VACUUM SOLUTIONS

Part of the BUSCH GROUP

Digital Transmitter

Vacuum Measurement Equipment
VACTEST DTP 400 or 400 D
VACTEST DTP 400 C or 400 DC

Instruction Manual

SERVICE
AND SPARE PARTS, INSTRUCTION MANUALS ...
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VACUUM APP

CE UK CA

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Table of Contents

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 VACTEST DTP 400

2.1 For Orientation

These operating instructions describe installation and operation of the DTP 400 or 400 D / DTP 400 C or 400 DC.

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 DTP 400 or 400 D / DTP 400 C or 400 DC
- Protective cover
- Instruction manual

Available accessories, consult the chapter *Spare Parts and Accessories* [➔ 28].

2.3 Product Description

The Digital transmitter DTP is measuring total gas pressure in the range of 1000 -1 x 10^{-4} mbar. The transmitter type DTP 400 C or 400 DC with Platinum / Rhodium filament is suitable for many applications with corrosive gases in the range 1000 - 5 x 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 the DTP 400 or 400 D is 1.5 V - 8.5 V, and for the DTP 400 C or 400 DC, it is 2.2 V - 8.5 V, respectively. These transmitters 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* [➔ 18].

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

For more pictorial information of device, refer to *Transmitter Handling* [➔ 14].

2.4 Proper Use

NOTE

The DTP 400 and DTP 400 D transmitters are not designed for use in a corrosive atmosphere!

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

DTP 400 and DTP 400 D: The aggressive media such as halogenides, carbon or oxygen plasma can reduce the device lifetime!

DTP 400 C and DTP 400 DC: The aggressive media such as fluorides can reduce device lifetime!

The DTP 400 or 400 D / DTP 400 C or 400 DC serves exclusively to provide pressure measurements in gaseous media in the range of 1000 - 1 x 10^{-4} (DTP 400 or 400 D) and 1000 - 5 x 10^{-4} (DTP 400 C or 400 DC) 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

Ambient 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).

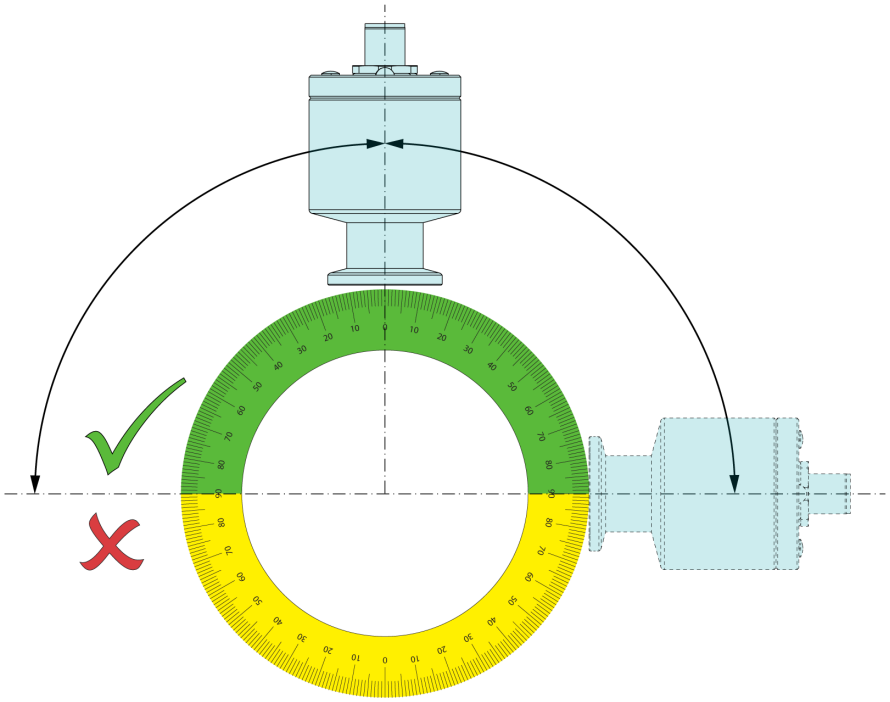
3.2.1 Gauge Mounting Orientation

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.

