Operating Manual
Incl. EU Declaration of Conformity

MEMS Pirani & Piezo Diaphragm Gauge

Analog output with either RS232 or RS485 interface

PPG550

CE

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: .....
Supply: ..... VDC ..... mW

Validity

This document applies to products with the following part numbers:

3PPM – 001 – DDR3

Analog output	**0**	0.61 ... 10.2 V [1]
	2	0.372 ... 5.570 V [2]
	3	1.0 ... 9 V [3]
	Z	No analog output
Digital interface	**0**	None
	R	RS232
	S	RS485
Electrical connection	**0**	FCC, 8-pin (27 kOhm)
	D	D-sub, 9-pin
	E	D-sub HD, 15-pin
Optional functions	**0**	No solid state relays
	2	2 solid state relays
	D	1 solid state relay
	E	3 solid state relays
Flange	**1**	DN 16 ISO-KF
	2	DN 16 ISO-KF, long tube
	6	DN 25 ISO-KF
	D	4 VCR female
	F	1/8" NPT
Unit	**0**	mbar
	1	Torr
	2	Pa

1) INFICON PCG55x / PSG55x, Leybold TTR 101N

2) GP / MKS 275

3) MKS 910 / 925 / 901P

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 3PPM-001-DDR3. They apply to the other gauges by analogy.

Intended Use

The MEMS Pirani & Piezo Diaphragm Gauge PPG550 has been designed for vacuum measurement of gases in the pressure range of 1×10^{-6} … 1333 mbar.

It must not be used for measuring flammable or combustible gases in mixtures containing oxidants (e.g. atmospheric oxygen) within the explosion range.

Functional Principle

The PPG gauge is a combination gauge consisting of a MEMS Pirani sensor and a MEMS Piezo diaphragm sensor. Both sensors are constantly active.

At low pressures, only the signal of the MEMS Pirani sensor is used for pressure measurement; at high pressures, only the signal of the MEMS Piezo diaphragm sensor. To determine the output signal in the intermediate range, both signals are used proportionally to the pressure.

Contents

For cross-references within this document, the symbol (→ 🗎 XY) is used, for cross-references to further documents and data sources, 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

1.2 Personnel Qualifications

Skilled personnel

All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the end-user of the product.

1.3 General Safety Instructions

- Adhere to the applicable regulations and take the necessary precautions for the process media used.

  Consider possible reactions between the materials (→ 🖹 7) and the process media.

  Consider possible reactions 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.

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.

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

2 Technical Data

Measurement principle

Pressure range		
2 … 1333 mbar		MEMS Piezo resistive diaphragm
1.5 … 2 mbar		crossover range
1×10^{-6} … 1.5 mbar		MEMS Pirani thermal conductivity

Measuring range

Range (N_2)	1×10^{-6} … 1333 mbar
Accuracy [1]	
1100 … 1333 mbar	0.5% of reading
800 … 1099 mbar	0.25% of reading
100 … 800 mbar	0.5% of reading
2 … 99.9 mbar	1% of reading
1×10^{-4} … 1.99 mbar	5% of reading
1×10^{-5} … 9.99×10^{-5} mbar	25% of reading
Hysteresis	
10 … 1333 mbar	0.1% of reading
1×10^{-3} … 10 mbar	1% of reading
Analog output resolution	16 bit (150 µV)
Analog output update rate	124 Hz
Response time (ISO 19685:2017)	<20 ms
Temperature compensation	+10 … +50 °C
Temperature measurement absolute accuracy	±1.5 °C (0 … +80 °C)
Gas type dependence	→ 🗎 13

Solid state relay

Set point range	5×10^{-6} … 1333 mbar
Contact rating	50 V, 100 mA_{rms} / mA (dc)
Contact on resistance	<35 Ω
Contact endurance	Unlimited (no mechanical wear)

Do not exceed maximum load rating of 250 mA, 50 V (dc) / V (ac) peak on relay contacts. Special precautions must be taken when driving an inductive load. Ensure that inrush peak current does not exceed relay contact ratings.

Analog output

3PPM-xxx-xxx**0**	0.61 … 10.2 V
3PPM-xxx-xxx**2**	0.375 … 5.570 V
3PPM-xxx-xxx**3**	1.0 … 9 V
3PPM-xxx-xxx**Z**	no analog signal
Error signal	→ 🗎 13

[1] Accuracy and repeatability specifications are typical values measured at ambient temperature in Nitrogen atmosphere after zero adjustment.

Power supply

DANGER

The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded extra-low voltage (PELV) according to EN 60204-1. The connection to the gauge has to be fused).

Supply voltage at the gauge	+12 … +30 V (dc) ripple max. 1 V_{pp}
Power consumption	≤350 mW
Internal fuse	100 mA (thermal recoverable)
Reverse polarity and overvoltage protection	yes

Sensor cable connection

Electrical connection	
3PPM-0xx-x**0**xx	FCC 68, 8-pin
3PPM-0xx-x**D**xx	D-sub, 9-pin, male
3PPM-0xx-x**E**xx	D-sub HD, 15-pin, male
Sensor cable	shielded, 0.14 mm^2/conductor
Cable length	≤100 m
RS232C operation RS485 operation	≤15 m ≤1200 m

RS232C/RS485 interface

Data rate	9600 Baud (default)
Data format	binary 8 data bits one stop bit no parity bit no handshake

For further information on the RS232C / RS485 interface → 15

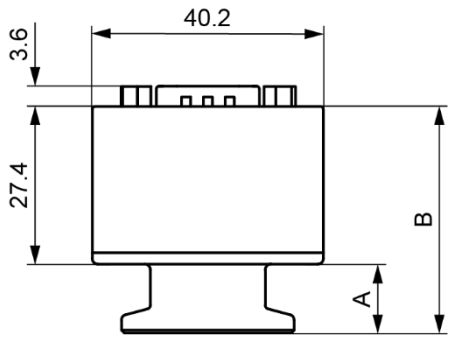
Materials used

Materials exposed to vacuum	
Housing	SS 1.4307, AISI 304L, Al 6061
Flange	SS 1.4307, AISI 304L
Further parts	AISI 304L, Kovar, glass, silicon, nickel, Al, SiO_2, Si_3N_4, gold, FPM, low out-gassing epoxy resin, solder, RO4305
Pressure max.	10 bar (absolute)

