



Gas quality analyser Q1

Technical documentation

**Function, operation,
commissioning and maintenance**

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Safety and warning notes

To ensure a safe and faultless operation of the device the instructions and notes contained in the documentation on hand must be observed.

The device must be used as prescribed and connected according to the connection diagram. The national and local regulations for electrical installations must be observed.

The mounting, electrical installation, commissioning and maintenance of the entire measuring system must be performed by qualified staff who have been trained in the field of explosion protection and have read and understood all parts of the operating instructions necessary for the actions to be carried out.

Please refer to the corresponding technical regulations (DIN, DIN EN, VDE, VDI, and DVGW) for general information on mounting, commissioning, taking out of service and maintaining. Below, we have listed the standards and guidelines that must be observed:

- **DIN EN 60079-14, Publication date: 1998-08**, Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines)
- **DIN EN 50110-1, Publication date: 1997-10**, Operation of electrical installations
- **DIN EN 60079-17, Publication date: 1999-08**, Electrical apparatus for explosive gas atmospheres – Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)
- **DIN VDE 0100-610, Publication date: 1994-04**, Erection of power installations with nominal voltages up to 1000 V; initial verification

***gas-lab* Q1 sensor system (sensor technology):**

- The sensor system must neither be stored at temperatures below -20°C nor above +55°C.
- Connect the electrical cables only to the EEx-e approved junction box! This junction box is located on the mounting plate of the *gas-lab* Q1.
- The sensor system is supplied by 24 V DC and must be secured externally by 2.5 A.
- Include the housing and mounting plate in the local earthing system.
- A temperature between +5 deg. C and +40 deg. C must be guaranteed during the operation of the sensor system (-x to +40 deg. C with additional heater, -x to +55 deg. C with cooling unit; the lower temperature limit depends on the heat output).
- Only gases of the second gas family according to DIN DVGW 460 or approved calibration gases are permissible. The oxygen content in the natural gas must not be higher than 2.0 percent by volume.
- The ventilation must be connected to the exhaust gas manifold via a stainless steel tube with a minimum inside diameter of 4 mm.
- After a voltage failure the measuring system automatically purges with process gas before it activates the sensors. After a new gas cylinder with flammable contents has been connected, the system must be purged manually before the normal measurement can be continued. This also applies if air may have got into a gas pipeline connected to the sensor system (see also Chapter 5.1.4).
- The user must ensure by means of high-pressure reduction and safety devices that all gases injected into the measuring system do not exceed an inlet pressure of 1,250 mbars absolute!
- The opening of the housing as well as inspection and maintenance must be carried out by specialists authorised by Elster!

- **Only if the atmosphere is not explosive or in de-energised conditions after a delay of 5 minutes after the electrical supply has been disconnected, the cover of the housing may be opened!**
- **The cable entries for the electrical connections of the EEx d housing of the measuring system must never be loosened if the atmosphere is explosive!**
- **The loosening or unscrewing of the breather is prohibited!**
- **Only authorised personnel is allowed to exchange the breather, if need be. In this case, the breather as a whole must be exchanged!**
- **Only authorised personnel are allowed to exchange a cable entry gland, if necessary.**
- **The sensor system may only be switched on before or together with the *gas-net* Q1 evaluation computer. It will result in an error (alarm) if you switch on the sensor system after having switched on the evaluation computer.**

gas-net Q1 evaluation computer:

- The *gas-net* Q1 evaluation computer must neither be stored at temperatures below -20°C nor above +55°C.
- A temperature between 0 deg. C and +40 deg. C must be guaranteed during operation.
- The *gas-net* Q1 must be installed outside ex-zone 2.
- The *gas-net* Q1 evaluation computer may contain subassemblies that are approved as associated *electrical apparatus* of the *ib* category according to DIN EN 50020 with intrinsically safe circuits. This renders the electronic evaluation computer Q1 suitable for connection to sensors and pulse generators located in hazardous areas (e.g. zone 1).
A mixed connection of intrinsically safe and not intrinsically safe circuits is not permitted in case of these subassemblies.
- The evaluation computer is supplied by 24 V DC and must be secured externally by 1 A.
- The earthing is connected to PE of the power supply connector for equipotential bonding.
- Observe the regulations of the relevant standards, in particular of DIN EN 50014, DIN EN 50020, and DIN EN 50029.
- Observe the limit values stated in the respective certificates of conformity of the boards to be connected.

Warning: The evaluation computer of the Q1 measuring system is a class A device that may cause interferences in living areas; in this case, the user may be asked for appropriate measures at his expense.

1 Introduction

1.1 The *gas-net* system idea

gas-net is the generic term for an Elster device family. The evaluation computer of the *gas-lab* Q1, too, is based on the *gas-net* device family. All *gas-net* devices, including future device types, are characterised by uniformity in appearance, operation and parameterisation.

Each Elster device always covers a multitude of measurement and control functionalities.

gas-net devices also provide this functional variety. To keep the operation and parameterisation 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 adjusted in the same way, no matter in which device type it has been installed.

1.2 The measuring principle

The *gas-lab* Q1 measuring system is a gas quality analyser that performs infrared absorption and thermal conductivity measurements. The primary target variables are the gross calorific value, standard density and CO₂ content of the natural gas being measured.

The entire measuring system consists of two components:

1. *gas-lab* Q1 sensor system

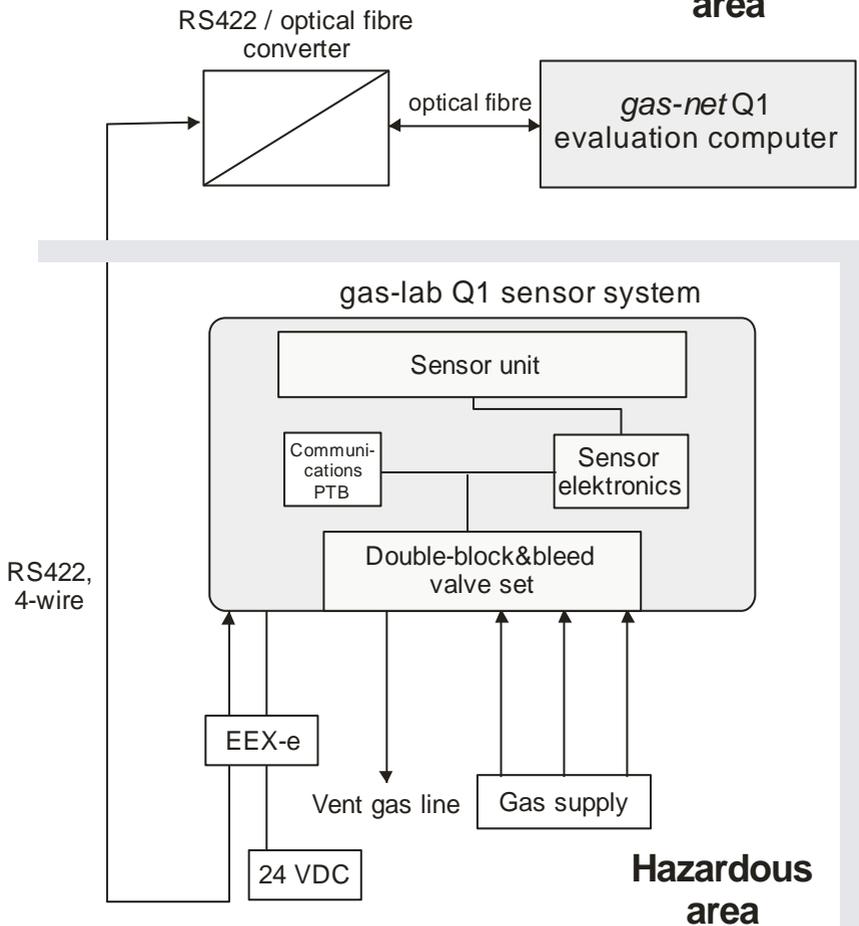
The actual sensor technology is located in an explosion-proof housing, which can be installed in a hazardous environment.

2. *gas-net* Q1 evaluation computer

The evaluation computer of the Q1 measuring system is located in a non-hazardous environment. The main tasks of the evaluation computer are controlling and monitoring the measuring process, evaluating the sensor measurements, calculating the target variables and supporting the user during calibration. Furthermore, the evaluation computer contains an

integrated data logging function, mainly for interval- and event-controlled data logging of analysis data as well as of error listing and logbook. The signal and message processing provides some digital and analogue output possibilities. The evaluation computer also controls the measuring process and calculates the target variables.

Non-hazardous area



The connection between sensor system and evaluation computer is implemented via interface cable, RS422/optical fibre-converter and fibre-optics cable, as illustrated above.

The sensor system contains two infrared sensors for measuring the absorption of the hydrocarbons and carbon dioxide contained in the natural gas. Another sensor additionally determines the thermal conductivity of the natural gas and thus also measures gas components such as nitrogen, for instance, which cannot absorb infrared light. Afterwards the evaluation computer evaluates all three measurements. As a result, these measurements supply the gross calorific value, standard density and CO₂ content of the natural gas. These variables are sufficient to establish with a flow computer the compressibility ratio k (real gas dependence) according to SGERG and the energy content of the natural gas. Besides, other variables such as the Wobbe and methane numbers are also determined. Other than that mentioned, the system provides also a non-calibratable sample analysis of the natural gas. The underlying algorithm is based on the systematic of the composition of natural gases. In case of non-typical gases a major deviation in the measured value of a single component can occur.

The device measures continually and determines new measurements every second. It can therefore also be used for fast closed-loop control tasks.

The manufacturer calibrates the *gas-lab* Q1 before delivery, i.e. he performs a zero point adjustment with nitrogen and afterwards a 3-point calibration with ultra-pure methane and two calibration gases. The correction values are saved in the sensor unit. This basic calibration is usually repeated during the commissioning and on the occasion of a recalibration.

The evaluation computer automatically performs a 1-point calibration with ultra-pure methane after a mains failure and after each switching on of the measuring sensor technology.

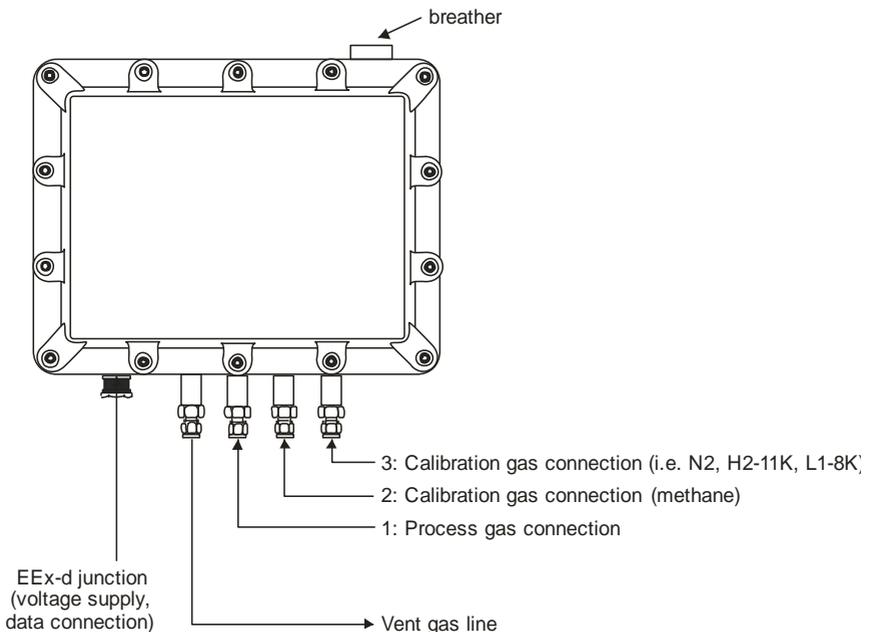
Moreover, the *gas-net* Q1 offers a wealth of additional functions for monitoring tasks and data communications. The *gas-net* Q1 also always includes a data logging function that logs important measurements at defined intervals and when errors occur. See Chapter 5.2 for a detailed description of the archive structure.

2 Device view and design

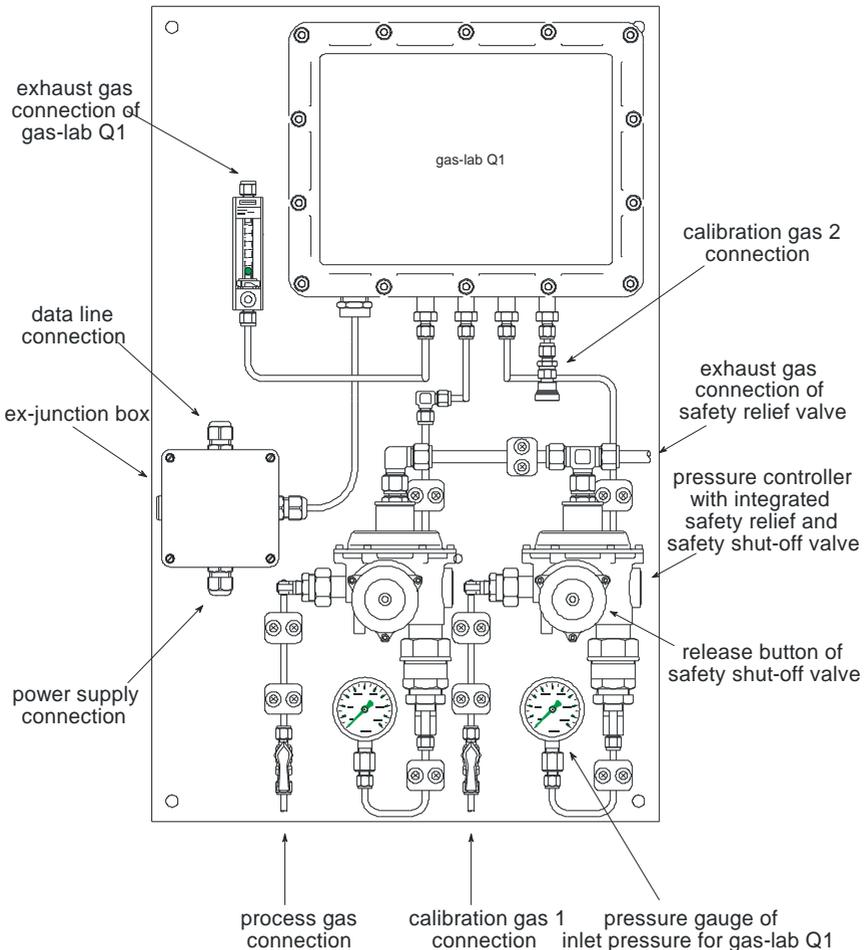
2.1 Sensor system

The actual sensor technology of the *gas-lab* Q1, the sensor system, is mounted in an explosion-proof housing. The gas is supplied at approximately 80 mbars overpressure and via a double block & bleed solenoid valve set, which is also located inside the housing. There are a total of three gas inlets for different gases, one connection for the process gas and two connections for calibration gases. The out flowing gas is led via a vent gas line.

The housing is mounted on a mounting plate in such a way that the gas and other process connections point downwards. In order to ensure that the housing withstands the maximum permissible inside pressure of 1,100 mbars, a *breather* is led out of the housing at the top. The following illustration shows the front of the sensor housing:



The parameterisation of the evaluation computer defines which gas has to be connected to which inlet. The process gas is assigned to path 1 and the internal calibration gas (ultra-pure methane) to path 2. Nitrogen and further calibration gases are injected via path 3 for performing the basic calibration. The test gas can either be injected via path 1 or 3.



Not only the sensor housing is installed on the mounting plate, but also regulators for the inlet pressure of the different gases to be injected, safety shut-off and safety relief valves as well as the EEx-e junction box for the interconnecting cables (voltage supply, data link to the evaluation computer).

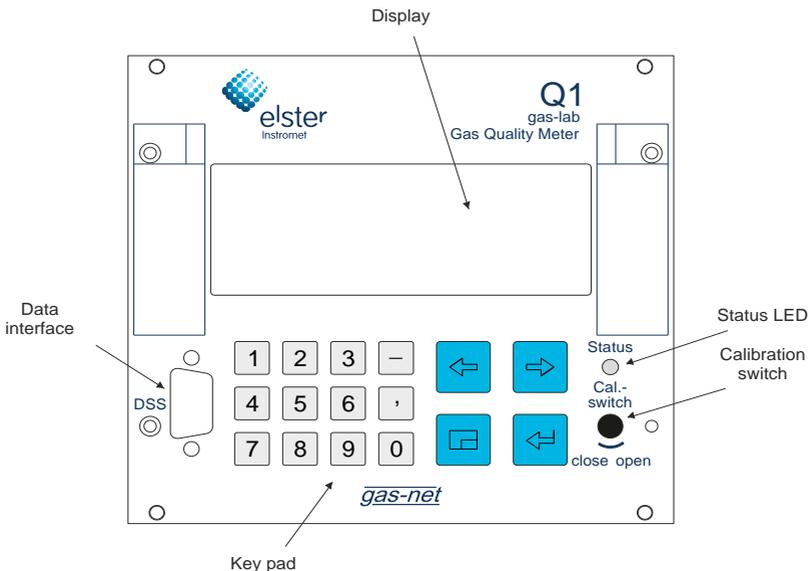
The pressure regulators with integrated safety shut-off/pressure relief valves for the process and calibration gases are necessary, as the maximum absolute inlet pressure of the gases must never exceed 1,250 mbars. The pressure regulators have been set by the manufacturer to a control pressure of 80 mbars (gauge). The integrated pressure relief valve starts to vent at an overpressure of about 110 mbars and above. The safety shut-off valve has been set to a tripping pressure of 142 mbars (gauge) by the manufacturer.

2.2 Evaluation computer

The housing of the *gas-net* Q1 evaluation computer is designed as plug-in unit for a 19" frame and is available in two housing sizes, i.e. with a mounting width of 1/3 for up to three process boards or a mounting width of 1/2 for up to six process boards.

The device front includes one 8x32 characters-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* Q1 in the narrow design with a mounting width of 1/3:



Most of the connection possibilities are located on the back of the device. The following interfaces are always available:

- fibre-optics connection for the sensor system
- DSfG bus connection
- COM2 interface: serial interface according to RS232. In case of devices with an integrated RDT, the modem is connected to COM2. A different software variant offers gateway functionality for interfacing a host protocol instead. In this case, the COM2 interface can be used as protocol channel.
- DCF77 interface for connecting a radio clock
- 24 V DC power supply connection
- HSB bus connection (not used)

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 (number of required output signals, etc.).

The name of the software variant, the version's number and the checksum for the identification of the software version can be invoked directly at the device via the main display of the *System* module.

The main functionality of the Q1 is measuring the gas quality. The sensor system is connected via an LMFA1-type process board, which provides 3 digital and 4 analogue outputs in addition to the fibre-optics connection for the sensor system.

Furthermore, the following boards can be used:

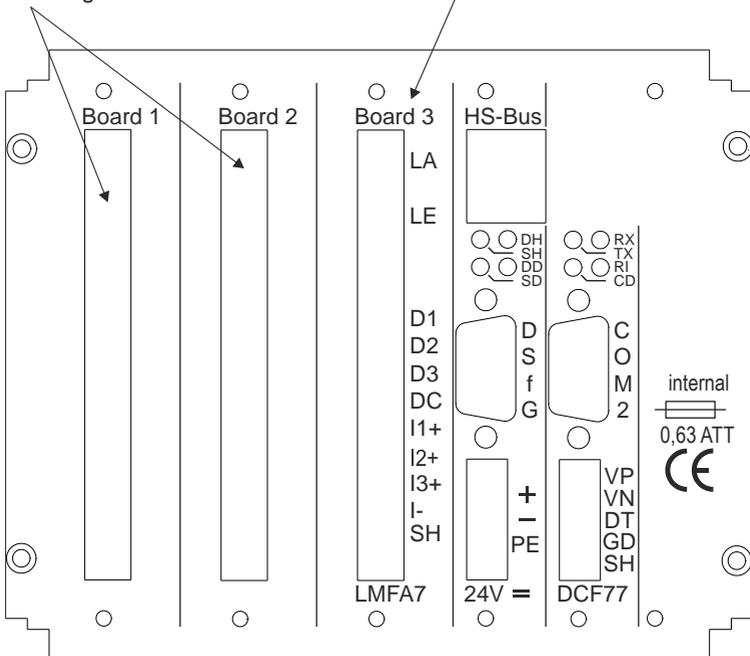
- A multi-functional EXMFE4 input board for the connection of a pressure and a temperature sensor (PT100) and two digital inputs (NAMUR). All channels are intrinsically safe (EX-i).
- An MSER2 board with 2 serial channels (RS232, RS422 or RS485) for interfacing communication protocols (e.g. MODBUS).
- An MFE11 input board with 8 digital and 3 analogue inputs.
- An MFA6 output board with 4 digital and 2 analogue outputs.

