

# Communication Protocol

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## 1 Introduction

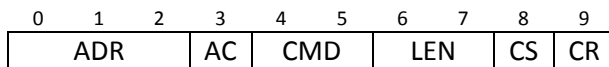
The new communication protocol is introduced in Thyracont Smartline Devices from a specific firmware version and is usable beside the old protocol. **But it is strongly recommend using either the old or the new communication protocol and not a mixture of both.**

E.g. the old commands for *Switchpoint*, *Setpoint* and *Hysteresis* have been superseded by a unique new command *Relay* and their respective read and write commands are not compatible to each other anymore. The new protocol has a complete new syntax with a 1 byte access code (AC), 2 byte command (CMD) and 2 byte length of the data field. The new syntax is described below.

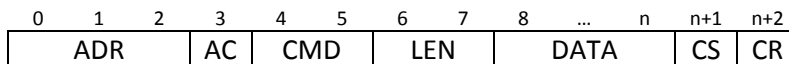
## 2 Syntax

### 2.1 Package

For packages without data:



For packages with data:



The bytes are summarized by the following table:

Syntax Part	Byte (with data)	Byte (without data)	Description
Address (ADR)	0-2	0-2	Address for communication
Access Code (AC)	3	3	Access type
Command (CMD)	4-5	4-5	Character codes command
Length (LEN)	6-7	6-7	Length of data
Data (DATA)	8-n		Data to send or receive
Checksum (CS)	n+1	8	Checksum for byte 0 to 7 (without data) Checksum for byte 0 to n (with data)
Carriage Return (CR)	n+2	9	Carriage return, mandatory

### 2.2 Address (ADR)

The address consists of 3 byte.

Address (ADR)	
001	RS232 or USB
001-016	RS485
100	VD12 (USB)

### 2.3 Access Code (AC)

The byte access code differs between read, write, factory default, error and binary mode. If you want to send a package with a read command from your master to the transmitter you must use "0" (zero) as access code. If the transmitter has executed the command it will answer and increase the access code by one. The received package has as access code "1". The same applies for the write command. From master to transmitter you must use "2" for a write command and the received feedback from transmitter contains a "3" as access code.

Factory default is an option for some commands to reset a parameter to its default value, e.g. the gas correction factor for a Pirani sensor.

If an error happens inside of any transmitter, the access code will be changed to “7” and not increased by one. The binary mode is to read and write binary data and is used for firmware update. Note: When using Binary Type of Access the length (LEN) must also be binary data of 2 byte.

Type of Access	Access Codes for Send Sequences Master → Transmitter	Access Codes for Receive Sequences Transmitter → Master
Read	0	1
Write	2	3
Factory Default	4	5
Error	-	7
Binary	8	9

## 2.4 Command (CMD)

The new command is a 2 byte case sensitive character [AA to ZZ]. A full list of valid commands is given in the next chapter.

## 2.5 Length (LEN)

The new part of a package is the length of DATA in byte. If the length is lower than 10 byte, fill up with zeros to the left. If there is no DATA (e.g. Read Commands) use “00” as length.

## 2.6 Checksum (CS)

Every package contains a checksum to verify the validity of the package and the calculation formula has not changed with respect to old protocol.

Package without data: build checksum from byte 0 to 7

Package with data: build checksum from byte 0 to n

The checksum equation:

$$\text{Decimal Number of CS} = \left( \sum \text{decimal numbers of characters} \right) \text{ mod } 64 + 64$$

To get the character for the checksum, convert the resulting decimal number of CS backwards into ASCII character.

Example: Read Measurement Value (MV) at address 1

0	1	2	3	4	5	6	7	8	9
ADR			AC	CMD		LEN		CS	CR
0	0	1	0	M	V	0	0	?	CR
48	48	49	48	77	86	48	48		

- 1.) Calculate sum: 48+48+49+48+77+86+48+48 = 452
- 2.) Calculate decimal number of CS character: (452 mod 64) + 64 = 4 + 64 = 68
- 3.) ASCII Character of decimal 68 is uppercase “D”
- 4.) Insert “D” as checksum character

0	1	2	3	4	5	6	7	8	9
ADR			AC	CMD		LEN		CS	CR
0	0	1	0	M	V	0	0	D	CR

### 3 Command Overview

#### 3.1 Main Commands

Command	CMD	Valid Access Codes (AC)				
		Read	Write	Factory Default	Error	Binary
		0/1	2/3	4/5	7	8/9
Measurement Range	MR	X			X	
Measurement Value	MV	X			X	
Measurement Value 1 (Pirani)	M1	X			X	
Measurement Value 2 (Piezo)	M2	X			X	
Measurement Value 3 (Hot Cathode)	M3	X			X	
Measurement Value 4 (Cold Cathode)	M4	X			X	
Relay 1	R1	X	X	X	X	
Relay 2	R2	X	X	X	X	
Relay 3	R3	X	X	X	X	
Relay 4	R4	X	X	X	X	
Display Unit	DU	X	X	X	X	
Display Orientation	DO	X	X	X		
Adjust High	AH		X		X	
Adjust Low	AL		X		X	

