Rexroth
Bosch Group

BODAS Controller RC

RC28-14/30
RC20-10/30
RC12-10/30

RE 95204
Edition: 02.2017
Replaces: 07.2015

▶ For closed- and open-loop control of hydraulic components

Features

▶ High performance thanks to ultra-modern 32-TriCore technology with 180 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 deactivation of 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

▶ Watchdog processor for program run monitoring
▶ Hardware-based RAM memory supervision
▶ CPU-internal Flash with ECC error-correcting code
▶ Three independent sensor power supplies
▶ Four independent CAN bus interfaces
▶ Two-channel stop function

Contents

Ordering code

01	02		03
RC		**/**	**30**

Type

01	BODAS controller	**RC**

Version

02	1st number: number of proportional outputs 2nd number: number of switched outputs	**28-14**
		20-10
		12-10

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 there is a sample label on the name plate, it is a prototype or sample, i.e., components not released for serial production.
  Possible sample labels are:
  – SC: A
  – SC: B
  – SC: C
  – SC: S (Software prototypes)

Optional accessories

▶ **BODAS-design software**
  The windows-based BODAS-design PC software (data sheet 95112) is used for programming the BODAS RC controllers. All graphical and textual programming languages specified according to IEC 61131-3 are available for the programming.
▶ **BODAS-service software**
  The windows-based BODAS-service PC software (data sheet 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 C-API (data sheet 95115) programming interface is used for programming the BODAS RC controllers in the C programming language. All required functions that are needed for the configuration and the reading of the inputs, the control of the outputs, the use of the communication interfaces and the creation of the diagnostics information for BODAS-service are available to the user.
  Additionally, the user needs a C-compiler, with which the created program is translated into a machine code that is readable for the BODAS controller.
▶ **BODAS MA6 measuring adapter**
  The BODAS MA6 measuring adapter (data sheet 95090) facilitates measuring all electrical signals at the inputs, outputs and interfaces of the BODAS controller. For testing purposes, it is connected in series between the control unit and the vehicle or device wiring.
▶ **BODAS TB3 test box**(2 pieces) and adapter kit (1 piece)
  The BODAS TB3 test box (data sheet 95092) is used for simulation of vehicle and device functions for development and testing purposes with BODAS controllers. The BODAS TB3 test boxes are connected to the control unit via the adapter TAK4/10 .

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

Description

These BODAS controllers RC are designed as universal central control units for complex mobile working machines. Thanks to the ultra-modern 32-bit TriCore technology, a clock frequency of 180 MHz and parallel processing, these control units push into completely new performance dimensions that were previously reserved for larger PLC systems. The fields of application extend from the programmable control of proportional solenoids and additional switching functions to travel drives and transmission control as well as coordination of highly complex control circuits in mobile working machines. With 75 input channels, up to 42 output stages, four voltage outputs (25% * V_{bat} to 75% * V_{bat}), an additional analog output (4 to 20 mA) as well as four CAN buses for communication in the vehicle, these control units provide a high-performance platform for all functions of mobile working machines.

Internally, the series 30 BODAS RC controllers contain a high performance 32-bit TriCore microprocessor and all input and output circuits. Analog voltages in the range from 0 to 10 V and 0 to 32 V, currents from 0 to 20 mA, frequencies from 0 to 10 kHz and switching information are processed as input signals. In addition, these control units offer special inputs for intelligent Bosch Rexroth sensors, such as the DSM1-10 speed sensor with integrated diagnostics function or resistor inputs from 10 to 2000 Ω, 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 are compensated for fluctuating temperature and voltage for high accuracy and minimum hysteresis. They are optimally harmonized with the electrical proportional control of the axial piston units and valves of Bosch Rexroth. The switching outputs are designed for direct switching of relays and switching solenoids. Moreover, the outputs have integrated voltage and current monitoring.

CAN-bus interfaces are included in all BODAS RC controllers for exchanging data with other bus users or electronic systems (e.g. RC, joystick, diesel engine injection, display). Each of the four independent CAN bus interfaces can be operated using different protocols.
Communication with the BODAS-design and BODAS-service software is likewise done via CAN bus and is based on the Standard Key Word Protocol 2000 (KWP 2000).

Simple and flexible programming of the BODAS controller according to the industry standard IEC 61131-3, which enables a very convenient and rapid introduction to the programming of the controller, is possible with the BODAS-design software. Comprehensive and complex applications can be conveniently developed and clearly represented with BODAS-design.

An application interface in the form of a C-API interface is available for the development of the full performance capability of these BODAS controllers when the C programming language is used. By using the C-API, the software developer can concentrate on the important functions of his machine without having to become immersed in the details of the TriCore technology.
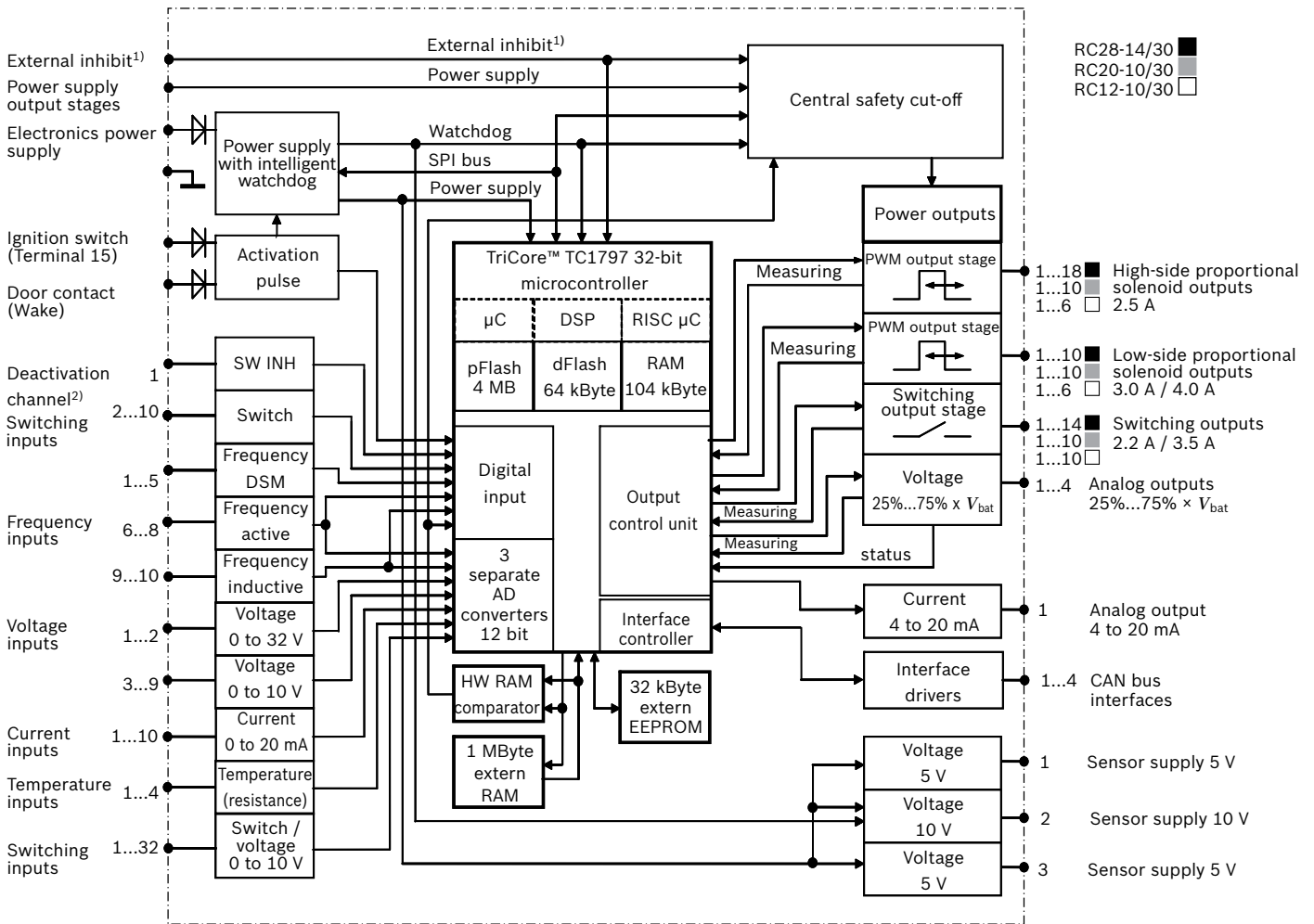
With the BODAS-service software, the programs can be quickly and easily downloaded to the control unit via the Flash module. Extensive service functions, such as diagnostics, parameter setting or display of process variables, are available via the graphical Windows interface of BODAS-service. This allows simple parameter setting and diagnostics in order to place the machine in service quickly and safely.

