



VACUUM SOLUTIONS

Part of the **BUSCH** GROUP

Digital Transmitter

Vacuum Measurement Equipment

VACTEST DPP 400

VACTEST DPP 400 D

Instruction Manual



Table of Contents

1	Safety	3
2	VACTEST DPP 400 or DPP 400 D	4
2.1	For Orientation	4
2.2	Delivery Content.....	4
2.3	Product Description	4
2.4	Proper Use	4
2.5	Improper Use.....	4
3	Installation.....	5
3.1	Notes for Installation.....	5
3.2	Vacuum Connection.....	6
3.2.1	Gauge Mounting Orientation	7
3.3	Electrical Connection	8
3.3.1	Connecting to the Active Sensor Controller.....	8
3.3.2	Connecting to the USB/RS485 Converter	9
3.3.3	I/O and Communication Port Schematic.....	10
4	Operation	12
4.1	General	12
4.2	Transmitter Handling	13
4.2.1	Operating Flowchart	14
4.3	Changing Display Unit and Orientation	14
4.4	Readjustment	15
4.4.1	Readjustment at Zero or Atmospheric Pressure	15
4.5	Bake-out	16
5	Communication	17
5.1	Setting RS485 Address.....	17
5.2	Commands Information.....	18
5.3	Device Parameters and Information	19
5.4	Measurement Query Information.....	19
5.5	Display Functions	20
5.6	Switching Points Parameters.....	20
5.7	Readjustment via Software commands	22
5.8	Sensor Parameters.....	23
5.8.1	Sensor Transition (ST)	23
5.8.2	Gas Correction Factor (C1).....	23
5.8.3	Scaling of Output - Analog Output Characteristic (OC)	24
5.8.4	Operating Hours (OH).....	24
5.8.5	Degree of Sensor Wear (PM).....	24
6	VACTEST Explorer Software	25
7	Maintenance and Service	26
7.1	Replacing the Sensor Head.....	27
7.2	Errors and Malfunctions.....	27
8	Spare Parts and Accessories	28
9	Technical Data	29
10	EU Declaration of Conformity	30
11	UK Declaration of Conformity.....	31

1 Safety

- Read and follow the instructions of this manual.
- Inform yourself regarding hazards, which can be caused by the product or arise in your system.
- Comply with all safety instructions and regulations for accident prevention.
- Check regularly that all safety requirements are being complied with.
- Take account of the ambient conditions when installing your gauge. The protection class is IP 40 (the unit is protected against penetration of foreign bodies) or IP 54 when using suitable electrical connectors.
- Adhere to the applicable regulations and take the necessary precautions for the process media used.
- Consider possible reactions between materials and process media, e.g. due to the heat generated by the product.
- Before you start working, find out whether any of the vacuum components are contaminated.
- Do not carry out any unauthorized conversions or modifications on the unit.
- Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.
- When returning the unit to us, please enclose a declaration of contamination.
- Communicate the safety instructions to other users.

This instruction manual highlights potential hazards where appropriate. Safety notes and warning messages are tagged with one of the keywords DANGER, WARNING, CAUTION, NOTICE and NOTE as follows:



DANGER

... indicates an imminent dangerous situation that will result in death or serious injuries if not prevented.



WARNING

... indicates a potentially dangerous situation that could result in death or serious injuries.



CAUTION

... indicates a potentially dangerous situation that could result in minor injuries.



NOTICE

... indicates a potentially dangerous situation that could result in damage to property.



NOTE

... indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

2 VATEST DPP 400 or DPP 400 D

2.1 For Orientation

These operating instructions describe installation and operation of the DPP 400 or DPP 400 D .

The article number can be found on the product's type label. Technical modifications are reserved without prior notification.

2.2 Delivery Content

Included in the delivery consignment are:

- Digital transmitter DPP 400 or DPP 400 D
- Protective cover
- Instruction manual

2.3 Product Description

The Digital transmitter DPP is measuring total gas pressure in the range of 1200 - 1×10^{-4} mbar. The Digital transmitter can be connected to the control units or to customer related power supply and evaluation units in compliance with pin assignment.

The analog output signal of DPP 400 or DPP 400 D is 1.5 V - 8.58 V and has a logarithmic dependence on pressure over the whole range.

In addition the device has a serial RS485 interface for digital data transfer, refer to *Setting RS485 Address* [→ 17].

The Digital transmitter is equipped with a metal-sealed combination sensor type Piezo / Pirani and temperature compensated. It can be mounted to suitable flange connectors.

2.4 Proper Use



NOTE

The device is not designed for use in a corrosive atmosphere!

Dust, oil or condensing vapours will affect sensor performance and may cause malfunctions!

Aggressive media such as halogenides, carbon or oxygen plasma can reduce the devices lifetime!

The DPP 400 or DPP 400 D serves exclusively to provide absolute pressure measurements in gaseous media in the range of 1200 – 1×10^{-4} mbar. It may only be connected to components specifically provided for such purpose.

2.5 Improper Use

The use for purposes not mentioned above is regarded as improper, in particular:

- Connection to pumps or units which are not suitable for this purpose according to their operating instructions.
- Connection to components containing touchable, voltage carrying parts.

In case of improper use the protection provided by the equipment may be impaired, no liability or warranty will be accepted for claims arising.

The user bears the responsibility with respect to the used process media. The equipment is intended for integration in an end-use system. Suitability of the final combination shall be evaluated in the end-use.

3 Installation



NOTE

Unauthorized modifications.

Risk of injury!

- Unauthorized modifications of the device are not allowed!
- The device shall be installed by trained personnel only.

3.1 Notes for Installation

Installation location: Indoor

Installation altitude: max. 2000 m ASL

Temperature: +5 °C ... +60 °C

Rel. humidity: max. 80% up to 30 °C, max. 50% at 40 °C, non-condensing

Air pressure: 860 - 1060 hPa (mbar)

3.2 Vacuum Connection



CAUTION

Unintended opening of clamp with an overpressure in the vacuum system over 1000 mbar.

Risk of injury!

Damage to your health!

- Parts may fly around.
- Unsecured hose connections can release process media.



CAUTION

Overpressure in the vacuum system over 1500 to 4000 mbar

Damage to your health!

The elastomer washers cannot withstand the pressure and can release process media.

- Use sealing rings with an outer centering ring.



NOTE

When mounting the VACTEST avoid forced twisting or violent opening. This can damage the device.



