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THE POWER OF **CONNECTED**

Flow Computer
Device Series enCore FC
FC1, MC1

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Manual
Station AFB

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1 About these Instructions

The enCore FC manual has a modular design. To get an overview of the enCore/enSuite concept, the structure of the manual, safety and risk instructions, and the text labeling, refer to the "Operating Instructions" of the enCore FC manual.

The present volume describes the basic functionality and operation of the Station AFB. Parameterization is explained in this document only by way of example as the meaning of individual parameters is documented in detail in the online help of enSuite.



Online help

In enSuite, you can call up the general help via the menu item **Help – ? [Show online help](#)**. Open the context-sensitive help directly from the desired branch in the parameterization window with **[F1]**.

This part of documentation is intended for specialist personnel who are responsible for the service activities of the following tasks after the successful assembly of the device and installation of the latest enSuite version on PC:

- customizing of device parameterization to the measuring task
- test of all data points and commissioning
- other service activities

The illustrations in this manual serve to depict the facts that are being explained, and therefore may differ from the actual design depending on the configuration of the device and enSuite.

2 Functional Description

The `Station AFB` is an **Application Function Block** for enCore devices. It provides different functions for controlling and monitoring a measurement plant, for example calculating the total flow during multi-stream operation or the VOS comparison when using an ultrasonic gas meter.

It is divided in the following functional areas:

- ⇒ [2.1 Calculating the Station Flow Totals](#) (p. 5)
- ⇒ [2.2 Converting the Event Messages in a Bit String](#) (p. 10)
- ⇒ [2.3 VOS Comparison](#) (p. 11)
- ⇒ [2.4 Meter Comparison for Meters Connected in Series](#) (p. 14)

2.1 Calculating the Station Flow Totals

The `Station AFB` offers the option to calculate the total flow rate Q of several measurement paths for the base flow Q_b , the flow at measurement conditions Q_m , the energy flow Q_E or the mass flow Q_M . Additionally, a related total counter for volume at base conditions, volume at measurement conditions, energy or mass is generated.

The function can thus be used for both gas as well as liquid measurements. Depending on the application you can use either the measured flow values from the Basic System or the calculated flow rates as input values, e.g. from AFBs of the type `Flow Conversion` or `Liquid Flow Conversion`.

Overall, the function can be used up to 10 times, each time considering up to 5 measurement paths. In every used entity of the function, you can either choose only the flow rates, only the counter values, or both flow rates *and* counter values as input values.

In principle, the indication of either all flow rates or all counters suffices for the calculation of total flow and total counter. In case that the input values of one of the physical quantities (flow rates or counters) are not assigned, the corresponding export value is calculated using the other physical quantity. Therefore, always both total flow and total counter are made available as export values.

However, the results tend to be more accurate if the summation is done using direct input values instead of values derived from the alternative input values.



Use both flow rate *and* total counter as input values

If you want to use the input values of both physical quantities (flow rate and counter), you have to take care that you choose each time the corresponding input values, i.e. originating from the same source. Otherwise, the export values for total flow rate and total counter do not correlate.

Parameterize station flow totals in enSuite

Prerequisite:

- The flow rates are made available by the Basic System or by other AFBs, e.g. a `Flow Conversion AFB`. Parameterize this AFB before parameterizing the station flow totals.
⇒ volume “Flow Conversion AFB” of the enCore FC manual
- The desired parameterization is opened in the branch `<device> – [<Group> –] <Station AFB>`.

- ▶ Open the folder **Station flow totals**.
- ✓ In order to add a new total flow, click the plus sign **+** on the tab **Parameters**.
- ✓ The tabular view **Station flow totals** contains a new section **Total flow <x>**.
- ▶ In the column **Value** select the physical quantity for the total flow which shall be calculated:
 - **Volume flow (base conditions)**

- **Volume flow (meas. conditions)**
(only reasonable for liquid measurements)¹
 - **Energy flow**
 - **Mass flow**
- ✓ For each defined **Total flow <x>** you can now parameterize up to 5 measurement paths.

To calculate counter input values, ...

- ▶ ... import into the parameter **Counter input 1** up to **Counter input 5** either counter values from the Basic System or calculated counters (e.g. from AFBs of *Flow Conversion* or *Liquids Flow Conversion* type), corresponding to the selected physical quantity of the total flow.
 -  volume at base conditions V_b
 -  volume at measurement conditions V_m
(only reasonable for liquid measurements)
 -  energy E
 -  mass M

To calculate flow rate input values, ...

