# Installation & Operation Manual

# VersaTorr BVT125
# Ultra-wide Range Vacuum Gauge

BROOKS® INSTRUMENT

*Beyond Measure*

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**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 BVT125 vacuum gauge is intended for non-corrosive vacuum gas pressure measurement and control within the limits listed in the specifications on page 34. 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 of 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.

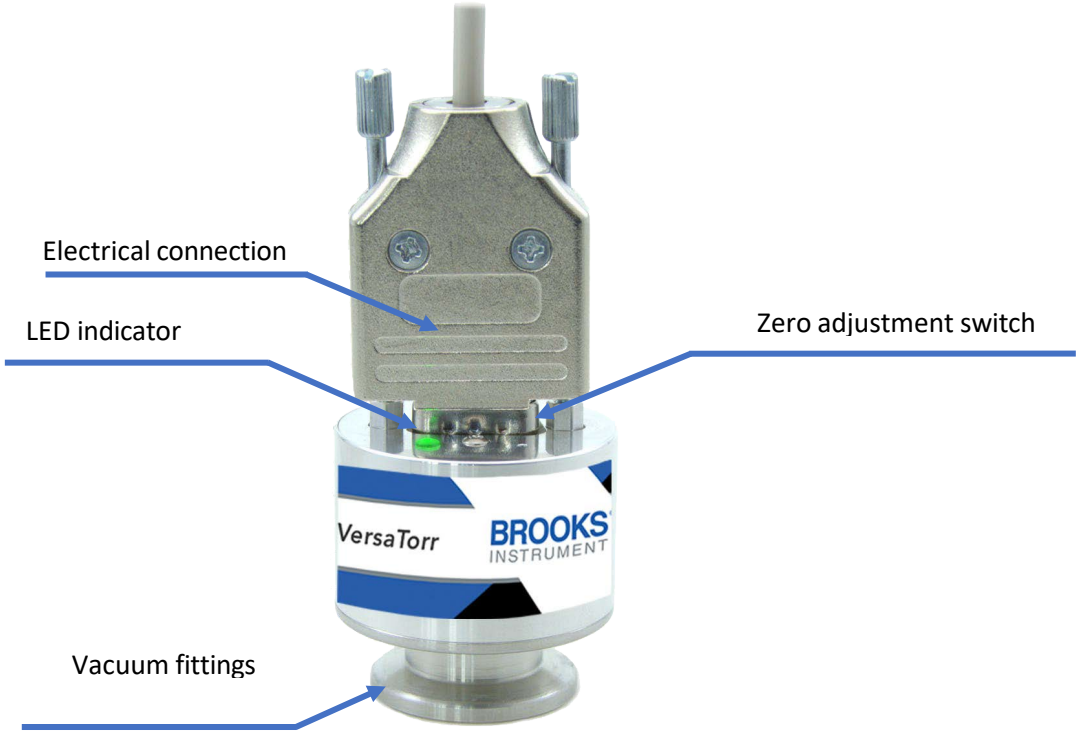
For proper treatment, recovery and recycling, please take this product to designated collection points. Please contact your local authority for further details of your nearest designated collection point.

**Liability**
The customer is solely responsible for determining the suitability and compatibility of the product for the customer's 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.

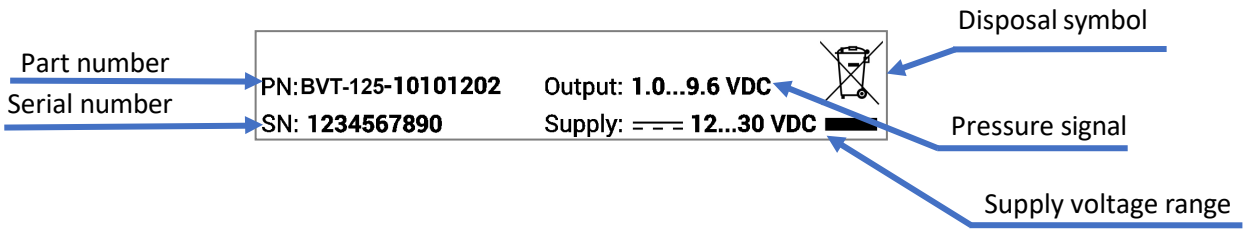
## BVT125 vacuum gauge

The BVT125 is available with different electrical connections and vacuum fittings. The illustration below is an example of the BVT125 with D-sub connector and DN16KF vacuum fitting.



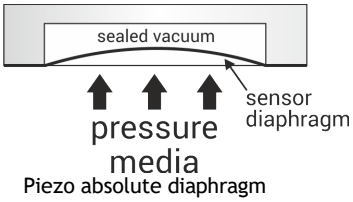

## Labeling

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 Transducer Communicator™ USB programmer and communicator. See page 26.

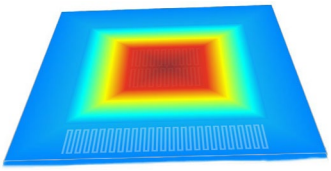


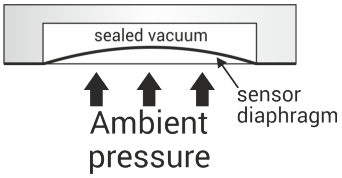
## About the BVT125 vacuum gauge

The BVT125 MEMS Piran ATM gauge is based on patent pending technology that 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 MEMS Pirani ATM combines a MEMS (Microelectromechanical Systems) heat-loss Pirani sensor and a Piezo diaphragm sensor with a barometric pressure diaphragm sensor.



Piezo absolute diaphragm


Heat-loss diaphragm pressure



Barometric 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.

