Vacuum Measurement
User-optimized Active Gauges for various applications from 2000 mbar to $10^{-10}$ mbar
Measurement principles suited for your application

**Vacuum Pressure Measurement and Principles**

The vacuum pressure range where pressure measurements can be performed ranges from atmosphere to $10^{-12}$ mbar, i.e. over 15 orders of magnitude.

Due to physical characteristics, no single vacuum sensor exists which is capable to perform high-precision measurements within the entire pressure range. For this reason Leybold offers sensors of different designs with their own characteristic measurement range, usually spanning several orders of magnitude.

A difference is made between direct and indirect pressure measurements.

The direct (absolute) type of pressure measurement is independent of the gas type to be measured. The measurement is performed mechanically by way of the pressure acting upon the surface of a diaphragm.

Indirect pressure measurement is determined as a function of a pressure dependent property of the gas (thermal conductivity, ionization probability, for example) and the molar mass, and is therefore dependent on the specific type of gas. The measurement readout is referenced to air or nitrogen and can be applied to other gases via correction factors.

The measurement range is the decisive factor for an appropriate vacuum sensor

**Simple gauge and controller selection:**

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<th>Range</th>
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<td></td>
<td>1</td>
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<td>10^{-10}</td>
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</tr>
<tr>
<td>Capacitive</td>
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<td>CERAVAC</td>
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<tr>
<td>CERAVAC CTR 100 N series</td>
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<tr>
<td>IONIVAC ITR 90 / 200 S</td>
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</tbody>
</table>

The direct (absolute) type of pressure measurement is independent of the gas type to be measured. The measurement is performed mechanically by way of the pressure acting upon the surface of a diaphragm.

*Controller selection example:*

- Graphix One
- Graphix Two
- Graphix Three
- Display One
- Display Three
The ideal vacuum gauge for your requirements

- Highly reliable fore vacuum and high vacuum pressure measurement
- Simple operation and integration
- Highly reproducible measurement results
- Control of multiple gauges allowing different locations to be controlled in parallel
- Simple, cost and space saving installation
- Direct data transfer to PLC/computer via digital/analog interface
- Increased transmission distances (up to 100 m) between measurement location and processing station
- Increased electromagnetic compatibility (EMC) requirements
- Compliance with international standards and regulations (CE, RoHS, WEEE etc.)

### Application Sensors: CERAVAC Linear pressure sensors DI/DU THERMOVAC TTR PENNINGVAC PTR IONIVAC ITR

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<th>Linear pressure sensors DI/DU</th>
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<tr>
<td>Solar</td>
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</tbody>
</table>

For further application examples, please refer to our full line catalog, chapter "vacuum - measuring, controlling".

Leybold transmitters are specially suited for system integration

Our high-precision vacuum sensors meet your demands:
Active Sensors / Vacuum Transmitters

**CERAVAC Transmitters**

The CERAVAC transmitters are suited for corrosive process gases.

**Benefits**
- New sensing cell: the new all-welded Inconel® sensor is much more robust than ceramic sensors
- Microprocessor-based electronics for excellent accuracy and reproducibility
- Long-term stability: no calibration shifts after bursts of pressure

**CTR 100 N / CTR 101 N**

**Principle of measurement**
Capacitance vacuum gauge

**Measurement/display range**
Spanning from $10^{-5}$ to 1000 Torr, depending on the model

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**Linear Pressure Sensors**

These sensors excel through a high overload response as well as excellent corrosion and vibration resistance.

**Benefits**
- Wide measurement range due to the combined measurement principle
- Very compact: just one sensor needed
- Two-in-one sensor: cost and space saving solution

**DI/DU 200/201**

**DI/DU 2000/2001**

**DI/DU 2001 rel.**

**Principle of measurement**
- Capacitive ceramic diaphragm sensor
- Piezo resistive diaphragm sensor

**Measurement/display range**
- Absolute pressure measurement: 0.1 to 200 mbar or 1 to 2000 mbar
- Relative pressure measurement: -1000 mbar to +1000 mbar

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**THERMOVAC Transmitters**

THERMOVAC transmitters are suited for almost any applications. Versions with set point relays for improved process control are available.