The BODAS RC controllers were developed specifically for use in mobile working machines and satisfy corresponding protection requirements regarding ambient temperatures, water and dust ingression, shock and vibration as well as electromagnetic compatibility (EMC).

BODAS RC controllers and corresponding software in combination with pumps, motors, valves, sensors, input devices and actuators from Bosch Rexroth make for complete system solutions.

Safety-relevant project planning instructions (95451-01-B for EN ISO 13849 and 95452-01-B for ISO 25119) have to be observed for the planning and implementation of safety functions and the two-channel stop function. These are available from Bosch Rexroth on request.

Block circuit diagram

External inhibit[1]		External inhibit[1]	RC28-14/30 ■
Power supply output stages		Power supply	RC20-10/30 ▦
Electronics power supply		Central safety cut-off	RC12-10/30 ☐

Power supply with intelligent watchdog — Watchdog, SPI bus, Power supply

Activation pulse — Ignition switch (Terminal 15), Door contact (Wake)

TriCore™ TC1797 32-bit microcontroller: μC | DSP | RISC μC; pFlash 4 MB | dFlash 64 kByte | RAM 104 kByte

Deactivation channel[2] 1 — SW INH

Switching inputs 2...10 — Switch

Frequency inputs:
- 1...5 — Frequency DSM
- 6...8 — Frequency active
- 9...10 — Frequency inductive

Voltage inputs:
- 1...2 — Voltage 0 to 32 V
- 3...9 — Voltage 0 to 10 V

Current inputs 1...10 — Current 0 to 20 mA

Temperature inputs 1...4 — Temperature (resistance)

Switching inputs 1...32 — Switch / voltage 0 to 10 V

Digital input — 3 separate AD converters 12 bit — HW RAM comparator — 1 MByte extern RAM

Output control unit — Interface controller — 32 kByte extern EEPROM

Power outputs:
- PWM output stage — Measuring — 1...18 ■ / 1...10 ▦ / 1...6 ☐ High-side proportional solenoid outputs 2.5 A
- PWM output stage — Measuring — 1...10 ■ / 1...10 ▦ / 1...6 ☐ Low-side proportional solenoid outputs 3.0 A / 4.0 A
- Switching output stage — 1...14 ■ / 1...10 ▦ / 1...10 ☐ Switching outputs 2.2 A / 3.5 A
- Voltage 25%...75% x V_{bat} — Measuring — 1...4 Analog outputs 25%...75% × V_{bat}

status

Current 4 to 20 mA — 1 Analog output 4 to 20 mA

Interface drivers — 1...4 CAN bus interfaces

Voltage 5 V — 1 Sensor supply 5 V
Voltage 10 V — 2 Sensor supply 10 V
Voltage 5 V — 3 Sensor supply 5 V

1) Input that is independent of the microcontroller, for the central enabling/deactivation of the power outputs.
2) Input for the central enabling/deactivation of the power outputs.

Abbreviations	
*μ*C	microcontroller
DSP	digital signal processor
RISC	reduced instruction set computer

Footnotes for page 5

1) Exception: GND, GND sensor, constant voltage sources and temperature inputs to battery.
2) Max. total current per group: 5 A
3) Sensor voltage inputs are raised when there is a short circuit to battery. A correct reading of sensor signals is no longer ensured. Connected sensors may be damaged.

4) Line protection. The wiring has to be rated according to the fuse protection.
5) Some functions do not comply fully with the respective specification at supply voltage < 11 V.
See also overview of functions.

Technical data

Controllers RC		28-14	20-10	12-10
		■	▣	☐
Nominal voltage	12 and 24 V		●	
Residual ripple (DIN 40839, part 1)	max. ±2 V		●	
Supply voltage, permissible range	8 to 32 V		(●)[5]	
Current consumption				
standby, in the 12 V vehicle electrical system	380 mA		●	
standby, in the 24 V vehicle electrical system	290 mA		●	
loaded, in the 12 V vehicle electrical system	max. 40 A		●	
loaded, in the 24 V vehicle electrical system	max. 40 A		●	
Fuses				
internal:			–	
external: in the supply path[4]	5 A (electronics), maximum 35 A (power outputs)		●	
Controllers enabling pin	Terminal 15 / Wake		●	
Constant voltage sources[3]				
e.g. for setpoint potentiometer				
150 mA	5 V ± 150 mV		●	
250 mA	5 V ± 250 mV		●	
1000 mA	10 V ± 500 mV		●	
Digital inputs			9	
Digital voltage inputs, diagnostics capable			32	
Analog voltage inputs, pulldown	0 to 10 V		7	
	0 to 32 V		2	
Analog current inputs, diagnostics capable	0 to 20 mA		10	
Resistor inputs				
e.g. for temperature sensors resistance measuring range	10 to 2000 Ω		4	
Frequency inputs total			10	
DSM	0 to 9 kHz		5	
	Level: 7 mA/14 mA			
Inductive sensors	0 to 10 kHz, Level: > 1 V_{RMS}		2	
Active sensors	500 Hz to 10 kHz		3	
	level low: < 1 V			
	level high: > 4 V			
Analog signal outputs total			5	
for 200 Ω load (ohmic resistance)	4 to 20 mA		1	
for 150 Ω load (ohmic resistance)	0 V (off), 0.1 to 5.0 V			
for 12 kΩ load (ohmic resistance)	0 V (off), 0% * V_{bat} to 90% * V_{bat}		4	
	(typically 25% * V_{bat} to 75% * V_{bat})			
Proportional solenoid outputs (PWM) total		28	20	12
High side current range	0 to 2.5 A	18	10	6
Pulsation frequency	0; 50 to 250 Hz			
Low side current range	0 to 3.0 A	8	8	4
	0 to 4.0 A	2	2	2
Pulsation frequency	0; 50 to 250 Hz and 1000 Hz			
Digital output stages total		14	10	10
High side current range	max. 2.2 A	10	6	6
High side current range	max. 3.5 A[2]	4	4	4
Interfaces			4	
CAN 2.0 B, ISO 11898				
Fault detection in the event of cable break and short circuit				
Analog inputs			●	
Proportional solenoid outputs			●	
Switching solenoid outputs			●	
Short circuit resistance when energized				
to supply voltage and ground for all inputs and outputs[1] [3]			(●)	

