EC type-examination Certificate

Number : **T10203** revision 7
Project number : SO14200663

Issued by	NMi Certin B.V. designated and notified by the Netherlands to perform tasks with respect to conformity modules mentioned in article 9 of Directive 2004/22/EC, after having established that the Measuring instrument meets the applicable requirements of Directive 2004/22/EC, to:
Manufacturer	Spirit IT B.V. Prof. Dr. Dorgelolaan 20 5613 AM Eindhoven The Netherlands
Sub assembly	An **electronic gas-volume conversion device (EVCD),** intended to be used for gas volume conversion as a sub-assembly (according to article 4 of the MID) of a gas meter

Type :
Designation : Flow-X/M, Flow-X/P, Flow-X/S and Flow-X/R
Conversion principle : PTZ
Device type : 2 (separate transmitters)
Ambient temperature range : +5 °C / +55 °C
Designed for : non-condensing humidity
Mechanical environment class : M2
Electromagnetic environment class : E2
The intended location for the instrument is a closed one.

Further properties are described in the annexes:
- Description number T10203 revision 7;
- Documentation folder number T10203-2.

Valid until: 11 February 2020

Remarks: This revision 7 replaces the previous revision 6.
The documentation folder has not been changed.

Issuing Authority: **NMi Certin B.V., Notified Body number 0122**
20 February 2014

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INSPECTION RvA I 122

Description

Number : **T10203** revision 7
Project number : SO14200663

1 General information about the electronic gas-volume conversion device

Properties of the EVCD, whether mentioned or not, shall not be in conflict with the legislation.

The EVCD is a so-called type 2 device, with external separate transducers for pressure and temperature (PTZ).

The Flow-X series of flow computers is based on a single stream modular concept where one Flow-X/M module is used for each meter stream. These modules can be installed in a number of different enclosures. Each module has its own LCD display.

Flow-X/M

The Flow-X/P is a Panel mounted flow computer that can contain up to four Flow-X/M flow modules (one for each stream), an additional station module with a 7” multi -lingual color touch -screen and additional serial (3x) and Ethernet interfaces (2x). This flow computer can be used in both horizontal and vertical position. Field connections are available in standard 37 -pin and 9 -pin D -Sub type connectors at the rear. Optionally an i -button is available for convenient and controlled operator login.

Description

Flow-X/P

The Flow-X/S is a Single stream, DIN rail mountable enclosure with direct screw terminals for field connections. Interfaces include dual Ethernet with built -in web server ia RJ45 connectors. Graphical LCD display with 4 lines for local display of measured & calculated data. The Flow-X/S may be mounted in 3 ways: Horizontally on Din -rail, vertically on Din –rail and Wall mounted.

Flow-X/S

The Flow-X/R is a 19" rack mountable enclosure that can accommodate up to eight Flow-X/M modules (i.e. 8 metering streams). For each module it provides a 24 Vdc power supply connector and two 37-pin D-Sub type connectors at the top and 2 Ethernet ports at the bottom.

Flow-X/R

1.1 Essential parts

1.1.1 Flow-X/M

Part	Part number	Documentation
Analog board	6557-0700-1305	10203/1-01
	6557-0700-1308	10203/1-02
	6557-0700-1309	10203/1-03
	6557-0700-1310	10203/1-03
Digital board	6557-0700-1206	10203/1-04
	6557-0700-1207	10203/1-05
	6557-0700-1208	10203/1-06
	6557-0700-1209	10203/1-06
	6557-0700-1210	10203/1-06
	6557-0700-1211	10203/1-06
Indicating device	6557-0800-6504	10203/1-07
Power supply	6557-0800-8202	10203/1-08
	6557-0800-8203	10203/1-09
	6557-0800-8204	10203/1-09

1.1.2 Flow-X/P

Part	Part number	Documentation
GUI module Touchscreen controller	6557-0700-1402	10203/1-10
	6557-0700-1407	10203/1-11
	6557-0700-1408	10203/1-12
	6557-0700-1409	10203/1-12
	6557-0700-1410	10203/1-12
Backplane PCB	6557-0800-2904	10203/1-13
	6557-0800-2905	10203/1-14
Connector panel	6557-0800-2803	10203/1-15
	6557-0800-2804	10203/1-16

The Flow-X/P enclosure may contain up to four Flow-X/M modules.

1.1.3 Flow-X/S

Part	Part number	Documentation
Back plane	6557-0800-4901	10203/1-17
	6557-0800-4902	10203/1-18

The Flow-X/S enclosure contains one Flow-X/M module.

1.1.4 Flow-X/R

Part	Part number	Documentation
Back plane	6557-0800-8401	10203/1-19

The Flow-X/R enclosure may contain up to eight Flow-X/M modules.