All in all, up to 6 process boards can be mounted in the broader housing and up to 3 boards in the narrow design. Please see Section **Fehler! Verweisquelle konnte nicht gefunden werden.** or the Technical Data Section in Chapter 10 for a description of the currently available boards.

The following illustration shows, as an example, a device in the narrow design with the always existing LMFA7 board.

- Output board LMFA7 (digital/analog)
- LA/LE: optical fibre connection for external I/O expansion (sensor system connection)
- D1-D3: Three digital outputs for digital signals / pulses.
- I1-I3: Three analog outputs for measurement output.

Any *gas-net* input or output board can be assigned to board locations 1 or 2.



gas-net Q1 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.

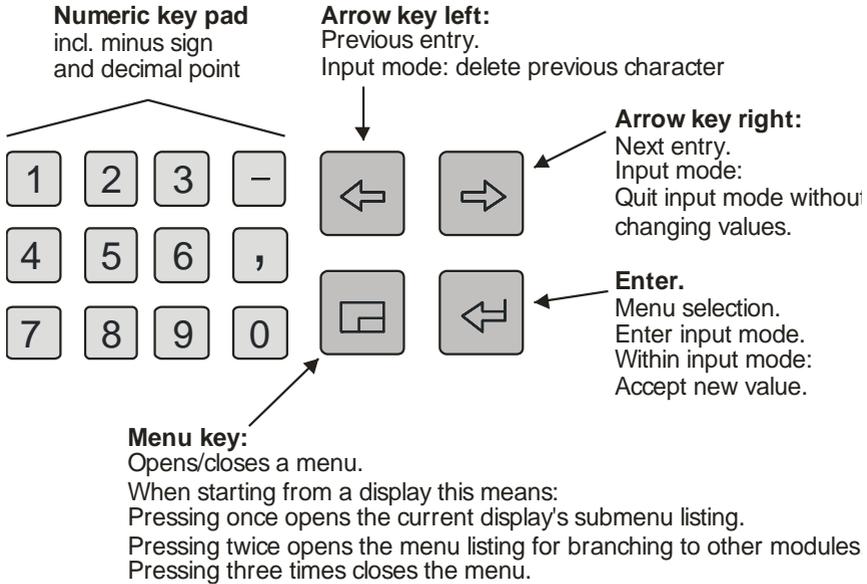
This means for the user: If you have operated a *gas-net* device once, you will also be able to operate all other device types without any problems.

According to our philosophy of how to parameterise *gas-net* devices, they are adjusted 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 The keypad

The keypad of *gas-net* devices consists of a numeric keypad for the entry of numbers, 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 in connection with the menu structure in Section 3.4.



3.2 Other operating elements: status LED, calibration switch

The status LED on the front of the device is a three-colour 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 individual colours:

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

The sequence of the LED status 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.

All *gas-net* devices 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 parameterisation software GW-GNET+.

Open the calibration switch by turning it anticlockwise as far as it will go. This first level of the safety concept is important for devices used for legal metrology and custody transfer. In this case, a seal may officially secure the calibration switch.

The basic display of the device 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 parameterisation 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. .

3.3 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.

3.4 Displays / Menus / Dialogs

One note at the outset:

The following section 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.

In accordance with the *gas-net* concept, however, 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: Among others, the *gas-net* Q1 contains the *gas-lab Q1* and *Monitoring* modules. The main display of the *gas-lab Q1* module shows the current measurements, whereas the main display of the *Monitoring* module indicates 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 been no keystroke for about 30 minutes.

For example: The basic display of the *gas-net* Q1 is the main display of the *gas-lab Q1* module.

A display serves to present 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.



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



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

Each display which can be shown belongs to a module within the device software, therefore to a closed functionality. If you see the display of any module, there are two entirely different targets in the menu structure of the device. On the one hand a subordinated display / dialogue¹ of the shown module and on the other hand the main display of any module.

To make the navigation within the menu structure as easy and fast as possible, the menu key  is configured as follows:

Unique pressing of the menu key opens up the list of submenus, which is provided by the actual module display.

Pressing the menu key again opens up the menu list to branch to any module. Repeated pressing closes the menu.

The list of submenus of a module is provided according to the current parameterisation: Menu items that relate to functionalities which are not parameterised, are not offered at all.

Submenus of a module are either calling other displays or dialogs, in which the user can manipulate values via control panel.

The menu structure is aborescent:

A subordinated menu item of a module can offer subordinated menu items by himself.

¹ A *Dialog* is a display window indicating values that can be changed by the operator.

In lower levels of the menu structure following contextual menu items are offered to return to the next upper level:

- Menu item *Back* in a display
- Menu items *OK / Cancel* in a dialog
(*OK* means acceptance of the changed values too, *Cancel* means to reject the changes)

Independent of the menu level which is shown at the moment, with the arrow keys you can move for- and backward within every menu list and select a menu item. 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: We assume you want to change from the basic display of the Q1 to the main display of the *Monitoring* module.

For this, press the menu key  first to open the menu window. The first entry of the appearing listing is selected, i.e. it is backlit in black:



Start:
Basic display *Gas quality*



Menu list of the module *Gas quality*.
The hyphen in front of the menu descriptions indicates that the list refers to subordinated menus.

Since we won't activate a gas quality menu in our example, but branch to another module, please press the menu key again.



```
12:47:21 -
Hs: 11 Gas quality
Rhon: 3 Data logging
CO2: 3 Monitoring
      3 Integrated RDT
      3 Host-Communication
      3 DSFG-Requester
```

Module list:
Without hyphens in front
of the menu descriptions

Now the menu shows a list of all modules the device software contains. Press the rightward arrow key several times until the module is selected, that you want to see. In our example it's the *Monitoring* module.



```
12:47:36 -
Hs: 11 Gas quality
Rhon: 3 Data logging
CO2: 3 Monitoring
      3 Integrated RDT
      3 Host-Communication
      3 DSFG-Requester
```

Module list:
Monitoring module
is selected

Then press the Enter key and the display of the just selected module will be invoked.



```
17:32:10 -
Gasquality 15.08.2002
Error listing
Error list empty
```

Tips:

- 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 want to quit an invoked menu selection window without having made a selection, just press the Menu key as often, until the menu window is closed.

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 will be crossed out in the display.

If you have selected a parameter that can be changed, you may switch into the edit mode via the Enter key.

In order to render 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 overwritten by the new entry.

Quit the edit mode via the Enter key. This initiates a test for consistency: 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 an erroneous 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).

For example:

Change of the lower hint limit for the GCV in the *Monitoring* module of the *gas-net* Q1. After you have invoked the associated menu item, the following display is visible:

```

Single message      15:08:16 -
                   21.09.2002
Name:  GCV
Type:  Upper limit
Status: off          0 s
      disabled
U. limit: 12.0000000 kWh/m3
L. limit: 12.0000000 kWh/m3
    
```

Start:
Display *Single message*



```

Single message      15:09:07 -
                   21.09.2002
Name:  GCV
Type:  Upper limit
Status: off          0 s
      disabled
U. limit: 12.0000000 kWh/m3
L. limit: 12.0000000 kWh/m3
    
```

Value to be modified is selected.

The currently set value is indicated.

Switch to the edit mode via the Enter key.



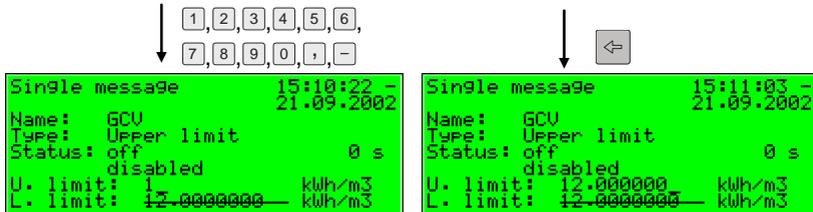
```

Single message      15:09:41 -
                   21.09.2002
Name:  GCV
Type:  Upper limit
Status: off          0 s
      disabled
U. limit: 12.0000000 kWh/m3
L. limit: 12.0000000 kWh/m3
    
```

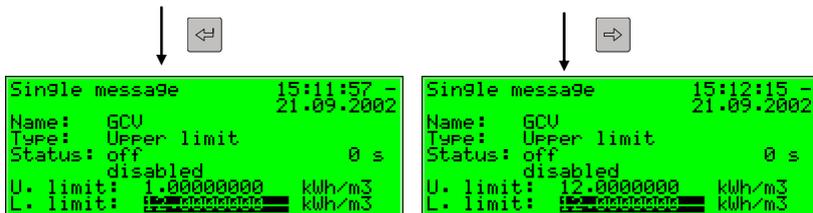
Edit mode:
The insertion mark is now blinking behind the value.

Enter a new value now:

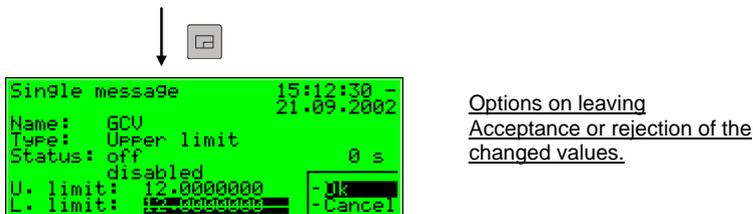
Either directly via the numerical keypad or by deleting individual numbers from the right using the leftward arrow key and by entering new numbers.



Quit the edit mode by pressing the Enter key. Thereby the new value will be accepted. If you don't want that, you should leave the edit mode via the rightward arrow key.



Invoke the menu now.



If you confirm *OK* by pressing the Enter key, the new value will be accepted. To reject the modification, go to *Cancel* by pressing the rightward arrow key and afterwards the Enter key.

You will quit the dialog in both cases.

New value by selection from a list

The device software offers a list of 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 list via the arrow keys and accept it by pressing the Enter key.

Example: Opening of the revision switch (Hint: Only possible with user locks opened!). The state of the revision switches can be changed in the submenu *Switches* of the *Monitoring* module. Therefore go to the related dialog via the menu items *Monitoring - Switches*.

```
Switches                               16:05:41 -
                                       21.09.2002
Revision 1:  off
Revision 2:  off
Switch 1:   off
Switch 2:   off
Switch 3:   off
```

Start:
Monitoring - Switches

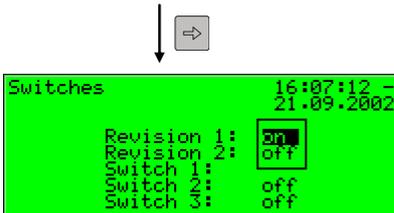
In the above illustration the revision switch for both streams is shown as closed (Revision 1 = off, Revision 2 = off). Let's assume that you want to activate the revision switch for the first stream. On entering the display this switch is already activated, so you can press the Enter key right now to switch to the edit mode.



```
Switches                               16:06:14 -
                                       21.09.2002
Revision 1:  on
Revision 2:  off
Switch 1:   off
Switch 2:   off
Switch 3:   off
```

Selective list:
All applicable values are offered.
(Here: *off* and *on*)

Select the desired value via the arrow keys, in our example select *on*.
The display looks as follows:

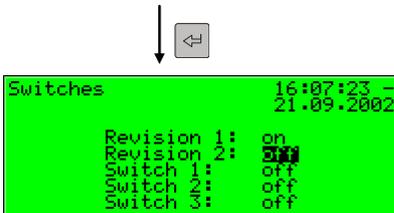


```

Switches                               16:07:12 -
                                       21.09.2002
Revision 1:  on
Revision 2:  off
Switch 1:    off
Switch 2:    off
Switch 3:    off
  
```

Selective list:
On is selected.

Then press the Enter key to leave the edit mode.

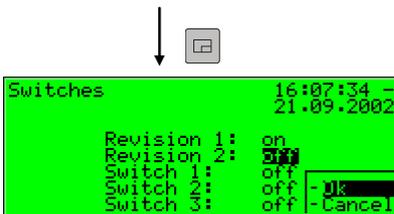


```

Switches                               16:07:23 -
                                       21.09.2002
Revision 1:  on
Revision 2:  off
Switch 1:    off
Switch 2:    off
Switch 3:    off
  
```

Revision switch 1 is opened now.

Invoke the menu now:



```

Switches                               16:07:34 -
                                       21.09.2002
Revision 1:  on
Revision 2:  off
Switch 1:    off
Switch 2:    off
Switch 3:    off
  
```

Options on leaving
Acceptance or rejection of the
changed values.

If you confirm *OK* the new value will be accepted. To reject the modification, go to *Cancel* and press the Enter key afterwards.

Modifying several values at once

Most of the dialogs don't offer individual values but whole sets 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 list.

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 values. Selecting *Cancel* means rejecting the changes. In both cases you will return to the display you invoked last.

4 Primer for impatient operators: What do I have to do to ...?

Notice: The following instructions are based on the assumption that you are in the basic device menu.

4.1 ... view the gas quality error listing?

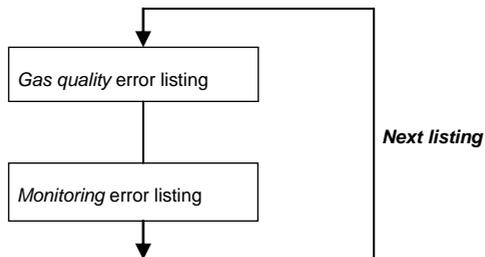
If the status LED blinks red or yellow or is steadily illuminated, the error listing contains alarm or warning entries.

Proceed as described below to view the error listing:

- 1) Invoke the menu (subordinated items) via the Menu key.
- 2) Invoke the next Menu (other modules) via the Menu key
- 3) Press the rightward arrow key until you have selected the *Monitoring* menu item.
- 4) Press the Enter key.

The main display of the *Monitoring* module is invoked. The error with the highest priority level is displayed. Scroll through the error listing using the arrow keys.

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



There may be up to two error listings. In addition to the *Gas quality* error listing, 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 5.3 for further information on the error listing of the message processing.

4.2 ... accept the gas quality measurement errors?

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

To accept an error, proceed as follows:

-  1) Open the error listing via the menu as described above in Chapter 4.1.
- 
 2) Select the error you want 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**. In this case, press the Menu key again to quit the menu.
 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 next lower priority level will be indicated on the display.
- 4) Repeat the steps explained above to accept further errors.

Note: Accepting errors as described above only refers to errors in connection with the device's gas quality functions. How to accept messages of the general message processing (*Monitoring* error listing) is explained in Chapter 5.3.

4.3 ... check all parameter settings?

The parameterisation 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 with the aid of the GW-GNET+ parameterisation program and a laptop.

Proceed as described below:

1. Connect the COM interface at the PC to the DSS interface of the Q1 evaluation computer using a parameterisation 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 parameterisation** 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.

Consult the GW-GNET+ online help for details on the operation of the user interface of GW-GNET+.

Please note: The **Change parameters** or **Edit parameterisation** 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+ comprehensive online help for further information.

4.4 ... check the input values?



1) The input values are in the *System* module. Therefore, change to this module: Press the Menu key twice, then move to the *System* entry using the rightward error key and press the Enter key.

2) Then press the Menu key and select the *Inputs* entry via the rightward arrow key.



3) Press the Enter key afterwards. The *Inputs* display will be invoked.

5) Please refer to Chapter 5.4.2 for information on how to proceed further.

4.5 ... view and check the outputs?



1) The output values are in the *System* module. Therefore, change to this module: Press the Menu key twice, then move to the *System* entry using the rightward arrow key and press the Enter key.

2) Then press the Menu key and select the *Outputs* entry by means of the rightward arrow key.

3) Press the Enter key afterwards.
The *Outputs* display will be invoked.

4) Please refer to chapter 5.4.2 for information on how to proceed further.

4.6 ... view the archives?



1) Change to the display of the *Data logging* module: Press the Menu key twice, move to the *Data logging* entry using the rightward error key and press the Enter key.

2) Select exactly the archive information you want to view in the appearing dialog. By the way it's more comfortable to view the archives with the PC-Software. Please refer to Chapter 5.2.2 for a detailed description of the function.

5 Functional description

5.1 Gas quality module

The *gas-lab* Q1 measuring system is a device for measuring the gas quality of natural gas. It measures the infrared absorption of hydrocarbons and carbon dioxide (CO₂) and also the thermal conductivity. The following variables are directly determined based on these measurements:

- H_s – Heating value superior, equal to GCV – gross calorific value
- standard density ρ_{s}
- concentration x_{CO_2} as mole fraction

Further variables are derived from these direct variables, such as:

- Wobbe index superior W_s
- Methane number MN
- Composition of the natural gas consisting of 10 components from C1 to C8+ as well as N₂ and CO₂.
- H_i – Heating value inferior, equal to NCV – net calorific value
- saturated H_s/GCV and H_i/NCV (gas with H₂O saturation)

When the device is started, the evaluation computer reads the calibration data out of the non-volatile memory of the sensor system and starts to measure. Therefore, make sure to switch on the sensor system either before or together with the evaluation computer. The measuring operation may only start after the Q1 has been successfully calibrated (see 5.1.2) and if the process gas is injected to path 1 with sufficient pressure. The sensor system is furnished with a pressure switch that detects whether gas is flowing or not.

The sensor system must have reached its operating temperature of about 55 to 60 °C before the device is ready to operate. It may take up to one hour to heat up a cold device. The evaluation computer waits until the operating temperature has been reached before indicating valid measurements. View the temperature of the sensor system in the *Process values* display (see 5.1.1.2).

Important: After the commissioning has been completed, operate the *gas-net* Q1 evaluation computer only with the calibration switch being closed. The calibration switch (the rotary switch on the front of the device) can be sealed for safety reasons. A closed calibration switch ensures that actions to be performed by trained and qualified staff, such as calibrating actions etc., cannot be started from the device.

5.1.1 Display and operation

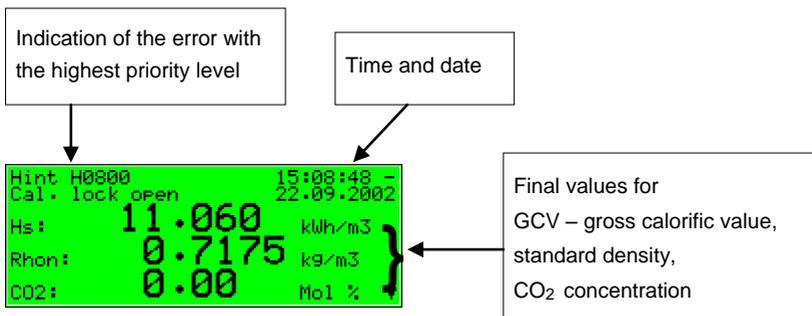
5.1.1.1 Main display *Gas quality*

The *gas-lab* system measures continuously during normal operation and constantly calculates actual values for the target variables gross calorific value GCV, standard density Rho_n and CO_2 content of the measured gas.

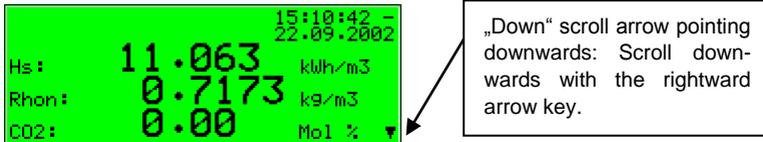
The basic display of the *gas-net* Q1 evaluation computer supplies a survey of the measurement status and currently calculated values of the gas analysis.

