FES Sensor Technology GmbH

H2-meTCD I2C

www.fes-sensor.com

Thermal Conductivity Hydrogen Sensor with I2C Interface

1. FEATURES

- Accurate detection of hydrogen levels in air and nitrogen up to 100 vol-%
- Fast response and recovery times
- Applicable in relative humidity (rh) between 0 % to 100 %
- Temperature range -20 °C to +85 °C
- Very low power consumption < 10 mW
- Programmable gain amplification (PGA), 16-bit $\Delta\Sigma$ analog-to-digital converter, offset-rheostat, on-board digital temperature sensor, and 1K EEPROM, all of them with I2C®bus connectivity

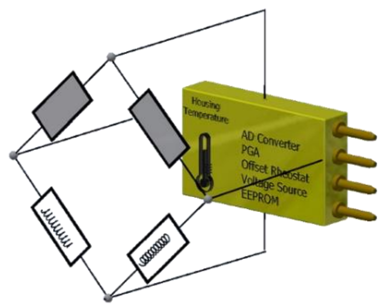
2. APPLICATION

- Precision hydrogen meters

3. DESCRIPTION

H2-meTCD I2C is a hydrogen sensor which is based on the thermal-conductivity-operation principle. The sensor contains a Si-based heated transducer, fabricated by anisotropic etching, and on-board electronics, including the voltage source for the transducer, a non-volatile digital rheostat for adjusting the Wheatstone bridge with the transducer, a digital converter of the sensor signal with programmable gain amplifier, a digital temperature sensor and an EEPROM for an advanced control of sensor characteristics in a temperature range of -20 to +85°C. It is designed for use in a variety of applications which require accurate hydrogen determination in nitrogen or other non-oxygen-containing atmospheres.

4. SIMPLIFIED SCHEMATIC



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5. REVISION HISTORY

Date	Rev.	
Feb 10, 2024	1.0	Initial version
July 4, 2025	1.1	0-100 vol-% and 90-100 vol-% H_2 calibration curves added in chapter 8.2

6. PIN CONFIGURATION AND FUNCTION

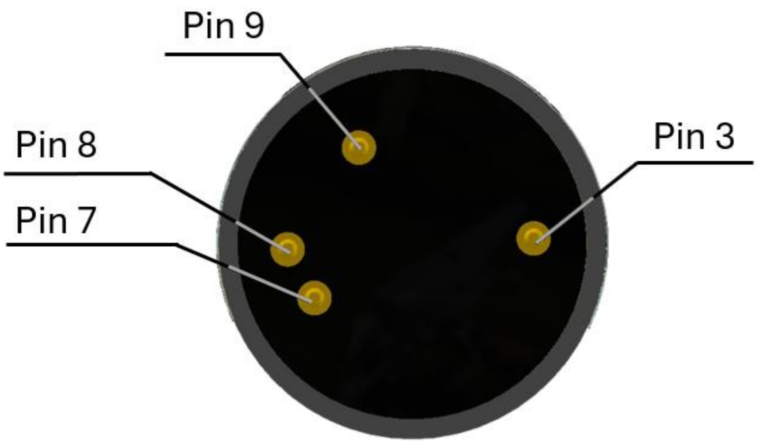

Figure 1: Bottom view of sensor

PIN NO.*	DESCRIPTION
9	+6 V positive supply voltage with respect to ground
7	Ground of the internal electronics. The pin is electrically not connected to the housing
3	SCL Clock line of the I2C bus**
8	SDA Data line of the I2C bus**
	* Numbers refer to the 9 pin-scheme of our evaluation kits ** If connected, provide necessary pull-up resistors to SCL and SDA (e.g. 4.7 kOhm).

7. SPECIFICATIONS

7.1. ABSOLUTE MAXIMUM RATINGS

At ambient temperature T_a = 20 °C.

Table 2	
Input supply voltage	+6 to +9 V
Storage temperature	-20°C to 85 °C

7.2. ESD CAUTION

ESD (electrostatic discharge) sensitive device. Although this product features protection circuitry, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

7.3. HANDLING RATINGS

The sensor must not be subjected to severe shocks which might result from suddenly applied forces or abrupt changes in motion. They may cause permanent damage to the device.

7.4. RECOMMENDED OPERATING CONDITIONS

At ambient temperature T_a = 20 °C (unless otherwise noted).

Table 3

	MIN	NOM	MAX	UNIT
Input supply voltage	+5.5	+6	+9	V

7.5. MECHANICAL

Table 4

Housing material	Stainless steel (1.4404; SUS316L)
Potting	Epoxy, flame retardant, according to UL-94
Base plate	FR4, flame retardant, according to UL-94
Weight	15 g
Diameter	20.0 mm
Height (housing)	16.6 mm
Height (overall)	21.6 mm
Pins	Gold over nickel
Pin diameter	1.0 mm
Pin length	4.7 mm

7.6. ELECTRICAL

Table 5	
Supply current	1 mA @ 20 °C

7.7. ENVIRONMENTAL

Table 6	
Ambient temperature range during operation	-20 to +80 °C
Operation humidity	0 … 100 % r.h.

7.8. SENSOR PARAMETERS

Table 7	
Signal at 50% LEL	5400 bit (typical) at a PGA setting of 16 V/V*
Resolution	50 ppm H_2
Linearity	1760 bit/1 vol-% at 20 °C
Response time	< 5 s
Thermal zero point drift	< 25 bits/°C at a PGA setting of 1 V/V*
	* The maximum number of bits equals 32768 bits at this amplification for a balanced Wheatstone bridge setting. The negative input range, which corresponds to half of the possible 2^{16} bit data range of the converter, is not used for this zero point setting.

7.9.SENSOR CROSS SENSITIVITIES

The H2-meTDC I2C sensors which are calibrated in order to measure hydrogen levels in air or nitrogen due to the large difference of of H_2 (0.15 W/mK) in comparison to nitrogen (0.02598 W/mK) and oxygen (0.02674 W/mK). Since for most gases and vapors thermal conductivity ranges between 0.01 and 0.03 W/mK at room temperature, cross-sensitivities are low in many applications. Among the light gases, which have high thermal conductivity, a notable interferent to hydrogen is helium (0.18 W/mK). Also, dense gases like xenon or others, which have low thermal conductivity, may affect the sensor´s output signal. The cross sensitivity of water vapor in humid air depends on the temperature and may be notably for ambient temperature well above room temperature.

