



# TRICOR®

TCD 9100/9200 HART® Communication





## Manual-Version

TCD\_COHA\_S\_EN\_100428\_E001

This document is supplied as standard in electronic media with the device. Latest version can be downloaded at [www.tricorflow.com](http://www.tricorflow.com).

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### NOTE:

This manual applies to the Coriolis Flow Meter with the brand TRICOR.

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## 1. Introduction

### 1.1. Purpose of this Documentation

This manual contains all information needed to integrate the process instruments into a communications network. The manual is aimed at control system designers, system integrators, instrument engineers.

In order to operate safely and for more detailed information you need the product specific manual. Available for download from Flow documentation <https://tricorflow.com/support/downloads/manuals/>.

### 1.2. Purpose of this Documentation

This manual applies to the TRICOR TCD transmitter HART version only. The TRICOR TCD transmitter can be used in combination with the following sensors:

- TCMP Series
- TCMQ Series

In order to operate a Coriolis flow meter, you need also Operating Instructions.

### 1.3. Legal information

#### Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

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#### **DANGER!**

indicates that death or severe personal injury **will** result if proper precautions are not taken.

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#### **WARNING!**

indicates that death or severe personal injury **may** result if proper precautions are not taken.

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#### **CAUTION!**

indicates that minor personal injury can result if proper precautions are not taken.

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#### **NOTE:**

indicates that property damage can result if proper precautions are not taken.

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If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

#### Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety



instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

## Proper use of KEM products

Note the following

### **WARNING!**

KEM products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by KEM. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

### **NOTE:**

#### **Use in a domestic environment**

This Class A Group 1 equipment is intended for use in industrial areas.  
In a domestic environment this device may cause radio interference.

#### **Trademarks**

All names identified by ® are registered trademarks of KEM. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

#### **Disclaimer of Liability**

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

## 1.4. Purpose of this Documentation

| Edition | Remarks       | Product compatibility                                                             | Compatibility of device integration package                                                    |
|---------|---------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 02/2020 | First release | HW revision 03<br>Compact FW revision 4.xx.xx-xx<br>Remote FW revision 4.xx.xx-xx | HART: Pactware DTM<br>Defice integration package for Field Device Communicator: Handheld FC475 |



## 2. HART Communication Interface

### 2.1. HART Communication Interface

#### System communication

| Manufacturer ID        | 42 (2A Hex) | Manufacturer ID parameter        |
|------------------------|-------------|----------------------------------|
| Device type            | 34 (22 Hex) | Device type parameter            |
| HART protocol revision | 7.5         | HART protocol revision parameter |
| Device revision        | 5           | Device revision parameter        |

Tab. 1: HART protocol identification data

#### NOTE:

Version numbers and other references shown above are typical or example values.

#### Device description files

Available EDD drivers:

- FDT/DTM for Pactware
- 475 Field Communicator
- SIMATIC PDM (on request)

The drivers can be downloaded here: [www.kem-kueppers.com/en/downloads/software-check.html](http://www.kem-kueppers.com/en/downloads/software-check.html)

#### Configuration of the HART polling address

The HART address can be set either via hardware (DIP switch) or via software (HMI or Pactware).

The DIP switch is located on the transmitter cassette.

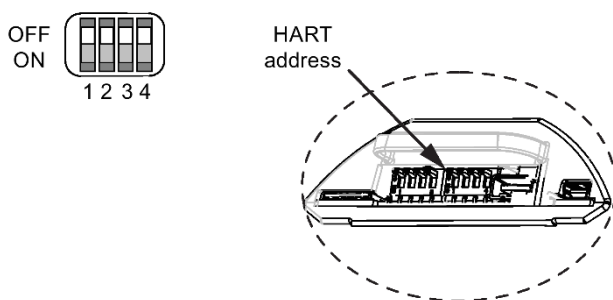


Fig. 1: HART slave address switch



- Configuration via DIP switch (HW polling address)  
Set 1 to 15 on the DIP switch if you wish to set a fixed (hardware-defined) HART polling address (SW polling address will be ignored). The configured HW polling address can be read via HMI in menu item 4.2.
- Configuration via HMI or Pactware (SW polling address)  
Disable the HW polling address by setting all switches to "OFF" on the HART DIP switch. The device starts up with default slave address = 0. The SW polling address can be changed to a value between 0 and 63 via HMI (menu item 4.1) or PDM for Pactware

## DIP switch configuration

| Address              | Switch 1 | Switch 2 | Switch 3 | Switch 4 |
|----------------------|----------|----------|----------|----------|
| "SW polling address" | Off      | Off      | Off      | Off      |
| 1                    | On       | Off      | Off      | Off      |
| 2                    | Off      | On       | Off      | Off      |
| 3                    | On       | On       | Off      | Off      |
| 4                    | Off      | Off      | On       | Off      |
| 5                    | On       | Off      | On       | Off      |
| 6                    | Off      | On       | On       | Off      |
| 7                    | On       | On       | On       | Off      |
| 8                    | Off      | Off      | Off      | On       |
| 9                    | On       | Off      | Off      | On       |
| 10                   | Off      | On       | Off      | On       |
| 11                   | On       | On       | Off      | On       |
| 12                   | Off      | Off      | On       | On       |
| 13                   | On       | Off      | On       | On       |
| 14                   | Off      | On       | On       | On       |
| 15                   | On       | On       | On       | On       |

Tab. 2: HW polling address

## Mapping of measured process variables

The assignment of the measured process values to HART device variables (PV - primary variable; SV - secondary variable; TV - tertiary variable; and QV - quaternary variable) can be modified and assigned as desired via local user interface or via HART interface using Pactware.

PV: The process value assigned to current output 1 (HMI menu item 2.4.1.1) is automatically assigned to PV.

- Measured values for PV
  - Mass Flow
  - Volume Flow
  - Density
  - Process media temperature
  - Standard Volume Flow
  - Fraction flow Media A (mass or Volume Flow)
  - Fraction flow Media B (mass or Volume Flow)
  - Fraction A %
  - Fraction B %
  - Frame Temperature



# HART Communication Interface

SV, TV, QV: Freely selectable (HMI menu item 4.6) from the list below.

- Measured values for SV, TV and QV
  - Mass Flow
  - Volume Flow
  - Density
  - Process media temperature
  - Standard Volume Flow
  - Fraction A Mass Flow
  - Fraction A Volume Flow
  - Fraction B Mass Flow
  - Fraction B Volume Flow
  - Fraction A %
  - Fraction B %
  - Frame temperature
  - Totalized batch amount
  - Totalized value of totalizers 1, 2 or 3

Communication is via the HART protocol, using:

- HART Communicator (load  $230\ \Omega$  to  $500\ \Omega$ )
- PC with HART modem, on which appropriate software is installed, for example Pactware (load  $230$  to  $500\ \Omega$ )
- Control system which can communicate via the HART protocol

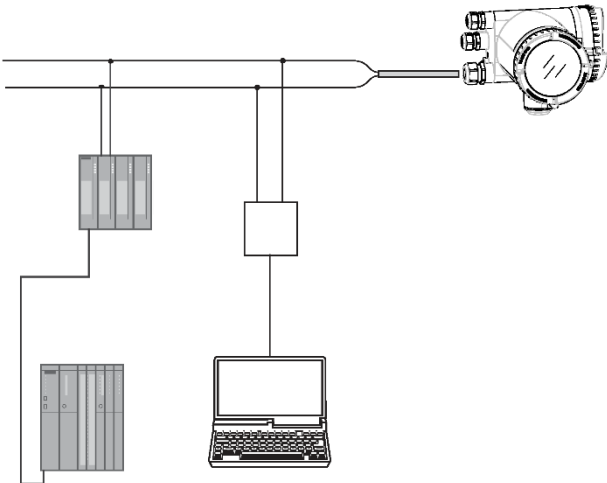


Fig. 2: Possible system configurations

- ① PLC system with HART interface
- ② PC with PDM or similar application
- ③ HART modem

## 2.2. Connecting the Current HART, CH1

### NOTE:

#### 4 to 20 mA output

It is not required to use shielded cables for the pure 4 to 20 mA current output.

