Compact Cold Cathode Gauge
IMG-500

Operating Instructions
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For cross-references within this document, the symbol (→ XY) is used.
Compact Cold Cathode Gauge IMG-500

**Product Identification**

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:

![Product Nameplate Image]

Agilent Technologies
Model: [Blank]
PN: [Blank]
SN: [Blank]
Made in Liechtenstein

**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 $2 \times 10^{-9} \ldots 1 \times 10^{-2}$ mbar.

The gauges can be operated in connection with an Agilent Vacuum Gauge Controller AGC-100, an Agilent 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.
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.

**Notice**

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
Compact Cold Cathode Gauge IMG-500

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. seals) are not covered by the warranty.
# 2 Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range (air, N\textsubscript{2})</td>
<td>2×10\textsuperscript{9} ... 1×10\textsuperscript{5} mbar</td>
</tr>
<tr>
<td>Accuracy (N\textsubscript{2})</td>
<td>≈30% (in the range 1×10\textsuperscript{8} ... 1×10\textsuperscript{3} mbar)</td>
</tr>
<tr>
<td>Reproducibility</td>
<td>≈5% (in the range 1×10\textsuperscript{8} ... 1×10\textsuperscript{3} mbar)</td>
</tr>
<tr>
<td>Gas type dependence</td>
<td>→ Appendix B</td>
</tr>
<tr>
<td>Output signal (measuring signal)</td>
<td></td>
</tr>
<tr>
<td>Voltage range</td>
<td>0 ... +10.5 V</td>
</tr>
<tr>
<td>Voltage vs. pressure</td>
<td>logarithmic, 1.0 V / decade</td>
</tr>
<tr>
<td>Error signal</td>
<td>&lt;0.5 V no supply</td>
</tr>
<tr>
<td>Output impedance</td>
<td>2×10 Ω</td>
</tr>
<tr>
<td>Minimum loaded impedance</td>
<td>10 kΩ, short-circuit proof</td>
</tr>
<tr>
<td>Response time (pressure dependent)</td>
<td></td>
</tr>
<tr>
<td>p &gt; 10\textsuperscript{6} mbar</td>
<td>&lt;10 ms</td>
</tr>
<tr>
<td>p = 10\textsuperscript{8} mbar</td>
<td>≈1000 ms</td>
</tr>
<tr>
<td>Gauge identification</td>
<td>100 kΩ referenced to supply common</td>
</tr>
<tr>
<td>Supply</td>
<td></td>
</tr>
</tbody>
</table>

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\textsuperscript{1).}

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage at the gauge</td>
<td>15 ... 30 VDC (ripple ≤ 1 V\textsubscript{pp})</td>
</tr>
<tr>
<td>Power consumption</td>
<td>≤2 W</td>
</tr>
<tr>
<td>Fuse\textsuperscript{1)</td>
<td>≤1 AT</td>
</tr>
<tr>
<td>The minimum voltage of the power supply must</td>
<td>be increased proportionally to the length of the</td>
</tr>
<tr>
<td>length of the sensor cable.</td>
<td></td>
</tr>
<tr>
<td>Voltage at the supply unit with maximum line</td>
<td>16 ... 30 VDC (ripple ≤ 1 V\textsubscript{pp})</td>
</tr>
<tr>
<td>length</td>
<td></td>
</tr>
<tr>
<td>Adjustment</td>
<td>the gauge is adjusted at the factory and requires no maintenance.</td>
</tr>
<tr>
<td>Electrical connection</td>
<td>FCC68 female, 8-pin</td>
</tr>
<tr>
<td>Sensor cable</td>
<td>8 conductors plus shielding</td>
</tr>
<tr>
<td>Line length</td>
<td>≤50 m (8×0.14 mm\textsuperscript{2})</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>≤3.3 kV</td>
</tr>
<tr>
<td>Operating current</td>
<td>≤500 µA</td>
</tr>
</tbody>
</table>

\textsuperscript{1) Agilent controller fulfill these requirements.}
### Compact Cold Cathode Gauge IMG-500

