BODAS Pressure sensor
PR3

RE 95155
Edition: 11.2018
Replaces: 09.2018

- Measurement ranges to 25, 50, 160, 200, 250, 400, 600 bar
- Ratiometric output signal 0.5 to 4.5 V with 5 V supply voltage
- Fixed output signal 0.5 to 4.5 V with 8 to 36 V supply voltage
- Output signal 25% to 75% supply voltage with 8 to 12 V supply voltage
- Type of protection: IP67 and IP69K

Features

- Thin-film measurement principle
- Compact dimensions for all pressure ranges
- Shock and vibration resistant
- EMC characteristics to 100 V/m
- High resistance to pressure spikes
- Very good resistance to temperature shock

Inhalt

Ordering code

	01	02	03	04	05		06
BODAS –	**PR3**					**/**	**10**

Type

01	Pressure sensor	**PR3**

Measurement range

02	0 to 25 bar	**025**
	0 to 50 bar	**050**
	0 to 160 bar	**160**
	0 to 200 bar	**200**
	0 to 250 bar	**250**
	0 to 400 bar	**400**
	0 to 600 bar	**600**

Mechanical connection		**25, 50, 160, 200, 250, 400**	**600**	
03	G1/4 A in according to DIN EN ISO 1179-2	●	●	**G**
	M14 x 1.5 according to ISO 6149-2	–	●	**M**

Electrical connection		**25, 50**	**160**	**200**	**250, 400**	**600G**	**600M**	
04	AMP Superseal 1.5	●	●	–	●	●	–	**S**
	DEUTSCH DT04-3P	–	–	–	–	–	●	**D**
	Jet connector	–	●	●	–	–	–	**J**

Supply	**Output signal**		**25, 50**	**160GS**	**160GJ**	**200**	**250, 400**	**600GS**	**600MD**	
05	5 ±0.5 V	0.5 to 4.5 V ratiometric	●	●	–	–	●	●	–	**05**
	8 to 36 V	0.5 to 4.5 V fixed	–	–	–	–	–	–	●	**36**
	8 to 12 V	25% to 75% U_{sup}	–	–	●	●	–	–	–	**12**

Series

06		**10**

● = Available – = Not available

Available variants

Type							Material number	Minimum torque	Maximum torque
PR3	025	G	S	05	/	10	R917008819	25 Nm	30 Nm
PR3	050	G	S	05	/	10	R917008821	25 Nm	30 Nm
PR3	160	G	S	05	/	10	R917008822	25 Nm	30 Nm
PR3	250	G	S	05	/	10	R917008823	25 Nm	30 Nm
PR3	400	G	S	05	/	10	R917008824	25 Nm	30 Nm
PR3	600	G	S	05	/	10	R917008825	30 Nm	45 Nm
PR3	160	G	J	12	/	10	R917008828	25 Nm	30 Nm
PR3	200	G	J	12	/	10	R917008829	25 Nm	30 Nm
PR3	600	M	D	36	/	10	R917008826	30 Nm	45 Nm

Description

This sensor is used for measuring pressure in hydraulic circuits, but is also suitable for measuring all kinds of gases of fluid group 2 according to the pressure vessel directive up to 200 bar (e.g. air). Due to its outstanding characteristics, it is also ideally suited for use in mobile hydraulics: shock and vibration resistance, type of protection, resistance to pressure spikes, resistance to temperature shock, EMC characteristics (up to 100 V/m), and much more. The measurement principle uses a hermetically welded thin-film measurement cell, which ensures long-term leak resistance. The sensor signal can be directly evaluated by a BODAS controller RC.

