

# Penning Gauge


## PEG100



CE

## Product Identification

In all communications with INFICON, please specify the information on the product nameplate. For convenient reference copy that information into the space provided below.

INFICON AG, LI-9496 Balzers	
Typ: .....	
No: .....	
F-No: .....	
..... V-..... W	

## Validity

This document applies to products with part numbers

351-000	(PEG100, DN 25 ISO-KF)
351-002	(PEG100, DN 40 CF-F)

The part number (No.) can be taken from the product nameplate.

We reserve the right to make technical changes without prior notice.

All dimensions in mm.

The references to diagrams, e.g. (4/1), consist of the fig. no. and the item no. in that order.

## Intended Use

The Penning Gauge PEG100 has been designed for vacuum measurement of in the pressure range of  $1 \times 10^{-9}$  to  $1 \times 10^{-2}$  mbar.

## Description

The Penning Gauge PEG100 is a compact active pressure converter housing a Penning measurement system as well as the corresponding operating electronics. They have been developed specifically for integration into vacuum systems and offer a measurement range from  $1 \times 10^{-9}$  to  $1 \times 10^{-2}$  mbar.

The gauge is connected directly to the vacuum system through its DN 25 KF or DN 40 CF flange.

The electrical connection is provided through a screened 8-pin FCC 68 connector.

## Unpacking and Checking

Unpack the PEG100 immediately after delivery, even if it is to be installed at a later date.

Examine the packaging for any external damage. Completely remove all packaging materials.

Retain the shipping container and the packaging materials in the event of complaints about damage.

Check that the PEG100 is complete and carefully examine the gauges visually.

If any damage is discovered, report it immediately to the forwarding agent and insurer. If the damaged part has to be replaced, please get in touch with the orders department.

## Design and Function

Based on a supply voltage of 24 V the PEG100 generates the internal supply voltages required for operation of the integrated Penning measurement system. The PEG100 supplies a logarithmic representation of the vacuum pressure by way of a voltage signal which ranges from 0.66 V to 10 V. Moreover, the high tension generated in the PEG100 can be switched on and off by applying an external control voltage or by connecting an external switch.

When the gas discharge in the Penning measurement system is ignited, the operating voltage is raised to 2.8 kV. After successful ignition, this voltage then drops to 1.6 kV thereby increasing the useful service life of the Penning measurement system.

A status output indicates the two possible conditions of the Penning measurement system:

1. not ignited (including high tension OFF) and
2. ignited (and pressure  $> 3 \times 10^{-9}$  mbar).

A much improved ignition characteristic in the high vacuum range has been obtained through the special design for the electrodes in the measurement system.

## Scope of Delivery

- Penning Gauge
- Replacement cathode plate of titanium
- Replacement ceramics disc
- Operating Manuals

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For cross-references within this document, the symbol (→  XY) is used.

# 1 Safety

## 1.1 Symbols Used

Symbols for residual risks



Information on preventing any kind of physical injury.



Information on preventing extensive equipment and environmental damage.



Information on correct handling or use. Disregard can lead to malfunctions or minor equipment damage.




Notice

## 1.2 Personnel Qualifications



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

## 1.3 General Safety Instructions

- Adhere to the applicable regulations and take the necessary precautions for the process media used.  
Consider possible reactions with the product materials (→  6).
- 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.

Communicate the safety instructions to all other users.

## 1.4 Liability and Warranty

INFICON assumes no liability and the warranty is rendered 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 corresponding product documentation.

## 2 Technical Data

General Data	Measurement range	$1 \times 10^{-9}$ to $1 \times 10^{-2}$ mbar	
	Measurement uncertainty in the range from	$1 \times 10^{-8}$ to $1 \times 10^{-4}$ mbar	
	Deviation from the characteristic	$\pm 30$ % of the displayed value	
	Average temperature coefficient of the output span	$< 0,5$ % / K of the displayed value	
	Reproducibility	$< 4$ % of the displayed value	
	Measurement principle	Cold cathode ionization according to Penning	
	Supply voltage	14.5 to 36 V (dc) typ. 24 V (dc), 2 V <sub>ss</sub>	
	Power consumption	$< 2$ W	
	Protection	IP 40	
	Flammability	UL 94 - V 2	
	Status displays		
	Operation (POWER)	orange LED	
	Ready to measure (ignited) READY	green LED	
	Measurement System	Measurement system	detachable
Vacuum connection		DN 25 KF or DN 40 CF	
Degassing temperature		see Section 4.3	
Internal volume		21 cm <sup>3</sup> approx.	
Materials in contact with the medium		stainless steel; CrNi; AL <sub>2</sub> O <sub>3</sub> ceramics; NiFe; Ni; titanium	
Overpressure tolerance (The limits for the flange connections must be observed)		$\leq 10$ bar abs.	
Operating voltage		1.6 kV (current limited to $< 0,5$ mA)	
Ignition voltage		2.8 kV (current limited to $< 0,5$ mA)	
Signal Output		Signal output	0 to 10,6 V
		Permissible load resistance	R <sub>a</sub> $\geq 10$ k $\Omega$
	Measurement signal	0,66 to 10,0 V logarithmic 1.333 V / per decade	
	Status signal (not ignited)	0.4 V	
	Control Inputs	Input resistance	R <sub>E</sub> : 10 k $\Omega$ approx.
High voltage cut-in with negative logic at pin 7:			
High voltage ON		at U $< 2.5$ V	
High voltage OFF		at U $> 4$ V	
or			
High voltage cut-in with positive logic at pin 8:			
High voltage ON		at U $> 12$ V	
High voltage OFF		at U $< 7$ V	
(for this refer also to figure 3 and section 3.2.2)			
Status Output		Ready to measure	High level (13.5 to 35 V, max. 50 mA)
	Error (not ignited, HV off)	0 V	
	For this refer also to section 3.2.4.		

