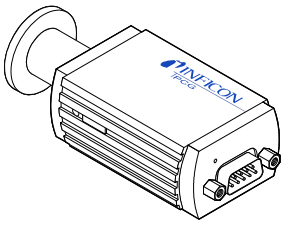
Pirani Capacitance Diaphragm Gauge

PCG410
PCG410-S

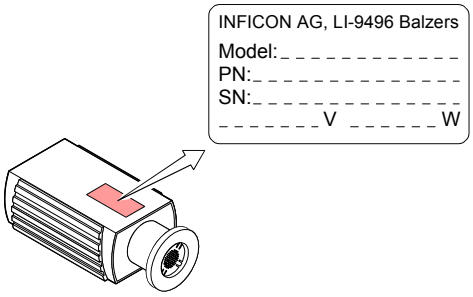


Operating Manual
Incl. Declaration of Conformity

tina36e1-a (0309)

Product Identification

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



Validity

This document applies to products with the following part numbers:

PCG410 (without switching function)
- 355-020 (DN 16 ISO-KF)
- 355-021 ($^1/_8$" NPT)
- 355-022 (DN 16 CF-F)
- 355-024 (8 VCR®)
- 355-025 (4 VCR®)

PCG410-S (1 switching function)
- 355-030 (DN 16 ISO-KF)
- 355-031 ($^1/_8$" NPT)
- 355-032 (DN 16 CF-F)
- 355-034 (8 VCR®)
- 355-035 (4 VCR®)

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 DN 16 ISO-KF vacuum connection. They apply to other vacuum connections by analogy.

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

All dimensions are indicated in mm.

Intended Use

The Pirani Capacitance Diaphragm Gauges PCG410 and PCG410-S have been designed for vacuum measurement of gases in the pressure range of 5×10^{-4} … 1500 mbar.

The gauge is intended be operated in connection with a suitable controller or a PLC.

Functional Principle

Due to the combination of two sensor technologies incorporated in the gauge (Capacitance diaphragm sensor and Pirani sensor), a minimized gas type dependence is achieved.

Between 10 mbar [1] and atmospheric pressure, the capacitance diaphragm sensor operates without any gas type dependence. Below 1 mbar, the Pirani sensor takes over with only a small gas type dependence.

Between 1 … 10 mbar [1] the gauges built in electronic circuits take care of a continuous and smooth crossover between the two ranges. Over the whole measurement range, the measurement signal is output as a logarithm of the pressure.

Additionally, the PCG410-S features one switching function with adjustable setpoints. A floating change over relay contact is provided for the switching function.

Trademarks

VCR® Swagelok Marketing Co.

Safety

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.

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.

General Safety Instructions

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

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 changes (modifications, alterations etc.) to the product
- use the product with accessories not listed in the product documentation.

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

Technical Data

Measurement principle	
10 mbar [1]… 1500 mbar	capacitance diaphragm sensor
5×10^{-4} … 1 mbar	thermal conductance according to Pirani
1 … 10 [1] mbar	crossover range
Measurement range (air, O_2, CO, N_2)	5×10^{-4} … 1500 mbar
Accuracy	
1×10^{-3} … 50 mbar	±15% of reading
50 … 950 mbar	±5% of reading
Atmospheric pressure (950 … 1050 mbar)	±2.5% of reading
Repeatability (air)	±2% of reading (1×10^{-3} … 1100 mbar)

Output signal (measurement signal)	
Voltage range	0 … +10.0 V
Mesasurement range	+2.2 … +8.68 V
Voltage vs. pressure	1 V/decade, logarithmic
Error signal (sensor error)	0 … +0.5 V
Output impedance	2 × 4.7 Ω, short circuit-proof
Minimum load impedance	10 kΩ
Response time	10 ms
HV Adjustment	at $<10^{-4}$ mbar (with potentiometer <HV>)

Switching functions (PCG410-S)

Setting range	1.5×10^{-3} … 1500 mbar with potentiometer <SP1>
Hysteresis	10% of threshold
Relay contact	
Type	1 floating change over contact per switching function
Contact rating	30 VDC, 1 A, resistive
Operation	Relay energizes if the pressure drops below the set threshold (On).
Status indicator	Green lamp lights up if the pressure drops below the set threshold (On).

