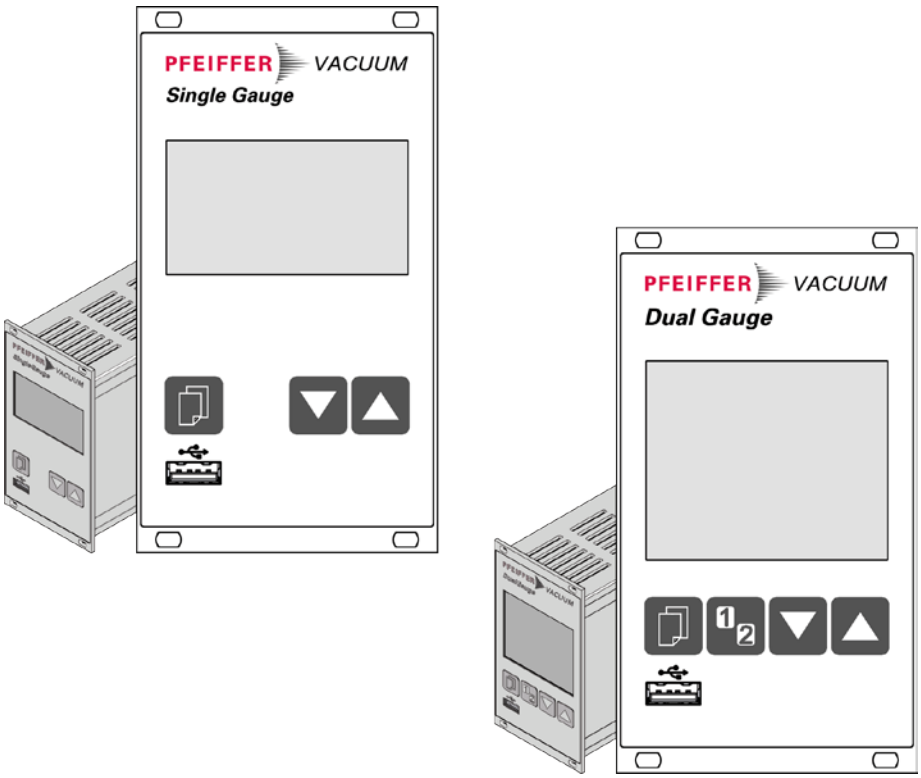

COMMUNICATION PROTOCOL

EN

Translation of the original instructions

TPG 361, TPG 362

Mnemonics and Pfeiffer Vacuum Protocol for Single- and Dual-Channel Measurement and Control Units for ActiveLine Gauges

BG 5510 BEN / D (2018-08)

PFEIFFER VACUUM

Product Identification

SingleGauge TPG 361 and DualGauge TPG 362 → 🕮 BG 5500 BEN

Validity

This document applies to products with part numbers:

PT G28 040	(SingleGauge TPG 361)
PT G28 290	(DualGauge TPG 362)

The part number (Mod.-No.) can be found on the product nameplate.

This manual is based on firmware version V010400.

If your unit does not work as described in this document, please check that it is equipped with the above firmware version (→ 🗎 30).

If not indicated otherwise in the legends, the illustrations in this document correspond to the unit TPG 362 (DualGauge). They apply to TPG 361 (SingleGauge) by analogy.

We reserve the right to make technical changes without prior notice.

Intended Use

The RS485 interface is used for communication between the TPG 361 / TPG 362 and a computer or a terminal.

Trademark

FullRange® Pfeiffer Vacuum GmbH

Contents

For cross-references within this document, the symbol (→ 🗎 XY) is used; for cross-references to further documents listed under "Literature", use is made of the symbol (→ 🕮 [Z]).

1 Mnemonics Protocol

The serial interface is used for communication between the TPG 36x and a computer. A terminal can be connected for test purposes.

When the TPG 36x is put into operation, it starts transmitting measured values in intervals of 1 s. As soon as the first character is transferred to the TPG 36x, the automatic transmission of measured values stops. After the necessary inquiries or parameter modifications have been made, the transmission of measured values can be started again with the **COM** command (→ 🗎 8).

Communication structure and procedures are identical for both controllers TPG 361 and TPG 362. Therefore the term TPG 36x is used in this chapter.

It should be noted that mnemonics with channel specific parameters must be issued with the number of values corresponding to the number of channels of the respective device.

Example: TPG 361 Transmit: **OFC** [,a]
TPG 362 Transmit: **OFC** [,a,b]

1.1 Installation

SingleGauge TPG 361 and DualGauge TPG 362 → 🕮 BG 5500 BEN

1.2 Data Transmission

The data transmission is bi-directional, i.e. data and control commands can be transmitted in either direction.

Configuration of the interface

SingleGauge TPG 361 and DualGauge TPG 362 → 🕮 BG 5500 BEN

Data format

1 start bit, 8 data bits, no parity bit, 1 stop bit, no hardware handshake

Definitions

The following abbreviations and symbols are used:

Symbol	Meaning	Dez	Hex
HOST	Computer or terminal		
[...]	Optional elements		
ASCII	American Standard Code for Information Interchange		
<ETX>	END OF TEXT (CTRL C) Reset the interface	3	03
<CR>	CARRIAGE RETURN Go to beginning of line	13	0D
<LF>	LINE FEED Advance by one line	10	0A
<ENQ>	ENQUIRY Request for data transmission	5	05
<ACK>	ACKNOWLEDGE Positive report signal	6	06
<NAK>	NEGATIVE ACKNOWLEDGE Negative report signal	21	15
<ESC>	ESCAPE	27	1B

"Transmit": Data transfer from HOST to TPG 36x
"Receive": Data transfer from TPG 36x to HOST

Flow Control

After each ASCII string, the HOST must wait for a report signal (<ACK><CR><LF> or <NAK> <CR><LF>).

The input buffer of the HOST must have a capacity of at least 32 bytes.

1.3 Communication Protocol

Transmission format

Messages are transmitted to the TPG 36x as ASCII strings in the form of mnemonic operating codes and parameters. All mnemonics comprise three ASCII characters.

Spaces are ignored. <ETX> (CTRL C) clears the input buffer in the TPG 36x.

