



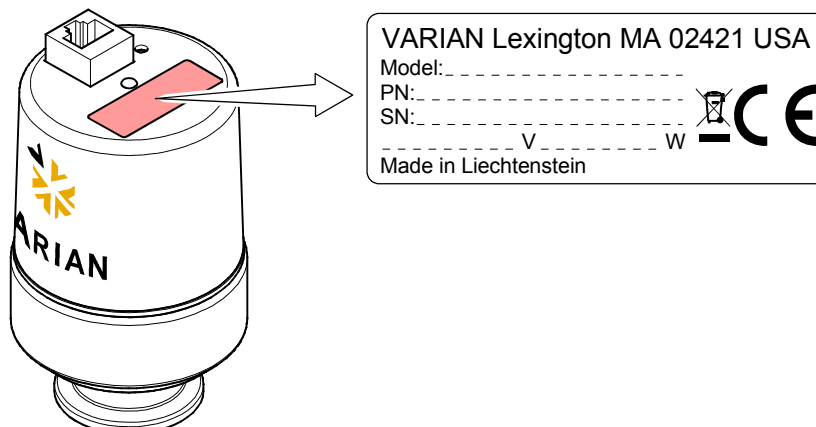
Compact Cold Cathode Gauge

IMG-500



Product Identification

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



Validity

This document applies to products with part numbers:

IMG500KF25 (DN 25 ISO-KF)
 IMG500CF35 (DN 40 CF-C)

The part number (PN) can be taken from the product nameplate.

If not indicated otherwise in the legends, the illustrations in this document correspond to the product with part number IMG00KF25. They apply to the other products by analogy.

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

All dimensions in mm.

Intended Use

The Compact Cold Cathode Gauge IMG-500 has been designed for vacuum measurement of gases in the pressure range of 2×10^{-9} ... 1×10^{-2} mbar.

The gauges can be operated in connection with a VARIAN Vacuum Gauge Controller AGC-100, a VARIAN Turbo AG Rack Controller, or with another controller.

Functional Principle

The gauge functions with a cold cathode ionization measurement circuit (according to the inverted magnetron principle).

Over the whole measurement range, the measuring signal is output as a logarithm of the pressure.


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

1 Safety

1.1 Symbols Used


 **DANGER**
Information on preventing any kind of physical injury.

 **WARNING**
Information on preventing extensive equipment and environmental damage.


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





1.2 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.

1.3 General Safety Instructions

- Adhere to the applicable regulations and take the necessary precautions for the process media used.
Consider possible reactions between the materials (→  7) 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.

 **DANGER**

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

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

Communicate the safety instructions to all other users.

1.4 Liability and Warranty

VARIAN 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 corresponding product documentation.

The end-user assumes the responsibility in conjunction with the process media used.

Gauge failures due to contamination or wear and tear as well as expendable parts (e.g. seals) are not covered by the warranty.

2 Technical Data


Measuring range (air, N ₂)	2×10 ⁻⁹ ... 1×10 ⁻² mbar
Accuracy (N ₂)	≈±30% (in the range 1×10 ⁻⁸ ... 1×10 ⁻³ mbar)
Reproducibility	≈±5% (in the range 1×10 ⁻⁸ ... 1×10 ⁻³ mbar)
Gas type dependence	→ Appendix B


Output signal (measuring signal)	
Voltage range	0 ... +10.5 V
Voltage vs. pressure	logarithmic, 1.0 V / decade (→ Appendix A)
Error signal	<0.5 V no supply

Output impedance	2×10 Ω
Minimum loaded impedance	10 kΩ, short-circuit proof
Response time (pressure dependent)	
p > 10 ⁻⁶ mbar	<<10 ms
p = 10 ⁻⁸ mbar	≈1000 ms

Gauge identification	100 kΩ referenced to supply common
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Supply




DANGER

The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded extra-low voltage (SELV). The connection to the gauge has to be fused¹⁾.

