Instruction Manual
HAS3xE-IM-SW39
10/2005

Software Version 3.9.x

NGA 2000 Software Manual for MLT or CAT 200 Analyzer and MLT or CAT 200 Analyzer Module (combined with NGA 2000 Platform, MLT, CAT 200 or TFID Analyzer)

ROSEMOUNT® Analytical

EMERSON™ Process Management

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ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Emerson Process Management (Rosemount Analytical) designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you **MUST properly install, use, and maintain them** to ensure they continue to operate within their normal specifications. The following instructions **MUST be adhered to** and integrated into your safety program when installing, using and maintaining Emerson Process Management (Rosemount Analytical) products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- **Read all instructions** prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, **contact your Emerson Process Management (Rosemount Analytical) representative** for clarification.
- **Follow all warnings, cautions, and instructions** marked on and supplied with the product.
- **Inform and educate your personnel in the proper installation, operation, and maintenance of the product**.
- **Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes**. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, **use qualified personnel** to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Emerson Process Management (Rosemount Analytical). Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, **and VOID YOUR WARRANTY**. Look-alike substitutions may result in fire, electrical hazards, or improper operation.
- **Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury**.

The information contained in this document is subject to change without notice.

1th Edition 05/2004 2nd Edition 04/2005 3rd Edition 10/2005

Emerson Process Management GmbH & Co. OHG
Industriestrasse 1
D-63594 Hasselroth
Germany
T +49 (0) 6055 884-0
F +49 (0) 6055 884-209
Internet: www.EmersonProcess.com

Cert. Reg. No. 254969 QM

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Contents

1 Introduction

This **software manual** describes step by step how to operate successfully the Emerson Process Management NGA 2000 Series MLT & CAT 200 analyzer modules and analyzers (MLT 1, 2, 3, 4 and 5; CAT 200 = MLT 1 in an EEx dem enclosure).
Chapter 2 shows the **structure** of the **MLT software menus**. Chapter **3** describes the **display** and the **keyboard** of the analyzer and the main menu and submenus. Chapter **4** describes the **basic controls incl. calibration** with detailed illustrations. So you can easily compare the actual analyzer (module) display with the illustrations of the manual.
Chapter **5** describes the **expert configurations** of the analyzer module and of the Input/ Output modules (I/O modules). Chapter **6** describes the **system configuration and diagnostics**. The layout of both chapters is not as detailed as in chapter four. Normally, the way to a certain menu of the MLT software is described with the software catchwords you have to press to reach this menu. You will find the illustration of the corresponding LCD screen at the end of the catchword listing. After that you can read the meaning of the functions and variables of each expert or system configuration menu. In chapter **7** you will find some information about the **display controls**.
Some contents of the expert configurations are not important for each customer. It depends on the configuration of your NGA 2000 system, relative to the following components:

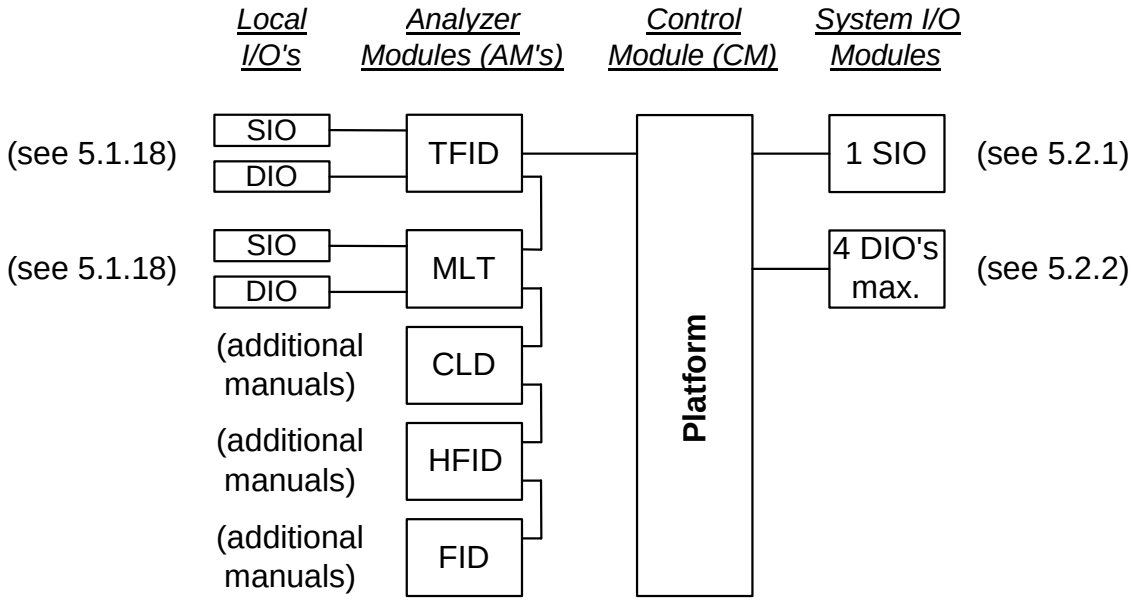
- Control Module **CM**
- Analyzer Module **AM**
- Input/Output Modules **I/O**'s (SIO = Standard I/O, DIO = Digital I/O)

You can distinguish the following system units and SIO/DIO configurations:

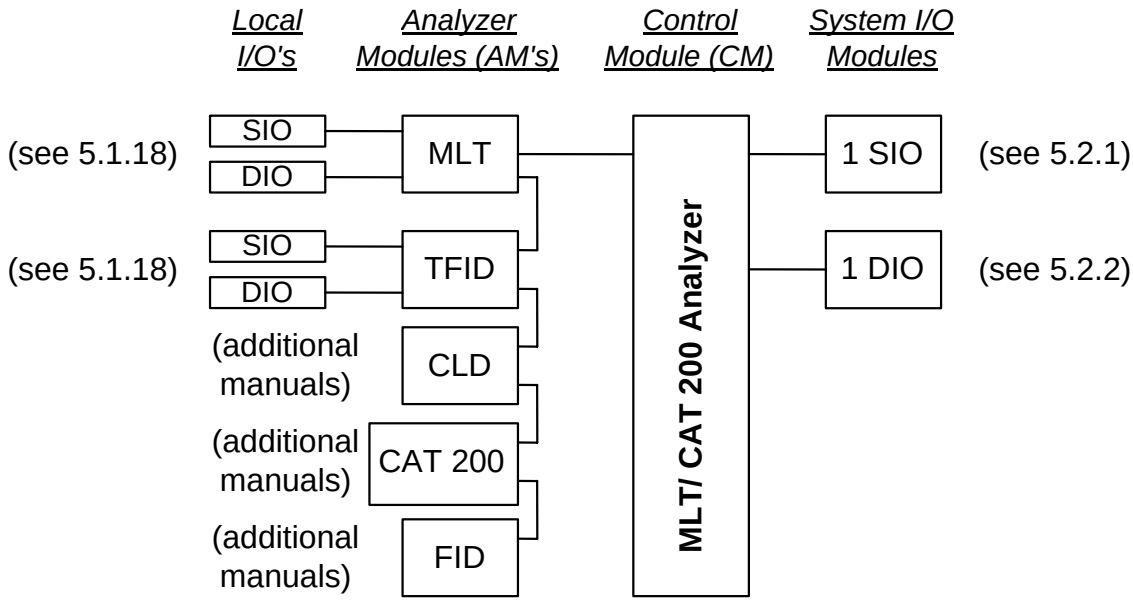
System Unit	SIO/DIO Configuration	Section Page
MLT analyzer module (AM): • without front panel, i.e. without control unit • can be combined with a platform, a MLT/ CAT 200/ TFID analyzer or a customer developed control unit	⇒ 1 local SIO and 1 local DIO (or 2 local DIO's) can be installed in the MLT/TFID analyzer module ⇒ SIO and DIO can be configured for the MLT AM channels or the TFID analyzer module only	∗ 5.1.18 p. 5-71
Platform (CM Software): • Control unit with front panel • Without measurement channels	⇒ 1 SIO and up to 4 DIO's can be installed in the platform (CM I/O's) ⇒ SIO and DIO can be configured for all MLT channels & AM's combined with the platform	∗ 5.2 p. 5-87
MLT analyzer (CM plus MLT AM software = MCA software): • Analyzer with front panel • CM and AM software in the same analyzer, i.e. all functions of the control unit and of the AM are combined in one controller board	⇒ 1 SIO and 1 DIO (or 2 DIO's) can be installed in the MLT/ CAT 200/ TFID analyzer (CM I/O) ⇒ SIO and DIO can be configured for all MLT channels & AM's combined with the MLT/ CAT 200/ TFID analyzer	∗ 5.2 p. 5-87

The following illustrations shall clarify the relationship between the hardware configuration and the software setup of the modules:

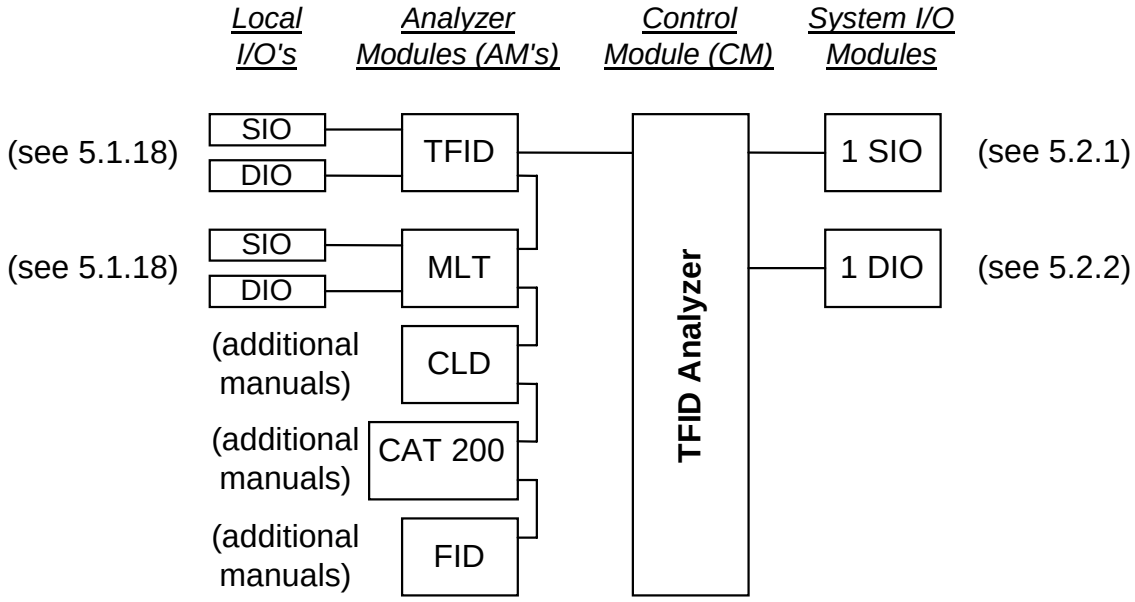
NGA 2000 System via Platform



NGA 2000 System via MLT/ CAT 200 Analyzer



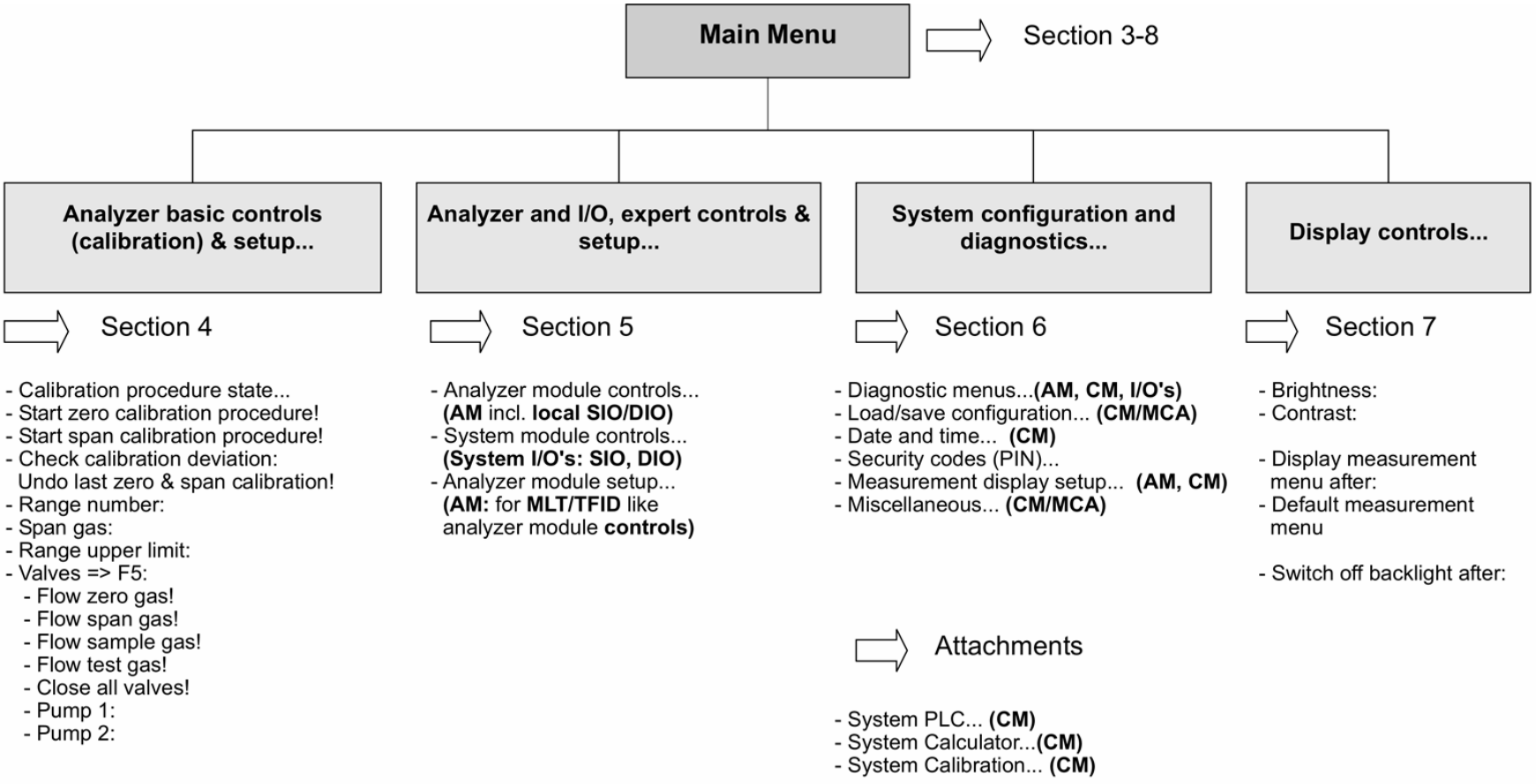
NGA 2000 System via TFID Analyzer



Note:

This software manual will describe the software of all MLT/ CAT 200 analyzers and MLT/ CAT 200 analyzer modules combined with a platform, an MLT analyzer or a TFID analyzer.
It will not describe the software of MLT analyzer modules running with a customers control unit.

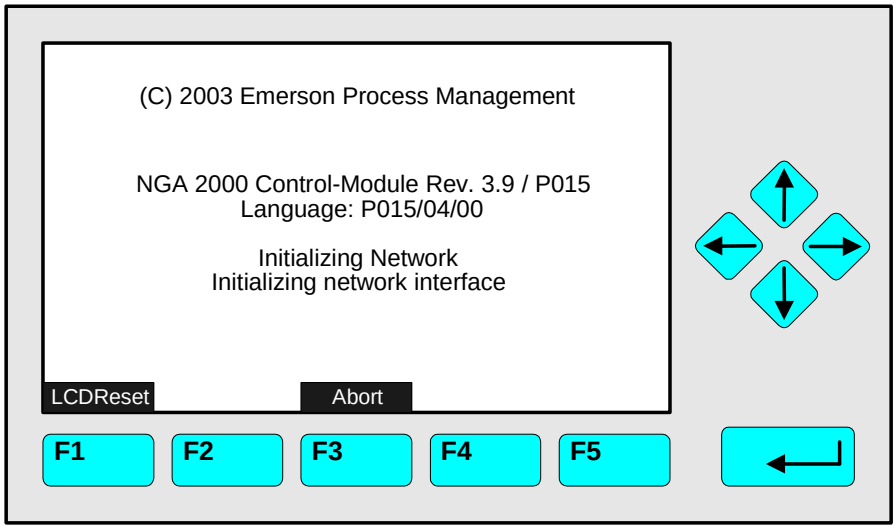
The software of TFID analyzers or TFID analyzer modules is nearly identically to the MLT software. An own TFID software manual is available containing the FID specific functions.



Notes:
*Menu lines ending with three points (...) are followed by submenus with further functions and setups, lines ending with "!" allow to start the function, lines ending with ":" display module parameters - some can be changed.
*All setups in the menu "Analyzer basic controls (calibration) & setup" are valid for the analyzer or analyzer module (AM).
*Each menu point of the menus "Analyzer and I/O, expert controls & setup" and "System configuration and diagnostics" allow to choose which functionality to setup: AM (Analyzer Module), CM (Control Module), local, system I/O's (Input/Output Module).

3.1 Starting and Initializing

After switching on the MLT/ CAT 200 analyzer or analyzer module (located in a platform or as part of a NGA network), the initialization procedure will be performed. A self test is started showing a sequence of several screens with information about the initialization status, software revision notes and the Emerson tag:



After “Initializing network interface” the next display shows “Searching for nodes” followed by “Calculating binds”.

If you press the **F1 -key** during the **initializing**, you will **reset** the **LCD brightness and contrast to factory settings** (see also section 7). Pressing the **F3 -key** will **abort** the **network initializing**. There will be no connection to any analyzer module. Only the menus of the control module (platform, MLT, CAT 200 or TFID analyzer) will be available.

At the **end** of the **initializing procedure** you can see the **single component display** of channel one (see illustration on next page). It is the starting point to all the other channel displays, menus and submenus.

The instructions of the basic controls (chapter four) are all beginning with the single component display. Since this screen is customer configurable the actual display might differ from the one shown in this manual (see section 5.1.8 p. 5-51 and section 7).

3.2 Display and Function

The LCD screen shows all measurement values of the analyzer and all customer instructions. You can operate with five function keys, four arrow keys (cursors) and the enter key. The function of each key depends on:

- the type of analyzer/analyzer module used
- the optional auxiliary modules (e.g. I/O boards) used
- the individual menu displayed

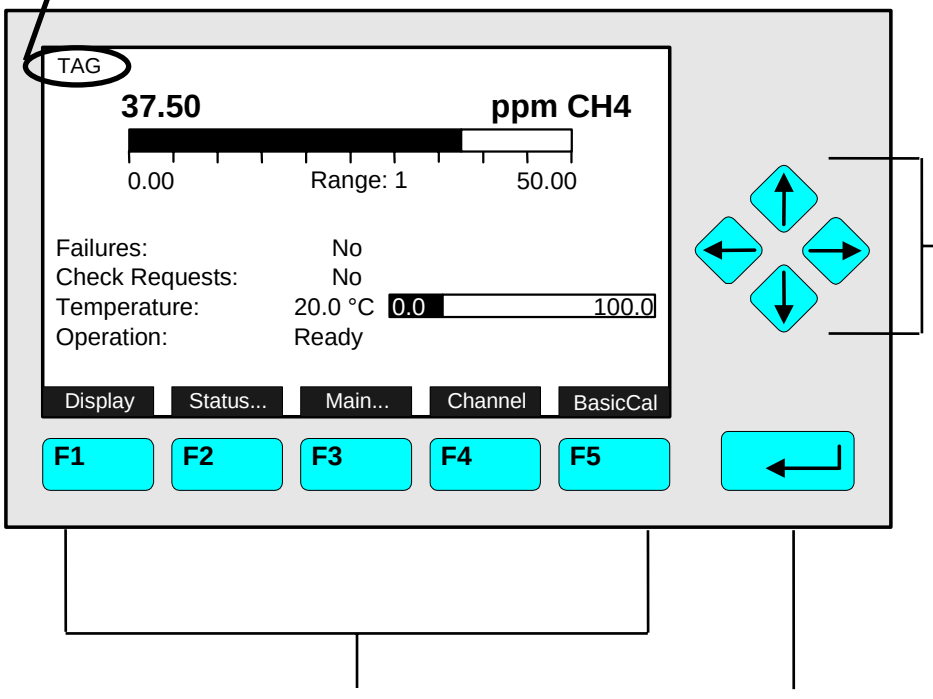
In case of power failure all customer specific module parameters are saved by a battery-powered buffer.

3.3 "TAG" and Operating Keys

At the top left of each menu page you will find the tag of the current channel.
Typical tags:

- MLT/CH1/R1: MLT Analyzer or Analyzer Module / CHannel 1 / Range 1
- TFID-R1: Thermo FID Analyzer or Analyzer Module - Range 1

In this manual the default screen will show "TAG". But specific MLT menu pages will use "MLT" instead of “TAG”.



Cursor keys:
↑ -key / ↓ -key:

- Line up / line down within the same menu
- Alteration of numbers, variables or digits

← -key / → -key:

- Moving back/forwards between the pages of a menu
- Selection of digits

Function Keys:

- Keys without defined functions
- The current function depends on the menu selected
- The soft key legend is shown on the display above the key

Enter Key:

- To confirm a previously entered value (variable)
- To start a selected function (alternative: → -key)
- To enter a menu (via menu line)

3.4 Lines and Soft key Functionality

Lines can be selected by using the ↓ -key or the ↑ -key. The selected line is displayed white on black (highlighted). You have four different types of lines in the menus:

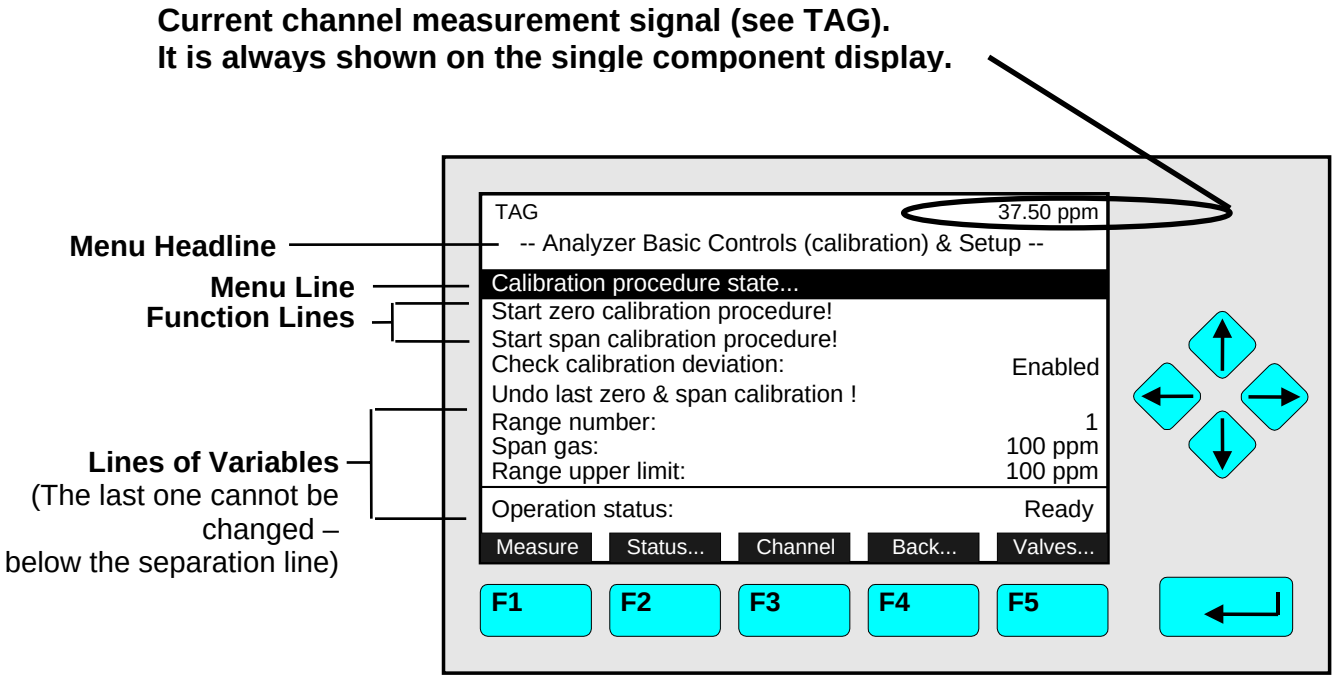
Menu line... / Menu Soft key...
- Line/Soft key description ending with three dots.
- You will enter a submenu/next menu by pressing the soft key resp. by pressing the ↵ -key or the → -key while the menu line is highlighted.

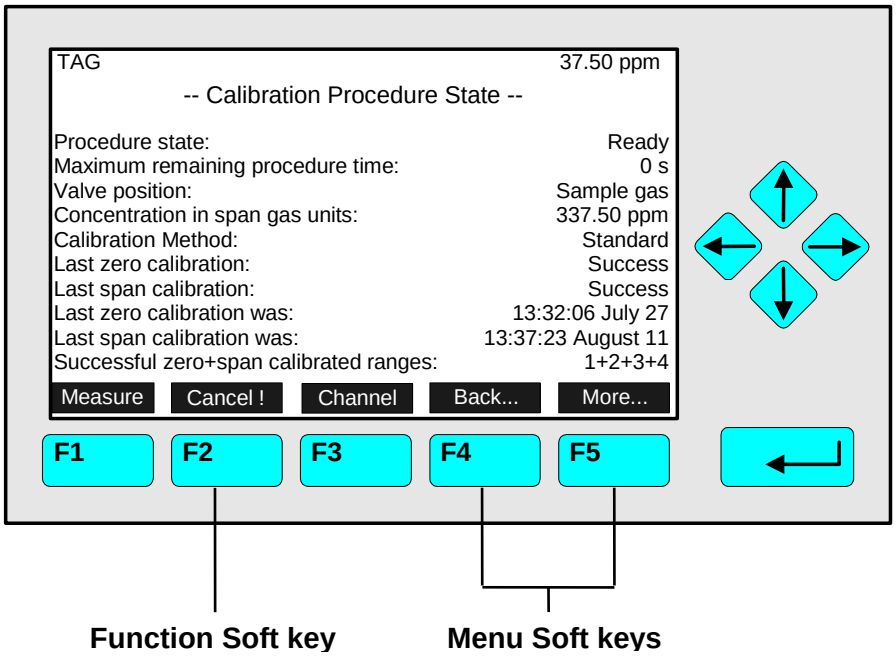
Function line / Function Soft key !
- Line/Soft key lettering ending with an exclamation-mark.
- You will start a function (e.g. calibration) by pressing the soft key resp. by pressing the ↵ -key or the → -key while the function line is highlighted.

Line of variables:
- Line ending with a colon.
- View module parameters (variables).
- Some parameters can be changed (e.g. begin of range), other parameters showing a status (e.g. temperature) are for information only and cannot be changed. They are displayed below a separation line within the menu.

Text line
- Line without any punctuation marks.
- Giving additional information only (such as headlines a.s.o.).

The following illustrations explain the functions of lines and soft keys as described above:





3.5 Important Functions of the Soft keys

Display
- Switch from the single component display to the multi component display.
- F1 in the single component display.

Measure
- Switch from any menu or submenu to the single component display of the selected channel.
- F1 in any screen except the single component display.

Status (see section 4.1 p. 4-3!)
- Switch to the menu "Analyzer Channel Status":
  Shows the most important parameters and information about the status of the current channel or module.
- If available: F2.

Main (see section 3.8 p. 3-7!)
- Switch from the single component display to the main menu.
- F3 in the single component display.

Channel
- Scroll through the channels in the current menu. In the main menu and the single component display you may scroll through all channels of the connected analyzer and analyzer modules (control module level). In submenus you can reach only the channels of the current analyzer or analyzer modules (analyzer module level).
- If available: F3 (F4 in the single component display).

Lock
- Lock all three operation levels at the main menu if a security code is activated in the system configuration level (see section 6.4 p. 6-11).
- F4 in the main menu.

BasicCal (see section 4.4 p. 4-17 and 5.1.1 p. 5-17!)
- Switch from the single component display to the menu "Analyzer module calibration".
- F5 in the single component display.

MFG Data (see section 3.8 p. 3-7/8!)
- Switch from the main menu to the menu "Module Manufacturing Data": Additional submenus are available with information about the control module and analyzer module data, such as manufacturer address, module serial numbers or software and hardware revisions.
- F5 in the main menu.

Back
- Return to the previous menu page (alternative: ← -key).
- reset a changed but not confirmed parameter to the previous value.
- If available: F4 for returning back, F2 for reset.

More
- Entering the next page of the current menu.
- If available: F5.

3.6 Entering/Changing Variables

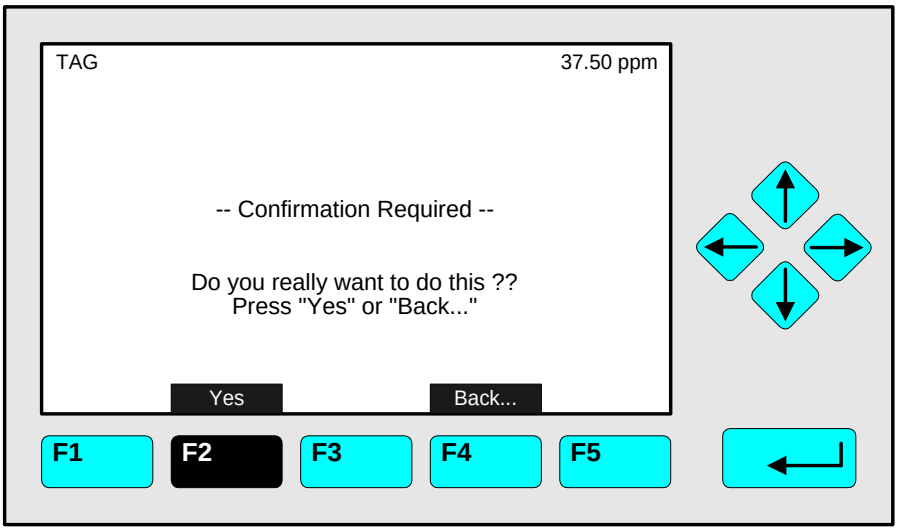
↵-key
- If you have already selected a line of variables (highlighted) and press the ↵ -key, the parameter will be selected and may be edited.
  If you press the ↵ -key again, the new value will be confirmed.

↑ -key / ↓ -key
- Function depends on the variable selected:
  - Changing the parameter values
  - Scrolling among variables selected
  - Changing single digits or characters
  - Increasing or decreasing numbers.

← -key / → -key
- Selects single digits within a number.
- The number of digits or characters of some variables may be changed.

3.7 Executing a function

If you press the ↵ -key or the → -key while a function line is highlighted the software will ask for a confirmation:



- If you press the F2 -key, the function will start immediately.
- If you press the F4 -key, you will return the previous menu page.

Note:
Confirmation of function line entries may be disabled:

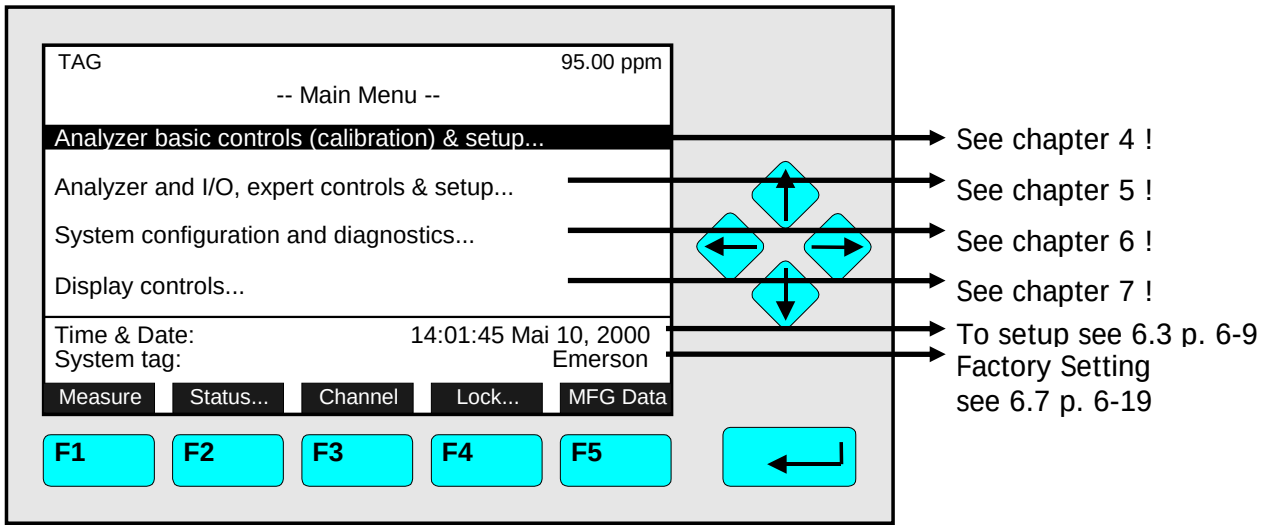
- Select "Measurement Display Configuration" from the expert configuration level (see section 5.1.8 p. 5-51).
- Change "Display confirmation menus" to "No".

Now the selected function will start immediately after entering. No confirmation is required.

3.8 Main Menu

If you press the **F3 -key (Main...) or** the → **-key in** any **single component display**, you will switch to the **"Main Menu"**. From there you can switch to all operating levels of your MLT/CAT200/TFID analyzer / analyzer module to **set up** and **control** the **parameters** of **measurement, calibration and data transfer**!
Via the **F5 -key (MFG Data)** you may enter **several submenus**, where you will find a lot of important **data** about the **control module** (**MLT/ CAT 200/ TFID analyzer or platform**) and the **analyzer module**, such as service address or serial number !

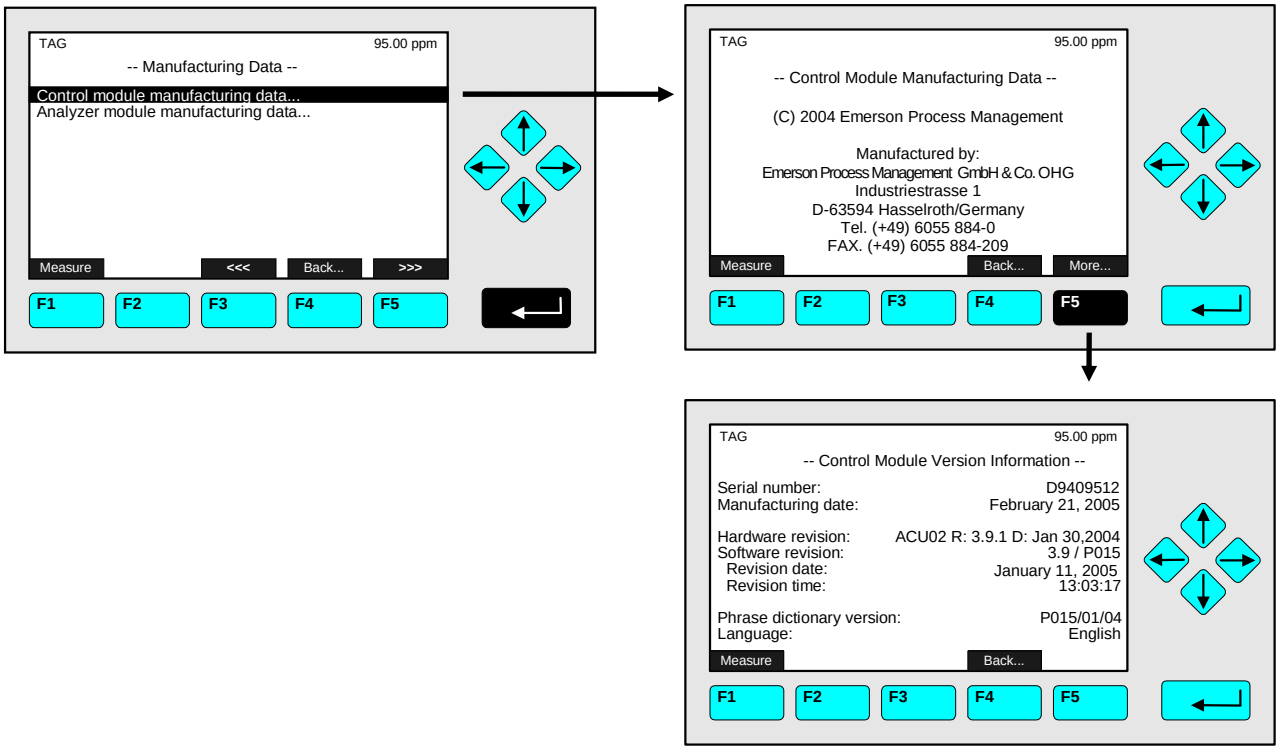
Ramifications from the Main Menu:



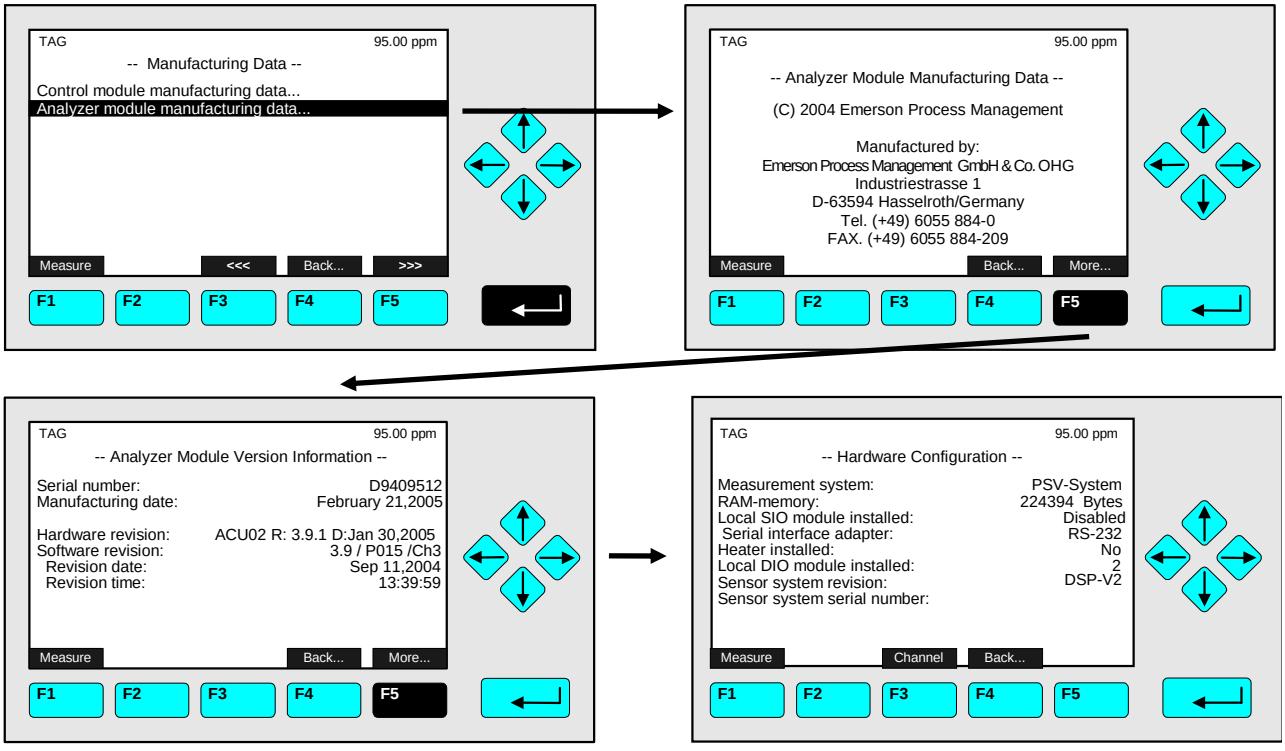
F1	Enter the current channel's single component display	→	Section 3.1 p. 3-1/2 !
F2	Enter the current channel's "Analyzer Channel Status" menu	→	Section 4.1 p. 4-3 !
F3	Scroll through all channels of connected analyzers / analyzer modules	→	See channel tag !
F4	Lock any operating level by security code	→	Section 6.4 p. 6-11/12 !
F5	Enter the menu " Manufacturing Data"	→	See next pages !

Ramifications from the menu "Manufacturing Data":

1. Control module manufacturing data:



2. Analyzer module manufacturing data:



Chapter 4 "Analyzer basic controls (calibration) & setup" describes the most important measurement, setup and calibration functions of your MLT/ CAT 200/ TFID analyzer or analyzer module.

All steps are figured with detailed illustrations and operation instructions. In the left column you can see display and keyboard of the NGA front panel. The **keys** you have **to press** are illustrated in **black**. In the right column you can read the instructions and notes. All instructions will begin with any single component display and will end with the corresponding single component display after the setups are done. So you can easily compare the actual display of the analyzer or analyzer module with the illustrations of the manual.

Example: You want to change from the single component display of channel 1(CO_2) to the single component display of channel 2 (CO).

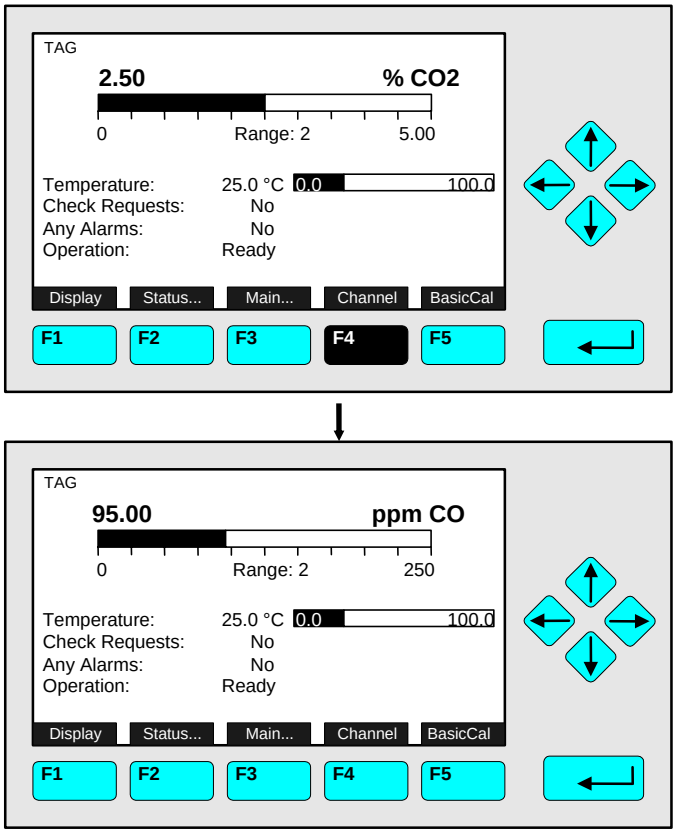
- Picture one shows the starting situation: single component display of CO_2.
- Picture two shows the result you get if you press the F4 -key (Channel): single component display of CO.

Left column:

Display and keyboard

Right column:

Instructions and notes

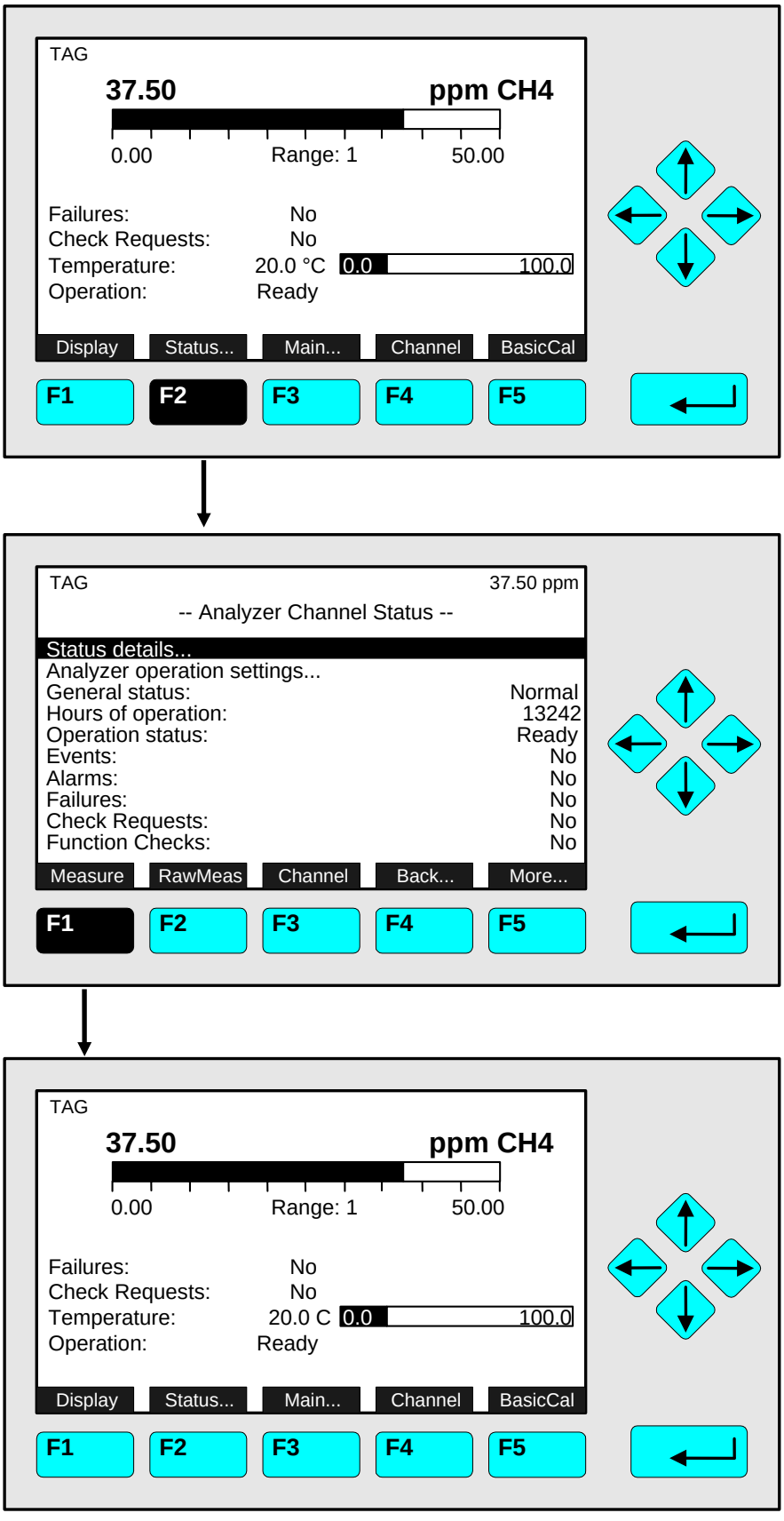


⇒ **Change to the single component display of another channel**

Press **F4**

Example:
Changing from CO_2 (Channel 1) to CO (Channel 2)

⇒ **Next instruction or step**



⇒ **Open the menu "Analyzer Channel Status"**

Press **F2**

The menu "Analyzer Channel Status" displays status information about the current channel.
Use the menu lines "Status details..." and "Analyzer operation settings..." to enter other submenus.
(see 4.1.1 p. 4-5...10 and 4.1.2 p. 4-11/12)

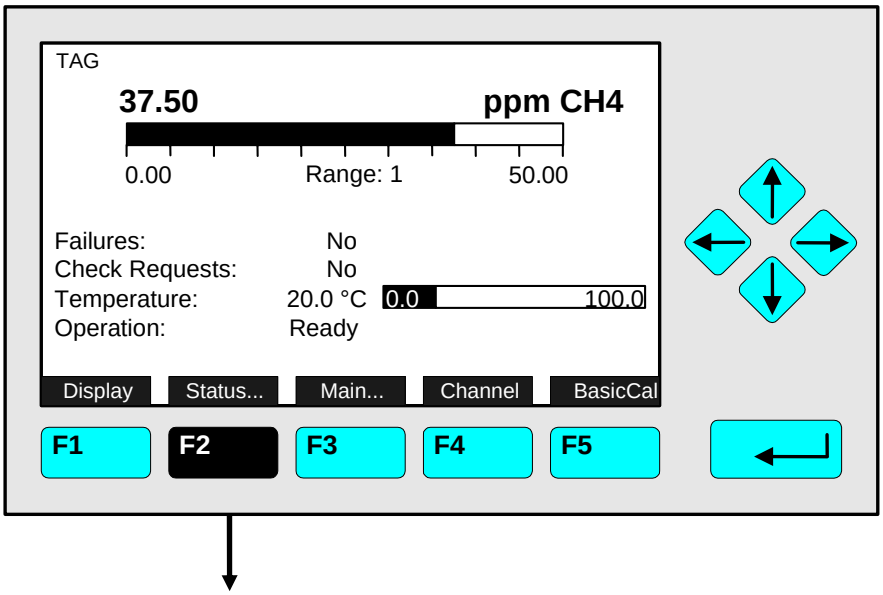
⇒ **Return to the single component display**

Press **F1**

Note:

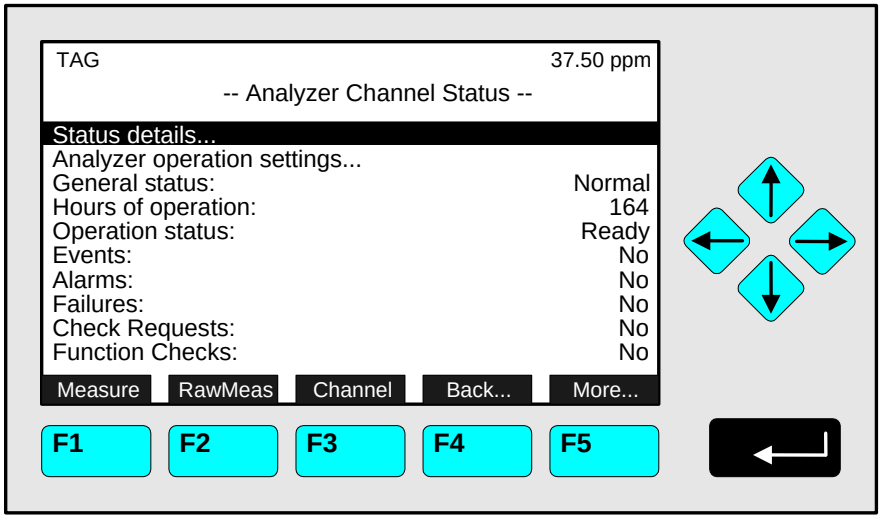
- The F2-key enters the submenu “Raw Signals” and from there in a second step using F5 to reach ”Secondary Raw Signals” if available.
- Via the F5 -key you can switch to the submenu "Special Functions".

⇒ **Back at the single component display**



⇒ **Open the menu "Analyzer Channel Status"**

Press **F2**



⇒ **Enter the submenu "Status Details"**

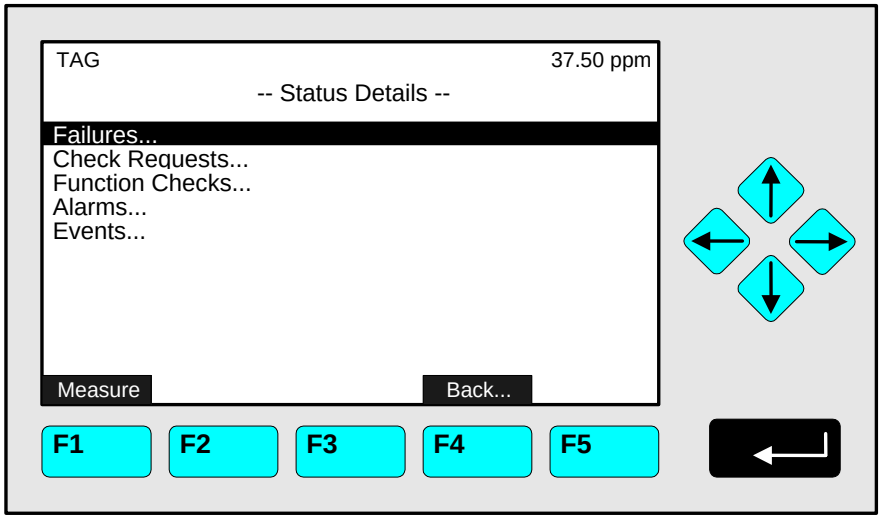
Press

or

Note:

Use the way described below to enter other sub-menus of status details:

- **Check Requests**
- **Function Checks**
- **Alarms**
- **Events**

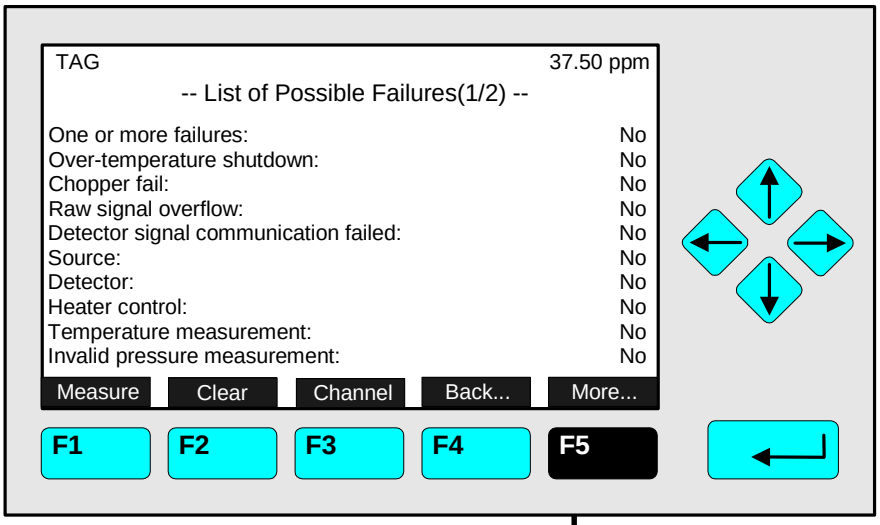


⇒ **Enter the menu "List of Possible Failures (page 1/ 2)"**

Press

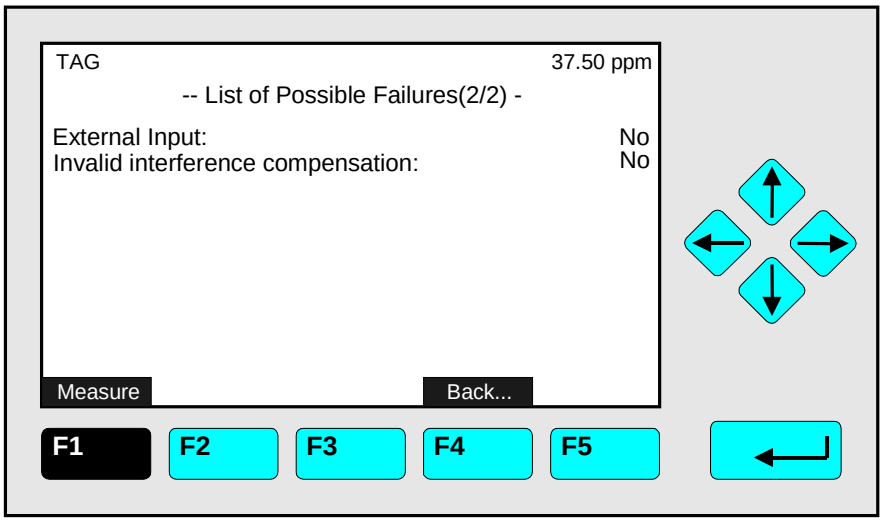
or

Note:
If you want to see other available status details, highlight the line you want using the ↓- or ↑**-key** and enter pressing the ↵**key** .



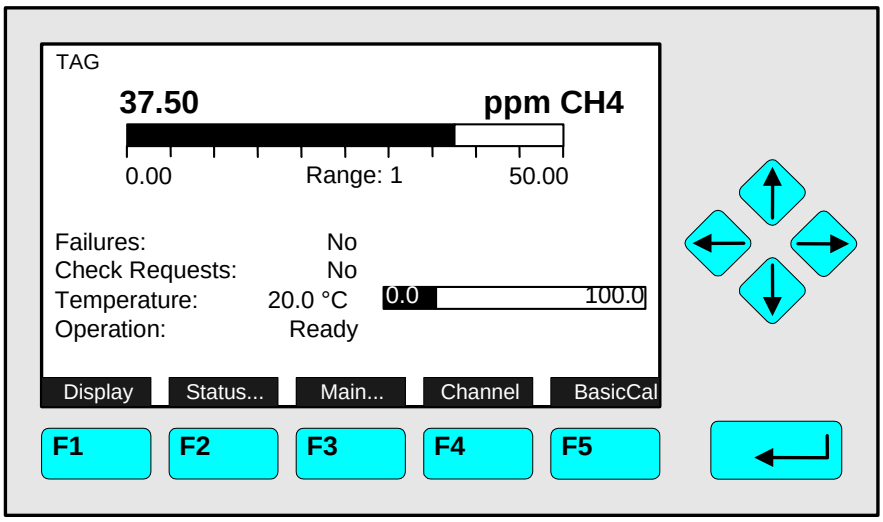
⇒ **Switch to the second menu page**

Press **F5**



⇒ **Return to the single component display**

Press **F1**



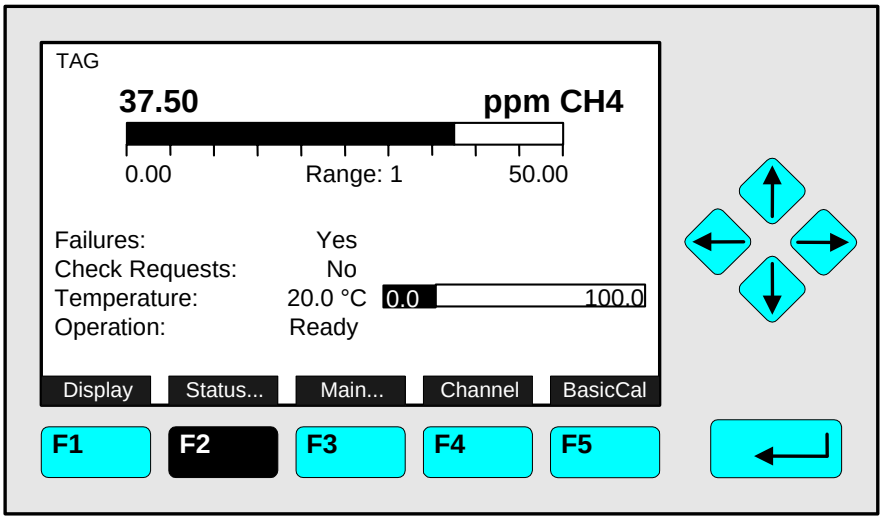
⇒ **Back in the single component display of the current channel**

Note:

- **If you have solved the reasons for the failures reported, you should start this function.**
- **The menu "List of Possible Failures" will be ready for new reports !**
- **Starting this function is only possible, if it is enabled in the menu "Acknowledgement of Status Reports": the line "Acknowledgement allowed in status menu: Yes/No" has to be set to "Yes"! (see 5.1.9 p. 5-55)**

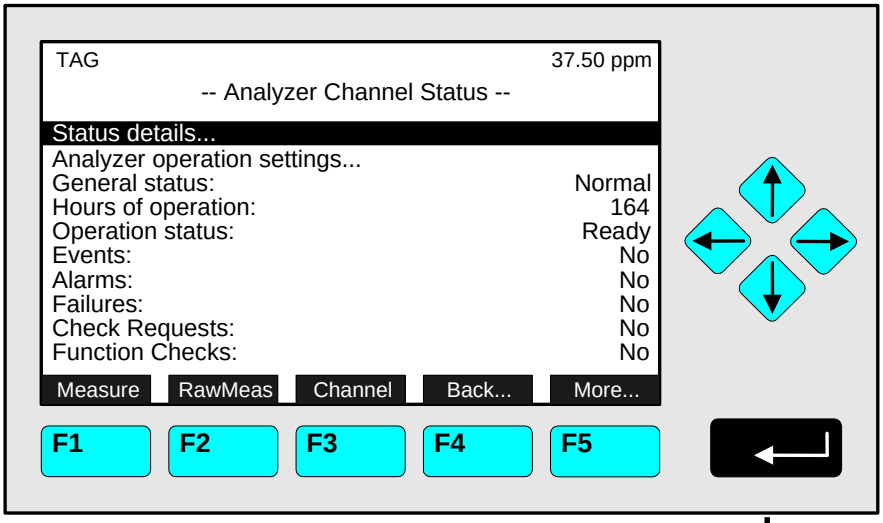
Use the same procedure as described below to start the other available functions in the menu "Status Details":

- Acknowledge and clear "Check Requests" !
- Acknowledge and clear "Function Checks" !



⇒ **Switch to the menu "Analyzer Channel Status"**

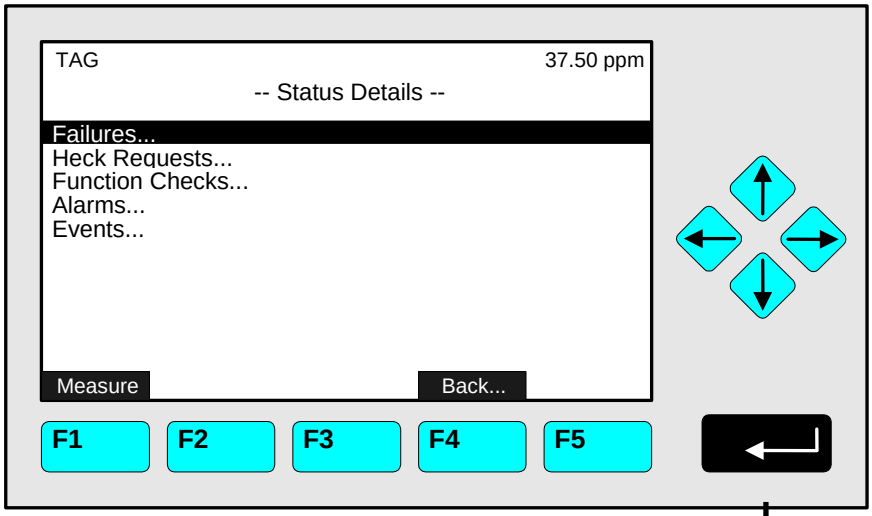
Press F2



⇒ **Enter the submenu "Status Details"**

Press ↵

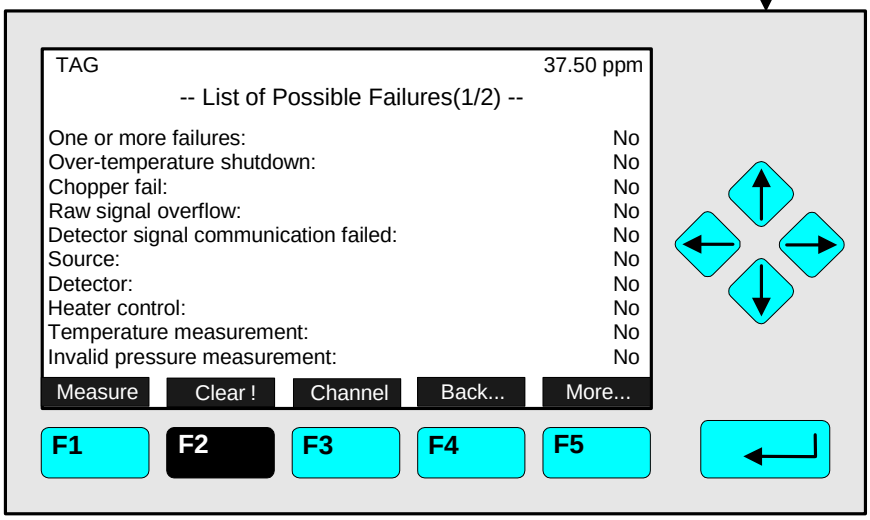
or →



⇒ **Switch to submenu "Failures"**

Press ↵

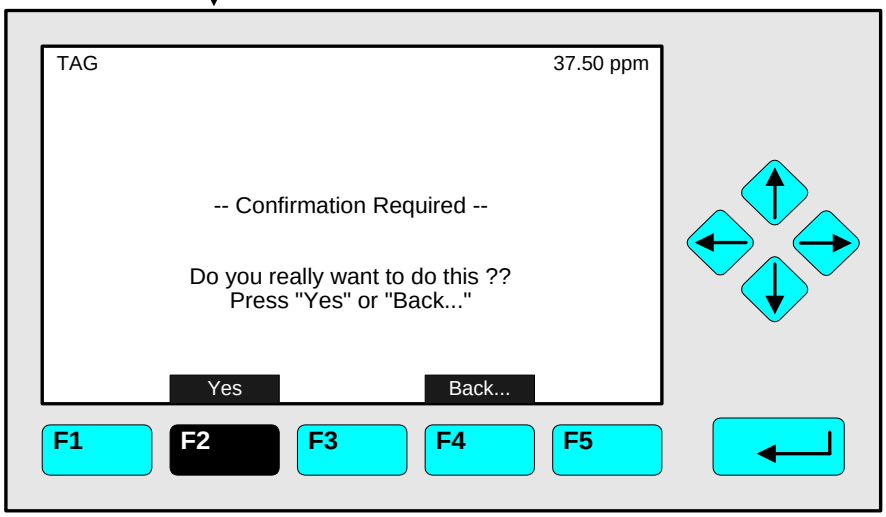
or → .



⇒ **To Acknowledgement and Clear Failures**

Press F2

Note:
Starting this function is only possible, if it is enabled in the menu " of Status Reports" (see 5.1.9 p. 5-55 !

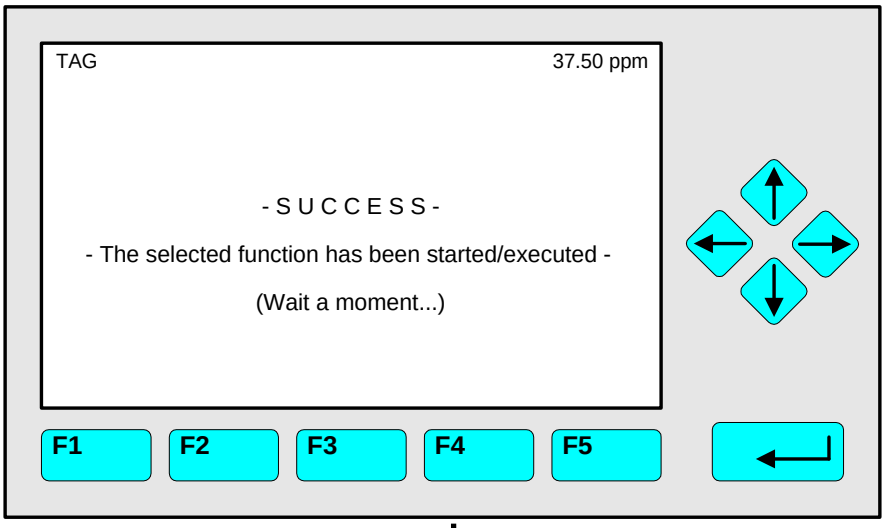


⇒ **Confirm the order**

Press F2
to start the function immediately.

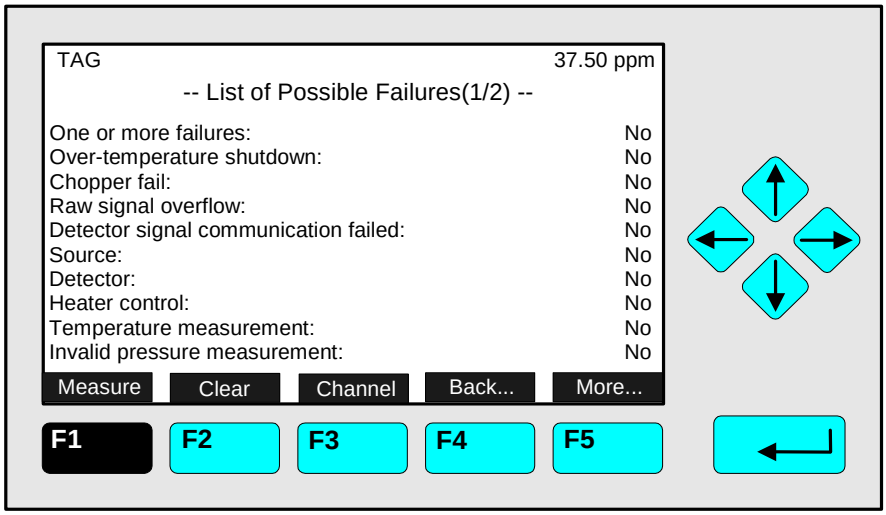
Option:
Press the F4 -key if you want to cancel the order and return to the menu "Status Details".

Notes:
The display of this message depends on the setup in the expert controls & setup (see 5.1.8 p. 5-51).



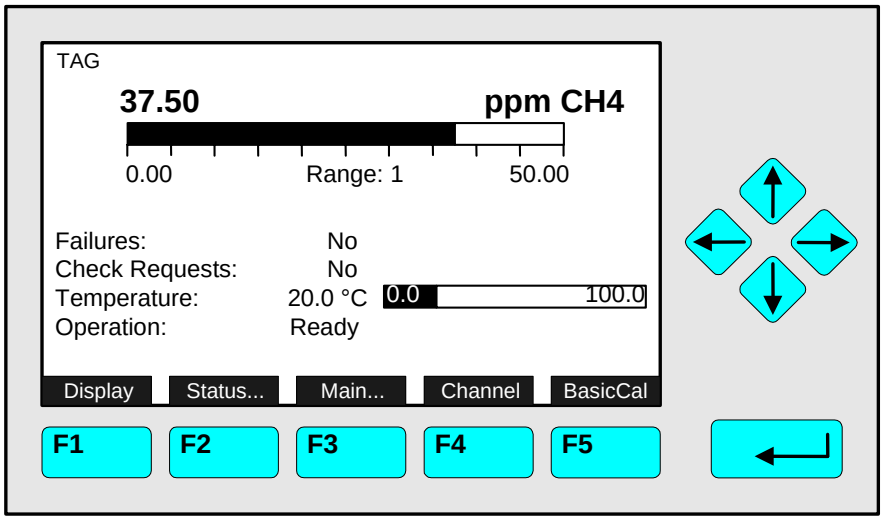
⇒ **Execution message appears**

This message will be displayed when the function has been started.
The display will return automatically to the menu "Status Details".