- The first two lines show the pending gas quality measurement error with the highest priority level on the left as well as time and date on the right.
- The last three lines of the basic display indicate the current gas analysis values GCV, Rho_n , and CO_2 , written in large numbers.

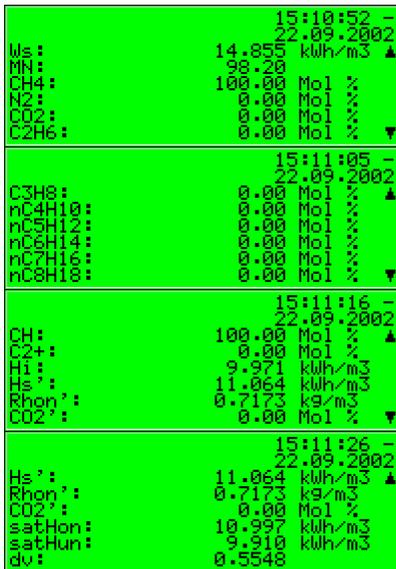
The values shown in the basic display are only current and valid if the system operates normally in undisturbed conditions. This means that the measurement is not in the alarm status and a calibration is not carried out.



The following illustration shows an example of the basic display in case of an undisturbed operation:



If you scroll downwards in the main display, further derived values will be indicated as illustrated by the following figures:



A calculated gas analysis with 10 components and the molar percentage of the C2+ components are indicated in addition to the Wobbe (Ws) and methane numbers (MN). Hi is the NCV – net calorific value. The variables Hs', Rhon' and CO2' are corrected values used in the automatic adjustment by means of a process gas chromatograph (PGC). The values satHon and sat Hun are the GCV and NCV in case of saturated concentration of H₂O for the defined reference condition. At last the density ratio is displayed.

5.1.1.2 Process values display

The *gas-net* Q1 evaluation computer provides a special display to indicate the source data measured by the sensor technology, the intermediate values that have been calculated based on these source values and all determined final values.

This display is called *Process values* and is invoked as described below:

- 1) Invoke the menu in the basic display.
- 2) Select the *Process values* entry by pressing the rightward arrow key. Press the Enter key afterwards.

The *Process values* display contains too many values to be indicated all at once. Scroll up or down the display with the arrow keys.

```

Process values          16:11:44 -
Values:  10010001 *   22.09.2002
Sens Nr:   90183
Status:   Meas run
-- Final values (T1,T2,X,BG) --
Hs:      39.8297      MJ/m3
Rhon:    0.7173      kg/m3
---- Final values (T1,T2,X) ----▼

```

The upper part of the display shows the last valve positioning command sent by the computer to the valve set as bit string (10010001). Also the number of the current measurement is displayed, which is consecutively numbered. Furthermore the current state of measurement is indicated.

All other values are intended for service and maintenance purposes. If you have questions for them please contact Elster.

5.1.2 Calibration

Each *gas-lab* Q1 measuring system has been calibrated when being delivered, i.e. the device has been calibrated by the manufacturer. During operation an automatic calibration with methane (1-point calibration) is carried out periodically. During the routine testing of the device after one year, we recommend to perform a manual basic calibration with nitrogen, methane and two other calibration gases (3-point calibration).

5.1.2.1 1-point calibration / automatic calibration

Precondition for a successful completion of a 1-point calibration is that the methane is properly connected on gas path 2 (see Cylinder change 5.1.4).

For this purpose the cylinder regulator must be set to approx 2 bars and the precision pressure regulator (M2R) of the second gas path must be set to about 80 mbars. If the methane cylinder is not already opened, open it now and do a purging right after it (see 5.1.5). Also the corresponding shut-off valve must be opened.

It is **not necessary to open** the calibration switch at the *gas-lab* Q1 for this calibration type.

An automatic 1-point calibration with methane can be carried out during normal measuring in the following conditions:

- In a fixed, configurable cycle every 1, 2, 3, 4, 5 or 6 days or 1, 2, 4, 8 or 12 weeks on a specified day at xx o'clock, typically every 7 days.
- After a configurable time in hours after each switching on of the supply voltage for the evaluation computer or sensor system, typically 12 hours later.
- After a configurable time in hours after each manual purge of a gas path, typically 12 hours later.
- After a configurable time in hours after errors that may affect the measurement have been cleared, for instance *Pressure disturbed evaluation computer (A607)*, typically 12 hours later.

- Manually by performing the *1P-cal. start* command in the *Calibration* menu what is described below.
- By setting a parameterised digital input.
- By means of a DSfG command.

The following reactions of the evaluation computer are indicating the status of the 1-point calibration:

- Via measurement outputs and on the controller's basic display the last valid gas quality values are maintained provided any values are available.
- The basic display shows **1P-cal.** during calibration.
- A **Revision** message will **not be generated**.

```
Hint H0760      16:49:25 -
G0 calibrating  22.09.2002

Status: 1P-cal.
```

If you want to abort the function prematurely, do so by keeping to the following instruction sequences:

Invoke the menu from the basic display and select *Calibration*.

```
Hint H0760      17:17:12 -
G0 calibrating  22.09.2002

Status: 1P-c  -IG channel 1 start
              -IG channel 3 start
              -Process values
              -Calibration
              -purging
```

Confirm the selection and invoke the menu again. Then select *Cal. Cancel* and confirm the selection

```
Calibration      17:17:27 -
                22.09.2002
Status: 1P Meth
remaining time:  -back
T: 0.0         -gas switched on
P: 0.0         -1P-cal start
UTCS: 0.00    -3P-cal start
R0CH: 0.00    -cal. cancel
```

The *gas-lab* Q1 terminates the calibration process and returns to normal operation.

The process will be aborted automatically if an alarm occurs during calibration. Afterwards, the *gas-lab* Q1 uses the previous calibration data, provided such data exists.

To manually start the 1-point calibration, do so by keeping to the following instruction sequences:

Invoke the menu from the basic display select *Calibration* and confirm.

```

17:37:15 -
22.09.2002
Hs: 10 -TG channel 1 start
Rhon: 0 -TG channel 3 start
CO2: 0 -Process values
      0 -1P calibration
      0 -Purging
    
```

Measurement values of different sensors are displayed now.

```

Calibration 17:37:29 -
                22.09.2002
Status: stopped
remaining time: 0 sec
T: 56.3 0.0504583
P: 1009.8
UTCS: 1.3910000
AOCH: 0.2750261
Calibration 17:37:42 -
                22.09.2002
P: 1009.8
UTCS: 1.3915000
AOCH: 0.2736556
AOCH2: -0.0067091
dICH: 0.6821000
dIC02: -0.0845000
    
```

By pressing the menu key again, the following submenu appears. Select the menu item *1P-cal. start* and confirm.

```

Calibration 17:37:56 -
                22.09.2002
Status: stopped
remaining time:
T: 56.3 -back
P: 1009 -1P-cal. start
UTCS: 1.39 -2P-cal. start
AOCH: 0.27 -cal. cancel
    
```

Now the actual status of the 1-point calibration is indicated on the display. Here e.g. the required operation – *switch on gas* (methane gas path 2)

```

Calibration          17:38:19 -
switch on gas       22.09.2002
Status: 1P Methane ch 2
remaining time:     600 sec
T:                 0.0      0.0465972
F:                 0.0
UTCS:              0.000000
R0CH:              0.000000
  
```

In case the methane is properly connected to gas path 2 (see beginning of chapter), please invoke the menu and select the menu item *gas switched on*.

```

Calibration          17:38:37 -
switch on gas       22.09.2002
Status: 1P Meth
remaining time:     -back
T:                 0.0      -gas switched on
F:                 0.0      -1p-cal_start
UTCS:              0.00     -3p-cal_start
R0CH:              0.00     -cal. cancel
  
```

After confirming the calibration with methane proceeds automatically, whereas the remaining time is displayed.

```

Calibration          17:41:45 -
switch on gas       22.09.2002
Status: 1P Methane ch 2
remaining time:     383 sec
T:                 56.3     0.0416667
F:                 1031.9
UTCS:              1.3891776
R0CH:              0.2728544
  
```

This process starts after approx. 2 minutes for purging and lasts for 10 minutes.

The end of calibration is indicated by the following display:

```
Calibration      10:01:17 -  
                25.09.2002  
Status: finished  
remaining time:  0 sec  
T:              0.0      0.0650417  
P:              0.0  
UTCS:           0.0000000  
AOCH:           0.0000000 ▾
```

Then the display changes to the following condition (same as before starting):

```
Calibration      10:11:52 -  
                22.09.2002  
Status: stopped  
remaining time:  0 sec  
T:              56.3     0.0366667  
P:              1090.7  
UTCS:           1.3836000  
AOCH:           0.2731707 ▾
```

After the 1-point calibration is finished, the sensor system automatically injects the process gas and starts measuring.

The new correction values determined during the calibration are written to the calibration archive.

We also recommend observing the deviations of the automatic 1-point calibration in the quality archive.

If these values are getting too high, a new basic calibration should be performed.

5.1.2.2 Basic calibration / 3-point calibration

Such a basic calibration is generally performed on the occasion of the yearly routine testing. Trained and qualified staff must perform the basic calibration. Although it runs automatically, the process steps are supported via the operator panel of the evaluation computer.

The calibration switch at the *gas-lab* Q1 must be **open** to facilitate a basic calibration.

The following reactions of the evaluation computer are indicating the status of the 3-point calibration:

- During the parameterisation of the *gas-lab* Q1 you may determine whether or not the last valid gas quality values shall be maintained via measurement outputs and on the basic display of the computer during this time.
- The display shows **3P-cal.** during calibration.
- A **Revision** message will be generated.

```
Hint H0760      16:49:25 -
GQ calibrating  22.09.2002

Status: 3P-cal.
```

If you want to abort the function prematurely, do so by keeping to the following instruction sequences:

In case you are not in the *Calibration* module: Invoke the menu from the basic display, select *Calibration* and confirm the selection.

```
Hint H0760      09:30:15 -
GQ calibrating  25.09.2002

Status: 3P-c   -IG channel 1 start
               -IG channel 3 start
               -Process values
               -calibration
               -purging
```

Invoke the menu and then select *Cal. Cancel*.

```
Calibration    09:28:37 -
Status: 3P H2-1 25.09.2002
remaining time: -back
T: 56.3        -gas switched on
P: 1052       -1P-cal_start
UTCS: 0.65    -3P-cal_start
A0CH: 0.97    -cal. cancel
```

By confirming the selection the *gas-lab* Q1 terminates the calibration process.

The process will be aborted automatically if an alarm occurs during calibration. Afterwards, the *gas-lab* Q1 uses the same calibration data as before, provided such data exists.

The basic calibration consists of the following steps:

1. Preparation
2. Zero point adjustment with nitrogen via path 3
3. Calibration with methane (1. calibration gas) via path 2
4. Calibration with H₂-11K (2. calibration gas) via path 3
5. Calibration with L1-8K (3. calibration gas), via path 3
optional with a binary gas mixture (5% CO₂ in methane)

1. Preparation

For successful completion of a 3-point calibration, the methane cylinder, also used for the automatic calibration, has to be connected correctly to the second gas path (see 5.1.4). The cylinder regulator must be set to approximately 2 bars and the precision pressure regulator (M2R) of the second gas path to about 80 mbars.

If the methane cylinder has not been opened yet, open it and perform a purge first (see 5.1.5).

Furthermore nitrogen and two other calibration gases (H₂-11K, L1-8K or binary mixture) will be connected one after another to the third gas path during the calibration process. Since they are not needed for normal operation, they have to be connected first.

The nitrogen is needed first, so his connection to the third gas path is described next and stands also for the other two gases.

As no precision pressure regulator (M2R) has been installed on the mounting plate for the third path normally, mount an additional precision pressure regulator behind the cylinder regulator of the nitrogen cylinder for you to adjust the operating pressure of the sensor system to approximately 80 mbars. This is done in the following way:

- Make sure that the nitrogen cylinder has been turned off and the cylinder regulator is set to zero.
- Connect a precision pressure regulator to the cylinder regulator of the nitrogen cylinder and attach a high-pressure tube to the precision pressure regulator.
- Open the precision pressure regulator, so that some gas can flow off in the next step, whereby the high-pressure tube is purged.
- Open the nitrogen cylinder. The cylinder regulator must be set to about 2 bars.
- Set the precision pressure regulator to approx. 80 mbars
- Connect the high-pressure tube to the third gas path of the sensor system finally

For performing a basic calibration the *gas-lab* Q1 needs to know the exact composition of the used calibration gases also.

For that purpose the gas analysis of the used calibration gases has to be entered in the actual parameterization.

Support in changing an existing parameterization is given in chapter 6.2 and regarding the affected parameters in chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** under periphery.

2. Zero point adjustment with nitrogen

While being in the gas quality main display press the menu key and activate the *Calibration* command in the invoked menu.

```

17:37:15 -
22.09.2002
Hs:      10
Rhon:
CO2:
-TG channel 1 start
-TG channel 3 start
-Process values
-Calibration
-Purging
  
```

A display with measurements of the different sensors appears.

```

Calibration      17:37:29 -
                  22.09.2002
Status: stopped
remaining time:  0 sec
T:              56.3      0.0504583
P:              1089.8
UTCS:           1.3910000
AOCH:           0.2750261
Calibration      17:37:42 -
                  22.09.2002
P:              1089.8
UTCS:           1.3915000
AOCH:           0.2736556
AOCH2:          -0.0067091
dICH:           0.6821000
dIC2:           -0.0845000
  
```

By pressing the menu key again, the following submenu appears. Select the menu item *3P-cal. start* and confirm.

```

Calibration      12:18:22 -
                  23.09.2002
Status: stopped
remaining time:
T:              56.3
P:              1020
UTCS:           1.35
AOCH:           0.27
-back
-1P-cal. start
-3P-cal. start
-cal. cancel
  
```

Now the actual status of the 3-point calibration is indicated on the display. Here e. g.: The required operation – *switch on gas* (nitrogen channel 3)

```

Calibration      12:18:40 -
switch on gas    23.09.2002
Status: 3P N2 ch 3
remaining time:  1500 sec
T:              0.0      0.0577778
P:              0.0
UTCS:           0.0000000
AOCH:           0.0000000
  
```

In case the nitrogen is properly connected to gas path 3 (see beginning of chapter), please invoke the menu and select the menu item *gas switched on*.

```

Calibration      12:19:00 -
switch on gas   23.09.2002
Status: 3P N2 c
remaining time:  -back
T: 0.0          -gas switched on
F: 0.0          -ip-cal_start
UTCS: 0.00     -3p-cal_start
A0CH: 0.00     -cal_cancel
  
```

After confirmation the zero point adjustment with nitrogen proceeds automatically. The process takes about 25 minutes. Meanwhile the display shows the remaining time. It will not count down before 2 minutes of flushing time.

```

Calibration      08:39:53 -
switch on gas   25.09.2002
Status: 3P N2 ch 3
remaining time:  1363 sec
T: 56.3         0.0380139
F: 1052.5
UTCS: 0.0026000
A0CH: -0.0016506
  
```

3. Calibration with methane (1. calibration gas)

Now the prepared methane has to be switched on, which the following display indicates:

```

Calibration      09:02:51 -
switch on gas   25.09.2002
Status: 3P Methane ch 2
remaining time:  900 sec
T: 0.0         0.0313889
F: 0.0
UTCS: 0.0000000
A0CH: 0.0000000
  
```

Please invoke the menu and select the menu item *gas switched on*.

```

Calibration      09:03:21 -
switch on gas   25.09.2002
Status: 3P Meth
remaining time:  -back
T: 0.0          -gas switched on
F: 0.0          -ip-cal_start
UTCS: 0.00     -3p-cal_start
A0CH: 0.00     -cal_cancel
  
```

After confirming the calibration with methane (1. calibration gas) runs automatically. The adjustment starts after approx. 2 minutes for purging and lasts for 15 minutes, whereas the remaining time is displayed.

```

Calibration      09:14:28 -
                  25.09.2002
Status: 3P Methane ch 2
remaining time:  366 sec
T:             56.3      0.0538889
P:             1059.4
UTCS:          1.4093662
AOCH:          0.2772368
  
```

Meanwhile turn off the nitrogen cylinder and remove the tube on both sides.

(Caution: Unpressurise the line first!).

Furthermore you can prepare the second calibration gas (H2-11K) on the third gas path (see step 1. Preparation) When the calibration process with methane (1. calibration gas) is finished, the following display appears:

```

Calibration      09:21:31 -
                  25.09.2002
switch on gas
Status: 3P H2-11K ch 3
remaining time:  900 sec
T:             0.0      0.0366667
P:             0.0
UTCS:          0.0000000
AOCH:          0.0000000
  
```

4. Calibration with H2-11K (2. calibration gas)

Now the prepared H2-11K has to be switched on. Please invoke the menu and select the menu item *gas switched on*.

```

Calibration      09:21:43 -
                  25.09.2002
switch on gas
Status: 3P H2-1
remaining time:  -back
T:             0.0      -gas switched on
P:             0.0      -local start
UTCS:          0.00     -3P cal start
AOCH:          0.00     -cal. cancel
  
```

After confirming the calibration with H2-11K (2. calibration gas) runs automatically, whereas the remaining time is displayed.

```

Calibration      09:25:28 -
switch on Gas   25.09.2002
Status: 3P H2-11K ch 3
remaining time: 873 sec
T: 56.3         0.0280972
F: 1052.6
UTCS: 0.6576758
R0CH: 0.9762261
  
```

The adjustment starts after approx. 2 minutes for purging and lasts for 15 minutes. When the calibration process with H2-11K (2. calibration gas) is finished, the following display appears:

```

Calibration      09:42:57 -
switch on Gas   25.09.2002
Status: 3P L1-8K ch 3
remaining time: 900 sec
T: 0.0         0.0400056
F: 0.0
UTCS: 0.0000000
R0CH: 0.0000000
  
```

Now turn off the H2-11K cylinder and remove the tube on both sides.

(Caution: Unpressurise the line first!).

5. Calibration with L1-8K or binary gas mixture (3. calibration gas)

Now the prepared L1-8K or binary gas mixture has to be connected. (see step 1. Preparation) Then the prepared 3rd calibration gas is started by opening the menu and selecting the menu item *gas switched on*.

```

Calibration      09:43:09 -
switch on Gas   25.09.2002
Status: 3P L1-8
remaining time:  -back
T: 0.0         -gas switched on
F: 0.0         -ip-cal-start
UTCS: 0.00     -3P-cal-start
R0CH: 0.00     -cal-cancel
  
```

After confirmation the calibration with the 3rd calibration gas (L1-8K or a binary gas mixture) proceeds automatically. The remaining time is indicated on the display. In any case “L1-8K” is shown on the display, even if you use a binary gas mixture instead.

```

Calibration          10:00:14 -
                    25.09.2002
Status: 3P L1-8K ch 3
remaining time:      61 sec
T:      56.3         0.0627222
P:      1052.5
UTCS:   0.7591856
AOCH:   0.3830408
  
```

The adjustment starts after approx. 2 minutes for purging and lasts for 15 minutes, whereas the remaining time is displayed

The end of calibration is indicated by the following display:

```

Calibration          10:01:17 -
                    25.09.2002
Status: finnished
remaining time:      0 sec
T:      0.0         0.0650417
P:      0.0
UTCS:   0.0000000
AOCH:   0.0000000
  
```

Then the display changes to the following condition (same as before starting):

```

Calibration          18:11:52 -
                    22.09.2002
Status: stopped
remaining time:      0 sec
T:      56.3         0.0366667
P:      1090.7
UTCS:   1.3836000
AOCH:   0.2731707
  
```

After the basic calibration is finished, the sensor system automatically switches back to the process gas and starts measuring.

