



Flow Computer
gas-net F1
Series 2

Technical Documentation
Volume 1

Function and Operation

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Safety and Warning Notes



Attention! The following safety and warning notes must be observed at any rate:

- The *gas-net* flow computer F1 must neither be stored at temperatures below -20°C nor above $+50^{\circ}\text{C}$.
- A temperature between 0°C und $+40^{\circ}\text{C}$ must be guaranteed during operation.
- The electronic flow computer must be installed outside ex-zone 2.
- The *gas-net* devices are equipped with hardware modules that are approved as *associated electrical apparatus* of category *ib* according to DIN EN 50020 with intrinsically safe circuits. The flow computer F1 is therefore suitable for being connected to sensors and pulse generators (and encoder totalizers, respectively) located in hazardous areas (e.g. zone 1).

It is not permitted to connect intrinsically safe and non-intrinsically safe circuits to these modules together.

- Only intrinsically safe temperature and pressure sensors of protection class EEx ib II C should be connected. If flameproof pressure and temperature sensors (Ex-d) are used, the connection of the gas meter to the EXMFE5 board must be implemented via suitable isolating switching amplifiers!
- The power supply of the *gas-net* devices is 24 V DC and must be secured externally by 1 A.
- The earthing is connected to PE of the power supply socket for equipotential bonding.
- Observe the regulations of the relevant standards, in particular the regulations of DIN EN 50014, DIN EN 50020 and DIN EN 50039.
- Observe the limit values stated in the respective certificates of conformity of the boards to be connected.

General Notes on the Structure of this Manual

The first volume of the *Flow Computer gas-net F1* documentation on hand describes the function and operation of the device.

Tip: Chapter 4 provides brief instructions on how to accomplish regular tasks during routine tests in the station. It is intended for the impatient reader who does not want to read the entire manual first just to accept an error. It is, however, necessary to read the entire manual to comprehend the device's mode of operation.

The Technical Documentation's second volume deals with the subjects *Commissioning, Maintenance* and *Technical Data*. It contains important documents, such as certificates of conformity and ATEX certificates.

Both volumes of the Technical Documentation must always be on hand in the station.

1 Introduction

1.1 The *gas-net* System Idea

gas-net is the generic term for an Elster device family. All *gas-net* devices, including future device types, are characterized by uniformity in appearance, operation and parameterization.

gas-net devices always cover a multitude of measurement and control functionalities. To keep the operation and parameterization of the devices well-structured and user-friendly, the *gas-net* series is based on a modular concept. A module corresponds to a special functionality. Each module has its own main display within the device's menu assistance, and each module has its own group of settings within the parameter data record.

A particular module can be employed in different device types. This yields a modular system that is advantageous to the user as a particular module can always be operated and parameterized in the same way, no matter in which device type it has been installed.

1.2 The *gas-net* F1 Flow Computer

The *gas-net* F1 device is an electronic flow computer for natural gases and may be used for the correction of up to three streams with one or two flow directions each. The volume correction functionality determines the flown base volume on the basis of the input variables volume, pressure and temperature (all at operating conditions).

The calculation is based on the following gas equation:

$$V_n = V * \frac{p}{p_n} * \frac{T_n}{T} * \frac{1}{k} = V * Z$$

The characters stand for:

V_n	the base volume in m^3	T_n	the base temperature in Kelvin
V	the volume in m^3 (at operating conditions)	T	the temperature in Kelvin (at operating conditions)
p_n	the base pressure in bar	k	the compressibility ratio
p	the pressure in bar (at operating conditions)	Z	the compression factor

The base volume is the volume of the gas at the reference conditions, i.e. at base pressure and base temperature.¹ Input values relating to reference conditions (i.e. the upper heating value and standard density) must always relate to the same reference conditions throughout the system. Should the input values relate to other conditions, it is possible to parameterize the use of correction factors, which may either be preset or calculated automatically based on the decisive parameters.

The compressibility ratio k represents the actual gas characteristics that are thus considered in the gas equation.

gas-net flow computers know the following operating modes for the k -ratio calculation:

1. $k = \text{constant}$.
2. Calculation of k according to the standard GERG-88 virial equation under ISO 12213-3. In addition to pressure and temperature at operating conditions, the following gas quality data is necessary for this calculation method:
 - Hs upper heating value (gross calorific value), either in kWh/m^3 or in MJ/m^3
 - ρ standard density in kg/m^3 , alternatively: density ratio d
 - CO₂ content in mole percent
 - H₂ content in mole percent
3. Calculation of k according to the standard GERG-88 virial equation as under point 2, but disregarding the H₂ content (H₂ content = 0 mole percent).

¹ In Germany for instance these are $p_n = 1.01325$ bar and $T_n = 273.15$ Kelvin.

4. Calculation of k according to the AGA-NX-19 method. Choose between the AGA-NX-19-mod (Herning, F. / Wolowski, E. 1966) and AGA-NX-19-mod-BR.KORR.3H methods (Jaeschke, M. / Harbrink, B. 1982).

In addition to pressure and temperature (at operating conditions) the following gas quality data has an influence on this calculation method:

Hs upper heating value (gross calorific value), either in kWh/m³ or in MJ/m³

density ratio (d)

CO₂ content in mole percent

N₂ content in mole percent

5. Calculation of k according to the AGA8-92 DC method².

In addition to pressure and temperature (at operating conditions) the following gas quality data has an influence on this calculation method:

CH₄ content in mole percent

C₂H₆ content in mole percent

C₃H₈ content in mole percent

i-C₄H₁₀ content in mole percent

n-C₄H₁₀ content in mole percent

i-C₅H₁₂ content in mole percent

n-C₅H₁₂ content in mole percent

C₆H₁₄₊ content in mole percent

CO₂ content in mole percent

N₂ content in mole percent

O₂ content in mole percent

H₂ content in mole percent

² The AGA8-DC92 calculation method is described in ISO 12213-2.

Gas quality data not being provided by the calibrated gas quality analyzer is assumed to be zero. According to the AGA8 regulations gas quality components being supplied by the gas quality analyzer but not being included in the input vector of the AGA8 is added to other similar components. A scaling to 100% is performed according to the AGA8 regulations before k is being calculated.

Following the correction of the volume at operating conditions, the F1 flow computer performs energy and mass calculations:

$$\text{energy } E = V_n * H_s$$

$$\text{mass } m = V_n * \rho$$

When using online gas quality data, the gas quality analyzer is usually connected via DSfG protocol or Modbus. A second gas quality source may be set up as redundant measurement. The measurements of this source are used when the first source is invalid. In principle, it is also possible to consider the gas quality only as fixed tabular values or the k -ratio as being constant.

The energy is specified in kWh, MJ or GJ. The unit of mass is kg.

Displays and totalizer structures of the *gas-net* F1 flow computer are explained in Chapter 5.

The *gas-net* F1 flow computer is always equipped with a data logging function that is capable of logging important measurements and totalizers at specific intervals and when errors occur.

Moreover, it offers a multitude of additional functions for monitoring tasks and data communication.

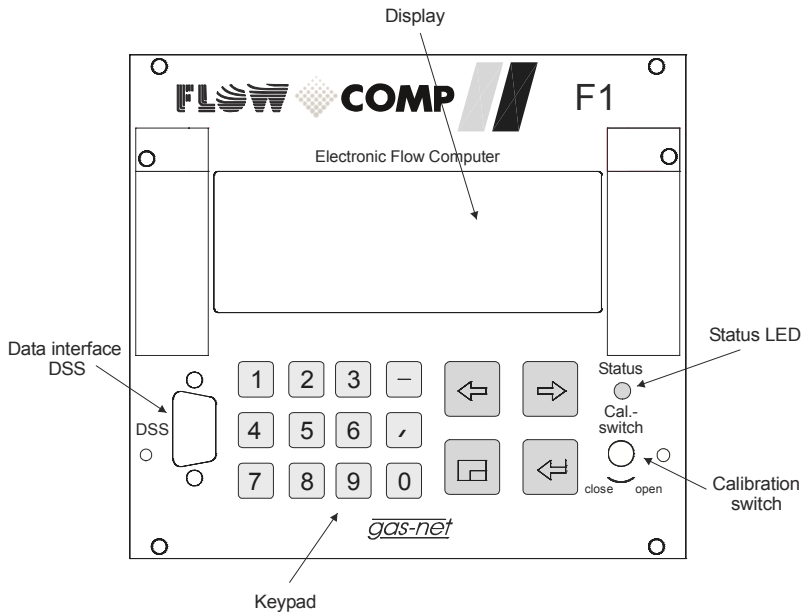
2 Device View and Design

The housing of *gas-net* flow computers is designed as plug-in unit for a 19"-frame and is usually available in two housing sizes, i.e. with a mounting width of 1/3 for up to four process boards or a mounting width of 1/2 for up to seven process boards.

The version number and check sum for identifying the software update are directly invocable via the main display of the *System* module.

The device front includes one 8x32 character-LCD, one keypad with 16 keys, one status LED and the calibration switch. The DSS data interface is also located on the device front. It serves the connection of a PC or laptop for servicing purposes.

The following illustration shows, as an example, the front view of a *gas-net* F1 in the narrow design with a mounting width of 1/3:



In addition to the 24 VDC mains connection up to two of the following interfaces are located on the back of the device:

- DSfG interface
- COM2 interface: serial interface according to RS232. Intended for connecting the modem for the integrated RDT. Alternatively suitable for connecting proprietary protocols (Modbus RTU, Modbus ASCII, RK512 or 3964R)
- TCP/IP for integration in a standard network installation (for data exchange via Modbus TCP or time synchronization via NTP)

All process connections are implemented via process boards installed in the housing. The exact composition of the I/O boards depends on the tasks of each individual device (correction of one, two or three streams, connection type of the gas meter(s), number of required output signals, etc.).

Volume correction is the main functionality of the F1. The following process boards are required for connecting the transmitters (pressure and temperature sensors, gas meter):

- A multi-functional EXMFE5 input board for the connection of the pressure and temperature sensors and possibly for the connection of a gas meter with pulse interface(s) or encoder totalizer. For the correction of a second or third stream, a second or third EXMFE5 input board is installed for the process connections.
- Q.Sonic ultrasonic gas meters of Elster or FLOWSIC ultrasonic gas meters of SICK/MAIHAK are connected to a protocol channel of a serial MSER2 board.
- If necessary, an MFE11 input board for flow reversal via digital input contact.

Usually, an additional multifunctional MFA8 output board for the output of volume pulses, messages and measurements is available.

The overview below shows the typical board assignments for common applications.

Operating modes (OM):

- 1 1 stream, 1 flow direction, gas meter connection via pulse interface with 1 or 2 ports or encoder totalizer with up to two additional HF pulsers
- 2 1 stream, 2 flow directions, gas meter connection via pulse interface with 1 or 2 ports or encoder totalizer with up to two additional HF pulsers
- 3 1 stream, 2 flow directions, Q.Sonic or FLOWSIC ultrasonic gas meter
- 4 2 streams with 1 flow direction, both gas meter connections via pulse interface with 1 or 2 ports or encoder totalizer with up to two additional HF pulsers
- 5 2 streams with 2 flow directions each, both gas meter connections via pulse interface with 1 or 2 ports or encoder totalizer with up to two additional HF pulsers
- 6 2 streams with 2 flow directions each, Q.Sonic or FLOWSIC ultrasonic gas meters

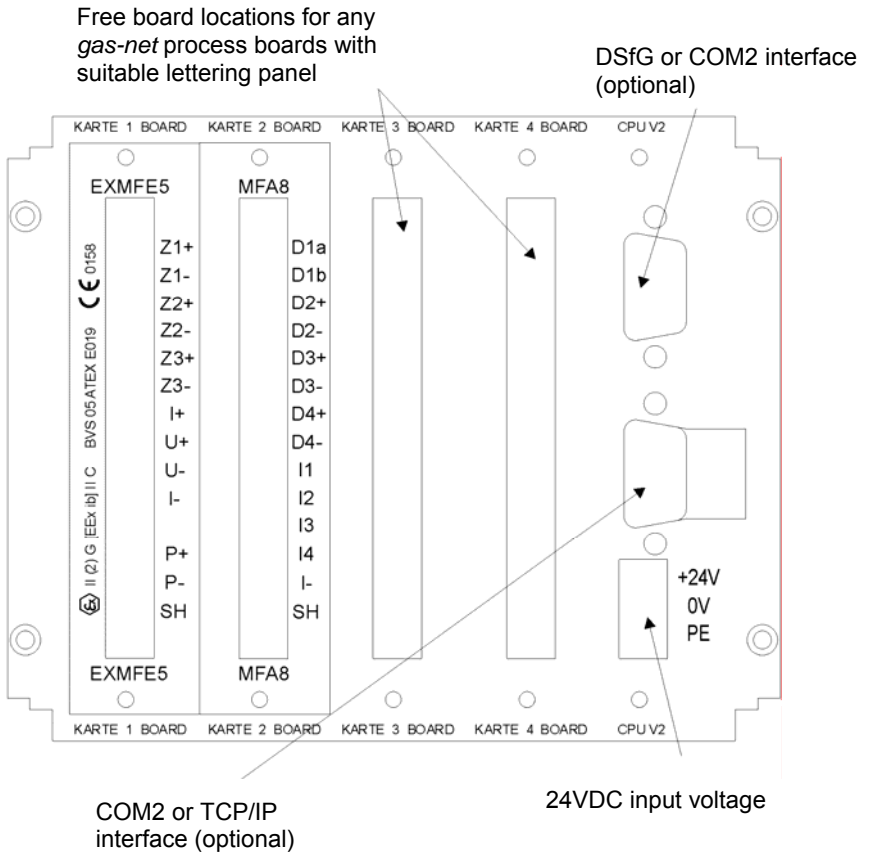
Unassigned board locations (BL) may contain any *gas-net* process boards for additional purposes. A description of the currently available boards is provided in the second volume of the Technical Documentation (cf. chapters Connecting the Lines and Technical Data).

Board locations 4 to 7 are only available in case of a 1/2 mounting width.

BL	1	2	3	4	5	6-7
OM						
1	EXMFE5 (Connection of gas meter, p sensor and T sensor)	MFA8				
2	EXMFE5 (Connection of gas meter, p sensor and T sensor)	MFA8		MFE11 for flow reversal		
3	EXMFE5 (Connection of p sensor and T sensor)	MFA8	MSER2 (connection of gas meter)	if necessary: MFE11 for flow reversal		

4	EXMFE5 (Connection of gas meter, p sensor and T sensor for stream 1)	MFA8			EXMFE5 (Connection of gas meter, p sensor and T sensor for stream 2)	
5	EXMFE5 (Connection of p sensor and T sensor for stream 1)	MFA8		MFE11 for flow reversal	EXMFE5 (Connection of p sensor and T sensor for stream 2)	
6	EXMFE5 (Connection of p sensor and T sensor for stream 1)	MFA8	MSER2 (connection of gas meters)	if necessary: MFE11 for flow reversal	EXMFE5 (Connection of p sensor and T sensor for stream 2)	

The illustration below shows a typical rear view of an F1 device in the narrow design for application no. 1 as described in the table above.



F1 rear view (example)

3 Operating *gas-net* Devices

This chapter's objective is to give you an understanding of the basic operating and menu structures of *gas-net* devices.

As already mentioned, all devices of the *gas-net* family have a uniform appearance and a comparable menu structure.

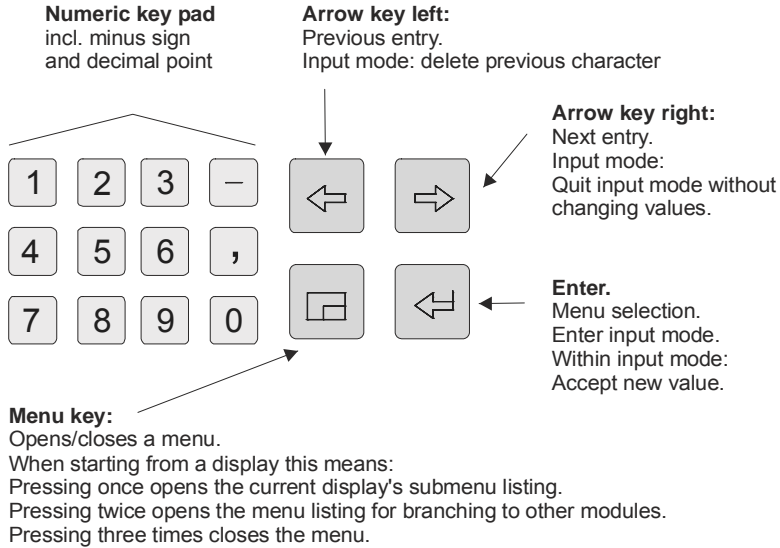
This means: If you have operated a *gas-net* device once, you will also be able to operate all other device types without any problems.

According to our philosophy of how to parameterize *gas-net* devices, they are parameterized by means of a PC or laptop and not via the operator panel. The device operation via the operator panel mainly serves the indication of the most important information on the display. The content of the operator interface on the display depends on the individual *gas-net* device type.

3.1.1 Keypad

The keypad of *gas-net* devices consists of a numeric keypad for entering numbers, the minus sign and decimal point keys and a group of four navigation keys. With these keys, you may move within the menu structure and invoke menus and displays. In some cases you may also trigger actions or change values via the navigation keys.

The illustration below shows an overview of the keys' meanings. The exact context-related meaning of each navigation key will be explained together with the menu structure in Chapter 3.1.4.



3.1.2 Other Operating Elements: Status LED, Calibration Switch

The status LED on the device front is a three-color light emitting diode. The status of this LED indicates whether an error of the gas quality measurement is pending or has been pending.

Please refer to the table below for the meaning of the colors:

LED status	Meaning
red, flashing	An alarm is pending, i.e. an error has occurred that affects the correction.
yellow, flashing	A warning is pending. That is, an event has occurred without affecting the correction.
green, flashing	A green flashing light appears during the start-up phase after a mains failure.
red, permanently illuminated	An alarm has been pending but is no longer relevant. It can be removed from the error listing by accepting it.
yellow, permanently illuminated	A warning has been pending but is no longer relevant. It can be removed from the error listing by accepting it.
green, permanently illuminated	The device runs error-free.

The sequence of the LED status lights in the above table corresponds to the sequence the error management keeps to: The system always indicates the error with the highest priority. A pending error always takes precedence over an error that is no longer relevant.

The exact meaning of the terms *alarm*, *warning* and *hint* is explained in Chapter 5.3.1.

The calibration switch is on the lower right side of the front panel.

gas-net volume correctors and flow computers are furnished with a two-level safety concept: All parameters being protected by the calibration switch can only be changed if the calibration switch is open. Such parameters are always modified with a PC or laptop and the associated GW-GNET+ parameterization software.

Open the calibration switch by turning it anticlockwise as far as it will go. This first safety level is important for devices used for legal metrology and custody transfer. In this case, seals may officially secure the calibration switch and must possibly be removed before.

The basic device display will automatically be invoked when you close the calibration switch.

Note: The *User lock* as the safety concept's second level consists of one numerical lock for each of the two contract parties. The user lock is, in contrast to the calibration switch, implemented via the device software. This means that the locks are defined via the device parameterization and opened or closed via the operator panel. Open locks allow the user to access certain parameters or actions. All parameters being subject to the user locks can be changed when both locks are or the calibration switch is open.

3.1.3 Display

The display is an illuminated LCD consisting of 8 lines with 32 characters each. After approximately 30 minutes without a keystroke, the display's background illumination switches off automatically.

3.1.4 Displays / Menus / Dialogs

This chapter describes the menu assistance and operation of all *gas-net* devices in general. Where appropriate, individual subjects have been illustrated with examples. These examples refer to currently available device types; therefore, it may happen that a special menu illustrated in an example does not exist in your *gas-net* device type or does not occur in the software variant. The operating mechanisms generally described here function in all devices in the same way. Each module has a main display, in which all important current values are indicated.

For example: All *gas-net* volume correctors and flow computers contain, among others, *Correction* and *Monitoring* modules. The main display of the *Correction* module shows the current totalizers and measurements, whereas the main display of the *Monitoring* module shows the error listing.

The main display of the first module is also the basic display of the device, i.e. the display that is invoked automatically if there has not been any keystroke for about 30 minutes.

For example: An F1 flow computer is capable of dual-stream operation, so it contains one *Correction* module per stream. In this case, the basic display of the device is the main display of the *Correction* module of stream 1.

A display serves to indicate values. If there are more entries than can be made visible at once, little scroll arrows on the right side indicate whether or not you may scroll upwards or downwards.


```
Correction 1  FD1  12:54:17 W
Cal. lock open 22.01.2007
+ E: 00000024042.977 kWh
+ Un: 00000002334.269 m3
+ Uo: 00000000289.209 m3
+ U: 00000000194.443 m3
+ m: 000000001937.677 kg
```

„Down“ scroll arrow pointing downwards: Scroll downwards with the rightward arrow key.

```
Correction 1  FD1  12:55:15 W
Cal. lock open 22.01.2007
P: 12.6598 bar
T: 16.12 °C
z: 0.974884
zn: 0.997527
k: 0.977381
Z: 12.071458
```

„Up“ scroll arrow pointing upwards: Scroll upwards with the leftward arrow key.

Each invocable display belongs to a module within the device software and thus to an enclosed functionality. In the display of a module, no matter which one, there are principally two different navigation targets within the menu of the device. One target may be a subordinate display/dialog³ of the indicated module, another one the basic display of any other module.

To be able to navigate within the menu structure as easily and quickly as possible, the Menu key  has been provided with the following functions:

Pressing the Menu key once opens the submenu listing offered by the currently opened module display. Pressing the Menu key again opens the menu listing containing all branching possibilities to other modules. Pressing the key again closes the menu.

The structure of a module's submenu listing depends on the current parameterization: Menu items referring to functionalities that have not been parameterized will not be offered for selection.

For example: A single-stream *gas-net* volume corrector or flow computer that has been parameterized for correction in exactly one flow direction will not offer the *other FD* menu item for switching over to the second flow direction.

Submenus of a module either invoke further displays or dialogs in which the user may adjust values via the operator panel.

The menu structure is tree-like: A subordinate menu item of a module may also have its own subordinate menu items.

At lower hierarchy levels of the menu tree the following menu items exist for returning to the next higher level, depending on the context:

- In a display: menu item *Back*
- In a dialog: menu items *OK / Cancel*
(*OK* also means accepting the modified values; *Cancel* means rejecting the modifications)

³ A dialog is a special kind of display indicating values that can be changed by the user via the operator panel.

No matter on which menu level you currently are: You may move back and forth within a menu listing and select a menu item by using the arrow keys. The selected target is presented in an inverted way, i.e. with green writing on a black background. Activate the menu item belonging to the selected entry by pressing the Enter key.

For example:

Let's assume you would like to check the output signals. There is an own display in the *System* module for this; we therefore have to invoke the *System* module and branch to the module-specific submenus from there. Let's also assume the basic display of the *Correction 1* module is currently invoked. If you press the Menu key, you will see the submenus offered by the *Correction 1* module.

```
Correction 1  FD1  12:57:11 W
Cal. lock open 22.01.2007
E: 000000030577 kWh
Un: 000000002968 m3
```

Start:
Basic display of *Correction 1*

```
Correction 1  FD1  12:57:39 W
Cal. lock open 22.01.2007
E: 0000[-]
Un: 0000[-]
[-] - Hs, rho, CO2, ...
[-] - Transm. monitoring
[-] - Snapshots
[-] - Hint limits
```

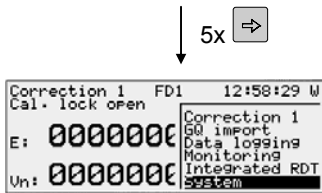
Invoke the menu:
Menu listing of the *Correction 1* module.
The dashes in front of the menu names indicate that the listing refers to subordinate menus.

As we do not want to activate a correction menu in our example but branch to a different module, please press the Menu key again.

```
Correction 1  FD1  12:58:05 W
Cal. lock open
E: 00000000
Un: 00000000
Correction 1
  - Mod import
  - Data logging
  - Monitoring
  - Integrated RDT
  - System
```

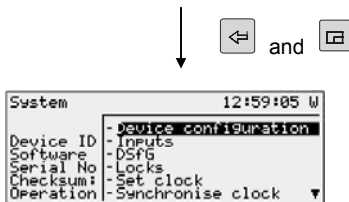
Module listing
(without listing dashes in front of the menu name)

Now the menu shows the listing of all modules included in the device software. Press the rightward arrow key a couple of times until the module you would like to invoke is selected. It's the *System* module in our example.



Module listing:
The *System* module has been selected.

Press the Enter key and the display of the module you have just selected will be invoked.
Now you can probably guess how to proceed: Please press the Menu key to open the subordinate menu listing.



Basic display of the *System* module with related menu listing

Our destination, the *Outputs* menu, is the third entry in the menu listing. Therefore, press the rightward arrow key twice to select the *Outputs* line. Press the Enter key afterwards to confirm your selection and to invoke the related display.

Further tips on navigating within the displays:

- * If you have pressed the rightward arrow key too often and went too far down in the menu selection list, move upwards again by pressing the leftward arrow key.
- * If you would like to quit an invoked menu selection window without having made a selection, just press the Menu key again as often as necessary to close the menu window (twice in case of a menu listing within a certain module; once in case of the module listing).

The selection of some menu items invokes a dialog. These dialogs are displays in which values can be modified. However, only a few values can be modified via the operator panel.

In such input dialogs you move from one parameter to another by using the arrow keys. If a parameter must not be changed (for instance, because it is a parameter that is subject to the calibration lock, which is closed at that moment), it is crossed out in the display.

If you have selected a changeable parameter, you may switch over to the edit mode via the Enter key.

To make the operation more comfortable, there are different methods of defining a new value, depending on the type of the value to be changed:

Direct Entry of a New Numerical Value

If you would like to replace individual characters only, delete the characters step by step from the right using the leftward arrow key. Then enter the new characters via the numerical keys including decimal point and minus sign.

If it is easier to replace the entire value by a new one, just start with your entry right away: As soon as you press any numerical key the preset value will be deleted and may then be overwritten by the new entry.

Quit the edit mode via the Enter key. This initiates a consistency check: If you have entered a value that does not make sense in the present context or is not permissible, you will not be able to quit the edit mode. This way, the user is forced to correct the value he has entered.

In order to quit the edit mode without accepting the change, for instance after a false entry, just press the rightward arrow key.

In order to quit the entire dialog, invoke the menu and select either *OK* (the new values will be accepted) or *Cancel* (the values will be rejected).

New Value by Selection from a Listing

The device software lists possible values in case of editable values the range of which is restricted to a fixed number of selectable values. Choose a suitable value from the listing via the arrow keys and accept it by pressing the Enter key.

For example: Opening the revision switch for the first stream of a volume corrector or flow computer. (Note: Only possible if the locks are open!). The status of the revision switches can be changed in the *Switches* menu of the *Monitoring* module. Therefore, go to the related dialog via the *Monitoring - Switches* menu item.

```

Switches                               11:47:10 S
                                       28.07.2004
Revision 1:  off
Revision 2:  off
Switch 1:   off
Switch 2:   off
Switch 3:   off

```

The revision switch is marked as being closed in the above figure (Revision 1 = off, Revision 2 = off). Let's assume you would like to activate the revision switch for the first stream. When entering the display this switch has already been selected, which means you can immediately press the Enter key to get into the edit mode. A selection list opens, offering useful values (in this case: *off* and *on*).

Select the desired value via the arrow keys, in our example: *on*.

The display looks as follows:

```

Switches                               11:48:59 S
                                       28.07.2004
Revision 1:  on
Revision 2:  off
Switch 1:   off
Switch 2:   off
Switch 3:   off

```

Press the Enter key to quit the edit mode and invoke the menu:

```

Switches                               11:50:25 S
                                       28.07.2004
Revision 1:  on
Revision 2:  off
Switch 1:   off
Switch 2:   off
Switch 3:   off

```

Confirm the new setting with *OK* or reject it with *Cancel*.

Modifying Several Values at once

Most of the dialogs do not offer individual values but whole groups of values for being modified. In such a case, edit the first selected value first. Switch to the edit mode by pressing the Enter key.

Move to the next value by pressing the Enter key.

- * **Tip:** If you don't want to modify an offered value, skip it by pressing the rightward arrow key.

Change the value either by directly entering the new value via the numerical keypad or by selecting a new value from a listing.

After having edited all values, press the Menu key. The invoked menu contains the menu items *OK* and *Cancel*. Selecting *OK* means accepting the modified values⁴. Selecting *Cancel* means rejecting the changes. In both cases you will return to the display you have invoked last.

⁴ In this case, too, a consistency check is performed: If you have entered a value that does not make sense in the present context or is not permissible, you will not be able to quit the edit mode. You will have to correct your entry first.



4 Primer: What do I have to do to ...

Note: The following instructions are based on the assumption that you are in the basic device menu, i.e. in the main display of the *Correction 1* module.

4.1 ... view the process values of a second or third stream?

The F1 flow computer is capable of dual- or triple-stream operation.

The basic display of the device is always the main display of the *Correction* module for stream 1. It shows the totalizers and process values of the first stream. To switch to the display of the second stream (*Correction 2* module), please proceed as follows:

- 1) Invoke the module listing by pressing the Menu key twice in the basic display.
-  2) Press the rightward arrow key until the *Correction 2* menu item is selected.
-  3) Press the Enter key to confirm your selection and invoke the main display of the *Correction* module for stream 2.




To switch to the third stream, repeat the procedure described above and activate the *Correction 3* menu item.

It is possible to discern at a glance to which stream the indicated totalizers and values belong by looking at the first line of the *Correction* display – the display indicates either *Correction 1* or *Correction 2* or *Correction 3*.

4.2 ... view the error listing of the *Correction* module?

If the status LED flashes red or yellow or is permanently illuminated, the error listing contains alarm or warning entries.

View the error listing by proceeding as follows:

-  1) Invoke the module listing by pressing the Menu key twice in the basic display.
-  2) Press the rightward arrow key until the *Monitoring* menu item is selected.
-  3) Press the Enter key. The main display of the *Monitoring* module is invoked. The error with the highest priority level is indicated. Scroll through the error listing by means of the arrow keys.

- 4) Proceed to Chapter 5.3.2, page 5-39, should you need more detailed information. If you would like to accept an error, proceed to read the very next chapter.

Note: In case of a flow computer for the correction of more than one stream, a separate error listing is kept for each stream. There is, however, only *one* status LED at the device. Consequently, it is not possible to distinguish by the LED to which stream a message refers. The status LED will also flash red, for instance, when an alarm is pending for stream 2, while stream 1 is operating error-free.

To be able to clearly assign an error condition indicated by the status LED, it is necessary to check the error listings.

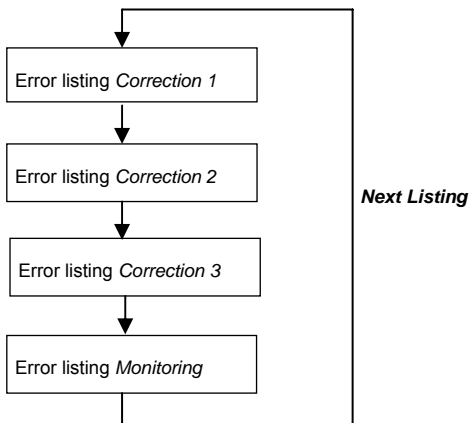
After the *Monitoring* menu has been invoked, the error listing of the first stream is displayed first. This is indicated by the text *Correction 1* in the third line.