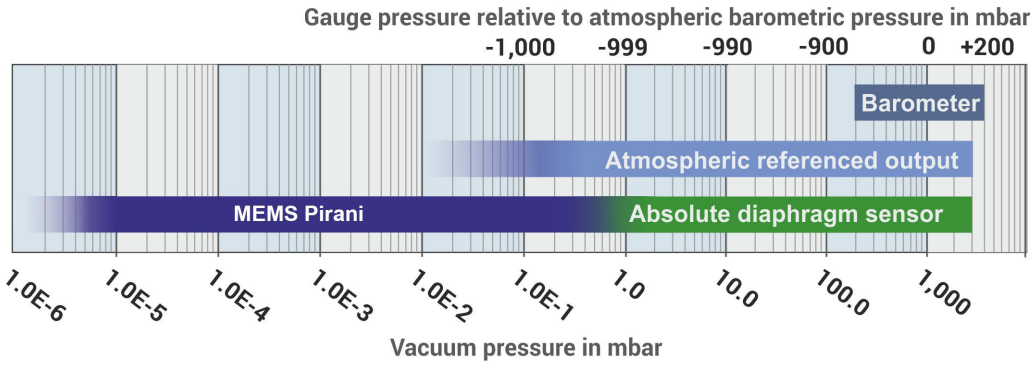
The barometric piezo MEMS sensor is based on the same measuring principle as the vacuum exposed piezo diaphragm sensor. The barometric diaphragm sensor is exposed to the ambient pressure,

**Measurement performance**

The BVT125 MEMS Pirani ATM has established new performance standards and extended range for heat-loss Pirani gauges. It combines a MEMS diaphragm piezo sensor and heat-loss MEMS Pirani sensor with a barometric piezo diaphragm sensor.

The diaphragm sensor 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 atmospheric referenced output is generated by subtracting the absolute diaphragm measurement in vacuum with the barometric diaphragm sensor measurement in ambient pressure. This method provides a measurement value relative to ambient pressure that allows accurate control of ventilation of vacuum chamber to ambient pressure.



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

## BVT125 MEMS Pirani ATM vacuum gauge applications

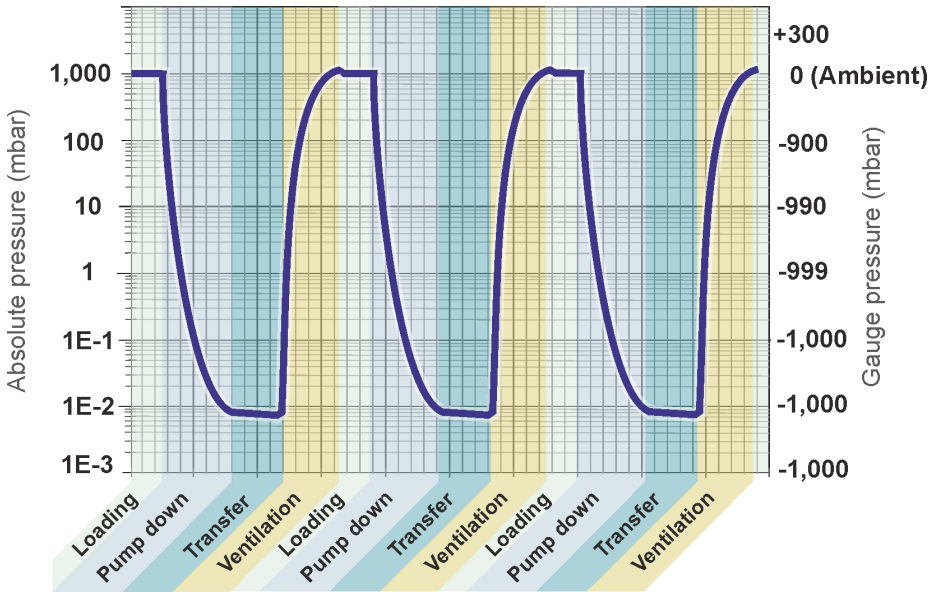
The BVT125 MEMS Pirani ATM gauge combines full-range vacuum measurement from high vacuum to atmospheric pressure with accurate measurement of pressure relative to atmospheric barometric pressure.

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 BVT125 MEMS Pirani ATM 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.

**Load-lock applications**

Fast cycle time of the load-lock is important to optimize the wafer processing cost. Use of accurate and modern load-lock control can shorten cycle times. Load-lock vacuum systems are not only used in the semiconductor industry, but also in analytical equipment, like scanning electron microscopes, where samples are transferred from ambient pressure to the analysis vacuum chamber.

In a PVD (Physical Vapor Deposition) system, it can also be an advantage to maintain the processing deposition chamber under permanent vacuum pressure and only having to vent an axillary load-lock vacuum chamber.

Single-chamber PVD systems have a large door system to the ambient pressure to load the carousels with the coating objects. The large door surface requires accurate control of the venting process to both prevent over pressurization of the vacuum chamber and to equalize the pressure in order to open the door.

Many vacuum processes and types of vacuum systems, where samples, wafers, test objects, substrates or other devices need to be transferred from ambient air to the vacuum system, can benefit from having an auxiliary load-lock system to ensure fast cycle-times, system uptime, reduced particulate contamination and water vapor contamination. Such applications include mass spectrometers, scanning electronics microscopes and freeze-drying equipment.

## Part numbers

The BVT125 is available with different electrical connections and process fittings. The illustration below is an example of the BVT125 with DN16KF, RS-232/Brooks Vacuum Transducer Communicator™, 0.5-9.6 VDC analog output, mbar unit, 3 relays and 15-pin HD D-sub connector.