Ambiance

Admissible temperatures	
Storage	-40 … +120 °C
Operation	-20 … +50 °C
Bakeout	+120 °C (non operating)
Relative humidity (IEC 68-2-38) (year's mean / during 60 days)	98%, non-condensing
Use	indoors only altitude up to 2000 m
Mounting orientation	any
Degree of protection	IP 40

Dimensions [mm]



	A [mm]	B [mm]
DN 16 ISO-KF	12	39.4
DN 16 ISO-KF, long tube	29	56.4
DN 25 ISO-KF	12	39.4
4 VCR female	37.5	64.9
⅛" NPT	37.0	64.4

Weight

DN 16 ISO-KF	≈136 g
DN 16 ISO-KF, long tube	≈154 g
DN 25 ISO-KF	≈155 g
4 VCR female	≈158 g
⅛" NPT	≈139 g

2.1 Output Signal vs. Pressure (1.0 … 9 V)

1V (dc) / decade (MKS 901P/925/910)

Unit Torr: 1.00 … 8.95 V (dc)
Unit Pa and mbar: 1.12 … 9.08 V (dc)

2.2 Output Signal vs. Pressure (0.372 … 5.75 V)

0.372 … 5.75 V (dc) (MKS GP275)

2.3 Output Signal vs. Pressure (0.61 … 10.2 V)

$$p = 10^{0.778(U-c)} \Leftrightarrow U = c + 1.286\log_{10} p$$

valid in the range 5×10^{-5} mbar <p< 1333 mbar

U	p	c	U	p	c
[V]	[mbar]	6.143	[V]	[mTorr]	2.448
[V]	[µbar]	2.287	[V]	[Pa]	3.572
[V]	[Torr]	6.304	[V]	[kPa]	7.429

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

2.4 Other Analog Output Options

Configuration and list of analog output options → 🗎 17.

3 Installation

DANGER

Leaking process media

High-intensity mechanical, chemical or thermal impacts can cause leaks in the measuring sensor. Process media can thus leak and possibly cause hazards, if overpressure is in the vacuum system.

- Avoid high-intensity mechanical, chemical or thermal impacts and overpressure in the vacuum system.
- Take appropriate measures (e.g. shut off gas supply, extraction, leak test) to avoid hazards or damage due to leaking process media.

3.1 Vacuum Connection

DANGER

Overpressure in the vacuum system >1 bar

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

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

DANGER

Overpressure in the vacuum system >2.5 bar

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

Use O-rings provided with an outer centering ring.

DANGER

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:

- VCR and NPT connections fulfill this requirement
- For gauges with a KF vacuum connection, use a conductive metallic clamping ring.

Caution

Vacuum component

Dirt and damages impair the function of the vacuum component.

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

Caution

Dirt sensitive area

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

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

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 consider using a seal with 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.

Procedure

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

Keep the protective lid.

3.2 Power Connection

Make sure the vacuum connection is properly made.

DANGER

The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded extra-low voltage (PELV) according to EN 60204-1. The connection to the gauge has to be fused.

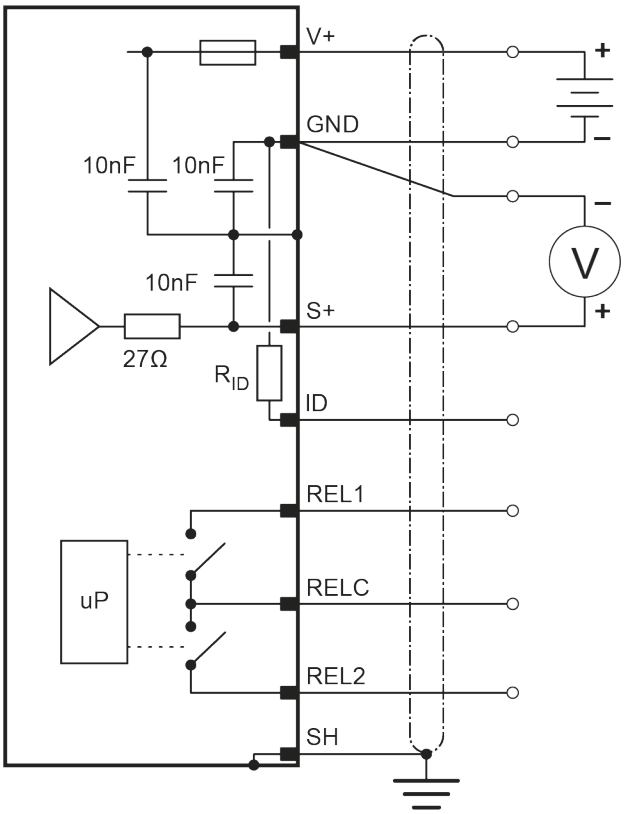
Ground loops, differences of potential, or EMC problems may affect the measurement signal. For optimum signal quality, please do observe the following notes:

- Connect the cable shield to ground on one side via the connector housing. Do not connect the other side of the shield.
- Connect the supply common with protective ground directly at the power supply.
- Use differential measurement input (signal common and supply common conducted separately).
- Potential difference between supply common and housing ≤18 V (overvoltage protection).

Do not exceed maximum load rating of 250 mA, 50 V (dc) / V (ac) peak on relay contacts. Special precautions must be taken when driving an inductive load. Ensure that inrush peak current does not exceed relay contact ratings.