Do not transmit any LINE FEEDS (<LF>) via the RS485 half duplex line for fear they could cause data collisions on the bus.

The use of LINE FEED is generally allowed for other interfaces (USB, Ethernet), but should be avoided for reasons of time.

Transmission protocol

HOST	TPG 36x	Explanation
Mnemonics [and parameters] <CR>[<LF>]	——————> ——————————>	Receives message with "end of message"
<——————————	<ACK><CR><LF>	Positive acknowledgment of a received message

Reception format

When requested with a mnemonic instruction, the TPG 36x transmits the measurement data or parameters as ASCII strings to the HOST.

<ENQ> must be transmitted to request the transmission of an ASCII string. Additional strings, according to the last selected mnemonic, are read out by repetitive transmission of <ENQ>.

If <ENQ> is received without a valid request, the ERROR word is transmitted.

Reception protocol

HOST	TPG 36x	Explanation
Mnemonics [and parameters] <CR>[<LF>]	——————> ——————————>	Receives message with "end of message"
<——————————-	<ACK><CR><LF>	Positive acknowledgment of a received message
<ENQ> -——————————>		Requests to transmit data
<——————————	Measurement values or parameters	Transmits data with "end of message"
<——————————	<CR><LF>	
:		:
<ENQ> ——————————>		Requests to transmit data
<——————————	Measurement values or parameters	Transmits data with "end of message"
<——————————	<CR><LF>	

Error processing

The strings received are verified in the TPG 36x. If an error is detected, a negative acknowledgment <NAK> is output.

Error recognition protocol

HOST	TPG 36x	Explanation
Mnemonics [and parameters] <CR>[<LF>]	——————> -——————————>	Receives message with "end of message"
***** Transmission or programming error *****		
<——	<NAK><CR><LF>	Negative acknowledgment of a received message
Mnemonics [and parameters] <CR>[<LF>]	——————-> ——————————>	Receives message with "end of message"
<——————————	<ACK><CR><LF>	Positive acknowledgment of a received message

1.4 Mnemonics

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IOT	I/O test	29
LCM	Start / stop data logger	26
LNG	Language (display)	23
LOC	Keylock	29
MAC	Ethernet MAC address	30
NAD	Node (device) address for RS485	23
OFC	Offset correction (linear gauges)	17
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PNR	Firmware version	30
PR1	Measurement data gauge 1	10
PR2	Measurement data gauge 2	10
PRE	Pirani range extension	23
PRO	Protocol serial interface	24
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SC2	Gauge 2 control	18
SCM	Save / load parameters (USB)	27
SEN	Gauge on/off	12

1.5 Measurement Mode

1.5.1 COM - Continuous Output of Measurement Values

Transmit: **COM** [,a] <CR>[<LF>]

	Description
a	Mode, a = 0 –> 100 ms 1 –> 1 s (default) 2 –> 1 minute

Receive: <ACK><CR><LF>

<ACK> is immediately followed by the continuous output of the measurement value in the desired interval.

Receive: b,sx.xxxxEsxx,c,sy.yyyyEsyy <CR><LF>

	Description
b	Status gauge 1, b = 0 –> Measurement data okay 1 –> Underrange 2 –> Overrange 3 –> Sensor error 4 –> Sensor off (IKR, PKR, IMR, PBR) 5 –> No sensor (output: 5.2.0000E-2 [hPa]) 6 –> Identification error
sx.xxxxEsxx	Measurement value gauge 1 [1)] [in current pressure unit] (s = sign)
c	Status gauge 2
sy.yyyyEsyy	Measurement value gauge 2 [1)] [in current pressure unit] (s = sign)

1) Values always in exponential format.
For logarithmic gauges, the 3rd and 4th decimal are always 0.

1.5.2 CPR - Combined pressure range (linear gauges, TPG 362 only)

This command combines different pressure ranges to one combined pressure range, if several linear gauges with different full scales (F.S.) are connected to the TPG 362. Thus the pressure for this combined pressure range can be read out with best accuracy.

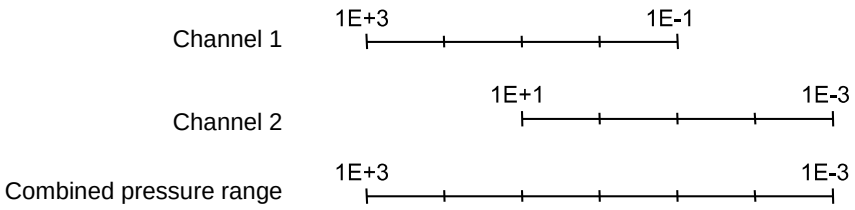
The pressure is higher than the full scale of the gauge with lower full scale: The TPG 362 switches to the gauge with higher full scale.

Only one linear gauge is connected: The measurement value of this gauge is output.

No linear gauge is connected: 1000 hPa is output as measurement value and the parameters a and b are set to "0".

Example

Channel 1: linear gauge, 1000 hPa F.S.
Channel 2: linear gauge, 10 hPa F.S.



Transmit command: CPR,1,2
CPR,2,1

Transmit: **CPR** [,a,b] <CR>[<LF>]

	Description
a	Measurement channel of the selected gauge, a =
	0 –> No linear gauge connected
	1 –> Measurement channel 1
	2 –> Measurement channel 2
b	Measurement channel of the selected gauge

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b,sx.xxxxEsxx

	Description
a	Measurement channel of the selected gauge
b	Measurement channel of the selected gauge
sx.xxxxEsxx	Combined measurement value [1] [in current pressure unit]
	(s = sign)

[1] Values always in exponential format.

1.5.3 ERR - Error Status

Transmit: **ERR** <CR>[<LF>] Error status

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: aaaa <CR><LF>

	Description
aaaa	Error status, aaaa = 0000 –> No error 1000 –> ERROR (controller error (see display on front panel) 0100 –> NO HWR (no hardware) 0010 –> PAR (inadmissible parameter) 0001 –> SYN (Syntax error)

The ERROR word is cancelled when read out. If the error persists, it is immediately set again.