| Code Description | Code Option | Option Descripton |
|---|---|---|
| I. Base Model | BVT125 | VersaTorr MEMS Load-Lock Vacuum Gauge |
| II. Units | 1 | Torr |
| | 2 | mbar |
| | 3 | Pascal |
| III. Programable Relays | 0 | None |
| | 1 | 1x Solid State Relay |
| | 2 | 2x Solid State Relay |
| | 3 | 3x Solid State Relay |
| IV. Vacuum Flange | 1 | DN16KF |
| | 2 | DN25KF |
| | 3 | NPT 1/8" |
| | 4 | VCR4F |
| | 5 | DN16KF Extended |
| | 6 | DN16KF with light baffle |
| | 7 | DN16KF with heavy duty baffle |
| | 8 | DN25KF with light baffle |
| | 9 | DN25KF with heavy duty baffle |
| | A | VCR8F |
| V. Electrical Connector | 1 | 9 Pin D-sub male |
| | 2 | 15 pin HD D-sub male (up to 3 relays) |
| | 3 | 15 pin HD D-Sub male / dual analog out (up to 3 relays) |
| VI Digital Interface | 1 | RS-232 / Brooks Vacuum Gauge Communicator |
| | 2 | RS-485 / Brooks Vacuum Gauge Communicator |
| VII. Analog Output | A | 0.5 - 9.5 (1 V/dec) |
| | B | 1.0-9 VDC 1 VDC/Dec (MKS 901P/925/910 emulation) |
| | C | 0.375 to 5.659 VDC (MKS GP275 emulation) |
| | D | 1.0-9 VDC (MKS 523 emulation) |
| | E | 1.9-10 VDC (Inficon PSG55x, Leybold TTR91 emulation) |
| | F | 1.5-8.5 VDC (Pfeiffer TPR260/27x/28x emulation) |
| | G | 1.9-9.1 VDC (Edwards APG100XLC emulation) |
| | H | 1.9-9.1 VDC (Edwards APG100XM emulation) |
| | J | 0-10 VDC 0.1Torr FS (Capacitance manometer emulation) |
| | K | 0-10 VDC 1 Torr FS (Capacitance manometer emulation) |
| | L | 0-10 VDC 10 Torr FS (Capacitance manometer emulation) |
| | M | 0-10 VDC 100 Torr (Capacitance manometer emulation) |
| | N | 0-10 VDC 1000 Torr (Capacitance manometer emulation) |
| VIII. Customer Special Request | XXXX | |

## Configuration accessories

When configuring the various digital and analog parameters of the BVT125, 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.

## 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 BVT125 transducers and MKS 901P, 902B, 910 and 925 transducers.

| 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 |

## 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 BVT125 transducers 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 |

## Brooks Vacuum Transducer Communicator

The Brooks Vacuum Transducer 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 Transducer Communicator is available in four configurations:

| Part number | Description |
|---|---|
| BVT-S4-DS15 | Brooks Vacuum Transducer Communicator™ USB programmer, 1.5 m cable, D-sub, 15-pin |
| BVT-S4-DS9 | Brooks Vacuum Transducer Communicator USB programmer, 1.5 m cable, D-sub, 9-pin |
| BVT-S4-RJ45 | Brooks Vacuum Transducer Communicator™ USB programmer, 1.5 m cable, RJ45, 8-pin |
| BVT-S4-HIR6 | Brooks Vacuum Transducer Communicator™ USB programmer, 1.5 m cable, Hirschmann GO-6, 6-pin |

## Software for configuration and on-screen measurement

The Brooks Vacuum Transducer Communicator™ and RS-232/485 software is freeware and can be downloaded from the Brooks Instrument website: https://BrooksInstrument.com/support/

## Calibration

The BVT125 is delivered factory-calibrated with a calibration test report. An optional accredited calibration traceable to national standards can also be supplied with the BVT125 gauge.

## Mechanical installation

The BVT125 gauge is available with KF clamp fittings or screw-in 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 BVT125 gauge can be mounted horizontally or vertically without impact on accuracy or performance.

## Application and process compliance

The BVT125 gauge is intended for use in vacuum applications where non-corrosive gases are present.

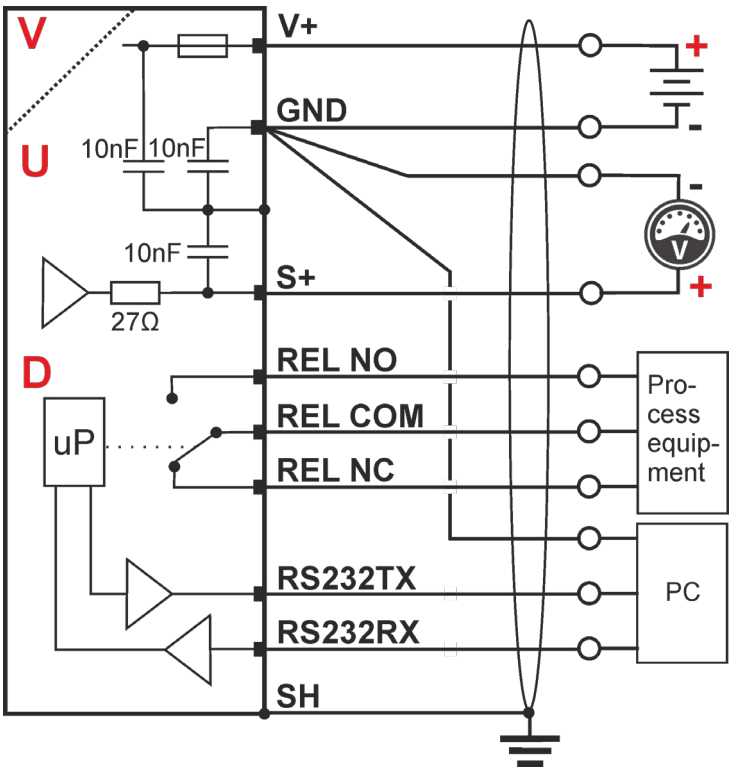
## Electrical installation

The BVT125 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.