To view the error listing for the second stream in case of a dual-stream corrector, proceed as follows:

- 1) Invoke the main display of the *Monitoring* module.
- 2) Press the Menu key to invoke the listing of the subordinate menu items.
- 3) Press the rightward arrow key until the *Next Listing* menu item is selected.
- 4) The error listing of the second stream is indicated, recognizable by the phrase *Correction 2* in the third line.



There may be up to four error listings. In addition to one, two or three correction error listings, an error listing of the *Monitoring* module's message processing is also available. Always switch to the display of the next error listing via the *Next listing* menu item.



Please refer to Chapter 5.2 for further information on the error listing of the message processing.

4.3 ... accept correction errors?

Errors can only be accepted and thus removed from the correction error listing if they are no longer pending.

To accept such an error, proceed as follows:

- 1) Open the error listing via the Menu key as described above in Chapter 4.2. If the flow computer is operated with more than one stream, please ensure that the error listing of the desired stream is indicated. The third line of the display indicates the stream to which the currently invoked error listing refers.
- 2) Select the error you would like to accept via the rightward or leftward arrow key.
- 3) Press the Menu key. If the error indicated on the display cannot be accepted, the first menu item appears as being crossed out: **Accept**. If the error can be accepted, just select **Accept** and press the Enter key. The error disappears from the error listing, and the error with the next lower priority level will be indicated on the display.⁵
- 4) Repeat the steps explained above to accept further errors.

Note: Accepting errors as described above only applies to errors in connection with the device's correction functions. How to accept messages of the general message processing (*Monitoring* error listing) is explained in Chapter 5.2.

4.4 ... freeze the display for comfortable viewing?

- 1) The *Freeze display* menu item for stopping the display is part of the detailed *V,p,T*-display of the *Correction* modules. Invoke the menu. *Freeze display* is the first item; just press the Enter key, and the display will be frozen. In the freeze mode all totalizers are indicated with three decimals.
- 2) To re-activate the continuous display update, invoke the menu again and select *Continue*.

⁵ The following special feature applies to a corrector for more than one stream: An error that refers to all streams disappears from all correction error listings as soon as it has been accepted in one of the listings. An example of such an error is Alarm A409 (supply voltage failure).

Note: In case of a flow computer operated with more than one stream, the snapshot always shows the values of the stream for which the display was selected last. To freeze values of another stream, you have to exit the freeze mode first, to change to the display of the other *Correction* module (see Chapter 4.1) and to select the *Freeze display* menu item there.



4.5 ... to view the device configuration?

Invoke the module listing by pressing the Menu key twice in the basic display.

- 1) Press the rightward arrow key until the *System* entry is selected.
- 2) Press the Enter key. The main display of the *System* module is invoked, showing device identification data (software variant, software version, serial number, check sum, etc.).
- 3) Press the Menu key again and select the *Device configuration* submenu. For a better overview the saved parameters are sorted on the modules they belong to. Choose the desired module in the *Device configuration* display: Press the Enter key, select a module via the arrow keys and press the Enter key again. Activate the *View* submenu, and the saved parameter listing of the module you have selected before will be invoked.



4.6 ... checking all parameter settings?

The parameterization of a *gas-net* device contains too many settings for them to be conveniently displayed via the operator panel. It is much easier to get a general idea of the device settings by means of the GW-GNET+ parameterization program and a laptop.

1. Connect the COM interface at the PC to the DSS interface at the *gas-net* device using a parameterization cable.
2. Start GAS-WORKS on your computer. Activate the communication program by clicking the **Import – Data interface** tool in the GW-BASE toolbar.
3. After having successfully started the communication program, you are linked with the connected device data technology-wise. The window appearing on your display shows some important basic device information.
4. Select the **Tools** tab now. Double-click the **Change parameters** or the **Edit parameterization** entry. The GW-GNET+ interface will appear on the screen. This is where you can invoke and check the parameter listings of the individual modules.



Please note: The **Change parameters** or **Edit parameterization** service programs also offer the option of changing device settings. The current status of the protection mechanisms (calibration switch / user lock) is of course taken into consideration. Please refer to the GW-GNET+ online help for further information.

4.7 ... check the input signals?



1) Change to the display of the *System* module: While in the basic display, press the Menu key twice, then move to the *System* entry using the rightward arrow key and press the Enter key.



2) Press the Menu key again and move to the *Inputs* entry using the rightward arrow key. Then press the Enter key. The *Inputs* display will be invoked.



3) For information on how to proceed, please refer to page 5-62.

4.8 ... view and test outputs?



1) Change to the display of the *System* module: While in the basic display, press the Menu key twice, then move to the *System* entry using the rightward arrow key and press the Enter key.



2) Press the Menu key again and move to the *Outputs* entry using the rightward arrow key. Then press the Enter key. The *Outputs* display will be invoked.



3) For information on how to proceed, please refer to page 5-63.

4.9 ... view archives?



1) Change to the display of the *Data Logging* module: While in the basic display, press the Menu key, move to the *Data logging* entry using the rightward arrow key and press the Enter key.

2) Select exactly the archive information you want to view in the appearing dialog. Please refer to Chapter 5.2.2 starting on page 5-20 for a detailed description of the filter function.

5 Functional Description

5.1 Correction Module(s)

5.1.1 Function

The *gas-net* F1 device is an electronic flow computer for natural gases. As already described in detail in Chapter 1.2, the *Correction* functionality of the device determines the flown base volume on the basis of the input variables volume or flow, pressure and temperature (all at operating conditions) and gas quality. After the base volume has been calculated, the corresponding energy quantity and mass are determined.

5.1.1.1 Streams, Flow Directions and Totalizer Structure

The F1 is able to correct up to three streams. In case of dual- or triple-stream operation, two or three separate *Correction* modules are activated in the device software. The device thus operates like two or three flow computers with one display; one pressure sensor, one temperature sensor and one gas meter are connected per stream. All correction functions, especially the creation of totalizers, are carried out two or three times in parallel, i.e. once with the data and signals from each stream.

An F1 device facilitates a dual-flow direction operation, which means that each *Correction* module may file up to two totalizer sets. Depending on the status of the flow direction signal, either the totalizers for flow direction 1 or flow direction 2 are increased. As it is physically the same measuring section, each stream is equipped with only one gas meter, one pressure and one temperature sensor even for an operation in two flow directions.

Each *Correction* module keeps different totalizers for the flown gas volume. They consist of the:

Vo: original-volume totalizer

Vu: totalizer for the uncorrected volume (at operating conditions)

V: totalizer for the corrected volume (at operating conditions)

Vn: base-volume totalizer

E: energy totalizer

m: mass totalizer

In addition to the main totalizers Vu, V, Vn and possibly E and m, there are also totalizers for disturbed volumes named Vud, Vd, Vnd, Ed and md, which are incremented in case of correction-relevant errors (more details later).

When the device is operated in two flow directions, all totalizers (Vu, V, Vn, Vud, Vd, Vnd and possibly E, Ed, m and md) exist once per flow direction.

Vo Totalizer

The increase of the original-volume totalizer Vo is based on the incoming information from the gas meter.

How the gas meter supplies its information depends on the meter type:

- A gas meter with a conventional pulse interface generates volume-proportional LF or HF pulses, which are rated with the cp value (number of pulses per cubic meter) to create the Vo totalizer.
- A gas meter with an encoder totalizer transfers its original meter reading via a digital protocol to the flow computer, which transfers this meter reading directly to its Vo totalizer.
- An Instromet Q.Sonic ultrasonic gas flow meter measures the flow at operating conditions as primary variable and provides this variable via a digital protocol (Q.Sonic). The flow computer increases the Vo totalizer on the basis of the measured flow at operating conditions.⁶

There is exactly one Vo totalizer available no matter which gas meter type is used. This Vo totalizer is always incremented during operation, independent of the flow direction used and no matter whether an error has been detected or not.

However, the exception proves the rule:

- A FLOWSIC ultrasonic gas meter of SICK/MAIHAK keeps four different original-volume totalizers:

+Vo	original-volume totalizer of flow direction 1, gas meter undisturbed
+Vod	original-volume totalizer of flow direction 1, gas meter indicates error

⁶ The gas may flow through a Q.Sonic ultrasonic gas flow meter in two directions; therefore, the connected flow computer has to keep totalizers for two flow directions.

- Vo original-volume totalizer of flow direction 2, gas meter undisturbed
- Vod original-volume totalizer of flow direction 2, gas meter indicates error

These totalizers are repeated on the F1 display.

→ Vu Totalizer / Vud Totalizer

As a rule, each Vo increase is used unchanged for incrementing the Vu totalizer and/or the Vud totalizer.

When the device is operated in two flow directions, the flow direction information⁷ is additionally evaluated. Based on this information either the totalizers of the first or the second flow direction are increased.

If the Vo increase is not transferred unchanged to the Vu totalizer, one of following exceptions is the case:

Exception 1: Minor Volume Suppression

It is possible to define a so-called *minor volume flow* in the parameterization of the *Correction* module. This way, volume suppression below a given flow at operating conditions is achieved. If this minimum flow cannot be reached, the totalizers for Vu and derived totalizers (V, Vn, E, m) are not increased. The original-volume totalizer Vo is increased only.

⁷ The information on the flow direction is usually derived from the status of the digital input contact.

Exceptions:

- A Q.Sonic ultrasonic gas flow meter supplies via its protocol information on the direction in which the gas flows through it. In case of a Q.Sonic meter, this piece of data can alternatively be evaluated as flow direction information.
- In case of a FLOWSIC ultrasonic gas meter the flow direction information is derived from the digital meter protocol.

Before parameterizing volume suppression, it is important to ensure that the local regulations are observed. In general, volume suppression should only be activated if at least one of the gas meter transmitters generates HF pulses.

Exception 2: Backward Run in case of Encoder Totalizer

If the gas meter is connected via an encoder totalizer, the original meter reading of the mechanical totalizer is provided via a digital protocol. This meter reading is always transferred to the Vo totalizer of the *gas-net* flow computer.

Normally, the gas meter will always count forwards as it is usually not designed for an operation in two directions. Nevertheless, the mechanical totalizer may slightly run backwards sometimes, although the system is actually standing still (e.g. due to temperature fluctuations). In such a case the new (lower) original meter reading is also transferred to the Vo totalizer of the flow computer. All other meters are standing still. The flow computer 'retains' the last Vo totalizer of the point of time before the backwards run of the meter's mechanical totalizer has begun. As soon as this retained totalizer is exceeded again during the following forward run, the occurring positive volumes will be added to the flow computer totalizers.

Exception 3: Encoder Totalizer, Decimals from the HF Pulser

The advantage of connecting an encoder totalizer is that the Vo totalizer corresponds to the actual meter reading of the gas meter. The disadvantage is that the Vo totalizer and thus all derived totalizers will not change continuously but sharply when the flow rate is low, especially if the encoder totalizer does not supply any decimals. However, if an additional HF pulser is available, it can be used to emulate additional decimals in the V totalizer between two encoder totalizer increments. With this method, Vo and Vu are accordingly adjusted each time the original meter reading increases.

Exception 4: Encoder Totalizer, all subsequent totalizers are derived from the pulser

When connecting an encoder totalizer it is possible to parameterize that the Vo totalizer shall only serve to repeat the encoder's original meter reading. In this operating mode all subsequent totalizers (Vu, V,...) are derived from the preferred pulser⁸.

⁸ In case of two additional pulsers the pulser with the higher cp value will be preferred. If this pulser is disturbed, the second pulser is used. Only if no undisturbed pulser is available, the totalizers are derived from the increase of the encoder totalizer.

→ V Totalizer / Vd Totalizer

If an official high-pressure test certificate is available for the gas meter, the results of this test can be parameterized as correction in the flow computer. The increases of V_u are not corrected. The flow computer applies the parameterized correction to the increase of V_u or V_{ud} to increase the V totalizer (and the totalizer for disturbed volumes, respectively; see below). Please refer to page 6-9 for a detailed description of the method.

The V totalizer is thus the totalizer for corrected volumes (at operating conditions).

Important: If no meter correction has been parameterized, the increments of V_u and V are identical. The V_u totalizer will thus not be indicated on the F1 display.

→ Vn Totalizer / Vnd Totalizer

Increments of the V totalizer are multiplied by the compression factor Z to create the V_n totalizer. The compression factor Z is calculated by considering the current measurements of pressure and temperature and the gas quality, based on the selected correction method.

→ E Totalizer / Ed Totalizer**→ m Totalizer / md Totalizer**

The increase of the energy totalizer E is calculated by multiplying the increment of V_n by H_s . The increment of V_n multiplied by the standard density ρ results in an increase of the mass totalizer m.

Interaction of Main Totalizers and Totalizers for Disturbed Volumes

The behavior of the main totalizers V_u , V, V_n , E and m in case of correction-relevant errors⁹ is parameterizable.

The following options are available:

1. When an error occurs, all main totalizers are stopped; the totalizers for disturbed volumes are incremented instead.

⁹ Correction-relevant errors are classified as *Alarms*. Please refer to Chapter 6.2 for a listing of all error situations resulting in alarms.

2. When an error occurs, all main totalizers continue to operate. The parameterized substitute value is used instead of the disturbed value (see below).
3. When an error of a correction-relevant value occurs, only those main totalizers stop that need the disturbed measurement for their creation. All other main totalizers continue to operate.

The totalizers for disturbed volumes always operate when an error occurs, no matter which reaction has been parameterized for the main totalizers. If a meter correction has been parameterized for the connected gas meter, it is also used for increasing the totalizers for disturbed volumes.

For example:

Let us assume the pressure measurement has failed.

Case 1 (all main totalizers stop):

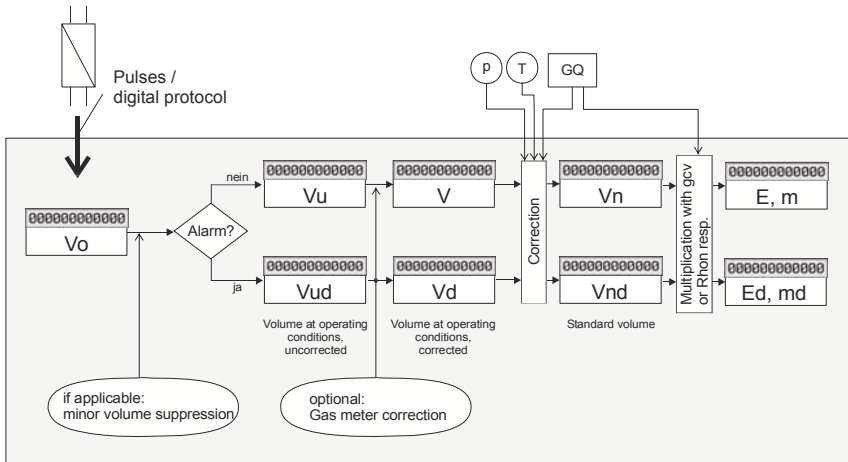
All main totalizers (V_n , V , V_u , E , m) stop, and the totalizers for disturbed volumes (V_{nd} , V_d , V_{ud} , E_d , m_d) are incremented instead. For the increase of the totalizers for disturbed volumes either the parameterized pressure substitute value or the last pressure measurement before the error occurred is used, depending on the parameterization of the substitute value strategy.

Case 2 (all main totalizers continue to operate):

The main totalizers continue to operate; at the same time the totalizers for disturbed volumes are increased. For the correction, a substitute value according to the parameterized substitute value strategy is used for the disturbed pressure (substitute value or last valid measurement value).

Case 3 (only the affected main totalizers continue to operate):

The pressure measurement is required for the correction and is therefore used for the calculation of V_n , E and m . If the pressure measurement is disturbed, the main totalizers V_u and V will therefore continue to operate, whereas the V_n , E and m main totalizers will stop. The totalizers for disturbed volumes V_{nd} , E_d and m_d and also the totalizers for disturbed volumes V_{ud} and V_d operate instead. The correction is carried out with the substitute pressure value according to the selected substitute value strategy.



Example: Increase of the totalizers for "stop all main totalizers"

5.1.1.2 Substitute Value Strategies When Input Measurements Are Disturbed

If the input values for the measurement variables pressure and temperature or for the gas quality are disturbed, you may choose between two different substitute value strategies:

1. Use substitute value

A parameterized pressure or temperature substitute value is used for the correction and for increasing the totalizers for disturbed volumes. If a gas quality component or the entire gas quality is disturbed, the parameterized, fixed table of gas quality substitute values is used.

2. Use last valid value

The last measurement or last valid gas quality before the error occurred still applies. In the special case of the gas quality, the *entire* last valid analysis is used, even if only one component has been identified as being disturbed.

5.1.1.3 Gas Meter: Connection and Error Detection

In many applications the gas meter is connected to the flow computer via two ports to improve the monitoring possibilities for this important measuring instru-

ment. When an encoder totalizer is connected, even a three-port connection (encoder with two additional pulsers) is possible.

If a gas meter is connected to the flow computer via two or three ports, all ports should signal the same average gas volume. The flow computer is thus able to compare the gas volumes and deduce responses in case of an error. There are two different objectives when performing such a volume comparison resulting in different requirements on the kind of comparison and the related parameters:

1. Detection of a complete failure of one transmitter. Because of a possible downstream control, this failure should be detected as quickly as possible. The indication for such a complete failure is the measuring of a certain gas volume via one of the transmitter inputs whereas no volume change is recognizable via one of the other inputs. The alarm *Transmitter x failed* will be generated in such a situation.

An alarm generated due to a complete failure of a transmitter will end after a mains failure or if a volume is received again via the failed transmitter.

Additional note: It is also possible to parameterize a physical cable break detection for pulsers by the EXMFE5 input board, which in contrast to the above described software solution responds immediately.

2. Monitoring both transmitters to detect a long-term deviation between the transmitter inputs; for instance, caused by a torn-off turbine wheel blade or wrong mating gears in case of the LF gear ratio. This detection is not time critical; however, it should be reliable. Minor long-term deviations (in particular when using an HF pulser) cannot be avoided due to the finite accuracy of the transmitter input's pulse value. To monitor the long-term deviation, the *Correction* module continuously accumulates the difference between the gas quantity inputs. As the average gas quantity signalized via each of the inputs should be the same, the mean accumulated difference should consequently be zero or at least very small. If a finite, considerable difference accumulates after some time, however, the gas volumes coming in via the inputs are different as for the measuring system. If the volume difference even reaches a set warning or alarm limit value, the *Correction*

module is able to deduce corresponding error reactions.¹⁰ Due to the above-described very small systematic deviations between the transmitter inputs, it is sensible for the *Correction* module to start calculating the difference at zero again after a very large gas volume has flown.

If the user locks are open, the procedure can also be reset manually at the device's operator panel.

A pending synchronism failure warning and/or a pending synchronism failure alarm will only end after the transmitter 1/2 monitoring has been reset.

The transmitter 1/2 monitoring will be automatically reset in the following cases:

- closing of the calibration switch
- changing of parameters that determine and configure the I/O connection of the gas meter transmitters

The transmitter 1/2 monitoring and complete failure monitoring are not taken into consideration as long as the flow rate is below the lower approval limit Q_{min} of the gas meter. The transmitter 1/2 monitoring will be stopped particularly if a cable break has been detected for one of the gas meter inputs or the complete failure detection has signalled a failure.

If the gas meter has been exclusively connected via pulse technique and two pulsers are available, the pulser with the higher cp value is always used for calculating the flow rate and increasing the totalizers. Only if this pulser is disturbed (cable break, complete failure, synchronism failure alarm), the reference pulser will be used.

If the gas meter supplies its information via an encoder totalizer, the original meter reading will always be used for further calculations; if available, the HF pulses of the second transmitter can be considered for creating additional Vu or Vud decimals (see above). When two additional pulsers are used, the pulser

¹⁰ If the amount of the added-up difference exceeds the parameterized warning limit value, a warning is generated to mark the transmitter with a minus deviation (W108: Pulser 1 deviation, W109: Pulser 2 deviation, W117: Encoder deviation). As soon as the alarm limit has been violated, alarm A116 (V synchronism failure) will be generated. The transmitter that supplied the smaller quantity is regarded as being defective.

with the higher cp value will be used; only if this pulser is disturbed (cable break, complete failure, synchronism failure alarm), the reference pulser will be used.

If the gas meter is connected via an encoder totalizer with one additional pulser, the flow will always be calculated based on the HF pulses, as this ensures a more uniform calculation. If two additional pulsers are available, the pulser with the higher cp value is used for calculating the flow rate. When the preferred pulser is disturbed, the second pulser will be used; only if all pulsers are disturbed, the flow calculation will be performed on the basis of the encoder increment.

The system only switches to a pulser to increase totalizers if the encoder input is regarded as being disturbed.

Another operating mode uses the Vo totalizer only for repeating the encoder totalizer when an encoder totalizer is connected; the preferred pulser is used for all other calculations.

Ultrasonic gas meters of the Q.Sonic series (of Elster) or FLOWSIC series (of SICK/MAIHAK) are always connected via one port.

5.1.1.4 Considering the Gas Quality

The *GQ Import* module is able to manage two different gas quality sources and in this case provides three different gas quality records:

1. data of GQ source 1
2. data of GQ source 2
3. data of GQ source 1 as long as this source supplies valid data, otherwise GQ source 2 is used (redundant measurement)

It is possible to separately parameterize for each *Correction* module the gas quality data record to be used (if only one gas quality analyzer has been connected, only one source will be available of course).

After start-up the *Correction* module calculates with the parameterized substitute values until the *GQ Import* module has received valid values via digital protocol and transfers them to the *Correction* module. During further operation, the gas quality data supplied by the *GQ Import* module is used.

If a flow computer alarm is generated due to invalid gas quality measurement values, there are two substitute value strategies available; it is either possible to continue calculating with the last valid data received before the error has occurred or with parameterized substitute values.

Should the gas quality data of the used source be marked with the *Revision* status, the *Correction* module continues calculating with the previously valid values.

If the second gas quality measurement is only used as substitute measurement (data record 3, redundant measurement), the following features also apply:

- If one of the two gas quality sources is marked as being invalid, the *Correction* module generates a warning (*Gas quality 1 or 2 failed*). A flow computer alarm is only generated when no gas quality source supplies valid data. In the alarm condition the parameterized substitute strategy is applied.
- The flow computer generates a hint when the second source is used because the first one is invalid (H 830 Substitute GQ active). This hint ends when the first source is considered valid again.

5.1.2 Display and Operation

Main Display (Correction Module)

When in the *Correction* module's main display, you can quickly invoke all important current correction data. The first line shows (if necessary) to which stream the display refers; the second line shows the pending error with the highest priority level in clear text. The right section of the first two lines is reserved for displaying the calendar time with the corresponding time zone.

The *Correction* module's main display only shows the most important totalizers in double-sized writing. Invoke all totalizers (for both flow directions in case of a dual flow direction operation) and the correction-relevant measurements and data (e.g. pressure and temperature, compression factor Z , compressibility factor k and flow rates) via the subordinate menu item V, p, T, \dots . View the currently used gas quality data after having selected the subordinate menu item H_s, ρ, CO_2, \dots .

For example:

```
Correction 1  FD1  12:57:11 W
Cal. lock open  22.01.2007

E: 000000030577 kwh
Un: 000000002968 m3
```

Invoking the menu:

```
Correction 1  FD1  12:57:39 W
Cal. lock open  22.01.2007

E: 0000 - V, p, T, ...
Un: 0000 - Hs, rho, CO2, ...
          - Transm. monitoring
          - Snapshots
          - Hint limits
```

Menu item V, p, T, \dots for displaying totalizers, coefficients, and measurements

Menu item H_s, ρ, CO_2, \dots for displaying the gas quality data used

The *Correction* module's main display shows the most important totalizers in double-sized writing¹¹.

¹¹ Up to three main totalizers can be displayed in double-sized writing in the *Correction* module's main display (parameterizable).

A multistream flow computer is equipped with one main display for each *Correction* module. To view another stream, you just have to change to the display of another module.



Subordinate Menu Items (Correction Module)

Freeze / Continue Display

The *Freeze / Continue Display* menu item is not part of the main display but is only available in the more detailed *V,p,T* display (see below).

Stop the display with all its information (totalizers, measurements, calendar time) by activating the *Freeze display* menu item. This display mode is indicated by the word *Frozen* in the second line of the display. This is why the indication of an error is dropped should an error be pending at the moment of the freeze. All calculations and processing routines continue in the background.

All actual values can be comfortably read off the „frozen“ display for testing purposes. Switch over to the display of the related frozen gas quality data via the subordinate menu item *Hs, rho, CO2,...*

To let the display continue again, return to the frozen totalizers' display via menu item *V,p,T,...* (see below). Then re-invoke the menu and activate the *Continue* menu item to let the display indication run again. After 30 minutes in the freeze mode the system automatically starts to continue.

V,p,T,...

The *V,p,T,...* menu item serves to switch over to a more detailed display with all totalizers, coefficients, and measurements (except for the gas quality).

This display shows content-related data blocks at once; use the arrow keys to switch back and forth between the individual pages.

The following figures show examples of this display for a device operated in 2 flow directions, with a 2-port gas meter connection and without gas meter correction:

```

Correction 1  FD1  12:54:17 W
Cal. lock open 22.01.2007
+ E: 000000024042.977 kWh
+ Un: 000000002334.269 m3
+ Uo: 000000000289.209 m3
+ U: 000000000194.443 m3
+ m: 000000001937.677 kg

```

Main totalizers of flow direction 1
(marked by a '+' sign placed in front)

(Vo identical for both flow directions)

```

Correction 1  FD1  12:55:02 W
Cal. lock open 22.01.2007
- E: 000000002910.520 kWh
- Un: 000000000282.374 m3
- Uo: 000000000289.209 m3
- U: 000000000024.003 m3
- m: 000000000234.565 kg

```

Main totalizers of flow direction 2
(marked by a '-' sign placed in front)

(Vo identical for both flow directions)

```

Correction 1  FD1  12:55:15 W
Cal. lock open 22.01.2007
P: 12.6590 bar
T: 16.12 °C
z: 0.974884
zn: 0.997527
k: 0.977301
Z: 12.071458

```

Pressure and temperature measurements,
compressibility ratio $k (= z/z_n)$ and compression
factor Z

```

Correction 1  FD1  12:55:37 W
Cal. lock open 22.01.2007
+ Ed: 000000006826.152 kWh
+ Und: 000000000662.733 m3
+ Ud: 000000000058.006 m3
+ md: 000000000550.134 kg

```

Disturbed volumes totalizers of flow direction 1
(marked by a '+' sign placed in front)

```

Correction 1  FD1  12:55:54 W
Cal. lock open 22.01.2007
- Ed: 000000001501.492 kWh
- Und: 000000000145.775 m3
- Ud: 000000000012.756 m3
- md: 000000000121.008 kg

```

Disturbed volumes totalizers of flow direction 2
(marked by a '-' sign placed in front)

```

Correction 1  FD1  12:56:24 W
Cal. lock open 22.01.2007
QE: 447824.4 kW
Qn: 43478.1 m3/h
Q: 3600.1 m3/h
Qm: 36091.2 kg/h

```

Flow rates

```

Correction 1  FD1  14:05:45 W
Cal. lock open 22.01.2007
U: Pulser 1
Q: Pulser 1

```

Only in case of a multiport gas meter connection:
Information on which gas meter transmitter is
responsible for incrementing the totalizers
and which one is responsible for the flow rate
calculation

If only one flow direction is corrected, there is only one set of main and disturbed volumes totalizers available and the flow direction is not marked by a "+"- or "-" sign in front.

The last line shows the currently valid correction factor $cf = Q/Qu$ if the gas meter correction has been activated.

Hs, rho, CO2...

The *Hs, rho, CO2,...* menu item serves to switch over to the indication of the gas quality data used. In case of tabular values, they may also be changed via the operator panel.

Transmitter 1/2 monitoring (only in case of a multiport gas meter connection)

This display serves to check the transmitter monitoring for synchronism.

It shows totalizers for the volumes detected via the various gas meter transmitters. **Vo** stands for the totalizer for volumes via an encoder totalizer, provided an encoder totalizer is connected. **V1** is the totalizer for the volumes of the first pulser; **V2** is the totalizer for the volumes of the second pulser, if available.

The differential volume between two of the transmitters is continuously calculated and monitored during operation. The display shows the differential volume between encoder transmitter and first pulser and/or the differential volume between the two pulsers (depending on the gas meter connection type).

The following illustration shows an example of a connected gas meter with encoder totalizer and two additional pulsers:

Transm. monitoring	12:25:10 S
Correction 1	18.05.2006
Vo:	833,000 m3
V1:	833,167 m3
V2:	833,270 m3
Vo - V1:	-0,167 m3
V1 - V2:	-0,103 m3

Vo: Volume increase via encoder totalizer

V1: Volume increase via 1st pulser

V2: Volume increase via 2nd pulser

Vo-V1: Difference between encoder totalizer and 1st pulser

V1-V2: Difference between 1st and 2nd pulser

All values are set to 0 if one of the volume totalizers has reached the reset volume and the difference totalizers have not violated any warning or alarm limits in the meantime. The procedure starts again.

If warning or alarm limits have been exceeded before the reset volume has been reached, a warning or an alarm will be generated. To be able to discern at a glance which transmitter is deviating, a W for warning and/or an A for alarm will appear directly behind the name of the volume totalizer in question. Volume and

difference totalizers continue to accumulate in this case and are not reset to 0. If necessary, the check will be performed for the other two transmitters, too.

The Transmitter 1/2 monitoring will be stopped if none of the transmitters signals a flow above the parameterized minor volume flow or if one of the transmitters has failed (physical cable break or software detection of complete failure). In order to indicate this situation the text *Monitoring stopped* appears on the display. If a complete failure has been detected, the transmitter's name flashes additionally.

Reset

The *Reset* submenu facilitates a manual resetting of the incrementing volume and difference totalizers to zero via the operator panel. This sets up the procedure anew, and a pending synchronism failure warning or alarm ends upon resetting.

Snapshots

The *Snapshots* menu offers the possibility to specify times at which all main totalizers and important coefficients shall be logged momentarily.

It is possible to view the snapshots on the device display. In contrast to a manual stopping of the display via the *Freeze Display* menu item (see above), the values of the snapshots are also retrievable via DSfG.¹²

Four different modes can be used for taking snapshots:

1. Cyclic logging of snapshots (every 1, 5, 6, 10, 15, 20, 30 minutes, every hour, at the billing interval, at the gas day beginning, at the gas month beginning).
2. Manual selection of two freeze times (*hours:minutes*) on the calendar day of the selection.
3. Logging when a message begins (e.g. by setting a digital input)
4. Logging when a message begins and when it ends. This operating mode does not log the original totalizers of the *Correction* module but continuous totalizers that are stopped each time a snapshot is logged that is taken because a message has ended.

¹² There are standard queries for retrieving these snapshots according to the DSfG Specification, which can be accessed via the addresses bka (flow direction 1) and bkb (flow direction 2). For the AGA8-92DC correction method, the respective standard query bkc (gas quality for revision) exists.

Each time a parameterization has been imported into the device, the cyclic freezing is always preset to the rhythm of the billing interval¹³.

The display looks as follows:

If the freeze rhythm is selected as in the above illustration, you can press the Enter key to open the selection listing offering all available rhythms.

To switch off the cyclic freezing, choose *Cyclic: no*. Afterwards, it is possible to define two freeze times (in *hours:minutes*, referring to the calendar day set at the device).

Notes:

- Freeze times may also be preset remotely via DSfG setting telegrams. In this case, the cyclic data logging will be deactivated automatically.
- An unscheduled snapshot is always logged when the totalizers are set via the data interface of the device.