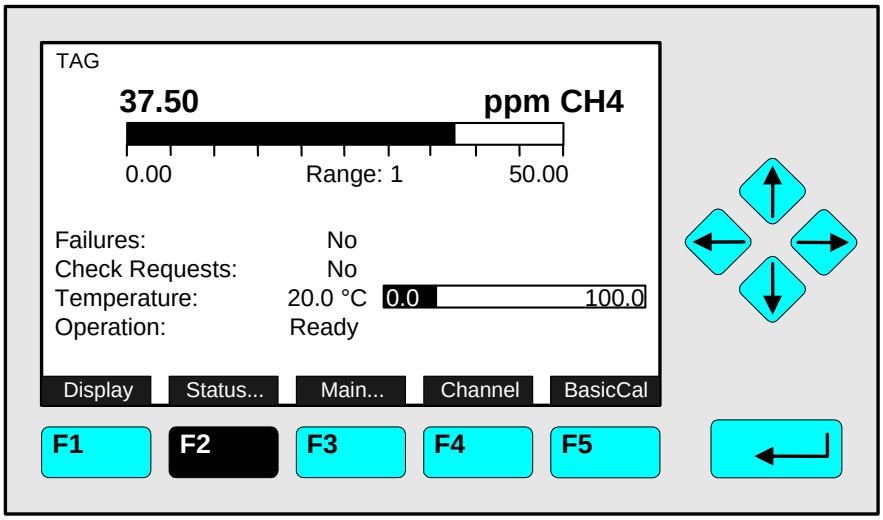


⇒ **Return to the single component display of the channel selected**

Press F1

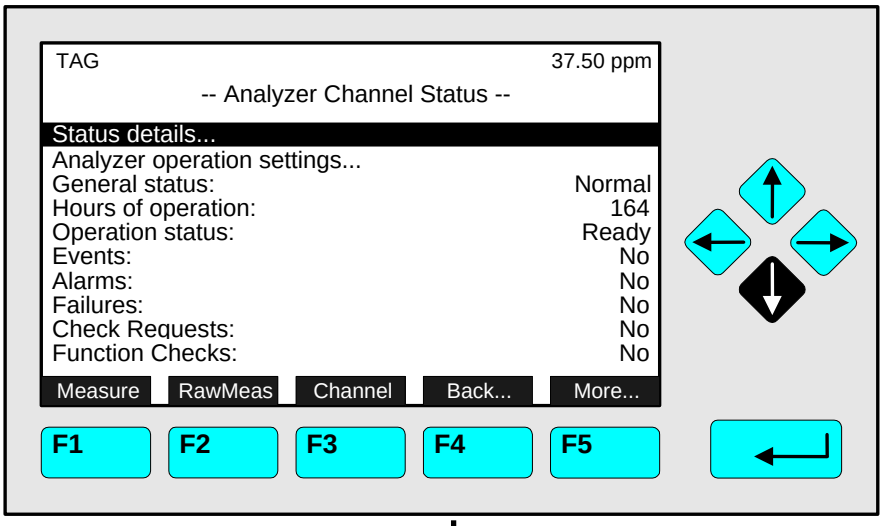


⇒ **Back to the single component display of the current channel after clearing of failures**



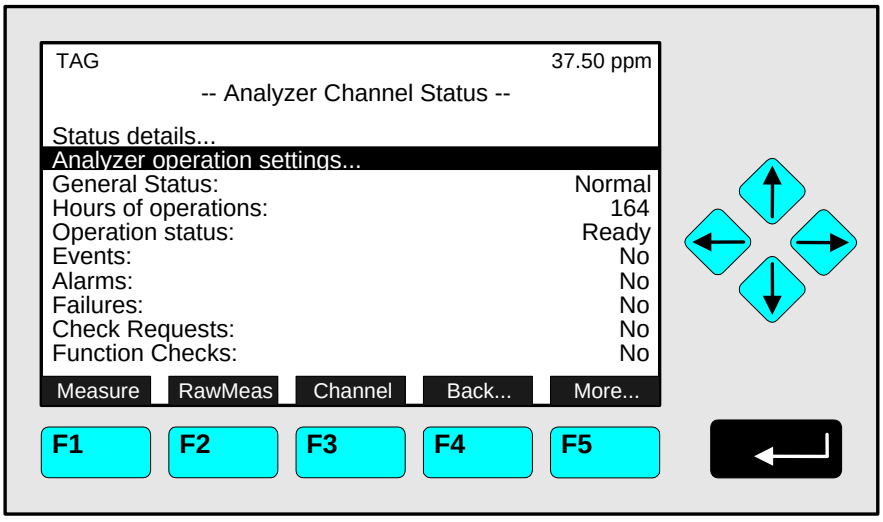
⇒ **Switch to the menu "Analyzer Channel Status"**

Press F2



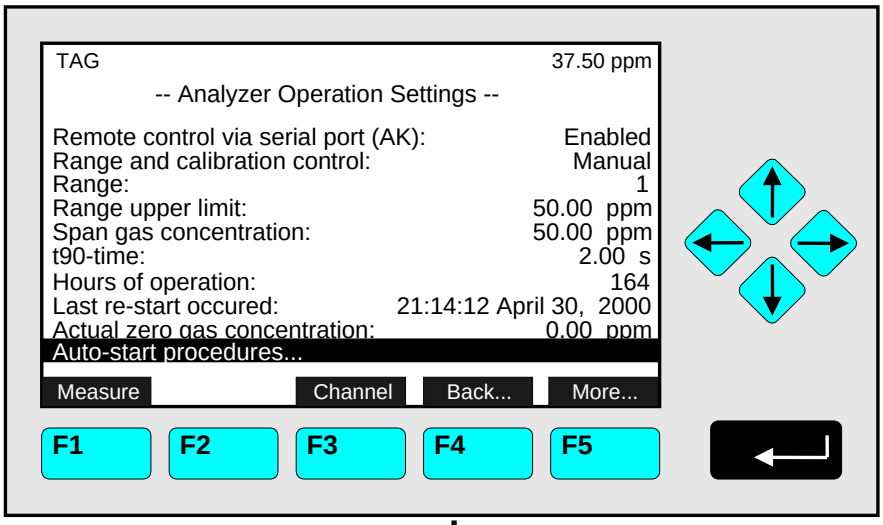
⇒ **Select the line "Analyzer operation settings..."**

Press ↓ once to get the line "Analyzer operation settings..." inverse.



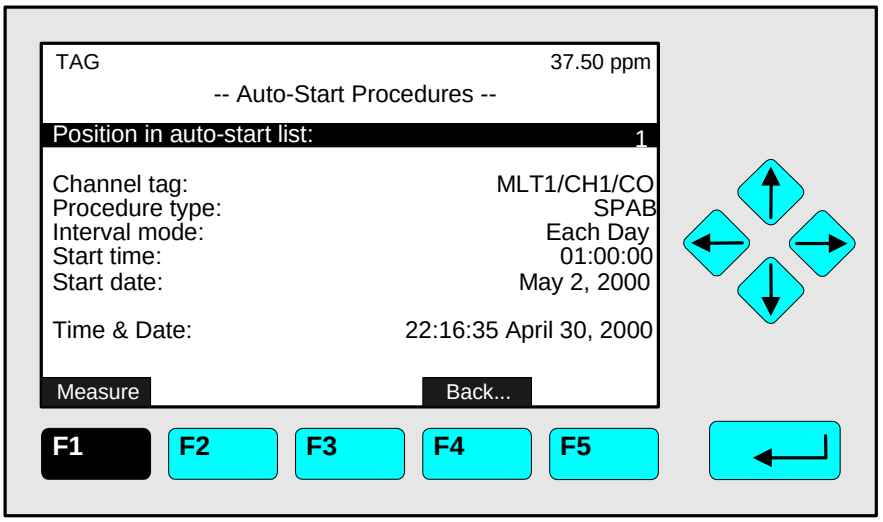
⇒ **Open the menu "Analyzer Operation Settings"**

Press ↵



⇒ **Enter the submenu "Auto-Start Procedures"**

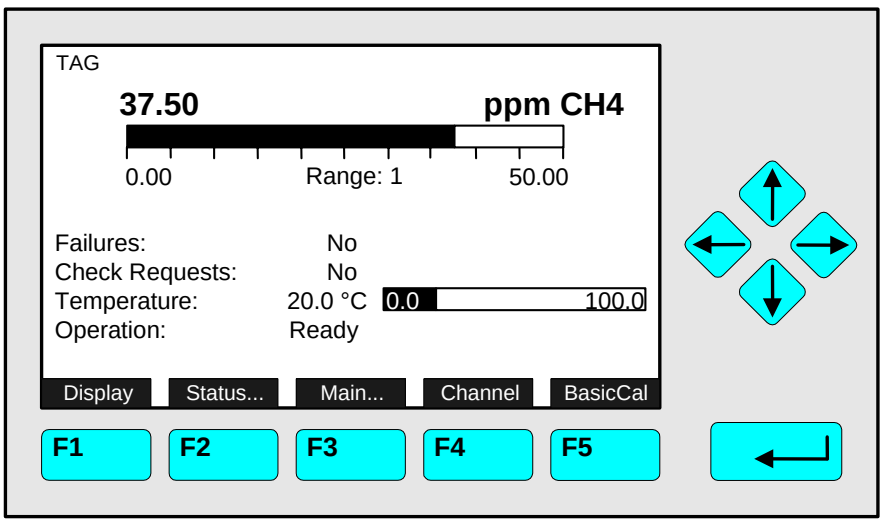
Press 



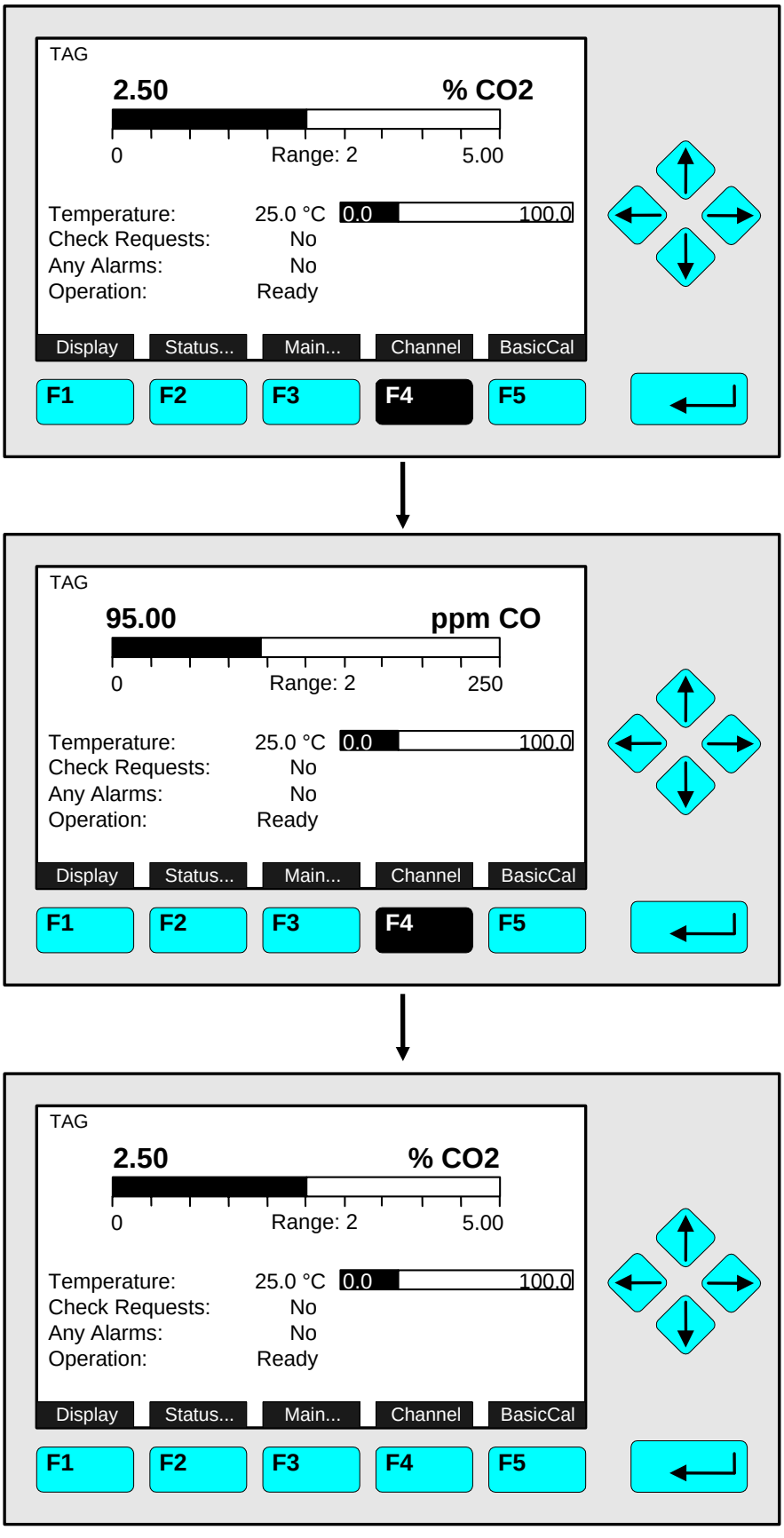
⇒ **Return to the single component display**

Press: **F1**

Note:
The menu "Auto-Start Procedures" enables you to view the status of the three different time controlled calibrations.
(see 5.1.1 p. 5-15/16)



⇒ **Back at the single component display of the current channel**



⇒ **Switch to the single component display of another channel**

Press **F4**

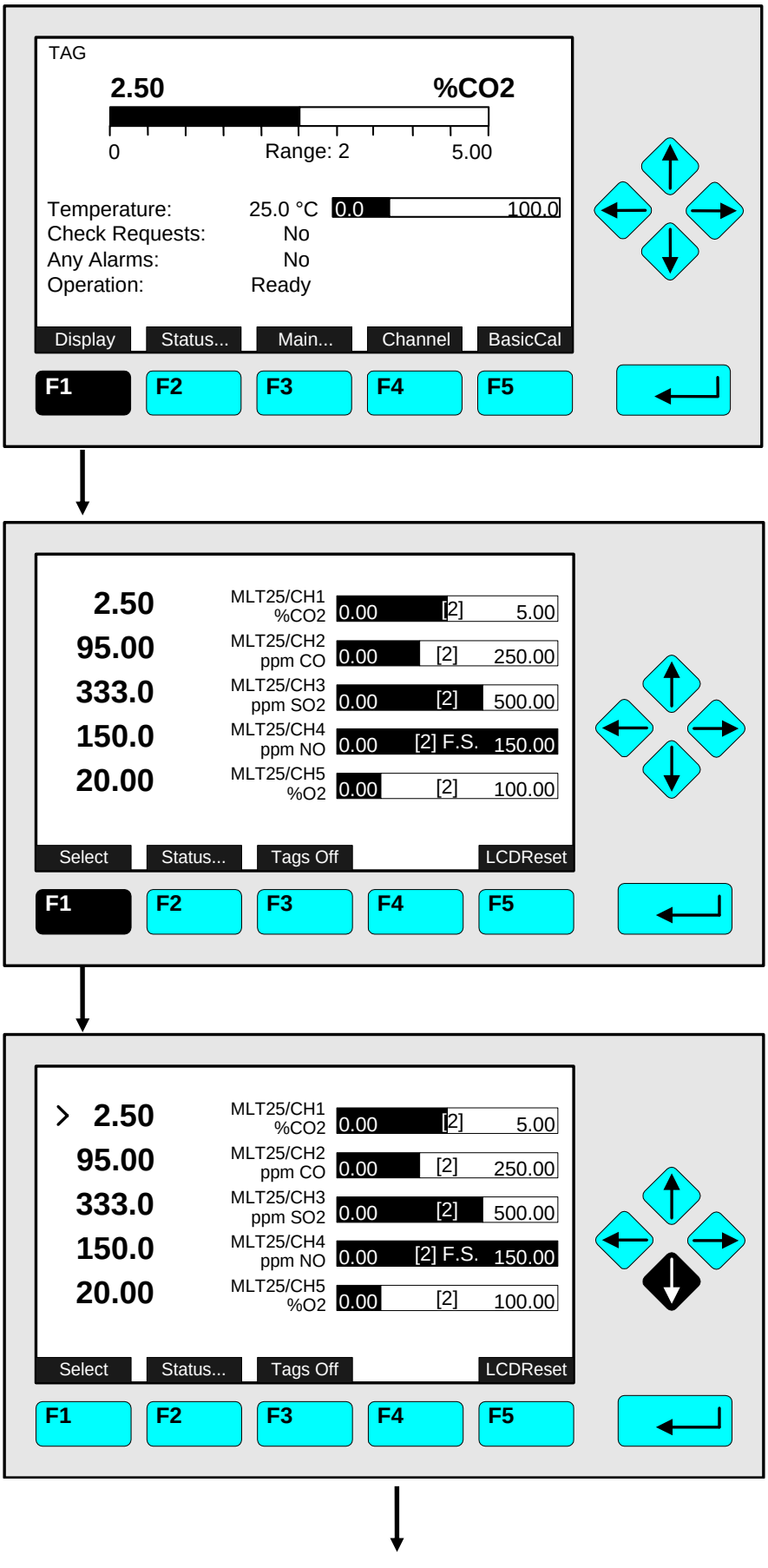
Example:
Switching from CO_2 (Channel 1) to CO (Channel 2)

⇒ **Return to the single component display of the starting channel**

Press **F4** as often as necessary to get the display of the channel you want

Note:
You can reach any existing channel by pressing the F4 -key several times.

⇒ **Single component display of the starting channel appears**



⇒ **Switch to the multi component display**

Press **F1**

Note:
You can change to the multi component display from any single component display.

⇒ **Enable the "selecting symbol": >**

Press **F1** or

Notes:
- Each bargraph shows the begin and end of range of the corresponding channel. (F.S. = full scale)
- The number in parentheses shows the number of the selected range.

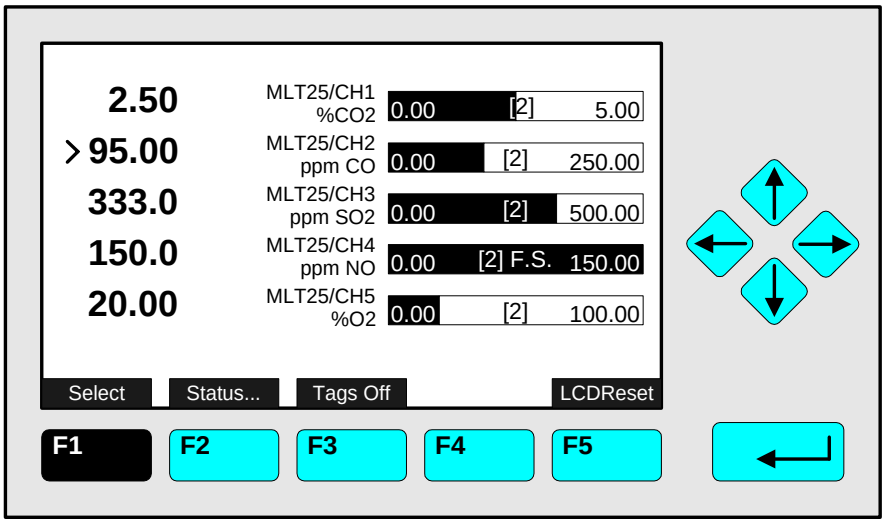
Option:
Using the F3-key you can fade out or in the tags.

⇒ **Select any channel**

Press or

as often as necessary to place the **" > mark"** at the line you want to select.

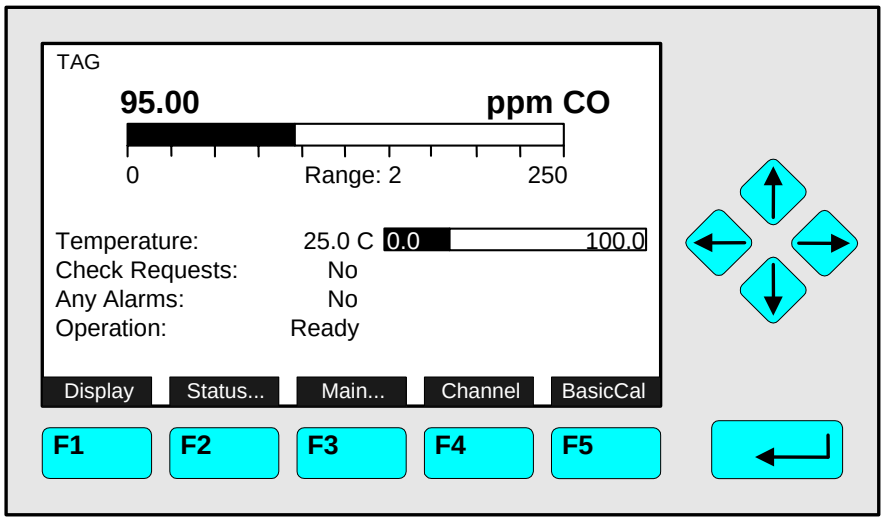
Example:
Change from CO_2 (Channel 1) to CO (Channel 2)



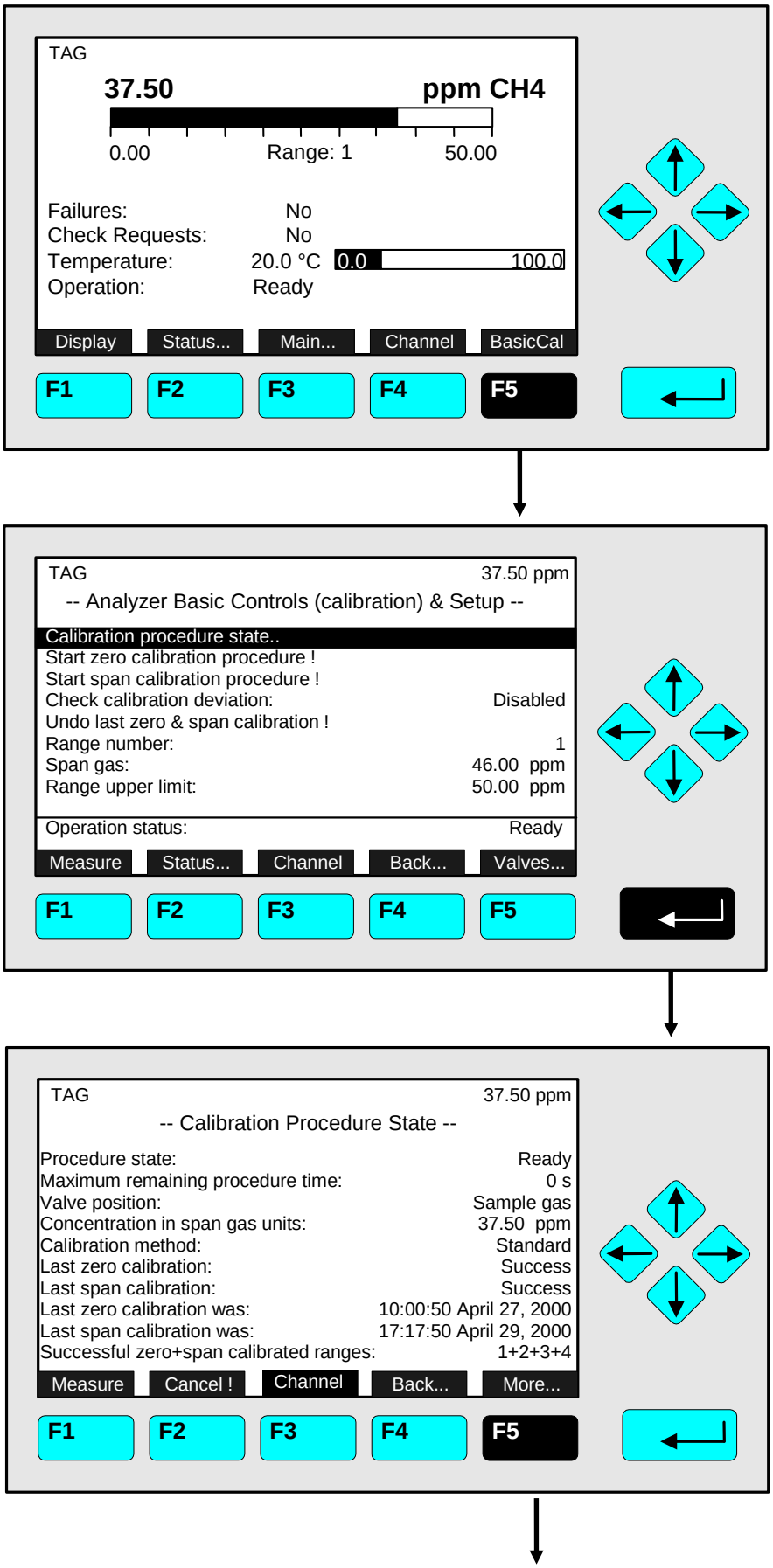
⇒ **Switch to the single component display of the channel selected**

Press **F1**

Note:
Pressing F5 resets the LCD brightness and contrast to factory default settings (see also section 7) !



⇒ **Single component display of the selected channel appears**



⇒ **Open the menu "Analyzer Basic Controls and Setup"**

Press **F5**

"BasicCal"

⇒ **Switch to the menu "Calibration Procedure State"**

Press ↵

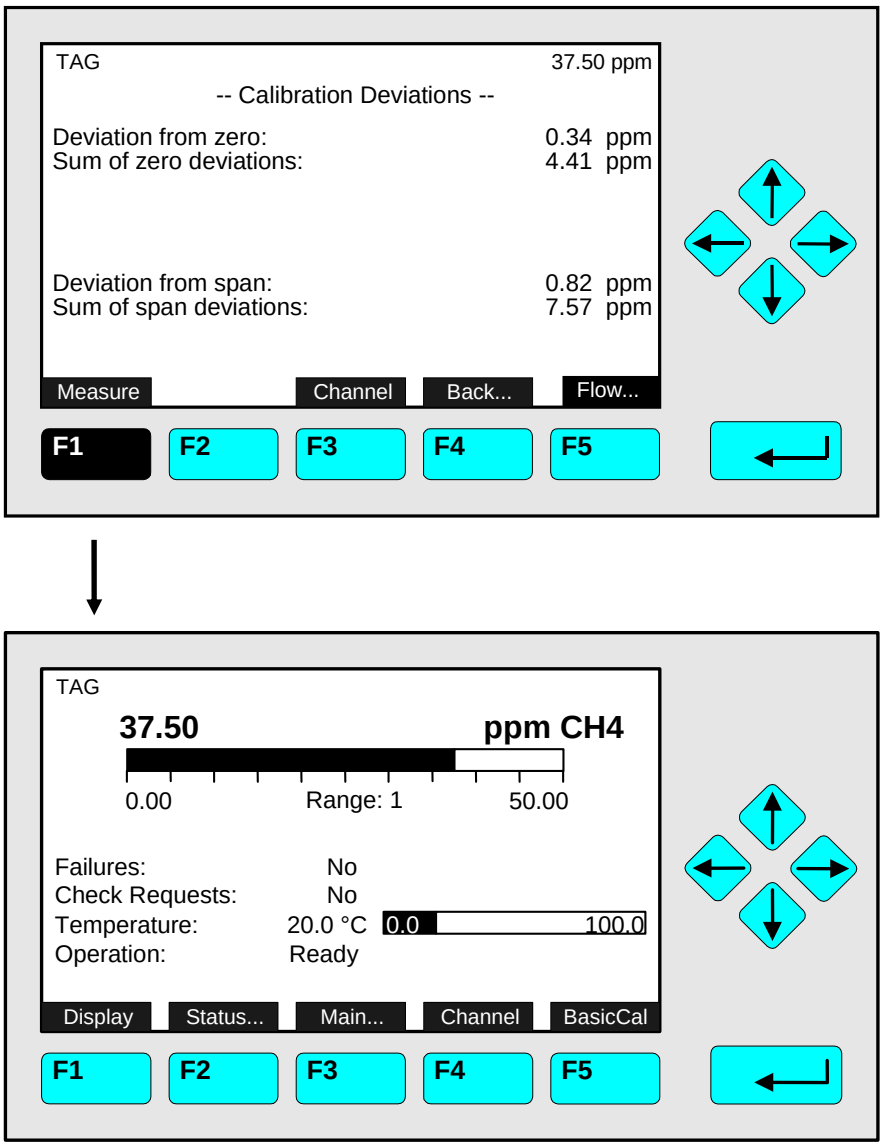
Options:
Via the F5 -key you can reach the submenu, where you can close all valves or set up each valve separately for:

- zero gas or
- span gas or
- sample gas or
- test gas.

(See section 4.7 , p. 4-29...)

⇒ **Open the menu page "Calibration Deviations"**

Press **F5**



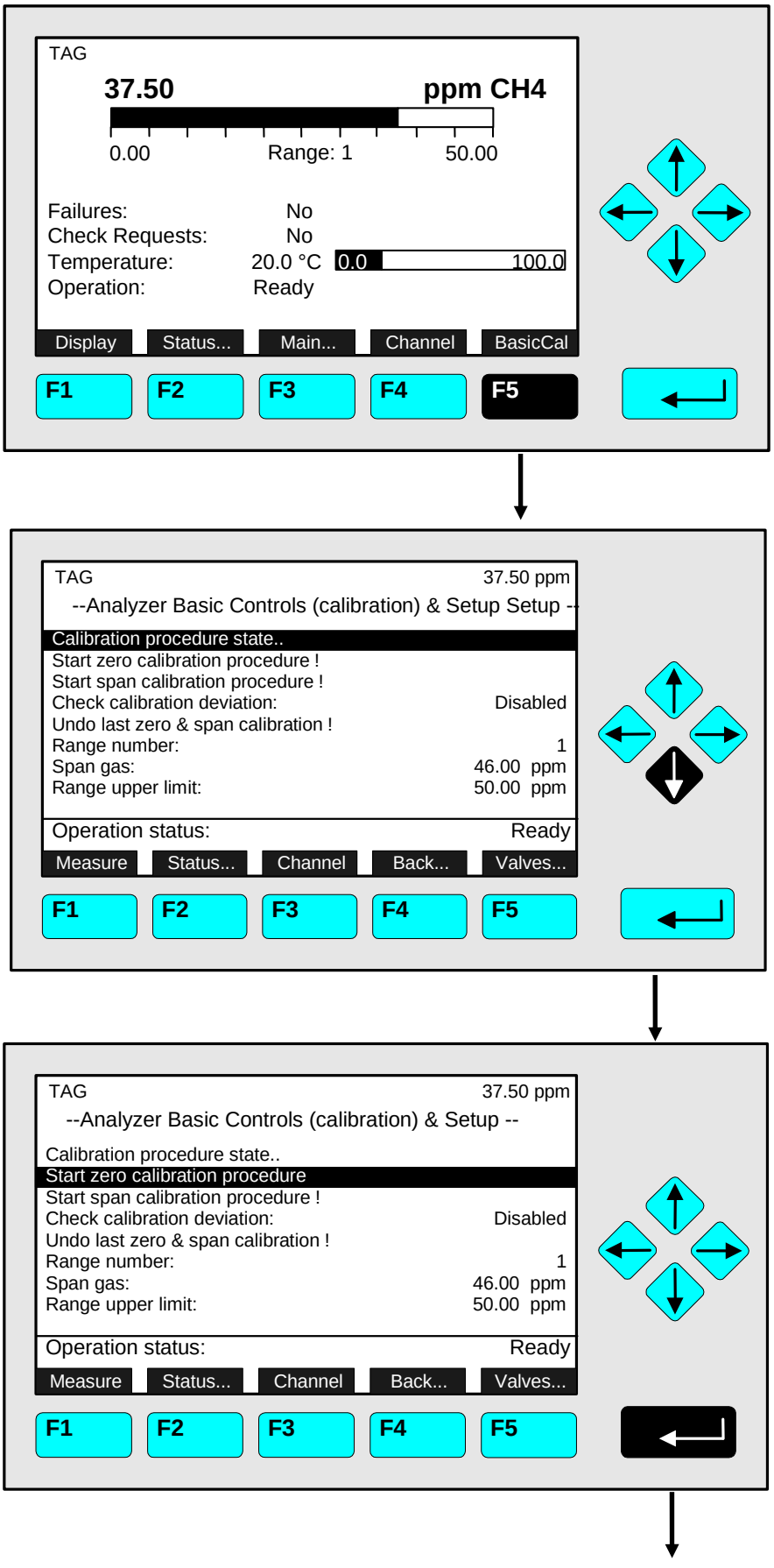
⇒ **Return to the single component display of the current channel**

Press **F1**

Notes:

- A basic calibration procedure will reset the deviations to 0.00 (see 5.1.1 Advanced Calibration Methods - Start basic calibration procedure !)
- Using the F3 -key you can change to other available channels to check their "Calibration Deviations".
- With the F4 -key you can return to the menu "Calibration Procedure State".

⇒ **Back at the single component display**



⇒ **Open the menu "Analyzer Basic Controls and Setup"**

Press F5

Caution:

Before starting zero calibration, make sure that zero gas is available ! (See also section 5.1.1, p. 5-5... !)

Note:
Zeroing of all measurement ranges of the same channel is running simultaneously.

⇒ **Highlight the line "Start zero calibration procedure !"**

Press ↓ once to get the line "Start zero calibration procedure !" highlighted.

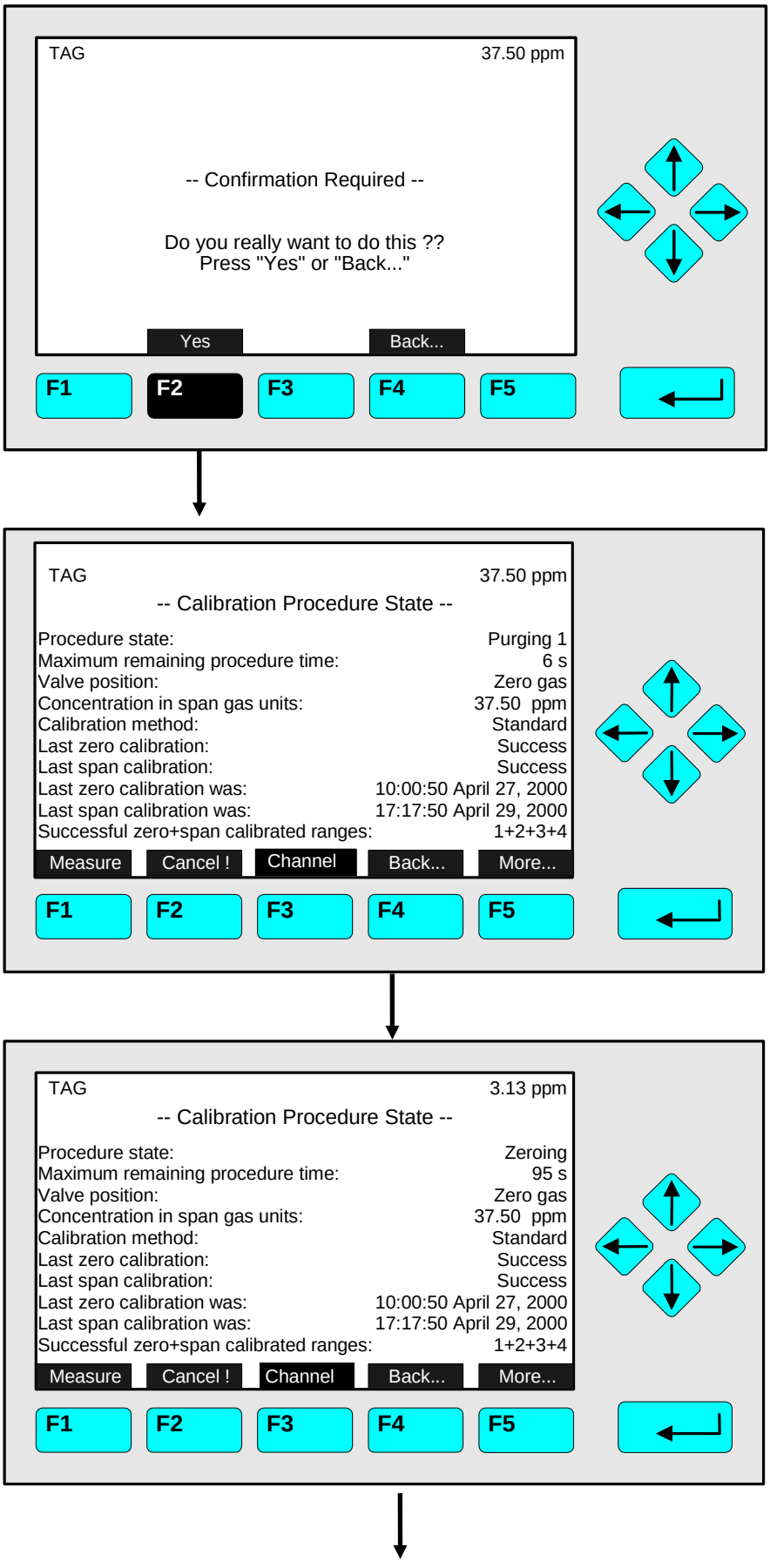
⇒ **Start the zero calibration**

Press ↵

or →

Note:

Take care that the correct valve is adjusted!



⇒ Confirm to start the zero calibration

Press **F2** to start the zeroing immediately.

Option:
Press the F4 -key if you want to cancel the procedure.

Notes:

- The display of this message depends on the setup in the expert controls & setup (see 5.1.8 p. 5-51).
- The next 3 illustrations show the displays you can see after starting the zeroing procedure.

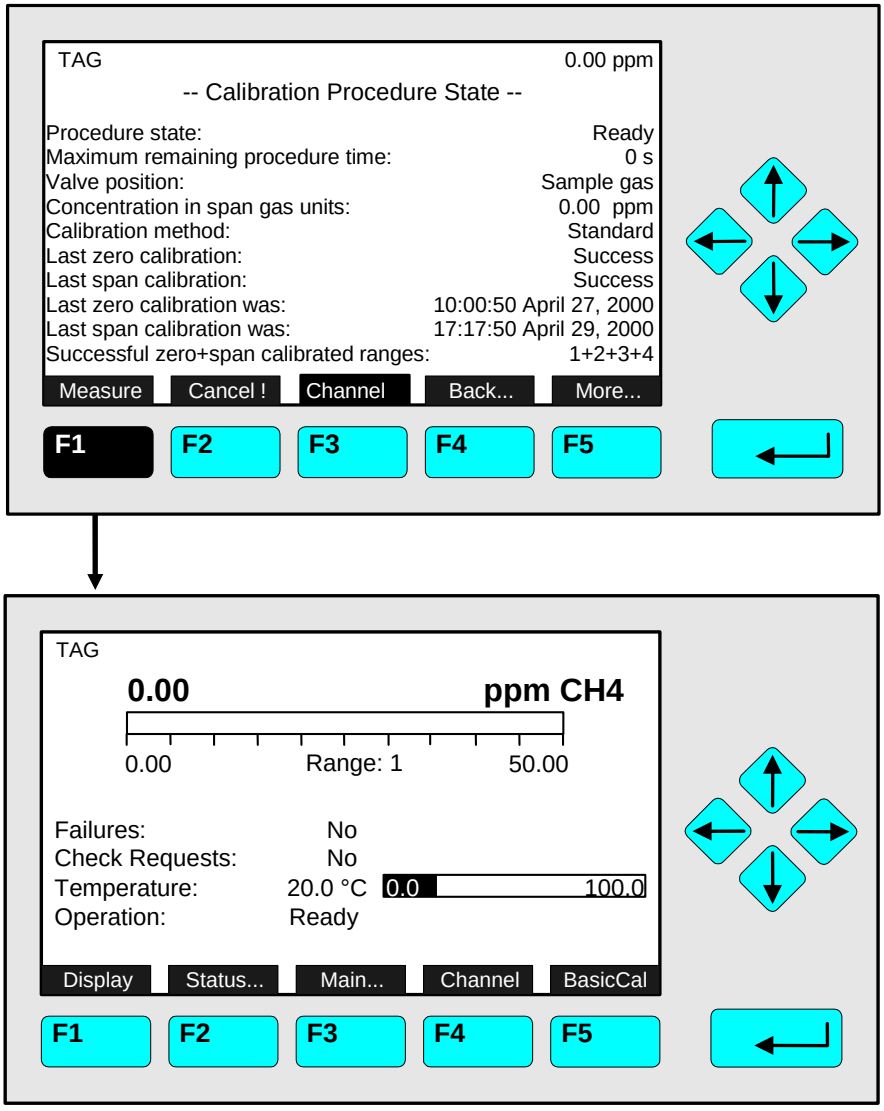
⇒ Zeroing: 1st Purging1

Notes:

- The procedure time depends on the parameters entered for purge time (see section 5.1.1 p. 5-11).
- The purge time must be long enough to get a stable signal before calibration.
- **You can cancel the running calibration procedure at any time with the F2 -key.**

⇒ Zeroing: 2nd Zeroing

Note:
The procedure time depends on the parameters entered for stability time and averaging time.
(see section 5.1.1 p. 5-11)



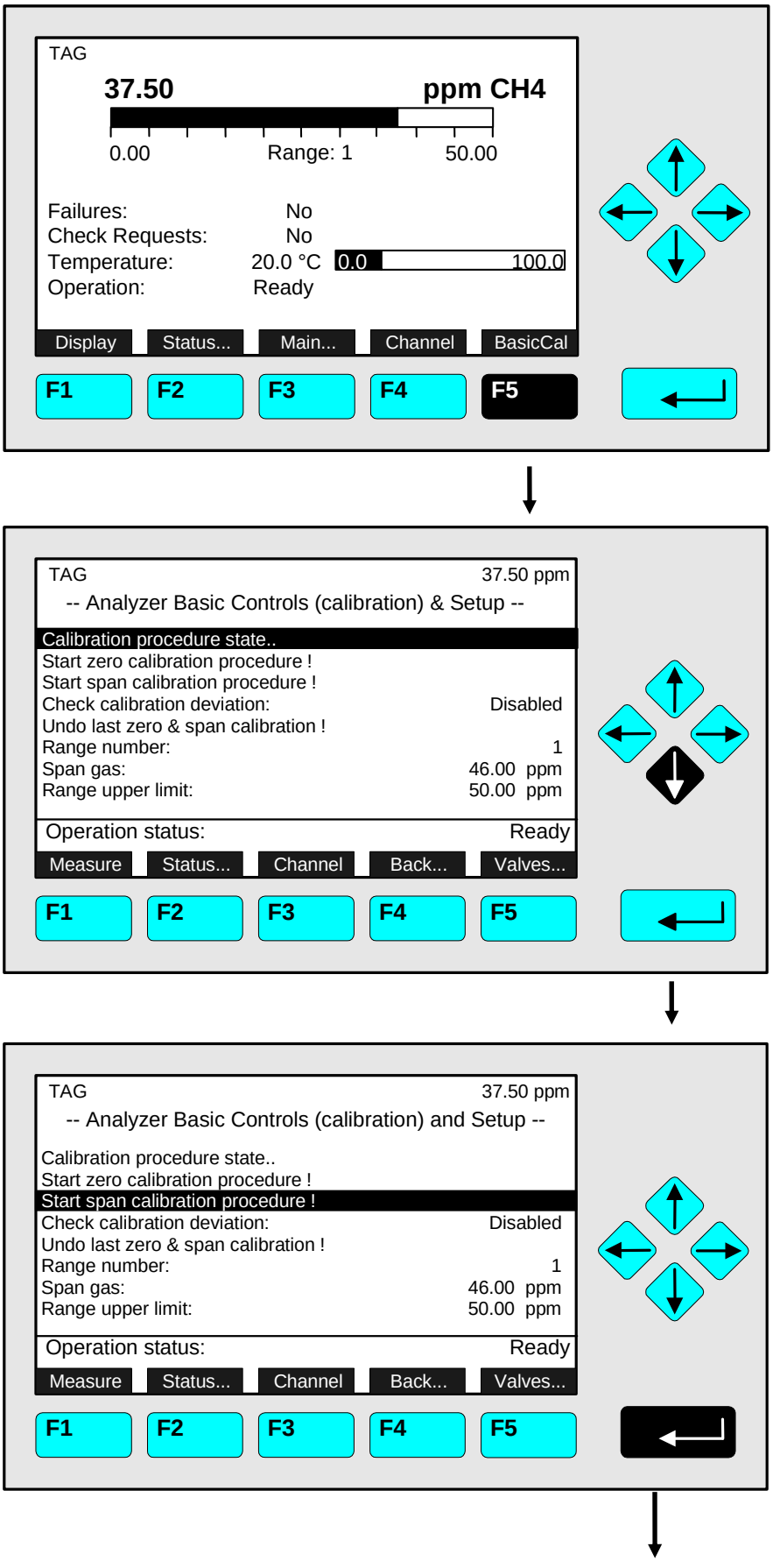
⇒ **Return the single component display of the current channel**

Press **F1**

Options:

- F4-key: Return to the menu "Analyzer Basic Controls & Setup".
- F5-key: Open the menu "Calibration Deviations".

⇒ **Single component display appears when zeroing has finished**



⇒ **<u>Span Calibration</u>: Open the menu "Analyzer Basic Controls (calibration) & Setup"**

Press **F5**

<u>Caution:</u>
Before starting span calibration, check that span gas with correct concentration is available ! (See also section 5.1.1, p.5-5... !)

⇒ **Highlight the line "Start span calibration procedure !"**

Press ↓ twice to get the line "Start span calibration procedure !" inverse.

<u>Note</u>:
- Normally, all measurement ranges of the same channel will be calibrated simultaneously.
- To calibrate separately you have to change the parameters (see 5.1.1 p. 5-11).

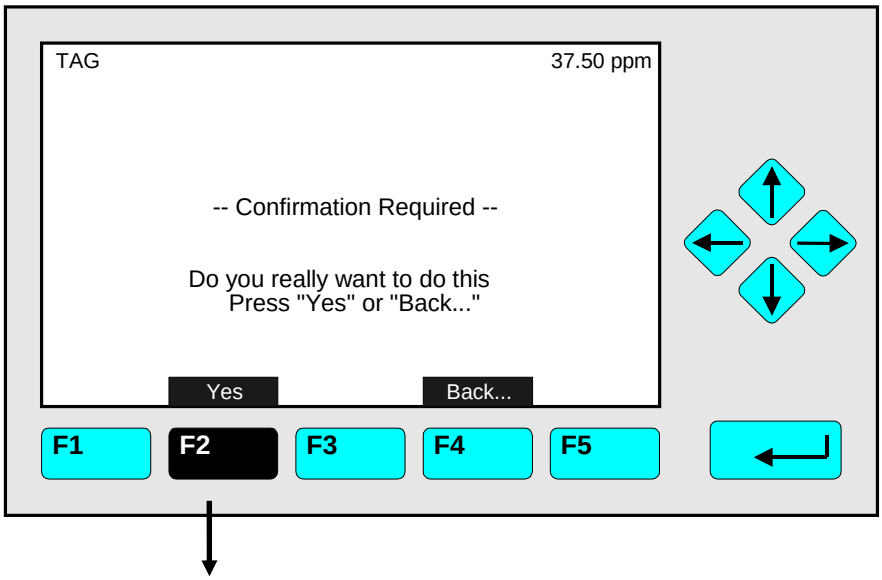
⇒ **Start span calibration**

Press ↵

or →

<u>Note:</u>

Take care that correct span gas valve is adjusted!



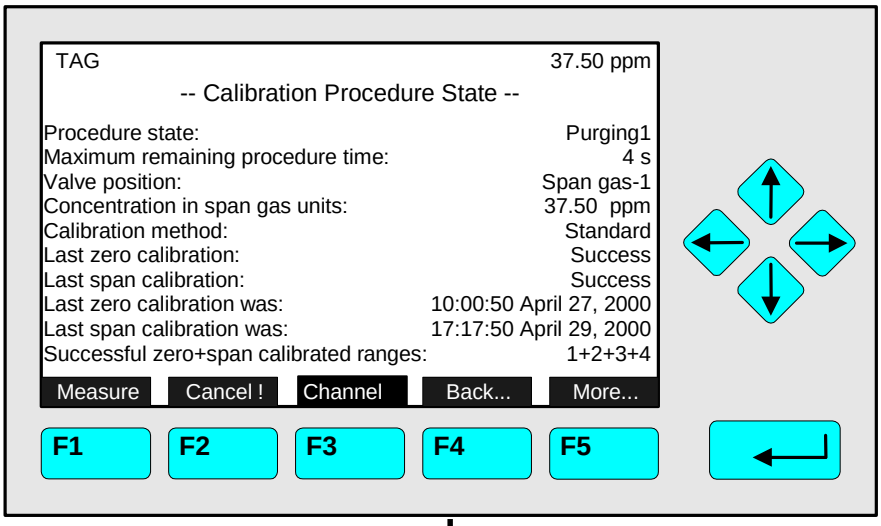
⇒ Confirm starting span calibration

Press **F2** to start the spanning immediately.

Option:
Press the F4 -key if you want to cancel the procedure.

Note:

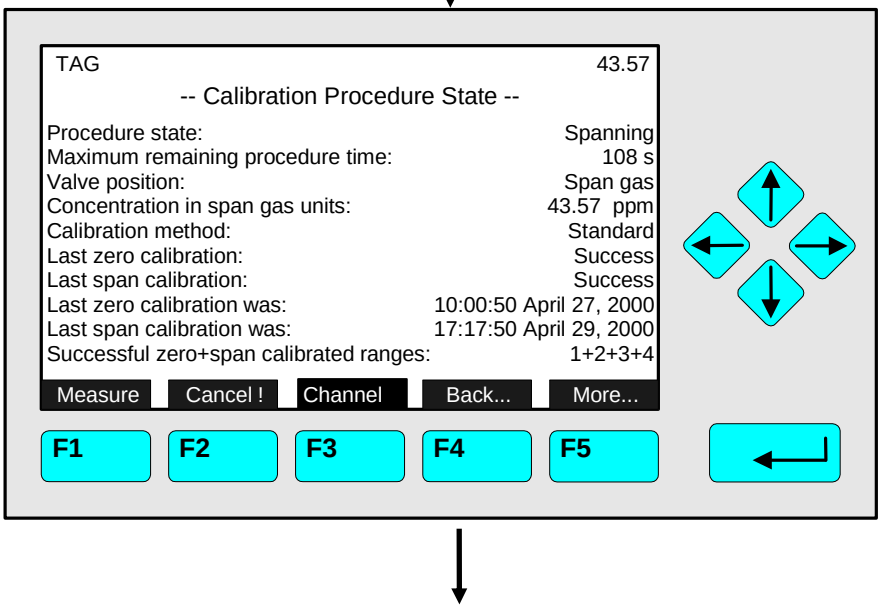
- The display of this message depends on the setup in the expert controls & setup (see 5.1.8 p. 5-51).
- The 3 following illustrations show the displays you can see after starting the spanning procedure.



⇒ Spanning: 1st: Purging1

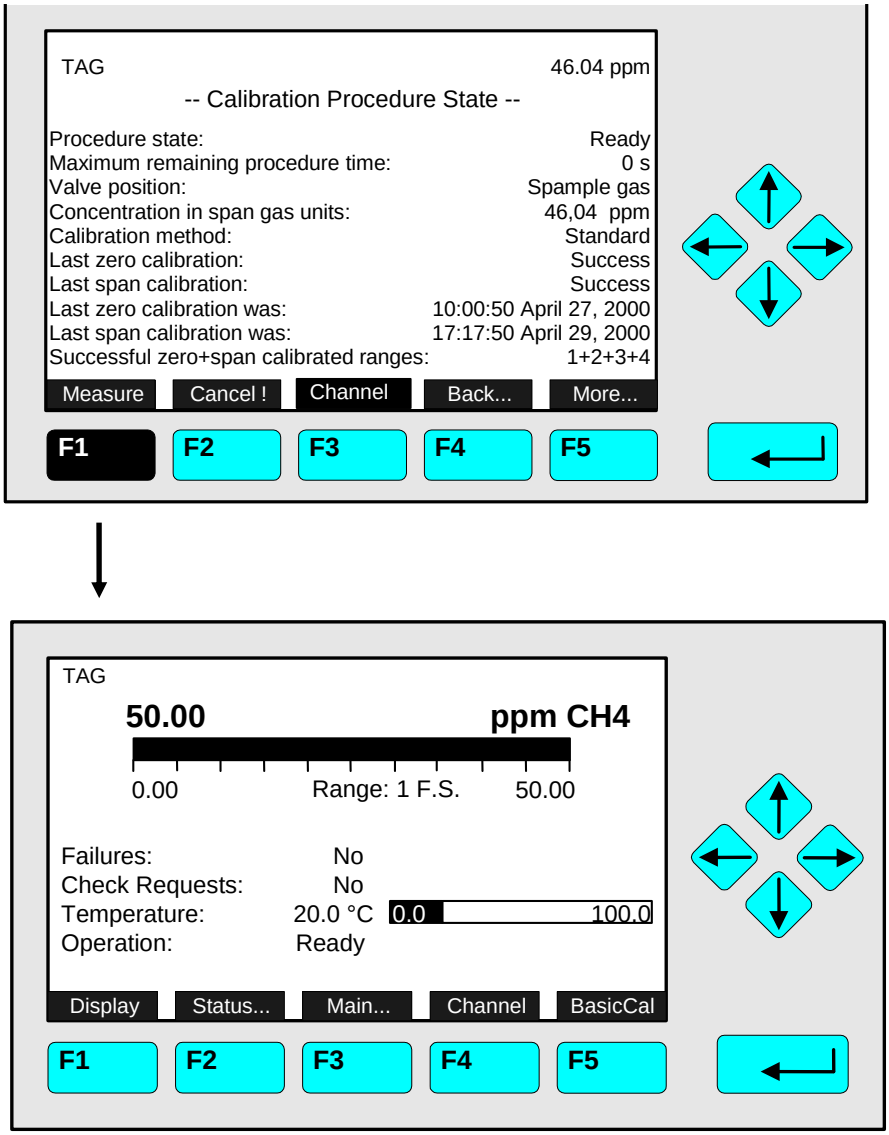
Note:

- The procedure time depends on the parameters entered for purge time (see 5.1.1 p. 5-11).
- The purge time must be long enough to get a stable signal before starting calibration.
- **You can cancel the running calibration procedure at any time with the F2 -key.**



⇒ Spanning: 2nd: Spanning

Note:
The procedure time depends on the parameters entered for stability time and averaging time.
(see 5.1.1 p.5-11)



⇒ **Return to the single component display of the current channel**

Press **F1**

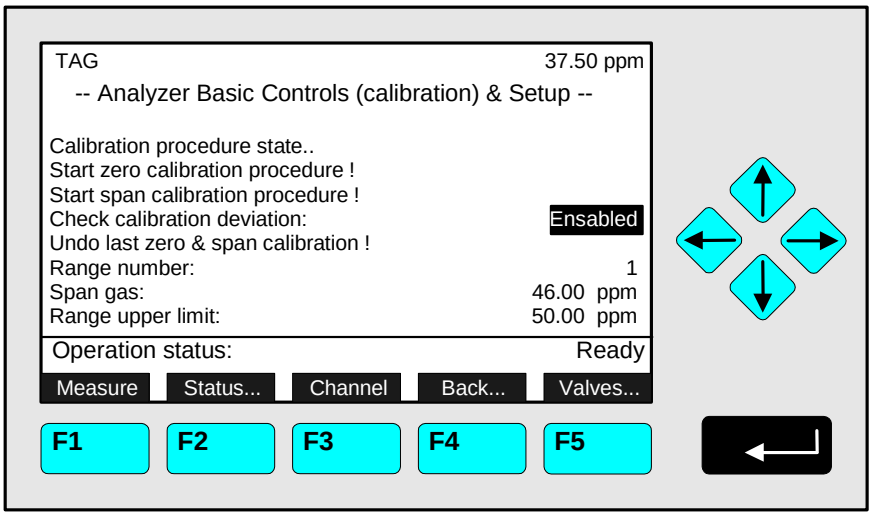
Options:

- F4 -key: Return to the menu "Analyzer Basic Controls".
- F5 -key: Switch to the menu "Calibration Deviations".

⇒ **Single component display appears when spanning has finished**

<u>Setup basic parameters</u> like check (of) calibration deviation, (measuring) range number, span gas and range upper limit (end of range):

- Press ↑ -key or ↓ -key to highlight the appropriate line.
- Select the variable to be edited by pressing ↵ -key or → -key, e. g. „Check calibration deviation" (see below). Possibly a check of <u>allowance to edit variables</u> via main menu is required first => Analyzer and I/O, expert controls & setup => Analyzer module setup => Measurement display configuration (with twice F5 to 3rd page) and => **"Application for Analyzer Basic Controls menu"**.



- Adjust span gas or range upper limit with ← -key or → -key.
- Define another range or enabled/disabled calibration deviation check with ↑ or ↓ -key.
- Enter new parameters using the ↵ -key or <u>return to previous values</u> pressing **F2** -key.

<u>Function Line "Undo last zero & span calibration !"</u>

Use this function to reset an analyzer's calibration values to default factory settings if the last calibration procedure has been completed with a poor result due to wrong settings and the calibration is in an undefined status.

Dependent on the "Measurement Display Configuration" settings a screen may appear asking for confirmation prior to executing the function (see chapter 3.7, pg. 3-6 and chapter 5.1.8, pg. 5-51).

<u>Line of variables „Check calibration deviation":</u>

Enables or disables the stability and tolerance control during calibration.

<u>Line of variables „Range number":</u>

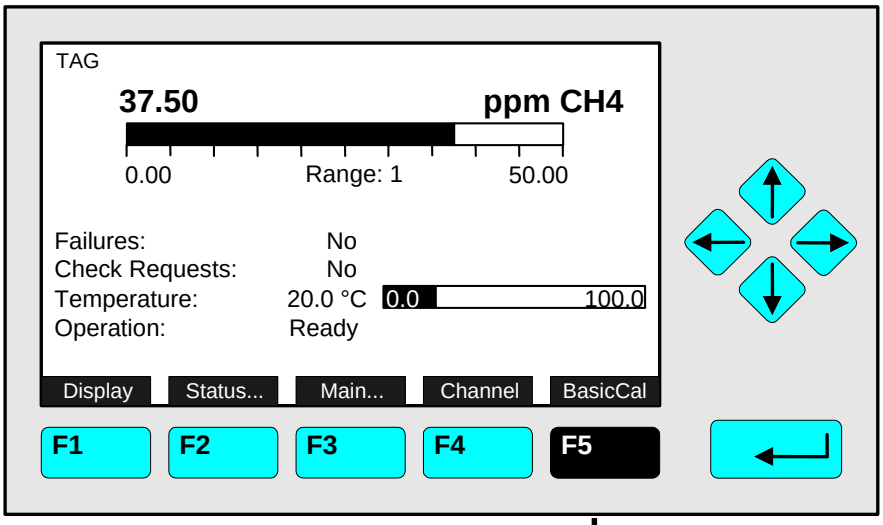
Use this variable to select the measuring range (1 to 4).

Line of variables „Span gas“:

- Insert the span gas value. Inadmissible high span gas values (outside the linearization) are not accepted (Take into account the lowest and highest end of range ! Span gas should be within 70 to 100 % of the upper limit !).

Line of variables „Range upper limit“:

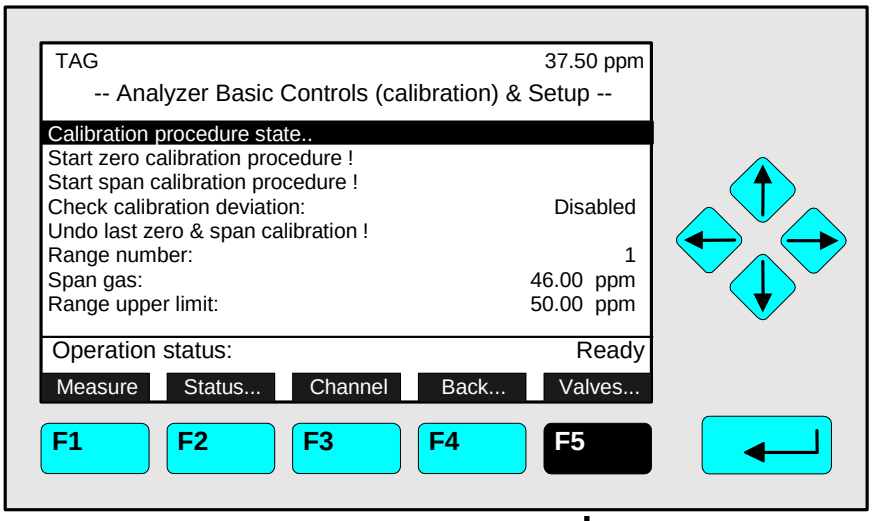
Put in the end of range (upper limit). Inadmissible high upper limits (outside the linearization) are not accepted.



⇒ **Open the menu "Analyzer Basic Controls (calibration) & Setup"**

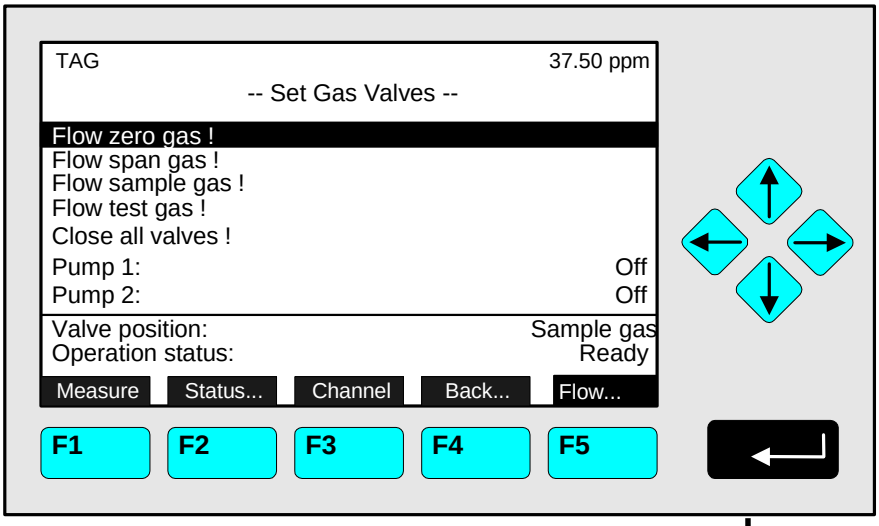
Press F5

Caution:
Before starting zero gas flow, make sure that zero gas is available !
(See also section 5.1.1, p.5-5... !)



⇒ **Switch to the menu "Set Gas Valves"**

Press F5

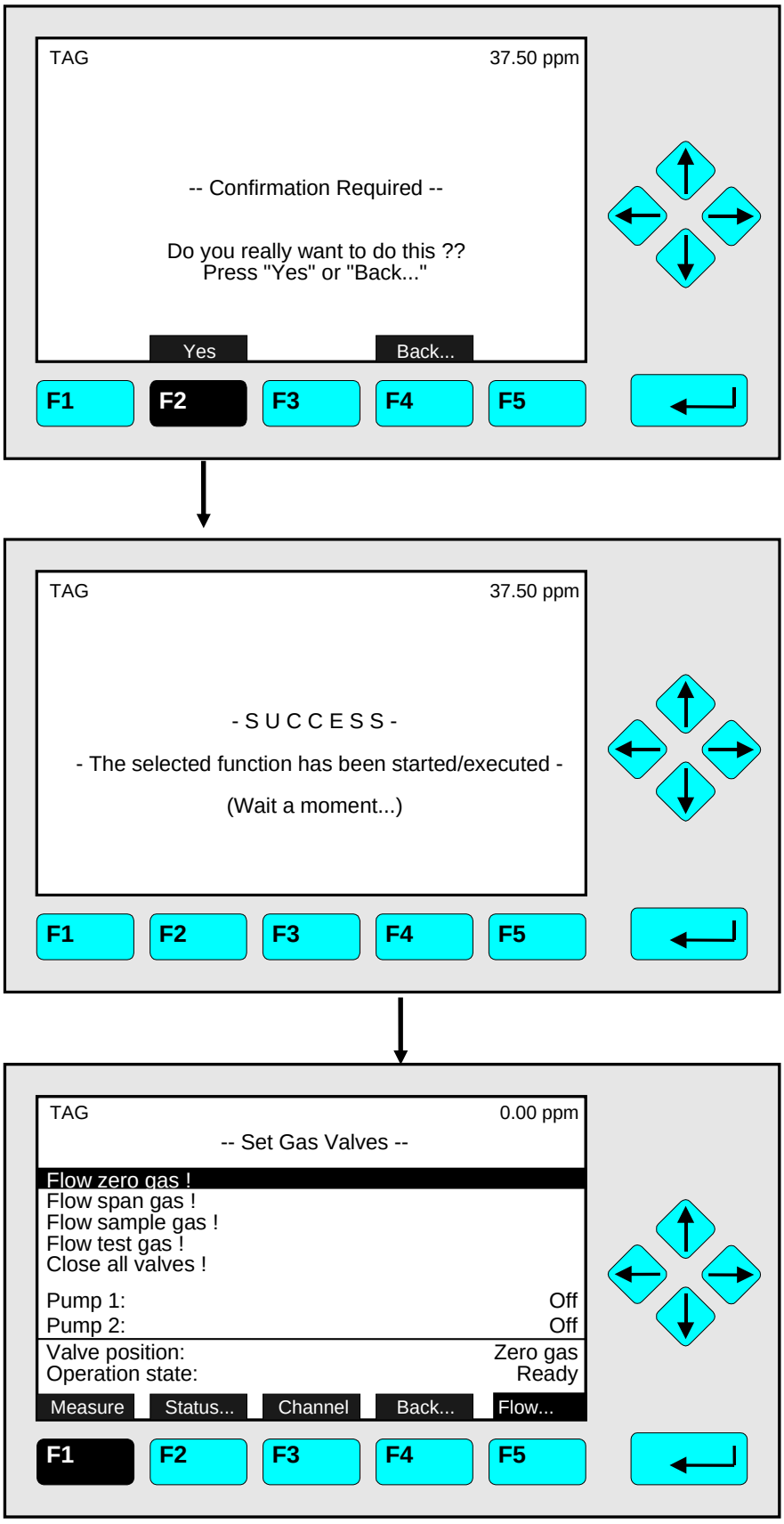


⇒ **Start "flow zero gas !"**

Press ↵

or →

Starting this function will open the zero gas valve as current gas valve.



⇒ Confirm to open the zero gas valve

Press **F2** to start the zero gas flow immediately.

Option:
Press the F4 -key if you want to cancel the procedure and return to the menu "Set Gas Valves".

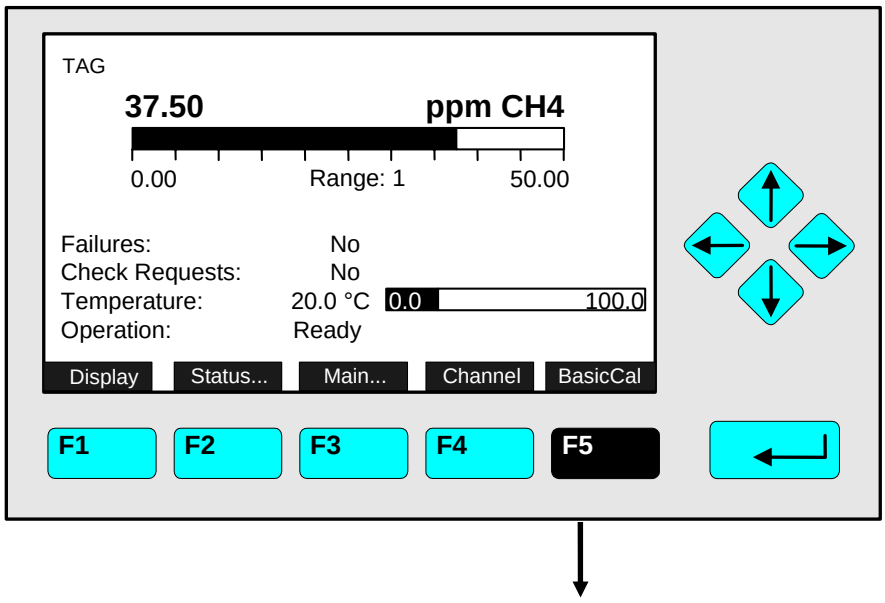
Note:
Whether this message appears or not depends on the setup in the expert controls & setup

⇒ Confirmation of function start

Note:
This message is displayed when the function has been started. After a moment the display will return automatically to the menu "Set Gas Valves".