#### 3.2 Device Parameters

Command	CMD	Valid Access Codes (AC)				
		Read	Write	Factory Default	Error	Binary
		0/1	2/3	4/5	7	8/9
DeGas	DG	X	X		X	
DeGas Logic (VSH) Cathode Control Logic (VSI)	DL	X	X		X	
Sensor Transition	ST	X	X	X	X	
Cathode Control	CC	X	X	X	X	
Cathode Control Mode	CM	X	X	X	X	
Filament Control	FC	X	X	X	X	
Filament Number	FN	X			X	
Filament Status	FS	X			X	
Gas Correction Factor 1 (Pirani)	C1	X	X	X	X	
Gas Correction Factor 3 (Hot Cathode)	C3	X	X	X	X	
Gas Correction Factor 4 (Cold Cathode)	C4	X	X	X	X	
Analog Output Characteristic	OC	X		X	X	
Panel Status	PS	X	X		X	
Controller Status	CS	X	X		X	

### 3.3 Device Information

Command	CMD	Valid Access Codes (AC)				
		Read	Write	Factory Default	Error	Binary
		0/1	2/3	4/5	7	8/9
Type of Device	TD	X			X	
Product Name	PN	X			X	
Serial Number Device	SD	X			X	
Serial Number Head	SH	X			X	
Baud Rate	BR		X		X	
Response Delay	RD	X	X	X	X	
Version Device	VD	X			X	
Version Head	VH	X			X	
Version Firmware	VF	X			X	
Version Bootloader	VB	X			X	
Device Restart	DR		X		X	

## 4 Command List

### 4.1 Smartline Family

Command	CMD	Transmitter					Display and Control Units	
		VSR	VSP	VSH	VSM	VSI	VD12	VD14
Measurement Range	MR	X	X	X	X	X		
Measurement Value	MV	X	X	X	X	X		
Measurement Value 1 (Pirani)	M1	X	X	X	X			
Measurement Value 2 (Piezo)	M2	X						
Measurement Value 3 (Hot Cathode)	M3			X <sup>2</sup>				
Measurement Value 4 (Cold Cathode)	M4				X <sup>2</sup>	X		
Relay 1	R1	X	X	X	X	X	X	X
Relay 2	R2	X	X	X	X	X	X	X
Relay 3	R3							X
Relay 4	R4							X
Display Unit	DU	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X	X
Display Orientation	DO	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>		
Adjust High	AH	X	X	X	X			
Adjust Low	AL	X	X	X	X			

DeGas	DG			X				
DeGas Logic (VSH)	DL			X	X	X		
Cathode Control Logic (VSM/VSI)								
Sensor Transition	ST	X		X	X			
Cathode Control	CC			X	X	X		
Cathode Control Mode	CM				X	X		
Filament Control	FC			X				
Filament Number	FN			X				
Filament Status	FS			X				
Gas Correction Factor 1 (Pirani)	C1	X	X	X	X			
Gas Correction Factor 3 (Hot Cathode)	C3			X				
Gas Correction Factor 4 (Cold Cathode)	C4				X	X		
Analog Output Characteristic	OC	X	X	X	X	X		
Panel Status	PS						X	X
Controller Status	CS						X	X

Type of Device	TD	X	X	X	X	X	X	X
Product Name	PN	X	X	X	X	X	X	X
Serial Number Device	SD	X	X	X	X	X		
Serial Number Head	SH	X	X	X	X	X		
Baud Rate	BR	X	X	X	X	X		
Response Delay	RD	X	X	X	X	X		
Version Device	VD	X	X	X	X	X	X	X
Version Firmware	VF	X	X	X	X	X	X	X
Version Bootloader	VB	X	X	X	X	X	X	X
Device Restart	DR	X	X	X	X	X	X	X

#### Notes:

- 1) Only valid if device has a LCD display
- 2) Only valid if cathode is not switched off permanently

## 5 Command Descriptions

### 5.1 Main Commands

#### 5.1.1 Measurement Range (MR)

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	MR	no data	
	Receive	1	MR	H[float]L[float]	H followed by upper limit as float [mbar] L followed by lower limit as float [mbar]
		7	MR	Error Code	See <a href="#">Error Messages</a>

Example: Read Measurement Range VSR53D, Address 1

Sequence Send:

0	1	2	3	4	5	6	7	8	9
ADR			AC	CMD		LEN		CS	CR
0	0	1	0	M	R	0	0	@	CR

Sequence Receive:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ADR			AC	CMD		LEN		DATA											CS	CR
0	0	1	1	M	R	1	1	H	1	.	2	e	3	L	1	e	-	4	w	CR

The transmitter VSR53D has a measurement range from 1.2e3 to 1e-4 mbar.