Now turn close the L1-8K or binary gas mixture cylinder and remove the tube on both sides.

(Caution: Unpressurise the line first!)

5.1.3 Test gas injection

The injection of test gases serves to check the gas quality meter with a known gas or to measure unknown gases on a non-routine basis.

The following reactions of the evaluation computer are indicating the status of the test gas injection:

Hint H0002	17:27:16 -
Revision	15.08.2002
Hs:	11.063 kWh/m ³
Rhon:	0.7173 kg/m ³
CO2:	0.00 Mol % ▼

- Via measurement outputs and on the controller's basic display the last valid gas quality values are maintained provided any values are available.
- A **Revision** message will be generated.

Please proceed as described below:

1. Decide whether you like to inject the test gas via gas path 1 or 3.
2. Make sure the test gas cylinder is closed and the cylinder regulator is set to zero. Set the associated precision pressure regulator to zero. Connect the outlet of the precision pressure regulator to the first or third gas path of the sensor system using a high-pressure tube. When using gas path 1, make sure the process gas, which is also connected to this path, has been shut-off tightly and thus is not able to affect the measurement by contaminating the test gas.
3. Open the test gas cylinder. The cylinder regulator must be set to about 2 bars.
4. Set the precision pressure regulator to approx. 80 mbars.
5. Now purge the first or third gas path (see 5.1.5).

6. Press the Menu key while being in the gas quality main display and activate the *TG path 1 start* or *TG path 3 start* command in the invoked menu.



7. Now, the sensor system will be purged with test gas for about 2 minutes. Afterwards, the measurement begins. The measurement results are shown in the main display.
8. To finish the test gas injection, press the Menu key and activate the *TG path 1 end* or the *TG path 3 end* command.



9. Now please turn off the test gas cylinder and remove the tube on both sides.

(Caution: Unpressurise the line first!).

A running test gas injection will be aborted automatically after 1 hour (which can be parameterised), and process gas will be injected instead.

When gas path 1 was used, make sure that after the test gas injection the process gas is reconnected and opened to this path. Otherwise the test gas is handed as process gas and the measurement results are mapped incorrectly.

5.1.4 Cylinder change

Different gases must be available in the plant for calibration and measurement tasks. Therefore it might be necessary from time to time to connect another gas cylinder to a gas supply connection of the *gas-lab* sensor housing; for instance, if the pressure of the methane cylinder is insufficient for the 1-point calibration to be carried out.

To remove an existing cylinder, proceed as follows:

1. Close the old cylinder at the main valve on top of the cylinder and unpressurize the connected gas line. You possibly have to wait until the remaining gas has been used up or use an available venting possibility (preferably low pressure side).
2. Remove the cylinder connection from the cylinder and close the cylinder with the corresponding nut.
3. Place the protective cap on the cylinder and fasten it..
4. Not until now detach the protection against falling down (safety chain or clamp) and remove the cylinder.

To connect a new cylinder, proceed as follows:

5. Secure the new cylinder with a chain or clamp against falling down at first.
6. Remove the protective cap from the cylinder by unscrewing it.
7. Make sure that the main valve on top of the cylinder is closed.
8. Remove the nut from the valve connection now.
9. Make sure that the pressure reducing valve and the shut-off valve of the high-pressure regulator or cylinder pressure regulator to be connected are closed. Close the pressure reducing valve by unscrewing its setting screw.
10. Now connect the cylinder connection of the high-pressure regulator or cylinder pressure regulator to the valve connection of the gas cylinder.
11. Open the main valve of the gas cylinder and adjust the outlet pressure of the high-pressure regulator or cylinder pressure regulator to the operating pressure needed by the sensor system for the gas stream you are preparing just now. (i.e.: 1 – 5 bars if in front of an additional low pressure regulator (M2R) or only 80 mbars if directly connected to gas path 3 of sensor system)

To purge the high-pressure or cylinder pressure regulator, proceed as follows:

12. Close the main valve of the gas cylinder and wait until the high-pressure regulator or cylinder pressure regulator is almost drained, i.e. until the outlet pressure has almost dropped down to 0 bar. Now open the gas cylinder again.
13. Repeat this draining and filling of the high-pressure regulator or cylinder pressure regulator twice to ensure that the regulator's dead volume does not contain gas from the previous use or air.
14. Pay attention to the fact that the gas cylinder must be open finally to make a calibration or measurement possible.

5.1.5 Purging

After having exchanged a gas cylinder with a flammable content, always make sure that no air gets into the sensor system. This is why a purge must be initiated manually after each cylinder change. This also applies if air may have entered in a gas path connected to the sensor system.

The following reactions of the evaluation computer are indicating the status of the test gas injection:



- The last valid gas quality values are maintained via measurement outputs, provided any values are available at all.
- The **Revision status** will not be indicated.

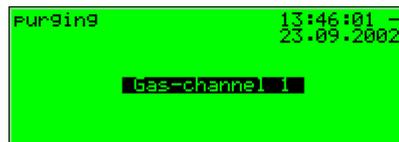
Proceed as described below:

1. Connect the gas cylinder to the relevant gas path. Set the pressure of the cylinder regulator output to 1 - 5 bars and the pressure of the downstream precision pressure regulator to 80 mbars.

2. Press the key while menu being in the main display, select the *purging* command and confirm it by pressing the key enter.



3. **Gas-channel 1** appears on the display.



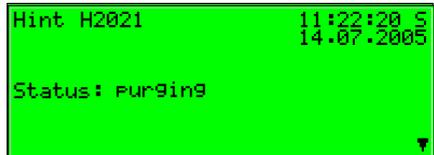
4. Press the Enter key again. The following selection list appears:
Select the gas path you would like to purge via the arrow keys.



Confirm your selection by pressing the enter key again.



5. Press the menu key now and start the purge with **OK** or quit the dialog via **Cancel**.
6. The purge lasts for about 7 minutes. The display shows **purging**.



After the purge has been finished automatically, the *gas-lab* Q1 starts measuring the process gas again.

5.1.6 Revision

The *gas-lab* Q1 sets the revision status in case of a zero point adjustment, a 3-point calibration or a test gas injection.

A set revision status means that the gas quality is not measured under normal and proper operating conditions.

All entries in the interval archive are marked with the *Revision* status note.

Furthermore, the *Revision switch open* hint will be generated and entered in the error listing and logbook.

The termination of the revision operation results in the ending of the *Revision switch open* hint with an entry in the logbook and induces a last entry marked *Revision* in the interval archive.

The gas quality measurement runs normally again.

5.2 Data logging module

5.2.1 Function

The *gas-net* Q1 evaluation computer is 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 parameterising 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 storage. 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 *gas-net* Q1 module provides:

Gas quality module:

The *gas quality* module provides 3 archive groups:

- The PTB archive logs the billing-relevant data, which consists of the gross calorific value GCV, CO₂ content and status of the measurement system. The data is recorded every 15 minutes. The PTB archive has a size of 180 days.
- The Interval archive logs the gross calorific value GCV, the standard density Rhon, the CO₂ content and the status of the measuring system. The data is logged at the full hour and when an error occurs. The Interval archive has a size of about 60 days.
- The Quality archive logs 6 quality factors during each 1-point calibration. These factors provide information on the corrections that have been made during the individual calibrations with methane. The Quality archive has a depth of 365 entries.

Monitoring module:

The *Monitoring* module facilitates the compilation of process value archives (archives with any measurements or count values). Moreover, it runs the gas quality measurement's error logbook. The beginning and ending 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. There is an additional, separate error listing for internal message processing, if this function is used. This error listing can also be logged.

System module:

The *System* module runs a parameter change archive (*changed settings archive*), in which changes of the parameterisation are logged.

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.

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

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

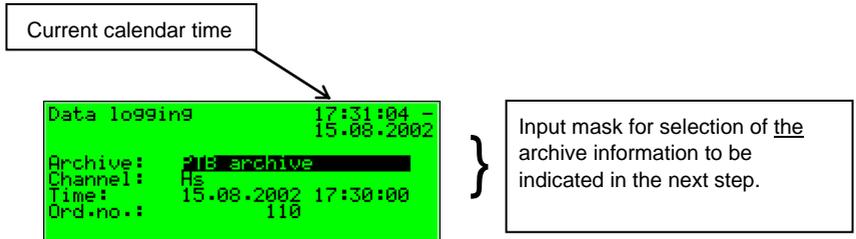
The devices have already been provided with a pre-defined archive structure corresponding to the common requirements before delivery.

5.2.2 Display and operation

Main display (Data logging module)

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

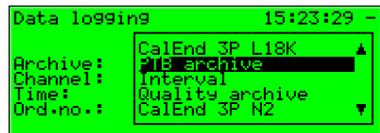
The main display of the *Data logging* module consists of a mask in which you may choose the data you want to view more closely. The following illustration shows an example:



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.

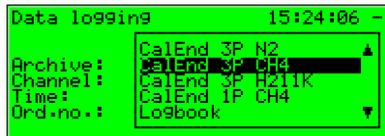
Choose the archive information you would like to view :

The archive type is selected at the beginning, i.e. it is backlit in black.



Press the Enter key to get into the edit mode.

A list opens up from which you may choose the desired archive type via the arrow keys.



Afterwards, confirm your choice by pressing the Enter key. The next field is selected.

```
Data logging 15:24:26 -
Archive: Logbook
Channel: Monitoring logbook
Time: Changed settings
Ord-no.: CalEnd 3P L18k
          PTB archive
```

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.

```
Data logging 15:25:05 -
          15.02.2013
Archive: Z
Channel: Hs
Time: Rhon
Ord-no.: CO2
```

For instance, for the *PTB* archive type you may choose between *GCV*, *CO2* and *Status*².

You may specify the point of time to be filtered by changing day, month, year and time one after the other.

```
Data logging 15:25:28 -
          15.02.2013
Archive: PTB archive
Channel: Hs
Time: 15.02.2013 15:14:46
Ord-no.: 1
```

You get into the edit mode (as indicated by the black underscore) for each respective field by pressing the Enter key and are thus able to specify date and time step by step.

```
Data logging 15:26:10 -
          15.02.2013
Archive: PTB archive
Channel: Hs
Time: 15.02.2013 15:14:46
Ord-no.: 1
```

Use the arrow- or number keys to set the date and time. Confirm your entry via the Enter key

² *Status* stands for a bit string that provides an overview of the status of the gas quality measurement system according to the DSfG Regulations. The meaning of the individual bits is defined in the DVGW documentation *Technische Spezifikation für DSfG-Realisierungen* (see Bibliography).

The next field is selected. Select the entry you want to view via the ordinal number³ in this field.

```
Data logging          11:10:24 S
                    18.07.2005
Archive:   PTB archive
Channel:   Hs
Time:      18.07.2005 10:45:00
Ord.no.:   ██████████ 3638
```

As there is an unambiguous relation between date and ordinal number, the associated 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. (See diverent times in the example)

```
Data logging          11:13:36 S
                    18.07.2005
Archive:   PTB archive
Channel:   Hs
Time:      18.07.2005 10:30:00
Ord.no.:   ██████████ 3637
```

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

³ Each individual measured variable of an archive group, which is filed by a device, has an ordinal number according to the DSfG Regulations. The sequence 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.

For instance, ordinal numbers are needed for the polling of archive data via DSfG.

Subordinate menu items (Data logging module)

View

By activating the *View* menu item, you invoke the display of the archive channel you have selected in the main display.

```

Data logging          11:13:36 -
                    18.07.2005
Archive:             PTB archive
Channel:             Hs
Time:               18.07.2005 10:30:00
Ord.no.:            357
                    - View
  
```

The archive type and current time are shown in the first two lines. Each entry is provided with a time mark. Name, value and unit of the logged data are shown. Exactly two successive archive entries are displayed at once. For example (interval archive gas quality, GCV channel):

```

PTB archive          17:31:37 -
Hs                  15.08.2002
15.08.2002 17:30:00  110
11.072 kWh/m3
Change:             -0.048 kWh/m3
  
```

The "up" and "down" scroll arrows indicate that you may view even more archive entries. (Scroll with leftward or rightward arrow key.)

Archive entry with ordinal no. 110

Return to the main display, i.e. to the selection mask for viewing archives, via the subordinate menu item *Back*. To be able to switch to the entries of other channels with the same time mark, exactly the same mask you have specified before will be invoked.

```

PTB archive          17:31:37 -
Hs                  15.08.2002
15.08.2002 17:30:00  110
11.072 kWh/m3
Change:             -0.048 kWh/m3
                    - Back
  
```

- * **Tip:** The archive presentation on the display is limited due to a lack of space. To analyse 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+. View the data afterwards in a table or as diagram by means of the GW-XL+ program.

The configuration of the data logging function is more comfortable via the PC-Software and therefore not described here. See the Online-Help for further questions.

5.3 *Monitoring* module

5.3.1 Function

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

- Monitoring the gas quality measurement for errors.
The error listing serves the user to analyse and remove gas quality measurement errors and to be able to understand the history of the course of error.
- Monitoring of any logged measurements.
- Signalling of operating states.
- Log-on of process value archives (archives for measurements and count values which can be used to replace a recording instrument, for example)
- Switching functionality

5.3.1.1 Monitoring the gas quality measurement and error listing

There are three different kinds of gas quality measurement errors, which are also treated differently by the error management:

- An *Alarm* is generated if a gas quality-relevant error has occurred. Beginning and end of an alarm are entered in the associated 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.
- A *Warning* is generated if a gas quality-relevant variable is affected but does not influence the result of the gas quality measurement. If a warning is no longer pending, i.e. it is no longer relevant, it can be accepted at the operator panel of the device and thus removed from the error listing.

- A *Hint* is generated if a measurement violates a hint limit specified by the operator (upper/lower hint limits for 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 be generated or removed only if the measurement is not within the hysteresis range.

A hint will also be generated if an event occurs which has no influence on the gas quality measurement (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 disappear from the error listing automatically after they have ended.

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

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 in Chapter 3.2.

5.3.1.2 Measurement indication

In addition to monitoring measurements for hint limits and gradients, the device may also file up to 32 measurements. For each defined measurement the minimum and maximum values measured since the last reset are indicated. The operator can view these values together with the associated time marks on the display.

5.3.1.3 Message processing; messages and groups

Note: The message processing function of the monitoring module runs completely independent of the device's gas quality measurement monitoring. Therefore, this functionality of the monitoring module is provided with a separate error listing and an own logbook.

Please take into consideration that the rules of this message processing differ considerably from those of the monitoring of the gas quality measurement (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 Q1 is oriented towards this standard wherever it has proved to be useful and possible with regard to the monitoring function.

The message processing of the Q1 may manage up to 64 messages defined by parameterisation. In principle, there are different types of conditions to be signalled which can be mapped to such a message. The operator himself defines the events that shall result in messages within the message processing by parameterising 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 integrated in the message processing, such as a gas quality alarm.

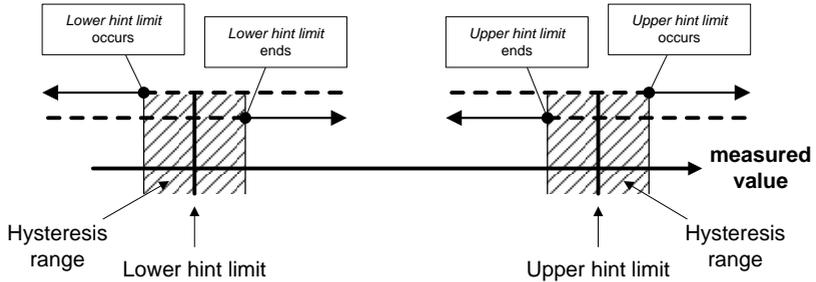
Second, measurements can be monitored for limit violation. This applies to measurements supplied via analogue inputs or measured values generated internally. In addition to monitoring upper and lower hint limits, it is also possible to *monitor gradients*. The gradient monitoring observes measurement changes within defined time ranges: If the difference between the highest and lowest values of a measured quantity exceeds the defined maximum value within a parameterised time range, the condition for generating the message *Hint limit gradient* has been met.

Note: All single messages referring to measurements are also pending if the associated 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 be defined to avoid fluttering messages if a measurement fluctuates around a limit value. The message *<Hint limit begins>* will then be generated or removed only if the measurement leaves the hysteresis range.



2. Considering a minimum pending time

When 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 associated error listing. Via the device parameterisation 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 messages can be *disabled* during operation. This is rather helpful during a plant inspection, for instance. The message processing completely disregards a disabled message, which is always considered as being not pending. The state of a message (disabled / enabled) can be changed via the operator panel of the device, the parameterisation and a DSfG adjusting telegram.

Single message data (characteristics, current values) can be enquired via DSfG. Certain properties are also adjustable via DSfG, such as hint limits and gradients⁴.

In order to simplify the monitoring of up to 64 messages, single messages can be combined by parameterisation 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.

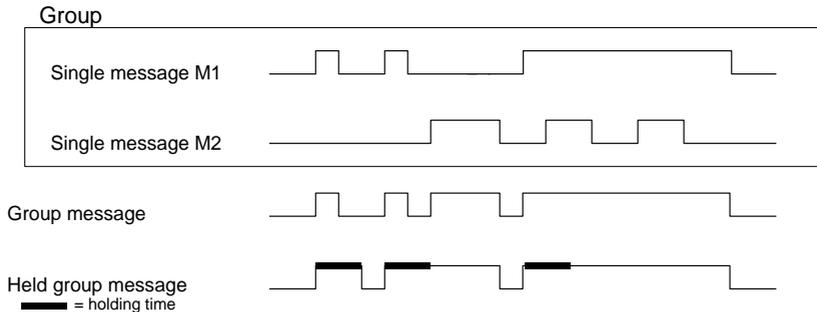
A group message is not linked with an acceptance.

⁴ The DSfG data elements for message processing are included in the DSfG data element tree of the *Control* entity. Please ask FLOW COMP 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 hold time; for instance, to take the telecontrol response times into consideration.

A held group message is pending at least as long as the hold time lasts, even if the normal group message ends during the hold time.



Centralized message

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

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

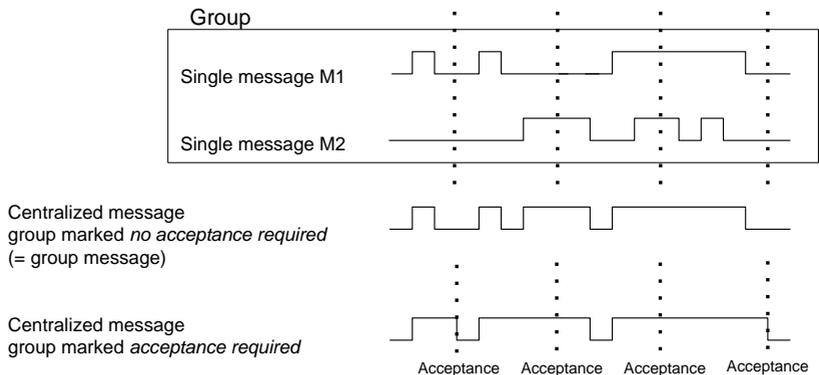
When a group is marked with *No acceptance required*, the result of the centralized message is always the same as the result of the group message. In contrast to the group message, however, the no acceptance requiring centralized message is entered in error listing and logbook.

The centralized message of a group characterised *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, no matter via which source it has been generated.

The centralized message of a group marked *Acceptance required* is pending if at least one single message of the group is pending. However, it will only end with the ending 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 has been accepted. In such a case the single message is or the single messages are to be accepted.

The following illustration shows how the centralized message of a group marked *No acceptance required* differs from the one of a group marked *Acceptance required*.



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 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 message processing error listing and logbook 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 affects each group differently:

- No influence
A set M-switch does not have any effect on the signalling 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 considered *not pending*.
- Suppression of all signalling 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.

