Installation & Operation Manual

VersaTorr BVT225
Ultra-wide Range Vacuum Gauge

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Beyond Measure

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General information
Thank you for purchasing this Brooks Instrument product. This operating manual contains important safety information, and we encourage you to read this manual and the quick start guide prior to installation and use of this product.

Symbols used
The following symbols are used in this manual:

WARNING! Critical information to prevent dangerous situations that can result in serious injury or death.

CAUTION! Important information to prevent dangerous situations that can damage the device or auxiliary equipment.

ACTION! Requires action or attention**.**

INFORMATION: Important recommendations and information for efficient use and best practice.

Intended use
The BVT225 vacuum gauge is intended for non-corrosive vacuum gas pressure measurement and control within the limits listed in the specifications on page 37. The device is designed for KF fittings or screw-in fittings mounting.

The device complies with EMC (Electro Magnetic Compatibility) class B immunity requirements for industrial environments.

Safety information
This product should be installed and operated by technically skilled or trained personnel only.

WARNING! This product is not intended for installation and use in the presence of flammable gases or other explosive environments.

WARNING! Ensure that the gases or liquids exposed to the wetted materials are compatible with the wetted materials described in the specifications table and the used sealing materials.

WARNING! The pressure rating of the sensor elements, connecting process fittings and sealing must comply with the maximum possible pressure in the application.
The CE marking on the device does not apply to the pressure equipment directive (PED) (2014/68/EU).

WARNING! Ensure that the process connection is tightened according to the recommended torque specification. Ensure that there are no leaks from the process connection before pressurizing the installation.

WARNING! Do not remove the gauge from the installation when the installation is evacuated, pressurized or contains hazardous fluids.

Disposal in the European Union
At the end-of-life of this product, it must be disposed according to the European Directive 2012/19/EU (WEEE). This product should not be mixed with general household waste.

WARNING! Ensure proper decontamination of the product before disposal if it has been exposed to humanly or environmentally hazardous materials during its use.

For proper treatment, recovery and recycling, please take this product to designated collection points. Please contact your local authority for further details of your nearest designated collection point.

Liability
The customer is solely responsible for determining the suitability and compatibility of the product for the customers application, environment and intended use. Brooks Instrument is not liable for any claims arising from improper use, incorrect installation or use with gases or liquid not compatible with the media wetted materials described in the specifications table. To the extent permitted by law, Brooks Instrument is not liable for incidental and consequential damages, including but not limited to loss of profits or revenue, overheads, loss of data, reinstallation costs, damage to other equipment or any incidental or consequential damages of any nature.
Brooks Instrument has taken reasonable care to ensure that the content of its published information and specifications is accurate and up-to date. However, Brooks Instrument does not guarantee or warrant that the content of the published information is error-free. Brooks Instrument reserves the right to change its product specifications without prior notice.

Trade restrictions and export control (ECCN: 2B230 Dual-use product)

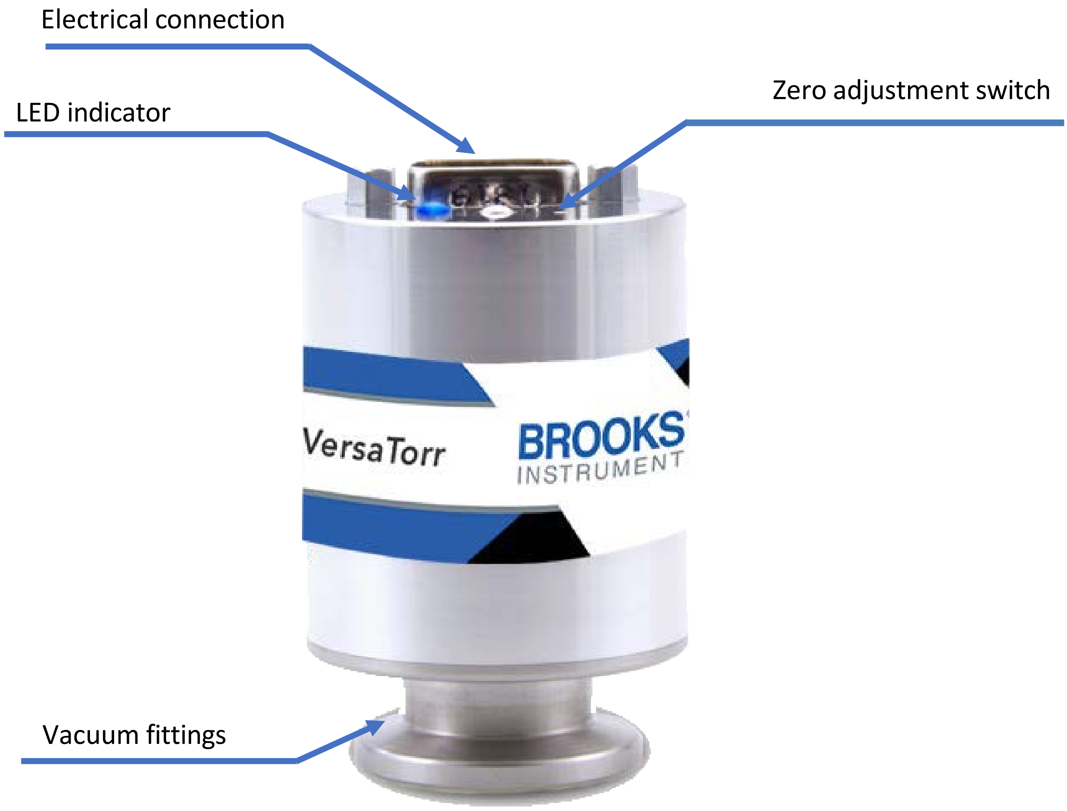
The TriSensor gauge is categorized as Dual-use product according ECCN: 2B230 and is subject to European Union and/or Danish trade and transfer laws and restrictions. In the event that the product is exported, transferred or in any way distributed to another country or territory than delivered to by Brooks Instrument, the recipient and/or customer is responsible for compliance to export restrictions, regulations or applicable law of Denmark, local law and/or the law of the European Union.

Diversion or transfer contrary to law of Denmark and/or law of the European Union is prohibited.

For export compliance questions consult your local authorities and/or Brooks Instrument on email: infoBrooks Instrument.com

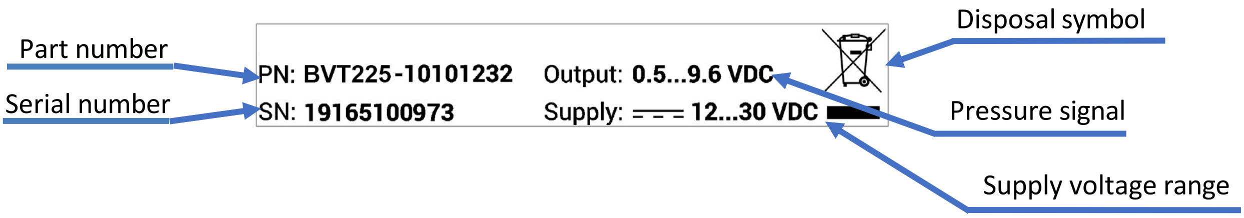
BVT225 vacuum gauge

The BVT225 is available with different vacuum fittings. The illustration below is an example of the BVT225 with D-sub connector and DN16KF vacuum fitting.



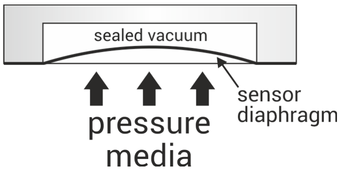
Labeling

If the serial label should become unreadable, the serial- and part numbers are also stored in the internal non-volatile memory and can be read using the Brooks Vacuum Gauge Communicator USB programmer and communicator. See page 27.

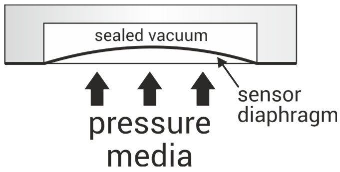


About the BVT225 TriSensor ATM vacuum gauge

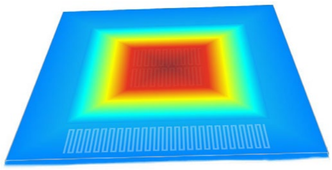
The BVT225 TriSensor gauge is based on cutting-edge sensor technology and offers best-in-class performance and has established new standards by extending the useable measuring range for thermal conductivity vacuum gauges by 1-3 decades. The TriSensor combines a MEMS (Microelectromechanical Systems) heat-loss Pirani sensor, a Piezo diaphragm sensor and a capacitance diaphragm sensor.



Piezo absolute diaphragm



Capacitance diaphragm sensor


Heat-loss diaphragm sensor

The piezo MEMS sensor consists of a diaphragm where one side of the diaphragm is exposed to the vacuum gas and the other side is exposed to a sealed reference vacuum. The applied pressure deflects the diaphragm, and the deflection is converted to an electric signal.

