SIEMENS

# SITRANS F

# Coriolis flowmeters SITRANS FC410/FCS400

**Operating Instructions**

7ME461 (Standard and hygienic sensor)




**06/2020**
A5E39789214-AB

## 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.

**⚠ DANGER**

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

**⚠ WARNING**

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

**⚠ CAUTION**

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

**NOTICE**

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

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 Siemens products

Note the following:

**⚠ WARNING**

Siemens 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 Siemens. 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.

### Trademarks

All names identified by ® are registered trademarks of Siemens AG. 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.

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# Table of contents

# Introduction

# 1

These instructions contain all information required to commission and use the device. Read the instructions carefully prior to installation and commissioning. In order to use the device correctly, first review its principle of operation.

The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it, as well as service and maintenance engineers.

## 1.1 Document history

The following table shows major changes in the documentation compared to the previous edition.

The most important changes in the documentation when compared with the respective previous edition are given in the following table.

| Edition | Note |
|---|---|
| 06/2020 | Second edition<br>• Chapter Technical data (Page 103) updated<br>• Overall revision of chapters and contents |
| 06/2017 | First edition |

| NOTICE |
|---|
| **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. |

## 1.2 Product compatibility FC410

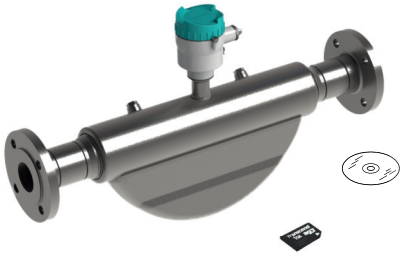
| Manual edition | Remarks | Device revision | Compatibility of device integration package | |
|---|---|---|---|---|
| 06/2020 | Manual updated | Modbus RS-485 RTU<br>FW: 4.00.00-xx<br>HW: 3 | SIMATIC PDM V8.2 Service Pack 1 or later | EDD: 2.00.01 or later |
| 12/2019 | Manual updated | Modbus RS-485 RTU<br>FW: 4.00.00-xx<br>HW: 3 | SIMATIC PDM V8.2 Service Pack 1 or later | EDD: 2.00.01 or later |

| Manual edition | Remarks | Device revision | Compatibility of device integration package | |
|---|---|---|---|---|
| 06/2017 | New Hardware extending sensor sizes | Modbus RS-485 RTU<br>FW: 4.00.00-xx<br>HW: 3 | SIMATIC PDM V8.2 Service Pack 1 | EDD: 2.00.xx or later |
| 05/2015 | Update of Modbus holding registers: Modbus address 2215 to 2218 added. | Modbus RS-485 RTU<br>FW: 2.03.03-01<br>HW: 2 | SIMATIC PDM 8 | EDD: 1.01.00-00 |
| 12/2013 | First edition | Modbus RS-485 RTU<br>FW: 2.03.02-01<br>HW: 2 | SIMATIC PDM 6 | EDD: 1.00.01-01 |

## 1.3 Items supplied

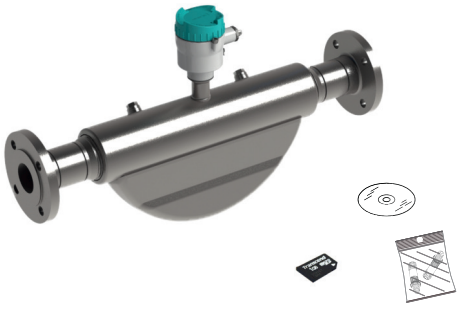
### With M12 plug connection

- SITRANS FC410/FCS400 flowmeter
- Micro SD card with production certificates
- DVD containing software, certificates and device manuals



**With sensor terminal housing**

- SITRANS FC410/FCS400 flowmeter
- Packet of cable glands
- Micro SD card with production certificates
- DVD containing software, certificates and device manuals



**Note**

**Supplementary information**

Supplementary product and production specific certificates are included on the SensorFlash® SD card.

**Note**

Scope of delivery may vary, depending on version and add-ons. Make sure the scope of delivery and the information on the nameplate correspond to your order and the delivery note.

## 1.4 Checking the consignment

1. Check the packaging and the delivered items for visible damages.
2. Report any claims for damages immediately to the shipping company.
3. Retain damaged parts for clarification.
4. Check the scope of delivery by comparing your order to the shipping documents for correctness and completeness.

**⚠ WARNING**

**Using a damaged or incomplete device**

Risk of explosion in hazardous areas.

- Do not use damaged or incomplete devices.

## 1.5 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines, and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions form one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. These systems, machines and components should only be connected to the enterprise network or the Internet if and only to the extent necessary and with appropriate security measures (firewalls and/or network segmentation) in place.

You can find more information on protective measures in the area of industrial security by visiting:
https://www.siemens.com/industrialsecurity.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends performing product updates as soon as they are available and using only the latest product versions. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/industrialsecurity.

## 1.6 Transportation and storage

To guarantee sufficient protection during transport and storage, observe the following:

- Keep the original packaging for subsequent transportation.
- Devices/replacement parts should be returned in their original packaging.
- If the original packaging is no longer available, ensure that all shipments are properly packaged to provide sufficient protection during transport. Siemens cannot assume liability for any costs associated with transportation damages.

| **NOTICE** |
| --- |
| **Insufficient protection during storage**<br>The packaging only provides limited protection against moisture and infiltration.<br>• Provide additional packaging as necessary. |

Special conditions for storage and transportation of the device are listed in Technical data (Page 103).

The contents of this manual shall not become part of or modify any prior or existing agreement, commitment or legal relationship. The sales contract contains all obligations on the part of Siemens as well as the complete and solely applicable warranty conditions. Any statements regarding device versions described in the manual do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of publishing. Siemens reserves the right to make technical changes in the course of further development.

# Safety notes

# 2

## 2.1 Preconditions for use

This device left the factory in good working condition. In order to maintain this status and to ensure safe operation of the device, observe these instructions and all the specifications relevant to safety.

Observe the information and symbols on the device. Do not remove any information or symbols from the device. Always keep the information and symbols in a completely legible state.

| Symbol | Explanation |
|---|---|
|  | Consult operating instructions |

Use the device only for flow measurement in accordance with this operating instructions and observe the technical data (Page 103).

**⚠ WARNING**

**Improper device modifications**

Risk to personnel, system and environment can result from modifications to the device, particularly in hazardous areas.

- Only carry out modifications that are described in the instructions for the device. Failure to observe this requirement cancels the manufacturer's warranty and the product approvals.

## 2.2 Laws and directives

Observe the safety rules, provisions and laws applicable in your country during connection, assembly and operation. These include, for example:

- National Electrical Code (NEC - NFPA 70) (USA)
- Canadian Electrical Code (CEC) (Canada)

Further provisions for hazardous area applications are for example:

- IEC 60079-14 (international)
- EN 60079-14 (EU)

**US Installations only: Federal Communications Commission (FCC) rules**

**Note**

- This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.
- This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the operating instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference to radio communications, in which case the user will be required to correct the interference at his own expense.

## 2.2.1 Conformity with European directives

The CE marking on the device symbolizes the conformity with the following European directives:

| | |
|---|---|
| Electromagnetic compatibility EMC 2014/30/EU | Directive of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to electromagnetic compatibility |
| Low voltage directive LVD 2014/35/EU | Directive of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits |
| Atmosphère explosible ATEX 2014/34/EU | Directive of the European Parliament and the Council on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres |
| Pressure equipment directive PED 2014/68/EU | Directive of the European Parliament and of the Council on the approximation of the laws of the Member States concerning pressure equipment |
| 2011/65/EU RoHS | Directive of the European Parliament and the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment |

The applicable directives can be found in the EC conformity declaration of the specific device.

**Note**

**CE declaration**

The CE declaration certificate is available on the SensorFlash SD card delivered with the device.

## 2.3 Requirements for special applications

Due to the large number of possible applications, each detail of the described device versions for each possible scenario during commissioning, operation, maintenance or operation in systems cannot be considered in the instructions. If you need additional information not covered by these instructions, contact your local Siemens office or company representative.

**Note**

**Operation under special ambient conditions**

We highly recommend that you contact your Siemens representative or our application department before you operate the device under special ambient conditions as can be encountered in nuclear power plants or when the device is used for research and development purposes.

## 2.4 Use in hazardous areas

**Qualified personnel for hazardous area applications**

Persons who install, connect, commission, operate, and service the device in a hazardous area must have the following specific qualifications:

- They are authorized, trained or instructed in operating and maintaining devices and systems according to the safety regulations for electrical circuits, high pressures, aggressive, and hazardous media.
- They are authorized, trained, or instructed in carrying out work on electrical circuits for hazardous systems.
- They are trained or instructed in maintenance and use of appropriate safety equipment according to the pertinent safety regulations.

**⚠ WARNING**

**Use in hazardous area**

Risk of explosion.

- Only use equipment that is approved for use in the intended hazardous area and labeled accordingly.
- Do not use devices that have been operated outside the conditions specified for hazardous areas. If you have used the device outside the conditions for hazardous areas, make all Ex markings unrecognizable on the nameplate.

**WARNING**

**Loss of safety of device with type of protection "Intrinsic safety Ex i"**

If the device or its components have already been operated in non-intrinsically safe circuits or the electrical specifications have not been observed, the safety of the device is no longer ensured for use in hazardous areas. There is a risk of explosion.

- Connect the device with type of protection "Intrinsic safety" solely to an intrinsically safe circuit.
- Observe the specifications for the electrical data on the certificate and/or in Technical data (Page 103).

## 2.4.1 Installation in hazardous areas

**WARNING**

**Equipment used in hazardous areas**

Equipment used in hazardous areas must be Ex-approved for the region of installation and marked accordingly. It is required that the special conditions for safe use provided in the manual and in the Ex certificate are followed!

### Hazardous area approvals

The device is approved for use in hazardous areas and has the approvals listed below. Special conditions for safe installation and operation specified by each approval authority are included in the relevant certificate.

### See also

Certificates and approvals (Page 109)

### Special conditions for safe use

In general, it is required that:

- EN/IEC 60079-14 is considered for installation in hazardous areas.
- Appropriate cable connectors are used.
- Sensor is connected to the potential equalization throughout the hazardous area.
- The device is not opened when energized and when an explosive gas or dust atmosphere may be present.

Further information and instructions including approval-specific special conditions for safe use in Ex applications can be found in the certificates on the documentation disk and at the product

web page of SITRANS FCS400 (www.siemens.com/FCS400) or SITRANS FC410 (www.siemens.com/FC410).

**WARNING**

**Substitution of components**

Substitution of components may impair Intrinsic Safety.

**WARNING**

**Laying of cables**

Risk of explosion in hazardous areas.

Cable for use in hazardous areas must satisfy the requirements for having a proof voltage of at least 500 V AC applied between the conductor/ground, conductor/shield and shield/ground.

Connect the devices that are operated in hazardous areas as per the stipulations applicable in the country of operation.

**WARNING**

**Field wiring installation**

Ensure that the national requirements of the country in which the devices are installed are met.

## 2.4.2 Maximum temperature specifications for Ex use

The maximum dust layer shall be no greater than 5 mm (T5 85°C).

The apparatus housing shall be connected to the potential equalising conductor in the hazardous area.

The maximum allowable process fluid temperatures with respect to the marked temperature class and maximum surface temperature for the device in the following maximum ambient temperatures are:

| Ta (°C) | Maximum Process Temperature per Temperature Class (°C) | | | |
|---|---|---|---|---|
| | T6 | T5 | T4 | T3 |
| 60 | 70 | 70 | 70 | 70 |
| 55 | 85 | 100 | 100 | 100 |
| 50 | 85 | 100 | 130 | 130 |
| 45 | 85 | 100 | 135 | 160 |
| 40 | 85 | 100 | 135 | 190 |
| 35 | 85 | 100 | 135 | 200 |
| 30 | 85 | 100 | 135 | 200 |

The maximum allowable process fluid temperatures with respect to maximum surface temperatures for hazardous dusts for the device when used with hazardous dusts in the following maximum ambient temperatures are:

| Ta (°C) | Tprocess max (°C) | |
|---|---|---|
| | **Applications with up to 500 mm dust or isolation** | **Applications with up to 5 mm dust or isolation** |
| 60 | -40 | 70 |
| 55 | -10 | 100 |
| 50 | 20 | 130 |
| 45 | 50 | 160 |
| 40 | 80 | 190 |
| 35 | 110 | 200 |
| 30 | 140 | 200 |

- If Tprocess ≤ 85°C, maximum surface temperature = 85°C
- If Tprocess > 85°C, maximum surface temperature = process temperature

The maximum pressure associated with the process medium in the internal pipes shall be limited to 100 bar.

The equipment internal circuits at the 4-Pin Connection – A, B, 0 and 15 V or Connector X700 (Pin 1 = 15 V, Pin 2 = 0 V, Pin 3 = A and Pin 4 = B) are not capable of withstanding a 500 V r.m.s. a.c. test to earth as required by clause 6.3.13 of IEC 60079-11:2011. This shall be taken into account in any equipment installation.

When the equipment is installed as 'Ex d', the connector (1/2" NPT or M20) shall be replaced with a suitably certified Ex d cable gland or Ex d Conduit Sealing Device and the voltage of the equipment shall not exceed 60 V d.c.

If the equipment is installed as flameproof only, it shall not subsequently be installed as intrinsically safe unless it can be verified that there has been no damage to the safety components within the intrinsically safe circuit on which safety depends by, for example, an over-voltage at the supply terminals. The safety components on which intrinsic safety depends have been assessed up to an input voltage of 60 V d.c.

**Intrinsically safe installations only:**

A temporary connection of the SITRANS to an uncertified programming or data download device is permitted, when the SITRANS is located in the non-hazardous area (typically prior to installation). Alternatively, such a connection may be made when the SITRANS remains in the hazardous area, but the area is declared 'gas-free'. The uncertified programming or data download device shall be suitably-approved as a SELV supply to IEC 60950-1, IEC 61010-1 or an equivalent standard, with a maximum output voltage of 60 V. The input terminals of the SITRANS have a maximum voltage Um = 60V.

If the equipment is installed as flameproof only, it shall not subsequently be installed as intrinsically safe unless it can be verified that there has been no damage to the safety components within the intrinsically safe circuit on which safety depends by, for example, a voltage above 60 V at the supply terminals.

If the Sensor is mounted remotely from the Adapter, the wiring shall be given protection against torsional and tensile stresses (e.g. by the use of conduit).

**Note**

Only installation as Ex ia can be used for installation in Zone 20.

# Description

# 3

SITRANS Coriolis flowmeter systems consist of a transmitter and a sensor. The following table lists the available combinations of transmitters and sensors.

| Transmitter | Sensor type |
|---|---|
| FCT010 | FCS400<br>DN 15 to DN 50 (0.5" to 2") |

## 3.1 System integration

The FC410 flowmeter functions as a Modbus RTU slave with standard Modbus commands implemented. Setup parameters, process values, diagnostics, and status information are mapped as Modbus registers.

The device can be connected point-to-point or in a multidrop network in non-hazardous or hazardous areas. It can be connected to different hosts for example a PLC system or a PC used as service tool or configuration tool.

**Note**

**Multidrop installations in hazardous areas**

Multidrop installations in hazardous areas require flameproof conduit seals for each device.

The FCS400 7ME4617-... is preconfigured for integration with the SITRANS FCT070.

## 3.2 Modbus RTU technology FC410

Modbus RTU is an open serial protocol based on master/slave architecture. The protocol interconnects field equipment such as sensors, actuators, and controllers and is widely used in both process and manufacturing automation. The fieldbus environment is the base level group of digital networks in the hierarchy of plant networks.

### Features

The SITRANS F Modbus RTU communication complies with the Modbus Serial Line Protocol. Among other things this implies a master / slave protocol at level 2 of the OSI model. A node (the master) issues explicit commands to one of the slave nodes and processes responses. Slave nodes will not transmit data without a request from the master node, and do not communicate with other slaves.

Modbus is a mono master system, only one master can be connected at a time.

### Unicast communication mode

In unicast mode (master/slave mode) the master sends a request to a specific slave device and waits a specified time for a response.

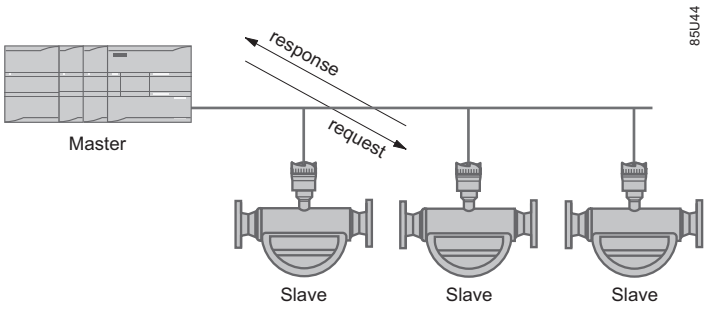



Figure 3-1 Unicast Mode

### Modbus Frame

The Modbus frame is shown below and is valid for both requests and responses.

Table 3-1 Modbus Frame

| SLAVE ADDRESS | FUNCTION MODE | DATA | CRC |
|---|---|---|---|
| 1 Byte | 1 Byte | 0 to 252 Bytes | 2 Bytes |

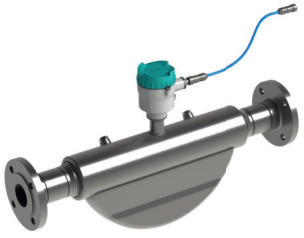
### References

For further information, please refer to the following specification and guidelines available at the Modbus Organization (http://www.modbus.org/) website

1. Serial Line Specification & Implementation guide
2. Application Protocol Specification

## 3.3 Design

The SITRANS FC410 flowmeter uses the Coriolis principle to measure flow. The device is a one channel flowmeter with Modbus RTU RS-485 output.



## Flowmeter design

All primary process measurement of mass flow, volume flow, density and process temperature are done in the SITRANS FCT010 transmitter.

The SITRANS FCS400 sensor comprises two parallel bent tubes welded directly to the process connections at each end via a manifold.

The sensors are available in AISI 316L stainless steel. The sensor enclosure is made of AISI 304 stainless steel which has a pressure rating related to size.

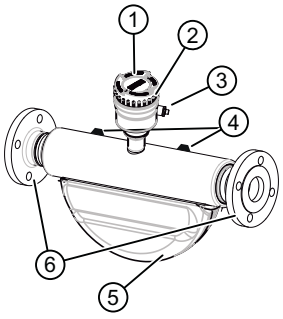
The sensor enclosure can be equipped with a pressure guard or flushed with dry inert gas at the threaded ports for non-hazardous applications only.

**Note**

Ex certification requires that the threaded ports always remain closed.

The SITRANS FCT010 transmitter is available in an aluminium enclosure with an ingress protection grade of IP67/NEMA 4X. It has a 4-wire M12 cable or terminated cable connection for communication and power supply.

## Flowmeter overview




① Transmitter
② Lid-lock
③ Cable feed-through (M12 socket or cable gland)
④ Plug and threaded port for example for pressure guard
⑤ Sensor enclosure
⑥ Process connections

## See also

Pressure - temperature ratings (Page 115)

## 3.4 Nameplate layout

Each part of the FC410/FCS400 Coriolis flowmeter has 3 nameplate types showing the following information:

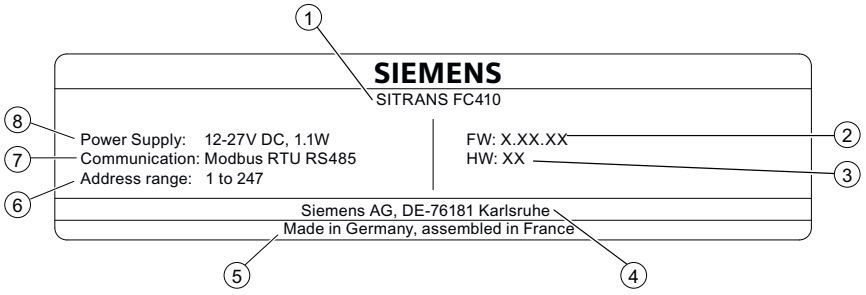
- product identification
- product specifications
- certificates and approvals

**Note**

**Identification**

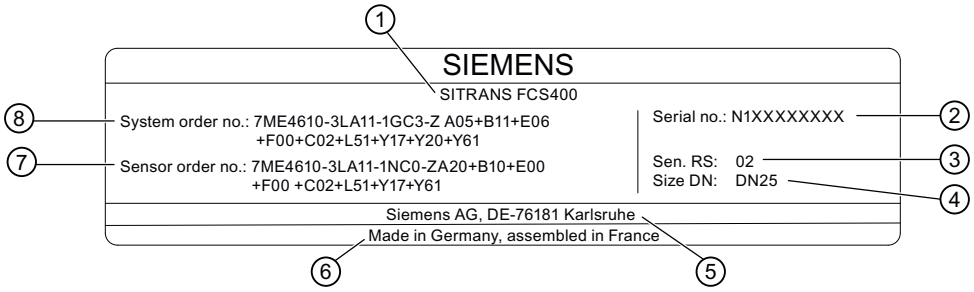
Identify your device by comparing your ordering data with the information on the product and specification nameplates.

### FC410: Nameplate with general information




| | | |
|---|---|---|
| ① | SITRANS FC410 | Product name |
| ② | FW | Firmware version |
| ③ | HW | Hardware version |
| ④ | Manufacturer | Manufacturer name and location |
| ⑤ | Country | Manufacturing country |
| ⑥ | Address range | Modbus device address range |
| ⑦ | Communication | Communication: Modbus Master/Slave RTU technology |
| ⑧ | Power Supply | Power supply |

## FCS400 sensor: Nameplate with general information




| | | |
|---|---|---|
| ① | SITRANS FCS400[1)] | Product name |
| ② | Serial no. | Sensor serial number |
| ③ | Sen. RS | Mechanical sensor version number |
| ④ | Size DN | Size |
| ⑤ | Manufacturer | Manufacturer name and location |
| ⑥ | Country | Manufacturing country |
| ⑦ | Sensor order no. | Sensor replacement order number |
| ⑧ | System order no. | Flowmeter system order number (transmitter and sensor) |

[1)] With remote versions, the transmitter is identified as 'SITRANS FCT070' and the sensor as 'SITRANS FCS400'.

## Flowmeter serial number construction

The flowmeter serial number is constructed as follows:

PPYMDDxxxxxx

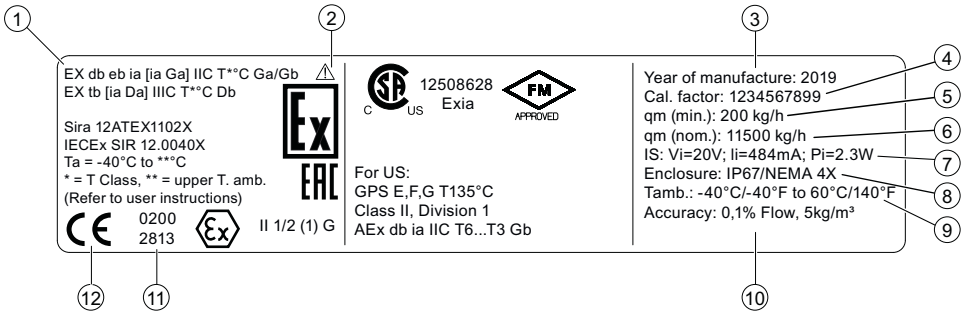
where
PP = Production factory (Siemens S.A.S. Haguenau: N1)
Y = Production year (for encryption, see below)
M = Production month (for encryption, see below)
DD = Production day (for encryption, see below)
xxxxxx = Sequential number

Encryption:

| **Calendar year (Y)** | **Code** |
|---|---|
| 1950, 1970, 1990, 2010 | A |
| 1951, 1971, 1991, 2011 | B |
| 1952, 1972, 1992, 2012 | C |
| 1953, 1973, 1993, 2013 | D |
| 1954, 1974, 1994, 2014 | E |
| 1955, 1975, 1995, 2015 | F |
| 1956, 1976, 1996, 2016 | H (G) |
| 1957, 1977, 1997, 2017 | J |
| 1958, 1978, 1998, 2018 | K |
| 1959, 1979, 1999, 2019 | L |

| | |
|---|---|
| 1960, 1980, 2000, 2020 | M |
| 1961, 1981, 2001, 2021 | N |
| 1962, 1982, 2002, 2022 | P |
| 1963, 1983, 2003, 2023 | R |
| 1964, 1984, 2004, 2024 | S |
| 1965, 1985, 2005, 2025 | T |
| 1966, 1986, 2006, 2026 | U |
| 1967, 1987, 2007, 2027 | V |
| 1968, 1988, 2008, 2028 | W |
| 1969, 1989, 2009, 2029 | X |
| **Month (M)** | **Code** |
| January | 1 |
| February | 2 |
| March | 3 |
| April | 4 |
| May | 5 |
| June | 6 |
| July | 7 |
| August | 8 |
| September | 9 |
| October | O |
| November | N |
| December | D |
| **Day (DD)** | **Code** |
| Day 1 to 31 | 01 to 31 (corresponding to the actual date) |

## FCS400 sensor: Nameplate with specific information



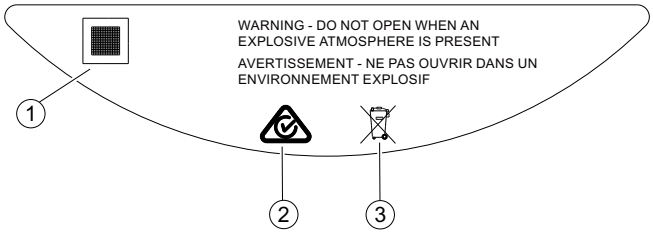

| | | |
|---|---|---|
| ① | EX approvals | Ex approval specifications |
| | II: Group II | |
| | 1/2: category 1/2 (On Zone 0) | |
| | G: for gas | |
| | Ex: for use in explosive atmosphere | |
| | db: type of protection flame proof | |
| | IIC: Gas group | |
| | T4: temperature class | |
| | Ga/Gb: Protection level | |
| ② | ⚠ | Consult the operating instructions |
| ③ | Year of manufacture | Manufacturing year<br>More detailed manufacturing date information is given in the serial number found on the identification nameplate |
| ④ | Cal. factor | Calibration factor |
| ⑤ | qm (min) | Minimum flow with water at 20 °C (68 °F) |
| ⑥ | qm (nom) | Nominal flow with water at 20 °C (68 °F) |
| ⑦ | IS | Power supply |
| ⑧ | Enclosure | Degree of protection |
| ⑨ | Tamb. | Ambient temperature range |
| ⑩ | Accuracy | Accuracy for mass flow and density |
| ⑪ | 2813 | Notified Body ID (ATEX, example) |
| ⑫ | CE | CE mark |

**Note**

**Approval identifications**

Approval certificates and notified body identifications are available for download at siemens.com

### FCS400 sensor: Nameplate with approval information




| | | |
|---|---|---|
| ① | QR code | Product-specific QR code |
| ② | C✓ | C-tick logo |
| ③ | | WEEE symbol, see Disposal (Page 90) |

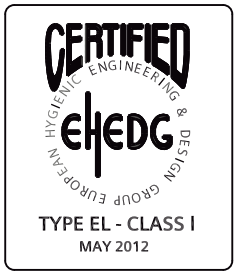
**Note**

**Logos and warnings**

Logos and warnings are only shown on the product where applicable. The combination shown in the example above is relevant for a hygienic sensor.

The Australian C-tick mark is mandatory on all products.

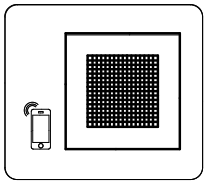
### Sensor EHEDG and 3A nameplate





These nameplates appear on all Hygienic sensors 7ME461.-.2...-.....

### QR code



With the use of a smart phone, the QR code provides a direct link to

- the product support portal, which includes access to the "How to Install" YouTube video
- the product and production-specific documentation maintained in the production database.

## 3.5 Features

- The flowmeter can be used as Modbus slave in stand-alone or parallel operation on Modbus or third party automation systems
- Compact sensor design
- NAMUR conforming sensor built-in lengths (on request)
- High immunity against process noise
- Fast response to step changes in flow
- High update rate (100 Hz) on all process values
- Measurement of:
  - Mass flow
  - Volume flow
  - Density
  - Medium temperature
  - Frame temperature
- Independent low flow cut-off settings for mass flow and volume flow
- Automatic zero point adjustment (initiated by host system)
- Process noise damping using digital signal processing (DSP).
- One totalizer for summation of mass flow. The totalizer is reset on loss of power.
- Empty tube monitoring
- Simulation of process values:
  - Mass flow
  - Volume flow
  - Density
  - Medium temperature
  - Frame temperature
- Troubleshooting and sensor checking
- Use in hazardous areas according to specification
- Intelligent filtering system for aerated flow
- Unit selection of process values and totalizer

## 3.6 Applications

The main applications of the Coriolis flowmeter can be found in all industries, such as:

- Chemical & Pharma: detergents, bulk chemicals, acids, alkalis, pharmaceuticals
- Food & Beverage: dairy products, beer, wine, soft drinks, fruit juices and pulps, bottling, $CO_2$ dosing, CIP/SIP-liquids, mixture recipe control

- Automotive: fuel injection nozzle & pump testing, filling of AC units, engine consumption, paint robots
- Oil & Gas: filling of gas bottles, furnace control, test separators, bore-hole plasticizer dosing, water-cut metering
- Water & Waste Water: dosing of chemicals for water treatment

## 3.7 Approvals

**Note**

For further details see Certificates and approvals (Page 109).

