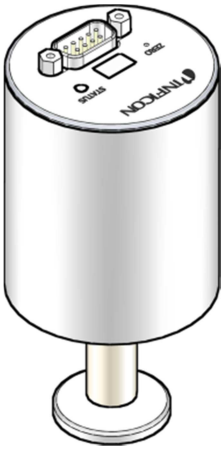
Capacitance Diaphragm Gauge

CDG025D-X3 4-20 mA Current Loop



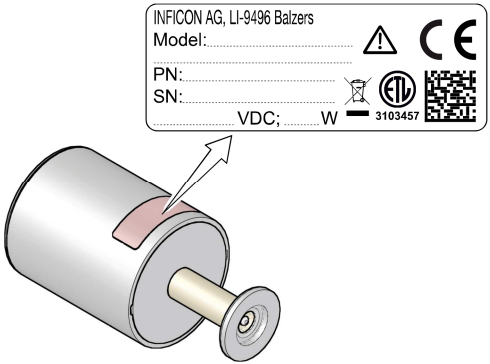
CE

Operating Manual

Incl. EU Declaration of Conformity

Product Identification

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

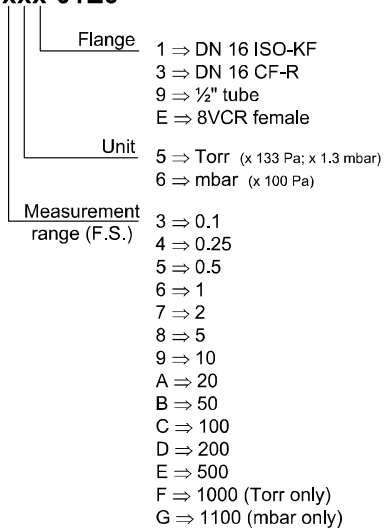


Validity

This document applies to products of the CDG025D-X3 4-20 mA Current Loop series.

Part numbers of standard products are indicated below. OEM products have other part numbers and different parameter settings as defined in the corresponding ordering information.

3CB1-xxx-01E0



The part number (PN) can be taken from the product nameplate.

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

Intended Use

The Capacitance Diaphragm Gauges of the CDG025D-X3 4-20 mA Current Loop series are intended for absolute pressure measurement of gases in their respective pressure ranges (→ 🗎 3). They are clean room compliant and double protected against contamination.

The gauges belong to the SKY® Smart Sensors family and can be operated in connection with an appropriate 4 … 20 mA measuring unit.

Function

The Capacitance Diaphragm Gauge consists of a capacitive sensor element made of aluminum oxide ceramics and electronics which convert the capacitance into a DC current output signal.

The output signal is linear to the measured pressure and independent of the gas type.

Trademarks

SKY® INFICON GmbH
VCR® Swagelok Marketing Co.

Patents

EP 1070239 B1, 1040333 B1

US Patents 6528008, 6591687, 7107855, 7140085

Scope of Delivery

1× Gauge in clean room packaging
1× Pin for adjusting settings via buttons
1× Calibration Test Report
1× Operating Manual (German and / or English)

Contents

For cross-references within this document, the symbol (→ 🗎 XY) is used, for cross-references to further documents, listed under "Further Information", 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.

Consultation of operating manual required (symbol printed on the product nameplate)

Notice

<.....> Labelling

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 with the product materials.
- 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 product documentation.

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

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

2 Technical Data

Measurement range	→ "Validity"
Accuracy [1]	
≥1 Torr/mbar (F.S.)	0.20% of reading
0.25 Torr/mbar (F.S.)	0.25% of reading
0.1 Torr/mbar (F.S.)	0.50% of reading
Temperature effect on zero	
≥10 Torr/mbar (F.S.)	0.0050% F.S./ °C
1 / 2 Torr/mbar (F.S.)	0.015% F.S./ °C
0.1 / 0.25 Torr/mbar (F.S.)	0.020% F.S./ °C
Temperature effect on span	
≥1 Torr/mbar (F.S.)	0.01% of reading / °C
0.1 / 0.25 Torr/mbar (F.S.)	0.03% of reading / °C
Resolution	0.003% F.S.
Gas type dependence	none

Output signal analog (measuring signal)	2-wire, current loop
Signal range	3.8 … 20.2 mA
Measuring range (zero … F.S.)	4.0 … 20.0 mA
Relationship current-pressure	linear
Loaded impedance R_L	typical 500 Ω ±1% at 24 ±3 V (dc) [2]
absolute	309 … 654 Ω at 24 V [2] 160 … 505 Ω at 21 V [2] 457 … 802 Ω at 27 V [2]
Step response time	≤100 ms

[1] Non-linearity, hysteresis, repeatability in the calibrated range at 25 °C ambient operating temperature without temperature effects after operation of 2 h.