Technical data

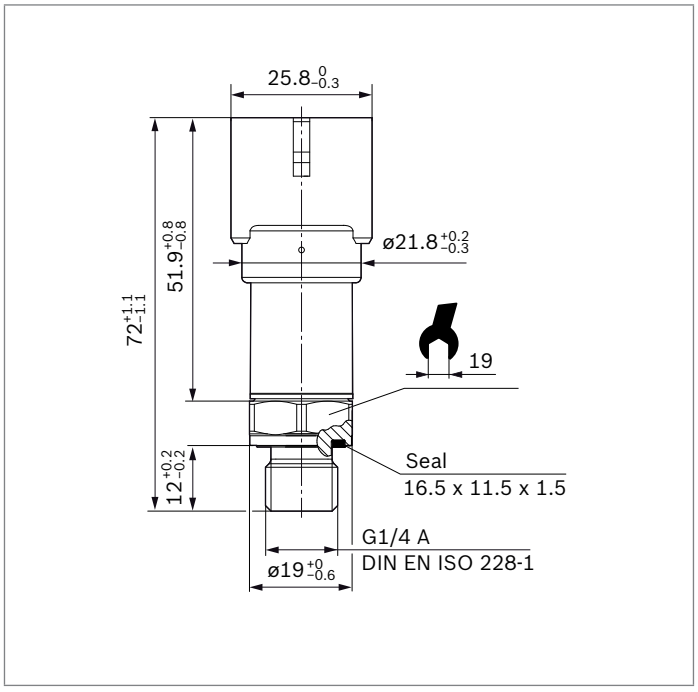
Type PR3		**025 GS05**	**050 GS05**	**160 GS05**	**250 GS05**	**400 GS05**	**600 GS05**	**600 MD36**	**160 GJ12**	**200 GJ12**
Pressure Equipment Directive		–	–	–	–	–	2014/68/EU	2014/68/EU	–	–
Measurement range	bar	0...25	0...50	0...160	0...250	0...400	0...600	0...600	0...160	0...200
Bursting pressure	bar	125	250	800	1200	1700	2400	2400	800	1000
Output signal		0.5 V to 4.5 V, ratiometric						0.5 to 4.5 V, fixed	25 to 75% U_{sup}	
Supply voltage U_{sup}		5 V ± 0.5 V						8 to 36 V	8 to 12 V	
Connector		AMP Superseal 1.5						DEUTSCH DT04-3P	Jet connector	
Parts contacting measuring materials		CrNi steel, HNBR								
Housing material		PPS GF40/CrNi steel								
Load resistance		4.5 kΩ, for Jet connectors however > 1 kΩ								
Maximum current consumption										
For voltage interface		≤ 5 mA without load								
Jet connector variants		≤ 10 mA without load								
Response time (10 to 90%)		≤ 2 ms						2 ms	≤ 2 ms	
Overall accuracy		≤ ±2%								
Reproducibility		≤ 0.2% of tensioning								
Stability per year		≤ 0.3% of tensioning (with reference conditions)								
Medium temperature range		–40 °C to +125 °C								
Ambient temperature range		–40 °C to +100 °C								
Storage temperature range		–40 °C to +120 °C								
Compensated range		0 °C to +80 °C								
Middle temperature coefficient zero point		≤ 0.15 % of tensioning / 10K in compensated range								
Middle temperature coefficient of tensioning		≤ 0.15 % of tensioning / 10K in compensated range								
Temperature error in the nominal temperature range		≤ 1 % of tensioning typ. ≤ 1.5% of tensioning								
CE conformity		Pressure vessel directive 2014/68/EU UN ECE 10 Rev4 and ISO 11452-2, -4, -5 as well as according to IEC 61000-4-3.								
E1 type approval		existing								
Pressure cycles over service life		20 million cycles (10% to 90% of nominal pressure)								
Shock resistance		50 g (DIN EN 60068-2-27, 11 ms), 500 g (DIN EN 60068-2-27, 1 ms)								
Vibration resistance		20 g (DIN EN 60068-2-6, 5 Hz to 2000 Hz)								
Electromagnetic compatibility EMC		100 V/m; Irradiation: ISO 11452-2 intensity IV; emissions: ISO 14982								
Electrical protection		Protection from voltage reversal, short circuits and undervoltage; protection from overvoltage in the defined supply voltage range								
Type of protection with installed mating connector		IP67 and IP69K								
ROHS		EU-RoHS2 compliant								
Weight		approx. 50 g								

The following oils are suitable for the PR3:

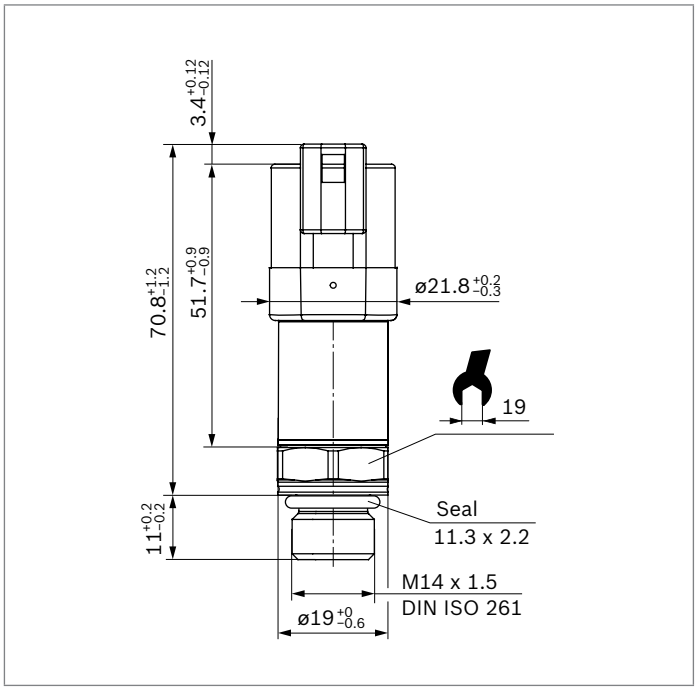
HETG, HEPG, HFE, HFB; HFB, HFC, HFA	
HEES:	Panolin HLP Synth 46
	Naturelle HF-E46
	Naturelle HFX 32
	Hydraulic HE 15
	Hydraulic HE 46
	Plantosyns Super S40
	Hydraulic oil based on mineral oils according to DIN 51524
	HLP according to DIN 51524
	Hydraulic oil HVLP 32/46/68 according to DIN 51524
	HD SAE 10 W 40
	HETG Fuchs Plantohyd 40/ Fragol TR46
	HEES Fuchs Plantosyns Super S40/ Fragol Hydraulic HE 15 + 46
	Motor oil according to API-C
	Motor oil according to API-CD
	Motor oil according to API-CF
	Colourant Renolin FST 101
HFD:	On request

