 SmartTest

HLT 550

HLT 560

HLT 570

Communication protocol

Product identification

The data specified on the rating plate are necessary in correspondence with Pfeiffer Vacuum. Therefore transfer the data to the copy.



Fig. 1

Validity

This document is valid for products with the article number
SmartTest

PT L02 100 (HLT 560, 230 V~, with rotary vane pump UNO 005 A)

PT L02 101 (HLT 560, 120 V~, with rotary vane pump UNO 005 A)

PT L02 102 (HLT 560, 100 V~, with rotary vane pump UNO 005 A)

SmartTest

PT L02 120 (HLT 550, 100 ... 230 V~, with backing pump provided by the customer)

SmartTest

PT L02 110 (HLT 570, 230 V~, with diaphragm pump MVP 035)

PT L02 111 (HLT 570, 120 V~, with diaphragm pump MVP 035)

PT L02 112 (HLT 570, 100 V~, with diaphragm pump MVP 035)

This document is based on firmware versions beginning with V2.3.

If the instrument does not work as described, check whether your instrument is equipped with these firmware versions.

Subject to technical modifications without prior notice. The figures are not to scale.

Content

1	Interfaces	5
1.1	Serial interfaces	6
1.1.1	Serial interface RS485	6
1.1.2	RS232 interface	9
1.1.2.1	Connection	9
1.1.2.2	Configuration	9
1.1.3	Abbreviations and symbols	9
1.2	Protocol	10
1.2.1	Protocol: Pfeiffer Vacuum	10
1.2.1.1	Parameter description	15
1.2.1.2	Commands of the serial interface RS232 / RS485	16
1.2.1.3	Conversion table	26

1 Interfaces

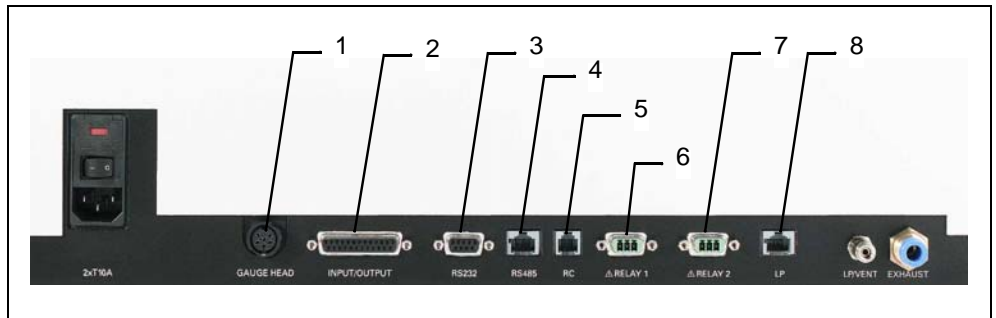


Fig. 2 Interface connections at the back of the SmartTest

- 1** GAUGE HEAD: Connection for compact gauge heads
- 2** INPUT/OUTPUT: control and output signals
- 3** RS232: connection for computer
- 4** RS485: connection for computer
- 5** RC: remote control or radio transmitter
- 6** RELAY 1: relay contact
- 7** RELAY 2: relay contact
- 8** LP: connection for sniffing probe LP 503, LP 505 or LP 510

Notice: All plugs are illustrated looking at the SmartTest from the outside.

1.1 Serial interfaces

1.1.1 Serial interface RS485

The connection of the SmartTest to a computer can be made through the serial interface RS485.

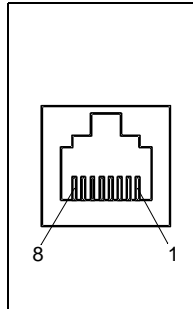


Fig. 3 RS485 Connector

Plug: RS485 (8pin)

See also [Fig. 2/4](#).

PIN 1	free
PIN 2	+24 V (for supplying the field bus converter; fuse 0.8 A slow blow)
PIN 3	free
PIN 4	free
PIN 5	D+ (galvanically isolated)
PIN 6	GND (0 V)
PIN 7	D- (galvanically isolated)
PIN 8	free

With the RS485 interface up to 32 instruments can be connected with each other by two lines, whereby never more than one instrument may transmit at once.

All instruments are connected with their D+ connection to the D+ line and with their D- connection to the D- line.

Since several instruments can be connected to the bus, no bus terminating resistors are integrated in the driver components as a rule. These must be connected at the two remotest ends of the bus.

The SmartTest may adopt the position of cases A, B or C in a bus.

See [Fig. 4](#).

