

179.01.02  
Excerpt from the  
Leybold Vacuum Full Line Catalog 2005  
Product Section C16  
Edition May 2005

# C16



## Total Pressure Gauges

Vacuum Gauges and  
Control Instruments

$10^{-12}$  – 2000 mbar ( $10^{-12}$  – 1500 Torr),  
Calibration Service

 **Leybold**  
vacuum

**General**

Applications for Vacuum Gauges .....	<b>C16.03</b>
Select the Combination of Sensor and Gauges which is ideal for your Application .....	<b>C16.04</b>
Basic Terms of Vacuum Metrology .....	<b>C16.06</b>
Connection Accessories for Small Flanges .....	<b>C16.08</b>

**Products****Mechanical Gauges (Vacuum Gauges Analog Readout)**

Bourdon Vacuum Gauges .....	<b>C16.09</b>
Capsule Vacuum Gauges .....	<b>C16.10</b>
Diaphragm Vacuum Gauge DIAVAC DV 1000 .....	<b>C16.12</b>

**Active Sensors / Transmitters**

CERAVAC Transmitters CTR 90/CTR 91 .....	<b>C16.14</b>
THERMOVAC Transmitters TTR 91/TTR 91S/TTR 96S .....	<b>C16.18</b>
THERMOVAC Transmitters TTR 100/TTR 100 S2 .....	<b>C16.22</b>
PENNINGVAC Transmitters PTR 225/PTR 225 S/PTR 237 .....	<b>C16.26</b>
IONIVAC Transmitter ITR 90 .....	<b>C16.30</b>

**Connection Cables for Active Sensors .....** **C16.34****Operating Units for Active Sensors**

DISPLAY ONE .....	<b>C16.36</b>
DISPLAY TWO / THREE .....	<b>C16.38</b>
CENTER ONE .....	<b>C16.40</b>
CENTER TWO / THREE .....	<b>C16.42</b>
COMBIVAC 2T .....	<b>C16.44</b>

**Additional Sensors**

Linear Pressure Sensors DI 200/DI 201/DI 2000/DI 2001/DI 2001 rel .....	<b>C16.48</b>
THERMOVAC Sensors TR 211/TR 211 NPT/TR 212/TR 216 .....	<b>C16.50</b>
PENNINGVAC Sensors PR 25/PR 26/PR 27/PR 28 .....	<b>C16.52</b>
IONIVAC Sensors IE 414/IE 514 .....	<b>C16.54</b>
Spare Sensors for Older Operating Units .....	<b>C16.56</b>

**Ultra High Vacuum Gauges**

IONIVAC IM 540 .....	<b>C16.58</b>
----------------------	---------------

**Pressures Switches and Control Instruments**

Low Pressure Safety Switch PS 113 A .....	<b>C16.62</b>
Pressure Switches PS 115 .....	<b>C16.64</b>
Switching Amplifier SV 110 .....	<b>C16.66</b>
Diaphragm Pressure Regulators MR 16/MR 50 .....	<b>C16.68</b>

**Miscellaneous**

Leybold Calibration Service .....	<b>C16.70</b>
-----------------------------------	---------------

# Applications for Vacuum Gauges

	BOURDONVAC A	BOURDONVAC C	Capsule vacuum gauge	DIAVAC DV 1000	CERAVAC	Linear Pressure Transmitter CTR	THERMOVAC Pressure Sensor DI	IONIVAC transmitter TTR	IONIVAC transmitter PTR	Pressure switch PS 113 A	Pressure switch PS 115	Diaphragm regulator MR 16/50
<b>Mechanical engineering</b>												
Car industry; filling of brake and air conditioning systems					■	■	■					
Vacuum conveying technology	■	■	■	■	■							■
Packaging technology			■	■	■						■	
Isolation vacuum	■		■	■	■	■					■	
<b>Chemical processes</b>												
Absolute pressure measurements in gas mixtures	■	■	■	■	■	■						
Drying and degassing processes		■		■	■							■
Solvent recovery				■		■						■
Vacuum pressure control in existing central vacuum supply systems						■						■
<b>Electrics/electronics/optics</b>												
Evaporation and coating systems				■		■	■	■				
Monitoring and controlling of sputter systems						■	■	■				
Semiconductor technology (CVD, plasma etching etc.)				■		■			■			
Ion implantation				■		■	■					
Lamp production		■		■	■	■						
<b>Analytical instruments and surface physics</b>												
ESCA, SIMS, AES, XPS						■	■	■	■			
Electron microscopy						■	■	■	■			
Crystal growing							■	■	■			
Gas analysis systems, mass spectrometers						■	■	■	■			
<b>Research</b>												
Measurement of ultimate pressure in UHV systems									■			
Application in MBE systems							■	■	■			
Particle accelerators									■			
Beam guidance systems, cyclotron							■		■			
Fusion experiments									■			
Space simulation chamber						■	■	■	■			
<b>System control/pressure control</b>												
Pressure checks on backing pumps and vacuum systems						■						■
Safety circuits in vacuum systems, protection of vacuum gate valves						■		■		■	■	
Control of ionization vacuum gauges						■						
Pressure measurements on HV pump systems, e.g. diffusion, TMP, cryo pump systems						■	■	■	■			
Venting systems										■	■	
Valve control, pressure dependant systems control					■	■	■	■	■	■	■	
Simple pressure control arrangements				■	■		■				■	■
<b>Calibration</b>												
Calibration of vacuum gauges and mass spectrometers				■					■			
Reference instruments for the determination of the physical properties of gases				■								
Precision measurements of low pressures also in the presence of corrosive or reactive gases				■								
<b>Miscellaneous</b>												
Vacuum annealing, melting, soldering and hardening furnaces				■		■	■	■				
Cooling and air conditioning technology					■	■						
Electron beam welding				■		■	■	■				
Metallurgy						■	■	■				

## Select the Combination of Sensor and Operating Range

mbar		10 <sup>-11</sup>	10 <sup>-10</sup>	10 <sup>-9</sup>	10 <sup>-8</sup>	10 <sup>-7</sup>	10 <sup>-6</sup>	10 <sup>-5</sup>	10 <sup>-4</sup>	10 <sup>-3</sup>	10 <sup>-2</sup>	10 <sup>-1</sup>	1	10	100	1000	
Part Number																	
<b>Capacitance Diaphragm</b>																	
<b>CERAVAC Transmitters (x = 2, 3, 4 or 5) <sup>1)</sup></b>																	
CTR 90	159 x1											0.13			1330	→	
CTR 90	159 x2										0.013				133		
CTR 90	159 x3									0.0013					13		
CTR 90	159 x4								0.00013				1.3				
CTR 91	159 x5											0.13			1330	→	
CTR 91	159 x6										0.013				133		
CTR 91	159 x7									0.0013					13		
CTR 91	159 x8								0.00013				1.3				
CTR 91	159 x9								0.000013			0.13					
<b>Linear Diaphragm Sensors <sup>2)</sup></b>																	
DI 200	158 12											0.1			200		
DI 201	158 14											0.1			200		
DI 2000	158 13												1		2000	→	
DI 2001	158 15												1		2000	→	
DI 2001 rel.	245 000												-1000		+1000	→	
<b>Thermal Conductivity (according to Pirani)</b>																	
<b>THERMOVAC Transmitters <sup>1)</sup></b>																	
TTR 100	230 026/230 028												0.0005			1500	→
TTR 91	230 035 - 230 038												0.0005			1000	
TTR 96 S	230 045 - 230 048												0.0005			1000	
<b>Cold Cathode Ionization (according to Penning)</b>																	
<b>PENNINGVAC Transmitters</b>																	
PTR 225, DN 25 KF	157 34												1 x 10 <sup>-9</sup>			0.01	
PTR 237, DN 40 CF	157 36												1 x 10 <sup>-9</sup>			0.01	
<b>Hot Cathode Ionization</b>																	
<b>IONIVAC Transmitters (Bayard-Alpert combined with Pirani) <sup>1)</sup></b>																	
ITR 90	120 90/120 92												5 x 10 <sup>-10</sup>				1000
ITR 90 with Display	120 91/120 94												5 x 10 <sup>-10</sup>				1000
<b>IONIVAC Sensors</b>																	
IE 414 (Bayard-Alpert)	158 66												2 x 10 <sup>-11</sup>				0.01
IE 514 (Extractor)	158 67												1 x 10 <sup>-12</sup>				0.0001
mbar		10 <sup>-11</sup>	10 <sup>-10</sup>	10 <sup>-9</sup>	10 <sup>-8</sup>	10 <sup>-7</sup>	10 <sup>-6</sup>	10 <sup>-5</sup>	10 <sup>-4</sup>	10 <sup>-3</sup>	10 <sup>-2</sup>	10 <sup>-1</sup>	1	10	100	1000	

<sup>1)</sup> Different part numbers depend on the vacuum connection

<sup>2)</sup> Differences of the sensors in the same operating range caused by the materials in contact with the medium



## Basic Terms of Vacuum Metrology

Today, the total range of vacuum pressure accessible to measurement extends from atmospheric pressure (about 1000 mbar (750 Torr)) down to  $10^{-12}$  mbar/Torr, i.e. it extends over 15 powers of ten. The instruments used for measuring the pressure within this wide range are called vacuum gauges. For physical reasons it is not possible to create a single vacuum sensor through which it might be possible to perform quantitative measurements within the entire pressure range. Therefore, a variety of different vacuum gauges are available, each with their own characteristic measurement range which commonly extends over several powers of ten. A difference is made between direct and indirect pressure measurements. In the case of direct (or absolute) pressure measurements, the readings obtained through the vacuum gauge are independent of the type of gas and the pressure which is to be measured. Common are so-called mechanical vacuum gauges where the pressure is determined directly by recording the force acting on the surface of a diaphragm. In the case of so-called indirect pressure measurements the pressure is determined as a function of a pressure dependant property of the gas (thermal conductivity, ionization probability, for example). These properties do not only depend on the pressure, but also on the molar mass of the gases. For this reason, the pressure readings obtained through vacuum gauges which rely on indirect pressure measurements, depend on the type of gas. The readings usually relate to air or nitrogen as the measurement gas. For the measurement of other vapors or gases the corresponding correction factors must be applied.

### Vacuum Gauges where the Pressure Readings are Independent of the Type of Gas (Mechanical Vacuum Gauges)

#### BOURDON Vacuum Gauge

The inside of a tube which is bent into a circular arc (the so-called Bourdon tube) is connected to the vacuum system. Due to the effect of the external atmospheric pressure, the end of the tube bends more or less during the evacuation process. This actuates the pointer arrangement which is attached to this point. The corresponding pressure can be read off on a linear scale. With Bourdon gauges it is possible to roughly determine pressures between 10 mbar (7.5 Torr) and atmospheric pressure.

#### Capsule Vacuum Gauge

This vacuum gauge contains a hermetically sealed, evacuated, thin-walled diaphragm capsule which is located within the instrument. As the vacuum pressure reduces, the capsule bulges. This movement is transferred via a system of levers to a pointer and can then be read off as the pressure on a linear scale.

### Diaphragm Vacuum Gauge

In the case of the diaphragm vacuum gauge which is capable of absolute pressure measurements, a sealed and evacuated vacuum chamber is separated by a diaphragm from the vacuum pressure to be measured. This serves as the reference quantity. With increasing evacuation, the difference between the pressure which is to be measured and the pressure within the reference chamber becomes less, causing the diaphragm flex. This flexure may be transferred by mechanical means like a lever, for example, to a pointer and scale, or electrically by means of a strain gauge or a bending bar for conversion into an electrical measurement signal. The measurement range of such diaphragm vacuum gauges extends from 1 mbar (0.75 Torr) to over 2000 mbar (1500 Torr).

### Capacitance Vacuum Gauge

The pressure sensitive diaphragm of these capacitive absolute pressure sensors is made of  $Al_2O_3$  ceramics. The term "capacitive measurement" means that a plate capacitor is created by the diaphragm with a fixed electrode behind the diaphragm. When the distance between the two plates of this capacitor changes, a change in capacitance will result. This change, which is proportional to the pressure, is then converted into a corresponding electrical measurement signal. Here too, an evacuated reference chamber serves as the reference for the pressure measurements. With capacitance gauges it is possible to accurately measure pressures from  $10^{-5}$  mbar/Torr to well above atmospheric pressure, whereby different capacitance gauges having diaphragms of different thickness (and therefore sensitivity) will have to be used.

## Vacuum Gauges where the Pressure Readings depend of the Type of Gas

### Thermal Conductivity Gauge (Pirani)

This measurement principle utilizes the thermal conductivity of gases for the purpose of pressure measurements in the range from  $10^{-4}$  mbar/Torr to atmospheric pressure. Today, only the principle of the controlled Pirani gauge is used by Leybold in order to attain a quick response. The filament within the gauge head forms one arm of a Wheatstone bridge. The heating voltage which is applied to the bridge is controlled in such a way, that the filament resistance and thus the temperature of the filament remains constant regardless of the quantity of heat given off by the filament. Since the heat transfer from the filament to the gas increases with increasing pressures, the voltage across the bridge is a measure of the pressure.

Improvements with regard to temperature compensation have resulted in stable pressure readings also in the face of large temperature changes, in particular when measuring low pressures.

### Cold Cathode Ionization Vacuum Gauge (Penning)

Here the pressure is measured through a gas discharge within a gauge head whereby the gas discharge is ignited by applying a high tension. The resulting ion current is output as a signal which is proportional to the prevailing pressure. The gas discharge is maintained also at low pressures with the aid of a magnet.

New concepts for the design of such sensors permit safe and reliable operation of these so-called Penning sensors in the pressure range from  $10^{-2}$  to  $1 \times 10^{-9}$  mbar/Torr.

### Hot Cathode Ionization Vacuum Gauge

These sensors commonly use three electrodes. A hot cathode emits electrons which impinge on an anode. The gas, the pressure of which is to be measured, is thus ionized. The resulting positive ion current is detected through the third electrode - the so-called ion detector - and this current is used as the signal which is proportional to the pressure.

The hot cathode sensors which are mostly used today, are based on the Bayard-Alpert principle. With this electrode arrangement it is possible to make measurements in the pressure range from  $10^{-10}$  to  $10^{-2}$  mbar/Torr.

Other electrode arrangements permit access to a higher range of pressures from  $10^{-1}$  mbar/Torr down to  $10^{-10}$  mbar/Torr. For the measurement of pressures below  $10^{-10}$  mbar/Torr so-called extractor ionization sensors after Redhead are employed. In extractor ionization gauges the created ions are focused onto a very thin and short ion detector. Due to the geometrical arrangement of this system, interfering influences such as X-ray effects and ion desorption can be almost completely eliminated. The extractor ionization gauge permits pressure measurements in the range from  $10^{-4}$  to  $10^{-12}$  mbar/Torr.

### Selection of the right Vacuum Gauge

When selecting a suitable instrument for pressure measurements, the pressure range is not the only criteria. The operating conditions for the instrument play an important part. If, for example, there is the risk of excessive contamination, vibrations, or if air inrushes are to be expected etc., the instrument must be rugged enough. Thus for industrial applications diaphragm gauges, controlled thermal conductivity gauges as well as cold cathode ionization gauges after Penning are strongly recommended. Precision instruments are very often quite sensitive to rough operating conditions. These should therefore only be used while observing the corresponding applications information.

## Connection Accessories for Small Flanges

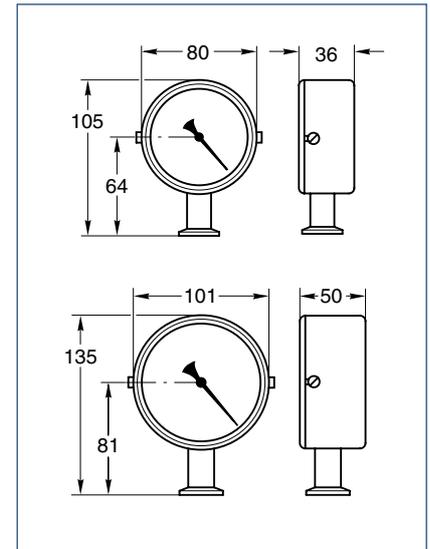
Ordering Information	DN 10 KF	DN 16 KF	DN 25 KF	DN 32 KF
Outer centering ring with O-ring Aluminium / FPM (Viton)	Part No. 183 53	Part No. 183 54	Part No. 183 55	-
Fine filter on centering ring with O-ring Stainless steel / FPM (Viton)	Part No. 883 95	Part No. 883 96	Part No. 883 97	-
Baffle with centering ring (FPM)	-	-	Part No. 230 078	-
Connection accessories for metal seals or degassing room up to 150 °C				
Ultra sealing ring, aluminum (Set of 3)	Part No. 883 73	Part No. 883 75	Part No. 883 75	-
Outer support ring	Part No. 883 74	Part No. 883 76	Part No. 883 76	-
Clamping ring	Part No. 882 75	Part No. 882 77	Part No. 882 77	-

Ordering Information	DN 40 KF	DN 16 CF	DN 40 CF
Outer centering ring with O-ring Aluminium / FPM (Viton)	Part No. 183 55	-	-
Fine filter on centering ring with O-ring Stainless steel / FPM (Viton)	Part No. 883 98	-	-
Baffle with centering ring (FPM)	Part No. 230 079	-	-
Connection accessories for metal seals or degassing room up to 150 °C			
Ultra sealing ring, aluminum (Set of 3)	Part No. 883 77	-	-
Outer support ring	Part No. 883 78	-	-
Clamping ring	Part No. 882 78	-	-
Connection accessories for CF connections			
Copper seals, (set of 10 pieces)	-	Part No. 839 41	Part No. 839 43
Screw (set of 25 pieces)	-	Part No. 839 40	Part No. 839 01

## Bourdon Vacuum Gauges



Rugged relative pressure vacuum gauges based on the Bourdon principle covering the pressure range from 1 to 1020 mbar (0.75 to 765 Torr).