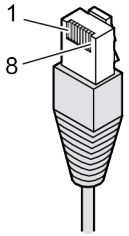
3.2.1 FCC 68 Connector

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



Pin assignment

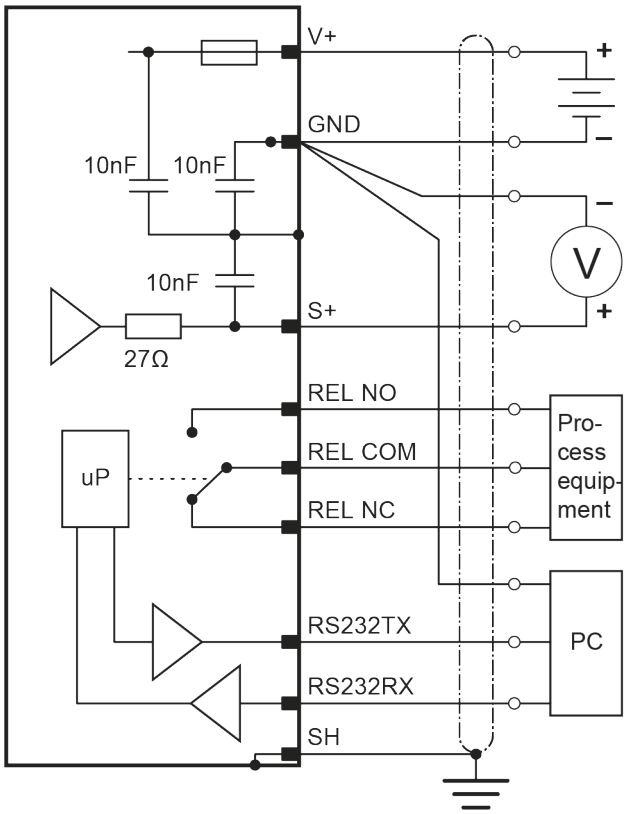
Pin	Symbol	Description
1	V+	Supply voltage 12 … 30 V (dc)
2	GND	Supply common, GND
3	S+	Measurement signal
4	ID	Gauge identification
5	GND	Signal common
6	REL2	Relay SP2, closing contact
7	REL1	Relay SP1, closing contact
8	RELC	Relay 1 and 2 common



FCC 68
8-pin
connector

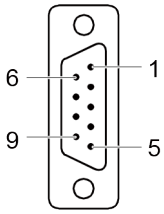
3.2.2 D-sub Connector

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



9-pin

Pin	Symbol	Description
1	REL NO	Relay 1 NO (normally open contact) (*)
2	REL NC	Relay 1 NC (normally closed contact) (*)
3	V+	Supply voltage12 … 30 V (dc)
4	GND	Supply common
5	S+	Measurement signal
6	REL COM	Relay 1 Common (*)
7	RS232TX	RS232 Transmit / RS485 (-)
8	GND	Signal common
9	RS-232RX	RS232 Receive / RS485 (+)

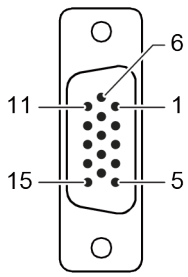


D-sub, 9-pin
female
soldering side

(*) Optional relay

15-pin HD

Pin	Symbol	Description
1	RS232TX	RS232 Transmit / RS485 (-)
2	RS-232RX	RS232 Receive / RS485 (+)
3	V+	Supply voltage12 … 30 V (dc)
4	GND	Supply common
5	S+	Measurement signal
6	GND	Signal common
7	REL NO	Relay 1 NO (normally open contact) (*)
8	REL COM	Relay 1 Common (*)
9	REL NC	Relay 1 NC (normally closed contact) (*)
10	REL NC	Relay 2 NC (normally closed contact) (*)
11	REL COM	Relay 2 Common (*)
12	REL NO	Relay 2 NO (normally open contact) (*)
13	REL NC	Relay 3 NC (normally closed contact) (*)
14	REL COM	Relay 3 Common (*)
15	REL NO	Relay 3 NO (normally open contact) (*)



D-sub HD,15-pin
female
soldering side

(*) Optional relay

4 Operation

When the supply voltage is applied, the measurement signal is available at the connector.

Allow a stabilization period of at least 1 minute. It is advisable to operate the gauge continuously, irrespective of the pressure.

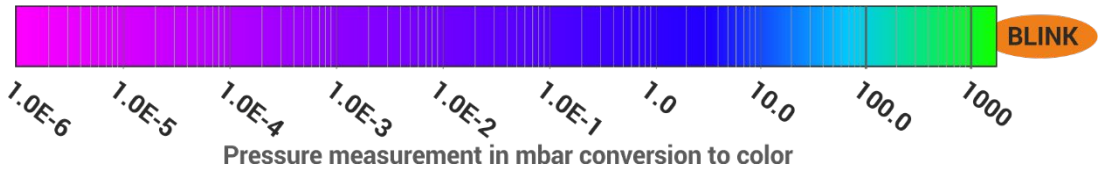
The gauge is factory calibrated. Due to long time operation or contamination, a zero drift could occur. Periodically check the zero and adjust it if necessary. In addition, we recommend performing a zero and ATM calibration after each reinstallation (adjusting the gauge → 🗎 23).

Status LED

Startup sequence	0.5 sec purple followed by 4 sec. pulsing green
Normal standard operation	Solid green
Overpressure indication (in Dynamic Mode only)	Flashing Orange (5 Hz)
Sensor fail stage	Flashing red (5 Hz)

LED for pressure indication (Dynamic mode)

A multi-color LED indicates the measured pressure by changing the color. The dynamic LED can be enabled via the digital interface. Refer to page 19 for LED configuration.



Pressure measurement in mbar conversion to color

Gas type dependence

Pressure range	Measurement principle	Gas type dependence
2 … 1333 mbar	MEMS Piezo sensor	independent of gas type, no correction required
1.5 … 2 mbar	MEMS Piezo sensor and MEMS Pirani sensor	crossover range
1×10^{-6} … 1.5 mbar	MEMS Pirani sensor	proportional to pressure [2)]

2) The pressure reading applies to N_2. For other gases, it has to be converted.

4.1 Switching Functions SP1, SP2, SP3

The relay switches are per default controlled by the pressure measurement but can also be configured to be controlled by the internal temperature sensor.

The switching functions can be set to any pressure within the measurement range of the gauge. A solid state relay is provided for each switching function.

The current threshold setting

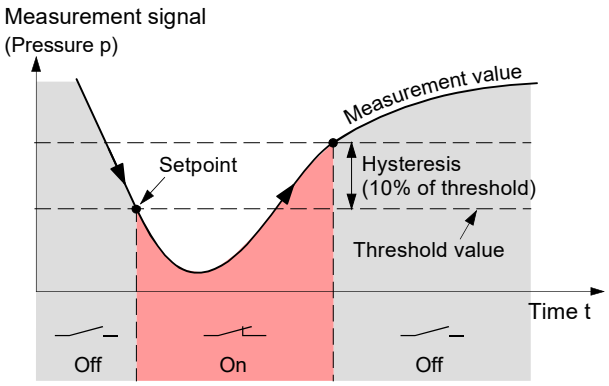
- is output at the measurement signal output instead of the pressure signal and can be measured with a voltmeter
- can be read / written via the RS232 or RS 485 interface.

Source for setpoint, switching characteristics and hysteresis

The source for setpoint (pressure or temperature), the switching characteristics and the hysteresis of each set point can be programmed (→ 🗎 22).