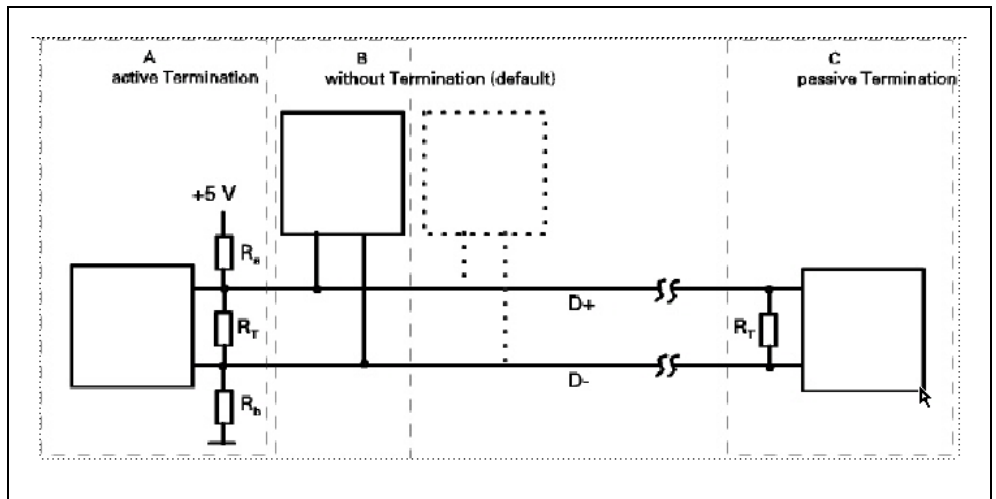


Fig. 4 RS485 cable connection

A: SmartTest: with active termination

B: SmartTest: without termination (default setting).

C: SmartTest: with passive termination

The choice of SmartTest connection can be made with the DIP switch 1-3, Fig. 5, according to table 1.1.

DIP switch 4 has no function.

	DIP 1 ($R_T = 121\Omega$)	DIP 2 ($R_b = 562\Omega$)	DIP 3 ($R_a = 562\Omega$)
A	closed	closed	closed
B	open	open	open
C	closed	open	open

Table 1.1: bus termination, terminating resistors

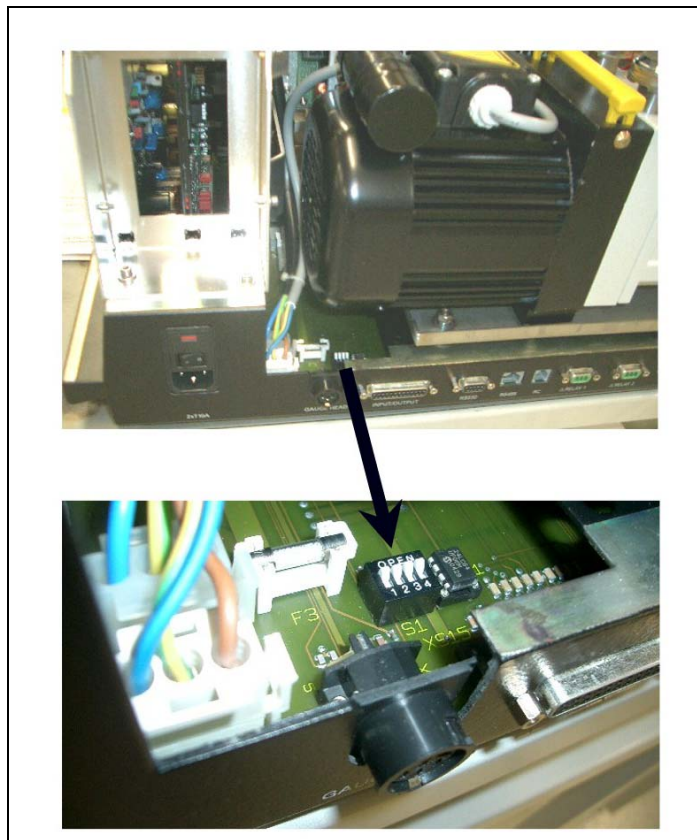


Fig. 5 RS485 DIP switches

A twisted, screened two-wire cable is recommended for the connection!

After receiving a command it takes about 5 to 10 ms until the SmartTest sends a reply.

1.1.2 RS232 interface

The RS232 interface enables communications between the SmartTest™ and a computer. A terminal can also be connected for test purposes.

1.1.2.1 Connection

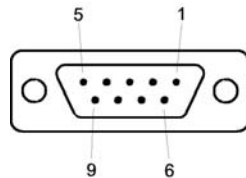
See also [Fig. 2/3](#).



Vorsicht

Screened cables must be used (EMC).

View of SmartTest



D-Sub plug
9-pole, sockets

Connection plug arrangement

Pin 1: not used
Pin 2: TXD (separated galv.)
Pin 3: RXD (separated galv.)
Pin 4: not used
Pin 5: GND (separated galv.)
Pin 6: not used
Pin 7: not used
Pin 8: not used
Pin 9: not used

Housing: screening

1.1.2.2 Configuration

Use the factory setting of the SmartTest for normal operation:

Baudrate: 9600
Number of bits: 8 Data bits, 1 stop bit
Parity: none

1.1.3 Abbreviations and symbols

Symbol	Meaning
ASCII	American Standard Code for Information Interchange
ENQ	ASCII 05 _h
Send	Transfer from RS232 to SmartTest
Receive	Transfer from SmartTest to RS232

1.2 Protocol

1.2.1 Protocol: Pfeiffer Vacuum

The Pfeiffer protocol uses the ASCII format, i.e. all data bytes are displayable characters with an ASCII code $\geq 32^{(*1)}$ with the exception of the EOT (end of telegram) character carriage return (CR, 13). The transferred telegrams are accommodated by a frame as follows without exception:

General protocol:

Address	Action	Parameter number	Data length	Data	Checksum	CR
---------	--------	------------------	-------------	------	----------	----

Address: Address of the addressed or replying instrument, e.g. "042". A distinction is made between the following addresses:

Single addresses: Only a certain instrument is addressed.