### NOTE:

#### HART communication

It is recommended by the FieldComm Group (FCG) to use shielded cables for the HART communication.

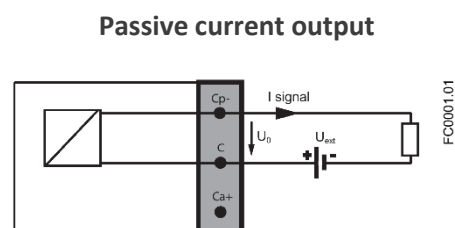
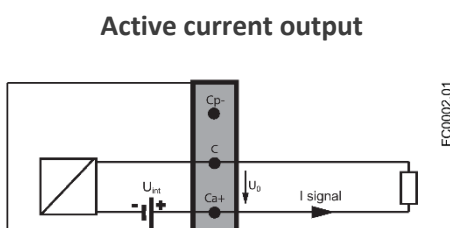
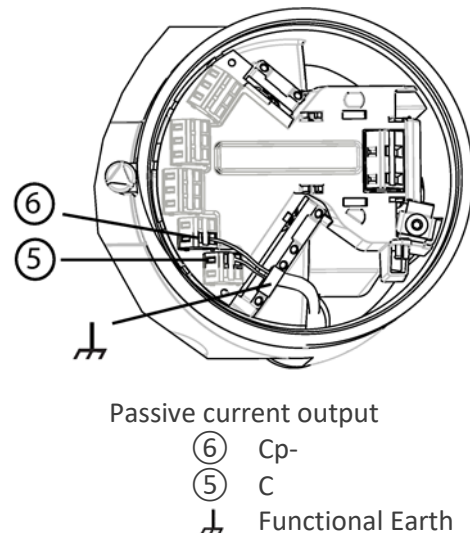
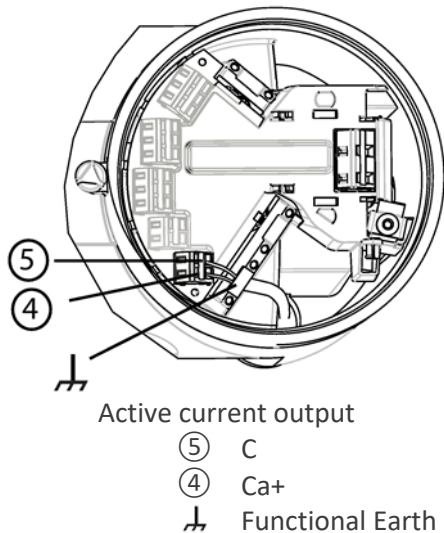
### NOTE:

#### Passive channels only

Channel 1 power supply must be separated from that for channels 2 to 4.

Signal return (or common) can be joined.

1. Remove cap and ferrule from cable gland and slide onto cable.
2. Push cable through open gland and cable path.
3. Restore ferrule and tighten cap to lightly hold cable in place.
4. Signal cable screen is folded back over outer sheath and grounded beneath cable clamp.
5. Connect wires to terminals using wiring tool, field mount transmitter





6. Tighten cable gland.

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**NOTE:**

For Ex versions active or passive current output is preselected at ordering and cannot be changed.

Non-Ex versions can be connected as either active or passive.

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**NOTE:****Load**

Signal output: < 500  $\Omega$  at 14 to 24 V DC (active), 14 to 30 V DC (passive)

Relay output: 30 V AC/V DC, 100 mA

Passive signal input: 15 to 30 V DC, 2 to 15 mA

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| Load [ $\Omega$ ] | Voltage (active Ex) [V] | Voltage (active non Ex) [V] | 24 V DC Voltage supply (passive)<br>[V] Ex and Non Ex |
|-------------------|-------------------------|-----------------------------|-------------------------------------------------------|
|                   |                         |                             | Measured                                              |
| 100               | 3                       | 3                           | 17.7                                                  |
| 200               | 5.9                     | 5.9                         | 19.6                                                  |
| 500               | 11.4                    | 14.9                        | 21.0                                                  |
| 1000              | 14.8                    | 19.2                        | 21.6                                                  |
| 2000              | 17.4                    | 20.1                        | 21.9                                                  |
| 5000              | 19.4                    | 20.4                        | 22.2                                                  |
| 10000             | 20.3                    | 21                          | 22.3                                                  |
| 20000             | 20                      | 20.4                        | 22.4                                                  |
| 50000             | 20.4                    | 20.6                        | 22.5                                                  |
| 100000            | 20.6                    | 20.7                        | 22.6                                                  |

Tab. 3: HW polling address



### 3. HART commands

#### 3.1. Device Variables

All four dynamic variables PV, SV, TV and QV are supported. Except for PV, they can all be freely mapped to all dynamic device variables. The following table shows the possible mappings.

Default values:

- PV = Mass Flow
- SV = Volume Flow
- TV = Density
- QV = Media temperature

| Device Variable Number | Device Variable Name         | PV | SV | TV | QV |
|------------------------|------------------------------|----|----|----|----|
| 0                      | Mass Flow                    | X  | X  | X  | X  |
| 1                      | Volume Flow                  | X  | X  | X  | X  |
| 2                      | Density                      | X  | X  | X  | X  |
| 3                      | Fluid Temperature            | X  | X  | X  | X  |
| 4                      | Standard Volume Flow         | X  | X  | X  | X  |
| 5                      | Fractional Flow A            | X  | X  | X  | X  |
| 6                      | Fractional Flow B            | X  | X  | X  | X  |
| 7                      | Fractional Percentage Flow A | X  | X  | X  | X  |
| 8                      | Fractional Percentage Flow B | X  | X  | X  | X  |
| 9                      | Reference Density            | X  | X  | X  | X  |
| 10                     | Electronics Temperature TRN  | X  | X  | X  | X  |
| 11                     | Totalized Value 1            |    | X  | X  | X  |
| 12                     | Totalized Value 2            |    | X  | X  | X  |
| 13                     | Totalized Value 3            |    | X  | X  | X  |
| 14                     | Frame Temperature            | X  | X  | X  | X  |
| 15                     | Totalized batch amount       |    | X  | X  | X  |

