Operating Manual

FTC320

Gas analysis using thermal
conductivity measurement

messkonzept
ANALYTICAL TECHNOLOGY

About this manual

Thank you for using the Messkonzept FTC320. It has been designed and manufactured using the highest quality standards to give you trouble-free and accurate measurements.

All information of technical nature and particulars of the product and its use (including the information in this manual) are given by Messkonzept in good faith. However, it is acknowledged that there may be errors or omissions in this manual. Images and drawings may not be in scale. For the latest revisions to this manual contact Messkonzept or visit www.messkonzept.de.
Messkonzept welcomes comments and suggestions relating to the product and this manual.

Please Note! The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from information contained in this manual.
Important! In correspondence concerning this instrument, please specify the model and serial number as given on the label on the right side of the instrument.

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This manual applies to: FTC320
Date of Release: July 19, 2023

Quick Installation Guide

For quick installation of the FTC320 we recommend reading the following chapters of this manual:

- Chapter 1 "Operator Safety": Important warnings, safety instructions and intended use.
- Chapter 3 "Assembly of the Instrument": Mounting, pneumatic and electric connection. Also see Chapter 10 "Appendix: Dimensional Drawing"
- Section 7.1 "Calibration": Recommended calibration intervals, the calibration process and recommended test of functionality after bringing into service.

Contents

Chapter 1

Operator Safety

This section provides information and warnings which must be followed to ensure safe operation and retain the instrument in safe condition. Read this section carefully before installing the device and using the software.

1.1 Notes on Safety Conventions and Icons

draws attention to application errors or actions that can lead to safety risks, including injury to persons or malfunctions - possibly even destruction of the device.

This icon indicates an additional function or hint.

Startup Safety Notes

- For the safe operation of the device, please pay attention to all instructions and warnings in this manual.
- Start operating the device only after it has been installed properly. A competent and authorized person is required for installation, connection, and operation of the device. Please read and follow this manual for the installation.
- Defective devices must be disconnected from the process! This applies for apparent damage to the device, such as physical damage, but also in the case of unclarified malfunctions in the operation. Separate the device from the process pneumatically (both gas inlet and gas outlet) and remove the power supply from the device.
- Make sure that the electric installation protection against accidental contact adheres to the applicable safety regulations.
- Pay regard to the local regulations and circumstances regarding electrical installations.
- Repairs should only be carried out by Messkonzept.

1.2 Intended Use

- Messkonzept GmbH does not assume any liability in case of improper handling of the measuring device. Improper handling can cause hazards due to malfunction of the measuring device.
- The FTC-series of gas analyzers offer high-precision measurement and detection of non-corrosive, dust-, condensate-, aerosol and oil mist-free gases (unless the design of the equipment is explicitly declared to be suitable for this purpose). Please contact info@messkonzept.de for detailed information and solutions.
- The specifications listed in the appendix of these operating instructions reflect the conditions under which the products described here may be operated. Individual requirements resulting from the customer's measuring task are determined and recorded with the Measuring Task Questionnaire (German: Messaufgabe 2.01.1FB180619MPL1V007, English: Measuring Task 2.01.1FB180619MPL1V007). Requirements that are not specified by the customer in the questionnaire are not taken into account in the mandatory evaluation of the measuring task by Messkonzept GmbH. In the evaluation of the measurement task by Messkonzept GmbH, it is also recorded whether the measurement task can be carried out with the proposed devices. In addition, restrictions can be demanded by Messkonzept GmbH, which must then be implemented by the customer. These restrictions can include, for example, special conditioning of the measuring sample by filter measures and measuring gas coolers or specifications of the pressure and flow rate ranges.
- FTC-series gas analyzers do not have a metrology marking in the sense of EU directive 2014/32/EU. They can, therefore, also not be used in medical or pharmaceutical laboratory analyses or in the manufacture of pharmaceuticals in pharmacies based on a doctor's prescription.
- The device must not be used in hazardous areas of explosion protection. Only FTC320 measuring instruments marked EX II 3G Ex nR IIC T4 Gc are suitable for use in ATEX- Zone 2.
- **Flammable gases:** Depending on the design, the measuring device is also suitable for the introduction of flammable gases. Whether this is the case can be found in the device log under the item "Glass bead filling". Measuring instruments with glass bead filling are also suitable for the introduction of combustible gases. The interior of the housing is tightly filled with glass balls (Ø 0.6mm). Due to the dense filling with the inert material, the volume that can be filled by a gas in the measuring device is reduced and segmented to such an extent that no explosive zone is created in the measuring device even if there is a leak in the measuring gas path.
- **Explosive gases:** Our gas detectors are designed in such a way that gases introduced up to temperature class T3 will not ignite if operated properly; the maximum surface temperature is below 200 °C. Users of our gas detectors must always carry out an individual risk assessment before such use, from which the necessary protective measures are to be derived and implemented. The use of flame arresters as part of the individual concept for handling ignitable mixtures is strongly recommended. If desired, we will be pleased to submit an individual offer to you if you require flame arresters. Please use only devices with the glass bead filling option described above even with this hazard.
- Check the function and tightness of our gas detectors, the connections and piping and the protective devices after installation and then at regular intervals during operation, especially in the event of severe stresses, such as shocks, vibrations, and corrosive attacks from inside or outside. If you

detect or suspect a malfunction in one of our gas detectors or the protective device, immediately disconnect the affected gas detector from the power supply and stop the gas supply immediately.

- The housing of the FTC320 must never be opened, in particular in case of devices filled with glass beads. After opening, the necessary filling density is no longer given. The guarantee becomes void if you open the housing of the FTC320.
- The device and cables must be effectively protected from damage and from UV light (protective roof when installed outdoors).
- The gas path inside the device is free of oil and grease and suitable for applications with pure oxygen ("Cleaned for Oxygen"). For such applications, contamination, such as that caused by the introduction of not oil-free compressed air, must be avoided.

Note: Please keep this manual for future use.

Chapter 2

Principle of Measurement

2.1 Determining Concentrations via Thermal Conductivity

Thermal Conductivity Detectors (TCD) have been used in the chemical industry since the 1920s as the first process gas analyzers for the quantitative composition of gas mixtures. Every gas has a unique heat conductivity that is governed by its molar mass and viscosity. The measurement is based on the principle that the thermal conductivity of a gas mixture is dependent on the thermal conductivity of its gas components and their fractional amounts in the mixture. Thus, the concentrations of different components of a gas mixture can be calculated from thermal conductivity.

The main advantage of the TCD's measurement principle compared with the widespread infrared analysis technique is that it is not limited to gases with a permanent dipole moment. It can identify noble gases (He, Ar, Ne, etc.) as well as homonuclear gases such as H_2 and N_2. Furthermore, it is robust and cost effective.

The principle of thermal conductivity measurement works best if the analyzed gas components' thermal conductivity varies greatly. For TC measurement-based analysis, one of the following conditions must be met:

- The mixture contains only two different gases (binary mixture), e.g., CO_2 in N_2 or H_2 in N_2
- The thermal conductivity of two or more components is similar but different than that of the measuring gas, e.g., measuring H_2 or He in a mixture of O_2 and N_2 (quasi binary mixture)
- The mixture contains more than two gases and the volumetric fractions of all but two components (or component groups) are constant over time
- The mixture contains more than two gases, of which all but two components' concentrations can be determined through other measurement principles (as employed in the FTC400 through cross-sensitivity compensation of IR- and TC-sensor information).

The thermal conductivity of gases rises with temperature and the slope of the increase with temperature is different for different gases. Upon request, it can be checked whether the temperature of heat sink and/or source should be changed in order to improve the accuracy or to avoid cross-sensitivity effects.
Cross-sensitivity is the sensitivity of the measurement on other gases than the measured component. Perturbation-sensitivity means the sensitivity of the measurement to other influences than the gas-composition, e.g., the gas pressure.

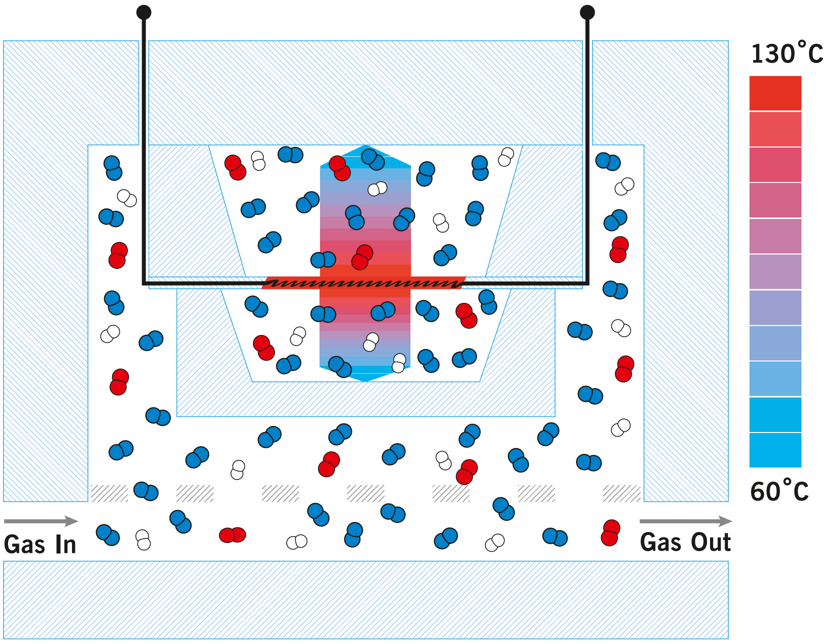


Figure 2.1: Schematic drawing of thermal conductivity measurement. The sensor is comprised in the stainless-steel block which is kept at a constant temperature.

The FTC320 contains a thermal conductivity sensor that analyzes the quantitative composition of gas mixtures. The measurement is based on the heat transfer between a heat source and a heat sink.

The measuring gas is led through a stainless-steel block that is kept at a constant temperature of 63°C (for most applications). The block temperature is stabilized using a control loop - it serves as a heat sink of constant temperature. A micro mechanically manufactured membrane with a thin-film resistor serves as a heat source. A control loop stabilizes the membrane temperature at 135°C (for most applications).

Above and below the membrane two small cavities are etched into the silicon. These cavities are filled with measuring gas by diffusion. The surfaces opposite the membrane are thermally connected with the heat sink. Through maintaining a constant temperature gradient between the two opposite surfaces, the heat flow is dependent on the gas mixture's thermal conductivity alone. Hence the voltage needed to keep the membrane temperature constant is a reliable measure for the thermal conductivity of the mixture and can be used further to determine the gas mixture's composition.