1.5.4 PR1, PR2 - Measurement Data Gauge 1 or 2

Transmit: **PRn** <CR>[<LF>]

	Description
n	Measurement value, n = 1 –> Gauge 1 2 –> Gauge 2

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,sx.xxxxEsxx <CR><LF>

	Description
a	Status, a = 0 –> Measurement data okay 1 –> Underrange 2 –> Overrange 3 –> Sensor error 4 –> Sensor off (IKR, PKR, IMR, PBR) 5 –> No sensor (output: 5,2.0000E-2 [hPa]) 6 –> Identification error
sx.xxxxEsxx	Measurement value [1] [in current pressure unit] (s = sign)

[1] Values always in exponential format.
For logarithmic gauges, the 3rd and 4th decimal are always 0.

1.5.5 PRX - Measurement Data Gauges 1 and 2

Transmit: **PRX** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,sx.xxxxEsxx,b,sy.yyyyEsyy <CR><LF>

	Description
a	Status gauge 1, a = 0 –> Measurement data okay 1 –> Underrange 2 –> Overrange 3 –> Sensor error 4 –> Sensor off (IKR, PKR, IMR, PBR) 5 –> No sensor (output: 5,2.0000E-2 [hPa]) 6 –> Identification error
sx.xxxxEsxx	Measurement value gauge 1 [1] [in current pressure unit] (s = sign)
b	Status gauge 2
sy.yyyyEsyy	Measurement value gauge 2 [1] [in current pressure unit] (s = sign)

[1] Values always in exponential format.
For logarithmic gauges, the 3rd and 4th decimal are always 0.

1.5.6 RES - Reset

Transmit: **RES** [,a] <CR>[<LF>]

	Description
a	a = 1 –> Cancels currently active error and returns to measurement mode

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: b[,b][,b][…] <CR><LF>

	Description (TPG 361 only)
b	List of all present error messages, b = 0 –> No error 1 –> Watchdog has responded 2 –> Task fail error 5 –> FLASH error 6 –> RAM error 7 –> EEPROM error 9 –> DISPLAY error 10 –> A/D converter error 11 –> Gauge error (e.g. filament rupture, no supply) 12 –> Gauge identification error

	Description (TPG 362 only)
b	List of all present error messages, b = 0 –> No error 1 –> Watchdog has responded 2 –> Task fail error 3 –> FLASH error 4 –> RAM error 5 –> EEPROM error 6 –> DISPLAY error 7 –> A/D converter error 8 –> UART error 9 –> Gauge 1 error (e.g. filament rupture, no supply) 10 –> Gauge 1 identification error 11 –> Gauge 2 error (e.g. filament rupture, no supply) 12 –> Gauge 2 identification error

1.5.7 SEN - Gauge on/off

Transmit: **SEN** [,a,b] <CR>[<LF>]

	Description
a	Gauge 1, a = 0 –> No status change 1 –> Turn gauge off 2 –> Turn gauge on
b	Gauge 2

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b <CR><LF>

	Description
a	Status gauge 1, a = 0 –> Gauge cannot be turned on/off 1 –> Gauge turned off 2 –> Gauge turned on
b	Status gauge 2

1.5.8 TID - Gauge Identification

Transmit: **TID** <CR>[<LF>] Gauge identification

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b <CR><LF>

	Description
a	Identification gauge 1, a = TPR/PCR (Pirani Gauge or Pirani Capacitance Gauge) IKR (Cold Cathode Gauge 10^{-9} and 10^{-11}) PKR (FullRange® CC Gauge) PBR (FullRange® BA Gauge) IMR (Pirani / High Pressure Gauge) CMR/APR (Linear gauge noSENSOR (no sensor) noIDENT (no identifier)
b	Identification gauge 2

1.6 Switching Function Parameters

1.6.1 SPS - Switching Function Status

Transmit: **SPS** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b,c,d <CR><LF>

	Description
a	Status switching function 1, a = 0 –> Off 1 –> On
b	Status switching function 2
c	Status switching function 3
d	Status switching function 4

1.6.2 SP1 … SP4 - Switching Function 1 … 4

Transmit: **SPx** [,a,x.xxxxEsxx,y.yyyyEsyy] <CR>[<LF>]

	Description
x	Switching function, x = 1 –> Switching function 1 2 –> Switching function 2 3 –> Switching function 3 4 –> Switching function 4
a	Switching function assignment, a = 0 –> Turned off 1 –> Turned on 2 –> Measurement channel 1 3 –> Measurement channel 2
x.xxxxEsxx	Lower threshold [1)] [in current pressure unit] (default = depending on gauge) (s = sign)
y.yyyyEsyy	Upper threshold [1)] [in current pressure unit] (default = depending on gauge) (s = sign)

1) Values can be entered in any format.
They are internally converted into the floating point format.

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,x.xxxxEsxx,y.yyyyEsyy <CR><LF>

	Description
a	Switching function assignment
x.xxxxEsxx	Lower threshold [in current pressure unit] (s = sign)
y.yyyyEsyy	Upper threshold [in current pressure unit] (s = sign)

1.7 Gauge Parameters

1.7.1 CAL - Calibration Factor

Precondition: Parameter "GAS" is set to "7" (other gases) (→ 🗎 16). Except linear gauges.

This parameter is effective in the entire measurement range of the gauge.

Transmit: **CAL** [,a.aaa,b.bbb] <CR>[<LF>]

	Description
a.aaa	Calibration factor gauge 1, 0.100 … 10.000 (default = 1.000)
b.bbb	Calibration factor gauge 2

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a.aaa,b.bbb <CR><LF>

	Description
a.aaa	Calibration factor gauge 1
b.bbb	Calibration factor gauge 2

1.7.2 CF1, CF2 - Calibration Factor Gauge 1 and 2

Transmit: **CFx** [,a.aaa] <CR>[<LF>]

	Description
x	Calibration factor gauge x = 1 –> Gauge 1 2 –> Gauge 2
a.aaa	Calibration factor gauge x, 0.100 … 10.000 (default = 1.000)

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a.aaa,b.bbb <CR><LF>

	Description
a.aaa	Calibration factor gauge 1
b.bbb	Calibration factor gauge 2

1.7.3 DCD - Display Resolution

Transmit: **DCD** [,a,a] <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,a <CR><LF>

	Description
a	Resolution a = 0 –> AUTO (default) 1 –> One digit 2 –> Two digits 3 –> Three digits 4 –> Four digits

When the PrE (→ 🗎 23) is ON and the pressure is in the range p<1.0E-4 hPa the display resolution of the PCR Gauge is reduced by one decimal digit.

