

# PENNINGVAC Transmitter

PTR 225 N, PTR 225 N S and PTR 237 N

Operating Manual 300544659\_002\_C1

## Part Numbers:

15734V02  
89642V02  
230703V02  
15736V02

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# 0 Safety Information

## 0.1 Symbols used


The first two symbols identify other information in this manual that is essential or useful in achieving optimal performance from the transmitter. The last symbol below is used throughout this manual to further define the safety concerns associated with the product.

 **Critical**  
Failure to read message could result in damage to the equipment.

 **Attention**  
Calls attention to important procedures, practices, or conditions.

 **Caution**  
Refer to manual. Failure to read message could result in personal injury or serious damage to the equipment or both.

## 0.2 Personnel Qualifications



 **Skilled personnel**  
All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the end-user of the product.



## 0.3 General safety information

The safety instructions should always be followed during installation and operation of the transmitter. Pass safety information to all users.

- Adhere to the applicable regulations and take the necessary precautions for the process media used. Consider possible reactions between the materials and the process media. Consider possible reactions (e.g. explosion) of the process media due to the heat generated by the product.
- Adhere to the applicable regulations and take the necessary precautions for all work you are going to do and consider the safety instructions in this document.
- Before beginning to work, find out whether any vacuum components are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

### Safety Precautions:

  **Critical**  
**Service and Repair.** Do not substitute parts or modify instrument other than described in chapter 9. Do not install substituted parts or perform any unauthorized modification to the instrument. Return the instrument to an Leybold Calibration and Service Center for service and repair to ensure all of the safety features are maintained.

  **Critical**  
**Explosive Environments.** Do not use the transmitter in presence of flammable gases or other explosive environments.  
**Corrosive Environments.** The transmitter is not intended for use in corrosive environments. Refer to Transmitter installation chapter 3 of this manual. If you need further support please contact LEYBOLD.



**STOP Critical**

**Danger: Magnetic fields**

Strong magnetic fields can disturb electronic devices like heart pacemakers or impair their function.



Maintain a safety distance of  $\geq 10$  cm between the magnet and the heart pacemaker or prevent the influence of strong magnetic fields by antimagnetic shielding.

**STOP Critical**



**DANGER: Overpressure in the vacuum system 2.5 bar < p < 5 bar**

KF flange connections with elastomer seals (e.g. O-rings) cannot withstand such pressures.

Process media can thus leak and possibly damage your health. Use O-ring with an outer centering ring + 3-part clamping ring (clamping collar).

**STOP Critical**



**DANGER: contaminated parts**

Contaminated parts can be detrimental to health and environment. Before beginning to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

**Attention**



**Caution: vacuum component**

Dirt and damages impair the function of the vacuum component. When handling vacuum components, take appropriate measures to ensure cleanliness and prevent damages.

**Attention**



**CE marking** The transmitter complies with European standards for CE marking. Refer to chapter 11 of this manual.

**Caution**



**Fuse.** The transmitter power supply input has an internal thermal fuse. The fuse is self-recoverable and should not be changed.

**Caution**



**Electrical connections.** The transmitter must be properly electrically connected in order to perform according to the specifications. Output pins are not protected against wrong electrical connections. Wrong electrical connections can cause permanent damage to the transmitter or interference to measuring performance. Refer to electrical connections description in chapter 4 of this manual.

**Caution**



**Caution: dirt sensitive area**

Touching the product or parts thereof with one's bare hands increases the desorption rate. Always wear clean, lint-free gloves and use clean tools when working in this area.

## **0.4 Liability and Warranty**

Leybold assumes no liability and the warranty becomes null and void if the end-user or third parties

- disregard the information in this document
- use the product in a non-conforming manner
- make any kind of interventions (modifications, alterations etc.) on the product
- use the product with accessories not listed in the product documentation

The end-user assumes the responsibility in conjunction with the process media used. Transmitter failures due to contamination are not covered by the warranty.

# 1 Unpacking

Before unpacking your transmitter, check all surfaces of the packing material for shipping damage. Inspect for visible damage. If found, notify the carrier immediately.

Please be sure that your transmitter package contains these items:

- 1 pcs. PTR 225 N, PTR 225 N S or PTR 237 N Transmitter
- 1 pcs. English short form manual (P/N: 300544673\_002)
- 1 pcs. English short form manual (P/N: 300544673\_001)
- 1 pcs. Product Inspection and Test Report
- 1 pcs. Pin for adjusting settings via button

If any items are missing, please contact Leybold.

## 2 Description

The PTR 225 N and PTR 237 N PENNINGVAC series vacuum transmitters offer a wide measuring range from  $1 \times 10^{-8}$  to  $5 \times 10^{-3}$  mbar and are based on measurement of cold cathode ionization current.

Transmitter versions with an RS232 digital communication interface (P/N: 89642V02) and EtherCAT digital communication interface (P/N: 230703V02) can set up transmitter parameters and provide real time pressure measurement. Please see the Communication Protocol 300544663 (RS232) and 300544664 (EtherCAT) for further details. (P/N: 230703V02)

The transmitters can be used in a variety of applications as standalone unit or with Graphix controllers (P/N: 230680V01, 230681V01, 230682V01) and the Display controllers (P/N: 230001, 230024, 230025). All PENNINGVAC transmitters are backward compatible with Graphix, Display and Center controllers.

Each transmitter is individually tested throughout the measuring range before leaving the factory. A test report is included in the package. In addition, each transmitter pressure reading is individually temperature-compensated within the specified operating temperature range.

The transmitters have up to three mechanical relays which can be used for process control, for example interlocking valves or pumps. The analog voltage output can be interfaced to external analog equipment for pressure readout or control.

### Sensor technology

The cold cathode inverted magnetron utilizes a high voltage anode, cathode and a permanent magnet. Electrons are accelerated towards the anode and will ionize molecules by collision. The magnetic field deflects the electrons, causing them to spiral as they move across the magnetic field to the anode. This spiraling movement increases the opportunity for them to encounter and ionize the molecules.

The ionization of the molecules creates an electric current as a function of the pressure.

### Applications

The transmitters can be used in many different vacuum applications within the industrial application, research and development, semiconductor, analytical and coating industries:

- General vacuum pressure measurement
- Coating
- Mass spectrometer control
- System process control
- Sense abnormal pressure and take appropriate security measures using set point relays
- Control system base pressure

### Disposal

The PTR 225 N and 237 N transmitters are manufactured according to the RoHS directive.



#### Attention

For the benefit of the environment, at the end of life of the transmitter, it should not be disposed in the normal unsorted waste stream. It should be deposited at an appropriate collection point or facility to enable recovery or recycling.

## 2.1 Technical Data

Measurement principle:	Cold cathode ionization current	
Measurement range (N <sub>2</sub> and Air):	1×10 <sup>-8</sup> to 5×10 <sup>-3</sup> mbar	
Accuracy <sup>(1)</sup> (N <sub>2</sub> ):	1×10 <sup>-8</sup> to 1×10 <sup>-3</sup> mbar:	±30% of reading
Repeatability <sup>(1)</sup> (N <sub>2</sub> ):	1×10 <sup>-8</sup> to 1×10 <sup>-3</sup> mbar:	±30% of reading
Supply Voltage:	9 – 30 VDC	
Power consumption:	< 2 Watt	
Fuse (thermal recoverable):	200 mA	
Analog output:	2-9.6 VDC, Log. 1.33 VDC/decade	
Analog output 1 resolution:	16 bit	
Analog output impedance:	100 Ω	
Analog output update rate:	16 Hz	
Voltage output if CC not ignited:	0.4 VDC	
Mechanical Setpoint relay(s):		
P/N: 15734V02, 15736V02:	0	
P/N: 89642V02:	3	
Setpoint relay range:	1×10 <sup>-8</sup> to 5×10 <sup>-3</sup> mbar	
Setpoint relay contact rating:	1A / 30 VDC/AC (resistive load)	
Setpoint relay contact resistance:	100 mΩ (max)	
Setpoint relay response time:	<100 ms	
Setpoint relay contact endurance:	100,000 cycles (min) (30 VDC/1 A load)	
Setpoint relay contact endurance:	2,000,000 cycles (min) (30 VDC/0.2 A load)	
Software setpoint relays:		
P/N: 230703V02:	2	
Setpoint relay response time:	< 20 ms	
Materials exposed to vacuum <sup>(2)</sup> :	304 stainless steel, sealing material FPM	
Internal volume: KF25	28.6 cm <sup>3</sup>	
CF40	32.7 cm <sup>3</sup>	
Housing material:	Stainless steel 304	
Flange material:	Stainless steel 304	
Weight:		
P/N: 15734V02, 89642V02:	321 g	
P/N: 230703V02:	600 g	
P/N: 230281V02:	318 g	
Max. allowed pressure:	6 bar	
Operating temperature:	0 to 40 °C (32 to 104 °F)	
Bake out temperature (Power off):	85 °C (185 °F)	
Filament temperature:	35 °C above ambient	
Ingress Protection Rating:	IP40	
Leak rate	< 5·10 <sup>-9</sup> mbar·l/s	

(1) Accuracy and repeatability are typical values measured in Nitrogen atmosphere after zero adjustment at ambient temperature.