When device is installed in different orientation without readjustment, this action will lead to reduced accuracy at pressures above 20 mbar.

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

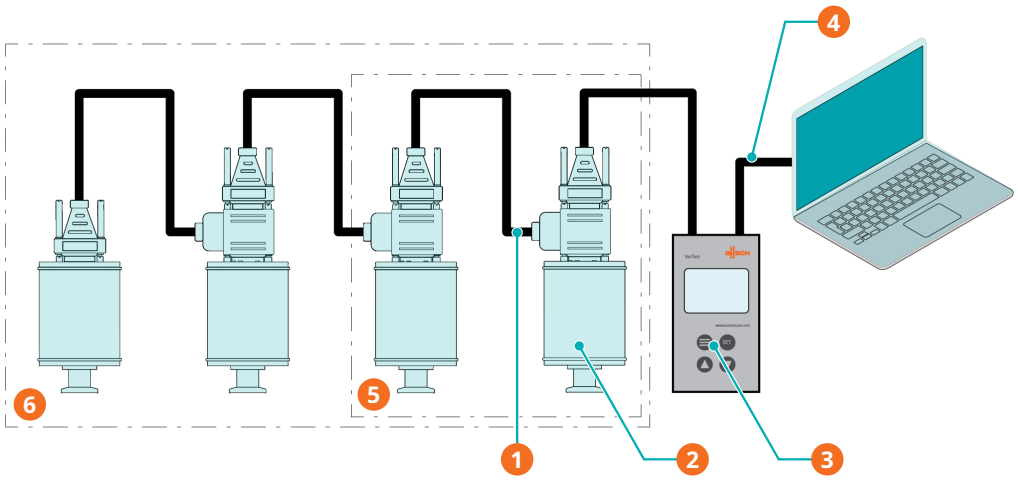
DANGER

Live wires!

Risk of electrical shock!

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

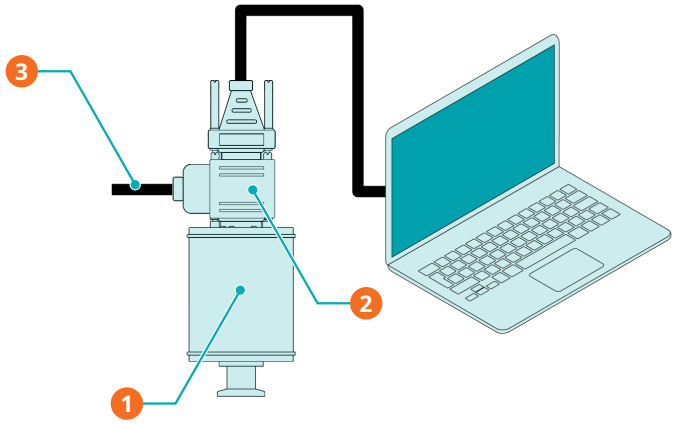
To operate the gauge with the controller, a suitable measurement connection cable must be used. In this case, contact your BUSCH representative or the responsible company of the controller to determine the appropriate connection cable.



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* [➔ 18].
- 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* [➔ 18].
- 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

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.

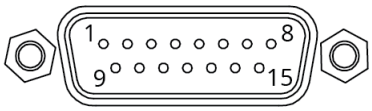
Equipment and the relay contacts shall be supplied only be a certified power supply which is used according to its environmental ratings. For use between 40°C and 60°C ambient temperature, a suitable rated power supply is required.