#### 5.1.2 Measurement Value (MV)

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	MV	no data	
	Receive	1	MV	float	Pressure [mbar]
		1	MV	OR	Overrange
		1	MV	UR	Underrange
		7	MV	Error Code	See <a href="#">Error Messages</a>

Example: Read Current Pressure from VSR53D, Address 1

Sequence Send:

0	1	2	3	4	5	6	7	8	9
ADR			AC	CMD		LEN		CS	CR
0	0	1	0	M	V	0	0	@	CR

Sequence Receive: Pressure 973.4 mbar

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
ADR			AC	CMD		LEN		DATA							CS	CR
0	0	1	1	M	V	0	7	9	.	7	3	4	e	2	h	CR



### 5.1.3 Measurement Value 1, 2, 3, 4 (M1, M2, M3, M4)

Mode	Sequence	AC	CMD	Data	Description	
Read	Send	0	M1	no data	Pressure Pirani [mbar]	
			M2	no data	Pressure Piezo [mbar]	
			M3	no data	Pressure Hot Cathode [mbar]	
			M4	no data	Pressure Cold Cathode [mbar]	
	Receive	1	M1/4	float	float	Pressure Value [mbar]
				OR	OR	Overrange
				UR	UR	Underrange
				Error Code	Error Code	See <a href="#">Error Messages</a>

### 5.1.4 Relay 1, 2, 3, 4 (R1, R2, R3, R4)

The relays can be configured independently and can follow different operating modes. These modes depend on the type of transmitter (VSR, VSP, VSH or VSM) and on the timeliness of the firmware of your transmitter. It may possible that not all modes are supported by your firmware; in that case your transmitter will return an error message and you must update the firmware first.

The following modes are possible:

- Switch by Pressure (default)
- Switch on if Error
- Switch on if Underrange
- Switch on if Overrange
- Switch on if cathode is on
- Switch on if filament is defect
- Switch temporarily by setting the relay actively on/off

Except the default mode all other can be inverted by using an exclamation mark as prefix. The default mode can be inverted by switching both pressure values.

For control units it is necessary to specify the appropriate measurement channel. Therefore an additional measurement channel parameter is appended with the parameter prefix "C" in the data field.

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	R1/4	no data	
	Receive	1	R1/4	T[float]F[float]	Mode: Switch by Pressure T followed by pressure [mbar] F followed by pressure [mbar]
				E	Mode: Switch on if Error
				!E	Mode: Switch off if Error
				U	Mode: Switch on if Underrange
				!U	Mode: Switch off if Underrange
				O	Mode: Switch on if Overrange
				!O	Mode: Switch off if Overrange
				C	Mode: Switch on if Cathode is on VSH/VSM Only
				!C	Mode: Switch off if Cathode is on VSH/VSM Only
				W	Mode: Switch on if filament defect VSH only
				!W	Mode: Switch off if filament defect VSH only
				T0	Mode: Temporarily, Relay off

				T1	Mode: Temporarily, Relay on				
		7	R1/4	Error Code	See <a href="#">Error Messages</a>				
Write	Send	2	R1/4	T[float]F[float]	Mode: Switch by Pressure T followed by pressure [mbar] F followed by pressure [mbar]				
				E	Mode: Switch on if Error				
				!E	Mode: Switch off if Error				
				U	Mode: Switch on if Underrange				
				!U	Mode: Switch off if Underrange				
				O	Mode: Switch on if Overage				
				!O	Mode: Switch off if Overage				
				C	Mode: Switch on if Cathode is on VSH, VSM, VSI only				
				!C	Mode: Switch off if Cathode is on VSH, VSM, VSI only				
				W	Mode: Switch on if filament defect VSH only				
				!W	Mode: Switch off if filament defect VSH only				
				T0	Mode: Temporarily, Relay off				
				T1	Mode: Temporarily, Relay on				
	Receive	3	R1/4	no data	Write Successful				
		7	R1/4	Error Code	See <a href="#">Error Messages</a>				
Factory Default	Send	4	R1/4	no data	Restore Default Mode and Default Pressure Values				
					Receive	5	R1/4	no data	Restore Default Successful
						7	R1/4	Error Code	See <a href="#">Error Messages</a>

Example: Write "1E-1 mbar on and 1.5 mbar off" as relay 1 setting for VSP53DL, Address 2

Sequence Send:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ADR		AC	CMD		LEN		DATA									CS	CR
0	0	2	2	R	1	0	8	T	0	.	1	F	1	.	5	l	CR

Sequence Receive:

0	1	2	3	4	5	6	7	8	9
ADR		AC	CMD		LEN		CS	CR	
0	0	2	3	R	1	0	0	h	CR

Example: Write "1E-1 mbar on, 1.5 mbar off on measurement channel 1" as relay 1 setting for VD12, Address 100