- ▶ ... import from tab **Export value** into parameter **Flow input 1** up to **Flow input 5** either measured flow rates from the Basic System or calculated flows (e.g. from AFBs of *Flow Conversion* or *Liquids Flow Conversion* type), depending on the selected physical quantity of the total flow:
 - Import the volume flow at base conditions from the corresponding *Flow Conversion* AFB:
[<Group>.] – <Flow Conversion AFB> – Calculations –  Q_b

¹ Calculating a total flow for the volumes at measurement conditions is reasonable only if liquids are measured, i.e. in combination with AFBs of the type *Liquid Quality AFB* and *Liquid Flow Conversion AFB*.

- Import the volume flow at measurement conditions either from the Basic System or from an AFB, which provides the volume flow at measurement conditions, e.g. an Liquid Flow Conversion AFB.
- Import the energy flow from the corresponding Flow Conversion AFB:
[<Group> –]<Flow Conversion AFB> – Calculations
–  QE
- Import the mass flow from the corresponding Flow Conversion AFB:
[<Group> –]<Flow Conversion AFB> – Calculations
–  QM



Erroneous input values

The total flow Q is marked as erroneous as soon as one of the input values **Flow input 1** up to **Flow input 5** is disturbed. An erroneous flow rate is also added when calculating the total flow Q , provided a value is available.

To let the input values of the related measuring path enter the calculation of total flow and total counter only as long as a specified message is pending,

- ▶ ... assign a message to **Inputs 1 active** up to **Inputs 5 active**.
- ▶ Adapt the sign for the input value in the parameters **Sign of inputs 1** up to **Sign of inputs 5**:
 - **+** (Plus sign) (*default*)
 The related input values are added for the calculation of the export values Total flow and Total counter.
 - **-** (Minus sign)
 The related input values are subtracted for the calculation of the export values total flow and total counter. If the total flow is negative, it assumes the value of zero (0) and will be marked as being erroneous. If the increment of the total counter is negative in

a calculation cycle, it is ignored, i.e. the total counter does not change.

-  Based on the parameterized input values, the Station AFB calculates the total flow Q for the chosen flow rate quantity and generates a corresponding total counter for the flowed amount:
- Volume flow (base conditions)
 -  **Q_b total** total flow for volume at base conditions
 -  **V_b total** total counter for the flown volume at base conditions
 - Volume flow (measurement conditions)
 -  **Q_m total** total flow for volume at measurement conditions
 -  **V_m total** total counter for the flown volume at measurement conditions
 - Energy flow
 -  **QE total** total flow for energy
 -  **E total** total counter for the flown energy
 - Mass flow
 -  **QM total** total flow for mass
 -  **M total** total counter for the flown mass

2.2 Converting the Event Messages in a Bit String

The function **Creating set of bits** converts up to nine event messages in one 2-bytes long bit string and provides it as an export value (presented as type signal). This export value can be transferred using a protocol such as Modbus.

The input messages are converted in the following bit positions (Bit 0 up to Bit 8) – Bit 9 up to Bit 15 always have the value zero (0):

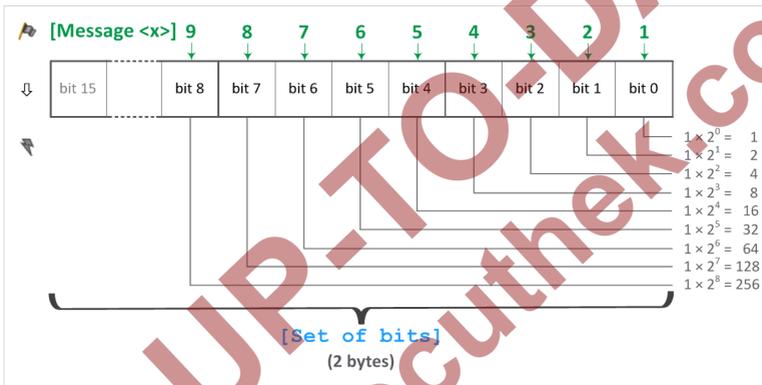


Fig. 2-1: Overview of the bit position (converted)

You can use the bit pattern to draw conclusions as to which message or messages are currently pending. For example, the bit pattern 0000 0001 0000 1010 is for the binary-coded number 266 and indicates that the messages **Message 2 (bit 1)**, **Message 4 (bit 3)** and **Message 9 (bit 8)** are pending.