The device is available with approvals for general purpose and for hazardous areas. In all cases, check the nameplate on your device, and confirm the approval rating.

# Installing/mounting

# 4

**Note**

The weight of the sensors > DN25 is exceeding 18 kg. It takes two persons to safely lift this part or unit.

## 4.1 Basic safety notes

**CAUTION**

**Hot surfaces resulting from hot process media**

Risk of burns resulting from surface temperatures above 65 °C (149 °F).

- Take appropriate protective measures, for example contact protection.
- Make sure that protective measures do not cause the maximum permissible ambient temperature to be exceeded. Refer to the information in Technical data (Page 103).

**WARNING**

**Wetted parts unsuitable for the process media**

Risk of injury or damage to device.

Hot, toxic and corrosive media could be released if the wetted parts are unsuitable for the process medium.

- Ensure that the material of the device parts wetted by the process medium is suitable for the medium. Refer to the information in Technical data (Page 103).

**Note**

**Material compatibility**

Siemens can provide you with support concerning selection of sensor components wetted by process media. However, you are responsible for the selection of components. Siemens accepts no liability for faults or failures resulting from incompatible materials.

**WARNING**

**Unsuitable connecting parts**

Risk of injury or poisoning.

In case of improper mounting, hot, toxic, and corrosive process media could be released at the connections.

- Ensure that connecting parts (such as flange gaskets and bolts) are suitable for connection and process media.

**WARNING**

**Exceeded maximum permissible operating pressure**

Risk of injury or poisoning.

The maximum permissible operating pressure depends on the device version, pressure limit and temperature rating. The device can be damaged if the operating pressure is exceeded. Hot, toxic and corrosive process media could be released.

Ensure that maximum permissible operating pressure of the device is not exceeded. Refer to the information on the nameplate and/or in Technical data (Page 103).

**WARNING**

**Unprotected cable ends**

Risk of explosion through unprotected cable ends in hazardous areas.

- Protect unused cable ends in accordance with IEC/EN 60079-14.

**WARNING**

**Incorrect mounting at Zone 0**

Risk of explosion in hazardous areas.

- Ensure sufficient tightness at the process connection.
- Observe the standard IEC/EN 60079-14.

**WARNING**

**Loss of explosion protection**

Risk of explosion in hazardous areas if the device is open or not properly closed.

- Close the device as described in Installing/mounting (Page 29).

**⚠ CAUTION**

**External stresses and loads**

Damage to device by severe external stresses and loads (e.g. thermal expansion or pipe tension). Process media can be released.

- Prevent severe external stresses and loads from acting on the device.

**⚠ DANGER**

**Pressure applications**

Danger to personnel, system and environment will result from improper disassembly.

- Never attempt to loosen, remove, or disassemble process connection while vessel contents are under pressure.

### 4.1.1 Installation location requirements

**NOTICE**

**Aggressive atmospheres**

Damage to device through penetration of aggressive vapors.

- Ensure that the device is suitable for the application.

**NOTICE**

**Direct sunlight**

Damage to device.

The device can overheat or materials become brittle due to UV exposure.

- Protect the device from direct sunlight.
- Make sure that the maximum permissible ambient temperature is not exceeded. Refer to the information in Operating conditions (Page 108).

### 4.1.2 Proper mounting

**NOTICE**

**Incorrect mounting**

The device can be damaged, destroyed, or its functionality impaired through improper mounting.

- Before installing ensure there is no visible damage to the device.
- Make sure that process connectors are clean, and suitable gaskets and glands are used.
- Mount the device using suitable tools. Refer to the information in Construction (Page 105).

**⚠ WARNING**

**High pressure hazard**

In applications with working pressures/media that can be dangerous to people, surroundings, equipment or others in case of pipe fracture, we recommend that special precautions such as special placement, shielding or installation of a pressure guard or a safety valve are taken when the flowmeter is mounted.

## 4.2 Installation instructions

### 4.2.1 Sensor installation

**⚠ CAUTION**

**Electromagnetic fields**

Do not install the flowmeter in the vicinity of strong electromagnetic fields, for example near motors, variable frequency drives, transformers etc.

**Upstream / downstream**

- No pipe run requirements, that is straight inlet/outlet sections, are necessary.
- Avoid long drop lines downstream from the sensor to prevent process media separation causing air / vapor bubbles in the tube (min. back pressure: 0.2 bar).
- Avoid installing the flowmeter immediately upstream of a free discharge in a drop line.

## Location in the system

The optimum location in the system depends on the application:

- Liquid applications
  Gas or vapor bubbles in the fluid may result in erroneous measurements, particularly in the density measurement.
  - Do not install the flowmeter at the highest point in the system, where bubbles will be trapped.
  - Install the flowmeter in low pipeline sections, at the bottom of a U-section in the pipeline.

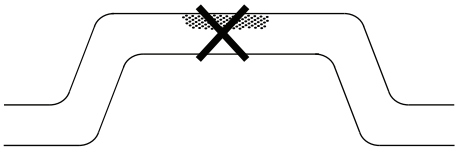


Figure 4-1 Liquid applications, wrong location with trapped air/gas

- Gas applications
  Vapor condensation or oil traces in the gas may result in erroneous measurements.
  - Do not install the flowmeter at the lowest point of the system.
  - Install a filter.

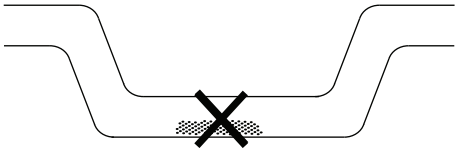


Figure 4-2 Gas applications, wrong location with trapped oil

## Flow direction

The calibrated flow direction is indicated by the arrow on the sensor. Flow in this direction will be indicated as positive by default. The sensitivity and the accuracy of the sensor do not change with reverse flow.

The indicated flow direction (positive/negative) is configurable.

| ⚠ CAUTION |
| --- |
| **Accurate measurement**<br>The sensor must always be completely filled with process media in order to measure accurately. |

| NOTICE |
| --- |
| **Orienting the sensor**<br>To avoid water or moist ingress, transmitters should be oriented with cable entrances aiming downwards. |

## Orienting the sensor

The sensor operates in any orientation. The optimal orientation depends on the process fluid and the process conditions. Siemens recommends orienting the sensor in one of the following ways:

1. Vertical installation with an upwards flow (self-draining)

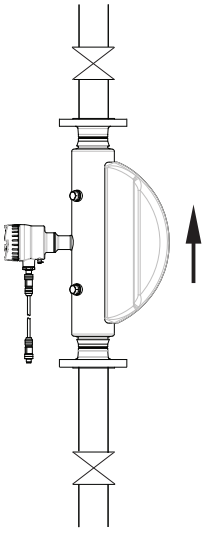


Figure 4-3 Vertical orientation, upwards flow

2. Horizontal installation, tubes down (recommended for liquid applications)

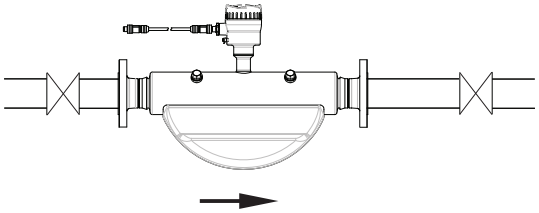


Figure 4-4 Horizontal orientation, tubes down

3. Horizontal installation, tubes up (recommended for gas applications)

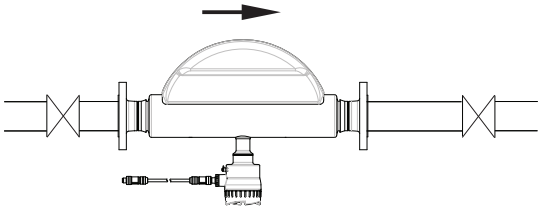


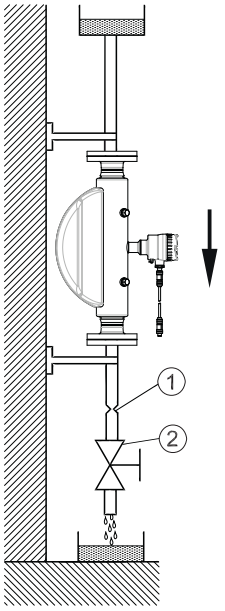
Figure 4-5 Horizontal orientation; tubes up

**Note**

**Hygienic applications**

In 3A and EHEDG certified hygienic applications the flowmeter must be installed vertically as shown in 1 above.

Installation in a drop line is only recommended if a pipeline reduction or orifice with a smaller cross-section can be installed to create back-pressure and prevent the sensor from being partially drained while measuring.




① Back pressure orifice
② On / off valve

Figure 4-6 Installation in drop line

#### 4.2.1.1 Mounting the sensor

- Install the sensor in well-supported pipelines in order to support the weight of the flowmeter.
- Center the connecting pipelines axially in order to assure a stress-free installation. The flowmeter must not be used to bring the rest of the pipework into line. Make sure the pipework is aligned correctly before inserting the flow sensor.
- Install two supports or hangers symmetrically and stress-free on the pipeline closely to the process connections.

**Note**

**Handling**

Lift the flowmeter by the sensor body. Do not lift the flowmeter by the housing.

### Avoid vibrations

- Make sure that any valves or pumps upstream of the sensor do not cavitate and do not send vibrations into the sensor.
- Decouple vibrating pipeline from the flow sensor using flexible tube or couplings.

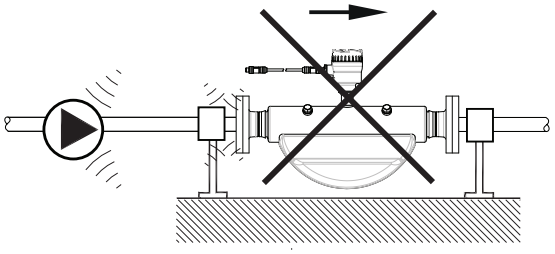


Figure 4-7 Non-flexible pipes not recommended in vibrating environment

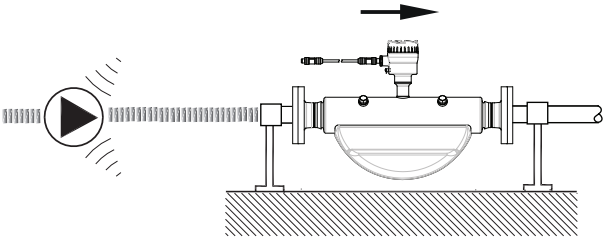


Figure 4-8 Flexible pipes recommended in vibrating environment

## Avoid cross talk

When operating more than one flowmeter in one or multiple interconnected pipelines there is a risk of cross talk.

Prevent cross talk in one of the following ways:

- Mount sensors on separate frames
- Decouple the pipeline using flexible tubes or couplings

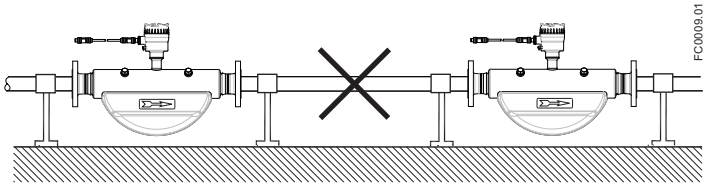



Figure 4-9 High risk of cross talk when using non-flexible pipes

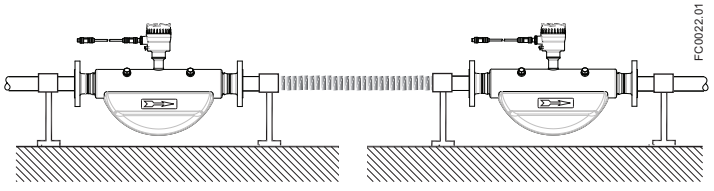



Figure 4-10 Low risk of cross talk when using flexible pipes and separate frames

#### 4.2.1.2 Hydrostatic testing

The flowmeter is pressure-tested before delivery to 1.5 times the rated working pressure of the sensor.

- In the case of process connections pressure-rated less than 100 bar, the connection is the limiting component.
- In the case of process connections pressure-rated above 100 bar (stainless steel sensors) or above 160 bar (Hastelloy sensors), the sensor is the limiting component.

In all cases the maximum allowed hydrostatic test pressure (MATP) of the flowmeter is 1.5 times the marked MAWP (PS) at 20 °C.

Pressure test of a completed flow system with piping and other components can be done at pressures no higher than 1.5 times the marked MAWP (PS) at 20 °C of the lowest rated system component.

#### 4.2.1.3 Installing with insulation

Insulation is added to pipes and equipment for two reasons:

- To protect personnel from exposure to hot or cold surfaces, thereby preventing burns and other injuries
- To prevent heat loss into or out of the process, thereby preserving the process temperature and process medium conditions.

In both cases, insulation can have the unexpected effect of shrouding other attached components not intended or designed for the process temperatures. When installing an FCS400 sensor with insulation, observe the following rules:

- Do not cover any part of the transmitter pedestal. The pedestal is designed to separate the process temperature from the ambient around the DSL or transmitter electronics housing.
- Allow free movement of air around the electronics housing to allow temperature equalisation to occur at all times.

#### 4.2.1.4 Pressure guard

The sensor enclosure is supplied with two G½" (parallel thread) purge ports. These ports can for example be used for a pressure guard, which can be connected to an automatic shut off valve to stop the flow in case of sensor pipe fracture. Because sensor enclosure is rated Ex[d] for hazardous applications, the purge ports may not be removed from Ex version sensors.

The AISI 304 / EN 1.4301 exterior enclosure is rated to approximately 20 bar static pressure to contain spilt process media in the event of a tube break. However it is not intended to contain high pressure or corrosive fluids and precautions must be taken in applications where vibrating tube failure is probable and may cause damage.

#### Pressure guard selection

Siemens does not supply the components of the pressure guard solution because the arrangement and components are closely related to individual safety and protection practices in each place.

The selection of pressure guard solution is the responsibility of the user, however Siemens recommends the following forms of pressure guard:

- A pressure switch screwed directly or piped into one of the purge ports and connected to an automatic shut-off valve will disable pressurized supply to the meter.
- A relief valve or bursting disc screwed directly or piped to one of the purge ports to carry any spilt fluid to drain after opening. Ensure the drain flow is safely contained away from personnel and other plant or equipment.

The pressure switch and relief valve set point should be 2-3 bar gauge. The pressure switch should be rated to withstand the full process pressure and temperature for a short time without rupture.

### Mounting of pressure guard

All sensors are filled with argon to avoid condensation. Avoid ingress of moisture, liquids or particles into the sensor; it may influence the measurement and in worst case inhibit the measuring function.

Install a pressure guard as follows:

1. Place the sensor in a dry, clean place and leave it to acclimatize.
2. Orient the sensor with the purge ports uppermost.
3. Carefully remove the plug and mount the pressure guard.
4. Replace the soft metal sealing rings with new ones to obtain proper hemetic sealing.
5. Make sure that the pressure guard does NOT touch any of the parts inside the sensor.
6. Check that the pressure guard has been correctly mounted and thoroughly tightened (torque: 80 Nm).

## 4.3 Disassembly

**⚠ WARNING**

**Incorrect disassembly**

The following risks may result from incorrect disassembly:

- Injury through electric shock
- Risk through emerging media when connected to the process
- Risk of explosion in hazardous area

In order to disassemble correctly, observe the following:

- Before starting work, make sure that you have switched off all physical variables such as pressure, temperature, electricity etc. or that they have a harmless value.
- If the device contains hazardous media, it must be emptied prior to disassembly. Make sure that no environmentally hazardous media are released.
- Secure the remaining connections so that no damage can result if the process is started unintentionally.

# Connecting

# 5

## 5.1 Basic safety notes

**⚠ WARNING**

**Unsuitable cables, cable glands and/or plugs**

Risk of explosion in hazardous areas.

- Use only cable glands/plugs that comply with the requirements for the relevant type of protection.
- Tighten the cable glands in accordance with the torques specified in Technical data (Page 103).
- Close unused cable inlets for the electrical connections.
- When replacing cable glands, only use cable glands of the same type.
- After installation, check that the cables are seated firmly.

**⚠ WARNING**

**Incorrect conduit system**

Risk of explosion in hazardous areas as result of open cable inlet or incorrect conduit system.

- In the case of a conduit system, mount a spark barrier at a defined distance from the device input. Observe national regulations and the requirements stated in the relevant approvals.

**NOTICE**

**Condensation in the device**

Damage to device through formation of condensation if the temperature difference between transportation or storage and the mounting location exceeds 20 °C (36 °F).

- Before taking the device into operation, let the device adapt for several hours in the new environment.

**NOTICE**

**Ambient temperature too high**

Damage to cable sheath.

- At an ambient temperature ≥ 60 °C (140 °F), use heat-resistant cables suitable for an ambient temperature at least 20 °C (36 °F) higher.

**WARNING**

**Improper power supply**

Risk of explosion in hazardous areas as result of incorrect power supply.

- Connect the device in accordance with the specified power supply and signal circuits. The relevant specifications can be found in the certificates, in Technical data (Page 103) or on the nameplate.

**WARNING**

**Lack of equipotential bonding**

Risk of explosion through compensating currents or ignition currents through lack of equipotential bonding.

- Ensure that the device is potentially equalized.

**Exception**: It may be permissible to omit connection of the equipotential bonding for devices with type of protection "Intrinsic safety Ex i".

**WARNING**

**Unprotected cable ends**

Risk of explosion through unprotected cable ends in hazardous areas.

- Protect unused cable ends in accordance with IEC/EN 60079-14.

**WARNING**

**Improper laying of shielded cables**

Risk of explosion through compensating currents between hazardous area and the non-hazardous area.

- Shielded cables that cross into hazardous areas should be grounded only at one end.
- If grounding is required at both ends, use an equipotential bonding conductor.

**WARNING**

**Incorrect selection of type of protection**

Risk of explosion in areas subject to explosion hazard.

This device is approved for several types of protection.

1. Decide in favor of one type of protection.
2. Connect the device in accordance with the selected type of protection.
3. In order to avoid incorrect use at a later point, make the types of protection that are not used permanently unrecognizable on the nameplate.

**Note**

**Electromagnetic compatibility (EMC)**

You can use this device in industrial environments, households and small businesses.

For metal enclosures there is an increased electromagnetic compatibility compared to high-frequency radiation. This protection can be increased by grounding the enclosure.

## See also

Connecting (Page 41)

**Note**

**Improvement of interference immunity**

- Lay signal cables separate from cables with voltages > 60 V.
- Use cables with twisted wires.
- Keep device and cables at a distance from strong electromagnetic fields.
- Take account of the conditions for communication specified in the Technical data (Page 103).
- Use shielded cables to guarantee the full specification according to HART/PA/FF/Modbus/ EIA-485/Profibus DP.

## Use in hazardous areas

Before accessing the sensor terminal compartment and application terminal space check that:

- A safe access permission certificate has been issued by plant operations management
- The flow transmitter may not be opened if energized
- All connection leads are potential free

**⚠ WARNING**

**Hazardous areas**

Observe the type examination certificates or the test certifications applicable in your country if you use transmitters as category 1/2 equipment.

**⚠ WARNING**

**Commissioning**

Only apply power and commission the device after the device has been properly connected and, if required, closed.

## 5.2 Wiring

### Hazardous area applications

Special requirements apply to the location and interconnection of sensor and transmitter.
See Use in hazardous areas (Page 13).

**⚠ WARNING**

**Transmitter enclosure**

Before opening the terminal box check that:

- No explosion hazard exists
- All connection leads are potential free

## 5.3 Connecting FC410/FCS400

**⚠ WARNING**

**Improper handling**

The sensor connected to this device can be operated with high pressure and corrosive media. Therefore improper handling of the device can lead to serious injuries and/or considerable material damage.

The device is optionally provided with a preformed cable terminated with M12 style stainless steel weather-proof plugs.

The cable shield is physically and electrically terminated within the body of the plug.

Take care when handling the cable and passing it through cable ducting. The plug is not subjected to excessive tension (pulling) as the internal connections may be disengaged.

**Note**

Never pull the cable by the plug.

1. Connect the device using the supplied 4-wire cable with M12 plug.

   **Note**

   **Grounding**

   The sensor cable screen is electrically connected to chassis, only when the M12 plug is correctly tightened.

| Terminal number | Description | Wire color (Siemens cable) |
|---|---|---|
| 1 | 15 V | Orange |
| 2 | 0 V | Yellow |
| 3 | RS-485 / B | White |
| 4 | RS-485 / A | Blue |

- Only use cables with at least the same degree of protection as the sensor to install the sensor. It is recommended to use cables supplied by Siemens.
- Siemens supplied cables can be ordered with M12 plug on one or both ends or without plug.
- To guarantee the IP67 degree of protection, ensure that both ends of the cables are given equivalent protection from ingress of moisture.
- For further information on Siemens-supplied cables, see Technical data (Page 103).

**WARNING**

**Cable requirements**

Cables must be suitable for the temperature (at least 70 °C) and be flammability-rated to at least V-2.

**A: Prepare the cable by stripping it at both ends.**

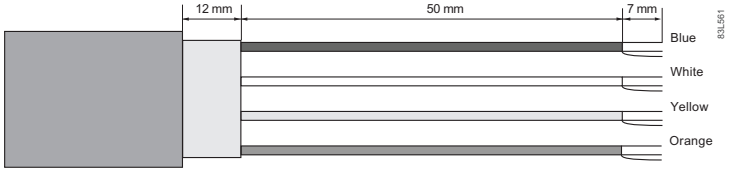



Figure 5-1 Cable end

**B: Connect wires within the sensor terminal compartment**

1. Remove the lock screw and remove the lid.
2. Undo the flexible strap.
3. Disconnect the sensor connection (white plug) from the electronic.
4. Loosen the mounting screw using a TX10 Torx driver and remove the electronic from the housing.
5. Remove the cap and the ferrule from the cable gland and slide onto the cable.
6. Push the cable through the open gland and anchor the cable shield and the wires with the clamp bar.
7. Remove the terminal block from the electronic.

8. Connect the wires to the terminals according to the list below.

| Terminal number | Description | Wire color (Siemens cable) |
|---|---|---|
| 1 | 15 V | Orange |
| 2 | 0 V | Yellow |
| 3 | RS-485 / B | White |
| 4 | RS-485 / A | Blue |

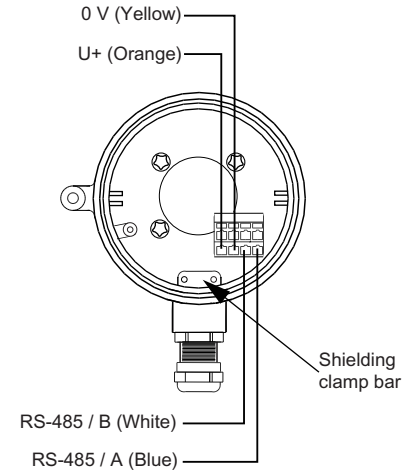
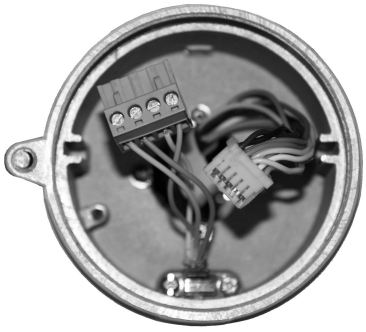
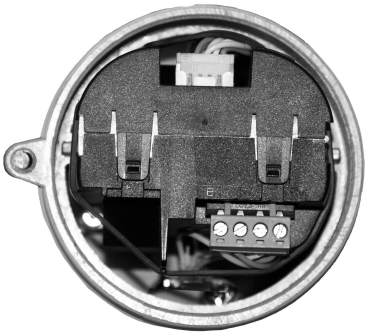



Figure 5-2 Sensor terminal compartment



9. Reinstall the electronic including the mounting screw.
10. Connect the sensor connection and the sensor cable.
11. Restore the flexible strap around all wires.



12. Assemble and tighten the cable gland.
13. Remove the O-ring from lid.
14. Reinstate the lid and screw in until the mechanical stop. Wind back the lid by one turn.
15. Mount the O-ring by pulling it over the lid and tighten the lid until you feel friction from the O-ring on both sides. Wind the lid by one quarter of a turn to seal on the O-ring.
16. Reinstate and tighten the lid lock screw.

**⚠ WARNING**

**Unprotected cable ends**

Risk of explosion through unprotected cable ends in hazardous areas.

- Protect unused cable ends in accordance with IEC/EN 60079-14.

### 5.3.1 Setting the EOL termination DIP switches

It is important to terminate the Modbus RS-485 line correctly at the start and end of the bus segment. Impedance mismatch results in reflections on the line which can cause faulty communication transmission.
If the device is at the end of the bus segment, it is recommended to terminate the device. The following table shows the relation between the DIP switch settings and the permissible communication interface set-ups.

**Note**

**End Of Line (EOL) termination**

The FCT010 EOL termination DIP switch is default set to EOL non-active. If the installation requires active termination resistors, the DIP switches should be set to the EOL Active state.

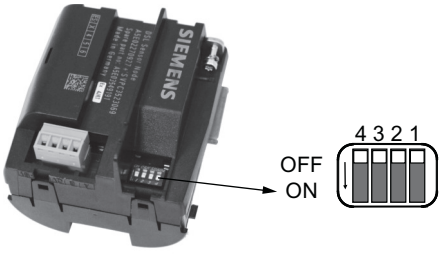
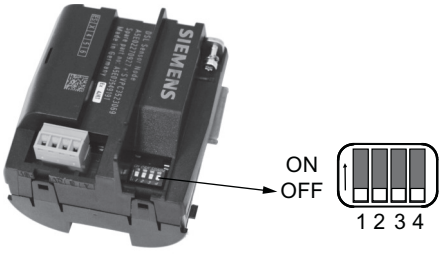
**⚠ CAUTION**

**Hazardous areas**

Only change the DIP switches in hazardous areas when the device is deenergized.

## Location of DIP switch

The DIP switch is located in the electronic as shown below.

| FW4 | FW3 (before 07/2018) |
|---|---|
|  |  |

## DIP switch settings for communication set-up

| DIP switch Communication set-up | Switch 1 | Switch 2 | Switch 3 | Switch 4 |
|---|---|---|---|---|
| EOL active | On | On | On | On |
| EOL not active | On | On | Off | Off |

| NOTICE |
|---|
| **Avoid DIP switch settings not mentioned in the table**<br>DIP switch settings not mentioned in the table preceding are not allowed and may reduce communication interface reliability. |

# Commissioning 6

## 6.1 Basic safety notes

**WARNING**

**Improper commissioning in hazardous areas**

Device failure or risk of explosion in hazardous areas.

- Do not commission the device until it has been mounted completely and connected in accordance with the information in Installing/mounting (Page 29).
- Before commissioning take the effect on other devices in the system into account.

**WARNING**

**Commissioning and operation with pending error**

If an error message appears, correct operation in the process is no longer guaranteed.

- Check the gravity of the error.
- Correct the error.
- If the error still exists:
  - Take the device out of operation.
  - Prevent renewed commissioning.

**DANGER**

**Toxic gases and liquids**

Danger of poisoning when venting the device: if toxic process media are measured, toxic gases and liquids can be released.

- Before venting ensure that there are no toxic gases or liquids in the device, or take the appropriate safety measures.

**WARNING**

**Loss of explosion protection**

Risk of explosion in hazardous areas if the device is open or not properly closed.

- Close the device as described in Installing/mounting (Page 29).

**⚠ WARNING**

**Opening device in energized state**

Risk of explosion in hazardous areas

- Only open the device in a de-energized state.
- Check prior to commissioning that the cover, cover locks, and cable inlets are assembled in accordance with the directives.

**Exception**: Devices having the type of protection "Intrinsic safety Ex i" may also be opened in energized state in hazardous areas.

## 6.2 General requirements

Before commissioning it must be checked that:

- The device has been installed and connected in accordance with the guidelines provided in Installing/mounting (Page 29) and Connecting (Page 41).
- Device installed in hazardous areas meets the requirements described in Use in hazardous areas (Page 13).

## 6.3 Remote commissioning with PDM FC410

**⚠ WARNING**

**Commissioning and operation with pending error**

If an error message appears, correct operation in the process is no longer guaranteed.

- Check the gravity of the error.
- Correct the error.
- If the error still exists:
  - Take the device out of operation.
  - Prevent renewed commissioning.

SIMATIC PDM (Process Device Manager) is a general-purpose, manufacturer-independent tool for the configuration, parameter assignment, commissioning, diagnostics and maintenance of intelligent field devices and field components. Follow-up installations and additional information on SIMATIC PDM are available on the Internet at SIMATIC PDM (www.siemens.com/simatic-pdm).

SIMATIC PDM monitors the process values, alarms and status signals of the device. It allows you to display, compare, adjust, verify, and simulate process device data; also to set schedules for calibration and maintenance.

For information on, for example, how to install and integrate devices, commission the software, see Operating Manual 'Help for SIMATIC PDM'. The manual is delivered with SIMATIC PDM

software. Once the SIMATIC PDM is installed on your computer you find the manual under: Start > All programs > Siemens Automation > SIMATIC > Documentation. Link at our website: 'Help for SIMATIC PDM' (https://support.industry.siemens.com/cs/ww/de/view/109482406/en).

