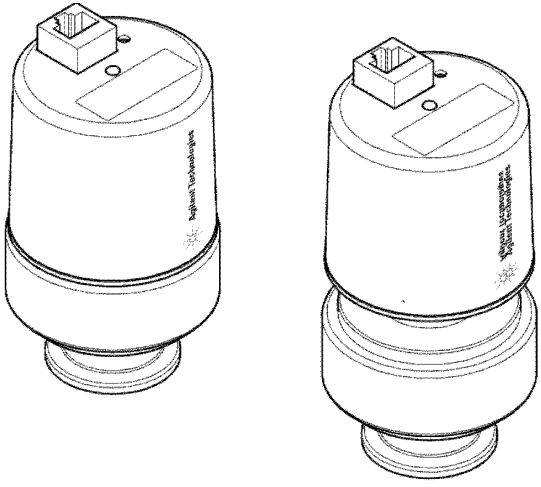
Agilent Inverted Magnetron Pirani Gauge FRG-700 and FRG-702

User Manual



Notices

Manual Part Number

TQMa74e1

Edition A.00, January 2024

Copyright

Agilent Technologies Italia S.p.A.
Vacuum Products Division
Via F.lli Varian, 54
10040 Leinì (TO)
ITALY

www.agilent.com

Instrument Manufacturing

Agilent Technologies LDA Malaysia Sdn Bhd Bayan Lepas
Free Industrial Zone 11900 Bayan Lepas, Penang Malaysia

Printed in Italy

Warranty

The material contained in this document is provided “as is,” and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

U.S. Government Restricted Rights. Software and technical data rights granted to the federal government include only those rights customarily provided to end user customers. Agilent provides this customary commercial license in Software and technical data pursuant to FAR 12.211 (Technical Data) and 12.212 (Computer Software) and, for the Department of Defense, DFARS 252.227-7015 (Technical Data - Commercial Items) and DFARS 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation).

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Contents

Contents

1 Instructions for Use

About this manual

Validity

This manual lists the instructions for the users of the FRG-700 and FRG-702, with particular reference to the notions relating to safety, operation and first level maintenance, limited to maintenance operations for which the user is responsible.

The maintenance operations, illustrated in the specific sections, with specific provisions relating to the higher level of maintenance (personnel specifically trained for maintenance operations) must not be carried out by the user.

For a correct installation and start/stop, please refer to "Installation" chapter.

For more detailed technical use, please refer to "Operations" chapter.

NOTE

1. This manual contains useful information so that all personnel using the FRG-700 and FRG-702 can operate it safely and guarantee perfect efficiency, for its entire life span.
2. Keep this manual, together with all the related publications, in an accessible place known to all operators/maintenance personnel.

Definitions and terminology

Definition of Caution, Warning and Note

Some important references of this manual are highlighted and framed in contrasting color.

CAUTION

Caution messages are displayed before procedures which, if not observed, could cause damage to the equipment.

WARNING

Warning messages draw the operator's attention to a specific procedure or practice which, if not performed correctly, could result in serious personal injury.

NOTE

Notes are intended to call attention to important information and provide more detail regarding specific steps.

Warning Symbols

The following is a list of symbols that appear in conjunction with warnings on the FRG-700 and FRG-702. The hazard they describe is also shown.

A triangular symbol indicates a warning. The meanings of the symbols that may appear alongside warnings in the documentation are as follows:

Generic hazard

ETL (Electrical Testing Laboratories)

European Declaration of Conformity

No access to pacemaker carriers

Magnetic Field

Waste Electrical and Electronic Equipment

Instructions for Use

The following symbol may be used on warning labels attached to the instrument. When you see this symbol, refer to the relevant operation or service manual for the correct procedure referred to by that warning label.

The following symbols appear on the instrument for your information.

CE	CE certification
	Waste Electrical and Electronic Equipment
	Generic Hazard
	No access to pacemaker carriers
	Magnetic Field
	ETL (Electrical Testing Laboratories)

Safety

This section contains the information, prescribed by the Low Voltage Directive 2014/35/EU, which is essential for the compliance and observance of the safety regulations both generally and in relation to the specific use of the product.

Failure to comply with these instructions and the other instructions contained in this manual may render the safety conditions envisaged in the design phase inefficient and cause accidents to those operating the product.

Agilent Technologies declines all responsibility for damage to the product or for the physical safety of the operator or third parties deriving from the non-observance of the safety rules indicated in the technical documentation.

Proper use

This manual contains important warnings and safety instructions to be observed in order for the unit to work safely.

The product described in this manual is intended exclusively for the area of application specified in the instructions. The manual also provides indications regarding the essential requirements for the application and operation of the product as well as the safety measures that can be adopted to guarantee regular operation. Agilent Technologies does not provide any guarantee or assume any responsibility for applications other than those described in this manual or in which the essential requirements and safety measures are not respected.

The product must only be used by qualified personnel who are able to take the necessary safety measures under conditions that do not cause damage or injury. Any accessories and equipment used with the product must be supplied or approved by Agilent Technologies. Any adjustment or maintenance operation must be performed by a professional technician informed about the risks.

Repairs on the product must be carried out exclusively by Agilent authorized personnel.

Improper use

Agilent Technologies declines all responsibility, deriving from the improper use of the FRG-700 AND FRG-702.

Agilent 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. filament) are not covered by the warranty.

Safety guideline for FRG-700 and FRG-702

- 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.

WARNING

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.

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

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.

Disposal

Meaning of the "WEEE" logo found in labels.

The following symbol is applied in accordance with the EC WEEE (Waste Electrical and Electronic Equipment) Directive.

This symbol (valid only in countries of the European Community) indicates that the product it applies to must NOT be disposed of together with ordinary domestic or industrial waste but must be sent to a differentiated waste collection system. The end user is therefore invited to contact the supplier of the device, whether the Parent Company or a retailer, to initiate the collection and disposal process after checking the contractual terms and conditions of sale.

Figure 1 Logo "WEEE"

For more information refer to:

http://www.agilent.com/environment/product/index.shtml

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.

Service

Should a customer need support, please contact local distributor or directly e-mail to:

vpt-customercare@agilent.com

vpl-customercare@agilent.com

Completion of the “Request for Return” form is required to return your product to Agilent for service (provided at the end of this manual).

2 Technical Information

Product Description

The Inverted Magnetron Pirani Gauges FRG-700 and FRG-702 have been designed for vacuum measurement in the pressure range of 5×10^{-9} ... 1000 mbar.

They must not be used for measuring flammable or combustible gases in mixtures containing oxidants (e.g. atmospheric oxygen) within the explosion range.