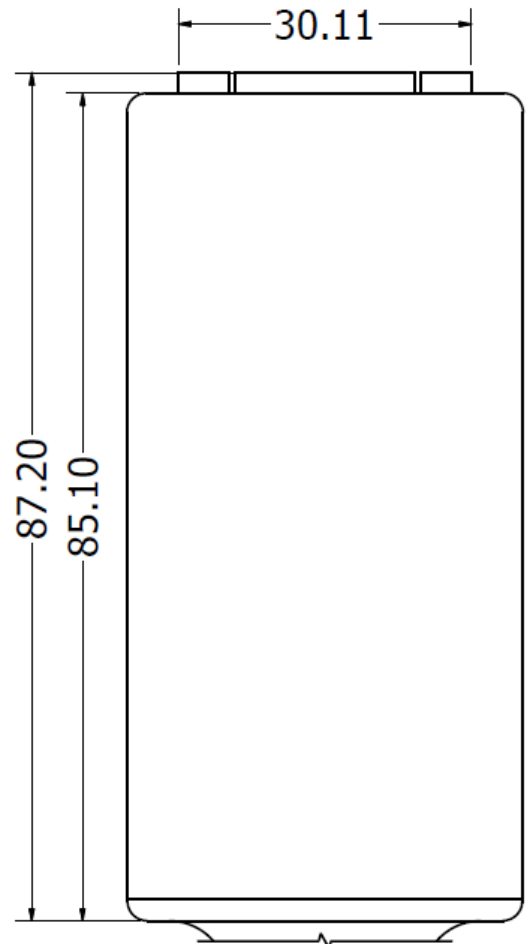
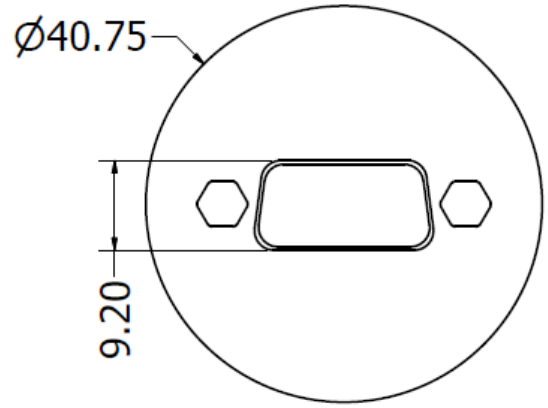
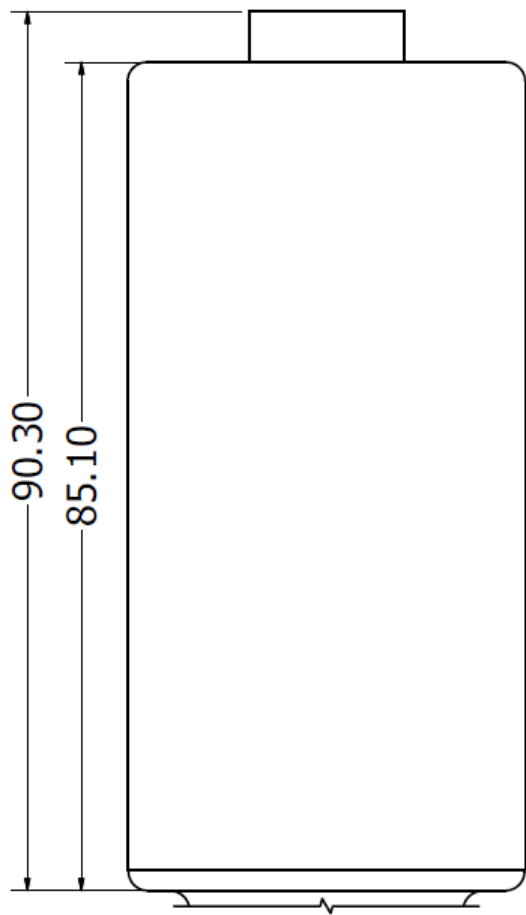
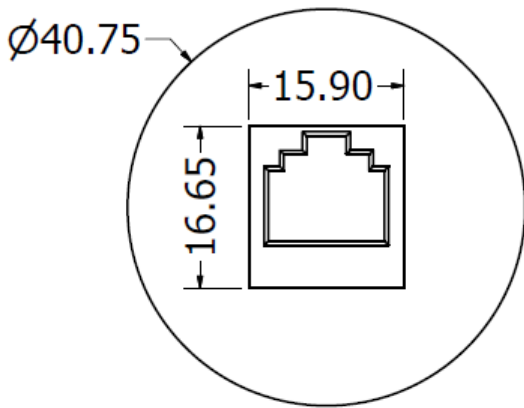
(2) For the full list of all materials exposed to process gases please contact LEYBOLD.

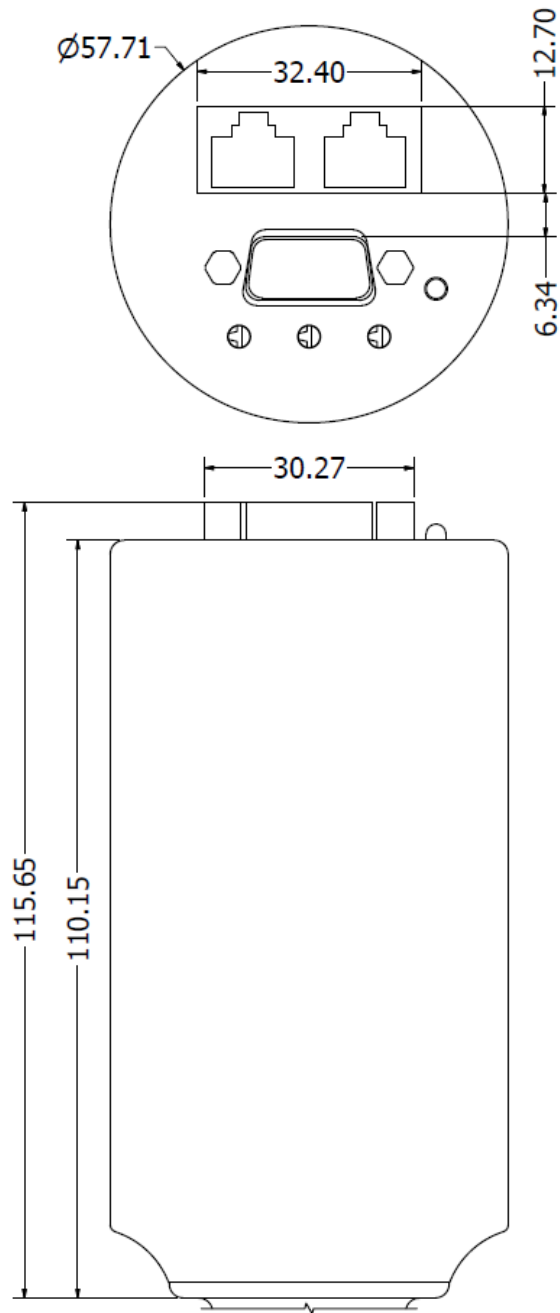
## 2.2 Dimensions

[mm]

P/N: 15734V02

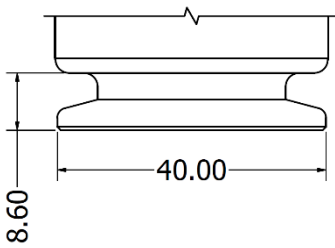
P/N: 89642V02



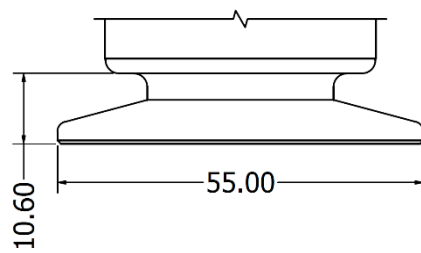


Flanges

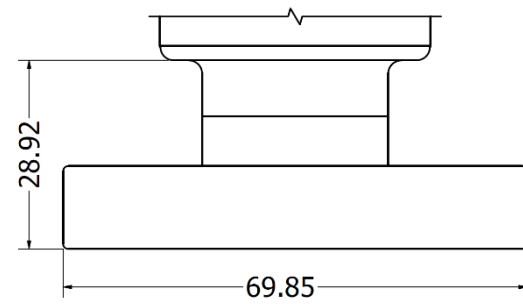
KF 25



KF 40

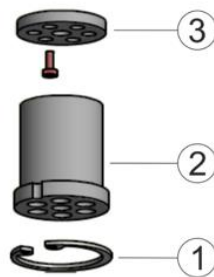


CF 40



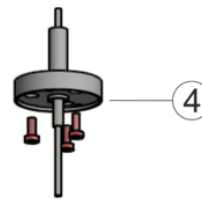
## 2.3 Accessories and replacement part numbers