Global address: Address "000", all Pfeiffer instruments are addressed, these react to the command accordingly but do not reply.
Address "948", all Pfeiffer instruments are addressed, these react to the command accordingly but do not reply.

Action: "00" = read parameter.
"10" = write parameter.

Parameter number (PV#): Number of the parameter concerned, e.g. "303"

Data length: e.g. "06" for six characters, corresponds to length of the "Data" field

(*1) all numbers decimal

Data: Data in ASCII format. Format and size of the data depends on the following points:

transfer of values \Rightarrow *master telegrams & parameter description*

data request \Rightarrow *slave telegrams & parameter description*

error messages \Rightarrow *slave telegrams*

Checksum: Sum of all ASCII characters up to before checksum modulo 256 (decimal),
e. g. sum = 786, 786 modulo 256 = 18 \Rightarrow checksum = "018"

CR: carriage return (ASCII character 13)

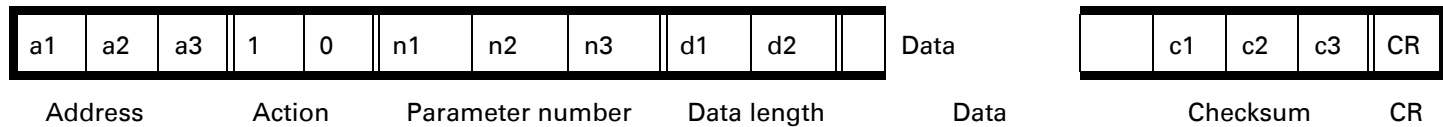
With the master-slave behaviour a data exchange always takes place according to the scheme: master sends (either setting demand or request), slave answers (confirmation or send data / error messages).

Telegrams:

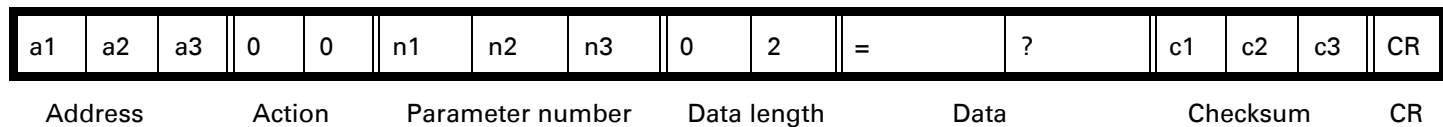
Master telegrams:

The instrument taking up communication (master, e.g. PC) can send the following telegrams:

Setting demand



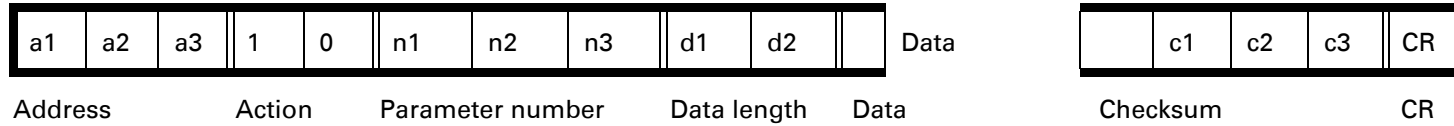
Data request:



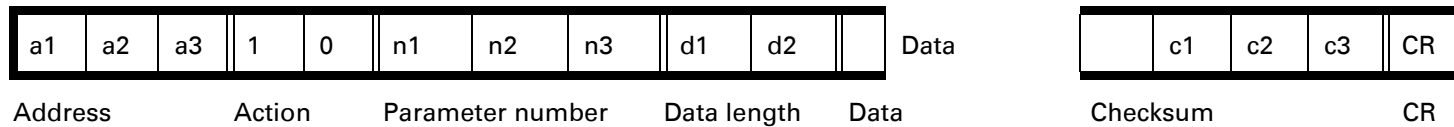
Slave telegrams

The slave instrument (e.g. Pfeiffer leak detector) cannot start communication by itself but only replies when it is addressed with a valid single address. Instruments addressed by the group or global address do not reply. Following telegrams are possible:

Send requested data (positive reply to "data request")