View

After having invoked the *View* menu item, you will see the values of the most recent snapshot on the device display.

Previous / Most recent

Difference

You may switch over to the data of the previous or most recent snapshot via the *Previous* and *Most recent* menu items, respectively. The third line indicates the related freeze time.

Each snapshot contains all main totalizers at the time of the freezing, indicated with three decimals.

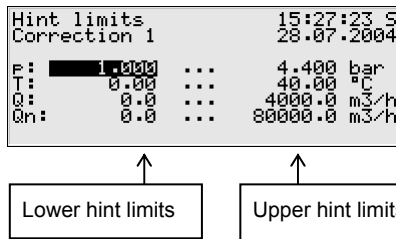
¹³ The *Billing interval* is a parameter of the *System* module and determines the data logging rhythm of the billing archive.

The measurements (pressure, temperature, flow rates, etc.) contained in the snapshot are mean values determined since the last but one freeze time.

You may have the difference between the most recent and last but one snapshot calculated and displayed (*Difference* menu item). This display option shows in the third line the time of the most recent freezing and the time difference between both snapshots (in days:hours:minutes:seconds).

Hint limits

Activating the *Hint limits* menu item invokes the display of the currently set hint limits for pressure, temperature, flow rate (at operating conditions) and base flow rate.



Hint limits are protected by user locks; they can be changed via the operator panel when the locks are open.

Main display

For switching over to the main display of the *Correction* module.

5.2 Data Logging Module

5.2.1 Function

All *gas-net* flow computers are always equipped with an integrated data logging function. The responsible *Data Logging* module, however, provides only the data logging *service*. The actual data to be logged is generated by other modules of the module group.

When parameterizing the *Data Logging* module, you only have to define *which* of the available archive groups shall actually be logged and which storage depth shall be applicable. All archives defined in that way are designed as ring storages. The data logging depth determines how many entries an archive is able to write at most. If an archive is full, the respective oldest entry will be overwritten by each new entry.

The following sections list the types of archive groups each module provides:

Correction module:

Each activated *Correction* module provides, among others, the archive type named *Interval archive*. The related data (totalizers, pressure and temperature at operating conditions) is logged cyclically with a time mark each time the daily archives start (gas day beginning) and each time an error occurs.

The data logging of the totalizers for disturbed volumes in the *Disturbed volumes archive* is carried out when a correction-relevant error (alarm) begins and when it ends. As long as an error is pending, the disturbed volumes are also filed at the end of the interval (also with a time mark).

A *Daily volumes archive* logs the main totalizers daily at a fixed hour (when the daily archives start, i.e. at the hour of the gas day beginning).

The *Revision* archive files specific snapshot values (cf. page 5-16), namely the logged main totalizers and the pressure and temperature values (at operating conditions).

If two flow directions are corrected, each flow direction is provided with an interval, a disturbed-volume, a daily-volume and a revision archive.

In addition, there is a special *Billing archive* available for the *Correction* module. This archive logs the billing-relevant values together with the time mark exclusively cyclically. Another channel of the billing archive contains the number of the alarm with the highest priority level that has been pending during the last billing interval.

Monitoring module:

The *Monitoring* module facilitates the compilation of process value archives (archives with any measurements or count values). Moreover, it runs the correction's error logbook, where the beginning and end of all error types (alarm, warning, hint – see Chapter 5.3.1) are entered in the listing in clear text and together with a time mark. The internal message processing is also provided with an additional, separate error listing, which can be logged.

System module:

The *System* module keeps a parameter change archive (*changed settings archive*), in which changes of the parameterization are logged. If the device is operated with more than one stream, the changed settings archive logs the parameter changes of all streams.

If individual parameters are modified, the old and new values will be logged in addition to the time mark. The module to which the changed parameter belongs is also displayed. This way it is possible to see, in particular in case of stream-related parameters, to which *Correction* module and thus to which stream the parameter belongs.

A completely new parameterization will be entered in the changed settings archive as *New parameterization* via the data interface when the calibration switch is open. A change of the parameterization's operational part is marked as *New parameterization (op.)*.

Note: The archive depth, exact composition and order of archives can largely be configured by the user himself via the parameterization. However, when changing the archive structure, you have to delete the old archives already existing in the device.

Before delivery, the devices have already been provided with a pre-defined archive structure corresponding to the common requirements.

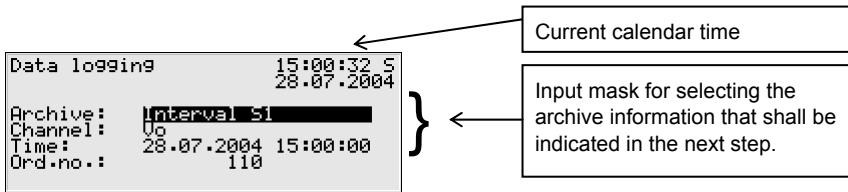
5.2.2 Display and Operation

Main Display (Data Logging Module)

All existing archive entries can be made visible at the operator panel.

The main display of the *Data Logging* module consists of a mask in which you may choose the data you want to view more closely.

The following illustration shows an example:



After the main display of the *Data Logging* module has been invoked, the most recent entry of the first channel of the first archive group is always indicated first. Choose the archive information you would like to view:

- The archive group type is selected at the beginning, i.e. the background is black. Press the Enter key to get into the edit mode. A listing opens up from which you may choose the desired archive type via the arrow keys. Afterwards, confirm your choice by pressing the Enter key.
- Specify the archive channel you want to view in detail in the next selection field. Several possibilities are offered, depending on the archive group type you have selected in the first step.
- You may now specify the point of time to be filtered by changing day, month, year, and time one after the other. You get into the edit mode for each respective field by pressing the Enter key and are thus able to specify date and time step by step. Confirm your entry by pressing the Enter key.
- The next field is selected. Select the entry you want to view via the ordinal number¹⁴ in this field. As there is an unambiguous relation between date and ordinal number, the related ordinal number is indicated automatically after the date has been entered (see above). If you enter a different ordinal number, the date in the second line of the selection mask will be adjusted automatically.

Invoke the selected archive via the menu (see next section).

¹⁴ Each individual measured variable of an archive group, which is logged by a device, additionally has an ordinal number for reasons of unambiguity. The order of the ordinal numbers is arranged in such a way that the very first archive entry receives the number 1. The ordinal number for each further entry is increased by one. Ordinal numbers are needed for instance for the polling of archive data.

Subordinate Menu Items (Data Logging Module)

View

Activating the *View* menu item invokes the display of the archive channel you have selected in the main display.

The archive type and current time are shown in the first two lines. Each entry is always indicated with a time mark. Name, value and unit of the logged data are shown. Totalizers are logged without decimals.

For example (interval archive stream 1, channel V):

Interval S1	15:06:12.5
Vo	28.07.2004
28.07.2004 15:00:00	106
14233 m3	
Change: 1728 m3	

Annotations:

- Archive entry with ordinal no. 106
- The "up" and "down" scroll arrows indicate that you may view even more archive entries (scroll with leftward and rightward arrow keys)
- Difference between last entry and currently displayed entry

Next channel

Previous channel

The *next/previous channel* menu items serve to quickly switch over to another channel of the same archive group.

Back

Return to the main display, i.e. to the selection mask for viewing archives.

Tip: The archive representation on the display is limited due to a lack of space. To analyze larger archive areas it is much more practical to read the archives out of the device and into a PC or laptop before; for example via the data interface by means of the GAS-WORKS module GW-REMOTE+. It is possible to view the data afterwards in a table or as diagram by means of the GW-DATA+ program.



5.3 *Monitoring* Module

5.3.1 Function

The *Monitoring* module basically performs the signaling and monitoring tasks of the device:

- Monitoring the correction(s) for errors.
Together with the *Logbook* functionality (*Data Logging* module, see Chapter 5.2) the error listings of the *Correction* module serve to analyze and remove correction-related errors and to be able to understand the history of the course of the error.
- Monitoring of any logged measurements.
- Signaling of operating states.
- Measurements.
- Log-on of process value archives (archives for measurements and count values which may be used to replace a recording instrument).
- Switching functionality.
- Performance of meter provings between correction entities connected via DSfG.
- Summation of count and flow values of two correction entities connected via DSfG.
- Controlling the gas meter lubrication

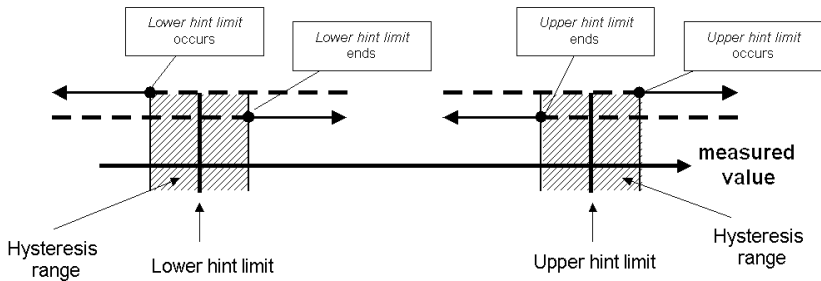
5.3.1.1 **Monitoring of Correction Functionality(ies), Error Listing(s)**

There are three different kinds of flow computer errors, which are also treated differently by the error management:

- An *Alarm* is generated if a correction-relevant error has occurred. Beginning and end of an alarm are entered in the related error listing together with a time mark (*<Alarm> begins/ends*).
If an alarm is no longer pending, i.e. it is no longer relevant, it can be accepted at the device and thus removed from the error listing.
As long as an alarm is pending the totalizers for disturbed volumes are increased. The reaction of the main totalizers in alarm conditions is parameterizable (see parameter description on page 6-3).

- A *Warning* is generated if a correction-relevant variable is affected by an error that does not influence the result of the correction. Incoming volumes continue to increase the main totalizers. If a warning is no longer pending, i.e. it is no longer relevant, it can be accepted at the operator panel and thus removed from the error listing.
- A *Hint* is generated if a measurement violates a hint limit specified by the user (upper/lower hint limits for pressure, temperature, flow at operating conditions, base flow, gas quality data).

In addition, a hysteresis can be defined to avoid fluttering messages when a measurement fluctuates around a limit value. The message *<Hint limit begins>* will then only be generated or removed if the measurement is not within the hysteresis range.



A hint will also be generated if an event occurs that has no influence on the correction (e.g. *Calibration switch open*).

The beginning of a hint is entered in the error listing together with a time mark. Hints cannot be accepted and automatically disappear from the error listing after they have ended.

Even in case of pending hints, incoming volumes are still counted exclusively by the main totalizers.

A complete listing of all errors together with their classification is included in the annex to this documentation.

Note: If the flow computer F1 is operated as dual- or triple-stream device, the error management is performed separately for each stream. Consequently,

there are also two or three correction error listings. There are alarms that are restricted to one stream; for example, a failure of the pressure measurement of stream 1 will only trigger an alarm for the first stream, whereas the error status of other streams is not affected. In addition to that there are errors affecting all streams equally. Such an error - an example is the *Supply voltage failure* alarm - is entered in the error listings of all streams.

The status LED of the device indicates the message with the highest priority level (pending alarm, pending warning, unaccepted alarm, unaccepted warning) according to the table shown in Chapter 3.1.2, page 3-2.

In dual- or triple-stream operation it does not matter to which stream the error with the highest priority level belongs; the status LED does not show which stream is affected. Detailed information can always be obtained from the error listings.

The software of the *gas-net* F1 flow computer includes one revision switch per stream to facilitate a system check by revision. This revision switch can be activated via the operator panel at the device if the user locks are open.

If the revision switch is set, the hint *Revision switch open* is generated and entered in the error listing and logbook of the affected stream. From then on, all entries in the interval archive are marked with the *Revision* status note.

A pulse output can be parameterized for the output of *Vn total revision*, *E total revision* or *m total revision*. Such an output channel outputs *Vn total* (*E total revision*, *m total revision* respectively) of a *Correction* module if the corresponding revision switch is closed. If the latter is open, the output of pulses is suppressed.

A closing of the revision switch results in the ending of the *Revision switch open* hint with an entry in the logbook and induces a last entry in the interval archive marked with the *Revision* note. The stream operates normally again.

5.3.1.2 Meter Proving via DSfG

If, in case of a revision during a plant test, a second volume corrector or flow computer is connected in series or a continuous series connection is installed, a *Meter proving* can be carried out. For this, both corrector entities must be connected via DSfG.

The comparison quantity is usually the base volume V_n ; in case of a proving between flow computers the proving can also be carried out via energy E or mass m .

There are two different operating modes for the meter proving:

1. Manual proving

The proving is initiated and stopped directly at the device (see Chapter 5.3.2). After the proving has been stopped, the device determines the percentage deviation of the quantities or rates that have flown via the two correction entities.

2. Automatic proving

The device parameterization includes the definition of a proving time and a maximum percentage deviation. If both volume correctors and flow computers operate faultlessly, the proving is started automatically. The percentage deviation is calculated at the end of each proving time. Should the maximum deviation be exceeded, the device generates an internal message, which can be output via a digital output.

During a plant test one of the volume correctors or flow computers involved in the meter proving has normally been switched into the revision mode before (see above). This way, the evaluation system can be informed that the quantities or rates have been measured twice during the test.

5.3.1.3 Summation between correction entities via DSfG

A *gas-net* F1 is capable of adding count values and flow rates of any two correction entities connected via DSfG and making them available for further processing. This way, for instance, summated quantities can be output via a pulse output or summated flow rates via an analog output.

Any two correction entities to participate in the summation may be defined in the parameterization.

The procedure works similar to the meter proving function described above: The information provided by the two corrector entities is obtained via DSfG approximately every 10 seconds. In case of totalizers the calculated difference is evenly distributed over one query interval to ensure that the totalizer sum is continuously increased and not suddenly every 10 seconds. This provides, in particular, a uniform output of pulses in case that a summated quantity or rate has been assigned to a pulse output.

5.3.1.4 Measurements

The measurements function offers a simple tool for capturing the changes and trends for up to 32 measuring values or count values. For each defined measurement the minimum and maximum values since the last reset are indicated. The display shows these values (together with the associated time marks) as well as the current value.

It is possible to reset the extreme values, i.e. to set these values to the current value. This reset procedure can either be activated manually via the operator panel or be executed automatically at regular and parameterizable intervals. During a power failure, the minimum and maximum values are held. After the mains have returned, the F1 device checks if there are any cyclic reset demands that have been missed due to the power failure. In that case, the affected measurements are reset instantly.

The typical application for the measurements function is to use it for observing *measured analog values*, e.g. provided by connected pressure or temperature sensors. Within the corresponding menu, the current value is indicated as well as the minimum and maximum value over a certain period of time.

But there are other, more special applications:

It is possible to assign a *count* value (pulse input or internally calculated totalizers) to a measurement. Such a measurement starts at 0 and increments the incoming quantities continuously (every second). The resulting measurement is monotonic increasing so that in this case the current value and the maximum value are identical, the minimum value is constantly 0. By resetting the measurement, current value and maximum value are set to 0 and start again.

By parameterizing an automatic reset rhythm, it is possible to determine the flown quantity that has been signaled by the count value input since the last resetting. For example: If the reset rhythm is set to "every 60 minutes", the assigned measurement counts the flown volumes/quantities since the last full hour.

The minimum and maximum values of a measurement are available within the system for further processing (data type *measurement* for both types of input values, count values and measuring values). Hence, these values may be

assigned to an analog output, logged in a process value archive or transferred via MODBUS protocol, for example.

5.3.1.5 Measurement Monitoring; Messages and Groups

Note: The message and signal processing of the *Monitoring* module runs completely independent of the monitoring of the device's correction functions. This functionality of the *Monitoring* module is therefore provided with a separate error listing and an own logbook.

Please take into consideration that the rules of this message processing considerably differ from those of monitoring the correction functions (see above); for instance, the acceptance mechanism is totally different. If you know the DIN 19 235 standard (*Signalling of operating conditions*), you may be familiar with many terms mentioned in the description below. The message processing of the *gas-net* device is oriented towards this standard wherever it has proved to be useful and possible with regard to the monitoring function.

The message processing may manage up to 64 single messages defined by parameterization. In principle, there are different types of conditions to be signaled which can be mapped to such a message. The operator himself defines the events that shall result in messages within the message processing when parameterizing the device.

First, the status of a digital message input (set/not set) can be evaluated as message. Messages generated by the device itself during operation may also be included in the message processing, such as a flow computer alarm.

Second, measurements can be monitored for limit violations. This applies to measurements supplied via analog inputs or measurements created internally, such as flow values of the *Correction* module. In addition to monitoring upper and lower hint limits, it is also possible to *monitor gradients*. The gradient monitoring observes measurement changes within defined time ranges: If the difference between the largest and smallest values of a measured quantity exceeds the defined maximum value within a parameterized time range, the condition for generating the *Hint limit gradient* message has been met.

Third, pulses or quantities may be monitored for the violation of hourly limits. This applies to pulses that come in via inputs and to internally calculated quantities. Should the quantities that have been summated since the beginning of the

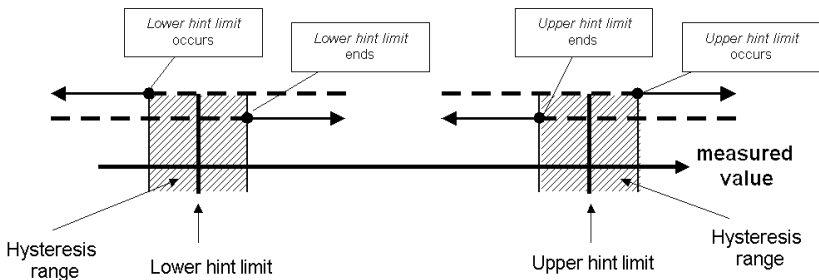
hour exceed the defined limit value, the message is regarded as being set till the hour ends.

Note: All single messages referring to measurements are also pending if the related input value is regarded as being disturbed.

There are two different methods of avoiding fluttering messages:

1. Hysteresis monitoring (only in case of measurement monitoring)

A hysteresis can additionally be defined to avoid fluttering messages when a measurement fluctuates around a limit value. The message *<Hint limit begins>* will then only be generated or removed if the measurement is not within the hysteresis range.



2. Considering a minimum pending time

If a minimum pending time is evaluated, a message is only considered pending if the condition to be signalled (set digital input, hint limit violation, etc.) is pending longer than the minimum pending time lasts.

The target of the message-processing concept is to combine messages in groups. Owing to group monitoring and evaluation the monitoring itself remains clearly understandable even if the amount of signals is rather large.

The user himself may define the scope of the related error listing. Via the device parameterization he determines for each message whether a *single* message shall be entered in the error listing and logbook of the *Monitoring* module. Only if this is the case, the message will be entered in the error listing as soon as it begins. There is no acceptance required for single messages; they are automatically removed from the error listing when they end. If a message is entered

in the error listing, beginning and end of this message are also entered in the logbook. The *Archive* module is able to log the logbook of the *Monitoring* module.

Individual single messages can be *disabled* during operation, which is, for instance, rather helpful during a plant inspection. The message processing completely disregards disabled messages, which are always considered not pending. The disable note of a message can be changed via the operator panel of the device, via the parameterization and with a DSfG setting telegram.

Single message data (characteristics, current values) can be enquired via DSfG. Some properties are also adjustable via DSfG, such as hint limits and gradients.¹⁵

In order to simplify the monitoring of up to 64 messages, single messages can be combined by parameterization in up to 8 groups in any composition whatever. Each group generates 3 different messages that are created by linking the single messages contained in that group. This way, the operator is able to monitor the status of content-related messages without getting lost in the observation of single messages.

The different message types of a group are called *Group message*, *Held group message* and *Centralized message*.

Group message

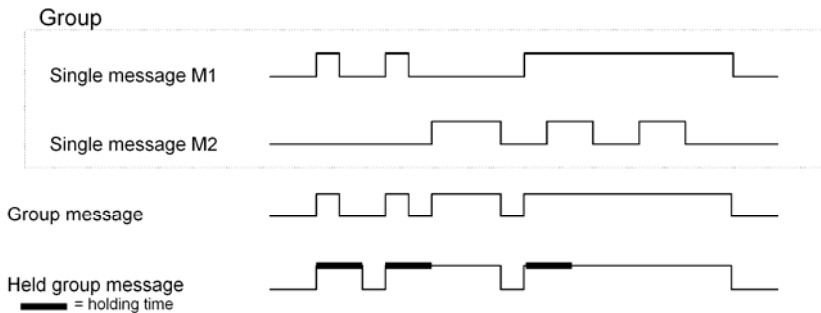
A group's group message results from the OR operation of the single messages belonging to the group. Thus, a group message is pending if at least one of the messages of the group is pending.

A group message is not linked with an acceptance.

¹⁵ The DSfG data elements for message processing are included in the DSfG data element tree of the *Control* entity. Please ask Elster for a precise list of the supported or used DSfG data elements, when required.

Held group message

The held group message only differs from the normal group message by always keeping to a holding time; for instance, for taking the telecontrol response times into consideration. A held group message is pending at least as long as the holding time lasts, even if the normal group message ends during the holding time.

Centralized message

A special feature of the centralized message is that it can link the states of single messages with an acceptance signal. The *Acceptance required* or *No acceptance required* property is defined as group characteristic in the parameterization.

All centralized messages are entered in the logbook and error listing.

If a group is marked with *No acceptance required*, the result of the centralized message is always the same as the result of the group message. In contrast to the group message, however, the no acceptance requiring centralized message is entered in the error listing and logbook.

There are two different procedures for the acceptance technique and the status of the centralized message of a group marked *Acceptance required*. These two procedures are described below.

Acceptance technique of centralized messages, procedure to DIN 19 235

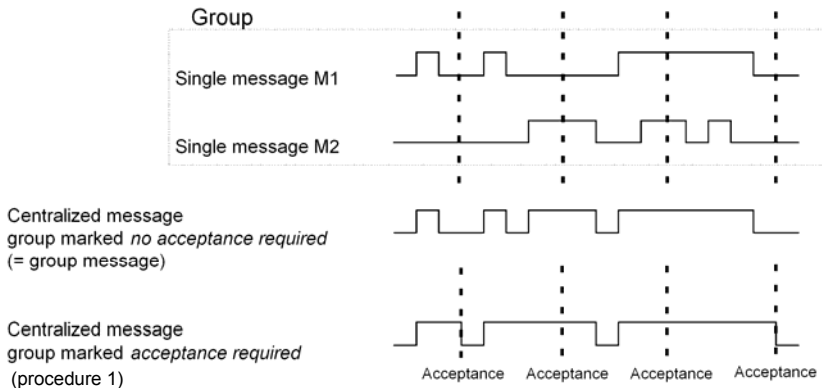
According to this procedure, the centralized message of a group characterized *Acceptance required* links the states of the single messages contained in that group with an acceptance signal.

The acceptance can either be implemented via an assigned digital input or via a corresponding menu item, i.e. via the operator panel. An acceptance accepts all groups at once. The source of the acceptance does not matter.

The centralized message of a group classified as *Acceptance required* is pending if at least one single message of the group is pending. However, it will only end with the end of the last single message if all pending messages have been accepted. A currently pending single message is also considered accepted if it had been accepted before it ended.

The fact that a centralized message is still pending after the last single message has ended indicates that at least one of the single messages has begun again after the last message was accepted. In such a case the single message is or the single messages are to be accepted.

The following illustration shows how, according to procedure 1, the centralized message of a group classified as *No acceptance required* differs from the one of a group classified as *Acceptance required*.



Acceptance technique of centralized messages, standard procedure

According to this procedure the result of the centralized message of a group classified *Acceptance required* ensues from the OR operation of the single messages. It does therefore not differ from the result of the group message and the no-acceptance-requiring centralized message.

This means in particular that the centralized message also ends when the last contained single message ends. In this case, however, it remains in the error listing and waits for being accepted. After acceptance, the centralized message disappears from the error listing.

These groups with their centralized and group messages are intended to provide an overview of the plant conditions. This is why the output of these message types is supported in different ways:

- In contrast to single messages, centralized and group messages can be output via digital outputs.
- The events *Group message begins / Group message ends / Any message of the group begins / Any message of the group ends* can be routed to the DSfG bus with an attention telegram. It can be determined separately for each group upon which events such attention telegrams shall be generated and of which type they shall be (*Alarm, Hint or Warning*).
- The status of centralized, group and held group messages can be enquired via DSfG.
- Only the centralized message of the messages linked within a group is entered in the error listing and logbook of the message processing to keep them well-structured.

A *Maintenance switch (M-switch)* is used to suppress group and/or centralized messages if maintenance work has to be carried out.

The setting of this M-switch may affect each group differently:

- No influence

A set M-switch does not have any effect on the signaling reactions of this group.

- Suppression "towards telecontrol"

This means that, if the M-switch is set, the group does no longer trigger any DSfG attention telegrams and the *Held group message* is always considered *not pending*.

- Suppression of all signaling reactions without exception

In this case all messages generated by a group are suppressed if the M-switch is set.

This means that the group neither generates held group nor group nor centralized messages. Nevertheless, the centralized message is still entered in the logbook and error listing.

If the M-switch is set, the main signaller no longer takes the group into account.

The M-switch is activated via an assigned digital input. It cannot be set via the operator panel for safety reasons.

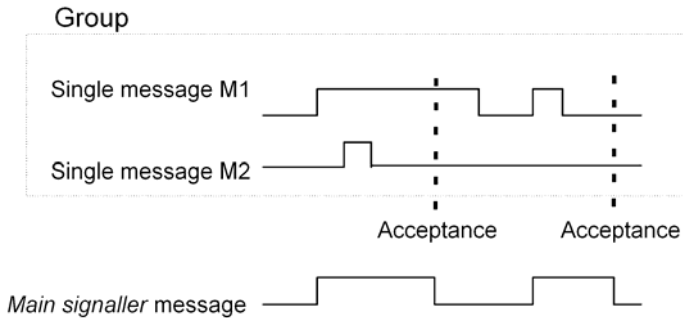
Status and signaling reactions of *single* messages remain unaffected by the M-switch. Single messages are suppressed via the disabling mechanism explained above.

In addition to the above-mentioned messages a message named *Main signaller* is also available. It usually triggers a hooter if being routed to an output. An additional acceptance input is assigned to the main signaller.

The main signaller may include any number of groups.

It starts operating when a message arrives that belongs to one of the involved groups, and it ends upon acceptance, no matter whether or not messages are still pending. The acceptance can be implemented via the digital input assigned to the main signaller. Besides, if all groups are accepted via the operator panel, the main signaller is also accepted. It starts operating again when the next involved message arrives.

The following illustration shows the behavior of the main signaller in connection with the acceptance (in case of one involved group):



5.3.1.6 Logging on Measurement or Counter Archives

A *gas-net* F1 is able to keep archives for process values, i.e. archives for measurements and count values. Up to four archive groups with up to 8 channels each are available. It can be determined individually for each archive group in which conditions the contained archive channels shall be logged.

The standard procedure used is cyclic data logging (with parameterizable data logging cycles of one second up to one hour).

Additionally or alternatively, the data logging can be made conditional on certain events detected during the monitoring of the process values:

- It is possible to link the data logging with one or more group(s) of single messages. In this case the logging takes place upon the beginning and end of each message contained in one of the involved groups.
- If the trend of a particular process value shall be logged in detail, a maximum change rate can be defined for an archive channel. Then the entire archive group is logged each time the difference between the current measurement and the value measured during the last data logging exceeds the maximum change rate. This way, the data is logged more often in case of quickly changing values.

This option is also available for counter archives, which means you may define that the data logging is to start each time a count value has increased by a defined difference.

Measurements and count values are always logged additionally if the input value has been identified as being disturbed.

It is possible to “freeze” process value archives. If an assigned message begins, the corresponding archive continues to log data and stops after a set number of entries has been reached. The point of time of the last entry will be marked with hint *PVA <no.> freeze begins* (PVA stands for **P**rocess**V**alue**A**rchive) in the error listing and logbook of the *Monitoring* module. The data logging will only be continued when the assigned message ends. Simultaneously, hint *PVA <no.> frozen* also ends.

The freezing of measurement archives is useful if you are interested in how a measurement behaves in case a certain event occurs. It may be possible, for instance, to link the freezing with a centralized message. Then, the freezing will be activated upon the first beginning of any message of the group. Normal data logging will not be continued after the end of the last message until the group has been accepted explicitly, for the centralized message only ends in this case. In addition, it is also possible to make the logging in a process value archive conditional on a message. In this case, data is only logged in the archive when the allocated message has been set, independent of all further conditions.

5.3.1.7 Gas Meter Lubrication

The *Gas meter lubrication* functionality facilitates the controlling and monitoring of up to three lubricating systems for turbine gas meters via digital outputs. Different control configuration possibilities are available, so each of the up to three lubricating systems may be adjusted to different operating requirements.

The following modes are selectable (and combinable):

- Cyclic lubrication at fixed intervals; selectable intervals are: every day, every 2/3/4/5/6 days, every week, every 2/4/6/8/12 weeks, every six months, annually. It is also possible to set the starting time for the lubrication (on the hour¹⁶), as well as the desired weekday in case of lubrication cycles from once per week up.
- Lubrication depending on the flown gas volume (lubricate after ... m³ of gas). A volume or flow rate input value (e.g. V, Vn, Q or Qn) is required for a gas volume-dependent lubrication.

¹⁶ However, the lubrication only starts 30 seconds past the hour.

- Manual triggering of a lubrication process via the operator panel of the gas-net device.

It is also possible to specify that no lubrication shall take place until a parameterizable flow rate has been reached. This requires, however, that the corresponding flow rate is available.

The gas-net device provides a message (*Piston displacement*) that is signalled via a digital output and thus controls the lubricating system. The following settings define the details of the lubrication process:

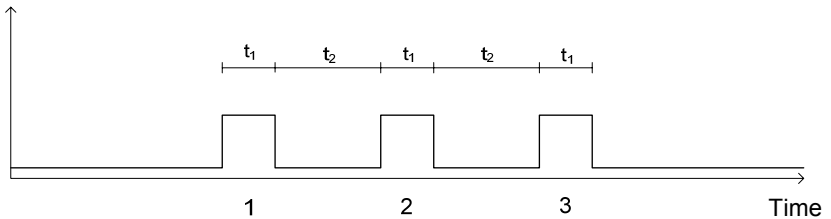
- Number of piston strokes of the lubricating system per lubrication process (this is how often the gas-net device sets the *Piston displacement* message during each requested lubrication cycle)
- Duration of piston control via digital output ("Piston active" – *Piston displacement* message is set)
- Breaks between piston control operations ("Piston inactive" – *Piston displacement* message is not set)

Following picture shows an example for a lubrication cycle with

t1: Duration of piston control (*Piston displacement* message is set)

t2: Duration of breaks between piston strokes (*Piston displacement* message is not set)

Number of piston strokes = 3



Note: As to all gas-net message outputs it also applies in this case that the reaction of the message output for the gas meter lubrication is selectable (*contact opens upon message* or *contact closes upon message*) and can also be made conditional on an output condition (message).

There is an internal message called *Cycle active*, which is set during an ongoing lubrication process.

The gas meter's lubricating system checks its own operating conditions and the lubrication process and provides the monitoring of the lubricating system with status information (messages or pulses via reed contact). provided the gas-net device evaluates the information, lubrication errors result in internal messages that are also indicated on the device display. These internal error messages can also be processed by the *Monitoring* module (see ...) and, in particular, be output via digital output channels. However, they do not affect the actual control of the lubricating system via the gas-net device.

