



## CPOS SERIES

### *Cylinder Pressure Only Sensors*

#### WORLD CLASS SENSING TECHNOLOGY

The CPOS Series in-cylinder combustion sensor is Sensata's piezo-resistive stand-alone combustion sensing technology to detect abnormal combustion in gasoline engines and help reduce raw emissions for diesels.

With in-cylinder developments reaching back to 1985 and a company history of more than 95 years, Sensata Technologies is a leading global manufacturer of sensors and switches.

This specification describes the general functional, electrical and mechanical performance of a pressure sensor in production and intended to be used to sense combustion pressure inside an engine combustion chamber: the Cylinder Pressure Only Sensor, or CPOS. The CPOS consists of a micro-fused strain gauge (MSG), custom ASIC signal conditioning, and metal housing with integral connector. The sensor provides an analogue voltage, proportional to the applied pressure and supply voltage.

#### FEATURES

- Micro-fused strain gage (MSG) technology, proven for glow-plug integrated sensing, powertrain and safety sensors
- Stable output ( $< \pm 2\%$ ) over life
- Integrated dynamic offset compensation
- Full internal and external diagnostics: enables combustion feedback from inside the cylinder
- Bandwidth:  $> 15\text{kHz}$
- Currently in production
- Detects abnormal combustion in gasoline engines
- Helps reduce raw emissions in diesel engines

#### BENEFITS OF CLOSED LOOP COMBUSTION

- Emissions reduction: soot, NO<sub>x</sub> and/or HC
- Improve efficiency: reduce CO<sub>2</sub>, improve fuel economy
- Compensate for tolerances: engine to engine, cylinder balancing, fuel and air composition variability, etc.
- Potential savings:
  - Switch back to low cost injectors (piezo  $>$  magnet)
  - Avoid second NO<sub>x</sub> sensor for OBD, avoid fuel quality sensor, etc.
  - Eventually replace knock sensor, camshaft sensor, etc.
- Increase engine power, torque calculation (IMEP)
- Noise reduction: combustion noise (smoothness of engine) and audible noise
- Control EGR
- Reduce engine development time at OEM and service diagnostics
- Enabler for homogeneous combustion: HCCI



## CONFIGURATION

<b>Mounting Dimension</b>	HEX12
<b>Thread of the Pressure Port</b>	M10x1 (M8 available)
<b>Electrical Connector</b>	Coaxial connection system

