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rexroth
A Bosch Company

BODAS Temperature sensor for fluids TSF

- Typical use in fan controls
- Measuring range −40 to +150 °C
- Resistor 800 to 2000 Ω temperature dependent
- Protection class IP65

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Product description

The sensor comprises a PTC nickel thin-film resistor, which is evaporated onto a ceramic carrier substrate in a meandering pattern. Installed in a metallic radiator housing, it is used to measure the temperature of fluids. Its resistance behavior is almost linear.

Type code

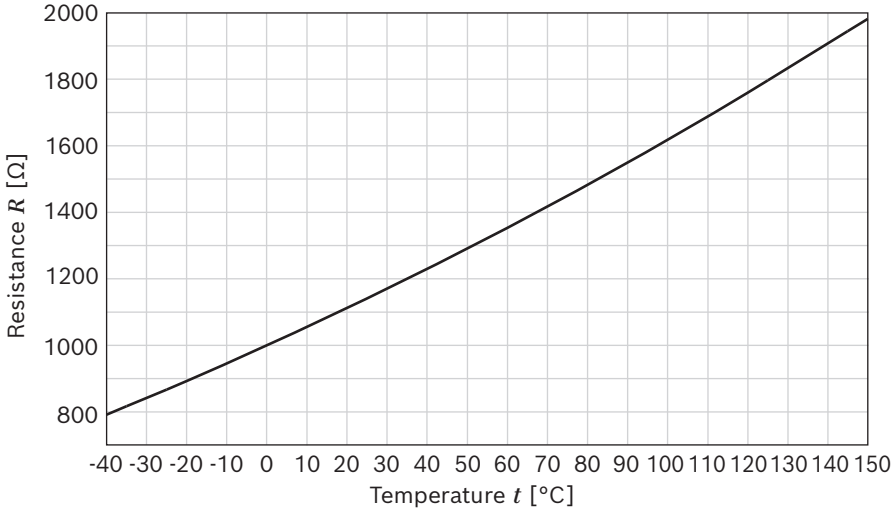
Designation	Ordering No.
TEMPERATURE SENSOR[1)]	0 538 009 252

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (see page 10 “Accessories”)

1) Without connector set

Technical data

Type		**TSF**
Measuring range		–40 ... 150 °C
Maximum pressure		150 bar
Resistor	at 0 °C	1000 Ω
Tolerance[1)]	at 20 °C	±0.5 K corresponds to ±0.3% of R20
	at 100 °C	±1.1 K corresponds to ±0.5% of R100
Supply voltage		5±0.5 V
Maximum permissible current		5 mA
Time constant (in standing water)		11 s
Delay		1 s
Vibration resistance		40 g
Type of protection		IP 65 with the connector plugged in
Plug connection		Jet connector, 2-pin
Screw thread		M14 × 1.5
Material		Brass and plastic
RoHS		EU-RoHS2-compliant
Maximum storage period from manufacturing date		2 years at relative humidity 40 ... 70 % and storage temperature –20 ... +50 °C, no storage with substances that emit aggressive steams or dusts