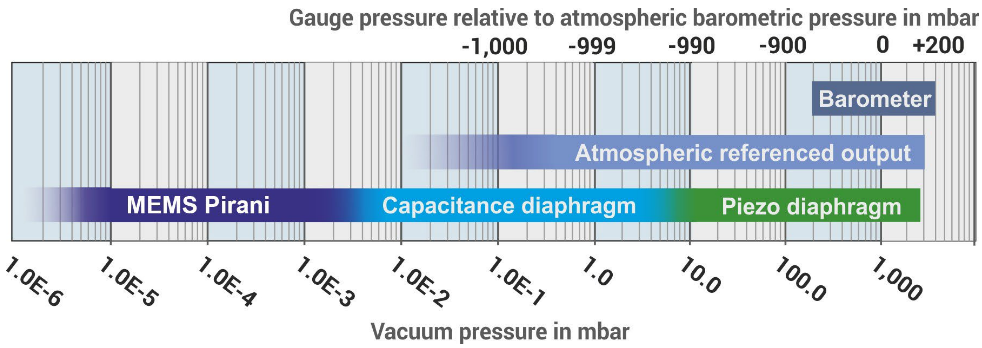
The MEMS Pirani sensor is based on a resistive element deposited on an ultra-thin diaphragm suspended in the vacuum gas to measure. The diaphragm is permanently mechanically fixed and does not bend or move with changes in vacuum gas pressure. The resistive element is made of nickel that offers a high temperature coefficient. The vacuum gas pressure is determined by measurement of the pressure dependent heat-loss from a heated resistive element. The measurement of heat-loss is gas concentration and gas type dependent.

The ceramic capacitance gauge is based on an elastic sensor diaphragm where the mechanical deflection is a function of the applied pressure. The diaphragm constitutes an electrode and together with an integrated auxiliary electrode it forms a pressure dependent capacitor that in an electrical measurement circuit converts the applied pressure to an electrical signal.
The precision capacitance diaphragm gauge (CDG) sensor eliminates the Pirani gas dependency and provides accurate measurements also when the gas properties change.

Measurement performance

The BVT225 TriSensor ATM has established new performance standards and extended range for heat-loss Pirani gauges. It combines a MEMS diaphragm piezo sensor, a heat-loss MEMS Pirani sensor and a ceramic capacitance diaphragm sensor.

The diaphragm sensors eliminates the well-known gas dependency in the rough vacuum range of thermal conductivity gauges. The Piezo offers precision performance comparable to more expensive capacitance manometers. This feature ensures more accurate control of vacuum system venting processes and can prevent over-pressurization of the vacuum system.



The MEMS-Pirani provides measurement resolution down to 1.00E-6 mbar (7.5E-7 Torr).

BVT225 TriSensor ATM vacuum gauge applications

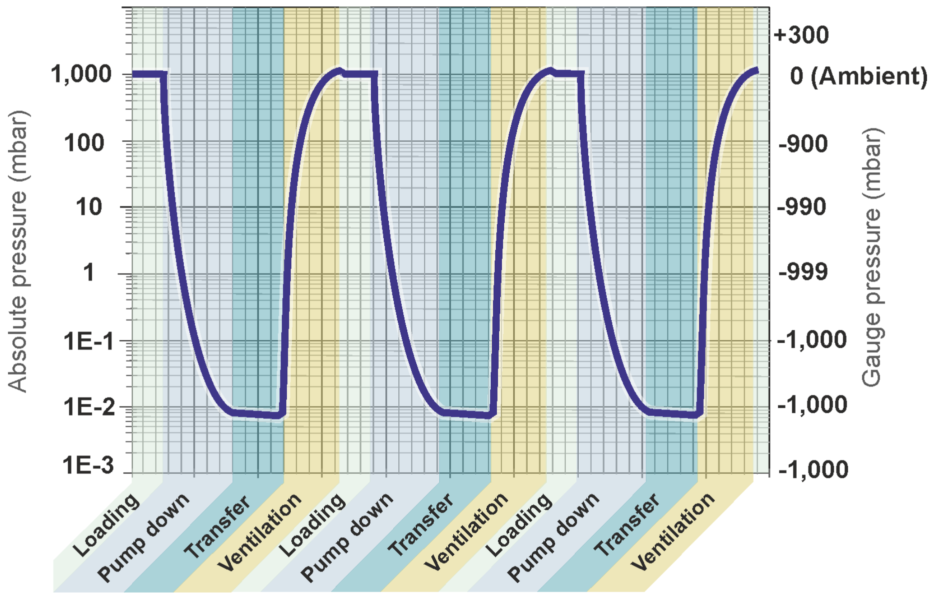
The BVT225 TriSensor ATM gauge combines full-range vacuum measurement from high vacuum to atmospheric pressure with accurate measurement of pressure relative to atmospheric barometric pressure.

A Load-lock is a vacuum chamber used in the vacuum and semiconductor industry for loading devices like semiconductor wafers from ambient air pressure conditions into the main vacuum processing chamber. In the semiconductor industry, the process vacuum chamber is maintained at high vacuum pressure and not vented to ambient pressure during process cycles. An auxiliary vacuum chamber is required to isolate the wafers from the main process chamber when ventilated.

The load-lock is typically cycled between atmospheric barometric ambient pressure and an adequate vacuum pressure required to transfer the wafers device to the processing vacuum chamber via a buffer transfer chamber. Accurate control of the vacuum gas pressure in the load-lock vacuum chamber is critically important in order to prevent inrush of ambient air and particulate contamination of the load-lock and wafers. Contamination by inrush of ambient air will cause longer pump-down times and increases the risk of particulate contamination of both wafers and the vacuum system itself.

Load-lock pumping cycle

To control pressure during the pumping cycle, a Pirani heat-loss gauge is typically used to measure the vacuum gas pressure and to provide a set-point control signal once the vacuum pressure between the load-lock and transfer chamber is equalized. The wafer is mechanically transferred to the transfer chamber and a processed wafer is transferred back to the load-lock. The load-lock is typically ventilated with Nitrogen gas to ambient pressure or a small overpressure to prevent atmospheric air to flow into the load-lock chamber when opened.



Load-lock venting to atmosphere cycle

To control the pressure in the venting cycle a vacuum sensor measuring relative to ambient pressure, commonly known as a gauge sensor, is used. The advantage of using a gauge sensor instead of an absolute sensor is that the load-lock pressure can be accurately equalized to zero differential pressure between the load-lock vacuum chamber and ambient pressure independently of variation in barometric ambient pressure due to weather changes.

Load-lock external control

The BVT225 is available with three independent setpoint solid-state relays that can be used to control external devices like valves, door, pumps or safety interlock circuits.

Each setpoint can programmed to a setpoint and hysteresis value that can be assigned to the pressure reading relative to ambient pressure or the wide-range absolute range.

Part numbers

The BVT225 is available with different electrical connections and process fittings. The illustration below is an example of the BVT225 with DN16KF, RS-232/Brooks Vacuum Gauge Communicator, 0.5-9.5 VDC analog output, mbar unit, 3 relays and 15-pin HD D-sub

Code Description	Code Option	Option Descripton		
I. Base Model	BVT200	VersaTorr Tri-sensor Gauge		
	BVT225	VersaTorr Tri-sensor Gauge w/ Barometer		
II. Units	1	Torr		
	2	mbar		
	3	Pascal		
III. Setpoints	0	None		
	1	1x Solid State Relay		
	2	2x Solid State Relay		
	3	3x Solid State Relay		
IV. Vacuum Flange			BVT200	BVT225
	1	DN16KF	x	x
	2	DN25KF	x	x
	3	NPT 1/8"	x	x
	4	VCR4	x	x
	5	DN16KF Extended	x	x
	6	DN16KF with light baffle	x	x
	7	DN16KF with heavy duty baffle	x	x
	8	DN25KF with light baffle	x	x
	9	DN25KF with heavy duty baffle	x	x
	A	VCR8F	x	x
V. Electrical Connector			BVT200	BVT225
	1	9 Pin D-sub male	x	x
	2	15 pin HD D-sub male	x	x
	3	15 pin HD D-Sub male / dual analog out	x	x
	4	6 pin Hirschmann, ID res 3K	x	
	5	6 pin Hirschmann, ID res 5.1K	x	
	6	6 pin Hirschmann, ID res 9.1K/11.1K	x	
	7	8 pin RJ45 / FCC68, ID Res 27K	x	
	8	8 pin RJ45 / FCC68, ID Res 36K	x	
	9	8 pin RJ45 / FCC68, ID Res 43K	x	
VI Digital Interface			BVT200	BVT225
	1	RS-232 / Brooks Vacuum Gauge Communicator	x	x
	2	RS-485 / Brooks Vacuum Gauge Communicator	x	x
	3	Brooks Vacuum Gauge Communicator	x	
VII. Analog Output	A	0.5 - 9.5 (1 V/dec)		
	B	1.0-9 VDC 1 VDC/Dec (MKS 901P/925/910		
	C	0.375 to 5.659 VDC (MKS GP275)		
	D	1.0-9 VDC (MKS 523)		
	E	1.9-10 VDC (Inficon PSG55x, Leybold TTR91)		
	F	1.5-8.5 VDC (Pfeiffer TPR260/27x/28x)		
	G	1.9-9.1 VDC (Edwards APG100XLC)		
	H	1.9-9.1 VDC (Edwards APG100XM)		
	J	0-10 VDC 0.1Torr FS Capacitance manometer		
	K	0-10 VDC 1 Torr FS Capacitance manometer		
	L	0-10 VDC 10 Torr FS Capacitance manometer		
	M	0-10 VDC 100 Torr Capacitance manometer		
	N	0-10 VDC 1000 Torr Capacitance manometer		
VIII. Customer Special Request	XXXX			

Configuration accessories

When configuring the various digital and analog parameters of the BVT225, three different categories of connectors can be used – as described in the following sections.

Neither of these connectors are included with the gauge and must be purchased separately.