Dimensions

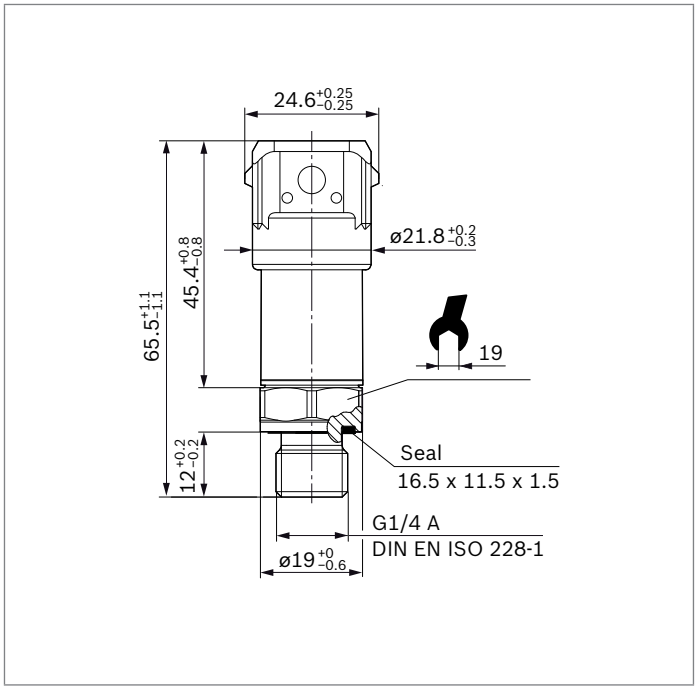
AMP Superseal



DEUTSCH DT04-3P



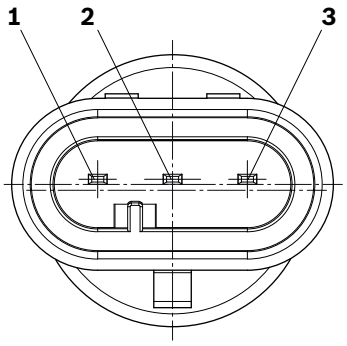
Jet connector



Connector

AMP Superseal

▼ **Pin assignment**



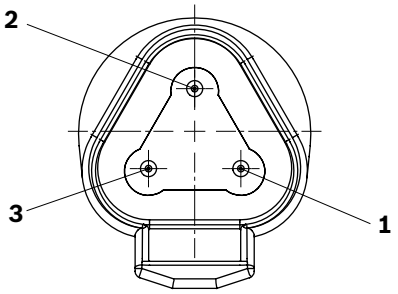
1 Ground GND
2 Signal voltage U_{sig}
3 Supply voltage U_{sup}

▼ **Mating connector** [1)]

Designation	Number	Material number
Mating connector set		R902602132[1)]
Socket housing 3-pin	1	282087-1[2)]
Single-wire seal, yellow	3	281934-2[2)]
Socket contact	3	183025-1[2)]

DEUTSCH DT04-3P

▼ **Pin assignment**



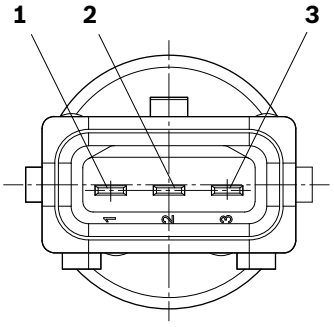
	Sensor DT04-3P	Connector DT06-3S-EP04
Ground GND	**1**	**B**
Signal voltage U_{sig}	**2**	**C**
Supply voltage U_{sup}	**3**	**A**

▼ **Mating connector** [1)]

Designation	Number	Material number
Mating connector set		R902603524[1)]
Housing 3-pin	1	DT06-3S-EP04[3)]
Wedge	1	W3S[3)]
Sockets	3	0462-201-16141[3)]

Jet connector

▼ **Pin assignment**



1 Ground GND
2 Signal voltage U_{sig}
3 Supply voltage U_{sup}

▼ **Mating connector** [1)]

Designation	Number	Material number
Bosch connector, 3-pin		R917000515[1)]
Connector housing with retention spring	1	1928402579[4)]
Contact for mini timer	3	929939[2)]
Protection cap	1	1280703022[4)]
Single seal	3	828904-1[2)]

1) The mating connectors are not included in the scope of supply. These are available from Bosch Rexroth under the corresponding material numbers.
2) Available from AMP
3) Available from DEUTSCH
4) Available from Bosch

Manufacturer confirmation of $MTTF_D$-values

The $MTTF_D$-values was determined in accordance with ISO 13849-1:2015, Appendix D, Parts Count Method.

According to ISO 13849-2:2012, the product meets the basic safety principles and the well-tried safety principles to the extent that they apply to the product.

The sensor is not a safety component in the sense of Directive on Machinery 2006/42/EC and has not been developed according to ISO 13849-1:2015, bzw. ISO 13849-2:2012.

Note
The $MTTF_D$-values given are only valid for the sensor. For assessment of the functional safety for sensors according to ISO ISO 13849-1:2015, the entire signal chain has to be considered. For this reason, the corresponding kinematics (e.g. geared ring) are also to be taken into account for sensor application in hydraulic drive units.

PR3 DEUTSCH-Connector

Valid for PR3-600MD36

Calculated with IEC TR 62380:2004 with real stress of the components

Ambient temperatur Control unit [°C]	**Self-heating [°C]**	**Temperature profile, Operating time share [%]**					
		1	**2**	**3**	**4**	**5**	**6**
10	10	1	1	1	1	1	0
30	10	2	2	2	2	1	0
40	10	3	3	3	3	1	0
50	10	4	3	3	3	1	100
60	10	5	3	3	3	1	0
70	10	6	3	3	3	1	0
80	10	79	85	3	3	1	0
90	10	0	0	82	3	1	0
100	10	0	0	0	79	92	0
110	10	0	0	0	0	0	0
125	10	0	0	0	0	0	0
$MTTF_D$-value [years] with use	4h per day	845	841	756	685	872	3547
	8h per day	802	797	712	639	617	3211
	16h per day	721	715	632	562	536	2672
	24h per day	783	774	661	570	534	4673

