

BODAS Draft sensor KMB



- ▶ Force measurement for hitch control and baling presses
- ▶ Measuring ranges ± 25 kN to ± 160 kN
- ▶ Output signal proportional voltage
- ▶ Supply voltage 5 V / 8 to 10 V
- ▶ Protection class up to IP67 / IP69K

Features

- ▶ Force sensor according to category 3 of ISO 730-1 rear-mounted three-point linkage
- ▶ Sensor element with magneto-elastic measurement principle
- ▶ Integrated electronics
- ▶ Output signal ratiometric and proportional to the force
- ▶ Zero point and sensitivity are calibrated

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Product description

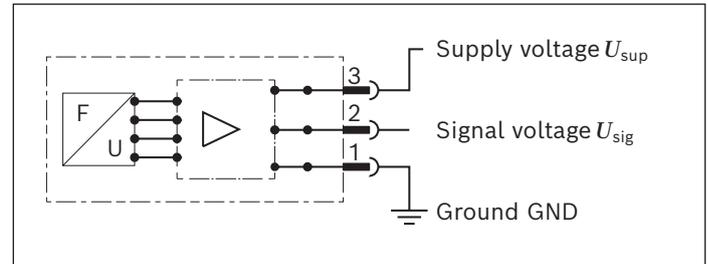
The force sensor is constructed as a bearing bolt. Shear stress arises at the bearing position which is analyzed as a magneto-elastic effect.

In the unloaded state a symmetrical magnetic field forms between the poles due to the primary coil. If tensile or compressive forces are introduced, the magnetic properties of the originally isotropic material change. The magnetic field becomes asymmetric as a result. This leads to a magnetic potential difference between the secondary poles. This causes a magnetic flux through the secondary circuit so that a voltage is induced in the secondary coils.

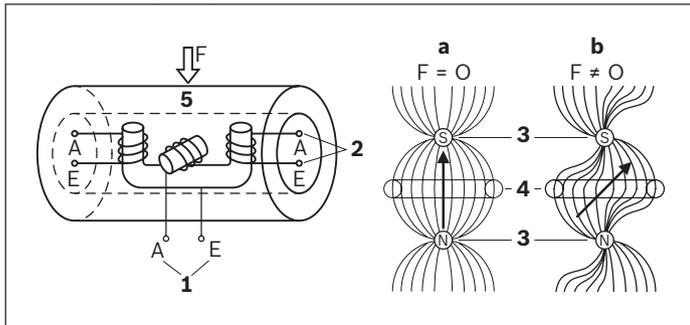
This voltage is proportional to the force that is exerted. It is amplified and rectified in an integrated evaluation circuit.

The sensor provides a ratiometric voltage (25 % to 75 % of the supply voltage). It is available for various measuring ranges and versions of cable. This sensor is a typical integral part of electro-hydraulic hitch control (EHC). This sensor is intended for being used in agricultural technology.

▼ Block diagram



▼ Functional principle



1	Primary coil
2	Secondary coil
3	Primary pole area
4	Secondary pole area
5	Steel sleeve
a	Symmetrical magnetic field
b	Asymmetrical magnetic field

Type code

01	02	03	04	05		06	07
KMB					/	30	

Type

01	Force measurement pin	KMB
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Load range

02	±25 kN	025
	±40 kN	040
	±50 kN	050
	±60 kN	060
	±90 kN	090
	±110 kN	110
	±150 kN	150
	±160 kN	160

Supply voltage

03	5 ±0.5 V	05
	8 V ... 12 V	10

Cable versions

04	Cable without protective sheath	1
	Cable with protective spiral sheath	2
	Cable with protective metal sheath	3
	Cable with protective plastic sheath	4

Connector

05	AMP JPT Connector, 3-pin	A
	DEUTSCH connector; 3-pin	B
	AMP Superseal 1.5	C

Series

06		30
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Cable length

07	800 mm	08
	965 mm	09
	1000 mm	10
	1500 mm	15
	1600 mm	16
	1800 mm	18
	2700 mm	27