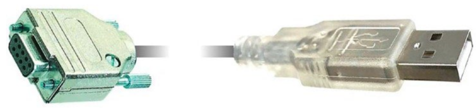
Wall plug-powered USB converter and programmer

The wall plug-powered variant includes either a USB-to-RS-232 or USB-to-RS-485 converter along with a 90-230 VAC wall plug power supply that enables powering of the gauge independently of a PC.

The wall plug power supply is compatible with BVT225 gauges and MKS 901P, 902B, 910, 925, 971B, 972B and 974B.

Part number	Description
BVT-RS2-DS15-WP	RS-232 USB programmer, 1.5 m cable, D-sub 15 pin, wall plug-powered
BVT-RS4-DS15-WP	RS-485 USB programmer, 1.5 m cable, D-sub 15 pin, wall plug-powered
BVT-RS2-DS9-WP	RS-232 USB programmer, 1.5 m cable, D-sub 9 pin, wall plug-powered
BVT-RS4-DS9-WP	RS-485 USB programmer, 1.5 m cable, D-sub 9 pin, wall plug-powered

USB-powered converter and programmer



The USB-powered converter and programmer provides direct USB communication and power from the PC.

The USB-powered programmer is compatible with BVT225 gauges and MKS 901P, 902B, 910 and 925 gauges.

Part number	Description
BVT-RS2-DS15-UP	RS-232 USB programmer, 1.5 m cable, D-sub 15 pin, USB powered
BVT-RS2-DS9-UP	RS-232 USB programmer, 1.5 m cable, D-sub 9 pin, USB powered

Brooks Vacuum Gauge Communicator programmer

The Brooks Vacuum Gauge Communicator communicates digitally via the power supply line, enabling configuration of products that would otherwise not have a standard digital interface like RS-232 or RS-485.

Brooks Vacuum Gauge Communicator is available in other configurations:

Part number	Description
BVT-S4-RJ45	Brooks Vacuum Gauge Communicator USB programmer, 1.5 m cable, RJ45, 8-pin
BVT-S4-HIR6	Brooks Vacuum Gauge Communicator USB programmer, 1.5 m cable, Hirschmann GO-6, 6-pin

Calibration

The BVT225 is delivered factory-calibrated with a calibration test report. An optional accredited DAKKS calibration traceable to national standards can also be supplied with the BVT225 gauge.

Mechanical installation

The BVT225 gauge is available with KF clamp fittings, VCR screw-in fittings or CF fittings.

⚠ **CAUTION!** For screw-in fittings do not exceed tightening torque values.

⚠ **CAUTION!** Use gloves when handling vacuum fittings. Ensure that the O-ring and vacuum sealing surfaces are clean and free of scratches or other damages.

The BVT225 gauge can be mounted horizontally or vertically without impact on accuracy or performance.

Application and process compliance

The BVT225 gauge is intended for use in vacuum applications where non-corrosive gases are present.

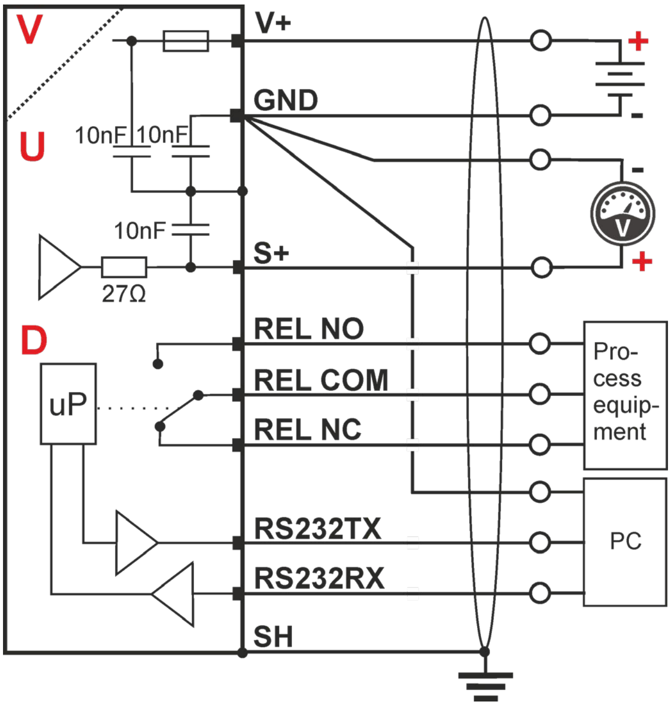
Electrical installation

The BVT225 requires an external power supply supplying in the range 12-30 VDC. The external power supply shall be with safe isolation according to PELV (Protective Extra Low Voltage) requirements of EN60204-1. The gauge is protected against momentary overvoltage on the supply line. The internal 100 mA thermal fuse will limit current draw in case of overvoltage to limit overheating.
Additionally, the gauge is protected against reverse polarity caused by incorrect wiring to the power supply.

The gauge electronics have a high level of immunity against external electromagnetic interference.

Electrical connection (D-sub)

The voltage output version provides a voltage signal proportional to the measured pressure.



The high resolution 16-bit voltage signal can be interfaced to a PLC, A/D converter, voltmeter or other readout devices.

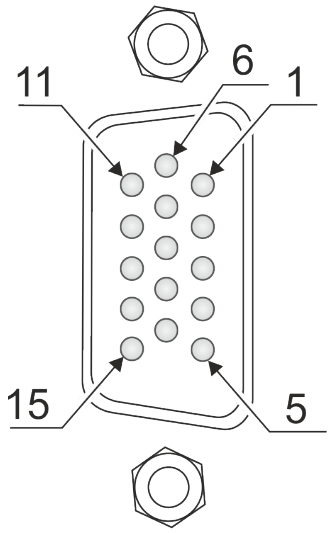
INFORMATION: It is recommended to use a differential input to measure the output signal that uses a separate signal return wire connected to the gauge connector. If power supply return and signal return share the same wire connection the voltage drop as function of supply current will cause a measurement deviation. In that case, the measurement deviation will increase with the cable length.

Connector pinout and cable wiring (0-10 VDC voltage output)

15-pin HD D-sub connector

Pin	Symbol	Description
1	RS232TX	RS-232 Transmit / RS-485 (-)
2	RS232RX	RS-232 Receive / RS-485 (+)
3	V+	Supply voltage 12-30 VDC
4	GND	Supply voltage - (return)
5	S+	Analog voltage signal +
6	GND	Analog voltage signal - (return)
7	REL NO	Relay 1 NO (normally open contact) (1)
8	REL COM	Relay 1 Common (1)
9	REL NC	Relay 1 NC (normally closed contact) (1)
10	REL NC	Relay 2 NC (normally closed contact) (1)
11	REL COM	Relay 2 Common (1)
12	REL NO	Relay 2 NO (normally open contact) (1)
13	REL NC	Relay 3 NC (normally open contact) or Analog output 2
14	REL COM	Relay 3 Common (1)
15	REL NO	Relay 3 NO (normally open contact) (1)

(1) Optional relay



INFORMATION: It is recommended to use a differential input to measure the output signal that uses a separate signal return wire connected to the gauge connector. If power supply return and signal return share the same wire connection the voltage drop as function of supply current will cause a measurement deviation. In that case, the measurement deviation will increase with the cable length.

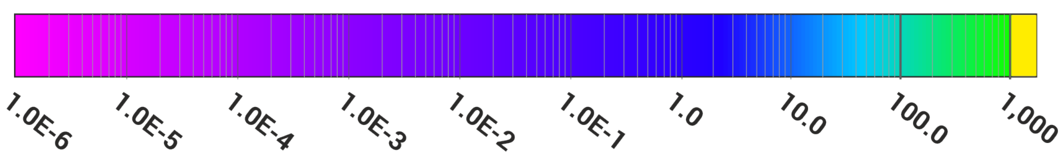
Status LED

The LED indicator signals the gauge status and can indicate following basic indications:

Startup sequence
0.5 sec purple followed by 4 sec. pulsing green
Normal standard operation
Solid green
Overpressure indication (in Dynamic Mode only)
Flashing green / yellow (5 Hz)
Brooks Vacuum Gauge Communicator mode
Pulsing green
Sensor fail stage
Flashing red (5 Hz)

RGB LED for pressure indication

The TriSensor gauge offers a new approach for visually determining the measured pressure by a multi-color LED that smoothly changes color throughout the pressure range. This selectable visual function is a low-cost alternative to integrated displays and provides a rough visual indication of the measured pressure. It also provides a clear visual warning if the vacuum system is pressurized above ambient pressure.