**Note**

**Field device parameters**

- For a list of parameters and additional information, consult section "Parameter assignment FC410 (Page 71)".
- The field device remains in measurement mode during the time you configure the field device.

### 6.3.1 Functions in SIMATIC PDM

SIMATIC PDM monitors the process values, alarms and status signals of the device. It allows you to display, compare, adjust, verify, and simulate process device data; also to set schedules for calibration and maintenance.

Parameters are identified by name and organized into function groups. See Modbus addressing model (Page 131) for more details.

See Modbus addressing model (Page 131) for parameters that do not appear in the menu structure in SIMATIC PDM.

### 6.3.2 Commissioning steps

In the following it is described how to commission the device with SIMATIC PDM.

The steps are divided into the following sections:

1. Initial setup (Page 51)
2. Adding device to the communication network (Page 53)
3. Configuring a new device (Page 56).
4. Wizard - Quick start with PDM (Page 57)
5. Wizard - Zero point adjustment (Page 62)

### 6.3.3 Initial setup

To ensure that SIMATIC PDM connects properly complete the two processes outlined below:

1. Deactivate buffers
2. Update the Electronic Device Description (EDD)

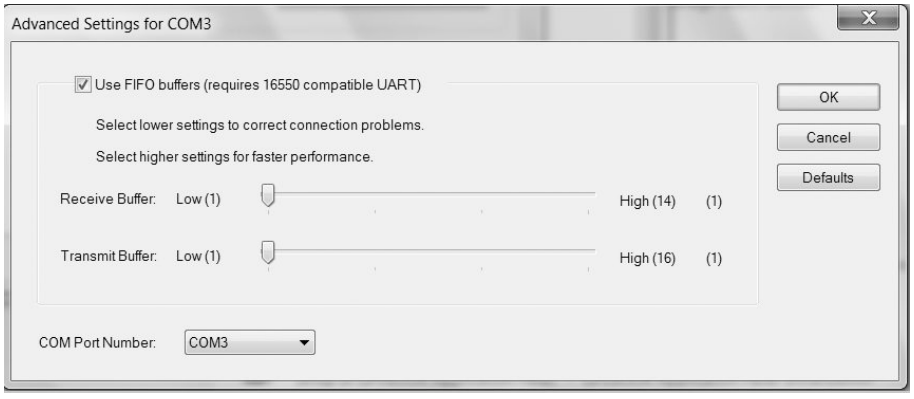
## Deactivate buffers for RS-485 COM port

This deactivation is required to align SIMATIC PDM with the Modbus modem for Windows® operating systems.

**Note**

You can find support for Windows operating systems here: support.automation.siemens.com (http://support.automation.siemens.com)

1. Click "Start" > "Control Panel" to begin configuration.
2. Click on "Hardware and Sound" > "Device Manager".
3. Open "Ports" folder and double-click the COM Port used by the system to open the "Communications Port Properties" window.
4. Select the "Port Settings" tab and click the "Advanced" button.
5. If the "Use FIFO buffers" check box is deselected, click to select.
6. Set "Receive Buffer" and "Transmitter Buffer" to Low (1).




7. Click "OK" to close out. Close all screens and then reboot.

## Update the Electronic Device Description (EDD)

You can locate the EDD in the SIMATIC PDM Device Library under "Devices" > "Modbus" > "Sensors" > "Flow" > "Coriolis" > "Siemens AG" > "SITRANS FC". Check the downloads on our website (www.siemens.com/FC410) to make sure you have the latest version of SIMATIC PDM, the most recent Service Pack (SP) and the most recent hot fix (HF).

**Installing a new EDD:**

1. Download the EDD from our website (www.siemens.com/FC410) and save the zip file to your computer.
2. Launch the SIMATIC PDM Device Integration Manager.
3. Browse to the zipped EDD file and select it.

### 6.3.4 Adding a device to communication network

Before setting the parameters, it is necessary to configure the transmitter project in PDM.

1. Add the device to SIMATIC Modbus network:
   - Select "File" > "New".
     Type in a project name, for example *FC commissioning*.
   - Go to "View" and select "Process Device Network" view.
   - Right-click on the typed in *Project name* and select "Insert New Object" > "Networks".
   - Right-click on "Networks" and "Insert New Object" > "Communication Network".
   - Click on "Assign Device Type" and select "Modbus Network".
   - Click "OK" two times.
     Your PC is now added to the Modbus Network.
   - Right-click on "Modbus Network" and select "Insert New Object" > "Object".
   - Click on "Assign Device Type" , and select "Devices" > "Modbus" > "Sensors" > "Flow" > "Coriolis" > "SIEMENS AG" > "SITRANS FC".

– Click "OK" two times.

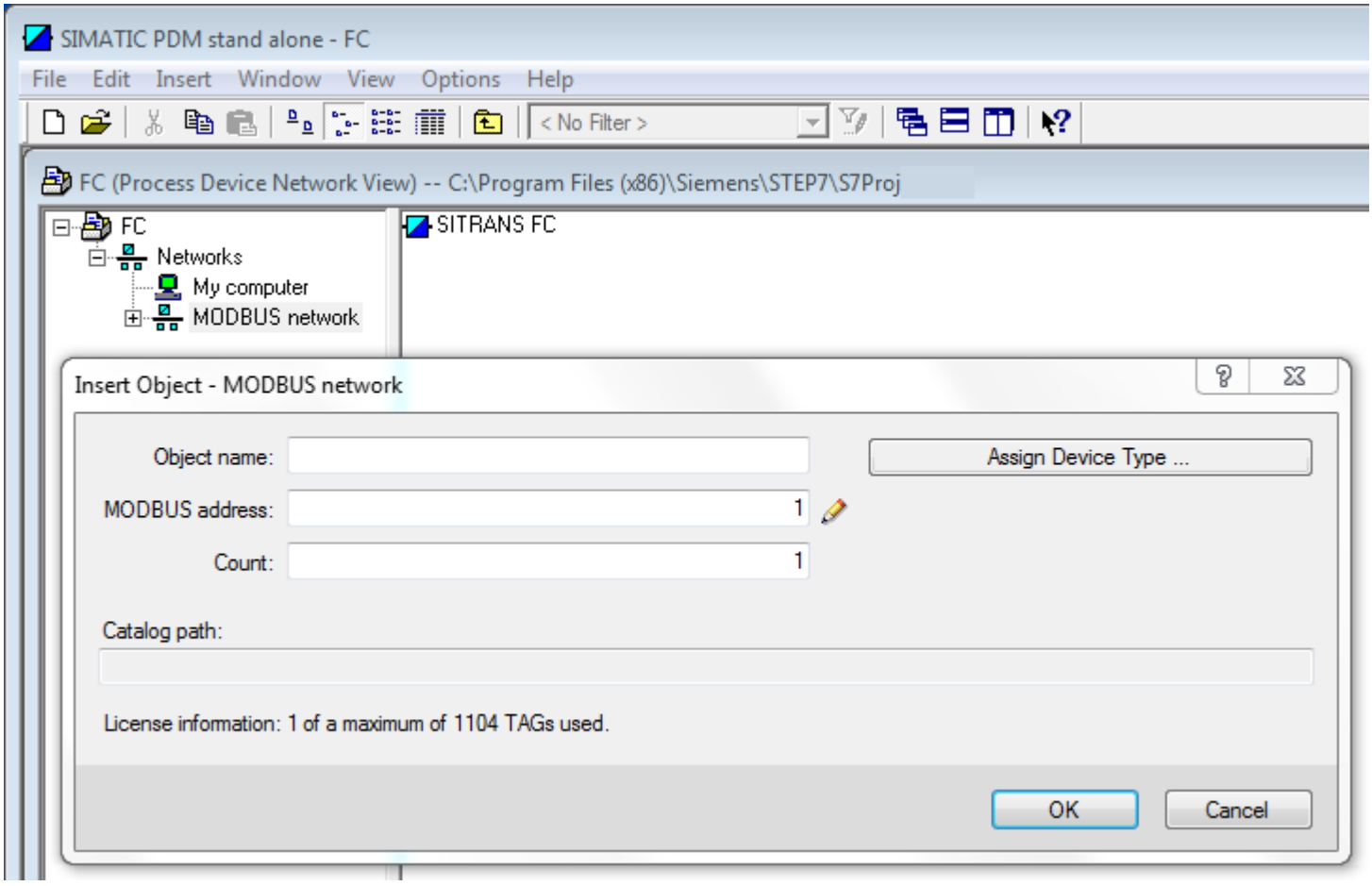



Figure 6-1 Assigning Modbus device to network

2. Set up the communication parameters for SIMATIC Modbus network:
   – Select "Networks" > "My computer", right-click on "COM Port Interface" and select "Object Properties".

– Select the "Communication" tab and configure the communication parameters. The transmitters default settings are:
 - Transmission rate: 19200 baud
 - Parity: even

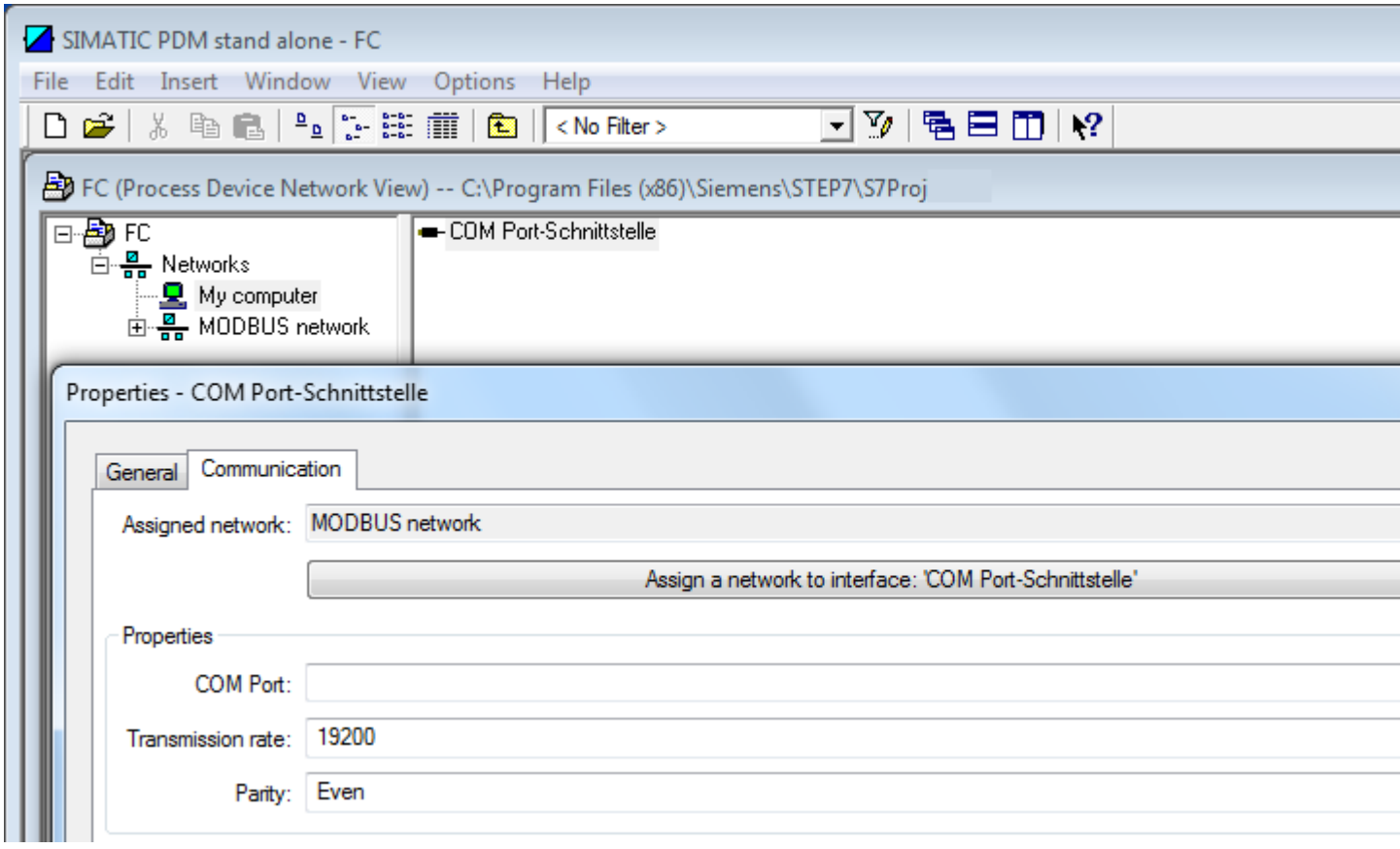



Figure 6-2 Set the COM Port

– Click "OK".

3. Set up the COM interface:
   – Select "Modbus Networks".
   – Right-click on the object name "SITRANS FC" and select "Object Properties".

– Select the "Communication" tab and configure the Modbus address.

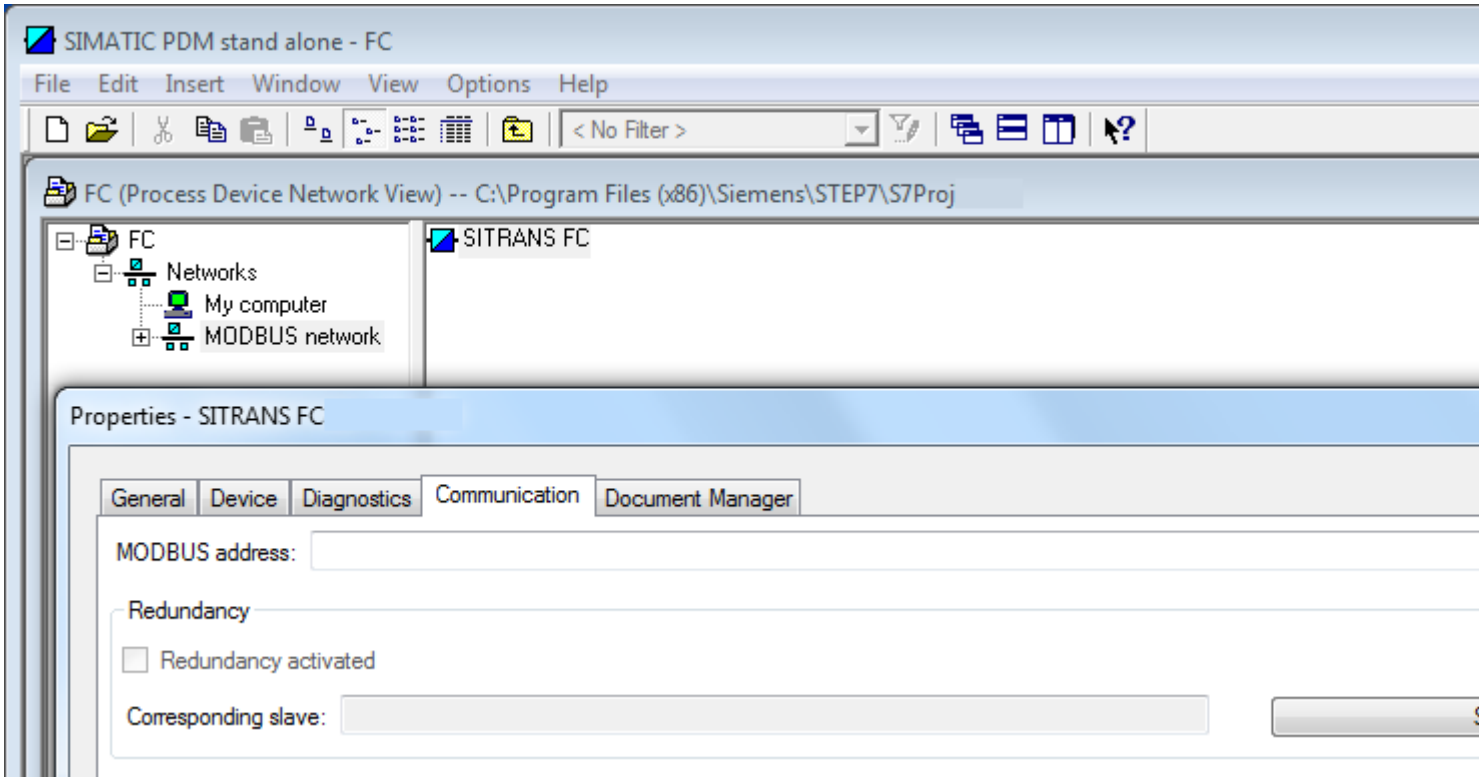



Figure 6-3 Set Modbus address

– Click "OK".

## 6.3.5 Configuring a new device

**Note**

**Configuring device via SIMATIC PDM**

- Clicking "Cancel" button during an upload from device to SIMATIC PDM will result in *some* parameters being updated.

1. Check that you have the most recent EDD, and if necessary update it. See Updating the Electronic Device Description (EDD) (Page 70).
2. Launch **SIMATIC Manager** and create a new project for the device.
3. Open the menu "Device > Operation > Reset > Restore ordered configuration". Select "Yes" button and click "OK" to perform a reset to customer ordered settings.
4. After the reset is complete click on “Upload to PG/PC...” to upload the parameters.
5. Configure the device via the quick start wizard. (See Wizard - Quick Start via PDM (Page 57).)

### 6.3.6 Wizard - Quick Start via PDM

The Quick Start wizard provides an easy 5-step procedure that configures the device for a simple application.

Please consult the SIMATIC PDM operating instructions or online help for details on using SIMATIC PDM.

#### Access level control

The parameters are protected against changes by access level control. To gain access follow this procedure:

1. Go to menu "Device" > "Security".
2. Select "User" and enter the PIN code.
   The default user PIN code is 2457.

#### Quick Start

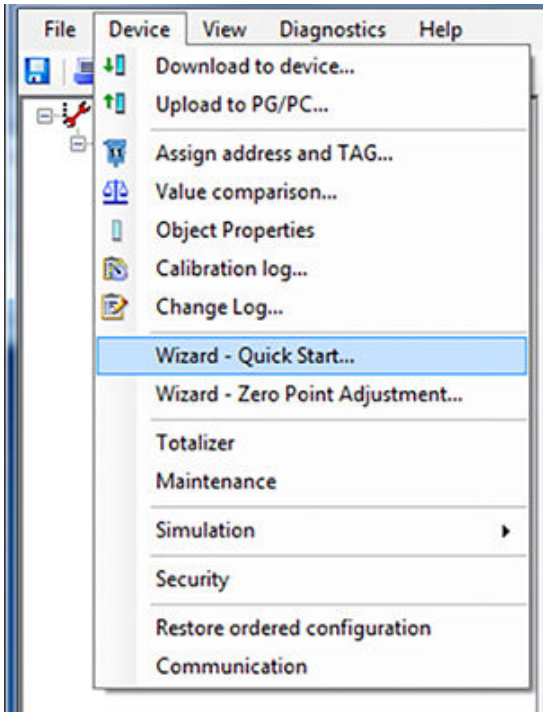
**Note**

- The "Quick Start" wizard settings are inter-related and changes apply only after you click on "Apply and Transfer" at the end of step 5 to save settings offline and transfer them to the device.

- Do not use the "Quick Start" wizard to modify individual parameters.

- Click on "Back" to return and revise settings or "Cancel" to exit the "Quick Start".

Launch SIMATIC PDM, open the menu "Device" > "Wizard - Quick Start...", and follow steps 1 to 5.

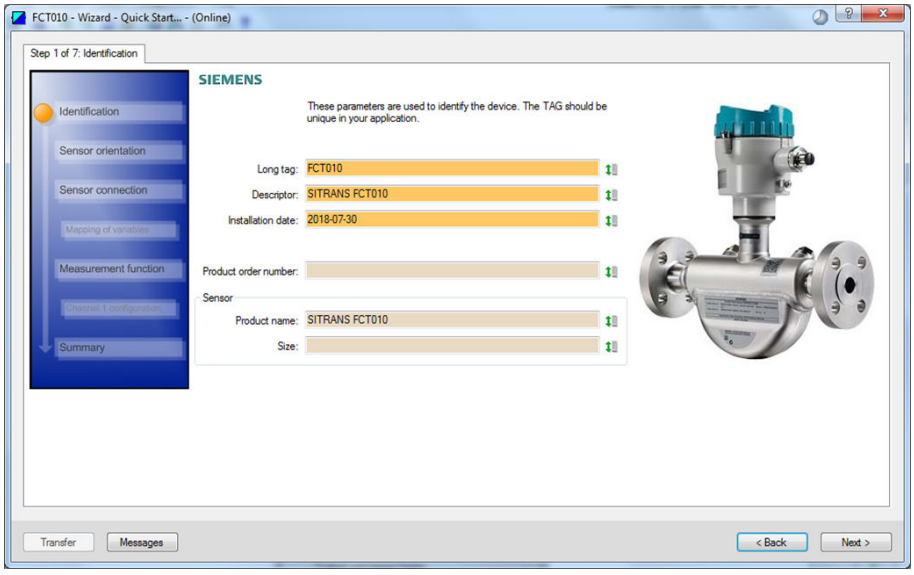



### Step 1 - Identification

**Note**

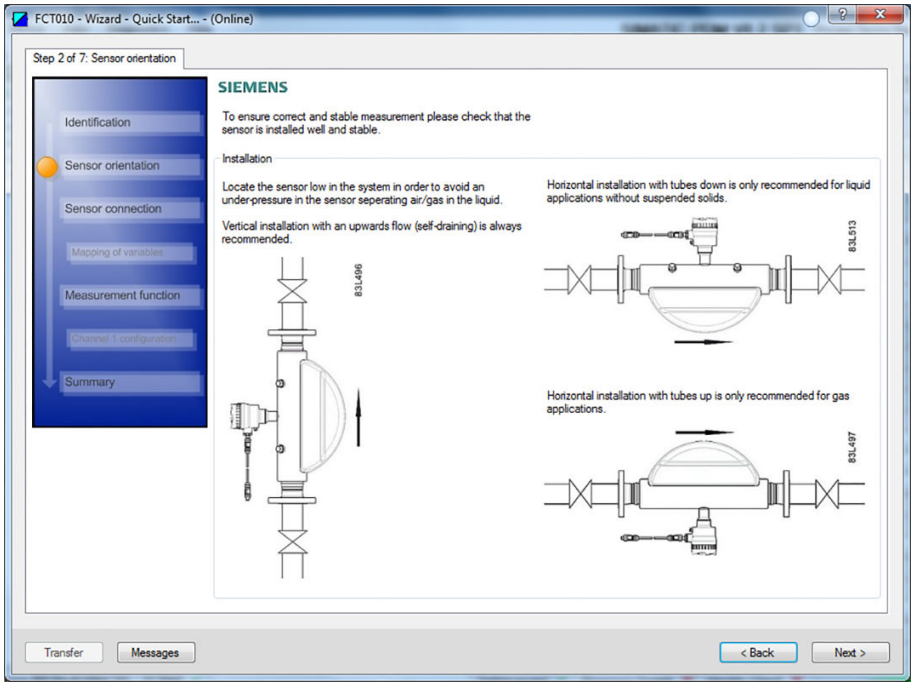
The layout of the dialog boxes shown may vary according to the resolution setting for your computer monitor. The recommended resolution is 1280 x 960.

1. Click on "Read Data from Device" to upload Quick Start parameter settings from the device to the PC/PG and ensure SIMATIC PDM is synchronized with the device.
2. Click on "Next" to accept the default values.



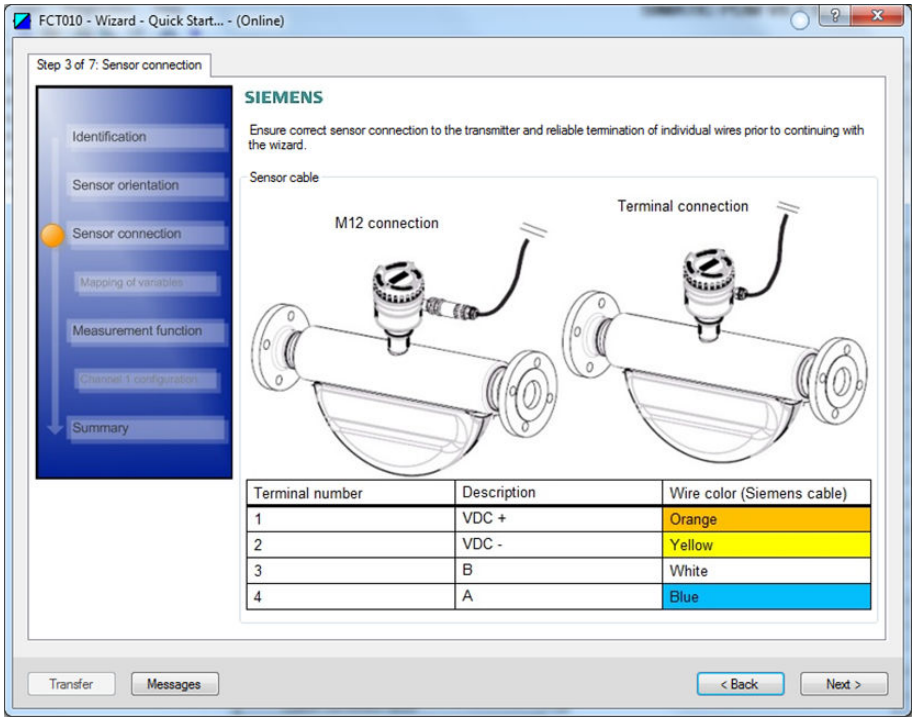

## Step 2 - Sensor orientation

Step 2 shows an overview of the various recommended installation orientations depending on the application.



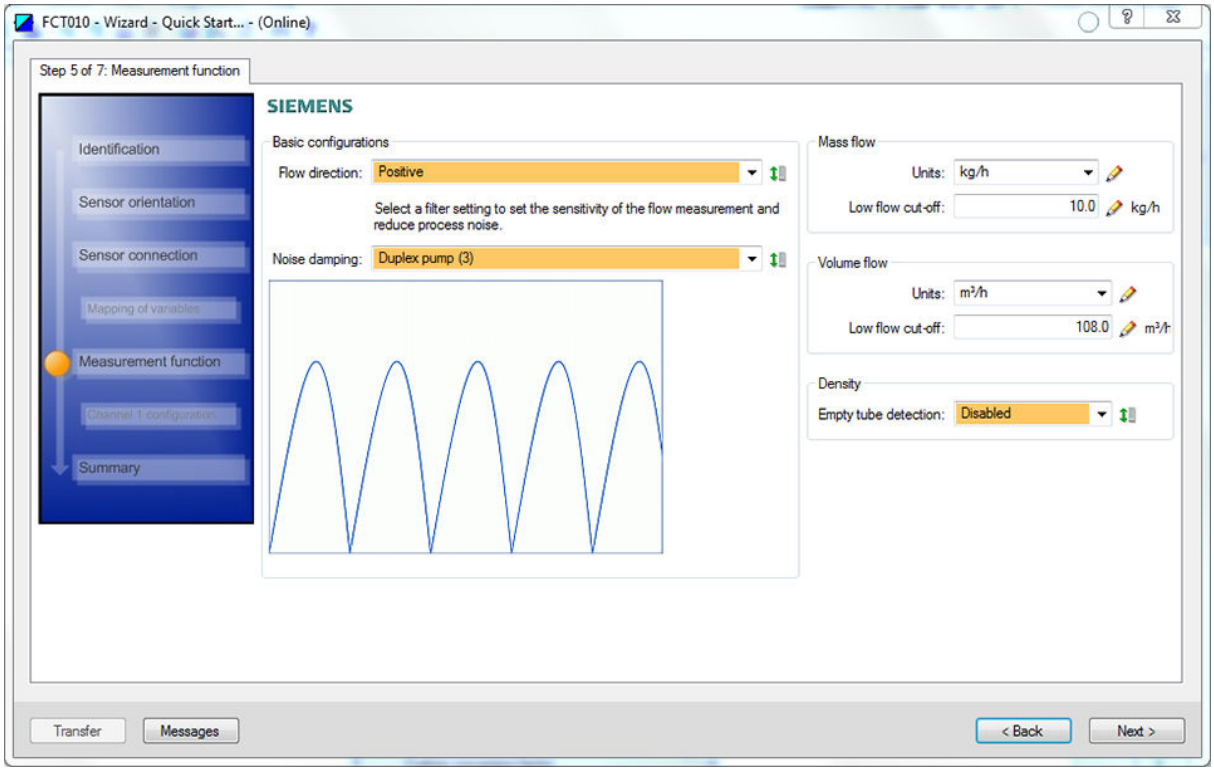
### Step 3 - Sensor connection

The transmitter can be ordered with M12 connection or with terminated cable (for example conduit connections).