<b>Part</b>	<b>Part no.</b>
PTR 225 N, DN 25 KF	<b>15734V02</b>
PTR 225 N, DN 25 KF, RS232, 3SP	<b>89642V02</b>
PTR 225 N , EtherCat, DN 25 KF	<b>230703V02</b>
PTR 237 N, DN 40 CF	<b>15736V02</b>
Replacement cathode plates PTR 90 N / PTR 225 N	<b>EK16291V02</b>
Replacement anode ring PTR 90 N / PTR 225 N	<b>20028711V02</b>
Display One	<b>230001</b>
Display Two	<b>230024</b>
Display Three	<b>230025</b>
Graphix One	<b>230680V01</b>
Graphix TWO	<b>230681V01</b>
Graphix Three	<b>230682V01</b>
Cables Type A 5 Meter	<b>12426</b>
Cables Type A 10 Meter	<b>230012</b>
Cables Type A 15 Meter	<b>12427</b>
Cables Type A 20 Meter	<b>12428</b>
Cables Type A 30 Meter	<b>12429</b>
Cables Type A 50 Meter	<b>12431</b>
Cables Type A 75 Meter	<b>12432</b>
Cables Type A 100 Meter	<b>12433</b>
Spiral tube DN 25 ISO-KF	<b>230083</b>
Centering Rings (Stainless Steel 1.4305) with O-Ring	<b>88374</b>
Centering Rings (Stainless Steel) with Sintered Metal Filter	<b>88352</b>
Clamping Rings (Aluminum)	<b>210043</b>
Baffle, with centering ring (FPM)	<b>230 078</b>



\* Part number EK16291V02 contains:

- 1) Clip ring (1)
- 2) Front cathode plate (2)
- 3) Rear cathode pate (3)
- 4) One screw



\*\* Part number 20028711V02 contains:

- 1) Anode module (4)
- 2) Three screws

### 3 Transmitter Installation (Mechanical)

#### 3.1 Conforming utilization

- The transmitter is intended for measuring pressure.
- The transmitters are intended for use in relatively clean environments.
- The transmitter can only be used by persons who have suitable technical training and the necessary experience or who have been instructed by the end-user of the product.
- Always ensure that all vacuum sealing items and surfaces are clean, without damage and free of particles.
- Use a cable with strain relief to ensure proper electrical connection and to reduce stress on the connectors.
- To comply with EN61326-1 immunity requirements, use a braided, shielded cable.

#### 3.2 Non-conforming utilization

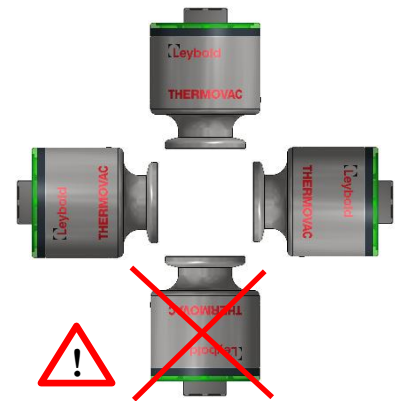
- The transmitter cannot be used for measurements other than described in this manual.
- The transmitters are not intended for use in dirty and corrosive environments
- Do not use the transmitter in presence of flammable gases or other explosive environments.
- Do not install substituted parts or perform any unauthorized modification to the instrument.
- The transmitter is not intended for use above maximum allowed pressure.

#### 3.3 Process compatibility

The PTR 225 N and PTR 237 N PENNINGVAC transmitters are intended for use in relatively clean environments. The transmitters cannot be used in corrosive environments like a semiconductor etch process chamber where aggressive gases such as fluorine are used.

If the transmitters are located close to a gas source connection like a flow controller or leak valve, the transmitter pressure measurement can be higher than the actual chamber pressure. Location close to a pumping system connection can cause a lower pressure measurement than actual chamber pressure.

The transmitters and their sensor design can be mounted in any orientation without compromising accuracy. However it is not recommended to mount the transmitters upside down, as dust and dirt might fall into the sensor.



**Not recommended**

	<b>Caution</b>
	<b>Do not use or install the transmitter where the following conditions occur:</b> <ul style="list-style-type: none"><li>- Temperatures lower than 0 °C or higher than 40 °C</li><li>- Corrosive or explosive gases</li><li>- Direct sunlight or other heat sources</li></ul>

#### Explosive Environments

The PTR 225 N and PTR 237 N PENNINGVAC transmitters should not be used in explosive environments, due to their high voltage potential that can cause ignition.

#### Bake out

The transmitter electronics can withstand maximum 85 °C (185 °F) when the power is turned off.

### Contamination

Locate and orient the PTR 225 N and PTR 237 N PENNINGVAC where contamination is least likely.

### 3.4 Vacuum connections

The transmitters are available with different types of vacuum fittings. When mounting the transmitters, always ensure that all vacuum sealing items and surfaces are clean, without damage and free of particles. Do not touch the vacuum flange sealing surface.



#### Caution

If the transmitter will be exposed to pressures above atmospheric pressure make sure that proper vacuum fittings are used. Ensure that the internal system pressure is at ambient pressure conditions before opening the vacuum system and removing any connections.

### Pressure range

The standard PTR 225 N and PTR 237 N PENNINGVAC transmitters are internally sealed with elastomer FPM sealing for use down to  $1 \times 10^{-8}$  mbar. If used in UHV applications the out gassing rate of FPM can be too high.

## 4 Transmitter Installation (Electrical)

The PTR 225 N and PTR 237 N PENNINGVAC are available with different input/output connectors. Use a cable with strain relief to ensure proper electrical connection and to reduce stress on the connectors.



### Attention



Ensure a low impedance electrical connection between the transmitter body and the grounded vacuum system to shield the sensor from external electromagnetic sources.  
Ensure that the analog output is connected to floating input.

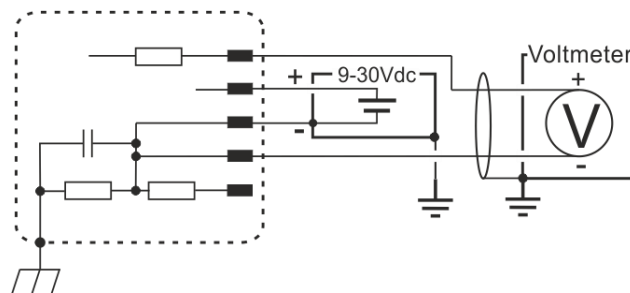
To comply with EN61326-1 immunity requirements, use a braided shielded cable. Connect the braid to the metal hoods at both ends of the cable with the end for power supply connected to earth ground.

Ground loops, differences of potential, or EMC problems may affect the measurement signal. For optimum signal quality, please do observe the following notes:

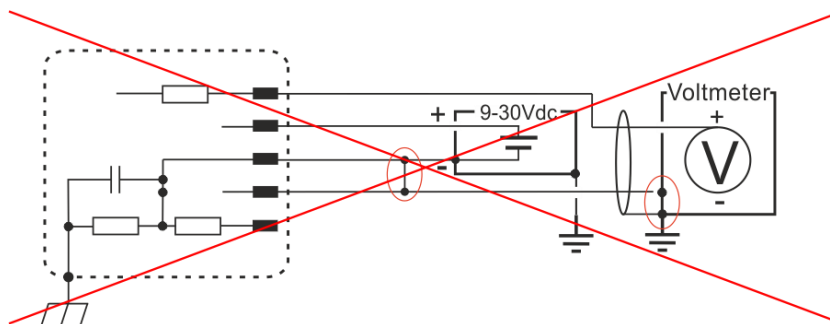
- Use an overall metal braided shielded cable. The connector must have a metal case.
- Connect the cable shield to ground at one side via the connector case. Make sure the connector case has direct contact to the cable's shield on its whole circumference. Do not connect the other side of the shield.
- Connect the supply common with protective ground directly at the power.
- Use differential measurement input (signal common and supply common conducted separately).
- Potential difference between supply common and housing  $\leq 18$  V (overvoltage protection).