8. TYPICAL PERFORMANCE CHARACTERISTICS

All data presented below are acquired in an automated gas mixing system with mass flow controllers and pressurized gas bottles with synthetic air (21 vol-% oxygen in nitrogen), calibrated hydrogen mixtures (5 vol-% H_2 in nitrogen), and pure hydrogen 5.0. Room temperature data are determined with the sensor attached to our test chamber TC 2x1/4”. Ambient temperatures are adjusted in a cooled or heated test chamber. The evaluation kit TC Controller 3.1 is used for the measurements.

8.1. INITIAL WARM-UP PHASE

The sensors are operational immediately after the power supply is switched on without a relevant warm-up phase.

8.2. CALIBRATION CURVE

The following figures show the response of H2-meTCD I2C over a H_2 volume fraction range from 0-100 vol-%, 0-5 vol-%, and 90-100 vol-%. Note the different gain settings during data collection.

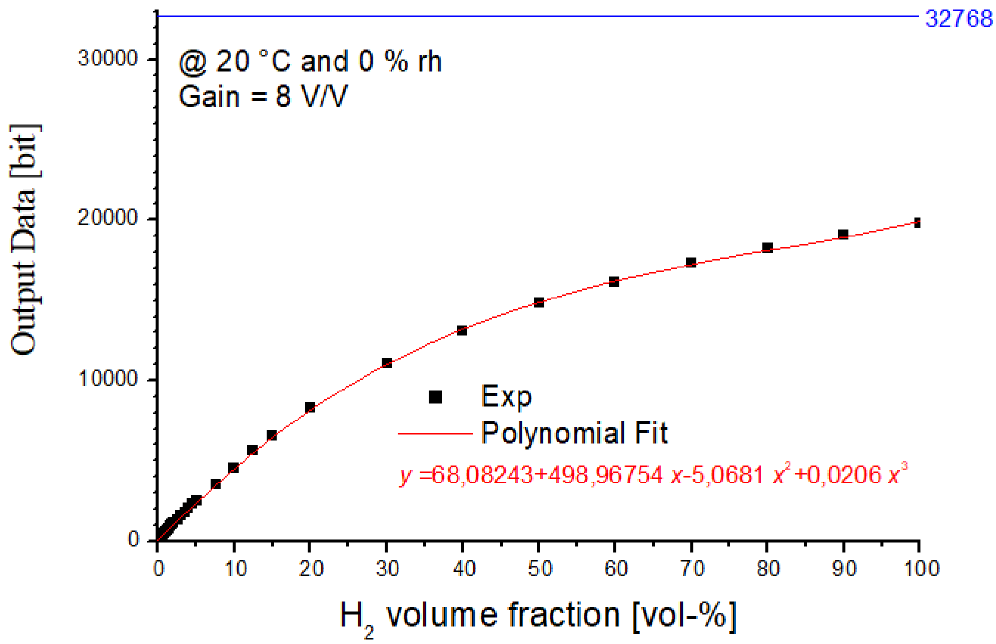

Figure 2. Typical values of the AD converter´s output (sensor signal) as a function of hydrogen volume fraction in nitrogen at 20 °C. Experimental data (Exp) are determined for a total flow of 50 sccm/min. Red: Polynomial fit of 3rd order. The blue line equals 2^{15} which corresponds to saturation of the sensor´s analog-digital converter. In the embedded formula y equals output data and x equals the volume fraction of H_2.

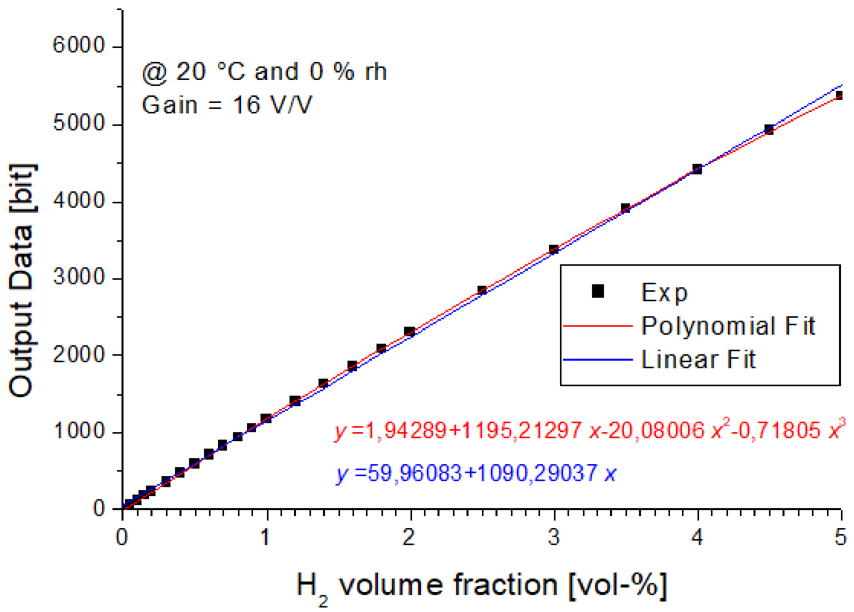

Figure 3. Typical values of the AD converter´s output (sensor signal) as a function of hydrogen volume fraction in synthetic dry air at 20 °C. Experimental data (Exp) are determined for a total flow of 50 sccm/min. Blue line: Linear approximation with a slope of approx. 1090 bits/1 vol-%. Red: Polynomial fit of 3rd order. In the embedded formula y equals output data and x equals the volume fraction of H_2.

