BRIEF INFORMATION
OPS+T (oil pressure and temperature sensor)

➔ Continuous measurement of the oil pressure
➔ Continuous measurement of the oil temperature
➔ Rugged and reliable design

PRODUCT FEATURES

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 for demand-responsive control of mechanical or electrical oil pumps. This minimizes CO$_2$ emissions and reduces fuel consumption. Recording the temperature is used as input data for thermal management of the engine. The two signals are evaluated in the higher-level control unit.

Usable in harsh environments thanks to the integration of the multi-chip module.

Design and function
The OPS+T is based on a multi-chip module (MCM), consisting a piezo-resistive cell for measuring the absolute pressure as well as an ASIC for the digital evaluation and further processing of the information. The oil temperature can also be established using a diode which is integrated in the MCM. The PWM output signal is used to transmit both the oil pressure as well as the oil temperature. The engine control unit (ECU) evaluates the PWM output signal from the sensor. The patented technology guarantees leak tightness in view of oils.
OUTPUT SIGNAL

General information for evaluating the PWM communication:
Due to the setting precision of the oscillator and its temperature dependency, 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 can be detected on the control unit by a permanent high level.

S1: Diagnosis signal

<table>
<thead>
<tr>
<th>DC (%)</th>
<th>S1</th>
</tr>
</thead>
<tbody>
<tr>
<td>42.5</td>
<td>640 µs</td>
</tr>
<tr>
<td>50</td>
<td>512 µs</td>
</tr>
<tr>
<td>37.5</td>
<td>384 µs</td>
</tr>
<tr>
<td>25</td>
<td>256 µs</td>
</tr>
</tbody>
</table>

OPS functions | Pressure failure | Temperature failure | Hardware failure

DC = 0.25 (S1 = 256 µs ± 25 µs) => OPS functional state
DC = 0.375 (S1 = 384 µs ± 25 µs) => Pressure failure
DC = 0.5 (S1 = 512 µs ± 25 µs) => Temperature failure
DC = 0.625 (S1 = 640 µs ± 25 µs) => Hardware failure

T1: Temperature evaluation

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

\[ T_{|\mu s} = 19.2 \ \frac{\mu s}{°C} \cdot \text{Temp} + 896 \ \mu s \]

T2: Pressure evaluation (T2 Level)

96.9% of the PWM blocking period T2 (3968 µs) corresponds to the highest point of the measuring range of 10.5 bar.
3.1% of the PWM blocking period T2 (128 µs) corresponds to the lowest point of the measuring range of 0.5 bar.

\[ T_{|\mu s} = 384 \ \frac{\mu s}{\text{bar}} \cdot \text{Pressure} - 64 \ \mu s \]

ECU calculation

Temperature = \( \left( 4096 \ \frac{\mu s}{T_{\text{nom,ps}}} \cdot T_{|\mu s} - 128 \ \mu s \right) \cdot \frac{1}{19.2} \ \frac{°C}{\mu s} = 40°C \)

Pressure = \( \left( 4096 \ \frac{\mu s}{T_{\text{nom,ps}}} \cdot T_{|\mu s} - 128 \ \mu s \right) \cdot \frac{1}{384} \ \frac{\text{bar}}{\mu s} + 0.5 \text{ bar} \)

Diagnostics = \( \left( 1024 \ \frac{\mu s}{T_{\text{nom,ps}}} \cdot S_{|\mu s} \right) \)
TECHNICAL DETAILS

Technical specifications

Temperature range: -40°C to 150°C
Max. temperature: 160°C (max. 100 h)
Supply voltage: 4.75 to 5.25 V
Output signal: PWM
Response time: 2 ms
Sampling frequency: < 3 kHz
Max. operating pressure: 40 bar
Overpressure: 60 bar
Pressure measurement range: 0.5 to 10.5 bar
Temperature measuring range: -40°C to 160°C
Protection class: IP69K

Tolerance band for pressure measurement

<table>
<thead>
<tr>
<th>Temperature</th>
<th>0.50 – 3.00 bar</th>
<th>3.00 – 5.50 bar</th>
<th>5.50 – 10.50 bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 – 160°C</td>
<td>+/- 0.15 bar</td>
<td>+/- 0.20 bar</td>
<td>+/- 0.30 bar</td>
</tr>
<tr>
<td>20 – 70°C</td>
<td>+/- 0.15 bar</td>
<td>+/- 0.20 bar</td>
<td>+/- 0.30 bar</td>
</tr>
<tr>
<td>0 – 20°C</td>
<td>+/- 0.20 bar</td>
<td>+/- 0.25 bar</td>
<td>+/- 0.35 bar</td>
</tr>
<tr>
<td>-40 – 0°C</td>
<td>+/- 0.40 bar</td>
<td>+/- 0.40 bar</td>
<td>+/- 0.50 bar</td>
</tr>
</tbody>
</table>

Tolerance band for temperature measurement

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>135 – 160°C</td>
<td>+/- 1 K</td>
</tr>
<tr>
<td>20 – 135°C</td>
<td>+/- 2 K</td>
</tr>
<tr>
<td>-40 – 20°C</td>
<td>+/- 3 K</td>
</tr>
</tbody>
</table>

Technical drawing

Installation space

Pin assignment

Pin 1: Supply
Pin 2: Ground
Pin 3: Output
## RANGE OVERVIEW

<table>
<thead>
<tr>
<th>Product image</th>
<th>Part number</th>
<th>Description</th>
<th>Packaging unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6PR 010 378-101</td>
<td>Oil pressure and temperature sensor</td>
<td>1 piece</td>
</tr>
<tr>
<td></td>
<td>6PR 010 378-107</td>
<td>Oil pressure and temperature sensor</td>
<td>120 pieces</td>
</tr>
</tbody>
</table>

## STRUCTURE

1 – Seal  
2 – Diffusor  
3 – Thread  
4 – Electronics with multi-chip module  
5 – Plug