1.7.4 DGS - Degas

Transmit: **DGS** [,a,b] <CR>[<LF>]

	Description
a	Degas gauge 1, a = 0 –> Degas off (default) 1 –> Degas on (3 minutes)
b	Degas gauge 2

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b <CR><LF>

	Description
a	Degas status gauge 1
b	Degas status gauge 2

1.7.5 FIL - Measurement Value Filter

Transmit: **FIL** [,a,b] <CR>[<LF>]

	Description
a	Filter gauge 1, a = 0 –> Filter off 1 –> Fast 2 –> Normal 3 –> Slow
b	Filter gauge 2

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b <CR><LF>

	Description
a	Filter time constant gauge 1
b	Filter time constant gauge 2

1.7.6 FSR - Measurement Range (Linear Gauges)

The full scale value of the measurement range (Full Scale) of linear gauges has to be defined by the user; the full scale value of logarithmic gauges is automatically recognized.

Transmit: **FSR** [,a,b] <CR>[<LF>]

	Description
a	Full scale value gauge 1, a = 0 –> 0.01 hPa 1 –> 0.1 hPa 2 –> 1 hPa 3 –> 10 hPa 4 –> 100 hPa 5 –> 1000 hPa (default) 6 –> 200 kPa 7 –> 500 kPa 8 –> 1000 kPa 9 –> 5000 kPa
b	Full scale value gauge 2

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b <CR><LF>

	Description
a	Full scale value gauge 1
b	Full scale value gauge 2

1.7.7 GAS - Gas Type Correction

Transmit: **GAS** [,a,a] <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,a <CR><LF>

	Description
a	Gas type correction, a = 0 –> nitrogen / air (default) 1 –> Argon 2 –> Hydrogen 3 –> Helium 4 –> Neon 5 –> Krypton 6 –> Xenon 7 –> Other gases Calibration factor for other gases by entering command "COR" (→ 14)

1.7.8 OFC - Offset Correction (Linear Gauges)

Transmit: **OFC** [,a,b] <CR>[<LF>]

	Description
a	Offset correction gauge 1, a = 0 –> Off (default) 1 –> On 2 –> Determine offset value and activate offset correction
b	Offset correction gauge 2

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b <CR><LF>

	Description
a	Offset correction gauge 1
b	Offset correction gauge 2

1.7.9 OFD - Offset Display (Linear Gauges)

Transmit: **OFD** [,sa.aaaaEsaa,sb.bbbbEsbb] <CR>[<LF>]

	Description
sa.aaaaEsaa	Gauge 1 Offset [1)], [in current pressure unit] (default = 0.0000E+00) (s = sign)
sb.bbbbEsbb	Gauge 2 Offset [1)] (s = sign)

[1)] Values can be entered in any format. They are internally converted into the floating point format.

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: sa.aaaaEsaa,sb.bbbbEsbb <CR><LF>

	Description
sa.aaaaEsaa	Gauge 1 Offset [1)] (s = sign)
sb.bbbbEsbb	Gauge 2 Offset [1)] (s = sign)

1.8 Gauge Control

1.8.1 SC1, SC2 - Gauge 1 and 2 Control

Transmit: **SCx** [,a,b,c.ccEscc,d.ddEsdd] <CR>[<LF>]

	Description
x	Controlled gauge, x =
	1 –> Gauge 1
	2 –> Gauge 2
a	Gauge activation, a =
	0 –> Manual (default)
	1 –> Hot start
	2 –> External
	3 –> Via measurement channel 1
	4 –> Via measurement channel 2
b	Gauge deactivation, b =
	0 –> Manual (default)
	1 –> Self control
	2 –> External
	3 –> Via measurement channel 1
	4 –> Via measurement channel 2
c.ccEscc	ON threshold (s = sign)
d.ddEsdd	OFF threshold (s = sign)

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b,c.ccEscc,d.ddEsdd <CR><LF>

	Description
a	Gauge activation
b	Gauge deactivation
c.ccEscc	ON threshold (s = sign)
d.ddEsdd	OFF threshold (s = sign)

1.9 General Parameters

1.9.1 BAL - Backlight

Transmit: **BAL** [,a] <CR>[<LF>]

	Description
a	Backlight in percent, a = 0 … 100
	100% is full brightness

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Backlight

1.9.2 BAU - Transmission Rate (USB)

Transmit: **BAU** [,a] <CR>[<LF>]

	Description
a	Transmission rate, a = 0 –> 9600 Baud (default) 1 –> 19200 Baud 2 –> 38400 Baud 3 –> 57600 Baud 4 –> 115200 Baud

The transmission rate of the RS485 interface is 9600 baud and cannot be changed.

As soon as the new baud rate has been entered, the report signal is transmitted at the new transmission rate.

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: x <CR><LF>

	Description
a	Transmission rate

1.9.3 DCB - Display Control Bar Graph

Transmit: **DCB** [,a,b] <CR>[<LF>]

	Description
a	Measurement channel, a =
	0 –> Measurement channel 1
	1 –> Measurement channel 2
b	Bar graph display, b =
	0 –> Off (default)
	1 –> Bar graph covering full scale range
	2 –> Bar graph covering full scale range, high-level presentation
	3 –> Bar graph covering full scale range and setpoint threshold
	4 –> Bar graph covering a decade according to current measurement value
	5 –> Bar graph covering a decade according to current measurement value, high-level presentation
	6 –> Bar graph covering a decade according to current measurement value and setpoint threshold
	7 –> p = $f_{(t)}$, autoscaled, 0.2 seconds / pixel For each measurement every 200 ms a measurement value is saved in tabular form and the last 100 measurement values (=100 pixel) are shown autoscaled. The represented data string corresponds to a logging duration of 20 seconds.
	8 –> p = $f_{(t)}$, autoscaled, 1 second / pixel For each measurement every second a measurement value is saved in tabular form and the last 100 measurement values (=100 pixel) are shown autoscaled. The represented data string corresponds to a logging duration of 100 seconds.
	9 –> p = $f_{(t)}$, autoscaled, 6 seconds / pixel For each measurement every 6 seconds a measurement value is saved in tabular form and the last 100 measurement values (=100 pixel) are shown autoscaled. The represented data string corresponds to a logging duration of 10 minutes.
	10 –> p = $f_{(t)}$, autoscaled, 1 minute / pixel For each measurement every minute a measurement value is saved in tabular form and the last 100 measurement values (=100 pixel) are shown autoscaled. The represented data string corresponds to a logging duration of 100 minutes.
	11 –> p = $f_{(t)}$, autoscaled, 30 minutes / pixel For each measurement every 30 minutes a measurement value is saved in tabular form and the last 100 measurement values (=100 pixel) are shown autoscaled. The represented data string corresponds to a logging duration of 50 houres.
	12 –> The sensor type is displayed for the selected measuring channel.

