EU-type examination Certificate

Number **T12660** revision 0
Project number 2546746

Issued by

NMi Certin B.V.,
designated and notified by the Netherlands to perform tasks with respect to conformity assessment procedures mentioned in article 17 of Directive 2014/32/EU, after having established that the measuring instrument meets the applicable requirements of Directive 2014/32/EU, to:

Manufacturer

FMC Kongsberg Subsea A/S
Kirkegårdveien 45
NO-3616 Kongsberg
Norway

Measuring instrument

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	:	Sigma³
Manufacturer's mark or name	:	TechnipFMC
Conversion principle	:	PTZ
Ambient temperature range	:	+5 °C / +55 °C
Designed for	:	Non-condensing humidity
Environment classes	:	M2 / E2

The intended location for the instrument is closed.

Further properties are described in the annexes:
- Description T12660 revision 0;
- Documentation folder T12660-1.

Valid until

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NMi Certin B.V., Notified Body number 0122
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Certification Board

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1 General information about the electronic gas-volume conversion device

All properties of the EVCD, whether mentioned or not, shall not be in conflict with the legislation.
The EVCD can be connected to any type of transducers for pressure and temperature as long as these transducers are covered by an MID Parts Certificate
The conversion of volume is based on PTZ conversion principle.
The EVCD can be connected to any gas meter which has a pulse output with characteristics as described in paragraph 1.5.1.

Figure 1 Example of the EVCD

Sigma³ is a panel mounted or rack mounted flow computer designed for fiscal measurement, custody transfer of gases. Sigma³ can be configured in single or multi stream operation with dual pulse input.
It consists of 8 channels of pure HART and 8 channels of analog I/O with HART.
16 channels for digital input are also available.
Sigma³ is equipped with a 7" touch screen for easy setup and control. Serial and Ethernet communication ports and runs in a Linux environment on ARM architecture.
The drawings of the flow computer are included in the document no. 12660/0-01.
The Sigma³ is always combined with the human interface software type HMI-207CE by the same manufacturer that can be used as a remote indicating device connected via ethernet and is intended for reading stored measurement data and for setting of parameters for the EVCD.

1.1 Essential parts

The electronic gas volume conversion device is composed of the following parts:

Part	Document	Remarks
SOC PCA	12660/0-02; 12660/0-03	System-on-chip PCA; both the main processor and FPGA are in the same chip.
Backplane	12660/0-04; 12660/0-05	The backplane includes all routing between the different boards/units in the rack: 1) Power distribution from main supply to each unit, 2) Routing of signals between main board and IO board, 3) Routing and switching of display and touch control between main board and display and 4) Routing and switching of signals to test panel.
Front Board	12660/0-06; 12660/0-07	A COTS (commercial-off-the-shelf) touch display with a customized front panel. The front panel is used to access selected signals for test purposes from the front of the rack unit. Common for all units in the rack.
IO PCA	12660/0-08; 12660/0-09	The I/O board holds the electrical transceivers for the external interfaces as well as required protection.
Display	12660/0-10	Make: Eversion Electronics Co. Ltd. Model: VGG128004-5TSLWH (RoHS)
Power supply	12660/0-11	Make: Eplax GmbH Model: VP-80 series

1.2 Essential characteristics

1.2.1 Software specification for Sigma^3 EVCD (refer to WELMEC 7.2):

- Software type U;
- Risk Class C;
- Extension L and T;

while extensions S and D are not applicable or excluded.

Software version Sigma^3	Identification number (checksum)	Remarks
V.20.03 MID	F8de26547c406794d8104b5c1131e4a9	-

The validity of the program and the parameters are continuously checked. If these checks fail, an alarm is generated. The metrological software is identified by the software version and/or checksum, which can be checked on the local display via the menu structure **System → Status**

1.2.2 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	-

1.2.3 Compression

The compression factor Z_b/Z can be calculated on the basis of the following algorithms:

- AGA8 – 1994 detailed (complete gas analyses);
- AGA8 – 2017 Part 2 Gerg-2008 Equation of State.