The power supply input is 9 to 30 VDC. The power supply input is protected by an internal thermal fuse. The fuse is self-recoverable; do not replace it. Damage may occur to the circuitry if excessive voltage is applied, polarity reversed or if a wrong connection is made.

If using the analog voltage output, connect the positive analog out and negative analog out pins to a differential input voltmeter or an analog-to-digital (A/D) converter. Do not connect the negative side of the analog output to the negative side of the power supply input or to any other ground. Doing so will cause half of the power current to flow through this wire. Measurement errors in the output voltage may be seen due to the voltage drop from this current. The longer the cable, the worse the error will be. Do not connect the setpoint relay terminals to the analog output.



Correct connection of analog output to floating input



Incorrect connection of analog output to non-floating input

## 4.2 Switching on the High Voltage

Refer to chapter 4.3 for pin-out diagrams.

### **P/N: 15734V02, 15736V02, 230281V02:**

The high voltage may be switched on either through Pin 7 using negative logic or Pin 8 using positive logic. In each case Pin 2 must be used as the reference potential.

Pin 7 switches the high voltage on when:

- contact is established with Pin 2 or
- a voltage of less than 2.5 V is present with reference to Pin 2.

Pin 7 switches the high voltage off when

- there is no contact with Pin 2 (open input) or
- a voltage greater than 4 V is present with reference to Pin 2.

Pin 8 switches the high voltage on when

- contact is established with Pin 1 (supply voltage) or
- a voltage greater than 12 V is present with reference to Pin 2.

Pin 8 switches the high voltage off when

- there is no contact with Pin 1 (open input) or
- a voltage of less than 7 V is present with reference to Pin 2.

### **P/N: 89642V02:**

The high voltage may be switched on through Pin 13. Pin 4 must be used as the reference potential.

Pin 13 switches the high voltage on when:

- contact is established with Pin 4 or
- a voltage of less than 2.5 V is present with reference to Pin 4.

Pin 13 switches the high voltage off when

- there is no contact with Pin 4 (open input) or
- a voltage greater than 4 V is present with reference to Pin 4.

Operation of the PTR 225 N or PTR 237 N in the pressure range above  $10^{-2}$  mbar will cause the accumulation of contaminations and will thus reduce service life. For this reason, the high voltage should only be switched on or off when the pressure has dropped to the  $10^{-2}$  to  $10^{-3}$  mbar range.

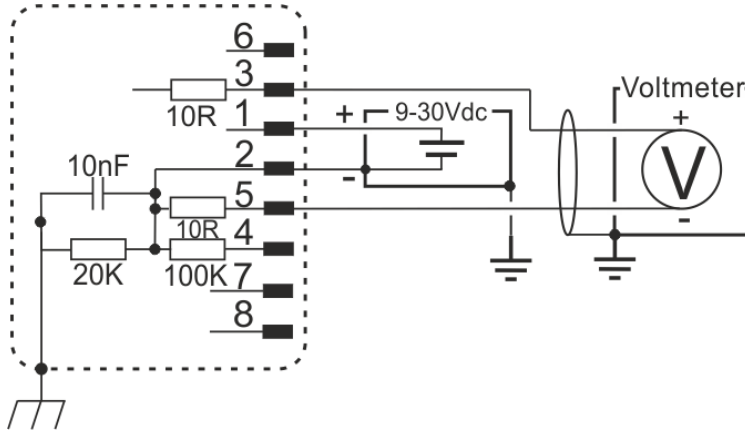
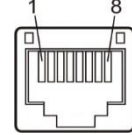
### 4.3 Input/Output Wiring

To comply with EN61326-1 immunity requirements, use a braided, shielded cable. Connect the braid to the metal hoods at both ends of the cable with the end for power supply connected to earth ground.

**Part Numbers: 15734V02, 15736V02:  
I/O Connector (8 pin RJ45/FCC68)**

PIN Description

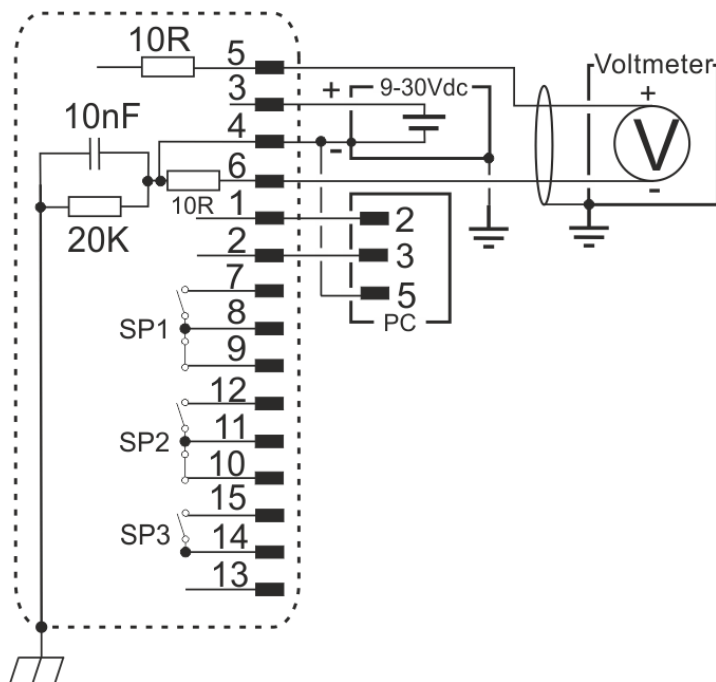
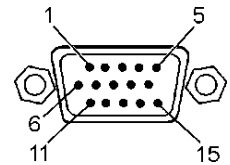
- |   |                           |   |                 |
|---|---------------------------|---|-----------------|
| 1 | Power + (9-30 VDC)        | 5 | Analog Output - |
| 2 | Power return - (GND)      | 6 | Status          |
| 3 | Analog Output +           | 7 | HV ON (Low)     |
| 4 | ID-Resistor, 100 kΩ (±1%) | 8 | HV ON (High)    |



**Part Numbers: 89642V02:  
I/O Connector (15 pin HD Sub D male )**

PIN Description

- |   |                        |    |                          |
|---|------------------------|----|--------------------------|
| 1 | RS232 Transmit         | 9  | Relay 1, Normally Closed |
| 2 | RS232 Receive          | 10 | Relay 2, Normally Closed |
| 3 | Power + (9-30 VDC)     | 11 | Relay 2, Common          |
| 4 | Power return - (GND)   | 12 | Relay 2, Normally Open   |
| 5 | Analog Output +        | 13 | HV ON (Low)              |
| 6 | Analog Output -        | 14 | Relay 3, Common          |
| 7 | Relay 1, Normally Open | 15 | Relay 3, Normally Open   |
| 8 | Relay 1, Common        |    |                          |

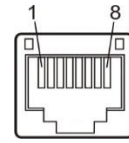


**Part Numbers: 230703V02:**

**2 x I/O Connector (8 pin RJ45/FCC68): <IN> and <OUT>**

PIN Description

1	TD+	5	Not Connected
2	TD-	6	RD-
3	RD+	7	Not Connected
4	Not Connected	8	Not Connected

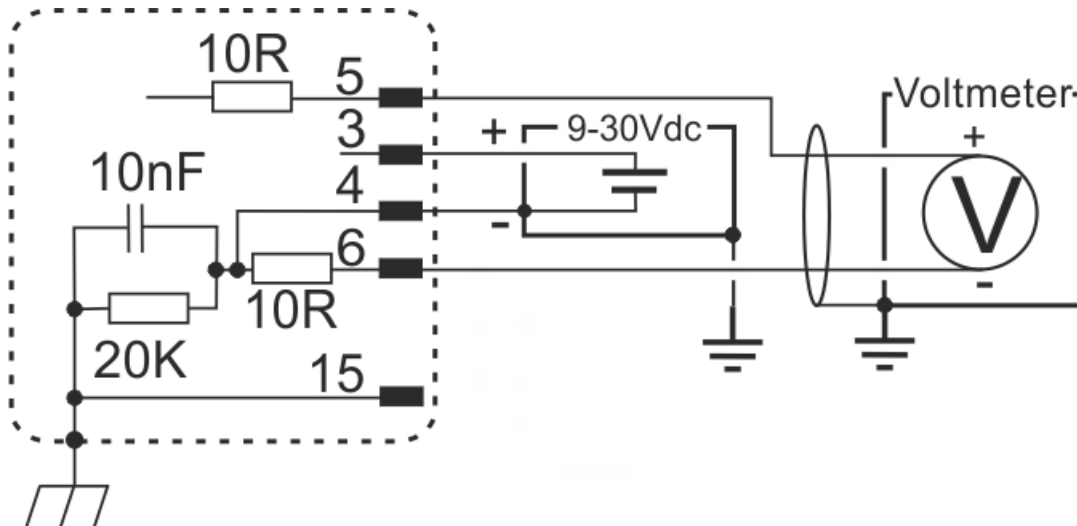
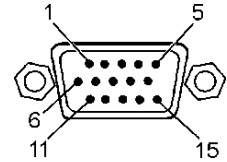