Pressure measurement in mbar conversion to color

Signal-to-pressure conversion (0-10 VDC voltage output)

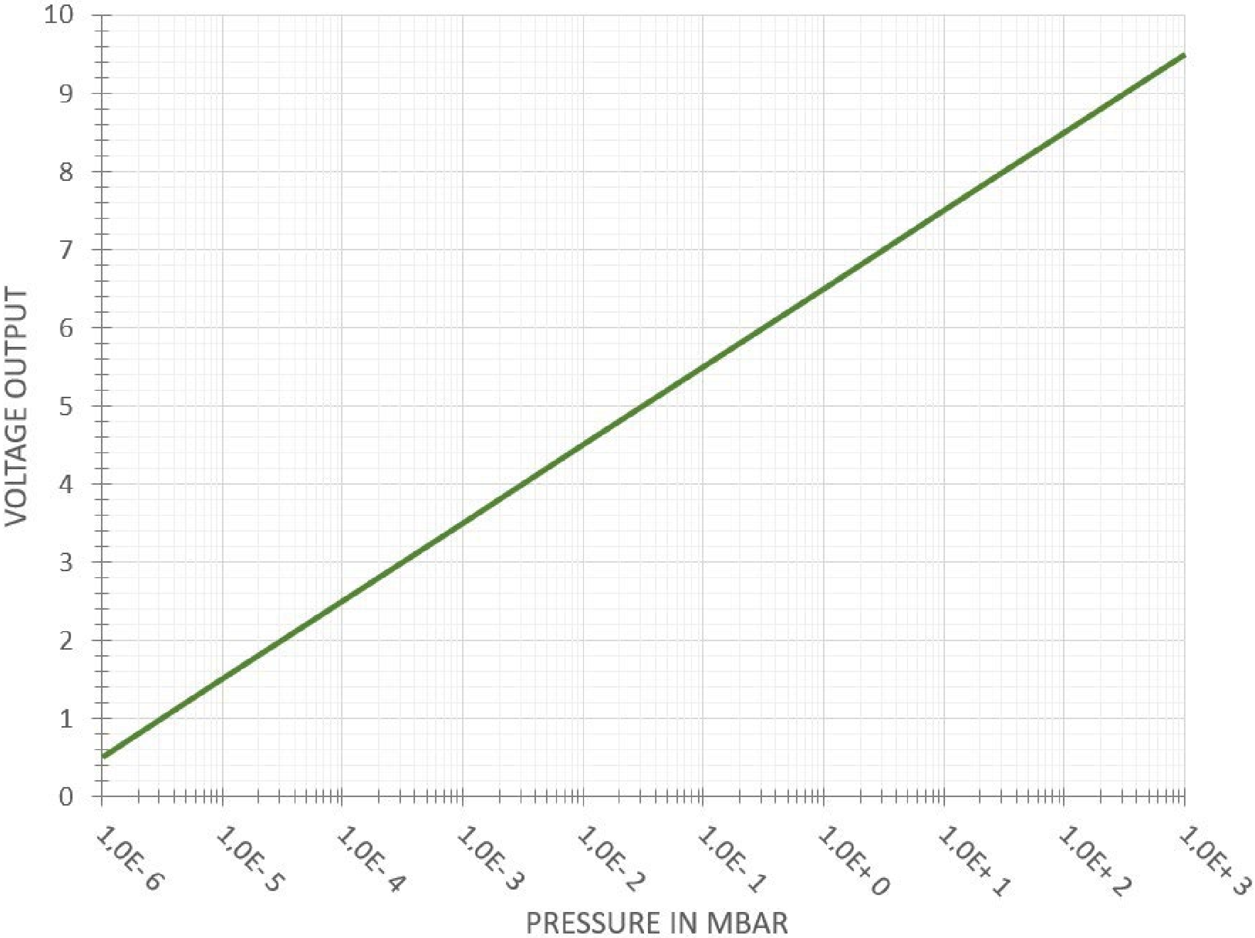
The gauge can provide a voltage output from 0-10 VDC and is available with different types of pre-configured output scaling.

In the BVT225's standard configuration with a voltage output of 1 VDC/decade, the output is scaled according to the configured pressure unit, e.g. when mbar is selected the gauge will provide 1 VDC per decade mbar. Likewise, when the unit is changed to torr, the gauge will provide 1 VDC per decade torr. Finally, when the unit is changed to Pascal, the gauge will provide 1 VDC per decade Pascal.

The voltage signal uu can be converted to pressure using the following linear expression:

Voltage to pressure conversion (mbar and torr): $PP(uu) = 10^{(uu-6.5)}$

Voltage to pressure conversion (Pascal): $PP(uu) = 10^{(uu-4.5)}$



Other vendors analog output emulation

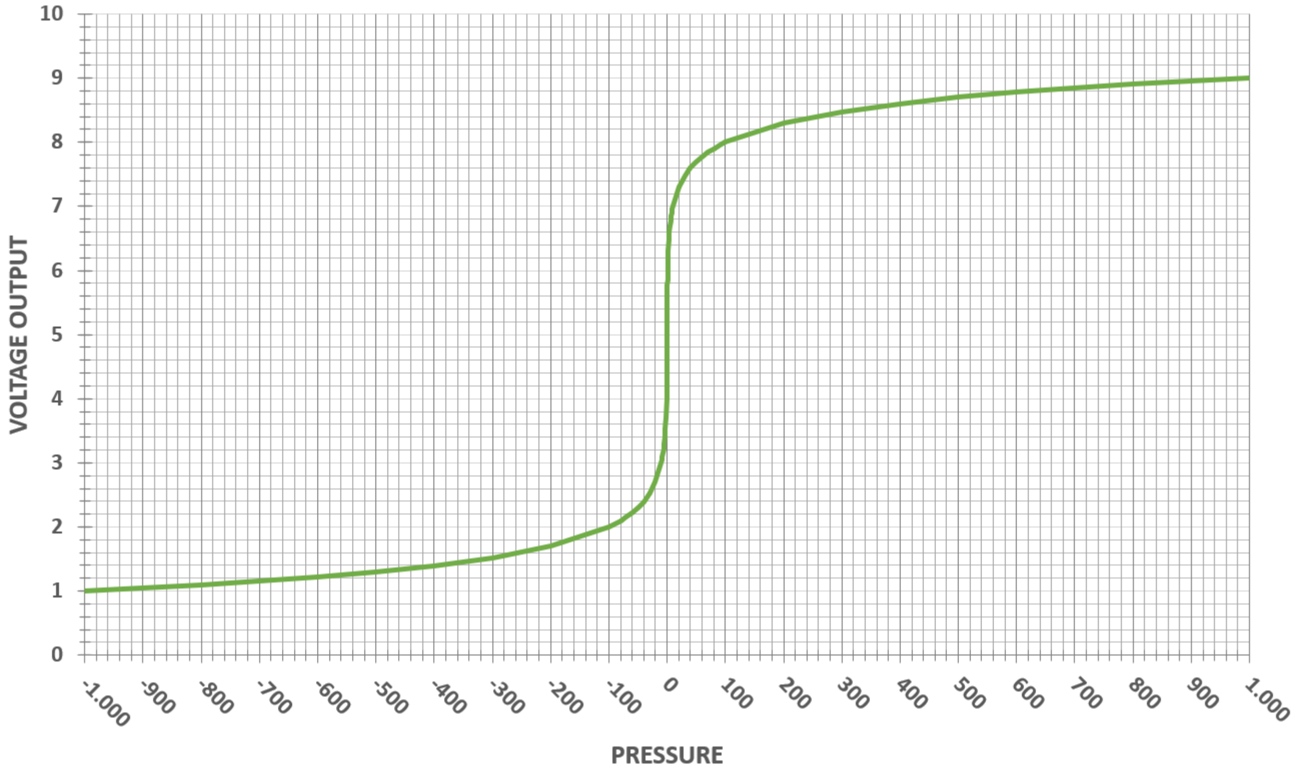
The BVT225 analog output emulation offers voltage output pressure scaling compatible with other vendors gauges. This feature enables drop-in replacement of gauges from other vendors.
Configuration and list of analog output options can be found on page 19.

Digital vacuum pressure and temperature measurement

The real-time digital vacuum gas pressure value and vacuum gas temperature can be acquired through the digital interface. Refer to digital command set on page 18.

Analog output 2 signal-to-pressure conversion (0-10 VDC voltage output)

The optional analog output 2 is per default assigned to the ambient pressure referenced pressure measurement.



The Piezo analog output provides 5 VDC at zero differential pressure relative to barometric ambient pressure.

For positive pressure of 5VDC and above the voltage can be converted to pressure with following equation:

Voltage to pressure conversion (torr): $PP(uu) = 10^{(uu-6)}$

For negative pressure of less than 5 VDC the voltage can be converted to pressure with following equation:

Voltage to pressure conversion (torr): $PP(uu) = {}^{-1}/10\ _{(uu-4)}$

Brooks Vacuum Gauge Communicator communication

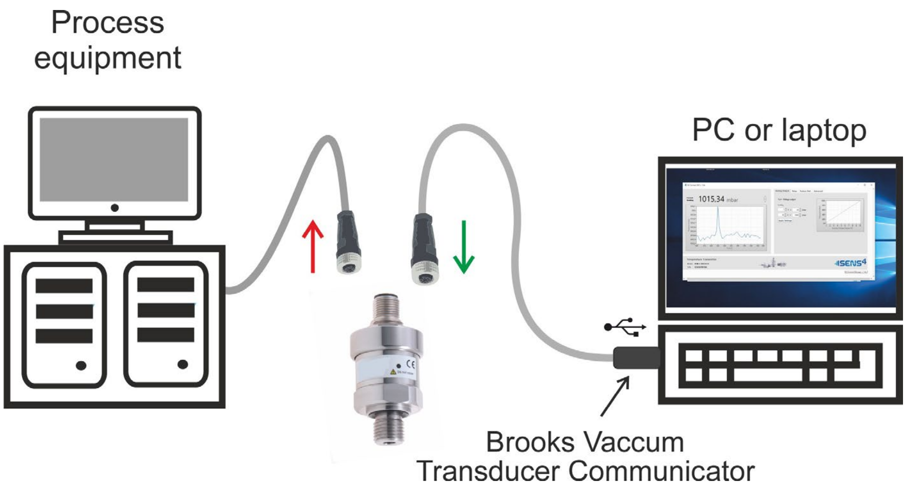
The Brooks Vacuum Gauge Communicator USB programmer and communicator provides access from PC software via a USB interface to the digital core of the gauge. It is compatible with both 4-20 mA current output and 0-10 VDC voltage output gauges from Brooks Instrument.