1.2.4 Heating value calculations

The heating value can be calculated be calculated based on the following algorithms:

- ISO6976:2016

1.2.5 Gas Pressure input

Gas pressure can be entered into the device via any external pressure transducer provided the following conditions are met:

- There is a respective Parts Certificate issued under WELMEC 8.8 by a Notified Body that acts under module B of the Directive 2014/32/EU for ANNEX VII (MI-005);
- the output signal of the pressure transducer has to be via HART-protocol or a standard 4-20 mA signal;
- For pressure measurement below 21 Bar absolute, an absolute pressure transducer must be used; for pressure measurement above or equal to 21 Bar absolute a gauge pressure transducer can be used.
- the pressure range is according to the concerning Evaluation/Parts certificate, besides the following restrictions are valid:
  - measuring pressure range should be within 1 – 120 bar;
  - the pressure range must be within the working range of the used algorithm for correcting the deviation from the ideal gas law.

1.2.6 Gas temperature input

Gas temperature can be entered into the device via any external temperature transducer provided the following conditions are met:

- There is a respective Parts Certificate issued under WELMEC 8.8 by a Notified Body that acts under module B of the Directive 2014/32/EU for ANNEX VII (MI-002);
- the output signal of the temperature transducer has to be via HART-protocol or a standard 4-20 mA signal;

- the temperature range is according to the concerning Evaluation/Parts certificate; besides the following restrictions are valid:
  - measuring temperature range should be within -50 – 150 °C;
  - the temperature range must be within the working range of the used algorithm for correcting the deviation from the ideal gas law.

1.2.7 Volume input

The volume input for the EVCD could be a through:

- A pulse input, this input should be volume at flowing conditions (uncorrected volume).

Volume pulse input should have an amplitude voltage of at least 24 Volts peak to peak.

1.2.8 Gas Composition input

The gas composition of the gas can be either a static composition through manual entry in the EVCD or it could be through a Gas chromatograph (optional)

Any gas chromatograph may be used provided the following conditions are met:

- There is a respective Parts certificate issued for the gas chromatograph by a Notified Body responsible for type examination;
- The communication between the EVCD and the gas chromatograph takes place through a RS-485 Modbus RTU, Modbus TCP interface;
- When the connection between the EVCD and gas chromatograph is broken or when the gas chromatograph is defective, this will cause an accountable alarm.

1.2.9 Presentation of legal data

The legal data is presented on the main screen. The volumes at flowing and base/reference conditions is preferentially displayed on the main screen.

Along with this on the main screen, Volume correction factor, base/reference temperature and pressure, base compressibility and disturbed (alarm condition) volume totalisers are also presented.

The Display automatically toggles back to displaying the main screen with volume at base/reference condition if there is no user activity for 255 seconds.

In addition, the user can return back to the main screen by pressing the Gas Application (MID) button in the menu structure.

All other legal data can be viewed on the display using the following menu structure navigation:

Menu → physical data
Menu → process → process values
Menu → setup → Gas
Menu → Setup

Or using the database search function.

1.2.10 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 otherwise a defect arises. Accountable alarms cause that the registration of the volume at base conditions will be stopped.

Number and type of alarms are displayed at the bottom left of the display.

By pressing on this number, details of the alarms present can be viewed.

The alarm indication can be reset by pressing the “Acknowledge alarm” button.

However, it is not possible to clear an alarm as long as the cause of the alarm is still present.

The status of accountable alarms is also displayed on each of the IO PCA using LED lights as seen below.

Figure 2 Critical alarm indication using LEDs on IO PCA.

1.2.11 Programming

The legal metrological changes are only possible when the physical key on the respective IO PCA is in maintenance mode.
For putting the device in the secure mode “available”, the physical key on the respective IO PCA shall be placed in the position as shown in the below picture.
Once the device is put in the secure mode, a 🔒 symbol appears on the bottom right of the display.
The key should be removed, and the keyhole should be sealed with a sticker seal.
The parameters that shall be set to the belonging values and in the secure mode “read only” are given in documentation number 12660/0-12.

Figure 3 Physical sealing key position

1.3 Essential shapes

1.3.1 Markings

The nameplate is bearing at least, good legible, the following information:

- CE marking including the supplementary metrological marking (M + last 2 digits of the year in which the instrument has been put into use);
- Notified Body identification number, following the supplementary metrological marking;
- EU-type examination certificate no. T12660;
- manufacturer's name, registered trade name or registered trade mark;
- manufacturer's postal address;
- serial number of the EVCD and year of manufacture.