Sequence Send:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ADR		AC	CMD		LEN		DATA											CS	CR
1	0	0	2	R	1	0	8	T	0	.	1	F	1	.	5	C	1	_	CR

Sequence Receive:

0	1	2	3	4	5	6	7	8	9
ADR		AC	CMD		LEN		CS	CR	
1	0	0	3	R	1	0	0	g	CR

### 5.1.5 Display Unit (DU)

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	DU	no data	
	Receive	1	DU	mbar	Current Unit is mbar
				Torr	Current Unit is Torr
				hPa	Current Unit is hPa
	7	DU	Error Code	See <a href="#">Error Messages</a>	
Write	Send	2	DU	mbar	New unit is mbar
				Torr	New unit is Torr
				hPa	New unit is hPa
	Receive	3	DU	no data	Write Successful
		7	DU	Error Code	See <a href="#">Error Messages</a>
Factory Default	Send	4	DU	no data	Reset to Default Unit mbar
	Receive	5	DU	no data	Reset Successful
		7	DU	Error Code	See <a href="#">Error Messages</a>

Example: Write "mbar" as new display unit for VSP53DL, Address 2

Sequence Send:

0	1	2	3	4	5	6	7	8	9	10	11	12	13
ADR			AC	CMD		LEN		DATA				CS	CR
0	0	2	2	D	U	0	4	m	b	a	r	c	CR

Sequence Receive:

0	1	2	3	4	5	6	7	8	9
ADR			AC	CMD		LEN		CS	CR
0	0	2	3	D	U	0	0	~	CR

Valid Units:

VSP,VSM, VSH: mbar, Torr, hPa, Torr760

VSR,VSI: mbar, Torr, hPa

VD12/VD14: mbar, Torr, hPa, bar, mTorr, Pa

### 5.1.6 Display Orientation (DO)

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	DO	no data	
	Receive	1	DO	0	Not rotated
				1	Rotated by 180°
7	DO	Error Code	See <a href="#">Error Messages</a>		
Write	Send	2	DO	0	Not rotated
				1	Rotate by 180°
	Receive	3	DO	no data	Write Successful
				7	Error Code
Factory Default	Send	4	DO	no data	Restore Default (not rotated)
	Receive	5	DO	no data	Restore Default Successful
				7	DO

### 5.1.7 Adjust High (AH)

Mode	Sequence	AC	CMD	Data	Description
Write	Send	2	AH	no data	Adjust High for VSP, VSM, VSH
			AH	float	Adjust High for VSR, Pressure in [mbar]
	Receive	3	AH	no data	Adjust High Successful
				7	AH

Example: Adjust High with 981.5 mbar for VSR53D, Address 1

Sequence Send:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ADR			AC	CMD		LEN		DATA				CS	CR	
0	0	1	2	A	H	0	5	9	8	1	.	5	v	CR

Sequence Receive:

0	1	2	3	4	5	6	7	8	9
ADR			AC	CMD		LEN	CS	CR	
0	0	1	3	A	H	0	0	m	CR

### 5.1.8 Adjust Low (AL)

Mode	Sequence	AC	CMD	Data	Description
Write	Send	2	AL	no data	Adjust to zero
			AL	float	Adjust Low to specific pressure Valid from 1e-4 to 1e-1 mbar
	Receive	3	AL	no data	Adjust Low Successful
				7	AL

## 5.2 Sensor Parameters

### 5.2.1 DeGas (DG)

The current pressure must be below 2E-6mbar to switch DeGas on.

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	DG	no data	
	Receive	1	DG	0	DeGas currently off
				1	DeGas currently on
		7	DG	Error Code	See <a href="#">Error Messages</a>
Write	Send	2	DG	0	Switch DeGas off
				1	Switch DeGas on
	Receive	3	DG	no data	Write Successful
				7	DG

### 5.2.2 Degas Logic (DL) for VSH, Cathode Control Logic (DL) for VSI/VSM

Degas Logic (DL) is a valid command for VSH serial numbers higher than 16580300 (VSH), otherwise you will get the error message NO\_DEF (see [Error Messages](#)). Cathode Control Logic (DL) is a valid command for VSI/VSM transmitter.

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	DL	no data	
	Receive	1	DL	0	DeGas Logic is active low (VSH) Logic is active low (VSI/VSM)
				1	DeGas Logic is active high (VSH) Logic is active high (VSI/VSM)
		7	DL	Error Code	See <a href="#">Error Messages</a>
Write	Send	2	DL	0	Set DeGas Logic to active low (VSH) Set logic to active low (VSI/VSM)
				1	Set DeGas Logic to active high (VSH) Set Logic to active high (VSI/VSM)
	Receive	3	DL	no data	Write Successful
				7	Error Code
Factory Default	Send	4	DL	no data	Restore Default (active low) for VSH Restore Default (active high) for VSI/VSM
	Receive	5	DL	no data	Restore Default Successful
				7	DL