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b <CR><LF>

	Description
a	Measurement channel
b	Bar graph display

1.9.4 DCC - Display Control Contrast

Transmit: **DCC** [,a] <CR>[<LF>]

	Description
a	Contrast in percent, a = 0 … 100 100% = full contrast

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Contrast

1.9.5 DCS - Display Control Screensave

Transmit: **DCS** [,a] <CR>[<LF>]

	Description
a	Screensave, a = 0 –> Off (default) 1 –> After 10 minutes 2 –> After 30 minutes 3 –> After 1 hour 4 –> After 2 hours 5 –> After 8 hours 6 –> The backlight is switched off completely after 1 minute

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Screensave

1.9.6 ERA - Error Relay Allocation

Transmit: **ERA** [,a] <CR>[<LF>]

	Description
a	Switching behaviour error relay, a = 0 –> Switches for all errors (default) 1 –> Only unit errors 2 –> Error sensor 1 and unit error 3 –> Error sensor 2 and unit error (TPG 362 only)

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Switching behaviour error relay

1.9.7 EVA - Measurement Range End Value

Transmit: **EVA** [,a] <CR>[<LF>]

	Description
a	Measurement range end value, a = 0 –> UR or OR is displayed (default) when an underrange or overrange occurs 1 –> The measurement range end value is displayed when an underrange or overrange occurs

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Measurement range end value

1.9.8 FMT - Number Format (Measurement Value)

Transmit: **FMT** [,a] <CR>[<LF>]

	Description
a	Number format (measurement value), a = 0 –> Floating point format, if possible (default) 1 –> Exponential format

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Number format

1.9.9 LNG - Language (Display)

Transmit: **LNG** [,a] <CR>[<LF>]

	Description
a	Language, a = 0 –> English (default) 1 –> German 2 –> French

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Language

1.9.10 NAD - Node (Device) Address for RS485

Transmit: **NAD** [,a] <CR>[<LF>]

	Description
a	RS485 node address, a = 1 … 24

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	RS485 node address

Addressing the unit (RS485)

Entering the corresponding node address connects the selected unit to the HOST. The other units release the bus.

Transmit: <ESC>a

	Description
a	Node address of the unit, a = 1 … 24

All node addresses have two digits (00 … 24). The address must always be transmitted when a different unit is to be accessed.

1.9.11 PRE - Pirani Range Extension

Transmit: **PRE** [,a] <CR>[<LF>]

	Description
a	Pirani range extension, a = 0 –> Disabled (default) 1 –> Enabled

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Pirani range extension

PCR gauges only, measurement range up to 5×10^{-5} hPa.

1.9.12 PRO - Protocol Serial Interface

Transmit: **PRO** [,a] <CR>[<LF>]

	Description
a	Protocol serial interface, a = 0 –> Automatic recognition (default) 1 –> Pfeiffer Vacuum protocol 2 –> Mnemonics protocol

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Protocol serial interface

1.9.13 PUC - Penning Underrange Control

Transmit: **PUC** [,a] <CR>[<LF>]

	Description
a	Underrange control, a = 0 –> Off (default) 1 –> On

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Underrange control

1.9.14 SAV - Save Parameters (EEPROM)

Transmit: **SAV** [,a] <CR>[<LF>]

	Description
a	Save parameters to EEPROM, a = 0 –> Save default parameters (default) 1 –> Save user parameters

Receive: <ACK><CR><LF>

1.9.15 UNI - Pressure Unit

Transmit: **UNI** [,a] <CR>[<LF>]

	Description
a	Pressure unit, a = 0 –> mbar/bar 1 –> Torr 2 –> Pascal 3 –> Micron 4 –> hPascal (default) 5 –> Volt

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Pressure unit

1.10 Data Logger Parameters

The group is only available when a USB memory stick formatted for the the FAT file system (FAT32) is plugged in. Use a max. 32 GB memory stick.

1.10.1 DAT - Date

Transmit: **DAT** [,yyyy-mm-dd] <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: yyyy-mm-dd <CR><LF>

	Description
yyyy-mm-dd	Current date in the format yyyy-mm-dd

1.10.2 LCM - Start / Stop Data Logger

Further processing of recorded data (e.g. with Excel): Pay attention to the corresponding decimal separator (comma or dot).

Transmit: **LCM** [,a,b,c,ddddddd] <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b,c,ddddddd <CR><LF>

	Description
a	Data logger command, a =
	0 –> Stop / data logging stopped
	1 –> Start / data logging started
	2 –> Clear / deletion of measurement data file (ending CSV) from USB memory stick
b	Data logging interval, b =
	0 –> Logging interval 1/s
	1 –> Logging interval 1/10 s
	2 –> Logging interval 1/30 s
	3 –> Logging interval 1/60 s
	4 –> Logging interval in the event of measurement value changes ≥1%
	5 –> Logging interval in the event of measurement value changes ≥5%
c	Decimal separator, c =
	0 –> , (decimal comma)
	1 –> . (decimal point)
ddddddd	File name (max. 7 digits)

1.10.3 TIM - Time

Transmit: **TIM** [,hh:mm] <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: hh:mm <CR><LF>

	Description
hh:mm	Current time in the format hh:mm [24 h]

1.11 Group Setup

The group is only available when a USB memory stick formatted for the the FAT file system (FAT32) is plugged in. Use a max. 32 GB memory stick.