The following information is mentioned on the nameplate or on the display:

- the ambient temperature range;
- the gas temperature range;
- the gas pressure range;
- the base pressure;
- the base temperature;
- the compression algorithm;
- the gas properties;

The following information is mentioned on the display and/or on the transducer nameplate:

- upper and lower limits of the transducers.

The following information is mentioned on the nameplate or in the manual:

- mechanical environment class;
- electromagnetic environment class.

An example of the markings is shown below.

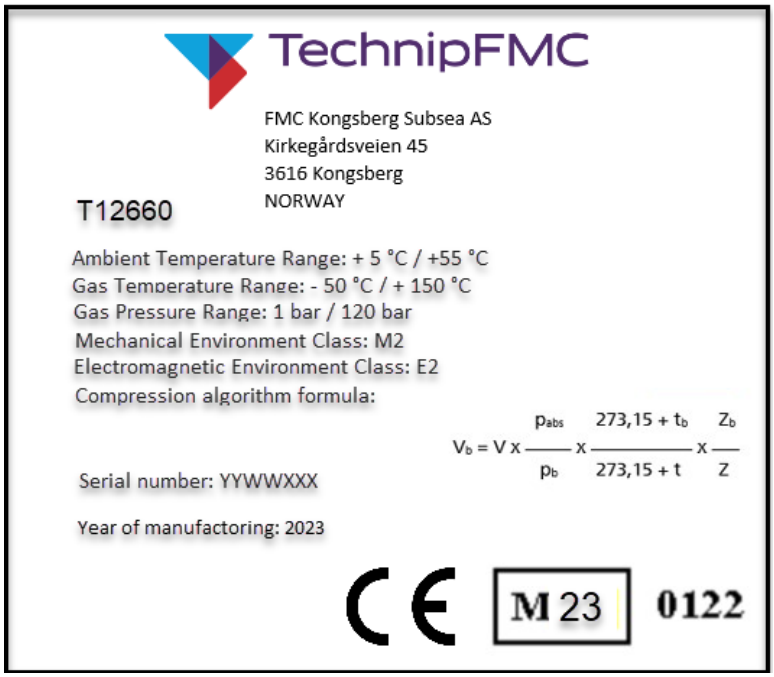

Figure 4 Example of nameplate

1.3.2 EMI protection measures
The following measures are taken for EMI protection:
Body of the EVCD should be grounded;
Volume pulse input should have an amplitude voltage of at least 24 Volts peak to peak;
All the cables connected to the EVCD should be shielded.

1.3.3 Sealing: see chapter 2.

1.4 Conditional parts

1.4.1 Housing
The housing of the EVCD is made of Aluminum, which has sufficient tensile strength. For an example of the housing see documentation no. 12660/0-01.
Metrological important parts only are accessible after breaking one or more seals.

1.4.1.1 External power supply
The EVCD is powered using redundant AC power supply in the range 100…230 VAC at 50/60 Hz

1.4.2 Multi stream (optionally)
The EVCD may be constructed such that up to 6 separate IO PCA units could be attached to it. Each IO PCA holds a separate expansion IO slot and can operate up to 3 streams simultaneously. By pressing the "Select" button beside the display it is possible to toggle through the different IO PCA units. The LED lights above the "Select" button highlights exactly which IO PCA is being displayed. The inscription nameplate attached to each IO PCA displays the assigned SLOT number.

Figure 5 Selection key to display multi stream slots.

1.4.3 Remote indicating device

The Sigma³ is always combined with the human interface software type HMI-207CE by the same manufacturer that can be installed on a remote device connected via ethernet and is intended for reading stored measurement data and for setting of parameters for the EVCD. Software specification for HMI client software HMI-207CE (refer to WELMEC 7.2):

- Software type U;
- Risk Class C;
- Extension T and S;

while extensions L and D are not applicable or excluded.