1.2 Essential characteristics

1.2.1 Calculation of volumetric and / or mass flow totals from volume impulses and / or mass impulses and / or serial data (RS232, RS485 or Ethernet).”
The calculation and indication of cumulative gross volume, base volume and / or mass, for station and each run, and for both forward and reverse streams, are under legal control.

1.2.2 The validity of serial communication is always checked by determining and comparing the CRC of received messages and in some cases additionally by checking if the received value is between valid limits.

The validity of Modbus messages is checked by comparing the received checksum with the calculated checksum of received bytes.

Modbus ASCII mode and RTU mode use different methods to determine the checksum. Modbus ASCII uses LRC (Longitudinal Redundancy Check) to generate the checksum.

Modbus RTU uses CRC (Cyclic Redundancy Check) to generate the checksum.
The checksum of HART messages is the result of the XOR function of all bytes in the message.

1.2.3 Software specification (see WELMEC guide 7.2):

- Software type P;
- Risk Class C;
- Extensions L, T, S, I.
  Extension D is not applicable because software download is disabled when the tamper switch is enabled and sealed.

Software part	Software version	Remarks
Firmware	B4A0633E	Core calculation, reporting and communication engine
	7E40F17AE	
	5B6AEFE1	
	63CBC842	
	A58377C1	
	4581A774	
	651B2653	
	A3DDC66F	
	5ADFEAA2	
	C587C032	
Add-on Programs	1.0.0.3	Boot loader and other auxiliary programs
	1.0.0.1107	
	1.0.0.1108	
	1.0.0.1127	
	1.0.0.1151	
	1.0.0.1157	
	1.0.0.1166	
	1.0.0.1167	
	1.0.0.1169	
	1.0.0.1170	
FPGA	1357-22-1-2009	Field-Programmable Gate Array for X/M
	1422-21-2-2012	Field-Programmable Gate Array for X/M
	1350-29-10-2009	Field-Programmable Gate Array for X/P
Operating system	1.55	Real-time operating system
	2.57	
	4.60	
	6.62	
	9.66	
	9.68	
	10.70	
	16.53	

Software part	Versions	checksum	Remarks
Gas application	1.0.4	9D263BD87	
	1.0.5	AB6CD0813	
	1.0.6	B8105CA80	
	1.2.2	72F8463D2	
	1.2.3	93D121AC0	
	1.2.3a	9413483E1	
	1.2.3b	959D32A00	
	1.3.0	93D121AC0	
	1.3.2	CE1F76217	
	1.3.2a	CFEB87157	
	1.4.0	D1723F20B	
	1.4.1	DFD489449	
	1.4.3	ECDD94451	

Remark: The version number and identification can be inspected on the local display by selecting display 'Metrological', 'Software version' or ‘Metrological/version’.

1.2.4 Conversion

The conversion is performed according to the following formula as stated below:

$$V_b = V \times \frac{p_{abs}}{p_b} \times \frac{273{,}15 + t_b}{273{,}15 + t} \times \frac{Z_b}{Z}$$

Symbol	Represented quantity	Unity
V_b	volume at base conditions	m^3
V	volume at measurement conditions	m^3
p_{abs}	absolute pressure at measurement conditions	bar
p_b	absolute pressure at base conditions	bar
t	gas temperature at measurement conditions	°C
t_b	temperature at base conditions	°C
Z_b	compression factor at base conditions	-
Z	compression factor at measurement conditions	-

1.2.5 Compression

The compression factor Z_b/Z can be programmed in the EVCD as a fixed value or it can be calculated on the basis of a gas composition or it can be read from an optional gas chromatograph.

Calculation by the EVCD is performed with one of the following the algorithms:

- SGERG91 (ISO12213-3) (known parameters are mol%N2, mol%H2, Hs and d), with correction factors for Hs and d for combustion temperatures other than 25 °C and reference temperatures other than 0 °C;
- AGA8 (ISO12213-2) (complete gas analyses).

In case the communication to the gas chromatograph fails, the last good value before failure or a configurable fallback value is used.

Composition setup is described in manufacturer’s documentation no. 02.10.03.A-2B (Gas Metric

Application Manual) and can be configured on display Configuration -> Run / Station -> Gas properties -> Gas composition.

1.2.6 Gas composition

A gas composition can be read from an optional gas chromatograph or can be manually input. In case the communication to the gas chromatograph fails, the last good composition before failure or a manually input override composition is used. The electronic gas-volume conversion device can be connected to 2 gas chromatographs. In case of a failure in one chromatograph, the composition and the values issued from the other chromatograph are used.

Composition setup is described in manufacturer's documentation no. 02.10.03.A-2B (Gas Metric Application Manual) and can be configured on display Configuration -> Run / Station -> Gas properties -> Gas composition.