NOTICE

Dirt and damage at the vacuum flange and/or thread connection.

Impairs the function of the gauge!

- Make sure that the flange and/or thread connection is/are clean, dry and free of grease.
 - When handling the instrument, make sure that the flange and/or thread connection is/are protected against dirt and damage.
-
- Remove the protective cover (is required again during maintenance work!).
 - Make vacuum connection via ISO KF small flange.
 - For small flange connection use clamps that can be opened and closed with appropriate tools only, use sealing rings with a centering ring.
 - Make sure that the sensor flange is connected to ground, e.g. by having electrical contact to grounded vacuum chamber (use metallic clamps).

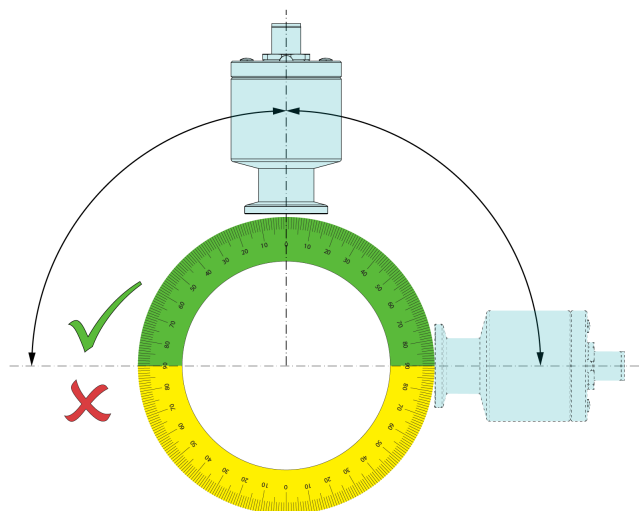
3.2.1 Gauge Mounting Orientation

You can mount the device in any orientation. However, mounting the device from below with the flange facing upwards, can lead to premature contamination and failure of the device. It is recommended to mount the device from upright position with the flange facing downwards to prevent dust and condensate from accumulating in the sensor cell.



NOTE

The device is adjusted ex-factory with the flange facing downwards position.



3.3 Electrical Connection



DANGER

Live wires.

Risk of electrical shock!

- Electrical installation work must only be executed by qualified personnel.



NOTICE

Establish a connection using a live cable.

Risk of damage to the device!

- Only connect cables when de-energized.

3.3.1 Connecting to the Active Sensor Controller



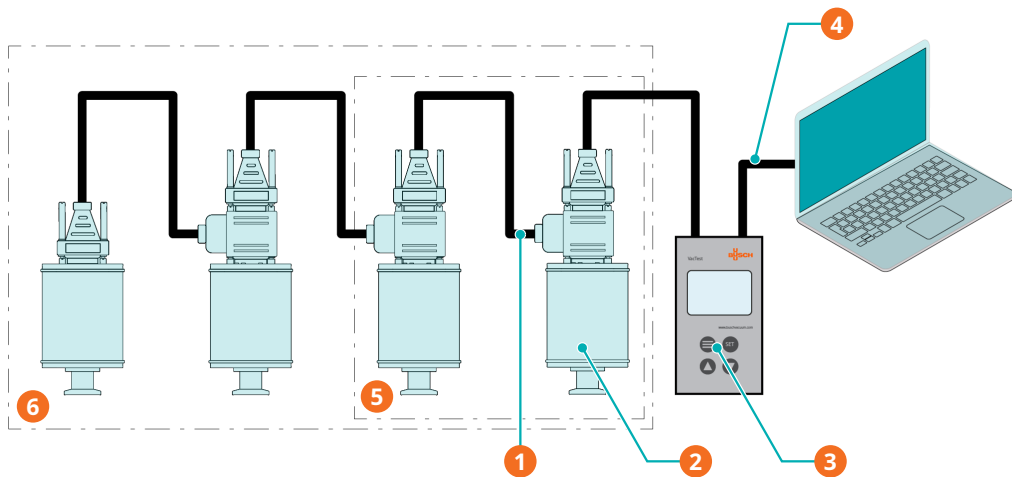
DANGER

Live wires!

Risk of electrical shock!

- Do not connect or disconnect the transmitter when the cable is on circuit!

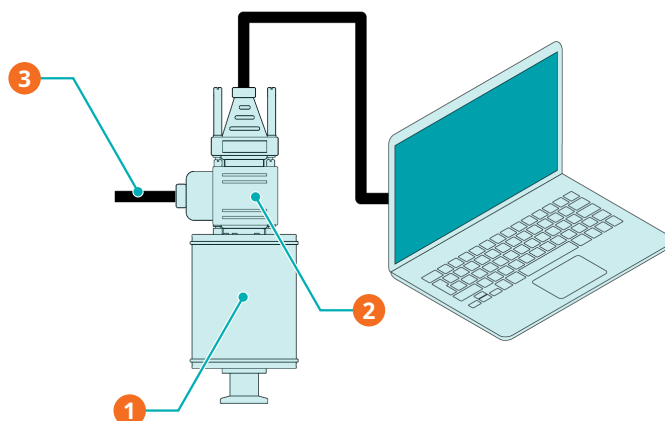
To operate the gauge with the controller, a suitable measurement connection cable must be used. In this case, contact your BUSCH representative or the responsible company of the controller to determine the appropriate connection cable.



Description			
1	D-SUB Cable	2	Transmitter
3	Active sensor controller	4	USB
5	With the controller CTR 002: up to 2 gauges can be connected.	6	With the controller CTR 004: up to 4 gauges can be connected.

- Set the relevant address at the address selector switch, see *Setting RS485 Address* [→ 17].
- Connect the D-Sub connector to the gauge and secure it with the screws.
- Connect the controller and secure the D-Sub connector with the screws.

3.3.2 Connecting to the USB/RS485 Converter



Description

1	Transmitter	2	USB/RS485 Converter
3	24 V DC		

- Set the relevant address at the address selector switch, see *Setting RS485 Address* [→ 17].
- Connect the gauge to the power supply cable.
- Connect the USB/RS485 converter and secure the D-Sub connector with the screws.
- Connect the power supply cable to the mains.

3.3.3 I/O and Communication Port Schematic



NOTICE

Incorrect supply voltage.

Risk of damage to the device!

- Make sure to supply a correct and admissible voltage.

The transmitter can be operated with other customer-related display units or voltage supplies. The external source for voltage supply of the transmitter must only be connected to mains supplies of max. over-voltage category II and must have a turn-off device.