Error situation	Meaning / Evaluation in the <i>Monitoring</i> module
Output signal of lubricating system: <i>Oil level too low</i> (message)	The oil level of the reservoir is below the defined minimum level. If the gas-net device evaluates this signal, the internal message <i>Oil level too low</i> is set. The display indicates the error message <i>Oil</i> .
Output signal of lubricating system: <i>Overpressure</i> (message)	The piston drive of the lubricating system for injecting the oil is gas pressure operated. The gas pressure of the lubricating system is being monitored. If the pressure is too high, the system is being vented via a safety valve and an <i>Overpressure</i> contact signal is possibly set. If the gas-net device evaluates this signal, the internal message <i>Overpressure</i> is set. The display indicates the error message <i>dp</i> .
Output signal of lubricating system: <i>Oil volume</i> (pulse)	Each stroke, i.e. each piston movement of the lubricating system that makes the oil flow, triggers a pulse; the number of pulses is therefore proportional to the flown lubricating oil volume. The lubrication process can be monitored by comparing the number of requested strokes with the number of actually performed strokes. If, after the end of a lubrication cycle, it turns out that the number of failed piston control operations has exceeded the

	parameterizable <i>Maximum stroke deviation</i> , the gas-net device generates the internal error message <i>Stroke deviations exceeded</i> . The 2 nd line of the display indicates the error text <i>Piston</i> . The error ends as soon as a lubrication cycle has been finished without exceeding the maximum number of stroke deviations.
The message <i>Stroke deviations exceeded</i> is pending or a cable break has been detected at a parameterized input for the lubrication (V, Q, corresponding message inputs).	The gas-net device generates the centralized message <i>Disturbance</i> .

5.3.2 Display and Operation

Main Display (Monitoring Module)

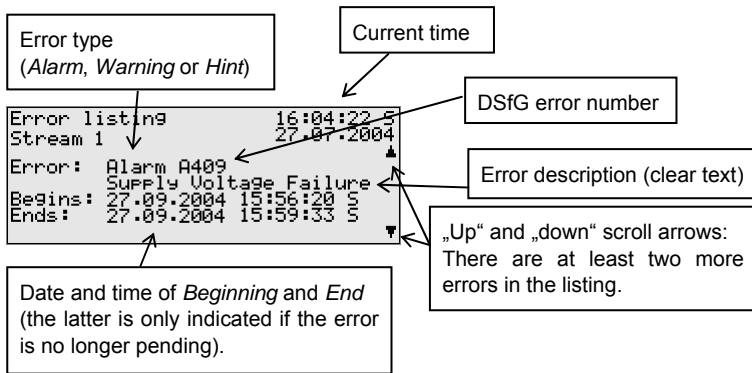
The display indicates the error listing of the first corrected stream when the *Monitoring* module is invoked. The error message with the highest priority level¹⁷ is visible, provided the error listing is not empty.

If the error listing contains further errors, it is possible to scroll through the error listing via the arrow keys. The little black scroll arrows on the right side of the display indicate whether or not there is more than one entry in the listing.

¹⁷ An alarm has the highest priority level, i.e. it is of greatest importance. A warning has a higher priority level than a hint.

Cf. Chapter 5.3.1 for an explanation of the terms *Alarm*, *Warning* and *Hint*.


The following information is provided for each error:



Subordinate Menu Items (Monitoring Module)

Accept

The *Accept* menu item only exists for correction error listings.

 If this menu item is crossed out, the indicated message cannot be accepted because it is still pending. If *Accept* is not crossed out, however, the currently indicated error message can be accepted and thus removed from the error listing. After the message has been accepted, the menu is cleared and the next error will be displayed. Just repeat the procedure if you would like to accept this error, too: Invoke the menu and confirm *Accept*.

Accept all (only available for the Monitoring error listing)

The *Accept all* menu item is only available if you are in the error listing display of the *Monitoring* module; via this menu item you accept all groups requiring an acceptance together with the main signaller (hooter).

Accept all is crossed out if there is no need to accept any messages.

Next listing

Via *Next listing* you may switch to the respective following error listing. There are up to four error listings: one for each corrected stream (*Correction 1/2/3 error listing*) and the *Monitoring error listing*.

The following messages are entered in the error listing of the *Monitoring* module:

- Messages named *System messages*¹⁸ have top priority.
- The next position shows an *M-switch* message if the maintenance switch has been activated.
- Then, all pending centralized messages of groups 1 to 32 are indicated.
- Pending single messages follow according to their priority level.

In order to keep the error listing clearly understandable only such single messages that have been parameterized accordingly are entered in the error listing.

In principle, all single messages of the message processing including the *M-switch* message do not require an acceptance. Only centralized messages of groups requiring an acceptance must be accepted. This means that all single, group and centralized messages of groups that do not require an acceptance automatically disappear from the error listing when they stop pending.

Centralized messages of groups requiring an acceptance will only end after they have been accepted and if none of the single messages of the group is pending any longer. The messages can be accepted even before the last single message has ended.

Measurements

A gas-net F1 may have up to 32 parameterized measurements for maximum/minimum indication on file. If you invoke the related display, the first measurement will be presented. You may switch to the display of another measurement via the name.

¹⁸ System messages are generated for instance for the events *Re-start performed*, *Supply voltage failure*, *New parameterization* and *Parameter changed*. These messages are usually not visible in the error listing as they are pending for only one second. Other messages that are important for the entire system, such as *Interface monitoring* in case of a board location error or *Calibration/User switch open* a more like hints and disappear automatically from the error listing after they have ended.

The display contains the following information in detail:

Name of the shown measurement. Pressing the Enter key opens up a selection list containing all measurement names. You may switch to the indication of another measurement via this listing.

```

Measurements 15:46:31 S
Pressure stream 1 28.07.2004
                2.9581 bar
2.9581         28.07.2004 15:45:57
2.9583         28.07.2004 15:46:02
  
```

Current value incl. unit.
Blinks if the data source is disturbed.

Line before last: Minimum value since last resetting, with time mark.
Last line: Maximum value since last resetting, with time mark.

If the associated data source is indicated as being disturbed, the display keeps showing the last valid value. In this case, however, the value is flashing.

Measurements for count values are indicated with 12 pre-decimal and 3 post-decimal digits. If the actual value exceeds the maximum value that can be displayed, the value is clipped at the upper limit. In practice, this case is irrelevant since measurements for count values are only reasonable in combination with a cyclic resetting.

The measurement display contains the following subordinate menu items:

Resetting

The *Resetting* menu item sets the minimum and maximum values of the indicated measurement to the current value.

Reset all

The *Reset all* menu item resets all filed measurements.

Meter Proving 1/2

If more than one volume corrector or flow computer is connected to the DSfG bus, the F1 may perform one or two *Meter provings*.

The comparison quantity is the base volume V_n ; in case of a proving between flow computers the proving may also be carried out via energy E or mass m .

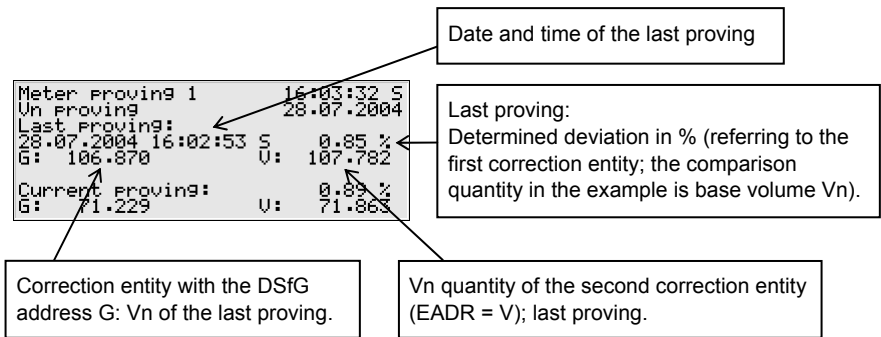
To facilitate a proving, the DSfG bus addresses of the two correction entities involved must be specified in the device parameterization.

Activating the *Meter proving 1* or *Meter proving 2* menu item at the device invokes the related display. If this function has not been used yet, the phrase *No last proving* is indicated on this display.

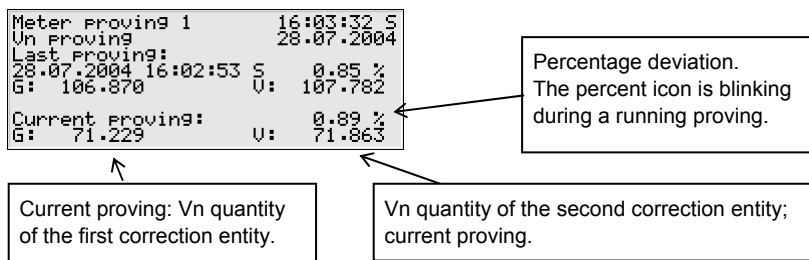
The second line shows via which quantity the proving is performed.

Up to two provings are indicated. The compared quantities of the two involved corrector entities are marked with the associated DSfG address (EADR).

Below *Last proving* the following information is indicated:



Below *Current proving* the values of the running proving or of the one that has been completed last are indicated:




If the meter proving has been activated, the totalizer of both correction entities will be polled cyclically via DSfG. If the DSfG communication is undisturbed, a response message will arrive approximately every 10 seconds. This means that the display of the meter proving is updated at intervals of 10 seconds and the

percentage deviation is determined. The percentage icon in the line before last is flashing as long as the proving is running.

It is possible to set an *automatic* proving mode via the parameterization. In this case, the meter proving starts automatically as soon as both correction entities are operating error-free. Whenever the parameterizable proving time has elapsed, the proving process is stopped and the deviation calculated. A new proving process is then initiated. The meter proving stops as soon as one of the two correction entities is in the alarm status.

In the automatic proving mode, a maximum deviation in % is defined when the device is parameterized. Each time a proving has been carried out, a check is made to ascertain whether the maximum deviation has been exceeded. If this is the case, there is an exclamation mark after the deviation data in the fourth line of the display. The internal message *maximum deviation meter proving 1 (or 2) exceeded* can additionally be issued via a digital output.

It is possible to abort a running proving via the *Stop* submenu. The next proving is started automatically afterwards.

 In the *manual* proving mode you may start and stop the meter proving via the following submenus:

Start

The meter proving is started.

During a running proving the indication of the meter proving is updated approximately every 10 seconds and the percentage deviation is calculated. You recognize a running proving by a flashing percentage icon behind the calculated deviation.

Stop

The meter proving is stopped.

Back

Return to the main display (error listing).

The Stop and Back menu items also exist in the automatic proving mode.

Notes:

- There is no general rule of how long you have to wait until you receive a representative result of the meter proving. The current flow rate and the types of the meter inputs are influencing factors.

A proving of two volume correctors or flow computers that receive only HF pulses from the gas meter will indicate a constant deviation relatively fast as a high input frequency leads to a continuous increase of the totalizers. The compared quantities always correspond.

If, however, two volume correctors or flow computers are compared which are both connected to an encoder totalizer, for example, you have to wait for a larger comparison quantity. In this case the totalizers are increased less often, abruptly and not necessarily synchronously.

In the manual proving mode the simplest way is to observe the display until the percentage deviation has adjusted itself to a constant value and to stop the proving then.

Please also consider that no reliable results are possible if the flow at operating conditions is below the lower flow limit of the gas meter (Q_{min}).

- A totalizer difference of a volume corrector or flow computer caused by the manual setting of the totalizers cannot be distinguished via DSfG from an actual totalizer increase. Therefore, please refrain from adjusting the totalizers of the correction entities during a running proving.
- The meter proving will stop automatically in the following conditions:
 1. At least one of the involved volume correctors or flow computers indicates a base flow that goes below the parameterized minimum flow for meter proving.
 2. One of two involved volume correctors or flow computers indicates an alarm status.
 3. One of two involved volume correctors or flow computers indicates a change of the revision status. (In the automatic proving mode, the meter proving is restarted afterwards.)
 4. The DSfG communication breaks off. This may only happen if the proving is performed with a volume corrector or flow computer that is externally connected via DSfG.
 5. The totalizer difference of a volume corrector or flow computer connected via DSfG is implausible.

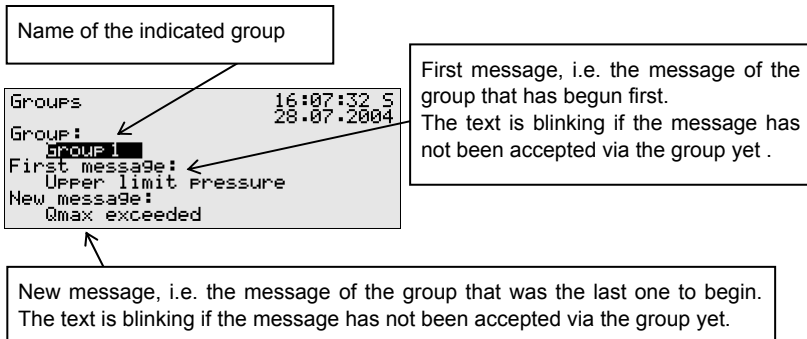
6. The accumulated quantities can no longer be indicated on the device display.

For your information: 8 numbers can be indicated on the display. The number of post-decimal digits is adjusted dynamically, i.e. if an accumulated quantity has already 7 numbers in front of the decimal point, only one post-decimal digit will be indicated.

As soon as a meter proving has stopped, the percentage icon behind the calculated deviation will stop flashing.

Groups

The *Groups* menu refers to the message processing of the *Monitoring* module. You may invoke the related display only if message groups have been created. The display facilitates an overview of the event status of the messages linked in a group. If you invoke the related display, you will see information on the first group. For switching to the display of another group, get into the edit mode (by pressing the Enter key) and select the name of the group you would like to view from the appearing listing. Confirm your choice by pressing the Enter key again.



If the centralized message of the invoked group is currently pending, the single message of the group that has begun first is indicated below *First message*. As this is always the message that has initially caused the beginning of the centralized message, this information helps to analyze the error status. The message text is flashing if no message has been accepted yet after the beginning of the centralized message.

Below *New message* you can read off the most recent single message of the group to begin. As long as the centralized message itself is pending, the *New message* indication is updated upon each beginning of a new message of the group. A *New message*, too, is flashing on the display until an acceptance has been performed after its beginning.

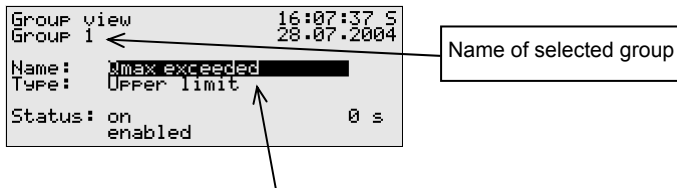
Only if neither first nor new messages are indicated, a centralized message is not pending at that point of time.

Activate the *View* submenu to check the status of all single messages contained in the group:

View

This display provides information on the single messages contained in the group invoked before. Besides, it provides information on the status of each contained single message. Due to the mass of information there is always only one single message indicated on the display at a time.

As the *Name* selection list contains all single messages of the corresponding group you can switch to the indication of any other single message of the currently selected group.



Currently indicated single message of the group. A listing with all messages existing in this group opens up if you press the Enter key. You may also switch to the indication of another single message of the group via this selection list.

The following information is indicated for each individual message:

Name

Each message is identified via its parameterized name. You may change to the indication of any other single message of the group via the *Name* selection list.

Type

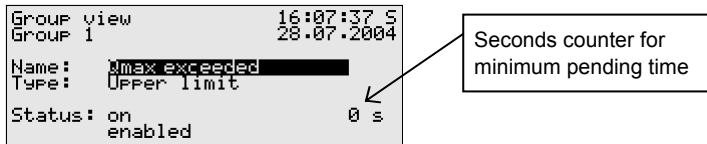
A single message can be derived from a *Message*, the monitoring of an *Upper* or *Lower limit value* or *Gradient monitoring*.

Status

The status of a single message is characterized by several specifications:

On or *Off* indicates whether the message is pending. Here, a possibly parameterized minimum pending time is taken into consideration: Even if the status to be signaled is currently pending, the related single message will only be set if this status is pending longer than the minimum pending time.

To be able to make out whether a single message would be pending if no minimum pending time were assigned to it, the display includes a seconds counter:



If the seconds counter starts counting backwards, the status to be signaled has already been pending. A minimum pending time is assigned to the single message, so the message itself will only be generated if its status is still pending after the minimum pending time has elapsed. Therefore, the counter constantly shows how many seconds of the minimum pending time are remaining. Only after the counter has reached 0, the status indication of the message will change from *Off* to *On*.

If the status to be signaled ends before the minimum pending time has elapsed, the counter will be set to 0, but the message will not begin.

The counter always shows 0 if a minimum pending time has not been assigned to a single message. In this case the message begins immediately after the status to be signaled has been detected.

Whether a single message is being routed at all depends on the fact whether the message is disabled or enabled: If a single message has

been disabled, the entire subsequent message processing considers it as not pending.

Tip: The main advantage of the *Groups – View* menu described here is the possibility to analyze the status of a group and of the single messages contained therein. This menu only provides information but does not allow changing the properties of a single message, for instance to disable or enable a single message. For this purpose the *Single messages* menu must be invoked, the display of which is structured similar to the one described above.

Single messages

The *Single messages* menu refers to the message processing of the *Monitoring* module. It does not only serve to indicate basic information relating to single messages but also provides the possibility to disable such messages via the operator panel of the device and to change limit values for single messages of the measurement monitoring.

In order to switch to the display of another single message you have to get into the edit mode (by pressing the Enter key) and select the name of the message you want to view from the appearing listing. Confirm your choice by pressing the Enter key again.

The *Single messages* display is basically identical with the display of the *Groups – View* menu described above.

The parameterized limit value is indicated as additional information in case of a message derived from measurement monitoring:

Limit

The *Limit* menu item indicates the currently set limit value of the limit monitoring or the maximum permissible change of the measurement within a parameterized monitoring period when monitoring gradients.

```

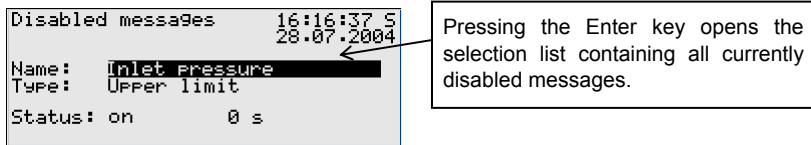
Single message      16:08:37 S
                   28.07.2004
Name:      Inlet Pressure
Type:      Upper limit
Status:    off          30 s
           enabled
Limit:     16.000      bar
    
```

Limit, here: upper limit value.
 Note: An additional hysteresis may have been parameterized via PC and with the parameterization program to avoid fluttering messages.

This dialog allows disabling single messages via the operator panel. It is also possible to change the limit value to be monitored in case of messages of the measurement monitoring directly at the device. However, the user locks must be open for such actions to be carried out.

Disabled messages

The *Disabled messages* menu refers to the message processing of the *Monitoring* module. The corresponding display lists all currently disabled single messages. Additional information indicated on the display comprises the type of the message, the real message status before the disabling, and possibly the counter for a monitored minimum pending time.



The *Disabled messages* menu described here merely provides information. Please switch to the *Single messages* menu (see above) if you would like to disable or enable a single message.

This is the last submenu of the *Monitoring* module:

Switches (Changing switch outputs and the revision status)

The *Switches* menu has two functions:

First it is possible to monitor and change the states of the revision switches in the relevant display. *Revision 1* indicates the revision status of the first corrected stream and *Revision 2/3* the revision status of the second or third stream, if present. *Off* means that the correction of the stream in question is not in the revision status. *On* means that the revision status is set (at the same time, hint H802 *Revision switch open* is pending).

A revision status can only be changed when the locks are open.

The second function of the *Switches* menu is to display the states of the so-called *Switches*.

A switch is a message with a preset status (*on* or *off*). The status of the switch can be changed manually, i.e. via the operator panel of the device. Messages of

the *Switch* type are routed to digital outputs (cf. Chapter 5.5.1) to trigger switching operations of any kind from the *gas-net* device.

Three switches are available (*Switch 1* to *Switch 3*). To change the status of a switch you need to invoke the *Switches* menu of the *Monitoring* module. It indicates the current switching status of each switch. Select the switch the status of which you would like to change and change to the edit mode. Select a different switch status now and confirm via **OK**. Changing switch states is subject to the user locks.

Note: Message outputs may be parameterized in such a way that they invert the output signal during operation. Please consider that this setting also applies to the output of switches.

Lubrication

After the *Lubrication* menu has been invoked, the status display of the first defined gas meter lubrication appears.

```
Lubrication          11:32:18 S
                   31.05.2007
Name:  Lubrication stream 1
Status: Idle
Q:      19.000 m3
Q:      1800.000 m3/h
Next:   31.05.2007 14:00:30
Strokes: 0020 OK / 0000 Errors
```

Display line	Meaning
Line 2: Reserved for error indication	<p>There are several lubrication errors that can be evaluated by the gas-net device (see above). If such an error message is pending, it will be indicated in the second line of the display. An error is also pending if the related input has been assigned in the parameterization of the gas-net device, but a cable break has been detected at the corresponding input channel.</p> <p>The following error messages may occur:</p> <p>Oil: The oil level is too low.</p> <p>dp: The pressure monitor of the lubricating system has tripped.</p> <p>Piston: The maximum stroke deviation has been exceeded.</p> <p>If such error messages are flashing on the display, the cor-</p>

	<p>responding error is currently pending.</p> <p>The error message disappears when the error ends – unless it has been parameterized that the messages shall be held (individually parameterizable). In this case the error message is no longer flashing and remains on the display after the cause of the error has ceased to exist. Held messages end when the user accepts them via the <i>Accept</i> menu command (see below). At the same time, the corresponding error messages disappear from the display.</p> <p>Qmin: The flow is currently below the parameterizable minor flow, below which no lubrication shall be started. This error message is flashing when a lubrication process has been requested in parallel.</p>										
Name	Name of gas meter lubrication (parameterizable)										
Status	<table border="0"> <tr> <td data-bbox="259 683 535 715">Idle</td> <td data-bbox="546 683 953 715">basic status</td> </tr> <tr> <td data-bbox="259 724 535 756">Requested</td> <td data-bbox="546 724 953 756">lubrication has been requested</td> </tr> <tr> <td data-bbox="259 766 535 900">Piston back (left ...)</td> <td data-bbox="546 766 953 900">During an ongoing lubrication: piston control is active, number of remaining piston displacements</td> </tr> <tr> <td data-bbox="259 909 535 1043">Piston forth (left ...)</td> <td data-bbox="546 909 953 1043">During an ongoing lubrication: piston control is inactive, number of remaining piston displacements</td> </tr> <tr> <td data-bbox="259 1053 535 1396">Fault</td> <td data-bbox="546 1053 953 1396">Fault due to an exceeding of the maximum stroke deviation during the last lubrication process or cable break of a defined input for the lubrication. If in this state a new lubrication is being requested, it will be performed as planned and instead of the text <i>Fault</i> the piston control operations are indicated (<i>Piston forth/back</i>, see above)</td> </tr> </table>	Idle	basic status	Requested	lubrication has been requested	Piston back (left ...)	During an ongoing lubrication: piston control is active, number of remaining piston displacements	Piston forth (left ...)	During an ongoing lubrication: piston control is inactive, number of remaining piston displacements	Fault	Fault due to an exceeding of the maximum stroke deviation during the last lubrication process or cable break of a defined input for the lubrication. If in this state a new lubrication is being requested, it will be performed as planned and instead of the text <i>Fault</i> the piston control operations are indicated (<i>Piston forth/back</i> , see above)
Idle	basic status										
Requested	lubrication has been requested										
Piston back (left ...)	During an ongoing lubrication: piston control is active, number of remaining piston displacements										
Piston forth (left ...)	During an ongoing lubrication: piston control is inactive, number of remaining piston displacements										
Fault	Fault due to an exceeding of the maximum stroke deviation during the last lubrication process or cable break of a defined input for the lubrication. If in this state a new lubrication is being requested, it will be performed as planned and instead of the text <i>Fault</i> the piston control operations are indicated (<i>Piston forth/back</i> , see above)										

V:	<p>The volume V count value can only be indicated if a volume or flow input has been defined for the gas meter lubrication. It counts the incoming quantities either directly via the assigned volume input or, as an alternative, derived from an assigned flow input. The count value is flashing when a cable break has occurred at the related input channel.</p> <p>Special feature: In case of a volume-dependent lubrication the volume V count value runs backwards and indicates how many cubic meters (m³) of gas still have to flow before the next volume-dependent lubrication will be requested.</p>
Q:	<p>The flow rate Q is only indicated if a flow input has been defined for the lubrication. It is flashing when a cable break has occurred at the related input channel.</p>
Next	<p>Time of the next lubrication request (only in case of cyclic lubrication).</p>
Strokes	<p>Number of strokes OK / Number of errors</p> <p>The number of strokes counts the number of piston displacements with a positive feedback from the lubricating system. Piston displacements are counted as errors when the feedback is missing, i.e. they are regarded as not having been performed.</p> <p>If, after the end of a lubrication cycle, it turns out that the number of errors exceeds the parameterized maximum number of stroke deviations, a message will be generated (<i>Piston</i>) and the error value is flashing on the display.</p> <p>The errors can only be determined if the <i>Oil volume</i> input has been assigned to the feedback of the piston movement. If this is not the case, the number of strokes function counts <u>all</u> requested piston displacements.</p>

Next

Changes over to the display of the next gas meter lubrication (up to three lubricating systems can be controlled).

Start

It is possible to trigger a manual lubrication process consisting of one stroke via the *Start* submenu item. Multiple activating of *Start* increases

the number of requested strokes; the parameterized settings for *Piston active* / *Piston inactive* are being considered.

Accept

The monitoring of the gas meter lubrication can generate several messages ("Stroke deviations exceeded", "Oil level too low", "Overpressure" and "(Centralized) Disturbance"). You may parameterize individually for each of these messages whether it shall be held after the cause of the error has ceased to exist or whether it shall end immediately. Held messages can be acknowledged by the user via the *Accept* menu command. When being accepted the message ends and the related error text disappears from the display.

Reset

Activating the *Reset* menu item resets the lubrication control and restarts it. This means in detail that:

- the volume totalizer (if available) will be reset
- the number of strokes/errors will be set to 0
- an ongoing lubrication will be aborted
- held messages of the lubrication will be accepted
- in case of cyclic lubrication, the time of the next lubrication is recalculated.

5.4 GQ Import Module

5.4.1 Function

The task of the *GQ Import* module is to manage gas quality data supplied as online values by one or two gas quality analyzers via digital protocol. Usually either the DSfG protocol or Modbus is used.

The F1 flow computer uses the supplied gas analysis mainly in the *Correction* module if the compressibility ratio k shall be calculated with online values (*online k-ratio calculation*).

One or two gas quality analyzers can be connected. The incoming telegrams are monitored for a parameterized timeout time. Status information such as *Revision* and *Error* are checked in the protocol data, and the most important measurements are monitored for alarm limits.

In case of two gas quality measurements each analyzer supplies its own values that can be evaluated separately and transferred to other modules by the *GQ Import* module.

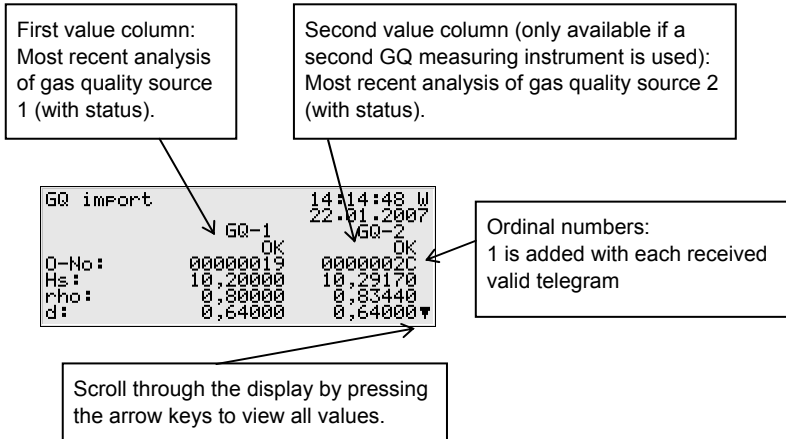
It is also possible to view the second gas quality measurement as redundant measurement. For this, the *GQ Import* module evaluates the status of both gas quality measurements and based on this evaluation chooses one data record for further use. This record principally consists of the measurements of the first source as long as the related analyzer supplies valid measuring data. Only if the first gas quality measurement is invalid, the second source will be used.

Important: When parameterizing other modules, in particular the *Correction* modules, the gas quality data source (*GQ measurement 1*, *GQ measurement 2* or *Redundant measurement*) must be assigned correctly.

5.4.2 Display

The display of the *GQ Import* module shows the status of the received gas quality telegrams and the current values. A subordinate display shows the result of the evaluation for a redundant use of both gas quality measurements when two gas quality sources exist.

The following illustration shows an example of the gas quality display:



Value columns 1 and 2 show which values have been received from the respective source in the last received telegram.

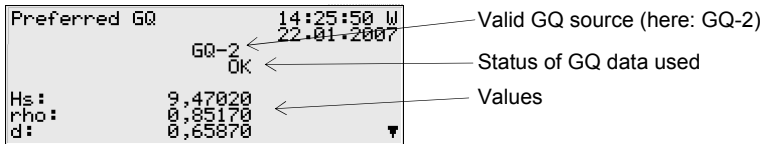
In addition, you may view the status of the telegram or values:

Status	Explanation
Start-up	The <i>Start-up</i> status appears after the device has been switched on and remains pending until the first gas quality source telegram has been received. No gas quality data from this source has been known so far and thus all dates are set to 0 in this display. If no telegram arrives within the parameterized timeout period, the status changes to <i>timeout</i> (see below).
OK	The most recent telegram of this gas quality entity has been recognized as being valid and contains valid values.
Revision	The revision bit was set in the most recent telegram of this gas quality entity.
Failure	The most recent telegram of this gas quality entity contained a set alarm bit.
Alarm	The most recent telegram of the gas quality entity in question contained at least one value that violates a parameterized alarm limit.
Timeout	More time has elapsed than was parameterized for the timeout period since the last telegram has arrived; the gas quality is therefore no longer valid.

Preferred GQ

(only relevant when the second gas quality measurement is used as redundant measurement)

The subordinate *Preferred GQ* display shows the gas quality that is considered valid when the second gas quality measurement is interpreted as being redundant (the first gas quality source will be preferred in this case; the second measurement is only used when the first measurement has been detected as being disturbed).



The status indication in this display (*Start-up*, *OK* or *Alarm*) indicates the status of the selected gas quality.

Details can be seen in the following table:

Status of the preferred gas quality in case of a redundant interpretation	Meaning
Start-up	Valid gas quality data is not available yet. (The fixed parameterized tabular values are used for correction and all further calculations.)
OK	The shown gas quality data is transferred as being valid and used for correction and all further calculations.
Alarm	The gas quality measurement is considered disturbed. Note: If the alarm condition has been caused by the violation of an alarm limit parameterized in the <i>GQ Import</i> module, the flow computer only generates an alarm if it actually uses the relevant GQ variable for the correction.

Return to the main display of the *GQ Import* module for further information such as the status of the related telegram.

5.5 System Module

5.5.1 Functions

The *System* module comprises all basic functionalities of the *gas-net* device.

Inputs

One such basic functionality of the *System* module is the processing of the input information and the transfer of this information to other modules. The availability of input channels depends on the process board equipment of each individual device.