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

15 Pin connector details:

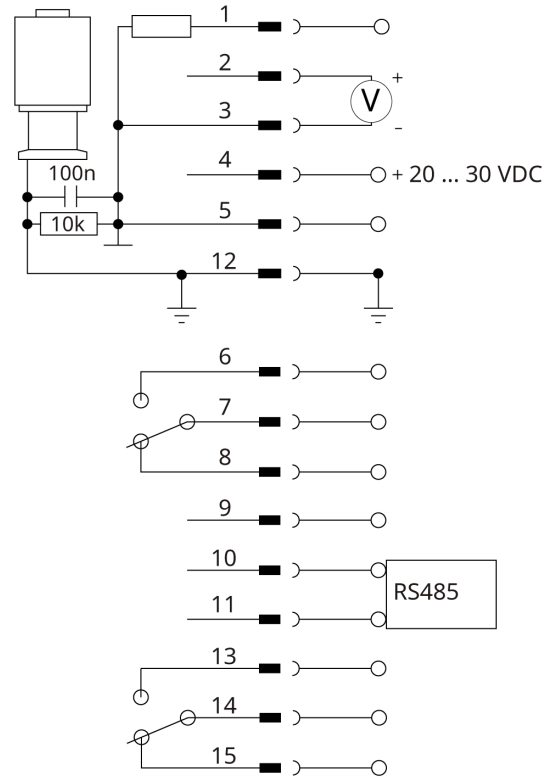
The Ground (Pin 12) and supply common (Pin 5) must always be grounded in the supply unit.

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



Pin No.	Description	Pin No.	Description
Pin 1	Identification: 15 kΩ	Pin 9	-
Pin 2	Signal output 0 ... 10 VDC	Pin 10	RS485 +
Pin 3	AGND	Pin 11	RS485 -
Pin 4	Voltage supply 24 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:



NOTE

We recommend to have "Ground" (Pin 12) and supply common (Pin 5) grounded.

4 Operation

4.1 General

The Digital transmitter is equipped with an internal Pirani sensor.

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 DTP 400 or DTP 400 C

The output signal 1.5 --- 8.5 V of the transmitter DTP 400 (DTP 400 C: 2.2 –-- 8.5 V) has a logarithmic dependence on pressure over the whole measurement range 1200 – 1 x 10^{-4} mbar (DTP 400 C: 1000 – 5 x 10^{-4} mbar). Conversion of voltage signal and pressure is done according to the following formula:

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

$p/mbar = 10^{(Vout/V - 5.5)}$

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* [➔ 18].

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

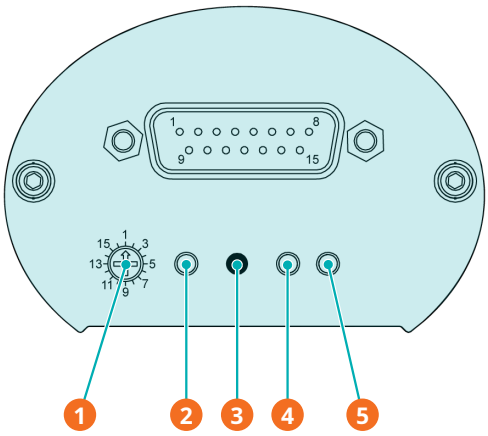
The gauge is adjusted ex-factory in upright position with a supply voltage of 24 VDC. Through contamination, aging, extreme climatic conditions, or other installation orientations readjustment may be required.

Accuracy is reduced in the range above 20 mbar.

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 N_2 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 DTP 400 or 400 D / DTP 400 C or 400 DC signalizes the following operational states:

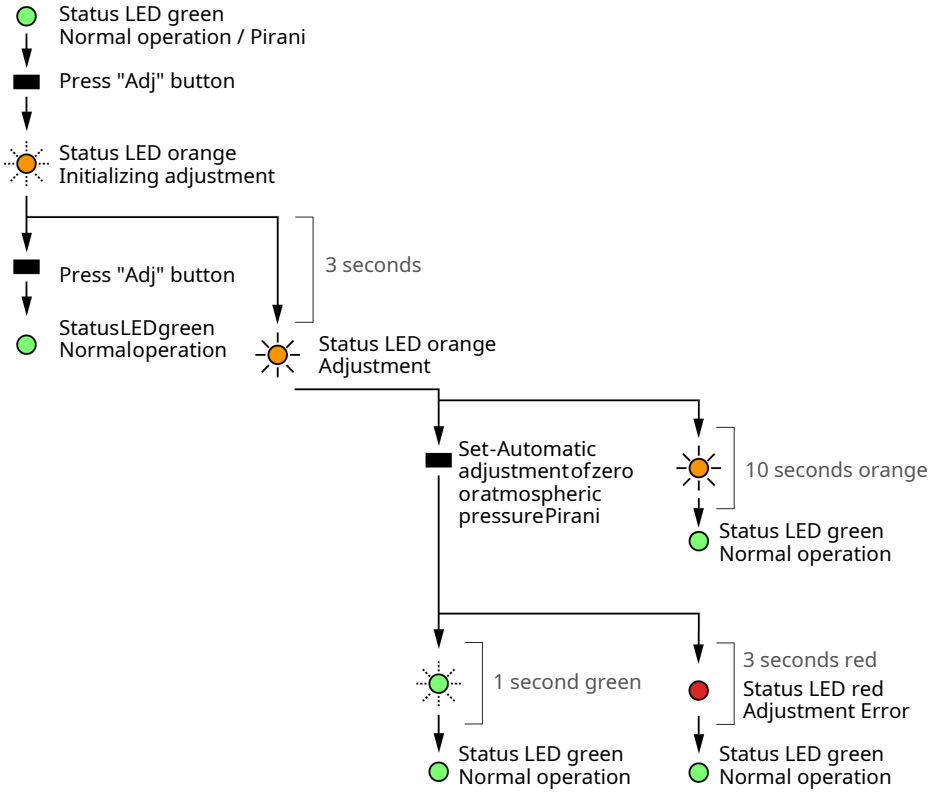
- Normal operation / Pirani (green LED continuously on)
- Error (red LED continuously on)
- Ready for adjustment (orange LED flashing slowly)
- Initializing adjustment (orange LED flashing quickly)

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

In addition, the digital transmitter “DTP 400 D or DTP 400 DC” 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* [➔ 23].

4.3 Changing Display Unit and Orientation

NOTE

This instruction is only applicable for DTP 400 D or DTP 400 DC.

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 VACTEST 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 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.

NOTE

For zero adjustment actual pressure should be less than 5 x 10^{-5} mbar. Simultaneously with zero adjustment an updated estimation for the Pirani sensor's actual degree of wear is calculated.

4.4.1 Readjustment at Zero or Atmospheric Pressure

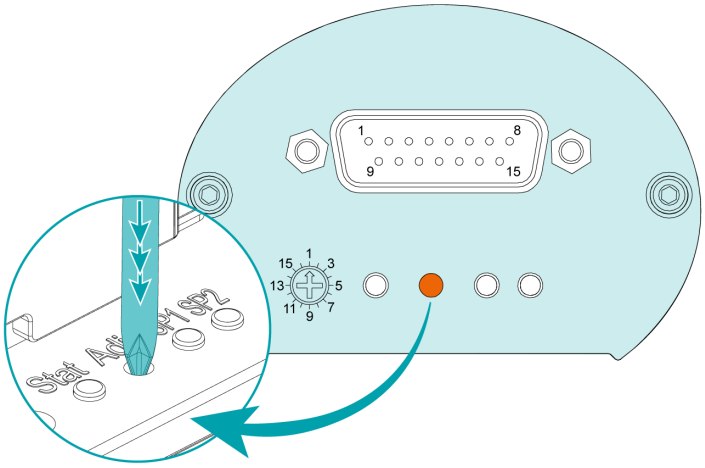
Digital readjustment at zero or atmospheric pressure can be done by means of the "Adj" pushbutton. There are two adjustment point in the digital transmitter; "zero adjustment by pushbutton" and "adjustment by the pushbutton at atmospheric pressure". The transmitter will notice automatically which adjustment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