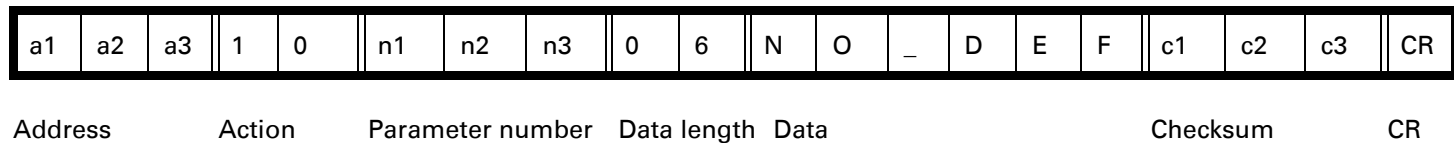


Confirm the received setting demand (positive reply to "setting demand"):

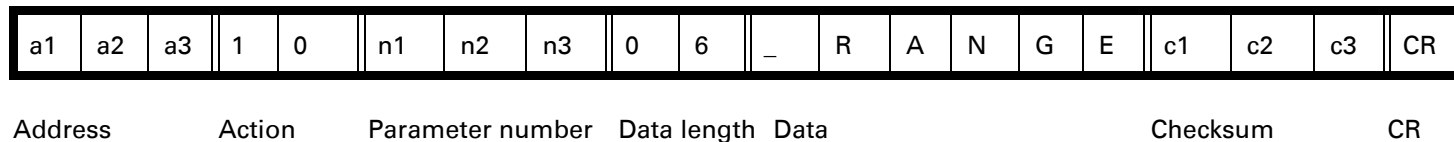


A confirmation of the received setting demand initially only means that the telegram sent by the master has been understood. If the operating state of the instrument allows an adjustment, this is also executed. It is advisable to then request the parameter as a check.

Parameter number does not exist (error message):



Transferred data outside allowed range (error message)



Switch on zero:

master ⇒ **slave**:

0	4	2	1	0	6	5	1	0	1	1	0	3	7	CR
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----

Address Action Parameter number Data length Data Checksum CR

slave ⇒ **master**:

0	4	2	1	0	6	5	1	0	1	1	0	3	7	CR
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----

Address Action Parameter number Data length Data Checksum CR

1.2.1.1 Parameter description

These may be formatted differently depending on content of the data represented by a parameter.

Format	Description	Size in characters	Examples
0 - boolean_old	true / false in form of six zeros (ASCII 48) or ones (ASCII 49)	6	000000 corresponds to false 111111 corresponds to true
1 - u_integer	signless integer with six digits	6	000042 123456 001200
2 - u_real	fixed point number with four places before and two after the point, standardised to 0.01	6	001570 corresponds to 15.70 000020 corresponds to 0.2
4 - string	any character string with ASCII characters ≥ 32 (decimal)	6	hallo! TC_600 hgnrfx
6 - boolean_new	true / false in the form of a zero (ASCII 48) or one (ASCII 49)	1	0 corresponds to false 1 corresponds to true
7 - u_short_int	signless integer with three digits	3	123 042 007
10 - u_expo_new	Positive exponential number 1.000E-20 to 9.999E79. The first four digits are mantissae with a place before the point $\neq 0$, the last two the exponent with offset -20	6	123456 corresponds to 1.234E36 100000 corresponds to 1.000E-20 243011 corresponds to 2.430E-9
11 - string16	any character string with ASCII characters ≥ 32 (decimal)	16	abcdefghijklmnop QrStUvWxYzAbCdEf

1.2.1.2 Commands of the serial interface RS232 / RS485

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
009	Error ackn	Acknowledge error	x	-	0 - boolean_old	111111	111111	111111 = delete error or warning
016	PresMaxRng	pressure gauge upper range value	x	x	7 - u_short_int	000	008	000 = 0,1 mbar 001 = 1 mbar 002 = 10 mbar 003 = 100 mbar 004 = 1000 mbar 005 = 2000 mbar 006 = 5000 mbar 007 = 10000 mbar 008 = 50000 mbar
023	Motor TMP	Motor TMP off / on	x	x	0 - boolean old	000000	111111	
043	EnabMaint	Menu page maintenance available	x	x	6 - boolean_new	0	1	0 = Menu page maintenance not available 1 = Menu page maintenance available
044	EnabCalibr	Enabeling of calibration	x	x	6-boolean_new	0	1	0 = Calibration in the menu "Ready to Start" not available 1 = Calibration in the menu "Ready to Start" available
089	AltnProtoc	Switching to alternative protocol	x	x	7 - u_short_int	000	002	000 = PV-Protocol 001 = HLT2xx-Protocol 002 = Diagnose-Protocol
303	Error code	Current error number	-	x	4 - string			000000 = no error ErrABC = error ABC WrnABC = warning ABC
309	Act rotspd	Actual rotation speed turbo pump in Hz	-	x	1 - u_integer	000000	002000	
310	TMP I-mot	Turbo pump current in A	-	x	2 - u_real	000000	001500	0-15.00
312	fw version	Software version MC68	-	x	4 - string			e.g. "V 3.60"
314	Op hours	Operating hours	-	x	1 - u_integer	000000	999999	
340	pv_mbar	Pressure of the ext. gauge in mbar		x	10 - u_expo_new	100016	500024	

