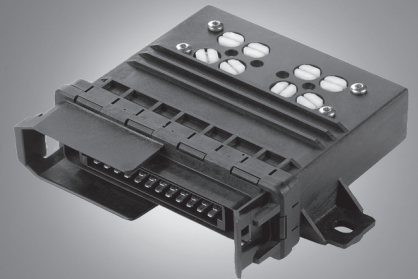


# Analog Amplifier RA

**RE 95 230/03.06 1/12**replaces: RE 95 022  
RE 95 023  
RE 29 874  
RE 29 875

## Technical Data Sheet

Series 10  
for control of hydraulic components

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### Features

- The electronic analog amplifier activates up to two proportional solenoids and a switching function:
- Optional interlock of actuation for proportional solenoids
  - Supply voltage for external setpoint potentiometer
  - Monitoring of setpoint potentiometer for cable breakage and short circuit
  - Externally actuated switching output
  - Error output
  - Separately adjustable ramp times
  - Overload protection, overvoltage protection, conditional short-circuit protection
  - Separately adjustable  $I_{\min}$  and  $I_{\max}$  for every solenoid
  - Externally adjustable PWM frequency

## Ordering Code

	RA		/	1	0
<b>Type</b>	Analog amplifier				
	RA				
<b>Design</b>	1. digit = no. of proportional outputs		2-1		
	2. digit = no. of switching outputs		1-0		
<b>Series</b>					1
<b>Index</b>					0

## Material Numbers

Analog amplifier RA				Material number
RA	2-1	/	10	R902091800
RA	1-0	/	10	R902091900

## Mating Connector

Order designation for Bosch 25-pin mating connector consisting of:

Designation	Material number
Handle shell, angled	Bosch 1 928 401 013
Contact carrier	Bosch 1 928 400 952
Screw for contact carrier	Bosch 1 928 491 082
Flat sealing ring for screws	Bosch 1 928 300 198
Locking piece, lilac color	Bosch 1 928 401 566
Clamping collar, large	Bosch 1 928 400 890
2 screws for clamping collar	Bosch 1 928 491 151
Sleeve, angled, 18 mm	Bosch 1 928 300 284
Seal for contact carrier	Bosch 1 928 300 191
Clamping band for sleeve	Bosch 1 928 401 280
25 contacts	AMP 927775-3

The mating connector is not included in supply. It is available from Rexroth with material number R902603063.

## Description

The analog amplifier activates up to two proportional solenoids. The specified control voltage is processed in the amplifier as an input variable. The analog amplifier provides a regulated electric current as an output variable for actuation of proportional solenoids.

Amplifier outputs for proportional solenoids are activated through a deadband of approx. 5% of the maximum setpoint voltage at the input, i.e. the minimum output current is applied. The level of this minimum output current can be adjusted separately for both proportional outputs using a trimming potentiometer. If the setpoint voltage at the input is increased, the output current for each respective proportional solenoid increases linearly.

The maximum output current can also be separately adjusted using a trimming potentiometer for the outputs. The gradient of the output curve is influenced by this.

The analog amplifier contains time ramp functions which can be used to adjust the period in which the output current can be adapted to match a modified setpoint. The ramp time adjustment range extends from 100 ms to 10 s. The time ramp functions can be adjusted using trimming potentiometers for each solenoid.

## Service Options

The RA1–0/10 analog amplifier is used to actuate an individual proportional solenoid.

The RA2–1/10 analog amplifier can be used to actuate two proportional solenoids in a single device (for example a toggling axial piston unit or a valve section with separate actuation of the proportional solenoids) or to actuate two devices independently of each other (for example two individual axial piston units or valves).

