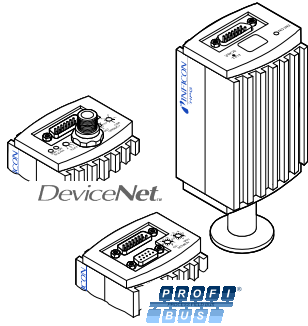


High Pressure / Pirani Gauge

HPG400
HPG400-SD
HPG400-SP

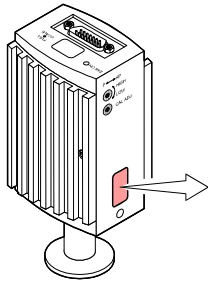


Instruction Sheet
Incl. Declaration of Conformity

tima31e1-a (2004-05)

Product Identification

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



INFICON AG, LI-9496 Balzers
Model: _____
PN: _____
SN: _____
_ V _ W

Validity

This document applies to products with part number (PN):

HPG400 (without display)
353-520 (DN 25 ISO-KF)
353-522 (DN 40 CF-R)

HPG400 (with display)
353-521 (DN 25 ISO-KF)
353-523 (DN 40 CF-R)

HPG400-SD (with DeviceNet interface and switching functions)
353-527 (DN 25 ISO-KF)
353-528 (DN 40 CF-R)

HPG400-SP (with Profibus interface and switching functions)
353-525 (DN 25 ISO-KF)
353-526 (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 the gauge with part number 353-520. They apply to the other types of the HPG400 family by analogy.

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

All dimensions in mm.

Intended Use

The High Pressure / Pirani Gauges of the type HPG400, HPG400-SD and -SP gauges have been designed for vacuum measurement of non-flammable gases and gas mixtures in a pressure range of $2 \times 10^{-6} \dots 1$ 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

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

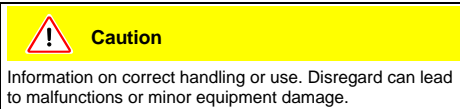
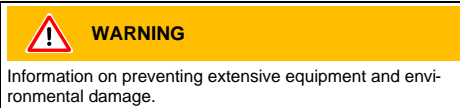
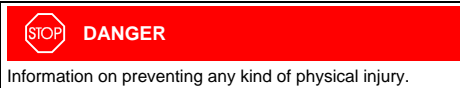
The HPG400 functions with a hot cathode ionization manometer, which is controlled by the built-in Pirani manometer (control range). The hot cathode is switched on only below the changeover threshold of ≈ 1 mbar (to prevent filament burn-out). For pressures above this threshold, the Pirani signal is output.

Trademarks

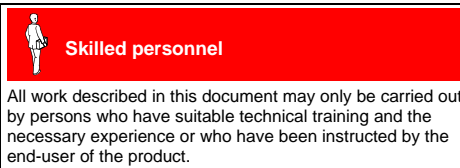
DeviceNet™ Open DeviceNet Vendor Association, Inc.

Safety

Symbols Used



Personnel Qualifications



General Safety Instructions

- Adhere to the applicable regulations and take the necessary precautions for the process media used. Consider possible reactions between the materials and the process media. Consider possible reactions of the process media (e.g. explosion) 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.

Communicate the safety instructions to all other users.

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.

Technical Data



In some points, the technical data of HPG400-SD and -SP differ from those of HPG400, which are given below (→ "Technical Data" in [1] and [2]).

Measuring range (air, N ₂)	
Hot cathode	$2 \times 10^{-6} \dots 1$ mbar
Pirani (control range)	$1 \times 10^{-2} \dots 1000$ mbar
Accuracy	
$10^0 \dots 1$ mbar	$\pm 15\%$ of reading, valid between 10^{-5} mbar and changeover threshold setting (<P ↔ HP>)
Repeatability	(after 10 min. stabilization)
$10^{-5} \dots 10^{-1}$ mbar	$\pm 2\%$ of reading
$10^{-1} \dots 100$ mbar	$\pm 30\%$ of reading

Emission of hot cathode	
Changeover threshold (selectable steps)	1 mbar, 5×10^{-1} mbar, 2×10^{-1} mbar, 1×10^{-1} mbar, 5×10^{-2} mbar (<P ↔ HP>)
Emission current	rising continuously
from 1 mbar	4 μ A
to 2×10^{-5} mbar	130 μ A
Anode voltage	180 VDC