Tab. 4: Device Variables



## 3.2. Universal commands

The device supports the following universal commands:

| Command number | Function                                   | Parameters                                                                                                                                                                                                                                                                                                                                       | Read / Write / Command |
|----------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 0              | Read Unique Identifier                     | 254, device_type, request_preambles, universal_revision, transmitter_revision, software_revision, hardware_revision <0xf8>, physical_signaling_code <0x07>, device_flags, device_id, response_preambles, max_num_device_variables, config_change_counter, extended_fld_device_status, manufacturer_id, private_label_distributor, device_profile | Read                   |
| 1              | Read Primary Variable                      | PV.DEVICE_VARIABLE.DIGITAL_UNITS, PV.DEVICE_VARIABLE.DIGITAL_VALUE                                                                                                                                                                                                                                                                               | Read                   |
| 2              | Read Loop Current And Percent Of Range     | PV.DAQ.ANALOG_VALUE, PV.RANGING.PERCENT_RANGE                                                                                                                                                                                                                                                                                                    | Read                   |
| 3              | Read Dynamic Variables And Loop Current    | PV.DAQ.ANALOG_VALUE, PV.DEVICE_VARIABLE.DIGITAL_UNITS, SV.DEVICE_VARIABLE.DIGITAL_UNITS, SV.DEVICE_VARIABLE.DIGITAL_VALUE, TV.DEVICE_VARIABLE.DIGITAL_UNITS, TV.DEVICE_VARIABLE.DIGITAL_VALUE, QV.DEVICE_VARIABLE.DIGITAL_UNITS, QV.DEVICE_VARIABLE.DIGITAL_VALUE                                                                                | Read                   |
| 6              | Write Polling Address                      | polling_address, loop_current_mode                                                                                                                                                                                                                                                                                                               | Write                  |
| 7              | Read loop configuration                    | polling_address, loop_current_mode                                                                                                                                                                                                                                                                                                               | Read                   |
| 8              | Read Dynamic Variable Classification       | PV.DEVICE_VARIABLE.CLASSIFICATION, SV.DEVICE_VARIABLE.CLASSIFICATION, TV.DEVICE_VARIABLE.CLASSIFICATION, QV.DEVICE_VARIABLE.CLASSIFICATION                                                                                                                                                                                                       | Read                   |
| 9              | Read Device Variable With Status           |                                                                                                                                                                                                                                                                                                                                                  | Read                   |
| 11             | Read Unique Identifier Associated With Tag | 254, device_type, request_preambles, universal_revision, transmitter_revision, software_revision, hardware_revision <0xf8>, physical_signaling_code <0x07>, device_flags, device_id, response_preambles, max_num_device_variables, config_change_counter, extended_fld_device_status, manufacturer_id, private_label_distributor, device_profile | Read                   |
| 12             | Read Message                               | message                                                                                                                                                                                                                                                                                                                                          |                        |
| 13             | Read Tag, Descriptor, Date                 | tag, descriptor, date                                                                                                                                                                                                                                                                                                                            |                        |



| Command number | Function                                        | Parameters                                                                                                                                                                                                                                                                                                                                                                     | Read / Write / Command |
|----------------|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 14             | Read Primary Variable Transducer Information    | PV.DEVICE_VARIABLE.SENSOR_SERIAL_NUMBER,<br>PV.DEVICE_VARIABLE.DIGITAL_UNITS,<br>PV.DEVICE_VARIABLE.UPPER_SENSOR_LIMIT,<br>PV.DEVICE_VARIABLE.LOWER_SENSOR_LIMIT,<br>PV.DEVICE_VARIABLE.MINIMUM_SPAN                                                                                                                                                                           |                        |
| 15             | Read Device Information                         | PV.DAQ.ALARM_CODE,<br>PV.RANGING.TRANSFER_FUNCTION,<br>PV.RANGING.RANGE_UNITS,<br>PV.RANGING.UPPER_RANGE_VALUE,<br>PV.RANGING.LOWER_RANGE_VALUE,<br>PV.DEVICE_VARIABLE.DAMPING_VALUE,<br>write_protect, 250,<br>PV.DAQ.ANALOG_CHANNEL_FLAGS                                                                                                                                    |                        |
| 16             | Read Final Assembly Number                      | final_assembly_number                                                                                                                                                                                                                                                                                                                                                          | Read                   |
| 17             | Write Message                                   | message                                                                                                                                                                                                                                                                                                                                                                        | Write                  |
| 18             | Write Tag, Descriptor, Date                     | tag, descriptor, date                                                                                                                                                                                                                                                                                                                                                          | Write                  |
| 19             | Write Final Assembly Number                     | final_assembly_number                                                                                                                                                                                                                                                                                                                                                          | Write                  |
| 20             | Read Long Tag                                   | longTag                                                                                                                                                                                                                                                                                                                                                                        | Read                   |
| 21             | Read Unique Identifier Associated With Long Tag | 254, device_type, request_preambles,<br>universal_revision, transmitter_revision,<br>software_revision, hardware_revision<br><0xf8>, physical_signaling_code <0x07>,<br>device_flags, device_id,<br>response_preambles,<br>max_num_device_variables,<br>config_change_counter,<br>extended_fld_device_status, manufacturer_id,<br>private_label_distributor,<br>device_profile | Read                   |
| 22             | Write Long Tag                                  | longTag                                                                                                                                                                                                                                                                                                                                                                        | Write                  |
| 38             | Reset Configuration Changed Flag                |                                                                                                                                                                                                                                                                                                                                                                                | Command                |
| 48             | Read Additional Device Status                   | device_specific_status_0,<br>device_specific_status_1,<br>device_specific_status_2,<br>device_specific_status_3,<br>device_specific_status_4,<br>device_specific_status_5,<br>extended_fld_device_status, 0x00                                                                                                                                                                 | Read                   |

Tab. 5: Universal commands

## NOTE:

### Command #15: Read Device Information / Write Protect Code

The device does not support Write Protection. Therefore the response to command #15 contains the Write Protect Code 251 (as specified in the HART specification).



## 3.3. Common practice commands

The device supports the following common practice commands:

| Command number | Function                                 |
|----------------|------------------------------------------|
| 33             | Read Device Variables                    |
| 34             | Write Primary Variable Damping Value     |
| 35             | Write Primary Variable Range Values      |
| 36             | Set Primary Variable Upper Range Value   |
| 37             | Set Primary Variable Lower Range Value   |
| 40             | Enter/Exit Fixed Current Mode            |
| 42             | Perform Device Reset                     |
| 44             | Write Primary Variable Units             |
| 45             | Trim Loop Current Zero                   |
| 46             | Trim Loop Current Gain                   |
| 50             | Read Dynamic Variable Assignments        |
| 51             | Write Dynamic Variable Assignments       |
| 53             | Write Device Variables Units             |
| 54             | Read Device Variables Information        |
| 59             | Write Number Of Response Preambles       |
| 60             | Read Analog Channel And Percent Of Range |
| 63             | Read Analog Channel Information          |
| 70             | Read Analog Channel Endpoint Values      |
| 95             | Read Device Communications Statistics    |

Tab. 6: Common practice commands

## 3.4. Burst Mode

This device does not support Burst-Mode.