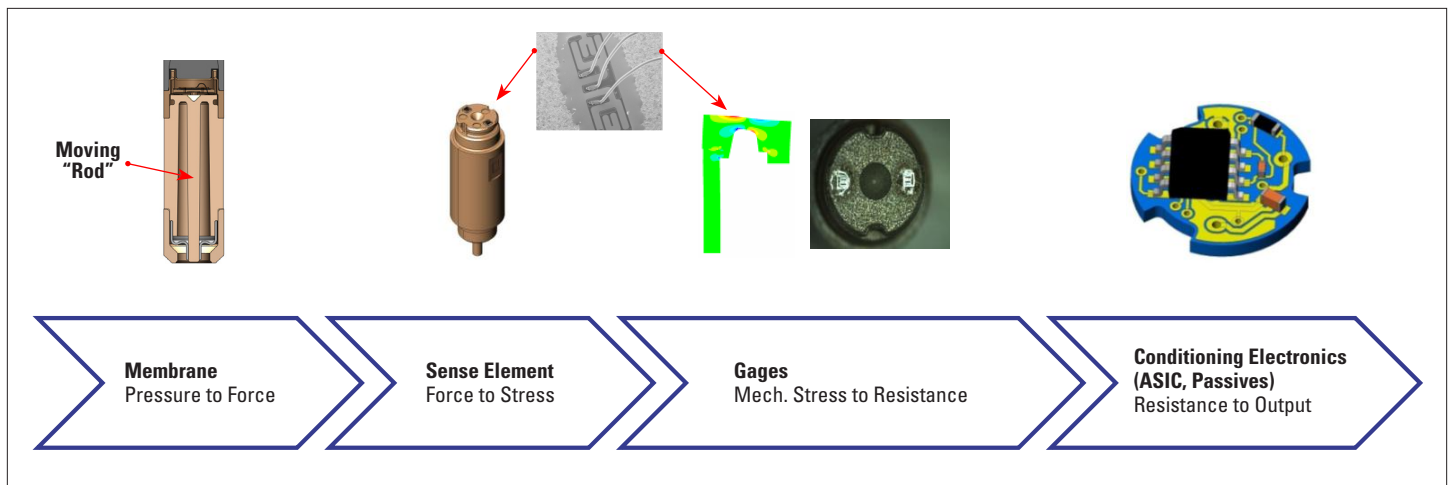
## FUNCTIONAL CHARACTERISTICS

<b>Operating Temperature</b>	-40°C to 140°C
<b>Operating Pressure</b>	Customer specific: 0 to 150 / 250 Bar
<b>Proof Pressure</b>	Customer specific (250 bar)
<b>Burst Pressure</b>	Customer specific (300 bar)
<b>Lifetime Expectancy</b>	250.000 km and beyond 12.000 hours
<b>Stable Output</b>	± 2% over lifetime
<b>Gain Accuracy</b>	± 2% of Vs over life
<b>Non Linearity</b>	< ± 1% of Vs over life
<b>Hysteresis</b>	< ± 1% of Vs over life
<b>Offset Variation</b>	± 1% of Vs over life
<b>Accuracy</b>	0-5 bar low pressure: ±0.4% of Vs (10°C to 140°C) ±0.6% of Vs (-40°C to 10°C)
<b>Supply Voltage</b>	5.0 ± 5% VDC (customer specific)
<b>Supply Current</b>	Max 10mA
<b>Load Resistor</b>	4.7kOhm pull up
<b>Response Time For Signal Delay</b>	<200us total
<b>Nominal Output Voltage</b>	11.5%Vs to 91.5%Vs
<b>Output Noise RMS</b>	<0.2% of Vs
<b>Overvoltage Protection</b>	24V
<b>Reverse Voltage Protection</b>	-13.5V
<b>Signal Resolution</b>	<50mBar (analog)
<b>Bandwidth</b>	15kHz

## DIAGRAM 1



## PHYSICAL TRANSFORMATION FROM COMBUSTION PRESSURE TO OUTPUT SIGNAL



A cylinder pressure sensor enables combustion feedback from inside the cylinder:

Partial "Open Loop" Combustion



Cylinder Pressure Sensor



Full Closed Loop Combustion

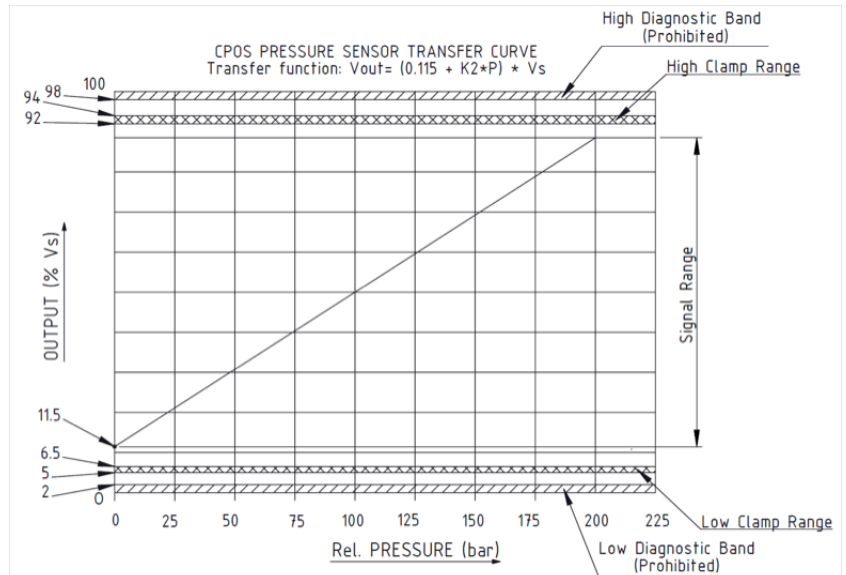
## TRANSFER CURVE

This graph represents the nominal output curve of the CPOS sensor (output voltage in %Vs versus pressure)

Nominal Transfer Curve is expressed by:

$$V_{out} = V_s * (K_2 * P + K_1)$$

<b>Supply</b>	$V_s$
<b>Offset</b>	$K_1 = 0.115 \pm 0.01$
<b>Slope</b>	$K_2$
<b>P</b>	Pressure (bar)



## DIAGNOSTIC FAULT MODES

<b>High Fault Band Output</b>	$\geq 98\%V_s$ In case of internal fault, typically the output signal is 99%Vs
<b>Low Fault Band Output</b>	$\leq 2\%V_s$ In case of internal fault, typically the output signal is 1%Vs

## SENSOR "CLAMP" LEVELS

<b>Nominal High Clamp Level</b>	Fixed at 93% of $V_s$
<b>Nominal Low Clamp Level</b>	Fixed at 6% of $V_s$
<b>High Clamp Level</b>	Minimum: 92%Vs Maximum: 94%Vs
<b>Low Clamp Level</b>	Minimum: 5%Vs Maximum: 6.5%Vs

NOTE: In case the under-pressure or over-pressure situation is abandoned, the sensor needs 1ms in order to provide the normal output signal again.



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