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

Over the whole measuring range, the measuring signal is output as a logarithm of the pressure. The gauge consists of two separate measurement systems (Pirani and cold cathode system) the signals of which are combined in such a way that one measurement signal is output. The Pirani measurement circuit is always on.

This document applies to products with part numbers:

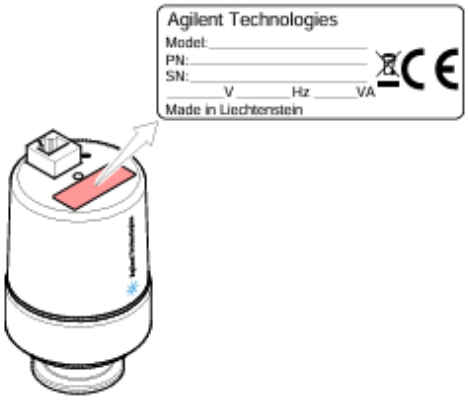
FRG-700 (FPM sealed)	FRG-702 (all-metal)
FRG700KF25 (DN 25 ISO-KF)	FRG702KF25 (DN 25 ISO-KF)
FRG700CF35 (DN 40 CF-C)	FRG702KF40 (DN 40 ISO-KF)
	FRG702CF35 (DN 40 CF-C)

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 FRG700KF25.

They apply to the other products by analogy. We reserve the right to make technical changes without prior notice. All dimensions in mm.

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



Technical Specifications

Table 1 Technical Specifications

Specifications	Value
Measuring range (air, N_2)	5×10^{-9} ... 1000 mbar
Accuracy (N_2)	≈±30% in the range 1×10^{-8} ... 100 mbar
Reproducibility	≈±5% in the range 1×10^{-8} ... 100 mbar
Gas type dependence	See page 21
Output signal (measuring signal)	
Voltage range	0 ... +10.5 V
Measuring range	1.82 ... 8.6 V
Voltage vs. pressure	logarithmic, 0.6 V / decade
Error signal	<0.5 V no supply >9.5 V Pirani measurement element defective (filament rupture)
Output impedance	2×10 Ω
Minimum loaded impedance	10 kΩ, short-circuit proof
Response time (pressure dependent)	
$p > 10^{-6}$ mbar $p = 10^{-8}$ mbar	<10 ms ≈1000 ms
Gauge identification	85 kΩ referenced to supply common
Status $p > 10^{-2}$ mbar Pirani-only mode $p < 10^{-2}$ mbar Cold cathode not ignited Pirani-only mode $p < 10^{-2}$ mbar Cold cathode ignited Combined Pirani / cold cathode mode	Pin 6  Low = 0 V  Low = 0 V  High = 15 ... 30 VDC
Lamp	High voltage on (LED on)

Table 1 Technical Specifications (continued)

Specifications	Value
Supply	
WARNING  **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 fused[1)].**	
Supply voltage at the gauge	15.0 ... 30.0 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	16.0 ... 30.0 VDC (ripple ≤1 V_{pp})
Adjustment <HV> potentiometer <ATM> potentiometer	 at <10^{-4} mbar at atmospheric pressure
Electrical connection Sensor cable Line length	FCC68 female, 8 poles 8 conductors plus shielding ≤50 m (8x0.14 mm²)
Operating voltage Operating current	≤3.3 kV ≤500 µA
Grounding concept Vacuum connection-signal common Supply common-signal common	see paragraoh Electrical Connection (page 28) connected via 10 kΩ (max. voltage differential with respect to safety ±50 V with respect to accuracy ±10 V) conducted separately

Materials exposed to vacuum
Vacuum connection
Measuring chamber
Feedthrough
Internal seals
  FRG-700
  FRG-702
Anode
Ignition aid
Pirani measuring tube
Pirani filament
	
	stainless steel
	stainless steel
	ceramic
	
	FPM 75
	Ag, Cu, soft solder (Sn, Ag)
	Mo
	stainless steel
	Ni, Au
	W

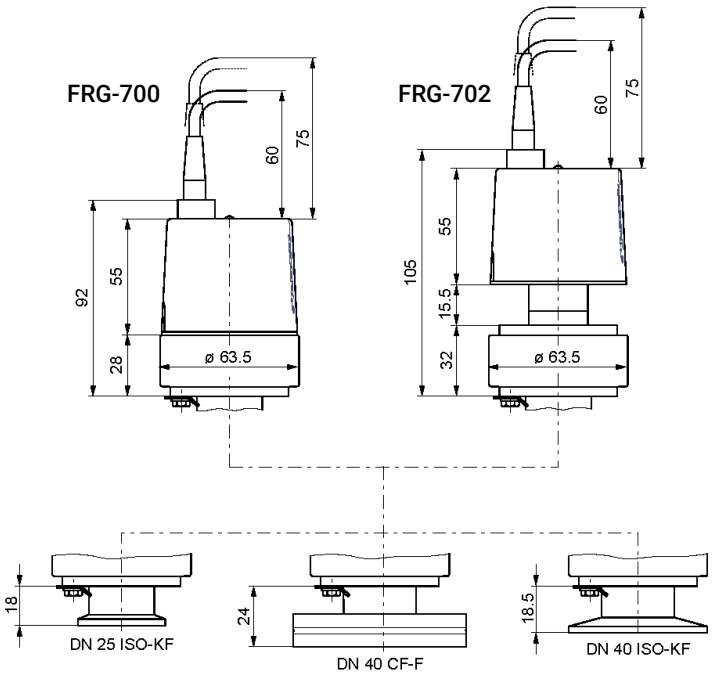
1) Agilent controller fulfill these requirements.

Table 1 Technical Specifications (continued)

Specifications	Value
Mounting orientation	any
Internal volume	≈20 cm³
Pressure	≤10 bar (absolute) limited to inert gases
Temperatures	
Operation	
FRG-700	+5 ... +55 °C
FRG-702	+5 ... +150 °C (at flange in horizontal mounting orientation, without magnetic shielding)
Bakeout	+150 °C (without magnetic shielding and electronics unit)
Pirani filament	+120 °C
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

FRG-700 and FRG-702 Outline

Dimensions [mm]



