œrlikon
leybold vacuum

Vacuum Measurement

User-optimized Active Gauges for Various Applications from 2000 mbar to 10^{-10} mbar

179.91.02

Measurement principles suited for your application

Vacuum Pressure Measurement and Principles

The vacuum pressure range where pressure measurements can be performed ranges from 2000 mbar to 10^{-12} mbar, i.e. over 16 orders of magnitude.

Due to physical characteristics, no single vacuum sensor exists which is capable to perform quantitative measurements within the entire pressure range. For this reason Oerlikon Leybold Vacuum offers sensors of different designs with own characteristic measurement range, usually spanning several orders of magnitude.
A difference is made between so-called direct and indirect pressure measurements.

Direct, gas type independent pressure measurement

Vacuum sensors:

- **CERAVAC** capacitive gauges equipped with diaphragms with different sensitivity covering the pressure range from 10^{-5} mbar to 1333 mbar (1000 Torr) with high precision.
- **DI/DU** capacitive and piezo pressure sensors with a pressure range from 10^{-1} mbar to 2000 mbar in absolute pressure measurements and -1000 mbar to +1000 mbar in relative 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, gas type dependent pressure measurement

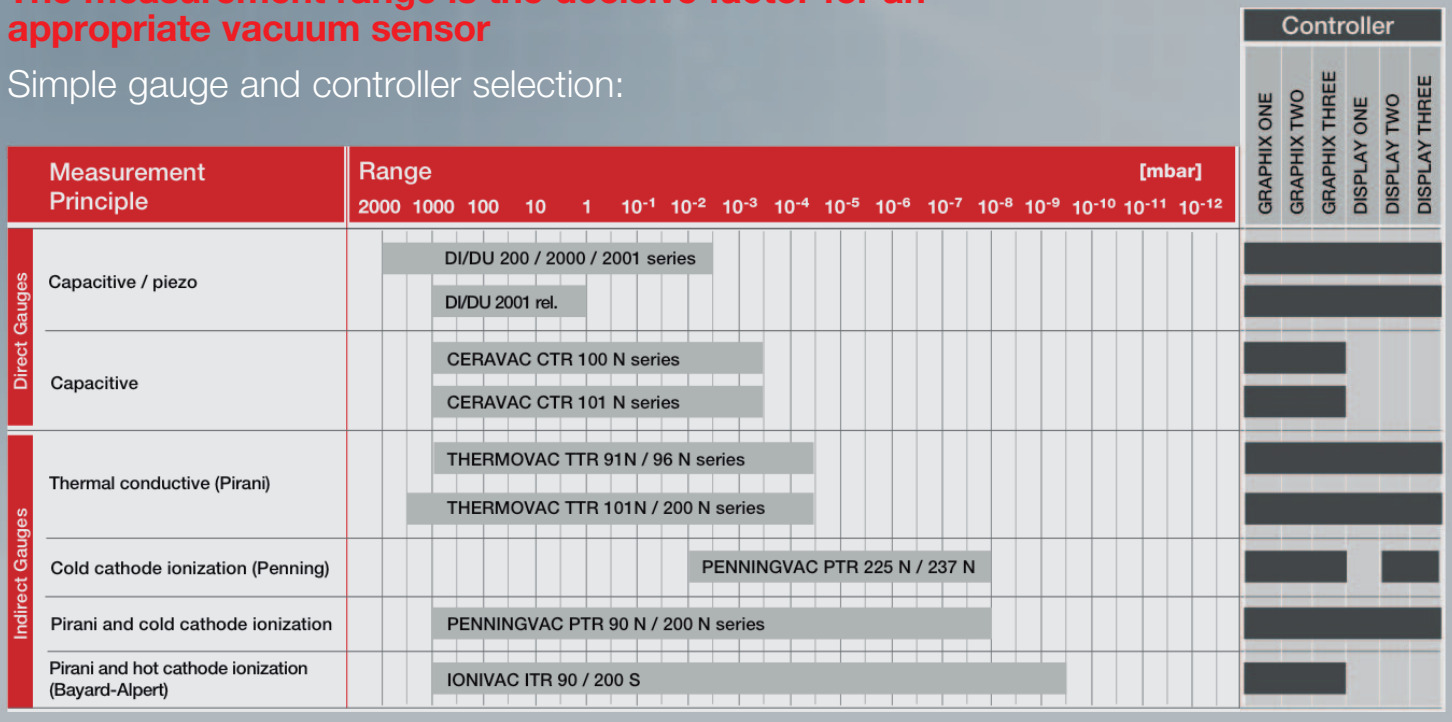
Vacuum sensors:

- **THERMOVAC** thermal conductivity vacuum gauges according to Pirani
- **PENNINGVAC** cold cathode ionization vacuum gauges according to Penning
- **IONIVAC** hot cathode ionization vacuum gauges according to Bayard-Alpert for pressures ranging from 10^{-10} mbar to 1000 mbar.

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:



The ideal vacuum gauge for your requirements

Application / Sensors:	CERAVAC CTR	Linear pressure sensors DI/DU	THERMOVAC TTR	PENNINGVAC PTR	IONIVAC ITR
Research and Development	■		■	■	
Chemical/Chemistry processes	■	■	■	■	
Heat Treatment/Metallurgy	■	■	■	■	■
Automotive Industry	■	■	■	■	
Space Simulation	■	■	■	■	■
Analytical	■	■	■	■	■
Refrigeration and Air conditioning		■	■		
Chemistry and Research laboratories	■	■	■	■	■
High vacuum pump systems	■		■	■	■
Mechanical Engineering	■	■	■	■	■
Sputter Systems	■	■	■	■	■
Process Industry	■	■	■	■	■
Solar	■	■	■		

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

Oerlikon Leybold Vacuum transmitters are specially suited for system integration

Our high-precision vacuum sensors meet your demands:

- Highly reliable fore vacuum pressure measurement
- Simple operation
- Highly reproducible measurement results
- Several measurement locations to be constantly monitored
- 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.)

Active Sensors / Vacuum Transmitters

Capacitance Diaphragm Gauges (CDG)

Thermal Conductivity Gauges (Pirani)

CERAVAC Transmitters

CTR 100 N / CTR 101 N

The CERAVAC transmitters are suited for corrosive process gases.

Benefits

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

Principle of measurement
Capacitive diaphragm stainless steel sensor

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

Linear Pressure Sensors

DI/DU 200/201, DI/DU 2000/2001, DI/DU 2001 rel.

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

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

THERMOVAC Transmitters

Operation of the THERMOVAC transmitters is based on the thermal conductivity principle after Pirani. S-versions offer set point relays for improved process control.

The THERMOVAC series is equipped with a LED-ring (360°) showing the sensor status.

Benefits

- New MEMS-Pirani for high resistance
- Fast response and high accuracy: time saving and highly reliable
- Optimized price-to-performance ratio

TTR 91 N(S) / TTR 96 N

Principle of measurement
Thermal conductivity after Pirani

Measurement/display range
$5 \cdot 10^{-5}$ to 1000 mbar

TTR 911 N(C/S) / TTR 916 N

The TTR 911 and TTR 916 have a touch display and/or digital interfaces.

C-versions are equipped with a Parylene HT®-coated sensor for chemical and aggressive applications.

Principle of measurement
Thermal conductivity after Pirani

Measurement/display range
$5 \cdot 10^{-5}$ to 1000 mbar

TTR 101 N(S)

The THERMOVAC TTR 101 N models use a thermal conductivity MEMS Pirani / Piezo solid state sensor combination. They are resilient to vibration and shock venting and provide superior accuracy and gas type independent readings between 10 mbar and 1500 mbar.

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 Piezo

Measurement/display range
$5 \cdot 10^{-5}$ to 1500 mbar

High endurance - accurate and reproducible results

Cold Cathode Ionization Gauges

Multiple combination Gauges

Hot Cathode Ionization Gauges

PENNINGVAC Transmitters

PTR 90 N

These PENNINGVAC transmitters are the perfect gauge for a wide range of applications.

