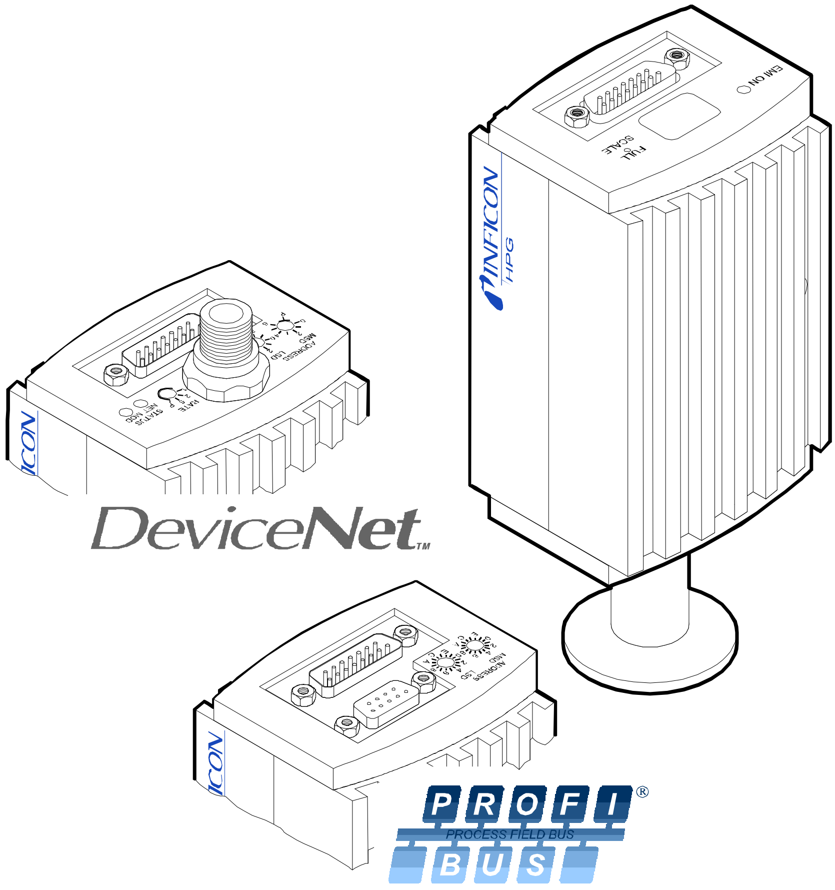
Operating Maual

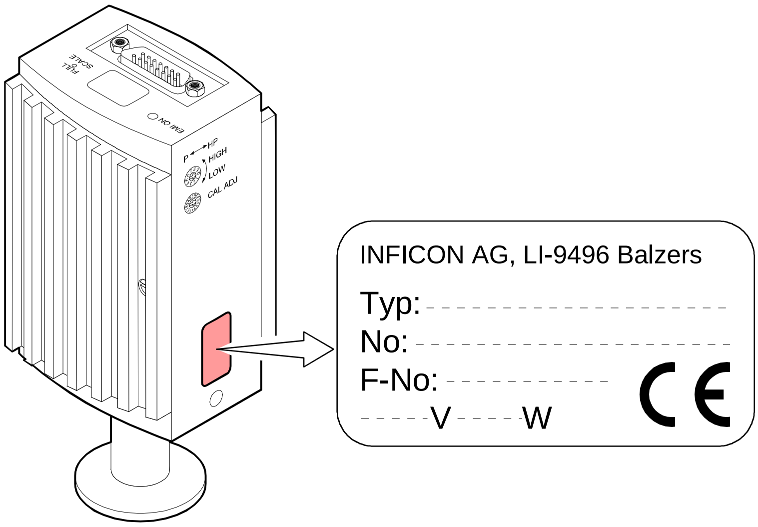
High Pressure / Pirani Gauge

HPG400
HPG400-SD
HPG400-SP



Product Identification

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



Validity

This document applies to products with the following part numbers:

HPG400 (without display)

- 353-520 (vacuum connection DN 25 ISO-KF)
- 353-522 (vacuum connection DN 40 CF-R)

HPG400 (with display)

- 353-521 (vacuum connection DN 25 ISO-KF)
- 353-523 (vacuum connection DN 40 CF-R)

HPG400-SD (with DeviceNet interface and switching functions)

- 353-527 (vacuum connection DN 25 ISO-KF)
- 353-528 (vacuum connection DN 40 CF-R)

HPG400-SP (with Profibus interface and switching functions)

- 353-525 (vacuum connection DN 25 ISO-KF)
- 353-526 (vacuum connection DN 40 CF-R)

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 gauge with part number 353-520. They apply to the other gauges by analogy.

All HPG400 versions are shipped with an instruction sheet (→ 🕮 [8]).

HPG400-SD and HPG400-SP come with a supplementary instruction sheet describing the fieldbus interfaces and the switching functions (→ 🕮 [9]).

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

Intended Use

The HPG400 gauges have been designed for vacuum measurement of non-flammable gases and gas mixtures in a pressure range of 2×10^{-6} … 1 mbar. The control range of the gauge allows trend display from <1 mbar to 1000 mbar.

The gauges can be operated in connection with the INFICON Vacuum Gauge Controller VGC4XX or with other control devices.

Functional Principle

The HPG400 functions with a HP (high pressure) hot cathode ionization manometer, which is controlled by the built-in Pirani manometer (control range). The hot cathode is switched on only below the switching threshold of ≈1 mbar (to prevent filament burn-out). For pressures above this threshold, the Pirani signal is output.

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

Trademarks

DeviceNet™	Open DeviceNet Vendor Association, Inc.

Contents

For cross-references within this document, the symbol (→ 🗎 XY) is used, for cross-references to other documents, the symbol (→ 🕮 [Z]).

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

Hint, recommendation

The result is O.K.

The result is not as expected

Optical inspection

Waiting time, reaction time

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 (→ 🗎 11) and the process media.

  Consider possible reactions of the process media (e.g. explosion) due to 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.

Communicate the safety instructions to all other users.

1.4 Liability and Warranty

INFICON 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.

2 Technical Data

Measurement	Measuring range (air, N_2)	
	Hot cathode	2×10^{-6} … 1 mbar
	Pirani (control range)	1×10^{-2} … 1000 mbar
	Accuracy	
	10^{-5} … 1 mbar	±15% of reading (valid between 10^{-5} mbar and change-over threshold setting (<P ↔ HP>, → 🗎 25).
	Repeatability	(after 10 min. stabilization)
	10^{-5} … 10^{-1} mbar	±2% of reading
	10^{-1} … 100 mbar	±30% of reading
	Gas type dependence	→ Appendix B

Emission	Switching (changeover) threshold (selectable from 5 defined setpoints)	1 mbar 5×10^{-1} mbar 2×10^{-1} mbar 1×10^{-1} mbar 5×10^{-2} mbar
	Emission current	continually rising
	from 1 mbar	4 µA
	to 2×10^{-6} mbar	130 µA
	Anode voltage	180 V

Output signal	Voltage range	0 … +10.2 VDC
	Measuring range	
	Hot cathode	1.5 … 7.5 V
	Pirani	8.5 … 9.75 V
	Overrange hot cathode	7.5 V ≤ U ≤ 8.0 V
	Underrange hot cathode	0.5 V ≤ U ≤ 1.5 V
	Overrange Pirani	9.75 V ≤ U ≤ 10.2 V
	Underrange Pirani	8.0 V ≤ U ≤ 8.5 V
	Relationship voltage-pressure	logarithmic, → Appendix A
	Hot cathode	1.00 V/decade
	Pirani	0.25 V/decade
	Error signals	
	Hot cathode error	≤+0.3 V, → 🗎 40
	Pirani error	≤+0.5 V, → 🗎 40
	Min. load impedance	10 kΩ, short cicuit proof

Identification of the gauge	Resistor	56 kΩ between pin 10 and pin 5 (sensor cable connector)

Display (HPG400)

For gauges with part numbers
353-521
353-523

Display panel	LCD matrix, 32×16 pixels, with background illumination green = normal operation red = error/warning → 🗎 27)
Dimensions	16.0 mm × 11.2 mm
Parameters	Pressure, pressure unit, status, error messages
Pressure units	mbar (factory setting), Torr, Pa (selecting the pressure unit → 🗎 28)

Power supply

DANGER

The gauge must only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded extra-low voltage (SELV-E according to EN 61010). The connection to the gauge has to be fused (INFICON controllers fulfill these requirements).

Operating voltage at the gauge	+24 VDC (20 … 28 VDC) [1)] ripple max. 2 V_{pp}
Power consumption	
Standard	≤0.5 A
Emission start (<200 ms)	≤1.4 A
Power consumption	
HPG400, HPG400-SD	≤16 W
HPG400-SP	≤18 W
Fuse necessary	1.25 AT

HPG400-SD requires an additional, separate power supply for the DeviceNet interface (→ 🗎 19).

Supply voltage at the DeviceNet connector (Pin 2 and Pin 3)	+24 VDC (+11 … 25 VDC)
Power consumption	<2 W

The gauge is protected against reversed polarity of the supply voltage.

[1)] Measured at sensor cable connector (consider the voltage drop as function of the sensor cable length).

Sensor cable connection

For reasons of compatibility, the expression "sensor cable" is used for all HPG400 versions in this document, although the pressure reading of the gauges with fieldbus interface (HPG400-SD and HPG400-SP) is normally transmitted via the corresponding bus.

Electrical connector	D-Sub,15 pins, male
HPG400	→ 🗎 17
HPG400-SD, HPG400-SP	→ 🗎 18
Cable for HPG400	
Analog values only	4 conductors plus shielding
Incl. RS232C interface and identification	7 conductors plus shielding
Cable for HPG400-SD, HPG400-SP	depending on the functions used, max. 14 conductors plus shielding
Max. cable length (supply voltage 24 V)	
Analog and fieldbus operation	≤35 m, conductor cross-section 0.25 mm² ≤50 m, conductor cross-section 0.34 mm ≤100 m, conductor cross-section 1.0 mm²
RS232C- and VGC4XX operation	≤30 m

Switching functions	
HPG400	none
HPG400-SD, HPG400-SP	2 (Setpoint A and B)
Adjustment range	2×10^{-6} mbar … 100 mbar Setpoints adjustable via potentiometers (setpoints A and B), one floating, normally open relay contact per setpoint (→ 🗎 18, 34).
Relay contact rating	
Voltage	≤60 V
Current	≤0.5 ADC

RS232C interface

Data rate	9600 Baud
Data format	binary 8 data bits one stop bit no parity bit no handshake
Connections (sensor cable connector)	
TxD (Transmit Data)	Pin 13
RxD (Receive Data)	Pin 14
GND	Pin 5

Function and communication protocol of the RS232C interface → 🗎 28

DeviceNet interface (HPG400-SD)

For HPG400-SD gauges with part numbers:
353-527
353-528

Fieldbus name	DeviceNet
Standard applied	→ 🕮 [6]
Communication protocol, data format	→ 🕮 [1], [4]
Interface, physical	CAN bus