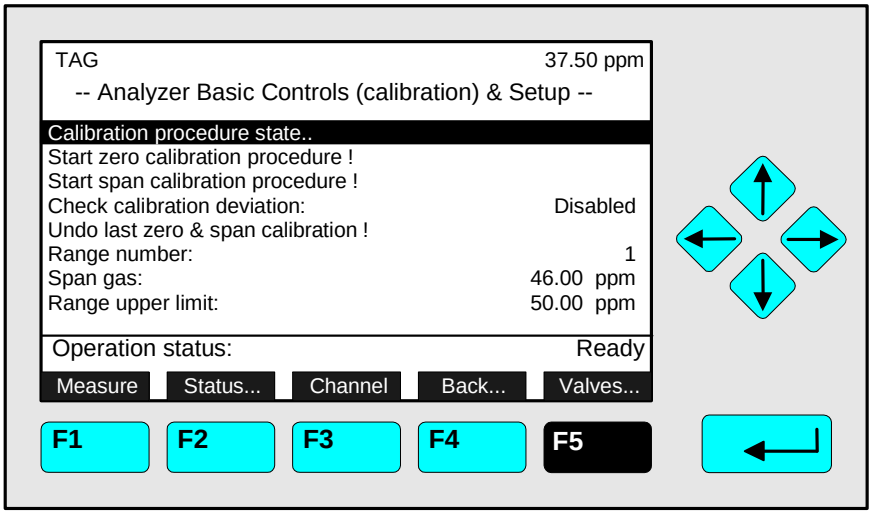
⇒ Additional options

- Start flow span gas, sample gas or test gas !
- Close all valves !
- Activate external pumps.
- F3 -key: Switch to another available channel to set gas valves.
- F4 -key: Return to the menu "Basic Controls and Setup " to start zeroing or spanning.
- F1 –key: Return to Single Component Display



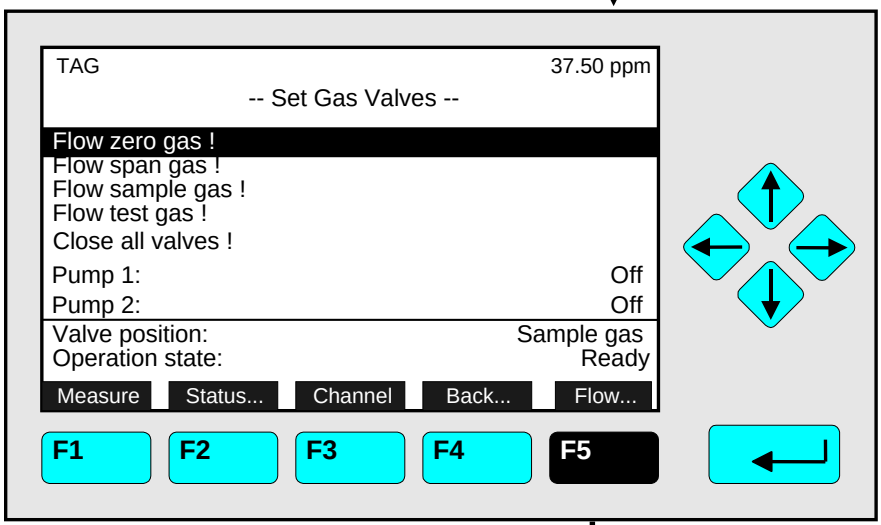
⇒ **Open the menu "Analyzer Basic Controls (calibration) & Setup"**

Press **F5**



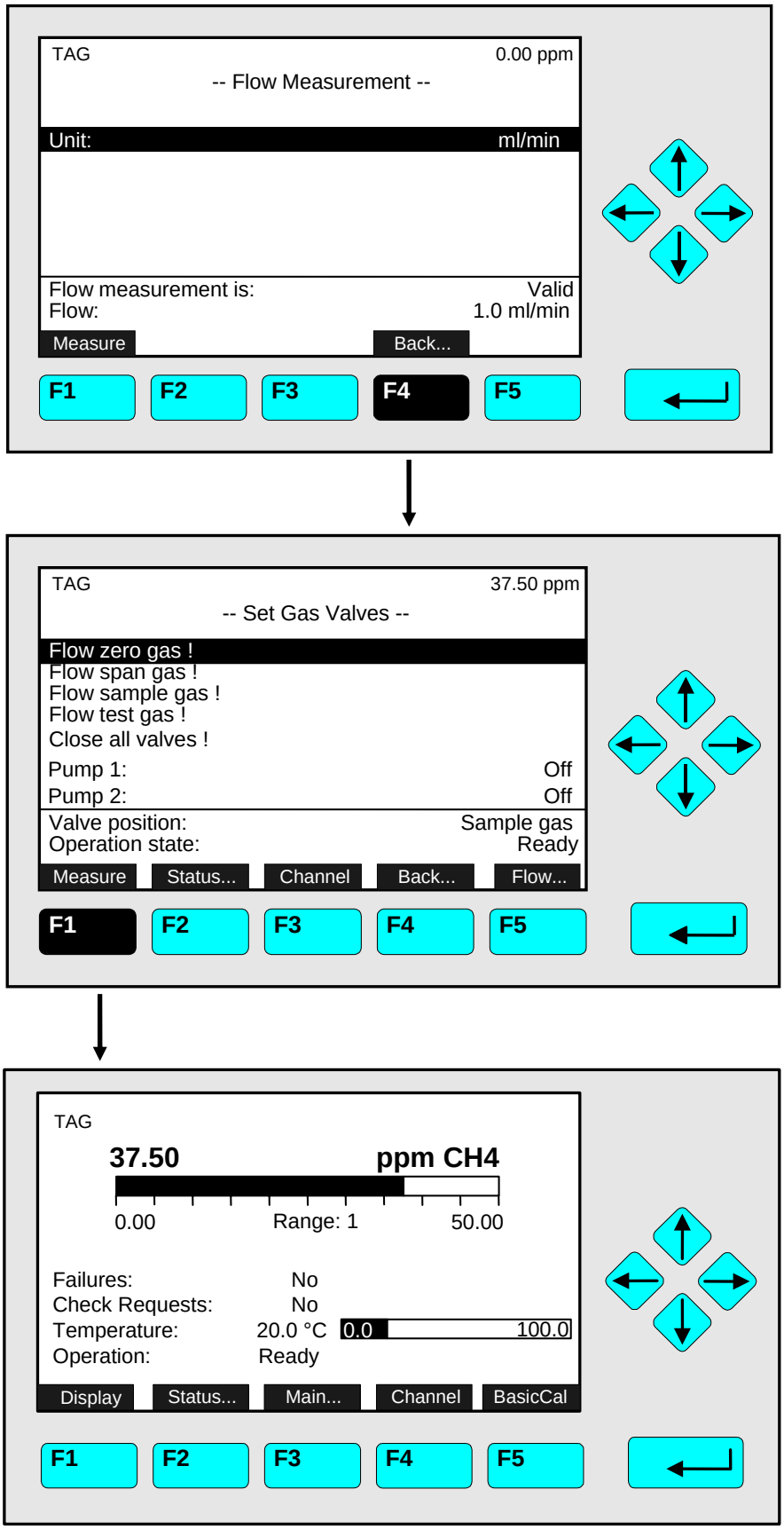
⇒ **Enter the menu "Set Gas Valves"**

Press **F5**



⇒ **Open the menu "Flow Measurement"**

Press **F5**



⇒ Set Flow unit

- Press the ↵ -key or the → -key to select the variable.
- Select the unit using the ↑ -key or the ↓ -key. Options: ml/min, l/min
- Confirm your adjustment using the ↵ -key or cancel and return to the previous value pressing F2.

Note:
If a flow sensor is not installed choosing this menu will display a message instead of the shown menu.

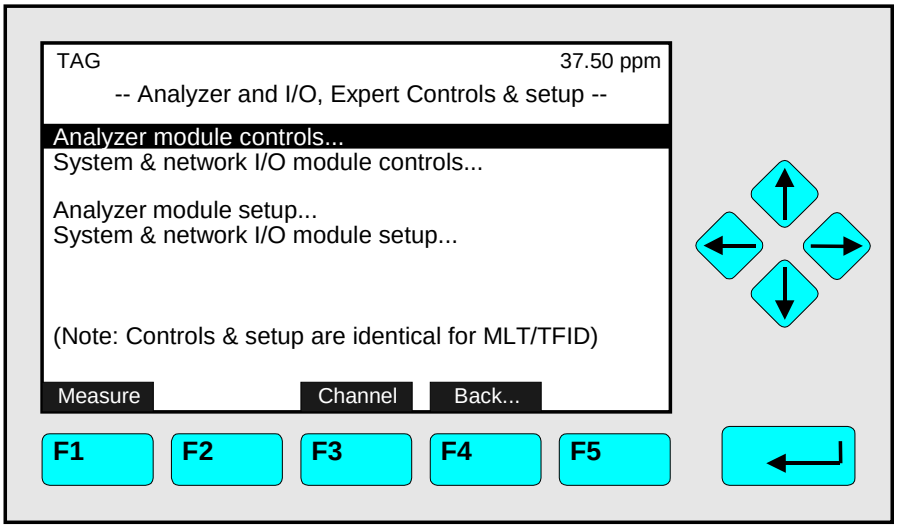
- Press F4 to return to the previous page.

⇒ Return to the single component display.

Press **F1**

5 Analyzer and I/O, Expert Controls & Setup

If you press the ↵ -key or the → -key in the line "Analyzer and I/O, expert controls & setup..." of the "Main Menu", the following menu will open:



In the menu "Expert Module Configuration" you can enter several submenus to set up parameters for measurement and calibration of your analyzer / analyzer module. Moreover you can set up the configuration for external modules. Which parts of these menus are important for you depends on the configuration of your NGA 2000 system.
The following table will give you a short overview about the contents of the menus:

Menu	Important Contents	Section/Page
Analyzer module controls...	⇒ See "Analyzer module setup" and note below!	
System & network I/O module controls... *System & network I/O module setup….*	⇒ Configuration of the SIO and of the DIO's installed in a platform or in a TFID/ MLT/ CAT 200 analyzer (**System I/O's**) ⇒ Configuration of network I/O's ⇒ See note below!	* 5.2 page 87–102 * 5.3 page 103-104
Analyzer module setup...	⇒ Set up of Measurement and calibration ⇒ SIO & DIO's configuration installed in TFID/ MLT/ CAT 200 AM's (**Local SIO/DIO**) ⇒ Programmable logic control (PLC) ⇒ Programmable calculators	* 5.1 page 3 - 86

Note:

All submenus of "Analyzer module/System & network I/O module controls…" are the same as those of "Analyzer module/System & network I/O module setup..." if you use a TFID/ MLT/ CAT 200 analyzer / analyzer module! If your analyzer is not of such type the submenus of "Analyzer module controls..." and "Analyzer module setup..." will look different (FID, HFID, CLD etc.). Refer to the corresponding software manuals.
Both analyzer module and I/O module functions are analyzer module resp. I/O module level in combination with a control module (platform, MLT/ CAT 200/ TFID analyzer) level.
The MLT/ CAT 200/ TFID analyzer does not have a pure platform (control module) level but a combined CM/AM level (MCA level) !

Structure of chapter five:

At the beginning of each section you will find the way to a defined submenu in the TFID/ MLT/ CAT 200 software: Starting from the line "Analyzer and I/O, expert controls & setup" in the "Main Menu" the way through the menus is described giving the menu lines you have to enter sequentially to reach the submenu. At the end of this description you will find an illustration of the final submenu screen followed by set up instructions and explanations. Sometimes the illustration may be completed by sketches or additional menu pictures.

Example: You want to set up the calibration parameters for the calibration procedure of the analyzer module.

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

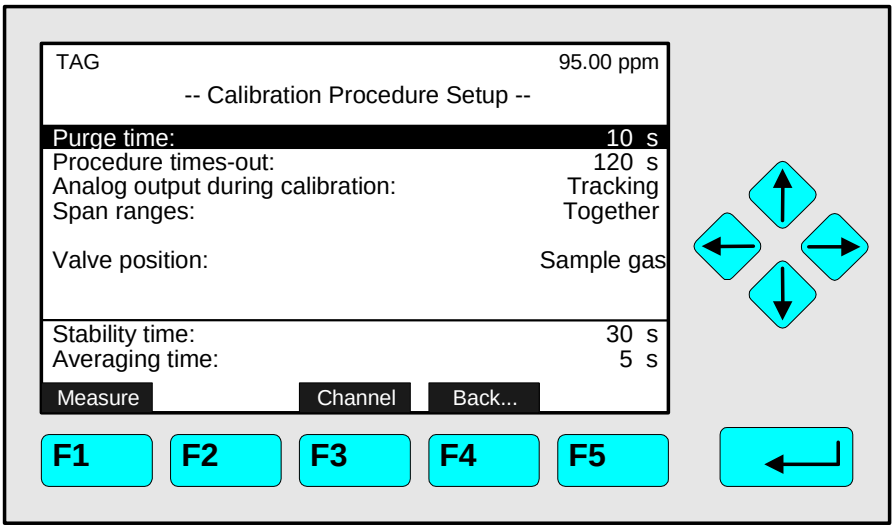
↓

Calibration parameters

↓

Calibration procedure setup

↓



In the menu "Calibration Procedure Setup" you can set the parameters for the calibration procedures zeroing and spanning.

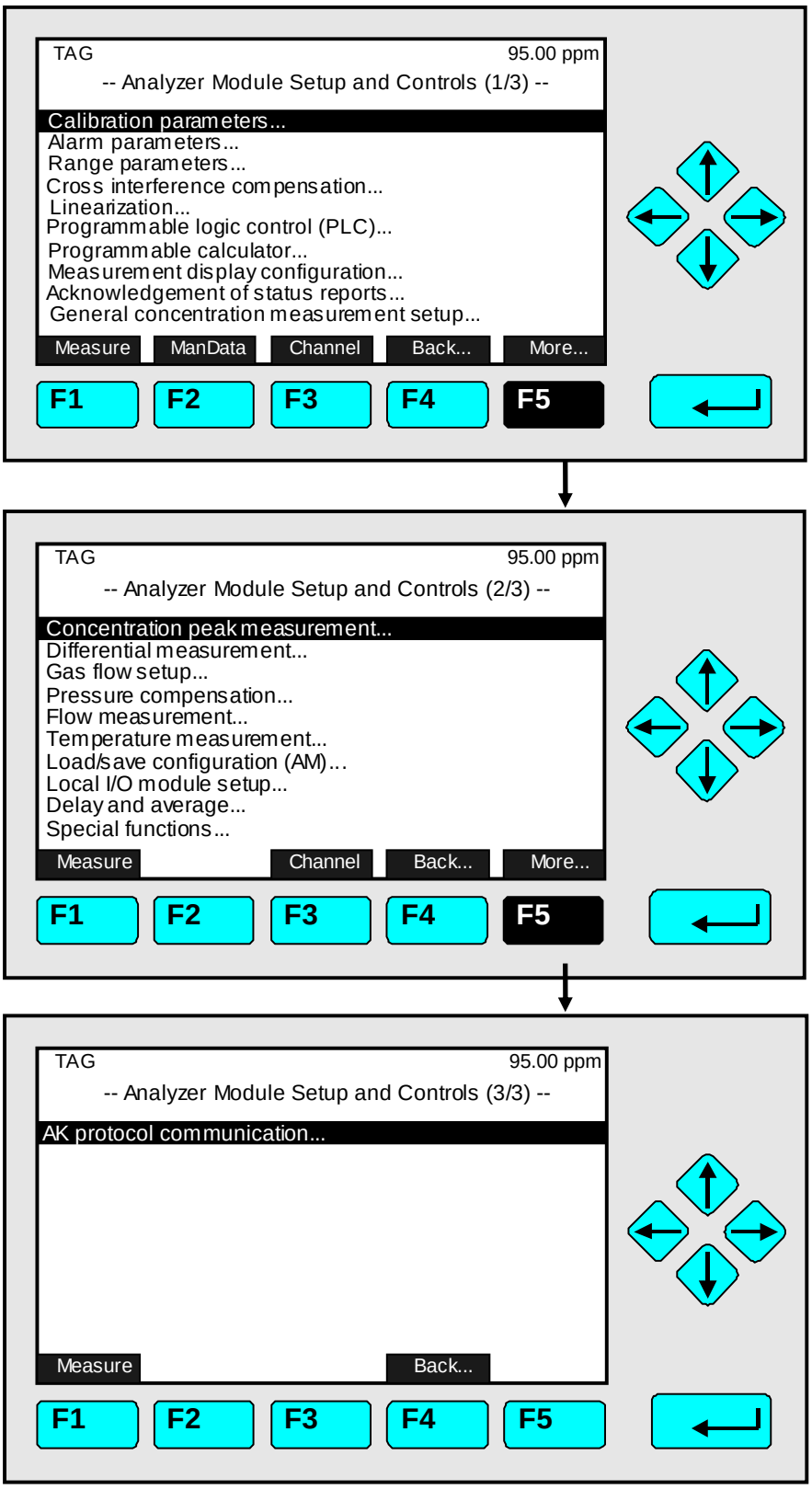
Detailed explanations and instructions will follow later in this chapter!

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

↓



Starting from the menu "Analyzer Module Setup and Controls" you can enter all menus and submenus of the expert configuration level via the corresponding menu lines.

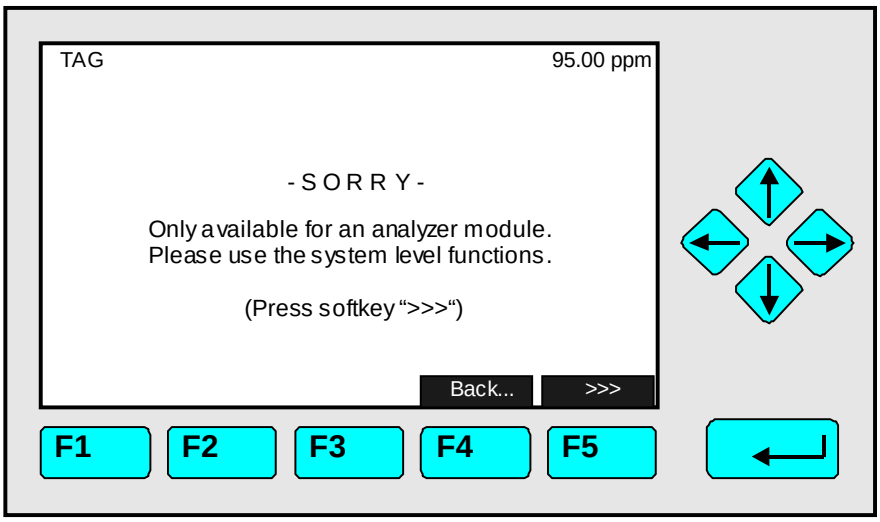
Entering menus and submenus:

- Select the menu line you want using the ↓ -key or the ↑ -key.
  If necessary: Enter the next menu page using the F5 -key (More...)
- Enter the corresponding menu/submenu using the ↵ -key or the → -key.

Menu "Load Factory Configuration" (Soft key ManData):

This function is used to delete the analyzer module RAM data and load factory default settings from the Flash-EPROM. If MLT/TFID is not an analyzer module but an analyzer enter the menu "Load/Save configuration (CM/MCA)" in the menu "System Configuration and Diagnostics" for loading control module factory default settings. For more information refer to chapter 6.2, page 6-7.

If you press the F2 -key (ManData) in the menu "Analyzer Module Setup and Controls (1/3)", anyway you will see the following display:



Pressing F5 as asked will take you to directly to the menu "Load/Save configuration (CM/MCA)" as described above.

F4 returns you back to the previous menu.

Main Menu — Analyzer and I/O, expert controls & setup

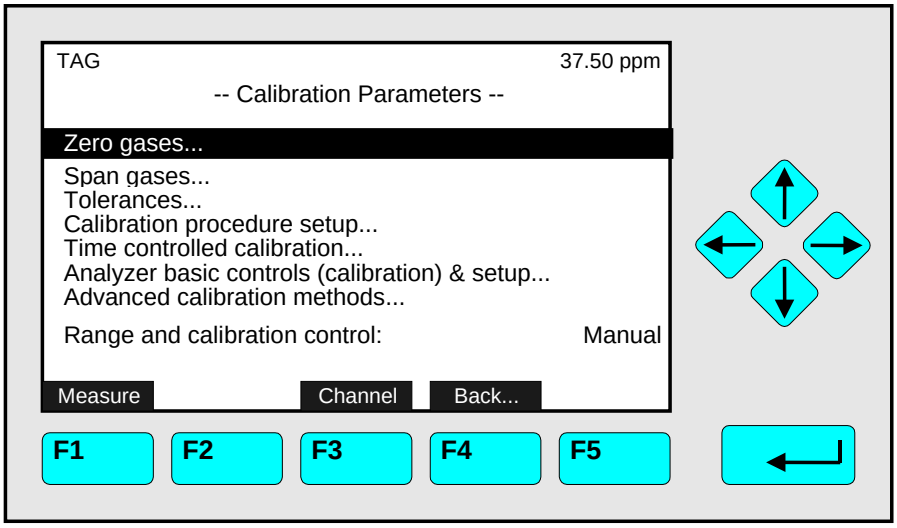
↓

Analyzer module setup

↓

Calibration parameters

↓



From the menu "Calibration Parameters" you can enter several submenus to set up zero and span gas calibration parameters and to start the different calibration methods.

Enter submenus:

- Select the menu line you want using the ↓ -key or the ↑ -key.
- Enter the submenu pressing the ↵ -key or the → -key.
- Select the parameter with the ↑ -key or the ↓ -key, switch into EDIT mode using the ← - key or → - key and change the value using the ↑ -key or ↓ -key
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value pressing F2.

Note:

Before starting Zero or Span Calibration please check the submenu “Cross Interference Compensation” to make sure that the compensation is “Disabled” or “Calibration: Off” is selected (S. 5.1.4 p. 5-33...).

Function keys:

- F1: Return to the single component display!
- F3: Switch to other MLT analyzer or analyzer module channels!
- F4: Return to the previous menu page!

Line of variables "Range and calibration control":

The parameter selected in this line is valid for the autoranging control of the current channel. You may set it in the menu "Range parameters" too. Refer to chapter 5.1.3, page 5-27 for explanation of parameter setting!

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

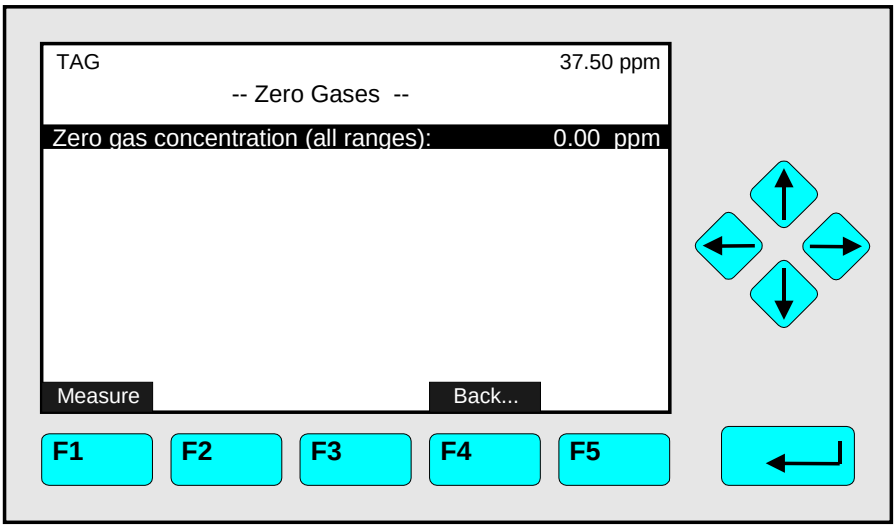
↓

Calibration parameters

↓

Zero gases

↓



In the menu "Zero Gases" you may set the actual zero gas concentration for all ranges of the current MLT analyzer or analyzer module channel. The concentration unit ("ppm", "ppb", "%" etc.) is determined by the setup of the current channel (see section 5.1.10 p. 5-57).

Zero gas concentration setup:

- Select the variable with the ↵ -key or the → -key.
- Select any digit with the ← -key or the → -key and adjust a new value with the ↑ -key or the ↓ -key
  resp. select the whole parameter with the ↑ -key or the ↓ -key.
- Confirm the new value with the ↵ -key or
  cancel and return to the previous value with the F2 -key.

5.1 Analyzer Module Setup

5.1.1 Calibration Parameters – Span Gases

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

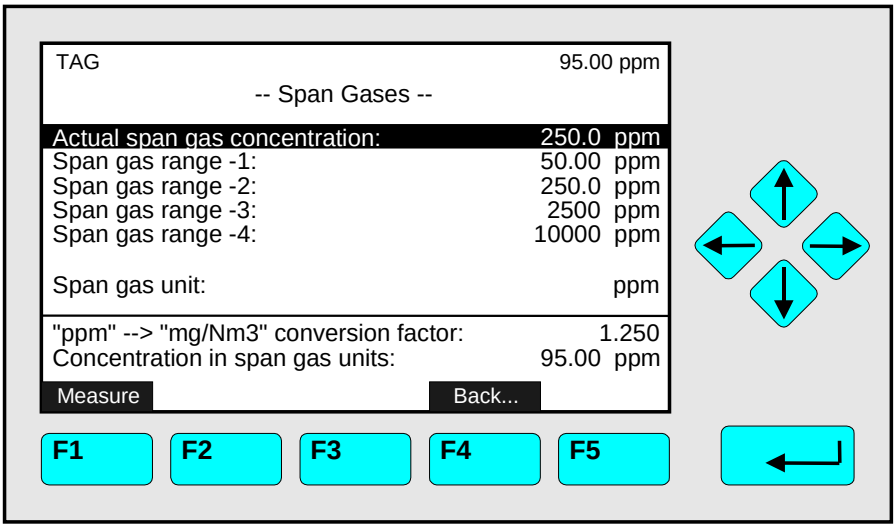
↓

Calibration parameters

↓

Span gases

↓



In the menu "Span Gases" you may set the actual span gas concentration, the default span gas value for each range of the current channel, and the desired span gas unit. The span gas concentration of each range should be a value between 70 % and 110 % of the end of range value.

Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Note:

To setup the "ppm → "mg/Nm^3" conversion factor you have to enter the menu "General Concentration Measurement Setup" (see section 5.1.10, page 5-57) !

The last two lines of variables:

These lines are for information only. The variables cannot be changed. The line "Concentration in span gas units" is only important for the TFID (see TFID manual) !

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

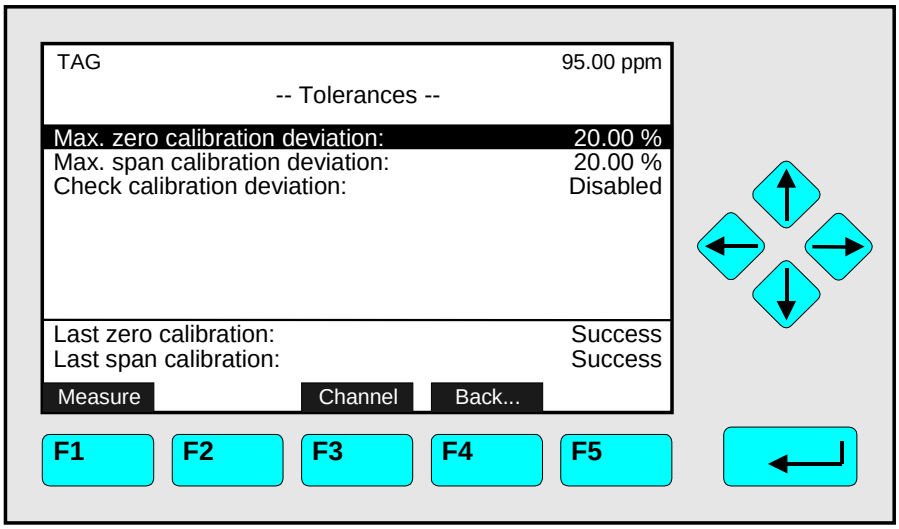
↓

Calibration parameters

↓

Tolerances

↓



In the menu "Tolerances" you can set the parameters for the stability controlled calibration procedure (see pg. 5-11/12/13) for one channel. Furthermore you may disable the stability control and the maximum calibration deviation (deviation control → deviation tolerance).

Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Lines "Last zero calibration/Last span calibration":

The status of the previous calibration is shown in these two lines.

Note:

Press F3 -key to set up other MLT analyzer or analyzer module channels.

Lines of variables "Max. zero calibration deviation" / "Max. span calibration deviation":

These two variables define if zero calibration and span calibration are executed or not. The value entered in line "Max. zero calibration deviation" refers to the smallest span gas range out of range 1...4 and defines one single "zero tolerance" for all ranges. The zero calibration gas applied has to generate a signal within this tolerance around 0, otherwise the calibration will run into time out. The value entered in line "Max. span calibration deviation" defines "span tolerances" calculated for each range 1...4 separately. The span gas applied for calibration has to generate a signal within the tolerance around the current end of range value to start calibration.

Line of variables "Check calibration deviation":

- **Enabled:** The deviation control during the calibration procedure will be based on the values of the menu "Deviation Parameters".
- **Disabled:** The calibration procedure is executed without deviation control. Any calibration will be accepted.

Example:

- End of range: 1000 ppm
- Max. calibration deviation: 0.5 % (equivalent 5 ppm)
- Expected value: 995 ppm
- Displayed value 980 ppm
- Deviation: 20 ppm (more than 5 ppm!)
- Result: Max. calibration procedure time over limit; Calibration will be canceled !

Potential solutions:

- Adjust up to 100 % in the line "Max. zero calibration deviation" resp. "Max. span calibration deviation" or select "Disabled" in the line "Check deviation".
- Result: Any Calibration will be accepted!

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

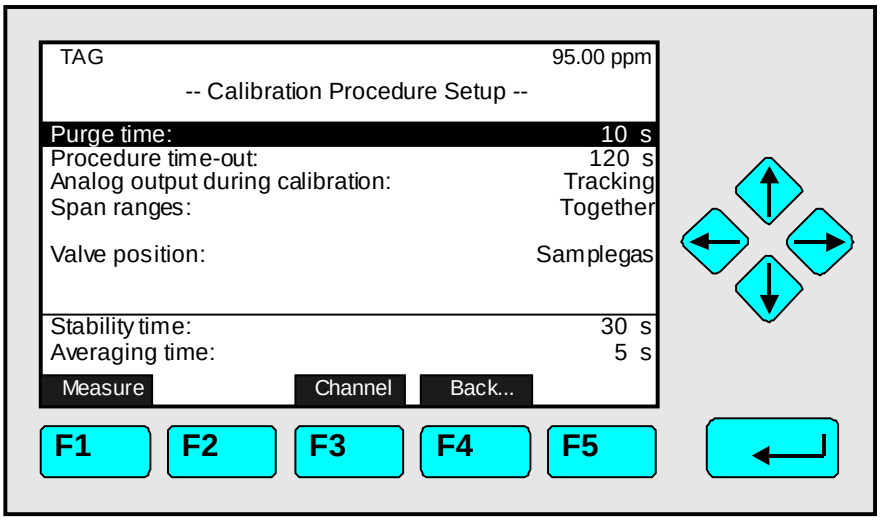
↓

Calibration parameters

↓

Calibration procedure setup

↓



In the menu "Calibration Procedure Setup" you can set up the parameters for the calibration procedure of zeroing and spanning. Every channel has it's own menu page

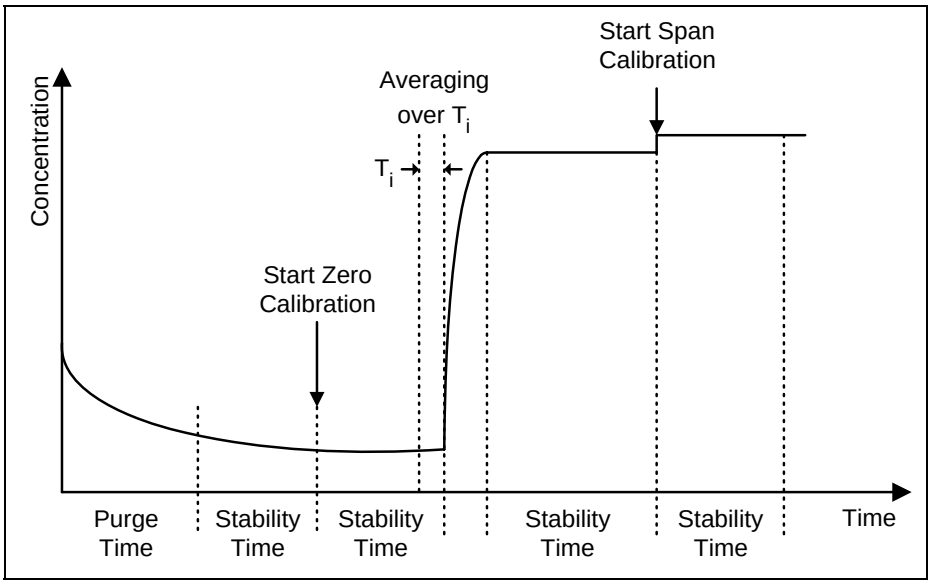
Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Lines of variables "Purge time" / "Procedure time-out" and
"Stability time" / "Averaging time" – Information about calibration procedures setup:

The measurement signal should be stable in a certain range before zeroing and spanning. Therefore the analyzer cell should be purged with zero gas or span gas before calibration. This purging time is followed by the stability time. During this time the average over a number of signals is calculated, where the number of signals taken into account is depending on stability time and averaging time. The averaging time defines the time

difference between two signals. If the noise calculated over all these values is within the allowed stability tolerance (factory setting: 10 %), the calibration will start. If not, the stability control is starting again until a stable measurement is possible or the time in the line "Procedure times-out after" is reached.
The following figure shows the procedure of stability controlled zero gas and span gas calibration:



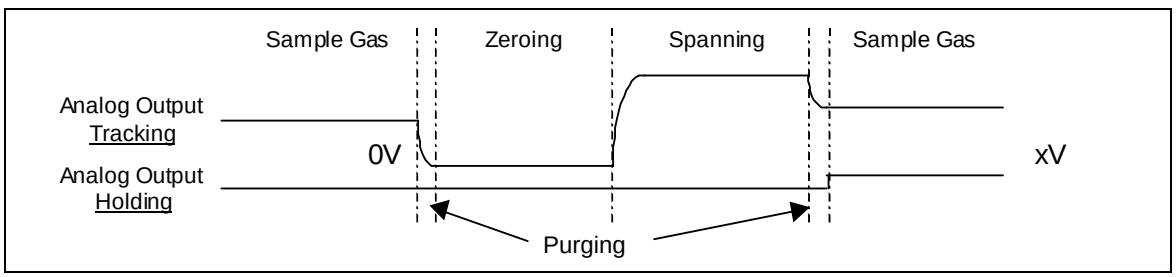
Note:

Stability time and averaging time are factory settings and cannot be changed by the operator. If you want to use other values, ask your service!

Line of variables "Analog output during calibration":

Here you can determine if you want to hold the analog output and the limits of a local SIO in the TFID analyzer module during calibration. The setup for a platform or TFID analyzer SIO has to be done in the menu "Analog Outputs" (see 5.2.1 p. 5-87).

- **Tracking:** The analog output signal is following to the signal during the whole calibration procedure.
- **Holding:** During the whole calibration procedure the analog output signal is fixed to the last value before calibration started. This adjustment is useful if limits are controlled using the analog output.



This sketch shows the difference between analog output TRACKING and HOLDING: While output tracking gives the actual value all the time during calibration, output holding is zero during calibration. It still remains zero after span calibration till purge time is over.

Line of variables "Span ranges":

- **Together:** All measurement ranges of the same channel will be calibrated together. This is the usual calibration mode.
- **Separately:** Each measurement range will be calibrated separately.

Line of variables "Valve position":

This line allows to control the actual gas flowing.

Options:

- Sample gas
- Zero gas
- Purge gas
- Test gas
- Span gas-1...-4
- Linearizer
- Span gas
- All Closed
- -
- Other Process
- Basic Status

Note:

Before starting Zero or Span Calibration please check the submenu "Cross Interference Compensation" to make sure that the compensation is "Disabled" or "Calibration: Off" is selected (S. 5.1.4 p. 5-33...).

Main Menu — Analyzer and I/O, expert controls and setup

↓

Analyzer module setup

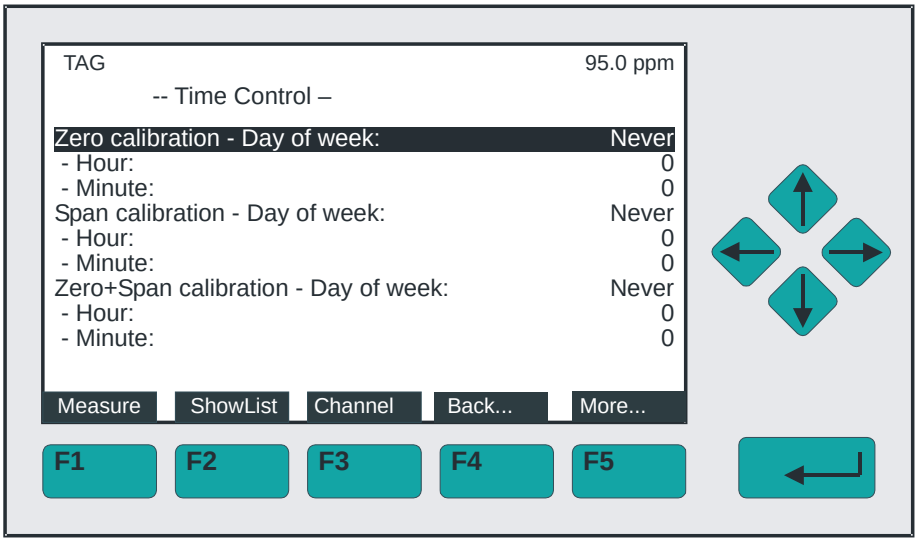
↓

Calibration parameters

↓

Time controlled calibration

↓



Use the menu "Time Control" to define time controlled zero gas calibration / span gas calibration for the actual channel. Press F3 if other channels need to be defined.

Notes:

- Time controlled calibration is only possible if span gas is supplied using a valve gear! If a valve gear is not connected you have to select "Never" in all lines containing "Day of week".
- Zero gas calibration should be performed before starting span gas calibration. Therefore the starting time of the zero gas calibration should be earlier than the starting time of span gas calibration. If you select the option "Zero+Span calibration" the zeroing will run prior to spanning automatically.

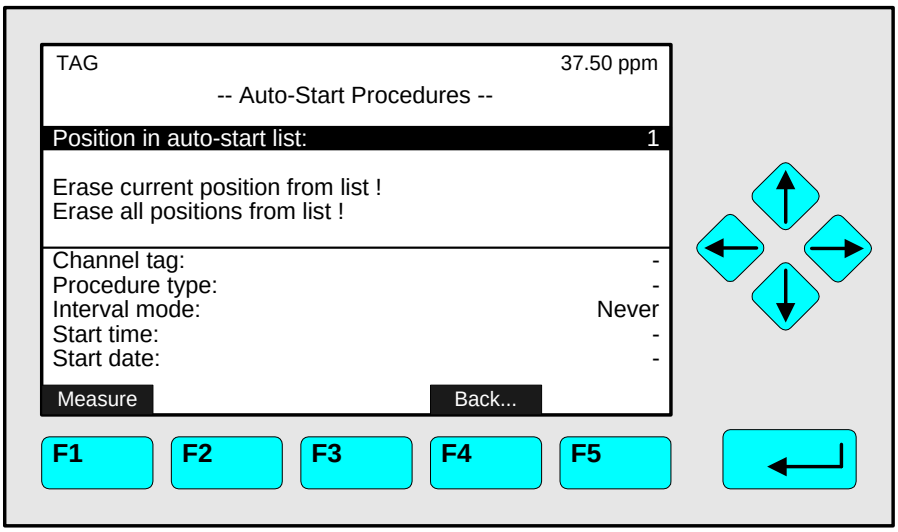
Set up time parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
  Options for day of week: Monday, ..., Sunday, Each day, Never, Free interval
  for hour: 0, 1, 2, 3, ..., 23
  for minute: 0, 1, 2, 3, ..., 59
- Selection of “Free interval” allows several calibration on one day (F5 –key for setup).

♦ Confirm the new value using the ↵ -key or
cancel and return to the previous value using the F2 -key.

Additional Parameters:

Pressing the F2 -key (ShowList) opens the following submenu:



In this submenu you can define some more parameters for time controlled calibration.

Lines "Position in auto-start list", "Erase current position from list!" and "Erase all positions from list!":

If you have disabled time controlled calibration in the menu "Time Control" you have to reset the memory to avoid future calibrations by time control. Starting the function "Erase current position from list !" will reset the memory for the position selected in the line "Position in auto-start list".

There are three positions corresponding with the lines in the menu "Time Control":

Position 1: Zero calibration
Position 2: Span calibration
Position 3: Zero+Span calibration

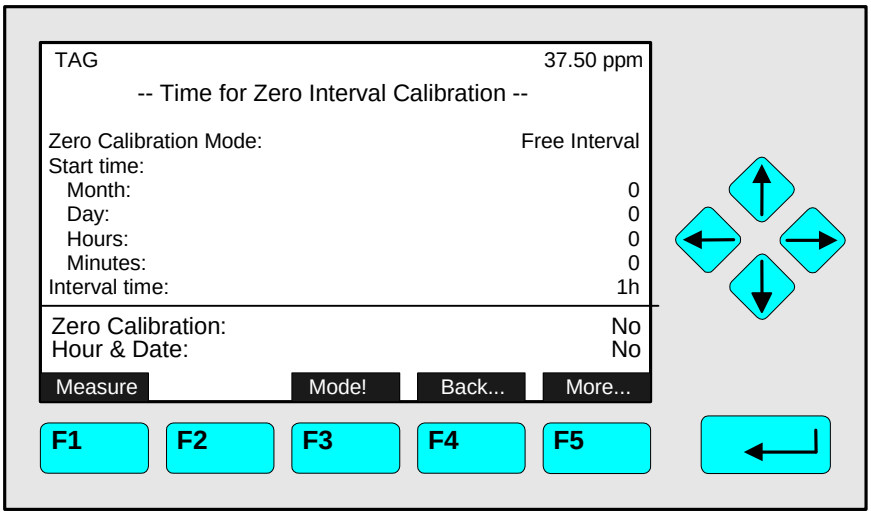
Starting the function "Erase all positions from list !" will delete the setup for all kinds of time controlled calibration in the menu "Time Control".

The last five lines of variables:

These lines show the parameters of the position selected in the line "Position in auto-start list:".

Selection of “Free interval” for zero, span or zero+span calibration:

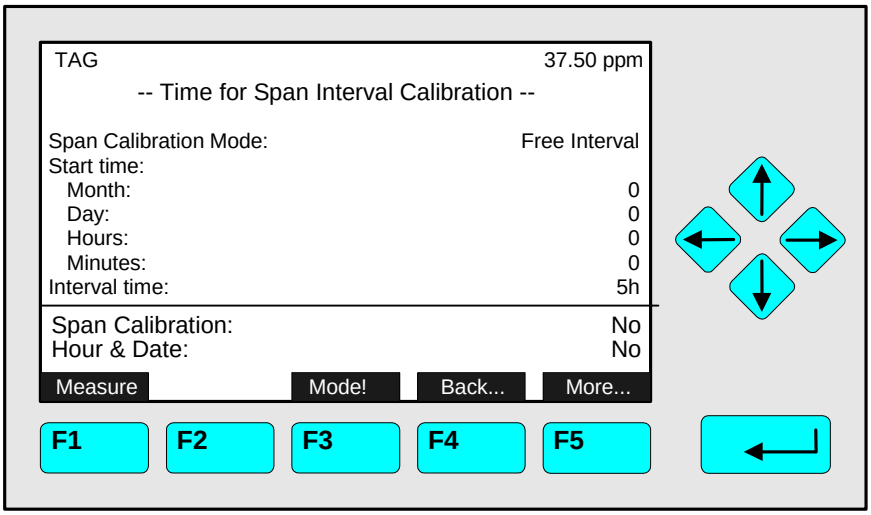
The option “free interval” allows to select the start time (month, day, hour, minute) and the interval time for zero, span or zero+span calibration.
Pressing the F5 -key (More…) in the menu “Time Control” opens the following submenus:



Adjust Zero Calibration mode.

Select start and interval time.

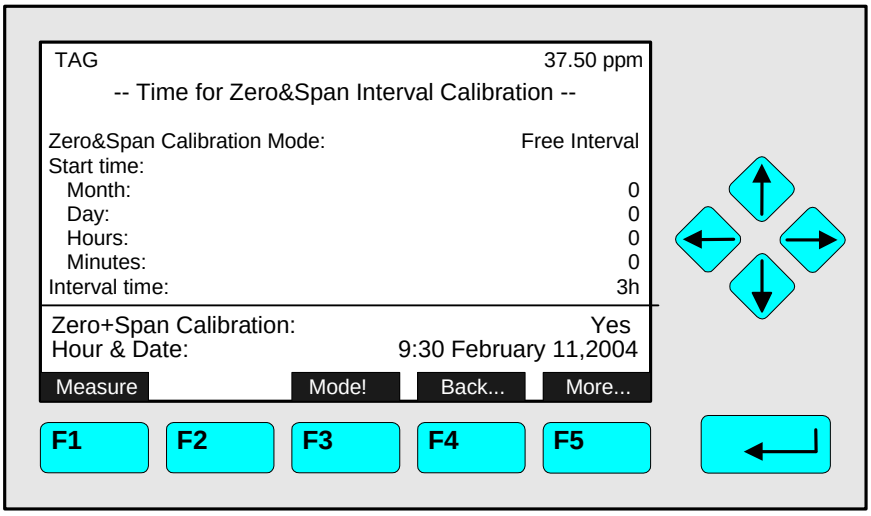
The settings are shown under “Hour & Date”.



Adjust Span Calibration mode.

Select start and interval time.

The settings are shown under “Hour & Date”.



Adjust Zero+Span Calibration mode.

Select start and interval time.

The settings are shown under “Hour & Date”.

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

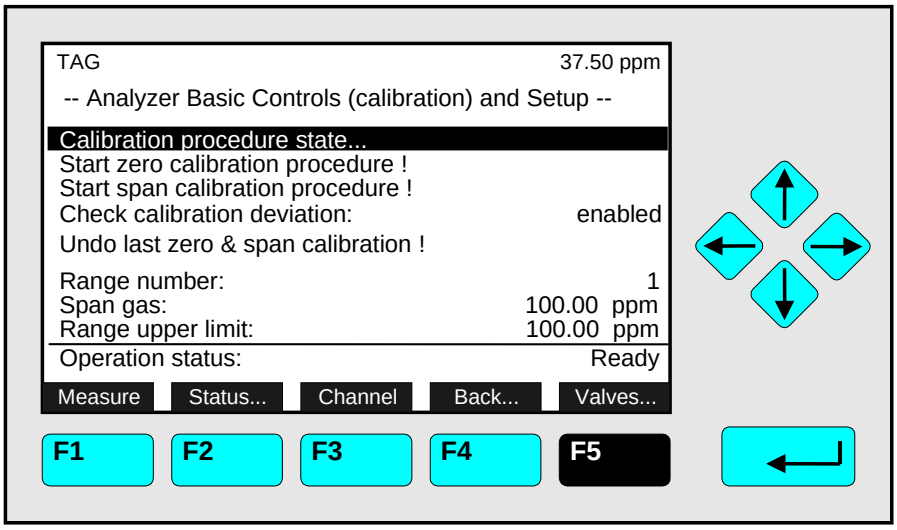
↓

Calibration parameters

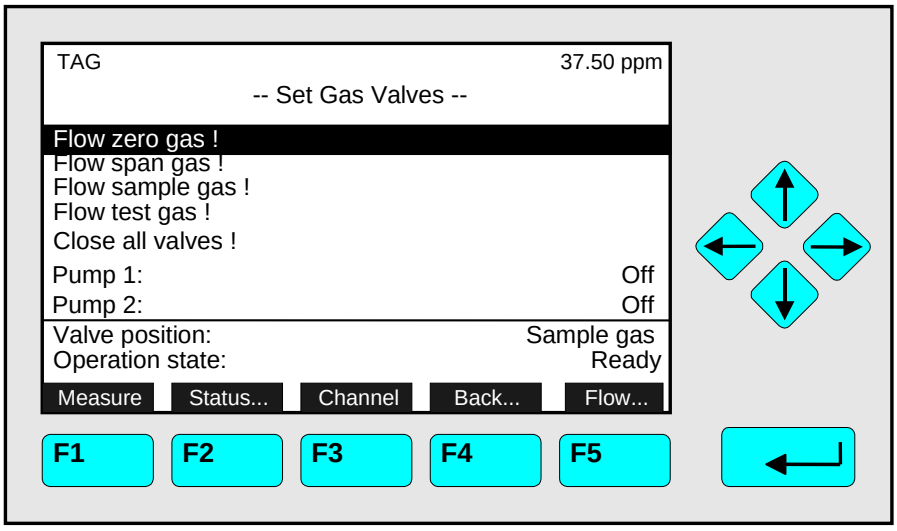
↓

Analyzer basic controls (calibration) & setup

↓



↓



In the menu " Analyzer basic controls (calibration) & setup " you may

- **start zero calibration** or **span calibration**
  for all measurement ranges of the current MLT analyzer / analyzer module channel.
- Press F3 to reach other channels.
- Variables lines "Check calibration deviation", "Range number", "Span gas" and "Range upper limit" may be edited depending on the setting of the application in the "Basic Controls Menu" (see 5.1.8, page 5-54).

Pressing the F5 -key you enter the menu **"Set Gas Valves"**, where you may

- **set up the gas flow** of the current channel by controlling valves for
  - zero gas or
  - span gas or
  - sample gas or
  - test gas or
  - close all valves.
- **set up the gas flow** with external pumps
  - pump 1 or
  - pump 2.

Starting the functions:

- Change to the line you want using the ↑ -key or the ↓ -key.
- Press the ↵ -key or the → -key or
  cancel and return to the previous menu page using the F4 -key (Back...) or the ← -key.
- If asked: Confirm using the F2 -key (Yes) or
  cancel and return to the previous menu page using the F4 -key (Back...) or the ← -key.

Notes:

The signal has to be stable prior to starting any calibration!

- The last line of the menu "Analyzer Module Calibration" resp. the last two lines of the menu "Set Gas Valves" are for information only.
- The menu "Analyzer Module Calibration" is the same as the menu "Analyzer Module Calibration" of "Basic Controls" (see sections 4.4 to 4.11), including all submenus. So, calibration and gas flow procedures are analogous to the descriptions in sections 4.5 to 4.11.
- If you want to start zero and/or span calibration for all channels simultaneously, you have to call up the menu "Advanced Calibration Methods" (see p. 5-20).
- If you want to calibrate the measurement ranges separately with span gas, you have to set up "Separately" in the line "Span ranges" in the menu "Calibration Procedure Setup" (see p. 5-12).
- **Pressing the F2 -key** you will enter the menu **"Analyzer Channel Status".** In this menu and its sub-menus you will find a status report for the current channel including

  - Hours of operation
  - Events
  - Alarms
  - Failures
  - Check requests
  - Function checks

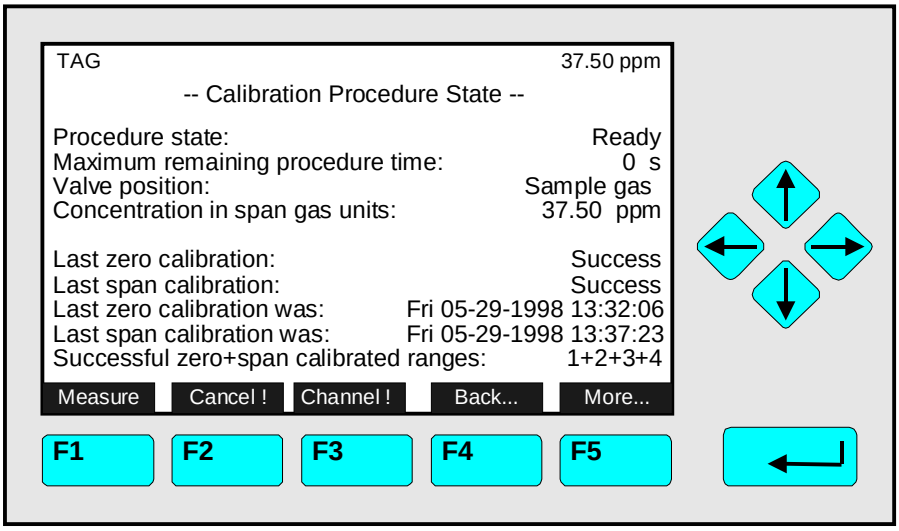
  and (in a sub-menu) operational settings for the current channel like

  - range settings and
  - response time (t_{90}-time).

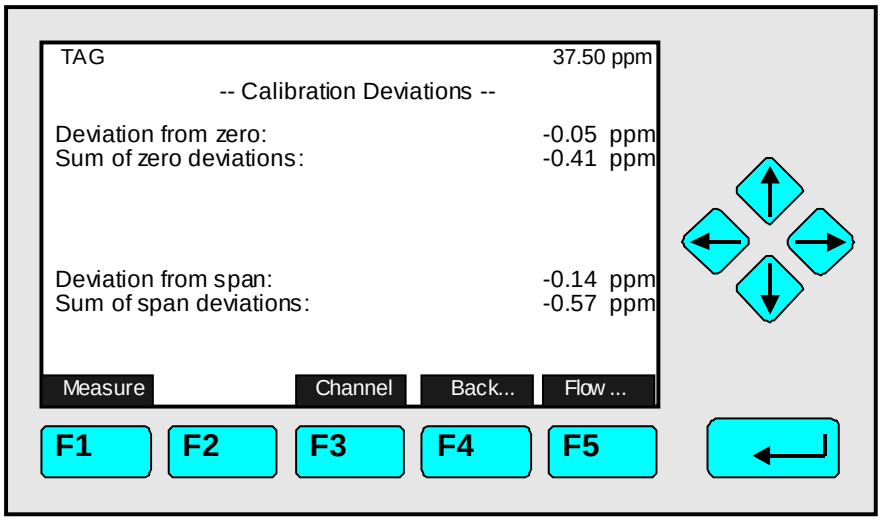
  Section 4.1 in detail describes the menu "Analyzer Channel Status" and its submenus.

Menu "Calibration Procedure State":

Press the ↵ -key or the → -key in the line "Calibration procedure state..." to enter the corresponding submenu:



In the menu "Calibration Procedure Status" you will find the results of the last calibrations. This menu will appear automatically after starting the zero or span gas calibration. Then it will display the status of the running calibration procedure (see sections 4.5/4.6, page 4-19 to 4-28). A running calibration may be canceled at any time by pressing the F2 -key.
Pressing F5 (More...) will open a submenu where you will find the calibration deviations of the current channel.



5.1 Analyzer Module Setup

5.1.1 Calibration Parameters – Advanced calibration methods

Main Menu — Analyzer and I/O, expert controls and setup

↓

Analyzer module setup

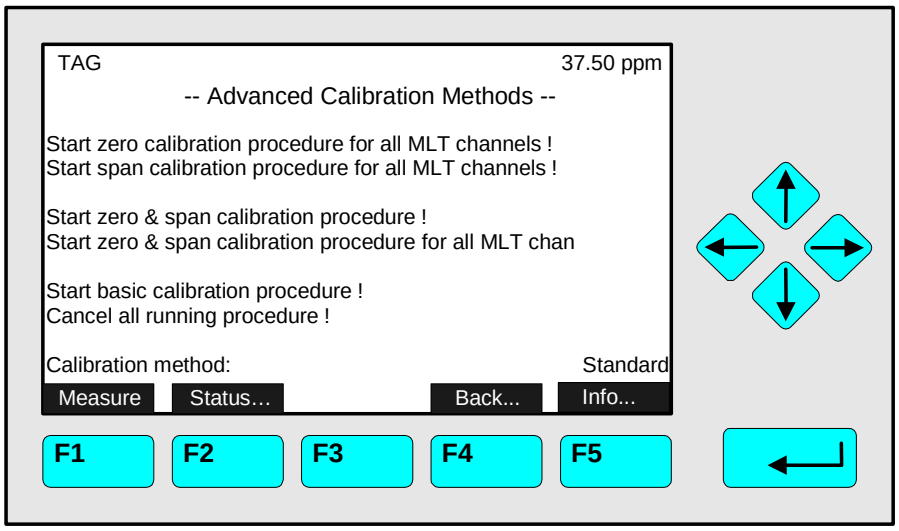
↓

Calibration parameters

↓

Advanced calibration methods

↓



Menu "Advanced Calibration Methods" allows to start several procedures:

- zero calibration simultaneously for all MLT channels
- span calibration simultaneously for all MLT channels
- zero and span calibration for actual channel selected
- zero and span calibration for all MLT channels
- start basic calibration to set all calibration deviations to zero.
- Cancel all running calibration procedures.

Note:

- If you start zero and/or span calibration for **all** MLT channels and no other analyzer modules are connected the single channel MLT, this channel will be calibrated only.

Starting the functions:

- Change to the line you want using the ↑ -key or the ↓ -key.
- Press the ↵ -key or the → -key or
  cancel and return to the previous menu page pressing F4 (Back...) or the ← -key.
- If asked: Confirm with F2 (Yes) or
  cancel and return to the previous menu page pressing F4 (Back...) or the ← -key.

Note:

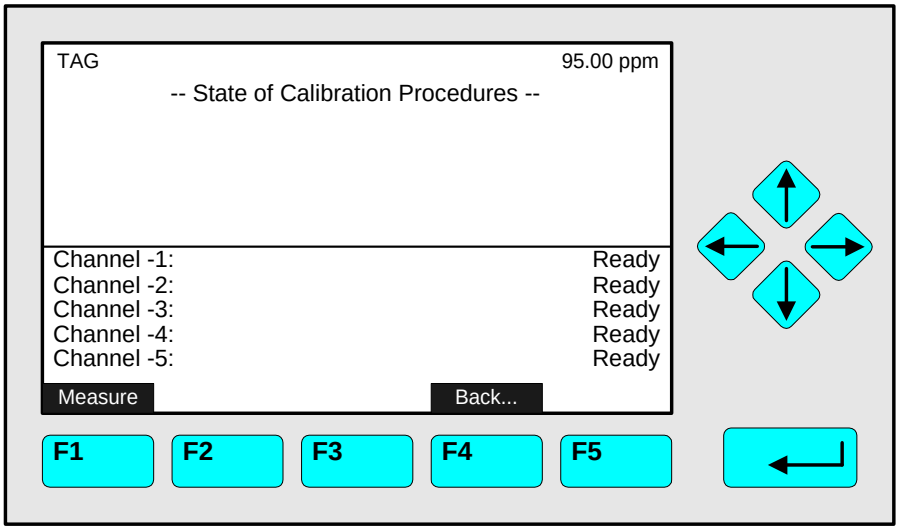
- The signal has to be stable before starting any calibration !
- If you want to start zero and span calibration separately, **or** if you want to calibrate separately each available channel of a MLT analyzer / analyzer modules, **or** if you want to calibrate the measurement ranges separately with span gas you have to switch to the menu "Analyzer Module Calibration" (see page 5-15) resp. to the menu "Calibration Procedure Setup" (page 5-10).
- You may cancel any calibration procedure using the function "Cancel all running procedures !"
- **Pressing the F2 -key** you will enter the menu **"Analyzer Channel Status".** In this menu and its sub-menus you will find a status report for the current channel including
  - Hours of operation
  - Events
  - Alarms
  - Failures
  - Check requests
  - Function checks

  and (in a sub-menu) operational settings for the current channel like
  - range settings and
  - response time (t_{90}-time).

  The menu "Analyzer Channel Status" and its submenus are shown in detail in section 4.1.

Menu line "Info...":

This menu line opens a screen "State of Calibration Procedures", where you may find the actual calibration status of all available channels.



Main Menu — Analyzer and I/O, expert controls & setup

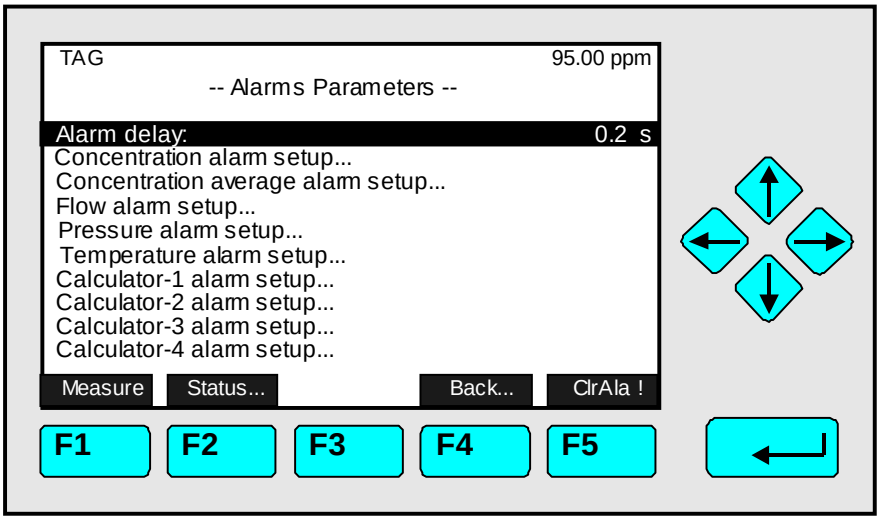
↓

Analyzer module setup

↓

Alarm parameters

↓



The menu "Alarms Setup" and its submenus you may use to set up and control alarms for several parameters of a MLT analyzer / analyzer module. If the selected parameter signal exceeds a certain limit you will get the corresponding alarm message. If the parameter selected is displayed with a mini bargraph in the single component display, you will find little flag icons at the alarm values on its bargraph.

With the F5 -key (ClrAla! = Clear Alarm) you can delete a actual alarm message. You should do this after the signal is back in the allowed range to reset the alarm message for new events.

<u>Parameter set up / entering submenus:</u>

- Select the line of variables, the function line or any menu line using the ↓ -key or the ↑ -key.
- Select the variable, start the function or enter the submenu using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or cancel and return to the previous value using the F2 -key.

Line of variables "Alarm delay":

The alarm message of any enabled parameter will be delayed the time entered in this line.
Options: 0, 0.1, ... , 30.0 s.

Note:

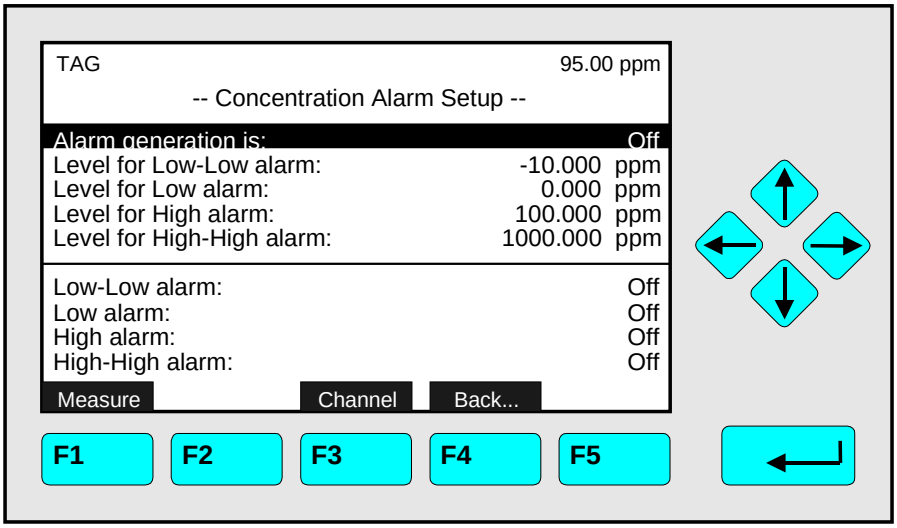
- **Pressing the F2 -key** will enter the menu **"Analyzer Channel Status".** In this menu and its submenus you will find a status report for the current channel including
  - General status
  - Hours of operation
  - Operation status
  - Events
  - Alarms
  - Failures
  - Check requests
  - Function checks

  and (in a submenu) operational settings for the current channel like
  - range settings and
  - response time (t_{90}-time).

The menu "Analyzer Channel Status" and its submenus are described in detail in section 4.1.

Alarms Setup and Control – Example: Concentration Alarm Setup

♦ Select the parameter you want in the menu "Alarm Parameters", i.e. "Concentration alarm setup" and enter the corresponding menu:



Notes:

♦ If setting the selected parameter is not possible, a message will appear on the screen, e.g. "no flow sensor installed to measure the flow".

1) Switch off alarm generation:
   - Before setting alarm parameters select "Off" in the line "Alarm generation is". Otherwise an alarm may start during parameter configuration.

2) Setup signal limits for alarm ("Level for Low-Low alarm,... , Level for High-High alarm"):
   - You may adjust four limit values for each signal parameter.
   - You may fix the low alarm with "Level for Low alarm" and the high alarm with "Level for high alarm". In a second step you may save a "Level for Low-Low alarm" and a "Level for High-High alarm".
   - The units and the possible range of values depend on the signal parameter selected.
   - You may also adjust negative values:

     Select the number with the ↵ -key or the → -key and press F4 (+/-) to change the sign.

   Note:

   Low-Low and Low alarms are activated if the signal subsides below these levels.
   High-High and High alarms are activated if the signal rises above these levels.

3) Switch on alarm control:

- Select one of the following options to start the alarm control for the parameter limits selected:

- **Off:** Alarm is disabled.

- **On:** The alarm message of the signal parameter selected will only appear as long as the signal will exceed the allowed level. The alarm message will disappear if the value is back in the range allowed.

- **On (Hold Alarm):** The alarm message for the signal parameter selected will come up after the signal has exceeded the allowed value. The alarm message will stay alive if the value will be back again in the range allowed.
  To delete the message, you have to enter the menu "Alarms Setup (as described above; s. page 5-23) and start the function "Clear alarm !" with the F5 -key.

4) Alarm status overview:

- The last four lines of the menu "Parameter Alarm Setup" (here: "Concentration Alarm Setup") show the status of each alarm level: On/Off

Main Menu — Analyzer and I/O, expert controls & setup

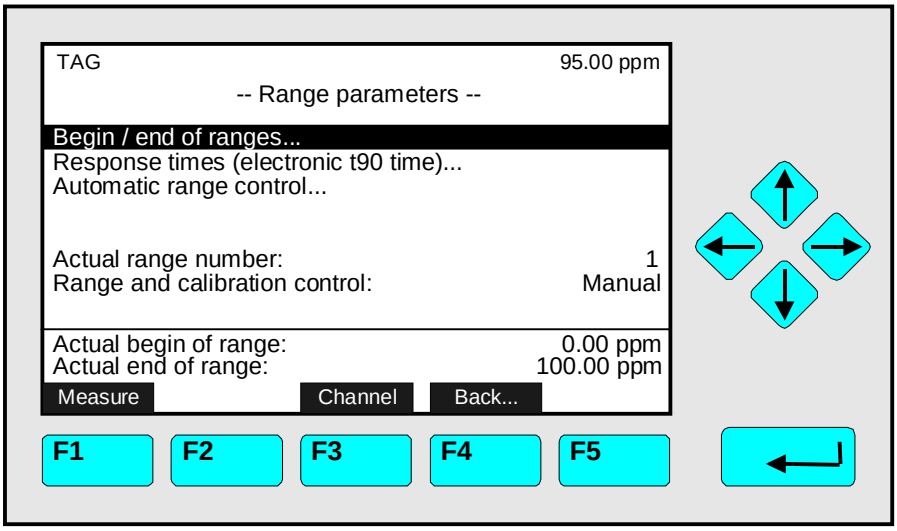
↓

Analyzer module setup

↓

Range parameters

↓



Use this menu and its submenus to define and setup up to four ranges for each available measurement channel. You may set and control range parameters like

- begin and end of range
- response time (electronic t_{90}-time)
- autoranging.

Parameter setup or entering submenus:

- Select the line of variables, the function line or any menu line using the ↓ -key or the ↑ -key.
- Select the variable, start the function or enter the submenu using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or cancel and return to the previous value using the F2 -key.

Line of variables "Actual range number":

In this line you will find the range number selected.

Line of variables "Range and calibration control":

The parameter selected in this line is valid for autoranging control of the current channel (see page 5-31). You have the following options:

- **Manual:** You have to change the range manual. The switch level hysteresis is disabled (see page 5-32).
- **Self/Automatic:** The autoranging is running by comparison of the current measurement value with the end of range. The signal at the analog output is tracking. The value in the line "Switch level hysteresis" of the menu "Automatic range control" is enabled (see page 5-32).
- **Program I/O-module:** The autoranging is controlled by the I/O-Board. The value in the line "Switch level hysteresis" of the menu "Automatic range control" is disabled (see page 5-32). For further information see the related manual.
- **Inputs I/O-module:** The autoranging is remote controlled by the digital inputs. The value in the line "Switch level hysteresis" of the menu "Automatic range control" is disabled (see page 5-32).

