

# FTC150 Transmitter

## Fast thermal conductivity analyzer

## Operating Manual



## TABLE OF CONTENTS

1	Operator Safety .....	3
1.1	Symbols .....	3
1.2	Startup .....	3
1.3	Intended Use.....	3
2	Description .....	5
2.1	Principal of Measurement.....	5
2.2	Available measuring gases and ranges .....	6
3	Mounting .....	6
3.1	Gas Flow .....	7
3.2	Pneumatic Connection .....	7
4	Electrical Connection.....	8
4.1	Ground.....	8
5	Communication with the FTC150 Transmitter.....	8
5.1	Current Output .....	8
5.2	Digital Communication .....	9
5.2.1	SetApp 3.0 .....	9
6	General Information on Test and Calibration .....	10
6.1	Offset and Gain Calibration .....	10
6.2	Performance Test.....	11
6.3	Gas Quality .....	11
6.4	Criteria for Test and Calibration.....	11
6.5	Carrying Out Calibration .....	12
6.5.1	Remote controlled Calibration via serial interface RS232 .....	12
6.5.2	Calibration via Pushbuttons.....	12
6.5.3	Gas supply during calibration .....	12
7	Specifications .....	13
7.1	Specifications of Thermal Conductivity Measurement .....	13
7.2	Conditions of The Sample to be Measured.....	13
7.3	Environmental Conditions.....	14
7.4	Electrical Specification .....	14
7.5	Dimensions .....	15
8	Scope of Delivery .....	15
9	Appendix .....	16

# 1 OPERATOR SAFETY

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## 1.1 SYMBOLS



### **Warning!**

“Warning” draws attention to application errors or actions that can lead to safety risks including the injury to persons or malfunctions – possibly even destruction of the device.



### **Note!**

“Note” indicates an additional function or hint.

## 1.2 STARTUP



### **Startup Safety Notes!**

- Read and follow this manual for the installation! For the safe operation of the device, pay attention to all given instructions and warnings.
- 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.
- 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 may only be carried out by Messkonzept.

## 1.3 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](mailto:info@messkonzept.de) for detailed information and solutions.

No liquids may be introduced into the gas path at any point! Liquids will likely destroy the sensing element or vary its measuring properties permanently! If you accidentally introduced a liquid into the device, disconnect the device from its power supply and contact Messkonzept before operating the device again.

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 (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 cannot be used in areas with an Ex-zone rating (hazardous areas of explosion protection).

**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 manufacturing protocol 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 ( $\varnothing$  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.

**Ignitable / 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 your gas detector. Test 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 FTC150 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 FTC150.

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!**

Keep this manual for future use!

## 2 DESCRIPTION

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The transmitter FTC150 is a highly precise and stable Thermal Conductivity Detector (TCD).

For indication of the signal, a 4mA to 20mA analog output is provided. Also the digital interface (RS232 or RS485) can be used to read out the gas concentration.

### 2.1 PRINCIPAL OF MEASUREMENT

The thermal conductivity of a gas mixture depends on the individual gas components and on the composition of the mixture. Under certain conditions, therefore, the concentration of individual gas components can be determined by measuring the thermal conductivity. In other cases, the identification of certain properties of gases is of special interest e.g., for quality control or safety reasons. Often these properties are related to thermal conductivity and are thereby identified. The concentration can be determined with high precision if one of the following conditions is met:

- The gas mixture consists of only two components, for example measuring CO<sub>2</sub> in N<sub>2</sub> or H<sub>2</sub> in N<sub>2</sub>.
- The gas mixture consists of more than two components but only concentrations of two components vary.
- The thermal conductivity of two of three constituents is similar, e.g., measuring H<sub>2</sub> or He in a mixture of O<sub>2</sub> and N<sub>2</sub>.

## 2.2 AVAILABLE MEASURING GASES AND RANGES

The FTC150 is specifically set up and calibrated for the gases and ranges that are part of the order of the device. The following list shows a selection of the most used gas pairs and the possible measuring ranges given in Vol.%.