Supply

DANGER

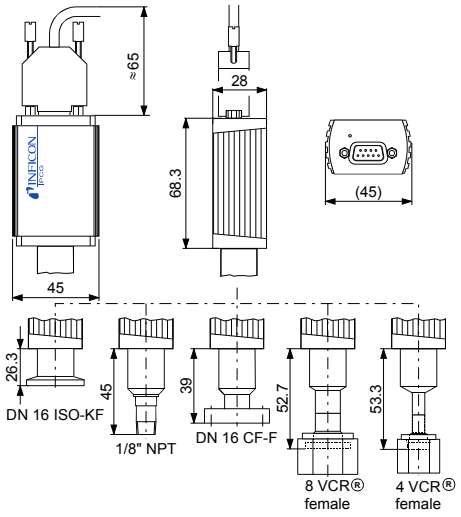
The gauge may only be connected to supply and evaluation units that conform to the requirements of a grounded protective extra-low voltage (SELV-E according to EN 61010). The connection to the gauge has to be fused.

Suppy voltage at gauge	+15 … +30 VDC (ripple ≤1 V_{pp})
Power consumption	≤2.5 W
Fuse to be connected	1 AT
Electrical connection	
PCG410	D-Sub, male, 9-pin
PCG410-S (1 switching function)	D-Sub, male, 9-pin
Sensor cable	screened, 0.25 mm^2/conductor
Cable length	≤100 m
Grounding concept	→ "Electrical Connection"
Vacuum connection to signal ground	connected via 1 MΩ
Materials exposed to vacuum	
Vacuum connection	stainless steel
Pirani filament	tungsten
Feedthrough	glass
Other materials	stainless steel, Ni, Cu, NiFe, SnAg, Al_2O_3, glass
Internal volume	
DN 16 ISO-KF	6 cm^3
$^1/_8$" NPT	8 cm^3
DN 16 CF-F	8 cm^3
8 VCR®	10 cm^3
4 VCR®	8 cm^3
Admissible pressure	≤5 bar (absolute)

[1] 10 mbar in air, O_2, CO, N_2
100 mbar in heavy gases

Admissible Temperatures	
Storage	–20 … +65 °C
Operation (ambient)	+5 … +60 °C
Bake-out	≤80 °C (at the vacuum connection)
Filament temperature	≈120 °C
Relative humidity	≤80% at temperatures ≤+31 °C, decreasing to 50% at +40 °C
Mounting orientation	any
Use	indoors only altitudes up to 2000 m NN
Protection category	IP 40

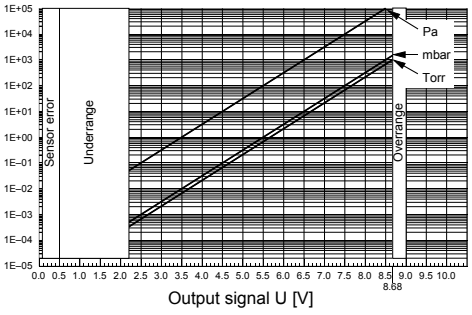
Dimensions [mm]



Weight	
DN 16 ISO-KF	90 g
$^1/_8$" NPT	90 g
DN 16 CF-F	120 g
8 VCR®	145 g
4 VCR®	130 g

Output Signal vs. Pressure

Pressure p [mbar]



Output signal U [V]

$p = 10^{(U-c)}$ ⇔ $U = c + \log_{10} p$

valid in the range 5×10^{-4} mbar <p< 1500 mbar

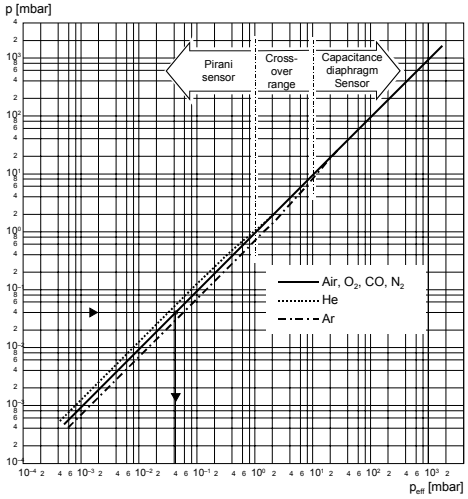
U	p	c
[V]	[mbar]	5.5
[V]	[µbar]	2.5
[V]	[Torr]	5.625
[V]	[mTorr]	2.625

U	p	c
[V]	[micron]	2.625
[V]	[Pa]	3.5
[V]	[kPa]	6.5

where p pressure
U output signal
c constant (pressure unit dependent)

Gas Type Dependence

Indicated pressure (gauge calibrated for air)



Calibration factors

valid for Pirani pressure range below 1 mbar

$p_{eff} = C \times$ indicated pressure

Gas type	Calibration factor C	Gas type	Calibration factor C
He	0.8	H_2	0.5
Ne	1.4	air, O_2, CO, N_2	1.0
Ar	1.7	CO_2	0.9
Kr	2.4	water vapour	0.5
Xe	3.0	Freon 12	0.7

Installation

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 >2.5 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

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, NPT and VCR® connections fulfill this requirement
- For gauges with a KF 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.

