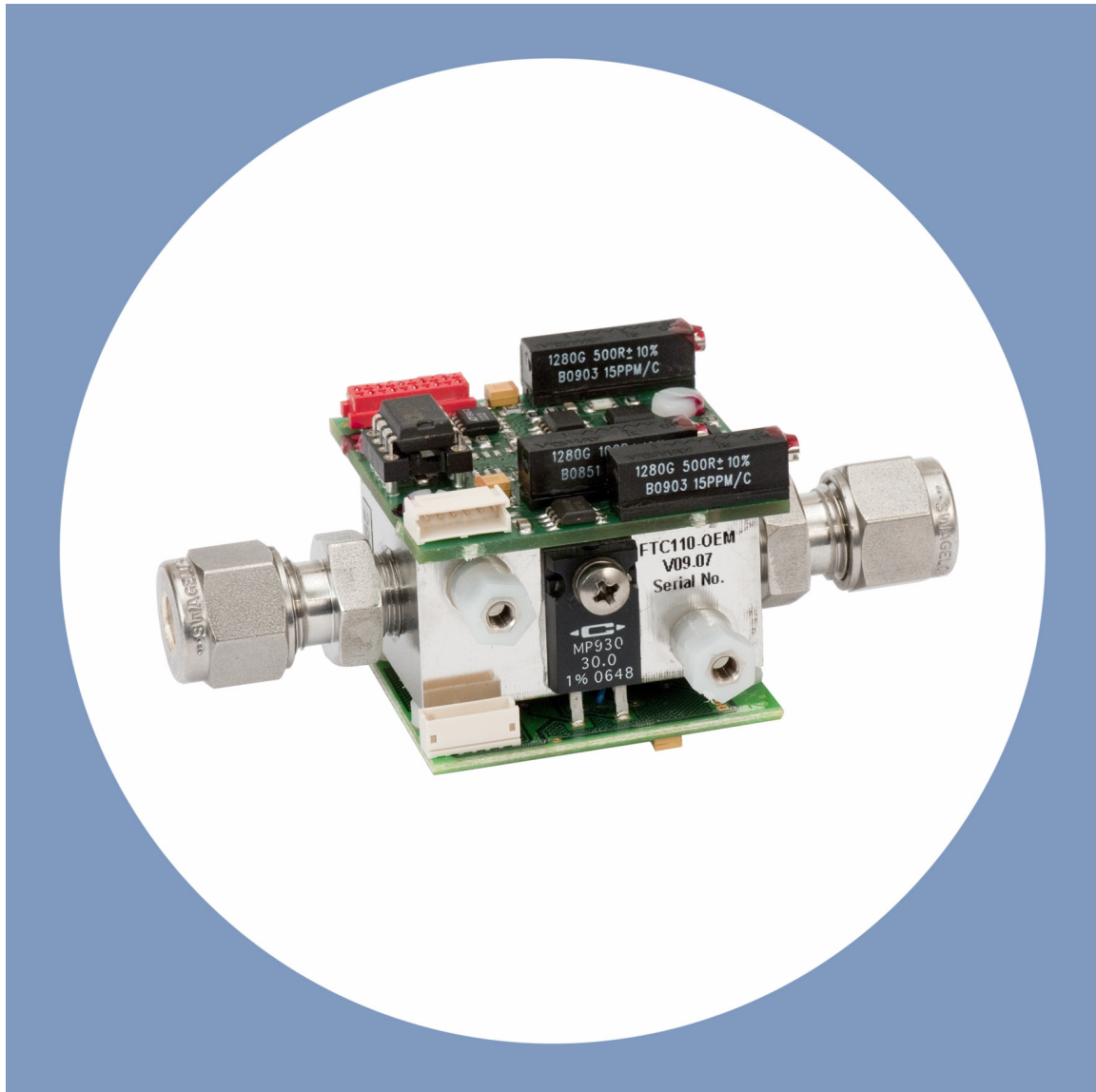


Operating Manual
Fast Thermal Conductivity Detector
FTC110-OEM



1. Features

- Precise and long term stable thermal conductivity measurement
- High sensitivity (e.g. 0 - 0.5% H₂ in N₂) independent of ambient temperature
- Fast response with a T₉₀ time of less than 1 sec
- Measurement independent of gas flow and pressure in a wide range
- Small and robust flow-through device made of stainless steel
- Signal processing included and thereby easy adaptation to customer's electronics
- Calibrated signal output e.g. ranging from 1V for N₂ to 10V for H₂

2. Applications

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 the thermal conductivity and thereby identified.