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
349	deviceName	Instrument name	-	x	4 - string			HLT5xx
360	Past Err 1	Error buffer 0: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
361	Past Err 2	Error buffer 1: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
362	Past Err 3	Error buffer 2: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
363	Past Err 4	Error buffer 3: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
364	Past Err 5	Error buffer 4: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
365	Past Err 6	Error buffer 5: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
366	Past Err 7	Error buffer 6: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
367	Past Err 8	Error buffer 7: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
368	Past Err 9	Error buffer 8: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
369	Past Err 10	Error buffer 9: Error number	-	x	4 - string			"000000", "WrnABC" or "ErrABC"
370	DateTime 1	Error buffer 0: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
371	DateTime 2	Error buffer 1: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
372	DateTime 3	Error buffer 2: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
373	DateTime 4	Error buffer 3: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
374	DateTime 5	Error buffer 4: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
375	DateTime 6	Error buffer 5: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
376	DateTime 7	Error buffer 6: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
377	DateTime 8	Error buffer 7: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
378	DateTime 9	Error buffer 8: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
379	DateTime 10	Error buffer 9: Date and time	-	x	11 - string16			"yyyy-mm-dd hh:mm", "0000-00-00 00:00"
600	opMode ST	Operating mode (writeable only in Ready to Start, Run-up and Error state)	x	x	7 - u_short_int	000	001	Write and Read: 000 = Vacuum 001 = Sniff
602	AnalogMode	Analog output type of representation	x	x	7 - u_short_int	000	077	Write and Read: abc a = 0 b = Channel 2 c = Channel 1 0 = off 1 = P2 2 = P1 3 = LR-Manitssa (Default for Channel 1) 4 = LR-Exponent (Default for Channel 2) 5 = LR-Lin. 6 = LR-Log. 7 = Pext
604	ctrl mode	Control mode (command always writeable)	x	x	7 - u_short_int	000	004	Write and Read: 0 = Local 1 = RS232 / RE485 2 = SPS 3 = Local, RS232 / RS485 4 = All (Local, SPS, RS232 / RE485)

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
609	valve test	State/position of the valves	x	x	1 - u_integer	000000	032639	Write and Read: Bit 0 = V1 - Valve state 1 = V2 - Valve state 2 = V3 - Valve state 3 = V4 - Valve state 4 = V5 - Valve state 5 = V6 - Valve state 6 = Vext - Valve state 7 = 0 8 = V1 - manually controlled 9 = V2 - manually controlled 10 = V3 - manually controlled 11 = V4 - manually controlled 12 = V5 - manually controlled 13 = V6 - manually controlled 14 = Vext - manually controlled 15 = 0
618	PreAmpVolt	Pre-amplifier voltage in mV (EVS)	-	x	11 - string16			
620	AnodeVolt	Anode potential in V (MIAP)	-	x	7 - u_short_int	000	999	0 - 999 Volt
621	CathodeVolt	Cathode potential in V (MIKP)	-	x	7 - u_short_int	000	999	0 - 999 Volt
622	SuppVolt	Suppressor potential in V (MISP)	-	x	7 - u_short_int	000	999	0 - 999 Volt
630	ExtPresSns	Choose pressure gauge	x	x	6 - boolean_new	0	1	0 = internal sensor active 1 = external sensor active
631	Ua_M2	stored anode potential mass 2 in V	x	x	7 - u_short_int	785	995	Write and Read: 785 ... 905 ... 995
632	Ua_M3	stored anode potential mass 3 in V	x	x	7 - u_short_int	510	670	Write and Read: 510 ... 610 ... 670
633	Ua_M4	stored anode potential mass 4 in V	x	x	7 - u_short_int	390	520	Write and Read: 390 ... 465 ... 520

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
642	mass	Mass of gas to be detected in amu (writeable only in Ready to Start, Run-up and Error state)	x	x	7 - u_short_int	002	004	Write and Read: 002 = mass 2 003 = mass 3 004 = mass 4
643	phys units	Units	x	x	7 - u_short_int	000	083	Write and Read: abc a = 0 b = leak rate 0 = mbar l/s 1 = Pam ³ /s 2 = Atma/s 3 = Torr l/s 4 = sccm 5 = sccs 6 = ppm * 7 = g/a * 8 = oz/yr * c = pressure 0 = mbar 1 = Pa 2 = Atm 3 = Torr * only in sniffer mode
644	BgroundAct	Underground display in Ready to Start	x	x	6 - boolean_new	0	1	0 = Underground display deactivated 1 = Underground display acitvated
645	filament	Cathode	x	x	7 - u_short_init	000	003	Write and Read: 000 = Emission off 001 = Cathode 1, emission on 002 = Cathode 2, emission on 003 = Emission on (keep act. Cathode)
646	zero time	Zero-Time in sec * 50ms	x	x	7 - u_short_int	002	200	Write and Read: 1.0 ... 5 ... 10 seconds 1 corresponds to 50 ms
651	zero	Zero (suppress background) in state Meas	x	x	6 - boolean_new	0	1	Write and Read: 0 = switch off / off 1 = switch on / on