Caution

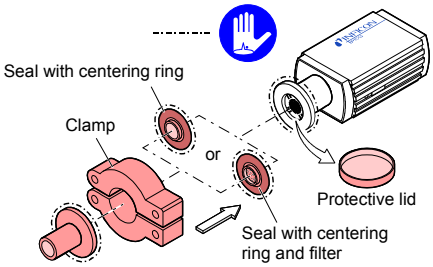
Caution: dirt sensitive area

Touching the product or parts thereof with one's 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 and possibly use a seal with a centering ring and filter. If adjustment should be possible after the gauge has been installed, be sure to install it so that potentiometers can be accessed (→ "Adjustment" and "Switching functions").

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



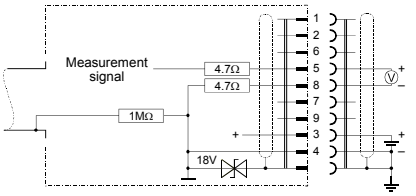
Keep the protective lid.

Electrical Connection

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

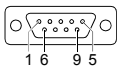
1. If no sensor cable is available, make one according to the following diagram.

PCG410 (without switching function)



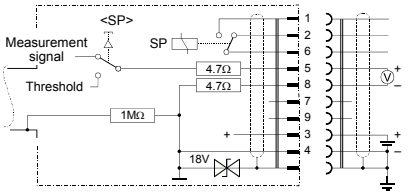
Electrical Connection

Pin 1	Not connected	Pin 6	Not connected
Pin 2	Not connected	Pin 7	Not connected
Pin 3	Supply (+24V)	Pin 8	Signal common
Pin 4	Supply common, GND	Pin 9	Not connected
Pin 5	Measurement signal		



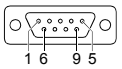
D-Sub, 9 pins female, soldering side

PCG410-S (1 switching function)



Electrical Connection

Pin 1	Relay SP, n.o.	Pin 6	Relay SP, common
Pin 2	Relay SP, n.c.	Pin 7	Not connected
Pin 3	Supply (+24V)	Pin 8	Signal common
Pin 4	Supply common, GND	Pin 9	Not connected
Pin 5	Measurement signal/ Threshold		



D-Sub, 9 pins female soldering side

2. Connect the sensor cable to the controller or PLC and secure it with the locking screws.

Operation

When the supply voltage is being applied, the measurement signal is available at the connector (→ "Electrical Connection").

Allow a stabilization period of ≈10 minutes after power has been applied.

It is advisable to operate the gauge continuously, irrespective of the pressure.

Gas Type Dependence

Pressure Range	Measurement Principle	Gas Type Dependence
10 [1] … 1500 mbar	capacitance diaphragm sensor	independent of gas type, no correction required
1 … 10 [1] mbar	capacitance diaphragm sensor and Pirani sensor	crossover range
5×10^{-4} … 1 mbar	Pirani sensor	small [2]

[2] The pressure reading applies to dry air, O_2, CO and N_2. For other gases, it has to be converted (→ "Technical Data").

Adjustment

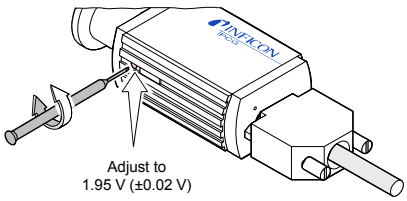
The gauge is factory calibrated. Due to long time operation or contamination, a zero drift could occur. Periodically check the zero and adjust it if necessary.

The zero must be adjusted at the ambient temperature at which the gauge is normally operated.

1. If you are using a seal with centering ring and filter, check that they are clean or replace them if necessary (→ "Deinstallation").
2. Activate the gauge.
3. Evacuate vacuum system to p <<10^{-4} mbar.

Wait 10 minutes (stabilization period).