Measuring Gas	Carrier Gas	Basic range	Smallest range	Smallest suppressed zero range	Multi Gas Mode
H_2	O_2	0% - 100%	0% - 0.5%	98% - 100%	Yes
H_2	N_2 / air	0% - 100%	0% - 0.5%	98% - 100%	Yes
H_2	Ar	0% - 100%	0% - 0.4%	99% - 100%	Yes
H_2	He	20% - 100%	20% - 40%	85% - 100%	On request
H_2	CH_4	0% - 100%	0% - 0.5%	98% - 100%	On request
H_2	CO_2	0% - 100%	0% - 0.5%	98% - 100%	On request
He	N_2 / air	0% - 100%	0% - 0.8%	97% - 100%	Yes
He	Ar	0% - 100%	0% - 0.5%	98% - 100%	Yes
CO_2	N_2 / air	0% - 100%	0% - 3%	96% - 100%	Yes
CO_2	Ar	0% - 60%	0% - 10%	-	Yes
Ar	N_2 / air	0% - 100%	0% - 3%	96% - 100%	Yes
Ar	CO_2	40% - 100%	-	80% - 100%	Yes
CH_4	N_2 / air	0% - 100%	0% - 2%	96% - 100%	Yes
CH_4	Ar	0% - 100%	0% - 1.5%	97% - 100%	Yes
O_2	N_2	0% - 100%	0% - 15%	85% - 100%	Yes
O_2	Ar	0% - 100%	0% - 2%	97% - 100%	Yes
N_2	Ar	0% - 100%	0% - 3%	97% - 100%	Yes
N_2	CO_2	0% - 100%	0% - 4%	96% - 100%	On request
NH_3	H_2	0% - 100%	0% - 5%	95% - 100%	On request
CO_2	H_2	0% - 100%	0% - 2%	99% - 100%	On request
SF_6	N_2 / air	0% - 100%	0% - 2%	96% - 100%	On request

Table 2.1: Measuring ranges of typical gas compositions for analysis with the FTC320.

As mentioned in section 1.2, explosive gases should not be led into the device without suitable protective measures. It is the responsibility of the user to prepare a risk assessment and to derive suitable protective measures from it.

For flammable gases, such as H_2, CH_4, etc., the use of a FTC320 with the option “glass-beads filling“ is strongly recommended. If a mixture of a combustible gas with an inert gas is present in a mixing ratio such that even adding any amount of air will not make the mixture explosive, it is called totally inert. Totally inert gas mixtures may be introduced into a FTC320 device without glass ball filling.

“Basic range“ is the largest possible measuring range and is set by default. The linearization is performed over the basic range. The smallest measuring ranges at the beginning and the end of the basic range are facilitated through specific calibration. The smallest possible range between the basic range and the smallest ranges at the end beginning and the end of the range can be estimated by linear interpolation.

The Multi Gas Mode (MGM) is a configuration that allows for the consecutive measurement of different gas pairs. The gas pair can be switched through the control panel or via the RS232-interface. Gas pairs labeled “Yes“ in Table 2.1 are commonly used. Gas mixtures labelled “On request“ can also be implemented upon request.

2.2 FTC320 Detector Unit

The FTC320 is a highly precise and stable Thermal Conductivity Detector (TCD) that is designed for use as a gas detector. The unit consists of a hermetically sealed pressure proof stainless-steel block with a gas duct, which is suited for pressures up to 20 bar. Sample gas entering through the gas inlet is guided to the micro-mechanical thermal conductivity sensor and further downstream to the outlet port. The pneumatics are designed to minimize the influence of a changing gas flow. The operating temperature of 63°C is stabilized by a highly accurate PI control loop.
In order to avoid electrical interference on the measuring output, the high-performance analog adaption circuit is directly mounted on top of the stainless-steel block. The Processor board digitizes the signal in a 24bit A/D converter. The micro-controller performs all calculations, such as linearization, calibration, and cross sensitivity compensation directly on the detector unit.

Chapter 3

Assembly of the Instrument

3.1 Installation of the FTC320

The FTC320 is designed for wall fastening. The four mounting holes are shown in Figure 3.1. M4 cylinder head bolts are suitable. Please remember to keep additional space for adequate assembly of gas hoses and cables (see Chapter 10 "Appendix: Dimensional Drawing" for more information).

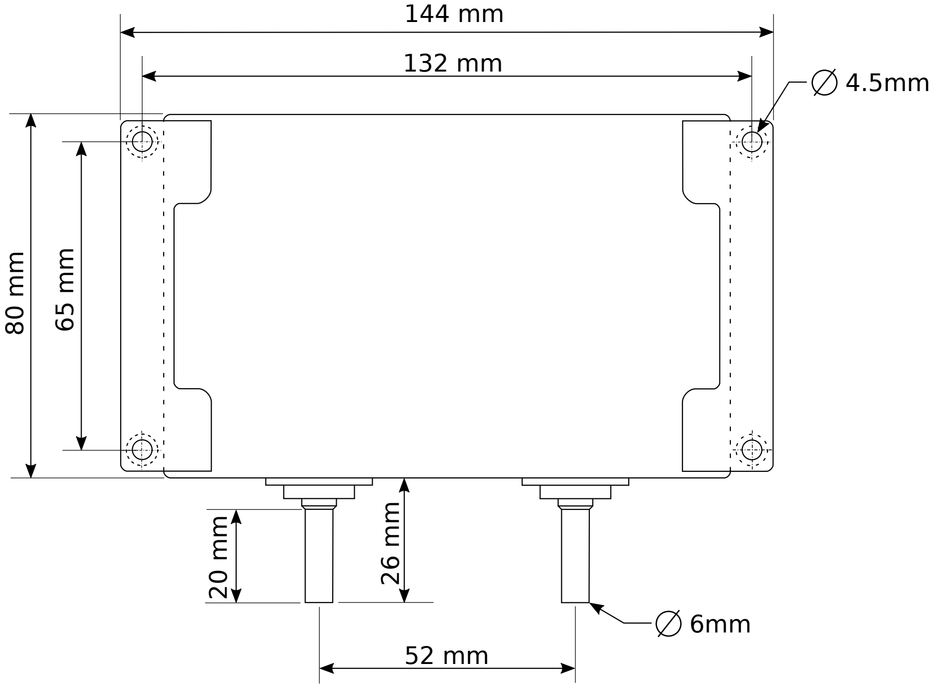


Figure 3.1: Mounting holes shown from the rear side of the housing.

If you are planning to lead flammable or toxic gases into the device, the device must be installed in a well-ventilated area. All devices undergo a leakage test during production, nevertheless a limited release of small gas quantities is possible.

3.2 Gas Ports

On the bottom of the FTC320 housing two tubes with 6mm outer diameter for gas connection are located. They are labeled with “GAS IN “ and “GAS OUT“.
For low requirements regarding gas tightness and resistance to pressure, the tubes can be used as hose connectors. For permanent gas and pressure tightness compression fittings are recommended (e.g. by “Swagelok“©).
After connecting the device, a leakage test should be performed (especially when working with flammable and/or toxic gases).

3.3 Electrical Connectors and Ground

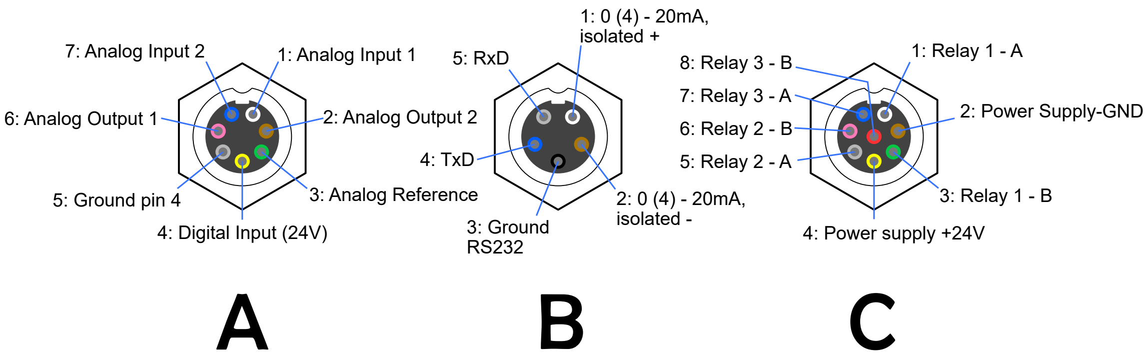


Figure 3.2: Electrical connector pin assignments of the three connectors on the FTC320

The FTC320 has three plug connectors as shown in Figure 3.2. The cables (712, IP67) with molded connector plug and a length of two meters (five meters available on request) are part of the purchased parts package. The cables have open ends. The cross-section of the conductors in cable A and C is 0,14mm^2, for cable B 0,25mm^2. Cable A is shipped with devices set up for analog output.

The protection class of the device is only effective with all cables attached. In case cable A is not used, connector plug A must closed with an end fitting.

3.3.1 Requirements for Electrical Connectors

Before using the device make sure that the power supply is in accordance with the specifications of the device and that all electric connections correspond to the information given in this manual.

The FTC320 is a device of protection class III. For power supply a source with PELV specification (Protective Extra Low Voltage) according to EN 60204-1 must be used. See also Section 3.3.2 "Ground". The potential-free relay contacts must also be monitored with a power supply unit with PELV specification.

3.3.2 Ground

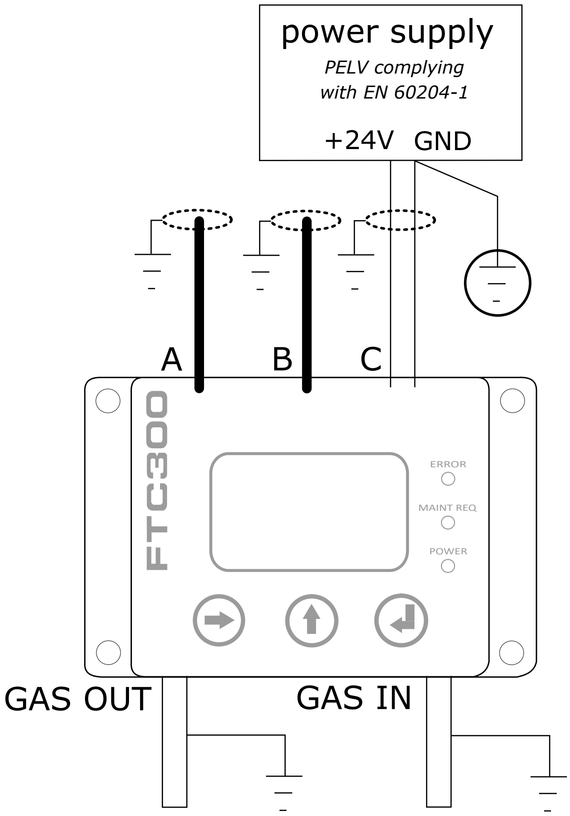


Figure 3.3: Grounding the FTC320

To comply with EN 60204-1 and to ensure your device's function, the device has to be installed such that the power supply (PELV) is connected to protective earth (PE) with its ground conductor, see Figure 3.3. The shielding of cables A, B and C should be connected to functional ground. Dependent on the circumstances, gas inlet and gas outlet can be grounded in addition. Connections to the ground should be made with short low-resistant cables of large diameter.

3.3.3 Data exchange via serial interface (RS-232)

The serial interface, often called UART (Universal Asynchronous Receiver Transmitter), is based on the RS-232 standard. The point-to-point data transmission is carried out via the two TxD (Transmit Data) and RxD (Receive Data) wires to be crossed with a common ground line (GND) for both devices. This creates a bidirectional bus that allows full-duplex communication. The communication partners can therefore send and receive data simultaneously.