1.11.1 SCM - Save / Load Parameters (USB)

Transmit: **SCM** [,a,bb] <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Setup parameters, a = 0 –> Saving completed (read only) 1 –> CSV file is being saved (read only) 2 –> Loading all parameters from the USB memory stick onto the TPG 36x 3 –> Formatting USB memory stick (FAT32) 4 –> Deleting parameter files (ending CSV) from the USB memory stick
bb	Number in the file name (0 … 99)

1.12 Test Parameters

(For service personnel)

1.12.1 ADC - A/D Converter Test

Transmit: **ADC** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: aa.aaaa,bb.bbbb <CR><LF>

	Description
aa.aaaa	A/D converter channel 1 Measurement signal [0.0000 … 11.0000 V]
bb.bbbb	A/D converter channel 2 Measurement signal [0.0000 … 11.0000 V]

1.12.2 CDA – Re-calibration

Transmit: **CDA** [,yyyy-mm-dd] <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: yyyy-mm-dd <CR><LF>

	Description
yyyy-mm-dd	Date of the next re-calibration. A warning is displayed when the date is reached.

1.12.3 DIS - Display Test

Transmit: **DIS** [,a] <CR>[<LF>]

	Description
a	Display test, a = 0 –> Stops the test - display according to current operating mode (default) 1 –> Starts the test - all LEDs on

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: x <CR><LF>

	Description
a	Display test status

1.12.4 EEP - EEPROM Test

Test of the parameter memory.

Transmit: **EEP** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ> Starts the test (duration <1 s)

Do not keep repeating the test (EEPROM life).

Receive: aaaa <CR><LF>

	Description
aaaa	Error word

1.12.5 EPR - FLASH Test

Test of the program memory.

Transmit: **EPR** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ> Starts the test (very brief)

Receive: aaaa,bbbb <CR><LF>

	Description
aaaa	Error word
bbbb	Check sum (hex)

1.12.6 HDW - Hardware Version

Transmit: **HDW** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: aaaaaa <CR><LF>

	Description
aaaaaa	Hardware version, e.g. 010100

1.12.7 IOT - I/O Test

Caution

The relays switch irrespective of the pressure.

Starting a test program may cause unwanted effects in connected control systems.

Disconnect all sensor cables and control system lines to ensure that no control commands or messages are triggered by mistake.

Transmit: **IOT** [,a,bb] <CR>[<LF>]

	Description
a	Test status, a = 0 –> Test stopped 1 –> Test runs
bb	Relay status (in hex format), bb = 00 –> All relays deactivated 01 –> Switching function relay 1 activated 02 –> Switching function relay 2 activated 04 –> Switching function relay 3 activated 08 –> Switching function relay 4 activated 40 –> Error relay activated 7F –> All relays activated

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,bb <CR><LF>

	Description
a	I/O test status
bb	Relay status

1.12.8 LOC - Keylock

Transmit: **LOC** [,a] <CR>[<LF>]

	Description
a	Keylock, a = 0 –> Off (default) 1 –> On

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Keylock status

1.12.9 MAC - Ethernet MAC Address

Transmit: **MAC** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: aa-aa-aa-aa-aa-aa <CR><LF>

	Description
aa-aa-aa-aa-aa-aa	Ethernet MAC address of the TPG 36x: 00-A0-41-xx-xx-xx

1.12.10 PNR - Firmware Version

Transmit: **PNR** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: aaaaaa <CR><LF>

	Description
aaaaaa	Firmware version, e.g. 010100

1.12.11 RHR - Operating Hours

Transmit: **RHR** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Run (operating) hours, e.g. 24 [hours]

1.12.12 TAI - Test A/D Converter, ID Resistance

Transmit: **TAI** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ> Starts the test (very brief)

Receive: a.aa,b.bb <CR><LF>

	Description
a.aa	Identification resistance gauge 1 [kOhm]
b.bb	Identification resistance gauge 2 [kOhm]

1.12.13 TKB - Operator Key Test

Transmit: **TKB** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: abcd <CR><LF>

	Description
a	Key 1, a = 0 –> Not pushed 1 –> Pushed
b	Key 2, b = 0 –> Not pushed 1 –> Pushed
c	Key 3, c = 0 –> Not pushed 1 –> Pushed
d	Key 4, d = 0 –> Not pushed 1 –> Pushed

1.12.14 TLC - Torr Lock

Transmit: **TLC** [,a] <CR>[<LF>]

	Description
a	Torr lock, a = 0 –> Off (default) 1 –> On

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Torr lock status

1.12.15 TMP - Inner Temperature of the Unit

Inner temperature of the TPG 36x.

Transmit: **TMP** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: aa <CR><LF>

	Description
aa	Temperature (±2 °C) [°C]

1.12.16 WDT - Watchdog Control

Transmit: **WDT** [,a] <CR>[<LF>]

	Description
a	Watchdog control, a = 0 –> Manual error acknowledgement 1 –> Automatic error acknowledgement [1] (default)

[1] If the watchdog has responded, the error is automatically acknowledged and cancelled after 2 s.

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a <CR><LF>

	Description
a	Watchdog control

1.13 Further

1.13.1 AYT - Are you There?

Transmit: **AYT** <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,b,c,d,e <CR><LF>

	Description
a	Type of the unit, e.g. TPG362
b	Model No. of the unit, e.g. PTG28290
c	Serial No. of the unit, e.g. 44990000
d	Firmware version of the unit, e.g.. 010100
e	Hardware version of the unit, e.g. 010100

1.13.2 ETH - Ethernet Configuration

Transmit: **ETH** [,a,bbb.bbb.bbb.bbb,ccc.ccc.ccc.ccc,ddd.ddd.ddd.ddd] <CR>[<LF>]

Receive: <ACK><CR><LF>
Transmit: <ENQ>

Receive: a,bbb.bbb.bbb.bbb,ccc.ccc.ccc.ccc,ddd.ddd.ddd.ddd <CR><LF>

	Description
a	DHCP (dynamic host configuration protocol), a = 0 –> Statically 1 –> Dynamically
bbb.bbb.bbb.bbb	IP address
ccc.ccc.ccc.ccc	Subnet address
ddd.ddd.ddd.ddd	Gateway address

1.14 Example

"Transmit (T)" and "Receive (R)" are related to Host.

