Rexroth
Bosch Group

BODAS Controller RC
Series 30

RE 95203/11.07 1/20

Technical Data Sheet

For closed- and open-loop control of hydraulic components

Contents

Features

- High level of efficiency with latest 32-bit TriCore technology with 150 MHz
- Component of BODAS system for mobile applications
- Robust design meeting specifications for mobile applications
- High electromagnetic compatibility (EMC)
- Inputs and outputs with fault detection
- Central safety cut-off for all outputs
- Pulse-width-modulated (PWM) solenoid currents for minimum hysteresis
- Closed-loop control of solenoid currents, i.e. not dependent on voltage and temperature

Main components

- Protected watchdog processor for program run monitoring
- Two independent sensor power supplies
- Four independent CAN-bus interfaces

Ordering Code

RC	36-20	/	30
01	02		03

Type

01	BODAS controller	**RC**

Version

02	Item 1: Number of proportional outputs	**36-20**
	Item 2: Number of switched outputs	

Series

03	Series 3, index 0	**30**

Notes:

The BODAS controllers are not functional without software.

In order to use the BODAS controllers, you also need:

– BODAS standard software or
– Application-specific software

If a model designation is present on the name plate, it concerns a prototype or samples, i.e. components that have not been approved for series production.

Possible model designations are:

– SC: A

– SC: B

– SC: C

– SC: S (software prototype)

Optional accessories

– **BODAS-design software**
The Windows-based PC software BODAS-design (RE 95112) is used for programming the BODAS controller RC. All graphic and text-based programming languages specified in the IEC 61131-3 standard are available for programming.

– **BODAS-service software**
The Windows-based PC software BODAS-service (RE 95086) is used for displaying functions, errors and system variables as well as for setting parameters via a PC.

– **C-programming interface C-API**
The programming interface C-API is used for programming BODAS controller RC in programming language C. The user is able to make use of a software library containing all functions needed for configuring and reading inputs, actuating outputs, using the communications interfaces and generating diagnostic information for BODAS-service.

In addition, the user needs a C compiler with which the created program is translated in an engines code readable for the controller.

– **BODAS measuring adapter MA**
The BODAS measuring adapter MA (RE 95090) is used for measuring all electric signals at the inputs, outputs and interfaces of the BODAS controller. For test purposes, it is connected in series between the controller and the vehicle or device wiring.

– **BODAS TB3 test box** (2x with adapter kit)
The BODAS TB3 test box (RE 95092) is used for simulating vehicle and equipment functions for development and test purposes with BODAS controllers. The BODAS TB3 test box is connected to the controller with the adapter cable TAK4/10.

– **BODAS CAN I/O extension module RCE12-4/22**
The BODAS CAN I/O extension module RCE12-4/22 (RE 95220) is used for I/O extension of a controller in the event that the number of controller inputs and outputs is insufficient for the specified application.

All products mentioned here are available from Rexroth.
Further information can be found on the Internet at:
www.boschrexroth.com/mobile-electronics

Description

The BODAS controller RC36-20 has been designed as a universal central controller for complex mobile working machines. State-of-the-art 32-bit TriCore technology, a clock frequency of 150 MHz and parallel processing enable the RC36-20 to move in completely new dimensions in terms of performance, previously the reserve of much larger PLC systems. The areas of application of the RC36-20 range from programmable actuation of proportional solenoids and additional switching functions through travel drive and gear shifting to coordination of highly complex control circuits in mobile working machines. With 67 input channels, 56 output stages and an additional analogue output (0 - 20 mA), plus four CAN buses for communications within the vehicle, the RC36-20 provides a powerful platform for all functions on mobile working machines.

Internally, the series 30 BODAS controller RC houses a powerful 32-bit TriCore microprocessor and all input and output circuitry. Analog voltages in the range 0 - 10 V and 0 - V_{sup}, currents from 0 - 20 mA, frequencies from 0 Hz - 10 kHz and switching information are processed as input signals. In addition, the RC36-20 has special inputs for intelligent Rexroth sensors such as the DSM1-10 speed sensor with integrated diagnostic function or for resistor inputs of 800 - 1800 ohms, for example for the direct connection of temperature sensors. The inputs are protected against overvoltage and electrical interference. The voltage inputs can be monitored to detect any cable breaks or short circuits. The current-controlled proportional solenoid outputs are pulse-width modulated (PWM) and temperature and voltage-compensated for high precision and minimum hysteresis. They are optimally tuned for electric proportional control of axial piston units and Rexroth valves. The switched outputs are designed for the direct switching of relays, lamps and switching solenoids. In addition they also have integrated voltage and current monitoring.

CAN-bus interfaces are available with all BODAS controllers RC for exchanging data with other bus users or electronic systems (e.g. RC or RCE, joystick, diesel engine injection, display). For communications, the BODAS controller RC36-20 has four independent CAN-bus interfaces, which can each be operated using different protocols. Communication with the software BODAS-design and BODAS-service is also conducted via CAN bus and is based on the Key Word Protocol 2000 (KWP 2000) standard.

The software BODAS-design makes simple and flexible programming of BODAS controllers possible in compliance with industrial standard IEC 61131, allowing a very convenient and fast introduction to RC36-20 programming. Comprehensive and complex applications can be easily developed and clearly presented with BODAS-design.

To develop the full potential of the BODAS controller RC36-20 when using programming language C, an application interface in the form of a C-API interface can be used. This allows the software developer to concentrate on the key functions of his machine without having to deal with the details of TriCore technology.

