ZIROX
Sensoren und Elektronik GmbH

ZIROX – Gas Measuring Technology

Hydrogen Sensor TCS

Manual

Power supply: 24 V DC

ZIROX Sensoren & Elektronik GmbH
Am Koppelberg 21, D-17489 Greifswald, Germany
☎+49 3834 8309 -00, Fax: +49 3834 8309 -29
E-Mail: info@zirox.de

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1 General information

The hydrogen sensor TCS (thermal conductivity sensor) serves the continuous measuring of the hydrogen concentration in industrial, lab and inert gases.

With the TCS

- the hydrogen concentration of a measuring gas is measured continuously and emitted via interface,
- deviations of the hydrogen concentration in the measuring gas from an adjustable set value are signalized,
- the running of certain production processes, which include hydrogen, is controlled.

The use of the measuring cell in explosive rooms and the introduction of explosive gas mixtures is not permitted.

Liquids (condensate formation) cause the destruction of the TCS.

The introduction of halogens in high concentration and sulphuric gases (e.g. SO_2) into the TCS leads to a destruction of the sensor.

2 Measuring principle

2.1 Basics

The **T**hermal **C**onductivity **S**ensor measures the hydrogen concentration.

In this case, the far higher thermal conductivity of hydrogen in contrast to other gases is utilized. The TCS produces a voltage linearly dependent on the hydrogen concentration (at best; actually, the characteristic line follows a complicated mathematical function established by complex calibrations).

Figure 1 shows the basic mode of operation. It is based on the temperature dependency of an electrically heated resistance wire on the thermal conductivity of the ambient gas.

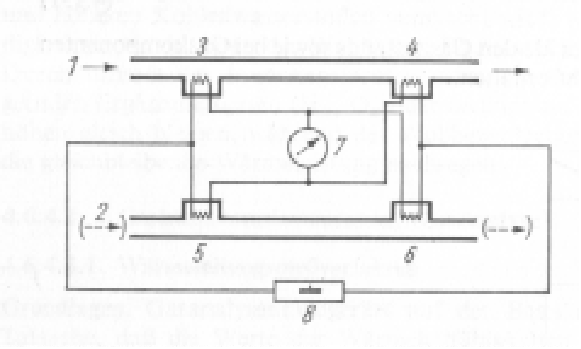


Fig. 1: *Basic drawing of the TCS*

The measuring gas (1) and the reference gas (2) flow around two measuring cuvettes connected as a Wheatstone bridge. In order to prevent direct gas flow influence on the wire temperature, a diffusion barrier is installed.

At concentration variations of the measuring gas the thermal conductivity and, with it, the electrical resistance of the measuring gas wire changes. The result is a change of the bridge voltage.

2.2 Special properties of the TCS

The TCS can also be used in low-pressure applications (e.g. surface treatment like case-hardening under vacuum conditions).

For this, a special software is needed. A complex calibration is conducted before dispatch. Additionally, the customer must know the **exact process pressure** (enter via set-up software).

All calibrations must be conducted under the preset process pressure. In case of disregard, the characteristic line will be changed significantly.

In case of low-pressure use, a special consultation with the manufacturer is recommended.

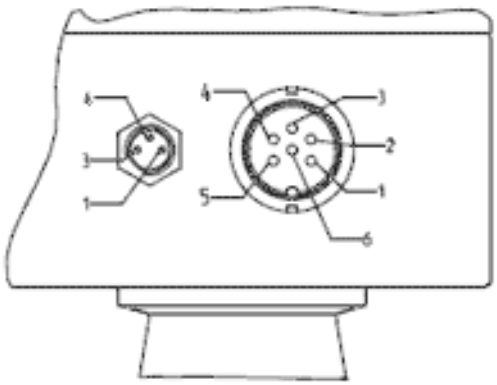
3 Technical data

3.1 General data

Measuring range	0…100 vol%	
Measurement precision	Relative error < 5 %	
Response time	t_{90} (sensor) < 90 s	Depends on flow and gas mixing in measuring chamber
Sensor temperature	50 °C	Pre-thermostated, controlled electronically
Dimensions (WxHxD)	80 mm x 125 mm x 83 mm	
Signal output	Analog output 0/4 - 20 mA (scaling via software) and serial interface RS232	0 – 5/10 V on request
Power supply	24 VDC ± 20 %, approx. 20 VA	
Display	None, operation via software	
Protection degree	IP 65	
Ambient temperature	0…50 °C, 0…95 % rH	
Storage temperature	-20…60 °C, 0…95 % rH	
Gas connection	Via DIN40KF	Others on request
Gas supply	Via diffusion (Gas distribution at measuring chamber)	Suction mechanism on request
Ambient pressure	950...1100 hPa (low-pressure application needs special calibration)	**Measuring value depends on pressure**
Warm-up	10 min	
Calibration	First calibration (characteristic line determination) by manufacturer. Customer must do a 2-point-calibration approx. every 3 month	Process pressure must be known and provided to the manufacturer
Mounting	No requirements	
Cross sensitivity	Gases with high thermal conductivity falsify the measuring result	

3.2 Power supply and signal output

Power supply and signal output are realized via 6pol. round pin plug (Figure 2). The socket is included in delivery.



