Leybold

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 own characteristic measurement range, usually spanning several orders of magnitude.

A difference is made between 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 after Pirani.
- **PENNINGVAC** cold cathode ionization vacuum gauges after the inverted magnetron principle.
- **IONIVAC** hot cathode ionization vacuum gauges after Bayard-Alpert for pressure measurements in the ultra-high vacuum range.

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:

	Measurement Principle	Range [mbar] 2000 1000 100 10 1 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5} 10^{-6} 10^{-7} 10^{-8} 10^{-9} 10^{-10}	Controller: GRAPHIX ONE	GRAPHIX TWO	GRAPHIX THREE	DISPLAY ONE	DISPLAY THREE
Direct Gauges	Capacitive / piezo	DI/DU 2000 / 2001	X	X	X	X	X
		DI/DU 200 / 201	X	X	X	X	X
		DI/DU 2001 rel.	X	X	X	X	X
	Capacitive	CERAVAC CTR 100 N series	X	X	X		
		CERAVAC CTR 101 N series	X	X	X		
Indirect Gauges	Thermal conductive (Pirani)	THERMOVAC TTR 91 N / 96 N series	X	X	X	X	X
		THERMOVAC TTR 101 series	X	X	X	X	X
		THERMOVAC TTR 91 R series	X	X	X		X
	Cold cathode ionization (Penning)	PENNINGVAC PTR 225 N / 237 N	X	X	X		X
	Pirani and cold cathode ionization	PENNINGVAC PTR 90 N / 200 N series	X	X	X	X	X
	Pirani and hot cathode ionization (Bayard-Alpert)	IONIVAC ITR 90 / 200 S	X	X	X		

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	■		■	■	■
Mechanical Engineering	■	■	■	❑	❑
Sputter Systems	■	❑	■	■	■
Process Industry	■	■	■	■	❑
Solar	■	■	■		

■ preferred choice
❑ possible

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:

- 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.)

Active Sensors / Vacuum Transmitters

Capacitance Diaphragm Gauges (CDG)

Capacitance Diaphragm Gauges (CDG)

Thermal Conductivity Gauges (Pirani)

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

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

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
$5 \cdot 10^{-5}$ to 1000 mbar (“N” range)
$5 \cdot 10^{-4}$ to 1000 mbar (“R” range)

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
$5 \cdot 10^{-5}$ 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 servicability

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^{-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

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

High Precision Vacuum Measurements

Technical Data		CERAVAC		Linear pressure sensors	
Vacuum Transmitter		**CTR 100 N**	**CTR 101 N**	**DI / DU 200 / 201**	**DI / DU 2000/2001/2001 rel.**
Principle of measurement		Capacitance diaphragm Inconel® diaphragm sensor	Capacitance diaphragm Inconel® diaphragm sensor	Capacitive ceramic diaphragm sensor	Piezo resistive ceramic diaphragm
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
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	
Status indicators		LED		–	
Max. bakeout temperature	**°C**	Not bakeable		70	
Overpressure limit	**bar**	3.1		6	5
Protection class	**IP**	40		54	
Setpoints		0	2	–	–
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)	
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	

*** 1 Torr = 1.333 mbar**

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

from 2000 mbar to 10^{-10} mbar

THERMOVAC			PENNINGVAC		IONIVAC	
TTR 91/911 N(S) TTR 96/916 N(S)	**TTR 91 R**	**TTR 101**	**PTR 90 N**	**PTR 225 N PTR 237 N**	**ITR 90**	**ITR 200 S**
TTR 91/911 N(S): MEMS-Pirani TTR 96/916 N: Coated MEMS-Pirani	Filament Pirani	Filament Pirani and Capacitance	Cold cathode according to the inverted magnetron MEMS Pirani	Cold cathode according to the inverted magnetron principle	Hot cathode and Pirani	
$5 \cdot 10^{-5}$ - 1000	$5 \cdot 10^{-4}$ - 1000	$5 \cdot 10^{-5}$ - 2000 (RS 232 / Display / EtherCAT)	$1 \cdot 10^{-8}$ - 1000	$1 \cdot 10^{-8}$ - $5 \cdot 10^{-3}$	$5 \cdot 10^{-10}$ - 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	$1 \cdot 10^{-3}$ to 100 ±5 % 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	15% at $1 \cdot 10^{-8}$ - $1 \cdot 10^{-2}$ mbar > 15% at 10^{-1} - 1000 mbar	
LED-ring (360°)	LED	LED	LED-ring (360°)		–	
85, non-operating	150 (electronics removed)	85, non-operating	85, non-operating		150 with bake-out extension	80
6	10	2	2	2	2	
40	40	40	40	40	30	
0 at TTR 91/96 N 2 at TTR 91 N (S) 2 at TTR 911/916 N	0	2 3 [RS 232]	0 3 (RS 232)	0 3 (RS 232) 2 (EtherCAT)	–	1 - 2
100 (type A) FCC 68 / RJ45 or Sub-D 15 Pin	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 RS 232	100 (type C) Sub-D, 15-way male	
Display RS 232		RS 232 / Display / EtherCAT / Profibus (TTR 101 PB)	RS 232	RS 232	RS 232 C Profibus	
DISPLAY and GRAPHIX series	DISPLAY and 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