Dimensions [mm], Weight

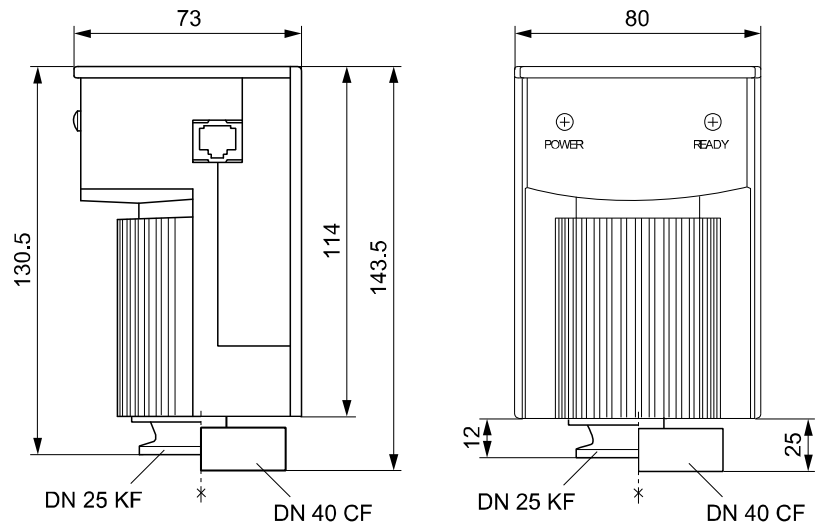


Fig. 1 Dimensional drawing

Weight

500 g approx

Ambient Conditions

Storage temperature range  $-20\text{ }^{\circ}\text{C}$  to  $+70\text{ }^{\circ}\text{C}$

Climatic rating KWF to DIN 40040

Operating temperature range  $10\text{ }^{\circ}\text{C}$  to  $50\text{ }^{\circ}\text{C}$

Max. rel. humidity of the ambient air (on 30 days per year, non-condensing)  $70\text{ }\%$ <sup>1)</sup> or  $95\text{ }\%$ <sup>2)</sup>

<sup>1)</sup> usable measurement range  $10^{-2}$  to  $10^{-9}$  mbar

<sup>2)</sup> usable measurement range  $10^{-2}$  to  $10^{-7}$  mbar

## 3 Installation

### 3.1 Vacuum Connection

Please check by referring to the technical data whether or not your gauge is suitable for your application.

The Penning Gauge PEG100 should preferably be mounted flange down. Inclined installation is possible but the horizontal orientation must not be exceeded.

Flange up installation is not permissible because under such circumstances condensate may collect in the PEG100. This will either adversely affect the measurements, or the sensor itself may possibly be damaged.

The Penning Gauge is equipped with a DN 25 KF or a DN 40 CF connection flange. The DN 25 KF flange is used to connect the gauge to the mating connection flange on a vacuum system with the aid of a centering ring and a clamping ring.

The cathode plate (7/5) also acts as a baffle.

### 3.2 Electrical Connection

The supply voltage and the high voltage switching signal as well as the measurement voltage signal are carried through the 8-way FCC 68 socket.

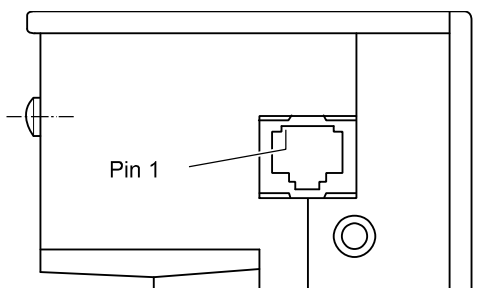


Fig. 2 Connection socket

The pinout is given in Fig. 2.