Low Trip Point **(default)**

If the pressure or the temperature in the vacuum system is lower than the setpoint, the corresponding LED is lit solid and the corresponding relay is closed.

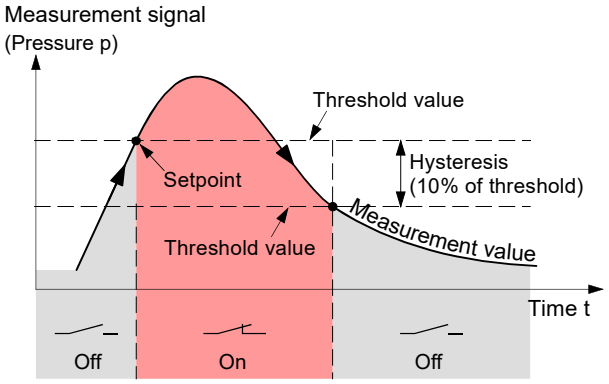


The setpoints are factory disenabled and therefore do not switch (enable setpoints (→ 🗎 22).

If the temperature measurement is selected as the source, the automatically calculated hysteresis values will be -1 °C / +1 °C instead of -10% / +10%.

High Trip Point

If the pressure or the temperature in the vacuum system is higher than the setpoint, the corresponding LED is lit solid and the corresponding relay is closed.



The setpoints are factory disenabled and therefore do not switch (enable setpoints (→ 🗎 22).

If the temperature measurement is selected as the source, the automatically calculated hysteresis values will be -1 °C / +1 °C instead of -10% / +10%.

4.2 RS232 / RS485 Interface

The built-in RS232 / RS485 interface allows transmission of digital measurement data and instrument conditions as well as the setting of instrument parameters.

Communication is based on an ASCII protocol that includes a start character, device address, command or query and an end character for termination.

The signs <> are written for separation of command name and values and are for informational purposes only. These signs should not be entered in the actual command.

For multiple parameter commands or queries each parameter is separated by a comma (ASCII: 2C Hex).

@<device address><command or query><? or !><parameter(s)>

Start character:	**@**
Device Address:	**001-253**
Command:	**see List of Commands**
Query or set:	**? or !**
Parameter(s):	**parameter(s)**
End character:	****

Example of sending a single parameter query to the transducer

Query pressure from MEMS Pirani sensor:

Send: **@254P?MP**

Reply: **@ACK1.23E-5**

Example of sending a multi parameter command to the transducer

Programming the setpoint 1 value to 1.23E-4 (using the default unit setting of the transducer, i.e. mbar):

Send: **@254SPV!1,1.24E-4**

Reply: **@ACK1.23E-4**

4.2.1 List of Commands

Command	Description	Query	Set	Valid input parameter	Page
ADR	Device address	●	●	1-3 digits (range 001-253)	16
AOUT	Analog output configuration	●	●	<STD / 0-99>	17
AO	Linear analog output	●	●	<Output1&2>, <LOW PRESSURE VALUE>,<HIGH PRESSURE VALUE>,<LOW VOLTAGE VALUE>,<HIGH VOLTAGE VALUE>	18
BAUD	Set baud rate	●	●	<4800 / 9600 / 19200 / 38400 / 57600 / 115200> (default 9600)	19
BTN	Enable/disable push-button	●	●	<ON>, <OFF>	19
FAIL	Sensor failure handling	●	●	<WORKING / ZERO >	19
FD	Factory default	●	●	<ADR / BAUD / GT / SP / U / (NONE)>	24
FS	Pirani / Piezo full-scale adjustment	●	●	<*PRESSURE VALUE* / CLEAR>	23
FV	Firmware version	●		-	23
GT	Gas type	●	●	<NITROGEN / HELIUM / ARGON / AIR>	
LED	LED behavior	●	●	<SOLID>, <DYNAMIC>, <ANALOG>	19
MF	Manufacturer	●		-	
MD	Model name	●		-	
P	Pressure measurement	●		<CMB / MP / PZ / (none)>	19
PN	Part number	●		-	23
Q	Quick query	●	●	<PZ>, <PIR>, <CMB5>, <TMP>, <SP>	20
SN	Serial number	●		-	23
SP	Setpoint settings	●		-	22
SPD	Setpoint direction [1)]	●	●	<SETPOINT #>, <ABOVE / BELOW>	22
SPE	Setpoint enable [1)]	●	●	<SETPOINT #>, <OFF / ON>	22
SPH	Setpoint hysteresis [1)]	●	●	<SETPOINT #>, <*PRESSURE VALUE*>	22
SPV	Setpoint value [1)]	●	●	<SETPOINT #>, <*PRESSURE VALUE*>	22
SPR	Setpoint relay status [1)]	●		<SETPOINT #>	22
SPS	Setpoint source [1)]	●	●	<SETPOINT #>, <P / T>	22
STAT	Statistics	●	●	<P / T / (none) / CLEAR (Set only)>	21
T	Vacuum sensor temperature	●		-	20
U	Pressure unit	●	●	(<PARAMETER>), <MBAR / PASCAL / TORR> or <CELSIUS / FAHRENHEIT / KELVIN>	20
VAC	Pirani Zero adjustment	●	●	No input or <*PRESSURE VALUE*>	23

[1)] Setpoint solid-state relay is optional and is not relevant for all part numbers.

All valid input parameters written in italics are to be entered as a number. These numbers will vary with the type and model number of the transducer. Refer to the specific commands for details.

4.2.1.1 ADR - Address Device

The sensor has an addressable communication protocol, and so it will only accept commands or queries with the following addresses. All queries or commands sent to all other addresses are simply ignored.

<device address>:	Pre-configured to 253, this value may be changed at any time to anything in the range 1-253 using the ADR command.
254	This is the ”global” address. The PPG550 will always respond to commands or queries at address 254, regardless of the device address setting.
255	This is the broadcast address, which may be used for performing the same operation on multiple PPG550 at once. The sensor will not issue any replies to broadcast commands. Note that broadcasting requires a multidrop communication interface such as RS-485.

Example

Change the device address from 253 (default) to 123 using the global address:

Send: **@254ADR!123**

Reply: **@253ACK123**

All replies after this one will begin with the new device address, 123.