The equipment shall be supplied only by a certified power supply which fulfils the requirements of the national authorities and provides reinforced or double insulation for protection against electric shock with output voltages below the limits of 6.3.1/6.3.2 of 61010-1 or 30 V r.m.s. and 42.4 V peak or 60 VDC max. (24 VDC nominal) and limited energy output according to 9.4 (LPS or CEC/NEC Class2).

The relay inputs shall be supplied only by a certified power supply which fulfils the requirements of the national authorities and provides reinforced or double insulation for protection against electric shock with output voltages below the limits of 6.3.1/6.3.2 of 61010-1, max. 49 V r.m.s. or 30 VDC max. 2 A max. 30 VA.

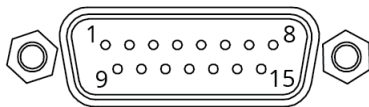
Equipment and the relay contacts shall be supplied only by a certified power supply which is used according to its environmental ratings. For use between 40°C and 60°C ambient temperature, a suitable rated power supply is required.

The electrical connection is to be made by means of suitable cables considering EMI demands and according to the pin description shown below:

Connector and Schematic of DPP 400:

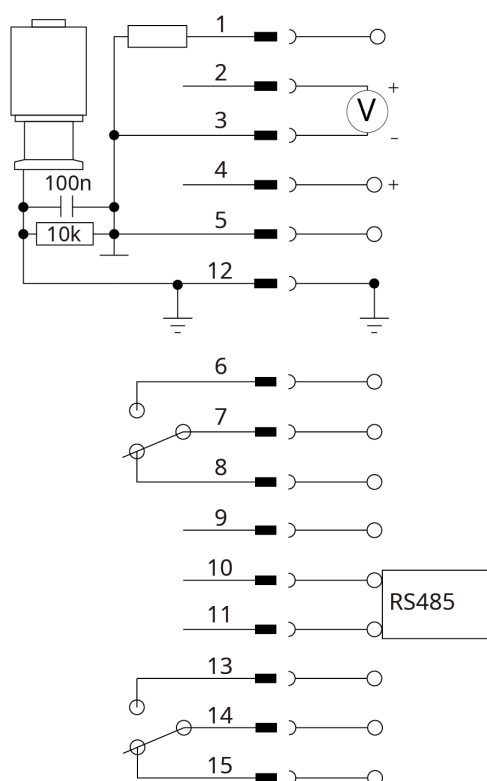
The Ground (Pin 12) and supply common (Pin 5) must always be grounded in the supply unit.

Connector Type: Sub-D, 15-pin, male



Pin No.	Description	Pin No.	Description
Pin 1	Identification: 22 kΩ	Pin 9	-
Pin 2	Signal output 0 ... 10 VDC	Pin 10	RS485 +
Pin 3	AGND	Pin 11	RS485 -
Pin 4	Voltage supply 20 ... 30 VDC	Pin 12	Shield
Pin 5	Supply GND	Pin 13	Relay 2, N.O.
Pin 6	Relay 1, N.O.	Pin 14	Relay 2, Common
Pin 7	Relay 1, Common	Pin 15	Relay 2, N.C.
Pin 8	Relay 1, N.C.		

Schematic diagram of electrical connection:



Pin No.	Description	Pin No.	Description
Pin 1	Identification: 22 kΩ	Pin 9	-
Pin 2	Signal output 0 ... 10 VDC	Pin 10	RS485 +
Pin 3	AGND	Pin 11	RS485 -
Pin 4	Voltage supply 20 ... 30 VDC	Pin 12	Shield
Pin 5	Supply GND	Pin 13	Relay 2, N.O.
Pin 6	Relay 1, N.O.	Pin 14	Relay 2, Common
Pin 7	Relay 1, Common	Pin 15	Relay 2, N.C.
Pin 8	Relay 1, N.C.		

4 Operation

4.1 General

The Digital transmitter is equipped with an internal combination sensor of type Piezo / Pirani.

Under the influence of pressure, the thin diaphragm of the piezo-resistive sensor is bent, on the back of which a resistor-bridge is applied. The bending forces the measuring bridge to come out of tune, which is a measure for the applied pressure. The Pirani principle uses the heat conduction of gases for measuring vacuum. A sensor filament in a Wheatstone circuit is heated to a constant temperature, so the bridge voltage is a measure for total gas pressure.

Output Signal for DPP 400

The output signal 1.5 --- 8.58 V of the Digital transmitter has a logarithmic dependence on pressure over the whole measurement range $1200 - 1 \times 10^{-4}$ mbar. Conversion of voltage signal and pressure is done according to the following formula:

$$V_{\text{out}}/V = \log(p/\text{mbar}) + 5.5$$

$$p/\text{mbar} = 10^{(V_{\text{out}}/V - 5.5)}$$

The output voltage characteristic can be scaled by software command, see *Sensor Parameters* [→ 23].

Serial Interface RS485

The measured absolute pressure can be read out digitally via the transmitter's serial RS485 interface. Additionally, you can set various parameters like gas correction factors. For further information, refer to *Communication* [→ 17].

Warm-Up Time

The signal output is available approx. 2 seconds after the device is switched on. To take advantage of the maximum accuracy of the unit it is appropriate to allow for a stabilization time of 5 minutes, especially when extreme pressure changes have occurred.

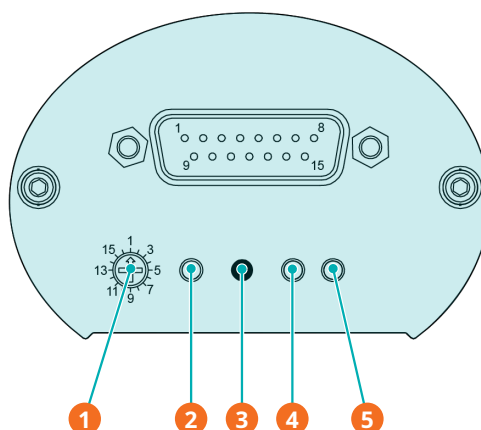
Accuracy

The gauge is adjusted ex-factory in upright position with a supply voltage of 24 VDC. Through contamination, aging, extreme climatic conditions, or other installation orientations may require readjustment.

Dependence on Gas Type

The output signal of the Pirani sensor depends on composition and type of the gas being measured. The unit is adjusted for N₂ and dry air. For other gases correction factors can be set (see *Gas Correction Factor (C1)* [→ 23]). This will result in a correct pressure display below 0.1 mbar.