Pin RS232 at SUB-D 9-pole	Conductor colouring	Designation
2	white	TxD
3	brown	RxD
5	green	GNDA

Pin	Conductor colouring	Plug assignment
1	pink	+ 24 V
2	blue	GND
3	green	+ Iout
4	yellow	- Iout
5	brown	Ready contact (potential-free)
6	white	

Fig. 2: *Plug assignment (Type 423 6pol., Fa. Binder, Best.-Nr.: 99-5622-15-06) and conductor colouring (if cable was provided)*

3.3 Digital interface

The digital output is an RS232 interface (9600 Baud). Via RS232, the regular two-point-calibration and the data transmission are realized.

The interface is located on the conductor board inside the housing. An adapter is included in delivery (Fig. 3).

Fig. 3: *Adapter for RS232 interface*

The RS232 must be connected with a PC by SUB-D-cable (9pol., 1:1, uncrossed)!

Transmission rate: max. 9600 Baud, adjustable

Stoppbits	1	Parity	none
Databits	8	Handshake	without

Protocol of the digital interface (CR = carriage return)

Input	Response/ example	Transmitted measuring value	Parameter/remark
M2CR	M2x.xxExxCR M22.06E+01	20,6 vol% H_2	concentration
A1CR	A1xxx.xCR A120.9	20,9 mV	sensor voltage in mV
A2CR	A2xx.xCR A249.9	49,9 °C	measuring temperature in °C

The adjustment of the parameters occurs via software (see chapter 4.3). Further software for display and storage of the measuring value is available (option).

Error messages

ERROR0	Transmission error RS232 (or wrong or invalid command)
ERROR1	Warm-up (sensor temperature too low and less than 30 min)
ERROR2	Sensor temperature too low (< set temp. – 1.0 °C, longer than 30 min)
ERROR4	Temperature measurement defective
ERROR6	System error

4 Mounting, initiation and operation

4.1 General equipment configuration

The hydrogen sensor was designed as a probe for real in-situ-measurements (no suction of the measuring gas). It is mounted via vacuum components (e.g. KF40). Figure 4 shows the dimensions.