### 3.4.1. Catch Device Variable

This device does not support Catch Device Variable.



### 3.5. Device specific commands

#### 3.5.1. Command #130: Read. User Login

##### Operation: READ

The access level of the HART fieldbus interface can be changed with this command.

By writing a wrong PIN or by timeout the HART-Access-Level falls back to the default access level.

The HART Access-Level is falling back to RUP after 10 minutes. Timeout is restarted with every Write-Access over HART.

| Byte | Format | Description |
|------|--------|-------------|
| None |        |             |

| Byte  | Format      | Description                                                |
|-------|-------------|------------------------------------------------------------|
| 0...1 | Unsigned-16 | Written User PIN                                           |
| 2     | Enum        | Resulting Access-Level<br>16 (RUP)<br>32 (EUP)<br>64 (SUP) |

| Code | Class   | Description                   | Explanation                  |
|------|---------|-------------------------------|------------------------------|
| 0    | Success | No Command-Specific Errors    |                              |
| 5    | Error   | Too few Data Bytes Received   | Not enough data for User PIN |
| 6    | Error   | Device Specific Command Error |                              |

Quintessence

The device supports the following device-specific commands:

| Command number | Function                         |
|----------------|----------------------------------|
| 130            | User Login                       |
| 131            | Read Current HART Access Level   |
| 140            | Read Parameter(s)                |
| 141            | Write Parameter(s)               |
| 142            | Read Unit Related Parameter(s)   |
| 143            | Write Unit Related Parameter(s)  |
| 144            | Read Device Variable Information |
| 145            | Read Unit Related Parameter(s)   |
| 146            | Write Unit Related Parameter(s)  |



## 3.5.2. Command #131: Read, Current HART Access Level

### Operation: READ

This command reads the currently set HART Access Level from the device.

| Byte | Format | Description |
|------|--------|-------------|
| None |        |             |

| Byte | Format | Description                                              |
|------|--------|----------------------------------------------------------|
| 0    | Enum   | Current Access Level<br>16 (RUP)<br>32 (EUP)<br>64 (SUP) |

| Code | Class   | Description                   | Explanation |
|------|---------|-------------------------------|-------------|
| 0    | Success | No Command-Specific Errors    |             |
| 6    | Error   | Device Specific Command Error |             |

## 3.5.3. Command #140: Read Parameter(s)

### Operation: READ

This command is a general read access command, used to read one or more parameters from the device. The parameters to read are specified by MODBUS registers that are provided in the request data.

The value returned when reading a parameter is in its base unit e.g. m<sup>3</sup>/s, kg/s, kg, m<sup>3</sup>, °C (depending on the parameter definition).

For unit related readings of parameters see command #142.

| Byte           | Format      | Description                    |
|----------------|-------------|--------------------------------|
| 0...1          | Unsigned-16 | MODBUS register of parameter 1 |
| 2...3          | Unsigned-16 | MODBUS register of parameter 2 |
|                |             |                                |
| 2*n-2... 2*n-1 | Unsigned-16 | MODBUS register of parameter n |

Tab. 7: Command #140: Read Parameter(s) - Request Data Bytes

| Byte  | Format               | Description          |
|-------|----------------------|----------------------|
| 0...? | <parameter-specific> | Value of parameter 1 |
|       | <parameter-specific> | Value of parameter 2 |
|       |                      | ...                  |
|       | <parameter-specific> | Value of parameter n |

Tab. 8: Command #140: Read Parameter(s) - Response Data Bytes



| Code | Class   | Description                   | Explanation                           |
|------|---------|-------------------------------|---------------------------------------|
| 0    | Success | No Command-Specific Errors    |                                       |
| 2    | Error   | Invalid Selection             | Register does not exist               |
| 5    | Error   | Too Few Data Bytes Received   | Not enough data for a Modbus register |
| 6    | Error   | Device Specific Command Error |                                       |
| 16   | Error   | Access Restricted             | Modbus register is not readable       |
| 30   | Error   | Command Response Truncated    | Response would be too large           |

### 3.5.4. Command #141: Write Parameter(s)

#### Operation: WRITE

This command is a general write access command, used to write one or more parameters to the device. The parameters to write are specified by MODBUS registers that are provided in the request data.

When writing floating-point values that are related to a unit (e.g. process value limits) the written value must be related to its base unit e.g. m<sup>3</sup>/s, kg/s, kg, m<sup>3</sup>, °C.

For unit related writings of parameters see command #143.

| Byte  | Format                            | Description                               |
|-------|-----------------------------------|-------------------------------------------|
| 0...1 | Unsigned-16                       | MODBUS register of parameter 1            |
| 2...? | <parameter-specific>              | value of parameter 1 to be written        |
|       | <i>Unsigned-16</i>                | <i>MODBUS register of parameter 2</i>     |
|       | <i>&lt;parameter-specific&gt;</i> | <i>value of parameter 2 to be written</i> |
|       |                                   | ...                                       |
|       | <i>Unsigned-16</i>                | <i>MODBUS register of parameter n</i>     |
|       | <i>&lt;parameter-specific&gt;</i> | <i>value of parameter n to be written</i> |

Tab. 9: Command #141: Write Parameter(s) - Request Data Bytes

| Byte  | Format                            | Description                           |
|-------|-----------------------------------|---------------------------------------|
| 0...1 | Unsigned-16                       | MODBUS register of parameter 1        |
| 2...? | <parameter-specific>              | value of parameter 1 as stored        |
|       | <i>Unsigned-16</i>                | <i>MODBUS register of parameter 2</i> |
|       | <i>&lt;parameter-specific&gt;</i> | <i>value of parameter 2 as stored</i> |
|       |                                   | ...                                   |
|       | <i>Unsigned-16</i>                | <i>MODBUS register of parameter n</i> |

Tab. 10: Command #141: Write Parameter(s) - Response Data Bytes

| Code | Class   | Description                   | Explanation                                     |
|------|---------|-------------------------------|-------------------------------------------------|
| 0    | Success | No Command-Specific Errors    |                                                 |
| 2    | Error   | Invalid Selection             | Register does not exist                         |
| 3    | Error   | Parameter too large           | Value is too large                              |
| 4    | Error   | Parameter too small           | Value is too small                              |
| 5    | Error   | Too Few Data Bytes Received   | not enough data for a Modbus register with data |
| 6    | Error   | Device Specific Command Error | Invalid value                                   |
| 7    | Error   | Write Protected               | Device is in write-protect-mode                 |
| 8    | Warning | Set to Nearest Possible Value | Value was adapted                               |
| 16   | Error   | Access Restricted             | Modbus register is not writeable                |

Tab. 11: Command #141: Write Parameter(s) - Command Specific Response Codes



## 3.5.5. Command #142: Write Parameter(s)

### Operation: READ

This command is a general read access command, used to read one ore more parameters from the device in a specified unit (only for float-types, has no effect on other parameter types). The parameters to read are specified by MODBUS registers that are provided in the request data.