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grounding concept</strong></td>
<td>&quot;Power Connection&quot;</td>
</tr>
<tr>
<td><strong>Vacuum connection-signal common</strong></td>
<td>connected via 10 kΩ (max. voltage differential with respect to safety ±50 V with respect to accuracy ±10 V)</td>
</tr>
<tr>
<td><strong>Supply common-signal common</strong></td>
<td>conducted separately; differential measurement recommended for cable lengths ≥10 m</td>
</tr>
<tr>
<td><strong>Materials exposed to vacuum</strong></td>
<td></td>
</tr>
<tr>
<td>Vacuum connection</td>
<td>stainless steel</td>
</tr>
<tr>
<td>Measuring chamber</td>
<td>stainless steel</td>
</tr>
<tr>
<td>Feedthrough</td>
<td>ceramic (Al₂O₃)</td>
</tr>
<tr>
<td>Internal seals</td>
<td>FPM 75</td>
</tr>
<tr>
<td>Anode</td>
<td>Mo</td>
</tr>
<tr>
<td>Ignition aid</td>
<td>stainless steel</td>
</tr>
<tr>
<td><strong>Mounting orientation</strong></td>
<td>any</td>
</tr>
<tr>
<td><strong>Internal volume</strong></td>
<td>≈20 cm³</td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
<td>≤10 bar (absolute) limited to inert gases</td>
</tr>
<tr>
<td><strong>Temperatures</strong></td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>+5 … +55 °C</td>
</tr>
<tr>
<td>Bakeout</td>
<td>+150 °C (without electronics and magnetic shielding)</td>
</tr>
<tr>
<td>Storage</td>
<td>−40 °C … +65 °C</td>
</tr>
<tr>
<td><strong>Relative humidity</strong></td>
<td>≤80% at temperatures up to +31 °C decreasing to 50% at +40 °C</td>
</tr>
<tr>
<td><strong>Use</strong></td>
<td>indoors only altitude up to 2000 m</td>
</tr>
<tr>
<td><strong>Degree of protection</strong></td>
<td>IP 40</td>
</tr>
<tr>
<td><strong>Dimensions [mm]</strong></td>
<td></td>
</tr>
<tr>
<td>DN 25 ISO-KF</td>
<td>28 55 92 Φ 63.5</td>
</tr>
<tr>
<td>DN 40 CF-F</td>
<td>24 75 60</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>≤950 g</td>
</tr>
</tbody>
</table>
3 Installation

3.1 Vacuum Connection

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: 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: 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 clam-
ring.

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.

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.
Compact Cold Cathode Gauge IMG-500

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 (→ 11).

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 (→ § 9).

3.2.1 Use With an Agilent 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.

![Diagram of the sensor cable connection](image1.jpg)

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.

![Diagram of the sensor cable connection](image2.jpg)
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 an Agilent 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, N\textsubscript{2}, O\textsubscript{2} and CO. They can be mathematically converted for other gases (→ Appendix B).

If you are using an Agilent measurement unit for Agilent 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:

- 10^{-7} mbar ≈ 0.1 minute
- 10^{-6} mbar ≈ 1 minute
- 2×10^{-9} mbar ≈ 5 minutes

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 (< 1×10^{-6} mbar), the gauge can be operated for more than one year without cleaning (cleaning the gauge → 17).

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

- In the low pressure range (p < 1×10^{-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 off 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 (→ 3 11).
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

1. Remove the gauge from the vacuum system (→ 14).

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

3. Remove the electronics unit.

   Caution
   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.

   Caution
   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) as well as the polarity insert (6) from the measuring chamber.

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

7. 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.
Position the ignition aid (10a) by pushing the mounting tool over the anode pin until the mechanical stop is reached.

Remove the particles in the measuring chamber with dry nitrogen (be careful to hold the measuring chamber with the flange pointing downwards).

Slide the polarity insert (6) into the measuring chamber up to the mechanical stop.

Place the circlip (5) snugly fitting on the polarity insert.

If possible perform a leak test (leak rate <10⁻⁹ mbar l/s).

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

Carefully slide the electronics unit (2) on the magnet unit until the mechanical stop is reached.

Fasten the electronics unit (2) by means of the socket head set screw (1).

The gauge is factory-calibrated and requires no maintenance. It must be replaced in the event of a defect (Spare Parts → 19).