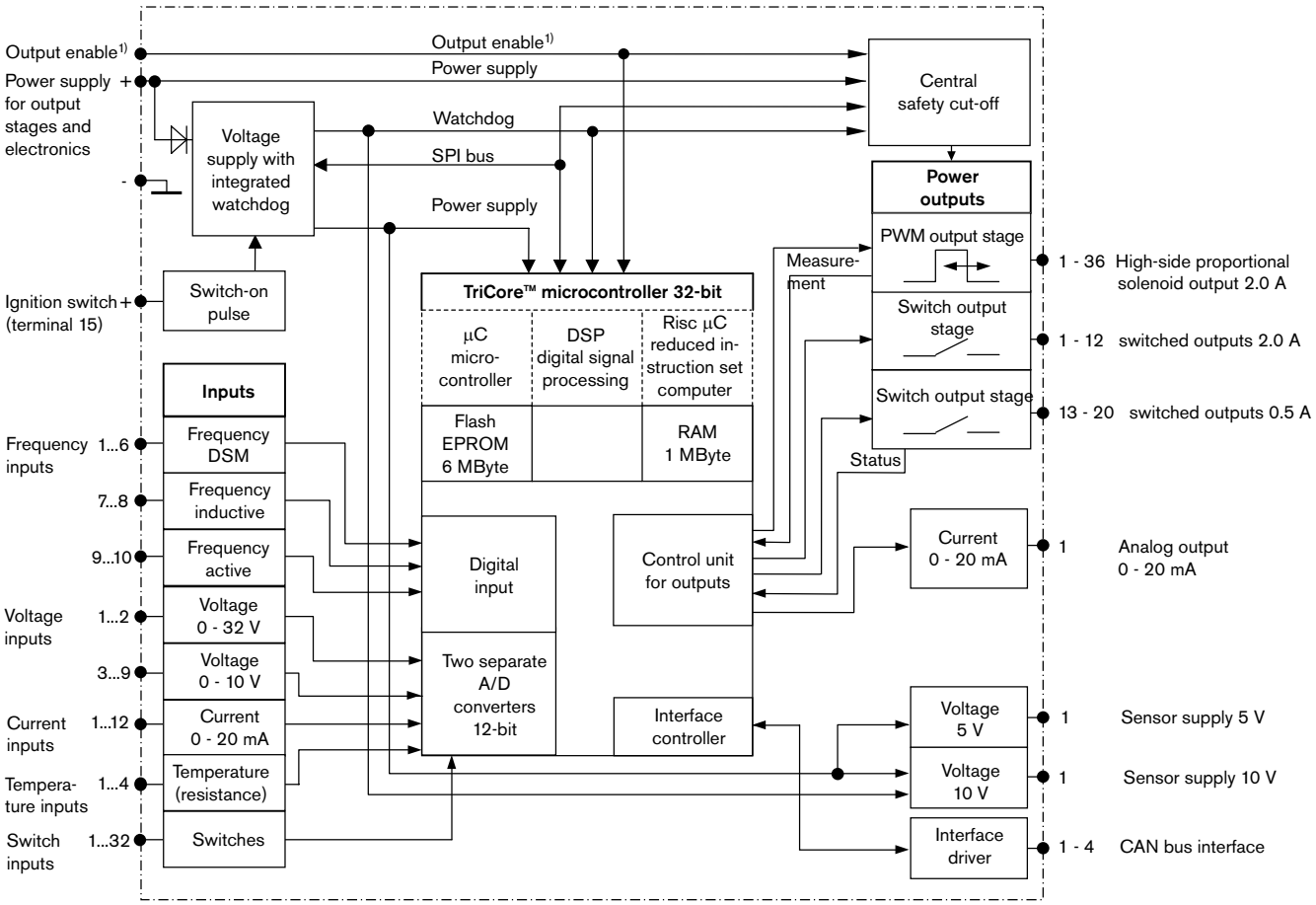
The software BODAS-service can be used to quickly and easily download programs onto the controller via the flash module. The graphic Windows interface of BODAS-service allows comprehensive service functions such as diagnostics, parameter setting or process variable display to be performed. This allows simple parameter programming and diagnostics, so that the machine can be quickly and reliably commissioned.

BODAS controllers RC were specially developed for use in mobile working machines, and satisfy the relevant safety requirements with regard to ambient temperature, tightness, resistance to shock and vibration, as well as electromagnetic compatibility (EMC).

Combined with pumps, motors, valves, sensors, input devices and actuators from Rexroth, BODAS controllers RC and corresponding software can be used to create complete system solutions.

Block Circuit Diagram

RC36-20



1) Independent input for release/shutdown of the power outputs.

Notes

Technical Data

Controller		RC36-20/30
Nominal voltage	12 and 24 V	✓
Residual ripple (DIN 40839, Part 1)	max. ± 2 V	✓
Supply voltage, permitted range	8 - 32 V	✓
Current consumption		
Without load, in 12 V system	380 mA	✓
Without load, in 24 V system	290 mA	✓
With load, in 12 V system	max. 50 A	✓
With load, in 24 V system	max. 25 A	✓
Fuse		
Internal:		–
External: in supply path	AT	50
Controller release pin	Terminal 15	✓
Constant voltage sources[3]		
E.g. for setpoint potentiometer		
1000 mA	10 V ± 350 mV	✓
500 mA	5 V ± 150 mV	✓
Digital voltage inputs, diagnostics-compatible		32
Analog voltage inputs, pull-down	0 - 10 V	7
	0 - 32 V	2
Analog current inputs, diagnostics-compatible	0 - 20 mA	12
Resistor inputs		4
E.g. for temperature sensors		
Resistance measuring range	800 - 1800 Ω	
Frequency inputs total		10
DSM	7 mA/14 mA	6
Inductive sensors	0 - 10 kHz level > 1 V_{eff}	2
Active sensors	0 - 20 kHz	2
	Level low < 1 V	
	Level high > 6 V	
Analog current outputs		1
For 200 Ohm load (burden)	4 - 20 mA	
Proportional solenoid outputs (PWM)		36
Current range, highside	0 - 2.0 A[2]	
Pulsation frequency	100 - 350 Hz	
Digital output stages total		20
Current range, highside	max 1.8 A[2]	12
Current range, highside	max 0.5 A	8
Interfaces		4
CAN 2.0 B, ISO 11898		
Fault detection for cable break and short circuit		
Analog inputs		✓
Proportional solenoid outputs		✓
Switching solenoid outputs		✓
Protection against short circuit		
Against supply voltage and ground		
For all inputs and outputs[1)3)]		✓
Reverse-connect protection		
Voltage supply / battery		✓