Dimensional drawing for the BOURDONVAC A (top) and the BOURDONVAC C (bottom)

### Advantages to the User

- Highly reliable, rugged, insensitive to vibrations
- Linear readout, independent of the type of gas
- Excellent media compatibility owing to the stainless steel movement (BOURDONVAC C)
- IP 54 protection (BOURDONVAC C)

### Typical Applications

- Vacuum distillation
- Drying processes
- For explosion hazard applications
- Vacuum conveying systems

Technical Data		BOURDONVAC A	BOURDONVAC C
Measurement range	mbar	1 to 1020	1 to 1020
Measurement uncertainty	% FS	1	1
Overload range (abs. briefly)	bar	1.5	1.3
Storage temperature range	°C	-25 to +60	-25 to +60
Nominal temperature range	°C	10 to 60	10 to 100 (max.)
Flange connection	DN	16 KF	16 KF
Length of scale	mm	140	207
Diameter	mm	79	101
Overall weight	mm	105	135
Weight	kg (lbs)	0.25 (0.55)	0.6 (1.33)
Materials in contact with the medium		nickel plated standard steel, bronze, soft solder	stainless steel 1.4571
Ordering Information		BOURDONVAC A	BOURDONVAC C
Bourdon vacuum gauge		Part No. 160 40	Part No. 161 20
(Operating Instructions)		(GA 09.100)	(GA 09.100)

## Capsule Vacuum Gauges



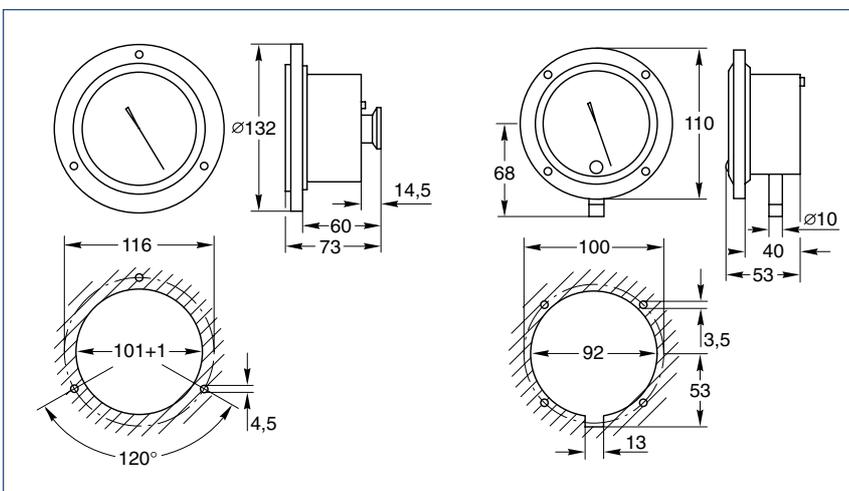
Rugged absolute pressure gauges for the pressure range from 1 to 1000 mbar (0.75 to 750 Torr).

### Advantages to the User

- Rugged and insensitive to vibrations
- Models available for two measurement ranges (1 to 100 mbar and 1 to 1000 mbar)
- Readout independent of the type of gas and changes in atmospheric pressure
- Linear pressure readout
- Installation direct via the connection flange or panel mounting
- Model with integrated isolation valve for use on packaging machines (Part No. 160 68)

### Typical Applications

- Measurement of absolute pressures (for inert gases only)
- Vacuum conveying systems
- Operation monitoring
- Packaging



Dimensional drawings and panel cut-outs for the capsule vacuum gauges  
Part Nos. 160 63/64 (left) and Part No. 160 68 (right)

Technical Data		Capsule Vacuum Gauges		
Measurement range	mbar	1 to 100	1 to 100	1 to 1000
Measurement uncertainty	% FS	1.0	2.5	1.6
Overload range (abs. briefly)	bar	1.5	1.5	1.5
Storage temperature range	°C	-25 to +60	-25 to +60	-25 to +60
Nominal temperature range	°C	10 to 50	10 to 50	10 to 50
Length of scale	mm	205	180	205
Totvolumen, ca.	cm <sup>3</sup>	235	167	235
Diameter	mm	132	110	132
Weight	kg (lbs)	0.7 (1.54)	0.6 (1.32)	0.7 (1.54)
Vacuum Connection	DN	16 KF	10 mm dia. hose nozzle with integrated isolation valve	16 KF
Max. inclination when installed		45°	45°	45°
Materials in contact with the medium		brass standard steel nickel plated glass NBR aluminum copper beryllium soft and hard solder resin	brass standard steel nickel plated glass NBR aluminum copper beryllium soft and hard solder resin	brass standard steel nickel plated glass NBR aluminum copper beryllium soft and hard solder resin
Ordering Information		Capsule Vacuum Gauges		
Capsule vacuum gauge		Part No. 160 63	Part No. 160 68	Part No. 160 64
(Operating Instructions)		(GA 09.101)	(GA 09.101)	(GA 09.101)

## Diaphragm Vacuum Gauge DIAVAC DV 1000



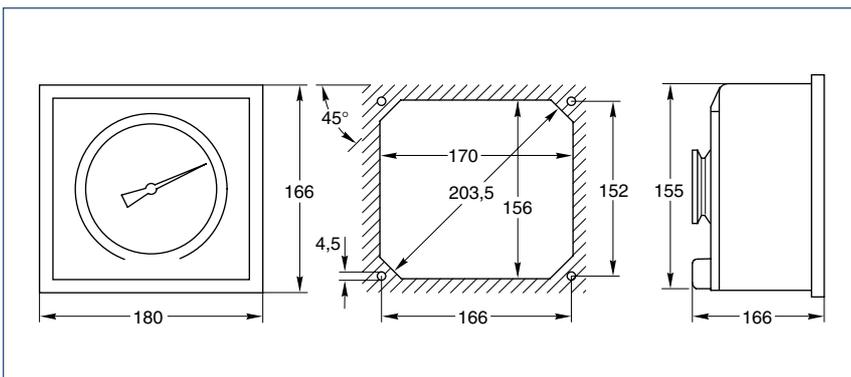
Rugged mechanical diaphragm vacuum gauge of high accuracy for the rough vacuum range from 1 to 1000 mbar (1 to 750 Torr).

### Advantages to the User

- Wide measurement range from 1 to 1000 mbar (1 to 750 Torr) with high resolution in the range from 1 to 100 mbar (1 to 75 Torr)
- The scale of each gauge is individually calibrated
- Absolute pressure gauge
- Readout independent of the type of gas and changes in atmospheric pressure
- Stainless steel diaphragm for excellent compatibility with most media
- Laser welding technology for high precision diaphragm mount
- Rugged table-top housing, can be freely mounted above the flange connection; also for panel mounting
- Measurement chamber can be easily cleaned owing to the detachable measurement flange

### Typical Applications

- Chemical processes
- Vacuum distillation
- Absolute pressure measurements for gas mixtures
- For use in explosion hazard rated areas
- Drying processes
- Lamp manufacture



Dimensional drawing and panel cut-out for the DIAVAC DV 1000

Technical Data		DIAVAC DV 1000
Measurement range	mbar (Torr)	1 to 1000 (1 to 750)
Measurement uncertainty		
1 - 10 mbar (1 - 7.5 Torr)		± 1 mbar (Torr)
10 - 1000 mbar (7.5 - 750 Torr)		± 10 % of meas. value
Storage temperature range	°C	-25 to +60
Nominal temperature range	°C	0 bis 60
Permissible overload (abs.)	bar	3
Length of scale / dead volume	mm	270 / 130
Vacuum Connection	DN	40 KF
Dimension (W x H x D)	mm	180 x 166 x 100
Weight	kg (lbs)	2.7 (5.95)
Materials in contact with the medium		stainless steel 1.4301, 1.4310 (diaphragm), FPM
Ordering Information		DIAVAC DV 1000
DIAVAC DV 1000		
mbar readout		Part No. 160 67 <sup>1)</sup>
Torr readout		Part No. 896 06 <sup>1)</sup>
(Operating Instructions)		(GA 09.102)
DKD-calibration		Part No. 157 12
Replacement sintred filter with DN 40 KF centering ring		Part No. 231 93 515
Replacement housing, complete		Part No. 240 000

<sup>1)</sup> Complete with centering ring and sintered filter

## CERAVAC Transmitters CTR 90 / CTR 91



The CERAVAC Transmitter with its diaphragm made of pure aluminium oxide ceramics offers excellent accuracy and reproducibility.

### Advantages to the User

- Excellent accuracy
- Corrosion resistant
- High resolution
- Very good temperature stability
- Electrically and mechanically compatible with the conventional capacitance manometers with stainless steel diaphragm
- Heated and unheated types are available

### Typical Applications

- General pressure measurements in the fine and rough vacuum range, also for corrosive process gases
- Chemical process engineering
- Semiconductor production processes
- Suited as a reference sensor for monitoring test instruments in accordance with DIN/ISO 9000

### The Ceramics Diaphragm

The stiffness of aluminium oxide ceramics is greater than that of metal so that the ceramics material offer improved long term stability characteristics when exposed to frequent pressure changes or overpressures. The aluminium oxide ceramics diaphragm of the CERAVAC sensors is capable of returning precisely to its initial position with respect to a certain pressure so that the measurements will be highly reproducible. Since the diaphragm is

not impaired by overpressures or frequent pressure changes, no blocking valves will be required – a significant contribution towards reducing costs.

Moreover, aluminium oxide ceramics diaphragms return faster to their initial position compared to metal diaphragms; the time need between the processes for the measurement to stabilise is reduced. This is particularly important in the case of measurements close to Zero where

metal diaphragms take several minutes to return to their rest position.

Whereas metal diaphragms suffer from residual tensions and unavoidable irregularities due to their production process, diaphragms made of aluminium oxide ceramics are exceptionally homogeneous, and owing to the firing process at 2500 °C entirely free of tensions. This considerably reduces part to part variations in the sensors.

Technical Data	<b>CTR 90</b> (Temperature Compensated)	
<b>Full Scale (FS)</b> 1000 Torr 100 Torr 10 Torr 1 Torr	Measurement Range 0.1 - 1000 Torr 0.01 - 100 Torr $1 \times 10^{-3}$ - 10 Torr $1 \times 10^{-4}$ - 1 Torr Pressure Units: 1 Torr = 1.33 mbar = 133 Pascal	Measurement Range 0.1 - 1000 Torr 0.01 - 100 Torr $1 \times 10^{-3}$ - 10 Torr $1 \times 10^{-4}$ - 1 Torr Pressure Units: 1 Torr = 1.33 mbar = 133 Pascal
<b>Materials exposed to gases</b>	ceramic (Al <sub>2</sub> O <sub>3</sub> ), stainless steel 316, Vacon 70	ceramic (Al <sub>2</sub> O <sub>3</sub> ), stainless steel 316, Vacon 70
<b>Max. overrange pressure</b>	1000 Torr for 0.1 Torr sensors, 2000 Torr for 1/10/100 Torr sensors, 3000 Torr for 1000 Torr sensors	1000 Torr for 0.1 Torr sensors, 2000 Torr for 1/10/100 Torr sensors, 3000 Torr for 1000 Torr sensors
<b>Measurement uncertainty</b>	0.2% of reading ± temperature effect	0.2% of reading ± temperature effect
<b>Resolution</b>	0.0025% of FS for 0.1/1 Torr sensors 0.0015% of FS for 10/100/1000 Torr sensors	0.0025% of FS for 0.1/1 Torr sensors 0.0015% of FS for 10/100/1000 Torr sensors
<b>Temperature effects</b> <b>Zero coefficient</b> %/°C <b>Span coefficient</b> %/°C	1 Torr sensor 0.015 of Full scale 0.01 of reading	10/100/1000 Torr sensor 0.005 of Full scale 0.01 of reading
<b>Reaction time</b> <b>ms</b>	≤ 30	≤ 30
<b>Nominal temperatur range</b> °C	5 to 50	5 to 50
<b>Supply voltage</b> <b>V DC</b>	either ± 15 or + 24	either ± 15 or + 24
<b>Current consumption</b> <b>mA</b>	23	23
<b>Signal Output</b> <b>V</b>	0 - 10; linear	0 - 10; linear
<b>Weight approx.</b> <b>kg (lbs)</b>	0.26 (0,57)	0.26 (0,57)
<b>Dead Volume</b> <b>cm<sup>3</sup></b>	6	6
<b>Connection cable</b>	see section "Connection Cable for active Sensors"	see section "Connection Cable for active Sensors"
<b>Calibration</b>	see section "Miscellaneous", para. "Leybold Calibration Service"	see section "Miscellaneous", para. "Leybold Calibration Service"

Technical Data	<b>CTR 91</b> (45 °C heated)	
<b>Full Scale (FS)</b> 1000 Torr 100 Torr 10 Torr 1 Torr 0.1 Torr	Measurement Range 0.1 - 1000 Torr 0.01 - 100 Torr 1 x 10 <sup>-3</sup> - 10 Torr 1 x 10 <sup>-4</sup> - 1 Torr – Pressure Units: 1 Torr = 1.33 mbar = 133 Pascal	Measurement Range 0.1 - 1000 Torr 0.01 - 100 Torr 1 x 10 <sup>-3</sup> - 10 Torr 1 x 10 <sup>-4</sup> - 1 Torr 1 x 10 <sup>-5</sup> - 0.1 Torr Pressure Units: 1 Torr = 1.33 mbar = 133 Pascal
<b>Materials exposed to gases</b>	ceramic (Al <sub>2</sub> O <sub>3</sub> ), stainless steel 316, Vacon 70	ceramic (Al <sub>2</sub> O <sub>3</sub> ), stainless steel 316, Vacon 70
<b>Max. overrange pressure</b>	1000 Torr for 0.1 Torr sensors, 2000 Torr for 1/10/100 Torr sensors, 3000 Torr for 1000 Torr sensors	1000 Torr for 0.1 Torr sensors, 2000 Torr for 1/10/100 Torr sensors, 3000 Torr for 1000 Torr sensors
<b>Measurement uncertainty</b>	0.2% of reading ± temperature effect	0.15% of reading ± temperature effect
<b>Resolution</b>	0.0025% of FS for 0.1/1 Torr sensors 0.0015% of FS for 10/100/1000 Torr sensors	0.0025% of FS for 0.1/1 Torr sensors 0.0015% of FS for 10/100/1000 Torr sensors
<b>Temperature effects</b> <b>Zero coefficient</b> <b>Span coefficient</b>	1 Torr sensor 0.005 of Full scale 0.01 of reading	10/100/1000 Torr sensor 0.0025 of Full scale 0.01 of reading
<b>Reaction time</b> <b>ms</b>	≤ 30	≤ 30
<b>Nominal temperatur range</b> <b>°C</b>	5 to 50	15 to 40
<b>Supply voltage</b> <b>V DC</b>	either ± 15 or + 24	either ± 15 or + 24
<b>Current consumption</b> <b>mA</b>	23	300
<b>Signal Output</b> <b>V</b>	0 - 10; linear	0 - 10; linear
<b>Weight approx.</b> <b>kg (lbs)</b>	0.26 (0.57)	0.485 (1.07)
<b>Dead Volume</b> <b>cm<sup>3</sup></b>	6	7
<b>Connection cable</b>	see section "Connection Cable for active Sensors"	see section "Connection Cable for active Sensors"
<b>Calibration</b>	see section "Miscellaneous", para. "Leybold Calibration Service"	see section "Miscellaneous", para. "Leybold Calibration Service"

**Ordering information**

Part No. 159 - \_\_\_\_\_ (GA 09.040)

CTR 90 (temperature-compensated)

Vacuum fitting  
 DN KF 16  
 DN CF 16  
 Cajon 8 VCR  
 1/2" tube

2  
 3  
 4  
 5

Measurement range

1000 Torr  
 100 Torr  
 10 Torr  
 1 Torr

1  
 2  
 3  
 4

**Ordering information**

Part No. 159 - \_\_\_\_\_ (GA 09.041)

CTR 91 (45 °C heated)

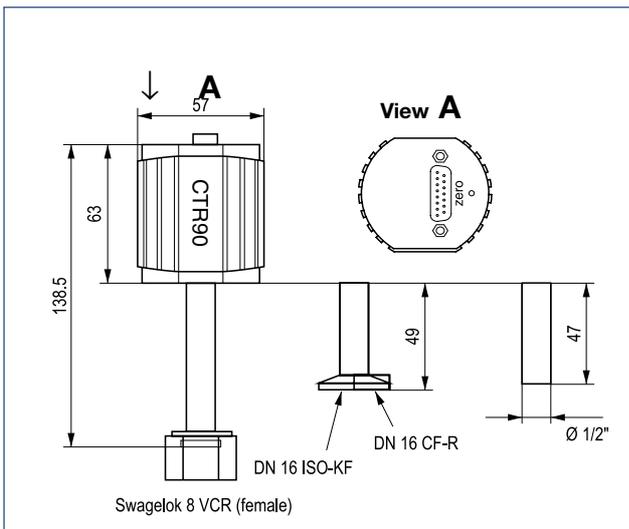
Vacuum fitting  
 DN KF 16  
 DN CF 16  
 Cajon 8 VCR  
 1/2" tube

2  
 3  
 4  
 5

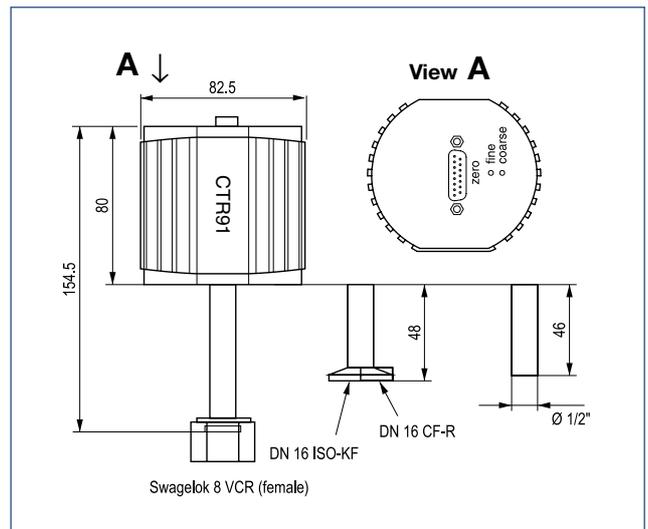
Measurement range

1000 Torr  
 100 Torr  
 10 Torr  
 1 Torr  
 0.1 Torr

5  
 6  
 7  
 8  
 9



Dimensional drawing for the CERAVAC Transmitter CTR 90



Dimensional drawing for the CERAVAC Transmitter CTR 91

# THERMOVAC Transmitters TTR 91 / TTR 91 S / TTR 96 S



THERMOVAC transmitters are active sensors (pressure to voltage converters) using thermal conductivity according to Pirani. The further developed THERMOVAC transmitters have optimized price-to-performance ratio. The value of the trigger point can be switched easily on the analog output and be shown on the display of the operating unit.