Weight

FRG700KF25	≈700 g	FRG702KF25	≈730 g
FRG700KF25	≈980 g	FRG702KF40	≈750 g
		FRG702CF35	≈1010 g

Figure 2 FRG-700 and FRG-702 Outline

A: Measuring Signal vs. Pressure

Conversion formulae

$$p = 10^{1.667U-d} \quad \Leftrightarrow \quad U = c + 0.6\log_{10} p$$

p	U	c	d
[mbar]	[V]	6.8	11.33
[Torr]	[V]	6.875	11.46
[Pa]	[V]	5.6	9.333

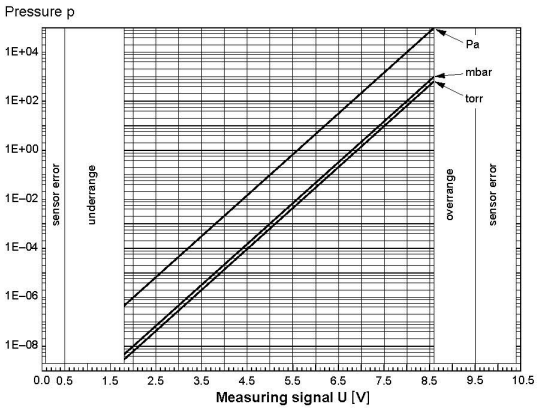
where:

p pressure
U measuring signal
c, d constant (pressure unit dependent)

valid in the range

5×10^{-9} mbar < p <1000 mbar
3.8×10^{-9} Torr < p <750 Torr
5×10^{-7} Pa < p <1×10^{5} pa

Conversion curves



Conversion table

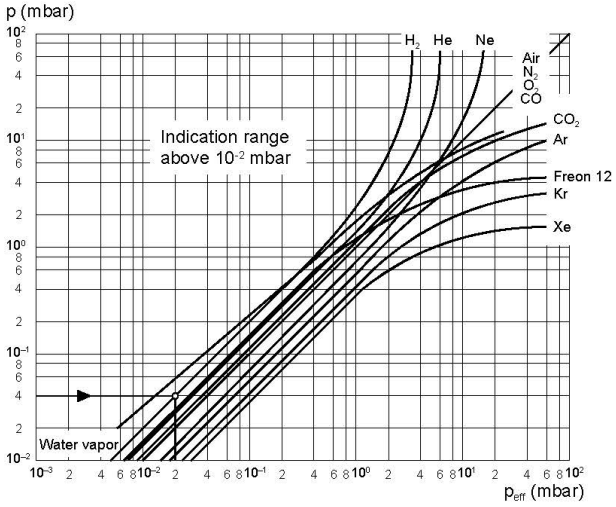
Meas. signal U [V]	Pressure p [mbar]	Pressure p [Torr]	Pressure p [Pa]
<0.5		Sensor error	
0.5 … 1.82		Underrange	
1.82	5.0×10^{-9}	3.8×10^{-9}	5.0×10^{-7}
2.0	1.0×10^{-8}	7.5×10^{-9}	1.0×10^{-6}
2.6	1.0×10^{-7}	7.5×10^{-8}	1.0×10^{-5}
3.2	1.0×10^{-6}	7.5×10^{-7}	1.0×10^{-4}
3.8	1.0×10^{-5}	7.5×10^{-6}	1.0×10^{-3}
4.4	1.0×10^{-4}	7.5×10^{-5}	1.0×10^{-2}
5.0	1.0×10^{-3}	7.5×10^{-4}	0.1
5.6	1.0×10^{-2}	7.5×10^{-3}	1.0
6.2	0.1	7.5×10^{-4}	10
6.8	1.0	0.75	100
7.4	10	7.5	1000
8.0	100	75	1.0×10^{4}
8.6	1000	750	1.0×10^{5}
8.6 … 9.5		Overrange	
9.5 … 10.5		Sensor error (Pirani defective)	

Figure 3 Measuring Signal vs. Pressure

B: Gas Type Dependence

Indication range above 10^{-2} mbar

Pressure indicated (gauge calibrated for air)



Indication range above 10^{-6} ... 0.1 mbar

Pressure indicated (gauge calibrated for air)

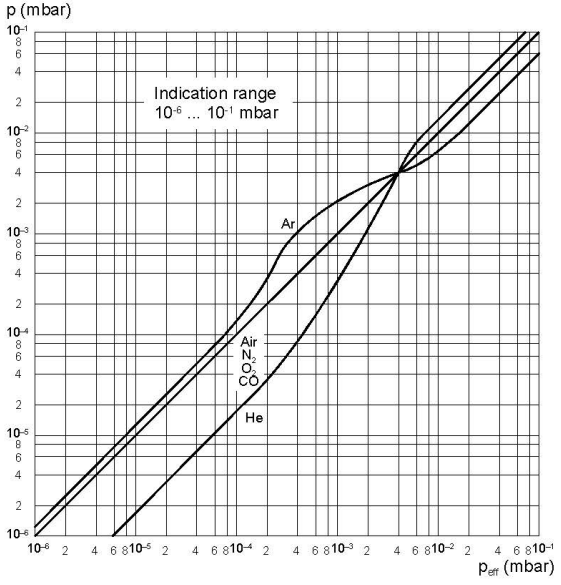


Figure 4 Gas Type Dependence

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:

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

where

gas type	K
air (O_2, CO, N_2)	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.

NOTE 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.

Installation

Vacuum Connection

WARNING

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.

WARNING

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.

WARNING

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.

NOTE

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.

NOTE

If adjustment should be possible after the gauge has been installed, be sure to install it so that the <HV> and <ATM> trimmer potentiometers can be accessed with a screw driver.

NOTE

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

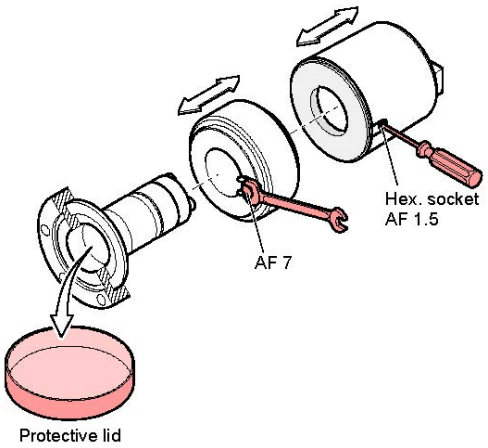


Figure 5

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

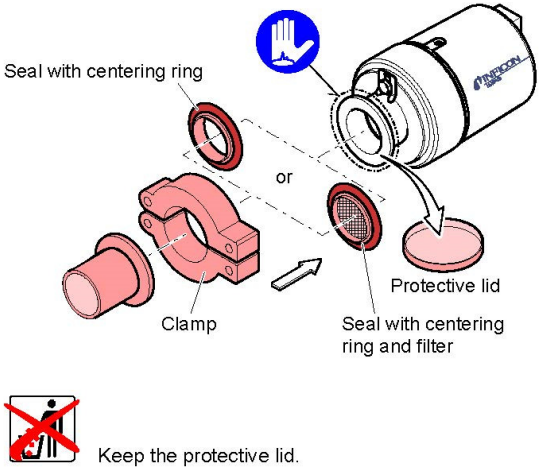


Figure 6

Removing the Magnet Unit (only for Gauges with CF Flanges)

Tools required

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

Procedure

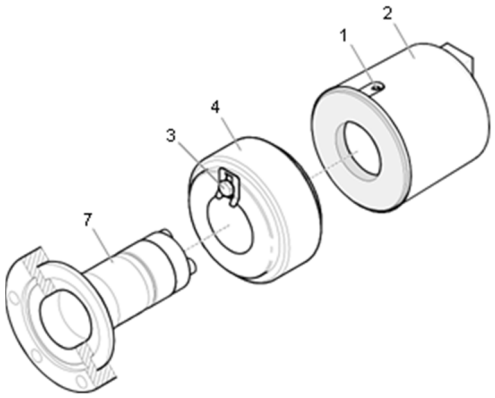


Figure 7

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.

