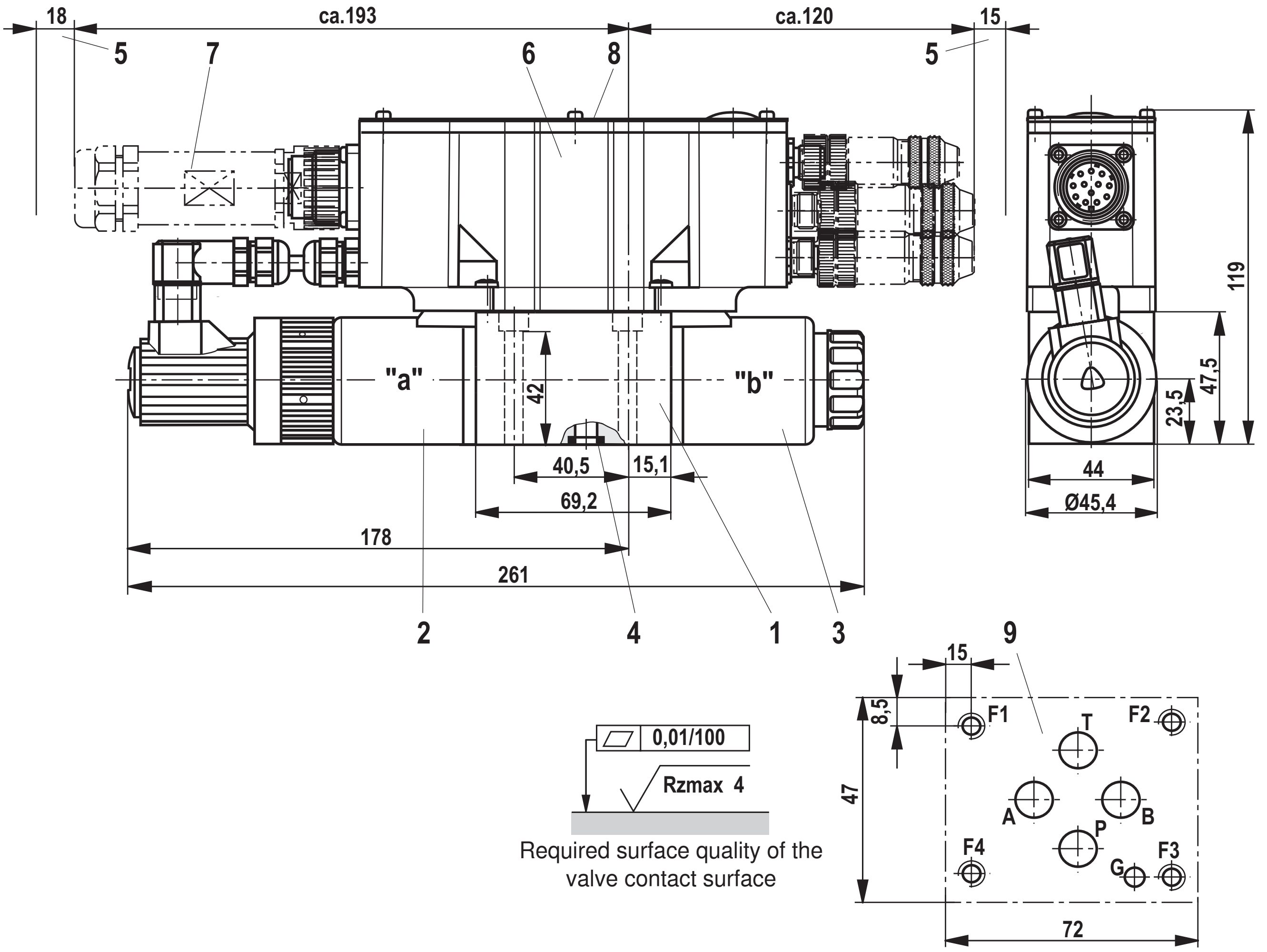
Deviating from the standard:
– Ports P, A, B, T Ø 8 mm
– Bore G can be omitted as the valve does not have a pin.

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



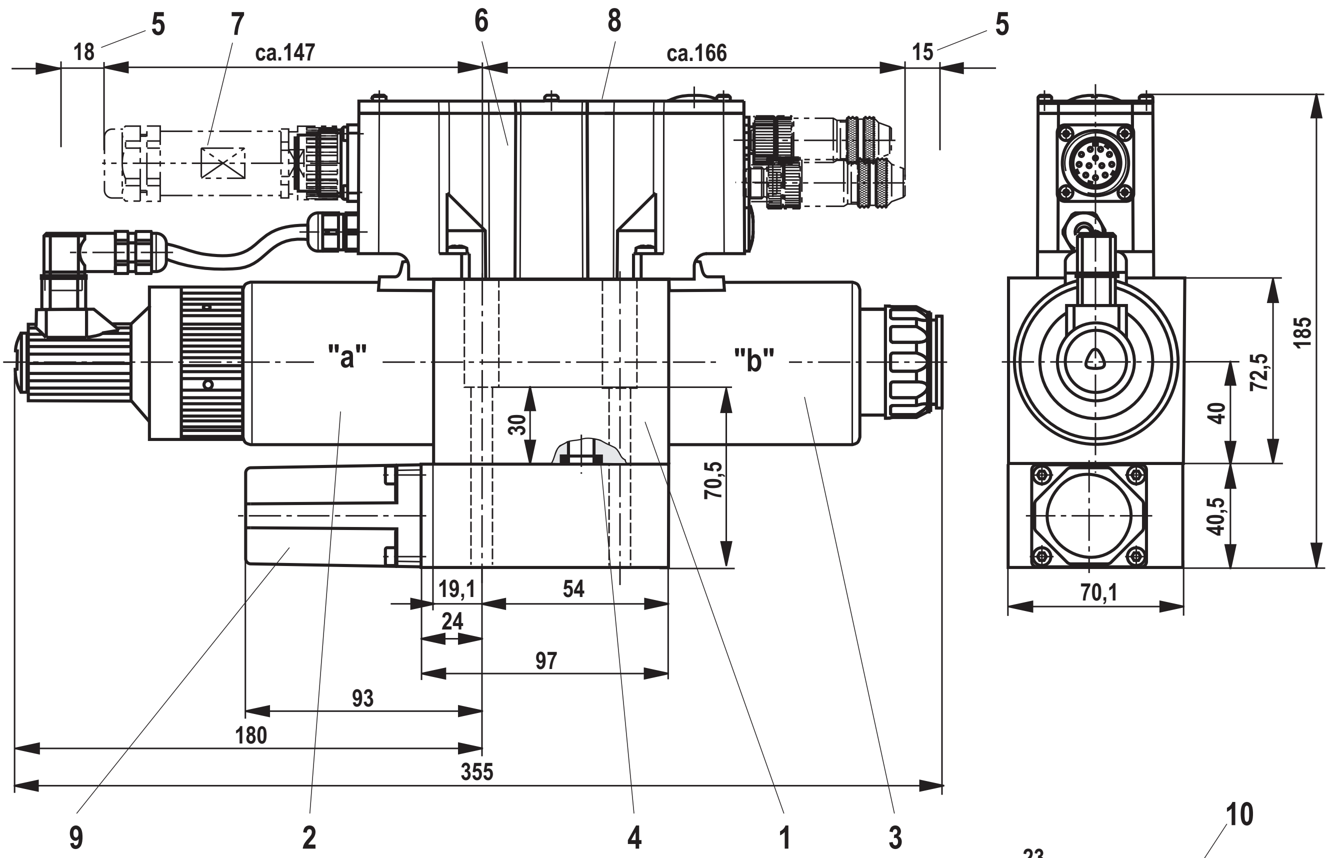
1 Valve housing
2 Proportional solenoid "a" with inductive position transducer
3 Proportional solenoid "b"
4 R-ring 9.81 x 1.5 x 1.78 (ports P, A, B, T)
5 Space required to remove the mating connector
6 Integrated digital control electronics
7 Mating connector according to DIN EN 175201-804; separate 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.

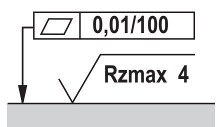
Notice!
The dimensions are nominal dimensions which are subject to tolerances.

Subplates and valve mounting screws see page 23

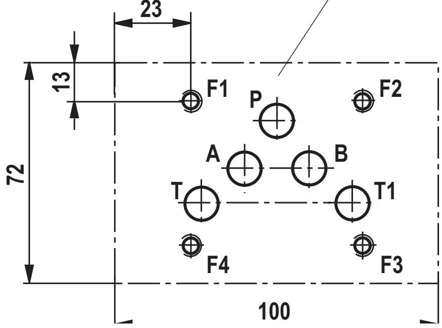
Dimensions: Size 10 (dimensions in mm)

Type 4WREQ with integrated pressure sensors





Required surface quality of the valve contact surface



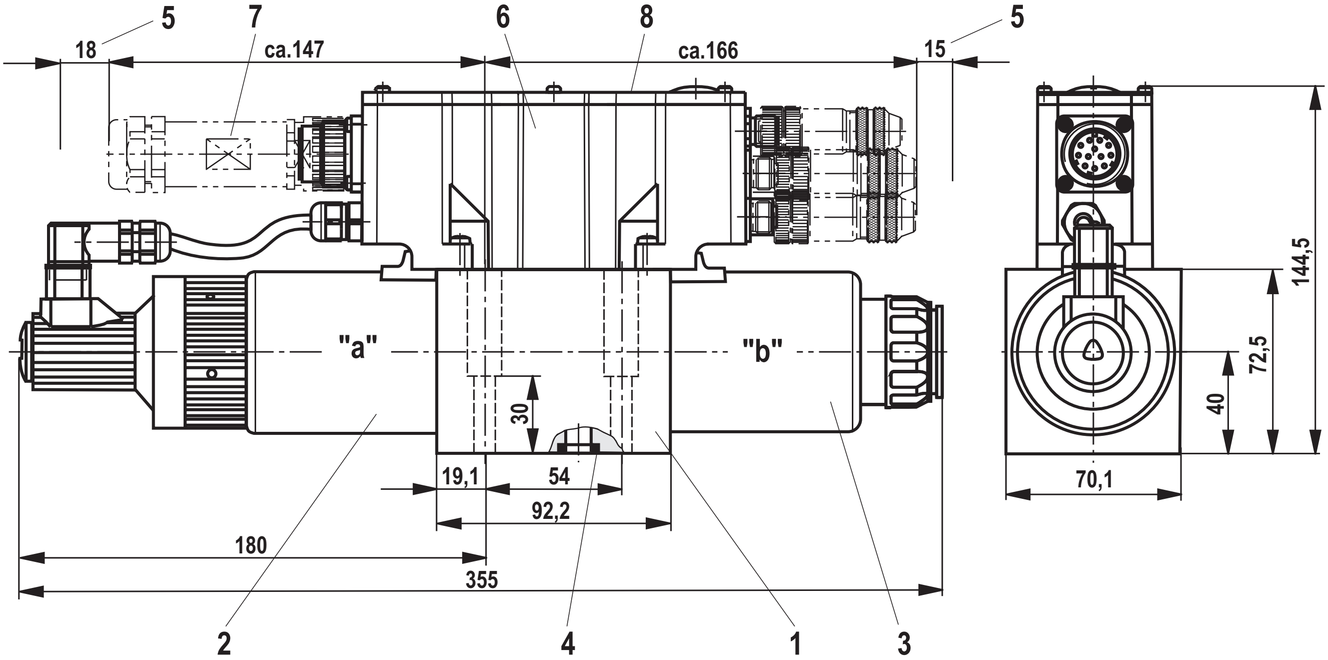
- **1** Valve housing
- **2** Proportional solenoid "a" with inductive position transducer
- **3** Proportional solenoid "b"
- **4** R-ring 13.0 x 1.6 x 2.0 (ports P, A, B, T1, T2)
- **5** Space required to remove the mating connector
- **6** Integrated digital control electronics
- **7** Mating connector 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

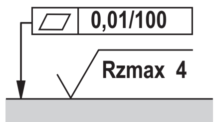
Notice!
The dimensions are nominal dimensions which are subject to tolerances.

Subplates and valve mounting screws see page 23

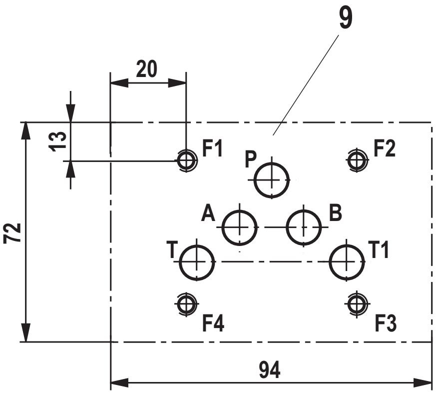
Dimensions: Size 10 (dimensions in mm)

Type 4WREQ for external pressure sensor





Required surface quality of the valve contact surface



1 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 A, B, P, T, T1)
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 4401-05-04-0-05

Notice!
The dimensions are nominal dimensions which are subject to tolerances.

Subplates and valve mounting screws see page 23

Dimensions

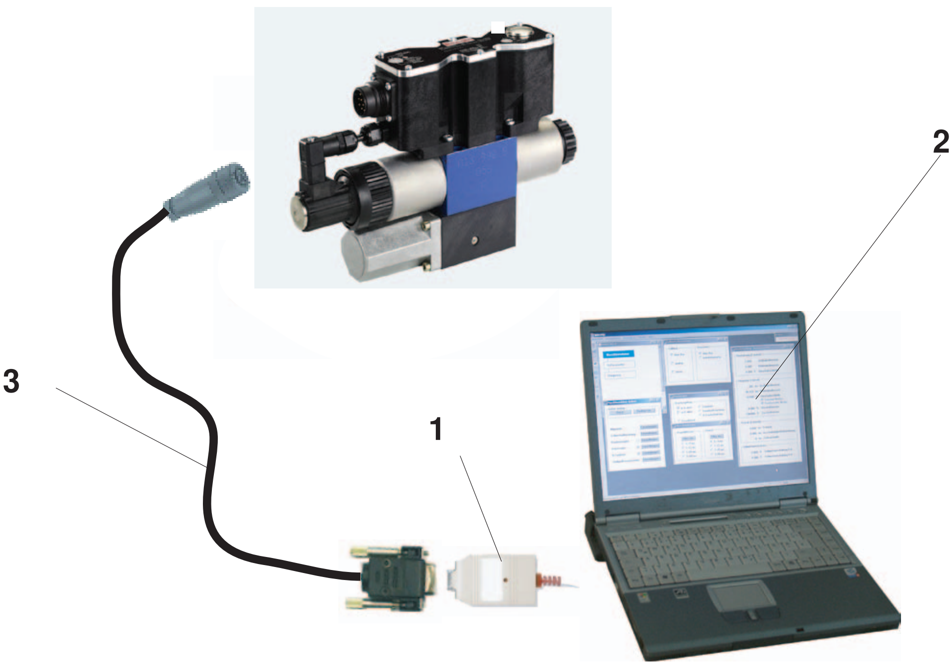
Hexagon socket head cap screws		Material number
Size 6 with integrated pressure sensors	4x ISO 4762 - M5 x 90 - 10.9-flZn-240h-L Tightening torque M_A = 7 Nm ±10 %	R913000222
Size 6 with external pressure sensor	4x ISO 4762 - M5 x 50 - 10.9-flZn-240h-L Tightening torque M_A = 7 Nm ±10 % or 4x ISO 4762 - 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	
3	Connection cable, 3 m	D-Sub / M12, coding A Mat.no. **R900751271**	D-Sub / M12, coding B Mat.no. **R901078053**

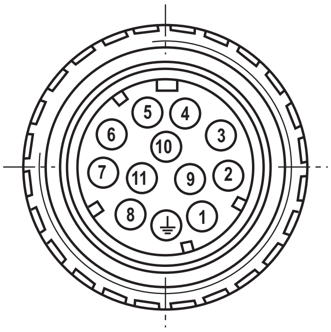


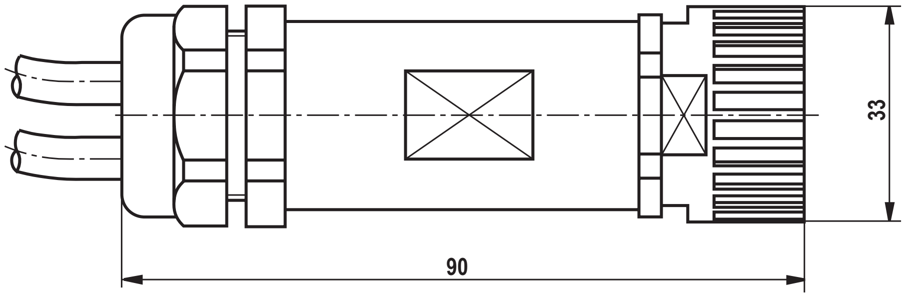
Accessories, port X1 (not included in the scope of delivery)

Mating connector for X1

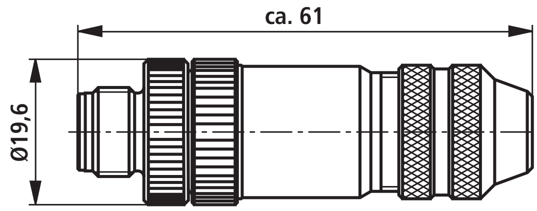
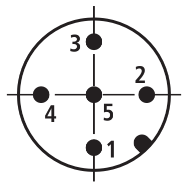
Mating connector according to DIN EN 175201 - 804 (11-pin + PE), plastic variant

- 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**

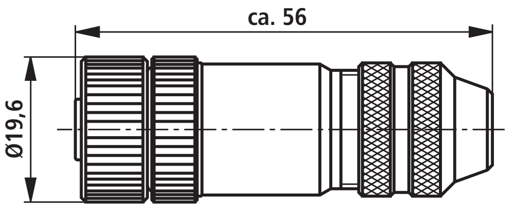
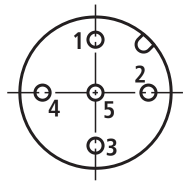
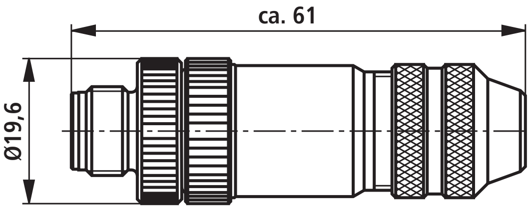
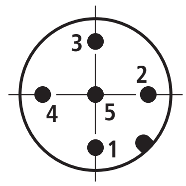
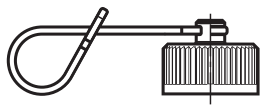




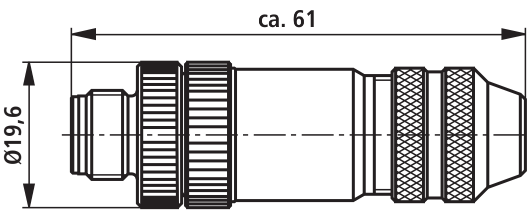
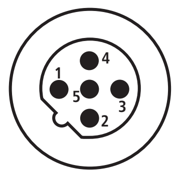
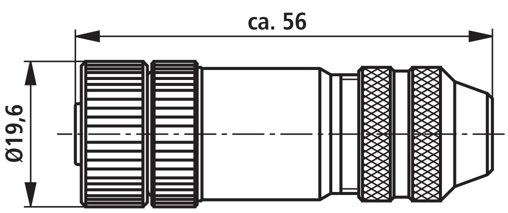
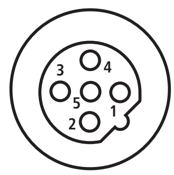
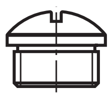
Accessories, sensor connection (not included in the scope of delivery)

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**

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

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)!

RE 30239
Edition: 2020-10
Replaces: 2018-04

rexroth
A Bosch Company

Digital axis control

Type VT-HMC

HMC_25093

- Component series 1X
- Digital axis controllers for one or two electro-hydraulic axes
- Function: position, pressure, force, velocity, substitutional closed-loop control (position/force or p/Q)
- Communication: Sercos, PROFINET RT, EtherCAT, EtherNET/IP, POWERLINK, optionally PROFIBUS, analog
- Parameterizable via standard Ethernet

Features

- PLC functionality according to IEC 61131-3, optional
- BEST IN CLASS hydraulic controllers
- Bus connection (slave)/Service interface (TCP/IP) switchable by parameters (Sercos, EtherNet IP, PROFINET RT, EtherCAT, PROFIBUS, Powerlink)
- Measurement system of hydraulic axes:
  - Incremental or absolute (SSI, Endat2.2)
  - Analog ±10 V and 4 ... 20 mA
- CE mark according to EMC Directive 2004/108/EC

Contents

Ordering code

	01		02		03		04		05		06		07
VT	**–**	**HMC**	**–**		**–**	**1X**	**/**	**M**	**–**		**–**	**00**	**/**	**00**

Type

01	Digital axis control for hydraulic drives	**HMC**

Axis controls

02	1 axis	**1**
	2 axes	**2**

Component series

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

Interface

04	Multi-Ethernet	**M**

Bus connection

05	**With** Profibus	**P**
	Without Profibus	**0**

Software option

06	Standard	**00**

Hardware option

07	Standard	**00**

Available variants

Type	Material no.
VT-HMC-1-1X/M-0-00/00	R901361289
VT-HMC-1-1X/M-P-00/00	R901361305
VT-HMC-2-1X/M-0-00/00	R901441904
VT-HMC-2-1X/M-P-00/00	R901361303

Included within the scope of delivery:
Mating connector for
- XD1 (Weidmüller BLZF 3.50/03/180F SN BK BX)
- XG20/XG21 (Weidmüller B2CF 3.50/30/180F SN BK BX)

Function

Description

The VT-HMC (Hydraulic Motion Controller) is a digital controller with integrated axis controller and programming functionality according to IEC 61131-3 (optional).
The following controller functionalities are available:
- Position control
- Force control
- Pressure control
- Substitutional closed-loop control (position/force or p/Q)
- Velocity control
- Position synchronization master/slave, average, min/max (optional)

This enables, amongst others, the following operating modes:
- Valve direct control
- Drive-controlled position control
- Drive-controlled positioning
- Positioning block operation
- Torque-/force control/valve direct control

Command value presetting is done via the bus interfaces (XF20/XF21 or XF30), via the analog interface (XG20/XG21) or, alternatively, via an internal PLC program. Axis variant 2 enables independent operation or synchronization control of the axes.

The feedback information of the actual value signals to the superior control system is provided optionally either via the bus interfaces (XF20/XF21 or XF30) or the analog/digital interface (XG20/XG21).

The controller parameters are set via one of the two Ethernet interfaces (XF20/XF21) using the freely available software Indraworks DS (integrated switch functionality).

Monitoring

The digital control electronics enable comprehensive monitoring functions/error detection, including
- Undervoltage
- Communication error
- Cable break for analog sensor inputs (4 ... 20 mA) and digital position measurement system
- Short-circuit monitoring for analog/digital outputs
- Monitoring of the microcontroller (watchdog)
- Temperature of the integrated electronics
- Over-current of 24 V sensor voltage and digital outputs

IndraWorks MLD or DS PC program

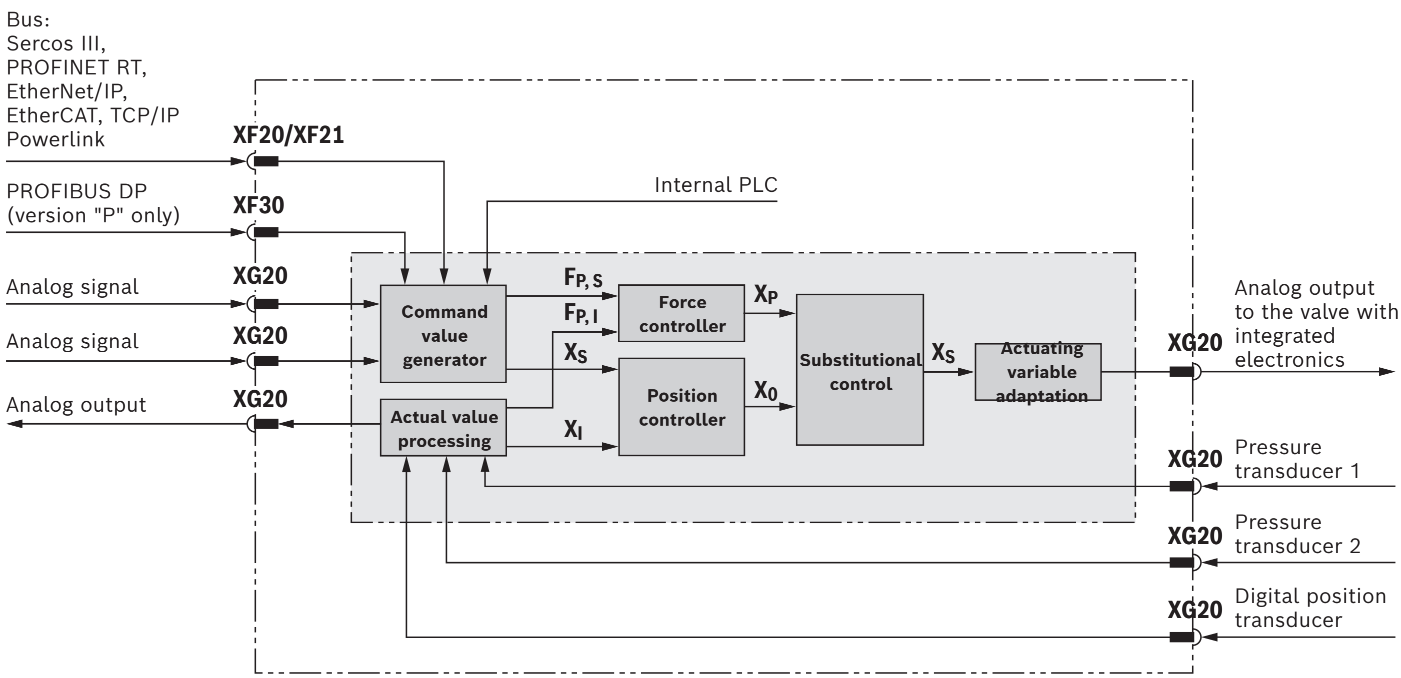
To implement the project planning task and to parameterize the VT-HMC, the IndraWorks engineering tool (see accessories) may be used:
- Project planning
- Parameterization
- Preparation of the PLC program (IndraWorks MLD requirement)
- Commissioning
- Diagnosis
- Comfortable administration of all data on a PC
- Requirement: PC operating system Windows 7, 8, 10

Slot for one SD memory card

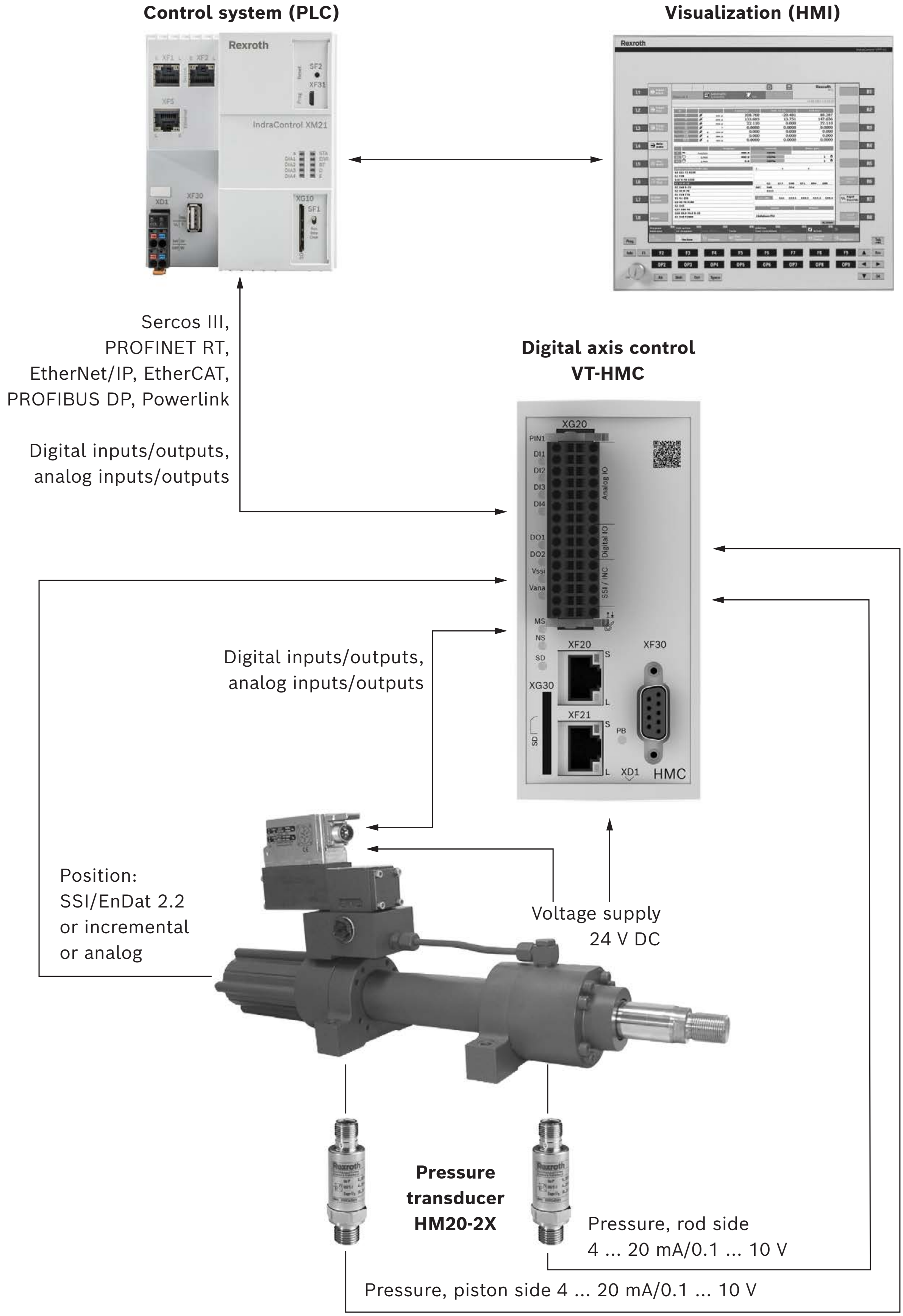
The following data may be saved:
- PLC program
- Any other data

Only SD memory cards with SPI bus connection are supported (no SDHC memory cards).
The card must already be inserted when the device is switched on, otherwise it will not be detected. Cards that are not FAT-formatted are formatted automatically (FAT 32).
The maximum capacity of the supported memory cards is 4 GB.

Controller functions



System overview (example)



Technical data

General		
Protection class according to EN 60529		IP20
Ambient temperature range	°C	–20 ... 60
Maximum admissible temperature change	°C/min	5
Transport temperature range	°C	–40 ... +70
Recommended storage temperature with UV protection	°C	+5 ... +40
Relative air humidity	%	10 ... 95 (without condensation)
Maximum altitude for use	m	2000
UV resistance		Housing is only partly UV resistant. Extended exposure to radiation may cause color changes.
Transport shock according to DIN EN 60068-2-27		15 g / 11 ms / 3 axes
Sine test according to DIN EN 60068-2-6		10 ... 500 Hz / maximum of 2 g / 10 cycles / 3 axes
Noise test according to DIN EN 60068-2-64		20 ... 500 Hz / 2.2 g RMS / 6.6 g peak / 30 min. / 3 axes
Free fall (in original packaging)	m	1 (see 61131-2)
Electro-magnetic compatibility (EMC) ▶ EN 61000-6-2 / EN 61131-2 – EN 61000-4-2 ESD	kV	4 CD / 8 AD with BWK B
– EN 61000-4-3 HF radiated	V/m	10 (80 ... 2700 MHz) with BWK A
– EN 61000-4-4 Burst	kV	2 with BWK B
– EN 61000-4-5 Surge	kV	0.5 / (sym. / asym.) with BWK B
– EN 61000-4-6 HF conducted	V_{eff}	10 (150 kHz ... 80 MHz) with BWK A
– EN 61000-4-8 Magnetic field 50/60 Hz	A/m	100 with BWK A
▶ EN 61000-6-3 / EN 61000-6-4 / EN 61131-2 – EN 55016-2-1 Interference voltage	MHz	0,15 ... 30, class A, EN 55022
– EN 55016-2-3 Radio interference field strength	MHz	30 ... 1000, class A, EN 55022
Installation position		Vertical. For the ventilation of the assembly, the ventilation slots of the top and bottom side must be at least 2 cm away from covers, walls, etc.
Assembly		Top hat rail TH35-7.5 or TH35-15 according to EN 60715
Housing material		Glass-fiber reinforced polyamide plastic
Resistance against aggressive media		Contact with conductive dusts is not admissible. Avoid contact with hydraulic fluids.
Weight	kg	0.6
Dimensions		see page10
Conformity		CE according to the EMC directive CE according to the RoHS directive

Technical data

Electric				
Operating voltage	▶ Nominal voltage	VDC	24	
	▶ Lower limit	VDC	17.5	
	▶ Upper limit	VDC	30	
Maximum admissible residual ripple (40 ... 400 Hz)		V_{PP}	5 (observe the admissible limits)	
Total current consumption			1 axis	2 axes
	▶ Running empty	A	0.2 ... 0.3	0.3 ... 0.5
	▶ Maximum load	A	0.9 ... 1.1 [1]	1.8 ... 2.2 [1]
Power loss (at 24 V)			< 8	< 14
External fuse		A	3.15, time-lag	
Bus systems			PROFIBUS DP (max. 12 MBaud acc. to IEC61158), Sercos III, PROFINET RT, EtherNet/IP, EtherCAT [2], Powerlink [2]	
Parameterization interface			Ethernet	
Scan time position controller (minimum)		ms	0.5	
Booting time		s	<15 (from switch on until the position control system is active)	
Digital inputs Di	▶ Quantity		4	8
	▶ Low level	V	−3 ... 5	
	▶ High level	V	11 ... $\boldsymbol{U}_B$	
	▶ Current consumption at high level	mA	2 ... 15	
	▶ Reference potential		GND	
Digital outputs Do	▶ Quantity		2	4
	▶ Low level	V	0 ... 3	
	▶ High level	V	14,5 ... $\boldsymbol{U}_B$	
	▶ Current carrying capacity	mA	50 (short-circuit-proof)	
	▶ Signal delay time	ms	0.5 ... 1.2 (depending on the set performance)	
	▶ Reference potential		GND	
Analog inputs Ai	▶ Number (current or voltage parameterizable)		4	8
	▶ Resolution	Bit	14 [3]	
	▶ Voltage inputs (differential inputs)			
	– Measurement range	V	−10 ... +10	
	– Input resistance	kΩ	200 ±10%	
	– Linearity at 20°C	mV	<20	
	– Noise	mV	±15	
	– Temperature drift	mV/10 K	<12	
	▶ Current inputs (reference to AGND)			
	– Input current	mA	4 ... 20 (0 ... 20 physically)	
	– Input resistance	Ω	100 (measuring resistance plus FET plus diode)	
	– Linearity at 20°C	µA	<20	
	– Temperature drift	µA/10 K	<12	

[1] External fuse protection required

[2] With the EtherCAT (profile CoE) and Powerlink bus systems, support of the second axis is only possible upon request

[3] related to ±12 V (1.465 mV/LSB) or 20.7 mA (1.27 µA/LSB)

Technical data

Supply for sensors $V_{encoder\_ANA}$	▶ Supply voltage	V	$\boldsymbol{U}_B$ – 4 (max. load) … $\boldsymbol{U}_B$ – 2.5 (running empty)	
	▶ Maximum supply current	mA	100	
Analog outputs Ao	▶ Number (current or voltage parameterizable)		2	4
	▶ Resolution	Bit	16 [4]	
	▶ Voltage outputs			
	– Output range	V	–10 … +10 (0 … 10 by software)	
	– Minimum load impedance	Ω	1000	
	– Linearity and noise at 20°C	mV	<25	
	– Temperature drift	mV/10 K	<12	
	▶ Current outputs			
	– Output range	mA	0 … 20 (4 … 20 by software)	
	– Maximum load	Ω	500	
	– Linearity and noise at 20°C	μA	<35	
	– Temperature drift	μA/10 K	<12	
Digital position transducers (encoders)	▶ Voltage supply for encoder (optional)			
	– +5 V_{enc}	VDC	5 ±5%	
	– $V_{encoder\_SSI}$	V	$\boldsymbol{U}_B$ … 3 (max. load) … $\boldsymbol{U}_B$ (running empty)	
	▶ Maximum supply current	mA	300	
	▶ Incremental transducer (transducer with TTL output)			
	– Encoder signals		Two impulse series (A and B, electrically shifted by 90°) and a reference signal (Z) or single ended	
	– Signal form		RS485	
	– Maximum input frequency	kHz	250	
	▶ SSI transducer (due to the higher control quality, a transducer with clock synchronization should be used)			
	– Coding		Gray or binary	
	– Data width	Bit	18 … 28	
	– Transfer frequency	kBit/s	80 … 500	
	– Line receiver / line driver		RS485	
	▶ Endat encoder		2.2	

[4] 0.334 mV/LSB (Least Significant Bit)

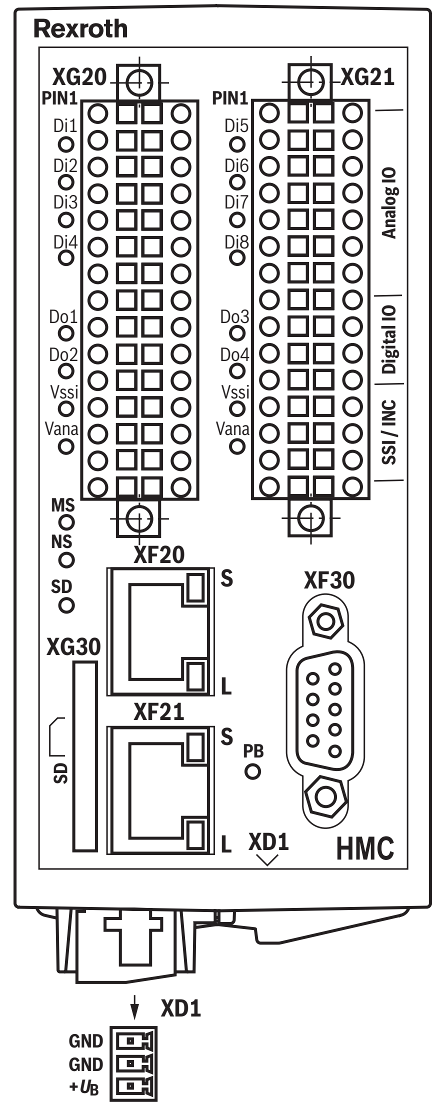
Pin assignment

XG20, XG21 [1], encoder/DIO/AIO

Signal	Pin	Pin	Signal
Vencoder_ANA (U_B)	a1	b1	AGND
Ai1+	a2	b2	Ai1–/Cin1 [2]
Ai2+	a3	b3	Ai2–/Cin2 [2]
Ai3+	a4	b4	Ai3–/Cin3 [2]
Ai4+	a5	b5	Ai4–/Cin4 [2]
Ao1	a6	b6	AGND
Ao2	a7	b7	AGND
Di1	a8	b8	Di2
Di3	a9	b9	Di4
Do1	a10	b10	Do2
R–	a11	b11	R+
CLK–/A–	a12	b12	CLK+/A+
Data–/B–	a13	b13	Data+/B+
+5Venc	a14	b14	GND
Vencoder_SSI (U_B)	a15	b15	GND

1) Only with 2-axis variant. XG20 and XG21 can be swapped. The scope of delivery of the 2-axis variant includes coding pins (see operating instructions 30239-B).

2) Wire current inputs (Cin) only at pin b2 ... b5, leave pin a2 ... a5 open. Reference potential: AGND (see operating instructions 30239-B)



XF20, XF21 (Ethernet connections)

Signal	Pin
TD+	1
TD–	2
RD+	3
–	4
–	5
RD–	6
–	7
–	8

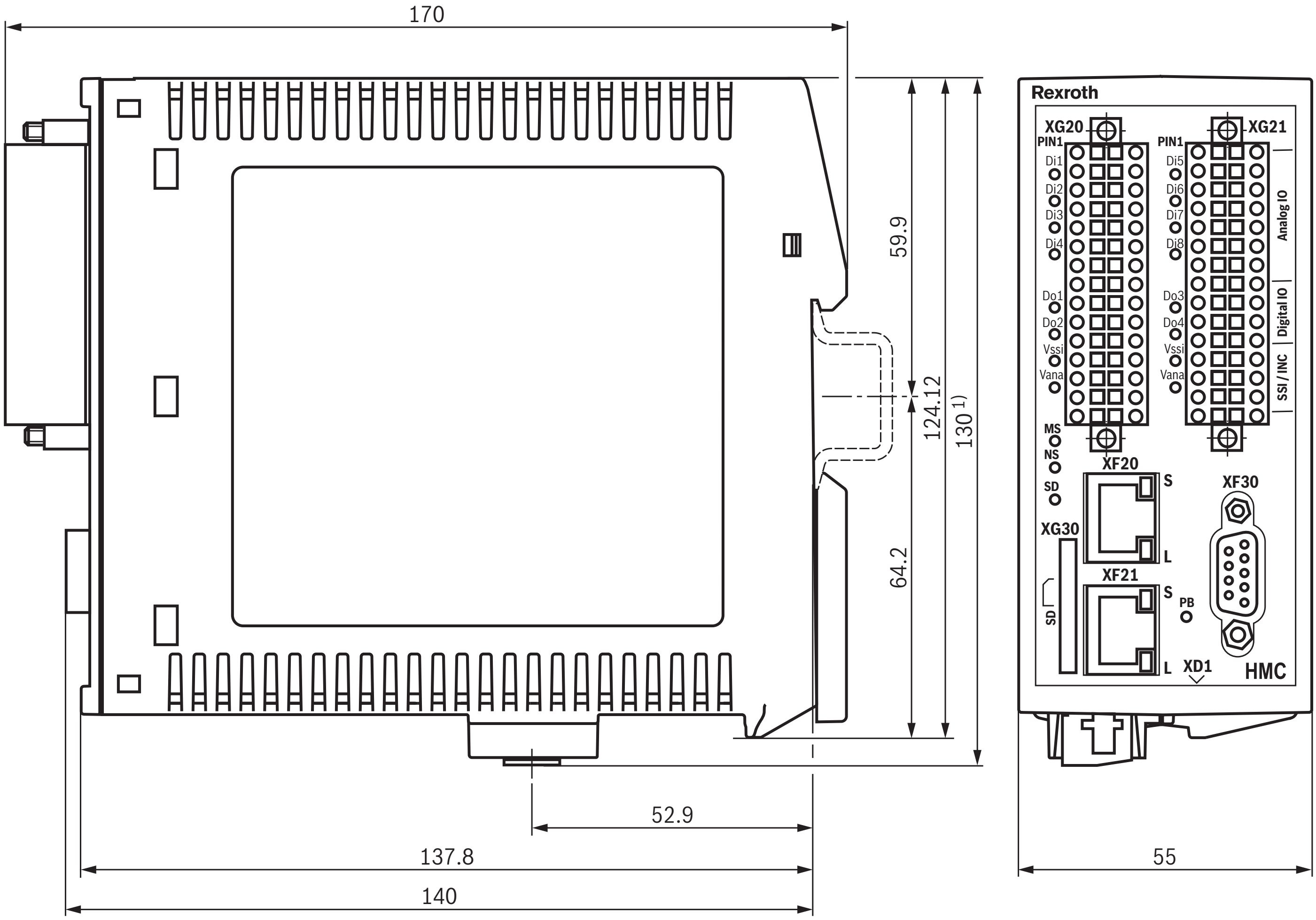
XD1, Power

Pin	Signal
1	GND
2	GND
3	+U_B (17.5 ... 30 V)

XF30, PROFIBUS DP (only for variant "P")

Pin	Signal
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved

Dimensions
(dimensions in mm)



Status LED	Display status
Module (MS)	
Off	No voltage supply
Green-red, flashing	Initialization
Green, flashing	Parameterization mode active
Green	Operating mode active, Drive active
Orange, flashing	Warning
Red, flashing	Error
illuminated red	Exception is available
Network status (NS)	
Off	No voltage supply
Green	Operation
SD card (SD)	
Off	No SD card available
Green, flashing	SD card not ready for operation
Green	SD card available and ready for operation

Status LED	Display status
Digital inputs (Di1 ... Di8) 2)	
Off	Logic input "0"
Green	Logic input "1"
Digital outputs (Do1 ... Do4, V_{x}) 3)	
Off	Logic output "0"
Orange	Logic output "1"
Profibus (PB)	
Off	Bus not active
Green	Bus in "Data_Exchange" status

Notice:
For a detailed description of the diagnosis LEDs, please refer to the functional description Rexroth HydraulicDrive HDx20.

1) +15 mm for connecting/disconnecting the plug-in connector
2) 1-axis variant Di1 ... Di4
3) 1-axis variant Do1 ... Do2

Accessories (separate order)

Denomination	Material no.
CONNECTOR 6ES7972-0BA42-0XA0 for port XF30 (Profibus)	R901312863
CONNECTOR SET VT-HMC...-1X/M...*ET	R961011116
VT-SD-HMC-SYNC-000-001-000-000	R901512467
SERVICE PACKAGE VT-HMC..-1X/MSHIELDING&	R961011117
MEMORY CARD XA-SD01 (1 GByte)	R911173844
BUS CABLE PC VT-HMC RKB0011/005.0 (RBS0016-REB0400-RBS0016), length 5 m	R911321548
Commissioning software IndraWorks DS as of version 14V12 (without PLC functionality)	–
Commissioning software IndraWorks MLD (as of version 14)	R911347042
Commissioning software IndraWorks Suite (as of version 14)	R911342952

Project planning and maintenance instructions

☞ **Maintenance instructions:**
- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices 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:**
- The supply voltage must be permanently connected; otherwise, bus communication is not possible.
- Connectors may only be plugged or unplugged in the de-energized condition.
- In especially EMC-sensitive environments, additional measures must be taken (depending on the application, e.g. shielding, filtration) [1)]
- **Wiring information**
  - Maximum possible spatial separation between signal and load lines.
  - Do not lead signal lines through magnetic fields.
  - If possible, install signal lines without intermediate terminals.
  - Do not install signal lines in parallel to the load lines.
  - Connect cable shields (see the operating instructions 30239-B)
  - For digital inputs and outputs, the max. recommended cable length is 30 m.
  - Only use shielded lines for sensors (incremental, absolute or analog). Max. recommended cable length: 50 m; also observe the sensor manufacturers' information.
  - The signals of the connector XG20/XG21 are not galvanically separated. A potential reference therefore always has to be established when connecting external devices.
- For additional notices, see IndraWorks online help and operating instructions 30239-B.
- The upper and lower ventilation slots must not be concealed by adjacent devices in order to provide for sufficient cooling.
- Observe the installation information in the operating instructions 30239-B.

[1)] For use in household or small business applications, special precautions, such as installation of a shielded housing and appropriately approved filter systems, are required to fulfill the emission requirements according to EN 61000-6-3.

Further information

▶ Digital axis control VT-HMC...1X	Operating instructions 30239-B
▶ CE Declaration of Conformity	upon request
▶ Operation VT-HMC (from 18V12 software version):	
– Functional description Rexroth HydraulicDrive HDx-20	30338-FK
– Parameter description Rexroth HydraulicDrive HDS-16, HDx-17 ... 20	30330-PA
– Description of diagnosis Rexroth HydraulicDrive HDS-16, HDx-17 ... 20	30330-WA
▶ Installation, commissioning and maintenance of proportional valves	Data sheet 07800
▶ Assembly, commissioning and maintenance of hydraulic systems	Data sheet 07900
▶ Commissioning software and documentation	
▶ Support	

Rexroth
Bosch Group

Digital control electronics

RE 30543/2018-09 1/16
Replaces: 12.10

Type VT-HACD-3

CE

Component series 2X

H7688

Table of contents

Contents	Page

Features

- Use as **control electronics** for 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) switchable via software, input resistance of AI1 > 10 MΩ
- 3 analog outputs, 1x switchable voltage (±10 V, 0...10 V) or current (0...20 mA, 4...20 mA), 2x 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
- Serial interface RS232
- Up to 32 electronics can be interconnected for parameterization and diagnosis via the local bus

Areas of application
- Machine tools
- Plastics processing machines
- Special machinery
- 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 with PC

Operation
- Comfortable management of the machine and measured data on the PC

Process connection
- Digital inputs and outputs,
- Analog inputs and outputs,
- PROFIBUS DP for the communication with a superior control system
- EtherNet/IP
- PROFINET RT

Assembly
- 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

Ordering code

VT-HACD – 3 – 2X / 0 / I – 00 – 000

Digital control electronics		VT-HACD
Standard	**= 3**	
Component series 20 to 29 (20 to 29: unchanged technical data and pin assignment)	**= 2X**	
Bus system		
without bus	**0 =**	
PROFIBUS DP	**P =**	
Ethernet-based:		
PROFINET RT	**N =**	
EtherNet/IP	**E =**	
Position transducer		
Incremental/SSI	**I =**	
Hardware marking		00
Options		000

Included in 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)

Denomination	Material number
Interface cable RS232, length 3 m	**R900776897**
USB RS232 converter	**R901066684**
Connector type 6ES7972-0BA41-0XA0 for PROFIBUS DP	**R900050152**
CD with BODAC software SYS-HACD-BODAC-01/	**R900777335**

Spare part kit (can be ordered separately)

Denomination	Material number
STECKERSATZ VT-HACD-3-2X...*ET	**R961009670**

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 (sensor technology, 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

To implement the project planning tasks, the BODAC PC program is available to the user. It 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 representation of up to eight process variables with great selection of trigger options

PC system requirements:

- Windows XP, Windows Vista, Windows 7, Windows 10
- RAM (recommendation: 256 MB)
- 250 MB of available hard disk capacity

Notice:

The BODAC PC program is **not** included in the scope of delivery. It is available for free download!

Overview of the controller functions

Position controller:
- PDT1 controller
- Linear amplification characteristic curve
- Direction-dependent gain adjustment
- Gain modification via the program possible
- Valve characteristic curve adaptation
- Fine positioning
- Residual voltage principle
- Compensation of zero point errors
- State feedback via
  - Pressure,
  - Pressure differential
  - Position
- Command value feedforward

Pressure / force controller:
- PIDT1 controller
- I share switchable via window
- Pressure differential evaluation
- Command value feedforward

Velocity controller:
- PI controller
- I share switchable via window

Monitoring functions:
- Dynamic following 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 control electronics is a module for top hat rail mounting.

A microcontroller controls the entire process, makes adjustments, establishes connections and realizes the closed control loops. Data for configuration, command values and parameters are stored in a FLASH in a non-volatile form.

The BODAC PC program is used for the entire configuration and also for the parameterization and diagnosis. Besides the switches for address setting, the module is not equipped with any additional 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 - simply connect the pre-defined functional components. For this purpose, no programming knowledge is necessary.

A mode is available:

- **Structural editor**
  Own motion sequences can be established. 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 times.

Signal linking [6] [8] [17]

The 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 minimum/maximum value generator, area ration 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 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
Y ... 2nd signal

T1 Lag = Low pass filter

Analog I/O [1] [15]

The 6 analog inputs are switchable 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 ±10V.

The output is switched over so that the whole range of the analog-digital converter is used.

Both working range and error detection can be defined for all analog inputs.

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 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
- Table completed
- 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

If VT-HACD-3-2X is used as control electronics, digital position measurement systems of type SSI or incremental can be used for actual value recording.

Limitations of use for the 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 evaluation by EXE (interpolation and digitalizing electronics) determine the frequency.

Determination formulas

Encoder resolution at given maximum velocity:

$$\text{Res}\ [\mu\text{m}] \geq \frac{v\left[\frac{\text{m}}{\text{s}}\right] \times 10^3}{f_G\ [\text{kHz}] \times \text{EXE}}$$

Velocity at specified encoder resolution:

$$v\left[\frac{\text{m}}{\text{s}}\right] \leq \frac{\text{Res}\ [\mu\text{m}] \times \text{EXE} \times f_G\ [\text{kHz}]}{10^3}$$

Controller

If the HACD is used as control electronics, select "Controller" for signal linking [8].

The LCx signals indicate the command value branch, the LFBx signals indicate the actual value branch. [8]

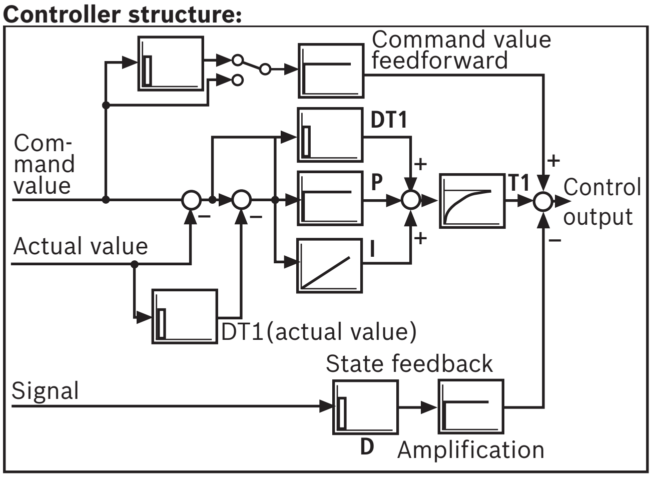
Both SSI encoder or incremental encoder [2] (digital measurement system) and one or more analog sensors can be used as actual value signal.

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.

A state feedback can be used for controller output damping.