## Advantages to the User

- Rugged sensing cells made of stainless steel
- Compact design
- Stable measurements within a wide temperature range
- Highly resistant to overpressures
- Exchangeable sensing cells
- Fast response
- Available with integrated switching relay (TTR 91 S, TTR 96 S)

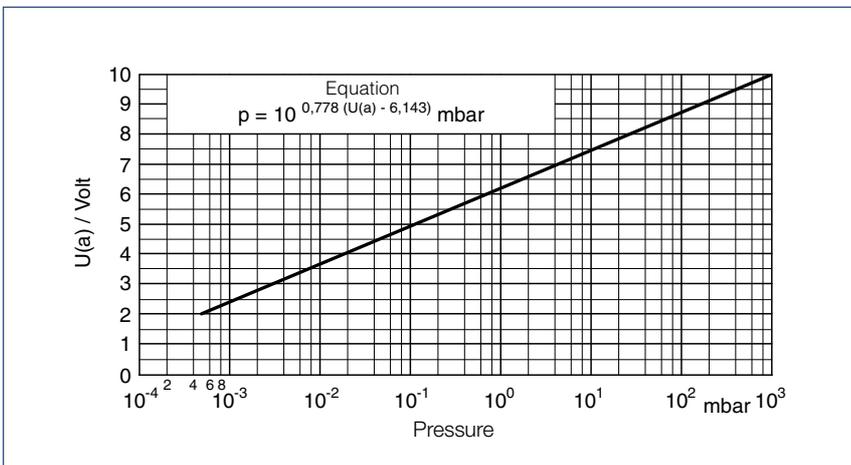
## Typical Applications

- Analytical engineering
- Safety circuits in vacuum systems
- Controlling ionization gauges
- General pressure measurement and control on systems in the fine and rough vacuum range

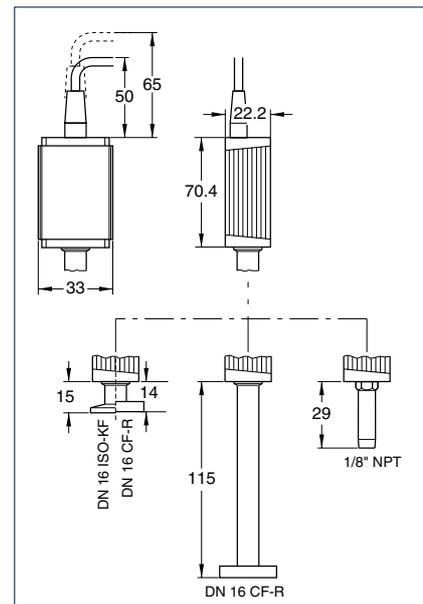
## Sensor

The THERMOVAC transmitter has a Pirani sensing cell equipped with a tungsten (TTR 91/TTR 91 S) or nickel (TTR 96 S) filament. If required, the sensing cells can easily be aligned to any precisely known pressure value (atmospheric,

“zero”, reference pressure) by pressing a button. Integration of the transmitters in programmable control systems is facilitated by the linear characteristic, which can be defined by entering a simple equation into the computer. The transmitters TTR 91 / TTR 91 S / TTR 96 S are compatible to older TTR models like TTR 211, TTR 216 S or TTR 90. Built-in relays allow switching functions to be performed directly by the transmitter, without the need of a programmable control.



Characteristic of the THERMOVAC Transmitters



Dimensional drawing for the TTR 91 / TTR 91 S / TTR 96 S

Technical Data		TTR Transmitter TTR 91 / TTR 91 S / TTR 96 S
Measurement range	mbar (Torr)	$5 \times 10^{-4}$ to 1000 ( $3.75 \times 10^{-4}$ to 750)
Measurement uncertainty		15 % in the range $1 \times 10^{-3}$ to 100 mbar ( $0.75 \times 10^{-3}$ to 75 Torr)
Principle of measurement		Thermal conductivity according to Pirani
Supply voltage		14 to 30 V DC Hum voltage $\leq 1 V_{pp}$
Power consumption	VA	$\leq 1$
Storage temperature range	°C	-20 to +65
Nominal temperature range	°C	5 to 60
Max. rel. humidity	% n.c.	$\leq 80$
Protection class		IP 40
Weight, approx., for DN 16 KF	kg (lbs)	0.08 (0.18)
Sensor		Exchangeable sensing cell
Degassing temperature, max.	°C	80 (250 with long tube)
Dead volume, approx.	cm <sup>3</sup>	2 (10 with long tube)
Materials in contact with the medium - filament		Stainless steel, Ni, glass, NiFe Tungsten (TTR 91, TTR 91 S) or nickel (TTR 96 S)
Over-pressure rating, abs.	bar	10
Signal output ( $R_a > 10 \text{ k}\Omega$ ) Measurement signal		0 to 10.3 V DC 1.9 to 10 V DC, corresp. $5 \times 10^{-4}$ to $1 \times 10^3$ mbar 1.286 V/decade, logarithmic
Status signal		Error: $\leq 0.5$ V
Trigger (only TTR 91 S / TTR 96 S) Adjustment range	mbar (Torr)	Normally open relay contact $2 \times 10^{-3}$ to 500 ( $1.5 \times 10^{-3}$ to 375)
Hysteresis		10 %
Rating		30 V, 0.5 A DC, floating
Error status		Relay contact open
Status indicators (only TTR 91 S / TTR 96 S)		Trigger (active): Green LED
Electrical connection		FCC-68/RJ45 socket, 8 way with shield
Cable length, max.	m	100

Ordering Information	<b>TTR Transmitter</b> TTR 91 / TTR 91 S / TTR 96 S
<b>Without switching threshold</b> TTR 91, DN 16 KF TTR 91, 1/8" NPT TTR 91, DN 16 CF TTR 91, 1/2" Tube, DN 16 CF	Part No. 230 035 Part No. 230 038 Part No. 230 036 Part No. 230 037
<b>With switching threshold</b> TTR 91 S, DN 16 KF TTR 91 S, 1/8" NPT TTR 91 S, DN 16 CF TTR 91 S, 1/2" Tube, DN 16 CF  TTR 96 S, DN 16 KF TTR 96 S, 1/8" NPT TTR 96 S, DN 16 CF TTR 96 S, 1/2" Tube, DN 16 CF	Part No. 230 040 Part No. 230 043 Part No. 230 041 Part No. 230 042  Part No. 230 045 Part No. 230 048 Part No. 230 046 Part No. 230 047
<b>(Operating Instructions)</b>	<b>(GA 09.222)</b>
<b>Replacement sensing cell</b> <b>for TTR 91 / TTR 91 S</b> DN 16 KF 1/8" NPT DN 16 CF 1/2" Tube, DN 16 CF <b>for TTR 96 S</b> DN 16 KF 1/8" NPT DN 16 CF 1/2" Tube, DN 16 CF	Part No. 230 050 Part No. 230 053 Part No. 230 051 Part No. 230 052  Part No. 230 055 Part No. 230 058 Part No. 230 056 Part No. 230 057
<b>Calibration</b>	see section "Miscellaneous", para. "Leybold Calibration Service"
<b>Connection cable, FCC 68 on both ends,</b> <b>8 way, shielded</b> 5 m 10 m 15 m 20 m 30 m 40 m 50 m 75 m 100 m	Type A Part No. 124 26 Part No. 230 012 Part No. 124 27 Part No. 124 28 Part No. 124 29 Part No. 124 30 Part No. 124 31 Part No. 124 32 Part No. 124 33



# THERMOVAC Transmitters TTR 100 / TTR 100 S2



The Pirani Capacitance Diaphragm Gauge is the first vacuum gauge which combines ceramic capacitance diaphragm and thermal conductivity technologies. Unlike standard heat transfer technology, the Leybold TTR 100 offers superior accuracy and gas-type-independent readings between 100 mbar and 1500 mbar.

### Advantages to the User

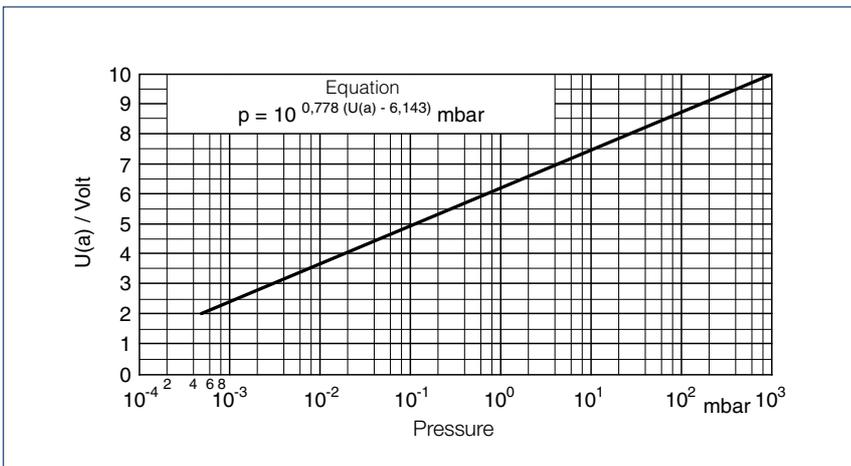
- Wide measurement range from  $5 \times 10^{-4}$  to 1500 mbar
- Gas-type-independent pressure measurement between 100 mbar and 1500 mbar
- Available with up to two integrated relays (TTR 100 S2)
- Mounts in any orientation
- 0 to 10.3 V analog output for easy system integration
- Compact design
- Flow independent
- Rapid cycling
- Follows true pressure in pump and vent

### Typical Applications

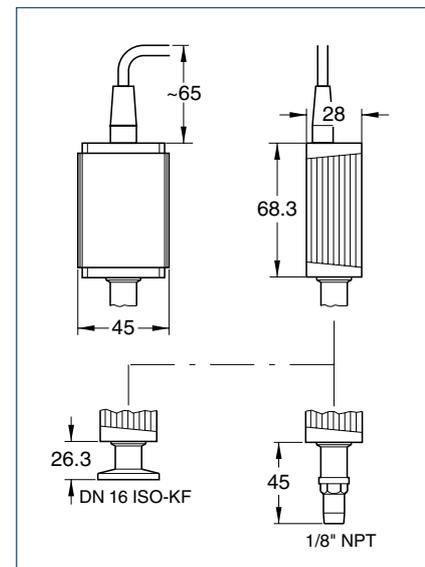
- Loadlock control
- Forevacuum pressure monitoring
- Safety circuits in vacuum systems
- General measurement and control in the medium and rough vacuum range
- Control of high vacuum ionization gauges

### Option

Dust and other particles may cause increasing measurement errors and reduced lifetime. Therefore we recommend the installation of a fine filter in critical applications. Fine filters are listed in section "General", para. "Connection Accessories for Small Flanges".



Characteristic of the THERMOVAC Transmitters



Dimensional drawing for the TTR 100

Technical Data	TTR Transmitter TTR 100 / TTR 100 S2	
<b>Measurement principle</b>	Thermal conductance according to Pirani combined with capacitance diaphragm	
<b>Measurement range</b> (air, O <sub>2</sub> , CO, N <sub>2</sub> )	<b>mbar(Torr)</b>	5 x 10 <sup>-4</sup> to 1500 (3.8 x 10 <sup>-4</sup> to 1125)
<b>Accuracy</b> 1 x 10 <sup>-3</sup> to 50 mbar 50 to 950 mbar ATM (atmospheric pressure)	±15% of reading ±5% of reading ±2.5% of reading	
<b>Repeatability</b>	±2% of reading	
<b>Trigger (only TTR 100 S2)</b> Setting range with potentiometer Relay contacts closed open Hysteresis Contact rating Relay status	2 1.5 x 10 <sup>-3</sup> to 1400 mbar N.O. / potential free at low pressure (lamp lit) at high pressure or no supply (lamp off) 10% of threshold 30 V DC / 1 A active: LED, green	
<b>Output signal analog</b> Measurement range Voltage vs. pressure	0 to 10.3 V +1.9 to +10.23 V 1.286 V / decade, logarithmic	
<b>Output impedance</b>	2 x 4.7 Ohm, short circuit-proof	
<b>Minimum load impedance</b>	10 kOhm	
<b>Response time</b>	10 ms	
<b>Power supply</b> Voltage (ripple ≤1 V <sub>pp</sub> ) Consumption, max. Fuse to be connected	+15 to +30 V DC 2.5 W 1 AT (slow)	
<b>Electrical connection</b>	FCC-68, 8 way with shield	
<b>Cable length, max.</b>	<b>m (ft)</b>	100 (330)

<b>Technical Data</b>		<b>TTR Transmitter</b> TTR 100 / TTR 100 S2	
<b>Materials exposed to vacuum (process media)</b>			
Vacuum connection		stainless steel	
Pirani filament		tungsten	
Capacitance sensor cell		Al <sub>2</sub> O <sub>3</sub>	
Feedthrough		glass	
Other materials		Ni, Cu, NiFe, SnAg, AgPd	
<b>Internal volume</b>			
DN 16 ISO-KF	cm <sup>3</sup> (inch <sup>3</sup> )	6 (0.37)	
1/8" NPT	cm <sup>3</sup> (inch <sup>3</sup> )	8 (0.49)	
<b>Over-pressure rating, abs.</b>	<b>bar</b>	5	
<b>Temperature</b>			
Operation (ambient)	°C	+10 to +50	
Storage	°C	-20 to +65	
Bakeout at flange, max.	°C	+80	
Filament temperature	°C	< 160	
<b>Relative humidity</b>		< 80 % at temperatures < +31 °C, decreasing to 50% at +40 °C	
<b>Mounting orientation any</b>		any	
<b>Use</b>		Indoors only, altitudes up to 2000 m NN	
<b>Protection class</b>	<b>IP</b>	40	
<b>Weight</b>			
DN 16 ISO-KF	kg (lbs)	0.09 (0.20)	
1/8" NPT	kg (lbs)	0.09 (0.20)	
<b>Ordering Information</b>		<b>TTR Transmitter</b> TTR 100 / TTR 100 S2	
<b>Without switching threshold</b>			
TTR 100, DN 16 KF		<b>Part No. 230 026</b>	
TTR 100, 1/8" NPT		<b>Part No. 230 028</b>	
<b>With switching threshold</b>			
TTR 100 S2, DN 16 KF		<b>Part No. 230 027</b>	
TTR 100 S2, 1/8" NPT		<b>Part No. 230 029</b>	
<b>(Operating Instructions)</b>		<b>(GA 09.221)</b>	
<b>Calibration</b>		see section "Miscellaneous", para. "Leybold Calibration Service"	
<b>Connection cable, FCC 68 on both ends, 8 way, shielded</b>			
5 m		Type A Part No. 124 26	
10 m		Part No. 230 012	
15 m		Part No. 124 27	
20 m		Part No. 124 28	
30 m		Part No. 124 29	
40 m		Part No. 124 30	
50 m		Part No. 124 31	
75 m		Part No. 124 32	
100 m		Part No. 124 33	



## PENNINGVAC Transmitters PTR 225 / PTR 225 S / PTR 237



The PENNINGVAC transmitters have been developed especially for integration in programmable control systems. As active sensors (pressure to voltage converters) - equipped with a rugged cold cathode sensing cell and with matched operating and processing electronics - these transmitters offer a wide measurement range of  $1 \times 10^{-9}$  to  $1 \times 10^{-2}$  mbar ( $0.75 \times 10^{-9}$  to  $0.75 \times 10^{-2}$  Torr). The measurement signal may be transmitted over long distances without problems.

### Advantages to the User

- All-metal cold cathode sensors (inverted Penning)
- High reproducibility
- Good ignition characteristics through the optimized design for the electrodes
- Low tendency for contamination (also during argon operation) due to high voltage reduction after ignition of the plasma and due to the titanium cathodes
- Switching threshold adjustable over a wide range ( $1 \times 10^{-9}$  to  $1 \times 10^{-2}$  mbar ( $0.75 \times 10^{-9}$  to  $0.75 \times 10^{-2}$  Torr)) and with a load-bearing relay contact (PTR 225 S)
- Low stray magnetic field
- High EMI compatibility through screened housing, FCC-68 connector and cables
- LED indicator for operation
- Logarithmic signal output (algorithm supplied)
- Intelligent interface
- CE mark
- High resistance against sputtering due to titanium cathode plates

### Typical Applications

- Evaporation and sputtering systems
- Analytical engineering
- Vacuum furnaces
- High vacuum systems
- General pressure measurement and control on systems in the fine and rough vacuum range which have the following requirements:
  - Immediate data transfer to a programmable control/ computer via analog interface
  - Coverage of greater distances between the point of the measurement and processing location
  - Several locations which are to be monitored continuously
  - Low voltage supply
  - Simple, cost and space saving installation
  - Increased reliability, also in argon processes (sputtering)
  - Simple operation
  - Increased requirements concerning electromagnetic compatibility (EMI)

### Option

For protection of the sensors PTR 225 against contamination, radiation and other disturbing factors the installation of a baffle is recommended.

## Sensor

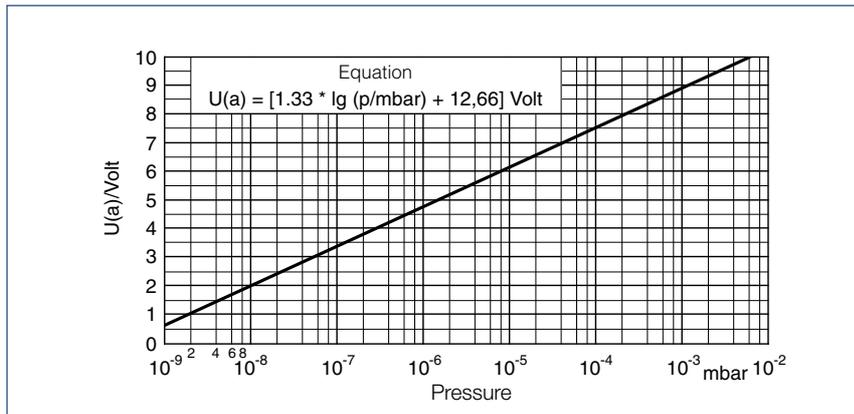
Cold cathode sensors - based on the well-proven principle of the inverted Penning - are built into the PENNINGVAC transmitters PTR 225/225 S/237 which have a DN 25 KF or DN 40 CF flange. The housing of the transmitter, including its electronics, as well as the magnet can easily be removed for degassing of the all-metal sensor with  $Al_2O_3$  current feed-through. The design of the Penning sensors with its closed magnetic field

causes a negligible stray field. Thus the PTR 225/225 S/237 may also be installed close to sensitive parts within a system.

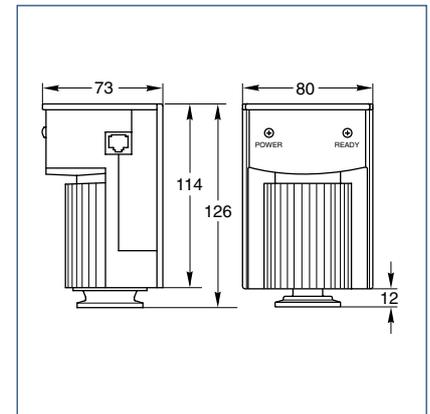
The anode ring and the titanium cathode plates can be exchanged easily for quick maintenance of the sensors in case of contamination. The shape of the cathode plates is such that they also act as a baffle for the sensors.

Integration of the transmitter in programmable control systems is facilitated by the linear characteristic which can be defined by entering a simple equation into the computer.

Built-in relays (PTR 225 S) allow switching functions to be performed directly by the transmitter, without the need of a programmable control.