Each device always contains at least one EXMFE5 board to be able to connect the transmitters for the correction of one stream. The connection of a Q.Sonic or FLOWSIC ultrasonic gas flow meter requires an additional MSER2 process board. If the flow computer keeps totalizers for two flow directions, an MFE11 input board is usually also installed. This board provides digital input contacts for a flow reversal.

Further information on *gas-net* input boards is provided in the second volume of the Technical Documentation in hand (chapters *Connecting the Lines* and *Technical Data*).

The *System* module's display offers a special menu for viewing the source and the raw and final values of the analog input signal or of a pulse input (see Chapter 5.5.2). There is also an own diagnosis display for protocol input channels (e.g. if the gas meter has been digitally connected or in case of measurement sensors being connected via HART protocol).

Outputs

There are several *gas-net* process boards providing output channels (see Volume 2, chapters *Connecting the Lines* and *Technical Data*).

Each board type has a pulse buffer for pulse outputs. If the number of volume pulses at a pulse output is higher than the parameterized maximum output frequency, the flow computer retains up to 1000 pulses in this buffer. These pulses are output as soon as possible.

Note: If a gas meter with an encoder totalizer and at least one additional pulser for the correction is connected, the following special feature applies:

In case of pulse outputs that are parameterized for the output of *V total*, *Vn total*, *E total* or *m total*, the pulses that shall be output are calculated on the basis of the input pulses of the preferred pulse channel. This way, a continuous pulse output is achieved (which is of advantage for driving an odorizing installation). The pulse output is only derived from the encoder totalizer if all available pulsers are defective (cable break, complete failure, synchronism failure alarm).

If a second volume corrector or flow computer is connected to the same DSfG bus, an F1 can also output sums of volumes (e.g. *Vn undisturbed stream 1 + Vn undisturbed stream 2*), quantities or flow rates. The values of the second volume corrector or flow computer are collected via DSfG approximately every 10 seconds.

In case of a multistream F1, it is of course possible to determine and output the sums of two internal streams.

Note: A totalizer increase of the second correction entity that is only caused by a manual setting of the totalizers cannot be distinguished via DSfG from a real increase. In unfavorable conditions the artificially generated totalizer differences are added to a summated pulse output.

Such a totalizer setting will happen rather seldom in practice. We recommend disconnecting the corresponding volume corrector or flow computer from the DSfG bus before setting the totalizer, re-connecting the DSfG plug afterwards and executing a general polling at the bus master.

The *gas-net* F1 flow computer provides a special menu for viewing and checking outputs (cf. Chapter 5.5.2). Checking the outputs is only possible if the locks are open.

DSfG (optional)

DSfG is a digital interface especially developed for data communication between gas meters (such as *gas-net* devices). The *gas-net* F1 is optionally equipped with a DSfG interface. The DSfG bus is connected via the connector labeled DSfG on the back of the device.

TCP/IP (optional)

The TCP/IP interface is used for integration into a standard network installation (for data exchange via Modbus TCP or time synchronization via NTP).

Locks

The parameter listing of the *gas-net* F1 contains various parameters that are not subject to the calibration lock but protected against willful changes by an operational safety mechanism. This protection mechanism is called user or numerical lock. Each of the two contract parties may define a lock of up to 6 digits. These locks are opened and closed via the keypad (see Chapter 5.5.2). The device parameterization defines the locks that shall be valid.

Set Clock / Synchronize Clock

If the calibration switch is open, a given time supplied by any source will always be accepted.

If the calibration switch is closed, the clock can only be set within a fixed time frame. This time frame is ± 20 seconds but not more than $\pm 3\%$ of the billing interval¹⁹. This restriction applies to all time sources, especially to the manual setting of the clock via the operator panel of the device. In principle, it also applies that subsequent synchronizations must be carried out at specific intervals to prevent them from being rejected from the start. Usually these are 2-minute intervals.

The following external synchronization sources are available:

- 1) synchronization by a host computer via digital protocol

¹⁹ The *Billing interval* mentioned here is a parameter of the *System* module. It also defines the data logging rhythm of the *Billing archive*.

- 2) synchronization by telephone time query²⁰ (Hardware requirements: COM2 interface and a connected modem)
- 3) synchronization via NTP (Hardware requirements: TCP/IP interface, NTP server within the network)
- 4) synchronization via GPS (Hardware requirements: free MSER2 interface and a GPS receiver in the station)
- 5) synchronization via DSfG protocol (Hardware requirements: DSfG interface and a device in the DSfG bus system that itself is synchronized via one of the sources 1), 2), 3) or 4))

If the time is adjusted by more than ± 20 seconds when the calibration switch is open, two warnings²¹ will be generated.

If the time is synchronized outside the permissible time frame and the calibration switch is closed, the warning *W812 Clock synch. failed* will be generated. Should such a synchronization attempt deviate by more than ± 3 % of the billing interval from the internal device time, the alarm *A813 Clock synch. failed* will be generated.

5.5.2 Display and Operation

Main Display (System Module)

The main display of the *System* module shows basic device information.

The following details are indicated:

- device name with software variant
- product version of the device software
- serial number of the relevant device
- check sum for software authentication (will be calculated after the display has been invoked)
- number of operating hours of the device.
- supply voltage
- operating temperature

²⁰ The usability of these procedures in dependence on local conditions has to be clarified in advance with Elster.

²¹ According to DSfG Specification:

W811: Clock set new, W810: Clock set old

Subordinate Menu Items (System Module)

Device configuration

The *Device configuration* menu item offers the possibility to check the assignments of all parameters protected by the calibration lock by module (cf. Chapter 4.5, page 4-4).

Inputs

The *Inputs* display makes it possible to view detailed information of message, pulse, current or resistance inputs (name, board/channel, input value, etc.).

After you have activated the *Inputs* menu item, the first channel of the input board will always be indicated at board location 1. Usually, this would be an EXMFE5 board, so the display would look as follows:

```

Inputs                                     14:30:28 W
                                           22.01.2007
Name:  SM transmitter 1
Board:  1  EXMFE5          01.3
Channel: 2  Pulse
Phys.val: 000000001305.887 m3
Inp. val.: 1000 1/s
  
```

Name	Name of the input channel: serves to identify the channel and is parameterized.
Board	Board location, board type, version number of board software.
Channel	Channel number with operating mode.
Phys. Value	The final value of the respective physical variable with physical unit.
Input value	In case of current input: current value in mA. In case of resistance input: resistance in ohms. In case of message input: contact closed / open. In case of pulse inputs: frequency in Hz.

To switch to the display of another channel get into the edit mode (by pressing the Enter key) and select the name of the desired input value from the appearing listing. After you have confirmed your choice by pressing the Enter key, the display of the selected board will be invoked.

Outputs

The *Outputs* system menu enables you, similar to the input channels' displays, to view the assignment and current status of the output channels.

After you have activated the corresponding menu item, details of the first defined output channel will be presented:

Name	Name of the output channel: serves to identify the channel and is parameterized.
Board	Board location, board type, version number of board software.
Channel	Channel number with operating mode.
Phys. value	The final value of the respective physical variable with physical unit.
Output value	In case of analog values: value for the current output (in mA) calculated on the basis of the final value. In case of messages: output contact closed / open. In case of pulse outputs: frequency in Hz, number of pulses retained in the pulse buffer.
Test value	Only for output testing (see below).

To change to the display of another channel, activate the edit mode (by pressing the Enter key). A listing with the names of all parameterized output channels appears. After you have chosen the desired output channel and pressed the Enter key, the display of the selected channel will be invoked.

Output testing

In addition to just viewing the current process values you may also test the output channels. This means that it is possible to output any current value between 0 and 20 mA via an analog output for testing purposes. A message output can be set to *Contact closed* or *open*. It is also possible to have pulses being output via a pulse output for testing reasons. However, only one output can be switched into the test mode at the same time.

Proceed as described below:



- 1) Select the desired output channel, and press the Menu key afterwards.
- 2) Select the *Test on* submenu.



The *Test value* line is selected automatically. Press the Enter key to activate the edit mode. If you enter a new value now and confirm it by pressing the Enter key, this value will be output via the selected output.



In the activated test mode the *Test value* indicated in the last line is no longer crossed out. The *Output value* menu item additionally indicates the output test value.



- 3) To quit the test mode, press the Menu key again and confirm the *Test off* menu item.

Note: You can also quit the test mode by quitting the current display, for instance via *Back* or by selecting a different channel.

Protocols

When measurement and signal transmitters are connected via digital protocols, the *Protocols* display offers an overview of the most important protocol data, for example data on pressure and temperature sensors connected via HART protocol, on gas meters with encoder totalizer, and on ultrasonic gas meters via Q.Sonic or SICK protocol. The *Protocols* display also supplies the most important information on the synchronization of the internal time via GPS or NTP for diagnostic purposes.

Note: The *Protocols* display is not intended for host protocols being processed by the *Data Exchange* module; please refer to the corresponding module display for information on these protocols.

The following table shows the display structure in case of HART/encoder/Q.Sonic or SICK protocols:

Line	Legend	Content
3	Name:	Name of protocol channel
4	I/O:	Board / channel indication In case of HART protocol: Board / channel / HART address indication

In brackets: Number of successful communication operations, counts continuously upwards when the communication is working.

When an asterisk * appears between the board/channel indication and the number of successful communication operations, the data transmission is disturbed (this indication possibly considers a maximum number of admissible communication errors).

For example:

```
Q.Sonic Protocol      14:34:18 W
                    22.01.2007
Name: Q.Sonic 2, 1
I/O: 2/1 (236 Com.)
Q: 3578,25069 m3/h
```

- Name of protocol channel
- Protocol input via board 2 / channel 1, already 236 successful communication operations
- Input value: flow rate

When an asterisk * appears here, the communication is disturbed. At the same time the counter for successful communication operations (in brackets) stops.

5	<p>Depending on the protocol type:</p> <p>Value: measurement (in case of HART protocol)</p> <p>ENC: encoder digit string and priority in digits/m3</p> <p>Q: flow rate supplied via Q.Sonic protocol</p> <p>Vf / Vr / Vfs / Vrs SICK gas meter: transmitted totalizers measuring volume undisturbed forwards (Vf), measuring volume undisturbed backwards (Vr), measuring volume disturbed forwards (Vfs), measuring volume disturbed backwards (Vrs)</p> <p>The shown value is only a valid and current value if the data communication is not disturbed, i.e. there is no asterisk in the fourth line between the board/channel indication and the number of successful communication operations (see above).</p>
---	---

All data shown in further lines are intended for diagnosis by experts; please refer to the documentations and specifications of the respective measuring instrument manufacturers or contact Elster.

In case of time synchronization via GPS or NTP the *Protocols* display is structured as shown below:

Operating mode:

The *operating mode*²² determines the transmission speed on the DSfG bus. Caution: If several devices are connected to the bus, you have to select the operating mode depending on the slowest station. If the bus communication does not work, the *gas-net* device may have been parameterized with a baud rate that is too high.

Own stations:

Own stations lists the bus addresses (EADRs²³) of the internal entities²⁴.

Known stations:

Known stations indicates the EADRs of all bus stations currently known to the device. If a general polling²⁵ has not yet taken place or there is no local DSfG bus available, only the stations within the device can be known as being connected to the bus.

Bus activity:

²² All DSfG-capable *gas-net* devices support the following operating modes:

0	9600 baud
1	19200 baud
2	38400 baud
3	57600 baud
7	115200 baud

²³ *EADR* is the address by which a station identifies itself in the DSfG bus traffic. The upper case letters A to Z and some special characters are used as bus addresses. An unambiguous address assignment is required for a faultless data communication.

²⁴ According to DSfG terminology an *Entity* is an enclosed functionality within a device. One single entity is not necessarily identical with an enclosed device, as a device may contain different entities with their own DSfG bus addresses. A single-stream *gas-net* F1 for instance contains one *Correction* entity, one *Data logging* entity, one *Control* entity and additionally a *Center via RDT* entity if the integrated RDT is used.

²⁵ Each DSfG bus system must contain one station that controls the data communication. This station is called *Bus master* and has the EADR “_”. *General polling* means addressing all permissible bus addresses to update the station list.

This line indicates the last activities on the bus. The last 32 activities can be shown, with the very last one always being indicated on the far right.

The abbreviations have the following meanings:

Upper case letters and special characters:

A, ..., Z, Ä, Ö, Ü, ^, _

The device has received a telegram from this DSfG address.

Lower case letters and special characters:

a, ..., z, ö, ü, ß, ■

The device has sent a telegram to this DSfG address.

Upper case letters with black background:


B, F, H, I, L, M, P, W, Y, Z

The device has received an attention telegram of this type²⁶.

Lower case letters with black background:

b, f, h, i, l, m, p, w, x, z

The device has sent an attention telegram of this type²⁶.

 The DSfG menu contains the following subordinate menu item in master operation:

General polling

²⁶ Each DSfG telegram contains a character for the telegram type (TTY). The telegram type identifiers of the currently valid attention telegram types are the following:

Telegram type	TTY
Bus alarm	B
Freeze request	F
Hint	H
End of billing period	I
Alarm	L
New measurement	M
Parameter change	P
Warning	W
Make-specific meaning	Y
Timesynch telegram	Z

If one of the entities within the device is the bus master (the station with the EADR “_”), you may trigger a general polling via this menu item. If there is no master operation, the menu cannot be activated.

Locks

After you have activated the *Locks* menu item, a display is invoked indicating the current status of the user locks. The display is empty if no lock has been defined. New lock digits must always be defined by parameterization.

 The submenu contains the following items:

Open

This menu item is crossed out if all locks are open. If at least one lock is closed, you may activate the *Open* menu item by pressing the Enter key. A dialog will be invoked in which you may enter the numerical lock(s):



```
Open locks                               16:50:31 S
                                           28.07.2004

Lock 1:  *****
Lock 2:  *****
```

If only one lock has been defined, only one line will be shown here. Select the lock you would like to open in the first step. Activate the edit mode via the Enter key as usual and enter the lock's string of digits. Confirm the code by pressing the Enter key. If the entered string of digits is incorrect, it is not possible to quit the edit mode via the Enter key. You have to correct the code first (or quit the menu via the rightward arrow key).

It is also possible to change the status of just one of two locks. Press the Menu key after you have successfully entered the numerical lock(s). Open the locks with *OK* or leave them closed by confirming *Cancel*.

Close

All defined locks are closed.

This menu item appears being crossed out and is thus not selectable if all locks are closed. If the calibration switch is open, all locks are automatically open, too, and cannot be closed.

Set clock

A free setting of the device time is only possible if the calibration switch is open. The *Set clock* menu item is invisible if the calibration switch is closed.

The display of the *Set clock* menu looks as follows:

```

Set clock          16:51:51.5
                  28.07.2004

Time:             16:51:40
Date:             28.07.2004
Time zone:        Summer time
  
```

You may re-enter time and date step by step via the numerical keypad in the edit mode, i.e. after you have pressed the Enter key.

The time zone menu item offers a selection list (*summer/winter time*) for you to choose the seasonal time zone as soon as you are in the edit mode.

However, it is also possible to operate the device throughout the year without a seasonal time change. The seasonal time change may be prevented by parameterization. In such a case, the phrase *not used* appears next to *Time zone*, and it is not possible to get into the edit mode here.

After having set the time correctly, invoke the menu. Return to the main display without accepting the new time adjustment via *Cancel*. Accept the new time by confirming *OK*.

Synchronize clock

The *Synchronize clock* menu item is visible even if the calibration switch is closed; however, it is protected by the user lock (numerical code). You may adjust the time by up to ± 20 seconds via *Synchronize clock* (and by a maximum of $\pm 3\%$ of the billing interval's length). Enter the desired time adjustment in seconds (with a positive sign for setting the clock forwards and with a negative sign for setting the clock backwards). Afterwards, invoke the menu and confirm via *OK*.

It is not possible to enter a synchronization time that is outside the permissible range in the *Synchronize clock* dialog. This way it is ensured that with the *Synchronize clock* menu item no *Clock synch. failed* alarm or warning can be triggered.

In principle, re-synchronizations must keep to specific intervals, which usually last 2 minutes, in order not to be rejected if the calibration switch is closed. This regulation is independent of the synchronizing source (entry via operator panel, via DSfG, via NTP, via GPS, via telephone time query, via digital protocol). Therefore, if synchronization has been performed by any source, each further synchronization attempt, in particular manual synchronization, will be rejected for 2 minutes. In such a case the phrase *Clock synch. rejected* is indicated in the bottom line of the display for about 10 seconds.

Even if the entered adjustment is permissible, it will not be accepted immediately if the calibration switch is closed. Setting the clock forwards will only be performed at the 2nd second of a minute whereas setting the clock backwards at the 57th second of a minute. That is why the setting will possibly not be carried out before the following minute starts. This prevents the generation of a minute change caused by *Synchronize clock*, which may trigger an archive entry. As long as the time adjustment has not been carried out yet, the bottom line of the display shows the phrase *Clock synch. delayed*. This message will be replaced by *Clock synch. executed* at the moment the adjustment starts.

Display test

You may check whether or not the display and the status LED function correctly by performing the display test. After you have activated the *Display test* menu item, the pixels of the display are alternately switched on and off. At the same time the status LED shows all three colors after each other.

Finish the display test via *Back*

5.6 Integrated RDT Module

5.6.1 Function

The *Integrated RDT* (**R**emote **D**ata **T**ransmission) module implements the data connection between the *gas-net* device and a remote center. The center accesses the data traffic as a logical equal-access station via the integrated

RDT during an established data connection. The data transmission is implemented according to DSfG specifications by means of a Class B DSfG interface. If the device is equipped with a DSfG interface, further devices may be connected via this interface. If such a local DSfG bus exists, the connection to the center not only refers to the communication with the entities inside the device but with the entire local DSfG bus traffic. With respect to data communications, the RDT integrated in the device thus completely replaces an independent DSfG RDT as other devices connected via DSfG may also use it.

The parameterization of the *gas-net* device assigns an own bus address (EADR) to the internal *Center via RDT* entity²⁷.

The data connection may use one of the following transmission media:

- 1) Public switched telephone network or GSM wireless network (hardware requirements: modem, COM2 interface)
- 2) Serial direct connection (hardware requirements: null-modem cable, COM2 interface)
- 3) TCP (hardware requirements: computer network, TCP/IP interface)

Independent of the data transmission type, the data connection established by the integrated RDT offers multiple diagnostic and information gathering possibilities.

For example, it is possible to poll archive data from a remote location. However, the RDT may also be parameterized in such a way that a special event (e.g. a correction alarm) will trigger a call at the center. This works as follows: According to the DSfG Specification, the entities generate *Attention telegrams* that are forwarded to all other stations in form of a multi-address message in case of special events. It is possible to separately define for each station that the center will be informed spontaneously in case of particular generated telegram types²⁸.

²⁷ See Footnote 24, page 5-67.

²⁸ Please refer to Footnote 26 (page 5-68) for the attention telegram types.

Re 1) Data connection via modem and telephone line or GSM wireless network

The data connection usually uses either the public or the company telephone network. If a system is not connected to a line-bound telephone network, a connection can be implemented via the GSM wireless network.

An external modem is connected to the COM2 interface of the *gas-net* device for connection to the respective telephone network.

In order to check the access authorization of the center, the integrated RDT manages the bus address, bus identifier and password of the center (*Center identifier*). A login procedure is carried out during a call connection. If errors occur during this procedure, each side is authorized to interrupt the connection by 'hanging up' for in this case a faulty connection or an unauthorized access can be assumed.

The remote center, however, is only linked via the integrated RDT during an established telephone connection. If the transmission of attention telegrams has been parameterized, the center will be spontaneously called and informed. For this, the integrated RDT has to know the center's telephone number.

Furthermore, it is possible to synchronize the internal device time via the integrated RDT if there is a server reachable by telephone and providing the time via telephone in accordance with a defined protocol. Should you be interested, please consult Elster to clarify the usability of this functionality in your case.

Re 2) Serial direct connection (null-modem cable)

In case of a serial direct connection the RDT assumes a continuous connection, i.e. a leased-line operation. The interface hardware is connected by a three-core null-modem cable; control lines are therefore not supported. The RDT is always online, so there is no connection set-up, no login procedure, and no connection tear-down. Telegrams to DSfG Class B may arrive at the RDT at any time and are processed there accordingly, i.e. they are answered by internal bus stations or routed to the local DSfG bus. Attention telegrams from local entities are spontaneously sent by the RDT via the leased line to the center directly after their creation.

This operating mode is thus intended for applications for which a continuously established serial direct connection is guaranteed.

Re 3) TCP (computer network)

The TCP connection type is intended for applications which use a TCP/IP network for the transmission of DSfG data. The easiest way is to imagine this operating mode without the modems and telephone network and with an IP network instead. Only the hardware is exchanged and telephone numbers are replaced by IP addresses. The connection remains being a dial-up network (between any IP address of the network and the IP address of the RDT). Like in case of the telephone dial-up network the connection set-up may be initiated by the center or local RDT.

In addition to the IP addresses of RDT and center, the values for the subnet mask and gateway usually used in the IP world and the port to be used for the transmission are special parameters of the TCP connection.

In case of this operating mode the preferred service for time synchronization would be NTP, which is a common network service.

A center that also supports DSfG queries via TCP/IP network is required for this operating mode; e.g. GW-Remote+.

The use of the TCP/IP network is advantageous for applications provided with a nearby IP network. In this case modem and telephone network can be saved.

5.6.2 Display and Operation

Main Display (Integrated RDT Module)

The main display of the *Integrated RDT* module indicates the current status of the RDT.

```

Integrated RDT          14:42:55 W
                        22.01.2007
Mode:   Dial modem analog
Status: Basic status
not connected
  
```

The *Mode* menu item indicates the current operating mode of the RDT (TCP/IP connection, dial modem analog, dial modem GSM, null modem).

Status indicates the current RDT status:

Status	Explanation
RDT not in operation	The <i>RDT not in operation</i> status may have the following causes: 1. During start up it turned out that the TCP/IP interface is either

	<p>not available or electrically defective. Additional message: <i>TCP/IP socket/module fault.</i></p> <p>2. Hardware error: wrong interface module. Additional message: <i>Module W3150 not recognized.</i></p>
TCP error (TCP/IP operation only)	During operation it turned out that the TCP/IP interface is electrically defective. Additional message: <i>TCP/IP socket/module fault.</i>
No modem (modem operation only)	The <i>No modem</i> status may have two causes: <ol style="list-style-type: none"> 1. No modem has been connected. 2. The modem initialization has failed. After some time the system will try to initialize the modem again, i.e. it changes in the <i>Modem initialization</i> status again (see below).
Modem initialization (modem operation only)	Directly after start-up, the RDT tries to initialize the modem. After a successful initialization the RDT status changes to <i>Basic status</i> .
Basic status not connected	The integrated RDT is ready for operation but is currently not connected to the center.
Calling (modem operation only)	The integrated RDT calls the center. Additional information is provided on the number of call attempts and the phone number being called.
Call attempt (TCP/IP only)	The integrated RDT tries to establish a connection to the center.
Call connection	An external call comes in. The telephone connection is established. The modems are setting up the connecting protocol.
Identification phase (not in case of a null modem)	During the <i>Identification phase</i> the center and bus identifiers are being exchanged and checked. The data connection has already been established. The operator is informed about when the telephone connection was established. Moreover, the telephone number of the station to which the connection has been established is indicated, provided the number is known. In case of a TCP/IP connection the display shows the host IP and the dynamically allocated port number instead.
Transparency mode	Connection set-up and login procedure have been completed successfully. Exchanging data is possible. The operator is informed about when the telephone connection was established. Moreover, the telephone number of the station to

	which the connection has been established is indicated, provided the number is known. In case of a TCP/IP connection the display shows the host IP and the dynamically allocated port number instead.
Call delay time	The RDT has attempted to call the center, but the connection could not be established. Now the dialing is interrupted by a parameterized <i>Call delay time</i> before a new call will be initiated. The display also indicates which call delay time is currently pending and how long it will last.
Long-term block (modem operation only)	The maximum number of call attempts can be parameterized. If the connection has not been established after this number was, the RDT is put into a <i>Long-term block</i> . Until the end of this block is reached, all attention telegrams are rejected.
Time query calling (modem operation and PTB time query only)	The integrated RDT calls the phone number for the telephone retrieval of the time standard. Additional information is provided on the number of call attempts and the telephone number of the time server. This status may only occur if time synchronization by time query calling has been set in the parameterization of the RDT.
Time query synch. (modem operation and telephone time query only)	The connection to the parameterized phone number for the telephone time query has been established. The time is now being enquired. This status may only occur if time synchronization by time query calling has been set in the parameterization of the RDT.



Subordinate Menu Items (Integrated RDT Module)

History

The *History* display lists the last three completed center connections together with start time and duration.

RDT statistics

The *RDT statistics* submenu is a tool for trouble shooting in case of recurring connection errors. The display provides an overview of the reason for and the number of failed connections, sorted following incoming and going calls.

Scroll through the listing by means of the arrow keys.

```

RDT statistics      09:47:22 S
                   27.07.2004
incom-calls without login 1
incom-calls with login error 13
Unsuccessful after redialing 3
going calls without login 0
going calls with login error 1
    
```

Number of failed calls (here: incoming calls with login error)

The meaning of the display texts and counters is described below:

Text	Meaning
incoming / going calls without login start	Those calls are counted during which the following error has occurred: The modems have established the connection logging. The login procedure, i.e. the checking of the access authorization by center and bus identifiers, has not started at all.
unsuccessful after redialing (only relevant in case of modem operation)	Counter for the occurred long-term blocks.
incoming / going calls with login error	Indicates the number of calls to which the following applies: The connection has been established, but the login procedure, i.e. the checking of the access authorization by center and bus identifiers, has failed.
incoming / going calls without transparency mode	Those calls are counted during which the following event has occurred: The participants have established the connection logging and the login procedure has been completed successfully. However, no data was exchanged as the center did not switch into the transparency mode.

GSM (only if a wireless modem is connected)

The GSM display indicates whether a connection to the radio network is currently established and, if so, it also indicates the measured data signal quality. The data signal quality is indicated as integer on a scale of 0 to 31 according to the convention of the modem manufacturers. The corresponding value is additionally indicated in dBm (see table below):

0	-113 dBm or less
1	-111 dBm
2-30	-109...-53 dBm
31	-51 dBm or more
99	Unknown

The minimum data signal quality level depends on the type of the connected wireless modem. Please refer to the corresponding modem manual for further information.

Synchronization (only if time synchronization is carried out via telephone time query)

In addition, a synchronization of the internal device time may be carried out via the integrated RDT if there is a server reachable by telephone and providing the time via telephone in accordance with a defined protocol. If this functionality is used, the *Synchronization* display contains additional information on the status of the time query.

5.7 Data Exchange Module, DSfG Module

The DSfG protocol is a digital data protocol that has been particularly developed for communication between gas measurement devices in gas measuring and regulating stations. If the *gas-net* F1 is equipped with a DSfG interface, all important measurements and characteristics are provided via DSfG protocol. The contents of DSfG data elements can be internally queried and provided even without a physical DSfG interface.

A PLC (programmable logic controller) is installed in many gas measuring and regulating stations. Its tasks are the closed- and open-loop control of the station and telecontrol connection to a remote center.

A PLC usually uses digital communication protocols such as *3964R/RK512* (e.g. S5/S7 in case of Siemens) or *Modbus-RTU* (e.g. in case of Cegelec Modicon).

In addition, there are non-DSfG-capable external measuring instruments (e.g. for gas quality measuring), which can be connected to the *gas-net* device and provide their measurements via MODBUS protocol, for example.

Therefore, in practice an interfacing of proprietary protocols or a conversion between DSfG and proprietary protocols is often necessary (gateway functionality).

These tasks are accomplished by the *DSfG* and *Data Exchange* modules of the *gas-net* software.

As this rather complex functionality exists in several *gas-net* device types, it is described by a separate documentation.

6 Annex

6.1 Parameters and their Meanings

The following parameter listing follows the order of the parameter listings for the individual modules as they are listed in the GW-GNET+ parameterization program.

6.1.1 *Correction* Module

Note: In case of a dual- or triple-stream flow computer, a second and possibly third *Correction* module is activated. In such a case, the following parameters are required once for each stream.

+ General parameters

Correction activated yes/no

Two *Correction* modules are offered in the parameterization environment for an F1. If the flow computer is to be operated with a single stream, the *Correction activated* parameters for the second and third stream (i.e. the *Correction 2 / Correction 3* modules) are set to *no*.

2 flow directions yes/no

Flow direction 1 active

Flow direction 2 active

Each *Correction* module may keep totalizers for two flow directions; set this operating mode by choosing the standard parameterization.

When the device is operated in two flow directions, two additional parameters are available defining the source of the flow reversal (*flow direction 1/2 active*).

Different methods for reversing the flow direction are parameterizable:

One message input for flow reversal

If the flow reversal shall be implemented via one single digital input contact, the related message input is either indicated under *Flow direction 2 active* or *Flow direction 1 active*, depending on the signal's meaning (the respective other parameter remains unassigned in this case).

If, for instance, a signal indicates the second flow direction, the related message input is assigned to the *Flow direction 2 active* parameter. This means that during operation flow direction 1 is active as long as this message input has not been set; flow direction 2 is active when the message input is set.

One message input for FD1 active, one message input for FD2 active

If one digital input contact each is available for *Flow direction 1 active* and *Flow direction 2 active*, both parameters are assigned with the related message inputs. During operation the flow direction is only reversed, when a new valid status of these two inputs is present (1-0 or 0-1); inconsistent conditions are ignored (i.e. FD1 and 2 are both either active or inactive).

Flow reversal via the digital protocol of the gas meter (Q.Sonic or FLOWSIC)

In case of Q.Sonic and Flowsic ultrasonic gas meters, the flow reversal may be directly derived from the digital meter protocol. To be able to evaluate this information, the entry *<Name of gas meter protocol channel>Flow direction 2* must be selected under *Flow direction 2 active*; the *Flow direction 1 active* parameter remains unassigned.

Important: The way of reversing the flow direction must be parameterized for a flow computer for two flow directions at any rate as otherwise the parameterization would be invalid and the flow computer would generate an alarm (*Vo failure*).

Freeze Input

Use command 'Freeze' as ... (trigger or gate)

The *Correction* module offers a comfortable freeze function that logs important totalizers and coefficients either cyclically or at fixed times (*Snapshots*, see also page 5-16). The freeze times may be set directly at the device or via DSfG.

As a third option you may also choose a message (derived from a digital input port or an intrasystem message) to initiate an event-driven freeze. Define this message under the *Freeze Input* parameter.

Two different operating modes are available for an event-driven freeze:

Use command 'Freeze' as trigger:

In this mode, a snapshot is always written when the message selected under *Freeze Input* begins. Each time such an event-driven snapshot is written, the cyclic freezing is switched off (when activated); however, it may be switched on again via the operator panel.

Use command 'Freeze' as gate:

In this mode, a snapshot is written when the assigned message begins and when it ends.

The following special feature applies: The logged totalizers are not the original totalizers of the *Correction* module, but incrementing totalizers that are stopped each time a snapshot is written because a message ends.

Only if the freeze function has been activated by the set message, it is possible to perform a cyclic freezing or freezing at specific presettable points of time.

Interval length

The *Interval length* defines at which intervals the cyclic data logging of the interval archives is carried out.

Moreover, an I-telegram is always generated on DSfG level at the end of an interval.

This requires, however, that the routing of I-telegrams to the DSfG bus is activated (cf. DSfG parameters).

Archive with Vo / Vu / m / E

The transfer of original totalizers Vo and uncorrected volume totalizers (at operating conditions) Vu has not been considered by older DSfG specifications.