Ambient temperatur Control unit [°C]	**Self-heating [°C]**	**Temperature profile, Operating time share [%]**					
		7	**8**	**9**	**10**	**11**	**12**
10	10	0	0	0	0	0	0
30	10	0	0	0	0	0	0
40	10	0	0	0	0	0	0
50	10	0	0	0	0	0	0
60	10	0	0	0	0	0	0
70	10	100	0	0	0	0	0
80	10	0	100	0	0	0	0
90	10	0	0	100	0	0	0
100	10	0	0	0	100	0	0
110	10	0	0	0	0	100	0
125	10	0	0	0	0	0	100
$MTTF_D$-value [years] with use	4h per day	3017	2743	2470	2205	1952	1605
	8h per day	2582	2273	1978	1705	1457	1139
	16h per day	1977	1666	1390	1150	947	704
	24h per day	2578	1938	1469	1124	868	599

PR3 AMP-Connector

Valid for PR3-025GS05, PR3-050GS05, PR3-160GS05, PR3-250GS05, PR3-400GS05, PR3-600GS05

Calculated with IEC TR 62380:2004 with real stress of the components

Ambient temperatur Control unit [°C]	**Self-heating [°C]**	**Temperature profile, Operating time share [%]**					
		1	**2**	**3**	**4**	**5**	**6**
10	10	1	1	1	1	1	0
30	10	2	2	2	2	1	0
40	10	3	3	3	3	1	0
50	10	4	3	3	3	1	100
60	10	5	3	3	3	1	0
70	10	6	3	3	3	1	0
80	10	79	85	3	3	1	0
90	10	0	0	82	3	1	0
100	10	0	0	0	79	92	0
110	10	0	0	0	0	0	0
125	10	0	0	0	0	0	0
$MTTF_D$-value [years] with use	4h per day	1077	1071	954	856	1048	4485
	8h per day	1007	999	882	784	751	3954
	16h per day	880	871	761	668	632	3159
	24h per day	1038	1038	880	752	702	4626

Ambient temperatur Control unit [°C]	**Self-heating [°C]**	**Temperature profile, Operating time share [%]**					
		7	**8**	**9**	**10**	**11**	**12**
10	10	0	0	0	0	0	0
30	10	0	0	0	0	0	0
40	10	0	0	0	0	0	0
50	10	0	0	0	0	0	0
60	10	0	0	0	0	0	0
70	10	100	0	0	0	0	0
80	10	0	100	0	0	0	0
90	10	0	0	100	0	0	0
100	10	0	0	0	100	0	0
110	10	0	0	0	0	100	0
125	10	0	0	0	0	0	100
$MTTF_D$-value [years] with use	4h per day	3662	3260	2876	2516	2186	1751
	8h per day	3031	2606	2218	1873	1572	1199
	16h per day	2219	1827	1493	1214	984	718
	24h per day	2537	1902	1439	1098	846	582

PR3 JET-Connector

Valid for PR3-160GJ12 and PR3-200GJ12

Calculated with IEC TR 62380:2004 with real stress of the components

Ambient temperatur Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		1	**2**	**3**	**4**	**5**	**6**
10	10	1	1	1	1	1	0
30	10	2	2	2	2	1	0
40	10	3	3	3	3	1	0
50	10	4	3	3	3	1	100
60	10	5	3	3	3	1	0
70	10	6	3	3	3	1	0
80	10	79	85	3	3	1	0
90	10	0	0	82	3	1	0
100	10	0	0	0	79	92	0
110	10	0	0	0	0	0	0
125	10	0	0	0	0	0	0
$MTTF_D$-value [years] with use	4h per day	843	838	751	678	821	3543
	8h per day	788	782	695	621	596	3120
	16h per day	690	683	599	528	501	2489
	24h per day	720	711	602	515	479	3721