Output signal (measuring signal)	
Voltage range	0 ... +10.2 V
Measuring range	
Hot cathode	1.5 ... 7.5 V
Pirani	8.5 ... 9.75 V
Overrange hot cathode	$7.5 \text{ V} \leq U \leq 8 \text{ V}$
Underrange hot cathode	$0.5 \text{ V} \leq U \leq 1.5 \text{ V}$
Overrange Pirani	$9.75 \text{ V} \leq U \leq 10.2 \text{ V}$
Underrange Pirani	$8 \text{ V} \leq U \leq 8.5 \text{ V}$
Relationship voltage-pressure	logarithmic
Hot cathode	1 V/decade
Pirani	0.25 V/decade
Error signal (→ [1])	
Hot cathode	$\approx 0.3 \text{ V}$
Pirani	$\approx 0.5 \text{ V}$
Minimum load impedance	10 k Ω , short-circuit proof

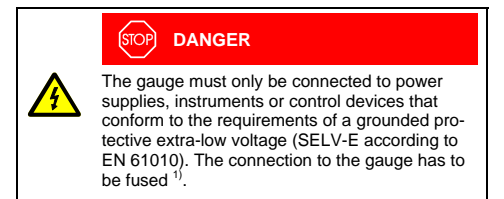
Gauge identification	56 k Ω between Pin 10 and Pin 5 (sensor cable)
RS232C interface	→ "Electrical Connection"
Data rate	9600 baud
Data format	binary 8 data bits one stop bit, no parity bit no handshake

Further information on the RS232C interface → [1]

Display panel (353-521, 353-523)	LCD matrix, 32x16 pixels with background illumination
Dimensions	16.0 mm x 11.2 mm
Pressure units	mbar (default), Torr, Pa

Selecting the pressure unit → [1]

Supply



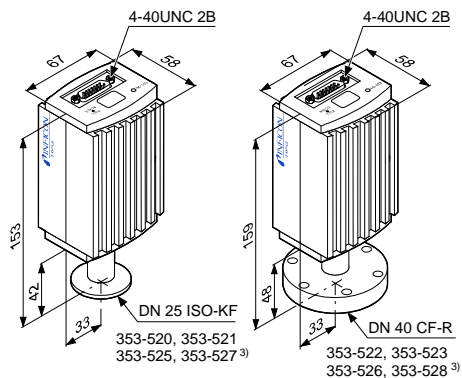
Voltage at gauge	24 VDC (20 ... 28 VDC) ripple $\leq 2 V_{pp}$ ²⁾
Current consumption	
Standard	$\leq 0.5 \text{ A}$
Emission start (200 ms)	$\leq 1.4 \text{ A}$
Fuse required ¹⁾	1.25 AT
Power consumption	$\leq 16 \text{ W}$ (HPG400)
Electrical connection	D-Sub 15 pins, male
Sensor cable	
For analog values only	4 conductors, shielded
For all functions	7 conductors, shielded
Cable length (24 VDC)	$\leq 35 \text{ m}$ (0.25 mm ² /conductor) $\leq 50 \text{ m}$ (0.34 mm ² /conductor) $\leq 100 \text{ m}$ (1.0 mm ² /conductor)
For operation with RS232 (e.g. VGC4XX)	$\leq 30 \text{ m}$

¹⁾ INFICON controllers fulfill these requirements.

²⁾ Consider the voltage drop in the supply lines.

Materials on the vacuum side	
Housing, supports, screens	stainless steel
Feedthroughs	NiFe nickel plated
Insulator	glass
Cathode	iridium, yttrium oxide (Y ₂ O ₃)
Cathode holder	molybdenum, platinum
Pirani element	tungsten, copper
Internal volume	≤20 cm ³ (DN 25 ISO-KF) ≤30 cm ³ (DN 40 CF-R)
Pressure max.	≤5 bar (absolute)
Admissible temperatures	
Storage	-20 ... +70 °C
Operation	0 ... +50 °C
Bakeout	150 °C (without electronics unit, → [1])
Relative humidity	
Year's mean	≤65% (not condensable)
During 60 days	≤85% (not condensable)
Use	indoors only altitude up to 2000 m NN
Type of protection	IP 30

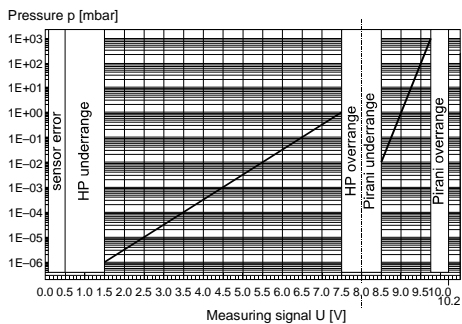
Dimensions



³⁾ Gauges with DeviceNet connector are 14 mm longer (→ [1] or [2]).