You can use the function **Creating set of bits** to monitor multi-streams measurement plants and check if the volume measurements are still functioning in an error-free manner. Thus, by converting the message **Volume measurement alarm** of the used **Flow Conversion AFB** in a bit string and transmitting it in form of a signal using the **Modbus AFB** to the control center.

Parameterize “Creating set of bits” in enSuite

Prerequisite:

- The desired parameterization is opened in the branch **<device> – [<Group>] – <Station AFB>**.
- ▶ Open the section **Creating set of bits**.
- ▶ Import the desired event messages into the parameter **Message 1 (bit 0)** up to **Message 9 (bit 8)**.
The messages can be of the type  warning,  alarm or  hint.
- The parameterized event messages are converted in a bit string; the bit string is provided to other AFBs as export value  **Set of bits**.
- ▶ Import the bit string in the desired protocol.
If you wish to transfer the bit string for instance using Modbus, then import the  **Set of bits** in an **Modbus AFB** as a register of type **Export Signal** into the parameter **Input**.

2.3 VOS Comparison

The VOS comparison monitors to see whether the measured velocity of sound (e.g. from a ultrasound gas meter) differs from the calculated velocity of sound. The calculation of velocity of sound (**Velocity Of Sound**, abbreviated as: VOS) is carried out by the **Gas Quality AFB** on the basis of the complete gas analysis according to the AGA10 procedures.

The VOS comparison is activated as soon as the input values are parameterized. However, you can even choose that the VOS comparison is carried out only if a particular message is pending.

Optionally, you can parameterize limit monitoring. Here, the **Station AFB** differentiates between a prewarning limit and a warning limit. Moreover, the AFB can observe a time delay, before a prewarning or warning message is generated due to exceeded limits.

Parameterize VOS comparison in enSuite

Prerequisite:

- The calculation process according to AGA10 is activated for the relevant *Gas Quality AFB* and a complete gas vector x_1 as well as the measurement conditions (t, p) are parameterized.
⇒ volume “Gas Quality AFB” of the enCore FC manual
- The desired parameterization is opened in the branch **<device> – [<Group>] – <Station AFB>**.

- ▶ Open the section **VOS comparison**.
- ▶ Import the measured velocity of sound from the Basic System into the parameter **Measured VOS (Input)**.

The export branch is for instance:

- for connection via COM port:
Basic System – I/O boards – Board <no.>: <board> – RSA RSB: USM <no.> –  VOS average
- for connection via LAN interface resp. Modbus IP:
Basic System – Measurements via IP – Ultrasonic gas meters – USM <no.> –  VOS average

- ▶ Import the calculated velocity of sound from the *Gas Quality AFB* into the parameter **Calculated VOS (Input)**.

The export branch is for instance:

[<Group> –]<Gas Quality AFB> – AGA10: Used –  VOS

-  The VOS comparison is activated. The *Station AFB* determines the percentage **% Deviation** of the measured velocity of sound from the calculated velocity of sound.

In order to parameterize a warning limit for the deviation, ...

- ▶ ... enter the desired percentage value in the parameter **Deviation warning limit**.
-  The message  **Warning VOS comparison** is generated as soon as percentage deviation exceeds the warning limit.

- ▶ Enter the desired duration in the parameter **Deviation warning delay** in order to take into consideration a time delay in case the warning limit is exceeded.
- The message  **Warning VOS comparison** is generated only if the deviation exceeds the warning limit and if this limit violation is still pending even after the course of parameterized duration.

Proceed similarly to set a prewarning limit for the deviation ...

- ▶ ... enter the desired percentage value in the parameter **Deviation prewarning limit**.
- The message  **Prewarning VOS comparison** is generated as soon as percentage deviation exceeds the prewarning limit.
- ▶ Enter the desired duration in the parameter **Deviation prewarning delay** in order to take into consideration a time delay in case the prewarning limit is exceeded.
- The message  **Prewarning VOS comparison** is generated only if the deviation exceeds the prewarning limit and if this limit violation is still pending even after the course of parameterized duration.

In order to activate the VOS comparison only when a particular event message is pending, ...

- ▶ ... import the desired  message into the parameter **Input for activation**.
- The VOS comparison is carried out only while the message is pending.