Ambient temperatur Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		7	**8**	**9**	**10**	**11**	**12**
10	10	0	0	0	0	0	0
30	10	0	0	0	0	0	0
40	10	0	0	0	0	0	0
50	10	0	0	0	0	0	0
60	10	0	0	0	0	0	0
70	10	100	0	0	0	0	0
80	10	0	100	0	0	0	0
90	10	0	0	100	0	0	0
100	10	0	0	0	100	0	0
110	10	0	0	0	0	100	0
125	10	0	0	0	0	0	100
$MTTF_D$-value [years] with use	4h per day	2937	2631	2334	2051	1788	1437
	8h per day	2422	2093	1788	1514	1274	974
	16h per day	1765	1458	1195	973	971	578
	24h per day	2032	1522	1151	879	677	467

Assessment of Safety Principles

List of the safety principles that must be to take into account in the higher-level system.

Basic safety principle A1	**Remarks**	**Assessment**
Application of the principle of energy separation	The safe state is achieved by connection of energy. Please check process for stopping in ISO 12100:2010, 6.2.11.3. Energy is supplied for actuation of movement of a mechanism. Please check process for movement in ISO 12100:2010, 6.2.11.3. Respect different operating categories, e.g. operating mode, maintenance mode. Important: This principle may not be applied if a dangerous situation can happen because of energy loss, e.g. release of a tool by loss of loading force.	Request has to be ensured by higher-level system.
Protection against unexpected movement	Consideration of unexpected movement caused by stored energy and after reestablishment of energy supply for different operation categories like operating mode, maintenance mode etc. A special device to let off stored energy may be is necessary. Special applications, e.g. for saving energy for clamping device or for ensuring of a position have to be considered separately.	Request has to be ensured by higher-level system.
Well-tried safety principle A2		
Application of components with defined breakdown	The predominant occurring breakdown behavior of a component is known in advance and always the same. Please check ISO 12100:2010, 6.2.12.3	Request has to be ensured by higher-level system.
Basic safety principle C1		
Application of principle energy separation	The safe state will be achieved by activating of energy at all relevant devices. Please check process for stopping in ISO 12100:2010, 6.2.11.3. Energy is supplied for actuation of movement of a mechanism.. Please check process for movement in ISO 12100:2010, 6.2.11.3. Respect different operating categories, e.g. operating mode, maintenance mode. This principle may not be applied for some applications, e.g.if because of loss of hydraulic pressure an additional endangering happens.	Request has to be ensured by higher-level system.
Protection against unexpected movement	Consideration of unexpected movement caused by stored energy and after reestablishment of energy supply for different operation categories like operating mode, maintenance mode etc. A special device to let off stored energy may be is necessary. Special applications, e.g. for saving energy for clamping device or for ensuring of a position have to be considered separately.	Request has to be ensured by higher-level system.

Basic safety principle D1	**Remarks**	**Assessment**
Application of energy separation principle	A safe state will be achieved by disconnecting all important devices from energy source, e.g. by application of a common closed contact (NC) for inputs (tactile and position switch) and common open contact (NO) for relay (see also ISO 12100:2010, 6.2.11.3). In some cases exceptions are possible, e.g. if the breakdown of energy source is an additional endangering. Time delayed functions can be necessary to achieve a safe state of the system (see IEC 60204-1:2005, 9.2.2).	Request has to be ensured by higher-level system.
Protection against unexpected movement	Protection of unexpected movement, e.g. recovering of energy supply (see ISO 12100:2010, 6.2.11.4, ISO 14118, IEC 60204-1).	Request has to be ensured by higher-level system.
Protection against steering current circuit	Steering current circuit shall be protected according to IEC 60204-1:2005, 7.2 und 9.1.1.	Request has to be ensured by higher-level system.
Well-tried safety principle D2		
Avoidance of errors in cables	In order to prevent short circuits between two lines: ▶ At every single line use a cable, which shield is connected to the protection system or ▶ In flat cables application of a protection conductor between all signal conductors.	Request has to be ensured by higher-level system.
Limiting of energy	For supply of a limited amount of energy a capacitor has to be used, e.g. for clock pulse steering.	Request has to be ensured by higher-level system.
State alignment of breakdowns	If possible in case of breakdown all devices/circuits shall switch to a safe state or safe conditions.	Request has to be ensured by higher-level system.
Directed breakdown	If realizable all components or systems shall be applied, where the case of breakdown is known ahead, (see ISO 12100:2010, 6.2.12.3).	Request has to be ensured by higher-level system.