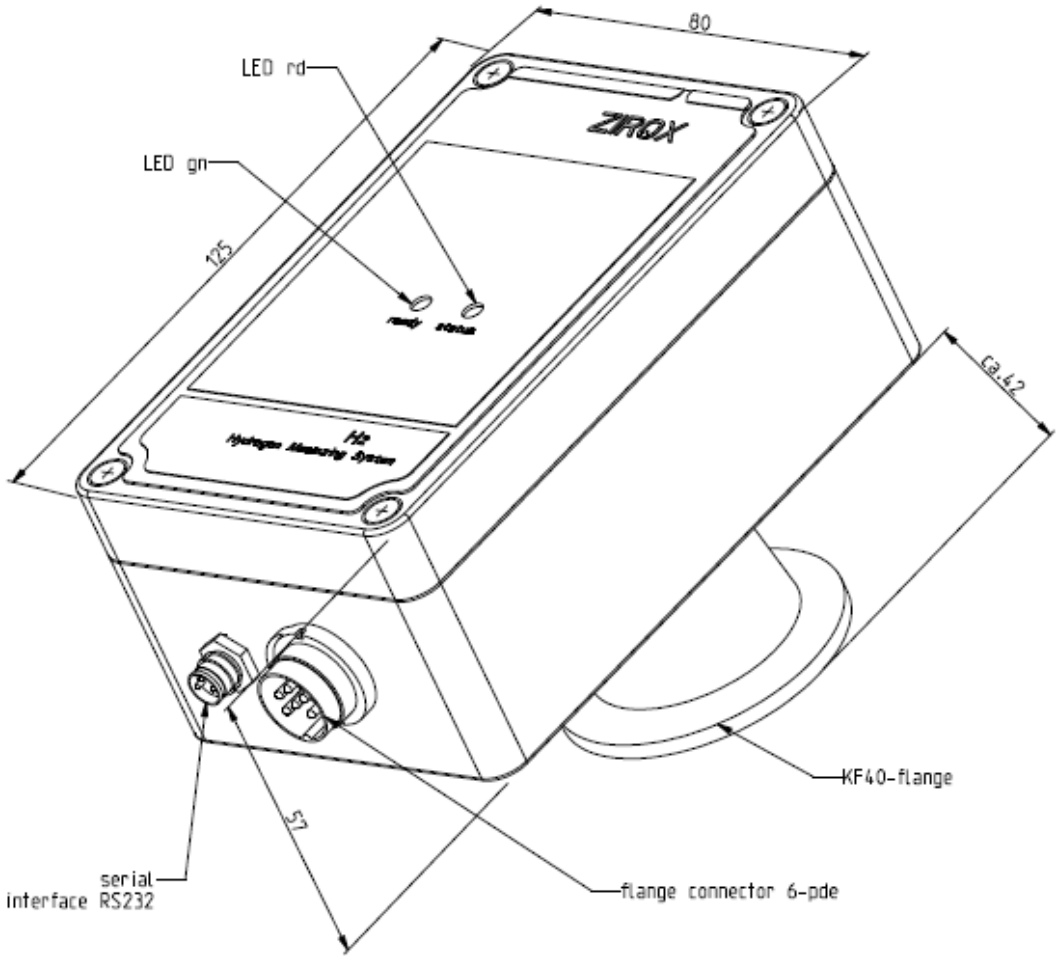


Fig. 4: *TCS dimensions*

4.2 Mounting and initiation

NOTE

A temperature compensation is required after the transportation of the device from cold surroundings to a site with higher ambient temperature or humidity**.** Consider a **waiting time of about 2 hours** before switching-on.

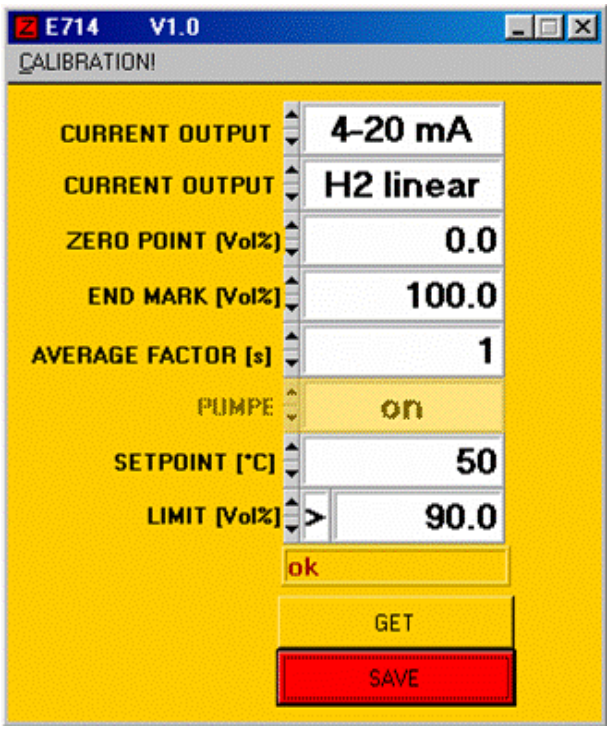
Install the sensor with the provided vacuum components. The power supply is 24 V DC (connection via 6-pol. plug at housing, socket included in delivery, pin assignment see chapter 3.2)

Heat sources or pieces of equipment, which produce strong magnetic fields (e.g. electric motors, transformers), must not be in the immediate proximity of the place of installation.

4.3 Operation and parametrization

The operation and parameterization is carried out via digital interface by software E714 (included in delivery). Two LED on the sensor cover serve the operation display and the signalization of operation and warning status (see chapter 5.1).

First, chose the COM-port of the digital interface (mostly COM1). After closing, the parametrization menu opens up (see below). In this menu the range of the analog output 0…20 mA or 4...20 mA resp. can be adjusted (Zero Point in vol%, End Mark in vol%). Furthermore, the averaging in seconds can be chosen.



If a limit value shall be indicated via relay output, enter this limit value in the box „LIMIT [vol%]“ (signalization of deviations with </>).

Read the data off the memory by pressing **GET**. After adjusting the parameters, the setting is stored with **SAVE**. With the selection of CALIBRATION, the measurement is started or the measuring value is shown in the top line of the menu (normally this menu is only for calibration – a special software can be ordered).

