

Honeywell

THE POWER OF **CONNECTED**

Flow Computer
Device Series enCore
FC1

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Manual
Flow Conversion 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.

The present volume describes the basic functionality and operation of the Flow Conversion 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 current enSuite version on PC:

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

The illustrations in these instructions serve to depict the facts that are being explained, and therefore deviate depending on the configuration of device and enSuite.

2 Functional Description

The flow conversion is an **Application Function Block** for enCore devices. Its main task is to calculate the measured volumes of natural-gas from measurement conditions to base conditions (flow conversion). In addition, the mass and energy of natural gas are also calculated (energy conversion). The **Flow Conversion AFB** always carries out this task along with the **Basic System** and the **Gas Quality AFB**:

- **Basic System**

The **Basic System** comprises the connections, parameterization and management of used measurement devices such as gas meters, pressure and temperature transmitters and, if required, gas quality measurement devices.

It prepares the input data and provides the volume at measurement conditions V_m and the flow rate Q to the **Flow Conversion AFB**; the temperature t and the pressure at measurement conditions p as well as optionally the analysis of natural gas to the **Gas Quality AFB**.

⇒ section [Parameterizing input values in enSuite](#) (p. 9)

Set an activation signal in the **Basic System** for the special case when you use two or multiple flow directions.

⇒ chapter [4.7 Representing Two Flow Directions](#) (p. 52)

- **Gas Quality AFB**

This AFB provides the essential specifications of gas such as the volume- and mass-based heating values, the conversion factor C , as well as the density at measurement conditions ρ_m and at base conditions ρ_b .

⇒ section [Set calculations in enSuite](#) (p. 18)

- **Flow Conversion AFB**

The **Flow Conversion AFB** calculates the flown volumes at base conditions, the energy and the mass based on the input values from the **Basic System** and the **Gas Quality AFB**.

For accounting and testing purposes, it manages various counters for the volume at measurement conditions V_m and the volume at base conditions V_b as well as for the energy E and the mass M .

Optionally, it can carry out an error curve correction of the gas meter and generate corrected counters ∇_c .

A flow conversion requires at least one **Flow Conversion AFB** and one **Gas Quality AFB**, besides the Basic System. This configuration depicts a single-stream operation with one flow direction.

The modularity of the enCore FC facilitates the realization of various extended operational and technical-measurement requirements. The number of measuring streams and their flow directions which the enCore FC can process is variable and is determined by the number of board slots as well as the configuration of hardware and software (\Rightarrow the “Operating Instructions” of the enCore FC manual).

For a single-stream operation with two flow directions, combine, e.g., two **Flow Conversion AFBs** with only one **Gas Quality AFB** and one Basic System.

The following is applicable in general:

- You require one **Flow Conversion AFB** for every stream and for every flow direction.
- For every **C** calculation which is based on different measured data such as pressure, temperature and/or gas quality (abbreviated as: **GQ**) or on different calculation specifications, you require another **Gas Quality AFB**.

The **Flow Conversion AFB** is divided in the following functional areas:

- \Rightarrow [2.1 Monitoring the Input Values of Gas Meters](#) (p. 8)
- \Rightarrow [2.2 Meter Correction \(optional\)](#) (p. 15)
- \Rightarrow [2.3 Flow Conversion](#) (p. 17)
- \Rightarrow [2.4 Managing Counters](#) (p. 20)

For a flow chart showing the interaction of the single functional areas refer to \Rightarrow chapter [2.5.1 Flowchart](#). (p. 30).

2.1 Monitoring the Input Values of Gas Meters

You can monitor minimum flow rate (Q_{min}) and/or maximum flow rate (Q_{max}) of the gas meter, distinguish the start and stop of gas streams from failure and control the counters specific to the measurement plant.

Optionally, you can activate a slider control.

- ⇒ [2.1.1 Monitoring Maximum Flow Rate](#) (p. 10)
- ⇒ [2.1.2 Monitoring the Minimum Flow Rate](#) (p. 11)
- ⇒ [2.1.3 Monitoring valves \(optional\)](#) (p. 14)

Firstly, a brief overview of configuration options in case of Q_{min}/Q_{max} monitoring:

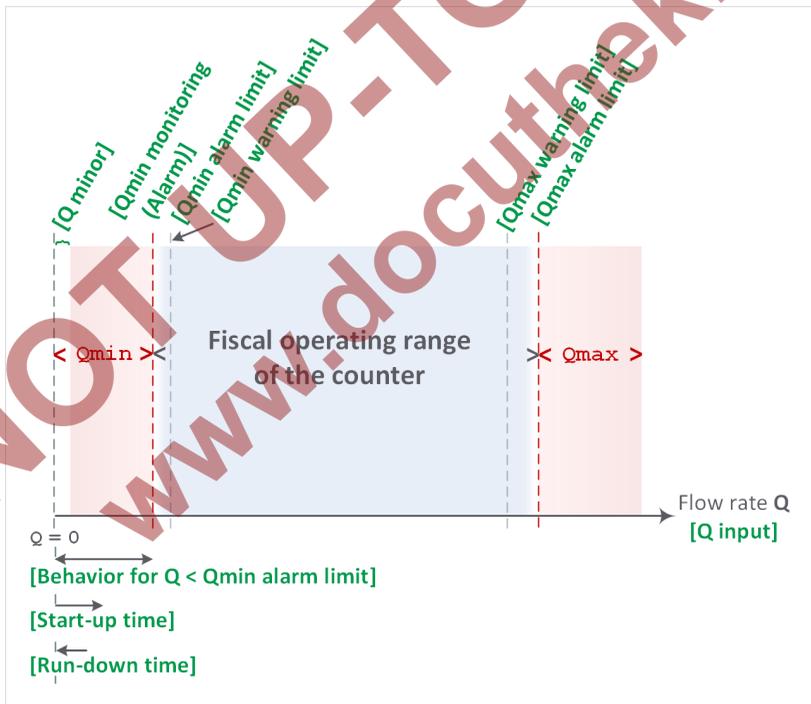


Fig. 2-1: Overview of Q_{min}/Q_{max} monitoring

The **Flow Conversion AFB** uses the flow rate and (optional) the volume of natural gas, which is provided by the Basic System, as input values for monitoring.

Parameterizing input values in enSuite

- ▶ Open the desired parameterization  in enSuite.
- ▶ Change to branch **<Device> – [<Group> –] <Flow Conversion AFB>**.
- ▶ On tab **Parameters** go to section **Measurement conditions**.
- ✓ This section contains all parameters that are important for monitoring the input values.
- ▶ Enter the gas volume from the basic system in the parameter **V Input** – this parameter is *optional*.

Example

If the volume is taken from the Basic System, which uses the measurements of a turbine meter, import, for instance, the value of the tab **Export values** from the branch **Basic System – I/O – I/O boards**.
Board 1: ExMFE5 – Z1+ Z1– –  Amount.

-  This value is used for all volume-based calculations, e.g. for increasing of counters.
- ▶ Enter the flow rate from the Basic System in the parameter **Q Input** – this parameter is *compulsory*.

Example

If the flow rate is taken from the Basic System, which uses the measurements of a turbine meter, import, for instance, the value of the tab **Export values** from the branch **Basic System – I/O – I/O boards**.
Board 1: ExMFE5 – Z1+ Z1– –  Flow rate.

-  This value is used for all flow rate-based calculations, e.g. for monitoring Q_{min} and Q_{max} .



