



# Smartline Vacuum Transmitter EtherCAT Communication Manual



VSR/VCR/VSP/VCP



VSM/VSU



VSH

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## 1 Communication

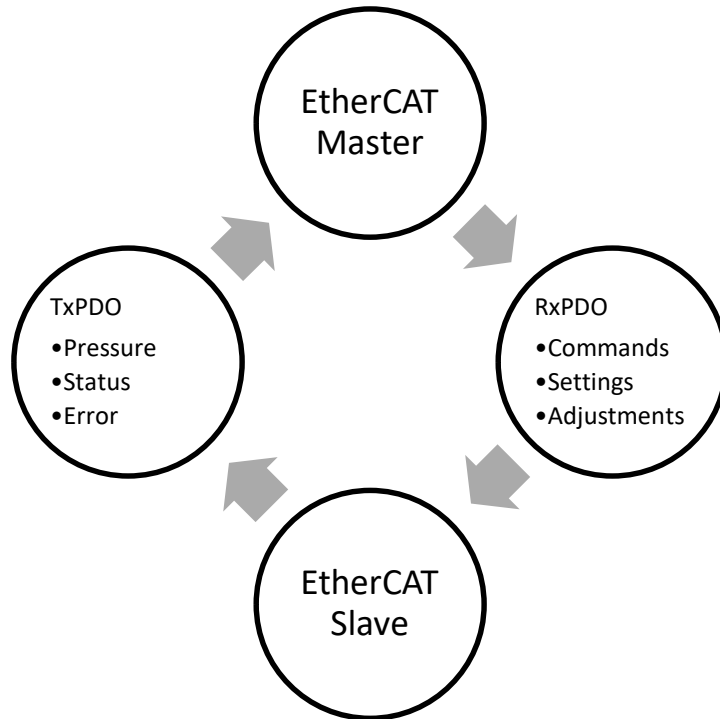
### 1.1 Communication Types

All Smartline Transmitter support the following communication type:

- Process Data Communication (PDO)

### 1.2 Process Data Objects (PDOs)

Process Data Objects (PDOs) are used to transfer data with a cyclic communication between slave and master. Reception PDOs (RxPDOs) are used to receive data and transmission PDOs (TxPDOs) transmit data.



### 1.3 CANopen over EtherCAT (CoE)

The Object Dictionary can be accessed by a Master via acyclic SDO services or from the device description from ESI file. Both Master and Slave need to exchange data cyclically. For this reason, CoE protocol allows to configure a specific subset of the Objects defined in the Object Dictionary as Process Data. The Process Data are not a second source of information for the Slave device: they are simply a subset of the Objects provided by the Slave which are exchanged with a preferred cyclic channel and the values are copied directly from the EtherCAT frame to the local variable in the Slave's firmware and vice-versa instead of processed by the mailbox.

### 1.4 Data exchange with Smartline Transmitter Slaves

The Objects with Index 0x200F and Index 0x300F are defined as Input Data respectively Output Data. These Objects are mapped as Process Data Objects (PDOs) for cyclic data exchange.

## 2 Process Data Objects (PDOs)

### 2.1 PDO List

Index	Bitsize	Name	Flags
0x1A00	64	Pressure Status	mandatory, fixed
0x1A01	8	Status and Type	mandatory, fixed
0x1A02	8	Transmitter Status	mandatory, fixed
0x1A03	16	Syntax	mandatory, fixed
0x1600	80	Outputs	mandatory, fixed

### 2.2 TxPDO Content (0x1A00) – Pressure Status

Index	Bitsize	Name	Type
0x200F:01	32	Actual Pressure	REAL
0x200F:02	16	Actual GCF 1	UINT
0x200F:03	16	Actual GCF 2	UINT