It is intended for configuration, calibration, and setup of the unit, but it can also be used to acquire measurement data and perform diagnostics using a PC.

The Brooks Vacuum Gauge Communicator interface enables easy and cost-optimized access to perform calibration, adjustments, and individual configuration of the gauge product to fit the customer application and requirements.

During the power-up cycle the gauge will detect if there is a Brooks Vacuum Gauge Communicator programmer connected and if so, the gauge will enter the Brooks Vacuum Gauge Communicator service mode.

WARNING! The Brooks Vacuum Gauge Communicator interface is not intended for digital communication between process equipment and the BVT225 gauge unit. Disconnect the gauge from any external installation before enabling the Brooks Vacuum Gauge Communicator service mode. During the Brooks Vacuum Gauge Communicator service mode the analog voltage output or analog current output will be disabled, and the analog output will be used for digital communication between gauge and Brooks Vacuum Gauge Communicator programmer.



Getting started:

1. Remove the electronics connection to the gauge so that it is disconnected from any process equipment.
2. Download the Brooks Vacuum Gauge Communicator software from www.Brooks Instrument.com and install the software. Alternatively, a standard serial terminal software can be used.

3. Connect the programmer to the PC and the Brooks Vacuum Gauge Communicator software. The Brooks Vacuum Gauge Communicator programmer will then enter a state where it searches for the gauge. During this period the LED on the programmer will alternate between green and blue.
4. Connect the gauge to the Brooks Vacuum Gauge Communicator cable. The Brooks Vacuum Gauge Communicator programmer's LED will turn solid green if a current output gauge is connected and solid blue if a voltage output gauge is connected.
5. When the Brooks Vacuum Gauge Communicator programmer's LED turns solid blue or green, it's ready for communication.

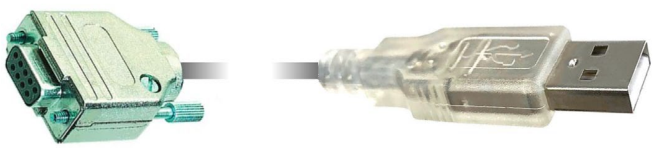
Brooks Vacuum Gauge Communicator USB programmer LED signals

The Brooks Vacuum Gauge Communicator USB programmer has an LED indicator that provides the following signals:

Alternating blue/green:	Searching for gauge.
Solid blue:	Voltage output gauge connected.
Solid green:	Current output gauge connected.
White strobe:	Locate mode for Brooks Vacuum Gauge Communicator programmer (see page 19).

USB-to-Serial Converter

The USB-to-Serial Converter is the quickest and simplest way to provide connectivity between an RS-232 or RS-485 capable Brooks Instrument gauge and a computer or other compatible device.
Featuring a built-in switch-mode power supply, the converter eliminates the need for an external power supply.



Command set

The BVT225 is available with Brooks Vacuum Gauge Communicator and either an RS-232 or an RS-485 serial interface. 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>\

Start character: **@**

Device address: **001-253**

Command: **See command list**

Query or set:

Parameter:

End character: \

INFORMATION: Throughout this manual 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

Example of how to send a command to the gauge

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

Send: **@254SPV!1,1.24E-4**
Reply: **@ACK1.23E-4**

The following table lists all commands supported by BVT225. Each command is described in more detail below the table.

Command	Description	Query	Set	Valid input parameter
ADR	Device address	●	●	1-3 digits (range 001-253)
AOUT	Analog output configuration	●	●	<STD / 0-39>
BAUD	Set baud rate	●	●	<4800 / 9600 / 19200 / 38400 / 57600 / 115200> (default 9600)
FAIL	Sensor failure handling	●	●	<WORKING / ZERO >
FD	Factory default	●	●	<ADR / BAUD / GT / SP / U / (NONE)>
FS	Piezo full-scale adjustment	●	●	<*PRESSURE VALUE* / CLEAR>
FV	Firmware version	●		-
GT	Gas type	●	●	<NITROGEN / HELIUM / ARGON / AIR>
MF	Manufacturer	●		-
MD	Model name	●		-
P	Pressure measurement	●		<CMB / MP / PZ / CP / (none)>
PN	Part number	●		-
Q	Quick query	●	●	<Parameter 1>, <Par. 2> … <Par. 5>
SN	Serial number	●		-
SP	Setpoint settings	●		-
SPD	Setpoint direction(1)	●	●	<SETPOINT #>, <ABOVE / BELOW>
SPE	Setpoint enable(1)	●	●	<SETPOINT #>, <OFF / ON>
SPH	Setpoint hysteresis(1)	●	●	<SETPOINT #>, <*PRESSURE VALUE*>
SPV	Setpoint value(1)	●	●	<SETPOINT #>, <*PRESSURE VALUE*>
SPR	Setpoint relay status(1)	●		<SETPOINT #>
SPS	Setpoint source(1)	●	●	<SETPOINT #>, <P / T>
STAT	Statistics	●	●	<P / T / (none) / CLEAR (Set only)>
T	Vacuum sensor temperature	●		-
U	Pressure unit	●	●	(<PARAMETER>), <MBAR / PASCAL / TORR> or <CELSIUS / FAHRENHEIT / KELVIN>
VAC	Pirani Zero adjustment	●	●	No input or <*PRESSURE VALUE*>

General note: 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 gauge. Refer to the specific commands for details.

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

Device Address (ADR)

The BVT225 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 BVT225 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 BVT225s at once. The BVT225 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.

Analog Output Configuration (AOUT)

BVT225's default analog output is 0.5-9.5 V, 1V/decade, however, the analog output can be configured to emulate a collection of other equipment via the AOUT command:

	Vendor	Gauge model	Output
STD	Brooks Instrument	BVT100,125,200,225	1 VDC/decade (0.5-9.5VDC)
0	MKS	901P, 910, 925	1 VDC/decade
1	Edwards	APG-L	1.99 - 10 VDC
2	Edwards	APG-100	2.00 - 9.00 VDC
3	Edwards	WRG	2.75 - 10.00 VDC
4	Inficon Leybold	PSG500 TTR91	1.547 - 10.00 VDC
5	Inficon Pfeiffer	MPG400 PKR251	2.07 - 8.603 VDC
6	Inficon MKS	BPG400 999 Quattro	1.843 - 10.00 VDC
7	MKS Granville Phillips	275	0.372 - 5.570 VDC
8	MKS HPS	Moducell 325	0.2509 - 3.2398 VDC
9	MKS HPS	Moducell 325 x3	0.753 - 9.719 VDC
10	MKS	Baratron® 0.1 Torr	0 - 10.00 VDC
11	MKS	Baratron® 1 Torr	0 - 10.00 VDC
12	MKS	Baratron® 10 Torr	0 - 10.00 VDC
13	MKS	Baratron® 100 Torr	0 - 10.00 VDC
14	MKS	Baratron® 1000 Torr	0 - 10.00 VDC
15	MKS	901P piezo differential output	1 VDC/decade
16	Edwards	AIM-S / - SL	2.5 - 10.00 VDC
17	Edwards	AIM-X / XL	3.286 - 9.799 VDC
18	Pfeiffer	IKR251	2.324 - 8.500 VDC
19	Pfeiffer	TPR 265 / 280	2.199 - 8.625 VDC
20	Hastings	HPM-2002-OBE special	5.00 - 9.995 VDC
21	Edwards	DV6M	2.00 - 10.00 VDC
22	Edwards	APG-M	2.00 - 10.00 VDC
23	MKS Granville Phillips	GP275 (0-9.0 VDC)	0 - 9.00 VDC
24	Thyracont	MT 241.1	0.41 - 9.99 VDC
25	MKS Granville Phillips	GP275 (0.375-5.659 VDC)	0.375 - 5.659 VDC
26	Edwards	APG100-LC	2.00 - 10.00 VDC
27	Edwards	APG100M	2.00 - 10.00 VDC
28	MKS	907	0.387 - 5.666 VDC
29	Alcatel	K6080	0.40 - 10.00 VDC
30	Inficon	PEG100	2.186 - 10.166 VDC
31	Varian	Eysys	1.00 - 8.00 VDC
32	Alcatel	TA111	0.10 - 9.20 VDC
33	MKS	685	1.00 - 7.00 VDC
34	MKS	901P special 2VDC/decade	1.00 - 9.00 VDC
35	Pfeiffer	TTR 101	0.61 - 10.2 VDC
50	MKS/Inficon	0.1 mbar full scale (linear)	0 - 10.00 VDC
51	MKS/Inficon	1 mbar full scale (linear)	0 - 10.00 VDC
52	MKS/Inficon	2 mbar full scale (linear)	0 - 10.00 VDC
53	MKS/Inficon	5 mbar full scale (linear)	0 - 10.00 VDC
54	MKS/Inficon	10 mbar full scale (linear)	0 - 10.00 VDC
55	MKS/Inficon	20 mbar full scale (linear)	0 - 10.00 VDC
56	MKS/Inficon	50 mbar full scale (linear)	0 - 10.00 VDC
57	MKS/Inficon	100 mbar full scale (linear)	0 - 10.00 VDC
58	MKS/Inficon	200 mbar full scale (linear)	0 - 10.00 VDC
59	MKS/Inficon	500 mbar full scale (linear)	0 - 10.00 VDC
60	MKS/Inficon	1000 mbar full scale (linear)	0 - 10.00 VDC

Example: Change the Analog output emulation to MKS Baratron 0.1 Torr:

Send: **@254AOUT!10**

Reply: **@253ACK10**

Set Baud Rate (BAUD)

The BVT225 supports the following baud rates: 4800, 9600, 19.000, 38.400, 57.600, 115.200. Note that whenever the baud rate is changed, the BVT225 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 115.200:

Send: **@254BAUD!115200**

Reply: **@253ACK115200**

Button Enabled (BTN)

Enable or disable the feature to perform Pirani zero-adjustments and Differential Piezo zero-adjustments via the BVT225's push-button.