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Product description

Available variants

Type	Material number
KMB 025 05 1A/30-15	R917007592
KMB 025 05 4A/30-08	R917008079
KMB 025 05 4A/30-15	R917008045
KMB 025 10 1A/30-15	R917000161
KMB 025 10 4A/30-08	R917000177
KMB 025 10 4A/30-10	R917000158
KMB 025 10 4A/30-15	R917000175
KMB 040 05 1A/30-15	R917008099
KMB 040 05 3A/30-15	R917008667
KMB 040 05 4A/30-18	R917008003
KMB 040 10 1A/30-15	R917000153
KMB 040 10 2A/30-27	R917000160
KMB 040 10 3A/30-15	R917000155
KMB 040 10 3A/30-15	R917001320
KMB 040 10 4A/30-08	R917000167
KMB 040 10 4A/30-16	R917000159
KMB 040 10 4A/30-18	R917000180
KMB 050 05 2A/30-08	R917008224
KMB 050 05 2C/30-08	R917014886
KMB 050 10 2A/30-08	R917000157
KMB 060 05 1A/30-15	R917008098
KMB 060 10 1A/30-15	R917000154
KMB 060 10 2A/30-27	R917000164
KMB 060 05 3A/30-15	R917008077
KMB 060 10 3A/30-15	R917000156
KMB 060 05 4A/30-08	R917009962
KMB 060 05 4A/30-18	R917008060
KMB 060 10 4A/30-08	R917000166
KMB 060 10 4A/30-15	R917000173
KMB 060 10 4A/30-16	R917000165
KMB 060 10 4A/30-18	R917000181
KMB 090 10 1A/30-15	R917000168
KMB 090 10 1A/30-15	R917000171
KMB 090 10 2A/30-27	R917001969
KMB 090 05 3A/30-15	R917008078
KMB 090 10 3A/30-15	R917000163
KMB 090 05 4A/30-18	R917008061
KMB 090 10 4A/30-15	R917000172
KMB 090 10 4A/30-18	R917000275
KMB 110 05 1A/30-15	R917005142

Type	Material number
KMB 110 10 1A/30-15	R917000179
KMB 110 10 2A/30-08	R917000162
KMB 150 10 1A/30-15	R917A05986

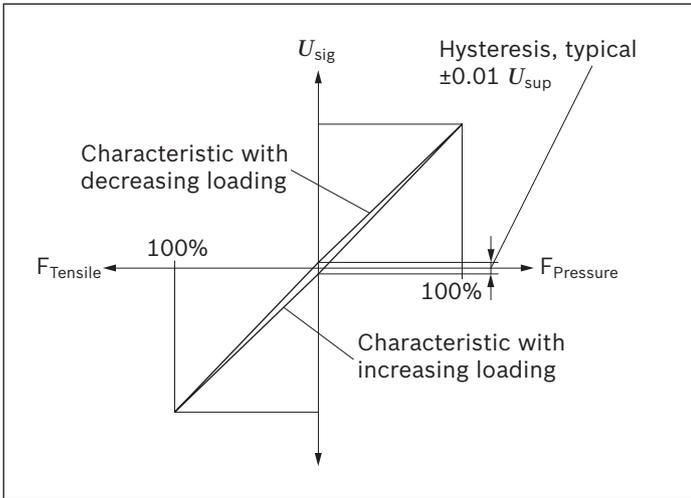
Further variants on request.