4.2.1.2 AOUT – Analog Output

PPG550 will be delivered with ordered analog output, however, the analog output can be configured to emulate a collection of other equipment via the AOUT command:

	Vendor	Transducer model	Output
LINEAR	INFICON	-	Programmable linear
0	MKS	901P, 910, 925	1 V (dc)/decade (1 … 9 V (dc))
1	Edwards	APG-L	1.99 … 10 V (dc)
2	Edwards	APG-100	2.00 … 9.00 V (dc)
3	Edwards	WRG	2.75 … 10.00 V (dc)
4	INFICON Leybold	PSG500 TTR91	1.547 … 10.00 V (dc)
5	INFICON Pfeiffer	MPG400 PKR251	2.07 … 8.603 V (dc)
6	INFICON MKS	BPG400 999 Quattro	1.843 … 10.00 V (dc)
7	MKS Granville Phillips	275	0.372 … 5.570 V (dc)
8	MKS HPS	Moducell 325	0.2509 … 3.2398 V (dc)
9	MKS HPS	Moducell 325 x3	0.753 … 9.719 V (dc)
10	MKS	Baratron® 0.1 Torr	0 … 10.00 V (dc)
11	MKS	Baratron® 1 Torr	0 … 10.00 V (dc)
12	MKS	Baratron® 10 Torr	0 … 10.00 V (dc)
13	MKS	Baratron® 100 Torr	0 … 10.00 V (dc)
14	MKS	Baratron® 1000 Torr	0 … 10.00 V (dc)
15	MKS	901P piezo differential output	1 V (dc)/decade
16	Edwards	AIM-S / - SL	2.5 … 10.00 V (dc)
17	Edwards	AIM-X / XL	3.286 … 9.799 V (dc)
18	Pfeiffer	IKR251	2.324 … 8.500 V (dc)
19	Pfeiffer	TPR 265 / 280	2.199 … 8.625 V (dc)
20	Hastings	HPM-2002-OBE special	5.00 … 9.995 V (dc)
21	Edwards	DV6M	2.00 … 10.00 V (dc)
22	Edwards	APG-M	2.00 … 10.00 V (dc)
23	MKS Granville Phillips	GP275 (0-9.0 VDC)	0 … 8.80 V (dc)
24	Thyracont	MT 241.1	0.41 … 9.99 (V (dc)
25	MKS Granville Phillips	(0-375.6VDC)	0.375 … 5.614 V (dc)
26	Edwards	APG100-LC	2.00 … 10.00 V (dc)
27	Edwards	APG100M	2.00 … 10.00 V (dc)
28	MKS	907	0.387 … 5.666 V (dc)
29	Alcatel	K6080	0.40 … 10.00 V (dc)
30	INFICON	PEG100	2.186 … 10.166 V (dc)
31	Varian	Eysys	1.00 … 8.00 V (dc)
32	Alcatel	TA111	0.10 … 9.20 V (dc)
33	MKS	685	1.00 … 7.00 V (dc)
34	MKS	901P special 2VDC/decade	1.00 … 9.00 V (dc)
35	Pfeiffer	TTR 101	0.61 … 10.2 V (dc)
50	MKS/INFICON	0.1 mbar F.S. (linear)	0 … 10.00 V (dc)
51	MKS/INFICON	1 mbar F.S. (linear)	0 … 10.00 V (dc)
52	MKS/INFICON	2 mbar F.S. (linear)	0 … 10.00 V (dc)
53	MKS/INFICON	5 mbar F.S. (linear)	0 … 10.00 V (dc)

54	MKS/INFICON	10 mbar F.S. (linear)	0 … 10.00 V (dc)
55	MKS/INFICON	20 mbar F.S. (linear)	0 … 10.00 V (dc)
56	MKS/INFICON	50 mbar F.S. (linear)	0 … 10.00 V (dc)
57	MKS/INFICON	100 mbar F.S. (linear)	0 … 10.00 V (dc)
58	MKS/INFICON	200 mbar F.S. (linear)	0 … 10.00 V (dc)
59	MKS/INFICON	500 mbar F.S. (linear)	0 … 10.00 V (dc)
60	MKS/INFICON	1000 mbar F.S. (linear)	0 … 10.00 V (dc)
61	MKS/INFICON	1100 mbar F.S. (linear)	0 … 10.00 V (dc)

Example

Change the Analog output emulation to MKS Baratron 0-10VDC with 0.1 Torr full scale:

Send: **@254AOUT!10**

Reply: **@253ACK10**

The PPG50 is available with a hardware optional secondary analog output. The output can be configured to the same output curves as the primary analog output.

Example

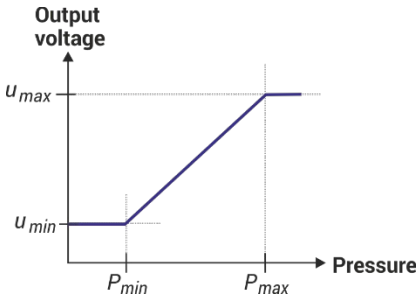
Change the Analog output emulation to Pfeiffer TTR 101 analog output:

Send: **@254AOUT!2,35**

Reply: **@253ACK2,35**

4.2.1.3 AO – Linear Analog Output

When selecting Aout to "Linear" the analog output configuration can be user configured to any linear scaling within the PPG550 measuring range and output limitation. This feature allows magnification of a specific pressure range.



Configuration of output

When programming the voltage output scaling, the minimum and maximum output voltage must be entered in millivolt and the minimum and maximum pressure in transducer configured pressure unit.

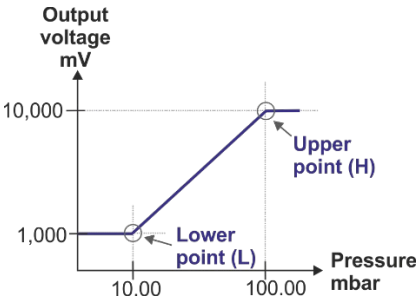
Command syntax: AO!<Output1&2>, *<LOW PRESSURE VALUE>,<HIGH PRESSURE VALUE>,<LOW VOLTAGE VALUE>,<HIGH VOLTAGE VALUE>*

Example

Configure the analog 1 output linear expression between 1 V (dc) @ 10 mbar and 10 V (dc) @ 100 mbar.

Send: **@254AO!1,10,1000,100,10000**

Reply: **@253ACKAO**
ANALOG OUT 1
 # : PRESSURE , AOUT [mV]
L : +1.00E+01, 1000
H : +1.00E+02, 10000



4.2.1.4 BAUD – Baud Rate

The PPG550 supports the following baud rates: 4800, 9600, 19000, 38400, 57600, 115200. Note that whenever the baud rate is changed, the PPG550 will send an acknowledgement to the BAUD command using the old baud rate setting before switching to the new one.