Supply voltage at the gauge	15 ... 30 VDC (ripple ≤ 1 V _{pp})
Power consumption	≤2 W
Fuse ¹⁾	≤1 AT
The minimum voltage of the power supply must be increased proportionally to the length of the sensor cable.	
Voltage at the supply unit with maximum line length	16 ... 30 VDC (ripple ≤ 1 V _{pp})

Adjustment	the gauge is adjusted at the factory and requires no maintenance.
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Electrical connection	FCC68 female, 8-pin
Sensor cable	8 conductors plus shielding
Line length	≤50 m (8×0.14 mm ²)

Operating voltage	≤3.3 kV
Operating current	≤500 μA

¹⁾ VARIAN controller fulfill these requirements.

Grounding concept	→ ("Power Connection")
Vacuum connection-signal common	connected via 10 kΩ (max. voltage differential with respect to safety ±50 V with respect to accuracy ±10 V)
Supply common-signal common	conducted separately; differential measurement recommended for cable lengths ≥10 m

Materials exposed to vacuum	
Vacuum connection	stainless steel
Measuring chamber	stainless steel
Feedthrough	ceramic (Al ₂ O ₃)
Internal seals	FPM 75
Anode	Mo
Ignition aid	stainless steel

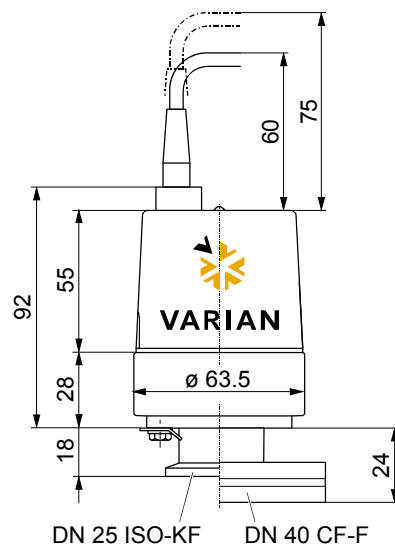
Mounting orientation	any
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Internal volume	≈20 cm ³
Pressure	≤10 bar (absolute) limited to inert gases

Temperatures	
Operation	+5 ... +55 °C
Bakeout	+150 °C (without electronics and magnetic shielding)
Storage	-40 °C ... +65 °C

Relative humidity	≤80% at temperatures up to +31 °C decreasing to 50% at +40 °C
Use	indoors only altitude up to 2000 m
Degree of protection	IP 40


Dimensions [mm]





Weight	≤950 g
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3 Installation


3.1 Vacuum Connection


 **DANGER**

 **DANGER:** overpressure in the vacuum system >1 bar
 Injury caused by released parts and harm caused by escaping process gases can result if clamps are opened while the vacuum system is pressurized.
 Do not open any clamps while the vacuum system is pressurized. Use the type of clamps which are suited to overpressure.


 **DANGER**


 **DANGER:** overpressure in the vacuum system >2.5 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-rings provided with an outer centering ring.


 **DANGER**


 **DANGER:** protective ground
 Products that are not professionally connected to ground can be extremely hazardous in the event of a fault.
 The gauge must be electrically connected to the grounded vacuum chamber. The connection must conform to the requirements of protective connection according to EN 61010:


- CF connections fulfill this requirement.
- For gauges with KF connections, use a conductive metallic clamping ring.


 **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.

 **WARNING**

 **WARNING:** electric arcing
 Helium may cause electric arcing with detrimental effects on the electronics of the product.
 Before performing any tightness tests put the product out of operation and remove the electronics unit.