Technical data

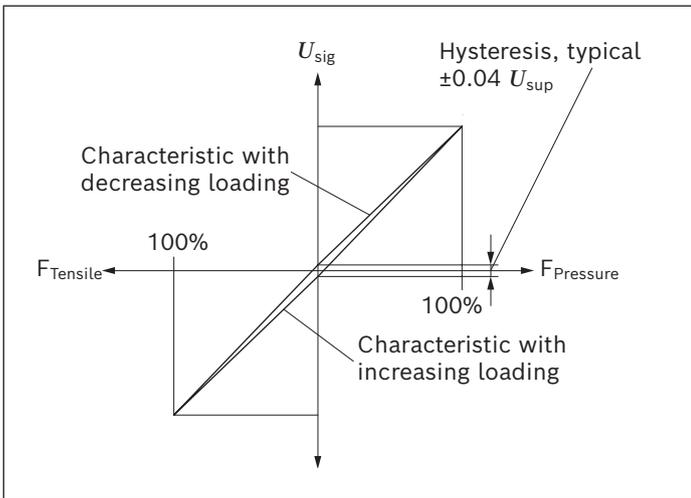
Type		025	040	050	060	090	110	150
Load range	F	±25 kN	±40 kN	±50 kN	±60 kN	±90 kN	±110 kN	±150 kN
Overload range: standard		±80 kN	±80 kN	±80 kN	±160 kN	±160 kN	±160 kN	±220 kN
Electrically measurable overload		+1.2 F _{pressure} ... -1.5 F _{tensile}						
Supply voltage	U _{sup}	8 ... 10 V controlled voltage (no direct supply from the vehicle electrical system (battery)) or 5±0.5 V						
Supply current	I _{sup}	5±0.5 V: inrush current = 1A; operating current = 20 mA (pulsed between -20 and 40 mA)						
		8 ... 10 V: inrush current = 3A; operating current = 40 mA (pulsed between -40 and 90 mA)						
Signal voltage	U _{sig}	25% ... 75% U _{sup} at 8 ... 10 V; 15% ... 85% U _{sup} at 5±0.5 V						
Lower clamping voltage	U _{Clamp Low}	8% U _{sup} at 8 ... 10 V; 12% U _{sup} at 5±0.5 V						
Upper clamping voltage	U _{Clamp High}	92% U _{sup} at 8 ... 10 V; 88% U _{sup} at 5±0.5 V						
Load resistance		≥ 10 kΩ (≥ 50 kΩ, if used in safety-related applications, where GND wire break shall be detected)						
Characteristic curve		1	1	1	2	2	2	2
Hysteresis		See offer drawings						
Operating temperature range		-35 ... +85 °C						
Maximum temperature for drying process for painting:		+130 °C at max. 2 hrs						
Type of protection with installed mating connector	AMP JPT	IP67 and IP69K						
	AMP Superseal 1.5	IP69K						
	DEUTSCH	IP66K						
Vibrational load		24 g						
Mating connector		3-pin connector with single-wire seal						
Electromagnetic compatibility	ISO 11452-5 2002-04; 1 MHz ... 2 GHz	150 V/m ≤ ±0.5% U _{sup}						
CE		ISO 14982:2009						
Storage time		5 years at an average relative humidity of 60 % and a temperature between -10 °C and +30 °C. For short periods of up to 100 hours a storage temperature of -20 °C to +40 °C is permissible						

Diagrams/characteristic curves

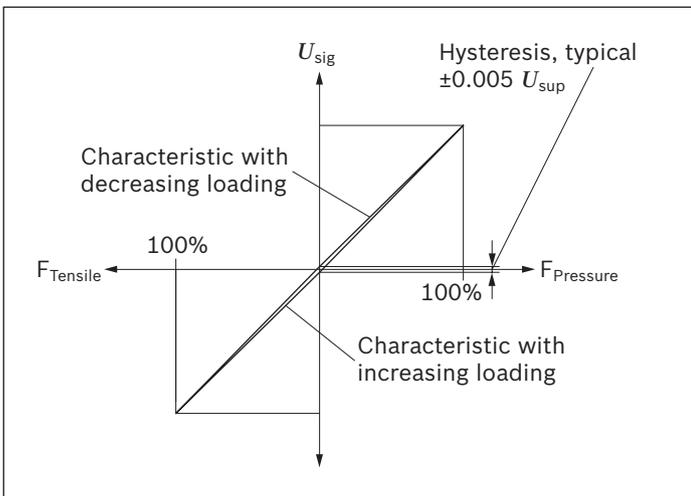
▼ Characteristic curve 1 (load range up to 50 kN or 5 V versions)



▼ Characteristic curve 1 for AMP Superseal 1.5 (load range up to 50 kN)



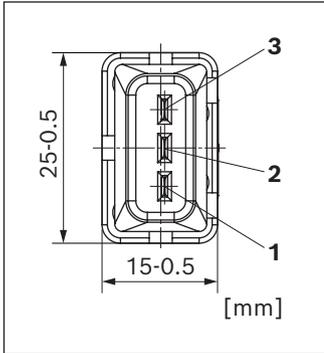
▼ Characteristic curve 2 (load range from 60 kN)



Electrical connection

Connector

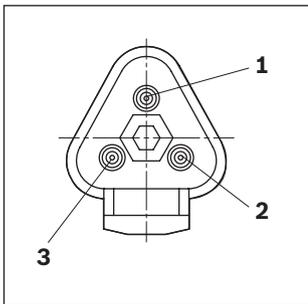
▼ Pin Assignment AMP JPT



Connecting U_{sup} with GND will cause a short-circuit. The short-circuit current must not exceed 1 A. Therefore, the current in the system must be limited.

