Level sensors
Measuring oil pressure and oil temperature

PRODUCT FEATURES

- → Continuous measurement of the oil pressure
- → Continuous measurement of the oil temperature
- → Robust and reliable design

DESIGN AND FUNCTION

The OPS+T is based on a multi-chip module (MCM) consisting of a piezoresistive cell for measuring absolute pressure and also of an ASIC for digital evaluation and further processing of the information. In addition, the oil temperature can be established using a diode which is integrated in the MCM. Both the oil pressure and also the oil temperature are transmitted via the PWM output signal. The engine control unit (ECU) evaluates the PWM output signal of the sensor. The patented technology guarantees protection against oil leakage.

APPLICATION

The oil pressure and temperature sensor OPS+T is used to measure the absolute oil pressure and the oil temperature directly in the main oil channel behind the oil filter.

It uses the pressure value to carry out demand-responsive control of mechanical or electrical oil pumps. This lowers the CO_2 emissions and reduces fuel consumption. Recording of the temperature serves as input data for the thermal management of the engine. Both signals are evaluated in the higher-level control unit.

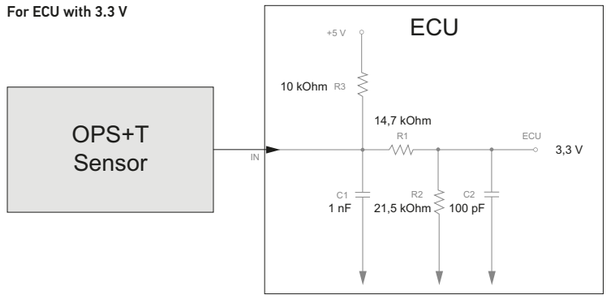
Using the multi-chip module means the sensor can be utilised in harsh environments.

EXTERNAL CIRCUITRY IN THE CONTROL UNIT

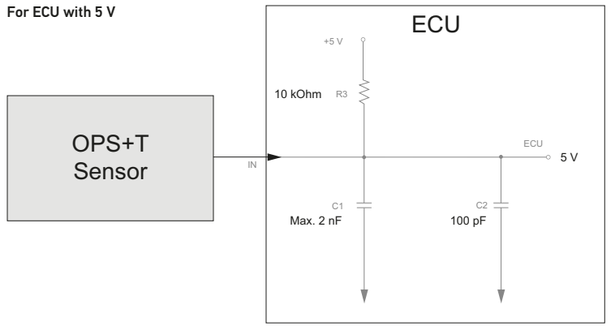
A 10 kΩ pull-up resistor should be integrated in the ECU of the vehicle in order to define an idle mode.

For optimum reading of the PWM signal, a capacitance of max. 2.2 nF should be integrated so as to compensate for the oscillations.

For ECU with 3.3 V



For ECU with 5 V



PROGRAM OVERVIEW

Mounting	Supply voltage	Measuring range	Part number	PU*
Sensor with screw thread, M12 x 1.5	4.75 – 5.25 V	Pressure 0.5 – 10.5 bar, Temperature -40°C to +160°C	**6PR 010 378-201 / 207**	1/120

* Packaging unit

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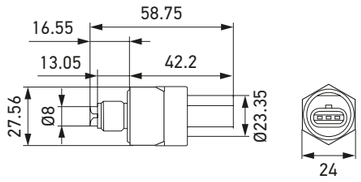
6PR 010 378-207

TECHNICAL DATA

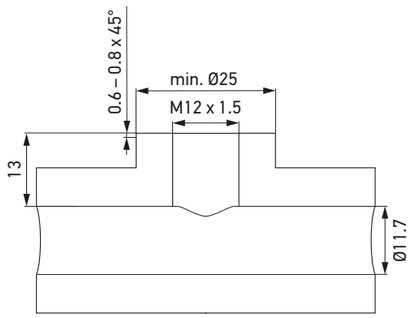
Temperature range	-40°C to +150 °C
Max. Temperature	160°C (max. 100 h)
Supply voltage	4.75 – 5.25 V
Output signal	PWM
Response time	2 ms
Sampling frequency	< 3 kHz
Max. operating pressure	40 bar
Overpressure	60 bar
Pressure measuring range	0.5 to 10.5 bar
Temperature measuring range	-40°C to +160 °C
Degree of protection	IP 69K
Mating connector[1)]	Hirschmann 872-858-541 or TE Connectivity 1-1670917-1

[1)] This accessory is not included in the scope of delivery.
Available from Hirschmann Automotive or TE Connectivity.

