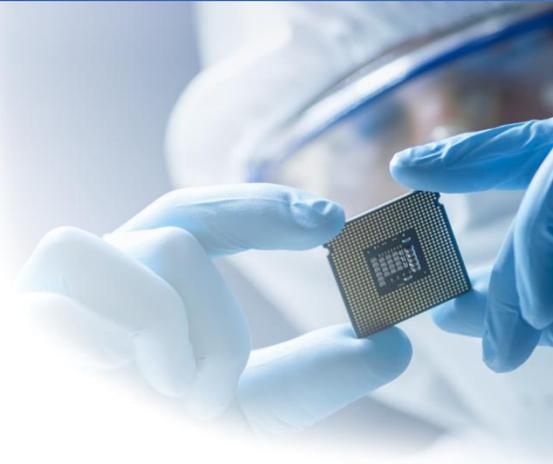


# VPM-7 SmartPirani™ ATM vacuum transducer

Heat-loss Pirani, diaphragm Piezo and atmospheric switch combination gauge with 1.0E-6 to 1333 mbar measuring range.

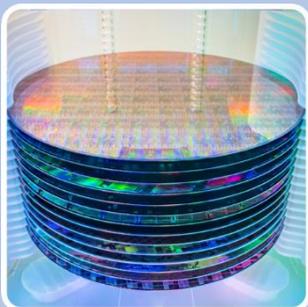


## Benefits & features

- Ultra-wide measuring range of 9 decades from 1.0E-6 to 1333 mbar
- Unmatched price-performance ratio
- Precision atmospheric switch function
- Gas independent measurement from 2 to 1333 mbar
- Easy configuration with USB programmer
- 0-10 VDC programmable voltage output
- Digital RS-232 or RS-485 interface
- Optional Ceramic or Parylene sensor protection for corrosive applications
- Optional solid state setpoint relay for external controlling
- Drop-in replacement for MKS 901P and other vendors' vacuum gauges

## Typical applications

- Loadlock control
- Semiconductor processing
- PVD coating
- Analytical instrumentation
- Vacuum furnaces
- Medical instrumentation
- Space simulation

