

THE LEADING TECHNOLOGY



# Pressure Sensors

## Miniature & High Performance

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[www.efe-sensor.com](http://www.efe-sensor.com)

# ABOUT US

## Technology and Quality



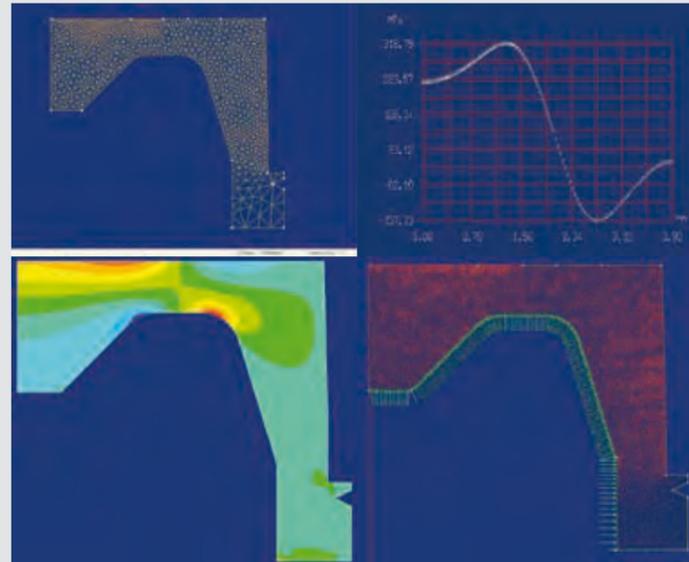
**L'Essor Français Electronique (EFE)** has been developing and manufacturing a complete range of pressure transducers since 1973.

During this time, we have designed our proprietary advanced sensing technologies and created a unique range of high performance and miniature pressure transducers.

From the beginning, we have catered for customers in the aerospace, marine, military, automotive, Formula-One & Rally, nuclear, oil & gas, research sectors and numerous industrial applications. Our products are designed to be used in the most demanding operating environments and to give highly accurate and reliable measurements.

Sensors from EFE are sold in France and overseas: in Europe, the United States and Asia. Our company devotes considerable resources to research and development programs, co-operating with several research institutes, universities and schools of engineering in France.

Located 60 km west of Paris, we have over 1500 m<sup>2</sup> of research and manufacturing facilities including the most advanced automated equipment for manufacturing high performance transducers. Our Engineering Department, responsible for designing all our sensors, from sensing elements to state of the art PCBs, can also develop specific sensors to meet your requirements.



We are using the most advanced techniques and components to develop our sensors: 3D, digital simulation and finite elements software by our engineering department.

To meet our customers' high requirements, EFE decided very early on to develop its proprietary sensing technology for pressure transducers.

This technology, thin film, is manufactured mainly using a physical vapour deposit, and more precisely sputtering process on a metal diaphragm (stainless steel, titanium, inconel, hastelloy, etc.).

Thin film as used by EFE is the only technology which does not require any intermediary between the sensing element and the fluid to be measured as with an oil separator for silicon based sensors or O-rings for ceramic technology.

These intermediaries are a weak point regarding the reliability and performances requested in customer's applications.

With our technology, the diaphragm is welded on to the pressure port and our wetted parts are fully metallic (stainless steel, titanium, inconel, etc.).

