Operating Manual
Incl. EU Declaration of Conformity

Trigon™ BCG552

Bayard-Alpert Pirani Capacitance Diaphragm TripleGauge®

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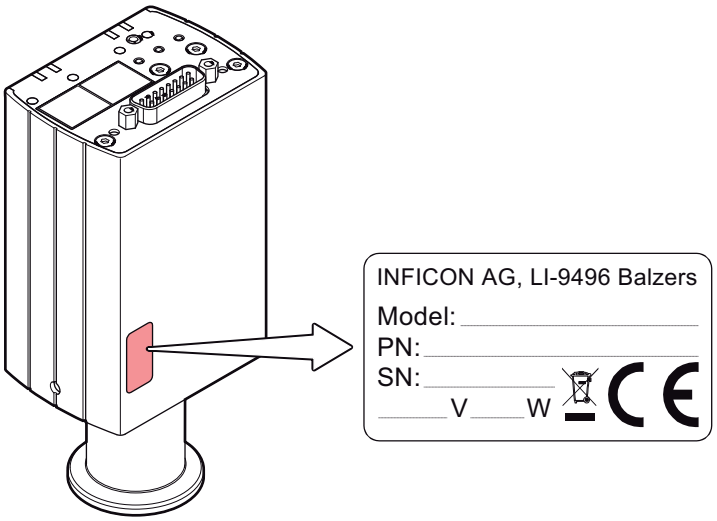
Symbol for cross-references within this document: → 🗎 XY
Symbol for references to literature list: → 🕮 [Z]

1 General

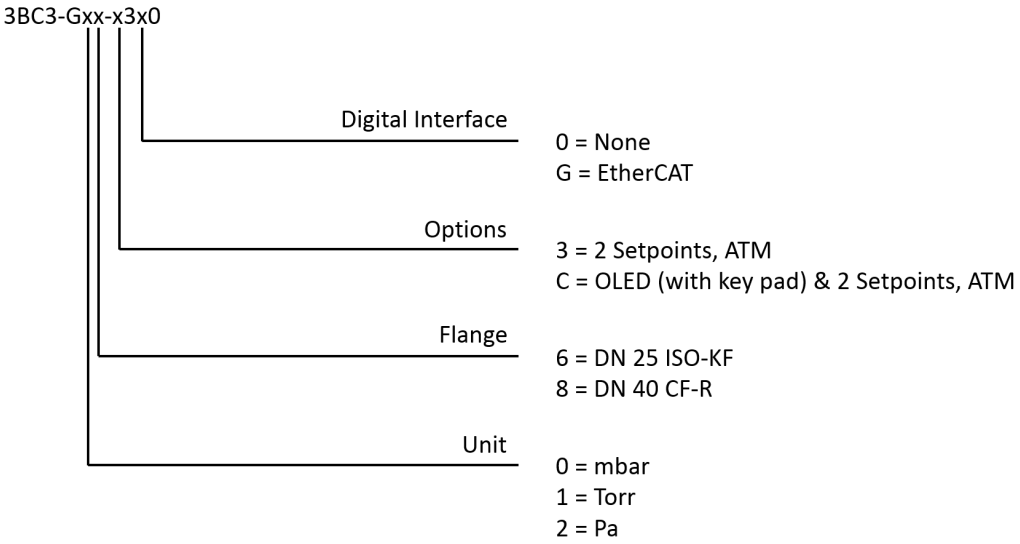
1.1 Product Identification

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



1.2 Validity

This document applies to products with the following part numbers:



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

1.3 Intended Use

The Trigon™ BCG552 gauges have been designed for vacuum measurement of gases in the pressure range 5×10^{-10} ... 1500 mbar.

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

The gauges can be operated in connection with the INFICON Vacuum Gauge Controller VGC501, VGC502, VGC503 and VGC401, VGC402, VGC403 (limited to BCG450 functionality) or with other control devices.

1.4 Functional Principle

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

Between 10 mbar and atmospheric pressure, the capacitance diaphragm sensor operates without any gas type dependence. Below 1 mbar, the Pirani sensor and the hot cathode ionization sensor take over with only a small gas type dependence.

Between 1 ... 10 mbar and 5×10^{-3} ... 2×10^{-2} mbar the gauge's built-in electronic circuits take care of continuous and smooth crossovers between the ranges. Over the whole measurement range, the measurement signal is output as a logarithm of the pressure.

The hot cathode is switched on by the Pirani measurement system only below the switching threshold of 2.4×10^{-2} mbar (to prevent filament burn-out). It is switched off when the pressure exceeds 3.2×10^{-2} mbar. Gauge adjustment is carried out automatically, no manual adjustment is required.

A user programmable atmospheric pressure switching function is incorporated.

1.5 Trademarks

Trigon™	INFICON Holding AG
TripleGauge®	INFICON Holding AG
EtherCAT®	EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

2 Safety

2.1 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 or wear and tear, as well as expendable parts (e.g. Pirani filament), are not covered by the warranty.

2.2 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 (Pirani filament 120 °C).
- 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.
- The device must not be connected to the Internet.

Communicate the safety instructions to all other users.

2.3 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

<…> Labeling

2.4 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.

3 Technical Data

Measurement principle	Pressure range	
	10 ... 1500 mbar	capacitance diaphragm sensor
	1 ... 10 mbar	crossover range
	2×10^{-2} ... 1 mbar	Pirani sensor
	5×10^{-3} ... 2×10^{-2} mbar	crossover range
	5×10^{-10} ... 5×10^{-3} mbar	hot cathode ionisation (BA)
Measuring range	Range (air, O_2, CO, N_2)	5×10^{-10} … 1500 mbar, continuous
	Accuracy	
	1×10^{-8} ... 50 mbar	±15% of reading
	50 ... 950 mbar	±5% of reading
	950 ... 1050 mbar	±2.5% of reading
	Repeatability	5% of reading, 1×10^{-8} … 1050 mbar (after 10 min. stabilization)
	Gas type dependence	→ 🗎 33
Emission	Switching on threshold	2.4×10^{-2} mbar
	Switching off threshold	3.2×10^{-2} mbar
	Emission current	
	Sliding mode (default)	
	$p \leq 8\times10^{-7}$ mbar	5 mA
	$p > 1\times10^{-3}$ mbar	25 µA
	Two-Point-Mode	
	$p \leq 7.2\times10^{-6}$ mbar	5 mA
	3.0×10^{-5} mbar < p < 3.2×10^{-2} mbar	25 µA

Emission current switching Two-Point-Mode 25 µA ➔ 5 mA 5 mA ➔ 25 µA	 7.2×10^{-6} mbar 3.0×10^{-5} mbar

Degas

Degas emission current ($p < 7.2\times10^{-6}$ mbar)	≈16 mA (P_{degas} ≈4 W)
Control input signal	0 V/+24 V (dc), active high (control via RS232 → 🗎 22)
Duration	max. 3 min, followed by automatic stop. A new degas cycle can only be started after a waiting time of 30 minutes.
In degas mode, BCG552-gauges keep supplying measurement values, however their tolerances may be higher than during normal operation.	

Output signal

Output signal (measuring signal)	0 … +10.13 V
Measuring range	0.774 … +10.13 V (5×10^{-10} … 1500 mbar)
Relationship voltage-pressure	logarithmic, 0.75 V/decade
Error signal	+0.1 V Diaphragm sensor or EEPROM error +0.3 V BA sensor error +0.5 V Pirani sensor error
Minimum load impedance	>10 kΩ

Display (BCG552)

Display panel	OLED, 128×128 pixels
Dimensions	1.5” x 1.5”
Pressure units (pressure p)	mbar (default), Torr, Micron, Pa, hPa

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). The connection to the gauge has to be fused (INFICON controllers fulfill these requirements).

Supply voltage at the gauge Ripple	+24 V (dc) (+20 … +28 V (dc))[1)] ≤2 V_{pp}
Current consumption Normal operation Degas Emission start (<200 ms)	 ≤0.5 A ≤0.9 A ≤1.4 A
Power consumption BCG552 BCG552 with EtherCAT	 ≤18 W ≤21 W
Fuse necessary	1.25 AT

Sensor cable connection

For reasons of compatibility, the expression "sensor cable" is used for all BCG552 versions in this document, although the pressure reading of the gauges with fieldbus interface (BCG552 with EtherCAT) is normally transmitted via the corresponding bus.