| Byte           | Format      | Description                             |
|----------------|-------------|-----------------------------------------|
| 0..1           | Unsigned-16 | MODBUS register of parameter 1          |
| 2              | Unsigned-8  | Unit Classification to read parameter 1 |
| 3              | Unsigned-8  | Unit Code to read parameter 1           |
| 4...5          | Unsigned-16 | MODBUS register of parameter 2          |
| 6              | Unsigned-8  | Unit Classification to read parameter 2 |
| 7              | Unsigned-8  | Unit Code to read parameter 2           |
|                |             | ...                                     |
| 4*n-4... 4*n-3 | Unsigned-16 | MODBUS register of parameter n          |
| 4*n-2          | Unsigned-8  | Unit Classification to read parameter n |
| 4*n-1          | Unsigned-8  | Unit Code to read parameter n           |

Tab. 12: Command #142: Write Parameter(s) - Request Data Bytes

| Byte  | Format               | Description          |
|-------|----------------------|----------------------|
| 0...? | <parameter-specific> | Value of parameter 1 |
|       | <parameter-specific> | Value of parameter 2 |
|       |                      | ...                  |
|       | <parameter-specific> | Value of parameter n |

Tab. 13: Command #142: Write Parameter(s) - Response Data Bytes

| Code | Class   | Description                   | Explanation                                                                                                                                                            |
|------|---------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | Success | No Command-Specific Errors    |                                                                                                                                                                        |
| 2    | Error   | Invalid Selection             | <ul style="list-style-type: none"> <li>Register does not exist</li> <li>Register is not readable</li> <li>invalid unit classification/unit code combination</li> </ul> |
| 5    | Error   | Too Few Data Bytes Received   | Not enough data for a Modbus register                                                                                                                                  |
| 6    | Error   | Device Specific Command Error |                                                                                                                                                                        |
| 30   | Error   | Command Response Truncated    | Response would be too large                                                                                                                                            |

Tab. 14: Command #142: Write Parameter(s) - Command-Specific Response Codes

The product ignores the Unit Classification request bytes. They are kept for compatibility reasons.

The supported unit codes are listed in chapter 11 Supported Engineering Units.



### 3.5.6. Command #143: Write Parameter(s)

#### Operation: WRITE

This command is a general write access command, used to write one or more parameters in to the device in a specified unit (only for float-types, has no effect on other parameter types). The parameters to write are specified by MODBUS registers that are provided in the request data.

| Byte  | Format               | Description                              |
|-------|----------------------|------------------------------------------|
| 0..1  | Unsigned-16          | MODBUS register of parameter 1           |
| 2     | Unsigned-8           | Unit Classification to write parameter 1 |
| 3     | Unsigned-8           | Unit Code to write parameter 1           |
| 4...x | <parameter-specific> | value of parameter 1 to be written       |
|       | Unsigned-16          | MODBUS register of parameter 2           |
|       | Unsigned-8           | Unit Classification to write parameter 2 |
|       | Unsigned-8           | Unit Code to write parameter 2           |
|       | <parameter-specific> | value of parameter 2 to be written       |
|       |                      | ...                                      |
|       | Unsigned-16          | MODBUS register of parameter n           |
|       | Unsigned-8           | Unit Classification to write parameter n |
|       | Unsigned-8           | Unit Code to write parameter n           |
|       | <parameter-specific> | value of parameter n to be written       |

Tab. 15: Command #143: Write Parameter(s) - Request Data Bytes

| Byte  | Format               | Description                                |
|-------|----------------------|--------------------------------------------|
| 0..1  | Unsigned-16          | MODBUS register of parameter 1             |
| 2     | Unsigned-8           | Unit Classification of written parameter 1 |
| 3     | Unsigned-8           | Unit Code of written parameter 1           |
| 4...x | <parameter-specific> | value of parameter 1 as stored             |
|       | Unsigned-16          | MODBUS register of parameter 2             |
|       | Unsigned-8           | Unit Classification of written parameter 2 |
|       | Unsigned-8           | Unit Code of written parameter 2           |
|       | <parameter-specific> | value of parameter 2 as stored             |
|       |                      | ...                                        |
|       | Unsigned-16          | MODBUS register of parameter n             |
|       | Unsigned-8           | Unit Classification of written parameter n |
|       | Unsigned-8           | Unit Code of written parameter n           |
|       | <parameter-specific> | value of parameter n as stored             |

Tab. 16: Command #143: Write Parameter(s) - Command-Specific Response Codes

| Code | Class   | Description                | Explanation                                                                                                                                      |
|------|---------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | Success | No Command-Specific Errors |                                                                                                                                                  |
| 2    | Error   | Invalid Selection          | <ul style="list-style-type: none"> <li>Register does not exist</li> <li>or</li> <li>invalid unit classification/unit code combination</li> </ul> |
| 3    | Error   | Parameter too large        | provided TRN parameter value is too large                                                                                                        |
| 4    | Error   | Parameter too small        | provided TRN parameter value is too small                                                                                                        |



| Code | Class   | Description                   | Explanation                                     |
|------|---------|-------------------------------|-------------------------------------------------|
| 5    | Error   | Too Few Data Bytes Received   | not enough data for a Modbus register with data |
| 6    | Error   | Device Specific Command Error | Invalid value of SEN parameter                  |
| 7    | Error   | Write Protected               | Device is in write-protect-mode                 |
| 8    | Warning | Set to Nearest Possible Value | Value was adapted                               |
| 16   | Error   | Access Restricted             | Modbus register is not writeable                |

Tab. 17: Command #143: Write Parameter(s) - Response Data Bytes

The product ignores the Unit Classification request bytes. They are kept for compatibility reasons.

The supported unit codes are listed in chapter 11 Supported Engineering Units.

The unit code is only evaluated if the specified parameter is an floating-point parameter. If a unit code unequal to 0 is used for another data type the request is responded with an error.

## 3.5.7. Command #144: Read Device Variable Information

### Operation: READ

The request is analog to HART Universal Command 9: For each requested PV send one byte defining the PV of interest, incl. the dynamic variables (see Common Table 34).

This command can be used to get the required information to use Commands 142+143 properly.

| Byte | Format     | Description                       |
|------|------------|-----------------------------------|
| 0    | Unsigned-8 | Device Variable Number for Slot 1 |
| 1    | Unsigned-8 | Device Variable Number for Slot 2 |
|      |            | ...                               |
| n-1  | Unsigned-8 | Device Variable Number for Slot n |

Tab. 18: Command #144: Read Device Variable Information - Request Data Bytes

| Byte                    | Format       | Description                                        |
|-------------------------|--------------|----------------------------------------------------|
| 0...1                   | Unsigned-16  | MODBUS register of process value                   |
| 2...3                   | Unsigned-16  | MODBUS register of process value unit              |
| 4...5                   | Unsigned-16  | MODBUS register of process value status            |
| 6                       | Unsigned-8   | Unit Classification                                |
| 7                       | Unsigned-8   | Unit Code                                          |
| 8...11                  | Float        | Process value related to the unit code             |
| 12                      | Unsigned-8   | Process value status                               |
| 13...16                 | Float        | Lower process value limit related to the unit code |
| 17...20                 | Float        | Upper process value limit related to the unit code |
| 21..41                  | <See 0...20> | Slot 2                                             |
|                         |              | ...                                                |
| (n-1)*21<br>...(n*21)-1 | <See 0...20> | Slot n                                             |