1.2.7 Pressure transducer

Any pressure transducer may be used provided the following conditions are met:

- For the pressure transducer a Parts certificate has been issued by a Notified Body responsible for type examination.
- The output signal must be according to a standard 4-20 mA signal or HART protocol.
- The pressure range is according to the appertaining Parts certificate; apart from that the following restrictions are valid.
- Maximum measuring range is 1:20.
- Maximum pressure does not exceed 120 bar.
- The pressure range must be within the working range of the algorithm used for correcting the deviation from the ideal gas law. On top of that the Flow-X optionally also raises an accountable alarm if the pressure drops below a configurable minimum accountable pressure PT_{min}.
  Note: if a gauge pressure transducer is used the constant value for the atmospheric pressure is stated on the main menu – MID page.

A gauge pressure transducer may be used if its minimum operating absolute pressure is equal to or greater than 21 bar. The electronic gas-volume conversion device may be equipped with an application that allows connection of two pressure transmitters, for calculating and presenting the average value of the two measured pressure values (versions 1.2.3a, 1.2.3b and 1.3.2a).
In case one of the pressure transmitters fails, the calculated average pressure value is replaced by the measured pressure value of the good pressure transmitter.
One of the transmitters can be manually taken out of service for calibration purposes. In that case the measured pressure of the other transmitter is used.
The maximum allowed deviation between the two measured pressure values is preset.
If the deviation is larger than the preset value, in version 1.2.3a the keypad pressure value is used, whereas in versions 1.2.3b and 1.3.2a the measured value of transmitter 1 is used. Of course the checks on that pressure transmitter value (not out of service, not defective, etc.) apply.
The constant for atmospheric pressure can be found in the menu Configuration -> Overall set up -> Constants.

1.2.8 Gas temperature range

The temperature range is: -30°C ≤ t ≤ +80°C; apart from that the temperature range has to be within the working range of the algorithm used for correcting the deviation from the ideal gas law.

1.2.9 Temperature transducer

Any temperature transducer may be used provided the following conditions are met:

- For the temperature transducer a Parts certificate has been issued by a Notified Body responsible for type examination.
- The output signal is according to the HART-protocol, it uses a standard 4-20 mA signal or the sensor is a Pt100.
- The temperature range is according to the appertaining Parts certificate; however the temperature t must not exceed: -30 °C ≤ t ≤ +80 °C.
- The temperature range must be within the working range of the algorithm used for correcting the deviation from the ideal gas law.

The electronic gas-volume conversion device may be equipped with an application that allows connection of two temperature transmitters, for calculating and presenting the average value of the two measured temperature values (software versions 1.2.3a, 1.2.3b and 1.3.2a).
In case one of the temperature transmitters fails, the calculated average temperature value is replaced by the measured temperature value of the good temperature transmitter.
One of the transmitters can be manually taken out of service for calibration purposes. In that case the measured temperature of the other transmitter is used.
The maximum allowed deviation between the two measured temperature values is preset.
If the deviation is larger than the preset value, in version 1.2.3a the keypad temperature value is used, whereas in versions 1.2.3b and 1.3.2a the measured value of transmitter 1 is used. Of course the checks on that temperature transmitter value (not out of service, not defective, etc.) apply.

1.2.10 Presentation of legal data on the Flow-X/M calculating and indicating device

The legal data is presented via a special menu by pressing the arrows keys on the front panel.
The legal data is presented via a special menu 'Metrological' accessible on the touch screen (Flow-X/P) and the LCD display (Flow-X/S and Flow-X/R).
The menu structure, keyboard, display and (alarm) indicators are described in chapter 'User interface' of the documentation no. 02.10.03.A-2A.

1.2.11 Presentation of legal data on the front panel display of the Flow-X/P calculating and indicating device.

The legal data is presented via a special menu 'Metrological' accessible on the touch screen (Flow-X/P) and the LCD display (Flow-X/S and Flow-X/R).
The menu structure, keyboard, display and (alarm) indicators are described in the manufacturer's documentation no. 02.10.03.A-2A (Operation and Configuration) and 02.10.03.A-2B (Gas Metric Application Manual).

1.2.12 Accountable alarms

The EVCD has to be programmed such that accountable alarms will be generated if extreme values are measured by the EVCD or if a defect is detected. Accountable alarms cause the registration of the volume at base conditions to be stopped.

Additional to the registration in the main totalizer, if there's no accountable alarm the volume at measurement conditions will be registered in the accountable totalizer, while during the

alarm the volume at measurement conditions will be registered in the non-accountable totalizer.

An accountable alarm is raised if a remote transmitter is forced or frozen.

The alarm indication can be acknowledged using the "Acknowledge" button on the alarms display. However, it is not possible to clear an alarm as long as the cause of the alarm is still present."