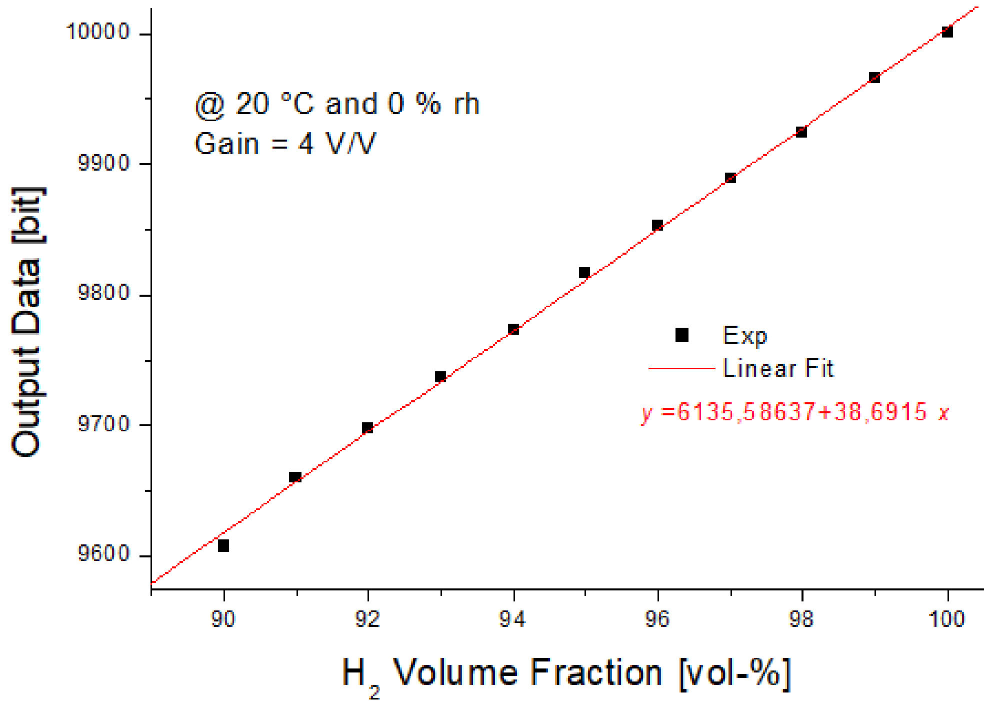

Figure 4. Typical values of the AD converter´s output (sensor signal) as a function of hydrogen volume fraction in nitrogen at 20 °C. Experimental data (Exp) are determined for a total flow of 50 sccm/min. Red: Linear fit. In the embedded formula y equals output data and x equals the volume fraction of H_2.

8.3. LOW DETECTION LIMIT AND RESOLUTION

The sensors show a low-detection limit of 100 ppm and a resolution of 50 ppm.

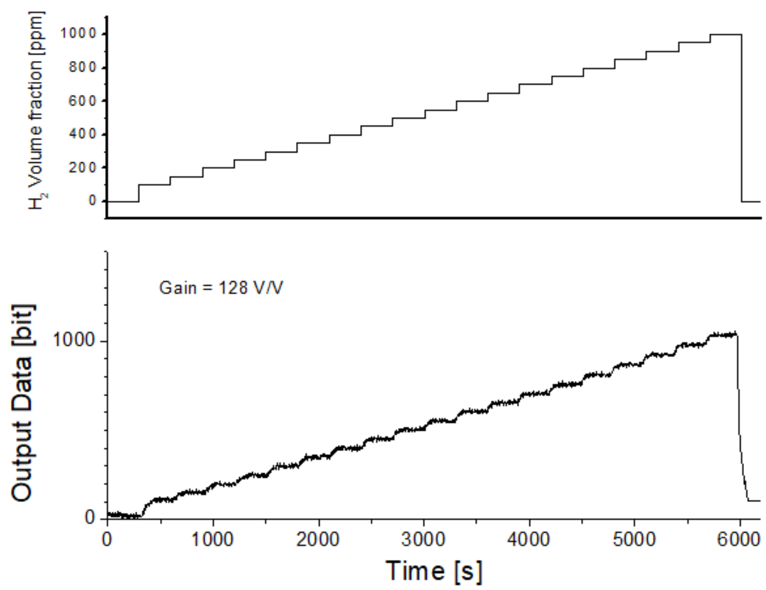

Figure 5. Top: Test protocol with an automated procedure of low hydrogen exposures (H_2 volume fractions between 100 and 1000 ppm with 500ppm steps) in the test chamber (dry air at 20 °C, total flow 100 sccm/min). Bottom: Output data (sensor signal) as a function of time with the PGA set to a gain of 128 V/V.

8.4. EFFECT OF RELATIVE HUMIDITY ON THE BASE LINE

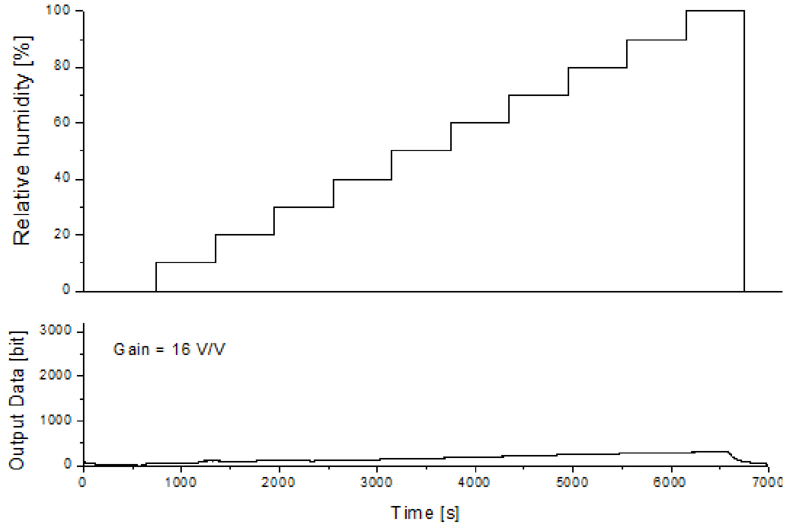

Figure 6. Top: Test protocol with an automated procedure of relative humidity changes in the test chamber, ranging from dry air to 100 % (temperature = 20 °C, total flow = 50 sscm/min). Bottom: Sensor signal (current) as a function of time.

8.5. EFFECT OF RELATIVE HUMIDITY ON THE SIGNAL

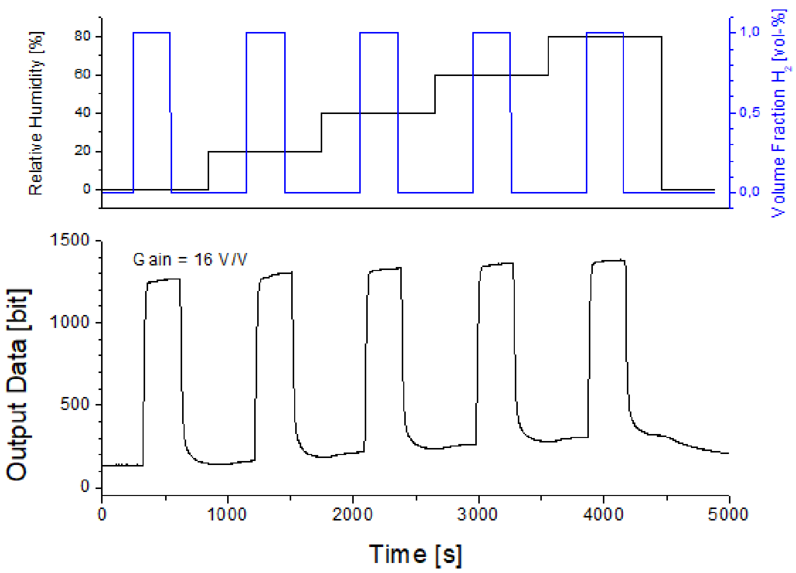

Figure 7. Top: Test protocol with an automated hydrogen exposure (1 vol-%) and variations of the relative humidity (0 to 80 %) at 20 °C (total flow = 50 sscm/min). Bottom: Sensor signal (current) as a function of time.