See page 4 for footnotes

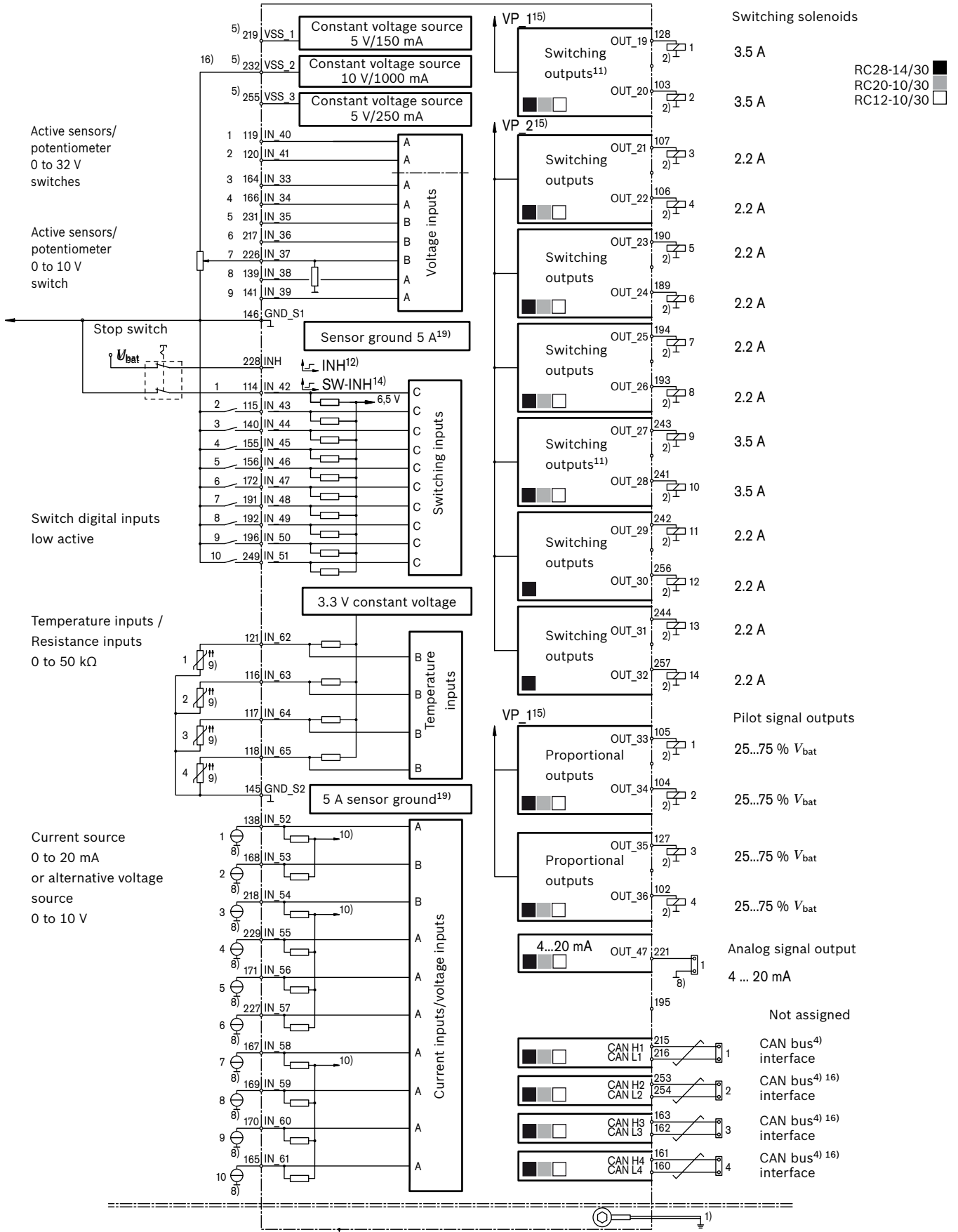| Controllers RC			28-14	20-10	12-10
			■	▨	☐
Reverse polarity protection[1]					
Power supply/battery				–	
Microcontroller				SAK-TC1797	
Clock frequency	MHz			180	
Memory capacities					
RAM	MByte			1	
Flash EPROM	MByte			4	
EEPROM	kByte			32	
Software installation Download to flash memory				●	
Electromagnetic compatibility[3]					
Spurious interference (ISO 11452-2)	200 V_{RMS}/m			●	
Spurious interference (ISO 11452-5)	100 V_{RMS}/m			●	
Electrostatic discharge ESD (according to ISO 10605)					
Out of service	8 kV			●	
In service	15 kV			●	
Max. power dissipation					
Electronics	W at 32 V			8.5	
Output stages	W at 32 V			60	
Operating temperature, housing with mounting point on cooling surface	-40 °C to +85 °C (-40 °C to +185 °F)			●	
Storage temperature, housing	Maximum permissible housing temperature in the short-term passive: -40 °C to +105 °C (-40 °C to +221 °F)			●	
Vibration resistance Broadband noise vibration (ISO 16750-3)	34 m/s², 10 to 1000 Hz, 32 h per axis 10 Hz: 18 (m/s²)²/Hz 20 Hz: 36 (m/s²)²/Hz 30 Hz: 36 (m/s²)²/Hz 180 Hz: 1 (m/s²)²/Hz 2000 Hz: 1 (m/s²)²/Hz			●	
Shock resistance Transport shock (IEC 60068-2-27)	a = 400 m/s²; t = 6 ms per spatial axis x, y, z and in each direction (pos./neg.)			●	
Moisture resistance (IEC 60068-2-30Db; variant 2)	95% (25 °C to +55 °C)			●	
Salt spray resistance (IEC 60068-2-52, test Kb)	4x 2 h salt spray (5% NaCl) 22 h at 40 °C/93% rF constant environment 72 h at storage room temperature			●	
IP rating (DIN EN 60529)[2] with assembled mating connector	IP65			●	
Housing material	Cover: Base:	Diecast aluminum Deep-drawing aluminum		●	
Weight	approx. kg			1.0 kg	
Outer dimensions	Length (in mm)			204.5	
	Width (in mm)			203	
	Height (in mm)			40.5	
Mating connector	96-pin			1	
	58-pin			1	

1) The external fuse can serve as reverse polarity protection.

2) While following installation instructions.

3) Up to 500 kBaud when using the CAN interfaces.

Connection diagram

Optional voltage circuit breaker
3 A[3]
230 — WAKE [6]
245 — Electronics voltage supply[17]
258
35 A[7]
201 — Power output voltage supply
203
204
205
206

Ignition switch
1 A
240 — Switch-on signal

+12 V/+24 V — 30
0 V ground — 31
202
207
220
233
246
122
123
124
19)

Speed sensor
1 — 112 IN_71 — DSM
2 — 113 IN_72 — DSM
3 — 110 IN_73 — DSM
4 — 111 IN_74 — DSM
5 — 109 IN_75 — DSM
6 — 213 IN_66 — Aktiv
7 — 208 IN_67 — Aktiv
8 — 108 IN_68 — Aktiv
9 — 133 IN_69 — Ind
10 — 132 IN_70 — Ind

Frequency inputs — B, B, B, A — 18)

See next page for connection to pin 146

VP_1 [15] — Proportional solenoids

Proportional outputs	OUT_1	153	1	2.5 A
	OUT_2	177	2	2.5 A
Proportional outputs	OUT_3	154	3	2.5 A
	OUT_4	178	4	2.5 A
Proportional outputs	OUT_5	151	5	2.5 A
	OUT_6	175	6	2.5 A
Proportional outputs	OUT_7	152	7	2.5 A
	OUT_8	176	8	2.5 A
Proportional outputs	OUT_9	149	9	2.5 A
	OUT_10	173	10	2.5 A
Proportional outputs	OUT_11	150	11	2.5 A
	OUT_12	174	12	2.5 A
Proportional outputs	OUT_13	130	13	2.5 A
	OUT_14	131	14	2.5 A
Proportional outputs	OUT_15	126	15	2.5 A
	OUT_16	101	16	2.5 A
Proportional outputs	OUT_17	125	17	2.5 A
	OUT_18	129	18	2.5 A

RC28-14/30 ■
RC20-10/30 ▦
RC12-10/30 ☐

Switch digital inputs high / low active
1 — 250 IN_1 — A
2 — 236 IN_2 — A
3 — 209 IN_3 — A
4 — 147 IN_4 — A
5 — 223 IN_5 — A
6 — 148 IN_6 — A
7 — 159 IN_7 — B
8 — 158 IN_8 — A
9 — 214 IN_9 — A
10 — 157 IN_10 — B
11 — 252 IN_11 — A
12 — 238 IN_12 — A
13 — 222 IN_13 — A
14 — 210 IN_14 — B
15 — 136 IN_15 — A
16 — 137 IN_16 — A
17 — 135 IN_17 — B
18 — 134 IN_18 — A
19 — 211 IN_19 — A
20 — 144 IN_20 — A
21 — 224 IN_21 — B
22 — 143 IN_22 — A
23 — 142 IN_23 — A
24 — 235 IN_24 — B
25 — 247 IN_25 — B
26 — 234 IN_26 — 0 V/+5 V[13] — A
27 — 225 IN_27 — A
28 — 212 IN_28 — A
29 — 248 IN_29 — A
30 — 237 IN_30 — 0 V/+5 V[13] — A
31 — 239 IN_31 — A
32 — 251 IN_32 — A

VSS_2 — Voltage inputs / Switching inputs — 18)

high / low active

Proportional solenoids

Proportional output	OUT_37	183	1	4.0 A
Proportional output	OUT_38	184	2	3.0 A
Proportional output	OUT_39	185	3	3.0 A
Proportional output	OUT_40	186	4	3.0 A
Proportional output	OUT_41	179	5	4.0 A
Proportional output	OUT_42	180	6	3.0 A
Proportional output	OUT_43	181	7	3.0 A
Proportional output	OUT_44	182	8	3.0 A
Proportional output	OUT_45	188	9	3.0 A
Proportional output	OUT_46	187	10	3.0 A

+ 20) (for each above)

GND

5) 219 VSS_1 — Constant voltage source 5 V/150 mA

16) 5) 232 VSS_2 — Constant voltage source 10 V/1000 mA

5) 255 VSS_3 — Constant voltage source 5 V/250 mA

VP_1 [15]   Switching solenoids

OUT_19   128   1   3.5 A
2)

OUT_20   103   2   3.5 A
2)

RC28-14/30 ■
RC20-10/30 ▨
RC12-10/30 □

Active sensors/
potentiometer
0 to 32 V
switches

1 119 IN_40   A
2 120 IN_41   A
3 164 IN_33   A
4 166 IN_34   A
5 231 IN_35   B
6 217 IN_36   B

Active sensors/
potentiometer
0 to 10 V
switch

7 226 IN_37   B
8 139 IN_38   A
9 141 IN_39   A

Voltage inputs

146 GND_S1

Stop switch

U_{bat}

228 INH

Sensor ground 5 A [19]

INH [12]
SW-INH [14]
6,5 V

1 114 IN_42   C
2 115 IN_43   C
3 140 IN_44   C
4 155 IN_45   C
5 156 IN_46   C
6 172 IN_47   C
7 191 IN_48   C
8 192 IN_49   C
9 196 IN_50   C
10 249 IN_51   C