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

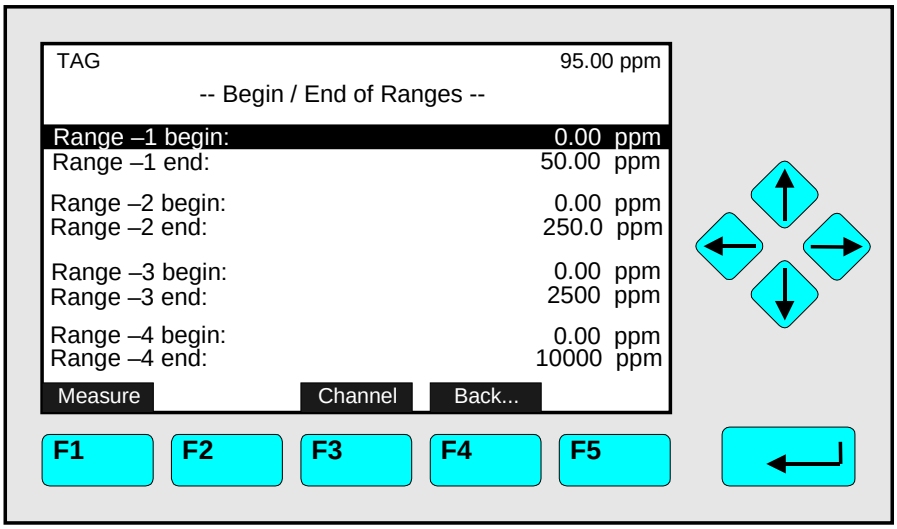
↓

Range parameters

↓

Begin / End of ranges

↓



The menu "Begin / End of Ranges" allows you to set begin and end of range for each range of the current channel

Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Allowed minimum/maximum range values:

- Concentrations in the lines "Begin of range/End of range"
  of the menu "Automatic range Control" (see page 5-31). You can set up each value between the full scale concentration of range 1 and the full scale concentration of range 4 to meet the specifications.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

5.1 Analyzer Module Setup

5.1.3 Range parameters – Response times (t_{90})

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

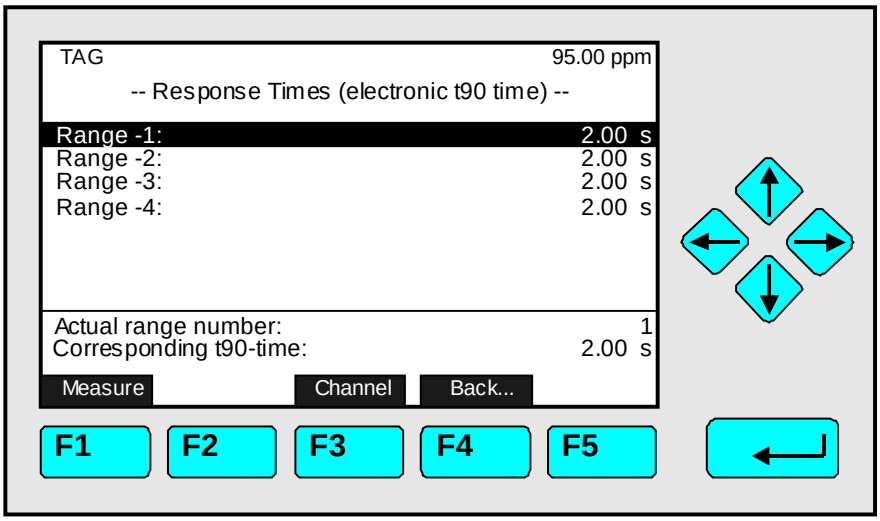
↓

Range parameters

↓

Response times (electronic t_{90} time)

↓



In the menu "Response Times" you may set up the response time (electronic t_{90}-time) for each range of the current channel.
The response time (t_{90}-time) is defined as the time the analyzer needs to display 90 % of a sudden component's concentration change of 100 %.

Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key. Options: 0,01 to 85 seconds for each range of a channel (see notes!).
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Notes:

- The minimum t_{90}-time given by the MLT physics is 0.1 s. Do not enter t_{90}-times of electronics shorter than this.
- Normally, the response time should not be less than 2s.
- You should use a value of 2s minimum for calibrations.
- The response time of this menu is not the response time of the whole analyzer!
- If you use the “Automatic range control” (see page 5-31), you need set up the same response time for all ranges of the autoranged channel!

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

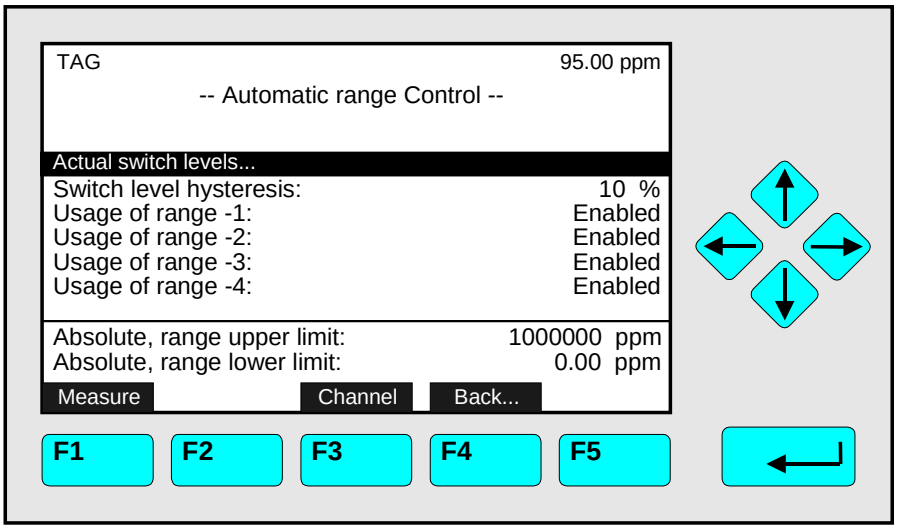
↓

Range parameters

↓

Automatic range control

↓



In the menu "Automatic range control" you may set up the parameters for autoranging control of the current channel
If autoranging is enabled, the best range for the current concentration will be selected automatically.

Conditions:

- Range control has to be enabled!
  To setup: See the line "Range control" in menu "Range parameters", page 5-27/28.
- Begin of range has to be zero for all four ranges of the current channel!
  To setup: See menu "Begin / End of Ranges", page 5-29.
- All four response times of the current channel must have the same value!
  To setup: See menu "Response Times", previous page.
- The span gas concentration has to be within the correct range!
  To setup: See menu "Span Gas Definition", chapter 5.1.1 page 5-8.

The last two lines of the menu:

The parameters in these lines are factory settings and cannot be changed in this menu.

- **Absolute, range upper limit:** It is 120 % of the largest end of range defined at first analyzer start-up. Higher values for end of range values will not be accepted!
- **Absolute, range lower limit:** Normally this value is zero. It will only differ from zero for differential measurements (see 5.1.12 page 5-61).

Notes:

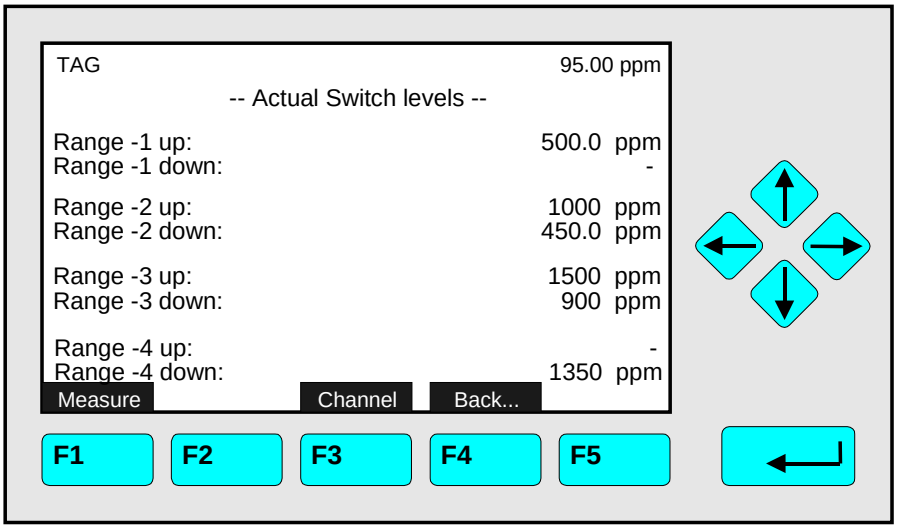
- You may enable or disable each range in the lines "Usage of range -1, ..., -4".
- "Range -4" has not to be the biggest range.

Setting parameters:

- Select the line of variables, the function line or any menu line using the ↓ -key or the ↑ -key.
- Select the variable, start the function or enter the submenu using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or cancel and return to the previous value using the F2 -key.

Line of variables “Actual switch levels”

Enters the submenu "Actual Switch levels", where you may view the actual switch levels. These are the levels the software uses for:

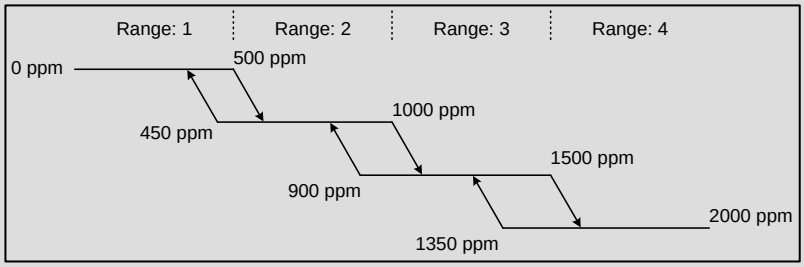


Line of variables "Switch level hysteresis":

The value in this line defines the autoranging and is calculated as percentage of the current end of range. There is only one value for all switch levels.
Options: 10 to 50 % (Standard value: 10 %)

Example:

Switch level hysteresis: 10 %; End of range -1, -2, -3, -4: 500, 1000, 1500, 2000 ppm



Main Menu — Analyzer and I/O, expert controls & setup

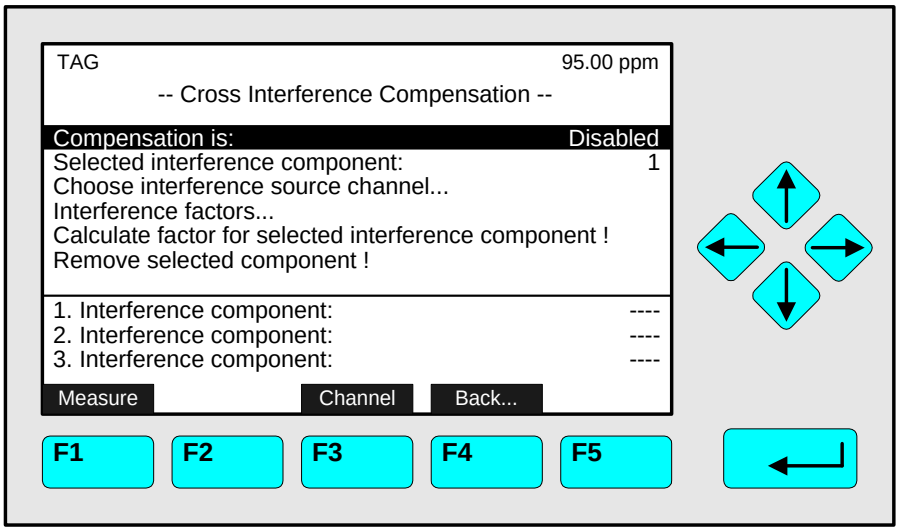
↓

Analyzer module setup

↓

Cross interference compensation

↓



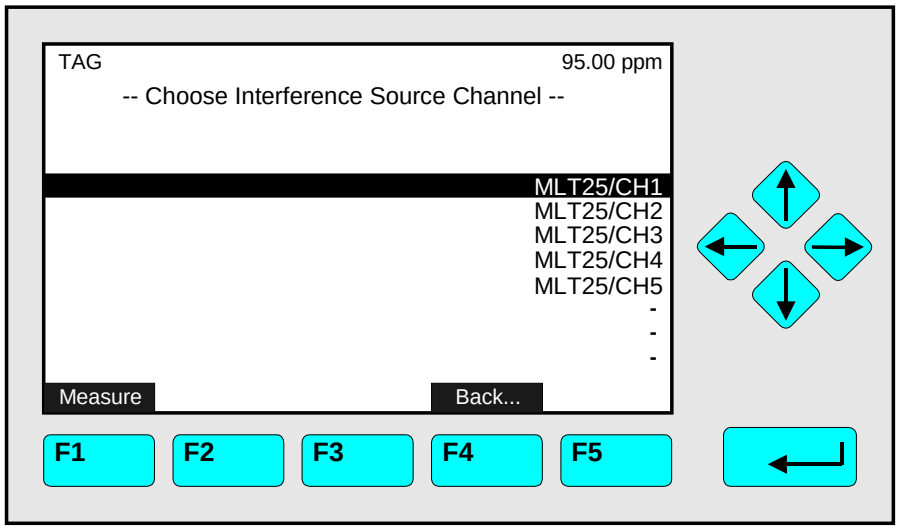
The menu "Cross Interference Compensation" allows to calculate/compensate the influence of up to 3 components into the result of the measured component. You can take internal channels for interference components only! It is not possible to calculate the cross interference compensation for signals of other analyzer modules!
Press the F3 -key to reach other MLT channels for cross compensation.

Conditions:

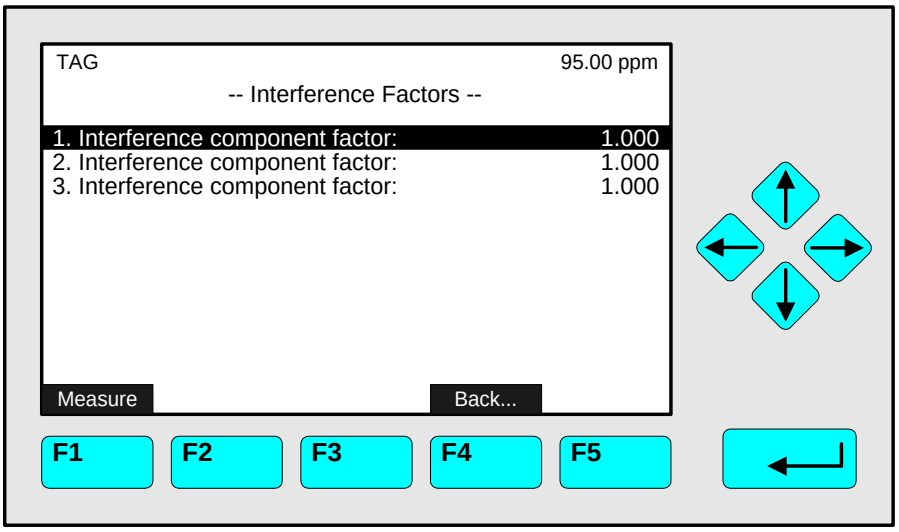
- Use pure gases or gases in inert atmosphere (e.g. CH_4 in N_2) only for all components to be compensated. Do not use mixed gases!
- Calibrate all channels before starting interference compensation. Besides, all channels must be part of the same MLT analyzer or analyzer module.

Calculation of the Cross Interference Compensation:

1) Select "Disabled" in the line "Compensation is". Otherwise the result would be influenced during the determination of the interference component factor.
2) Select the number of the current interference component (max. 3) in the line "Selected interference component".
3) Press the ↵ -key or the → -key in the line "Choose interference source channel..." to switch to the submenu “channels" (illustration see next page):
   - Select the line you want using the ↓ -key or the ↑ -key.
   - Choose the interference source channel using the ↵ -key or the → -key: The display will return to the menu "Cross Interference Compensation" automatically. The tag of the interference component will appear in one of the last three lines in the menu. The position depends on the number selected in the line "Selected interference component".
   - You can repeat the last two steps as often as necessary until you have selected all interference components (maximum 3) you need.



4) Insert the interference gas component into the analyzer (module) and wait for a stable signal.
5) Go to the line "Calculate factor for selected interference component !" using the ↑ -key or the ↓ -key and then start the calculation using the ↵ -key or the → -key. If you want to see the results switch to the line "Interference factors..." and press the ↵ -key to reach the corresponding submenu:



This submenu allows to setup manually each interference component factor.

6) Select "**Calibration: Off**" in the line "Compensation is" of the menu "Cross Interference Compensation" to **start the cross interference compensation**. Use for the Calibration pure gases or gases in inert atmosphere only. This will avoid (in opposite to “Enabled”) that the calibration is affected incorrectly by the cross interference compensation. For the use of mixed calibration gases (unidirectional and interactive cross influences) please consult factory. Special instruments are documented separately (Information about the calibration gases).

Function line "Remove selected component !"

Press the ↵ -key or the → -key in this line to delete the interference factor of the selected interference component!

Main Menu — Analyzer and I/O, expert controls & setup

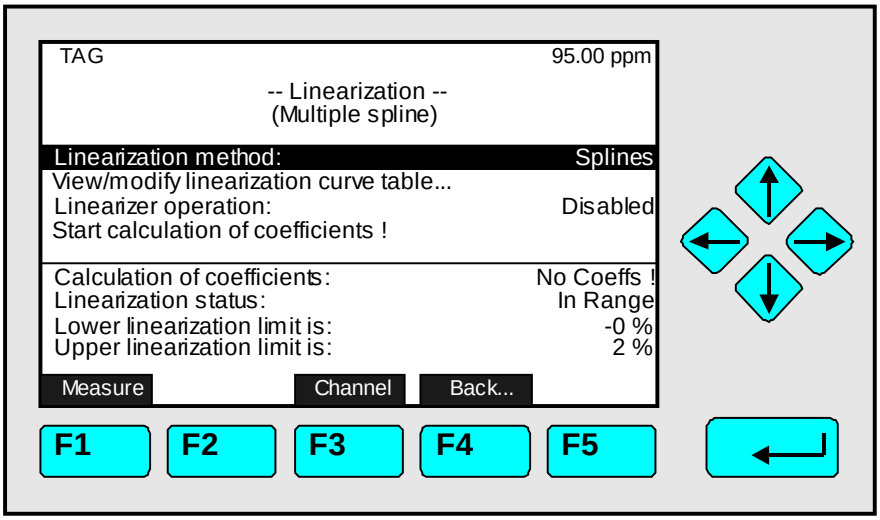
↓

Analyzer module setup

↓

Linearization

↓



The menu "Linearization" and its submenus allow to set up and start the calculation to linearize one MLT analyzer or analyzer module channel.

Background:

The relation between the optical absorption of a gas and its concentration is not linear within the whole measuring range. Therefore the analyzer's measurement value has to be linearized. You can linearize manual or semi-automatically. This chapter describes the manual linearization. If you want to linearize semi-automatically contact your customer service.

Conditions:

- Before you start linearization you have to calibrate the largest range of the channel (usually range 4) with zero gas and span gas.
- You have to record a set of raw values/set point values to linearize a channel. You need at minimum 6 raw values and their corresponding set point values: zero, end of range and 4 values in between. You should take 10 to 15 values (maximum: 30) to improve the precision of the linearization curve.

Executing the linearization:

1) Disable the linearization:

Prior to recording linearization values you have to disable the current linearization to avoid the calculation of the new curve being influenced by old values:

- Highlight the line "Linearizer operation" using the ↑ -key or the ↓ -key.
- Press the ↵ -key or the → -key and select "Disabled" using the ↑ -key or the ↓ -key.
- Confirm your adjustment pressing the ↵ -key.

2) Zero and span gas calibration:

- Calibrate the largest range (usually: range 4) with zero and span gas.
- The method is described in 4.5, page 4-19 and 4.6, page 4-23 or in 5.1.1, page 5-17 to 5-19.

3) Recording the raw values/set point values table:

- If you have a defined gas flow, you can read each raw value display at the top right in any menu or single component display.

- *Example:*
  You have got the following values for the NO-Channel of the analyzer:

No.	Set point Value [ppm NO]	Raw Value [ppm NO]
1	0.000	0.000
2	217.455	266.291
3	319.620	387.709
4	428.610	517.464
5	536.760	645.199
6	636.510	757.313
7	955.395	1113.910
8	2105.560	2263.390
9	3163.860	3163.860

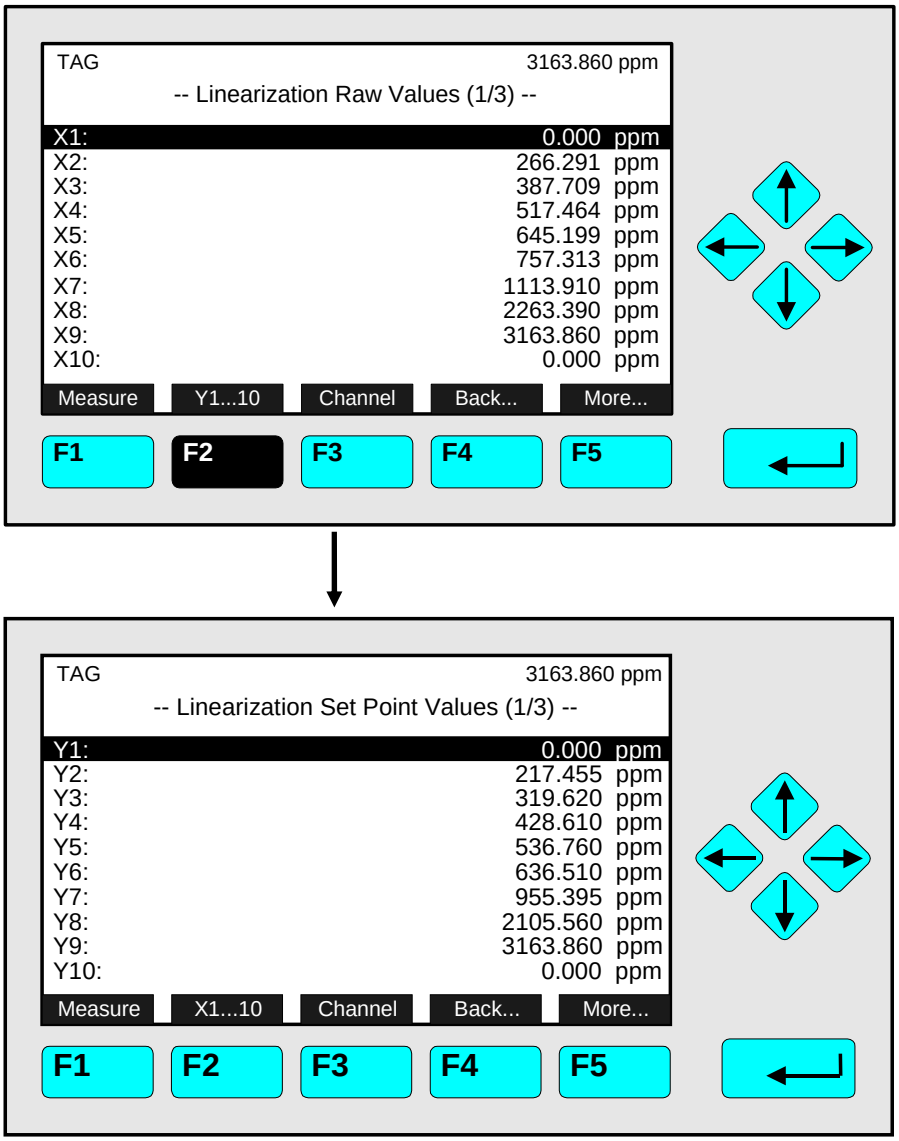
4) Entering the table values into the corresponding menus:

- Highlight the menu line "View/modify linearization curve table..." and enter the menu pressing the ↵ -key
- Highlight the menu line "Linearization raw values…" using the ↑ -key or the ↓ -key.
- Press the ↵ -key or the → -key to open the menu.
- Select the first number using the ↵ -key or the → -key.
- Enter the first raw value of the table:
  Select any digit using the ← -key or the → -key, adjust the new value with the ↑ -key or the ↓ -key and confirm the new value with the ↵ -key.
- Press F2 to switch into the "Linearization Set Point Values…" menu and enter the corresponding set point value. Press F2 again to return to the "Linearization raw values" menu.
- Enter the next line to put in the second value using the ↓ -key
- Repeat these steps until all raw/set point values of the table are part of the corresponding menus.
- If you have more than 10 values you may enter additional menu pages pressing F5 (More...). There are at maximum 30 lines available. The current menu page number is always displayed in the headline. If you have less than 30 values set the first unused values to "0" (alternatively: “set all raw/set point values to 0.0!” at the begin before entering values)!

Note:

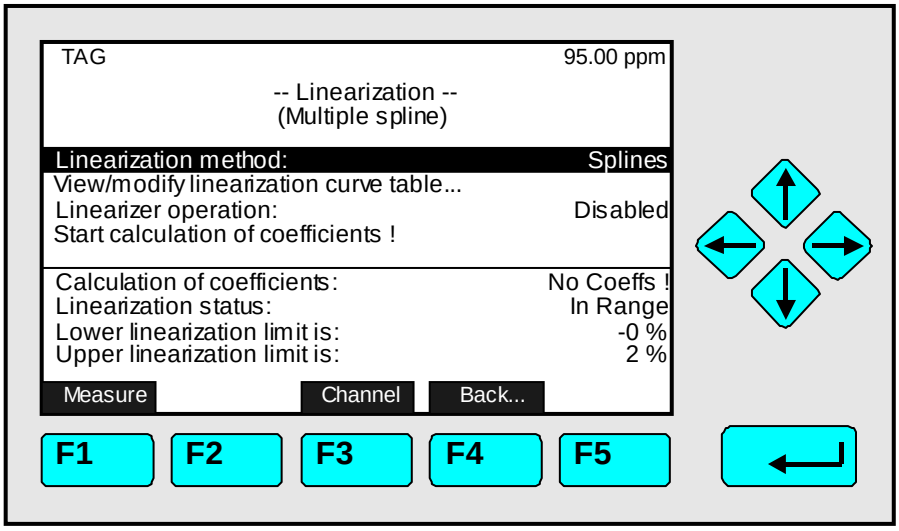
♦ Another way entering the values is entering the set point value first and then the corresponding raw value. In addition it is possible to enter all set points first and in a second pass all raw values (or vice versa).

♦ The set point value entered must belong to the raw value (e.g. set point1 - raw1; set point2 - raw2)! Do not mix values, the calculation of the linearization will be wrong!



5) Define linearization method

- Press F4 twice to enter the menu where to define the "Linearization method". This menu is opened from line "Linearization" from "Analyzer module setup and controls (1/3)" too, see page 5-33.
- Highlight the first line "Linearization method". Press ↵ -key or the → -key to select the parameter and choose "Splines" or "4th-order polyn." as the method to be used. To suit this manual select "Splines". "4th-order polyn." method needs additional inputs in submenu "Miscellaneous setup...", which is available only if this method is selected (context sensitive menu).



6) Calculate linearization curve (using splines)

- Highlight the function line "Start calculation of coefficients !" using the keys ↑ or ↓ and start calculation pressing the ↵ -key.
- If asked: Confirm pressing F2.
- When calculation has finished the analyzer will return to the "Linearization" menu.

7) Enable linearization

- Highlight the line "Linearizer operation:"
- Press the ↵ -key or the → -key to select the parameter and choose "Enabled" using the keys ↑ or ↓.
- Press the ↵ -key to enter the new value.

8) Check linearization

- Repeat the measurement with the same set point values used for the linearization curve.
- The resulting full scale deviation has to be better than 1 % rel!

<u>More Setups and ramifications in the menu "Linearization":</u>

9) Please consult your Service Support Center!

Main Menu — Analyzer and I/O, expert controls & setup

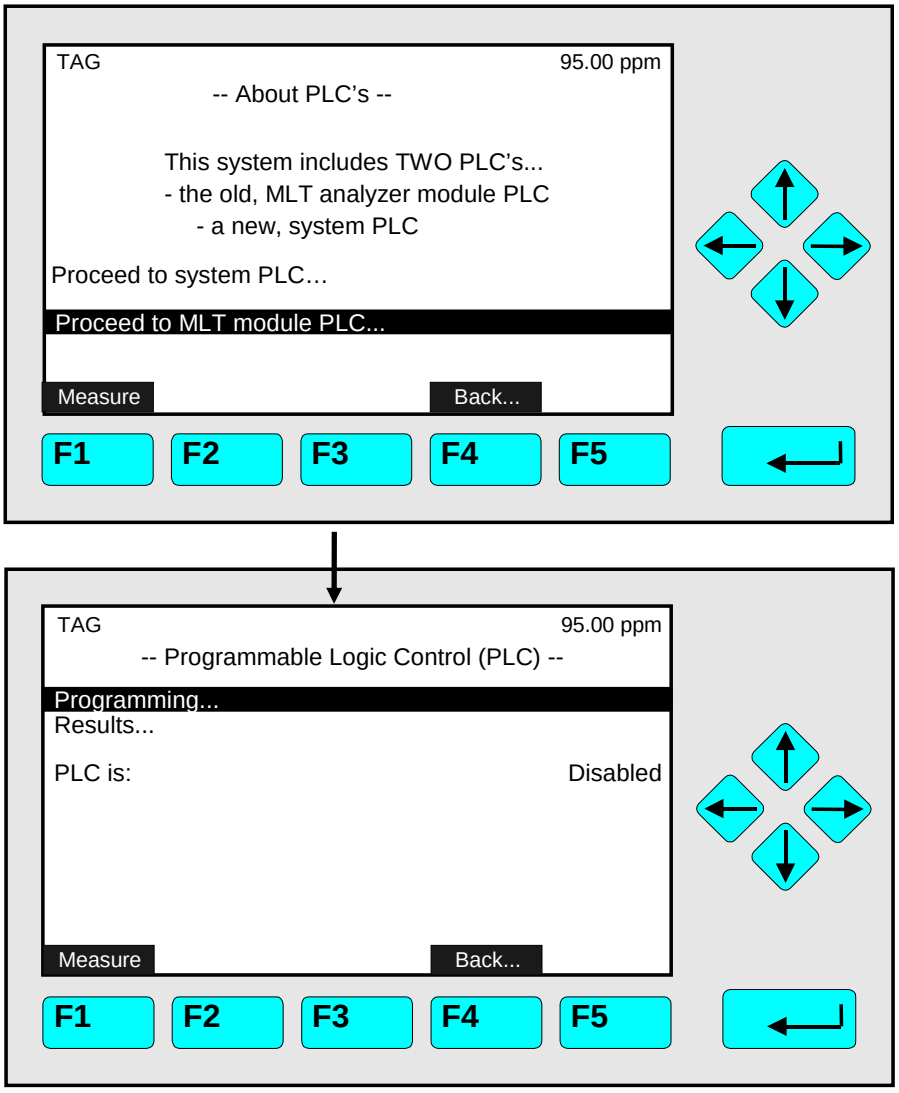
↓

Analyzer module setup

↓

Programmable logic control (PLC)

↓



In the menu "Programmable Logic Control (PLC)" you can select between **system PLC** (see Supplement) and TFID/MLT **analyzer or module PLC**. The analyzer module PLC can be **enabled or disabled** by using an individual program (e.g. some calibration results may be sent to a certain analyzer output). If you want to create a program, you have to enter the **submenu "Programming"**. If you want to control the output status you have to enter the **submenu "Results"** (PLC outputs 1…20).

Note: The PLC described here is only able to work with signals of the MLT/TFID analyzer or analyzer module selected! It is not possible to work with other analyzer modules, with the control module or external undefined input signals (see system PLC supplement)!

Programming (➔ Consider the example page 5-43 to 5-45!):

1) Disable PLC:

- Before you start programming you have to disable the PLC function in the line "PLC is" to avoid starting the program while you are writing it (➔ see set up parameters page 5-45).

2) Put in the program:

- Press the ↵ -key or the → -key in the line "Programming..." to enter the sub-menu, where you can write your program step by step (➔ see example page 5-43).
- A program is a combination of single commands (e.g. selecting a gas valve), which have to be connected by logical operators (e.g. OR). For available operators and commands refer to the listings below.
- You have to set every operator in the line above the commands that shall be combined. If an intermediate result is not used in the process directly, you have to delete the result buffer ("CLEAR"). So you can avoid errors of the following logical operations. Each program must end with the operator "-7" ("END of the program").

3) Enable PLC:

- To start the program select "Enabled" in the line "PLC is" in the menu "Programmable Logic Control".

4) Checking the results:

- Press the ↵ -key or the → -key in the line "Results..." of the menu "Programmable Logic Control" to open the submenu "PLC Outputs" where you can view the output status.

Available operators for PLC:

Operator types	Operator Description	
-1	**NOP**	No operation (= blank line)
-2	**OR**	OR combine the next commands; store operand to buffer
-3	**AND**	AND combine the next commands; store operand to buffer
-4	**INVERT**	Invert the buffer
-5	**STORE**	Store the buffer to result buffer
-6	**CLEAR**	Clear the buffer
-7	**END**	End of program

Available Commands for PLC (Signal Codes 1 - 359):

General Signals	
Signal ID	**Signal**
1	RAM-Failure
2	ROM-Failure
3	Seconds; LOW/HIGH change all 1000 ms
4	Any sample gas valve selected (Channel 1...5)
5	Any zero gas valve selected (Channel 1...5)
6	Any span gas valve selected (Channel 1...5)
7	NAMUR-status: Failure (Channel 1...5)
8	NAMUR-status: Check Request (Channel 1...5)
9	NAMUR-status: Function Check (Channel 1...5)
10 - 19	Reserved

Programmable Calculator	
Signal ID	**Signal**
20	Execution status
21	Result 1 / Limit 1
22	Result 1 / Limit 2
23	Result 1 / Limit 3
24	Result 1 / Limit 4
25	Result 2 / Limit 1
26	Result 2 / Limit 2
27	Result 2 / Limit 3
28	Result 2 / Limit 4
29	Result 3 / Limit 1
30	Result 3 / Limit 2
31	Result 3 / Limit 3
32	Result 3 / Limit 4
33	Result 4 / Limit 1
34	Result 4 / Limit 2
35	Result 4 / Limit 3
36	Result 4 / Limit 4
37 - 39	Reserved

Programmable Logic Controls	
Signal ID	**Signal**
40	Output Result buffer #1
41	Output Result buffer #2
42	Output Result buffer #3
43	Output Result buffer #4
44	Output Result buffer #5
45	Output Result buffer #6
46	Output Result buffer #7
47	Output Result buffer #8
48	Output Result buffer #9
49	Output Result buffer #10
50	Output Result buffer #11
51	Output Result buffer #12
52	Output Result buffer #13
53	Output Result buffer #14
54	Output Result buffer #15
55	Output Result buffer #16
56	Output Result buffer #17
57	Output Result buffer #18
58	Output Result buffer #19
59	Output Result buffer #20
60	Execution status
61 -69	Reserved

SIO I/O Module	
Signal ID	**Signal**
70	Output #1 < 0V
71	Output #1 > 10V
72	Output #2 < 0V
73	Output #2 > 10V
74	Output #3 < 0V
75	Output #3 > 10V
76	Output #4 < 0V
77	Output #4 > 10V
78	Output #5 < 0V
79	Output #5 > 10V
80	Output #6 < 0V
81	Output #6 > 10V
82	Output #7 < 0V
83	Output #7 > 10V
84	Output #8 < 0V
85	Output #8 > 10V
86	Relay #1
87	Relay #2
88	Relay #3
89	Reserved

DIO I/O Module	
Signal ID	**Signal**
90	Input #1
91	Input #2
92	Input #3
93	Input #4
94	Input #5
95	Input #6
96	Input #7
97	Input #8
98	Output 1..8 failure
99	Output 9..16 failure
100	Output 17..24 failure
101	General Failure
102 - 109	Reserved

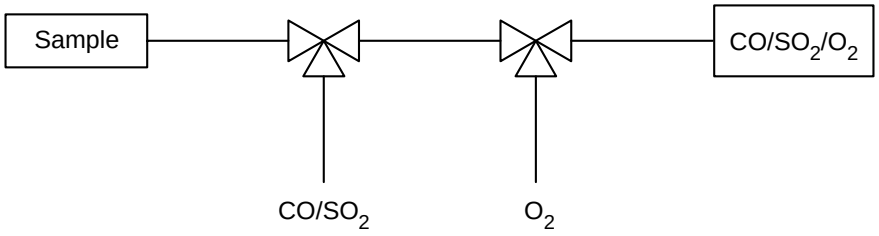
➔ **Table to be continued on the next page !**

Measurement-Channels					
Signal ID Ch. 1	**Signal ID Ch. 2**	**Signal ID Ch. 3**	**Signal ID Ch. 4**	**Signal ID Ch. 5**	**Signal**
110	160	210	260	310	Raw signal failure
111	161	211	261	311	Sample gas valve
112	162	212	262	312	Zero gas valve
113	163	213	263	313	Test gas valve
114	164	214	264	314	Span gas valve - range 1
115	165	215	265	315	Span gas valve - range 2
116	166	216	266	316	Span gas valve - range 3
117	167	217	267	317	Span gas valve - range 4
118	168	218	268	318	Any of the span gas valves
119	169	219	269	319	Lin1 gas valve
120	170	220	270	320	Lin2 gas valve
121	171	221	271	321	Purge gas valve
122	172	222	272	322	Linearization Underflow
123	173	223	273	323	Linearization Overflow
124	174	224	274	324	Zero calibration in progress
125	175	225	275	325	Span calibration in progress
126	176	226	276	326	Range Underflow
127	177	227	277	327	Range Overflow
128	178	228	278	328	Range #1
129	179	229	279	329	Range #2
130	180	230	280	330	Range #3
131	181	231	281	331	Range #4
132	182	232	282	332	Failure (NAMUR)
133	183	233	283	333	Check Request (NAMUR)
134	184	234	284	334	Function Check (NAMUR)
135	185	235	285	335	Concentration / Low-Low Alarm
136	186	236	286	336	Concentration / Low Alarm
137	187	237	287	337	Concentration / High Alarm
138	188	238	288	338	Concentration / High-High Alarm
139	189	239	289	339	Conc. Average / Low-Low Alarm
140	190	240	290	340	Conc. Average / Low Alarm
141	191	241	291	341	Conc. Average / High Alarm
142	192	242	292	342	Conc. Average / High-High Alarm
143	193	243	293	343	Temperature / Low-Low Alarm
144	194	244	294	344	Temperature / Low Alarm
145	195	245	295	345	Temperature / High Alarm
146	196	246	296	346	Temperature / High-High Alarm
147	197	247	297	347	Pressure / Low-Low Alarm
148	198	248	298	348	Pressure / Low Alarm
149	199	249	299	349	Pressure / High Alarm
150	200	250	300	350	Pressure / High-High Alarm
151	201	251	301	351	Flow / Low-Low Alarm
152	202	252	302	352	Flow / Low Alarm
153	203	253	303	353	Flow / High Alarm
154	204	254	304	354	Flow / High-High Alarm
155	205	255	305	355	External signal #1
156	206	256	306	356	External signal #2
157	207	257	307	357	External signal #3
158	208	258	308	358	External signal #4
159	209	259	309	359	External signal #5

Example: PLC Programming:

Note: This an example only!

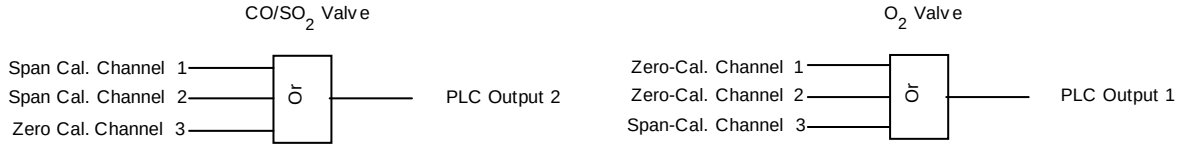
- You have three channels in your analyzer: CO, SO_2 and O_2.
- You want to write a program for the zero and span gas calibration.
- The valve gear is:



You have the following zero and span gases for each gas component:

Channel:	**CO**	**SO_2**	**O_2**
Zero gas:	O_2	O_2	CO/SO_2
Span gas:	CO/SO_2	CO/SO_2	O_2

You need the following logical combination for the valves:



With the conditions described you will get the following program:

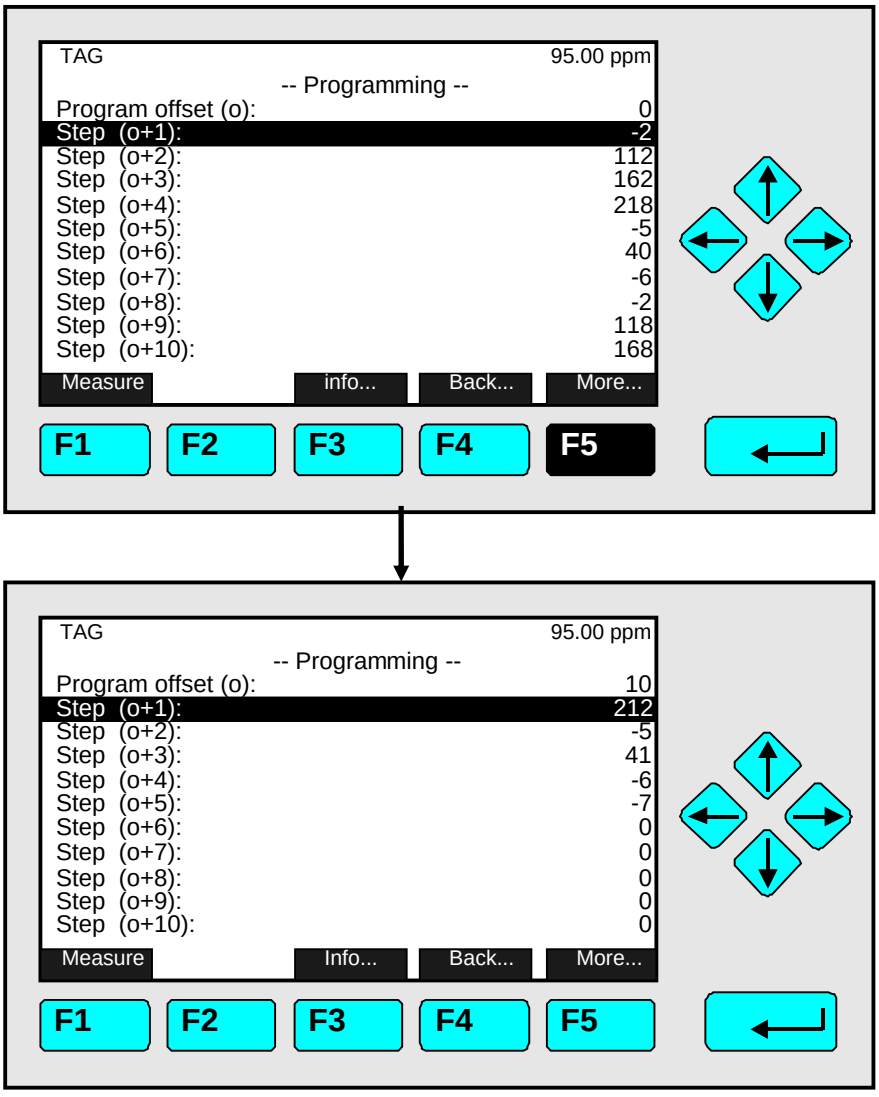
Step-No.	Code	Function/Parameter
1	-2	OR (Combination of the next three operands)
2	112	Zero gas calibration of channel 1
3	162	Zero gas calibration of channel 2
4	218	Span gas calibration of channel 3
5	-5	STORE (Saving the intermediate result to the result buffer)
6	40	Output result buffer 1
7	-6	CLEAR (Deleting the intermediate result of the calculator)
8	-2	OR (Combination of the next three operands)
9	118	Span gas calibration of channel 1
10	168	Span gas calibration of channel 2
11	212	Zero gas calibration of channel 3
12	-5	STORE (Saving the intermediate result to the result buffer)
13	41	Output result buffer 2
14	-6	CLEAR (Deleting the intermediate result of the calculator)
15	-7	END (End of program)

You have enter the codes of the table into the corresponding lines of the submenu "Program". If you have more than ten program steps, just open the next menu page using the F5 -key (More...). An indicator about the steps to enter on the actual page is shown in the first line on each page: "Program offset (o)" is "0" on the first page, "10" on the second, "20" on the 3rd, a.s.o. Pressing F5 (More...) on the last page (Program offset = 90) returns to the first page (Program offset = 0).

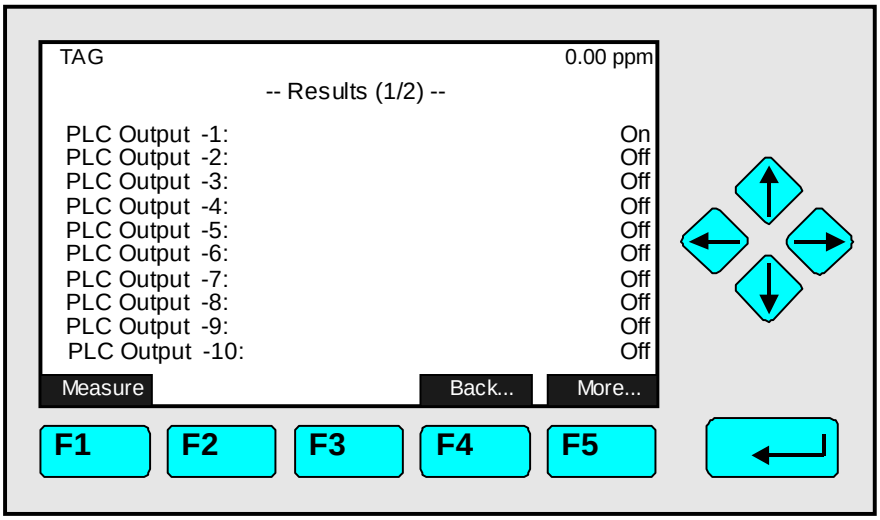
Maximum of program steps to enter: **100**. **Maximum** of **results: 20**.

Entering the codes into the menu:

- Select the program steps using the ↑ -key or the ↓ -key.
- Select the field for the code number pressing the ↵ -key or the → -key.
- Select any digit with the ← -key or the → -key and adjust the code number with the ↑ -key or the ↓ -key. If necessary, change the sign (+/-) pressing F4.
- Confirm the code with the ↵ -key or cancel and return to the previous value using the F2 -key.



Start the program with "Enabled" in the line "PLC is" of the menu "Programmable Logic Control (PLC)". Then check the output status in the submenu "PLC Outputs". You will open this menu via the line "Results..." in the menu "Programmable Logic Control (PLC)":



In the display shown above the output 1 is "On". That means for the example described:

The O_2 valve is activated (open):
The zero gas calibration of channel 1 or 2 or
the span gas calibration of channel 3 is running.

Note:

To view the results of PLC outputs 11 to 20 open the next menu page pressing F5 (More...).

Set up parameters:

- Select the line of variables or any menu line using the ↓ -key or the ↑ -key.
- Select the variable or enter the submenu using the ↵ -key or the → -key.
- Select "Enabled" or "Disabled" in the line "PLC is" pressing the ↑ -key or the ↓ -key.
- Confirm the parameter selected with the ↵ -key or
  cancel and return to the previous value pressing F2.

5.1 Analyzer Module Setup

5.1.7 Programmable Calculator

Main Menu — Analyzer and I/O, expert controls & setup

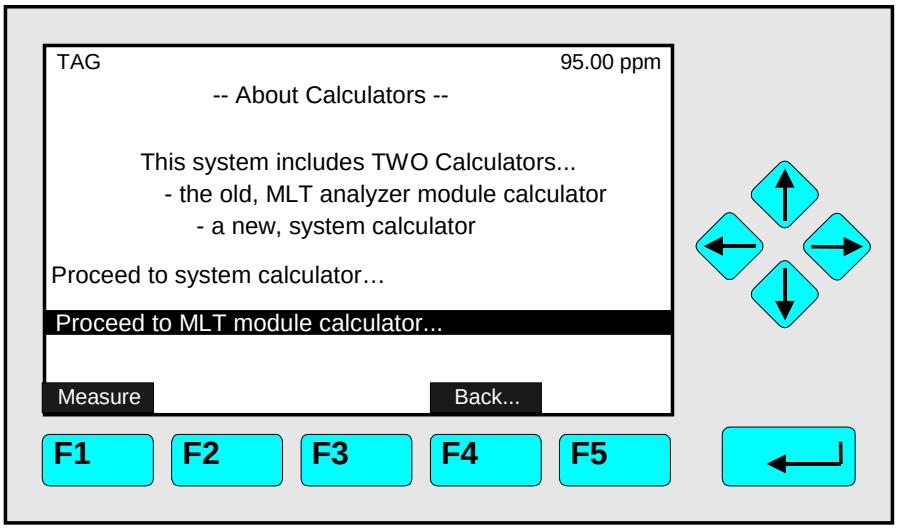
↓

Analyzer module setup

↓

Programmable Calculator

↓



In the menu "Programmable Calculator" you can select between **System Calculator** (see Supplement) and TFID/ MLT/ CAT 200 **analyzer or analyzer module Calculator**.

The MLT/ CAT 200/ TFID **analyzer module Calculator** is described in this chapter.

Set up parameters:

- Select "Proceed to MLT module calculator" pressing the ↑ -key or the ↓ -key.
- Confirm the parameter selected with the ↵ -key or return to the previous menu pressing F4 (Back…).

Note:

The Calculator described here is only able to work with signals of the MLT/TFID analyzer or analyzer module selected! It is not possible to work with other analyzer modules or with the control module.

Otherwise "Proceed to system calculator" needs to be selected (Description see chapter "System Calculator" in the supplement).

Main Menu — Analyzer and I/O, expert controls & setup

↓

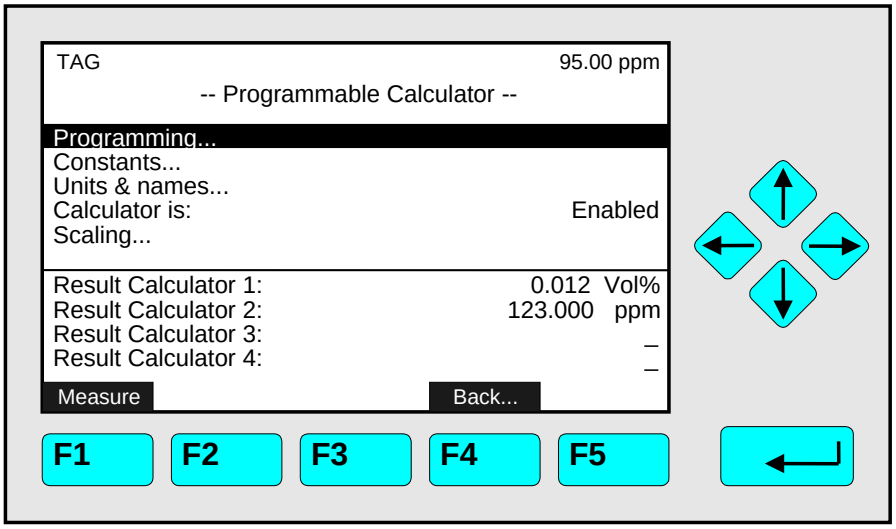
Analyzer module setup

↓

Programmable calculator

↓

Proceed to MLT module calculator



In the menu "Programmable Calculator" you can start the calculation with variables of the MLT/TFID analyzer or analyzer module selected, e.g. conversion of concentrations from ppm to mg/m^3. You have 10 memory buffers to calculate intermediate results. The required program and further conditions have to be set up in several submenus.
The calculation with values of external modules is not possible!

Set up parameters:

- Select "Enabled" or "Disabled" in the line "Calculator is" pressing the ↑ -key or the ↓ -key.
- Confirm the parameter selected with the ↵ -key or cancel and return to the previous value pressing F2.

Programming and starting the calculator (➔ Consider the example pg. 5-49/50 !):

1) Disable the calculator:

- Before you will begin with the programming, you select "Disabled" in the line "Calculator is" to avoid starting calculation while you are writing the program.

2) Editing the program:

- Press the ↵ -key or the → -key in the line "Programming..." to enter the sub-menu "Program", where you can insert your program step by step.
- A calculator program consists of operands like concentration or flow and of operators like the addition command. You have to insert a code in each program line for each operator and each variable or constant.

In the following table you can see the types of operators and operands you can use:

Operator types	Operator Description	
-1	**ADD**	Add Operand to IR (intermediate result)
-2	**SUB**	Subtract Operand from IR
-3	**DIV**	Divide IR by operand
-4	**MUL**	Multiply IR with operand
-5	**ADDC c**	Add Constant to IR
-6	**SUBC c**	Subtract constant from IR
-7	**DIVC c**	Divide IR by constant
-8	**MULC c**	Multiply IR with constant
-9	**ADDM m**	Add Memory to IR
-10	**SUBM m**	Subtract Memory from IR
-11	**DIVM m**	Divide IR by memory
-12	**MULM m**	Multiply IR with memory
-13	**STOM m**	Store IR at memory and set IR = 0.0
-14	**STOR r**	Store IR to *result* and set IR=0.0
-15	**NOP**	No operation
-16	**ABS**	Convert IR into absolute value
-17	**EOP**	End of program
-18	**SQR**	Calculate the square root
Operand Types	**Operand Description**	
1	**Calculator Result #1**	
2	**Calculator Result #2**	
3	**Calculator Result #3**	
4	**Calculator Result #4**	
5	**Concentration**	Channel 1 (PPM!)
6	**Concentration average**	Channel 1 (PPM!)
7	**Temperature**	Channel 1
8	**Pressure**	Channel 1
9	**Flow**	Channel 1
10	**Concentration**	Channel 2 (PPM!)
11	**Concentration average**	Channel 2 (PPM!)
12	**Temperature**	Channel 2
13	**Pressure**	Channel 2
14	**Flow**	Channel 2
15	**Concentration**	Channel 3 (PPM!)
16	**Concentration average**	Channel 3 (PPM!)
17	**Temperature**	Channel 3
18	**Pressure**	Channel 3
19	**Flow**	Channel 3
20	**Concentration**	Channel 4 (PPM!)
21	**Concentration average**	Channel 4 (PPM!)
22	**Temperature**	Channel 4
23	**Pressure**	Channel 4
24	**Flow**	Channel 4
25	**Concentration**	Channel 5 (PPM!)
26	**Concentration average**	Channel 5 (PPM!)
27	**Temperature**	Channel 5
28	**Pressure**	Channel 5
29	**Flow**	Channel 5

- You need to set every operator in the line above the corresponding variable. After each calculating step you need to store the intermediate result and to delete the memory before you continue with the next step. Each program must end with the command "End of program" (code -17).

3) Inserting constants:

- Press the ↵ -key or the → -key in the line "Constants..." of the menu "Programmable Calculator" to switch to the corresponding submenu, where you can define at maximum 21 constants, e.g. conversion constant from ppm to mg/m^3.

4) Determination of the units and names:

- Press the ↵ -key or the → -key in the line "Units & names..." of the menu "Programmable Calculator" to set the unit the calculator's result shall be displayed, e.g. ppm, mg/Nm^3, Vol% and so on.
- Note: The units may be set while the program is running too.

5) Starting the program:

- Select "Enabled" in the line "Calculator is" of the menu "Programmable Calculator" to start the calculation.

6) Check the results:

- The results of up to four calculators will be displayed in the last four lines of the menu "Programmable Calculator".

Example for programming a calculation:

You want to calculate the whole content of NO_x as NO_2 in mg/m^3 from the concentrations of NO in ppm (Cannel 1) and of NO_2 in ppm (Channel 2). So you have to add the single concentrations and then to multiply with a constant:

(ppm NO + ppm NO_2) • "conversion constant (here: 2,05 mg/ml)" = NO_x as mg/m^3 NO_2

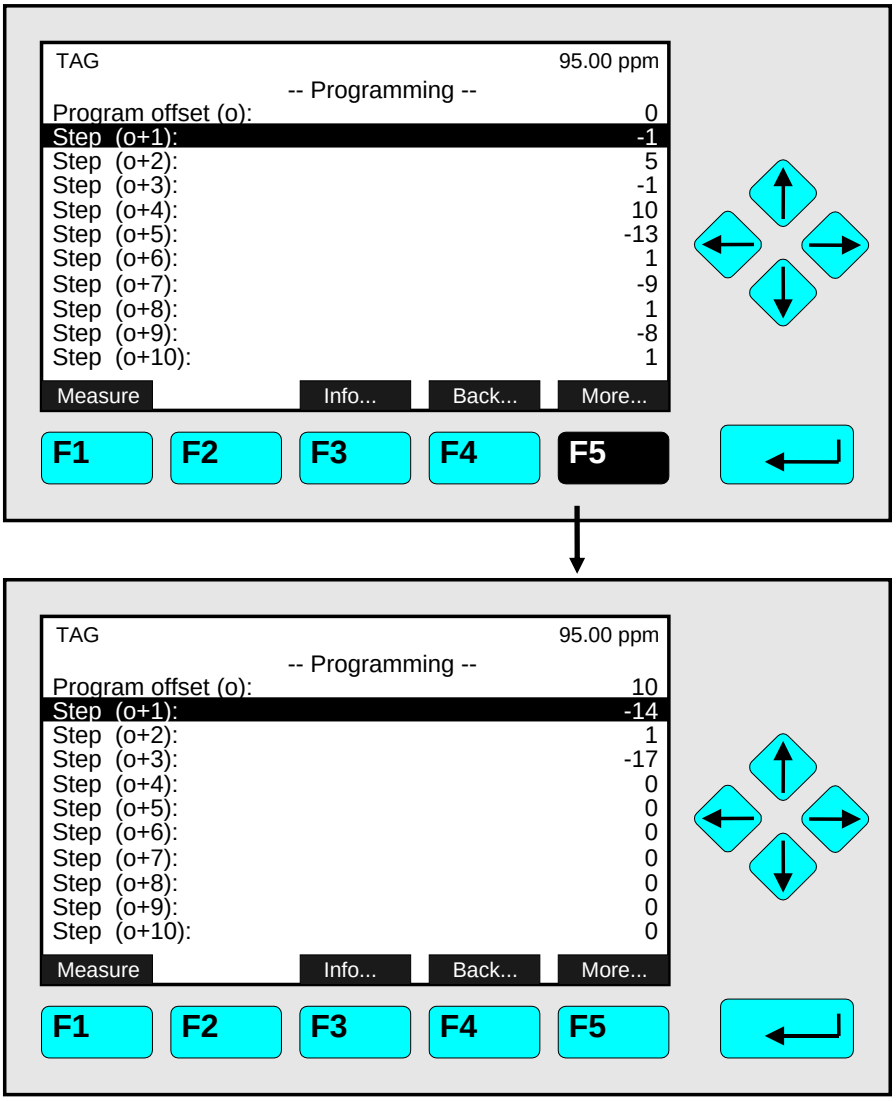
You will get the following program:

Step-No.	Code	Program Description
1	-1	Add to intermediate result (At the beginning the memory is zero)
2	5	NO-Concentration from channel 1 (ppm)
3	-1	Add to IR (the concentration of channel 1)
4	10	NO_2-Concentration from channel 2 (ppm)
5	-13	Store the result of the addition to memory and set IR = 0
6	1	Result 1
7	-9	Add memory to IR (= sum of NO and NO_2 in ppm)
8	1	Result 1
9	-8	Multiply IR with constant ([ppm NO + ppm NO_2] • "conversion constant")
10	1	Result 1 (= "conversion constant" ppm to mg/m^3, here: 2,05 mg/ml)
11	-14	Store IR to result and set IR = 0
12	1	Result 1 (= mg/m^3 NO_2)
13	-17	End of program

You have to insert the codes of the table into the corresponding lines of the submenu "Program". If the program consists of more than ten steps, you can open another menu page with the F5 -key. Maximum of program steps: 200; maximum of results: 4; maximum of constants: 21 editable memory buffer for intermediate results.

Inserting the program steps into the menu:

- Select the program steps with the ↑ -key or the ↓ -key.
- Select the field for the code number with the ↵ -key or the → -key.
- Select any digit with the ← -key or the → -key and adjust the code number with the ↑ -key or the ↓ -key. If necessary, change the sign (+/-) with the F4 -key.
- Confirm the code with the ↵ -key or cancel and return to the previous value with the F2 -key.



Start the calculation with "Enabled" in the line "Calculator is" of the menu "Programmable Calculator". The results will appear in the last 4 lines of that menu.

Main Menu — Analyzer and I/O, expert controls & setup

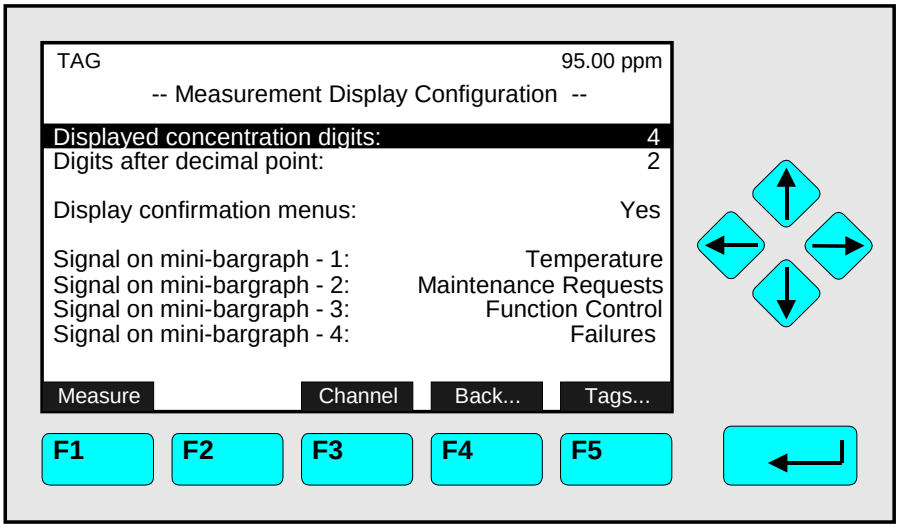
↓

Analyzer module setup

↓

Measurement display configuration

↓



In the menu "Measurement Display Configuration" you can determine

- the parameters for the single component display of the current MLT analyzer / analyzer module channel. Press F3 to reach other channels.
- the display of the confirmation menus.
- the tags of the MLT analyzer / analyzer module and the tags of each range for the current channel (2nd page of the menu).
  Caution:
  If you change the identification tag, you have to change the configuration of the programmable digital inputs and analog outputs too because the parameters of the module are changed and relations got lost!

<u>Set up parameters:</u>

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable pressing the ↵ -key or the → -key.
- Adjust a new value using the ↑ -key or the ↓ -key
  resp. select the whole parameter pressing the ↑ -key or the ↓ -key.
- Confirm the new value with the ↵ -key or
  cancel and return to the previous value pressing F2.

Line of variables "Displayed concentration digits":

- You can adjust the number of digits displayed for the concentration display.
  Options: 3, 4, 5, 6

Line of variables "Digits after decimal point":

- Options: 0, 1, 2, 3

Line of variables "Display confirmation menus":

- **Yes:**
  Each time a function is started you will be asked "Do you really want to do this ?". So you will have the option to cancel the execution or to confirm and start.
- **No:**
  You will never be asked to cancel or confirm any function.
  Caution: Each function will start immediately when entered!

Lines of variables "Signal on mini-bargraph -1, -2, -3, -4":

You can decide which of the following parameters shall appear in the last four lines of the single component display for the current channel:

- Temperature (measurement value with bargraph)
- Pressure (measurement value with bargraph)
- Flow (measurement value with bargraph)
- Calc-1, -2, -3, -4 (results of a Calculator's program; see 5.1.7, p. 5-46 to 5-48)
- Failures (message: yes/no)
- Check Requests (message: yes/no)
- Function Checks (message: yes/no)
- Range ID (measurement range with bargraph)
- Operation (status message: ready, warm-up, etc.)
- Any Alarms (message: yes/no)
- Span Conc. (span gas concentration value with bargraph)
- Gas flow (zero gas, span gas, sample gas)
- Heater Fail
- Raw Sign.
- Raw Sign. 1, 2, 3, 4, 5, 6, 7, 8 (raw signals of temperature, flow, pressure)
- Concentration (measurement value with bargraph)
- Average (measurement value with bargraph)
- Minimum (measurement value with bargraph)
- Maximum (measurement value with bargraph)

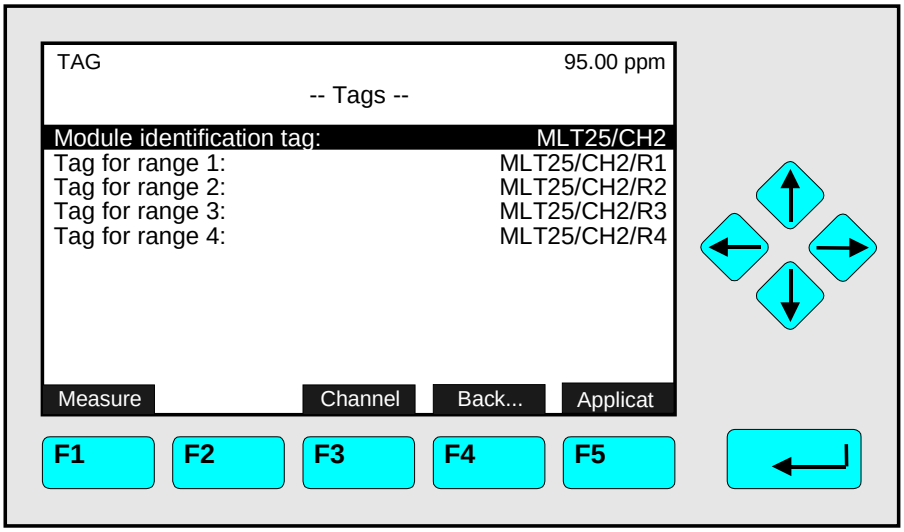
Note:

- Each bargraph will display the low limit (beginning value) and the high limit (end value) of the corresponding parameter.

"Tags...":

Press F5 (Tags...) to enter the second page of the menu "Measurement Display Configuration". There you can adjust the identification tag of the MLT analyzer / analyzer module and the tag of each range for the current channel. These range tags will appear at the top left of each menu page display

Caution:
If you change the identification tag, you have to change the configuration of the programmable digital inputs and analog outputs because the parameters of the module have changed and relations got lost!



Setting Tags:

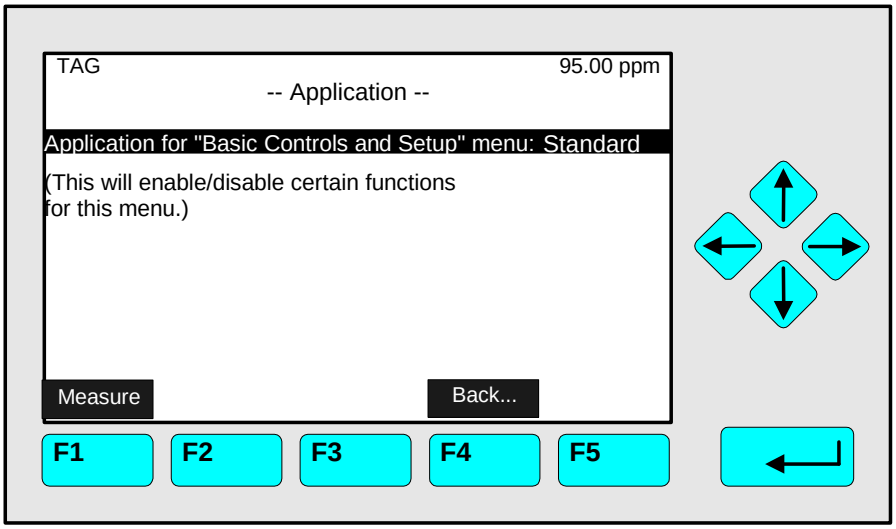
- Select the line you want with the ↑ -key or ↓ -key.
- Select the parameter with the ↵ -key or the → -key.
- Select the digit you want to change with the → -key or the ← -key and adjust the new value with the ↑ -key or the ↓ -key;
  Maximum of digits for each tag: 30
  Options: alphabet (capital and small letters), umlauts, letters from different languages, 0, 1, 2,..., 9, +, -, *, /, =, ?, !, %, $ and many others.
- Confirm the new value pressing the ↵ -key or
  cancel and return to the previous value pressing F2.

Notes:

- **To activate changed range tags you have to change the range one time!**
- **You may set the digits faster by holding the ↑ -key or the ↓ -key.**
  The scrolling will accelerate.

Application for Basic Controls Menu:

Via F5-key (Applicat) you can enter the 3rd page of the menu „Measurement Display Configuration...". There you can adjust the authorization which settings are allowed to be changed in the menu "BasicCal" ("Analyzer Basic Controls (calibration) & Setup", chapter 4.4). This function gives you the opportunity depending on the application and usefulness to allow or reduce the possibilities of operation.



Tags set up:

- Select the line you want with the ↑ -key or ↓ -key.
- Select the parameter with the ↵ -key or the → -key.
- Adjust the new parameter with the ↑ -key or the ↓ -key.
- Confirm the new value with the ↵ -key or
  cancel and return to the last value with the F2 -key.

Possible Settings:

Settings:	Standard	CEMS	All allowed	Calibration only
Start zero calibration:	+	+	+	+
Start span (gas) calibration:	+	+	+	+
(Current) range upper limit:			+	
Span gas (value):	+	+	+	
Range number:	+		+	
Check calibration deviation: enabled/disabled	+		+	

+ = Executing this function / editing this parameter is **permitted**.

Main Menu — Analyzer and I/O, expert controls & setup

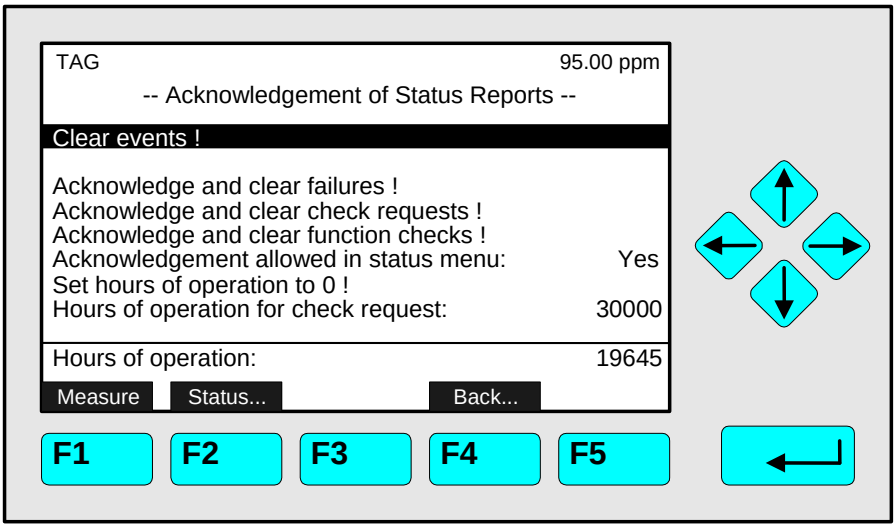
↓

Analyzer module setup

↓

Acknowledgement of status reports

↓



In the menu "Acknowledgements" you can

- acknowledge and clear all events of the MLT/ CAT 200 analyzer / analyzer module start the function "Clear events !" or
  acknowledge and clear certain events with the functions
  "Acknowledge and clear failures / check requests / function checks !"
- allow the acknowledgement and clear functions for the corresponding lines in the menu "Status Details" (see section 4.1.1 pg. 4-5 to 4-9)
- set hours of operation to zero in the corresponding function line
- set hours for check request in the corresponding line of variables.