Subindex	Description										
0x01	Actual Pressure: Contains the actual pressure value										
0x02	Actual GCF 1: Contains the actual Gas Correction Factor (GCF) for Pirani sensor of all Smartline transmitters. <table border="1"> <tr> <th>Type</th><th>Data Range</th></tr> <tr> <td>VSR/VCR</td><td>0x0014 – 0x0320 (20 – 800)</td></tr> <tr> <td>VSP/VCP</td><td>0x0014 – 0x0320 (20 – 800)</td></tr> <tr> <td>VSM/VS1</td><td>0x0014 – 0x0320 (20 – 800)</td></tr> <tr> <td>VSH</td><td>0x0014 – 0x0320 (20 – 800)</td></tr> </table>	Type	Data Range	VSR/VCR	0x0014 – 0x0320 (20 – 800)	VSP/VCP	0x0014 – 0x0320 (20 – 800)	VSM/VS1	0x0014 – 0x0320 (20 – 800)	VSH	0x0014 – 0x0320 (20 – 800)
Type	Data Range										
VSR/VCR	0x0014 – 0x0320 (20 – 800)										
VSP/VCP	0x0014 – 0x0320 (20 – 800)										
VSM/VS1	0x0014 – 0x0320 (20 – 800)										
VSH	0x0014 – 0x0320 (20 – 800)										
0x03	Actual GCF 2: Contains the actual Gas Correction Factor (GCF) for hot or cold cathode for Smartline transmitters. <table border="1"> <tr> <th>Type</th><th>Data Range</th></tr> <tr> <td>VSR/VCR</td><td>0x0000 (0), fixed</td></tr> <tr> <td>VSP/VCP</td><td>0x0000 (0), fixed</td></tr> <tr> <td>VSM/VS1</td><td>0x0014 – 0x0320 (20 – 800) for cold cathode</td></tr> <tr> <td>VSH</td><td>0x0014 – 0x0320 (20 – 800) for hot cathode</td></tr> </table>	Type	Data Range	VSR/VCR	0x0000 (0), fixed	VSP/VCP	0x0000 (0), fixed	VSM/VS1	0x0014 – 0x0320 (20 – 800) for cold cathode	VSH	0x0014 – 0x0320 (20 – 800) for hot cathode
Type	Data Range										
VSR/VCR	0x0000 (0), fixed										
VSP/VCP	0x0000 (0), fixed										
VSM/VS1	0x0014 – 0x0320 (20 – 800) for cold cathode										
VSH	0x0014 – 0x0320 (20 – 800) for hot cathode										

### 2.3 TxPDO Content (0x1A01) – Status and Type

Index	Bitsize	Name	Type
0x200F:04	3	Sensor Type	BIT3
0x200F:05	1	DeGas active	BIT
0x200F:06	1	High vacuum cathode inactive	BIT
0x200F:07	1	Spare Filament	BIT
0x200F:08	2	Sensor Switch Mode	BIT2

Subindex Description

0x04 Sensor Type: Contains the Smartline Transmitter Type

Type	Data	
VSR/VCR	0x1 (1)	
VSP	0x2 (2)	
VSM	0x3 (3)	
VSH	0x4 (4)	
VCP	0x5 (5)	
VSI	0x6 (6)	

0x05 Degas active: Indicates the status of DeGas.

Type	Data	Description
VSR/VCR VSP/VCP VSM/VSI	0x0 (0)	fixed
VSH	0x0 (0)	Degas is inactive (default)
	0x1 (1)	Degas is active

0x06 High vacuum cathode inactive: For certain vacuum processes it may be favored to suppress the start of the hot cathode (VSH) or cold cathode (VSM/VSI) sensor, which is automatically controlled by the transducer electronics.

Type	Data	Description
VSR/VCR VSP/VCP	0x0 (0)	fixed
VSM/VSI	0x0 (0)	cold cathode is active (default)
	0x1 (1)	cold cathode is inactive
VSH	0x0 (0)	hot cathode is active (default)
	0x1 (1)	hot cathode is inactive

0x07 Spare Filament: VSH transmitters have two filaments. This bit indicates that the VSH transmitter has switched to the spare filament, filament 1 is depleted.

Type	Data	Description
VSR/VCR VSP/VCP VSM/VSI	0x0 (0)	fixed
VSH	0x0 (0)	Filament 1 is active, CoE Object is FALSE
	0x1 (1)	Filament 2 (spare Filament) is active, CoE Object is TRUE

0x08 Sensor Switch Mode: By default the VSR/VCR, VSM/VSI and VSH transmitter performs a continuous transition between their sensors principles over a pressure range whereupon an assimilation of the sensor signals is carried out. The Sensor Switch Mode contains the actual mode.