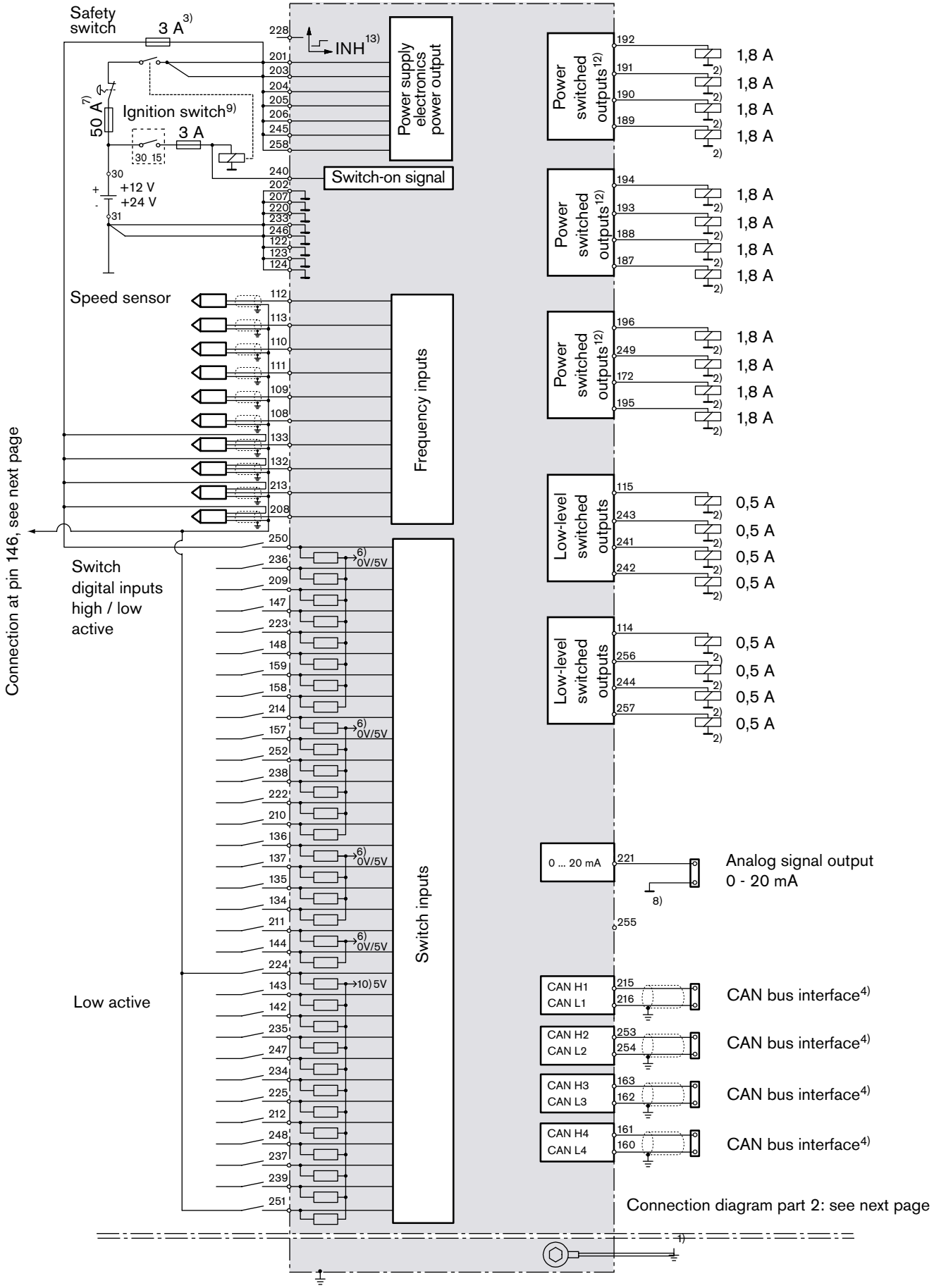
[1]) Exceptions: GND, sensor GND against battery
[2]) Max. cumulative current per group: 5 A
[3]) Sensor voltage inputs are raised in case of short circuit to battery.
A correct reading of sensor signals is no longer guaranteed.

Technical Data

Controller		RC36-20/30
Microcontroller		TC1796
Clock frequency	MHz	150
Memory capacities		
RAM	MByte	1
Flash EPROM	MByte	6
EEPROM	kByte	32
Software installation Download to flash memory		✓
Electromagnetic compatibility		
Spurious interference (ISO 11452-2)	200 V_{RMS}/m;	✓
Spurious interference (ISO 11452-5)	100 V_{RMS}/m;	✓
Electrostatic discharge ESD (acc. to ISO 10605)		
Not in operation	8 kV	✓
In operation	15 kV	✓
Max. dissipation power		
Electronics	W at 32 V	8.5
Output stages	W at 32 V	60
Operating temperature, case with bolting point on cooling surface	-40 to +85°C (-40 to +185°F)	✓
Storage temperature, case	-40 to +105°C (-40 to +221°F)	✓
Vibration resistance:		
Broadband noise vibration (IEC 60068-2-34)	34 m/s², 10 - 1000 Hz, 20 cycles per axis	✓
Sinusoidal vibration (IEC 60068-2-6)	Values on request	
Random-shaped vibration (IEC 60068-2-36)	1.5 mm, 5 - 57 Hz, 10 *g*, 58 - 2000 Hz, 8 cycles per axis	✓
Shock resistance:		
Transport shock (IEC 60068-2-27)	15 *g*; 11 ms per spatial axis x, y, z and in each direction (pos./neg.)	✓
Continuous shock (IEC 60068-2-29)	25 *g*; 6 ms per spatial axis x, y, z and 1000x in each direction (pos./neg.)	✓
Type of protection (DIN / EN 60529)[1)] with mounted mating connector	IP65	✓
Resistance to moisture (IEC 60068-2-30Db; version 2)	95% (+25 to +55°C)	✓
Resistance to salt spray (IEC 60068-2-11, part 2, test Ka)	72 h, 35°C, 5% NaCl	✓
Case material	Diecast aluminum	✓
Weight	Approx. kg	1.5 kg
Outer dimensions	Length (in mm)	303.4
	Width (in mm)	210
	Height (in mm)	50.8
Mating Connector	96-pin	1
	58-pin	1