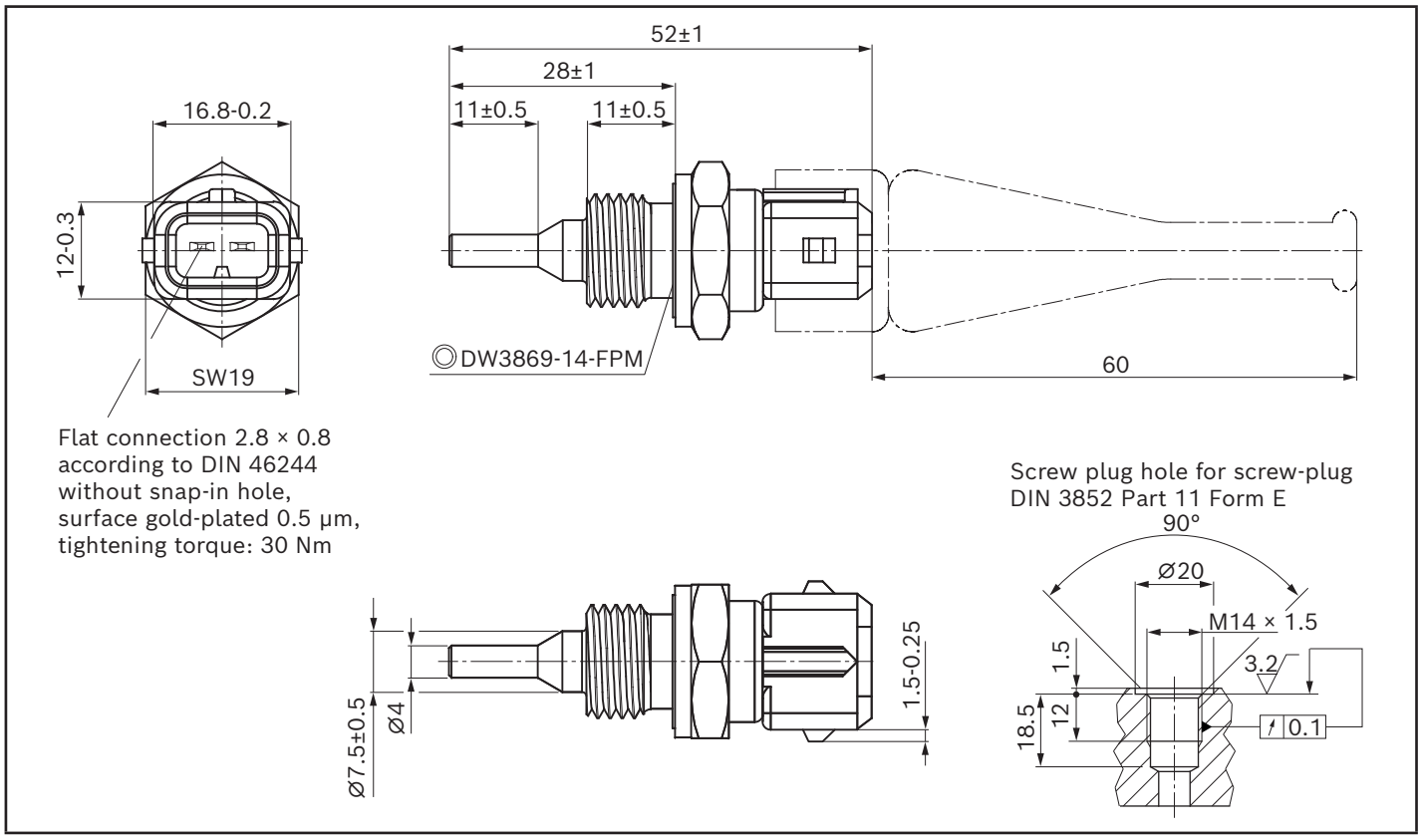


Temperature / resistance data

Temperature t	**°C**	**–40**	**–30**	**–25**	**–20**	**–15**	**–10**	**–5**	**0**	**5**	**10**
Resistor R	Ω	791.0	841.5	867.0	893.0	919.2	945.8	972.7	1000.0	1027.6	1055.5
Temperature t	**°C**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
Resistor R	Ω	1083.8	1112.4	1141.3	1170.6	1200.2	1230.1	1260.4	1291.1	1322.0	1353.4
Temperature t	**°C**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**
Resistor R	Ω	1385.1	1417.2	1449.7	1482.5	1515.7	1549.4	1583.4	1617.8	1652.7	1687.9
Temperature t	**°C**	**115**	**120**	**125**	**130**	**135**	**140**	**145**			
Resistor R	Ω	1723.6	1759.8	1796.4	1833.4	1871.0	1909.0	1947.5			

1) To determine tolerances at other temperatures, the formula applies:
Tolerance = 0.4 + 0.007 × temperature

Dimensions


52±1
28±1
11±0.5
11±0.5
16.8-0.2
12-0.3
SW19
DW3869-14-FPM
60
Flat connection 2.8 × 0.8
according to DIN 46244
without snap-in hole,
surface gold-plated 0.5 µm,
tightening torque: 30 Nm
Screw plug hole for screw-plug
DIN 3852 Part 11 Form E
90°
Ø20
M14 × 1.5
3.2
1.5
12
18.5
0.1
Ø7.5±0.5
Ø4
1.5-0.25

Information

Manufacturer confirmation of $MTTF_D$ values

The component was developed and series produced before the validity of the currently applicable machinery directive 2006/42/EC and the harmonized EN ISO 13849 standard.