Pin	Connection	
1	Weight	GND
2	Signal voltage	U_{sig}
3	Supply voltage	U_{sup}

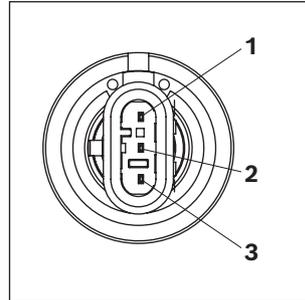
▼ Pin assignment DEUTSCH



Connecting U_{sup} with GND will cause a short-circuit. The short-circuit current must not exceed 1 A. Therefore, the current in the system must be limited.

Pin	Connection	
1	Supply voltage	U_{sup}
2	Signal voltage	U_{sig}
3	Weight	GND

▼ Pin assignment AMP Superseal 1.5



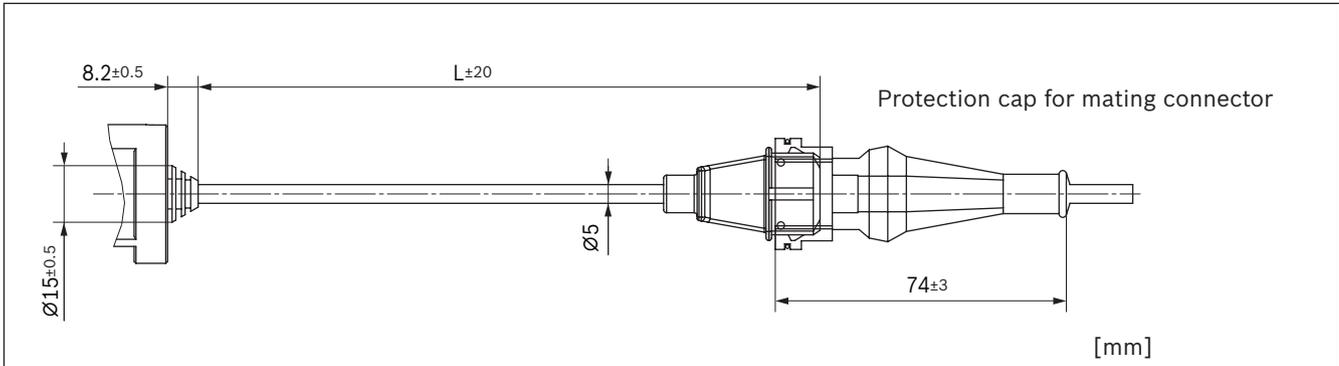
Connecting U_{sup} with GND will cause a short-circuit. The short-circuit current must not exceed 1 A. Therefore, the current in the system must be limited.