Example

- ▶ Import the message  **$Q_m > 0$** from the **Flow Conversion AFB** in order to carry out the VOS comparison only when the gas actually flows through the pipe.
 - The VOS comparison is carried out only while this message is pending.
-

Limit monitoring in the overview

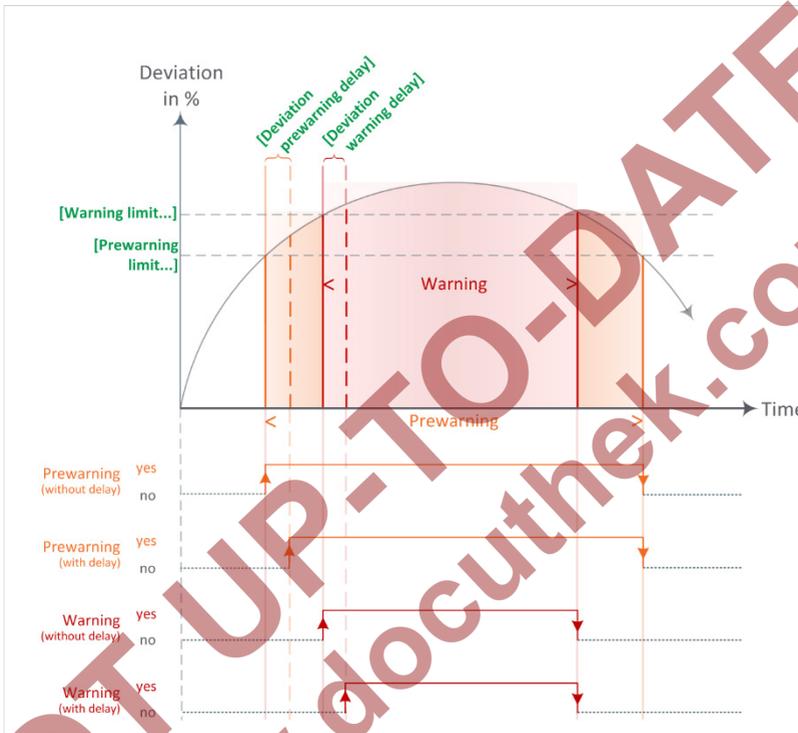


Fig. 2-2: VOS comparison – limit monitoring

2.4 Meter Comparison for Meters Connected in Series

If you use two meters connected in series, you can carry out a meter comparison with the help of the `Station AFB` and can monitor the deviation in both measurements concerning volume, energy and/or mass flow. The function can be used for both gas as well as liquid measurements.

Optionally, you can even choose that the meter comparison is carried out only if a minimum flow (**Qmin**) is exceeded for the primary or the secondary measurement device.

The `Station AFB` distinguishes between the **Automatic** and **Manual** operating modes. In **Automatic** operating mode the AFB automatically re-

starts the meter comparison after a comparison cycle has ended; whereas you specifically carry out a *single* meter comparison in **Manual** operating mode. The duration of a comparison can be parameterized; a manual comparison is started manually and can also be stopped manually before the comparison cycle has ended.

In **Automatic** operating mode, a limit monitoring can be carried out additionally.

Parameterize meter comparison in enSuite

The meter comparison is parameterized exemplarily for measurements of a turbine meter and an ultrasonic meter:

- ▶ For the folder **Meter comparison** select in the column **Value** the physical quantity for the comparison:

- **Volume (base conditions)**
- **Volume (meas. conditions)**
(only reasonable for liquid measurements)²
- **Energy**
- **Mass**

✓ The column **Value** for the parameter **Counter primary meter** and **Counter secondary meter** is assigned with the symbol of the selected counter:

-  Volume at base conditions V_b
-  Volume at measurement conditions V_m
-  Energy E
-  Mass M

²Meter comparison of volumes at measurement conditions is reasonable only if liquids are measured, i.e. in combination with AFBs of the type **Liquid Quality AFB** and **Liquid Flow Conversion AFB**.

- ▶ Import the primary measurement counter into the parameter **Counter primary meter**.

Example

Import the volumes at base conditions v_b from the Flow Conversion AFB, which generate the counters for the turbine meter, into the parameter **Counter primary meter**.

The export branch is for instance: **Flow Conversion 1 – Calculations –**

 v_b

- ▶ Import the secondary measurement counter into the parameter **Counter secondary meter**.

Example

Import the volumes at base conditions v_b from the Flow Conversion AFB, which generate the counters for the ultrasonic meter, into the parameter **Counter secondary meter**.

The export branch is for instance: **Flow Conversion 2 – Calculations –**

 v_b

In order to activate and carry out the comparison only when a minimum flow is exceeded, ...