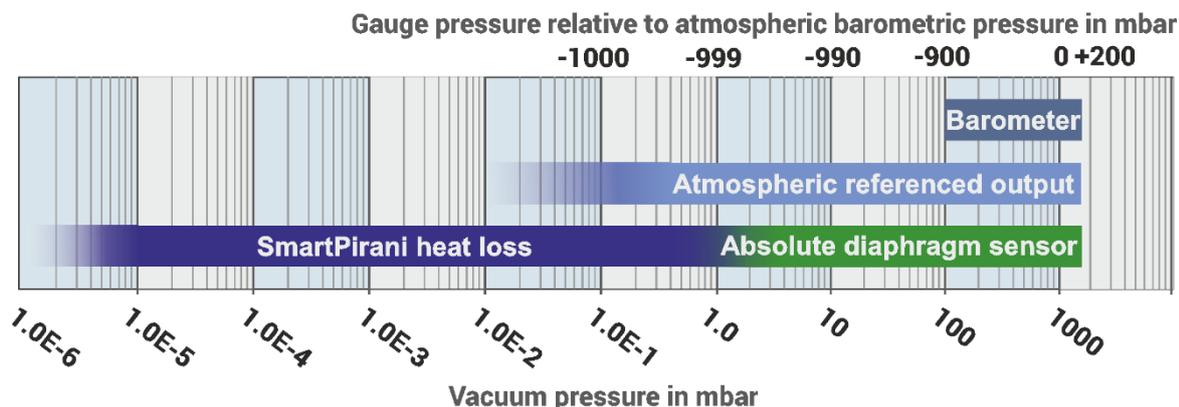


Product datasheet



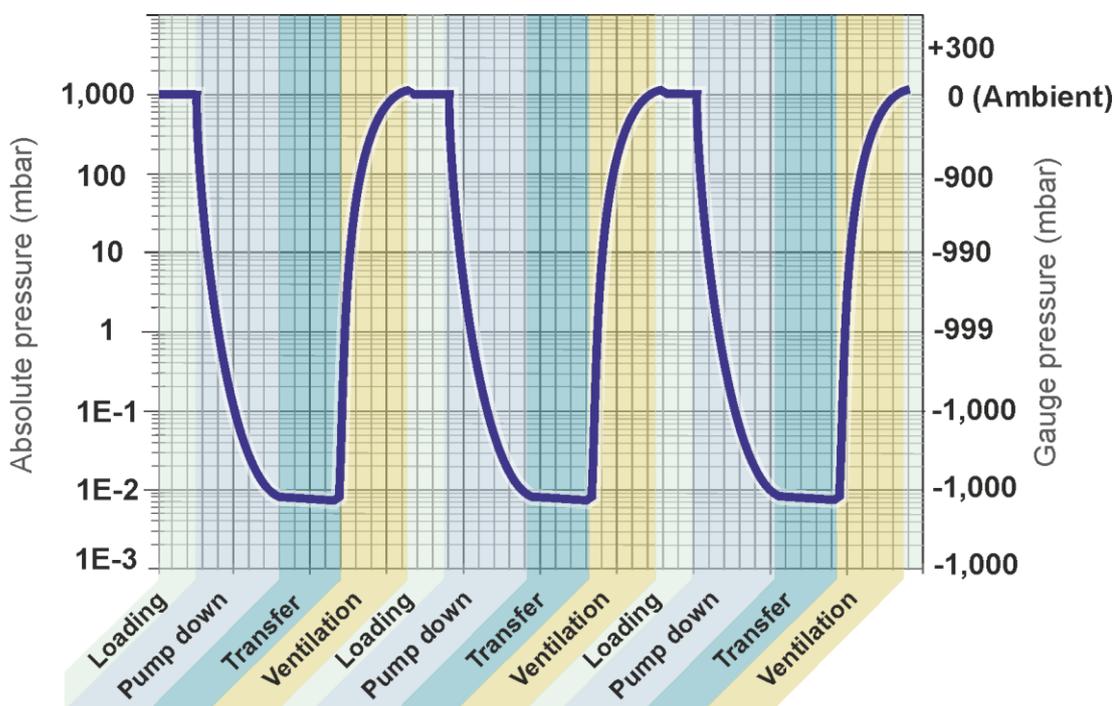
## Designed for load lock pressure control

The VPM-7 SmartPirani™ ATM transducer combines several sensor technologies and offers an all-in-one transducer solution for semiconductor load-lock precision pressure control and other vacuum applications where accurate pressure measurement relative to atmospheric ambient pressure in combination with vacuum measurement is important.



The VPM-7 functions as a genuine multi-sensor transducer featuring four pressure outputs that integrate a barometric ambient sensor, a wide-ranging heat-loss Pirani, an absolute diaphragm sensor, and a signal relative to atmospheric pressure. This combination is designed to enhance the pressure control capabilities of a contemporary load-lock vacuum chamber. Notably, the diaphragm sensor reading remains gas-independent within the absolute pressure range of 2 to 1333 mbar.

A Load-lock is a vacuum chamber used for loading devices like semiconductor wafers from the ambient air pressure to the vacuum processing chamber. The Load-lock is typically cycled between atmospheric barometric ambient pressure and an adequate vacuum pressure required to transfer the wafers to the processing vacuum chamber. Accurate control of pressure in the load-lock vacuum chamber is critically important to prevent ambient air and particulate contamination of the load-lock and wafers.



## Enabling use in demanding applications

The VPM-7 is engineered not only for clean nitrogen vented load-lock applications in the semiconductor industry, but also for applications where particulates and aggressive media may be present. For applications where the sensors can be exposed to corrosive or aggressive gases, the SmartPirani™ is available with conformal protective coating serving as an effective barrier.

Depending on the application, the SmartPirani™ transducer series is now available with either an optional ceramic or Parylene protective barrier against corrosion or oxidation of sensor materials.

Ceramic is highly corrosion resistant and is a well-proven material for vacuum sensor diaphragms in capacitance diaphragm gauges.

Parylene, a unique polymer with highly corrosion resistant and hydrophobic properties, is specifically designed for medical applications such as lyophilization and sterilization.

In vacuum processes, where vacuum sensors may be prone to damage from particulates, the SmartPirani™ transducers are available with a protective baffle, acting as a barrier against macroscopic particles. Combining these protective coating options, the novel SmartPirani™ transducers are well-equipped to handle challenging vacuum environments.