NOTE 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).

Electrical Connection

Precondition

Make sure the vacuum connection is properly made.

Use With an Agilent Controller

Connect the sensor cable to the gauge and the controller.

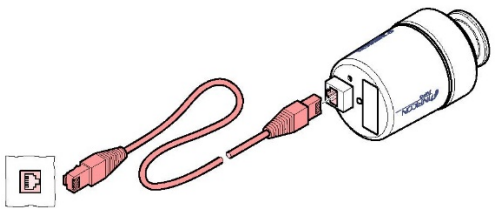
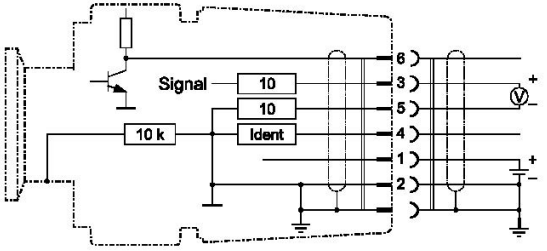


Figure 8

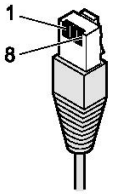
Use With Another Control Device

1 Make a sensor cable according to the diagram.



Electrical connection

Pin 1	Supply (15 … 30 V (dc)
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.



8 poles FCC-68

Figure 9

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

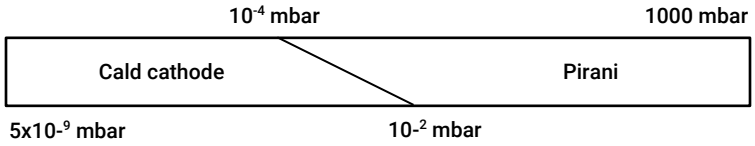
Operation

As soon as the required supply voltage is applied, the measuring signal is available between pins 3 and 5.

Allow for a stabilizing time of approx. 10 min. Once the gauge has been switched on, permanently leave it on irrespective of the pressure.

The gauge consists of two separate measuring systems: Pirani and cold cathode system according to the inverted magnetron principle. They are combined in such a way that for the user, they behave like one measuring system.

The optimum measuring configuration for the particular pressure range, in which measurement is performed, is used.



- The Pirani measuring circuit is always on
- The cold cathode measuring circuit is controlled by the Pirani circuit and is activated only at pressures <1×10^{-2} mbar

The identification output (pin 6) indicates the current status of the gauge:

Table 2

Pressure	Lamp on the gauge	Operating mode	Pin 6
p > 1x10^{-2} mbar		Pirani-only mode	Low = 0 V
p < 1x10^{-2} mbar		Cold cathode not ignited Pirani-only mode	Low = 0 V
p < 1x10^{-2} mbar		Cold cathode ignited Combined Pirani / cold cathode mode	High = 15 ... 30 VDC

As long as the cold cathode measuring circuit has not ignited, the measuring value of the Pirani is output as measuring signal.

Gas type dependence

The measuring signal depends on the type of gas being measured. The curves are accurate for dry air, O_2, CO and N_2. They can be mathematically converted for other gases.

If you are using an Agilent controller, you can enter a calibration factor to correct the pressure reading.

Ignition delay

When cold cathode measuring systems are activated, an ignition delay occurs. The delay time increases at low pressures and is typically:

10^{-5} mbar ≈1 second

10^{-7} mbar ≈20 seconds

5×10^{-9} mbar ≈2 minutes

As long as the cold cathode measuring circuit has not yet ignited, the measured value of the Pirani is output as measuring signal. The status output (pin 6, low) indicates the Pirani-only mode.

NOTE If the gauge is activated at a pressure $p < 3\times10^{-9}$, the gauge cannot recognize whether the cold cathode system has ignited.

NOTE Once flanged on, permanently leave the gauge in the operating mode irrespective of the pressure range. Like this, the ignition delay of the cold cathode measuring circuit is always negligible (<1 s), and thermal stabilizing effects are minimized.

Contamination

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

Gauge contamination is influenced by the process media used as well as by any present 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 (p <1x10^{-6} mbar), the gauge can be operated for more than one year without cleaning.

Contamination of the gauge generally causes a deviation of the measured values:

- In the high pressure range (1< 10^{-3} mbar ... 0.1 mbar), the pressure reading is too high (contamination of the Pirani element). Readjustment of the Pirani measuring system.
- In the low pressure range (p < 1x10^{-3} mbar), the pressure reading is usually too low (contamination of the cold cathode system). In case of severe contamination, instabilities can occur (layers of the measuring chamber peel off). Contamination due to insulation layers can even lead to a complete failure of the discharge ("Underrange" is displayed).

Contamination can to a certain extent be reduced by:

- geometric protection measures (e.g. screenings, elbows) for 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 such vapors occur.

Adjusting the Gauge

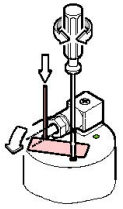
The gauge is factory-calibrated. If used under different climatic conditions, through extreme temperatures, aging or contamination, and after exchanging the sensor, the characteristic curve can be offset and readjustment may become necessary.

The cold cathode measuring circuit, which is dominant for low pressures (<1×10^{-3} mbar), is factory-calibrated and cannot be adjusted. By way of contrast, the Pirani measuring circuit can be adjusted. Any adjustment has a negligible effect on the pressure range between approx. 10^{-2} mbar and 10^{2} mbar.

Tools required

- Screw driver 1.5 mm
- Cylindrical pin ø≈3 mm

Procedure

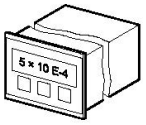
1. If you are using a seal with centering ring and filter, check that they are clean or replace them if necessary.
2. Put the gauge into operation (if possible, in the position, in which it will be used later on).
3. Evacuate the vacuum system to p << 10^{-4} mbar, and then wait 10 minutes.
4. Turn the nameplate counter-clockwise until the mechanical stop is reached.
5. 