## 5.2.3 Sensor Transition (ST)

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	ST	no data	
	Receive	1	ST	0	Direct Switch VSR: 1 mbar VSH: 4e-4 mbar VSM: 1e-3 mbar
				1	Continuous Transition between VSR: 5 to 15 mbar VSH: 1e-3 to 2e-3 mbar VSM: 1e-3 to 2e-3 mbar
				2	Continuous Transition between VSH: 2e-3 to 5e-3 mbar
				F[float]T[float]	Custom Continuous Transition (F)rom [float] (T)o [float], float [mbar]
				D[float]	Custom Direct Switch D[float], float in [mbar]
	7	ST	Error Code	See <a href="#">Error Messages</a>	
Write	Send	2	ST	0	Direct Switch VSR: 1 mbar VSH: 4e-4 mbar VSM: 1e-3 mbar
				1	Continuously Transition between VSR: 5 to 15 mbar VSH: 1e-3 to 2e-3 mbar VSM: 1e-3 to 2e-3 mbar
				2	Continuously Transition between VSH: 2e-3 to 5e-3 mbar
				F[float]T[float]	Custom Continuous Transition (F)rom [float] (T)o [float], float [mbar] VSR: 1 mbar to 20 mbar VSH: 4e-4 mbar to 1e-2 mbar VSM: 4e-4 to 2e-3 mbar
				D[float]	Custom Direct Switch D[float], float in [mbar] VSR: 1 mbar to 20 mbar VSH: 4e-4 mbar to 1e-2 mbar VSM: 4e-4 to 2e-3 mbar
	Receive	3	ST	no data	Write Successful
				7	ST
Factory Default	Send	4	ST	no data	Restore Default
	Receive	5	ST	no data	Restore Default Successful
		7	ST	Error Code	See <a href="#">Error Messages</a>

### 5.2.4 Cathode Control (CC)

All modifications with Cathode Control are temporary.

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	CC	no data	
	Receive	1	CC	0	Cathode is off
				1	Cathode is on
		7	CC	Error Code	See <a href="#">Error Messages</a>
Write	Send	2	CC	0	Cathode off
				1	Cathode on
	Receive	3	CC	no data	Write Successful
				Error Code	See <a href="#">Error Messages</a>
Factory Default	Send	4	CC	no data	Restore Default
	Receive	5	CC	no data	Restore Default Successful
				Error Code	See <a href="#">Error Messages</a>

### 5.2.5 Cathode Control Mode (CM)

All modifications with Cathode Control Mode are permanent.

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	CM	no data	
	Receive	1	CM	0	User Control (manually)
				1	Automatic Control
		7	CM	Error Code	See <a href="#">Error Messages</a>
Write	Send	2	CM	0	User Control (manually)
				1	Automatic Control
	Receive	3	CM	no data	Write Successful
				Error Code	See <a href="#">Error Messages</a>
Factory Default	Send	4	CM	no data	Restore Default (Automatic Control)
	Receive	5	CM	no data	Restore Default Successful
				Error Code	See <a href="#">Error Messages</a>

### 5.2.6 Filament Control (FC)

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	FC	no data	
	Receive	1	FC	0	Switch to Fil. 2 if Fil. 1 is defect (default)
				1	Force use Fil. 1
				2	Force use Fil. 2
				3	Toggle Filament if pressure > 1 mbar
		7	FC	Error Code	See <a href="#">Error Messages</a>
Write	Send	2	FC	0	Switch to Fil. 2 if Fil. 1 is defect (default)
				1	Force use Fil. 1
				2	Force use Fil. 2
				3	Toggle Filament if pressure > 1 mbar
	Receive	3	FC	no data	Write Successful
		7	FC	Error Code	See <a href="#">Error Messages</a>
Factory Default	Send	4	FC	no data	Restore Default
	Receive	5	FC	no data	Restore Default Successful
				Error Code	See <a href="#">Error Messages</a>

**5.2.7 Filament Number (FN)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	FN	no data	
	Receive	1	FN	1 or 2	Return current filament number
		7	FN	Error Code	See <a href="#">Error Messages</a>

**5.2.8 Filament Status (FS)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	FS	no data	
	Receive	1	FS	0	Filament 1 and 2 ok
			FS	1	Filament 1 defect
			FS	2	Filament 2 defect
			FS	3	Filament 1 and 2 defect
	7	FS	Error Code	See <a href="#">Error Messages</a>	

**5.2.9 Gas Correction Factor 1, 3, 4 (C1, C3, C4)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	C1	no data	
			C3	no data	
			C4	no data	
	Receive	1	C1	float (2 decimals)	Factor for Pirani
			C3	float (2 decimals)	Factor for Hot Cathode
			C4	float (2 decimals)	Factor for Cold Cathode
		7	C1 C3/4	Error Code	See <a href="#">Error Messages</a>
Write	Send	2	C1	float	New Factor for Pirani (0.2 to 8.0)
			C3	float	New Factor for Hot Cathode (0.2 to 8.0)
			C4	float	New Factor for Cold Cathode (0.2 to 8.0)
	Receive	3	C1	no data	Write Successful
		7	C3/4	Error Code	See <a href="#">Error Messages</a>
Factory Default	Send	4	C1	no data	Restore Default Factor for Pirani
			C3	no data	Restore Default Factor for Hot Cathode
			C4	no data	Restore Default Factor for Cold Cathode
	Receive	5	C1	no data	Reset Successful
		7	C3/4	Error Code	See <a href="#">Error Messages</a>