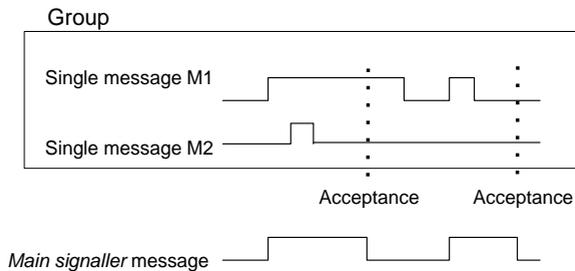
Status and signalling reactions of *single* messages remain unaffected by the M-switch. Single messages are suppressed via the disabling mechanism explained above.

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 behaviour of the main signaller in connection with the acceptance (in case of one involved group):



5.3.1.4 Logging on measurement or counter archives

The Q1 is able to run 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 for each archive group in which conditions the contained archive channels shall be logged.

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

Additionally or alternatively, the data logging can be made conditional upon certain events occurring 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 development 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 can specify that the data logging shall always start when a count value has increased by a defined difference.

In addition, measurements and count values are always logged 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 certain number of entries have been reached. The point of time of the last entry will be marked with hint *PVA <no.> freeze begins* (PVA stands for **ProcessValueArchive**) in the error listing and logbook of the monitoring module. The data logging will only be continued if 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 develops 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.

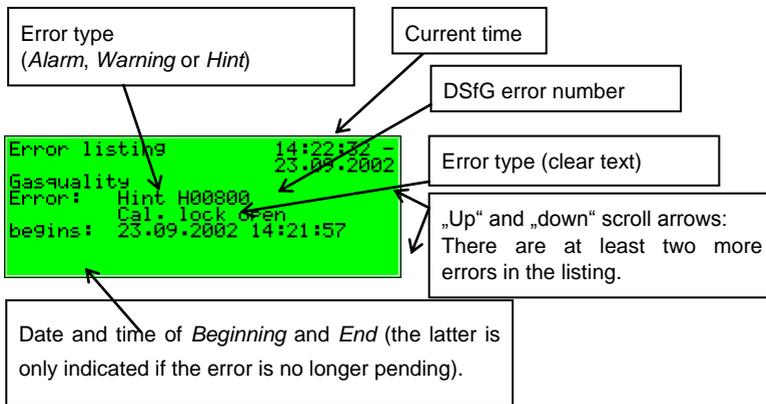
5.3.2 Display and operation.

Main display (Monitoring module)

The display indicates the error listing of the gas quality measurement when you invoke the *Monitoring* module. The error message with the highest priority level⁵ is displayed, provided the error listing is not empty.

If the error listing contains further errors, you may 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.

The following information is provided for each error:



⁵ 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*.



Subordinate menu items (Monitoring module)

Accept

The *Accept* menu item only exists for the gas quality measurement error listing. 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 two error listings: the *Gas quality measurement* error listing and the *Monitoring* error listing.

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

- Messages named *System messages*⁶ have top priority. These messages are usually not visible in the error listing as they are pending for only one second.
- 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.

⁶ System messages are generated for the events *Re-start performed*, *Supply voltage failure*, *New parameterisation*, and *Parameter changed*.

- Pending single messages follow according to their priority level.
In order to keep the error listing clearly understandable only such single messages are entered in the error listing that have been parameterised accordingly.

In principle, all single messages of the message processing and 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

The *gas-net* Q1 evaluation computer may have up to 32 parameterised measurements for maximum/minimum indication on file. If you invoke the corresponding display, the first measurement will be presented. You can switch to the display of another measurement via the name. 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 list.

```
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 measured quantity of the associated measurement, incl. unit. Blinks if the value 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 measurement is indicated as being disturbed, the display keeps showing the last valid value. In this case, however, the value is blinking.

The measurement display contains the following subordinate menu items:

Resetting

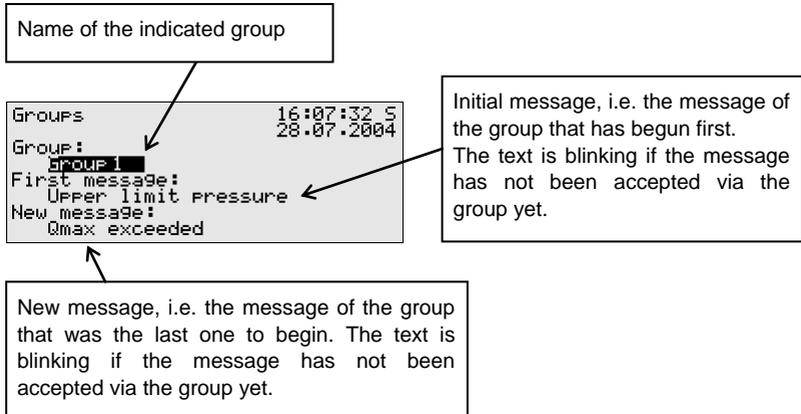
The *Resetting* menu item sets the minimum and maximum values of the measurement to the current measurement.

Reset all

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

Groups

The *Groups* menu refers to the message processing of the monitoring module. You may invoke the associated 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 associated display, you will see information on the first group. For switching to the display of another group you have to get into the edit mode (by pressing the Enter key) and select the name of the group you want to view from the appearing list. 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 *Initial message*.

As this is always the message that has initially caused the beginning of the centralized message, this information helps to analyse the error status. The message text is blinking if no message has been accepted yet after the beginning of the centralized message.

Below the *New message* menu item you can read off the most recent single message of the group that has begun. 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, does not stop blinking on the display before a message has been accepted after the beginning of the new message.

Only if neither initial nor new message are indicated, a centralized message is not pending.

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.

Name of the selected group

```

Group view: 16:07:37 S
Group 1     28.07.2004
Name:      Wmax exceeded
Type:      Upper limit
Status:    on          0 s
           enabled
  
```

Currently indicated single message of the group. A list 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 parameterised 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*.

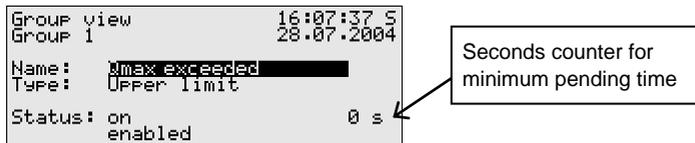
Status

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

On or *Off* indicates whether the message is pending. Here, a possibly parameterised minimum pending time is taken into consideration: Even though the status to be signalled is currently pending, the associated single message will only be set if the 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 would have been assigned to it, the display includes a seconds counter.

```
Group view          16:07:37 S
Group 1             28.07.2004
Name:  Wmax exceeded
Type:  Upper limit
Status: on          0 s
        enabled
```



If the seconds counter starts counting backwards, the status to be signalled has already been pending. A minimum pending time is assigned to each single message. This is why the message itself is only 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 signalled 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 signalled has been detected.

However, it depends on its state (disabled / enabled) whether a single message is being routed at all: 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 analyse the status of a group and the single messages contained therein. This menu only provides information but does not allow to change the properties of a single message, for instance to set a disabling mark. For this purpose the *Single messages* menu must be invoked. The display of this menu 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 list. 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 parameterised 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 parameterised 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 adjusted via PC and with the parameterisation 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 measurement monitoring messages. However, the numerical locks must have been opened 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.

```

Disabled messages   16:16:37 S
                   28.07.2004
Name:      Inlet Pressure
Type:      Upper limit
Status:    on      0 s
  
```

Pressing the Enter key opens the selection list containing all currently blocked messages.

The *Disabled messages* menu described here merely provides information. Please switch to the *Single messages* menu (see above) if you want to change the status of a single message (disabled / enabled).

This is the last subordinate menu of the *Monitoring* module:

Switches (Change of switch outputs)

The task of the *Switch* menu is to display the status of the *Switches*.

A switch is a message with a preset status (*on* or *off*), which can be changed manually, i.e. via the operator panel of the device. *Switch*-type messages are routed to digital outputs (cf. Chapter 5.4.1) 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, which indicates the current status of each switch. Select the switch the status of which you would like to change and change into the edit mode. Afterwards, you may select the other switching status and confirm via **OK**. Changing a switch status is subject to the user lock.

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

Note: The *Switches* menu offers with *Revision 1* and *Revision 2* two additional switching options. However, the *gas-net* Q1 does not use these options.

5.4 System module

5.4.1 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 transmission of this information to other modules. The availability of input channels depends on the process board equipment of each individual device. A Q1 always contains at least one LMFA7 board for the connection of the sensor system. Besides that, there are further process boards providing input channels (see Chapter 7.2.2).

The *System* module's display offers a special menu for viewing the source, source value and final value of the input signal on the device display (see Chapter 5.4.2).

Outputs

The evaluation computer always contains one **LMFA7** board.

One LMFA7 output board offers 3 transistor outputs for the output of messages. Furthermore, it contains 4 current outputs for the output of measurements.

In addition to that, there are further *gas-net* process boards providing output channels (see Chapter 7.2.2).

The *gas-net* evaluation computer provides a special menu for viewing and checking outputs (see Chapter 5.4.2). Checking outputs is only possible if the locks are open.

DSfG (optional feature for the European market)

DSfG is a digital interface especially developed for data communications between gas meters (such as *gas-net* devices).

If you need further information, please contact your local agent.

Please see www.elster.com

Locks

The parameter list of the Q1 contains various parameters that are not subject to the calibration lock but protected against wilful 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 5.4.2). The device parameterisation defines the locks that shall be valid.

Setting the clock

A free setting of the device internal clock is only possible if the calibration switch is open. If the latter is closed, you may only reset the clock within a range of ± 20 seconds (and only once within 24 hours). This restriction applies to all time sources, especially to the manual clock setting via the device's operator panel. If you were successful in resetting the time outside the ± 20 seconds-range, two warnings will be generated. Unsuccessful adjustments result in *Clock-synch failed* warnings.⁷

DCF-77 (optional feature for the European market)

Optional the gas-net Q1 can have a DCF77 interface for connecting a radio – clock that receives the PTB time normal about DCF-77 radio signal.

If you need further information, please contact your local agent.

Please see www.elster.com

⁷ According to the DSfG Specification:

W811: Clock set new

W820: Clock set old

W812: Clock-synch failed

5.4.2 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



Subordinate menu items (System module)

Inputs

The *Inputs* display enables you to view detailed information of individual analogue input channels (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. For instance, the display of the first channel of an EXMFE4 board looks as follows:

```
Inputs                               16:42:11.5  
                                     28.07.2004  
Name: 51 GHz transm. 1  
Board: 1 EXMFE4 02.3  
Channel: 1 Pulse  
Phys.val.: 00000000264.817 m3  
Inf. val.: 205 1/s
```

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

Outputs

The system menu *Outputs* enables you, similar to the input channels' display, 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 defined by the device parameterisation.
Board	Board location, board type, version number of the 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 analogue 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 pending 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 list with the names of all parameterised output channels appears. After you have chosen the desired output channel and have 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 check the output channels. This means that you can output any current value between 0 and 20 mA via an analogue output for testing purposes. A message output can be set to *Contact closed* or *open*, and you may also output pulses 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 switch to 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 also 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 may also quit the test mode by quitting the current display, for instance via *Back* or by selecting a different channel.

DSfG (optional feature for the European market)

DSfG is a digital interface especially developed for data communications between gas meters (such as *gas-net* devices).

Sub menu *DSfG*

Operating mode menü

Among the „own participants“ bus addresses (EADRs) lists the Q1 internal instances..

Menu known participants

Menu line: Bus activityät:

The Q1 can get an attention-Telegram .

If you need further information, please contact your local agent.

Please see www.elster.com

DCF77 (optional feature for the European market)

Optional the gas-net Q1 can have a DCF77 interface for connecting a radio – clock that receives the PTB time normal about DCF-77 radio signal.

If you need further information, please contact your local agent.

Please see www.elster.com

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 parameterisation.



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. Change to 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 lock. 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

Activate this menu item to adjust the internal device time.

```

Set clock                               16:51:51 S
                                         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 can be prevented by parameterisation. In such a case, the phrase ~~not used~~ appears next to *Time zone*, and it is not possible to change to 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*. You may only confirm your setting via *OK* if the acceptance of the new time is permissible⁸.

Display test

You may check whether or not the display and 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 colours after each other. Finish the display test via *Back*.

⁸ If the calibration switch is closed, resetting the clock is only permissible within a range of ± 20 seconds and only once within 24 hours.

5.5 *Integrated RDT* module

(optional feature for the European market and, not available with all software variants)

5.5.1 Function

The optional function block has the task of realizing a data connection between the gas-net device and a remote control center. The center is a couple of him during an active data connection to be logically equal participant in the data traffic.

If you need further information, please contact your local agent.
Please see www.elster.com

5.5.2 Display and operation

Main display (Modul Integrated RDT)

The main display of the module Integrated RDT indicates in what state the RDT is.

Optional feature for the European market and, not available with all software variants.

If you need further information, please contact your local agent.
Please see www.elster.com

***Subordinate menu items (modul integrated RDT)***

Optional feature for the European market and, not available with all software variants.

HistorieMenu RDT-statisticsGSM (only when connected to a wireless modem)

Optional feature for the European market

If you need further information, please contact your local agent.

Please see www.elster.com

5.6 DSfG module, *Data exchange* module

(Gateway functionality, not available with all software variants)

The DSfG protocol is a digital data protocol, especially developed for the communication between gas meters in gas measuring and regulating stations. The *gas-net* Q1 is always equipped with a DSfG interface. All important measurements and characteristic data are provided as DSfG data elements via the DSfG protocol according to the specification. These data elements are addressed via special addresses.

However, gas measuring and regulating stations often also contain a PLC (programmable controller) the tasks of which are the open- and closed-loop control of the station and the telecontrol interfacing to a remote control centre. Most of the PLCs are not DSfG-capable but use other digital communication protocols⁹. Consequently, they cannot be simply included in the DSfG station group. In such cases a protocol interfacing between DSfG and host protocol is necessary (gateway functionality).

This functionality is only available in Q1 software variants containing the *DSfG* and *Data exchange* modules.

5.6.1 DSfG module (Optional feature for the European market)

The optional module controls the DSfG side of data exchange.

If you need further information, please contact your local agent.

Please see www.elster.com

⁹ Typical protocols are, for instance, *3964R/RK512* (e.g. in case of Siemens S5/S7) or *Modbus-RTU* (e.g. in case of Cegelec Modicon).

5.6.2 *Data exchange module*

5.6.2.1 **Function.**

The *Data exchange* module controls the host side of the gateway functionality. All data points that are available during operation and shall be forwarded to a host must be positioned on registers or data blocks/data words for the host. It is also possible to scale the value in a suitable way before forwarding it, depending on the data type. Usually, the data to be forwarded is the content of DSfG data elements that have been polled by the *DSfG* module via a DSfG query telegram. The forwarding of the received DSfG data to the host is defined in the *Data exchange* module. The data transport in the direction to the host is processed cyclically. If a new telegram arrives from the DSfG side, the associated export values will be updated. In addition to the specification of the destination in the host, the description of the export value also defines the way of positioning the data point in the host (e.g. size, scaling, limits, and bit position).

A particular import value describes for the reverse data flow direction at which position in the host a data point shall be collected and in which way it shall be converted. It can be defined in the parameterisation whether the transmission to the DSfG side shall be cyclic or event-driven.

Any number of import values from the host can be combined to a job group. All data points of a job group are always put into the transfer memory together and simultaneously. However, only after all of them have been collected again once more. Moreover, a job group may be linked with a trigger. A trigger is a defined position in the host and initiates a new processing of a job when its content has changed.

5.6.2.2 Protocol-specific facts: RK512 / 3964R

The gateway functionality of the *gas-net* Q1 supports the protocol consisting of 3964R (data link layer) and RK512 (data presentation).

Look up the settings of the protocol parameters in exactly this form in the manuals of the programmable controller and adjust them in the communications processor procedure.

The implementation of the RK512 protocol in the *gas-net* device is restricted to the data transmission between data blocks. The smallest information unit is a *data word*. Such a data word has a length of 16 bits and may contain, for instance, several messages, a status overview in the form of a bit string, or a binary measurement.

The structure of the management of these data words is rather simple; there are up to 256 larger units, called *data blocks*, each of which may contain up to 256 data words. Data blocks and data words are numbered consecutively from 0 to 255, with the numbers serving as addresses.

A single data word is clearly defined by exactly three details:

- the address of the data block (0..255)
- the address of the data word (0..255)
- the content of the data word

The addresses to be assigned to the host data in the *gas-net* parameterisation therefore consist of a data block/data word (DB/DW) pair. Data block 0 is usually used for intrasystem host variables. This is why you should use data block 0 neither for exporting values towards the host nor for importing host values.

In special cases it may happen that the host only masters the subordinate 3964R protocol layer. This means that the following restriction applies: As no DB/DW information is transmitted on the 3964R protocol level, all data to be exported or imported must be arranged as a string. The number of dates is thus limited to 64 data words per transmission. This is why in the GW-GNET+ interface (*Data exchange* module) the positions for import and export values are not indicated in the DB/DW form but as serial register numbers.

The necessary programming of the host can be minimised by selecting the *Master* operating mode for the *gas-net* Q1. In this case it is not necessary to compile a job list for the host. The entire data block assignment is carried out via the *gas-net* device parameterisation. However, at least the agreed data blocks and the basic protocol functionality must have been created in the host of course.

The communication between the host computer and the *gas-net* Q1 is subject to several basic requirements. The following list provides a summary:

Communication protocol:	RK512/3964R – point-to-point
Interface:	V24 (RS232) with PC/AT pin assignment at the <i>gas-net</i> device (COM2-interface). RS232 or RS422 via serial interface of an MSER2-board in the <i>gas-net</i> device.
Transmission rate:	adjustable to 2400, 9600, 19200 or 38400 baud
Transmission parameters:	8 data bits, even parity, 1 stop bit
3964R telegrams:	Max. 128 bytes (64 DW) per telegram
RK512 response telegrams:	A maximum of 64 data words per telegram, no 3964R response telegrams. In the RK512 slave operating mode (i.e. host = master), the <i>gas-net</i> device generates the response telegrams listed in the table below:

Error number	S5/S7 error name	Cause of the error
00H	-----	OK telegram after SEND
0CH	memory access	<ul style="list-style-type: none"> - A DB has been addressed which does not correspond with the DB of an RK512 job. - The first addressed data word is not within the data area of the addressed DB. - The addressed data is longer than the addressed DB.
10H	instruction 2	The second instruction letter is wrong. Here, only 'D' is permitted to stand for DB.
11H	access not permitted	A telegram with data has been sent, but no access rights for its DB/DW area exist.
16H	instruction 1	The first instruction letter is wrong. Only 'A' for SEND and 'E' for FETCH are admissible.
34H	telegram length	<ul style="list-style-type: none"> - The telegram that arrived was incomplete (not enough data). - The length stated in the SEND telegram and the length of the telegram itself do not correspond.

5.6.2.3 Protocol-specific facts: MODBUS RTU / MODBUS ASCII

The Modbus protocol is supported, for instance, by the PLC series of AEG Modicon. The data presentation according to the Modbus protocol is one-dimensional. The smallest data unit in the memory consists of 16 bits. The protocol contains a number of registers that are numbered consecutively from 0 up and each of which may contain exactly such a 16-bit word. In each individual case the number of registers depends on the size of the memory available on the host side.

The positions of the import and export values of the host are indicated as serial register numbers in the parameterisation of the *gas-net* device, too. These register details always refer to the MODBUS telegram presentation. This may possibly lead to different register numbers in the PLC, depending on the host type.