External systems (e.g. evaluation systems) often expect a certain archive structure.

If you set the *Archive with Vo* or *Archive with Vu* parameters to *no* in the parameterization, the Vo and/or Vu totalizers will not be supplied when the data logging entity is queried. This avoids problems during further data processing.

You may additionally choose whether or not totalizers for m and E shall be supplied when archive queries are made.

Order of totalizers

(Number of) double-sized totalizers

The order of totalizers and the number of double-sized totalizers determine the structure of the main display of the *Correction* module.

Main totalizers on disturbance

The reaction of the main totalizers in case of errors is parameterizable: *Stop all totalizers* means that all main totalizers are stopped when an alarm is pending.

Stop affected totalizers means that only those main totalizers are stopped that are actually affected by an error. The third possibility is *Continue all totalizers* in case of an error.

++ Archive names

The *Correction* module provides some archive groups that can be stored by the *Data Logging* module in a parameterizable depth. The names of these archive groups are completely optional; the archive groups identify themselves under these names, for instance on the device display or during polling.

The following table lists the characteristics and differences between the available archive types:

Archive group	Channels	Data logging
Billing archive	1 V_n 2 E^2 3 possibly V_n of the 2 nd flow direction 4 possibly E of the 2 nd flow direction ² 5 error with the highest priority, last interval	cyclically at the end of the billing interval
Interval, one archive group per flow direction	1 V_o^1 2 V 3 V_n 4 E^2 5 p 6 T 7 status bit string 8 V_u^3 9 m^4	cyclically at the end of the interval, when alarms begin and when they end
Daily volumes, one archive group per flow direction	1 V_o^1 2 V 3 V_n 4 E^2 5 V_u^3 6 m^4	cyclically when the daily archives are logged (gas day beginning)
Disturbed volumes, one archive group per flow direction	1 V_d 2 V_{nd} 3 E_d^2 4 V_{ud}^3 5 m_d^4	when alarms begin and when they end, in the alarm condition also at the end of the interval
Revision, one archive group per flow direction	1 V_o^1 2 V_u^3 3 V 4 V_n 5 E^2 6 m^4 7 p 8 T	at each snapshot entry (cf. page 5-16)
Logbook	1 number 2 text 3 attribute	when alarms begin and when they end

¹ only if parameter *Archive with V_o* = yes

² only if *Archive with E* = yes

³ only if *Archive with V_u* = yes

⁴ only if *Archive with m* = yes

+ Gas meter

++ Gas meter – General parameters

Manufacturer

Year of manufacture

Year of calibration

Gas meter type

Meter size

Meter serial number

Gas meter approval

++ Gas meter – I/O connection

Transmitter type

Protocol channel

Transmitter 1

Transmitter 2

The connection of the gas meter signals to the input board(s) of the device is defined in the *System* module by parameterizing the input channels. The further processing of the gas meter signals, however, takes place in the *Correction* module. It is therefore necessary for the *Correction* module to know which gas meter inputs shall be used.

Preset the input by choosing the *Transmitter type*; the following transmitter types are supported:

Transmitter type	Description
Pulses	Single- or dual-port connection of the gas meter to the EXMFE5 input board in pulse technique. Allocation in the <i>Correction</i> module under <i>Pulser 1, Pulser 2</i> .
Encoder	Connection of the gas meter to the EXMFE5 input board via encoder totalizer (parameterizable in the <i>Correction</i> module under <i>Protocol channel</i>), up to 2 pulsers additionally possible (<i>Pulser 1, Pulser 2</i>)
Q.Sonic	Q.Sonic ultrasonic gas meter; connection to MSER2 protocol channel (parameterizable in the <i>Correction</i> module under <i>Protocol channel</i>)
FLAWSIC	Flowsic ultrasonic gas meter; connection to MSER2 protocol channel (parameterizable in the <i>Correction</i> module under <i>Protocol channel</i>)

Create V from pulses (only when an encoder totalizer is connected)

If the parameter *Create V from pulses* is set to *yes* when an encoder totalizer is connected, the V_0 totalizer at the device only serves to repeat the encoder's original meter reading. All subsequent totalizers (V_u, V, \dots) are derived from the pulser(s) in this operating mode.

Use encoder digits only (only relevant if an encoder totalizer is connected)

The connection of an encoder totalizer has the advantage that the Vo totalizer corresponds to the actual meter reading of the gas meter. The disadvantage is that the Vo totalizer and thus also all derived totalizers will not increase continuously but sharply in case of small flow rates, especially if the encoder totalizer does not supply any decimals. If, however, an additional HF pulser is connected, it can be used to emulate additional decimals in the Vu totalizer between two encoder totalizer increases. With this method Vo and Vu are accordingly adjusted each time the original meter reading increases.

- Transmitter 1/2 monitoring (only in case of a multiport connection)

Deviation for alarm (in m³)

Deviation for warning (in m³)

Reset volume (in m³)

Deviation for transmitter failure (in m³)

If the gas meter is connected via more than one port, the input signals of the transmitters can be monitored for deviations. Please refer to page 5-12 for a detailed description of the corresponding procedures. Please find some tips and examples of how to determine the volumes practically below.

- Monitoring the *Deviation for transmitter failure* enables you to detect the complete failure of a transmitter: If this quantity has flown via one of the transmitters, but another transmitter does not show any increase, the latter must be defective. In such a case the *Transmitter x failed* alarm will be generated. Switch this monitoring off by setting *Deviation for transmitter failure* to 0.
- Synchronization deviation for alarm = 0 means that no monitoring for alarms takes place; setting the synchronization deviation for warning to 0 deactivates the monitoring for warnings.
- The deviation values for the generation of alarms and warnings must be so large that systematic errors and errors fluctuating around 0 will never trigger an alarm or warning.

The value of Q_{max} of the meter provides a good clue for the adjustment of the parameters responsible for the detection of a deviation between the gas meter inputs. We describe each parameter individually, propose a value for a sensible presetting and perform an example calculation below. All examples refer to a G400 ($Q_{max}=650 \text{ m}^3/\text{h}$) with an HF pulser ($cp=1764.00/\text{m}^3$) and an LF pulser or encoder totalizer ($cp=0.1/\text{m}^3$).

Parameter for detecting the complete failure (*Deviation for transmitter failure*):

A sensible choice would be a value amounting to 5 % of Q_{max} (in m^3).

In the example this would be a setting of $650 * 0.05 = 32.5 \text{ m}^3$.

This means if 32.5 m^3 have come in via one of the two inputs and no gas volume has come in via the other input, the criterion for a complete failure has been met. 32.5 m^3 correspond to 57330 pulses for the HF input and to 3 pulses for the LF input. If 57330 pulses have come in via the HF input whereas no pulses came in via the LF input, the LF input is considered failed. On the other hand, if 3 pulses come in via the LF input whereas no pulses come in via the HF input, the HF is considered failed. If the speed with which a complete failure shall be detected in a particular application is decisive, then the calculation should be repeated with the actual values of the gas meter used to determine an optimum adjustment.

Parameter for resetting the volume difference (*Reset volume*):

A sensible choice would be 100 times Q_{max} (in m^3).

In our example this would be 65000 m^3 . If the meter runs within the medium load range (i.e. with an average at $Q_{max}/2$), the determination of the volume difference would start again after 200 hours, i.e. after about 8 days.

It is ensured for a volume of 100 times Q_{max} that the differential error caused by the finite accuracy of the HF- cp remains smaller than 1 m^3 .

Let's assume the cp value is wrong by 0.01.

Then the HF volume would be $65000 * 1764.00 / 1764.01 = 64999.63 \text{ m}^3$.

Parameter for the warning limit value of the volume difference (*Deviation for warning*):

A sensible choice would be $Q_{max} / 2$ (in m^3). In our example this would be a value of $325 \text{ (in } \text{m}^3)$. If the two transmitters differ by 325 m^3 at a maximum absolute volume of 65000 m^3 , a warning will be generated.

325 of 65000 m^3 are 0.5 %. This adjustment thus ensures that a transmitter error of 0.5 % will be detected before the volume difference is reset to zero. If the requirements are higher, you may also choose a lower warning limit. However, you need to take care not reach the resolution limit of the LF input, which is 10 m^3 in the example.

Parameter for the alarm limit value of the volume difference (*Deviation for alarm*): A sensible choice is Q_{max} (in m^3).

In our example this is a value of 650 m^3 . This means that an alarm will be generated if the two transmitters deviate by 650 m^3 at a maximum absolute volume of 65000 m^3 .

++ Gas meter – Alarm limits

Lower flow limit Q_{\min}

Upper flow limit Q_{\max}

Upper alarm limit Q

The *Correction* module generates the alarm A105 *Upper alarm limit Q* if the flow rate (at operating conditions) exceeds the upper alarm limit (cf. Chapter 6.2).

Q_{\min} monitoring: yes/no

The monitoring of the minimum flow rate Q_{\min} (at operating conditions) must be explicitly switched on or off in the device parameterization.

The Q_{\min} monitoring should not be activated if only LF transmitters or one encoder totalizer without an additional HF pulser are or is connected.

If Q_{\min} is monitored, this is carried out in consideration of parameterizable start-up and run-down times and the also parameterizable minor volume flow (see below). The precise effect of the Q_{\min} monitoring is described in Chapter 6.2, page 6-51.

Start-up time

Run-down time

Start-up Time and *Run-down Time* are only relevant when Q_{\min} is monitored (see above). The precise effect of the Q_{\min} monitoring, in particular the effect of start-up and run-down times, is described in Chapter 6.2, page 6-51.

Minor volume flow

By parameterizing a minor volume flow you achieve that the volume is suppressed as long as it is below a specific flow rate (at operating conditions). If the minor volume flow cannot be reached, the totalizers for V_u , V , V_n , E and m are not increased. The original-volume totalizer V_o is incremented only.

The minor volume flow may be set in a range of 0.0 to $0.5 \cdot Q_{\min}$.

If $0 \cdot Q_{\min}$ has been parameterized as minor volume flow, the volume suppression is switched off. If an encoder totalizer without a second transmitter is connected or if only LF transmitters are used, the minor volume suppression should always be deactivated.

The minor volume flow also affects the response of the Q_{\min} monitoring (cf. Chapter 6.2, page 6-51).

++ Gas meter – Hint limits

Lower hint limit Q

Upper hint limit Q

Hysteresis Q

If the flow (at operating conditions) violates a parameterized hint limit, the flow computer generates the corresponding hint (H112 or H113, cf. Chapter 6.2).

To prevent fluttering messages when a measurement fluctuates around a limit value, it is possible to parameterize a hysteresis (cf. Chapter 5.3.1, page 5-24). The percent Q hysteresis refers to the flow range of the gas meter ($Q_{max} - Q_{min}$).

++ Gas meter – Characteristic curve

If an official high-pressure test has been carried out, up to two characteristic curve corrections can be parameterized in the flow computer.

The correction is carried out as follows: The original flow rate Q_0 and the original-volume totalizer V_0 in the flow computer reflect the uncorrected values as they come from the gas meter. The uncorrected totalizer V_u or, in disturbed conditions, the totalizer for disturbed volumes V_{ud} is created based on the original-volume totalizer V_0 . Afterwards the totalizers are corrected to create flow Q (at operating conditions) and the totalizer for corrected volumes (at operating conditions) V or V_d .

In case of a parameterized characteristic curve, linear interpolation is carried out between the different flow values for which an error is given in the test protocol. The error for the smallest flow value given in the test certificate is applied below this flow value. The calculation at the upper end is analogous: The error of the largest flow value which given in the test certificate is applied above this flow.

In the case of two correction characteristic curves, the correction values of each curve are first determined and then a mean value for a single correction is ascertained for both series of values.

The test certificate for a gas meter high-pressure test shows the measurement deviations ascertained in one or two series at one given pressure; the actual flow and the gas meter deviation determined for this flow compared to the reference gas meter(s) in the testing center.

If the device is operated in two flow directions, a gas meter correction with up to two characteristic curves is available for each flow direction in the parameterization. This is necessary for a Q.Sonic ultrasonic gas flow meter through which the gas may actually flow in two directions and in case of which both flow directions have been high-pressure tested separately.

In case of all gas meter types through which the gas flows only in one direction, the same gas meter correction according to the test certificate must be specified for both flow directions.

The following data is required for the parameterization of the characteristic curves:

Correction type

Correction type *Q = measured value* must be selected if the flow rates listed in the test certificate specify the values measured by the meter.

Correction type *Q = corrected value* must be set if the flow rates in the test certificate specify the set values, i.e. the values indicated by the reference gas meter(s) of the testing center.

Correction type *No correction* switches the application of the characteristic curve off.

Characteristic curve 1 / Characteristic curve 2

The test certificate data is entered under *Characteristic curve correction 1/2*:

- Test pressure in bar, at which the curve was recorded in the testing center.
- Up to 10 value pairs, consisting of the flow rate in m³/h and the related error in %.

+ Temperature sensorMeasurement temperature

Reference to the input channel (assignment by means of the channel's name; see *System* module) to which the respective temperature sensor is connected.

ManufacturerYear of manufactureSensor typeSensor serial numberLower alarm limit temperatureUpper alarm limit temperature

If the temperature alarm limit is violated, the flow computer will generate alarm A002 or A003 (cf. Chapter 6.2).

The lower alarm limit should not be set lower than -10°C and the upper one should not be higher than +60°C. Within this range, the k-ratio calculation according to SGERG-88 is also valid.

Note on correction according to AGA-NX-19:

In case of a correction according to AGA-NX-19, no other consistency check of the input values is carried out during operation apart from checking the parameterized alarm limits. The reason for this is that no consistent details on the range of application of AGA-NX-19 can be found in the literature. The effective temperature range can be limited by setting the respective alarm limits; this is therefore the responsibility of the user.

Lower hint limit temperatureUpper hint limit temperatureHysteresis

If the temperature violates a parameterized hint limit (upper or lower hint limit temperature), the flow computer will generate the corresponding hint (H005 or H006, cf. Chapter 6.2)

In order to prevent fluttering messages in case the temperature measurement fluctuations around a limit value, you may additionally parameterize a hysteresis (cf. Chapter 5.3.1, page 5-24). The percent hysteresis refers to a value of 70°C.

Substitute value strategy

Two different substitute value strategies can be parameterized for the case of an error in the temperature measurement. If you select *Use substitute value*, the parameterized substitute value will be used if errors occur (see below). As a second option you may select *Use last valid value*; then, in case of an error, the last error-free value before the error occurred will be used for calculating.

Substitute value

The temperature substitute value is used for the correction if you have selected *Use substitute value* as substitute value strategy and if there is an error in the temperature measurement. In addition, the temperature substitute value is always used when the device has just been started up, the calibration switch is closed and the temperature measurement is invalid.

Extended temperature range yes/no

The parameterization interface of GW-GNET+ usually prevents a setting of the lower temperature alarm limit below -10°C.

However, if you set *Extended temperature range* to *yes*, you may set the lower alarm limit to -30°C.

This way you may prevent that a temperature alarm is triggered if the temperature falls below -10°C. However, please consider that the calculation of the compressibility ratio k according to SGERG-88 is invalid below -10°C.

+ Pressure sensorMeasurement pressure

Reference to the input channel (assignment via the channel's name; see *System* module) to which the respective pressure sensor is connected.

ManufacturerYear of manufactureSensor typeSensor serial number

Lower alarm limit pressure

Upper alarm limit pressure

If a pressure alarm limit is violated, the *Correction* module will generate alarm A031 or A032 (cf. Chapter 6.2).

Note on correction according to AGA-NX-19:

In case of a correction according to AGA-NX-19, no other consistency check of the input values is carried out during operation, apart from checking the parameterized alarm limits. The reason for this is that no consistent details on the range of application of AGA-NX-19 can be found in the literature. The effective pressure range can be limited by setting the respective alarm limits; this is therefore the responsibility of the user.

Note: The parameters *pmin* and *pmax* (limits of the pressure measuring range) belong to the *System* module (limit values of the related input channel).

Substitute value strategy

Two different substitute value strategies can be parameterized for the case of an error in the pressure measurement. If you select *Use substitute value*, the parameterized substitute value will be used if errors occur (see below). As a second option, you may select *Use last valid value*; then, in case of an error, the last error-free value before the error occurred will be used for calculating.

Substitute value

After the device has been started up and if the calibration switch is closed, the substitute value for pressure is used if and as long as the pressure measurement is invalid. In addition, the pressure substitute value is always used if the device has just started up, the calibration switch is closed and the pressure measurement is disturbed.

Lower hint limit pressure

Upper hint limit pressure

Hysteresis

If the pressure violates a parameterized hint limit (upper and lower pressure hint limits), the flow computer will generate a corresponding hint (H034 or H035, cf. Chapter 6.2)

To avoid fluttering messages when the pressure measurement fluctuates around a limit value, you may additionally parameterize a hysteresis (cf. Chapter 5.3.1, page 5-24). The percent hysteresis refers to the measuring range of the pressure sensor ($pmin - pmax$).

Pressure offset

In order to be able to also connect relative pressure sensors for the correction, it is necessary to parameterize a fixed air pressure (*Pressure offset*).

For the further processing of the pressure value (for displaying, data logging of correction values, monitoring of alarm and hint limits, etc.) only the calculated absolute pressure is used.

The pressure sensor measuring the pressure (at operating conditions) for the *Correction* module is usually an absolute pressure sensor. In this case the pressure offset must thus be set to 0.

+ Correction

Base pressure p_n

Base temperature T_n

Base values for pressure and temperature. They influence the k-ratio and Z-factor calculations.

The base volume calculated by the *Correction* module refers to the reference conditions defined by p_n and T_n .

Important note:

The gas quality data upper heating value H_s and standard density ρ also refer to a defined reference state.

Input values referring to reference conditions must always refer to the *same* reference conditions throughout the system to ensure that all calculations can be performed correctly.

In addition, please note that in case of the k-ratio calculation method SGERG-88 the input values H_s and ρ must in principle refer to the (German) standard reference state with $p_n=1.01325$ bar and $T_n=273.15$ K.

If different reference conditions have to be taken into account, the use of conversion factors can be parameterized. These conversion factors are either preset as fixed values or calculated automatically while considering the decisive parameters (see below).

Automatic conversion = no

H_s conversion factor

Rho conversion factor

Energy calculation factor

Mass calculation factor

Base pressure p_n / Base temperature T_n

All conversion factors are preset with a value of 1 as a standard; hence a conversion will not take place. This is always the correct setting if all values refer to the same (standard) reference state defined by $p_n=1.01325$ bar and $T_n=273.15$ K.

If you use the k-ratio calculation method SGERG-88 and the input values for H_s and ρ do not refer to the reference conditions $p_n=1.01325$ bar and $T_n=273.15$ K, correct conversion factors must be parameterized for H_s and ρ . During operation, H_s is multiplied by the *H_s conversion factor* before the multiplication result influ-

ences the k-ratio calculation. The same applies analogously to the *rho conversion factor*.

The upper heating value is also needed for calculating energy E, independent of the selected correction method, whereas the standard density is needed for calculating mass m. The *energy and mass calculation factors* must be used if the target reference state differs from the reference state to which the input values for Hs and rho refer.

The factors are used as follows: The input value for Hs is multiplied by the *Energy calculation factor* before the result influences the calculation of the totalizer increments for energy E. Correspondingly, the input value for rho is multiplied by the *Mass calculation factor* before the result influences the calculation of the totalizer increments for mass m.

Important: The user is responsible for the correct calculation and parameterization of the conversion factors.

When using conversion factors for energy and mass calculations you must not forget to ensure that the target reference state p_n , T_n belonging to these factors has been parameterized (see above).

The following applies in particular: If it is necessary to parameterize conversion factors for Hs and rho because of deviating reference conditions on part of the GQ input values for SGERG-88 and the target state (p_n , T_n) corresponds to the standard reference conditions, the same factors must be parameterized once again for the energy and mass calculations.

Automatic conversion = yes

Base temperature GC

Temp. combustion GC

Temp. combustion target state

Base pressure p_n / Base temperature T_n

The conversion factors may also be calculated automatically. For this, it is necessary to know the reference state to which the values for Hs and rho measured by the GC refer and to which target state the volume (at operating conditions) shall be corrected.

Note: The automatic calculation of the conversion factors is based on the assumption of an ideal gas in order to minimize the computing load of the *gas-net* device. If the deviation between real gas and ideal gas shall be considered, we recommend calculating the conversion factors by hand and parameterizing them as fixed conversion factors (see above).

The following table shows the meaning of the parameters in case of an automatic calculation of the conversion factors:

Parameter	Meaning
Base temperature GC	Base temperature to which the GC measurements refer (a base pressure of 1.01325 bar is assumed).
Temp. combustion GC	The Hs of a gas depends on the combustion temperature. The combustion temperature to which the Hs measured by the GC refers must therefore be specified.
pn, Tn	Base pressure and base temperature of target state.
Temp. combustion target state	Combustion temperature of target state.

k-ratio calculation: k=constant, SGERG-88, SGERG-88 with H₂=0, AGA-NX-19, AGA8-92 DC

The following operating modes may be selected with respect to the k-ratio calculation:

1. Correction with a constant k-ratio.
2. K-ratio calculation according to the standard SGERG-88 virial equation.
3. K-ratio calculation according to the standard SGERG-88 virial equation; however, with the fixed value H₂ = 0 mole percent.
4. K-ratio calculation according to AGA-NX-19.
5. K-ratio calculation according to AGA8-92 DC

Take the local regulations into consideration when choosing the correction method.

Constant k-ratio

Constant k-ratio FD2 (only in case of 2 flow directions)

k-ratio for the correction with k=constant (see above).

Substitute k-ratio

Substitute k-ratio FD2 (only in case of 2 flow directions)

Only in case of a correction according to SGERG 88. The *Substitute k-ratio* is used if the alarm *Error k-ratio calculation* occurs (cf. with description of this error in Chapter 6.2).

Lower hint limit QnUpper hint limit QnHysteresis Qn

If the base flow violates a parameterized hint limit, the flow computer will generate the corresponding hint (H114 or H115, cf. Chapter 6.2).

To avoid fluttering messages when the measurement fluctuates around a limit value, you may additionally parameterize a hysteresis (cf. Chapter 5.3.1, page 5-24). The percent Qn hysteresis refers to the value (upper hint limit Qn) – (lower hint limit Qn).

+ Gas qualityOnline gas quality yes/no

The *Online gas quality* parameter must be set to *yes* if an import of online gas quality data is planned. In this case, the gas quality analyzer is usually connected via DSfG. Please consider that the *GQ Import* module must also be parameterized accurately in such a case – here, for instance, the DSfG bus addresses of the up to two gas quality sources are indicated.

Substitute value strategy

Two different substitute value strategies can be parameterized for the case of an error in the gas quality received via digital protocol. If you select *Use substitute value*, the parameterized substitute gas quality table will be used if errors occur (see below). As a second option, you may select *Use last valid values*; then, in case of an error, the last error-free values received before the error occurred will be used for calculating.

++ Gas quality – AGA8-92DC limit values

When using the AGA8-92DC conversion method, you may parameterize upper and lower alarm limits for the individual gas quality components influencing the method. If one of these alarm limits is violated during operation, the flow computer generates the A509 alarm (Error k-ratio calculation).

++ Gas quality – substitute values

If the compressibility ratio is calculated with online gas quality data, substitute values are parameterized additionally.

These substitute values are used in the following situations, namely

- until the first valid gas quality telegram has been received after the device has started up.
- as substitute values in the case of a gas quality error if *Use substitute values* has been selected as substitute value strategy.

If two flow directions are corrected, the parameterized substitute values apply to both flow directions.

++ Gas quality – constant values

(only if no online gas quality data is available)

The gas quality tabular values for the operating mode *Online gas quality data = no* are parameterized under *Gas quality – constant values*.

If there are two flow directions available, there is one gas quality table available for each flow direction.

++ Gas quality – source

Values from

FD2 values from

The *GQ Import* module is able to process one or two connected gas quality measurements.

When two GQ measurements are performed, each analyzer supplies its own values that are separately evaluated.

It is also possible to interpret the second GQ measurement as redundant measurement. To support this function the *GQ Import* module evaluates the status of both GQ measurements and based on this evaluation chooses one GQ data record for further processing. This record always consists of the first source's measurements as long as the related measurement supplies valid measuring data. Only if the first GQ measurement is invalid, the second source is used.

The gas quality data to be used for each of the up to two flow directions must be specified in the *Correction* module: *Gas quality 1*, *Gas quality 2* or *Redundant measurement*.

6.1.2 Data Logging Module

The *Data logging* module provides the integrated data logging function. The data being logged in this module has been generated by other modules of the module group.

When parameterizing the *Data Logging* module, you only have to define which of the available archive groups shall actually be logged and which storage depth shall be applicable. A useful archive structure has been preset in factory and standard parameterizations.

Attention:

A re-parameterization of the archive structure requires the deletion of all old archives existing in the device!

+ Archive group <number>

Assignment

All assignments possible for an archive group are offered under *Assignment*. The assignment possibilities depend on the module composition of the *gas-net* device in each individual case.

Archive depth

All archives are designed as ring storage. The archive depth defines the number of entries an archive is able to write at most. If an archive is full, the respective oldest entry will be overwritten by each new entry.

6.1.3 Monitoring Module

Parameters

+ Meter proving 1 / meter proving 2 (DSfG functionality)

If more than one corrector entity is connected to the DSfG bus, the *gas-net* device may retrieve correction data via DSfG – for example data on totalizer increases. This method facilitates a meter proving between two volume correctors or flow computers.

It is possible to activate up to two meter proving functionalities in the parameterization of the *gas-net* device. The following parameters are required:

Meter proving via...

The meter proving is usually carried out via the proving quantity base volume V_n ; if the meter proving is carried out between flow computers the proving may also be performed via mass m or energy E .

EADR first correction entityEADR second correction entity

Under *EADR of the first correction entity* the bus address of the reference correction entity is chosen. *EADR of the second correction entity* is used to define which second correction entity is to participate in the meter proving.

The setting *EADR first correction entity = EADR second correction entity = unassigned* deactivates the *Meter proving* option.

Automatic proving yes/no

The meter proving can be carried out automatically. This means that the proving is repeated cyclically and checked for a parameterizable maximum deviation. The message *Maximum deviation meter proving 1* (or *Maximum deviation meter proving 2*) can be assigned to a digital output for monitoring this deviation.

An automatic meter proving is programmed for testing the station in case of a continuous series connection.

The setting *automatic proving=no* switches off the automatic operation. In this mode it is possible to start and stop a meter proving manually via the operating panel of the device. A manual proving is useful for instance in case of a revision during a plant test.

Proving timeMax. deviation

(only in case of automatic proving)

If the meter proving is performed in the automatic mode, a proving time is additionally parameterized in minutes. If both volume correctors or flow computers involved are in an error-free state, the proving starts automatically. After the proving time has elapsed, the percentage deviation is calculated and the proving is restarted.

If the parameterized maximum deviation in % is exceeded, an internal message is generated, which can be forwarded via a digital output.

Qn for comparison at least ...

A minimum base flow Qn may be parameterized to avoid that minor quantities of flown gas result in a large the meter proving deviation. A meter proving will only take place if the base flow rate of both correction entities exceeds this minimum flow rate.

+ Summation (DSfG functionality)

If several corrector entities are connected to the DSfG bus, count values or flow data of two via DSfG connected correction entities can be summated; for instance, in order to output summated quantities via a pulse output.

EADR first correction entityEADR second correction entity

To facilitate a summation, the DSfG bus addresses (EADRs) of the two participating correction entities have to be parameterized.

Setting *EADR first correction entity* = *EADR second correction entity* = *unassigned* switches the summation function off.

+ SwitchesNameProtection

Switches are messages the status of which (on/off) can be changed via the operator panel. They can be assigned, for instance, to digital outputs and used for triggering external switching processes. Five switches are available. One each is reserved per corrected stream as revision switch for the correction. The remaining switches are available and can be parameterized as desired with respect to name and access protection (independent / under calibration switch protection / under user lock protection).

Message processing

+ General notes

Holding time

The messages generated by the groups include messages called *held group messages*. These held group messages only differ from normal group messages by the fact that they always keep to a parameterized holding time. A held group message is pending at least as long as the holding time lasts, even if the normal group message ends during the holding time.

The telecontrol response times can be taken into account when a holding time has been parameterized.

M-switch input

The maintenance switch is set via a digital input assigned by parameterization. The reaction of each group of single messages to the setting of the M-switch is parameterized for each group separately.

Acceptance input

Centralized messages of groups requiring an acceptance as well as the main signaller (hooter triggering message) must be accepted explicitly before they can end. You may trigger such an acceptance, among others, via the operator panel, but you may also assign a digital input to the acceptance via the *Acceptance input* parameter.

Input for accepting sounder (main signaller)

You may define a separate acceptance input for accepting the main signaller (hooter/sounder message).

Acceptance technique

The *Acceptance technique* parameter only affects the acceptance technique and status of centralized messages of groups marked *Acceptance required*. There are two different procedures:

1) According to DIN 19 235

Single messages can be accepted even though they are still pending. A centralized message is pending when at least one of the group's single messages is pending or has been pending without having been accepted. The centralized message ends when all related single messages have ended and all single messages that were pending have been accepted.

If a centralized message is still pending after the last single message has ended, it means that after the last acceptance at least one of the related single messages has begun anew. In such a case this message just has to be accepted.

2) Standard

According to this procedure the centralized message results from the OR operation of the status of the related single messages. The centralized message consequently ends with the end of the last pending single message, totally independent of its acceptance. After the centralized message has ended, it can be removed from the error listing by accepting it.

+ **Single messages**

Monitoring type (message, limit value or gradient)

A single message can be derived in different ways:

- by monitoring message inputs or internal messages
- by monitoring measurements for limits (upper or lower limit value)
- by monitoring measurements for range limits (range between upper and lower limit values)
- by monitoring gradients of measurements
- by monitoring pulses/quantities for violations of hourly limits

The monitoring type must be specified during the creation of a new single message as the composition of the required parameters depends on it.

Name

The names of single messages serve to identify the message; for instance, on the device display. We recommend using rather expressive names to avoid mistakes. Up to 23 characters are available.

Source

Either messages or measurements are available here, depending on the monitoring type (see above).

When an hourly limit is monitored, usually a meter input value is used as source. If the quantity coming in via this input within an hour (i.e. for instance from 11:00 a.m. till noon) exceeds the parameterized limit value, the message will be generated. It is also possible to choose a derived count value as source.

alternatively: flow rate (only in case of *Hourly limit*)

When an hourly limit is monitored and the original input value is a flow rate (e.g. in case of a Q.Sonic ultrasonic gas meter), you may directly choose the flow rate as data source for the *Monitoring* module instead of a count value. The corresponding quantity is continuously calculated based on the flow rate. If this quantity exceeds the parameterized limit value within an hour (i.e. for instance from 11:00 a.m. till noon), the message will be generated.

Logbook number

The logbook numbers serve to identify messages in the logbook and in the error listing. As certain logbook numbers are preset according to the DSfG regulations, an unassigned range (between 2,000 and 50,000) has been reserved for freely parameterizable logbook numbers. Please make sure that the logbook numbers are unambiguous and please consider that logbook numbers are also assigned to centralized messages (see below).

Disabled (yes/no)

Whether a message is disabled or enabled is preset by parameterization. During operation you may disable or enable a single message via the operator panel or with a DSfG setting telegram.

The entire message processing considers a disabled single message as not pending.

Minimum pending time

The minimum pending time determines how long a status to be signaled must be pending before the assigned single message begins, thus preventing fluttering messages.