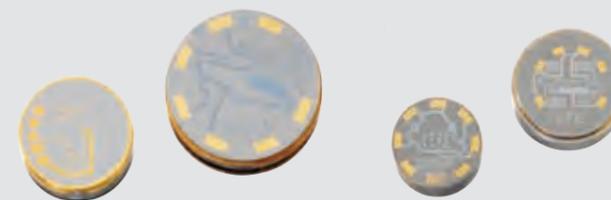
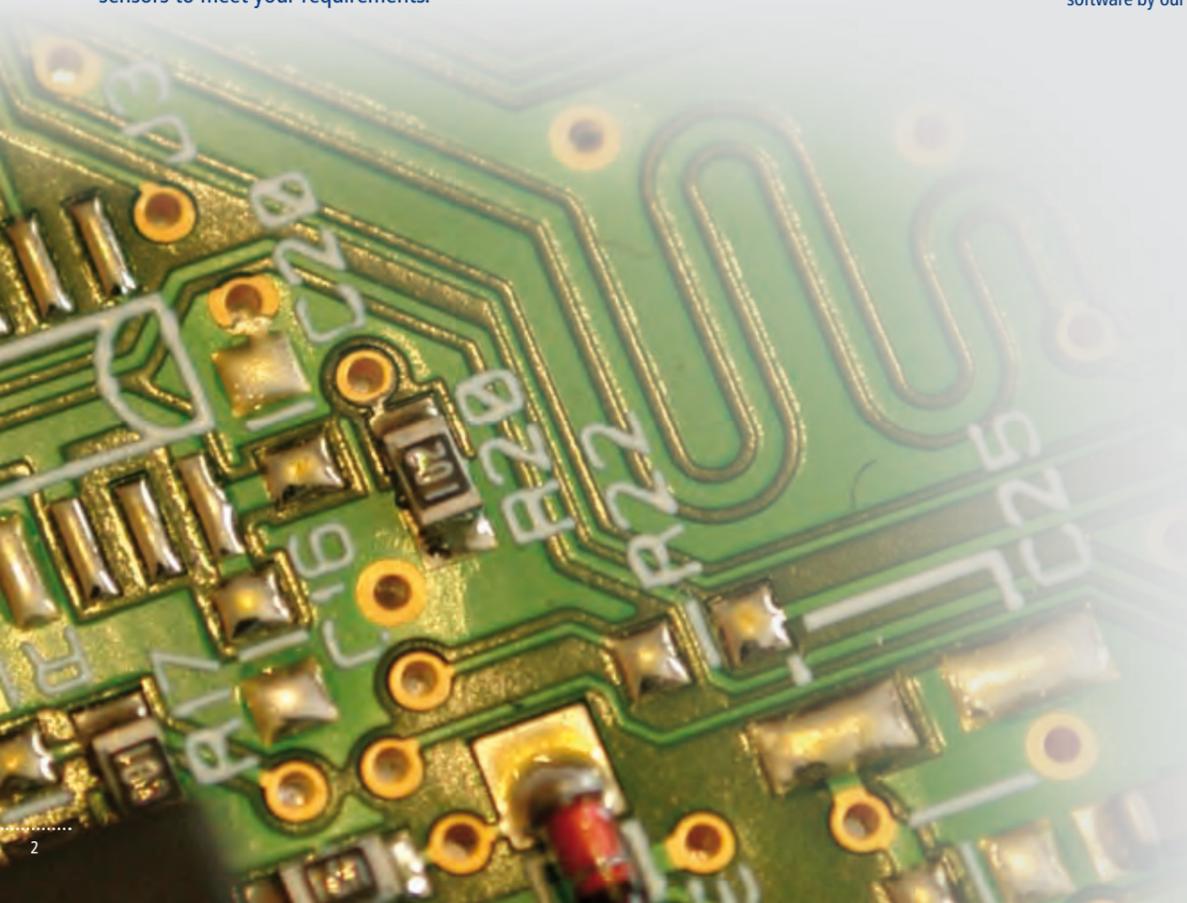
### Main advantages of thin film technology

- Very limited shifts with temperature, easily correctable
- Standard capability to measure negative pressure (down to -1 bar)
- High Accuracy capability at 20°C and in the compensated temperature range (total error band).
- Active compensation integrated directly on the diaphragm for very quick changes of temperature of the measured fluid.
- Long life and excellent long term stability
- No internal seals, no oil separator
- Direct compatibility with most corrosive fluids: oils, Skydrol, brake fluids, etc.
- High temperature capability (up to 300°C) with limited thermal shifts

For low pressure ranges, we have developed our proprietary silicon-based technology, devoting every effort to achieve the highest performance in comparison to our thin film. That's why our silicon piezo-resistive sensing element is all stainless steel, welded on pressure port (no O-ring) and with high temperature capability.