8.6. EFFECT OF FLOW RATES ON THE BASE LINE

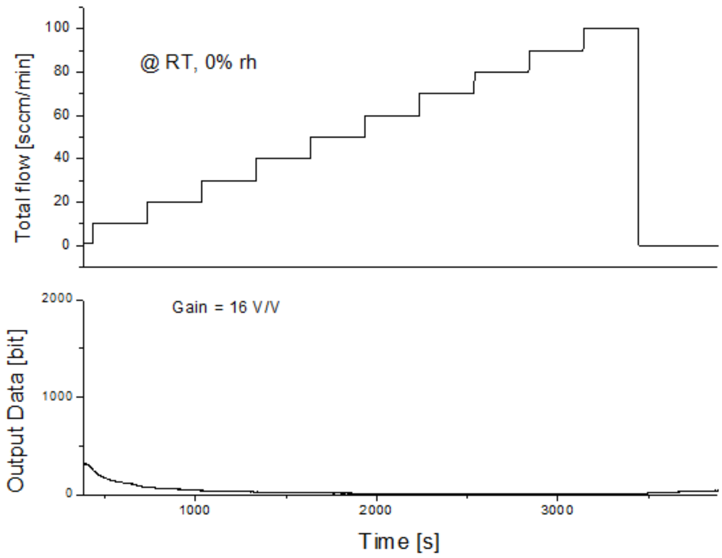

Figure 8. Top: Test protocol with an automated total flow variation between 0 and 100 sccm/min at 20 °C and 0 % rh. Bottom: Sensor signal (current) as a function of time.

8.7. EFFECT OF FLOW RATES ON THE SIGNAL

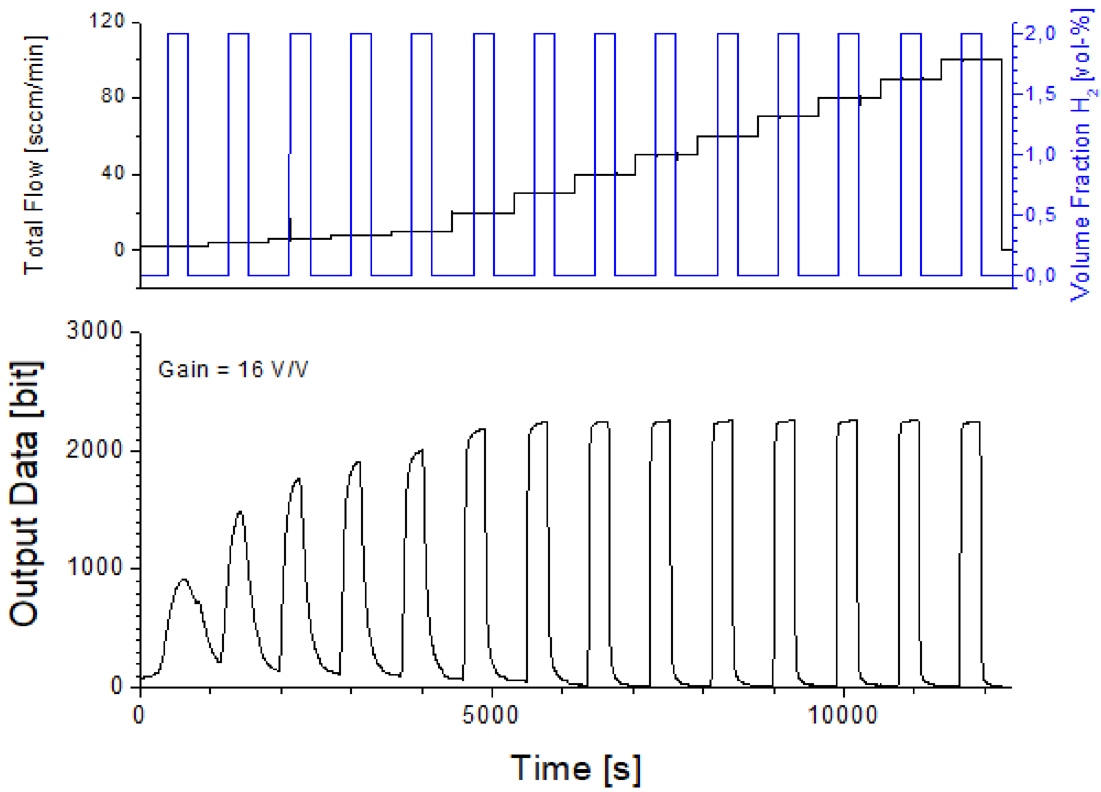

Figure 9. Top: Test protocol with an automated total flow variation between 1 and 100 sccm/min at 20 °C and 0 % rh (black) and repeated exposures with a hydrogen volume fraction of 2 vol-% (blue). Bottom: Sensor signal (current) as a function of time.

8.8.RESPONSE AND DECAY TIMES

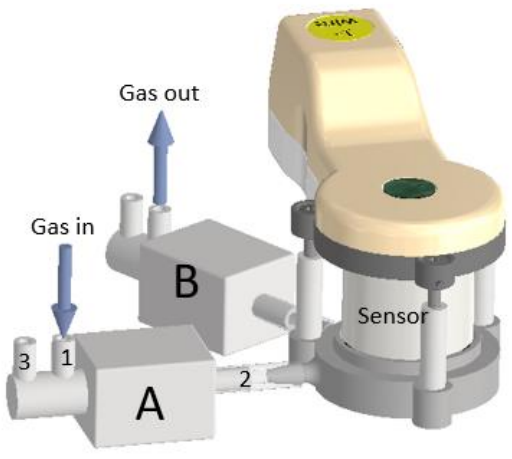

Figure 10. Special setup to determine the response and decay time of the sensor. A flow of 2 vol-% H_2 in air with 50 sccm/min flows into the system at the "gas in" through port 1 of valve A. The valve can be switched electrically to pass the flow through port 3 to the ambient air or port 2 to the sensor, attached to a small test chamber. Valve B is operated together with valve A and cut off the test chamber from the outlet if A is switched into the 1-3 position.