### Step 4 - Measurement function

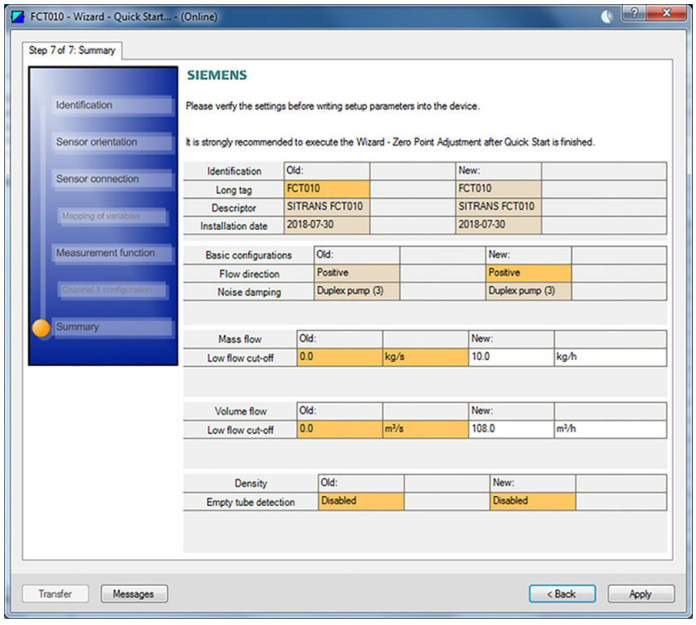
Configure the measurement conditions for the selected process variables. Change "Flow direction" if necessary.




### Step 5 - Summary

Check parameter settings, and click on

- "Back" to return and revise values or
- "Apply" to save settings offline or
- "Apply and Transfer" to save settings offline and transfer them to the device.




The message "Quick Start was successful" will appear. Click on "OK".

**See also**

Configuring a new device (Page 56)

## 6.3.7 Wizard - Zero Point Adjustment

**Note**

**Preconditions**

Before a zero point adjustment is initiated, the pipe must be flushed, filled and at an absolute flowrate of zero preferably also at operating pressure and temperature.

## Performing a zero point adjustment

1. Flush out the flowmeter until a homogenous flow is established and the tubes are completely filled.

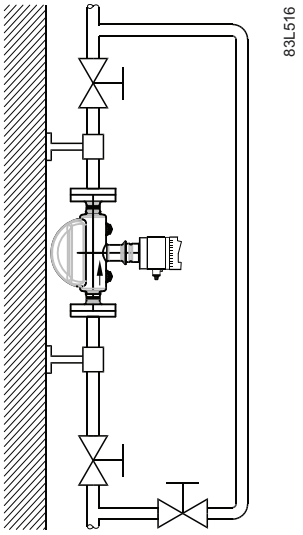
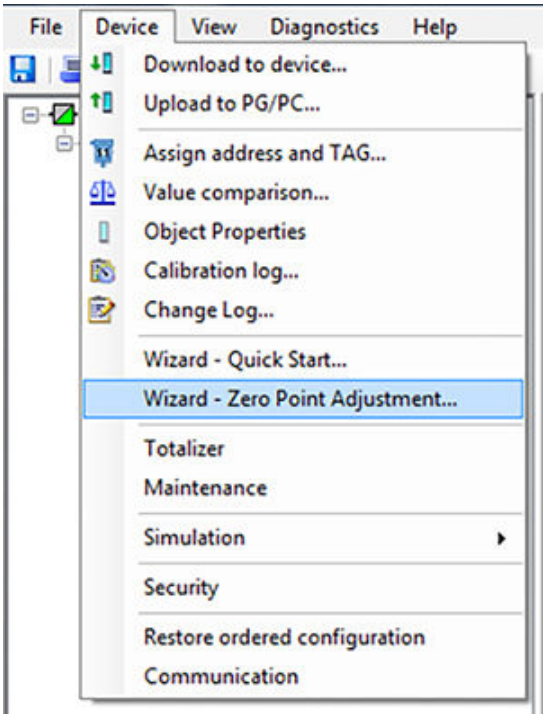
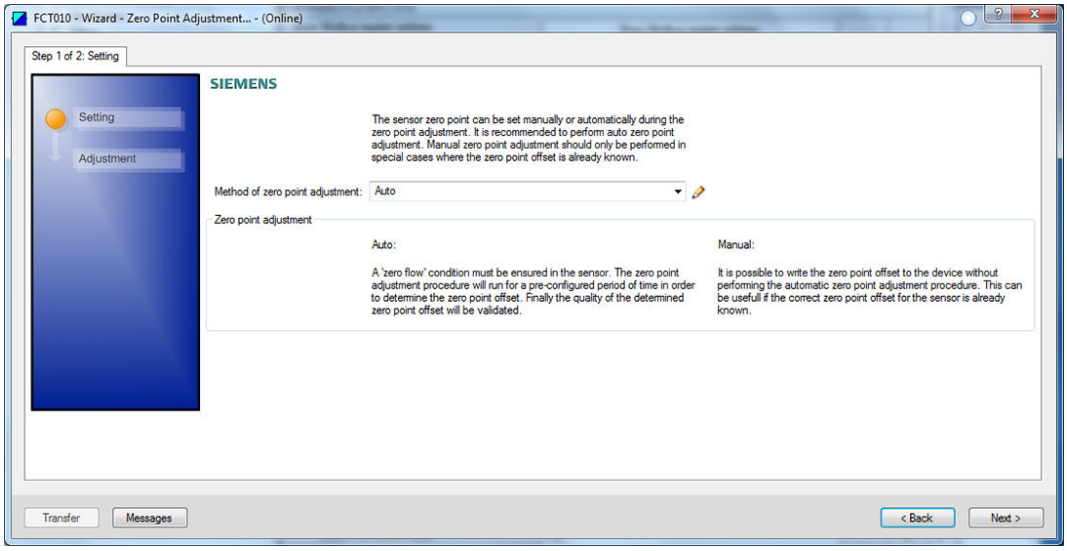



Figure 6-4 Best practice zero point adjustment with a by-pass line and two shut-off devices

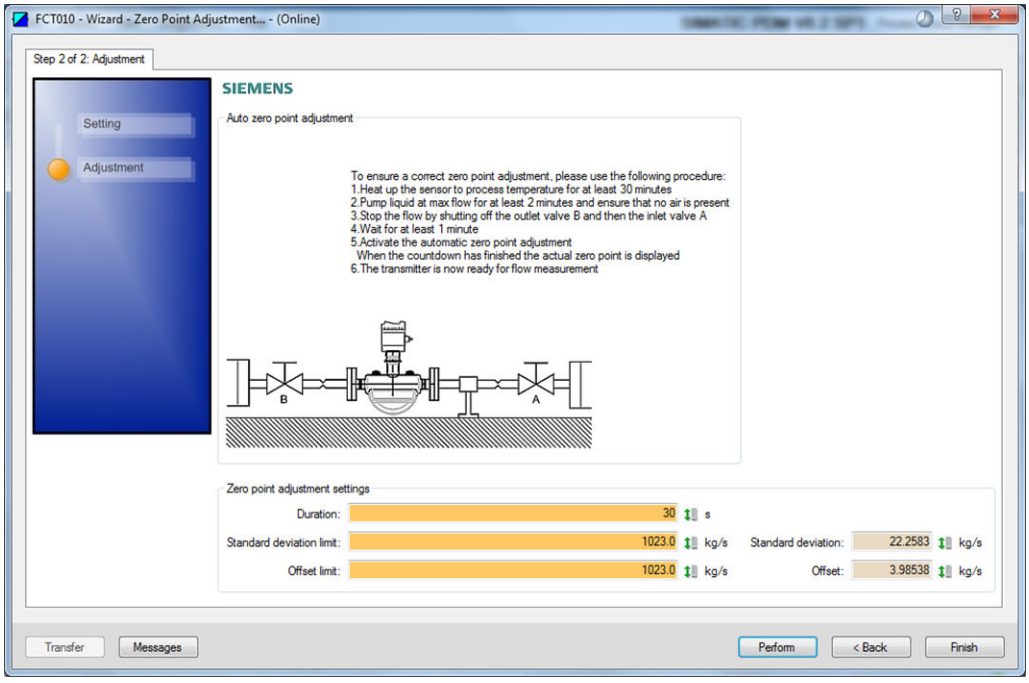
2. Establish zero flow for example by closing the shut off-valves.
3. Wait 1 to 2 minutes for the system to settle, and then perform zero point adjustment as described in the following steps.
4. Select "Device" > "Wizard - Zero Point Adjustment..." from the main menu of SIMATIC PDM to perform an automatic zero point adjustment.



5. It is recommended to use the default settings ("Auto"). If necessary, change the "Zero Point Adjustment Settings".




6. Click on "Next".
7. Click on "Perform".



8. During the process a progress bar is visible.
9. At the end of the zero point adjustment the outcome is displayed as an offset and a standard deviation.

**Note**

If you get an error message after the zero point adjustment, refer to Fault codes and corrective actions (Page 92).

The system is now ready for normal operation.

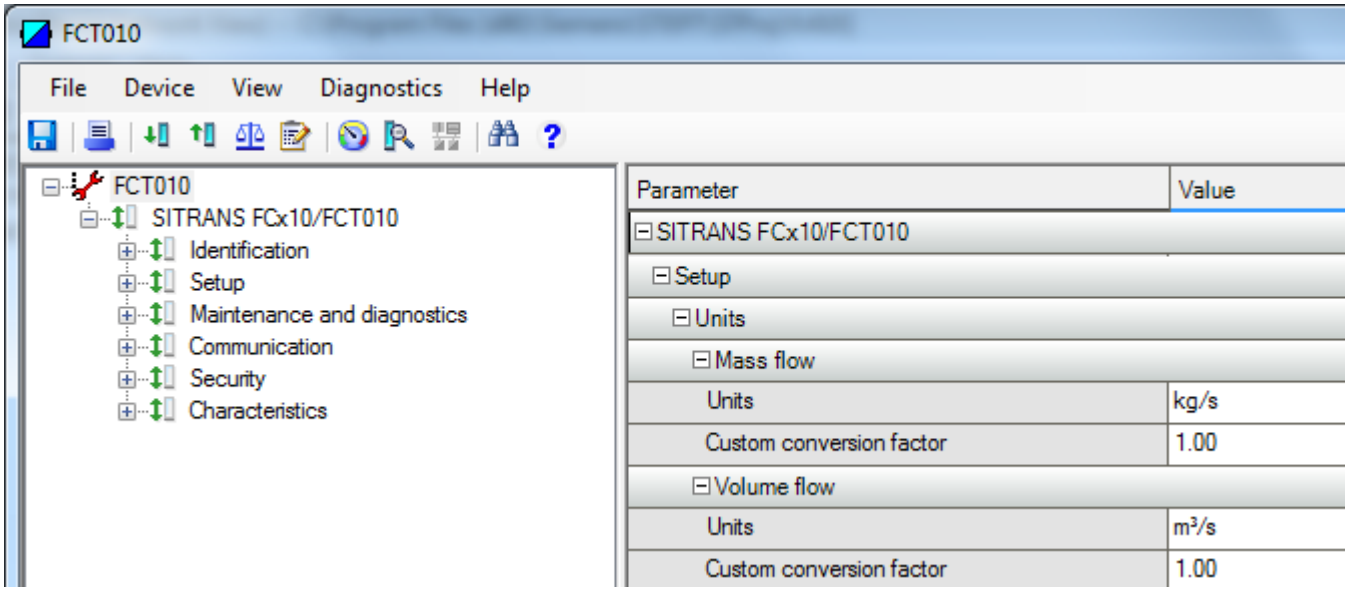
## 6.3.8 Changing parameter settings using SIMATIC PDM

**Note**

Clicking on "Cancel" during an upload from device to SIMATIC PDM will result in some parameters NOT being updated.

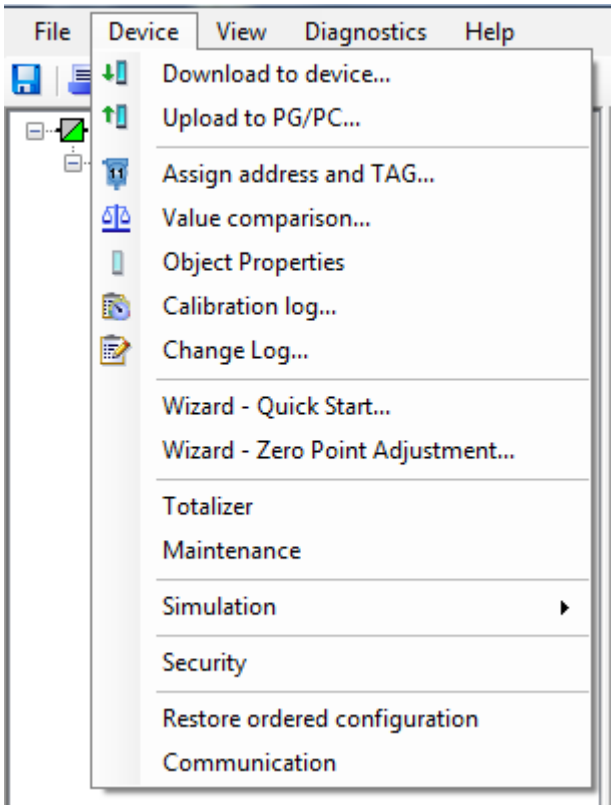
Many parameters are accessed via the online menus in SIMATIC PDM, see Parameters accessed via drop-down menus (Page 66) for the others.

1. Launch SIMATIC PDM, connect to the appropriate device and upload data.
2. Adjust parameter values in the parameter value field.
3. Click on "Enter".
   The status fields read "Changed".
4. Open the menu "Device".
5. Click on "Download to device".
6. In menu "File" click "Save" to save settings offline.
   The status fields are cleared.



### 6.3.9 Parameters accessed via drop-down menus

Click on menu "Device" or "View" to open the associated drop-down menus.




#### Drop-down menus

Table 6-1 Menu "Device"

| Option | Description |
|---|---|
| Download to device | Download all writable parameters to the device. |
| Upload to PC/PG | Upload all parameters from the device to the parameter table. |
| Assign address and TAG | Assign communication address and TAG name. |
| Value comparison | Compare values between device / project. |
| Object Properties | Show Properties for device and project. |
| Calibration log | Create calibration logs for field devices. |
| Change Log | The change log records which actions have been performed with SIMATIC PDM on devices. |
| Wizard - Quick Start | Start guide for quick commissioning of the device. |
| Wizard - Zero Point Adjustment | Start guide for zero point adjustment (automatic and manual). |
| Totalizer | Show or change totalizer settings. |
| Maintenance | Show maintenance parameters. |

| Option | Description |
|---|---|
| Simulation | Start simulation for testing purposes. |
| Security | Select or change access level. |
| Restore ordered configuration | Set all parameters to customer ordered settings. |
| Communication | Show communication settings. |

Table 6-2 Menu "View"

| Option | Description |
|---|---|
| Process values (online dialog) | Show all process values. |
| Device Diagnostic (online dialog) | Show all diagnostics information (alarms and diagnostics parameters). |
| Toolbar (online dialog) | Show or hide the toolbar. |
| Status Bar | Show or hide the status bar. |
| Update | Update the content of the active window. |

## 6.3.10 Process values

1. To compare outputs in real time select "View" > "Process values" to see all process values, totalizers and loop current.
2. Verify that the process values show the expected values.

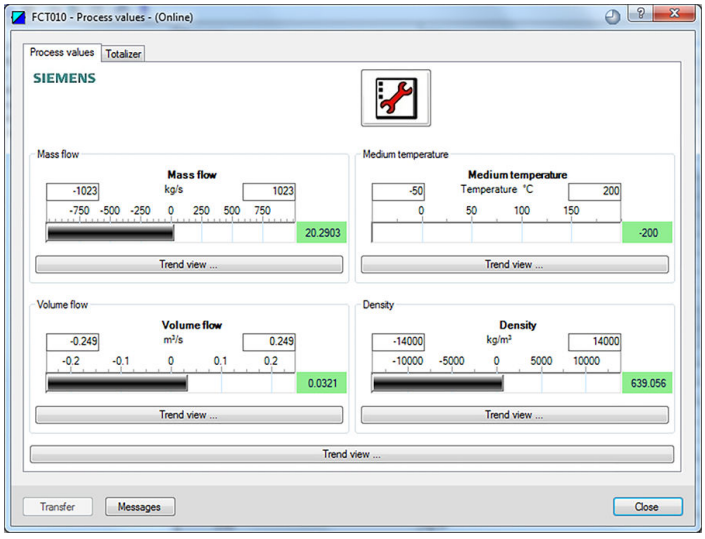



Figure 6-5 Process variables

### Trend view

Open the menu "View" > "Process values" and click on one of the "Trend view" buttons to monitor the trend of one or all process values available at each tab.

# Operating FC410

# 7

## 7.1 Remote operation

For information on Modbus addresses, registers and function codes see appendix Modbus communication FC410 (Page 131).

### 7.1.1 Overview of device configuration software

There are currently two competing technologies for configuring field devices:

- Electronic Device Description Language (EDDL)-based software
- Field Device Tool / Device Type Manager (FDT/DTM)-based software

From a practical point of view, both EDDL and FDT/DTM solutions do the same thing: provide a way of reading and writing configuration parameters to field devices and viewing advanced diagnostics.

**Note**

- SIMATIC PDM (an EDDL-based software) configures a field device using the Electronic Device Description (EDD) for that device.
- PACTware and Fieldcare (FDT-based software) use the DTM for that field device.

In addition, there is a new standard called Field Device Integration (FDI) which is a merger of these two technologies. Many of the major vendors have stated that their configuration software will evolve into being an FDI host. At the time this manual was written, Siemens had announced that SIMATIC PDM will become a FDI host system in the near future.

### 7.1.2 SIMATIC PDM

#### 7.1.2.1 Check SIMATIC PDM version

**Procedure**

1. Go to SIMATIC PDM Download (http://www.siemens.com/simaticpdm/downloads).
2. Check the support page to make sure you have:
   - The latest version of SIMATIC PDM
   - The most recent Service Pack (SP)
   - The most recent hot fix (HF)

### 7.1.2.2 Updating the Electronic Device Description (EDD)

**Procedure**

1. Check that the EDD revision match the Firmware revision in the device according to the table in section Product compatibility FC410 (Page 7).
2. Go to the support page Software downloads (http://www.siemens.com/processinstrumentation/downloads).
3. Enter the product name in the field "Enter search term...".
4. Download the most current EDD of your device.
5. Save files to your computer in an easily accessed location.
6. Launch SIMATIC PDM – Device Integration Manager.
   From the File menu, click "Read device descriptions from compressed source...".
7. Browse to the zipped EDD file, select and open it.
8. Use the "Integration" function to integrate the EDD into the device catalog. The EDD is now accessible via SIMATIC Manager.

### 7.1.2.3 Set address

Open in SIMATIC PDM the menu Device – Set Address, enter a value for New Address, and click on Assign Address.

# Parameter assignment FC410

# 8

## 8.1 Functions

### 8.1.1 Process values

According to standard practice with serial communication the Modbus RTU signal updates primary process values and error status values every 10 ms (100 Hz update rate) synchronous with the DSP update cycle.

**Process value parameters**

Default units for process values can be changed, default values are:

- Mass flow (MassflowValue) [kg/s]
- Volume flow (VolumeflowValue) [$m^3$/s]
- Density (Density) [kg/$m^3$]
- Medium temperature (MediumTemp) [°C]
- Sensor frame temperature [°C]

| Process value | Modbus register | Units |
|---|---|---|
| Mass flow | 7400 | • g/s (grams per second)<br>• g/min (grams per minute)<br>• g/h (grams per hour)<br>• **kg/s (kilograms per second) (default)**<br>• kg/min (kilograms per minute)<br>• kg/h (kilograms per hour)<br>• kg/d (kilograms per day)<br>• t/min (metric tons per minute)<br>• t/h (metric tons per hour)<br>• t/d (metric tons per day)<br>• ton/min (short tons per minute)<br>• ton/h (short tons per hour)<br>• ton/d (short tons per day)<br>• ton (UK)/h (long tons per hour)<br>• ton (UK)/d (long tons per day)<br>• lb/s (pounds per second)<br>• lb/min (pounds per minute)<br>• lb/h (pounds per hour)<br>• lb/d (pounds per day)<br>• Custom |

| Process value | Modbus register | Units |
|---|---|---|
| Volume flow | 7500 | • l/s (liters per second)<br>• l/min (liters per minute)<br>• l/h (liters per hour)<br>• **$m^3$/s (cubic meters per second) (default)**<br>• $m^3$/min (cubic meters per minute)<br>• $m^3$/h (cubic meters per hour)<br>• $m^3$/d (cubic meters per day)<br>• Ml/d (megaliters per day)<br>• gal/s (US gallons per second)<br>• gal/min (US gallons per minute)<br>• gal/h (US gallons per hour)<br>• gal/d (US gallons per day)<br>• bbl-beer/s (beer barrels per second = 31 US gallons)<br>• bbl-beer/min (beer barrels per minute = 31 US gallons)<br>• bbl-beer/h (beer barrels per hour = 31 US gallons)·<br>• bbl-beer/d (beer barrels per day = 31 US gallons)<br>• bbl/s (oil barrels per second)<br>• bbl/min (oil barrels per minute)<br>• bbl/h (oil barrels per hour)<br>• bbl/d (oil barrels per day)<br>• $ft^3$/s (cubic feet per second)<br>• $ft^3$/min (cubic feet per minute)<br>• $ft^3$/h (cubic feet per hour)<br>• $ft^3$/d (cubic feet per day)<br>• gal/s (UK gallons per second)<br>• gal/min (UK gallons per minute)<br>• gal/h (UK gallons per hour)<br>• gal/d (UK gallons per day)<br>• Mgal/d (US megagallons per day)<br>• Custom |

| Process value | Modbus register | Units |
|---|---|---|
| Density | 7600 | • µg/l (micrograms per liter)<br>• µg/m³ (micrograms per cubic meter)<br>• mg/l (milligrams per liter)<br>• g/ml (grams per milliliter)<br>• g/cm³ (grams per cubic centimeter)<br>• g/l (grams per liter)<br>• kg/l (kilograms per liter)<br>• **kg/m³ (kilograms per cubic meter) (default)**<br>• lb/in³ (pounds per cubic inch)<br>• lb/gal (pounds per US gallon)<br>• lb/ft³ (pounds per cubic foot)<br>• ton/yd³ (short tons per cubic yard)<br>• Custom |
| Temperature | 7700 | • **°C (degrees Celsius) (default)**<br>• °F (degrees Fahrenheit)<br>• °R (degrees Rankine)<br>• K (kelvins) |
| Mass totalizer | | • g (grams)<br>• kg (kilograms)<br>• t (metric tons)<br>• ton (short tons)<br>• ton (UK) (long tons)<br>• oz (ounces avoirdupois)<br>• lb (pounds)<br>• Custom |

See also the description of the Zero point adjustment via SIMATIC PDM (Page 62).

**Note**

**Preconditions**

Before a zero point adjustment is initiated, the pipe must be flushed, filled and at an absolute flowrate of zero preferably also at operating pressure and temperature.

**Note**

**Change of parameters during zero point adjustment**

Do not change any other parameter during the zero point adjustment procedure.

## Automatic zero point adjustment

The device measures and calculates the correct zero point automatically.

The automatic zero point adjustment of the flowmeter is set by the following parameters:

- Duration (Modbus address 2135)
- Start Zero Point Adjustment (Modbus address 2180)

When zero adjust is initiated by selecting **Start Zero Point Adjustment**, the mass flow values are acquired and totalized for the configured period (Duration). The default zero point adjustment period (30 s.) is normally sufficient for a stable zero point measurement.

**Note**

**Extremely low flow quantity**

If the flow quantity is extremely small, extremely precise measurement is necessary. In this case, a long zero point adjustment period can be selected for improved zero point adjustment.

## Zero point calculation

During zero point adjustment, an average value is automatically calculated using the following formula:

| **Zero point offset value** | | |
|---|---|---|
| Average of N flow values | $\bar{x} \equiv \frac{\sum_{i=1}^{N} x_i}{N}$ | $x_i$ is an instantaneous flow value sampled in the time domain<br>N = Number of samples during zero point adjustment |

The offset value must be within the determined **Zero Point Offset Limit** (Modbus address 2140).

**Note**

**Exceeded zero point offset limit**

If the offset value is greater than the configured limit, proceed as follows:

- Check that the tube is completely filled and that the flowrate is absolute zero.
- Check the validity of the configured zero point offset limit.
- Repeat the zero point adjustment.

## Zero point standard deviation

After completion of the procedure, the standard deviation is calculated in accordance with the following formula:

| **Zero point standard deviation** | |
|---|---|
| Standard deviation of N values | $s \equiv \sqrt{\frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{N-1}}$ |

The standard deviation contains important feedback on the homogeneity of the fluid, for example on the presence of bubbles or particles.

The standard deviation must be within the determined **Standard deviation limit** (Modbus address 2138).

**Note**

**Exceeded standard deviation limit**

If the standard deviation is greater than the configured limit, proceed as follows:

- Check that the tube is completely filled and that the flow rate is absolute zero.
- Check that the installation is vibration-free.
- Check the validity of the configure **Standard deviation limit** (Modbus address 2138).
- Repeat the zero point adjustment.

### Successful automatic zero point adjustment

If the new zero point offset value is valid, it is automatically stored as the new zero point for the sensor. It remains stored in the case of a power failure.

### Manual zero point adjustment

In case an automatic zero point adjustment cannot be performed, it is possible to do a manual zero point adjustment by entering the zero point offset value.

1. Select Modbus address 2132 **Zero Point Adjustment** and set the value to 1 = **Manual Zero Point Adjustment**.
2. Select Modbus address 2133 **Manual Zero Point Offset** and enter the desired offset value.

## 8.1.2 Low flow cut-off

In certain applications, for example dosing applications, no flow signals under a certain flow level are desired. In these applications, the flow signal can be forced to zero when the flow is lower than a predefined flow value (low flow cut-off).

The transmitter provides two parameters for setting the low flow cut-off:

- Mass flow cut-off limit (Modbus address 2125)
- Volume flow cut-off limit (Modbus address 2170)

## 8.1.3 Empty tube monitoring

The empty tube monitoring function uses the process density for detecting an empty tube. Use of this function is recommended for all standard applications.

**Note**

**Gas applications**

Deactivate the empty tube monitoring function.

### Empty tube monitoring parameters

Two parameters for setting the empty tube monitoring function are available:

- Empty tube detection (Modbus address 2129)
- Empty tube limit (Modbus address 2127)

The empty tube monitoring is activated via the Empty tube detection parameter. When the empty tube monitoring function is on, the mass flow / volume flow value is forced to zero if the tube is empty.

The tube is defined as empty if the measured density value is lower than the value defined via the Empty tube limit parameter.

**Note**

**Process media density**

Risk of unintentionally forcing flow values to zero if the difference between the Empty tube limit density value and the density of the process media is not sufficient.

- Ensure sufficient difference between the Empty tube limit density value and the process media density.

## 8.1.4 Process noise damping

### Noise damping function

The dynamic sensitivity of the flow measurement signal to rapid changes in process flows can be reduced by use of the process noise damping function. The function is typically used in environment with:

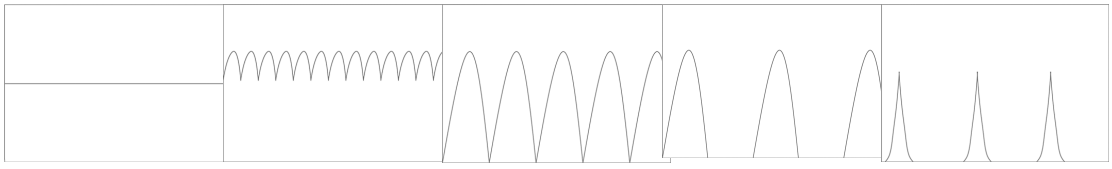
- Strongly pulsating flow
- Changing pump speeds
- Large pressure variations

### Process noise damping settings

Reduce interfering process noise by increasing the setting of the parameter **Process noise damping** (Modbus address 2130).

- Centrifugal pump (1: low)
- Triplex pump (2)
- Duplex pump (3)
- Simplex pump (4)
- Cam pump (5: high)

The default value is **Duplex pump**. The damping affects all functions and outputs of the sensor.



**Centrifugal pump (1, low)** | **Triplex pump (2)** | **Duplex pump (3, default setting)** | **Simplex pump (4)** | **Cam pump (5, high)**

**Note**

**Increased reaction time**

The reaction time of the sensor increases when the process noise is damped.

## 8.1.5 Totalizer

### Totalizer function

The device has one totalizer function that can be used to totalize the mass flow process value. Default unit of the totalizer can be changed, see Modbus register 8320.

The totalizer may be paused, resumed or reset:

- Pause (Modbus address 2613): the totalizer holds the last value before the failure occurred
- Resume (Modbus address 2614): the totalizer continues counting the actual measured value
- Reset (Modbus address 2612): the totalizer continues counting based on the last input value (for example mass flow) before the failure occurred.