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
653	MeasStdby	Measure (START / STOP)	x	x	6 - boolean_new	0	1	Write and Read: 0 = StandBy 1 = Measure
654	CalRequest	Calibration request	x	x	7 - u_short_int	000	001	Write: 000 = switch off request 001 = activate request Read: 000 = request switched off 001 = request activated but unavailable 002 = request activated and available
655	Filtertype	Type of filter for calculation of leak rate (writeable only in Ready to Start, Run-up and Error state)	x	x	7 - u_short_int	000	002	0 = Without 1 = Static 2 = Dynamic
659	Sniff Flow	Flow in sniffer mode in sccm		x	7 - u_short_int	000	255	
660	Trigger CF	Switching pressure when evacuating after Counter Flow in mbar	x	x	2 - u_real	000010	002500	0,1 mbar to 25 mbar
661	Trigg TFlo	Switching pressure of Counter Flow after Twin Flow Low in mbar	x	x	2 - u_real	000010	000500	0,1 mbar to 5 mbar
662	Trigg TFhi	Switching pressure of Twin Flow Low after Twin Flow High in mbar	x	x	2 - u_real	000001	000050	0,01 mbar to 0,05 mbar
663	LockTFVent	Free vacuum ranges and venting	x	x	7 - u_short_int	000	031	Bit 0 = Enable Counter Flow Bit 1 = Enable Twin Flow Low Bit 2 = Enable Twin Flow High Bit 3 = Vent manual Bit 4 = Vent when Stop
664	Flow Min	Minimum of flow in sccm	x	x	7 - u_short_int	001	040	1sccm ... 10 ... 40sccm
665	Flow Max	Maximum of flow in sccm	x	x	7 - u_short_int	010	050	10sccm bis 50 sccm

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
666	Curr State	State of unit		x	7 - u_short_int	000	015	0 = Initialising 1: Run-up 2: Ready to start 3: Pump down 4: Stopped 6: Calibration is running 7: Error 8: Preparing of the MS 9: Pumping for measuring the internal test leak 10: Measuring Counter Flow 11: Measuring Twin Flow Low 12: Measuring Twin Flow High 13: Measuring TL intern Counter Flow 14: Measuring TL intern Twin Flow Low 15: Measuring TL intern Twin Flow High
667	GetCalStat	State of Calibration		x	7 - u_short_int	000	012	0 = inactive 1 = wait "Test leak connected" 2 = Pump down 3 = Wait "Test leak signal stable" 4 = Adjustment of masses 5 = Measure Twin Flow High 6 = Measure Twin Flow Low 7 = Measure counter Flow 8 = Wait "Test leak closed" or "Underground stable" 9 = Underground Twin Flow High 10 = Underground Twin Flow Low 11 = Underground counter Flow 12 = Wait "Calibration result"
668	AckCalStep	Acknowledgement or break of calibration	x		6 - boolean_new	0	1	0 = Break 1 = Acknowledgment of CAL-Steps
669	leakrate	Leak rate in chosen unit	-	x	10 - u_expo_new	100000	999999	100000 = underrange 999999 = overrange otherwise valid value
670	lr_mbarls	Leak rate in mbar l/s	-	x	10 - u_expo_new	100002	999932	

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
671	TLExt_vac	Leak rate external test leak in mbar l/s pam ³ /s atm cc/s torr l/s sccm sccs ppm g/a oz/yr	x	x	10 - u_expo_new	100010 100009 987009 750009 592011 987009 100016 518013 183012	100020 100019 987019 750019 592021 987019 100026 518023 183022	Write and Read: 1E-10 ... 1E-7 ... 1E+0 (for mbar l/s)
673	TLExt_snif	Leak rate external test leak Sniff in mbar l/s pam ³ /s atm cc/s torr l/s sccm sccs ppm g/a oz/yr	x	x	10 - u_expo_new	100014 100013 987013 750013 592015 987013 100020 518017 183016	100020 100019 987019 750019 592021 987019 100026 518023 183022	Write and Read: 1E-6 ... 1E-5 ... 1E+0 (for mbar l/s)
676	TL_int	Leak rate internal test leak in mbarl/s	x	x	10 - u_expo_new	100011	100015	Write and Read: 1E-9 ... 1E-6 ... 1E-5 (für mbar l/s)
679	pressure	Fore-vacuum pressure in chosen unit	-	x	10 - u_expo_new	100013	100025	
680	press p2	Pressure test port in chosen unit	-	x	10 - u_expo_new	100013	100025	
681	trigger 1	Trigger 1 in mbar l/s atm cc/s Pam ³ /s Torr l/s sccm ppm g/a oz/yr	x	x	10 - u_expo_new	100008 100007 987007 750007 592009 987007 100014 518011 183010	100023 100022 987022 750022 592024 987022 100029 518026 183025	Write and Read: 1E-12 ... 1E-9 ... 1E+2 (for mbar l/s)