While depressing the pin with the cylindrical pin, adjust the <HV> potentiometer

… to 4.20 V

or

… to 5×10^{-4} mbar.

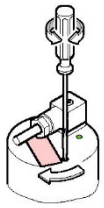


After that, turn the potentiometer counter-clockwise by 1/3 of a turn.

6 Vent the gauge with air or nitrogen to atmospheric pressure, and wait at least 10 minutes.

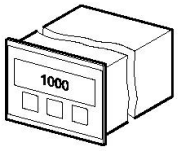
7 Turn the nameplate clockwise until the mechanical stop is reached.

8



Using the 1.5 mm screwdriver, adjust the <ATM> potentiometer …

… to 8.60 V or … to 1×10^3 mbar.



9 Turn the nameplate back to its original position (it catches).

Deinstallation

WARNING

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

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

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 off operation and unplug the sensor cable.
3. Remove the gauge from the vacuum system and install the protective lid.

NOTE

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

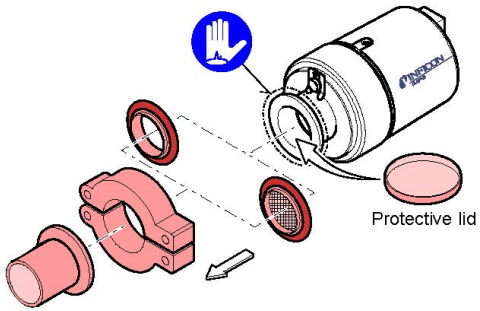


Figure 10

Cleaning FRG-700

Cleaning the measuring chamber and the polarity insert

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

NOTE 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 used ignition aid (10a) with tweezers.

2 Using a polishing cloth rub the anode pin to a bright finish

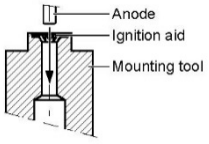
NOTE Do not bend the anode. Do not carry out mechanical work on the ceramic part.

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.



Cleaning the Pirani element

1 Remove the FPM seal (13a) from the Pirani element (13).

2 Fill the Pirani measuring tube with cleaning alcohol and let it work.

3 Pour the alcohol out of the tube.

4 Dry the tube (e.g. with a blow dryer <150 °C).

5 Slide a new FPM seal over the Pirani element and insert it into the corresponding groove.

6 Reinstall the Pirani element.

Replacing the Pirani element

NOTE If it is severely contaminated or defective.

- Slide a new FPM seal (13a) over the Pirani element (13) and insert it into the corresponding groove.
- Mount the Pirani element.

Cleaning FRG-700, Replacing Parts

WARNING

DANGER: cleaning agents.
Cleaning agents can be detrimental to health and environment.
Adhere to the relevant regulations and take the necessary precautions when handling cleaning agents and disposing of them. Consider possible reactions with the product materials.

NOTE We recommend replacing the Pirani element when cleaning the gauge.

Tools / material required

- Allen wrench AF 1.5
- Allen wrench AF 3
- 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
- Pirani element (13) incl. FPM seal (13a)
- FPM seal (11) for anode feedthrough.

Disassembling FRG-700

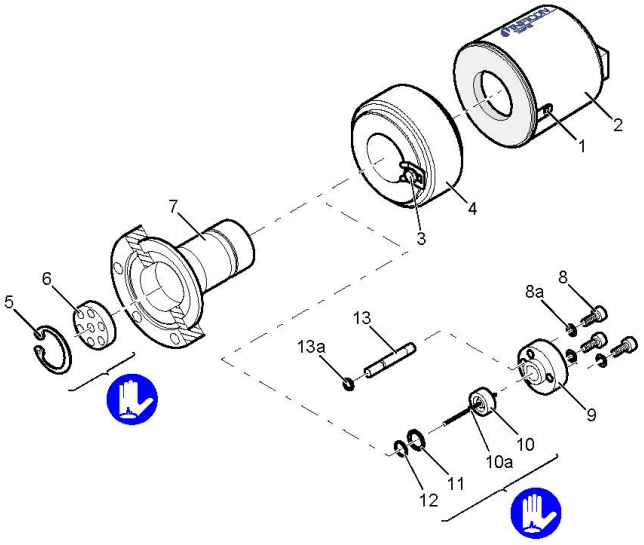


Figure 11

1 Remove the gauge from the vacuum system.

2 Unfasten the hexagon socket set screw (1) on the electronics unit (2).

3 Remove the electronics unit without twisting it.

NOTE The cover of the electronics unit cannot be removed.

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

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

5 Remove the circlip (5) and the polarity insert (6) from the measuring chamber.

6 Remove the three hexagon socket screws (8) incl. lock washers (8a) on the back of the measuring chamber.

7 Carefully remove the following parts in this order (without exerting stress on the Pirani element (13)): pressure piece (9), complete anode (10), FPM seal (11) incl. support ring (12), Pirani element (13) incl. FPM seal (13a).

The parts can now be cleaned or replaced individually.

Replacing the Pirani element

NOTE If it is severely contaminated or defective.

1. Slide a new FPM seal (13a) over the Pirani element (13) and insert it into the corresponding groove.
2. Mount the Pirani element.

Reassembling FRG-700

1. Insert the FPM seal (11) with the support ring (12) centered into the measuring chamber (7). 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. Insert the Pirani element (13) with the FPM seal (13a) slid over it into the corresponding bore hole.
4. Carefully place the pressure piece (9) on the measuring chamber and tighten them with the three hexagon socket screws (8) incl. lock washers (8a) uniformly until the stop position is reached.
5. Position the ignition aid (10a) by pushing the mounting tool over the anode pin until the mechanical stop is reached.
6. Blow the particles in the measuring chamber with dry nitrogen (be careful to hold the measuring chamber with the flange pointing downwards).
7. Slide the polarity insert (6) into the measuring chamber until the mechanical stop is reached.
8. Place the circlip (5) snugly fitting on the polarity insert.

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

9. 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.

10 Mount the magnet unit (4) and lock it with the screw (3).

11 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).

12 Push the electronics unit up to the mechanical stop and lock it with the hexagon socket set screw (1).

13 Adjust the gauge.

Cleaning FRG-702

Cleaning the measuring chamber and the polarity insert

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

NOTE 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 used ignition aid (10a) with pliers.

2 Using a polishing cloth rub the anode pin to a bright finish.

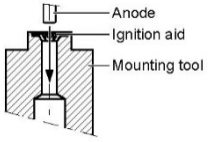
NOTE Do not bend the anode. Do not carry out mechanical work on the ceramic part.

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.