Pin	Signal	Designation on the rear
Pin 1	Supply voltage 14,5 V to 36 V (dc)	+24 V (dc)
Pin 2	0 V supply; used as the ground reference for the supply and control signal voltages	COMMON
Pin 3	Pressure dependent logarithmic signal output	SIGN 0 - 10 V
Pin 4	Gauge identification (100 k $\Omega$ )	IDENT
Pin 5	Signal ground (use only for the pressure signal)	SIGN COM
Pin 6	Status (ready to measure)	STATUS
Pin 7	High tension "ON / OFF" (control input); Low active	HV ON (L)
Pin 8	High tension "ON / OFF" (control input); High active	HV ON (H)

Signal ground (Pin 5) and power supply ground (Pin 2) are internally linked. For this also refer to the block diagram of Fig. 3.



Two examples of how to connect the PEG100 are given in Annex B.

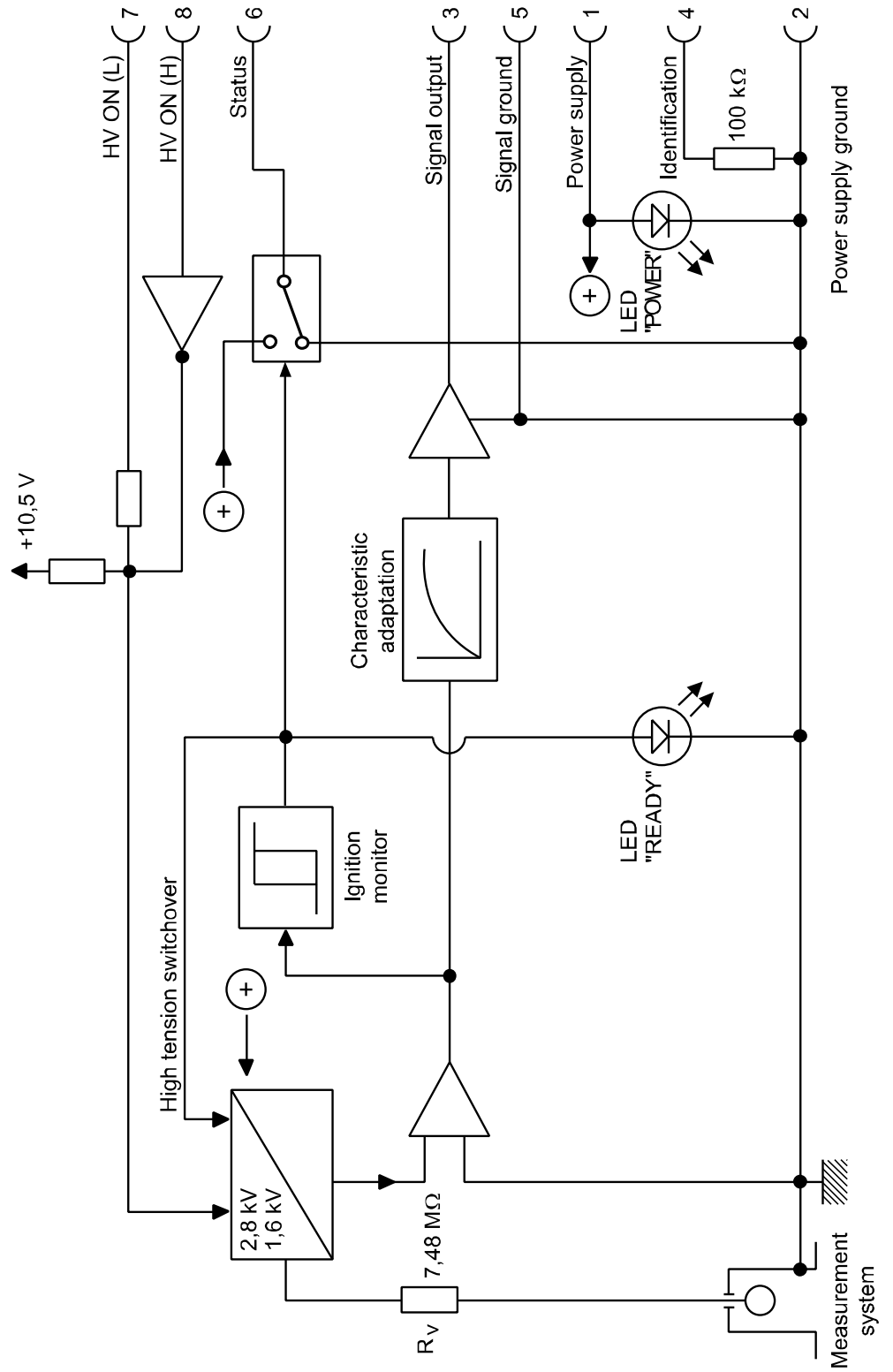


Fig. 3 Block diagram

### 3.2.1 Power Supply

**DANGER**

The Penning Gauge PEG100 may only be connected to supply units or measuring instruments which meet the requirements of mains isolated extra-low voltages (PELV) and VDE 0100.