**Part Numbers: 230703V02:**

**I/O Connector (15 pin HD Sub D male )**

PIN Description

1	Not Connected	9	Not Connected
2	Not Connected	10	Not Connected
3	Power + (9-30 VDC)	11	Not Connected
4	Power return - (GND)	12	Not Connected
5	Analog Output +	13	Not Connected
6	Analog Output -	14	Not Connected
7	Not Connected	15	Chassis GND
8	Not Connected		



## 4.4 Setpoint relays

The PTR 225 N and PTR 237 N PENNINGVAC have up to 3 mechanical relays that can be used for controlling external process equipment. The relay has closing and breaking contacts and the contacts are rated 30 VDC, 1A resistive load. For the setup of the setpoints, refer to the Communication Protocol 300544663 (RS232) and 300544664 (EtherCAT) for further details.

### Inductive relay load

Special precautions should be taken when driving inductive loads with the relay contact. When an inductive load like a solenoid is energized, the in-rush current is significant higher than the regular load current. In-rush currents exceeding the relay contact rating can cause reduction of relay contact life time or contact reliability.

When a solenoid is de-energized, the collapsing magnetic field can cause significant voltage spikes. These spikes can couple capacitively from cable to cable and interfere with measuring electronics or transmitter signal.

STOP
Critical

Driving inductive loads via the setpoint relay contacts requires de-energizing spike protection. Inadequate protection can cause permanent damage to the transmitter or interfere with the analog output signal.

Always ensure that inductive in-rush currents do not exceed relay contact rating.

An arc suppression network, as shown schematically to the right, is recommended. The values of the capacitance C and the resistance R can be calculated by the following equations:

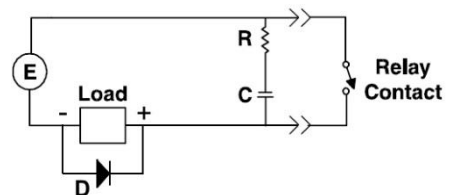
$$C = I^2 / (1 \times 10^7) \quad R = E / I^a$$

where:

C is in Farads. R is in ohms

I is DC or AC<sub>peak</sub> load current in amperes. E is DC or AC<sub>peak</sub> source voltage in volts

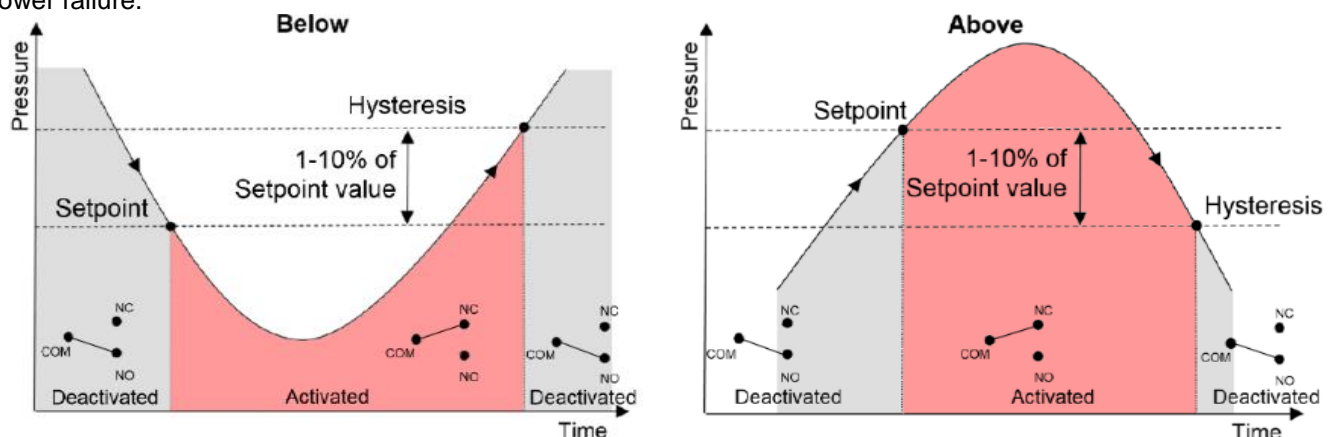
$$a = 1 + (50 / E)$$



Note that  $R_{min} = 0.5 \Omega$  and  $C_{min} = 1 \times 10^{-9} F$ , D is a fast transient suppression diode.

### Setpoint functionality

The set point relays can be activated either above or below the set point values. The graphs below show the different relays stages in either below or above configuration. The NC contact will always be closed in case of power failure.



STOP
Critical

When using the setpoint relay to control process equipment always take appropriate precautions to prevent system damage in case of transmitter power failure. The NC contact will be closed in case of transmitter power failure.

# 5 Operations

## 5.1 Pressure output

The PTR 225 N and PTR 237 N PENNINGVAC transmitters can provide pressure measurement output as an analog voltage or RS232 digital value (P/N: 89642V02) or EtherCAT digital value (P/N: 230703V02). For details about the digital interface, please refer to the Communication Protocol 300544663 (RS232) and 300544664 (EtherCAT).

In some application it is preferred not to have the Cold Cathode (high voltage) turned on during vacuum process or during mass spectrometer analyzing. The PTR 225 N and PTR 237 N PENNINGVAC Cold Cathode turn-on pressure (SLC) and turn-off pressure (SHC) can be changed by the user. Please refer to the Communication Protocol 300544663 (RS232).



### Caution



When designing external pressure control loops make sure that external equipment like pumping system is not damaged if the transmitter output enters Sensor defect mode or in case of power failure.



### Caution



When designing pressure data collecting software and controlling loop make sure that the software does not interpret a communication error as a valid pressure value.

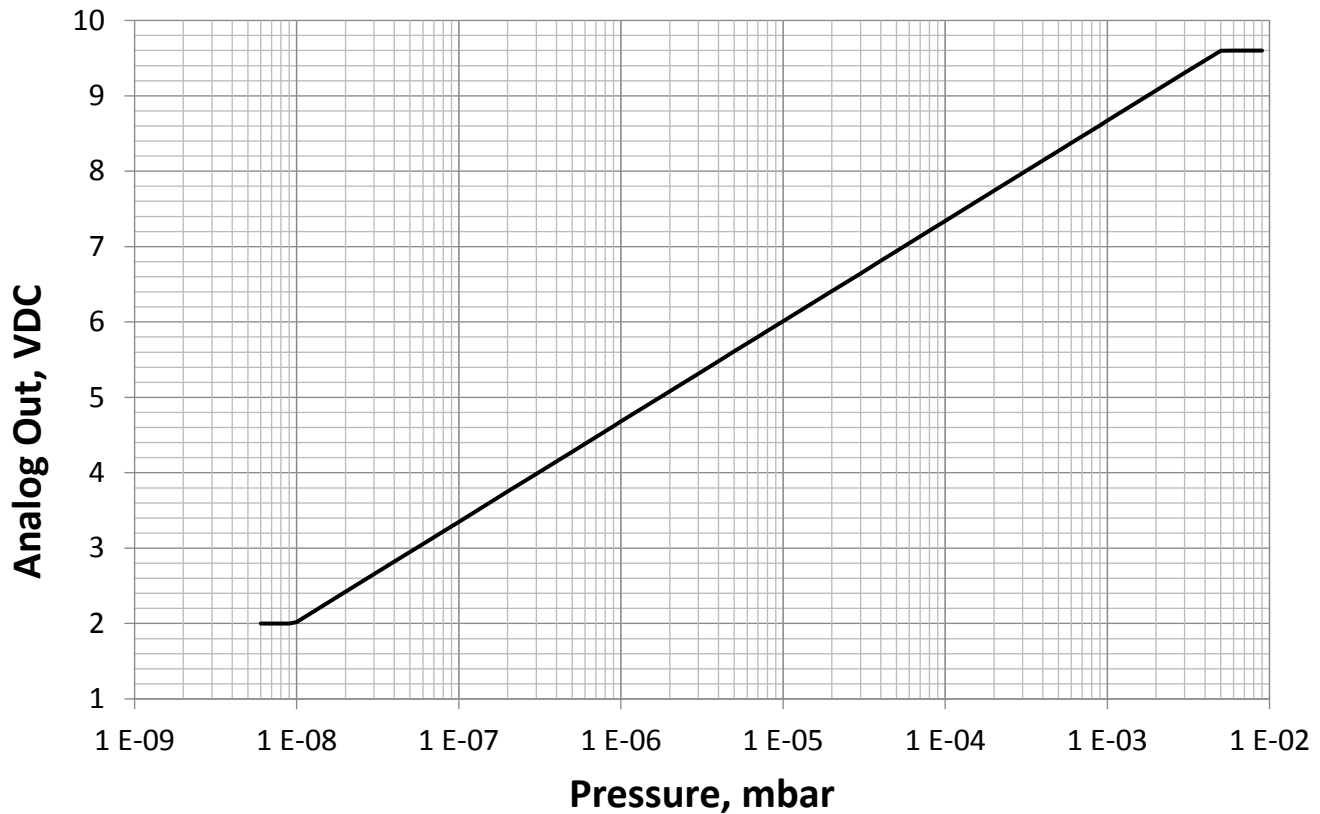
## 5.2 Analog output

The PTR 225 N and PTR 237 N PENNINGVAC transmitters provide a voltage output as function of pressure. The standard output is 1.33 VDC/decade but can also be configured to emulate other analog outputs.