Replacing the Pirani element

1 Slide the screw fitting (13a) and the copper seal (13b) over the Pirani element (13).

2 Mount the Pirani element.

Cleaning FRG-702, Replacing Parts

WARNING

DANGER: cleaning agents.
Cleaning agents can be detrimental to health and environment.
Adhere to the relevant regulations and take the necessary precautions when handling cleaning agents and disposing of them. Consider possible reactions with the product materials.

NOTE

For cleaning the measuring chamber, the Pirani element must be removed and replaced.

Tools / material required

- Allen wrench AF 1.5
- Allen wrench AF 3
- Open-end wrench AF 6
- Open-end wrench AF 7
- Pliers for circlip
- Polishing cloth (400 grain) or Scotch-Brite
- Tweezers
- Cleaning alcohol
- Mounting tool for ignition aid
- Ignition aid
- Metal seal (11) for anode feedthrough
- Pirani element (13) incl. set of seals (13a, 13b).

Disassembling FRG-702

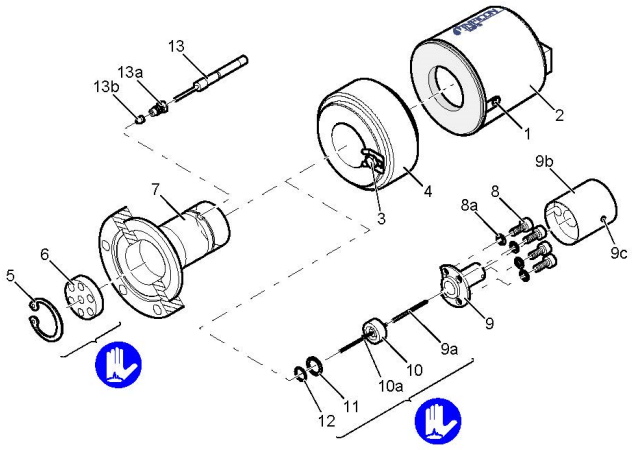


Figure 12

1 Remove the gauge from the vacuum system.

2 Unfasten the hexagon socket set screw (1) on the electronics unit (2).

3 Remove the electronics unit without twisting it.

NOTE The cover of the electronics unit cannot be removed.

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

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

5 Remove the circlip (5) and the polarity insert (6) from the measuring chamber.

6 Unfasten the hexagon socket set screw (9c) and remove the insulator (9b) **without twisting it**.

7 Remove the four hexagon socket screws (8) incl. lock washers (8a) on the back of the measuring chamber.

8 Carefully remove the following parts in this order (without exerting stress on the Pirani element (13)): pressure piece (9), anode extension piece (9a), complete anode (10), metal seal (11) incl. centering ring (12).

9 Unfasten the screw fitting (13a) of the Pirani element and remove Pirani element together with the copper seal (13b).

The parts can now be cleaned or replaced individually.

Reassembling FRG-702

1. Insert the Pirani element (13) with the screw fitting (13a) and copper seal (13b) slid over it into the corresponding conic bore hole (7) of the measuring chamber.
2. Tighten the screw fitting (13a) with your fingers while slightly pushing the Pirani element against the mechanical stop. Then tighten the screw fitting by one turn with the open-end wrench.
3. Insert a new metal seal (11) incl. the centering ring (12) centered into the measuring chamber (7).
4. Carefully insert the anode (10) with the ignition aid (10a) and extension piece (9a) slid onto it into the measuring chamber.
5. Carefully place the pressure piece (9) on the measuring chamber.
6. Insert the four hexagon socket screws (8) incl. lock washers (8a) and tighten them uniformly until the mechanical stop is reached.
7. Carefully slide the insulator (9b) onto the pressure piece (9) and lock it with the hexagon socket set screw (9c).
8. Position the ignition aid (10a) by pushing the mounting tool over the anode pin until the mechanical stop is reached.
9. Blow the particles in the measuring chamber with dry nitrogen (be careful to hold the measuring chamber with the flange pointing downwards).
10. Slide the polarity insert (6) into the measuring chamber until the mechanical stop is reached.
11. Place the circlip (5) snugly fitting on the polarity insert.

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

12 If possible perform a leak test (leak rate <10-9 mbar l/s). If necessary slightly retighten the screw fitting (13a).

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.

13 Mount the magnet unit (4) and lock it with the hexagon head screw (3).

14 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).

15 Push the electronics unit up to the mechanical stop and lock it with the hexagon socket set screw (1).

16 Adjust the gauge.

Troubleshooting

Table 3 Troubleshooting Table

Problem	Possible Causes	Remedy
Measuring signal continually < 0.5 V "Error low".	No supply voltage.	Turn on the power supply.
Measuring signal continually > 9.5 V "Error high".	Pirani measurement element defective (filament rupture).	Replace the Pirani element. (FRG-700 page 38) (FRG-702 page 41).
	Electronics unit not correctly mounted.	Mount the electronics unit correctly. (FRG-700 page 38) (FRG-702 page 42).
The green lamp is ON and the status output indicates Pirani-only mode (measuring signal continually > 4.0 V)	The cold cathode discharge has not ignited.	Wait until the gas discharge ignites (in case of contamination with insulation layers, the cold cathode may completely fail to ignite). Cleaning (FRG-700 page 36) (FRG-702 page 41).
	The FRG has only been activated with $p < 3 \times 10^{-9}$ mbar.	Slightly increase the pressure.
Measuring signal continually > 5 V or display > 10-3 mbar although vacuum pressure is OK.	Pirani measurement circuit not adjusted, e.g. due to severe contamination.	Readjust the Pirani measurement circuit. If adjustment is impossible, replace the Pirani element.
	Measurement of heavy gases.	Convert with the corresponding formula.
	Severe outgassing in the cold cathode measuring chamber.	Clean the measuring chamber.
Measuring signal unstable.	Gauge contaminated.	Clean the gauge (FRG-700 page 36) (FRG-702 page 41).