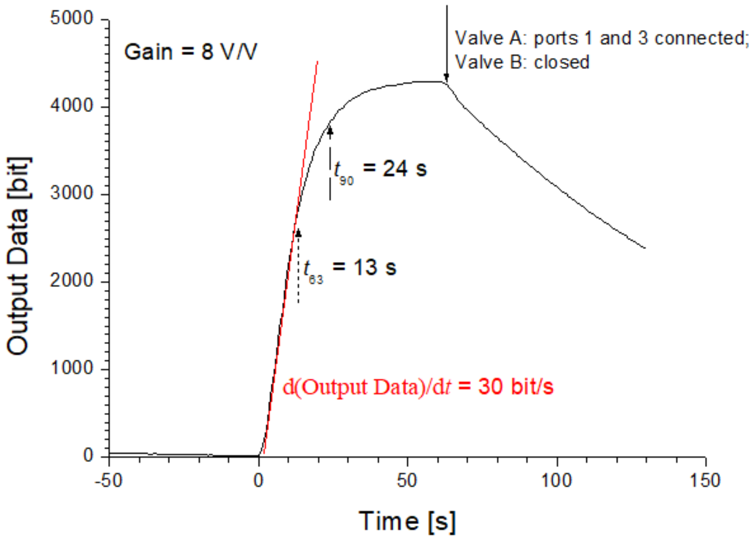

Figure 11. Sensor signal as a function of time after applying 2 vol-% H_2 in dry air at 20 °C. The sensor signal reaches a steady-state signal with a t_{63} response time of 13 s (dotted arrow) and a t_{90} response time of 24 s (dashed arrow). The slope d(Output Data)/dt is approx. 30 bit/s.

8.9.CALIBRATION PROCEDURE

For offset adjustment, the sensor contains a digitally adjustable, non-volatile rheostat, controlled over the I2C bus. For changing the factory setting, a special PCB board is available. The number of possible changes of offset settings, stored permanently in the rheostat, is limited to 50.

8.10. MECHANICAL TESTS

The electronic board of the sensor has been tested in shock tests with the sensor placed on a vibrating plate (50 Hz) and on an alternating acceleration test stand with 8 G.

9. THEORY OF OPERATION

The hydrogen sensors H2-meTCD I2C contains a Si-based heated transducer, fabricated by anisotropic etching, with a thin membrane that is heated by a thin-film resistor. The membrane´s temperature is higher than the temperature of the adjacent solid silicon chip which carries a second temperature-dependent resistor. Both resistors form a Wheatstone bridge arrangement together with additional resistors in the two branches of the bridge, one of them is made adjustable by a digital rheostat. The rheostat allows for nulling of the voltage decay across the bridge.

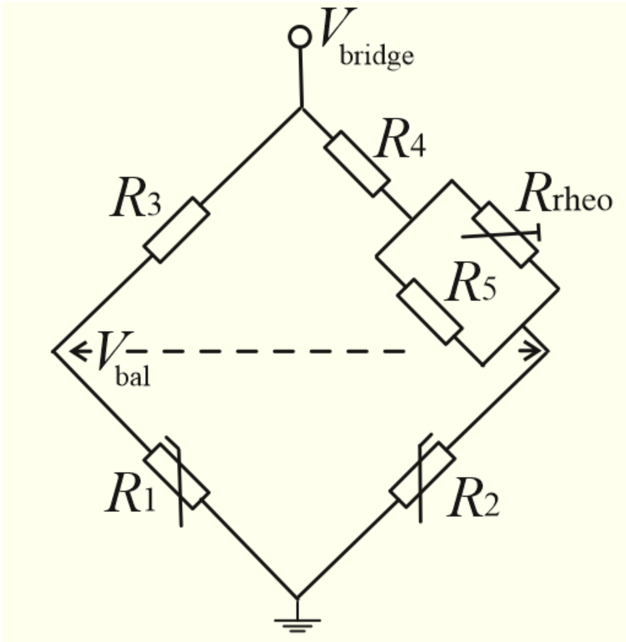

Figure 12. Wheatstone bridge configuration of the thermal conductivity detector R1 and R2. Note that the balance voltage V_{bal} is measured with an analog-digital converter.

Changes of the thermal conductivity of the surrounding atmosphere changes the resistance R_1 which in turn modifies the balance voltage V_{bal}. If the latter has been nulled prior to exposure of hydrogen by appropriate setting of the rheostat´s resistance **R**$_{\text{rheo}}$, the voltage V_{bal} deviates from its pre-set value $V_{\text{bal}} = 0$. The deviation is determined with a 16-bit $\Delta\Sigma$ analog-to-digital converter whose reference input is set to $V_{\text{bridge}}/2$. This configuration allows to measure positive and negative deviations of the balance voltage.

10.APPLICATION AND IMPLEMENTATION

The H2-meTCD I2C sensors are optimized for the use as hydrogen detectors in nitrogen or air. They can be operated with only a few additional components (see section 12). A practical hardware-software solution is available as an evaluation kit. Contact our distributor for further support.

10.1. I²C BUS

Two pull-up resistors are required to ensure that the SCL and SDA lines of the I²C bus are at high potential.

The following 7bit addresses are used in the H2-meTCD I2C sensors:

Table 8: 7bit Addresses

Binary code	Hexadecimal code	IC
1001000	x48	9- to 12-bit selectable, ±1.0°C accurate digital temperature sensor
1010000	x50	1K bit serial electrically erasable PROM
0100110	x26	16-Bit ΔΣ ADC with Easy Drive® technology and on-chip programmable gain as analog-to-digital converter with PGA
0101111	X2F	Nonvolatile 1024-position digital potentiometer used as rheostat for offset adjustment

All command and data information is transferred with the Most-Significant Bit (MSB) first.

10.2. EEPROM

The EEPROM is organized as a single block of 128 x 8-bit memory. The following table indicates the information, kept under the different word addresses. The word addresses 0x00 to 0x03, 0x05 and 0x06 keep basic information about the sensor, including a CRC value calculated from the entries and stored in 0x04. This information must not be altered.