## Other vendor compatibility

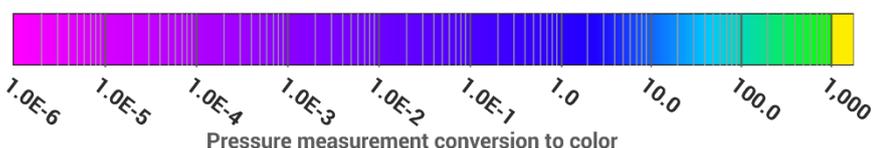
The drop-in replacement vacuum transducers are designed with connector pin-out compatibility, enabling seamless replacement of other vendor gauges without change of cabling.

Additionally, these transducers emulate the analog output scaling and range of equivalent products from other manufacturers.

Moreover, Sens4 transducers have the capability to emulate the digital serial communication protocol, facilitating easy installation without requiring adjustments to the communication software of the vacuum equipment. This digital protocol emulation ensures compatibility with power supply and controller display units from different vendors.

## RGB LED for pressure indication

The SmartPirani™ ATM offers a novel method for visually ascertaining the measured pressure using a multi-color LED that seamlessly transitions through colors across the pressure range. This selectable visual feature offers a cost-effective alternative to integrated displays, offering a basic representation of the measured pressure. Additionally, it serves as a distinct visual indicator, warning users if the vacuum system is pressurized beyond ambient pressure.



## Measure and control advanced vacuum processes

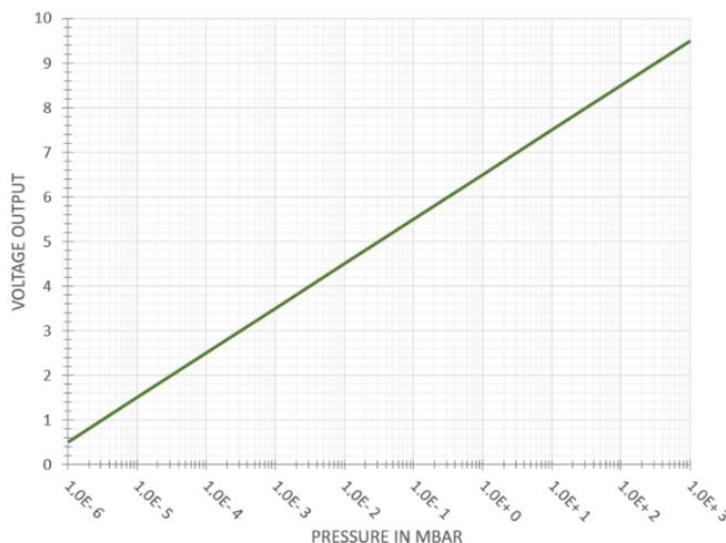
The VPM-7 SmartPirani™ ATM is engineered for best-in-class measurement and control of vacuum gas pressure. Several output options are providing more than just a pressure measurement signal.

### Analog voltage output

The analog output provides a voltage signal for external pressure readout or controls.

The VPM-7 comes with a default voltage output signal of 1VDC/decade for mbar, Torr, or Pascal. Additionally, it provides the flexibility for user configuration or can be preconfigured with a diverse range of analog output options, allowing for seamless replacement of gauges from various vendors.

An optional secondary analog output is also available for applications where both the full-range absolute measuring range and the measurement relative to the atmosphere need to be monitored simultaneously.



### Digital interface

The RS-232 and RS-485 serial interfaces facilitate the transfer of measurement data without being affected by signal degradation over extended cable lengths or interference from electrical noise.

The digital interface enables diagnostics, predictive maintenance, service, calibration, setpoint configuration, analog output scaling and acquisition of real-time vacuum pressure measurements for on-screen visualization.

### Reliable and robust setpoint relay control

The three independent solid-state switch relays can be used to externally control pumps, valves, safety interlock circuits, and other equipment. The primary control function involves on/off regulation with a programmable setpoint and hysteresis value.

In comparison to electro-mechanical relays, solid-state relays offer enhanced reliability and faster switching times. They also provide arc-free contacts and generate no electromagnetic interference (EMI) during contact switching. The SmartPirani™ relays are built for durability and hold UL listing, CSA recognition, and EN/IEC 60950-1 certification. This ensures maximum confidence when employing them to oversee critical vacuum processes and high-cycle load-lock applications.

### Temperature measurement

The VPM-5 SmartPirani™ is designed for measuring pressure, yet it additionally provides a temperature measurement signal on the vacuum side. This temperature data can be utilized for monitoring and diagnosing vacuum processes, and access to this information is available through the digital interface.