# Technical Data

		RA1-0	RA2-1
<b>Nominal voltage</b> Residual ripple (DIN 40839, Section 1) Supply voltage, perm. range	12 and 24 V max. $\pm 2$ V 10 ... 32 V	✓	✓
<b>Current consumption</b> without load with load, max.	mA A	150 3	150 6
<b>Fuse</b> internal: external: for switching and proportional solenoid outputs and for electronics	A T	– 3	– 7.5
<b>Potentiometer supply voltage</b> (for setpoint potentiometer 2 ... 5 k $\Omega$ )	0 V, 4.0 V 7.2 V ... 8.4 V (depending on load)	✓	✓
<b>Voltage input (differential amplifier)</b> (Setpoint voltage)	4.0 V	1	2
<b>Switch input</b>	> 5.0 V	–	1
<b>Proportional solenoid outputs (PWM)</b> Current range Pulse frequency	0 ... 2.3 A 100, 200 or 350 Hz	1	2
<b>Switch output (MOSFET)</b>	max. 1 A	–	1
<b>LED indicators:</b> red green yellow yellow	Error (error indication) Power (operating indicator) I1 (PWM current Channel 1) I2 (PWM current Channel 2)	✓ ✓ ✓ –	✓ ✓ ✓ ✓
<b>Error detection</b> Potentiometer: for broken wires and short circuit (with exception of wiper) Voltage supply: undervoltage monitoring		✓ ✓	✓ ✓
<b>Resistance to short circuits</b> To supply voltage and ground for all inputs and outputs (Exception: potentiometer supply 4.0 V to supply voltage)		✓	✓
<b>Reverse polarity protection</b> Supply/Battery		✓	✓
<b>Electromagnetic compatibility</b> Spurious interference (motor vehicles directive 95/54/EG)  Line-bound interference (ISO 7637-1/-2/-3)  Load Dump	100 V <sub>ms</sub> /m; (Details on request)  Values on request  70 V	✓	✓
<b>Max. power loss</b>	W at 32 V	4	4
<b>Operating temperature, case</b>	–40 ... 85°C	✓	✓
<b>Storage temperature, case</b>	–40 ... 85°C	✓	✓
<b>Vibration resistance</b> Sinusoidal vibration (IEC 60086-2-6)  Random vibration (IEC 60086-2-36)	10 g / 57 ... 2000 Hz 20 cycles per axis  0.05 g <sup>2</sup> / Hz 30 min per axis	✓	✓

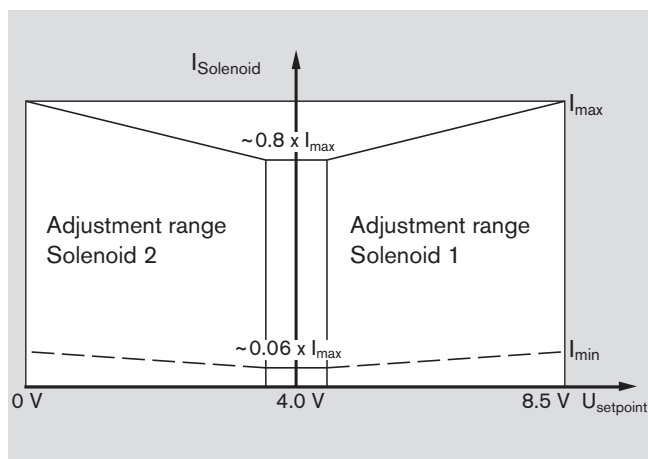
# Technical Data

		RA1-0	RA2-1
<b>Shock resistance:</b> Transport shock (IEC 60068-2-27)	15 g / 11 ms 3x in each direction (pos./neg.) and in each axis	✓	✓
	Continuous shock (IEC 60068-2-29)	25 g / 6 ms 1000x in each direction (pos./neg.) and in each axis	
<b>Resistance to moisture</b> (IEC 60068-2-30Db; Variant II)	90% (+25°C to +55°C)	✓	✓
<b>Resistance to salt spray</b> (IEC 60068-2-11)	72 h, 35°C, 5% NaCl	✓	✓
<b>Type of protection (DIN / EN 60529):</b> with mounted mating connector <sup>1)</sup>	IP65	✓	✓
<b>Case material</b>	Plastic injection molding PA66 GF 35	✓	✓
<b>Mass</b>	approx. kg	0.3	0.3
<b>Outer dimensions</b>	Length (in mm)	108	108
	Width (in mm)	135	135
	Height (in mm)	42	42

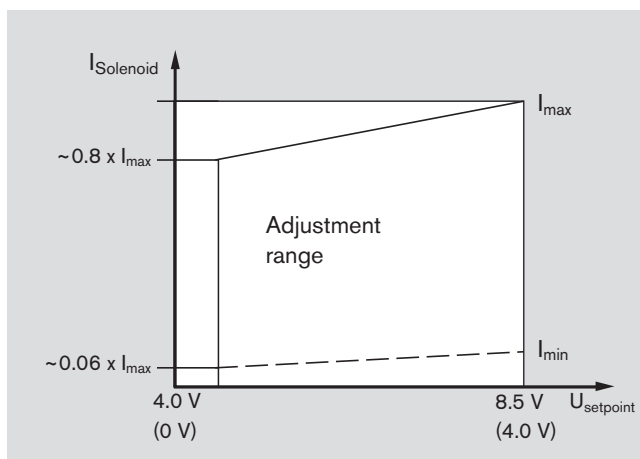
<sup>1)</sup> where the connecting cable is laid suitably, see "Installation position"