Characteristic of the PTR 225/225 S/237



Dimensional drawing for the PTR 225/225 S/237

Technical Data		PTR Transmitter
Display range	mbar (Torr)	$1 \times 10^{-9}$ to $1 \times 10^{-2}$ ( $0.75 \times 10^{-9}$ to $0.75 \times 10^{-2}$ )
Measurement uncertainty		30 % in the range $1 \times 10^{-8}$ to $1 \times 10^{-4}$ mbar ( $0.75 \times 10^{-8}$ to $0.75 \times 10^{-4}$ Torr)
Principle of measurement		Cold cathode ionization according to Penning
Supply voltage		14.5 to 36 V DC typ. 24 V DC hum voltage < 2 Vpp
Power consumption	VA	< 2
Storage temperature range	°C	-20 to +70
Nominal temperature range	°C	10 to 50
Max. rel. humidity (climatic class F)	% n.c.	95
Protection class		IP 40
Dimensions (H x W x D)	mm	125 x 80 x 73
Weight, approx.	kg (lbs)	0.5 (1.1)
Inflammability		UL 94 - V 2
Sensor		Detachable for cleaning
Vacuum connection	DN	25 KF or 40 CF
Degassing temperature, max.	°C	350 with electronics detached
Dead volume, max.	cm <sup>3</sup>	21
Materials in contact with the medium		Stainless steel, CrNi, Al <sub>2</sub> O <sub>3</sub> ceramics, NiFe, Mo, Cu, Ni, titanium
Over-pressure rating (abs.)	bar	10
Signal output (R <sub>a</sub> > 10 kΩ) Measurement signal		0 to 10.6 V 0.66 to 10 V, corresponds to $1 \times 10^{-9}$ to $1 \times 10^{-2}$ mbar logarithm. divisions 1.333 V/decade
Trigger (PTR 225 S) Adjustment range Hysteresis Rating Error status	mbar (Torr)	Changeover relay contact $1 \times 10^{-9}$ to $1 \times 10^{-3}$ ( $0.75 \times 10^{-9}$ to $0.75 \times 10^{-3}$ ) About 30 % of the adjusted pressure 60 V, 0.5 A DC Contact in its rest position when "no ignition" / "HT off"
High voltage control input		ON: At U < 2.9 V, or U > 12 V OFF: At U > 3 V, or U < 7 V
Status output Ready to measure Error (no ignition)		Voltage level HIGH (typ. 24 V DC) LOW (0 V)
Status indicators		Operation: Orange LED Ready to measure (ignited): Green LED Trigger (active): Green LED
Monitor output (R <sub>a</sub> > 100 kΩ)		Jack socket (3.5 mm) at which the trigger setting is available
Electrical connection		FCC-68 socket, 8 way with shield
Cable length, max.	m	100
Interface PTR 225 PB PTR 237 D		Profibus DP DeviceNet

Ordering Information	PTR Transmitter
PTR 225, DN 25 KF	Part No. 157 34
PTR 225 S, DN 25 KF	Part No. 164 34
PTR 225 PB, DN 25 KF Profibus interface	Part No. 896 41
PTR 237, DN 40 CF	Part No. 157 36
PTR 237 D, DN 40 CF DeviceNet interface	Part No. 896 42
(Operating Instructions)	(GA 09.308)
Baffle, DN 25 KF, with centering ring	Part No. 230 078
Replacement cathode plates, titanium (set of 5 pieces)	Part No. 162 91
Replacement anode ring	Part No. 240 002
Calibration	see section "Miscellaneous", para. "Leybold Calibration Service"
Connection cable, FCC 68 on both ends, 8 way, shielded 5 m 10 m 15 m 20 m 30 m 40 m 50 m 75 m 100 m	Type A Part No. 124 26 Part No. 230 012 Part No. 124 27 Part No. 124 28 Part No. 124 29 Part No. 124 30 Part No. 124 31 Part No. 124 32 Part No. 124 33

## IONIVAC Transmitter ITR 90



The ITR 90 is an optimized combination transmitter. The combination of a hot cathode ionisation sensor according to Bayard-Alpert and a Pirani sensor permits vacuum pressure measurements of non-ignitable gases and gas mixtures in the pressure range from  $5 \times 10^{-10}$  to 1000 mbar.

If needed, the pressure can be displayed via the integrated display.

### Advantages to the User

- Continuous pressure measurements from  $10^{-10}$  mbar to atmospheric pressure
- High degree of reproducibility within the typical range for process pressures of  $10^{-2}$  to  $10^{-8}$  mbar
- Controlled switching on and off sequencing through the integrated double Pirani optimises the service life of the yttrium coated iridium cathodes
- Compact design
- Enclosed, rugged electrode geometry in a rugged metal housing
- Efficient degassing by electron bombardment
- Simple fitting of the sensor
- Extension for higher degassing temperatures during the measurements
- One signal covering 13 decades
- One flange joint for 13 decade
- ITR 90 model with built-in display for stand-alone operation without additional display components
- RS 232 C interface

### Typical Applications

- Analytical
- Evaporation and coating
- Vacuum furnaces
- General purpose pressure measurements in the fine and high vacuum ranges

### Option

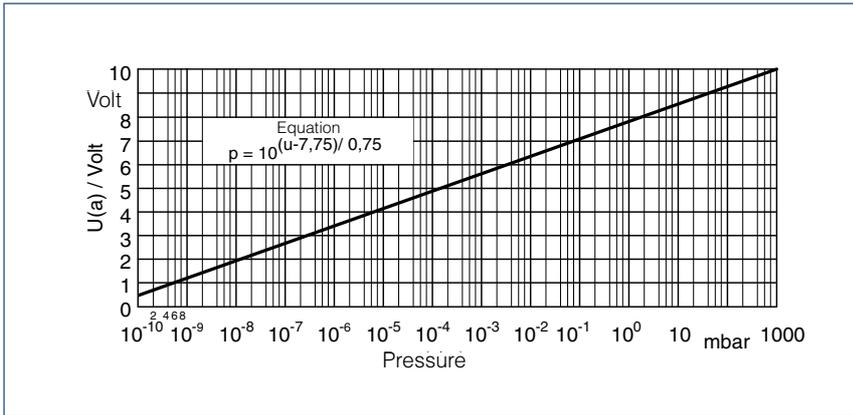
For protection of the sensor ITR 90 against contamination, radiation and other disturbing factors the installation of a baffle is recommended.

Two types of baffles are available: A build-in version for CF connections is mounted in the sensor; the baffle for KF connections is integrated in a centering ring.

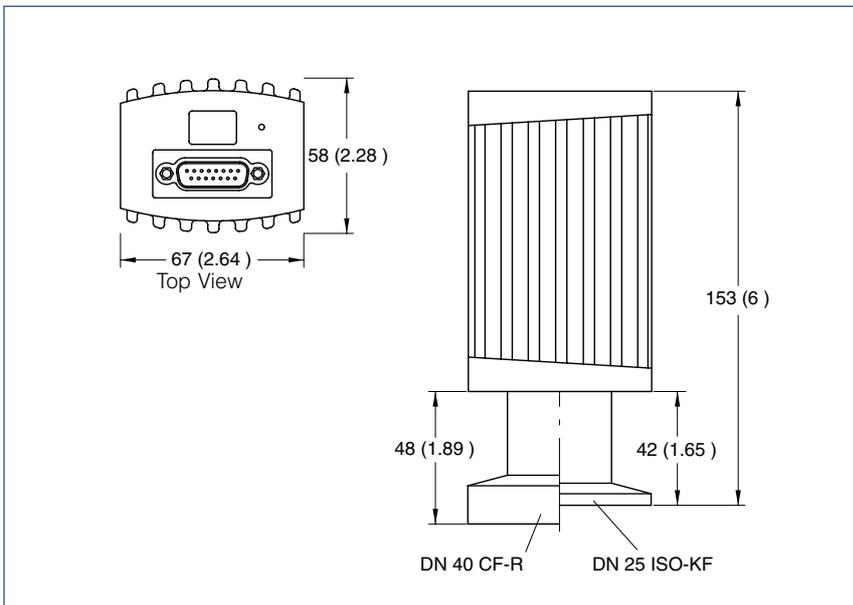
**Sensor**

The sensor of the ITR 90 contains a dual filament Pirani system as well as a Bayard-Alpert measurement system.

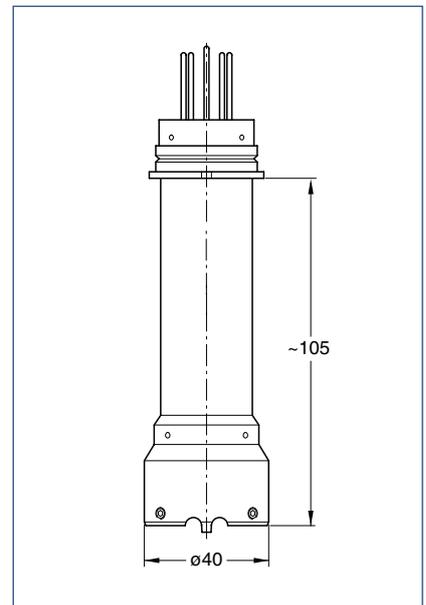
When using the degassing extension, measurements will be possible also at flange temperatures up to 150 °C.



Characteristic of the ITR 90



Dimensional drawing for the ITR 90; dimensions in brackets ( ) are in inch



Dimensional drawing for the degassing extension

Technical Data		ITR Transmitter
Display range	mbar (Torr)	$5 \times 10^{-10}$ to 1000 ( $3.75 \times 10^{-10}$ to 750)
Measurement uncertainty, $10^{-8}$ - $10^{-2}$ mbar		15 % of the meas. value
Reproducibility, $10^{-8}$ - $10^{-2}$ mbar		5 % of the meas. value
Principles of measurement		Hot cathode ionization according to Bayard-Alpert combined with thermal conductivity according to Pirani
Degas		Electron bombardment 3 minutes, max.
Supply voltage		20 to 28 V DC, typ. 24 V DC
Power consumption, max.	W	16
Storage/nominal temperature range	°C	-20 to +70 / 0 to +50
Protection class		IP 30
Weight, approx.		
ITR 90, DN 25 KF	kg (lbs)	0.285 (0.64)
ITR 90, DN 40 CF	kg (lbs)	0.550 (1.24)
Sensor		Fully sealed, exchangeable
Degassing temperature, max.	°C	150 <sup>1)</sup>
Dead volume, max.	cm <sup>3</sup>	24 at DN 25 KF 34 at DN 40 CF
Materials in contact with the medium		Cu, W, Glas, NiFe, Mo, stainless steel, Aluminum, Iridium, Yttrium, NiCr,
Over-pressure rating (abs.)	bar	2
Signal output ( $R_a \geq 10 \text{ k}\Omega$ )		
Measurement signal		0 - 10 V, 0.774 - 10 V, 0.75 V pro decade
Error signal		< 0,5 V
Interface (standard / optional)		RS 232 C / ProfiBus
Electrical connection		15 way Sub-D male connector / pin contacts
Cable length, max.	m	100 / 30 at RS 232 C

<sup>1)</sup> Flange temperature when using the degassing extension

Ordering Information	ITR Transmitter	
	Without Display	With Display
ITR 90, DN 25 KF	<b>Part No. 120 90</b>	<b>Part No. 120 91</b>
ITR 90, DN 25 KF Profibus interface	<b>Part No. 230 030</b>	–
ITR 90, DN 40 CF-R, rotatable CF flange	<b>Part No. 120 92</b>	<b>Part No. 120 94</b>
ITR 90, DN 40 CF-R, rotatable CF flange Profibus interface	<b>Part No. 230 031</b>	–
(Operating Instructions)	<b>(GA 09.420)</b>	<b>(GA 09.420)</b>
<b>Options</b> Power supply for IONIVAC transmitter 100 V - 240 V AC / 24 V DC incl. 5 m connection cable and 5 m RS 232 C cable Degassing extension (100 mm, approx.) Baffle, DN 25 KF, with centering ring (FPM) Installation baffle for CF variant	Part No. 121 06 Part No. 127 06  Part No. 230 078 Part No. 121 07	Part No. 121 06 Part No. 127 06  Part No. 230 078 Part No. 121 07
<b>Replacement sensor</b> IE 90, DN 25 KF <sup>1)</sup> IE 90, DN 40 CF-R <sup>1)</sup>	Part No. 121 02 Part No. 121 03	Part No. 121 02 Part No. 121 03
<b>Calibration</b>	see section "Miscellaneous", para. "Leybold Calibration Service"	see section "Miscellaneous", para. "Leybold Calibration Service"
<b>Connection cable</b>	see section "Connection Cable for active Sensors"	see section "Connection Cable for active Sensors"

<sup>1)</sup> including hex. socket screw key

## Connection Cables for Active Sensors

Active Sensors	Operating Units for Active Sensors		
	DISPLAY ONE	DISPLAY TWO DISPLAY THREE	CENTER ONE CENTER TWO CENTER THREE
THERMOVAC Transmitter TTR 91, TTR 91 S, TTR 96 S a. o.	Type A	Type A	Type A
PENNINGVAC PTR 225, PTR 225 S, PTR 237	-	Type A	Type A
CERAVAC CTR 90, CTR 91	-	-	Type B
IONIVAC ITR 90	-	-	Type C

Active Sensors	Operating Units for Active Sensors		
	COMBIVAC 2T	IONIVAC IM 540 (Channel 3 and 4)	Bare wire ends
THERMOVAC Transmitter TTR 91, TTR 91 S, TTR 96 S a. o.	Type A	Type A	-
PENNINGVAC PTR 225, PTR 225 S, PTR 237	Type A	-	-
CERAVAC CTR 90, CTR 91	Type B	Type B	-
IONIVAC ITR 90	Type C	-	Type E

Technical Data	Connection Cable
----------------	------------------

<b>Cables</b> Type A Type B Type C Type D Type E	FCC 68 (RJ45) on both ends, 8 way, shielded Sub-D 15 way female to FCC 68 (RJ45), 8 way, shielded Sub-D 15 way female to Sub-D 15 way male, shielded Sub-D 15 way female to MAS 70 S, shielded Sub-D 15 way female to bare wire ends, shielded
---	--

Ordering Information	Connection Cable	
	Type A	Type B

<b>Cable length</b> 5 m 10 m 15 m 20 m 30 m 40 m 50 m 75 m 100 m	<b>Part No. 124 26</b> <b>Part No. 230 012</b> <b>Part No. 124 27</b> <b>Part No. 124 28</b> <b>Part No. 124 29</b> <b>Part No. 124 30</b> <b>Part No. 124 31</b> <b>Part No. 124 32</b> <b>Part No. 124 33</b>	<b>Part No. 230 013</b> <b>Part No. 230 014</b> <b>Part No. 230 015</b> <b>Part No. 230 016</b> <b>Part No. 230 017</b> <b>Part No. 230 018</b> <b>Part No. 230 019</b> <b>Part No. 230 020</b> <b>Part No. 230 021</b>
---	---	---

Ordering Information	Connection Cable	
	Type C	Type E

<b>Cable length</b> 5 m 10 m 15 m 20 m 30 m 40 m 50 m 75 m 100 m	<b>Part No. 124 55</b> <b>Part No. 230 022</b> <b>Part No. 124 56</b> <b>Part No. 124 57</b> <b>Part No. 124 58</b> 1) 1) 1) 1)	<b>Part No. 124 63</b> <b>Part No. 230 023</b> <b>Part No. 124 64</b> <b>Part No. 124 65</b> <b>Part No. 124 66</b> <b>Part No. 124 67</b> <b>Part No. 124 68</b> <b>Part No. 124 69</b> <b>Part No. 124 70</b>
---	---	---

<sup>1)</sup> Longer cable runs are not specified because of the RS 232 C connection

## DISPLAY ONE



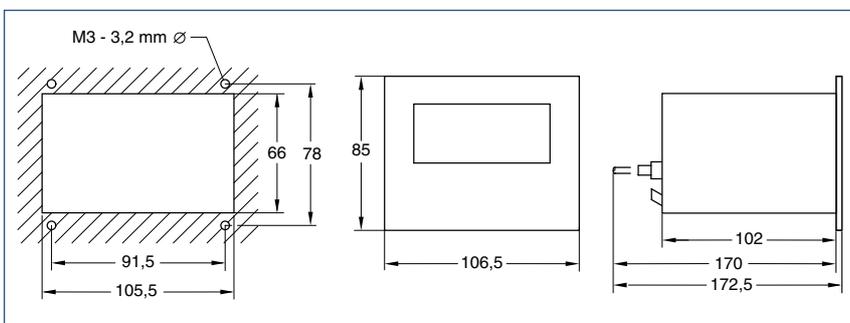
Cost-effective, compact single channel display unit for the transmitters from the THERMOVAC serie.

### Advantages to the User

- Power supply voltage for the transmitters
- Two-digit mantissa in the range from  $5 \times 10^{-4}$  to  $1 \times 10^3$  mbar
- Readout selectable between mbar, Torr or Pascal
- 0 to 10 V chart recorder output via plug-in screw terminals
- The switching threshold of the transmitters has been looped through to plug-in terminals
- Transmitter threshold settings can be displayed by a single key press on the transmitter
- Compact bench top enclosure (1/4 19 in., 2 HU)
- For fitting into 19 in., 3 HU racks

### Connectable Sensors

- TTR 211
- TTR 216 S
- TTR 90
- TTR 90 S
- TTR 91
- TTR 91 S
- TTR 96 S



Dimensional drawing and panel cut-out for the DISPLAY ONE

Technical Data	DISPLAY ONE
Number of measurement channels	1
Display for measured values	digital, 7 segment LED
Display range mbar (Torr)	$5 \times 10^{-4}$ to $1 \times 10^3$ ( $3.8 \times 10^{-4}$ to $7.5 \times 10^2$ )
Unit of measurement (selectable)	mbar, Torr, Pascal
Switching thresholds	from the transmitter are run to a terminal strip
Chart recorder output ( $R_a > 2.5 \text{ k}\Omega$ )	0 - 10 Volt, characteristic corresponds to the connected transmitter
Main connection	
EU version	180 V - 250 V / 50-60 Hz
US version	90 V - 130 V / 50-60 Hz
Ordering Information	DISPLAY ONE
EU version, including mains cord	<b>Part No. 230 001</b>
US version, including mains cord	<b>Part No. 235 001</b>
(Operating Instructions)	<b>(GA 09.034)</b>
THERMOVAC Transmitter TTR 91, TTR 91 S, TTR 96 S	see section "Active Sensors/Transmitters"
Connection cable, FCC 68 on both ends, 8 way, shielded	
5 m	<b>Type A</b> Part No. 124 26
10 m	Part No. 230 012
15 m	Part No. 124 27
20 m	Part No. 124 28
30 m	Part No. 124 29
40 m	Part No. 124 30
50 m	Part No. 124 31
75 m	Part No. 124 32
100 m	Part No. 124 33
Adapter panel for installation in a 3 HU, 19 in. rack	Part No. 230 005

## DISPLAY TWO / THREE



Cost-effective, operating and display units for the transmitters from the THERMOVAC and PENNINGVAC series.