Example: Disable the push-button.

Send: **@254BTN!OFF**

Reply: **@253ACKOFF**

Sensor failure handling (FAIL)

The BVT225 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**

LED Behavior (LED)

The BVT225'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.
DYNAMIC	The LED changes color to reflect the measured pressure.

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

Send: **@254LED!DYNAMIC**

Reply: **@253ACKDYNAMIC**

Pressure measurement (P)

The digital pressure measurement can be accessed using the Brooks Vacuum Gauge Communicator programmer or RS-232/485 serial digital interface.

Reading the full range combined pressure value:

Send: **@254P?**

Reply: **@ACK1.0131E+3**

Reading the Vacuum Piezo value:

Send: **@254P?PZV**

Reply: **@ACK2.345E+2**

Reading the MEMS Pirani pressure value:

Send: **@254P?MP**

Reply: **@ACK1.1230E-4**

Reading the Capacitance diaphragm pressure value:

Send: **@254P?CP**

Reply: **@ACK1.123E-1**

Reading the barometric Piezo value:

Send: **@254P?PZA**

Reply: **@ACK1.0134E+3**

Quick data acquisitions (Q)

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,SETP,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**

Parameters	Description
PZV	Piezo diaphragm vacuum pressure measurement
PZA	Ambient barometric pressure measurement
PZD	Relative to ambient pressure measurement (PZV-PZA)
PIR	Pirani pressure measurement
CP	Capacitance pressure measurement
CMB	Combined pressure measurement
TEMP	Temperature measurement
SP	Setpoint status

Parameters	Description
PZ	Piezo pressure measurement
PIR	Pirani pressure measurement
CP	Capacitance 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.

Pirani and capacitance ratio measurement (RAT)

The ratio readout provides the calculated ratio between the gas depended Pirani measurement and the none-gas depended capacitance diaphragm measurement. The ratio readout can be used to determine change of gas composition or detection of water vapor content.

Ration = ((Pir-Cap)/Cap) x 100

Reading the ratio

Send: **@254RAT?**

Reply: **@ACK5.67**

Temperature measurement (T)

The BVT225 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**

Gas type selection (GT)

The Pirani measurement is based on measurement of heat-loss to the gas and consequently its measurement depends on the gas type and concentration. The gas type selection provides a gas correction for the measurement when used in Helium, Air or Argon gas.

Read the gas type configuration:

Send: **@254GT?**

Reply: **@ACKNITROGEN**

Change gas type selection (Nitrogen, Air, Helium Argon):

Send: **@254GT!ARGON**

Reply: **@254ACKARGON**

Unit (U)

The BVT225 can be configured to three different pressure units and three different temperature units. If no explicit parameter (pressure, temperature) is defined, pressure is assumed.

Pressure unit		
mbar	Pascal	torr

Temperature unit		
Celsius	Fahrenheit	Kelvin

Setting pressure unit to Pascal:

Send: **@254U!PASCAL**

Reply: **@ACKPASCAL**

Setting pressure unit to mbar:

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

Reply: **@ACKMBAR**

Setting temperature unit to Fahrenheit:

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

Reply: **@ACKFAHRENHEIT**

Reading current temperature unit:

Send: **@254U?T**

Reply: **@ACKFAHRENHEIT**

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

Statistics (STAT)

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

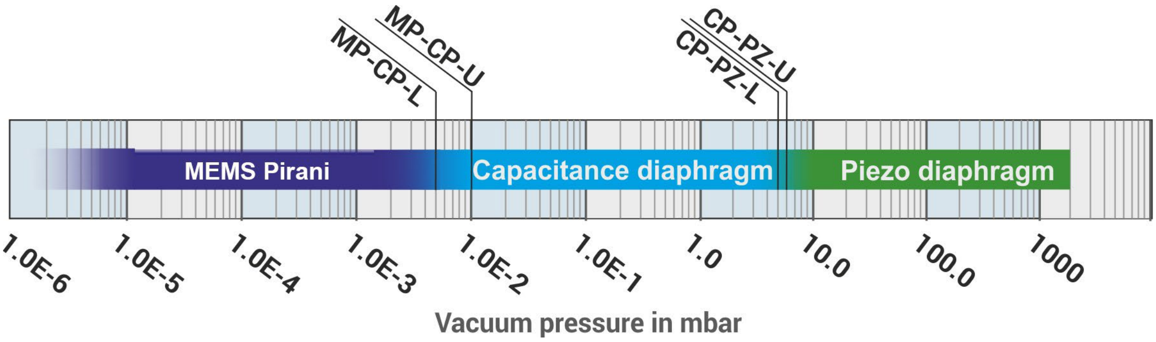
Clearing the statistics (parameter is left out, so pressure is assumed):

Send: **@254STAT!CLEAR**

Reply: **@254ACKCLEAR**

Sensor blending (BL)

The combined pressure output blends the three individual sensor output to provide a smooth pressure over a wide range. The blending pressures can be user adjusted to the actual application pressure profile.



In the transition between the lower and upper blending pressure a linear weighting of the pressure is calculated.

INFORMATION: If the capacitance diaphragm zero offset is deviating or other gases than Nitrogen is present causing the MEMS Pirani to deviate from actual pressure discontinuity during the transition phase can occur.

Blend configuration command

@254BL!<BLENDTYPE>,<LOWER BLEND VALUE> ,<UPPER BLEND VALUE>

Change MEMS Pirani and capacitance diaphragm blending pressure:

Send: **@254BL!MPCP,6.0000E-03,1.0000E-02**

Reply: **@254ACK MPCP - LOWER: 6.0000E-03, UPPER: 1.0000E-02**

The MEMS Pirani and capacitance diaphragm blending pressure can be set to values between 1E-3 to 1 mbar

Change capacitance diaphragm and piezo diaphragm blending pressure:

Send: **@254BL!CPPZ,2.000,6.000**

Reply: **@254ACK CPPZ - LOWER: 2.0000E00, UPPER: 6.0000E00**

The capacitance diaphragm and piezo diaphragm blending pressure can be set to values between 1E-1 to 7.5 mbar.

Switch function (Optional)

The solid-state setpoint relay function can be used for controlling and surveillance by external equipment.

The three independent solid-state switch relays can be used for external control of pumps, valves, safety interlock circuits and other external equipment. The basic control uses on/off regulation with a programmable setpoint and hysteresis value. Each solid-state relay offers both normally closed and normally open contacts. Solid-state relays are a hardware option that must be specified when ordering the gauge.

Compared to electro-mechanical relays, the solid-state relays offer superior reliability and faster switching time while providing arc free contacts and generating no EMI (electromagnetic interference) when switching contacts.

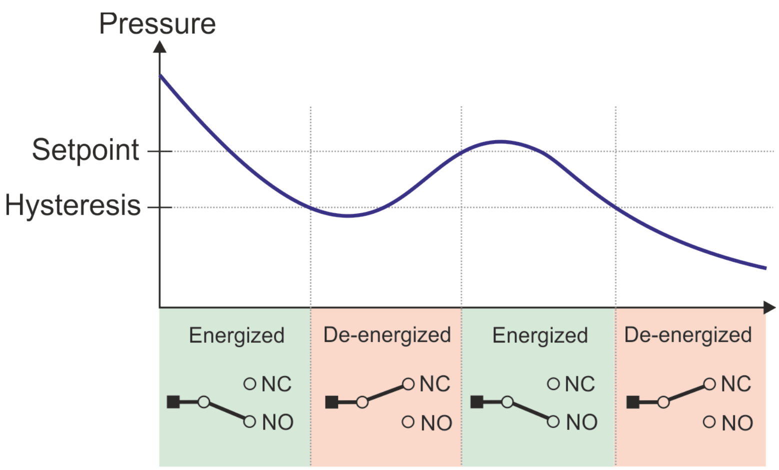
The relays are UL listed, CSA recognized, and EN/IEC 60950-1 certified for maximum confidence when used to control critical vacuum processes and high-cycle applications.