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
684	Relay Mode	Mode of relais	x	x	7 - u_short_int	000	088	Byte 0 = 0 Byte 1 = Relais 2 Byte 2 = Relais 1 0 = Aus 1 = Start (V2 open) 2 = Stop (V6 open) 3 = Start/Stop (Evakuere, TL measurement, Measurement) 4 = Measurement 5 = Trigger leak rate 6 = Ein 7 = Warning limit leak rate 8 = Trigger pressure
686	BGSubtract	Zero Mode	x	x	7 - u_short_int	000	003	0 = disable 1 = enable 2 = with Start 3 = Zero constant
688	ZeroStTime	Delay time for "Zero at Start" in s	x	x	7 - u_short_int	002	300	2 ... 10 ... 300
690	pressext	Press the ext. gauge in chosen unit		x	10 - u_expo_new	100013	100025	
694	GetCalFHi	Factor of calibration Twin Flow High		x	10 - u_expo_new	100019	100022	
695	GetCalFHi	Factor of calibration Twin Flow Low		x	10 - u_expo_new	100019	100022	
696	GetCalFHi	Factor of calibration Counter Flow		x	10 - u_expo_new	100019	100022	
698	SetTLLoc	Chooses the test leak	x	x	7 - u_short_int	000	002	0 = internal automatically 1 = internal manually 2 = external
699	StartCal	Start calibration from Ready to Start	x		6 - boolean_new	1	1	

PV#	Name	Meaning	Command Write	Command Read	Data type	Min	Max	Parameter description/ parameter options
738	Gaugetype	Type of the external pressure gauge (distinction by identification resistance)		x	4 - string	6*0X20	6*0X7f	"nogauge" = no gauge "xxxTPR" = TPR or PCR "xxxPKR" = PKR "linear" = lin. tube"
797	Address	Address of attendee	x	x	1 - u_integer	000001	000255	

1.2.1.3 Conversion table

DEC	HEX	Binär	ASCII
0	0	0000 0000	NUL
1	1	0000 0001	SOH
2	2	0000 0010	STX
3	3	0000 0011	ETX
4	4	0000 0100	EOT
10	A	0000 1010	LF
11	B	0000 1011	VT
12	C	0000 1100	FF
13	D	0000 1101	CR
14	E	0000 1110	SO
15	F	0000 1111	SI
16	10	0001 0000	DLE
17	11	0001 0001	DC1
18	12	0001 0010	DC2
19	13	0001 0011	DC3
20	14	0001 0100	DC4
21	15	0001 0101	NAK
22	16	0001 0110	SYSN
23	17	0001 0111	ETB
24	18	0001 1000	CAN
25	19	0001 1001	EM
26	1A	0001 1010	SUB
27	1B	0001 1011	ESC
28	1C	0001 1100	FS
29	1D	0001 1101	GS
30	1E	0001 1110	RS
31	1F	0001 1111	US
32	20	0010 0000	SP
33	21	0010 0001	!
34	22	0010 0010	"

DEC	HEX	Binär	ASCII
5	5	0000 0101	ENQ
6	6	0000 0110	ACK
7	7	0000 0111	BEL
8	8	0000 1000	BS
9	9	0000 1001	HT
41	29	0010 1001)
42	2A	0010 1010	*
43	2B	0010 1011	+
44	2C	0010 1100	,
45	2D	0010 1101	-
46	2E	0010 1110	.
47	2F	0010 1111	/
48	30	0011 0000	0
49	31	0011 0001	1
50	32	0011 0010	2
51	33	0011 0011	3
52	34	0011 0100	4
53	35	0011 0101	5
54	36	0011 0110	6
55	37	0011 0111	7
56	38	0011 1000	8
57	39	0011 1001	9
58	3A	0011 1010	:
59	3B	0011 1011	;
60	3C	0011 1100	<
61	3D	0011 1101	=
62	3E	0011 1110	>
63	3F	0011 1111	?
64	40	0100 0000	@
65	41	0100 0001	A

DEC	HEX	Binär	ASCII
35	23	0010 0011	#
36	24	0010 0100	\$
37	25	0010 0101	%
38	26	0010 0110	&
39	27	0010 0111	'
40	28	0010 1000	(
72	48	0100 1000	H
73	49	0100 1001	I
74	4A	0100 1010	J
75	4B	0100 1011	K
76	4C	0100 1100	L
77	4D	0100 1101	M
78	4E	0100 1110	N
79	4F	0100 1111	O
80	50	0101 0000	P
81	51	0101 0001	Q
82	52	0101 0010	R
83	53	0101 0011	S
84	54	0101 0100	T
85	55	0101 0101	U
86	56	0101 0110	V
87	57	0101 0111	W
88	58	0101 1000	X
89	59	0101 1001	Y
90	5A	0101 1010	Z
91	5B	0101 1011	[
92	5C	0101 1100	\
93	5D	0101 1101]
94	5E	0101 1110	^
95	5F	0101 1111	_
96	60	0110 0000	`
97	61	0110 0001	a