Use of volume and flow rate input

If the gas meter provides the volume and the flow rate via the Basic System, you should assign both the values. The same input sources must be specified in both the parameters. This is the normal operating mode.

If the gas meter provides only the flow rate, the **V input** may remain blank. In this case, the volume-based calculations are performed by integrating flow rate via time.

2.1.1 Monitoring Maximum Flow Rate

The enCore FC can monitor the maximum flow rate (Q_{max}) and generate – depending on the parameterization – corresponding messages when warning or alarm limit is reached. These can be used e.g. to control a gas plant.

Set Q_{max} monitoring in enSuite

Take the value for the alarm limit from the specific values of the connected gas meter. You can choose the warning limit plant-specific depending on the application.

Prerequisite:

- The desired parameterization  is opened on branch **<Device> – [Group –] <Flow Conversion AFB>** in section **Measurement conditions**.
 - ▶ To set a warning limit, enter the desired value in the parameter **Q_{max} warning limit**.
 -  The device generates the message  **Q_{max} warning** as soon as this flow rate value is reached.
 - ▶ To set an alarm limit, enter the specific value of the gas counter in the parameter **Q_{max} alarm limit**.
 -  The device generates the message  **Q_{max} alarm** as soon as this limit is reached.

2.1.2 Monitoring the Minimum Flow Rate

Also when monitoring the minimum volume flow at measurement conditions, the `Flow Conversion AFB` distinguishes between a warning and an alarm limit and generates corresponding messages when the monitoring function detects an error.

When monitoring the lower alarm limit, the enCore FC can take into account the start-up and run-down times which the connected gas meters require when starting and stopping the gas plant. An alarm or warning message is only generated when the flow rate falls below the alarm limit however is still above the parameterized minor flow limit after the expiry of start-up and run-down time.

If the measured flow rate is below the **Qmin alarm limit**, you have various options to determine the behavior of derived flow rates and meters.

Set **Qmin monitoring** in enSuite

Parameterize (if required) the specific values of the connected gas meter.

Prerequisite:

- The desired parameterization  is opened on the branch **<Device> – [Group –] <Flow Conversion AFB>** in section **Measurement conditions**.

In order to activate the Qmin monitoring, ...

- ▶ ... activate the checkbox of the parameter **Qmin monitoring**.
-  The monitoring of minimum flow rate is switched on. All further parameters for Qmin monitoring are taken into account by the device.

In order to set a warning limit, ...

- ▶ ... enter the desired value in the parameter **Qmin warning limit**.
-  As soon as the devices detects that the criteria for the warning are met, taking into account all influencing parameters, the device generates the message  **Qmin warning**.

In order to set an alarm limit...

- ▶ ... enter the desired value in the parameter **Qmin alarm limit**.
- ▣ As soon as the device detects that the criteria for the alarm are met, taking into account all influencing parameters, the device generates the message 🚩 **Qmin alarm**.
- ▶ To set a minor volume limit, enter the desired value in the parameter **Q minor**.
- ▣ If the flow rate drops below this value, all the flow rates are set to the zero (0) and all the counters are stopped.
In this case, flow rate related warning and alarm messages are not generated.



Special case: minor volume suppression

The following is applicable in general: Activate the volume suppression by parameterizing **Q minor** only if the resolution of flow rate signals is high enough, e.g. if HF pulses are available in case of a turbine meter.

Due to their mass inertia, some gas meter types require some time to adapt to the new conditions after the start or stop of gas line. This adaptation time can be taken into account as start-up and run-down time in case of Qmin monitoring.

- ▶ Select in the drop-down list **Use start-up and run-down time** for which case the start-up and run-down time shall be considered:
 - **only for Qmin alarm (default)**
When evaluating whether a Qmin alarm is set, the start-up and run-down times are taken into account.
 - **for Qmin alarm and Qmin warning**
The start-up and run-down times are taken into account both when evaluating whether a Qmin warning is present and whether a Qmin alarm is present.

- ▶ If required, enter the time in the parameter **Start-up time** which the gas meter requires for adaptation when starting the gas stream.

- The start-up time begins when the minor volume limit **Q minor** is exceeded.

If the parameterized time expires and the flow rate still lies between **Q minor** and **Qmin alarm limit**, the message 🚩 **Qmin alarm** is generated.

- ▶ If required, enter the time in the parameter **Run-down time** which the gas meter requires for adaptation when stopping the gas stream.

- The run-down time begins when the flow rate falls below **Qmin alarm limit**.

If the run-down time expires and the flow rate still lies between...

- ...**Q minor** and **Qmin alarm limit**, the message 🚩 **Qmin alarm** is generated.
- ...**Q minor** and **Qmin warning limit**, the message 🚩 **Qmin warning** is generated.

Prerequisite:

The parameter **Use start-up and run-down time** is set to for **Qmin alarm and Qmin warning**.

If required, enter the time in the parameter **Run-down time** which the gas meter requires for adaptation when the gas stream is being closed.

- If the Run-down time is also taken into account for the evaluation of a **Qmin warning (Use start-up and run-down time is set to for Qmin alarm and Qmin warning)**, then the Run-down time for alarm and for warning is considered separately.

The run-down time for alarm begins when the flow rate falls below **Qmin alarm limit**.

The run-down time for warning, on the other hand, begins when the flow rate falls below **Qmin warning limit**.

If the run-down time for warning has expired and the flow rate is still between the **Qmin warning limit** and **Q minor**, the 🚩 **Qmin warning** message is generated.

If the run-down time for alarm has expired and the flow rate is still between the **Qmin alarm limit** and **Q minor**, the **Qmin alarm** message is generated.

 (default behavior)

If the Run-down time is only taken into account for the evaluation of a Qmin alarm (**Use start-up and run-down time: only for Qmin alarm**), the run-down time starts as soon as the flow rate falls below **Qmin alarm limit**. If the run-down time for alarm has expired and the flow rate is still between the **Qmin alarm limit** and **Q minor**, the **Qmin alarm** message is generated.

- ▶ In parameter **Behavior for Q < Qmin alarm limit**, define the behavior in case the flow rate falls below the parameterized **Qmin alarm limit**.
 - **Q_m, ΔV_m as measured (default)**
The current measurement for the volume flow at measurement conditions Q_m is still used and the measured volume progression still entered in the counters.
 - **Q_m := 0, ΔV_m := 0**
The volume flow at measurement conditions Q_m is set to zero (0) and all the counters are stopped.
 - **Q_m as measured, ΔV_m := 0**
The current value for the volume flow at measurement conditions Q_m is still used, however all the counters are stopped.

2.1.3 Monitoring valves (optional)

The valve control function allows you to monitor whether the valves of the measuring section are still functioning without interference. As soon as the AFB receives the information that a stream is closed, it checks whether the currently measured operating flow rate exceeds the parameterized minor flow rate despite a closed valve ($Q > Q_{\text{minor}}$). If this is the case, the AFB generates a corresponding message.

Parameterizing valve control in enSuite

Prerequisite:

- The desired parameterization  is opened on branch:
 <Device> – [ <Group> –]  < Flow Conversion AFB >

► On the **Parameter** tab, switch to the section **Measurement conditions**.

To activate the function, ...

- ... in the **Valve control** parameter, import the event message indicating whether the associated stream is currently closed or not.
-  The function is activated. As soon as the stream is closed, the AFB monitors whether Q is greater than Q_{minor} .
If this is the case, it generates the message  **Q while closed**.