Data rate (adjustable via "RATE" switch)	125, 250 and 500 kBaud "P" (125, 250 and 500 kBaud, programmable via DeviceNet (→ 🕮 [1]))
Node address (MAC ID) (Adjustable via "ADDRESS", "MSD", "LSD" switches)	0 … 63_{dec} "P" (programmable 0 … 63 via DeviceNet, → 🕮 [1])

	DeviceNet connector	Micro-Style, 5 pins, male
	Cable	Shielded, special DeviceNet cable, 5 conductors (→ 🗎 19 and 🕮 [4])
	Cable length, system wiring	According to DeviceNet specifications (→ 🕮 [4], [6])

Profibus interface (HPG400-SP)

For HPG400-SP gauges with part numbers:
353-525
353-526

Fieldbus name	Profibus
Standard applied	→ 🕮 [7]
Communication protocol, data format	→ 🕮 [2], [7]
Interface, physical	RS485
Data rate	≤12 MBaud (→ 🕮 [2])
Node address	
Local: (Adjustable via hexadecimal "ADDRESS", "MSD", "LSD" switches)	00 … $7D_{hex}$ (0 … 125_{dec})
Via Profibus: (hexadecimal "ADDRESS" switches set to >$7d_{hex}$ (>125_{dec}))	00 … $7D_{hex}$ (0 … 125_{dec})
Profibus connection	D-Sub, 9 pins, female
Cable	Shielded, special Profibus cable (→ 🗎 20 and 🕮 [5])
Cable length, system wiring	According to Profibus specifications (→ 🕮 [5], [7])

Vacuum

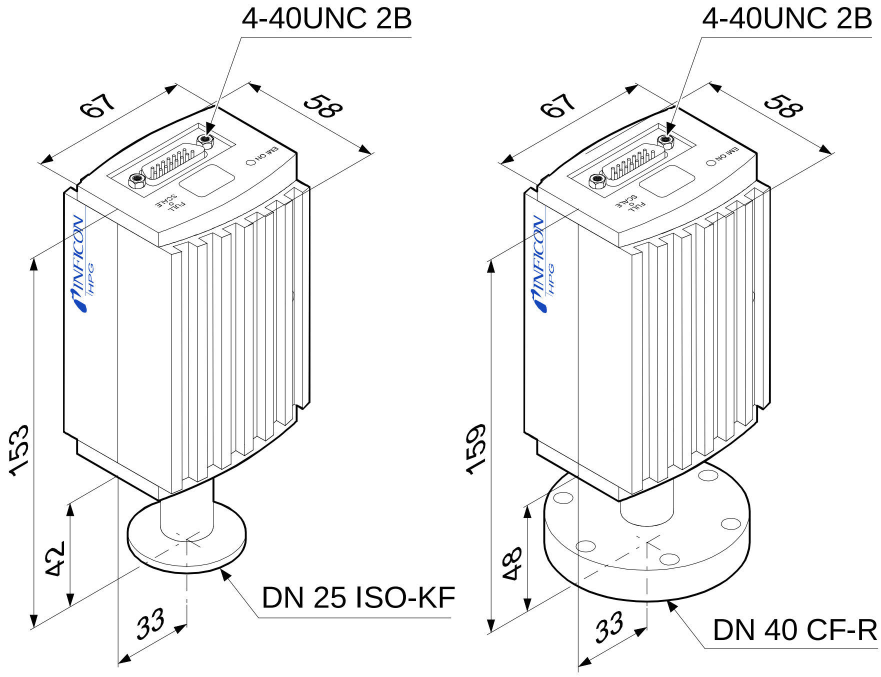
Materials exposed to vacuum	
Housing, supports, screens	stainless steel
Feedthroughs	NiFe, nickel plated
Insulator	glass
Cathode	iridium, yttrium oxide (Y_2O_3)
Cathode holder	molybdenum
Pirani element	tungsten, copper
Internal volume	
353-520, 353-521	≤20 cm^3
353-525, 353-527	≤20 cm^3
353-522, 353-523	≤30 cm^3
353-526, 353-528	≤30 cm^3
Pressure max.	5 bar (absolut) (only for Inert gases and temperatures <100 °C).

Environment

Admissible temperatures	
Storage	-20 … 70 °C
Operation	0 … 50 °C
Bakeout	+150 °C (without electronics unit)
Relative humidity (year's mean / during 60 days)	≤65 / 85% (no condensation)
Use	indoors only altitude up to 2000 m NN
Type of protection	IP 30

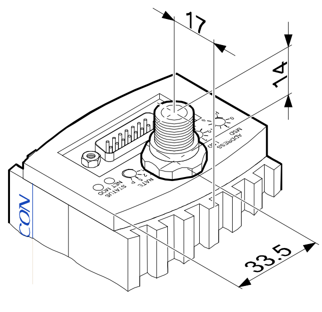
Dimensions [mm]

Part numbers	Part numbers
353-520	353-522
353-521	353-523
353-525	353-526
353-527 [1)]	353-528 [1)]



1) Gauges with DeviceNet connector are 14 mm longer.
The other dimensions of housing and vacuum connection are identical.

Part numbers
353-527
353-528



Weight

353-520, 353-521	285 g
353-522, 353-523	550 g
353-525, 353-527	430 g
353-526, 353-528	695 g

3 Installation

3.1 Vacuum Connection

DANGER

Caution: 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

Caution: overpressure in the vacuum system >2 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

The gauge must be electrically connected to the grounded vacuum chamber. This connection must conform to the requirements of a protective connection according to EN 61010:

- CF connections fulfill this requirement
- For gauges with a KF vacuum connection, 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.

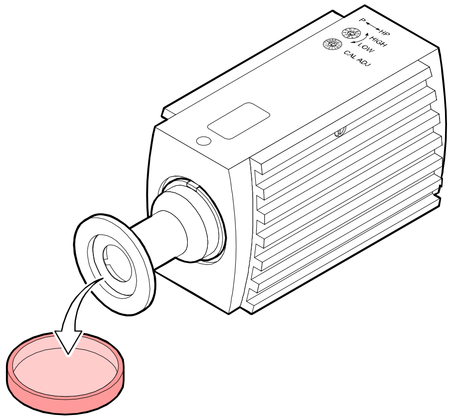
The gauge may be mounted in any orientation. To keep condensates and particles from getting into the measuring chamber, preferably choose a horizontal to upright position. See dimensional drawing for space requirements(→ 🗎 12).

- The gauge is supplied with a built-in baffle.
- The sensor can be baked at up to 150 °C. At temperatures exceeding 50 °C, the electronics unit has to be removed (→ 🗎 15).

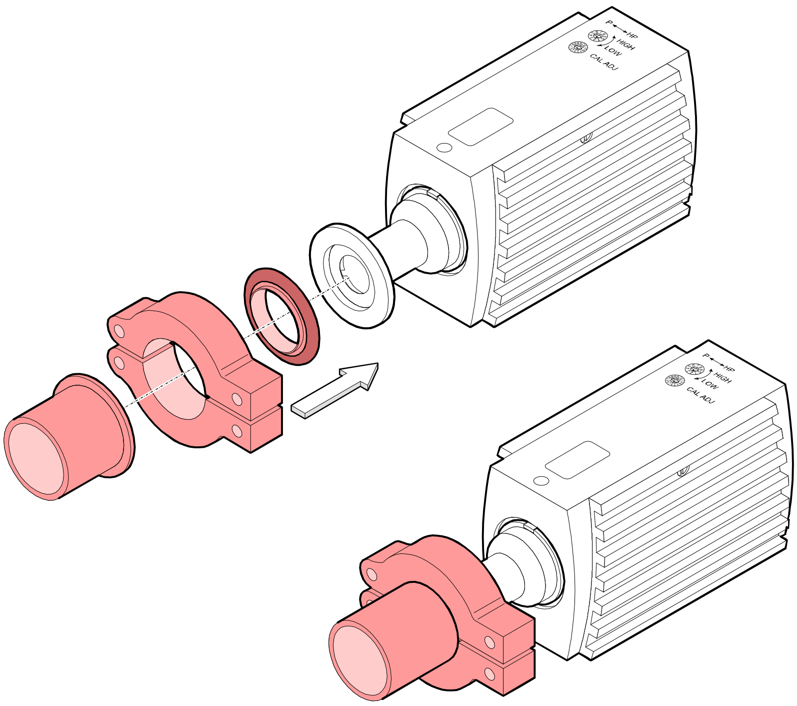
Procedure

❶ Remove the protective lid.

The protective lid will be needed for maintenance.



❷ Make the flange connection to the vacuum system, preferably without applying vacuum grease.



When installing the gauge, make sure that the area around the connector is accessible for the tools required for adjustment while the gauge is mounted

When installing the gauge, allow for installing/deinstalling the connectors and accommodation of cable loops.

If you are using a gauge with display, make sure easy reading of the display is possible.

✓ The gauge is now installed.

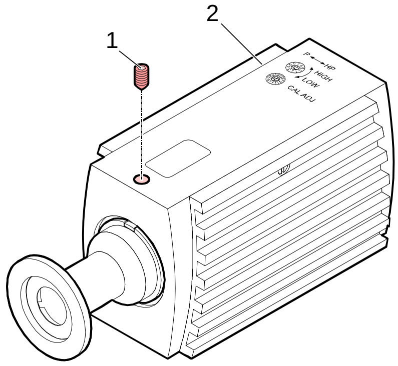
3.1.1 Removing and Installing the Electronics Unit

Required tools / material

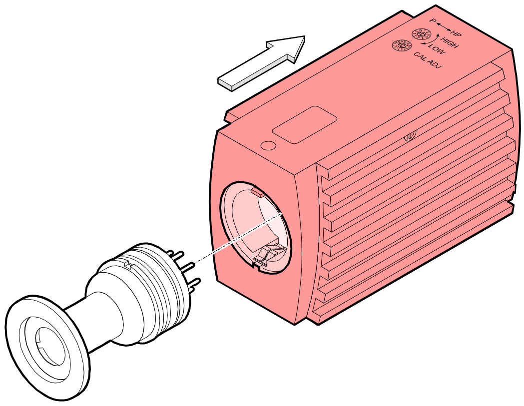
- Allen key, size 2.5 mm

Removing the electronics unit

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



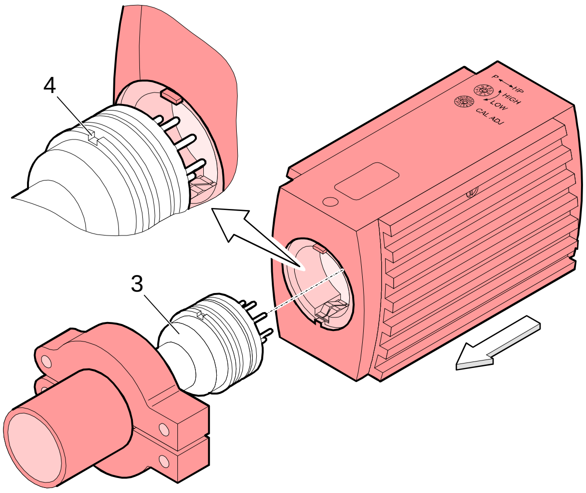
➋ Remove the electronics unit **without twisting it**.