DEC	HEX	Binär	ASCII
66	42	0100 0010	B
67	43	0100 0011	C
68	44	0100 0100	D
69	45	0100 0101	E
70	46	0100 0110	F
71	47	0100 0111	G
103	67	0110 0111	g
104	68	0110 1000	h
105	69	0110 1001	i
106	6A	0110 1010	j
107	6B	0110 1011	k
108	6C	0110 1100	l
109	6D	0110 1101	m
110	6E	0110 1110	n
111	6F	0110 1111	o
112	70	0111 0000	p
113	71	0111 0001	q
114	72	0111 0010	r
115	73	0111 0011	s
116	74	0111 0100	t
117	75	0111 0101	u
118	76	0111 0110	v
119	77	0111 0111	w
120	78	0111 1000	x
121	79	0111 1001	y
122	7A	0111 1010	z
123	7B	0111 1011	{
124	7C	0111 1100	
127	7F	0111 1111	DEL
129	81	1000 0001	
130	82	1000 0010	
131	83	1000 0011	

DEC	HEX	Binär	ASCII
98	62	0110 0010	b
99	63	0110 0011	c
100	64	0110 0100	d
101	65	0110 0101	e
102	66	0110 0110	f
103	67	0110 0111	g
138	8A	1000 1010	
139	8B	1000 1011	
140	8C	1000 1100	
141	8D	1000 1101	
142	8E	1000 1110	
143	8F	1000 1111	
144	90	1001 0000	
145	91	1001 0001	
146	92	1001 0010	
148	94	1001 0100	
149	95	1001 0101	
150	96	1001 0110	
151	97	1001 0111	
152	98	1001 1000	
153	99	1001 1001	
154	9A	1001 1010	
155	9B	1001 1011	155
156	9C	1001 1100	156
157	9D	1001 1101	157
158	9E	1001 1110	158
159	9F	1001 1111	
160	A0	1010 0000	
161	A1	1010 0001	
162	A2	1010 0010	
163	A3	1010 0011	
164	A4	1010 0100	

DEC	HEX	Binär	ASCII
132	84	1000 0100	
133	85	1000 0101	
134	86	1000 0110	
135	87	1000 0111	
136	88	1000 1000	136
137	89	1000 1001	
172	AC	1010 1100	
173	AD	1010 1101	
174	AE	1010 1110	
175	AF	1010 1111	
176	B0	1011 0000	
177	B1	1011 0001	
178	B2	1011 0010	
179	B3	1011 0011	
180	B4	1011 0100	
181	B5	1011 0101	
182	B6	1011 0110	
183	B7	1011 0111	
184	B8	1011 1000	
185	B9	1011 1001	185
186	BA	1011 1010	186
187	BB	1011 1011	187
188	BC	1011 1100	188
189	BD	1011 1101	189
190	BE	1011 1110	190
191	BF	1011 1111	191
192	C0	1100 0000	192
193	C1	1100 0001	193
194	C2	1100 0010	194
195	C3	1100 0011	195
196	C4	1100 0100	196
197	C5	1100 0101	197

DEC	HEX	Binär	ASCII
165	A5	1010 0101	
166	A6	1010 0110	
167	A7	1010 0111	
168	A8	1010 1000	
170	AA	1010 1010	
171	AB	1010 1011	
205	CD	1100 1101	
206	CE	1100 1110	
207	CF	1100 1111	
208	D0	1101 0000	
209	D1	1101 0001	
210	D2	1101 0010	
211	D3	1101 0011	
212	D4	1101 0100	
214	D6	1101 0110	
215	D7	1101 0111	
216	D8	1101 1000	
217	D9	1101 1001	
218	DA	1101 1010	
219	DB	1101 1011	
220	DC	1101 1100	
221	DD	1101 1101	
222	DE	1101 1110	
223	DF	1101 1111	
224	E0	1110 0000	
225	E1	1110 0001	
226	E2	1110 0010	
227	E3	1110 0011	
228	E4	1110 0100	
229	E5	1110 0101	
230	E6	1110 0110	

DEC	HEX	Binär	ASCII
198	C6	1100 0110	198
199	C7	1100 0111	199
200	C8	1100 1000	200
201	C9	1100 1001	201
203	CB	1100 1011	
204	CC	1100 1100	
231	E7	1110 0111	
233	E9	1110 1001	
234	EA	1110 1010	
235	EB	1110 1011	
236	EC	1110 1100	
237	ED	1110 1101	
238	EE	1110 1110	
239	EF	1110 1111	
240	F0	1111 0000	
241	F1	1111 0001	
242	F2	1111 0010	
243	F3	1111 0011	
244	F4	1111 0100	
245	F5	1111 0101	
246	F6	1111 0110	
247	F7	1111 0111	
248	F8	1111 1000	
249	F9	1111 1001	
250	FA	1111 1010	
251	FB	1111 1011	
252	FC	1111 1100	
253	FD	1111 1101	
254	FE	1111 1110	
255	FF	1111 1111	(Error)

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