Notes:

- In the line "Hours of operation for check request" you set how many hours the MLT analyzer / analyzer module may run until the maintenance will be required. Options: 1 to 30000 hours.
- The last line of the menu shows the total number of hours of operation since the startup of the MLT/ CAT 200 analyzer / analyzer module resp. since the last time, hours of operation was reset.

♦ Via the F2 -key you will reach the menu "Analyzer Channel Status". This menu and its submenus show a status report for the current channel including

- Failures
- Check requests
- Function checks
- Alarms
- Events

and the operational settings of the current channel like

- range settings and
- response time (t_{90}-time).

The menu "Analyzer Channel Status" and its submenus are shown in detail in section 4.1.

Setting parameters:

♦ Select any line of variables using the ↓ -key or the ↑ -key.

♦ Select the variable using the ↵ -key or the → -key.

♦ If asked after function start: Confirm pressing F2 (Yes) or
cancel and return to the menu page with F4 (Back...) or the ← -key.

♦ Variable editing: Select any digit with the ← -key or the → -key
and adjust a new value with the ↑ -key or the ↓ -key
resp. change the whole value with the ↑ -key or the ↓ -key.

♦ Confirm the new value using the ↵ -key or
cancel and return to the previous value using the F2 -key.

Main Menu — Analyzer and I/O, expert controls & setup

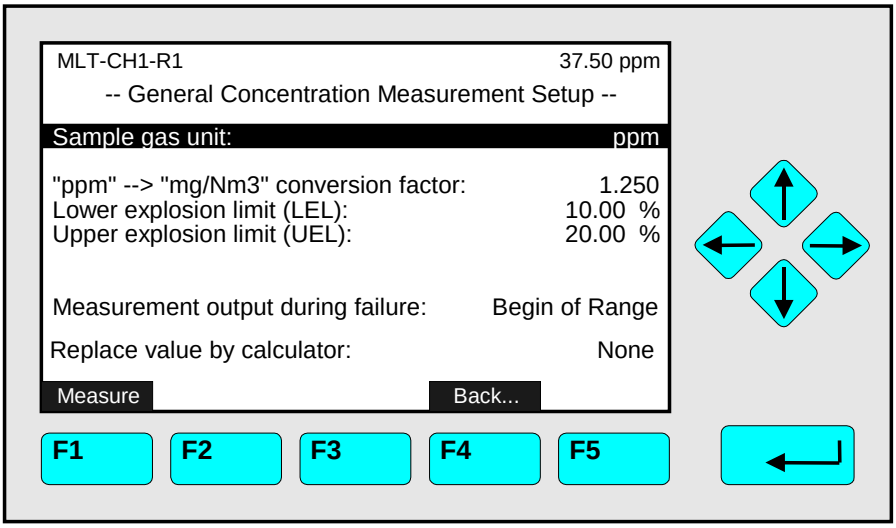
↓

Analyzer module setup

↓

General concentration measurement setup

↓



In the menu "General Concentration Measurement Setup" you can set the following parameters for the current MLT analyzer / analyzer module channel:

- the sample gas unit
  Options: ppb, ppm, %, µg/Nm^3, mg/Nm^3, g/Nm^3, %LEL, %UEL
- the "ppm → mg/Nm^3" conversion factor
  Options: 0 to 1000000
  Note: The "ppm" → "mg/Nm^3" conversion factor is required if you want to view sample gas values in "mg/Nm^3". (see attached Table: Conversion Factors ppm ↔ mg/Nm^3)!
- the lower explosion limit (LEL) and the upper explosion limit (UEL)
  Options: 0 to 100 % (consult corresponding literature)
- the measurement output during failure
  Options: Actual, Low – High, End of Range+10%, Begin of Range-10%, End of Range, Begin of Range
- replace value by calculator

  Options: None, Result 1, Result 2, Result 3, Result 4 (see section 5.1.7 analyzer module calculator or system calculator as supplement)

  Instead of showing the actual measuring value (none), calculator results can be selected.

Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.

- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Main Menu — Analyzer and I/O, expert controls & setup

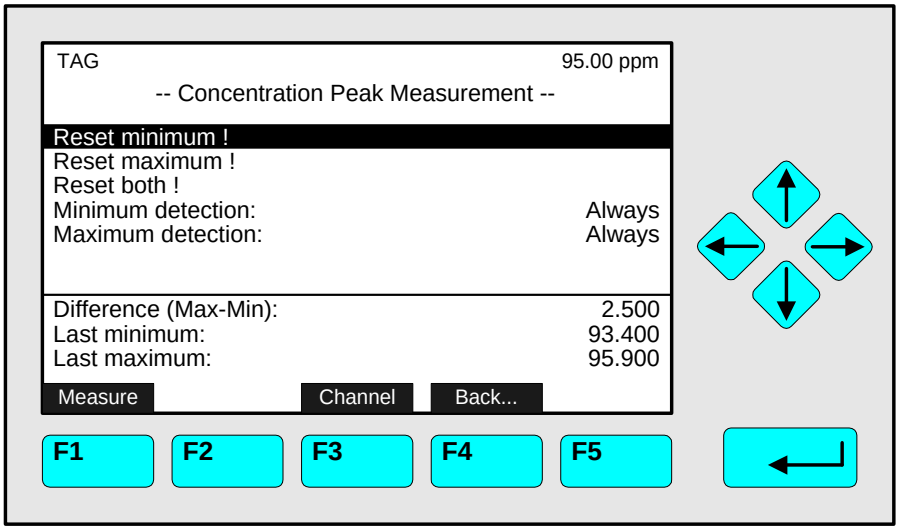
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Concentration peak measurement

↓



In the menu "Concentration Peak Measurement" you may define conditions for detecting extreme (maximum, minimum) values of a channel and view these values.

Set up parameters:

- Select the line of variables or any function line using the ↓ -key or the ↑ -key.
- Select the variable or start the function using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.
- If asked after function start: Confirm with the F2 -key (Yes) or
  cancel and return to the menu page with the F4 -key (Back...) or the ← -key.

Function lines "Reset minimum !" or "Reset maximum !"

Executing these functions will reset the last minimum or maximum value of concentration. This is necessary to start a new minimum or maximum detection.

Function line "Reset both !"

Executing this function will reset both last minimum and last maximum values of concentration simultaneously.

Lines of variables "Minimum detection" or "Maximum detection":

- **Always:** The minimum / maximum detection is running automatically.
- **External:** The minimum / maximum detection depends on an external instruction.
- **Off:** No detection of the extreme values is running.

Lines of variables "Difference (Max-Min), "Maximum", "Minimum":

- These lines show the actual or last minimum/maximum value and the difference of the extreme values for the actual channel of a MLT analyzer / analyzer module.
- You may send these values to the analog outputs.
- You may show the minimum and the maximum value in one of the last four lines of the single component display using the adjustments of menu "Measurement Display Configuration" (see 5.1.8 page 5-51/52).

Main Menu — Analyzer and I/O, expert controls & setup

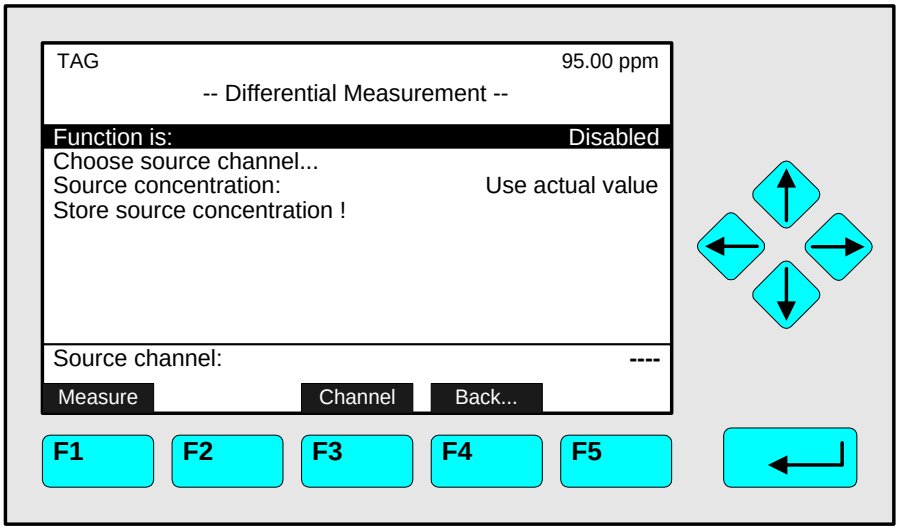
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Differential measurement

↓



In the menu "Differential Measurement" you can measure the difference between the current concentration and a reference concentration of the same gas component. That means, the measurement value is not based on the zero value as it is usual for an absolute value measurement. Instead of this the signal will be compared to a defined concentration of the component selected. That may be useful for concentrations that only differ a little from the basic value of this component in the measurement environment (Example: CO_2 of plants in air).
If you want to have a differential measurement for other components, you may change to other connected channels pressing the F3 -key.

Condition:

- ♦ You have to calibrate with zero gas and to linearize the measurement channel and the reference channel.
  - To calibrate see 4.5 page 4-19 and 4.6 page 4-23 or 5.1.1 page 5-17 to 5-19.
  - To linearize see 5.1.5 page 5-35

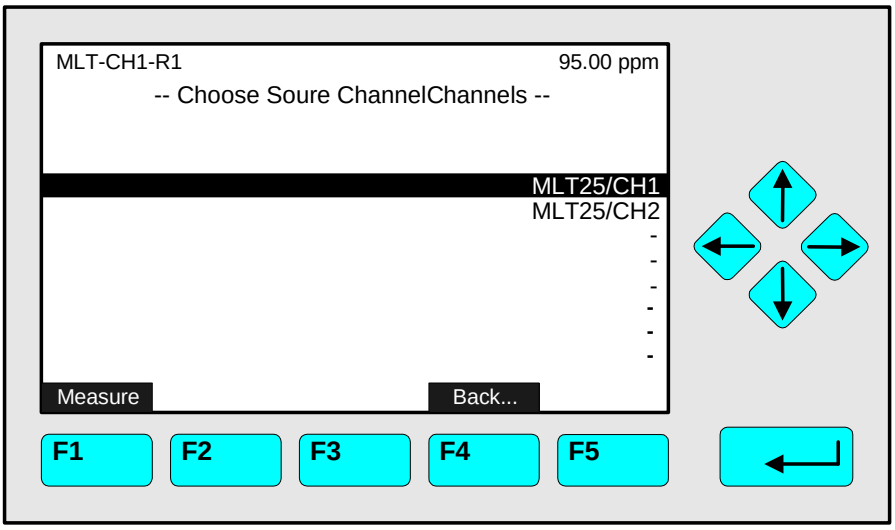
Differential measurement:

1) Disable the function:

- Press the ↵ -key or the → -key in the line "Function is" to select the parameter and adjust "Disabled" with the ↑ -key or the ↓ -key. Confirm it using the ↵ -key.
- This is necessary to avoid interference of values while the parameters are defined.

2) Select the reference channel:

- Select the menu line "Choose source channel..." using the ↓ -key and press the ↵ -key or the → -key to enter the submenu "Choose Source Channel":



- Select the line you want using the ↓ -key or the ↑ -key.
- Select the tag of the reference channel using the ↵ -key or the → -key:
  The display will return to the menu "Differential Measurement" automatically. You can see the channel selected in the line "Source channel".

3) Status determination of the reference channel:

- Select the line "Source concentration" with the ↑ -key or the ↓ -key and press the ↵ -key or the → -key to select the parameter. Adjust the parameter with the ↑ -key or the ↓ -key and confirm it with the ↵ -key.
- **Use actual value:**
  The reference value to calculate the difference concentration will always be the current value of the reference channel.
- **Use stored value:**
  The reference value to calculate the difference concentration will be fixed during the whole differential measurement.

4) Apply reference gas to the reference channel:

- Apply measurement gas with a defined concentration to the reference channel to determine the reference value.
- If the reference signal is stable, you have to change to the line "Store source concentration !" with the ↑ -key or the ↓ -key. Press the ↵ -key or the → -key to start this function. If asked, confirm with the F2 -key (Yes) or cancel and return to the menu page pressing the F4 -key (Back...) or the ← -key:
  The current signal will be fixed for the differential measurement.

5) Give up measurement gas to the measurement channel:

- Apply the measurement gas to the measurement channel while the reference signal is stable to measure the differential concentration.

6) Enable the differential measurement:

- Press the ↵ -key or the → -key in the line "Function is" and adjust "Enabled" with the ↑ -key or the ↓ -key. Confirm it with the ↵ -key:
  The differential measurement will start and the differential concentration calculated.

Main Menu — Analyzer and I/O, expert controls & setup

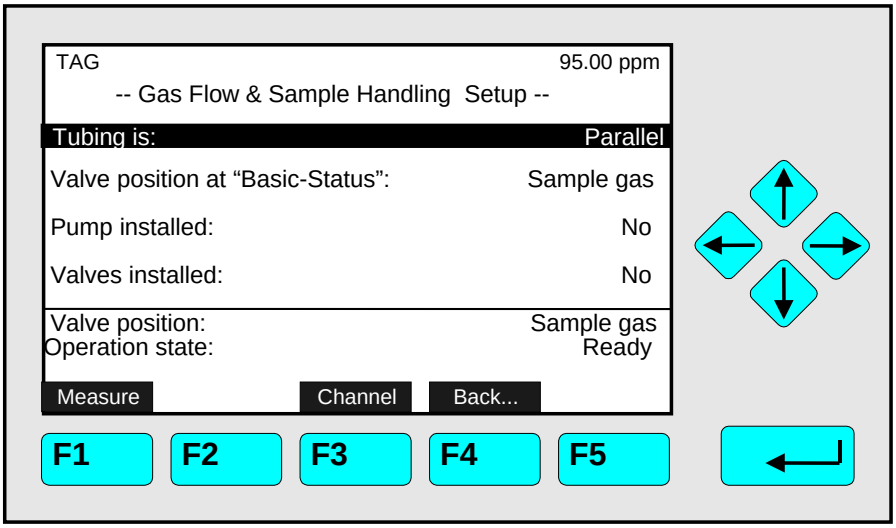
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Gas flow & Sample handling setup

↓



In the menu "Gas Flow & Sample Handling Setup" you can set the method of “tubing is” (gas flow through physical/optical benches of the analyzer):

- Parallel or Serial

the valve position at "Basic-Status":

- Sample gas or All closed

Pump installed:

- Yes/No (correct setting important for FF and RS interface)

Valves installed:

- Yes/No (correct setting important for FF and RS interface)

Note:

- **The adjustment for the gas flow through the analyzer benches has to match the real configuration of the analyzer cells- real tubing!**
- The setup is normally correct by factory setting.
  Only change it if you modify your configuration of cells.
- The correctness of this adjustment is very important while using time controlled calibration with a valve gear (see 5.1.1 page 5-14)

Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.

5.1 Analyzer Module Setup

5.1.14 Pressure Compensation

Main Menu — Analyzer and I/O, expert controls & setup

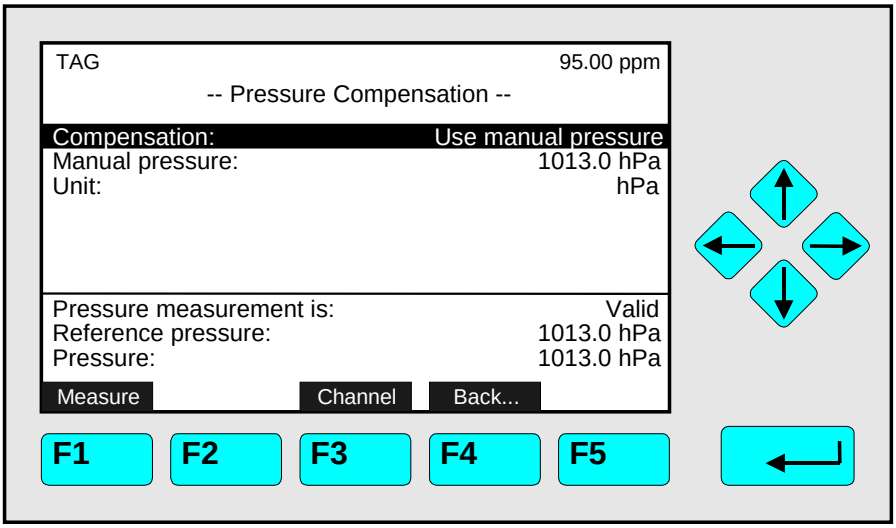
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Pressure compensation

↓



In the menu "Pressure Compensation" you may set the pressure parameters for the MLT analyzer / analyzer module. Pressing F3 you may switch to other available channels.

Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Line of variables "Compensation":

- **Use manual pressure:**
  The pressure compensation of the current channel is based on the value of the line "Manual pressure".
- **Use sensor value:**
  The pressure compensation of the current channel is based on the value measured by a pressure sensor. The corresponding value will be displayed in the line "Reference pressure". Setting this value is not possible if no sensor is installed. In this case the standard pressure of 1013.0 hPa resp. 14.7 psig is shown in this line.
- **Measure pressure:**
  Pressure is measured, but compensation is disabled.

- **Disabled:**
  Pressure compensation is disabled.

Line of variables "Manual pressure":

- You may insert the actual atmospheric pressure which has to be used for pressure compensation.
- Allowed values: 500 to 1300 hPa resp. 7,3 to 18,9 psig

Line of variables "Unit":

- You may select the pressure unit for pressure compensation.
- Options:
  - hPa
  - psig

Lines of variables "Pressure measurement is", "Reference pressure", "Pressure":

These lines are for information only. They are not selectable.

5.1 Analyzer Module Setup

5.1.15 Flow Measurement

Main Menu — Analyzer and I/O, expert controls & setup

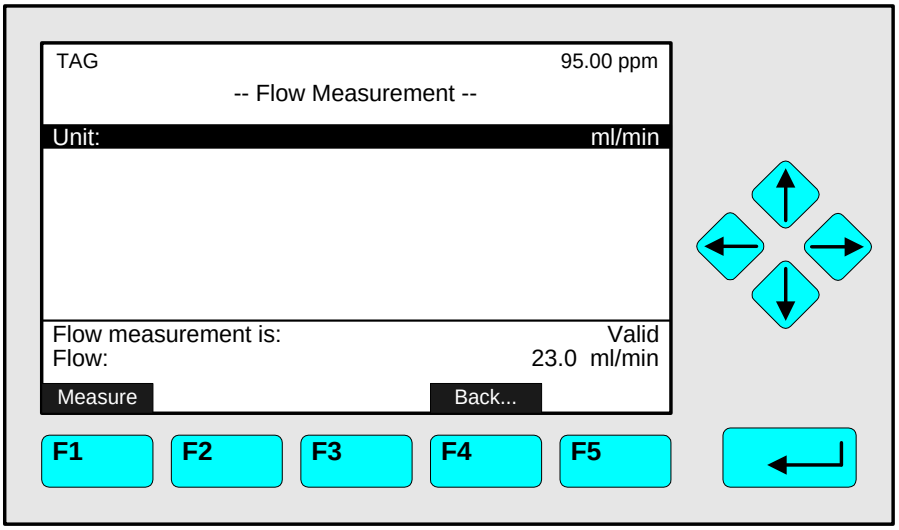
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Flow measurement

↓



In the menu "Flow Measurement" you can set up the flow unit of a MLT analyzer / analyzer module. In the last line of this menu you will find the actual flow of the channel selected.

Selecting the flow unit:

- Press the ↵ -key or the → -key to select the variable.
- Select the unit with the ↑ -key or the ↓ -key.
  Options: ml/min, l/min
- Confirm your adjustment with the ↵ -key or
  cancel and return to the previous value pressing F2.

Note:

If a flow sensor is not installed choosing this menu will display a message instead of the above shown menu. Press F4 to return to the previous page.

Main Menu — Analyzer and I/O, expert controls & setup

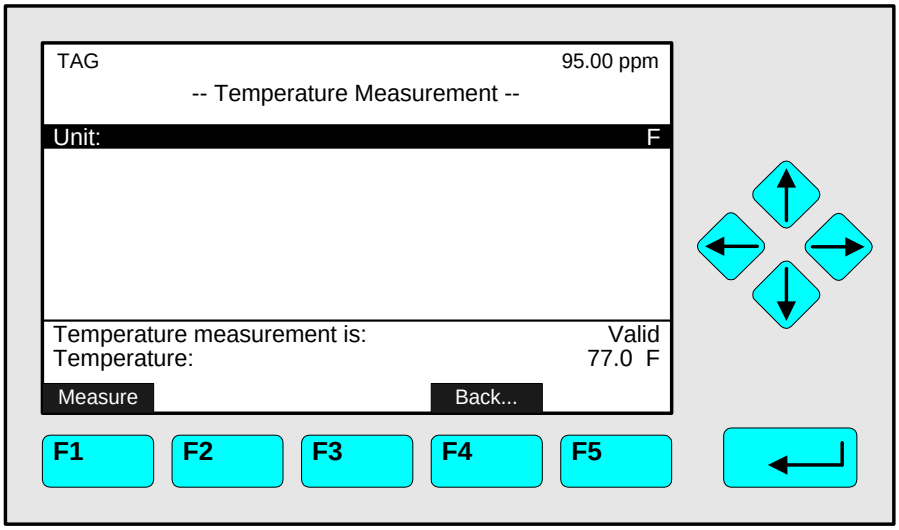
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Temperature measurement

↓



In the menu "Temperature Measurement" you can set up the temperature unit of a MLT analyzer or analyzer module. In the last line of this menu you will find the actual temperature of the channel selected.

Selecting the temperature unit:

- Press the ↵ -key or the → -key to select the variable.
- Select the unit with the ↑ -key or the ↓ -key.
  Options: F, °C
- Confirm your adjustment with the ↵ -key or
  cancel and return to the previous value pressing F2.

Note:

If no temperature sensor is installed a message will be displayed instead of the menu page shown above. Press F4 to return to the previous page.

5.1 Analyzer Module Setup

5.1.17 Load/Save Analyzer Module Configuration

Main Menu — Analyzer and I/O, expert controls & setup

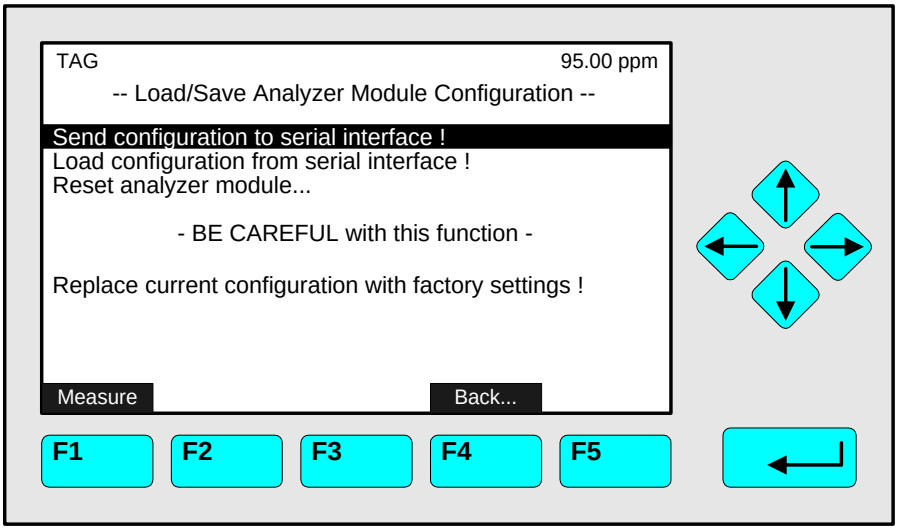
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Load/Save configuration (AM)

↓



This menu is only available if an analyzer module is connected. Otherwise a message will appear referring to the system level functions "Load/Save Configuration (CM/MCA)". Pressing F5 will open this menu (s. 6.2, page 6-7).

In the menu "Load/Save Analyzer Module Configuration" you may start several functions to send or load configuration data of the TFID/MLT analyzer module via the serial interface. These functions are only available, if a SIO with serial interface is installed in the TFID/MLT analyzer module.

Caution!

Loading data will delete all existing RAM data!

Starting the functions:

- Select the function line you want with the ↓ -key or the ↑ -key.
- Press the ↵ -key or the → -key to start the function.
  If asked, confirm using the F2 -key (Yes) or
  cancel and return to the menu page pressing the F4 -key (Back...) or the ← -key.

Function line "Send configuration to serial interface !":

You will send the RAM data via the serial interface of the TFID/MLT analyzer module to an EPROM programmer or to an external computer!

Function line "Load configuration from serial interface !":

You will load data from an external memory to the RAM of the TFID/MLT analyzer module via the serial interface. This will override the actual RAM data!

Function line "Replace current configuration with factory settings !":

You will delete the RAM data and load factory settings from Flash-EPROM!

NOTE:
THIS SECTION WILL GIVE A DESCRIPTION OF THE **LOCAL INPUT/OUTPUT BOARDS** INSTALLED IN AN MLT/ CAT 200/ TFID ANALYZER MODULE ONLY!
SYSTEM I/O BOARDS ARE DESCRIBED IN SECTION 5.2 !

Main Menu — Analyzer and I/O, expert controls & setup

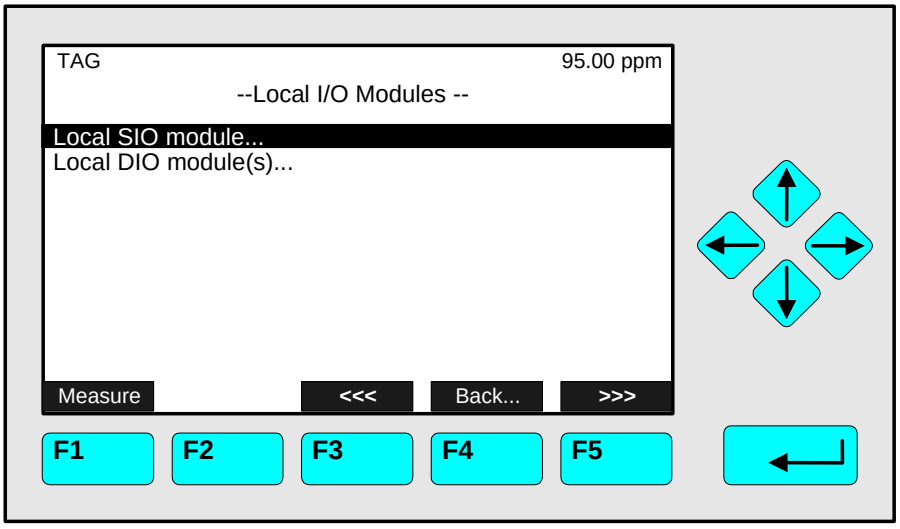
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Local I/O modules

↓



From the menu "Local I/O Modules" you can open several submenus where you can set parameters for the local SIO module or the local DIO module of a TFID/ MLT/ CAT 200 analyzer module:

- Press the ↵ -key or the → -key in the line "Local SIO module..." or "Local DIO module(s)..." to open the corresponding submenus

Note:

- If there is no local I/O module in the analyzer module, you will see a corresponding note on the display instead of the menu page shown above.
- If you want to set up the system SIO or DIO modules, you have to go to the submenus of the menu "System I/O Modules" (see 5.2 page 5-87).

5.1 Analyzer Module Setup

5.1.18 Local I/O modules – Local SIO

Main Menu — Analyzer and I/O, expert controls & setup

↓

Analyzer module setup

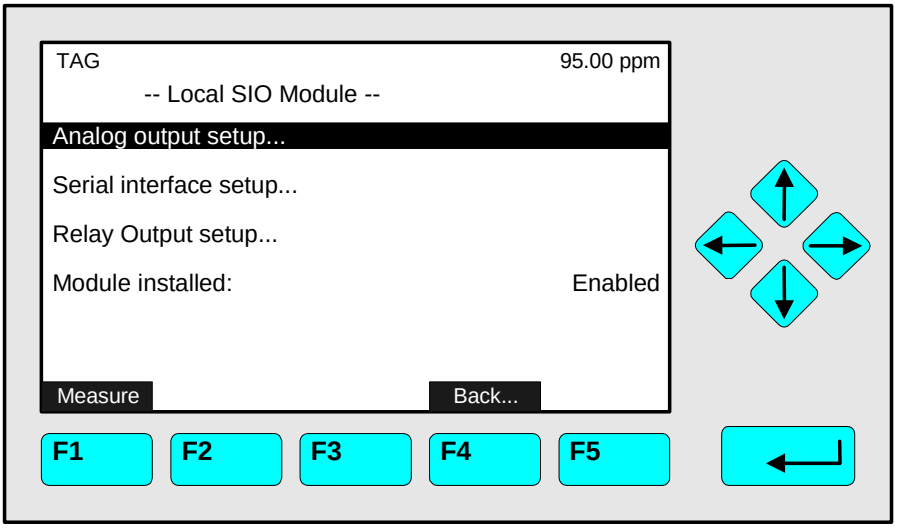
↓ [2nd menu page via F5 (More...)]

Local I/O modules

↓

Local SIO module

↓



From the menu "Local SIO Module" you can enter submenus to control and set up several output configurations of the local SIO module.
General Configuration of a SIO board (the whole specification see its own manual):

- Analog outputs: minimum 2, maximum 8
- Serial interface (RS 232 or RS 485) to connect the analyzer module with an external computer
- Three relay outputs

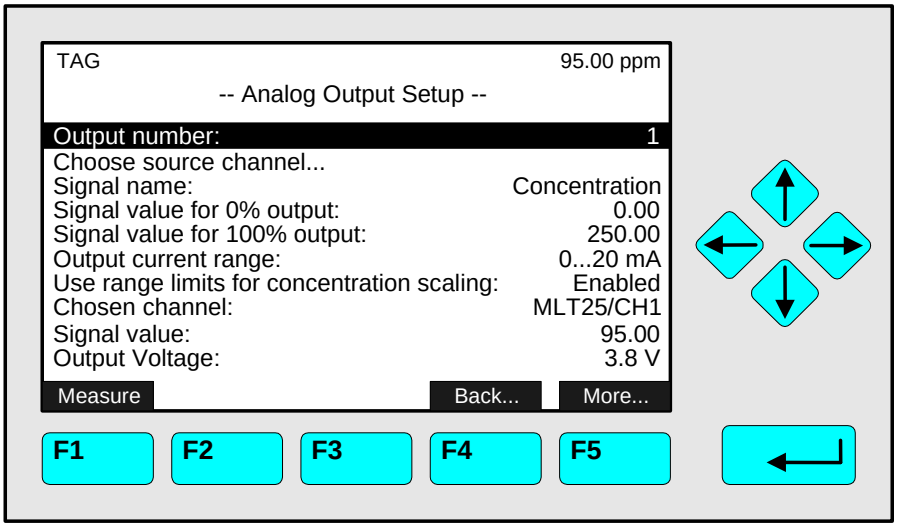
If there is a SIO module installed in the analyzer you have select "Enabled" in the line "Module installed", otherwise "Disabled".

Set up parameters:

- Select the line of variables or any menu line using the ↓ -key or the ↑ -key.
- Select the variable or enter the submenu with the ↵ -key or the → -key.
- Select the parameter pressing ↑ or ↓.
- Confirm the new adjustment using the ↵ -key or cancel and return to the previous value pressing F2.

Analog Output Setup:

Press the ↵ -key or the → -key in the line "Analog Output Setup..." to open the corresponding submenu:



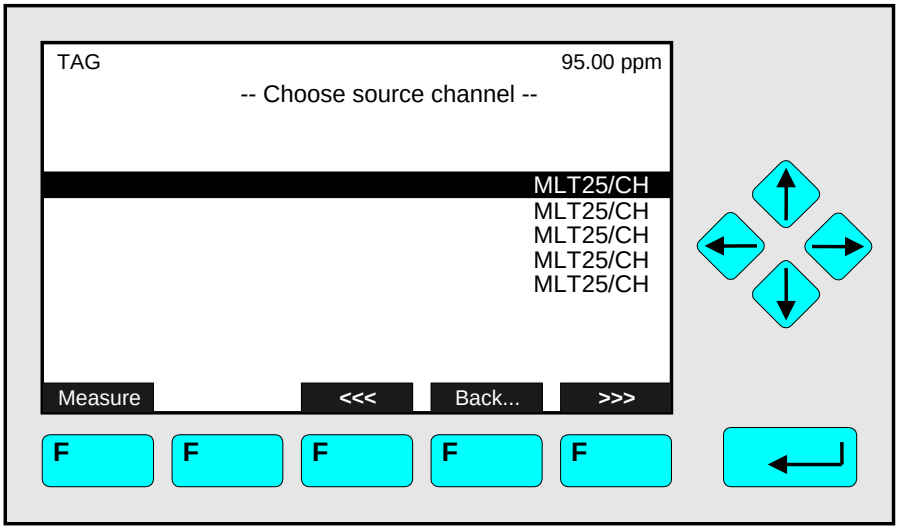
Configuring the analog output:

1) Select the analog output number:

- You may set all parameters in the menu "Analog Output Setup" separately for each of the available analog outputs. The number of outputs depends on the hardware configuration of the local SIO module (minimum: 2, maximum: 8).
- Press the ↵ -key or the → -key to select the output number and adjust the value you want using the ↑ -key or the ↓ -key.
- Confirm the number selected with the ↵ -key.

2) Choose the analyzer module:

- Use the ↓ -key to highlight the line "Choose source channel..."
- Open the submenu " Choose source channel..." pressing the ↵ -key or the → -key:



- Choose the line you want with the ↑ -key or the ↓ -key.
- Select the tag of the channel with the ↵ -key or the → -key:
  The display will return to the menu "Analog Outputs" automatically.
  The tag of the channel selected will appear in the line "Analyzer module".

3) Select the signal name:

- Highlight the line "Signal name" using the ↓ -key
- Select the parameter with the ↵ -key or the → -key and adjust one of the following parameters with the ↑ -key or the ↓ -key:
  - Concentration
  - Average
  - Peak-Value
  - Temperature
  - Pressure
  - Flow
  - Range
  - Calculator-1
  - Calculator-2
  - Calculator-3
  - Calculator-4
- Confirm the parameter selected pressing the ↵ -key.

4) Selecting output signal values:

- You may select signal values for 0 % output and 100 % output in the lines "Signal value for 0 % output" or "Signal value for 100 % output". So you have the possibility to zoom out a certain part of the whole range.

Example: Range from 0 to 1000 ppm		
0 % value shall be 400 ppm, 100 % value shall be 700 ppm		
Standard analog output is:	0 V = 0 ppm	10 V = 1000 ppm
Modified output signal is:	0 V = 400 ppm	10 V = 700 ppm

- Select the line "Signal value for 0 % output" or "Signal value for 100 % output" with the ↓ -key. Select the value with the ↵ -key or the → -key. Select any digit with the ← -key or the → -key and adjust a new value using the ↑ -key or the ↓ -key. Confirm by ↵ -key.
- **Note:**
  Changing the signal for 0 % or 100 % will result in overriding the adjustment and reset to the standard values of the range! To change the output signal values permanently you have to change the ranges in the menu "Begin and End of Ranges" (see 5.1.3 page 5-27) or select “Disabled” in the submenu “Use range limits for concentration scaling”
- **Caution:**
  The signal range at the analog output should not be less than the smallest range otherwise the noise level at the analog output may increase! Special conditions and specifications for suppressed ranges, consult factory!

5) Assigning the output current range:

- Press the ↵ or → -key in the line "Output current range" to select the range. Select the value you want with the ↑ or ↓ -key and confirm with ↵
- Options: 0...20 mA (and automatically 0...10 V) or 4...20 mA (2...10 V).

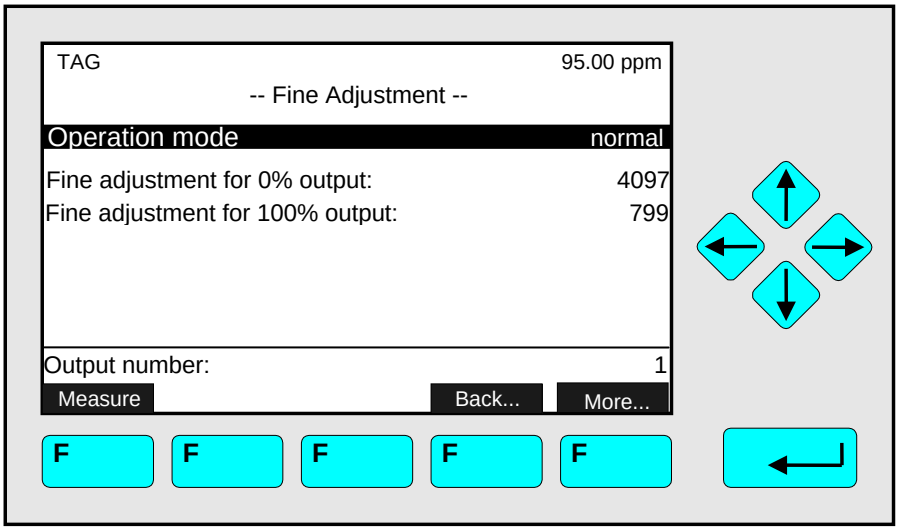
6) Concentration scaling:

- Press the ↵ -key or the → -key in the line "Use range limits for concentration scaling" to select the parameter and select "Enabled" using the ↑ -key or the ↓ -key to enable the limits control or "Disabled" to disable it.
- Confirm the new parameter pressing ↵.

The last three lines of variables in the menu "Analog Outputs" are for information only and show some analog output values! They are not selectable.

F5 (More…) Fine adjustment of the analog output:

- If you press F5 (More...) in the menu "Analog Outputs", you open the submenu "Fine Adjustment", where you may fine adjust the analog output:



- Press the ↵ -key or the → -key in the line "Operation mode" to select the parameter and adjust one of the following parameters with the ↑ -key or the ↓ -key:
  - **Normal:** The absolute measurement signal will be sent to the analog output.
  - **Zero:** Coordination between the display and the analog output for 0 V with fine adjustment 0 %.
  - **Full Scale:** Coordination between the display and the analog output for 10 V with fine adjustment 100 %.
- Confirm the new parameter pressing the ↵ -key.
- Press the ↵ -key or the → -key in the line "Fine adjustments for 0 % output" or "Fine adjustment for 100 % output" to select the corresponding value.
- Adjust the value you want using the ↑ -key or the ↓ -key and confirm it with the ↵ -key. Options: 3000 - 6000 for 0 % and 600 - 1000 for 100 %.

F5 –key (More…) Status of analog outputs:

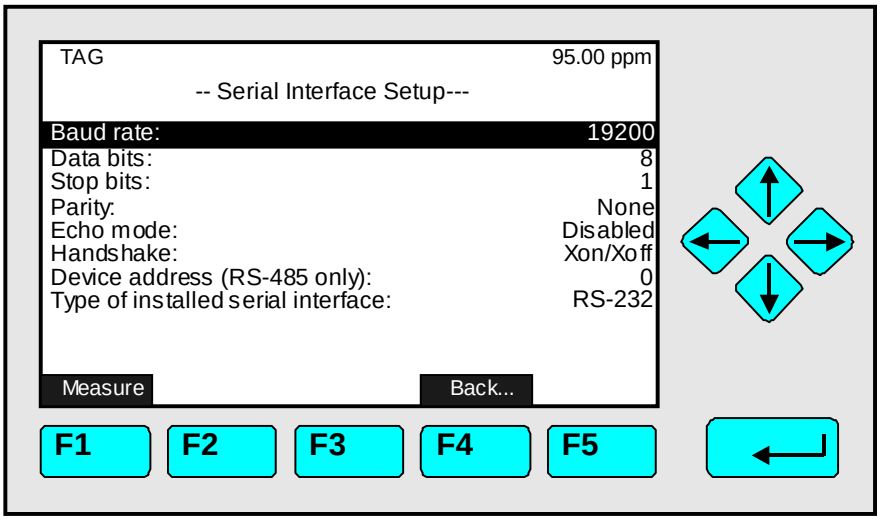
- With F5 you reach the next submenu indicating the actual stage of the “Hold Status of the Analog outputs” is “On” or “Off”.

F5 -key (More...) Analog Output Updates per Second":

- This submenu indicates how often the analog outputs are updated.

Serial Interface Setup:

Press the ↵ -key or the → -key in the line "Serial Interface Setup..." of the menu "Local SIO Module" to enter to the corresponding submenu:



In the submenu "Serial Interface Setup" you may define parameters for data transfer between the analyzer module and external computer. The settings in this menu depend on the configuration of the analyzer module and the corresponding computer. The serial interface specification is described in another manual.

Set up parameters:

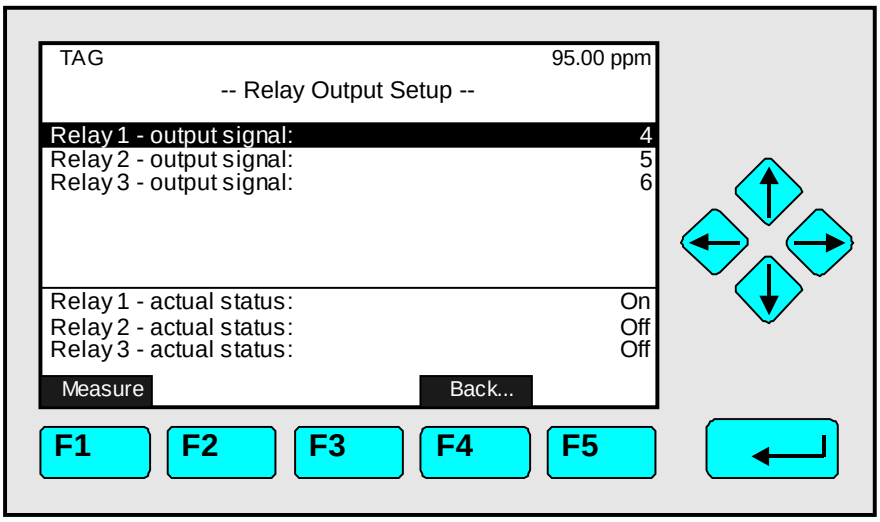
- Select any line of variables or the menu line with the ↓ -key or the ↑ -key.
- Select the variable or enter the submenu with the ↵ -key or the → -key.
- Select any digit with the ← -key or the → -key and adjust a new value with the ↑ -key or the ↓ -key
  resp. select the whole parameter with the ↑ -key or the ↓ -key.
- Confirm the new value with the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Options:

Baudrate:	300	1200	2400	4800	9600	19200
Data bits:	7	8				
Stop bits:	1	2				
Parity:	None	Even	Odd			
Echo mode:	Enabled	Disabled				
Handshake:	None	Xon/Xoff				
Transmission delay:	0 ... 100					
Type of installed serial interface:	RS 232	RS 485/2w	RS 485/4w	RS 485/4w-Bus	None	

Relay Outputs Setup:

Press the ↵ -key or the → -key in the line "Relay Outputs Setup..." of the menu "Local SIO - Configuration Parameters" to enter the corresponding menu:



Use the menu "Relay Outputs Setup" to attach signals to the relay outputs of the local SIO board, e.g. the relation between the zero valve and a certain channel. Insert a number code (= variable of a signal) in the corresponding line for the relay:

See the table "Signal Codes 1 - 359" on the following pages: page 5-79 to 5-81 !

There are three relays on the local SIO board. With a jumper you may define the relay contact status: normally open (NO) or normally closed (NC). For Information about the whole specification of the SIO board refer to the corresponding manual.

Note:

This menu allows to define the relay output configuration for analyzer module channels only, not for channels of system modules.

Set up parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Select the code number for the signal with the ↑ -key or the ↓ -key.
  Options: Code 1 to 359 according to the list at pages 5-79 to 5-81!
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Lines of variables "Relay 1, 2, 3 - actual status":

These lines show the current gear status of each relay. The lines are not selectable.

5.1 Analyzer Module Setup

5.1.18 Local I/O modules – Local DIO

Main Menu — Analyzer and I/O-module expert configuration

↓

Analyzer module setup

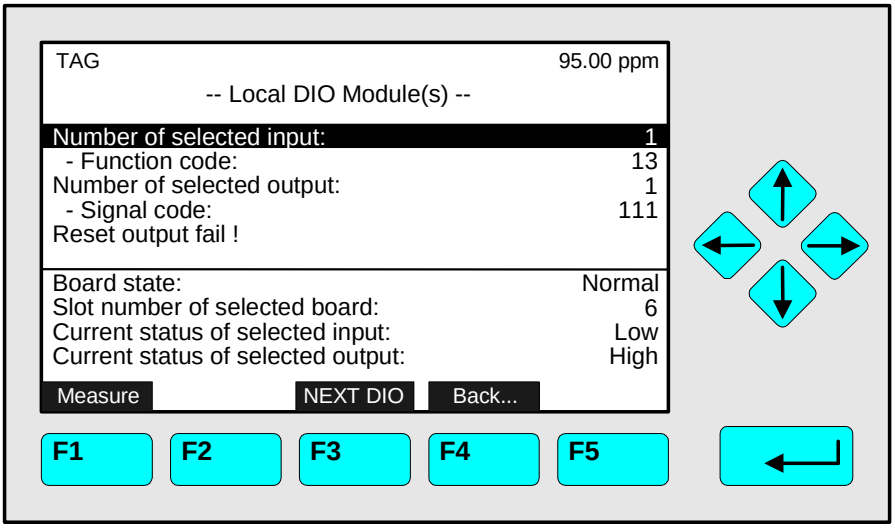
↓ [2nd menu page via F5 (More...)]

Local I/O modules

↓

Local DIO module(s)

↓



In the menu "Local DIO Module(s)" you can set up the configuration of the local DIO modules of an **analyzer module**. Every DIO module consists of 8 digital inputs and 24 digital outputs. You may assign a function to each input (e.g. opening of a valve) and a signal to each output (e.g. zero valve) by a corresponding code.

See the tables on the following pages:

➔ **Signal codes 1- 359: see page 5 - 79 to 5 - 81; Function codes: 1 - 599 see page 5 - 82!**

Set up parameters:

- Select the line of variables or the function line using the ↓ -key or the ↑ -key.
- Select the variable or start the function with the ↵ -key or the → -key.
- If asked after function start: Confirm pressing F2 (Yes) or cancel and return to the menu page pressing the F4 -key (Back...) or the ← -key.
- Changing Variables: Select any digit using the ← -key or the → -key and adjust a new value with the ↑ -key or the ↓ -key.
- Confirm the new value with the ↵ -key or cancel and return to the previous value pressing F2.

Function line "Reset output fail !"

The 24 digital outputs are organized in 3 units with 8 outputs each. If there is a short circuit or an overload in one unit, it will be switched off and saved against destruction. When the fault is removed, select the line "Reset output fail !", press the ↵ -key or the → -key and the board is available immediately. If asked: Confirm with F2 -key (Yes).
For information about the whole specification of the DIO board refer to another manual.

The last four lines of variables:

These lines show the DIO board status, the slot number and the gear. The lines are not selectable.

Signal Codes 1 - 359

Available for:

- SIO relay outputs (see **page** 5-77)
- DIO outputs (see **page** 5-78)
- Programmable logic control (see 5.1.6 **page** 5-39)

General Signals	
Signal ID	**Signal**
1	RAM-Failure
2	ROM-Failure
3	Seconds; LOW/HIGH change all 1000 ms
4	At least 1 sample gas valve activated
5	At least 1 zero gas valve activated
6	At least 1 span gas valve activated
7	At least 1 NAMUR-status: Failure
8	At least 1 NAMUR-status: Check Request
9	At least 1 NAMUR-status: Function Check
10	Sample gas activated (all channels)
11	Zero gas activated (all channels)
12	Span gas activated (all channels)
13	Standby activated (all channels)
14	Purge gas activated (all channels)
15	
16	Pump 1
17	Pump 2
18	
19	

Programmable Calculator	
Signal ID	**Signal**
20	Execution status
21	Result 1 / Limit 1
22	Result 1 / Limit 2
23	Result 1 / Limit 3
24	Result 1 / Limit 4
25	Result 2 / Limit 1
26	Result 2 / Limit 2
27	Result 2 / Limit 3
28	Result 2 / Limit 4
29	Result 3 / Limit 1
30	Result 3 / Limit 2
31	Result 3 / Limit 3
32	Result 3 / Limit 4
33	Result 4 / Limit 1
34	Result 4 / Limit 2
35	Result 4 / Limit 3
36	Result 4 / Limit 4
37 - 39	Reserved

Programmable Logic Controls	
Signal ID	**Signal**
40	Output Result buffer #1
41	Output Result buffer #2
42	Output Result buffer #3
43	Output Result buffer #4
44	Output Result buffer #5
45	Output Result buffer #6
46	Output Result buffer #7
47	Output Result buffer #8
48	Output Result buffer #9
49	Output Result buffer #10
50	Output Result buffer #11
51	Output Result buffer #12
52	Output Result buffer #13
53	Output Result buffer #14
54	Output Result buffer #15
55	Output Result buffer #16
56	Output Result buffer #17
57	Output Result buffer #18
58	Output Result buffer #19
59	Output Result buffer #20
60	Execution status
61 -69	Reserved

I/O Module SIO	
Signal ID	**Signal**
70	Output #1 < 0V
71	Output #1 > 10V
72	Output #2 < 0V
73	Output #2 > 10V
74	Output #3 < 0V
75	Output #3 > 10V
76	Output #4 < 0V
77	Output #4 > 10V
78	Output #5 < 0V
79	Output #5 > 10V
80	Output #6 < 0V
81	Output #6 > 10V
82	Output #7 < 0V
83	Output #7 > 10V
84	Output #8 < 0V
85	Output #8 > 10V
86	Relay #1
87	Relay #2
88	Relay #3
89	Reserved

I/O Module DIO	
Signal ID	**Signal**
90	Input #1
91	Input #2
92	Input #3
93	Input #4
94	Input #5
95	Input #6
96	Input #7
97	Input #8
98	Output 1..8 failure
99	Output 9..16 failure
100	Output 17..24 failure
101	General Failure
102 - 109	Reserved

Measurement Channels					
Signal ID Ch 1	**Signal ID Ch 2**	**Signal ID Ch 3**	**Signal ID Ch 4**	**Signal ID Ch 5**	**Signal**
110	160	210	260	310	Raw signal failure
111	161	211	261	311	Sample gas valve
112	162	212	262	312	Zero gas valve
113	163	213	263	313	Test gas valve
114	164	214	264	314	Span gas valve - range 1
115	165	215	265	315	Span gas valve - range 2
116	166	216	266	316	Span gas valve - range 3
117	167	217	267	317	Span gas valve - range 4
118	168	218	268	318	Any of the span gas valves
119	169	219	269	319	Lin1 gas valve
120	170	220	270	320	Lin2 gas valve
121	171	221	271	321	Purge gas valve
122	172	222	272	322	Linearization Underflow
123	173	223	273	323	Linearization Overflow
124	174	224	274	324	Zero calibration in progress
125	175	225	275	325	Span calibration in progress
126	176	226	276	326	Range Underflow
127	177	227	277	327	Range Overflow
128	178	228	278	328	Range #1
129	179	229	279	329	Range #2
130	180	230	280	330	Range #3
131	181	231	281	331	Range #4
132	182	232	282	332	Failure (NAMUR)
133	183	233	283	333	Check Request (NAMUR)
134	184	234	284	334	Function Check (NAMUR)
135	185	235	285	335	Concentration / Limit #1
136	186	236	286	336	Concentration / Limit #2
137	187	237	287	337	Concentration / Limit #3
138	188	238	288	338	Concentration / Limit #4
139	189	239	289	339	Conc. Average / Limit #1
140	190	240	290	340	Conc. Average / Limit #2
141	191	241	291	341	Conc. Average / Limit #3
142	192	242	292	342	Conc. Average / Limit #4
143	193	243	293	343	Temperature / Limit #1
144	194	244	294	344	Temperature / Limit #2
145	195	245	295	345	Temperature / Limit #3
146	196	246	296	346	Temperature / Limit #4
147	197	247	297	347	Pressure / Limit #1
148	198	248	298	348	Pressure / Limit #2
149	199	249	299	349	Pressure / Limit #3
150	200	250	300	350	Pressure / Limit #4
151	201	251	301	351	Flow / Limit #1
152	202	252	302	352	Flow / Limit #2
153	203	253	303	353	Flow / Limit #3
154	204	254	304	354	Flow / Limit #4
155	205	255	305	355	External signal #1
156	206	256	306	356	External signal #2
157	207	257	307	357	External signal #3
158	208	258	308	358	External signal #4
159	209	259	309	359	External signal #5

Function Codes 1 - 599

Available for:

- DIO inputs (see **page** 5-78)

The following functions are activated only if the input signal changes from low to high level:

ID	General functions
1	Set all channels into STANDBY state (Stop procedures)
2 – 99	Reserved

ID CH1	ID CH2	ID CH3	ID CH4	ID CH5	Channel dependent functions
100	200	300	400	500	Start Zero calibration
101	201	301	401	501	Start Span calibration
102	202	302	402	502	Start Zero + Span calibration
103	203	303	403	503	Open sample gas valve
104	204	304	404	504	Open zero gas valve
105	205	305	405	505	Open purge gas valve
106	206	306	406	506	Open test gas valve
107	207	307	407	507	Open linearizer gas valve
108	208	308	408	508	Open span gas valve (of current range)
109	209	309	409	509	Open span gas valve of range-1
110	210	310	410	510	Open span gas valve of range-2
111	211	311	411	511	Open span gas valve of range-3
112	212	312	412	512	Open span gas valve of range-4
113	213	313	413	513	Close all valves (STANDBY)
114	214	314	414	514	Set range-1
115	215	315	415	515	Set range-2
116	216	316	416	516	Set range-3
117	217	317	417	517	Set range-4
118	218	318	418	518	Reserved
...	...	...	...	...	...
149	249	349	449	549	Reserved

The following functions are active if the input signal is set to high level:

ID CH1	ID CH2	ID CH3	ID CH4	ID CH5	Channel dependent functions
150	250	350	450	550	*AK key-switch*: Remote
151	251	351	451	551	*NAMUR signal:* Function Check
152	252	352	452	552	Reserved
...	...	...	...	...	...
199	299	399	499	599	Reserved

Main Menu — Analyzer and I/O, expert controls & setup

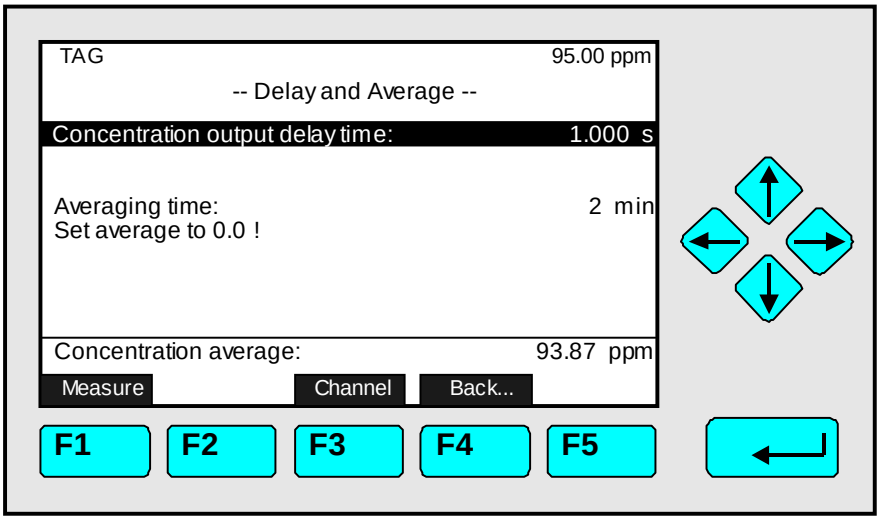
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Delay and average

↓



In the menu "Delay and Average" you may set the

- ♦ analog output delay time of the measurement signal and
- ♦ averaging time to calculate the mean value of concentration

for one MLT analyzer / analyzer module channel.

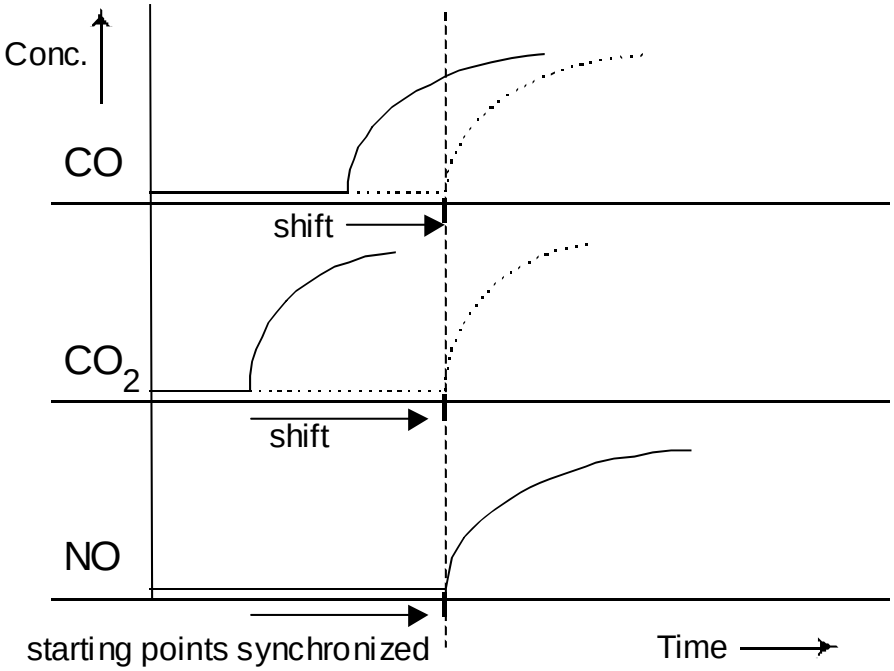
Set up parameters:

- ♦ Select the line of variables or any function line using the ↓ -key or the ↑ -key.
- ♦ Select the variable or start the function using the ↵ -key or the → -key.
- ♦ Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- ♦ Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.
- ♦ If asked after function start: Confirm with the F2 -key (Yes) or
  cancel and return to the menu page with the F4 -key (Back...) or the ← -key.

Lines of variables "Concentration output delay time":

- The line "Concentration output delay time" allows to shift the analog output signal on the time line. Proper shifting may be used to synchronize the starting points of different channels output signals.
- Options: 0.000 to 10.000 seconds.
- To disable shifting set concentration output delay time to 0.000 s.

Example:



Line of variables "Averaging time" and function line "Set average to 0.0 !":

- The mean value of a measurement is calculated as follows (arithmetic mean value):

$$\text{Concentration mean value} = \frac{\text{Sum of all concentrations}}{\text{Number of values}}$$

- The number of measurement values depends on the averaging time.
- Options: 1, 2, 3, ... , 60 minutes
- You will find the result of the previous / actual mean value calculation in the line "Concentration average".
- Starting the function "Set average to 0.0 !" will calculate a new mean value. After the time set in the line "Averaging time" is over the result is shown in the line "Concentration average".

Main Menu — Analyzer and I/O, expert controls & setup

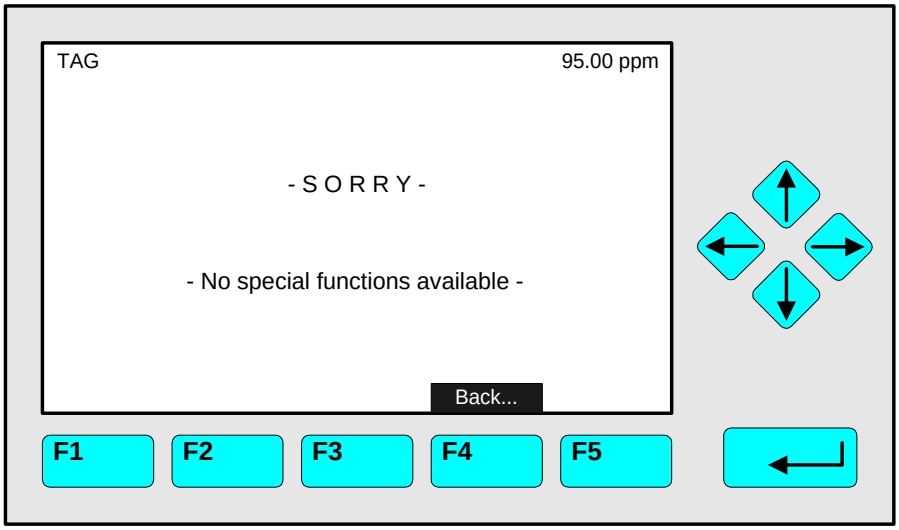
↓

Analyzer module setup

↓ [2nd menu page via F5 (More...)]

Special functions

↓



The menu "Special Functions" offers special functions for different analyzer (modules) like TFID, CLD, FID.

5.1 Analyzer Module Setup

5.1.21 AK-Protocol Communication

Main Menu — Analyzer and I/O, expert controls & setup

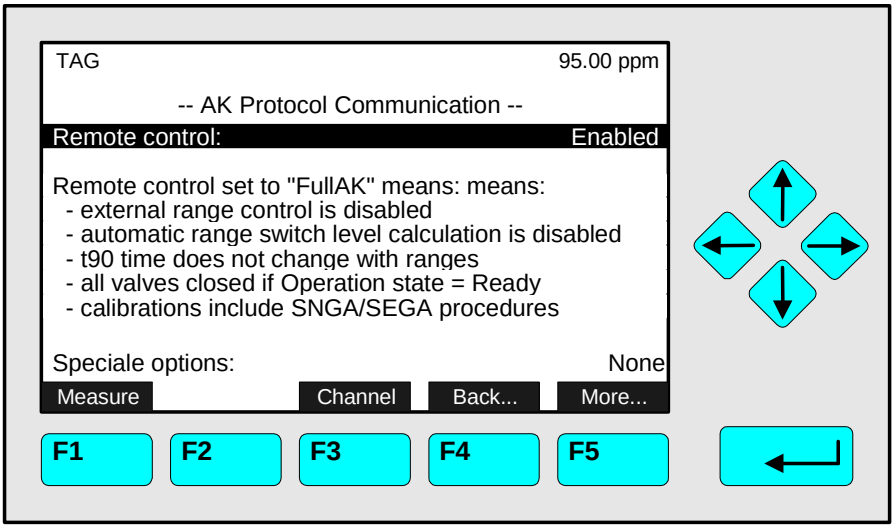
↓

Analyzer module setup

↓ [3rd menu page via 2 times F5 (More...)]

AK protocol communication

↓



In the menu "AK-Communication" you may set the parameters for current channel remote control via serial interface.

Set up parameters:

- Press the ↵ -key or the → -key to select the parameter.
- Select the parameter you want with the ↑ -key or the ↓ -key.

  Options:

  - **Disabled:** No data transfer by remote control is possible.
  - **Full AK:** The data transfer is only possible for commands of the AK standard.
  - **Enabled:** The data transfer is possible for the commands of the AK standard and further commands like service commands.
- Confirm the parameter selected with the ↵ -key or cancel and return to the previous option pressing the F2 -key.

Note:

- Use the F5 -key (More...) to enter a submenu to set the times of the AK commands "SNGA", "SEGA", "SATK" and "SMGA". Refer to the manual "AK commands" (No. 90003752) for information about the AK-communication protocol and its settings !
- To set data transfer parameters (e.g. baud rate) enter the menu "Serial Interface" (see section 5.1.18 page 5-76resp. 5.2.1 page 93).

NOTE:
THIS SECTION **DESCRIBES** THE **SYSTEM I/O BOARDS** (CONTROL MODULE LEVEL IN **PLATFORM, TFID OR MLT/ CAT 200 ANALYZER**) IN SECTION 5.2.1 AND 5.2.2 !
THE DESCRIPTION OF **NETWORK I/O'S** INSTALLED IN A PLATFORM TO SUPPORT ESPECIALLY CLD'S AND FID'S YOU WILL FIND IN SECTION 5.2.3 !

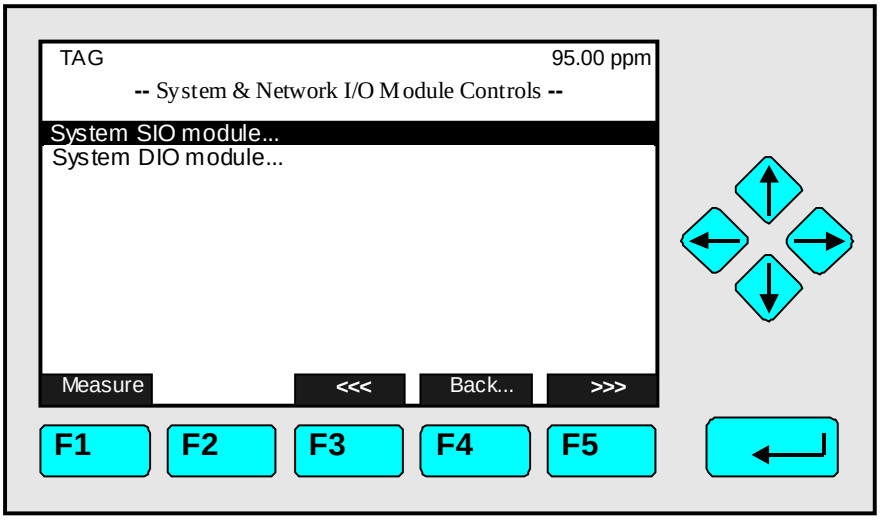
THE DESCRIPTION OF LOCAL I/O'S INSTALLED IN AN MLT/ CAT 200 OR TFID **ANALYZER MODULE** YOU WILL FIND IN SECTION 5.1.18 !

Main Menu — Analyzer and I/O, expert controls & setup

↓

System & Network I/O Module Controls (or ... I/O Module Setup)

↓



From the menu "System & Network I/O Module Controls" or "System & Network I/O Module Setup" you may enter some submenus to set parameters for the SIO module and/or DIO module(s) of the TFID/ MLT/ CAT 200 analyzer / platform:

- Select the line you want with the ↑ -key or the ↓ -key.
- Press the ↵ -key or the → -key in the line "System SIO module..." or in the line "System DIO module(s)..." to open the corresponding submenu.

5.2 System & Network I/O Module Controls

5.2.1 System SIO Module

Main Menu — Analyzer and I/O, expert controls & setup

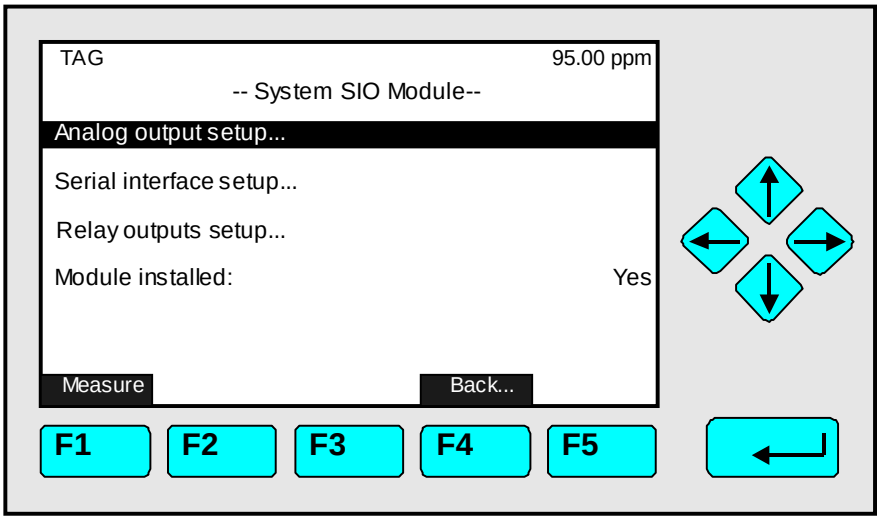
↓

System & Network I/O Module Controls (or ... I/O Module Setup)

↓

System SIO module

↓



Use the menu "System SIO Module" to enter submenus to control and set up several output configurations of the programmable system SIO module.
General Configuration of a SIO board (for the whole specification see its own manual):

- Analog outputs: minimum 2, maximum 8
- Serial interface (RS 232 or RS 485) to connect the analyzer to an external computer
- Three relay outputs

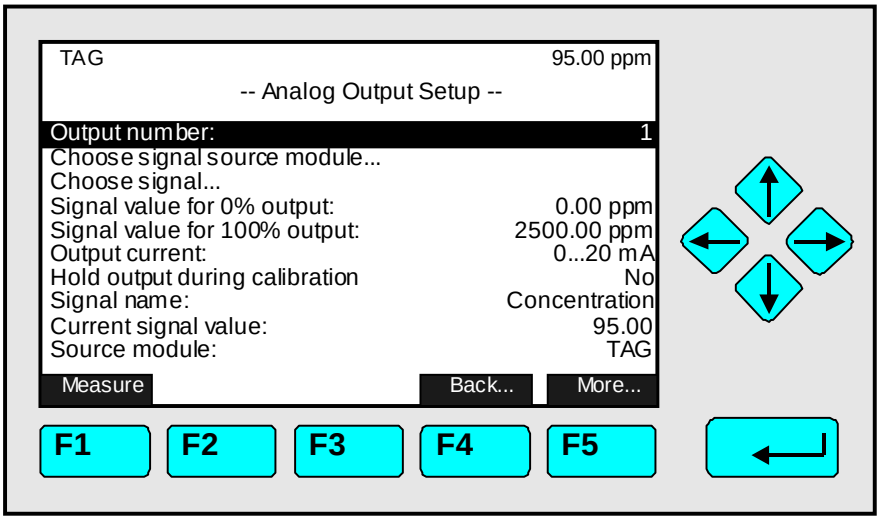
If there is a SIO module installed in the **platform** or in the **TFID/ MLT/ CAT 200 analyzer**, select **"Yes"** in the line "Module installed", otherwise **"No"**.