4. Connect a DC voltmeter to output signal (→ "Electrical Connection").
5. Carry out adjustment with potentiometer <HV> by means of the enclosed screwdriver.

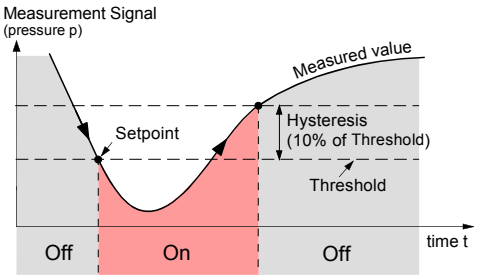


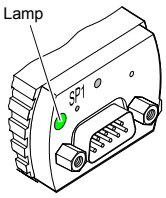
PCG410/410-S gauges do not require adjustment at atmospheric pressure.

Switching Function (PCG410-S)

The setpoint is adjustable in a pressure range of 1.5×10^{-3} … 1500 mbar. The switching function provides a floating change over relay contact (→ "Electrical Connection").

The status is indicated by a lamp.





Status	Lamp	Relay
Off	dark	deenergized
On	lit	energized

Adjustment of Switching Function

GEFAHR

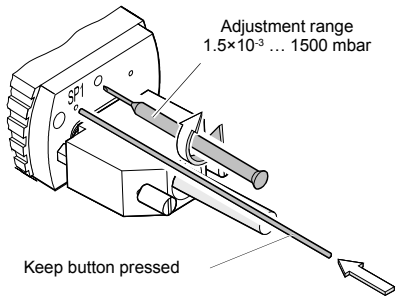
Caution: malfunction

If processes are controlled via the signal output, it should be borne in mind that by pressing the <SP1> button the measurement signal is suppressed and the threshold is output instead. This may lead to malfunctions.

Press the <SP1> button only when you are sure that no damages can arise from a malfunction.

Status of relay and lamp is not affected while the button is beeing pressed.

1. Press button <SP1> with a pin (ø<1mm) and adjust threshold by means of the enclosed screwdriver.



2 Turns (cw) will rise the threshold by one pressure decade. The upper threshold is 10% higher (hysteresis).

2. Release the button. The gauge resumes normal operation. The controller connected to the gauge shows the current pressure value again.

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.

Caution

Caution: dirt sensitive area

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

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

1. Vent vacuum system.
2. Turn the gauge off.
3. Loosen locking screws of sensor cable.
4. Unplug sensor cable.
5. Remove the gauge from the vacuum system and cover the vacuum connection with the protective lid.

Maintenance, Repair

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

The product requires no maintenance.

Accessories

	Part number
Centering ring with fine filter (For DN 16 ISO-KF vacuum connection only)	211-097

Returning the Product

WARNING

Caution: forwarding contaminated products

Contaminated products (e.g. radioactive, toxic, caustic or microbiological 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

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.

Disposal

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.

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.

1 Description of product
Type _____
Part number _____
Serial number _____

2 Reason for return
_____
_____
_____

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

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

5 Process related contamination of product:

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

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

6 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 manufacturer	Chemical name (or symbol)

Precautions associated with substance	Action if human contact

7 Legally binding declaration:

We hereby declare that the information on this form is complete and accurate 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 _____
Company stamp

This form can be downloaded from our website.
Copies: Original for addressee
1 copy for accompanying documents
1 copy for file of sender

Declaration of Conformity

CE

We, INFICON, hereby declare that the equipment mentioned below complies with the provisions of the Directive relating to electrical equipment designed for use within certain voltage limits 73/23/EEC and the Directive relating to electromagnetic compatibility 89/336/EEC.

Pirani Capacitance Diaphragm Gauge

PCG410
PCG410-S

Part numbers

355-020
355-021
355-022
355-024
355-025

355-030
355-031
355-032
355-034
355-035

Standards

Harmonized and international/national standards and specifications:

- EN 61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use)
- EN 61000-6-2 (Electromagnetic compatibility generic emission standard)
- EN 61000-6-3 (Electromagnetic comatibility generic immunity standard)

Signatures

INFICON AG, Balzers

29 April 2003

Remo Klaiber
Product Marketing Management

29 April 2003

Dr. Georg Sele
Technical Support Manager
Quality Representative

INFICON
LI–9496 Balzers
Liechtenstein
Tel +423 / 388 3111
Fax +423 / 388 3700
reach.liechtenstein@inficon.com
www.inficon.com