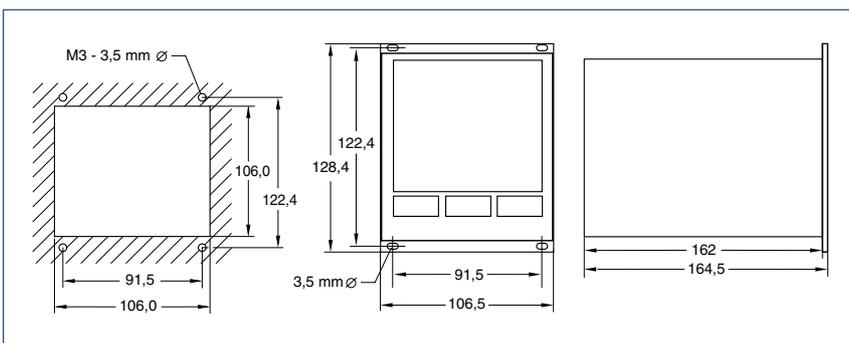
All channels are displayed simultaneously.

### Advantages to the User

- Power supply voltage for the transmitters
- Display range from  $1 \times 10^{-9}$  to 1500 mbar
- Readout selectable between mbar, Torr or Pascal
- Adjustable switching thresholds with variable hysteresis, floating changeover contacts and visual indication of the switching status in the display
- Option of entering gas correction factors for PENNINGVACs
- Separate chart recorder outputs 0-10 V for each measurement channel
- Compact bench top enclosure (1/4 19 in., 3 HU)
- For fitting into 19 in., 3 HU racks

### Connectable Sensors

- TTR 211
- TTR 216 S
- TTR 90
- TTR 91
- TTR 96 S
- TTR 100
- PTR 225
- PTR 227



Dimensional drawing and panel cut-out for the DISPLAY TWO and THREE

Technical Data	DISPLAY TWO	DISPLAY THREE
Number of measurement channels	2	3
Display for measured values	digital, 7 segment LED, 4 digits	digital, 7 segment LED, 4 digits
Display range <b>mbar(Torr)</b>	1 x 10 <sup>-10</sup> to 2000 (0.75 x 10 <sup>-10</sup> to 1500)	1 x 10 <sup>-10</sup> to 2000 (0.75 x 10 <sup>-10</sup> to 1500)
Unit of measurement (selectable)	mbar, Torr, Pascal	mbar, Torr, Pascal
Gas type correction (for PTR)	factor adjustable	factor adjustable
Sensor connection	FCC68 (RJ45)	FCC68 (RJ45)
Sensor power supply <b>V DC</b>	24	24
Electrical outputs	screw terminal	screw terminal
Switching threshold Number Adjustment range Hysteresis Relay contact Load rating	2 (1 per channel) sensor dependent adjustable floating changeover contact 60 V, 1 A DC / 30 V, 1 A AC	3 (1 per channel) sensor dependent adjustable floating changeover contact 60 V, 1 A DC / 30 V, 1 A AC
Ready relay Relay contact Load rating	normally open contact 60 V, 1 A DC / 30 V, 1 A AC	normally open contact 60 V, 1 A DC / 30 V, 1 A AC
Chart recorder output (R <sub>a</sub> > 10 kΩ)	0 - 10 V per measurement channel, output characteristic corresponds to the connected transmitter	0 - 10 V per measurement channel, output characteristic corresponds to the connected transmitter
Control input	PENNINGVAC PTR: high voltage on	PENNINGVAC PTR: high voltage on
Mains connection <b>V AC / Hz</b>	85 - 240 / 50 - 60	85 - 240 / 50 - 60
Power consumption <b>W</b>	< 10	< 15
Nominal temperature range <b>°C</b>	+5 to +50	+5 to +50
Weight <b>kg (lbs)</b>	1.3 (2.87)	1.4 (3.09)
Protection class <b>IP</b>	40	40
Ordering Information	DISPLAY TWO	DISPLAY THREE
EU version, including mains cord US version, including mains cord	<b>Part No. 230 024</b> <b>Part No. 235 024</b>	<b>Part No. 230 025</b> <b>Part No. 235 025</b>
(Operating Instructions)	<b>(GA 09.037)</b>	<b>(GA 09.037)</b>
THERMOVAC Transmitter TTR 91, TTR 96 S, TTR 100	see section "Active Sensors/Transmitters"	see section "Active Sensors/Transmitters"
PENNINGVAC Transmitter PTR 225, PTR 227	see section "Active Sensors/Transmitters"	see section "Active Sensors/Transmitters"
Connection cables for THERMOVAC and PENNINGVAC (Type A)	see section "Connection Cables for Active Sensors"	see section "Connection Cables for Active Sensors"
Adapter panel for installation in a 3 HU, 19 in. rack	<b>Part No. 230 005</b>	<b>Part No. 230 005</b>

## CENTER ONE



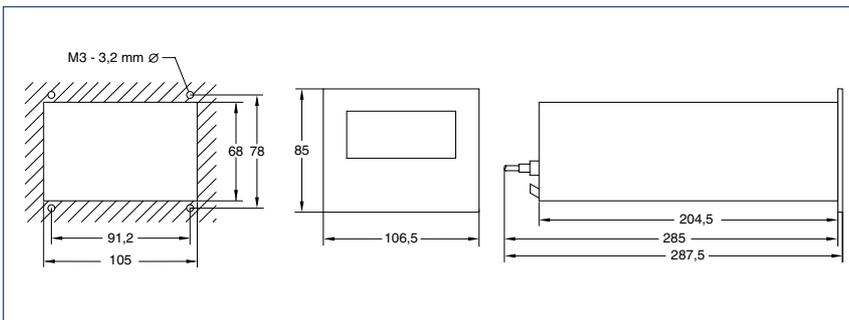
Universal and compact display and operating unit for the active sensors from the CERAVAC, THERMOVAC, PENNINGVAC and IONIVAC series.

### Advantages to the User

- Power supply voltage for the transmitters
- Display range from  $1 \times 10^{-10}$  to 1500 mbar
- Automatic switchover to exponential readout of the measured data depending on the pressure range
- Readout selectable between mbar, Torr or Pascal
- Adjustable switching threshold with variable hysteresis, floating changeover contact and visual indication of the switching status on the display
- Zero correction for both display and chart recorder output through a key when using CERAVAC transmitters
- Option of entering gas correction factors for PENNINGVACs
- Chart recorder output 0 - 10 Volt
- RS 232 C interface with adjustable baud rate
- Relay output for error signalling
- Compact bench top enclosure (1/4 19 in., 2 HU)
- For fitting into 19 in., 3 HU racks

### Connectable Sensors

- THERMOVAC TTR 90, TTR 91, TTR 96 S, TTR 100, TTR 211, TTR 216 S
- PENNINGVAC PTR 225 and PTR 237
- CERAVAC CTR 90 and CTR 91
- IONIVAC ITR 90 and ITR 100



Dimensional drawing and panel cut-out for the CENTER ONE

Technical Data	CENTER ONE
Number of measurement channels	1
Display for measured values	digital, 7 segment LED, 5 digits
Display range <b>mbar (Torr)</b>	1 x 10 <sup>-10</sup> to 1500 (0.75 x 10 <sup>-10</sup> to 1125)
Unit of measurement (selectable)	mbar, Torr, Pascal, Micron
Gas type correction	factor adjustable
Sensor connection	15 way Sub-D socket FCC68 (RJ45)
Sensor power supply <b>V DC</b>	24
Electrical inputs and outputs	9 way Sub-D plug
Switching threshold Number Adjustment range Hysteresis Relay contact Load rating	1 sensor dependent adjustable floating changeover contact 60 V, 0.5 A DC / 30 V, 0.5 A AC
Error message Relay contact Load rating	floating normally open contact 60 V, 0.5 A DC / 30 V, 0.5 A AC
Chart recorder output (R <sub>a</sub> > 10 kΩ)	0 - 10 Volt, characteristic corresponds to the connected transmitter
Control input	PTR: high voltage on ITR 100: emission on
Interface RS 232 C	9 way Sub-D socket
Mains connection <b>V AC / Hz</b>	85 V - 264 / 50-60
Power consumption <b>W</b>	< 30
Weight <b>kg (lbs)</b>	0.85 (1.9)
Protection class <b>IP</b>	30
Ordering Information	CENTER ONE
EU version with 2 m EURO mains cord US-Version with 2 m US mains cord	<b>Part No. 230 002</b> <b>Part No. 235 002</b>
(Operating Instructions)	<b>(GA 09.033)</b>
THERMOVAC, PENNINGVAC, CERA VAC and IONIVAC Transmitters	see section "Active Sensors / Transmitters"
Connection cables for THERMOVAC and PENNINGVAC (Type A), CERA VAC (Type B) and IONIVAC (Type C)	see section "Connection Cables for Active Sensors"
Adapter panel for installation in a 3 HU, 19 in. rack	<b>Part No. 230 005</b>
Screw terminal for the 25 way output socket	<b>Part No. 230 006</b>

## CENTER TWO / THREE



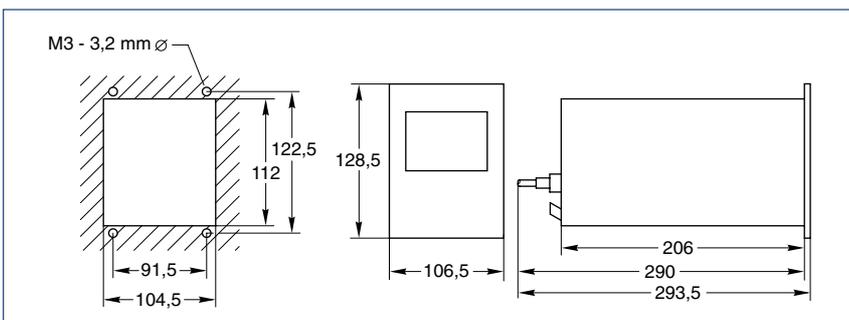
Universal display and operating units for the active sensors from the CERAVAC, THERMOVAC, PENNINGVAC and IONIVAC series. All channels are displayed simultaneously.

### Advantages to the User

- Power supply voltage for the transmitters
- Display range from  $1 \times 10^{-10}$  to 1330 mbar
- Automatic switchover to exponential readout of the measured data depending on the pressure range
- Readout selectable between mbar, Torr, Micron or Pascal
- Adjustable switching thresholds with variable hysteresis, floating changeover contacts and visual indication of the switching status in the display, freely assignable to the individual measurement channels
- Zero correction for both display and chart recorder output through a key when using CERAVAC transmitters
- Option of entering gas correction factors for PENNINGVACs
- Separate chart recorder outputs 0-10 V for each measurement channel
- Additional chart recorder output 0-10 V programmable to several measurement channels
- RS 232 C interface with adjustable baud rate
- Relay output for error signalling
- Compact bench top enclosure (1/4 19 in., 3 HU)
- For fitting into 19 in., 3 HU racks

### Connectable Sensors

- THERMOVAC TTR 90, TTR 91, TTR 96 S, TTR 100, TTR 211, TTR 216 S
- PENNINGVAC PTR 225 and PTR 237
- CERAVAC CTR 90 und CTR 91
- IONIVAC ITR 90



Dimensional drawing and panel cut-out for the CENTER TWO and THREE

Technical Data	CENTER TWO	CENTER THREE
Number of measurement channels	2	3
Display for measured values	digital, 7 segment LED, 5 digits	digital, 7 segment LED, 5 digits
Display range <b>mbar(Torr)</b>	1 x 10 <sup>-10</sup> to 1330 (0.75 x 10 <sup>-10</sup> to 1000)	1 x 10 <sup>-10</sup> to 1330 (0.75 x 10 <sup>-10</sup> to 1000)
Unit of measurement (selectable)	mbar, Torr, Pascal, Micron	mbar, Torr, Pascal, Micron
Gas type correction	factor adjustable	factor adjustable
Sensor connection	15 way Sub-D socket FCC68 (RJ45)	15 way Sub-D socket FCC68 (RJ45)
Sensor power supply <b>V DC</b>	24	24
Electrical outputs	25 way Sub-D socket	25 way Sub-D socket
Switching threshold	independently assignable	independently assignable
Number	4	6
Adjustment range	sensor dependent	sensor dependent
Hysteresis	adjustable	adjustable
Relay contact	floating changeover contact	floating changeover contact
Load rating	60 V, 0.5 A DC / 30 V, 0.5 A AC	60 V, 0.5 A DC / 30 V, 0.5 A AC
Error message		
Relay contact	floating normally open contact	floating normally open contact
Load rating	60 V, 0.5 A DC / 30 V, 0.5 A AC	60 V, 0.5 A DC / 30 V, 0.5 A AC
Chart recorder output (R <sub>a</sub> > 10 kΩ)	0 - 10 V per measurement channel, output characteristic corresponds to the connected sensor, in addition one chart recorder output can be programmed	0 - 10 V per measurement channel, output characteristic corresponds to the connected sensor, in addition one chart recorder output can be programmed
Control input	PENNINGVAC PTR: high voltage on	PENNINGVAC PTR: high voltage on
Interface RS 232 C	9 way Sub-D socket	9 way Sub-D socket
Mains connection <b>V AC / Hz</b>	90 - 250 / 50 - 60	90 - 250 / 50 - 60
Power consumption <b>W</b>	45	65
Nominal temperature range <b>°C</b>	+5 to +50	+5 to +50
Weight <b>kg (lbs)</b>	1.1 (2.43)	1.2 (2.65)
Protection class <b>IP</b>	20	20
Ordering Information	CENTER TWO	CENTER THREE
EU version with 2 m EURO mains cord US-Version with 2 m US mains cord	<b>Part No. 230 004</b> <b>Part No. 235 004</b>	<b>Part No. 230 003</b> <b>Part No. 235 003</b>
(Operating Instructions)	<b>(GA 09.035)</b>	<b>(GA 09.035)</b>
THERMOVAC, PENNINGVAC, CERAVAC and IONIVAC Transmitters	see section "Active Sensors / Transmitters"	see section "Active Sensors / Transmitters"
Connection cables for THERMOVAC and PENNINGVAC (Type A), CERAVAC (Type B) and IONIVAC (Type C)	see section "Connection Cables for Active Sensors"	see section "Connection Cables for Active Sensors"
Screwed connection for 9 way Sub-D socket	<b>Part No. 230 006</b>	<b>Part No. 230 006</b>

# COMBIVAC 2T



By combining two transmitter types, the COMBIVAC 2T covers the entire range of vacuum pressure measurement from  $10^{-10}$  mbar to 2000 mbar.

Moreover, the unit offers a manually or pressure controlled switching function to START and STOP the high-vacuum pumps from the TW line.

The pump status "normal operation", "run-up", "standby" and "fail" is indicated on the display.

## Advantages to the User

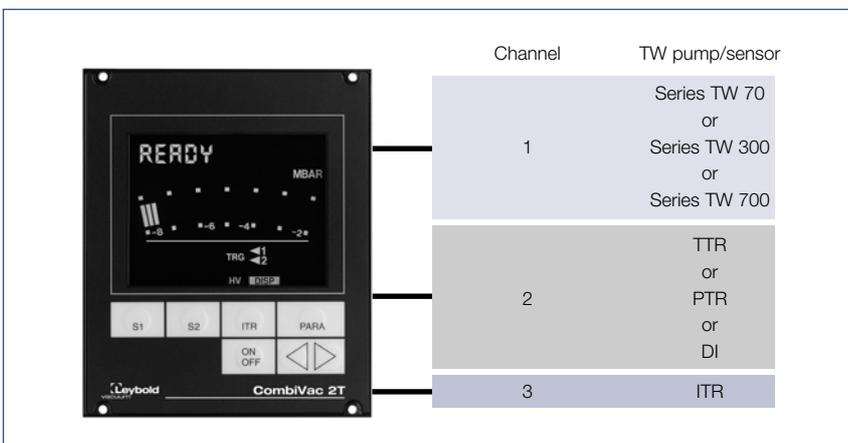
- Wide measurement and display range from 2000 to  $1 \times 10^{-10}$  mbar ( $1500$  to  $0.75 \times 10^{-10}$  Torr) through the combination of two sensors with automatic switchover on the display
- Analog bargraph display runs simultaneously with digital readouts
- Three adjustable thresholds with relay contacts and adjustable hysteresis, assignable to each channel
- Userfriendly adjustment to each application, e. g. by
  - selectable measurement unit
  - automatic emission start of IONIVAC transmitter
- automatic ignition of PENNINGVAC transmitter
- Separate 0 to 10 V chart recorder outputs for each measurement channel
- Additional 0 to 10 V chart recorder output, programmable for coverage of several measurement channels
- Full remote control via RS 232 C interface
- Compact bench-top unit (1/4 19 in., 3 HU) which can also be installed in panel cutouts and 19 in. racks
- CE mark

## Connectable Sensors

- THERMOVAC TTR 90, TTR 91, TTR 96 S, TTR 211, TTR 216 S
- PENNINGVAC PTR 225 and PTR 237
- IONIVAC ITR 90 and ITR 100
- DI 200/201 and DI 2000/2001

## Typical Applications

- General pressure measurements on high vacuum pump systems
- Vacuum furnaces
- Coating systems
- Analytical instruments



Connectable transmitters COMBIVAC 2T

Technical Data	<b>COMBIVAC 2T</b>	
Number of measurement channels	2	
Measurement display (backlit)	digital, 7-segments LCD analog LCD-bargraph display can be switched over by hand or automatically to the connected sensors	
Display range	mbar (Torr)	2000 to $2 \times 10^{-10}$ ( $1500$ to $1.5 \times 10^{-10}$ )
Display range by using the connectable transmitters		
DI 200/DI 201	mbar (Torr)	0.1 to 200 (0.075 to 150)
DI 2000/DI 2001	mbar (Torr)	1 to 2000 (0.75 to 1500)
TTR 90/91/96 S	mbar (Torr)	$5 \times 10^{-4}$ to 1000 ( $3.75 \times 10^{-4}$ to 750)
PTR 225/237	mbar (Torr)	$1 \times 10^{-9}$ to $1 \times 10^{-2}$ ( $0.75 \times 10^{-9}$ to $0.75 \times 10^{-2}$ )
ITR 90	mbar (Torr)	$5 \times 10^{-10}$ to 1000 ( $3.75 \times 10^{-10}$ to 750)
ITR 100	mbar (Torr)	$1 \times 10^{-10}$ to $1 \times 10^{-1}$ ( $0.75 \times 10^{-10}$ to $0.75 \times 10^{-1}$ )
Unit of measurement (selectable)	mbar, Torr, Pascal, Micron	
Type of gas (selectable)	Air, Ar, N <sub>2</sub> (only ITR 100)	
Switching thresholds	3, independently assignable	
Adjustment range	according to the assigned sensor	
Hysteresis	adjustable	
Relay contact	potential free changeover contact	
Capacity	60 V, 0.5 A DC	
Ready indication	1 relay contact 60 V, 0.5 A DC for all channels	
Chart recorder output (R <sub>a</sub> > 10 kΩ)	4, each 0 to 10 V per channel: initial characteristics dependent on connected transmitters one 0 to 10 V analog output per one or several linear or logarithmic channels	
Electric outputs	relay contacts and chart recorder outputs over 25 pin Sub-D-socket	
Interface	RS 232 C	
Main supply	90 - 250 V AC	
Power consumption	VA	40
Nominal temperature range	°C	0 to 50
Max. rel. humidity	% n. c.	85
Weight	kg (lbs)	1.5 (3.31)
Dimensions (W x H x D)	mm	106.5 x 128.5 x 240