<table>
<tr><th colspan="4">Table 9. Contents of the EEPROM</th></tr>
<tr><th>Word address</th><th>Data byte</th><th colspan="2">Remarks</th></tr>
<tr><td>0x00</td><td>Device code</td><td rowspan="5"></td><td rowspan="7">Data must not be changed</td></tr>
<tr><td>0x01</td><td>Serial number (upper byte)</td></tr>
<tr><td>0x02</td><td>Serial number (middle byte)</td></tr>
<tr><td>0x03</td><td>Serial number (lower byte)</td></tr>
<tr><td>0x04</td><td>CRC value</td></tr>
<tr><td>0x05</td><td>Fabrication date/month</td><td rowspan="2">See (a)</td></tr>
<tr><td>0x06</td><td>Fabrication month/year</td></tr>
<tr><td>0x07...0x02F</td><td>Fabrication-related data</td><td colspan="2">Encrypted data. Not intended for users</td></tr>
<tr><td>0x30</td><td>Excitation</td><td colspan="2" rowspan="7">Default settings for evaluation kit</td></tr>
<tr><td>0x31</td><td>Gain preamplifier</td></tr>
<tr><td>0x32</td><td>Gain</td></tr>
<tr><td>0x33</td><td>Offset A (upper byte)</td></tr>
<tr><td>0x34</td><td>Offset A (lower byte)</td></tr>
<tr><td>0x35</td><td>Offset B U(upper byte)</td></tr>
<tr><td>0x36</td><td>Offset B (lower byte)</td></tr>
<tr><td>0x37…0x4D</td><td>Control data for other evaluation kits not useful for H2-meTCD I2C sensors</td><td colspan="2">Encrypted data. Not intended for users</td></tr>
<tr><td>0x4E…0x52</td><td>Resistances and thermal coefficients of sensor and reference elements</td><td colspan="2">Encrypted data. Not intended for users</td></tr>
<tr><td>0x53…0x56</td><td></td><td colspan="2">Encrypted data. Not intended for users</td></tr>
<tr><td>0x57…x6E</td><td></td><td colspan="2">Not used</td></tr>
<tr><td>0x70</td><td>Calibration offset (upper byte)</td><td colspan="2" rowspan="2">See equation (b) for decoding</td></tr>
<tr><td>0x71</td><td>Calibration offset (lower byte)</td></tr>
<tr><td>0x72</td><td>Calibration gain (upper byte)</td><td colspan="2" rowspan="2">See equation (c) for decoding</td></tr>
<tr><td>0x73</td><td>Calibration gain (lower byte)</td></tr>
<tr><td>0x74…0x7F</td><td></td><td colspan="2">Not used</td></tr>
</table>

Read operations allow the master to access any memory location. Sequential reads are also possible. Any read operation is initiated by the bust master with the Start signal (S), followed by the address AD = 1010000, and the R/$\overline{W}$ bit, which is a logic low. The EEPROM will acknowledge (ACK) this byte during the ninth clock pulse. The next byte transmitted by the master is the word address and will be written into the address pointer of the EEPROM. After receiving another acknowledge signal from the EEPROM the master must transmit a Start signal (repeated Start, Sr), followed by the address AD= 1010000 and the R/$\overline{W}$ bit set to one. The EEPROM issues an acknowledge and the eight bit data word. For a single read operation, the master does not acknowledge the transfer but generates a Stop signal (P) which terminates the read operation.

S	AD,0	ACK	Word Address (n)	ACK	Sr	AD,1	ACK	Data word n	P

The sequential read of data bytes are initiated in the same way but the master transmits an acknowledge after the first data word is send by the EEPROM. This directs the EEPROM to transmit the next sequentially addressed data byte.

S	AD,0	ACK	Word Address (n)	ACK	Sr	AD,1	ACK

Data word n	ACK	Data word n+1	ACK	Data word n+2	…	Data word n+X	P

Use the following decoding procedure to get the required information from the word addresses:

a) Fabrication time from data bytes in 0x05 and 0x06

Data byte in 0x06								Data byte in 0x05							
MSB							LSB	MSB							LSB
+ 2000 = Fabrication year							Fabrication month				Fabrication date				

b) Calibration offset from data bytes in 0x70 and 0x71

Data byte in 0x70								Data byte in 0x71							
MSB							LSB	MSB							LSB
MSB															LSB
16 bit word															

$$Offset = -0.15\ \mathrm{V} + \frac{16\ \text{bit word}}{65535} \times 0.30\ \mathrm{V}$$

c) Calibration slope from data bytes in 0x72 and 0x73

Data byte in 0x72								Data byte in 0x73							
MSB							LSB	MSB							LSB
MSB															LSB
16 bit word															

$$Slope = \frac{16\ \text{bit word}}{1{,}000{,}000}\ \mathrm{V/vol\text{-}\%}\ H_2$$

To write a single byte into a memory location, the master issues a Start signal, followed by the, address code AD=1010000, and the $R/\overline{W}$ bit, which is a logic low. The device will acknowledge this byte during the ninth clock pulse. The next byte transmitted by the master is the word address and will be written into the address pointer of the EEPROM. After receiving another acknowledge bit from the EEPROM the master device will transmit the data bye to be written into the addressed memory location. The EEPROM acknowledges again and the master generates a Stop condition. This initiates the internal write cycle, and during this time the EEPROM will not generate acknowledge signals.

S	AD,0	ACK	Word Address (n)	ACK	Data word n	ACK	P

Write operations should be limited to the free memory locations 0x75…0x7F or if the calibration offset and slope must be adapted to sensing conditions different from those used during the initial calibration of the sensor.

10.3. ADJUSTING THE BALANCE VOLTAGE

The second branch of the Wheatstone bridge contains a nonvolatile 1024-step variable resistor, used as rheostat, to allow precise zeroing of the balance voltage V_{bal}. The corresponding wiper position is stored in the rheostat and automatically adjusted after powering-up. Due to the special configuration of the Wheatstone bridge, the change of the balance voltage depends nonlinearly on the rheostat wiper setting (see Figure 14). This allows the user to extend the AD converter input voltage beyond its usual limitation (0 to 2.5 V) into the negative voltage range (see Table 11 in Section 10.5).

In this case the risk of overloading the input of the AD converter at larger hydrogen volume fractions is reduced. On the other hand, precise zeroing of the Wheatstone bridge is also possible with rheostat settings at or in the vicinity of the ideal midpoint setting. The midpoint value is stored under 0x75 address in the EEPROM of the sensor.

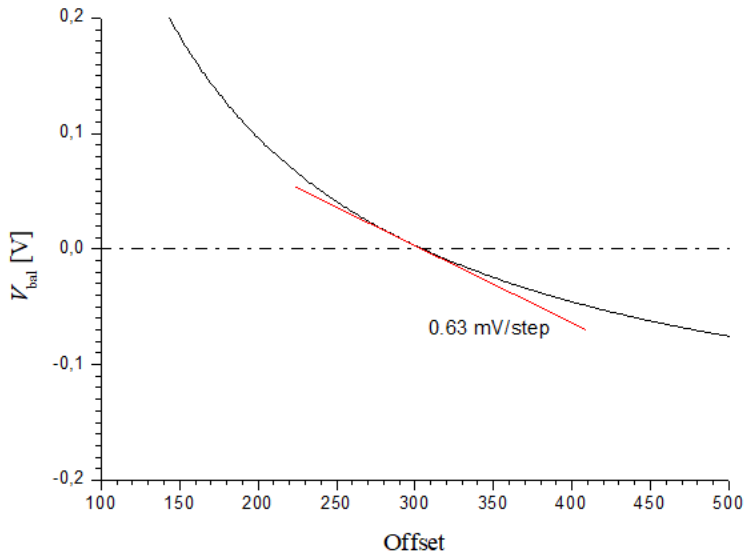

Figure 13. V_{bal} as a function of the rheostate offset setting.