Controller structure:



Adjustment to hydraulic system

For the optimum adjustment to the particularities of hydraulic drives, the following functions are implemented upstream of the analog output:

- Direction-dependent amplification [10]
  For positive and negative values, the amplification can be set separately. In this way, adjustment to the area ratio of a differential cylinder is possible.
- Characteristic curve correction [11]
  In this way, the progressive flow characteristics of proportional directional valves are 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 treatment

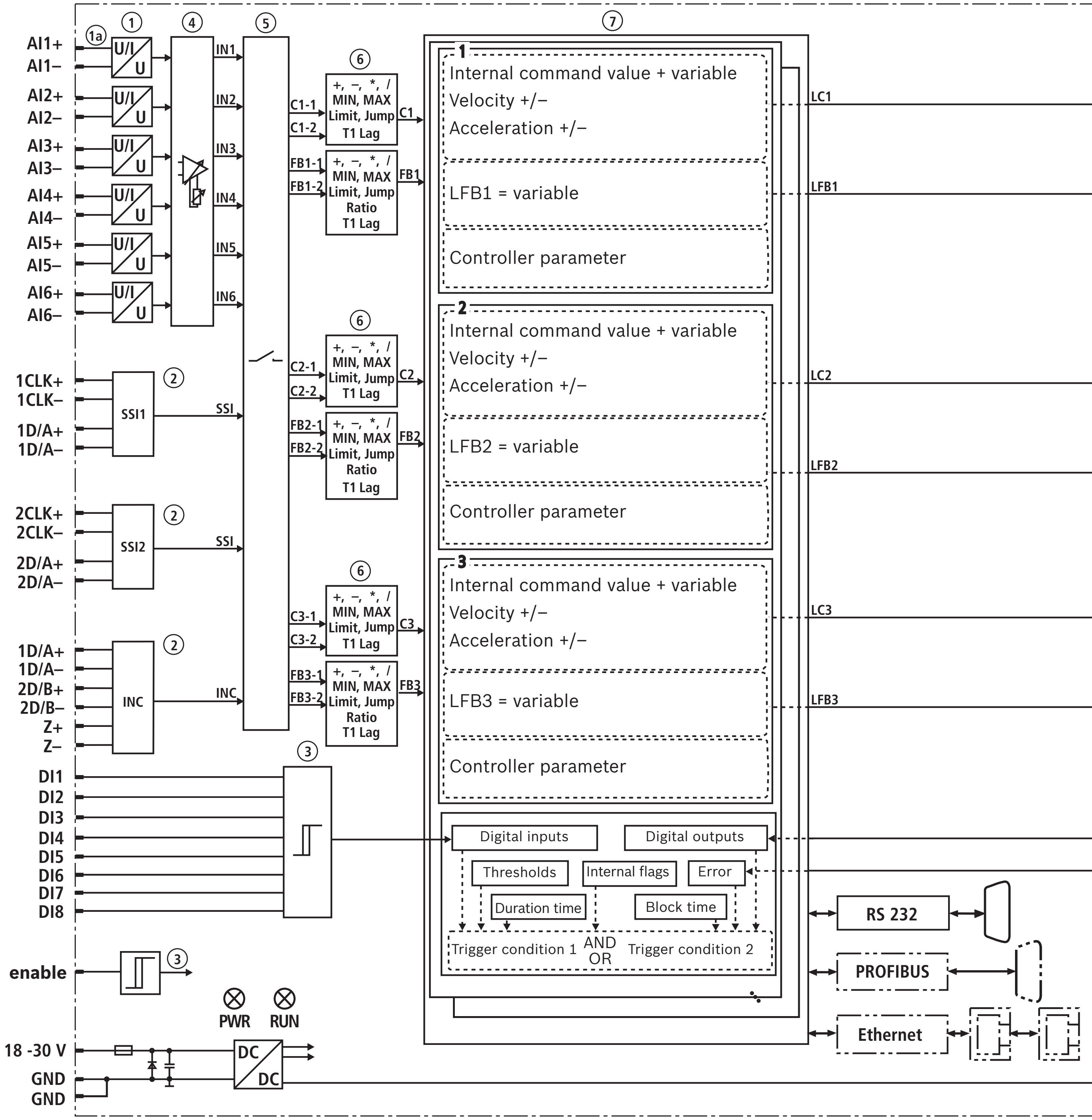
The HACD supports numerous error monitoring possibilities:

- Monitoring of analog inputs for lower deviation or exceedance of the range
- Monitoring the sensor technology for cable break
- Control error monitoring when configuring the HACD as controller
- Monitoring of the supply voltage, all internal voltages as well as the +10V reference voltage
- Monitoring the microcontroller (watchdog) as well as the memory (checksum)

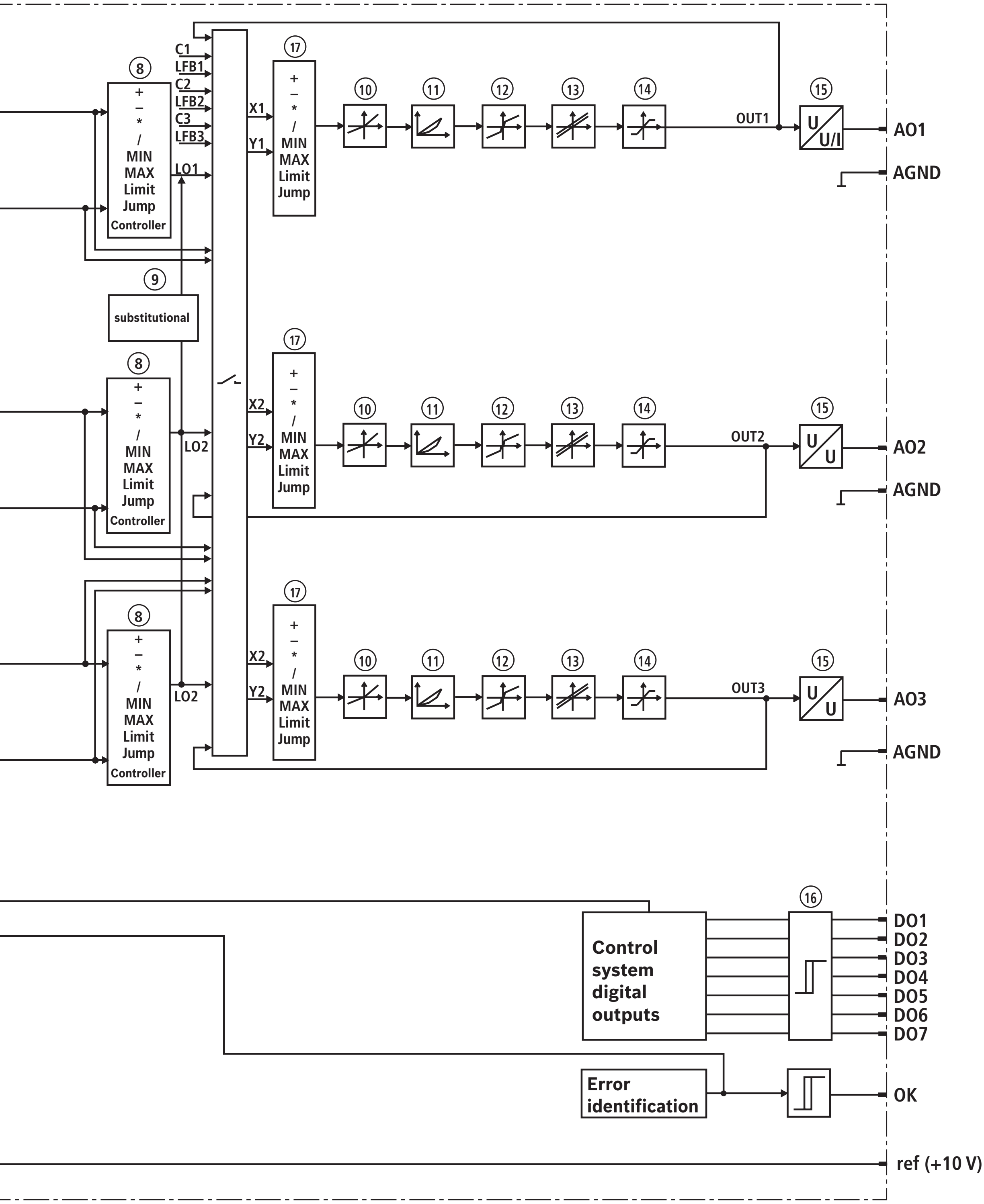
The error monitoring as well as its reaction can be configured as well.

[ ] = Assignment to the block diagram on page 8/9

Block diagram: Structural editor



1 Analog voltage or current inputs
1a High-impedance input AI1
2 SSI or incremental
3 Enable input and digital inputs
4 Analog input adjustment
5 Switching matrix
6 Math. connection of 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 Characteristic curve adjustment
12 Residual velocity and overlap jump

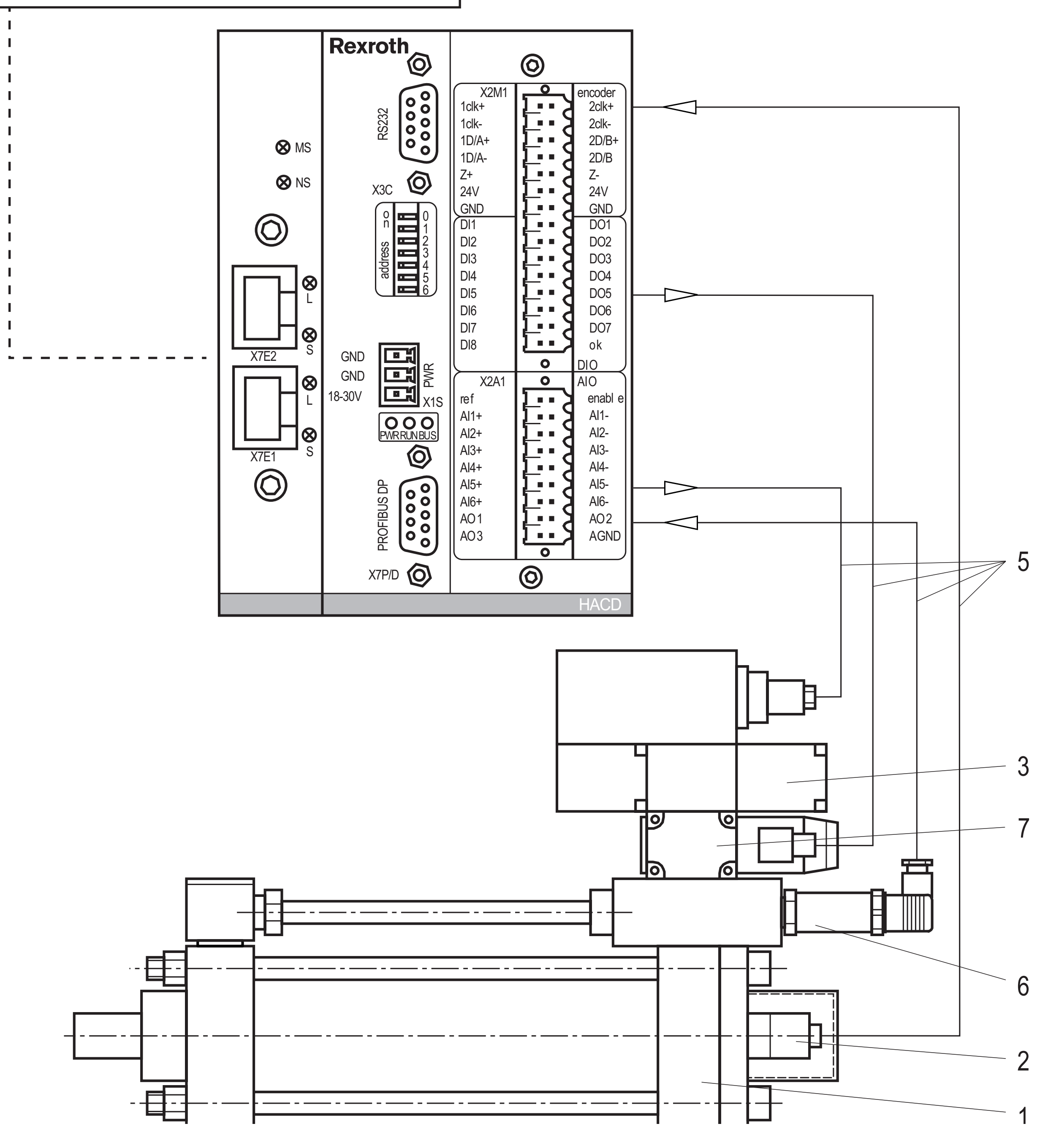


13 Offset
14 Limitation
15 Analog voltage or current outputs
16 OK output and digital outputs
17 Math. connection of outputs

System overview, interfaces

Superior control system
Possible interfaces with the VT-HACD-3-2X:
- analog signals
- digital inputs/outputs
- serial interface
- Bus systems

Example:
VT-HACD-3-2X/... with one hydraulic cylinder axis



1 Differential 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 shut-off valve (with connector switching amplifier)

Technical data

Operating voltage [1)]	U_B	18 to 30 VDC
Current consumption at 24VDC		200 mA (also observe 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 measurable)
• 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 24V encoder supply is realized directly via the VT-HACD-3-2X (supply voltage is looped in), the encoder specification has to be observed.

Technical data, continued

X3C, interface for BODAC X7P, interface for bus X7E1(2), interface for Ethernet		RS232 PROFIBUS DP (max. 12 MBaud acc. to IEC 61158) PROFINET RT, EtherNet/IP
Switching inputs (DI) and/or outputs (DO)	Quantity	DI = 9 / D0 = 8
Switching inputs (DI)	Logic level	log 0 (low) ≤ 5 V; log 1 (high) ≥ 10 V to U_B, I_e = 7 mA with U_B = 24 V
	Port	Flexible conductor up to 1.5 mm^2
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
	Port	Flexible conductor up to 1.5 mm^2
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. 28bit
• Line receiver / line driver		RS485
– Voltage supply for SSI transducers via 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
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		
without Ethernet	*m*	930 g
with Ethernet	*m*	1162 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 30543-U.

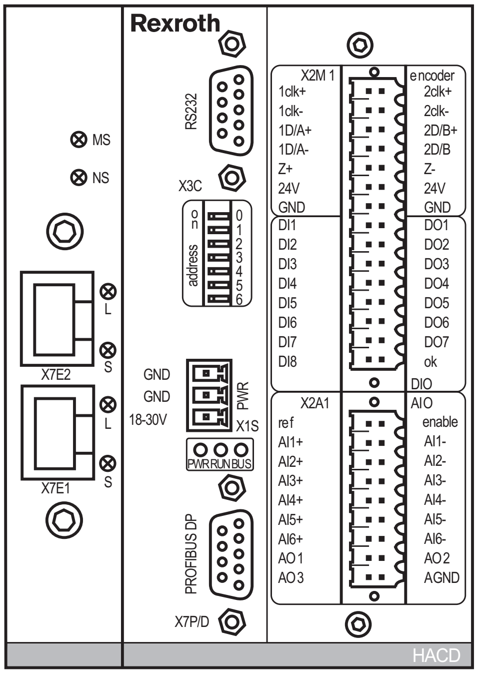
Pin assignment

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

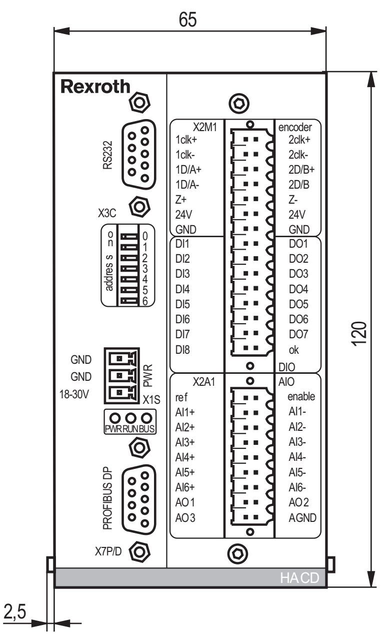
Notes:

– The pins marked with **"reserved"** are reserved and must not be connected!

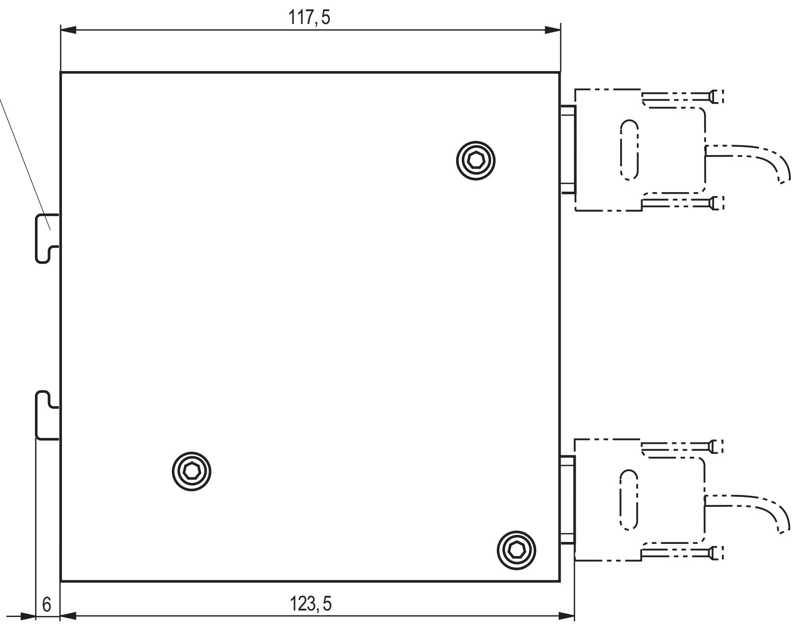
– PROFIBUS DP (port X7P/D) is not available with the Ethernet version.

Unit dimensions (dimensions in mm)

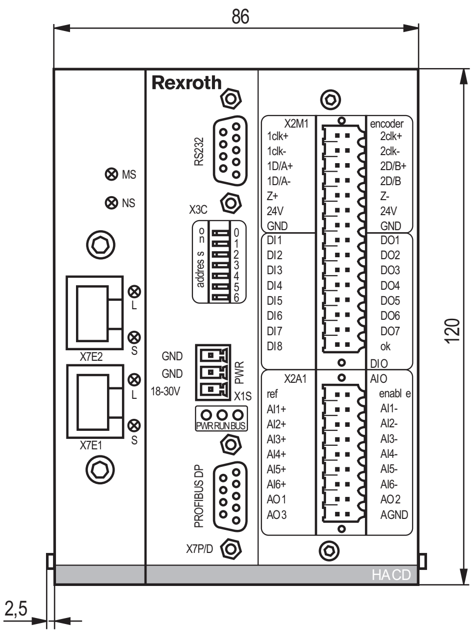
VT-HACD-3-2X/
(**without** Ethernet)



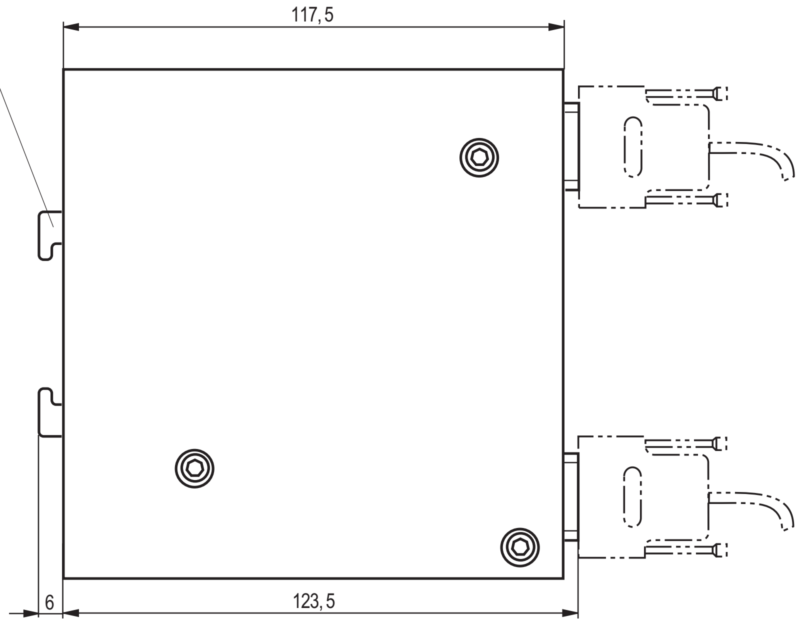
Assembly on top hat rail TH 35-7.5 or TH 35-15 according to EN 60715



VT-HACD-3-2X/
(**with** Ethernet)



Assembly 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**
- **Commissioning instructions PROFIBUS interface 30543-01-Z**
- **Commissioning instructions EtherNET/IP interface 30543-04-Z**
- **Commissioning instructions PROFINET RT interface 30543-05-Z**
- **General information on the maintenance and commissioning of hydraulic components 07800/07900**

Maintenance instructions:

– The devices have been tested in the plant 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 must transfer all appropriate user parameters and programs again.

Notes:

– Electrical signals provided 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)!
– For additional information, see BODAC software description 30543-01-B and operating instructions 30543-B
– The upper and lower ventilation slots must not be concealed by adjacent devices in order to provide for sufficient cooling.

Declaration on the environmental compatibility for EMC[1], climate and mechanical load

Type VT-HACD-3-2X

Digital control electronics

Product types

– VT-HACD-3-2X... according to data sheet RE 30543 and operating instructions RE 30543-B

Description of the product family

The digital VT-HACD-3-2X control electronics are parameterizable control electronics for controlled axes. They comply with the specific requirements for control of hydraulic axes.

[1] In the sense of the EMC directive 2004/108/EC and the EMVG (act on the electromagnetic compatibility of operating media) dated 02/26/2008

The products comply with the following standards:

1. EMC (electromagnetic compatibility)

Test according to generic standard **EN 61000-6-2:2005**

			Interference resistance
EN 61000-4-2:2007	VDE 0847-4-2	ESD (electrostatic discharge)	Air discharge: Severity level 4 / evaluation criterion A Contact discharge: Severity level 4 / evaluation criterion A
EN 61000-4-3:2006 + A1:2008	VDE 0847-4-3	HF fields, freely beamed	Severity level 3 / evaluation criterion A 80…1000 MHz Severity level 3 / evaluation criterion A 1…2.7 GHz
EN 61000-4-4:2004	VDE 0847-4-4	BURST (transient interference)	Repetition rate 5 kHz Supply voltage: Severity level 3 / evaluation criterion A Data lines: Severity level 4 / evaluation criterion A Repetition rate 100 kHz Supply voltage: Severity level 3 / evaluation criterion A Data lines: Severity level 4 / evaluation criterion A
EN 61000-4-5:2006	VDE 0847-4-5	SURGE (surge voltage)	Supply voltage: Asymmetric (line against ground) Symmetric (line against line) Severity level 1 / evaluation criterion A Data lines: [1] [2] Asymmetric (line against ground) Severity level 2 / evaluation criterion C Symmetric (line against line) Severity level 2 / evaluation criterion B
EN 61000-4-6:2007	VDE 0847-4-6	HF fields, conducted	Severity level 3 / evaluation criterion A 0.15...80…230 MHz
EN 61000-4-8:1993 + A1:2001	VDE 0847-4-8	Magnetic fields	Severity level 4 / evaluation criterion A

Footnotes, see page 3

The products comply with the following standards (continued):

1. EMC (electromagnetic compatibility), continued

Test according to generic standards **EN 61000-6-3:2007** and **EN 61000-6-4:2007**

			Transient emissions
EN 55022:2006 + A1: 2007	IEC/CISPR 16-2-1:2005-09 point 7.4.1 IEC/CISPR16-1-2:2006-08 point 4.3	Emission Radio interference voltage (direct voltage / power supply connection)	Limits according to EN 61000-6-4:2007 0.15…30 MHz table 1 / line 2) 3) Limits according to EN 61000-6-3:2007 0.15…30 MHz table 1 / line 3) 3)
EN 55022:2006 + A1: 2007	IEC/CISPR 16-2-3:2006-07	Emission Radio interference field strength (housing, freely radiated)	Limits according to EN 61000-6-4:2007 30…230...1000 MHz table 1 / line 1) 3) Limits according to EN 61000-6-3:2007 30…230...1000 MHz table 1 / line 1) 4)

Notes:

If not otherwise indicated, the data with regard to standard conformity apply for all VT-HACD-3-2X types. The installation instructions apply (top hat rail mounting structure, shield connections, cable laid bundled in the duct, application used according to standard cables for ProfiBus and/or EtherNet/IP).

1) We recommend to use unshielded individual wires (here: DIGITAL I/Os of the VT-HACD-3-2X) only up to a maximum length of 30 m per wire. For lines which are longer than 30 m shielded cables must be used. The cable shield must be applied with low impedance according to the installation instructions.

2) Evaluation criterion C on the basis of the protection and safety shut-down of the electronic system. The electronic system can be switched to operation mode by pressing the reset or Power OFF/ON button.

3) Valid without restriction for all control types of the VT-HACD-3-2X

4) Valid for all control types of the VT-HACD-3-2X with the following requirements:
Folding ferrite (WE 74271112) mounted on the supply line (U_B)

The presumption of conformity is given in the sense of the EMC directive 2004/108/EC and the EMVG (act on the electromagnetic compatibility of operating media) dated 02/26/2008.

The products comply with the following standards (continued):

2. Climate

Test according to EN 60068-2 / IEC 68-2 (environmental test)

EN 60068-2-1:1994		Cold test	2 cycles –5 °C Duration: 2 hours
EN 60068-2-2:1993		Dry heating test	2 cycles +55 °C Duration: 2 hours
EN 60068-2-1:1994 EN 60068-2-2:1993		Storage temperature	–25 °C, duration: 16 hours +85 °C, duration: 16 hours
	IEC 68-2-14:1986	Temperature change	2 cycles –5 °C to +55 °C Duration: 3 hours each at min. / max. temperature
EN 60068-2-30:1999		Humid heat, cyclic	Variant 2 +25 °C to +40 °C 93 % to 97 % of relative humidity 2 cycles à 24 hours

3. Mechanical load

Vibration and shock test according to EN 60068-2 / IEC 68-2 / DIN 40046 (environmental test)
Test on three axes (X/Y/Z)

EN 60068-2-6:1996			Vibrations, sinusoidal	20 cycles, 5...500 Hz with logarithmic frequency changing speed of 1 oct./ min. 5 to 57 Hz, amplitude 0.3 mm (p-p) 57 to 500 Hz, amplitude 2 g
EN 60068-2-64:1995	IEC 68-2-36:1973	DIN 40046-24:1977	Vibrations (random) Broadband noise	20 to 500 Hz, Amplitude 0.01 g^2 / Hz (2.2 g RMS) Testing time: 30 min
EN 60068-2-27:1993			Shock test	Half sine 15g / 11 ms, 3 x in positive/ 3 x in negative direction per axis, total of 18 individual shocks

Rexroth
Bosch Group

Digital
multi-axis NC control

RE 30156/03.12
Replaces: 04.05

Type VT-MAC8

Component series 1X

H 7304

Table of contents

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

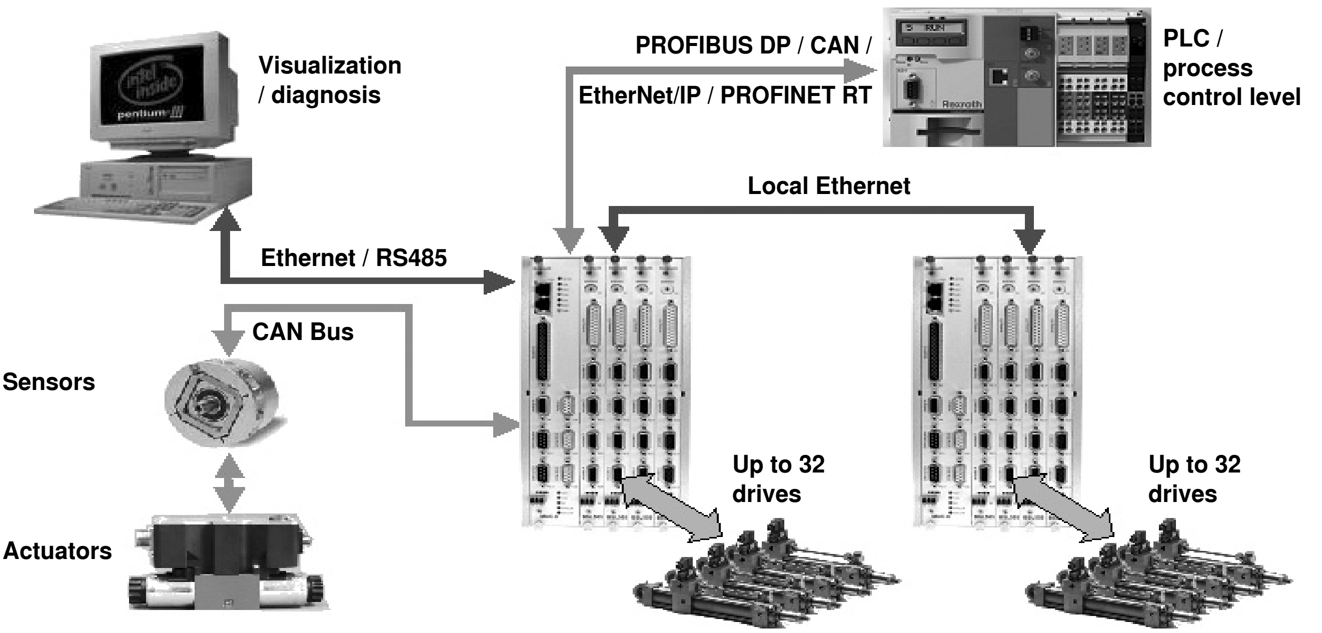
Hydraulic axes

– 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

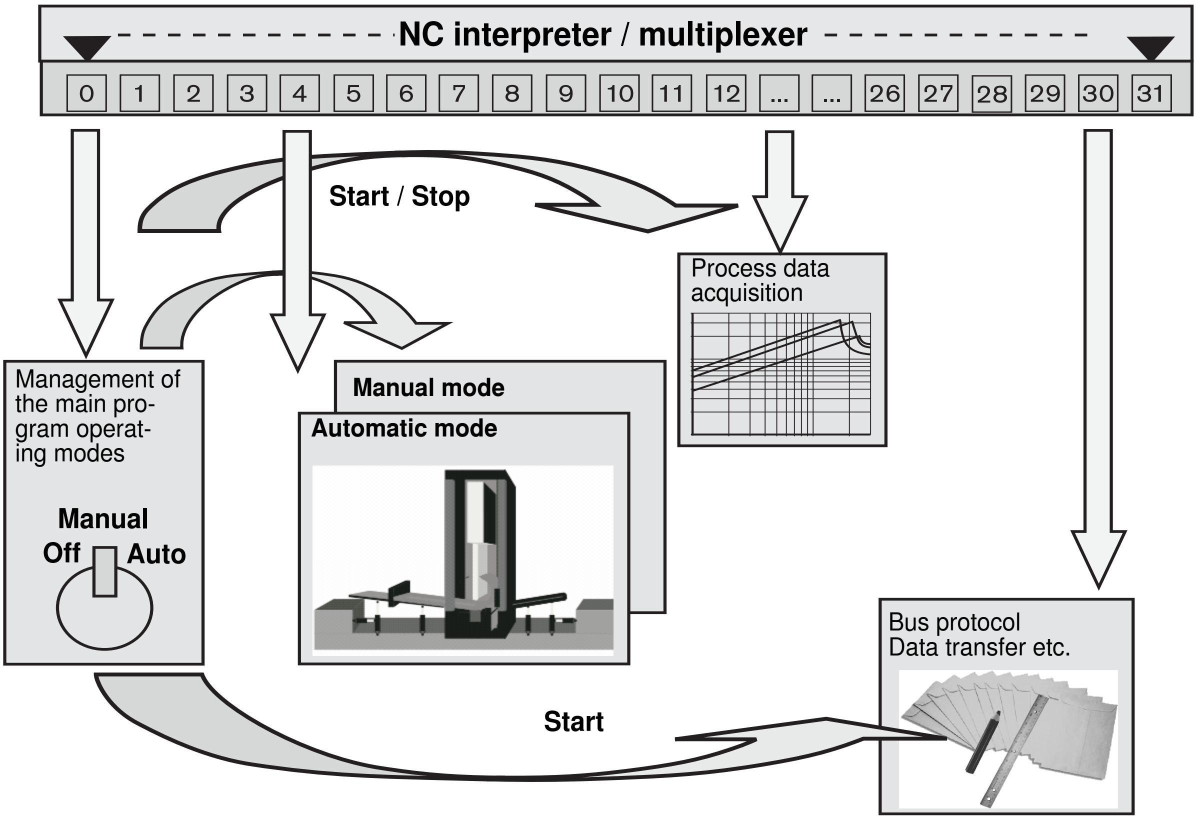
Velocity controller:
- PI controller
- I share switchable via window

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.



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

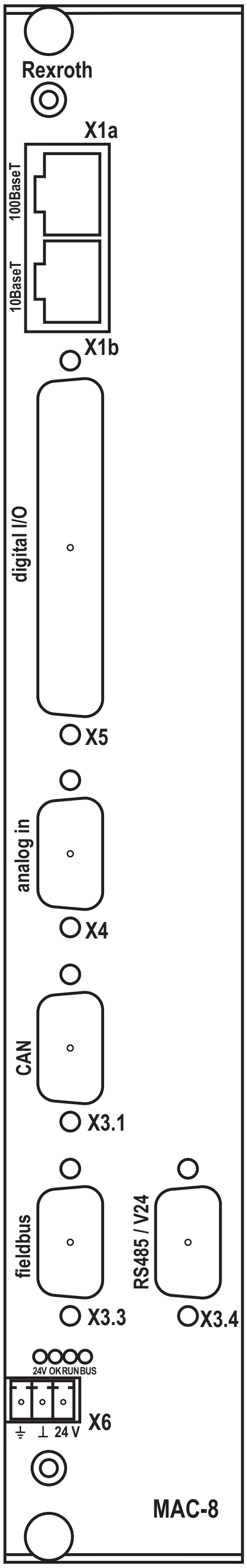
Front plate shows: VT-MAC8-1X/K-PM1

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.	

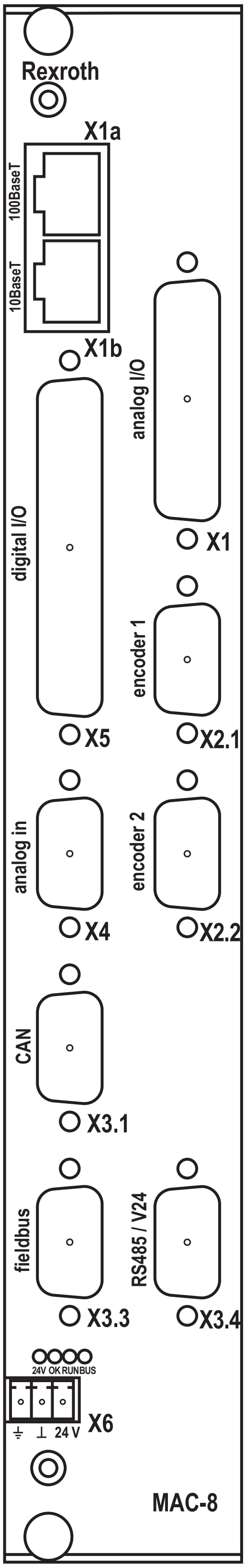
X3.3	PROFIBUS DP	
Pin		**Pin**
1	n.c.	
	VP	6
2	n.c.	
	n.c.	7
3	RxD/TxD -P	
	RxD/TxD -N	8
4	CNTR -P	
	n.c.	9
5	DGND	

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



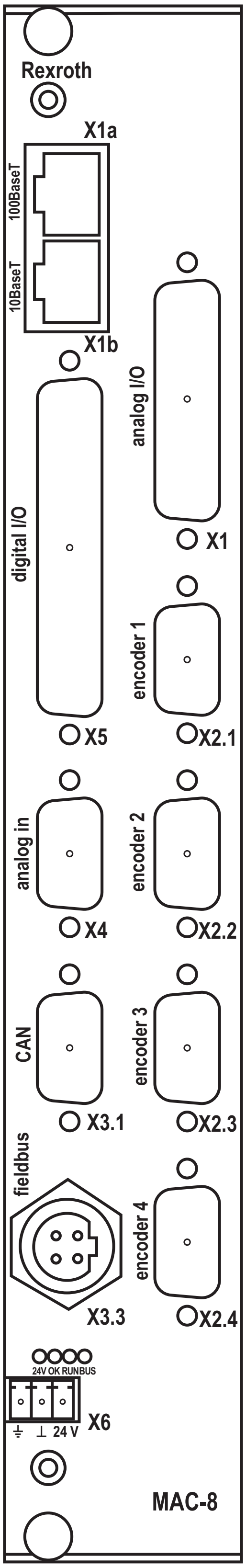
X5		Digital I/O			
Pin	**Description**	**Pin**	**Description**	**Pin**	**Description**
		22	Reserved		
43	Reserved			1	Reserved
		23	In0		
44	In2			2	In1
		24	In3		
45	In5			3	In4
		25	In6		
46	In8			4	In7
		26	In9		
47	In11			5	In10
		27	In12		
48	In14			6	In13
		28	In15		
49	In17			7	In16
		29	In18		
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

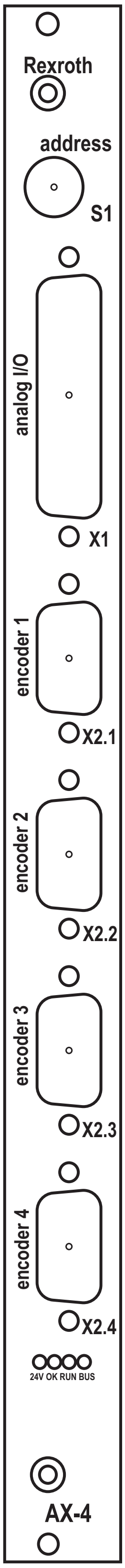
X2.x	Encoder plug	
Pin	**INC**	**SSI**
1	/Ua 2	
2		+Clk
3	Ua 0	
4	/ Ua 0	
5	Ua 1	
6	/ Ua 1	
7		–Clk
8	Ua 2	
9		–Data
10	0 V	0 V
11		+Data
12	Reserved	Reserved
13	n. c.	n. c.
14	Reserved	Reserved
15	n. c.	n. c.

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

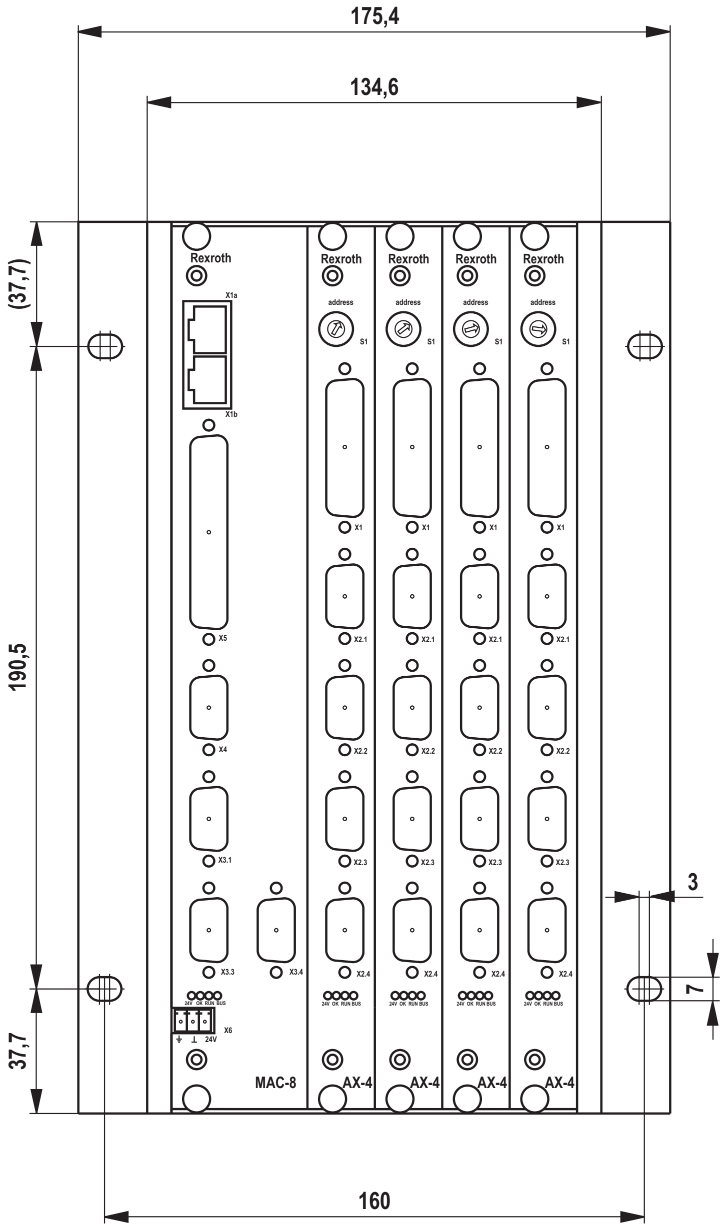
Notice:
Address the card according to the slot.

Notice:
The pins marked with "reserved" must not be connected.

Unit dimensions (dimensions in mm)

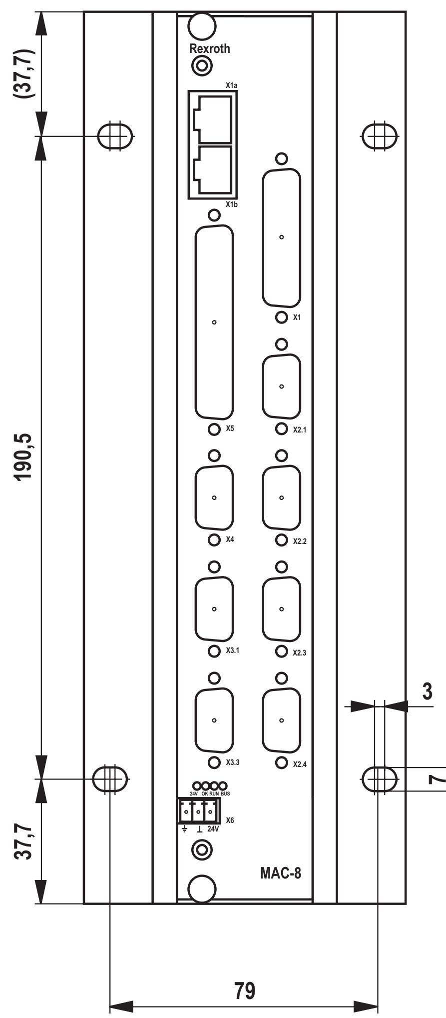
VT-MAC8-1X/K-RACK5

System with 5 slots



VT-MAC8-1X/K-RACK1

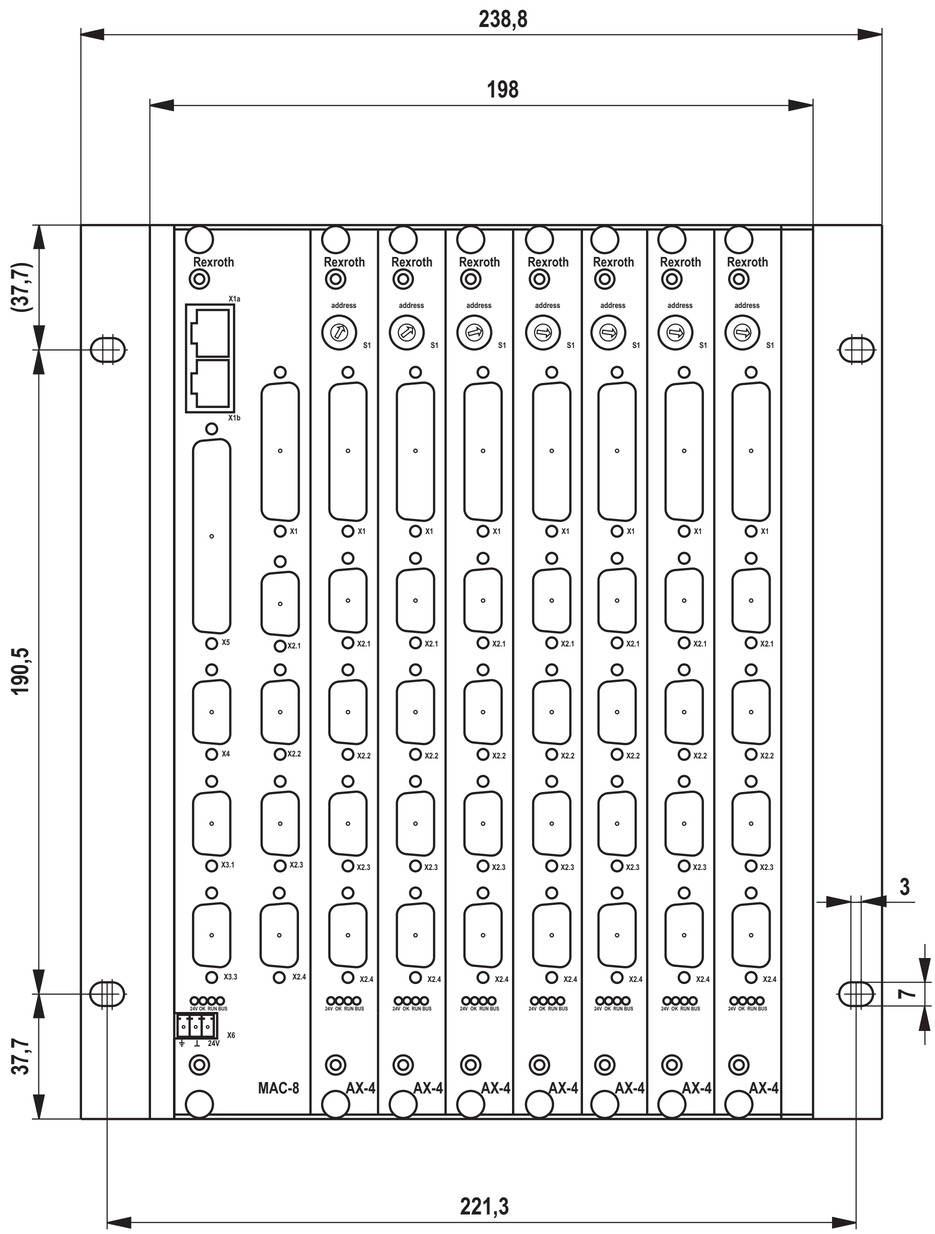
System with 1 slot



Unit dimensions (dimensions in mm)

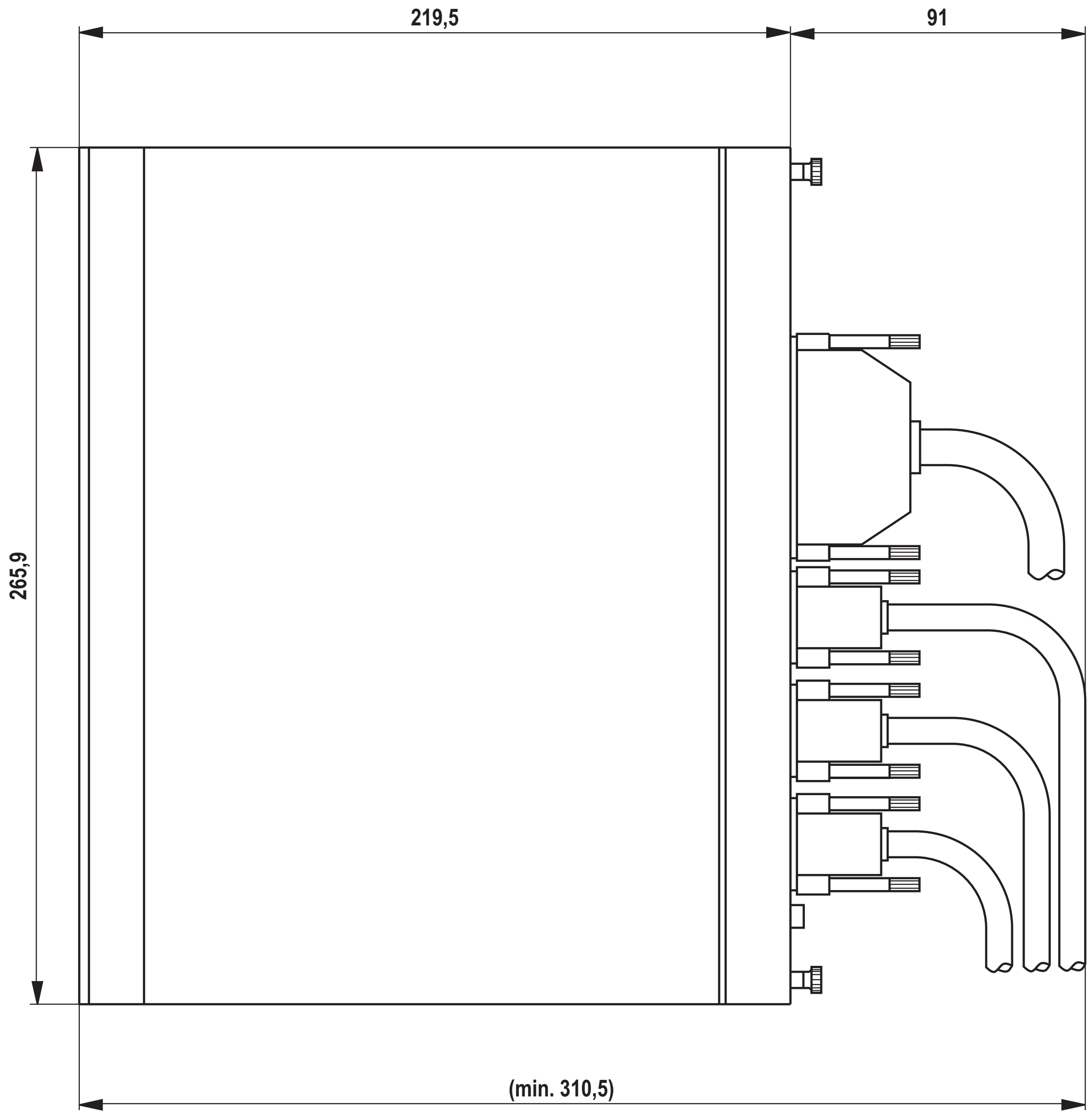
VT-MAC8-1X/K-RACK8

System with 8 slots



Unit dimensions (dimensions in mm)

VT-MAC8-1X/K-RACK1/5/8



Embedded Controls

XM

- Scaled in the scope of performance and functions based on the latest chip technology
- Robust design with extended temperature range
- Simple, flexible I/O integration
- Optionally expandable with extension modules (communication, safety)

- Protection type IP20

The compact control platform XM is available for a variety of Motion Logic applications. The local connection of the S20 I/O modules extends the control flexibly for high-performance process connection. Decentralized I/O stations can be easily integrated via a number of fieldbus couplers. Optional extension modules open up further functions. The robust design simplifies handling and allows for a wide range of applications.

Features

- Ideal for centralized and decentralized controller topologies
- Simple commissioning with First Touch web server

Embedded Controls
XM21

- CPU: Intel ATOM E620 600 MHz
- On-board Sercos master with 250 µs cycle time
- Gigabit Ethernet, USB host and device, SD card slot, diagnostic LED
- Modular expansion options with extension and I/O modules
- Ideal for centralized and decentralized controller topologies
- Scaled in the scope of performance and functions based on the latest chip technology
- Robust design with extended temperature range
- Simple, flexible I/O integration
- Optionally expandable with extension modules (communication, safety)
- Protection type IP20

Embedded Controls
XM22

- CPU: Intel ATOM E660 1300 MHz
- On-board Sercos master with 250 µs cycle time
- Gigabit Ethernet, USB host and device, SD card slot, diagnostic LED
- Modular expansion options with extension and I/O modules
- Ideal for centralized and decentralized controller topologies
- Scaled in the scope of performance and functions based on the latest chip technology
- Robust design with extended temperature range
- Simple, flexible I/O integration
- Optionally expandable with extension modules (communication, safety)
- Protection type IP20

Embedded Controls
XM42

- CPU: Intel Core i, Dual Core, 6th Generation, 2.3 GHz
- On-board: Sercos Master (Sercos, EtherCAT I/O)
- On-board: Multi-Ethernet (PROFINET, EtherNet/IP)
- Gigabit Ethernet, USB host and device, SD card slot, diagnostic LED
- Modular expansion options with extension and I/O modules
- Scaled in the scope of performance and functions based on the latest chip technology
- Robust design with extended temperature range
- Simple, flexible I/O integration

- Optionally expandable with extension modules (communication, safety)
- Protection type IP20

Extension modules XFE

- Expansion of connectivity with additional interfaces
- Expansion of the standard control to the SafeLogic safety controller

Embedded Controls

CML75

- CPU: Intel Atom E3827 DualCore with 1.75 GHz
- PLC, Motion and CNC functionality
- PROFIBUS and real-time Ethernet communication
- On-board I/O
- Expansion with function modules
- Scalable performance and functionality

- Standardized communications interfaces
- Simple, flexible I/O integration
- Optionally expandable with function modules (communication, technology, safety)
- Protection type IP20

Technical data

General data

Type		**CML75.1-NP-900**
Diagnostics		Powerfail Watchdog Temperature monitoring
Display		LCD 1-line
Number of control keys		4
Ambient temperature (operation)	°C	+5 ... +55
Permissible relative humidity (operation)		5 % ... 95 %, EN 61131-2
Protection type		IP20
Weight	kg	1.5

Processor

Type	**CML75.1-NP-900**
CPU	Atom 2 x 1.7 GHz
Real-time clock	Integrated

Memory

Type	**CML75.1-NP-900**

Type		CML75.1-NP-900
Application (RAM)	GB	4
Remanent memory	kB	256
Buffered	MB	16
Flash size	GB	1

Connection data

Type			CML75.1-NP-900
Number of channels, used			≤ 256
Number of function modules			≤ 4
I/O extension	Number of Inline modules		≤ 63
		byte	≤ 64

Interfaces

Type	CML75.1-NP-900
Type	1 x Ethernet TCP/IP (standard) 1 x ready contact (standard) 2 x Ethernet TCP/IP (option)
Fieldbus system	1 x Sercos III (option) 1 x PROFINET IO controller/device (option) 1 x ETHERNET/IP scanner/adapter (option) 1 x PROFIBUS master/slave (standard)

Digital inputs

Type	CML75.1-NP-900
Number	8 galvanically isolated inputs (interrupt capable)

Digital outputs

Type	CML75.1-NP-900
Number	8 galvanically isolated outputs

Electrical data

Type			CML75.1-NP-900
Supply voltage U		V DC	24
U_{min} … U_{max}			19 V DC … 30 V DC
Residual ripple		%	± 5
Logic supply U_L		V [1]	7.5
		A	≤ 2
Logic, segment supply U_{LS}	Tolerance		-25 % … +30 %
		A	≤ 3
Segment supply voltage U_S	Tolerance		-15 % … +20 %
			Max. 8 A (total of UM + US)
Main supply voltage U_M		V DC	24
	Tolerance		-15 % … +20 %
			Max. 8 A (total of UM + US)
Power consumption		W	20

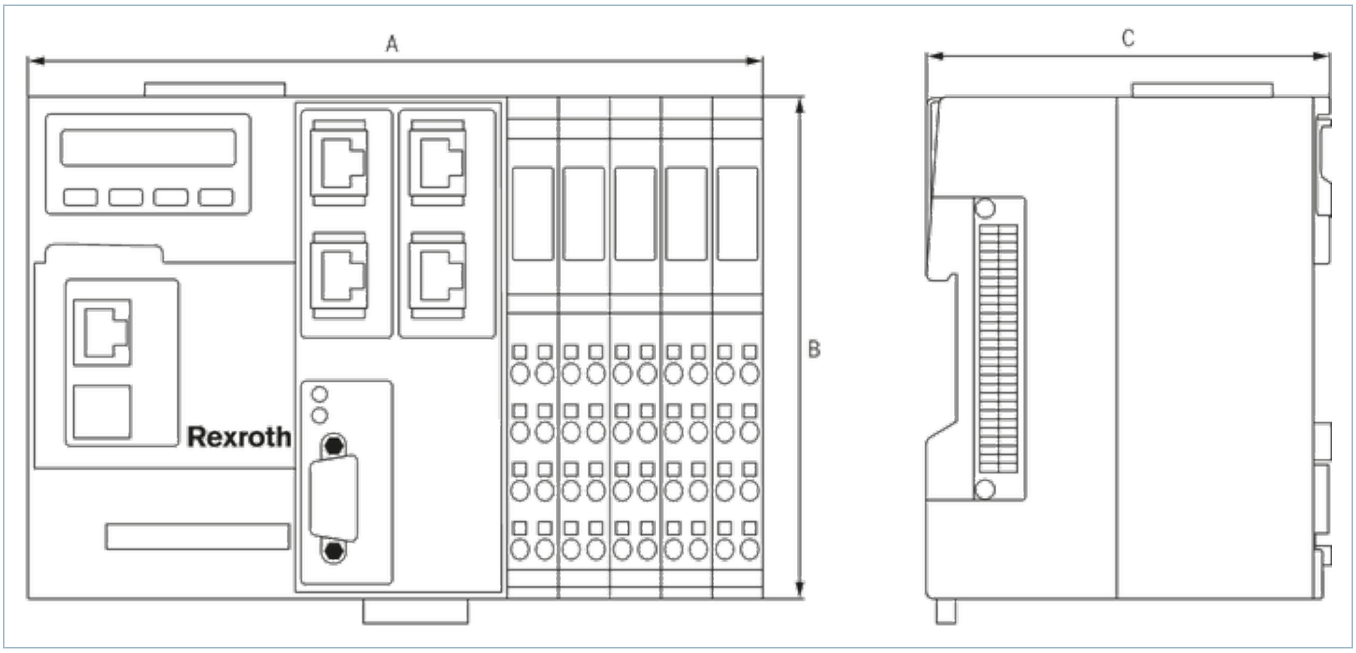
[1] Converted from external 24 V DC

Mechanical tests

Type	CML75.1-NP-900

Type		CML75.1-NP-900
Vibration resistance	g	1
Shock	g	15

Dimensions



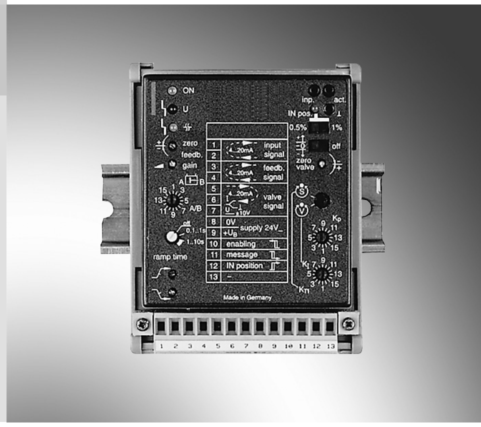
Dimensions

Type		CML75.1-NP-900
A	mm	175
B	mm	120
C	mm	98

Analog positioning module

RE 30050/07.12
Replaces: 03.04

Type VT-MACAS-...