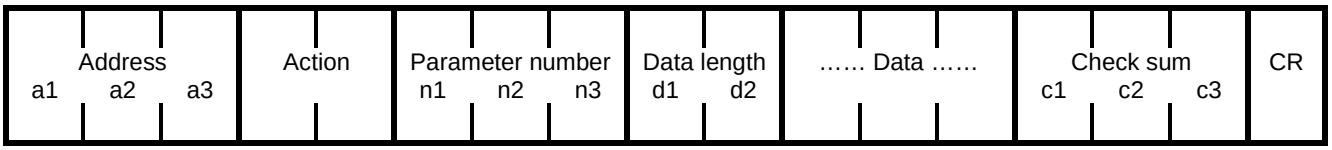
T: **TID** <CR> [<LF>]	Request for gauge identification
R: <ACK> <CR> <LF>	Positive acknowledgement
T: <ENQ>	Request for data transmission
R: TPR/PCR,CMR <CR> <LF>	Gauge identifications
T: **SEN** <CR> [<LF>]	Request for gauge statuses
R: <ACK> <CR> <LF>	Positive acknowledgement
T: <ENQ>	Request for data transmission
R: 0,0 <CR> <LF>	Gauge statuses
T: **SP1** <CR> [<LF>]	Request for parameters of switching function 1 (setpoint 1)
R: <ACK> <CR> <LF>	Positive acknowledgement
T: <ENQ>	Request for data transmission
R: 2,1.0000E-09,9.0000E-07 <CR> <LF>	Thresholds
T: **SP1**,2,6.80E-3,9.80E-3 <CR> [<LF>]	Modification of parameters of switching function 1 (setpoint 1)
R: <ACK> <CR> <LF>	Positive acknowledgement
T: **FOL**,1,2 <CR> [<LF>]	Modification of filter time constant (syntax error)
R: <NAK> <CR> <LF>	Negative acknowledgement
T: <ENQ>	Request for data transmission
R: 0001 <CR> <LF>	ERROR word
T: **FIL**,1,2 <CR> [<LF>]	Modification of filter time constant
R: <ACK> <CR> <LF>	Positive acknowledgement
T: <ENQ>	Request for data transmission
R: 1,2 <CR> <LF>	Filter time constants

2 Pfeiffer Vacuum Protocol

2.1 Telegram frame

The Pfeiffer Vacuum protocol is in ASCII format. Which means that all data bytes are representable symbols with an ASCII code between 32 and 127 with the exeption of the telegram final symbol carriage return (CR, ASCII 13).

The transmitted telegrams are located, without exception, within the following frameworks:



Address

Address of the unit addressed or answering (Slave), e.g. "042".

The controller and each measurement channel of a controller is assigned a own address ("aab"):

- aa: Address of the controller [1 … 24] (1 = default)
- b: Channel No. SingelGauge = {1}, DualGauge = {1, 2}

Ranges for measurement channel addresses:

SingleGauge: 011 … 241 (default = 011)

DualGauge: 011 … 242 (default = 011 for channel 1, 012 for channel 2)

Measurement channel independent parameters (e.g. node address, operating hours) are addressed via channel number b = 0 (e.g. "200" for controller 20).

Action

"00" = Read parameter (from master to slave).

"10" = Describe parameter (from master to slave), or
transmit requested parameter value (from slave to master), or
confirm written parameter value (from slave to master).

Parameter number

Number of the respective parameter, e.g. "303".

Daten length

E.g. "06" for six symbols, corresponds to the length of the field "Data".

Data

Data in the respective data type (→ 🗎 36).

Check sum

The sum of all ASCII symbols up to preceding check sum modulo 256 (decimal). E.g. sum = 786, 786 modulo 256 = 18 ⇒ Check sum = "018" (converted into ASCII string).

CR

carriage return (ASCII symbol 13) = end of frame.

As a result of the master/slave behaviour, data exchange always proceeds on the pattern: Master transmits (either control command or request). Slave answers (conformation or transmission of data / error messages).

2.2 Telegrams

2.2.1 master Telegrams

The component accepting the communication (master, e.g. PC) can send two different telegrams.

Read parameters:

a1	a2	a3	0	0	n1	n2	n3	0	2	=	?	c1	c2	c3	CR

Describe parameters:

a1	a2	a3	1	0	n1	n2	n3	d1	d2	……Data……	c1	c2	c3	CR

2.2.2 slave Telegrams

The slave component cannot independently begin a communication and only answer when it is addressed with a valid individual address. The following telegrams are possible:

Data response / control command understood:

a1	a2	a3	1	0	n1	n2	n3	d1	d2	……Data……	c1	c2	c3	CR

The control command is valid and processed by the slave. The sendet data are used, so the telegram looks just as the control command.

Error message:

a1	a2	a3	1	0	n1	n2	n3	0	6	N _ _	O R L	_ A O	D N G	E G I	F E C	c1	c2	c3	CR

"NO_DEF"	The parameter number does not exist
"_RANGE"	Data are outside the permitted range
"_LOGIC"	Logical access violation, e.g. describing a read-only parameter

2.3 Data Types

Depending on the content of the parameter, the data field can present various formats. The following data types are possible:

Data type	Description	Length	Example
0 – boolean_old	False / true in the form six zeros (ASCII 48) or ones (ASCII 49)	6	000000 = false 111111 = true
1 – u_integer	Pre-symbol-less integer number with six positions (leading zeros)	6	000042 123456 001200
2 – u_real	Fixed comma number with four positions before and two after the comma standardized to 0.01 (leading zeros)	6	001570 = 15.70 000020 = 0.2
4 – string	Optional symbol chain with ASCII symbols ≥32 (decimal)	6	Hallo! TC_600
6 – boolean_new	False / true in the form of a zero (ASCII 48) or one (ASCII 49)	1	0 = false 1 = true
7 – u_short_int	Pre-symbol-less integer number with three positions (leading zeros)	3	123 042 007
10 – u_expo_new	Positive exponential number. The first four numbers include the mantissa multiplied with 1000, the last both include the exponent with Offset 20	6	100023 = 1.000E3 456711 = 4.567E-9

2.4 Parameters

Sub address xx0 = Measurement channel independent parameter
xx1 = Parameter measurement channel 1
xx2 = Parameter measurement channel 2