Ordering Information	<b>COMBIVAC 2T</b>
<b>COMBIVAC 2T, 90 - 250 V AC</b>	<b>Part No. 230 000</b>
<b>(Operating Instructions)</b>	<b>(GA 09.594)</b>
<b>Calibration</b>	see section "Miscellaneous", para. "Leybold Calibration Service"
<b>THERMOVAC, PENNINGVAC and IONIVAC Transmitters</b>	see section "Active Sensors / Transmitters"
<b>Linear pressure sensors DI</b>	see section "Additional Sensors"
<b>Connection cable</b> <b>THERMOVAC and PENNINGVAC</b> 5 m 10 m 15 m 20 m 30 m 40 m 50 m 75 m 100 m	<b>Type A</b> Part No. 124 26 Part No. 230 012 Part No. 124 27 Part No. 124 28 Part No. 124 29 Part No. 124 30 Part No. 124 31 Part No. 124 32 Part No. 124 33
<b>Connection cable</b> <b>IONIVAC</b> 5 m 10 m 15 m 20 m 30 m	<b>Type C</b> Part No. 124 55 Part No. 230 022 Part No. 124 56 Part No. 124 57 Part No. 124 58
<b>Connection cable DI sensor, 5 m</b>	<b>Part No. 163 84</b>
<b>Connection cable</b> <b>TW 70, TW 300 and TW 700</b> 5 m 10 m 15 m 20 m	Part No. 230 007 Part No. 230 008 Part No. 230 009 Part No. 230 010



## Linear Pressure Sensors DI 200/DI 201/DI 2000/DI 2001/DI 2001 rel



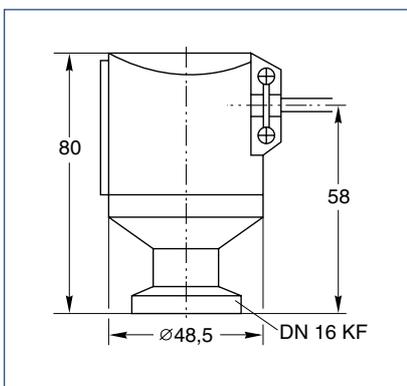
Capacitive pressure sensor based on ceramics technology. Available as absolute or relative pressure sensor

### Advantages to the User

- Pressure sensor of the two-wire type
- Absolute pressure ranges from 0.1 to 200 mbar or 1 to 2000 mbar
- Relative pressure range from -1000 mbar to +1000 mbar
- Excellent overload characteristic due to the  $Al_2O_3$  ceramics diaphragm
- Highly corrosion resistant
- Independent of the type of gas
- Vibration resistant
- Supply voltage range of 12 to 30 V DC
- Linear output signal of 4 to 20 mA
- Compact design

### Typical Applications

- Pressure measurements in the rough vacuum range, and for corrosive media
- Chemical process engineering
- Vacuum packaging
- Drying processes
- Measurement of operating and filling pressure, during the production of lamps
- Filling systems for brake fluids (DI 201/DI 2001)
- Filling systems for refrigerants
- Measurement of pressure relative to atmospheric pressure (DI 2001 rel)



Dimensional drawing for the sensors  
DI 200/DI 201/DI 2000/DI 2001/DI 2001 rel

Technical Data		DI 200	DI 201	DI 2000	DI 2001	DI 2001 rel
Measurement range	<b>mbar (Torr)</b>	0.1 to 200 (0.075 to 150)	0.1 to 200 (0.075 to 150)	1 to 2000 (0.75 to 1500)	1 to 2000 (0.75 to 1500)	-1000 to +1000 (-750 to +750) relative pressure
Overload range, max.	<b>bar</b>	5	5	10	10	10
Nominal temperature range	<b>°C</b>	0 to +60	0 to +60	0 to +60	0 to +60	0 to +60
Measurement uncertainty <sup>1)</sup> (± temperature error)	<b>% FS</b>	0.2	0.2	0.2	0.2	0.2
Resolution	<b>% FS</b>	0.05	0.05	0.05	0.05	0.05
Reproducibility	<b>% FS</b>	0.1	0.1	0.1	0.1	0.1
Linearity	<b>% FS</b>	0.1	0.1	0.1	0.1	0.1
Temperature error						
Zero drift	<b>% FS/10°K</b>	0.1	0.1	0.1	0.1	0.1
Sensitivity drift	<b>% FS/10°K</b>	0.15	0.15	0.15	0.15	0.15
Principle of measurement		Capacitive	Capacitive	Capacitive	Capacitive	Capacitive
Sensing head supply		Two-wire system	Two-wire system	Two-wire system	Two-wire system	Two-wire system
Output signal	<b>mA</b>	4 to 20	4 to 20	4 to 20	4 to 20	4 to 20
Supply voltage	<b>V DC</b>	+24 typ.	+24 typ.	+24 typ.	+24 typ.	+24 typ.
Operating range	<b>V</b>	12 to 30, ripple 1 V <sub>pp</sub>	12 to 30, ripple 1 V <sub>pp</sub>	12 to 30, ripple 1 V <sub>pp</sub>	12 to 30, ripple 1 V <sub>pp</sub>	12 to 30, ripple 1 V <sub>pp</sub>
Dead volume	<b>cm<sup>3</sup></b>	3	3	3	3	3
Vacuum connection	<b>DN</b>	16 KF	16 KF	16 KF	16 KF	16 KF
Weight, approx.	<b>kg (lbs)</b>	0.55 (1.2)	0.55 (1.2)	0.55 (1.2)	0.55 (1.2)	0.55 (1.2)
Protection class	<b>IP</b>	44	44	44	44	44
Materials in contact with the medium		Stainless Steel 1.4305 Al <sub>2</sub> O <sub>3</sub> (96 %) Ceramics FKM	Stainless Steel 1.4305 Al <sub>2</sub> O <sub>3</sub> (96 %) Ceramics EPDM	Stainless Steel 1.4305 Al <sub>2</sub> O <sub>3</sub> (96 %) Ceramics FKM	Stainless Steel, 1.4305 Al <sub>2</sub> O <sub>3</sub> (96 %) Ceramics, EPDM	Stainless Steel 1.4305 Al <sub>2</sub> O <sub>3</sub> (96 %) Ceramics EPDM
Operating units		MEMBRANOVAC DM 11, DM 12 / PIEZOVAC PV 20 / COMBIVAC CM 32, 2T	MEMBRANOVAC DM 11, DM 12 / PIEZOVAC PV 20 / COMBIVAC CM 32, 2T	MEMBRANOVAC DM 11, DM 12 / PIEZOVAC PV 20 / COMBIVAC CM 32, 2T	MEMBRANOVAC DM 11, DM 12 / COMBIVAC CM 32, 2T	MEMBRANOVAC DM 11, DM 12 / COMBIVAC CM 32
Ordering Information		DI 200	DI 201	DI 2000	DI 2001	DI 2001 rel
Linear absolute pressure sensor, complete with 5 m long connection cable and connecting plug		<b>Part No. 158 12</b>	<b>Part No. 158 14</b>	<b>Part No. 158 13</b>	<b>Part No. 158 15</b>	<b>Part No. 245 000</b>
(Operating Instructions)		<b>(GA 09.116)</b>	<b>(GA 09.116)</b>	<b>(GA 09.116)</b>	<b>(GA 09.116)</b>	<b>-</b>

<sup>1)</sup> Sum of linearity, hysteresis and reproducibility

## THERMOVAC Sensors TR 211/TR 211 NPT/TR 212/TR 216



These passive sensors use thermal conductivity technology according to Pirani.

### Advantages to the User

- Measurement range  $5 \times 10^{-4}$  to 1000 mbar ( $3.75 \times 10^{-4}$  to 750 Torr)
- Tungsten or platinum filament
- Cost-effective sensing cell
- Fully aligned and temperature compensated 0 to +40 °C
- Constant filament temperature

### TR 211

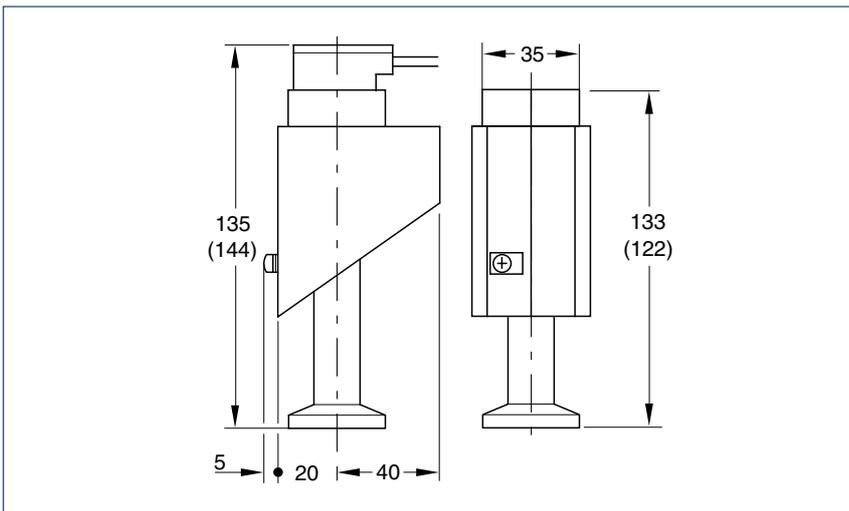
- Aluminum sensing cell with tungsten filament
- Improved temperature compensation

### TR 211 NPT/TR 212

- Stainless steel sensing cell with tungsten filament
- Over-pressure resistant

### TR 216

- Stainless steel sensing cell with platinum filament and ceramics feed through
- Well suited for corrosive processes and water vapour atmospheres



Dimensional drawing for the TR 211, TR 212 and TR 216; TR 211 NPT in brackets

Technical Data	TR 211	TR 211 NPT	TR 212	TR 216
Measurement range mbar (Torr)	5 x 10 <sup>-4</sup> to 1000			
Operating temperature range (compensated) °C	0 to +40	0 to +40	0 to +40	0 to +40
Storage temperature range, max. °C	80	80	80	80
Filament	tungsten	tungsten	tungsten	platinum
Filament temperature °C	110	110	110	110
Permissible overload (abs.), max. bar	3	3	10	10
Volume of the sensing cell, approx. cm <sup>3</sup>	11	11	11	11
Vacuum connection DN	16 KF	1/8" NPT	16 KF/16 CF	16 KF
Materials in contact with the medium	aluminum, Vacon, glass, tungsten CrNi 8020, epoxy cement	stainless steel, Vacon, glass, tungsten CrNi 8020 epoxy cement	stainless steel, Vacon, glass, tungsten CrNi 8020 epoxy cement	stainless steel 1.4301 (SS 304), Al <sub>2</sub> O <sub>3</sub> ceramics, CrNi 8020,
Operating units	THERMOVAC TM 21, 22, 23 / COMBIVAC CM 31, 32, 33 / PIEZOVAC PV 20	THERMOVAC TM 21, 22, 23 / COMBIVAC CM 31, 32, 33 / PIEZOVAC PV 20	THERMOVAC TM 21, 22, 23 / COMBIVAC CM 31, 32, 33 / PIEZOVAC PV 20	THERMOVAC TM 21, 22, 23 / COMBIVAC CM 31, 32, 33 / PIEZOVAC PV 20
Ordering Information	TR 211	TR 211 NPT	TR 212	TR 216
THERMOVAC sensors Series 200 DN 16 KF DN 16 CF DN 1/8" NPT	Part No. 157 85 - -	- - Part No. 896 33	Part No. 158 52 Part No. 157 86 -	Part No. 157 87 - -
(Operating Instructions)	(GA 09.210)	(GA 09.210)	(GA 09.210)	(GA 09.210)
Replacement sensing cell	Part No. 157 75	Part No. 896 34	-	Part No. 157 77

## PENNINGVAC Sensors PR 25/PR 26/PR 27/PR 28



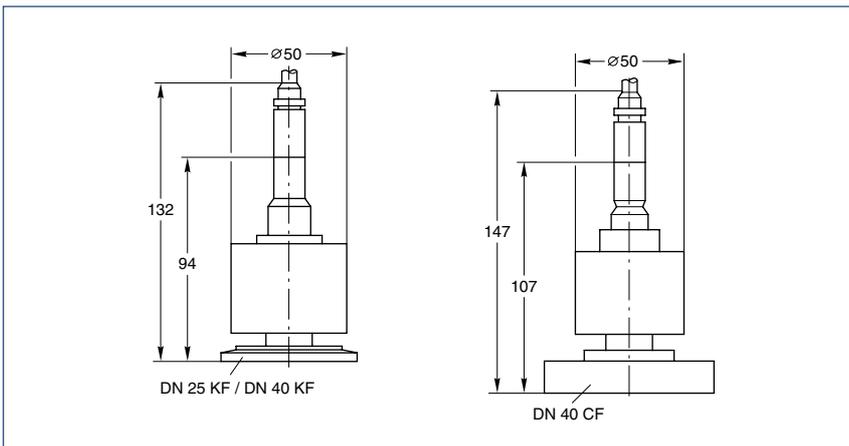
These passive sensors use cold cathode ionization technology according to Penning.

### Advantages to the User

- Rugged
- Insensitive to air inrushes and vibrations
- Easy disassembly and cleaning of the measurement system
- Exchangeable cathode plate
- Improved ignition characteristic through titanium cathodes

### Option

For protection of the PENNINGVAC sensors against contamination, radiation and other disturbing factors the installation of a baffle is recommended.



Dimensional drawing for the PENNINGVAC PR Sensors

Technical Data		PR 25	PR 26	PR 27	PR 28
Measurement range	<b>mbar (Torr)</b>	1 x 10 <sup>-9</sup> to 10 <sup>-2</sup> (0.75 x 10 <sup>-9</sup> to 10 <sup>-2</sup> )	1 x 10 <sup>-9</sup> to 10 <sup>-2</sup> (0.75 x 10 <sup>-9</sup> to 10 <sup>-2</sup> )	1 x 10 <sup>-9</sup> to 10 <sup>-2</sup> (0.75 x 10 <sup>-9</sup> to 10 <sup>-2</sup> )	1 x 10 <sup>-9</sup> to 10 <sup>-2</sup> (0.75 x 10 <sup>-9</sup> to 10 <sup>-2</sup> )
High voltage supply (anode potential)	<b>kV</b>	+3.3/+1.6	+3.3/+1.6	+3.3/+1.6	+3.3/+1.6
Storage temperature range	<b>°C</b>	-25 to +80	-25 to +80	-25 to +80	-25 to +80
Nominal temperature range	<b>°C</b>	0 to +80	0 to +80	0 to +80	0 to +200
Degassing temperature (flange)	<b>°C</b>	–	–	–	350
Permissible overload (abs.)	<b>bar</b>	6 <sup>1)</sup>	6 <sup>1)</sup>	6 <sup>1)</sup>	6 <sup>1)</sup>
Dead volume	<b>cm<sup>3</sup></b>	21	21	21	21
Materials in contact with the medium		stainless steel, nichrome, ceramics, titanium	stainless steel, nichrome, ceramics, titanium	stainless steel, nichrome, ceramics, titanium	stainless steel, nichrome, ceramics, titanium
Weight, approx.	<b>kg (lbs)</b>	0.75 (1.66)	0.75 (1.66)	0.8 (1.66)	0.8 (1.66)
Vacuum connection	<b>DN</b>	25 KF	40 KF	40 CF	40 CF
Operating units		COMBIVAC CM 31, 32, 33 / PENNINGVAC PM 31			
Ordering Information		PR 25	PR 26	PR 27	PR 28
PENNINGVAC sensors		<b>Part No. 157 52</b>	<b>Part No. 136 46</b>	<b>Part No. 136 47</b>	<b>Part No. 136 48</b>
(Operating Instructions)		<b>(GA 09.309)</b>	<b>(GA 09.309)</b>	<b>(GA 09.309)</b>	<b>(GA 09.309)</b>
Replacement cathode plate, titanium (5 pcs., incl. 5 ceramics discs)		Part No. 162 91			
Replacement anode ring		Part No. 200 28 711			
Baffle, with centering ring		Part No. 230 078	Part No. 230 079	–	–

<sup>1)</sup> When using an ultra sealing gasket at the vacuum connection

## IONIVAC Sensors IE 414/IE 514



These passive sensors use hot cathode ionization technology.