Component series 1X

Table of contents

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
without = Marking
Variant with voltage input
I = Variant with current input

Customer version
V0 = Catalog version

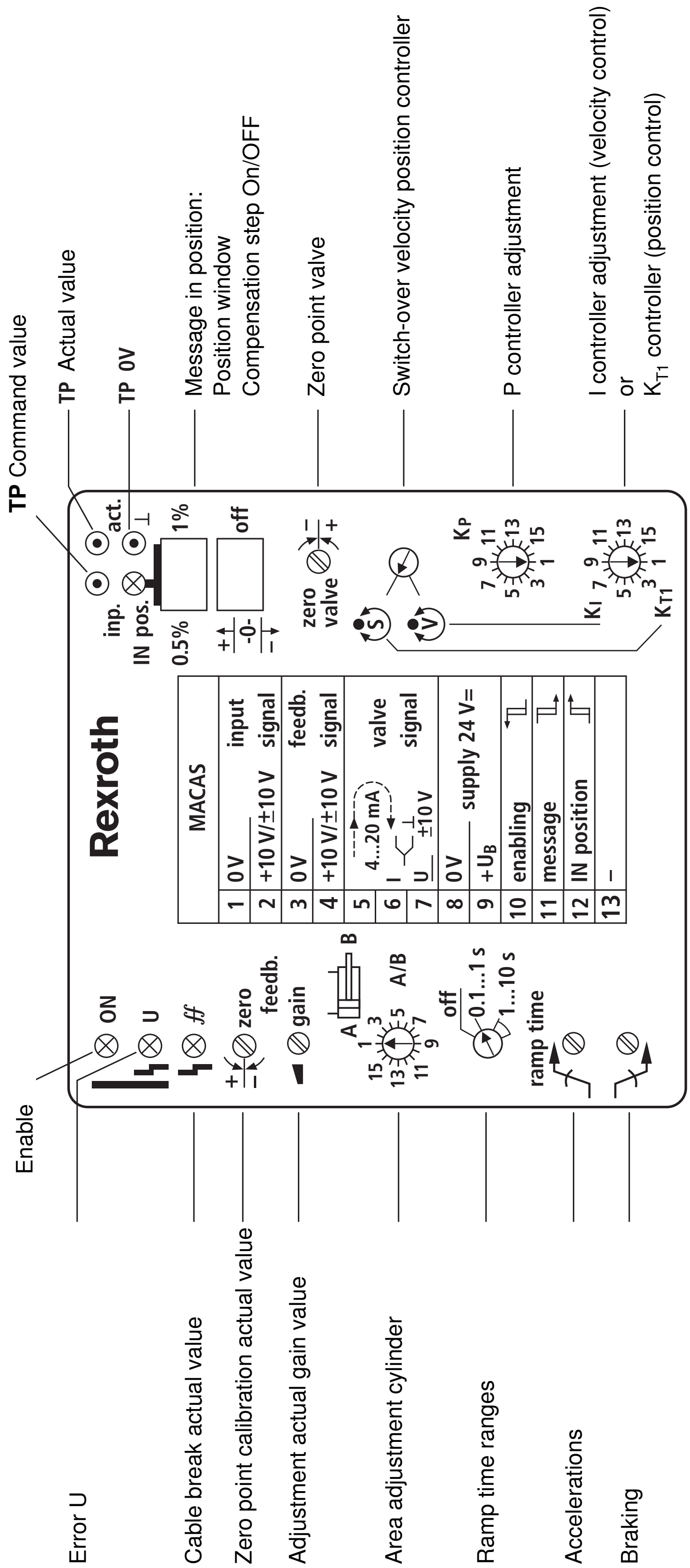
1X = Component series 10 to 19
(10 to 19: Unchanged technical data and pin assignment)

Serial number for types
500 = Standard variant without valve amplifier function

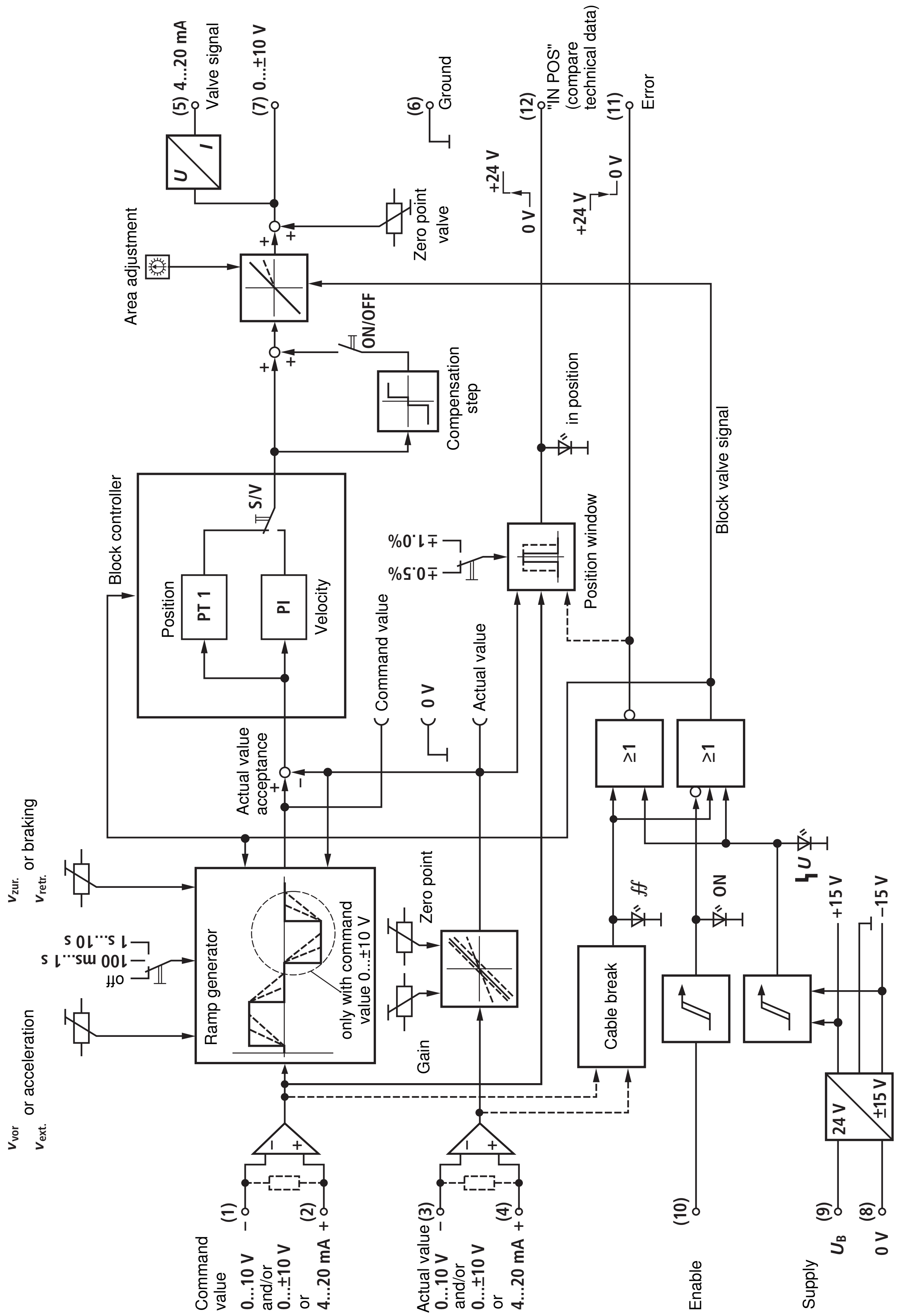
Preferred types

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 supply 24 V=
9 +U_B
10 enabling
11 message
12 IN position
13 –
inp.
act.
IN pos.
0.5%
1%
off
-0-
zero valve
ON
U
zero feedb.
gain
A
B
A/B
off
0.1...1 s
1...10 s
ramp time
K_P
K_I
K_T1

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

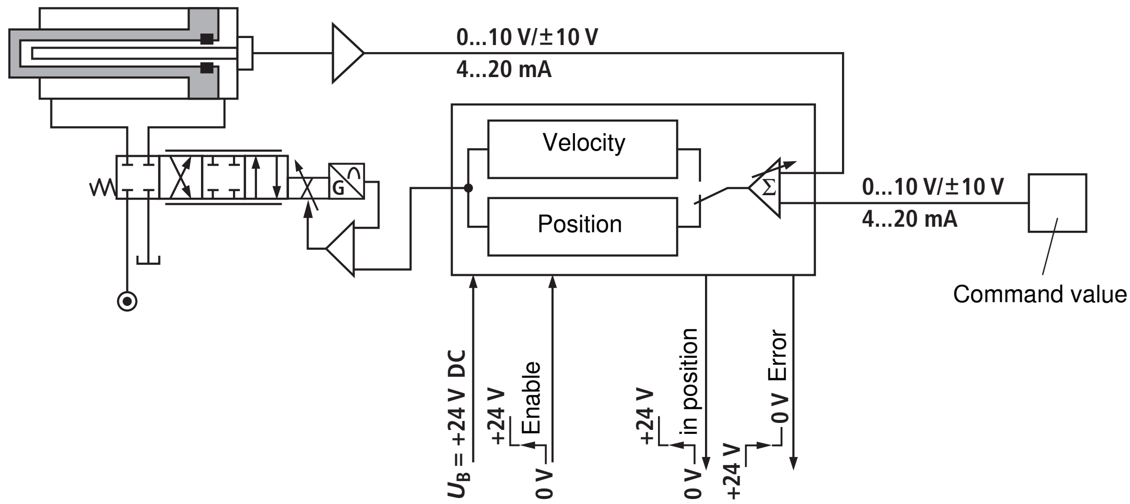
Function

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.

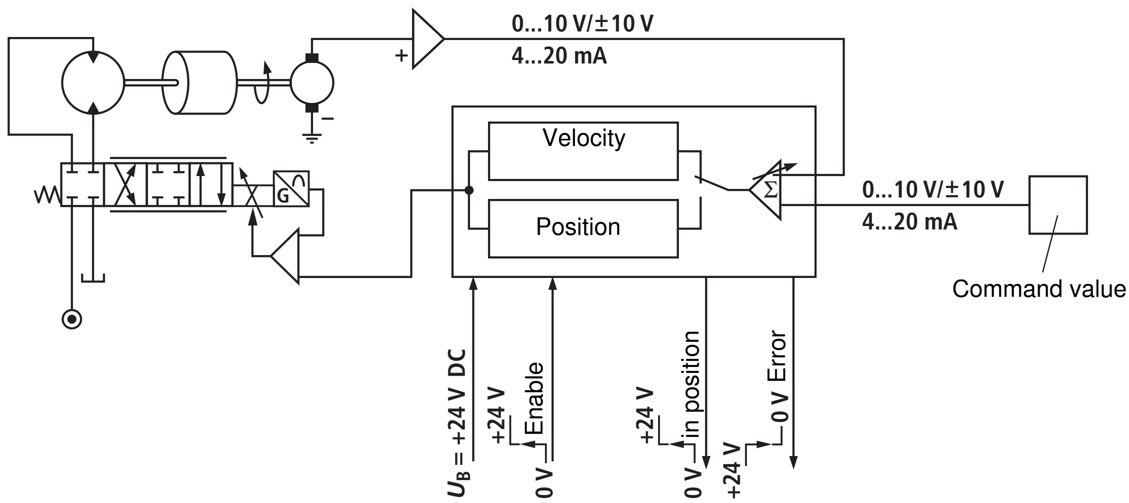


Velocity control*

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.

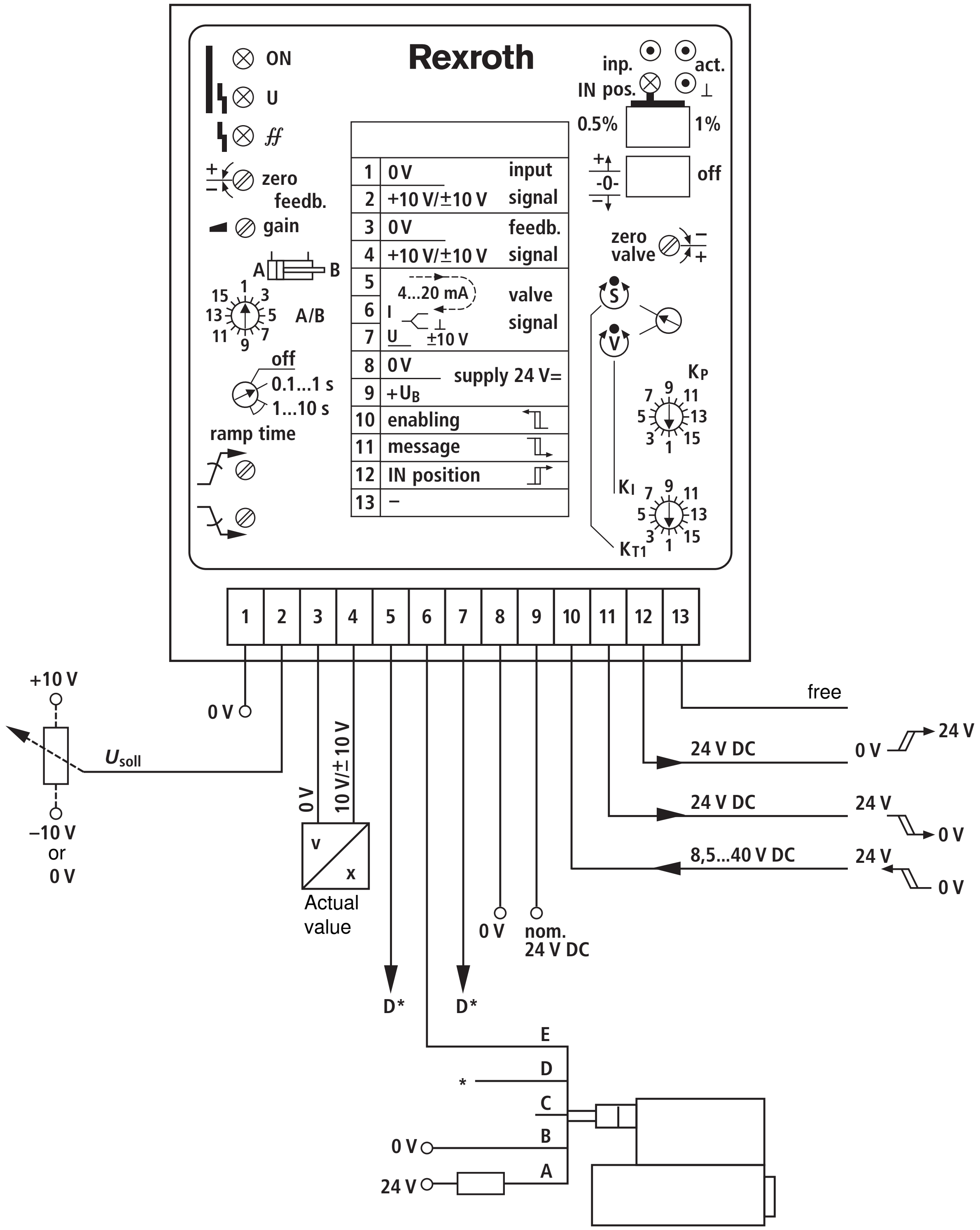
With a ramp function as input signal, there is a gradual acceleration and/or deceleration with a constant value.

* Only possible with tachometer (speed indicator).



Electrical connection

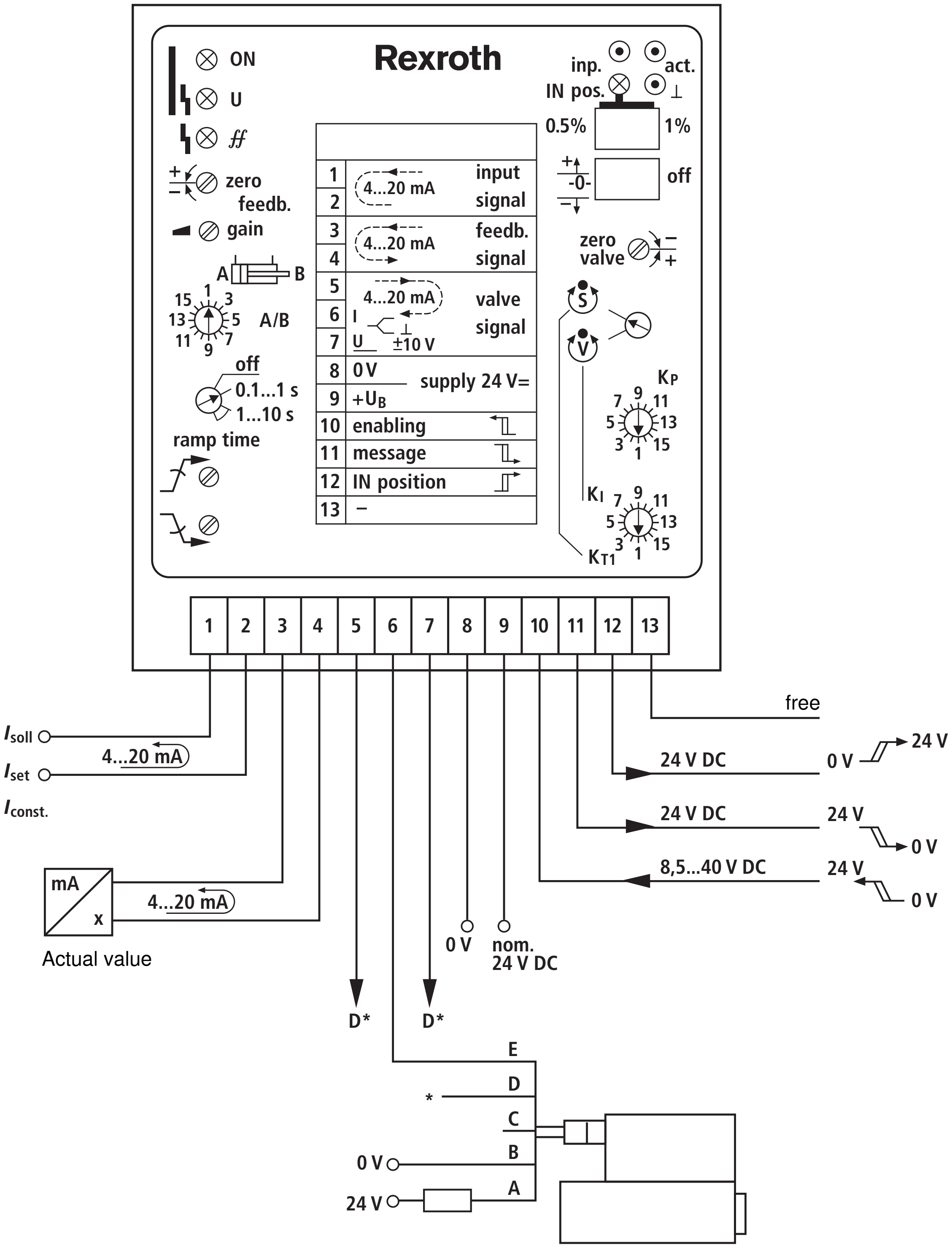
Wiring diagram
AVPC-V



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 "↯U" and LED "↯∫∫" 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

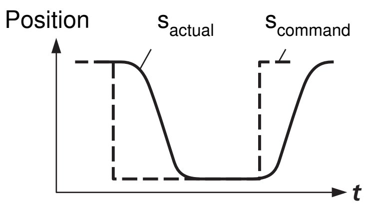
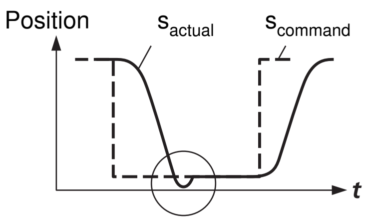
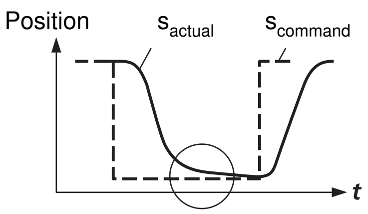
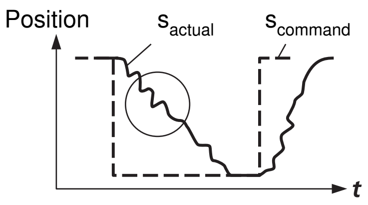
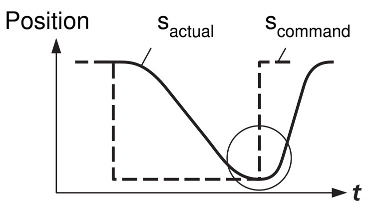
Error reactions

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)

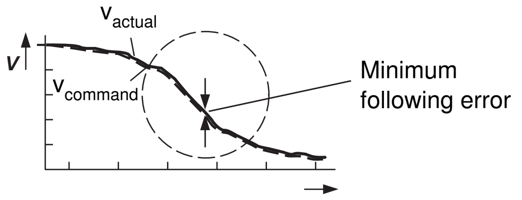
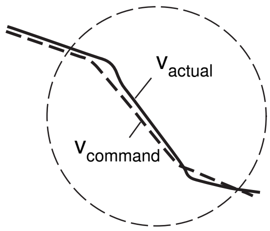
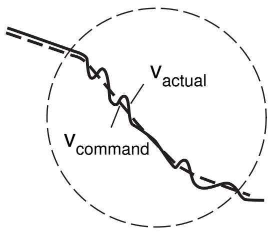
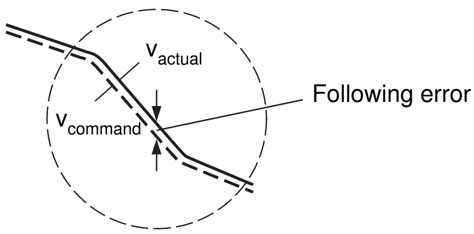
Possible causes: External supply voltage too low (< 16 V) or internal error (→ repair).

ϟ ∫∫: **Tripping** if the actual value or command value lines break
⇒ Valve signal 0 V and/or 12 mA;
⇒ Message LED "∫∫" and (9)

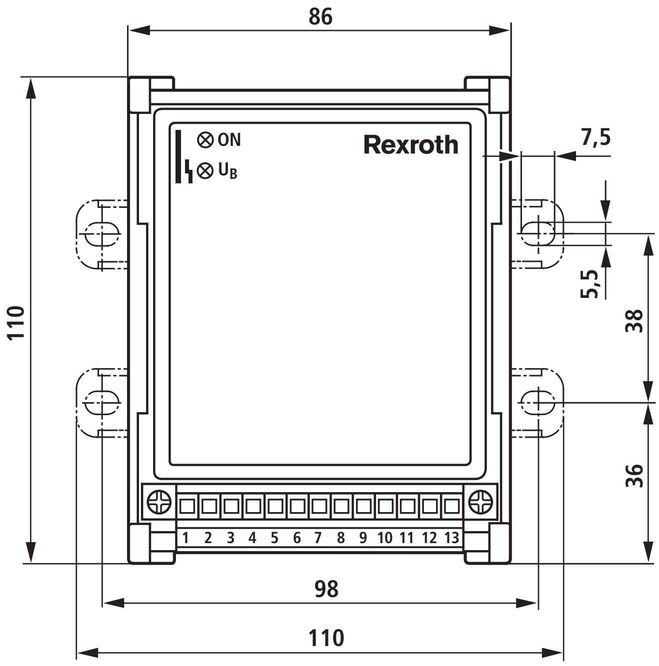
The error is stored.
Deletion of the error by switching the enable signal or the supply voltage off and on again.

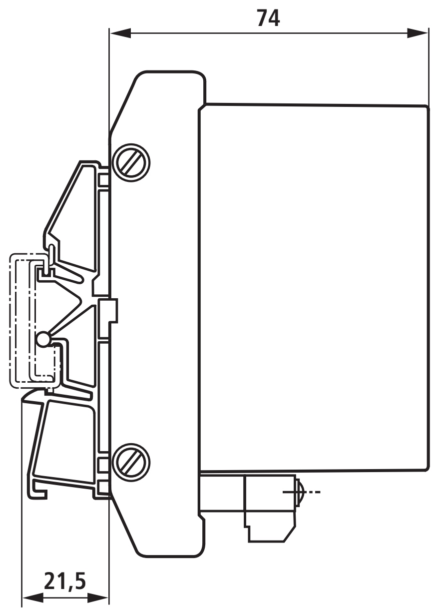
	Ideal development (without command value ramps)
	"Overshooting", P gain too high, → rotate switch K_P against 1
	"Creeping into the position", P gain too low, → rotate switch K_P against 16
	"Vibrations", time constant too small, → rotate switch K_{T1} against 16
	"Area ratio wrong"; set symmetric motion 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.

Rexroth
Bosch Group

Δp/Q controller

RE 30136/07.12
Replaces: 05.04

Type VT-VACAF

Component series 1X

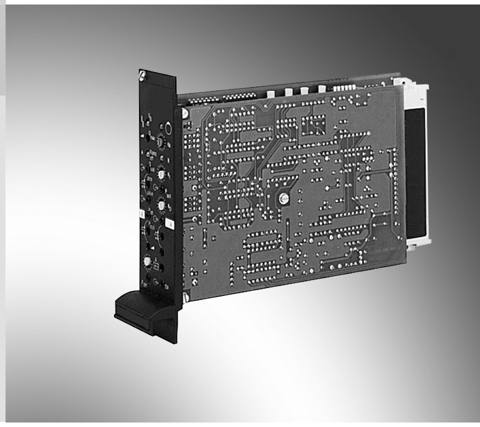


Table of contents

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**

500 = Serial number for types 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

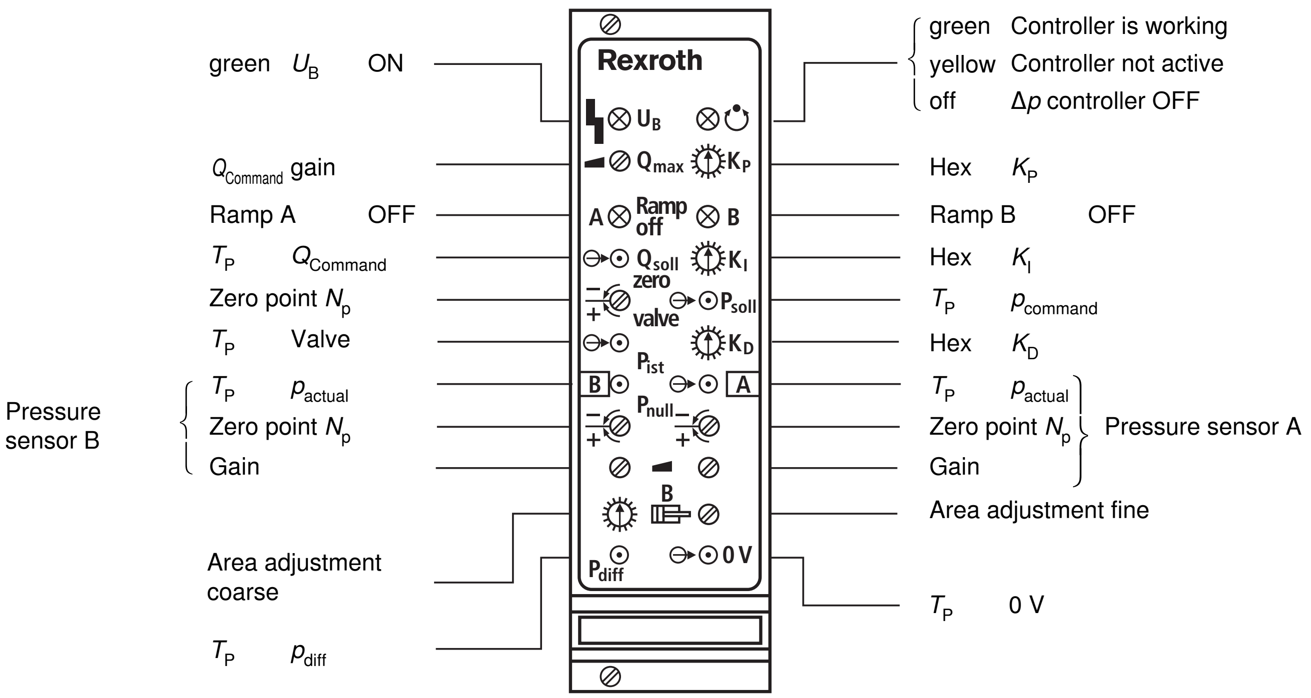
Preferred types

Amplifier type	Material number
VT-VACAF-500-10/V0	0811405147

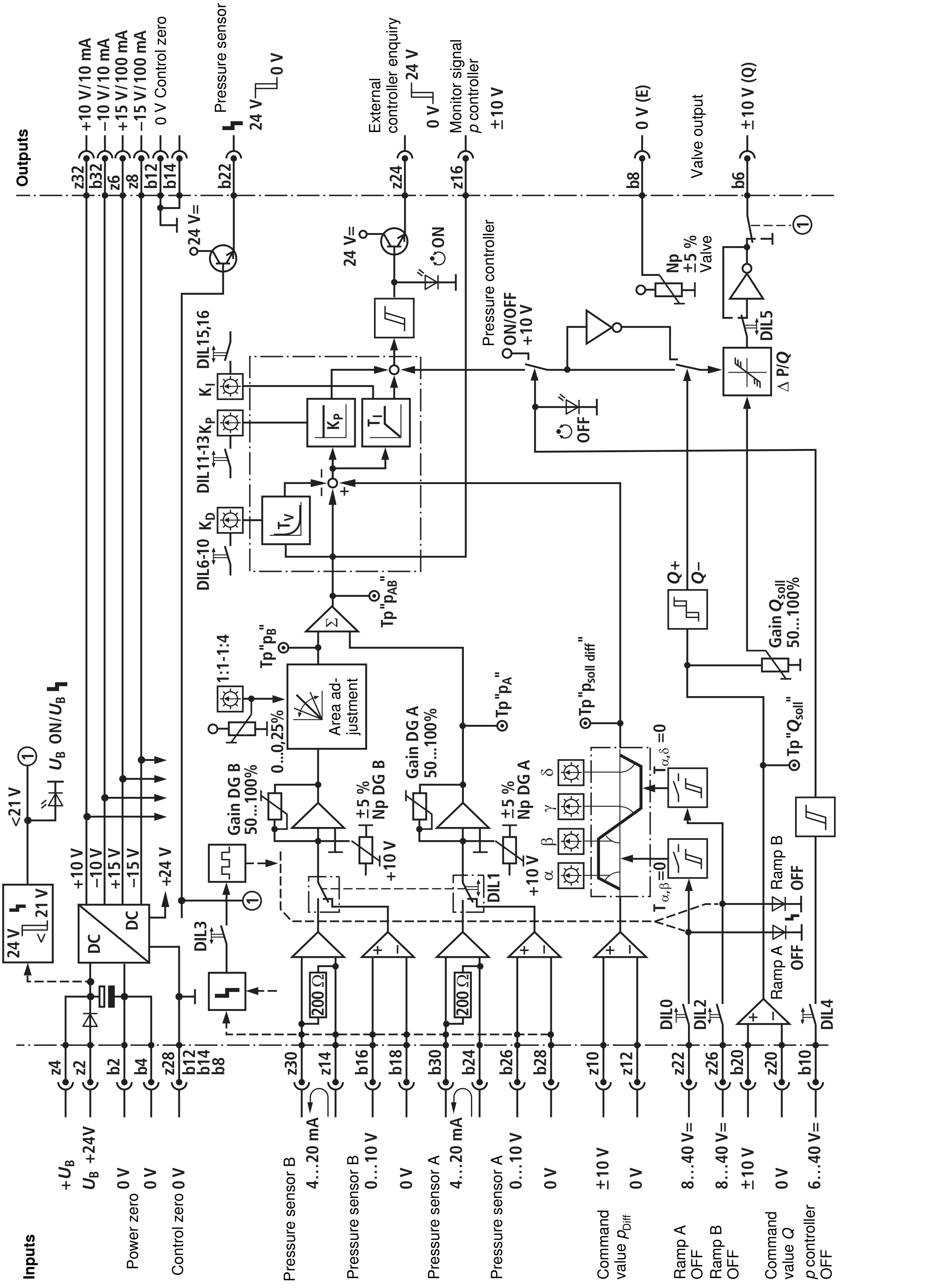
Suitable card holder:

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

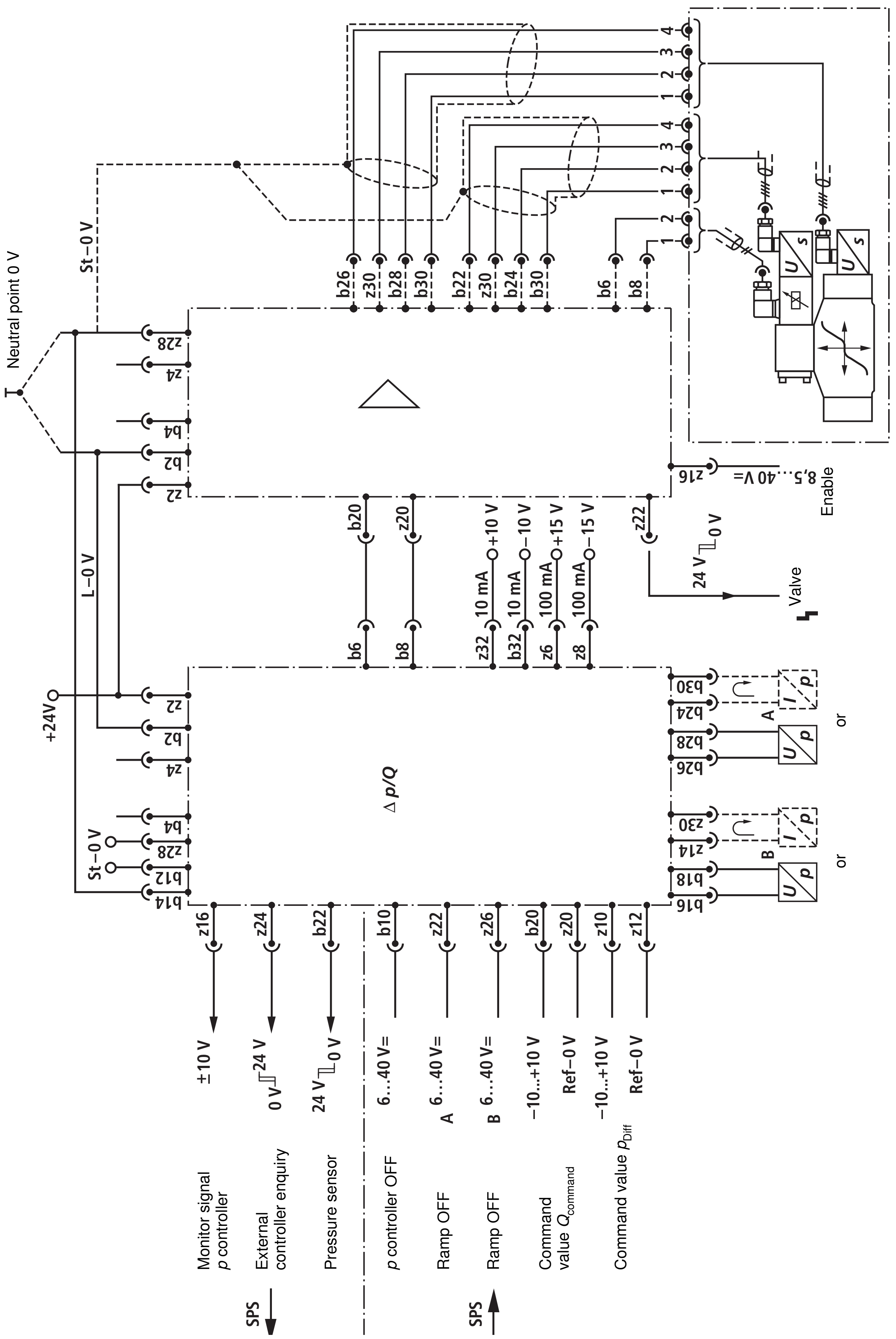
Front plate



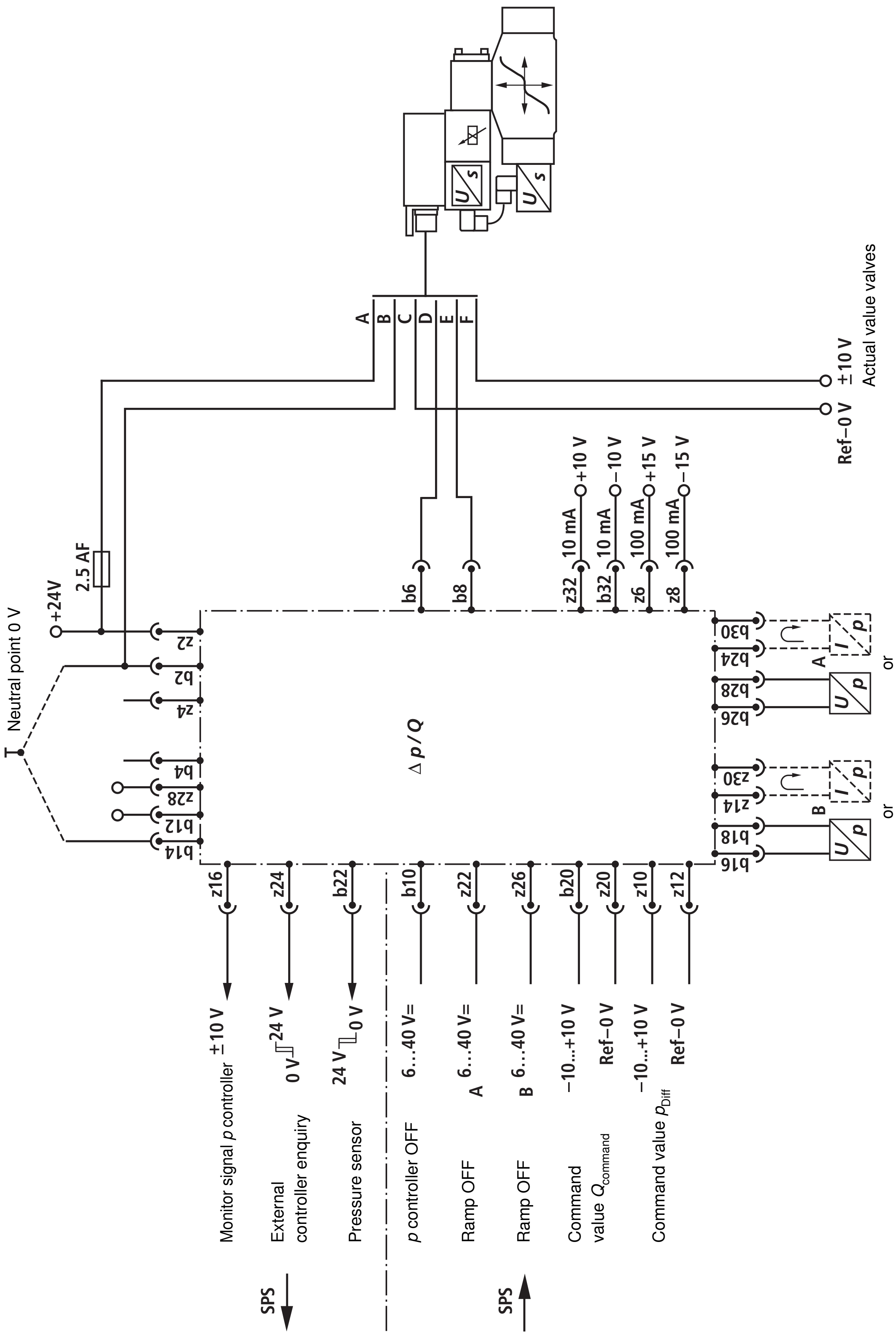
Block diagram with pin assignment



Wiring diagram with valve amplifier card



Wiring diagram – Valve with installed electronics



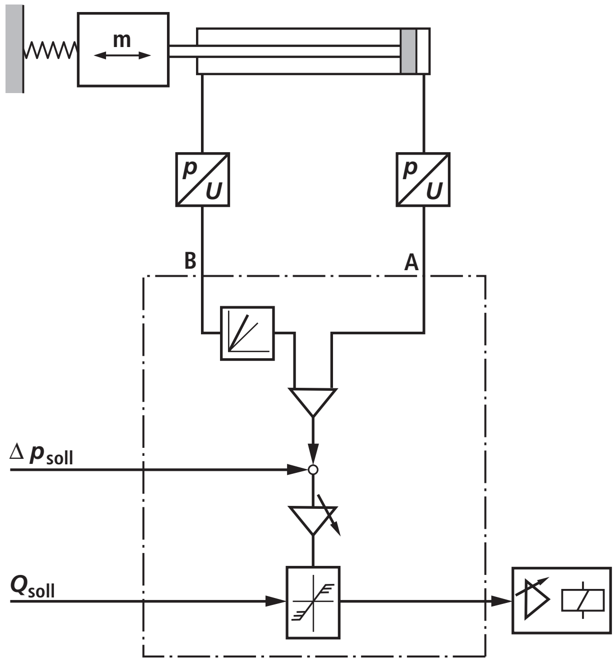
Technical data (For applications outside these parameters, please consult us!)

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 } Differential amplifier z20: 0...±10 V (R_i = 100 kΩ)
Command value p_{diff}		z10: 0...±10 V } Differential amplifier z12: 0 V
Actual value from the pressure sensor	A	b26: 0...+10 V } Differential amplifier b28: 0 V b24: b30: 4...20 mA
	B	b16: 0...+10 V } Differential amplifier b18: 0 V 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) } 16 steps Max. 5.6 s (16) 350 ms/step
Ramp OFF	A	z22: 8...40 V =
	B	z26: 8...40 V =
Area adjustment cylinder		Min. 1:1 (1) } 16 steps Max. 1:4 (16)
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

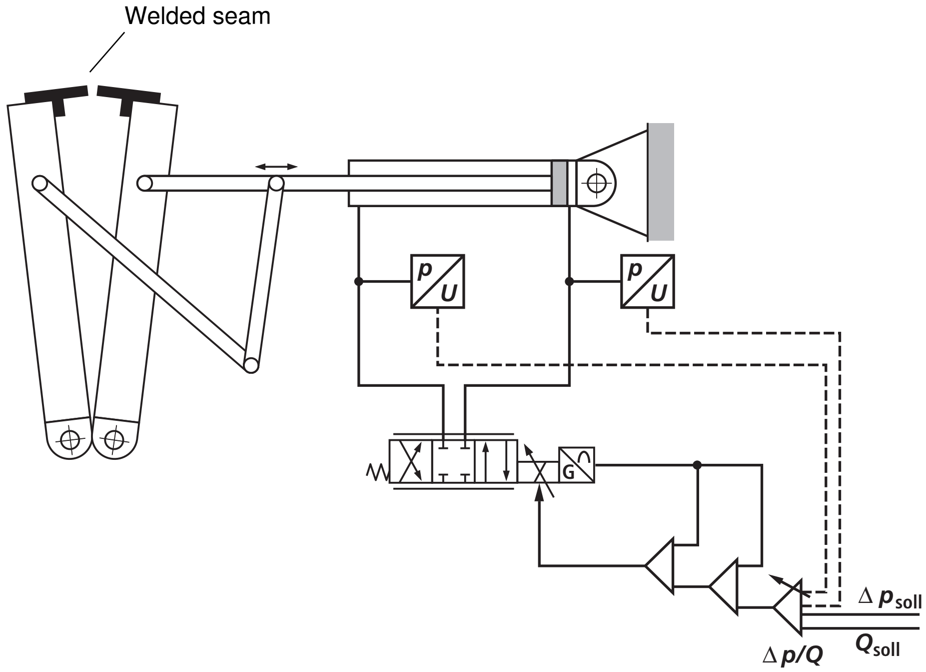
Applications

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.

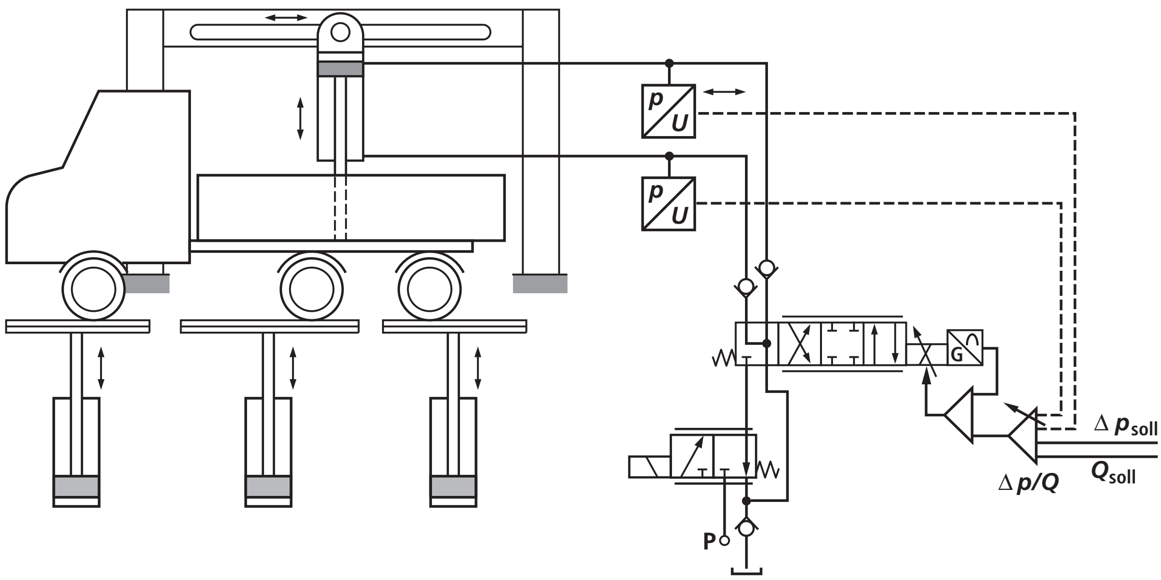
The command value ramps allow for the design of command value steps of $\Delta p_{command}$ as ramp function. The error monitoring logic detects cable break of the signal lines of the sensors and errors in the voltage supply. The pressure control circuit can also be switched off externally (flow control).
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.

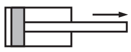
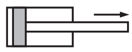
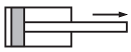
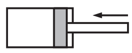
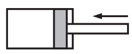
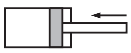
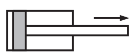
The $\Delta p/Q$ controller takes effect:

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.

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		

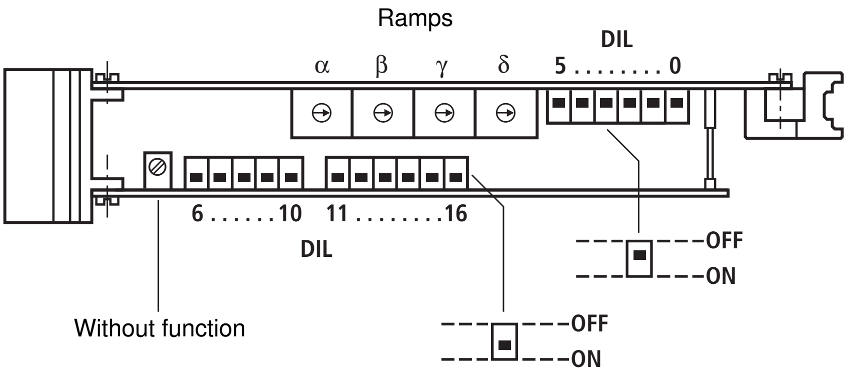


Table 1
Using the DIL switches 6 ... 10, the setting of the hex switch K_D (front plate) can be reduced.
The setting can be reduced in a direction-dependent form.
Step 1 is the lowest, step 8 the highest reduction.

	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

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

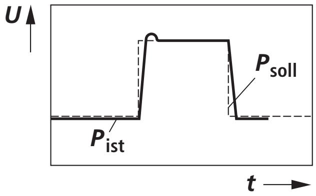
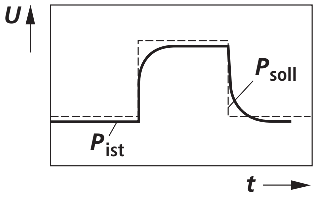
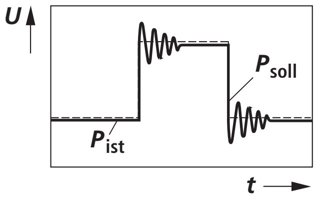
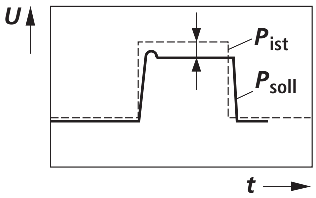
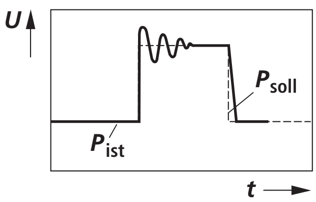
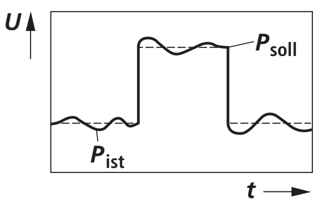
Commissioning and adjustment

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 $R_L \geqq 10$ kΩ.

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).

Step	Instructions
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.

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)

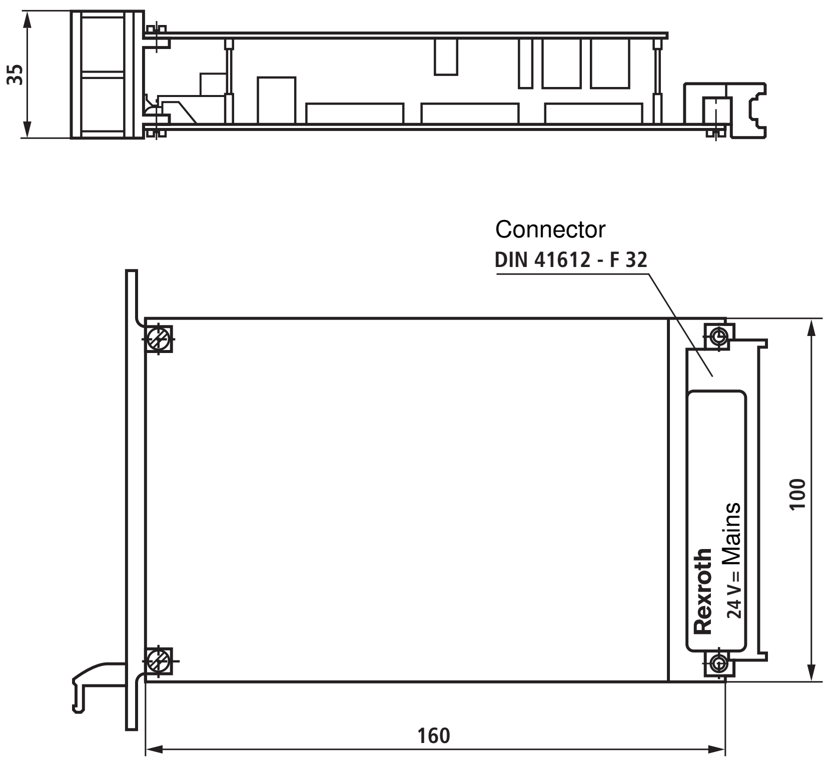
Adjustment protocol

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.

Rexroth
Bosch Group

p/Q closed-loop control amplifier

RE 30134 **1**/12
Edition: 2017-05
Replaces: 06.12

Type VT-VACAP-500-2X/V0/...