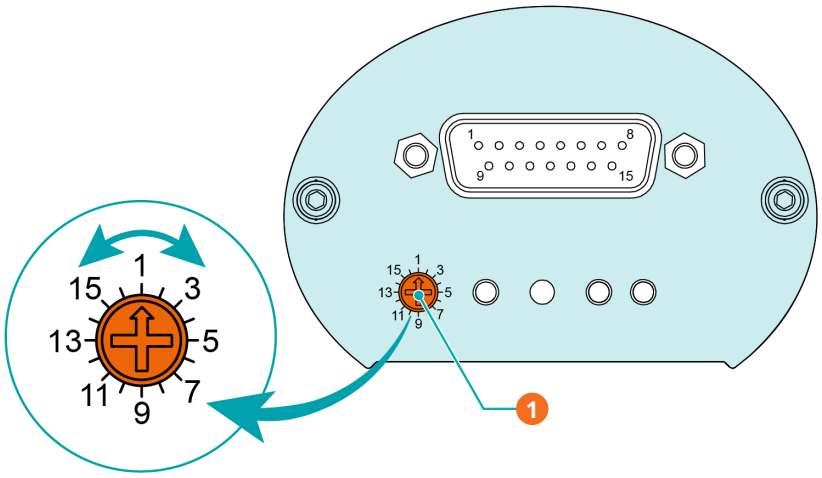
Ask your Busch representative to get the document.

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 *Switching Points Parameters* [➔ 21] for more information.
R2	Relay 2: Display and set the relay mode; see chapter *Switching Points Parameters* [➔ 21] for more information.
AH	Adjust High (Atmosphere Pressure): Adjustment of the Pirani sensor at atmospheric pressure; see chapter *Readjustment via Software commands* [➔ 23] for more information.
AL	Adjust Low (Zero Pressure): Adjustment of the Pirani sensor at zero pressure; see chapter *Readjustment via Software commands* [➔ 23] for more information.
MR	Measurement Range
MV	Measurement Value
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 *Scaling of Output - Analog Output Characteristic (OC)* [➔ 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. DTP 400 D or DTP 400 DC
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

5.5 Display Functions

NOTE

This instruction is only applicable for DTP 400 D or DTP 400 DC.

The table below 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

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.

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* [➔ 11].

Relay R1, R2:

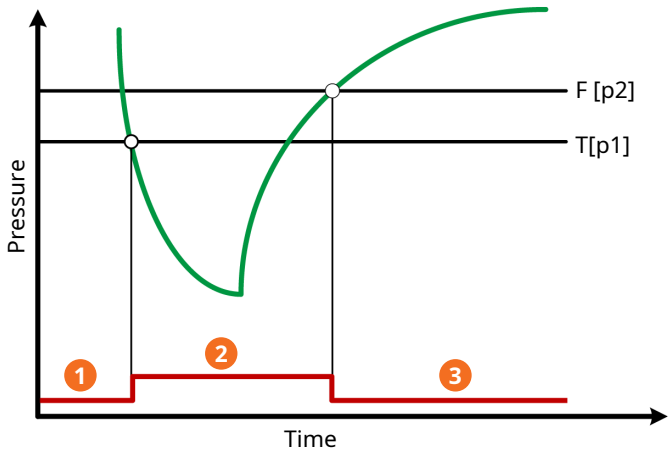
The relays can be configured independently for various switching modes. The parameter is used to query and set these switching modes.