The PEG100 is capable of operating off supply voltages ranging from 14.5 V to 36 V. A supply voltage of 24 V (dc) is recommended.

The power supply must be connected to Pin 1 (+) and Pin 2 (power supply ground).

### 3.2.2 Switching on the High Tension

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.

Operation of the PEG100 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 tension should only be switched on or off when the pressure has dropped to the  $10^{-2}$  to  $10^{-3}$  mbar range.

The high tension may also be switched on or off directly by the output signal provided by a Pirani Standard Gauge with switching functions (e.g. PSG500-S). Thus the PEG100 can be switched on or off automatically at a pressure of approximately  $5 \times 10^{-3}$  mbar.

### 3.2.3 Measurement Signal Output

The PEG100 supplies a defined output signal ranging from 0.66 V to 10 V at Pin 3 with reference to Pin 5 which is signal ground. For this also refer to Table 1 in Annex A.

Table 1 has been included to clarify the relationship between the output voltage and the pressure.

The measurement signal provided by the PEG100 depends on the type of gas. The values stated in Table 1 apply to nitrogen and air. For other gases, corresponding correction factors must be used which are available from INFICON upon request.

### 3.2.4 Status Output

When the gauge is ready to measure, this is indicated via the status output.

Status	Status signal at Pin 6 (with respect to Pin 2)
High voltage OFF	0 V
High voltage ON (not yet ignited)	0 V
High voltage ON at $p < 3 \times 10^{-9}$ mbar	0 V
High voltage ON at $p > 3 \times 10^{-9}$ mbar	High (13.5 - 32 V, depending at $p > 3 \times 10^{-9}$ mbar on the supply voltage (50 mA max.))

When the pressure drops below  $3 \times 10^{-9}$  mbar, the status signal remains HIGH.

### 3.2.5 Identification

For the purpose of identifying the connected type of gauge and the pressure range, the PEG100 is equipped with an identification resistor ( $R = 100 \text{ k}\Omega$ ) between Pin 4 and Pin 2. This resistor may be sensed by connected operating or control units so that these can automatically adapt.

## 4 Operation

### DANGER



A high tension which is dangerous when touched is applied to the sensor in the PEG100. You must always switch off the supply voltage for the PEG100 before starting any work on the gauge (even when removing the gauge from the connection flange) so as to avoid injury when inadvertently coming in to contact with the high tension.



Key to Fig. 6:

- 1 LED "POWER" (orange)
- 2 LED "READY" (green)

Fig. 6 PEG100 - front view

### 4.1 Operation

Apply the 24 V supply voltage to the PEG100. The orange "POWER" LED (6/1) comes on.

Switch the high tension on via the high tension switching input. See Section 3.2.2.

After successful ignition and at a pressure  $> 3 \times 10^{-9}$  mbar the additional green or READY LED (6/2) will come on.

Now the gauge is ready to make measurements.

No LED on

- Supply voltage is missing.
- ⇒ Measurement signal 0 V

Only the orange LED (6/1) is on

- The supply voltage is present.
  - The high tension has not been switched on.
- ⇒ Measurement signal 0 V

The green LED (6/2) is on, the orange LED (6/1) is on

- The supply voltage is present.
  - The high tension has been switched on.
  - The gas discharge has been started.
  - The pressure is over  $3 \times 10^{-9}$  mbar
- ⇒ Measurement signal 0.66 V

## 4.2 Measurement System Status Indication

In the case of the Penning method of measurement one only may draw conclusions as to proper functioning while the gauge is in the measurement mode, i.e. when the gas discharge is running.


Trouble-free operation ("READY" LED (6/2) is on, status output HIGH) is marked by the presence of a pressure dependent signal starting at a pressure of about  $3 \times 10^{-9}$  mbar up to the range limit of  $1 \times 10^{-2}$  mbar. When the pressure drops  $< 3 \times 10^{-9}$  mbar this status is also maintained.

When the "READY" LED (6/2) is not on, status output 0 V:


Cause 1: When the high voltage was switched on the pressure was below  $p < 3 \times 10^{-9}$  mbar.

Cause 2: No ignition of the gas discharge, even if the power supply voltage is present, the high tension has been switched on and a pressure between about  $3 \times 10^{-9}$  mbar and  $1 \times 10^{-2}$  mbar.

## 4.3 Degassing



**WARNING**



Before baking out the sensing cell you must detach the electronics assembly from the sensing cell. The electronics assembly may be damaged when exceeding a temperature of 70 °C.

Before baking out, you must make sure that an ultra sealing disc (PEG100, DN 25 KF) or a copper seal (PEG100, DN 40 CF) is used as the flange seal.

The PEG100 is equipped with all-metal sensing cells so that any outgassing caused by polymer seals is entirely avoided.

After having detached the electronics (refer to Section 5.2.1) from the sensing cell, the outgassing rate of the sensing cell may be reduced considerably by baking out, so that the accuracy of the measurements in the range below  $1 \times 10^{-6}$  mbar is improved.