4.2 Transmitter Handling



Description			
1	Address-Switch	2	Status-LED
3	Adjustment-Pushbutton	4	Switchpoint LEDs (SP1)
5	Switchpoint LEDs (SP2)		

The status LED of the DPP 400 or DPP 400 D signals the following operational states:

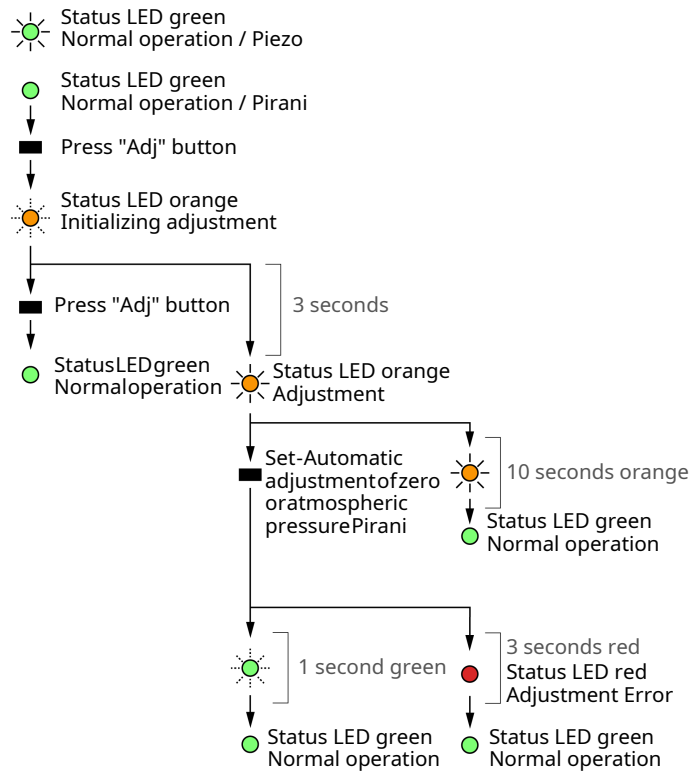
-  Normal operation / Pirani (green LED continuously on)
-  Normal operation / Piezo (green LED flashing slowly)
-  Error (red LED continuously on)
-  Ready for adjustment (orange LED flashing slowly)
-  Initializing adjustment (orange LED flashing quickly)

The switchpoint LEDs are "ON" when the related relay is activated.

In addition, the digital transmitter "DPP 400 D" have an LCD with backlight that displays the measured actual pressure. In case of an operation error or malfunction, the display is illuminated by a red background color.

4.2.1 Operating Flowchart

By means of the "Adj" pushbutton of the gauge "adjustment" function can be started.



NOTE

To readjustment of transmitter via software command, refer to *Readjustment via Software commands* [→ 22].

4.3 Changing Display Unit and Orientation



NOTE

This instruction is only applicable for DPP 400 D.

In order to change the display unit (mbar, Torr, hPa):

- Hold the "Adj" pushbutton pressed while connecting power supply until the display shows "Unit".
- Select the desired unit by pressing the "Adj" pushbutton.

After 5 seconds without further keypress the setting is saved!

Display unit and orientation can be changed via VATEST explorer or by software command, see chapter *Display Functions* [→ 20].

4.4 Readjustment

The gauge is adjusted ex-factory in upright position with a supply voltage of 24 V with the flange facing down. Other orientations, different climatic conditions, extreme temperature changes, ageing or contamination may necessitate readjustment of the Piezo / Pirani sensor.



NOTE

For zero adjustment actual pressure should be less than 5×10^{-5} mbar.



NOTE

To achieve optimum results of the adjustment we recommend to consider a warm-up of at least 10 minutes at the appropriate calibration pressure before any adjustment.

4.4.1 Readjustment at Zero or Atmospheric Pressure

Digital readjustment at zero or atmospheric pressure can be done by means of the "Adj" pushbutton. There are two adjustment point in the digital transmitter; "zero adjustment by pushbutton" and "adjustment by the pushbutton at atmospheric pressure". The transmitter will notice automatically which adjustment point is relevant.



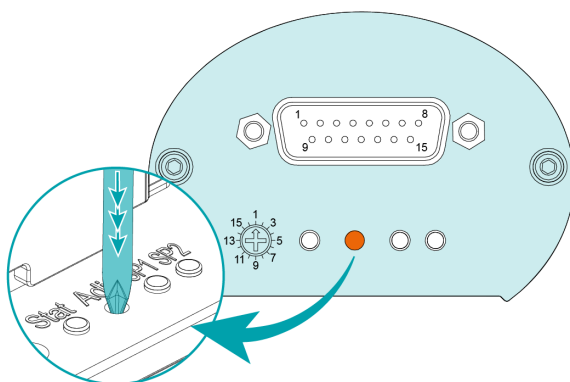
NOTE

Adjustment by the pushbutton at atmospheric pressure will apply exclusively to the Pirani sensor. Adjustment of Piezo and Pirani sensor at atmospheric pressure is possible via software-command only, see chapter Readjustment via Software Command.



NOTE

Zero adjustment by the pushbutton will apply to the Piezo as well as the Pirani sensor. For zero adjustment the actual pressure must be less than 5.0×10^{-5} mbar. Simultaneously with zero adjustment an updated estimation for the Pirani sensor's actual degree of wear is calculated.



Adjust the gauge pressure as follows:

- Remove the rubber cap from the »Adj« pushbutton.
- Press the button several times by means of a small screwdriver or similar tool until the status LED starts quickly flashing in orange color.

After further 3 seconds, a slowly flashing status LED signalizes that the gauge now can be readjusted.

- Push the button once again.
- Insert the rubber cap again to its initial position.

4.5 Bake-out



NOTICE

Excessive bake-out temperature.

Risk of damage to the electronics!

- Baking temperatures up to 150 °C, always switch off the power supply.
 - Baking temperatures higher than 150 °C may damage the sensor head and electronics.
 - The vacuum flange and the sensor must not be thermally isolated. During baking it needs to be cooled by natural convection of ambient air.
-

5 Communication



NOTE

The Busch communication protocol is available separately on request.

Ask your Busch representative to get the document.