Reset of message Q while closed

The message ends under the following conditions:

- The valve control is deactivated, i.e. no message is assigned to the parameter **Valve control**.
- The stream is open.
- The measured flow rate falls to the parameterized minor flow rate or below ($Q \leq Q_{\text{minor}}$).

2.2 Meter Correction (optional)

If an volume flow error curve is present for one of the gas meters connected to the enCore FC, the `Flow Conversion AFB` can carry out an error curve correction. Based on the saved correction points, the `Flow Conversion AFB` calculates the correction factor K_f through the linear interpolation for every measured flow rate Q and carries out a meter correction on this basis.

The correction takes place for main, error and unhaltable counters of operating volumes and is calculated as follows:

$$\Delta V_c = \Delta V_m \times C_f$$

$$Q_c = Q_m \times C_f$$

Parameterize the correction points in enSuite.

Special cases for minimum and maximum flow rate

Any error curve correction is not carried out if the measured flow rate Q_m ...

... falls below the lowest correction point.

In such a case, the correction factor C_f gets the value 1.

... exceeds the highest correction point.

In this case, the correction factor C_f corresponds to the correction value of highest correction point.



If the meter correction is not in use, $\Delta V_c = \Delta V_m$

If you do not activate the meter correction, the correction factor C_f automatically gets the value 1. The counters of uncorrected operating values and the counters of corrected operating values then have equal values. Counters for corrected volume is suppressed in the default setting of displays.

Set Meter Correction in enSuite (optional)

The activation of meter correction is optional. The information for the meter correction can be taken via the flow rate from the error curve determined for the meter.

Prerequisite:

- The desired parameterization  is opened on branch **<Device> – [Group –] <Flow Conversion AFB>**.

- ▶ Change to the branch **Meter correction**.
- ✓ It is displayed whether and, if any, which type of meter correction is activated on the tab **Meter correction**.
- ▶ Determine the type of meter correction in the parameter **Gas meter correction type**:
 - **no correction** (*default*)
Select this entry if no meter correction should be carried out.
 - **Q = measured value**
Select this entry in order to activate correction and relate the deviations to flow rate measured by gas meter.
 - **Q = corrected value**
Select this entry in order to activate correction and relate the deviations to the target flow rate of reference measurement.
- ✓ If correction is deactivated, no further action is necessary.
OR
If correction is activated, all the errors are displayed for input of up to 10 correction points.

Enter the correction points successively according to the error curve:

- ▶ Enter the flow rate in the column **Q** and the respective deviation in the column **Deviation**.
- ▶ To sort the flow rates in column **Q** in ascending order, click [**Sort first column**].
- If the error curve correction is activated, the corrected flow Q_c as well as the corrected operating volume flows V_c are the basis for all further calculations (derived flow rates, derived counters).

2.3 Flow Conversion

On the basis of volume and flow rate – from the Basic System – as well as the conversion factor C , the heating rate (H_{Vol} or H_{Mass}) and the density (ρ_b or ρ_m) – from the Gas Quality AFB – the Flow Conversion AFB calculates the flowed volumes at base conditions V_b , the energy E and the mass M . Analogous to this, it calculates the base flow rate Q_b , the energy flow rate Q_E and the mass flow rate Q_M .

You can specify the sequence in which the **Flow Conversion AFB** does the calculations. It determines which input values you must parameterize in enSuite.

Set calculations in enSuite

Determine the flow conversion sequence in enSuite for the calculations and enter the required input quantity.

The input values are generally generated from the respective **Gas Quality AFB**.

Prerequisite:

- The desired parameterization  is opened on branch **<Device> – [Group –] <Flow Conversion AFB>**.
- ▶ Go to the section **Calculations**.
- ✓ In this section the current parameters for flow conversion are displayed.
- ▶ Determine the sequence of calculation steps for flow conversion in parameter **Conversion mode**:
 - **$V_b = V_c \times C$; $E = V_b \times HVol$; $M = V_b \times \rho_b$** (default)
The following input values are required for calculations:
 - **C** conversion factor C
 - **HVol** volume-based heating value
 - **ρ_b** density at base conditions
 - **$M = V_c \times \rho_m$; $V_b = M / \rho_b$; $E = V_b \times HVol$**
The following input values are required for the calculations:
 - **ρ_b** density at base conditions
 - **ρ_m** density at measurement conditions
 - **HVol** volume-based heating value
 - **$V_b = V_c \times C$; $M = V_b \times \rho_b$; $E = M \times HMass$**
The following input values are required for the calculations:
 - **C** conversion factor C
 - **ρ_b** density at base conditions
 - **HMass** mass-based heating value

- Configure the appropriate parameters depending on the required input values:
- **C Input** conversion factor C
 - **HVol Input** volume-based heating value
 - **HMass Input** mass-based heating value
 - **ρ_b Input** density at base conditions
 - **ρ_m Input** density at measurement conditions



Set non-required parameters to “<Not used>”

Set the parameters of non-required input values via the context menu to **<Not used>**. This makes the displays of device and the parameterization in enSuite clearer.

Example

In the following example, the first calculation mode was selected; the Gas Quality AFB provides the input values:

Parameter	Sample value
Conversion mode	$V_b = V_c \times C$; $E = V_b \times \text{HVol}$; $M = V_b \times \rho_b$
C input	GQ1.End base-conditions.C
HVol input	GQ1.End base conditions.H _s V
HMass input	<Not used>
ρ_b input	GQ1.End base conditions. ρ_b
ρ_m Input	<Not used>

Table 2-1: Example of input values from the Gas Quality AFB

2.4 Managing Counters

The `Flow Conversion AFB` manages a total of four counters for the normal operation, for error cases as well as for testing and monitoring purposes.

- main counters

Main counters contain the fiscal values which are relevant for calculation:

- volume at base conditions V_b
- volume at operating conditions V_m
- corrected volume at measurement conditions V_c
- energy E
- mass M

- Error counters

Error counters are provided for the time period of an error message:

- volume at base conditions $V_{b,e}$
- volume at measurement conditions $V_{m,e}$
- corrected volume at measurement conditions $V_{c,e}$
- energy E_e
- mass M_e



Operating mode of main and error counters

Under what conditions the main counters are stopped and the error counters are activated depends on the parameterization on the branch **<Device> – <Flow Conversion AFB>** in section **Counters' operating mode**.

⇒ chapter [2.4.1 Determining the Counters' Operating Mode in Normal Cases and in Case of Breakdown](#) (p. 21)

- Unhactable counters

These unhactable counters are always in use irrespective of the error status of flow conversion:

- volume at base conditions $V_{b,u}$
- volume at measurement conditions $V_{m,u}$
- corrected volume at measurement conditions $V_{c,u}$
- energy E_u
- mass M_u
- Held counters

The hold function saves the current main counters, error counters and measurements when certain events occur:

 - volume at base conditions $V_{b,held}$, $V_{b,e,held}$
 - volume at measurement conditions $V_{m,held}$, $V_{m,e,held}$
 - corrected volume at measurement conditions $V_{c,held}$, $V_{c,e,held}$
 - energy E_{held} , $E_{e,held}$
 - mass M_{held} , $M_{e,held}$

⇒ chapter 2.4.2 [Hold Current Counters and Measurements](#) (p. 24)

If you use more than one `Flow Conversion AFB`, e.g. for the dual-stream operation, each manages its own counters.