10.4. READING THE BALANCE VOLTAGE

The H2-meTCD I2C sensor contains a 16-bit plus sign no latency ΔΣ analog-to-digital converter which includes an on-chip programmable gain from 1 to 256 in 8 steps and reject line frequencies (50Hz, 60Hz or simultaneous 50Hz/60Hz). The converter powers up in a default mode with a gain of one, is automatically calibrated, and the digital filter simultaneously rejects 50Hz and 60Hz line frequency noise.

A gain of 1 V/V and 8 V/V is recommended for applications in a wide range of hydrogen volume fractions (0 to 100 vol-%) and for typical LEL values (0 to 4 vol%) in air. The gains are written by the following sequence, initiated by the Start signal (S) of the master and terminated by the Stop signal (P). The 7 bit address of the converter is AD = 0100110.

S	AD,0	ACK	Configuration byte	ACK	P

The following table configuration bytes are used to set the gain and consequently the input voltage span of the converter. These spans are resolved with a 16 bit resolution, and hence the smallest resolvable voltages increases with increasing gain. Since the balance voltage of the Wheatstone bridge decreases from zero to negative values in the presence of hydrogen, an appropriate gain should be set to prevent the converter from being overloaded.

Table 10. Gain, configuration byte, input voltage span, and resolvable voltages			
Gain	Configuration byte	Input voltage span	Resolvable voltages
1 (default)	00000110	±2.5 V	76 μV
4	00100110	±0.625 V	19 μV
8	01000110	±0.3125 V	4.77 μV
16	01100110	±0.156 V	2.38 μV
32	10000110	±78 mV	1.19 μV
64	10100110	±39 mV	0.596 μV
128	11000110	±19.5 mV	0.298 μV
256	11100110	±9.77 mV	0.149 μV

The balance voltage decreases by approximately 46 mV for 1 vol-% H2 and shows a linear dependence from the hydrogen volume fraction, so the above-given gains of 4 and 16 for wide-range and LEL applications are good starting values. Taking account of the various sources of noise, that may contribute to the signal, resolutions of better than 100 ppm H2 are achievable with gains of 4 and 16. For very stable ambient conditions, even higher gains might be used to reduce the low detection limit even further.

To initiate a conversion and to receive the balance voltage, the master must perform the following Read operation:

S	AD,1	ACK	Data byte 1	ACK	Data byte 2	ACK	Data byte 3	NACK	P

After the complete Read operation of 3 bytes, the output register of the converter is emptied, a new conversion is initiated, and a following Read request in the same input/output phase will be NACKed. The converter´s output data stream is 24 bits long:

Bit 23 SIG	Bit 22 MSB	Bit 21	Bit 20	…	Bit 6 LSB	Bit 5 PG2	Bit 4 PG1	Bit 3 PG0	Bit 2 x	Bit 1 IM	Bit 0 SPD

The first bit is the conversion result sign bit (SIG) and the second bit is the most significant bit. These two bits can be used to indicate over range conditions. If both bits are high, the differential input voltage is above + full-scale voltage and the following 16 bits are set to low to indicate an overrange condition. If both bits are low, the input voltage is below – full-scale voltage and the following 16 bits are set to high to indicate an under-range condition. The adjusted gain can be derived from the bits 5, 4, and 3 according to the following table.

Table 11. Gain of the converter from PG2, PG1 and PG0			
PG2	PG1	PG0	Gain
low	low	low	1
low	low	high	4
low	high	low	8
low	high	high	16
high	low	low	32
high	low	high	64
high	high	low	128
high	high	high	256

Bit 2 is reserved, bit 1 (IM) refers to the internal temperature sensor (not used here), and bit 0 (SPD) indicates the output rate (not used here).

The following table and the formulae in the flow diagram in figure 14 can be used to get the voltage from the converter´s output.

Table 12. Converter Output Format for SPD=0							
V_{bal}	Bit 23 SGN	Bit 22 MSB	Bit 21	Bit 20	Bit 19	...	Bit 6
$V_{\mathrm{bal}} \geq FS$	1	1	0	0	0		0
$V_{\mathrm{bal}} = FS - 1LSB$	1	0	1	1	1		1
$V_{\mathrm{bal}} = 0.5 \cdot FS$	1	0	1	0	0		0
$V_{\mathrm{bal}} = 0.5 \cdot FS - 1LSB$	1	0	0	1	1		1
$V_{\mathrm{bal}} = 0$	1	0	0	0	0		0
$V_{\mathrm{bal}} = -1LSB$	0	1	1	1	1		1
$V_{\mathrm{bal}} = -FS$	0	1	0	0	0		0
$V_{\mathrm{bal}} < -FS$	0	0	1	1	1		1
Full-scale voltage $FS = 2.5 \frac{\mathrm{V}}{Gain}$, *LSB* = least significant bit							

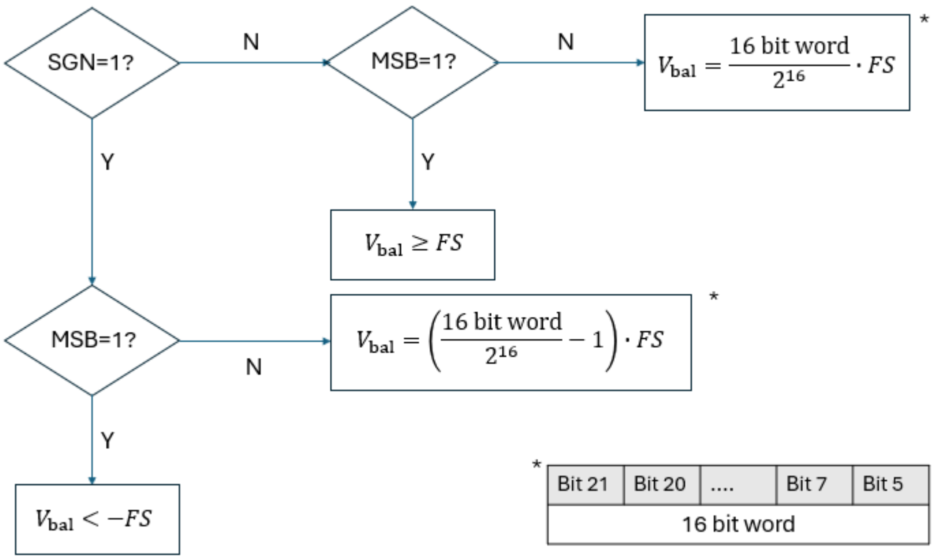

Figure 14. Flow diagram.