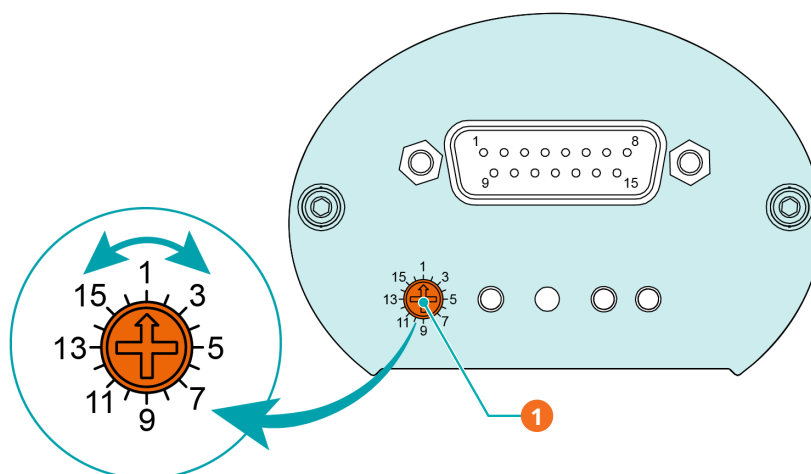
5.1 Setting RS485 Address

The transmitter is equipped with an RS485 serial interface, enabling effective communication.



NOTE

The analog output signal 0 – 10 V is simultaneously available with RS485.



Description

1	RS485 address selector switch		
---	-------------------------------	--	--

Set the device address for communication via RS485 as follows:

- Remove the rubber cap over the address selector switch.
- Set the address selector switch to a value between 1 to 16 using a small screwdriver or similar tool.
- Reinsert the rubber cap.

5.2 Commands Information

Below table includes a list of main commands and its information.

Code	Command Information
TD	Type of Device
PN	Product Name
SD	Serial Number Device
SH	Serial Number Head (Sensor)
VD	Version Device
VF	Version Firmware
VB	Version Bootloader
BR	Baud Rate: Set the baud rate for data transmission. Value range: 9600, 14400, 19200, 28800, 38400, 57600, 115200 Bd.
RD	Response Delay: Display and set the time delay between receiving a telegram and sending the answer. Value range: 1 ... 99999 µs (default 5500 µs).
DR	Device Restart
DU ¹	Display Unit: Display and set the pressure unit used for the LCD display of the gauge. Value range: mbar (default), Torr, hPa.
DO ¹	Display Orientation: Display and set the display orientation, i.e. the display can be rotated by 180°. Value range: 0 (default), 1 (rotated 180°).
R1	Relay 1: Display and set the relay mode; see chapter <i>Switching Points Parameters</i> [→ 20] for more information.
R2	Relay 2: Display and set the relay mode; see chapter <i>Switching Points Parameters</i> [→ 20] for more information.
AH	Adjust High (Atmosphere Pressure): Adjustment of the Pirani sensor at atmospheric pressure; see chapter <i>Readjustment via Software commands</i> [→ 22] for more information.
AL	Adjust Low (Zero Pressure): Adjustment of the Pirani sensor at zero pressure; see chapter <i>Readjustment via Software commands</i> [→ 22] for more information.
MR	Measurement Range
MV	Measurement Value
M1	Measurement Value 1 (Pirani)
M2	Measurement Value 2 (Piezo)
ST	Sensor Transition: Configure the transition between the sensors; see chapter <i>Sensor Transition</i> [→ 23] for more information.

Code	Command Information
C1	Gas Correction Factor 1 (Pirani): Display and set the gas correction factor for the Pirani sensor.
OC	Analog Output Characteristic: Scale the analog output characteristic of the gauge; see chapter <i>Scaling of Output - Analog Output Characteristic (OC)</i> [→ 24] for more information.
OH	Operating Hours
PM	Degree of Sensor Wear

⁽¹⁾ Valid only for transmitters with LCD display.

5.3 Device Parameters and Information

This table includes device commands and information.

Code	Description	Information
TD	Type of device	Displays the device type, e.g. DPP 400 D
PN	Product Name	Displays the product name (article number)
SD	Serial Number Device	Displays the device serial number
SH	Serial Number Head	Displays the sensor head serial number
VD	Version Device	Displays the device's hardware version
VF	Version Firmware	Displays the device's firmware version
VB	Version Bootloader	Displays the device's bootloader version
BR	Baud Rate	Set the baud rate for data transmission Value range: 9600, 14400, 19200, 28800, 38400, 57600, 115200 Bd
RD	Response Delay	Display and set the time delay between receiving a telegram and sending the answer. Value range: 1 ... 99999 µs (default 5500 µs)
DR	Device Restart	Make a device reset

5.4 Measurement Query Information

This table includes measurement commands and its information.

Code	Description	Information
MR	Measurement Range	Displays the measurement range of the gauge
MV	Measurement Value	Displays the current pressure measurement
M1	Measurement Value M1	Displays the current pressure measurement of the Pirani sensor
M2	Measurement Value M2	Displays the current pressure measurement of the piezo sensor

5.5 Display Functions



NOTE

This instruction is only applicable for DPP 400 D.

This table includes display commands information of the transmitter.

Code	Description	Information
DU	Display Unit	Display and set the pressure unit used for the LCD display of the transmitter. Value range: mbar (default), Torr, hPa
DO	Display Orientation	Display and set display orientation, i.e. the display can be rotated by 180° Value range: 0 (default), 1 (rotated 180°)

5.6 Switching Points Parameters

The transmitter provides 2 independent, potential-free relay switching points. These are available as change-over switches at the connector according to the pin assignment, described in chapter *I/O and Communication Port Schematic* [→ 10].

Relay R1, R2:

The relays can be configured independently for various switching modes. The parameter is used to query and set these switching modes.



CAUTION

Setting T[p1] = F[p2] is forbidden!

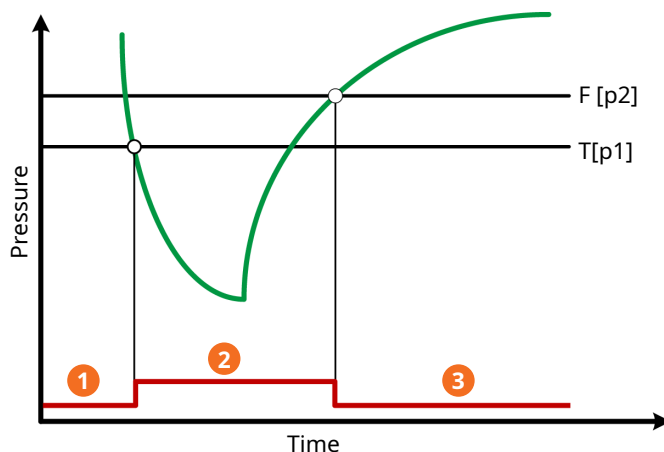
Risk of flickering or damage to the relay!