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring signal continually &lt; 0.5 V and green lamp is OFF.</td>
<td>No supply voltage.</td>
<td>Turn on the power supply.</td>
</tr>
<tr>
<td>Measuring signal continually &lt; 0.5 V and green lamp is ON</td>
<td>Supply voltage too low.</td>
<td>Increase the supply voltage (→ 7).</td>
</tr>
<tr>
<td>Measurement signal continually in the range of 0.5 ... 1.8 V (underrange).</td>
<td>Vacuum chamber pressure &lt; 2×10⁻⁹ mbar.</td>
<td>–</td>
</tr>
<tr>
<td>Measuring signal unstable.</td>
<td>Gas discharge has not ignited.</td>
<td>Wait until the gas discharge ignites (&lt; 5 minutes at a pressure of 10⁻⁹ mbar).</td>
</tr>
<tr>
<td>Measuring signal unstable.</td>
<td>Gauge contaminated.</td>
<td>Clean the gauge (→ 17).</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Description</th>
<th>Ordering number</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Maintenance kit, consisting of:</td>
<td>FRG700MAINT</td>
</tr>
<tr>
<td></td>
<td>1× support ring</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1× O-ring FPM ø10.82 × 1.78</td>
<td></td>
</tr>
<tr>
<td>10a</td>
<td>3× ignition aid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1× O-ring FPM75 3.69 × 1.78 (not used with IMG)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Repair kit, consisting of:</td>
<td>IMG500REPR</td>
</tr>
<tr>
<td>12</td>
<td>1× support ring</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1× O-ring FPM ø10.82 × 1.78</td>
<td></td>
</tr>
<tr>
<td>10a</td>
<td>3× ignition aid</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1× anode, complete</td>
<td></td>
</tr>
<tr>
<td>10a</td>
<td>Set of ignition aids, comprising:</td>
<td>FRG700IGN</td>
</tr>
<tr>
<td></td>
<td>10× ignition aid</td>
<td></td>
</tr>
<tr>
<td>10a</td>
<td>Mounting tool for ignition aid</td>
<td>FRG700IGNT</td>
</tr>
<tr>
<td></td>
<td>Measuring system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DN 25 ISO-KF flange</td>
<td>IMG500MEAS25</td>
</tr>
<tr>
<td></td>
<td>DN 40 CF-F flange</td>
<td>IMG500MEAS40</td>
</tr>
</tbody>
</table>
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 Agilent 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.
A: Measuring Signal vs. Pressure

Conversion formulae

\[ p = 10^U c \quad \Leftrightarrow \quad U = c + \log_{10} p \]

<table>
<thead>
<tr>
<th>p</th>
<th>U</th>
<th>c</th>
</tr>
</thead>
<tbody>
<tr>
<td>[mbar]</td>
<td>[V]</td>
<td>10.5</td>
</tr>
<tr>
<td>[µbar]</td>
<td>[V]</td>
<td>7.5</td>
</tr>
<tr>
<td>[Torr]</td>
<td>[V]</td>
<td>10.625</td>
</tr>
<tr>
<td>[mTorr]</td>
<td>[V]</td>
<td>7.625</td>
</tr>
<tr>
<td>[micron]</td>
<td>[V]</td>
<td>7.625</td>
</tr>
<tr>
<td>[Pa]</td>
<td>[V]</td>
<td>8.5</td>
</tr>
<tr>
<td>[kPa]</td>
<td>[V]</td>
<td>11.5</td>
</tr>
</tbody>
</table>

where

- \( U \) Measurement signal
- \( p \) Pressure
- \( c \) Constant (dependent on pressure unit)

valid in the range

- \( 2 \times 10^{-9} \) mbar < \( p < 1 \times 10^{-7} \) mbar
- \( 1.5 \times 10^{-9} \) Torr < \( p < 7.5 \times 10^{-7} \) Torr
- \( 2 \times 10^{-7} \) Pa < \( p < 1 \) Pa

Conversion curves

Measuring signal \( U \) [V]

Conversion table

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.5</td>
<td></td>
<td></td>
<td>Sensor error</td>
</tr>
<tr>
<td>0.5 ... 1.8</td>
<td></td>
<td></td>
<td>Underrange</td>
</tr>
<tr>
<td>1.8</td>
<td>( 2 \times 10^{-9} )</td>
<td>( 1.5 \times 10^{-9} )</td>
<td>( 2 \times 10^{-7} )</td>
</tr>
<tr>
<td>2.5</td>
<td>( 1 \times 10^{-8} )</td>
<td>( 7.5 \times 10^{-9} )</td>
<td>( 1 \times 10^{-6} )</td>
</tr>
<tr>
<td>3.5</td>
<td>( 1 \times 10^{-7} )</td>
<td>( 7.5 \times 10^{-8} )</td>
<td>( 1 \times 10^{-5} )</td>
</tr>
<tr>
<td>4.5</td>
<td>( 1 \times 10^{-6} )</td>
<td>( 7.5 \times 10^{-7} )</td>
<td>( 1 \times 10^{-4} )</td>
</tr>
<tr>
<td>5.5</td>
<td>( 1 \times 10^{-5} )</td>
<td>( 7.5 \times 10^{-6} )</td>
<td>( 1 \times 10^{-3} )</td>
</tr>
<tr>
<td>6.5</td>
<td>( 1 \times 10^{-4} )</td>
<td>( 7.5 \times 10^{-5} )</td>
<td>( 1 \times 10^{-2} )</td>
</tr>
<tr>
<td>7.5</td>
<td>( 1 \times 10^{-3} )</td>
<td>( 7.5 \times 10^{-4} )</td>
<td>( 0.1 )</td>
</tr>
<tr>
<td>8.5</td>
<td>( 1 \times 10^{-2} )</td>
<td>( 7.5 \times 10^{-3} )</td>
<td>( 1 )</td>
</tr>
<tr>
<td>8.5 ... 10.5</td>
<td></td>
<td></td>
<td>Overrange</td>
</tr>
</tbody>
</table>
B: Gas Type Dependence