Type	Data	Description
VSR/VCR	0x0 (0)	no transition, direct switch at 1 mbar
	0x1 (1)	continuous transition between 5 mbar and 15 mbar (default)
VSP/VCP	0x0 (0)	fixed
VSM/VSI	0x0 (0)	no transition, direct switch at 1E-3 mbar
	0x1 (1)	continuous transition between 1E-3 mbar and 2E-3 mbar (default)
VSH	0x0 (0)	no transition, direct switch at 4E-4 mbar
	0x1 (1)	continuous transition between 1E-3 mbar and 2E-3 mbar (default)
	0x2 (2)	continuous transition between 2E-3 mbar and 5E-3 mbar

## 2.4 TxPDO Content (0x1A02) – Transmitter Status

Index	Bitsize	Name	Type
0x200F:09	1	Warning – Overrange	BIT
0x200F:0A	1	Warning – Underrange	BIT
-	1	-	Padding Bit
0x200F:0C	1	Error – Filament 1 defect	BIT
0x200F:0D	1	Error – Filament 2 defect	BIT
0x200F:0E	1	Error – Internal Communication	BIT
0x200F:0F	1	Error – EEPROM failure	BIT
0x200F:10	1	Error – Sensor defect/stacked out	BIT

### Subindex Description

#### 0x09 Warning – Overrange

Type	Data	Description
all	0x0 (0)	no error
	0x1 (1)	overrange detected, pressure level exceeds the measurement range

#### 0x0A Warning – Underrange

Type	Data	Description
all	0x0 (0)	no error
	0x1 (1)	underrange detected, pressure level is lower than the measurement range. The Actual Pressure (0x200F:01) will be fixed to the minimum measurement value of the transmitter.

#### 0x0C Error – Filament 1 defect

Type	Data	Description
VSR/VCR VSP/VCP VSM/VSJ	0x0 (0)	fixed
VSH	0x0 (0)	no error
	0x1 (1)	Filament 1 is defect

#### 0x0D Error – Filament 2 defect

Type	Data	Description
VSR/VCR VSP/VCP VSM/VSJ	0x0 (0)	fixed
VSH	0x0 (0)	no error
	0x1 (1)	Filament 2 (spare filament) is defect

#### 0x0E Error – Internal Communication

Type	Data	Description
all	0x0 (0)	no error
	0x1 (1)	internal communication error of the transmitter electronics

#### 0x0F Error – EEPROM failure

Type	Data	Description
all	0x0 (0)	no error
	0x1 (1)	failure on EEPROM

#### 0x10 Error – Sensor defect/stacked out

Type	Data	Description
all	0x0 (0)	no error
	0x1 (1)	sensor head is stacked out or sensor head is defect

## 2.5 TxPDO Content (0x1A03) – Syntax

Index	Bitsize	Name	Type
-	2	-	Padding Bits
0x200F:13	1	Error – Sensor Switch Mode, Value mismatch	BIT
0x200F:14	1	Error – GCF 1, Value mismatch	BIT
0x200F:15	1	Error – GCF 2, Value mismatch	BIT
0x200F:16	1	Error – Pressure Adjust, Value mismatch	BIT
0x200F:17	1	Error – Command supported	BIT
0x200F:18	1	Error – Command invalid	BIT
0x200F:19	8	Command executed	BYTE

### Subindex Description

0x13 Error – Sensor Switch Mode, Value mismatch

Type	Data	Description
VSP/VCP	0x0 (0)	fixed
VSR/VCR	0x0 (0)	no error
VSH VSM/VS	0x1 (1)	The value in Data Sensor Switch Mode (0x300F:05) is wrong or out of range

0x14 Error – GCF 1, Value mismatch

Type	Data	Description
all	0x0 (0)	no error
	0x1 (1)	The value in Data GCF 1 (0x300F:02) is wrong or out of range

0x15 Error – GCF 2, Value mismatch

Type	Data	Description
VSR/VCR VSP/VCP	0x0 (0)	fixed
VSH	0x0 (0)	no error
VSM/VS	0x1 (1)	The value in Data GCF 2 (0x300F:03) is wrong or out of range

0x16 Error – Pressure Adjust, Value mismatch

Type	Data	Description
all	0x0 (0)	no error
	0x1 (1)	The value in Data Pressure (0x300F:01) is wrong or out of range

0x17 Error – Command Supported

Type	Data	Description
all	0x0 (0)	Command not supported
	0x1 (1)	no error

0x18 Error – Command invalid

Type	Data	Description
all	0x0 (0)	no error
	0x1 (1)	Command is invalid and can't be executed

0x19 Command executed

Type	Data	Description
all		Contains the value of the last executed command that was written in Command (0x300F:04)

## 2.6 RxPDO Content (0x1600) – Outputs

Index	Bitsize	Name	Type
0x300F:01	32	Data Pressure	REAL
0x300F:02	16	Data GCF 1	UINT
0x300F:03	16	Data GCF 2	UINT
0x300F:04	8	Command	BYTE
0x300F:05	8	Data Sensor Switch Mode	BYTE