### Customized settings

The VPM-7 transducer is available with a tailored customized configuration out of the box to align with application needs, ensuring compatibility with specific equipment installations. For customized products, a distinct part number will be assigned, streamlining future reordering for convenience and simplicity. Our team of experienced vacuum professionals are always available to discuss and explore customized options and possibilities for even the most demanding applications.

## Typical applications

The SmartPirani™ is designed for reliable measurement and control of advanced vacuum processes and is suitable for a wide range of applications in industry and science. The wide selection of VPM-7 configurations is available to meet different requirements in various applications.

### Semiconductor industry

The VPM-7 transducer offers a superior atmospheric switching function in combination with vacuum measurement that enables accurate control of load-lock pressure independent of ambient pressure changes due to alterations in weather conditions or altitude.

The vacuum measurement capability is typically used in the load-lock application for determining that an adequate vacuum level is achieved, allowing the wafer to be transferred to the transfer chamber.

The ceramic corrosion resistant sensor option enables use in fore-lines and other areas where residuals of corrosive process gases can be present.



### Analytical instrumentation

Mass spectrometers and scanning electron microscopes are types of analytical equipment that use vacuum gauges to determine safe operation of an ion source. In these applications samples need to be transferred from ambient pressure to the vacuum system for analyzing. The VPM-7 SmartPirani, with its ultra-wide range, can be employed to provide a signal when an adequate vacuum pressure is present for initiating the analysis process, and the measurement relative to atmospheric pressure can be used for regulating the venting of the sample load-lock.

### Physical vapor deposition

Physical vapor deposition (PVD) processes for coating materials finds widespread use across various industries, including solar, medical, automotive, tooling, optics, and packaging. The SmartPirani™ can be equipped with a user-cleanable integrated particulate baffle system, specifically tailored for PVD applications. This baffle system is engineered to block particulates effectively, ensuring high vacuum gas conductance and preventing particulate clogging. The innovative baffle feature not only extends the time between service intervals but also enhances equipment uptime. Additionally, in specific PVD applications, the extended range of the SmartPirani™ obviates the need for cold cathode vacuum gauges for base pressure verification.