✓ Removal of the electronics unit is completed.

Installing the electronics unit

➊ Place the electronics unit on the sensor (3) (be careful to correctly align the pins and notch (4)).



❷ Slide the electronics unit in to the mechanical stop and lock it with the hexagon socket set screw (1).

✓ The electronics unit is now installed.

3.2 Electrical Connection

3.2.1 Use With INFICON VGC4XX Vacuum Gauge Controller

If the gauge is used with an INFICON VGC4XX controller, a corresponding sensor cable is required (→ 🗎 43). The sensor cable permits supplying the gauge with power, transmitting measurement values and gauge statuses, and making parameter settings.

> ⚠ **Caution**
>
> Caution: data transmission errors
>
> If the gauge is operated with the INFICON VGC4XX Vacuum Gauge Controller (RS232C) and a fieldbus interface at the same time, data transmission errors may occur.
>
> The gauge must not be operated with an INFICON VGC4XX controller and DeviceNet or Profibus at the same time.

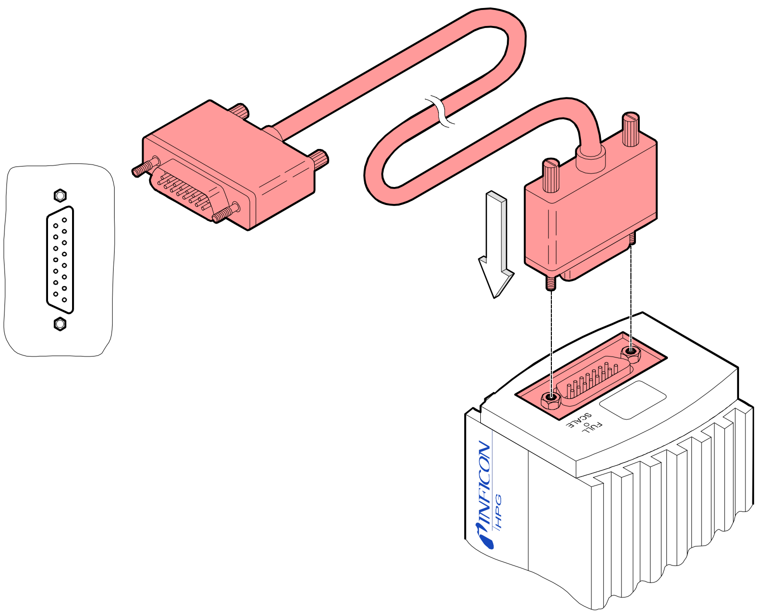
Required material

- Sensor cable (→ 🕮 [10] INFICON sales literature)

Procedure

❶ Plug the sensor connector into the gauge and secure it with the locking screws.

❷ Connect the other end of the sensor cable to the INFICON controller and secure it.



✓ The gauge can now be operated with the VGC4XX controller.

3.2.2 Use With Other Controllers

The gauge can also be operated with other controllers.

Especially the fieldbus versions HPG400-SD (DeviceNet) and HPG400-SP (Profibus) are usually operated as part of a network, controlled by a master or bus controller. In such cases, the control system has to be operated with the appropriate software and communication protocol (→ 🕮 [1] and [2]).

3.2.2.1 Making a Sensor Cable

For reasons of compatibility, the expression "sensor cable" is used for all HPG400 versions in this document, although the pressure reading of the gauges with fieldbus interface (HPG400-SD or HPG400-SP) is normally transmitted via DeviceNet or Profibus.

The sensor cable is required for supplying all HPG400 types with power. In connection with the gauges with fieldbus interface (HPG400-SD and HPG400-SP), it also permits access to the relay contacts of the switching functions (→ 🗎 18, 34).

Cable type

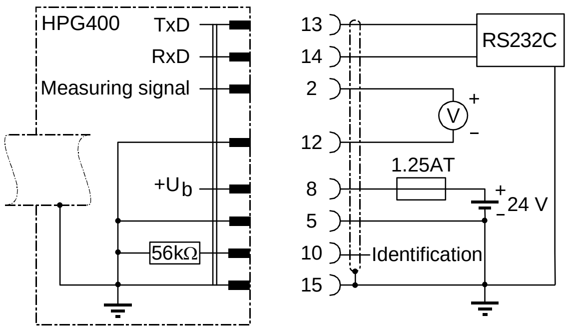
The application and length of the sensor cable have to be considered when determining the number and cross sections of the conductors (→ 🗎 10).

Procedure

❶ Open the cable connector (D-Sub, 15 pins, female).

❷ Prepare the cable and solder/crimp it to the connector as indicated in the diagram of the gauge used:

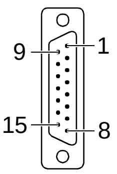
Sensor cable connection HPG400



Electrical connection

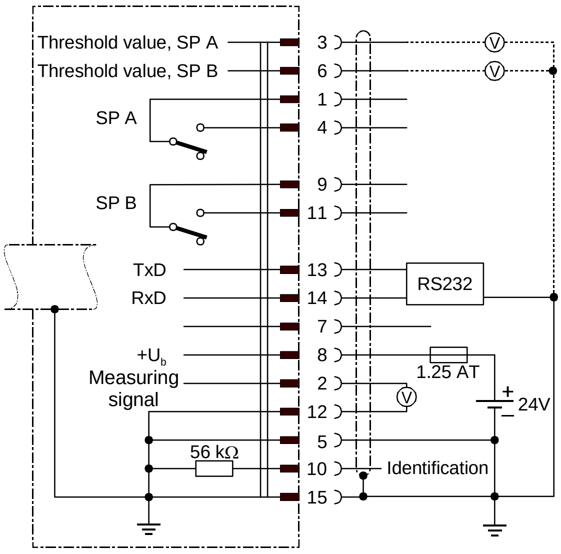
Pin 2 Signal output (measuring signal) 0 … +10 V
Pin 5 Supply voltage common, GND
Pin 8 Supply voltage +24 VDC
Pin 10 Gauge identifcation
Pin 12 Signal common, GND
Pin 13 RS232C, TxD
Pin 14 RS232C, RxD
Pin 15 Shielding, housing, GND

Pins 1, 3, 4, 6, 7, 9 and 11 are not connected internally.



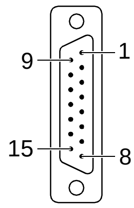
D-Sub, 15 pins
female
soldering side

Sensor cable connection HPG400-SD, HPG400-SP



Electrical connection

Pin 1	Relay Switching function A, COM contact	
Pin 2	Signal output (measuring signal)	0 … +10 V
Pin 3	Threshold value (Setpoint) A	0 … +10 V
Pin 4	Relay Switching function A, N.O. contact	
Pin 5	Supply common, GND	
Pin 6	Threshold value (Setpoint) B	0 … +10 V
Pin 7	not connected	
Pin 8	Supply voltage	+24 V
Pin 9	Relay Switching function B, COM contact	
Pin 10	Gauge identification	
Pin 11	Relay Switching function B, N.O. contact	
Pin 12	Signal common, GND	
Pin 13	RS232, TxD	
Pin 14	RS232, RxD	
Pin 15	Shielding, housing, GND	



D-Sub, 15 pins female soldering side

WARNING

The supply common (Pin 5) and the shielding (Pin 15) must be connected at the supply unit with protective ground.

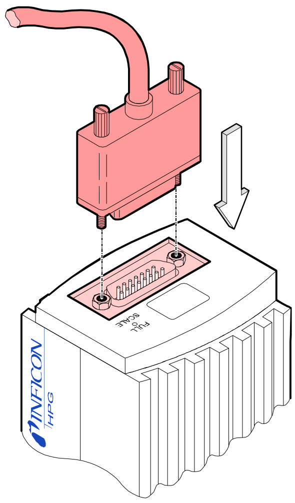
Incorrect connection, incorrect polarity or inadmissible supply voltages can damage the gauge.

For cable lengths up to 5 m (0.34 mm^2 conductor cross-section) the output signal can be measured directly between the positive signal output (Pin 2) and supply common GND (Pin 5) without loss of accuracy. At greater cable lengths, differential measurement between signal output (Pin 2) and signal common (Pin 12) is recommended.

❸ Reassemble the cable connector.

❹ On the other cable end, terminate the cable according to the requirements of the gauge controller you are using.

❺ Plug the sensor connector into the gauge and secure it with the locking screws.



❻ Connect the other end of the sensor cable to the connector of the instrument or gauge controller you are using.

✓ The gauge can now be operated via analog and RS232C interface.

3.2.2.2 Making a DeviceNet Interface Cable (HPG400-SD)

For operating HPG400-SD via DeviceNet, an interface cable conforming to the DeviceNet standard is required.

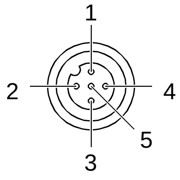
If no such cable is available, make one according to the following indications.

Cable type

A shielded special 5 conductor cable conforming to the DeviceNet standard has to be used (→ 🕮 [4], [6]).

Procedure

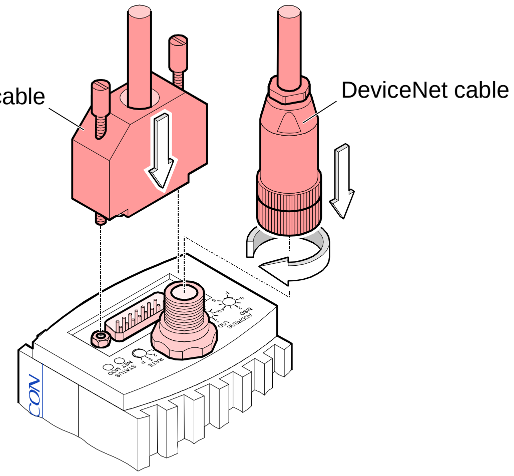
❶ Make the DeviceNet cable according to the following indications.



Micro-Style, 5 pins,
(DeviceNet)
female, soldering side

Pin 1	Drain		
Pin 2	Supply	+24 VDC	(DeviceNet interface only)
Pin 3	Supply common	GND	(DeviceNet interface only)
Pin 4	CAN_H		
Pin 5	CAN_L		

❷ Plug the DeviceNet (and sensor) cable connector into the gauge.



❸ Lock the DeviceNet (and sensor) cable connector.

✓ The gauge can now be operated via DeviceNet interface (→ 🗎 31).

3.2.2.3 Making a Profibus Interface Cable (HPG400-SP)

For operating HPG400-SP via Profibus, an interface cable conforming to the Profibus standard is required.

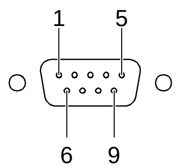
If no such cable is available, make one according to the following indications.

Cable type

Only a cable that is suited to Profibus operation may be used (→ 🕮 [5], [7]).

Procedure

❶ Make the Profibus interface cable according to the following indications.