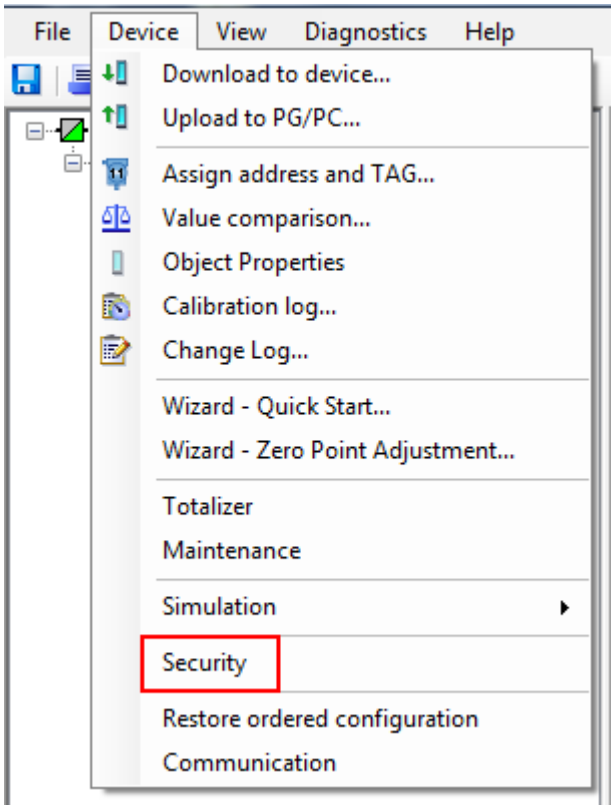
**Note**

The totalizer is reset on power failure.

### 8.1.6 Security

All parameters may be viewed but some are protected against changes by access level control.

The Security menu makes it possible to gain access to PIN code protected parameters and to change PIN codes.




The access levels are:

- Read only
  Allows no configuration. The user is only able to read the parameter values. No PIN code is required.
- User
  Allows configuration and service of all parameters except calibration parameters. Default PIN code is 2457.

**Note**

**Auto Log Off function**

The access level will be set to Read only mode if the device is powered off.

## 8.1.7 Simulation

Simulation is used for testing purposes, typically for checking that the readings of the control system are correct.

### Process value simulation

The following process values can be simulated:

- Mass flow (Modbus address 2764)
- Density (Modbus address 2766)
- Medium temperature (Modbus address 2768)
- Sensor frame temperature (Modbus address 2770)
- Volume flow (Modbus address 2772)

The simulation can be activated through SIMATIC PDM in the menu **Device → Simulation → Process Variables**.

## 8.1.8 Float transmission

The Float Byte Order function ensures that the master and slave use the same sequence of the bytes when transmitting float values. This enables the user to configure the transmitter using the configuration tool, SIMATIC PDM, and operate the device with all types of PLCs without reprogramming the PLC. The transmission order is configured by setting the parameter **Byte Order** in the submenu **Device → Communication**.

**Note**

The command **Restart Communication** must be executed to activate the new byte order setting.

This table shows the different options for setting the transmission method:

| Selection | Sequence | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th |
| 1 - 0 - 3 - 2 | Byte 1 (MMMMMMMM) | Byte 0 (MMMMMMMM) | Byte 3 (SEEEEEEE) | Byte 2 (EMMMMMMM) |
| 0 - 1 - 2 - 3 | Byte 0 (MMMMMMMM) | Byte 1 (MMMMMMMM) | Byte 2 (EMMMMMMM) | Byte 3 (SEEEEEEE) |

| Selection | Sequence | | | |
|---|---|---|---|---|
| | **1st** | **2nd** | **3rd** | **4th** |
| 2 - 3 - 0 - 1 | Byte 2<br>(EMMMMMMM) | Byte 3<br>(SEEEEEEE) | Byte 0<br>(MMMMMMMM) | Byte 1<br>(MMMMMMMM) |
| 3 - 2 - 1 - 0 * | Byte 3<br>(SEEEEEEE) | Byte 2<br>(EMMMMMMM) | Byte 1<br>(MMMMMMMM) | Byte 0<br>(MMMMMMMM) |

* = Factory setting

S = Sign

E = Exponent

M = Mantissa

**NOTICE**

**Change of float byte order**

If the float byte order is changed by use of PDM to anything other than default, all float values shown in PDM are wrong.

# Service and maintenance

# 9

## 9.1 Basic safety notes

**Note**

The device is maintenance-free.

The device is maintenance-free. However, a periodic inspection according to pertinent directives and regulations must be carried out.

An inspection can include, for example, check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover
- Reliability of power supply, lightning protection, and grounds

**⚠ WARNING**

**Impermissible repair of explosion protected devices**

Risk of explosion in hazardous areas

- Repair must be carried out by Siemens authorized personnel only.

**⚠ WARNING**

**Dust layers above 5 mm**

Risk of explosion in hazardous areas.

Device may overheat due to dust build up.

- Remove dust layers in excess of 5 mm.

**NOTICE**

**Penetration of moisture into the device**

Damage to device.

- Make sure when carrying out cleaning and maintenance work that no moisture penetrates the inside of the device.

**WARNING**

**Leaks in the sample gas path**

Risk of poisoning.

When measuring toxic process media, these can be released or collect in the device if there are leaks in the sample gas path.

- Purge the device as described in Commissioning (Page 49).
- Dispose of the toxic process media displaced by purging in an environmentally friendly manner.

**WARNING**

**Use of a computer in a hazardous area**

If the interface to the computer is used in the hazardous area, there is a risk of explosion.

- Ensure that the atmosphere is explosion-free (hot work permit).

## 9.2 Recalibration

Siemens offers to recalibrate the sensor.

The following calibration types are offered as standard according to configuration:

- Standard mass flow calibration
- Density calibration
- Customer specified mass flow calibration
- Accredited Siemens ISO/IEC 17025 mass flow calibration

**Note**

**SensorFlash**

For sensor recalibration the SensorFlash memory unit must always be returned with the sensor.

## 9.3 Cleaning

### Cleaning the enclosure

- Clean the outside of the enclosure with the inscriptions using a cloth moistened with water or a mild detergent.
- Do not use any aggressive cleansing agents or solvents, e.g. acetone. Plastic parts or the painted surface could be damaged. The inscriptions could become unreadable.

**WARNING**

**Electrostatic charge**

Risk of explosion in hazardous areas if electrostatic charges develop, for example, when cleaning plastic surfaces with a dry cloth.

- Prevent electrostatic charging in hazardous areas.

## 9.4 Maintenance and repair work

**WARNING**

**Impermissible repair of explosion protected devices**

Risk of explosion in hazardous areas

- Repair must be carried out by Siemens authorized personnel only.

**WARNING**

**Maintenance during continued operation in a hazardous area**

There is a risk of explosion when carrying out repairs and maintenance on the device in a hazardous area.

- Isolate the device from power.

- or -

- Ensure that the atmosphere is explosion-free (hot work permit).

**WARNING**

**Impermissible accessories and spare parts**

Risk of explosion in areas subject to explosion hazard.

- Only use original accessories or original spare parts.
- Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

**⚠ WARNING**

**Enclosure open**

Risk of explosion in hazardous areas as a result of hot components and/or charged capacitors inside the device.

To open the device in a hazardous area:

1. Isolate the device from power.
2. Visually inspect sensor inlet and outlet.

**Exception:** Devices exclusively having Intrinsic safety (Ex i) may be opened in an energized state in hazardous areas.

**⚠ WARNING**

**Hot, toxic or corrosive process media**

Risk of injury during maintenance work.

When working on the process connection, hot, toxic or corrosive process media could be released.

- As long as the device is under pressure, do not loosen process connections and do not remove any parts that are pressurized.
- Before opening or removing the device ensure that process media cannot be released.

**⚠ WARNING**

**Improper connection after maintenance**

Risk of explosion in areas subject to explosion hazard.

- Connect the device correctly after maintenance.
- Close the device after maintenance work.

Refer to Cables and cable entries (Page 107).

The device is maintenance-free. However, a periodic inspection according to pertinent directives and regulations must be carried out.

An inspection can include check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover screws
- Reliability of power supply, lightning protection, and grounds

**NOTICE**

Repair and service must be carried out by Siemens authorized personnel only.

**Note**

Siemens defines flow sensors as non-repairable products.

## 9.4.1 Maintenance information FC410

### Maintenance information parameters

The basic maintenance information parameters are:

- Current date and time
- Operating time total
- Operating time
- Transmitter Hardware version
- Sensor Hardware version

## 9.4.2 Service information FC410

Service information is information about the condition of the device used for diagnostics and service purposes.

### Service information parameters

The basic service information parameters are:

- Driver current
- Pickup 1 amplitude
- Pickup 2 amplitude
- Sensor frequency
- Sensor frame temperature
- Medium temperature
- Zero point adjustment Auto/Manual
- Zero point Offset
- Manual Zero Point
- Zero Point Standard deviation

## 9.5 Replacing the device

**⚠ CAUTION**

**Corrosive substances**

Risk of chemical burns when replacing the sensor.

The sensor in the device contains corrosive substances that result in burns on unprotected skin.

- Make sure that the sensor enclosure is not damaged when replacing the sensor.
- If contact with the corrosive substances occurs, rinse the affected skin immediately with large amount of water to dilute substance.

## 9.6 Spare parts/Accessories

### 9.6.1 Ordering of spare parts

Ensure that your ordering data is not outdated. The latest ordering data is always available on the Internet: SIOS catalog Coriolis (https://support.industry.siemens.com/cs/products?dtp=Catalog&mfn=ps&pnid=17346&lc=de-DE)

### 9.6.2 Replaceable components

This table gives an overview of which components can be replaced.

| Component | Order number | Photo | Replacable in Ex devices | Hot swappable [1)] |
|---|---|---|---|---|
| SITRANS FC<br>Bag of loose parts for sensor<br>Contents:<br>Screws, O-rings, cable clamp parts | A5E03549324 |  | **Yes**<br>Observe hazardous area access protocol | **No** |
| SITRANS FCT010<br>Blind lid in painted aluminum small (∅85 mm) | A5E03549295 |  | **Yes**<br>Observe hazardous area access protocol | **Yes**<br>Observe hazardous area access protocol |
| Sensor housing with cable entries in metric tread | A5E03549313 |  | **No** | **No** |

| Component | Order number | Photo | Replacable in Ex devices | Hot swappable [1] |
|---|---|---|---|---|
| Sensor housing with cables entries in NPT tread | A5E03906080 |  | **No** | **No** |
| SITRANS FCS400<br>M12 option for sensor housing | A5E03906095 |  | **No** | **No** |
| Frontend cassette<br>Spare part frontend cassette for FCT010<br>From firmware 2.X | A5E03549191 |  | **No** | **No** |
| Frontend cassette<br>Spare part frontend cassette for FCT010<br>From firmware 4.0 | A5E41526286 | | | |

[1] Components may be replaced while power is on in non-hazardous areas only.

## 9.7 Transportation and storage

To guarantee sufficient protection during transport and storage, observe the following:

- Keep the original packaging for subsequent transportation.
- Devices/replacement parts should be returned in their original packaging.
- If the original packaging is no longer available, ensure that all shipments are properly packaged to provide sufficient protection during transport. Siemens cannot assume liability for any costs associated with transportation damages.

| **NOTICE** |
|---|
| **Insufficient protection during storage**<br>The packaging only provides limited protection against moisture and infiltration.<br>• Provide additional packaging as necessary. |

Special conditions for storage and transportation of the device are listed in Technical data (Page 103).

## 9.8 Return procedure

Enclose the bill of lading, return document and decontamination certificate in a clear plastic pouch and attach it firmly to the outside of the packaging.

### Required forms

- Delivery note
- Return goods delivery note (http://www.siemens.com/processinstrumentation/returngoodsnote)
  with the following information:
  - Product (item description)
  - Number of returned devices/replacement parts
  - Reason for returning the item(s)
- Decontamination declaration (http://www.siemens.com/sc/declarationofdecontamination)
  With this declaration you warrant "that the device/replacement part has been carefully cleaned and is free of residues. The device/replacement part does not pose a hazard for humans and the environment."
  If the returned device/replacement part has come into contact with poisonous, corrosive, flammable or water-contaminating substances, you must thoroughly clean and decontaminate the device/replacement part before returning it in order to ensure that all hollow areas are free from hazardous substances. Check the item after it has been cleaned. Any devices/replacement parts returned without a decontamination declaration will be cleaned at your expense before further processing.

## 9.9 Disposal

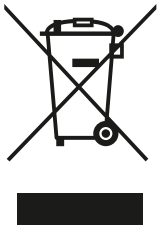
### 9.9.1 Special disposal required

**Note**

**Special disposal required**

The device includes components that require special disposal.

- Dispose of the device properly and environmentally through a local waste disposal contractor.



Devices described in this manual should be recycled. They may not be disposed of in the municipal waste disposal services according to the Directive 2012/19/EC on waste electronic and electrical equipment (WEEE).

Devices can be returned to the supplier within the EC, or to a locally approved disposal service for eco-friendly recycling. Observe the specific regulations valid in your country.

Further information about devices containing batteries can be found at: Information about battery / product return (WEEE) (https://support.industry.siemens.com/cs/document/109479891/)

# Diagnostics and troubleshooting FC410

# 10

## 10.1 Device status symbols

**Device status symbols**

| SIMATIC PDM/PLC | | |
|---|---|---|
| **Sym-bol** | **Device status** | **Priority** |
|  | Maintenance alarm | 1 |
| **Cause:** Output signal invalid due to fault in the field device or in the peripherals.<br>**Action:** Maintenance is required immediately. | | |
| | | |
|  | Manual operation | 4 |
| **Cause:** Output signal temporarily invalid (e.g. frozen) due to work being performed on the device.<br>**Action:** Disable manual mode via HMI or engineering system. | | |
| | | |
|  | Process value alarm | 8 |
| **Cause:** Deviations from permissible ambient or process conditions detected by the device (through self-monitoring, or warnings / faults in the device) indicate that the measured value is unreliable or deviations from the set value in the actuators is most likely greater than anticipated under normal operating conditions. Process or ambient conditions will damage the device or result in unreliable output.<br>**Action:** Check ambient temperature or process conditions. If possible, install device at different location. | | |
| | | |
|  | Process value warning | 10 |
| **Cause:** Deviations from permissible ambient or process conditions detected by the device (through self-monitoring, or warnings / faults in the device) indicate that the measured value is unreliable or deviations from the set value in the actuators is most likely greater than anticipated under normal operating conditions. Process or ambient conditions can damage the device or result in unreliable output.<br>**Action:** Check ambient temperature or process conditions. If possible, install device at different location. | | |

# 10.2 Fault codes and corrective actions

## 10.2.1 Diagnostics

| ID | Icons | Message | Cause/Action |
|---|---|---|---|
| 36 |  | Sensor supply volt. out of range | Contact your local Siemens representative. |
| 37 |  | Sensor supply volt. out of range | Contact your local Siemens representative. |
| 38 |  | Temperature measurement fault | Turn off the power, wait 5 seconds and turn on the power again. If the problem persists, contact your local Siemens representative. |
| 39 |  | Temperature measurement fault | Turn off the power, wait 5 seconds and turn on the power again. If the problem persists, contact your local Siemens representative. |
| 40 |  | Temperature measurement fault | Turn off the power, wait 5 seconds and turn on the power again. If the problem persists, contact your local Siemens representative. |
| 41 |  | Temperature measurement fault | Turn off the power, wait 5 seconds and turn on the power again. If the problem persists, contact your local Siemens representative. |
| 42 |  | Flow values not valid | Can be due to problems with measured fluid or hardware malfunction. If the problem persists, contact your local Siemens representative. |
| 43 |  | Flow values not valid | Can be due to problems with measured fluid or hardware malfunction. If the problem persists, contact your local Siemens representative. |
| 44 |  | Flow values not valid | Can be due to problems with measured fluid or hardware malfunction. If the problem persists, contact your local Siemens representative. |
| 45 |  | Flow values not valid | Can be due to problems with measured fluid or hardware malfunction. If the problem persists, contact your local Siemens representative. |
| 46 |  | Invalid calibration data | Contact your local Siemens representative for recalibration. |
| 47 |  | Invalid compensation data | Contact your local Siemens representative. |
| 49 |  | Malfunction in Pickup Amplitude | Contact your local Siemens representative. |
| 50 |  | Malfunction in Pickup Amplitude | Contact your local Siemens representative. |
| 55 |  | Malfunction in sensor driver | Contact your local Siemens representative. |
| 56 |  | Malfunction in sensor driver | Contact your local Siemens representative. |

| ID | Icons | Message | Cause/Action |
|---|---|---|---|
| 57 |  | Malfunction in sensor driver | Contact your local Siemens representative. |
| 58 |  | Unstable driver oscillation | Contact your local Siemens representative. |
| 59 |  | Mass flow out of specification | Reduce the flow. If the problem persists, contact your local Siemens representative. |
| 60 |  | Volume flow out of specification | Reduce the flow. If the problem persists, contact your local Siemens representative. |
| 61 |  | Density out of specification | Contact your local Siemens representative. |
| 62 |  | Fluid temp. below limit | Increase the fluid temperature. If the problem persists, contact your local Siemens representative. |
| 63 |  | Fluid temp. above limit | Reduce the fluid temperature. If the problem persists, contact your local Siemens representative. |
| 64 |  | Frame temp. below limit | Increase fluid temperature and check that ambient temperature is within specified limits. If the problem persists, contact your local Siemens representative. |
| 65 |  | Frame temp. above limit | Reduce fluid temperature and check that ambient temperature is within specified limits. If the problem persists, contact your local Siemens representative. |
| 66 |  | Standard Deviation above limit | Measurement continues with values from last successful zero point adjustment. Improve conditions for automatic zero point adjustment and repeat adjustment. |
| 67 |  | Zero Point Offset above limit | Measurement continues with values from last successful zero point adjustment. Improve conditions for automatic zero point adjustment and repeat adjustment. |
| 68 |  | Zero point adjustment failed | Measurement continues with values from last successful zero point adjustment. Improve conditions for automatic zero point adjustment and repeat adjustment. |
| 69 |  | Empty Tube Limit' exceeded | Make sure that the sensor is filled with liquid and that the liquid density is within the specified 'Empty Tube Limit'. |
| 70 |  | Too little fluid in tube | Make sure that the sensor is filled with liquid. |
| 71 |  | Parameter storage malfunction | Turn off the power, wait 5 seconds and turn on the power again. If the problem persists, contact your local Siemens representative. |
| 72 |  | Internal error in sensor | Contact your local Siemens representative. |
| 73 |  | Internal error in sensor | Contact your local Siemens representative. |
| 74 |  | Internal error in sensor | Contact your local Siemens representative. |
| 75 |  | Internal error in sensor | Contact your local Siemens representative |
| 76 |  | Internal error in sensor | Contact your local Siemens representative. |

| ID | Icons | Message | Cause/Action |
|---|---|---|---|
| 77 |  | Internal error in sensor | Contact your local Siemens representative. |
| 78 |  | Unstable measurement condition | Check if air is present in the liquid and that the flowmeter is operated within its specifications. |
| 79 |  | Auto filtering | Check that the flowmeter is operated within its specifications. Check other alarms to rule out HW malfunction. |
| 87 |  | Sensor startup | Unplug and reconnect the sensor cable. If the diagnostic persists after the specified startup time, restart the device. If the problem persists, contact Technical Support. |

## 10.2.2 Alarm messages

In the following tables the bits for alarm group 1 and alarm group 2 can be found along with possible causes and directions for corrective action.

**Alarm group 1 (Modbus address 3012)**

| Bit | Diagnostic | Action |
|---|---|---|
| 4<br>5 | Sensor supply volt. out of range | Contact Siemens customer support |
| 6<br>7<br>8<br>9 | Temperature measurement fault | Contact Siemens customer support |
| 10<br>11<br>12<br>13 | Flow values not valid | Can be due to problems with measured fluid or hardware malfunction. If the failure continues then contact Siemens customer support |
| 14 | Invalid calibration data | Contact Siemens customer support for recalibration |
| 15 | Invalid compensation data | Contact Siemens customer support |
| 17<br>18 | Malfunction in Pickup Amplitude | Contact Siemens customer support |
| 23<br>24<br>25 | Malfunction in sensor driver | Contact Siemens customer support |
| 26 | Unstable driver oscillation | Contact Siemens customer support |
| 27 | Massflow out of specification | Reduce the flow. If the failure continues then contact Siemens customer support |
| 28 | Volumeflow out of specification | Reduce the flow. If the failure continues then contact Siemens customer support |
| 29 | Density out of specification | Contact Siemens customer support |
| 30 | Fluid temp. below limit | Increase the fluid temperature. If the failure continues then contact Siemens customer support |
| 31 | Fluid temp. above limit | Reduce the fluid temperature. If the failure continues then contact Siemens customer support |

**Alarm group 2 (Modbus adddress 3014)**

| Bit | Diagnostic | Action |
|---|---|---|
| 0 | Frame temp. below limit | Increase fluid temperature and check that ambient temperature is within specified limits. If the failure continues then contact Siemens customer support |
| 1 | Frame temp. above limit | Reduce fluid temperature and check that ambient temperature is within specified limits. If the failure continues then contact Siemens customer support |
| 2 | **Standard Deviation** above limit<br><br>(shown for only 2 seconds) | Measurement continues with values from last successful zero point adjustment. Improve conditions for automatic zero point adjustment and repeat adjustment. |
| 3 | **Zero Point Offset** above limit<br><br>(shown for only 2 seconds) | Measurement continues with values from last successful zero point adjustment. Improve conditions for automatic zero point adjustment and repeat adjustment. |
| 4 | Zero point adjustment failed<br><br>(shown for only 2 seconds) | Measurement continues with values from last successful zero point adjustment. Improve conditions for automatic zero point adjustment and repeat adjustment. |
| 5 | **Empty Tube Limit** exceeded | Make sure that the sensor is filled with liquid and that the liquid density is within the specified **Empty Tube Limit** |
| 6 | The sensor is partially filled | Make sure that the sensor is filled with liquid |
| 7 | Parameter storage malfunction | Turn off the power, wait 5 seconds and turn on the power again. If the failure continues then contact Siemens customer support |
| 8<br>9<br>10<br>11<br>12<br>13 | Internal error in sensor | Contact Siemens customer support |
| 14 | Unstable measurement condition | Check if air is present in the liquid and that the flowmeter is operated within its specifications |
| 15 | Auto filtering | Check that the flowmeter is operated within its specifications. Check other alarms to rule out HW malfunction |
| 23 | The sensor is stabilizing | Turn off the power, wait 5 seconds and turn on the power again. If the failure continues then contact Siemens customer support. |

## 10.3 Operation troubleshooting

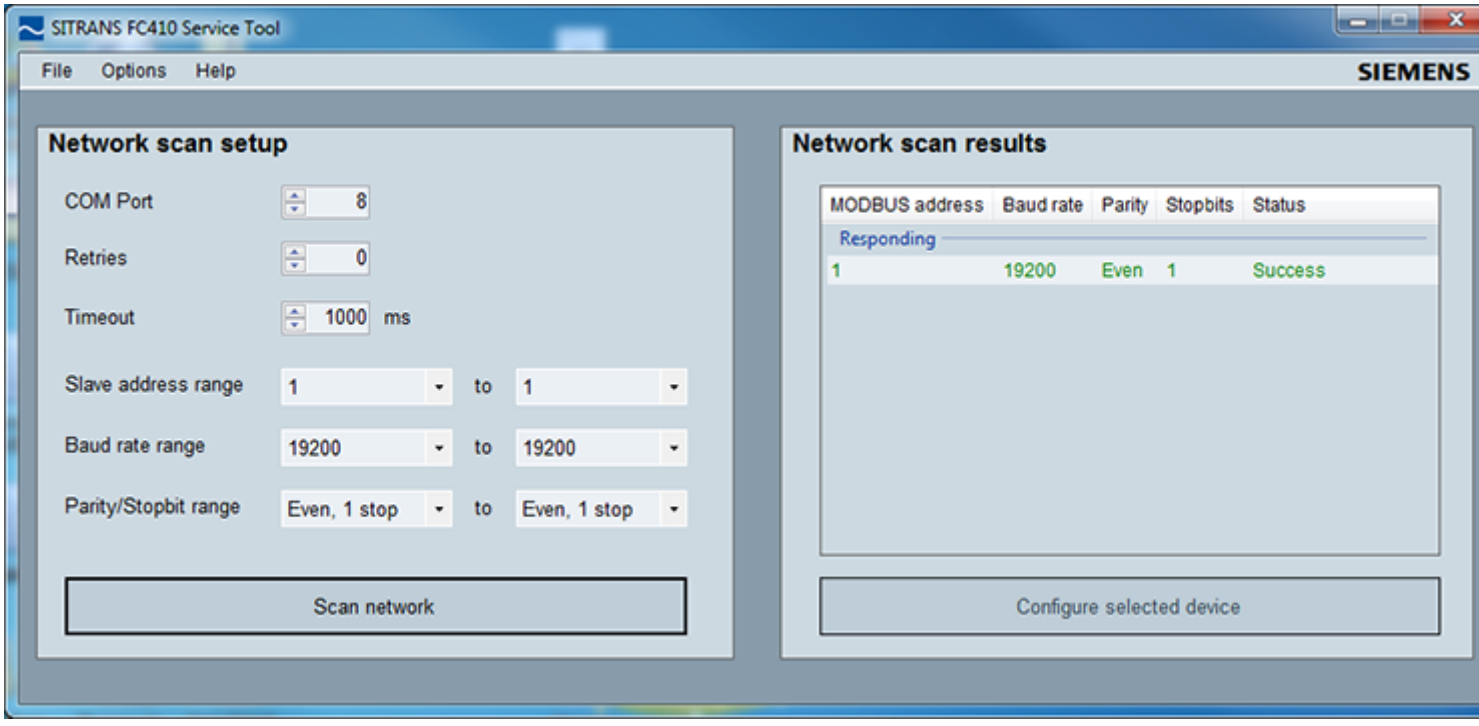
### 10.3.1 Updating the firmware

**Note**

**Firmware update**

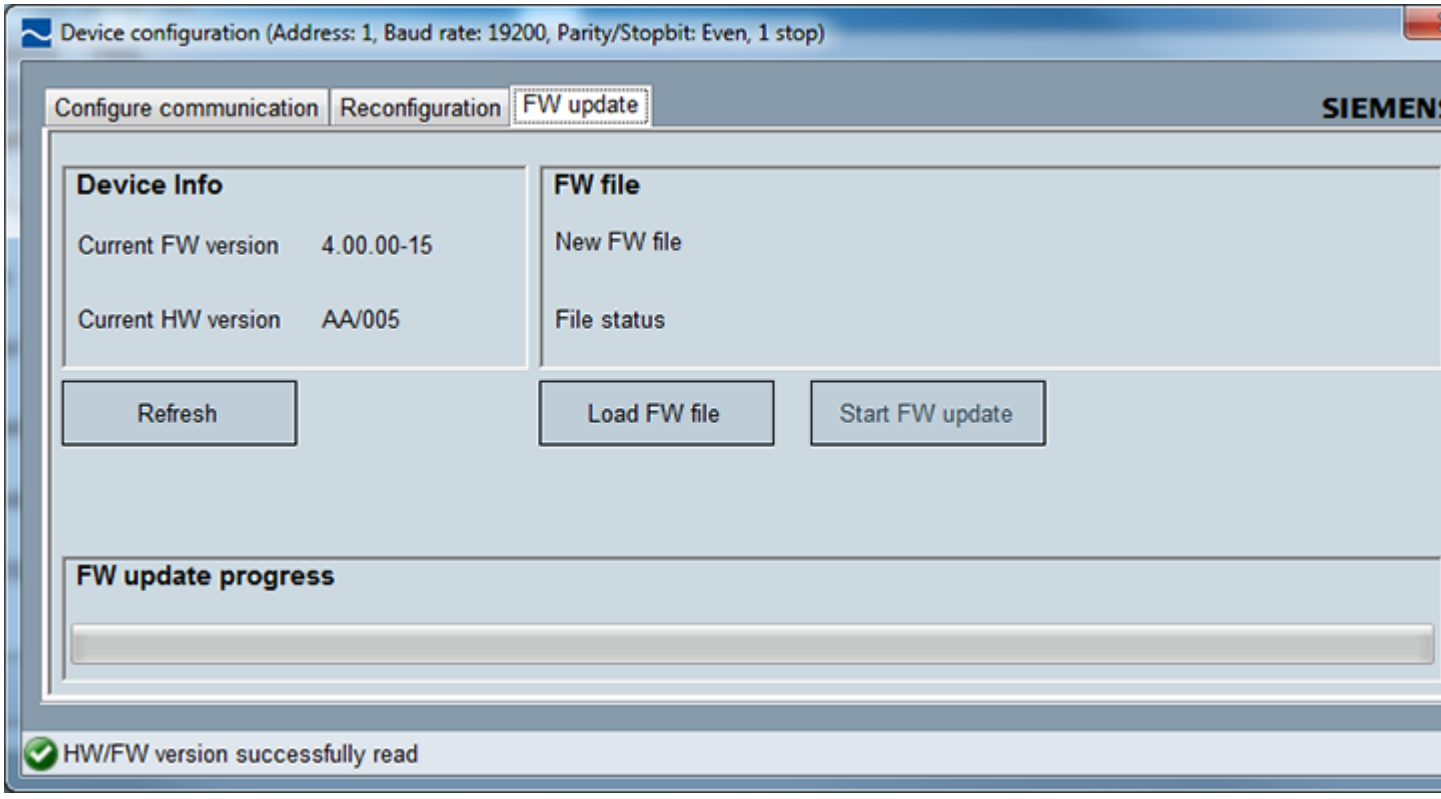
FW update is to be done only by authorized and trained service personnel.