Indicated pressure (gauge calibrated for air)

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

<table>
<thead>
<tr>
<th>gas type</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>air (N\textsubscript{2}, O\textsubscript{2}, CO)</td>
<td>1.0</td>
</tr>
<tr>
<td>Xe</td>
<td>0.4</td>
</tr>
<tr>
<td>Kr</td>
<td>0.5</td>
</tr>
<tr>
<td>Ar</td>
<td>0.8</td>
</tr>
<tr>
<td>H\textsubscript{2}</td>
<td>2.4</td>
</tr>
<tr>
<td>Ne</td>
<td>4.1</td>
</tr>
<tr>
<td>He</td>
<td>5.9</td>
</tr>
</tbody>
</table>

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.
Vacuum Products Division
Instructions for returning products

Dear Customer:

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

1) Complete the attached Request for Return form and send it to Agilent Technologies (see below), taking particular care to identify all products that have pumped or been exposed to any toxic or hazardous materials.

2) 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, etc).

3) Important steps for the shipment of returning product:
   - Remove all accessories from the core product (e.g. inlet screens, vent valves).
   - Prior to shipment, 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.
   - Agilent Technologies is not responsible for returning customer provided packaging or containers.
   - 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.

4) Return only products for which the RA was issued.

5) Product being returned under a RA must be received within 15 business days.

6) 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.

7) Return shipments must comply with all applicable Shipping Regulations (IATA, DOT, etc.) and carrier requirements.

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

**EUROPE:**
Fax: 00 39 011 8979 330
Fax Free: 00 800 345 345 00
Toll Free: 00 800 234 234 00
vpt-customer-care@agilent.com

**NORTH AMERICA:**
Fax: 1 781 860 9252
Fax Free: 800 882 7426, Option 3
Toll Free: 800 882 7426, Option 3
vpl-ra@agilent.com

**PACIFIC RIM:**
Fax: please visit our website for individual office information
Fax Free: 1 800 234 234 00
Toll Free: 800 882 7426, Option 3
http://www.agilent.com
1) **CUSTOMER INFORMATION**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Contact Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Tel:</td>
<td>Email:</td>
</tr>
<tr>
<td>Customer Ship To</td>
<td>Customer Bill To</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Europe only: VAT reg. Number:    USA/Canada only:  [ ] Taxable  [ ] Non-taxable

2) **PRODUCT IDENTIFICATION**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Agilent P/N</th>
<th>Agilent S/N</th>
<th>Original Purchasing Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3) **TYPE OF RETURN** (Choose one from each row and supply Purchase Order if requesting a billable service)

3A. [ ] Non-Billable  [ ] Billable  New PO # (hard copy must be submitted with this form):

3B. [ ] Exchange  [ ] Repair  [ ] Upgrade  [ ] Consignment/Demo  [ ] Calibration  [ ] Evaluation  [ ] Return for Credit

4) **HEALTH and SAFETY CERTIFICATION**

AGILENT TECHNOLOGIES CANNOT ACCEPT ANY PRODUCTS CONTAMINATED WITH BIOLOGICAL OR EXPLOSIVE HAZARDS, RADIOACTIVE MATERIAL, OR MERCURY AT ITS FACILITY.

Call Agilent Technologies to discuss alternatives if this requirement presents a problem.