**Benefits**
- New MEMS/Parylene coated MEMS Pirani sensor for high resistance
- Fast response and high accuracy: time saving and highly reliable
- Analogue or digital, 360° LED status ring or integrated screen, options available
- Optimized price-to-performance ratio

**TTR 91 N(S) / TTR 96 N(S)**

**TTR 91 R**

**Principle of measurement**
Thermal conductivity after Pirani

**Measurement/display range**
- Absolute pressure measurement: 5 · $10^{-5}$ to 1500 mbar
- Relative pressure measurement: 5 · $10^{-4}$ to 1000 mbar

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**TTR 101**

**Benefits**
- Two-in-one sensor: cost and space saving measurement solution
- Large measurement range and time-saving measurements

**Principle of measurement**
Thermal conductivity after Pirani combined with Capacitance

**Measurement/display range**
- 5 · $10^{-5}$ to 1500 mbar
High endurance - accurate and reproducible results

**Cold Cathode Ionization Gauges**

**Multiple function Gauges**

**Hot Cathode Ionization Gauges**

**PENNINGVAC Transmitters**

PENNINGVAC provide a very long life time due to a low ionisation current and the stainless steel body.

**Benefits**
- New MEMS-Pirani / cold cathode combination for cost and time-saving measurements
- Complete coverage of the measurement range from 1x 10⁻⁸ mbar to atmosphere by a single transmitter
- Automatic ignition from the MEMS-Pirani to the cold cathode: ease of use and high process stability
- Modular design for easy serviceability

**PTR 90 N**

**Principle of measurement**
Cold cathode ionization after the inverted magnetron principle combined with thermal conductivity (MEMS Pirani)

**Measurement/display range**
1 · 10⁻⁸ to 1000 mbar

**PTR 225 N / PTR 237 N**

**Benefits**
- Robust cold cathode sensing cell: reliable measurements and high process quality
- Modular design provides low TCO by easy and inexpensive servicing

**Principle of measurement**
Cold cathode ionization after the inverted magnetron principle

**Measurement/display range**
1 · 10⁻⁸ to 5 · 10⁻³ mbar

**Absolute / Differential pressure transmitters**

Combination of different measurement technologies in one housing making them the perfect gauges for load lock applications.

**TTR 200 N**

**PTR 200 N**

**Principle of measurement**
Up to three sensors in one housing for a wide measurement range

**Measurement/display range**
TTR 200: 5 · 10⁻⁸ mbar to 1500 mbar
PTR 200: 1 · 10⁻⁸ mbar to 1500 mbar

Gas type independent pressure measurements from 50 mbar to 1300 mbar

**IONIVAC Transmitters**

The IONIVAC units permit vacuum pressure measurements on non-combustible gases and gas mixtures within a wide range of pressures.

**Benefits**
- The Pirani / hot cathode ionization (Bayard-Alpert) combination allows continuous pressure measurements
- Just one gauge required to cover a wide measurement range
- Cost- and space-saving solution
- High process reliability of the ITR 200 through two cathodes

**ITR 90/ITR 90 PB**

**ITR 200 S/ITR 200 SP**

**Principle of measurement**
Hot cathode ionization vacuum gauges after Bayard-Alpert combined with thermal conductivity after Pirani