Spare Parts

When ordering spare parts, always mention:

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

Table 4 Spare Parts for FRG-700

Pos.	Description	Ordering number
	Maintenance kit, consisting of:	FRG700MAINT
12	1× support ring	
13a	1× O-ring FPM ø3.69×1.78	
11	1× O-ring FPM ø10.82×1.78	
10a	3× ignition aid	
	Repair kit, consisting of:	FRG700REPR
13	1× Pirani element	
12	1× support ring	
13a	1× O-ring FPM ø3.69×1.78	
11	1× O-ring FPM ø10.82×1.78	
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	FRG700MEAS25
	DN 40 CF-F flange	FRG700MEAS40

FRG-700

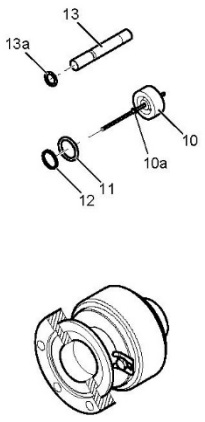


Figure 13

Table 5 Spare Parts for FRG-702

Pos.	Description	Ordering number
	Maintenance kit, consisting of:	FRG702MAINT
11	1× seal HN 100 (9x1.6)	
12	1× centering ring	
10a	3× ignition aid	
	Repair kit, consisting of::	FRG702REPR
13	1× Pirani element with glass feedthrough	
13a	1× screw fitting	
13b	1× copper seal	
9a	1× anode extension piece	
10	1× anode, complete	
10a	3× ignition aid	
11	1× seal HN 100 (9x1.6)	
12	1× centering ring	
	Set of ignition aids, comprising:	FRG700IGN
10a	10× ignition aid	
	Mounting tool for ignition aid	FRG700IGNT
	Measuring system	
	DN 25 ISO-KF flange	FRG702MEAS25
	DN 40 CF-F flange	FRG702MEAS40

FRG-702

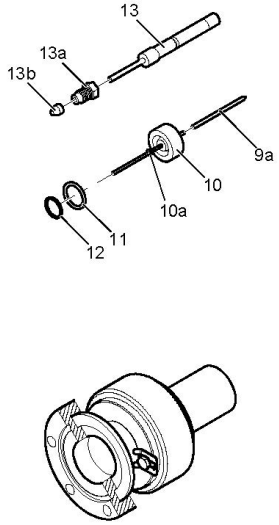


Figure 14

Agilent Technologies

Vacuum Products Division
Instructions for returning products

Dear Customer,

Please follow these instructions whenever one of our products needs to be returned.

Complete the attached **Request for Return form** and send it to Agilent Technologies (see below), taking particular care to include the completed **Health and Safety** declaration Section. No work can be started on your unit until we receive a completed copy of this form.
After evaluating the information, Agilent Technologies will provide you with a **Return Authorization (RA) number** via email or fax, as requested. Note: Depending on the type of return, a Purchase Order may be required at the time **the Request for Return is submitted**. We will quote any necessary services (evaluation, repair, special cleaning, eg).

Product preparation

- Remove all accessories from the core product (e.g. inlet screens, vent valves).
- Prior to shipment and if applicable for your product, drain any oils or other liquids, purge or flush all gasses, and wipe off any excess residue.
- If ordering an Advance Exchange product, please use the packaging from the Advance Exchange to return the defective product.
- Seal the product in a plastic bag, and package product carefully to avoid damage in transit. You are responsible for loss or damage in transit.
- Include a copy of the Health and Safety Declaration in the shipping documentation on the outside of the shipping box of your returning product.
- Clearly label package with RA number. Using the shipping label provided will ensure the proper address and RA number are on the package. Packages shipped to Agilent without a RA clearly written on the outside cannot be accepted and will be returned.
- Return only products for which the RA was issued.

Shipping

- Ship to the location specified on the printable label, which will be sent, along with the RA number, as soon as we have received all of the required information. Customer is responsible for freight charges on returning product.
- Return shipments must comply with all applicable Shipping Regulations (IATA, DOT, ADR, etc.) and carrier requirements.

RETURN THE COMPLETED **REQUEST FOR RETURN** FORM TO YOUR NEAREST LOCATION:

EUROPE:	**NORTH AMERICA:**	**PACIFIC RIM:**
Fax: 00 39 011 9979 330	Fax: 1 781 860 9252	Please visit our website for
Toll Free: 00 800 234 234 00	Toll Free: 800 882 7426, Option 3	individual office information
vpt-customercare@agilent.com	vpl-ra@agilent.com	http://www.agilent.com

TERMS AND CONDITIONS

Please read the terms and conditions below as they apply to all returns and are in addition to the Agilent Technologies Vacuum Product Division – Products and Services Terms of Sale.

- Unless otherwise pre-negotiated, customer is responsible for the freight charges for the returning product. Return shipments must comply with all applicable Shipping Regulations (IATA, DOT, etc.) and carrier requirements.
- Agilent Technologies is not responsible for returning customer provided packaging or containers.
- Customers receiving an Advance Exchange product agree to return the defective, rebuildable part to Agilent Technologies within 15 business days. Failure to do so, or returning a non-rebuildable part (crashed), will result in an invoice for the non-returned/non-rebuildable part.
- Returns for credit toward the purchase of new or refurbished Products are subject to prior Agilent approval and may incur a restocking fee. Please reference the original purchase order number.
- Units returned for evaluation will be evaluated, and a quote for repair will be issued. If you choose to have the unit repaired, the cost of the evaluation will be deducted from the final repair pricing. A Purchase Order for the final repair price should be issued within 3 weeks of quotation date. Units without a Purchase Order for repair will be returned to the customer, and the evaluation fee will be invoiced.
- Products returned that have not been drained from oil will be disposed.
- A Special Cleaning fee will apply to all exposed products
- If requesting a calibration service, units must be functionally capable of being calibrated.

Agilent Technologies

Vacuum Products Division
Request for Return Form

Customer information		
Company :	Contact Name:	
Address:	Tel:	Fax:
	Email:	

Equipment			
Product description	Agilent PartNo	Agilent Serial No	Original Purchasing Reference
Failure description		Type of process (for which the equipment was used)	

Type of return

☐ Non Billable ☐ Billable ➡ New PO # (hard copy must be submitted with this form): _____

☐ Exchange ☐ Repair ☐ Upgrade ☐ Demo ☐ Calibration ☐ Evaluation ☐ Return for Credit

Health and safety

The product has been exposed to the following substances:
(by selecting 'YES' you MUST complete the table to the right)

Substances (please refer to MSDS forms)

* Agilent will not accept delivery of any product that is exposed to radioactive, biological, explosive substances or dioxins, PCB's without written evidence of decontamination.

		Trade name	Chemical name	Chemical Symbol	CAS Number
Toxic	☐ YES ☐ NO				
Harmful	☐ YES ☐ NO				
Corrosive	☐ YES ☐ NO				
Reactive	☐ YES ☐ NO				
Flammable	☐ YES ☐ NO				
Explosive (*)	☐ YES ☐ NO				
Radioactive (*)	☐ YES ☐ NO				
Biological (*)	☐ YES ☐ NO				
Oxidizing	☐ YES ☐ NO				
Sensitizer	☐ YES ☐ NO				
Other dangerous substances	☐ YES ☐ NO				

Goods preparation

If you have replied YES to one of the above questions. Has the product been purged? ☐ YES ☐ NO
If yes, which cleaning agent/method:

Has the product been drained from oil? ☐ YES ☐ NOT APPLICABLE
I confirm to place this declaration on the outside of the shipping box. ☐

I declare that the above information is true and complete to the best of my knowledge and belief.
I understand and agree to the terms and conditions on page 2 of this document.