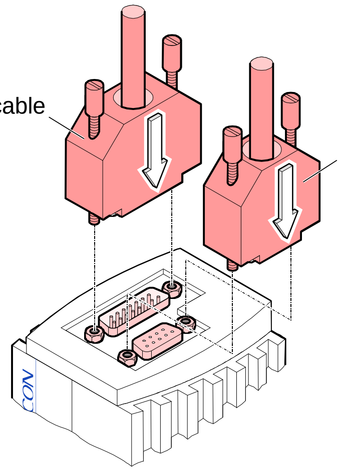
D-Sub, 9 pins
male, soldering side

Pin 1	Do not connect	
Pin 2	Do not connect	
Pin 3	RxD/TxD-P	
Pin 4	CNTR-P	1)
Pin 5	DGND	2)
Pin 6	VP	2)
Pin 7	Do not connect	
Pin 8	RxD/TxD-N	
Pin 9	Do not connect	

1) Only to be connected if an *optical link* module is used.

2) Only required as line termination for devices at both ends of bus cable (→ 🕮 [5]).

❷ Plug the Profibus (and sensor) cable connector into the gauge.



❸ Lock the Profibus (and sensor) cable connector.

✓ The gauge can now be operated via Profibus interface (→ 🗎 33).

3.2.3 Using the Optional Power Supply (With RS232C Line)

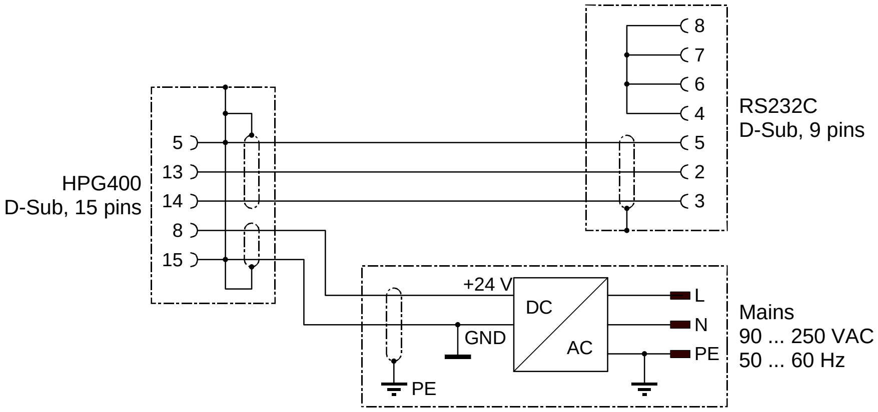
The optional 24 V power supply (→ 🗎 43) allows RS232C operation of the HPG400 gauge with any suitable instrument or control device (e.g. PC).

The instrument or control device needs to be equipped with a software that supports the RS232C protocol of the gauge (→ 🗎 28).

Technical data

Mains connection	
Mains voltage	90 … 250 VAC 50 … 60 Hz
Mains cable	1.8 meter (Schuko DIN and U.S. connectors)
Output (operating voltage of gauge)	
Voltage	21 … 27 VDC, set to 24 VDC
Current	max. 1.5 A
Gauge connection	
Connector	D-Sub, 15 pins, female
24 V cable	5 m, black
Connection of the instrument or control device	
RS232C connection	D-Sub, 9 pins, female
Cable	5 m, black, 3 conductors, shielded

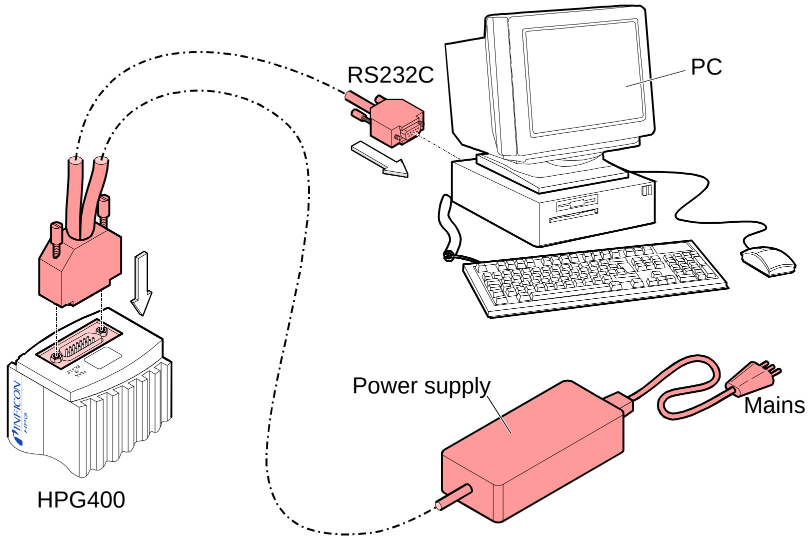
Wiring diagram



Connecting the power supply

❶ Connect the gauge to the power supply and lock the connector with the screws.

❷ Connect the RS232C line to the instrument or control device and lock the connector with the screws.



❸ Connect the power supply to the mains.

❹ Turn the power supply on.

✓ The gauge can now be operated via RS232C interface (→ 🗎 28).

4 Operation

4.1 Measuring Principle, Measuring Behavior

The HPG400 consists of two separate measuring systems (high pressure (HP) hot cathode and Pirani).

High pressure (HP) hot cathode

The HP hot cathode measuring system is based on the electrode arrangement shown in the figure below, which grants sensitivity, linearity, and stability even at high pressures.

The measuring principle of this system is based on gas ionization. Electrons emitted by the hot cathode (F) ionize a number of molecules proportional to the pressure in the measuring chamber. The ion collector (IC) collects the thus generated ion current I^+ and feeds it to the electrometer amplifier of the measuring instrument. The ion current is dependent on the emission current I_e, the gas type, and the gas pressure p according to the following relationship:

$$I^+ = I_e \times p \times C$$

Factor C represents the sensitivity of the gauge. It is generally specified for N_2.

The lower measurement limit is 2×10^{-6} mbar.

In order for the entire range of 2×10^{-6} mbar … 1 mbar to be covered, the emission current is continually increased from 4 µA at 1 mbar to 130 µA at 2×10^{-6} mbar (no transients due to switching of the emission current).

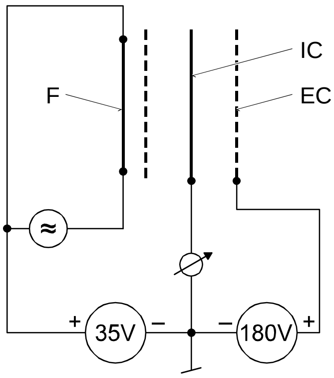
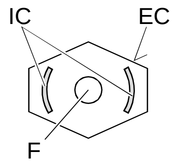
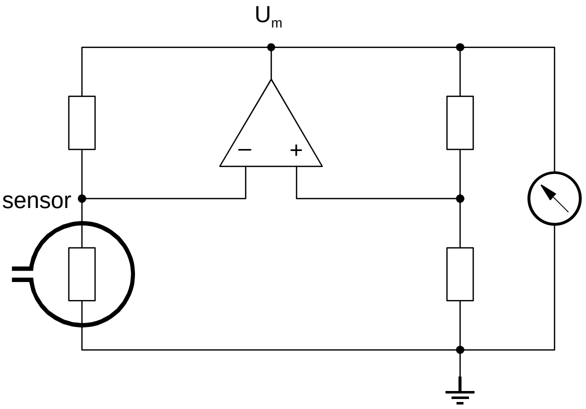


Diagram of the HP measuring system
F hot cathode (filament)
IC ion collector
EC electron collector (anode)



Pirani (control range)

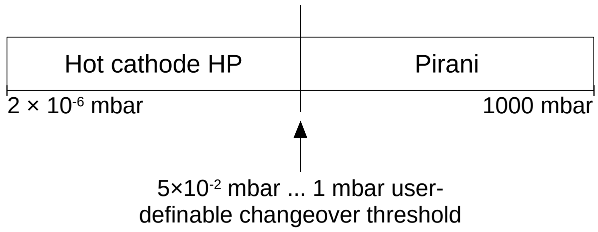
Within certain limits, the thermal conductance of gases is pressure dependent. This physical phenomenon is used for pressure measurement in the thermal conductance vacuum meter according to Pirani. A self-adjusting bridge is used as measuring circuit. A thin tungsten wire is used as sensor element. Wire resistance and thus temperature are kept constant through a suitable control circuit. The electric power supplied to the wire is a measure for the thermal conductance and thus the gas pressure. The basic principle of the self adjusting bridge circuit is shown below.



The bridge voltage U_m is a measure for the gas pressure and is further processed electronically (linearization, conversion).

Measuring range, changeover threshold

The HPG400 covers the measuring range 2×10^{-6} ... 1000 mbar.



- The Pirani permanently monitors the pressure.
- The hot cathode (controlled by the Pirani) is activated only at pressures <1 ... 5×10^{-2} mbar (threshold can be set with a switch).

If the measured pressure is higher than the set changeover threshold (which can be selected with a switch within the range of 1 ... 5×10^{-2} mbar), the hot cathode remains off and the Pirani value is output as signal (→ Appendix A).

When the pressure measured by the Pirani drops below the threshold, the hot cathode is activated. This is indicated by a green lamp. After warming up of the measuring system, the hot cathode value is output. When the pressure rises above the set threshold, the hot cathode is deactivated, and the Pirani value is output again.

4.2 Operational Principle of the Gauge

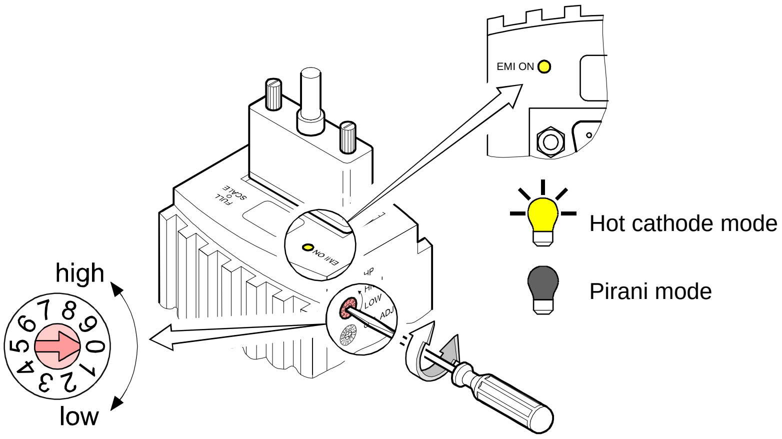
The measuring currents of the HP hot cathode and Pirani sensors are converted into a frequency. A micro controller converts this frequency into a digital value representing the measured total pressure. After further processing this value is available as analog measurement signal (0 … +10.2 V) at the output (sensor cable connector Pin 2 and Pin 12) with the usable ranges 1.5 … 7.5 V (hot cathode) and 8.5 … 9.75 V (Pirani). The maximum output signal is internally limited to +10.2 V (atmosphere). The measured value can be read as digital value through the RS232C interface (Pins 13, 14, 15) (→ 🗎 28). Gauges with a display show the value as pressure. The default setting of the displayed pressure unit is mbar. It can be modified via the RS232C interface (→ 🗎 28).