**Measurement/display range**
5 · 10⁻¹⁰ to 1000 mbar
## Technical Data

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<th>Vacuum Transmitter</th>
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<th>Linear pressure sensors</th>
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<td>Capacitance diaphragm sensor</td>
</tr>
<tr>
<td><strong>Measurement range / Display range</strong></td>
<td>mbar</td>
<td>mbar</td>
</tr>
<tr>
<td>Measurement range</td>
<td>1000 / 1 · 10⁻¹ Torr*</td>
<td>1000 / 1 · 10⁻¹ Torr*</td>
</tr>
<tr>
<td>Display range</td>
<td>100 / 1 · 10⁻² Torr</td>
<td>100 / 1 · 10⁻² Torr</td>
</tr>
<tr>
<td>Measurement uncertainty</td>
<td>mbar</td>
<td>mbar</td>
</tr>
<tr>
<td>Measurement uncertainty 1</td>
<td>0.2% of reading ± temperature effect</td>
<td>0.12% of reading ± temperature effect</td>
</tr>
<tr>
<td>Measurement uncertainty 2</td>
<td>0.2% of reading ± temperature effect</td>
<td>0.15% of reading ± temperature effect</td>
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<tr>
<td>Measurement uncertainty 3</td>
<td>0.1 Torr</td>
<td>0.1 Torr</td>
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<tr>
<td>Status indicators</td>
<td>LED</td>
<td>–</td>
</tr>
<tr>
<td>Max. bakeout temperature</td>
<td>°C</td>
<td>Not bakeable</td>
</tr>
<tr>
<td>Overpressure limit</td>
<td>bar</td>
<td>3.1</td>
</tr>
<tr>
<td>Protection class</td>
<td>IP</td>
<td>40</td>
</tr>
<tr>
<td>Setpoints</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Max. cable length</td>
<td>m</td>
<td>30 (type C) Sub-D, 15 pin</td>
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<tr>
<td>Electrical connection</td>
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<td>Interfaces</td>
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<tr>
<td>Controller type</td>
<td></td>
<td>GRAPHIX series</td>
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* 1 Torr = 1.333 mbar
** Example, please refer to catalog for further details
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<th>PENNINGVAC</th>
<th>IONIVAC</th>
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<td>TTR 91 R</td>
<td>TTR 101</td>
</tr>
<tr>
<td>TTR 96/916 N: Coated MEMS-Pirani</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Principle of measurement**

- Capacitance diaphragm
- Inconel® diaphragm sensor
- Capacitive ceramic diaphragm
- Piezo resistive ceramic diaphragm
- TTR 91/911 N(S): MEMS-Pirani
- TTR 96/916 N: Coated MEMS-Pirani

**Cold cathode according to the inverted magnetron MEMS Pirani**

**Filament Pirani**

**Hot cathode and Pirani**

- Measurement range / Display range: mbar
  - 1000 / 1 · 10⁻¹ Torr*
  - 100 / 1 · 10⁻² Torr
  - 20 / 2 · 10⁻³ Torr
  - 10 / 1 · 10⁻³ Torr
  - 1 / 1 · 10⁻⁴ Torr
  - 0.1 / 1 · 10⁻⁵ Torr

- Measurement uncertainty: mbar
  - ± 0.2% of reading
  - ± 0.5% of reading
  - ± 0.5% of reading (0.1 Torr)
  - ± 0.12% of reading
  - ± 0.15% of reading (0.1 Torr)
  - ± 0.25% of full scale
  - ± 10% of reading
  - ± 5% of reading
  - ± 25% of reading
  - ± 0.12% of reading
  - ± 0.15% of reading (0.1 Torr)
  - ± 0.25% of full scale
  - ± 10% of reading
  - ± 5% of reading
  - ± 25% of reading
  - ± 30% of reading

**Status indicators**

- LED – LED-ring (360°)
- Max. bakeout temperature °C
  - Not bakeable 70
  - 85, non-operating 150 (electronics removed) 85, non-operating
  - with bake-out extension 80