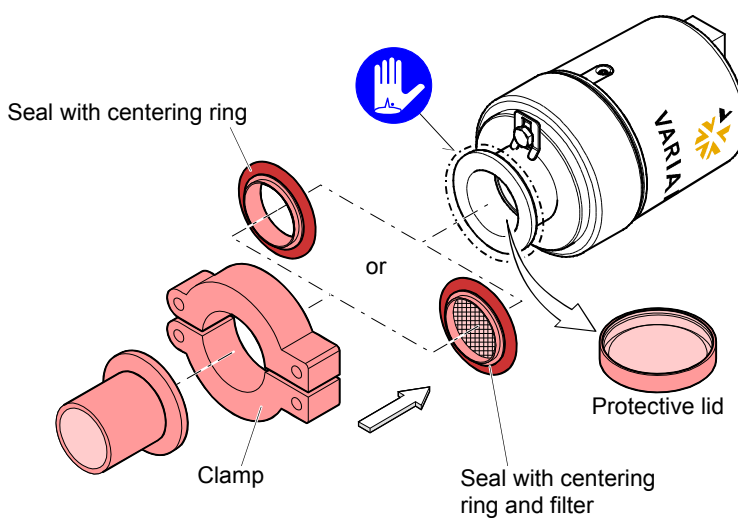
The gauge may be mounted in any orientation. To keep condensates and particles from getting into the measuring chamber preferably choose a horizontal to upright position and possibly use a seal with a centering ring and filter.



When making a CF flange connection, it may be advantageous to temporarily remove the electronics and the magnet unit (→ 10).

Procedure

Remove the protective lid and connect the product to the vacuum system.



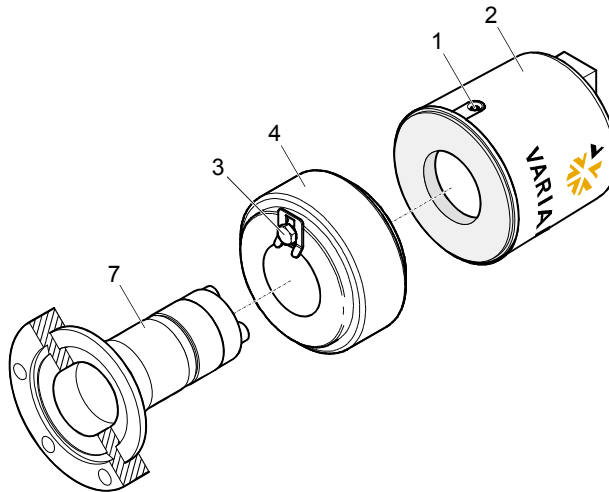
Keep the protective lid.

3.1.1 Removing the Magnet Unit (Only for Gauges With CF Flanges)

Tools required

- Allen wrench AF 1.5
- Open-end wrench AF 7

Procedure



- a) Unfasten the hexagon socket set screw (1) on the electronics unit (2).
- b) Remove the electronics unit **without twisting it**.
- c) Unfasten the hexagon head screw (3) on the magnet unit (4) and remove the magnet unit.



The magnetic force and the tendency to tilt make it difficult to separate the magnet unit and the measuring chamber (7).

- d) Make the flange connection between the gauge and the vacuum system.
- e) Remount the magnet unit and lock it with the hexagon head screw (3).
- f) Carefully mount the electronics unit (2). (Make sure the pin of the Pirani element is properly plugged into the corresponding hole of the electronics unit.)
- g) Push the electronics unit up to the mechanical stop and lock it with the hexagon socket set screw (1).

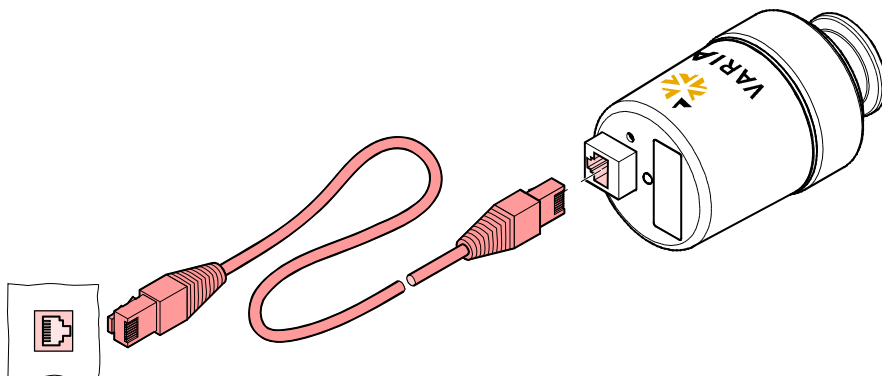
3.2 Electrical Connection

Precondition

Make sure the vacuum connection is properly made (→ 8).