Data transmission via UART is performed with a fixed data frame (UART frame). This frame must be known to both communication partners. It consists of: A start bit, 5-9 data bits, an optional parity bit and one or two stop bits. If a PC is connected to the analyzer, the necessary settings are typically identified automatically. If this is not the case, the parameters can be set manually according to Table 9.2. (see Section 9.1).
Only a few PCs are still delivered with a so-called COM port (serial RS-232 interface). To be able to operate and program devices that have an RS-232 interface with computers without this, use of con-

verters from RS232 to USB is advised. The converters often have a 9-pin D-Sub connector as input, but there are also converters with screw terminal connections.

The serial interface allows operation of the instrument and the display and storage of measurement data with the SetApp program. More information and a link to download the software can be found at www.messkonzept.de.

If you plan to develop or use your own software solutions for communication via the RS-232 interface, you may need more detailed information on the available parameters... etc. Please contact Messkonzept in this regard.

Chapter 4

The Front Panel

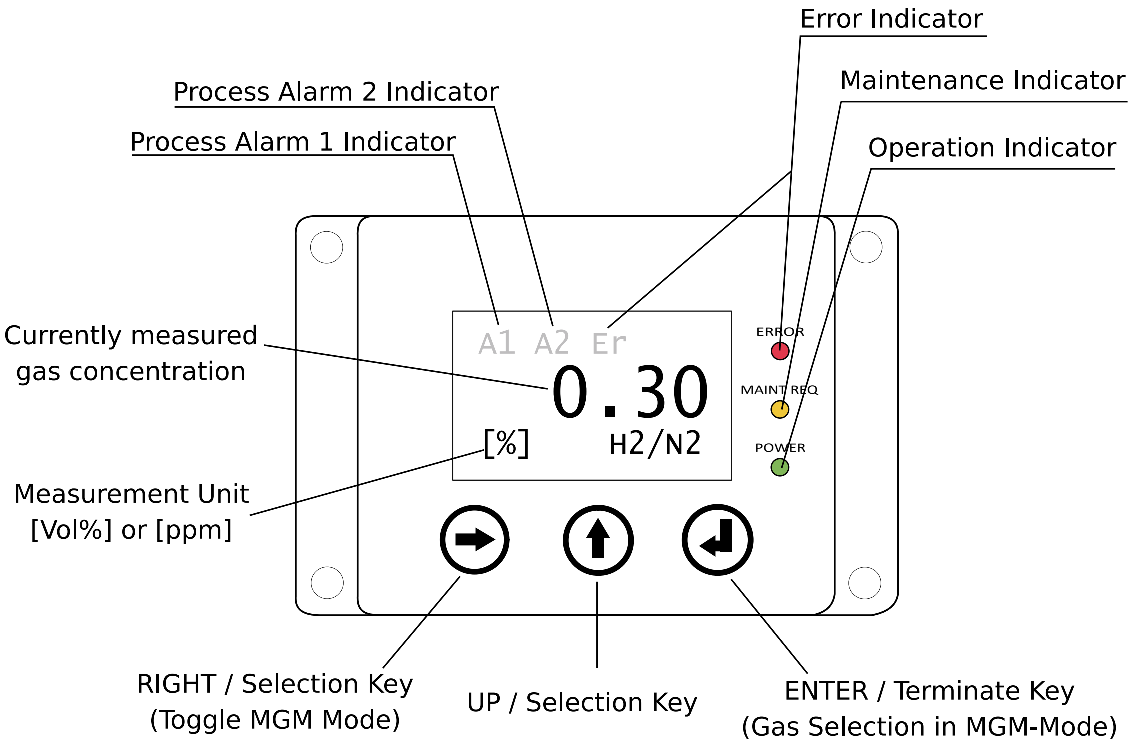
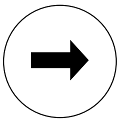


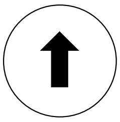
Figure 4.1: Front view schematic of the FTC320 front panel

4.1 Display

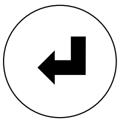
4.2 Keys



RIGHT / Selection Key
On the operation screen, the <RIGHT> key can be used to select one of the measured variables displayed on the work screen. With the <ENTER> key the menu related to the measured parameter can be called up, in which, for example, the calibration routine of the parameter can be accessed.
The <RIGHT> key enables the operator to scroll through the various menu items of menus and submenus. The currently selected menu item is marked by black background and is called with the <ENTER> key.
In submenus requiring numerical inputs, the <RIGHT> key scrolls to the next digit and to “ESC/OK“ at the end.



UP / Selection Key
In menus or submenus, the <UP> key quits the recent menu and brings you back to the menu above and ultimately to the main menu.
To quit menus with an “ESC/OK“ option, select one of these fields with the <RIGHT> key and confirm with <ENTER>.
In submenus requiring numerical inputs, the <UP> key changes the selected digit.



ENTER / Termination Key
The <ENTER> key calls the item that is marked as selected (selection is indicated through black background highlighted text). Menu items are selected by the <RIGHT> key. In submenus with an “ESC/OK“ option the <ENTER> key confirms the selection of “ESC“ or “OK“.

Chapter 5

Instrument display

This chapter describes the device start-up routine. The warmup screen, see Figure 5.1, shows the block temperature while the block warms up. After the warmup, the device switches to the operation screen, see Figure 5.2. From the operation screen the main menu can be opened.

Note: To make device-specific settings on the device, it is necessary to enter an Expert code (preset to 222.0000).

5.1 warmup Screen

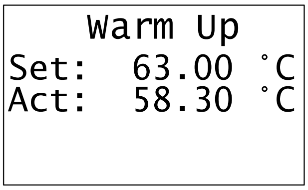


Figure 5.1: warmup screen of the FTC320

The warmup screen shows the current block temperature during warmup in the center of the screen (see Figure above). The target value of the block temperature, 63 °C for the standard version or 70 °C for the high temperature version, is shown in the bottom line of the screen.

Pressing the <UP> key during warmup switches directly to the operation screen and activates the current loop. The displayed concentration value will not be precise until the needed block temperature is reached.

5.2 Operation Screen

After warmup the operation screen is shown (see Figure above). Depending on the version of the instrument, either one measured value or several measured values are displayed on the working screen. From the operational screen the main menu can be opened using the <UP> key.

5.2.1 Display of one measured value

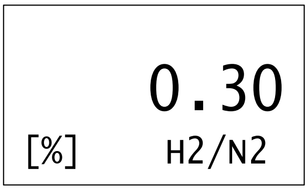


Figure 5.2: FTC320 operation screen (one measured parameter)

In the center of the display the currently measured gas concentration is shown, the associated unit of the measurement (ppm or Vol.%) is indicated in the bottom left corner of the operation screen. The currently measured gas pair, e.g. “H2/N2“ for hydrogen in nitrogen, can be found in the bottom right corner of the display. The display resolution in ppm is 1 ppm, the number of digits displayed in Vol.% indication is adjusted according to your requirements upon shipment (can be changed manually in the Expert mode, see Sections 6.3.1 and 6.5.1).

In the top display line status information may be shown: Alarms are indicated by “A1“ and “A2“, system errors are indicated by “Er“. If the top display line is empty, there are no active alarm indications.

5.2.2 Display of several measured values

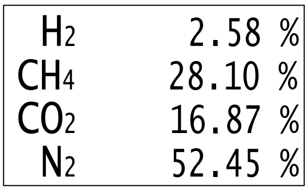


Figure 5.3: FTC320 operation screen (several measured parameters)

Each line of the display is assigned to a measured variable whose designation is shown on the left side, for example "O2" for oxygen or Pr. for pressure (for devices with pressure sensor). The value of the measured variable is shown next to it on the right. The associated units (Vol. %, ppm, bar, etc.) are displayed on the right side of the display. When displayed in Vol.%, the number of decimal places displayed can be selected (preset according to customer requirements, modification requires Expert Mode, see Section 6.3.1).

Chapter 6

General instrument settings

6.1 Top Level Main Menu

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Diagnosis
Instr. Setup
Output Setup
Expert Setup
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Figure 6.1: main menu of the FTC320

The main menu of the general instrument settings can be accessed from the operation screen (display of measured values) by pressing the <UP> key. Pressing the <UP> key again will take you back to the working screen.

Other submenus are accessible from the main menu. To select the following menu item in the main menu, press the <RIGHT> key. Pressing the <ENTER> button selects the highlighted menu item with a black background and opens the submenu.

The menu paths shown in the following chapters all start from the main menu.

Note: To enter the general device configuration, an Expert Code must be entered, which unlocks the device for one hour. By default, this is 222.0000. The code can be changed in the Expert Setup menu.

6.2 Diagnosis

The FTC320 has several integrated diagnosis and test functions that can be accessed through the diagnosis menu. The menu provides the following functions:

- A parameter menu in which device-internal parameters/variables can be read out
- An error menu in which pending errors are listed

6.2.1 Parameter Menu

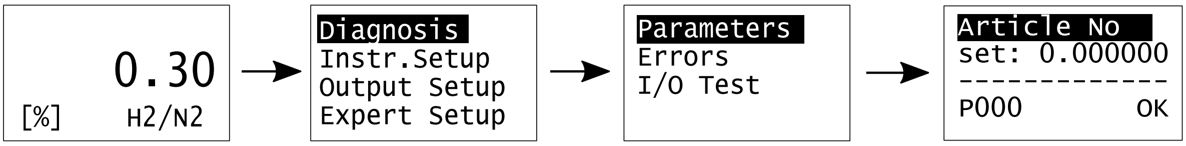


Figure 6.2: parameter menu for advanced diagnosis

The configuration of the FTC320 is defined by a list of internal parameters. The “Parameter“ menu gives read-only access to these parameters. This may help an experienced user to diagnose malfunctions caused by wrong settings. The parameter menu allows you to scroll through the entire parameter list. Contact Messkonzept for detailed information on the listed parameters. The first display line contains the name of the parameter, in the second line the parameter value is shown. The last line shows the parameter index. To move forward in the list, press <ENTER>, to move backwards, press <Up>. To leave the parameter menu mark <OK> by pressing <RIGHT> and confirm with <ENTER>. Some parameters can be changed in the expert setup, see Section 6.5 for more information.

6.2.2 Errors

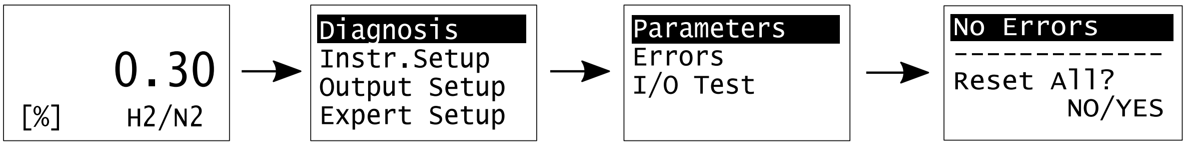


Figure 6.3: error menu

When the device is in the measuring mode or calibrating, several parameters are continuously checked for plausibility. The parameters checked, the list of possible errors and the ranges defining a plausible value can be found in Chapter 8 "Appendix: System Errors".

Errors are indicated by a flashing red light on the front panel. The menu “Errors“ gives access to the list of current errors . “No Errors“ indicates that no error is pending, for pending errors the name of the error is given. Pressing <ENTER> proceeds to the next pending error and <UP> to the previous error. To leave the error menu press <RIGHT> once or twice to select ***NO*** or ***YES*** and the <ENTER> key to confirm your selection. An error reset will affect maintenance-warnings only - all other errors and warnings are continuously monitored and automatically reset when the error no longer persists.