In addition to converting the output signal, the micro controller's functions include monitoring of the emission, calculation of the total pressure based on the measurements of the two sensors, and communication via RS232C interface.

Selecting the changeover threshold

The HPG400 has five definable changeover thresholds (setpoint "emission on"). It is thus possible to prevent the switching range from being situated within the process pressure range. The factory setting of the threshold is 1 mbar. Other setpoints can be selected via the <P ↔ HP> switch. Since the contamination of the hot cathode system is reduced at low pressures, the lowest possible setpoint should be selected.

Since the switch position is only polled upon activation of the gauge, the setpoint should be selected before the gauge is turned on.



Switch position <P ↔ HP>	Corresponding setpoint
0 or 1	1 mbar (factory setting)
2 or 3	5×10^{-1} mbar
4 or 5	2×10^{-1} mbar
6 or 7	1×10^{-1} mbar
8 or 9	5×10^{-2} mbar

Accuracy

The gauge is factory-calibrated. Adjustment may become necessary due to use in different climatic conditions, extreme temperatures, contamination or aging (→ 🗎 37).

The accuracy is reduced in the pressure range above 1×10^{-1} mbar and below 1×10^{-5} mbar.

Gas type dependence

The output signal is gas type dependent. The characteristic curves (→ Appendix A) are accurate for dry air, N_2 and O_2. They can be mathematically converted for other gases (→ Appendix B).

If you are using a INFICON vacuum gauge controller, you can enter a calibration factor to correct the displayed measured value (→ 🕮 of the corresponding measurement unit).

Contamination

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

The HPG400 is designed in such a way that contamination by process products is minimal. The baffle and the closed internal design of the measuring system as well as the heat generated by the measuring system contribute to this.

The HPG400 is factory-adjusted in such a way that the hot cathode is switched on at ≈1 mbar. A lower threshold can be set in order for the contamination of the system to be reduced (→ 🗎 25). The gauge can also be switched externally by the supply voltage, control by the Pirani still being insured.

In case of severe contamination, the measuring system should be replaced (→ 🗎 42).

4.3 Putting the Gauge Into Operation

When the operating voltage is supplied (→ "Technical Data", 🗎 8 and "Electrical Connection", 🗎 16), the output signal is available between Pin 2 (+) and Pin 12 (–) of the sensor cable connector (Relationship Output Signal – Pressure → Appendix A).

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

Communication via the digital interfaces is described in separate sections.

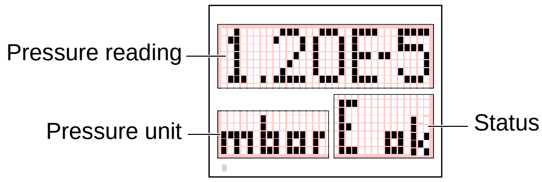
4.4 **Display** (HPG400)

The gauges with part numbers

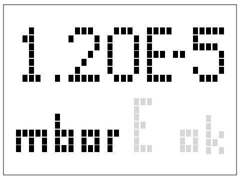
353-501 and
353-503

have a built-in two-line display with an LCD matrix of 32×16 pixels. The first line shows the pressure in normal operation, the second line the pressure unit, the function and operational status and possible error messages.

The background illumination is usually green, in the event of an error, it changes to red.



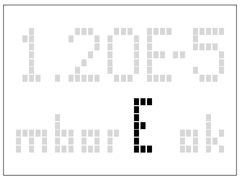
Pressure display



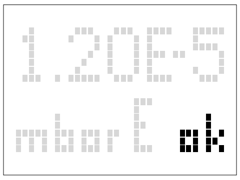
Pressure reading in mbar (factory setting), Torr or Pa.

The pressure unit can be changed via RS232C interface (→ 🗎 28).

Function display (status)

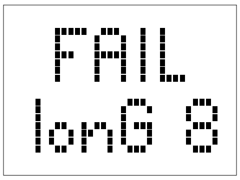


E	=	Emission of HP hot cathode on
A	=	Adjustment at atmospheric pressure in progress

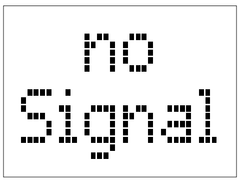


ok	=	Normal operation, no error (green background illumination)

Error display



FAIL lonG 5	=	Pirani sensor warning
FAIL lonG 8	=	Hot cathode sensor warning
FAIL lonG 9	=	Pirani sensor error
		(red background illumination)



Internal data connection failure
(red background illumination)

4.5 RS232C Interface

The built-in RS232C interface allows transmission of digital measurement data and instrument conditions as well as the setting of instrument parameters.

Caution

Caution: data transmission errors

If the gauge is operated with the RS232C interface and a fieldbus interface at the same time, data transmission errors may occur.

The gauge must not be operated with the RS232C interface and DeviceNet or Profibus at the same time.

4.5.1 Description of the Functions

The interface works in duplex mode. A nine byte string is sent continuously without a request approx. every 20 ms.

Commands are transmitted to the gauge in a five byte input (receive) string.

Operational parameters

- Data rate — 9600 Baud — set value, no handshake
- Byte — 8 data bits, 1 stop bit

Electrical connections

- TxD — Pin 13
- RxD — Pin 14
- GND — Pin 5

(Sensor cable connector)

4.5.1.1 Output String (Transmit)

The complete output string (frame) is nine bytes (byte 0 … 8). The data string is seven bytes (byte 1 … 7).

Format of the output string

Byte No.	Function	Value	
0	Length of data string	7	(Set value)
1	Page number	5	(Set value)
2	Status		→ Status byte
3	Error		→ Error byte
4	Measurement high byte	0 … 255	→ Calculation of pressure value
5	Measurement low byte	0 … 255	→ Calculation of pressure value
6	Software version	0 … 255	→ Software version
7	Sensor type	11	(For HPG400 gauges)
8	Check sum	0 … 255	→ Synchronization

Synchronization

Synchronization of the master is achieved by testing three bytes:

Byte No.	Function	Value	Comment
0	Length of data string	7	(Set value)
1	Page number	5	(Set value)
8	Check sum of bytes No. 1 … 7	0 … 255	Low byte of check sum [1)]

1) High order bytes are ignored in the check sum.

Status byte

Bit 1	Bit 0	Definition
0	0	Emission off
0	1	Emission on

Bit 2	Definition
0	1000 mbar adjustment off
1	1000 mbar adjustment on

Bit 3	Definition
0 ⇔ 1	Toggle bit, changes with every string received correctly

Bit 5	Bit 4	Definition
0	0	Current pressure unit mbar
0	1	Current pressure unit Torr
1	0	Current pressure unit Pa

Bit 7	Bit 6	Definition
x	x	Not used

Error byte

Bit 3	Bit 2	Bit 1	Bit 0	Definition
x	x	x	x	Not used

Bit 7	Bit 6	Bit 5	Bit 4	Definition
0	1	0	1	Pirani adjusted poorly
1	0	0	0	Hot cathode error
1	0	0	1	Pirani error

Software version

The software version of the gauge can be calculated from the value of byte 6 of the transmitted string according to the following rule:

$$\text{Version No.} = \text{Value}_{\text{Byte 6}} / 20$$

(Example: According to the above formula, $\text{Value}_{\text{Byte 6}}$ of 32 means software version 1.6)

Calculation of the pressure value

The pressure can be calculated from bytes 4 and 5 of the transmitted string. Depending on the measuring range (hot cathode or Pirani) and the currently selected pressure unit (→ byte 2, bits 4 and 5), the appropriate rule must be applied.

As result, the pressure value results in the usual decimal format.

Measuring range hot cathode

(Range of values for byte 4 and 5 = 16666_{dec} … 48666_{dec})

$$\boxed{p \quad = \quad 10^{(\text{high Byte} \times 256 + \text{low Byte}) / 5333.3) - k1}}$$

Where

Pressure unit	k1
mbar	9.125
Torr	9.249903
Pa	7.125

Measuring range Pirani

(Range of values for byte 4 and 5 = 54000_{dec} … 60666_{dec})

$$\boxed{p \quad = \quad 10^{(\text{high Byte} \times 256 + \text{low Byte}) / 1333.3) - k2}}$$

Where

Pressure unit	k2
mbar	42.5
Torr	42.624903
Pa	40.5

Example

The example is based on the following output string:

Byte No.	0	1	2	3	4	5	6	7	8
Value	7	5	0	0	242	48	20	11	63

The instrument or controller (receiver) interprets this string as follows:

Byte No.	Function	Value	Comment
0	Length of data string	7	(Set value)
1	Page number	5	(Set value)
2	Status	0	Emission = off Pressure unit = mbar
3	Error	0	No error
	Measurement		
4	High byte	235	Calculation of the pressure:
5	Low byte	48	$p = 10^{(235 \times 256 + 48) / 1333.3 - 42.5} = 454$ mbar
6	Software version	20	Software version = 20 / 20 = 1.0
7	Sensor type	11	(HPG400 gauges)
8	Check sum	63	5 + 0 + 0 + 235 + 48 + 20 + 11 = $319_{dec} \triangleq 01\ 3F_{hex}$ High order byte is ignored $\Rightarrow$ Check sum = $3F_{hex} \triangleq 63_{dec}$

4.5.1.2 Input String (Receive)

For transmission of the commands to the gauge, a string (frame) of five bytes is sent (without <CR>). Byte No. 1 … 3 form the data string.

Format of the input string

Byte No.	Function	Value	
0	Length of data string	3	(Set value)
1	Data		→ admissible input strings
2	Data		→ admissible input strings
3	Data		→ admissible input strings
4	Check sum (from bytes No. 1 … 3)	0 … 255	(low byte of sum) [1)]

[1)] High order bytes are ignored in the check sum.

Admissible input strings

For commands to the gauge, the following defined strings are used:

	Byte No.				
Command	0	1	2	3	4 [2)]
Set the unit mbar in the display	3	16	62	0	78
Set the unit Torr in the display	3	16	62	1	79
Set the unit Pa in the display	3	16	62	2	80
Power-failure-safe storage of current unit	3	32	62	62	156

[2)] Only low order byte of sum (high order byte is ignored).

4.6 DeviceNet Interface (HPG400-SD)

This interface allows operation of HPG400-SD with part numbers

353-527 and
353-528

in connection with other devices that are suited for DeviceNet operation. The physical interface and communication firmware of HPG400-SD comply with the DeviceNet standard (→ 🕮 [4], [6]).

Two adjustable switching functions are integrated in HPG400-SD. The corresponding relay contacts are available at the sensor cable connector (→ 🗎 8, 18, 34).

The basic sensor and sensor electronics of all HPG400 gauges are identical.

> **Caution**
>
> Caution: data transmission errors
>
> If the gauge is operated via RS232C interface and DeviceNet interface at the same time, data transmission errors may occur.
>
> The gauge must not be operated via RS232C interface and DeviceNet interface at the same time.

4.6.1 Description of the Functions

Via this interface, the following and further data are exchanged in the standardized DeviceNet protocol (→ 🕮 [1]):

- Pressure reading
- Pressure unit (Torr, mbar, Pa)
- Gauge adjustment
- Status and error messages
- Status of the switching functions

4.6.2 Operating Parameters

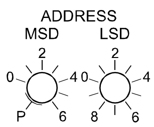
As the DeviceNet protocol is highly complex, the parameters and programming of HPG400-SD are described in detail in the separate Communication Protocol (→ 🕮 [1]).