Software version HMI-207CE	CRC checksum	Remarks
2.0.1	6c102ed4584efa73e379b163d48e7acf	-

The validity of the program and the parameters are continuously checked. If these checks fail, an alarm is generated. The metrological software is identified by the software version and/or checksum, which can be checked on the local display via the menu structure **Help → Info**

1.4.4 Grounding

The EVCD should be externally grounded in the field according to manufacturer's specification. Please refer to the user manual for details of grounding.

1.5 Conditional characteristics

1.5.1 Gas meter impulse input

The EVCD has an impulse input from gas meter which has to be with a minimum amplitude of 24 V DC. The maximum frequency is not higher than 50 kHz if the gas meter is running at Q_{max}. The pulse input low signal should not be floating. It must be tied down to power ground for proper operation. The lowest frequency is 10 Hz.

2 Seals

The following items are sealed:

- The inscriptions are fixed to the electronic calculating and indicating device and secured against removal by a sticker seal.
- The expansion IO cards or covers when not all slots are used, are sealed against removal using sticker seals;
- The electronic calculating and indicating device is sealed against opening;
- The physical sealing key position is sealed using a sticker seal after putting the device in custody transfer mode;
- Cables connected to the electronic calculating and indicating device are sealed against removal.
- External indicating device connected to the electronic calculating and indicating device is sealed against removal using sticker seals.
  Connection between the external indicating device and the electronic calculating and indicating device are sealed against removal using sticker seals.

The contents of the audit trail will be displayed after pressing the key sequence:
System -> Audit Log

See below for an example of the sealing positions.

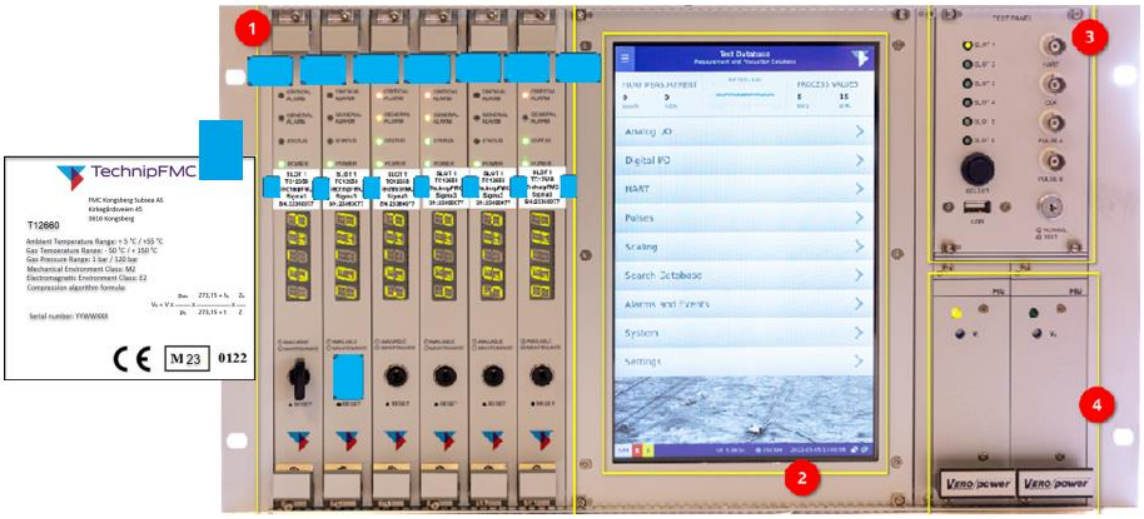

Figure 6 Sealing of name plate, sealing of expansion IO PCA front side, sealing of physical securing key using sealing stickers.

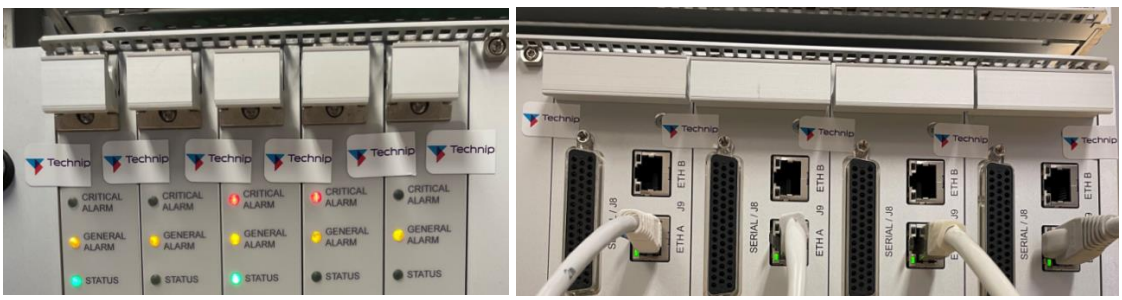

Figure 7 Example of sealing of Expansion IO PCA front side (left); back side (Right).