### Conversion formulae:

$$P_{\text{mbar}} = 10^{((V_{\text{out}} - 12.66)/1.33)}$$

$$V_{\text{out}} = \log_{10}(P_{\text{mbar}}) \times 1.33 + 12.66$$



P [mbar]	Analog out [V]	P [mbar]	Analog out [V]	P [mbar]	Analog out [V]
1.00E-08	2.0200	3.00E-06	5.3146	4.00E-04	8.1407
2.00E-08	2.4204	4.00E-06	5.4807	5.00E-04	8.2696
3.00E-08	2.6546	5.00E-06	5.6096	6.00E-04	8.3749
4.00E-08	2.8207	6.00E-06	5.7149	7.00E-04	8.4640
5.00E-08	2.9496	7.00E-06	5.8040	8.00E-04	8.5411
6.00E-08	3.0549	8.00E-06	5.8811	9.00E-04	8.6091
7.00E-08	3.1440	9.00E-06	5.9491	1.00E-03	8.6700
8.00E-08	3.2211	1.00E-05	6.0100	2.00E-03	9.0704
9.00E-08	3.2891	2.00E-05	6.4104	3.00E-03	9.3046
1.00E-07	3.3500	3.00E-05	6.6446	4.00E-03	9.4707
2.00E-07	3.7504	4.00E-05	6.8107	5.00E-03	9.5996
3.00E-07	3.9846	5.00E-05	6.9396	6.00E-03	9.6000
4.00E-07	4.1507	6.00E-05	7.0449		
5.00E-07	4.2796	7.00E-05	7.1340		
6.00E-07	4.3849	8.00E-05	7.2111		
7.00E-07	4.4740	9.00E-05	7.2791		
8.00E-07	4.5511	1.00E-04	7.3400		
9.00E-07	4.6191	1.20E-04	7.4453		
1.00E-06	4.6800	2.00E-04	7.7404		
2.00E-06	5.0804	3.00E-04	7.9746		

## Analog output setup

The PTR 225 N and PTR 237 N PENNINGVAC can emulate analog voltage outputs from other vacuum transmitters (Only for transmitters with a serial interface). Refer to the Communication Protocol 300544663 (RS232) and 300544664 (EtherCAT) for analog output setup. The analog output provides 16 bit resolution.



### Attention

Due to curve form and limits, some of the alternative analog outputs will cause loss of measuring range and accuracy. For best performance use the standard Leybold analog output. Change of analog output setup does not interfere on digital reading.

## 5.3 Cold Cathode Ignition

When the Cold Cathode high voltage is enabled, an ignition delay may occur. The ignition waiting time is from less than a second at high pressures to minutes at low pressures. The ignition time is a function of gas density, cleanness of the gauge and presence of any other ion sources in the system.

When power is connected to the transmitter, but ionization has not started, the LED-ring will flash green. When the Cold Cathode is turned on and the ionization current is running, the LED-ring will turn to constant green.

The LED-ring will be illuminated continuously green when valid measurements are present. If the ignition has not started after 5 min, from enabling the Cold Cathode, the LED-ring will turn red.

### Pressure

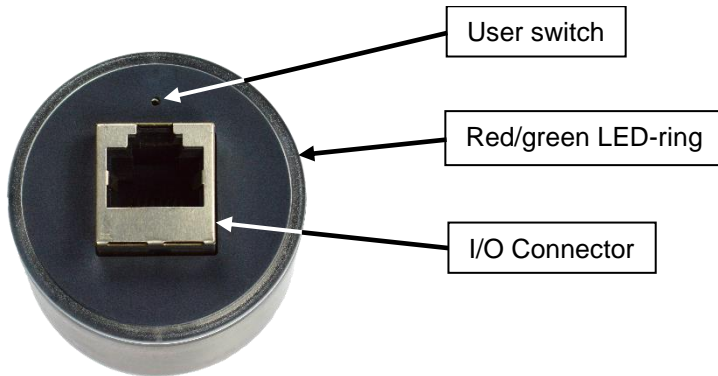
1.00E-4 mbar  
1.00E-6 mbar  
≤5.00E-7 mbar

### Typical ignition time

≈1 Second  
≈10 Seconds  
>10 Seconds

## 6 Functions

The user switch, red/green LED-ring/LED status indicator and connector can be found at the top of the transmitter.



### 6.1 LED-ring/LED status indicator

The LED-ring/LED will indicate the status of the transmitter by showing a certain color-code:

LED-ring/LED	Transmitter status
Solid green	Power on and Cold Cathode ignited
2 sec. red	Power on sequence
Flashing green	Power on but Cold Cathode not ignited
Continuously RED	Cold Cathode not ignited after 5 min.
Off	Power off
Other	Relates to configuration of Vacuum-zero/Full-scale adjustment see chapter 6.2

The LED status indicator for transmitter versions with EtherCAT digital communication interface (P/N: 230703V02) is compliant with the EtherCAT standard, described in the Communication Protocol 300544664.

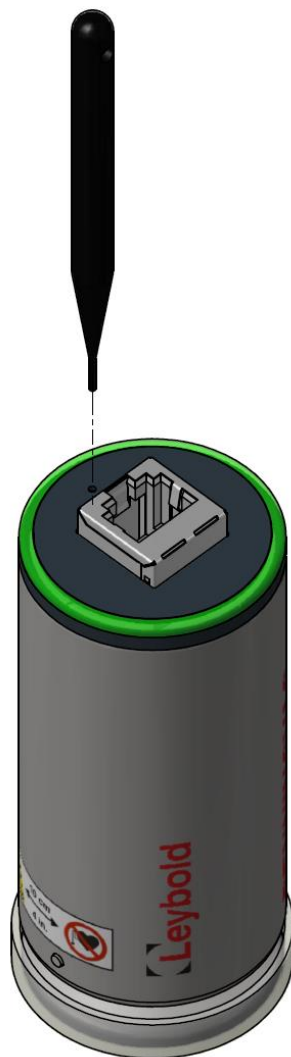
## 6.2 Vacuum-zero/full-scale adjustment and setpoint adjustment

Zero adjustment before operation is recommended to obtain best measurement performance in the lowest part of the measuring range.

Only for transmitter versions with RS232 digital communication interface (P/N: 89642V02V02) or EtherCAT digital communication interface (P/N: 230703V02) is it possible to make setpoint adjustments by using the digital communication interface. Refer to Communication Protocol 300544663 (for RS232) or Communication Protocol 300544664 (for EtherCAT) for further details.

## 6.3 User switch function

The user switch button can be pressed (as seen below) by using the adjusting-pin that is added in the transmitter package or by using another pin with similar shape ( $\varnothing$  1mm). While the user switch button is pressed, the cold cathode will be switched on. When the button is released, the cold cathode will be switched off.



## 7 FAQ (Frequently Asked Questions)

### Applications

**Q:** *Can the transmitter and sensor element continuously withstand vibrations from a mechanical fore-pump?*

**A:** Yes – the cold cathode sensor can withstand continuous vibrations.

**Q:** *Is the transmitter compatible with fluorine gases?*

**A:** No – The transmitter is not intended for use in aggressive environments, like semiconductor etch applications.

**Q:** *When the transmitter is pumped down and isolated by closing a valve the pressure is raising. Is the transmitter leaking?*

**A:** Not likely - when a confined space is evacuated and the pumping is stopped the pressure will rise because of out gassing, mainly by water vapor. The pressure can easily rise to a few mbar over time.