Measuring Gas	Carrier Gas	Basic range in Vol.%	Smallest range in Vol.%	Smallest range at end point in Vol.%
H <sub>2</sub>	O <sub>2</sub>	0% - 100%	0% - 0.5%	98% - 100%
H <sub>2</sub>	N <sub>2</sub> or air	0% - 100%	0% - 0.5%	98% - 100%
H <sub>2</sub>	Ar	0% - 100%	0% - 0.4%	99% - 100%
H <sub>2</sub>	He	20% - 100%	20% - 40%	85% - 100%
H <sub>2</sub>	CH <sub>4</sub>	0% - 100%	0% - 0.5%	98% - 100%
H <sub>2</sub>	CO <sub>2</sub>	0% - 100%	0% - 0.5%	98% - 100%
He	N <sub>2</sub> or air	0% - 100%	0% - 0.8%	97% - 100%
He	Ar	0% - 100%	0% - 0.5%	98% - 100%
CO <sub>2</sub>	N <sub>2</sub> or air	0% - 100%	0% - 3%	96% - 100%
CO <sub>2</sub>	Ar	0% - 100%	0% - 20%	50% - 100%
Ar	N <sub>2</sub> or air	0% - 100%	0% - 3%	97% - 100%
Ar	CO <sub>2</sub>	0% - 100%	0% - 50%	80% - 100%
CH <sub>4</sub>	N <sub>2</sub> or air	0% - 100%	0% - 2%	96% - 100%
CH <sub>4</sub>	Ar	0% - 100%	0% - 1.5%	97% - 100%
O <sub>2</sub>	H <sub>2</sub>	0% - 100%	0% - 2%	99.5% - 100%
O <sub>2</sub>	N <sub>2</sub>	0% - 100%	0% - 15%	85% - 100%
O <sub>2</sub>	Ar	0% - 100%	0% - 2%	97% - 100%
N <sub>2</sub>	Ar	0% - 100%	0% - 3%	97% - 100%
N <sub>2</sub>	CO <sub>2</sub>	0% - 100%	0% - 4%	97% - 100%
NH <sub>3</sub>	H <sub>2</sub>	0% - 100%	0% - 5%	95% - 100%
CO	H <sub>2</sub>	0% - 100%	0% - 2%	99.5% - 100%
SF <sub>6</sub>	N <sub>2</sub> or air	0% - 100%	0% - 2%	96% - 100%

Other gases and ranges are available or can be provided upon request.

## 3 MOUNTING

The FTC150 is designed for wall fastening. M4 cylinder head bolts fit for the four mounting holes. See the Appendix at the end of this document for a detailed dimension drawing. Please take note of the needed clearances for the gas duct und the cable. Chapter 9 shows the hole pattern.

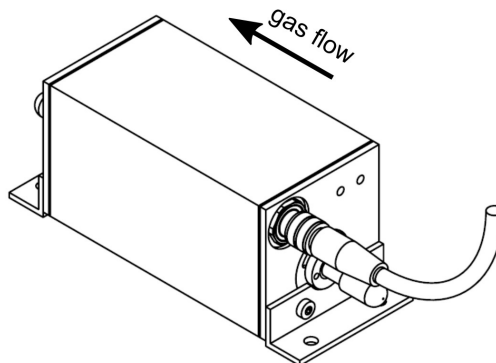
The device may be mounted in any orientation in the room. An upright alignment as shown in Figure 1 is preferable.



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.

### 3.1 GAS FLOW

The recommended flow rate depends on the variant used, so the gas flow is indicated. The low-flow variant is suitable for flow rates of a few l/h up to 40l/h. The regular device is best in the range between 40l/h and 80l/h. Up to 300l/h are possible with the "protected against condensate and dust" variant. For details, please refer to the specifications in chapter 7.2.