### Advantages to the User

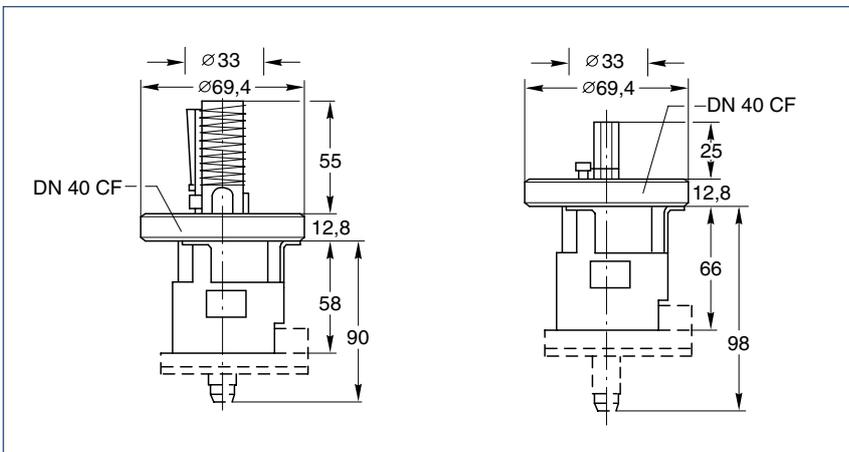
- Exchangeable cathode
- High accuracy of the measurements due to individually calibrated sensing system

### IE 414

- Bayard-Alpert sensing system
- Measurement range to  $2 \times 10^{-11}$  mbar ( $1.5 \times 10^{-11}$  Torr)
- Protection shield welded in place

### IE 514

- Extractor sensing system
- Reliable to  $1 \times 10^{-12}$  mbar ( $0.75 \times 10^{-12}$  Torr)
- Significant reduction of X-ray and ion desorption effects



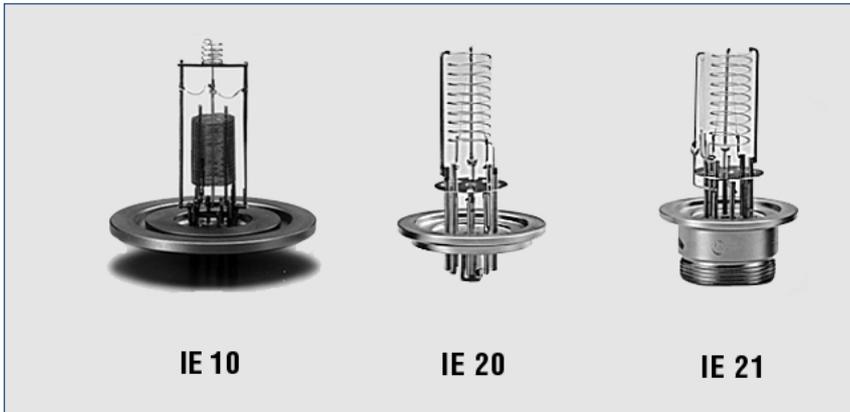
Dimensional drawing for the IE 414 (left) and IE 514 (right)

Technical Data		IE 414	IE 514
Measurement range	mbar (Torr)	$2 \times 10^{-11}$ to $10^{-2}$ ( $1.5 \times 10^{-11}$ to $10^{-2}$ )	$10^{-12}$ to $1 \times 10^{-4}$ ( $10^{-12}$ to $7.5 \times 10^{-5}$ )
X-ray limit	mbar (Torr)	$\leq 10^{-11}$ ( $\leq 10^{-11}$ )	$\leq 10^{-12}$ ( $\leq 10^{-12}$ )
Operating temperature range	°C	0 to +80	0 to +80
Degassing temperature at the flange, max.	°C	+250 <sup>1)</sup> / +350 <sup>2)</sup>	+250 <sup>1)</sup> / +350 <sup>2)</sup>
Material			
Cathode		Iridium with yttric oxid coating	Iridium with yttric oxid coating
Feedthrough pins		NiFe 42	NiFe 42
Anode		Pt/Ir 90/10/pt wire	Mo and CoNiCr
Vacuum connection	DN	40 CF	40 CF
Adjustment data			
Ion detector potential	V	0	0
Cathode potential	V	80	100
Anode potential	V	220	220
Emission current	mA	0.06 to 0.6	1.6
Heating current for the hot cathode	A	1.4	1.4
Heating voltage for the hot cathode	V	2.7	3.7
Sensitivity for nitrogen	mbar <sup>-1</sup>	17	6.6
Degassing operation	V	700	700
Electron bombardment	mA	30	30
Operating units		IM 520, 510, 540	IM 520, 510, 540
Ordering Information		IE 414	IE 514
IONIVAC sensors		Part No. 158 66	Part No. 158 67
Replacement cathode		Part No. 158 63	Part No. 158 61

<sup>1)</sup> With bakeable gauge head cable

<sup>2)</sup> With gauge head cable detached

## Spare Sensors for Older Operating Units



Type	Corresponding Sensors/ Operating Units	Ordering Information
IE 10	IM 110, IM 110 D	Part No. 163 43
IE 20	IM 210, IM 210 D, IT 230	Part No. 163 14
IE 21	IM 210, IM 221	Part No. 158 17
Cathode	IE 220	Part No. 158 58 <sup>1)</sup>
TR 301	TM 320, CM 350, IM 520, DM 11, DM 12, CM 32	Part No. 157 40 <sup>1)</sup>
Sensing Cell	TR 201/901 DN 16 KF	Part No. 162 09 <sup>1)</sup>
Sensing Cell	TR 201/901 NPT	Part No. 896 76 <sup>1)</sup>
Sensing Cell	TR 301	Part No. 157 43 <sup>1)</sup>
VK 201	VISCOVAC VM 212	Part No. 158 82 <sup>1)</sup>

<sup>1)</sup> to be discontinued



## IONIVAC IM 540



The 3-channel display and operating unit IONIVAC IM 540 offers, by combination of up to 4 different principles of measurement – Pirani, capacitive, Bayard-Alpert and Extractor –, complete coverage and control of the vacuum pressure in the range between  $10^{-12}$  mbar and atmospheric pressure.

### Advantages to the User

- Precise UHV pressure measurements with the Bayard-Alpert sensor IE 414 (offering excellent long-term stability) or the Extractor sensor IE 514 (offering an extremely low X-ray limit of  $< 1 \times 10^{-12}$  mbar)
- 1 measurement channel for IONIVAC sensor (Bayard-Alpert or Extractor)
- Possibility of simultaneously connecting a second IONIVAC sensor
- Degassing of the anode through electron bombardment with time-limit
- Continuous UHV measurement also during the degassing phase (up to  $+250^\circ$  C with bakeable gauge head cable)
- 2 measurement channels for direct connection of transmitters from the series THERMOVAC TTR and CERAVAC CTR 90/91
- Selectable pressure units (mbar, Torr, Pascal, Micron)
- Display of a single measurement channel with pressure trend through analogue bargraph or simultaneous display of all measurement channels
- Two adjustable thresholds with adjustable hysteresis and freely assignable to the measurement channels

- Compact benchtop enclosure (1/2 19 in., 3 HU)
- RS 232 C interface provided as standard
- Simple software updates possible through the RS 232 interface
- Profibus interface (optional)
- CE mark

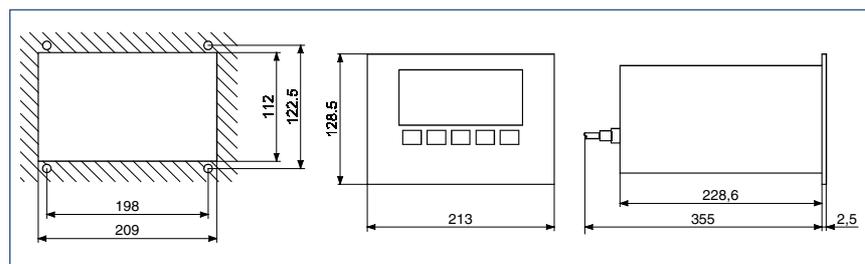
### Typical Applications

- Pressure measurement and control in the UHV range
- Measurement of ultimate pressure in UHV systems
- Checking of ultimate pressure in semiconductor production
- Total pressure measurements in the area of cryo technology
- Total pressure measurements in calibration systems

### Connectable Sensors

- Bayard-Alpert sensor IE 414
- Extractor sensor IE 514 (see Chapter “Additional Sensors”) combined with
- THERMOVAC TTR 90, TTR 211, TTR 91, TTR 96 S, TTR 100
- CERAVAC CTR 90 and CTR 91 (see Chapter “Active Sensors/ Transmitters”)

Two passive sensors working with ionization technology (IE 414 and/or IE 514) could be connected simultaneously to the IONIVAC 540 while only one is in operation. A pressure dependent emission control of these sensors is possible if a THERMOVAC TTR or CERAVAC CTR 90/CTR 91 of suitable range overlap is connected.



Front panel cut out (left) and dimensional drawing (right) for the IONIVAC 540

Technical Data		IONIVAC IM 540	
Number of measurement channels		3	
Bayard-Alpert / Extractor		Channel 1 or 2	
THERMOVAC / CERAVAC		Channel 3 and 4	
Display range	mbar	1 x 10 <sup>-12</sup> to 1100	
Display range Extractor	mbar	1 x 10 <sup>-12</sup> to 1 x 10 <sup>-4</sup>	
Display range Bayard-Alpert	mbar	1 x 10 <sup>-11</sup> to 1 x 10 <sup>-2</sup>	
Measurement range switching		automatic or decade pre-select	
Units of measurement (selectable)		mbar, Torr, Pa, Micron	
Measurement uncertainty	%	± 10 of the value displayed	
Trend indication		bargraph	
Measurement value display rate		1 x 10 <sup>-10</sup> to 1 x 10 <sup>-2</sup> mbar, 5 s <sup>-1</sup> 1 x 10 <sup>-12</sup> to 1 x 10 <sup>-10</sup> mbar, 0.5 s <sup>-1</sup>	
Emission current			
Extractor sensor	mA	1.6	
Bayard-Alpert sensor	mA	0.1 to 10; automatic control	
Emission current shutdown at		p > 1 x 10 <sup>-2</sup> mbar, broken cathode, short-circuit, interruption of the electric circuit	
Bake out power			
Extractor/ Bayard-Alpert	W	20 / 40	
Sensor supply, potential for		anode Extractor / Bayard-Alpert: 220 V, cathode Extractor / Bayard-Alpert: 100 V/ 80 V, Reflector Extractor: 205 V	
Sensor connections		Bayard-Alpert and Extractor - single operation is possible 2 x Bayard-Alpert or Extractor (redundant operation)	
Measurement system detection		automatically	
Measurement system switchover		automatically, pressure dependent, error dependent	
Chart recorder outputs for Extractor/Bayard-Alpert (Ra > 2.5 kΩ)		logarithmic 0 to 10 V (1 V / dec.) or linear 0 to 10 Volt, error indication U > 10.5 V	
Interface (standard / optional)		RS 232 C / Profibus	
Switching thresholds (single operation or interval)		2 with floating changeover contact	
Mains connection	V / Hz	90 - 264 / 50/60	
Storage temperature range	°C	-40 to +60	
Nominal temperature range	°C	+5 to +50	
Dimensions of the benchtop instrument (WxHxD)		mm	
Weight, approx.		kg (lbs)	
		3 (6.62)	

Ordering Information	IONIVAC IM 540
IONIVAC IM 540 with 2 m long mains cord (EU + US)	<b>Part No. 230 100</b>
(Operating Instructions)	<b>(GA 09.419)</b>
Options Profibus DP interface	Part No. 230 101
DKD calibration	see section "Miscellaneous"
IONIVAC sensors IE 414, DN 40 CF Replacement cathode IE 414 IE 514, DN 40 CF Replacement cathode IE 514	see also section "Additional Sensors" Part No. 158 66 Part No. 158 63 Part No. 158 67 Part No. 158 61
Gauge head cables for IE 414/514 5 m 10 m 5 m, bakeable up to 250 °C	Part No. 158 68 Part No. 150 88 Part No. 158 44
Extension cables for IE 414/514 10 m 20 m	Part No. 245 002 Part No. 200 02 937
THERMOVAC Transmitter TTR	see section "Active Sensors/Transmitters"
Connection cable for THERMOVAC (Type A)	see section "Connection Cables for Active Sensors"
CERAVAC Transmitter CTR 90/91	see section "Active Sensors/Transmitters"
Connection cable for CERAVAC (Type B)	see section "Connection cables for active sensors"



## Low Pressure Safety Switch PS 113 A



Switch indicating whether or not the pressure has reached the level of the atmospheric pressure after venting. Preset diaphragm pressure switch set to a trigger of 6 mbar (4 Torr) below atmospheric pressure.

### Advantages to the User

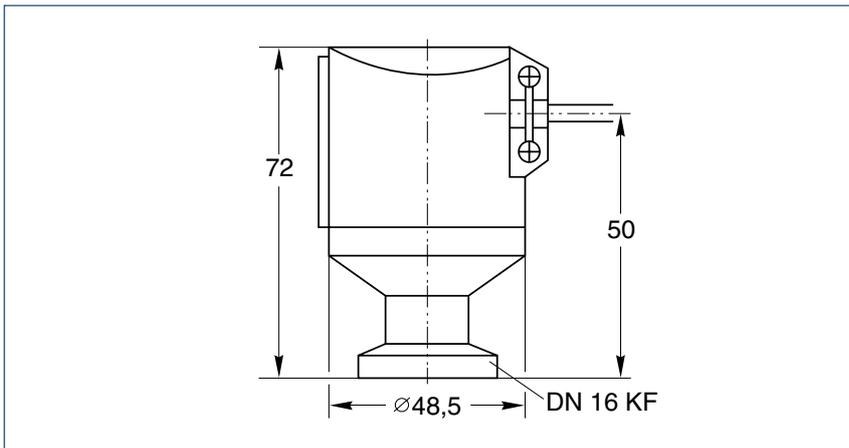
- Rugged design
- High switching capacity
- Corrosion protected
- Easy to use
- IP 44 protection
- Can be connected to a programmable control

### Typical Applications

- Venting facilities
- Safety shutdown of vacuum systems
- Load locks

### Technical Note

Due to the diaphragm material used (EPDM) the PS 113 A is not suited for applications in which the process gas contains large quantities of helium. Owing to diffusion effects the leak rate of the diaphragm settles at about  $1 \times 10^{-6}$  mbar l/s for helium.



Dimensional drawing for the low pressure safety switch PS 113 A

Technical Data		Low Pressure Safety Switch
Switching pressure	mbar (Torr)	Approx. 6 (4.5) below atmospheric pressure
Return switching pressure	mbar (Torr)	3 (2.3) below atmospheric pressure
Switching inaccuracy	mbar (Torr)	2 (1.5)
Max. permissible operating pressure (abs.)	mbar (Torr)	2000 (1500)
Storage temperature range	°C	-25 to +85
Nominal temperature range	°C	0 to +85
Switching contact		Changeover contacts, gold-plated, for prog. controls
Contact life		> 10 <sup>5</sup> switching cycles
Switching capacity		100 mA / 24 V AC 30 mA / 24 V DC
Electrical connection		6.3 mm flat plug
Vacuum connection	DN	16 KF
Materials in contact with the medium		Stainless steel 1.4305, 1.4310, Stainless steel 1.4300 PTFE coated
Protection class	IP	44
Ordering Information		Low Pressure Safety Switch
Low pressure safety switch PS 113 A, DN 16 KF; complete with 3 m long cable		Part No. 230 011
(Operating Instructions)		(GA 09.616)

## Pressure Switch PS 115

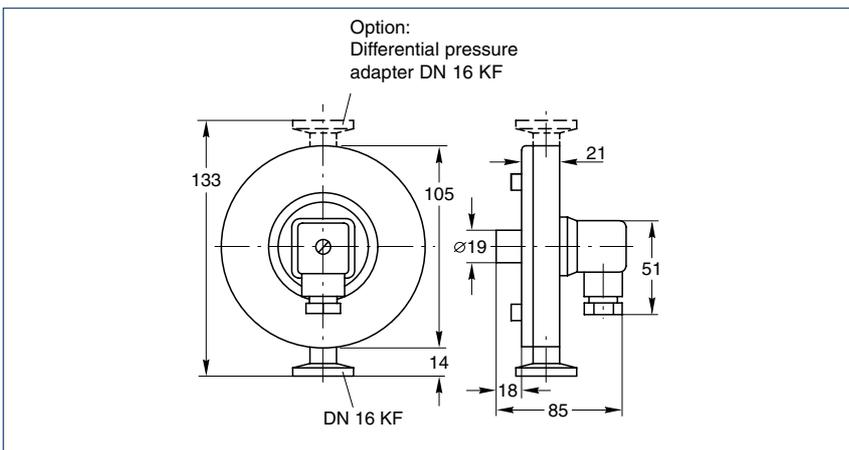


Rugged absolute pressure switch with electrical switching contact and an adjustable switching pressure between 0.5 and 2000 mbar (0.4 and 1500 Torr).

Through the differential pressure adapter (optional) the PS 115 pressure switch may be converted to operate as a differential pressure switch. The adapter consists of a DN 16 KF flange with screw-in thread and a sealing arrangement, and it is screwed into the PS 115 instead of the adjustment valve. The operating range extends to 2000 mbar (1500 Torr). Brief overloading to 3000 mbar (2250 Torr) is permissible without impairing switching accuracy. In this operating range differential values of +5 to -20 mbar (+3.75 to -15 Torr) can be adjusted via the set screw.

### Advantages to the User

- High switching accuracy ( $\pm 0.1$  mbar)
- Stable long term operating characteristics
- Rugged, corrosion protected design
- Increased switching capacity (floating) when using the switching amplifier SV 110
- Switching contact (n.c.) in the reference chamber and thus protected against corrosion
- For operating pressures up to 3 bar
- For high ambient temperatures
- Upon request, the switching threshold may be set in the factory



Dimensional drawing for the pressure switch PS 115

Technical Data		Pressure Switch
Switching range	mbar (Torr)	0.5 to 2000 (0.375 to 1500)
Overload limit	mbar (Torr)	3000 (2250)
Sensitivity	mbar (Torr)	0.1 (0.75)
Switching hysteresis	mbar (Torr)	0.5 (0.375)
Temperature coefficient	%/°K	0.4 of the switching value
Nominal temperature range		
briefly (max. 8 h)	°C	120
continuous	°C	0 to +90
Switching contact		Normally closed, gold-plated, for prog. controls
Switching voltage	V	24
Switching current (max.)	mA	10
Contact resistance, max.	kΩ	1
Electrical connection		Plug (DIN 43 650)
Protection class	IP	65
Vacuum connection	DN	16 KF
Materials in contact with the medium		
Measurement chamber		Stainless steel 1.4301; 1.4401; 1.4310; 1.3541; FPM
Reference chamber		Stainless steel 1.4301; 1.4401; 1.3541; glass; gold
Volume of the measurement chamber	cm <sup>3</sup>	4
Volume of the reference chamber	cm <sup>3</sup>	20
Weight	kg (lbs)	1.3 (2.87)
Ordering Information		Pressure Switch
Pressure Switch PS 115, DN 16 KF		<b>Part No. 160 04</b>
Pressure switch adjustment		<b>Part No. 160 05</b>
(Operating Instructions)		<b>(GA 09.611)</b>
For floating installations without SV 110, Clamping ring DN 16 KF, plastic Centering ring, DN 16 KF, plastic		Part No. 200 28 306 Part No. 200 28 307
Option Differential pressure adapter, DN 16 KF, for connection to the PS 115		Part No. 160 74
Spare parts kit PS 115		Part No. 160 06
SV 110 switching amplifier		Part No. 160 78

## Switching Amplifier SV 110

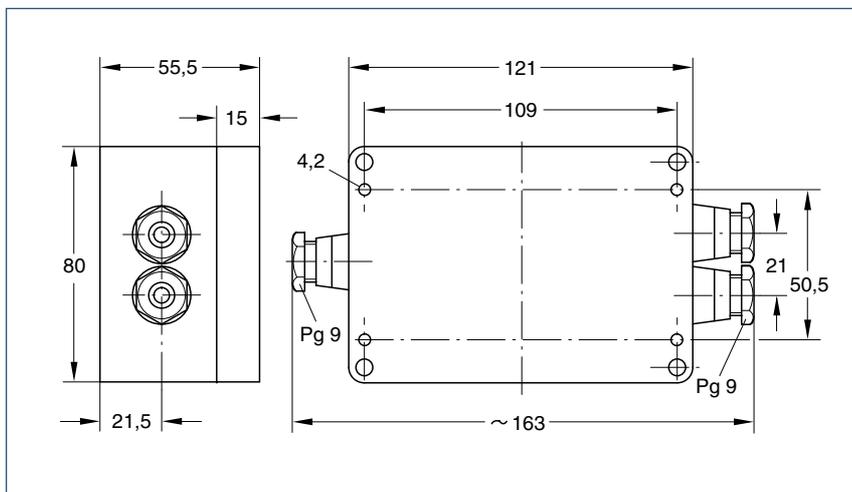
The diaphragm contact of the pressure switches is connected on one side to ground and is rated to 24 V / 10 mA max. When wanting to switch higher voltages or currents, a switching amplifier will be needed. The switching amplifier is equipped with powerful floating changeover

contacts. The output relay is energized as soon as the pressure drops below the switching threshold set up on the pressure switch.