Switch digital inputs
low active

Switching inputs

VP_2 [15]

Switching outputs

OUT_21   107   3   2.2 A
2)
OUT_22   106   4   2.2 A
2)

Switching outputs

OUT_23   190   5   2.2 A
2)
OUT_24   189   6   2.2 A
2)

Switching outputs

OUT_25   194   7   2.2 A
2)
OUT_26   193   8   2.2 A
2)

Switching outputs [11]

OUT_27   243   9   3.5 A
2)
OUT_28   241   10 3.5 A
2)

Switching outputs

OUT_29   242   11 2.2 A
2)
OUT_30   256   12 2.2 A
2)

Switching outputs

OUT_31   244   13 2.2 A
2)
OUT_32   257   14 2.2 A
2)

3.3 V constant voltage

Temperature inputs /
Resistance inputs
0 to 50 kΩ

121 IN_62   B
1 9)
116 IN_63   B
2 9)
117 IN_64   B
3 9)
118 IN_65   B
4 9)

145 GND_S2

Temperature inputs

5 A sensor ground [19]

VP_1 [15]   Pilot signal outputs

Proportional outputs

OUT_33   105   1   25...75 % V_{bat}
2)
OUT_34   104   2   25...75 % V_{bat}
2)

Current source
0 to 20 mA
or alternative voltage
source
0 to 10 V

1 138 IN_52   A
8)   10)
2 168 IN_53   B
8)
   218 IN_54   B
3 229 IN_55   A
8)   10)
4 171 IN_56   A
8)
5 227 IN_57   A
8)
6 167 IN_58   A
8)
7 169 IN_59   A
8)   10)
8 170 IN_60   A
8)
9 165 IN_61   A
8)
10
8)

Current inputs/voltage inputs

Proportional outputs

OUT_35   127   3   25...75 % V_{bat}
2)
OUT_36   102   4   25...75 % V_{bat}
2)

4...20 mA   OUT_47   221   1   Analog signal output
                    8)   4 ... 20 mA

195

Not assigned

CAN H1   215   1   CAN bus [4]
CAN L1   216   interface

CAN H2   253   2   CAN bus [4] [16]
CAN L2   254   interface

CAN H3   163   3   CAN bus [4] [16]
CAN L3   162   interface

CAN H4   161   4   CAN bus [4] [16]
CAN L4   160   interface

1)

See page 1 for connection

Connection diagram part 1
see page 7

Footnotes for pages 7 and 8

1) Short, low-resistance connection from a housing screw to the vehicle ground.
2) Independent ground connection to battery (via chassis possible).
3) Separate fuse required for switches and sensors. Sensor supply application specific.
4) CAN bus: 120 Ω termination resistor and twisted pair wire required.
5) 5 V/10 V outputs can also be used as sensor supply.
6) Temporary wake up of the control unit when a signal > 8 V is applied for more than 1 sec.
7) Note max. current consumption with simultaneous actuation of proportional solenoids and switching outputs.
8) Separate ground connection for current source to the battery, control unit GND possible
9) Can be used as switching inputs if externally switched to GND.
10) For use as voltage inputs (0 to 10 V), the internal ohmic resistance can be switched by the software in groups for these inputs. Groups: inputs 1 to 2, inputs 3 to 6, inputs 7 to 10.
11) Outputs arranged in groups with 2 output stages each. Maximum permissible output current per group: 5 A
12) Primary deactivation channel for proportional and switch outputs: enabling with level > 4.5 V, deactivation with level < 1 V, cable break leads to deactivation.

13) Input groups may be switched to pull down or pull up in software.
14) Secondary deactivation channel for proportional and switch outputs: enabling with level < 0.7 V, deactivation with level > 2 V, cable break leads to deactivation.
15) Supply can be switched by the software.
16) Shuts off on response from watchdog. Temporarily interrupted for diagnostic purposes when turning on the main switch for the first time.
17) If disabled during operation, data will not be saved to the non-volatile memory and there will be no after-run.
18) A, B and C indicate different A/D converters which may be selected for redundancy reasons.
19) Terminal 31 (supply ground) and sensor ground are bridged at a star point in the control unit and connected to the housing.
20) Loads on low-side outputs should be supplied by high-side outputs so that they can also be disabled in the event of a short circuit to ground. See "Safety outputs" in the API manual. If this is not possible, the power must be routed through a relay switched via Terminal 15. In this case, the lines must be equipped with fuses. Connecting directly to Terminal 30 is not permitted.

Connection variants

Monitored potentiometer 2.5 to 5 kΩ

Fault monitoring of the potentiometer
▶ Internal measurements of the sensor supply voltage (5 V)
▶ Connection of the potentiometer to a current input, via which the current of the potentiometer is checked.
▶ Checking the loop voltage. It must be within a valid range (software).
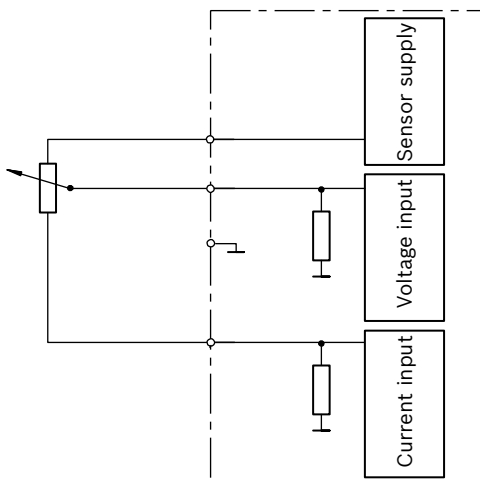
Switching input with fault detection