4.6.2.1 Operating Software

Before the gauge is put into operation, it has to be configured for DeviceNet operation. A configuration tool and the device specific EDS file (Electronic Data Sheet) are required for this purpose. The EDS file can be downloaded via internet (→ 🕮 [3]).

4.6.2.2 Node Address Setting

For unambiguous identification of the gauge in a DeviceNet environment, a node address is required. The node address setting is made on the gauge or programmed via DeviceNet.

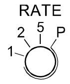


Set the node address (0 … 63_{dec}) via the "ADDRESS" "MSD" and "LSD" switches. The node address is polled by the firmware when the gauge is switched on. If the setting deviates from the stored value, the new value is taken over into the NVRAM. If a setting higher than 63 is made, the previous node address setting remains valid.

If the „MSD" switch is in the "P" position, the node address is programmable via DeviceNet (→ 🕮 [1]).

4.6.2.3 Data Rate Setting

The admissible data rate depends on a number of factors such as system parameters and cable length (→ 🕮 [4], [6])]). It can be set on the gauge or programmed via DeviceNet.

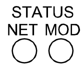


By means of the "RATE" switch, the data rate can be set to 125 ("1"), 250 ("2") or 500 kBaud ("5").

If the switch is in any of the "P" positions, the data rate is programmable via DeviceNet (→ 🕮 [1]).

4.6.3 Status Lights

Two lights (LEDs) on the gauge inform on the gauge status and the current DeviceNet status.



"STATUS MOD" (gauge status)

Light status	Description
Dark	No supply
Flashing red/green	Selftest
Green	Normal operation
Red	Non recoverable error

"STATUS NET" (network status)

Light status	Description
Dark	Gauge not online: – Selftest not yet concluded – No supply, → "STATUS MOD" light
Flashing green	Gauge online but no communication: – Selftest concluded but no communication to other nodes established – Gauge not assigned to any master
Green	Gauge online; necessary connections established
Flashing red	One or several input/output connections in "timed out" status
Red	Communication error. The gauge has detected an error that impedes communication via the network (e.g. two identical node addresses (MAC IC) or "Bus-off")

Electrical connections

The gauge is connected to the DeviceNet system via the 5-pin DeviceNet connector(→ 🗎 19).

4.7 Profibus Interface (HPG400-SP)

This interface allows operation of HPG400-SP with part numbers

353-525 and
353-526

in connection with other devices that are suited for Profibus operation. The physical interface and communication firmware of HPG400-SP comply with the Profibus standard (→ 🕮 [5], [7]).

Two adjustable switching functions are integrated in the HPG400-SP. The corresponding relay contacts are available at the sensor cable connector (→ 🗎 8, 18, 34).

The basic sensor and sensor electronics of all HPG400 gauges are identical.

Caution

Caution: data transmission errors

If the gauge is operated via RS232C interface and Profibus interface at the same time, data transmission errors may occur.

The gauge must not be operated via RS232C interface and Profibus interface at the same time.

4.7.1 Description of the Functions

Via this interface, the following and further data are exchanged in the standardized Profibus protocol (→ 🕮 [2]):

- Pressure reading
- Pressure unit (Torr, mbar, Pa)
- Gauge adjustment
- Status and error messages
- Status of the switching functions

4.7.2 Operating Parameters

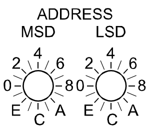
As the DeviceNet protocol is highly complex, the parameters and programming of HPG400-SP are described in detail in the separate Communication Protocol (→ 🕮 [2]).

4.7.2.1 Operating Software

For operating the gauge via Profibus, prior installation of the HPG400 specific GSD file is required on the bus master side. This file can be downloaded via internet (→ 🕮 [3]).

4.7.2.2 Node Address Setting

For unambiguous identification of the gauge in a Profibus environment, a node address is required. The node address setting is made on the gauge.



The node address (0 … 125_{dec}) is set in hexadecimal form (00 … $7D_{hex}$) via the "ADDRESS", "MSD", and "LSD" switches. The node address is polled by the firmware when the gauge is switched on. If the setting deviates from the stored value, the new value is taken over into the NVRAM. If a value >$7D_{hex}$ (>125_{dec}) is entered, the node address setting currently stored in the device remains valid but it can now be defined via Profibus ("Set slave Address", → 🕮 [2]).

Electrical connections

The gauge is connected to the Profibus via the 9-pin Profibus connector (→ 🗎 20).

4.8 Switching Functions (HPG400-SD, HPG400-SP)

The gauges HPG400-SD and HPG400-SP have two independent, manually adjustable switching functions. Each switching function has a floating normally open relay contact. The relay contacts are accessible at the sensor cable connector (→ 🗎 18).

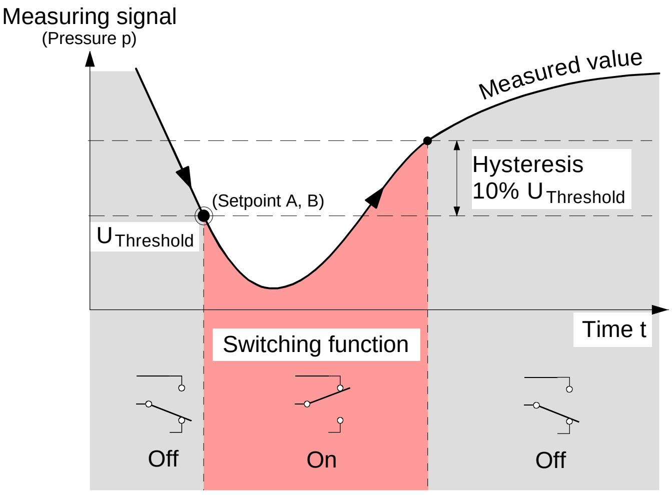
The threshold values of switching functions A and B can be set within the pressure range 1×10^{-9} mbar … 100 mbar via potentiometers "SETPOINT A" and "SETPOINT B" (voltage settings representing pressures >100 mbar can be set, but the relay trigger point will remain at 100 mbar).

$$\boxed{U_{Thresholdt} = 10 / 9 \times (\log p_{Setpoint} - c) + 6}$$

Where

U	p	c
[V]	[mbar]	0
[V]	[Pa]	2
[V]	[Torr]	-0.125

(→ Appendix A).



The hysteresis of the switching functions is 10% of the threshold setting.

4.8.1 Setting the Switching Functions

The threshold values of the two switching functions "SETPOINT A" and "SETPOINT B" are set locally on the potentiometers of the gauge that are accessible via the openings on one side of the gauge housing.

Required tools

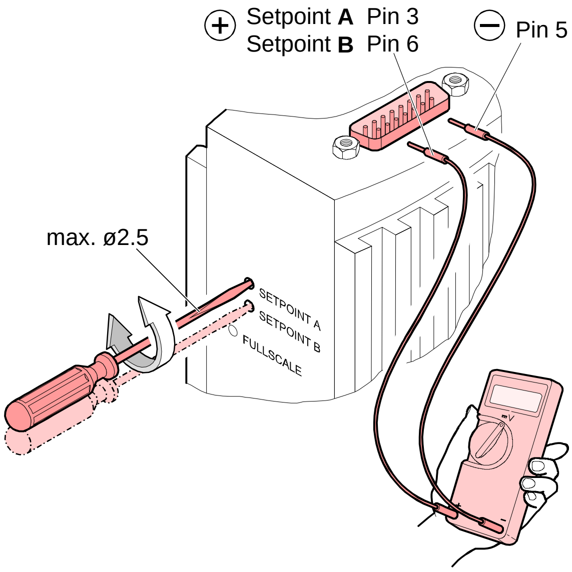
- Voltmeter
- Ohmmeter or continuity checker
- Screwdriver, max. ø2.5 mm

Procedure

The procedure for setting thresholds is identical for both switching functions.

❶ Put the gauge into operation.

❷ Connect the **+** lead of a voltmeter to the threshold measurement point of the selected switching function ("Setpoint A" Pin 3, "Setpoint B" Pin 6) and its **–** lead to Pin 5.



❸ Using a screwdriver (max. ø2.5 mm), set the voltage of the selected switching function (Setpoint A, B) to the desired value $U_{Threshold}$.

✓ Setting of the switching functions is now concluded.

☞ There is no local visual indication of the statuses of the switching functions. However, a functional check of the switching functions (On/Off) can be made with one of the following methods:

- Reading the status via fieldbus interface (→ 🕮 [1] for HPG400-SD, → 🕮 [2] for HPG400-SP).
- Measurement of the relay contacts at the sensor cable connector with a ohmmeter/continuity checker (→ 🗎 18).

5 Deinstallation

DANGER

Caution: 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.

Procedure

1. Vent the vacuum system.

Before taking the gauge out of operation, make sure that this has no adverse effect on the vacuum system.

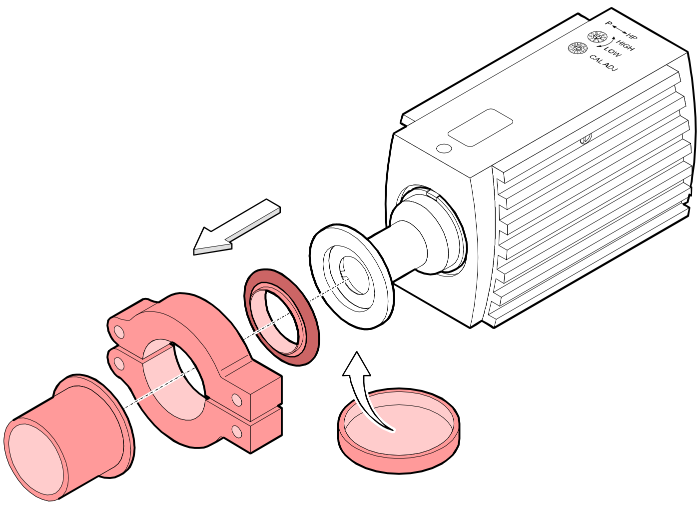
Depending on the programming of the superset controller, faults may occur or error messages may be triggered.

Follow the appropriate shut-down and starting procedures.

2. Take gauge out of operation.

3. Disconnect all cables from the gauge.

4. Remove gauge from the vacuum system and replace the protective lid.



✓ The gauge is now deinstalled.

6 Maintenance, Repair

6.1 Maintenance

DANGER

Caution: 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.

6.2 Adjusting the Gauge

The gauge is factory-calibrated. Through the use in different climatic conditions, fitting positions, aging or contamination and after exchanging the sensor (→ 🗎 42) a shifting of the characteristic curve can occur and readjustment can become necessary. Only the Pirani part can be adjusted.