Example

Change the baud rate to 115200:

Send: **@254BAUD!115200**

Reply: **@253ACK115200**

4.2.1.5 BTN – Button Enable

Enable or disable the feature to perform Pirani zero-adjustments via the PPG550 push-button.

Example

Disable the push-button:

Send: **@254BTN!OFF**

Reply: **@253ACKOFF**

4.2.1.6 LED – LED Behavior

The PPG550's LED can be programmed to work in three different ways during normal operation. See "Status LED" section for more details.

Parameter	Description
SOLID	The LED is solid green. (Factory default)
DYNAMIC	The LED changes color to reflect the measured pressure.
ANALOG	The LED changes color to reflect the 0-10V analog output.

Example

Have the LED change color as a function of the measured pressure:

Send: **@254LED!DYNAMIC**

Reply: **@253ACKDYNAMIC**

4.2.1.7 FAIL – Failure Handling

The PPG550 can be configured to handle sensor failure in two different ways:

- Switch the Combined Pressure output (P? or P?CMB) and Analog Output to only use the working sensor, i.e. if the Piezo sensor is malfunctioning, the combined output is only based on the Vacuum Pirani and vice versa.
- Set both the Combined Pressure output and the Analog Output to zero in case of sensor errors to signal an error condition.

Parameter	Description
WORKING	Base Combined Pressure output and Analog Output on working sensor only.
FAIL	Set Combined Pressure output and Analog Output to 0 in case of sensor errors.

Example

Have the Combined Pressure output and Analog Output go to zero if a sensor is malfunctioning:

Send: **@254FAIL!ZERO**

Reply: **@253ACKZERO**

4.2.1.8 P – Pressure Measurement Handling

The digital pressure measurement can be accessed using the RS-232/485 serial digital interface.

Reading the digital combined pressure value

Send: **@254P?**

Reply: **@ACK1013.12**

Reading the digital Piezo pressure

Send: **@254P?PZ**
Reply: **@ACK1013.12**

Reading the digital MEMS Pirani pressure

Send: **@254P?MP**
Reply: **@ACK1.23E-3**

4.2.1.9 Q – Quick Data Acquisitions

The quick data acquisition command provides all variable measurement data and setpoint status in one string.

Reading the quick data acquisition

Send: **@254Q?**
Reply: **@ACK1.0000E-2,1.2300E-2,1.2300E-2,23.24,101**

Configuration of the quick data acquisition

Send: **@254Q!,PZ,PIR,CMB,SP,TEMP**
Reply: **@ACK1.0000E-2,1.2300E-2,1.2300E-2,23.24,101**

Read the currently configured Q-configuration

Send: **@254Q?CONFIG**
Reply: **@ACKPZ,PIR,CMB,SP,TEMP**

Parameter	Description
PZ	Piezo pressure measurement
PIR	Pirani pressure measurement
CMB	Combined pressure measurement
TEMP	Temperature measurement
SP	Setpoint status

Setpoint status
The setpoint status value provides a 3-digit value, where each digit represents the status of the setpoint relay 1, 2 and 3, respectively. Each digit may be 1=Energized relay, 0=De-energized relay, X=No relay installed.

4.2.1.10 T – Temperature Measurement

The PPG550 has a built-in high-resolution precision temperature sensor that provides a temperature measurement of the vacuum gas in degrees Celsius with a typical accuracy of better than ±1 °C.

Reading the temperature

Send: **@254T?**
Reply: **@ACK25.22**

4.2.1.11 U – Unit

The PPG550 can be configured to three different pressure units and three different temperature units. If no explicit parameter (pressure, temperature) is defined, pressure is assumed.

All values related to pressures like setpoint values and full-scale must be entered in the current unit for the transducer. When changing unit all setpoint values are converted to the new unit and consequently setpoint functionality will remain intact when changing unit.

Pressure unit		
mbar	Pascal	Torr

Temperature unit		
Celsius	Fahrenheit	Kelvin

Setting pressure unit to mbar

Send: **@254U!P,MBAR**
Reply: **@ACKMBAR**

Setting pressure unit to Pascal

Send: **@254U!PASCAL**
Reply: **@ACKPASCAL**

Setting temperature unit to Fahrenheit

Send: **@254U!T,FAHRENHEIT**
Reply: **@ACKFAHRENHEIT**

Reading current temperature unit

Send: **@254U?T**
Reply: **@ACKFAHRENHEIT**

4.2.1.12 STAT – Statistics

The statistics function logs the number of operation hours and the maximum and minimum measured pressure or temperature value. If no explicit parameter (pressure, temperature) is defined, pressure is assumed.

Reading the statistics

Parameter is left out, so pressure is assumed:

Send: **@254STAT?**
Reply: **@254ACKSTAT<cr>**
MIN : 5.6104E+00<cr>
MAX : 1.0159E+03<cr>
HOURS : 37

Reading the temperature statistics

Send: **@254STAT?T**
Reply: **@254ACKSTAT<cr>**
MIN : 2.345E+01<cr>
MAX : 3.123E+01<cr>
HOURS : 37

Clearing the statistics

Parameter is left out, so pressure is assumed:

Send: **@254STAT!CLEAR**
Reply: **@254ACKCLEAR**

4.2.1.13 SPx – Setpoints

All values related to pressures like setpoint values and full-scale must be entered in the current unit for the transducer. When changing unit all setpoint values are converted to the new unit and consequently setpoint functionality will remain intact when changing unit.

SP - Setpoint status

@254SP?

(This step is not mandatory.) Print an overview of all setpoint settings. If no setpoints have previously been defined, a PPG550 with three relays will produce the following overview:

```
#: ENABLE, ENERGIZED, SOURCE, DIRECTION,      VALUE, HYSTERESIS<cr>
1:    OFF,        NO,   PRES,     ABOVE, +0.000E+00, +0.000E+00<cr>
2:    OFF,        NO,   PRES,     ABOVE, +0.000E+00, +0.000E+00<cr>
3:    OFF,        NO,   PRES,     ABOVE, +0.000E+00, +0.000E+00<cr>
\
```

If the unit is set to mbar and the pressure reading is above 600 – energizing the Setpoint 1 relay – the generated output would look like this:

```
#: ENABLE, ENERGIZED, SOURCE, DIRECTION,      VALUE, HYSTERESIS<cr>
1:     ON,        YES,   PRES,     ABOVE, +6.000E+00, +5.000E+00<cr>
2:    OFF,        NO,    PRES,     ABOVE, +0.000E+00, +0.000E+00<cr>
3:    OFF,        NO,    PRES,     ABOVE, +0.000E+00, +0.000E+00<cr>
\
```

SPS- Setpoint source

@254SPS!1,P

Assign pressure measurement as the source for Setpoint 1.