- A gap between the thresholds being too small may result in flickering of the relay and can even cause damage to the relay.

Setting T[p1] F[p2]:

In this case 2 pressure thresholds T[p1] (true) and F[p2] (false) are transmitted.

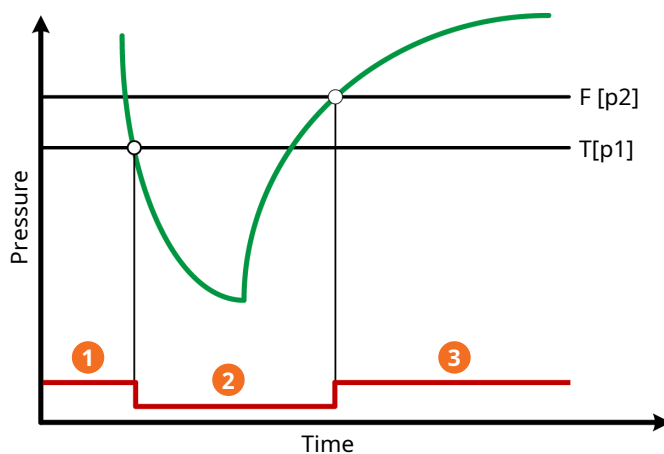
$T[p1] < F[p2]$: The relay closes when actual pressure falls below threshold $T[p1]$ and opens again as soon as actual pressure exceeds threshold $F[p2]$.



Description

1	Relay "OFF"	2	Relay "ON"
3	Switching function "OFF"		

$T[p1] > F[p2]$: The relay opens when actual pressure falls below threshold $F[p2]$ and closes again as soon as actual pressure exceeds threshold $T[p1]$.



Description

1	Relay "ON"	2	Relay "OFF"
3	Switching function "ON"		



NOTE

The control LEDs on top of the transmitter will be "ON" as soon as the related relay is closed.

Relay Settings and Results:

Settings	Result
E	Relay closes in case of a device error.
E!	Relay opens in case of a device error.
U	Relay closes in case of pressure under range.
U!	Relay opens in case of pressure under range.
T0	Open relay by software command (off).
T1	Close relay by software command (on).
O	Relay closes in case of pressure overrange.
O!	Relay opens in case of pressure overrange.

5.7 Readjustment via Software commands

The transmitter is adjusted ex-factory with 24 V voltage supply in upright position, flange to the bottom. Other orientation, operation under different climatic conditions, extreme temperature changes, ageing or contamination can result in the need for readjustment of the Piezo / Pirani sensor.

**NOTE**

To achieve optimum results of the adjustment we recommend to consider a warm-up of at least 10 minutes at the appropriate calibration pressure before any adjustment.

Adjust High (AH[p])

Adjustment of piezo and Pirani sensor at atmospheric pressure. A reference pressure "p" will be required!

Adjust Low (AL)

Adjustment of piezo and Pirani sensor at zero pressure. For this purpose, actual pressure must be less than 5×10^{-5} mbar.

Adjust Low (AL[p])

It is also possible to adjust the Pirani sensor at a certain reference pressure in the range $1/5 \times 10^{-4} \dots 1 \times 10^{-1}$ mbar. Command AL then must be transmitted together with the pressure value p as reference pressure. This can be beneficial, if a suitably low pressure for zero adjustment cannot be applied.

5.8 Sensor Parameters



NOTE

The Piezo sensor measures independently of the type of gas, whereas the measurement of the Pirani depends on the type of gas. Hence, adjusting the transition range of the sensors or the pressure for direct switch-over will also affect the range where the transmitter output is independent of the gas type.

For the default setting (ST=1) this will be the case if the pressure reading is above 15 mbar.



NOTE

Any validation of the degree of wear must always be related to the specific application!



NOTE

If a zero adjustment according to chapter *Readjustment via Software commands* [→ 22] is carried out at reference pressures above 5×10^{-4} mbar, no recalculation or update of the degree of sensor wear will be done as this would result in falsified parameter values.

5.8.1 Sensor Transition (ST)

By default, the device performs a continuous transition between Pirani and Piezo range whereupon an assimilation of the sensor signals is carried out.

In order to adapt the performance of the transmitter to the requirements of the vacuum process the following options can be configured by means of parameter »Sensor Transition« (ST):

Configuration Options	Transition Results
0	No transition, but direct switch-over between Pirani and Piezo sensor at 1 mbar
1	Continuous transition in the range 5 ... 15 mbar (default)
D[p]	No transition, but direct switch-over between Pirani and piezo sensor at pressure p
F[p1] T[p2]	Continuous transition in the range p1 ... p2
Value range; p, p1, p2	1 ... 20 mbar

5.8.2 Gas Correction Factor (C1)

The measurement signal of the device in the Pirani range depends on type and composition of the gas being measured. The unit is adjusted for N₂ and dry air. For other gases the pressure display can be corrected below 0.1 mbar by setting a correction factor.

The measurement results of the sensor are then multiplied with the correction factor by the unit's microcontroller, thereby providing a corrected pressure reading as analog and digital output.

Value range: 0.20 ... 8

Correction factor for pirani sensor

Gas Name	Value	Gas Name	Value	Gas Name	Value	Gas Name	Value
Ar	1.6	CO ₂	0.89	He	1.0	Ne	1.4
CO	1.0	H ₂	0.57	N ₂	1.0	Kr	2.4

5.8.3 Scaling of Output - Analog Output Characteristic (OC)

The analog output characteristic can be scaled according to the application requirements by adjusting the parameters via software command. The voltage output curve can, for example, be modified to become compatible with transmitters of other brand labels.

A very comfortable way of scaling the output curve with graphical support is offered by the VACTEST Explorer software.



NOTE

Regarding the data section and parameter details for Scaling of Output, contact your Busch representative.

5.8.4 Operating Hours (OH)

This parameter is used to read the counter of operating hours.

5.8.5 Degree of Sensor Wear (PM)

To support strategies for preventive maintenance the transmitter will assess and update the actual degree of sensor wear.