The component is not a safety component in the sense of machinery directive 2006/42/EC and has not been developed according to ISO 13849.

The $MTTF_D$ value was determined according to field experience.

The $MTTF_D$ value of 455.58 is determined for 8760 hours of continuous operation in a temperature range of −40 ... 150 °C.

Rating of the safety principles based on DIN EN ISO 13849-2

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

General safety principles	Comment A1	Methods applied for development
Use of suitable materials and appropriate manufacturing processes	Selection of the materials, manufacturing and treatment processes taking into consideration, e.g. tension, durability, elasticity, friction, wear, corrosion, temperature.	Materials used are specified in the data sheet. The system operator must ensure correct selection.
Correct sizing and configuration	Accounting for e.g. tension, expansion, fatigue, surface roughness, tolerances, snagging, manufacturing processes.	Selected dimensions and configuration are specified in the data sheet. The system operator must ensure correct selection.
Suitable selection, combination, arrangement, assembly and installation of the components/system	Consideration of the manufacturer's application instructions, e.g. catalog sheets, installation instructions, specifications, as well as application of proven technical experience with similar components/ systems.	The components of the sensor are matched to one another with regard to geometry and materials.
Application of the principle of energy separation	Safe state is achieved by disconnecting from energy. See authoritative shutdown procedure in ISO 12100:2010, 6.2.11.3. Energy is required to initiate movement in a mechanism. See authoritative start-up procedure in ISO 12100:2010, 6.2.11.3. Accounting for various operating states, e.g. operating mode, maintenance mode. IMPORTANT - This principle should not be applied if a loss of power would cause a hazard, e.g. loss of clamping force releases tool.	Since the sensor is a passive component, it is supplied with current from the higher-level electronics.
Adequate mounting	Manufacturer's application instructions must be observed when using screw locks. An appropriate torque limitation method can be used to prevent excessive stress and to achieve adequate resistance to prevent the connection from loosening.	The correct mounting is specified in the data sheet (max. 30 Nm) and must be ensured by the system operator.
Limitation of the generation and/or transmission of force and like parameters	Examples include shear pin, shear plate, torque limiting coupler. IMPORTANT - This principle should not be applied if the continued integrity of the components is essential for maintaining the necessary level of control.	Not applicable to the temperature sensor (N/A).

General safety principles	Comment A1	Methods applied for development
Limitation of the range of environmental parameters	Temperature, air humidity and contamination at the installation location are examples of these parameters. See ISO 13849-2, Section 10 and the manufacturer's application instructions.	The operating temperature / ambient temperature is specified in the data sheet and is –40 ... 150 °C.
Limitation of speed and similar parameters	Observe the speed, acceleration and deceleration that are required by the application.	Not applicable to the temperature sensor (N/A).
Adequate reaction time	Observance of, e.g. reduction of spring force, friction, lubrication, temperature, inertia during acceleration and deceleration, combination of tolerances.	Response times are specified in the data sheet. Response times in water t05 = 1.2 sec / t09 = 3.2 sec.
Protection against unexpected start-up	Accounting for unexpected start-up caused by stored energy and after reestablishment of energy supply for different operating states, such as operating mode, maintenance mode, etc. A special mechanism for discharging stored energy may be necessary. Special applications, e.g., for saving energy for clamping device or for ensuring of a position have to be considered separately.	Not applicable to the temperature sensor (N/A).
Simplification	Avoidance of unnecessary components in safety-related systems.	Not applicable to the temperature sensor (N/A).
Isolation	Isolation of safety-related functions from other functions.	The temperature sensor only has one function (Temperature measurement).
Adequate lubrication	Observance of the necessity of lubrication mechanisms, specifications on lubricants and lubrication intervals.	Not applicable to the temperature sensor (N/A).
Adequate protection to keep out fluids and dust	Observance of IP type of protection (see IEC 60529).	Qualification with identical versions.