Pin	Connection	
1	Weight	GND
2	Signal voltage	U_{sig}
3	Supply voltage	U_{sup}

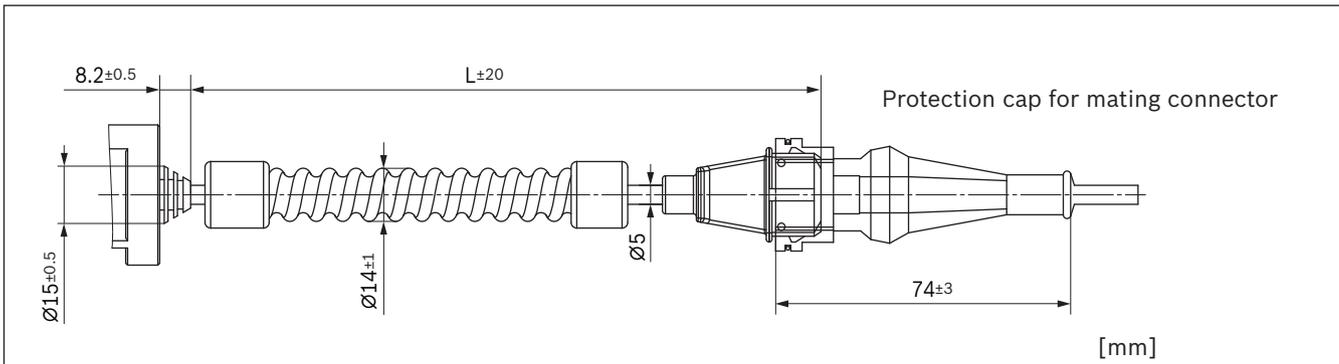
Project planning information

Cable versions

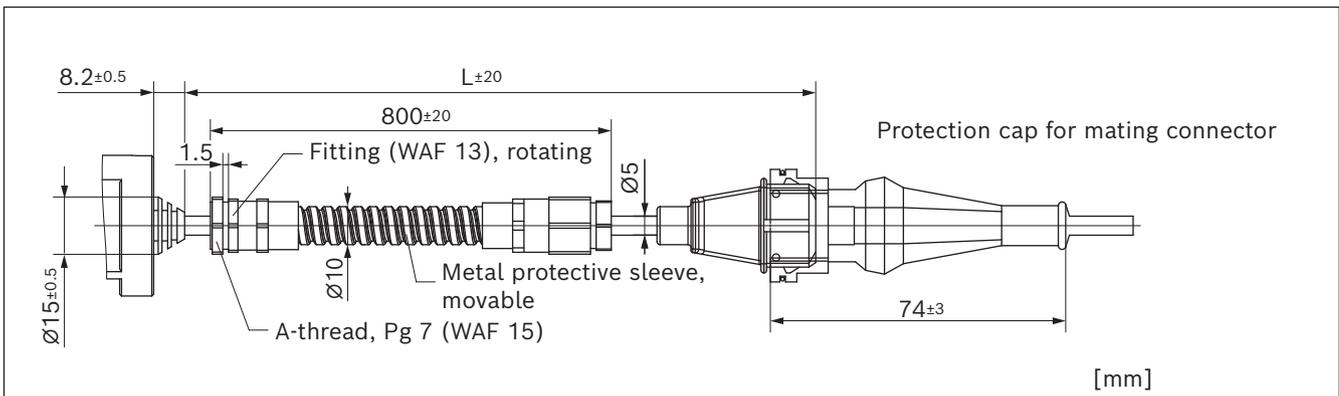
▼ Cable without protective sheath



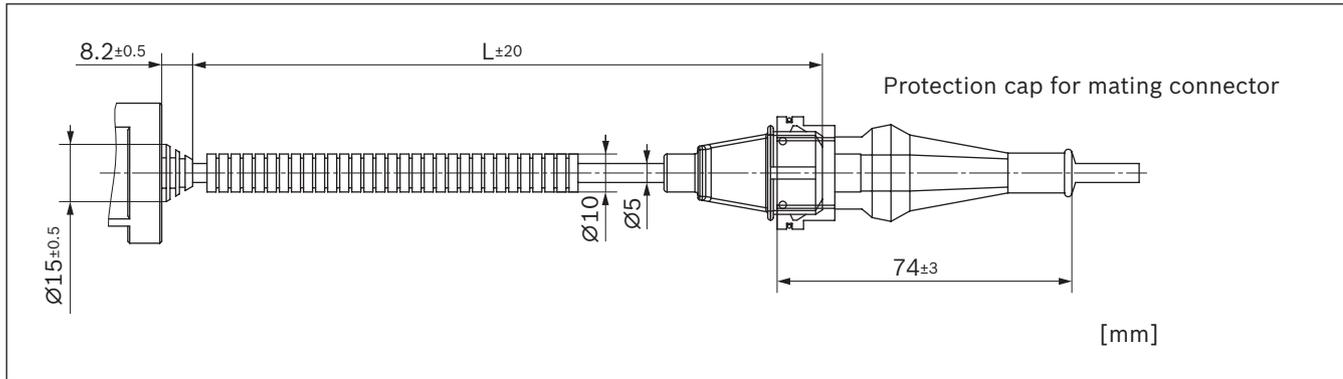
▼ Cable with protective spiral sheath



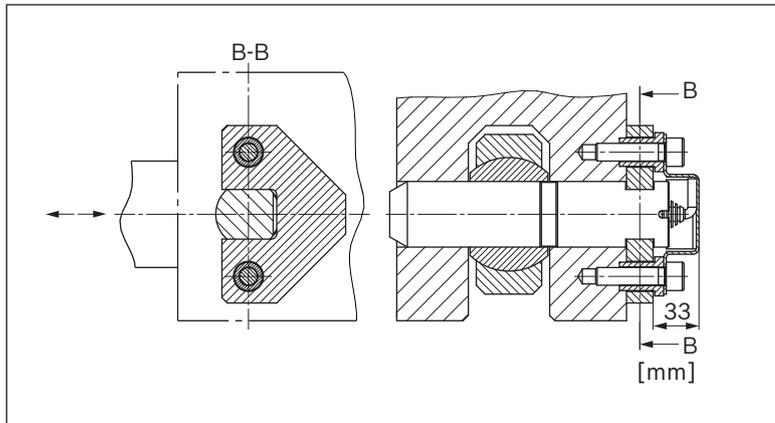
▼ Cable with protective metal sheath



▼ **Cable with protective plastic sheath**



Installation instructions



- ▶ See installation drawing Y 830 304 223 to avoid measurement uncertainties
- ▶ Defined force application, e.g. ball-type nipple
- ▶ Float mounting in radial direction with key plate