When using the gauge chiefly in the UHV range ( $< 10^{-8}$  mbar) it is recommended to remove the cathode plate. This helps to reduce the surface area of the surfaces which may release gas.


How to proceed in order to detach the electronics assembly is described in Section 5.2 (cleaning of the sensor).

Permissible bake out temperature:

Sensing cell of the PEG100 (DN 25 KF)	150 °C (with ultra sealing disc)
Sensing cell of the PEG100 (DN 40 CF)	350 °C


## 5 Maintenance

**DANGER**




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

**Caution**



**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.

**Caution**




**Caution: dirt sensitive area**  
Touching the product or parts thereof with bare hands increases the desorption rate. Always wear clean, lint-free gloves and use clean tools when working in this area.

### 5.1 The Electronics Assembly

The electronics assembly of the PEG100 does not require any maintenance.

### 5.2 Cleaning the Sensor

**DANGER**



A high tension which is dangerous when touched is applied to the sensor in the PEG100. You must always switch off the supply voltage for the PEG100 before starting any work on the gauge (even when removing the PEG100 from the connection flange) so as to avoid injury when inadvertently coming in to contact with the high tension.

#### 5.2.1 Detaching the Electronics Assembly

In order to detach the electronics assembly and the magnet assembly (7/1) you must loosen the two cross head screws which can be accessed through two holes in the rear of the PEG100 by turning these by about 1.5 turns.

Then the electronics assembly and the magnet assembly (7/1) may be pulled off from the sensor housing.



The magnet assembly (7/1) may drop down during the pulling off process.

## 5.2.2 Disassembly of the Sensor

The sensor consists of the vacuum housing, the anode ring (7/4) with ignition aid (7/2) and the cathode plate (7/5). See Fig. 7.

How to disassemble:

- 1) Use a pair of tweezers to pull the cathode plate (7/5) out of the sensor.
- 2) Use a pair of pliers to pull the anode ring out from the housing; for this move the pliers to and fro a little.
- 3) Detach the ceramics disc (7/3) from the current feed-through.

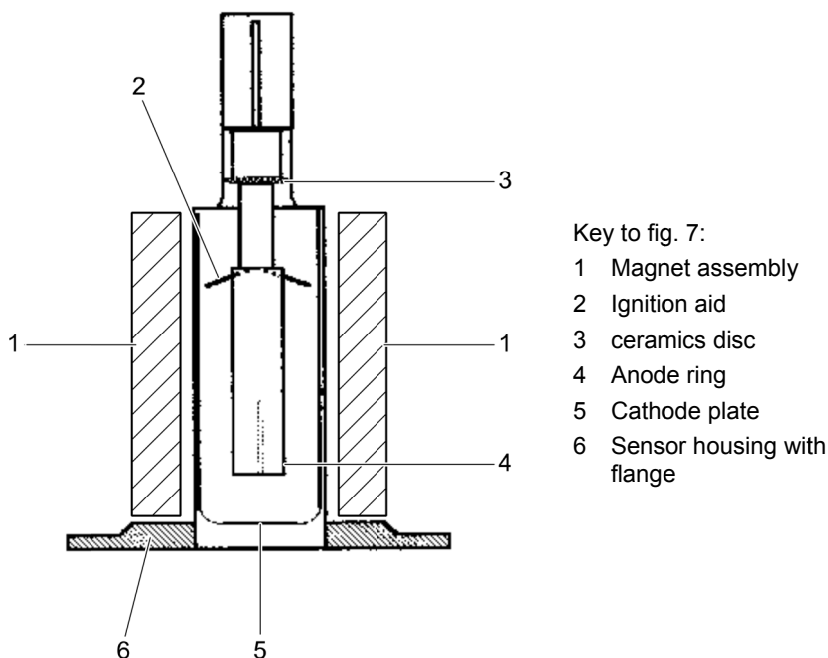


Fig. 7 Sensor

## 5.2.3 Cleaning the Individual Parts



Do not damage the sealing surfaces of the vacuum flange.

In the case of severe contamination, the inside of the housing may be cleaned with steel wool or similar and then subjected to further cleaning with alcohol. Finally blow clean with oil-free pressurized air or nitrogen. Any possibly present flakes will be removed by blowing these out of the housing.

If possible, the cathode plate (7/5) should be replaced by a new cathode plate. The same should be done for the anode ring (7/4) with the ignition aid (7/2) and the ceramics protection disc (7/3) which protects the current feed-through against contamination.

## 5.2.4 Assembly of the Sensor

The sensor is reassembled in the reverse order as for disassembly which is described in Section 5.2.2.

When inserting the anode ring (7/4) you must make sure that a clearance of 1 mm remains between the wings of the ignition aid (7/2) and the wall of the housing. Moreover, make sure that the anode ring is lying snug on the ceramics disc.