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 of the cold cathode by the MEMS-Pirani: ease of use and high process stability
- Modular design for easy servicability

Principle of measurement
Cold cathode ionization after Penning combined with thermal conductivity (MEMS Pirani)

Measurement/display range
1 · 10^{-8} to 1000 mbar

PTR 225 N / PTR 237 N

Easy system integration, providing excellent process control even in rough applications.

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 Penning

Measurement/display range
1 · 10^{-8} to 5 · 10^{-3} mbar

LoadLock Transmitters

TTR 200 N
PTR 200 N

The TTR 200 N and PTR 200 N combine different measurement technologies in one housing making them the perfect gauges for load lock applications.

Benefits

- Combination of absolute and differential measurements offers unprecedented loadlock control
- Differential range (relative to ambient pressure):-1013 to 1013 mbar
- The highly accurate differential sensor is ideal for loadlock control since it is insensitive to changes in ambient pressure conditions
- Efficient loadlock control improves throughput and cycle time

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

Measurement/display range
TTR 200: 5 · 10^{-5} 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

ITR 90 / ITR 90 PB
ITR 200 S / ITR 200 SP

The IONIVAC units permit, by way of combined hot cathode ionization meters with a Pirani sensor, vacuum pressure measurements on non-combustible gases and gas mixtures within a wide range of pressures.

Optionally, the pressure can be displayed on an integrated display.

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
- The integrated dual Pirani provides a long service life

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

High Precision Vacuum Measurements

Technical Data		CERAVAC		Linear pressure sensors		
Vakuum Transmitter		**CTR 100 N**	**CTR 101 N**	**DI / DU 200 / 201**	**DI / DU 2000/2001/2001 rel.**	**TTR 91 N(S) TTR 96 N**
Principle of measurement		Capacitance diaphragm Stainless steel sensor	Capacitance diaphragm Stainless steel sensor	Capacitive ceramic diaphragm sensor	Piezo resistive ceramic diaphragm	TTR 91 N(S): MEMS-Pirani TTR 96 N: Coated MEMS-Pirani
Measurement range / Display range	**mbar**	1000 / $1 \cdot 10^{-1}$ Torr* 100 / $1 \cdot 10^{-2}$ Torr 20 / $2 \cdot 10^{-3}$ Torr 10 / $1 \cdot 10^{-3}$ Torr 1 / $1 \cdot 10^{-4}$ Torr 0.1 / $1 \cdot 10^{-5}$ Torr	1000 / $1 \cdot 10^{-1}$ Torr* 100 / $1 \cdot 10^{-2}$ Torr – 10 / $1 \cdot 10^{-3}$ Torr 1 / $1 \cdot 10^{-4}$ Torr 0.1 / $1 \cdot 10^{-5}$ Torr	0.1 to 200	1 to 2000 DI/DU 2001 rel.: -1000 to +1000 relative pressure	$5 \cdot 10^{-5}$ - 1000
Measurement uncertainty	**mbar**	0.2% of reading ± temperature effect 0.5% of reading ± temperature effect (0.1 Torr)	0.12% of reading ± temperature effect 0.15% of reading ± temperature effect (0.1 Torr)	0.25 % of full scale linearity, reproducibility and hysteresis		$5 \cdot 10^{-4}$ to $1 \cdot 10^{-3}$ ±10 % of reading $1 \cdot 10^{-3}$ to 100 ±5 % of reading 100 to atm ±25 % of reading
Status indicators		LED		–		LED-ring (360°)
Max. bakeout temperature	**°C**	Not bakeable		70		85, non-operating
Overpressure limit	**bar**			6	5	6
Protection class	**IP**	40		54		40
Setpoints		0	0	–	–	0 at TTR 91 N 2 at TTR 91 NS 2 at TTR 96 N
Max. cable length **Electrical connection**	**m**	30 (type C) Sub-D, 15 pin		25 DI: 7 pole diode plug (5 m) / DU: FCC 68 (5 m)		100 (type A) FCC 68 / RJ45
Interfaces		RS 232		DI: 4 - 20 mA / DU: 2 - 10 V		– –
Controller type		GRAPHIX series		DI: GRAPHIX and DISPLAY series via signal converter DU: DISPLAY and GRAPHIX series		DISPLAY and GRAPHIX series