Setting *Minimum pending time* = 0 results in an immediate response by the single message.

Entry in logbook and error listing yes/no

To prevent the error listing and logbook from getting confusing, you may specify for each single message whether or not it shall be entered in the error listing and logbook.

Group assignment

Assign a single message to one or several group(s) via the group assignment. The states of all assigned single messages are linked for each group during operation to generate centralized and group messages (cf. Chapter 5.3.1.5, page 5-28).

DSfG representation board / channel

It is in principle possible to gather information on the status and characteristics of a parameterized single message via DSfG. If this functionality shall not be used, the two parameters *DSfG representation board / channel* are not required and set to <unassigned>.

However, the possibility to gather information on single messages via DSfG may be useful for certain applications.

The individual data that can be queried can be mapped to certain DSfG data elements in the data element tree of the DSfG entity called Control and Monitoring Unit. The parameters *DSfG representation board / channel* then define certain parts of these data element addresses for each single message.

Please contact Elster for further information on the data element addresses used, when required.

With respect to measurement monitoring:

Limit value

As upper limit value yes/no (only in case of hint limit monitoring):

Monitoring period (only in case of gradient monitoring):

The meaning of the *Limit value* depends on the monitoring type:

Define the maximum permissible change value within an additionally defined *Monitoring period* when monitoring gradients.

If hint limits shall be monitored, enter the limit value to be monitored here. A separate parameter defines whether this limit value is an upper or a lower one.

Hysteresis

A hysteresis can additionally be parameterized to avoid fluttering messages when a measurement fluctuates around a limit value (cf. page 5-29).

+ Linkage of messages

++ Group no. 1..group no. 8

Type

You may choose between *Acceptance required* and *No acceptance required* to select the group type.

The *Acceptance required/No acceptance required*-property of a group only affects the reaction of the group's centralized message: If *Acceptance required* applies, an additional acceptance signal is included in the logic operation of the centralized message. Please refer to Chapter 5.3.1.5, page 5-28, for more details.

Setting *switched off* deactivates an entire group.

Name

All groups need to be given expressive names to simplify the identification of a group on the device display, for instance.

Logbook number

The centralized message of each group is entered in the error listing and logbook. The logbook number serves the identification of a centralized message. As certain logbook numbers are preset according to the DSfG regulations, an unassigned range (between 2,000 and 50,000) has been reserved for freely parameterizable logbook numbers. Please make sure that the logbook numbers are unambiguous and please consider that logbook numbers are also assigned to single messages (see above).

Trigger main signaller (yes/no)

The so-called *Main signaller* combines all messages of the assigned groups to one message that can be routed to a digital output.

The main signaller usually triggers a hooter or similar sounders. The functioning of the main signaller is described in Chapter 5.3.1.5 on page 5-35.

Attention type (alarm / warning / hint)

The group type defines the type of the attention telegrams it may generate towards the DSfG bus (see below).

Generate attention telegrams in case of ...

Each group may generate DSfG attention telegrams in case of particular events. Events available as triggers are: *Group message begins / Group message ends / Any message of the group begins / Any message of the group ends*. The parameterized group type (see above) thereby determines the type of the attention telegram (L = alarm, W = warning, H = hint, F = freeze request).

M-switch function

The M-switch function refers to the reactions of the group to a setting of the M-switch.

Note: A set M-switch never affects single messages.

M-switch function	Group reaction to set M-switch
<i>none</i>	The message reactions of this group are not affected by the M-switch.
<i>suppress remote messages</i>	The held group message is suppressed if the M-switch is set. Besides, the group no longer generates DSfG attention telegrams.

<i>suppress all messages</i>	If the M-switch is set, all message reactions of the group are suppressed, such as held group messages, group messages, centralized messages, main signaller and DSfG attention telegrams. Entries in the logbook and error listing are still made to enable the operator to view the actual condition of the station on site.
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Data logging

The *Monitoring* module may log on up to 4 process value archive groups with up to 8 channels each. The actual data logging of the values, however, is performed by the data logging module. This means you have to set up an archive group in the data logging module for each process value archive defined in the monitoring module.

+ Process value archives 1..4

Name

The name of the process value archive is for identification. If you select expressive names here, the assignment in the *Data Logging* module will be easier.

Cyclic data logging

Define the data logging rhythm under *Cyclic data logging* if you want to log the process values cyclically. The following rhythms are available: *each second, every 2 (5, 10, 15, 30) seconds, each minute, every 2 (5, 6, 10, 15, 20, 30, 60) minutes, every 2 (3, 4, 6, 8, 12, 24) hours, at the gas day beginning (when the daily archives are logged), gas month beginning (when the monthly archives are logged on the first day of each month.*

Setting *<none>* deactivates the cyclic data logging.

Triggered by

The data logging process can be linked with results of one or more message group(s), alternatively to or in parallel with the cyclic data logging.

Each group generates a trigger upon *any single message of the group begins or ... ends*. These triggers initiate entries in process value archives. It is also possible to assign several groups, and thus several triggers, to individual archives.

For instance, if you have selected *Triggered by: Group 1*, the process value archive will always start data logging when any single message of this group begins or ends.

Log only if...

Choose a message here. As soon as a message has been selected, archive entries are only logged when this message is pending.

Freeze on ...Freezing depth

Process value archives can be frozen with the result that the archive will only write a parameterized number of entries when an assigned message begins. As soon as this number has been reached the archive will stop logging data. The data logging will not be continued until the assigned message ends.

In the logbook and error listing of the *Monitoring* module the beginning and end of the freeze status are marked by the hints *PVA<no.> frozen begins/ends*.

Archive channels 1..8Name

The name of the archive channel is important for its identification.

Archive type (measurement or counter archive)

Each channel may either log a measurement or a count value.

Process value (assignment)

All measurements existing according to the current status of the parameterization data record are available for being assigned to a measurement archive. These values are measurements coming in via analog inputs as well as all internally available measurements, such as the flow rates of an internal correction entity.

All count values existing within the system may be assigned to the counter archive.

Generate mean value yes/no (only in case of the *Measurement* archive)

An archive channel may either log the arithmetic mean of the values measured since the last data logging or the current measurement.

Entry upon change by ...

You may also link the data logging with a process value change. By assigning a change value to data logging you achieve that archive entries are always made when the difference between the current process value and the value recorded during the last data logging exceeds this maximum change value. You may activate this procedure for measurements and count values.

Entry upon change by is a parameter referring to a particular archive channel. If data logging is performed due to this setting, not only the related channel but all channels of the related process value archive are logged simultaneously.

Data element of source

The data logging entity is able to supply particular information on each archive channel via DSfG when being queried. For instance, there is a data element for inquiring the data element address of the archive value.

The user may assign the channels of the process value archives as he pleases as they do not have a fixed source data element. As some processors face difficulties if the data element for the source is empty, it is possible to parameterize a source data element address for each archive channel of a process value archive as desired.

Measurements

Name

The name serves to identify the measurement; for instance, on the device display. We recommend using rather expressive names to avoid mistakes. Up to 20 characters are available.

Type

The input value type of a measurement can either be *measuring value* or *count value*.

Source

All measuring or count values existing according to the current status of the parameterization data record are available to be assigned to a measurement.

Post-decimal digits for display

The maximum number of post-decimal digits with which an input value of *measuring value* type is indicated in the measurement display is parameterizable (1 to 8 decimals). This way the number of decimals of a measurement may only be limited regarding the increase of decimals, as there are precisely 12 characters available for the indication of the values including sign and decimal point. If a measurement value is getting so large during operation that not all decimals can be shown on the display, the decimals that do not fit in will be cut off at the end.

In case of a *count value* input, the number of indicated post-decimal digits is not parameterizable. The current value is always indicated with 12 pre-decimal and 3 post-decimal digits. Due to the limited display space, the indication of the maximum value is limited to the pre-decimal digits.

Automatic resetting

Define an automatic resetting rhythm if you want to reset the measurement cyclically. The following rhythms are available: *each minute*, *every 2 (3, 5, 6, 10, 15, 20, 30, 60) minutes*, *every 2 (3, 4, 6, 8, 12, 24) hours*, *at the gas day beginning* (i.e. the time of day when the daily archives are logged, parameterizable, standard setting 6:00 am), *gas month beginning* (first day of month, gas day beginning).

Setting *<none>* deactivates the automatic resetting.

Measurements for count values are only reasonable in combination with a cyclic resetting.

+ Lubrication

++ Lubrication 1 / 2 / 3

Deactivated (yes/no)

Please set the parameter *Deactivated (yes/no)* explicitly to *no* to activate and define the settings for a lubrication. Selecting *Deactivated = yes* deactivates a particular lubrication in the parameterization and the display of the *gas-net* device.

Name

An unambiguous name for the gas meter lubrication functionality makes the identification of the messages provided by this functionality much easier later on.

Q

A flow input value must be specified if the lubrication control shall be suppressed below a certain minor flow volume (see below). Furthermore, the volume calculation for a volume-dependent lubrication (lubricate after ...m³) can be performed based on a flow value if a volume input is not available.

V

A volume input value is required if a volume-dependent lubrication shall be performed (as an alternative, the volume count value can also be derived from a flow rate; see above).

Oil level too low

Overpressure

Oil volume

The lubricating device checks itself and provides several output signals for the *Monitoring* module. If these signals shall be evaluated by the *gas-net* device, they must be assigned to device input channels and allocated correctly in the parameterization of the gas meter lubrication functionality.

Lubrication cycle (deactivated, every day, every 2/3/4/5/6 days, every week, every 2/4/6/8/12 weeks, every six months, annually)

Day of lubrication

Lubricate at...o'clock

Instead of or in addition to a volume-dependent lubrication it is possible to parameterize a cyclic lubrication at defined intervals (lubrication cycle). Another parameter defines the starting time of the lubrication process (*Lubricate at ...o'clock*). In case of lubrication cycles from once per week up, you may also select the desired weekday (*Day of lubrication*).

Lubricate after...m³

The parameter *Lubricate after ...m³* defines for a volume-dependent lubrication after how many flown m³ of gas a lubrication process shall be triggered.

Lubricate only if Q higher ...

By specifying a minor flow > 0 you achieve that lubrications are suppressed as long as the flow is below this minor flow. A lubrication that has already been started will not be aborted when the flow falls below Qmin.

Number of strokes

Piston active for...seconds

Piston inactive for...seconds

The gas-net device provides a message (*Piston displacement*) that is output via a digital output and thus triggers the lubricating system. The following settings define the details of the lubrication process:

Number of strokes: Number of piston strokes of the lubricating system per lubrication process (this is how often the gas-net device sets the *Piston displacement* message during each requested lubrication cycle)

Piston active for ... seconds: The duration of the piston control via the digital output – *Piston displacement* message is set

Piston inactive for ... seconds: Break between piston control operations – *Piston displacement* message is not set

Max. stroke deviation

The lubrication process can be monitored by comparing the number of requested strokes with the number of actually performed strokes. If, after the end of a lubrication cycle, it turns out that the number of failed piston control operations has exceeded the parameterizable *Maximum stroke deviation*, the gas-net device generates an internal error message: *Stroke deviations exceeded*.

Important: Each lubricating cycle is being monitored separately. Therefore, the parameter *Max. stroke deviations* must be smaller than the *Number of strokes*. The *Number of strokes* is the number of piston control operations per lubricating cycle.

Hold message "Stroke deviations exceeded" yes/no

Hold message "Oil level too low" yes/no

Hold message "Overpressure" yes/no

Hold message "Disturbance" yes/no

The gas-net device can generate several messages (if the necessary input signals are available) to monitor the operational capability of the lubricating system. It is possible to parameterize for each of these messages whether or not it shall be held when the

cause of the error ceases to exist. Held messages only end after they have been accepted.

6.1.4 GQ Import Module

An F1 device may receive and process online gas quality data from a gas quality analyzer connected via digital protocol.

Parameters

+ Gas quality 1 / Gas quality 2

EADR

Adjust the DSfG bus address of the gas quality source under *EADR*. If only one gas quality source exists, the *EADR* of the second source should be set to *unassigned*. If no gas quality analyzer is connected or if i.e. the gas quality data comes in via MODBUS, set both DSfG bus addresses to *unassigned*.

CRC start value

The CRC start value is the start value for the check sum calculation according to CRC and is used to verify the data provided by the gas quality source. The start value must agree in the sender (=gas quality source 1 or 2) and the receiver (=gas-net device).

GQ via link 1/2 (for importing of the gas quality via digital protocol)

If the gas quality is imported via a digital protocol other than DSfG, the applicable link, i.e. the data point providing the related value, has to be assigned to each individual GQ component (typically, this would be an import value of a communication channel).

Status information for alarm

Status information for revision

Mask for alarm

Mask for revision

The status bit string, which contains alarm and revision information, is assigned to the parameters *Status information for alarm* and *Status information for revision*. The bit to contain the corresponding information is assigned under *Mask for alarm/revision* (binary coded, i.e. 1 = bit 0, 2 = bit 2, 4 = bit 3, etc.).

Ordinal number

The ordinal number must be specified; otherwise a gas quality source cannot be used. Only if this "ordinal number" changes during operation, a new analysis will be accepted. This ensures that the individual values of a new analysis will only be transferred together.

The term "ordinal number" is rather misleading here: It is not always ensured that an ascending ordinal number, which marks new analysis values, is available to the GQ

source. This is why it is sufficient to choose a data point of the "bit string" type here, the content of which changes upon each new analysis.

Timeout

The timeout time in minutes defines at which intervals a telegram of a gas quality source must arrive before this source is regarded as being disturbed. This is why the timeout time must be larger than the measuring cycle of the corresponding gas quality analyzer.

++ Device identification

Type

Manufacturer

Serial number

Approval

Year of manufacture

++ Alarm, hint limits

lower / upper hint limits Hs, rho, d, CO2, H2, N2

If a measurement sent by a gas quality source violates an upper or lower alarm limit, the gas quality source is classified as invalid.

The *Correction* module only generates an alarm, however, if the quality source which is currently used supplies invalid data and if the correction module in fact evaluates the value in question.

The parameterized substitute value strategy²⁹ is used in an alarm state.

lower / upper hint limits Hs, rho, d, CO2, H2, N2

Hysteresis

The *gas-net* F1 monitors the incoming gas quality data for adherence to parameterizable hint limits. The violation of a hint limit only leads to the generation of a hint if the *Correction* module currently evaluates the sending gas quality source and the relevant value.

To avoid fluttering messages if the measurement fluctuates around a specific value, a hysteresis may additionally be parameterized (cf. Chapter 5.3.1, page 5-24). The percent hysteresis refers in case of gas quality components each time to the value (*upper alarm limit*) – (*lower alarm limit*).

²⁹ The substitute value strategy for gas quality is parameterized separately for each stream under *Correction – Gas quality*. The settings *Use last valid values* or *Use substitute values* can be selected.

Notes:

- Hint and alarm limits must be adjusted separately for each of the up to two gas quality sources.
- The general task of the *GQ Import* module is the acquisition of gas quality data via a digital protocol and the transfer of this data to other modules (such as the *Correction* module).
This is why alarm and hint limits for GQ components may also be parameterized here, which the *Correction* module of the flow computer does not need at all due to correction method selected in the *Correction* module.
- If the data is corrected according to AGA-NX-19 no other consistency check of the gas quality data is carried out during operation, apart from checking the parameterized alarm limits. The reason for this is that no consistent details on the range of application of AGA-NX-19 can be found in the literature. The effective range can be limited by setting the respective alarm limits; this is therefore the responsibility of the user.
- If the AGA8-92DC correction method is used, the *Correction* module contains further alarm limits for the additional input components.

6.1.5 System Module

Board assignment

Board type

When the documentation on hand was printed, the following *gas-net* board types were available to be installed in a *gas-net* F1 device:

- EXMFE5, multi-functional explosion-proof input board, for instance for the process connection of the correction function (gas meter, pressure and temperature sensors). A further possibility is to connect p and T sensors the measurements of which shall be logged (as data logger replacement).
- EXDE6, explosion-proof input board with 6 message/pulse inputs
- MFA8, multi-functional output board for the output of messages, quantity-proportional pulses and measurements.
- MFE11, multi-functional input board with 8 message/pulse inputs and 3 analog inputs.
- AE12, input board with 12 analog inputs.
- DA12, digital output board with 12 output channels for the output of messages and pulses.
- LMFA7, digital output board with 3 message/pulse outputs, 4 analog outputs and a fiber-optics process connection for an external I/O expansion.
- MSER2, serial 2-channel process board.

Important: The parameter data record imported into the device has to correspond with the physically existing boards regarding the board assignment.

The parameter description of the individual input and output channels does not depend on the type of the *board* providing the channel. It is rather the type of the *input* that determines the parameters necessary for describing the channel. Therefore, the following parameter listing is sorted on channel types and not on board types.

Note: Some input or output channels may be used in different operating modes.

Setting for all channel types:

Channel name

The names of input and output channels serve to identify them and are indicated for instance on the device display.

++ Message input

inverted_no/yes

The standard setting for message inputs is *not inverted*. In this case the related message is regarded as being pending when the input contact is closed. You achieve the reversed evaluation by setting *inverted=yes*. In this case, the message is regarded as being pending when the input contact is open.

++ Pulse input

Operating mode of channel (HF or LF)

It depends on the maximum output frequency of the pulse generator whether a pulse input of the EXMFE5 or EXDE6 board has to be configured as HF or LF input; up to an output frequency of 2 Hz LF is set, whereas an output frequency between 2 Hz and 5 kHz is regarded as HF.

The pulse inputs of an MFE11 board are automatically configured as NF inputs as in this case the maximum input frequency is 20 Hz.

Unit of value (only in case of pulse inputs)

The physical unit of the count value coming in via the pulse channel is set via the *Unit of value* parameter.

You have to select m^3 as physical unit for pulse inputs that are used as gas meter inputs for corrections performed inside the device.

cp value (number of pulses per cubic meter)

The cp value indicates the number of pulses generated by the relevant pulse generator per unit. In case of a gas meter in pulse technique this is the number of pulses generated by the gas meter per flown cubic meter of gas.

Cable break monitoring yes/no

An EXMFE5 or EXDE6 pulse input is able to physically detect a cable break. If the cable break monitoring signals a cable break, the related input value is considered disturbed.

++ Encoder input (possible operating mode for EXMFE5 and EXDE6, channel 1)Maximum number of communication errors

The maximum number of permissible communication errors defines how often the data communication between a gas meter that can be read out electronically and a *gas-net* device may fail in a row. If this number is exceeded during operation, the *Correction* module generates an alarm.

cp value

If an encoder totalizer is connected, the cp value indicates by how much the last drum of the gas meter's mechanical totalizer has incremented per flown cubic meter. In other words: $1/cp$ determines the value of the last position of the mechanical totalizer (in m³).

++ Analog input (current)Operating mode of the channel

The operating mode of the channel denotes the current range to which the sensor maps the measuring range: 0..20 mA or 4..20 mA. The analog input of an EXMFE5 board is always a 4..20 mA input.

In case of an 4..20 mA input the measurement is regarded as being disturbed if the input current is below 3.8 mA or above 20.2 mA.

The upper limit value is also monitored in case of a 0..20 mA input. In this case, however, a wire breakage can of course not be detected.

Channel unit

The *Channel unit* is the physical unit of the measurement coming in via the channel.

Physical value 1 / physical value 2Current limit 1 / current limit 2

An analogously connected sensor performs a linear mapping of its measuring range to the output signal range, i.e. either to 0..20 mA or 4..20 mA.

In the parameterization of the analog input *Physical value 1* and *Physical value 2* stand for the limits of the physical measuring range whereas *Current limit 1* and *Current limit 2* stand for the corresponding current values.

For example: The lower measurement limit p_{min} is parameterized under *Physical value 1* for a pressure sensor connected via a 4..20 mA current interface. This is the measurement that corresponds to the lower output signal (4mA = current limit 1) of the pressure sensor. The upper limit of the measuring range, p_{max}, is parameterized

under *Physical value 2* - that corresponds to a 20 mA-output signal of the pressure sensor (current value 2).

The current limits of analog inputs of other boards (e.g. MFE11, channels 9 to 11) can be parameterized freely between 0 and 20 mA. Please pay attention to the fact that the order has to be ascending: current limit 1 must be lower than current limit 2.

++ HART input

(possible operating mode for EXMFE5, channel 5, max. 4 HART sensors)

Parameters for each of the up to 4 HART sensors being connected:

used yes/no

The parameter structure offers four HART addresses 1..4 for one HART input channel as only sensors with these polling addresses can be connected. The address assignment must, of course, be clear and correspond to the addresses adjusted in the sensors.

Selecting *used=no* deactivates a particular address in the parameterization of the *gas-net* device.

Unit of the value

The *Unit of the value* is the physical unit of the measured variable coming in via the HART channel.

upper limit value / lower limit value

The physical final value of the measured variable is directly supplied via HART protocol.

The upper and lower limit values determine the sensor's measuring range.

The device may also monitor the measurement supplied via HART protocol for a violation of these limit values (see below).

Check limit values yes/no

If a HART measurement is monitored for the violation of limit values, it is regarded as being disturbed when it falls below the lower or exceeds the upper limit value.

++ Resistance input (EXMFE5, channel 4)

The resistance input on the EXMFE5 board (channel 4) is used for connecting a Pt100 temperature sensor. The evaluation of the input signal is determined by the Pt100 characteristic that is defined in the parameterization by three value pairs (temperature in °C / resistance in Ω). The standard setting consists of the three value pairs (–187.44°C / 24.8 Ω), (0°C / 100 Ω) and (61.97°C / 124 Ω) and is based on the calculation according to the Pt100 characteristic to DIN EN 60751.

If a calibration of the temperature sensor is desired in the course of a recalibration measure, the temperature characteristic can be adjusted by specifying three suitable measured value pairs (temperature in °C / resistance in Ω).

++ Message output

Please pay attention to the fact that the first channel of an MFA8 or MFA6 and the first digital output on an LMFA7 react like relay outputs and are thus closed when the device is de-energized. These outputs can only be operated in the *Message output* operating mode and are thus not suitable for the output of pulses.

Operating mode:

- *contact opens upon message*
- *contact closes upon message*

Assignment:

For the assignment of a message output all messages are offered which are available depending on the respective parameterization.

For instance, the following output values exist:

- *any alarm (pending)*
- *any alarm (unaccepted)*
- *any warning (pending)*
- *any warning (unaccepted)*
- *any hint*
- *timesynch* (every 5, 6, 10, 15, 20, 30 or 60 minutes)
- *maximum deviation meter proving* (only if the meter proving is activated in the automatic proving mode)
- *gas quality revision* (of the selected gas quality source)
- *gas quality alarm*
- *revision switch stream 1 / 2 / 3*
- *switch 1 to switch 3*

In addition, the message processing of the *Monitoring* module provides further messages.

Output only if

Reverse output condition

The output of a message may be made conditional on another message. This condition / message can additionally be reversed.

++ Pulse output

Pulse value

The *Pulse value* defines how many output pulses will be generated per volume, energy or mass unit.

Pulse width

Parameterize the length of the pulses to be output with *Pulse width*. As the ratio between pulse and interpulse period is always 1:1, the pulse width also determines the maximum output frequency.

Generate H700 (yes/no)

When parameterizing pulse outputs, you define a pulse value and the pulse width (and thus the maximum output frequency, see above). If the number of volume pulses to be output exceeds the maximum output frequency, the *gas-net* device retains up to 1,000 pulses. These pulses will be output as soon as possible.

Only if this pulse buffer is also full, further pulses to be output will be dismissed. This situation is indicated by hint H700 *Pulse buffer overflow*, which will only be generated if the parameter *generate H700* has been set to *yes*. Setting *generate H700 = no* deactivates the generation of hint H700 for this output.

Assignment

All count values available within the system may be assigned to the pulse output.

For instance, the correction functions provide the following count values:

- *V undisturbed, disturbed, total*
- *Vn undisturbed, disturbed, total*
- *E, m undisturbed, disturbed, total*
- *Vn total revision, E total revision, m total revision*³⁰

Output only ifReverse output condition

The output of a message may be made conditional on another message. This condition / message can additionally be reversed. This way, for instance, the output of volume pulses can be made conditional on the flow direction by assigning the message *FD1 active* or *FD2 active* to the *Output only if* parameter.

³⁰ No pulses will be output via a channel to which *Vn (E, m) total revision* has been assigned when the revision switch is open. In case of a corresponding sum output *Sum Vn (E, m) total revision*, only quantities are included in the sum that are not designated by a revision mark.

++ Analog output

Current limit 1 / Physical value 1

Current limit 2 / Physical value 2

The *lower Physical value 1... Physical value 2* interval specifies the measuring range which is output via the analog output. Physical value 1 is mapped on the parameterized *Current limit 1* whereas the physical value 2 is mapped on the parameterized *Current limit 2*. A straight-line interpolation is carried out in-between.

The parameters *Current limit 1* and *Current limit 2* can be parameterized with any value between 0 and 20 mA.

generate H706/710 (yes/no)

Hints H706 and H710 are usually generated when the current output value calculated on the basis of the current measurement cannot be output because it is outside the range of the lower and upper current limits (cf. error description in Chapter 6.2, page 6-58).

However, these hints will only be generated if *generate H706/710* is set to *yes*. Setting *H706/710 = no* deactivates the hint generation.

Assignment:

All measurements available within the system may be assigned to an analog output. The following correction-specific assignment possibilities are offered:

- *pressure*
- *temperature*
- *pressure for correction*
- *temperature for correction*
- *flow (at operating conditions) Q*
- *base flow Qn*
- *energy flow QE, mass flow Qm (only F1)*
- *Qn [revision], QE [revision], Qm [revision]*³¹

In case of two or three corrected streams all values are of course also available for the second/third stream.

Output only if

Reverse output condition

The output of a message may be made conditional on another message. This condition / message can additionally be reversed. If the output condition does not apply, the parameterized lower current limit will be output instead of the calculated value.

³¹ The revision flow rates are always regarded as being 0 if the revision switch of the relevant stream is set. In case of a corresponding sum output (e.g. *Sum Qn revision*) only flow rates are included in the sum that are not designated by a revision mark.

++ Protocol channel

Operating mode (channel type)

When creating a protocol channel you have to select the operating mode:

1. If the protocol channel shall be used as serial channel for connecting a host computer (gateway functionality), the *serial channel* operating mode must be selected. In this case only the channel name is parameterizable here. All other specifications (protocol type, etc.) are to be made in the *Data Exchange* module. The *serial channel* operating mode must also be selected if a GPS receiver for time synchronization shall be connected.
2. If an ultrasonic flow gas meter of Instromet shall be connected to this channel, you have to select *Q.Sonic* as operating mode. In this case the following parameters may be set in addition to the channel's name:

Maximum number of communication errors

The maximum number of permissible communication errors defines how often the data communication between the gas meter and *gas-net* device may fail in a row. If this number is exceeded during operation, the *Correction* module generates an alarm.

Hysteresis for flow reversal

A Q.Sonic gas meter may be flown through in two flow directions. The flow direction information can be directly deduced from the protocol. In this case it may happen that a fluttering flow reversal is performed for the correction totalizers due to fluctuations of the gas column, even if the station is actually standing still. In order to prevent this misleading reaction, a hysteresis flow may be defined. If the current flow falls below this hysteresis flow, the flow direction will no longer be reversed.

3. For the connection of a FLOWSIC ultrasonic gas meter of SICK/MAIHAK the *FLOWSIC* operating mode has to be selected for the protocol channel.

Slave ID

The slave ID is the bus address of the gas meter for communicating with the *gas-net* device.

Maximum number of communication errors

The maximum number of permissible communication errors defines how often the data communication between the gas meter and *gas-net* device may fail in a row. If this number is exceeded during operation, the *Correction* module generates an alarm.

Totalizer structure (+/- Vo, +/- Vod or +/- Vo (total))

It is necessary that the parameter *Totalizer structure* is set to the standard setting (+/- Vo, +/- Vod). Otherwise, the gas-net flow computer will generate the alarm *Vo failure*.

The parameter *Totalizer structure* is meant for future applications, to support different totalizer structures in newer *FLOWSIC* software versions.

+ Interface configuration

DSfG bus exists / Serial interface exists / TCP/IP interface exists

Each F1 may be equipped with up to two of the three optional digital interfaces DSfG, serial interface COM2 and TCP/IP.

Note: It is important to correctly parameterize which of these interfaces actually exist.

Parameters

+ General parameters

Parameterization editor

Lock 1

Lock 2

The *User lock* consists of one numerical lock for each of the two contract parties. The locks are optional. Open locks allow the user to access specific parameters or actions that can be edited directly at the device.

Plant signature

The *Plant signature* is the character string that clearly tells the measuring point apart from all the others. For instance, the archive data is clearly assigned to a device with the plant signature.

Units for energy, upper heating value, power, density

The units of the physical variables energy, upper heating value, power and density are separately adjustable:

- energy in kWh, MJ, GJ or BTU
- upper heating value in kWh/m³, MJ/m³, GJ/m³, BTU/scf, kcal/m³
- power in kW, MJ/h, GJ/h or BTU/h
- density in kg/m³ or lb/scf

If you change the unit selection in GW-GNET+, the units of the dependent variables will change automatically.

Do not filter HF pulses yes/no

In case of a pulse input the device software always applies a smoothing filter algorithm to the incoming pulses to be able to calculate a flow that does not fluctuate too much. This is particularly necessary for downstream controls or other procedures, such as the Qmin monitoring of the *Correction* modules.

This smoothing function may be switched off for all HF pulse inputs (do not filter HF pulses = no) for testing purposes.

Billing interval

The billing interval determines the data logging rhythm of the *Billing archive*.

+ DSfGOperating mode

The *Operating mode* determines the transmission speed on the DSfG bus.

The F1 supports the following operating modes:

0	9600 baud
1	19200 baud
2	38400 baud
3	57600 baud
7	115200 baud

General polling time (in master operation only)First general polling after.. (in master operation only)

If the EADR '_' has been assigned to one of the device entities, this entity represents the bus master within the bus communication. The *general polling time* then defines, at which intervals (specified in minutes) a cyclic general polling is performed. A general polling is a multi-address call of the master to all connected entities to update the station listing.

In addition, a period of time is indicated explicitly, after which the first general polling shall be carried out after start-up.

Ts (in bit times)

The Ts transport timeout time is always set to 240,000 bit times. This value should only be changed for special applications; please contact Elster before.

Permit timesynch telegrams yes/no

Permit timesynch telegrams yes/no must be set to *yes* if the device shall accept incoming DSfG timesynch telegrams.

Send timesynch telegrams yes/no

Explicitly define via *Send timesynch telegrams yes/no* whether or not timesynch telegrams shall be sent to all other DSfG bus stations, too.

Synch telegrams every ... minutes

This parameter determines at which intervals synch telegrams shall be sent to the DSfG bus. We recommend setting intervals of at least 20 minutes.

Prevent synch via DSfG at the full hour yes/no

To reduce the load of the DSfG bus at the full hour, set the *Prevent synch via DSfG at the full hour* parameter to *yes*. This delays the synch telegrams being generated at the full hour.

++ DSfG entityEADR correction 1/2/3EADR data loggingEADR monitoringEADR integrated RDT

EADR is the address by which a station identifies itself in the DSfG bus traffic.

Bus addresses are the upper case letters A to Z and some special characters. Without a clear address assignment a faultless data communication is impossible.

Each bus station must receive an unambiguous bus address (*EADR*).

Data with CRC (yes/no)CRC start value

The CRC start value is the initial value for a check sum calculation according to the CRC polynomial. This procedure serves to control the data transmission.