Set up parameters:

- Select the line of variables or any menu line using the ↓ -key or the ↑ -key.
- Select the variable or open the submenu pressing the ↵ -key or the → -key.
- Adjust the parameter with the ↑ -key or the ↓ -key.
- Confirm the new value with the ↵ -key or
  cancel and return to the previous value pressing F2.

Analog Output Setup:

Press the ↵ -key or the → -key in the line "Analog Output Setup..." to open the corresponding submenu:



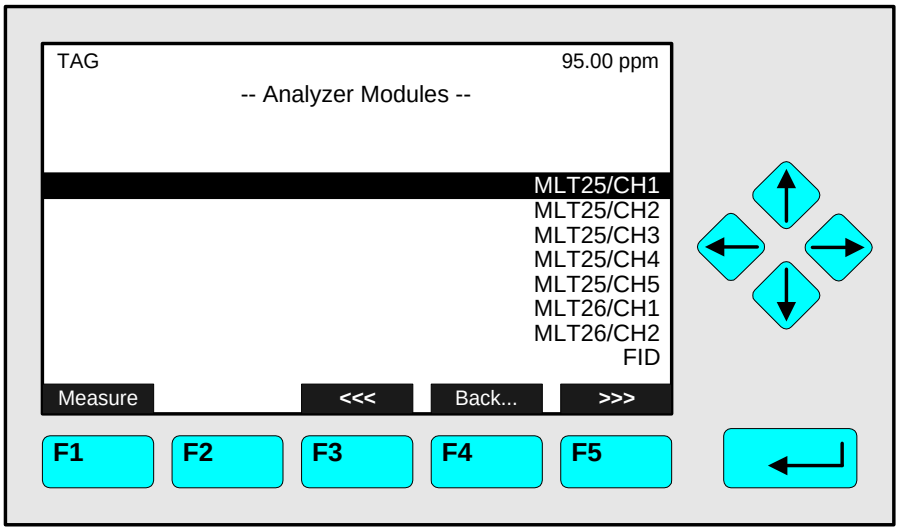
Analog output configuration:

1) Select the analog output number:

- You may set all parameters in the menu "Analog Output Setup" separately for each of the available analog outputs. The number of outputs depends on the hardware configuration of the SIO module (minimum: 2, maximum: 8).
- Press the ↵ -key or the → -key to select the output number and adjust the value you want with the ↑ -key or the ↓ -key.
- Confirm pressing the ↵ -key.

2) Choose the analyzer module:

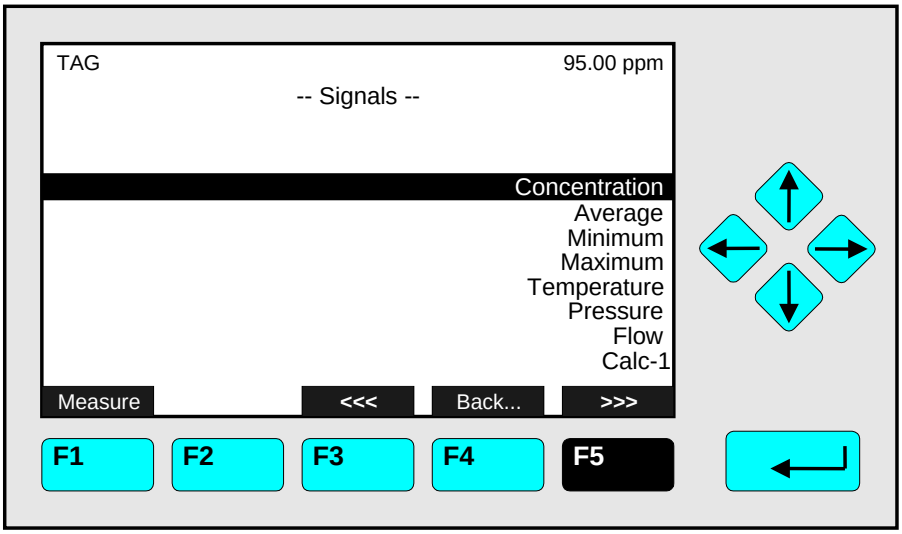
- Highlight the line "Choose signal source module..." using the ↓ -key
- Open the submenu "Analyzer Modules" with the ↵ -key or the → -key. The tags of all analyzer modules connected to the platform or the TFID/MLT analyzer will appear:



- Highlight the line you want with the ↑ -key or the ↓ -key.
- Select the tag of the channel with the ↵ -key or the → -key:
  The display will return to the menu "Analog Outputs" automatically.
  The tag of the channel selected will appear in the line "Source module".

3) Select any signal:

- Switch to the line "Choose signal" with the ↓ -key.
- Press the ↵ -key or the → -key to change to the submenu "Signals":



Available signals on additional menu pages:

- Calc-2 (Calculator-2)
- Calc-3 (Calculator-3)
- Calc-4 (Calculator-4)
- Failures Calc
- Check Requests
- Function Checks
- Range ID
- Operation
- Any Alarms
- Span Conc.
- Gas flow
- Heater Fail
- Raw Sign.
- Raw Sign. 1, …,8

- Go to the line you want using the ↓ -key or the ↑ -key. Pressing the F5- key (>>>) will open additional menu pages containing more signals. Pressing the F4 -key will return to the menu "Analog Outputs".

- Select the signal pressing the ↵ -key or the → -key:
  The display will return to the menu "Analog Output Setup" automatically.
  The signal selected will appear in the line "Signal name".

4) Selecting output signal values:

- You may set the signal value for the 0 % output and the 100 % output in the lines "Signal value for 0 % output" or "Signal value for 100 % output". So you have the possibility to zoom out a certain part of the whole range.

Example:	Range from 0 to 1000 ppm		
	0 % value shall be 400 ppm, 100 % value shall be 700 ppm		
	Standard analog output is:	0 V = 0 ppm	10 V = 1000 ppm
	Modified output signal is:	0 V = 400 ppm	10 V = 700 ppm

- Select the line "Signal value for 0 % output" or "Signal value for 100 % output" with the ↓ -key. Select the value with the ↵ or → -key. Select any digit with the ← or → -key and adjust a new value using the ↑ or ↓ -key. Confirm by ↵ -key

- **Note if "Concentration" is selected as signal :**
  Changing the signal for 0 % or 100 % will result in overriding the adjustment and reset to the standard values of the range! To change the output signal values permanently you have to change the ranges in the menu "Begin and End of Ranges" (see 5.1.3 page 5-27) or selected with twice F5 (More…) the submenu "Special Scaling for Concentration Signal". Adjustment of signals is possible ONLY if "No" is selected!

- **Caution:**
  The signal range at the analog output should not be less than the smallest range otherwise the noise level at the analog output may increase!

5) Assigning the output current range:

- Press the ↵ or → -key in the line "Output current" to select the range. Select the value with the ↑ or ↓ -key and confirm with ↵.
- Options: 0...20 mA (and automatically 0...10 V) or 4...20 mA (2...10 V).

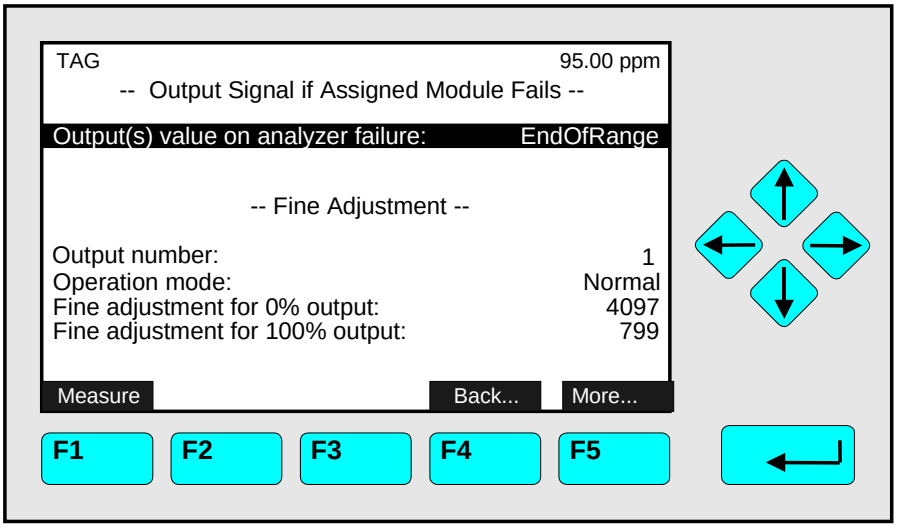
6) Analog output during calibration:

- In the line "Hold output during calibration?" you may determine the signal drift of the analog output and of the limits during calibration:
  - **Yes:** During the whole calibration the analog output signal and the status of the limits are fixed to the last value before calibration.
  - **No:** The analog output signal and the status of the limits are following the measurement signal during the whole calibration procedure.

- **Note:**
  - The adjustments "Yes/No" are valid for all kinds of calibrations of a platform or TFID/MLT analyzer SIO: manual, time controlled, AK controlled, a system calibration.
  - The signal drift and status of limits of a local SIO in a TFID/MLT analyzer module may be assigned in the menu "Calibration Procedure Setup" in the line "Analog output during calibration: ... Holding/Tracking" (see 5.1.1 page 5-11/12).

The last three lines of variables in the menu "Analog Output Setup" show some analog output values only! They can't be changed.

F5 (More…) Output signal if assigned module fails / Fine adjustment



Note:

If an **analyzer module** (and channel) **fails** the appropriate **analog output** value can be defined to show one of the following **signals**:

- End of range
- Begin of range
- Actual
- End of range + 10 %
- Begin of range - 10 %

- The submenu "Fine Adjustment" allows to fine adjust the analog outputs:
- The line "Output number" shows the output number selected in the menu "Analog Outputs". You may select another output between number 1and 8:
  - Press the ↵ -key or the → -key to select the output number and adjust the value.

Fine adjustment setup of the analog output:

Note: This function is used to compensate an offset possibly existing at the analog output caused by hardware tolerances. Selecting the modes "Adjust 0V" or "Adjust 10 V" will simulate a measurement signal of 0% respectively 100%. Meanwhile the analog output may be adjusted to give 0 V respectively 10 V to have full correlation between analog signal and measurement signal as it is shown on the display.

- Press the ↵ -key or the → -key in the line "Operation mode" to select the parameter and choose one of the following parameters using the ↑ -key or the ↓ -key:
  - **Normal:** The measurement signal is used to drive the analog output.
  - **Adjust 0 V:** Adjust 0 V output at 0 % for correlation between display and analog output.
  - **Adjust 10 V:** Adjust 10 V output at 100 % measurement signal for correlation between display and analog output.
- Confirm the parameter using the ↵ -key and enter the next line with the ↑ or ↓ -key.
- Press the ↵ -key or the → -key in the line "Fine adjustment for 0 % output" or "Fine adjustment for 100 % output" to select the corresponding value.
- Adjust the value you want with the ↑ -key or the ↓ -key and confirm it with the ↵ -key. Options: 3500 - 4800 for 0 % and 750 - 900 for 100 %.

F5 -key (More...) Special Scaling for Concentration Signal":

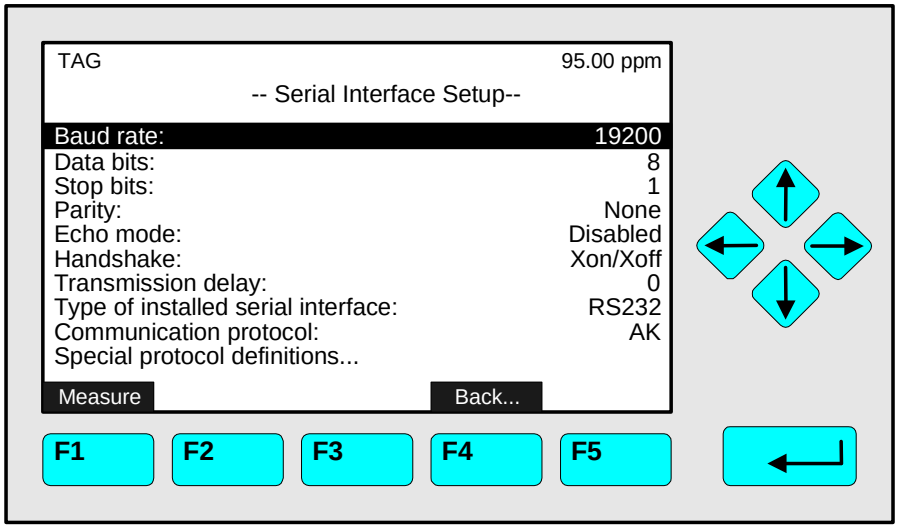
- The submenu "Special Scaling for Concentration Signal" allows to scale the analog output signal as the range limits with “Yes”. Free setting is possible with “No”.

F5 -key (More...) Analog Output Updates per Second":

- This submenu indicates how often the analog outputs are updated.

Serial Interface Setup:

Press the ↵ -key or the → -key in the line "Serial Interface Setup..." of the menu "System SIO Module" to enter the corresponding submenu:



In the submenu "Serial Interface Setup" you may set the data transfer parameters for serial communication between the TFID/MLT analyzer / platform and external computer. The setups in this menu depend on the configuration of the analyzer / platform and the corresponding computer. The serial interface specification is described in another manual.

Parameter set up or entering submenus:

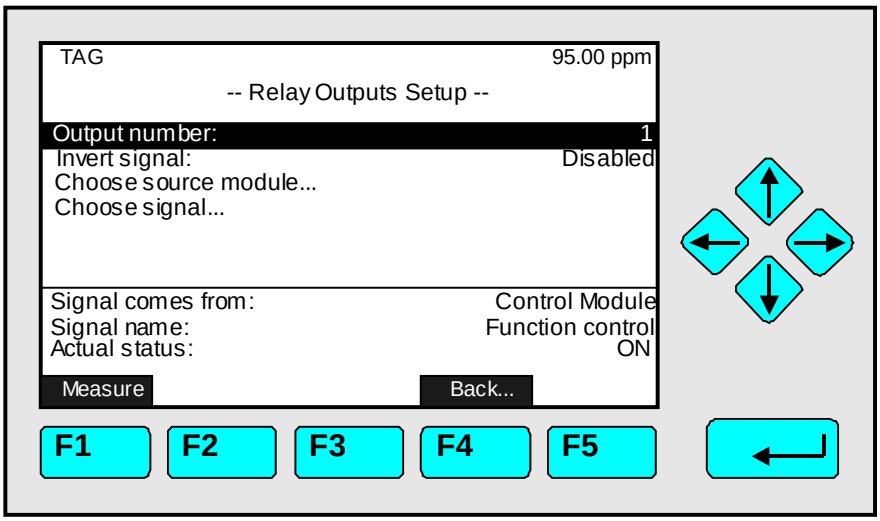
- Select the line of variables or menu line using the ↓ -key or the ↑ -key.
- Select the variable or enter the submenu using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Options:

Baudrate:	300	1200	2400	4800	9600	19200
Data bits:	7	8				
Stop bits:	1	2				
Parity:	None	Even	Odd			
Echo mode:	Enabled	Disabled				
Handshake:	None	Xon/Xoff				
Transmission delay:	0 ... 100					
Type of installed serial interface:	RS 232	RS 485/2w	RS 485/4w	RS 485/4w-Bus	None	

Relay Outputs Setup:

Press the ↵ -key or the → -key in the line "Relay Outputs Setup..." of the menu "System SIO Module" to enter the corresponding submenu:



There are three relays on any SIO board. The relay contact status is NO (normally open) by factory setting. A jumper gives the option to set the relay contact status as NC (normally closed). For information about the whole specification of the SIO board refer to another manual.
In the menu "Relay Outputs Setup" you may define the configuration of the three relay outputs of the SIO!

Configuration setup:

1) Select the output number:

- Press the ↵ -key or the → -key in the line "Output number" and select the output number one, two or three using the ↑ -key or the ↓ -key.
- Enter the number selected pressing the ↵ -key.

2) Invert signal:

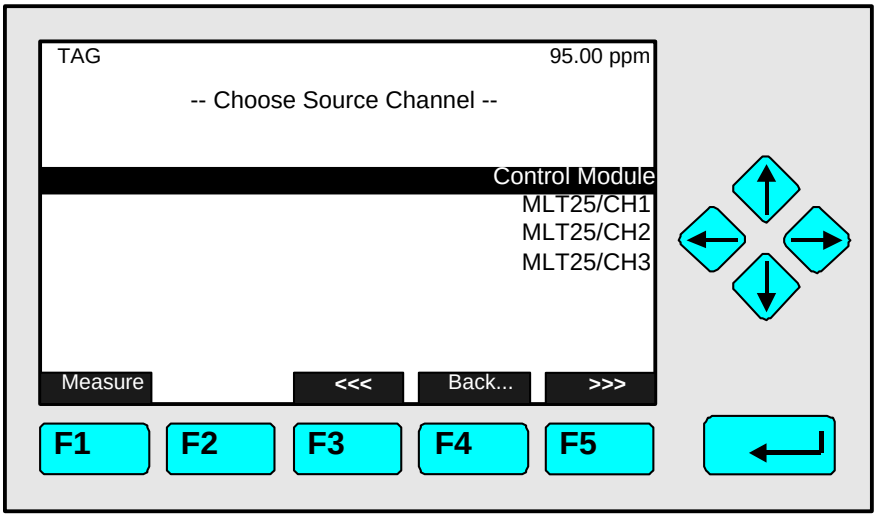
- Select the variables line to invert the measurement signal at the relay output. This may be necessary to combine a failure with an alarm control.
  - Press the ↵ -key or the → -key in the line "Invert signal" to select the parameter and choose "Enabled" or "Disabled" using the ↑ -key or the ↓ -key.
  - Confirm the parameter selected with the ↵ -key or the → -key.

The last three lines of variables in the menu "Relay Outputs Setup" show the actual configuration for the relay output selected:

- "Signal comes from:" shows the source module selected for the current relay output.
- "Signal name:" shows the signal driving the current relay output.
- "Actual status:" shows the status of the current relay ("On" or "Off").

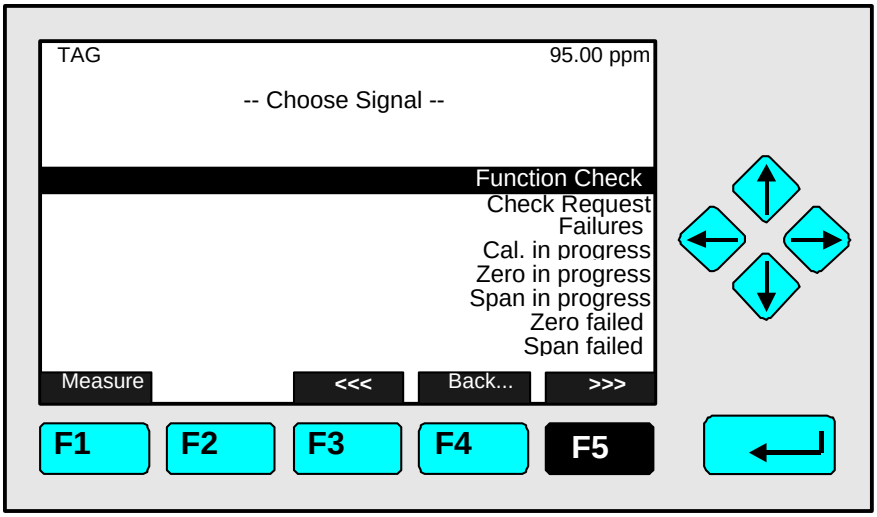
3) Choose the source module:

- Change to the line "Choose source module...".using the ↓ -key
- Enter the submenu " Choose Source Module" pressing the ↵ -key or the → -key. All analyzer modules connected to the platform / TFID/MLT analyzer and the control module are available.
- Highlight the line you want using the ↑ -key or the ↓ -key. If there are more than eight source modules available, press F5 to open the next menu page.
- Select the module tag pressing the ↵ -key or the → -key: The display will return to the menu "Relay Outputs" automatically. The tag of the module selected will appear in the line "Signal comes from".



4) Select any signal:

- Change to the line "Choose signal..." with the ↓ -key.
- Press the ↵ -key or the → -key to change to the submenu "Signals":



- Highlight the signal you want to choose using the ↓ -key or the ↑ -key, press ↵ -key or the → -key to confirm the selection.

- Pressing F5 (>>>) opens additional menu pages containing more available signals:
  - Range low
  - Range high
  - Flow Low, Flow High
  - Conc. Low-Low
  - Conc. Low
  - Conc. High
  - Conc. High-High
  - Sys:Valve-1…, 32
  - Ext.Switch-1…, 8
  - System pump 1;2
  - PLC-Results 1…, 15

If you selected an **TFID analyzer (module) channel** the menu pages 2 to 10 will show the following **signals:**

- Range 1, ..., 4
- Sample gas
- Zero gas
- Span gas
- Span gas 1, ..., -4
- Purge gas
- Test gas
- Linearizer gas
- Average-Alarm 1, ..., 4
- Flow-Alarm 3, 4
- Temperature-Alarm 1, ..., 4;
- Calculator1-Alarm 1, ..., 4; Calculator2-Alarm 1, ..., 4; Calculator3-Alarm 1, ..., 4; Calculator4-Alarm 1, ..., 4
- Pressure-Alarm 1, ..., 4
- PLC-Output 1, ..., 20

If you selected an **other analyzer module channel (e.g. CLD, MLT, CAT 200)** the menu pages show the corresponding signals. Refer to the manuals of these analyzer modules to get a list of specific signals.

Note:

All signals of the control module and the analyzer modules connected to the platform or TFID/ MLT/ CAT 200 analyzer (e.g. CLD, TFID, MLT AM) are available in the menu "Signals".

- Select the signal using the ↵ -key or the → -key:
  The display will return to the menu "Relay Outputs Setup" automatically.
  The signal selected will appear in the line "Signal name".

Main Menu — Analyzer and I/O, expert controls & setup

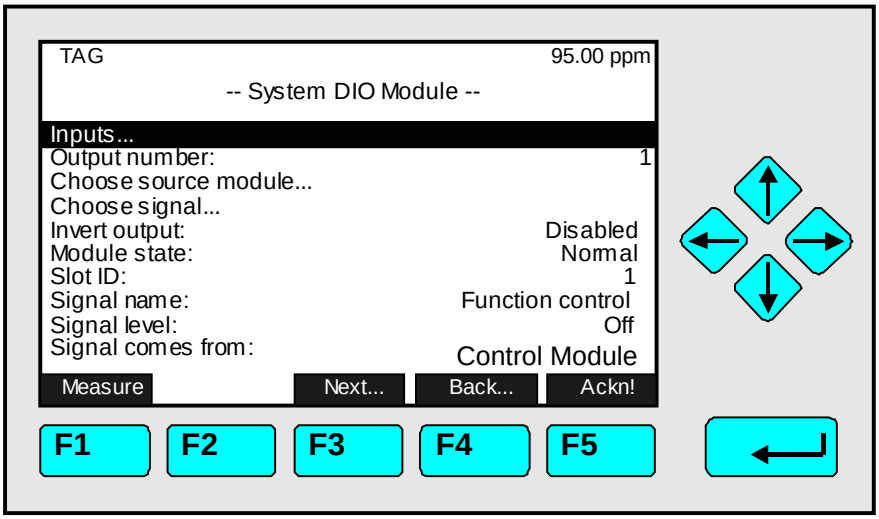
↓

System & network I/O module controls (or ... I/O module setup)

↓

System DIO module(s)

↓



The "System DIO Module(s)" allows to configure Digital Inputs and Outputs individually. The tag of the DIO Module which is actually to be configured is displayed in the menu line "Slot ID". **Analyzers (MLT, CAT 200 or TFID) or the platform may be equipped with more than one DIO module and F3 is used to browse through all these modules.**
Any DIO module contains 8 digital inputs and 24 digital outputs. The 24 digital outputs consist of 3 units with 8 outputs each. If there is a short circuit or an overload the entire unit it will be switched off and saved against destruction. After the fault has been removed press F5 (Ackn!) and the unit is available again.
For information about the whole specification of the DIO board refer to another manual.

Set up parameters:

- Select the line of variables or menu line using the ↓ -key or the ↑ -key.
- Select the variable or enter the submenu using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Line of variables "Invert output":

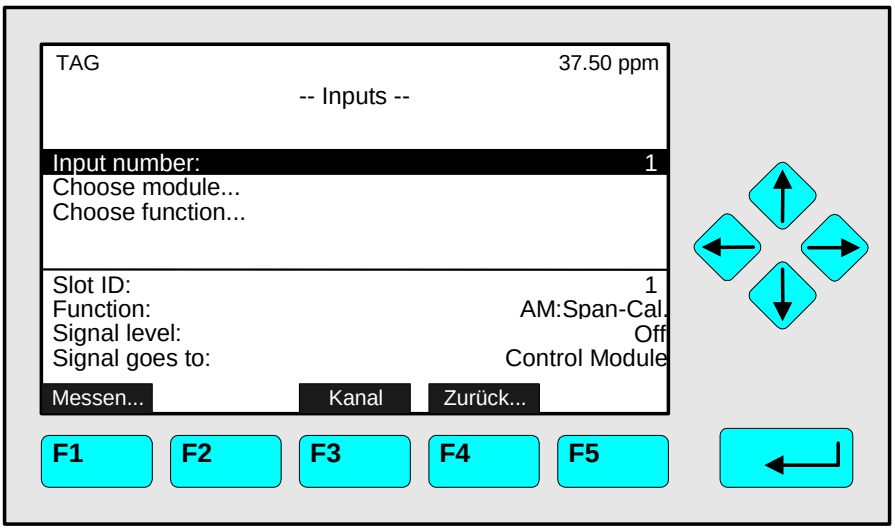
Select "Enabled" in the line "Invert output", if you want to invert the measurement signal at the actual digital output, otherwise select "Disabled". The output inversion may be necessary if you want to combine a failure with an alarm control.

The last five lines of variables in the menu "System DIO Module(s)" show some adjustments of the selected DIO output only! They cannot be adjust here:

- "Module status:" shows the status of the current DIO board.
- "Slot ID:" gives the tag number of the DIO board selected.
- "Signal name:" shows the signal driving the current DIO output.
- "Signal level:" gives the status of the signal selected.
- "Signal comes from:" shows the source module selected for the current DIO output.

Configuring 8 DIO module inputs:

Press the ↵ -key or the → -key in the line "Inputs..." to open the corresponding submenu:



The menu "Inputs" allows to configure the **8 DIO** module **inputs**!

DIO input configuration setup:

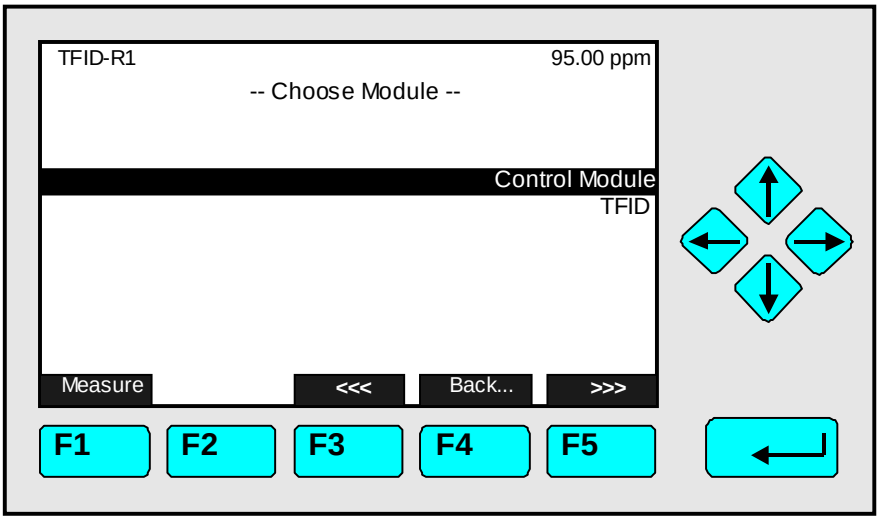
1) Select the input number:

- Press the ↵ -key or the → -key in the line "Input number" and select an input number (1, ... , 8) with the ↑ -key or the ↓ -key.
- Confirm the number selected using the ↵ -key.

2) Choose the module:

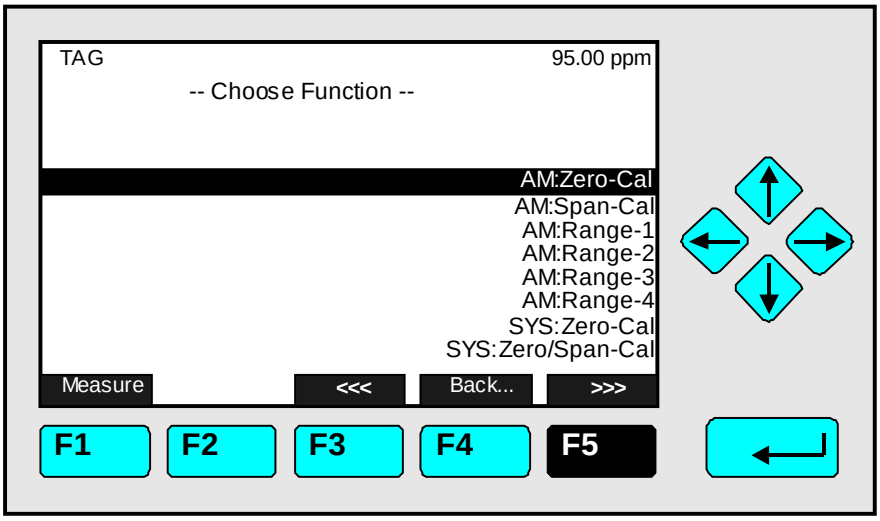
- Highlight the line "Choose module..." using the ↓ -key.
- Enter the submenu " Choose Module " pressing the ↵ -key or the → -key. (illustration see next page)
  All modules connected to the platform / TFID/MLT analyzer and the control module will be available as target.
- Highlight the line you want using the ↑ -key or the ↓ -key. If more than eight source modules are available press F5 to open the next menu page.

- Select the tag of the module using the ↵ -key or the → -key:
  The display will return to the menu " Inputs" automatically.
  The tag of the module selected will appear in the line "Signal goes to".



3) Choose any function:

- Highlight the line "Choose function..." using the ↓ -key.
- Press the ↵ -key or the → -key to open the submenu "Choose Function":



- Highlight the line you want using the ↓ -key or the ↑ -key. Press F5 to open additional menu pages containing more available functions:
  - SYS: Program-Cal
  - SYS: Cancel-Cal
  - SYS: CAL-Test-Mode
  - SYS: AM-Zero-Gas
  - SYS: AM-Span-Gas1, 2, 3, 4
  - External function check
  - AM: Hold Outputs
  - AM-closed-valves
  - External failure
  - External check request
  - All zero gas
  - All span gas
  - All sample gas
  - All standby
  - All zero + span gas
  - All AK-Error#8
  - and more functions, depending on the selected analyzer module.

- Select the function with the ↵ -key or the → -key:
  The display will return to the menu "Inputs" automatically.
  The function selected will appear in the line "Function name".

The last four lines of variables in the menu " Inputs" only show some adjustments of the selected DIO input! They are not selectable:

- "Slot ID:" shows the tag of the DIO board selected. (TFID offers the option to have one DIO only. Slot ID is always 1 and F3 is not activated!).
- "Function name:" shows the signal driving the current DIO input.
- "Signal level:" shows the status of the signal selected.
- "Signal goes to:" displays the target module selected for the current DIO input.

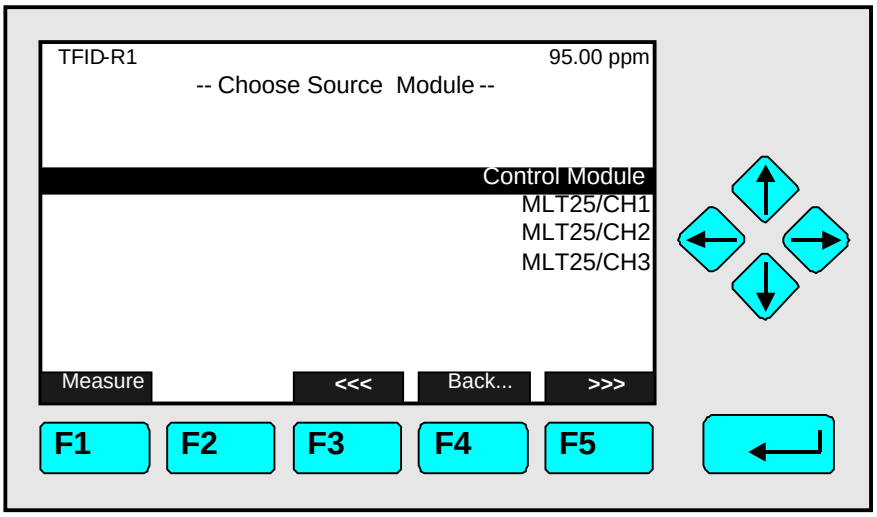
Configuring the 24 DIO module outputs:

1) Select the output number:

- Press the ↵ -key or the → -key in the line "Output number" of the menu "System DIO Module" and select an output number (1, ... , 24) using the ↑ -key or the ↓ -key.
- Confirm the number selected pressing the ↵ -key.

2) Choose the source module:

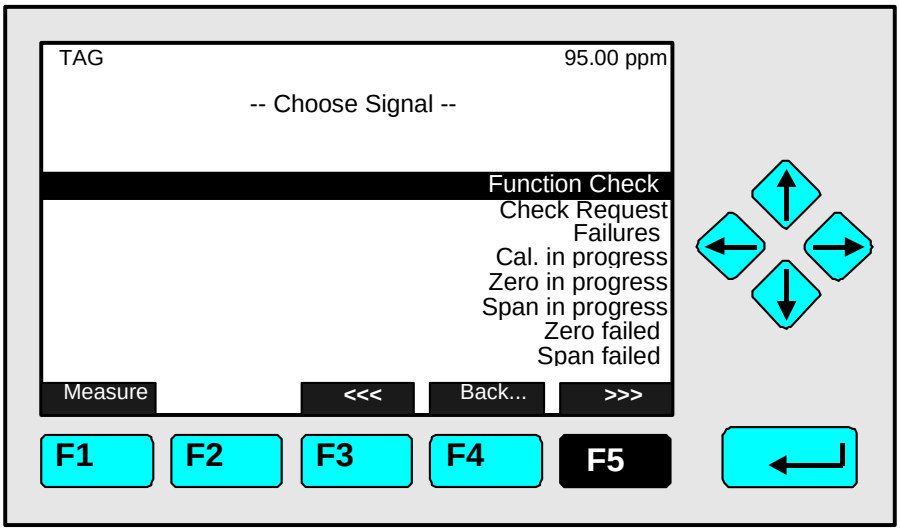
- Change pressing the ↓ -key to the line "Choose source module...".
- Enter the submenu "Choose Source Module" using the ↵ -key or the → -key.
  All modules connected the platform / the TFID analyzer and the control module will be listed:



- Highlight the line you want using the ↑ -key or the ↓ -key. If more than eight source modules are available press F5 to open the next menu page.
- Select the tag of the module with the ↵ -key or the → -key:
  The display will return to the menu "System DIO Module" automatically.
  The tag of the module selected will appear in the line "Signal comes from".

3) Select any signal:

- Select the line "Choose signal..." with the ↓ -key.
- Press the ↵ -key or the → -key to enter the submenu "Choose Signal":



- Highlight the line you want using the ↓ -key or the ↑ -key. Press F5 to open additional menu pages containing more available signals:
  - Range Low
  - Range High
  - Flow Low
  - Flow High
  - Conc. Low-Low
  - Conc. Low
  - Conc. High
  - Conc. High-High
  - SYS:Valve-1, -2, ... , -32
  - Ext.Switch-1, ..., -8
  - System Pump 1-2
  - PLC-Result 1, …, 15

  If you had selected an **TFID/MLT analyzer module channel** you will find the following **signals** on the other menu pages**:**
  - Range overflow, Range underflow
  - Flow low, Flow high
  - Concentration-Alarm1, ..., 4
  - Range 1, ..., 4
  - Sample gas
  - Zero gas
  - Span gas
  - Span gas-1, ..., -4
  - Purge gas
  - Test gas
  - Linearizer gas
  - Average-Alarm1, ..., 4

- Flow-Alarm3, 4
- Temperature-Alarm1, ..., 4
- Calculator1-Alarm1, ..., 4; Calculator2-Alarm1, ..., 4; Calculator3-Alarm1, ..., 4; Calculator4-Alarm1, ..., 4
- Pressure-Alarm1, ..., 4
- PLC-Output1, ..., 20

If you had selected an **other analyzer module channel (e.g. CLD, MLT),** the corresponding signals are listed. Refer to the manuals of these analyzer modules to get a list of specific signals.

Note:

All signals of the control module and of analyzer modules connected to the platform / **TFID/MLT** analyzer (e.g. CLD, FID, TFID or MLT) are available in the menu "Signals".

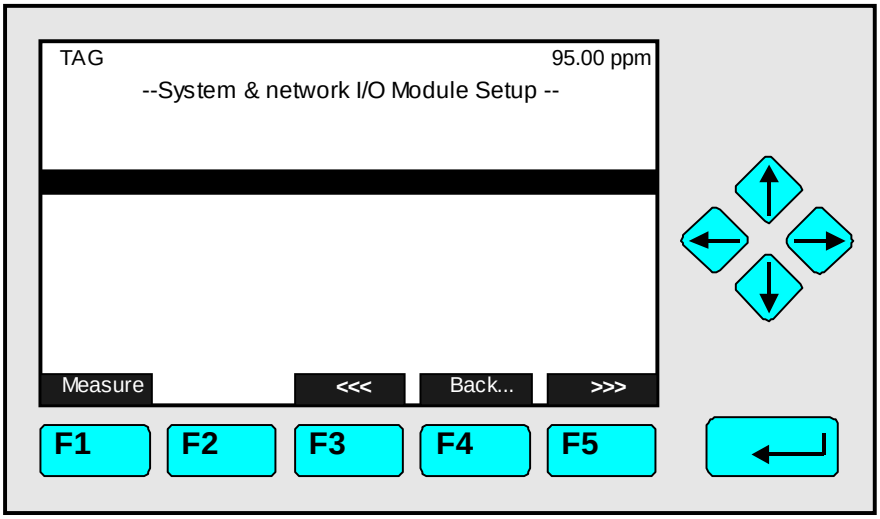
- Select the signal with the ↵ -key or the → -key:
  The display will return to the menu "System DIO Module" automatically.
  The signal selected will appear in the line "Signal name".

Main Menu — Analyzer and I/O expert control & setup

↓

System & network I/O module controls (or ... I/O module setup)

↓



If the analyzer / analyzer module is equipped with one or more network options, you will find them listed in the menu "System & Network I/O Module Controls" or "System & Network I/O Module Setup". Depending on the analyzer any of the following types of **network I/O modules** may be available:

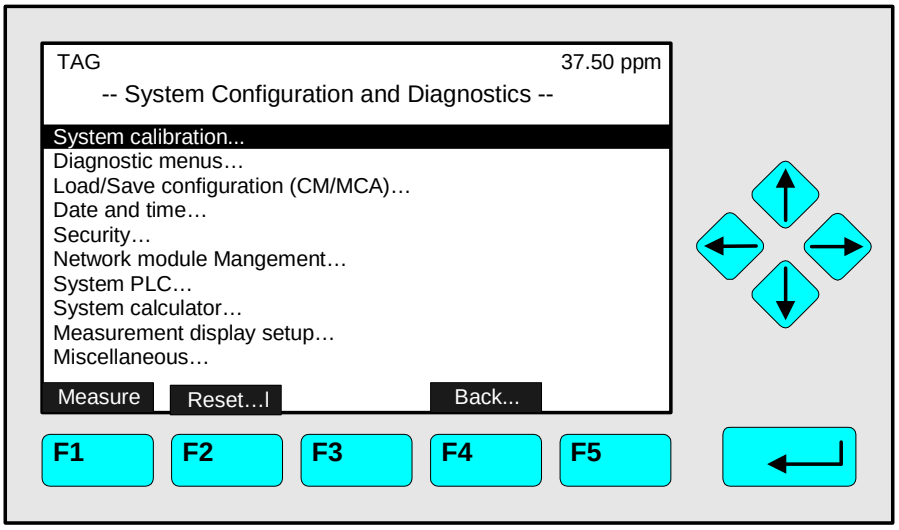
1) Analog Output with 3 Alarms I/O Module
2) **Auto Cal**ibration I/O Module
3) **Sys**tem Auto **Cal**ibration I/O Module
4) **WNOx** Analyzer Module (see separate instruction and software manual)

Notes:

- If one of these network modules is available you will find its corresponding tag listed in this menu. If more than eight such modules are available you may open additional menu pages pressing the F5 -key.
- Press the ↵ -key or the → -key in the line where the tag of the module is displayed to open the setup submenu of the corresponding I/O board.
- For **further Information** please contact your customer service or refer to the **manual** of the **corresponding I/O board**!
- For **further Information about WCLD and WNOx** please contact your customer service or refer to the **manual** of the **corresponding Analyzer Module**!

6 System Configuration and Diagnostics

Pressing the ↵ -key or the → -key in the line **"System configuration and diagnostics..."** of the "Main Menu" will open the following display:



This menu "System configuration" offers to open several submenus to set the platform / TFID/ MLT/ CAT 200 analyzer system parameters. Furthermore you may set or view the control module/ analyzer module (CM/AM) software and hardware configuration.
The following table will give a short overview about the contents of the menus and where to find their description in this manual:

Menu	Important Contents	Section
Diagnostic menus...	⇒ Error messages of the control module/ analyzer module (CM/AM) software	* 6.1
Load/Save configuration (CM/MCA)...	⇒ Sending or loading configuration data (CM/MCA) via the serial interface	* 6.2
Date and time	⇒ Date and time setup of the control module (platform, TFID/ MLT/ CAT 200 analyzer); = network time	* 6.3
Security codes...	⇒ Setting security codes for the different operating levels	* 6.4
Network module management...	⇒ Binding of AM's with being connected to the platform / TFID/ MLT/ CAT 200 analyzer	* 6.5
Measurement display setup	⇒ Configuration of the Measurement display on Control Module (CM) Level	* 6.6
Miscellaneous	⇒ System tag and system pump settings	* 6.7
System calibration...	⇒ Calibration of all analyzer modules in a common process	* See Supplement!
System PLC	⇒ Programmable Logic Control on Control Module Level (CM PLC)	* See Supplement
System Calculator	⇒ Calculator on Control Module Level (CM Calculator)	* See Supplement

Structure of chapter six:

The structure of chapter six is analogous to the structure of chapter five:
At the beginning of each section you will find the way to a defined submenu in the TFID/ MLT/ CAT 200 software: Starting from the line "System configuration and diagnostics..." in the "Main Menu the way through the menus is described giving the menu lines you have to enter sequentially to reach the submenu. At the end of this description you will find an illustration of the final submenu screen followed by set up instructions and explanations. Sometimes the illustration may be completed by sketches or additional menu pictures.

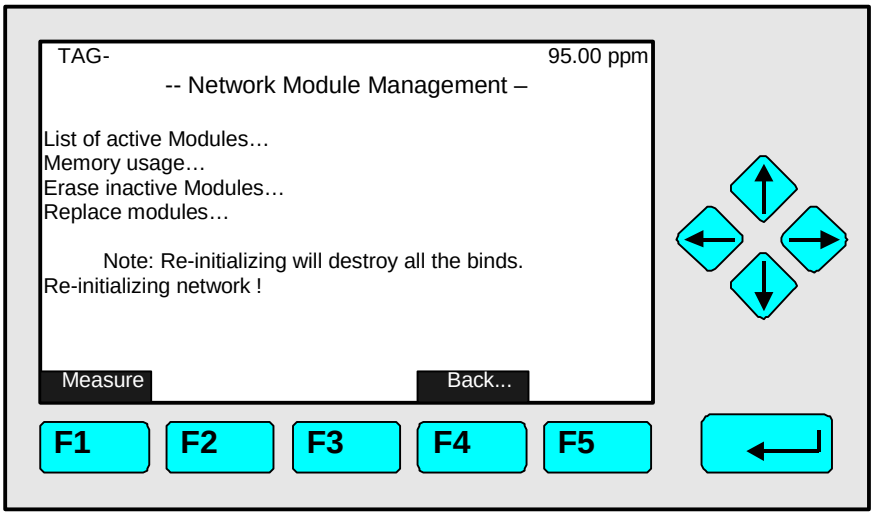
Example: Network Module Management with “List of active Modules”.

Main Menu — System Configuration and Diagnostics

↓

Network module management

↓



The menu "Network Module Management" is used for showing the active modules, the memory used, erasing of inactive modules etc.

The “List of active Modules” shows all the Analyzer Modules (AM’s) being connected to the platform / TFID/ MLT/ CAT 200 analyzer, e.g.:

1) MLT
2) FID
3) CLD
4) HFID (HFD)

Pressing F4 returns to the menu "System Configuration and diagnostics".

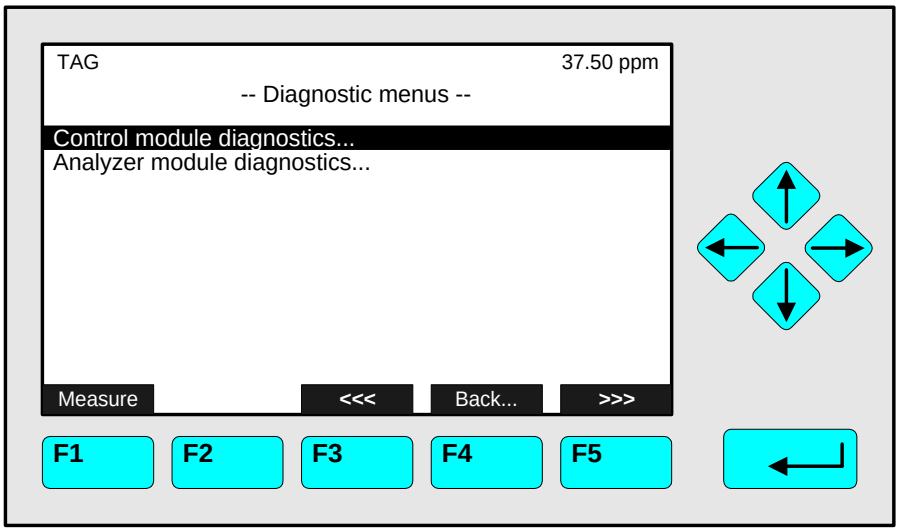
Further explanations and setup instructions follow!

Main Menu — System Configuration and Diagnostics

↓

Diagnostic menus

↓



From the menu "Diagnostic menus" you may open submenus showing software error messages of the control module or analyzer module. If necessary the error messages may be reset in these menus, too.

Entering the submenus:

- Scroll using the ↑ -key or the ↓ -key to select the menu line you want.
- Press the ↵ -key or the → -key in the line selected to open the corresponding submenu.

6.1 Diagnostic Menus

6.1.1 Control Module Diagnostics

Main Menu — System Configuration and Diagnostics

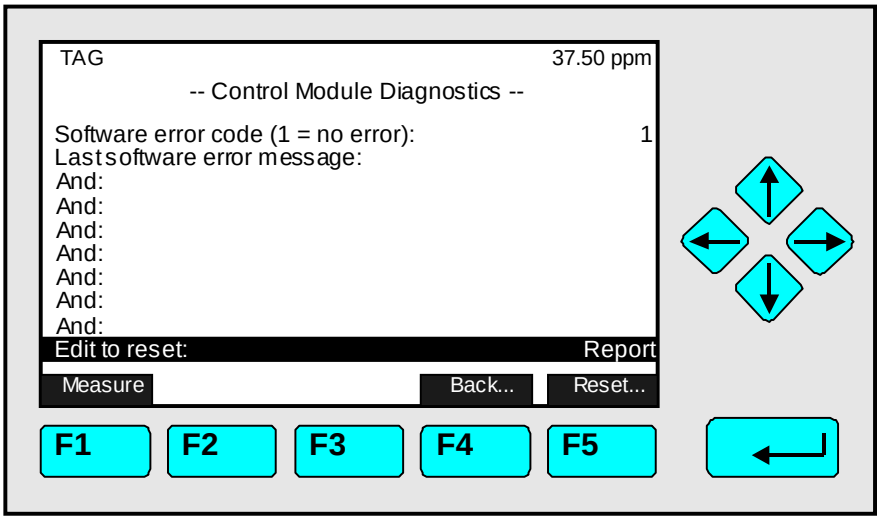
↓

Diagnostic menus

↓

Control module diagnostics

↓



The menu "Control Module Diagnostics" shows actual control module software error messages. If messages are listed the preferred procedure is as follows:

1) Write down the error messages.

2) Reset the messages:

- Press the ↵ -key or the → -key in the line "Edit to reset".
- Select "Reset" using the ↑ -key or the ↓ -key and confirm pressing the ↵ -key: The error messages will be cleared if the cause is not existing any more.
- If error messages are still shown:

3) System reset:

- Enter the menu "System Reset" pressing the F5 -key (Reset...).
- Press the ↵ -key or the → -key again in the line "System reset !" to reboot (this reboot corresponds to switching off and on the control module using the mains switch or to pull the plug off).

4) Check the error messages:

- Return to the menu "Control Module Diagnostics".
- If all error messages are cleared highlight the line "Edit to reset" and select "Report".
- If error messages are still shown contact your customer service center.

Main Menu — System configuration and

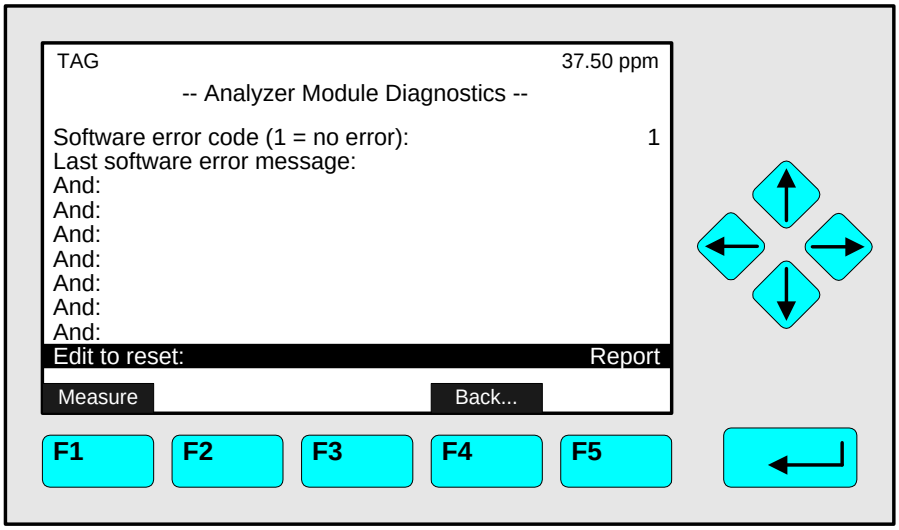
↓

Diagnostic menus

↓

Analyzer module diagnostics

↓



The menu " Analyzer Module Diagnostics " shows actual analyzer module software error messages. If messages are listed the preferred procedure is as follows:

1) Write down the error messages.

2) Reset the messages:

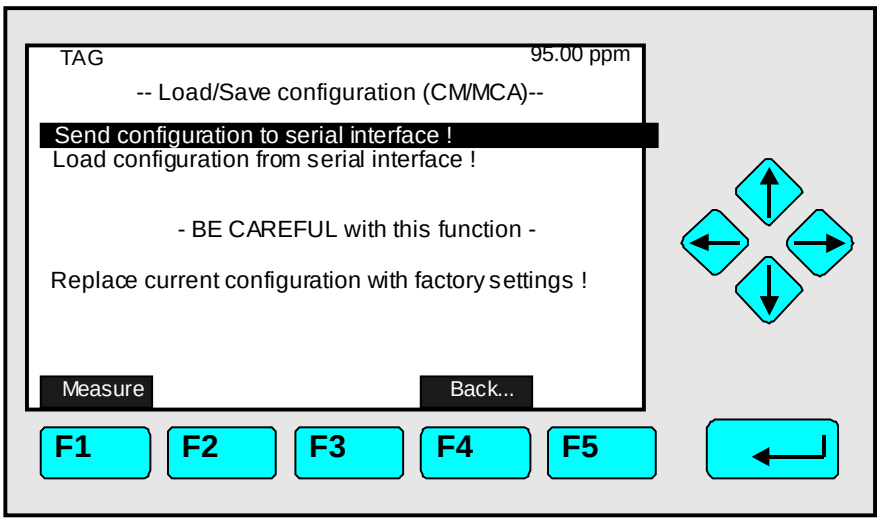
- Press the ↵ -key or the → -key in the line "Edit to reset".
- Select "Reset" using the ↑ -key or the ↓ -key and confirm pressing the ↵ -key:
  The error messages will be cleared if the cause is not existing any more. The line "Edit to reset" will show "Report" again.
- If error messages are still shown contact your customer center.

Main Menu — System configuration and diagnostics

↓

Load/Save configuration (CM/MCA)

↓



In the menu "Load/Save Configuration (CM/MCA)" you may start several functions to send or load configuration data of the TFID/ MLT/ CAT 200 analyzer/ analyzer module via the serial interface. Additional terminal software is required for data transfer (contact your customer center). These functions are only available if a SIO with serial interface is installed in the TFID/ MLT/ CAT 200 analyzer/ analyzer module.

Caution!
Loading data will overwrite all RAM data!

Executing functions:

- Select the function line you want using the ↓ -key or the ↑ -key.
- Press the ↵ -key or the → -key to start the function.
  If asked, confirm pressing F2 (Yes) or
  cancel and return to the menu page using the F4 -key (Back...) or the ← -key.

Function line "Send configuration to serial interface !":

You will send the RAM data via the serial interface of the MLT/ CAT 200/ TFID analyzer/ analyzer module to an EPROM programmer or to an external computer!

Function line "Load configuration from serial interface!":

You will load data from an external memory to the RAM of the MLT/ CAT 200/ TFID analyzer/ AM via the serial interface. This will overwrite the current RAM data!

Function line "Replace current configuration with factory settings!":

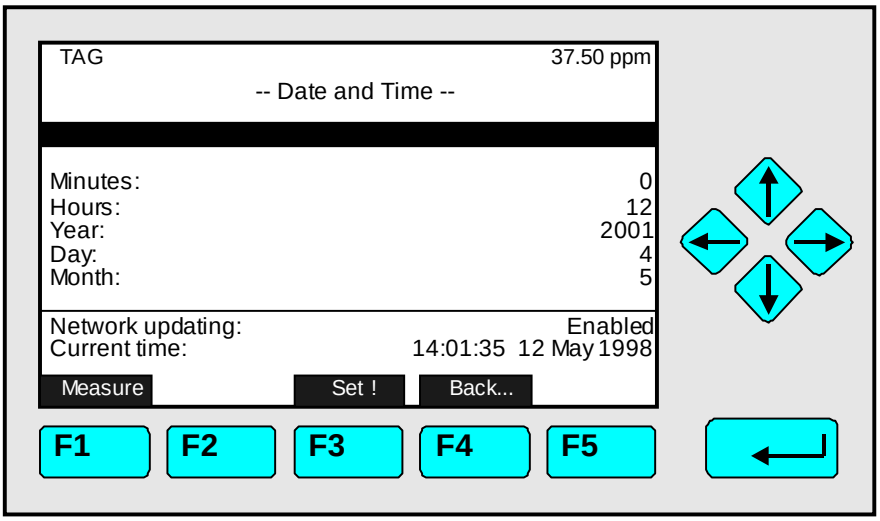
You will overwrite the RAM data loading factory settings from the Flash-EPROM!

Main Menu — System configuration and diagnostics

↓

Date and time

↓



Use the menu "Date and Time" to set date and time for the control module (platform or MLT/ CAT 200/ TFID analyzer).

Line of variables "Network updating":

All modules connected to the control module can use its date and time settings if this variable is set to "Enabled".

Set a new date or time:

1) Press the ↵ -key or the → -key in the line "Minutes", "Hours", "Year", "Day", or "Month" to select the variable.

2) Select any digit using the ← -key or the → -key and adjust a new value pressing the ↑ -key or the ↓ -key.
   - Options:
     - Minutes: 0 to 59
     - Hours: 0 to 23
     - Year: manufacturing year (e.g. 1998) up to 2035.
     - Day: 1 to 28/30/31 depending on the month selected
     - Month: 1 to 12

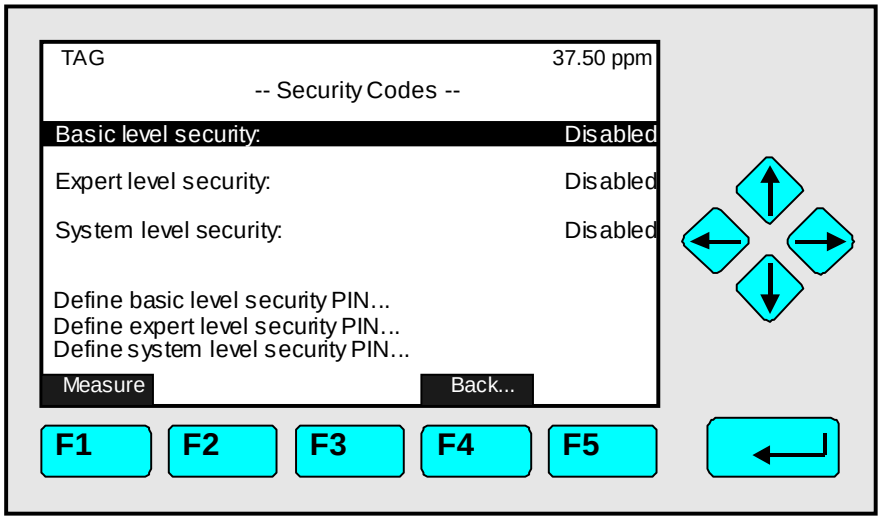
3) Press the F3 -key to set the new date or time. The new settings will appear in the line "Current time". This line will be refreshed every five second.

Main Menu — System configuration and diagnostics

↓

Security codes

↓



The menu "Security Setup" offers the opportunity to enable security codes the "Basic level" as well as for the "Expert level" and for the "System level". If enabled a security code is required to enter the levels.
Caution: If you enable a security code and forget it, you will not have any possibility to enter the locked level!

How to set and enable the security codes:

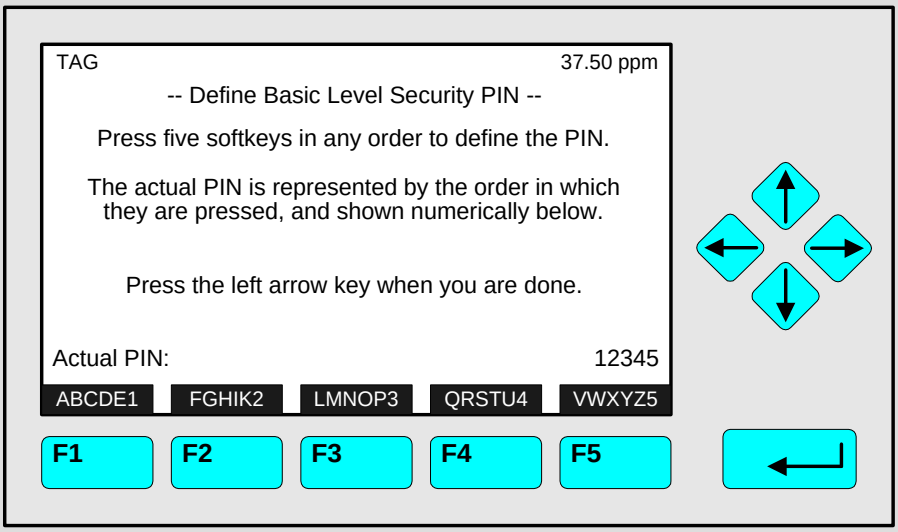
1) Setting the code for:

- *"Basic level"* (factory setting: 12345):
- *"Expert level"* (factory setting: 12345):
- *"System level"* (factory setting: 54321):

  - Highlight the line
    - "Define basic level security PIN..." or
    - "Define expert level security PIN..." or
    - "Define system level security PIN..."
  - using the ↑ -key or the ↓ -key and open the corresponding submenu pressing the ↵ -key or the → -key (see illustration on the next page; "basic level" as example).

- Enter the code you want using the function keys F1, ..., F5:
  - The sequence of the code numbers will appear in the line "Actual PIN".
- Note:
  - Only numbers are used for security codes, the letters shown above the function keys will not be used. Cipher "1" is attached to F1, "2" to F2 a.s.o.
  - Press the keys in desired order to combine a security code. Repeat these step until the correct PIN is shown.
  - Press the ← -key to return to the "Security Codes" menu.

- Example:
  - Desired security code: 53412
  - Press the sequence: F5 F3 F4 F1 F2



2) Enable the security code:

- Use the ↑ -key or the ↓ -key to highlight one of the following lines:
  - "Basic level security" to enable the code for the "Basic level".
  - "Expert level security" to enable the code for the "Expert level".
  - "System level security" to enable the code for the "System level".
- Press the ↵ -key or the → -key to select the parameter and adjust "Enabled" with the ↑ -key or the ↓ -key. Confirm it with the ↵ -key.

3) Enter a level locked by security code:

- Return to the "Main Menu", for instance pressing F4 (two times).
- Try to enter the locked level via the corresponding menu line with the ↵ -key or the → -key:
  - A menu page will appear prompting for security code. The line "Input" shows "Ready".
- Enter the security code pressing the correct sequence of function keys:
  - The symbol "∗" will appear in the line "Input" for each input.
  - If the code is wrong, "Ready" will appear again in this line, preventing you from entering the locked level.
  - If the code is correct, the screen will switch to the secured level after the last digit of the code has been entered.

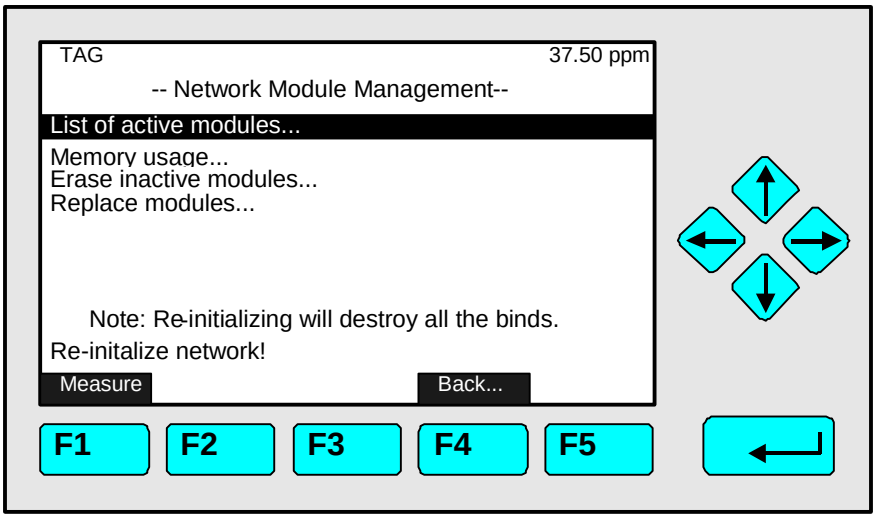
Note:
Once a secured level is opened by entering the security code it will stay unlocked. Locking it again needs to press F4 (Lock...) in the "Main Menu" each time you leave the level to be locked.

Main Menu — System configuration and diagnostics

↓

Network module management

↓



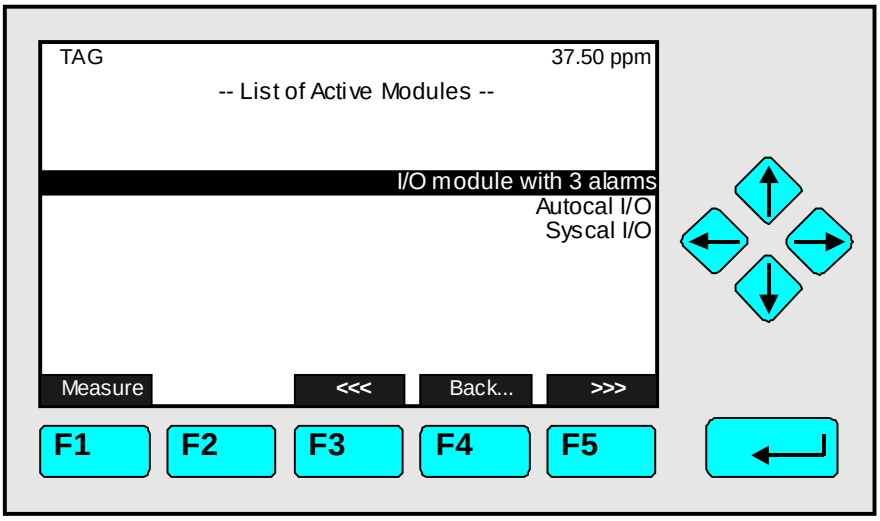
The menu "Network Module Management" is used for **listing active modules,** showing the **required memory, erasing (unbinding)** and **replacing** Analyzer Modules being connected to the platform, TFID, MLT, CAT 200 analyzer.

The following types of Analyzer Modules may be selected:

- MLT
- CLD, WCLD, WNX (WNOx)
- FID, FID2, PFD (TFID), HFD (HFID)

List of active modules:

This menu shows tags of all available modules/channels.



Memory usage:

This menu page shows all available modules, the memory they have allocated (in bytes) and remaining free memory in bytes. If more than 8 modules are available open additional menu pages pressing F5.

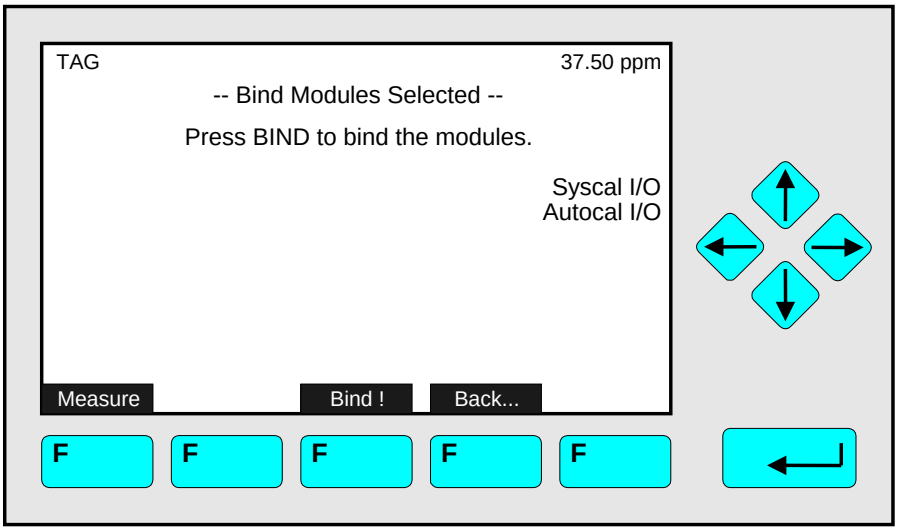
Line of variables “Automatic bind of I/O-modules”

If only one single analyzer module is connected to a platform or TFID/MLT analyzer this parameter allows to choose whether to automatically bind the I/O modules to this module or not:

- **Yes**: Bind automatically
- **No**: Bind manually

Bind modules:

- Enter the submenu pressing the ↵ -key or the → -key in the line "Bind modules..."
- Highlight the line containing the module's tag you want to bind using the ↑ -key or the ↓ -key.
  If there are more than eight I/O modules available, you may open the next menu page pressing the F5 -key (>>>).
- Press the ↵ -key or the → -key to select the tag of the I/O module:
  The display will return to the menu "Module binding" automatically.
- Repeat the steps 1 and 2 as often as necessary until all modules you want to bind are selected.
- Press the F4 -key (Bind!) open the submenu "Bind Modules Selected":



- Press the F3 -key (Bind!) to bind the selected modules:
  The control module will change to the initializing mode and the binding will be done automatically.

Erase inactive modules:

- Act with respect to the content of the above section, starting from the submenu "Erase inactive modules..."

Replace modules

- Act with respect to the content of section "Binding modules", starting from the submenu "Replace modules..."

Re-initializing network

- Highlight the line "Re-initialize network!" using the ↑ -key or the ↓ -key.
- Press the ↵ -key or the → -key to re-initialize the network.

CAUTION!