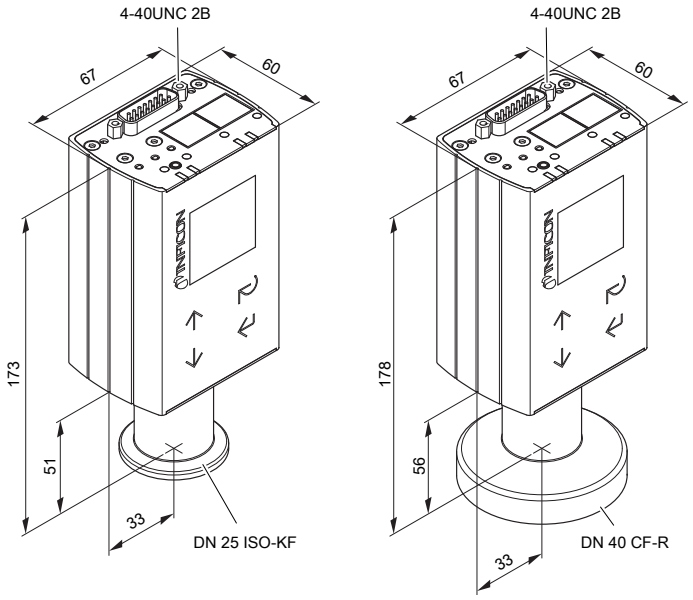
Receptacle	D-sub, 15-pin, male
Measuring cable	shielded, number of conductors depending on the functions used (max. 15 conductors plus shielding)

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

	Cable length (supply voltage 24 V [1])	
	Analog and fieldbus operation	≤35 m (0.25 mm^2 conductor cross-section), ≤50 m (0.34 mm^2 conductor cross-section), ≤100 m (1.0 mm^2 conductor cross-section)
	RS232C operation	≤30 m
	Gauge identification	42 kΩ resistor between Pin 10 and Pin 5
Switching functions	Switching functions	
	BCG552	2 (setpoints 1 and 2)
	Adjustment range	$5×10^{-10}$ … 1500 mbar Setpoints adjustable via diagnostic or EtherCAT interface with High Trip and Low Trip functionality and Atmosphere switching function
	Relay contact rating	≤60 V (dc), 0.5 A (dc)
RS232C interface	Data rate	9600 Baud
	Data format	binary, 8 data bits, one stop bit, no parity bit, no handshake
	Function and communication protocol of the RS232C interface → 🗎 22	
EtherCAT interface (BCG552)	Fieldbus name	EtherCAT
	Standard applied, data format, communication protocol	→ 🕮 [3], → 🕮 [4]
	Data rate	100 Mbps
	Node address	explicit device identification
	Physical layer	100Base-Tx (IEEE 802.3)
	Ethernet connector	2×RJ45, 8-pin, socket, IN and OUT
	Cable	shielded, 8-pin special Ethernet Patch cable (quality CAT5e or higher)
	Cable length	≤100 m
Diagnostic port	Plug	Jack connector 2.5 mm, 3-pin
	Data rate	57600 Baud
	Data format	binary, 8 data bits, one stop bit, no parity bit, no handshake
	For further information on the diagnostic port → 🕮 [2].	
Materials used, internal volume	Materials exposed to vacuum:	
	Housing, supports, screens	stainless steel
	Feedthroughs	NiFe, nickel plated, Hastelloy
	Insulator	glass
	Cathode	iridium, yttrium oxide (Y_2O_3)
	Cathode holder	Ni
	Pirani element	tungsten, copper
	Sensor diaphragm	ceramic (Al_2O_3)
	Sensor contacts	SnAg
	Internal volume	
	DN 25 ISO-KF	≈24 cm^3
	DN 40 CF-R	≈34 cm^3
	Pressure max. (absolute)	5 bar
Ambiance	Admissible temperatures	
	Storage	–2 … +70 °C
	Operation	0 ... +50 °C
	Bakeout	+80 °C (at vacuum connection, without electronics unit, horizontally mounted)
	Relative humidity (year's mean / during 60 days)	≤65% (no condensation) / ≤85% (no condensation)
	Use	indoors only altitude up to 2000 m above sea level
	Mounting orientation	any
	Pollution degree	2

Degree of protection	IP40

Dimensions [mm]



Weight 300 … 700 g

4 Installation

4.1 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

Protective ground

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

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.

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.

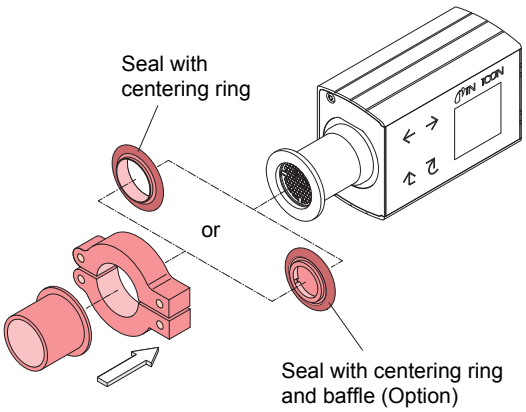
Mount the gauge so that no vibrations occur. Vibrations at the gauge cause a deviation of the measured values.
The gauge may be mounted in any orientation. To keep condensates and particles from getting into the measuring chamber preferably choose a horizontal to upright position.

The gauge is supplied with a built-in grid. For potentially contaminating applications and to protect the electrodes against light and fast charged particles, installation of the optional baffle is recommended.

The sensor can be baked at up to 80 °C (at vacuum connection, horizontally mounted). At temperatures exceeding 50 °C, the electronics unit has to be removed.

INFICON recommends to install the gauge without applying vacuum grease.

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



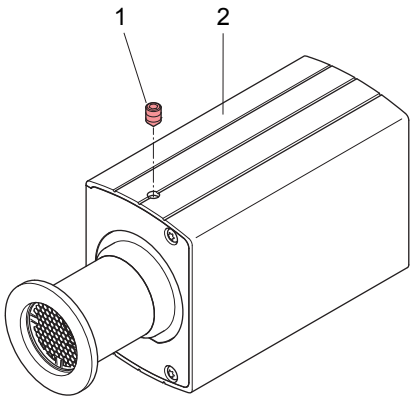
Keep the protective lid.

4.1.1 Removing and Installing the Electronics Unit

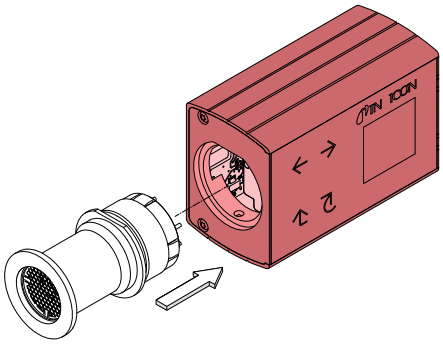
Required tools/material: Allen key, AF 2.5

Removing the electronics unit

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

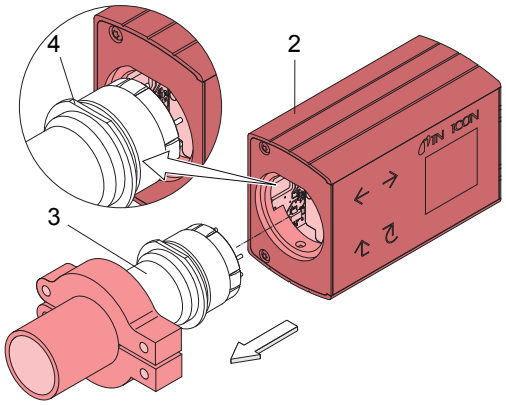


2 Remove the electronics unit **without twisting** it.



Installing the electronics unit

3 Place the electronics unit (2) on the sensor (3) (be careful to correctly align the pins and notch (4)).



4 Slide the electronics unit in to the mechanical stop and lock it with the hexagon socket set screw.

4.1.2 Using the Optional Baffle

In severely contaminating processes and to protect measurement electrodes optically against light and fast charged particles, replacement of the built-in grid by the optional baffle is recommended.

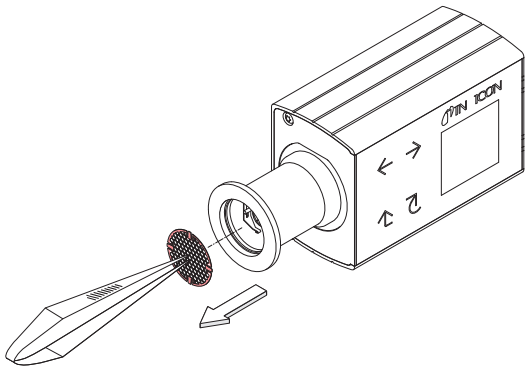
Requirement: The gauge is deinstalled.