Whenever a zero adjustment is carried out manually or automatically the wear of the Pirani sensor will be recalculated. It is an estimated value expressed as percentage. Positive signs denote contamination of the sensor, whereas a negative percentage may indicate corrosion.

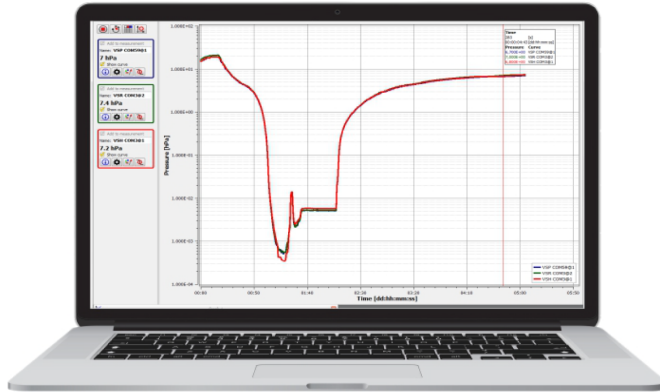
Additionally, the parameter contains the number of operating hours which have elapsed since the last zero adjustment.

Values above 100% imply the assumption that the sensor is likely to be out of the specified tolerance.

6 VACTEST Explorer Software

Digital transmitter Explorer software has been especially developed for use with VACTEST gauges from **Busch Vacuum Solutions** and is compatible with operating system Windows.

Digital transmitter Explorer features plotting and saving of measurement data as well as comfortable configuration of all device parameters.



Download: www.buschvacuum.com

- Plot, analyze and save measurement curves
- Compare multiple plots
- Export measurement data for MS Excel
- Transfer of recorded measurements from the data logger to a PC
- Automatic calculation of leak rates from rate-of-rise measurements
- Easy configuration of all device parameters

7 Maintenance and Service



DANGER

Danger of possibly contaminated parts!

Contaminated parts can cause personal injuries.

- Inform yourself regarding possible contamination before you start working.
- Be sure to follow the relevant instructions and take care of necessary protective measures.



CAUTION

The unit is not prepared for customer repair!

Defective sensor heads can be exchanged on-site by calibrated replacement sensors.



NOTE



Malfunction of the unit which is caused by contamination or wear and tear is not covered by warranty.

The unit requires no maintenance. External dirt and soiling can be removed by a damp cloth.

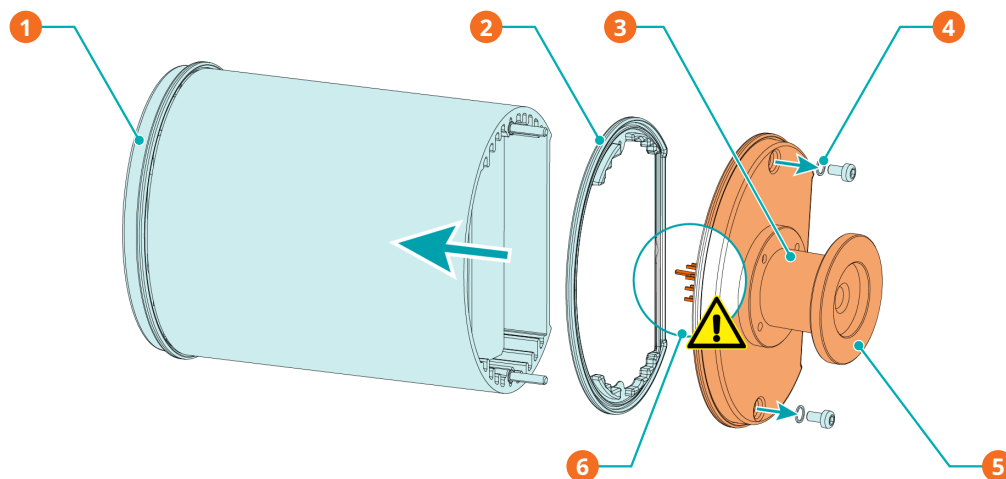
When returning the gauge for service please fill out a declaration of contamination form and include it in the shipment. This document is mandatory to protect our service staff.

For downloading the declaration of contamination form, [click here](#).

7.1 Replacing the Sensor Head

Disassemble the sensor head as follows:

- Vent the vacuum system to atmospheric pressure and allow to cool.
- Switch off the power supply on the controller or disconnect the gauge from the mains.
- Disconnect the gauge from the flange.
- Unscrew the small hex head screws paying attention to the sealing washers.
- Remove carefully the housing.



Description

1	Housing including electronics	2	Seal
3	Sensor head	4	Screw with seal
5	Vacuum flange	6	Mind the pins

Assemble the sensor head as follows:

- Assemble carefully the housing and the sensor head (pay attention to pins and seal positions).
- Screw the small hex head screws with their respective seal.
- Install the gauge.

7.2 Errors and Malfunctions

The device will show error messages as plain text on the display. Additionally, the following typical issues can appear:

Problem	Possible Cause	Correction
High measurement error	Contamination, ageing, extreme temperature, incorrect adjustment	Readjustment, replace sensor or send unit to repair
Pirani zero adjustment not possible	Measurement error exceeds adjustment range	Replace sensor or send unit to repair
Access code »7« via RS485	Error message / warning	Contact Busch for communication protocol
Output signal < 0.5 V / »ERROR1« via RS485 / status LED cont. red	Defective electronics or sensor	Send unit for repair or replace sensor
0.5V < output signal < 1.0V / »UR« via RS485	Pressure under range	Pressure is below range limit, see <i>Technical Data</i> [→ 29] for measuring range
Output signal > 9.0V / »OR« via RS485	Pressure over range	Pressure is above range limit, see <i>Technical Data</i> [→ 29] for measuring range