# Technical data

| <b>Specifications</b> <i>Specifications</i>                           |  |
|---|--|
| Measuring range in mbar   | 1×10 <sup>-6</sup> to 1333 mbar (7.5×10 <sup>-7</sup> to 1000 Torr)  |
| Measuring principle 1×10 <sup>-6</sup> to 1.5 mbar                    | MEMS Pirani thermal conductivity   |
| Measuring principle 1.5 to 2 mbar                                     | Blended MEMS Pirani / piezo reading  |
| Measuring principle 2 to 1333 mbar                                    | MEMS piezo resistive diaphragm   |
| Accuracy 1×10 <sup>-5</sup> to 9.99×10 <sup>-5</sup>                  | 25% of reading   |
| Accuracy 1×10 <sup>-4</sup> to 7.99 mbar                              | 5% of reading  |
| Accuracy 8.00 to 99.9 mbar  | 1% of reading  |
| Accuracy 100 to 800 mbar  | 0.5% of reading  |
| Accuracy 800 to 1099 mbar   | 0.25% of reading   |
| Accuracy 1100 to 1333 mbar  | 0.5% reading   |
| Hysteresis 1×10 <sup>-3</sup> to 10 mbar (ISO19685:2017)              | 1%   |
| Hysteresis 10 to 1333 mbar (ISO19685:2017)                            | 0.1%   |
| Barometric measurement range  | 300 to 1200 mbar   |
| Barometric accuracy   | +/- 0.5 mbar   |
| Atmospheric referenced pressure output range                          | -1333 to + 1333 mbar   |
| Vacuum temperature sensor range                                       | -20 to + 85°C  |
| Vacuum temperature sensor accuracy                                    | +/- 1.5 °C   |
| Transducer temperature sensor range                                   | -20 to + 85°C  |
| Transducer temperature sensor accuracy                                | +/- 1.5 °C   |
| Analog output resolution  | 16 bit (150 µV)  |
| Analog output update rate   | 124 Hz   |
| Response time (ISO 19685:2017)  | <20 ms   |
| Temperature compensation  | +10 to +50 °C  |
| Solid state relay set point range                                     | 5×10 <sup>-6</sup> to 1333 mbar (3.75×10 <sup>-6</sup> to 1000 Torr)   |
| Solid state relay contact rating                                      | 50 V, 100 mA <sub>rms</sub> / mA <sub>DC</sub>   |
| Solid state relay contact endurance                                   | Unlimited (no mechanical wear)   |
| Solid state relay approvals   | UL Recognized: File E76270<br>CSA Certified: Certificate 1175739<br>EN/IEC 60950-1 Certified   |
| <b>Environment conditions</b> <i>environment conditions</i>           |  |
| Operating ambient temperature   | -20 to +50 °C  |
| Media temperature   | -20 to +50 °C  |
| Storage ambient temperature   | -40 to +120 °C   |
| Bake-out temperature (non-operating)                                  | +120 °C  |
| Maximum media pressure <sup>(3)</sup>                                 | 10 bar absolute  |
| Mounting position   | Arbitrary  |
| Protection rating, EN 60529/A2:2013                                   | IP40   |
| Humidity, IEC 68-2-38   | 98%, non-condensing  |
| <b>Power supply</b> <i>Power supply</i>                               |  |
| Supply voltage  | 12-30 VDC  |
| Power consumption   | 240 mW (max)   |
| Reverse polarity protection   | Yes  |
| Overvoltage protection  | Yes  |
| Internal fuse   | 100 mA (thermal recoverable)   |
| <b>Materials</b> <i>materials</i>                                     |  |
| Enclosure   | SS 1.4307 / AISI 304L / Aluminum 6061  |
| Vacuum Process flange (media wetted)                                  | SS 1.4401 / AISI 316   |
| Vacuum exposed materials (media wetted)<br>Standard version           | 316 Stainless steel, Kovar, glass, silicon, nickel, aluminum, SiO <sub>2</sub> , Si <sub>3</sub> N <sub>4</sub> , gold, Viton <sup>®</sup> , low out-gassing epoxy resin, solder, RO4305 |
| Vacuum exposed materials (media wetted)<br>Parylene protected version | 316 Stainless steel, Viton <sup>®</sup> , Parylene   |
| Vacuum exposed materials (media wetted)<br>Ceramic protected version  | 316 Stainless steel, Viton <sup>®</sup> , Aluminum oxide ceramic (Al <sub>2</sub> O <sub>3</sub> )   |
| Process leak tightness  | <1·10 <sup>-9</sup> mbar·l/s   |
| <b>Reliability</b> <i>reliability</i>                                 |  |
| MTBF (Mean Time Between Failure)                                      | 13.092.170 hours / 1494 years  |
| Failure rate FIT (Failure In Time, where time=10E+9 hours)            | 76,38  |

**Approvals**

|                 |                          |
|-----------------|--------------------------|
| CE              | EMC directive 2014/30/EU |
| RoHS compliance | Directive EU 2015/863    |

- (1) Accuracy specifications are typical values at stable temperature after zero adjustment.
- (2) Viton® is a trademark of THE CHEMOURS COMPANY FC, LLC
- (3) Overpressure limits only applicable when using fittings rated to the specified pressure.

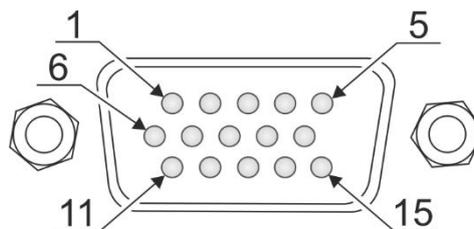
Specifications are subject to change without further notice.