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

Relationship Measuring Signal – Pressure



Measuring range hot cathode

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

Measuring range Pirani

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

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

Where p pressure
U measuring signal
c1, c2 constant (depending on pressure unit)

Valid in range Hot cathode 1.50 V ≤ U ≤ 7.50 V
Pirani 8.50 V ≤ U ≤ 9.75 V

Gas Type Dependence

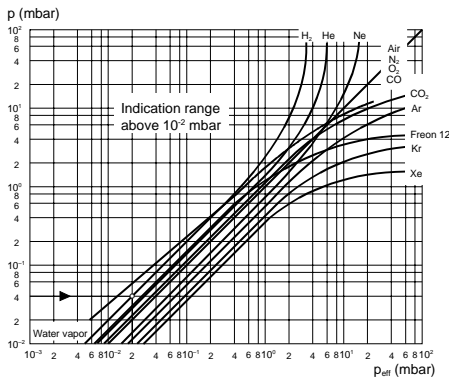
Hot cathode measuring range

For gases other than air, the pressure in the measuring range $p < 10^{-1}$ mbar can be determined by a simple conversion:

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

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 measuring range



Installation

Vacuum Connection

STOP 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 clamps which are suited to overpressure.

STOP DANGER



Caution: overpressure in the vacuum system >2.0 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.

STOP DANGER



Caution: protective ground

Incorrectly grounded products can be extremely hazardous in the event of a fault.

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 flange, use a conductive metallic clamping ring.

Caution



Caution: vacuum component

Dirt and damages impair the function of the vacuum component.

When handling vacuum components, take appropriate measures to ensure cleanliness and prevent damages.

Caution



Caution: dirt sensitive area

Touching the product or parts thereof with bare hands increases the desorption rate.

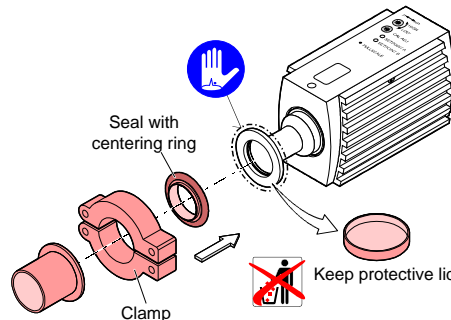
Always wear clean, lint-free gloves and use clean tools when working in this area.



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.

The gauge is supplied with a built-in baffle.

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



Electrical Connection (HPG400)



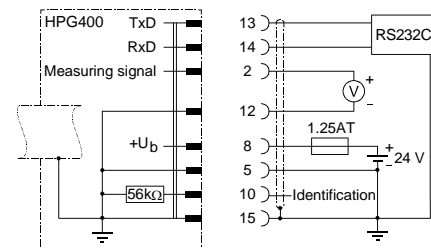
The following information on the electrical connection as well as the wiring diagram apply to HPG400 only (→ [1] and [2] for details on the electrical connection and additional functions of HPG400-SD and -SP).



Make sure the vacuum connection is properly made (→ "Vacuum Connection").

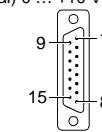


If no sensor cable is available, make one according to the following diagram.



Electrical connection

- Pin 2 Signal output (measuring signal) 0 ... +10 V
 - Pin 5 Supply common, GND
 - Pin 8 Supply voltage +24 VDC
 - Pin 10 Gauge identification
 - 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



Connect the sensor cable to the gauge.



Secure the cable connector with the lock screws.



Connect the sensor cable to the controller.



(2004-05)

Operation

When the voltage is supplied, the measuring signal is available between pins 2 (+) and 12 (-) (Relationship Measuring Signal – Pressure → "Technical Data" and [1]).

HPG400-SD and -SP can also be operated via the corresponding fieldbus interface (DeviceNet or Profibus) (→ [1] and [2]) for further details and functions).

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

Gas Type Dependence

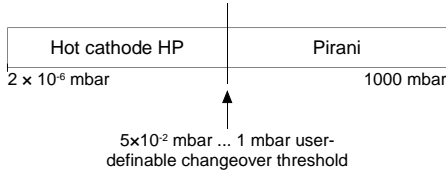
The measurement value is gas dependent. The displayed reading applies to dry air, O₂ and N₂. For other gases, it has to be converted (→ "Technical Data" and [1]).

Measuring Range

The HPG400 covers the measuring range
2×10⁻⁶ mbar ... 1000 mbar.

- The Pirani part permanently monitors the pressure.
- The hot cathode part (controlled by the Pirani) is only switched on when the pressure drops below the changeover threshold. The hot cathode will be ready for operation after a few seconds heating time, when the <EMI ON> lamp is lit.
- When the pressure rises above the changeover threshold, the hot cathode is switched off and the <EMI ON> lamp turns off.

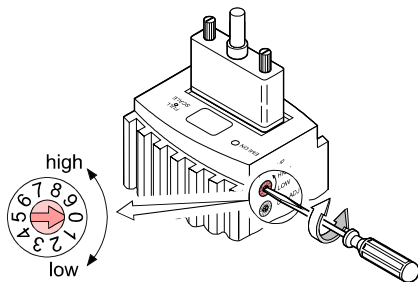
In the upper pressure range, the Pirani reading and in the lower pressure range, the hot cathode reading is output.