1.3 Essential shapes

1.3.1 The nameplate is bearing at least, good legibly, the information as mentioned in the regulations on electronic gas volume conversion devices.
The name plate should bear at least the following information:

1. Logo or name of the manufacturer
2. Accuracy information
3. Identification: Type Flow-X, serial number
4. Approval number: T10203
5. Special environmental conditions: Environmental temperature range: +5°C .. +55°C
6. CE mark, year of manufacturing and notified body number.

1.3.2 Seals: see chapter 2.

1.4 Conditional parts

1.4.1 Housings
See the General Information in this EC Type-Examination Certificate.
Metrological important parts only are accessible after breaking the tampering switch seal.

1.4.2 Use of a gas chromatograph (optionally)
Any gas chromatograph may be used provided the following conditions are met:
- For the Gas chromatograph a part certificate has been issued by a Notified Body responsible for type examination;
- the communication between the EVCD and the gas chromatograph takes place through an RS232, RS485 or Ethernet interface;
- when the connection between the EVCD and gas chromatograph is broken or when the gas chromatograph is defective an accountable alarm is raised.

1.5 Conditional characteristics

1.5.1 Maximum impulse input frequency: dual impulse train: 5 kHz; single impulse train: 10 kHz.

1.5.2 Programming
Change of metrological parameters is protected by a programming switch (tamper switch). See paragraph 'Software and data protection' of manufacturer's documentation no. 02.10.03.A-2A for a full description of the programming, the parameters and the data protection.
All metrological parameters are at security level 1000 or higher. All parameters on security level 1000 or higher are locked by the tamper switch. The definition of the security levels is under the metrological checksum.

The user shall account for all Weights & Measures parameter settings.

1.6 Non essential characteristics

For station and each run, and for both forward and reverse streams the calculation and indication device supports the following totalizers.

Cumulative totalizers
- Cumulative indicated (volume or mass, does not apply to station totalizers)
- Cumulative number of impulses (does not apply to station totalizers)
- Cumulative number of error impulses (does not apply to station totalizers)
- Cumulative energy
- Cumulative accountable indicated (volume or mass, does not apply to station totalizers)
- Cumulative accountable energy
- Cumulative non-accountable indicated (volume or mass, does not apply to station totalizers)
- Cumulative non-accountable gross volume
- Cumulative non- accountable base volume
- Cumulative non-accountable mass
- Cumulative non-accountable energy

Period totalizers
- Current [xxx] indicated (volume or mass, does not apply to station totalizers)
- Current [xxx] number of impulses (does not apply to station totalizers)
- Current [xxx] number of error impulses (does not apply to station totalizers)
- Current [xxx] gross volume
- Current [xxx] base volume
- Current [xxx] mass
- Current [xxx] energy
- Current [xxx] accountable indicated (volume or mass, does not apply to station totalizers)
- Current [xxx] accountable gross volume
- Current [xxx] accountable base volume
- Current [xxx] accountable mass
- Current [xxx] accountable energy
- Current [xxx] non-accountable indicated (volume or mass, does not apply to station totalizers)

- Current [xxx] non-accountable gross volume
- Current [xxx] non-accountable base volume
- Current [xxx] non-accountable mass
- Current [xxx] non-accountable energy
- Previous [xxx] indicated (volume or mass, does not apply to station totalizers)
- Previous [xxx] number of impulses (does not apply to station totalizers)
- Previous [xxx] number of error impulses (does not apply to station totalizers)
- Previous [xxx] gross volume
- Previous [xxx] base volume
- Previous [xxx] mass
- Previous [xxx] energy
- Previous [xxx] accountable indicated (volume or mass, does not apply to station totalizers)
- Previous [xxx] accountable gross volume
- Previous [xxx] accountable base volume
- Previous [xxx] accountable mass
- Previous [xxx] accountable energy
- Previous [xxx] non-accountable indicated (volume or mass, does not apply to station totalizers)
- Previous [xxx] non-accountable gross volume
- Previous [xxx] non-accountable base volume
- Previous [xxx] non-accountable mass
- Previous [xxx] non-accountable energy

With [xxx] either ‘hour’, ‘hour open’, ‘day’, ‘day open’, ‘period A’, ‘period A open’, ‘period B’, or ‘period B open’.

“Current” totalizers register during the applicable time period. At the start of the applicable time period the respective “current” totalizers are reset to zero. “Previous” totalizers show the previous applicable time period. Totalizers indicated with the word “open” show the value of the cumulative totalizers at the start of the applicable time period.

2 Seals

The following items are sealed:

- All enclosures have the option of locking the flow computer with a lead seal by an authorized body, to prevent access to the tamper switch of the individual modules (see below). In a Flow-X/P (Panel) and a Flow-X/R, one bar is used to seal all installed modules with one lead seal.

- Removal without destroying the nameplate shall not be possible; otherwise the nameplate shall be sealed to the housing.

- The tampering switch must be sealed if the access is not protected by a bar.