Defective devices must be disconnected from the process! This applies for apparent damage of the device such as physical damage but also in the case of unclarified malfunctions in the operation. Separate the device from the process pneumatically (both gas inlet and gas outlet) and remove the power supply from the device.

6.3 Instrument Setup

6.3.1 Display Unit

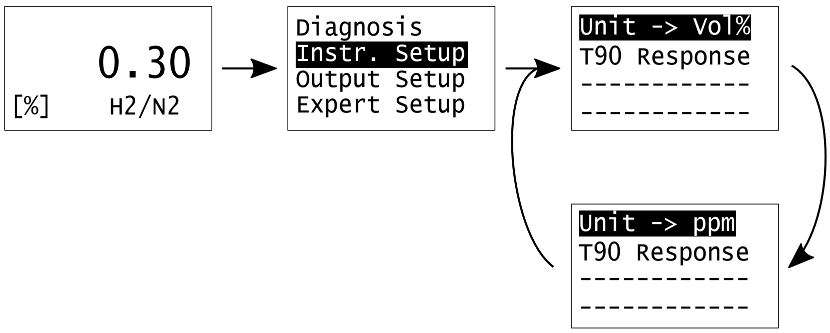


Figure 6.4: changing the displayed unit for gas concentrations.

The first item of the instrument setup menu allows selection of the display unit. Pressing <ENTER> alternates the unit between ppm and Vol.%. Quit the menu with the <UP> key. The value of parameter P56 (see Section 6.5.1) sets the number of digits after the decimals point between 1 and 4 when the display unit is set to Vol.%. The resolution in ppm is always 1 ppm. All internal calculations of the FTC320 are in ppm. Values retrieved through the RS-232 interface will always be in ppm with 1ppm resolution.

6.3.2 Response Time Setup

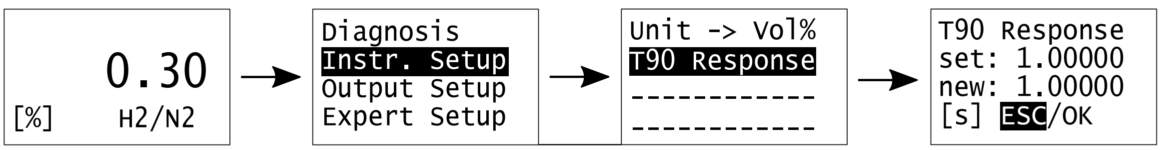


Figure 6.5: T90 response time setup

In the menu “T90 Response“ the response time of the exponential filter can be adjusted. The filter reduces the influence of fast variations of the raw signal (signal noise smoothing). The numerical value for the T90 response time is given in the unit of seconds. A range between 0s and 100s is permitted for this value, reasonable values lie between 0.5s to 10s. You can change the numerical value by navigating through the digit position using the <RIGHT> key and changing it using the <UP> key. Confirm by pressing the <UP> key until ***OK*** is selected. The changed value can be discarded by selecting ***ESC*** instead. Setting “T90 Response“ to 0.0 turns the exponential filter off.

The true response time is influenced by the gas exchange time which depends on the pneumatic installation and the flow rate of measuring gas. A gas flow of 80l/h leads to a gas exchange time of under 0.5s measured from the gas inlet of the device.
Note that the response time in your process depends greatly on the upstream volume before the FTC320. Shorter and/or thinner tubing will benefit response times.

The T90-time is the time in which a sudden change of the measurand (e.g. the gas concentration) reaches 90% of its final value.

6.4 Output Setup

The FTC320 is equipped with three analog outputs:

- One isolated current output with an output range of 0 to 20 mA called ***Current Out***.
- Two not DC-isolated voltage outputs with an output range from 0 to 10 V:
  - ***Voltage Out 1***.
  - ***Voltage Out 2***.

These analog outputs can be configured from the ***Output Setup*** menu.
The FTC320 internally uses up to five channels to process different measured gas concentrations, which can be mapped to the analog outputs mentioned above. For each output, a channel can be selected as the signal source. The five channels are typically configured as shown in Table 6.1. Note that your device might only use a sub-set of the 5 channels shown in Table 6.1 and not all of them, depending on the hardware configuration. In this case, the other channels will not output any meaningful data.

Channel (Ch.)	Routed Measurement
1	AUX (Measurement of O_2 by the external electrochemical sensor, of humidity, or flow).
2*	The gas measurement of the infrared channel IR2.
3*	The gas measurement of the infrared channel IR3.
4*	The gas measurement of the infrared channel IR4.
5	The gas measurement of the thermal conductivity channel.

Table 6.1: The measurement channels and the parameters routed to them. The channel numbers with an asterisk (2*, 3*, and 4*), i.e. the infrared channels, are only used in the FTC400!

6.4.1 Current Output Setup

The measuring range is typically mapped to a current output of 4mA to 20mA, where 4mA (the minimum value) corresponds to the beginning of the measuring range and 20mA (the maximum value) corresponds to its end. The FTC device is equipped with 4 current output modes suitable for different purposes (For setting the output range (in vol.% or ppm), see section 7.2).
In Table 6.2 the 4 current output modes are explained, from which you can choose the most suitable one for you.
Figure 6.7 also shows the meaning of the current ranges for the commonly used 4-20mA output with error indication (NARMUR compliant).
Below is a step-by-step instruction on how to adjust the current output:

1. From the ***Output Setup*** menu, select ***Current Out***.
2. A new menu opens with 2 options: ***I/O Mode*** and ***Cal. frozen***.

   In the later you can toggle between the options ***Cal. frozen*** and ***Cal. active*** to determine the behavior of the current output during calibration:

   - ***Cal. frozen:*** freezes the current output to the last value before calibration in order to avoid unnecessary jumps during e.g. the logging of the current values.
   - ***Cal. active:*** shows the actual current output during calibration.

   The current output settings are, however, found under ***I/O Mode***. Clicking <ENTER> after highlighting it opens the menu where the different current output modes can be adjusted.
3. Press <ENTER> on the first display line successively until you reach the desired current output mode (see Table 6.2).
4. **Changing the signal's source:** from the second display line where usually ***Ch. 5*** is shown, the source of the current signal can be changed. To change the channel, click <ENTER> key multiple times to toggle through the channels until you reach the desired channel (see Table 6.1 for the typical assignment of the channels). The gas measured by thermal conductivity is routed to channel 5 (displayed as e.g. ***Ch5. H2*** for hydrogen).
5. **Changing the value of the constant output:** in case you chose the ***Const. Outp.*** mode, you can manually change the value of the constant current output by moving the cursor to the second display line ***Const. I-Out***, clicking <ENTER>, and entering the desired value followed by clicking ***OK*** (see Figure 6.6).

   If you are not using the current output, it can be set to a constant value of 0.

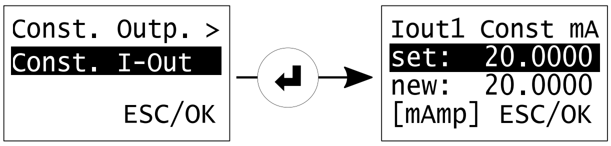


Figure 6.6: Setting a constant current output.

Output Mode	Current Range	Error Indication
4-20mA (Err)	Output current range: 4-20mA. Minimum: 3.8mA. Maximum: 20.5mA.	Freely configurable.
0-20mA (Err)	Output current range: 0-20mA. Minimum: 0mA. Maximum: 20.5mA.	Error value: 21mA.
0-20mA	Output current range: 0-20mA. Minimum: 0mA. Maximum: 21mA.	No error indication.
Const. Outp.	The output current: a freely configurable constant value between 0-20mA.	No error indication.

Table 6.2: The available modes of the current output.

The minimum and maximum values given in the table indicate the limit values of the transition region. The analog output is held at these values when the measured variable falls below or rises above the limit value.

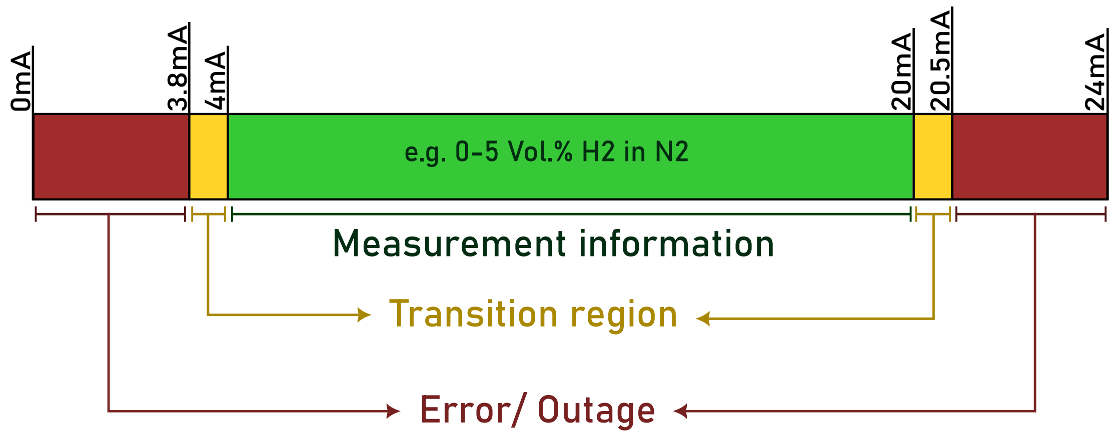


Figure 6.7: The current output ranges and their indication. The mode ***4-20mA (Err)*** corresponds to the NAMUR recommendation NF43.