Component series 2X

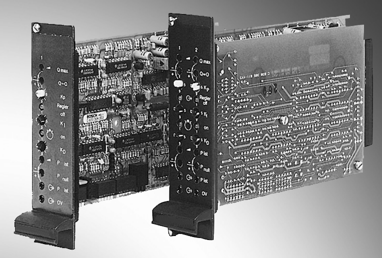


Table of contents

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**

500 = Serial number for types Standard variant without valve amplifier function

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

V0 = Customer version Catalog version

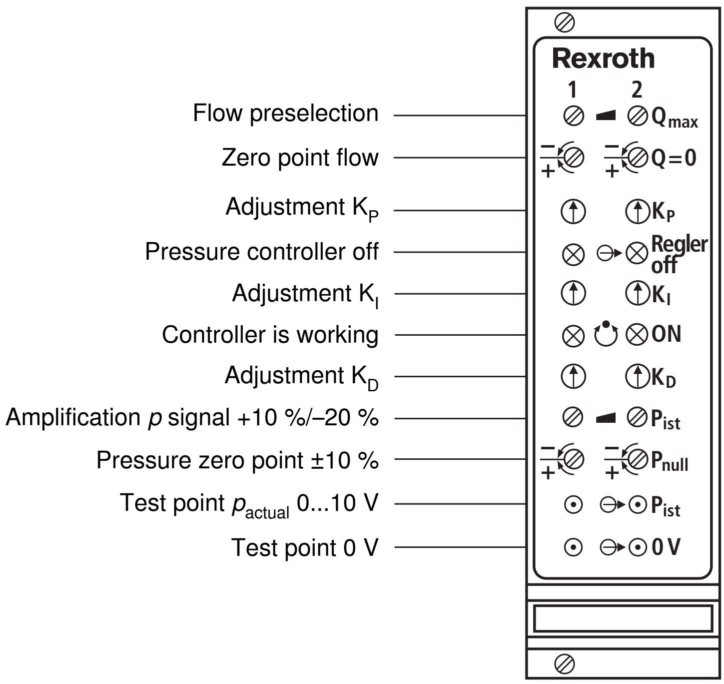
Option
no code = 1 channel
2CH = 2 channels

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	

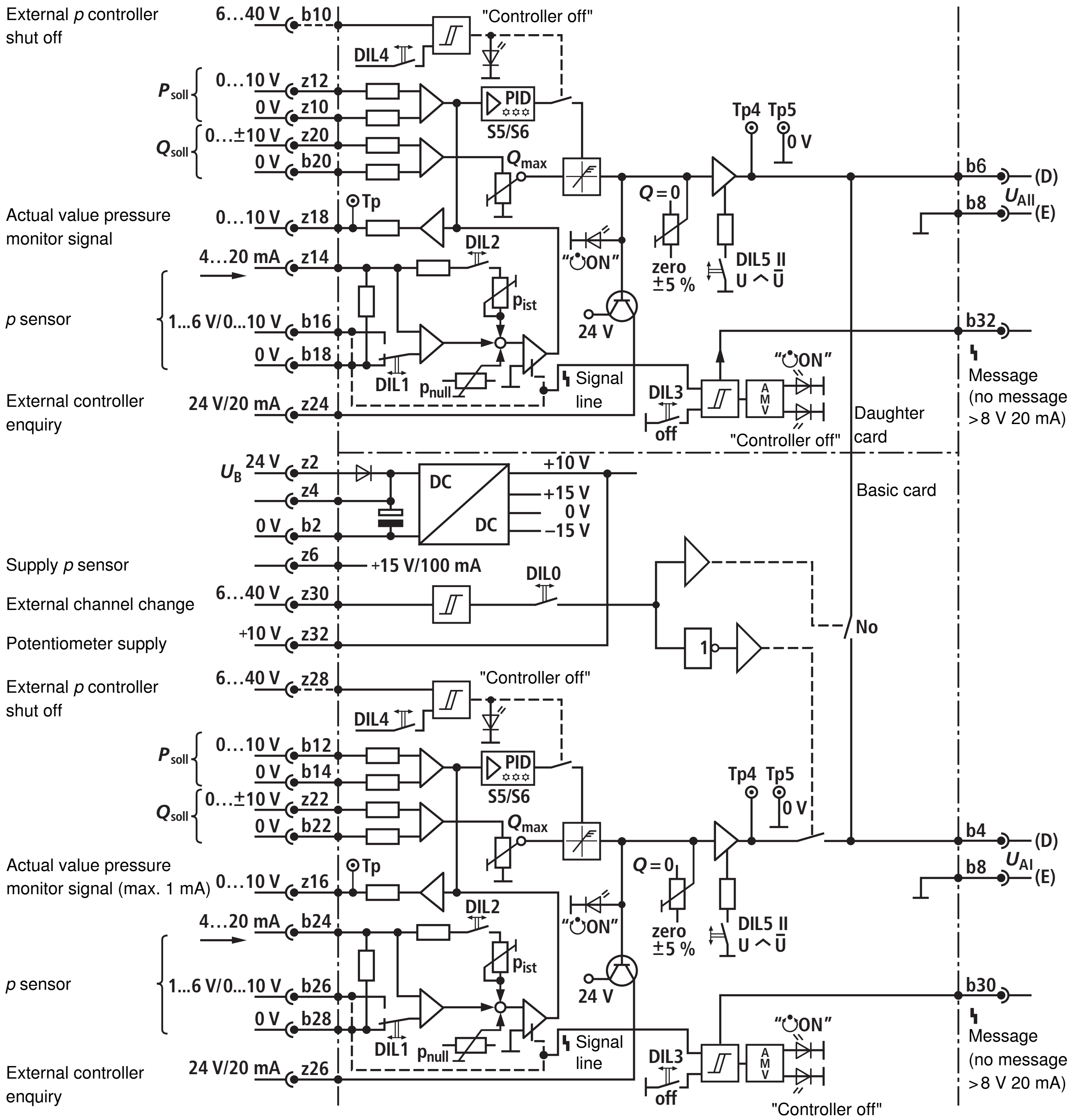
Suitable card holder:
- Open card holder VT 3002-1-2X/32F (see data sheet 29928). Only for control cabinet installation!

Front plate



1 and 2 with 0811405157
1 only with 0811405158

Block diagram with pin assignment



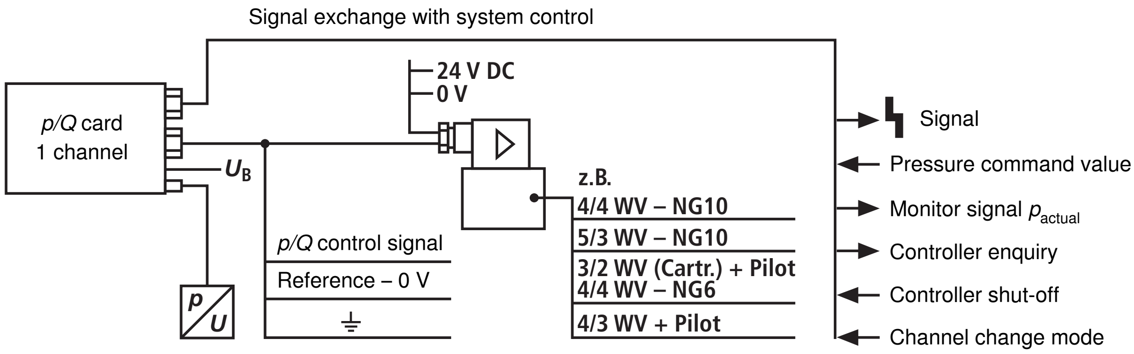
* Daughter card only attached with 2-channel variant

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

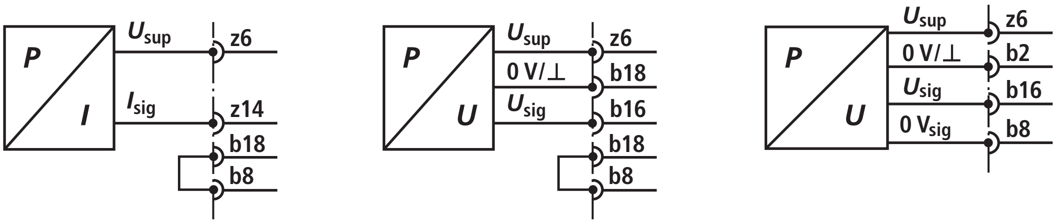
Supply voltage U_B at z2 – b2	Nominal 24 V = Battery voltage 21...40 V, Rectified alternating voltage U_{eff} = 21...28 V (one-phase, full-wave rectifier)	
Smoothing capacitor, separately at z2 – b2	Recommendation: Capacitor module VT 11110 (see data sheet 30750) (only necessary if the ripple of U_B > 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 mm² (shielded) 5 x 0.5 mm² (shielded) 0.5 mm² (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



Additional information

Applications

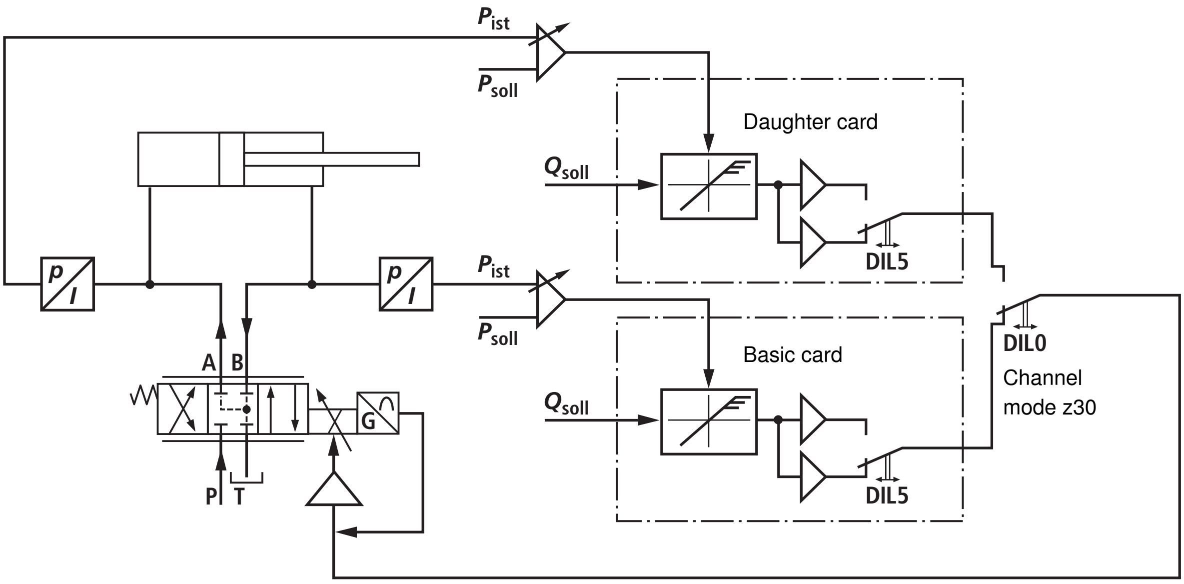
The "1-channel *p/Q* control card" consists of the basic card in Europe format with DC/DC converter and front plate. With the "2-channel *p/Q* control card", this basic card contains a *p/Q* daughter card with identical circuit and a joint front plate. The supply voltage is 24 V =. The voltage of the 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

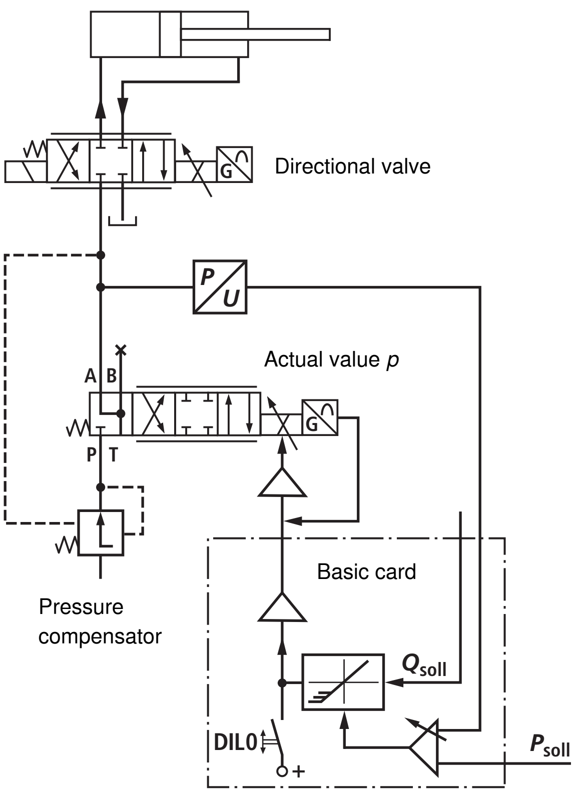
Example 1

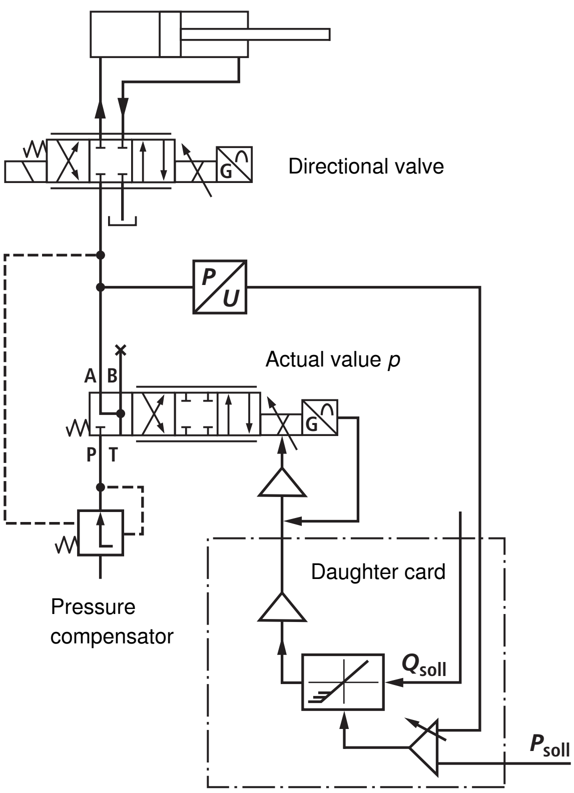
Channel mode "joint output"



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).

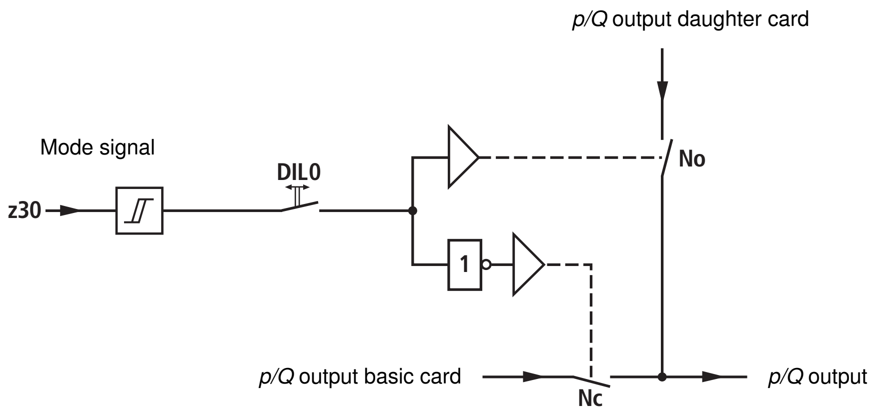
Special function "channel selection" of the "2-channel control card"

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).

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] $\triangleq \sim p_{nom}$[2]
	OFF	Actual p value amplification $p_{sys} \triangleq \sim 0.5 \cdot p_{nom}$
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.

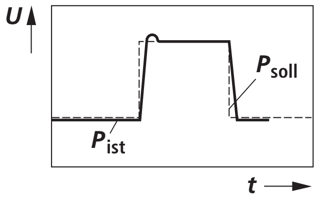
1) Pressure controller ON – DIL 4 ON
2) Connection of an oscilloscope at the test point "p_{actual}"
3) Usefully connection of a 2nd oscilloscope channel at the terminals "$p_{command}$"
4) DIL 6 and DIL 7 serve to compensate dynamic differences in the pressure build-up and reduction in the system
   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).

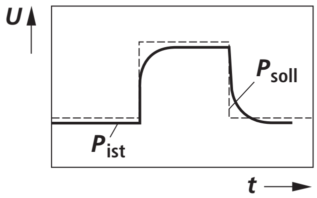
Procedure (see table, page 11):
An increase in the **P share** of the controller increases the dynamic of the control behavior (b). In case of excessive gain, the tendency to oscillate increases (c).
Limitation of the **I share** reduces the static gain. With increasing static gain, the control deviation 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

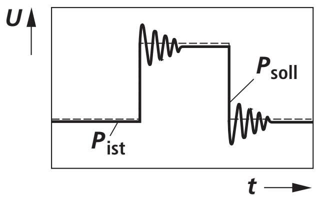


Problem:
P share too small

Solution:
→ Rotate K_p against F (fine adjustment)
→ P gain >

DIL 14	ON
DIL 15	OFF
DIL 16	ON

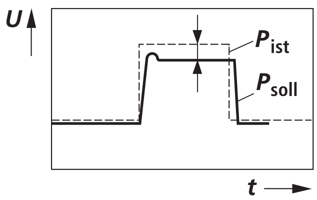
c



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

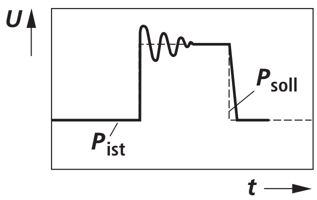
d



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

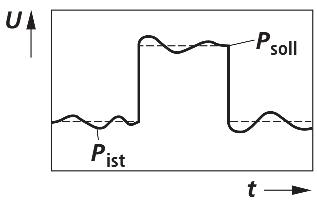
e



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

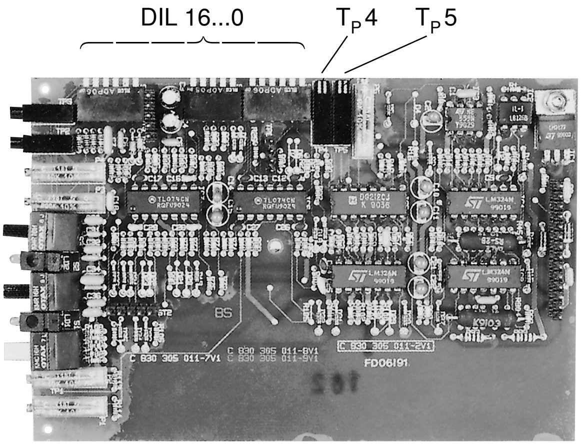


Problem:
D share too low

Solution:
→ Rotate K_D against F
→ D share >

DIL 8	ON
DIL 9	OFF
DIL 10	OFF

Adjustment table



T_P4: U_A
T_P5: 0 V

Basic card

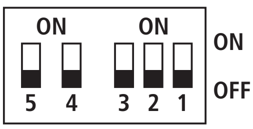
Set by		Rexroth		
Date		As-delivered state		
DIL 0	DIL switch	OFF		
DIL 1		OFF		
DIL 2		ON		
DIL 3		ON		
DIL 4		ON		
DIL 5		OFF		
DIL 6		OFF		
DIL 7		OFF		
DIL 8		OFF		
DIL 9		OFF		
DIL 10		OFF		
DIL 11		OFF		
DIL 12		OFF		
DIL 13		OFF		
DIL 14		OFF		
DIL 15		ON		
DIL 16		OFF		
HEX K_P	HEX code	B		
HEX K_I		1		
HEX K_D		D		

* Daughter card

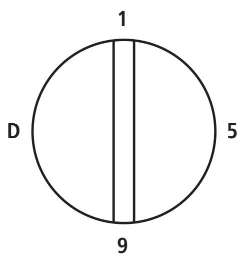
Set by		Rexroth		
Date		As-delivered state		
DIL 0	DIL switch	OFF		
DIL 1		OFF		
DIL 2		ON		
DIL 3		ON		
DIL 4		ON		
DIL 5		OFF		
DIL 6		OFF		
DIL 7		ON		
DIL 8		OFF		
DIL 9		OFF		
DIL 10		OFF		
DIL 11		OFF		
DIL 12		OFF		
DIL 13		OFF		
DIL 14		OFF		
DIL 15		ON		
DIL 16		OFF		
HEX K_P	HEX code	3		
HEX K_I		9		
HEX K_D		5		

* Only with 2-channel variant

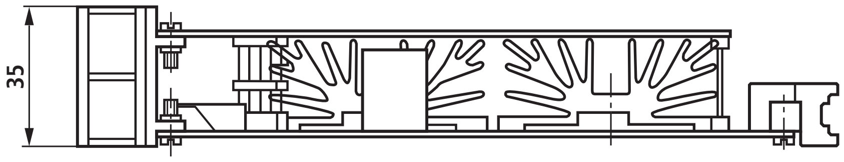
DIL switch

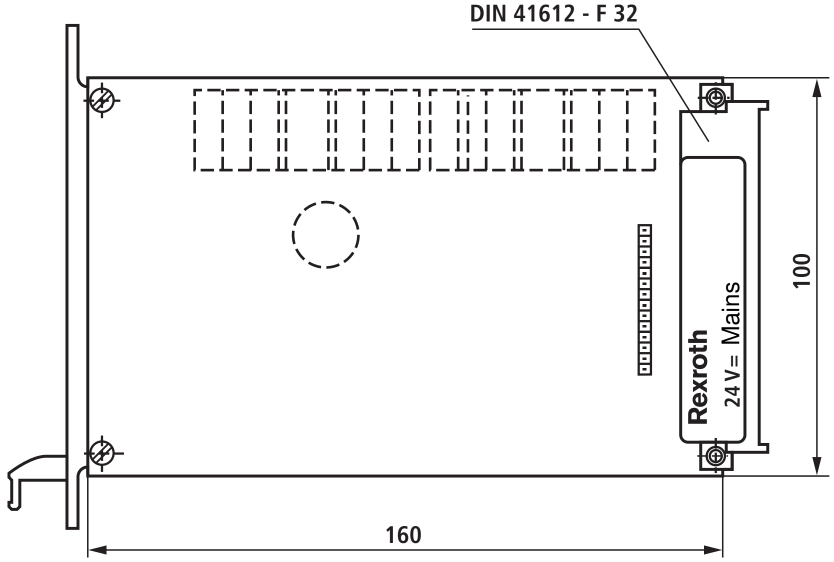


HEXCODE switch



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.

p/Q closed-loop control amplifier

RE 30058/**06.12**
Replaces: 03.04

Type VT-VARAP1-...-2X/...

Component series 2X

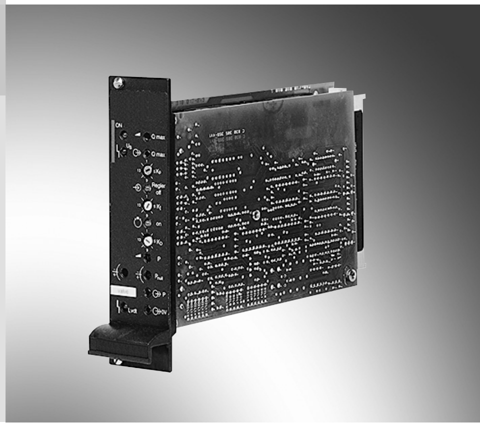


Table of contents

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

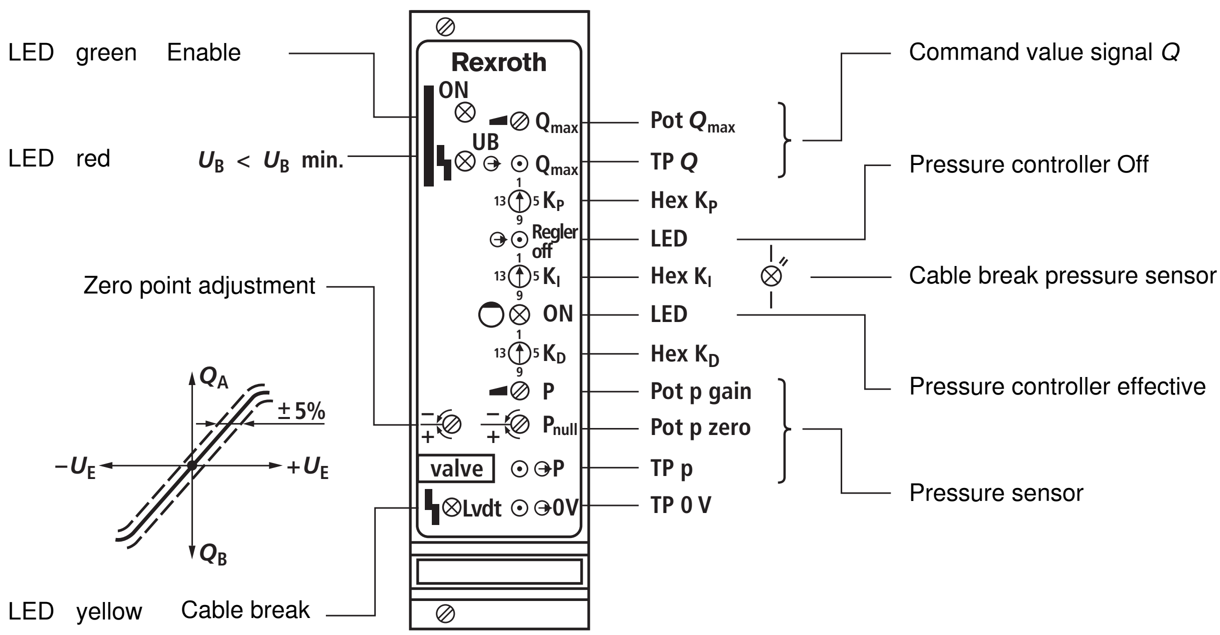
Preferred types

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:

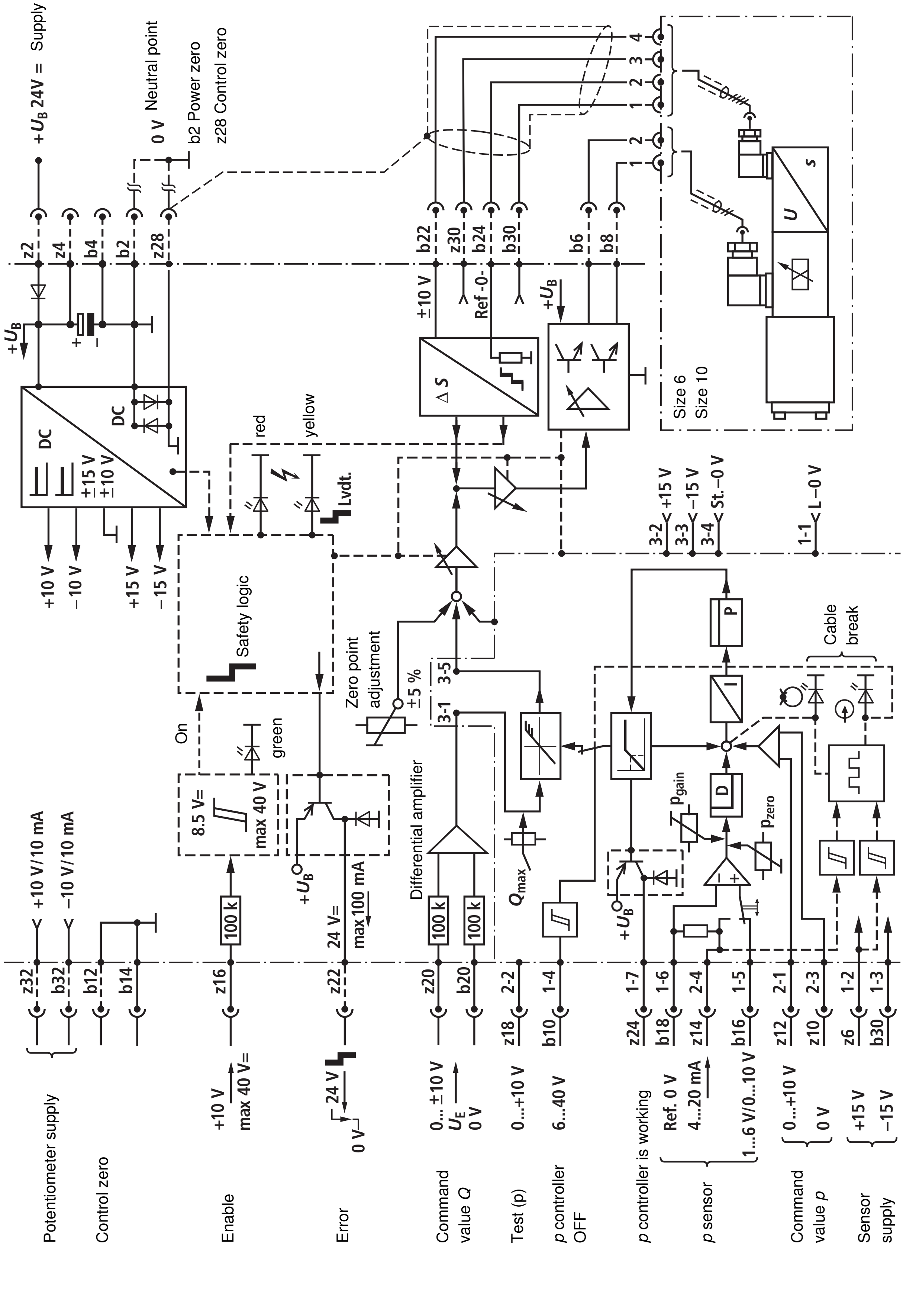
– Open card holder VT 3002-1-2X/32F
  (see data sheet 29928).
  Only for control cabinet installation!

Front plate



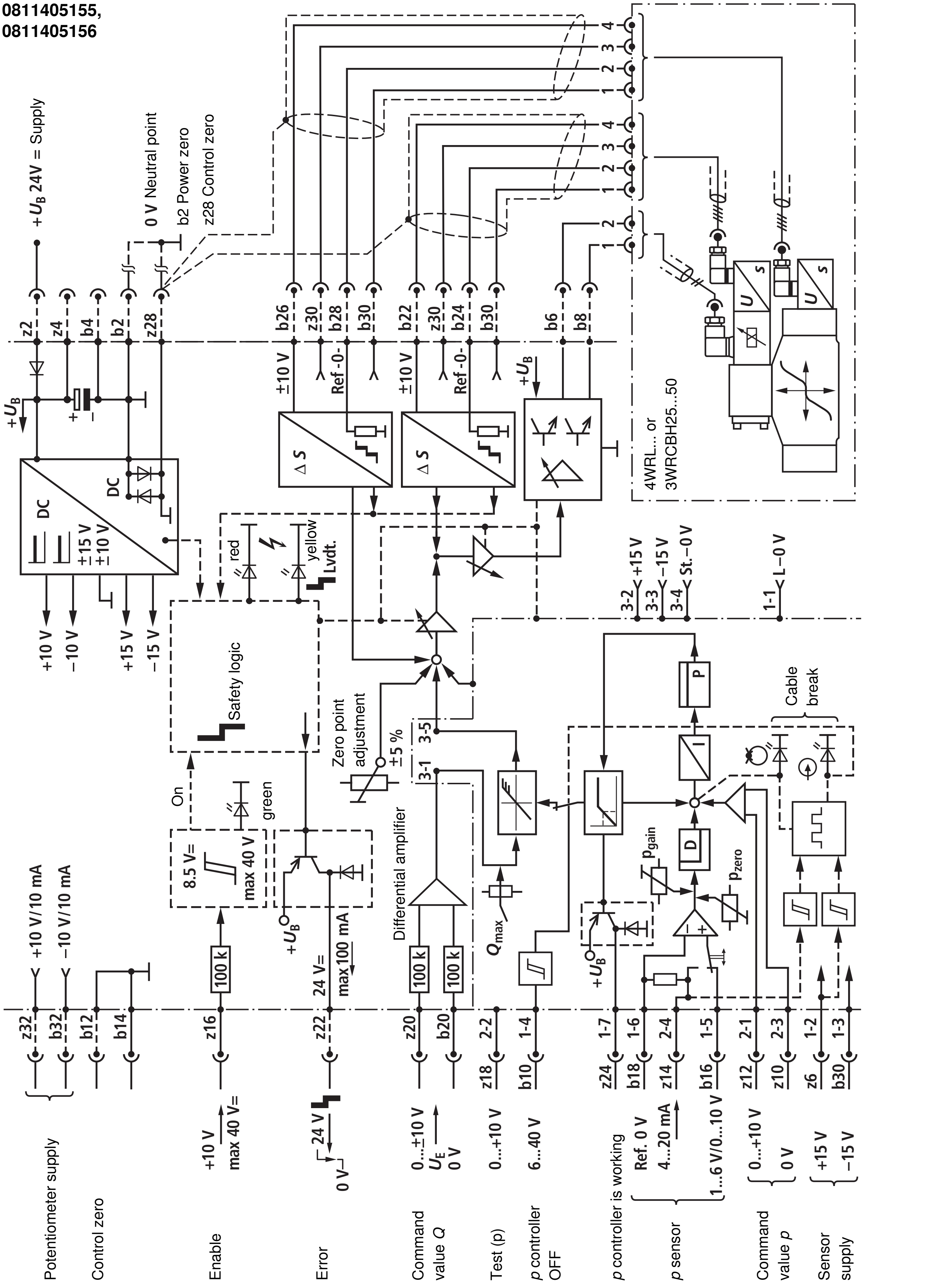
Block diagram with pin assignment

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		Clocked current controller	
b6 – b8	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:

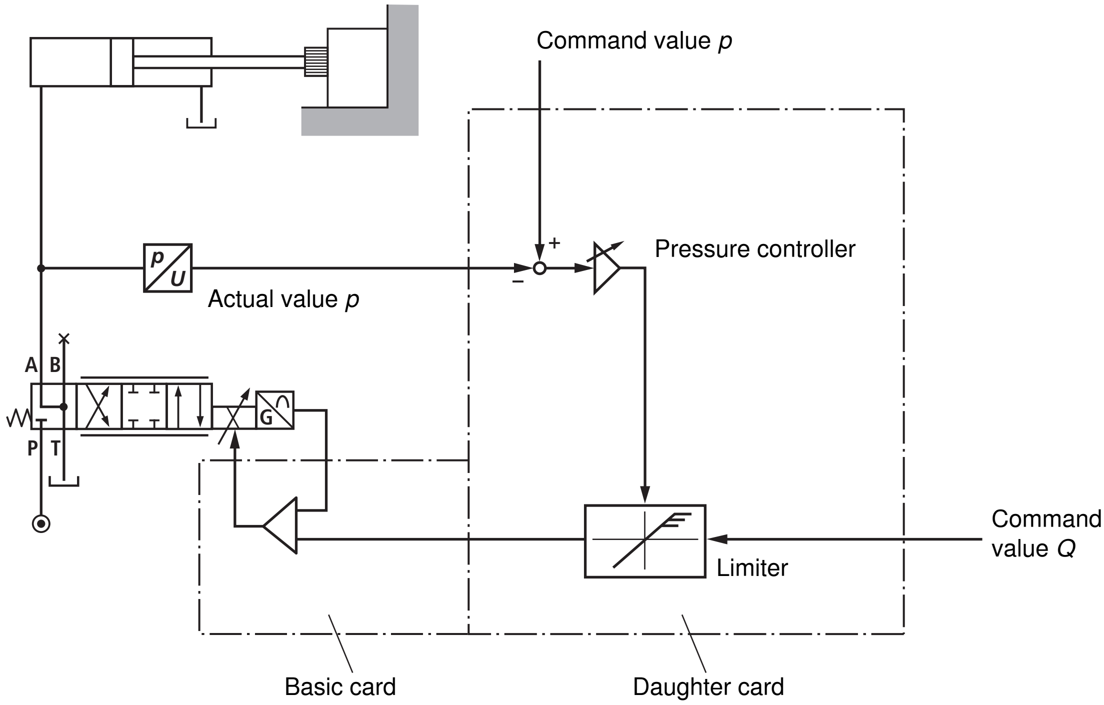
a) As long as $p_{command} < p_{actual}$ as flow control, i.e. the pressure control does not take effect, yet.
b) With $p_{command} \geqq p_{actual}$ as pressure control, i.e. the flow is reduced until $p_{actual} = p_{command}$. The pressure control works only with a positive command value voltage at 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

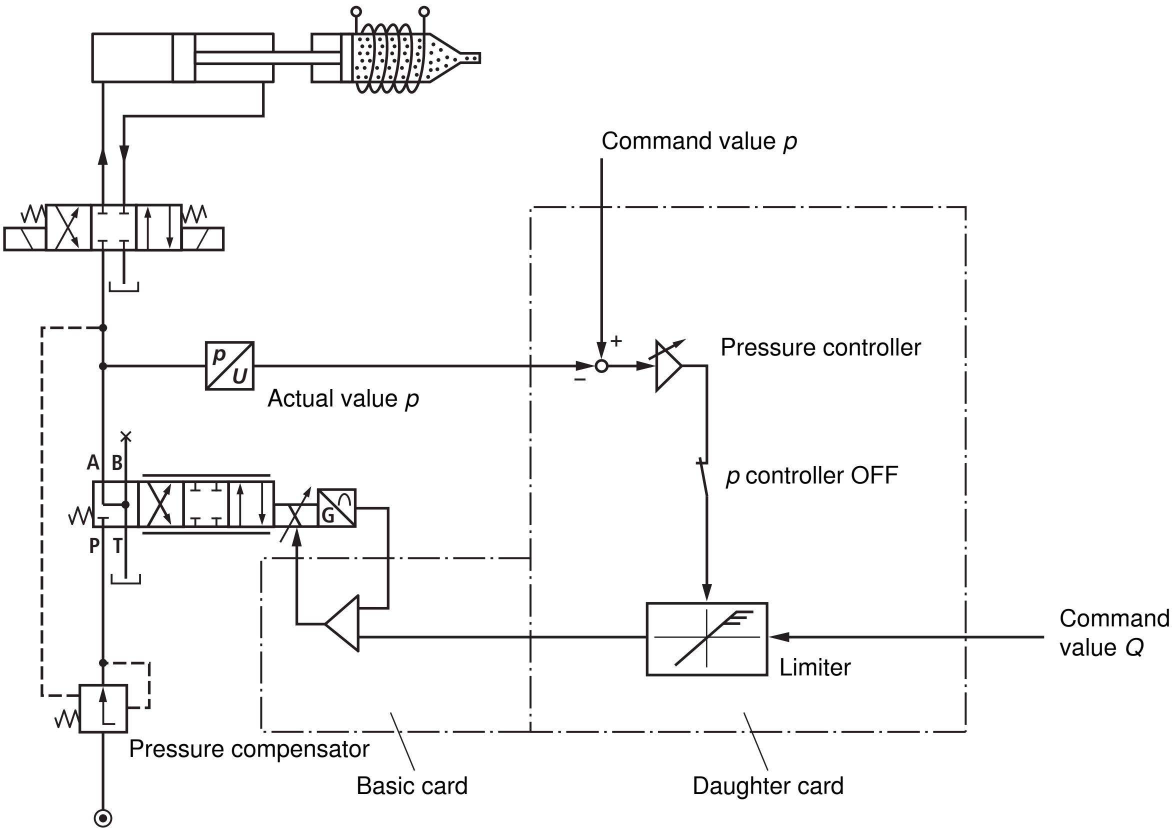
Example 1

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).

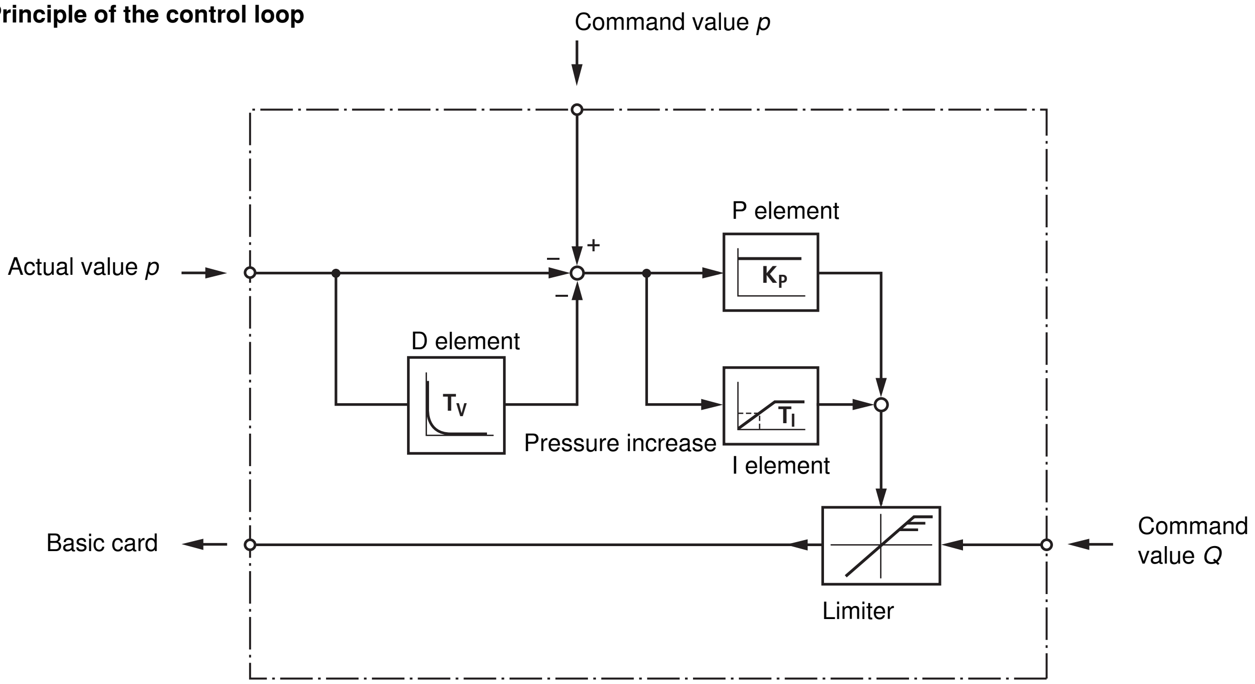


Function

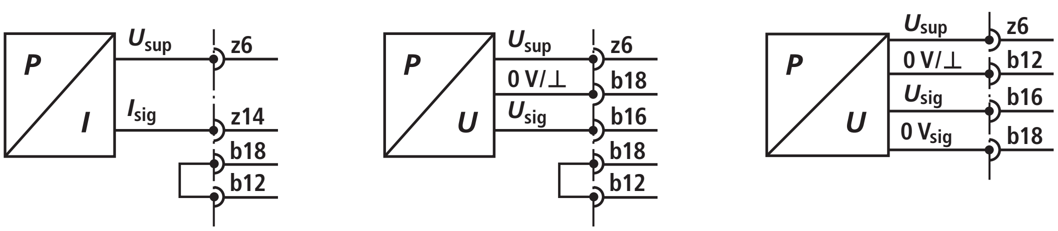
The combination of basic card and daughter card is shown in the block diagrams on page 3 and 4. Details of the daughter card, i.e. the pressure control, result from a detailed block diagram on page 9.
The command value *p* (z12) is specified by the user by a voltage 0...+10 V, e.g. by means of a potentiometer 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}.

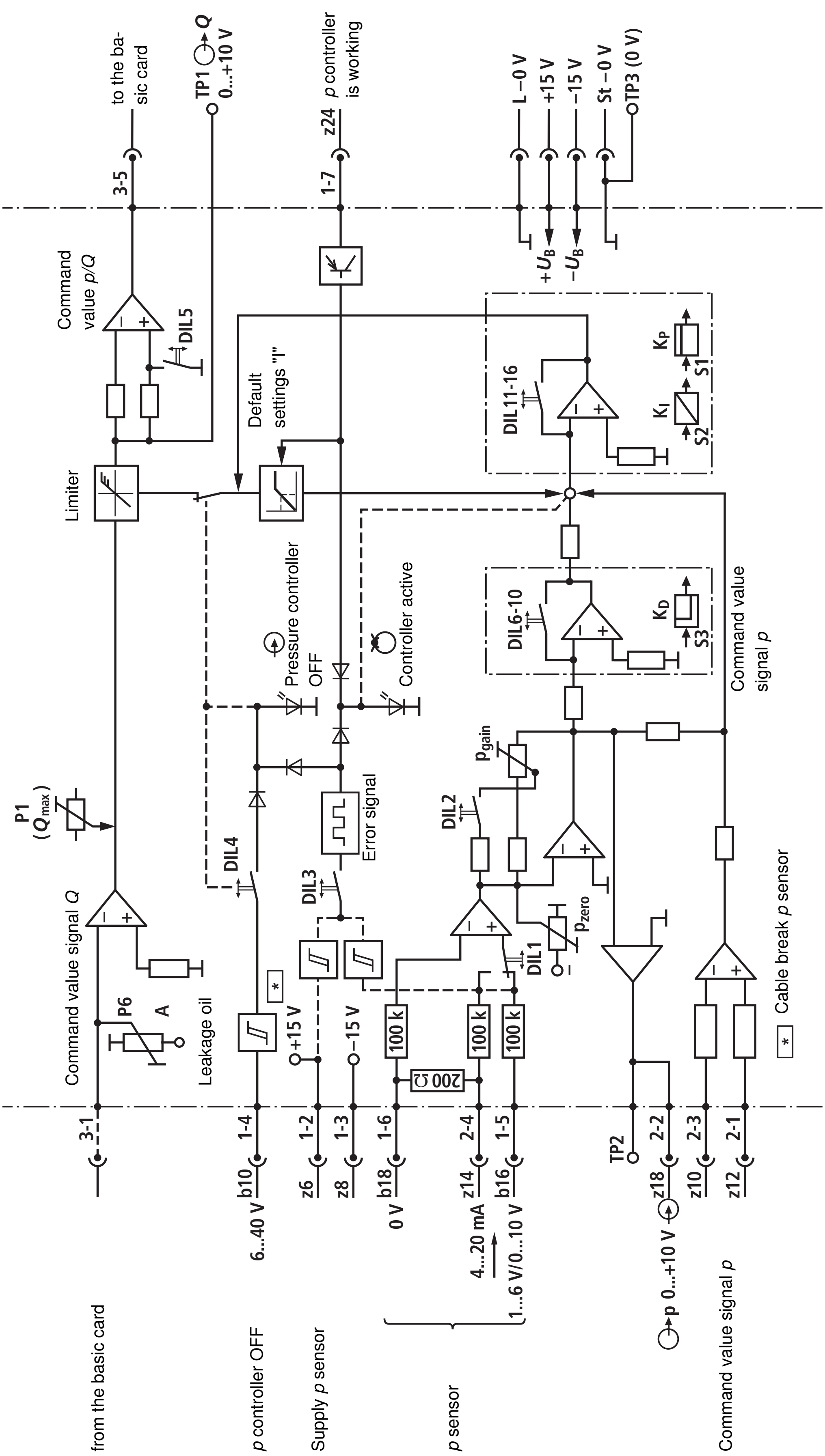
Principle of the control loop



Pressure sensor connection versions

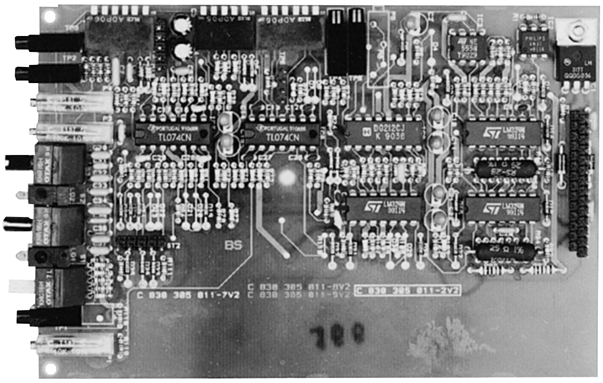


Block diagram daughter card



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)] ≙ ~ p_{NOM}[3)]
	OFF			p_{SYS} ≙ ~ 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	D		reduced [1)]
7	ON	D	Pressure reduction	normal
	OFF	D		reduced [1)]
8	ON	D	Share high	(9, 10 = OFF)
9	ON	D	Share medium	(8, 10 = OFF)
10	ON	D	Share low	(8, 9 = OFF)
11	ON	I	Share = 0	(12 = OFF)
12	ON	I	Share available	(11 = OFF)
13	ON	P	Reduced pressure reduction	Valve opening in case of pressure reduction < approx. 15%
	OFF	P		ineffective
14	ON	P	Share low	(16 = ON/15 = OFF)
15	ON	P	Share medium	(14, 16 = OFF)
16	ON	P	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 $R_L \geqq 10$ kΩ. 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.

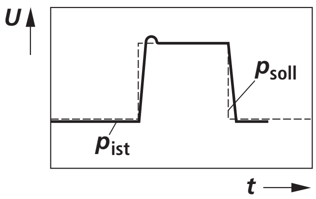
1) Pressure controller ON – DIL 4 ON
2) Connection of an oscilloscope at terminals z18 and b12 (0 V) → p_{actual}
3) Usefully connection of a 2nd oscilloscope channel at z2 and z10 (0 V) → $p_{command}$
4) DIL 6 and DIL 7 serve to compensate dynamic differences in the pressure build-up and reduction 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)

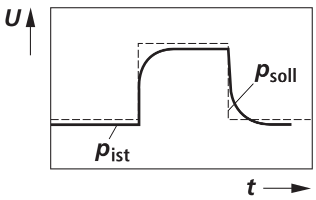
An increase in the P share of the controller increases the dynamic of the control behavior (b). In case of excessive gain, the tendency to oscillate increases (c). Limitation of the I share reduces the static gain. With increasing static gain, the control deviation is reduced (d).
The D share can be 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).

Ideal development

a



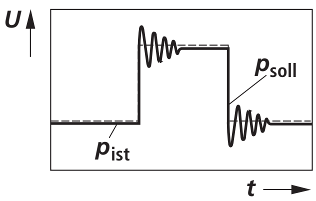
b



Problem:
P share too small
Solution:
→ Rotate K_P against 13 (fine adjustment)
→ P gain >

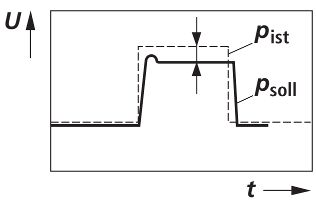
DIL 14	ON
DIL 15	OFF
DIL 16	ON

c



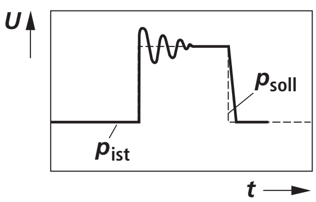
Problem:
P share too large
Solution:
→ Rotate K_P against 0 (fine adjustment)
→ use DIL 14 –16 to reduce the P gain according to the table

d



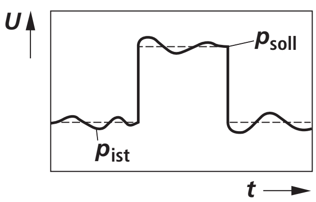
Problem:
P share correct, control deviation too large
Solution:
→ Increase the I gain share
→ DIL 11 ON = I share = 0
DIL 12 ON = I share connected
→ Rotate K_I against 13

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

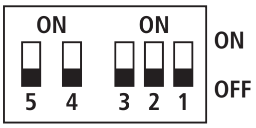
Adjustment protocol

Created by:

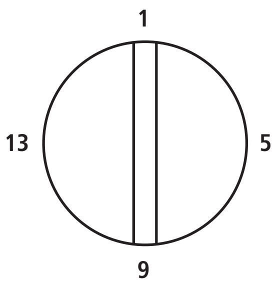
Date:

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		

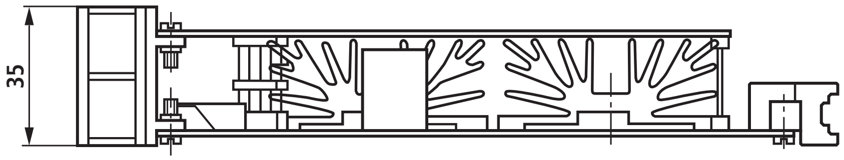
DIL switch

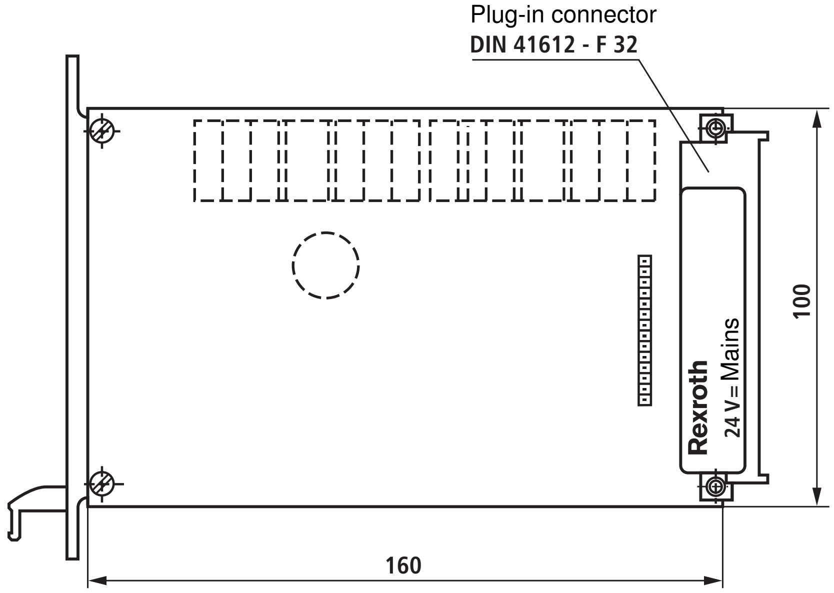


HEXCODE switch



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 5 must be complied with.

The Drive & Control Company

Rexroth
Bosch Group

Digital control electronics for axial piston pumps

Type VT-HPC

RE 30237
Edition: 2018-07
Replaces: 2016-05

HPC_150826

- ▶ Component series 1X
- ▶ Control electronics for the A4VS axial piston pump with HS5 adjustment
- ▶ Function: Swivel angle, pressure control, torque limitation, master/slave
- ▶ Communication: Sercos, PROFINET RT, EtherCAT, EtherNET/IP, POWERLINK, optionally PROFIBUS, analog
- ▶ Parameterizable via standard Ethernet

CE

Features

- ▶ Digital control electronics for the axial piston pump A4VS with HS5 control from size 40 to size 1000
- ▶ Bus connection (slave)/Service interface (TCP/IP) switchable by parameters (Sercos, EtherNet/IP, PROFINET RT, EtherCAT, Powerlink, PROFIBUS DP)
- ▶ Pressure and swivel angle controller
- ▶ Parameterizable torque limitation
- ▶ Optional: Speed-variable function
- ▶ Leakage compensation
- ▶ Master/slave capability
- ▶ Mooring capability
- ▶ CE mark according to EMC Directive 2004/108/EC
- ▶ Optional: PLC functionality according to IEC 61131-3

Contents

Ordering code

01		02		03		04		05		06
VT–HPC–1	–	1X	/	M	–		–	00	/	00

01	Digital control electronics for controlling axial piston variable displacement pumps	**VT-HPC-1**
02	Component series 10 to 19 (10 to 19: unchanged technical data and pin assignment)	**1X**
03	Multi-Ethernet	**M**
04	**With** Profibus	**P**
	Without Profibus	**0**
05	Software option: Standard	**00**
06	Hardware option: Standard	**00**

Available variants

Type	Material no.
VT-HPC-1-1X/M-0-00/00	R901413449
VT-HPC-1-1X/M-P-00/00	R901413446

Included within the scope of delivery:
Mating connector for
- XD1 (Weidmüller BLZF 3.50/03/180F SN BK BX)
- XG20 (Weidmüller B2CF 3.50/30/180LH SN BK BX)
- XG21 (Weidmüller B2CF 3.50/14/180LH SN BK BX)

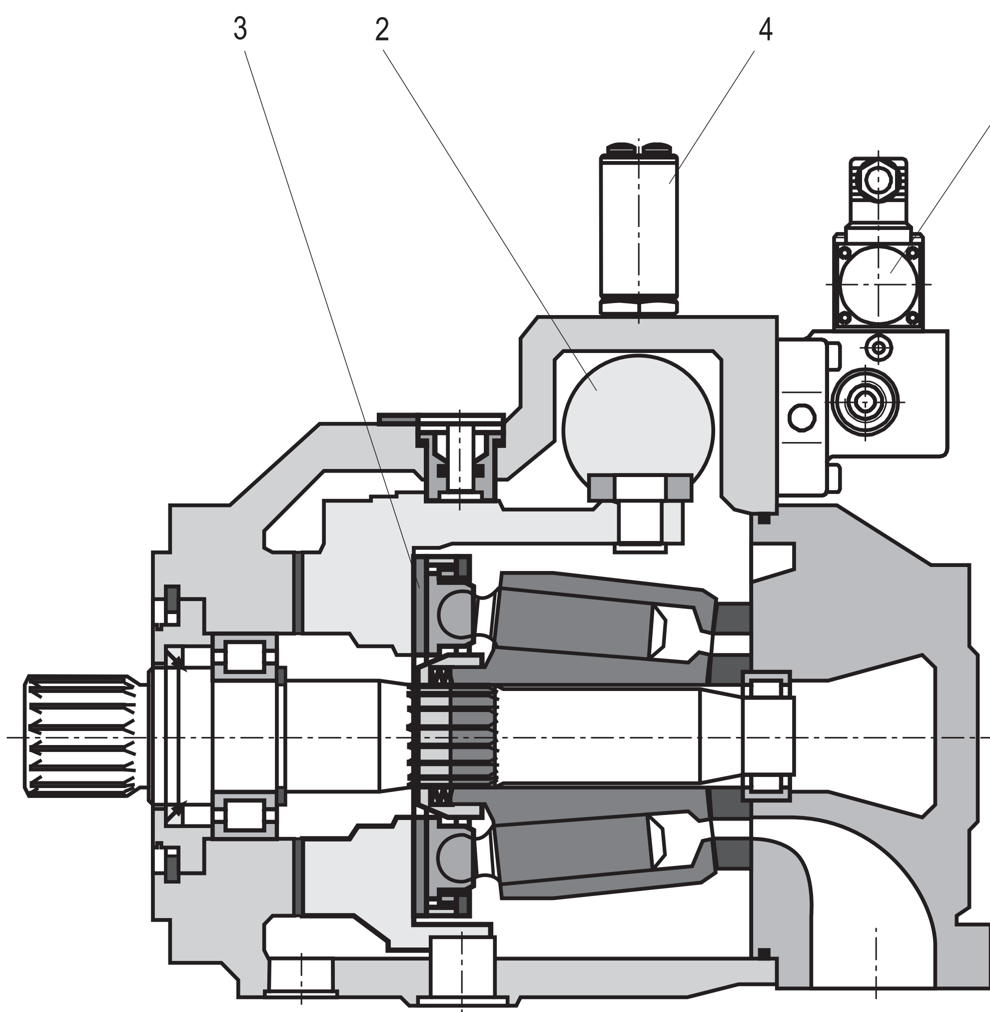
Recommended accessories (can be ordered separately)

Denomination	Material no.
STECKER 6ES7972-0BA42-0XA0 for port XF30 (Profibus)	R901312863
Connection cable PC VT-HPC (RJ45, XF20 or XF21) RKB0011/005.0 length: 5 m	R911321548
STECKERSATZ VT-HMC...-1X/M...*ET	R961011116
SERVICEPAKET VT-HMC...-1X/M...shielding*ET	R961011117
Commissioning software IndraWorks DS from version 14V14	–
SD memory card XA-SD01 (1 GByte)	R911173844
SD card for PLC functionality VT-SD-HDX-PLC-10VXX	R901444436
SD card for n function VT-SD-HPC-HSSN-10VXX	R901495806

Functional description using the A4VS axial piston pump with HS5 control as an example

The swivel angle and pressure control as well as the torque 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).
The position of the swash plate is determined by a swivel angle sensor (4); the actual pressure value is recorded by a pressure transducer.
The actual torque value is calculated from the product of the actual pressure value and the 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.
The sectional drawing shows the A4VS... variable displacement pump with HS5 control; the proportional valve (1) is controlled using the VT-HPC control electronics.