Information

Safety-related characteristics in accordance with ISO 25119:2018

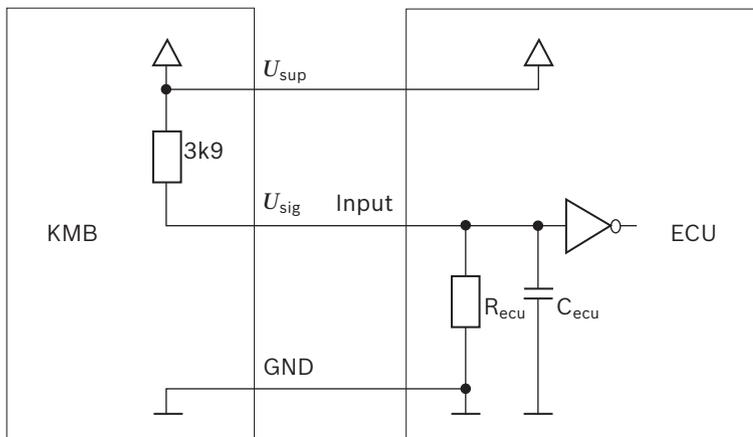
Safety function of the draft sensor KMB is defined as the system integrity, i.e. KMB should sense, calculate the force applied on it correctly and convert the force into corresponding analog voltage output without failure.

- ▶ The KMB possesses a Category B architecture (single channel)
- ▶ The KMB contains no safety-related software
- ▶ The KMB fulfills the requirements of basic and well-tried safety principles

Temperature profile and the corresponding $MTTF_D$ and DC_{avg}

Temperature (°C)	Self heating (°C)	Working hours (%)	$MTTF_D$ (years)	$DC_{avg}^{1)}$ (%)
10	5	2	738	35
20	5	2		
30	5	12		
40	5	13		
50	5	17		
60	5	18		
70	5	15		
80	5	15		
85	5	6		

- 1) It is assumed that the machine control unit will
- monitor the sensor supply voltage, and switch off the sensor in case of over-current, over- and under-voltage.
 - react to the out of range sensor outputs, and bring the machine into machine safe state



Failure detection possibilities

The KMB contains an internal resistance of 3.9 kΩ between the U_{sup} and U_{sig} . At an open circuit failure of the KMB GND cable, the KMB internal resistance will work with the ECU internal input resistance R_{ECU} as a voltage divider and results in a U_{sig} that is dependent of the R_{ECU} but less than U_{sup} . During machine system integration, an open circuit failure of the KMB GND cable shall be simulated and the corresponding KMB output signal ($U_{OC\ GND}$) shall be measured. Please make sure (e.g. by adding additional resistors) that $U_{OC\ GND} > 92\% U_{sup}$.

Failures of the KMB that will cause out-of-range output signals and therefore detectable by the machine control system is listed in the following table:

Failure	Failure reaction	Failure response time
Connector/ wire break of U_{sig} , and/or KMB internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} < 8\% U_{sup}$	immediate
U_{sig} short circuit to U_{sup} and/or KMB internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} = U_{sup}$	immediate
U_{sig} short circuit to GND and/or KMB internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} = 0\ V$	immediate
Connector/ wire break of U_{sup} , and/or KMB internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} < 8\% U_{sup}$	250 ms ¹⁾
Connector/ wire break of GND, and/or KMB internal failures that lead to the same effect	Sensor output out-of-range: $U_{sig} > 92\% U_{sup}$	250 ms ¹⁾

1) Failure response time valid for control unit with $R_{ECU} = 50 \dots 200\ k\Omega$ and $C_{ECU} = 100\ nF$

Accessories

AMP JPT mating connector R917000515¹⁾

Designation	Number	Ordering details	
Housing	1	1928402579 ²⁾	
Protective cap	1	1280703022 ²⁾	
Contacts	3	929939 ³⁾	
Single-wire seal	3	828 905-1 ³⁾	at FLK cable type
(wire size 0.5 ... 1 mm ²)	3	828 904-1 ³⁾	at FLKr, FLX cable