[1)] Taking installation notes into account

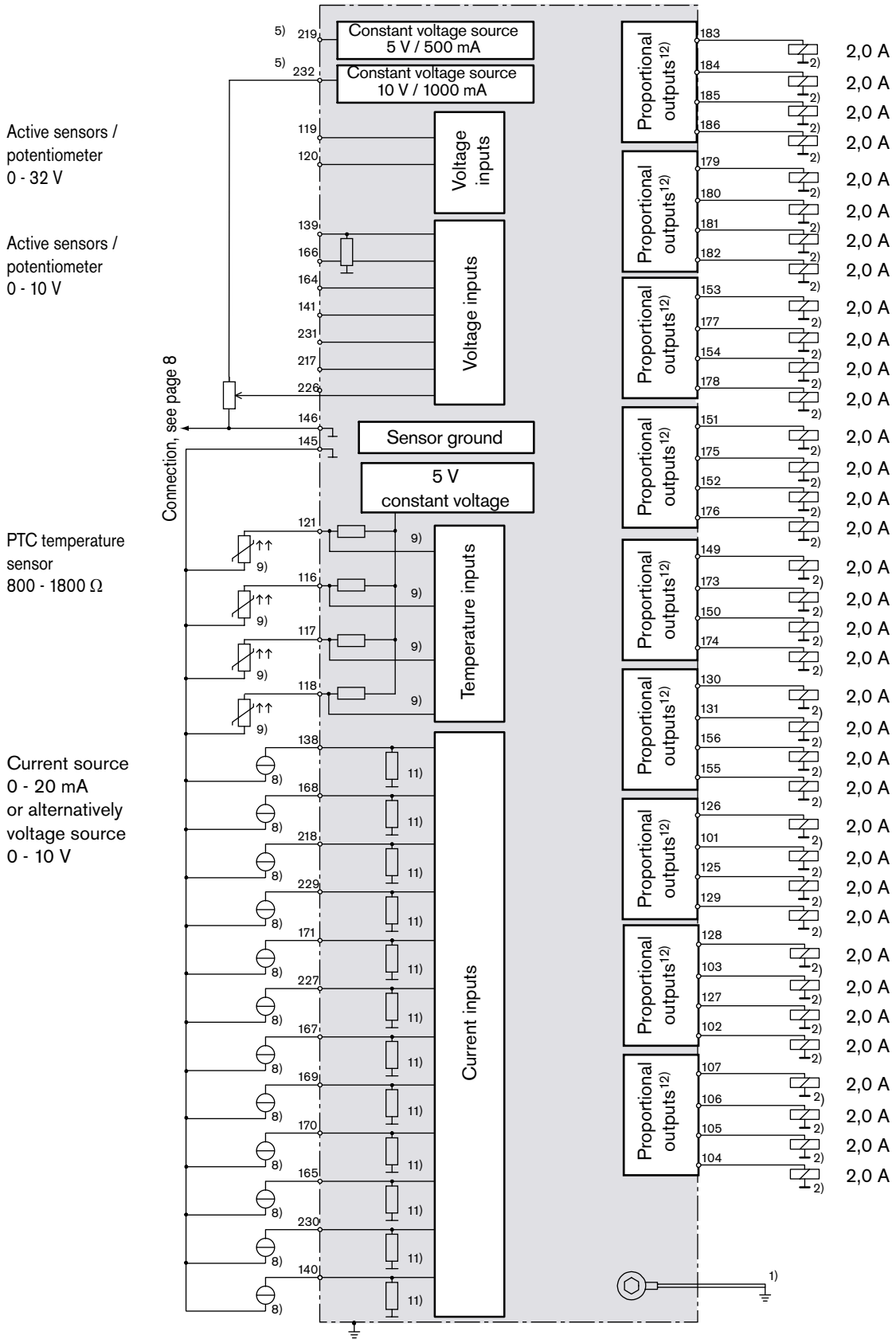
Connection Diagram RC36-20/30 part 1



1) Short, low-resistance connection from a case screw to the device ground or vehicle ground
2) Separate ground connection from solenoid return line to battery (chassis possible)
3) Separate fuses for switches and sensors necessary
4) CAN bus: termination resistor 120 Ω necessary

See next page for further foot notes

Connection Diagram RC36-20/30 part 2



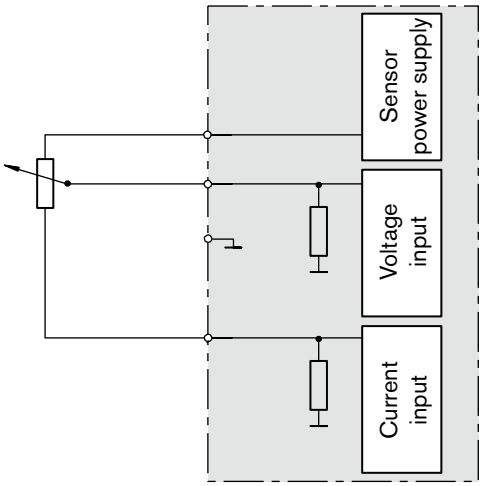
5) Outputs 5 V/10 V can also be used alternatively as sensor supply.
6) Can be switched together between high / low active by means of software.
7) Note max. current consumption with simultaneous actuation of proportional solenoids and switched outputs
8) Separate ground connection for current source to battery, controller GND possible
9) Can be used as switch inputs if externally switched to GND
10) All low active switch inputs are provided with internal pull-up as with pin 224.
11) For use as voltage inputs (0 - 10 V), the load can be switched by the software into groups for these inputs.
Groups: inputs 1 - 6, inputs 7 - 10, inputs 11 - 12
12) Outputs arranged in groups, each with 4 output stages. Maximum permissible output current of a group: 5 A
13) Levels ≥ 5 V result in shutdown of output stages (proportional and switched outputs)