When inserting the cathode plate (7/5) into the housing the wings of the ignition aid (7/2) must not be bent. Therefore insert slowly and carefully.

### 5.2.5 Assembly of the Electronics Assembly

How to proceed:

- 1) Place the magnet assembly on the sensor.
- 2) Push the electronics assembly over the magnet assembly and the sensor, and turn slightly as required until the correct orientation between electronics assembly and sensor has been found. When the electronics assembly has been placed as required, the black magnet housing is fully surrounded by the housing of the PEG100.
- 3) Retighten the cross head screws at the rear of the gauge.

## 6 Troubleshooting

Problem	Possible cause	Correction
No LED is on.	Supply voltage is missing.	
The "POWER" LED (6/1) is on, the "READY" LED (6/2) is not on.	High tension has not been activated. Pressure has dropped below $< 3 \times 10^{-9}$ mbar. The gas discharge has not ignited. Sensing cell not properly connected to the electronics assembly (e.g. after maintenance). Missing anode ring (e.g. after maintenance).	
The measurement signal is always greater than 10 V even if the pressure is much lower than $10^{-2}$ mbar.	Short circuit in the sensing cell.	Clean the sensing cell. For this refer to section 5.2.
During pumpdown the measurement signal remains at some level although the pressure is dropping.	Contamination within the sensing cell.	Replace the sensing cell.



## 7 Wearing Parts and Original Spare Parts

When ordering spare parts, always indicate:

- all information on the product nameplate
- description and ordering number according to the spare parts list

	Ordering number
Replacement kit, consisting of: Cathode plate of titanium (5 pcs.) Ceramics disc (5 pcs) Gauge	351-490
Anode complete with ignition plate	351-499
Sensor (DN 25 KF), complete with magnet assembly (PEG050)	399-510

## Accessories

	Ordering number
Connection cable with two FCC 68 plugs, screened	
3 m	398-500
5 m	398-501
10 m	398-502
15 m	398-503
20 m	398-504
30 m	398-505
Pirani Standard Gauge	
PSG500-S (DN 16 ISO-KF)	350-080
PSG500-S (DN 16 CF-R)	350-082
DN 20 / 25 KF clamping ring	211-002
DN 25 KF (Al) centering ring	211-061

For overpressure operation and degassing:

	Ordering number
Ultra sealing disc (3 pcs.)	211-168
Clamping ring for ultra sealing discs	211-009

## 9 Returning the Product

**WARNING**

**WARNING: forwarding contaminated products**

Products returned to INFICON for service or repair should, if possible, be free of harmful substances (e.g. radioactive, toxic, caustic or micro-biological). Otherwise, the type of contamination must be declared.

Adhere to the forwarding regulations of all involved countries and forwarding companies and enclose a completed contamination declaration (Form under [www.inficon.com](http://www.inficon.com)).

Products that are not clearly declared as "free of harmful substances" are decontaminated at the expense of the customer.

Products not accompanied by a duly completed declaration of contamination are returned to the sender at his own expense.

## 10 Disposal

**DANGER**

**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.

**WARNING**

**WARNING: substances detrimental to the environment**

Products or parts thereof (mechanical and electric components, operating fluids etc.) can be detrimental to the environment. Dispose of such substances in accordance with the relevant local regulations.

Separating the components

After disassembling the product, separate its components according to the following criteria:

Contaminated components

Contaminated components (radioactive, toxic, caustic or biological hazard etc.) must be decontaminated in accordance with the relevant national regulations, separated according to their materials, and disposed of.

Other components

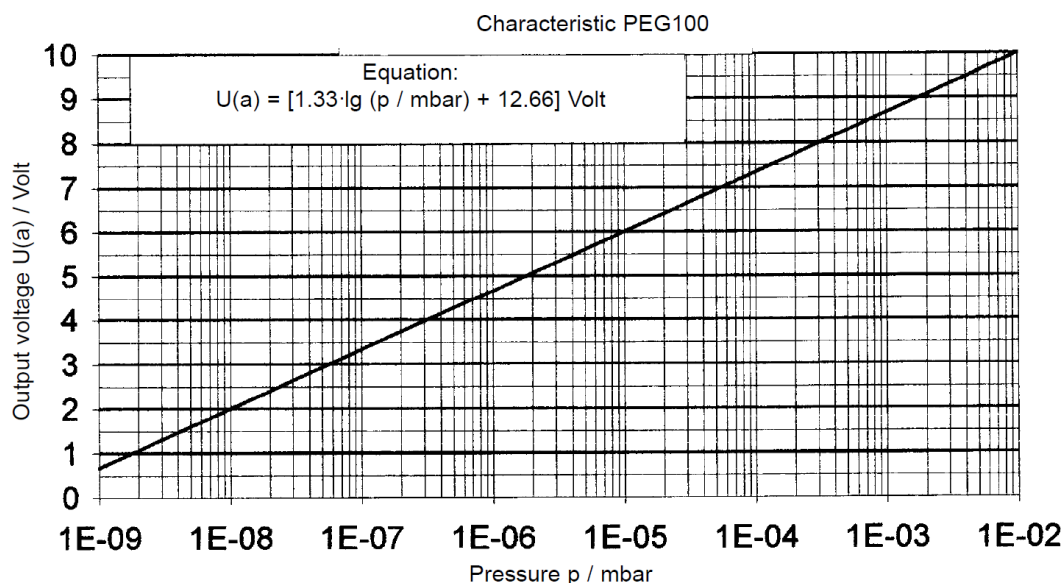
Such components must be separated according to their materials and recycled.