Communication problems between sensor and PC are displayed in a command line (error messages see chapter 3.3).

4.4 Calibration

All calibrations must be conducted at the preset process pressure. In case of disregard, an extreme change of the characteristic line occurs.

ATTENTION

The user has to calibrate regularly (2-point-calibration, every 3 month). This means that an offset-calibration in clean ambient air and a test gas calibration with a hydrogen concentration similar to the process hydrogen concentration are conducted. For this, connect the sensor with a PC. The calibration can be conducted with the delivered software E714 (zip-file).

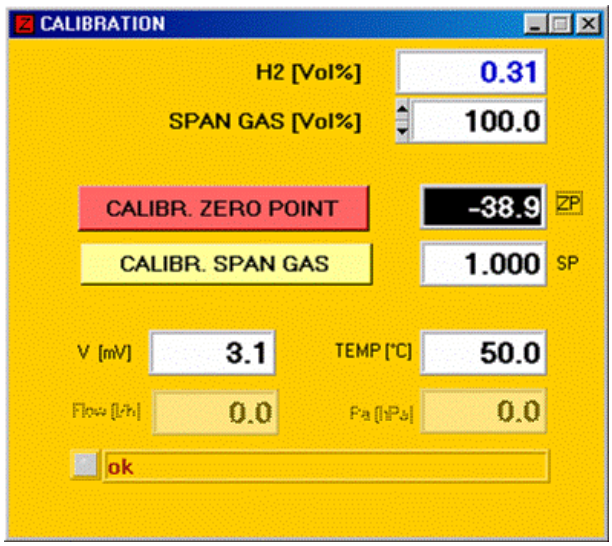
First, chose the COM-port of the digital interface (mostly COM1). After that, the adjustment menu opens. Click on **CALIBRATION**! In this menu the sensor voltage (**V [mV]**) and the calculated hydrogen concentration (**H2 [vol%]**) are displayed.

Before starting the calibration, flush the sensor with test gas (clean air or test gas with known hydrogen concentration) for at least 15 minutes.

After flushing with clean (hydrogen-free) air, please click on „CALIBR. ZERO POINT“. After that, the hydrogen concentration must be shown as 0.00.

For the span gas calibration (Span Gas), insert the test gas value in the button **SPAN GAS [vol%]**. After sufficient flushing of the sensor, finish the calibration by clicking **CALIBR. SPAN GAS**.

The two buttons next to ZP (here -38.9) and SP (here 1.000) are intended for cases of need. This means that in the case of calibration errors (no reasonable values) the factoring settings can be entered (available from manufacturer).



If a calibration is not conducted, the sensor is ready for operation but the measuring values are not within the indicated error limits (see chapter 4.5).

4.5 Measurement accuracy

The manufacturer guarantees a measuring error of < 5% (relative error) for measurements of hydrogen concentrations in the range of 1…100 vol%.

In measurements of hydrogen, concentrations of < 1 vol% a relative error of < 5% can only be reached if the following aspects are considered:

- Good mixing of the measuring gas under normal pressure conditions.
- Tight gas supply (special construction without vacuum components).
- If the measuring gas contains other components with high thermal conductivity besides hydrogen, these parts must be considered in the error analysis.
- All calibrations must be conducted at the preset process pressure.

5 Status messages and fault clearance

5.1 Status messages LED

Nr.	Description	LED red	LED green
1	OK	off	on
2	Sensor temperature < 50 °C (set temp.)	flashing	off
3	Temperature measurement defective		
4	System error		
5	Limit value exceeded	on	on

In status 2 to 4 the current output goes to 0 mA!

5.2 Fault clearance

Fault	Cause	Clearance
No output signal	Power supply off	Check power supply, check pin assignment of the socket
	Sensor temperature too low	Check power supply
	System error	Consult service
Higher measuring value than expected	System contains additional gas compounds with high thermal conductivity coefficient	Contact service, check the general suitability of the system for the measuring task
Measuring value is considerably lower than expected	Leaks	Check sealings

Fuse: The sensor electronics has a resettable fuse (1.1 A).

6 Warranty conditions

ZIROX Sensoren & Elektronik GmbH warrants that the products manufactured and sold are free from manufacturing and material defects at the time of dispatch. In case of defects and faults within 12 months (probe) and 24 months (electronics assembly) respectively after dispatch, ZIROX will clear faults at its own option by repair or replacement. The purchaser must give prompt written notice to ZIROX. The purchaser is not entitled to claim other legal remedies based on this warranty.

ZIROX does not warrant supplied products which are subject to normal wear and tear (e.g. reference gas pump).