*Figure 1 - Preferred flow direction through the FTC150.*

### 3.2 PNEUMATIC CONNECTION

Gas inlet and outlet tubes – as well as the body - are made of stainless steel (1.4404 – 316L). The outer diameters of the tubes are 6mm. As indicated in Fig. 1 the gas input is at the electrical connector's side. The gas must not contain dust, condensate, and potentially condensing matter unless the design of the equipment is explicitly declared to be suitable for this purpose. The inner gas duct is heated up to 63°C higher temperature version available on demand. With use of properly heated lines and connections, a dew point up to 55°C is permissible. Please contact Messskonzept if you require further information.



#### **Warning!**

Condensate will destroy the sensing element immediately (condensate tolerant version on request).

## 4 ELECTRICAL CONNECTION

The FTC150 has an 8-pin connector for which the cable is provided by Messkonzept with the device. Table 1 describes the functions of each pin of the 8-pin connector (see Figure 2):

Table 1: Description of the 8-pin connector.

Pin No.	Color coding	Function	Description
1	white	Current Loop 1– (return)	Return for Pin 8
2	brown	Ground	GND for pin 3, 4, 5
3	green	Serial Interface RS232	RxD (receive)
4	yellow	Power Supply	+ 24V DC (18 V - 30 V), max. 700mA
5	grey	Serial Interface RS232	TxD (transmit)
6	pink	<b>B</b> (RS-485)	
7	blue	<b>A</b> (RS-485)	
8	red	Current Loop 1+ (send)	4 to 20mA, floating, isolated $\pm 500V$ to ground, max. 800 Ohm burden, 16-bit resolution

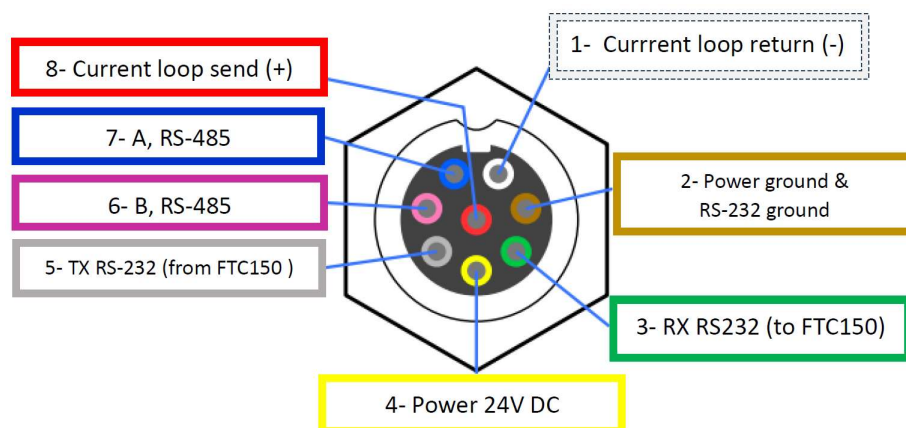


Figure 2 - Pinout of the FTC150

### 4.1 GROUND

The cable shield should be connected to functional ground. Dependent on the circumstances gas inlet and gas outlet might need to be connected to ground also.

To comply with EN 60204-1, the power supply must be connected to a PE ground conductor (protective ground).

Connections to ground should be made with low-resistant, large diameter, short cables to one neutral point.

## 5 COMMUNICATION WITH THE FTC150 TRANSMITTER

### 5.1 CURRENT OUTPUT

The FTC150 is equipped with an active and potential free current output. Active output means, that no external power source is required to drive the output. If not stated otherwise, the current



mode is configured as a 4-20mA output, following the NAMUR recommendation NE43 as shown in Figure 3.