Required tools / material

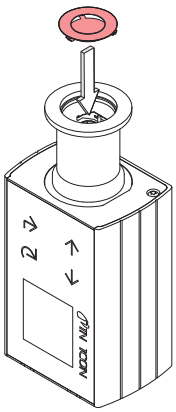
- Baffle
- Pointed tweezers
- Pin (e.g. pencil)
- Screwdriver No 1

Baffle Installation

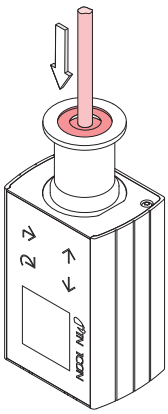
1 Carefully remove the grid with tweezers.



2 Carefully place the baffle onto the sensor opening.

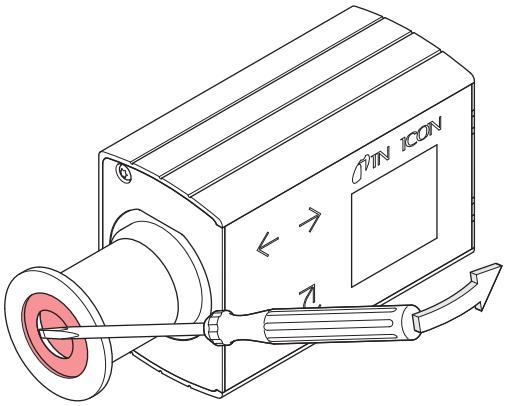


3 Using a pin, press the baffle down in the center until it catches.



Baffle Deinstallation

4 Carefully remove the baffle with the screwdriver.



4.2 Power Connection

4.2.1 Use With INFICON VGC50x / VGC40x Vacuum Gauge Controller

If the gauge is used with an INFICON VGC50x / VGC40x controller, a corresponding sensor cable is required (www.inficon.com). The sensor cable enables supplying the gauge with power, transmitting measurement values and gauge statuses, and making parameter settings. All controllers detect the BCG552 in the backward compatible mode as BCG450. A software update is available for the VGC5xx controller which enables full functionality of the BCG552 gauge.

Caution

Data transmission errors

The attempt to operate a fieldbus gauge with the VGC50x / VGC40x Vacuum Gauge Controller (RS232C) causes data transmission errors.

- Fieldbus gauges must not be operated with an INFICON VGC50x / VGC40x controller.

Connect the gauge to the INFICON controller with the corresponding sensor cable.

4.2.2 Use With Other Controllers

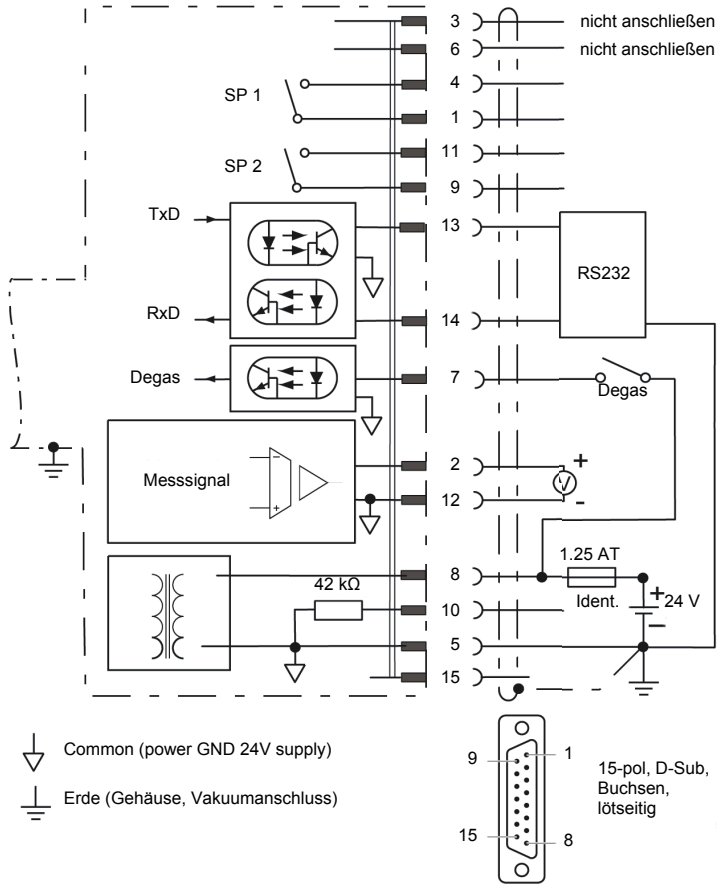
The gauge can also be operated with other controllers.

Especially the fieldbus version BCG552 with EtherCAT is usually operated as part of a network, controlled by a master or bus controller. In such cases, the control system has to be operated with the appropriate software and communication protocol.

4.2.2.1 Making an Individual Sensor Cable

For reasons of compatibility, the expression "sensor cable" is used for all BCG552 versions in this document, although the pressure reading of the gauges with fieldbus interface BCG552 with EtherCAT is normally transmitted via EtherCAT.
The sensor cable is required for supplying all BCG552 types with power. It also enables access to the relay contacts of the switching functions.

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



Pin 1	Relay switching function SP 1, common	
Pin 2	Measuring signal output	0 ... +10,13 V
Pin 3	Do not connect	
Pin 4	Relay switching function SP 1, NO	
Pin 5	Supply common	0 V
Pin 6	Do not connect	
Pin 7	Degas on, active high	0 V/+24 V
Pin 8	Supply	+24 V
Pin 9	Relay switching function SP 2, common	
Pin 10	Gauge identification	
Pin 11	Relay switching function SP 2, NO	
Pin 12	Measuring signal common	
Pin 13	RS232C, TxD	
Pin 14	RS232C, RxD	
Pin 15	Do not connect	

For cable lengths up to 5 m (0,34 mm^2 conductor cross-section) the output signal can be measured directly between the positive signal output (Pin 2) and supply common GND (Pin 5). At greater cable lengths, differential measurement between signal output (Pin 2) and signal common (Pin 12) is recommended.

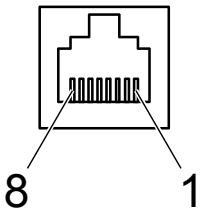
4.2.2.2 Making two EtherCAT Interface Cables

If no Ethernet cables are available, make two according to the following indications.

Cable type

Shielded Ethernet Patch cable (quality CAT5e or higher).

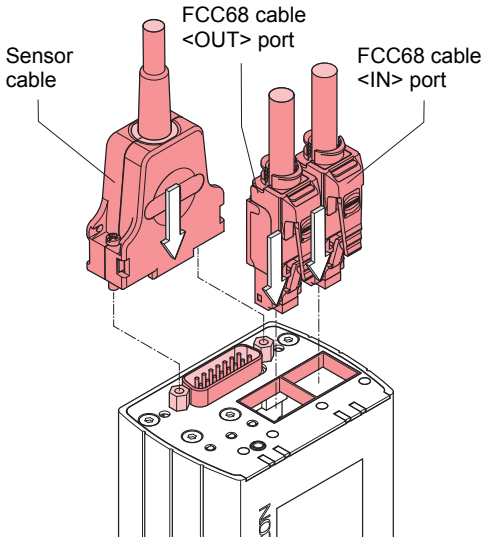
Pin assignment:



FCC68, 8-pin,
male, soldering side

Pin 1	TD+ Transmission data +
Pin 2	TD– Transmission data –
Pin 3	RD+ Receive Data +
Pin 4	not used
Pin 5	not used
Pin 6	RD– Receive Data –
Pin 7	not used
Pin 8	not used

1 Connect the Ethernet cables (and sensor cable) to the gauge: From the previous device the cable connected to the <OUT> port has to be connected to the BCG552 <IN> port. And the cable from the BCG552 <OUT> port has to be connected to the next device's <IN> port.