# Appendix

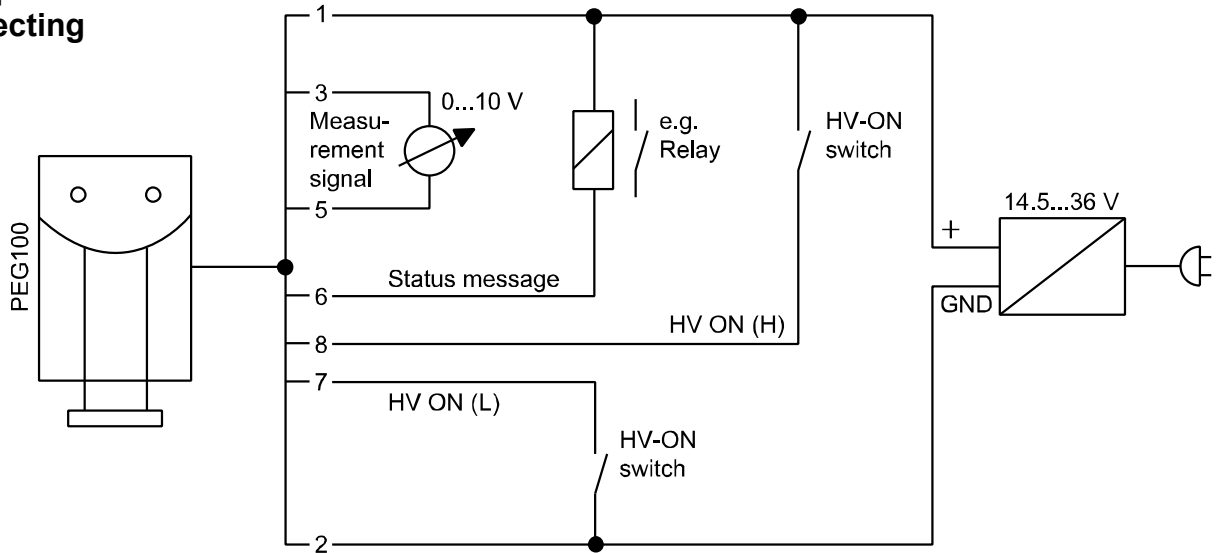
## A: Output Voltage vs. Pressure

(U = 0.4 V; "not ignited")