Tab. 19: Command #144: Read Device Variable Information - Response Data Bytes



| Code | Class   | Description                   | Explanation                             |
|------|---------|-------------------------------|-----------------------------------------|
| 0    | Success | No Command-Specific Errors    |                                         |
| 2    | Error   | Invalid Selection             | Device Variable does not exist          |
| 5    | Error   | Too Few Data Bytes Received   | At least one variable must be requested |
| 6    | Error   | Device Specific Command Error |                                         |
| 30   | Error   | Command Response Truncated    | Response would be too large             |

Tab. 20: Command #144: Read Device Variable Information - Command Specific Response Codes

### 3.5.8. Command #145: Read Unit Related Parameter(s)

This command is a general read access command, used to read one or more parameters from the device. Each unit related parameter has a reference to a unit parameter that is valid for the HART interface. The currently set unit is used to convert the returned parameter value (only for float-types, has no effect on other parameter types). The parameters to read are specified by HART registers that are provided in the request data.

| Byte           | Format      | Description                  |
|----------------|-------------|------------------------------|
| 0..1           | Unsigned-16 | HART register of parameter 1 |
| 2...3          | Unsigned-16 | HART register of parameter 2 |
|                |             | ...                          |
| 2*n-2... 2*n-1 | Unsigned-16 | HART register of parameter n |

Tab. 21: Command #145: Read Unit Related Parameter(s) - Request Data Bytes

| Byte  | Format               | Description          |
|-------|----------------------|----------------------|
| 0...? | <parameter-specific> | Value of parameter 1 |
|       | <parameter-specific> | Value of parameter 2 |
|       |                      | ...                  |
|       | <parameter-specific> | Value of parameter n |

Tab. 22: Command #145: Read Unit Related Parameter(s) - Response Data Bytes

| Code | Class   | Description                   | Explanation                         |
|------|---------|-------------------------------|-------------------------------------|
| 0    | Success | No Command-Specific Errors    |                                     |
| 2    | Error   | Invalid Selection             | Register does not exist             |
| 5    | Error   | Too Few Data Bytes Received   | Not enough data for a HART register |
| 6    | Error   | Device Specific Command Error |                                     |
| 16   | Error   | Access Restricted             | HART register is not readable       |
| 30   | Error   | Command Response Truncated    | Response would be too large         |

Tab. 23: Command #145: Read Unit Related Parameter(s) - Command-Specific Response Codes



## 3.5.9. Command #146: Write Unit Related Parameter(s)

This command is a general read access command, used to read one or more parameters from the device. Each unit related parameter has a reference to a unit parameter that is valid for the HART interface. The currently set unit is used to convert the returned parameter value (only for float-types, has no effect on other parameter types). The parameters to read are specified by HART registers that are provided in the request data.

| Byte  | Format               | Description                        |
|-------|----------------------|------------------------------------|
| 0...1 | Unsigned-16          | HART register of parameter 1       |
| 2...x | <parameter-specific> | value of parameter 1 to be written |
|       | Unsigned-16          | HART register of parameter 2       |
|       | <parameter-specific> | value of parameter 2 to be written |
|       |                      | ...                                |
|       | Unsigned-16          | HART register of parameter n       |
|       | <parameter-specific> | value of parameter n to be written |

Tab. 24: Command #146: Write Unit Related Parameter(s) - Request Data Bytes

| Byte  | Format               | Description                    |
|-------|----------------------|--------------------------------|
| 0...1 | Unsigned-16          | HART register of parameter 1   |
| 2...x | <parameter-specific> | value of parameter 1 as stored |
|       | Unsigned-16          | HART register of parameter 2   |
|       | <parameter-specific> | value of parameter 2 as stored |
|       |                      | ...                            |
|       | Unsigned-16          | HART register of parameter n   |
|       | <parameter-specific> | value of parameter n as stored |

Tab. 25: Command #146: Write Unit Related Parameter(s) - Response Data Bytes

| Code | Class   | Description                   | Explanation                                   |
|------|---------|-------------------------------|-----------------------------------------------|
| 0    | Success | No Command-Specific Errors    |                                               |
| 2    | Error   | Invalid Selection             | Register does not exist                       |
| 3    | Error   | Parameter too large           | provided value is too large                   |
| 4    | Error   | Parameter too small           | provided value is too small                   |
| 5    | Error   | Too Few Data Bytes Received   | not enough data for a HART register with data |
| 6    | Error   | Device Specific Command Error |                                               |
| 7    | Error   | Write Protected               | Device is in write-protect-mode               |
| 8    | Warning | Set to Nearest Possible Value | Value was adapted                             |
| 16   | Error   | Access Restricted             | Parameter is not writeable                    |

Tab. 26: Command #146: Write Unit Related Parameter(s) - Command-Specific Response Codes



### 3.6. Supported Engineering Units

The following table lists all engineering units supported by this device.

| Byte | Format          | Description                 |
|------|-----------------|-----------------------------|
| 15   | Volumetric Flow | cubic feet per minute       |
| 16   | Volumetric Flow | US gallons per minute       |
| 17   | Volumetric Flow | liters per minute           |
| 18   | Volumetric Flow | imperial gallons per minute |
| 19   | Volumetric Flow | cubic meters per hour       |
| 22   | Volumetric Flow | US gallons per second       |
| 23   | Volumetric Flow | million US gallons per day  |
| 24   | Volumetric Flow | liters per second           |
| 25   | Volumetric Flow | million liters per day      |
| 26   | Volumetric Flow | cubic feet per second       |
| 27   | Volumetric Flow | cubic feet per day          |
| 28   | Volumetric Flow | cubic meters per second     |
| 29   | Volumetric Flow | cubic meters per day        |
| 30   | Volumetric Flow | imperial gallons per hour   |
| 31   | Volumetric Flow | imperial gallons per day    |
| 32   | Temperature     | Degrees Celsius             |
| 33   | Temperature     | Degrees Fahrenheit          |
| 34   | Temperature     | Degrees Rankine             |
| 35   | Temperature     | Kelvin                      |
| 36   | Voltage         | millivolts                  |
| 38   | Frequency       | Hertz                       |
| 39   | Current         | milliamperes                |
| 40   | Volume          | US gallons                  |
| 41   | Volume          | liters                      |
| 42   | Volume          | imperial gallons            |
| 43   | Volume          | cubic meters                |
| 46   | Volume          | barrels (= 42 US gallons)   |
| 51   | Time            | seconds                     |
| 57   | Ratio           | percent                     |
| 60   | Mass            | grams                       |
| 61   | Mass            | kilograms                   |
| 62   | Mass            | metric tons                 |
| 63   | Mass            | pounds                      |
| 64   | Mass            | short tons                  |
| 65   | Mass            | long tons                   |
| 70   | Mass Flow       | grams per second            |
| 71   | Mass Flow       | grams per minute            |
| 72   | Mass Flow       | grams per hour              |
| 73   | Mass Flow       | kilograms per second        |
| 74   | Mass Flow       | kilograms per minute        |
| 75   | Mass Flow       | kilograms per hour          |
| 76   | Mass Flow       | kilograms per day           |
| 77   | Mass Flow       | metric tons per minute      |
| 78   | Mass Flow       | metric tons per hour        |