The concentration can be determined with higher precision if one of the following conditions is met:

- (a) The gas mixture consists of only two components, for example measuring O₂ in Ar or H₂ in N₂.
- (b) The gas mixture consists of more than two components but only concentrations of two components vary, for example measuring CO₂ in air.
- (c) The gas mixture consists of more than two components but the component of interest has a thermal conductivity that is very different from the other components (quasi-binary mixtures), for example monitoring impurities in H₂.

3. Description

The FTC110 detector is based on a micro-mechanical silicon chip with a thin membrane. Two thin film resistors are integrated into the membrane and are used for both heating the membrane and detecting its temperature. Both resistors are protected by an inert coating in order to prevent chemical reactions with the gas molecules. Above and underneath the membrane, two cavities are etched into the silicon. The measuring gas diffuses into the cavities and depending on the thermal conductivity of the gas more or less energy is dissipated from the membrane (source) which is held at a higher temperature than the remaining chip (hollow). The quantity measured is the voltage that is needed to keep the temperature of the membrane at the higher level.

The micro-mechanical chip is fitted into a stainless steel housing where the measuring gas flows through. Gas inlet and outlet are made of 6mm Swagelok® fittings. In order to allow a temperature controlled operation mode of the detector, the temperature of the stainless steel housing is controlled using two heating elements and a temperature sensor that are attached to the housing. The temperature control circuit is on a first board mounted underneath the housing. The temperature may be set with a 10-turn potentiometer. The default value is

60°C. Above the housing, a second board controls the temperature of the membrane (~105°C) and generates the output signal.

4. Technical Data

4.1 Absolute maximum ratings:	min.	typ.	max.	Units
Ambient temperature	-20	---	+55	°C
Sensor temperature	---	+60	+75	°C
Gas pressure (absolute)	0.4	1	10	bar

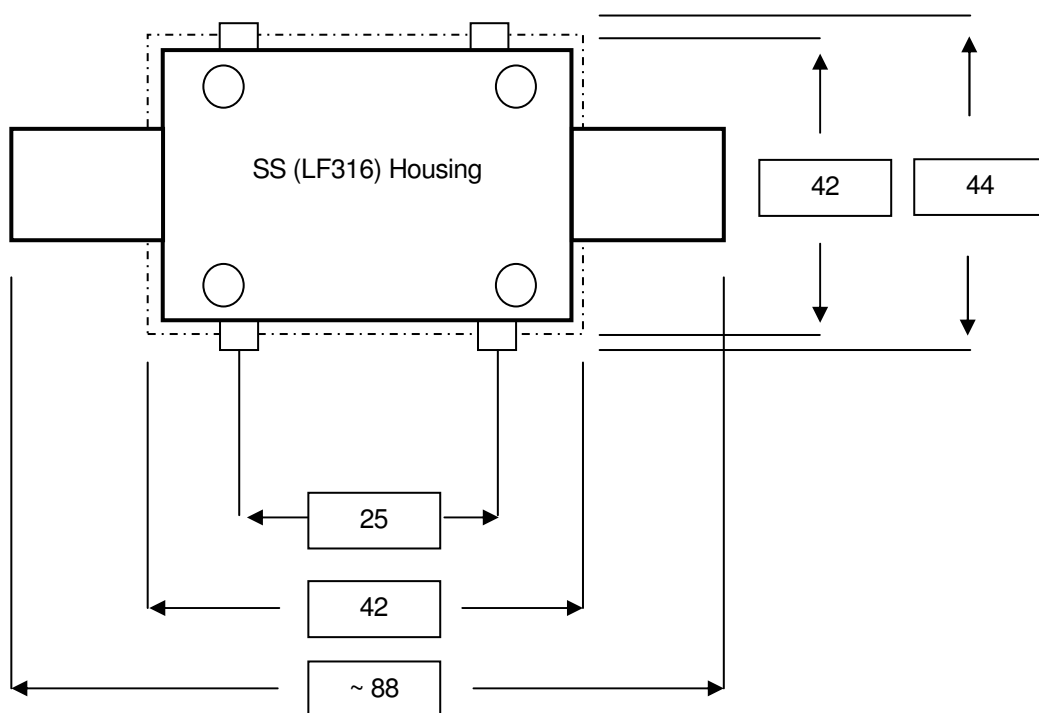
4.2 Specifications:	min.	typ.	max.	Units
Weight	---	~200	---	g
Gas flow	20	50	150	l/h
T90 time at a flow of 50 l/h	---	<1	---	sec
Volume of the device	---	~1.5	---	cm ³
Warm-up time---	---	~20	---	min