Latest and highest quality electronic PCBs and components to withstand the harshest environments

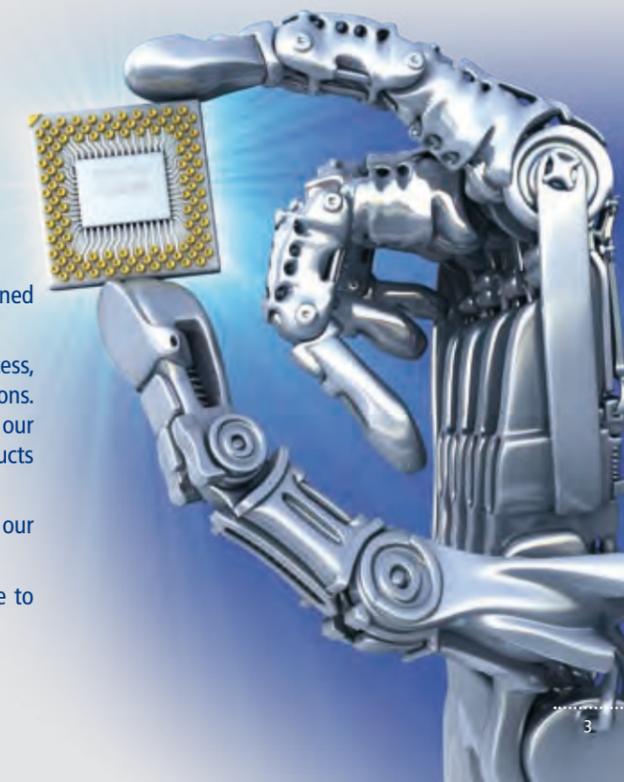


Our quality system is ISO 9001 –2000 certified. Our organisation has been designed to target 100% customer satisfaction.

Every sensor manufactured in our factory passes a long burn-in and control process, ensuring the highest performance and stability in our customers' applications. In the case of custom-made or specific sensors we can add additional tests in our manufacturing process to guarantee the reliability and performance of our products in a specific application.

Most of these tests are recorded in our database to ensure good traceability of our production.

All our calibration equipment is Cofrac traceable or equivalent and we are able to provide calibration certificates with new or used units.



# HIGH PERFORMANCE Pressure Sensors



Our range of high performance pressure sensors and transducers offers a solution to most applications.

They are available from 50 mbar up to 3000 bar. We also propose negative and positive pressure from  $\pm 50$  mbar up to  $-1/+10$  bar.

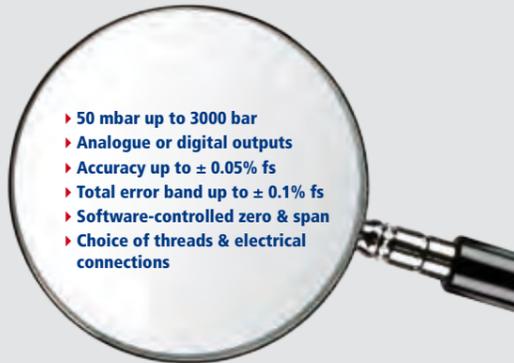
Analogue transducers offer standard outputs (2mV/V, 0.5-4.5V DC, 0-5V DC, 1-6V DC, 0-10V DC, 4-20mA) while digital sensors have RS485, CANbus, Modbus outputs.

Thanks to the latest linearization and digital correction techniques, our transducers, both analogue and digital, have high accuracy at room temperature ( $\leq 0.05\%$  fs) as well as ultimate total error band (all errors included  $\leq 0.1\%$  fs) over compensated temperature range.

With our high performance transducers, accuracy does not limit other major specifications for our customers' applications such as:

- bandwidth, available up to 5kHz with built-in electronics
- large temperature capability, from  $-55^{\circ}\text{C}$  up to  $125^{\circ}\text{C}$  ( $150^{\circ}\text{C}$  on option)
- robust construction, all stainless steel or Inconel

Some models, analogue or digital, offer software-controlled zero and span.