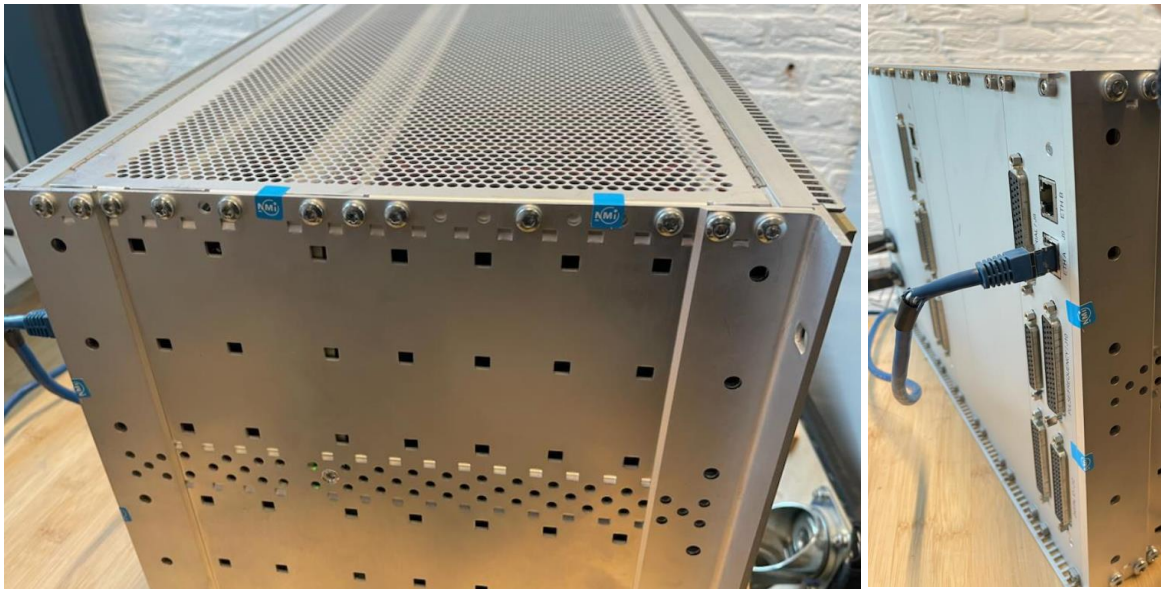

Figure 8 Example sealing of Sigma³ against opening using sticker seals from back and sides.

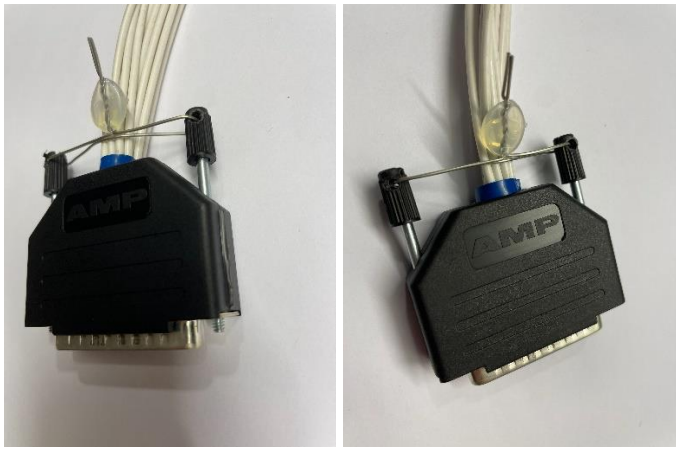

Figure 9 Example of sealing of cables connected to Sigma³ against removal using wire and lead seals.