[2] Supply voltage at the gauge.

Remote zero input	digital input, floating contact
High level	+19 … +27 V (dc) / ≤8 mA
Low level (open)	<2 V
Remote Zero function	
High level (pulse >1 s … <5 s)	auto zero adjust
Low level	measurement operation

Supply

DANGER

The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded protective extra-low voltage (PELV) and limited power source (LPS), Class 2.

Supply voltage	
at the gauge	+24 ± 3 V (dc)

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

Electrical connection	9-pin D-Sub, male
Sensor cable	
without remote zero	2-pin plus shielding, twisted
with remote zero	4-pin plus shielding, twisted
Cable length / cross-section	
<25 m	0.14 mm² / conductor
25 …50 m	0.25 mm² / conductor
>50 … 300 m	0.50 mm² / conductor

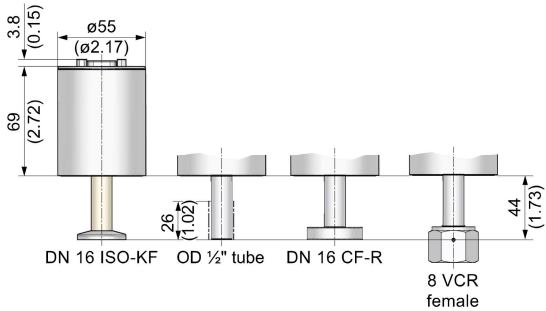
For longer cables, larger conductor cross-sections are required (R_{cable} ≤1.0 Ω).

Grounding concept	
Vacuum flange - loop common	potential isolated

Materials exposed to vacuum	
Flange, tube	stainless steel AISI 316L
Sensor and diaphragm	ceramics (Al_2O_3 ≥99.5%)
Internal volume	≤3.6 cm^3
Admissible pressure (absolute)	
≥200 Torr/mbar (F.S.)	4 bar | 400 kPa
1 … 100 Torr/mbar (F.S.)	2.6 bar | 260 kPa
0.1 / 0.25 Torr/mbar (F.S.)	1.3 bar | 130 kPa
Bursting pressure (absolute)	5 bar | 500 kPa

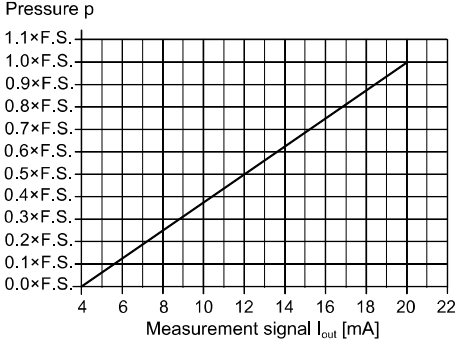
Admissible temperatures	
Storage	–20 °C … +65 °C
Operation	+5 °C … +60 °C
Bakeout (not in operation)	≤110 °C at the flange
Relative humidity	≤80% at temperatures ≤+31 °C decreasing to 50% at +40 °C
Use	indoors only, altitude up to 2000 m NN
Degree of protection	IP 30

Dimensions [mm (inch)]



Weight	≤370 g

Analog Measuring Signal vs. Pressure



$$p = [(I_{out} - 4\ mA) / 16\ mA] \times p\ (F.S.)$$

Conversion Torr ↔ Pascal

	Torr	mbar [3]	Pa [3]
c	1.00	1013.25 / 760 = 1.3332…	101325 / 760 = 133.3224…

Example: Gauge with 10 Torr F.S.
Measuring signal I_{out} = 12 mA

$$p = [(12\ mA - 4\ mA) / 16\ mA] \times 10\ Torr$$
$$= 0.5 \times 10\ Torr = \mathbf{5\ Torr}$$

[3] Source: NPL (National Physical Laboratory)
Guide to the Measurement of Pressure and Vacuum,
ISBN 0904457x / 1998

3 Installation

WARNING

WARNING: fragile components

The ceramic sensor may be damaged by impacts.