Installation instructions

Electrical connection

- The device may only be installed by a trained electrician.
- The national and international specifications regarding the installation of electro-technical systems must be followed.
- Voltage supply according to SELV, PELV.
- De-energize the system.

Mechanical connection

- Before installing and removing the device, make certain that the system is not pressurized.

Safety instructions

Risk of injury!
Overload pressures that exceed the specified maximum permissible pressure are to be prevented through appropriate measures. The specified bursting pressure must not be exceeded. Even exceeding the bursting pressure for brief periods can destroy the device.

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.
- It is not permissible to open the BODAS pressure sensor PR3 or to modify or repair the BODAS pressure sensor PR3. Modifications or repairs to the wiring could result in dangerous malfunctions.
- Only allow pressure measurement devices to be installed by trained and specialist personnel who are authorized by the system owner.
- Connections must only be opened while in a depressurized state!
- The sensor may only be assembled/disassembled in a depressurized and deenergized state.
- In order to prevent damage at the sensor and to maintain its unobjectionable functioning, professional air bleed of the hydraulic system is required.
- 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 both the components used and with the complete system.
- While commissioning the BODAS pressure sensor PR3, the machine may pose unforeseen dangers. 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 BODAS pressure sensor PR3 should fail or demonstrate faulty operation, it must be replaced.
- Residual measurement materials in unmounted pressure measurement devices could endanger people, the environment and equipment. Take appropriate precautionary measures.
- In spite of taking great care in preparing this document, all conceivable application cases could not be taken into account. If information is lacking for your specific application, please contact Bosch Rexroth.

Pressure vessel directive

- Devices with MEV (measurement range end value) 600 bar correspond to directive 2014/68/EU and are not designed for overheated fluids of fluid group 2. These devices are manufactured and inspected according to module A.
- Devices with MEV 25 to 400 bar correspond to article 3 paragraph (3) of directive 2014/68/EU and are not designed and manufactured for overheated fluids of fluid group 2, in accordance with good engineering practice.

Notes on the installation location and position

- Do not install the BODAS pressure sensor PR3 close to parts that generate considerable heat (e.g. exhaust).
- A sufficiently large distance to radio systems must be maintained.
- The connector of the BODAS pressure sensor PR3 is to be unplugged during electrical welding and painting operations.
- Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- Please inspect the device for any damages which may have occurred during transport. If there are obvious signs of damage, please immediately inform the transport company and Bosch Rexroth.
- If it is dropped, the BODAS pressure sensor PR3 must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- Lines to the pressure sensors must be designed as short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- The BODAS pressure sensor PR3 should only be plugged and unplugged when it is in a de-energized state.
- Lines from the BODAS pressure sensor PR3 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 fixated so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting points).
- 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 distance from hot or moving vehicle parts.
- The sensor lines are sensitive to radiation 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.

Intended use

- The BODAS pressure sensor PR3 is designed for use in mobile working machines provided no limitations/ restrictions are made to certain application areas in this data sheet.
- Prior to installation, commissioning and operation, make certain that the correct pressure measurement device was selected with respect to measurement range, design and – based on the specific measurement conditions – parts which are in contact with measuring materials (corrosion). Furthermore, the respective national safety regulations are to be observed.
- Operation of the BODAS pressure sensor PR3 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 mobile working machine.
- Failure to observe the respective specifications may result in serious bodily injury and/or property damage.

Improper use

- Any use of the BODAS pressure sensor PR3 other than that described in chapter “Intended use" is considered to be improper.
- Use in explosive areas is not permissible.
- Damages which result from improper use and/or from unauthorized, interference in the component 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 mobile working machine and determining the possible safety-related functions.
- In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- Product data that is necessary to assess the safety ofthe machine are listed in this data sheet.

Further information

- Further information about the BODAS pressure sensor PR3 can be found at www.boschrexroth.com/mobile-electronics.
- The BODAS pressure sensor PR3 must be disposed according the national regulations of your country.

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