Notice for the HS5 control:
- With de-energized proportional valve and pump with clockwise rotation and if the set pressure is available, the pump swivels to swivel angle α = 0 (A4VSO design) or α = −100% (A4VSG design).



Functional description of the control electronics

Description

The VT-HPC (Hydraulic Pump Control) is a digital control system with integrated controller, optionally with programming according to IEC 61131. The internal PLC functionality is activated by plugging the SD card SD-HPC-PLC. It is not included in the VT-HPC scope of delivery and must be ordered separately.
The following controller functionalities are available:
- Pressure control
- Swivel angle/flow control
- Torque limitation
- Optional: Speed-variable function (n function)

This enables, amongst others, the following operating modes:
- Pressure/swivel angle control
- Pressure/flow control

Command value presetting is done via the bus interfaces (XF20/XF21 or XF30), via the analog interface (XG20) or, alternatively, via an internal PLC program.
The feedback information of the actual value signals to the superior control system is provided optionally either via the bus interfaces (XF20/XF21 or XF30) or the analog/digital interface (XG20).
The controller parameters are set via one of the two Ethernet interfaces (XF20/XF21) (integrated switch functionality)

Monitoring

The digital control electronics enable comprehensive monitoring functions/error detection including:
- Undervoltage
- Communication error
- Cable break for analog sensor inputs (4 ... 20 mA)
- Short-circuit monitoring for analog/digital outputs
- Temperature of the integrated electronics

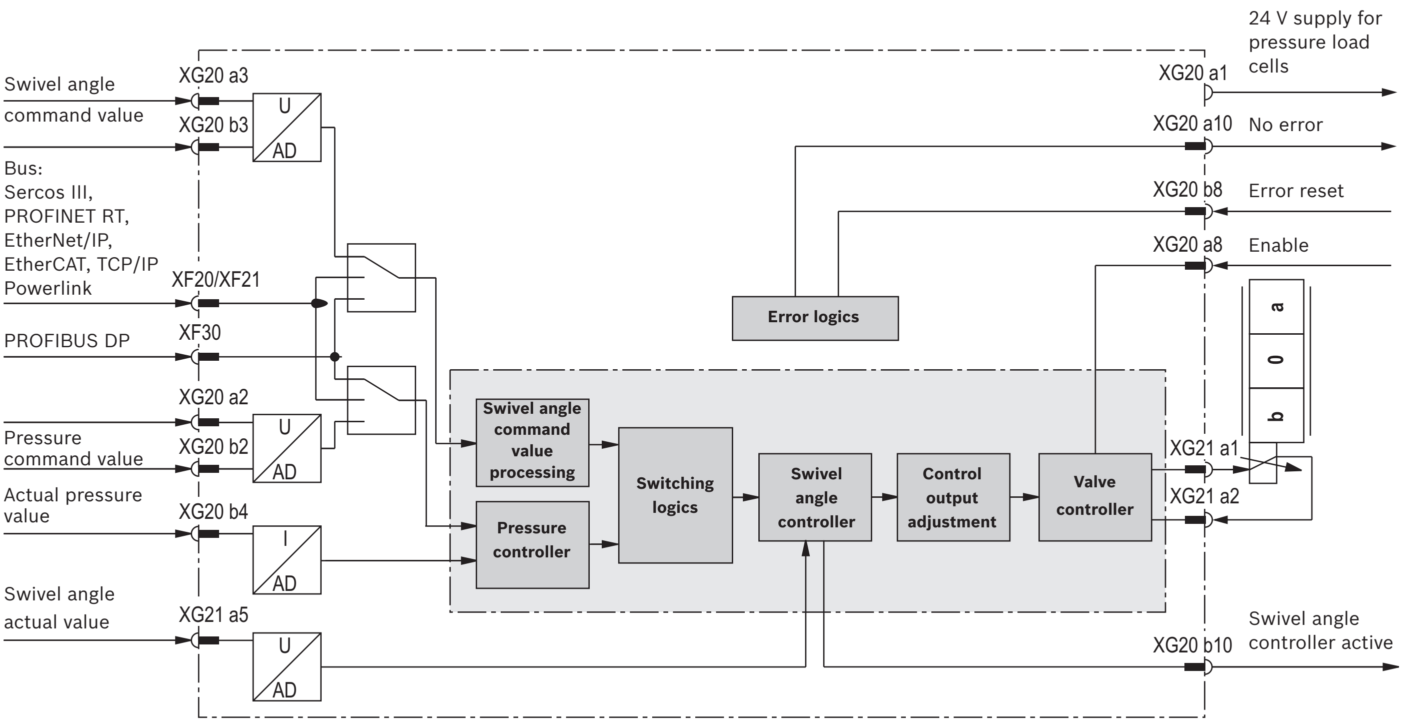
IndraWorks PC program

To implement the project planning task and to parameterize the VT-HPC, the user may use the IndraWorks DS operation tool. For the use of the PLC function, IndraWorks MLD is necessary: Project planning
- Parameterization
- Commissioning
- Diagnosis
- Comfortable management of all data on a PC
- Requirement: PC operating system at least Windows 7

Slot for one SD memory card
The following data may be saved:
- Parameter data
- Any other data
- Update of the speed-variable function (see Accessories)

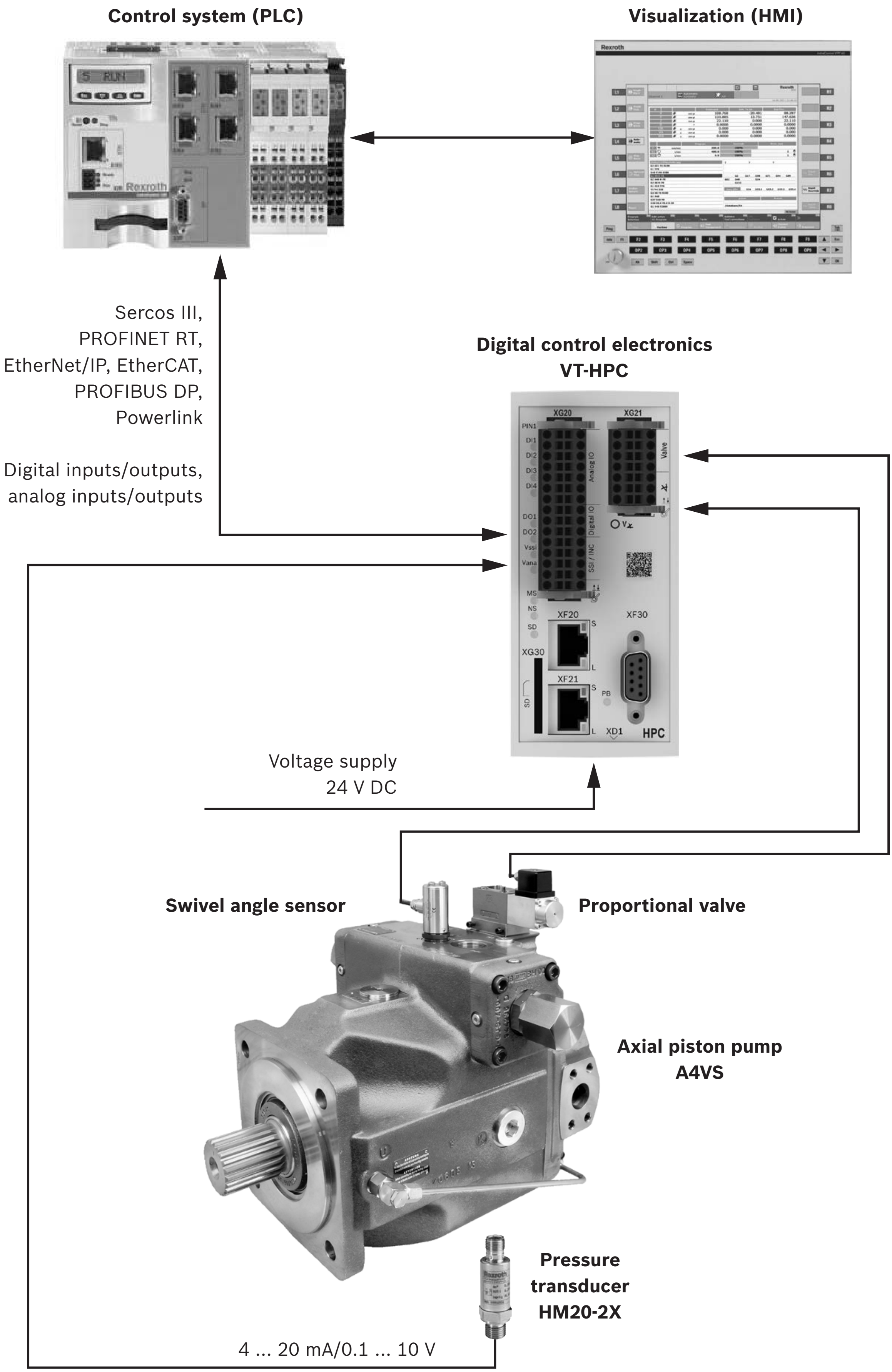
Only SD and SDHC memory cards up to a size of 4 Gbyte with FAT32 formatting are supported. The card must already be inserted when the device is switched on, otherwise it will not be detected. It is recommended to use the Rexroth memory card (see Accessories).

Overview of the controller functions (in the condition as supplied)



Example of open circuit, switch-over between current and voltage interface for the analog inputs via IndraWorks (observe wiring).

System overview (example)



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

Operating voltage		
– Nominal voltage	U_B	24 V DC
– Lower limit	$U_{Bmin.}$	20 V DC
– Upper limit	$U_{Bmax.}$	28 V DC
– Maximum admissible residual ripple (40 ... 400 Hz)	u	5 V_{pp} (observe the admissible limits)
Total current consumption	I	– Running empty: 0.2 ... 0.4 A – Max. admissible load: 0.9 ... 2.6 A (external fuse protection required)
Power loss (at 24 V)		< 15 W
External fuse		4 A time-lag
Bus systems		PROFIBUS DP (max. 12 MBaud acc. to IEC61158), Sercos III, PROFINET RT, EtherNet/IP, EtherCAT, Powerlink
Parameterization interface		Ethernet
Scan time swivel angle/pressure controller (minimum)		0.5 msec
Booting time		< 15 sec (from switch on until the control system is active)
Digital inputs Di		
– Number		4
– Low level	U	–3 V ... 5 V
– High level	U	11 V ... U_B
– Current consumption at High level	I	2 mA ... 15 mA
– Reference potential		GND
Digital outputs Do		
– Number		4
– Low level	U	0 ... 3 V
– High level	U	14.5 V ... U_B
– Current carrying capacity	$I_{max.}$	50 mA (short-circuit-proof) [1)]
– Maximum capacitive load		200 µF
– Signal delay time	t	Depending on the set performance
– Reference potential		GND
Analog inputs Ai		
– Inputs Ai1 to Ai5		
• Number (current or voltage input parameterizable)		5
• Resolution		14 Bit [2)]
– Input Ai_sv (swivel angle sensor)		
• Number (current or voltage input via separate pin)		1
• Resolution		13 Bit [2)]
– Voltage inputs (differential inputs)		
• Measurement range	U_E	–10 V ... +10 V
• Input resistance	R_E	200 kΩ ± 10%
• Linearity at 20 °C	U	< 20 mV
• Noise	U	± 15 mV
• Temperature drift		< 12 mV/10 K
– Current inputs (reference to AGND)		
• Input current	I_E	4 mA ... 20 mA (0 ... 20 mA physical)
• Input resistance	R_E	100 Ω
• Linearity at 20 °C	I	< 20 µA
• Temperature drift		< 12 µA/10 K

1) If a short-circuit is detected, all digital outputs are switched to Low level.

2) Minimum feasible resolution of 1.465 mV or 1.27 µA

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

Analog outputs Ao			
	– Number (current or voltage parameterizable individually)		2
	– Resolution		16 Bit [1]
	– Voltage outputs		
	• Output range	*U*	–10 V ... +10 V (0 ... 10 V via software)
	• Minimum load impedance	*Z*	1000 Ω
	• Linearity and noise at 20 °C	*U*	< 25 mV
	• Temperature drift		< 12 mV/10 K
	– Current outputs		
	• Output range	*I*	0 ... 20 mA (4 mA ... 20 mA via software)
	• Maximum load	*R*	500 Ω
	• Linearity and noise at 20 °C	*I*	< 35 µA
	• Temperature drift		< 12 µA/10 K
Swivel angle V_{SV}			
	– Voltage supply	*U*	U_B - 3V
	– Maximum supply current	*I*	60 mA
Valve output stage			
	– Maximum solenoid current	$I_{max.}$	2.7 A

[1] 0.334 mV/Bit

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

Environmental conditions, other specifications		
– Protection class according to EN 60529		IP20
– Ambient temperature range		–20 °C ... 60 °C
– Maximum admissible temperature change		5 °C/min
– Transport temperature range		–40 °C ... +70 °C
– Recommended storage temperature range with UV protection		+5 °C ... +40 °C
– Relative air humidity		10 ... 95% (without condensation)
– Max. altitude		2000 m
– UV resistance		Housing is only partly UV resistant. Extended exposure to radiation may cause color changes.
– Transport shock according to DIN EN 60068-2-27		15 g / 11 ms / 3 axes
– Sine test according to DIN EN 60068-2-6		10 ... 500 Hz / maximum of 2 g / 10 cycles / 3 axes
– Noise test according to DIN EN 60068-2-64		20 ... 500 Hz / 2.2 g RMS / 6.6 g peak / 30 min. / 3 axes
– Free fall (in original packaging)		1 m (see EN ISO 61131-2)
– Electro-magnetic compatibility (EMC)		
• EN 61000-6-2 / EN 61131-2:		
▶ EN 61000-4-2 ESD		4 kV CD / 8 kV AD with BWK B
▶ EN 61000-4-3 HF radiated		10 V/m (80 ... 6000 MHz) with BWK A
▶ EN 61000-4-4 Burst		2 kV with BWK B
▶ EN 61000-4-5 Surge		0.5 kV / (sym. / unsym.) with BWK B
▶ EN 61000-4-6 HF conducted		10 Veff (150 kHz ... 80 MHz) with BWK A
▶ EN 61000-4-8 Magnetic field 50/60 Hz		100 A/m with BWK A
• EN 61000-6-3 / EN 61000-6-4 / EN 61131-2:		
▶ EN 55016-2-1 Interference voltage		0.15 ... 30 MHz, class A, EN 55022
▶ EN 55016-2-3 Radio interference field strength		30 ... 6000 MHz, class A, EN 55022
– Installation position		Vertical. For the ventilation of the assembly, the ventilation slots of the top and bottom side must be at least 2 cm away from covers, walls, etc.
– Installation		Top hat rail TH35-7.5 or TH35-15 according to EN 60715
– Housing material		Glass-fiber reinforced polyamide plastic
– Resistance against aggressive media		Contact with conductive dusts is not admissible. Avoid contact with hydraulic fluids.
– Weight	m	0.7 kg
– Dimensions		See page 10
– Conformity		CE according to the EMC directive
		CE according to the RoHS directive
$MTTF_D$ values according to EN ISO 13849 [1)]		For further details, see data sheet 08012
▶ **With** Profibus **"P"**	Years	28.3
▶ **Without** Profibus **"0"**	Years	29.3
MTBF values according to EN ISO 13849 [1)] ?		For further details, see data sheet 08012
▶ **With** Profibus **"P"**	Years	14.1
▶ **Without** Profibus **"0"**	Years	14.7

1) With an ambient temperature of the components of 60 °C

Pin assignment VT-HPC-1-1X

XG20, encoder/DIO/AIO			
Signal	**Pin**	**Pin**	**Signal**
Do4 [1]	a1	b1	AGND
Ai1+	a2	b2	Ai1−/Cin1 [2]
Ai2+	a3	b3	Ai2−/Cin2 [2]
Ai3+	a4	b4	Ai3−/Cin3 [2]
Ai4+	a5	b5	Ai4−/Cin4 [2]
Ao1	a6	b6	AGND
Ao2	a7	b7	AGND
Di1	a8	b8	Di2
Di3	a9	b9	Di4
Do1 [1]	a10	b10	Do2 [1]
reserved	a11	b11	reserved
reserved	a12	b12	reserved
reserved	a13	b13	reserved
reserved	a14	b14	GND
Do3 [1]	a15	b15	GND

XG21			
Signal	**Pin**	**Pin**	**Signal**
Ma+	a1	b1	reserved
Ma-	a2	b2	reserved
reserved	a3	b3	reserved
reserved	a4	b4	reserved
Ai_sv [3]	a5	b5	Cin_sv [3]
Vsv	a6	b6	GNDsv
Ai5+	a7	b7	Ai5-/Cin5 [2]

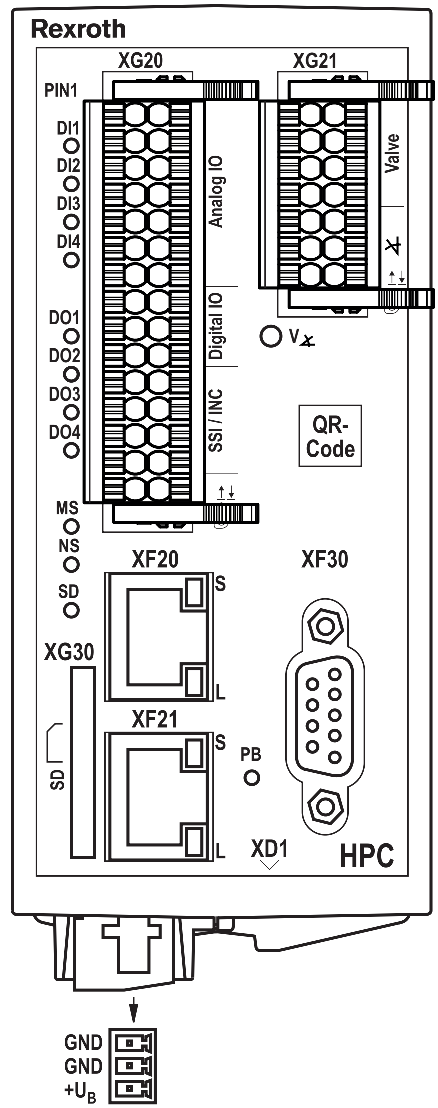
XF20, XF21	
Ethernet connections	
Signal	**Pin**
TD+	1
TD−	2
RD+	3
–	4
–	5
RD−	6
–	7
–	8

XD1, Power	
Pin	**Signal**
1	GND
2	GND
3	$+U_B$

1) All digital outputs may be used as a voltage supply pin for sensor technology.

2) Wire current inputs (Cin) for XG20 only at pin b2 ... b5, leave pin a2 ... a5 open. For XG21, wire pin b7, leave pin a7 open. (See also the information in the operating instructions 30237-B)

3) When connecting swivel angle sensors, you may only connect the relevant required input (Ai_sv for voltage or Cin_sv for current input). The other output must remain open (in this connection also refer to 30237-B)



XF30, PROFIBUS DP (only for variant P)	
Pin	**Signal**
1	reserved
2	reserved
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	reserved
8	RxD/TxD-N
9	reserved

Notice:
- The pins marked with "reserved" are reserved and must not be connected!

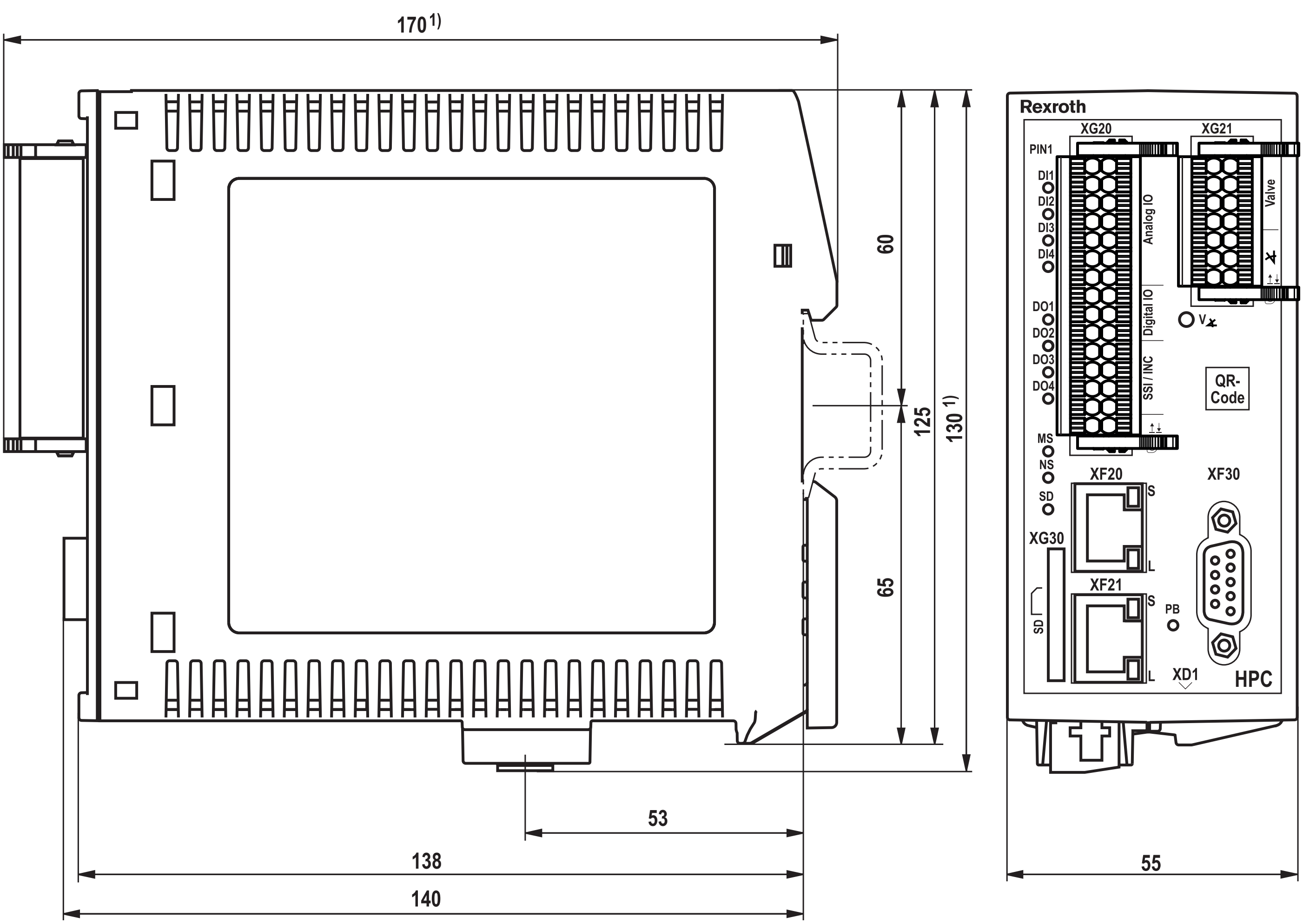
LED displays (Status LEDs)

Status LED	Display status
Module (MS)	
Off	No voltage supply
Green-red, flashing	Initialization
Green, flashing	Drive ready for operation
Green	Drive active
Orange, flashing	Warning
Red, flashing	Error
Network status (NS)	
Off	No voltage supply
Green	Operation
SD card (SD)	
Off	No SD card available
Green, flashing	SD card not ready for operation
Green	SD card available and ready for operation

Status LED	Display status
Digital inputs (Di1 to Di4)	
Off	Logic input "0"
Green	Logic input "1"
Digital outputs (Do1 to Do4, V_x)	
Off	Logic output "0"
Orange	Logic output "1"
Profibus (PB)	
Off	Bus not active
Green	Bus in "Data_Exchange" status

Notes:
- For a detailed description of the diagnosis LEDs, please refer to the functional description Rexroth HydraulicDrive HDx20.

Dimensions
(dimensions in mm)



1) Plus 15 mm for connecting/disconnecting the plug-in connector

Project planning information/maintenance instructions/additional information

Product documentation for VT-HPC:

- Data sheet 30237 (this data sheet)
- Operating instructions 30237-B
- CE declaration of conformity (available from Bosch Rexroth upon request)
- Operation of VT-HPC (from firmware version 20V06):
  - Functional description Rexroth HydraulicDrive from HDx-20
  - Parameter description Rexroth HydraulicDrive from HDx20 RD30330-PA
  - Description of diagnosis Rexroth HydraulicDrive from HDx20 RD3030-WA
  - Library description Rexroth HydraulicDrive, Rexroth IndraMotion MLD (2G), libraries from HDx-20
- Additional information Pump control 30237-Z:
  - Notes for commissioning and controller optimization
  - Description of the technology function speed-variable pump control
- General information on the maintenance and commissioning of hydraulic components: Data sheet 07800 / 07900

Product documentation for base pump A4/HS:

- Data sheet RE 92076

Maintenance instructions:

- The devices have been tested in the plant and are supplied with default settings.
- Only complete devices 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; otherwise bus communication is not possible.
- In particularly EMC-sensitive environments, additional measures must be taken (depending on the application, e.g. shielding, filtration) [1)]
- Wiring information
  - Maximum possible separation between signal and load lines.
  - Do not lead signal lines through magnetic fields.
  - If possible, install signal lines without intermediate terminals.
  - Do not install signal lines in parallel to the load lines.
  - Cable shields must be attached on both sides.
  - For digital inputs and outputs, the max. recommended cable length is 30 m.
  - Only use shielded lines for sensors. Max. recommended cable length: 50 m; also observe the sensor manufacturers' information.
  - Valve lines are to be shielded. Max. recommended cable length: 30 m; also observe the information on the valve.
  - The signals of the connector XG20 and XG21 are not galvanically separated. A potential reference therefore always has to be established when connecting external devices.
- For additional notes, see IndraWorks online help and operating instructions 30237-B.
- The upper and lower ventilation slots must not be concealed by adjacent devices in order to provide for sufficient cooling.
- Observe the installation information in the operating instructions 30237-B

1) To use the HPC for household or small business applications, special precautions, such as installation of a shielded housing and appropriately approved filter systems, are required to fulfill the emission requirements according to EN61000-6-3.

Further information

☞ **Notice:**
For general information on safety, installation or commissioning, see operating instructions:

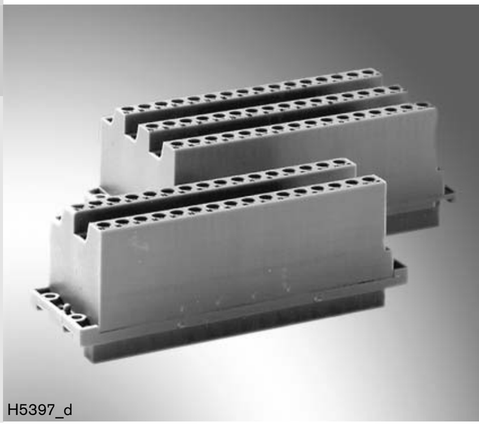
07602-B	Electronics for industrial applications

Connection adapter

RE 30105/06.05
Replaces: 08.03

Type VT 10812

Series 2X



H5397_d

Table of contents

Contents	**Page**

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

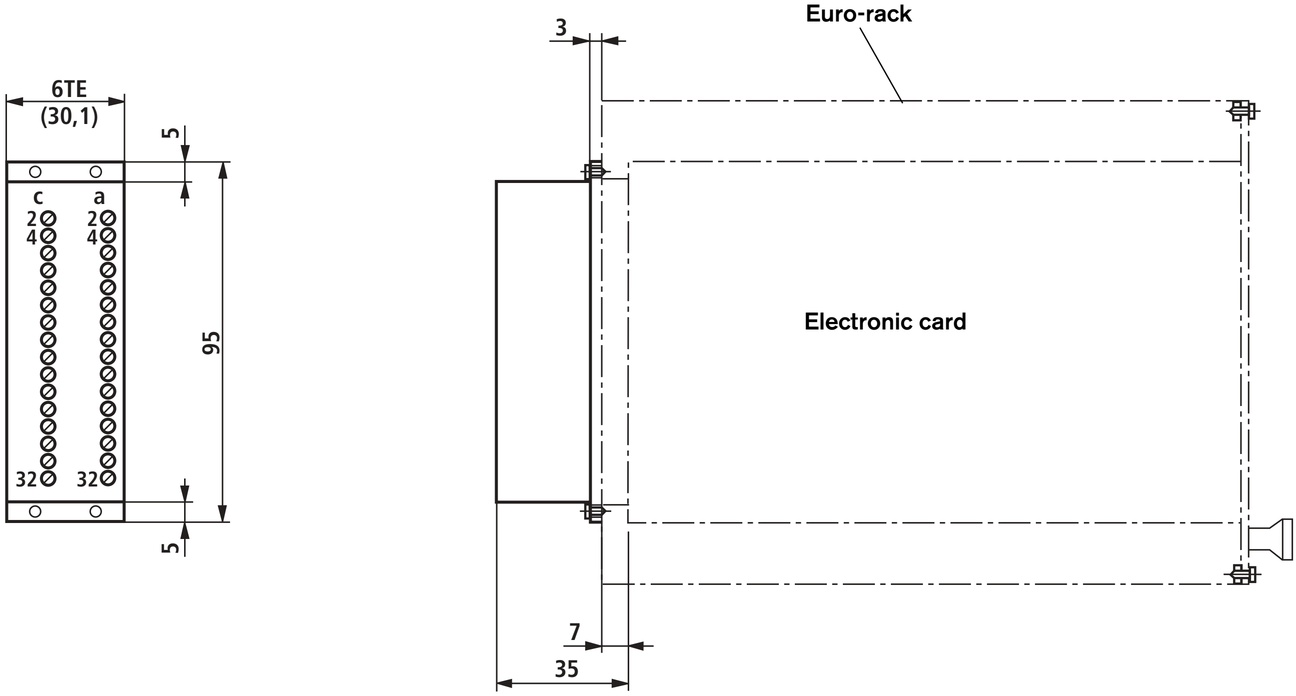
Series 20 to 29 = 2X
(20 to 29: unchanged installation dimensions and pin assignment)

32D = 32-pin, form D
48F = 48-pin, form F
64G = 64-pin, form G

Further details in clear text

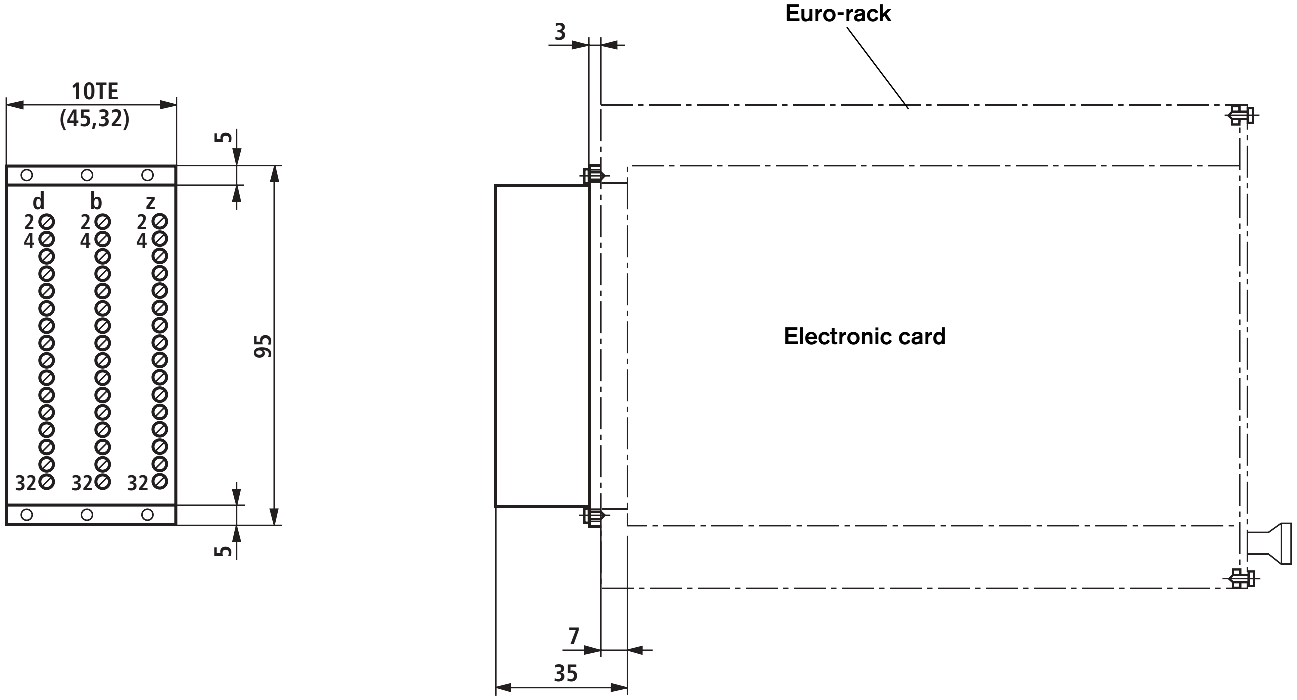
Unit dimensions (dimensions in mm)

Adapter, 32-pin, form D

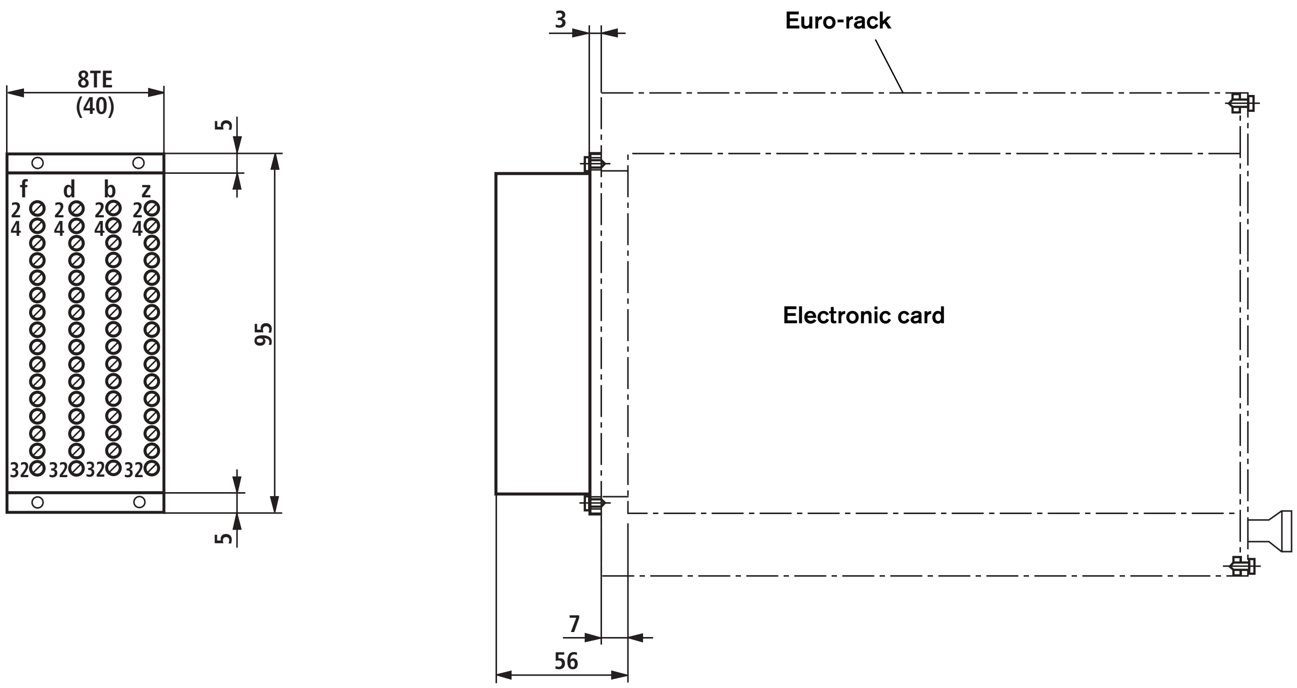


Unit dimensions (dimensions in mm)

Adapter, 48-pin, form F



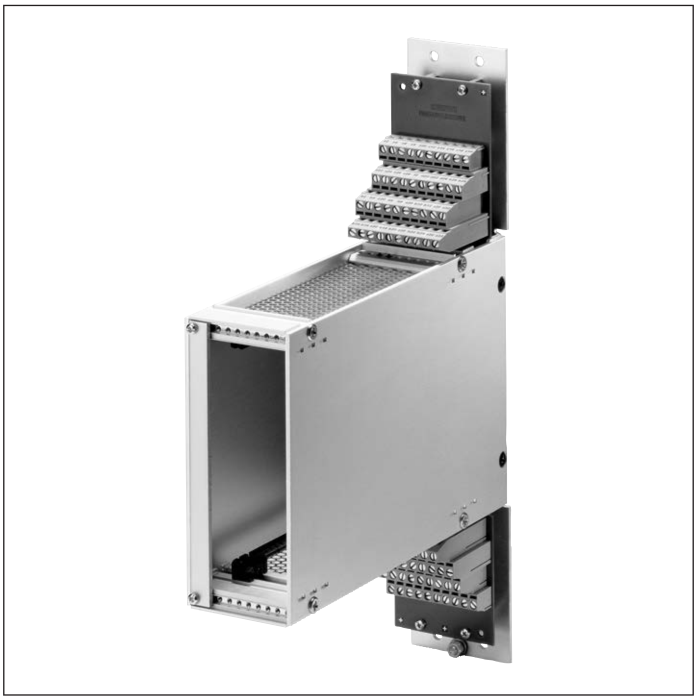
Adapter, 64-pin, form G



Closed card holder

Type VT 12302

RE 30103
Version: 2015-05
Replaces: 2013-02



- Component series 3X

Features

- Suitable for electronic cards with 64-pole male multipoint connector according to DIN 41612, design G
- Recommended for digital valve amplifiers and control electronics, e.g. VT-HACD, VT-VPCD, VT-VRPD-2-2X and VT-VSPD-1-2X
- Housing made of colourlessly passivated sheet steel
- Earthing screw

Contents

Ordering code

01		02		03	04
VT 12302	**–**	**3X**	**/**		*****

01	Closed card holder	**VT 12302**
02	Component series 30 to 39 (30 to 39: Unchanged installation and connection dimensions)	**3X**
03	One slot	**1**
	Two slots	**2**
04	Further details in the plain text	*

Functional description

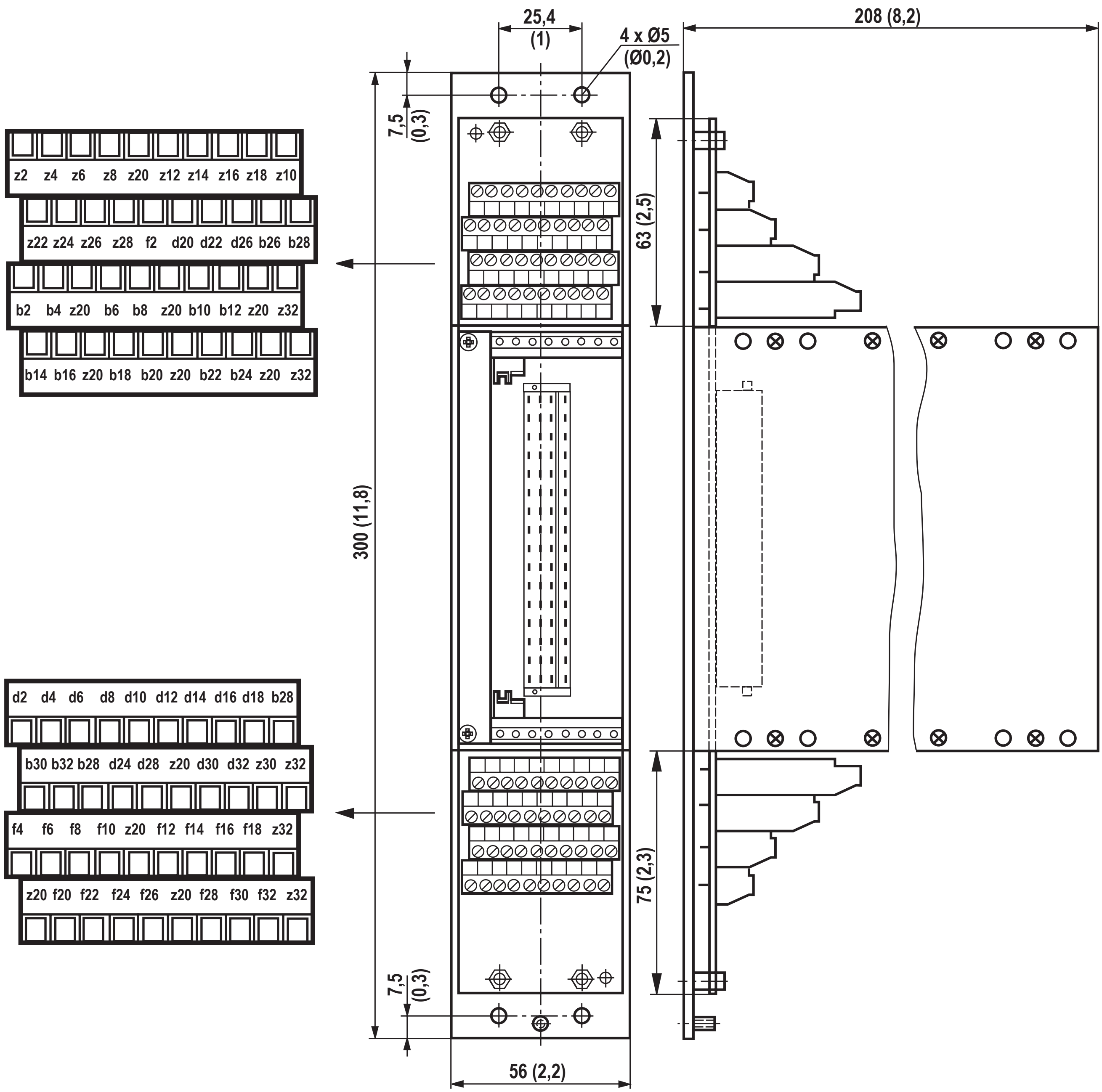
The closed card holder VT 12302 allows for easy assembly and wiring of individual electronic cards in euro format (100 x 160 mm) with a front plate width of 8 TE. Due to their stable set-up (tested according to EN 60068-2-27, DIN IEC 68-2-6 and DIN IEC 68-2-36) they can also be used outside control cabinets.

The closed design guarantees EMC protection according to EN 61000-4-2.

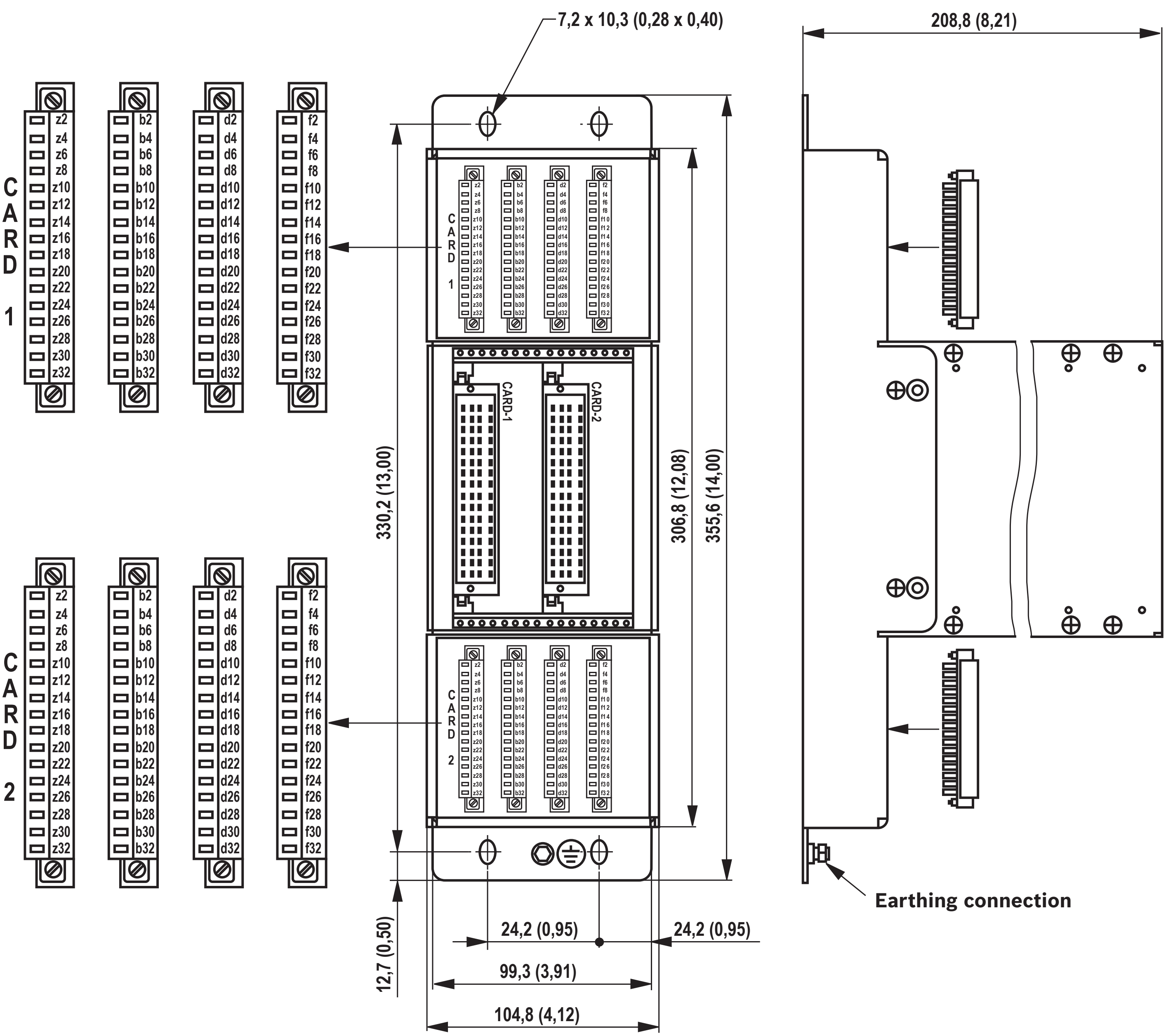
Technical data (for applications outside these parameters, please consult us!)

Terminal voltage according to VDE 0110 C		U	Max. 30 VDC
Current carrying capacity	Connections z2, z4, z6, z8, z30, z32	I	Max. 4 A
	All other connections	I	Max. 2.5 A
Connection cross-section	flexible		0.14 to 1.5 mm^2
	rigid		0.14 to 2.5 mm^2
	AWG (according to EN 60204, part 1)		24 to 12
Type of connection			64-pole female multipoint connector, DIN 41612, design G
Pin assignment			Even lines f/d/b/z
Admissible ambient temperature range		ϑ	–20 to +70 °C
Protection class according to EN 60529			IP 20
Weight		m	1.250 kg

Unit dimensions, type VT 12302-3X/1 (dimensions in mm (inch))



Unit dimensions, type VT 12302-3X/2 (dimensions in mm (inch))



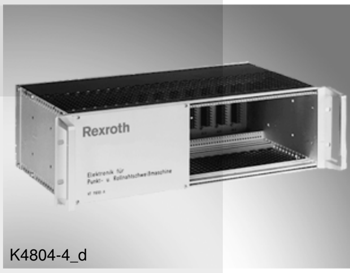
Rexroth
Bosch Group

19´´racks

RE 29768/05.08
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

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 (10 to 19: unchanged installation and connection dimensions)	**= 1X**

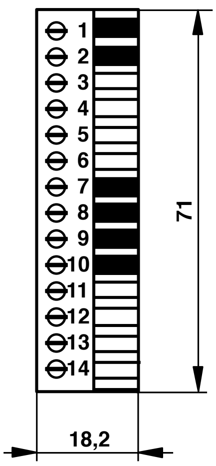
Magazine nominal depth
For VT 19101 to VT 19103
(card dimensions 100 x 160 mm):

1 =	160 mm (without rear panel)
2 =	220 mm (with rear panel)

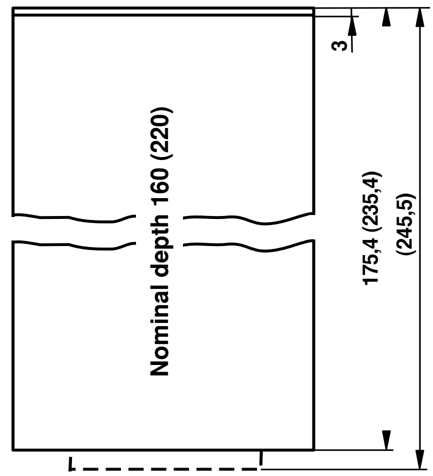
Further details (options) in clear text

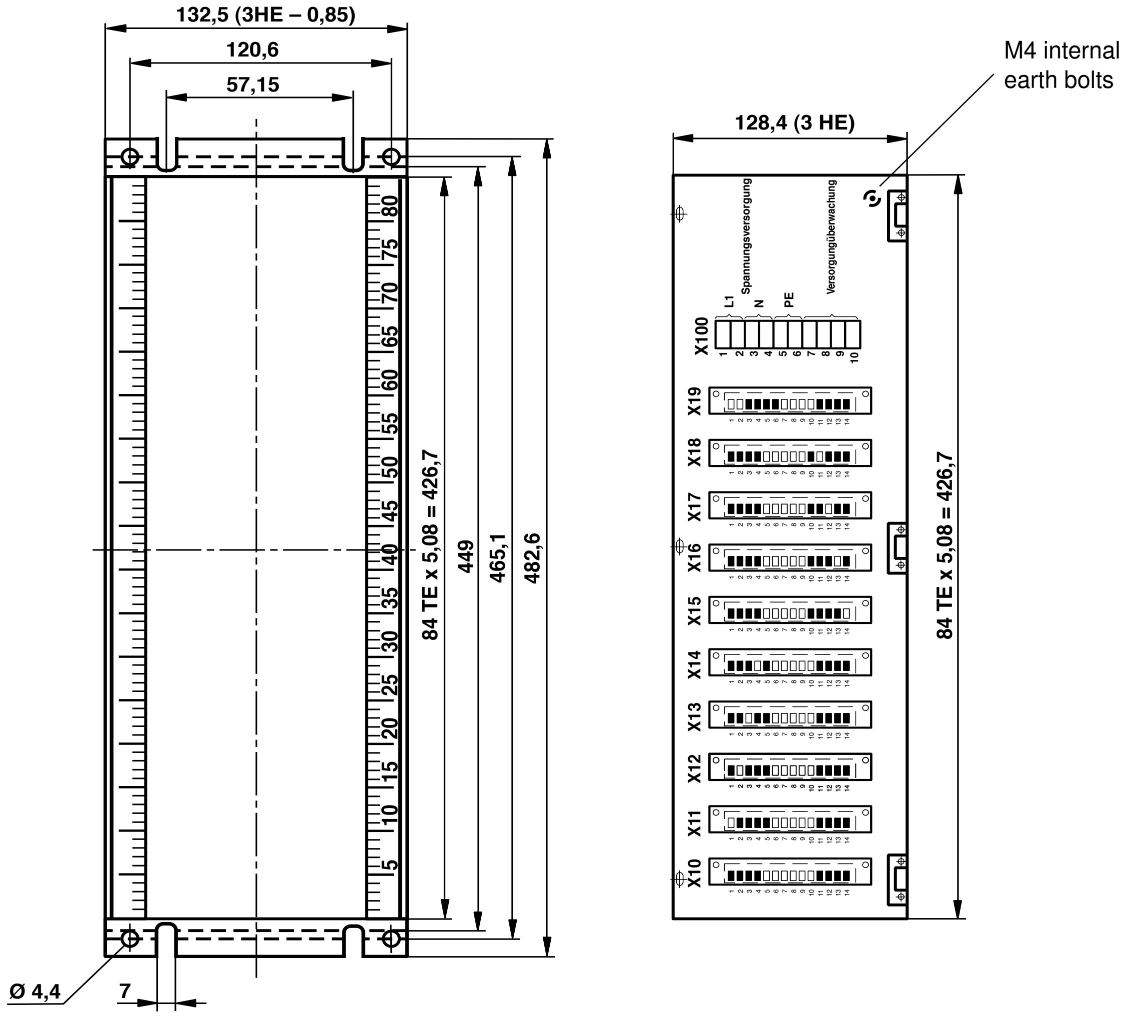
Unit dimensions: terminal plug (dimensions in mm)

Coded terminal plug



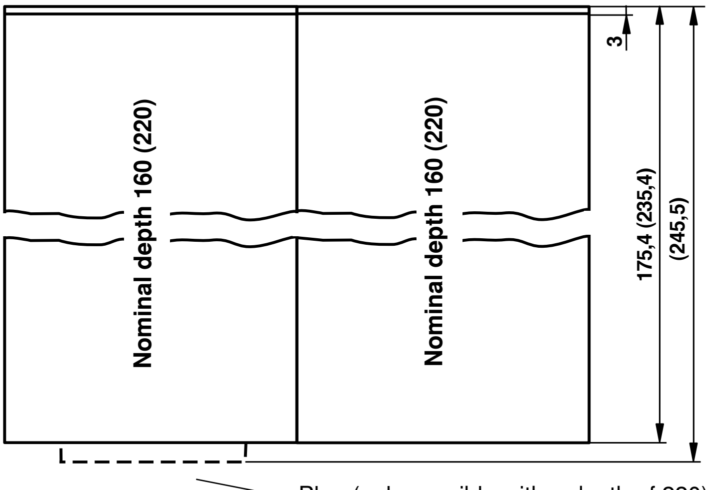
Unit dimensions: VT 19101-1X (dimensions in mm)

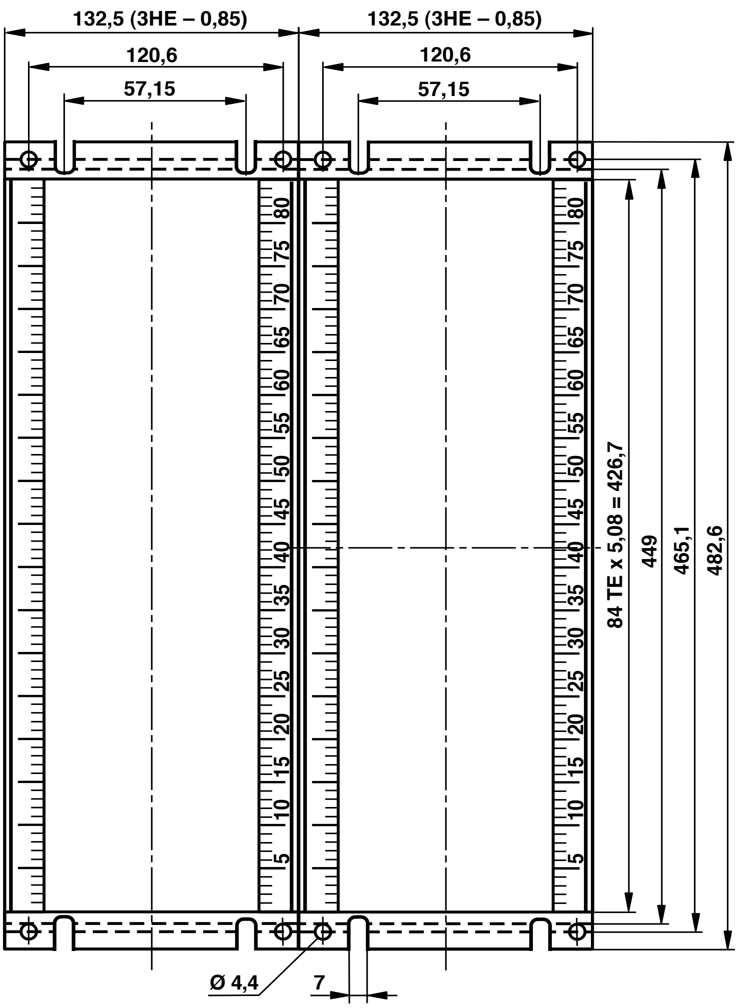


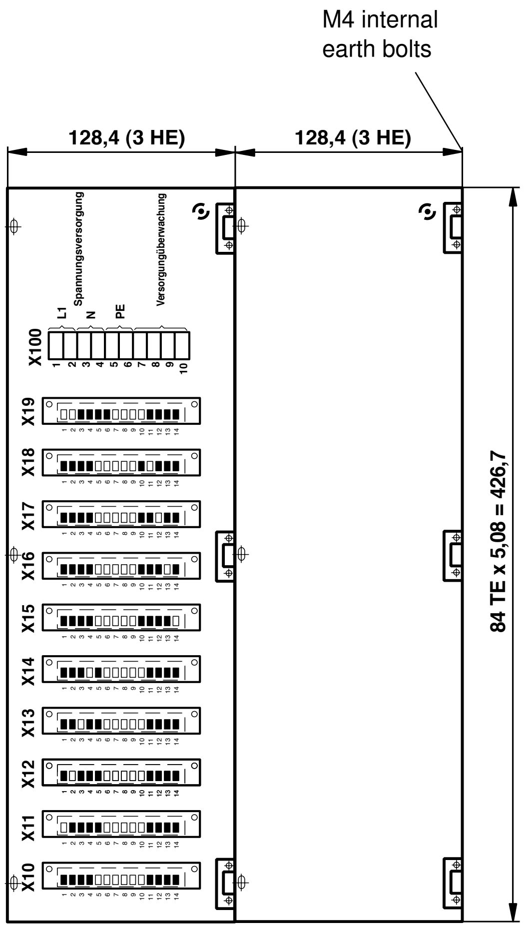


The „u" numbers indicate the location of the cards within the magazine.
The first digit of the "u" number and the plug number gives the tier location.