| Byte | Format                   | Description                          |
|------|--------------------------|--------------------------------------|
| 79   | Mass Flow                | metric tons per day                  |
| 80   | Mass Flow                | pounds per second                    |
| 81   | Mass Flow                | pounds per minute                    |
| 82   | Mass Flow                | pounds per hour                      |
| 83   | Mass Flow                | pounds per day                       |
| 84   | Mass Flow                | short tons per minute                |
| 85   | Mass Flow                | short tons per hour                  |
| 86   | Mass Flow                | short tons per day                   |
| 87   | Mass Flow                | long tons per hour                   |
| 88   | Mass Flow                | long tons per day                    |
| 91   | Density                  | grams per cubic centimeter           |
| 92   | Density                  | kilograms per cubic meter            |
| 93   | Density                  | pounds per US gallon                 |
| 94   | Density                  | pounds per cubic foot                |
| 95   | Density                  | grams per milliliter                 |
| 96   | Density                  | kilograms per liter                  |
| 97   | Density                  | grams per liter                      |
| 98   | Density                  | pounds per cubic inch                |
| 99   | Density                  | short tons per cubic yard            |
| 110  | Volume                   | bushel                               |
| 111  | Volume                   | cubic yards                          |
| 112  | Volume                   | cubic feet                           |
| 113  | Volume                   | cubic inches                         |
| 121  | Standard Volumetric Flow | normal cubic meter per hour          |
| 122  | Standard Volumetric Flow | normal liter per hour                |
| 123  | Standard Volumetric Flow | standard cubic feet per minute       |
| 124  | Volume                   | liquid barrels (= 31.5 US gallons)   |
| 125  | Mass                     | ounces                               |
| 130  | Volumetric Flow          | cubic feet per hour                  |
| 131  | Volumetric Flow          | cubic meters per minute              |
| 132  | Volumetric Flow          | barrels (= 42 US gallons) per second |
| 133  | Volumetric Flow          | barrels (= 42 US gallons) per minute |
| 134  | Volumetric Flow          | barrels (= 42 US gallons) per hour   |
| 135  | Volumetric Flow          | barrels (= 42 US gallons) per day    |
| 136  | Volumetric Flow          | US gallons per hour                  |
| 137  | Volumetric Flow          | imperial gallons per second          |
| 138  | Volumetric Flow          | liters per hour                      |
| 146  | Density                  | micrograms per liter                 |
| 147  | Density                  | micrograms per cubic meter           |
| 166  | Standard Volume          | normal cubic meters                  |
| 167  | Standard Volume          | normal liters                        |
| 168  | Standard Volume          | standard cubic feet                  |
| 170  | Density                  | milligrams per liter                 |
|      | Volume                   | beer barrel                          |
|      | Volumetric Flow          | <i>beer barrel per second</i>        |
| 171  | Standard Volume          | standard liter                       |
|      | Volumetric Flow          | beer barrel per minute               |
| 172  | Standard Volume          | standard cubic meter                 |
|      | Volumetric Flow          | beer barrel per hour                 |



| Byte | Format                    | Description                     |
|------|---------------------------|---------------------------------|
| 173  | Volumetric Flow           | beer barrel per day             |
| 174  | Standard Volumetric Flow  | normal liter per day            |
| 175  | Standard Volumetric Flow  | normal liter per minute         |
| 176  | Standard Volumetric Flow  | normal liter per second         |
| 177  | Standard Volumetric Flow  | standard liter per day          |
| 178  | Standard Volumetric Flow  | standard liter per hour         |
| 179  | Standard Volumetric Flow  | standard liter per minute       |
| 180  | Standard Volumetric Flow  | standard liter per second       |
| 181  | Standard Volumetric Flow  | normal cubic meter per day      |
| 182  | Standard Volumetric Flow  | normal cubic meter per minute   |
| 183  | Standard Volumetric Flow  | normal cubic meter per second   |
| 184  | Standard Volumetric Flow  | standard cubic feet per day     |
| 185  | Standard Volumetric Flow  | standard cubic feet per hour    |
| 186  | Standard Volumetric Flow  | standard cubic feet per second  |
| 187  | Standard Volumetric Flow  | standard cubic meter per day    |
| 188  | Standard Volumetric Flow  | standard cubic meter per hour   |
| 189  | Standard Volumetric Flow  | standard cubic meter per minute |
| 190  | Corrected Volumetric Flow | standard cubic meter per second |
| 235  | Volumetric Flow           | US gallons per day              |
| 236  | Volume                    | hectoliters                     |
| 253  | Volume                    | Special (custom unit)           |
|      | Volumetric Flow           | Special (custom unit)           |
|      | Standard Volumetric Flow  | Special (custom unit)           |
|      | Mass                      | Special (custom unit)           |
|      | Mass Flow                 | Special (custom unit)           |

Tab. 27: Supported Engineering Units - Request Data Bytes

## 3.7. HART specific information table

In the following table available Modbus device parameters of the TRICOR TCD 9x00 are described.

| Modbus register | Data type / Size in bytes | Parameter      | Description                                                                                                                                                                                                                                                                                                                                       | Default value | Value range | Access level |
|-----------------|---------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------|--------------|
| 2100            | Unsigned / 1              | Flow Direction | <p>Define positive and negative flow direction.</p> <p>Default positive flow direction is indicated by the arrow on the sensor.</p> <p>Possible selections:</p> <p>0: Negative:<br/>The flow is measured '+' in default negative direction and '-' in default positive direction.</p> <p>1: Positive:<br/>The flow is measured '+' in default</p> | 1             | 0 to 1      | Read/Write   |



| Modbus register | Data type / Size in bytes | Parameter                   | Description                                                                                                                                                                                                                                             | Default value        | Value range      | Access level |
|-----------------|---------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------|--------------|
| 2130            | Unsigned / 1              | Process Noise Damping       | Select process noise damping level:<br>0: 55 ms filtering (Centrifugal Pump)<br>1: 110 ms filtering (Triplex Pump)<br>2: 220 ms filtering (Duplex Pump)<br>3: 400 ms filtering (Simplex Pump)<br>4: 800 ms filtering (Cam Pump)                         | 2                    | 0 Low to 4 High  | Read/Write   |
| 2125            | Float / 4                 | Low Mass Flow Cut-Off       | Set Mass Flow limit for low flow cut-off.<br>Below this limit Mass Flow output is forced to zero.<br>If Low Flow Cut-Off is set to 0, the cut-off functionality is disabled.<br>Notice:<br>It is recommended to set a lower value for gas applications. | Sensor size Specific | 0 to 1023        | Read/Write   |
| 426             | Float / 4                 | Mass Flow Correction Factor | Specify correction factor for use in the Mass Flow calculation                                                                                                                                                                                          | 1                    | -1.999 to +1.999 | Read/Write   |