4.3 Material:	
Material exposed to the gas	Stainless steel (LF316SS), Kovar, Si, SiOxNy, gold, epoxy, Viton

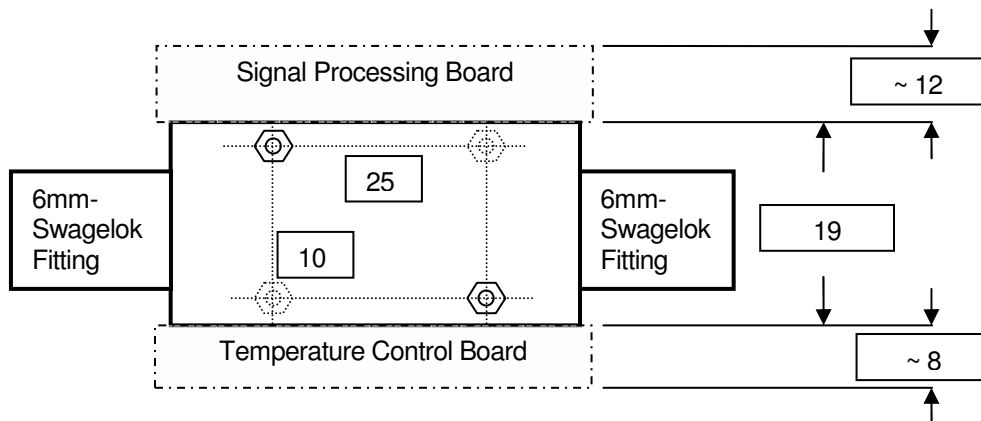
5. Dimensions and Installation

The following diagrams show the top and side view of the FTC110-OEM detector. Dimensions are given in mm. The detector might be mounted at the sides with four 3mm screws. It is recommended to install it in an upright position so that the signal processing board points up.

Top View:



Side view:



Warning: Check the leak tightness after installation.

Warning: Avoid condensation inside the sensor device. Ensure liquids, aerosols, dust and particles are removed from the sample before it enters the sensor device.

6. Electrical Connection

The electrical connection of the FTC110 detector is made with five wires. The color code is given below:

Color	Connection
Yellow	Ground; Signal Processing
Blue	+24V; Signal Processing
Gray	Signal Output
White	Ground; Temperature Controller
Brown	+24V; Temperature Controller

Warning: Do not interchange common and plus wires. This causes serious damage to the electronics and/or sensor element.

Warning: The return for the signal must be gripped where the ground of the signal processing, the temperature controller and the power supply are connected.