- ▶ 50 mbar up to 3000 bar
- ▶ Analogue or digital outputs
- ▶ Accuracy up to  $\pm 0.05\%$  fs
- ▶ Total error band up to  $\pm 0.1\%$  fs
- ▶ Software-controlled zero & span
- ▶ Choice of threads & electrical connections



**PST220**  
Industrial pressure transducer  
The high quality at a standard price  
Analogue outputs: mV/V, 0-5V, 0-10V & 4-20mA  
1 kHz bandwidth standard



**PTA220**  
Accurate pressure transducer  
High accuracy:  $\pm 0.1\%$  fs  
Analogue outputs: mV/V, 0-5V, 0-10V & 4-20mA  
Available with 0-5V - 4 wires (PTA228)



**PGP220**  
Global performance transducer  
For applications requiring a total error band  
Accurate at  $20^{\circ}\text{C}$  (up to  $\pm 0.05\%$  fs) and in temperature  
Ideal for test bench measurements



**PDC220**  
Highest accuracy  
This pressure transducer includes a digital correction.  
Total error band up to  $\pm 0.1\%$  fs  
Optional temperature ranges available up to  $-55^{\circ}\text{C}$  /  $+150^{\circ}\text{C}$   
Software-controlled adjustable zero and span



**PDS220**  
Pressure transducer with digital outputs  
Available with several protocols: CANbus, Modbus (...)  
High accuracy by linearization and polynomial correction over the compensated temperature range



**PGA220**  
General purpose aerospace transducer  
Compensated over  $-55^{\circ}\text{C}$  /  $+70^{\circ}\text{C}$  up to  $-55^{\circ}\text{C}$  /  $+125^{\circ}\text{C}$   
All stainless steel, compatible with Skydrol and Kerosene  
High accuracy at  $20^{\circ}\text{C}$  and in temperature



Our company is certified ISO9001-  
Version 2000.

Every sensor manufactured in our factory passes a long burn-in and control process, ensuring the highest performance and stability in our customers' applications.



# MINIATURE & SUB-MINIATURE Pressure Sensors



With over 35 years of experience, we have developed a unique range of miniature and sub-miniature pressure transducers. This complete range includes:

- Low pressure (from 100 mbar), high pressure (up to 3000 bar) and negative/positive pressure ranges (from -1 bar).
- Unamplified sensors,
- Transducers with analogue or digital built-in electronics
- Standard or high accuracy with digitally corrected transducers offering ultimate total error band including all errors in the compensated temperature range ( $\leq 0.1\%$  fs).
- Large temperature capability: from  $-60^{\circ}\text{C}$  to  $260^{\circ}\text{C}$  on standard and  $300^{\circ}\text{C}$  on request for unamplified sensors and  $-55^{\circ}\text{C}$  to  $+175^{\circ}\text{C}$  for amplified transducers.
- High dynamic capability with semi-flush diaphragms
- High performance built-in electronics adapted to on-board applications (8-16V or 8-30V power supply), high bandwidth capability (up to 5 or 10 kHz), low noise and low consumption ( $<10$  mA)
- All stainless steel or titanium construction allowing compatibility with corrosive media
- Robust construction proven in the harshest environments



## PST160

Available in nearly every configuration:

- mV/V, 0-5V, 4-20mA
- starting from 100 mbar up to 600 bar
- with accuracy up to  $\pm 0.05\%$  fs
- cable or connector output



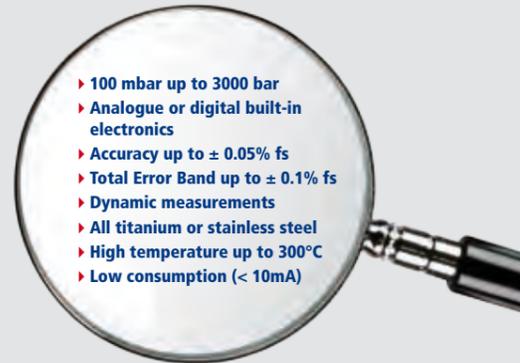
## PSF120 & PSF160

Miniature transducers for dynamic measurement  
Semi-flush diaphragm: 0-5 to 0-400 bar  
0.5-4.5V DC or 0-5V DC outputs  
Up to 5 kHz with built-in electronics, 100 kHz without\*  
\* according to pressure range



## PCM120

Pressure and temperature in one sensor  
PT100 or PT1000: direct output in ohms  
Amplified pressure output: 0.5-4.5V DC  
Operating temperature  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$



- ▶ 100 mbar up to 3000 bar
- ▶ Analogue or digital built-in electronics
- ▶ Accuracy up to  $\pm 0.05\%$  fs
- ▶ Total Error Band up to  $\pm 0.1\%$  fs
- ▶ Dynamic measurements
- ▶ All titanium or stainless steel
- ▶ High temperature up to  $300^{\circ}\text{C}$
- ▶ Low consumption ( $<10$  mA)