Communication protocol :	Based on Modbus RTU/Modbus ASCII according to the <i>Modicon Modbus Protocol Specification</i> (Jan. 1991, MODICON Inc.), point-to-point
Interface:	V24 (RS232) with PC/AT pin assignment at the <i>gas-net</i> device (COM2-interface). RS232, RS422 or RS485 via serial interface of an MSER2-board in the <i>gas-net</i> device.
Transmission rate:	adjustable to 2400, 9600, 19200 or 38400 baud
Transmission parameters:	Modbus RTU 8 data bits, Modbus ASCII 7 data bits even parity, 1 stop bit pre-allocated
Modbus telegrams:	Maximum of 250 bytes (125 register words) per telegram. Only the Modbus telegram types 03 and 16 are supported.
Modbus response telegrams:	In the gateway = slave operating mode, the gateway generates the response telegrams listed in the table below when an error occurs:

Error number	Modbus error designation	Cause of the error
01	illegal function	The telegram type received is not permissible, i.e. it is neither of the 03 nor of the 16 telegram type. Only Modbus telegram types with the functional numbers 03 (= read holding registers) or 16 (= preset multiple registers) are needed in the gateway; this is why only these are supported.
02	illegal data address	The indicated data address is not permissible.
04	failure in associated device	Other

5.6.2.4 Display and operation

The *(Host) Communication* menu item for the *Data exchange* module is intended for trouble shooting by experts and thus not explained in detail here. Please get into contact with FLOW COMP if you need support or more detailed information.

The *Protocol channel* submenu provides status information for individual protocol channels via which a host is connected. Select the protocol channel to be indicated via the *Protocol selection* list. The subordinate menu item *Host registers* gives detailed information on the data exchange via this protocol channel, broken down into host registers. Either scroll through the individual register positions using the arrow keys or select a particular start register for the display via the *Register selection* submenu.

The *Error statistics* subordinate menu shows the number and type of the communications errors that have been detected in case of the selected protocol channel. You may reset the error statistics manually via the operator panel (*Clear statistics*).

6 GAS-WORKS / GW-GNET+

gas-net devices are parameterised with a PC or laptop computer and the software system GAS-WORKS.

All *gas-net* devices are parameterised with the same GAS-WORKS module, called GW-GNET+. ¹⁰

The next two sections generally explain how to compile or edit a complete *gas-net* parameterisation using GW-GNET+ and how to export it to the device. It is rather easy to learn how to work with the parameterisation program. As soon as you have mastered the techniques you only need to know the meaning and effect of each adjustable parameter, no matter which *gas-net* device type is actually concerned. This is why we have enclosed a complete parameter list with additional information in the annex to this documentation.

For a detailed description of the parameterisation program and other editing methods read the online help of GW-GNET+. ¹¹

Important note: Protected parameters can only be changed by a computer and not on the panel with open calibration switch.

The following description refers specifically to a parameterization, with modified parameters protected with calibration switch.

¹⁰ Please refer to the GAS-WORKS CD-ROM, which is part of the delivery scope of each *gas-net* device, for further information on the GAS-WORKS program system with all the possibilities it provides. All GAS-WORKS components can be installed from this CD. The CD also contains the operating instructions for all GAS-WORKS modules, in particular for GW-GNET+.

¹¹ It is possible to change the device parameterisation or single parameters via an established data connection between the computer and the device. This is advantageous with respect to different situations: For instance, you may exchange operational parts of the parameterisation in the GW-GNET+ Edit parameterisation mode, even if the calibration switch is closed. In the Change parameter mode, parameters characterised as changeable online can be edited without restarting the device.

6.1 Compiling and exporting a parameterisation: Brief description

To create a completely new *gas-net* parameterisation, please proceed as follows:



1. Start GW-BASE from the Windows environment by double-clicking the lantern icon.



2. Invoke the GW-GNET+ module by clicking the **New – Create *gas-net* parameterisation** tool in the toolbar. Alternatively, you may select the **Tools – New – Create *gas-net* parameterisation** menu item from the main menu.

3. Select the device type you want to parameterise in the appearing dialog box and the version number of the device software in the next step. In the subsequent dialog box choose an existing standard parameterisation, on which the new parameter data record shall be based.

After you have confirmed your selection by clicking **OK**, the GW-GNET+ interface is activated.

4. The **Modules and linkages** window contains one white box with a name and icon for each module included in the device software. By double-clicking this box you activate a dialog box listing all parameters that belong to the module concerned.

Adjust the settings according to your requirements.

Important note:

When compiling the parameterisation, you have to ensure the consistency of the data records.

Gas-net devices contain functional groups, or modules, which are largely independent of one another. In some cases modules provide other modules with the values to be processed.

For this reason it is important to ensure, each time a parameter is edited, that the respective cross-references are correct.

Examples for such linkages are the references in the *Monitoring* module to the input channels for cylinder pressure and temperature. These input channels are defined in the *System* module.

If you delete or fundamentally change an input value being used in a different context in a parameterisation, all linkages to this value become invalid and are automatically deleted by the parameterisation program.

You will receive a corresponding message indicating which linkages you have to set up again afterwards to render the parameterisation consistent again.

Detailed information is available in the GW-GNET+ online help.

5. Go through all modules in this way until all adjustments meet your requirements.
6. Select **File – Save as** and enter the name under which the parameter data record shall be saved in GAS-WORKS. Close GW-GNET+, for instance via **File – Exit**.
7. The parameter data record is now in the worksheet of GW-BASE. Before exporting it to the device, you have to drag it into a suitable hierarchy of the GAS-WORKS data management¹².
8. Connect the DSS data interface at the device to a COM interface of the computer using a parameterisation cable.
9. Turn the calibration switch at the device to “open”.
10. Mark the parameter data record and select the **Data – Export** menu item from the main or context menu of GAS-WORKS.
11. The communication program starts.

The window appearing on your screen shows the information **Data transmission to *gas-net* device**.

As soon as the transmission has been completed, the device will be restarted. The message **Data transmission to *gas-net* device** in the communication window disappears. The type plate of the connected *gas-net* device is indicated instead, stating the most important device data.

Close the communication program now.

¹² To drag a data record from the worksheet into a hierarchy, proceed as described below:

1. Mark the target hierarchy (which must possibly be created before).
2. Drag the data record with the mouse from the worksheet into the right half of the configuration window.

Alternatively, drag the data record directly to a folder in the hierarchy (on the left side of the configuration window).

Please refer to the GW-BASE User's Guide or online help for more detailed information.

6.2 Importing and editing a parameterisation: Brief description

You may read out the current parameterisation of a *gas-net* device via the data interface and edit it afterwards.

The read-in process is implemented as follows:

1. Connect the PC and the evaluation computer by connecting the COM interface of the computer to the DSS interface at the *gas-net* device using a parameterisation cable.



2. Start GAS-WORKS on your computer if you haven't done so before. Activate the communication program by clicking the **Import – Data interface** tool in the GW-BASE toolbar.



After having successfully started the communication program, you are connected with the device as regards data technology. The window appearing on your display contains some important basic device information.

3. Change to the **Content** tab now.
4. Mark the **Parameterisation** data record and click the lantern icon.
A **Save as**-dialog box appears asking for the file name under which the data record shall be saved in GAS-WORKS.
After you have entered the name and confirmed your entry by clicking OK, the reading in of the data will start.
5. After the reading in has been finished, close the communication program via the main menu item **File – Exit**.

The parameter data record is filed in the GAS-WORKS worksheet under the specified file name. Before starting GW-GNET+, you have to file this data record away in the hierarchy, as worksheet data records cannot be processed further.¹³

And this way you edit an existing parameter data record:

1. Mark the parameter data record in the configuration window of GW-BASE.
2. Select **Data – Edit** from the main or context menu.
GW-GNET+ starts.
3. Edit the parameterisation according to your requirements. Please observe the notes in Chapter 6.1
4. Save your adjustments:
By clicking **Save** you save the data record under its old name.
If you select **Save as**, however, you may enter a new file name. The created data record is saved in the GW-BASE worksheet in this case and must be filed away in a suitable hierarchy.
5. Close GW-GNET+ and export the modified parameterisation as described in Chapter 6.1, steps 8 to 11.

¹³ For brief instructions see footnote page 112.

6.3 Extras: GW-GNET+ service programs

The GW-GNET+ program includes some additional service programs fulfilling different tasks relating to *gas-net* devices. The range of available service programs depends on the *gas-net* device type.

The following tools are available for the *gas-net* Q1, for example:

	For changing individual parameters via the data interface during an established data connection to the device.
Change parameters	Note: For instructions, please refer to the GW-GNET+ online help
	For changing the parameterisation during an established data connection to the device. Purely operational parts of the parameterisation can be exchanged this way even if the calibration switch is closed.
Edit parameterisation	Note: For instructions, please refer to the GW-GNET+ online help.
	As this device type does not contain any totalizers, this help program has no function.
Totalizer setting	As this device type does not contain any totalizers, this help program has no function.
Snapshot function	
	Facilitates the deletion of archives of the <i>gas-net</i> device when the calibration switch is open.
Delete archives	
	Starts GW-REMOTE+ via the data interface, if installed. Facilitates data access to all devices connected via DSfG; for instance, for reading out archive data and viewing current data.
DSfG bus access	

These programs may only be activated if a data connection is established via the DSS data interface.

Proceed as usual:

1. Start GW-BASE on your laptop computer.
2. Connect the DSS interface of the gas-net device to a COM interface of the laptop using a parameterisation cable. Alternatively, you can use a USB-to-serial converter cable to connect the parameterisation cable
-  3. Start the communication program by clicking the **Import – Data interface** tool in the GW-BASE toolbar. After the data connection to the device has been established, the type plate of the connected device appears on the display.
4. Select the **Tools** tab. The appearing tab lists all available service programs.
5. Start the desired program by double-clicking.

The function range of the service programs is manageable and practical. The operation is thus rather easy. A comprehensive online help is also available for each program. It can be activated via the **Help – Content** menu item or by pressing the **F1** key.

6.4 Optional: GW-Remote+ for downloading archives (Optional function, extra fee required)

This program may only be activated if a data connection is established via the DSS data interface.

Proceed as usual:

1. Start GW-BASE on your laptop computer.
2. Connect the DSS interface of the *gas-net* device to a COM interface of the laptop using a parameterisation cable.



3. Start the communication program by clicking the **Import – Data interface** tool in the GW-BASE toolbar. After the data connection to the device has been established, the type plate of the connected device appears on the display.
4. Select the **Contents** tab. The appearing tab lists all available data.
5. Start **Archives, Logbooks** by double-clicking.

In the appearing program window the archive query configuration window is displayed. Please select all the archive groups you wish to read out in the left shown list (Use Shift or Ctrl to select multiple). On the right you can define which range you want to download.

The option **Add to GAS-WORKS data records** means that the data that will be downloaded in the following is added to former downloaded data records. Furthermore the data can be grouped i.e. in monthly packets. If you download archive data at a later time values of a former month is added to the corresponding existing monthly packet and newer data is stored in a newer one.

6. When reading is complete, you may close the communication program via the main menu item **File - Exit**. (You have to confirm dialog window first)

The archive records are stored with the specified names in the GAS-WORKS worksheet. Before they could be displayed, these records must be transferred to the hierarchy. Records in the worksheet section could not directly be processed.¹⁴

¹⁴ For brief instructions see footnote page 112.

7 Installation

7.1 Mounting the *gas-net* Q1

The *gas-net* Q1 evaluation computer is designed for mounting in a 19"-cabinet and is available with mounting widths of 1/3 or 1/2. Pay attention to a mounting depth of 170 mm (with connectors: approximately 220 mm) to guarantee the accessibility of the terminals on the back. We recommend mounting the device in a hinged bay.

The *gas-net* Q1 device must be installed in an ex-free installation area (electrical operating area) according to protection class IP 20.

7.2 Connecting the lines

Ensure that the device is in de-energised conditions before connecting the transmitter, supply, signal and data lines.

Any modification of the wiring is only permitted if the supply is disconnected!

Connect the transmitter and signal lines to the Q1 using plug-in screw terminals, each of which is located in a cable terminal box. Connect the power supply via fixed screw terminals. Data lines have to be connected to the corresponding SUB-DB9 connector housings.

Please pay special attention to the intrinsically safe circuits. Before switching on the supply, make sure that the connectors for the intrinsically safe signals are plugged in as only in this case a thread measure of 50 mm can be guaranteed, which is required by the relevant guidelines.

If necessary for wage according to local metrological approval, the plugs for connecting transmitter cables, could be secured by official adhesive labels, or alternatively, by wire sealing.

Please consider the relevant installation regulations when arranging the wiring. The lines must be tensile stress-free and must be provided with a bend protection, if the *gas-net* device is mounted in a hinged bay. Dimension the cable length in such a way that there is no tensile stress on the cable during the swinging of the hinged bay.

We recommend to conduct the lines coming from the transmitters on transfer terminals in a control cabinet and to connect them from there to the Q1 device. These terminals, however, have to partly comply with the EX-regulations and may need to be officially sealed in addition.

7.2.1 Power supply and protective earthing

Operate the *gas-lab* Q1 with a nominal voltage of 24 V DC.

The connection of 24 V is implemented via the terminals + and - on the back of the device, and must be externally protected against short circuits with 1 A.

Connect the protective earth to **PE** of the power supply terminal for equipotential bonding.

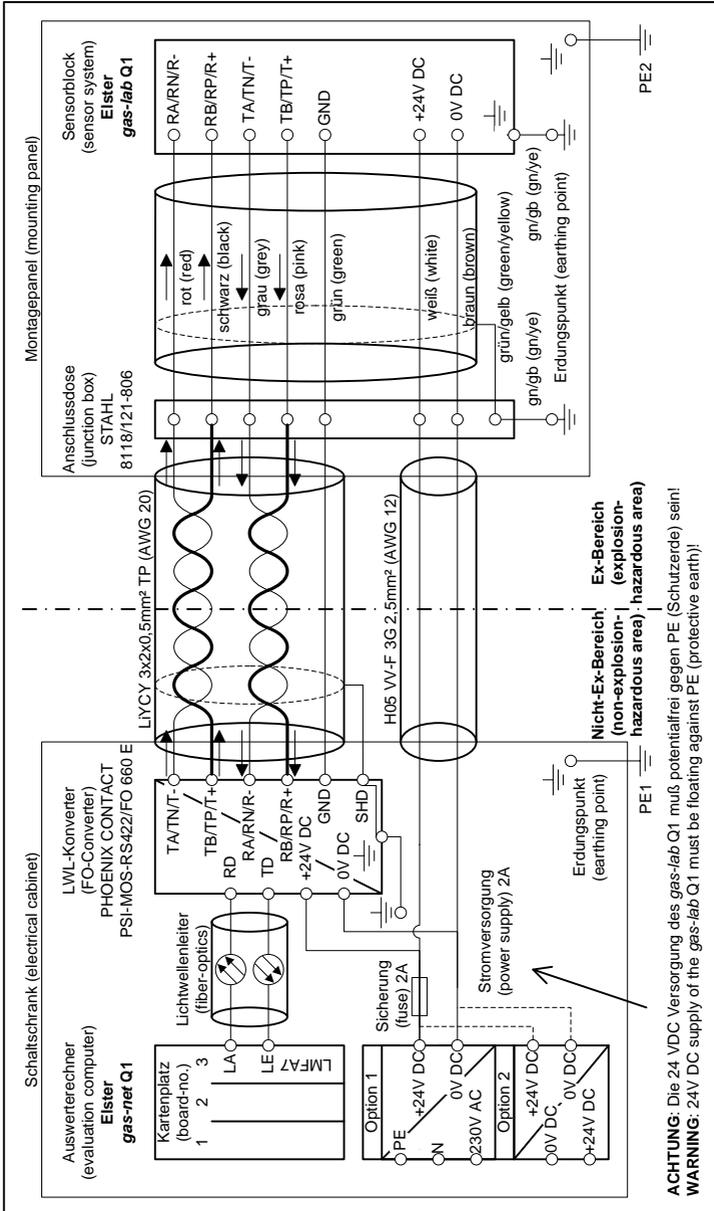
A fuse with 0.63A/TT for a device with a width of 1/3 and a fuse with 0.8 A/TT for a device with a width of 1/2 are provided, respectively. The fuse is inaccessible from outside for protection reasons. This is why each device should be individually connected in a cabinet via an accordingly dimensioned automatic circuit breaker (1 A).

7.2.2 Process boards

The process board equipment of a Q1 depends on the tasks the device is supposed to accomplish. Generally, it depends on the mounting width of the device casing, how many process boards can be built in: A 1/3 mounting width casing accommodates up to three process boards whereas a 1/2 mounting width casing accommodates up to six process boards.

Altogether, only up to four boards of the types EXMFE4 and MSER2 can be employed in a device.

7.2.2.1 Connection between sensor system and evaluation computer



7.2.2.2 EXMFE4 input board

Important note: The EXMFE4 input board is approved as an *associated electrical apparatus* of category *ib* according to DIN EN 50020 with intrinsically safe circuits. This is why sensors and signal transmitters located in hazardous areas (e.g. zone 1) can be connected to this board. A mixed operation of intrinsically safe and non-intrinsically safe circuits is not permissible for such an input board.

One or two intrinsically safe pulse generators in NAMUR technique can be connected to the first two channels of an explosion-proof EXMFE4 input board, and the first two channels of the EXMFE4 can be used as message input channels.

Connect the signals for channels 1 and 2 to terminals **Z1+**, **Z1-** and **Z2+**, **Z2-**.

The inputs are intrinsically safe. Use shielded cables for a better interference suppression. The maximum cable length is 100 m at a cross section of 1.5 square mm. If the cables are longer, you have to ensure that the lines are installed separately from other conducting lines to avoid interferences.

Moreover, each EXMFE4 board has one intrinsically safe temperature sensor input in 4-wire technique to be connected to terminals **I+**, **U+**, **U-** and **I-** according to the Pt100 Specification.

The board is also equipped with an intrinsically safe input for measuring sensors (e.g. a pressure sensor) in 4..20 mA-two wire-technique (terminals **P+** and **P-**).

This fourth channel of the EXMFE4 input board can also be used for the parallel connection of up to 4 measuring sensors with HART interface (multi-drop procedure). For the sensors, only HART polling addresses from 1 to 4 are allowed; make sure that the addresses are unambiguous and that the address assignment corresponds to the assignment in the parameterisation of the *gas-net* device.

Important note: It is very important to adjust the HART polling addresses individually in the sensors *before* connecting them altogether to the corresponding input channel at the *gas-net* device in de-energized conditions.

If you change the polling addresses later, the device cannot correctly identify the individual sensors. If this cannot be avoided, it is sufficient to initiate a short mains failure afterwards. When the device starts up again, all connected HART sensors are polled once for the device to find out the current polling addresses.

The device supplies the measuring sensors with power. For this, shielded cable must be used. However, the shielding is only fixed at the device but not at the sensor. If the line diameter is 1.5 square mm, the cable should not be longer than 100 m. If the cable is longer, it must be guaranteed that the lines are installed separately from other conducting lines to avoid interferences.

The cable shielding for all transmitter lines is connected to the **SH** terminal at the EXMFE4 input board.

7.2.2.3 Serial process board MSER2

The MSER2 serial process board provides two interfaces that support V24 (RS232) as well as RS422 and RS485. The table below shows the assignment of the individual PINs:

Signal	Assignment
TXD	RS232: Transmitted data
RXD	RS232: Received data
RXB	RS422/RS485: Received data (B)
RXA	RS422/RS485: Received data (A)
TXB	RS422/RS485: Transmitted data (B)
TXA	RS422/RS485: Transmitted data (A)
SGD	Signal ground
SH	Shield

In the *gas-lab* Q1 the MSER2 board serves as protocol gateway functionality for the connection of a host computer.

Notes:

- When RS422 and RS485 are used, a matching resistor of 120 ohms may be required in the receiver between RXB and RXA, depending on the cable length.
- In case of RS485, you have to externally connect RXB to TXB and RXA to TXA.
- Pay attention to the specification of the individual protocols. For instance, there are protocols that render a connection via RS485 impossible (e.g. in case of RK512).

7.2.2.4 MFE11 input board

The multi-functional MFE11 input board is equipped with 8 digital message inputs 0/24 V DC. However, it is also possible to use these channels as pulse inputs with a maximum input frequency of 25 Hz. Connect the inputs at terminals **D1+** to **D8+** with the common ground **D-**.