**5.2.10 Panel Status (PS)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	PS	no data	
	Receive	1	PS	0	Panel unlocked
				1	Panel locked
7	PS	Error Code	See <a href="#">Error Messages</a>		
Write	Send	2	PS	0	Unlock Panel
				1	Lock Panel
	Receive	3	PS	no date	Write Successful
		7	PS	Error Code	See <a href="#">Error Messages</a>



**5.2.11 Controller Status (CS)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	CS	no data	
	Receive	1	CS	0	Controller is off
					1
		7	CS	Error Code	See <a href="#">Error Messages</a>
Write	Send	2	CS	0	Switch Controller off
				1	Switch Controller on
	Receive	3	CS	no data	Write Successful
				7	CS

**5.3 Transmitter Parameter****5.3.1 Type of Device (TD)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	TD	no data	
	Receive	1	TD	string	identification string for the device
		7	TD	Error Code	See <a href="#">Error Messages</a>

**5.3.2 Product Name (PN)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	PN	no data	
	Receive	1	PN	string	Product Name, e.g. VSP53D
		7	PN	Error Code	See <a href="#">Error Messages</a>

**5.3.3 Serial Number Device (SD)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	SD	no data	
	Receive	1	SD	string	Serial Number of Device
		7	SD	Error Code	See <a href="#">Error Messages</a>

**5.3.4 Serial Number Head (SH)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	SH	no data	
	Receive	1	SH	string	Serial Number of Sensor Head
		7	SH	Error Code	See <a href="#">Error Messages</a>

**5.3.5 Baud Rate (BR)**

Mode	Sequence	AC	CMD	Data	Description
Write	Send	2	BR	[baud rate]	Use baud rate as data 9600, 14400, 19200, 28800, 38400, 57600, 115200
				no data	Write Successful
	Receive	3	BR	Error Code	See <a href="#">Error Messages</a>

Note: If no error, the new baud will be activated after the receive sequence.

**5.3.6 Response Delay (RD)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	RD	no data	
	Receive	1	RD	int	Response delay in $\mu\text{s}$
		7	RD	Error Code	See <a href="#">Error Messages</a>
Write	Send	2	RD	int	New response delay in $\mu\text{s}$ (Valid Values from 1 to 99999 $\mu\text{s}$ )
	Receive	3	RD	no data	Write Successful
		7	RD	Error Code	See <a href="#">Error Messages</a>

Note: The change of the response delay is always temporarily. After switching the device on/off or sending a Device Restart (DR) command the device will use the default value again.

**5.3.7 Version Device (VD)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	VD	no data	
	Receive	1	VD	string	Version Device
		7	VD	Error Code	See <a href="#">Error Messages</a>

**5.3.8 Version Head (VH)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	VH	no data	
	Receive	1	VH	string	Version Sensor Head
		7	VH	Error Code	See <a href="#">Error Messages</a>

**5.3.9 Version Firmware (VF)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	VF	no data	
	Receive	1	VF	string	Version Firmware
		7	VF	Error Code	See <a href="#">Error Messages</a>

**5.3.10 Version Bootloader (VB)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	VB	no data	
	Receive	1	VB	string	Version Bootloader
		7	VB	Error Code	See <a href="#">Error Messages</a>

**5.3.11 Device Restart (DR)**

Mode	Sequence	AC	CMD	Data	Description
Write	Send	2	DR	no data	
	Receive	3	DR	no data	
		7	DR	Error Code	See <a href="#">Error Messages</a>

Note: If no error, device will restart after the receive sequence.

**5.3.12 Analog Output Characteristic (OC)**

Mode	Sequence	AC	CMD	Data	Description
Read	Send	0	OC	no data	
	Receive	1	OC	Data String	See Description Data String
7		OC	Error Code	See <a href="#">Error Messages</a>	
Write	Send	2	OC	Data String	See Description Data String
	Receive	3	OC	no data	Write Successful
		7	OC	Error Code	See <a href="#">Error Messages</a>
Factory Default	Send	4	OC	no data	Restore Default
	Receive	5	OC	no data	Restore Default Successful
		7	OC	Error Code	See <a href="#">Error Messages</a>

Description Data String:

The data string for the analog output characteristic has a mutable length and is divided into eight sub data contents. The order of sub data is mandatory.