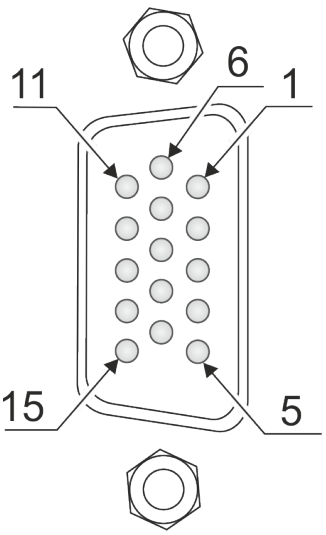
**INFORMATION:** It is recommended to use a differential input to measure the output signal that uses a separate signal return wire connected to the gauge connector. If power supply return and signal return share the same wire connection the voltage drop as function of supply current will cause a measurement 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) (1) |
| 14 | REL COM | Relay 3 Common (1) |
| 15 | REL NO | Relay 3 NO (normally open contact) (1) |

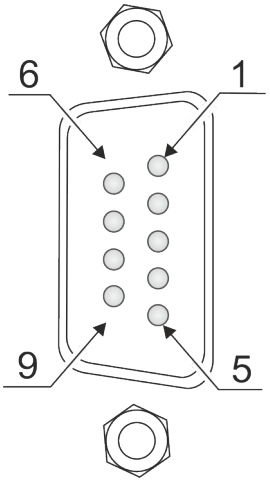
(1) Optional relay



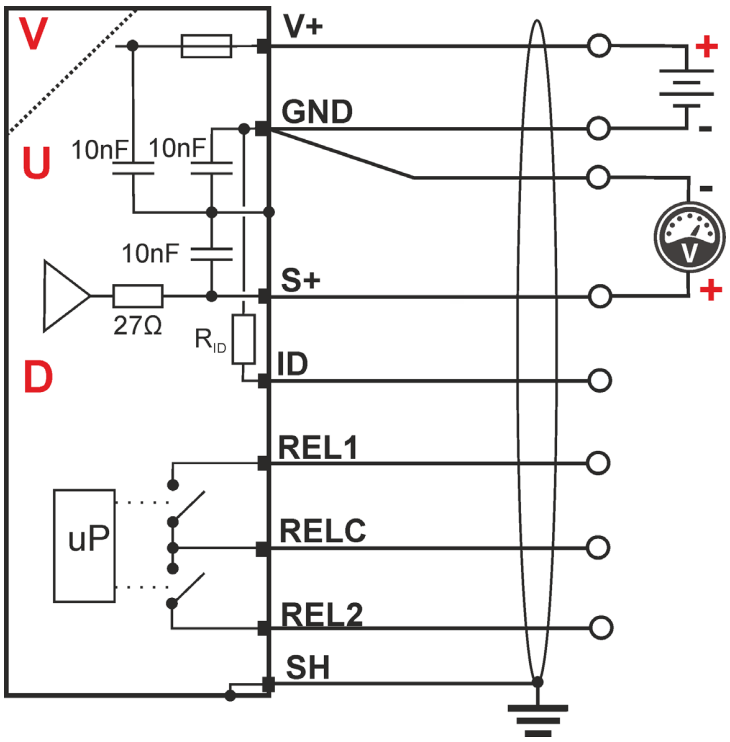
## 9-pin D-sub connector

| Pin | Symbol | Description |
|---|---|---|
| 1 | REL NO | Relay 1 NO (normally open contact)(1) |
| 2 | REL NC | Relay 1 NC (normally closed contact) (1) |
| 3 | V+ | Supply voltage 12-30 VDC |
| 4 | GND | Supply voltage - (return) |
| 5 | S+ | Analog voltage signal + |
| 6 | REL COM | Relay 1 Common(1) |
| 7 | RS-232TX | RS-232 Transmit / RS-485 (-) |
| 8 | GND | Analog voltage signal - (return) |
| 9 | RS-232RX | RS-232 Receive / RS-485 (+) |

(1) Optional relay

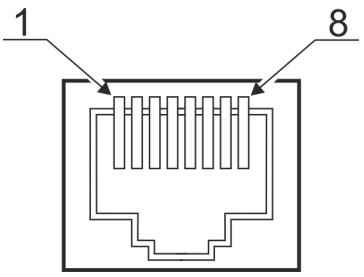



## Electrical connection (RJ45/8P8C connector)



## RJ45/8P8C connector

| Pin | Symbol | Description |
|---|---|---|
| 1 | V+ | Supply voltage 12-30 VDC |
| 2 | GND | Supply voltage - (return) |
| 3 | S+ | Analog pressure voltage signal + |
| 4 | ID | Identification resistor(7) |
| 5 | GND | Analog voltage signal - (return) |
| 6 | REL2 | Relay 2 Setpoint (closing contact) |
| 7 | REL1 | Relay 1 Setpoint (closing contact) |
| 8 | RELC | Relay 1 and 2 common |




(7) Identification resistor for RJ45/8P8C connector

The identification resistor is used by external equipment to identify the type of gauge. External equipment can be a display or a controller from another vendor. The BVT125 is available with different ID resistors. The ID resistor is identified by the last digit in the part number:

| P/N | ID resistor value |
|---|---|
| 5 | 27 KΩ |
| 6 | 36 KΩ |
| 7 | 43 KΩ |

**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.

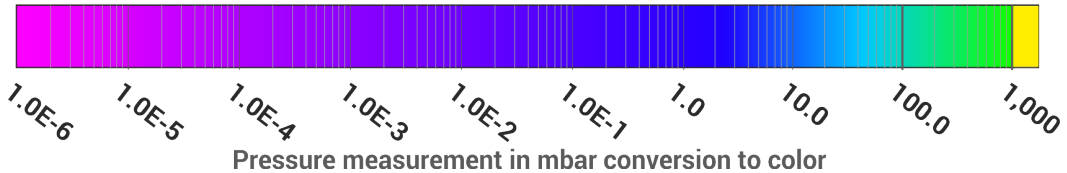
### Status LED

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 Transducer Communicator mode**
Pulsing green
**Sensor fail stage**
Flashing red (5 Hz)

### RGB LED for pressure indication

The MEMS Pirani™ ATM introduces 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)