Well-tried safety principles	Comment A2	Methods applied for development
Use of carefully selected materials and manufacturing processes	Selection of suitable materials for the application, as well as appropriate manufacturing and treatment processes.	The selected material is indicated in the customer drawing; the system operator must make sure that the material is suitable.
Use of components with defined failure behavior	The predominant failure behavior of a component is known in advance and is consistent. See ISO 12100:2010, 6.2.12.3.	Not applicable to the temperature sensor (N/A).
Oversizing/ safety factor	The safety factors specified in the standards or based on experience with safety-related applications should be applied.	Not applicable to the temperature sensor (N/A).
Secured position	The mobile element of the component is mechanically held in a secure position (friction alone is insufficient). The application of force is required for movement out of the secured position.	Not applicable to the temperature sensor (N/A).
Increased OUT force	A safe position/safe state is achieved by increasing the OUT force in relation to the IN force.	Not applicable to the temperature sensor (N/A).
Careful selection, combination, arrangement, assembly and installation of the components/systems for the relevant application	-	The components of the sensor are matched to one another with regard to geometry and materials.
Careful selection of the mounting type for each application	Avoidance of mounting by friction only.	Mounting the sensor with M14 x 1.5 screw thread (friction) (see customer drawing).
Positive mechanical action	In order to achieve positive mechanical action, all mechanical moving parts necessary for performing the safety function must also move connected components, e.g. a trip that directly opens the contacts of an electric switch instead of a spring-based connection (see SO 12100:2010, 6.2.5).	Not applicable to the temperature sensor (N/A).
Multiplication of parts	Reduction in the impact of failures by using several parts of the same type that act in parallel, e.g., the failure of one of many springs does not result in a hazardous state.	Not applicable to the temperature sensor (N/A).
Use of proven springs	A proven spring requires: the use of carefully selected materials, manufacturing processes (e. g. static and dynamic setting before use) and treatment processes (e. g. rolling and shot-blasting) a sufficient guide for the spring a sufficient safety factor for continuous use (i. e. high probability of no breakage) Proven compression springs can also be designed with: the use of carefully selected materials, manufacturing processes (e. g. static and dynamic setting before use) and treatment processes (e. g. rolling and shot-blasting) a sufficient guide for the spring a distance between the coils for unloaded springs that is smaller than the wire diameter sufficient force maintained after breakage or after several breakages (i. e. breakage/ breakages does/do not result in a hazardous state). NOTE: Compression springs are preferred.	Not applicable to the temperature sensor (N/A).

Well-tried safety principles	Comment A2	Methods applied for development
Reduced range of speed and similar parameters	Setting the required limitation depending on experience and the respective application. Examples include shear pin, shear plate and torque limiting coupler. IMPORTANT - This principle should not be applied if the continued integrity of the components is essential for maintaining the necessary level of control.	Not applicable to the temperature sensor (N/A).
Reduced speed range and similar parameters	Set the required limitation depending according to experience and the respective application. Examples include centrifugal governor, secure monitoring of speed and travel limitation.	Not applicable to the temperature sensor (N/A).
Reduced environmental parameters range	Determining the necessary limitations. Examples are temperature, air humidity and contamination during installation. ISO 13849-2, observe section 10 and the manufacturer's application instructions.	The operating temperature / ambient temperature is specified in the data sheet and is –40 ... 150 °C.
Reduced reaction time range, hysteresis limitation	Determination of the necessary limitations. Observance of, e. g. reduction of spring force, friction, lubrication, temperature, inertia during acceleration and deceleration, combination of tolerances.	Not applicable to the temperature sensor (N/A).

Service and maintenance works

The following inspections and tests are recommended in certain time intervals:

- Every 12 months, the isolation resistance of the measuring circuit to the protection fitting has to be measured (in case of several measuring circuits, the insulation test is also to be carried out between the individual measuring circuits). The minimum isolation resistance at room temperature should be 100 MΩ at 100 V.
- Damage and corrosion at thermometer protective pipes
- Corrosion and correct seat at contacts and terminals of line connections
- Seals of connection heads at line ducts
- Interruptions by “knocking” at the thermometer/measuring insert

Accessories

Mating connector (connector set)

Material number	Connector set
R917000516	comprising: 1 x connector housing (Bosch-Material number 1928402571) 2 x contact (Tyco Electronics number 929 939-3) 1 x protective cap (Bosch-Material number 1280703031) 2 x single-wire seal (Tyco Electronics number 828904-1)

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request.

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, 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 mobile working machine and determining the possible safety-related functions.
- In safety-related applications, the customer is responsible for taking proper measures to ensure safety (sensor redundancy, plausibility check, emergency switch, etc.).

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.com/mobile-electronics.

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