*** 1 Torr = 1.333 mbar**

**** Example, please refer to catalog for further details**

from 2000 mbar to 10^{-10} mbar

THERMOVAC		PENNINGVAC		Loadlock Combinations		IONIVAC	
TTR 911 N(C/S) TTR 916 N	**TTR 101 N(S)**	**PTR 90 N**	**PTR 225 N PTR 237 N**	**TTR 200 N**	**PTR 200 N**	**ITR 90**	**ITR 200 S**
TTR 911 N: MEMS-Pirani TTR 911 N/C / TTR 916 N: Coated MEMS-Pirani	MEMS-Pirani and Piezo	Cold cathode according to Penning and MEMS Pirani	Cold cathode according to Penning	MEMS-Pirani and Diff. Piezo	Cold cathode, MEMS-Pirani and Diff. Piezo	Bayard-Alpert and Pirani	
$5 \cdot 10^{-5}$ - 1000	$5 \cdot 10^{-5}$ - 1500	$1 \cdot 10^{-8}$ - 1000	$1 \cdot 10^{-8}$ - $5 \cdot 10^{-3}$	absolute: $5 \cdot 10^{-5}$ - 1500 ** differential [RS 232]: -1013 to 1013	absolute: $1 \cdot 10^{-8}$ - 1500 ** differential [RS 232]: -1013 to 1013	$5 \cdot 10^{-10}$ - 1000	
$5 \cdot 10^{-4}$ to $1 \cdot 10^{-3}$ ±10 % of reading $1 \cdot 10^{-3}$ to 100 ±5 % of reading 100 to atm ±25 % of reading	$5 \cdot 10^{-4}$ to $1 \cdot 10^{-3}$ ±10 % of reading ** $1 \cdot 10^{-3}$ to 11 ±5 % of reading ** 11 to 1333 ±0.75 % of reading **	$1 \cdot 10^{-4}$ to $1 \cdot 10^{-3}$ ±10% of reading** $1 \cdot 10^{-3}$ to 100 ±5% of reading** 100 to 1000 ±25% of reading** $1 \cdot 10^{-8}$ to $1 \cdot 10^{-3}$ ±30% of reading**	± 30% at $1 \cdot 10^{-8}$ to $1 \cdot 10^{-3}$ mbar	MEMS-Pirani: $1 \cdot 10^{-4}$ to $1 \cdot 10^{-3}$ ±10 % of reading ** Diff. Piezo: -10 to 10 ±10 % of reading ±0.67 mbar **	Cold cathode: $1 \cdot 10^{-8}$ to $1 \cdot 10^{-3}$ ±30 % of reading ** MEMS-Pirani: $1 \cdot 10^{-4}$ to $1 \cdot 10^{-3}$ ±10 % of reading ** Diff. Piezo: -10 to 10 ±10 % of reading ±0.67 mbar **	15% at $1 \cdot 10^{-8}$ - $1 \cdot 10^{-2}$ mbar > 15% at 10^{-1} - 1000 mbar	
LED-ring (360°)	LED-ring (360°)	LED-ring (360°)		LED-ring (360°)	LED-ring (360°)	–	
85, non-operating	85, non-operating	85, non-operating		85, non-operating	85, non-operating	150 with bake-out extension	80
6	2	2		2	2	2	
40	40	40		40	40	30	
2 [Profibus / EtherCAT / Display] 3 [RS 232]	2 3 [RS 232]	0 3 (RS 232)	0 3 (RS 232) 2 (EtherCAT)	3	3	–	1 - 2
100 (type A) FCC 68 / RJ45	100 (type A) 1 x FCC 68 or 2 x FCC 68 + 1 x Sub-D 15 pin	100 (type A) FCC 68 / RJ 45	100 (type A) FCC 68 / RJ 45 EtherCat: RS 232	20 (type A) Sub-D 15 pin	20 (type A) Sub-D 15 pin	100 (type C) Sub-D, 15-way male	
TTR 911 N Display: – TTR 911 N S: RS 232 TTR 911 N/C: EtherCAT/ Profibus TTR 916 N Display: –	RS 232 / Display / EtherCAT / Profibus	RS 232 EtherCAT	RS 232 EtherCAT	RS 232	RS 232	RS 232 C Profibus	
DISPLAY and GRAPHIX series	DISPLAY and GRAPHIX series	DISPLAY and GRAPHIX series	DISPLAY TWO DISPLAY THREE GRAPHIX series			GRAPHIX series	