SPD - Setpoint direction

@254SPD!1,ABOVE

Configure the Setpoint 1 relay to be energized whenever the pressure reading is greater than the Setpoint 1 value. Whenever this value is changed, the corresponding Hysteresis value is automatically calculated to either -10% of the current setpoint value (when direction = ABOVE) or +10% of the current setpoint value (when direction = BELOW). If the temperature measurement is selected as the source, the automatically calculated Hysteresis values will be -1 °C /+1 °C instead of -10% / +10%.

SPV - Setpoint value

@254SPV!1,600

Set the value of Setpoint 1 to 600 and auto-calculate Hysteresis value. As the direction is set to ABOVE, the hysteresis value will be automatically set to 540 (the setpoint value -10%). Had the direction been BELOW, the hysteresis would have been automatically set to 660 (the setpoint value +10%).

SPH - Setpoint hysteresis

@254SPH!1,500

Set the Hysteresis value for Setpoint 1 to 500.

SPE - Setpoint enable

@254SPE!1,ON

Enable Setpoint 1.

SPR - Setpoint relay status

@254SPR?1

Get the current status of the Setpoint 1 relay.

Parameter	Description	Valid Input
SPD	Setpoint Direction	<SETPOINT #>, <ABOVE, BELOW>
SPE	Setpoint Enable	<SETPOINT #>, <OFF/ON>
SPH	Setpoint Hysteresis	<SETPOINT #>, <PRESSURE VALUE>
SPV	Setpoint Value	<SETPOINT #>, <PRESSURE VALUE>
SPS	Setpoint Source (pressure or temperature)	<SETPOINT #>, <P/T>
SP	Read all setpoint settings	–

4.2.1.14 SN – Serial Number

Serial number of the PPG550.

Send: **@254SN?**
Reply: **@ACK191230123456;**

4.2.1.15 PN – Part Number

Part number of the PPG550.

Send: **@254PN?**
Reply: **@ACKPPG550-123456;**

4.2.1.16 MF – Manufacturer identity

Manufacturer identity.

Send: **@254MF?**
Reply: **@ACKINFICON;**

4.2.1.17 FV– Firmware Version

Firmware version of the PPG550.

Send: **@254FV?**
Reply: **@ACK1.00;**

4.2.1.18 VAC – Pirani Zero Adjustment

Pirani zero adjustment at a pressure below 1.00E-6 mbar

Evacuate the transducer to a vacuum pressure below 1.00E-6 mbar.

Send: **@254VAC!**
Reply: **@254ACK<value>**

The reply <value> is the calculated offset pressure value as function of the factory default zero offset subtracted from the user offset adjustment.

If the recommended zero adjustment vacuum pressure cannot be achieved due to inadequate vacuum pumping capacity, the zero-point adjustment can be performed at a higher pressure by entering the actual pressure value measured by a reference transducer. Following command example will perform a zero adjustment at 5.00E-5 mbar:

Pirani zero adjustment at known reference pressure

Following command example will perform a zero adjustment at e.g. 5.00E-5 mbar:

Send: **@254VAC!5.00E-5**
Reply: **@254ACK<value>**

4.2.1.19 FS – Full Scale Adjustment

Piezo sensor full-scale adjustment

Obtain the actual atmospheric pressure (e.g. 1013.1 mbar) from a reference gauge

Send: **@254FS!PZ,1013.1**
Reply: **@254ACK<value>**

The acknowledge value represents the scaling factor for the new piezo full-scale calibration. The full-scale adjustment can be executed in the pressure range 400 … 1100 mbar (300 … 825 Torr).

Pirani sensor full-scale adjustment

Obtain the actual pressure (e.g. 11.2 mbar) from a reference gauge:

Send: **@254FS!MP,11.2**
Reply: **@254ACK<value>**

Pirani sensor full-scale adjustment by Piezo sensor

The Pirani sensor can also be full-scale adjusted by use of the internal Piezo sensor as reference.
Expose the sensor flange to a Nitrogen pressure between 1 and 20 mbar.

Send: **@254FS!MP**
Reply: **@254ACK<value>**

4.2.1.20 FD – Factory Default

This command will reset all user settings to factory default, including setpoint settings, pressure unit and user-adjustment of zero point and full-scale. If the PPG550 is delivered with a special user configuration, the factory default command will reset to the original user configuration as delivered.

Send: **@254FD!**
Reply: **@ACKFD**

Factory default settings

Parameter	Value
Vacuum zero adjustment	0
Full scale adjustment	1
Unit	As delivered
Baud rate	9600
Address	253
Analog output configuration	As delivered
Setpoint direction	Above or as delivered
Setpoint enable	OFF or as delivered
Setpoint hysteresis	As delivered
Setpoint value	As delivered
Setpoint source	Pressure

Individual reset to factory default

It is possible to reset only certain settings to their factory default values. This is done by adding an optional argument to the FD command:

Analog output configuration
Send: **@254FD!AOC**
Reply: **@ACKFD**

Gas type
Send: **@254FD!GT**
Reply: **@ACKFD**

Device address
Send: **@254FD!ADR**
Reply: **@ACKFD**

Baud rate
Send: **@254FD!BAUD**
Reply: **@ACKFD**

Setpoints
Send: **@254FD!SP**
Reply: **@ACKFD**

Unit
Send: **@254FD!U**
Reply: **@ACKFD**

Pirani zero adjustment
Send: **@254FD!VAC**
Reply: **@ACKFD**

4.3 RS232 / RS485 MKS Compatibility

The PPG550 offers pin, analog output and digital communication protocol compatibility with the 901P, 925 and 910 vacuum transducers from MKS Instruments.