## Curves

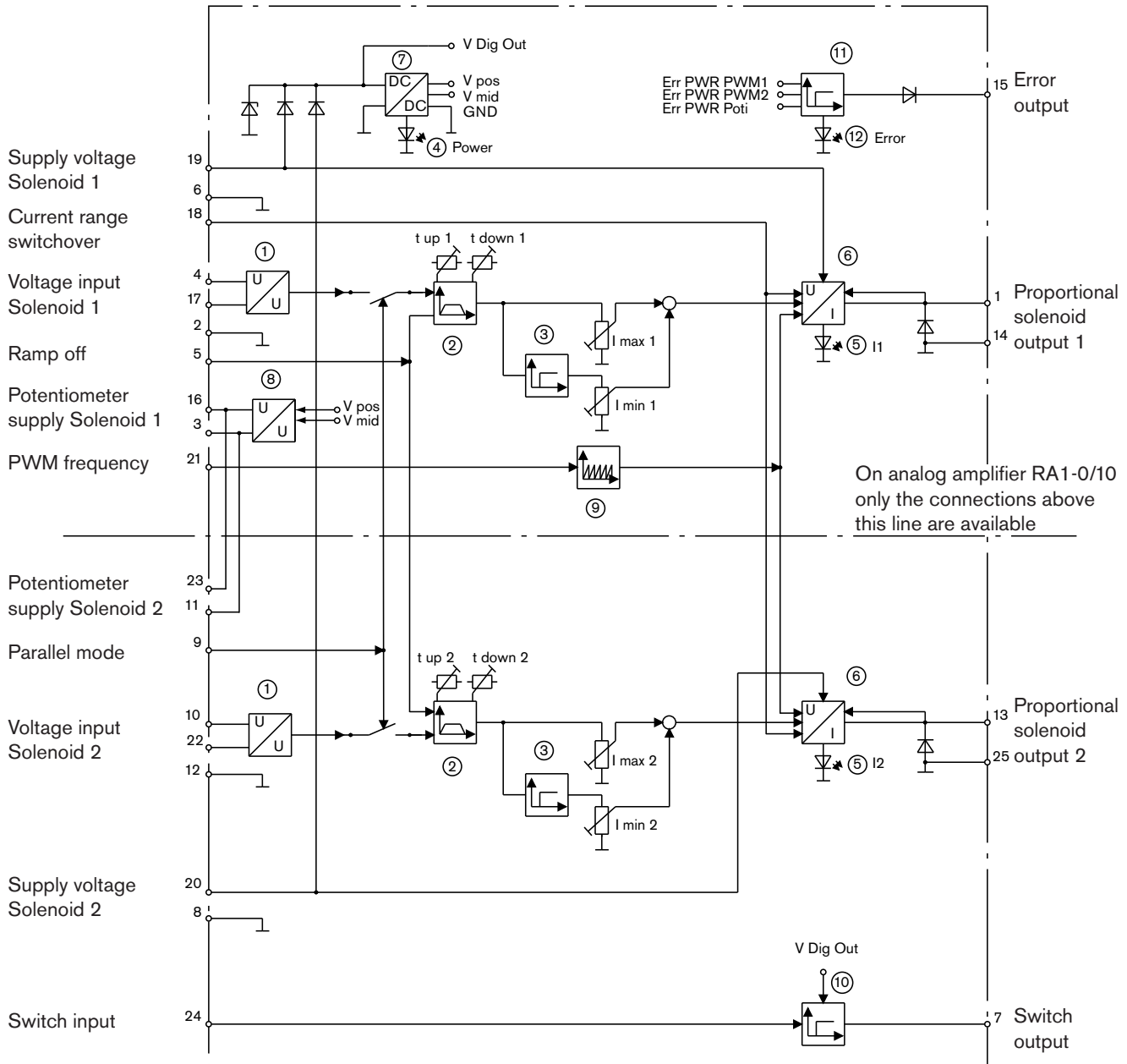
**For 2 solenoids with interlocked actuation (toggling mode)**