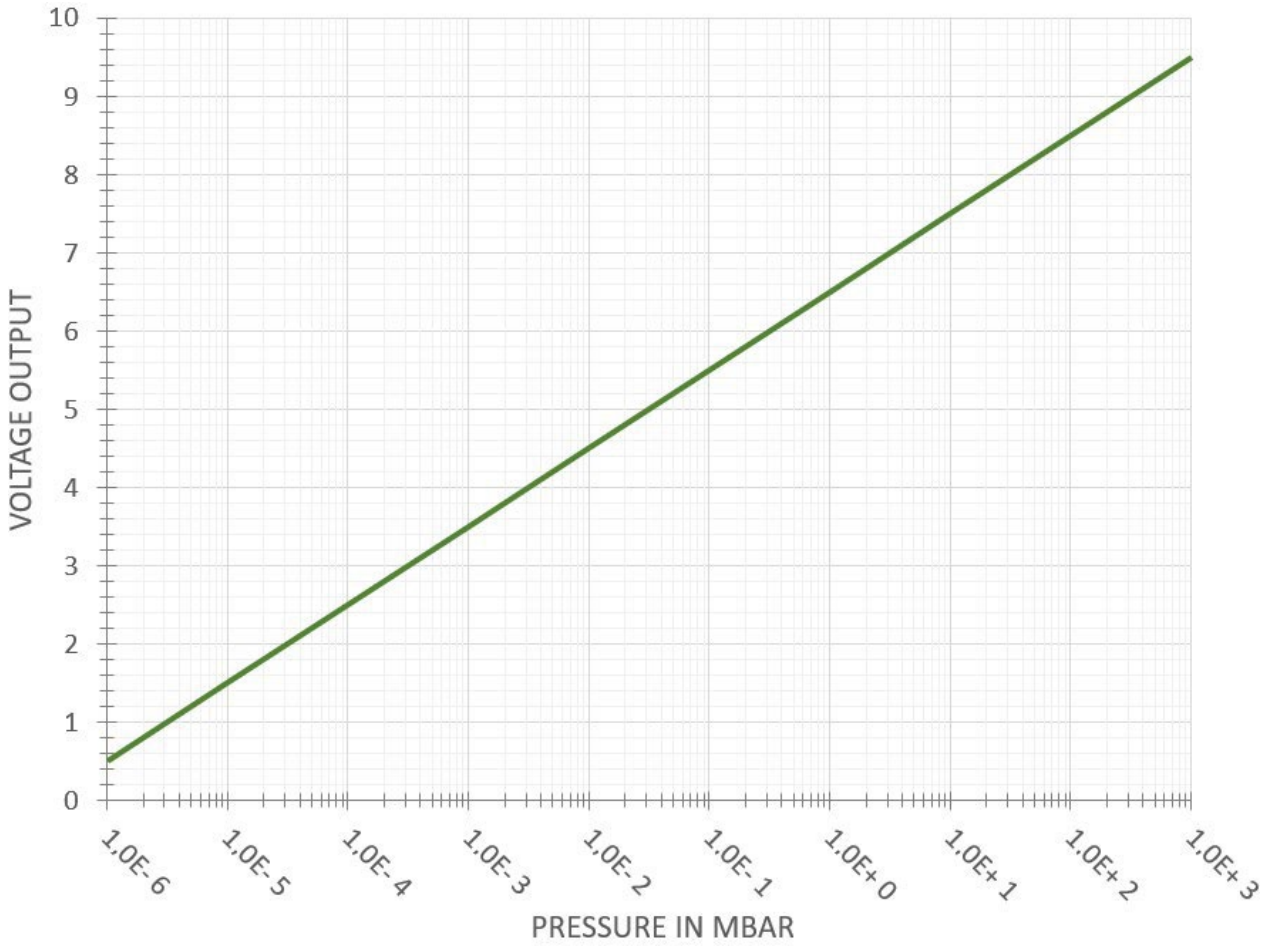
The gauge can provide a voltage output from 0-10 VDC and is available with different types of pre-configured output scaling.

In the BVT125'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 BVT125 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 17-18.

## 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 17.

## Brooks Vacuum Transducer Communicator™ communication

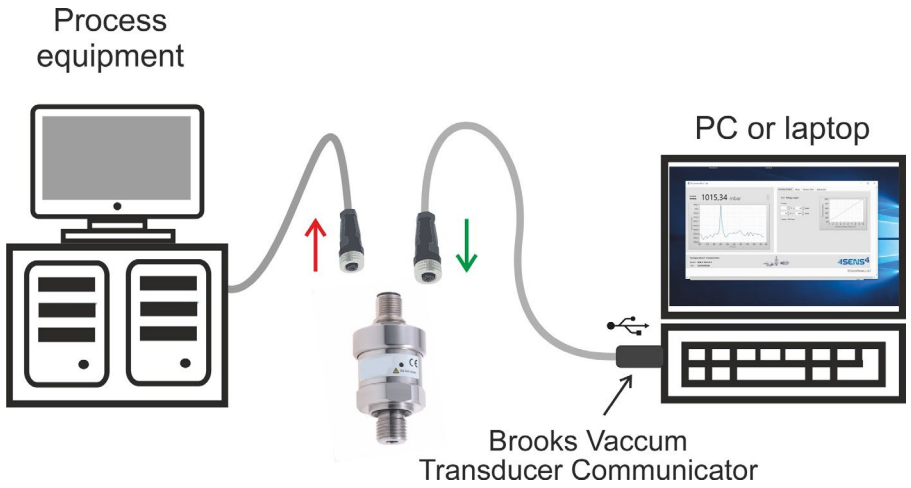
The Brooks Vacuum Transducer Communicator™ USB programmer and communicator provides access from PC software via a USB interface to the digital core of the gauge. It is compatible with both 4-20 mA current output and 0-10 VDC voltage output transducers from Brooks Instrument.


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 Transducer 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 Transducer Communicator™ programmer connected and if so, the gauge will enter the Brooks Vacuum Transducer Communicator™ service mode.

**WARNING!** The Brooks Vacuum Transducer Communicator™ interface is not intended for digital communication between process equipment and the BVT125 gauge unit. Disconnect the gauge from any external installation before enabling the Brooks Vacuum Transducer Communicator™ service mode. During the Brooks Vacuum Transducer 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 Transducer 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 Transducer Communicator™ software from www.BrooksInstrument.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 Transducer Communicator™ software. The Brooks Vacuum Transducer 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 Transducer Communicator™ cable. The Brooks Vacuum Transducer 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 Transducer Communicator™ programmer's LED turns solid blue or green, it's ready for communication.