Unit dimensions: VT 19102-1X (dimensions in mm)

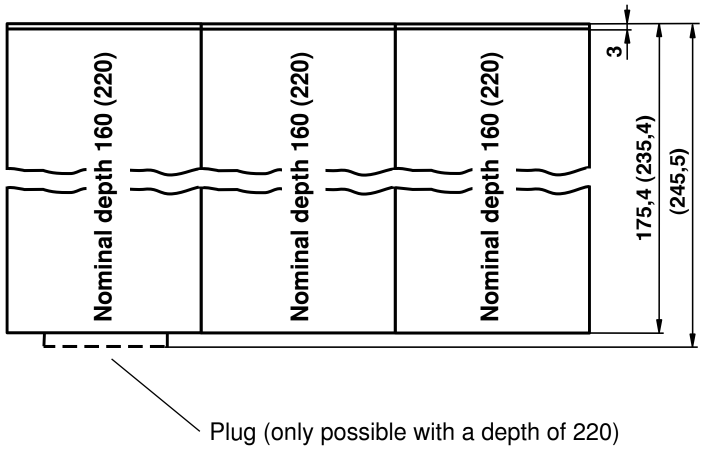


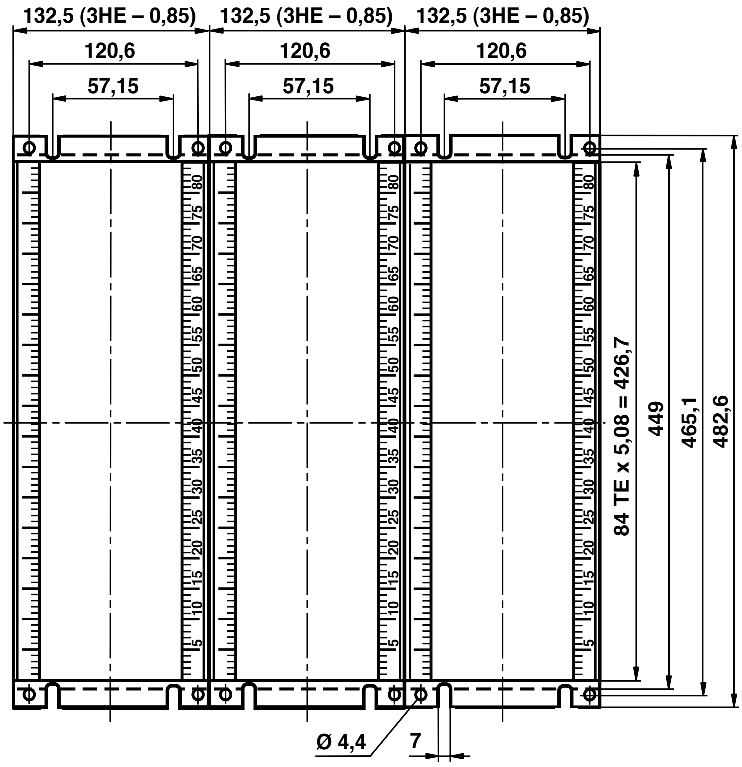


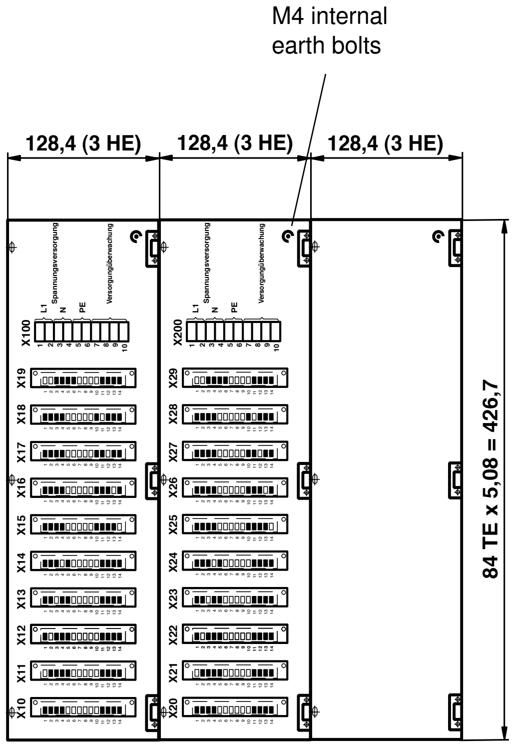


The „u“ numbers indicate the location of the cards within the magazine.
The first digit of the “u” number and the plug number gives the tier location.

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.

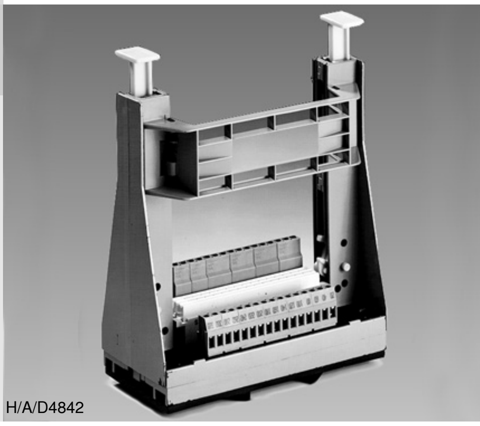
Rexroth
Bosch Group

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

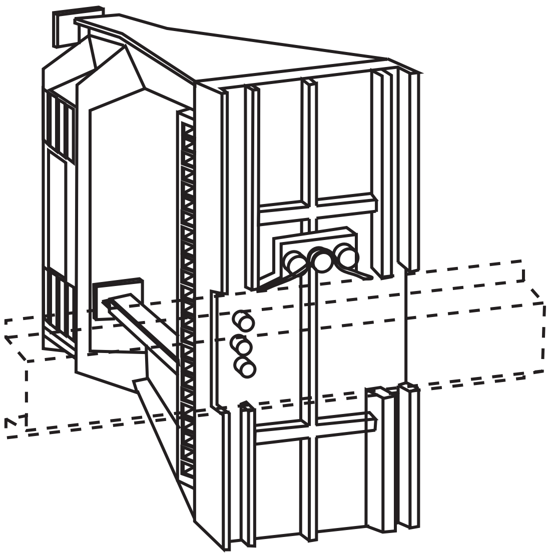
Technical data (For applications outside these parameters, please consult us!)

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

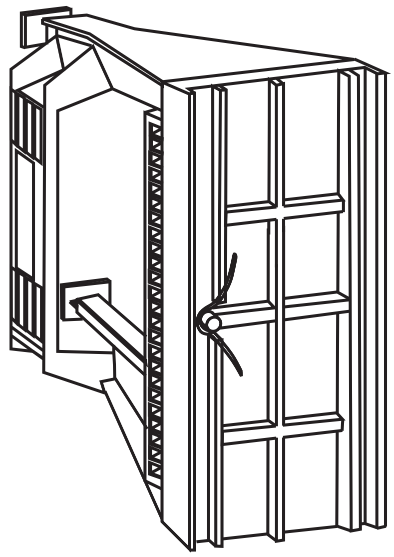
Notes on installation

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.



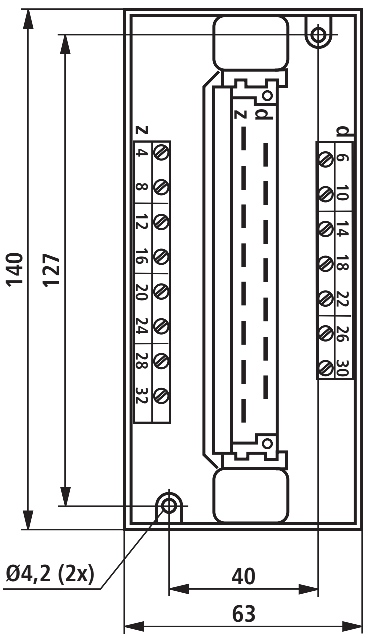
Card holder for forms H 15-pin, D 32-pin, F 32-pin, and F 48-pin



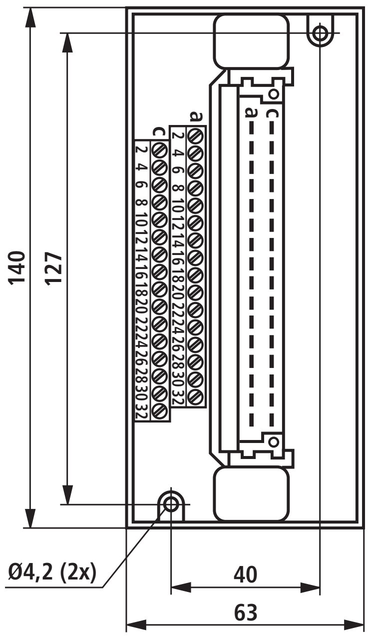
Card holder for designs double Europe format 32 D
as well as G 64-pole
Hat rail mounting only possible in vertical position

Unit dimensions (dimensions in mm)

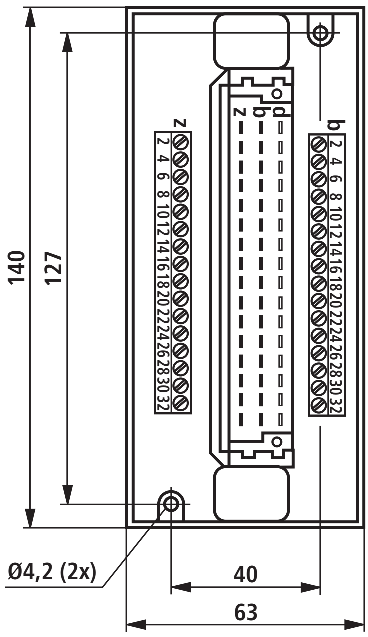
VT 3002-1-2X/15H



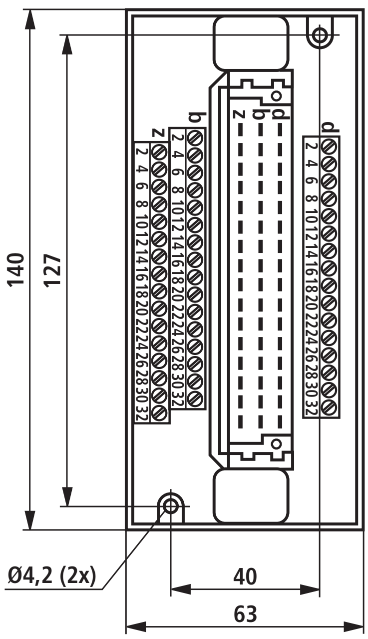
VT 3002-1-2X/32D



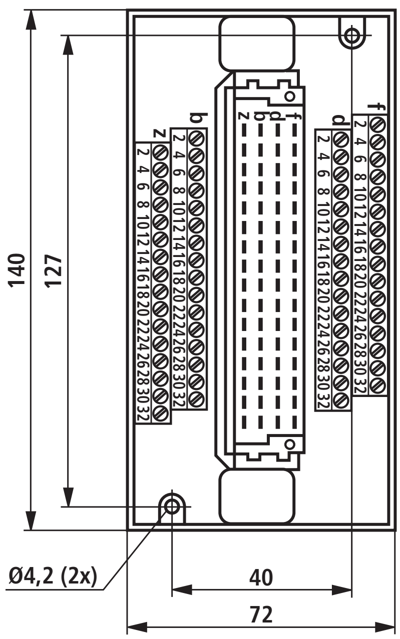
VT 3002-1-2X/32F



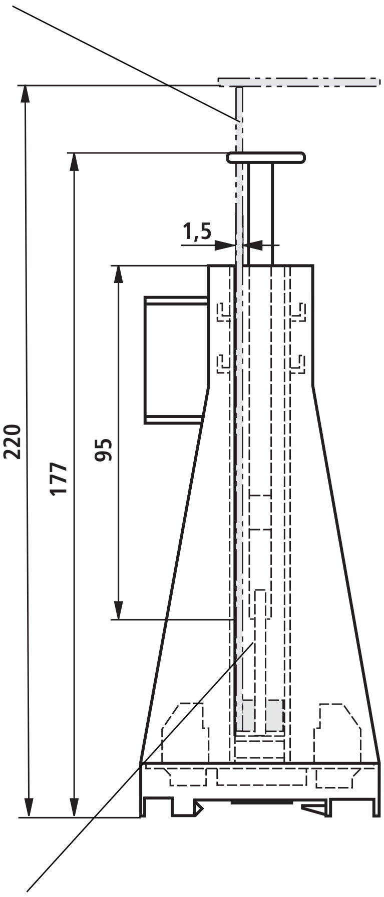
VT 3002-1-2X/48F



VT 3002-1-2X/64G



Electronic card with front panel



Card locking mechanism

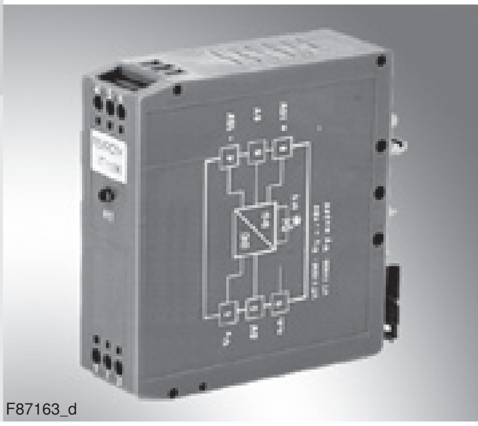
Rexroth
Bosch Group

Power supply module

RE 29729/11.09
Replaces: 07.05

Type VT 11006, VT 11116

Series 1X



F87163_d

Table of contents

Contents	Page

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**

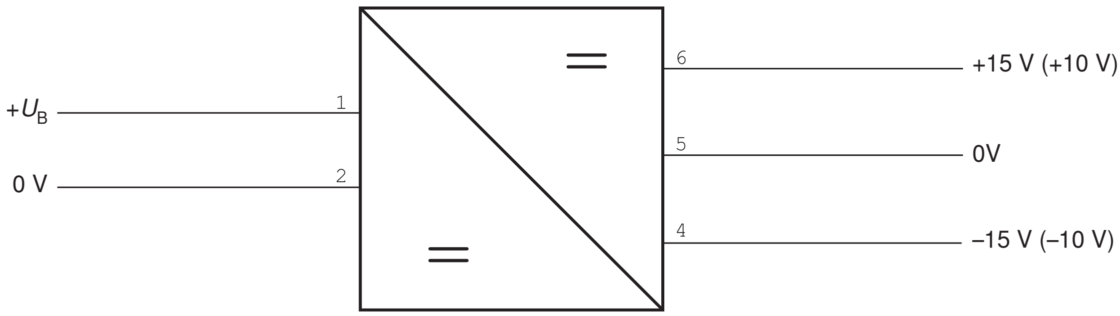
1X = Series 10 to 19 (10 to 19: unchanged installation and connection dimensions)

Further details in clear text

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 %)	±10 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)

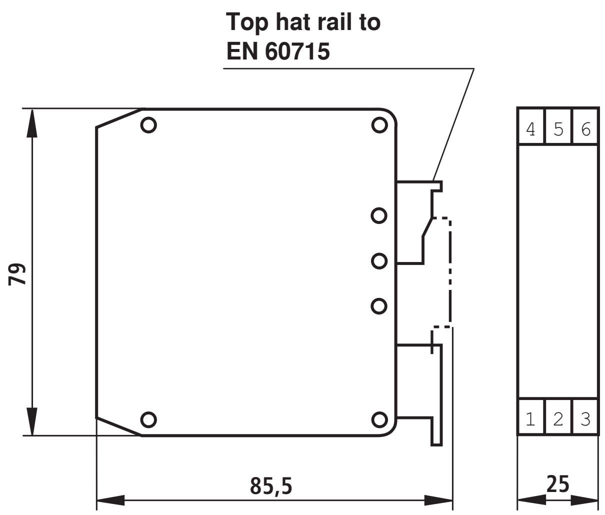
Notes

– 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)

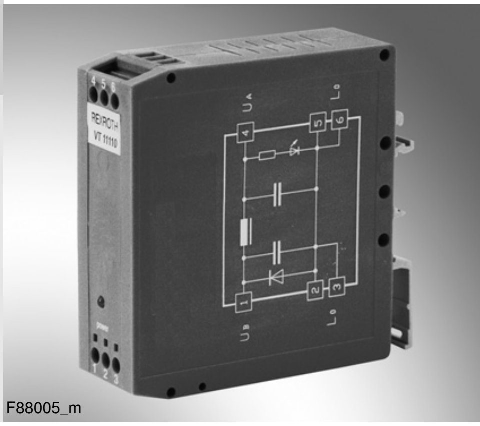


Capacitor module

RE 30750/04.10 1/4
Replaces: 29750

Type VT 11110

Series 1X



F88005_m

Table of contents

Contents	**Page**
Features	1
Supplementary information	1
Ordering code	2
Technical data	2
Pin assignment and block circuit diagram	2
Terminal assignment	3
Unit dimensions	3

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 | *

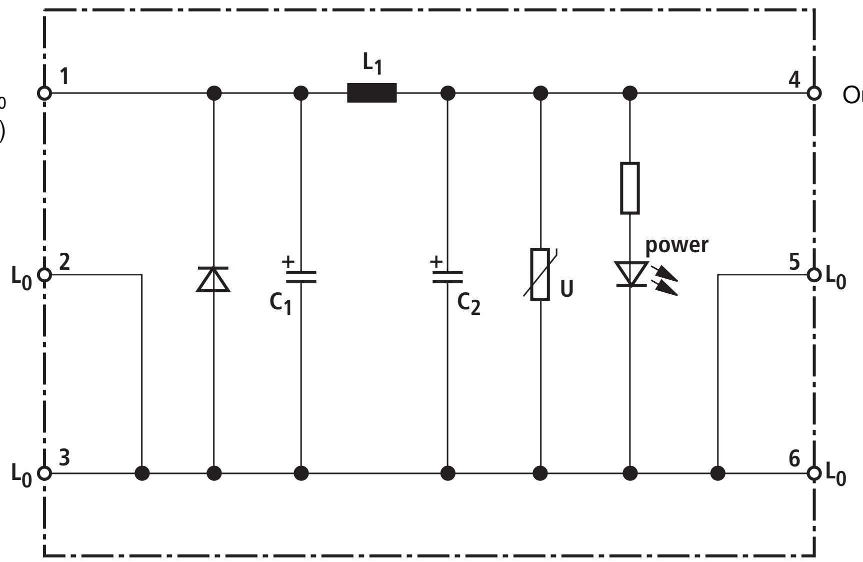
Capacitor module	
Series 10 to19	**= 1X**
(10 to 19: unchanged installation and connection dimensions)	
Further details in clear text	

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

Operating voltage $+U_0$
(pre-fuse max. 6 A)

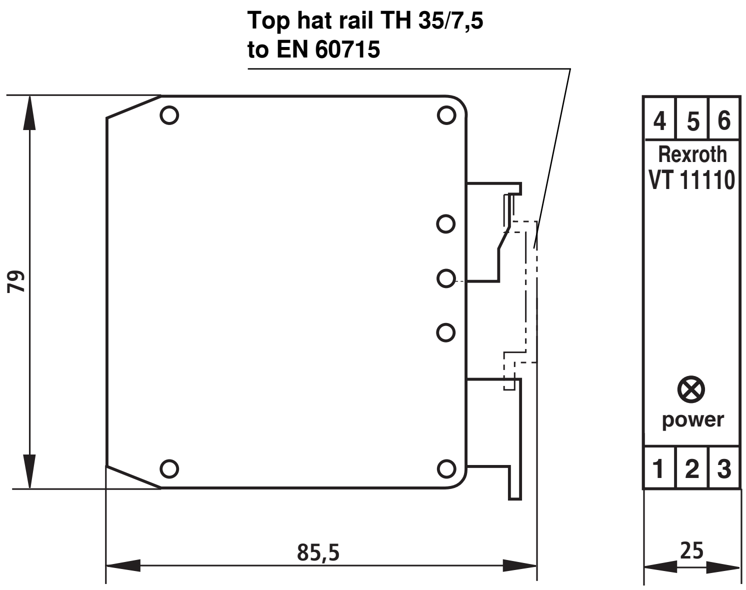


Output voltage U_O

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)



RE 29681
Edition: 2019-11
Replaces: 05.11

rexroth
A Bosch Company

Service case with test device for servo valves without integrated electronics

Type VT-SVTSY-1

H6100

- ▶ Component series 1X

CE

RoHS

Features

- ▶ Service case
  - – Test device with power supply unit and connection cable (see ordering code)
- ▶ Test device
  - – suitable for commissioning and service works at hydraulic systems with servo valves without integrated electronics
  - – In case of faulty machine behavior, allows for functional check and error location without disassembly of the servo valve
  - – Voltage supply by means of 9V block battery or 12V power supply unit

Contents

Ordering code

01		02		03		04		05		06		07		08
VT-SVTSY-1	**–**	**1X**	**/**	**1**	**–**		**–**		**–**		**–**		**/**	*****

01	Service case with test device for servo valves without integrated electronics	**VT-SVTSY-1**
02	Component series 10 ... 19 (10 to 19: unchanged technical data and pin assignment)	**1X**
03	Test device type VT-SVT-1-1X	**1**

Connection cable for valves with electrical connection "K31"

04	Without connection cable	**0**
	With connection cable type VT-SVTK-1-1X	**1**

Connection cable for valves with electrical connection "K17"

05	Without connection cable	**0**
	With connection cable type VT-SVTK-2-1X	**1**

Connection cable for valves with electrical connection "K8"

06	Without connection cable	**0**
	With connection cable type VT-SVTK-3-1X	**1**

Power supply unit

07	Without power supply unit	**0**
	With power supply unit type VT-SVTNT-2-2X/G12	**1**
08	Further details in the plain text	*****

Test device type VT-SVT-1-1X

The test device is suitable for the control and functional testing of servo valves without integrated electronics.
The voltage for the test device is supplied by a 9V block battery (not included in the scope of delivery) or optionally by a 12V power supply unit type VT-SVTNT-2-2X/G12.

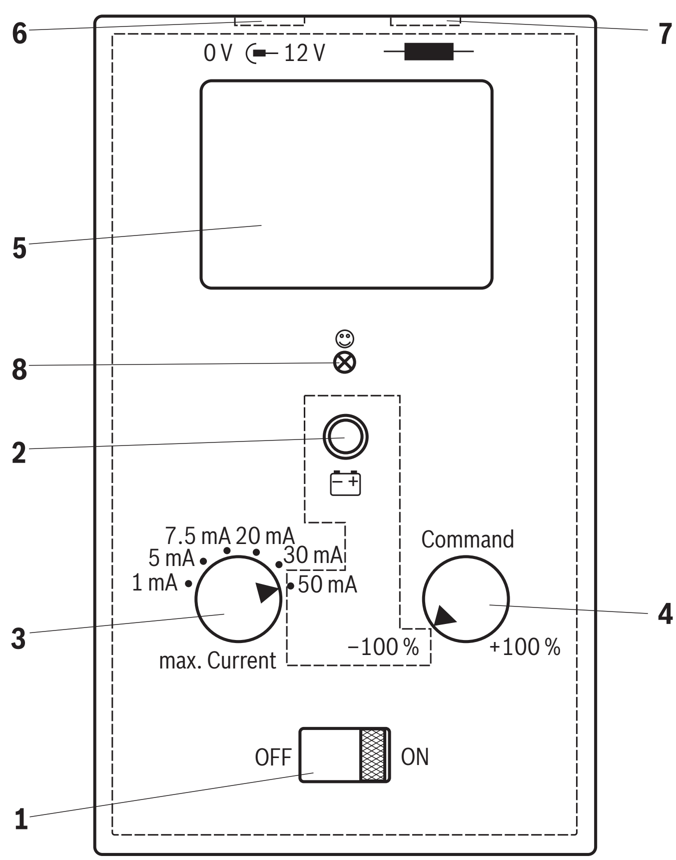
Notice:
The test device may only be used by persons who are familiar with the device, the valve and the hydraulic system. With corresponding setting, it will ignore the control signals coming from the system. If safety precautions have been taken on the control side, they are invalidated.
For damage caused by the incorrect operation, no liability is accepted.

Function, operating instructions

Valve test

- ▶ Connect the connection cable of the power supply unit at socket (6) of the test device or insert the battery.
- ▶ Set the functional switch (1) to "ON" → "Power" LED (8) lights up.
- ▶ In case of battery operation, carry out the battery test:
  - – Set the selector switch (3) to "50 mA"
  - – Set the command value potentiometer (4) to "–100%"
  - – Press the push-button (2) for battery test
  - – The test device indicator shows the battery charge in %
- ▶ Select the coil type of the valve with selector switch (3) at the test device.
- ▶ Bring the command value potentiometer (4) into the central position.
- ▶ Use a suitable valve connection cable (see ordering code) to connect test device (socket (7)) and servo valve. (The valve connection cables are wired so that both coils of the servo valve are switched in series.)
- ▶ Slowly rotate the command value potentiometer (4) to the left or right; observe the movement of the motor or the cylinder while doing so.
- ▶ With the servo valve working smoothly, this allows for the sensitive movement of the controlled motor or cylinder into the desired direction or to the desired position.

1 Functional switch
2 Push-button for battery test
3 Selector switch for coil type
4 Command value potentiometer
5 Coil current indication (in %)
6 Socket for power supply unit cable
7 Socket for valve connection cable
8 "Power" LED display



Assignment of coils / valve types

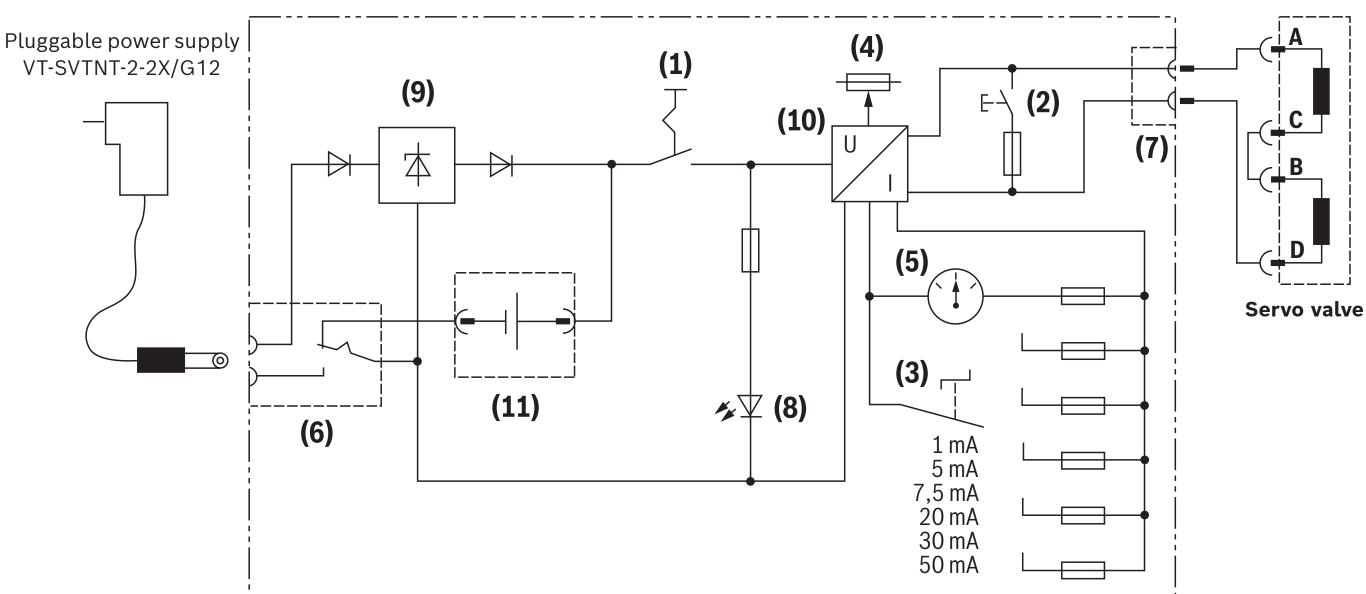
5 mA / 500 Ω per coil	4WS2E.10-4X [1]
7.5 mA / 200 Ω per coil	
20 mA / 80 Ω per coil	4WS2E.10A-4X [1]
30 mA / 40 Ω per coil	4DS1EO2-1X [1]
50 mA / 28 Ω per coil	3DS2EH10-2X [1]
30 mA / 85 Ω per coil	4WS2EM6-2X/...
	4WS2EM10-5X/...
30 mA / 100 Ω per coil	4WS2EM6-1X
50 mA / 80 Ω per coil	
50 mA / 85 Ω per coil	4WS2EM6-2X

[1] Not for new applications

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

Operating voltages		
Battery operation	V	9 (E block, not included in the scope of delivery)
Power supply unit operation	VDC	12 ±5%
Current consumption of the test device	mA	20 (additional valve current)
Ambient temperature range	°C	0 ... +50
Protection class according to EN 60529		IP20
Dimensions (W x H x D)	mm	95 x 158 x 45
Weight	g	0.34
Conformity		▶ CE according to EMC directive 2014/30/EU, tested according to EN 61326-2-1 and EN 61000326-1 ▶ RoHS directive 2011/65/EU

Block diagram / pin assignment



1 Functional switch
2 Push-button for battery test
3 Selector switch for coil type
4 Command value potentiometer
5 Coil current indication
6 Socket for power supply unit cable (with change-over switch)
7 Socket for valve connection cable
8 "Power" LED
9 Voltage regulator
10 Output stage
11 9V block battery

Servo valves suitable for testing

Valve type	Electrical connection	Connection cable type
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)] Not for new applications

Accessories

Power supply unit type VT-SVTNT-2-2X/G12

Pluggable power supply 100 ... 240 VAC; 12 VDC, 1.0 A
The mains connector of the power supply unit is suitable for sockets in Germany and many European countries.

(Actual product may differ)

Technical data (For applications outside these parameters, please consult us!)		
Operating voltage	VAC	100 ... 240 (50 ... 60 Hz)
Current consumption	A	0.19 ... 0.32
Output voltage	VDC	12 (1.0 A)
Length of the connection cable to the test device	m	approx. 1.5
Dimensions (W x H x D)	mm	80 x 46 x 40.5
Weight	kg	0.12

Accessories

Connection cable type VT-SVTK-1-1X

Connection cable between test device VT-SVT-1 and servo valves without integrated electronics (valves with ordering code "K31" for the electrical connection).
The servo valve coils are switched in series (serial connection).

Technical data (For applications outside these parameters, please consult us!)		
Valve port		Mating connector according to DIN 43563-BF6-3/Pg11 (serial connection)
Test device port		Mono jack 2.5 mm
Cable length	m	3
Weight	kg	0.16

Connection cable type VT-SVTK-2-1X

Connection cable between test device VT-SVT-1 and servo valves without integrated electronics (valves with ordering code "K17" for the electrical connection).
The servo valve coils are switched in series (serial connection).

Technical data (For applications outside these parameters, please consult us!)		
Valve port		Mating connector VG 95328 (serial connection)
Test device port		Mono jack 2.5 mm
Cable length	m	3
Weight	kg	0.13

Connection cable type VT-SVTK-3-1X

Connection cable between test device VT-SVT-1 and servo valves without integrated electronics (valves with ordering code "K8" for the electrical connection).
The servo valve coils are switched in series (serial connection).

Technical data (For applications outside these parameters, please consult us!)		
Valve port		Mating connector 14S-2P (serial connection)
Test device port		Mono jack 2.5 mm
Cable length	m	3
Weight	kg	0.16

RE 29685
Edition: 2021-10
Replaces: 2019-11

rexroth
A Bosch Company

Service case with test device for proportional servo valves with integrated electronics (OBE)

Type VT-VETSY-1


H5967

- Component series 1X

Features

- Service case
  - Test device, 24V power supply unit, connection cable and adapter (see ordering code)
- Test device
  - suitable for the control and functional testing of proportional servo valves with integrated electronics and an operating voltage of ±15V or +24V
  - Simplifies commissioning and troubleshooting in hydraulic systems with proportional servo valves

Contents

Ordering code

01		02		03		04		05		06		07		08
VT-VETSY-1	–	1X	/	1	–	2	–	1	–	1	–	0	/	*

01	Service case with test device for proportional servo valves with integrated electronics (OBE)	**VT-VETSY-1**
02	Component series 10 ... 19 (10 to 19: unchanged technical data and pin assignment)	**1X**
03	Test device type VT-VET-1-1X	**1**
Connection cable to the valve		
04	2 units, 6-pole, type VT-VETK-1-1X	**2**
Adapter cable for valve type 4WSE2EM 6 -1X		
05	Type VT-VETAK-1-1X	**1**
Power supply unit		
06	90 ... 264 VAC; +24 VDC, 3.75 A; type VT-VETNT-3-1X/G24	**1**
07	**Without** power supply unit	**0**
08	Further details in the plain text	*****

Test device type VT-VET-1-1X

The test device is suitable for the control and functional testing of proportional servo valves with integrated electronics and an operating voltage of ±15V or +24V.

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 presetting via the test device; operating voltage from the control cabinet
- Internal operation → Operating voltage via a separate power supply unit; command value presetting via the test device
- Command value presetting via BNC socket → Operating voltage optional

☞ **Notice:**
The test device may only be used by persons who are familiar with the device, the valve and the hydraulic system. With corresponding setting, it will ignore the control signals coming from the system. If safety precautions have been taken on the control side, they are invalidated.
For damage caused by the incorrect operation, no liability is accepted.

Function, operating instructions

Voltage supply
The test device can be supplied with +24 V or ±15 V, depending on the operating voltage required by the valve. To this end, the "power selector" change-over switch must be set accordingly before the commissioning.
An internal DC/DC converter creates the required auxiliary voltages ±15 V for the internal command value presetting.
The "power selector" selector switch amongst others switches the internal **reference potential L0** to the relevant, externally applied ground.
Spool position "+24 V" → input pin B = reference potential
Spool position "±15 V" → input pin C = reference potential

Connections

▶ **Input connector ES (1) and 4 mm input sockets**
The input connector ES (1) on the left side serves the connection of the connection cable coming from the control or from the control cabinet. Depending on the setting of the operating elements (see operating and display elements), the 4 mm sockets on the left side are directly connected to the pins of the input connector ES (1).
So all signals coming from the control can be measured at the sockets.
For operation of the test device and the valve, the necessary operating voltages +24 V or ±15 V (depending on the valve type) must be available.
If no operating voltage is available yet on the control cabinet side, a corresponding power supply unit can be connected at the input connector ES.

▶ **Output socket AB (16) and 4 mm output sockets**
The output socket AB (16) on the right side serves the connection of the valve. The 4 mm sockets on the right side are directly connected with the pins of output socket AB (16).
So all signals to or from the valve can be measured at the 4 mm sockets.
By means of the short-circuit connectors, every single wire of the connection cable can be separated, e.g. for allowing for current measurement.

▶ **BNC socket**
At the BNC socket, an externally generated command value signal can be fed in via a standardized 50 Ω cable. In this connection, the "setpoint selector" command value switch is to be switched to "BNC" position.

▶ **PE socket**
The PE socket is directly connected to the PE connection of the input connector ES (1). The output socket AB (16) does not have a PE connection.

Item explanations can be found on page 5.

Potentiometer / trimmer

Designation	Function	Prerequisites
Setpoint internal	Command value presetting to the valve (AB - pin D) The output switches automatically between U_{Command} = ±10 V or I_{Command} = ±20 mA, depending on the load resistance of the valve command value input.	Operating voltage at the input connector ES Position of the "power selector" switch according to the operating voltage type "Setpoint selector" switch to "internal" position "Stepfunction key" push-button not pressed
Stepfunction level	Setting the step amplitude The step function is activated by means of the "stepfunction key" push-button.	Operating voltage at the input connector ES Position of the "power selector" switch according to the operating voltage type "Setpoint selector" switch to "internal" position Operation of the "stepfunction key" push-button triggers the step function.

Function, operating instructions

LED displays

Designation	Function	Prerequisites
power	Display of the internal voltage supply	Operating voltage at the input connector ES
enable indication control	Indication of the enable signal coming from the control / the control cabinet (input socket ES - pin C)	Operating voltage amounts to +24 V "power selector" switch to "24 V" position "power" LED is illuminated
enable indication valve	Indication of the enable signal going to the valve (output socket AB - pin C and measuring socket C). The LED is also illuminated if an enable signal is only available at the left 4 mm measuring socket. Without short-circuit connector, this signal is not available at the output socket AB and thus at the valve.	Operating voltage amounts to +24 V "power selector" switch to "24 V" position "power" LED is illuminated Enable signal is activated

Switch

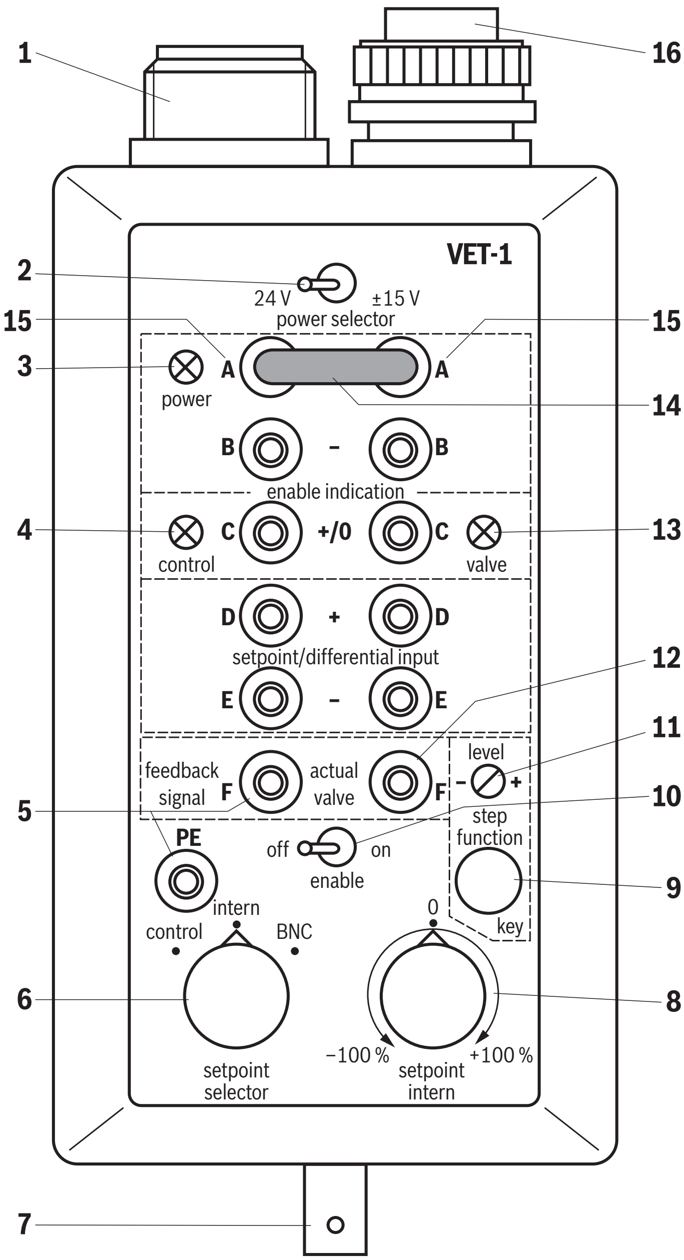
Designation	Spool position	Function
power selector	+24 V	The internal reference potential is connected to ES - pin B (0 V with U_B = 24 V).
		Using the "enable" switch, an enable signal can be generated ("on") or switched off ("off").
	±15 V	The internal reference potential is connected to ES - pin C (0 V with U_B = ±15 V).
		The enable signal generation is deactivated.
		ES - pin C is directly connected to AB - pin C (short-circuit bridge).
enable (only with 24 V operation)	on	"setpoint selector" switch to "control" position → An enable signal externally applied by the control (ES - pin C) is switched through.
		"setpoint selector" switch to "internal" or "BNC" position → The enable signal for the valve is set.
	off	There is a low-ohmic connection between the enable signal output (AB - pin C) and the reference potential (0 V).
setpoint selector	control	Via pin D and pin E, the command value lines are directly switched through from the control to the valve.
		If "power selector" switch to "24 V" position and "enable" switch to "on" position → The enable signal of the control is switched through to the valve (pin C).
	internal or BNC	"power selector" switch to "24 V" position → The enable signal to the valve corresponds to the "enable" switch position.
		The reference potential for the command value (AB - pin E) corresponds to the internal reference potential (0 V).
	internal	If the "stepfunction key" push-button is not operated → The command value signal to the valve (AB - pin D) corresponds to the specification by the "internal setpoint" command value potentiometer.
		If the "stepfunction key" push-button is operated → The command value signal to the valve (AB - pin D) corresponds to the specification by the "stepfunction level" trimmer.
	BNC	The signal applied at the BNC socket is switched through as command value signal to the valve (AB - pin D).

The described functions are only valid until all short-circuit bridges are plugged.

Push-buttons

Designation	Function	Prerequisites
stepfunction key	Switch-over between the "setpoint internal" and "stepfunction level" command value presettings (push-button operated)	Operating voltage available at the input connector ES. "power selector" spool position according to the operating voltage type "setpoint selector" switch to "internal"

Ports, display and adjustment elements



Item	Functional element	Labeling
1	Input connector ES: connection on the control side via connector K31, CM02E14S-61P	
2	Switch for selecting the operating voltage required by the valve	power selector
	LED displays:	
3	Ready for operation	power
4	Enable signal of the input connector ES and from the external control at pin C	enable indication control
5	Input measuring sockets	A to F and PE
6	Switch for the selection of the command value signal source	setpoint selector
7	BNC socket for connecting an external, independent command value encoder	
8	Potentiometer for setting the internal command value signal	setpoint internal
9	Shift key between the internal command value signals for generating a step signal	stepfunction key
10	Enable switch for generating an enable signal independent of the external control	enable
11	Trimmer for the amplitude adjustment of the internal step function generator	stepfunction level
12	Output measuring sockets for controlling the signals on the valve connection cable	A ... F
13	Enable signal at measuring sockets, output socket AB and pin C	enable indication valve
14	Short-circuit bridges for separating individual cable wires of the connection from control to the valve	
15	Designation for measuring sockets A to F	A to F
16	Output socket AB: valve-side connection via flange socket MS3108A-14S-6S	
17	Current/voltage output for valve command value with automatic switch-over between U_A = 0 V ... ±10 V or I_A = 0 ... ±20 mA	
18	Voltage converter DC/DC for the internal voltage supply	

Notice:

- **Operating mode without enable input**
  Valves with integrated electronics and an operating voltage of +24 V without enable input use port C as reference potential for the actual valve value. In this case, the "enable" enable switch is to be set to "off" position.
- **Operating mode with enable input**
  Valves with integrated electronics and an operating voltage of +24 V with enable input use port B as reference potential for the actual valve value. In this case, the "enable" enable switch is to be set to "on" position.

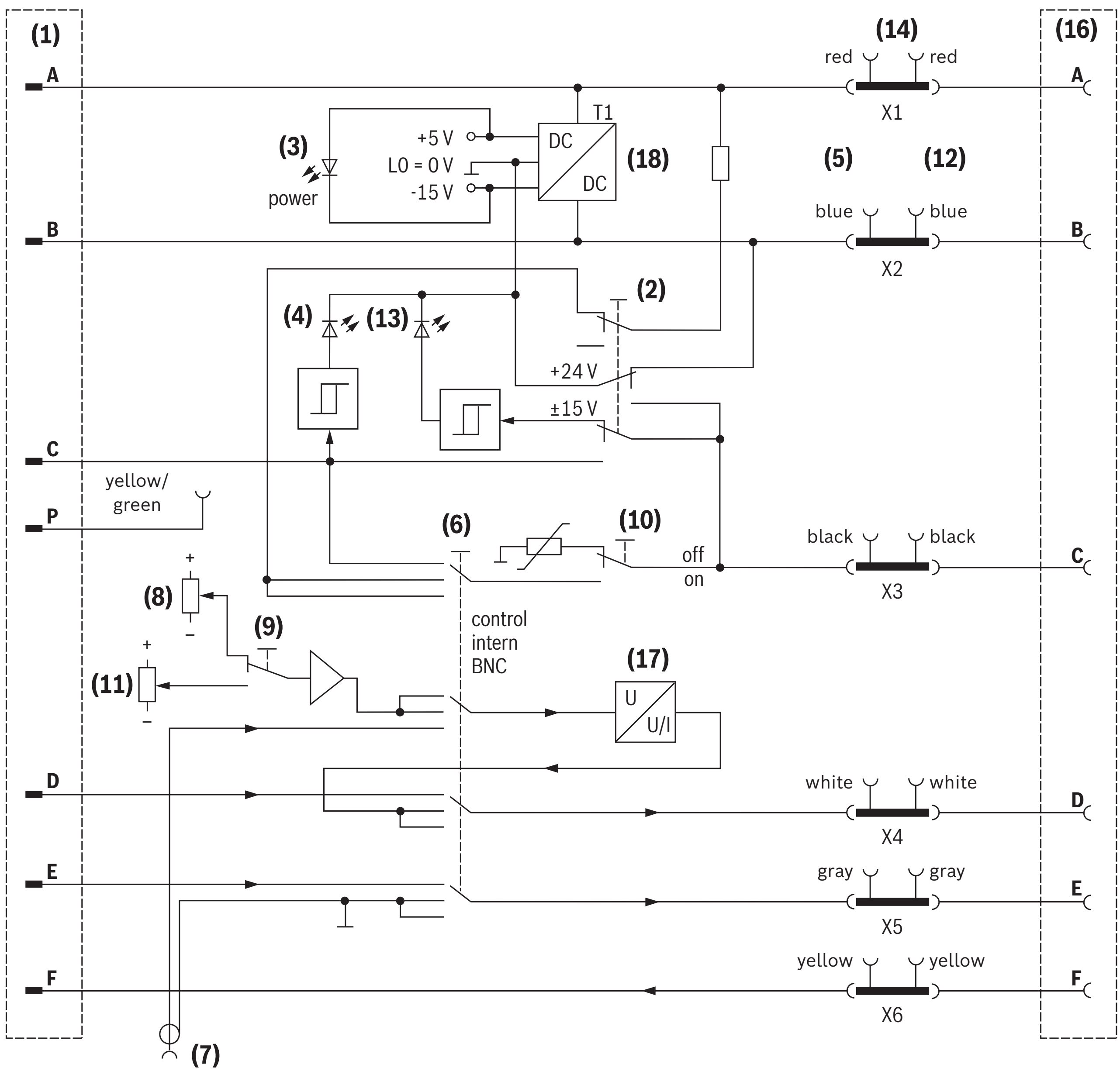
Technical data
(For applications outside these values, please consult us!)

Operating voltages			
Switch "power selector"	▶ "24 V" spool position	V	$24^{+40\%}_{-20\%}$
	▶ "±15 V" spool position	V	±15; ±10%
Current consumption of the test device		A	0.1
Maximum current carrying capacity of pin A and B of the input connector ES and the output socket AB when testing 24 V proportional or high-response valves		A	6

Inputs			
Input connector ES	▶ Command values at pin E and D		according to the valve specifications
	▶ Enable signal at pin C (24V operation)		
	– not active	V	0 ... 10
	– active	V	16 ... $\boldsymbol{U}_B$
Output socket AB	▶ Actual value at pin F		according to the actual value output of the valve
BNC socket		V	0 ... ±10

Output (all short-circuit bridges plugged)			
Input connector ES	▶ Actual value at pin F		according to the actual value output of the valve
Output socket AB	▶ Enable signal at pin C (24 V operation)		
	– "setpoint selector" switch; "internal" or "BNC" spool position; "enable" enable switch		
	– in "off" spool position	V	0
	– in "on" spool position		U_B
	– "control" spool position; "enable" enable switch		
	– in "off" spool position	V	0
	– in "on" spool position		according to pin C of the input connector ES
Command values at pin D and E	▶ "setpoint selector" switch		
	– "internal" or "BNC" spool position		
	– Pin E		Reference potential
	– Pin D	V	0 ... ±10, if $R_{e\ valve}$ > 500 Ω
		mA	0 ... ±20, if $R_{e\ valve}$ < 500 Ω
	▶ "control" spool position		
	– Pin E and D		according to the input connector ES (pin E and D)
Ambient temperature range		°C	0 ... +50
Protection class according to EN 60529			IP20
Dimensions (W x H x D)		mm	94 x 54 x 160
Weight		kg	0.36
Conformity			▶ CE according to EMC directive 2014/30/EU, tested according to EN 61326-2-1 and EN 61000326-1 ▶ RoHS directive 2011/65/EU

Block diagram / pin assignment



Pin assignment

Pin	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 the actual valve value, e.g. with 4WRSE	0 V
PE	Protective ground	Protective ground
D	Command value +	Command value +
E	Command value –	Command value –
F	Actual value	Actual value

Item explanations, see page 5.

Proportional servo valves suitable for testing

Valve type	Operating voltage U_B
Servo valves with integrated 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 integrated 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
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 valves on request	±15 V or +24 V
DREE (without electrical position feedback)	+24 V

Accessories

Power supply unit type VT-VETNT-3-1X/G24
(included in the scope of delivery)

Table power supply unit 90 ... 264 VAC; +24 VDC, 3.75 A
(Material no. **R900739627**)
The mains connector of the power supply unit is suitable for sockets in Germany and many European countries.
In some countries, a country-specific adapter has to be used (not included in the scope of delivery).

(Actual product may differ)

Technical data (For applications outside these parameters, please consult us!)		
Operating voltage	VAC	90 ...264; 47 ... 63 Hz
Current consumption	A	1.2
Fuse		electronic overload protection
Output voltage	VDC	24 ± 1 V; 3.75 A
Length of the mains line	m	approx. 1.5
Length of the line to the test device	m	approx. 1.5
Dimensions (W x H x D)	mm	139 x 61 x 36
Weight	kg	0.46

Connection cable type VT-VETK-1-1X (2 units included in the scope of delivery)

Connection cable between test device VT-VET-1-1X and proportional servo valves with integrated electronics (valves with ordering code "K9" and "K31" for the electrical connection) (material no. **R900575335**)

Technical data (For applications outside these parameters, please consult us!)		
Valve port		Mating connector according to DIN EN 175201-804
Test device port		Connector MS3101A 14S 6P
Length of the connection cable	m	3
Weight	kg	0.3

Notice:
- For extension, several cables can be connected with each other.
- When operating valves with electrical connection "K31", the grounding conductor is interrupted.

Accessories

Adapter cable type VT-VETAK-1-1X (included in the scope of delivery)

Adapter cable between test device VT-VET-1-1X and proportional servo valves with integrated electronics (valves with ordering code "K17" for the electrical connection) (material no. **R900943189**)

Technical data (For applications outside these parameters, please consult us!)		
Valve port		Mating connector VG 95328
Test device port		Connector MS3101A 14S 6P
Length of the connection cable	m	3
Weight	kg	0.3

The Drive & Control Company

Rexroth
Bosch Group

Module for monitoring and limiting the solenoid currents with proportional valves

Type VT-MUXA2-2

RE 30290
Edition: 2014-02
Replaces: 02.11

H7312

- Component series 1X

Features

- Shut-off of the solenoid currents after exceedance of the admissible maximum current
- Additional, not safety-relevant command value correction prevents early switch-off of the solenoid currents
- Additional fuse protection for the solenoid circuits by means of non-exchangeable fuses 1.25 A, fast-acting according to IEC 60127-4
- Redundant relay contacts per solenoid circuit
- Redundant solenoid current measurement per solenoid circuit
- Reverse polarity protection of the solenoid circuits
- Reverse polarity protection of the operating voltage
- Reset input – edge-triggered
- Differential input
- Command value output
- OK output
- Top hat rail mounting
- Pluggable connection terminals

Contents

Use

The module VT-MUXA2-2 can be used to monitor 1 or 2 solenoid circuits. The solenoid currents are limited so that there is no overheating of the solenoids. The solenoid currents necessary for operating the valve are provided by an amplifier (order separately).
The amplifier is adjusted according to the rated current data of the solenoid (rated current = 1.03 A). With a command value presetting of 10 V, it provides an output current of 1.0 A.
In case of defect or incorrect operation, the amplifier may provide a current of more than 1.0 A. The interconnected VT-MUXA2-2 monitoring module recognizes the overcurrent, reduces the command value or switches off the solenoid current.
The VT-MUXA2-2 monitoring module must be protected against voltage peaks from the 24V mains. Our capacitor module VT 11110 protects against voltage peaks and smoothes the 24 V supply voltage.