The setting *Data with CRC = no* switches the check sum calculation off.

Routing I telegrams yes/noRouting L telegrams yes/noRouting W telegrams yes/noRouting H telegrams yes/noRouting P telegrams yes/no

The parameterization of the *gas-net* flow computer explicitly defines the types of attention telegrams to be routed to the DSfG bus.

Please refer to Footnote 26 on page 5-68 for the meaning of the different telegram types.

+ Time synchronization

Daily archives at ... (gas day beginning)

Daily archives at ... (gas day beginning) defines at which change of the hour the data is entered in the archives every day.

Daylight savings time (none / Central European Time CET)

If the *Daylight savings time* parameter is set to *none*, it is not possible to switch between winter and summer or daylight savings time. *CET* stands for the EU regulations concerning the daylight savings time: On the last Sunday of March the time is set to daylight savings time; on the last Sunday in October it is set back.

Time zone

Specify the time zone of the station in which the device to be parameterized is installed. The time zone is indicated as deviation from GMT (Greenwich Mean Time).

TCP/IP socket for NTP

IP address NTP server

If the device is equipped with a TCP/IP connection and an NTP server can be reached within the network, it is also possible to synchronize via NTP (Network Time Protocol). The TCP/IP socket and IP address of the NTP server must then be specified.

Ser. channel for GPS

If the time shall be synchronized via GPS, a GPS receiver is connected to a free channel of an MSER board. This channel must be assigned to the *Ser. channel for GPS* parameter. The GPS protocol's baud rate usually is 4800 baud, 8 data bits, 1 stop bit, no parity (default settings).

Timesynch interval

It is possible to assign a timesynch signal to a message output, with the signal being set at regular intervals. This interval is defined by the *Timesynch interval* parameter.

external synchronization

Time zone information

A synchronization of the internal device time may also be performed by means of an external data source. When using this option, you should deactivate all other possible time sources in the parameterization.

The time information may be delivered either in Unix format or as individual values. In the first case, you only have to choose the data source of the Unix time; for instance, an import value via a communication channel.

In the second case, you have to specify the data source for each individual time datum (year, month, day, hour, minute, second). It must be ensured that the individual dates are always updated at the same time.

It is also possible to perform a summer time/winter time switch in this way. For this, a bit string must be available that supplies the time zone information on bit position 0 (0=winter time, 1=summer time) and an announcement bit to be set one hour before a switch on bit position 1. This bit string is assigned under time zone information in the *System* module.

+ TCP/IP

IP address

Subnet mask

Gateway address

Name socket 1..3

The IP address of the *gas-net* device and the related subnet mask and gateway address have to be specified for TCP/IP communication.

Three sockets are available and may be used for different purposes. For instance, if the device is equipped with a *Data Exchange* module, one of these sockets may be used for a Modbus/TCP channel. It is advisable to name the three sockets unambiguously for an easier identification later on.

6.1.6 Integrated RDT Module

+ General parameters

Connection type

Select *RDT disconnected* if the RDT shall not be used. *Modem* means that the public telephone network shall be used via a dial-up or wireless modem for data communication. The modem is connected to the serial interface (COM2) in this case.

Serial direct connection or *Null modem* is the operating mode in which the *gas-net* device and host computer are directly connected by means of a special null-modem cable at COM2.

Select the *TCP* connection type if the RDT uses a network connection.

Use serial port

If you select *Modem* or *Serial direct connection*, the COM2 interface is the only option for the RDT functionality; choose one of the three available TCP sockets for a connection via TCP/IP.

Bus identifier

The *Bus identifier* is the unambiguous designation (data unit) by means of which the DSfG bus identifies itself towards the center.

+ RDT parameters

Extension grade

The DSfG specification has been continuously developed further. The extension grade defines the standard version to be supported (extension grade 0: older version / extension grade1: later version). Further extension grades are possible in the future. The extension grade to be parameterized must be coordinated with the center, as for instance the login procedure also differs slightly.

Answer delay (seconds) (only for the *Modem* connection type)

The *Answer delay (seconds)* defines the time that is supposed to elapse between the arrival of a call at the integrated RDT and its acceptance.

If you don't accept the standard setting here, pay attention to the timeout times of the center.

max. quantity of call attempts (only for the *Modem* connection type)

Call delay times between individual call attempts (only for the *Modem* connection type)

The *maximum quantity of call attempts* defines the number of call attempts made by the integrated RDT if a connection has not been established immediately. You may also parameterize the call delay times in-between.

The call delay time stays the same after the fifth call attempt, i.e. until the maximum quantity of call attempts has been reached.

Call delay time after max. quantity of call attempts (long-term block)

(only for the *Modem* connection type)

The *Long-term block* is the call delay time after the maximum quantity of call attempts has been reached. It will rarely be activated, as many call attempts must have failed before.

It is generally preset with a duration of 7200 seconds, i.e. 2 hours, and is thus much longer than the other call delay times (this is why it is called *long-term block*).

The reason for the call, i.e. the telegram that triggers the call, is dismissed during a pending long-term block. All attention telegrams that occur in the meantime and must normally be routed according to the RDT's parameterization are also rejected during the long-term block.

Telephone number for time query (only for the *Modem* connection type)

If the phone number for the telephone time query has been parameterized, the integrated RDT will call this number at calculated points of time to collect the time standard. The internal device time can be synchronized with this time information.

This option is deactivated if no telephone number has been specified.

Preset PIN?

PIN

The parameters *Preset PIN* and *PIN* are only relevant if a GSM wireless modem is connected. *Preset PIN* must be set to *yes* if the chip card belonging to the modem has

a PIN number. In this case, the PIN number itself must also be parameterized for a successful connection.

Single numbering scheme (yes/no)

There are different services that are provided via mobile network (telephony, fax and data service). To deal with these various services, different providers are embarking on different communication strategies.

It is possible that the provider offers an own telephone number for each of these services. In that case, you have to set the parameter *single numbering scheme* to *no*. Please make sure, that the RDT uses the correct number, i.e. the number for the data service.

The other method is called single numbering scheme and uses for all services the same number. In that case, please select the setting *single numbering scheme* = *yes*. Whether your provider uses the so-called single numbering scheme or not, may be checked up in the contract. Please ask your provider if you are not sure.

Null modem baud rate (only for null-modem operation)

Handshake in case of null modem (only for null-modem operation)

The special parameters needed for a null-modem operation, i.e. the *Baud rate* (transmission speed) and *Handshake in case of null modem yes/no*, have to be coordinated with the center.

TCP Source Port (only for the *TCP* connection type)

The *TCP Source Port* is the TCP port via which the center connects the call. Usually, port 8000 is used as standard. (The device's IP address is defined in the TCP/IP settings of the *System* module.) For the call connection to be successful, the device's IP address and the port must be known in the center.

TCP connection timeout (only for the *TCP* connection type)

The *TCP connection timeout* is the time in seconds after which the connection attempt shall be aborted. A useful specification heavily depends on the network used. When it's quite a distance, it may take some time until a connection attempt is successful. A value of 20 seconds is specified as default value; in general, this should be long enough.

+ Stations

Center identifier

The *Center identifier* is the data unit via which the center identifies itself during a call connection.

The center identifier facilitates together with the *Bus identifier* (see above) a check of the access authorization during call connections.

Phone number centre (only for the *Modem* connection type)

The telephone number of the center. This phone number is required when a call to the center shall be triggered in case special attention telegrams occur in the DSfG communication.

alternative phone number centre (only for the *Modem* connection type)

It is possible to specify a second (alternative) phone number for the centre. If a number cannot be reached (e.g. because the line is busy), the RDT entity will try to call the centre via the alternative number.

DSfG stations at the busAttention telegram masks

Attention telegram masks indicate in form of a table in case of which attention telegrams of which DSfG stations the center shall be called.

Routing masks can be defined for all bus addresses selected under *DSfG stations at the bus*. Only those bus addresses are important for the RDT's mode of operation that actually exist during operation.

TCP target port / TCP target address (only for the *TCP* connection type)

The *TCP target port* is the port via which the connection to the center shall be set up. The *TCP target address* is the IP address under which the center is reachable.

+ ModemModem name

The *Modem name* defines the connected modem. All other modem settings (call commands, etc.) are fixed, depending on the selected modem.

Maximum time till online

The *Maximum time till online* parameter defines a monitoring time for the connection of the modems. If this maximum time is exceeded, the connection set-up or the momentary call will be aborted. The *Maximum time till online* parameter is preset with a standard value, depending on the modem type.

6.1.7 DSfG Module

The *DSfG* module is responsible for controlling the DSfG side of the communication between host and *gas-net F1*.

The parameterization defines the data to be polled on the part of the DSfG bus. The data being collected through DSfG queries is converted into individual data points by the *DSfG* module. These data points are made available as export values to the *Data Exchange* module, if necessary after a format conversion.

In addition, setting telegrams towards DSfG can be defined.

Due to the subject's complexity we refer to the corresponding separate document or GW-GNET+ online help for the parameter description of the *DSfG* module.

6.1.8 *Data Exchange* Module

The *Data Exchange* module controls the host side of the gateway functionality.

All data points that are available during operation (e.g. through DSfG data element queries, see above) and shall be routed to a host must be positioned on registers or data blocks/data words for the host. Depending on the data type, it is also possible to scale the value in a suitable way before routing it.

Due to the subject's complexity we refer to the corresponding separate document or GW-GNET+ online help for the parameter description of the *Data Exchange* module.

6.2 Error Listing of the Correction Module

The following listing describes all error messages that may appear on the error listing of the correction function(s). Furthermore, the reaction of the device to correction-relevant errors is explained.

The error classification follows the *DVGW-Arbeitsblatt G485* (DVGW Code of Practice G485) and thus complies with the DSfG Specification. The letter in front of the error number classifies the priority level of the error: **A** stands for alarm, **H** for hint, and **W** for warning.

The manner in which the correction and the totalizer management react when alarms occur depends on the parameterization of the *Correction* module:

- In the case of measurements, it is possible to choose between two substitute strategies when an error occurs (*Use substitute value* or *Use last valid value*).
- It is also possible to parameterize the reaction of the main totalizers in case of an error (*Continue all main totalizers*, *Stop all main totalizers*, *Stop all main totalizers affected*). The totalizers for disturbed volumes always run in case of an error.

A107 Vo failure

The alarm *A107 Vo failure* will be generated if the gas meter is connected via a digital protocol (encoder totalizer or Q.Sonic ultrasonic gas flow meter or FLOWSIC ultrasonic gas flow meter) and a protocol error has been detected.

Possible causes of a protocol error are:

- The digital interface is defective.
- The transmitted data does not correspond to the expected format.
- The sensor technology of an ultrasonic gas flow meter works insufficiently.
- Wrong parameterization in case of encoder totalizer:
The value of the last digit of the meter reading that has been supplied via the protocol is included in the parameterization of the flow computer. This way the encoder protocol is checked additionally. If the parameterized cp value does not correspond to the one that is supplied by the gas meter protocol, the meter readings are not accepted.
- Wrong parameterization in case of FLOWSIC ultrasonic meter:
The parameter *Totalizer structure* has to be set to the standard setting (+/- Vo, +/- Vod).

A parameterizable number of maximum communication errors conceals a finite number of communication errors before an alarm will be triggered. For a detailed error analysis please refer to the *System – Protocols* display.

Alarm A 107 will also be generated in the events described below:

- Defect of any process board of the device. This condition is also characterized by hint *H423 Interface monitoring*.
- Complete encoder failure: If an encoder totalizer with one or two additional HF pulsers is connected, the software is able to detect an encoder failure (e.g. due to jammed mechanics) as follows: If one of the HF pulsers has signaled the parameterized *Quantity for complete failure*, but the encoder has not continued totalizing during this time, the encoder must be defective.
- Parameterization error: The transmitter type indicated in the parameterization is either encoder, Q.Sonic or Flowsic but the gas meter protocol channel in the *Correction* module is unassigned.
- Parameterization error: A *Correction* module is designed for two flow directions but the source for the flow reversal is unassigned.

A102 Pulser 1 failed

A103 Pulser 2 failed

In case of a pulse input a cable break may be physically detected via the EXMFE5 input board (parameterizable). If this happens to a gas meter input, the alarm *A102 Pulser 1 failed* or *A103 Pulser 2 failed* will be generated.

In case of a multiport gas meter connection a pulser failure is also detectable as follows: A *Deviation for transmitter failure* is parameterized in m³. Each time this defined volume has flown via a pulser and another pulser has not signaled any increase during this time, the alarm *A102 Pulser 1 failed* or *A103 Pulser 2 failed* will be generated.

The alarm *A102 Pulser 1 failed* will also be generated if the first pulser has not been assigned under the *Pulses* transmitter type or if in case of an encoder/pulser combination the second pulser has been assigned but the first one has not.

A116 V synchronism failure

If the gas meter connection is connected via more than one port, a transmitter 1/2 monitoring may be performed (cf. page 5-12). This monitoring comprises the monitoring for warning and alarm limits. If the alarm condition has been met, alarm A116 is generated. Usually, the related transmitter-specific warning begins before an alarm is generated (*W108 for Pulser 1 deviation*, *W109 for Pulser 2 deviation*, *W117 for Encoder deviation*) so that the pulser with the minus deviation has already been clearly identified when alarm A 116 is generated. If the monitoring for warning limits has been deactivated via the parameterization, the warning will be generated at the same time as alarm A116 to identify the deviating pulser.

A030 Pressure failed

- An analogously connected pressure sensor maps the pressure measurement range on an output current of 4..20 mA. If the input signal is below 3.8 mA, the flow computer generates the alarm *Pressure failed*.
- In case of a pressure sensor connected via HART protocol the pressure measurement has failed if the digital protocol is disturbed (wire breakage, protocol error, etc.) or if the limit value monitoring of the measurement is active and causes the generation of an alarm.
- The *Pressure failed* alarm is also generated if any process board of the device is defective. This is simultaneously marked by hint H423 (*Interface monitoring*).
- Besides, *Pressure failed* is also pending if the pressure source has been set wrongly to *unassigned* in the parameterization of the *Correction* module.

A001 Temperature failed

- The *Temperature failed* alarm is generated if any process board of the device is defective. This is simultaneously marked by hint H423 (*Interface monitoring*).
- In case of a temperature sensor connected via HART protocol the temperature measurement has failed if the digital protocol is disturbed (wire breakage, protocol error, etc.) or if the limit value monitoring of the measurement is active and causes the generation of an alarm.
- Besides, *Temperature failed* is also pending if the temperature source has been set wrongly to *unassigned* in the parameterization of the *Correction* module.

A104 Qmin underflown

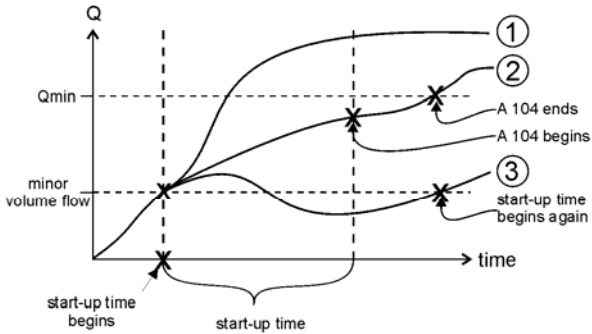
The monitoring of the lower flow limit Qmin must be explicitly switched on or off in the flow computer's parameterization. It should always be switched off if the gas meter is exclusively connected via LF pulses or via an encoder totalizer without HF transmitter.

If the Qmin monitoring is switched on, the monitoring is carried out in consideration of the parameterizable start-up and run-down times and the also parameterizable minor volume flow.

During the opening of the gas stream the flow computer reacts as follows:

As soon as the minor volume flow is exceeded, the start-up time begins. The accumulating volumes result in an increase of the main totalizers. The following situations may occur:

1. The flow rises higher than Qmin before the start-up time has elapsed. This is a faultless start-up; alarm 104 will not be generated.
2. The flow does not rise higher than Qmin within the start-up time, but does not fall below the minor volume flow again either. At the point of time at which the start-up time is exceeded, the alarm *Qmin underflown* will be triggered. Alarm 104 ends if the flow exceeds Qmin or falls below the minor volume flow.
3. The flow does not rise higher than Qmin, but falls below the minor flow again before the start-up time has elapsed. An alarm will not be generated. If the minor volume flow is exceeded again, the start-up time will start again.

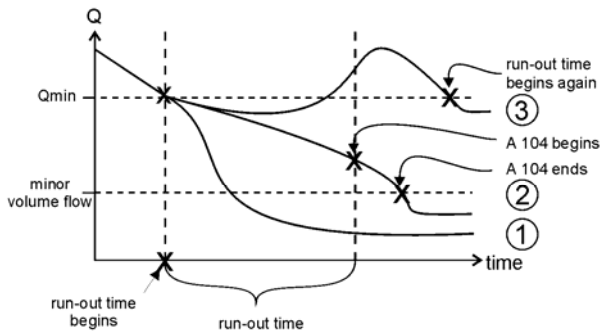


Q_{min} monitoring during opening of the gas stream

During the closing of the gas stream the flow computer reacts as follows: As soon as Q_{min} is underflow, the run-down time will start. An alarm will not be generated yet.

The following situations may occur:

1. The flow falls below the minor flow limit for Q before the run-down time has elapsed. This is a faultless run-down; alarm 104 will not be generated.
2. The flow does not fall below the minor flow during the run-down time but does not exceed Q_{min} again either. At the point of time at which the run-down time is exceeded, the alarm Q_{min} underflow will be triggered. Alarm 104 ends as soon as the flow falls below the minor volume flow or exceeds Q_{min} again.
3. The flow does not fall below the minor volume flow but rises higher than Q_{min} again before the run-down time has elapsed. An alarm will not be generated. If the flow falls below Q_{min} again, the run-down time will start again.



Q_{min} monitoring during closing gas stream

The *Qmin*, *Start-up time*, *Run-down time* as well as the *Minor volume flow* parameters are set by parameterization. The *Qmin* monitoring is only carried out if this has been explicitly activated in the parameterization. It is a prerequisite that at least one channel generates HF pulses.

A105 upper alarm limit Q

If the flow at operating conditions exceeds the parameterized upper alarm limit Q, alarm A105 will be generated.

A031 lower alarm limit pressure

A032 upper alarm limit pressure

A002 lower alarm limit temperature

A003 upper alarm limit temperature

In the parameterization of the flow computer the lower and upper alarm limits are defined for *Pressure* and *Temperature* measurements. If the pressure or the temperature falls below the corresponding alarm limit, the alarm *lower alarm limit pressure (or temperature)* is generated. The reaction to the upper alarm limit is similar: As soon as the pressure or temperature exceeds the parameterized upper alarm limit, the corresponding alarm is generated.

Note: If the calibration switch is open, alarms A031, A032, A002 and A003 are suppressed. This way the input values may be driven to the measuring range limits during a check on site, without the flow computer falling into the alarm status.

A040 rho / d failed³²

A060 Hs failed

A070 CO2 failed

A090 H2 / N2 failed³³

In case of online gas quality data, the gas quality components used for correction are marked by the alarm *<component> failed* in the following cases:

- The timeout has elapsed, and it is impossible to switch to a substitute measurement.
- The data telegram contains an *error* designation; it is impossible to switch to a substitute measurement.

³² The meaning depends on the correction method: These alarms refer to the standard density rho in case of a correction according to SGERG-88; in case of a correction according to AGA-NX-19, however, they refer to the density ratio d.

³³ The meaning depends on the correction method: These alarms refer to the H2 component in case of a correction according to SGERG-88; in case of a correction according to AGA-NX-19, however, they refer to the N2 component.

- The gas quality import via digital protocol is not parameterized correctly (*GQ import* module, e.g. source not assigned).

A041/A042 rho / d min alarm, rho / d max alarm³²

A061/A062 Hs min alarm, Hs max alarm

A071/A072 CO2 min alarm, CO2 max alarm

A091/A092 H2 / N2 min alarm, H2 / N2 max alarm³³

In case of online gas quality, the incoming measurements are monitored for lower or upper alarm limit violations.

A500 T unpermissible (only in case of a correction according to SGERG-88)

The temperature input variable must be within a temperature range of -10°C to 62°C for the SGERG-88 correction method to be carried out. In case of temperatures outside this range, alarm A500 will be generated.

Note: If the calibration switch is open, alarm A500 is suppressed.

A508 Error k-ratio calculation

In case of a correction according to SGERG-88, the device generates the alarm *Error in k-ratio calculation* if the current gas quality data is inconsistent. If fixed values are used for calculation, this is thus a parameterization error. However, it is also possible for such an error situation to occur when considering online gas quality data via DSfG³⁴.

In case of a correction according to AGA-NX-19, the device generates the alarm *Error in k-ratio calculation* if the temperature or the pressure value would cause an error within the calculation method.

When the alarm *Error in k-ratio calculation* is pending, the system continues to calculate with the constant k-substitute value.

³⁴ If a second redundant gas quality source is available, the system does not switch over to the substitute measurement in the case of an error in the k-ratio calculation. In this case, too, alarm A508 is generated and the system switches over to correcting with the substitute compressibility ratio k. The reason is: Technically speaking, the values received are not invalid (no DSfG timeout, no violation of an alarm limit, no error values), and are therefore forwarded by the monitoring module to the correction module as valid values.

A509 Error k-ratio calculation

In case of a correction according to AGA8-92DC, the flow computer generates the alarm *Error in k-ratio calculation* if the calculation method fails due to inconsistent input values or the alarm limits for the gas quality components parameterized in the *Correction* module have been violated.

When the alarm *Error in k-ratio calculation* is pending, the system continues to calculate with the constant k-substitute value.

A407 Re-start performed

The *Re-start performed* alarm is generated after a software update.

If this alarm occurs during normal operation, however, a software problem has occurred in the device. In this case a faultless operation of the device is no longer guaranteed.

A409 Supply voltage failure

The flow computer generates the *Supply Voltage Failure* alarm in case of a mains failure. It is pending until the device starts up again after the mains has returned and has carried out the k-ratio calculation for the first time. During this time the incoming gas meter information (via volume pulses or digital protocol) is not evaluated.

A405 Error in data memory

The *Error in Data Memory* alarm occurs if an inconsistency in the memory area of the data has been detected. A faultless operation of the device is no longer guaranteed.

W108 Pulser 1 deviation**W109 Pulser 2 deviation****W117 Encoder deviation**

If the gas meter is connected via more than one port, a transmitter 1/2 monitoring may be performed (cf. page 5-12). This monitoring comprises the monitoring for warning and alarm limits. If the warning condition has been met, warning W108 or W109 will be generated if a smaller quantity has been received via the first or second pulser respectively; warning W117 indicates a minus deviation of the encoder totalizer.

If the monitoring for warning limits has been deactivated in the parameterization, a warning (W108 / W109 / W117) will be generated at the same time as alarm A116 to clearly identify the deviating transmitter.

W770 GQ1 failed**W771 GQ2 failed**

When a gas quality source has been identified as being invalid, the *Gas quality failed* warning is generated. The following causes lead to a gas quality source being classified as being disturbed:

- The parameterized timeout has elapsed, i.e. no telegram has been received from the gas quality entity for longer than the timeout period lasted.
- A message has been received from the gas quality entity that is identified as being disturbed.
- The last message from the gas quality entity contained at least one measurement value violating an alarm limit.

W811 Clock set new

W810 Clock set old

Each time the internal device time is adjusted by more than ± 20 seconds or by $\pm 3\%$ of the billing interval³⁵, two warnings will be generated. This way you may see by how much time the clock has been adjusted.

W812 Clock synch. failed

A813 Clock synch. failed

The setting of the internal device time is only possible within a range of ± 20 seconds, and by no more than $\pm 3\%$ of the length of the billing interval³⁶ if the calibration switch is closed.

In case of a synchronization attempt outside the permissible time range with the calibration switch being closed, warning W812 will be generated. If such a synchronization attempt deviates from the internal device time by more than $\pm 3\%$ of the billing interval, alarm A813 will be generated.

³⁵ The *Billing interval* is a parameter of the system module and in addition determines the data logging rhythm of the billing archive.

³⁶ The *Billing interval* is a parameter of the system module and in addition determines the data logging rhythm of the billing archive.

H112 / H113 lower / upper hint limit Q

H114 / H115 lower / upper hint limit Qn

H034 / H035 lower / upper hint limit pressure

H005 / H006 lower / upper hint limit temperature

H044 / H045 lower / upper hint limit ρ / d ³⁷

H064 / H065 lower / upper hint limit Hs

H074 / H075 lower / upper hint limit CO2

H094 / H095 lower / upper hint limit H2 / N2³⁸

The parameterization of the flow computer defines hint limits for measurements (upper/lower hint limits for pressure, temperature, flow at operating conditions, base flow and, in case of online gas quality data, also gas quality components). If the values exceed or fall below these hint limits, a hint will be generated. A possibly parameterized hysteresis will then be considered.

To prevent that the hints *lower hint limit Q* and *lower hint limit Qn* are pending during a standstill of the station, the hint limits are monitored as described below:

The *lower hint limit Q* hint begins during the run-down of the station when Q falls below the lower hint limit Q (while taking the hysteresis into account). The hint ends when Q = 0 (without taking the hysteresis into account as the flow rate cannot fall below 0).

The hint begins during start-up when Q > hysteresis < lower hint limit Q.

The procedure analogously applies to the monitoring of the *lower hint limit Qn*.

H700 Pulse buffer overflow

The parameterization of the pulse outputs defines a pulse value as well as a maximum output frequency. If more volume pulses come in than can be output with the maximum output frequency, the flow computer will retain up to 1000 pulses. These pulses are output as soon as possible.

Only if this pulse buffer is full, too, further incoming pulses are rejected. This situation is indicated by hint H700 *Pulse buffer overflow*.

Note: In order to avoid that pulses are lost, you should make sure during the parameterization that the pulse value and maximum output frequency are in correct proportion to the maximum flow.

³⁷ Cf. Footnote 32.

³⁸ Cf. Footnote 33.

H706 lower hint limit output**H710 upper hint limit output**

Pending hints H706 and H710 indicate an error in the parameterization of an analog output. The output range was probably set larger by the limit values than the measuring range of the measured variable to be output actually is. If, for example, the pressure range is 14..70 bars and an analog output for the *Corrector pressure* is parameterized to a range of 14..50 bars, the *upper limit value output* hint will be generated, if the pressure rises higher than 50 bars.

H423 Interface monitoring

If the *Interface monitoring* hint is pending, the device software is not able to recognize an interface or a board. This occurs, for example, if a board is defective. A faultless operation of the device is no longer guaranteed.

H800 Calibration lock open

An opening of the calibration switch is marked by hint H800. If the calibration switch is open, it is possible to adjust all parameters, i.e. also billing-relevant parameters, by means of a PC and the GAS-WORKS software.

H801 User lock open

The *User lock* consists of one numerical lock for each of the two contract parties. The locks are optional and are defined via the device parameterization. They are opened and closed via a special operator panel menu. The *User lock open* hint is generated if all defined locks are open.

Open locks facilitate an access to special parameters or actions – either via the operator panel of the device or by means of GAS-WORKS via the data interface.

H802 Revision switch open

If a revision switch is set at the device, the device reacts as follows:

The *Revision switch open* hint is generated. From this moment, all archive entries in the interval archive receive a *Revision* mark.

As long as the revision switch is open, the output of volume pulses via a pulse output, to which *Vn total revision* has been assigned, is suppressed.

The revision switch is a software tool and is opened via the operator panel of the device.

It refers to a particular stream; in case of a flow computer which is operated for the correction of more than one stream, there is one revision switch per stream.



H830 Substitute GQ active

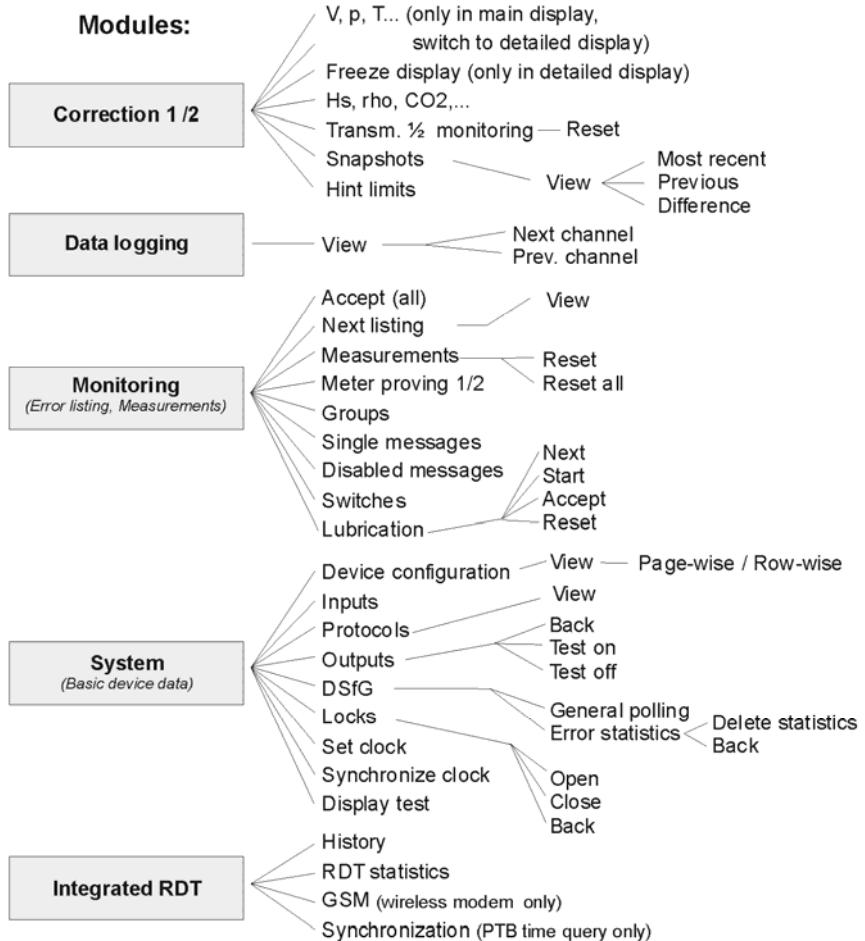
An F1 device may receive online gas quality data from one or two GQ meters being connected via digital protocol. The second GQ source may be used as substitute measurement that is always used if the first source is invalid. Hint H830 is generated upon such a switch to GQ source 2. This hint ends as soon as the first source is used as being valid again.

H1931 Logbook service request**H1932 Archive service request**

Hints H1931 and H1932 are triggered when a logbook or an archive exceeds a certain size. Please refer to the *Technische Spezifikation für DSfG-Realisierungen (Technical Specification for DSfG Implementations)* for further details.

6.3 Menu Structure

Within the main display of a module, you may open the listing of the subordinate menu items by pressing the menu button . By pressing the button  again, the menu with the listing of all available modules is opened.



Menu items for functionalities that are not parameterised are not displayed.

Following modules are not listed in the menu overview shown above:

- **GQ Import** (Display for incoming gas quality values without any subordinate menu items)
- **DSfG(-Requester)** and **Data exchange** (Host communication) for the gateway functionality (this display is meant for diagnosis by experts only)

7 Bibliography

- ISO 12213-3: Natural gas – Calculation of compression factor
- DIN EN 50014, DIN EN 50020 and DIN EN 50029
- DIN 19 235: Measurement and control; signalling of operating conditions
- ISO 6976: Natural gas – Calculation of calorific values, density, relative density and Wobbe index from composition, especially Annex J: Approximate conversion factors between reference states

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