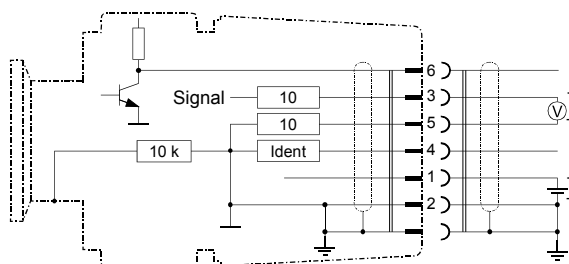
3.2.1 Use With an VARIAN Controller

Connect the sensor cable to the gauge and the controller.



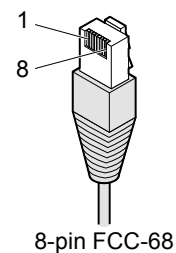
3.2.2 Use With Another Control Device

1 Make a sensor cable according to the diagram.



Electrical connection

Pin 1 Supply (15 ... 30 VDC)
 Pin 2 Supply common
 Pin 3 Signal output
 (measuring signal)
 Pin 4 Identification
 Pin 5 Signal common
 Pin 6 Status
 Pin 7, 8 n.c.



2 Connect the sensor cable to the gauge and the controller.

4 Operation

As soon as the required voltage is applied, the measuring signal is available between pins 3 and 5. (→ Appendix for the relationship between the measuring signal and the pressure).

The LED on the gauge indicates the operating state:

 Supply voltage present.

 No supply voltage.



Caution




Turn on the gauge only at pressures $<10^{-2}$ mbar to prevent excessive contamination.

If you are using a VARIAN measurement unit for Compact Gauges with at least two gauge connections, the cold cathode gauge can be controlled, for example, by a Pirani gauge.

Gas type dependence

The measuring signal depends on the type of gas being measured. The curves are accurate for dry air, N₂, O₂ and CO. They can be mathematically converted for other gases (→ Appendix B).

If you are using a VARIAN measurement unit for VARIAN Compact Gauges, you can enter a calibration factor to correct the measurement value displayed (→  of that measurement unit).


Ignition delay

An ignition delay occurs when cold cathode gauges are switched on. The delay time increases at low pressures and is typically:

$$\begin{aligned} 10^{-7} \text{ mbar} &\approx 0.1 \text{ minute} \\ 10^{-8} \text{ mbar} &\approx 1 \text{ minute} \\ 2 \times 10^{-9} \text{ mbar} &\approx 5 \text{ minutes} \end{aligned}$$

Contamination

Gauge failures due to contamination are not covered by the warranty.

Gauge contamination is influenced by the process media used as well as any existing or new contaminants and their respective partial pressures. Continuous operation in the range of 10^{-4} mbar ... 10^{-2} mbar can cause severe contamination as well as reduced up-time and maintenance cycles. With constantly low pressures ($< 1 \times 10^{-6}$ mbar), the gauge can be operated for more than one year without cleaning (cleaning the gauge →  16).

In general, contamination of the gauge leads to deviations of the measured values:

- In the low pressure range ($p < 1 \times 10^{-3}$ mbar), the pressure indication is usually too low (as a consequence of the contamination of the cold cathode system). In case of severe contamination, instabilities can occur (layers of the measuring chamber peel off). Contamination due to isolating layers can even lead to a complete failure of the discharge.

Contamination can to a certain extent be reduced by:

- geometric protection (e.g. screenings, elbows) against particles that spread rectilinearly
- mounting the flange of the gauge at a place where the partial pressure of the pollutants is particularly low.