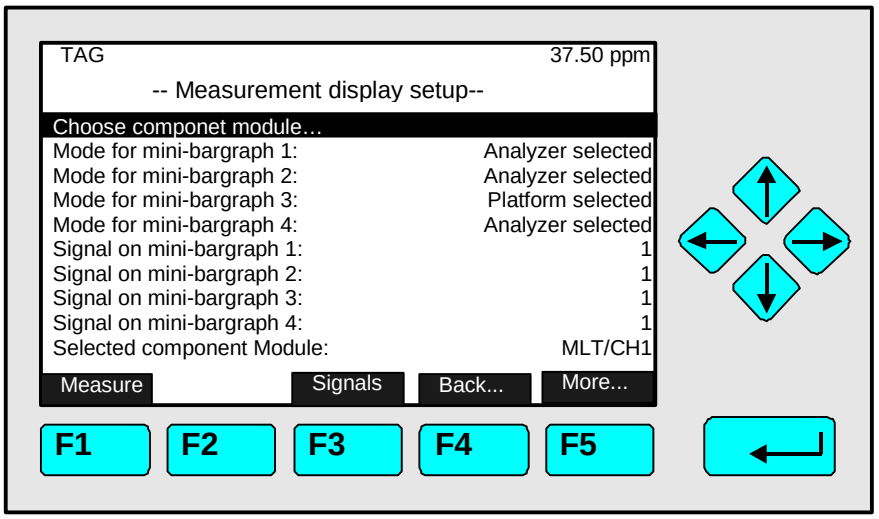
- Re-initializing network will delete all bindings between analyzer modules and I/O modules **and** will delete all SIO and DIO configurations!

Main Menu — System configuration and diagnostics

↓

Measurement display setup

↓



Measurement display setup:

- Choose Component Module:
  This menu allows to select between all modules or MLT/Cat 200 channels of a NGA 2000 system for witch then the mini-bargraph settings will change. Under “Selected component module” indicated which module / channel is selected for the editing.

- Mode for mini-bargraph1/2/3/4:
  allows to select between the MLT Analyzer or Analyzer module, the platform (control module) or to disable the mini-bargraph.

  Disabled: The mini-bargraph is switched off.

  Analyzer selected: The mini-bargraph receives the signal from the Analyzer/Analyzer module. These are set in the Analyzer settings. (See also S. 5.1.8 p. 5-51/52)

  Platform selected: The mini-bargraph receives the signal from the Platform (the Control module, or all other installed modules of the NGA 2000 system). To define the signals ***press F3*** (Signals) and please refer to the Supplement “Calculator on Control Module Level” (S. 2.2 p. 12/13) for further information.

- Signal for mini-bargraph1/2/3/4:
  determine witch from the max. 10 defined signals will shown on the mini-bargraph.

  Note: **These signals are ONLY active for the mini-bargraph modes were “Platform selected” is chosen!**

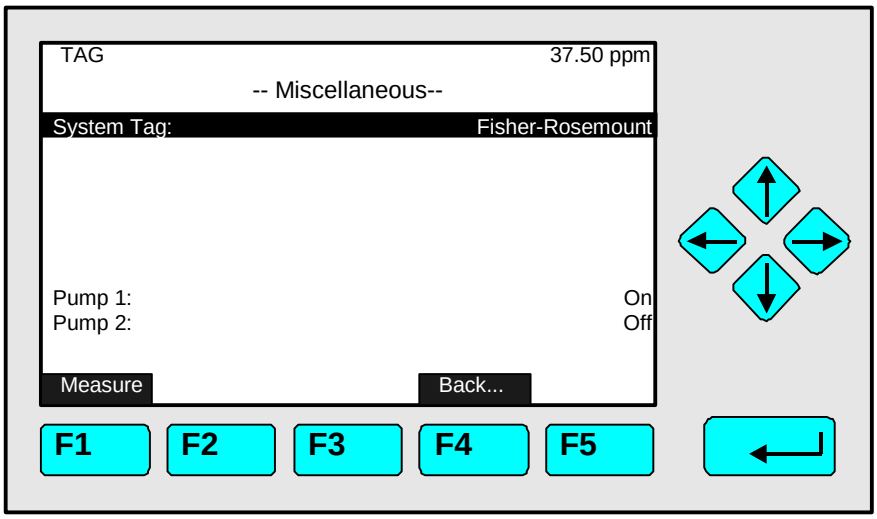
- Selected component module:
  Please see under “Choose Component Module” for information.

Main Menu — System configuration and diagnostics

↓

Miscellaneous

↓



Miscellaneous:

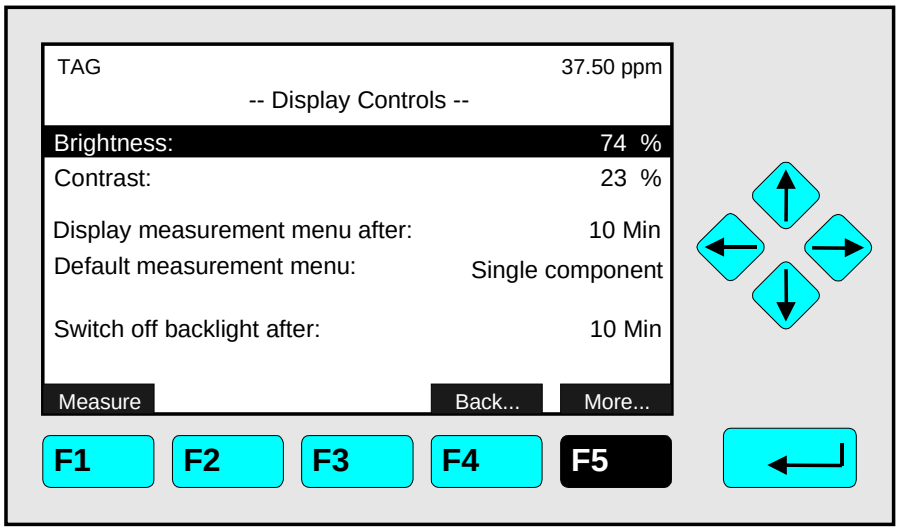
- System tag:
  with this it is possible to change the System tag.

- Pump 1/2:
  allows to switch system pump 1/2 On (Off) manually.

Note:
System pump needs to be selected in the SIO/DIO menu.
(5.2.1 System SIO Module – Configuration of relay outputs (p. 5-94 – 5-96)

Section 5.2.2 System DIO Module(s) – Input configuration (p. 5-100 - 5-102))

Main Menu — Display controls



In the menu "Display Controls" you may set several display parameters for the front panel:

Setting parameters:

- Select any line of variables using the ↓ -key or the ↑ -key.
- Select the variable using the ↵ -key or the → -key.
- Change the whole value using the ↑ -key or the ↓ -key
  or select single digits using the ← -key or the → -key and enter a new value using the ↑ -key or the ↓ -key.
- Confirm the new value using the ↵ -key or
  cancel and return to the previous value using the F2 -key.

Lines of variables "Brightness" and "Contrast":

Use these two lines to adjust LCD brightness and contrast for best reproduction. The optimum values depend on your position towards the screen and on the light of the environment.

- Options: 20 to 100 % for LCD brightness and 10 to 80 % for LCD contrast.
- Usually: 70 to 90 % (brightness) and 20 to 30 % (contrast).
- **Caution:** Be careful changing these values! Perhaps you can not read the display any longer if you use very extreme values!
  In case the display is not visible any more you have two possibilities to reset the display to factory settings:

  1) Return to the multi component display by pressing the F1 -key twice.
     In the multi component display press the F5 -key (LCDReset) to reset brightness and contrast to default values.

  or

  2) Restart your analyzer and press the F1 -key (LCDReset) while initialization is running.

Line of variables "Display measurement menu after:"

The value entered in this line defines the time to expire without operator input before the display automatically returns to the measurement display.
Options: 10 s, 30 s, 1 min, 5 min, 10 min, 30 min, Never.

Line of variables "Default measurement menu:"

Use this line to select the display the analyzer returns to when the time entered in line “Display measurement menu after:” has expired.
Options: Single Component (Display) or Multi Component (Display)

Line of variables "Switch off backlight after:"

The value entered in this line defines the time to expire without operator input before the backlight is switched off automatically. Using this function saves energy and expands the backlight’s lifetime.
Options: 10 s, 30 s, 1 min, 5 min, 10 min, 30 min, Never.

Calculator on Control Module Level (Platform or MLT, CAT 200 or TFID Analyzer)

1 System Calculator (on Control Module Level)

1.1 Principle of program set-up

As it would be a too high effort to realize a comfortable mathematical formula system we created a syntax which is easy to input and easy to realize.
As we assume that customers or service people have to set-up the program only one times for an installed system it should be acceptable to realize a form which is only done by inputting numbers.

Therefore we have mainly to differ between positive and negative numbers.
The program **operations** are assigned with **negative numbers**.
The **operands** which are used by these input operations are **positive numbers**. These positive numbers symbolize signals which are part of a signal pool.

Also we have to know that there are used **different classes of operands**. That means we have different classes of signal pools.

Those are:
- Live values (real measuring values)
- Constant values
- Memory values.

In each of these classes exists an own numbering and we determine by the operator itself which class of these operands is meant.

Remark:

Opposite to former versions allowing calculator function within ONE MLT analyzer module (AM) or for ONE MLT analyzer (or CAT 200 resp. TFID analyzer) ONLY now the system calculator is based on the Control Module level (CM).
This allows to include ALL analyzer modules resp. MLT channels of a NGA 2000 analyzer system into the calculation.
The results of the system calculator can be put onto the 2-8 analog outputs of the programmable Input/Output Module SIO.
The SIO as a Control Module I/O is then located in a platform or in a MLT, CAT 200 or TFID Analyzer.

In the following table we find all the currently available operators (negative numbers) and their meaning. Hereby is used the acronym "IR" for the actually calculated intermediate result of the program.

Table 1-1: The Operators of the System Calculator

Operator number	Acronym	Description
-1	ADD l	add following live value operand to the IR (IR = IR + l)
-2	SUB l	subtract following live value operand from IR (IR = IR – l)
-3	DIV l	divide IR by following live value operand (IR = IR / l)
-4	MUL l	multiply IR with following live value operand (IR = IR * l)
-5	ADDC c	add following constant value operand to the IR (IR = IR + c)
-6	SUBC c	subtract following constant value operand from IR (IR = IR – c)
-7	DIVC c	divide IR by following constant value operand (IR = IR / c)
-8	MULC c	multiply IR with following constant value operand (IR = IR * c)
-9	ADDM m	add following memory value operand to the IR (IR = IR + m)
-10	SUBM m	subtract following memory value operand from IR (IR = IR – m)
-11	DIVM m	divide IR by following memory value operand (IR = IR / m)
-12	MULM m	multiply IR with following memory value operand (IR = IR * m)
-13	STOM m	store IR at following memory value and set IR = 0.0 (m = IR; IR = 0)
-14	STOR r	store IR to following result and set IR = 0.0 (r = IR; IR = 0)
-15	NOP	no operation (placeholder)
-16	ABS	convert IR into absolute value (IR = |IR|)
-17	EOP	end of program
-18	SQRT	build square root of IR (IR = $\sqrt{IR}$)
-19	NEG	negate IR (IR = -IR)
-20	INC	increment IR (IR = IR + 1)
-21	DEC	decrement IR (IR = IR – 1)
-22	INV	invert IR (IR = 1 / IR)
-23	EXP	exponential function (IR = e^{IR})
-24	POWM	IR raised to the power of the following memory *value operand (IR = IR^m)*
-25	IF> m1 m2 m3	if IR > 1st following memory value then IR = 2nd following memory value else IR = 3rd following memory value
-26	IF< m1 m2 m3	if IR < 1st following memory value then IR = 2nd following memory value else IR = 3rd following memory value
-27	IF= m1 m2 m3	if IR = 1st following memory value then IR = 2nd following memory value else IR = 3rd following memory value
-28	LN	natural logarithm (IR = ln(IR))
-29	LOG	base 10 logarithm (IR = log(IR))

1.2 Live values (real measuring values)

In the platform calculator we have a **signal pool** of momentary up to 25 possible live signals.
The first 10 signals in this pool are fix assigned the rest of the signals are free assignable.

Table 1-2: Live Values Pool

Number	Assignment	assignment type
Signal 1	Result 1	fixed
Signal 2	Result 2	fixed
Signal 3	Result 3	fixed
Signal 4	Result 4	fixed
Signal 5	reserved	fixed
Signal 6	reserved	fixed
Signal 7	reserved	fixed
Signal 8	reserved	fixed
Signal 9	reserved	fixed
Signal 10	reserved	fixed
Signal 11	MLT 1/CH1 Concentration	programmable
Signal 12	CLD Concentration	programmable
Signal 13	MLT 2/CH3 Temperature	programmable
Signal 14	FID Temperature	programmable
Signal 15	not assigned	programmable
....	.....	programmable
Signal 25	not assigned	programmable

By using these numbers of the signal pool we determine the live value operands in the calculator's program.

Example of a calculator program with upper signal assignment:

Result 1 = (MLT 1/CH1 Concentration) + (CLD Concentration)

Step (o+1)	-1	ADD (at beginning the intermediate result IR = 0)
Step (o+2)	11	Signal 11 (here: MLT1/CH1 Concentration)
Step (o+3)	-1	ADD
Step (o+4)	12	Signal 12 (here: CLD Concentration)
Step (o+5)	-14	Store IR to result
Step (o+6)	1	Result 1
Step (o+7)	-17	End of program

1.3 Constant values

The same principle is used for the constant values. We have a **pool** of free assignable constant values.

Example of a constant signal pool:

Number	Assignment
Constant-1	1.000000
Constant-2	10.00000
Constant-3	100.0000
Constant-4	1000.000
Constant-5	10000.00
....	.....
Constant-21	500.0000

By using the numbers of the signal pool we determine again the constant operands in the calculator's program.

Example of a calculator program with upper live signal and constant assignment:

Result1 = (MLT 1/CH1-Concentration) + 100

Step (o+1)	-1	ADD (addition by using the live operand's class)
Step (o+2)	11	Live value number 11 (here: MLT1/CH1-Concentration)
Step (o+3)	-5	ADDC (addition by using the constant operand's class)
Step (o+4)	3	Constant number 3 (here: 100.0)
Step (o+5)	-14	Store IR to result
Step (o+6)	1	Result 1
Step (o+7)	-17	End of program

1.4 Memory values

The same principle as in constant values is used again for the memory values. We have a **pool** of usable memory places where intermediate calculation results can be stored to.

1.5 Menu tree for the system calculator

The following pictures show the menu tree and the LON variables which are assigned to the single menu lines.

System configuration and diagnostics...
↓
System calculator...
↓

- System calculator-		
Programming...		
Signals...		
Units...		
Scaling...		
Calculator is:	**Enabled**	**CALCSTATUS**
Program error in step:	**0**	**CLCERRLINE**
Result Calculator 1:	**0.1234**	**CALC1RESULT**
Result Calculator 2:	**1234.5**	**CALC2RESULT**
Result Calculator 3:	**123.45**	**CALC3RESULT**
Result Calculator 4:	**98.765**	**CALC4RESULT**

Picture 1-1: System Calculator Menu

With the 'Calculator is' parameter we show whether the system calculator functionality is

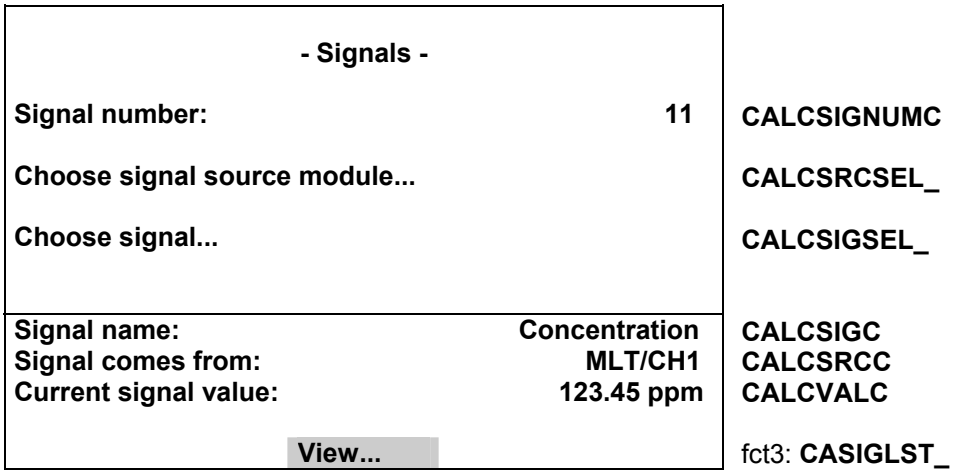
- **Disabled**
- **Enabled**
- has a **Program Error** (after trying to enable)

In the case of a program error by the 'Program error in step:' parameter is displayed in what step of the program this error happened. If there is no error this parameter equals '0'.

1.5.1 Submenu 'Signals'

The live values' signal assignment is done in the submenu 'Signals...".

System configuration and diagnostics...
↓
System calculator...
↓
Signals...
↓



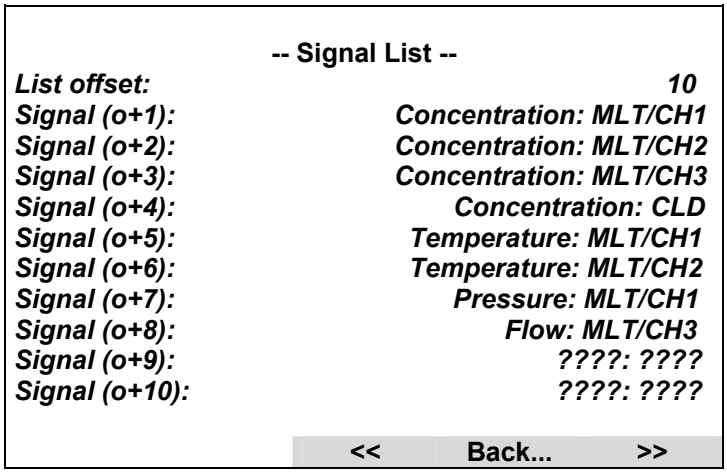
Picture 1-2 : Signal Assignment of System Calculator

The single signals of the pool (selected by 'Signal number') are assigned by first selecting the source analyzer module (AM) resp. analyzer channel of the requested signal and then the signal name itself.
Please, note that is only possible to modify the programmable type of signal numbers.

To realize the signal name's selection there is used an already implemented feature of the AMs. It has being used for the small bar graphs display and for the analog outputs of the SIO module. It is the **SVCONT/SVNAME** variable mechanism. This mechanism provides the possibility to have a link to the LON variables of an AM which are listed in the SVCONT enum. In the SVNAME variable are listed the related human readable strings.

If we want to assign the signals not via the menu but via LON variable access we have to do the following steps:
1. Enter signal number by setting CALCSIGNUMC.
2. Enter the source of the signal by setting CALCSRCC to the TAG-variable's string of the requested channel.
3. Set CALC_ENTRYSIG (instead of using CALCSIGC) to the enum value that the signal has in the SVCONT-variable.

It is possible to show a listing of the whole signal pool with the entered programmable as well as the fixed assignments.

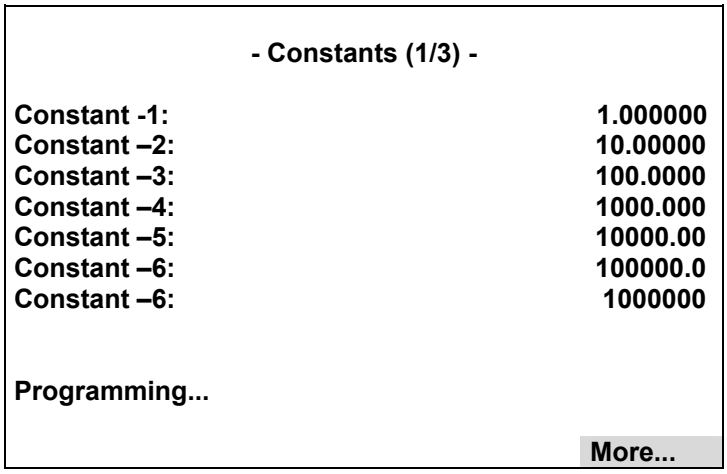


Picture 1-3: Listing of Signal Assignment

1.5.2 Submenu 'Programming'

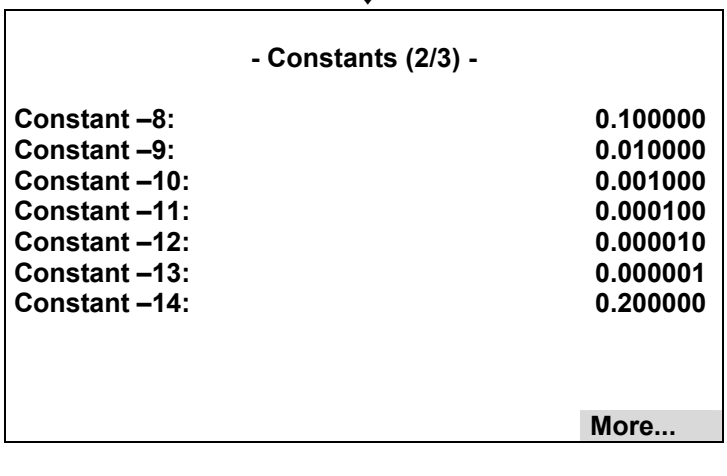
The constant values are configured in the submenu 'Programming...".

System configuration and diagnostics...
↓
System calculator...
↓
Programming...
↓



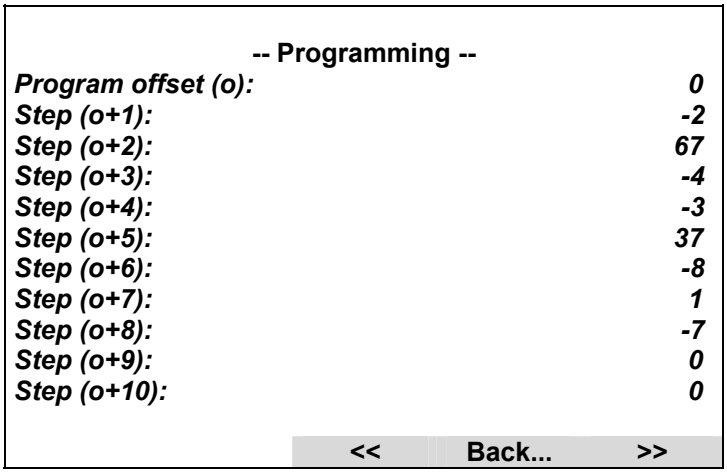
Picture 1-4: Constant Values Assignment

System configuration and diagnostics...
↓
System calculator...
↓
Programming...
↓
More...
↓



After having done the set-up of the signals we can do the programming of Calculator algorithm itself. It is done in the submenu 'Programming...".

System configuration and diagnostics...
↓
System calculator...
↓
Programming...
↓
Programming...
↓



Picture 1-5: Programming the System Calculator

If we want to assign the signals not via the menu but via LON variable access we have to be aware of following:

1. The PLC-programming as well as the programming for the system calculator happens indirectly via the edit variable-array ED_INTx.
   To differ what the programming is for there exists the LON variable PROGTYP.
   Setting PROGTYP = 0 means we want to program the system calculator.
   Setting PROGTYP = 1 means we want to program the system PLC.
2. By using the variable LISTOFFSET we determine what part of the whole programming list we want to program.
   For example, setting LISTOFFSET = 60, means by usage of ED_INT1...ED_INT10 we are able to modify the program steps 61...70.

2 Display Calculator Results on Mini-bargraph

In order to show the calculator results on the mini-bargraphs of the single component display we overworked the architecture of the bargraph displays.

All the signals which are shown on this display in the versions up to now belonged always to the selected component, that means they belonged all to the same AM-channel or to an I/O module which is bound to it.

To show a calculator result which belongs to the CM we have to **assign signals of a different node/subnode** to the single component display's bargraphs. Therefore we have chosen a way which enables us to do a complete free signal assignment.

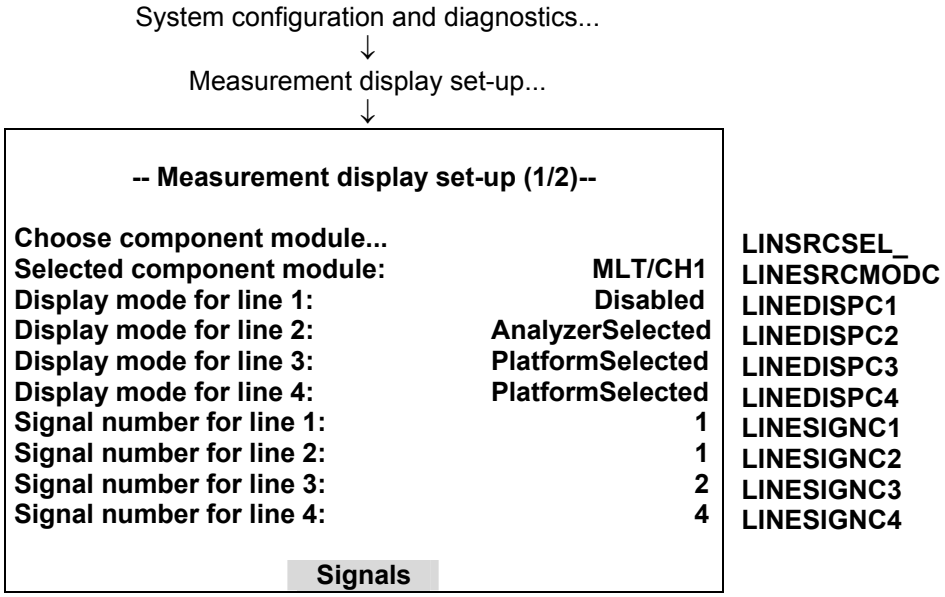
Also we are able to set-up the calculator result's **unit** and its **range limits**.

And finally we are able to assign an own **signal name** to the bar graphs. Up to now there have been shown the name that is noticed in the SVNAME variable. For most of signals this is sufficient. But especially for signals which have no unique function (like calculator results) we want to show configurable and therefore more intuitive signal names.

By inventing this new bargraphs display structure we also looked to have a behavior which can fulfill the current functionalities.
Therefore we created the possibility to assign signals of I/O modules and their implemented SVCONT/SVNAME signals as well as the ANALOGOUTPUT/ANOPUNITS variable of older I/O module versions.

2.1 Display mode

For each selectable component we can compose bar graph displays. This composition can show signals of a prepared pool from any attached network node.
To have the possibility of being compatible to current software versions we create also a mode which displays the signals as they are selected by the analyzers itself.



Picture 2-1: Measurement Display Set-up

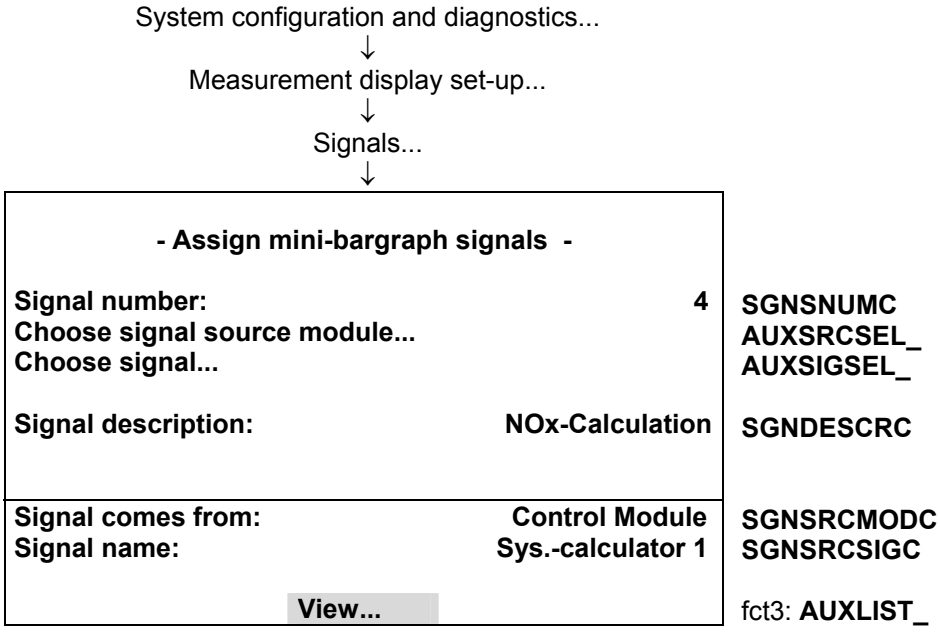
In upper menu we first select the component we want to do the assignment for ("Choose component module...").

By use of the four "Display mode for line x"-parameters we select the handling of the 4 bar graphs.
Disabled: The bar graph is switched off.
AnalyzerSelected: The bar graph receives the signal from the SVNAMEx-variable of the selected component module (AM). This is the already implemented and mainly used mode.
PlatformSelected: The bar graph receives its signal from a signal pool that is installed in the Control Module itself.

2.2 Assign signals and convenient names

If we use the 'PlatformSelected' signal mode we have to determine what signal number of the pool has to be displayed. The selection of this number is performed in the appropriate menu line "Signal number for line x".

Now we have to determine only what kind of signal is behind each signal number of the pool.
This is done in the following menu display.



Picture 2-2: Platform selected Signal Assignment

We are able to assign signals which come from all installed nodes/subnodes and have the SVCONT/SVNAME variable. Further more we present I/O modules which have the ANALOGOUTPUT / ANOPUNITS variable.

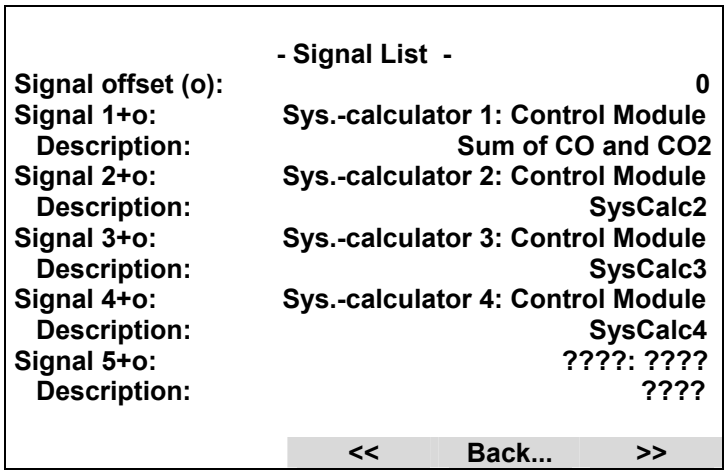
The procedure is the following:
First we select the signal number we want to assign the signal for.
Then we choose the source (node/subnode) the signal shall come from.
After this we choose the signal itself of the selected source.

With the "Signal description" parameter, which is an editable string variable, we create the ability to give a convenient signal name to each of the assigned signals.

If we want to assign this not via the menu but via LON variable access we have to do the following steps:
1. Enter signal number by setting SGNSNUMC.
2. Enter the source of the signal by setting SGNSRCMODC to the TAG variable's string of the requested channel.
3. Set SGN_ENTRYSIG (instead of using SGNSRCSIGC) to the enum value that the signal has in the SVCONT variable.
4. Enter the signal description by setting SGNDESCRC.

A complete overview of the signals in the pool can be obtained then in the following menu.

System configuration and diagnostics...
↓
Measurement display set-up...
↓
Signals...
↓
View...
↓



Picture 2-3: Listing of assigned Signals

3 Assignment to SIO Analog Outputs

The assignment of the system calculator results to an analog output of the SIO board is realized by extending the selectable module types. Now it is also possible to select the platform itself with its own signals (calculator results).

That means we have added the SVCONT/SVNAME variable for node/subnode 0 (platform).
Here we assigned then the new CALCxRESULT variables of the system calculator.

Programmable Logic Control (PLC) on Control Module Level (Platform or MLT, CAT 200, or TFID Analyzer)

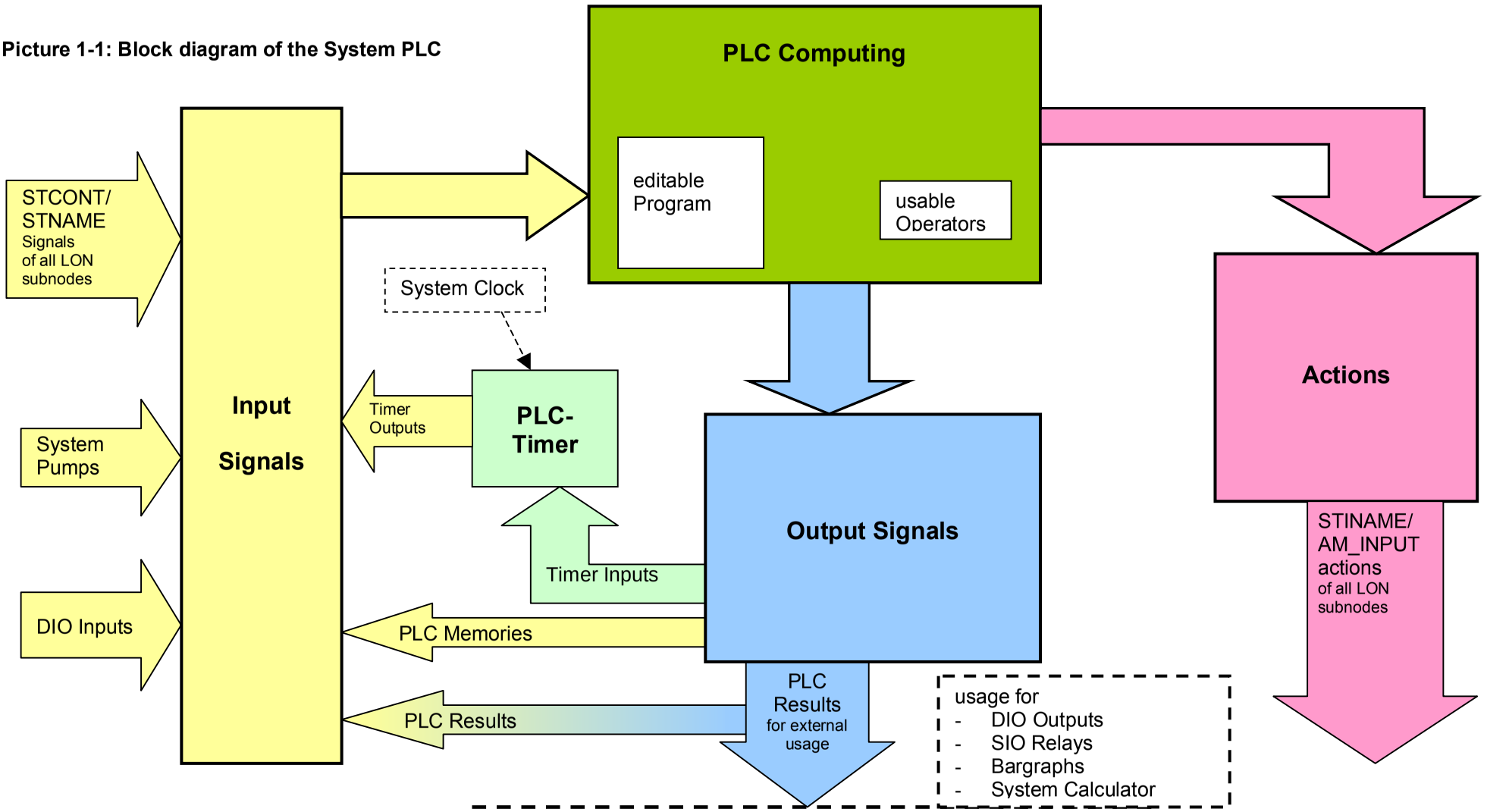
Contents

Listing of used Pictures

Listing of used Tables

1 Function Survey

Picture 1-1: Block diagram of the System PLC



2 Principle of Program Setup

As it would be a too high effort to realize a comfortable mathematical formula system we created a syntax which is easy to input and easy to realize.
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Therefore we have mainly to differ between positive and negative numbers.
The program **operations** are assigned with **negative numbers**.
The **operands** which are used by these input operations are **positive numbers**. These positive numbers symbolize signals which are part of a signal pool.

Also we have to know that there are used **different classes of operands**. That means we have different classes of signal pools.

Those are:
- Input signals
- Output signals
- Actions.

In each of these classes exists an own numbering and we determine by the operator itself which class of these operands is meant.

Remark:

Opposite to former versions allowing PLC function within ONE MLT analyzer module (AM) or for ONE MLT analyzer (or CAT 200 resp. TFID analyzer) ONLY now the system PLC is based on the Control Module level (CM).
This allows to include ALL analyzer modules resp. MLT channels of a NGA 2000 analyzer system into the PLC system.
The results of the system PLC can be put onto the programmable Input/Output Modules SIO or DIO.
The SIO or DIO's can work as Control Module I/O's being then located in a platform or in a MLT, CAT 200 or TFID Analyzer but also as local I/O's in (remote) MLT, CAT 200 or TFID analyzer module.

3 Operators

In the following table we find all the currently available operators (negative numbers) and their meaning. Hereby is used the acronym "IR" for the actually calculated intermediate result of the PLC program.

Table 3-1: The Operators of the System PLC

Operator number	Acronym	Description
-1	NOP	no operation (placeholder)
-2	OR	OR combine the input signals with following ID; store to IR
-3	AND	AND combine the input signals with following ID; store to IR
-4	INVERT	invert the IR
-5	STORE	set/clear the output signal with the following ID according IR
-6	CLEAR	clear the IR
-7	END	end of program
-8	SET	set the IR
-9	LOAD	load IR according input signal with following ID;
-10	IF i1 i2	if IR = True then IR = input signal with 1st following ID else IR = input signal with 2nd following ID
-11	CALL	actions call according IR by using following ID of actions pool

4 Input Signals

In the platform PLC we have a **signal pool** for the input signals.
The first part in this pool are fix assigned the rest of the signals are free assignable.

Table 4-1: Example of an Input Signals Pool

Signal ID	Assignment	assignment type
1	PLC Result 1	fixed
2	PLC Result 2	fixed
3	PLC Result 3	fixed
..	..	fixed
15	PLC Result 15	fixed
16	PLC Memory 1	fixed
17	PLC Memory 2	fixed
..	..	fixed
30	PLC Memory 15	fixed
31	PLC Timer1 Out	fixed
32	PLC Timer2 Out	fixed
33	PLC Timer3 Out	fixed
34	PLC Timer4 Out	fixed
35	PLC Timer5 Out	fixed
36	PLC Timer6 Out	fixed
37	PLC Timer7 Out	fixed
38	PLC Timer8 Out	fixed
39	reserved	fixed
40	reserved	fixed
41	System-DIO-Board 1 Input 1	fixed
42	System-DIO-Board 1 Input 2	fixed
..	..	fixed
47	System-DIO-Board 1 Input 7	fixed
48	System-DIO-Board 1 Input 8	fixed
49	System-DIO-Board 2 Input 1	fixed
50	System-DIO-Board 2 Input 2	fixed
..	..	fixed
55	System-DIO-Board 2 Input 7	fixed
56	System-DIO-Board 2 Input 8	fixed
57	System-Pump 1	fixed
58	System-Pump 2	fixed
..	..	fixed
62	reserved	fixed
63	On-Signal	fixed
64	Off-Signal	fixed
65	MLT1/CH1-Failure	programmable
66	MLT1/CH1-Conc.Low-Low	programmable
67	MLT1/CH3-Flow Low	programmable
68	FID-Cal. in progress	programmable
69	CLD-Maintenance request	programmable
70	Control Module-SYS:Valve1	programmable
71	Control Module-SYS:Valve2	programmable
72	Control Module-SYS:Valve3	programmable
..	..	programmable
127	not assigned	programmable
128	not assigned	programmable

5 Output Signals

The same principle as for input signals is used for the output signals. We have a **pool** of usable buffer places where intermediate calculation results can be stored to.
The content of these buffers may be used for further processing.

Table 5-1: Output Signals Pool

Signal ID	Assignment	Tip
1	Result 1	full usable LON variable (PLCRESULT1)
2	Result 2	full usable LON variable (PLCRESULT2)
3	Result 3	full usable LON variable (PLCRESULT3)
..	..	full usable LON variable
..	..	full usable LON variable
14	Result 14	full usable LON variable (PLCRESULT14)
15	Result 15	full usable LON variable (PLCRESULT15)
16	Memory 1	intermediate storage
17	Memory 2	intermediate storage
..	..	intermediate storage
..	..	intermediate storage
29	Memory 14	intermediate storage
30	Memory 15	intermediate storage
31	Timer 1 Input1	usage depends on timer mode
32	Timer 2 Input1	usage depends on timer mode
33	Timer 3 Input1	usage depends on timer mode
34	Timer 4 Input1	usage depends on timer mode
35	Timer 5 Input1	usage depends on timer mode
36	Timer 6 Input1	usage depends on timer mode
37	Timer 7 Input1	usage depends on timer mode
38	Timer 8 Input1	usage depends on timer mode
39	reserved	
40	reserved	
41	Timer 1 Input2	usage depends on timer mode
42	Timer 2 Input2	usage depends on timer mode
43	Timer 3 Input2	usage depends on timer mode
44	Timer 4 Input2	usage depends on timer mode
45	Timer 5 Input2	usage depends on timer mode
46	Timer 6 Input2	usage depends on timer mode
47	Timer 7 Input2	usage depends on timer mode
48	Timer 8 Input2	usage depends on timer mode
49	reserved	
50	reserved	
..	..	
56	reserved	
57	System-Pump 1	full usable LON variable (SYSPUMP1)
58	System-Pump 2	full usable LON variable (SYSPUMP2)
59	reserved	
..	..	
69	reserved	
70	reserved	

In the output signal pool the Results1..15 are assigned as full usable LON variable-array.

They are also implemented in the STCONT/STNAME-feature. So the PLC Results can be linked to digital outputs of DIO or to the relays of SIO.

They are also implemented in the SVCONT/SVNAME-feature. So we are able to link them to analog outputs of SIO, the bargraphs display and to the system calculator signals.

By using the signal IDs of the signal pools we determine the input resp. the output signal operands in the PLC's program.

Following are examples that use the signal assignment of "Table 4-1: Example of an Input Signals Pool".

Result1 = (MLT1/CH1-Failure) OR (MLT/CH1-Conc.Low-Low) OR (DIO1-Input5)

Table 5-2: Example of a PLC program using input and output signals

Step (o+1)	-2	OR (at beginning the intermediate result IR = 0)
Step (o+2)	65	Input-Signal 65 (here: MLT1/CH1-Failure)
Step (o+3)	66	Input-Signal 66 (here: MLT/CH1-Conc.Low-Low)
Step (o+4)	45	Input-Signal 45 (System-DIO-Board 1 Input 5)
Step (o+5)	-5	Store IR to output buffer
Step (o+6)	1	Output-Signal 1 (PLC Result 1)
Step (o+7)	-7	End of program

SR-Flip-Flop

Set (DIO1-Input5)	Reset (DIO1-Input6)	Out (Result5)
0	0	last Out
0	1	0
1	0	1
1	1	1

Table 5-3: Example of a SR-Flip-Flop as PLC program

Step (o+1)	-9	LOAD
Step (o+2)	46	IR = 'Reset' ->Input-Signal 46 (System-DIO-Board 1 Input 6)
Step (o+3)	-10	IF (Reset = 1)
Step (o+4)	64	then IR = 0
Step (o+5)	5	else IR = last Out (PLC Result 5)
Step (o+6)	-5	STORE
Step (o+7)	30	to Memory15
Step (o+8)	-9	LOAD
Step (o+9)	45	IR = 'Set' ->Input-Signal 45 (System-DIO-Board 1 Input 5)
Step (o+10)	-10	IF (Set = 1)
Step (o+11)	63	then IR = 1
Step (o+12)	30	else Memory15
Step (o+13)	-5	STORE
Step (o+14)	5	to Out (PLC Result 5)
Step (o+15)	-7	End of program

6 Actions

The same principle as for input and output signals is used again for the **actions**
We have a **pool** where available actions of the different modules can be assigned to. By using the action IDs of this pool the single actions can be called according to the intermediate result which is calculated in the PLC program.

Table 6-1: Example of an Actions Pool

Action ID	Assignment	assignment type
1	MLT1/CH1-AM:Zero-Cal	programmable
2	MLT1/CH1-HoldAnalogOutput	programmable
3	MLT1/CH3-ExtStatus1	programmable
4	MLT1/CH2-External failure	programmable
5	Control Module-SYS:Zero-Cal	programmable
6	Control Module-SYS:Cancel-Cal	programmable
7	not assigned	programmable
8	not assigned	programmable
	..	programmable
	..	programmable
19	not assigned	programmable
20	not assigned	programmable

Following is an example that uses the signal assignment of "Table 4-1: Example of an Input Signals Pool" and of "Table 6-1: Example of an Actions Pool"

MLT1/CH1-AM:Zero-Cal = /(MLT1/CH3-Flow Low) AND (DIO1-Input5)

This means: Start zero calibration of MLT1/CH1 if flow of MLT1/CH3 is not too low and digital input 5 of DIO-Board 1 goes high.

Table 6-2: Example of a PLC program using actions

Step (o+1)	-2	OR (at beginning the intermediate result IR = 0)
Step (o+2)	67	Input-Signal 67 (here: MLT1/CH3-Flow Low)
Step (o+3)	-4	invert the IR (build "/(MLT1/CH3-Flow Low)")
Step (o+4)	-3	AND (current IR with following input signals)
Step (o+5)	37	Input-Signal 37 (System-DIO-Board 1 Input 5)
Step (o+5)	-8	perform action
Step (o+6)	1	Action-ID 1 (here: MLT1/CH1-AM:Zero-Cal)
Step (o+7)	-7	End of program

7 Time controlled Logic

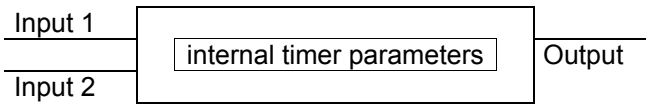
In order to do time dependent logic controls it is necessary to use **timers**.

These timers enable us to have:
- switch-off delays
- switch-on delays
- configurable pulse width square waves
- date and time controlled start of timer functions

To achieve all these variety of features the timers are implemented in different running modes. To control the timers by other PLC signals the timers are provided with 2 digital inputs. The function of the digital inputs depends on the elected timer mode.

The output of the timer function block is used by the PLC again for further processing.

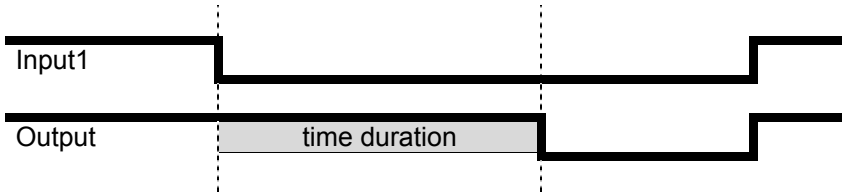
Picture 7-1: The Timer Function Block



7.1 Off-Delay Mode

The following picture shows the timed response of the 'Off-delay' timer mode.

Picture 7-2: Off-delay Timer Mode Diagram



When 'Input1' of the timer is True, 'Output' is set True and the elapsed time counter is set to zero.
When 'Input1' is False for longer than the 'time duration', 'Output' is set False.

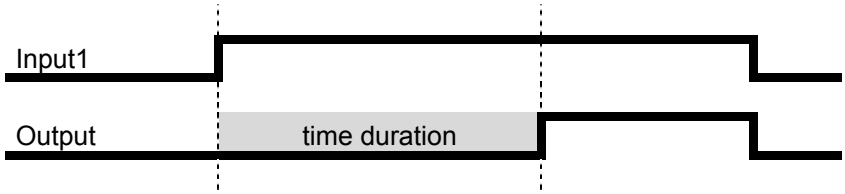
That means it is specified the time duration that must elapse before the False output value is applied.

'Input2' of the timer is not used in this mode.

7.2 On-Delay Mode

The following picture shows the timed response of the 'On-delay' timer mode.

Picture 7-3: On-delay Timer Mode Diagram



When 'Input1' of the timer is False, 'Output' is set False and the elapsed time counter is set to zero. When 'Input1' is True for longer than the 'time duration', 'Output' is set True.

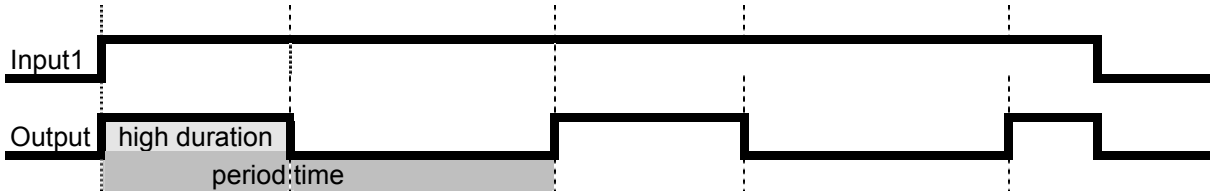
That means it is specified the time duration that must elapse before the True output value is applied.

'Input2' of the timer is not used in this mode.

7.3 Repeated Pulse Mode

The following picture shows the timed behavior of the 'Repeated-Pulse' timer mode.

Picture 7-4: Repeated-Pulse Timer Mode Diagram



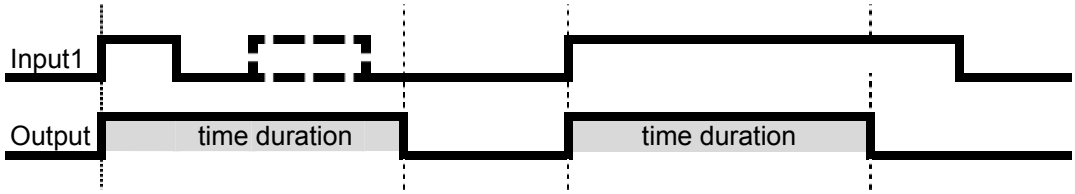
When 'Input1' of the timer is False, 'Output' is set False.
When 'Input1' is True, the 'Output' is set according a square wave. On the rising edge of 'Input1' it begins with setting the 'Output' True until the high duration time is elapsed. Then 'Output' is set False and remains False for the rest of the period time. Then 'Output' is set True again for the high duration time, and so forth. This procedure goes on endless until Input1 is set False.

'Input2' of the timer is not used in this mode.

7.4 Single Pulse Mode

The following picture shows the timed behavior of the 'Single Pulse' timer mode.

Picture 7-5: Single Pulse Timer Mode Diagram



When 'Input1' of the timer changes from False to True (rising edge trigger) during 'Output' is False, 'Output' is set True until time duration is elapsed. Then 'Output' is set False.

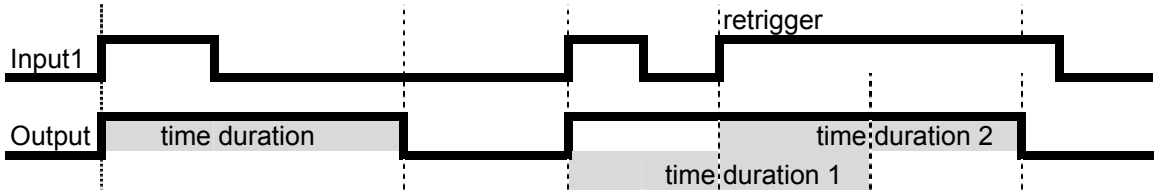
'Input2' of the timer is not used in this mode.

Tips: The pulse width on Input1 is not relevant, the duration of the pulse on 'Output' is always the same. The level changes on Input1 are scanned on a configurable rate. Therefore the time between edges (rising and falling) has to be at minimum of this set update rate.

7.5 Retriggering Single Pulse Mode

The following picture shows the timed behavior of the 'Retriggering Single Pulse' timer mode.

Picture 7-6: Retriggering Single Pulse Timer Mode Diagram



When 'Input1' of the timer changes from False to True (rising edge trigger), 'Output' is set True until time duration is elapsed. Then 'Output' is set False.
When 'Input1' changes from False to True again during Output is still set True the elapsing of the duration starts new.

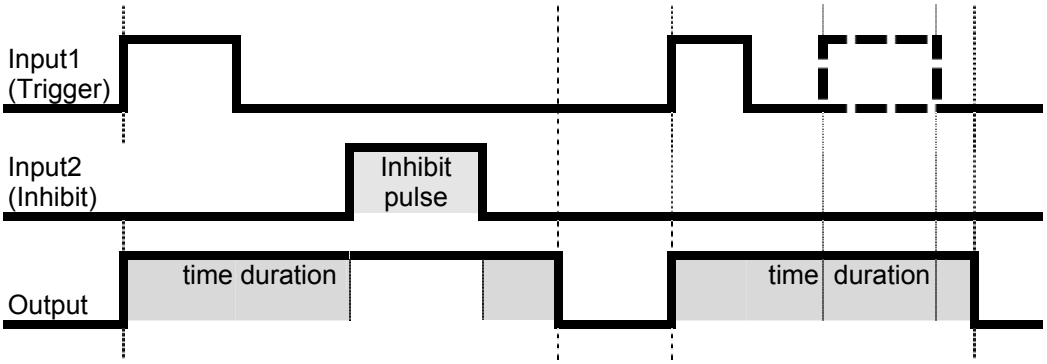
'Input2' of the timer is not used in this mode.

Tips: The pulse width on Input1 is not relevant, the duration of the pulse on 'Output' is only stretched if there is a rising edge on Input1 again.
The level changes on Input1 are scanned on a configurable rate. Therefore the time between edges (rising and falling) has to be at minimum of this set update rate.

7.6 Inhibited Single Pulse Mode

The following picture shows the timed behavior of the 'Inhibited Single Pulse' timer mode.

Picture 7-7: Inhibited Single Pulse Timer Mode Diagram



When 'Input1' (logical trigger) of the timer transitions from False to True (rising edge trigger), 'Output' is set True until time duration is elapsed. Then 'Output' is set False.

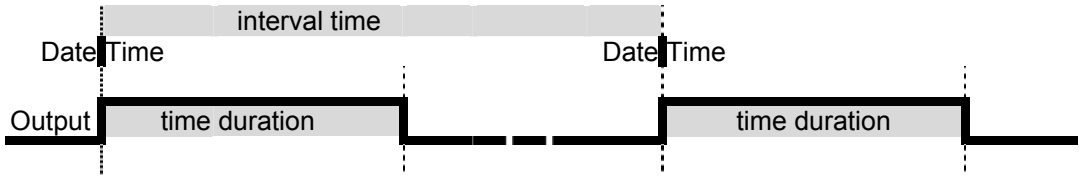
'When 'Input2' (logical inhibit) of the timer is set during 'Output' is True (elapsing duration) the time stops and retains its value until Input2 transitions to False again. I.e., the duration time is increased by the inhibit pulses duration.

Tips: The duration of the pulse on 'Output' does not depend on the pulse width of Input1.
The level changes on Input1 are scanned on a configurable rate. Therefore the time between edges (rising and falling) has to be at minimum of this set update rate.

7.7 Clock Triggered Pulse Mode

In the clock triggered pulse mode the behavior of the output is similar as in 'single pulse mode'. But the pulse is not triggered by Input1 but at a certain date/time.

Picture 7-8: Clock Triggered Pulse Timer Mode Diagram



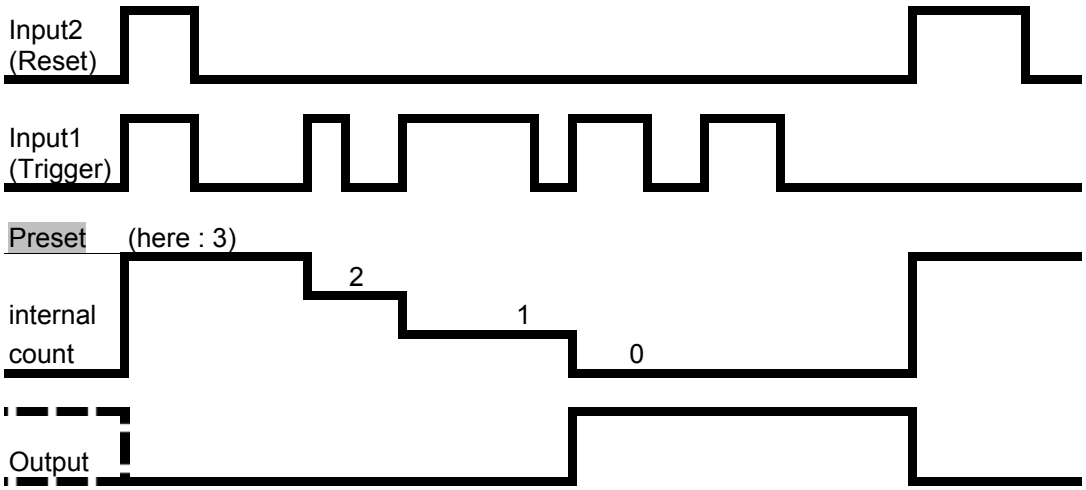
When the real time clock of the device reaches a set date/time (time trigger), 'Output' is set True until time duration is elapsed. Then 'Output' is set False.
This procedure recurs after a set interval time.

'Input1' and 'Input2' of the timer are not used in this mode.

7.8 Counter Mode

The following picture shows the timed behavior of the 'Counter' mode.

Picture 7-9: Counter Mode Diagram



When 'Input2' (logical 'Reset') of the timer is set to True, 'Output' is set False and the internal decrement counter is set to its preset value.
After Input2 is set False the rising edges on Input1 (logical 'Trigger') decrement the counter. When the counter is less than or equal to zero, 'Output' is set True and the counter holds its value.

Tips: The level changes on Input1 are scanned on a configurable rate. Therefore the time between edges (rising and falling) has to be at minimum of this set update rate.

8 Menu Tree for the System PLC

The following pictures show the menu tree and the LON variables which are assigned to the single menu lines.

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓

- System programmable logic control (PLC)-	
Programming...	fct: **PLCPROG_**
Signals...	
Timer...	
Results...	
PLC is: **Cycle: 1.0 s**	**PLCSTATUS**
Program error in step: ***0***	**PLCERRLINE**

Picture 8-1: System PLC Menu

With the 'PLC is' parameter we disable or enable PLC function. Also, with enabling the PLC there is the choice with which cyclic rate the programmed algorithm is called.

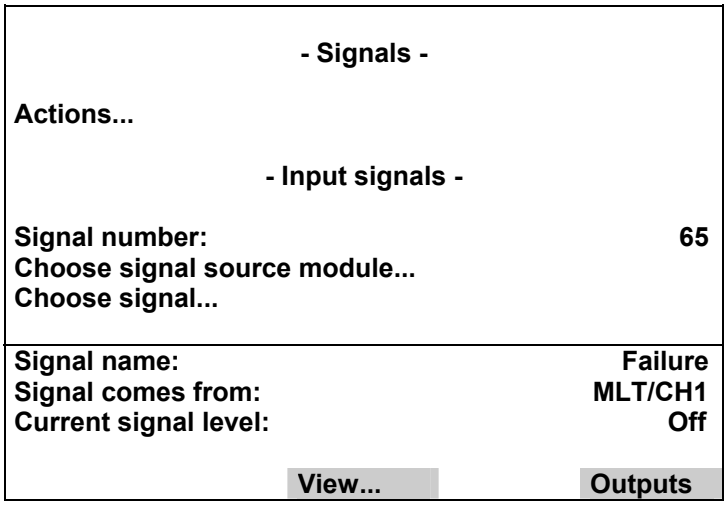
- **Disabled**
- has a **Program Error** (after trying to enable)
- **Cycle 0.1 s**
- **Cycle 0.2 s**
- **Cycle 0.5 s**
- **Cycle 1.0 s**

In the case of a program error by the 'Program error in step:' parameter is displayed in what step of the program this error happened. If there is no error this parameter equals '0'.

8.1 Submenu 'Signals'

All programmable signal assignments are done in the submenu 'Signals...".

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Signals...
↓



PLCSIGNUMC [65 .. 128]
PLCSRCSEL_
PLCSIGSEL_

PLCSIGC
PLCSRCC
PLCLEVELC

fct3: **PLCSIGLST_**
fct5: **PLCOUTLST_**

Picture 8-2 : Input Signal Assignment of System PLC

The single signals of the pool (selected by 'Signal number') are assigned by first selecting the source analyzer module (AM) resp. analyzer channel of the requested signal and then the signal name itself.
Please, note that it is only possible to modify the programmable type of signal numbers.

For the signal name's selection there is used an already implemented feature of the AMs. It has being used for the digital outputs of the DIO resp. the SIO module. It is the **STCONT/STNAME** variable mechanism. This mechanism provides the possibility to have a link to the LON variables of an AM which are listed in the STCONT enum. In the STNAME variable are listed the related human readable strings.

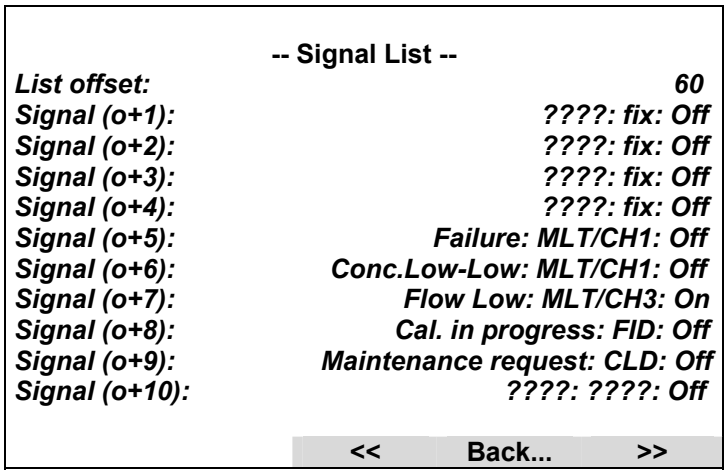
If we want to assign the signals not via the menu but via LON variable access we have to do the following steps:
1. Enter signal number by setting PLCSIGNUMC.
2. Enter the source of the signal by setting PLCSRCC to the TAG-variable's string of the requested channel.
3. Set PLC_ENTRYSIG (instead of using PLCSIGC) to the enum value that the signal has in the STCONT-variable.

8.1.1 Input Signals Listing

Via the View function key it is possible to show a listing of the whole input signal pool with the entered programmable as well as the fixed assignments.

The name of the fix signal assignments can be listed easily by using the enum variable PLC1INAME/ PLC2INAME which contains all the fix assigned signal's name (currently 64 names).

Here is shown a display according "Table 4-1: Example of an Input Signals Pool".



Picture 8-3: Listing of Input Signal Assignment

8.1.2 Output Signals Listing

Via the Outputs function key it is possible to show a listing of the whole output signal pool.

The name of the this fix output signal assignments can be listed easily by using the enum variable PLC1ONAME/PLC2ONAME which contains all the fix assigned signal's name.

Here is shown a display with Output Signals

-- Signal List --		
List offset:	***30***	**LISTOFFSET**
Signal (o+1):	***PLC Timer-1 In1: Off***	**MENU1LINE** (live)
Signal (o+2):	***PLC Timer-2 In1: Off***	**MENU2LINE** (live)
Signal (o+3):	***PLC Timer-3 In1: Off***	**MENU3LINE** (live)
Signal (o+4):	***PLC Timer-4 In1: Off***	**MENU4LINE** (live)
Signal (o+5):	***PLC Timer-5 In1: Off***	**MENU5LINE** (live)
Signal (o+6):	***PLC Timer-6 In1: Off***	**MENU6LINE** (live)
Signal (o+7):	***PLC Timer-7 In1: Off***	**MENU7LINE** (live)
Signal (o+8):	***PLC Timer-8 In1: Off***	**MENU8LINE** (live)
Signal (o+9):	***Reserved: Off***	**MENU9LINE** (live)
Signal (o+10):	***Reserved: Off***	**MENU10LINE** (live)
<< **Back...** **>>**		fct3: **BACKVARS**
		fct4: **ESCAPE**
		fct5: **LOADVARS**

Picture 8-4: Listing of Output Signal Assignment

8.2 Submenu 'Actions'

All programmable action assignments are done in the submenu 'Actions...".

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Signals...
↓
Actions...
↓

- Actions -		
Action number:	**1**	**PLCACTNUMC** [1..20]
Choose module...		**PLCASRCSEL_**
Choose function...		**PLCACTSEL_**
Function name:	**AM:Zero-Cal**	**PLCACTIONC**
Action goes to:	**MLT/CH1**	**PLCACTSRCC**
View...		fct3: **PLCACTLST_**

Picture 8-5 : Actions Assignment of System PLC

The single actions of the pool (selected by 'Action number') are assigned by first selecting the source analyzer module (AM) resp. analyzer channel of the requested action and then the function name itself.

For the function name's selection there is used an already implemented feature. It has being used for the digital inputs of the DIO module. It is the **STINAME** and **AM_INPUT/DI_MSGE** variable mechanism. This mechanism provides the possibility to have a link to functions of an AM which are listed in the STINAME-enum of the platform or at the AM_INPUT-enum of the single modules.

If we want to assign the actions not via the menu but via LON variable access we have to do the following steps:

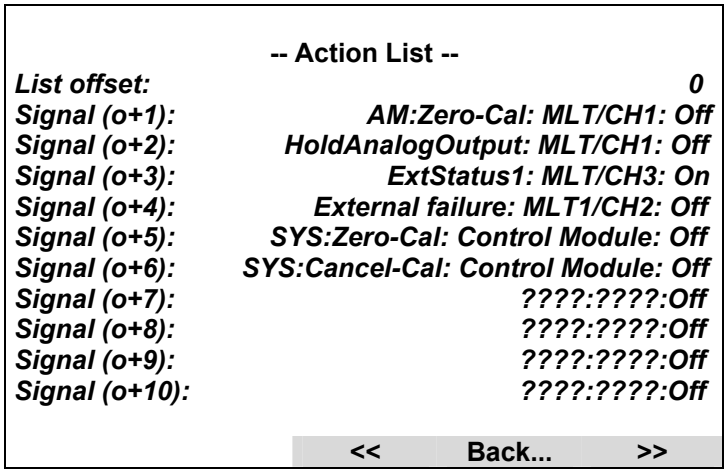
1. Enter action number by setting PLCACTNUMC.
2. Enter the source of the signal by setting PLCACTSRCC to the TAG-variable's string of the requested channel.
3. Set PLC_ENTRYACT (instead of using PLCACTIONC) to the corresponding enum value. This value is calculated by usage of STINAME of the platform and AM_INPUT of the selected module.

   If you select an action which is listed in STINAME, the enum value is just the value of STINAME.
   If you select an action which is listed in AM_INPUT you have to add the enum value of AM_INPUT to the number of available enum values of STINAME.

8.2.1 Actions Listing

It is possible to show a listing of the whole actions pool with the entered assignments as well as the corresponding signal levels.

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Signals...
↓
Actions...
↓
View...
↓

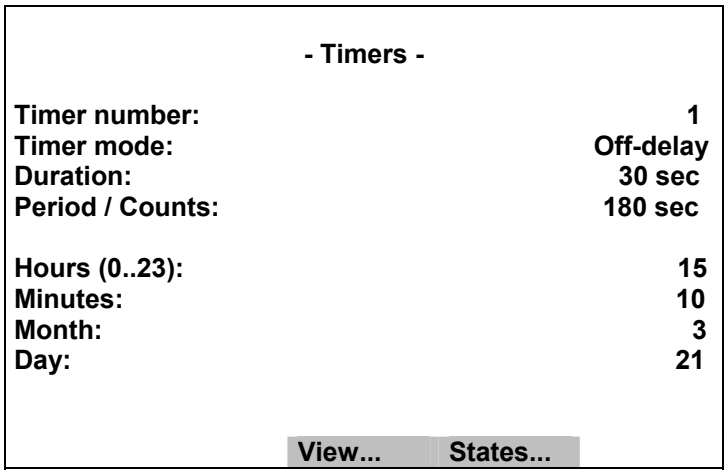


Picture 8-6: Listing of Actions Assignment

8.3 Submenu 'Timers'

The setup of the timers is configured in the submenu 'Timers...".

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Timers...
↓



PLCTMRNUMC [1..8]
PLCTMRMODC [see Table 8-1]
PLCDURATC [1..3600]
PLCTIMC [1..3600] **/ PLCUC** (variable unit)

PLCHOURC
PLCMINUTC
PLCMONTHC
PLCDAYC

fct3: **PLCTMRLST_**
fct4: **PLCTMRSTAT_**

Picture 8-7: Timers Setup of System PLC

The single timers are configured by first selecting the timer number itself (currently 1...8).

Further configuration parameters depend on the mode the timer has to run in. Therefore the mode has to be elected as next.

In following table see the selectable timer modes and the related meaning of the rest of the parameters.

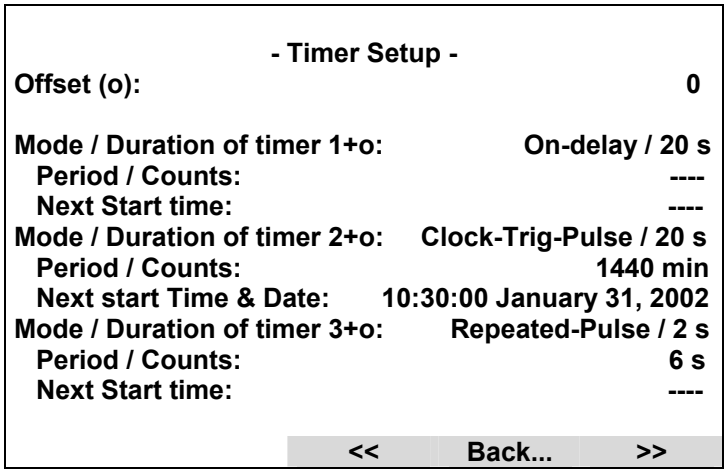
Table 8-1: Different Timer Modes and the Related Meaning of the other Parameters

Timer mode	Off-delay	On-delay	Repeated-Pulse	Single-Pulse	Retrig-Single-Pulse	Inhib-Single-Pulse	Clock-Trig-Pulse	Counter
Duration	delay time	delay time	True pulse width	True pulse width	min. True pulse width	min. True pulse width	True pulse width	-
Period/ Counts	-	-	period time [seconds]	-	-	-	Interval time [minutes]	Preset count value
Hours Minutes Month Day	-	-	-	-	-	-	date/time of next triggering the pulse	-

For more information on the different timer modes see also chapter "7 Time controlled Logic".