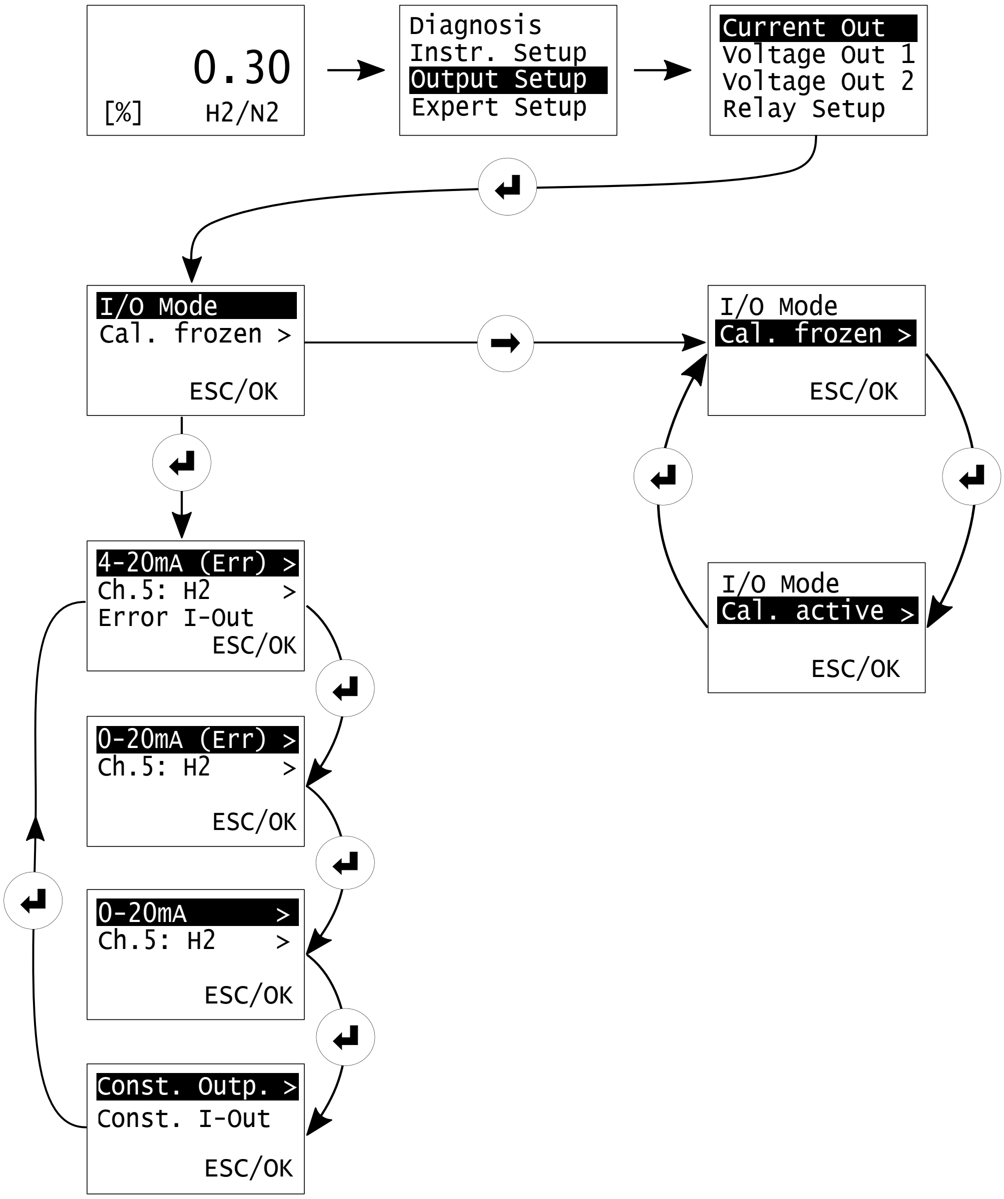


Figure 6.8: Current output setup.

6.4.2 Voltage Output Setup

The voltage outputs setting is analogous to the current output's in structure and operation. This section will describe in detail how the voltage output settings can be adjusted as desired.
The FTC320 has 2 voltage outputs that can be mapped to two different gas concentrations. Either or each of them can be mapped to a measuring channel. The typical assignments of the channels, which are the voltage signal's possible sources, are listed in Table 6.1 above.
The voltage output settings are described below:

1. From the ***Output Setup*** menu, select ***Voltage Out 1*** (or ***Voltage Out 2***).

2. A new menu opens with 2 options: ***I/O Mode*** and ***Cal. frozen***.

In the latter you can toggle between the options ***Cal. frozen*** and ***Cal. active*** to determine the behavior of the voltage output during calibration:

- ***Cal. frozen:*** freezes the current output to the last value before calibration in order to avoid unnecessary jumps during e.g. the logging of the current values.
- ***Cal. active:*** shows the actual current output during calibration.

The voltage output settings are, however, found under ***I/O Mode***. Clicking <ENTER> after highlighting it opens the menu where the different voltage output modes can be adjusted.

3. Press <ENTER> on the first display line successively until you reach the desired voltage output mode. (see Table 6.3).
4. **Changing the signal's source:** from the second display line where usually ***Ch. 5*** is shown, the source of the voltage signal can be changed. To change the channel, click <ENTER> key multiple times to toggle through the channels until you reach the desired channel. (see Table 6.1 for the typical assignment of the channels). The gas measured by thermal conductivity is routed to channel 5 (displayed as e.g. ***Ch5. H2***).
5. **Changing the value of the constant output:** in case you chose the ***Const. Outp.*** mode, you can manually change the value of the constant voltage output by moving the cursor to the second display line ***Const. U-Out***, clicking <ENTER>, and entering the desired value followed by clicking ***OK*** (see Figure 6.9).

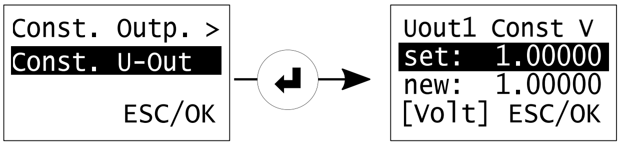


Figure 6.9: Setting a constant voltage output.

These settings can be set for each voltage output, ***Voltage Out 1*** or ***Voltage Out 2***, separately.

Output Mode	Voltage Range	Error Indication
0-10V	Output voltage range: 0-10V. Minimum: 0V. Maximum: 10.5V.	No error indication.
0-5V	Output voltage range: 0-5V. Minimum: 0V. Maximum: 5V	No error indication.
2-10 (Err)	Output voltage range: 2-10V. Minimum: 1.9V. Maximum: 10.25V.	Error value: 1.5V.
Const. Outp.	The output voltage is constant, its value can be changed to be any value between 0-10V.	No error indication.

Table 6.3: The available modes of the voltage outputs.

The minimum and maximum values given in the table indicate the limit values of the transition region. The analog output is held at these values when the measured variable falls below or rises above the limit value.

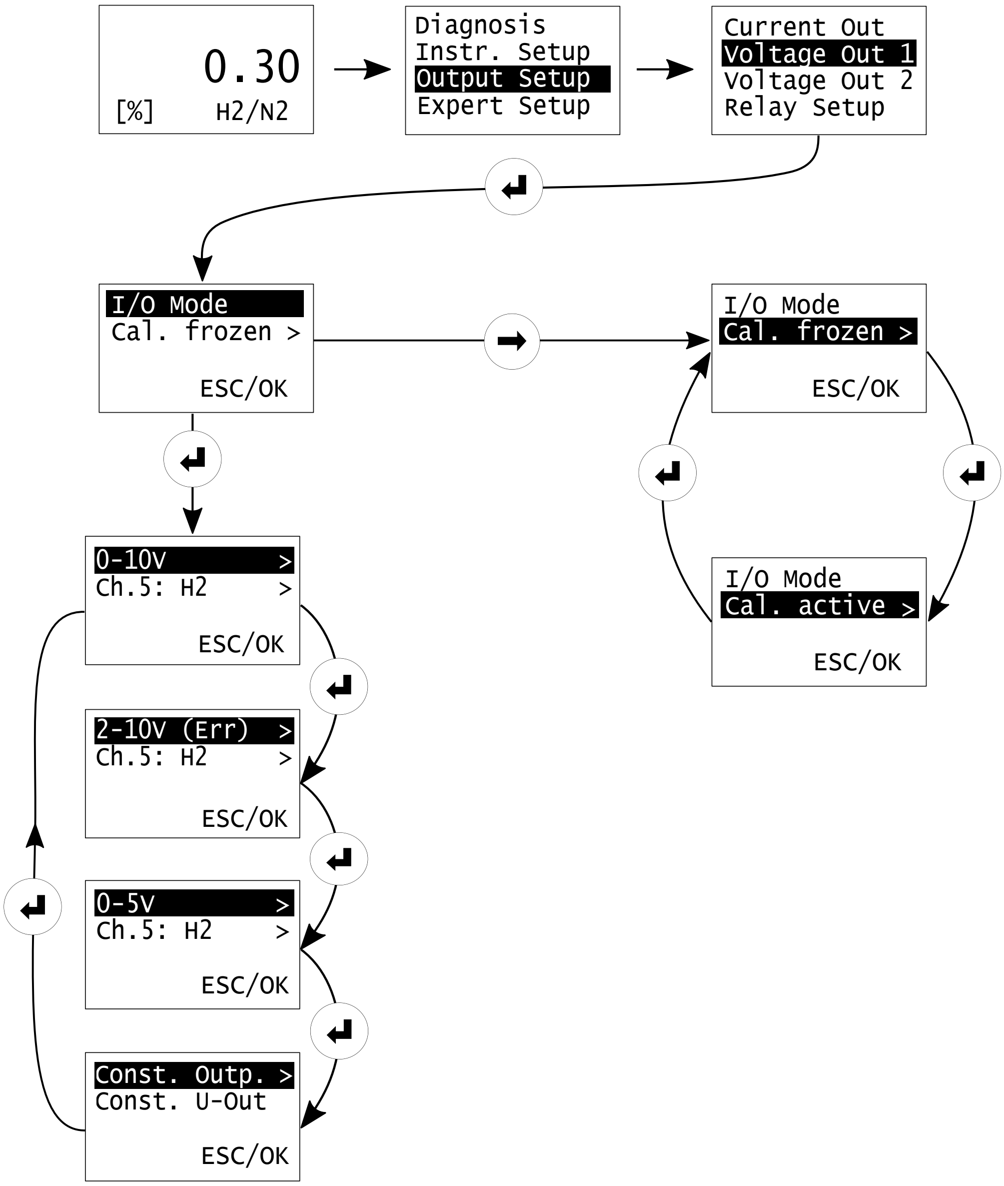


Figure 6.10: Voltage output setup.

6.5 Expert Setup

Figure 6.11: Expert Setup menu

The Expert Setup provides a couple of functionalities that should only be used by an advanced user or expert:

- set parameters
- reset to factory settings
- change the "Operator Code" and the "Expert Code"
- swap between "Normal Mode" and "Safety Mode"
- simulate alarms and analog outputs

The settings explained here are for advanced users or experts and should not be entered by normal operators. It is in the responsibility of experts to set the parameters properly. The default expert code is "222.000".

6.5.1 Parameter

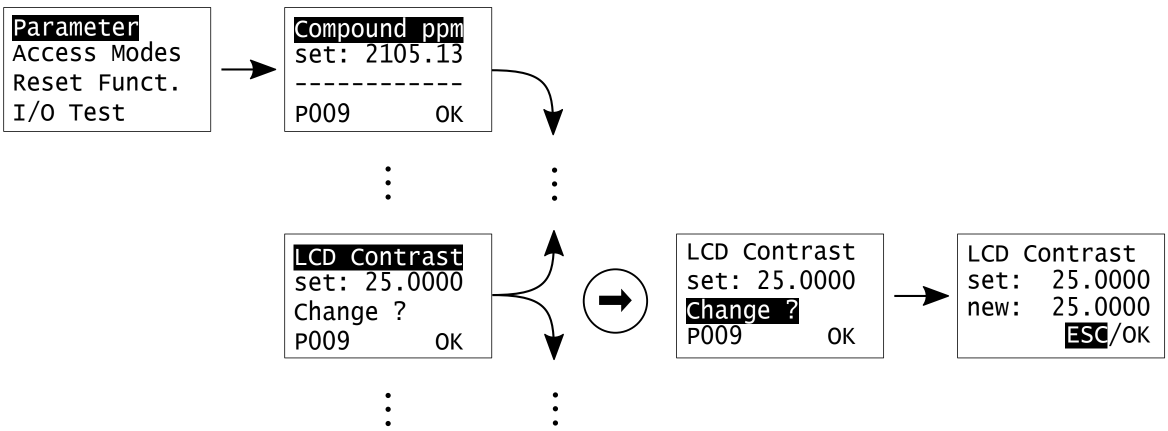


Figure 6.12: Parameter change in expert mode.