Special precautions are required for vapors deposited under plasma (of the cold cathode measuring system). It may even be necessary to temporarily switch of the gauge while vapors occur.

5 Deinstallation

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.

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




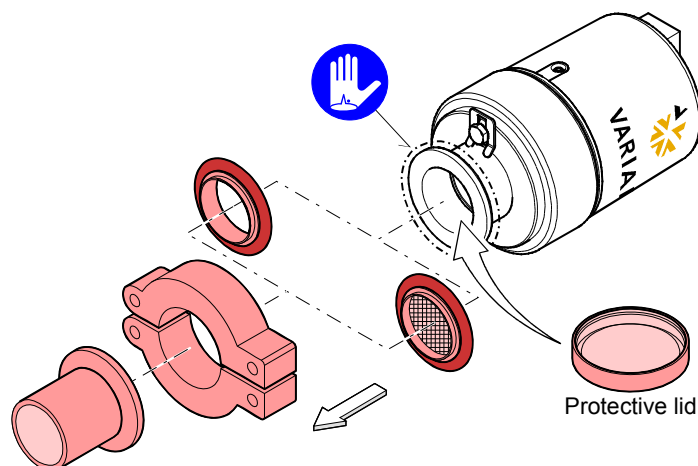
Caution: dirt sensitive area
Touching the product or parts thereof with bare hands increases the desorption rate. Always wear clean, lint-free gloves and use clean tools when working in this area.

Procedure

- 1** Vent the vacuum system.
- 2** Put the gauge out of operation and unplug the sensor cable.
- 3** Remove the gauge from the vacuum system and install the protective lid.



When deinstalling the CF flange connection, it may be advantageous to temporarily remove the magnet unit (→  10).



6 Maintenance



Gauge failures due to contamination or wear and tear as well as expendable parts (e.g. seals) are not covered by the warranty.

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.



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

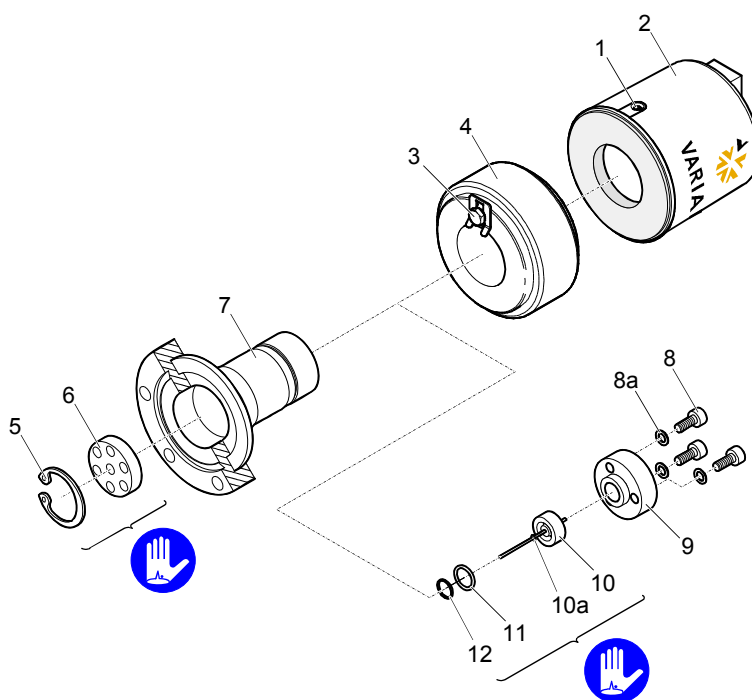
Touching the product or parts thereof with bare hands increases the desorption rate. Always wear clean, lint-free gloves and use clean tools when working in this area.