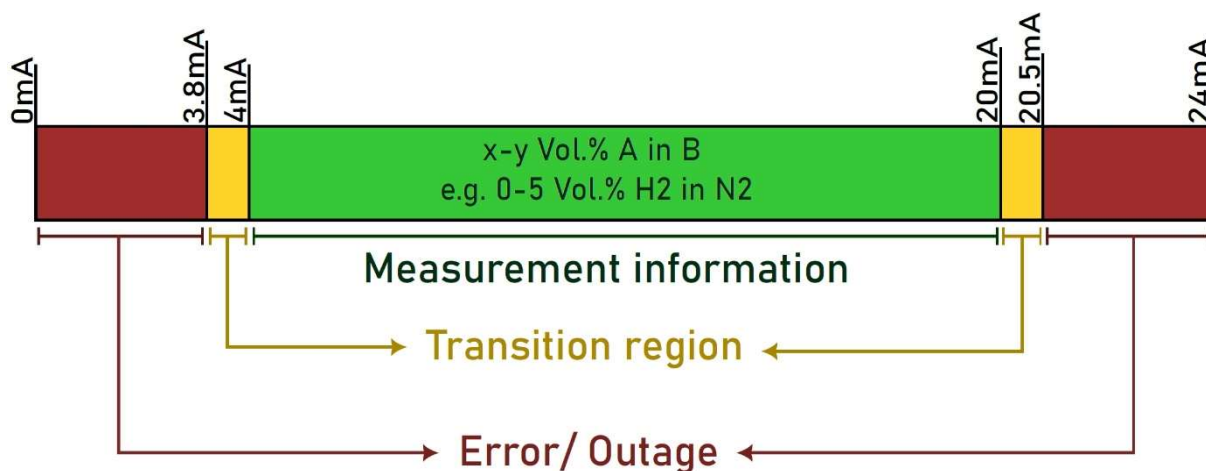


Figure 3 - Specification of current output according NAMUR recommendation NE43

The measured value is mapped onto the current output in the green and yellow region of Figure 3. But it is cut below 3.8mA and above 20.5mA. An error is indicated as 3mA.

Messkonzept also preconfigures the output following customer request. The output configuration can be changed by the customer via digital communication, see below.

## 5.2 DIGITAL COMMUNICATION

The FTC150 is equipped with an RS232 interface that allows reading out of measurement values and configuration the device parameters. A dedicated manual explaining relevant device parameters is available. Please ask Messkonzept for further information.

### 5.2.1 SetApp 3.0

Messkonzept offers the free Windows 10/11 based software SetApp 3.0, which can be used to interface with the FTC150 more easily. Please note that the prior software version (SetApp 2.0) may not be used with the FTC150!

SetApp3.0 offers the following features:

- Calibration and adjustment of the test gas concentrations used
- Plot and log the measured gas concentration and other device parameters
- comfortable calibration of the device through the user interface
- Backup feature to save or restore the device configuration
- Changing of other device parameters (proceed with caution, and consult the Serial Communication manual mentioned above)

The SetApp 3.0 can be found in the download section on the Messkonzept website.

## 6 GENERAL INFORMATION ON TEST AND CALIBRATION

This section explains how the readjustment of the device should be planned and carried out on site. Different installation, dew point, pressure, flow rate and test gas quality can lead to a shift in the indication right from the start. In addition, the reading may vary by 2% of the smallest measuring range per week, e.g., measuring H<sub>2</sub> in N<sub>2</sub>, the drift per week may be 100 ppm.

### 6.1 OFFSET AND GAIN CALIBRATION

The aim of calibration is to ensure that the measured concentration matches the specified test gas concentration. This is achieved by the correct adjustment of two calibration parameters, called "offset" and "gain", which correspond to the ordinate intercept and the slope of a linear equation calculated in the device. Figures 4 explain how offset and gain correction works.