The configuration of the FTC320 is represented by an internal list of parameters. These parameters govern all settings and functions of the device. In the expert-menu's parameter list press <ENTER> to scroll forward through the list and backwards by pressing <UP>. Some parameters cannot be changed (e.g. sensor information such as "Compound ppm", see Figure above) others can be changed (e.g. "LED Contrast", see Figure above). All changeable parameters are indicated by "Change?" in the third line of the display. Selecting and clicking "Change?" opens a submenu in which a parameter's value can be modified.

Setting certain parameters to improper values can cause faulty measurement results, malfunctions, or even permanent physical destruction of the device!

6.5.2 Access Modes

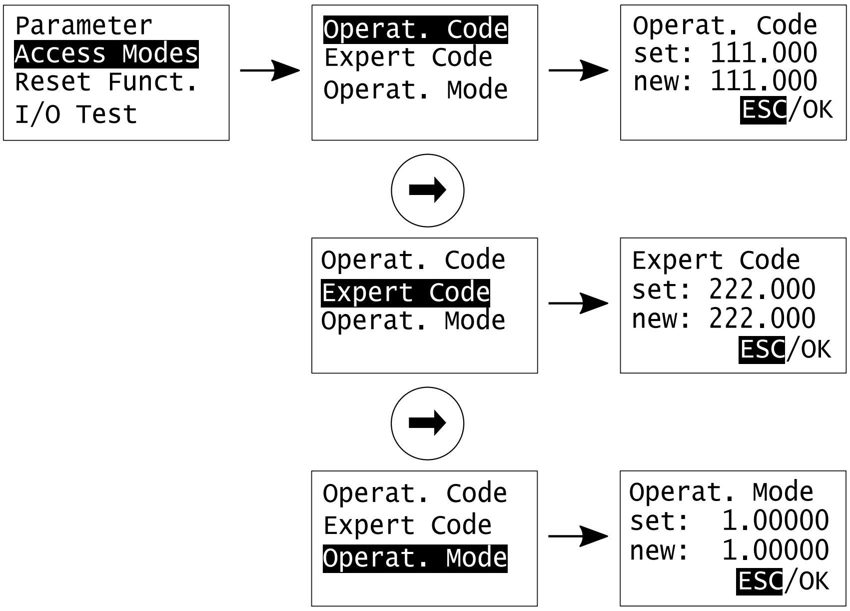


Figure 6.13: Access Mode menu

In this menu the passcodes for the "Operator Mode" and the "Expert Mode" can be changed. Further, the device's mode can be switched between "Safety Mode" and "Operation Mode". For the "Operation Mode" set "1.00000" in the menu "Mode Set", for the safe mode enter "3.00000". In the safe mode, every change of settings requires manual input of the Operator Code.

6.5.3 Reset Functions

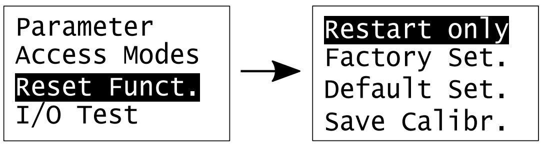


Figure 6.14: Reset Functions menu.

This menu provides three reset functions and the possibility to save the current calibration parameters to the Factory Settings:

- "Restart only": Restart of the software
- "Factory Set.": Resets all parameters to the factory set values
- "Default Set.": Resets all parameters to the default set values. CAREFUL: These values are not suited for a properly working device,
- "Save Calibration": Saves the parameters relevant to calibration. They can be retrieved by "Factory Set."

If a reset to Factory Settings is performed without saving the calibration parameters beforehand, a new calibration might be necessary.

If the device, against the given warnings, was reset to “Default Settings“ the parameters relevant for the proper operation are overwritten by default values. With these values the device will not work properly. The correct parameters (contact Messkonzept) have to be written to the device again, see Section 6.5.1 or the manual of SetApp which you can find on www.messkonzept.de.

6.5.4 Test of Relays, Analog Outputs and Connections

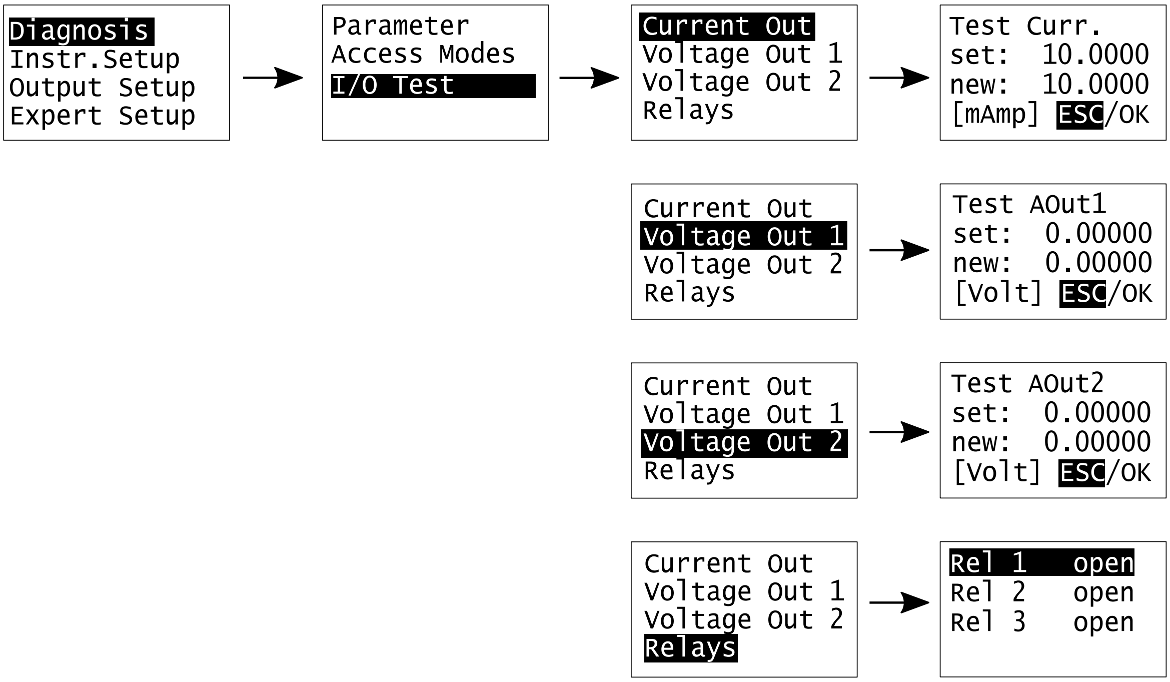


Figure 6.15: I/O Test menu

The “I/O Test“ menu provides the opportunity to set the following properties to a defined status in order to test subsequently connected equipment:

- Relay 1 (Rel 1) (open/closed)
- Relay 2 (Rel 2) (open/closed)
- Common Relay (Rel 3) (open/closed)
- Current of current loop
- Voltage for Analog Out 1
- Voltage for Analog Out 2

The digital input “DIN“ is “low“ for voltages below 4.6V and “high“ above 11.4 V. The output “Current Loop“ can be set to currents between 0 and 22mA. The analog outputs 1 and 2 can be set to supply a voltage between 0V and 10V.

⚠ Note! All test signals are permanently on until leaving the “I/O Test“ menu. It is the responsibility of the expert to assure that the I/O test does not interfere with the subsequent connected systems and processes in an unintended way.

Chapter 7

Measurand related settings

For each measured variable, usually given by a gas concentration, measurand-related settings can be changed. The settings related to the measured parameter can be accessed from the working screen by selecting the measured parameter with the <RIGHT> key and confirming with the <ENTER> key (see Figure 7.1). The calibration and the alarm setup of the measured parameter can be called up in the parameter-related menu.

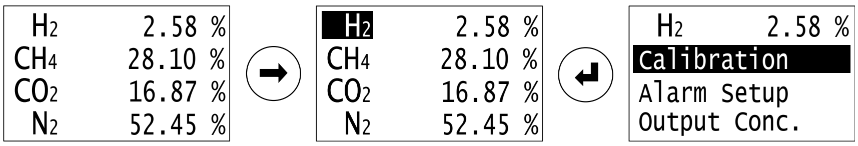


Figure 7.1: Accessing the settings related to the measured parameter.

To select the following menu item in the measurand related menu, press the <RIGHT> button. Pressing the <ENTER> button selects the highlighted menu item with a black background and opens the sub-menu.

All inputs of numbers within the menu structure work according to the following principle: With <RIGHT> the respective digit of the number can be selected and with the <UP> key the digit can be changed. Select "OK" with <RIGHT> and confirm with <ENTER> to save the changes and return to the previous menu. Selecting "ESC" interrupts the input and discards changed values.

7.1 Calibration

For devices operated in “safety mode“, the operator code is required to access the calibration menu. By default, the operator code is set to 111.000.

We recommend a calibration, resp. a check of the calibration if one of the following criteria is met:

- After bringing the device into service

- On a regular cycle, depending on the precision aimed for. To find out the appropriate time between calibrations, we recommend beginning with a more frequent check of the calibration. The time between calibrations can range between:
  - several months for a measuring task in the Vol.% range
  - days to weeks for a measuring task in the sub-Vol.% range
  - directly before every measurement if highest accuracy is needed.
- When the situation of the measurement regarding pressure, temperature or gas flow changes

The goal of the calibration is that the measured concentration agrees with the given test gas concentration. To obtain this, two calibration parameters that correspond to the offset/zero and the gain/span of a linear equation are available. A two-point calibration requires two test gases. Both calibration parameters, offset and gain, are adjusted. The concentration of the test gases does not have to meet the beginning and the end of the measuring range, a difference of $\pm$10% is permitted.

The menu sequence is designed such that prior to a gain always an offset calibration has to be done first. Usually, a single point calibration determining a new offset value is sufficient to obtain a good calibration.
In the case of one point calibration, a test gas of any concentration in the measuring range is feasible. For two point calibrations it is preferable to use the gas concentrations at the lower and upper end of your measuring range.

7.1.1 Calibration gas purities and flooding time

Messkonzept uses gases with the following purities for calibration:

H_2	He	N_2	Ar	O_2	CO_2	CH_4
5.0	5.0	5.0	4.6	4.5	4.5	4.5

Table 7.1: Recommended calibration gas purities

These gas purities are selected such that the devices comply with the specifications for the smallest measuring ranges feasible with the FTC320. Messkonzept recommends gases of the same purity for calibration on-site. For differing individual requirements, opt for an appropriate gas purity.
To ensure high precision results after calibration, you have to make sure that the device is well flooded with the calibration gas before starting the calibration sampling. In Messkonzept's internal calibration process for 60 l/h applications this flooding is performed for min. 30 minutes for most gas mixtures (containing H_2, N_2, Ar, O_2, CH_4, ...) and for min. 60 minutes in Helium mixtures. Note that the supply pipe volume needs to be flooded as well. In Messkonzept's calibration process the volume before the device is <100ml. If your calibration setup has a larger volume in front of the device, you might have longer running-in times. Please contact us if you need advice.

7.1.2 Use of Substitute Gases

Instead of using toxic or explosive gases for calibration, substitute gases may be used. A substitute gas has (at a certain concentration) the same thermal conductivity as the test gas it is substituting, such it can also be used for the calibration instead. Please contact Messkonzept for details on possible substitute gases for your application.