Corrosive gases and solid particles may cause damage and require repair or replacement due to normal wear and tear.

The contact of the products with explosive gas compounds, halogens in high concentrations and sulphuric gases (e.g. SO_2) is not permitted.

The contact of the products with siliconic or phosphoric compounds is not permitted either.

A connection of ZIROX and non-ZIROX products voids any warranty claims.

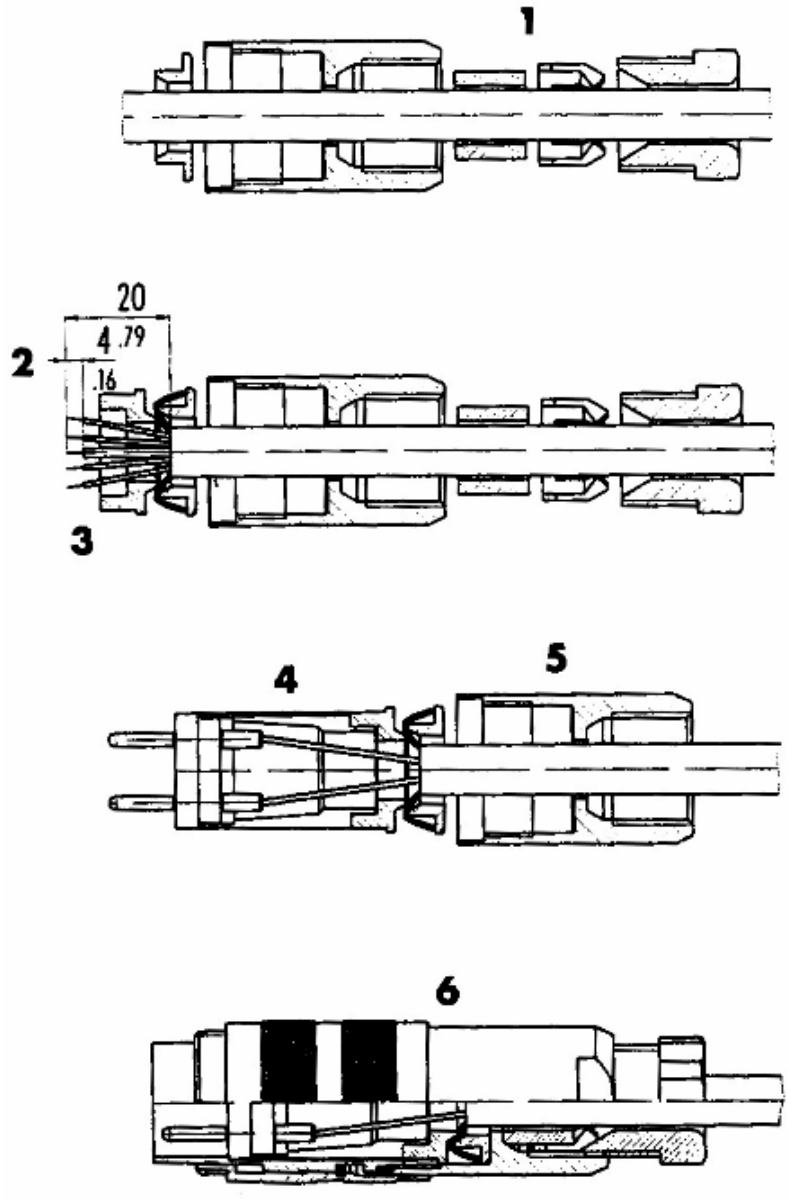
Warranty and warranty claims are only accepted if they are in accordance with the "General Sales and Delivery Conditions" of the manufacturer.

Warranty and liability claims for damage to persons and/or property are void if they are subject to the following:

- Normal wear and tear
- Improper use of the product
- Disregard of the manual's instructions
- Improper installation, initiation, operation and maintenance of the product
- Operation of the product without protective measures
- Unauthorized functional and technical modification of the product
- Dismantling of parts as well as installation of spare parts or additional units which are not delivered or permitted by the manufacturer
- Improper repairs or faulty operation
- External impact
- Acts of God

Attention: When installing the equipment, the customer must ensure that all necessary supply lines are connected and the operating temperature of the probe is reached. Experience has shown that products installed but not in use may be damaged by the process or by external influence. ZIROX will not accept any responsibility for such damage.

7 Assembly instructions for connection socket



1. Thread parts
2. Strip the insulation and widen shield
3. Assemble shield clamping ring
4. Solder wire, attach distance bush
5. Cut off lapping shield
6. Assemble remaining parts according to plan