2 Secure the sensor cable connector using the lock screws.

4.2.3 Using the Optional Power Supply (With RS232C Line)

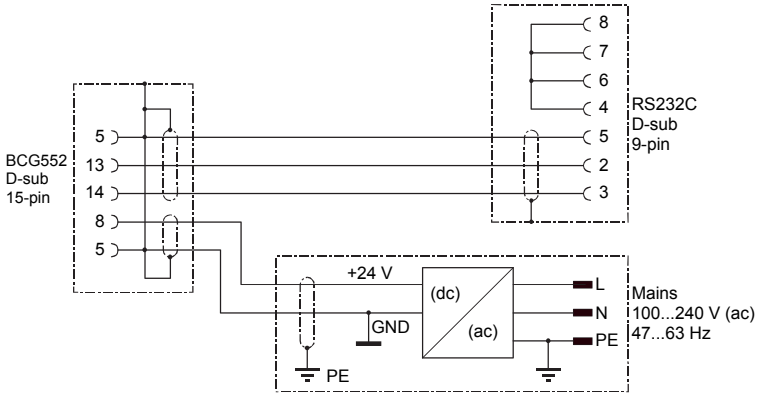
The optional 24 V power supply allows RS232C operation of the BCG552 gauge with any suitable instrument or control device.

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

Technical data

Mains connection	
Mains voltage	100 ... 240 V (AC) 47 ... 63 Hz
Mains cable	1.8 meter (Schuko DIN and U.S. connectors)
Output (operating voltage of gauge, V_s)	
Voltage	21 ... 27 V (DC), set to 24 V (DC)
Current	max. 1,5 A
Gauge connection	
Connector	D-sub, 15 pin, female
24 V (dc) cable	5 m, black
Connection of the instrument or control device	
RS232C connection	D-sub, 9-pin, female
Cable	5 m, black, 3 conductors, shielded

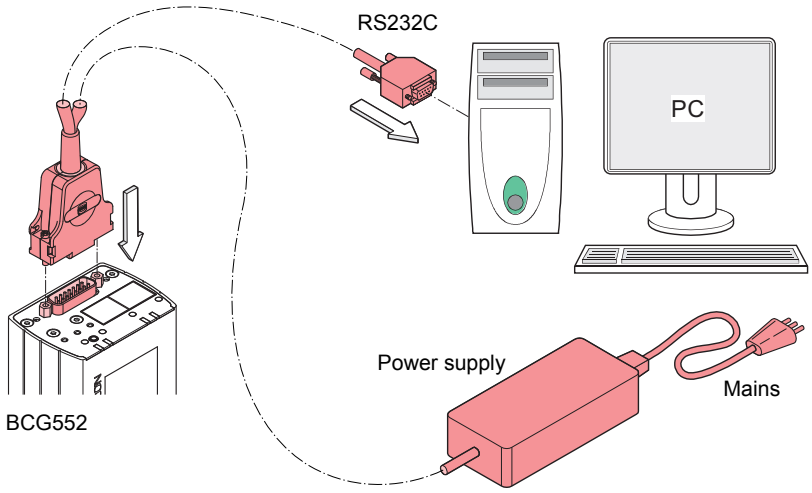
Wiring diagram



Connecting the power supply

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

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



3 Connect the power supply to the mains.

5 Operation

5.1 Putting the Gauge Into Operation

When the operating voltage is supplied, the output signal is available between Pin 2 (+) and Pin 12 (–) of the sensor cable connector (Relationship Output Signal – Pressure).

Allow for a stabilizing time of approx. 10 min. Once the gauge has been switched on, permanently leave it on irrespective of the pressure. The gauge is factory calibrated. Due to long time operation or contamination, a zero drift could occur.

Communication via the digital interfaces is described in separate sections of this document.

Gas type dependence

Due to the capacitance diaphragm sensor used in the upper pressure range, a minimized gas type dependence is achieved.

Pressure range	Measuring principle	Gas type dependence
10 … 1500 mbar	capacitance diaphragm sensor	independent of gas type, no correction required
1 … 10 mbar	capacitance diaphragm sensor and Pirani sensor	crossover range
2×10^{-2} … 1 mbar	Pirani sensor	[2]

[2] Pressure indicated applies to dry air, O2, CO and N2 and has to be converted for other gases.

5×10^{-3} … 2×10^{-2} mbar	Pirani sensor and hot cathode ionization sensor (BA)	crossover range
5×10^{-10} … 5×10^{-3} mbar	hot cathode ionization sensor (BA)	[2)]

5.2 Degas

Contamination

Gauge failures due to contamination or wear and tear, as well as expendable parts (e.g. filament), are not covered by the warranty.

Deposits on the electrode system of the BA sensor can lead to unstable measurement readings.

The degas process allows in-situ cleaning of the electrode system by heating the electron collector grid to approx. 700 °C by electron bombardment.

Depending on the application, this function can be activated by the system control via one of the gauge's digital interfaces. The BCG552 automatically terminates the degas process after 3 minutes, if it has not been stopped before.

The degas process can be run at pressures below 7.2×10^{-6} mbar.

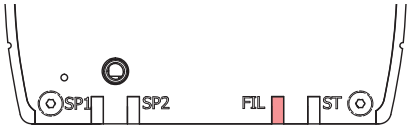
For a repeated degas process, the control signal first has to change from On to Off. Then degas can be started again with a new On command. To achieve an unambiguous operating status, it is recommended that the degas signal is set to Off again by the system control after 3 minutes of degassing.

A new degas cycle can only be started after a waiting time of 30 minutes.

5.3 Filament Status

5.3.1 Filament Status Indicator

The status of the dual filament hot cathode is indicated by a LED on top of the gauge.



Filament status	Emission	Filament status indicator (FIL)
–	off	off
Both filaments O.K.	on	green
One filament broken	on	green, flashing
Both filaments broken	on	red

INFICON recommends the replacement of the sensor as soon as the first filament failure has been detected.

5.3.2 Filament Status Relay (Only without fieldbus)

The BCG552 without fieldbus features a "Filament status" relay contact available at the sensor cable connector:

Filament status	Relay contact (This is an option for SP2)
Both filaments O.K.	closed
One filament broken	open
Both filaments broken	open

5.3.3 Filament Status via Interface

The filament status can be read via the serial interfaces:

Gauge	Interface	Detailed information
BCG552	RS232C	→ 🗎 22
BCG552 EtherCAT	EtherCAT	→ 🕮 [3], → 🕮 [4]

5.4 Filament Control Mode

Filament Control Mode	Description
Automatic (AUTO)	In automatic mode (AUTO) (default) the gauge automatically alternates between filaments in order to age both filaments evenly.
Manual (MAN)	In manual mode (MAN) filament selection can be commanded via the interfaces.

The filament control mode can only be changed via the interfaces.

5.5 Emission Control Mode

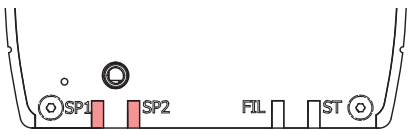
General

The emission control mode function defines the rules by which the emission of the gauge is switched on and off. The manual mode feature has a positive effect on gauge lifetime, mainly in process situations where the process chamber has to be vented frequently.

Emission Control Mode	Description
Automatic (AUTO)	By default, the automatic mode is active and the emission is switched on and off automatically by the gauge. However, the emission will only be switched on if the pressure falls below "Switching on pressure". If the pressure rises above the "Switching off pressure" the emission is switched off. However, the user can switch off the emission any time via the interfaces. If the emission is switched off manually while it is in the on state, it is switched on again only after pressure has exceeded "Switching off pressure" and subsequently fallen below "Switching on pressure".
Manual (MAN)	In manual mode, the emission can be switched on and off by the user. However, switching on the emission is only possible if the pressure is below "Switching on pressure". If the pressure rises above the "Switching off pressure" while the emission is on, the emission will be switched off by the gauge.

The emission control mode parameter is only accessible via the serial interfaces and described in the respective sections.
It is described in the relevant sections (Switching the emission on/off via RS232).

5.6 Trip Points / Setpoints



The gauge has two relays which get activated / deactivated according to the installed setpoints. The setpoints can be set by EtherCAT (see EtherCAT manual), by diagnostic port or via display.

The status of the setpoints / trip points determines if the gauge pressure is below or above a certain value. The status of the low trip point is on, if the pressure falls below a certain threshold value. Hence, the status of the high trip point is on, if the pressure surpasses a certain threshold value. To prevent a toggling behavior of the status at pressure close to the threshold value, a hysteresis is added to the threshold value.