Do not drop the product and prevent shocks and impacts.

3.1 Vacuum Connection

DANGER

DANGER: overpressure in the vacuum system >1 bar

Injury caused by released parts and harm caused by escaping process gases can result if clamps are opened while the vacuum system is pressurized.

Do not open any clamps while the vacuum system is pressurized. Use the type clamps which are suited to overpressure.

DANGER

DANGER: overpressure in the vacuum system >2.5 bar

KF flange connections with elastomer seals (e.g. O-rings) cannot withstand such pressures. Process media can thus leak and possibly damage your health.

Use O-rings provided with an outer centering ring.

DANGER

DANGER: protective ground

Products that are not correctly connected to ground can be extremely hazardous in the event of a fault.

Electrically connect the gauge to the grounded vacuum chamber. This connection must conform to the requirements of a protective connection according to EN 61010:

- 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

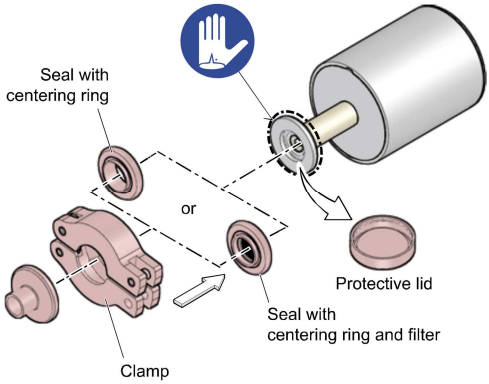
Caution: dirt sensitive area

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.

Mount the gauge so that no vibrations occur. 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 the buttons can be accessed with a pin (→ 🗎 18).

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



Keep the protective lid.

3.2 Electrical Connection

Make sure the vacuum connection is properly made (→ 12).

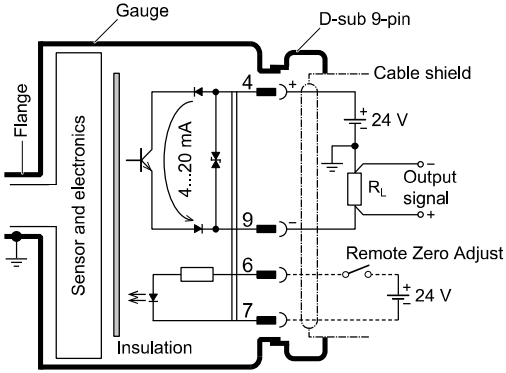
DANGER

The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded protective extra-low voltage (PELV) and limited power source (LPS), Class 2.

Ground loops, differences of potential, or EMC problems may affect the measurement signal. For optimum signal quality observe the following notes:

- Typically connect the cable shield to ground on gauge side via the chassis ground.
- Depending on the situation, following measures can cause better signal quality:
  - connect the cable shield to ground on power supply side, or
  - connect the cable shield to ground on both sides.

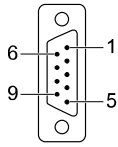
If no sensor cable is available, make one according to the following diagram. Connect the cable.



Electrical Connection

Pin 4	Positive Exitation
Pin 6	Remote Zero Supply
Pin 7	Remote Zero Common
Pin 9	Negative Exitation

Pin 1, 2, 3, 5, 8: n.c.



D-Sub 9-pin female, soldering side

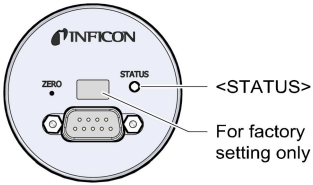
4 Operation

Put the gauge into operation.

Warm-up time

- for general purpose reading (within specifications) >¼ hour
- for zero adjustment and precision measurement >2 hours

4.1 Status Indicator



<STATUS> indicator	Meaning
Off	no supply voltage
Lit solid green	measurement mode
Blinking green	zero-adjust mode or warning, over/underrange
Blinking red	zero-adjust error
Lit solid red	error

4.2 Zeroing the Gauge

The gauge is factory calibrated while "standing upright" (→ "Calibration Test Report").