1. Contact Technical Support (https://support.industry.siemens.com/cs/my/src?lc=en-WW) to receive the latest available firmware bundle.
2. Install the SITRANS FC410 service tool (https://support.industry.siemens.com/cs/ww/en/view/95197152). Use this tool to download the firmware to the transmitter.
3. Click "Scan network" to connect to your device via the Service tool:




4. Select your device in the "Network scan results" list.

5. Click on "Configure selected device".




6. Go to the tab "FW update".
7. Click "Load FW file".
8. Select firmware bundle.
9. Click "Start FW update".

## 10.3.2 Troubleshooting sensor-related problems

Incorrect and unstable measurements, especially at low flows, are typically a result of an unstable zero point due to:

- Incorrect installation
- Bubbles in the liquid
- Vibrations or cross talk
- Solid particles settling in the liquid

Follow the 4-step guide to troubleshooting:

Step 1 Preliminary application inspection (Page 98)
Step 2 Zero point adjustment (Page 98)

Step 3 Measurement error calculation (Page 98)
Step 4 Application improvement (Page 99)

The guide enables you to trace the reason for incorrect measurements and to improve the application.

### 10.3.2.1 Step 1: Inspecting the application

Ensure that:

1. The sensor is installed as described in Installing/mounting (Page 32).
2. The sensor is located in a vibration-free position. Vibrations can disturb the sensor and therefore cause measurement error.

Depending on application, you should furthermore ensure the following:

- Liquid application
  Ensure that the sensor is filled with liquid and liquid only.
  Air or gas bubbles in the liquid cause instability and can result in measurement errors.
  Flush the pipe systems and the sensor for several minutes at maximum flowrate to remove any air bubbles which may be present.

  **Note**

  The liquid must be homogeneous in order to measure with high accuracy. If the liquid contains solid particles of greater density than the liquid, then these solids can settle, especially at low flow rates, which will cause instability in the sensor and lead to measurement errors.

  For pastes or process fluids with suspended solids always orient the sensor vertically with flow in upward direction to maintain solids suspension.

- Gas application
  Ensure that the gas pressure/temperature conditions contain sufficient superheat to prevent dewing or precipitation. If the gas contains vapor or droplets then these may precipitate, causing instability.

### 10.3.2.2 Step 2: Performing a zero point adjustment

The second step in the troubleshooting procedure is to zero point adjust the device. For further information on zero point adjustment, see Remote commissioning with PDM FC410 (Page 50).

### 10.3.2.3 Step 3: Calculating the measurement error

The result of the zero point adjustment will show you if the zero point was set under good and stable conditions.

The lower the obtained value of the parameter **Zero Point Standard Deviation**, the lower is the achievable measuring error. For a well-installed flowmeter, the Zero Point Standard Deviation corresponds to the specified zero point stability for the sensor size, see Performance (Page 103).

The parameter **Zero Point Standard Deviation** is located in the **Maintenance & Diagnostics** menu in the SIMATIC PDM.

- The error curve is plotted from the formula:

$$E = \pm\sqrt{(Cal)^2 + \left(\frac{z \times 100}{qm}\right)^2}$$

E = Error [%]
Z = Zero point [kg/h]
qm = Mass flow [kg/h]
Cal. = Calibrated flow accuracy: 0.10

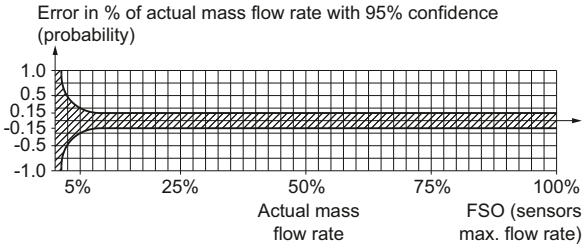



Table 10-1 **Reference conditions for flow calibrations (ISO 9104 and DIN/EN 29104)**

| | |
|---|---|
| Flow conditions | Fully developed flow profile |
| Temperature, medium | 20 °C ± 2 °C (68 °F ± 3.6 °F) |
| Temperature, ambient | 20 °C ± 2 °C (68 °F ± 3.6 °F) |
| Liquid pressure | 2 ± 1 bar |
| Density | 0.997 g/cm3 |
| Supply voltage | Un ± 1 % |
| Warming-up time | 30 min. |
| Cable length | 5 m between transmitter and sensor |

### 10.3.2.4 Step 4: Improving the application

In the following it is described how to find the causes of a high Zero Point Standard Deviation and how to improve the installation.

**Setting Low flow cut-off**

In order to see if the zero point becomes more stable when making changes / adjustments, the Low mass flow cut-off (MassFlowCutOff) must be set to 0.0%.

When Low flow cut-off has been set, it is possible to see the instability directly from the massflow in the online window (**View → Process Variables**)

This information can be used to troubleshoot. For example, tightening the brackets which hold the sensor, or turning off the pump to check if vibrations from the pump are disturbing the sensor, etc.

**Incorrect installation of the sensor**

- Has the sensor been correctly installed, that is fastened to the floor / wall or frame with good mounting brackets as shown in the instructions?

Especially for low flowrates, that is flowrates less than 10% of the maximum capacity of the flow meter, it is important that the sensor is correctly and stably installed.

If the sensor is not correctly fixed in place, the zero point of the sensor will change, leading to measuring errors.

Try to tighten up the sensor brackets to see whether the flow instability is reduced.

**Vibrations and cross talk**

Vibrations in the pipe system are normally generated by pumps.

Typically, cross talk is generated by two sensors of identical size and positioned in close proximity in the same pipe, or installed on the same rail or frame.

Vibrations / cross talk have a greater or lesser effect upon the zero point stability and therefore also the measurement accuracy.

1. Check whether there are vibrations.
   Turn off the pump and check whether the zero point stability improves, that is if the flowrate fluctuation in kg/h is reduced.
   If the sensor is disturbed by vibration from the pump or by pressure pulsations, the installation should be improved or the pump should be exchanged, for example to another type.
2. Check for cross talk.
   Turn off the power to the other flow meter(s) and wait approximately 2 minutes, so the vibrating tubes in the sensor have stopped vibrating. Then check if the zero point stability has improved, that is that the fluctuation in kg/h has been reduced. If this is the case, the sensors disturb one another and the installation should be improved.

**Air in the liquid**

When air is present in the liquid, the zero point becomes unstable, which leads to a poor measurement accuracy.

Checking for air:

- Check the Driver Current (View → Device Diagnostics → Advanced Diagnostic)
- Check if the Driver Current varies more than ±1 mA. If this is the case, it is usually due to the presence of air or gas bubbles in the liquid.
- Increase the pressure in the sensor, creating a large back pressure upon the sensor by reducing the opening of the outlet valve or by increasing the pump pressure. Thereby the size of air bubbles inside the sensor will be minimized. If the Driver Current value increases and / or the stability of the Driver Current decreases, it is proof that the liquid contains air or gas bubbles.

**Typical causes of air in the liquid**

- The entry pipe and sensor have not been properly filled with liquid.
- The pump cavitates, the rotary speed of the pump is too high in relation to the supply of liquid to the pump.
- The flow rate in the pipe is too high, so components sitting in front of the flowmeter can cause cavitation.
- If there is a filter installed before the flowmeter, it may be close to blocking, which also can cause cavitation.
- Liquid flashes to vapor bubbles while passing through partially open valves or orifices.
- The piping on the pump suction side, pump gaskets or the pump itself is not tight. Air gets sucked into the system due to a low pressure on the pump suction side.

**Solid particles in the liquid**

If the solid particles in a liquid have a density higher than that of the liquid, they can precipitate inside the sensor and cause instability which leads to a measurement error.

If solid particles are present in the liquid, they must be homogeneously distributed and have similar density as the liquid. Otherwise they can cause relatively large measurement errors.

It is important that the sensor is installed such that solid particles can easily run out of the sensor.

1. Ensure that the sensor is installed vertically with an upwards flow.
2. Check if solid particles are present in the liquid:
   Take a sample of the liquid, fill a glass and see if the solids precipitate.

## 10.4 Diagnosing with PDM

SIMATIC PDM is a suitable tool for diagnosing the device.

You can use SIMATIC PDM to read all available parameters to a table for analyzing offline, view online/actual process values and online/actual diagnostic information.

### Requirements

The following procedure must be completed before diagnosing:

- Installation of PDM and PDM device driver
- Connection of communications or digital communications interface

Refer to SIMATIC PDM (Page 69).

# Technical data

# 11

**Note**

**Device specifications**

Siemens makes every attempt to ensure the accuracy of these specifications but reserves the right to change them at any time.

## 11.1 Power

Table 11-1 Power supply

| Description | Specification |
|---|---|
| Supply voltage [V] | 12 - 27 VDC<br>Um: 60 VDC |
| for Ex d, t | 12 - 24 VDC |
| Reverse polarity protection | Yes |
| Power consumption | 1.1 W |

Specification in case of Intrinsic safety power supply: Ui: 20 V, Ii: 484 mA, Pi: 2.3 W, Li: 0.6 uH, Ci: 1.9 nF.

## 11.2 Performance

Table 11-2 Reference conditions

| Description | Specification |
|---|---|
| Process media | Water |
| Process media temperature | 20 °C (68 °F) |
| Ambient temperature | 25 °C (77 °F) |
| Process media pressure | 2 bar (29 psi) |
| Process media density | 0.997 g/cm³ (62.2 lb/ft³) |
| Reference device orientation | Horizontal installation, tubes down, flow in direction of arrow on casing, see Installing/Mounting (Page 29). |

Table 11-3 Mass flow accuracy

| Specification | Unit | Sensor size | | |
|---|---|---|---|---|
| | | **DN15** | **DN25** | **DN50** |
| Qmin - minimum flowrate | kg/h<br>(lb/min) | 20<br>(0.735) | 200<br>(7.35) | 750<br>(27.6) |
| Qnom - nominal flowrate | kg/h<br>(lb/min) | 3700<br>(136) | 11500<br>(423) | 52000<br>(1910) |
| Qmax - maximum flowrate | kg/h<br>(lb/min) | 6400<br>(235) | 17700<br>(650) | 70700<br>(2598) |
| Max. zero point stability | kg/h | ±0.2 | ±2.0 | ±7.5 |
| Measuring accuracy | % | ±0.1 | ±0.1 | ±0.1 |
| Repeatability error | % | ±0.05 | ±0.05 | ±0.05 |

Table 11-4 Density accuracy (liquids)

| Specification | Unit | Sensor size | | |
|---|---|---|---|---|
| | | **DN15** | **DN25** | **DN50** |
| Density accuracy, standard calibration | kg/m³ | ±5 | ±5 | ±5 |
| Density accuracy, extended calibration | kg/m³ | ±0.5 | ±0.5 | ±0.5 |
| Density repeatability | kg/m³ | ±0.25 | ±0.25 | ±0.25 |
| Density, media pressure effect | (kg/m³)/bar | ±0.5 | ±0.25 | ±0.25 |
| Density, media temperature effect | (kg/m³)/°C | ±0.1 | ±0.1 | ±0.1 |

Table 11-5 Media temperature accuracy

| Specification | Unit | Sensor size | | |
|---|---|---|---|---|
| | | **DN15** | **DN25** | **DN50** |
| Media temperature accuracy | °C | ±1 | ±1 | ±1 |
| Media temperature repeatability | °C | ±0.25 | ±0.25 | ±0.25 |

Table 11-6 Additional error by deviations from reference conditions

| Specification | Unit | Sensor size | | |
|---|---|---|---|---|
| | | **DN15** | **DN25** | **DN50** |
| Effect of process pressure | % of actual flowrate per bar | <-0.015 | <-0.015 | <-0.015 |
| Effect of process pressure at nominal flowrate | (kg/h) per bar | -0.56 | -1.73 | -7.8 |
| Effect of ambient temperature:<br>Display/Frequency/Pulse/Communication output | %/K actual flow-rate | < ±0.003 | < ±0.003 | < ±0.003 |
| Effect of power supply fluctuations | | | None | |
| Effect of media temperature | (kg/h)/°C | ±0.0875 | ±0.175 | ±1.05 |

## 11.3 Construction

Table 11-7 Designated use

| Description | Specification |
|---|---|
| Measurement of process media | • Fluid Group 1 (suitable for dangerous fluids)<br>• Aggregate state: Paste/light slurry, liquid and gas |

Table 11-8 Function and system design

| Description | Specification |
|---|---|
| Measuring principle | Coriolis |
| System architecture | • Point-to-point (1 Modbus RTU master - 1 transmitter slave)<br>• Multidrop (1 Modbus RTU master - up to 32 transmitter slaves per segment. Max 247 slaves) |

The FCS400 7ME4617-... is preconfigured for integration with the SITRANS FCT070.

Table 11-9 Installation torques

| Description | Torque (Nm) |
|---|---|
| Pressure guard fittings<br>G 1/4 inch | 80 |
| Pedestal lock screw cap | 10 |
| Cable gland to housing (Siemens supplied, metric) | 10 |

**Note**

**NPT glands**

When using NPT glands, user must take care when packing threads and installing cables that sufficient tightness is obtained to prevent ingress of moisture.

## 11.4 Sensor design

| Description | | Specification |
|---|---|---|
| Dimension and weight | | See "Sensor dimensions" (Page 119) |
| Process connectors | | • EN1092-1 B1, PN16, PN40, PN63, PN100, PN160*<br>• EN1092-1 D (gasket groove), PN40, PN63, PN100, PN160*<br>• ISO 228-1 G male pipe thread<br>• ASME B1.20.1 NPT male pipe thread<br>• ASME B16.5, Cl 150, Cl 300, Cl 600, Cl 900<br>• DIN 11851**<br>• DIN 32676<br>• DIN 11864-1A**, DIN 11864-2C (inch)**, DIN 11864-3A**<br>• ISO 2852**<br>• ISO 2853**<br>• JIS B 2220, 10K, 20K, 40K, 62K |
| Electrical connection | | • M12 connector with 4-wire cable<br>• Standard cable with polymer / brass / stainless steel cable glands (metric or NPT)<br>• Conduit entries (metric or NPT) |
| Material | | |
| | Measuring tubes | • AISI 316L / EN1.4404 |
| | Process connectors | • Standard:<br>– AISI 316L / EN1.4435 or EN1.4404<br>• Hygienic:<br>– AISI 316L / EN1.4435 |
| | Sensor enclosure | AISI 304 / W1.4301 |
| | DSL enclosure | Aluminum with corrosion-resistant coating |
| Measuring tube design | | Split flow through 2 parallel tubes with combined cross-section area 50% of the nominal pipe<br>The measuring tubes are bent in a trapezoidal curve |
| Measuring tube surface roughness | | • Standard: 1.6 µm<br>• Hygienic: 0.8 µm |
| Self-draining design | | Yes, when mounted vertically |

*: Pressure ratings max. 100 bar
**: Pressure ratings depend on process connection dimension

## 11.5 Basic electrical requirement for master system

Table 11-10 Power unit

| Description | Specification |
|---|---|
| Protection class | Class I (EN60950) |
| Galvanic isolation primary/secondary | SELV acc. to EN 60950 and EN 50178 or equivalent |
| Master/Receiver | Isolation 500 VAC |

## 11.6 Cables and cable entries

The following information applies to cables and cable glands supplied as accessories to the device.

Table 11-11 Power and signal cable, basic data

| Description | Specification |
|---|---|
| Number of conductors | 4 |
| Square area [$mm^2$] | 0.326 (AWG 22/7) |
| Screen | Common shield for all 4 conductors |
| Outside color | Gray (RAL 7001) |
| External diameter [mm] | 6.5 |
| Maximum length | 600 m (1968 ft.) |
| Installation environment | Industrial including chemical processing plants |
| Insulation material | Special polyolefin |
| Halogen-free | Yes |
| RoHS compliant | Yes |
| Torsional strength | • >3 million cycles at ± 180° on 200 mm<br>• Not adapted for garland mounting (festoon) |
| Permissible temperature range [°C (°F)] | -40 to +80 (-40 to +176) |
| Min. bending radius allowed | Single 5 X ø |

Table 11-12 Cable glands and entries

| Description | Specification |
|---|---|
| Glands | • Material<br>– Nylon[1)]<br>– Brass/Ni plated<br>– Stainless steel AISI 316/1.4404<br>• Cable cross section<br>– ∅ 5 to 10 mm (0.20" to 0.39") |
| Entry | • 1 x M20 or 1 X NPT ½" for communication |

[1)]: If operating temperature is below -20 °C (-4 °F), use Brass/Ni plated or stainless steel cable glands.

**Note**

For hygienic applications (3A & EHEDG) the cable glands and blind plugs must be made from corrosion resistant material like nickel brass, stainless steel or plastic. The exposed threads must be minimized when they are tightened up on the cable and they must have a seal (plastic or rubber) under the threads where they screw into the terminal housing or enclosure.

## 11.7 Operating conditions

Table 11-13 Basic conditions

| Description | | Specification |
|---|---|---|
| Ambient temperature (°C[°F])<br>(Humidity max. 90 %) | Operation | -40 to +60 [-40 to +140] |
| Ambient temperature (°C[°F])<br>(Humidity max. 90 %) | Storage | -40 to +70 [-40 to +158] |
| Climate class | | DIN 60721-3-4 |
| Altitude | | Up to 2000 m (6560 ft) |
| Relative humidity [%] | | 95 |
| EMC performance | | EN/IEC 61326-1 (Industry) |

Table 11-14 Cleaning and sterilizing conditions

| Description | Specification |
|---|---|
| Cleaning method | • CIP<br>• SIP |

Table 11-15 Process media conditions

| Description | Specification |
|---|---|
| Process media temperature ($T_s$) (min to max) [°C (F)] | |
| • DN15 - DN50 | -50 up to +200 [-58 to 392] |
| Process media density (min to max) [kg/m³ (lb/ft³] | 1 to 5000 (0.06 to 312) |
| Process media gauge max pressure [bar (psi)] | 100 (1450) st. steel |
| Pressure drop | See Pressure drop curves (Page 118) |
| Pressure temperature ratings | See Pressure - temperature ratings (Page 115) |

## 11.8 Process variables FC410

| Description | Specification |
|---|---|
| Primary process variables | • Mass flow<br>• Density<br>• Medium temperature |
| Derived process variable | • Volume flow |

## 11.9 Approvals note

**Note**

**Device-specific approvals**

Always refer to nameplates on the device for device-specific approvals.

## 11.10 Certificates and approvals

| **SITRANS FC410/FCS400 flowmeter** | |
|---|---|
| "Intrinsic safety" type of protection | |
| ATEX | II 1/2 G Ex db ia IIC T* Ga/Gb |
| Sira 11ATEX 1341 X | II 1/2 G Ex db IIC T* Ga/Gb<br>1D Ex ia IIIC T*°C Da/Db<br>2D Ex tb IIIC T*°C Db<br>Ta = -40°C to +*°C<br>* Temperature class (dependent on the maximum process temperature and the maximum ambient temperature, see Special conditions for safe use (Page 14)) |

| **SITRANS FC410/FCS400 flowmeter** | |
|---|---|
| cCSAus (Kanada, USA)<br>2508644 | Ex db ia IIC T6-T3 Gb<br>Ex tb IIIC T135°C Db<br>Ex ia IIIC T135°C Da<br><br>Class I, II, III, Division 1, Groups A, B, C, D, E, F, G<br>Class I, Zone 1, AEx db ia IIC T6-T3 Gb<br>Zone 21, AEx tb IIIC T135°C Db<br>Zone 20, AEx ia IIIC T135°C Da |
| Hygienic version | • 3A<br>• EHEDG<br>• 1935/2004/EC and 2023/2006/EC (food contact material: stainless steel) |

**See also**

Certificates (http://www.siemens.com/processinstrumentation/certificates)

## 11.11 SensorFlash

Table 11-16 SensorFlash

| **Description** | **Specification** |
|---|---|
| | **Micro SD card** |
| Capacity | 4 GB |
| File system support | FAT32 / 8.3 |
| Temperature range<br>Operation:<br>Storage: | <br>-40 to +85 °C (-40 to 185 °F)<br>-40 to +100 °C (-40 to 212 °F) |

## 11.12 Modbus Communication Specification

Table 11-17 Modbus communication specification

| **Description** | **Specification** |
|---|---|
| Device type | Slave |
| Baud rates | • 9600<br>• 19 200 (Factory setting FC410)<br>• 38 400<br>• 57 600<br>• 76 800<br>• 115 200 (Factory setting FCS400/FCT070) |

| Description | Specification |
|---|---|
| Number of stations | Max. 31 per segment without repeaters |
| Device address range | 1 to 247 |
| Protocol | Modbus RTU |
| Electrical interface | RS-485, 2-wire |
| Connector type | M12 or cable termination |
| Supported function codes | • 3: read holding registers<br>• 16: write multiple registers<br>• 8: diagnostics |
| Broadcast | No [1)] |
| Maximum cable length [m] | 600 meters (@ 115 200 bits/sec) |
| Standard | Modbus over serial line v 1.0 [2)] |
| Certification | one |
| Device Profile | None |

[1)]: Standard restriction. The standard requires a LED indicator for visual diagnosis. This device does not support a LED indicator. This device does not react to any Broadcast commands.

[2)]: According to the Specification & Implementation guide v. 1.0 available at the Modbus Organization website

**Note**

**Storage location**

All Modbus settings of the device are stored in a non-volatile memory.

## 11.13 PED

The pressure equipment directive 2014/68/EU applies to the alignment of the statutory orders of the European member states for pressure equipment. Such equipment in the sense of the directive includes vessels, pipelines and accessories with a maximum allowable pressure of more than 0.5 bar above atmospheric. Flowmeters are considered as piping.

A detailed risk analysis of the flowmeter has been performed in accordance with the PED 2014/68/EU. All risks are assessed to be "none" provided that the procedures and standards referenced in these operating instructions are observed.

### Division according to the danger potential

Flowmeters which are categorized as piping are divided into categories according to danger potential (medium, pressure, nominal diameter). The flowmeters fall into the categories I to III or they are manufactured according to Paragraph 3 - Sound Engineering Practice (SEP).

The following criteria are decisive for assessment of the danger potential and are also shown in Diagrams 1 to 4, see Diagrams (Page 111).

| Fluid group | Group 1 or 2 |
|---|---|
| • Aggregate state | Liquid or gaseous |
| • Type of pressurized equipment<br>– Pipeline | Product of pressure and volume (PS * V [barL]) |

The maximum allowable temperature for the used liquids or gases is the maximum process temperature which can occur, as defined by the user. This must be within the limits defined for the equipment.

## Division of media (liquid/gaseous) into the fluid groups

Fluids are divided according to Article 13 into the following fluid groups:

**Group 1 fluids**

| | |
|---|---|
| **Explosive**<br>R phrases: for example: 2, 3 (1, 4, 5, 6, 9, 16, 18, 19, 44)<br>  | **Very toxic**<br>R phrases: for example: 26, 27, 28, 39 (32)<br>  |
| **Extremely flammable**<br>R phrases: for example: 12 (17)<br>  | **Toxic**<br>R phrases: for example: 23, 24, 25 (29, 31)<br>  |

| | |
|---|---|
| **Highly flammable**<br>R phrases: for example: 11, 15, 17 (10, 30)<br>  | **Oxidizing**<br>R phrases: for example: 7, 8, 9 (14, 15, 19)<br>  |
| **Flammable**<br>R phrases: for example11 (10)<br>  | |

**Group 2 fluids**

All fluids not belonging to Group 1.

Also applies to fluids which are for example dangerous to the environment, corrosive, dangerous to health, irritant or carcinogenic (if not highly toxic).

## Conformity assessment

Flowmeters of categories I to III comply with the safety requirements of the directive. They are affixed with the CE mark and an EC declaration of conformity is provided.

The flowmeters are subjected to the conformity assessment procedure - Module H.

Flowmeters according to Article 4 Paragraph 3 are designed and manufactured in accordance with sound engineering practice. PED conformity reference is not affixed to the CE mark.

## Diagrams

### Gases of fluid group 1

- Pipelines according to Article 4 (a) (i) First dash
- Exception: unstable gases belonging to Categories I and II must be included in Category III.

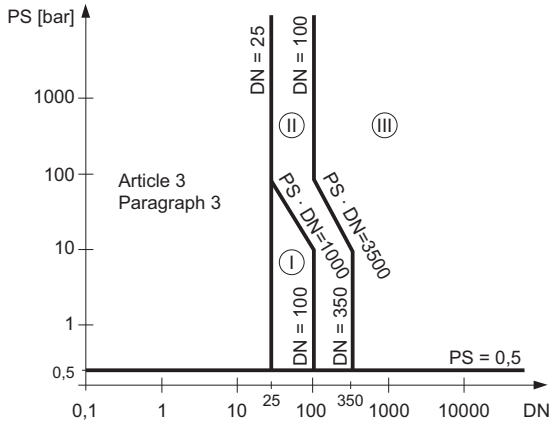



Figure 11-1 Diagram 1

### Gases of fluid group 2

- Pipelines according to Article 4 (a) (i) Second dash
- Exception: liquids at temperatures > 350 °C belonging to Category II must be included in Category III.

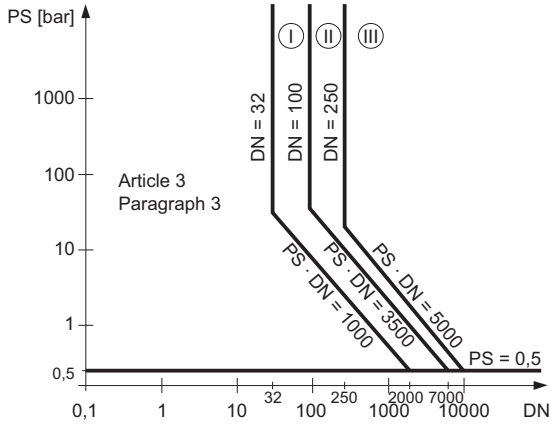



Figure 11-2 Diagram 2

**Liquids of fluid group 1**

- Pipelines according to Article 4 (a) (ii) First dash

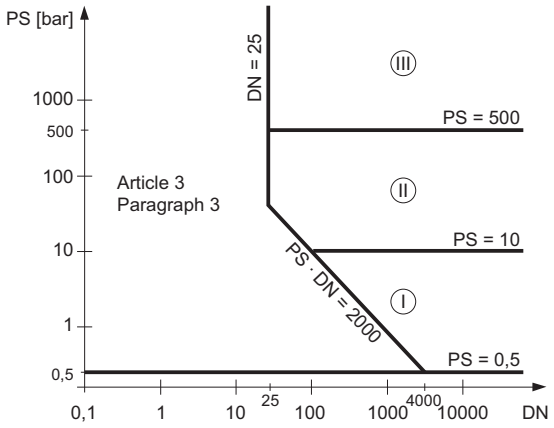



Figure 11-3 Diagram 3

**Liquids of fluid group 2**

- Pipelines according to Article 4 (a) (ii) Second dash

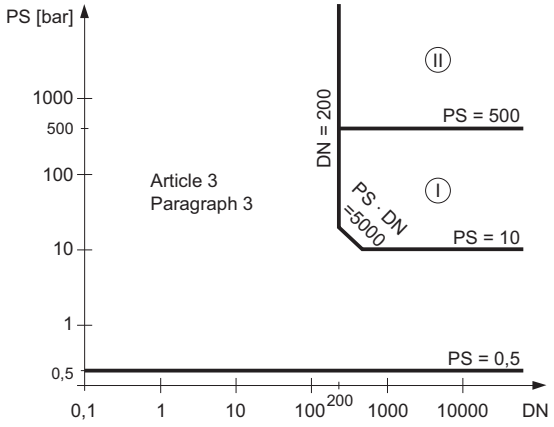



Figure 11-4 Diagram 4

## 11.14 Pressure - temperature ratings

Pressure - temperature ratings are determined by process connection material and applicable standards. The tables below detail the allowed maximum process pressure for sensor variants with stainless steel measuring tubes.

With two major exceptions, the pressure rating of the flow sensors is independent of the process medium temperature. Design rules for flange connections in both the EN1092-1 and ASME B16.5 standards dictate pressure derating with increasing temperature. The charts below show the effect of process medium temperature on the pressure ratings for the flanges within the product program.

**Note**

**Maximum sensor operating pressure**

The maximum sensor operating pressure is limited to 100 bar.