Display With Pfeiffer Vacuum measurement and control units

Access type R = read, W = write

corresponds to ASCII 32 ~ corresponds to ASCII 127

Parameter No.	Sub address	Display	Designation	Description	Data type	Type of access	Unit	Min. value	Max. value
008	xx0	KeysLocked	Keylock	0: Keylock function disabled 1: Keylock function enabled	0	RW	####	000000	111111
040	xx1	DeGas#####	"DeGas sensor 1	W0/1: Deactivate/activate DeGas R:0/1: Status (0: not active, 1: active) DeGas is deactivated automatically after 180 seconds	6	RW	####	0	1
	xx2	DeGas#####	"DeGas sensor 2						
041	xx1	SensEnable	Gauge 1 on/off	0: off 1: on 3: the ON/OFF threshold of the other measurement channel is below/above the limit (TPG 362 only)	7	RW	####	000	001 or 003
	xx2	SensEnable	Gauge 2 on/off	TPG 361: Max. value 1; TPG 362: Max. value 3					003
045	xx0	Cfg#Rel#R1	Configuration Relay 1	9: always passive 10: always active 19: Threshold sensor 1 under limit 20: Threshold sensor 2 under limit The threshold sensor 1/2 can only be accessed via the display or the MNE protocol (SPx) TPG 361: Max. value 19; TPG 362: Max. value 20; TPG362: #047 and #048	7	RW	####	009	019 or 020
046	xx0	Cfg#Rel#R2	Configuration Relay 2						
047	xx0	Cfg#Rel#R3	Configuration Relay 3						
048	xx0	Cfg#Rel#R4	Configuration Relay 4						
303	xx0	Error#Code	Error TPG	"000000", "WrnXXX", "ErrXXX" XXX = error number or warning number (e.g. "Err042") "Wrn036" = Unit not calibrated "Err107" = Sensor error / hardware defective	4	R	####	######	~~~~~~
	xx1	Error#Code	Error sensor 1						
	xx2	Error#Code	Error sensor 2						
312	xx0	FW#Version	Firmware version TPG36x	E.g. "010100": First firmware version	4	R	####	######	~~~~~~
314	xx0	Operat.Hrs	Operating (run) hours TPG36x	The display of the operating hours stops, when the max. value is reached (may be <999999)	1	R	h###	000000	999999
349	xx0	DeviceName	Device name TPG 36x	"TPG361" or "TPG362"	4	R	####	######	~~~~~~
	xx1	DeviceName	Device name sensor 1	"TPR###" or "IKR###" or "PKR###" or "PBR###" or "IMR###" or "CMR###" or "noSENS" or "noID##"					
	xx2	DeviceName	Device name sensor 2						
354	xx0	HW#Version	Hardware version TPG	E.g. "010100": First hardware version	4	R	####	######	~~~~~~
730	xx1	SwOn#Thrs#	ON threshold sensor 1	Range 1E-5 … 1 hPa Pressure always hPa, independent of the pressure unit displayed on the display	10	RW	hPa#	100015	100020
	xx2	SwOn#Thrs#	ON threshold sensor 2						
732	xx1	SwOff#Thrs	OFF threshold sensor 1	Range 1E-5 … 1 hPa Pressure always hPa, independent of the pressure unit displayed on the display	10	RW	hPa#	100015	100020
	xx2	SwOff#Thrs	OFF threshold sensor 2						
740	xx1	Pressure##	Actual pressure sensor 1	R: Actual pressure value (000000: underrange, 999999: overrange) W: Offset value (this value is substracted from the actual pressure value) Pressure always hPa, independent of the pressure unit displayed on the display	10	RW	hPa#	000000	999999
	xx2	Pressure##	Actual pressure sensor 2						
742	xx1	Press#Corr	Correction factor sensor 1	0.10 … 10.00, or analog display	2	RW	####	000010	001000
	xx2	Press#Corr	Correction factor sensor 2						
797	xx0	RS485#Adr#	Device address TPG	{010, 020, 030, … 240}	1	RW	####	000010	000240

3 Appendix

A: Literature

🕮 [1] www.pfeiffer-vacuum.com
Instruction Sheet
Compact Pirani Gauge TPR 261
BG 5105 BEN
Pfeiffer Vacuum GmbH, D–35614 Asslar, Germany

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Instruction Sheet
Compact Pirani Gauge TPR 265
BG 5177 BEN
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Compact Pirani Gauge TPR 280, TPR 281
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Compact FullRange® Gauge PKR 251
BG 5119 BN
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[12] www.pfeiffer-vacuum.com
Instruction Sheet
Compact FullRange® Gauge PKR 261
BG 5122 BN
Pfeiffer Vacuum GmbH, D–35614 Asslar, Germany

[13] www.pfeiffer-vacuum.com
Instruction Sheet
Compact Process Ion Gauge IMR 265
BG 5132 BEN
Pfeiffer Vacuum GmbH, D–35614 Asslar, Germany

[14] www.pfeiffer-vacuum.com
Instruction Sheet
Compact FullRange® BA Gauge PBR 260
BG 5131 BEN
Pfeiffer Vacuum GmbH, D–35614 Asslar, Germany

[15] www.pfeiffer-vacuum.com
Instruction Sheet
Compact Capacitance Gauge CMR 261 … CMR 275
BG 5133 BEN
Pfeiffer Vacuum GmbH, D–35614 Asslar, Germany

[16] www.pfeiffer-vacuum.com
Operating Instructions
Compact Capacitance Gauge CMR 361 … CMR 365
BG 5136 BEN
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[17] www.pfeiffer-vacuum.com
Operating Instructions
Compact Capacitance Gauge CMR 371 … CMR 375
BG 5138 BEN
Pfeiffer Vacuum GmbH, D–35614 Asslar, Germany

[18] www.pfeiffer-vacuum.com
Instruction Sheet
Compact Piezo Gauge APR 250 … APR 267
BG 5127 BN
Pfeiffer Vacuum GmbH, D–35614 Asslar, Germany

[19] www.pfeiffer-vacuum.com
Istallation Instructions
TPG 361, TPG 362
PG 0034 BXX
Pfeiffer Vacuum GmbH, D–35614 Asslar, Germany

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