- ▶ ... activate the check box **Used** in the context menu of the parameter **Qmin**.
 - ▶ Enter the desired limit in the column **Value**.
-  The Station AFB starts the meter comparison only when at least one of the meters (Counter **primary meter** or **Counter secondary meter**) exceeds the minimum flow.
- A meter comparison will end before the **Comparison time** if the flow rate of both the meters are below or equal to **Qmin**.

In order to change the duration of comparison cycle, ...

- ▶ ... adapt the value of the parameter **Comparison time** – the default is **3600 s**.

Note that a value smaller to or equal to zero deactivates the meter comparison.

- Once started, the meter comparison determines the difference and the percentage deviation and provides the currently determined deviation during the parameterized **Comparison time** (Δ cycle) in the export value **% Current deviation**.
- As soon as a cycle is completed or has ended before time, the currently determined difference and the **% Current deviation** are copied to the export values    **Last difference** as well as **% Last deviation**. Subsequently, the **% Current deviation** is set to zero (0) till the next comparison begins and the value is calculated anew.



Prerequisites for executing meter comparison

As a general rule, the meter comparison is carried out only if the input values for the **Counter primary meter** and the **Counter secondary meter** are *not* marked as erroneous and – in case a minimum flow **Qmin** is parameterized – the absolute input value of at least one meter is exceeding **Qmin**.

If an input value is marked as erroneous, or both absolute values are below or equal to **Qmin**, then the current meter comparison is stopped.

In this case, the recently determined difference and deviation are copied to the export values    **Last difference** as well as **% Last deviation**. Subsequently, the export value **% Current deviation** is set to zero (0), marked as erroneous and highlighted in red font.

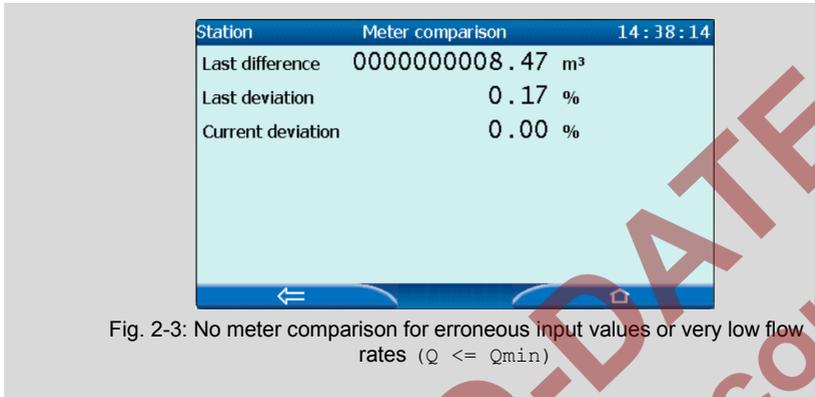


Fig. 2-3: No meter comparison for erroneous input values or very low flow rates ($Q \leq Q_{\min}$)

In order to parameterize the meter comparison operating mode, ...

► ... select the operating mode from the drop-down list **Mode**:

- **Automatic** (*default*)
- **Manual**

In this operating mode, activate the meter comparison manually at the device or via enSuite using the remote operation panel.

☰ For the operating mode ...

- **Automatic...**
... the meter comparison is carried out cyclically for the parameterized **Comparison time**.

After an error the meter comparison is automatically re-started as soon as both input values are error-free and **Q_{min}** is exceeded, in case **Q_{min}** is parameterized.

- **Manual**
... the action [Start comparison](#) is displayed in the display **Meter comparison**.

The meter comparison is carried out as soon as the action is triggered. As long as the meter comparison is running, the text **Manual comparison in progress** is displayed for the course of meter comparison. You can end the meter comparison before the **Comparison time** using the action [Stop](#).

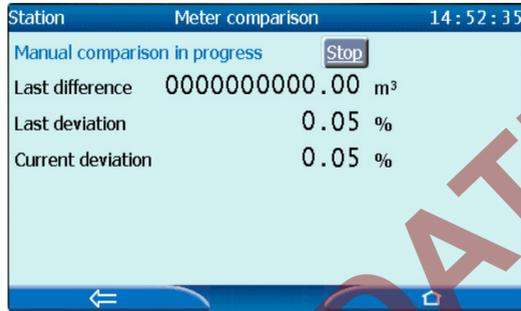


Fig. 2-4: **Manual** operating mode – currently running meter comparison

After an error the meter comparison can be re-started manually as soon as both input values are not in error and the parameterized minimum flow **Q_{min}** is exceeded.