Furthermore, the MFE11 input board provides 3 analogue inputs for the connection of measuring sensors with a 0/4..20 mA output signal. Connect the inputs via terminals **A1+** / **A2+** / **A3+** with the common ground **A-**.

The analogue inputs of the MFE11 board are electrically isolated from the digital inputs. Besides, all channels are electrically isolated from the rest of the system. Connect the cable shielding for the inputs to the **SH** terminal.

7.2.2.5 AE12 input board

The AE12 input board offers 12 analogue inputs for the connection of measuring sensors with a 0/4..20 mA output signal. Connect the inputs via terminals **I1+** to **I12+** with the common ground **I-**. Connect the cable shielding to the **SH** terminal.

7.2.2.6 MFA6 output board

The multi-functional MFA6 output board contains 1 relay contact for the output of a message as break contact (**D1a/D1b**). Furthermore, there are 3 transistor outputs for the output of additional messages or volume pulses (**D2+/D2-**, **D3+/D3-**, **D4+/D4-**). The output assignment can be parameterised as desired within a certain range.

The MFA6 output board also provides 2 analogue outputs for the output of measurements. The current limits can be parameterised in a range of 0 to 20 mA. The associated terminals are marked **I1+/I1-** and **I2+/I2-**, respectively.

The outputs are electrically isolated from each other and from the rest of the system.

The parameterisation for the analogue output assignment is unrestricted.

Connect the cable shielding for the outputs to the **SH** terminal of the board.

7.2.2.7 DA12 output board

The digital output board DA12 has 12 transistor outputs for the output of messages or volume pulses (to be connected to terminals **D1**, ..., **D12** with the common reference point **COM**). Connect the cable shielding for the outputs to the **SH** terminal.

7.2.2.8 LMFA7 output board

The LMFA7 output board offers 3 digital outputs: one relay output (active break contact) for the output of a message and two transistor outputs for the output of messages or pulses. Connect the outputs via terminals **D1**, **D2**, **D3** with common ground **DC**.

Furthermore, the LMFA7 board is equipped with 4 analogue outputs 0/4..20 mA (terminals **I1**, **I2**, **I3**, and **I4** with common ground **I-**).

The terminals named **LA** and **LE** right at the top of the board are fibre-optics connections for an external I/O expansion (LA = fibre-optics output, LE = fibre-optics input).

Connect the cable shielding to the **SH** terminal of the board.

7.2.3 Further connection possibilities

7.2.3.1 Serial interface

The serial interface DSS in form of a SUB-DB 9 female connector on the front panel serves the connection of the *gas-net* Q1 to other devices, such as a laptop computer or PC. The technical data is stated in the annex. An interconnecting cable to the computer can be delivered as accessory. A standard COM connection (one-to-one connection) is not permissible.

7.2.3.2 DSfG interface

Proprietary interface for the european market.

If you need further information, please contact your local agent.

Please see www.elster.com

7.2.3.3 HSB interface

The HSB interface has currently no function at all.

7.2.3.4 DCF77 interface

Proprietary interface for the european market.

If you need further information, please contact your local agent.

Please see www.elster.com

7.2.3.5 COM2 interface

The COM2 interface is a serial interface according to RS232 for RDT applications for the European market.

If you need further information, please contact your local agent.

Please see www.elster.com

Assembling components

Suitable antenna

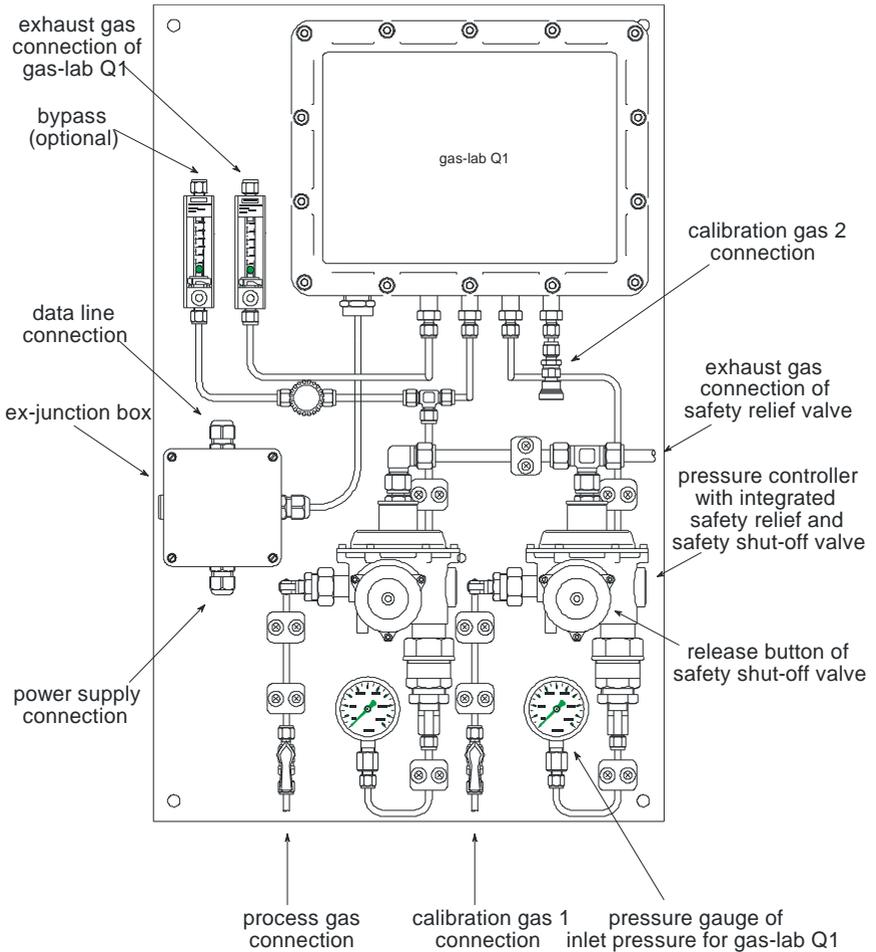
If you need further information, please contact your local agent.

Please see www.elster.com

7.3 Mounting the sensor system

7.3.1 Mounting plate

The sensor system is always mounted on a mounting plate, which also contains the electrical junction box, the low pressure controllers with safety devices (safety relief and safety shut-off valves) as well as the vent gas lines (see above illustration).



As an option, a bypass for the process gas flow may be installed to speed up the sampling. With a flow meter and a needle valve, it is possible to adjust the gas flow in the vent gas line. The gas flow in the bypass can be separately measured and adjusted. The mounting plate must be earthed at the installation site.

7.3.2 Installation site

The installation site of the sensor system has to offer protection against direct solar radiation and rain and has to comply with protection class IP 54 of the sensor system.

An ambient temperature from 5 to 40°C is permissible; a temperature drop to 0°C or a rise to 45°C will result in increasing measurement errors, but it won't damage the device.

The ex-protection class of the sensor system is: II 2G EEx d IIB T4. The Q1 evaluation computer, however, must be installed in a non-hazardous room.

For official approved applications the installation site must according to local metrological approval. For example German PTB-A 7.62. The room temperature has to be monitored for example in the limits from 5 °C to 40 °C.

7.3.3 Gas injection line

The pipes for the process and calibration gases (methane) are connected to the respective low-pressure regulators (Elster M2R); usually these are stainless steel pipes with a 6-mm diameter. The inlet pressure must range between 1 to 5 bars overpressure. The outlet pressure has been preset by the manufacturer, amounts to about 80 mbars and is indicated at the pressure gauge. Each low-pressure regulator is equipped with a safety shut-off valve that is protected by a safety relief valve. The regulators have a joint venting pipe, which must be conducted to the outside separately from the other vent gas pipes by means of a stainless steel pipe with a diameter of 10 mm.

The process gas and calibration gas flows can be shut off on the mounting plate by means of valves. When gas is injected, these valves must be closed at first and then opened very slowly to prevent the safety shut off valve from tripping and the pressure gauge from getting overloaded. Should the safety shut-off valve have been triggered nevertheless, it can be released by strongly pulling at the release button.

7.3.4 Vent gas line

During the regular measurement operation the process or calibration gas flows through the sensor system and is led off via the vent gas line. The diameter of the vent gas line must be at least 6 mm. The gas flow is indicated by a flow meter and can be adjusted via a needle valve; the flow meter should show a rate of about 25l/h.

As an option, a bypass can be installed to speed up the gas sampling. It can be separately adjusted by means of a flow meter and a needle valve. The gas flow in the bypass is adjusted depending on gas consumption and measurement response time.

The vent gas lines of the sensor system and bypass can be separately led to the outside with a minimum diameter of 6 mm. Alternatively the vent gas lines can also be combined outside the mounting plate; however, the minimum diameter of the joint pipe should then be 12 mm.

7.3.5 Electrical connection

An equipotential bonding must be implemented between sensor system/mounting plate and Q1 computer. The power supply and the data communication with the Q1 computer are connected to the explosion-proof junction box.

The power supply has to be able to supply a current of 4 A at a voltage of 24 V DC +/- 5 %. The fuse protection is preferably implemented by means of a C6 automatic circuit breaker. Examples for the design of the connecting cable of the power supply are shown in the table below. The earthing is connected in the explosion-proof junction box as well as at the power supply.

Power supply cable	Length: 0 - 30 m	Length: > 30 m
Indoor	Ölflex 3G x 2.5 mm ²	Ölflex 3G x 4 mm ²
Outdoor	NYY-J 3 x 2.5 mm ²	NYY-J 3 x 4 mm ²

Examples for the design of the communication line to the Q1 computer are shown in the table below. The shielding is connected in the explosion-proof junction box and control cabinet and at the Q1 computer, respectively.

Data communication cable	Max. length: 300 m
Indoor	LiYCY 3 x 2 x 0.5 (TP)
Outdoor	LiYCYv 3 x 2 x 0.5 (TP)

8 Commissioning

This chapter briefly describes the most important aspects of the commissioning of a Q1.

All Q1 parameters are listed in the Annex (Chapter 11) to this documentation.

8.1 Parameter protection against unauthorised access

The functionality of the Q1 can be completely configured via a parameter data record. Unauthorised persons must be prevented from changing these parameters. In order to guarantee this protection, the *gas-lab* Q1 is provided with a two-level security system consisting of the *Calibration lock* (official safeguarding) and the *Locks* (user lock, password protection).

8.1.1 Calibration lock / Calibration switch

The calibration lock physically consists of a sealable rotary switch on the front of the device. Open the calibration switch by turning it anticlockwise as far as it will go. For additional control purposes the device generates hint *H800: Calibration lock open* when the calibration switch is open.

Opening the calibration switch enables the operator to access all device parameters.

8.1.2 User lock

The *User lock* consists of one (numerical) lock for each of the two contract parties and is implemented via the software. This means that the locks are defined by the device parameterisation and opened or closed via the operator panel. Open locks allow the user to access specific parameters or actions that can be edited directly at the device. All parameters being subject to the user locks can be modified when both locks are or the calibration switch is open.

8.2 Parameterisation

Use a PC or laptop computer to create a complete parameterisation or to modify existing parameters (except for a few). Create the parameter data record using the parameterisation software GW-GNET+. The calibration switch has to be open during the import of a complete parameterisation via DSS data interface.

Note: Please refer to Chapter 6 for a brief description on the parameterisation by means of the GW-GNET+ program. For a comprehensive description of the parameterisation program, the GW-NET+ online help is available.

You may change operational parameters with GW-GNET+ via the data interface even if the calibration switch is closed, provided the user locks are open.

Checking the settings

It is possible to check the complete set of parameter settings of *gas-net* devices by means of the GW-GNET+ parameterisation program (for a brief description cf. Chapter 4.3. You may observe the currently incoming measurements of the connected sensor in a special menu at the device (for brief instructions cf. Chapter 4.4).

The output signals supplied via the MFA6 output board(s) can also be indicated for each channel via a special menu (see Chapter 4.4). This way it is possible to check the output performance easily by comparing it with the physical data.

8.3 Sealing of the device (if applicable/when required)

It is possible and might be required according to local law to secure both the sensor system and the evaluation computer of Q1 by adhesive stamps and seals against forbidden change / opening. The sealing scheme can be found in the annex. Please see documentation chapter 11.4 for more details.

8.4 Commissioning of Integrated RDT module (optional feature for the European market and, not available with all software variants)

If you need further information, please contact your local agent.

Please see www.elster.com

8.5 Commissioning the sensor system

Prerequisites for the commissioning:

The Q1 evaluation computer and Q1 sensor system have been installed according to the mounting instructions in Chapter 7. Power supply is switched off.

The inlet valves for process and calibration gases located on the mounting plate are closed and the gases are coming in with an appropriate pressure.

The needle valve at the flow meter of the sensor system's vent gas line is partly open to prevent the vent gas line from getting blocked.

Steps

- 1 Switch on the power supply of the Q1 sensor system.
- 2 Switch on the power supply of the *gas-net* Q1 evaluation computer.
The Q1 computer communicates with the Q1 sensor system (uploading of calibration data etc.) and injects process gas. The display shows **Waiting for PG**.

The gas paths and in particular the pressure controllers are purged in the next step.

- 3 Invoke the **Purge** menu at the Q1 computer. **Gas path 1** is displayed. If you press the Enter key while being in this display, a box for selecting the gas path (1 = process gas, 2 = calibration gas, 3 = optional inlet) will appear. Choose the corresponding path by means of the arrow keys and invoke the menu afterwards. Confirm your selection via **OK** or abort it via **Cancel**.
- 4 4. e.g. choose gas path 1 (process gas path).

The following description assumes that you have chosen gas path 1 in step 4 (process gas path).

- 5 Open the inlet valve of the process gas very slowly.
- 6 The flow controller of the sensor system's vent gas line must be set to 30l/h (top of ball).

- 7 Purge the pressure regulator by repeatedly closing and opening the inlet valve: For this, close the inlet valve while the gas is flowing until the control pressure has dropped to 0. Afterwards, re-open the valve very slowly. Quickly repeat this cycle 5 times without stopping.
- 8 The device remains in the *Purge* mode for about 5 minutes while the gas is flowing and then returns to the *Process gas measurement* mode. The display shows **Waiting for PG**.
- 9 After the device has returned to the *Process gas measurement* mode, the other gas paths can be purged in the same way.

After a cold start at room temperature the sensor system takes about 1 hour for warming up. Afterwards, it is ready for operation. The final warm-up stage of the sensor system and thus the measurement stabilisation, however, takes 3 hours. This is why the device automatically performs a 1-point calibration with methane 12¹⁵ hours after it has been switched on. If you would like to perform valid measurements during these first 12 hours, we recommend to manually carry out a 1-point calibration. Nevertheless, the automatic calibration will be triggered after 12 hours at any rate.

¹⁵ This waiting time can be adjusted. This is important for a redundant (double) installation of the measurement devices, since else both – e.g. after power failure – will calibrate at the same time and during this time none of both can be used. Please contact Elster for further questions.

9 Maintenance

The *gas-lab* measuring system, consisting of the evaluation computer and sensor system, does not require much maintenance.

9.1 Maintaining the *gas-net* Q1 evaluation computer

9.1.1 Battery replacement

When maintaining the device, check whether the internal RAM battery has to be replaced. For this, a device internal elapsed-hour meter¹⁶ is used as indicator. The period of time during which the backup battery has supplied the energy is calculated by subtracting the operating hours supplied by the power supply from the total operating time in hours.

A battery life of 45 000 hours is guaranteed. However, the battery must be replaced after 10 years at the latest. The battery should be replaced when a reserve of less than 20 000 hours at the beginning of the maintenance period is remaining. In addition: The battery must be replaced after 10 years at the latest.

If the RAM battery must be replaced, this should only be executed by a service engineer or trained expert for safety reasons.

For replacement of the battery, it is necessary to open the housing of the *gas-net* device. For open an officially sealed housing the presence of an officially authorized person might be required.

¹⁶ The elapsed hour meter is part of the main display of the *System* module.

Proceed as described below:

- A battery of the following type is required: lithium 3V CR ½ AA.
- Save the device parameterisation by reading it out with GAS-WORKS, to be on the safe side. Read out the archives, too.
- Disconnect the supply voltage.
- Loosen the 4 fixing screws on the back of the device. Two of these screws could be hidden and secured by (official) adhesive labels or seals.
- Slightly withdraw the mounting rail. **Attention:** The boards are sensitive! Avoid any contact with other components!
- The battery compartment is down on the left of the board that is located on the far right side (seen from behind). Detach the cover strap of the battery compartment with a screwdriver. Remove the old battery. Now you have 15 minutes for the battery exchange, during which a data backup is guaranteed by a capacitor. Insert the new battery.
Note: When inserting the battery, pay attention to the correct polarity: The positive pole (+) must point downwards! A wrong polarity will not be noticed at first, but during the next power failure of more than 15 minutes the device data will be lost.
- Re-assemble the device and connect the supply voltage.

9.1.2 Fuse replacement

If the fuse must be replaced, this should only be executed by a service engineer or trained expert for safety reasons.

For replacement of the fuse, it is necessary to open the housing of the gas-net device. For open an officially sealed housing the presence of an officially authorized person might be required.

Proceed as described below:

- A fuse of the following type is required: cartridge fuse link 5 x 20 mm; 0.63 A (device with 1/3 mounting width) or 0.8 A (device with 1/2 mounting width); slow-blowing fuse according to DIN.
- Disconnect the supply voltage.
- Loosen the 4 fixing screws on the back of the device. Two of these screws could be hidden and secured by (official) adhesive labels or seals.
- Slightly withdraw the mounting rail. **Attention:** The boards are sensitive! Avoid any contact with other components!
- The fuse is on the bottom of the mounting rail on the board for the mains connection. Unscrew the cover of the base using a screwdriver and replace the fuse.
- Re-assemble the device and connect the supply voltage.

9.2 Maintaining the *gas-lab* Q1 sensor system

The sensor system does not require much maintenance and does not contain any wearing parts. Only methane is used for calibration during normal operation. The following tasks must be accomplished during the yearly routine testing:

- 1 The calibration gas methane must be replaced if the residual gas volume has dropped below 200 nm³, which corresponds to a residual pressure of about 20 bars in case of a 10-litre cylinder. This guarantees a remaining time of 6 months when a calibration is regularly performed each week.
- 2 We recommend to yearly perform a basic calibration with nitrogen, methane, and the calibration gases (H2-11K and L1-8K resp. binary gas mixture with 5% CO₂ in methane).
- 3 Visually check the breather (located on the upper right side of the sensor system): Remove the protective screwed cap of the breather and check it together with the breather's aperture for contamination.
- 4 Observe the national regulations regarding safety checks when checking the safety devices of the low-pressure regulators (i.e. safety relief and safety shut-off valves). Usually, we recommend to perform a visual check once a year and a functional check once every six years.

The Q1 computer automatically monitors the sensor technology of the Q1 sensor system and triggers an alarm if a sensor signal is missing. During the cyclic automatic 1-point calibration changes of the sensor technology are quantitatively logged and monitored for limit values. Afterwards, it is possible to decide whether a basic calibration or possibly a repair is required when an alarm occurs.

10 Technical data: Q1

10.1 Device type

The *gas-lab* Q1 measuring system is a flameless measuring instrument for determining the quality of natural gases using an infrared absorption-based measuring method. It consists of a heavy-duty housing, in which the actual sensor unit is accommodated, and of an evaluation computer, which must be operated in a non-hazardous environment. The system operates continuously and fast and can be used for billing or controlling applications.

10.2 Sensor technology details (*gas-lab* Q1)

Measurements¹⁷

Primary measurements: Heating value superior $H_s =$
 gross calorific value GCV: 30 to 47MJ/m³
 Standard density ρ_s .0.71 to 0.97 kg/m³
 xCO₂ content: 0 to 5 % (optional 0 to 20 %)

Derived measurements: Heating value inferior $H_i =$ net calorific value NCV,
 Wobbe number, methane number and calculated gas
 analysis (10 components)

Suitable gases

2nd gas family (natural gases) according to G260

CH ₄ :	75%	to	100%
C ₂ +	0%	to	15%
N ₂ :	0%	to	20%
CO ₂ :	0%	to	5% (Optional 0 – 20 %)
O ₂ :	0%	to	2.0%
Others parts		<	0.1 %

¹⁷ According to the national type approval in Germany.