The equipment listed above (check one):

- [ ] HAS NOT pumped or been exposed to any toxic or hazardous materials. OR
- [ ] HAS pumped or been exposed to the following toxic or hazardous materials. If this box is checked, the following information must also be filled out. Check boxes for all materials to which product(s) pumped or was exposed:
  - [ ] Toxic  [ ] Corrosive  [ ] Reactive  [ ] Flammable  [ ] Explosive  [ ] Biological  [ ] Radioactive

List all toxic/hazardous materials. Include product name, chemical name, and chemical symbol or formula:

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.

Print Name: __________________________  Authorized Signature: __________________________  Date: _______

5) **FAILURE INFORMATION:**

Failure Mode (REQUIRED FIELD. See next page for suggestions of failure terms):

Detailed Description of Malfunction: (Please provide the error message)

Application (system and model):

I understand and agree to the terms of Section 6, Page 3/3.
Print Name: __________________________  Authorized Signature: __________________________  Date: _______
Please use these Failure Mode to describe the concern about the product on Page 2.

### TURBO PUMPS and TURBO CONTROLLERS

<table>
<thead>
<tr>
<th>APPARENT DEFECT/MALFUNCTION</th>
<th>POSITION</th>
<th>PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Does not start</td>
<td>Vertical</td>
<td>Power: Rotational Speed:</td>
</tr>
<tr>
<td>- Does not spin freely</td>
<td>Horizontal</td>
<td>Current: Inlet Pressure:</td>
</tr>
<tr>
<td>- Does not reach full speed</td>
<td>Upside-down</td>
<td>Temp 1: Foreline Pressure:</td>
</tr>
<tr>
<td>- Mechanical Contact</td>
<td>Other:</td>
<td>Temp 2: Purge flow:</td>
</tr>
<tr>
<td>- Cooling defective</td>
<td></td>
<td>OPERATING TIME:</td>
</tr>
<tr>
<td>- Noise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Vibrations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Leak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Overtemperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Clamping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ION PUMPS/CONTROLLERS

<table>
<thead>
<tr>
<th>DEFECT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Bad feedthrough</td>
<td>Poor vacuum</td>
</tr>
<tr>
<td>- Vacuum leak</td>
<td>High voltage problem</td>
</tr>
<tr>
<td>- Error code on display</td>
<td>Other</td>
</tr>
</tbody>
</table>

### VALVES/COMPONENTS

<table>
<thead>
<tr>
<th>DEFECT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Main seal leak</td>
<td>Becomes leak</td>
</tr>
<tr>
<td>- Solenoid failure</td>
<td>Damaged flange</td>
</tr>
<tr>
<td>- Damaged sealing area</td>
<td>Other</td>
</tr>
</tbody>
</table>

### LEAK DETECTORS

<table>
<thead>
<tr>
<th>DEFECT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cannot calibrate</td>
<td>No zero/high background</td>
</tr>
<tr>
<td>- Vacuum system unstable</td>
<td>Cannot reach test mode</td>
</tr>
<tr>
<td>- Failed to start</td>
<td>Other</td>
</tr>
</tbody>
</table>

### INSTRUMENTS

<table>
<thead>
<tr>
<th>DEFECT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Gauge tube not working</td>
<td>Display problem</td>
</tr>
<tr>
<td>- Communication failure</td>
<td>Degas not working</td>
</tr>
<tr>
<td>- Error code on display</td>
<td>Other</td>
</tr>
</tbody>
</table>

### SCROLL AND ROTARY VANE PUMPS

<table>
<thead>
<tr>
<th>DEFECT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Pump doesn’t start</td>
<td>Noisy pump (describe)</td>
</tr>
<tr>
<td>- Doesn’t reach vacuum</td>
<td>Over temperature</td>
</tr>
<tr>
<td>- Pump seized</td>
<td>Other</td>
</tr>
</tbody>
</table>

### DIFFUSION PUMPS

<table>
<thead>
<tr>
<th>DEFECT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Heater failure</td>
<td>Electrical problem</td>
</tr>
<tr>
<td>- Doesn’t reach vacuum</td>
<td>Cooling coil damage</td>
</tr>
<tr>
<td>- Vacuum leak</td>
<td>Other</td>
</tr>
</tbody>
</table>

### ADDITIONAL TERMS

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

- 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.
- 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.
- A Special Cleaning fee will apply to all exposed products per Section 4 of this document.
- If requesting a calibration service, units must be functionally capable of being calibrated.

Pg 3/3
Service & Support

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Fax: +1 781 860 5437
vpl-customerservice@agilent.com

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Fax: +65 6754 0574
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Learn more:
www.agilent.com/chem/vacuum

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