6.1 Cleaning the Gauge / Replacing Parts

Tools / material required

- Allen wrench AF 1.5
- Allen wrench AF 3.0
- Open-end wrench 7.0 mm
- Pliers for circlip
- Polishing cloth (400 grain) or Scotch-Brite
- Tweezers
- Cleaning alcohol
- Mounting tool for ignition aid
- Ignition aid
- FPM seal (11) for anode feedthrough

6.1.1 Disassembling the Gauge



Procedure

- ➊ Remove the gauge from the vacuum system (→ 13).
- ➋ Unfasten the hexagon socket set screw (1) on the side of the electronics unit (2).
- ➌ Remove the electronics unit.



Caution



The cover of the electronics unit cannot be removed.

- ➍ Unfasten the hexagon head screw (3) on the magnet unit (4) and remove the magnet unit.



Caution



The magnetic force and the tendency to tilt make it more difficult to separate the magnet unit and the measuring chamber (7).


- ➎ Remove the circlip (5) as well as the polarity insert (6) from the measuring chamber.
- ➏ Remove the four (or two) hexagon socket screws (8) incl. lock washers (8a) on the back of the measuring chamber.
- ➐ Carefully remove the following items in this order: pressure piece (9), complete anode (10), FPM seal (11) incl. support ring (12).

The parts can now be cleaned or replaced.


6.1.2 Cleaning the Gauge

Procedure

- 1 Using a polishing cloth rub the inside walls of the measuring chamber and the polarity insert to a bright finish.



Caution




The sealing surfaces must only be worked concentrically.


- 2 Rinse the measuring chamber and the polarity insert with cleaning alcohol.
- 3 Allow both to dry.

Cleaning or replacing the anode:

- 1 Remove the old ignition aid (10a) with tweezers.
- 2 Using a polishing cloth rub the anode pin to a bright finish.



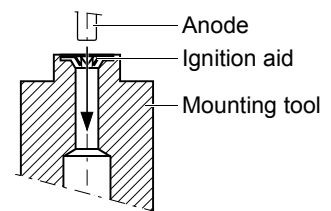
Caution



Do not bend the anode. Do not carry out mechanical work on the ceramic part.

- 3 Rinse the anode with cleaning alcohol.
- 4 Allow the anode to dry.
- 5 Insert a new ignition aid (10a) into the mounting tool.

- 6 Carefully press the anode (clean or new) centered and parallel to the tool axis into the ignition aid and insert it to a depth of approx. 15 mm. The final positioning is established after the anode is installed.




6.1.3 Reassembling the Gauge


Procedure

- 1 Insert the FPM seal (11) with the support ring (12) centered into the measuring chamber. The sealing surface, seal, and ceramic part must be clean.
- 2 Carefully insert the anode (10) incl. ignition aid (10a) into the measuring chamber.
- 3 Carefully place the pressure piece (9) on the measuring chamber and tighten it **uniformly** with the four (or two) hexagon socket screws (8) incl. lock washers (8a) until the stop position is reached.
- 4 Position the ignition aid (10a) by pushing the mounting tool over the anode pin until the mechanical stop is reached.

- 5 Remove the particles in the measuring chamber with dry nitrogen (be careful to hold the measuring chamber with the flange pointing downwards).
- 6 Slide the polarity insert (6) into the measuring chamber up to the mechanical stop.
- 7 Place the circlip (5) snugly fitting on the polarity insert.




Caution




Visually check that the anode pin is centered over the middle hole of the polarity insert (max. eccentricity = 0.5 mm).

- 8 If possible perform a leak test (leak rate $<10^{-9}$ mbar l/s).




WARNING






WARNING: electric arcing
 Helium may cause electric arcing with detrimental effects on the electronics of the product.
 Before performing any tightness tests put the product out of operation and remove the electronics unit.

- 9 Mount the magnet unit (4) and lock it with the hexagon head screw (3).
- 10 Carefully slide the electronics unit (2) on the magnet unit until the mechanical stop is reached.
- 11 Fasten the electronics unit (2) by means of the socket head set screw (1).

6.1.4 Adjusting the Gauge

The gauge is factory-calibrated and requires no maintenance. It must be replaced in the event of a defect (Spare Parts →  18).