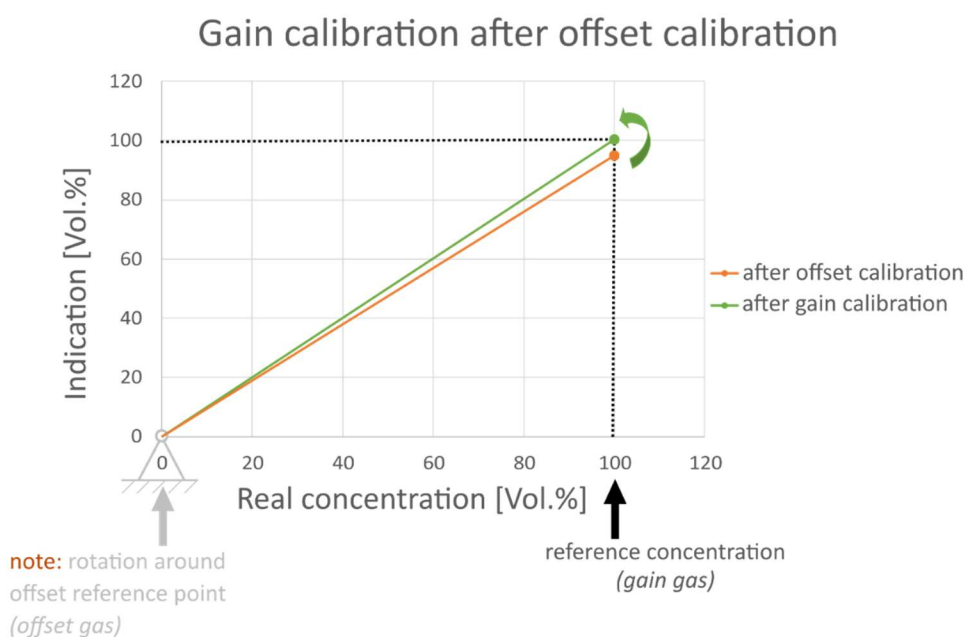
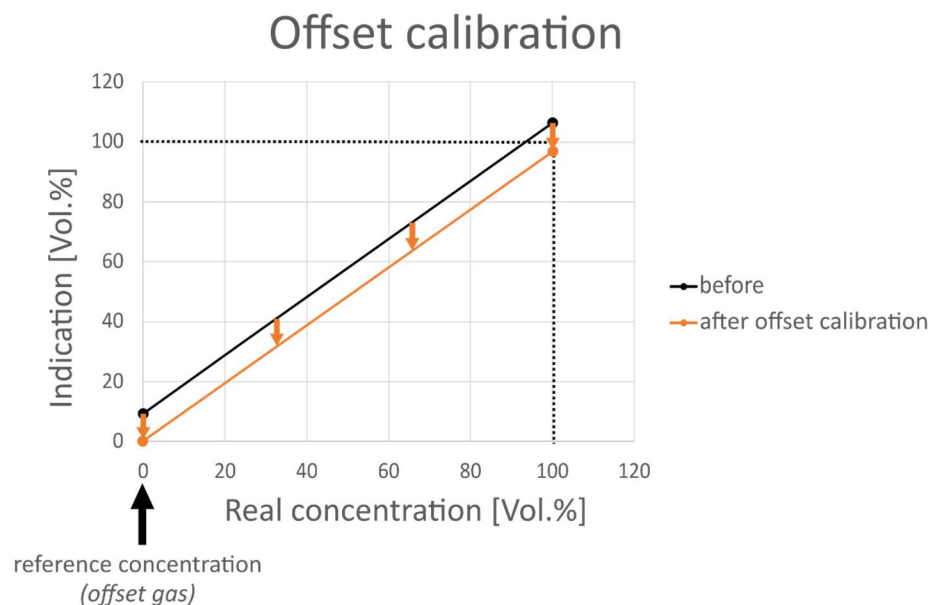


Figure 4

For a determination of offset and gain a two-point calibration must be performed. The concentration of the offset test gases should be close to the start-point and the concentration of the span test gas should be close to end-point of the measuring range; a difference of  $\pm 10\%$  of the measuring range from the start- or end-point is permissible.

For instance, when measuring  $H_2$  in  $O_2$  at a measuring range from 0 Vol.% – 100 Vol.%, use pure  $O_2$  as offset test gas and pure  $H_2$  as the span test.