The electrical connections are provided via screw terminals and are run out of the plastic enclosure through PG fittings.

### Advantages to the User

- Increased ratings for the switch
- Changeover contact



Dimensional drawing for the switching amplifier SV 110

Technical Data		Switching Amplifier
Mains supply, 50/60 Hz		110/130/220/240 V, selectable
Power consumption	VA	3
Output relay		
Switching voltage/current	V / A	250 / 5
Switching power, max.	VA	500
Response time	ms	30
Relaise time	ms	7
Control circuit	V / mA	24 / 10
Ambient temperature, max.	°C	50
Weight, approx	kg (lbs)	0.36 (0.79)
Ordering Information		Switching Amplifier
Switching amplifier SV 110		Part No. 160 78
(Operating Instructions)		(GA 09.611)

## Diaphragm Pressure Regulators MR 16/MR 50



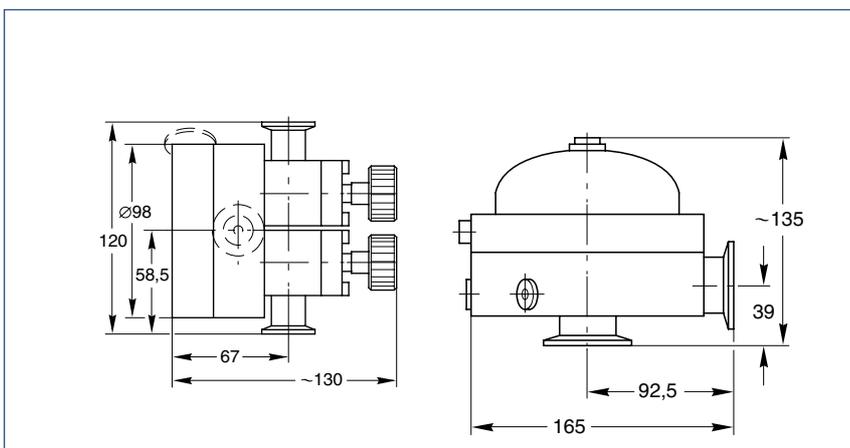
The MR 16/50 diaphragm regulators are absolute pressure regulators which automatically adapt the pumping speed of a vacuum pump depending on the amount of gas, without the need for an external power supply.

### Advantages to the User

- Non-incremental, automatic pressure control
- Simple setting of the control pressures
- High control accuracy
- Corrosion protected stainless steel design
- Easy to disassemble for cleaning and maintenance
- Trouble-free operation in ex. areas
- Built-in isolation valves for the process connection and the vacuum pump (MR 16)

### Typical Applications

- Distillation processes of all kinds
- Solvent recovery
- Drying processes
- Temperature control on bath cryostats
- Degassing of liquids and plastics



Dimensional drawing for the diaphragm regulator MR 16 (left) and MR 50 (right)

<b>Technical Data</b>		<b>Diaphragm Pressure Regulator</b>	
		<b>MR 16</b>	<b>MR 50</b>
<b>Control range</b>	<b>mbar (Torr)</b>	10 to 1000 (7.5 to 750)	10 to 1000 (7.5 to 750)
<b>Control inaccuracy</b>		± 2 % of the pressure control (10 - 90 % of flow)	± 2 % of the pressure control (10 - 90 % of flow)
<b>Throughput</b>	<b>m<sup>3</sup>/h</b>	16	50
<b>Nominal temperature range</b>	<b>°C</b>	+5 to +100	+5 to +100
<b>Storage temperature range</b>	<b>°C</b>	-25 to +60	-25 to +60
<b>Temperature coefficient</b>	<b>%/K</b>	0.3	0.3
<b>Settling time</b>	<b>ms</b>	5	5
<b>Permissible overload for brief periods</b>	<b>bar</b>	3	3
<b>Diaphragm material</b>		FPM/EPDM	FPM/EPDM
<b>Housing material</b>		stainless steel 1.4571	stainless steel 1.4571
<b>Installation orientation</b>		Any	Any
<b>Dimensions</b>		see dimensional drawing	see dimensional drawing
<b>Vacuum connection</b>	<b>2x DN</b>	16 KF	40 KF
<b>Measurement connection</b>	<b>3x thread R</b>	1/8"	1/8"
<b>Weight, approx.</b>	<b>kg (lbs)</b>	2.7 (6.0)	8.0 (17.6)
<b>Ordering Information</b>		<b>Diaphragm Pressure Regulator</b>	
		<b>MR 16</b>	<b>MR 50</b>
<b>Diaphragm pressure regulator</b> MR 16, DN 16 KF MR 50, DN 40 KF		<b>Part No. 160 25</b> -	- <b>Part No. 160 27</b>
<b>(Operating Instructions)</b>		<b>(GA 09.605)</b>	<b>(GA 09.606)</b>
<b>Options</b> Stainless steel measurement flange, DN 16 KF, for connection to a reference and/or process chamber or pumping stud KALREZ diaphragm		Part No. 160 26 -	Part No. 160 26 Part No. 200 28 597
<b>Spare parts</b> EPDM diaphragm and seal kit Viton diaphragm and seal kit Seal kit MR 50, incl. EPDM and Viton diaphragms Adjustment screw for the adjustable valve, complete with seal		Part No. 160 29 Part No. 160 31  - -	- -  Part No. 160 32  Part No. 240 001

## Leybold Calibration Service



Calibration of vacuum gauges in the pressure range from  $10^{-9}$  to 1000 mbar ( $10^{-9}$  to 750 Torr) as DKD or factory calibration.

### Advantages to the User

- Clear reference to the reference quantities
- Reproducible measurements
- Constantly high quality over time
- Reliable checking of existing gauges
- Unambiguous description of the process
- If an unambiguous reference is required for a large number of pressure gauges
- If an unambiguous description for processes is required
- If for experiments and processes unambiguous traceability of the measured pressures to basic quantities is demanded by the authorities

Since 1981 Leybold has been offering to all customers an impartial calibration service for gauges and sensors of any make. A DKD calibration certificate or a factory calibration certificate is issued for every calibration. Instruments with insufficient long-term stability or such instruments where the principle of measurement is not suited for calibration, can not be calibrated.

### Typical Applications

Calibrated vacuum gauges are used under the following conditions:

- If the requirements concerning reproducibility and comparability of experiment runs are high
- If testing to DIN/ISO 9000 is required in the following areas
  - Research
  - Thin-film engineering
  - Manufacture of systems
  - Military
  - Energy
  - Chemistry production
  - Production of pharmaceuticals and herbicides
  - Sputtering systems
  - Aircraft and space industry
  - Manufacture of lamp

### DKD / Factory Calibration

It is the task of the German Calibration Service (DKD) to ensure traceability of industrial measurements and testing to national standards.

The German Calibration Service is supported jointly by the Federal Institution for Physics and Technology (PTB), the industry, the Federal Minister for Economics and the Western European Metrology Club (WEMC).

The transfer standards in the DKD calibration facility used by Leybold are checked regularly (recalibrated) by the PTB.

Within the framework of the German Calibration Service, the calibration system at Leybold has been checked and approved by the PTB and the applied transfer standards have been calibrated by the PTB.

Factory calibrations were performed with standards which have not been calibrated directly at the PTB; instead the transfer standards of the in-house DKD calibration service are used. Thus traceability to national standards is ensured in both cases.

Technical Data	DKD Calibration		
Calibration range <b>mbar</b>	to 10 <sup>-3</sup>	to 10 <sup>-5</sup>	to 10 <sup>-9</sup>
Ordering Information	DKD Calibration		
DKD calibration	Part No. 157 12	Part No. 157 13	Part No. 157 14

Technical Data	Factory Calibration		
Calibration range <b>mbar</b>	to 10 <sup>-3</sup>	to 10 <sup>-5</sup>	to 10 <sup>-8</sup>
Ordering Information	Factory Calibration		
Factory calibration	Part No. 154 22	Part No. 154 23	Part No. 154 24

Calibration Systems are described in the Product Section C10.

# Sales and Service Net Worldwide

## Germany

**Leybold Vacuum GmbH**  
Bonner Strasse 498  
D-50968 Cologne  
Phone: +49-221-347 1234  
Fax: +49-221-347 1245  
sales@leybold.com

**Leybold Vacuum GmbH**  
**Sales Area North/East**  
Branch office Berlin  
Buschkrugallee 33  
1. Obergeschoss  
D-12359 Berlin  
Phone: +49-30-435 609 0  
Fax: +49-30-435 609 10  
sales.berlin@leybold.com

**Leybold Vacuum GmbH**  
**Sales Area South/Southwest**  
Branch office Munich  
Karl-Hammerschmidt-Strasse 38  
D-85609 Aschheim/Dornach  
Phone: +49-89-357 33 90  
Fax: +49-89-357 33 933  
sales.muenchen@leybold.com  
service.muenchen@leybold.com

**Leybold Vacuum GmbH**  
**Sales Area West**  
Branch office Cologne  
Emil-Hoffmann-Straße 43  
D-50996 Cologne-Suerth  
Phone: +49-221-347 1270  
Fax: +49-221-347 1291  
sales.koeln@leybold.com

**Leybold Vacuum GmbH**  
**Service Center**  
Emil-Hoffmann-Straße 43  
D-50996 Cologne-Suerth  
Phone: +49-221-347 1439  
Fax: +49-221-347 1945  
service@leybold.com

**Leybold Vacuum GmbH**  
**Mobile after sales service**  
Emil-Hoffmann-Straße 43  
D-50996 Cologne-Suerth  
Phone: +49-221-347 1765  
Fax: +49-221-347 1944  
kundendienst@leybold.com

**Leybold Vacuum**  
**Dresden GmbH**  
Zur Wetterwarte 50, Haus 304  
D-01109 Dresden  
Service:  
Phone: +49-351-88 55 00  
Fax: +49-351-88 55 041  
info@leybold-dresden.de  
www.leybold-dresden.de

## Europe

Belgium  
**Leybold Vacuum Nederland B.V.**  
**Belgisch bijkantoor**  
Leuvensesteenweg 542-9A  
B-1930 Zaventem  
Sales:  
Phone: +32-2-711 00 83  
Fax: +32-2-720 83 38  
sales.belgium@leybold.com  
Service:  
Phone: +32-2-711 00 82  
Fax: +32-2-720 83 38  
service.belgium@leybold.com

France  
**Leybold Vacuum France S.A.**  
7, Avenue du Québec  
Z.A. de Courtaboef, B.P. 42  
F-91942 Courtaboef Cedex  
Sales and Service:  
Phone: +33-1-69 82 48 00  
Fax: +33-1-69 07 57 38  
sales.france@leybold.com

**Leybold Vacuum France S.A.**  
**Valence Factory**  
640, Rue A. Bergès - B.P. 107  
F-26501 Bourg-lès-Valence Cedex  
Phone: +33-4-75 82 33 00  
Fax: +33-4-75 82 92 69  
marketing.valence@leybold.fr

Great Britain  
**Leybold Vacuum UK Ltd.**  
Waterside Way, Plough Lane  
GB-London SW17 0HB  
Sales:  
Phone: +44-20-8971 7000  
Fax: +44-20-8971 7001  
sales@leybold.com  
Service:  
Phone: +44-20-8971 7030  
Fax: +44-20-8971 7003  
service@leybold.com

Italy  
**Leybold Vacuum Italia S.p.A.**  
8, Via Trasimeno  
I-20128 Milano  
Sales:  
Phone: +39-02-27 22 31  
Fax: +39-02-27 20 96 41  
sales@leybold.it  
Service:  
Phone: +39-02-27 22 31  
Fax: +39-02-27 20 96 41  
service@leybold.it  
Field Service Base  
Z.I. Le Capanne  
I-05021 Acquasparta (TR)  
Phone: +39-0744-93 03 93  
Fax: +39-0744-94 42 87  
service@leybold.it

Netherlands  
**Leybold Vacuum Nederland B.V.**  
Computerweg 7  
NL-3542 DP Utrecht  
Sales and Service:  
Phone: +31-346-58 39 99  
Fax: +31-346-58 39 90  
sales.netherlands@leybold.com  
service.netherlands@leybold.com

Spain  
**Leybold Vacuum España S.A.**  
C/ Huelva, 7  
E-08940 Cornellà de Llobregat  
(Barcelona)  
Sales:  
Phone: +34-93-666 46 16  
Fax: +34-93-666 43 70  
sales.spain@leybold.com  
Service:  
Phone: +34-93-666 49 51  
Fax: +34-93-685 40 10

Sweden  
**Leybold Vacuum Scandinavia AB**  
Box 9084  
SE-40092 Göteborg  
Sales and Service:  
Phone: +46-31-68 84 70  
Fax: +46-31-68 39 39  
info@leybold.se  
Visiting/delivery address:  
Datavägen 57B  
SE-43632 Askim

Switzerland  
**Leybold Vacuum Schweiz AG**  
Leutschenbachstrasse 55  
CH-8050 Zürich  
Sales:  
Phone: +41-1-308 40 50  
Fax: +41-1-302 43 73  
sales@leybold.ch  
Service:  
Phone: +41-1-308 40 62  
Fax: +41-1-308 40 60

## America

USA  
**Leybold Vacuum USA Inc.**  
5700 Mellon Road  
Export, PA 15632  
info@leyboldvacuum.com  
Sales:  
Eastern & Central time zones  
Phone: +1-724-327-5700  
Fax: +1-724-733-1217  
Pacific, Mountain,  
Alaskan & Hawaiian time zones  
Phone: +1-480-752-9191  
Fax: +1-480-752-9494  
Service:  
Phone: +1-724-327-5700  
Fax: +1-724-733-3799

## Asia

P.R. China  
**Leybold Vacuum (Tianjin)**  
**International Trade Co., Ltd.**  
Beichen Economic  
Development Area (BEDA),  
No. 8 Western Shuangchen Road  
Tianjin 300400, China  
Sales and Service:  
Phone: +86-22-2697 0808  
Fax: +86-22-2697 4061  
leybold@leybold.com.cn

**Leybold Vacuum (Tianjin)**  
**Equipment Manufacturing Co., Ltd.**  
Beichen Economic  
Development Area (BEDA),  
No. 8 Western Shuangchen Road  
Tianjin 300400, China  
Phone: +86-22-2697 0808  
Fax: +86-22-2697 4061  
leybold@leybold.com.cn

**Leybold Vacuum (Tianjin)**  
**International Trade Co., Ltd.**  
Beijing Branch:  
1-908, Beijing Landmark Towers  
8 North Dongsanhuan Road  
Chaoyang District  
Beijing 100004, China  
Sales and Service:  
Phone: +86-10-6590-7607  
Fax: +86-10-6590-7622

**Leybold Vacuum (Tianjin)**  
**International Trade Co., Ltd.**  
Shanghai Branch:  
Add: No. 33, 76 Futedong San  
Rd., Waigaoqiao FTZ,  
Shanghai 200131, China  
Sales and Service:  
Phone: +86-21-5064-4666  
Fax: +86-21-5064-4668  
leybold\_sh@leybold.com.cn

**Leybold Vacuum (Tianjin)**  
Guangzhou Branch:  
Add: G/F, #301 Building,  
110 Dongguangzhuang Rd.  
Tianhe District,  
Guangzhou 510610, China  
Sales:  
Phone: +86-20-8723-7873  
Phone: +86-20-8723-7597  
Fax: +86-20-8723-7875  
leybold\_gz@leybold.com.cn

India  
**Leybold Vacuum India Pvt Ltd.**  
A-215 Road No. 30  
MIDC Wagle Industrial Estate  
Thane(W) - 400 604 Maharashtra  
India  
Sales and Service:  
Phone: +91-22-2581 2929  
Fax: +91-22-2581 2626  
ivt2004@yahoo.com

Japan  
**Leybold Vacuum**  
**Japan Co., Ltd.**  
Head Office  
Tobu A.K. Bldg. 4th Floor  
23-3, Shin-Yokohama  
3-chome  
Kohoku-ku, Yokohama-shi  
Kanagawa-ken 222-0033  
Sales:  
Phone: +81-45-4713330  
Fax: +81-45-4713323

**Leybold Vacuum**  
**Japan Co., Ltd.**  
Osaka Branch Office  
MURATA Bldg. 7F  
2-7-53, Nihl-Miyahara  
Yodogawa-ku  
Osaka-shi 532-0004  
Sales:  
Phone: +81-6-6393-5211  
Fax: +81-6-6393-5215

**Leybold Vacuum**  
**Japan Co., Ltd.**  
Tsukuba Technical S.C.  
Tsukuba Minami Daiichi  
Kogyo Danchi  
21, Kasumi-no-Sato,  
Ami-machi, Inashiki-gun  
Ibaraki-ken, 300-0315  
Service:  
Phone: +81-298-89-2841  
Fax: +81-298-89-2838

Korea  
**Leybold Vacuum Korea Ltd.**  
#761-4, Yulkeum-ri,  
SungHwan-eup, Cheonan-City  
Choongchung-Namdo,  
330-807, Korea  
Sales:  
Phone: +82-41-580-4420  
Fax: +82-41-588-3737  
Service:  
Phone: +82-41-580-4415  
Fax: +82-41-588-3737

Singapore  
**Leybold Vacuum**  
**Singapore Pte Ltd.**  
No.1, International  
Business Park,  
B1-20B, The Synergy  
Singapore 609917  
Sales and Service:  
Phone: +65-66652910  
Fax: +65-65668202  
vacuum@leyboldvac.com.sg

Taiwan  
**Leybold Vacuum Taiwan Ltd.**  
No 416-1, Sec. 3  
Chung-Hsin Rd., Chu-Tung  
Hsin-Chu, Taiwan, R.O.C.  
Sales and Service:  
Phone: +886-3-5833988  
Fax: +886-3-5833999

## Hotline

**Sales: +49-221-347 1234**

**Service: +49-221-347 1765**

sales@leybold.com  
service@leybold.com

**Leybold Vacuum GmbH**  
Bonner Strasse 498  
D-50968 Cologne  
Phone: +49-221 347-0  
Fax: +49-221-347-1250  
info@leybold.com

**Leybold**  
vacuum

www.leybold.com