## 11.14.1 Stainless steel sensors

Table 11-18 EN1092-1 [bar]

| PN (bar) | Temperature TS (°C) | | | | | |
|---|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **100** | **150** | **180** |
| 16 | 16.0 | 16.0 | 16.0 | 15.2 | 13.7 | 13.1 |
| 40 | 40.0 | 40.0 | 40.0 | 37.9 | 34.5 | 32.9 |
| 63 | 63.0 | 63.0 | 63.0 | 59.7 | 54.3 | 51.8 |
| 100 | 100.0 | 100.0 | 100.0 | 94.8 | 86.1 | 82.1 |
| 160 | 100 *(see Note "Maximum sensor operating pressure)* | | | | | |

Table 11-19 ISO228-G and ASME B1.20.1 NPT [bar]

| PN (bar) | Temperature TS (°C) | | | | | |
|---|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **100** | **150** | **200** |
| 110 | 100 *(see Note "Maximum sensor operating pressure)* | | | | | |

Table 11-20 ASME B16.5 [bar]

| Class / Group | Temperature TS (°C) | | | | | |
|---|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **100** | **150** | **200** |
| 150 / 2.2 | 19 | 19 | 18.4 | 16.2 | 14.8 | 13.7 |
| 300 / 2.2 | 49.6 | 49.6 | 48.1 | 42.2 | 38.5 | 35.7 |
| 600 / 2.2 | 99.3 | 99.3 | 96.2 | 84.4 | 77.0 | 71.3 |
| 900 / 2.2 | 100 *(see Note "Maximum sensor operating pressure)* | | | | | |

Table 11-21 JIS [bar]

| PN (bar) | Temperature TS (°C) | | | | | |
|---|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **120** | **150** | **200** |
| 10K | 14 | 14 | 14 | 14 | 13.4 | 12.4 |
| 20K | 34 | 34 | 34 | 34 | 33.1 | 31.6 |

| PN (bar) | Temperature TS (°C) | | | | | |
|---|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **120** | **150** | **200** |
| 40K | 68 | 68 | 68 | 68 | 66.2 | 63.2 |
| 63K | 100 | 100 | 100 | 100 | 100 | 99 |

Table 11-22 DIN 11851 [bar]

| PN (bar) / DN | Temperature TS (°C) | | | | |
|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **100** | **140** |
| 25 / 50-100 | 25 | 25 | 25 | 25 | 25 |
| 40 / 10-40 | 40 | 40 | 40 | 40 | 40 |

Table 11-23 DIN 32676 & ISO 2852 [bar]

| PN (bar) / DN | Temperature TS (°C) | | | | |
|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **100** | **140** |
| 10 / 85-219.1 | 10 | 10 | 10 | 10 | 10 |
| 16 / 48.3-76.2 | 16 | 16 | 16 | 16 | 16 |
| 25 / 6.35-42.4 | 25 | 25 | 25 | 25 | 25 |

Table 11-24 ISO 2853 [bar]

| PN (bar) / DN | Temperature TS (°C) | | | | |
|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **100** | **140** |
| 25 / 50-100 | 25 | 25 | 25 | 25 | 25 |
| 40 / 10-40 | 40 | 40 | 40 | 40 | 40 |

Table 11-25 DIN 11864-1 [bar]

| DN | Temperature TS (°C) | | | | |
|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **100** | **140** |
| 50-80 | 25 | 25 | 25 | 25 | 25 |
| 15-25 | 40 | 40 | 40 | 40 | 40 |

Table 11-26 DIN 11864-2 [bar]

| DN | Temperature TS (°C) | | | | |
|---|---|---|---|---|---|
| | **-50** | **0** | **50** | **100** | **140** |
| 50-80 | 16 | 16 | 16 | 16 | 16 |
| 15-25 | 25 | 25 | 25 | 25 | 25 |

Table 11-27 DIN 11864-3 [bar]

| DN | Temperature TS (°C) | | | | |
|---|---|---|---|---|---|
| | -50 | 0 | 50 | 100 | 140 |
| 80 | 16 | 16 | 16 | 16 | 16 |
| 50 | 25 | 25 | 25 | 25 | 25 |
| 15-25 | 40 | 40 | 40 | 40 | 40 |

Table 11-28 Swagelok SS-12-VCO-3 socket weld with SS-12-VCO-4 nut [bar]

| PN (bar) | Temperature TS (°C) | | | | | |
|---|---|---|---|---|---|---|
| | -50 | 0 | 50 | 100 | 150 | 200 |
| 100 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

**Note**

**Test pressure**

Maximum allowable test pressure (MATP) for the flowmeter and process connection is 1.5 times the nominal pressure up to 150 bar (2176 psi).

## 11.14.2 Pressure drop curves

The pressure drop is dimension-dependent and influenced by process media viscosity and density. Sensors with undersized process connections experience higher pressure drop due to reduction in inlet/outlet dimensions.

**Note**

**Pressure drop information**

Pressure drop information is available on request.

# Dimension drawings

# 12

## 12.1 Sensor dimensions

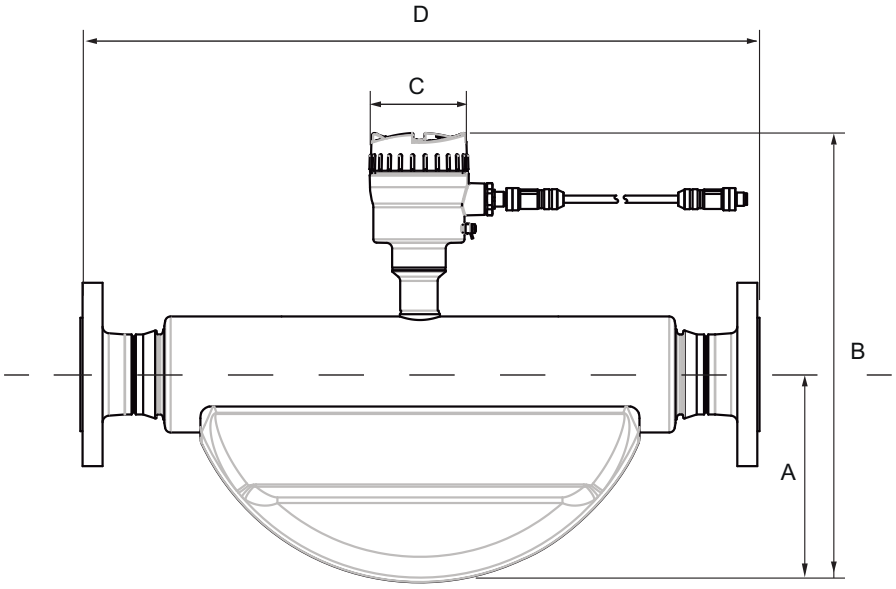



Table 12-1 Basic dimensions

| Sensor DN | A in mm (inch) | B in mm (inch) | C in mm (inch) | Weight in kg (lb) |
|---|---|---|---|---|
| 15 (½") | 90 (3.54) | 280 (11.0) | 90 (3.54) | 4.6 (10.1) |
| 25 (1") | 123 (4.84) | 315 (12.4) | 90 (3.54) | 7.9 (17.4) |
| 50 (2") | 187 (7.36) | 390 (15.4) | 90 (3.54) | 25.7 (56.7) |

**Note**

The build in length (D) depends on the process connector.

## 12.2 316L stainless steel - standard & hygienic

Table 12-2 Sensor sizes DN15, DN25 and DN50

| **Sensor** | **DN15 (½")** | | | | | **DN25 (1")** | | | **DN50 (2")** | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Connection** | **DN6 (⅛")** | **DN10 (⅜")** | **DN15 (½")** | **DN20 (¾")** | **DN25 (1")** | **DN25 (1")** | **DN32 (1¼")** | **DN40 (1½")** | **DN40 (1½")** | **DN50 (2")** |
| EN1092-1 B1, PN16 | | | 265 (10.4) | | 265 (10.4) | 360 (14.2) | | 365 (14.4) | 610 (24.0) | 610 (24.0) |
| EN1092-1 B1, PN40 | | | 265 (10.4) | | 265 (10.4) | 360 (14.2) | | 365 (14.4) | 610 (24.0) | 610 (24.0) |
| EN1092-1 B1, PN63 | | | 265 (10.4) | | | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |
| EN1092-1 B1, PN100 | | | 270 (10.6) | | 275 (10.8) | 360 (14.2) | | 365 (14.4) | 610 (24.0) | 610 (24.0) |
| EN1092-1 B1, PN160 | | | 270 (10.6) | | | 360 (14.2) | | | | 620 (24.4) |
| EN1092-1 D, PN40 | | | 265 (10.4) | | | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |
| EN1092-1 D, PN63 | | | 265 (10.4) | | | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |
| EN1092-1 D, PN100 | | | 270 (10.6) | | | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |
| EN1092-1 D, PN160 | | | 270 (10.6) | | | 360 (14.2) | | | | 620 (24.4) |
| ANSI B16.5, Class 150 | | | 270 (10.6) | 270 (10.6) | | 360 (14.2) | | 365 (14.4) | | 620 (24.4) |
| ANSI B16.5, Class 300 | | | 270 (10.6) | 270 (10.6) | | 360 (14.2) | | 380 (15.0) | | 620 (24.4) |
| ANSI B16.5, Class 600 | | | 270 (10.6) | 285 (11.2) | | 360 (14.2) | | 380 (15.0) | | 620 (24.4) |
| ANSI B16.5, Class 900 | | | 290 (11.4) | | | 385 (15.2) | | | | 620 (24.4) |
| ISO 228-1 G male pipe thread | 265 (10.4) | | 265 (10.4) | | | 365 (14.4) | | | | 620 (24.4) |
| ANSI B1.20.1 NPT male pipe thread | 265 (10.4) | | 270 (10.6) | | | 365 (14.4) | | | | 620 (24.4) |
| DIN 11851 Hygienic screwed [1)] | | 265 (10.4) | 265 (10.4) | | 270 (10.6) | 360 (14.2) | 360 (14.2) | | 610 (24.0) | 610 (24.0) |
| DIN 32676-C Hygienic clamp [1)] | | | 265 (10.4) | 265 (10.4) | | 360 (14.2) | | 360 (14.2) | | 610 (24.0) |
| DIN 11864-1 Aseptic screwed [1)] | | | 265 (10.4) | | | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |

| **Sensor** | **DN15 (½")** | | | | | **DN25 (1")** | | | **DN50 (2")** | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Connection** | **DN6 (⅛")** | **DN10 (⅜")** | **DN15 (½")** | **DN20 (¾")** | **DN25 (1")** | **DN25 (1")** | **DN32 (1¼")** | **DN40 (1½")** | **DN40 (1½")** | **DN50 (2")** |
| DIN 11864-2A Aseptic flanged [1] | | | 265 (10.4) | | | 360 (14.2) | | | 620 (24.4) | 610 (24.0) |
| DIN 11864-3A Aseptic clamp [1] | | | 265 (10.4) | | | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |
| ISO 2852 Hygienic clamp [1] | | | | | 265 (10.4) | 360 (14.2) | | 360 (14.2) | 610 (24.0) | 610 (24.0) |
| ISO 2853 Hygienic screwed [1] | | | | | 265 (10.4) | 360 (14.2) | | 360 (14.2) | 630 (24.8) | 610 (24.0) |
| SMS 1145 Hygienic screwed | | | | | 265 (10.4) | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |
| 12-VCO-4 Quick connect | | | 285 (11.2) | | | | | | | |
| JIS B2220 10K | | | 265 (10.4) | | | 360 (14.2) | | | 620 (24.4) | 610 (24.0) |
| JIS B2220 20K | | | 265 (10.4) | | | 360 (14.2) | | | 620 (24.4) | 610 (24.0) |
| JIS B2220 40K | | | 270 (10.6) | | | 360 (14.2) | | | 620 (24.4) | 610 (24.0) |
| JIS B2220 63K | | | 275 (10.8) | | | 370 (14.6) | | | | 620 (24.4) |

Dimensions in mm (inch)

[1] Available with 3A and EHEDG certification.

**Note**

**3A**

DIN 11851 and ISO 2853 are only 3A-approved if self-centering gaskets are used.

## 12.3 316L stainless steel - NAMUR

Table 12-3 Sensor sizes DN15, DN25 and DN50

| **Sensor** | **DN15 (½")** | | | | | **DN25 (1")** | | | **DN50 (2")** | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Connection** | **DN6 (⅛")** | **DN10 (⅜")** | **DN15 (½")** | **DN20 (¾")** | **DN25 (1")** | **DN25 (1")** | **DN32 (1¼")** | **DN40 (1½")** | **DN40 (1½")** | **DN50 (2")** |
| EN1092-1 B1, PN40 | | | 510 (20.1) | | 510 (20.1) | 600 (23.6) | | 605 (23.8) | 715 (28.1) | 715 (28.1) |

Dimensions in mm (inch)

## 12.4 316L stainless steel - Hygienic versions

Table 12-4 Sensor sizes DN15, DN25 and DN50

| **Sensor** | **DN15 (½")** | | | | **DN25 (1")** | | | **DN50 (2")** | |
|---|---|---|---|---|---|---|---|---|---|
| **Connection** | **DN10 (3.8")** | **DN15 (½")** | **DN20 (¾")** | **DN25 (1")** | **DN25 (1")** | **DN32 (1¼")** | **DN40 (1½")** | **DN40 (1½")** | **DN50 (2")** |
| DIN 11851 Hygienic screwed | 265 (10.4) | 265 (10.4) | | 270 (10.6) | 360 (14.2) | 360 (14.2) | | 610 (24.0) | 610 (24.0) |
| DIN 32676-C Hygienic clamp | | 265 (10.4) | 265 (10.4) | | 360 (14.2) | | 360 (14.2) | | 610 (24.0) |
| DIN 11864-1 Aseptic screwed | | 265 (10.4) | | | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |
| DIN 11864-2A Aseptic flanged | | 265 (10.4) | | | 360 (14.2) | | | 620 (24.4) | 610 (24.0) |
| DIN 11864-3A Aseptic clamp | | 265 (10.4) | | | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |
| ISO 2852 Hygienic clamp | | | | 265 (10.4) | 360 (14.2) | | 360 (14.2) | 610 (24.0) | 610 (24.0) |
| ISO 2853 Hygienic screwed | | | | 265 (10.4) | 360 (14.2) | | 360 (14.2) | 630 (24.8) | 610 (24.0) |
| SMS 1145 Hygienic screwed | | | | 265 (10.4) | 360 (14.2) | | | 610 (24.0) | 610 (24.0) |

Dimensions in mm (inch)

**Note**

**3A**

DIN 11851 and ISO 2853 are only 3A-approved if self-centering gaskets are used.

# Product documentation and support

# A

## A.1 Product documentation

Process instrumentation product documentation is available in the following formats:

- Certificates (http://www.siemens.com/processinstrumentation/certificates)
- Downloads (firmware, EDDs, software) (http://www.siemens.com/processinstrumentation/downloads)
- Catalog and catalog sheets (http://www.siemens.com/processinstrumentation/catalogs)
- Manuals (http://www.siemens.com/processinstrumentation/documentation)
  You have the option to show, open, save, or configure the manual.
  - "Display": Open the manual in HTML5 format
  - "Configure": Register and configure the documentation specific to your plant
  - "Download": Open or save the manual in PDF format
  - "Download as html5, only PC": Open or save the manual in the HTML5 view on your PC

You can also find manuals with the Mobile app at Industry Online Support (https://support.industry.siemens.com/cs/ww/en/sc/2067). Download the app to your mobile device and scan the device QR code.

### Product documentation by serial number

Using the PIA Life Cycle Portal, you can access the serial number-specific product information including technical specifications, spare parts, calibration data, or factory certificates.

#### Entering a serial number

1. Open the PIA Life Cycle Portal (https://www.pia-portal.automation.siemens.com).
2. Select the desired language.
3. Enter the serial number of your device. The product documentation relevant for your device is displayed and can be downloaded.

To display factory certificates, if available, log in to the PIA Life Cycle Portal using your login or register.

#### Scanning a QR code

1. Scan the QR code on your device with a mobile device.
2. Click "PIA Portal".

To display factory certificates, if available, log in to the PIA Life Cycle Portal using your login or register.

Certification documents including calibration report are supplied with each sensor included on the SensorFlash. Material, pressure test, and factory conformance certificates are optional at ordering.

**Note**

**EAC declaration**

The EAC declaration is available on the SensorFlash SD card delivered with the device.

## A.2 Technical support

### Technical support

If this documentation does not completely answer your technical questions, you can enter a Support Request (http://www.siemens.com/automation/support-request).

Additional information on our technical support can be found at Technical Support (http://www.siemens.com/automation/csi/service).

### Service & support on the Internet

In addition to our technical support, Siemens offers comprehensive online services at Service & Support (http://www.siemens.com/automation/serviceandsupport).

### Contact

If you have further questions about the device, contact your local Siemens representative at Personal Contact (http://www.automation.siemens.com/partner).

To find the contact for your product, go to "all products and branches" and select "Products & Services > Industrial automation > Process instrumentation".

Contact address for business unit:
Siemens AG
Digital Industries
Process Automation
Östliche Rheinbrückenstr. 50
76187 Karlsruhe, Germany

# Technical reference

# B

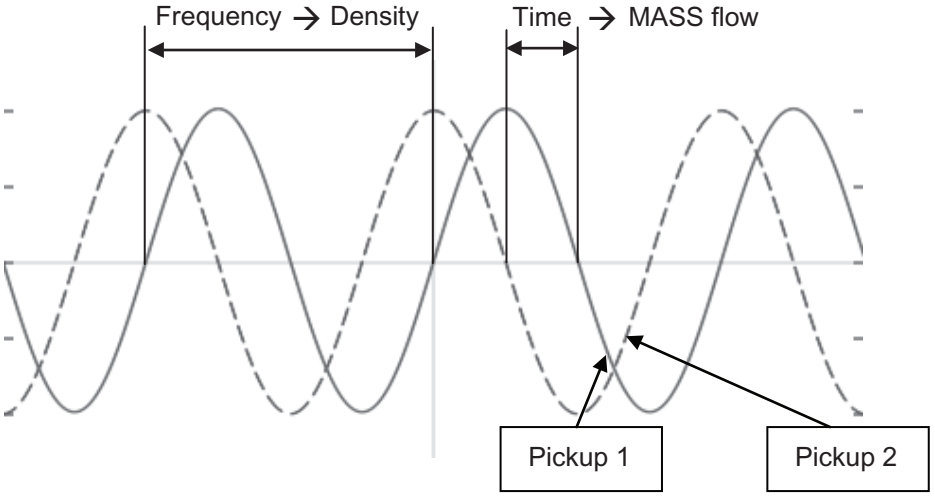
## B.1 Theory of operation

### The Coriolis principle of measurement

The flow measurement is based on the Coriolis law of motion. Particles moving in a rotating / oscillating system will resist imposed oscillations in a manner consistent with their mass and velocity (momentum).

The SITRANS F C sensors are energized by an electromagnetic driver circuit which oscillates the pipes at their resonant frequency. Two pickups are placed symmetrically on either side of the driver to provide position signals for digital processing.

When the media flows through the sensor, Coriolis force will act on the measuring tubes and cause deflection which can be measured as a phase shift between Pickup 1 and Pickup 2. The phase shift is proportional to the mass flowrate.




The frequency (or period) of the vibration is a direct function of the process media density.

The frequency and amplitude of the driver is regulated to ensure a stable output from the 2 pickups. The temperature of the sensor tubes is measured to provide accurate compensation for changes in the material stiffness. As a result the process media temperature is also accurately measured.

The flow proportional phase signal from the pickups, the temperature measurement and the driver frequency enable calculation and reporting of mass, density, volume, and temperature.

### Digital signal processing (DSP)

The analog to digital conversion takes place in an ultra low noise sigma delta converter with high signal resolution. With fast digital signal processing mass flow and density values are calculated using a patented DFT technology (Discrete Fourier Transformation). The combination of this patented DFT technology and the fast DSP enables short response time (< 10 ms) to changes in the measured values.

The built-in noise filter is configurable and can be used for improving the performance of the flowmeter, in case the installation and application conditions are not ideal. Typical process noise such as gas bubbles (two-phase-flow) can be reduced through the filter functions.

## B.2 Sensor dimension dependent default settings

### B.2.1 Mass flow

#### FCS400

| Sensor size | Default value kg/s |
|---|---|
| **Upper alarm limit and Upper warning limit** | |
| DN 15 | 2.209 |
| DN 25 | 6.136 |
| DN 50 | 24.54 |
| **Lower alarm limit and Lower warning limit** | |
| DN 15 | -2.209 |
| DN 25 | -6.136 |
| DN 50 | -24.54 |

| Sensor size | Default value kg/s | Default value kg/h |
|---|---|---|
| **Low flow cut-off** | | |
| DN 15 | 0.0103 | 37.08 |
| DN 25 | 0.0319 | 114.84 |
| DN 50 | 0.1444 | 519.84 |

## B.2.2 Volume flow

### FCS400

| Sensor size | Default value $m^3/s$ |
|---|---|
| **Upper alarm limit and Upper warning limit** | |
| DN 15 | 0.0225 |
| DN 25 | 0.0626 |
| DN 50 | 0.250 |
| **Lower alarm limit and Lower warning limit** | |
| DN 15 | -0.0225 |
| DN 25 | -0.0626 |
| DN 50 | -0.250 |

| Sensor size | Default value $m^3/s$ | Default value $m^3/h$ |
|---|---|---|
| **Low flow cut-off** | | |
| DN 15 | 0.000010278 | 0.037 |
| DN 25 | 0.000031944 | 0.115 |
| DN 50 | 0.000144444 | 0.52 |

## B.2.3 Standard volume flow

### FCS400

| Sensor size | Default value $m^3/s$ |
|---|---|
| **Upper alarm limit and Upper warning limit** | |
| DN 15 | 0.0225 |
| DN 25 | 0.0626 |
| DN 50 | 0.250 |
| **Lower alarm limit and Lower warning limit** | |
| DN 15 | -0.0225 |
| DN 25 | -0.0626 |
| DN 50 | -0.250 |

| Sensor size | Default value $m^3/s$ | Default value $m^3/h$ |
|---|---|---|
| **Low flow cut-off** | | |
| DN 15 | 0.000010278 | 0.037 |
| DN 25 | 0.000031944 | 0.115 |
| DN 50 | 0.000144444 | 0.52 |

## B.2.4 Fraction

### FCS400

| Sensor size | Unit | Default value |
|---|---|---|
| **Upper alarm limit and Upper warning limit** | | |
| DN 15 | Mass flow kg/s | 2.209 |
| | Volume flow $m^3/s$ | 0.0225 |
| DN 25 | Mass flow kg/s | 6.136 |
| | Volume flow $m^3/s$ | 0.0626 |
| DN 50 | Mass flow kg/s | 24.54 |
| | Volume flow $m^3/s$ | 0.250 |
| **Lower alarm limit and Lower warning limit** | | |
| DN 15 | Mass flow kg/s | -2.209 |
| | Volume flow $m^3/s$ | -0.0225 |
| DN 25 | Mass flow kg/s | -6.136 |
| | Volume flow $m^3/s$ | -0.0626 |
| DN 50 | Mass flow kg/s | -24.54 |
| | Volume flow $m^3/s$ | -0.250 |

## B.2.5 Zero point adjustment

### FCS400

| Sensor size | Default value kg/s | Default value kg/h |
|---|---|---|
| **Standard deviation limit** | | |
| DN 15 | 0.0004 | 1.44 |
| DN 25 | 0.004 | 14.4 |
| DN 50 | 0.015 | 54 |

| Sensor size | Default value kg/s | Default value kg/h |
|---|---|---|
| **Zero offset limit** | | |
| DN 15 | 0.0103 | 37.08 |
| DN 25 | 0.0319 | 114.84 |
| DN 50 | 0.1444 | 519.84 |

| Sensor size | Default value kg/s | Default value kg/h |
|---|---|---|
| **Low flow cut-off** | | |
| DN 15 | 0.0103 | 37.08 |

| Sensor size | Default value kg/s | Default value kg/h |
|---|---|---|
| DN 25 | 0.0319 | 114.84 |
| DN 50 | 0.1444 | 519.84 |

## B.3 Exception handling

There is a defined set of exception codes to be returned by slaves in the event of problems. All exceptions are signalled in the response from the slave by adding 80 hex to the function code of the request and following this byte by an exception code.

Table B-1 Exception codes

| Exception code (dec) | Exception text | Description |
|---|---|---|
| 01 | Illegal function | The function code received in the query is not an allowable action for the slave |
| 02 | Illegal data address | The data address received in the query is not an allowable address for the slave. |
| 03 | Illegal data value | A value contained in the query data field is not an allowable value for the addressed location. This may indicate a fault in the structure of the remainder of a complex request, such that the implied length is incorrect or the number of registers is too high. |
| 04 | Slave device failure | The request is for some other reason not acceptable. It may e.g. indicate that the data value to write is evaluated to be beyond limits. |

## B.4 Float definition

Stuffing of multi-byte numbers into multiple Modbus RTU registers differs among Modbus devices. "Big Endian" and "Little Endian" describe the order or sequence in which multi-byte data is stored in memory. This device uses (IEEE 741) a "Big-Endian" representation for addresses and data items as default. This means that when a numerical quantity larger than a single byte is transmitted, the MOST significant byte is sent first.

Float transmission order can be changed as described in Float transmission (Page 80).

Following example describes the Big-Endian representing of float IEEE741.

| Value (decimal) | IEEE FP B MSB LSB | Register N | | Register N + 1 | |
|---|---|---|---|---|---|
| | | high | low | high | low |
| 100.0 | 42C80000h | 42h | C8h | 00h | 00h |
| 55.32 | 425D47AEh | 42h | 5Dh | 47h | AEh |
| 2.0 | 40000000h | 40h | 00h | 00h | 00h |
| 1.0 | 3F800000h | 3Fh | 80h | 00h | 00h |
| -1.0 | BF800000h | bFh | 80h | 00h | 00h |

**Read absolute massflow (4.03001)**

| | |
|---|---|
| Query: | 01,03,0B,B8,00,02,46,0A |
| Response: | 01,03,04,40,C3,52,93,62,C8 |
| Absolute mass-flow = | 6.10383 kg/s |

# Modbus communication FC410

C

## C.1 Modbus addressing model

The device allows read/write access to the following standard Modbus RTU data holding register blocks:

- Holding registers (ref. 4x address range)

The minimum value of a writable **holding register** can be read by adding 10000 to the Modbus address of the register.

The maximum value of a writable **holding register** can be read by adding 20000 to the Modbus address of the register.

The default value of a writable **holding register** can be read by adding 30000 to the Modbus address of the register.

## C.2 Modbus function codes

This device supports following function codes: 3, 8 and 16.

Function codes 3 and 16 are used for accessing registers, max. 16 registers per read/write request is accepted.

Function code 8 is used for reading Modbus communication diagnostic information.

Below the various function code are described.

### Function code 3 (Read holding registers)

**General exceptions:**

- Requesting less than 1 or more than 16 registers => Exception 3 (Illegal data value)
- Requesting invalid start address or start address with invalid quantity => Exception 2 (Illegal data address)

**Application exceptions:**

- Application errors; min/max limit of parameter exceeded; or parameter write-protected => Exception 4 (Slave device error)

**Holes/register alignment:**

- The read command always returns data if no exception is given.
- Holes in the holding register map return value zero in all bytes. E.g. reading 2 registers starting at 4:0004 above will result in 2 bytes of "float B" followed by 2 zeroes.

## Function code 3 example

### Query

| | |
|---|---|
| Slave address | 1 byte |
| Function | 1 byte |
| Starting Address Hi | 1 byte |
| Starting Address Lo | 1 byte |
| Quantity of Registers Hi | 1 byte |
| Quantity of Registers Lo | 1 byte |
| CRC | 2 bytes |

### Response

| | |
|---|---|
| Slave address | 1 byte |
| Function | 1 byte |
| Byte count | 1 byte |
| Register Value Hi | 1 byte |
| Register Value Lo | 1 byte |
| : | : |
| Register Value Hi | 1 byte |
| Register Value Lo | 1 byte |
| CRC | 2 bytes |

**Example: Read absolute massflow (address 3000)**

**Query:** 1,3,11,184,0,2,70,10

Slave address = 1 (0x01)
Function = 3 (0x03)
Starting Address Hi, Lo = 11, 184 (0x0B,0xB8)
Quantity of Registers Hi , Lo = 0, 2 (0x00,0x02)
CRC = 70,10 (0x46, 0x0A)

Starting address 0x0BB8 = 3000
Quantity of registers = 0x0002 = 2

**Response:** 1,3,4,64,195,82,139,98,200

Slave address = 1 (0x01)
Function = 3 (0x03)
Byte Count = 4 (0x04)
Register 1 - Register Value Hi, Lo = 64, 195 (0x40, 0xC3)
Register 2 - Register Value Hi, Lo = 82, 139 (0x52, 0x93)
CRC = 98,200 (0x62, 0xC8)

Absolute mass flow = 0x40C35293 = 6.10383 kg/sec

## Function code 16 (Write multiple registers)

**General exceptions**

- Writing less than 1 or more than 16 registers => Exception 3 (Illegal data value)
- If ByteCount is not exactly 2 times NoOfRegisters => Exception 3 (Illegal data value)
- Requesting invalid start address or start address with invalid quantity => Exception 2 (Illegal data address)

**Application exceptions:**

- Application errors; min/max limit of parameter exceeded; or parameter write-protected => Exception 4 (Slave device error)
- Application errors include writing to ReadOnly holding registers

**Holes/register alignment:**

- If start-address is not the start of a mapped holding register => Exception 2 (Illegal data address)
- Writing to holes is allowed (ie ignored - and no exception occurs) - except for the condition described above
- If the end address is only part of a mapped holding register item (e.g. one half of a float value), the action depends on the data type. Writing parts of all data types => Exception 4 (Slave device error)

## Function code 16 example

**Query**

| | |
|---|---|
| Slave address | 1 byte |
| Function | 1 byte |
| Starting Address Hi | 1 byte |
| Starting Address Lo | 1 byte |
| Quantity of Registers Hi | 1 byte |
| Quantity of Registers Lo | 1 byte |
| Byte Count | 1 byte |
| Registers Value Hi | 1 byte |
| Registers Value Lo | 1 byte |
| : | : |
| Registers Value Hi | 1 byte |
| Registers Value Lo | 1 byte |
| CRC | 2 bytes |

**Response**

| | |
|---|---|
| Slave address | 1 byte |
| Function | 1 byte |
| Starting Address Hi | 1 byte |

| | |
|---|---|
| Starting Address Lo | 1 byte |
| Quantity of Registers Hi | 1 byte |
| Quantity of Registers Lo | 1 byte |
| CRC | 2 bytes |

**Example: Set baud rate to 115200 baud (address 529)**

**Query:** 1,16,2,17,0,1,2,0,5,70,210

Slave address = 1 (0x01)
Function = 16 (0x10)
Starting Address Hi, Lo = 2, 17 (0x02,0x11)
Quantity of Registers Hi, Lo = 0, 1 (0x00,0x01)
Byte Count = 2 (0x02)
Registers Value Hi, Lo = 0, 5 (0x00,0x05)
CRC = 70,10 (0x46, 0x0A)

Starting address 0x0211 = 529
Number of registers = 0x0001 = 1
Data 0x0005 = (115200 = value 5)

**Response:** 1,16,2,17,0,1,80,116

Slave address = 1 (0x01)
Function = 16 (0x10)
Starting Address Hi, Lo = 2, 17 (0x02,0x11)
Quantity of Registers Hi, Lo = 0, 1 (0x00,0x01)
CRC = 80,116 (0x50, 0x74)

## Function code 8 (Diagnostics)

Modbus function code 8 provides a series of tests for checking the communication system between a client (Master) device and a server (Slave).