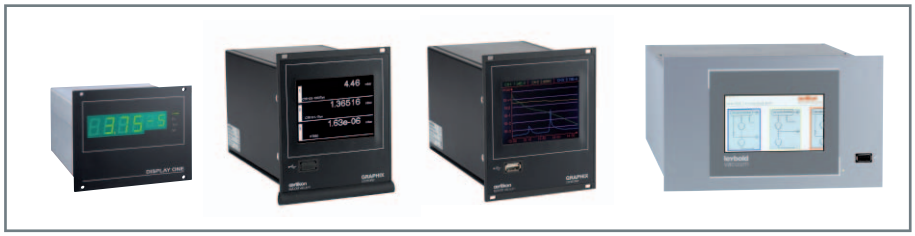
Display and Operating Instruments

A number of different display and operating units is available for the active sensors from Oerlikon Leybold Vacuum.

- **DISPLAY** series
  Single and multichannel instruments
- **GRAPHIX** series
  Single and multichannel instruments
- **VACVISION**
  Universal vacuum controller

All these display and operating units display the measured values and supply the operating voltage. They may be operated either as a bench top unit or within 19” racks.

The new GRAPHIX series comprises vacuum controllers with up to three measurement channels.
GRAPHIX monitors and controls the entire vacuum process of active sensors for direct pressure measurements (10^{-10} mbar to 2000 mbar).



DISPLAY ONE, DISPLAY THREE, GRAPHIX THREE and VACVISION

Display and Operating Instruments

for active sensors	P/N	CTR	DI [1] DU	ITR	TTR	PTR 90 N	PTR 225/237 N
Single/multichannel instruments							
DISPLAY ONE	230 001	–	✓	–	✓	✓	–
DISPLAY TWO	230 024	–	✓	–	✓	✓	✓
DISPLAY THREE	230 025	–	✓	–	✓	✓	✓
GRAPHIX ONE	230680V01	✓	✓	✓	✓	✓	✓
GRAPHIX TWO	230681V01	✓	✓	✓	✓	✓	✓
GRAPHIX THREE	230682V01	✓	✓	✓	✓	✓	✓
VACVISION vacuum controller	230400V01	✓	–	✓	✓	✓	–

Typification of the Connection Lines

Display and operating unit	DISPLAY ONE	DISPLAY TWO DISPLAY THREE	GRAPHIX ONE GRAPHIX TWO GRAPHIX THREE
THERMOVAC transmitter TTR series	Type A	Type A	Type A
PENNINGVAC transmitter PTR series	Type A	Type A	Type A
CERAVAC transmitter CTR series (digital signal)	—	—	Type C
Linear pressure sensors DU 200/1 and DU 2000/1/rel	Type A*	Type A*	Type A*
Linear pressure sensors DI 200/1 and DI 2000/1/rel (with signal converter)	Type A** [1]	Type A** [1]	Type A** [1]
IONIVAC transmitter ITR series	—	—	Type C

Type A: FCC 68 (RJ 45) at both ends, eight-way shielded / **Type A***: Preconnected measuring cable (5 m) with FCC 68 (RJ 45), eight-way shielded
Type A**: Preconnected measuring cable (5 m) with diode plug, 7-pole. [1] Operation requires the use of a signal converter
Type C: Sub-D, 15-way female to Sub-D 15-way male, shielded

For more detailed information, please refer to the Oerlikon Leybold Vacuum full line catalog, chapter “vacuum - measuring, controlling”.

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