Data	Sub Term	Sub Data	Description
DATA	TYPE	Log	Logarithmic Output
		Lin	Linear Output
	GAIN	G[float]	Gain shortcut "G" followed by float
	OFFSET	O[float]	Offset shortcut "O" followed by voltage float in [V]
	LOW. L.	L[float]	Lower Limit shortcut "L" followed by voltage float in [V]
	UPP. L.	L[float]	Upper Limit shortcut "L" followed by voltage float in [V]
	UNDER.	U[float]	Underrange shortcut "U" followed by voltage float in [V]
	OVER.	O[float]	Overrange shortcut "O" followed by voltage float in [V]
FAULT	F[float]	Fault shortcut "F" followed by voltage float in [V]	

For table function:

Data	Sub Term	Sub Data	Description
DATA	Type	Tab	Logarithmic Output
	Size	S[int]	Table size count, maximum is 64
	UNDER.	U[float]	Underrange shortcut "U" followed by voltage float in [V]
	OVER.	O[float]	Overrange shortcut "O" followed by voltage float in [V]
	FAULT	F[float]	Fault shortcut "F" followed by voltage float in [V]

Data	Sub Term	Sub Data	Description
DATA	Type	Tab	Logarithmic Output
	Entry	E[int]	Entry index
	Pressure	P[float]	Pressure shortcut "P" followed by voltage float in [V]
	Voltage	U[float]	Voltage shortcut "U" followed by voltage float in [V]

Data Package Syntax for Analog Output Characteristic:

8	9	10	11	...	...	...	...	...	...	...	...	...	...	...	...	...	n
DATA																	
TYPE			GAIN		OFFSET		LOW. L.		UPP. L.		UNDER.		OVER.		FAULT		
L	o	g	G	float	O	float	L	float	L	float	U	float	O	float	F	float	
L	i	n	G	float	O	float	L	float	L	float	U	float	O	float	F	float	

Example: Read Analog Output Characteristic

Sequence Send:

0	1	2	3	4	5	6	7	8	9
ADR			AC	CMD		LEN		CS	CR
0	0	1	0	0	C	0	0	s	CR

For a table entry:

0	1	2	3	4	5	6	7	8	9	10	11
ADR			AC	CMD		LEN		Type	Index	CS	CR
0	0	1	0	0	C	0	2	E	1	k	CR

Sequence Receive:

0	1	2	3	4	5	6	7	8	...	n	n+1	n+2
ADR			AC	CMD		LEN		DATA			CS	CR
0	0	1	1	0	C	3	7	37 Byte			I	CR

The content of DATA will be:

8	9	10	11	...	...	...	...	...	...	...	...	...	...	...	...	n
DATA																
TYPE			GAIN		OFFSET		LOW. L.		UPP. L.		UNDER.		OVER.		FAULT	
L	o	g	G	1.0	0	5.5	L	0.0	L	10.5	U	0.9	O	9.2	F	0.4

## 6 Warnings and Error Messages

If any error occurs, you will receive a feedback from the device with access code 7 and a short message in DATA to explain what kind of error happens.

DATA	Description
NO_DEF	Command is not valid (not defined) for the device, e.g. DeGas (DG) for VSR
_LOGIC	Access Code is not valid or execution of command is not logical
_RANGE	Error if any data value in send sequence is out of range, e.g. to high value for a gas correction factor
ERROR1	Sensor is defect or stacked out
SYNTAX	Command is valid, but the syntax in data is wrong or the selected mode in data is not valid for your device
LENGTH	Command is valid, but the length of data is out of expected range
_CD_RE	Calibration Data Read Error
_EP_RE	EEPROM Read Error
_UNSUP	Unsupported Data, e.g. no valid value for baud rate
_SEDIS	Sensor element disabled, e.g. read measurement of cathode if cathode is disabled

## 7 ASCII Table

Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC
0	00	NUL	22	16	SYN	44	2C	,	66	42	B	88	58	X	110	6E	n
1	01	SOH	23	17	ETB	45	2D	-	67	43	C	89	59	Y	111	6F	o
2	02	STX	24	18	CAN	46	2E	.	68	44	D	90	5A	Z	112	70	p
3	03	ETX	25	19	EM	47	2F	/	69	45	E	91	5B	[	113	71	q
4	04	BOT	26	1A	SUB	48	30	0	70	46	F	92	5C	\	114	72	r
5	05	ENQ	27	1B	ESC	49	31	1	71	47	G	93	5D	]	115	73	s
6	06	ACK	28	1C	FS	50	32	2	72	48	H	94	5E	^	116	74	t
7	07	BEL	29	1D	GS	51	33	3	73	49	I	95	5F	_	117	75	u
8	08	BS	30	1E	RS	52	34	4	74	4A	J	96	60	`	118	76	v
9	09	TAB	31	1F	US	53	35	5	75	4B	K	97	61	a	119	77	w
10	0A	LF	32	20	SP	54	36	6	76	4C	L	98	62	b	120	78	x
11	0B	VT	33	21	!	55	37	7	77	4D	M	99	63	c	121	79	y
12	0C	FF	34	22	„	56	38	8	78	4E	N	100	64	d	122	7A	z
13	0D	CR	35	23	#	57	39	9	79	4F	O	101	65	e	123	7B	{
14	0E	SOH	36	24	\$	58	3A	:	80	50	P	102	66	f	124	7C	
15	0F	SI	37	25	%	59	3B	;	81	51	Q	103	67	g	125	7D	}
16	10	DLE	38	26	&	60	3C	<	82	52	R	104	68	h	126	7E	~
17	11	DC1	39	27	,	61	3D	=	83	53	S	105	69	i	127	7F	DEL
18	12	DC2	40	28	(	62	3E	>	84	54	T	106	6A	j			
19	13	DC3	41	29	)	63	3F	?	85	55	U	107	6B	k			
20	14	DC4	42	2A	*	64	40	@	86	56	V	108	6C	l			
21	15	NAK	43	2B	+	65	41	A	87	57	W	109	6D	m			