2.4.1 Determining the Counters' Operating Mode in Normal Cases and in Case of Breakdown

You have different options in a `Flow Conversion AFB` of `enCore FC` to influence the behavior of main and error counters in case of an error. The measurement is then erroneous if the `Flow Conversion AFB` has at least one active error of  **Alarm** type.

Thus, the `Flow Conversion AFB` thematically differentiates two error types:

- Error in flow conversion

The message  **Conversion alarm** is set in case ...

 - ... an input value which is required for the selected flow conversion mode such as the conversion factor C , the heating value (HV_{01} or HM_{ass}) or the density (ρ_b or ρ_m) is erroneous.

- ... an 🚩 alarm message from the `System SFB` or `Time Service` is pending in the device. Source of the alarm can f.i. be the message 🚩 **Alarm time adjustment** of the `Time Service`.
- Error in measurement of volume at measurement conditions
An input value which influences the result of measurement of operating volume flows such as operating volume flows V_m , flow Q and the message for activating counters is erroneous.
In such cases, the message 🚩 **Volume measurement alarm** is set.

In case of an alarm of volume measurement, the flow conversion automatically is taken to the alarm condition because the volume is an input value of flow conversion. Conversely, the flow conversion can be in an alarm condition while the measurement of volume at measurement conditions is still working erroneous.

Determine the behavior of counters in case of an error in the folder **Counters' operating mode**. In case of main and error counters, define the conditions under which the counters should be started or stopped. This determination is executed separately for the counters of volume at measurement conditions as well as the counters for base volume, energy and mass.

Setting Counters' operating mode in enSuite

Prerequisite:

- The desired parameterization 📄 is opened on branch **<Device> – [Group –] <Flow Conversion AFB>**.

▶ On tab **Parameters** go to section **Counters' operating mode**.

Configuring the behavior for the counters of volumes at measurement conditions in case of error:

- ▶ In order to determine the behavior of main counters V_m and V_c , select one of the following entries in the parameter **Stop V_m/V_c counters**.
 - **never**
Main counters are not stopped even in case of an alarm.

- **if affected by alarm** (*default*)
Main counters are stopped if an alarm is indicated during measurement of volume (at measurement conditions). (see above)
 - **during any alarm**
Main counters are stopped for every Flow conversion AFB alarm. (see above)
- ▶ In order to determine the behavior of error counters V_{me} and V_{ce} , select one of the following entries in the parameter **Start V_{me}/V_{ce} counters**.
- **never**
Error counters are not started even in case of an error.
 - **if affected by alarm** (*default*)
Error counters are started if an error is indicated during measurement of volume (at measurement conditions). (see above)
 - **during any alarm**
Error counters are started for every alarm of Flow Conversion AFB. (see above)

Configuring the behavior for the counters of volumes at base conditions, energy and mass in case of error:

- ▶ In order to determine the behavior of the main counters V_b , E and M , select one of the following entries in the parameter **Stop $V_b/E/M$ counters**.
- **never**
Main counters are not stopped even in case of an alarm.
 - **during any alarm** (*default*)
Main counters are stopped for every Flow Conversion AFB alarm. (see above)
- ▶ In order to determine the behavior of error counters V_{be} , Ee and Me , select one of the following entries in the parameter **Start $V_{be}/Ee/Me$ counters**.
- **never**
Error counters are not started even in case of an error.

- **during any alarm** (*default*)
Error counters are started for every alarm of Flow Conversion AFB. (see above)

2.4.2 Hold Current Counters and Measurements

The hold function facilitates the “freezing” of the conversion-relevant main counters, error counters and measurements of a flow conversion. These values were managed in the frozen values and are labeled with the key word **held**.

The basic configuration of hold function is available in enSuite. Here, you can specifically control freezing via a message, save the data in archive and transfer it via Modbus, e.g., to the superordinate monitoring of measuring device. You can determine whether the current measurements or the average values are frozen for pressure and temperature.

Thus, the hold function is apt for testing and monitoring purposes, e.g., in case of two gas meters connected in series, or in dual-stream operation in case of temporary series connection for testing operation counter.

The following counters and values are frozen in every hold set:

- time stamp of the last execution of hold function (Time stamp held)
- energy (Eheld, Eeheld)
- mass (Mheld, Meheld)
- volume at base conditions (V_{bheld} , V_{beheld})
- corrected volume at measurement conditions (V_{cheld} , V_{ceheld})
- volume at measurement conditions (V_{mheld} , V_{meheld})
- pressure (p_{held})
- temperature (t_{held})



Hold sets cannot be extended

Please note that the composition of values is determined in the hold sets. If more values are added in the display editor of enSuite, these are *not* taken into account for the display on the

device.

The values of pressure and temperature are derived from the related Gas Quality AFB. You link the Flow Conversion AFB and the Gas Quality AFB by assigning in the branch **<Flow Conversion AFB>** – **Calculations** the import values of Gas Quality AFB (⇒ chapter [2.3 Flow Conversion](#), p. 17).

Configuring hold function in enSuite

Prerequisite:

- The desired parameterization  is opened on branch **<Device>** – **[Group –] <Flow Conversion AFB>**.
- ▶ On tab **Parameters** go to section **Hold function**.
- ▶ Determine in parameter **Held measurements** the way in which the measurements of pressure and temperature are taken into account in the hold sets:
 - **actual** (default)
In order to hold the current measurements, select this entry from the drop-down list.
 - **mean**
In order to hold the arithmetic average value since the last freezing time, select this entry from the drop-down list .
- ▶ In order to control the hold function via an event, select the desired  message in the export branch and drag the message via Drag-and-drop into the parameter **Input to trigger hold function**. The message can be derived, e.g. from an digital input. It is always frozen if the assigned message is received.

Alternatively, you can directly release the hold function manually at the device.

Carry out hold function manually on the enCore FC

On-site, you can hold the current counters and measurements and easily read and note the values. The hold function is always available to you on the

main display of a Flow Conversion AFB (⇒ chapter 3 Display and Operation, p. 33).

- ▶ If required, change to the home display.
- ▶ Open the **Fiscal display** by double-clicking the symbol of desired  Flow Conversion AFB.
- ▶ With a click of **V_b** change to the main display.
- ▶ Activate the hyperlink **Hold function**.

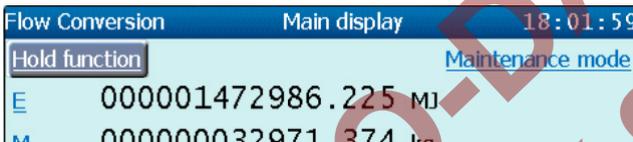


Abb. 2-2: Hyperlink **Hold function**

- ✓ In the display **Hold function**, the values of the last hold are displayed. The value **Time stamp held** specifies the time at which the values were frozen.
- ✓ No values are displayed during first call-up or after restarting the device.
- ▶ Release the hold function with the action **Hold**.
- ✓ The current counters are frozen at the same time and the display is updated accordingly.

The held counters are overwritten as soon as you re-trigger the action **Hold**. The hold sets are not maintained in case of a voltage drop.

2.4.3 Activating the Maintenance Mode for one Conversion

With enCore FC1, you have the option to activate the maintenance mode for a flow conversion. During maintenance mode, all main counters of this flow conversion are stopped (V_m , V_c , V_b , M , E) and the error counters are started ($V_{m,e}$, $V_{c,e}$, $V_{b,e}$, Me , Ee). In addition, all flow-relevant events are suppressed.