### Brooks Vacuum Transducer Communicator USB programmer LED signals

The Brooks Vacuum Transducer 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 Transducer 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 BVT125 is available with Brooks Vacuum Transducer 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: | **@253ACK1.23E-4** |

The following table lists all commands supported by BVT125. 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> |
| ATD | Atmospheric Piezo adjustment | ● | ● | <(AMBIENT PRES.) / CLEAR> |
| ATZ | Differential Piezo zero adjustment | ● | ● | <(NONE) / CLEAR> |
| BAUD | Set baud rate | ● | ● | <4800 / 9600 / 19200 / 38400 / 57600 / 115200> (default 9600) |
| BTN | Button enabled | ● | ● | <ON / OFF> |
| FAIL | Sensor failure handling | ● | ● | <WORKING / ZERO > |
| FD | Factory default | ● | ● | <ADR / ATD / ATZ / AO / BAUD / FS / GT / SP / U / VAC / (NONE)> |
| FS | Piezo full-scale adjustment | ● | ● | <*PRESSURE VALUE* / CLEAR> |
| FV | Firmware version | ● | | - |
| GT | Gas type | ● | ● | <NITROGEN / HELIUM / ARGON / AIR> |
| LED | LED Behavior | ● | ● | <SOLID / DYNAMIC> |
| MF | Manufacturer | ● | | - |
| MD | Model name | ● | | - |
| P | Pressure measurement | ● | | <CMB / MP / PZ / (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 / PZD> |
| 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 / CMB / VAC / ATM / DIFF / PIR> |
| 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 BVT125 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 BVT125 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 BVT125s at once. The BVT125 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)

BVT125'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 | Transducer model | Output |
|---|---|---|---|
| 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<br>Leybold | PSG500<br>TTR91 | 1.547 – 10.00 VDC |
| 5 | Inficon<br>Pfeiffer | MPG400<br>PKR251 | 2.07 – 8.603 VDC |
| 6 | Inficon<br>MKS | BPG400<br>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® 1,000 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 |

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

Send: **@254AOUT!10**

Reply: **@253ACK10**

## Set Baud Rate (BAUD)

The BVT125 supports the following baud rates: 4800, 9600, 19.000, 38.400, 57.600, 115.200. Note that whenever the baud rate is changed, the BVT125 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 BVT125's push-button.

Example: Disable the push-button.

Send: **@254BTN!OFF**

Reply: **@253ACKOFF**

## Sensor failure handling (FAIL)

The BVT125 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 BVT125'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 Transducer Communicator™ programmer or RS-232/485 serial digital interface.

Reading the full range combined pressure value:

Send: **@254P?**

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

Reading the differential pressure value:

Send: **@254P?DIFF**

Reply: **@ACK-1.1000E2**

Reading the Vacuum Piezo value:

Send: **@254P?PZV**

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

Reading the ambient Atmospheric Piezo value:

Send: **@254P?PZA**

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

Reading the MEMS Pirani pressure value:

Send: **@254P?MP**

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

## 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: **@ACKPZD,PIR,CMB,SP,TEMP**

| Parameters | Description |
|---|---|
| PZV | Piezo diaphragm vacuum pressure measurement |
| PZA | Ambient pressure measurement |
| PZD | Relative to ambient pressure measurement (PZV-PZA) |

## 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: **@ACKPZD,PIR,CMB,SP,TEMP**

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

**Setpoint status**

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

## Temperature measurement (T)

The BVT125 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**

## Unit (U)

The BVT125 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**

## 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.

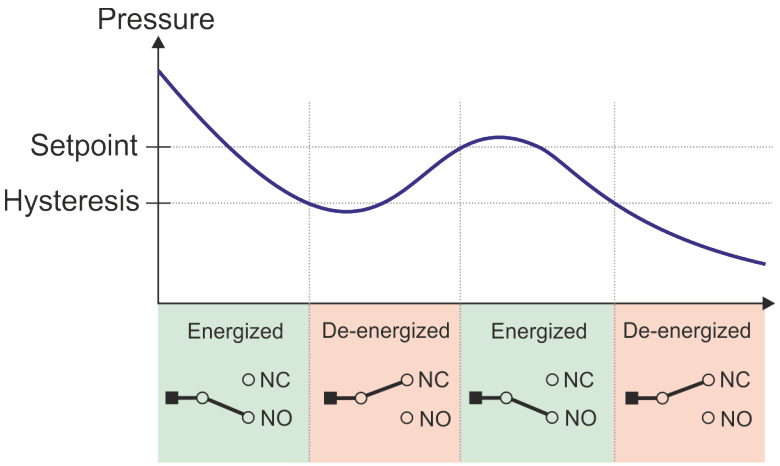
The relay switches are per default controlled by the pressure measurement but can also be configured to be controlled by the internal temperature sensor.

**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.

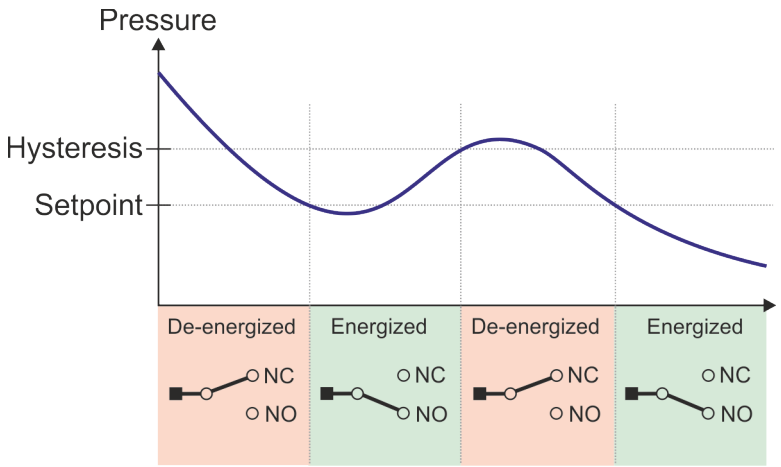
**Above**

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 Transducer 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 BVT125 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 to full-scale combined vacuum measurement. |
| @254SPE!2,PZD\ | Enable Setpoint 2 to pressure measurement relative to ambient atmospheric pressure |
| @254SPR?1\ | Get the current status of the Setpoint 1 relay. |
| @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/CMB/VAC/ATM/DIFF/PIR> |
| SP | Read all setpoint settings | - |

### Pre-configuration of setpoint values

The BVT125 gauge can be delivered with custom defined setpoint values. Contact Brooks Instrument sales team for more information.