AMP Superseal 1.5 mating connector⁴⁾

Designation	Number	Ordering details	
Housing	1	282 087-1 ⁵⁾	
Contacts	3	183 035-1 ⁵⁾	
Single-wire seal	3	281934-4 ⁵⁾	

DEUTSCH mating connector⁶⁾

Designation	Ordering details
Plug-in connection	DEUTSCH DT 04-3P ⁷⁾
Wedge locking	DEUTSCH W 3P ⁷⁾
Contacts	DEUTSCH 0460-202-16141 ⁷⁾

¹⁾ The mating connector is not included in the scope of delivery.

²⁾ Available from Bosch

³⁾ Available from AMP

⁴⁾ The mating connector is not included in the scope of delivery.

⁵⁾ Available from AMP

⁶⁾ The mating connector is not included in the scope of delivery.

⁷⁾ Available from DEUTSCH

Safety Instructions

General instructions

- ▶ Before finalizing your design, request a binding installation drawing.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Opening the sensor or carrying out modifications to or repairs on the sensor is prohibited. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ The sensor may only be assembled/disassembled in a deenergized state.
- ▶ Only trained and experienced specialists who are adequately familiar with both the components used and the complete system should implement system developments or install and commission electronic systems for controlling hydraulic drives.
- ▶ When commissioning the sensor, the machine may pose unforeseen hazards. 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.
- ▶ Do not use defective components or components not in proper working order. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to consider all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.
- ▶ The use of sensors by private users is not permitted, since these users do not typically have the required level of expertise.

Notes on the installation location and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g., exhaust).
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ A sufficient distance to radio systems must be maintained.
- ▶ Before electric welding and painting operations, the sensor must be disconnected from the power supply and the sensor connector must be removed.
- ▶ Cables/wires must be sealed individually to prevent water from entering the sensor.

Notes on transport and storage

- ▶ Please examine the sensor for any damage which may have occurred during transport. If there are obvious signs of damage, please inform the transport company and Bosch Rexroth immediately.
- ▶ If it is dropped, the sensor must not be used any longer, as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the sensors must be designed in order to ensure sufficient signal quality: as short as possible and if necessary shielded. In case of shielding, shield must be connected to the electronics (chassis ground not signal ground) on one side or to the device or to vehicle ground via a low resistance connection.
- ▶ The sensor mating connector must only be plugged and unplugged when it is in a deenergized state.
- ▶ The sensor lines are sensitive to spurious interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the sensor is installed (spacing < 150 mm). The wiring harness should be secured so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting 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.

Intended use

- ▶ The sensor 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 sensor must generally occur within the operating ranges specified and approved in this data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and approved boundary conditions may result in danger to life and/or cause damage to components which could result in sequential damage to the mobile working machine.
- ▶ Serious personal injury and/or damage to property may occur in case of non-compliance with the appropriate regulations.

Improper use

- ▶ Any use of the sensor other than that described in the chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permitted.
- ▶ 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.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the machine and determining the possible machine safety functions.
- ▶ It is customer's responsibility to evaluate the complete safety-related system and to determine the suitability of KMB for any machine safety functions.
 - KMB as a single component fulfills the requirements of ISO 25119:2018 AgPL b, restricted by DC. However, if used as part of a Category 2 machine safety-related system, where a better DC could be reached via monitoring by the logic subsystem and/or additional test concepts, it is capable to support a safety level up to AgPL c.
 - The KMB failure responses are listed in the table above. The KMB shall not be used if the failure responses including the response time is determined to be insufficient for the machine safety functions.
- ▶ The machine control system shall monitor the sensor supply voltage, and switch off the sensor in case of over-current, over- and under-voltage.
- ▶ The machine control system shall monitor the sensor output and react to the out-of-range outputs by bring

the machine into the safe state.

- ▶ If the KMB is operated outside the mechanical specification, this can result in a zero shift of the sensor output or even the breakage of the KMB. Appropriate methods must be implemented by the machine manufacturer to prevent and detect these failures.
- ▶ An efficient field observation process shall be established by the customer. Any field failures involving the KMB should be immediately notified to Bosch Rexroth, even if it is not covered by warranty.

Disposal

- ▶ Disposal of the sensor and packaging must be in accordance with the national environmental regulations of the country in which the sensor is used.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.de/mobilelektronik.

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