Connection Variants

Monitored potentiometer 2.5 - 5 kΩ

Error monitoring for potentiometer

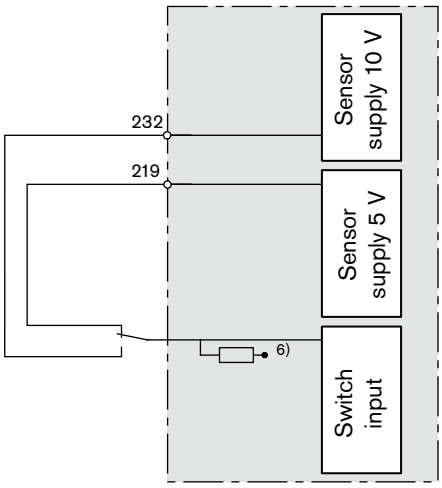
- Internal measurements for sensor supply voltage (5 V)
- Connection for potentiometer at current input, used for checking current in potentiometer.
- Check wiper voltage
  This must be within a valid range (software).



Switch input with fault detection

Error monitoring for switch inputs

- Switch input level between 10 V and 5 V
- Read switch level and check valid range (software)



Overview of Functions

Pin	Description	Main function	Alternative functions
250, 236, 209, 147, 223, 148, 159, 158, 214, 157, 252, 238, 222, 210, 136, 137, 135, 134, 211, 144	**Digital input** with selectable pull-up/pull-down after 5 V/GND Pull-up/pull-down switched in 4 groups: IN_1 - IN_8 IN_9 - IN_14 IN_15 - IN_18 IN_19 - IN_20	**Digital input** Threshold programmable via software Pull-up / pull-down resistance, switchable by means of software	**Analog voltage input** Measuring range 0 - 10 V Resolution 12 bit (2.7 mV/Bit) Input resistance DC to 5 V 15 kΩ (pull-up) DC to GND 49.5 kΩ (pull-down) Limit frequency filter 330 Hz Basic setting with terminal 5 VDC open
224, 143, 142, 235, 247, 234, 225, 212, 248, 237, 239, 251	**Digital input** IN_21 - IN_32	**Digital input** Operating threshold programmable via software. Switch externally to GND	**Analog voltage input** Measuring range 0 - 10 V Resolution 12 bit (2.7 mV/bit) Input resistance DC to GND 49.5 kΩ Limit frequency filter 330 Hz
112, 113	**DSM frequency input** IN_58 - IN_59	**Frequency input for Rexroth DSM sensors** Frequency evaluation including additional information such as direction of rotation and error monitoring up to 5 kHz tooth pulsation frequency	**Frequency input for active sensors** Frequency evaluation for active speed sensors switched to ground. **Caution:** Short circuit current up to 47 mA **Analog voltage input** Measuring range 0 - 10 V Resolution 12 bit (2.7 mV/bit) Input resistance DC to GND 49.5 kΩ Limit frequency filter 330 Hz **Digital input switching to GND** Evaluation options • Threshold programmable via software • Digital current threshold 10 mA ±3 mA
110, 111, 109, 108	**DSM frequency input** IN_60 - IN_63	**Frequency input for Rexroth DSM sensors** Frequency evaluation including additional information such as direction of rotation and error monitoring up to 5 kHz tooth pulsation frequency	**Frequency input for active sensors** Frequency evaluation for active speed sensors switched to ground. **Caution:** Short circuit current up to 47 mA **Digital input switching to GND** Evaluation options • Digital current threshold 10 mA ±3 mA

Overview of Functions

Pin	Description	Main function	Alternative functions
133, 132	**Inductive frequency input** IN_64 - IN_65	**Frequency input for inductive sensors** Frequency evaluation up to 10 kHz Input resistance 4.64 kΩ	**Digital input** Evaluation options • Threshold programmable via software
			Analog voltage input Measuring range 0 - 30 V Resolution 12 bit (7.65 mV/bit) Input resistance DC to GND 44 kΩ
213, 208	**Active frequency input** IN_66 - IN_67	**Frequency input for type TPT active sensors** (e.g. HDD1) Frequency evaluation of active speed sensors switched to ground. Short circuit current up to 1.37 mA	**Digital input switching to GND** Evaluation options • Threshold programmable via software • Digital current threshold Limit frequency filter 13.21 kHz
			Analog voltage input Measuring range 0 - 5 V Resolution 12 bit (1.78 mV/bit) Limit frequency filter 510 Hz
119, 120	**Analog voltage input** IN_33 - IN_34	**Analog voltage input** Measuring range 0 - 32 V Resolution 12 bit (8.8 mV) Input resistance DC to GND 51 kΩ Limit frequency filter 800 Hz	**Digital input** Evaluation options • Threshold programmable via software
139, 166, 164, 141, 231, 217, 226	**Analog voltage input** IN_35 - IN_41	**Analog voltage input** Measuring range 0 - 10 V Resolution 12 bit (2.7 mV) Input resistance DC to GND 49.5 kΩ Limit frequency filter 330 Hz	**Digital input** Evaluation options • Threshold programmable via software
138, 168, 218, 229, 171, 227, 167, 169, 170, 165, 230, 140	**Analog current input** with selectable load (input resistance) IN_42 - IN_53	**Analog current measurement input** Measuring range 0 - 20 mA Load 488 Ω Resolution 12 bit (2.71 mV/Bit) Limit frequency filter 330 Hz	**Analog voltage input** Measuring range 0 - 10 V Resolution 12 bit (2.71 mV/bit) Input resistance DC to GND 12.38 kΩ Limit frequency filter 330 Hz
			Digital input Evaluation options • Threshold programmable via software
121, 116, 117, 118	**Temperature input** IN_54 - IN_57	**Temperature measurement by means of resistance measurement in connected temperature sensors** Evaluation of passive temperature sensors with PTC measuring resistors	**Digital input switching to GND** Evaluation options • Threshold programmable via software
			Analog voltage input Measuring range 0 - 5 V Resolution 12 bit (1.26 mV/bit) Input resistance DC to GND 156.2 kΩ Limit frequency filter 94 Hz