Fault monitoring of the switching inputs
▶ Switching of the input voltage between 10 V and 5 V
▶ Reading the switching level and checking the valid range (software)
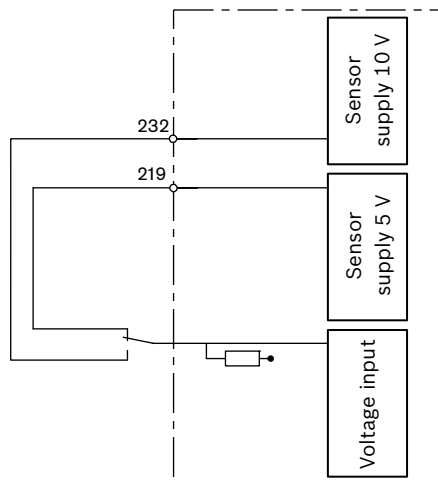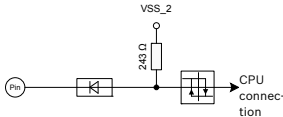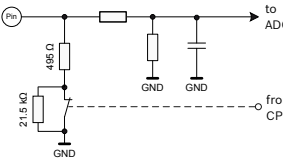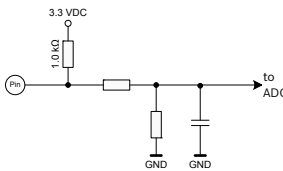
Overview of functions
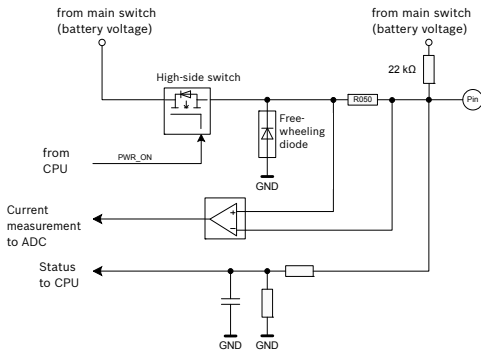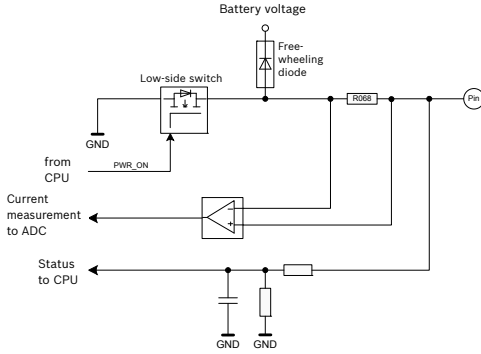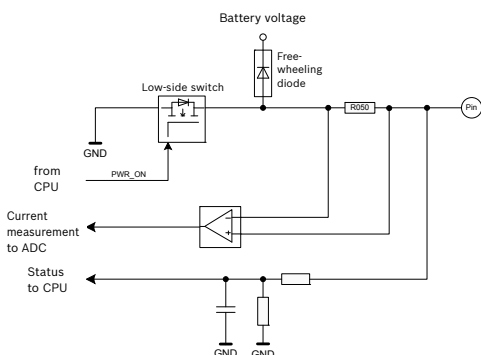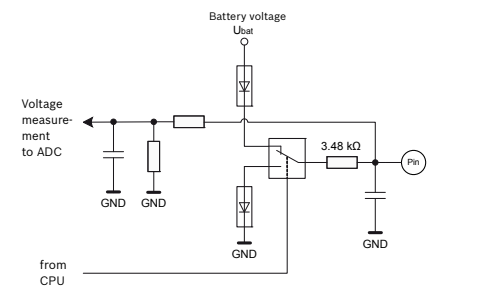
Pin	Description	Main function	Alternative functions
250, 236, 209, 147, 223, 148, 159, 158, 214, 157, 252, 238, 222, 210, 136, 137, 135, 134, 211, 144, 224, 143, 142, 235 VSS_2 (10 V) — 15.0 kΩ — Pin — 6.4 kΩ — GND — GND — GND — to ADC	**Digital input** IN_1 to IN_24 15 kΩ pull-up resistance to VSS_2 sensor supply[1] and 5.6 kΩ pull-down resistance to ground	**Digital input** Switching threshold configurable via software (max. 10 V) Externally switchable to GND, VSS_x or V_{bat}. If V_{bat} = 24 V then max. 10 of these inputs may be switched to 24 V simultaneously.	**Analog voltage input** Measuring range: 0 to 10 V Resolution: 12 bit (2.7 mV/bit) Input resistance DC to GND: 5.6 kΩ DC to VSS_2: 15.0 kΩ Filter frequency limit: 330 Hz Limited diagnostics of cable breakage due to fixed pull-up and pull-down resistance
247, 234, 225, 212 248, 237, 239, 251 Pin — 21.5 kΩ — 5 VDC — GND — GND — GND — to ADC — from CPU	**Digital input** Pull-up/pull-down resistance can be switched between 5V/ground in two groups IN_25 to IN_28 IN_29 to IN_32	**Digital input** Switching threshold configurable via software (max. 10 V) Externally switchable to GND, VSS_x or V_{bat}. Open terminal voltage: Pull-up: 3.5 V Pull-down: 0 V (default)	**Analog voltage input** Input resistance with pull-up configuration: 21 kΩ to 5 V and 50 kΩ to GND Input resistance with pull-down configuration: 15 kΩ to GND Filter frequency limit: 330 Hz
164, 166, 231, 217, 226, 139, 141 Pin — 21.5 kΩ — GND — GND — GND — to ADC	**Analog voltage input** IN_33 to IN_39	**Analog voltage input** Measuring range: 0 to 10 V Resolution: 12 bit (2.71 mV/bit) Input resistance DC to GND: 15 kΩ Filter frequency limit: 330 Hz	**Digital input active high** Evaluation options: Switching threshold configurable via software (max. 10 V) Externally switchable to VSS_x
119, 120 Pin — 21.5 kΩ — GND — GND — GND — to ADC	**Analog voltage input** IN_40 to IN_41	**Analog voltage input** Measuring range: 0 to 32 V Resolution: 12 bit (8.8 mV/bit) Input resistance DC to GND: 15 kΩ Filter frequency limit: 800 Hz	**Digital input active high** Evaluation options: Switching threshold configurable via software (max. 32 V) Externally switchable to VSS_x or V_{bat}
114 6.5 V — 21.5 kΩ — Pin — to Logic — GND	**Digital input** IN_42 (SW INH) 21.5 kΩ pull-up resistor to 6.5 V	**Secondary inhibit input** Activation of output stages: Level low < 0.7 V (switch to GND with low resistance) Deactivation of output stages: Level high > 2 V, ≦ V_{bat} (switch open) Cable break leads to the deactivation of all output stages.	**Digital input active low** Evaluation options: Digital switching thresholds Level low < 0.7 V (switch to GND with low resistance) Level high > 2 V (switch open) Filter frequency limit: 100 Hz

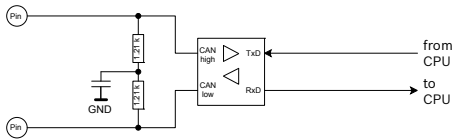[1] When $V_{bat} \geqq 11$ V, VSS_2 = 10 V; when $V_{bat} < 11$ V, VSS_2 = V_{bat} -1 V

Pin	Description	Main function	Alternative functions
115, 140, 155, 156, 172, 191, 192, 196, 249	**Digital input** IN_43 to IN_51 21.5 kΩ pull-up resistor to 6.5 V	**Digital input active low** Evaluation options: Digital switching thresholds Level low < 0.7 V (switch to GND with low resistance) Level high > 2 V (switch open) Filter frequency limit: 100 Hz	
213, 208	**Active frequency input** IN_66 to IN_67 6.8 kΩ pull-up resistor to VSS_2[1] and 24 kΩ pull-down resistor to ground	**Frequency input for Type NPN active sensors** Frequency evaluation of active speed sensors that switch to ground. Frequency evaluation up to 10 kHz Phase measuring between IN_66 (Pin 213) and IN_67 (Pin 208) Short circuit current up to 1.4 mA	**Low active digital input** Evaluation options: Switching threshold configurable via software (max. 5 V), accuracy ±0.25 V Digital switching thresholds Level low < 1 V (switch to GND with low resistance) Level high > 4 V (switch open) Open terminal voltage: > 6 V
108	**Active frequency input** IN_68 6.8 kΩ pull-up resistor to VSS_2[1] and 24 kΩ pull-down resistor to ground	**Frequency input for Type NPN active sensors** Frequency evaluation of active speed sensors that switch to ground. Frequency evaluation up to 10 kHz Short circuit current up to 1.4 mA	
133, 132	**Inductive frequency input** IN_69 to IN_70 44 kΩ pull-down resistance to ground	**Frequency input for Type PNP and NPN inductive and active sensors** Frequency evaluation: 500 Hz to 10 kHz Min. required signal amplitude: 1 V_{RMS} (sine wave) Phase measuring between IN_69 (Pin 133) and IN_70 (Pin 132)	**High active digital input** Evaluation options: Switching threshold configurable via software (max. 32 V) (switch to V_{bat} with low resistance) Open terminal voltage: < 1 V Analog voltage input Measuring range: 0 to 32 V Resolution: 12 bit (7.6 mV/bit)

[1] When $V_{bat} \geqq 11$ V, VSS_2 = 10 V; when $V_{bat} < 11$ V, VSS_2 = V_{bat} -1 V
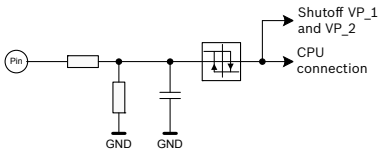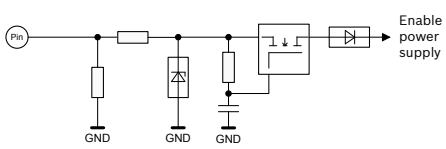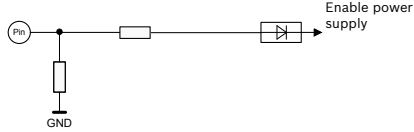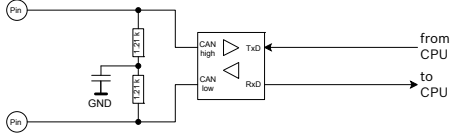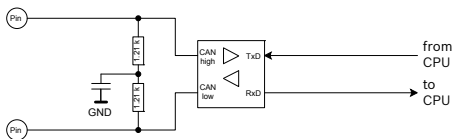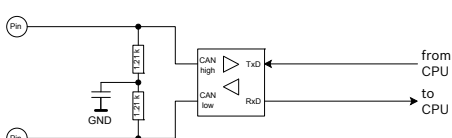
Pin	Description	Main function	Alternative functions
112, 113, 110, 111, 109	**DSM frequency input** IN_71 to IN_75 This input has an internal pull-up resistance of 243 Ω to VSS_2 (10 V).	**Frequency input for Rexroth DSM sensors** Frequency evaluation up to 9 kHz Evaluation of additional information, such as direction of rotation and fault monitoring.	**Frequency input for Type NPN active sensors** Frequency evaluation of active speed sensors that switch to ground. Level low < 5 V (7 mA) Level high > 9 V (13 mA) Phase measuring between IN_71 (Pin 112) and IN_72 (Pin 113) Phase measuring between IN_73 (Pin 110) and IN_74 (Pin 111) Attention: Short circuit current to ground up to 40 mA. Digital input switching to GND Evaluation options: - Digital current threshold 10 mA ± 3 mA

138, 168
218, 229, 171, 227
167, 169, 170, 165
	Analog current input with switchable internal ohmic resistance IN_52 to IN_61
	
	Switchable in three groups between analog current and voltage input
	
	IN_52 and IN_53
	IN_54 to IN_57
	IN_58 to IN_61
		Analog current measuring input
		Measuring range: 0 to 20 mA
		Internal ohmic resistance: 490 Ω
		Resolution: 12 bit
		    (5.5 µA/bit)
		