Adjustment is necessary if

- at atmospheric pressure, the output signal is <9.75 V or the display reads < atmospheric pressure.
- when the vacuum system is vented, the output voltage reaches 9.75 V [1)] before the measured pressure has reached atmospheric pressure (gauges with display will show the error "5" at atmospheric pressure (Pirani sensor warning → 🗎 27).
- at atmospheric pressure, the digital value of the RS232C interface is < atmospheric pressure.
- at atmospheric pressure, the digital value received by the bus controller of the fieldbus gauges (DeviceNet or Profibus) is < atmospheric pressure.
- when the vacuum system is vented, the digital value of the RS232C interface reaches its maximum before the measured pressure has reached atmospheric pressure.
- when the vacuum system is vented, the digital value received by the bus controller of the fieldbus gauges (DeviceNet or Profibus) reaches its maximum before the measured pressure has reached atmospheric pressure.

[1)] The output signal is internally limited to +10.2 V.

Adjustment procedures for HPG400-SD/-SP and HPG400 gauges differ and will be described separately.

6.2.1 Pirani Adjustment (HPG400)

The following procedures are described:

- HV adjustment Pirani
- ATM adjustment Pirani

Required tools

- Pin approx. ø1.3 × 50 mm (e.g. a bent open paper clip)

HV adjustment Pirani

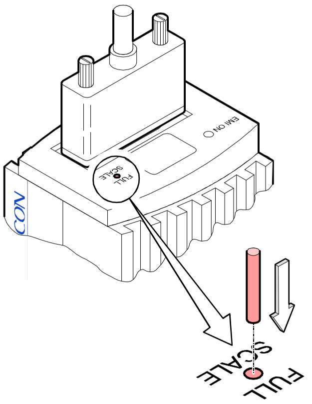
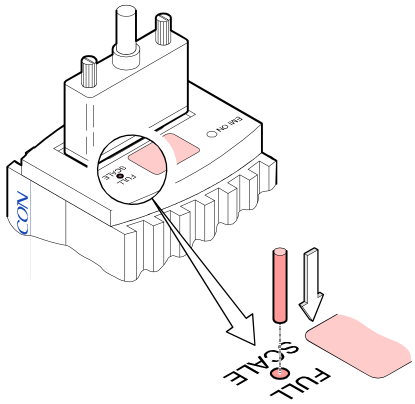
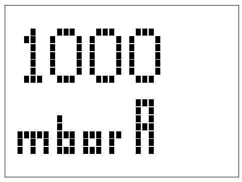
The Pirani part is automatically adjusted by the hot cathode part when the gauge is activated and a pressure value of 1 … 3×10^{-3} mbar is reached for the first time.

Pirani adjustment at atmospheric pressure

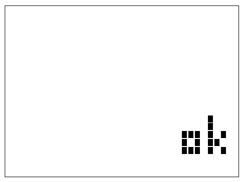
❶ Put the gauge into operation.

Operate the gauge for ≈10 minutes at atmospheric pressure. If the gauge was operated within the hot cathode range, a cooling-down time of ≈30 minutes is to be expected (gauge temperature = environmental temperature).

❷ Adjust the gauge:

<table>
<tr><th>HPG400 without display
353-520, 353-522</th><th>HPG400 with display
353-521, 353-523</th></tr>
<tr><td colspan="2">Insert a pin (≈ø1.3×50mm) through the opening <FULL SCALE> and push the button inside for at least 5 seconds.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>–</td><td></td></tr>
</table>

Automatic adjustment in progress (≈10 s).

<table>
<tr><td>–</td><td></td></tr>
</table>

✓ Adjustment completed.

6.2.2 Pirani Adjustment (HPG400-SD, HPG400-SP)

The following procedures are described:

- HV adjustment Pirani
- ATM adjustment Pirani

Required tools

- Pin, approx. ø1.3 × 50 mm (e.g. abent open paper clip)

HV adjustment Pirani

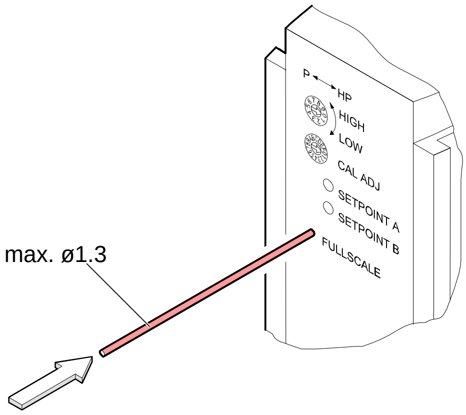
The Pirani part is automatically adjusted by the hot cathode part when the gauge is activated and a pressure value of 1 … 3×10^{-3} mbar is reached for the first time.

Pirani adjustment at atmospheric pressure

1. Put the gauge into operation.

   Operate the gauge for ≈10 minutes at atmospheric pressure. If the gauge was operated within the hot cathode range, a cooling-down time of ≈30 minutes is to be expected (gauge temperature = environmental temperature).

2. Insert the pin through the opening marked <FULL SCALE> and push the button inside for at least 5 seconds.

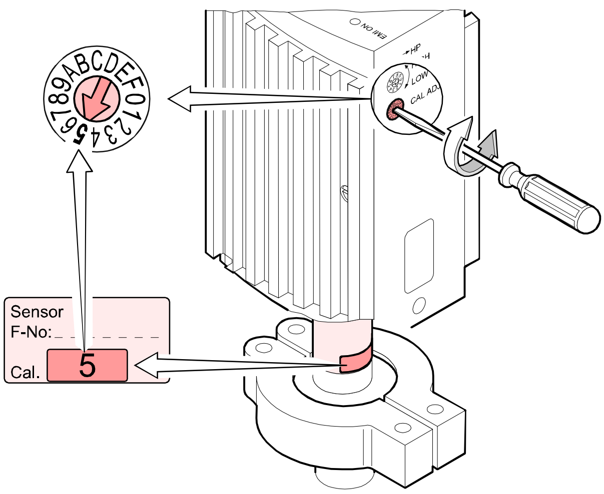


   The gauge is automatically adjusted (≈10 s).

✓ The gauge is now adjusted at atmospheric pressure.

6.3 Adjusting the Calibration Setting of the Hot Cathode

The sensor is factory calibrated. The calibration setting of the hot cathode range 0 … F is printed on the label. Correct this value with the <Cal adj> switch to adjust the electronics to the sensor. Before operating the gauge for the first time or after replacing the sensor, check the calibration value setting and adjust it if necessary.



6.4 What to Do in Case of Problems

In the event of a fault or a complete failure of the output signal, the gauge can easily be checked.

Required tools / material

- Voltmeter / ohmmeter
- Allen key, size 2.5 mm
- Spare sensor (if the sensor is faulty)

Troubleshooting

The output signal is available at the sensor cable connector (Pin 2 and Pin 12).

In case of an error, it may be helpful to just turn off the supply voltage and turn it on again after 5 seconds.

Problem	Possible cause	Correction
Output signal permanently ≈0V	Sensor cable defective or not correctly connected	Check the sensor cable
	No supply voltage	Turn on the power supply
	Gauge in an undefined status	Turn the gauge off and on again (reset)
Output signal ≈0.3 V (Display: error = 8)	Hot cathode error (sensor faulty)	Replace the sensor (→ 🗎 42)
Output signal ≈0.5 V (Display: error = 9)	Pirani error (sensor defective)	Replace the sensor (→ 🗎 42)
	Electronics unit not mounted correctly on sensor	Check the connection
Display: no Signal	Internal data connection not working	Turn the gauge off and on again after 5 s Replace the electronics unit

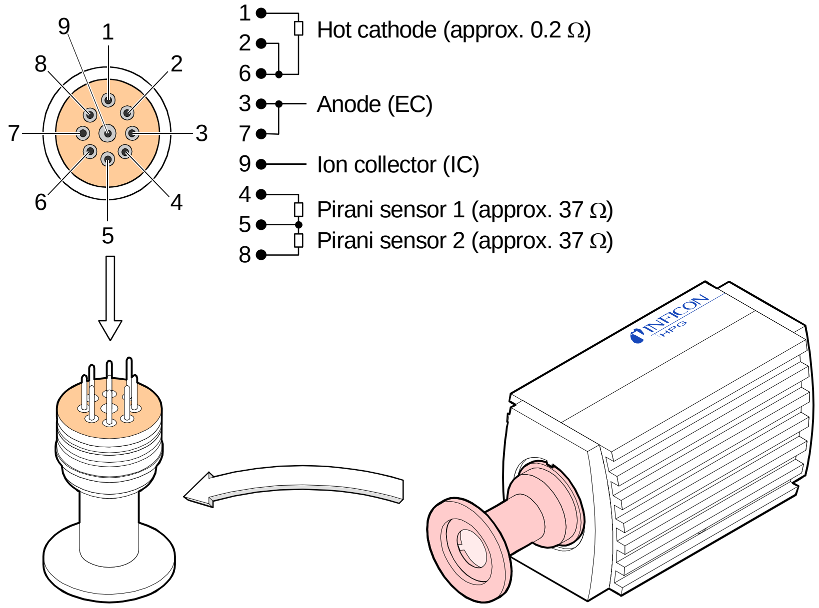
Troubleshooting (sensor)

If the cause of a fault is suspected to be in the sensor, the following checks can be made with an ohmmeter (the vacuum system need not be vented for this purpose).

Separate the sensor from the electronics unit (→ 🗎 15). Using an ohmmeter, make the following measurements on the contact pins..

Ohmmeter measurement between pins			Possible cause
4 + 5	$\approx 37\ \Omega$	$\gg 37\ \Omega$	Pirani element 1 broken
5 + 8	$\approx 37\ \Omega$	$\gg 37\ \Omega$	Pirani element 2 broken
1 + 2/6	$\approx 0.2\ \Omega$	$\gg 0.2\ \Omega$	Filament of hot cathode broken
2 + sensor housing	∞	$\ll \infty$	Short circuit electrode to ground
3 + sensor housing	∞	$\ll \infty$	Short circuit electrode to ground
5 + sensor housing	∞	$\ll \infty$	Short circuit electrode to ground
9 + sensor housing	∞	$\ll \infty$	Short circuit electrode to ground
2 + 3	∞	$\ll \infty$	Short circuit between electrodes
2 + 9	∞	$\ll \infty$	Short circuit between electrodes
3 + 9	∞	$\ll \infty$	Short circuit between electrodes
2 + 5	∞	$\ll \infty$	Short circuit between electrodes
3 + 5	∞	$\ll \infty$	Short circuit between electrodes
5 + 9	∞	$\ll \infty$	Short circuit between electrodes

View on sensor pins



Correction

All of the above faults can only be remedied by replacing the sensor (→ 🗎 42).

Troubleshooting on fieldbus gauges (HPG400-SD, HPG400-SP)

Error diagnosis of fieldbus gauges can only be performed as described above for the basic sensor and sensor electronics. Diagnosis of the fieldbus interface can only be done via the superset bus controller (→ 🕮 [1] and [2]).

For diagnosis of the HPG400-SD (DeviceNet) gauges, the status lights might produce some useful information (→ 🗎 32).

6.5 Replacing the Sensor

Replacement is necessary, when

- the sensor is severely contaminated.
- the sensor is mechanically deformed.
- the sensor is faulty, e.g. filament of hot cathode broken (→ 🗎 40).
- the sensor is faulty, e.g. Pirani element broken (→ 🗎 40).