DISPLAY and GRAPHIX series			**for active sensors from the series -** matching connection lines, 5 m					
			**CTR**	**DI DU**	**ITR**	**TTR**	**PTR 90 N**	**PTR 225/237 N**
Features	Model	P/N						
DISPLAY series: - 4 digit display for the mantissa in the range from 5 · 10^{-9} to 2000 mbar - Wide-area power supply for a mains connection voltage of 100 - 240 V AC at 50/60 Hz	DISPLAY ONE	230 001	–	✓ included	–	✓ 124 26	✓ 124 26	–
	DISPLAY THREE	230 025	–	✓ included	–	✓ 124 26	✓ 124 26	✓ 124 26
GRAPHIX series: - 3.5“ TFT touchscreen display with intuitive user interface - Easy to read curve or bar graph display - Internal and external data logging (USB) - Connectable to active vacuum gauges from various brands	GRAPHIX ONE	230680V01	✓ 124 55	✓ included	✓ 124 55	✓ 124 26	✓ 124 26	✓ 124 26
	GRAPHIX TWO	230681V01	✓ 124 55	✓ included	✓ 124 55	✓ 124 26	✓ 124 26	✓ 124 26
	GRAPHIX THREE	230682V01	✓ 124 55	✓ included	✓ 124 55	✓ 124 26	✓ 124 26	✓ 124 26

Ordering Information (extract from the product range)

Sensor type	Model	Description	Pressure range	Part. No.
CERAVAC	CTR 100 N	DN16 ISO-KF	1 x 10^{-1} Torr - 1000 Torr	230300V02
	CTR 101 N	DN16 ISO-KF	1 x 10^{-1} Torr - 1000 Torr	230320V02
Linear pressure sensors	DI 200	DN 16 ISO-ISO-KF, incl. 5 m connection cable	0.1 mbar - 200 mbar	15812V01
	DU 200	DN 16 ISO-ISO-KF, incl. 5 m connection cable	0.1 mbar - 200 mbar	230500V01
THERMOVAC	TTR 91 R	DN 16 ISO-KF	5 x 10^{-4} mbar - 1000 mbar	230049V01
	TTR 91 N	DN 16 ISO-KF, 2 switching points	5 x 10^{-5} mbar - 1000 mbar	230040V02
	TTR 96 NC	DN 16 ISO-KF, 2 switching points	5 x 10^{-5} mbar - 1000 mbar	230045V02
	TTR 911 N	DN 16 ISO-KF, 2 switching points and display	1.2 x 10^{-4} mbar - 1000 mbar	89654V02
	TTR 916 NC	DN 16 ISO-KF, 2 switching points and display	5 x 10^{-4} mbar - 1500 mbar	89656V02
	TTR 101	DN 16 ISO-KF	5 x 10^{-5} mbar - 1500 mbar	230350V01
PENNINGVAC	PTR 90 N	DN 25 ISO-KF	1 x 10^{-8} mbar - 1000 mbar	230070V02
	PTR 90 N	DN 25 ISO-KF, display	1 x 10^{-8} mbar - 1000 mbar	230085V02
	PTR 225 N	DN 25 ISO-KF	1 x 10^{-8} mbar - 5 x 10^{-3} mbar	15734V02
Absolute/Differential pressure sensors	THERMOVAC TTR 200 N	DN 16 ISO-KF, 3 switching points	5 x 10^{-5} mbar - 1500 mbar	230365V02
	PENNINGVAC PTR 200 N	DN 25 ISO-KF, RS232	1 x 10^{-8} mbar - 1500 mbar	230087V02
IONIVAC	ITR 90	DN 25 ISO-KF	5 x 10^{-10} mbar - 1000 mbar	120 90
	ITR 200 S	DN 25 ISO-KF	5 x 10^{-10} mbar - 1000 mbar	230 250

For more detailed information and the entire product range, please refer to the Leybold full line catalog.
Visit our webshop www.leyboldproducts.com.

Leybold

Pioneering products. Passionately applied.