The threshold value can be set directly (Standard mode) or indirectly (ATM mode). In Standard mode the setpoint value is defined by the parameter High Trip Point / Low Trip Point. The calculation of the setpoints for the ATM mode is described below:

ATM Mode:

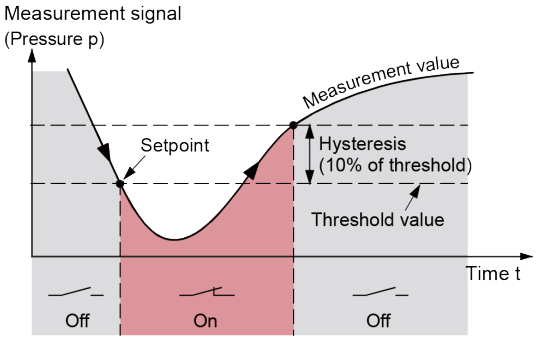
Low setpoint = Low Trip Point ATM Factor * ATM Pressure

High setpoint = High Trip Point ATM Factor * ATM Pressure

The functionality of the two setpoints and the setpoint mode is described below.

Low Trip Point (default for fieldbus gauges)

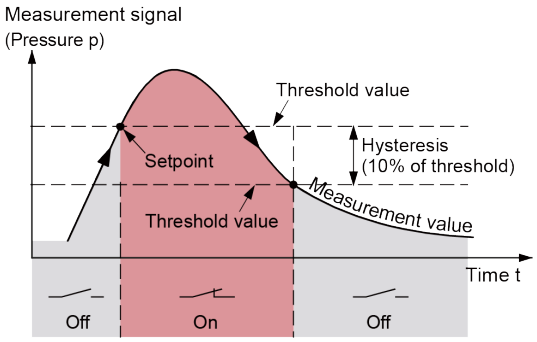
If the pressure in the vacuum system is lower than the setpoint, the corresponding LED (<SP1> or <SP2>) is lit solid and Status Low Trip Point 1/2 is set to 1. The corresponding relay is closed.



The setpoints SP1 and SP2 are factory set to the lower measurement range limit and therefore do not switch.

High Trip Point

If the pressure in the vacuum system is higher than the setpoint, the corresponding LED (<SP1> or <SP2>) is lit solid and Status High Trip Point 1/2 is set to 1. The corresponding relay is closed.

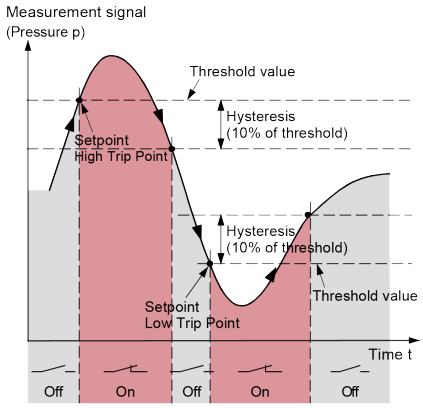


High & Low Trip Point

Both a High Trip Point and a Low Trip Point are assigned to each setpoint.

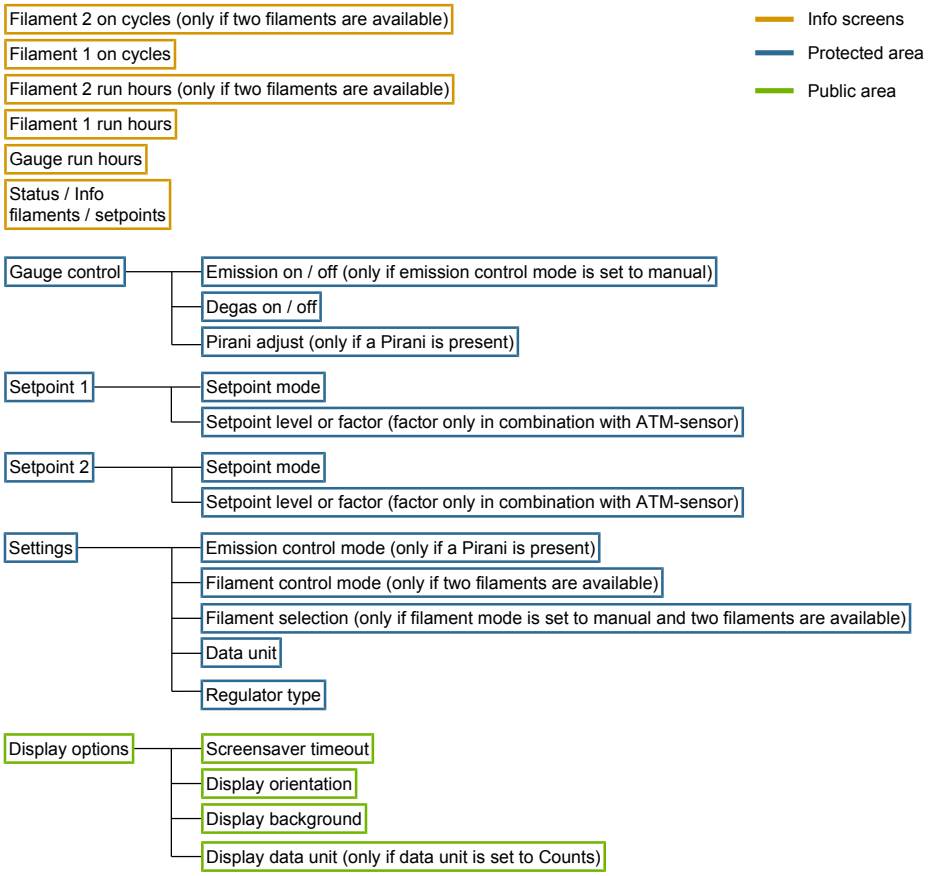
If the pressure in the vacuum system is higher than the defined High Trip Point threshold, the corresponding LED (<SP1> or <SP2>) is lit and Status High Trip Point 1/2 is set to 1. The corresponding relay is closed.

If the pressure in the vacuum system is lower than the defined Low Trip Point threshold, the corresponding LED (<SP1> or <SP2>) is lit and Status Low Trip Point 1/2 is set to 1. The corresponding relay is closed.

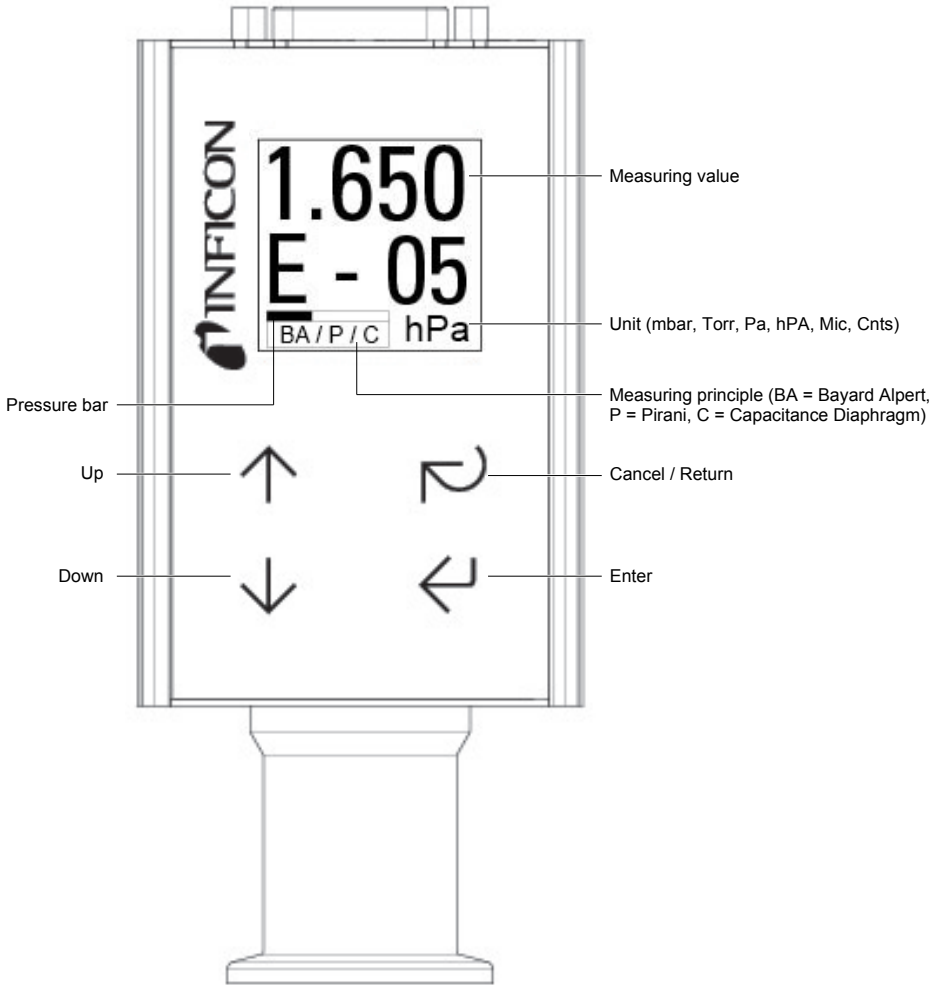


5.7 Display

5.7.1 Display Structure



5.7.2 User Interface Basics



There is an internal timeout to come back to the previous menu.