## Connector Pin outs

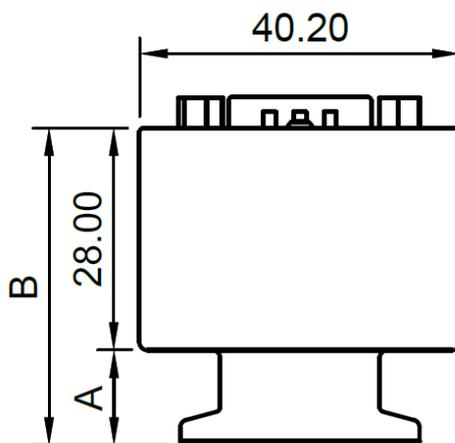
### 15 Pin HD D-sub RS-232 / RS-485

| Pin | Description  |
|-----|--|
| 1   | RS-232 Transmit / RS-485 (-)   |
| 2   | RS-232 Receive / RS-485 (+)  |
| 3   | Supply voltage 12-30 VDC   |
| 4   | Supply voltage – (return)  |
| 5   | Analog voltage signal +  |
| 6   | Analog voltage signal – (return)   |
| 7   | Relay 1 NO (normally open contact) <sup>(4)</sup>                                |
| 8   | Relay 1 Common <sup>(1)</sup>  |
| 9   | Relay 1 NC (normally closed contact) <sup>(4)</sup>                              |
| 10  | Relay 2 NC (normally closed contact) <sup>(4)</sup>                              |
| 11  | Relay 2 Common <sup>(1)</sup>  |
| 12  | Relay 2 NO (normally open contact) <sup>(4)</sup>                                |
| 13  | Relay 3 NO (normally open contact) <sup>(4)</sup> or analog out 2 <sup>(5)</sup> |
| 14  | Relay 3 Common <sup>(1)</sup>  |
| 15  | Relay 3 NO (normally open contact) <sup>(4)</sup>                                |

- (4) Optional relay
- (5) Optional secondary analog voltage output



# Dimensions



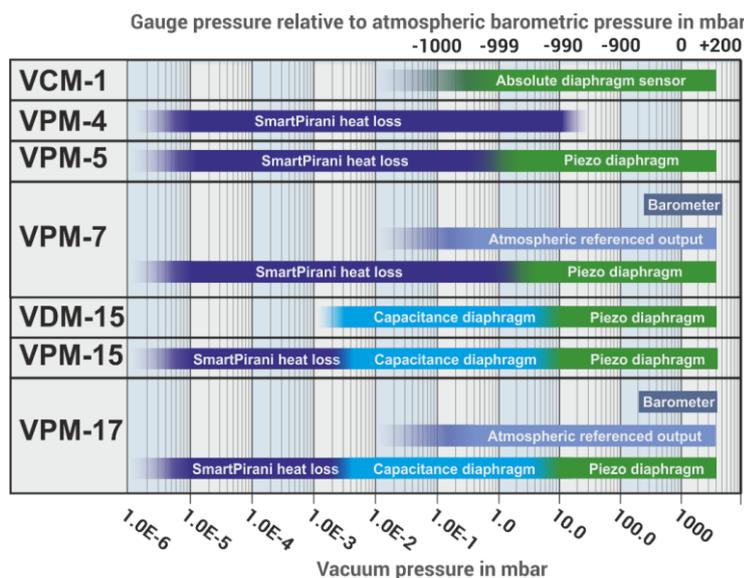
| Flange type                         | A [mm] | B [mm] | A [inch.] | B [inch.] |
|-------------------------------------|--------|--------|-----------|-----------|
| DN16KF (P/N: VPM-5-1...)            | 12.00  | 40.00  | 0.47      | 1.57      |
| DN25KF (P/N: VPM-5-2...)            | 12.00  | 40.00  | 0.47      | 1.57      |
| VCR4 <sup>1</sup> (P/N: VPM-5-4...) | 33.70  | 61.70  | 1.32      | 2.43      |
| VCR8 <sup>1</sup> (P/N: VPM-5-5...) | 29.43  | 57.43  | 1.15      | 2.26      |
| 1/8" NPT (P/N: VPM-5-3...)          | 37.00  | 65.00  | 1.45      | 2.56      |
| DN16CF (P/N: VPM-5-6...)            | 21.83  | 49.83  | 0.86      | 1.96      |





## Other vacuum measurement products

The Sens4 vacuum transducer product range offers the market's most advanced multi-sensor transducers for use in a wide selection of industrial and scientific vacuum applications.



### VPM-17 TriCAP™ ATM transducer

The VPM-17 TriCAP™ transducer offers the same functionality as the VPM-7, however an additional CDG (Capacitance Diaphragm Gauge) sensor enhances the gas independent measuring range from 5.0E-3 to 1333 mbar, which can be an advantage in applications where gas composition or type can change.

For demanding applications, the VPM-17 TriCAP™ ATM is available with corrosion resistant ceramic or Parylene coated sensors.



## About

Sens4 is a Danish technology company that develops, manufactures, markets, and distributes vacuum, pressure and temperature measuring equipment for industrial and scientific applications worldwide. It's our mission to provide compelling product solutions that fit our customers' needs and enable them to efficiently measure and control advanced processes around the world.

Learn more about Sens4 on: [sens4.com](https://sens4.com)

## Connect on social media



### Contact

Sens4 A/S  
 Nordre Strandvej 119G  
 3150 Hellebaek  
 Denmark

Phone: +45 88447044  
 Email: [info@sens4.com](mailto:info@sens4.com)