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

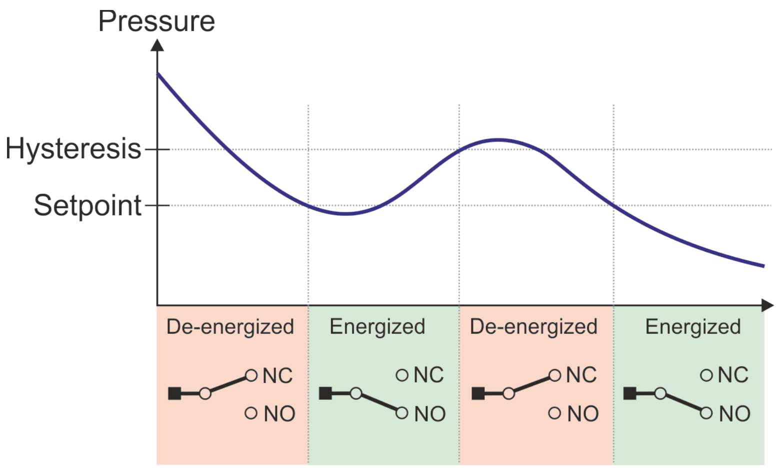
WARNING! Do not exceed maximum load rating of 250 mA, 50 VDC / VAC peak on relay contacts. Special precautions must be taken when driving an inductive load. Ensure that inrush peak current does not exceed relay contact ratings.

The switch can be configured to close the relay contact either above or below the setpoint value.

Above
When the switch direction is configured to above, the relay will remain energized (NO contact closed) until the hysteresis value is exceeded. Then it will change to de-energized (NC contact closed). The relay will energize (NO contact closed) again when the setpoint value is exceeded.



Below
When the switch direction is configured to below, the relay will remain de-energized (NC contact closed) until the hysteresis value is exceeded. Then it will change to energized (NO contact closed). The relay will de-energize (NC contact closed) again when the setpoint value is exceeded.



Configuration of setpoint

Setpoints can be configured either via the Brooks Vacuum Gauge Communicator software or the command protocol.

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

Command sequence example:

@254SP?\	(This step is not mandatory.) Print an overview of all setpoint settings. If no setpoints have previously been defined, a BVT225 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>
\
```

@254SPS!1,P\	Assign pressure measurement as the source for Setpoint 1.
@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 -1ºC /+1ºC instead of -10%/+10%.
@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%).
@254SPH!1,500\	Set the Hysteresis value for Setpoint 1 to 500.
@254SPE!1,ON\	Enable Setpoint 1.
@254SPE!2,PZD\	Enable Setpoint 2 to pressure measurement relative to ambient atmospheric pressure
@254SP?\	(This step is not mandatory.) Print an overview of all setpoint settings to verify the new settings. 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>
\
```

Command	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	-

Pre-configuration of setpoint values

The BVT225 gauge can be delivered with custom defined setpoint values. Contact Brooks Instrument sales team for more information.

Product information and identification

The BVT225 has a serial number, product part number, manufacturer identity and firmware version programmed in its internal non-volatile memory.

Serial number:

Send: **@254SN?**

Reply: **@ACK211230123456;**

Part number:

Send: **@254PN?**

Reply: **@ACKBVT225-123456;**

Manufacturer identity:

Send: **@254MF?**

Reply: **@ACKBROOKS INSTRUMENT;**

Firmware version:

Send: **@254FV?**

Reply: **@ACK1.00;**

Maintenance

Maintenance is not required in many applications during the lifecycle of this product. The calibration may shift during the life-time and re-calibration by adjusting the zero point and full-scale value can be performed by the user.

The BVT225 can be user configured, calibrated and tested using the Brooks Vacuum Gauge Communicator USB adapter or RS-232/485 interface.

Adjustment of the zero point

The BVT225 has an active and individual temperature compensation to account for zero-point drift. In many applications, a user adjustment of the zero point is not required during the lifetime of the product.

If drift of the zero-point is observed, it can be adjusted using the Brooks Vacuum Gauge Communicator USB programmer, RS-232 / RS-485 communication interface or by pressing the zero switch.

Zero-point adjustment procedure using digital interface

1. Evacuate the gauge to a vacuum pressure below 1.00E-6 mbar.
2. Send command: @254VAC!\
3. Reply: @254ACK<value>\

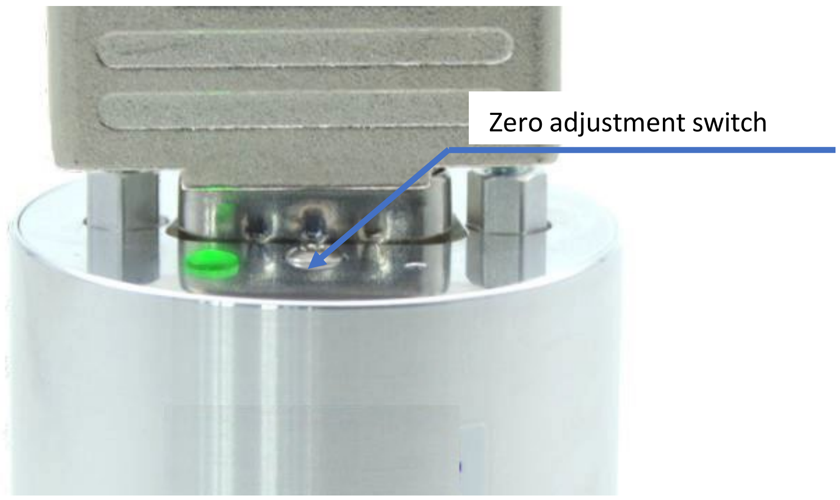
The reply <value> is the calculated offset pressure value as function of the factory default zero offset subtracted from the user offset adjustment.

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

1. Adjust the vacuum pressure to a known value
2. Send command: @254VAC!5.00E-5\
3. Reply: @254ACK<value>\

Zero-point adjustment procedure using the zero switch

The BVT225 can also be zero adjusted by pressing the zero-adjustment switch using a tool with a maximum diameter of 1.5 mm.



1. Evacuate the gauge to a vacuum pressure below 1.00E-6 mbar.
2. Press the zero switch for 2 seconds
3. The LED will strobe green after completion of zero adjustment or red if the gauge is not able to perform zero adjustment.

Piezo sensor zero adjustment
The Piezo sensor is automatically zero-adjusted, whenever the pressure measured by the Pirani is lower than 1.00E-2 mbar (7.50E-3 Torr).

Capacitance diaphragm sensor zero adjustment
The capacitance diaphragm sensor is automatically zero-adjusted, whenever the pressure measured by the Pirani is lower than 1.00E-3 mbar (7.50E-4 Torr).

The capacitance diaphragm auto zero-point adjustment pressure point is programmable and can be trimmed to the actual application pressure profile and achievable base pressure.

The capacitance diaphragm auto zero adjustment feature have several safeguards to prevent wrong zero adjustment of the capacitance diaphragm gauge. The zero adjustment will only be executed when the pressure measured by the Pirani is lower than auto zero point and the pressure measured by the Pirani and Capacitance manometer is decreasing or stable within a certain level.

The capacitance diaphragm auto zero point can be adjusted (e.g. 5.67E-4 mbar) using following command:

1. Send the command: @254**VAC!AUTO,5.67E-4**
2. Reply: @254ACK5.67E-4\

Adjustment of full-scale

Piezo sensor full-scale adjustment
The piezo sensor can be full-scale adjusted using the digital interface by the following procedure:

1. Expose the gauge flange to atmospheric ambient pressure
2. Obtain the actual atmospheric pressure (e.g. 1,013.1 mbar) from a reference gauge
3. Send the command: @254**FS!PZ,1013.1**
4. Reply: @254ACK<value>\

The acknowledged 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
The pirani sensor can be full-scale adjusted using the digital interface by the following procedure:

1. Expose the gauge flange to a Nitrogen pressure between 1 and 20 mbar
2. Obtain the actual pressure (e.g. 11.2 mbar) from a reference gauge
3. Send the command: @254FS!MP,11.2\
4. Reply: @254ACK<value>\

The Pirani sensor can also be full-scale adjusted by use of the internal piezo sensor as reference:

1. Expose the gauge flange to a Nitrogen pressure between 1 and 20 mbar
2. Send the command: @254FS!MP\
3. Reply: @254ACK<value>\

Adjustment of the ambient pressure zero point

The pressure measurement relative to ambient pressure is calculated by subtracting the ambient atmospheric pressure from the vacuum absolute pressure. If these two measurements deviate when the gauge flange is exposed to ambient atmospheric pressure it will result in on offset at the relative measurement.

Such offset can be adjusted by performing an ambient zero adjustment of the relative measurement.

Differential Piezo zero adjustment is only allowed whenever the pressure measured by the Vacuum Piezo is in the range 450 mbar through 1333 mbar.

Atmospheric zero-point adjustment procedure using digital interface

The Atmospheric piezo zero adjustment will adjust the deviation between the vacuum exposed Piezo sensor and the atmospheric barometric piezo sensor.

1. Expose the gauge vacuum flange to barometric ambient pressure
2. Send the command: @254ATZ!\
3. Reply: @254ACK\

Example: The Vacuum Piezo measures 1000 mbar, while the Atmospheric Piezo measures 1000.3 mbar – resulting in a differential pressure of -0.3 mbar. A zero-adjustment of the Differential Pressure reading is performed:

Send: **@254ATZ!1**

Reply: **@253ACK3.00E-1**

In the above example, the “3.00E-1” value in the BVT225’s reply indicates the offset applied to the Differential Pressure reading for the reading to become (very close to) 0.

Atmospheric zero-point adjustment procedure using the zero switch

The BVT225 can also be atmospheric zero-adjusted by pressing the zero-adjustment switch using a tool with a maximum diameter of 1.5 mm. Expose the vacuum flange to barometric ambient pressure and press the zero switch.

To perform an atmospheric zero adjustment the measured pressure by the piezo diaphragm sensor must be higher than 450 mbar.