Required tools / material

- Allen key, size 2.5 mm
- Spare sensor (→ 🗎 43)

Procedure

❶ Deinstall the gauge (→ 🗎 36).

❷ Deinstall the electronics unit from the faulty sensor and mount it to the new sensor (→ 🗎 15).

❸ Adjust the calibration setting of the hot cathode (→ 🗎 39).

❹ Adjust the gauge (→ 🗎 37).

✓ The new sensor is now installed.

7 Options

	Part number
24 VDC power supply / RS232C line (→ 🗎 21)	353-511

Controllers, power supplies, sensor cables in various lengths and a large range of vacuum installation material can be found in the INFICON sales literature (→ 🕮 [10]).

8 Spare Parts

When ordering spare parts, always indicate:

- All information on the product nameplate
- Description and part number

	Part number
Sensor HPG400, vacuum connection DN 25 ISO-KF (including Allen key)	354-487
Sensor HPG400, vacuum connection DN 40 CF-R (including Allen key)	354-488

9 Storage

Caution

Caution: vacuum component

Inappropriate storage leads to an increase of the desorption rate and/or may result in mechanical damage of the product.

Cover the vacuum ports of the product with protective lids or grease free aluminum foil. Do not exceed the admissible storage temperature range (→ 🗎 11).

10 Returning the Product

WARNING

Caution: forwarding contaminated products

Contaminated products (e.g. radioactive, toxic, caustic or biological hazard) can be detrimental to health and environment.

Products returned to INFICON 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 (→ 🗎 49).

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.

11 Disposal

STOP DANGER

Caution: 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

Caution: substances detrimental to the environment

Products or parts thereof (mechanical and electric components, operating fluids etc.) can be detrimental to the environment.

Dispose of such substances in accordance with the relevant local regulations.

Separating the components

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

Contaminated components

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

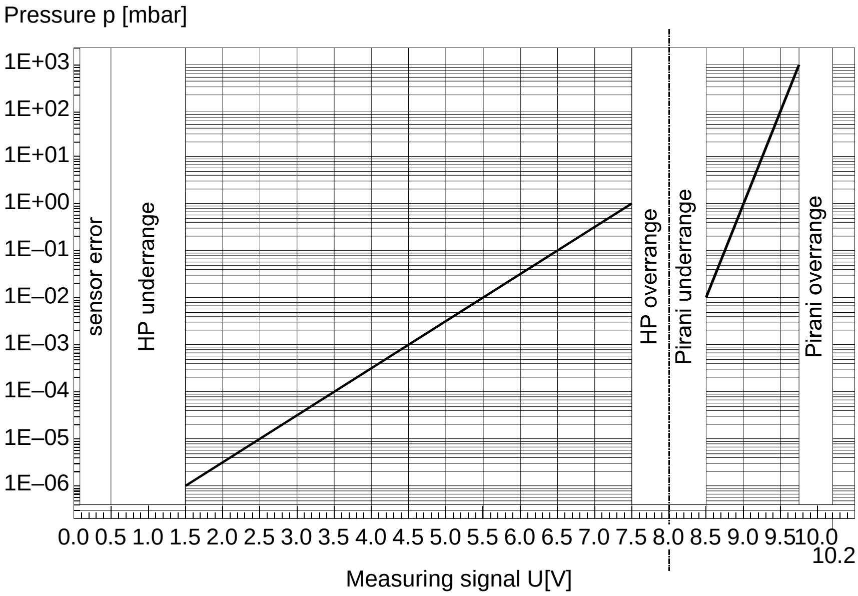
Other components

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

Appendix

A: Relationship Output Signal – Pressure

Conversion curve



Hot cathode range and Pirani range require different conversion formulae:

Conversion formula hot cathode range

$\boxed{p = 10^{U - c1}}$ ⇔ $\boxed{U = c1 + \log p}$

Conversion formula Pirani range

$\boxed{p = 10^{(4 \times (U - c2))}}$ ⇔ $\boxed{U = c2 + 0.25 \log p}$

Where

U	p	c1	c2
[V]	[mbar]	7.5	9
[V]	[Torr]	7.625	9.031
[V]	[Micron]	4.625	8.281
[V]	[Pa]	5.5	8.5

Changeover threshold hot cathode ↔ Pirani

Switch position <P ↔ HP>	Threshold
0 or 1	1 mbar (factory setting)
2 or 3	5×10^{-1} mbar
4 or 5	2×10^{-1} mbar
6 or 7	1×10^{-1} mbar
8 or 9	5×10^{-2} mbar

Conversion table
output signal - pressure

Output signal U [V]		Pressure p [mbar]	[Torr]	[Pa]
0 … 0.5	Hot cathode	Sensor error		
0.5 … 1.5		Underrange		
1.5		1.0×10^{-6}	7.5×10^{-7}	1.0×10^{-4}
2.5		1.0×10^{-5}	7.5×10^{-6}	1.0×10^{-3}
3.5		1.0×10^{-4}	7.5×10^{-5}	1.0×10^{-2}
4.5		1.0×10^{-3}	7.5×10^{-4}	1.0×10^{-1}
5.5		1.0×10^{-2}	7.5×10^{-3}	1
6.5		1.0×10^{-1}	7.5×10^{-2}	10
7.5		1	7.5×10^{-1}	100
7.5 … 8.0		Overrange		
8.0 … 8.5	Pirani	Underrange		
8.5		1.0×10^{-2}	7.5×10^{-3}	1
8.75		1.0×10^{-1}	7.5×10^{-2}	10
9.0		1	7.5×10^{-1}	100
9.25		10	7.5	1000
9.5		100	75	10000
9.75		1000	750	100000
9.75 … 10.2		Overrange		

B: Gas Type Dependence

For gases other than air, the pressure can be determined by a simple conversion:

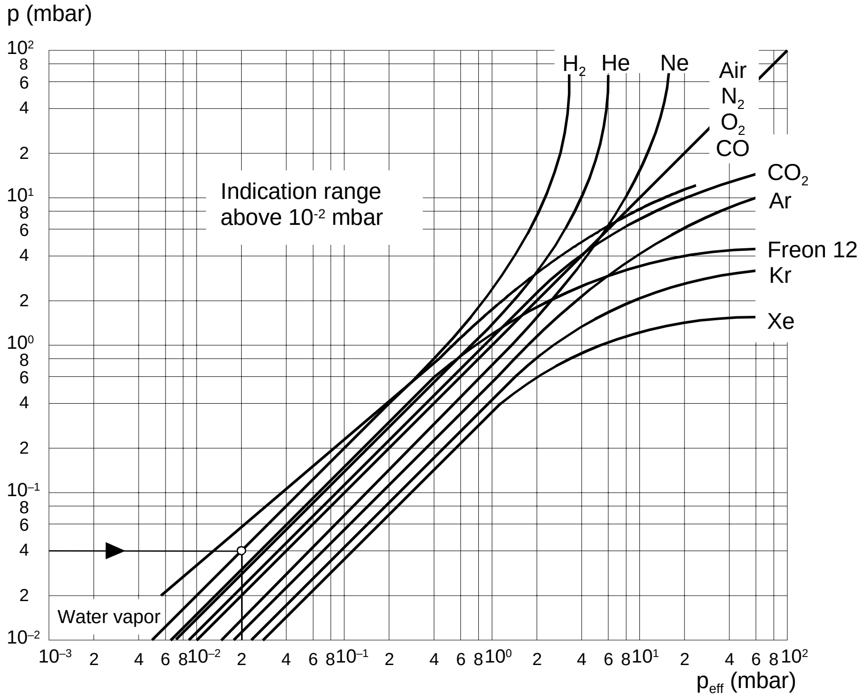
Hot cathode range
(1×10^{-6} mbar < p < $p_{Changeover}$)

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

Where

Gas type	K (mean values)
Air (N_2, O_2)	1.0
Xe	0.4
Kr	0.5
Ar	0.8
H_2	2.4
Ne	4.1
He	5.9

Pirani range
($p_{Changeover}$ < p < 1000 mbar)



A mixture of gases and vapors is often involved. In this case, accurate determination is only possible with a partial-pressure measuring instrument.

C: Literature

📖 [1] www.inficon.com
Communication Protocol
DeviceNet™ HPG400-SD (BPG400-SD)
tira03e1
INFICON AG, LI–9496 Balzers, Liechtenstein

📖 [2] www.inficon.com
Communication Protocol
Profibus HPG400-SP (BPG400-SP)
tira36e1
INFICON AG, LI–9496 Balzers, Liechtenstein

📖 [3] www.inficon.com
Product descriptions and downloads
INFICON AG, LI–9496 Balzers, Liechtenstein

📖 [4] www.odva.org
Open DeviceNet Vendor Association, Inc.
DeviceNet™ Specifications

📖 [5] www.profibus.com
Profibus user organization

📖 [6] European Standard for DeviceNet EN 50325

📖 [7] European Standard for Profibus EN 50170

📖 [8] www.inficon.com
Instruction Sheet
HPG400 (all versions)
tima31e1
INFICON AG, LI–9496 Balzers, Liechtenstein

📖 [9] www.inficon.com
Instruction Sheet
HPG400-SD, HPG400-SP
tima32e1
INFICON AG, LI–9496 Balzers, Liechtenstein

📖 [10] www.inficon.com
INFICON AG, LI–9496 Balzers, Liechtenstein

Declaration of Contamination

The service, repair, and/or disposal of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay.

This declaration may only be completed (in block letters) and signed by authorized and qualified staff.

❶ Description of product

Type ______________________

Part number ______________________

Serial number ______________________

❷ Reason for return

____

❸ Operating fluid(s) used (Must be drained before shipping.)

____

❹ Used in copper process

no ❑ yes ❑ → Seal product in plastic bag and mark it with a corresponding label.

❺ Process related contamination of product:

toxic	no ❑ 1)	yes ❑
caustic	no ❑ 1)	yes ❑
biological hazard	no ❑	yes ❑ 2)
explosive	no ❑	yes ❑ 2)
radioactive	no ❑	yes ❑ 2)
other harmful substances	no ❑ 1)	yes ❑

The product is free of any substances which are damaging to health. yes ❑

1) or not containing any amount of hazardous residues that exceed the permissible exposure limits

2) Products thus contaminated will not be accepted without written evidence of decontamination.

❻ Harmful substances, gases and/or by-products

Please list all substances, gases, and by-products which the product may have come into contact with:

Trade/product name	Chemical name (or symbol)	Precautions associated with substance	Action if human contact

❼ Legally binding declaration:

We hereby declare that the information on this form is complete and that we will assume any further costs that may arise. The contaminated product will be dispatched in accordance with the applicable regulations.

Organization/company ______________________

Address ______________________ Post code, place ______________________

Phone ______________________ Fax ______________________

Email ______________________

Name ______________________

Date and legally binding signature ______________________

Company stamp

This form can be downloaded from our website.

Copies:
Original for addresee - 1 copy for accompanying documents - 1 copy for file of sender

Notes

Notes

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