## Product information and identification

The BVT125 has a serial number, product part number, manufacturer identity and firmware version programmed in its internal non-volatile memory.

**Serial number**:

Send: **@254SN?**

Reply: **@ACK201230123456;**

**Part number:**

Send: **@254PN?**

Reply: **@ACKBVT125;**

**Manufacturer identity:**

Send: **@254MF?**

Reply: **@ACKBROOKS**

**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 lifetime and re-calibration by adjusting the zero point and full-scale value can be performed by the user.

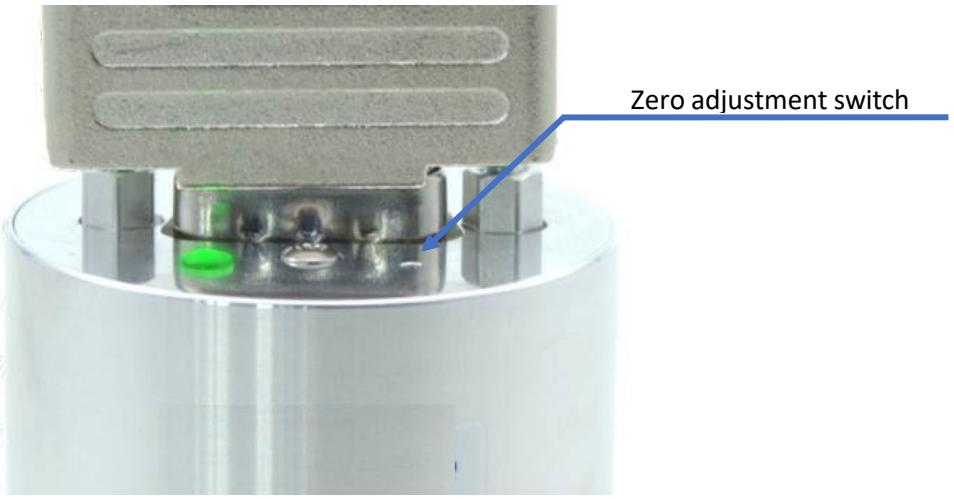
The BVT125 can be user configured, calibrated and tested using the Brooks Vacuum Transducer

## Zero adjustment switch

The BVT125 zero adjustment switch has two functions. When the measurement pressure is below XXX the switch will perform a vacuum zero adjustment of the Pirani measurement. When the measured pressure is above 450 mbar the zero-adjustment switch will perform an atmospheric zero adjustment of the deviation vacuum exposed piezo diaphragm sensor and the barometric ambient sensor.

Use a tool with a maximum diameter of 1.5 mm to activate the zero-adjustment switch using.

Refer to zero adjustment procedure before pressing the zero switch.




## Adjustment of the vacuum zero point

The BVT125 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 Transducer 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 BVT125 can also be vacuum zero adjusted by pressing the zero-adjustment switch using a tool with a maximum diameter of 1.5 mm. when measuring a pressure lower than 1.0E-2 mbar

1. Evacuate the gauge to a vacuum pressure below 1.00E-6 mbar (7.50E-7 Torr).
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 absolute vacuum 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).

## 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 BVT125'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 BVT125 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.

## Adjustment of full-scale

**Piezo vacuum sensor full-scale adjustment**
The piezo vacuum 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**
3. 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 400-1,100 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>\

**Atmospheric barometric sensor full-scale adjustment**
Full-scale adjustment of the Atmospheric Piezo sensor is achieved by applying the difference between the pressure value currently measured by the Atmospheric Piezo and the value supplied via the ATD command as an offset to future Atmospheric Piezo readings.

Atmospheric Piezo adjustment is only allowed for supplied pressure values in the range 400 mbar through 1100 mbar.

**INFORMATION**: Performing Atmospheric Piezo adjustments will directly affect the Differential Pressure reading – and so a Differential Piezo zero adjustment (ATZ) should be performed after an Atmospheric Piezo adjustment.

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

1. Expose the gauge to barometric ambient pressure
2. Send the command: @254ATD!<Reference barometric pressure>\
3. Reply: @254ACK<offset from factory calibrated value>\

Example: The Atmospheric Piezo measures 1003 mbar, while a reference barometer measures 1003.5 mbar. The Atmospheric Piezo can be adjusted to match the reference pressure:

Send: **@254ATD!1003.5**

Reply: **@253ACK5.00E-1**

In the above example, the “5.00E-1” value in the BVT125's reply indicates the offset applied to the Atmospheric Piezo in order to match the reference pressure supplied by the user.

## 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**

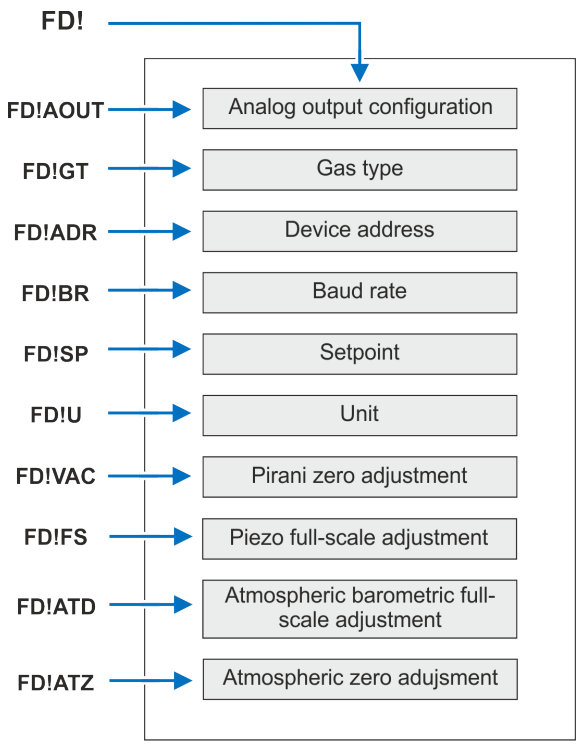
| Parameter | Value |
|---|---|
| Vacuum zero adjustment | 0 |
| Full scale adjustment | 1 |
| Atmospheric barometric full-scale adjustment | 1 |
| Atmospheric barometric full-scale adjustment | 0 |
| Unit | As delivered |
| Baud rate | 9600 |
| Address | 253 |
| Analog output configuration | As delivered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