Name:	Authorized Signature:
Position:	
Date:	

NOTE: If a product is received at Agilent which is contaminated with a toxic or hazardous material that was not disclosed, **the customer will be held responsible** for all costs incurred to ensure the safe handling of the product, and is liable for any harm or injury to Agilent employees as well as to any third party occurring as a result of exposure to toxic or hazardous materials present in the product.

Agilent Vacuum Products Division/Sales and Service Offices

United States
Agilent Technologies
121 Hartwell Avenue
Lexington, MA 02421 - USA
Ph. +1 781 861 7200
Fax: +1 781 860 5437
Toll-Free: +1 800 882 7426
vpl-customercare@agilent.com

Netherlands
Agilent Technologies Netherlands B.V.
Customer Contact Center
Laan van Langerhuize 1, toren A-8
1186 DS Amstelveen
Tel. +31 020 547 2600
Fax +31 020 654 5748
customercare_netherlands@agilent.com

Belgium
Agilent Technologies Belgium S.A./N.V.
Customer Contact Center
Pegasus Park
De Kleetlaan 12A bus 12
B-1831 Diegem
Tel. +32 2 404 92 22
Fax +32 2 626 46 30
customercare_belgium@agilent.com

Brazil
Agilent Technologies Brasil
Avenida Marcos Penteado de Ulhoa
Rodrigues, 939 - 6° andar
Castelo Branco Office Park
Torre Jacarandá - Tamboré
Barueri, Sao Paulo CEP: 06460-040
Toll free: 0800 728 1405

China
Agilent Technologies Co. Ltd (China)
No.3, Wang Jing Bei Lu, Chao Yang District
Beijing, 100102, China
Tel: +86 (0)10 64397888
Fax: +86 (0)10 64397666
Toll free: 400 8203278 (mobile)
Toll free: 800 8203278 (landline)
vacuum.cnmarketing@agilent.com
vpc-customerservice@agilent.com

France
Agilent Technologies
Parc Technopolis - Z.A. de Courtaboeuf
3, avenue du Canada - CS 90263
91978 Les Ulis cedex, France
Tel: +33 (0) 1 64 53 61 15
Fax: +33 (0) 1 64 53 50 01
vpf.sales@agilent.com

Southeast Asia
Agilent Technologies Sales Sdn Bhd
Unit 201, Level 2 uptown 2,
2 Jalan SS21/37, Damansara Uptown
47400 Petaling Jaya, Selangor, Malaysia
Ph. +603 7712 6181
Fax: +603 7727 1239
Toll free: 1 800 880 805
vps-customerservice@agilent.com

India (Sales)
Agilent Technologies India Pvt. Ltd.
Unit Nos 110- 116, & Part of 101 & 109
First Floor, Splendor Forum,
Plot No.-3 , District Centre, Jasola
New Delhi-110025
Ph. +91 11 4623 7100
Fax: +91 4623 7105
Toll Free: 1 800 180 1517

Italy
Agilent Technologies Italia S.p.A.
Via F.lli Varian, 54
10040 Leini, (Torino) - Italy
Tel: +39 011 9979 111
Fax: +39 011 9979 350
Toll free: 00 800 234 234 00
vpt-customerservice@agilent.com

Japan
Agilent Technologies Japan, Ltd.
9-1 Takakura-cho Hachioji-city,
Tokyo, Japan
Tel.: +81- 3-5232-1253
Fax: +81-120-565-154
Toll-Free: +81-120-477-111
jp-vvt-sales.pdl-ext@agilent.com

Singapore
Agilent Technologies Singapore Pte. Ltd,
1 Yishun Avenue 7,
Singapore 768923
Tel : (65) 6215 8045
Fax : (65) 6754 0574
Toll free: 1 800 2762622
vps-customerservice@agilent.com

Korea
Agilent Technologies Korea, Ltd.
Ilshin Buiilding 4F
Yongsan-gu Hannam-daero
Seoul Korea 04418
Tel: +82 (0)2 2194 9449
Fax: +82 (0)2 2194 9853
Toll free: 080 222 2452
vpk-customerservice@agilent.com

UK and Ireland
Agilent Technologies LDA UK Limited
Lakeside Cheadle Royal Business Park
Cheadle, Cheshire SK8 3GR,
United Kingdom
Ph. +44 01865291570
Fax +44 01865291571
Toll free: 00 800 234 234 00
Toll free fax: 00 800 345 345 00
vpt-customercare@agilent.com

10/2022

India (Service)
Agilent Technologies India Pvt. Ltd.
C-Block, RMZ Centennial Plot Number- 8A, 8B, 8C, 8D,
Doddanakundi Industrial Area, ITPL Road,
Mahadevapura Post, Bangalore- 560048
Ph. +91 80 40614000
Fax: +91 80 40148991

Taiwan
Agilent Technologies Taiwan Limited
No. 20 Gao-shuang Road, Ping-zhen Dist
Tao-Yuan City
32450 Taiwan
Tel: +886 3 4959004
Toll free: 0800 018 768
vpw-customerservice@agilent.com

Germany and Austria
Agilent Technologies
Sales & Services GmbH & Co. KG
Lyoner Str. 20
60 528 Frankfurt am Main
Germany
Tel: +49 69 6773 43 2230
Fax: +49 69 6773 43 2250

Mexico
Agilent Technologies
Concepcion Beistegui No 109
Col Del Valle
C.P. 03100 – Mexico, D.F.
Tel.: +52 5 523 9465
Fax: +52 5 523 9472

Other Countries
Agilent Technologies Italia S.p.A.
Via F.lli Varian, 54
10040 Leini, (Torino) - Italy
Tel.: +39 011 997 9111
Fax: +39 011 997 9350
Toll-Free: 00 800 234 234 00
vpt-customercare@agilent.com

Customer Support & Service
NORTH AMERICA:
Toll Free: 800 882 7426
vpl-ra@agilent.com
Lexington-service@agilent.com

EUROPE:
Toll Free: 00 800 234 234 00
vpt-customercare@agilent.com

PACIFIC RIM:
please visit our website for individual office information
http://www.agilent.com/chem/vacuum

Worldwide Web Site, Catalog and Order On-line:
www.agilent.com/chem/vacuum
Representatives in most countries

Agilent Technologies

In This Book

The manual describes the following:

- Instruction for Use
- Technical information

This information is subject to change without notice.

TQMa74e1

Edition 01/24
Issue A.00

Agilent Technologies Italia S.p.A.
Vacuum Products Division
Via F.lli Varian, 54
10040 Leinì (TO)
ITALY

Agilent