Explosion hazard in case of incorrect assembly!

Please observe the following rules in any circumstance!

1. **The Rexroth electronics listed in this data sheet must be installed and operated outside the explosive area.**
2. **The VT-MUXA2-2 module must be switched between amplifier output and solenoids and between control output (command value presetting by superior control) and amplifier input (see block diagram).**
3. **Only connect valve solenoids the maximum current of which complies with the monitoring current of the VT-MUXA2-2 monitoring module.**

Notice:
The VT-MUXA2-2 module is an electrostatically endangered component. It has to be assembled complying with ESD protection measures.

Ordering code

01	02		03		04		05	06	07
VT-MUXA	2	–	2	–	1X	/	V0	1A	*

01	Analog module for monitoring solenoid coils	**VT-MUXA**
02	Monitoring for valves with one or two solenoids	**2**
03	Serial number (module type)	**2**
04	Component series 10 to 19 (10 to 19: Unchanged technical data and pin assignment)	**1X**
05	Standard version	**V0**
06	I_{max} = 1.0 A	**1A**
07	Further details in the plain text	*****

Included in the scope of delivery:
- Two ferrite sleeves for lines between amplifier and monitoring module conducting solenoid current

Function

Power supply unit (1)
The internal power supply unit provides the internally required auxiliary voltages.
A green LED (power) shows that the power supply unit is working.

Power supply unit monitoring (2)
If the internal supply voltages are missing, this causes the relay switch-off via the NTF signal. Voltages without which the relays cannot be controlled are not monitored additionally.

Current measurement (3)
The solenoid currents I_A and I_B are in each case measured in the supply path and in the return path (AV, AR, BV, BR).

Function (continued)

Both measurement results are analyzed independently of each other. Against reversed polarity, protective diodes are provided. The two currents I_A and I_B are added as neither each individual solenoid current nor the total of the currents must exceed the specific limit value.

Symmetry monitoring (4)
As the supply and return currents must be identical, the total currents are identical, as well. If there are deviations, e.g. in case of earth fault or faulty current measurement, the DI error signal for the relay switch-off is generated.

Correction signal generation (5)
The correction signals serve
1. as auxiliary signal for correcting (amount reduction) the command value forwarded to the amplifier as soon as the maximum admissible solenoid current is exceeded.
2. as auxiliary signal for switching off the solenoid circuits if the correction is not effective.

Command value correction (6)
As long as the solenoid current is within the nominal range, the command value for the solenoid current coming from the control is forwarded to the valve amplifier without being influenced. If the maximum admissible current is exceeded, the command value amount is within few seconds reduced with a ramp-shaped development until the current reaches the limit value. Thus, an abrupt switch-off of the current is avoided. If the corrected command value reaches a value smaller than 50 % of the nominal value and the solenoid current is not reduced, there is a switch-off by the relay contacts. The command value correction is not structured in a redundant form. A circuit failure or an incorrect command value signal always results in the switch-off by the relay contacts if the solenoid current values are inadmissible.

Relay control (7)
The relays for switching the solenoid currents on and off all have their own control electronics with DI, NTF inputs and the signals of the correction signal generation (5).

Shut-off
Shut-off is initiated in case the admissible maximum current is exceeded and as soon as at least one correction signal does not result in a current reduction or one of the redundant current measurements shows differences in the measurements (symmetry monitoring). Moreover, the relays remain switched off as long as after switch-on or reset, the self-test is executed.

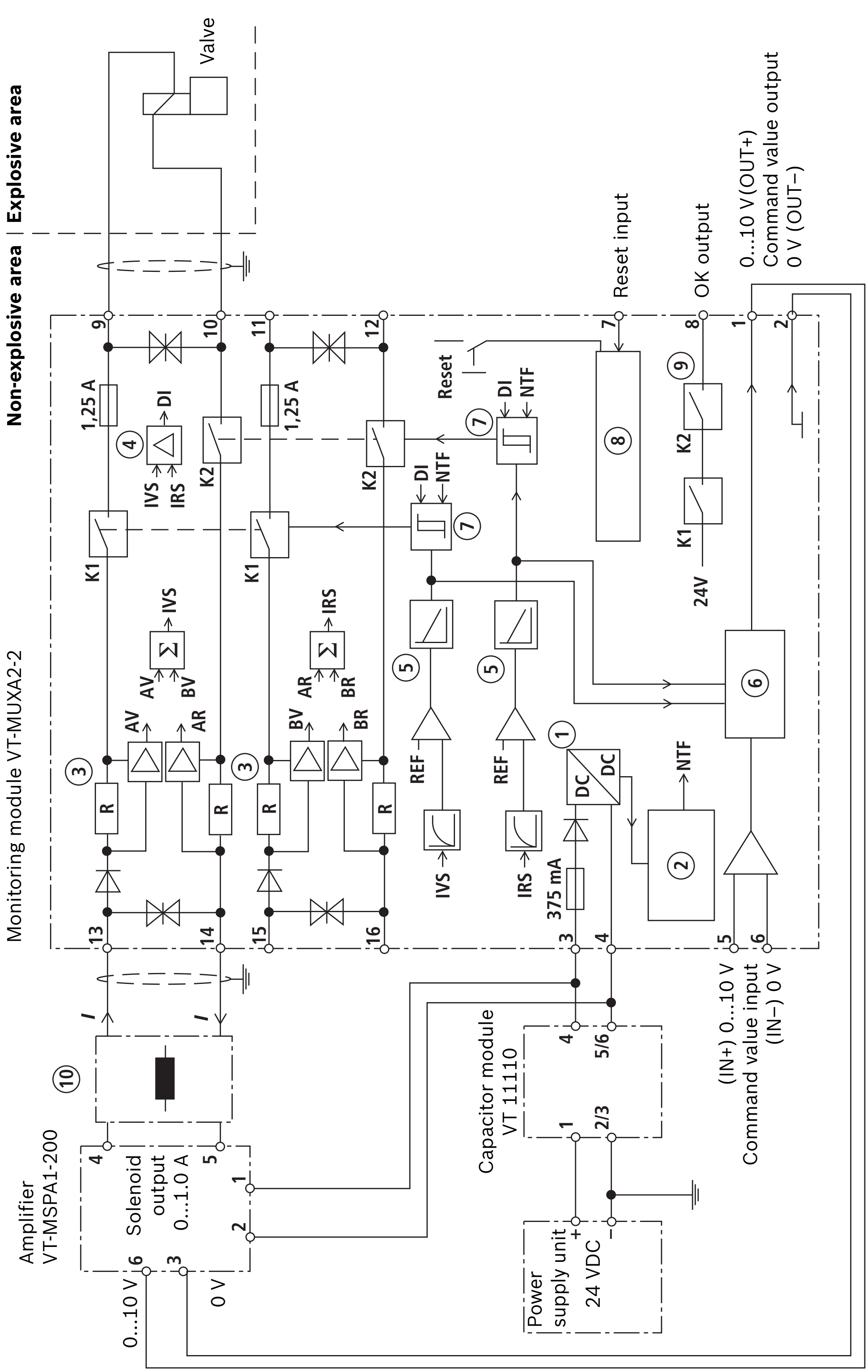
Switch-on
The relays are always only switched on after passed self-test.

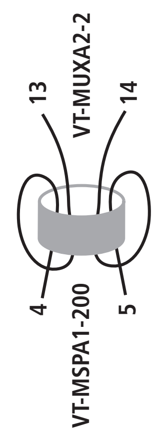
Safety measures
- Power supply unit monitoring
- Redundant current measurement
- Symmetry monitoring of the current measurement
- Redundant correction signal generation
- Redundant relay control circuits and relays
- Relay with positively driven contacts
- Self-test

Self-test (8)
The self-test is necessary as an occurred error has to be detected in the redundant monitoring functions. The command value correction circuit (6) is not checked by means of the self-test. The self-test is carried out after each operating voltage switch-on and each manual and each electronic reset of the electronics. The manually started self-test is performed after actuating the "S1" reset pushbutton. The electronic reset is performed by a positive edge at the 24 V reset input.
Unintended movements of the system/machine are possible!
If the self-test is activated during operation, both relays are opened. Thus, the hydraulic function is considerably disturbed.
The function of the "S1" reset pushbutton can be suppressed by a 24 V signal at the reset input in order to prevent an accidental tripping. So that the self-test for checking the VT-MUXA2-2 monitoring module can be performed, the 24 V signal must be removed again.

"OK" output (9)
As soon as the "Test OK" signal is set and both relays have switched, as well, this is signaled by a 24 V output signal and by the LED.

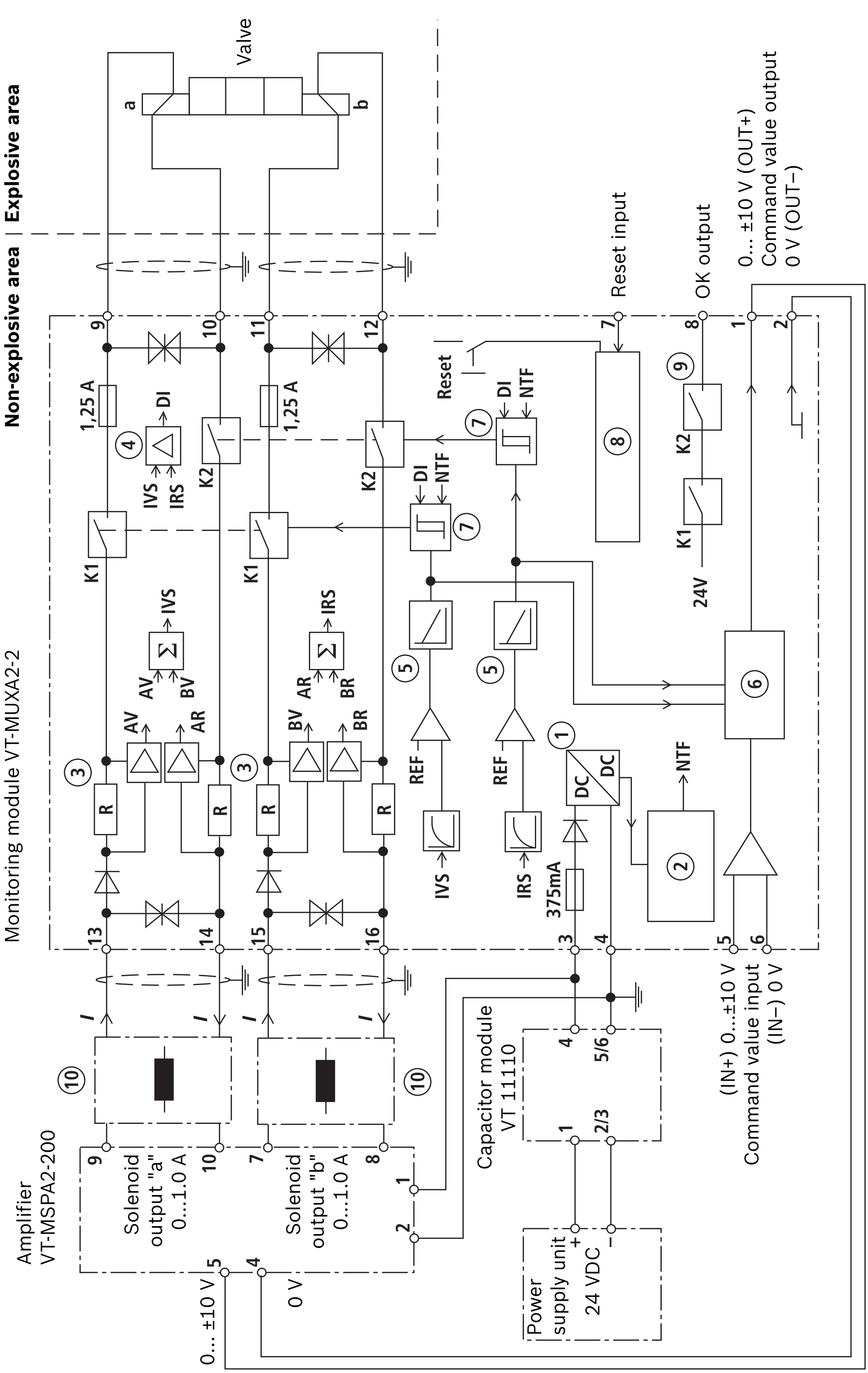
Block diagram VT-MUXA2-2 for one solenoid

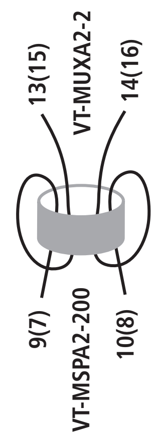




(1) Internal power supply unit
(2) Power supply unit monitoring
(3) Current measurement
(4) Symmetry monitoring
(5) Correction signal generation
(6) Command value correction
(7) Relay control
(8) Self-test
(9) OK output
(10) One ferrite sleeve, connection as shown on the right

Block diagram VT-MUXA2-2 for two solenoids





(1) Internal power supply unit
(2) Power supply unit monitoring
(3) Current measurement
(4) Symmetry monitoring
(5) Correction signal generation
(6) Command value correction
(7) Relay control
(8) Self-test
(9) OK output
(10) Two ferrite sleeves, connection as shown on the right

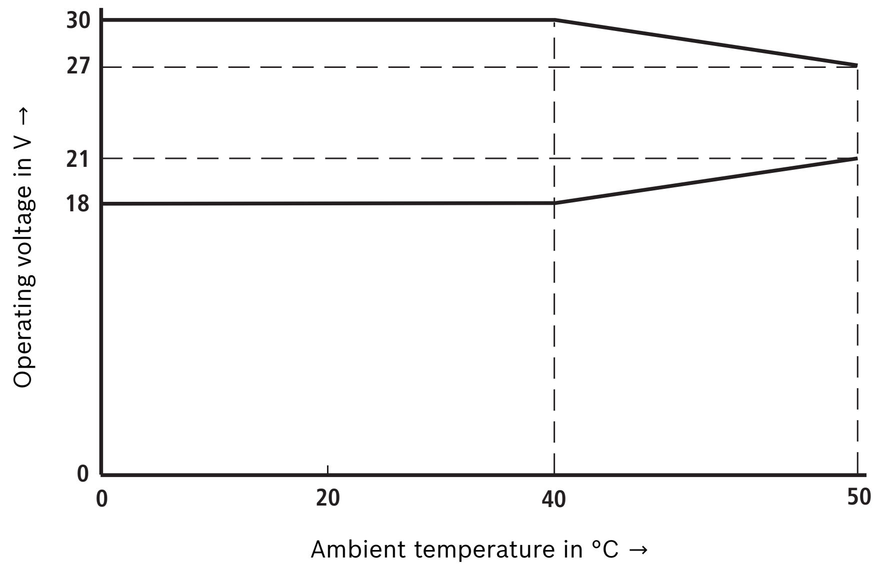
Technical data (For applications outside these parameters, please consult us!)

Operating voltage	Nominal value		U_B	24 V DC
	Maximum value		$u(t)_{max}$	30 V at 0 °C ≤ ϑ_U ≤ 40 °C [1]
	Minimum value		$u(t)_{min}$	18 V at 0 °C ≤ ϑ_U ≤ 40 °C [1]
	Reverse polarity protection			Yes
Power consumption			P	< 5 VA
Current consumption			I	< 0.2 A
Fuses/short-circuit protection 1 or 2 fuses for the solenoid currents, not exchangeable			I	1.25 A fast-acting (SMD)
Display LEDs	OK		Green	Is illuminated if the self-test has been completed, the relays have operated and there is no error
	Power		Green	Is illuminated if the internal power supply unit works
Inputs	Command value differential input		U	0 ... +10 V and/or 0 ... ±10 V, R_E = 100 kΩ
	Reset input – Low – High		 U_R U_R	Edge-triggered, Low → High 0 ... 6.5 V 10 V ... U_B
	1 or 2 monitored solenoid current inputs – Admissible common-mode voltage – Reverse polarity protection – Admissible clock frequency of the solenoid currents		 U Hz	 −2 V ... U_B By means of diodes 0 ... 500
Outputs	Command value output		U	0 ... +10 V and/or 0 ... ±10 V, I = 2 mA (command value presetting at amplifier)
	2 solenoid current outputs		I	1.0 A (monitored to ±2 %)
	OK output	High = OK		U_B – 3 V / 50 mA, short-circuit-proof
		Low = OK		< 2 V, R_i = 10 kΩ
Clearances and creepage distances				According to EN 50178
Admissible degree of contamination				2 according to EN 60664
Type of connection				16-pole terminal housing with detachable terminals
Connection cross-section			A	0.2 ... 2.5 mm²
Type of mounting				Top hat rail TH 35-7.5 according to EN 60715
Protection class				IP 20
Dimensions (W x H x D)				See unit dimensions on page 8
Operating temperature range			ϑ	0 ... +50 °C [1]
Storage temperature range			ϑ	−25 ... +85 °C
Weight			m	0.15 kg
Maximum admissible operating hours			h	40000

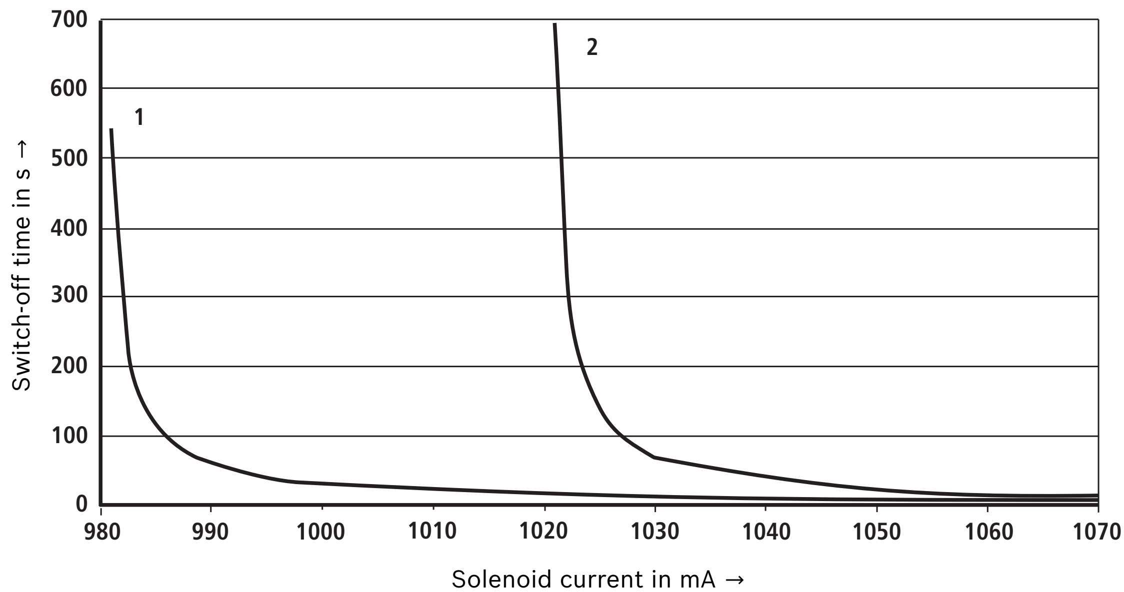
[1] See also derating characteristic curves on page 7

Characteristic curves

Temperature derating for the operating voltage



Switch-off behavior



1 and 2 are limit curves

Terminal assignment

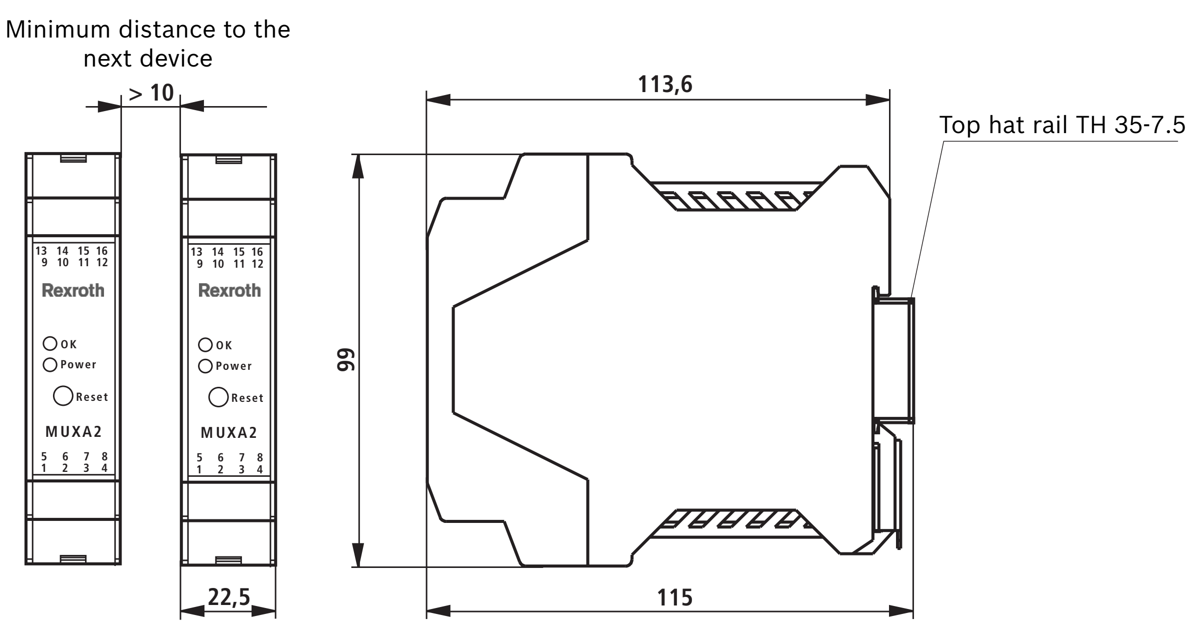
VT-MUXA2-2 for one solenoid

Terminal	Function	Terminal	Function
1	Command value output 0...10 V (OUT+)	9	Solenoid: "+" output
2	Command value output 0...0 V (OUT−)	10	Solenoid: "−" output
3	+ U_B	11	Not connected!
4	Weight	12	Not connected!
5	Command value input 0...10 V (IN+)	13	Solenoid: "+" input
6	Command value input 0 V (IN−)	14	Solenoid: "−" input
7	Reset input	15	Not connected!
8	OK output	16	Not connected!

VT-MUXA2-2 for two solenoids

Terminal	Function	Terminal	Function
1	Command value output 0...±10 V (OUT+)	9	Solenoid a: "+" output
2	Command value output 0...0 V (OUT−)	10	Solenoid a: "−" output
3	+ U_B	11	Solenoid b: "+" output
4	Weight	12	Solenoid b: "−" output
5	Command value input 0...±10 V (IN+)	13	Solenoid a: "+" input
6	Command value input 0 V (IN−)	14	Solenoid a: "−" input
7	Reset input	15	Solenoid b: "+" input
8	OK output	16	Solenoid b: "−" input

Installation conditions and unit dimensions



RE 08006
Edition: 2021-05
Replaces: 2016-04

rexroth
A Bosch Company

Mating connectors and cable sets for valves and sensors in hydraulics

Features

- Mating connectors and cable sets for electrical connection to:
  - Valve solenoids
  - Valves with installed electronics
  - Position and pressure sensors
- Various designs and standards
- Plastic and metal versions

Contents

Table of contents

Table of contents

Table of contents

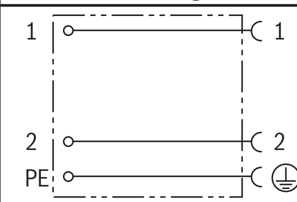
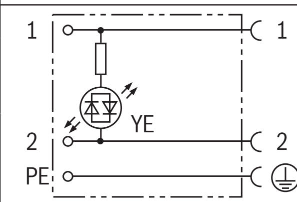
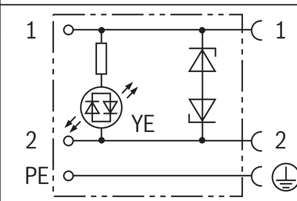
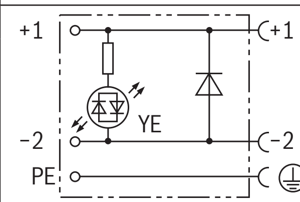
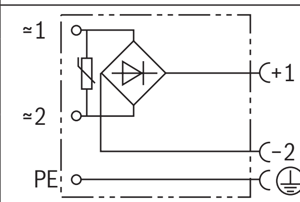
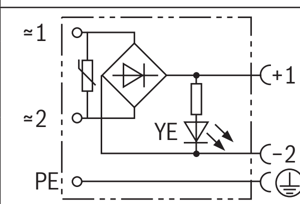
Table of contents

Notice:
Plug-in connectors must not be disconnected or connected under load

Mating connectors

For valves with "K4" device connector, 2-pole + PE, design A (large cubic connector)

Ordering code

Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Color	Line fitting	Material number	Circuit diagram
Without circuitry, standard						
Z4	12 ... 240 V	16 A 4)	gray	M16 x 1.5	R901017010	
	12 ... 240 V	16 A 4)	black	M16 x 1.5	R901017011	
Z45	12 ... 240 V	16 A 4)	brown	NPT 1/2"	R900004823	
	12 ... 240 V	16 A 4)	black	NPT 1/2"	R900011039	
With indicator light						
Z5L	12 ... 240 V	4 A 4)	black	M16 x 1.5	R901017022	
Z55L	12 ... 240 V	4 A 4)	black	NPT 1/2"	R900057453	
With indicator light and Z-diode-suppressor						
Z5L1	24 V ±10% 1)	4 A 4)	black	M16 x 1.5	R901017026	
With indicator light and protective diode						
Z5L2	24 V ±10% 2) DC only	3 A 4)	black	M16 x 1.5	R901017027	
With rectifier						
RZ5	80...240 V 3)	1.5 A 4)	black	M16 x 1.5	R901017025	
RZ55	80...240 V 3)	1.5 A 4)	black	NPT 1/2"	R900842566	
With indicator light and rectifier						
RZ5L	80...240 V 3)	1.5 A 4)	black	M16 x 1.5	R901017029	
RZ55L	80...240 V 3)	1.5 A 4)	black	NPT 1/2"	R900057455	

1) Switch-off voltage peak limitation to 55 V
2) Switch-off voltage peak limitation to 1 V
3) Switch-off voltage peak limitation to 2 V
4) Please observe the temperature range and/or derating (see technical data)

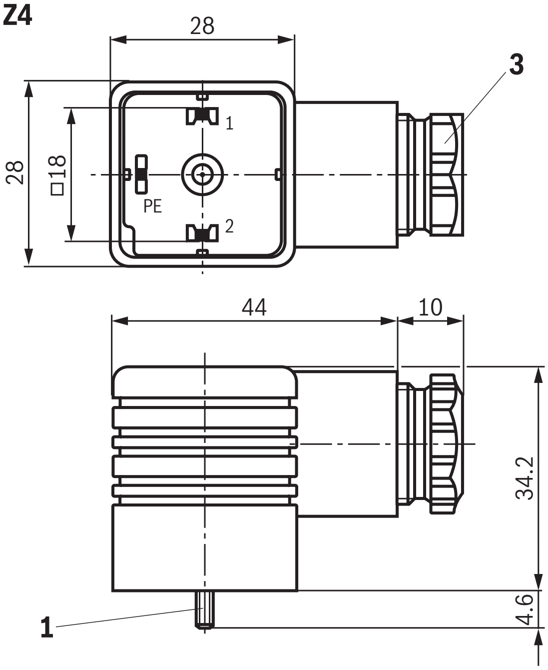
Technical data (For applications outside these parameters, please consult us!)

Mating connector				
Design				A
Ambient temperature	▶ Standard (Z4, Z45)		°C	-30 ... +90
	▶ with indicator light/rectifier (Z5L, Z55L, Z5L1, Z5L2, RZ5, RZ55, RZ5L, Z55L)		°C	-20 ... +60
Protection class according to EN 60529				IP65 (with mating connector mounted and fitted)
Indicator light (Z5L, Z55L, Z5L1, Z5L2, RZ5L, Z55L)				LED yellow
Number of poles				2 + PE
Terminal area for lines with external diameter			mm	5 ... 10
Maximum wire cross-section			mm^2	1.5 [1)]
Type of connection				Screw connection
Standard				EN 175301-803
Certification/conformity	▶ Z4			VDE, SEV, RoHS
	▶ Z45			VDE, SEV, UL, CSA, RoHS
Derating	▶ Z4, Z45	16 A	°C	max. 40°C
		9.5 A	°C	max. 60°C
	▶ Z5L, Z55L, Z5L1, Z5L2			–
	▶ RZ5, RZ55, RZ5L, Z55L	1.5 A	°C	max. 25°C
		1 A	°C	max. 60°C

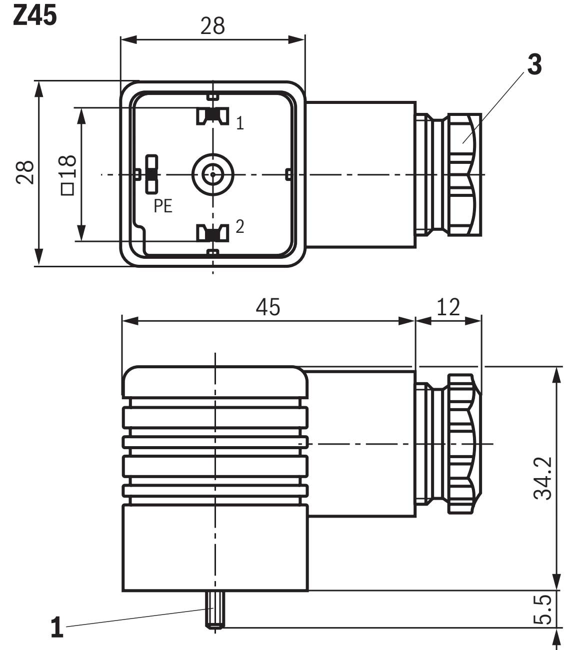
1) 2.5 mm^2 with special wire end ferrule clamp (e.g. Knipex 975314 or Weidmüller PZ 6/5)

Dimensions
(dimensions in mm)

Z4



Z45



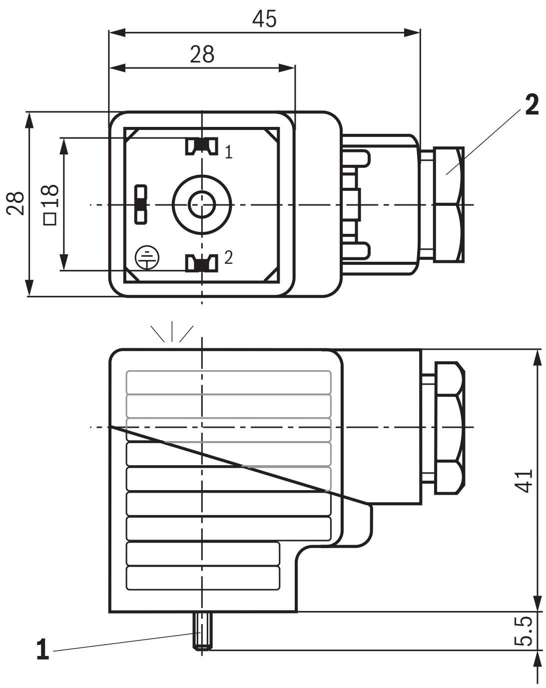
1 M3 mounting screw, tightening torque $\boldsymbol{M}_A$ = 0.5 Nm

2 Line fitting M16 x 1.5,
Tightening torque $\boldsymbol{M}_A$ = 1.5 ... 2.5 Nm (4.5 ... 10 mm)

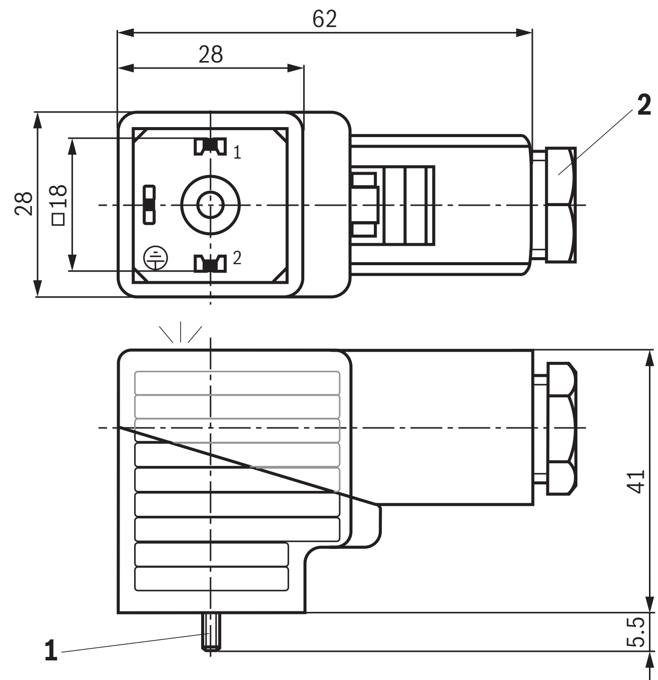
3 Line fitting NPT 1/2",
Tightening torque $\boldsymbol{M}_A$ = 2.5 ... 3.75 Nm (4 ... 11 mm)

Dimensions
(dimensions in mm)

Z5L, Z5L1, Z5L2, RZ5, RZ5L



Z55L, RZ55L, RZ55



1 M3 mounting screw, tightening torque $\boldsymbol{M}_A$ = 0.5 Nm

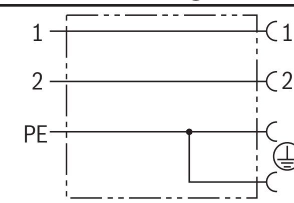
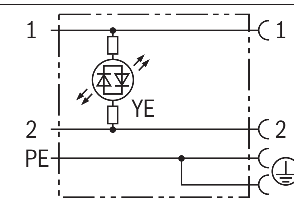
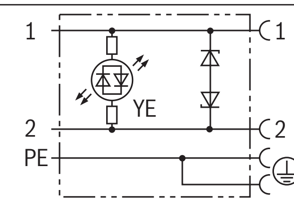
2 Line fitting M16 x 1.5,
Tightening torque $\boldsymbol{M}_A$ = 1.5 ... 2.5 Nm (5 ... 10 mm)

3 Line fitting NPT 1/2",
Tightening torque $\boldsymbol{M}_A$ = 2.5 ... 3.75 Nm (4.5 ... 10 mm)

Cable sets

For valves with "K4" device connector, 2-pole + PE, design A (large cubic connector)

Ordering code

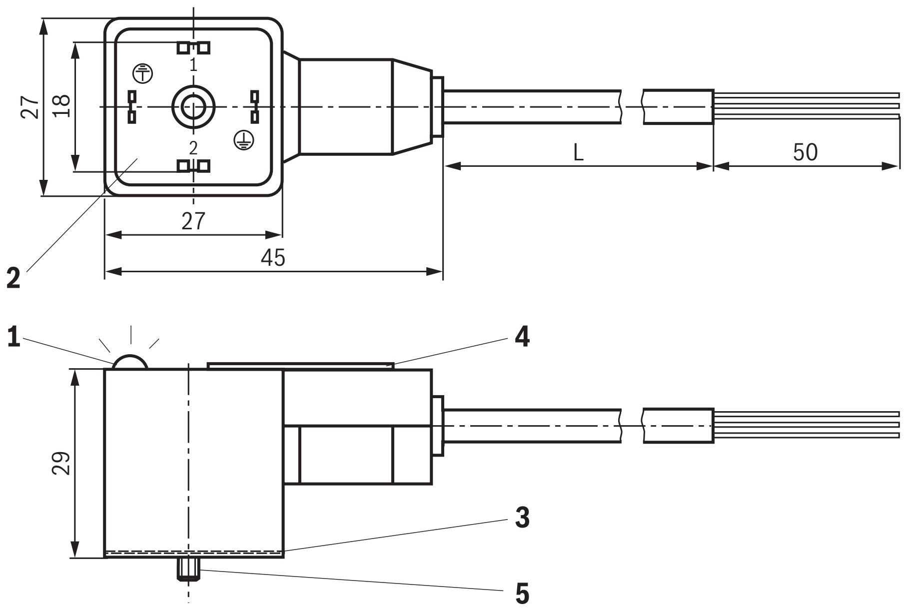
Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Color	Material number for cable length 3 m	5 m	10 m	Circuit diagram
Without circuitry, standard							
Z4	12 ... 240 V	10 A	black	R900032020	R900032014	R900217134	
With indicator light							
Z4L	24 V	4 A	black	R900032050	R900032018	R900217135	
	90 ... 130 V	1 A	black	R900032023	R900032012	R900217136	
	230 V	0.5 A	black	R900032024	R900032010	R900217137	
With indicator light and Z-diode-suppressor							
Z4L1	24 V [1]	4 A	black	R900032021	R900032015	R900217138	

[1] Switch-off voltage peak limitation to 55 V

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

Mating connector			
Design			A
Ambient temperature	▶ Fixed line installation	°C	-20 ... +80
	▶ Flexible line	°C	-5 ... +70
Protection class according to EN 60529			IP67 (with mating connector mounted and fitted)
Indicator light		Z4L...	LED yellow
Number of poles			2 + PE
Standard			EN 175301-803
Certification/conformity			RoHS
Derating			-
Connection line			
Type			Oilflex 150 PVC, gray
Wire cross-section		mm^2	3 x 1.0
Core marking	▶ PE		green/yellow
	▶ other wires		black with numbers
Line diameter		mm	approx. 7
Bending radius	▶ Fixed line installation		min. 4 x line diameter
	▶ Flexible line		min. 12.5 x line diameter

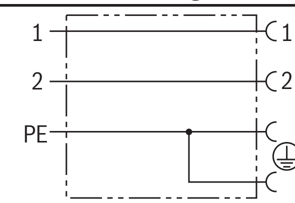
Dimensions
(dimensions in mm)



- **1** LED
- **2** Contacting 0 + 180° rotatable
- **3** Flat seal (not detachable)
- **4** Name plate
- **5** Mounting screw M3 (not detachable)
  Tightening torque M_A = 0.5 Nm
- **L** Cable length 3, 5 or 10 m (see "Ordering code")

Cable sets
For **ATEX** valves with "K4" connector, 2-pole + PE, design A (large cubic connector)

Ordering code

Short designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Color	Material number for cable length 3 m	5 m	12 m	Circuit diagram
Without circuitry, standard							
DS2513...ATEX	0 ... 230 V	4 A	black	R901200418	R901200460	R901200582	

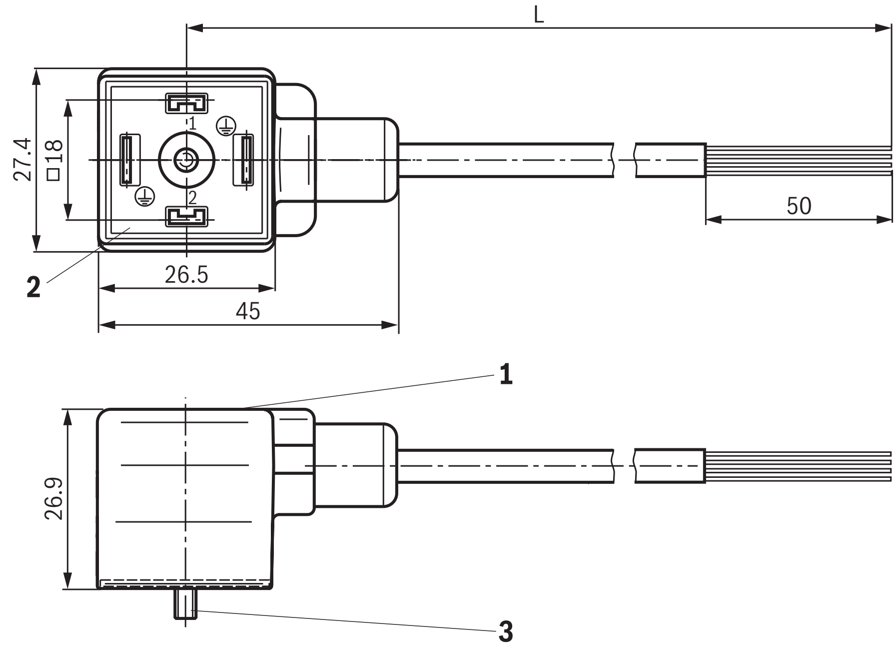
Technical data (For applications outside these parameters, please consult us!)

Mating connector			
Design			A
Ambient temperature		°C	–30 ... +90
Protection class according to EN 60529			IP65 (with mating connector mounted and fitted)
Number of poles			2 + PE
Standard			DIN EN 175301-803
Certification/conformity			ATEX cat. 3 GD, EN 60079-0, EN 60079-15, EN 60079-31
Derating			–
Impact resistance		Joule	4
Connection line			
Type			LiF9YH-11YH, PUR
Wire cross-section		mm^2	3 x 0.75
Shielding braid overlap		%	approx. 85
Core marking	▶ PE	Color	green-yellow
	▶ others	Color	brown, blue
Line diameter		mm	5.5 ... 6.5
Bending radius	▶ Flexible		min. 10 x line diameter

☞ **Notice:**
The enclosed NBR seal must be used in connection with Rexroth valves.

Enclosed:
- Labeling plate
- Additional NBR seal for use with Rexroth valves

Dimensions
(dimensions in mm)



1 Name plate

2 Contacting 0 + 180° rotatable

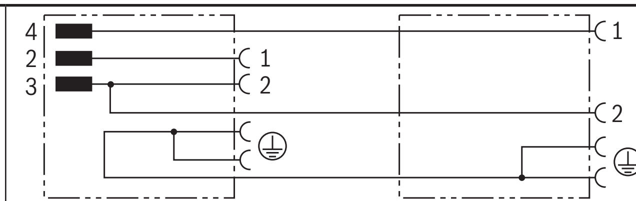
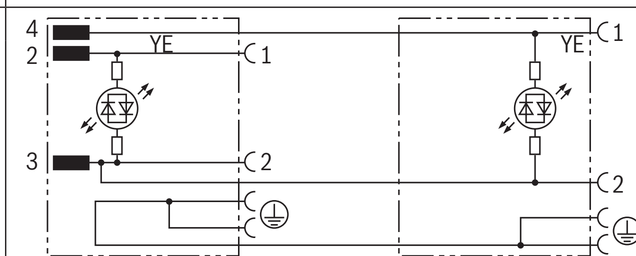
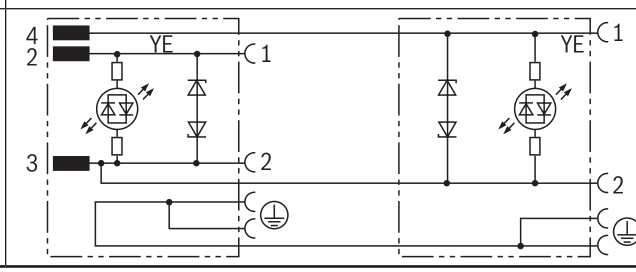
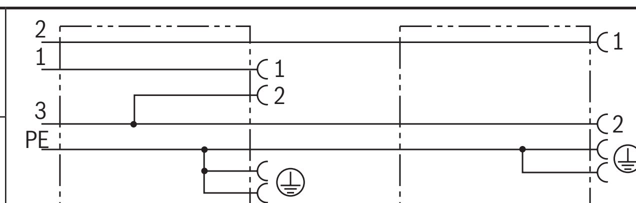
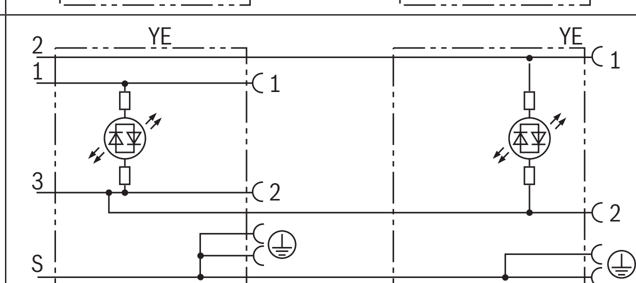
3 Mounting screw M3 (not detachable)
Tightening torque $\boldsymbol{M}_A$ = 1 Nm

L Cable length 3, 5 or 12 m (see "Ordering code")

Cable sets

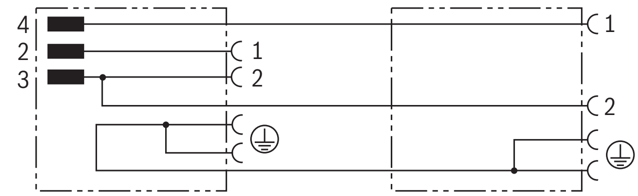
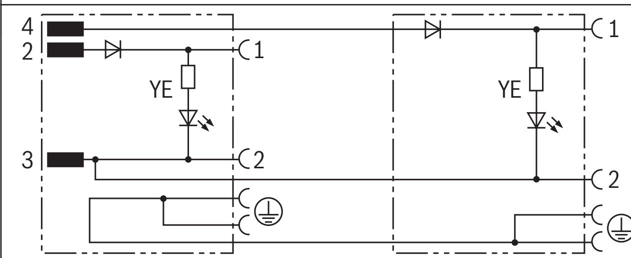
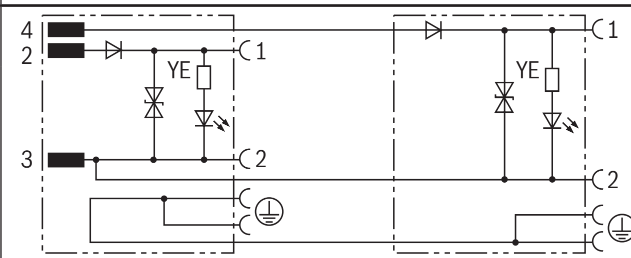
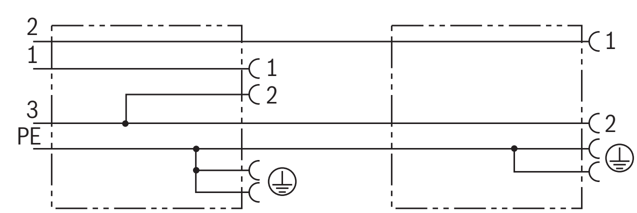
for valves with two solenoids (double mating connectors) and "K4" device connector, 2-pole + PE, design A (large cubic connector)

Ordering code: for directional valves type WE NG6, type SEC and pilot-operated on/off valves

Short designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Cable length	Material number	Circuit diagram
Cable sets with M12 x 1 connector					
Z60	24 V ±10%	4 A	–	R901207820	
With indicator light					
Z60L	24 V ±10%	4 A	–	R901207819	
With indicator light and Z-diode-suppressor					
Z60L8	24 V ±10% [1]	4 A	–	R901205511	
Cable sets with free line end					
Z61	12 ... 240 V	4 A	3 m	R901207821	
	12 ... 240 V	4 A	5 m	R901207822	
With indicator light, shielded					
Z61L	24 V	4 A	3 m	R901286065	 S = shield

[1] Switch-off voltage peak limitation to ≤50 V

Ordering code: for directional valves type WE, NG10

Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Cable length	Material number	Circuit diagram
Cable sets with M12 x 1 connector					
Z60	24 V ±10%	4 A	–	R901207825	
With indicator light					
Z60L	24 V DC only	4 A [2]	–	R901207824	
Cable sets with free line end					
With connector M12 x 1, indicator light and Z-diode-suppressor					
Z60L8	24 V [1] DC only	4 A [2]	–	R901207823	
With free line end					
Z61	230 V ±10%	4 A	3 m	R901207826	
	230 V ±10%	4 A	5 m	R901207892	

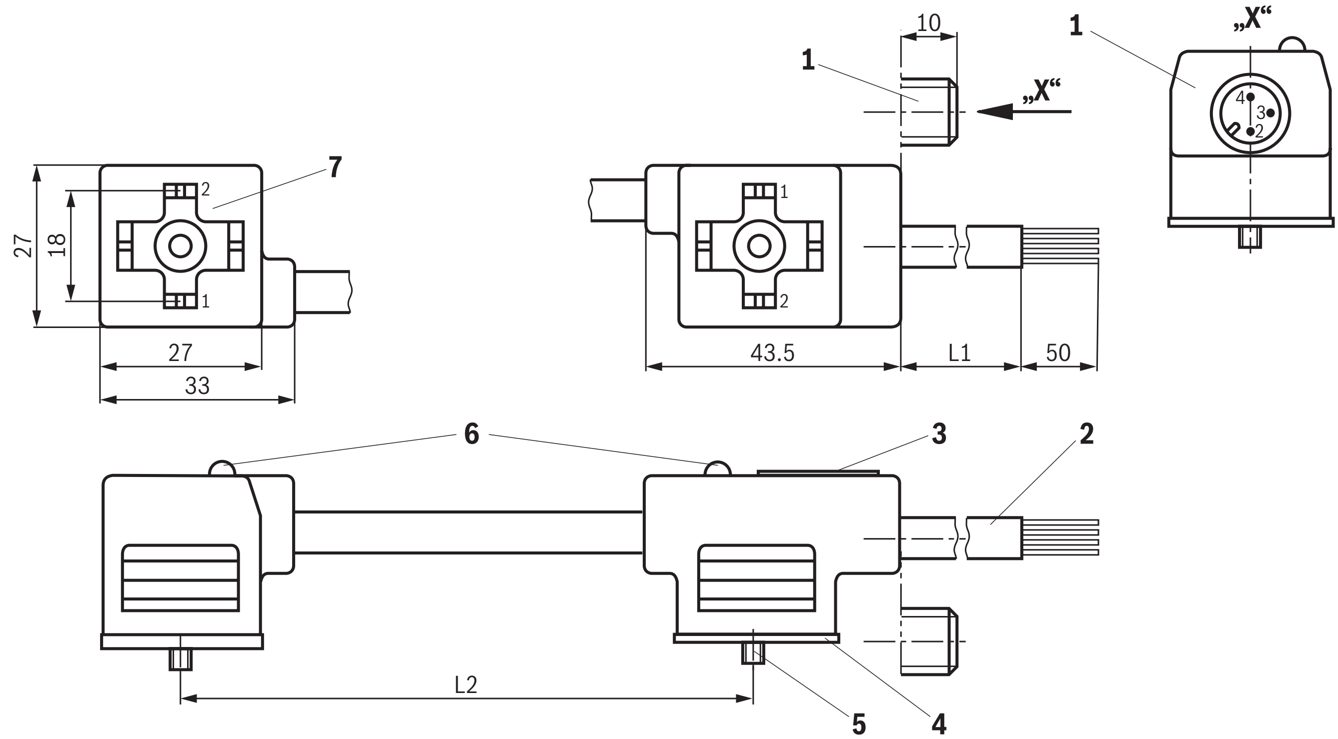
1) Switch-off voltage peak limitation to ≤50 V

2) Please observe the temperature range and/or derating (see technical data)

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

Mating connector			
Design			A
Connector			M12 metal thread, A coding, version according to 61076-2-101
Ambient temperature	▶ Fixed line installation	°C	−25 ... +80
	▶ Flexible line	°C	−20 ... +80
Protection class according to EN 60529			IP67 (with mating connector mounted and fitted)
Indicator light	▶ Z60L..., Z61L...		LED yellow
Number of poles			2 + PE
Standard			EN 175301-803A/ISO4400
Certification/conformity			RoHS, CSA
Derating	▶ Z60L, Z60L8 4 A	°C	max. +40
	2 A	°C	max. +95
Connection line			
Type			PUR-JZ black
Connection line wire cross-section		mm^2	3 x 0.75
Wire cross-section of the breakout cable	▶ Z61	mm^2	4 x 0.75
	▶ Z61L	mm^2	3 x 0.75
Shielding braid overlap at "Z61L"			min. 85%
Core marking with "Z61"	▶ PE		green/yellow
	▶ other wires		black with numbers
Line diameter	▶ Z61	mm	5.9 ±0.2
	▶ Z61L	mm	6.5 ±0.2
Bending radius	▶ Fixed line installation		min. 4 x line diameter
	▶ Flexible line		min. 10 x line diameter

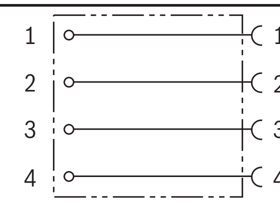
Dimensions
(dimensions in mm)



1 Version "Z60..."
2 Version "Z61..."
3 Name plate
4 Flat seal (not detachable)
5 M3 mounting screw (not detachable), tightening torque
M_A = 0.4 Nm
6 LED (versions "Z60L" and "Z61L" only)
7 Contacting 0° (PE bridged)
L1 Cable length 3 or 5 m (see "Ordering code")
L2 113 mm (for NG6 valves), 135 mm (for NG10 valves)

Mating connectors
For valves with connector, 4-pole (small cubic connector)

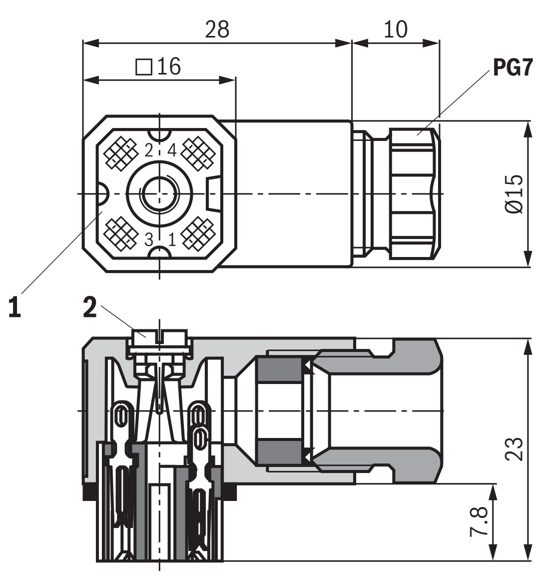
Ordering code

Short designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Color	Line fitting	Material number	Circuit diagram
G4W1F	50 V	6 A	black	PG 7	R900023126	

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

Mating connector		
Design		without designation (see "Dimensions")
Ambient temperature	°C	–40 ... +90
Protection class according to EN 60529		IP65 (with mating connector mounted and fitted)
Number of poles		4
Terminal area for line diameter	mm	4 ... 7.5
Maximum wire cross-section	mm²	0.14 ... 0.5
Type of connection		Soldered joint
Standard		DIN VDE0627/IEC61984
Certification/conformity		VDE
Derating		–

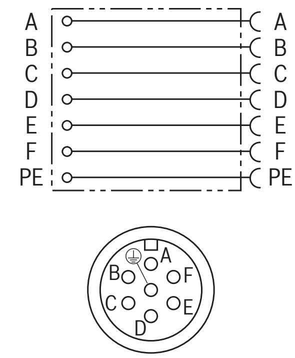
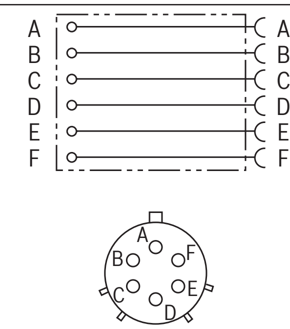
Dimensions
(dimensions in mm)



1 Contacting (rotatable)
2 M3 x 20 mounting screw, tightening torque M_A = 0.5 Nm

Mating connectors
For valves with round connector, 6-pole + PE and 6-pole

Ordering code

Short designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Line fitting	Material number	Circuit diagram
6-pole + PE, plastic version					
7PZ31...K	24 V	3 A [1]	PG 11	R900021267	
6-pole + PE, metal version					
7PZ31...M	24 V	3 A	PG 11	R900223890	
6-pole, metal version, connection compatible with VG 95328 (for servo valves)					
6P KPTC6	24 V	3 A	SW16 clamping nut	R901043330	

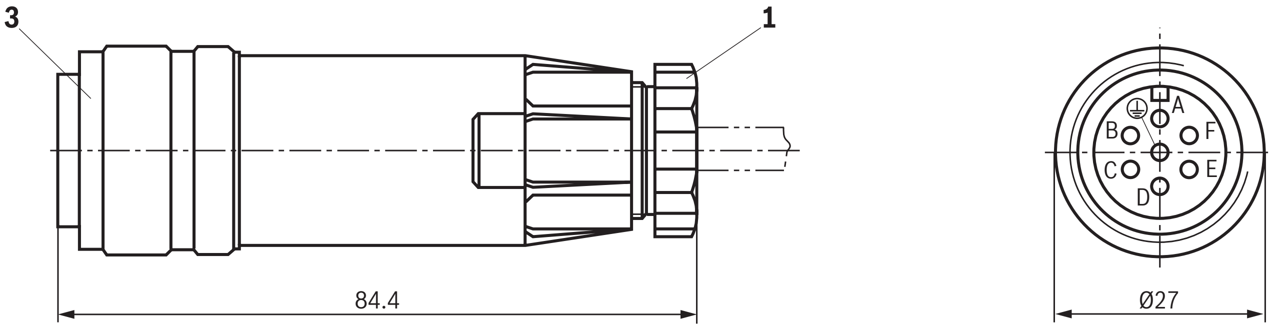
[1] Please observe the temperature range and/or derating (see "Technical data").