## Individual reset to factory default

It is possible to reset only certain settings to their factory default values. This is done by adding an optional argument to the FD command. If the argument is left blank, all parameters will be reset to their default values.

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

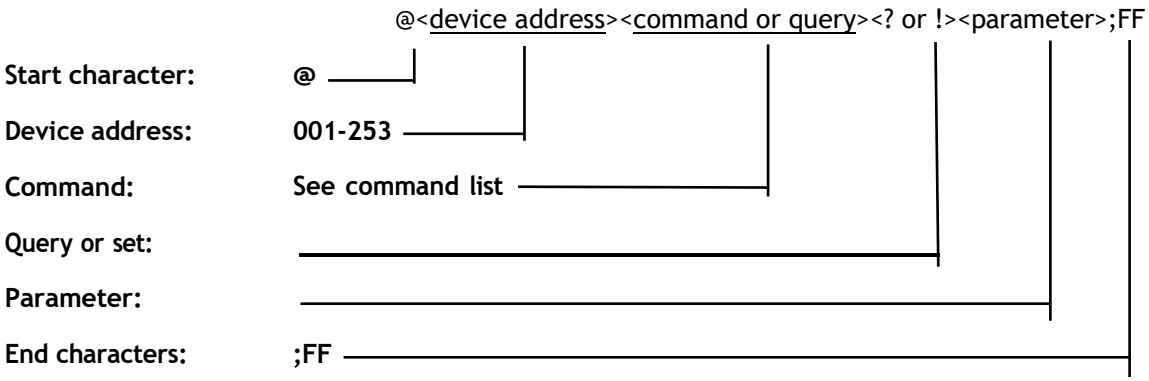
Reply: **@ACKFD**



## 900 Series vacuum gauge compatibility

The BVT125 offers pin, analog output and digital communication protocol compatibility with the 901P, 925 and 910 vacuum transducers from MKS Instruments.

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




**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 BVT125 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 |
| ATD | Atmospheric Piezo adjustment | X | X | <atmospheric pressure reference value> |
| ATZ | Differential Piezo zero adjustment | X | X | - |
| 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 (relative to ambient barometric pressure) | X | | - |
| PR3 | Pressure measurement (Combined) | X | | - |
| PR4 | Pressure measurement (Combined with 4-digit resolution) | 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, ABS, DIFF |
| 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, ABS, DIFF |
| 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, ABS, DIFF |
| 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 | $1\times10^{-6}$ to 1,333 mbar ($7.5\times10^{-7}$ to 1,000 Torr) |
| Measuring principle $1\times10^{-6}$ to 1.5 mbar | MEMS Pirani thermal conductivity |
| Measuring principle 1.5 to 2 mbar | Blended MEMS Pirani / piezo reading |
| Measuring principle 2 to 1,333 mbar | MEMS piezo resistive diaphragm |
| Accuracy(9) $1\times10^{-5}$ to $9.99\times10^{-5}$ | 25% of reading |
| Accuracy(9) $1\times10^{-4}$ to 9.99 mbar | 5% of reading |
| Accuracy(9) 10.0 to 99.9 mbar | 1% of reading |
| Accuracy(9) 100 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 |
| Hysteresis $1\times10^{-3}$ to 10 mbar | 1% of reading |
| Hysteresis 10 to 1,333 mbar | 0.1% of reading |
| Barometric measurement range | 300 to1200 mbar |
| Barometric accuracy | +/- 0.5 mbar |
| Atmospheric referenced pressure output range | -1,333 to + 1,333 mbar |
| Vacuum temperature sensor range | -20 to + 85°C |
| Vacuum temperature sensor accuracy | +/- 1.5 °C |
| Transducer temperature sensor range | -20 to + 85°C |
| Transducer temperature sensor accuracy | +/- 1.5 °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 (absolute) | $5\times10^{-6}$ to 1,333 mbar ($3.75\times10^{-6}$ to 1,000Torr) |
| Solid state relay set point range (atm. relative) | -1,100 to + 500 mbar (-770 to +375 Torr) |
| 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<br>CSA Certified: Certificate 1175739<br>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 +120 °C |
| Bake-out temperature (non-operating) | +120 °C |
| Maximum media pressure | 10 bar absolute(10) |
| Mounting position | Arbitrary |
| Protection rating, EN 60529/A2:2013 | IP40 |
| Humidity, IEC 68-2-38 | 98%, non-condensing |

(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.

| 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) |
| **Materials** | |
| Enclosure | SS 1.4307 / AISI 304L / Aluminum 6061 |
| Vacuum flange (media wetted) | SS 1.4307 / AISI 304L |
| Vacuum exposed materials (media wetted) | AISI 304L Stainless steel, Kovar, glass, silicon, nickel, aluminum, $SiO_2$, $Si_3N_4$, gold, Viton®, low out-gassing epoxy resin, solder, RO4305 |
| Process leak tightness | $<1 \cdot 10^{-9}$ mbar·l/s |
| Enclosure | AISI 304L / Aluminum 6061 |
| **Approvals** | |
| CE | EMC directive 2014/30/EU |
| RoHS compliance | Directive EU 2015/863 |

## 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 Transducer
Product part number: BVT125-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 with 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 transducers 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 |

## 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.



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