We recommend performing a zero adjustment, when the gauge is operated for the first time.

Due to long time operation or contamination, a zero drift could occur and zero adjustment may become necessary.

For adjusting the zero, operate the gauge under the same constant ambient conditions and in the same mounting orientation as normally.

The output signal (measuring signal) is depending on the mounting orientation. The signal difference between the vertical and horizontal mounting orientation is:

F.S.	Δp / 90°
1000 Torr	≈0.02% F.S.
100 Torr	≈0.1% F.S.
10 Torr	≈0.5% F.S.
1 Torr	≈3% F.S.
0.1 Torr	≈18% F.S.

4.2.1 <ZERO> Adjustment

The zero can be adjusted via

- the <ZERO> button on the gauge,
- the digital input "Remote Zero" (briefly apply the supply voltage to pin 6: pulse → 🗎 9).

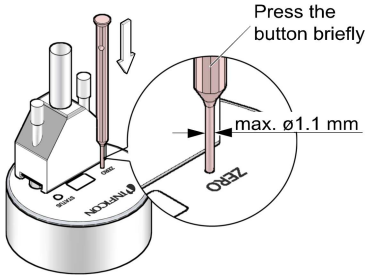
❶ Evacuate the gauge to a pressure according to the table below:

F.S.		Recommended final pressure for zero adjustment		
1100	mbar	–	<6.7×10^{0} Pa	<6.7×10^{-2} mbar
1000	Torr	<5×10^{-2} Torr	<6.7×10^{0} Pa	–
500	Torr/mbar	<2.5×10^{-2} Torr	<3.3×10^{0} Pa	<3.3×10^{-2} mbar
200	Torr/mbar	<10^{-2} Torr	<1.3×10^{-0} Pa	<1.3×10^{-2} mbar
100	Torr/mbar	<5×10^{-3} Torr	<6.7×10^{-1} Pa	<6.7×10^{-3} mbar
50	Torr/mbar	<2.5×10^{-3} Torr	<3.3×10^{-1} Pa	<3.3×10^{-3} mbar
20	Torr/mbar	<10^{-3} Torr	<1.3×10^{-1} Pa	<1.3×10^{-3} mbar
10	Torr/mbar	<5×10^{-4} Torr	<6.7×10^{-2} Pa	<6.7×10^{-4} mbar
5	Torr/mbar	<2.5×10^{-4} Torr	<3.3×10^{-2} Pa	<3.3×10^{-4} mbar
2	Torr/mbar	<10^{-4} Torr	<1.3×10^{-2} Pa	<1.3×10^{-4} mbar
1	Torr/mbar	<5×10^{-5} Torr	<6.7×10^{-3} Pa	<6.7×10^{-5} mbar
0.5	Torr/mbar	<2.5×10^{-5} Torr	<3.3×10^{-3} Pa	<3.3×10^{-5} mbar
0.25	Torr/mbar	<10^{-5} Torr	<1.3×10^{-3} Pa	<1.3×10^{-5} mbar
0.1	Torr/mbar	<5×10^{-6} Torr	<6.7×10^{-4} Pa	<6.7×10^{-6} mbar

If the final pressure in the gauge is too high for zero adjustment (>25% of the F.S.), the zero cannot be reached and the <STATUS> indicator flashes.

❷ Operate the gauge for at least 2 hours (until the signal is stable).

❸ Briefly (>1 s) press the <ZERO> button with a pin (max. ø1.1 mm), or …



… briefly apply the supply voltage to pin 6 (Remote Zero, (→ diagram 🗎 16, pulse → 🗎 9).

The zero adjustment runs automatically. The <STATUS> indicator flashes until the adjustment (duration ≈8 s) is completed.

☞ After zero adjustment the gauge automatically returns to measurement mode.

The <STATUS> indicator flashes if

- the signal output is negative (< 4 mA) when the final pressure has been attained
- the zero adjustment has failed.