Tab. 28: HART specific information table - Operating conditions

| Modbus register | Data type / Size in bytes | Parameter               | Description                                                                                 | Default value        | Value range | Access level |
|-----------------|---------------------------|-------------------------|---------------------------------------------------------------------------------------------|----------------------|-------------|--------------|
| 2170            | Float / 4                 | Low Volume-flow Cut Off | Define the numerical volumeflow value below which the Volume Flow output is forced to zero. | Sensor size specific | 0 to 0.177  | Read/Write   |

Tab. 29: HART specific information table - Volume Flow



| Modbus register | Data type / Size in bytes | Parameter                 | Description                                                                                                                                                                                                                                              | Default value            | Value range        | Access level |
|-----------------|---------------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------|--------------|
| 2127            | Float / 4                 | Empty Tube Limit          | Define threshold value of empty tube                                                                                                                                                                                                                     | 500 [kg/m <sup>3</sup> ] | -14 000 to +14 000 | Read/Write   |
| 2129            | Unsigned / 1              | Empty Tube Detection      | Set automatic detection of Empty Tube On/Off<br>0 = off (Empty tube is off).<br>1 = on<br>(a density value below Empty Tube Limit triggers an alarm. All flow rate values are forced to zero %).                                                         | 0                        | 0 to 1             | Read/Write   |
| 2442            | Float / 4                 | Density Correction Factor | Set density compensation value (gain) in order to make a density correction (scale factor).<br>To increase the displayed density value with +0.5 %, set the density factor to 1.005.<br>The displayed density value will now be 0.5 % higher than before | 1                        | -1.999 to +1.999   | Read/Write   |
| 2444            | Float / 4                 | Density Correction Offset | Set density compensation value (offset) in order to make an offset on the measured density.                                                                                                                                                              | 0 [kg/m <sup>3</sup> ]   | -1 400 to +1 400   | Read/Write   |

Tab. 30: HART specific information table - Density

| Modbus register | Data type / Size in bytes | Parameter | Description         | Default value | Value range                                     | Access level |
|-----------------|---------------------------|-----------|---------------------|---------------|-------------------------------------------------|--------------|
| 8303            | Unsigned / 1              | TOT1_SET  | Control totalizer 1 | 0             | 0: TOTALIZE<br>1: RESET<br>2: PRESET<br>3: HOLD | Read/Write   |
| 8403            | Unsigned / 1              | TOT2_SET  | Control totalizer 2 | 0             | 0: TOTALIZE<br>1: RESET<br>2: PRESET<br>3: HOLD | Read/Write   |
| 8503            | Unsigned / 1              | TOT3_SET  | Control totalizer 3 | 0             | 0: TOTALIZE<br>1: RESET<br>2: PRESET<br>3: HOLD | Read/Write   |

Tab. 31: HART specific information table - Totalizers

**NOTE:**

After the command Reset or Preset has been send to the device, the command Totalize must be send, to continue totalizing



| Modbus register | Data type / Size in bytes | Parameter       | Description                                                        | Default value | Value range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Access level |
|-----------------|---------------------------|-----------------|--------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 7869            | Unsigned / 1              | ACTIVE_FRACTION | Selection of the currently used fraction calibration parameter set | 0             | 0: no fraction<br>Standard Fractions:<br>1: American Petroleum Institute (API) number<br>2: Balling<br>3: Baumé light<br>4: Baumé heavy<br>5: Brix<br>6: Oechsle<br>7: Plato<br>8: Specific Gravity<br>9: Twaddell<br>10: % High Fructose Corn Syrup HFCS42<br>11: % High Fructose Corn Syrup HFCS55<br>12: % High Fructose Corn Syrup HFCS90<br>13: Ethanol-Water 0% to 20%<br>14: Ethanol-Water 15% to 35%<br>15: Ethanol-Water 30% to 55%<br>16: Ethanol-Water 50% to 100%<br>17...127: reserved<br>Customized Fraction:<br>128: customized fraction | Read/Write   |

Tab. 32: HART specific information table - Fraction

## 3.8. Example using HART command

### 3.8.1. Reset totalizer

Use the HART command 141: Write Parameter(s)

Command #141: Operation: WRITE

| Byte  | Format               | Description                        |
|-------|----------------------|------------------------------------|
| 0...1 | Unsigned-16          | Modbus register of parameter 1     |
| 2...? | <parameter-specific> | value of parameter 1 to be written |
|       | Unsigned-16          | Modbus register of parameter 2     |
|       | <parameter-specific> | value of parameter 2 to be written |
|       |                      | ...                                |
|       | Unsigned-16          | Modbus register of parameter n     |
|       | <parameter-specific> | value of parameter n to be written |

Tab. 33: Reset totalizer - Request Data Bytes



| Byte  | Format               | Description                    |
|-------|----------------------|--------------------------------|
| 0...1 | Unsigned-16          | Modbus register of parameter 1 |
| 2...? | <parameter-specific> | value of parameter 1 as stored |
|       | Unsigned-16          | Modbus register of parameter 2 |
|       | <parameter-specific> | value of parameter 2 as stored |
|       |                      | ...                            |
|       | Unsigned-16          | Modbus register of parameter n |
|       | <parameter-specific> | value of parameter n as stored |

Tab. 34: Reset totalizer - Response Data Bytes

| Code | Class   | Description                   | Explanation                                   |
|------|---------|-------------------------------|-----------------------------------------------|
| 0    | Success | No Command-Specific Errors    |                                               |
| 2    | Error   | InHartvalid Selection         | Register does not exist                       |
| 3    | Error   | Parameter too large           | provided value is too large                   |
| 4    | Error   | Parameter too small           | provided value is too small                   |
| 5    | Error   | Too Few Data Bytes Received   | not enough data for a HART-register with data |
| 6    | Error   | Device Specific Command Error |                                               |
| 7    | Error   | Write Protected               | Device is in write-protect-mode               |
| 8    | Warning | Set to Nearest Possible Value | Value was adapted                             |
| 16   | Error   | Access Restricted             | HART-register is not writeable                |

Tab. 35: Reset totalizer - Command-Specific Response Codes

Request Data Bytes for Reset totalizer 1

| Byte  | Format               | Description |
|-------|----------------------|-------------|
| 0...1 | Unsigned-16          | 206F        |
| 2...? | <parameter-specific> | 01          |

Tab. 36: The HART information for Totalizer 1 is (8303 Dec) / (206F Hex)

Response Data Bytes for Totalize totalizer 1

| Byte  | Format               | Description |
|-------|----------------------|-------------|
| 0...1 | Unsigned-16          | 206F        |
| 2...? | <parameter-specific> | 01          |

Tab. 37: The HART information for Totalizer 1 is (8303 Dec) / (206F Hex)

## 3.9. Specification

This device has the following specifications:

| Description                | Specification | More information                                    |
|----------------------------|---------------|-----------------------------------------------------|
| Manufacturer ID            | 42 (2A Hex)   | Manufacturer ID parameter                           |
| Device ID                  | 34 (22 Hex)   | Device type parameter                               |
| HART protocol revision     | 7.5           | HART protocol revision parameter                    |
| Device revision            | 5             | Device revision parameter                           |
| Number of device variables | 16            | Number of process values, both measured and derived |
| Physical layers supported  | FSK           | Frequency Shift Keyed                               |

Tab. 38: Specification HART communication



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