Setting T[p1] F[p2]:

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

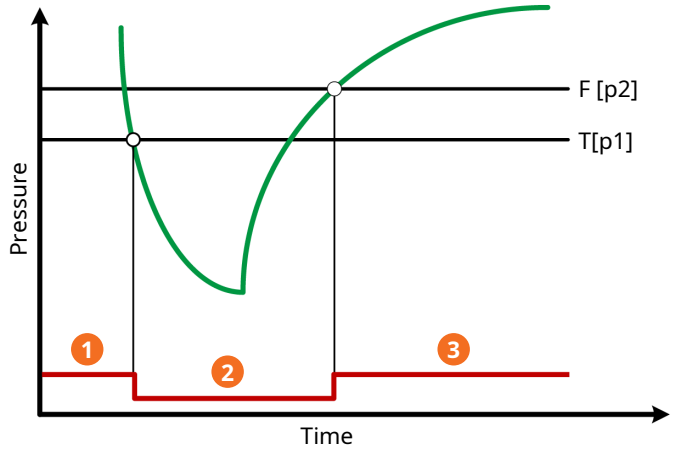
Setpoint Functionality

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).

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 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 x 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 x 10^{-4} ... 1 x 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

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* [➔ 23] is carried out at reference pressures above 5 x 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 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 N_2 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

5.8.2 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.

5.8.3 Operating Hours (OH)

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

5.8.4 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.

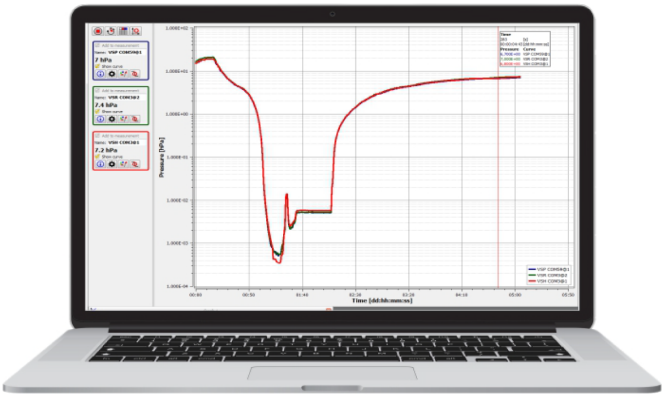
Additionally, the parameter contains the number of operating hours which have elapsed since the last zero adjustment.

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.

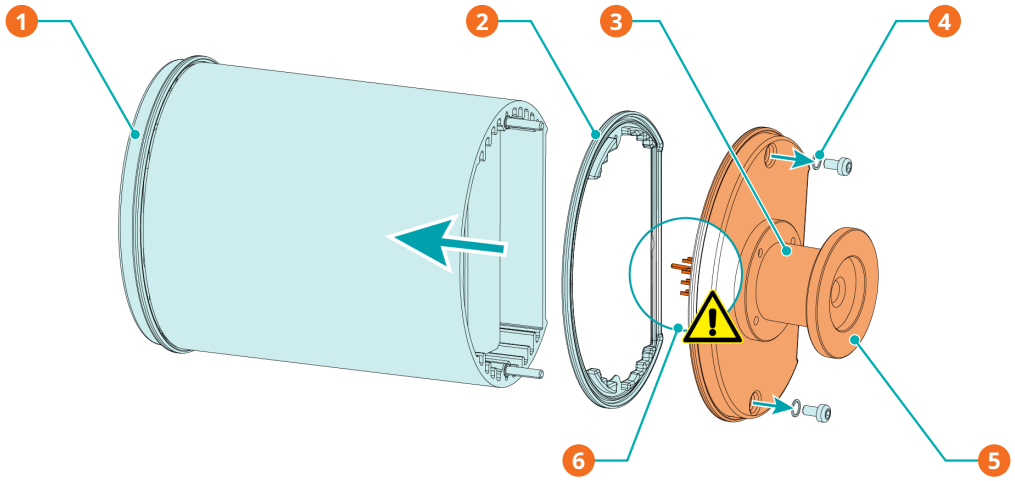
When returning the gauge for service please fill out a declaration of contamination form and include it in the shipment. This document is mandatory to protect our service staff.