## PHT100

High temperature sub-miniature transducers  
Operating temperature  $-40^{\circ}\text{C}$  to  $+175^{\circ}\text{C}$   
Amplified output: 0.5-4.5V DC  
Sub-miniature and ultra light sensor (all titanium)  
Very robust design



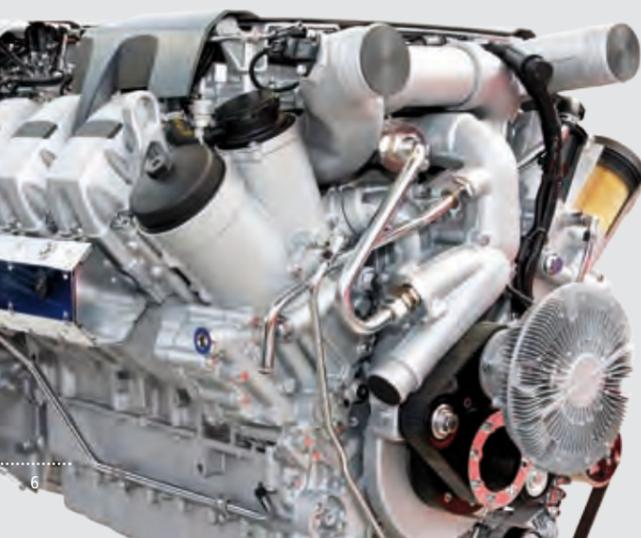
## PDC120

Highest accuracy in sub-miniature package  
Total error band from  $\pm 0.1\%$  to  $\pm 0.5\%$  fs according to temperature range  
Available from  $-55^{\circ}\text{C}$  up to  $+150^{\circ}\text{C}$   
0.5-4.5V signal with 8-30V DC power supply

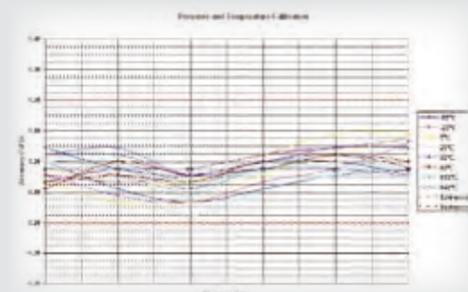


## PST860

Smallest pressure transducer  
8.6mm diameter and only 3 grams  
Built in electronics (0.5-4.5V DC)  
Large bandwidth capability  
High temperature version available



We can provide calibration certificates for pressure, pressure and temperature as well as certificate of conformity with delivered sensors.



# HARSH ENVIRONMENT

## Pressure Sensors



Our products are designed to withstand the harshest environments. Supplying pressure sensors for on-board applications for over 35 years has made us aware of the constraints of such environments on sensors, especially miniature.

Our robust thin film technology, associated with proven high quality electronics have been successfully used on board applications in automotive, motor sport, military and aerospace applications.

Harsh environments for our sensors consist often in applications combining high levels of shocks, vibrations, accelerations and temperature.

Nevertheless unsuitable sensors can also be damaged by corrosive fluids, radiations (nuclear), pressure pulsations or spikes.

In all these cases we are offering dedicated proven solutions. Our thin film technology has many advantages, being 100% metallic, capable of high numbers of pressure cycles and adapted to gamma radiation environments.

Our manufacturing process, with adapted burn-in and high numbers of quality controls applied at 100% of our production, as well as the choice of high quality components, is a guarantee of the reliability of our sensors in your application.