1. Expose the vacuum flange to barometric ambient pressure and press the
2. Press the zero switch for 2 seconds
3. The LED will strobe green after completion of atmospheric zero adjustment or red if the gauge is not able to perform zero adjustment.

Resetting to factory default

The Factory Default command will reset all user settings to factory default, including setpoint settings, pressure unit and user-adjustment of zero point and full-scale.

Brooks Instrument offers pre-configuration of user parameters, and if the product is delivered with a special user configuration, the factory default command will reset to the original user configuration as delivered.

Reset to factory default:

Send: **@254FD!**

Reply: **@ACKFD**

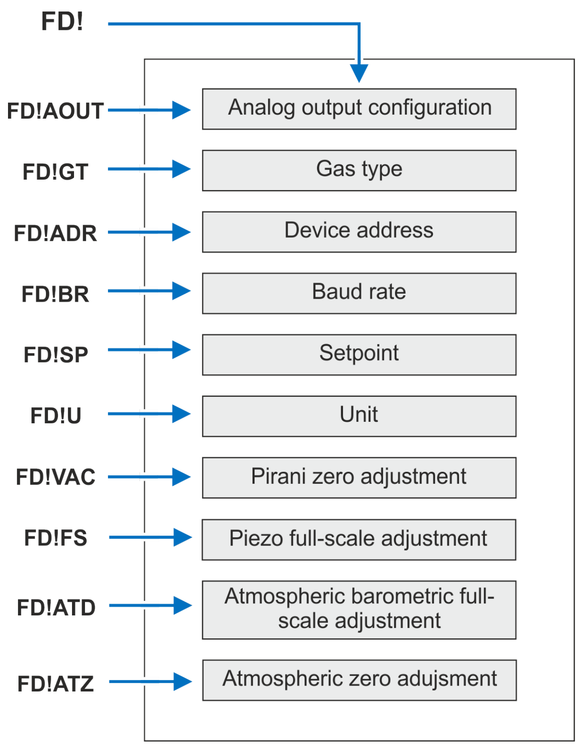
Parameter	Value
Vacuum zero adjustment	0
Full scale adjustment	1
Capacitance auto-zero	1.00E-3 mbar
Unit	As delivered
Baud rate	9600
Address	253
Analog output configuration	As delivered
Setpoint direction	Above or as delivered
Setpoint enable	OFF or as delivered
Setpoint hysteresis	As delivered
Setpoint value	As delivered
Setpoint source	Pressure
Capacitance / Piezo lower blend	5.00 mbar
Capacitance / Piezo upper blend	6.00 mbar
Pirani / Capacitance lower blend	5.00E-3 mbar
Pirani / Capacitance upper blend	1.00E-2 mbar

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. If the argument is left blank, all parameters will be reset to their default values.

Send: **@254FD!<ARGUMENT>**

Reply: **@ACKFD**



900 Series vacuum gauge compatibility

The BVT225 offers pin, analog output and digital communication protocol compatibility with the 901P, 925 and 910 vacuum gauges 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>;FF

Start character: **@**

Device address: **001-253**

Command: **See command list**

Query or set:

Parameter:

End characters: **;FF**

Example of how to send a command to the gauge 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!1.24E-4;FF**
Reply: **@ACK1.23E-4;FF**

The BVT225 supports following 900 Series commands:

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

Specifications

Specifications	
Measuring range in mbar	1×10^{-6} to 1333 mbar (7.5×10^{-7} to 1000 Torr)
Measuring principle 1×10^{-6} to 4.99×10^{-3} mbar	MEMS Pirani thermal conductivity
Measuring principle 5×10^{-3} to 1.00×10^{-2} mbar	Blended MEMS Pirani / CDG reading
Measuring principle 1.0×10^{-2} to 4.99 mbar	Capacitance diaphragm gauge (CDG)
Measuring principle 5 to 6 mbar	Blended MEMS Piezo / CDG
Measuring principle 6 to 1333 mbar	MEMS piezo resistive diaphragm
Accuracy(9) 1×10^{-5} to 9.99×10^{-5} mbar	25% of reading
Accuracy(9) 1×10^{-4} to 9.99×10^{-3} mbar	5% of reading
Accuracy(9) 1×10^{-2} to 800 mbar	0.5% of reading
Accuracy(9) 800 to 1099 mbar	0.25% of reading
Accuracy(9) 1100 to 1333 mbar	0.5% of reading
Barometric measurement range	300 to1200 mbar
Barometric accuracy	+/- 0.5 mbar
Atmospheric referenced pressure output range	-1333 to + 1333 mbar
Vacuum temperature sensor range	-20 to + 85°C
Analog output resolution	16 bit (150 µV)
Analog output update rate	124 Hz
Response time (ISO 19685:2017)	<20 ms
Temperature compensation	+10 to +50 °C
Temperature measurement range	-40 to +80 °C
Temperature measurement absolute accuracy	±1.5 °C (0 to +80 °C)
Solid state relay set point range	5×10^{-6} to 1333 mbar (3.75×10^{-6} to 1000Torr)
Solid state relay contact rating	50 V, 100 mA_{rms} / mA_{DC}
Solid state relay contact on resistance	<35 Ω
Solid state relay contact endurance	Unlimited (no mechanical wear)
Solid state relay approvals	UL Recognized: File E76270 CSA Certified: Certificate 1175739 EN/IEC 60950-1 Certified
Environment conditions	
Operating ambient temperature	-20 to +50 °C
Media temperature	-20 to +50 °C
Storage ambient temperature	-40 to +80 °C
Bake-out temperature (non-operating)	+80 °C
Maximum media pressure	4 bar absolute(10)
Mounting position	Arbitrary
Protection rating, EN 60529/A2:2013	IP40
Humidity, IEC 68-2-38	98%, non-condensing
Power supply	
Supply voltage	12-30 VDC
Power consumption	350 mW (max)
Reverse polarity protection	Yes
Overvoltage protection	Yes
Internal fuse	100 mA (thermal recoverable)

(9) Accuracy and repeatability specifications are typical values measured at ambient temperature in Nitrogen atmosphere after zero adjustment.

(10) Refer also to maximum pressure rating for the used fittings. Exceeding maximum pressure will cause permanent damage to the capacitance diaphragm sensor.

Materials	
Enclosure	SS 1.4307 / AISI 304L / Aluminium 6061
Vacuum flange (media wetted)	SS 1.4307 / AISI 304L
Vacuum exposed materials (media wetted)	304 Stainless steel, Kovar, glass, silicon, nickel, aluminium, SiO_2, Si_3N_4, Al_2O_3, gold, Viton®, low out-gassing epoxy resin, solder, RO4305, vitreous silica
Process leak tightness	$<1\cdot10^{-9}$ mbar·l/s
Enclosure	AISI 304L / Aluminium 6061
Approvals	
CE compliance	Directive 2014/30/EU
RoHS compliance	Directive EN 63000:2018
REACH compliance	Directive 1907/2006/CE

Cables

Part number	Description
BVT-F15DSM15DS-003	15 p HD D-sub female to 15 p D-sub male with 3 m cable
BVT-F15DSM15DS-005	15 p HD D-sub female to 15 p D-sub male with 5 m cable
BVT-F15DSM15DS-010	15 p HD D-sub female to 15 p D-sub male with 10 m cable
BVT-F15DSM15DS-003	9 p D-sub female to 15 p D-sub male with 3 m cable
BVT-F15DSM15DS-005	9 p D-sub female to 15 p D-sub male with 5 m cable
BVT-F15DSM15DS-010	9 p D-sub female to 15 p D-sub male with 10 m cable

Declaration of Conformity

This declaration of conformity has been made in accordance with EN ISO/IEC 17050-1:2010

Manufacturer:	Brooks Instrument

We hereby declare under our sole responsibility that the following products:

Product description:	Vacuum Pressure Gauge
Product part number:	BVT225-xxxxxxxx

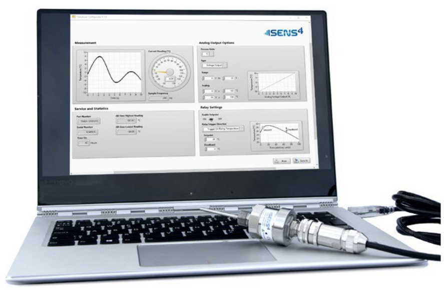
Complies with the requirements of following relevant European Union harmonization directive:

Electromagnetic Compatibility (EMC) Directive 2014/30/EU
RoHS Directive EU 2015/863

Conformity is assessed in accordance to the following standards:

Reference: Date	Title
EN 61326-1:2021	Product family standard, Measurement, control and laboratory equipment
EN 61326-2-3:2021	Test configuration, operational conditions and performance criteria for gauges with integrated or remote signal conditioning
EN 61000-3-2:2006 + A1:2009 and A2:2009	Limits for harmonic current emissions
EN 61000-3-3:2008	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems
EN 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Brooks Vacuum Gauge Communicator programmer



LIMITED WARRANTY

Visit www.BrooksInstrument.com for the terms and conditions of our limited warranty.

SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.
For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons.

Please contact your nearest sales representative for more details.

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

ISO 9001 QUALITY SYSTEM

X-VAC-BVT-225-eng/2023-02

Global Headquarters
Brooks Instrument
407 West Vine Street
Hatfield, PA
19440-0903 USA

Toll-Free (USA): 888-554-FLOW
T: 215-362-3500
BrooksAM@BrooksInstrument.com

A list of all Brooks Instrument locations and contact details can be found at www.BrooksInstrument.com

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