A two-point calibration always requires an offset calibration directly before a gain calibration!

A one-point calibration, in which only a new offset value is determined, is sufficient in most cases. It is suitable for correcting drift or changes in operating parameters such as flow rate, pressure, or dew point. Compared to the offset, the gain is stable over years and practically unaffected by changes in flow or pressure. In the case of a pure offset calibration, a test gas with any concentration in the measuring range can be used but must be set before starting the offset calibration.

## 6.2 PERFORMANCE TEST

During a performance test, the reaction of the device to a test gas that is within the measuring range is monitored and recorded. In contrast to a calibration, the settings of the device are not changed. An inspection of the recorded performance test might uncover phenomena that can be masked by repeated calibration. This applies, for example, to a persistent signal drift or a periodicity in the signal curve due to unsteady flow, pressure, or dewpoint.

The correct indication of the test gas is almost always sufficient to prove that the device is working properly.

## 6.3 GAS QUALITY

A test gas of sufficient quality for your application should be used for performance testing and calibration. For calibration, Messkonzept uses gases with the following purities:

$H_2$	He	$N_2$	Ar	$O_2$	$CO_2$	$CH_4$
5.0	5.0	5.0	4.6	4.5	4.5	3.5

The gas purities are selected so that the devices comply with the specifications for the smallest measuring range. Messkonzept recommends gases of the same purity for on-site calibration. If your own requirements differ, please choose the appropriate gas purity. Please contact Messkonzept if you would like advice.

## 6.4 CRITERIA FOR TEST AND CALIBRATION

Carry out a test or calibration under - as far as possible - similar physical conditions to those used for the measurement, e.g. pressure, flow, temperature, filtration, dew point, etc.

A performance test and, if necessary, calibration with test gases is required if one of the following criteria is met:

- After new installation of the device, as new device or after it was serviced
- After changes to the sample preparation system and outlet that affect, for example, pressure, flow, temperature, filtration, dew points, etc.
- In a regular cycle, depending on the desired accuracy - but at least once a year! To determine the appropriate time interval, we recommend starting with a more frequent recorded performance test and determining the optimum interval from these results. The time between tests/calibrations can be in the range of:

- months for a measurement task in the basic or medium measuring ranges
- days to weeks for small measurement (low- or sub-vol%) ranges
- directly before each measurement if maximum accuracy is required.

## 6.5 CARRYING OUT CALIBRATION

### 6.5.1 Remote controlled Calibration via serial interface RS232

Adjustment of the test gas concentrations used, and calibration is a function in the free Windows based app “SetApp 3.0”. Please mind chapter “Calibration” in the manual “SetApp 3.0: Laboratory Software”.

A terminal emulator, e.g. Tera Term, can be used for adjustment of the test gas concentrations used and triggering of the calibration. Please contact Messkonzept for the structure of the necessary command.

### 6.5.2 Calibration via Pushbuttons

The transmitter is equipped with two hidden buttons on the front. To trigger the buttons, press for one second using a blunt rod with a maximum diameter of 2.5mm. The button “Offset” triggers the offset calibration. The button “Gain” triggers the gain calibration.

If the test gas composition to be used does not match the values set in the device, the concentrations must be entered into the device. This must be done via serial communication, see 6.5.1.

### 6.5.3 Gas supply during calibration

Ensure that the appropriate test gas has fully entered the device before performing an offset or gain calibration. You should monitor the signal for stability to ensure this. After triggering the calibration by pressing one of the buttons or sending the corresponding command via the serial interface, a sampling phase of 10 seconds begins. Keep the gas supply stable and continuous during this phase.



#### Note!

Always do an offset calibration first before doing a gain calibration!

In most cases an offset calibration alone is sufficient for the proper performance of the device! First check if there is a deviation before possibly calibrating!



#### Note!

It is possible to deactivate the buttons by changing a device parameter via the digital communication. Contact Messkonzept if you require assistance.