**For 2 solenoids with independent actuation (parallel mode)**



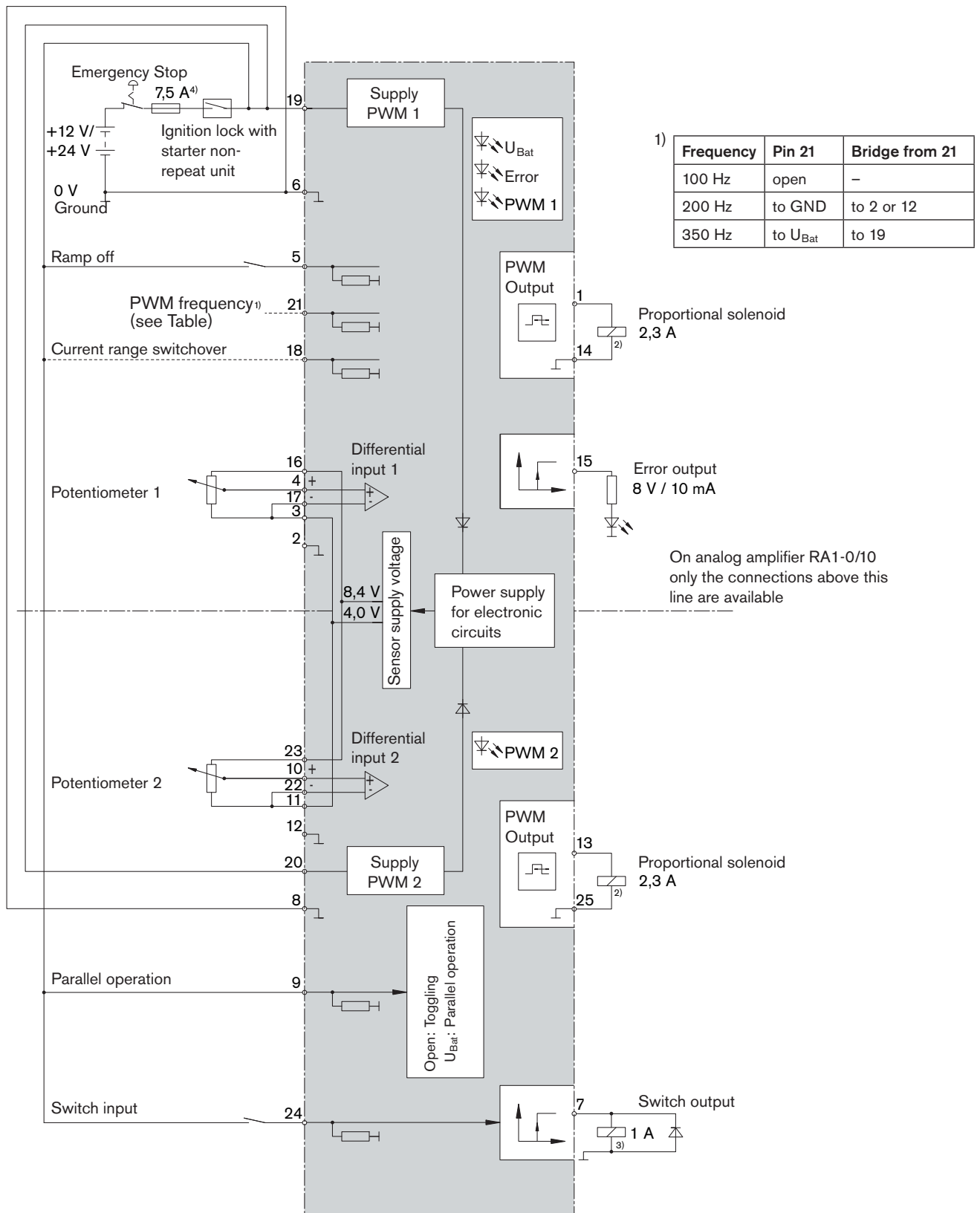
# Block Circuit Diagram



Key	
①	Differential amplifier
②	Time ramp function
③	Reference voltage generation
④	LED operational status (Power)
⑤	LED displaying PWM current (I1 or I2)
⑥	PWM output stage