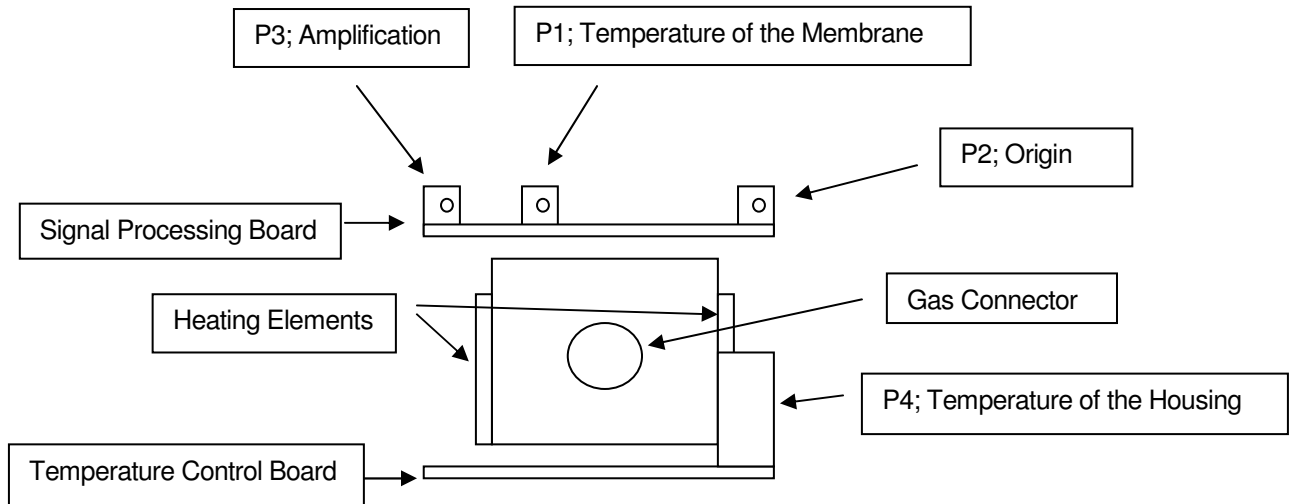
Specifications:

Description	Specification	Recommended	Current
Power Supply; Signal Processing	18V to 24V DC	24V DC	up to 50mA
Power Supply; Temp. Controller	18V to 24V DC	24V DC	up to 400mA
Signal Output	0.7V - 12.5V		
Load Impedance	>10kOhm		

The output signal of the FTC110 detector may not be linear.

7. Calibration

The following diagram shows a schematic of the flow-through device along with the signal processing and the temperature control board. Depending on the application the membrane excess temperature, origin and amplification of the signal as well as the basic temperature of the sensor may be set with the indicated potentiometers.



The setting of the potentiometer P1 depends on the application (gases and ranges) and should only be changed by personnel who is familiar with the FTC110 detector.

The potentiometer P2 is used to set the origin of the measurement range. Apply the gas with the lowest thermal conductivity (e.g. N₂) to the detector and turn P2 until the output is 1V. Apply the gas with the highest thermal conductivity (e.g. H₂) to the detector and turn P3 until the output is 10V. Check again the origin and the span. Now the output of the FTC110 detector is calibrated ranging from 1V to 10V. The interval of calibration depends very much on the application and might vary from weeks to months.

The potentiometer P4 might be used to set the basic temperature of the stainless steel housing of the sensor element up to 75°C. In order to achieve this, insert a temperature sensor through the gas inlet or outlet and position it in between the heating elements. While carefully watching the temperature indication, turn the potentiometer stepwise until the desired temperature is reached.

8. Measuring Ranges and Specifications

Typical Measurement Ranges:

Gas to be Measured	Background Gas	Range
H ₂	N ₂ or Air	0% - 0.5%
H ₂	N ₂ or Air	0% - 100%
H ₂	N ₂ or Air	98% - 100%
H ₂	Ar	0% - 0.3%
H ₂	He	20% - 100%

He	N ₂ or Air	0% - 0.8%
He	N ₂ or Air	0% - 100%
He	N ₂ or Air	97% - 100%
CO ₂	N ₂ or Air	0% - 4%
CO ₂	N ₂ or Air	0% - 100%
Ar	N ₂ , Air or O ₂	0% - 3%
Ar	N ₂ or Air	96% - 100%
Ar	N ₂ or Air	0% - 100%
CH ₄	N ₂ or Air	0% - 2%
CH ₄	N ₂ or Air	96% - 100%
CH ₄	N ₂ or Air	0% - 100%

Other ranges on demand.

Warning: Consultation with Messkonzept is required if the measuring gas contains corrosive components like SO₂ or H₂S.

Specifications:

T90 time	< 1 sec at a flow of 50 l/h
Noise	< 1% of smallest range
Drift	< 2% of smallest range per week
Repeatability	< 1% of range
Influence of ambient temp.	< 2% of smallest range / 10°C
Influence of gas flow	< 1% of smallest range from 40l/h - 150l/h for mixtures mainly consisting of N ₂ < 2% of smallest range from 40l/h - 60l/h for mixtures mainly consisting of H ₂
Influence of pressure between 800 and 1200 hPa	< 0.4% of smallest measuring range per 10 hPa < 0.04% of largest measuring range per 10 hPa