8 Spare Parts and Accessories

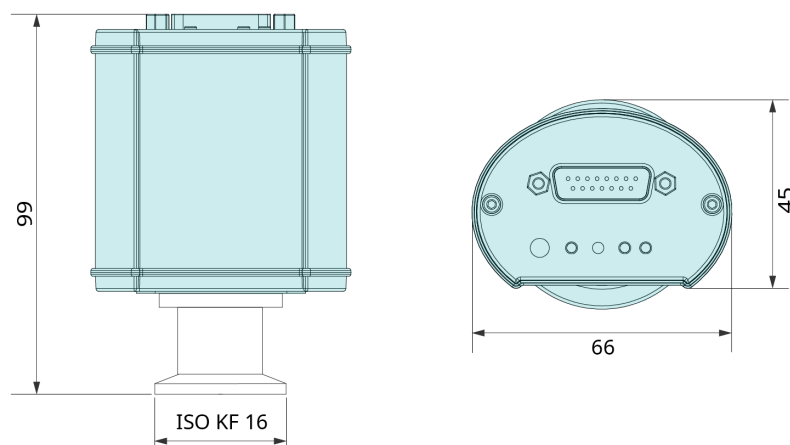
Spare part	Description	Part no.
Spare sensor	Intended for: - DPP 400 (DN 16 ISO-KF flange) - DPP 400 D (DN 16 ISO-KF flange)	0680 204 595

Controller	Description	Part no.
Active Sensor Controller	CTR 002, 2 channels	0656 202 928
Active Sensor Controller	CTR 004, 4 channels	0656 202 929

Accessory	Description	Part no.
Connecting cable	2 x D-Sub 15 poles – 2 meters	0671 204 577
Connecting cable	2 x D-Sub 15 poles – 6 meters	0671 204 578
Connecting cable	2 x D-Sub 15 poles – 10 meters	0671 204 580
Connecting cable	2 x D-Sub 15 poles – 20 meters	0671 204 581
Bluetooth module	RS485 Interface converter to Bluetooth	0680 204 592
Connecting cable	RS485 Interface converter to USB	0671 204 593
Power supply	100 - 240 VAC / 50 - 60 Hz, 300 mA - with EURO/US/UK/AUS plugs	0671 204 594
Software	VACTEST explorer - Pro version (1 license)	0870 203 191

These are only available accessories parts, check on Busch's website or contact your Busch representative for more information.

9 Technical Data



	VACTEST DPP 400	VACTEST DPP 400 D
Measurement principle	Piezo-resistive / heat conduction Pirani (Pirani depending on gas type)	
Measuring range	1200 - 1 x 10 ⁻⁴ mbar (900 - 1 x 10 ⁻⁴ Torr)	
Max. overload	4 bar abs.	
Accuracy	1200 ... 40 mbar: approx. 0.3 % full scale end 40 ... 2 x 10 ⁻³ mbar: 10 % of reading	
Repeatability	1200 ... 40 mbar: approx. 0.1 % full scale end 40 ... 1 x 10 ⁻² mbar: 2 % of reading	
Materials in contact with vacuum	Stainl. steel 1.4307, tungsten, nickel, glass, gold, silicon oxide	
Reaction time	40 ms	
Environment	Indoor, pollution degree max PD 2 installation altitude max. 2000 m ASL Rel. humidity max. 80 % up to 30 °C, max. 50 % at 40 °C, non-condensing	
Operating temperature	5 ... 60 °C	
Storage temperature	-40 ... +65 °C	
Bake-out temperature	Max. 150 °C at the flange (voltage supply switched-off)	
Voltage supply	20 – 30 VDC, 24 VDC nominal	
Power consumption	max. 2.5 W (relays)	2.5/0.8 (relays / Display)
Output signal	0 – 10 VDC, min. 10 kΩ, measuring range 1.5 - 8.58 VDC, logarithmic	
Serial interface	RS485: 9.6 ... 115 kBd, 8 databit, 1 stopbit, no parity	
Switching points	2x relay, potential free 49 V r.m.s. / 2 A or 30 VDC / 2 A, max. 60 VA	
Electrical connection	Sub-D, 15 pins, male, lockable	
Vacuum connection	Small flange DN16 ISO KF	
Protection class	IP 40 (IP 54), non-certified	
Display	Without display	With display
Weight	Approx. 195 g	

10 EU Declaration of Conformity

This Declaration of Conformity and the CE-markings affixed to the name plate are valid for the gauge within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

The manufacturer **Busch Produktions GmbH**
Schauinslandstr. 1
DE-79689 Maulburg

declares that the gauge: VACTEST DPP 400 / DPP 400 D

fulfill(s) all the relevant provisions from EU directives:

- 'Electromagnetic Compatibility' (EMC) 2014/30/EU
- 'RoHS' 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment (incl. all related applicable amendments)

and comply(-ies) with the following harmonized standards that have been used to fulfill those provisions:

Standard	Title of the Standard
EN 61326-1 : 2013 Group 1 / Class B	Electrical equipment for measurement, control and laboratory use, EMC requirements. General requirements
EN IEC 63000 : 2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Legal person authorized to compile the technical file and authorized representative in the EU (if the manufacturer is not located in the EU): **Busch Dienste GmbH**
Schauinslandstr. 1
DE-79689 Maulburg

Maulburg, 2025.01.02



Dr. Martin Gutmann, General Manager
Busch Produktions GmbH

11 UK Declaration of Conformity

This Declaration of Conformity and the UKCA-markings affixed to the nameplate are valid for the gauge within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

The manufacturer **Busch Produktions GmbH**
Schauinslandstr. 1
DE-79689 Maulburg

declares that the gauge: VACTEST DPP 400 / DPP 400 D

fulfill(s) all the relevant provisions from UK legislations:

- Electromagnetic Compatibility Regulations 2016
- Restriction of the use of certain hazardous substances in Electrical and Electronic Equipment Regulations 2012

and comply(-ies) with the following designated standards that have been used to fulfill those provisions:

Standard	Title of the Standard
EN 61326-1 : 2013 Group 1 / Class B	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements
EN IEC 63000 : 2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Legal person authorized to compile the technical file and importer in the UK (if the manufacturer is not located in the UK): **Busch (UK) Ltd**
30 Hortonwood
Telford - UK

Maulburg, 2025.01.02



Dr. Martin Gutmann, General Manager
Busch Produktions GmbH

BUSCH GROUP

The Busch Group is one of the world's largest manufacturers of vacuum pumps, vacuum systems, blowers, compressors and gas abatement systems. Under its umbrella, the group houses two well-known brands: Busch Vacuum Solutions and Pfeiffer Vacuum+Fab Solutions. Together, they offer solutions to a wide range of industries. A global network of highly competent local teams in 44 countries ensures that expert, tailor-made support is always available near you. Wherever you are. Whatever your business.



● Busch Group companies

▲ Busch Group production sites

● Busch Group service centers

■ Busch Group local representatives

www.buschvacuum.com

www.pfeiffer-vacuum.com