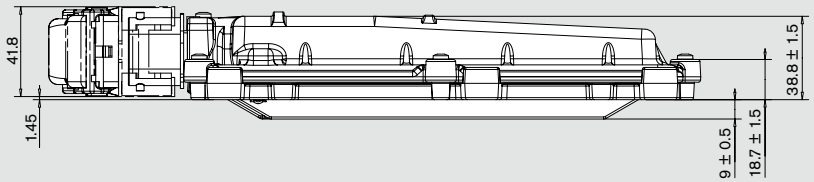
Overview of Functions

Pin	Description	Main function	Alternative functions
183, 184, 185, 186, 179, 180, 181, 182, 153, 177, 154, 178, 151, 175, 152, 176, 149, 173, 150, 174, 130, 131, 156, 155, 126, 101, 125, 129, 128, 103, 127, 102, 107, 106, 105, 104	**PWM output stage** OUT_1 - OUT_36	**PWM output stage** High-side switch PWM frequency programmable via software Integrated suppression diode for inductive kickback. Max. current 2.0 A Pulse duty factor 0 - 100%	**Switch output stage** Diagnostics-compatible Actuated time 100%
192, 191, 190, 189, 194, 193, 188, 187, 196, 249, 172, 195	**Power switch output stage** OUT_37 - OUT_48	**Switch output stage** High-side switch Max. current 1.8 A Integrated suppression diode for inductive kickback	
115, 243, 241, 242, 114, 256, 244, 257	**Low-level switch output stage** OUT_49 - OUT_56	**Switch output stage** High-side switch Max. current 0.5 A	
221	**Analog current output** OUT_57	**Analog current output** Output signal 0 - 20 mA	
219	**Sensor supply** VSS_1	**Sensor supply, can be switched off** Output voltage 5.0 V Precision ± 0.15 V Load capacity 500 mA	
232	**Sensor supply** VSS_2	**Sensor supply, can be switched off** Output voltage 10.0 V Precision ± 0.35 V Load capacity 1000 mA	
228	**Output enable**[1)] INH	**Digital input** Levels ≥ 5 V cause output stages to be blocked Input resistance DC to GND 20 kΩ	
215, 216	**CAN interface** CAN1_H, CAN1_L	**CAN interface** CAN 2.0B, 1 Mbaud Termination resistor needed in wiring harness	
253, 254	**CAN interface** CAN2_H, CAN2_L	**CAN interface** CAN 2.0B, 1 Mbaud Termination resistor needed in wiring harness	
163, 162	**CAN interface** CAN3_H, CAN3_L	**CAN interface** CAN 2.0B, 1 Mbaud Termination resistor needed in wiring harness	
161, 160	**CAN interface** CAN4_H, CAN4_L	**CAN interface** CAN 2.0B, 1 Mbaud Termination resistor needed in wiring harness	

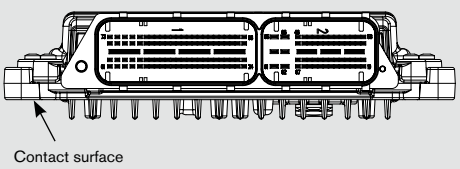
[1)] Independent input for release/shutdown of the power outputs.

Dimensions

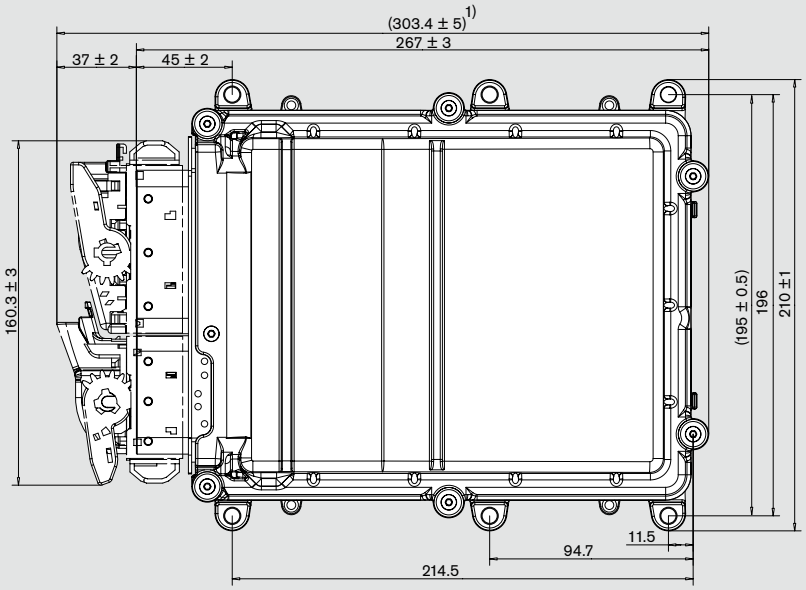
Side view (long side)



Side view
(plug side with plug disconnected)