The maintenance mode is e.g. useful when the gas meter of this flow conversion is in revision. In principle, you activate the maintenance mode in two ways:

- Automatically when the parameterized event message is pending – e.g. an external switch or signal via a communication protocol (parameter **Input for activation of maintenance mode**).
- Manually at the operation panel in the **Maintenance** display of the flow conversion.
Requirement: The user logged in has the right **Change general system settings**.

In this case, you can enter a substitute value for the volume flow at the control panel, otherwise the value zero (0).

The maintenance mode supports the operating modes **Type 1** und **Type 2**. In both modes, the maintenance mode can be started and stopped manually as well as automatically. Whereby in mode **Type 1**, activation via the event message has a higher priority and can blocks the fields for the user inputs in the **Maintenance** display.

You configure the basic configuration of the maintenance mode in enSuite.

Parameterizing maintenance mode in enSuite

Prerequisite

- In the parameterization  the folder of the Flow Conversion AFB opened:  **<device>** –  **<group>** –  **<Flow Conversion>**
 - ▶ On tab **Parameter**, switch to the **General** section.
 - ▶ In order to control the maintenance via an event, select the desired  event message in the export branch and drag the message via Drag-and-drop into the parameter **Input to trigger maintenance mode** – e.g. the status message  **In revision** of the gas meter, which provides the values for this flow conversion.
 -  As soon as the message begins, the maintenance mode is activated for the selected flow conversion.
- ▶ Set the operating mode with the drop-down list **Maintenance mode**:
 - **Type 1**

In this mode, activation via the event message has a higher priority. This means: As soon as the maintenance mode is activated via the parameterized message, the AFB blocks the fields for the user inputs in the **Maintenance** display. Even in the case, a user with the right **Change general system settings** is logged in.

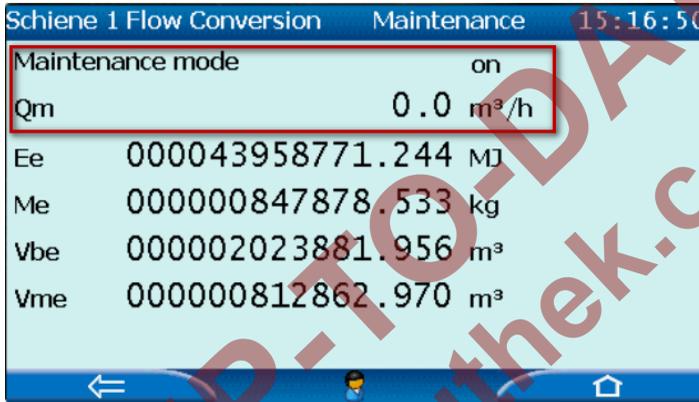


Fig. 2-3: Maintenance mode **Type 1** of a flow conversion is active, input fields are disabled

- **Type 2**

The maintenance mode can also be started and terminated via the parameterized event message and directly at the control panel.

- As soon as you log on to the device having the right **Change general system settings**, you can start and stop the maintenance mode via the control panel, and enter a constant value (value range 0 . . 100000) that simulates the operating flow rate Q_m .

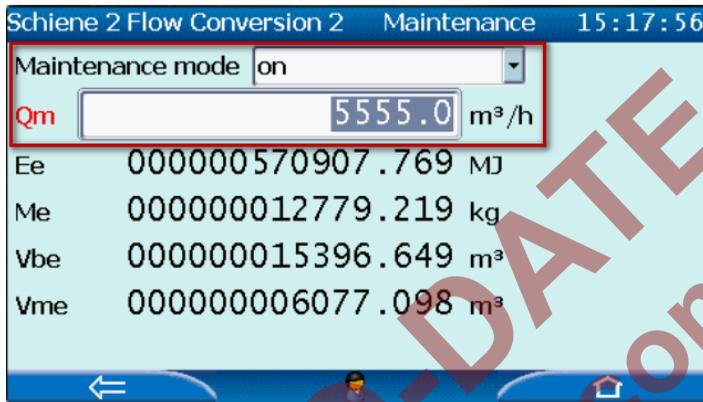


Fig. 2-4: Maintenance mode **Type 2** of a flow conversion is active, input fields are enabled

- The maintenance mode stops in the following ways:
 - Automatically when the parameterized event message ends (parameter **Input to trigger maintenance mode**).
 - Manually at the operation panel in the **Maintenance** display of the flow conversion by selecting the entry **off** from the drop-down list **Maintenance mode**.
Requirements: The user logged in has the right **Change general system settings** and the maintenance mode is not locked for user input (operating mode **Type 1**).
 - after restart of the device e.g. due to power failure



Special feature

The maintenance mode does *not* end (!) when the user logs off or is automatically logged out due to the **Inactivity timeout** (user and rights management).

2.5 Functioning at a Glance

2.5.1 Flowchart

The interaction of functional areas and individual configuration parameters is depicted in the following flow chart:

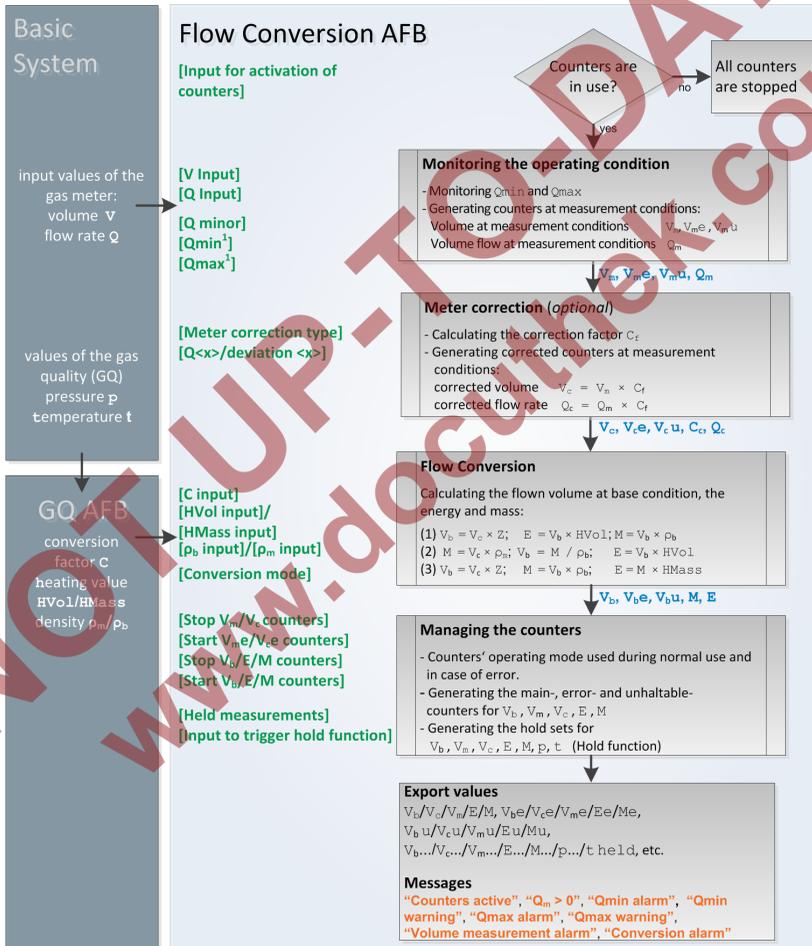


Fig. 2-5: Functional areas at a glance

2.5.2 List of Error Messages

Depending on the parameterization of the device, the following warning and alarm messages can appear during flow conversion:

Identifier	Type	Cause
Q _{max} warning	 Warning	The volume flow at measurement conditions exceeded the warning limit (Q_{max} warning limit).
Q _{max} alarm	 Alarm	The volume flow at measurement conditions exceeded the alarm limit (Q_{max} alarm limit).
Q _{min} warning	 Warning	The volume flow at measurement conditions has fallen below the warning limit (Q_{min} warning limit).
Q _{min} alarm	 Alarm	The Q _{min} monitoring has generated one alarm.
Volume measurement alarm	 Alarm	Error in volume measurement, i.e. an input value of gas meter is erroneous (volume, flow rate or message for the activation of counters) or the Q _{max} or the Q _{min} monitoring has generated an alarm.