### Subindex Description

#### 0x01 Data Pressure

Type	Data	Description
all	Var.	Contains a Pressure value as 32bit Real

#### 0x02 Data GCF 1

Type	Data	Description
all	0x0014 – 0x0320 (20 – 800)	New value for the GCF 1, used for Pirani sensor

#### 0x03 Data GCF 2

Type	Data	Description
VSR/VCR VSP/VCP		all data values will be ignored
VSH VSM/VS	0x0014 – 0x0320 (20 – 800)	New value for the GCF 2, used for hot cathode and cold cathode

#### 0x04 Command

Type	Data	Description
all	0x00 (0)	Zero Command
	0x01 (1)	Adjust High Vacuum
	0x02 (2)	Adjust Atmospheric Pressure
	0x03 (3)	Set Gas Correction Factors (GCF)
VSR/VCR	0x39 (57)	Set Sensor Switch Mode
VSP/VCP	-	no special VSP/VCP commands
VSM/VS	0x46 (70)	Activate Cold Cathode
	0x47 (71)	Deactivate Cold Cathode
	0x4D (77)	Set Sensor Switch Mode
VSH	0x50 (80)	Active Hot Cathode
	0x51 (81)	Deactivate Hot Cathode
	0x55 (85)	Activate DeGas
	0x56 (86)	Deactivate DeGas
	0x57 (87)	Set Sensor Switch Mode



0x05

Data Sensor Switch Mode

Type	Data	Description
VSR/VCR	0x0 (0)	no transition, direct switch at 1 mbar
	0x1 (1)	continuous transition between 5 mbar and 15 mbar (default)
VSP/VCP	-	VSP/VCP has no transition
VSM/VS1	0x0 (0)	no transition, direct switch at 1E-3 mbar
	0x1 (1)	continuous transition between 1E-3 mbar and 2E-3 mbar (default)
VSH	0x0 (0)	no transition, direct switch at 4E-4 mbar
	0x1 (1)	continuous transition between 1E-3 mbar and 2E-3 mbar (default)
	0x2 (2)	continuous transition between 2E-3 mbar and 5E-3 mbar

### 3 Commands (0x300F:04)

#### 3.1 Command List

All commands are separated into two groups:

- General Commands, that are valid for all Smartline transmitter
- Commands, that are valid only for a specific transmitter

Rules for commands:

- Each command will be executed only once.
- Always the last executed command will be written into Command executed (0x200F:19)

Type	Data	Name
all	0x00 (0)	Zero Command
	0x01 (1)	Adjust High Vacuum
	0x02 (2)	Adjust Atmospheric Pressure
	0x03 (3)	Set Gas Correction Factors (GCF)
VSR/VCR	0x39 (57)	Set Sensor Switch Mode
VSP/VCP	-	No special VSP/VCP commands
VSM/VSJ	0x46 (70)	Activate Cold Cathode
	0x47 (71)	Deactivate Cold Cathode
	0x4D (77)	Set Sensor Switch Mode
VSH	0x50 (80)	Active Hot Cathode
	0x51 (81)	Deactivate Hot Cathode
	0x55 (85)	Activate DeGas
	0x56 (86)	Deactivate DeGas
	0x57 (87)	Set Sensor Switch Mode

## 3.2 General Commands for all Smartline Transmitter

### 3.2.1 0x00 (0) – Zero Command

Type	Chain	PDO	Name	Data	Description
all	1.	0x300F:04	Zero Command	0x00 (0)	clear 0x200F:19

### 3.2.2 0x01 (1) – Adjust High Vacuum

Type	Chain	PDO	Name	Data	Description
all	1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x01 (1)
	2.	0x300F:02	Data Pressure	0x00 (0)	mandatory
	3.	0x300F:04	Command	0x01 (1)	adjust high vacuum

### 3.2.3 0x02 (2) – Adjust Atmospheric Pressure

Type	Chain	PDO	Name	Data	Description
VSR/VCR	1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x02 (2)
	2.	0x300F:02	Data Pressure	variable	actual atmospheric pressure
	3.	0x300F:04	Command	0x02 (2)	adjust atmospheric pressure
VSP/VCP VSM/VS VSH	1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x02 (2)
	2.	0x300F:02	Data Pressure	0x03E8 (1000)	1000 mbar
	3.	0x300F:04	Command	0x02 (2)	adjust atmospheric pressure