Online parameterization

If you change the operating mode **Mode** via online parameterization, the change takes effect only after the current carried out meter comparison has ended.

Optionally you can parameterize a limit monitoring in **Automatic** operating mode:

- ▶ Activate the check box **Used** in the context menu of the relevant parameter **Alarm limit** and/or **Warning limit**.
 - ▶ Parameterize the desired percentage value for the parameter **Alarm limit** and/or **Warning limit**.
-  If the determined deviation at the end of the comparison cycle exceeds ...
- ... the **Warning limit**, the message  **Warning** is generated.
 - ... the **Alarm limit**, the message  **Alarm** is generated.
-  An alarm or warning message ends only after a new comparison is completed *without* exceeding the relevant limit.



Limit monitoring only for the “Automatic” operating mode

Note that the parameterized limits are utilized only for the **Auto-**
matic operating mode, however, not for the **Manual** operating
mode.

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3 Display and Operation

The values of the VOS comparison and of the Meter comparison are displayed in the device displays of the Station AFB.



Display and Navigation in enCore devices

The general layout of displays for enCore devices and the basic navigation options are documented in detail in the “Station AFB” of the enCore FC manual in chapter for display and navigation.

Generally, hyperlinks and actions are distinguished during the device operation – both are shown with blue underline on the device and in the manual. Navigate through the device displays using hyperlinks, carry out a specific functionality with actions.

A list of symbols and names shown below is available in the appendix (⇒ appendix [4.1 Nomenclature](#), p. 24).

3.1 Displays at a Glance

The following figure sketches the hierarchical order and the navigation through the displays of the Station AFB:

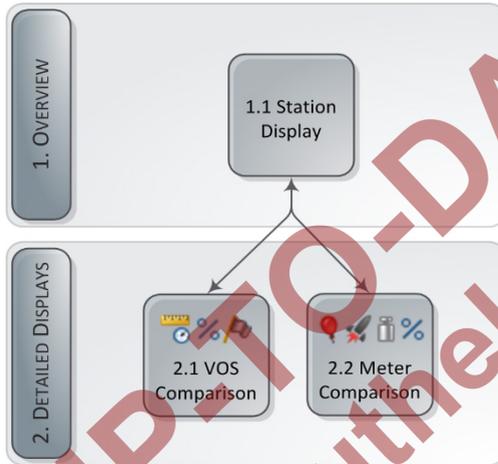


Fig. 3-1: Displays – hierarchical structure

3.2 Displays in Detail

From the first display of a *Station AFB* you can switch to both detailed displays to view the values from the VOS comparison and the Meter comparison. The main display does not show any values.

The main display and its target displays

Main Display	⇒ [<Target display>]
VOS Comparison	⇒ 2.1 VOS Comparison Measured VOS measurement of gas meter Calculated VOS calculated value of device Deviation current deviation in % VOS comparison inactive!!!³ Prewarning!!!⁴ Warning!!!⁴
Meter Comparison	⇒ 2.2 Meter Comparison [Start comparison Stop] ⁵ Last difference last counter difference Last deviation last counter deviation in % Current deviation curr. counter deviation in % Deviation warning!!!⁶ Deviation alarm!!!⁶

Table 3-1: The main display and its target displays

³ This text is displayed only if the message in parameter **Input for activation** is not pending and therfor the VOS comparison has been deactivated.

⁴ These messages are displayed only when a prewarning or a warning limit has been parameterized and exceeded (section **VOS comparison**, parameter **Deviation prewarning limit/Deviation warning limit**).

⁵ These actions are displayed only in the **Manual** operating mode, depending on the context.

⁶ These messages are displayed only when a limit monitoring has been parameterized and the warning or alarm limit has been exceeded (section **Meter comparison: <Counter>**, parameter **Alarm limit/Warning limit**).

4 Appendix

4.1 Nomenclature

The following symbols and names are used in the enCore FC and in enSuite for measuring data and calculated values in the context of Station AFB:

Symbol	Abbreviated as	Description
	VOS	measured or calculated velocity of sound
	-	percentage deviation
	-	binary-coded bit string (Set of bits), which represents up to 9 messages
	Q _b	volume flow at base conditions
	Q _m	volume flow at measurement conditions
	Q _c	volume flow at measurement conditions (corrected)
	Q _E	energy flow
	Q _M	mass flow
	V _b	volume at base conditions
	V _m	volume at measurement conditions
	E	energy
	M	mass

Table 4-1: Nomenclature

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