**Q:** *When the transmitter is leak checked on a helium leak detector, leak reading is building up slowly after approximately 30 seconds. Is the transmitter leaking?*

**A:** No - the internal sealing of the transmitter uses elastomer FPM sealing and consequently helium molecules can penetrate through the FPM material and cause slow increase of helium leak readout. If a leaking transmitter is tested directly on a helium leak detector the leak is almost instantly displayed.

**Q:** *Can the transmitter be mounted in any orientation?*

**A:** Yes - the transmitter can be mounted in any orientation without compromise of performance or calibration. However it is recommended not to mount the transmitter with the flange port facing upwards to avoid contamination like particulates or liquids from entering the device.

**Q:** *Can the transmitter withstand instant ventilation?*

**A:** Yes - the Cold cathode sensor element is extremely robust to mechanical forces and can withstand continuously pressure cycles and instant air ventilation. It's not recommended to perform instant ventilation when the Cold Cathode is turned on.

**Q:** *Can I connect a valve to be controlled by the transmitter relay contact?*

**A:** Driving inductive loads such as valves requires special precautions. Refer to chapter 4.4.

**Q:** *How many pressure cycles can the transmitter withstand?*

**A:** The Cold Cathode sensor element is very mechanical robust to pressure changes and the number of pressure cycles will have no effect on the lifetime of the transmitter. In applications where fast pressure cycles occur, the Cold Cathode sensor can be sputtered and this can lead to change of accuracy.

**Q:** *The Cold Cathode sensor chamber has changed color, Why?*

**A:** If the Cold Cathode is operated at high pressure ( $>1.00E-4$  mbar) the inside walls of the cold cathode ionization cell can be sputtered. This will change the color of the internal measuring chamber and can also result in change of measuring accuracy.

### Analog output

**Q:** *What is the update rate of the analog output?*

**A:** 16 times per second.

**Q:** *What is the maximum length of analog output cable?*

**A:** The length of analog cable depends on cable quality and electrical noise environment, but cable length up to 100 m do not normally require any special precautions other than the cable must be screened.

**Q:** *The digital reading is correct but the analog output reading has some deviation from actual pressure?*

**A:** Check that the analog out is connected to a floating input and not an input that is connected to ground. If connected analog out return is connected to ground, the supply current will flow in the signal line and cause voltage drop and ground looping.

### Digital output

**Q:** *How fast can I request pressure measurements via the digital interface?*

**A:** 10 times per second is the fastest recommended pressure request frequency.

**Q:** *How long is the waiting time from turning power on to valid measuring values?*

**A:** The power on sequence is approximately 2 seconds. The light ring is illuminating red during power up sequence and the digital interface will not reply on commands. The cold cathode has a stabilization of a few minutes after turning the high voltage on.

**Q:** *The first character is sometimes lost in the transmitter digital communication reply?*

**A:** This can be caused by too fast transmitter communication reply. See the Communication Protocol 300544663 (RS232).

### **Calibration and adjustment**

**Q:** *How often does the transmitter require calibration or Zero adjustment?*

**A:** It depends on the application and pressure range but in many applications user adjustment is never required. Factors that temporarily or permanently can influence the measuring performance is contamination, corrosion, heat and electronic interference.

**Q:** *Will the transmitter retain user calibration after power is shut off?*

**A:** Yes - all transmitter parameters including calibration data are stored internally in the transmitter nonvolatile memory.

### **Service and repair**

**Q:** *Can the sensor element be changed if contaminated?*

**A:** Yes - The cold cathode anode and cathode plates can be changed by following the procedure described in chapter 9.

**Q:** *A +24 VDC supply voltage has been connected to analog output+. Is the transmitter damaged?*

**A:** Likely - the analog output is not protected against applying power to the output pin.

**Q:** *Reverse voltage has been connected to power supply input. Is the transmitter damaged?*

**A:** Not likely – the transmitter power supply circuit has reverse voltage and over voltage protection, however, Leybold cannot guarantee that the transmitter will not be damaged.

**Q:** *The status LED is constantly illuminating red?*

**A:** The LED will turn red 5 min after the cold cathode has been started but was not successfully ignited.

## 8 Trouble shooting

Symptom	Possible Cause/Remedy
<b>No digital communication</b>	<ul style="list-style-type: none"> <li>- Check electrical connections (3 wires from transmitter to communication equipment)</li> <li>- Transmitter and communication equipment baud rates have to match</li> <li>- Use of incorrect transmitter address. Try address 254</li> <li>- Attention characters missing (@)</li> <li>- Termination characters missing (;FF)</li> </ul>
<b>NAK180 is received when transmitting setpoint commands</b>	<ul style="list-style-type: none"> <li>- The transmitter setup is locked. Refer to disable lock procedure in the communication protocol.</li> </ul>
<b>Incorrect pressure value</b>	<ul style="list-style-type: none"> <li>- Other gas present than transmitter calibration gas (nitrogen).</li> <li>- Contaminated sensor. Transmitter repair required.</li> <li>- Corroded sensor. Transmitter repair required.</li> <li>- Perform a zero adjustment/FS adjustment.</li> <li>- Check Setting of Controller or display.</li> </ul>
<b>Incorrect pressure value at low pressure</b>	<ul style="list-style-type: none"> <li>- Contaminated sensor. Transmitter repair required.</li> <li>- Corroded sensor. Transmitter repair required.</li> <li>- Incorrect zero adjustment has been executed.</li> <li>- Transmitter exposed to heat or cooling air stream.</li> <li>- Perform a zero adjustment.</li> </ul>
<b>Incorrect pressure value at high pressure</b>	<ul style="list-style-type: none"> <li>- Contaminated sensor. Transmitter repair required.</li> <li>- Corroded sensor. Transmitter repair required.</li> <li>- Incorrect FS adjustment has been executed.</li> <li>- Other gas or gas trace present than transmitter gas setting.</li> <li>- Perform a FS adjustment.</li> </ul>
<b>Cold Cathode does not provide measurements</b>	<ul style="list-style-type: none"> <li>- If the Cold cathode is turned on at low pressure <math>&lt;1.00E-7</math> mbar or is contaminated a delay can occur from turning on high voltage to the ionization begins. At low pressure the delay can be several minutes.</li> </ul>
<b>Cold Cathode value is lower than actual pressure</b>	<ul style="list-style-type: none"> <li>- If the Cold Cathode sensor has been operated a too high pressure or exposed to fast pressure cycles the sensor can be sputtered. Sputtering of sensor will normally provide lower reading than actual pressure.</li> </ul>
<b>Setpoint relay does not trip</b>	<ul style="list-style-type: none"> <li>- Setpoint not enabled.</li> <li>- Setpoint value not set to proper value.</li> <li>- Setpoint direction is different than the user expects.</li> <li>- Check electrical connection.</li> <li>- Check part number to see if transmitter has setpoint relays.</li> </ul>
<b>No analog output</b>	<ul style="list-style-type: none"> <li>- Power supply turned off.</li> <li>- Check electrical connections.</li> </ul>
<b>Status LED illuminating red</b>	<ul style="list-style-type: none"> <li>- The LED will turn red 5 min after the cold cathode has been started but was not successfully ignited. Increase the pressure and/or clean or replace replaceable parts.</li> </ul>

## 9 Maintenance

Transmitter failures due to contamination, as well as expendable parts (filament), are not covered by the warranty.

### 9.1 Cold cathode maintenance

When a Cold Cathode sensor is turned on and operated at pressures higher than  $1E-3$  mbar the inside wall of the ionization chamber can be sputtered by ions formed by the high energetic plasma. Inert gases like argon are easier to ionize and consequently the sputter effect is more significant in such environment.

If the transmitter is contaminated, the pressure measurement will typically be lower than actual pressure. Sputtering can also be visually detected since the inside wall of the transmitter changes color. When operated in oil lubricated pumping systems, hydrocarbons can cause contamination of cold cathode measuring cell.

If sputtering or contamination occurs, the cathode plates and anode ring can be changed from the flanges side without disassembling the transmitter. The anode ring and cathode plates are available as replacement parts (See chapter 2.3). The basic accuracy of the cold cathode sensor can change after replacement of anode. The anode ring and cathode plates can also be cleaned by mechanical polishing. It is recommended to perform a zero adjustment after replacing or cleaning the cold cathode parts to achieve the best measurement performance in the lowest part of the measurement range.