4.2.2 <ZERO> Adjustment with Ramp Function

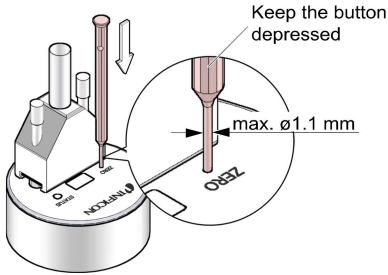
The ramp function allows to adjust the zero at a known reference pressure within the measurement range of the gauge.

It also permits to adjust an offset of the characteristic curve in order to compensate for the offset of the measuring system.

The offset should not exceed 1.5% of the F.S. (4 … 4.2 mA). At a higher positive offset, the upper limit of the measurement range is exceeded.

❶ Operate the gauge for at least 15 minutes (until the signal is stable).

❷ Push the <ZERO> button with a pin (max. ø1.1 mm) and keep it depressed. The <STATUS> indicator starts flashing. After 5 s, the zero adjustment value, starting at the current output value, keeps continually changing (ramp) until the button is released or until the setting limit (max. 25% F.S.) is reached. The corresponding output signal is delayed by about 1 s.



- Change of direction (inverse ramp): Release the button. Press and keep it depressed again within 3 … 5 s (the flashing frequency of the <STATUS> indicator changes briefly).
- Fine adjustment: Release the button. Briefly press it again within 0 … 3 s. The zero adjustment value changes by one unit (push <ZERO> button in intervals of 1 s).

If the <ZERO> button is released for more than 5 s, the gauge returns to the measurement mode.

The <STATUS> indicator flashes if the signal output is negative (<4 mA).

4.3 Activating the Factory Setting (Factory Reset)

All user defined parameters (e.g. zero, filter) are restored to their default values.

Loading of the default parameters is irreversible.

Loading the default parameters:

1. Put the gauge out of operation.
2. Keep the <ZERO> button depressed for at least 5 s while the gauge is being put into operation (Power ON).

5 Deinstallation

WARNING

WARNING: fragile components

The ceramic sensor may be damaged by impacts.

Do not drop the product and prevent shocks and impacts.

DANGER

DANGER: contaminated parts

Contaminated parts can be detrimental to health and environment.

Before beginning to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Caution

Caution: vacuum component

Dirt and damages impair the function of the vacuum component.

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

Caution

Caution: dirt sensitive area

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

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

1. Vent the vacuum system.
2. Put the gauge out of operation.
3. Unfasten the lock screws and disconnect the sensor cable.
4. Remove the gauge from the vacuum system and install the protective lid.

6 Maintenance, Repair

Under clean operating conditions, the product requires no maintenance.

Gauge failures due to contamination are not covered by the warranty.
We recommend checking the zero at regular intervals (→ 19).

INFICON assumes no liability and the warranty becomes null and void if any repair work is carried out by the end-user or third parties.

7 Returning the Product

WARNING

WARNING: 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 (form under www.inficon.com).

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.

8 Disposal

DANGER

DANGER: contaminated parts

Contaminated parts can be detrimental to health and environment.

Before beginning to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

WARNING

WARNING: substances detrimental to the environment

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

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

Separating the components

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

- Contaminated components

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

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

ETL Certification

C ETL US LISTED
Intertek
3103457

ETL LISTED

The product CDG025D-X3 4-20 mA

- conforms to the UL Standard UL 61010-1
- is certified to the CSA Standard CSA C22.2 # 61010-1

EU Declaration of Conformity

CE

We, INFICON, hereby declare that the equipment mentioned below complies with the provisions of the Directive relating to electromagnetic compatibility 2014/30/EU and the Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2011/65/EU.

Capacitance Diaphragm Gauge

CDG025D-X3 4-20 mA Current Loop

Standards

Harmonized and international/national standards and specifications:

- EN 61000-6-2:2005 (EMC: generic immunity standard)
- EN 61000-6-3:2007 + A1:2011 (EMC: generic emission standard)
- EN 61010-1:2010 (Safety requirements for electrical equipment for measurement, control and laboratory use)
- EN 61326:2013 (EMC requirements for electrical equipment for measurement, control and laboratory use)

Manufacturer / Signatures

INFICON AG, Alte Landstraße 6, LI-9496 Balzers

22 April 2015	22 April 2015
Dr. Urs Wälchli	Michael Wildi
Managing Director	Product Manager

Original: German tinb16d1-a (2017-02)

tinb16e1-a

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