Identifier	Type	Cause
Conversion alarm	🚩 Alarm	<p>This alarm is set in on eof the following cases:</p> <ul style="list-style-type: none"> • The input value which is required for the selected flow conversion mode such as the conversion factor, a heating value or a density is erroneous. • An 🚩 alarm message from System SFB or Time Service is pending. • The 🚩 Volume measurement alarm is pending.

Table 2-2: Warning and alarm messages of Flow Conversion AFB

The enCore FC manages the warning and alarm messages in its error list. For further information, refer to:

- ⇒ [4.4 View Error Messages](#) (p. 49)
- ⇒ [4.5 Accepting Warning and Alarm Messages](#) (p. 50)

3 Display and Operation

The `Flow Conversion AFB` has different displays in which the values of the flow conversion are shown. The displays are classified as overview, detailed and counter displays.

The overview displays of `Flow Conversion AFB` include the displays **Fiscal display** and **Main display** which show the most important data of flow conversion at a glance.

Navigate from the main display to the detailed display in which various combinations of counters and measurements are displayed.

In the detailed displays you can access the corresponding counter display via the main, error or total counters.

As every `Flow Conversion AFB` manages its own counters, each one has its own separate display.



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 “Operating Instructions” of the enCore FC manual in chapter for display and navigation.

Generally, hyperlinks and actions are highlighted 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 (⇒ chapter [5.1 Nomenclature](#), p. 53).

3.1 Displays at a Glance

The following figure sketches the hierarchical order and the navigation by displays:

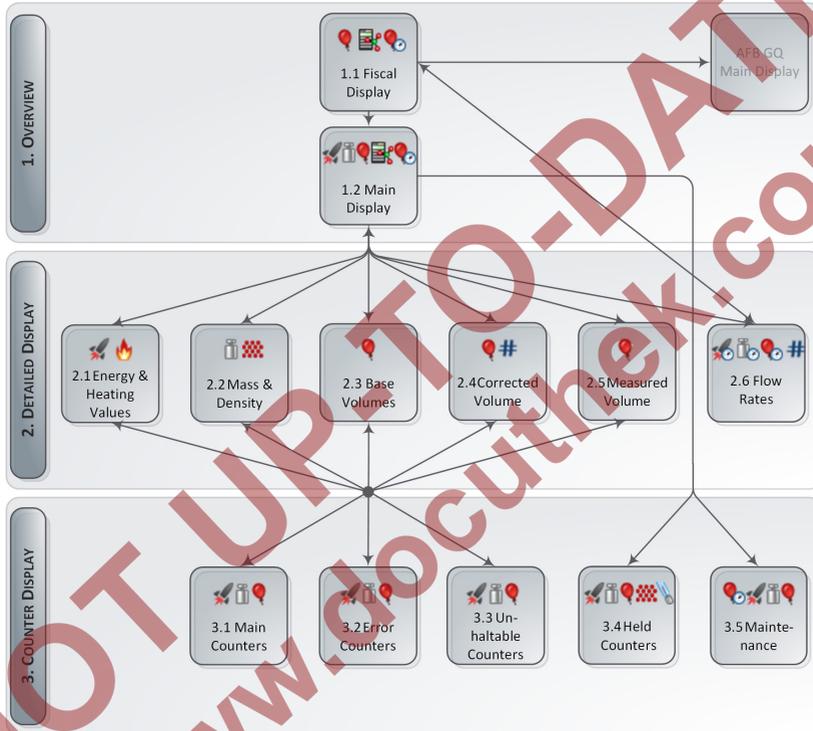


Fig. 3-1: Display – hierarchical structure

3.2 Displays in Detail

The first display of every **Flow Conversion AFB** is the **Fiscal Display**. The main task of the fiscal display is to show the results of flow conversion that are relevant from a fiscal point.

It is the standard display of FC1, i.e. the device starts with the Fiscal display of the first **Flow Conversion AFB**.



Fig. 3-2: Example – Fiscal display

The primary result of a flow conversion is the volume at base conditions. The main counter for the base volume is presented with a larger font size in the Fiscal display and marked with the symbol .

From the Fiscal display, you can change to the displays **Main display** and **Flow rates** of **Flow Conversion AFB** as well as to the main display of **Gas Quality AFB**.

All the important results of flow conversion are presented in an overview in the main display. From this display, you can change to the detailed displays for energy, mass, volumes and flow rates and to the display **Hold function**.



Display editor of enSuite

In this documentation, the layout of individual displays is described in the delivery status.

For some of the displays, you can determine in the display editor of enSuite which values are displayed in which sequence. The

Fiscal display is subject to some legal restrictions here.

You reach the display editor in an open parameterization in enSuite by opening the branch **Displays – [<Group> –] <Flow Conversion AFB>**.

The link of displays one after the other and the displayed values are presented in the following tables:

- ⇒ [The Fiscal display and target displays](#) (p. 37)
- ⇒ [The Main display and its target displays](#) (p. 39)
- ⇒ [Counter displays](#) (p. 42)

The Fiscal display and target displays

Fiscal display	⇒ [<Target display>]
<p><u>V_b</u> volume at base conditions</p>	<p>⇒ [1.2 Main display] <u>Hold function</u> ⇒ Hold function <u>Maintenance</u> ⇒ Maintenance main counter... <u>E</u> ... energy <u>M</u> ... mass <u>V_b</u> ... volume at base conditions <u>V_c¹</u> ... corrected volume (at measurement conditions) <u>V_m</u> ... volume at measurement conditions <u>C</u> conversion factor</p>
<p><u>V_c¹</u> corrected volume</p>	<p>/</p>
<p><u>V_m</u> volume at measurement conditions</p>	<p>/</p>
<p><u>C</u> conversion factor (input value from the Gas Quality AFB)</p>	<p>⇒ [Main display of Gas Quality AFB] (⇒ volume "Gas Quality AFB" of the enCore FC manual)</p>
<p><u>Q_m²</u> volume flow at measurement conditions</p>	<p>⇒ 2.6 Flow rates flow of... QE ... energy QM ... mass Q_b ... volume at base conditions Q_m ... volume at measurement conditions</p>

¹V_c is displayed only if the counter correction is activated in device.

²Q_m is displayed in the device in case of deactivated meter correction; Q_c is displayed instead in case of activated meter correction.