### 3.2.4 0x03 (3) – Set Gas Correction Factors

Type	Chain	PDO	Name	Data	Description
VSR/VCR VSP/VCP	1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x03 (3)
	2.	0x300F:03	Data GCF 1 Pirani	0x0014 (20) – 0x0320 (800)	Gas Correction Factor for Pirani
	3.	0x300F:01	Data GCF 2 BA / CC	d.c.	will be ignored, value
	4.	0x300F:04	Command	0x03 (3)	set GCF factors
VSH VSM/VS	1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x03 (3)
	2.	0x300F:03	Data GCF 1 Pirani	0x0014 (20) – 0x0320 (800)	Gas Correction Factor for Pirani
	3.	0x300F:01	Data GCF 2 BA / CC	0x0014 (20) – 0x0320 (800)	Gas Correction Factor for Hot Cathode (BA) or Cold Cathode (CC)
	4.	0x300F:04	Command	0x03 (3)	set GCF factors

### 3.3 VSR/VCR Commands

#### 3.3.1 0x39 (57) – Set Sensor Switch Mode

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x39 (57)
2.	0x300F:05	Data Sensor Switch Mode	0x0 (0) or 0x1 (1)	
3.	0x300F:04	Command	0x39 (57)	set sensor switch mode

### 3.4 VSM/VSİ Commands

#### 3.4.1 0x46 (70) – Activate Cold Cathode

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x46 (70)
2.	0x300F:04	Command	0x46 (70)	activate cold cathode

#### 3.4.2 0x47 (71) – Deactivate Cold Cathode

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x47 (71)
2.	0x300F:04	Command	0x47 (71)	deactivate cold cathode

#### 3.4.3 0x4D (77) – Set Sensor Switch Mode

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x4D (77)
2.	0x300F:05	Data Sensor Switch Mode	0x0 (0) or 0x1 (1)	
3.	0x300F:04	Command	0x4D (77)	set sensor switch mode

### 3.5 VSH Commands

#### 3.5.1 0x50 (80) – Activate Hot Cathode

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x50 (80)
2.	0x300F:04	Command	0x50 (80)	activate hot cathode

#### 3.5.2 0x51 (81) – Deactivate Hot Cathode

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x51 (81)
2.	0x300F:04	Command	0x51 (81)	deactivate hot cathode

#### 3.5.3 0x55 (85) – Activate DeGas

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x55 (85)
2.	0x300F:04	Command	0x55 (85)	activate DeGas

#### 3.5.4 0x56 (86) – Deactivate DeGas

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x56 (86)
2.	0x300F:04	Command	0x56 (86)	deactivate DeGas

#### 3.5.5 0x57 (87) – Set Sensor Switch Mode

Chain	PDO	Name	Data	Description
1.	0x300F:04	Zero Command	0x00 (0)	mandatory if 0x200F:19 is 0x57 (87)
2.	0x300F:05	Data Sensor Switch Mode	0x0 (0), 0x1 (1) or 0x2 (2)	Data value depends on transmitter
3.	0x300F:04	Command	0x57 (87)	set sensor switch mode

## 4 ESI File

You can download the ESI files and this document from the Thyracont webpage:

1. Open Thyracont webpage [www.thyracont-vacuum.com](http://www.thyracont-vacuum.com)
2. Browse to Support → [Download Center](#)
3. Section “Smartline - Intelligent Vacuum Transducers” -> “Smartline: ESI files for Smartline”

The ZIP File contains:

1. ESI File

## 5 Document History

Date	Version	Comment	Revision Number (0x1018:13)	Software Version (0x100A)
2014-01-14	1.0	Initial Release v1.0	0x2774 (10100)	-
2014-03-17	1.1	Editorial changes	0x2774 (10100)	-
2014-05-30	1.2	Description of CoE Objects (first public release)	0x2774 (10100)	3.0e
2014-07-09	1.3	1.) Several names of parameters changed and editorial changes of their description 6000:01 → “Actual GCF 1” 6000:02 → “Actual GCF 2” 6000:07 → “Spare Filament” 6000:14 → “Error – GCF 1, value mismatch” 6000:15 → “Error – GCF 2, value mismatch” 7000:01 → “Data GCF 2” 7000:03 → “Data GCF 1”  2.) Notes on Display Bug of TwinCAT added for Sensor Type (0x6000:04) and Sensor Switch Mode (0x6000:08)	0x27D8 (10200)	3.0g
2016-02-03	1.3	Typing errors in RxPDO Content (0x1A01)		
2017-11-06	1.3	Some corrections		
2018-11-16	1.4	Some corrections		
2021-06-25	1.5	Add VSI/VCP/VCR		
2022-03-01	1.7	New ESI New object index: 200F instead of 6000 300F instead of 7000	0x3040101	3.4.2

## 6 License

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