## 8 Command comparison between old and new protocol

Old Protocol	New Protocol	Compatibility of Data	Description
Type (T)	Type of Device (TD)	Yes	
Measurement (M)	Measurement Value (MV)	No	old: 6 Byte fixed, coded new: float value
Setpoint (S,s) Hysteresis (H,h)	Relay 1,2,3,4 (R1,R2,R3,R4)	No	Complete overhaul, see command description
Parameter Set (P,p)			not supported anymore
Correction Factor (C,c)	Gas Correction Factor 1,3,4 (C1, C3, C4)	No	old: integer multiplied by 100 new: float value and distinction between hot and cold cathode possible
Adjustment (j)	Adjust High (AH) Adjust Low (AL)	No	Complete overhaul, see command description
Start/Stop Control (A,a)	Controller Status (CS)	Yes	
Lock Keyboard (K,k)	Panel Status (PS)	Yes	
DeGas (D,d)	DeGas (DG)	Yes	
Filament Number (F)	Filament Number (FN)	No	old: 0=Fil. 1, 1=Fil. 2 new: 1=Fil. 1, 2=Fil. 2
Sensor Transition (W,w)	Sensor Transition (ST)	partly	Complete overhaul, see command description
Cold Cathode (I,i)	Cathode Control (CC)	Yes	
Display Unit (U,u)	Display Unit (DU)	No	Complete overhaul, see command description

## 9 Document History

Date	Version	Author	Changes
12.04.2016	2.0.0	SJ	first public release
18.04.2016	2.0.1	SJ	Update Sensor Transition (ST) Custom Continuous Transition and Custom Direct Switch Added: Valid Pressure Ranges for VSR, VSH and VSM
			Update Gas Correction Factor 1, 3, 4 (C1, C3, C4) Fixed: Write Command, wrong sensor principle for C3 and C4 Added: Valid Factor Ranges for C1, C3 and C4
26.04.2016	2.0.2	SJ	Update Response Delay (RS) Added: Valid Value Range for RS
28.06.2016	2.0.3	SJ	Added: Degas Logic (DL)
			Fixed some typing errors in these commands: Adjust Low (AL) Device Restart (DR) Analog Output Characteristic (OC)
			Added: Adjust Low (AJ), Write with float as data to adjust low to a specific pressure
16.09.2016	2.0.4	SJ	Changed parameter descriptions with [hPa] to [mbar]. However the value itself will not change but mbar is the default unit: Changes done in: Measurement Range (MR) Measurement Value (MV) Measurement Value 1, 2, 3, 4 (M1, M2, M3, M4) Adjust High (AH) Adjust Low (AL) Relay 1, 2, 3, 4 (R1, R2, R3, R4) Sensor Transition (ST) Filament Control (FC)
			Update Response Delay (RD) Fixed typing error, changed "99999 $\mu$ " to "99999 $\mu$ s"
12.10.2016	2.0.5	SJ	Update Display Unit (DU) Existing Access Code "Factory Default" wasn't documented
17.10.2016	2.0.6	SJ	Update Degas (DG) and DeGas Logic (DL) Added some information to both commands.
			Removed Version Head (VH) from valid command list for Smartline Transmitter
03.04.2017	2.0.7	SJ	Added: Cathode Control Mode (CM) Read, Write and Factory Default
			Added: Display Orientation (DO) Read, Write and Factory Default
			Added Overrange and Underrange Message to Command Measurement Value (MV) and Measurement Value 1,2,3,4 (M1/4)
			Reorganization of Command Overview section into Main Commands, Sensor Parameter and Device Information
25.07.2017	2.0.8	MN	Added: VD14
04.08.2017	2.0.9	MN	Added: VSM Digital Logic "DL"
16.10.2017	2.1.0	MN	Added: valid display units
13.11.2017	2.1.1	MN	Added: Analog Output Characteristic Table Function