- ▶ All metallic wetted parts
- ▶ Stainless steel, titanium, Inconel
- ▶ No internal O-rings
- ▶ No oil separator
- ▶ Compatible with corrosive fluids
- ▶ Designed for harshest environments
- ▶ Reliable and long term stable measurements



**PHE220**  
Compact transducer for the harshest environments  
Very robust design for reliable measurements  
Built in electronics (0-5V or 1-6V)  
Operating temperature - 40°C /+125°C  
High accuracy from -1 bar up to +600 bar



**PHE160**  
Miniature transducer with built in electronics  
Available from 2 bar up to 600 bar  
Operating temperature -40°C to +140°C  
0.5-4.5V DC with 8-30V DC power supply



**PHP160**  
High pressure transducer: 2000, 2500 and 3000 bar  
Built in electronics: 0-5V with 8-30V DC power supply  
High speed electronics: 5kHz bandwidth available  
High accuracy: up to ± 0.05% fs  
Compatible with on-board and test bench applications



**PHE100 & PHE860**  
Smallest transducers with built-in electronics  
All titanium: only 3 grams (PHE860)  
Operating temperature -40°C to +140°C  
High dynamic measurement



**PHT220**  
High temperature pressure sensor  
Operating temperature -40°C to +175°C  
Extreme accuracy in temperature  
Optional remote amplifier



**PET160**  
Pressure sensor for extreme temperatures  
Operating up to 260°C  
Optional remote amplifier in the cable  
All stainless steel sensor



We can provide you a turn key solution with display, connector assemblies and accessories (O-ring, dowty seals) adapted to our sensors.



# SPECIFIC AND CUSTOMIZED Pressure Sensors



If your application requires a specific pressure sensor, we can provide you a solution within a reasonable time frame. Our team of applications engineers are ready to study your requirements and define with you the right sensor for your application.

We can offer to customize one of our standard sensors for you. With our large range of products, we are usually able to answer most of the customer's requirements. Every year we design customized solutions for our customers to tight timeframes.

However, if we are unable to do so, we can develop a specific sensor based on your requirements. We can also manage the qualification of the product to your specifications with internal or external tests thanks to our partnership with specialist laboratories: EMC, environmental tests, vibrations, qualification to a norm (RTCA-160 D0 for instance) For these special developments, we will compile a complete design specification, guaranteeing manufacture of your products over their working life and will provide you with the technical support needed for your project to succeed.

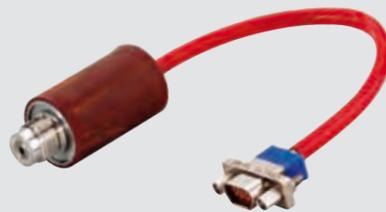
Do not hesitate to contact us and draw on our experience of specific solutions in numerous applications: automotive, aerospace, military, oil & gas, nuclear, research, etc.



- ▶ Standard sensors customized to your applications
- ▶ Specific Sensor developed on your specifications
- ▶ You can rely on our engineering team:
  - responsive
  - technical support
  - experience in automotive, aerospace, defence, nuclear, oil & gas, research (...)



Highly accurate and reliable transmitter  
Designed for sonar applications  
Waterproof to a depth of 300 metres  
Proven technology: 20 years of experience



Miniature and dynamic pressure sensor  
Designed for missile applications  
Robustness and high temperature capability  
Military flight test qualified



Highly accurate and stable pressure transducer  
Stainless steel or Inconel  
Mechanical connections: VCR® or flange  
Qualified for nuclear applications



Customized miniature pressure transducers  
SAE®, Swagelok®, flange connections  
Automotive, aerospace or offshore applications  
Hermetically sealed designs for immersion available



Submersible pressure transducer  
Compatible with sea water  
High response time to measure pressure spikes



Wet/wet differential pressure transducer  
±100 mbar to 250 bar uni- and bi-directional  
Compact with amplified output  
Operating temperature - 40°C to +125°C



High pressure sensor  
Dedicated mechanical connection  
Accuracy < 0,05%fs  
All stainless steel



OEM pressure sensor  
Integrated in customer's equipment  
0,1%fs total error band (0-40°C)  
Battery power supplied  
Low consumption < 3mA



# Pressure Sensors

## Miniature and High Performance



### A complete range of unique high performance and miniature pressure sensors

- > From 50 mbar up to 3000 bar
- > Analogue or digital outputs
- > Designed for the harshest environments
- > Sub-miniature to industrial sizes
- > All metallic: stainless steel, titanium, Inconel (...)
- > Highly dynamic models available (semi-flush)
- > High temperature capabilities: from  $-60^{\circ}\text{C}$  up to  $260^{\circ}\text{C}$  and  $300^{\circ}\text{C}$
- > Customized or specific products to meet your requirements



## THE LEADING TECHNOLOGY

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