		Filter frequency limit: 330 Hz
		
		In 12 V applications two current inputs may be connected in parallel to halve the internal ohmic resistance.
			Analog voltage input
			Measuring range: 0 to 10 V
			Resolution: 12 bit
			    (2.71 mV/bit)
			Input resistance
			DC to GND: 12.38 kΩ
			Filter frequency limit: 330 Hz
			
			Digital input active high
			
			Evaluation options:
			Switching threshold configurable via software (max. 10 V)
			Open terminal voltage: < 1 V

121, 116, 117, 118	**Temperature input** IN_62 to IN_65 1 kΩ pull-up resistor to 3.3 V and 150 kΩ pull-down resistor to ground Not short circuit-proof to battery.	**Resistance input** Measuring range 0 .. 50 kΩ **Temperature input** Measuring range -50 .. 150 °C Can be used with Bosch Rexroth TSA or TSF (PTC) temperature sensors or Bosch NTC temperature sensors. For details see API manual.	**Digital input active low** Evaluation options: Switching threshold configurable via software (max. 3.3 V) (switch to GND with low resistance or switch open) Open terminal voltage: > 3 V Analog voltage input Measuring range: 0 to 3 V Resolution: 12 bit (0.8 mV/bit) Filter frequency limit: 230 Hz

Pin	Description	Main function	Alternative functions
153, 177, 154, 178, 151, 175, 152, 176, 149, 173, 150, 174, 130, 131, 126, 101, 125, 129	**PWM output stage** OUT_1 to OUT_18	**PWM output stage** **High-side switch** Clock frequency adjustable via software Integrated free-wheeling diode for switching of inductive loads Max. current: 2.5 A Duty factor: 0 to 100% Power supply centrally switchable via VP_1	**Switching output stage** with diagnostics duty cycle: 100%
184, 185, 186, 180, 181, 182, 188, 187	**PWM output stage** OUT_38 to OUT_40 and OUT_42 to OUT_46	**PWM output stage** **Low-side switch** Clock frequency configurable via software Integrated free-wheeling diode for switching of inductive loads Max. current: 3.0 A Duty factor: 0 to 100%	**Switching output stage** with diagnostics Duty cycle: 100%
183, 179	**PWM output stage** OUT_37 and OUT_41	**PWM output stage** **Low-side switch** Clock frequency adjustable via software Integrated free-wheeling diode for switching of inductive loads Max. current: 4.0 A Duty factor: 0 to 100% Maximum current depends on duty factor and load.	**Switching output stage** with diagnostics Duty cycle: 100%
105, 104, 127, 102	**Analog voltage output** OUT_33 to OUT_36	**PWM control voltage** Output voltage: 0% x V_{bat} to 90% x V_{bat} (typically 25% x V_{bat} to 75% x V_{bat}) 400 to 5000 Hz OUT_33 to OUT_36: Power supply centrally switchable via VP_1	

Pin	Description	Main function	Alternative functions
107, 106, 190, 189, 194, 193, 242, 256, 244, 257 	**Switching output stage with current sensing** OUT_21 to OUT_26 and OUT_29 to OUT_32	**High-side switch switching output stage**[1] Max. current 2.2 A Integrated free-wheeling diode for switching of inductive loads Power supply centrally switchable via VP_2	
128, 103, 243, 241 	**Switching output stage with current sensing** OUT_19 to OUT_20 and OUT_27 to OUT_28	**High-side switch switching output stage**[1] Max. current 3.5 A Integrated free-wheeling diode for switching of inductive loads OUT_19 to OUT_20: switchable via VP_1 OUT_27 to OUT_28: switchable via VP_2	
221 	**Analog signal output** OUT_47	**Analog current output** Output signal 4...20 mA with 200 Ω external ohmic resistance Output powered via VSS_2	**Analog voltage output** Output signal 0.5 to 5.0 V 150 Ω external ohmic resistance to ground required
219	**Sensor supply** VSS_1	**Sensor supply** Output voltage 5.0 V Accuracy ±0.15 V Load capacity 150 mA	
232	**Sensor supply** VSS_2	**Sensor supply, deactivatable** Output voltage 10.0 V[2] but not more than V_{bat} -1 V Accuracy ±0.50 V Load capacity: 1000 mA	
255	**Sensor supply** VSS_3	**Sensor supply, deactivatable** Output voltage 5.0 V Accuracy ±0.25 V Load capacity 250 mA	

[1] Software configuration as proportional output with 100% duty cycle required.

[2] When $V_{bat} \geqq 11$ V, VSS_2 = 10 V; when $V_{bat} < 11$ V, VSS_2 = V_{bat} -1 V

Pin	Description	Main function	Alternative functions
228 Shutoff VP_1 and VP_2 / CPU connection / GND GND	**External inhibit INH**	**Primary inhibit input** Activation of the output stages: Level > 4.5 V, $\leq V_{bat}$ Deactivation of output stages: Level < 1 V Cable break leads to the deactivation of all output stages. Input resistance DC to GND: 34 kΩ	
230 Enable power supply / GND GND GND	**Door contact WAKE** Enables temporary power up of the control unit	**Digital input** Switch on control unit Level > 8 V, $\leq V_{bat}$ Input resistance DC to GND: 18.5 kΩ	
240 Enable power supply / GND	**KL15 ignition switch** Power on signal for the control unit	**Digital input** Controller activation Level > 8 V, $\leq V_{bat}$ Input resistance DC to GND: 10 kΩ	
215, 216 CAN high TxD from CPU / CAN low RxD to CPU / GND	**CAN interface** CAN1_H, CAN1_L	**CAN interface** CAN 2.0 B, factory setting 250 kBaud, standard diagnostics interface up to 1 Mbaud, termination resistor in cable harness required	
253, 254 CAN high TxD from CPU / CAN low RxD to CPU / GND	**CAN interface** CAN2_H, CAN2_L	**CAN interface** CAN 2.0 B, up to 1 Mbaud, termination resistor in cable harness required	
163, 162 CAN high TxD from CPU / CAN low RxD to CPU / GND	**CAN interface** CAN3_H, CAN3_L	**CAN interface** CAN 2.0 B, up to 1 Mbaud, termination resistor in cable harness required	
161, 160 CAN high TxD from CPU / CAN low RxD to CPU / GND	**CAN interface** CAN4_H, CAN4_L	**CAN interface** CAN 2.0 B, up to 1 Mbaud, termination resistor in cable harness required	

Dimensions

Long-side side view
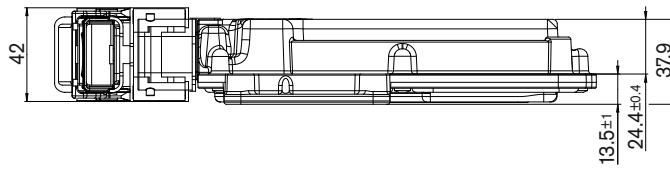
Side view of connector side
with pulled connector
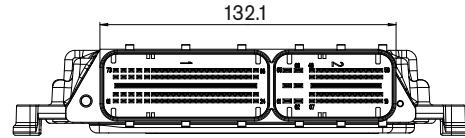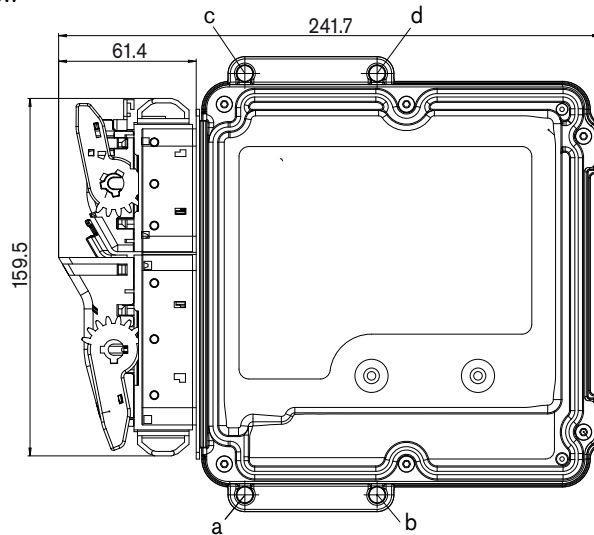
Plan view
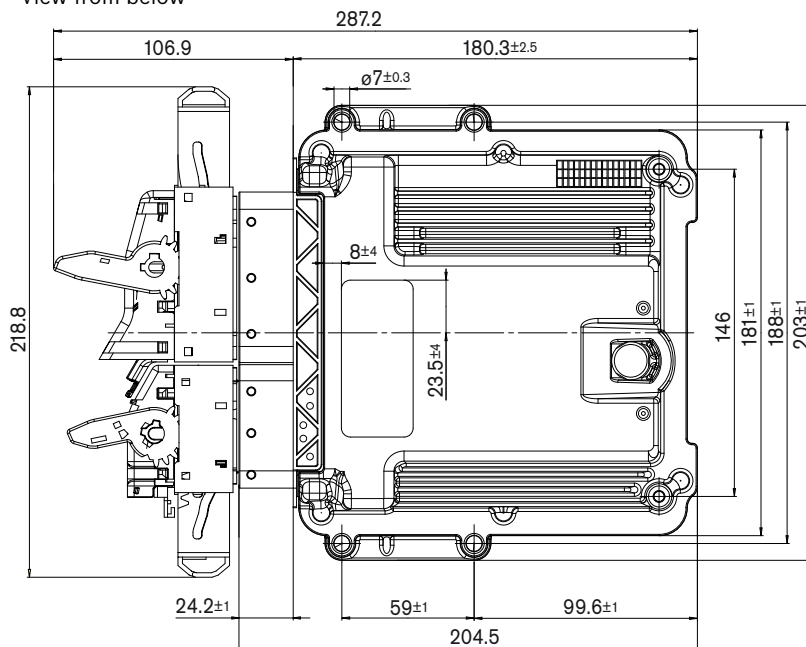
Fixing:

▶ The BODAS controller must be fixed at 4
    positions (a, b, c and d).

▶ Tightening torque MA = 8 ± 2 Nm for mount-
    ing the BODAS control unit with M6 screws.

▶ Tightening torque applies for fitting without
    washer. The equivalent tightening torque
    must be calculated when using washers.

▶ Rexroth's consent is required if fixing is
    different from above.

▶ Installation point: flatness of the mounting
    surface ▱ 0.5

▶ The wiring harness should be mechanically
    fixed in the area in which the control unit is
    installed (spacing < 150 mm).
    The wiring harness should be fixated so that
    in-phase excitation with the controller occurs
    (e.g. at the controller mounting points).

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

▶ Space required for mating connector

▶ Space required for plugging and
    unplugging the mating connector

View from below

Display without scale, dimensions in mm

Installation position

90°

360°

90°
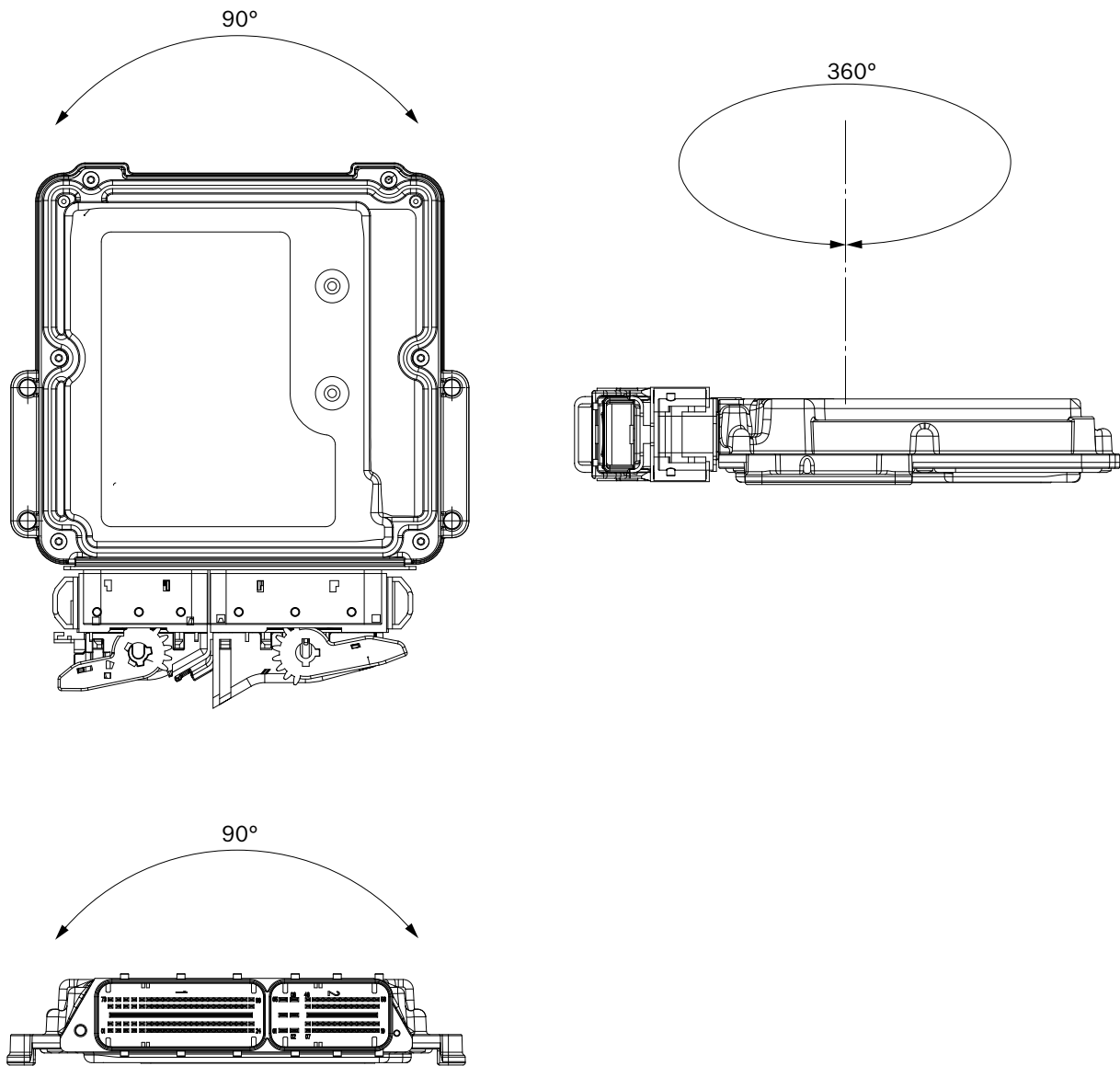
Note:
Installation position only permissible with specified angular range.

Mating connector

Order designations for the connector set with the Rexroth
material number R902603622

Designation	Number	Bosch part numbers of the individual parts	
		Module 58-pin	**Module 96-pin**
Contact carrier code: A	1 per connector	1 928 404 780	1 928 404 781
Cover pre-installed, cable exit left**)	1 per connector	1 928 404 774	1 928 404 773
Secondary lock 1.2	1 per connector	1 928 404 760	1 928 404 762
Secondary lock 2.8	1	1 928 404 761	–
Wire tie (cable tie)	1 per connector	1 928 401 713	
Contacts BDK 2.8 contact Surface: SN Insulation cross section: 2.2 to 3.0 mm Line cross section: 1.5 to 2.5 mm	6 (8)*)	1 928 498 057	–
Matrix 1.2 contact Surface: SN Insulation cross section: 1.2 to 1.6 mm Line cross section: 0.35 to 0.5 mm	52 (55)*)	1 928 498 679	–
Matrix 1.2 contact Surface: SN Insulation cross section: 1.2 to 1.6 mm Line cross section: 0.35 to 0.5 mm	96 (100)*)	–	1 928 498 679
Individual sealing White for BDK 2.8 Cross section: 2.2 to 3.0 mm	6 (8)*)	1 928 300 600	–

*) The number in the brackets indicates how many contacts or
individual seals are included in the Rexroth connector set.
The number without brackets indicates the requirement.

**) Other variants are available from Bosch.
See www.bosch-connectors.com.

View of connector strip

Connector section 1   Connector section 2
Pins 101 to 196   Pins 201 to 258
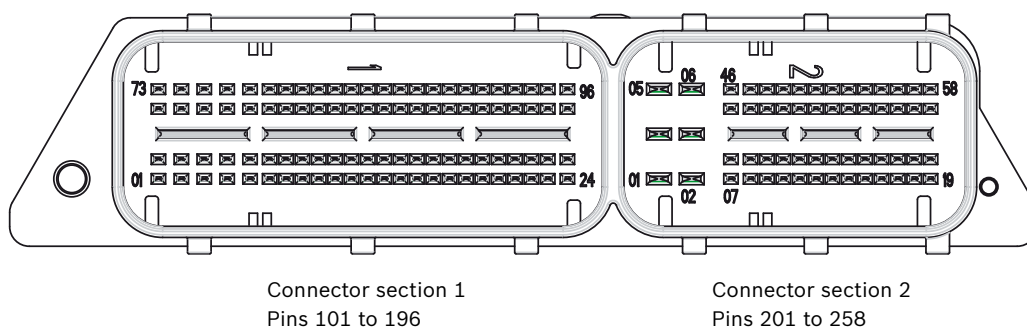
The control unit connector strip can be ordered separately
under Rexroth material number R917009804, e.g., for testing
a wiring harness. Delivery only in quantities for lab use.