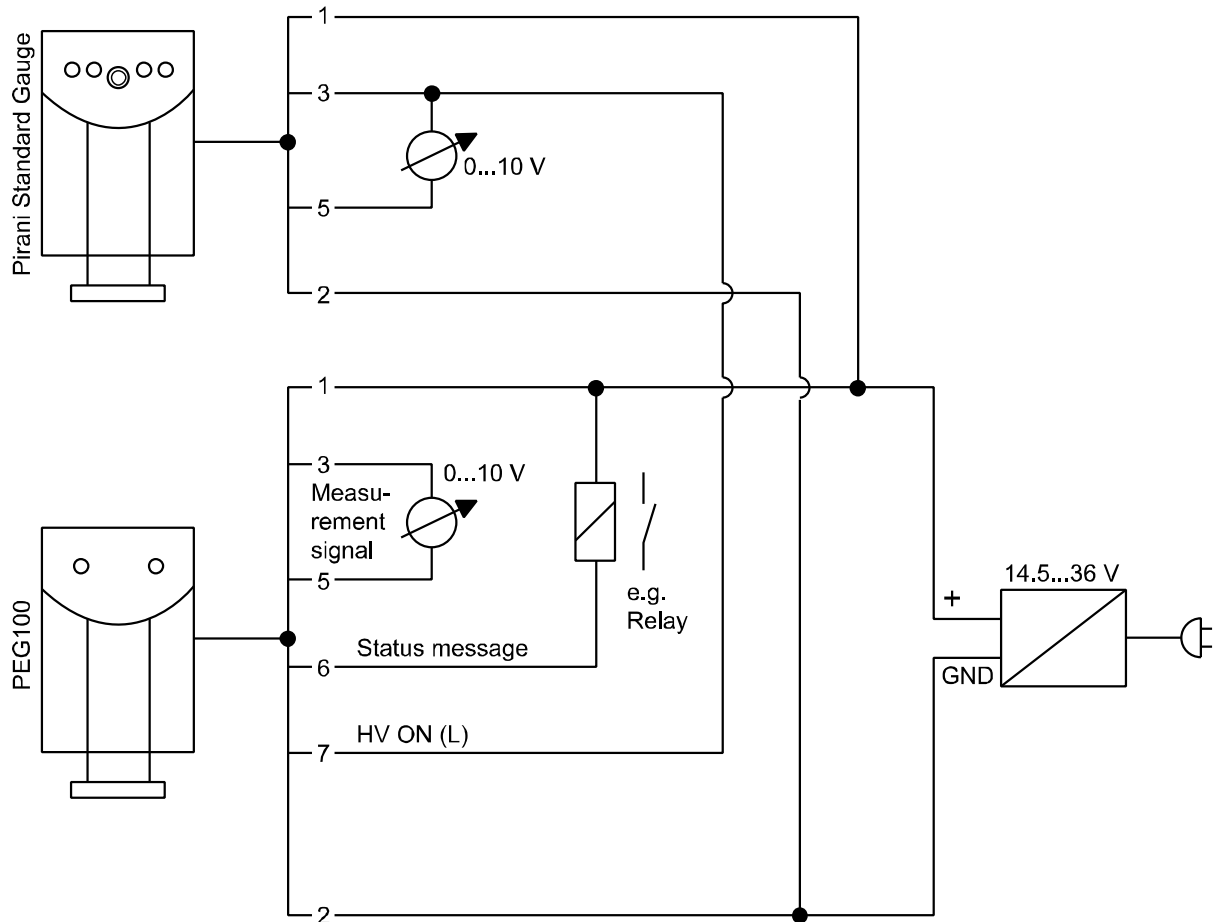
U (Out) [V]	Pressure [mbar]	U (Out) [V]	Pressure [mbar]	U (Out) [V]	Pressure [mbar]	U (Out) [V]	Pressure [mbar]
0,667	1,00E-09	3,4	1,12E-07	6	1,00E-05	8,6	8,91E-04
0,8	1,26E-09	3,5	1,33E-07	6,1	1,19E-05	8,7	1,06E-03
1	1,78E-09	3,6	1,59E-07	6,2	1,41E-05	8,8	1,26E-03
1,1	2,11E-09	3,7	1,88E-07	6,3	1,68E-05	8,9	1,50E-03
1,2	2,51E-09	3,8	2,24E-07	6,4	2,00E-05	9	1,78E-03
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1,5	4,22E-09	4,1	3,76E-07	6,7	3,35E-05	9,3	2,99E-03
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1,7	5,96E-09	4,3	5,31E-07	6,9	4,73E-05	9,5	4,22E-03
1,8	7,08E-09	4,4	6,31E-07	7	5,62E-05	9,6	5,01E-03
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2,6	2,82E-08	5,2	2,51E-06	7,8	2,24E-04		
2,7	3,35E-08	5,3	2,99E-06	7,9	2,66E-04		
2,8	3,98E-08	5,4	3,55E-06	8	3,16E-04		
2,9	4,73E-08	5,5	4,22E-06	8,1	3,76E-04		
3	5,62E-08	5,6	5,01E-06	8,2	4,47E-04		
3,1	6,68E-08	5,7	5,96E-06	8,3	5,31E-04		
3,2	7,94E-08	5,8	7,08E-06	8,4	6,31E-04		
3,3	9,44E-08	5,9	8,41E-06	8,5	7,50E-04		



**B: Examples for Connecting**



Example for connecting the PEG100: Switching the high tension via an external switch or contact



Example for connecting the PEG100: Switching the high tension automatically through a Pirani Standard Gauge with switching point

## EU Declaration of Conformity



We, INFICON, hereby declare, that the equipment mentioned below complies with the following directives:

- 2014/30/EU, OJ L 96/79, 29.3.2014  
(EMC directive; Directive on electromagnetic compatibility)
- 2011/65/EU, OJ L 174/88, 1.7.2011  
(RoHS directive; Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment)

Product Penning Gauge  
PEG100

Part numbers 351-000  
351-002

Standards Harmonized and international / national standards and specifications:

- EN 61000-6-2:2005 (EMC: generic immunity standard)
- EN 61000-6-3:2007 + A1:2011 (EMC: generic emission standard)
- EN 61010-1:2010 (Safety requirements for electrical equipment for measurement, control and laboratory use)
- EN 61326: 2013; Group 1, Class B (EMC requirements for electrical equipment for measurement, control and laboratory use)

Manufacturer / Signatures

INFICON AG, Alte Landstraße 6, LI-9496 Balzers

6 December 2017

6 December 2017




Dr. Bernhard Andreaus  
Director Product Evolution

Markus Truniger  
Product Manager

Notes

Notes

Original: German tina14d1-a (2017-12)



tina14e1-a



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