**Max. overpressure limit bar**

- 3.1
- 6
- 5
- 2
- 2
- 2
- 2
- 1 - 2

**Protection class IP**

- 40
- 54
- 40
- 40
- 40
- 30
- 40
- 40
- 40
- 40
- 40
- 80

**Setpoints**

- 0 at TTR 91/96 N
- 2 at TTR 91 N (S)
- 2 at TTR 911/916 N
- 0
- 10
- 2
- 2
- 40
- 40
- 40
- 0
- 2
- 3 [RS 232]
- 0
- 3 (RS 232)
- 2
- 1 - 2
- 2
- 2
- 2

**Max. cable length Electrical connection m**

- 30 (type C)
- Sub-D, 15 pin
- 25
- 3 [RS 232]
- 0
- 3 (RS 232)
- 2 (EtherCAT)
- 100 (type A)
- FCC 68 / RJ45
- or Sub-D 15 Pin
- 100 (type A)
- FCC 68 / RJ45
- 100 (type A)
- FCC 68 or 2 x FCC 68 + 1 x Sub-D 15 pin
- 100 (type A)
- FCC 68 / RJ 45
- RS 232
- 100 (type A)
- FCC 68 / RJ45
- RS 232
- 100 (type C)
- Sub-D, 15-way male
- 100 (type A)
- FCC 68 / RJ45
- or Sub-D 15 Pin
- 100 (type A)
- FCC 68 / RJ45
- 100 (type A)
- FCC 68 / RJ 45
- RS 232
- 100 (type C)
- Sub-D, 15-way male

**Interfaces**

- RS 232
- DI: 4 - 20 mA / DU: 2 - 10 V
- Display
- RS 232 / Display / EtherCAT / Profibus (TTR 101 PB)
- RS 232
- RS 232
- RS 232 C Profibus
- RS 232
- RS 232

**Controller type**

- GRAPHIX series
- DISPLAY and GRAPHIX series
- DISPLAY and GRAPHIX series
- DISPLAY THREE GRAPHIX series
- GRAPHIX series
Display and Operating Instruments

Ordering Information

Display and Operating Instruments
Universal controllers with 1, 2, 3 measurement channels for operation and control of the entire vacuum system.

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<th>Display and GRAPHIX series</th>
<th>for active sensors from the series - matching connection lines, 5 m</th>
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<td>Model</td>
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<tr>
<td>DISPLAY series:</td>
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<tr>
<td>- 4 digit display for the mantissa in the range from 5 · 10⁻⁹ to 2000 mbar</td>
<td>DISPLAY THREE 230 025</td>
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<tr>
<td>- Wide-area power supply for a mains connection voltage of 100 - 240 V AC at 50/60 Hz</td>
<td>GRAPHIX ONE 230680V01</td>
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<td>- Easy to read curve or bar graph display</td>
<td>GRAPHIX TWO 230681V01</td>
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<td>- Internal and external data logging (USB)</td>
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<td>- Connectable to active vacuum gauges from various brands</td>
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<td>CTR 101 N</td>
<td>DN16 ISO-KF</td>
<td>1 x 10⁻⁵ Torr - 1000 Torr</td>
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<td>Linear pressure sensors</td>
<td>DI 200</td>
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<td>DU 200</td>
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<td>0.1 mbar - 200 mbar</td>
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<td>DN 16 ISO-KF</td>
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<td>TTR 91 N</td>
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<td>TTR 96 NC</td>
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<td>TTR 911 N</td>
<td>DN 16 ISO-KF, 2 switching points and display</td>
<td>1.2 x 10⁻⁴ mbar - 1000 mbar</td>
<td>89654V02</td>
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<td>TTR 916 NC</td>
<td>DN 16 ISO-KF, 2 switching points and display</td>
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<td>TTR 101</td>
<td>DN 16 ISO-KF</td>
<td>5 x 10⁻⁴ mbar - 1500 mbar</td>
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<td>120 90</td>
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<td>ITR 200 S</td>
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<td>230 250</td>
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For more detailed information and the entire product range, please refer to the Leybold full line catalog. Visit our webshop www.leyboldproducts.com.