7.1.3 Set Offset Gas Concentration

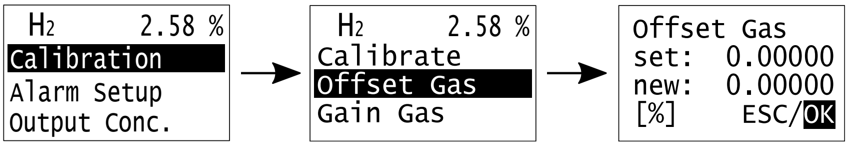


Figure 7.2: offset gas setup menu

Before performing a calibration, the concentrations of the used test gases have to be set. In the submenu “Offset Gas“ the used concentration of the offset gas has to be entered. Select the submenu “Offset Gas“ by pressing the <RIGHT> key and press <ENTER> to open the menu for the numerical entry. Enter the offset calibration gas concentration by changing each digit to the desired value. The position of the cursor in the number is moved by the <RIGHT> key, the value of the digit (0-9 or . for the decimal separator) at the current position of the curser is changed with the <UP> key. When the correct value is set, move the cursor to “OK“ and confirm with <ENTER>.

7.1.4 Set Gain Gas Concentration

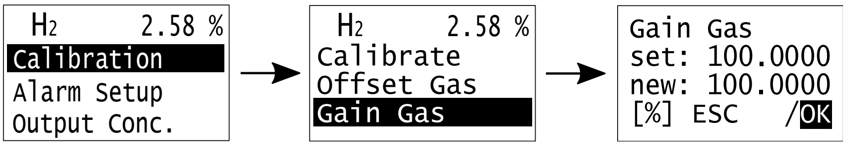


Figure 7.3: gain gas setup menu

Prior to a two-point calibration, the gain gas concentration has to be set in the submenu “Gain Gas“. This menu is operated analogously to the “Offset Gas“ menu described in Section 7.1.3.

7.1.5 Offset Calibration

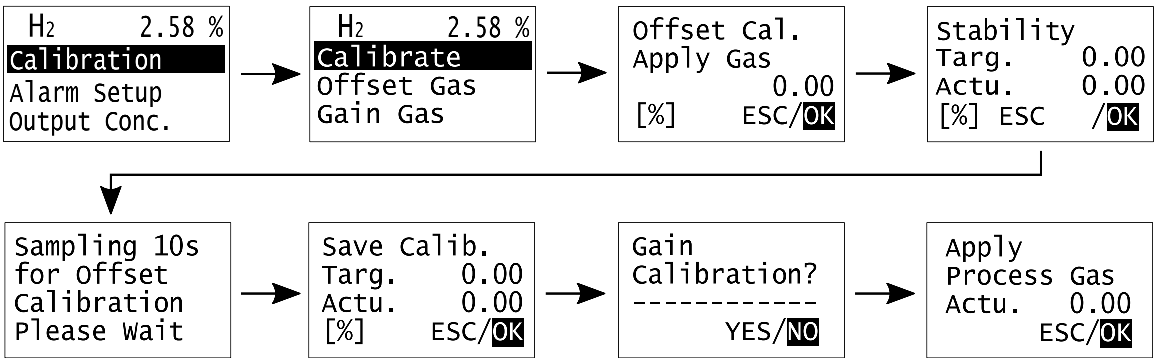


Figure 7.4: menu path if only offset is calibrated.

After opening the menu “Calibrate“, you are asked to apply the offset test gas. The third line of the display shows the test gas concentration as set in the “Offset Gas“ menu (see Section 7.1.3). Please calibrate using the same/a similar flow rate as in your process measurement situation. Confirming with “OK“ leads to the menu “Stability“. The second line contains the set test gas concentration (“Targ.“), the third line the measured concentration (“Actu. “) using the current (unchanged) calibration. Before continuing, wait for a sufficient running-in time to evacuate possible disturbing gases from the device. Only continue if the value of the actually measured concentration reaches a final value (you might observe some signal noise around a constant value). To start the calibration sampling, select “OK“ and press <ENTER>. The sampling phase of 10s is started. Based on the average measured concentration, the new offset is determined such that the currently measured (and calibrated) value accords with the given test gas concentration within the specifications of the device. Repeat the calibration in case the measured concentration after calibration is not in agreement with the test gas concentration. By selecting “ESC“ and pressing <ENTER>, the offset calibration is repeated. With “OK“ the calibration is confirmed as correct and the new offset value is saved.

The following menu offers the option to proceed with the gain calibration. Choosing “YES“ leads to the gain calibration menu described below. It is highly recommended to select “NO“ at this point. The gain value is very stable over time. Faulty gain calibration may worsen the device’s performance. After quitting the calibration, you are asked to apply process gas again, giving you time to restore your typical process measurement environment while error warnings are deactivated and relays stay frozen.

7.1.6 Gain Calibration

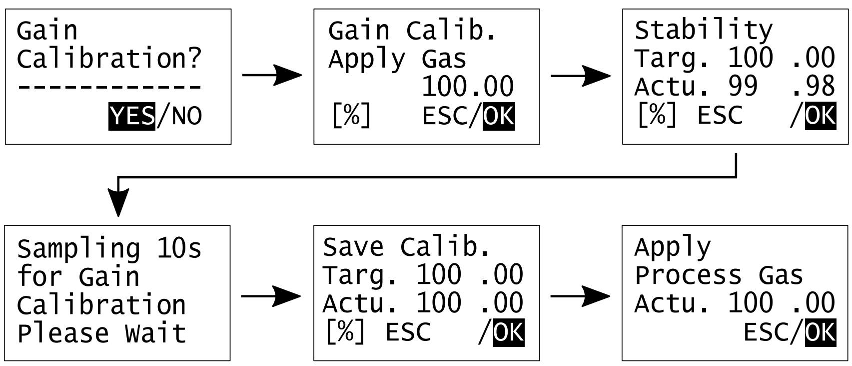


Figure 7.5: menu path of the gain calibration

The menu structure is designed such that the gain calibration procedure is only accessible after an offset calibration. The steps of the gain calibration correspond to the offset calibration described above (of course now using a different gas concentration, as set up in the ***Gain Gas*** menu, see Section 7.1.4). Again, please remember to wait for sufficient running-in time to evacuate possible disturbance gases. The gain calibration can be canceled in any sub-menu by selecting “ESC“. If gain calibration is canceled, the previous slope of your calibration line remains unchanged.

7.2 Mapping of Analog Output

By default, the (analog) output range of a measured variable is preset to the measuring range (see nameplate). If required, this output range can also be configured to other start and end values.

Under ***Output Conc.***, the minimum and maximum output concentrations can be set as follows: (see Figure 7.6)

- **Setting the Minimum Output:** from the menu ***Output Conc.*** choose ***C-> Min. Outp.***, type in the new value, then confirm by clicking ***OK***.
- **Setting the Maximum Output:** from the menu ***Output Conc.*** choose ***C-> Max. Outp.***, type in the new value, then confirm by clicking ***OK***.

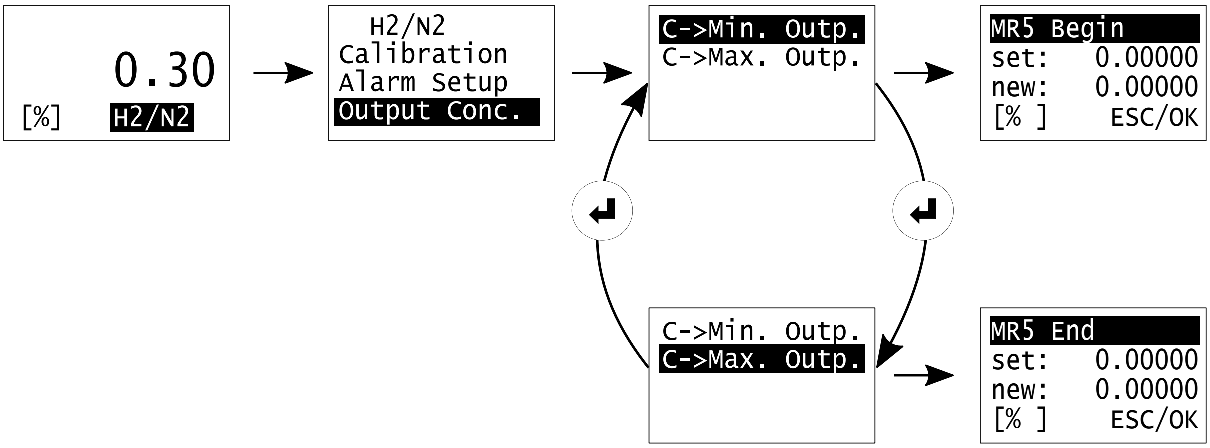


Figure 7.6: Adjusting the output concentration.

7.3 Alarm Setup

Individual process alarms can be activated and configured for the selected measurand/gas in the alarm setup accessible from the measurand related menu. Limit values and hysteresis can be set. Only one alarm can be set per gas.

A triggered alarm is signaled by a flashing of the measured variable on the display. Alarms can be used to switch relays.

7.3.1 Selection of alarm groups

In the first display line the <ENTER> key can be used to select the alarm group to which the set alarm should belong. The following modes can be selected:

- Alarm 1: The alarm belongs to alarm group 1
- Alarm 2: The alarm belongs to alarm group 2
- Alarm 3: The alarm belongs to alarm group 3
- Alarm OFF: The alarm is switched off.

The setting which alarm groups are to be output via which relay can be made in the relay setup (in the general device configuration). If the alarm is assigned to a group which already contains other gas alarms, the individual traceability to a single gas alarm is lost when a relay is triggered. In the line below, further settings can be made, between which you can switch by pressing the <ENTER> key. The setting options for the respective sub-item can be changed in the line below.

The following settings can be edited:

7.3.1.a Lower Limit

Gives the user the possibility to set the lower limit of the alarm in the unit of measurement used (e.g. Vol % or ppm). When the limit value is exceeded, the alarm is triggered. The selection of the limit value is independent of the measuring range used. With <RIGHT> the digits of the setting value can be selected and edited with <ENTER>.

7.3.1.b Upper Limit

Gives the user the possibility to set the upper limit of the alarm in the measuring unit used (e.g. Vol % or ppm). If the value falls below the limit value, the alarm is triggered. The selection of the limit value is independent of the measuring range used. With <RIGHT> the digits of the setting value can be selected and edited with <ENTER>.

If you only need one of the limit values, you can simply set the other limit value to a sufficiently distant value so that triggering at the limit value not required in your process is no longer possible. Please note that displayed measured values can also become negative under certain circumstances. This is the case for a gas concentration determined by means of thermal conductivity if you feed a gas into the device which has a lower thermal conductivity than the carrier gas for which the device is set up (e.g. if you feed CO_2 into a device which is set up for H_2 in N_2).

7.3.1.c Hysteresis

In order to avoid frequently changing switch-on and switch-off processes of relays at an alarm limit value, a hysteresis value can be set. The setting is made in the measuring unit used (e.g. Vol % or ppm). In the FTC320 the hysteresis is implemented in such a way that an increasing measured value at [Upper Limit] + [Hysteresis] leads to triggering of the alarm at the upper limit and only switches off again when the measured variable has fallen to a value lower than [Upper Limit] - [Hysteresis].