It is possible to show a listing of the timers' configuration.

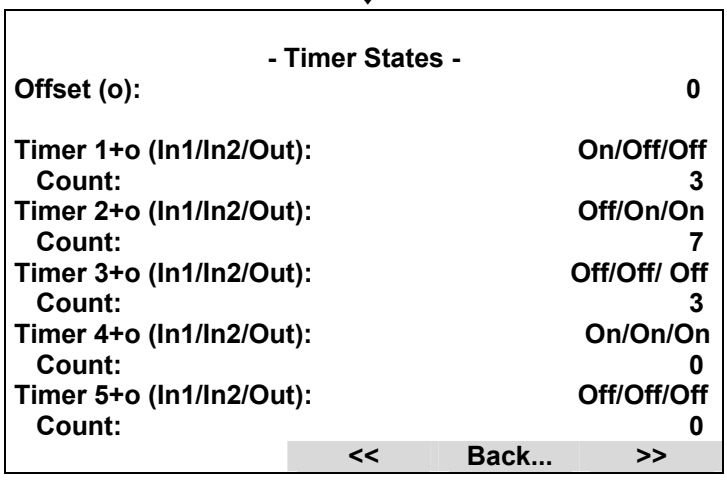
System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Timers...
↓
View...
↓



Picture 8-8: Listing of Timers' Configuration

It is possible to show the actual states of timers' inputs and outputs as well as the current counting to perform the different timing functions.

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Timers...
↓
States...
↓

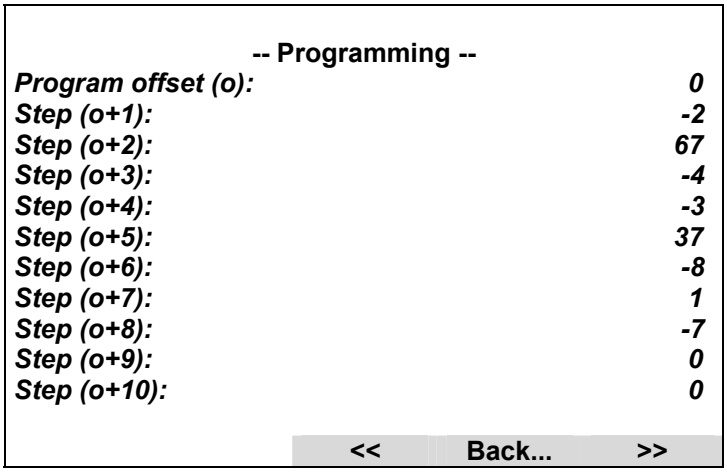


Picture 8-9: Display of Timers' States

8.4 Submenu 'Programming'

After having done the setup of the signals and eventually necessary timers we can do the programming of PLC algorithm itself. It is done in the submenu 'Programming...".

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Programming...
↓



Picture 8-10: Programming the System PLC

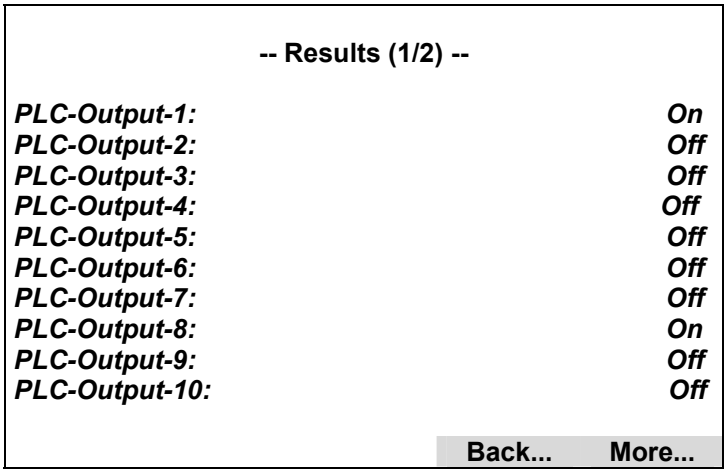
If we want to assign the signals not by means of the menu but via LON variable access we have to be aware of following:

1. The PLC-programming as well as the programming for the system calculator happens indirectly via the edit variable-array ED_INTx.
   To differ what the programming is for there exists the LON variable PROGTYP.
   Setting PROGTYP = 0 means we want to program the system calculator.
   Setting PROGTYP = 1 means we want to program the system PLC.
2. By using the variable LISTOFFSET we determine what part of the whole programming list we want to program.
   For example, setting LISTOFFSET = 60, means by usage of ED_INT1...ED_INT10 we are able to modify the program steps 61...70.

8.5 Submenu 'Results'

The results of the PLC calculations can be observed in the submenu 'Results...".

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Results...
↓

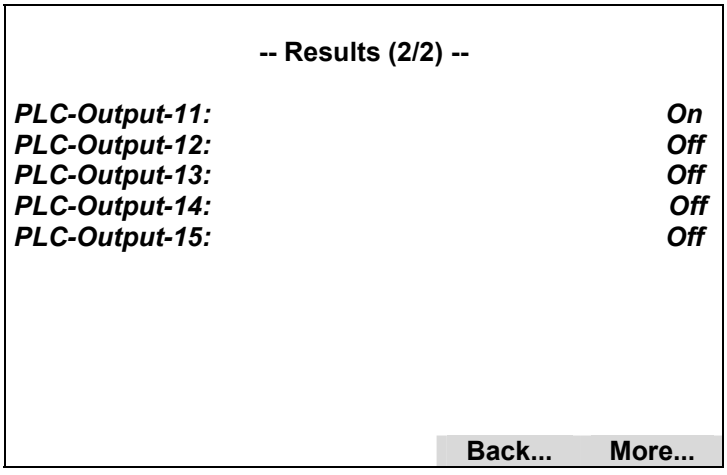


PLCRESULT1
PLCRESULT2
PLCRESULT3
PLCRESULT4
PLCRESULT5
PLCRESULT6
PLCRESULT7
PLCRESULT8
PLCRESULT9
PLCRESULT10

Picture 8-11: Display of the System PLC Results

fct4: **ESCAPE**
fct5: **PLCRESULTS2**

System configuration and diagnostics...
↓
System programmable logic control (PLC)...
↓
Results...
↓
More...
↓



PLCRESULT11
PLCRESULT12
PLCRESULT13
PLCRESULT14
PLCRESULT15

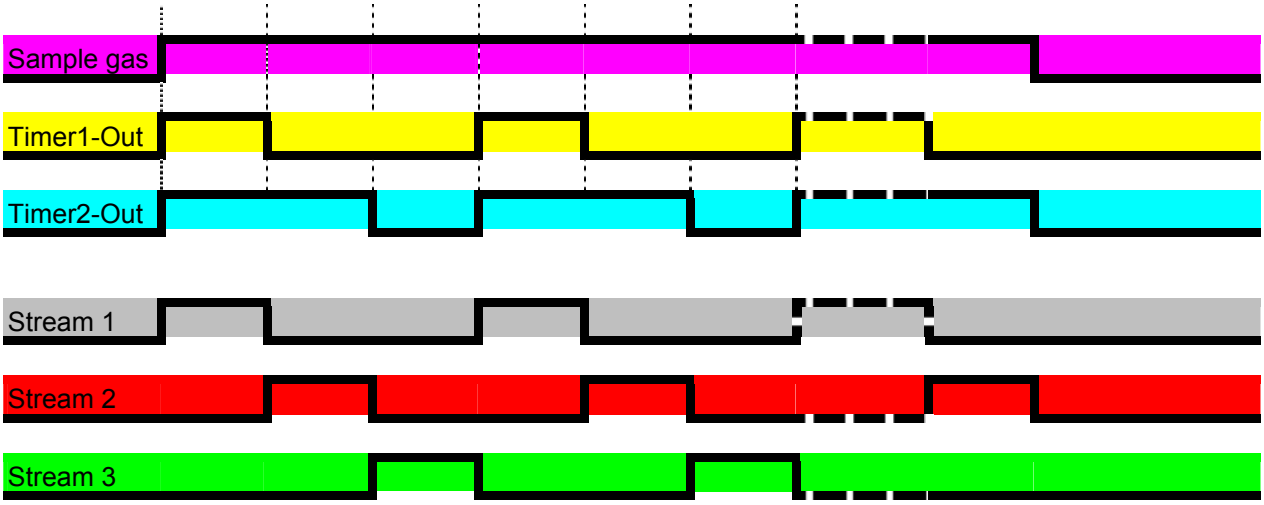
9 Applications

9.1 Stream Control with an active System Calibration

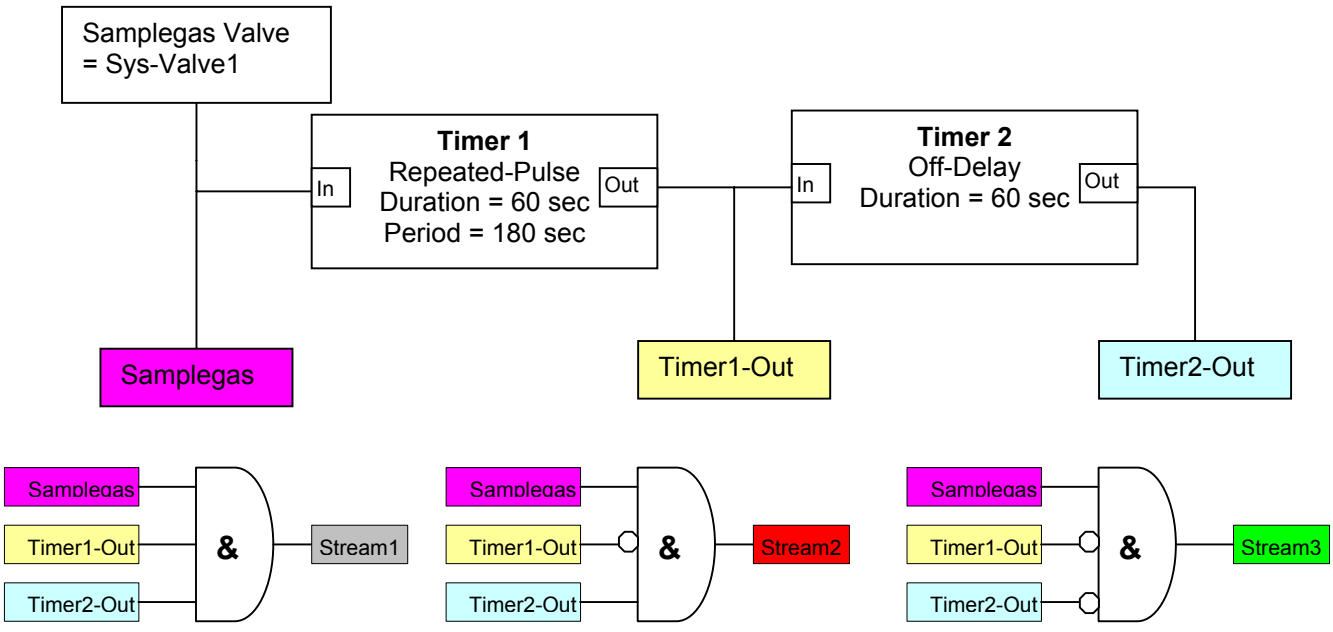
If the system calibration is in the 'sample gas state' we do not want to have only one sample gas stream flowing but alternating 3 gas streams.

To realize this, we could use 2 timers which give us 3 different signal combinations. These 3 signal combinations are evaluated in that way that for each combination one of the streams is switched on.

Timer1-Out	Timer2-Out	Stream 1	Stream 2	Stream 3
On	On	On	Off	Off
Off	On	Off	On	Off
Off	Off	Off	Off	On



To vary the switching durations we only have to configure the both timers.



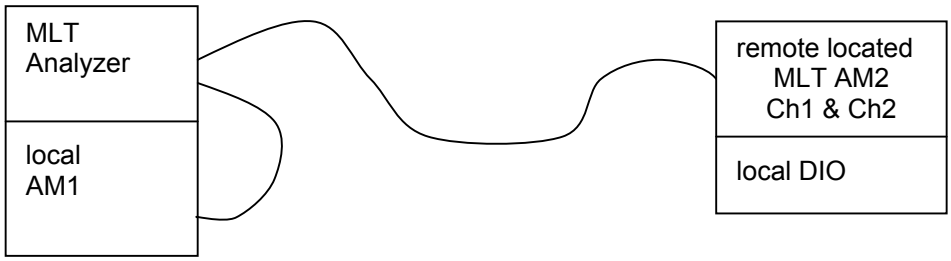
For the program we presuppose following assignments:

Programmable Logic Control (PLC) on Control Module Level
Input-ID 65 = Control Module: Sys.-Valve1
PLC-Result 1 = Stream 1
PLC-Result 2 = Stream 2
PLC-Result 3 = Stream 3

Step (1)	-9	LOAD
Step (2)	65	Control-Module SYS:Valve-1 (= Input-Signal 65)
Step (3)	-5	STORE to
Step (4)	31	Timer1-Input1 (= Output-Signal 31)
Step (5)	-9	LOAD
Step (6)	31	Timer1-Output (= Input-Signal 31)
Step (7)	-5	STORE to
Step (8)	32	Timer2-Input1 (= Output-Signal 32)
Step (9)	-1	
Step (10)	-1	
Step (11)	-9	LOAD
Step (12)	65	Control-Module SYS:Valve-1 (= Input-Signal 65)
Step (13)	-3	AND
Step (14)	31	Timer1-Output
Step (15)	32	Timer2-Output
Step (16)	-5	STORE to
Step (17)	1	PLC-Result1 (= Output-Signal 1) => Stream 1
Step (18)	-1	
Step (19)	-1	
Step (20)	-9	LOAD
Step (21)	31	Timer1-Output
Step (22)	-4	INVERT
Step (23)	-3	AND
Step (24)	65	Control-Module SYS:Valve-1
Step (25)	32	Timer2-Output
Step (26)	-5	STORE to
Step (27)	2	PLC-Result2 (= Output-Signal 2) => Stream 2
Step (28)	-1	
Step (29)	-1	
Step (30)	-9	LOAD
Step (31)	31	Timer1-Output
Step (32)	-2	OR
Step (33)	32	Timer2-Output
Step (34)	-4	INVERT (build: not Timer1-Output and not Timer2-Output)
Step (35)	-3	AND
Step (36)	65	Control-Module SYS:Valve-1
Step (37)	-5	STORE to
Step (38)	3	PLC-Result3 (= Output-Signal 3) => Stream 3
Step (39)	-7	End of program

9.2 Remote Valve Switching with an active System Calibration

We have a MLT AM involved in a system calibration. But the MLT AM is not located nearby the platform device but in a certain distance.



Here we have the possibility to give the MLT AM2 valve switching commands via the LON network correspondingly to the activated system valves of the system calibration utility.
These commanded valve states can be put onto the digital outputs of a local DIO board resp. onto the relays of a local SIO board.

We presuppose the following situation:

System calibration Module setup	AM1-Ch1	MLT-AM2/CH1	MLT-AM2/CH2
Samplegas-Valve	Valve-1	Valve-1	Valve-1
Zerogas-Valve	Valve-2	Valve-2	Valve-2
Spangas1-Valve	Valve-3	Valve-3	Valve-4
Spangas2-Valve	Valve-3	Valve-3	Valve-4
Spangas3-Valve	Valve-3	Valve-3	Valve-4
Spangas4-Valve	Valve-3	Valve-3	Valve-4

For the local DIO board of MLT-AM2 we do the following setup:

setup of local DIO on AM2	Signal code	Signal-Description
Output #1	155	External Signal #1 of Ch1
Output #2	156	External Signal #2 of Ch1
Output #3	157	External Signal #3 of Ch1
Output #4	158	External Signal #4 of Ch1

For the inputs signal pool of the System PLC we do following assignment:

Signal ID	Assignment
71	Control Module: SYS:Valve-1
72	Control Module: SYS:Valve-2
73	Control Module: SYS:Valve-3
74	Control Module: SYS:Valve-4

For the action pool of the System PLC we do following assignment:

Signal ID	Assignment
1	MLT-AM2/CH1: ExtStatus1
2	MLT-AM2/CH1: ExtStatus2
3	MLT-AM2/CH1: ExtStatus3
4	MLT-AM2/CH1: ExtStatus4

The System PLC program could look like as follows:

Programmable Logic Control (PLC) on Control Module Level

Step (1)	-9	LOAD
Step (2)	71	Control-Module SYS:Valve-1 (= Input-Signal 71)
Step (3)	-11	CALL action
Step (4)	1	ExtStatus1 of MLT-AM2/CH1 (= Action #1)
Step (5)	-9	LOAD
Step (6)	72	Control-Module SYS:Valve-2 (= Input-Signal 72)
Step (7)	-11	CALL action
Step (8)	2	ExtStatus2 of MLT-AM2/CH1 (= Action #2)
Step (9)	-9	LOAD
Step (10)	73	Control-Module SYS:Valve-3 (= Input-Signal 73)
Step (11)	-11	CALL action
Step (12)	3	ExtStatus3 of MLT-AM2/CH1 (= Action #3)
Step (13)	-9	LOAD
Step (14)	74	Control-Module SYS:Valve-4 (= Input-Signal 74)
Step (15)	-11	CALL action
Step (16)	4	ExtStatus4 of MLT-AM2/CH1 (= Action #4)
Step (39)	-7	End of program

NGA 2000

Software Manual

Supplement: System Calibration

NGA Software Version 3.9.X

Table of Contents

1 Introduction

Beside the possibility to zero and span each analyzer or analyzer module (MLT/CAT 200 channel) individually and independently from the others, ***System Calibration*** (**SYSCAL**) allows to combine the calibration procedures of **ALL Analyzer Modules** (AM's) of an **NGA 2000 analyzer system** into a **common process**.

This is been achieved with a new assignment of the valves. The idea is not longer to require for each gas of each analyzer an own valve.
Instead of we have a pool of valves. The valves of this pool can be assigned to the different gases of the analyzers. That also means different analyzers can share the same valve for their gases. So we have the possibility to reduce the number of valves and also the consumption of calibration gases.

The program, which will allow this, runs on the **Control Module** (CM) level and needs **programmable Input/Output Modules** (I/O's: **DIO** and **SIO**) on control module level too (CM [system] I/O's located in a platform or MLT, CAT 200 or TFID analyzer):

SIO: Standard I/O module with 2 to 8 analog outputs, RS 232/485 and 3 relay contacts

DIO: Digital I/O board with 8 digital inputs and 24 digital outputs

System calibration allows to use those outputs - relay contacts or digital outputs - to run calibration valves after assigning the valves to certain outputs (of course: physical connections between I/O's and valves are required as well!).
The assignment has to be done in a proper way which is described in the next chapters.

The displayed menus are also inscribed with the appropriate LON Variables.

2 Valves for system calibration

Before using the system calibration we have to put together the required valve pool. There are three types of I/O modules supporting this:

- DIO - 24 digital outputs / 8 digital inputs (max. 4 modules per CM)
- SIO - 3 digital outputs [relay contacts] (max. 1 module per CM)
- [CVU - 4 digital outputs (max. 4 modules per CM) – in progress; not available, c.f.]

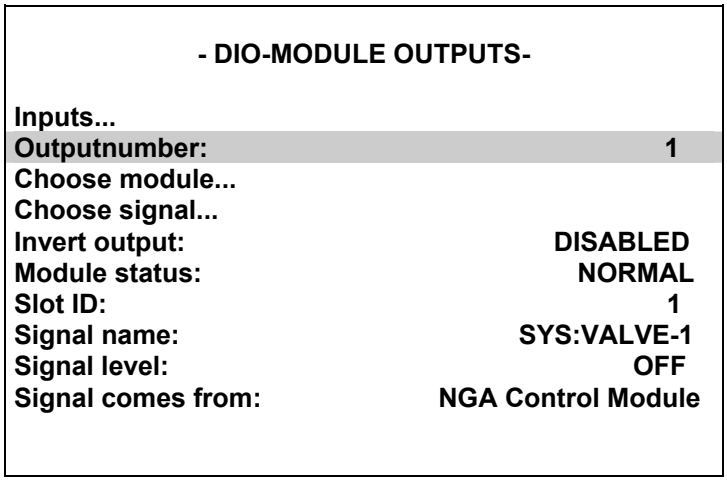
Software supports up to 32 system valves.

2.1 Assigning an output port to a system valve

Assigning of an output can be accomplished by using the menus for selected output module (DIO, SIO or CVU [c.f.]).
There we have to select the NGA Control Module as the Source Module. Control module then provides the signals for system valve V1...V32.

For example the DIO:

Analyzer and I/O module expert configuration...
↓
I/O module controls...
↓
DIO module(s)...
↓



There we have to

- select "Outputnumber"
- then choose ”NGA Control Module“ as module
- then choose the wanted valve “SYS: VALVE-x“ as signal

It is also possible to configure the DIO outputs via LON Variables (i.e. SLTA adapter or protocol).

Therefore is the LON variable "DIOOUT_ENTRYSIG" which corresponds to “DIOOUTSIGC“ and evaluates enum values of “ST1NAME” (enum values 0..19), “ST2NAME” (enum values 20..39) or “ST3NAME” (enum values 40..59).

For digital output we have to set-up variables in following order.

1. DIOSLOTIDC
2. DIOOUTNUMC
3. DIOOUTSRCC
4. DIOOUT_ENTRYSIG SYS: VALVE-1 = 20 (enum value in ST2NAME)
   SYS: VALVE-2 = 21
   . .
   . .
   . .
   SYS:VALVE-32 = 51 (enum value in ST3NAME)

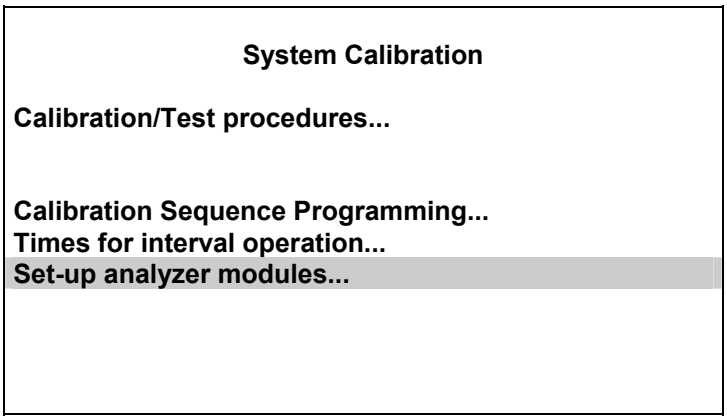
For each needed system valve we have to repeat these appropriate selections.

It is also possible to distribute the system valves onto different output modules.

3 Operating System Calibration

Because there are many possibilities how to use SYSCAL it must be customized through the Expert Operator. There we can find the menu “System Calibration“ from were we can do the required set-ups and start routines.

System configuration and diagnostics...
↓
System calibration...
↓



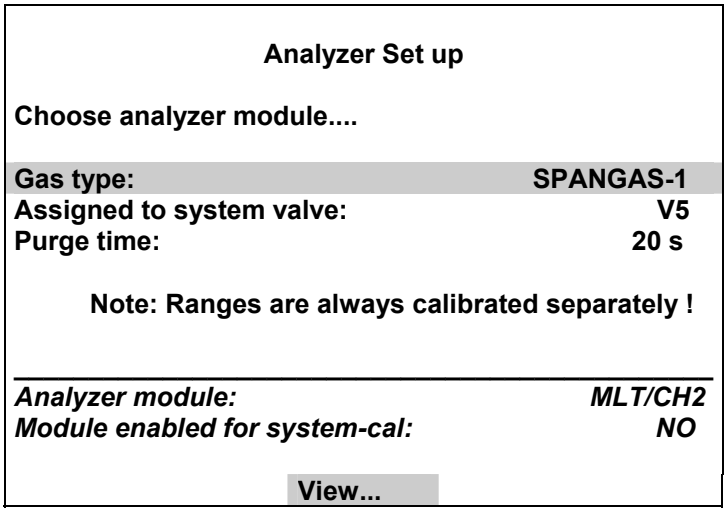
Meaning of displayed menu points:

- Calibration/Test procedures...: starting and stopping of system calibration and test procedures
- Calibr. Sequ. Programming...: programming of user defined calibration sequences
- Times for interval operation...: setting up of automatically started system calibrations
- Set-up analyzer modules...: include and set-up different analyzer modules into system calibration.

3.1 Set-up analyzer modules

Before we can run any system calibration features we have to include the different analyzer modules (**AM's**) into system calibration by set-up needed parameters. Only after correct setting up, an AM is included into system calibration and only then it makes sense to go into the other menus.

System configuration and diagnostics...
↓
System calibration...
↓
Set-up analyzer modules...
↓



SCAMGAS
SCVALVE
SCPURGE
SCMODULE
SCCONTROL

Setting up an AM for system calibration means **assigning valves from system valve pool.** The Control Module provides support of up to **32 system-valves** V1....V32. We have to decide which valves deliver which gases for an analyzer module. Also we have to know the purge time from a valve to the AM.

For each of the following types in the parameter „Gas type" we have to assign a valve and the appropriate purge time :

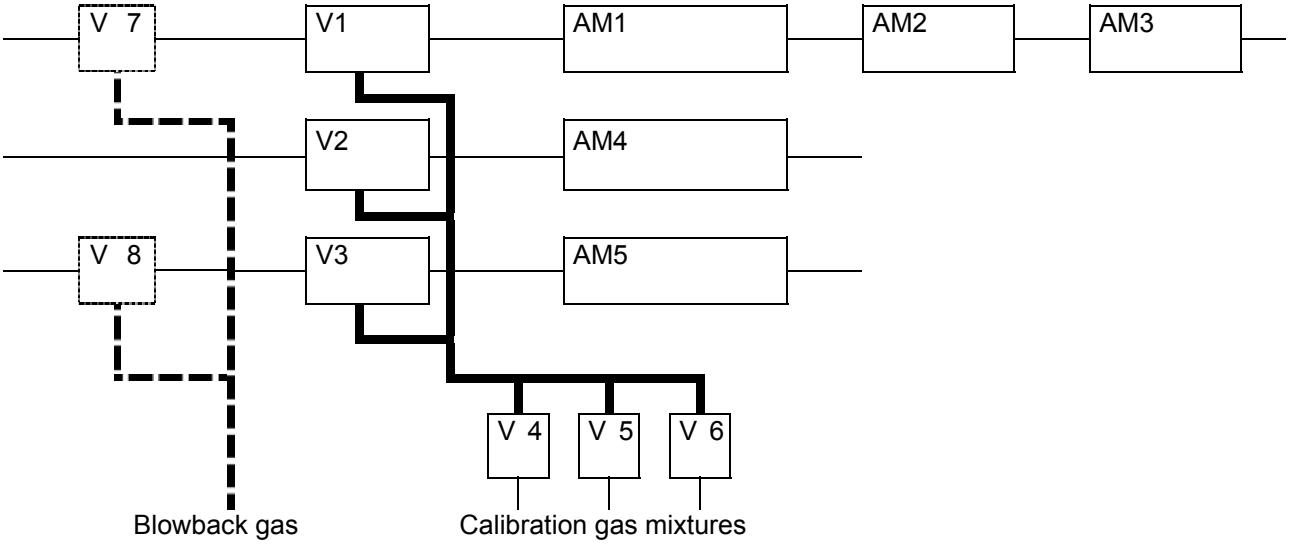
- SAMPLE-GAS
- ZERO-GAS
- SPANGAS-1 (span gas for range 1)
- SPANGAS-2 (span gas for range 2)
- SPANGAS-3 (span gas for range 3)
- SPANGAS-4 (span gas for range 4)

Optionally we can assign a blowback valve but this is not mandatory.

Conditions for the assignment:

- **Once a valve has been assigned to be a sample gas valve for any AM it must not be used for zero or span gases !**
- **The zero valve of an AM can not be a span valve of the same AM.**
- **All upper gas types have to be assigned to a system-valve.**
- **If we assign a blowback valve it must not be used for any other gases.**

Example for an analyzer system:



Appropriate assignment:

	AM1	AM2	AM3	AM4	AM5
SAMPLE-GAS	V1	V1	V1	V2	V3
ZERO-GAS	V4	V4	V5	V5	V6
SPANGAS-1	V5	V5	V4	V6	V5
SPANGAS-2	V5	V5	V4	V6	V5
SPANGAS-3	V6	V5	V4	V4	V4
SPANGAS-4	V6	V5	V4	V4	V4
BLOWBACK	V7	V7	V7	-	V8

As we can see, additionally we can assign **blowback valves** in the "Gas Type" set-up. In the upper example these are valves V7 and V8.
The blowback valve is switched on then during a blowback procedure, all other valves are switched off.
The blowback procedure looks for the purge times which are configured for this blowback valves. For the procedure is taken then the **maximal purge time** of the assigned blowback valves.

This entire assigning procedure is to perform for all analyzer modules which should be included in system calibration.
To display the assigned valves and purge times for each AM we can push the soft key „View...“.

If we want to exclude an AM from SYSCAL we can do this by entering an invalid valve.
We can watch in the display whether an AM is enabled for system calibration.

Attention: Remember to assign a system valve to an output port!

3.2 Programming Calibration Sequences

Beside the standard programs “zero calibration“ and “zero/span calibration“ it is possible to run the system calibration in an user definable order of up to 40 steps.

The menu to set-up this feature looks as follows.

System configuration and diagnostics...
↓
System calibration...
↓
Calibration sequence programming...
↓

-- Calibration Sequence Programming --		
Step #:	**1**	**SCSTEP**
Calibration procedure type:	**ZERO-CAL**	**SCCALTYPE1**
Choose specific analyzer module...		
Select all analyzer modules!		
Program steps 1-10...		
Program steps 11-20...		
Program steps 31-40...		
Analyzer-module:	***MLT/CH3***	**SCSTEPMOD**

For programming the sequence you must

1. select “Step #“
2. select “Calibration procedure type“
3. select module

Repeat this order for all program steps.

The programmable “Calibration procedure types“ are:

1. NoOp	no operation (for deleting a step in an existing program)
2. Zero-Cal	do a zero calibration
3. Span-Cal	do a span-calibration for all available ranges
4. Zero/Span-Cal	do a zero-cal then a span-cal for all available ranges
5. Span1-Cal	do a span calibration only for range #1
6. Span2-Cal	do a span calibration only for range #2
7. Span3-Cal	do a span calibration only for range #3
8. Span4-Cal	do a span calibration only for range #4
9. END-OF-PGRM	end of sequence
10.Blowback	do a blowback

For each step we have the choice to select a specific AM or to activate the step for all enabled AM's.

After the program is input, the appropriate menu can give an overview of the current program:

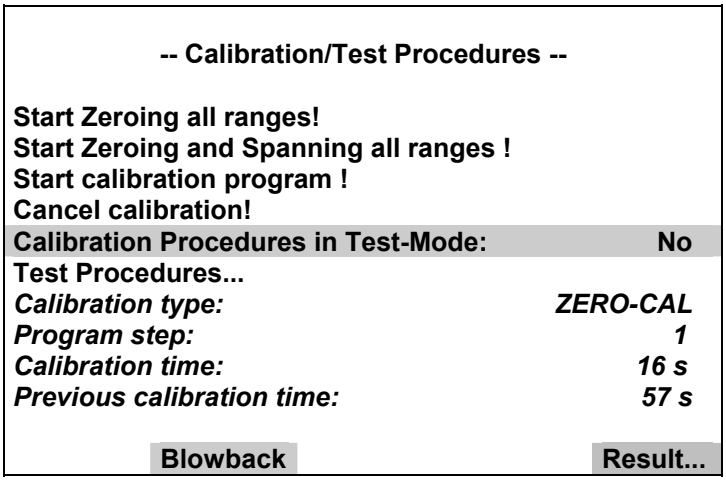
-- Calibration Sequence Program --

Step #1:	***Zero-Cal:ALL***
Step #2:	***Span-Cal: FID***
Step #3:	***Span-Cal: CLD***
Step #4:	***Span1-Cal:MLT/CH1***
Step #5:	***Span2-Cal:MLT/CH1***
Step #6:	***Span3-Cal:MLT/CH1***
Step #7:	***Span4-Cal:MLT/CH1***
Step #8:	***Span3-Cal:MLT/CH2***
Step #9:	***END-OF-PROGRAM***
Step #10:	***END-OF-PROGRAM***

3.3 Set-up general parameters

One general parameter is "Calibration Procedures in Test-Mode". It is located in the menu "Calibration/Test procedures".

System configuration and diagnostics...
↓
System calibration...
↓
Calibration/Test procedures...
↓



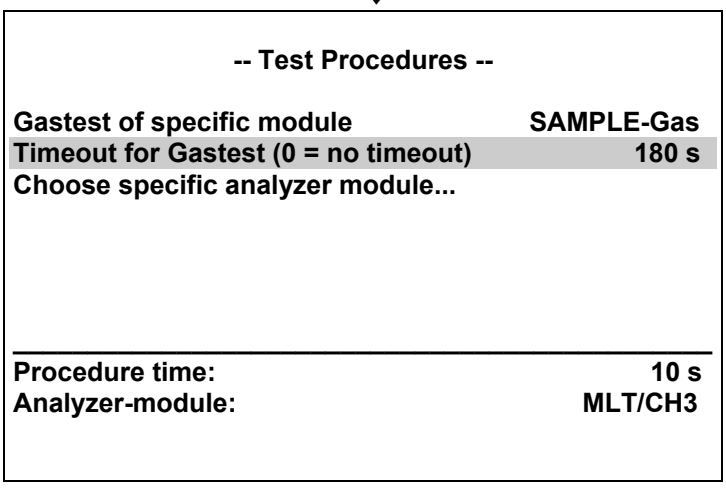
SCTESTMOD

SCCALTYPE2
SCPROGSTEP
SCCALTIME1
SCCALTIME2

With this parameter we can run all the calibration procedures either in the defined mode or in a test mode. The test mode means that the valve switching and waiting for purge times is done in the same manner like in the normal calibration procedure.
The only difference is that the single **calibrations** of the modules and the appropriate times the modules would need for the calibration **are not done**.

A further general parameter is "Timeout for Gastest". It is located in the menu "Test procedures".

System configuration and diagnostics...
↓
System calibration...
↓
Calibration/Test Procedures...
↓
Test procedures...
↓



SCTESTGAS
SCTIMEOUT

SCCALTIME1
SCSTEPMOD

This parameter is related to the possibility to activate a gas valve of a specific module for test purposes. Here we can determine a time after which an activated gas test automatically switches back onto SAMPLE-Gas.
Is this parameter set to "0" no automatic back switching is done.

3.4 Controlling System Calibration

After setting-up there is the possibility to start 3 different modes:

system zero-calibration:	In this mode a zero-cal of all modules, which are enabled for SYSCAL, will be performed. The order of modules depends on purge time for zero-valves because the whole calibration is time optimized.
system zero/span-calibration:	In this mode will be performed a zero-cal and a span-cal for every enabled AM. The order of calibration is optimized to have a minimum of calibration time. The only condition is to have for each AM first the zero-cal and after this the span-cal. With zero-cal an AM is zeroed with all ranges together, the span-cal is done separately for all available ranges. A range is available if its span-gas value is > 0.0.
user defined sequence program:	In this mode the user is responsible for the optimization. See set-up of this mode.
blowback procedure:	In this mode are switched off the assigned sample gas and calibration gas valves. An assigned blowback valve is switched on.
gas test:	It is also possible to switch for test purposes onto a specific gas of a specific module. A calibration is not done.

Any mode can be started by the following instances:
- Manually by operator interaction
- Triggered by programmable input (DIO)
- protocol command
- Programmed time-automatic (no gas test possible!)
- LON Variable “CMFUNC »

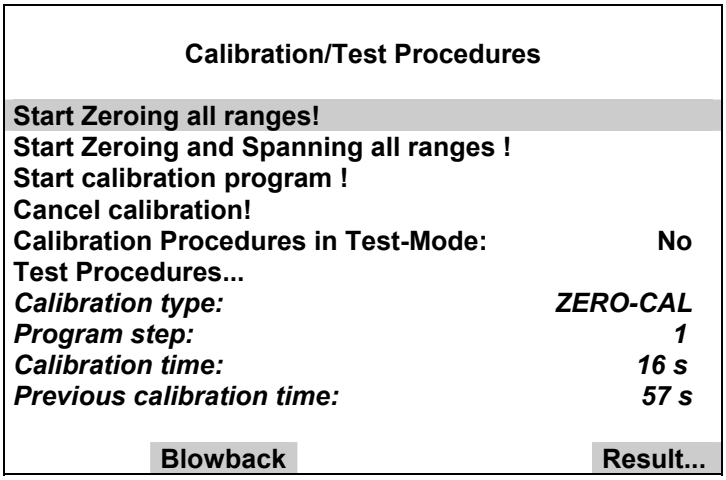
It is also possible to cancel a running system calibration. This can be done by the following instances:
- Manually by operator interaction
- Triggered by programmable input (DIO)
- protocol command
- LON Variable “CMFUNC”

There is no priority by which way SYSCAL can be started. If SYSCAL was started it can not be restarted by a further instance. Only after canceling it can be restarted.

3.4.1 Control via menu system

The possibility to control via menu is located in the menu page „Calibration/Test procedures“. There can be started and stopped any kind of system calibration respectively test procedure.

System configuration and diagnostics...
↓
System Calibration...
↓
Calibration/Test procedures...
↓



SCTESTMOD

SCCALTYPE2
SCPROGSTEP
SCCALTIME1
SCCALTIME2

During a running SYSCAL there can be watched current information:

- running calibration type
- running program step of user defined program (other modes than user program show a „0“!)
- consumed calibration time
- calibration time of last valid SYSCAL

The result of calibration for included AM's is displayed in an own menu page. This can be achieved by soft key "Result..." from different menu pages of SYSCAL.

- Calibration Results -		
Choose analyzer module...		
Analyzer-module:	**CLD**	**SCMODULE**
Enabled for system-cal:	**No**	**SCCONTROL**
Result of last run:	**OK**	**SCLRESULT**
Successfully calibrated ranges:	**1+2+4**	**SCVALIDITY**
Zero-Cal fail of any analyzer module:	**NO**	**SCRESULT1**
Span-Cal fail of any analyzer module:	**YES**	**SCRESULT2**

Remember to run the calibration procedures as a test without actually to calibrate assert parameter "Calibration Procedures in Test-Mode" to <Yes>.

It is also possible to switch for test purposes onto a specific gas of a specific module. This possibility is located in menu "Test procedures".

System configuration and diagnostics...
↓
System Calibration...
↓
Calibration/Test Procedures...
↓
Test procedures...
↓

-- Test Procedures --		
Gastest of specific module	**SAMPLE-Gas**	**SCTESTGAS**
Timeout for Gastest (0 = no timeout)	**180 s**	**SCTIMEOUT**
Choose specific analyzer module...		
Procedure time:	**10 s**	**SCCALTIME1**
Analyzer-module:	**MLT/CH3**	**SCSTEPMOD**

Here we first choose the specific analyzer module and then we select at the parameter "Gastest of specific module" the required gas.

Each of the following types is possible:

- All closed
- Zero-Gas
- SAMPLE-Gas (test mode deactivated)
- SpanGas-1 (span gas for range 1)
- SpanGas-2 (span gas for range 2)
- SpanGas-3 (span gas for range 3)
- SpanGas-4 (span gas for range 4)
- Blowback

With parameter "Timeout for Gastest" we can determine a time after which the activated gas test switches automatically back onto SAMPLE-Gas.

Is this parameter set to "0" the automatic back switching is not done automatically and user must break this mode with a "Cancel Calibration" Command.

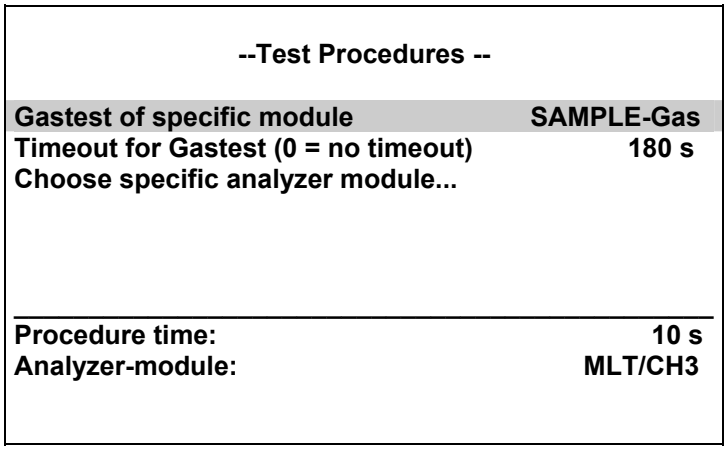
3.4.2 Control System Calibration by LON Variables

SYSCAL can also be controlled by LON Variable CMFUNC. Setting this variable will cause the appropriate function (see following table).

CMFUNC	function which is started
1	system zero-calibration
2	system zero/span-calibration
3	user defined sequence program
4	cancel a running system calibration
5	blowback procedure

We can also realize some other functionality with setting of LON Variables.
Therefore see the appropriate menu pages, where the concerned variables are documented.

For example: "Test procedures".



Here we have first to set variable SCSTEPMOD similar to the TAG of the requested analyzer module. Setting SCTIMEOUT will set the timeout.
And setting variable SCTESTGAS to the appropriate enum value will start the procedure.

Table of enum values and procedures:

SCTESTGAS-function	????	Zero-Gas	SAMPLE-Gas	Span Gas-1	Span Gas-2	Span Gas-3	Span Gas-4	Blowback
enum value	0	1	2	3	4	5	6	7

3.4.3 Control System Calibration by Programmable Input

We can use the possibility to control SYSCAL by triggering with a programmable input. This feature is supported by inputs of the DIO Module.
Assigning of an programmable input can be accomplished by using the menus for DIO module.

Analyzer and I/O-module expert configuration...
↓
I/O module controls...
↓
DIO module(s)...
↓
Inputs...
↓

-- DIO- Module Inputs --

Inputnumber:	**5**	**DIOINPNUMC**
Choose module...		
Choose function...		
Slot ID:	**1**	**DIOSLOTIDC**
Signal name:	**SYS:Cancel-Cal**	**DIOINPSIGC**
Signal level:	**OFF**	**DIOINPSTATC**
Signal comes from:	**Control Module**	**DIOINPSRCC**

There we have to select
1. wanted input number
2. the appropriate module as Source Module (see following table)
3. the wanted function for system calibration

The provided functions for system calibration are:

function	source module	function (positive edge)	function (negative edge)	enum value in STINAME
SYS:Zero-Cal	CM	start system zero-calibration	-	6
SYS:Zero/Span-Cal	CM	start system zero/span-calibration	-	7
SYS:Program-Cal	CM	start user defined sequence program calibration	-	8
SYS:Cancel-Cal	CM	stop a running procedure and disable any start commands	enable starting commands	9
SYS:CAL-Test-Mode	CM	switches into test mode	switches off test mode	10
SYS:AM-Zero-Gas	AM	switches zero gas-valve	stop a running procedure	11
SYS:AM-Span-Gas1	AM	switches span gas-valve for range 1	stop a running procedure	12
SYS:AM-Span-Gas2	AM	switches span gas-valve for range 2	stop a running procedure	13
SYS:AM-Span-Gas3	AM	switches span gas-valve for range 3	stop a running procedure	14
SYS:AM-Span-Gas4	AM	switches span gas-valve for range 4	stop a running procedure	15
SYS:Blowbackl	CM	start system blowback procedure	-	22

Please take notice that all actions are edge-triggered. Therefore take care of functionality of positive as well as negative edge.

It is also possible to configure the DIO inputs only per LON Variables (i.e. SLTA-adapter or protocol). Therefore is the LON variable "DIOINP_ENTRYSIG" which corresponds to “DIOINPSIGC” and evaluates enum values of “STINAME”.

For each digital input we have to set-up variables in following order.

1. DIOSLOTIDC
2. DIOINPNUMC
3. DIOINPSRCC
4. DIOINP_ENTRYSIG (see enum value in STINAME)

3.4.4 Control System Calibration by protocol command

We can start and stop SYSCAL over serial interface by protocol commands. Therefore the commands **SCAL, STBY** and **ASTZ** has to be used.

Start-Command: SCAL Kx m (n)

m (type of SYSCAL)	Kx (channel number)	n (optional parameter)
0 = ZERO-CAL	K0	n = 1: switch into test mode
1 = ZERO/SPAN-CAL	K0	
2 = PROGRAM	K0	else: switch into normal mode
3 = TEST ZERO-GAS	K1...999	timeout in sec
4 = TEST SPAN-GAS1	K1...999	timeout in sec
5 = TEST SPAN-GAS2	K1...999	timeout in sec
6 = TEST SPAN-GAS3	K1...999	timeout in sec
7 = TEST SPAN-GAS4	K1...999	timeout in sec
8 = TEST CLOSE GASES	K1...999	timeout in sec
9 = BLOWBACK	K0	not used

If optional parameter n is not in command string the appropriate variable is not changed.

Starting condition: All attached AM's are in the Standby-Mode (AK STBY) and the variable CALSTAT is 0, otherwise the response is BUSY (BS).

Stop-Command: STBY K0

Only using K0 will stop running SYSCAL-procedure (besides all the procedures of the other AM's).

Check-Command: ASTZ K0

The ASTZ K0 command gives the information if a SYSCAL-procedure is running or not.
If running it returns a "SCAL" if not this string is missed.

3.4.5 Time controlled System Calibration

To activate a time controlled system calibration we have to set-up this in own menu pages. For each of the time controlled procedures exists an own menu page.

System configuration and diagnostics...
↓
System Calibration...
↓
Times for interval operation...
↓

-- Times for Zero Interval Operation --

Zero-Cal is:	**ENABLED**	**SCSTZERO**
Start time		
Month:	**2**	**SCBGNZERO1**
Day:	**20**	**SCBGNZERO2**
Hours:	**10**	**SCBGNZERO3**
Minutes:	**15**	**SCBGNZERO4**
Interval time:	**24 h**	**SCIVZERO**
Next calibration events...		
Time & Date:	**15:26:10 February 19, 2001**	**S_TIME**

ZeroSpan **Program** **Blowback**

System configuration and diagnostics...
↓
System Calibration...
↓
Times for interval operation...
↓
fct2: ZeroSpan
↓

-- Times for Zero&Span Interval Operation --

Zero&Span Cal is:	**DISABLED**	**SCSTZEROSPAN**
Start time		
Month:	**2**	**SCBGNZSPAN1**
Day:	**20**	**SCBGNZSPAN2**
Hours:	**10**	**SCBGNZSPAN3**
Minutes:	**15**	**SCBGNZSPAN4**
Interval time:	**24 h**	**SCIVZEROSPAN**
Next calibration events...		
Time & Date:	**15:26:10 February 19, 2001**	**S_TIME**

System configuration and diagnostics...
↓
System Calibration...
↓
Times for interval operation...
↓
fct3: Program
↓

-- Times for Program Cal Interval Operation --

Program Cal is:	**DISABLED**	**SCSTPRGM**
Start time		
Month:	**2**	**SCBGNPRGM1**
Day:	**20**	**SCBGNPRGM2**
Hours:	**10**	**SCBGNPRGM3**
Minutes:	**15**	**SCBGNPRGM4**
Interval time:	**24 h**	**SCIVPRGM**
Next calibration events...		
Time & Date:	**15:26:10 February 19, 2001**	**S_TIME**

System configuration and diagnostics...
↓
System Calibration...
↓
Times for interval operation...
↓
fct5: Blowback
↓

-- Times for Blowback Interval Operation --

Blowback is:	**DISABLED**	**SCSTBLOWB**
Start time		
Month:	**2**	**SCBGNBLOWB1**
Day:	**20**	**SCBGNBLOWB2**
Hours:	**10**	**SCBGNBLOWB3**
Minutes:	**15**	**SCBGNBLOWB4**
Interval time:	**24 h**	**SCIVBLOWB**
Next calibration events...		
Time & Date:	**15:26:10 February 19, 2001**	**S_TIME**

For the different SYSCAL-modes there is the possibility to

- enable/disable the time controlled activation
- determine start time of activities (date/time of current year)
- determine in which time intervals after start time the activation is done

Attention:
Other than in some AM-functionalities the interval time is to be input as interval hours. For example, for a weekly calibration you have to calculate 24 h * 7 = 168 h.

Is the input date/time before present point of date/time then there are added further interval times until it is later.

We can display the calculated times in menu page „next calibration events“...
But these times will only appear when the appropriate time controlled procedure type is enabled.

System configuration and diagnostics...
↓
System Calibration...
↓
Times for interval operation...
↓
Next calibration events...
↓

Next Calibration Events		
Zero-Cal:	**10:15:00 February 22, 2003**	**Menu1Line**
Zero&Span-Cal:	**10:15:00 February 22, 2003**	**Menu2Line**
Program-Cal:	**10:15:00 February 22, 2003**	**Menu3Line**
Blowback:	**10:15:00 February 22, 2003**	**Menu4Line**
Time & Date:	**15:26:10 February 19, 2003**	**S_TIME**

3.5 Calibrate single Analyzers

Each specific analyzer has still the possibility to start a calibration over other instances than SYSCAL. For this functionality we now have some additional considerations.

- Do not start a calibration of a single AM during a running SYSCAL. This will confuse the valve switching and the calibration commands of SYSCAL. Therefore look also for all automatic start instances of an analyzer.

- A single calibration cannot use the purge times of system valve settings. Instead of we have to set-up the AM's own parameters in the manner to wait for the required purge time after a valve switching.

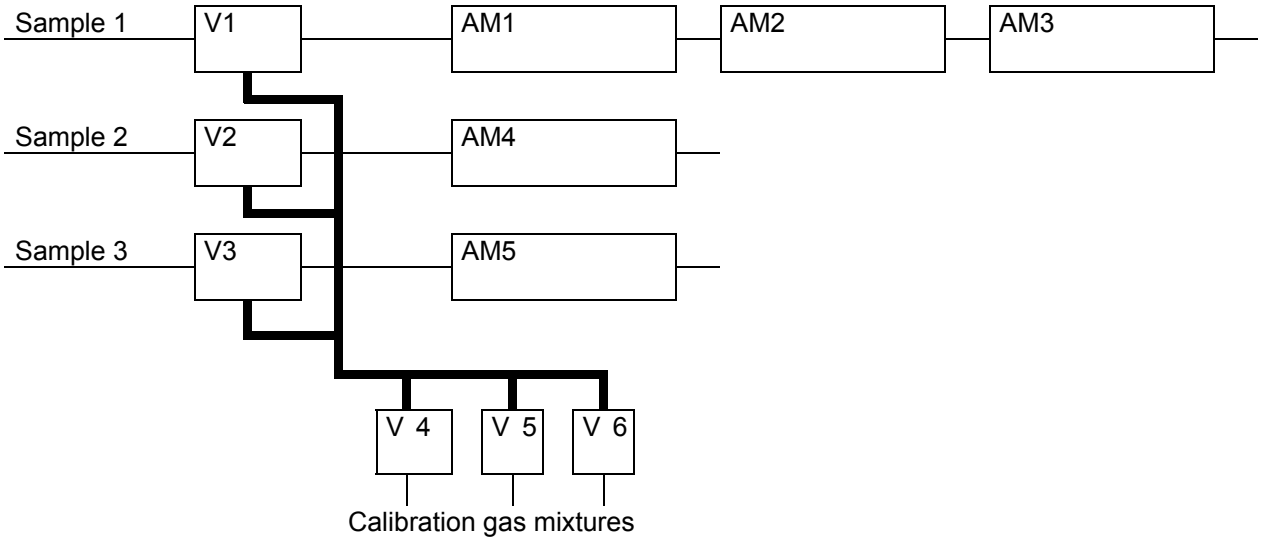
- It is refused to start single calibration of a second AM if the needed calibration gas valve is also any calibration gas valve of the first started AM.

These considerations are valid for all AM's which are included into SYSCAL.

4 Functionality

4.1 Gas flow

The gas flow through the analyzers can be configured in any way:
1. only serial
2. only parallel
3. serial and parallel mixed



Connections for program logic and flow configurations:

- To each AM (MLT/ CAT 200 channel) must be assigned a sample gas valve.
- During a calibration of an AM the assigned sample gas valve will be closed and returns to the OPEN-state after the calibration of the AM is done.
- The calibration gases can only flow into an AM if sample gas valve is closed.
- With a opened sample gas valve it is expected to actually flow sample gas.

The state of assigned sample gas valve also decides about some AM specific states!

4.2 Running system calibration

The system calibration is running in an own task. This task is only allowed to run once. Any try to restart this task is refused.

The main steps SYSCAL task has to do are realized in the following way.

1. Fill all actions to do into a **sequence buffer**.
2. Make some preparations before starting the actions
3. Work through the sequence buffer
4. Restore states and make some other finishing work

The contents of the sequence buffer depends on the type of SYSCAL (ZERO_ALL, ZEROSPAN_ALL or USER_PROG). With the start command this type is delivered.

It is allowed to cancel the SYSCAL task. This is realized by setting a parameter to a defined value. This parameter is watched during step 3("working through the sequence buffer").
If a cancel is caused the task cancels its current action in step 3, works through step 4 and ends.

Canceling the SYSCAL task per digital input will also disable any further starting action as long as the digital input will stay at “cancel state“.

4.2.1 Filling sequence buffer

The contents of the sequence buffer depends on
- calibration types and belonging module type
- coherence of modules and system valves

An evaluation procedure has the choice of listed action types.

Calibration types	module type
NOP	ALL-AM's
ZERO-CAL	single AM
SPAN-CAL	
ZERO/SPAN-CAL	
SPAN1-CAL	
SPAN2-CAL	
SPAN3-CAL	
SPAN4-CAL	
END-OF-PGRM	

Evaluation-procedure

action types	action data	
USER-STEP	Nr	
SWITCH_VALVE	mask	
PURGEWAIT	time	
ZERO	AM	
SPAN	AM	range
CALWAIT	AM	

One calibration type has following sequence frame:

1. SWITCH_VALVE
2. do different PURGEWAIT, ZERO, or SPAN which are possible with this valve adjustment (order is determined by shortest purge time)
3. do different CALWAIT (wait for finishing a started calibration)

The evaluation procedure optimizes the order of actions by time.
The only condition is in case of ZERO/SPAN-CAL, where an AM has to do first its "ZERO" before any of its "SPAN's" can be done.

The PURGEWAIT-delay-measurement is started with the last SWITCH_VALVE-action.

We can see, that the SYSCAL-types "ZERO_ALL" and "ZEROSPAN_ALL" are special cases of a user program.
- ZERO_ALL: ZERO CAL of ALL AM's
- ZEROSPAN_ALL: ZERO/SPAN CAL of ALL AM's

Example of a filled sequence buffer

Assignment of modules, system valves and purge times:

	AM1	AM2	AM3
SAMPLE-GAS	V1 / 5 sec	V1 / 5 sec	V2 / 4sec
ZERO-GAS	V4 / 10 sec	V4 / 10 sec	V5 / 12 sec
SPANGAS-1	V5 / 10 sec	V5 / 10 sec	V6 / 12 sec
SPANGAS-2	V5 / 10 sec	V5 / 10 sec	V6 / 12 sec
SPANGAS-3	V6 / 10 sec	V5 / 10 sec	V4 / 14 sec
SPANGAS-4	V6 / 10 sec	V5 / 10 sec	V4 / 14 sec

To do is following user program:

1. ZERO-CAL ALL modules
2. SPAN4-CAL AM2
3. END-OF-PGRM

Belonging sequence buffer:

action type	action data[0]	action data[1]
USER_STEP	1	
SWITCH_VALVE	0006 hex (V4, V2)	
PURGEWAIT	10	
ZERO	AM1	
PURGEWAIT	10	
ZERO	AM2	
CALWAIT	AM1	
CALWAIT	AM2	
SWITCH_VALVE	0011 hex (V5,V1)	
PURGEWAIT	12	
ZERO	AM3	
CALWAIT	AM3	
USER_STEP	2	
SWITCH_VALVE	0012 hex (V5, V2)	
PURGEWAIT	10	
SPAN	AM2	4
CALWAIT	AM2	
END-OF-PGRM		

The size of sequence buffer is currently 320.

4.2.2 Before starting actions

Before any action of sequence buffer is done there are some preparations to do:

- store previous calibration time for the case of canceling
- previous calibration time is now the actual one
- actual calibration time is reset
- cancel any running calibration of an AM

4.2.3 Control of actions

4.2.3.1 Switch valves

The SWITCH_VALVE action just takes the action data[0] (valve mask) for the new setting of system valves.
We have just to modify LON variable STCONT3, STCONT4 and partially STCONT5 , which are linked to system valves.

This action also resets time (takes system tick) for delay measurement of purge times.

4.2.3.2 Wait for Purging

The PURGEWAIT action looks for the present time went over since last SWITCH_VALVE action.

For the still required difference up to the needed purge time is now waited. It gives time to other tasks. If there is no additional time to wait it is continued directly with next action.

4.2.3.3 Zero Calibration

Before starting of zero calibration there are some parameters (LON variables) to modify. After ending system calibration these modified variables are restored to their previous value.

- CONTROL: This variable determines which instance is controlling range of an AM. The parameter is set to "controlled by control module"
- ZERORNGS: This variable determines if all ranges are zeroed together or separately. The parameter is set to "zero all ranges together".
- AMSERPHYSTAT: This variable exists only in a multi-channel AM (MLT!) and determines if the AM has a serial/parallel gas flow. The parameter is set to "parallel gas flow" because only this state allows SYSCAL to calibrate the different channels simultaneously.

After modifying these parameters zero calibration is started by LON variable:

- AMFN: This variable can start functions on a AM. It is set to the value for function "Zero".

4.2.3.4 Span Calibration

The span calibration can be done only in single ranges. Any action for a span calibration in a range can only be done if "span gas value <> 0.0".

Before starting then span calibration there are some parameters (LON variables) to modify. After ending system calibration these modified variables are restored to their previous value.

- CONTROL: This variable determines which instance is controlling range of an AM. The parameter is set to "controlled by control module"
- CALRANGES: This variable determines if all ranges are spanned together or separately. The parameter is set to "span all ranges separately".
- AMSERPHYSTAT: This variable exists only in a multi-channel AM (MLT!) and determines if the AM has a serial/parallel gas flow. The parameter is set to "parallel gas flow" because only this state allows SYSCAL to calibrate the different channels simultaneously.
- CRANGE: This variable controls the current range of an AM. It is set to the respectively required range.

After modifying these parameters span calibration is started by LON variable:

- AMFN: This variable can start functions on a AM. It is set to the value for function "Span".

4.2.3.5 Wait for Finishing Calibration

Any AM has the LON variables

- CALSTAT

Whether the selected AM is still calibrating or not, is checked by reading the variable CALSTAT.

This CALSTAT-check is done in time intervals. During the intervals time is given to other tasks.

4.2.4 Finishing System Calibration

After system calibration was working through the sequence buffer or it was canceled there is to do some finishing work.

- Actualize some displayed LON variables
- Look for some still running calibrations in case of canceling and cancel them, too.
- Restore modified LON variables of AM's.
- Switch system valves to sample gas state for all AM's
- Cause to set any AM's LON variable PROCESS = "valid sample gas" after purging time of sample gas valve.

4.3 Running Single Analyzer Calibration

A single analyzer calibration also needs to switch appropriate system valves.

The difference to the system calibration is that calibration procedure of AM is already running and we have to respond upon this state.

The reaction is possible by watching any change of the LON variable CALSTAT.

- CALSTAT_ZERO (zero calibration in progress): switch off belonging sample valve and switch on zero valve.
- CALSTAT_SPAN (span calibration in progress): switch off belonging sample valve and switch on span valve appropriate

  to current state of CRANGE-variable.
- CALSTAT_DONE (calibration finished): switch on sample valve and switch off calibration gas valves.

After a calibration command the AM itself is responsible to wait the required purge times until calibration actually is done.

The reaction onto a CALSTAT-change is only active if no system calibration is running.

4.4 Holding analog outputs of the SIO and avoid limit violation alarms

Any AM has LON variable:

- PROCESS

This variable is an input-variable. Its meaning is to tell the AM that another instance is not allowing the measurement sample to flow valid.

In the AM are some states depending from PROCESS.

- "valid measurement" only if PROCESS = "valid sample gas".
- holding analog outputs if PROCESS = "no valid sample gas"
- watching limit violations is switched off if PROCESS = "no valid sample gas"

It's now the task of the system calibration to handle the variable PROCESS for any involved AM. This is done in the following way:

Any switching of a system valve looks if in the switched valves is a sample valve of any AM. If yes, then it sets PROCESS like follows.

sample gas valve	**time delay**	**PROCESS-variable**
switched off	-	sample not valid
switched on	purge time of sample valve	sample valid

It's very important to notice following:

SYSCAL only watches state of appropriate sample gas valve for setting of PROCESS-variable.

Any additional valve, serial to sample valve, which can switch off flow of sample gas cannot be registered for logic of PROCESS variable.

NGA 2000

Additional AK Protocol Commands

NGA Software Version 3.9.x

SHDA Kn — deactivate “Hold” Status

Description: We have the possibility to activate the "Hold" feature not only per calibration. We can do this also by AK Command “SHDE”. With command “SHDA” we have the possibility to deactivate an activated "Hold" again.

see also: SHDE

SHDE Kn — activate “Hold” Status

Description: We have the possibility to activate the "Hold" feature not only per calibration. We can do this also by AK Command “SHDE”. With command “SHDA” we have the possibility to deactivate an activated "Hold" again.

see also: SHDA

SCAL Kx m (n) — start “System Calibration” procedures

Description: To control the system calibration procedures the commands “**SCAL”, “STBY”** and **“ASTZ”** have to be used. With “SCAL” the procedures are started. For more exact description of procedures see also "documentation of system calibration".

Starting condition:
All attached AMs are in the Standby Mode (AK STBY) and the variable “CALSTAT” is 0, otherwise the response is BUSY (BS).

Syntax:

m (type of SYSCAL)	Kx (channel number)	n (optional parameter)
0 = ZERO-CAL	K0	n = 1: switch into test mode
1 = ZERO/SPAN-CAL	K0	
2 = PROGRAM	K0	else: switch into normal mode
3 = TEST ZERO-GAS	K1...999	timeout in sec
4 = TEST SPAN-GAS1	K1...999	timeout in sec
5 = TEST SPAN-GAS2	K1...999	timeout in sec
6 = TEST SPAN-GAS3	K1...999	timeout in sec
7 = TEST SPAN-GAS4	K1...999	timeout in sec
8 = TEST CLOSE GASES	K1...999	timeout in sec
9 = BLOWBACK	K0	not used (NEW)

If optional parameter n is not in command string the appropriate variable is not changed.

Stop Command: STBY K0

Only using K0 will stop running “SYSCAL” procedure
(besides all the procedures of the other AM’s).

Check Command: ASTZ K0

The “ASTZ K0” command gives the information if a “SYSCAL” procedure is running or not.

If running it returns a “SCAL“ if not this string is missed.

ALIK Kn a b c — Output of Linearization curve

Description: With this command we can get x/y values of linearization curve. We can determine the wanted segment of the linearization curve and the intervals between the curve pairs.
This command is only possible with a MLT Analyzer.

Syntax:
- Kn: it is only a single channel call possible (no K0!).
- a: starting concentration of segment (in ppm)
- b: ending concentration of segment (in ppm)
- c: interval between the curve pairs (in ppm)

Conditions: a < b ; c > 0.0

Answer: ALIK s y1 x1 y2 x2 y3 x3 ...

s: error status
y: nominal value
x: actual value

Tables

Conversion Factors ppm ↔ mg/Nm³

Measuring Component (Species)	Chemical Formula	Factor for 273 K / 1013 hPa		Molecular Weight
		1 mg/Nm³ → n Vol.-ppm	1 Vol.-ppm → n mg/Nm³	M (g/mol)
Carbon monoxide	CO	0,80	1,25	28,01
Carbon dioxide	CO_2	0,51	1,96	44,01
Sulfur dioxide	SO_2	0,35	2,86	64,06
Nitric oxide (Nitrogen monoxide)	NO	0,75	1,34	30,01
Methane	CH_4	1,40	0,72	16,04
Ethane	C_2H_6	0,75	1,34	30,07
Ethylene	C_2H_4	0,80	1,25	28,05
Acetylene	C_2H_2	0,86	1,16	26,04
Propane	C_3H_8	0,51	1,97	44,10
Propylene	C_3H_6	0,53	1,88	42,08
Butane, n-	C_4H_{10}	0,39	2,59	58,12
Hexane, n-	C_6H_{14}	0,26	3,84	86,18
Butadiene	C_4H_6	0,41	2,41	54,09
Butene, Iso-	C_4H_8	0,40	2,50	56,11
Water Vapor	H_2O	1,24	0,80	18,02
Ammonia	NH_3	1,32	0,76	17,03
Nitrous oxide (Dinitrogen monoxide)	N_2O	0,51	1,96	44,01
Halon 1211	CF_2ClBr	0,14	7,38	165,36
Halon 1301	CF_3Br	0,15	6,64	148,91
Benzene	C_6H_6	0,29	3,48	78,11
Sulfur hexafluoride	SF_6	0,15	6,52	146,05
Methanol	CH_3OH	0,70	1,43	32,04
Ethanol	C_2H_5OH	0,49	2,06	46,07
Dibromomethane	CH_2Br_2	0,13	7,76	173,83
Dichloromethane	CH_2Cl_2	0,26	3,79	84,93
Acetone	CH_3COCH_3	0,39	2,59	58,08
Ethyl iodide (Ethane, iodo-)	C_2H_5I	0,14	7,00	156,97
Bromodichloromethane	$CHBrCl_2$	0,14	7,31	163,83
Perchloroethylene	C_2Cl_4	0,14	7,40	165,83
Bromomethane	CH_3Br	0,24	4,24	94,94
Dichloroethane (Ethylene dichloride)	$C_2H_4Cl_2$	0,23	4,42	98,96

Measuring Component (Species)	Chemical Formula	Factor for 273 K / 1013 hPa		Molecular Weight
		1 mg/Nm³ → n Vol.- ppm	1 Vol.-ppm → n mg/Nm³	M (g/Mol)
Carbon tetrachloride (Tetra chloromethane)	CCl_4	0,15	6,86	153,82
Trichloroethane	$C_2H_3Cl_3$	0,17	5,95	133,40
Ozone	O_3	0,47	2,14	48,00
Styrene ($C_6H_5CHCH_2$)	C_8H_8	0,22	4,65	104,15
Bromochloromethane	CH_2BrCl	0,17	5,77	129,39
Chloromethane	CH_3Cl	0,44	2,25	50,48
Nitrogen dioxide	NO_2	0,49	2,05	46,01
Ozone	O_3	0,47	2,14	48,00
Mercury	Hg	0,11	8,95	200,59
Acetone	CH_3COCH_3	0,39	2,59	58,08
Bromoform (Tribromomethane)	$CHBr_3$	0,09	11,28	252,73
Sulfur dioxide	SO_2	0,35	2,86	64,06
Methyl iodide	CH_3I	0,16	6,33	141,94
Phosgene	$COCl_2$	0,23	4,41	98,92
Hydrogen cyanide	HCN	0,83	1,21	27,03
Chlorine	Cl_2	0,32	3,16	70,91
Acetic acid	CH_3COOH	0,37	2,68	60,05
Ethylene oxide	C_2H_4O	0,51	1,97	44,05
Hydrogen sulfide	H_2S	0,66	1,52	34,08
Bromine	Br_2	0,14	7,13	159,81
Formaldehyde	HCHO	0,75	1,34	30,03
Vinylchloride	CH_2CHCl	0,36	2,79	62,50
Trimethyl amine	$N(CH_3)$	0,38	2,64	59,11
Bromotrichloromethane	$CBrCl_3$	0,11	8,85	198,29
Methyl amine (H_2NCH_3)	CH_3NH_2	0,72	1,39	31,05

Remarks:

Volume Concentration (ppm) x Density (@ 273 K, 1013 hPa) =
Mass Concentration (mg/Nm³)

Norm Density = Mol weight (g/Mol) ÷ Mol volume (Nl/Mol)

Mol Volume = 22,414 Nl/Mol Norm Conditions: 273 K, 1013 hPa

Requirements: Ideal Gases with sufficient dilution!

A

B

C

N

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R

S

U

V

Z

NGA 2000 MLT Software

Instruction Manual
HAS3xE-IM-SW39
10/2005

WORLD HEADQUARTERS
ROSEMOUNT ANALYTICAL EUROPE
Emerson Process Management
GmbH & Co. OHG
Industriestrasse 1
63594 Hasselroth
Germany
T 49 6055 884 0
F 49 6055 884209

Emerson Process Management
Rosemount Analytical Inc.
6565 P Davis Industrial Parkway
Solon, OH 44139 USA
T 440.914.1261
Toll Free in US and Canada 800.433.6076
F 440.914.1271
e-mail: gas.csc@EmersonProcess.com
www.raihome.com

GAS CHROMATOGRAPHY CENTER
AND LATIN AMERICA
Emerson Process Management
Rosemount Analytical Inc.
11100 Brittmoore Park Drive
Houston, TX 77041
T 713 467 6000
F 713 827 3329

EUROPE, MIDDLE EAST AND AFRICA
Emerson Process Management
Shared Services Limited
Heath Place
Bognor Regis
West Sussex PO22 9SH
England
T 44 1243 863121
F 44 1243 845354

ASIA-PACIFIC
Emerson Process Management
Asia Pacific Private Limited
1 Pandan Crescent
Singapore 128461
Republic of Singapore
T 65 6 777 8211
F 65 6 777 0947
e-mail: analytical@ap.emersonprocess.com

EMERSON™
Process Management