Selecting the Changeover Threshold

The HPG400 has five user-definable changeover thresholds. It is thus possible to prevent the changeover range from being situated within the process pressure range. The factory setting of the threshold is 1 mbar. Another changeover threshold can be selected via the <P ↔ HP> switch. Since the contamination of the hot cathode part is reduced at low pressures, the lowest possible changeover threshold should be selected.

Switch position (<P ↔ HP>)	Changeover 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



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

Adjusting the Gauge (HPG400)

The adjustment of HPG400-SD and -SP (→ [1] and [2]) is slightly different from the procedure for HPG400, which is described below.

The gauge is factory calibrated. If used under different climatic conditions, at extreme temperatures, through aging or contamination and after exchanging the sensor, the characteristic curve can be offset and readjustment can become necessary. Only the Pirani element can be adjusted and only at atmosphere.

Readjustment becomes necessary if

- at atmosphere the output voltage is <9.75 V or the display reading is <atmosphere
- when venting the vacuum system, the output voltage reaches 9.75 V before the measured pressure has reached atmosphere (Gauges with display will show the error "5" at atmosphere (Pirani sensor warning)).

(For more details → [1], "Maintenance, Repair").

Adjustment of the Pirani part under high vacuum conditions:

The Pirani part is automatically adjusted by the hot cathode part when the gauge is activated and the pressure range 1 ... 3×10⁻³ mbar is reached for the first time.

Adjustment of the Pirani part at atmospheric pressure:

- Put the gauge into operation.

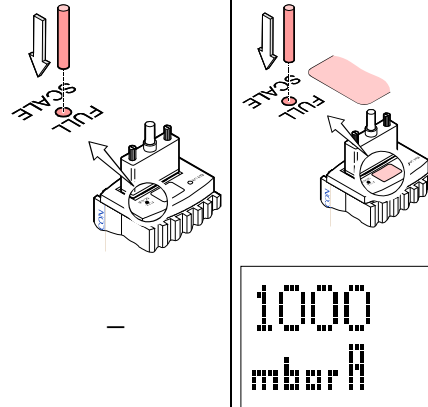


Operate the gauge for ≈10 minutes at atmospheric pressure. If the gauge was operated within the hot cathode range, a cooling-down time of ≈30 minutes is to be expected (gauge temperature = environmental temperature).

- Adjust the gauge

HPG400 without display	HPG400 with display
353-520 353-522	353-521 353-523

Insert a pin (≈∅1.3×50mm) through the opening <FULL SCALE> and push the button inside for at least 5 seconds.

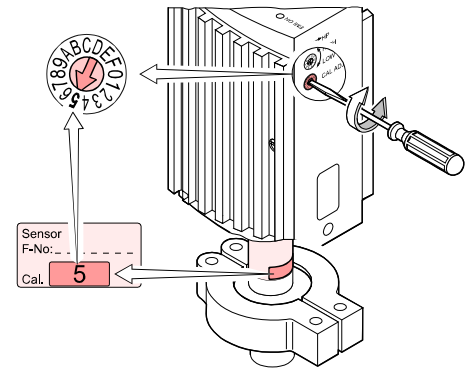


Automatic adjustment in progress.

Adjustment completed.

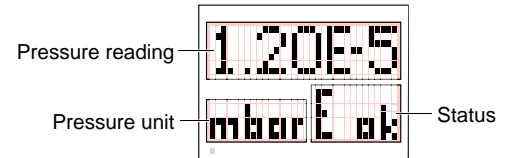
Adjusting the Calibration Setting of the Hot Cathode Part

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.



Display

(HPG400 with part numbers 353-521 and 353-523)



Parameter	Display	Description
Reading	0 ... 1000	mbar, Torr, Pa
Pressure unit	mbar, Torr, Pa	Factory setting: mbar
Status	(none)	Pirani operation
	E	Emission hot cathode on
	A	Adjustment at atmospheric pressure in progress
	ok	Normal operation, no error
	Fail IonG 5	Pirani sensor warning ¹⁾
	Fail IonG 8	Hot cathode sensor warning ¹⁾
	Fail Ion G 9	Pirani sensor error
	no Signal	Internal data connection failure ¹⁾

¹⁾ Background illumination red (in normal operation green).

Deinstallation

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.

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.

- Vent the vacuum system.
- Take the gauge out of operation.
- Unfasten the lock screws and unplug the sensor cable. (If you are using HPG400-SD or -SP, unfasten and unplug the interface connector, too (→ [1] and [2])).