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 *Technical Data* [➔ 29] for measuring range

8 Spare Parts and Accessories

NOTICE

Use of non-Busch genuine spare parts.

Risk of premature failure!

Loss of efficiency!

- Use only Busch genuine spare parts, consumables and supplies to ensure correct operation of the device and to validate the warranty.

Spare part	Description	Part no.
Sensor head	Intended for: - DTP 400 (DN 16 ISO-KF flange) - DTP 400 D (DN 16 ISO-KF flange)	0680 204 596
Sensor head	Intended for: - DTP 400 C (DN 16 ISO-KF flange) - DTP 400 DC (DN 16 ISO-KF flange)	0680 204 597

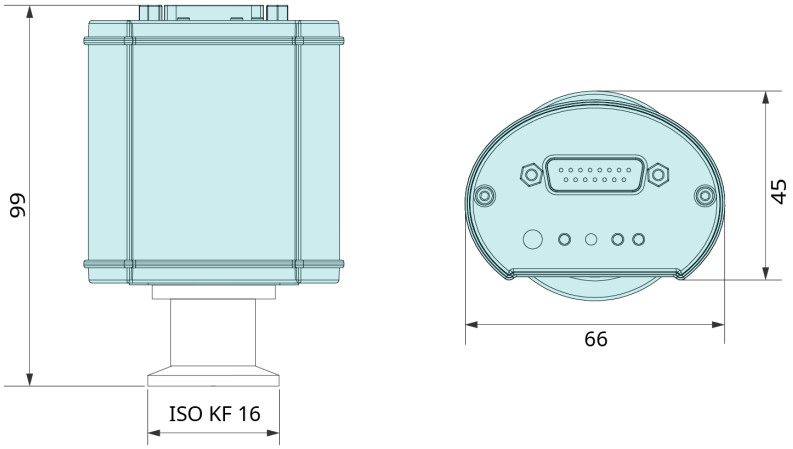
Controller	Description	Part no.
Active Sensor Controller	CTR 002, 2 channels	0656 202 928
Active Sensor Controller	CTR 004, 4 channels	0656 202 929

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

NOTE

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

9 Technical Data



	DTP 400 or 400 C	DTP 400 D or 400 DC
Measurement principle	Heat conduction Pirani (Pirani depending on gas type)	
Measuring range	1000 - 1.0 x 10^{-4} mbar (700 - 1.0 x 10^{-4} Torr)	
Measuring range	1000 – 1 x 10^{-4} mbar (700 - 1 x 10^{-4} Torr)	1000 - 5 x 10^{-4} mbar (700 - 5 x 10^{-4} Torr)
Max. overload	10 bar abs.	
Accuracy	1000 ... 20 mbar: approx. 0.3 % full scale end 20 ... 2 x 10^{-3} mbar: 10 % of reading	1000 ... 20 mbar: approx. 0.3 % full scale end 20 ... 2 x 10^{-3} mbar: 10 % of reading
Repeatability	20 ... 2 x 10^{-3} mbar: 2 % of reading	10 ... 2 x 10^{-3} mbar: 5 % of reading
Materials in contact with vacuum	Stainl. steel 1.4307, tungsten, nickel, glass	Stainl. steel 1.4307, platinum/ rhodium, nickel, glass
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 W (relays / display)
Output signal	0 – 10 VDC, min. 10 kΩ, measuring range: 1.5 - 8.5 VDC, logarithmic	0 – 10 VDC, min. 10 kΩ, measuring range: 2.2 - 8.5 VDC, logarithmic
Serial interface	RS485: 9.6 ... 115 kBd, 8 databit, 1 stopbit, no parity	
Switching points	2x relay, potential free 49 VAC / 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 DTP 400 or 400 D / DTP 400 C or 400 DC

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 61326-1 : 2021 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 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 DTP 400 or 400 D / DTP 400 C or 400 DC

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 61326-1 : 2021 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

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