Key	
⑦	Internal voltage supply
⑧	Sensor or potentiometer supply
⑨	Clock-pulse generator
⑩	Switch output
⑪	Error detection
⑫	LED displaying error (Error)

# Terminal Connection



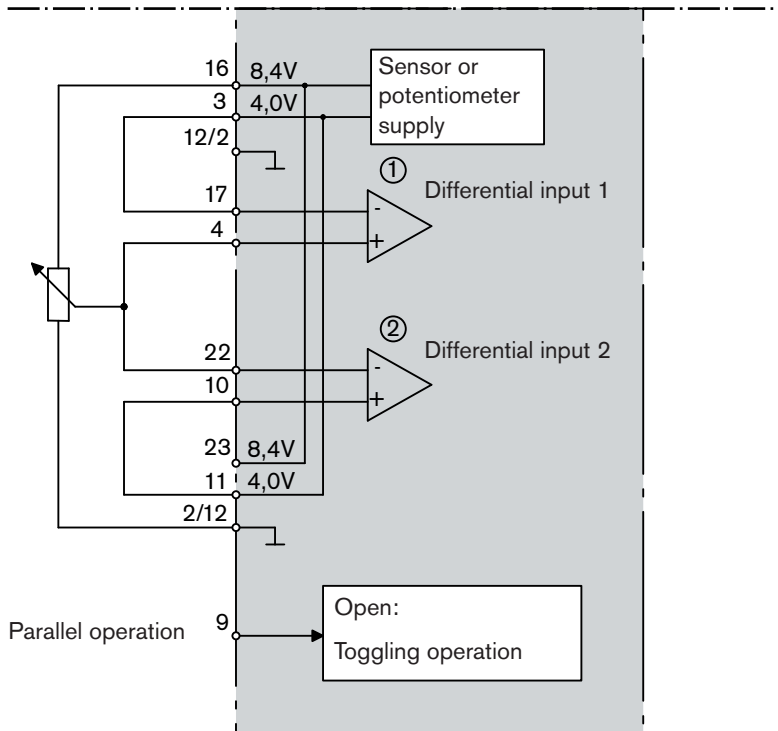
- 1) 3 connection options to switch over the PWM dither frequency (see Table): 100 Hz, 200 Hz, 350 Hz if required
- 2) Ground connection from solenoid return lead to battery (or chassis) possible
- 3) Separate ground connections from solenoid return lead to battery (or chassis) required; in the case of an inductive load, a freewheeling diode must be connected
- 4) 3A for RA1-0

# Terminal Connection Variant

(Additional terminal assignments available on request.)

## Toggling operation with single potentiometer

If the analog amplifier RA2-1/10 is used in the toggling operation with just one potentiometer, then the potentiometer must be connected as per the following section:

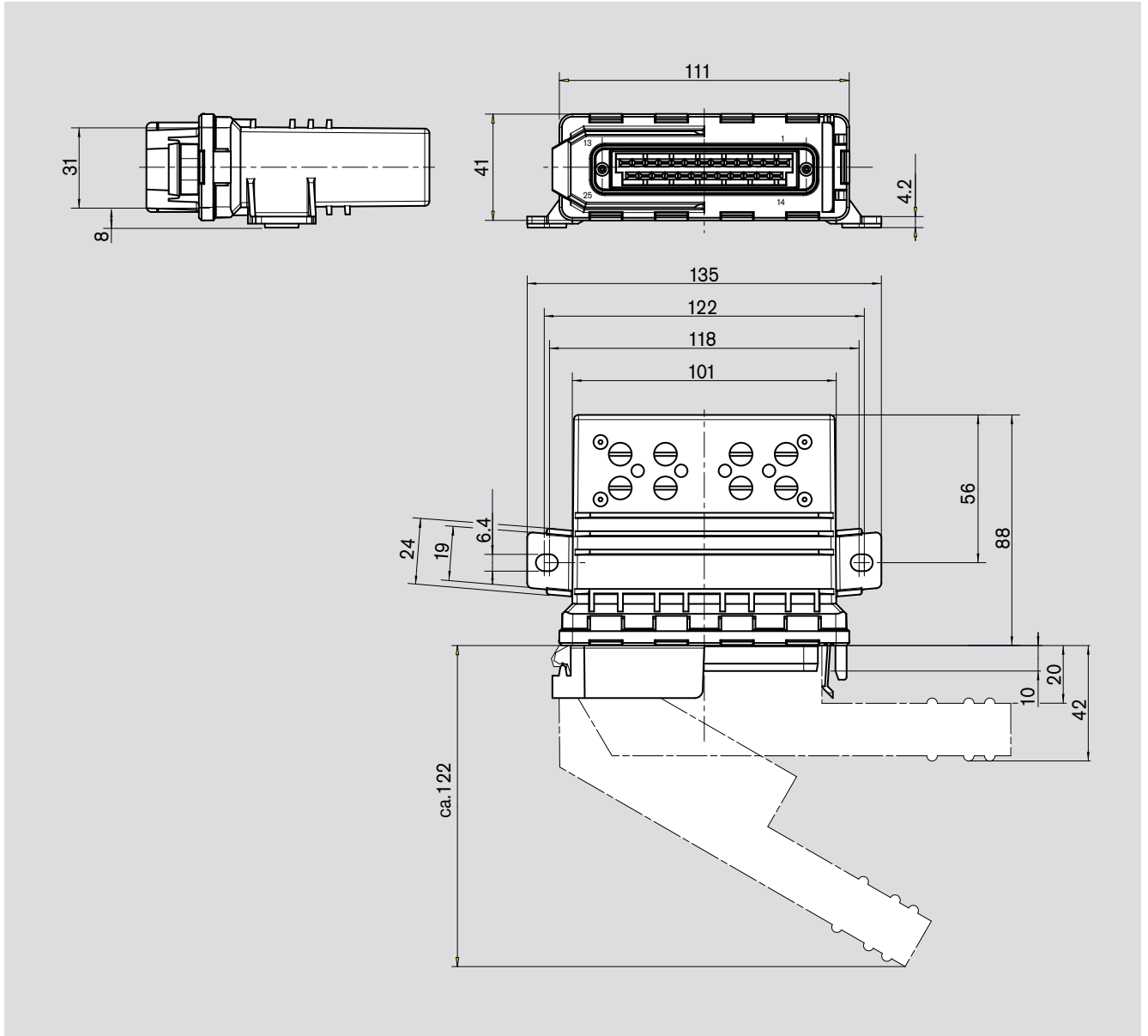


### Key

- |   |   |
|---|---|
| ① | Analog input 1 (4.0 V ... 8.4 V): Setpoint ( $U_{\text{setpoint}}$ ) for output signal amplifier 1 (solenoid 1) |
| ② | Analog input 2 (4.0 V ... 0.0 V): Setpoint ( $U_{\text{setpoint}}$ ) for output signal amplifier 2 (solenoid 2) |