Fiscal display	⇒ [<Target display>]
Q_c^2 corrected volume flow (at measurement conditions)	⇒ 2.6 Flow rates flow of... QE ... energy QM ... mass Q_b ... volume at base conditions Q_c ... corrected volume (at measurement conditions) Q_m ... volume at measurement conditions C_f correction factor

Table 3-1: The Fiscal display and target displays

The Main display and its target displays

Main display	⇒ [<Target display>]
Hold function	⇒ [3.4 Hold] (⇒ target display [3.4 Hold], S. 43)
Maintenance mode	⇒ [3.5 Maintenance] (⇒ target display [3.5 Maintenance] Fehler! Verweisquelle konnte nicht gefunden werden. , S. 44)
E energy	⇒ [2.1 Energy] energy... E ... main counter Ee ... error counter E u ... unhaltable counter HVol volume-based heating value HMess mass-based heating value
M mass	⇒ [2.2 Mass] mass... M ... main counter ME ... error counter M u ... unhaltable counter ρ_m density at base conditions ρ_m density at measurement conditions

Main display	⇒ [<Target display>]
<u>V_b</u> volume at base conditions	⇒ [2.3 Base Volume volume at base conditions... <u>V_b</u> ... main counter <u>V_be</u> ... error counter <u>V_b u</u> ... total counter
<u>V_c</u> ³ corrected volume (at measurement conditions)	⇒ [2.4 Corrected Volume corrected volume (at measurement conditions)... <u>V_c</u> ... main counter <u>V_ce</u> ... error counter <u>V_c u</u> ... unhaltable counter C_f correction factor
<u>V_m</u> volume at measurement conditions	⇒ [2.5 Measured Volume volume at measurement conditions <u>V_m</u> ... main counter <u>V_me</u> ... error counter <u>V_m u</u> ... unhaltable counter
C conversion factor	/
<u>Q_m</u> ⁴ volume flow at measurement conditions	⇒ [2.6 Flow Rates flow of... QE ... energy QM ... mass Q_b ... volume at base conditions Q_m ... volume at measurement conditions

³V_c is displayed only if the meter correction is activated in device.

⁴Q_m is displayed in the device in case of deactivated meter correction; Q_c is displayed instead in case of activated meter correction.

Main display	⇒ [<Target display>]
<p>Q_c⁴ corrected volume flow (at measurement conditions)</p>	<p>⇒ [2.6 Flow Rates]</p> <p>flow of...</p> <p>QE ... energy</p> <p>QM ... mass</p> <p>Q_b ... volume at base conditions</p> <p>Q_c ... corrected volume (at measurement conditions)</p> <p>Q_m ... volume at measurement conditions</p> <p>C_f correction factor</p>

Table 3-2: The main display and its target displays

Counter displays

Display	⇒ [<Target display>]
(counter primary meter of detailed displays)	⇒ [3.1 Main Counters] main counter... E ... energy M ... mass V_b ... volume at base conditions V_c ... corrected volume (at measurement conditions) V_m ... volume at measurement conditions
(error counter of detailed displays)	⇒ [3.2 Error Counters] error counter... Ee ... energy Me ... mass V_be ... volume at base conditions V_ce ... corrected volume (at measurement conditions) V_me ... volume at measurement conditions
(unhaltable counter of detailed displays)	⇒ [3.3 Unhaltable Counters] unhaltable counter... E u ... energy M u ... mass V_b u ... volume at base conditions V_c u ... corrected volume (at measurement conditions) V_m u ... volume at measurement conditions

<p>[1.2. Main display] Hold function</p>	<p>⇒ [3.4 Hold]</p> <p>Hold action to „freeze“ current counters and values</p> <p>Time stamp held time stamp of the last execution of hold function held counters and values... ... volume at measurement conditions:</p> <p>V_m held main counter V_{me} held error counter ... corrected volume (at measurement conditions):</p> <p>V_c held main counter V_{ce} held error counter ... volume at base conditions</p> <p>V_b held main counter V_{be} held error counter ... conversion factor</p> <p>C held main counter Ce held error counter</p> <p>p held ... pressure</p> <p>t held ... temperature ... energy:</p> <p>E held main counter Ee held error counter ... mass:</p> <p>M held main counter Me held error counter</p>
--	---

<p>[1.2. Main display] Maintenance mode</p>	<p>⇒ [3.5 Maintenance]</p> <p>Maintenance mode [on/off]⁵</p> <p>Q_b simulated flow⁶ error counter ...</p> <p>Ee ... energy</p> <p>Me ... mass</p> <p>V_be ... volume at base conditions</p> <p>V_ce¹ ... corrected volume (at measurement conditions)</p> <p>V_me ... volume at measurement conditions</p>
---	--

Table 3-3: The counter displays

⁵ You can start and stop the maintenance mode manually, if you are currently logged on to the device with the right **Change general system settings** and the maintenance mode is not blocked for user input. In this case the dropdown list with the entries **on/off** is displayed.

⁶ Under the following conditions, you can parameterize a value and thus simulate an operating flow: you are currently logged on to the device with the right **Change general system settings**, the maintenance mode is executed, and the fields are not blocked for user input. In this case, an input field is displayed in row **Q_b**.

4 FAQ

This chapter contains the most important settings and issues in order to support you in regular tasks:

- ⇒ [4.1 Adding Another Flow Conversion AFB](#) (p. 45)
- ⇒ [4.2 Combining AFBs in a Group](#) (p. 46)
- ⇒ [4.3 Viewing Process Values of another Flow Conversion AFB](#) (p. 48)
- ⇒ [4.4 View Error Messages](#) (p. 49)
- ⇒ [4.5 Accepting Warning and Alarm Messages](#) (p. 50)
- ⇒ [4.6 Stopping the Main Display for Reading](#) (p. 51)
- ⇒ [4.7 Representing Two Flow Directions](#) (p. 52)



Detailed documentation

Detailed documentation of `Flow Conversion AFB` is available in chapter [2 Functional Description](#) (p. 6) as well as in chapter [3 Display and Operation](#) (p. 33).

4.1 Adding Another Flow Conversion AFB

Background

The modular design principle of enCore FC allows to even implement applications in which many counter sets must be available separated from one another.

A `Flow Conversion AFB` carries out exactly one counter set. Subsequently, for each additional counter set you need to add one `Flow Conversion AFB` in enSuite.

More counter sets are necessary, e.g. for a dual-stream flow conversion or for an operation with multiple flow directions.

Procedure:

- ▶ Open the desired parameterization .
- ✓ The current AFB Configuration is displayed in the main window.
- ▶ Mark the entry **Flow Conversion** in the column **AFB type**.
- ▶ If **[Add AFB]** is not activated, ensure that sufficient credits are left.
- ▶ Click **[Add AFB]**.
- ✓ The branch **Flow Conversion <x>** is added to the parameter branch.
- ▶ Configure the Flow Conversion AFB as per your requirements.

**Further Gas Quality AFB necessary?**

Every Flow Conversion AFB requires input values of a related Gas Quality AFB. If no related Gas Quality AFB is available in the parameterization for a newly added Flow Conversion AFB, you must add and configure an additional Gas Quality AFB.

Thus, two Flow Conversion AFBs can be connected to the same Gas Quality AFB. This is the case if the input values of gas quality are derived from the same source and the same calculation procedure have to be used.

In any case, create the necessary connections by parameterizing the necessary input values of the related Gas Quality AFB in enSuite for the Flow Conversion AFB (⇒ [chapter 2.3 Flow Conversion](#), p. 17).

4.2 Combining AFBs in a Group

Background

You can combine many AFBs in a functional group and give it a logical name. Thus, you can e.g. create for the dual-stream operation one group for stream 1 and one group for stream 2, and assign to each one Flow Conversion AFB and one Gas Quality AFB.