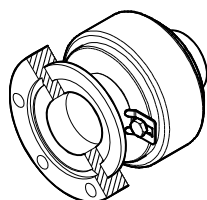
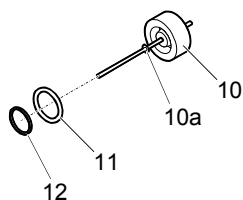
6.2 What to Do in Case of Problems

Problem	Possible cause	Correction
Measuring signal continually < 0.5 V and green lamp is OFF.	No supply voltage.	Turn on the power supply.
Measuring signal continually < 0.5 V and green lamp is ON	Supply voltage too low.	Increase the supply voltage (→  6).
	Electronics unit defective.	Replace the electronics unit (→  18).
Measurement signal continually in the range of 0.5 ... 1.8 V (underrange).	Vacuum chamber pressure $< 2 \times 10^{-9}$ mbar.	–
	Gas discharge has not ignited.	Wait until the gas discharge ignites (≈ 5 minutes at a pressure of 10^{-9} mbar).
Measuring signal unstable.	Gauge contaminated.	Clean the gauge (→  16).

7 Spare Parts


When ordering spare parts, always mention:

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




Pos.	Description	Ordering number
	Maintenance kit, consisting of:	FRG700MAINT
12	1× support ring	
11	1× O-ring FPM $\varnothing 10.82 \times 1.78$	
10a	3× ignition aid	
	1× O-ring FPM75 3.69×1.78 (not used with IMG)	
	Repair kit, consisting of:	IMG500REPR
12	1× support ring	
11	1× O-ring FPM $\varnothing 10.82 \times 1.78$	
10a	3× ignition aid	
10	1× anode, complete	
	Set of ignition aids, comprising:	FRG700IGN
10a	10× ignition aid	
	Mounting tool for ignition aid	FRG700IGNT
	Measuring system	
	DN 25 ISO-KF flange	IMG500MEAS25
	DN 40 CF-F flange	IMG500MEAS40

8 Returning the Product



WARNING




WARNING: forwarding contaminated products
 Contaminated products (e.g. radioactive, toxic, caustic or biological hazard) can be detrimental to health and environment.
 Products returned to VARIAN should preferably be free of harmful substances. Adhere to the forwarding regulations of all involved countries and forwarding companies and enclose a duly completed declaration of contamination.


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.


9 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: Measuring Signal vs. Pressure

Conversion formulae

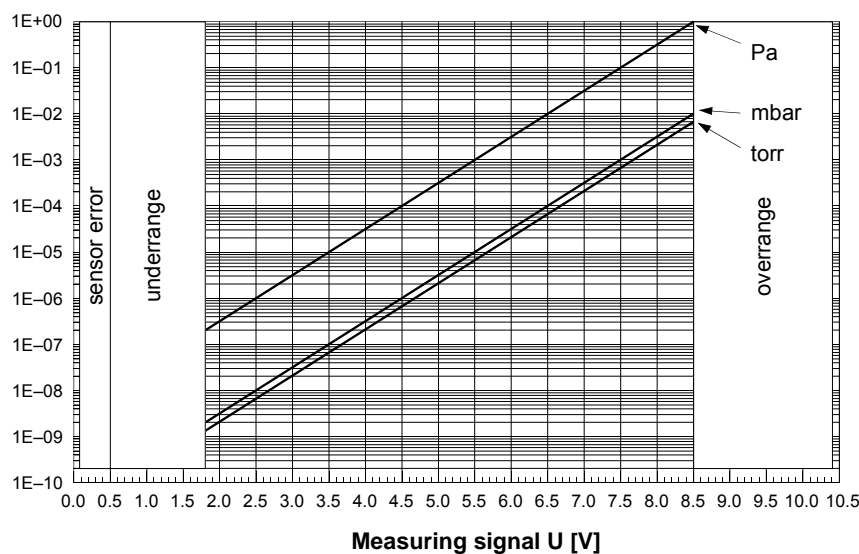
$$p = 10^{U-c} \Leftrightarrow U = c + \log_{10} p$$