#### Changing the cathode plates

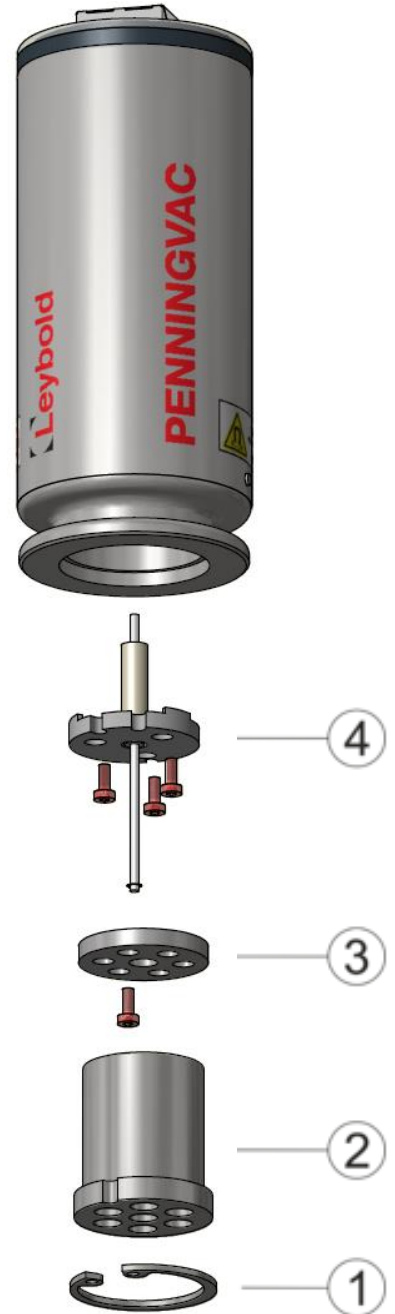
1. Turn power off and remove cable.
2. Dismount the transmitter from the vacuum system.
3. Remove the clip ring (1) using a clip ring remove/insert tool.
4. Remove the front cathode plate (2).
5. Unscrew the Torx (T6) screw at the rear cathode plate (3).
6. Remove the rear cathode plate (3).
7. Insert the new rear cathode plate (3) (Do not touch by hand).
8. Insert the Torx (T6) screw (3) and tighten.
9. Insert the new front cathode plate (2).
10. Insert the clip ring (1).

#### Changing the anode

1. Remove the cathode plates (2,3) by following step 1 to 6 in the previous guide.
2. Unscrew the 3 Torx (T6) screws at the anode module.
3. Remove the anode module and clean module or insert new.
4. Insert the anode module screw and DO NOT tighten. After all screws are inserted carefully tighten the screw a little and move on to the next one. Continue to tighten the screws one by one until all tight.
5. Perform leak testing of transmitter.
6. Insert the cathode plates by following step 7 to 10 in the previous guide.

#### Cleaning the cathode plates and anode

Contaminated parts can be cleaned by mechanical polishing or ultrasonic cleaned followed by alcohol degreasing (e.g. Isopropanol). Make sure that all parts are clean and remove any discoloring of the stainless steel and titanium parts. Alternatively the anode module or screens can be replaced with new parts.



# 10 Declaration of Contamination

## Safety information on contamination of compressors, vacuum pumps and components.

### Scope:

Every employer (user) is held responsible for the health and safety of his employees. This also applies to service personnel performing maintenance work either at the premises of the user or the service company in charge.

By means of the declaration attached the contractor is to be informed about any possible contamination of the compressor, vacuum pump or component sent in for servicing. Based on this information the contractor will be able to take the necessary safety precautions.

### Preparation before dispatch

Before shipping any parts, the user must complete the following declaration and add it to the dispatch papers. All dispatch instructions laid down in the manual must be followed e.g.:

- Drain all service fluids
- Remove filter elements
- Seal all openings airtight
- Pack / handle appropriately
- Attach the declaration of contamination outside of the packaging

## Declaration of Contamination of Compressors, Vacuum Pumps and Components

The repair and / or servicing of compressors, vacuum pumps and components will be carried out only if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer can refuse to accept any equipment without a declaration.

A separate declaration has to be completed for each single component.

This declaration may be completed and signed only by authorized and qualified staff.

Customer/Dep./Institute : _____ Address : _____ _____ Person to contact: _____ Phone : _____ Fax: _____ End user: _____	Reason for return: <input checked="" type="checkbox"/> applicable please mark <b>Repair:</b> <input type="checkbox"/> chargeable <input type="checkbox"/> warranty <b>Exchange:</b> <input type="checkbox"/> chargeable <input type="checkbox"/> warranty <input type="checkbox"/> Exchange already arranged / received <b>Return only:</b> <input type="checkbox"/> rent <input type="checkbox"/> loan <input type="checkbox"/> for credit <b>Calibration:</b> <input type="checkbox"/> DKD <input type="checkbox"/> Factory-calibr. <input type="checkbox"/> Quality test certificate DIN 55350-18-4.2.1																																																
<b>A. Description of the Leybold product:</b> _____ <b>Failure description:</b> _____ Material description : _____ Catalog number: _____ <b>Additional parts:</b> _____ Serial number: _____ <b>Application-Tool:</b> _____ Type of oil (ForeVacuum-Pumps) : _____ <b>Application- Process:</b> _____																																																	
<b>B. Condition of the equipment</b> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 10%; text-align: center;">No<sup>1)</sup></th> <th style="width: 10%; text-align: center;">Yes</th> <th style="width: 10%; text-align: center;">No</th> <th style="width: 10%;"></th> <th style="width: 10%;"></th> <th style="width: 10%;"></th> <th style="width: 10%;"></th> </tr> </thead> <tbody> <tr> <td>1. Has the equipment been used</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;">→</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2. Drained (Product/service fluid)</td> <td style="text-align: center;">↓</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3. All openings sealed airtight</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4. Purged</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="8">                     If yes, which cleaning agent _____                      and which method of cleaning _____  <sup>1)</sup> If answered with "No", go to D. ←                 </td> </tr> </tbody> </table>			No <sup>1)</sup>	Yes	No					1. Has the equipment been used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→				2. Drained (Product/service fluid)	↓	<input type="checkbox"/>	<input type="checkbox"/>					3. All openings sealed airtight	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					4. Purged	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					If yes, which cleaning agent _____ and which method of cleaning _____ <sup>1)</sup> If answered with "No", go to D. ←							
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<b>C. Description of processed substances (Please fill in absolutely)</b> 1. What substances have come into contact with the equipment ? Trade name and / or chemical term of service fluids and substances processed, properties of the substances According to safety data sheet (e.g. toxic, inflammable, corrosive, radioactive) <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 5%;">X</th> <th style="width: 40%;">Tradename:</th> <th style="width: 55%;">Chemical name:</th> </tr> </thead> <tbody> <tr><td> </td><td>a)</td><td> </td></tr> <tr><td> </td><td>b)</td><td> </td></tr> <tr><td> </td><td>c)</td><td> </td></tr> <tr><td> </td><td>d)</td><td> </td></tr> </tbody> </table>		X	Tradename:	Chemical name:		a)			b)			c)			d)																																		
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<sup>2)</sup> Components contaminated by microbiological, explosive or radioactive products/substances will not be accepted without written evidence of decontamination.																																																	

### D. Legally binding declaration

I / we hereby declare that the information supplied on this form is accurate and sufficient to judge any contamination level.

Name of authorized person (block letters) : \_\_\_\_\_  
 \_\_\_\_\_  
 Date \_\_\_\_\_ signature of authorized person \_\_\_\_\_

firm stamp

# 11 Declaration of Conformity



## EU Declaration of Conformity

(Translation of original Declaration of Conformity)

**The manufacturer:** Leybold GmbH  
Bonner Strasse 498  
D-50968 Köln  
Germany

herewith declares that the products specified and listed below which we have placed on the market, comply with the applicable EU Council Directives. This declaration becomes invalid if modifications are made to the product without agreement of Leybold GmbH.

**Product designation:** PENNINGVAC Transmitter

**Type designation:** PTR 81 N, PTR 82 N, PTR 90 N, PTR 200 N, PTR 225 N,  
PTR 237 N

**Part numbers:** 15734V02, 15736V02, 230070V02, 230071V02, 230072V02,  
230085V02, 230087V02, 230088V02, 230281S02, 230281V02,  
230282S02, 230282V02, 89642V02, 230089V02\*,  
230703V02\*

**The products complies to the following European Council Directives:**

Electromagnetic Compatibility (2014/30/EU)

**The following harmonized standards have been applied:**

EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use —  
EMC requirements — Part 1: General requirements  
Immunity: controlled EM environments

EN 55011:2009/A1:2010 Industrial, scientific and medical equipment — Radio-frequency  
disturbance characteristics — Limits and methods of measurement  
Group 1, Class B (\* Class A)

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Cologne, November 16, 2016

Cologne, November 16, 2016

  
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