Chapter 8

Appendix: System Errors

In this appendix possible error messages on the FTC320 (see Section 6.2.2) are listed.
In case of an error please check for the description of the error and the actions recommended to remove potential causes. In case this does not lead to a solution, please contact Messkonzept and describe the circumstances that led to this error. Some issues can be resolved through remote maintenance.
If the error persists you might be requested to send the FTC320 back to Messkonzept. Please pay attention to these points when sending the device:

- Close gas ports to keep gas duct clean. Preferably use black rubber caps that came with delivery.
- Put the device in a suitable shockproof packing material. Preferably use the foam box that came with delivery.
- Please attach a brief note with a description of the problem or refer to prior mail correspondence on this subject with Messkonzept.

⚠ Never open the housing of the FTC320. Warranty is void if the housing was opened, refrain from attempts of repairing the device yourself! Messkonzept may charge more for the repair if the housing was opened. It is more work to check if an attempted repair by the user lead to further damages.

Displayed label	Cause	Default range	Corrective Measure
EEPROM ERROR	Error reading or writing data to or from internal FLASH-EEPROM	-	Repeat procedure. If the error persists, send the device to Messkonzept with description of error.
CAL GAIN ER	Calibration gain exceeding max. allowed range	0.5-1.5	Check if the used test gas concentration gives the set concentration. Repeat procedure. If the error persists, send the device to Messkonzept with description of error.
CAL OFFS ER	Calibration offset exceeding max. allowed range	100 mV	*See CAL GAIN ER*
CAL DEV ER	Calibration deviation exceeding max. allowed range	50000 ppm	*See CAL GAIN ER*.
CAL VAR ER	Calibration variation exceeding max. allowed range	1000ppm	Repeat procedure. Check if the measurement is stable before data sampling. Are there sudden fluctuations in relevant process parameters, for example pressure pulses caused by a pump? Has the calibration gas flooded the device properly? Please verify your calibration setup and repeat the calibration. If the error persists, send the device to Messkonzept with description of error.

Displayed label	Cause	Default range	Corrective Measure
BT MIN ER	Block temperature below specified range	SetTemp-0.6K	The device might still be warming up after start-up or a sudden change of ambient temperature and/or gas flow occurred and disturbed the temperature control loop temporarily. Please wait for a couple of minutes and see if the error persists. Another reason for the error might be operation of the device outside the specified ambient temperature or gas temperature range. Consider the device specifications. If the error persists, send the device to Messkonzept with description of error.
BT MAX ER	Block temperature above specified range	SetTemp+0.6K	*See BT MIN ER*.
BU MIN ER	Bridge voltage below specified range	1V	Send the device to Messkonzept with description of error.
BU MAX ER	Bridge voltage above specified range	11V	Send the device to Messkonzept with description of error.
TC MIN ER	TC-signal below specified range	500mV	Send the device to Messkonzept with description of error.
TC MAX ER	TC-signal above specified range	7000mV	Send the device to Messkonzept with description of error.
EXT. ERROR	Error routed from input “DIN“ (0V=no error, +24V=error)	Signal <14V	Check the surveyed external unit.

Table 8.1: Description of System Errors

Chapter 9

Appendix: Specifications

9.1 Specification of Thermal Conductivity Measurement

Attribute	**Range / Precision**
Linearity	< 1 % of range
Warm up time	Approx. 20 min; up to 1 h for small measuring ranges
Flow rate	10 l/h - 150 l/h, 60 l/h - 80 l/h (recommended)
T90-time	< 1 sec at flow rate higher 60 l/h (or dependent on user selected T-90-filter time)
Noise	< 0.5 % of smallest range
Drift at zero point	< 2 % of smallest range per week
Repeatability	< 1 % of range
Error due to change of ambient temperature	< 1 % of smallest range per 10 K temperature change
Error due to change of flow at 80 l/h	< 1 % of smallest range per 10 l/h
Error due to change of pressure (800 hPa < p < 1200 hPa)	< 1 % of smallest range per 10 hPa

Table 9.1: Specification of TC measurement

9.2 Electrical Specifications

Unit / Interface	Feature	Value
Display	128 x 64 dot graphic LCD	
Keypad	3 short-travel keys	
Analog Input 1/2	Voltage range:	0 to 10 V
	Reference potential:	ground
	Input resistance	approx. 50 kΩ
	Resolution	24 bit
Current Loop	Signal Current:	0/4 to 20 mA
	Reference potential:	fully floating, max. ±500 V to ground
	Burden:	max. 800 Ω
	Resolution:	16 bit
Voltage Output	Voltage range:	0 to 10 V
	Reference potential:	ground
	Load resistance:	min. 50 kΩ
	Resolution:	16 bit
Relay 1/2/3	Maximum Voltage:	30 V
	Switching current:	0.5 A (max.)
	Switching capacity:	10 W (max.)
	Reference potential:	fully floating, max. ±500 V to ground
Power Supply	Voltage range:	24 V DC, Permissible range 21V to 30V
	Max. current:	1 A
	Typical current draw:	500 mA
	Safeguard:	PELV (Protective Extra Low Voltage)
Digital Interface	Type:	RS-232
	Baud rate:	19.2 kbaud
	Data:	8 bit
	Parity:	None
	Stop:	1
	Flow control	None
	Reference potential:	ground

Table 9.2: Electrical Specifications

9.3 Permissible Conditions of the sample to be measured

Pressure (absolute)	Standard version: max. 20 bar abs. with flow measurement: max. 2 bar abs. for flammable gases: max. 3 bar abs. Note the deviations of special models!
Gas temperature	At 60 l/h: - max. 80 °C at 25 °C ambient temperature - max. 50 °C at 50 °C ambient temperature - min. -20 °C for version without glass beads - min. -5 °C for version with glass beads
Dust, aerosols, oil mist, fluids	Avoid at all costs (e.g. via separator/filter), the option "Protection against condensate and dust" can prevent impairment of the measuring capability
corrosive gases	Only with corrosion-tolerant design and after consulting Messkonzept
Humidity	None should exist below dew point temperature in the sample gas path, 60 °C in the measuring devices and, if necessary, heat the connection pipe
Water condensate/drops)	Avoid at all costs, the "Protection against condensate and dust" option can prevent the sensor element from being destroyed by water

Table 9.3: Properties of the sample gas.

Regarding the introduction of flammable and explosive gases in the devices, please note the instructions in section 1.2.

9.4 Environmental conditions

Operating temperature:	-20 °C to 50 °C (-4 °F to 122 °F) or if casing filled with glass balls: -5 °C to 50 °C (23 °F to 122 °F)
Storage temperature:	-25 °C to 70 °C (-15 °F to 160 °F) (not-condensing)
Protection class	IP 65 (if cables are plugged and/or all unused jacks are sealed using protective caps)

Table 9.4: Environmental conditions.

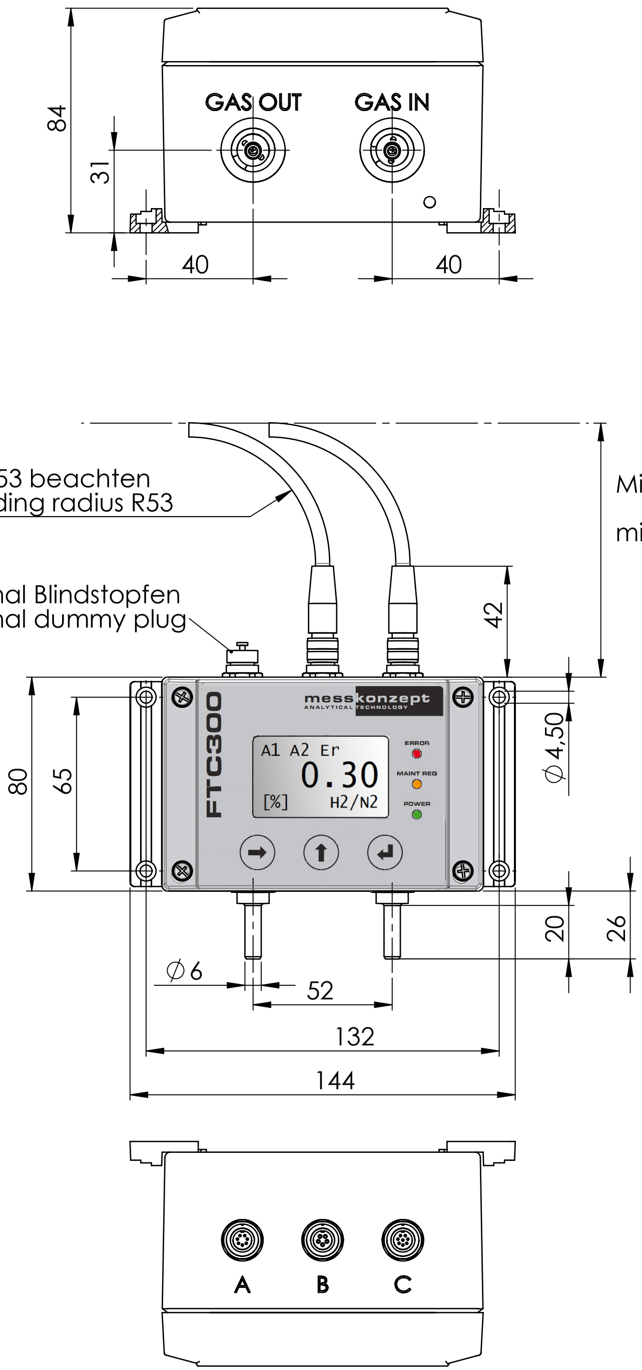
9.5 Dimensions

Dimensions:	Depth: 85 mm Width: 144 mm Height: 80 mm without connectors
Weight:	max. 1800 g
Mounting:	Wall mounting

Table 9.5: Dimensions.

Chapter 10

Appendix: Dimensional Drawing

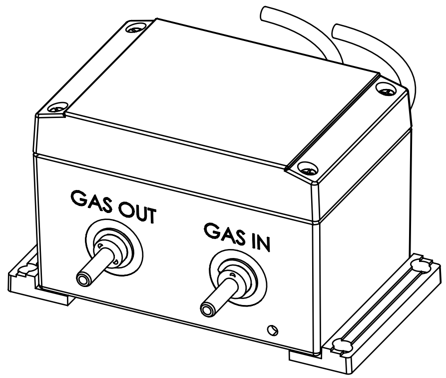


min. Biegeradius R53 beachten
consider min. bending radius R53

optional Blindstopfen
optional dummy plug

Minimaler Freiraum
minimal clearance

95mm bei fixierten Kabeln /
122mm bei losen Kabeln
95mm with cables fixed /
122mm with cables movable



Steckverbindung / plug-and-socket connection

A	7 polig / 7 pins
B	5 polig / 5 pins
C	8 polig / 8 pins

zulässiger Biegeradius: feste Installation R_{min} 53mm
bewegliche Kabel R_{min} 80
tolerable bending radius: fixed installation R_{min} 53mm
flexibel cable R_{min} 80mm

Obfl.:

DIN ISO 2768-mK

Maßstab 1:2

Datum	28.04.2015
Name	Ashmore

messkonzept ANALYTICAL TECHNOLOGY

FTC 300
Massbild

A090-X005

Blatt 1 / 1
CAD

Zust.	Änderungsnr.	Datum	Name
003		21.11.18	VA
002		15.01.16	VA
01		28.04.15	VA

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