p	U	c
[mbar]	[V]	10.5
[µbar]	[V]	7.5
[Torr]	[V]	10.625
[mTorr]	[V]	7.625
[micron]	[V]	7.625
[Pa]	[V]	8.5
[kPa]	[V]	11.5

where U Measurement signal valid in the range $2 \times 10^{-9} \text{ mbar} < p < 1 \times 10^{-2} \text{ mbar}$
 p Pressure $1.5 \times 10^{-9} \text{ Torr} < p < 7.5 \times 10^{-3} \text{ Torr}$
 c Constant (dependent on pressure unit) $2 \times 10^{-7} \text{ Pa} < p < 1 \text{ pa}$

Conversion curves

Pressure p

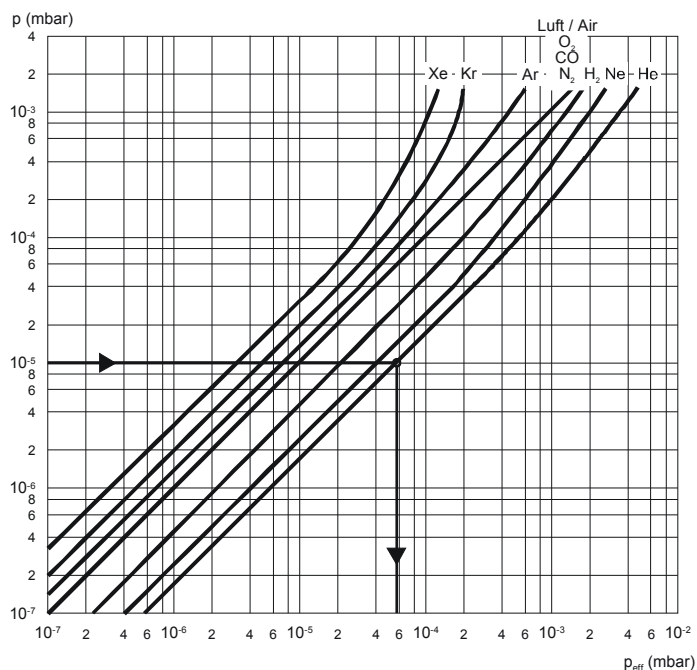


Conversion table

Measuring signal U [V]	Pressure p		
	[mbar]	[Torr]	[Pa]
< 0.5		Sensor error	
0.5 ... 1.8		Underrange	
1.8	2.0×10^{-9}	1.5×10^{-9}	2.0×10^{-7}
2.5	1.0×10^{-8}	7.5×10^{-9}	1.0×10^{-6}
3.5	1.0×10^{-7}	7.5×10^{-8}	1.0×10^{-5}
4.5	1.0×10^{-6}	7.5×10^{-7}	1.0×10^{-4}
5.5	1.0×10^{-5}	7.5×10^{-6}	1.0×10^{-3}
6.5	1.0×10^{-4}	7.5×10^{-5}	1.0×10^{-2}
7.5	1.0×10^{-3}	7.5×10^{-4}	0.1
8.5	1.0×10^{-2}	7.5×10^{-3}	1.0
8.5 ... 10.5		Overrange	

B: Gas Type Dependence

Indicated pressure (gauge calibrated for air)



Indication range below 10^{-5} mbar

In the range below 10^{-5} mbar, the pressure indication is linear. For gases other than air, the pressure can be determined by means of a simple conversion formula:

$$p_{\text{eff}} = K \times \text{indicated pressure}$$

where	gas type	K
	air (N ₂ , O ₂ , CO)	1.0
	Xe	0.4
	Kr	0.5
	Ar	0.8
	H ₂	2.4
	Ne	4.1
	He	5.9

These conversion factors are average values.



A mixture of gases and vapors is often involved. In this case, accurate determination is only possible with a partial pressure measurement instrument, e.g. a quadrupole mass spectrometer.

Notes

Notes



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