TECHNICAL DRAWING



INSTALLATION SPACE



TOLERANCE BAND FOR PRESSURE MEASUREMENT

Temperature	0.50–3.00 bar	3.00–5.50 bar	5.50–10.50 bar
70 °C to 160 °C	± 0.15 bar	± 0.20 bar	± 0.30 bar
20 °C to 70 °C	± 0.15 bar	± 0.20 bar	± 0.30 bar
0 °C to 20 °C	± 0.20 bar	± 0.25 bar	± 0.35 bar
-40°C to 0 °C	± 0.40 bar	± 0.40 bar	± 0.50 bar

TOLERANCE BAND FOR TEMPERATURE MEASUREMENT

Temperature	Accuracy
135 °C to 160 °C	± 1 K
20 °C to 135 °C	± 2 K
-40°C to 20 °C	± 3 K

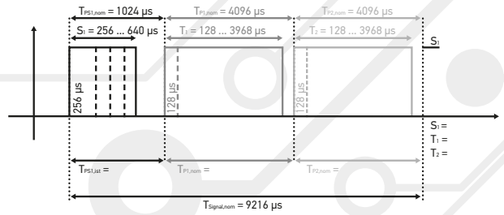
PIN ASSIGNMENT/ELECTRICAL CONNECTION

Pin 1: Power supply
Pin 2: Ground
Pin 3: Output

OUTPUT SIGNAL

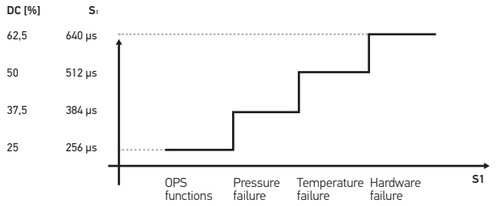
A pulse width modulated signal (PWM) is used to provide temperature, pressure and diagnostic information. All the information is sent every 9,216 µs. The higher-level control unit must be able to measure the different pulse widths of the three square wave signals, which can vary from 128 µs to 3,958 µs. The control unit must provide a suitable sampling frequency and logic for measuring and recording the signals.

General information on the evaluation of PWM communication:
Because of the adjustment accuracy of the oscillator and its temperature dependence, the length of a PWM frame is subject to a maximum tolerance of ±10 %. Serious hardware errors in the program sequence of the ASIC cancel the PWM communication and are then detectable by the control unit on account of a permanent high level.



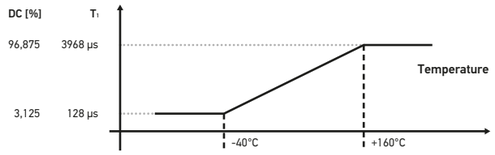
S_1: Signal
T_1: Temperature
T_2: Pressure

S_1: DIAGNOSTIC SIGNAL



DC = 0.25 (S_1 = 256 µs ± 25 µs) => OPS functional state
DC = 0.375 (S_1 = 384 µs ± 25 µs) => pressure failure
DC = 0.5 (S_1 = 512 µs ± 25 µs) => temperature failure
DC = 0.625 (S_1 = 640 µs ± 25 µs) => hardware failure

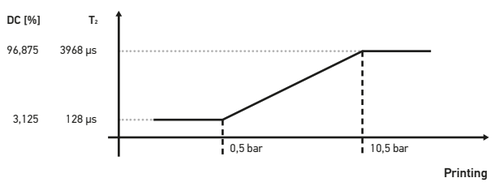
T_1: TEMPERATURE EVALUATION



96.9 % of the PWM block duration T1 (3968 µs) corresponds to the uppermost point of the measuring range of 160°C.
3.1 % of the PWM block duration T1 (128 µs) corresponds to the lowest point of the measuring range of -40°C.

$$T_1|_{\mu s} = 19.2 \frac{\mu s}{^\circ C} \text{ - Temp + 896 µs}$$

T_2: PRESSURE EVALUATION(T_2 LEVEL)



96.9 % of the PWM block duration T2 (3968 µs) corresponds to the uppermost point of the measuring range of 10.5 bar.
3.1 % of the PWM block duration T2 (128 µs) corresponds to the lowest point of the measuring range of 0.5 bar.

$$T_2|_{\mu s} = 384 \frac{\mu s}{bar} \bullet \text{Pressure - 64 µs}$$

ECU CALCULATION

$$\text{Temperature} = \left(\frac{4096\ \mu s}{T_{P1,ist}|_{\mu s}} \bullet T_1|_{\mu s} - 128\ \mu s \right) \bullet \frac{1}{19.2} \frac{^\circ C}{\mu s} - 40\ ^\circ C$$

$$\text{Pressure} = \left(\frac{4096\ \mu s}{T_{P1,ist}|_{\mu s}} \bullet T_2|_{\mu s} - 128\ \mu s \right) \bullet \frac{1}{384} \frac{bar}{\mu s} + 0.5\ bar$$

$$\text{Diagnostics} = \left(\frac{1024\ \mu s}{T_{PS1,ist}|_{\mu s}} \bullet S_1|_{\mu s} \right)$$