Calibration gas

Methane (quality 4.5) with automatic injection for 1-point calibration. Nitrogen, methane, calibration gas mixture H2-11K and a binary mixture of 5% CO₂ in methane (formerly L1-8K) for manual activated basic calibration.

Operating pressure/consumption

Standard configuration with low-pressure controller and integrated safety shut-off/safety relief valves

Inlet pressure: 0,5 to 5 barg, 30 l/h

90 % response time (T90)

Approx. 20 to 60 seconds (in case of standard configuration, depending on bypass flow rate (Optional 10 sec.)

Accuracy in the range of 34.2 to 45.0 MJ/m³

Hs=GCV: < 0.4 % (relative), ρ_s : < 0.8 % (relative), CO₂: < 0.2 % (absolute).

Reproducibility:

Hs=GCV: < 0.1 % (relative), ρ_s : < 0.1 % (relative), CO₂: < 0.1% (absolute).

Sensor housing

Dimensions/weight: L=38 cm, W=28 cm, H=22 cm, 21 kg

Protection class IP 54

Ex-protection class II 2G EEx d IIB T4

Ambient conditions

5 to 40°C, protection against direct solar radiation and rain required (additional heating system and /or air conditioning chamber is available)

Power supply

24 V DC \pm 5 %, 2 A, power input: max. 50 W (cold start) normal 35 W

Gas injection

3-channel double block and bleed valve block integrated in the sensor housing for the process gas and two calibration gases, vent line connection.

10.3 Evaluation computer details (*gas-net* Q1)

Plug-in unit in 19"-design, 3 height units, 1/3 or 1/2 mounting width for hinged bay mounting. Mounting depth without connectors: approx. 170 mm, with connectors: approx. 220 mm. Process interfacing on the back; operator panel on the front.

Power supply

24 V DC +/- 20 %; power input: up to 12 W. As an option: 230 V AC via external power supply.

Operation

16 input keys (12 for numerical entry and 4 for navigation) and one calibration switch. Easy-to-learn operation via invocable menus. The GAS-WORKS program system provides a remote control function via modem and COM2 or DSS data interface.

Display

Illuminated LCD; 8 lines with 32 characters each; status LED for the indication of mains/alarm/warning.

Board array

A Q1 evaluation computer must provide at least one LMFA7 board for the connection of the sensor technology via fibre-optics cable.

The process boards may optionally be extended by further boards; the maximum number of boards depends on the casing size: A 1/3 mounting width casing accommodates up to three process boards whereas a 1/2 mounting width casing accommodates up to six process boards. The following board types are currently available:

EXMFE4 input board:

- Two pulse or message inputs [EEx ib] IIC. When being used as pulse input, the board is suitable for the connection of LF and HF pulse generators similar to DIN 19234, with max. 10 kHz; automatic level adaptation by channel. The first channel is also suitable for the connection of an encoder totalizer.
- Temperature sensor input for a PT100 in 4-wire technique; [EEx ib] IIC; maximum measuring error in a range of -10 to +60°C and 0 to 40°C ambient temperature: ± 0.05 % of the measurement.
- Measuring sensor input from 4 to 20 mA; [EEx ib] IIC; maximum measuring error in a range of 4 to 20 mA and 0 to 40°C ambient temperature: ± 0.05 % of the measurement.
This channel can alternatively be used for the connection of up to 4 measuring sensors with HART interface (multi-drop).

MFA6 output board:

- One relay output (break contact, max. 28.8 V at 120 mA).
- Three transistor outputs (max. 28.8 V DC at 90 mA) for messages or pulses max. 25 Hz.
- Two analogue outputs 0/4 ... 20 mA for measurements; max. load impedance: 300 ohms. Error in a range of 4 to 20 mA and 0 to 40°C ambient temperature: ± 0.1 % of the output value.

LMFA7 output board:

- Fibre-optics connection for external I/O expansion. The *gas-lab* Q1 needs this fibre-optics connection for the connection of the sensor technology.
- One relay output (break contact, max. 28.8 V at 120 mA).
- Two transistor outputs (max. 28.8 V DC at 90 mA) for messages or pulses with max. 25 Hz.
- Four analogue outputs 0/4...20mA.

Interfaces

DSfG interface with a maximum transmission rate of 115200 baud. Gas quality data and data logging archives retrievable via DSfG.

DSS data interface for the connection to the COM interface of a PC or laptop (for parameterisation when commissioning and for archive polling).

COM2 interface (serial interface to RS232C) for the connection of a modem with a maximum transfer rate to V.34bis (33600 baud) and data compression to V.42 or NMP5.

DCF77 interface for the connection of a radio clock receiver.

Data logging

Integrated data logging function for logging billing and operating data.

Parameterisation

Commissioning and parameterisation are implemented via the GAS-WORKS PC software. Parameter data records can be stored, documented and managed in the PC under GAS-WORKS.

11 Annex

11.1 Error listing of the *gas-lab Q1*

The following list describes all error messages that may appear on the error listing of the gas quality measurement. Furthermore, the performance of the device when gas quality-relevant errors occur 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 following list describes all error messages that may appear on the error listing of the gas quality measurement.

A040 Rhon failure / A060 Hon failure / A070 CO2 failure

If one of the alarms A040, A060 or A070 is generated, the respective physical final value can not be calculated due to inconsistency of the supplied raw values. Possible causes are:

- Timeout expired for GQ source data telegram and no replacement available measurement;
- data source available marked as disturbed and no replacement measurement,
- by incorrect GQ data source setting in parametration..

A041 Rhon min alarm / A042 Rhon max alarm

The lower and upper alarm limits for the target value Rho is defined in the parameterisation of the *gas-net Q1*. If one of the calculated final values violates an alarm limit, the associated alarm will be generated.

A061 Hs min alarm / A062 Hs max alarm

The lower and upper alarm limits for the target value Hs is defined in the parameterisation of the *gas-net Q1*. If one of the calculated final values violates an alarm limit, the associated alarm will be generated.

A071 CO2 min alarm / A072 CO2 max alarm

The lower and upper alarm limits for the target value CO₂ is defined in the parameterisation of the *gas-net Q1*. If one of the calculated final values violates an alarm limit, the associated alarm will be generated.

A 405 Data memory error

The alarm is generated if an inconsistency occurs in the memory area for the official data storage of the gas-net Q1.

A407 Restart

The alarm *Restart* is always generated at the first start-up of the *gas-net* Q1 evaluation computer after a software update. If A407 is generated during normal operation, a device software internal problem has occurred. In this case, a correct operation of the *gas-net* Q1 is no longer guaranteed.

A409 Supply voltage failure

The *gas-net* Q1 generates this alarm in case of a mains failure or after restart with new parametrisation. This alarm does not stop pending until the device has started up completely after voltage recovery. Switching on the power supply automatically triggers a 1-point calibration with methane.

A604 Timeout

The data communication between the Q1 computer and the Q1 sensor system is interrupted longer than 5 sec. The measurement stops until the communication has been re-established.

A605 Data error

Implausible data has been transferred during the data communication between the Q1 computer and Q1 sensor system. The alarm is generated along with the hints H2003, H2004, H2007, H2008, H2009, H2010, H2011, H2012, H2013, H2014, H2015, H2016 and H2018 (see below). The individual hint indicates the exact cause of the fault. In particular, this includes faulty data relating to the CH, CO₂, THC, T and p measurements. The measurement stops until the data is plausible again.

A606 Temperature failure

The alarm is generated during in violation of a temperature alarm limit (upper or lower). At the same time H2005 (Tmin) or H2006 (Tmax) is generated. Also the alarm is displayed when the minimum temperature is not reached within a given timeout period, at the same time H2019 (Tmin startup) is generated. Another reason for the alarm is given when the temperature stability check during the start up fails, in this case H2020 (T instab startup) is generated. The measurement stops until the temperature is stable again.

A607 Pressure failure

The alarm is provided for monitoring the pressure of the sensor system. Its appearance during violation of the configured limit values (upper / lower alarm limit) is set by the parameter "Pressure error is warning". If this parameter is set to "No", the alarm is always generated (after a timeout), if no gas pressure is present in the instrument. When "Pressure error is warning" = Yes and calibration gas is switched on, this alarm is replaced by warning W2030 (see below). Such a pressure error with process gas connected always leads to the alarm A607 Pressure failure.

A647 GQ disturbed

The alarm indicates a general problem in the gas quality measurement. It is generated in the following situations:

- Any sensor raw value (eg ICHmeas, ICHref, ...) from the violates the configured alarm limits.
- A triggered 1-point calibration with methane has been canceled without success (violating a stability timeout).

A 670 CGM disturbed

The alarm indicates that the calibration gas measurement is disturbed. Examples:

- Incorrect associated measuring equipment or incorrect serial number, (in this case, H20021 is generated simultaneously)
- Calibration time out (in this case W 753 is generated additionally)

H423 Interface monitoring

If this hint is pending, the device software can not recognize an interface or internal board. This occurs, for example, if a card is broken, a connector is not plugged in or the communication between the controller and sensor system is interrupted. A correct device operation is no longer guaranteed.

H671 Pmax p-regulator

This hint (group signal) is generated when the safety relief valve (SBV) of the high-, medium- or low-pressure reduction is triggered or it indicates a violation of the upper limit of input pressure for the high-pressure reduction. Corresponding contact pressure meter provided.

H672 P min methane

An input signal indicates the violation of the pmin limit of the methane gas bottle. This signal does not prevent a following calibration gas injection, but indicated a drained methane calibration gas.

H674 Pmin test gas

An input signalling a violation of the pmin limit of the gas cylinder for the automatic test gas injection. This signal does not prevent a following automatic test gas injection, but indicated a drained test gas.

H675 Tmin room

An input signal indicates the violation of Tmin limit of ambient temperature or the room temperature measurement falls below the hint limit. This signal does not prevent from futhur measurement progress, but shows a possible impact on the measurement accuracy.

H676 Tmax room

An input signal indicates the violation of Tmax limit of ambient temperature, or the room temperature measurement exceeds the reference limit. This signal does not prevent from futhur measurement progress, but shows a possible impact on the measurement accuracy.

H678 Tmin test gas

An input signal indicates the violation of Tmin limit of the test gas cylinder. This signal does not prevent a test gas injection, but shows a possible impact on the measurement by condensation of higher hydrocarbons at temperatures below the hydrocarbon dew point.

H700 Pulse buffer overflow

The parameterisation of the pulse outputs defines a pulse value and maximum output frequency. If more volume pulses occur than can be dent out with the maximum output frequency, the *gas-net* Q1 will retain up to 1000 pulses. These pulses will be sent out as soon as possible. Only if this pulse buffer isfilled up, too, further incoming pulses are rejected. This situation is indicated by this hint.

Note: To avoid loosing any pulses, ensure that the pulse value and the maximum output frequency are in the correct proportion to the maximum flow when parameterising the device.

H706 Lower hint limit output

This hint draws attention to an error in the configuration of an analog output. The assigned reading of an analog output falls below the lower benchmark, which is assigned to the lower current limit. Probably the output range defined by the lower under parameter's limit set smallerer than the actual measurement range of the output measure.

H710 Upper hint limit output

This hint draws attention to an error in the configuration of an analog output. The assigned reading of an analog output falls below the upper benchmark, which is assigned to the lower current limit. Probably the output range defined by the lower under parameter's limit set larger than the actual measurement range of the output measure.

H760 GQ calibrating

The hint begins and ends each time a calibration starts or ends. After a (re-)start of the device, this status remains till the startup process is finished and the regular measurement has started.

H800 Calibration lock open

An opening of the rotary switch called calibration switch (wich can be sealed) on the front panel of the device is marked by this hint. Only if the calibration switch is open, it is possible to:

- import a new parameterisation into the *gas-net* computer
- switch off the automatic measurement
- switch gas paths
- perform basic calibrations (3-point calibration)

The calibration switch should always be closed for safety reasons during normal operation. To open a switch officially closed, the presence of an officially authorized person may be required.

H801 User lock open

The *User lock* consists of one numerical lock for each of the two contract parties. The locks are optional and defined via the device parameterisation. 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 enable the user to access particular parameters or actions, either via the operator panel of the device or with GAS-WORKS via the data interface.

H802 Revision

When the revision /service switch is set, the gas-net Q1 responds as follows: The hint "Revision" is created. From this moment, all entries in the interval archive are marked revision. The device is in revision mode. The revision switch is set automatically in case of basic calibration and test gas injection. The revision switch is implemented in software and can also be opened from the operator panel of the device.

H1931 Logbook service request / H1932 Archive service request

Hints H1931 and H1932 are generated when a logbook or an archive has exceeded a certain size. Please refer to *Technische Spezifikation für DSfG-Realisierungen (Technical Specification for DSfG Implementations)* for further details.

H 2002 No pressure

The hint is generated after 5 seconds, without pressure when the measurement system gas pressure expects.

H 2003 P min

The hint is generated along with alarm A605 (data error) when the lower alarm limit is violated.

H 2004 P max

The hint is generated along with alarm A605 (data error) when the upper alarm limit is violated

H 2005 T min

The hint is generated along with alarm A606 when the lower temperature alarm limit is violated.

H 2006 T max

The hint is generated along with alarm A606 when the upper temperature alarm limit is violated.

H 2007 UTCS min

The hint appears when the signal voltage of the thermal conductivity detector, violates the low alarm limit. It is generated together with alarm A605 (data error), to describe the exact cause of the fault.

H 2008 UTCS max

The hint appears when the signal voltage of the thermal conductivity detector violates the upper alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2009 ICHref min

The hint appears when the signal voltage of the infrared sensor for hydrocarbons, reference channel, violates the lower alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2010 ICHref max

The message appears when the signal voltage of the infrared sensor for hydrocarbons, reference channel violates the upper alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2011 ICHmeas min

The hint appears when the signal voltage of the infrared sensor for hydrocarbons, measurement channel, violates the lower alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2012 ICHmeas max

The hint appears when the signal voltage of the infrared sensor for hydrocarbons, channel violates the upper alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2013 ICO2ref min

The hint appears when the signal voltage of the infrared sensor for CO₂, reference channel, violates the lower alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2014 ICO2ref max

The hint appears when the signal voltage of the infrared sensor for CO₂, reference channel violates the upper alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2015 ICO2meas min

The hint appears when the signal voltage of the infrared sensor for CO₂ measurement channel violates the lower alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2016 ICO2meas max

The hint appears when the signal voltage of the infrared sensor for CO₂ measurement channel violates the upper alarm limit. It is generated together with alarm A605 (data error), to mark the exact cause of the fault.

H 2017 Numeric ERROR

The message appears when the calculation of the target values exceeds error limits.

H 2018 Result ERROR

The hint appears when the calibration is wrong or missing. The calculation of the target values (Hs, Rhon, CO₂) is not possible. During measurement operating gas or revision gas and it can be calculated not a virtual analysis. Simultaneously A605 (data error) is generated.

H 2019 T min startup

If during startup of the system, the sensor temperature will not rise above a minimum value, this hint is generated along with alarm A606. Meanwhile calculations are not performed.

H 2020 T instab startup

If during startup of the system, the sensor temperature fluctuates too much this hint is generated together with alarm A606. Meanwhile calculations are not performed.

H 2021 Sensors off

Information that the gas sensors are shut off. For example, because:

- no pressure
- startup not yet finished
- communication problem between the Q1 sensor unit and controller (together with H423).

H 2022 Path purge

During startup or when the input channel is switched / exchanged, the new channel is purged first. This is announced by this hint. Meanwhile, there is no measurement.

W753 Calibration timeout

A 1-point calibration has not produced an acceptable (stable) result after a parameterised time. Hence the calibration is aborted without a result, and the system switches back to process gas measuring. The warning ends with the next successful calibration. W753 is always accompanied by A670.

W755 Calibration deviation

A 1-point calibration has produced a result outside the planned confidence interval (1-point calibration with methane too high). The calibration is aborted without result and the system switches back to process gas measuring. The warning ends with the next successful calibration. W755 is always accompanied by A670.

W810 Clock set old

With each adjustment to the device's internal clock of more than ± 20 seconds or $\pm 3\%$ of the monthly interval, the two warnings W810 and W811 are generated. The entry in the log is done with old time stamp and the time adjustment can be traced in the logbook.

W811 Clock set new

With each adjustment to the device's internal clock of more than ± 20 seconds or $\pm 3\%$ of the monthly interval, the two warnings W810 and W811 are generated. The entry in the log is done with a new time stamp and the time adjustment can be traced in the logbook.

W812 Clock-synch failed

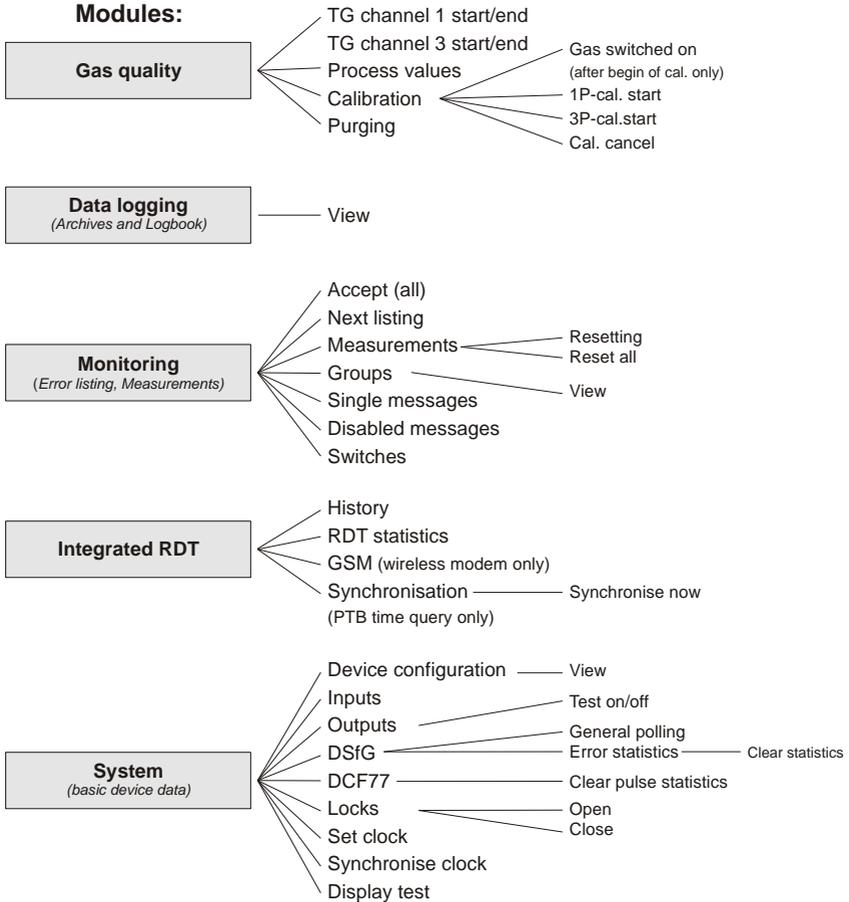
The setting of the device internal time is only possible within a range of ± 20 seconds and only once within 24 hours with the calibration switch being closed. The *Clock-synch failed* warning will be generated in case of an inadmissible attempt to set the clock.

W 2030 Pressure failure

Can be generated if the parameter "pressure error is warning" = yes is set. But this applies only to a pressure failure during calibration gas measurement (taking a timeout). During process gas measurement still the alarm **A607 Pressure failure** is generated allways.

11.2 Menu structure of the Q1

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:

- **DSfG(-Requester)** and **Data exchange (Host-Communication)** for the gateway functionality (this display is meant for diagnosis by experts only)

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