Notes regarding assembly

Please observe the assembly instructions for connectors (1 928 A00 48M) as well as the processing specifications for BDK 2.8 contacts (1 928 F00 025) and Matrix 1.2 contacts (1 928 A00 47M) when assembling the connectors. These assembly instructions are available from Bosch Rexroth upon request.

Note

Please observe the following when assembling the connector in the vehicle:
The wiring harness must be attached ≤ 150 mm from the outgoing wires and at the same vibration level as the control unit.

Recommended lines

Recommended connecting lines for contacts 201 to 206:
▶ Cross section 1.5 mm² to 2.5 mm² (16 to 14 AWG, 14 AWG with thin electric insulation)
▶ Outer diameter: 2.2 mm to 3.0 mm

Recommended connecting lines for contacts 101-105, 124, 125-129, 148, 149-153, 172, 173-177, 196, 207, 220, 233, 246:
▶ Cross section 1.0 mm² to 1.5 mm² (18 to 16 AWG)
▶ Outer diameter: 1.9 to 2.1 mm for 1.0 mm², 2.2 to 2.4 mm for 1.5 mm²
Lines with a cross section of 0.35 mm² to 0.5 mm² can also be used for these contacts (see other contacts below). However, the 1.0 mm² to 1.5 mm² cross sections can make it easier to insert the contacts into the connector.

Recommended connection lines for the contacts not mentioned above:
▶ Cross section: 0.35 mm² to 0.5 mm² (22 AWG)
▶ Outer diameter: 1.2 to 1.6 mm

Required tools

Bosch part numbers for **tools**[1]

Designation	Type FLK-R line cross sections			
	BDK 2.8 contacts	Matrix 1.2 contacts		
	1.5 to 2.5 mm^2	0.35 to 0.5 mm^2	1.0 mm^2	1.5 mm^2
Contact	1 928 498 057	1 928 498 679	1 928 498 680	1 928 498 681
Crimping tool with matrix	1 928 498 162	1 928 498 212	1 928 498 213	1 928 498 214
Quick-change tool	1 928 498 164	1 928 498 720	1 928 498 722	1 928 498 723
Wear parts set	1 928 498 166	1 928 498 724	1 928 498 726	1 928 498 727
Disassembly extraction tool	1 928 498 167		1 928 498 218	
10 replacement needles for the extraction tool	1 928 498 168		1 928 498 219	

Drawings and further information about Bosch connectors and tools can be found on the internet:
www.bosch-connectors.com

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[1] Tools can be ordered from Bosch retailers or Bosch Service (www.bosch-service.com).

Safety information

General

- ▶ Reliable operation cannot be guaranteed if samples or prototypes are used in series production machines.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the control unit.
- ▶ Incorrect programming or parameter settings on the control unit may create potential dangers while the machine is in operation.
  It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Rexroth assumes no liability for dangers of this type.
- ▶ The component firmware/software must be installed or changed by Bosch Rexroth or by the authorized partner concerned in order to uphold the warranty.
- ▶ It is not permissible to open the control unit or to modify or repair the control unit. Modifications or repairs to the wiring could result in dangerous malfunctions. Repairs to the control unit may only be performed by Bosch Rexroth or by an authorized partner.
- ▶ To switch off the system in emergencies, the stop switch (two-channel stop function) or the optional de-energize switch may be used. The switch must be in an easily accessible position for the operator. The system must be designed in such a way that safe braking is ensured when the outputs are switched off.
- ▶ Make sure no pins are connected to a voltage source when the electronics is not powered. Thus, when the current supply is switched off, the supply for the electronics, the output stages and the external sensor supply have to be switched off together.
- ▶ Make sure that the control unit´s configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. Such system behavior could result in death or serious property damage.
- ▶ System developments, installation 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.

- ▶ The machine may cause unforeseen hazards during control unit commissioning and maintenance (with BODAS Tools). Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- ▶ Controllers used to develop software may only be installed in series production machines if it can be guaranteed that these control units have not been flash-programmed with new software more than 500 times. Controllers that have been programmed more than 1000 are not to be installed in series production machines.

Notes on the installation point and position

- ▶ Do not install the control unit close to parts that generate considerable heat (e.g. exhaust).
- ▶ Radio transmitting equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- ▶ A sufficiently large distance to radio transmitting systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.
- ▶ The control unit must not be electrostatically charged, e.g. during painting operations.
- ▶ The control unit will heat up beyond normal ambient temperature during operation. To avoid danger caused by high temperatures, it should be protected against contact.
- ▶ Install the control unit in such a way that the electrical plug is not facing upwards. This ensures that any condensation water that may form can flow out.
- ▶ Standing and permanently running water are not permitted anywhere near the circumferential groove (lid/base connector) or the pressure balance element (DAE).
- ▶ The case must be wired to vehicle ground in order to comply with EMC guidelines. Metallic screws are used to create a connection to vehicle ground.

Notes on transport and storage

▶ If it is dropped, the control unit must not be used any longer as invisible damage could have a negative impact on reliability.

▶ Store control units at an average relative humidity of 60% and at a temperature between -10 °C and 30 °C. Storage temperatures between -20 °C and +40 °C are briefly permissible, for up to 100 hours.

▶ After a storage time of more than 5 years, the control unit must be examined by the manufacturer.

Notes on wiring and circuitry

▶ The electronics and the power outputs of a controller must be fed from the same power source.

▶ 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.

▶ Lines to the speed sensors are to be shielded and kept as short as possible. The shield must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.

▶ The product may only be wired when it is de-energized.

▶ Lines to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.

▶ The wiring harness should be fixed mechanically in the area in which the control unit is installed (spacing < 150 mm). The wiring harness should be fixed so that in-phase excitation with the control unit occurs (e.g. at the control unit bolting point).

▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.

▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

▶ Lines are to be routed with sufficient spacing to hot or moving vehicle parts.

▶ PWM outputs must not be linked or bridged.

▶ PMW outputs (OUT_1 to OUT_18 and OUT_37 to OUT_46) must not be used to power lamps.

▶ The sensor supplies can be "pulled up" by external connection, e.g. the application of a higher voltage, because they operate only as a voltage source but not as a voltage sink! Pulling up a sensor supply may result in unexpected malfunctions and damage the control unit in continuous operation.

▶ The "high side" outputs may not be externally connected to battery.

▶ If the stop function is used in an application, contact 228 (INH) of the control unit must be connected to the stop switch in the vehicle. For a dual channel switch off function the contact SW-INH has to be connected to the stop switch too. Refer to the connection diagram.

Notes on proportional and switching solenoids and other wired inductive consumers

▶ The proportional solenoids must not be wired with free-wheeling diodes.

▶ Switching solenoids at control unit outputs do not need to be connected to free-wheeling diodes.

▶ The electronics may only be tested with the proportional solenoids connected.

▶ Other inductive loads that are in the system but not connected to the control unit must be connected to free-wheeling diodes. This also applies to relays (e.g. for shutting off the control unit) that are powered by the same source as the control unit.

Intended use

▶ The control unit 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 control unit must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.

▶ Use outside of the specified and released boundary conditions may result in hazard to persons and/or cause damage to components which could result in subsequential damage to the mobile working machine.

Improper use

▶ Any use of the control unit other than as described under "Intended use" is considered to be improper.

▶ Use in explosive areas is not permissible.

▶ Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

Use in functions relevant to safety

▶ The customer is responsible for performing risk analysis on the mobile working machine and determining the possible safety-related functions.

▶ In safety-related applications, the customer is responsible for taking suitable measures to ensure safety (sensor redundancy, plausibility check, emergency switch, etc.).

– For example, a suitable assignment of input variables (e.g., by connecting the acceleration pedal signal to two independent analog inputs) can be used to detect faults and to trigger specially programmed reactions.

– Special measures may be taken if the plausibility check shows deviations between the setpoint values and the values read back from the microcontroller.

▶ Product data that is necessary to assess the safety of the machine can be provided upon request or are listed in this data sheet.

– For all control units, the notes found in the API description, in the online help section of BODAS design and in the "safety-relevant project planning instructions" must be observed.

– The service life of the control unit may be reduced depending on the conditions in which it is used. See the "safety-relevant project planning instructions" for more information.

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 voltage supply are detected by internal monitoring.

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

▶ For service purposes, the control units can be operated with all power outputs de-energized.

▶ The internal watchdog module centrally switches off the power supply of all proportional and switched outputs when there are malfunctions in the program run.

Further information

▶ In addition, the application-specific documents (connection diagrams, software descriptions, etc.) are to be observed.

▶ More detailed information on BODAS controllers may be found at www.boschrexroth.com/mobile-electronics