## 7 SPECIFICATIONS

### 7.1 SPECIFICATIONS OF THERMAL CONDUCTIVITY MEASUREMENT

Warm-up time	approx. 20 min; 1 h for small range
Linearity	< 1 % of range
T90-time at recommended flow value and user selected filter < 0.5 sec	< 1 sec for variant A070B900 < 2 sec for other variants
Noise	< 1 % of smallest range
Drift at zero point	< 2 % of smallest range per week
Drift of span	usually negligible
Repeatability	< 1 % of range
Error due to change in ambient temperature	< 1 % of smallest range per 10 °C
Error due to change of flow within recommended flow range	< 1 % of smallest range
Error due to change of pressure (above 80kPa = 800 mbar)	< 1 % of smallest range per 1 kPa (10 mbar)

Note: The values given above may vary for some gas pairs.

Note: T90 time for all variants is close to 1 sec when at least one light gas is involved.

### 7.2 CONDITIONS OF THE SAMPLE TO BE MEASURED

Temperature of the sample at recommended flow value	max. 80°C at 25°C ambient temp. max. 50°C at 50°C ambient temp.
Gas pressure (absolute)	80kPa (0,8 bar) to 1000 kPa (10 bar) flammable gases max. 300kPa (3bar)
Corrosive gas	avoid, variants A070B901/B903/B908 have corrosion tolerant design
Contamination with dust, aerosols, oil mist, fluids, drops	avoid, variants A070B902/B907/B908 have contamination tolerant design
Humidity	Avoid condensing in the pipes/device, variants A070B902/B907/B908 have condensate tolerant design

Note: Corrosion-tolerant does not mean fully corrosion-resistant, contact Messkonzept for more information.

Note: Evacuation of the device is allowed

Flow rates for the different variants		
Article no.:	Variant description	Flow at atmospheric pressure
A070B900 A070B901	without protection protected corrosion calibrated at 60l/h	recommended value 60/h recommended range 40l/h - 80l/h permissible range 10l/h - 120l/h
A070B902 A070B903	protected for condensate and dust protected for corrosion, condensate, dust calibrated at 60l/h	recommended value 60/h recommended range 40l/h - 150l/h permissible range 10/h - 300l/h
A070B907 A070B908	low flow protected for condensate and dust protected for corrosion, condensate, dust calibrated at 10l/h	recommended value 10/h recommended range 3l/h - 20l/h permissible range 1l/h - 60l/h
	low flow protected for condensate and dust protected for corrosion, condensate, dust calibrated at 30l/h	recommended value 30/h recommended range 20l/h - 40l/h permissible range 1l/h - 60l/h

Note: Heavier gases may have more limited flow ranges, contact Messkonzept

Note: Higher flow rates than the recommended can cause additional noise

Warning: Drastically exceeding the maximum permissible flow rates can destroy the device.

### 7.3 ENVIRONMENTAL CONDITIONS

Operating temperature	-20°C to 50°C (-4°F to 122°F) -5°C to 50°C (23°F to 122°F) with option “glass beads filling”
Storage temperature	-25°C to 70°C (-15°F to 160°F), not-condensing
Class of protection	IP65 (if cable properly pugged in)

### 7.4 ELECTRICAL SPECIFICATION

Power supply (Protective Extra Low Voltage, PELV)	24V DC (21V to 30V); typ. 500mA, max. 1A
RS232 – Baud rate / Data	19200 /8N1 (8 bits, no parity, 1 stop bit) ESD protection ±15 kV
RS485	Max. 115200 Baud/s ESD protection ±12 kV
Current Loop (active)	0/4 to 20mA Fully floating, max.±500V to GND 800Ohm Burden 16 bit resolution

## 7.5 DIMENSIONS

Dimensions with gas connectors	B=144 mm, H=50 mm, D=50 mm
Weight	up to 700 g

## 8 SCOPE OF DELIVERY

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- FTC150
- Cable
- Manufacturing Protocol