When using the 900 series communication protocol, the communication is based on an ASCII protocol that includes a start character, device address, command or query and an end character for termination:

@<device address><command or query><? or !><parameter(s)>;FF

Start character:	**@**
Device Address:	**001-253**
Command:	**see List of Commands**
Query or set:	**? or !**
Parameter(s):	**parameter(s)**
End character:	;**FF**

Example of sending a command

Example of how to send a command to the transducer using the 900 series protocol. Programming a setpoint value of 1.23E-4 (using the default unit setting of the gauge, e.g. mbar):

Send: **@254SP1!1.23E-4;FF**

Reply: **@ACK1.23E-4;FF**

The PPG550 supports following
900 series commands

Command	Description	Query	Set	Valid input parameter
AD	Communication address	●	●	3 digits (range 001-253)
AO1	Analog output configuration	●	●	STD, 0-39
BR	Set baud rate	●	●	4800, 9600, 19200, 38400, 57600, 115200 (default 9600)
FD	Factory default	●	●	ADR,AOC,FS,U,SP,VAC,<NONE>
FS	Full-scale adjustment	●	●	
FV	Firmware version	●		-
GT	Gas type	●	●	Nitrogen, Helium, Argon, Air
MF	Manufacturer	●		-
MD	Model name	●		-
PR1	Pressure measurement (Pirani)	●		-
PR2	Pressure measurement (Piezo)	●		
PR3	Pressure measurement (Combined)	●		
PN	Part number	●		-
SP1	Setpoint 1 value	●	●	<PRESSURE VALUE>
SD1	Setpoint 1 direction	●	●	ABOVE, BELOW
EN1	Setpoint 1 enable	●	●	OFF, ON
SH1	Setpoint 1 hysteresis	●	●	<PRESSURE VALUE>
SP2	Setpoint 2 value	●	●	<PRESSURE VALUE>
SD2	Setpoint 2 direction	●	●	ABOVE, BELOW
EN2	Setpoint 2 enable	●	●	OFF, ON
SH2	Setpoint 2 hysteresis	●	●	<PRESSURE VALUE>
SP3	Setpoint 3 value	●	●	<PRESSURE VALUE>
SD3	Setpoint 3 direction	●	●	ABOVE, BELOW
EN3	Setpoint 3 enable	●	●	OFF, ON
SH3	Setpoint 3 hysteresis	●	●	<PRESSURE VALUE>
SN	Serial number	●		-
T	Sensor temperature	●		-
U	Pressure unit	●	●	MBAR, PASCAL, TORR
VAC	Pirani Zero adjustment	●	●	No input or <PRESSURE VALUE>

5 Deinstallation

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

Vacuum component

Dirt and damages impair the function of the vacuum component.

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

Caution

Dirt sensitive area

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

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

Procedure

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

6 Maintenance, Repair

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

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.

6.1 Zero Adjustment Pirani Sensor

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. In addition, we recommend performing a zero calibration after each reinstallation.

The zero can be adjusted via

- the button on the gauge,
- the RS232 / RS485 interface (→ 🗎 23).

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

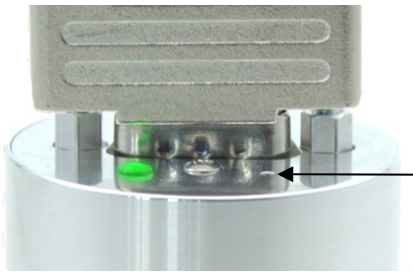
The gauge is adjusted to default values. However, it can also be adjusted to other pressure values, if the exact pressure value is known (reference measurement).

❶ If you are using a seal with centering ring and filter, check that they are clean or replace them if necessary.

❷ Evacuate the vacuum system to $<1\times10^{-6}$ mbar and wait at least 2 minutes.

If the recommended pressure cannot be achieved the Pirani zero should be adjusted at a known reference pressure via the RS232 / 485 interface (→ 🗎 23).

❸ Press the button with a pin (max. ø1.5 mm) for 2 seconds and the zero adjustment is carried out.



The LED blinks green if the zero was successful or red if the zero has failed. In the latter case repeat steps 1-3.

6.2 Zero Adjustment Piezo Sensor

The Piezo sensor is automatically zero-adjusted, whenever the pressure measured by the Pirani is lower than 1×10^{-2} mbar.

6.3 Full Scale Adjustment Piezo Sensor

The full scale can be adjusted via the RS232 / 485 interface (→ 🗎 23).

The command "FS!PZ" allows to adjust the full scale at a known reference pressure within the pressure range 400 … 1100 mbar.

6.4 Full Scale Adjustment Pirani Sensor

The full scale can be adjusted via the RS232 / 485 interface (→ 🗎 23).

The command "FS!MP" allows to adjust the full scale

- at a known reference pressure
- by use of the internal Piezo sensor as reference

7 Returning the Product

WARNING

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 (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

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

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.

EU Declaration of Conformity

CE

We, INFICON, hereby declare that the equipment mentioned below complies with the provisions of the following directives:

- 2014/30/EU, OJ L 96/79, 29.3.2014
  (EMC Directive; Directive relating to electromagnetic compatibility)
- 2011/65/EU, OJ L 174/88, 1.7.2011
  (RoHS Directive; Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment)

Product

MEMS Pirani & Piezo Diaphragm Gauge
PPG550

Standards

Harmonized and international/national standards and specifications:

- EN 61326-1:2013; Group 1, Class B
  (EMC requirements for electrical equipment for measurement, control and laboratory use)
- EN 61326-2-3:2013
  (EMC: Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning)

Manufacturer / Signatures

INFICON AG, Alte Landstraße 6, LI-9496 Balzers

12 July 2022

Dr. Christian Riesch
Head of Development

12 July 2022

Marco Kern
Product Manager

UKCA Declaration of Conformity

We, INFICON, hereby declare that the equipment mentioned below complies with the provisions of the following regulations:

- S.I. 2016/1091
  (EMC Regulations; The Electromagnetic Compatibility Regulations 2016)
- S.I. 2012/3032
  (RoHS Regulations; The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012)

Product

MEMS Pirani & Piezo Diaphragm Gauge
PPG550

Standards

Harmonized and international/national standards and specifications:

- EN 61326-1:2013; Group 1, Class B
  (EMC requirements for electrical equipment for measurement, control and laboratory use)
- EN 61326-2-3:2013
  (EMC: Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning)

Manufacturer / Signatures

INFICON AG, Alte Landstraße 6, LI-9496 Balzers

12 July 2022

Dr. Christian Riesch
Head of Development

12 July 2022

Marco Kern
Product Manager

Notes

Original: English

tinb85e1

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

www.inficon.com