Touch key	Menu	Parameter	Value
Up and **Down**	Select menu	Select parameter	Select value
Enter	Access menu	Access parameter	Save value
Cancel / Return	Return to previous menu	Return to previous menu	Discard value

5.7.3 Adjusting Pirani

Start adjustment of the Pirani gauge with **Enter**.
The screen shows the result of this command after processing (ATM/HV adjustment or failure).

5.7.4 Starting the Degas Process

1. Check conditions for executing the degas process (→ 🗎 17).
2. Start or stop the degas process of the hot ion gauge with **Enter**.

5.7.5 Switching on Emission

1. Check conditions for switching on/off the emission current (→ 🗎 18).
2. Ensure that Emission Mode is set to Manual.
3. Switch on/off the emission of the hot ion gauge with **Enter**.

5.7.6 Setting Setpoint 1 or 2

Off	The setpoint is deactivated.
LTP	The setpoint is activated and works as Low Trip Point.
HTP	The setpoint is activated and works as High Trip Point.
LTP-ATM	The setpoint is activated and works as atmosphere switch (Low Trip Point).
HTP-ATM	The setpoint is activated and works as atmosphere switch (High Trip Point).

1. Set the setpoint mode.
   ⇨ Depending on the selected setpoint type the level or pressure screen appears.
2. Set the setpoint level.
   If the atmosphere switching mode is selected a factor relative to the atmosphere pressure can be put in.
   For a standard Low or High Trip Point a pressure value can be chosen.
3. Confirm each digit with **Enter**.
   After the last digit the new value will be checked and saved.
   Following this, a failure or success screen is shown.

5.8 RS232C Interface

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

Caution

Data transmission errors

The attempt to operate a fieldbus with the RS232C interface causes data transmission errors.

- Fieldbus gauges must not be operated with the RS232C interface.

5.8.1 Description of the Functions

The interface works in duplex mode. A nine byte string is sent continuously without a request approx. every 8 ms. Commands are transmitted to the gauge in a five byte input (receive) string.

Operational parameters

- 9600 Baud
- 8 data bits
- 1 stop bit
- no parity bit
- no handshake

Electrical connections

Signal	Sensor cable connector
TxD	Pin 13
RxD	Pin 14
GND	Pin 5

5.8.1.1 Output String (Transmit)

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

Format of the output string

Byte No.	Function	Value	Comment
0	Length of data string	7	
1	Page number	5	for hot cathode gauges
2	Status		Status byte
3	Error		Error byte
4	Measurement high byte	0 ... 255	Calculation of pressure value
5	Measurement low byte	0 ... 255	Calculation of pressure value
6	Software version	0 ... 255	Software version
7	Response value	13	for BCG552
8	Check sum	0 ... 255	Synchronization

Synchronization

Synchronization of the master is achieved by testing three bytes:

Byte No.	Function	Value	Comment
0	Length of data string	7	
1	Page number	5	for hot cathode gauges
8	Check sum of bytes 1 ... 7	0 ... 255	Low byte of check sum [1]

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

Status byte

Bit 1	Bit 0	Definition
0	0	emission off
0	1	emission 25 µA
1	0	emission 5 mA
1	1	degas

Bit 2	Definition
x	reserved for future use

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

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

Bit 6	Definition
0	filament 1 active
1	filament 2 active

Bit 7	Definition
x	reserved for future use

Error byte

Bit Nr.	Definition
0	diaphragm sensor error
1	reserved for future use
2	Pirani sensor error
3	reserved for future use
4	BA sensor error
5	reserved for future use
6	hardware failure, EEPROM failure
7	reserved for future use

Software version

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

Version No = $Value_{Byte\ 6}$ / 20

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

Calculation of the pressure value

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

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

$p_{mbar} = 10^{((\text{high byte} \times 256 + \text{low byte}) / 4000 - 12.5)}$

$p_{Torr} = 10^{((\text{high byte} \times 256 + \text{low byte}) / 4000 - 12.625)}$

$p_{Pa} = 10^{((\text{high byte} \times 256 + \text{low byte}) / 4000 - 10.5)}$

Example

The example is based on the following output string:

Byte No.	0	1	2	3	4	5	6	7	8
Value	7	5	0	0	242	48	20	13	72

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

Byte No.	Function	Value	Comment
0	Length of data string	7	
1	Page number	5	hot cathode gauges
2	Status	0	emission = off Pressure unit = mbar
3	Error	0	No error
4 5	Measurement High byte Low byte	242 48	Calculation of the pressure: $p = 10^{((242 \times 256 + 48) / 4000 - 12.5)} = 1000$ mbar
6	Software version	20	Software version = 20 / 20 = 1.0
7	Sensor type	13	BCG552
8	Check sum	72	5 + 0 + 0 + 242 + 48 + 20 + 13 = $328_{dec} = 01\ 48_{hex}$ High order byte is ignored Check sum = $48_{hex} = 72_{dec}$

5.8.1.2 Input String (Receive)

For transmission of the commands to the gauge, a string (frame) of five bytes is sent (without <CR>). Byte 1 to byte 3 form the data string.

Format of the input string

Byte No.	Function	Value	Comment
0	Length of data string	3	
1	Data		➔ admissible input strings
2	Data		➔ admissible input strings
3	Data		➔ admissible input strings
4	Check sum (of Bytes No. 1 ... 3)	0 ... 255	(low byte of sum) [1]

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

Admissible input strings

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

	Byte No.				
Command:	**0**	**1**	**2**	**3**	**4** [2]
Set the unit mbar on the display [1]	3	0x10	0x8E	0	0x9E
Set the unit Torr on the display [1]	3	0x10	0x8E	1	0x9F
Set the unit Pa on the display [1]	3	0x10	0x8E	2	0xA0
Switch degas on (switches itself off after 3 min.)	3	0x10	0xC4	1	0xD5
Switch degas off (before 3 min.)	3	0x10	0xC4	0	0xD4
Read software version [3]	3	0x00	0xD1	0	0xD1
Reset	3	0x40	0	0	0x40
Switch emission on [4]	3	0x40	0x10	1	0x51
Switch emission off [4]	3	0x40	0x10	0	0x50
"Emission Control Mode" automatic (AUTO) [5]	3	0x10	0x8B	1	0x9B
"Emission Control Mode" manual (MAN) [5]	3	0x10	0x8A	0	0x9A
Set Filament Control Mode to AUTO [6]	3	0x10	0xD3	0	0xE3
Set Filament Control Mode to MAN [6]	3	0x10	0xD3	1	0xE4
Select filament 1 [7]	3	0x10	0xD2	0	0xE2
Select filament 2 [7]	3	0x10	0xD2	1	0xE3
Read filament status	3	0x00	0xD4	0	0xD4

[1] Only required for gauges with display. Transmitted data is not affected by this setting.

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

[3] Response value in byte no. 6 of transmitted string.

[4] On/off switching requirements

[5)] Defines the Emission Control Mode :
AUTO = emission on/off automatically controlled by the gauge
MAN = emission on/off controlled via interfaces

[6)] Defines the Filament Control Mode
AUTO = Selection of filament automatically controlled by the gauge
MAN = Selection of filament controlled via interfaces.

[7)] The "Select filament x" command can be sent any time but is only executed if the gauge is in the "Emission OFF" state.

5.9 EtherCAT Interface

The physical interface and communication firmware of the BCG552 comply with the EtherCAT standard.

Two adjustable switching functions are integrated in BCG552. The corresponding relay contacts are available at the sensor cable connector.