# Unit Dimensions

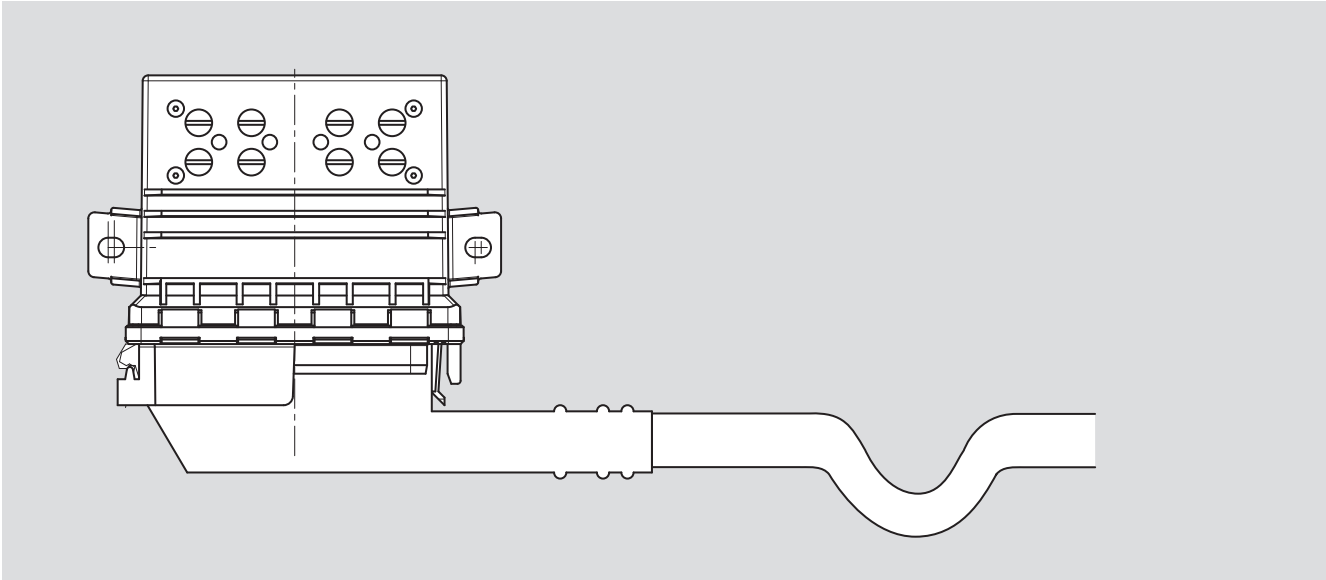


## Installation Position

The permissible installation position is with the plug positioned vertically downwards.

The cable must be routed such that it lies completely or partially below the amplifier connection (see illustration).

The IP65 type of protection is only achieved in the shown installation position in combination with a sealing of the connector relative to the wiring harness sleeve. Any ingress of water into the analog amplifier by way of the wiring harness must be avoided by routing the wiring harness accordingly.



# General Information

**Before commissioning the operating instructions is to be read!**

## Project planning notes

- The total of setpoints for parallel wired potentiometers must lie in a range between 2 k $\Omega$  and 5 k $\Omega$ . Potentiometers with 4.7 k $\Omega$  or 5 k $\Omega$  are recommended.
- The externally actuated switch output can be used to actuate an additional device such as, e.g. for an emergency valve or a horn.
- Do not use a freewheeling diode in the solenoid line.
- Other inductive consumers in the system must be equipped with freewheeling diodes.
- External switching contacts in the solenoid lines are not permissible.
- Toggling or parallel mode is applied to Pin 9:
  - Not connected: toggling mode, interlocked actuation of Solenoid 1 and Solenoid 2
  - wired with +U<sub>Bat</sub>: parallel mode, independent of each other actuation of Solenoid 1 and Solenoid 2
- To switch off the time ramp function Pin 5 (Ramp off) must be connected.
- The PWM frequency of the output current is set by connecting Pin 21 (PWM frequency).
- The PWM output stages are supplied with voltage via Pin 19 (Solenoid 1) or Pin 20 (Solenoid 2) separately. Interruption of the supply voltage enables them to be switched off individually and independent from each other.
- Connection of Pin 24 (Dig In) activates switch output (Pin 7, Dig Out).

## Safety instructions

- In contrast to digital control units analog amplifiers only allow a limited diagnosis and monitoring capability. The use of an analog amplifier in applications in which – in the event of a error – hazardous machine states may arise, is therefore not permissible without additional external protective measures.
- If an analog amplifier develops a error – i.e. unintended actuation or switching off of one or several solenoids – then malfunctions cannot be reliably prevented.
- The suggested circuits do not imply any technical liability of Rexroth for the system.
- The safety instructions contained in RDE 90 301-01 must be observed.
- In emergency situations or a malfunction the operating voltage is to be externally interrupted. To this end, interruption of the electronic circuit's supply voltage is to be effected using an emergency stop switch. The emergency stop switch must be installed in an easily accessible position for the operator. Safe braking must be ensured when the emergency stop function is activated.
- To avoid malfunctions the lines shielded from and to the potentiometers are to be connected on one side with low-impedance to devices or vehicle ground.
- Cables to the electronics must not be routed close to other power-conducting cables in the machine or vehicle.
- A sufficient distance to radio systems must be maintained.
- All connectors must be unplugged from the electronics during electrical welding operations.
- The analog amplifier may only be wired up when in de-energized state.
- Cable connection must have a strain relief and be attached such that vibration will not cause any corrosion to the plug contacts. Contacts must be protected against corrosion.
- If the solenoid output is overloaded (short circuit) the relevant output is *not* constantly switched off.
- The two PWM outputs must not be connected to each other (bridged)!

Bosch Rexroth AG  
Hydraulics  
Product Segment Mobile Electronics  
Glockeraustraße 4  
89275 Elchingen, Germany  
Telephone +49 (0) 73 08 82-0  
Facsimile +49 (0) 73 08 72-74  
info.brm-me@boschrexroth.de  
[www.boschrexroth.com/mobile-electronics](http://www.boschrexroth.com/mobile-electronics)

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