Plan view



Underside view

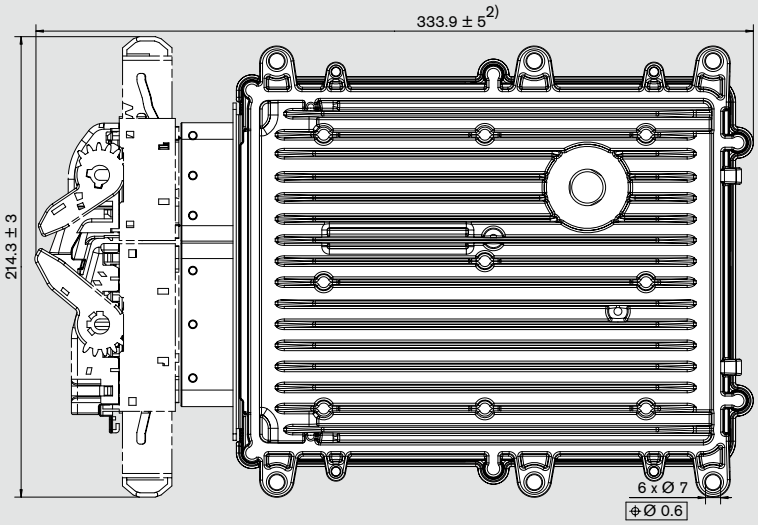


Illustration not to scale
Dimensions in mm

Fixing:

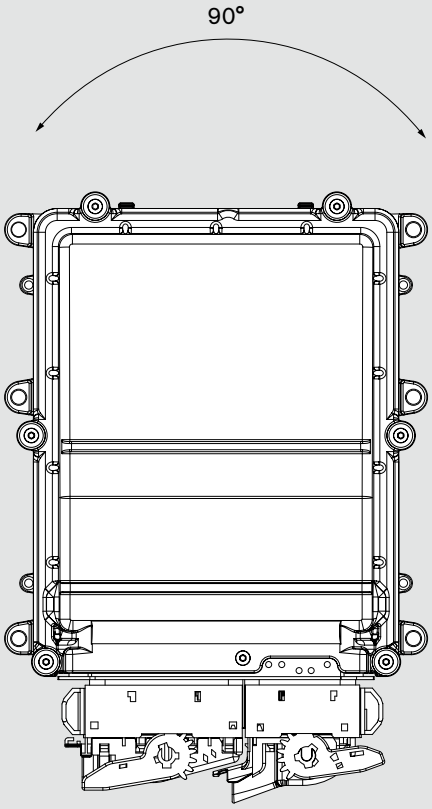
- The BODAS controller must be fixed at 6 points.
- Tightening torque MA = 8 ± 2 Nm for fixing the BODAS controller with M6 screws.
- Tightening torque applies for mounting without washer. The equivalent tightening torque must be calculated when using washers.
- Rexroth approval is required if mounting is different from above.
- Installation point: evenness of mounting surface ▱ 0.5
- The wiring harness should be fixated mechanically in the area in which the controller is installed (spacing < 150 mm).
  The wiring harness should be fixated such that a phase excitation with the controller occurs (e.g. at the controller mounting point).

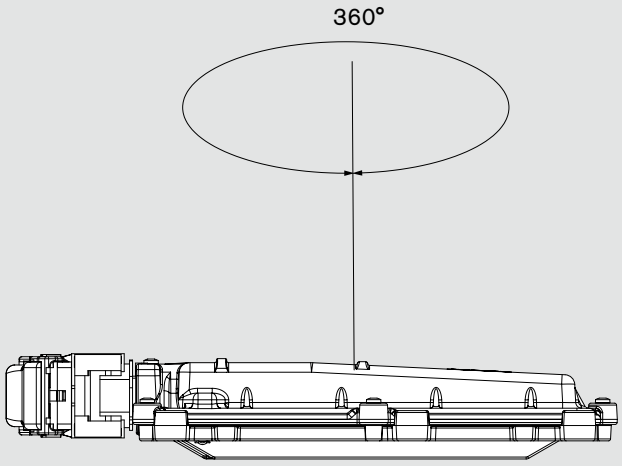
If the mounting surface is not sufficiently even, place flexible compensating elements (e.g. rubber washers) between the fixing points of the BODAS controller and the mounting surface.

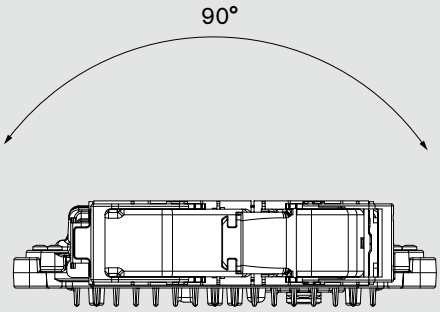
1) Space required for mating connector

2) Space required for plugging and unplugging the mating connector

Installation Position







Note:

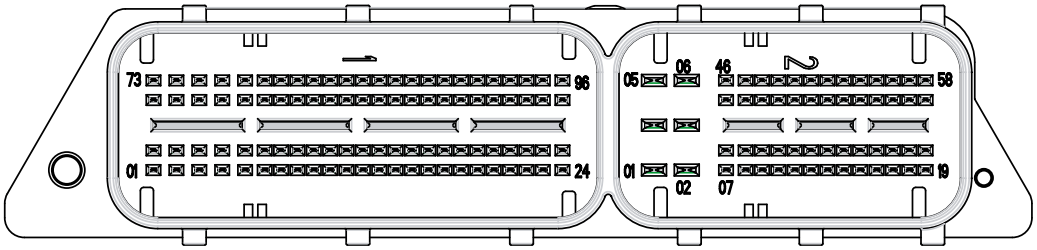
Installation position only permissible with specified angular range.

Mating Connector

Order designation for the connector set with Rexroth material number R902603622

Designation	Number	Bosch order numbers for individual parts	
		Module, 58-pin	Module, 96-pin
Contact carrier coding: A	1 per plug	1 928 404 780	1 928 404 781
Cover, pre-assembled	1 per plug	1 928 404 774	1 928 404 773
Secondary lock 1.2	1 per plug	1 928 404 760	1 928 404 762
Secondary lock 2.8	1	1 928 404 761	–
Wire tie (cable tie)	1 per plug	1 928 401 713	
Contacts BDK 2.8 contact Surface: SN Insulator cross section: 2.2 - 3.0 mm Line cross section: 1.5 - 2.5 mm	6 (8)*)	1 928 498 057	–
Matrix 1.2 contact Surface: SN Insulator cross section: 1.2 - 1.6 mm Line cross section: 0.35 - 0.5 mm	52 (55)*)	1 928 498 137	–
Matrix 1.2 contact Surface: SN Insulator cross section: 1.2 - 1.6 mm Line cross section: 0.35 - 0.5 mm	96 (100)*)	–	1 928 498 137
Individual seal White for BDK 2.8 Cross section: 2.2 - 3.0 mm	6 (8)*)	1 928 300 600	–

*) The number in brackets indicates the number of contacts or individual seals contained in the Rexroth connector set. The number without brackets indicates the number needed.