The basic sensor and sensor electronics of all BCG552 gauges are identical.

Caution

Data transmission errors

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

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

5.9.1 Description of the Functions

Via this interface, the following and further data are exchanged in the standardized EtherCAT protocol:

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

5.9.2 Operating Parameters

As the EtherCAT protocol is highly complex, the parameters and programming of BCG552 are described in detail in the separate Communication Protocol.

5.9.2.1 Operating Software

For operating the gauge via EtherCAT, prior installation of the device specific ESI file is required on the bus master side. This file can be downloaded from our website (www.inficon.com).

5.9.2.2 Explicit Device Address Setting

During device initialization, the device address switches are read by the device firmware. This device address is supported to the master as Explicit Device Identification.

Three switches are supplied via <x100>, <x10> and <x1>.

5.9.3 Status Indicators

Two LEDs on the gauge inform on the gauge status and the current EtherCAT status.

6 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

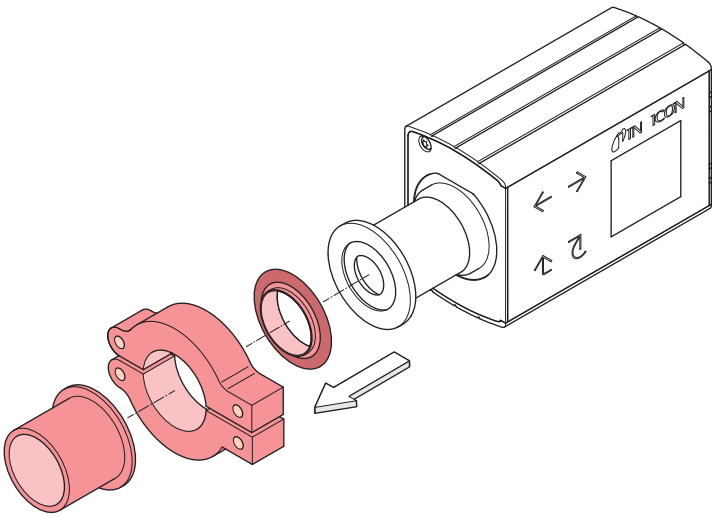
Dirt sensitive area

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. Take gauge out of operation.
   NOTICE! Before taking the gauge out of operation, make sure that this has no adverse effect on the vacuum system. Depending on the programming of the superset controller, faults may occur or error messages may be triggered. Follow the appropriate shut-down and starting procedures.
3. Disconnect all cables from the gauge.
4. Remove gauge from the vacuum system and replace the protective lid.



7 Maintenance, Repair

7.1 Maintenance

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.

7.1.1 Cleaning the Gauge

Small deposits on the electrode system can be removed by baking the anode. In the case of severe contamination, the baffle can be exchanged easily. The sensor itself cannot be cleaned and needs to be replaced in case of severe contamination.

A slightly damp cloth normally suffices for cleaning the outside of the unit. Do not use any aggressive or scouring cleaning agents.

Make sure that no liquid can penetrate the product. Allow the product to dry thoroughly before putting it into operation again.

Gauge failures due to contamination or wear and tear, as well as expendable parts (e.g. filament), are not covered by the warranty.

7.2 Adjusting the Gauge

The gauge is factory-calibrated. Through the use in different climatic conditions, fitting positions, aging or contamination and after exchanging the sensor a shifting of the characteristic curve can occur. However, readjustments are automatically carried out during operation of the gauge.

7.3 Adjusting the Atmosphere Sensor

The ambient atmospheric pressure of the gauge is measured by a separate sensor built into the electronics unit of the gauge (outside the vacuum chamber).

This sensor can be calibrated against the Capacitance Diaphragm sensor in the gauge. While the gauge is in a vented state, the gauge electronics compares the output signals of the two sensors and carries out the necessary adjustments to the atmospheric pressure sensor signal.

The following adjustment procedure can only be carried out via the serial interfaces.

Adjustment via RS232 interface (BCG552)

1 Vent vacuum system (or operate gauge in the deinstalled state).

2 Two 5 byte long command strings have to be sent to the gauge in succession:

String No. 1 (Unlock atmosphere sensor adjustment):

Byte No.	Function	Value		Comment
0	Length of data string	0x03	hex	
1	Data	0x10	hex	
2	Data	0x1C	hex	
3	Data	0x00	hex	
4	Check sum (of bytes No. 1 ... 3)	0x2C	hex	low byte of sum, high byte is ignored

String No. 2 (execute sensor adjustment):

Byte No.	Function	Value		Comment
0	Length of data string	0x03	hex	
1	Data	0x40	hex	
2	Data	0x20	hex	
3	Data	0x01	hex	
4	Check sum (of bytes No. 1 ... 3)	0x61	hex	low byte of sum, high byte is ignored

After the conclusion of this procedure, the separate atmospheric pressure sensor is calibrated to match the Capacitance Diaphragm sensor.

Adjustment of the atmosphere sensor via fieldbus interface

The adjustment of the atmospheric pressure sensor via the fieldbus interface is described in the respective communication protocol for EtherCAT.

7.4 What to Do in Case of Problems

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

Required tools / material

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

Troubleshooting

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

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

Problem	LED <ST>	Display	Possible cause	Correction
No voltage at signal output.	off	dark	No voltage supply	Turn on power supply.
Output signal: 0.1V [3]	blinking red	"FAILURE EEPROM Memory"	EEPROM error	Switch the gauge off and on again after 5 s.
				Replace the sensor
Output signal: 0.1V [3]	lit solid red	"FAILURE Cap.Dia. Gauge"	Diaphragm sensor error	Replace the sensor
Output signal: 0.5V [3]	lit solid red	"FAILURE Pirani Gauge"	Pirani sensor error	Replace the sensor
Output signal: 0.3V [3]	lit solid red	"FAILURE Hot Ion. Gauge"	Hot cathode sensor error	Replace the sensor

Troubleshooting (sensor)

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

Separate the sensor from the electronics unit. Using an ohmmeter, make the following measurements on the contact pins.

Ohmmeter measurement between pins	OK	Not OK	Possible cause
PIR1	≈37 Ω	>>37 Ω	Pirani element 1 broken
PIR2	≈37 Ω	>>37 Ω	Pirani element 2 broken
F1-FC und F2-FC	≈0,15 Ω	>>0,15 Ω	Filament of hot cathode broken
CDG	∞	<<∞	Electrode short circuit to ground
PIR1-GND und PIR 2 -GND	∞	<< ∞	Electrode short circuit to ground
F1, FC, F2 - GND	∞	<< ∞	Electrode short circuit to ground
A - GND	∞	<< ∞	Electrode short circuit to ground
C-GND	∞	<< ∞	Short circuit between electrodes

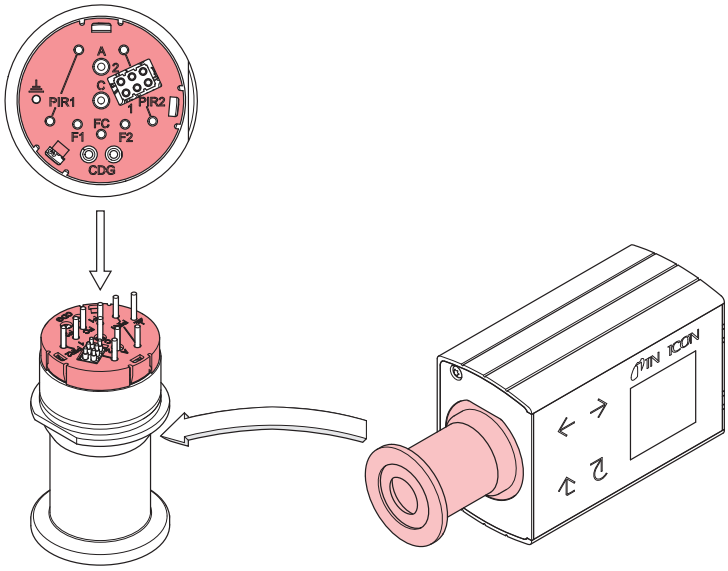
[3] Standard output voltage (depending on setting for safe value)

Caution

Electrostatic discharge (ESD)

All unmarked pins in the diagram are used by the diaphragm sensor electronics and cannot be utilized for diagnostic purposes due to electrostatic discharge (ESD).

- Do not connect an ohmmeter/continuity checker to these pins.