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

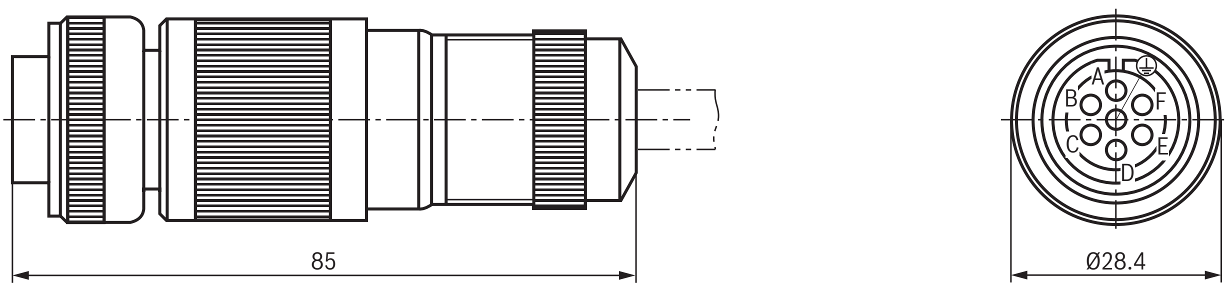
Mating connector				
Design				without designation (see "Dimensions")
Ambient temperature	▶ 7PZ31...		°C	–40 ... +100
	▶ 6P KPTC6		°C	–55 ... +125
Protection class according to EN 60529	▶ 7PZ31...K			IP67 (with mating connector mounted and fitted)
	▶ 7PZ31...M, 6P KPTC6			IP65 (with mating connector mounted and fitted)
Number of poles				6 + PE
Terminal area for line diameter	▶ 7PZ31...K		mm	6.5 ... 11 mm
	▶ 7PZ31...M		mm	9.0 ... 12.5 mm
	▶ 6P KPTC6		mm	4.5 ... 7 mm
Maximum Wire cross-section	▶ 7PZ31...		mm^2	0.5 ... 1.5 mm^2
	▶ 6P KPTC6		mm^2	0.4 ... 0.75 mm^2
Type of connection	▶ 7PZ31...			Soldered joint
	▶ 6P KPTC6			Crimping connection (crimping contact included in the scope of delivery)
Standard	▶ 7PZ31..., 6P KPTC6			EN175201-804
	▶ 7PZ31...			DIN43563
Certification/conformity	▶ 7PZ31...			DIN 43563
	▶ 6P KPTC6			RoHS
Derating	▶ 7PZ31...K	6 A at 0.5 mm^2	°C	max. +70
		9 A at 1.5 mm^2	°C	max. +70

Dimensions
(dimensions in mm)

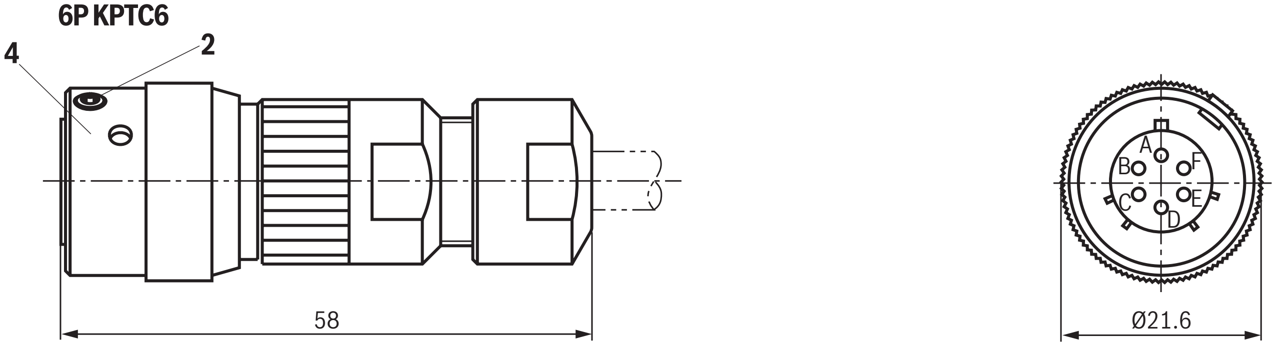
7PZ31...K



7PZ31...M



6P KPTC6



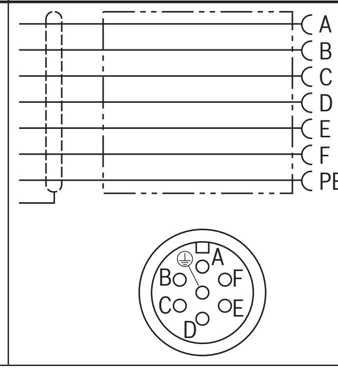
1 PG11 line fitting
2 Fuse: M3 grub screw, tightening torque M_A = 0.3 Nm
3 7/8" - 20 UNEF 2B
4 9/16" - 24 UNEF 2B

Accessories for "6P KPTC6" (not included in scope of delivery)

ITT Cannon	Order number
Crimping pliers	M22520/1-01
Crimping insert	M22520/1-02
Installation tool	CiTG-20A
Installation pliers	CIT-KPTC-20

Cable sets
For valves with round connector, 6-pole + PE

Ordering code

Short designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Color	Material number for cable length			Circuit diagram
				3 m	5 m	10 m	
6-pole + PE, plastic version, shielded							
7P Z31 BF6 ...	< 50 V	8.5 A	black	R901420483	R901420491	R901420496	

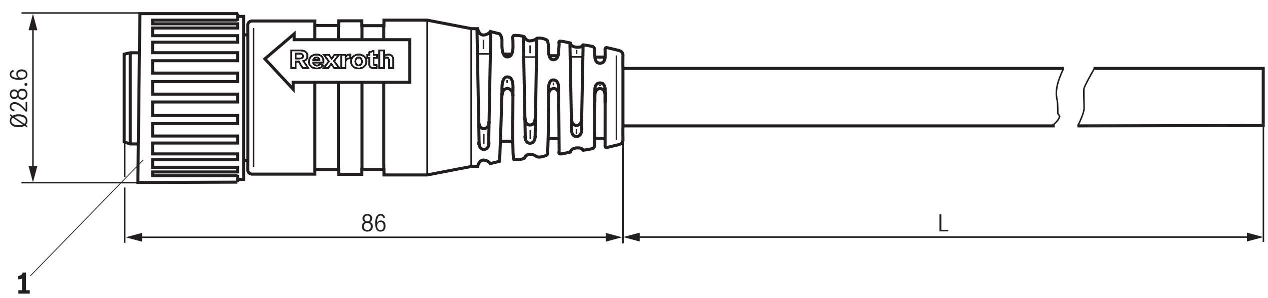
Technical data (For applications outside these parameters, please consult us!)

Mating connector			
Design			without designation (see "Dimensions")
Ambient temperature	▶ Fixed installation	°C	–40 ... +80
	▶ Flexible	°C	–25 ... +80
Protection class according to EN 60529			IP65 (with mating connector mounted and fitted) IP67 (with mating connector mounted and fitted)
Number of poles			6 + PE
Standard			MIL-C 5015, VG 95 342
Certification/conformity			RoHS, cULus (UL2238)
Derating [1]	8.5 A	°C	max. +40
	4 A	°C	max. +65
Connection line			
Type			Li9Y11CVY, black, halogen-free, flame-resistant, shielded, drag chain-compatible
Wire cross-section		mm^2	7 x 0.75
Shielding braid overlap		%	85 ±5%
Core marking	PE	Color	green-yellow
	others	Color	A: brown, B: yellow, C: green, D: blue, E: gray, F: white
Line diameter		mm	9 ±0.2
Bending radius	Fixed installation		min. 5 x line diameter
	Flexible		min. 10 x line diameter

[1] Maximum admissible current dependent on ambient temperature; with rising ambient temperature, the admissible current declines linearly.

Dimensions
(dimensions in mm)

7P Z31 BF3 ...

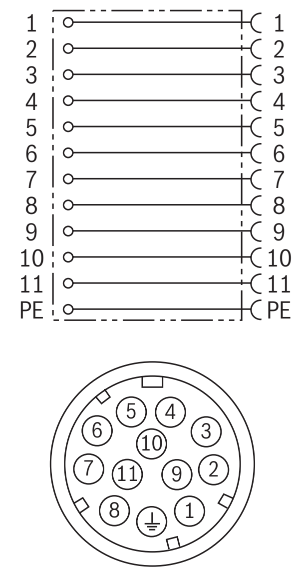


1 Coupling nut, tightening torque $\boldsymbol{M}_A$=1 ... 1.5 Nm

Mating connectors
For valves with round connector, 11-pole + PE

Ordering code

Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Line fitting	Material number	Circuit diagram
11-pole + PE, metal version, shielded					
12PN11 ... EMC	24 V	3 A	PG 13.5	R901268000	
11-pole + PE, plastic version					
12PN11	24 V	3 A	PG 16	R900752278	
11-pole + PE, plastic version, two cable outlets					
12PN11...2XD8	24 V	3 A	PG 16	R900884671	



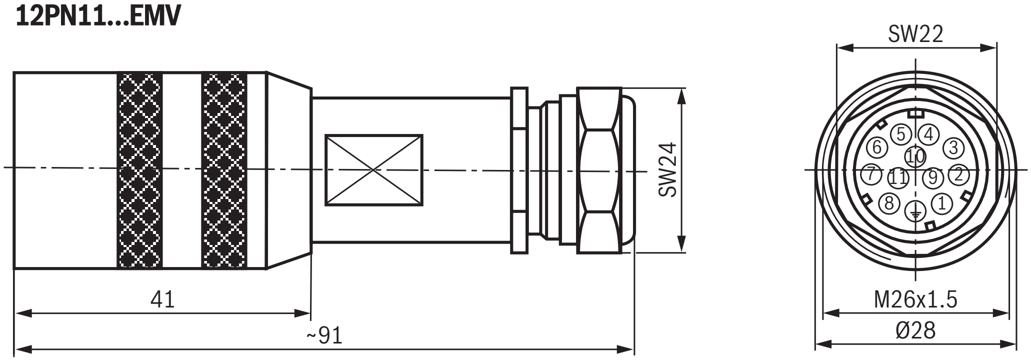
Technical data (For applications outside these parameters, please consult us!)

Mating connector			
Design			without designation (see "Dimensions")
Ambient temperature		°C	–40 ... +90
Protection class according to EN 60529			IP65 (with mating connector mounted and fitted)
Number of poles			11 + PE
Terminal area for line diameter	▶ 12PN11 ... EMC	mm	12 ... 15
	▶ 12PN11	mm	12 ... 14
	▶ 12PN11...2XD8	mm	2 x 6 ... 8
Maximum Wire cross-section	▶ 12PN11, 12PN11... EMC	mm^2	0.5 ... 1.5
	▶ 12PN11...2XD8	mm^2	3 x 0.5 ... 1.5
		mm^2	9 x 0.14 ... 0.5
Type of connection			Crimping connection
Crimping contacts	▶ 12PN11	mm	12 x 0.5 ... 1.5 (included in the scope of delivery)
	▶ 12PN11...2XD8	mm	3 x 0.5 ... 1.5 (included in the scope of delivery)
		mm	9 x 0.14 ... 0.5 (included in the scope of delivery)
Standard			DIN 43651
Certification/conformity			–
Derating			–

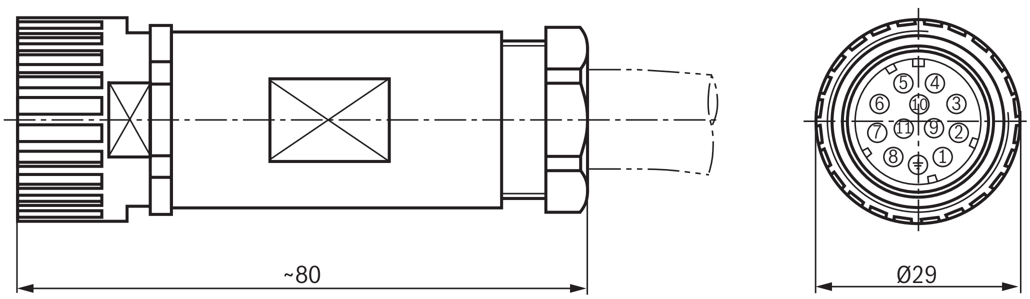
Dimensions

(dimensions in mm)

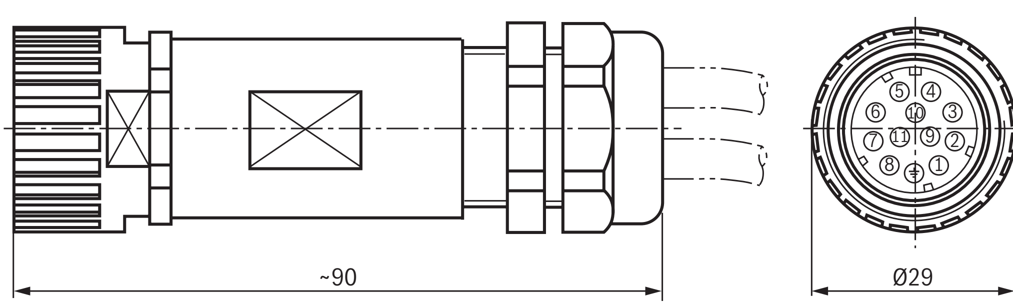
12PN11...EMV



12PN11



12PN11

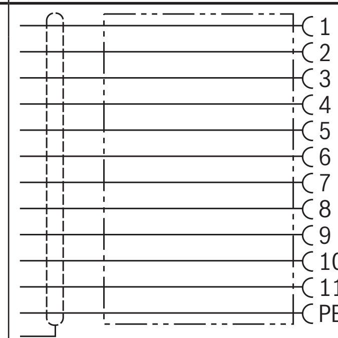
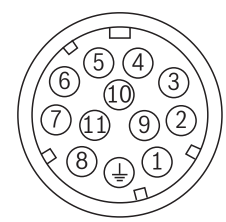


Accessories (not included in the scope of delivery)

Hirschmann	Order number
Crimping pliers	XCZ 0701
Ejection tool	XWA 164
Installation tool	CiTG-20A
Installation pliers	CIT-KPTC-20

Cable sets
For valves with round connector, 11-pole + PE

Ordering code

Short designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Color	Material number for cable length 5 m	Material number for cable length 20 m	Circuit diagram
11-pole + PE, metal version, shielded						
12PN11REFS EMC...BG	25 VAC 50 VDC	5 A	gray	R901272854	R901272852	 

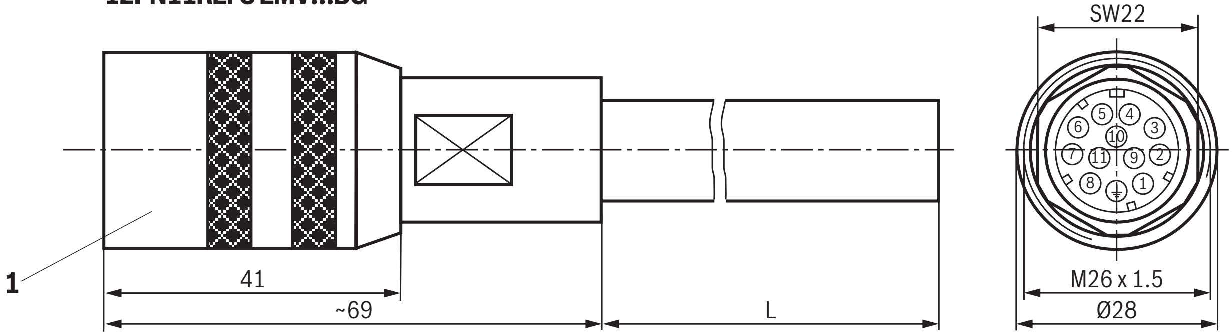
Technical data (For applications outside these parameters, please consult us!)

Mating connector			
Design			without designation (see "Dimensions")
Ambient temperature	▶ Fixed installation	°C	−40 ... +80
	▶ Flexible	°C	−20 ... +80
Protection class according to EN 60529			IP65 (with mating connector mounted and fitted)
Number of poles			11 + PE
Standard			DIN 43651
Certification/conformity			RoHS
Derating			–
Connection line			
Type			F-C-PURö-JZ, coolant-resistant, Cu-shielded, increased oil resistance
Wire cross-section		mm^2	12 x 0.75
Shielding braid overlap		%	85
Core marking	▶ PE	Color	green-yellow
	▶ others	Color	Black wires with serial white numbers
Line diameter		mm	approx. 10.5
Bending radius	▶ Fixed installation		min. 5 x line diameter
	▶ Flexible		min. 10 x line diameter

Dimensions

(dimensions in mm)

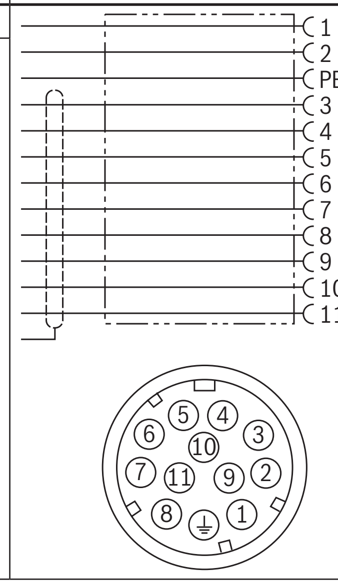
12PN11REFS EMV...BG



1 Coupling nut, tightening torque $\boldsymbol{M}_A$=1 ... 1.5 Nm

Cable sets
For valves with round connector, 11-pole + PE

Ordering code

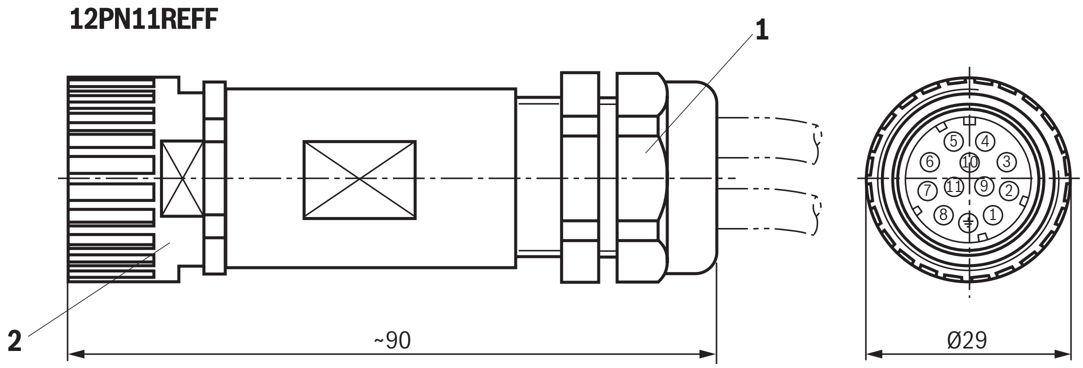
Short designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Color	Material number for cable length 5 m	Material number for cable length 20 m	Shield	Circuit diagram
11-pole + PE, plastic version, shielded							
12PN11REFF 2X...	< 50 V	5 A	black	R900032356	R900860399	only data line 10 x 0.14 mm² shielded	

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

Mating connector			
Design			without designation (see "Dimensions")
Ambient temperature	▶ Fixed installation	°C	–40 ... +80
	▶ Flexible	°C	–5 ... +70
Protection class according to EN 60529			IP65 (with mating connector mounted and fitted)
Number of poles			11 + PE
Standard			DIN 43651
Certification/conformity			–
Derating			–
Connection line			
Type	▶ Data line:		PVC, Unitronic LiYCY, shielded, flame-resistant according to IEC 60332-1-2
	▶ Control line		PVC, classic 110, flame-resistant according to IEC 60332-1-2
Wire cross-section	▶ Data line:	mm^2	10 x 0.14
	▶ Control line	mm^2	3 x 1.0
Core marking	▶ PE	Color	green-yellow
	▶ others	Color	Black wires with serial white numbers 1: 1; 2: 2; 3: white; 4: yellow; 5: green; 6: violet; 7: pink; 8: red; 9: brown; 10: black; 11: blue; n.c.: gray
Line diameter	▶ Data line:	mm	approx. 6.1
	▶ Control line	mm	approx. 6
Bending radius	▶ Fixed installation		min. 6 x line diameter
	▶ Flexible		min. 15 x line diameter

Dimensions

(dimensions in mm)



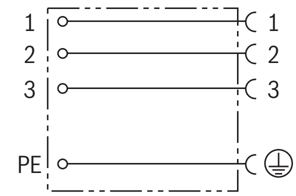
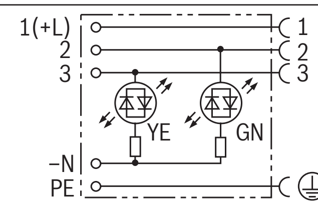
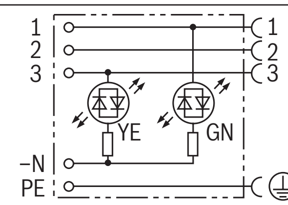
1 Line fitting, tightening torque $\boldsymbol{M}_A$ =1 ... 1.5 Nm

2 Coupling nut, tightening torque $\boldsymbol{M}_A$ =0.8 ... 1.0 Nm

Mating connectors

For mechanical pressure switches with "K14" connector, 3-pole + PE, design A (large cubic connector)

Ordering code

Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Color	Line fitting	Material number	Circuit diagram
Without circuitry, standard						
Z14	250 V	16 A [1]	black	M16 x 1.5	R901017012	
With indicator lights at connections 2 and 3						
Z15L	6...14 V	4 A	black	M16 x 1.5	R901017030	
	16...36 V	4 A	black	M16 x 1.5	R901017048	
	36...60 V	4 A	black	M16 x 1.5	R901017032	
	90...130 V	4 A	black	M16 x 1.5	R901017035	
	180...240 V	4 A	black	M16 x 1.5	R901017037	
With indicator lights at connections 1 and 3						
Z15L6	16...36 V	4 A	black	M16 x 1.5	R901017040	

[1] Please observe the temperature range and/or derating (see "Technical data").

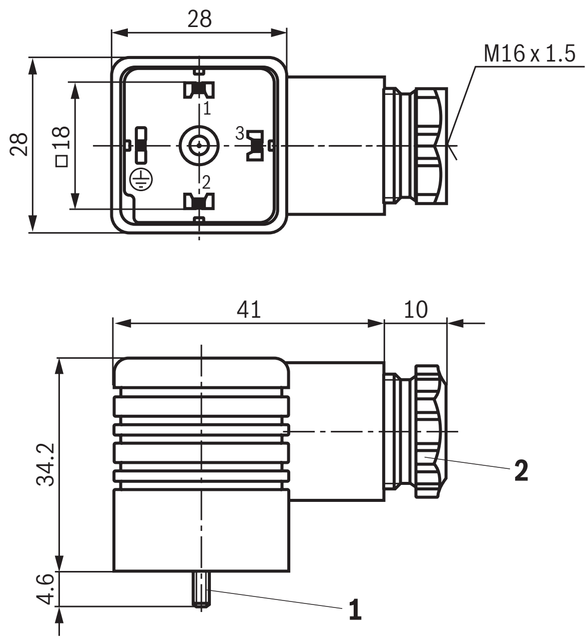
Technical data (For applications outside these parameters, please consult us!)

Mating connector				
Design				A
Ambient temperature	▶ Standard		°C	–40 ... +90
	▶ with indicator light		°C	–20 ... +60
Protection class according to EN 60529				IP65 (with mating connector mounted and fitted)
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 line diameter			mm	5 ... 10
Maximum wire cross-section			mm^2	1.5 with wire end ferrule
Type of connection				Screw connection
Standard				DIN EN175301-803A
Certification/conformity	▶ Z14			RoHS, VDE, SEV
	▶ Z15..			RoHS
Derating	▶ Z14	16 A	°C	max. +40
		9.5 A	°C	max. +60

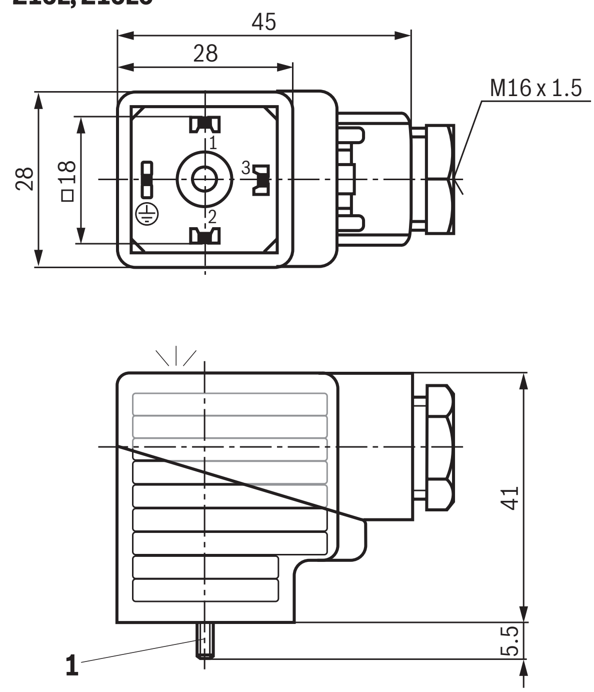
Dimensions

(dimensions in mm)

Z14



Z15L, Z15L6



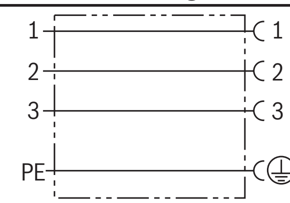
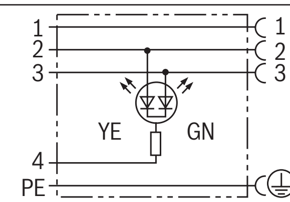
1 M3 mounting screw, tightening torque M_A = 0.5 Nm

2 M16 x 1.5 line fitting, tightening torque M_A = 0.15 ... 0.25 Nm

Cable sets

For mechanical pressure switches with "K14" connector, 3-pole + PE, design A (large cubic connector)

Ordering code

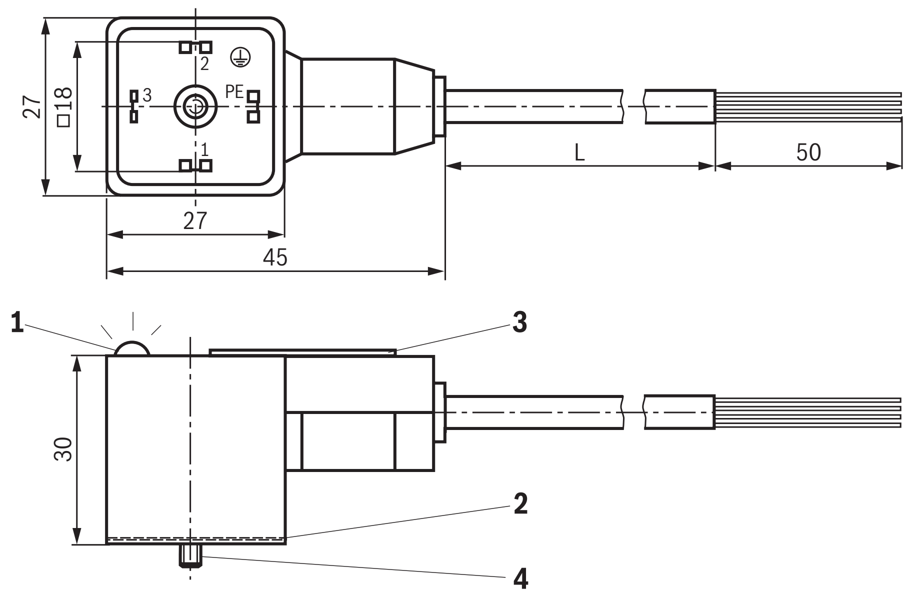
Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Color	Material number for cable length 5 m	Material number for cable length 10 m	Circuit diagram
Without circuitry, standard						
Z14	12 ... 240 V	10 A	black	R900058528	R900217139	
With indicator light						
Z14L	24 VDC	4 A	black	R900210635	R900217140	

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

Mating connector				
Design				A
Ambient temperature			°C	–5 ... +70
Protection class according to EN 60529				IP67 (with mating connector mounted and fitted)
Indicator light	▶ Z14L			Connection 2 LED green, connection 3 LED yellow
Number of poles				3 + PE
Standard				EN 175301-803/ISO4400
Certification/conformity				–
Derating				–
Connection line				
Type				PUR-JZ, gray
Wire cross-section	▶ Z14		mm^2	4 x 0.75
	▶ Z14L		mm^2	5 x 0.5
Core marking	▶ PE			green/yellow
	▶ other wires			black with numbers
Line diameter			mm	approx. 7
Bending radius	▶ Z14	Fixed line installation		min. 15 x line diameter
		Flexible line		min. 20 x line diameter
	▶ Z14L	Fixed line installation		min. 12.5 x line diameter
		Flexible line		min. 17.5 x line diameter

Dimensions

(dimensions in mm)



1 LED

2 Flat seal (not detachable)

3 Name plate

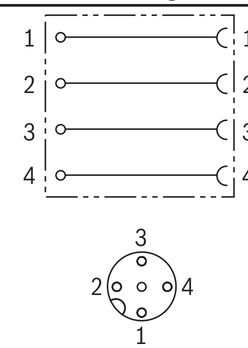
4 Mounting screw M3 (not detachable)
Tightening torque M_A = 0.5 Nm

L Cable length 5 or 10 m (see "Ordering code")

Mating connectors
For sensors and valves with "K24", "K35" and "K72" connectors, 4-pole

Ordering code

Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Color	Line fitting	Material number	Circuit diagram
M12 x 1, straight						
4PZ24	250 V	4 A	black	PG 7	R900773042	
	250 V	4 A	black	PG 9	R900031155	
M12 x 1, angled						
4PZ24	250 V	4 A	black	PG 7	R900779509	
	250 V	3 A	black	PG 9	R900082899	



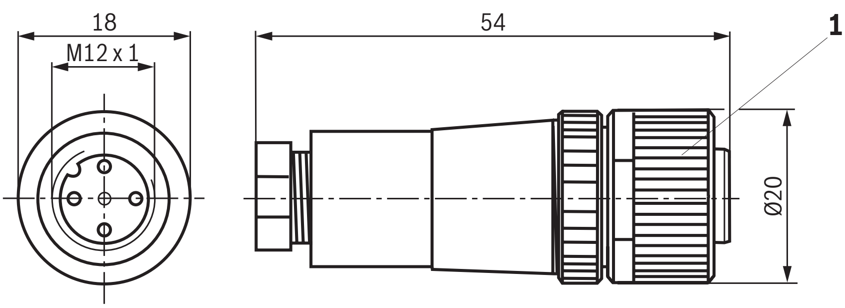
Technical data (For applications outside these parameters, please consult us!)

Mating connector			
Design			M12, coding A
Ambient temperature		°C	–25 … +85
Protection class according to EN 60529	▶ 4PZ24		IP67 (with mating connector mounted and fitted)
Number of poles			4
Terminal area for line diameter	▶ 4PZ24, PG 7	mm	4 … 6
	▶ 4PZ24, PG 9	mm	6 … 8
Maximum wire cross-section		mm^2	4 x 0.75
Type of connection			Screw connection
Standard			–
Certification/conformity	▶ 4PZ24, straight		UL, CSA
Derating			–

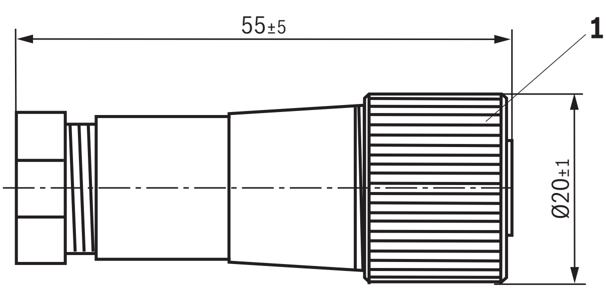
Dimensions

(dimensions in mm)

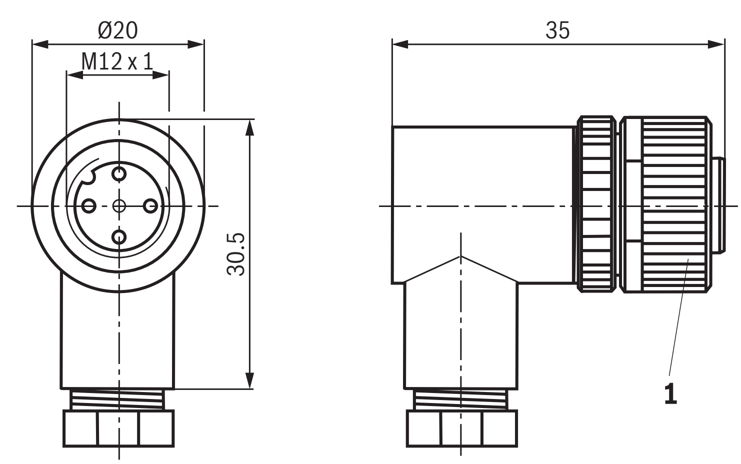
M12 x 1, straight, 4PZ24, PG 7



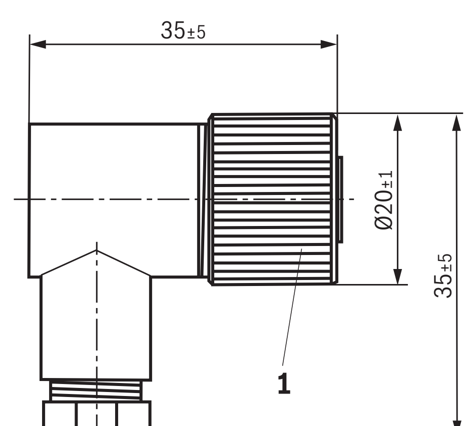
M12 x 1, straight, 4PZ24, PG 9



M12 x 1, angled, 4PZ24, PG 7



M12 x 1, angled, 4PZ24, PG 9

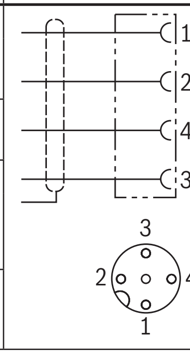


1 Coupling nut, tightening torque $\boldsymbol{M}_{A}$ = 0.6 Nm

Cable sets

For sensors and valves with "K24", "K35" and "K72" connectors, 4-pole

Ordering code

Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Color	Material number for cable length				Shield	Circuit diagram
				2 m	3 m	5 m	10 m		
M12 x 1, straight									
4PM12	250	4	black	R900773031	–	R900779498		Cable shielded	
4PZ24 [1]	250	40	black	–	R900064381	–	R913005668	shielded	
M12 x 1, angled									
4PM12	250	4	black	R900779504	–	R900779503		Cable shielded	
4PZ24 [1]	250	40	black	–	–	–	R913011722	shielded	

[1] For version with UL certification up to 30 V.

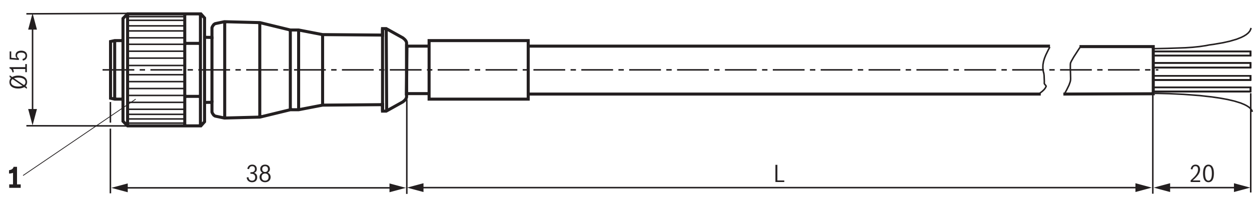
Technical data (For applications outside these parameters, please consult us!)

Mating connector			
Design			M12, coding A
Ambient temperature		°C	-25 ... +85
Protection class according to EN 60529			IP67 (with mating connector mounted and fitted)
Number of poles			4
Standard			–
Certification/conformity			UL, CSA
Derating			–
Connection line			
Type			PUR-OB, black with approval: UL, CSA
Wire cross-section		mm^2	4 x 0.34
Core marking			1: brown; 2: white; 3: blue; 4: black
Line diameter	▶ 4PM12	mm	5.9
	▶ 4PZ24	mm	5.2
Bending radius	▶ Fixed line installation		min. 10 x line diameter
	▶ Flexible line		min. 15 x line diameter

Dimensions

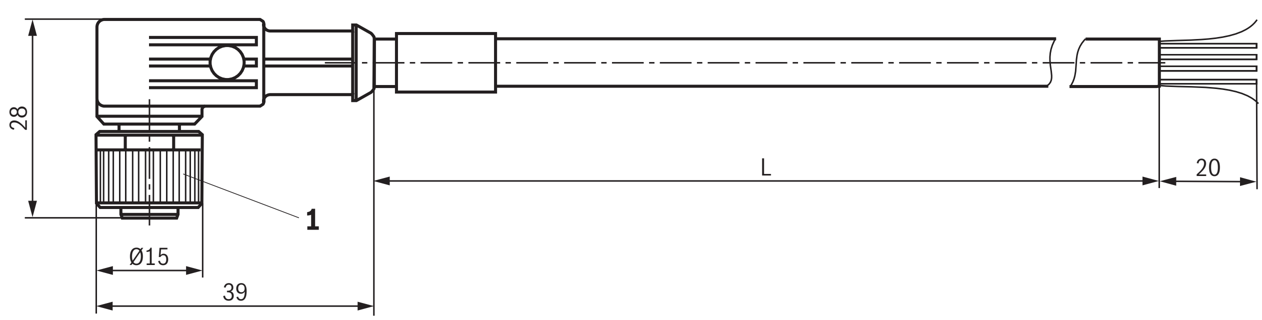
(dimensions in mm)

M12 x 1, straight, 4PM12 and 4PZ24



L in m	**Material number**
2	R900773031
3	R900064381
5	R900779498
10	R913005668

M12 x 1, angled, 4PM12 and 4PZ24

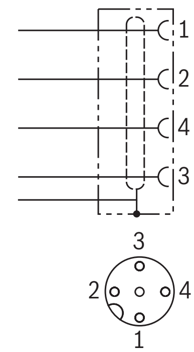


L in m	**Material number**
2	R900779504
5	R900779503
10	R913005668

1 Coupling nut, tightening torque $\boldsymbol{M}_A$ = 0.6 Nm

Cable sets
For sensors and valves with "K24", "K35" and "K72" connectors, 4-pole

Ordering code

Designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Color	Material number	Shield	Circuit diagram
M12 x 1, straight					Cable and mating connector shielded	
CABLE SET VT-SSPA1-1X/M12/1/V00	60 V	4 A	black	R901241656		
M12 x 1, angled						
CABLE SET VT-SSPA1-1X/M12/2/V00	60 V	4 A	black	R901241651		

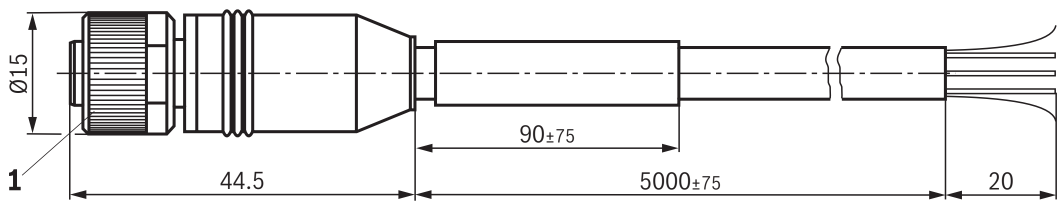
Technical data (For applications outside these parameters, please consult us!)

Mating connector			
Design			M12
Ambient temperature	▶ Fixed installation	°C	–25 ... +80
	▶ Flexible	°C	–5 ... +80
Protection class according to EN 60529			IP67 (with mating connector mounted and fitted)
Number of poles			4
Standard			–
Certification/conformity			CSA, RoHS
Derating			–
Connection line			
Type			PVC, black
Wire cross-section		mm^2	4 x 0.75
Line diameter		mm	5.9 ±5%
Bending radius	▶ Fixed installation		min. 5 x line diameter
	▶ Flexible		min. 10 x line diameter

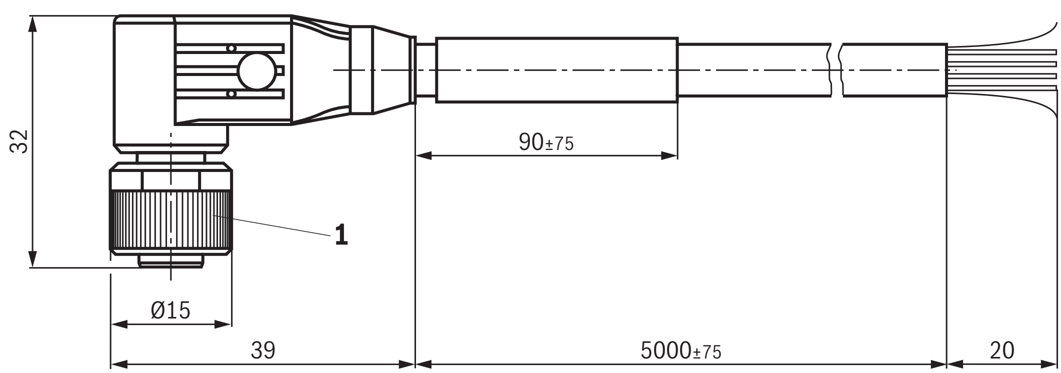
Dimensions

(dimensions in mm)

M12 x 1, straight, CABLE SET VT-SSPA1-1X/M12/1/V00



M12 x 1, angled, CABLE SET VT-SSPA1-1X/M12/2/V00

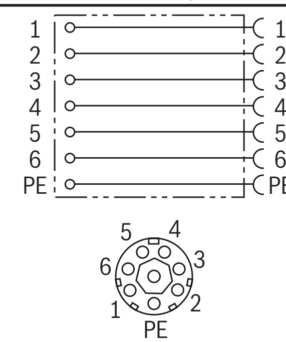


1 Coupling nut, tightening torque $\boldsymbol{M}_A$ = 0.6 Nm

Mating connectors

For mechanical position switches, mechanical pressure switches and valves with central connection with "K6" and "DK6L" connectors

Ordering code

Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Color	Line fitting	Material number	Circuit diagram
6-pole + PE						
7PZ6	250 V	10 A	gray	PG 11	R900002803	

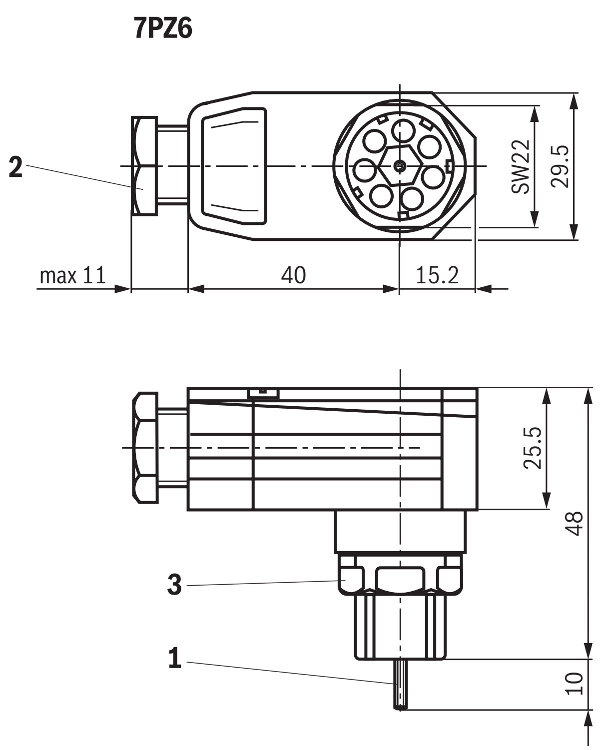
Technical data (For applications outside these parameters, please consult us!)

Mating connector			
Design			without designation (see "Dimensions")
Ambient temperature		°C	–40 ... +90
Protection class according to EN 60529			IP65 (with mating connector mounted and fitted)
Number of poles			6 + PE
Terminal area for line diameter		mm	7 ... 9
Maximum wire cross-section		mm^2	1.5
Type of connection			Crimping connection (crimping contact included in the scope of delivery)
Standard			DIN EN175201-804
Certification/conformity			–
Derating [1]	▶ 10 A	°C	max. +40
	▶ 4 A	°C	max. +65

[1] Maximum admissible current dependent on ambient temperature; with rising ambient temperature, the admissible current declines linearly.

Dimensions

(dimensions in mm)



1 Mounting screw M3,
Tightening torque $\boldsymbol{M}_A$ = 0.5 ... 0.6 Nm

2 PG11 line fitting,
Tightening torque $\boldsymbol{M}_A$ = 2.5 ... 3.8 Nm

3 Coupling nut SW22,
Tightening torque $\boldsymbol{M}_A$ = 1.0 ... 1.5 Nm

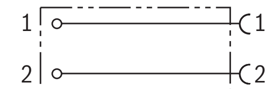
Accessories (not included in the scope of delivery)

Hirschmann	**Order number**
Crimping pliers	XCZ 0701
Ejection tool	XWA 164

Mating connectors

For directional valves with "C4" and "C4Z" device connectors (AMP Junior Timer)

Ordering code

Short designation	Voltage (V) DC / AC *U*	Current (A) I_{max}	Color	Braided wire external diameter	Material number	Circuit diagram
2P JUNIOR D2 2	10 ... 32 V	5 A	black	2.2 ... 3.0 mm	R901022127	
2P D1.2 JUNIOR	10 ... 32 V	5 A	black	1.2 ... 2.1 mm	R900313533	

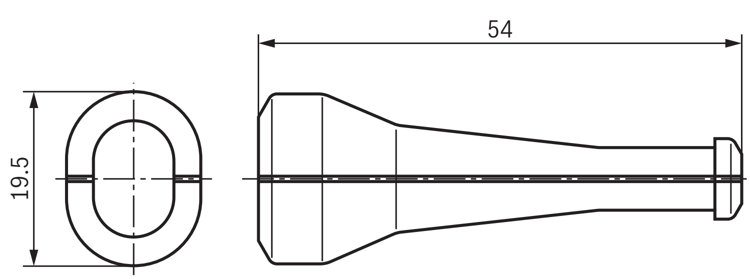
Technical data (For applications outside these parameters, please consult us!)

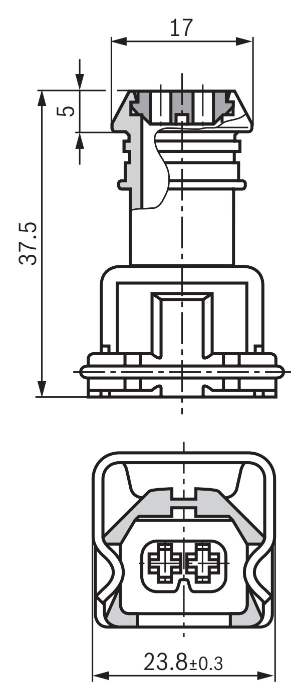
Mating connector		
Design		without designation (see "Dimensions")
Ambient temperature range	°C	–20 ... +125
Protection class according to EN 60529		IP66A (with mating connector mounted and fitted)
Number of poles		2
Terminal area for line diameter	mm	5.2 ... 7
Maximum wire cross-section	mm²	0.5 ... 1
Type of connection		Crimping connection
Standard		–
Certification/conformity		–
Derating		–
As-delivered state		1 connector housing, 2 contacts, 2 individual conductor sealings, 1 rubber bushing in package, not mounted

Dimensions

(dimensions in mm)

Housing AMP; type 282189-1



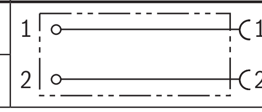


Accessories (not included in the scope of delivery)

TYCO	Order number
Basic pliers	Type 539635-1
Die	Type 539737-2

Mating connectors
For directional valves with "K40" device connector (Deutsch plug)

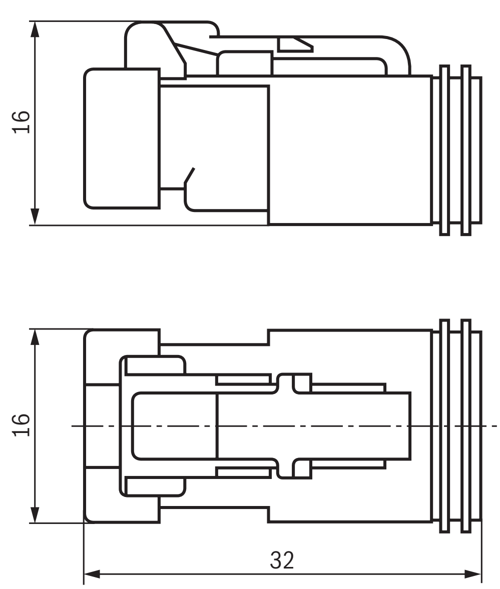
Ordering code

Short designation	Voltage (V) DC / AC U	Current (A) I_{max}	Color	Wire cross-section	Material number	Circuit diagram
2P DT06 K40AWG14	10 ... 32 V	5 A	gray	AWG 14-16	R900733451	
2P DT06 K40AWG16	10 ... 32 V	5 A	gray	AWG 16-18	R901017847	

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

Mating connector			
Design			without designation (see "Dimensions")
Connector housing			DT06-2S-CE01
Ambient temperature range		°C	–20 ... +125
Protection class according to EN 60529			IP69K (with mating connector mounted and fitted)
Number of poles			2
Terminal area for line diameter		mm	1.35 ... 3.05
Maximum wire cross-section	▶ AWG 14-16	mm²	1.3 ... 2.08
	▶ AWG 16-18	mm²	0.83 ... 1.3
Type of connection			Crimping connection
Standard			–
Certification/conformity			–
Derating			–
As-delivered state			1 connector housing, 2 contacts, 1 locking wedge in package, not mounted

Dimensions
(dimensions in mm)



Accessories (not included in the scope of delivery)

Deutsch	Order number
Crimping tool	Type HDT-4800

Further information

- Electronics for industrial applications — Operating instructions 07602-B
- Selection of filters
- Information on available spare parts

RE 30581
Edition: 2020-09

rexroth
A Bosch Company

Bluetooth® dongle

Type VT-ZBT-1

- Component series 1X
- Suitable for valve types with bracket for Bluetooth® interface

Features

- Bluetooth® Low Energy
- UART valve interface
- Fast and easy assembly and disassembly
- State display on the LED display
- Connection with Android or iOS via the "easy2connect app" (available in the Google Play Store and Apple App Store)
- Country-specific certification

Contents

Ordering code

01		02
VT-ZBT-1	**–**	**1X**

01	Bluetooth® dongle	**VT–ZBT-1**
02	Component series 10 … 19 (10 … 19: unchanged technical data and connections)	**1X**

Material no.: R901505294

Technical data

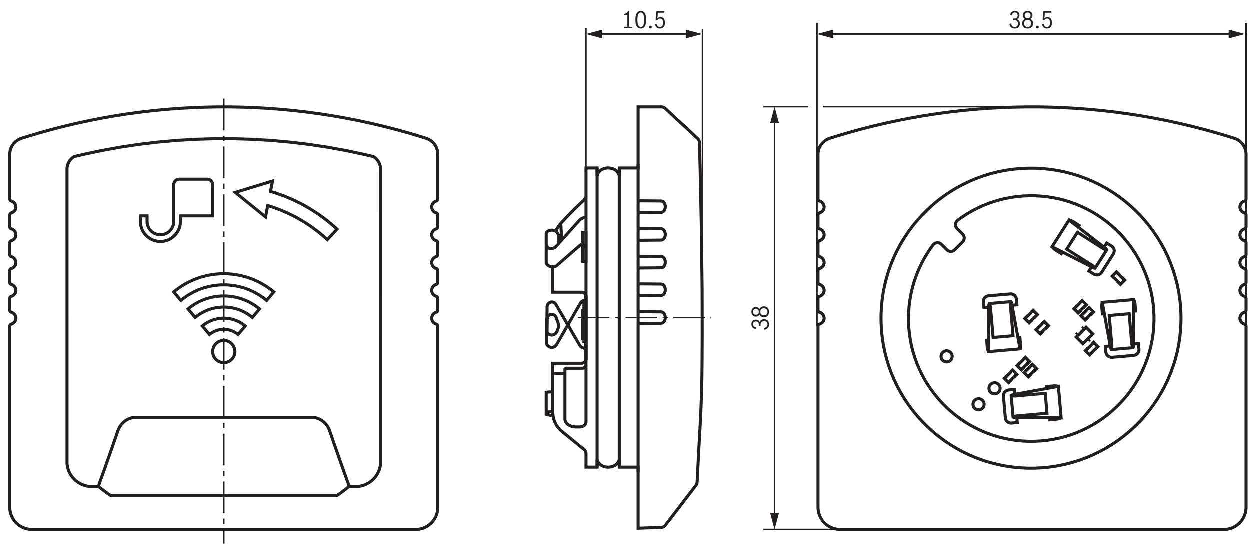
General		
Weight	g	10
Ambient temperature range	°C	–40 … +85
Storage temperature range	°C	–20 … +80

Electric		
Supply voltage	VDC	3.3
Frequency range	GHz	2.360 … 2.500
Maximum current consumption	A	0.1 (power supply via valve electronics)
Transmission output	dBm	+4
Receiver sensitivity	dBm	–96
Data transmission		Bluetooth® Low Energy

State display

Device state	**Diagnosis LED**			
	0.5 s	0.5 s	0.5 s	0.5 s
De-energized	OFF	OFF	OFF	OFF
No error	green	green	green	green
No sync between dongle and valve (not connected)	green	red	green	red
Bluetooth® connection activated	blue	blue	blue	blue
Identification of the device via Bluetooth®	blue	–	blue	–

Dimensions
(dimensions in mm)



Certification

Title	Document number
EU declaration of conformity	DCTC-31000-175
China certificate	DCTC-31000-181
India certificate	DCTC-31000-182
South Korea certificate	DCTC-31000-183
US certificate	DCTC-31000-184

Safety instructions

IT security
The operation of installations, systems and machines basically requires the implementation of a holistic IT security concept which is state-of-the-art in terms of technology.
Accordingly, Bosch Rexroth products and their properties must be considered as components of installations, systems and machines for their holistic IT security concept.

Unless otherwise documented, Bosch Rexroth products are designed for operation in local, physically and logically secured networks with access restrictions for authorized persons, and they are not classified according to IEC 62443-4-2.

Further information

- Proportional pressure reducing valve — Data sheet 29283
- Bluetooth® dongle — Operating instructions 30581-B

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