View of connector strip

Mating Connector

Notes on assembly

When assembling the plugs, please comply with the assembly instructions for plug connections (1 928 A00 48M). These assembly instructions are available on request from Rexroth.

Caution:

Please note the following when assembling the plug:

The wiring harness must be fixed at the same vibration level of the controller at intervals of ≤ 150 mm from the wire outlet.

Recommended line

Recommended connection lines for contacts 201 - 206:

– Cross section 1.5 mm² - 2.5 mm² (14 AWG with thin insulation)

– Outer diameter: 2.2 mm - 3.0 mm

Recommended connection lines for the other contacts (except 201 - 206):

– Cross section 0.35 mm² - 0.5 mm² (20 AWG)

– Outer diameter: 1.2 mm - 1.6 mm

Tools needed

Bosch order numbers for crimping tools[*)]

	Line cross section, wire type FI Kr	
	BDK 2.8 contacts	**Matrix 1.2 contacts**
	1.5 - 2.5 mm²	0.35 - 0.5 mm²
Pliers with die	1 928 498 162	1 928 498 212
Quick-change tool	1 928 498 164	1 928 498 200
Set of wearing parts	1 928 498 166	1 928 498 206
Removal/extractor tool	1 928 498 167	
10 replacement needles for extractor tool	1 928 498 168	

*) The crimping tools can be ordered from Bosch dealers.

Safety Notes

• General instructions:
- Reliable operation cannot be guaranteed if samples or prototypes are used in series production machines.
- The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- Incorrect connections could cause unexpected signals at the outputs of the controller.
- Dangerous malfunctions may result if the control electronics are opened or modified or the wiring repaired without authorization.
- In addition, the application-specific documents (connection diagrams, software descriptions, etc.) are to be observed.
- To switch off the system in emergencies, the power supply to the electronics must be disconnected with a safety switch. The safety switch must be installed in an easily accessible position for the operator. The system must be designed in such a way that actuating the safety switch ensures safe braking.
- System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with the components used and with the complete system.
- Unexpected dangers may be present at the machine during commissioning of the RC. For this reason, before commissioning the system, you must ensure that the vehicle and the hydraulic system are in a safe condition. Make certain that no persons are present in the danger zone of the machine.
- No components that are defective or not working properly should be used. If components fail and/or exhibit malfunction, repairs must be carried out immediately.
- The controller RC warms up above regular ambient temperature during operation. To prevent risks due to high temperatures, it should be attached and protected before it is touched.
- Incorrect programming of the RC may create potential sources of danger while the machine is in operation. It is the responsibility of the machine manufacturer to determine dangers of this type in a risk assessment and to bring them to the attention of the end user. Rexroth assumes no liability for risks of this type.
- Make sure that the controller configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.

• Conventional use:
- The controller RC is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- Operation of the controller RC must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences. Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the complete system.
- Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

• Notes on the installation point and position:
- Do not install the controller near parts which generate considerable heat (e.g. exhaust).
- Install the controller in such a way that the connector is pointing downwards. This ensures that any condensation water can drain.
- A sufficiently large distance to radio systems must be maintained.
- All connectors must be unplugged from the electronics during electrical welding operations.
- The controller must not be electrostatically charged, e.g. during painting operations.
- Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- Cables/wires must be sealed individually to prevent water from entering the controller.

• Notes on transport and storage:
- Controllers must be stored in mean relative humidity of 60% at a temperature between -10°C and +30°C. Briefly, for 100 hours, a storage temperature range of -20°C to +40°C is permissible.
- After a storage time of more than 5 years, the controller must be examined by the manufacturer before it is used.
- The controller must not be used if it has been dropped, as damage that is not visible could still affect its reliability.

Safety Notes

• Notes on circuitry and on wiring:
  – The lines used for speed sensors are to be shielded. The shield must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
  – Cables to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
  – The electronics and the power outputs of a controller must be fed from the same power source.
  – The wiring harness should be fixated mechanically in the area in which the controller is installed (spacing < 150 mm). The wiring harness should be fixated such that a phase excitation with the controller occurs (e.g. at the controller mounting point).
  – When wiring the output stages, the maximum cumulative output current for each output stage group should be noted. The cumulative output current means a permanent, simultaneous actuation of the output stages.

• Notes on proportional solenoids and switching solenoids and other switched inductive consumers:
  – The electronics may only be tested with the proportional solenoids connected.
  – The proportional solenoids must not be wired with suppression diodes.
  – Switching solenoids at the outputs of the controller RC do not need to be connected to suppression diodes.
  – Other inductive loads that are in the system but not connected to the controller RC must be connected to suppression diodes.

Safety features in the BODAS controller

– The input circuits for speed and analog signals partially feature circuits that are mutually electrically isolated. Through appropriate input connections, the microcontroller and, when used, the software diagnostic function can detect faults.

– Faults in the supply voltage are detected by internal monitoring.

– All output signals can be monitored by the microcontroller with the appropriate software.

– For service purposes, the controllers can be operated with all power outputs de-energized.

– The internal watchdog module centrally switches off all proportional and switched outputs in the event of disturbances to the program run.

Product-specific notes

– Via the release input, the output stages (proportional and switched outputs) are switched off independent of the CAN bus.

Safety measures during use of the BODAS controller

– Faults can be detected and specially programmed safety functions activated by means of appropriate input variable assignments (e.g. connection of the acceleration pedal signal to two independent analog inputs).

– Special safety functions can be initiated if the plausibility check reveals discrepancies between the setpoints and the values read back by the microcontroller.

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