	Part number
Replacement sensor BCG552, vacuum connection DN 25 ISO-KF (including allen key)	354-423
Replacement sensor BCG552, vacuum connection DN 40 CF-R (including allen key)	354-424

10 Storage

Caution

Vacuum component

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

- Cover the vacuum ports of the product with protective lids or grease-free aluminum foil.
- Do not exceed the admissible storage temperature range.

11 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.

12 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.

Appendix

A: Relationship Measuring Signal – Pressure

Conversion formulae

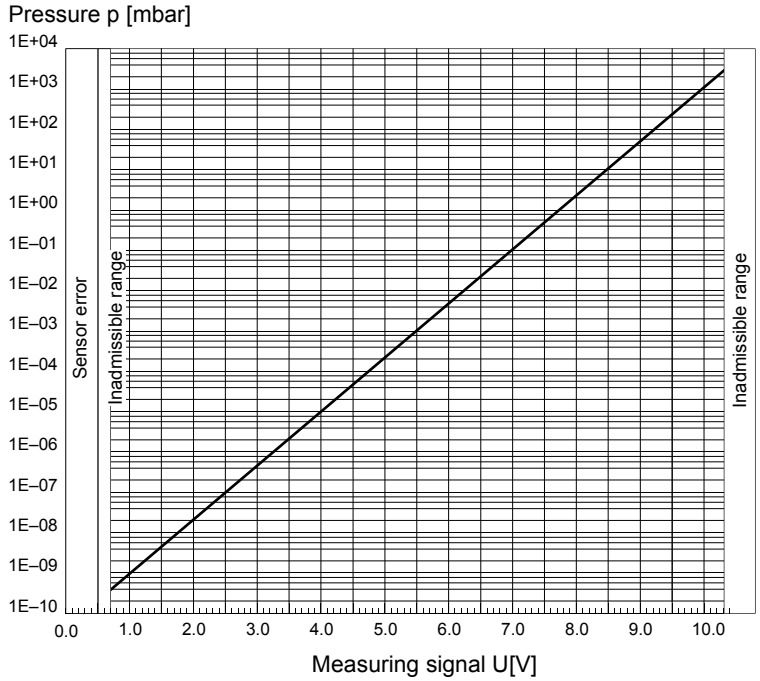
$$p = 10^{(U - 7,75) / 0,75 + c}$$

$$U = 0,75 \times (\log p - c) + 7,75$$

where	**U**	**p**	**c**
	[V]	[mbar]	0
	[V]	[Torr]	-0.125
	[V]	[Mic]	2.875
	[V]	[Pa]	2
	[V]	[hPa]	0

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

Conversion curve



Conversion table

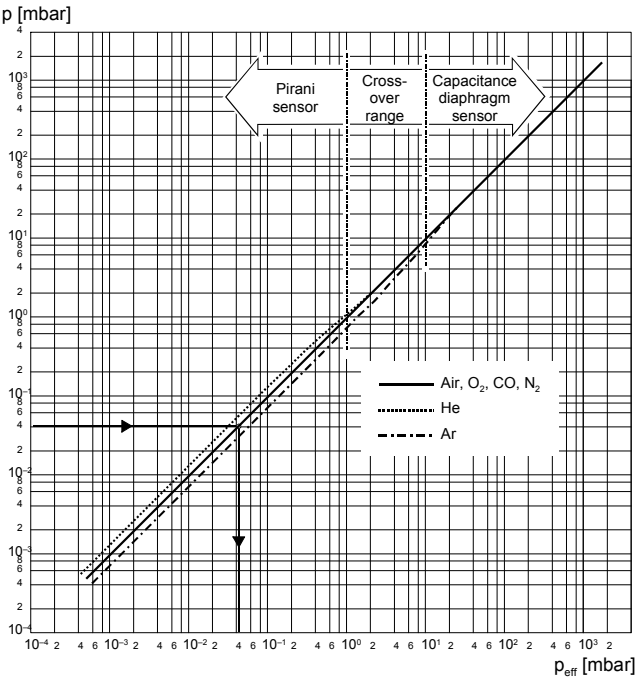
Output signal U [V]	**[mbar]**	**Pressure p [Torr]**	**[Pa]**
0.1 / 0.3 / 0.5		Sensor error	
0.51 ... 0.774		Inadmissible range	
0.774	5×10^{-10}	3.75×10^{-10}	5×10^{-8}
1.00	1×10^{-9}	7.5×10^{-10}	1×10^{-7}
1.75	1×10^{-8}	7.5×10^{-9}	1×10^{-6}
2.5	1×10^{-7}	7.5×10^{-8}	1×10^{-5}
3.25	1×10^{-6}	7.5×10^{-7}	1×10^{-4}
4.00	1×10^{-5}	7.5×10^{-6}	1×10^{-3}

Output signal U [V]	[mbar]	Pressure p [Torr]	[Pa]
4.75	1×10^{-4}	7.5×10^{-5}	1×10^{-2}
5.50	1×10^{-3}	7.5×10^{-4}	1×10^{-1}
6.25	1×10^{-2}	7.5×10^{-3}	1×10^{0}
7.00	1×10^{-1}	7.5×10^{-2}	1×10^{1}
7.75	1×10^{0}	7.5×10^{-1}	1×10^{2}
8.50	1×10^{1}	7.5×10^{0}	1×10^{3}
9.25	1×10^{2}	7.5×10^{1}	1×10^{4}
10.00	1×10^{3}	7.5×10^{2}	1×10^{5}
>10.13	Inadmissible range		

B: Gas Type Dependance

Indication range above 10^{-2} mbar

Pressure indicated (gauge adjusted for air)



Calibration in pressure range 2×10^{-2} ... 1 mbar

The gas type dependence in the pressure range 2×10^{-2} ... 1 mbar (Pirani sensor range) can be compensated by means of the following formula:

p_{eff} = C × indicated pressure

where	Gas type	Calibration factor C
	He	1.2
	Ne	1.4
	Ar	1.7
	Kr	2.4
	Xe	3
	H_2	0.5
	Air, O_2, CO, N_2	1
	CO_2	0.9
	Water vapor	0.5
	Freon 12	0.7

(The above calibration factors are mean values.)

Calibration in pressure range <5×10^{-3} mbar

The gas type dependence in the pressure range <5×10^{-3} mbar can be compensated by means of the following formula (gauge adjusted for air):

p_{eff} = C × indicated pressure

where	**Gas type**	**Calibration factor C**
	He	5.9
	Ne	4.1
	Ar	0.8
	Kr	0.5
	Xe	0.4
	H_2	2.4
	Air, O_2, CO, N_2	1

(The above calibration factors are mean values.)

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

Literature

[1] Communication Protokoll
EtherCAT
tirb77e1
INFICON AG, LI–9496 Balzers, Liechtenstein

[2] Communication Protocol
Serial Interface RS232C, RS485C
BAG500, BAG552, BPG500, BPG552, BCG552
tirb89e1

[3] ETG.5003.1 S (R) V1.1.0: Semiconductor Device profile – Part 1: Common Device Profile (CDP)

[4] ETG.5003.2080 S (R) V1.3.0: Semiconductor Device profile – Part 2080: Specific Device Profile (SDP): Vacuum Pressure Gauge

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

Trigon™ BCG552
Bayard-Alpert Pirani Capacitance Diaphragm TripleGauge®

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 + A1:2019 + A1:2019/AC:2019 (Safety requirements for electrical equipment for measurement, control and laboratory use)
- EN 61326-1:2013; Group 1, Class B (EMC requirements for electrical equipment for measurement, control and laboratory use)

Manufacturer / Signatures

INFICON AG, Alte Landstraße 6, LI-9496 Balzers

28 September 2023

Rolf Enderes
Director Development & Software

28 September 2023

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, 11.2016
  (EMC Regulation; Regulation relating to electromagnetic compatibility)
- S.I. 2012/3032, 12.2012
  (RoHS Regulation; Regulation on the restriction of the use of certain hazardous substances in electrical and electronic equipment)

Product

Trigon™ BCG552
Bayard-Alpert Pirani Capacitance Diaphragm TripleGauge®

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 + A1:2019 + A1:2019/AC:2019 (Safety requirements for electrical equipment for measurement, control and laboratory use)
- EN 61326-1:2013; Group 1, Class B (EMC requirements for electrical equipment for measurement, control and laboratory use)

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Notes

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