The following diagnostics functions are supported:

| **Sub-function code (Dec)** | **Name** | **Description** |
|---|---|---|
| 00 | Return Query Data | The data passed in the request data field is to be returned (looped back) in the response. |
| 10 | Clear Counters and Diagnostic Register | Clears all counters and the diagnostic register. Counters are also cleared upon power–up. |
| 11 | Return Bus Message Count | The response data field returns the quantity of messages that the remote device has detected on the communications system since its last restart, clear counters execution, or power–up. |
| 12 | Return Bus Communication Error Count | The response data field returns the quantity of CRC errors encountered by the remote device since its last restart, clear counters execution, or power–up. |

| Sub-function code (Dec) | Name | Description |
|---|---|---|
| 13 | Return Bus Exception Error Count | The response data field returns the quantity of MODBUS exception responses returned by the remote device since its last restart, clear counters execution, or power–up. |
| 14 | Return Slave Message Count | The response data field returns the quantity of messages broadcast or addressed to the remote device that the remote device has processed since its last restart, clear counters execution, or power–up. |
| 15 | Return Slave No Response Count | The response data field returns the quantity of messages addressed to the remote device for which it has returned no response (neither a normal response nor an exception response), since its last restart, clear counters execution, or power–up. |
| 16 | Return Slave NAK Count | The response data field returns the quantity of messages addressed to the remote device for which it returned a Negative Acknowledge (NAK) exception response, since its last restart, clear counters execution, or power–up. |
| 17 | Return Slave Busy Count | The response data field returns the quantity of messages addressed to the remote device for which it returned a Slave Device Busy exception response, since its last restart, clear counters execution, or power–up. |
| 18 | Return Bus Character Overrun Count | The response data field returns the quantity of messages addressed to the remote device that it could not handle due to a character overrun condition, since its last restart, clear counters execution, or power–up. |
| 20 | Clear Overrun Counter and Flag | Clears the overrun error counter and resets the error flag. |

## Function code 8 example

### Query

| | |
|---|---|
| Slave address | 1 byte |
| Function | 1 byte |
| Sub-function Hi | 1 byte |
| Sub-function Lo | 1 byte |
| Data Hi | 1 byte |
| Data Lo | 1 byte |
| : | : |
| Data Hi | 1 byte |
| Data Lo | 1 byte |
| CRC | 2 bytes |

### Response

| | |
|---|---|
| Slave address | 1 byte |
| Function | 1 byte |

| | |
|---|---|
| Sub-function Hi | 1 byte |
| Sub-function Lo | 1 byte |
| Data Hi | 1 byte |
| Data Lo | 1 byte |
| : | : |
| Data Hi | 1 byte |
| Data Lo | 1 byte |
| CRC | 2 bytes |

**Example: Read Return Slave Message Count (address 529)**

**Query:** 1,8,0,14,0,0,129,200

Slave address = 1 (0x01)
Function = 8 (0x08)
Sub-function Hi, Lo = 0, 14 (0x00,0x0E)
Data Hi, Lo = 0, 0 (0x00,0x00)
CRC = 129,200 (0x81, 0xC8)

Sub-function 0x000E = 14 = Read Return Slave Message Count

**Response:** 1,8,0,14,0,97,64,32

Slave address = 1 (0x01)
Function = 8 (0x08)
Sub-function Hi, Lo = 0, 14 (0x00,0x0E)
Data Hi, Lo = 0, 97 (0x00,0x65)
CRC = 64,32 (0x41, 0xE3)

Read Return Slave Message Count = 0x0065 = 97 message received

## C.3 Changing Modbus communication settings

Changing communication parameters, for example **Baud Rate**, **Modbus Parity Framing** or **Bus Address** effects the Modbus communication as follows:

- The new settings have effect only after a reset, either by restarting the device or writing the value 1 to Modbus address 600 **Restart communication**.
- The new settings will not have effect until the Modbus driver has responded to any ongoing Modbus request.

| **NOTICE** |
|---|
| **Setting addresses in a multidrop network**<br>It is recommended NOT to use the default address in a multi-drop network. When setting device addresses, make sure that each device has a unique address. Replication of addresses may cause abnormal behavior of the entire serial bus and make the master unable to communicate with all slaves on the bus. |

## C.4 Modbus holding registers tables

In the following the Modbus RTU holding registers available for the device are described.

**Note**

All Write parameters require password access.

Table C-1 Process values

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 3000 | float / 4 | Mass flow | Measured mass flow | - [kg/s] | - | Read Only |
| 3002 | float / 4 | Volume flow | Measured volume flow | - [$m^3$/s] | - | Read Only |
| 3004 | float / 4 | Density | Measured density | - [kg/$m^3$] | - | Read Only |
| 3010 | float / 4 | Media temperature | Measured temperature of the process media | - [°C] | - | Read Only |
| 3023 | float / 4 | Frame Temperature | Measured temperature of the sensor frame(1) | - [°C] | - | Read Only |

(1) Only available if the sensor has frame temperature measurement

Table C-2 Units for Process values and totalizer

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 7400 | unsigned / 2 | Mass flow unit | Select unit for mass flow process value | 73: kilograms per second [Kg/s] | 70: grams per second<br>71: grams per min<br>72: grams per hour<br>73: kilograms per second<br>74: kilograms per minute<br>75: kilograms per hour<br>76: kilograms per day<br>77: metric tons per minute<br>78: metric tons per hour<br>79: metric tons per day<br>80: pounds per second<br>81: pounds per minute<br>82: pounds per hour<br>83: pounds per day<br>84: short tons per minute<br>85: short tons per hour<br>86: short tons per day<br>87: long ton per hour<br>88: long ton per day<br>253: customized unit | Read / Write |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 7500 | unsigned / 2 | Volume flow unit | Select unit for volume flow process value | 28: cubic meters per second<br>[$m^3/s$] | 15: cubic feet per minute<br>16: US gallons per minute<br>17: liters per minute<br>18: imperial gallons per minute<br>19: cubic meters per hour<br>22: US gallons per second<br>23: million US gallons per day<br>24: liters per second<br>25: million liters per day<br>26: cubic feet per second<br>27: cubic feet per day<br>28: cubic meters per second<br>29: cubic meters per day<br>30: imperial gallons per hour<br>31: imperial gallons per day<br>130: cubic feet per hour<br>131: cubic meters per minute<br>132: barrels (= 42 US gallons) per second<br>133: barrels (= 42 US gallons) per minute | Read / Write |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| | | | | | 134: barrels (= 42 US gallons) per hour<br>135: barrels (= 42 US gallons) per day<br>136: US gallons per hour<br>137: imperial gallons per second<br>138: liters per hour<br>170: beer barrel per second<br>171: beer barrel per minute<br>172: beer barrel per hour<br>173: beer barrel per day<br>235: US gallons per day<br>253: custom volume flow unit | |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 7600 | unsigned / 2 | Density unit | Select unit for density process value | 92: kilograms per cubic meter [kg/m³] | 91: grams per cubic centimeters<br>92: kilograms per cubic meter<br>94: pounds per cubic foot<br>95: grams per milliliter<br>96: kilograms per liter<br>97: grams per liter<br>98: pounds per cubic inch<br>93: pounds per gallon<br>99: short tons per cubic yard<br>146: micrograms per liter<br>147: micrograms per cubic meter<br>170: milligrams per liter<br>253: custom mass flow unit | Read / Write |
| 7700 | unsigned / 2 | Temperature unit | Select unit for temperature process value | 32: °C | 32: °C<br>33: °F<br>34: °R<br>35: K | Read / Write |
| 8320 | unsigned / 2 | Mass totalizer units | Select unit for mass totalizer value | 61: kilograms [kg] | 60: grams<br>61: kilograms<br>62: metric tons<br>63: pounds<br>64: short tons<br>65: long tons<br>125: ounces<br>253: customized unit | Read / Write |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 8456 | Float / 4 | Custom unit factor mass flow value | Custom unit for mass flow value, only active if customized unit is selected<br><br>Calculation is based on [kg/s] | 1 | 0 to 60000000 | Read / Write |
| 7516 | Float / 4 | Custom unit factor volume flow value | Custom unit for volume flow value, only active if customized unit is selected<br><br>Calculation is based on [$m^3$/s] | 1 | 0 to 1000 | Read / Write |
| 8462 | Float / 4 | Custom unit factor density value | Custom unit for density value, only active if customized unit is selected<br><br>Calculation is based on [kg/$m^3$] | 1 | 0 to 60000 | Read / Write |
| 8474 | Float / 4 | Custom unit factor mass totalizer | Custom unit for mass totalizer, only active if customized unit is selected<br><br>Calculation is based on [kg] | 1 | 0 to 1000000 | Read / Write |

Table C-3 Identification

| Modbus address | Data type / Size (bytes) | Parameter | Description | Default value (unit) | Value range | Access level |
|---|---|---|---|---|---|---|
| 4000 | String / 20 | Manufacturer | Device manufacturer | Siemens | - | Read Only |
| 4020 | String / 10 | Sensor Firmware Revision | Sensor firmware version | - | - | Read Only |
| 4025 | String / 16 | SensorType | Sensor type.<br>Also shown on the device nameplate | - | - | Read Only |
| 4033 | String / 20 | Sensor Serial Number | Unique sensor serial number.<br>Also shown on the device nameplate | - | - | Read Only |
| 4095 | String / 10 | Sensor Hardware Revision | Sensor hardware version | - | - | Read Only |
| 4100 | String / 10 | Sensor Frontend Type | Sensor hardware variant | - | - | Read Only |
| 4121 | String / 20 | Sensor Order Number | Sensor order number part 1 (MLFB).<br>Also shown on the device nameplate | - | - | Read Only |
| 4131 | String / 32 | Sensor Order Number | Sensor order number part 2 (MLFB).<br>Also shown on the device nameplate | - | - | Read Only |

| Modbus address | Data type / Size (bytes) | Parameter | Description | Default value (unit) | Value range | Access level |
|---|---|---|---|---|---|---|
| 4147 | String / 32 | Sensor Order Number | Sensor order number part 3 (MLFB).<br>Also shown on the device nameplate | - | - | Read Only |
| 4164 | String / 32 | Long TAG | Enter a unique TAG name for the device (up to 32 characters) | | | |
| 4180 | String / 16 | Descriptor | Enter a unique description for the measurement point (up to 16 characters) | | | |
| 4188 | String / 16 | Startup Date | Enter the installation date of the device | | | |

Table C-4 Operating conditions

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2100 | Unsigned / 2 | Flow Direction | Define positive and negative flow direction.<br>Default positive flow direction is indicated by the arrow on the sensor.<br>Possible selections:<br>• 0: Negative: The flow is measured '+' in default negative direction and '-' in default positive direction.<br>• 1: Positive: The flow is measured '+' in default positive direction and '-' in default negative direction | 1 | 0 to 1 | Read / Write |
| 2130 | Unsigned / 2 | 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 |

Table C-5 Mass flow

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 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 [kg/s] [1)] | 0 to 1023 | Read / Write |
| 2426 | Float / 4 | Mass flow Correction Factor | Specify correction factor for use in the mass flow calculation | 1 | -1.999 to +1.999 | Read / Write |

[1)]: See Sensor dimension dependent default settings (Page 126)

Table C-6 Volume flow

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2170 | Float / 4 | Low Volume flow Cut Off | Define the numerical volume flow value below which the volume flow output is forced to zero. | Sensor size specific [$m^3$/s] [1)] | 0 to 0.177 | Read / Write |

[1)]: See Sensor dimension dependent default settings (Page 126)

Table C-7 Density

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2127 | Float / 4 | Empty Tube Limit | Define threshold value of empty tube | 500 [kg/$m^3$] | -14 000 to +14 000 | Read / Write |
| 2129 | Unsigned / 2 | Empty Tube Detection | Set automatic detection of Empty Tube On/Off<br><br>0 = off (Empty tube is off).<br>1 = on (a density value below Empty Tube Limit triggers an alarm. All flow rate values are forced to zero %). | 0 | 0 to 1 | Read / Write |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 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.<br>To make the flowmeter show + 2 kg/m³, change the density offset to 2.000 kg/m³ in the 'Sensor' menu | 0 [kg/m³] | -1 400 to +1 400 | Read / Write |

Table C-8 Totalizer

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2609 | unsigned / 2 | Totalizer State | Totalizer state<br>• 0 = paused<br>• 1= running | 1 | 0 to 1 | Read only |
| 2610 | float / 4 | Totalizer Value | The totalized MASS value in kg | 0 [kg] | Min. -1.70E+38<br>Max. 1.70E+38 | Read Only |
| 3018 | Unsigned / 4 | Totalizer fixed point part | The totalized MASS value in kg. Most significant word of the totalizer (MSW).<br>The format of the totalizer is a TotalType.<br>The TotalType represent a fixed point value in the MSW 32 bit and a fractional part in the LSW 32 bit.<br>Example: 2.03 would be represented as fixed point part = 2 and fractional part = 30000000 | 0 [kg] | Min -2147483648<br>Max 2247483647 | Read Only |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 3020 | Unsigned / 4 | Totalizer fractional part | The totalized MASS value in kg. Least significant word of the totalizer (LSW).<br>The format of the totalizer is a TotalType.<br>The TotalType represent a fixed point value in the MSW 32 bit and a fractional part in the LSW 32 bit.<br>Example: 2.03 would be represented as fixed point part = 2 and fractional part = 30000000<br>Note: The data type is signed32 | 0 [kg] | Min -999999999<br>Max 999999999 | Read Only |
| 2612 | unsigned / 2 | Reset totalizer | Reset totalizer Value | - | Enter **1** to reset | Read / Write |
| 2613 | unsigned / 2 | Pause totalizer | Pause totalizer<br>Totalizer can only be paused when running | - | Enter **1** to pause | Read / Write |
| 2614 | unsigned / 2 | Resume totalizer | Resume totalizer<br>Totalizer can only be resumed when paused | - | Enter **1** to pause | Read / Write |

Table C-9 Access level

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 404 | Unsigned / 2 | Access level | Access level status | - | 32 (logged in)<br>4 (logged out) | Read Only |
| 412 | Unsigned / 2 | User password | Password to enable writing commands | - | 2457 (enable user password<br>0 (disable user password) | Read / Write |

Table C-10 Maintenance

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 700 | Unsigned / 2 | Set To Default | Reset all parameters to factory settings | - | Enter **1** to reset | Write |
| 2700 | Unsigned / 4 | Operating Time Total | Total operating time since first power up | 0 [h] | - | Read Only |
| 2702 | Unsigned / 4 | Operating Time | Operating time since last power up | 0 [h] | - | Read Only |
| 4088 | String / 14 | Firmware Time Stamp | Firmware time stamp specifies the date and time when the sensor firmware was built | - | - | Read Only |
| 4105 | String / 32 | Sensor PCBA Serial Number | Serial number of the sensor electronic | - | - | Read only |

Table C-11 Device diagnostics

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2756 | Float / 4 | Driver Current | Actual sensor driver current.<br>The actual driver current is viscosity and sensor size dependent | - [A] | 0 to 0.124 | Read Only |
| 2758 | Float / 4 | Pick-up Amplitude 1 | Actual pick-up 1 amplitude | - [V] | 0 to 0 9999 | Read Only |
| 2760 | Float / 4 | Pick-up Amplitude 2 | Actual pick-up 2 amplitude | - [V] | 0 to 0 9999 | Read Only |
| 2762 | Float / 4 | Sensor Frequency | Actual sensor frequency | - [Hz] | 0 to 1 023 | Read Only |
| 3032 | Float / 4 | PCB Temperature | Actual sensor electronic temperature | - [C°] | -50 to 200 | Read Only |

Table C-12 Aerated flow

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2200 | Unsigned / 2 | Aerated Flow Alarm Limit | Alarm limit calculated in per cent of accepted bad measurements. | 80 [%] | 0 to 99 | Read / Write |
| 2201 | Unsigned / 2 | Aerated Flow Warning Limit | Warning limit calculated in per cent of accepted bad measurements | 0 [%] | 0 to 99 | Read / Write |
| 2202 | Unsigned / 2 | Measurement Sample Time | The time period over which the actual percentage of bad measurements is calculated | 5 [s] | 1 to 10 | Read / Write |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2203 | Unsigned / 2 | Aerated Flow Filter | Aerated flow filter<br>0: Disabled<br>1: Enabled<br>2: Auto<br>Auto means that filtering starts automatically when aerated flow is measured. | 2 | 0 to 2 | Read / Write |
| 2204 | Unsigned / 2 | Filter Time Constant | PV Filter Time Constant<br>0: 0.5 seconds<br>1: 1 second<br>2: 2 seconds<br>3: 5 seconds<br>4: 10 seconds<br>5: 20 seconds<br>6: 30 seconds<br>7: User Defined Value | 4 | 0 to 7 | Read / Write |
| 2205 | Float / 4 | Filter Start Hysteresis | The filter is active when the hysteresis value is exceeded.<br>Aerated Flow Filter must be set to Auto | 0.015 [V] | 0 to 0.124 | Read / Write |
| 2207 | Unsigned / 2 | Minimum Filtering Time | The filtering time is reset each time hysteresis band is exceeded | 10 [ms cycles] | 0 to 65535 | Read / Write |
| 2214 | Unsigned / 2 | Pickup Amplitude Filter | Enable/disable pickup amplitude filter.<br>0 = Disable<br>1 = Enable | 1 | 0 to 1 | Read / Write |
| 2215 | Unsigned / 2 | Bad Measurement Count | Number of bad measurements counted during the last period | 0 | 0 - 65535 | Read Only |
| 2216 | Unsigned / 2 | Filter Iteration | Set the number of times to repeat the same filter. Increasing the number will increase the damping.<br>Active only if Filter Time Constant is set to 7. | 3 | 1 to 5 | Read / Write |
| 2217 | Unsigned / 2 | Bandwidth Factor | Increase the Bandwidth Factor to reduce the LP (low pass) bandwidth filtering.<br>Active only if Filter Time Constant is set to 7. | 2 | 0 to 4 | Read / Write |
| 2218 | Unsigned / 2 | Filter Pole Shift | Configure the bandwidth and damping in the stop band. A high number will give a small bandwidth and an increased damping in the stop band.<br>Active only if Filter Time Constant is set to 7. | 2 | 1 to 5 | Read / Write |

Table C-13 Zero point adjustment

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2132 | Unsigned / 2 | Zero Point Adjustment | Select zero-point adjustment method. Automatic zero point adjustment is recommended.<br>• 0 = Auto<br>• 1 = Manual | 0 | 0 to 1 | Read / Write |
| 2133 | Float / 4 | Manual Zero Point Offset | Enter agreed zero point offset value for manual zero point adjustment mode. | 0 [kg/s] | 0 to 1023 | Read / Write |
| 2135 | Unsigned / 2 | Zero Point Duration | Define duration of zero point adjustment. | 30 [s] | 1 to 999 | Read / Write |
| 2136 | Float / 4 | Standard Deviation | Standard deviation during auto zero point adjustment | 0 [kg/s] | -1023 to +1023 | Read only |
| 2138 | Float / 4 | Standard Deviation Limit | Set limit for zero point adjustment **Standard Deviation** value. If the **Standard Deviation** exceeds the **Standard Deviation Limit**, the auto zero point adjustment is aborted. | Sensor size specific [kg/s] [1)] | 0 to +1023 | Read / Write |
| 2140 | Float / 4 | Zero Point Offsett Limit | Set limit for zero point offset.<br>If the zero point offset exceeds the zero point offset limit, the zero point offset cannot be stored | Sensor size specific [kg/s] [1)] | -1023 to +1023 | Read / Write |
| 2142 | Float / 4 | Zero Point Offset Value | Default zero point offset based on factory calibration of sensor.<br>A Zero point offset compensates for sensor variations due to process conditions. | 0 [kg/s] | -1023 to +1023 | Read only |
| 2144 | Unsigned / 2 | Zero Point Adjust Progress | Shows the progress of the currently running Zero Point adjustment in percentage | 0 [%] | 0 to 100 | Read Only |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2145 | Unsigned / 2 | Zero Point Adjust Status | Status of the last zero point adjustment performed<br>Every high bit ('1') represents an error occurred in the last zero point adjustment performed.<br><br>No high bits equals ok.<br>Bit 0 = Zero sigma limit exceeded<br>Bit 1 = Zero offset limit exceeded<br>Bit 2 = Quality of zero point conditions | - | • 1<br>• 2<br>• 4 | Read Only |
| 2180 | Unsigned / 2 | Start Zero Point Adjustment | Start automatic zero point adjustment.<br>The automatic zero point adjustment determines the application specific zero point offset automatically.<br>Possible selections:<br>• 0: Idle<br>• 1: Running<br>• 2: Start | 0 | 0 to 2 | Read / Write |

[1)]: See Sensor dimension dependent default settings (Page 126)

Table C-14 Modbus

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 527 | Unsigned / 2 | Float byte order | The float byte order used in Modbus messages.<br><br>Selection 0: Byte order: 1-0-3-2<br>Selection 1: Byte order: 0-1-2-3<br>Selection 2: Byte order: 2-3-0-1<br>Selection 3: Byte order: 3-2-1-0<br><br>The first mentioned byte is the first byte sent.<br>Byte 3 corresponds to the left-most byte (MSB) of a 32 bit float in big endian format, byte 0 corresponds to the right-most byte (LSB). | 3 | 0 to 3 | Read / Write |
| 528 | Unsigned / 2 | Modbus Address | Set Modbus Device Address | 1 | 1 to 247 | Read / Write |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 529 | Unsigned / 2 | Baudrate | Set communication baudrate.<br>Following baud rates are available:<br>• 0 = 9600<br>• 1 = 19200 (Default)<br>• 2 = 115200<br>• 4 = 38400<br>• 5 = 57600<br>• 6 =76800 | 1 | 0 to 5 | Read / Write |
| 530 | Unsigned / 2 | Modbus Parity Framing | RS-485 parity and framing<br>8 databits are always used<br><br>0 = even parity, 1 stopbit<br>1 = odd parity, 1 stopbit<br>2 = no parity, 2 stopbits | 0 | 0 to 2 | Read / Write |
| 600 | Unsigned / 2 | Restart communication | Restart Modbus communication<br>Write:<br>• 0 = No effect<br>• 1 = Restart<br>Read:<br>• Always 0 | - | 0 to 1 | Write |

Table C-15 Sensor

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2113 | Float / 4 | Minimum Frame Temperature | Lower limit of the frame temperature | -50 [°C] | | Read only |
| 2115 | Float / 4 | Maximum Frame Temperature | Lower limit of the frame temperature | 200 [°C] | | Read only |
| 4043 | String / 16 | Sensor size | Nominal sensor diameter (DN) | - | - | Read only |
| 4051 | String / 32 | Hazardous area approval | Hazardous area approval of the sensor | - | - | Read only |
| 4078 | String / 20 | Wetted materials | Sensor enclosure material | - | - | Read Only |

Table C-16 Volume flow calibration

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2103 | Float / 4 | Maximum Volume flow Capacity | Maximum volume flow measurement capacity of the sensor | Sensor size specific [$m^3$/s] [1)] | 0 to 0.177 | Read only |

[1)]: See Sensor dimension dependent default settings (Page 126).

Table C-17 Mass flow calibration

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2101 | Float / 4 | Maximum Mass flow Capacity | Maximum mass flow measurement capacity of the sensor | Sensor size specific [kg/s] [1)] | 0 to 1023 | Read only |
| 2402 | Float / 4 | Calibration Factor | Factory-set sensor-specific calibration factor.<br>The calibration factor is shown on the sensor nameplate | - | Min: 5.00E +07<br>Max: 4.29E +09 | Read only |

[1)]: See Sensor dimension dependent default settings (Page 126).

Table C-18 Density calibration

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2428 | Float / 4 | Density Calibration Offset | Specify an offset in the density flow calculation | - | -14 000 to +14 000 | Read only |
| 2430 | Float / 4 | Density Calibration Factor | Specify gain factor in the density flow calculation | - | -2147483583 to 2147483583 | Read only |
| 2432 | Float / 4 | Dens. Comp. Tube Temp. | Specifies a tube temperature coefficient in the density calculation | - | -0.001953 to +0.001953 | Read only |
| 2434 | Float / 4 | Dens. Comp. Frame Temp. | Specifies a frame temperature coefficient in the density calculation | - | -0.001953 to +0.001953 | Read only |

Table C-19 Simulation

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 2764 | Float / 4 | Mass flow Simulation Value | Set mass flow simulation value.<br>The mass flow will be set to this value on all outputs, if **Simulation Mass Flow** is enabled | 0 [kg/s] | -1023 to +1023 | Read / Write |
| 2766 | Float / 4 | Density Simulation Value | Set density simulation value.<br>The density will be set to this value on all outputs, if **Simulation Density** is enabled | 1000 [kg/m$^3$] | -20000 to +20000 | Read / Write |
| 2768 | Float / 4 | Media Temperature Simulation Value | Set media temperature simulation value. The media temperature will be set to this value on all outputs if **Simulation media Temperature** is enabled | 0 [°C] | -50 to +200 | Read / Write |
| 2770 | Float / 4 | Frame Temperature Simulation Value | Set frame temperature simulation value.<br>The frame temperature will be set to this value on all outputs if **Simulation Frame Temperature** is enabled | 0 [°C] | -50 to +200 | Read / Write |
| 2772 | Float / 4 | Volume flow Simulation Value | Set volume flow simulation value.<br>The volume flow will be set to this value on all outputs, if **Simulation Volume Flow** is enabled | m$^3$/s | -65 to +65 | Read / Write |
| 2780 | Unsigned / 2 | Enable Simulation | Activate simulation.<br>Select one of the following values:<br>• Bit 0: Mass flow<br>• Bit 1: Density<br>• Bit 2: Volume flow<br>• Bit 3: Media temperature<br>• Bit 4: Frame temperature | 0 | 0 to 63 | Read / Write |

Table C-20 Alarms

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 3012 | Unsigned / 4 | Alarm Group 1 | The following bit is set in case of active alarm:<br>• Bit 4: Power Supply Malfunction<br>• Bit 6: Temperature Circuit Malfunction<br>• Bit 10: Measurement Out Of Range<br>• Bit 14: Calibration Malfunction<br>• Bit 15: Compensation Out Of Range<br>• Bit 17: Pickup Malfunction<br>• Bit 23: Driver Malfunction<br>• Bit 26: Measurement Out Of Range<br>• Bit 27: Mass Flow Max Limit Exceeded<br>• Bit 28: Volume Flow Max Limit Exceeded<br>• Bit 29: Density Max Limit Exceeded<br>• Bit 30: Min Tube Temp Exceeded<br>• Bit 31: Max Tube Temp Exceeded | - | - | Read Only |

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 3014 | Unsigned / 4 | Alarm Group 2 | The following bit is set in case of active alarm:<br>• Bit 0: Min Frame Temp Exceeded<br>• Bit 1: Max Frame Temp Exceeded<br>• Bit 2: Zero Sigma Limit Exceeded<br>• Bit 3: Zero Offset Limit Exceeded<br>• Bit 4: Quality Of Zero Point Conditions<br>• Bit 5: Empty Pipe<br>• Bit 6: Sensor Partially Filled<br>• Bit 7: Storage Malfunction<br>• Bit 8: System Internal<br>• Bit 14: Unstable Measurement Conditions<br>• Bit 15: Auto-filtering enabled<br>• Bit 23: Sensor Startup | - | - | Read Only |

Table C-21 Quality code for process values

| Modbus address | Data type / Size [bytes] | Parameter | Description | Default value [unit] | Value range | Access level |
|---|---|---|---|---|---|---|
| 3014 | Unsigned / 4 | Alarm Group 2 | Quality code of a measured value | Process values for quality codes<br>Media temperature<br>Density<br>Volume flow<br>Mass flow<br>Quality code for each process value consist of 2 bits:<br>Bit 24/25: Media temperature<br>Bit 26/27: Density<br>Bit 28/29: Volume flow<br>Bit 30/31: Mass flow | 11 Good<br>01 Reserved<br>10 Simulation<br>00 Bad | Read Only |

# Index

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