Besides the better clarity of the device display, the grouping provides the advantage that the error list manages their messages group-wise. In case of an

error, you can display errors per group. If, e.g., an alarm is generated, it can be quickly assigned to a group, e.g. of measuring streams.

Procedure in enSuite

An `Flow Conversion AFB` and an `Gas Quality AFB` are combined in one group below by way of an example:

- ▶ Open the desired parameterization  in enSuite.
- ▶ Mark the desired AFB, e.g. the `Flow Conversion AFB` in the parameter branch.
- ▶ Open the context menu.
- ▶ Enter the name of the group in the field **Move to group**. Select a distinct and logical name, e.g. **Stream 1**.
- ▶ Confirm your entry with the Enter-key.
- ✓ If no group with name exists, then the folder **<Group>** is created in the parameter branch and the `Flow Conversion AFB` is assigned to it.
- ▶ As soon as a group is created, you can assign more AFBs to this group by dragging them in this folder via Drag and Drop, e.g. an `Gas Quality AFB` in the folder **Stream 1**.
- ✓ All the AFBs of a group automatically receive the same group name in the field **Move to group**.

OR

- ▶ Alternatively, you can assign an AFB to a group by saving the same group name in the field **Move to group**.
- ✓ The AFB is automatically assigned to the group having this name.
-  The groups in the folders are managed in the device display as the folder **Stream 1** shown here:



Fig. 4-1: Folder for the group **Stream 1**

4.3 Viewing Process Values of another Flow Conversion AFB

Background

Counters that are fiscally relevant are displayed in the Fiscal display of the respective Flow Conversion AFB. The standard display of device is thus always the Fiscal display of the firstly created Flow Conversion AFB. Follow the following procedure to access the Fiscal display of every further Flow Conversion AFB:

Procedure on the enCore FC

- ▶ Change with the button  to the home display.
- ▶ If you manage AFBs in a group structure, go to the corresponding group folder .
- ▶ Double-click the symbol of desired  **<Flow Conversion AFB>**.



Assigning names to a Flow Conversion AFB

In enSuite you can assign a name for every Flow Conversion AFB. Open the context menu of the folder **<Flow Conversion AFB>** and modify the field **Rename AFB**.

Generally, enSuite and the enCore FC use the name **Flow Conversion<x>** by default, where x implies a number which is counted up with every new Flow Conversion AFB.

- ✓ The **Fiscal Display** of this Flow Conversion AFB opens.

You can access all further displays of this Flow Conversion AFB from here (⇒ chapter 3 [Display and Operation](#), p. 33).

4.4 View Error Messages

Background

If the status LED is flashing yellow or red, or has continuous yellow or red light, the warning and/or the alarm messages are present in the error list. In this list, the enCore FC manages the warning and alarm messages of Basic System and all AFBs.

The error list is sorted chronologically; the current message is displayed at first. You can specifically filter the entire list, e.g. as per the desired Flow Conversion AFB.

Procedure:

- ▶ You reach the error list in the home display  via the symbol  **Error List**.
- ✓ The error list shows all the current warning or alarm messages.

You have many options:

- ▶ If only few errors are included in the entire list, scroll specifically for messages of Flow Conversion AFB.



Naming convention of error messages

AFB messages follow the naming convention:
[<Group>.<Flow Conversion AFB>.<message>

- ▶ In order to specifically filter messages of a Flow Conversion AFB, select the entry **<Flow Conversion AFB>** from the drop-down list **Filter**.
- ✓ Only the messages of the corresponding Flow Conversion AFB are displayed.
- ▶ In order to specifically filter messages of a Flow Conversion AFB, which are grouped with other AFBs, select the **<Group>** from the drop-down list **Filter**.
- ✓ All the messages of AFBs, which are allocated to this group, are displayed.

⇒ The next section describes the way you can accept Flow Conversion AFB errors.

4.5 Accepting Warning and Alarm Messages

Background

Define the acceptance procedure in the parameter **Acceptance procedure** (branch **Basic System – System**, section **Error List**). This parameter checks if only errors, which are no longer currently pending, can be accepted or whether errors can always be accepted irrespective of whether they are currently pending or are no longer pending. Errors are accepted list-wise and not individually.



Details on the acceptance procedure are available in the online help.

For additional information on parameterization of acceptance behavior refer to ⇒ the “Operating Instructions” of the enCore FC.

Procedure:

- ▶ Open the error list as described in section [4.4 View Error Messages](#) (p. 49).
- ▶ In order to accept messages of a specific list, open it by selecting the corresponding entry **<Flow Conversion AFB>** or **<Group>** from the drop-down list **Filter**.
- ▶ Trigger the action [Accept all](#).
- ✓ The selected list is accepted and updated according to the parameterized acceptance procedure.
- ▶ If required, repeat these steps for other lists.

4.6 Stopping the Main Display for Reading

Background

The hold function offers you the option to generate a snap-shot of the main counters E , M , V_b , V_c , V_m , error counters E_e , M_e , V_{be} , V_{ce} , V_{me} and the measurements for p and t .

This function is available in the main display of *Flow Conversion AFB*. If you are using further *Flow Conversion AFBs*, each one has a separate display **Hold function**. The snap-shots of values are labeled with the key word **held**.

When required, you can easily read the held counters and measurements; these are transferred via Modbus or saved in the archive.

Procedure:

The procedure to configure and manually carry out the hold function is described in detail in ⇒ chapter [2.4.2 Hold Current Counters and Measurements](#) (p. 24).

4.7 Representing Two Flow Directions

Background

The counters of a `Flow Conversion AFB` are generally in use. If you would like to do a flow conversion for two flow directions with one `enCore FC`, use a separate `Flow Conversion AFB` for every flow direction. In operation, it must be ensured that only the counters of current flow direction are active.

You can use the flow direction manager for this task. It ensures clear activation inputs for the related `Flow Conversion AFB`. In this way, no nonsensical intermediate statuses are generated when changing the flow direction.

You can define and evaluate groups with up to four incoming flow direction signals using the flow direction manager. As result, the flow direction manager provides the derived consistent signals which can be used as activation signal for the related `Flow Conversion AFB`.

Procedure:

The parameterization of flow direction managers is described in detail in ⇒ volume "Basis System with SFBs" of the `enCore FC` manual.

5 Appendix

5.1 Nomenclature

Following symbols and names are used in the enCore FC and in enSuite for counters and values in the context of Flow Conversion AFB:

Symbol	Abbr.	Description
	ρ_b	density at base conditions
	ρ_m	density at measurement conditions
	E	energy
	HVol	volume-based heating value
	HMass	mass-based heating value
	C_f	correction factor (calculated)
	p	pressure
	Q_m	volume flow rate at measurement conditions
	QE	energy flow rate
	Q_c	corrected volume flow rate at measurement conditions
	QM	mass flow rate
	Q_b	volume flow rate at base conditions
	M	mass
	t	temperature

Symbol	Abbr.	Description
	V_n	volume at base conditions
	V_b	volume at measurement conditions
	V_k	corrected volume at measurement conditions
	C	conversion factor (input value from the Gas Quality AFB)

Table 5-1: Nomenclature

Apart from counters for standard operation, the error and unhaltable counters as well as the frozen counters are always labeled with a suffix:

Suffix	Meter
–	main counter (e.g. V_b)
e	error counter (e.g. $V_b e$)
u	unhaltable counter (e.g. $V_b u$)
held	held counter (e.g. $V_b held$)

Table 5-2: Suffixes of counters

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