10.5. READING THE HOUSING TEMPERATURE

The temperature sensor is configured by the following write operation, initiated by the master with the Start signal, followed by the address AD=1001000 and the R/$\overline{\text{W}}$ bit, which is a logic low. The temperature sensor acknowledges and the master sends the data byte 00000001 to set the pointer to the configuration register of the sensor.

After receiving the next acknowledge condition the master terminates the write operation with the Stop signal.

In the next Write operation the master transmits the data byte 01100000 for selecting a 12 bit resolution of the temperature. The register of the temperature sensor must subsequently set back to the temperature register issuing a Write operation with the data byte 00000000.

S	AD,0	ACK	Data byte	ACK	P

The Read operation is initiated by the master by sending the address, followed by the R/$\overline{\text{W}}$ bit, which is a logic high. The temperature will send two data bytes according to the following sequence.

S	AD,1	ACK	Data byte 1	ACK	Data byte 2	ACK	P

Bit 15 SIG	Bit 14 MSB	Bit 13	…	Bit 5	Bit 4 LSB	Bit 3 0	Bit 2 0	Bit 1 0	Bit 0 0

Table 13. Temperature Sensor Output Format

Temperature	Bit 15 SGN	Bit 14 MSB	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
+125 °C	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0
+100 °C	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
+75 °C	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0
+50.5 °C	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0
+25.25 °C	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0
+10.125 °C	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0
+0.0625 °C	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
0 °C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.0625 °C	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
-10.125 °C	1	1	1	1	0	1	0	1	1	1	1	0	0	0	0	0
-25.25 °C	1	1	1	0	0	1	1	1	1	1	0	0	0	0	0	0
-50.5 °C	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0
-55 °C	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0

The following block scheme reveals a LabVIEW® based solution to determine the temperature from data byte 1 and 2. The 'theoretical' resolution of the temperature sensor is 0.0625 °C within the maximum temperature regime between -55 °C and +125 °C. Note, that the hydrogen sensor only allows an industrial regime from -40 °C to +85 °C.

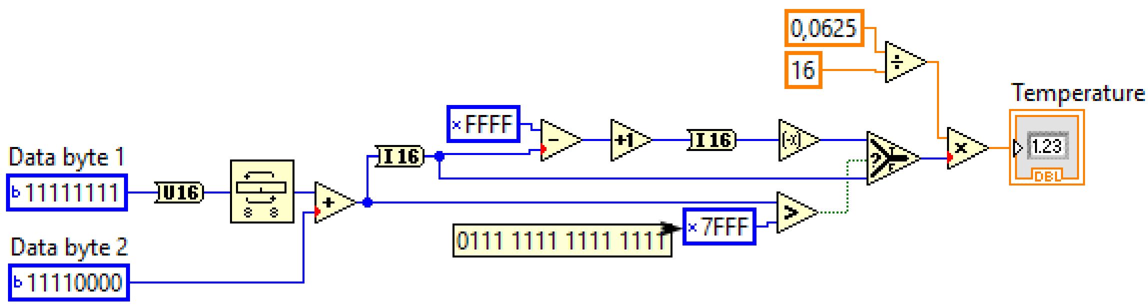

Figure 15. LabVIEW® code to get the temperature from the two data bytes.

11.FOOTPRINT AND RECOMMENDED PLUG-IN SOCKETS

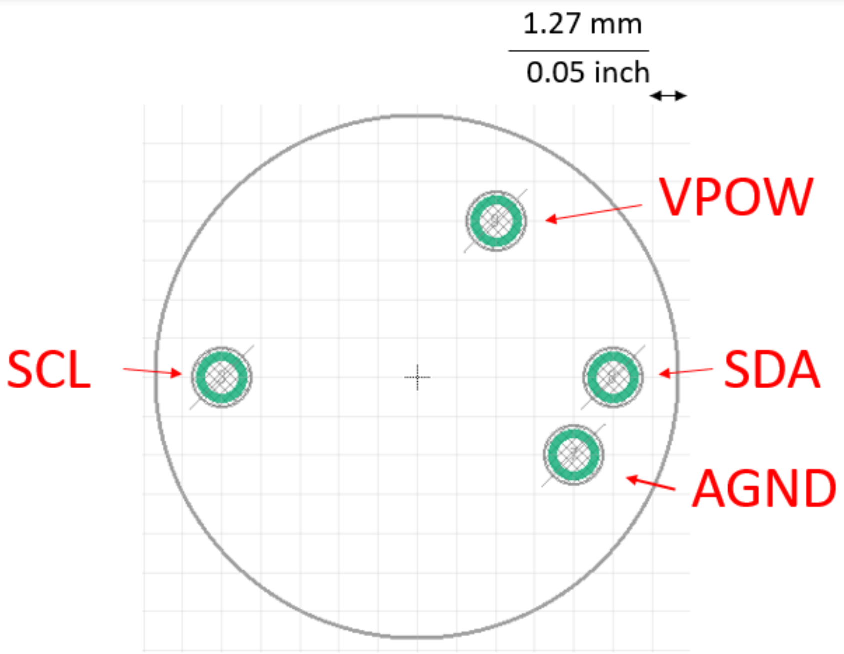

Figure 16: Footprint (dimensions shown in millimeter and inch).

Table 14	
Recommended plug-in sockets	450-3704-01-03-00 (Cambion)
Drill hole:	1.6 mm

12.ORDERING INFORMATION

Hydrogen sensor H2-meTCD I2C

13.PACKAGING/SHIPPING INFORMATION

This sensor is shipped individually in an ESD/EMI shielded and water vapor-proofed bag according to IPC/JDEC J-STAD-033.

14.QUALITY CONTROL

Each sensor is tested before delivery. The test includes standard protocols and an exposure of the sensor to a hydrogen/air mixture with H_2 volume fractions above the low-explosion limit, performed at ambient temperature and pressure.

15.WARNINGS

Warnings: The sensor H2-meTCD I2C is intended to be part of a customer safety system, enabling audible alarms, system shutdown, ventilation, or other measures to ensure safe handling and use of hydrogen gas. The sensor itself does not provide protection from hydrogen/air explosion. Make sure that your application meets applicable standards, and any other safety, security, or other requirements.

16.NOTES

17.WORLDWIDE SALES AND CUSTOMER SUPPORT

ALDERS electronic GmbH

Arnoldstraße 19 , 47906 Kempen (Germany)

sales@alders.de

+49 2152 8955-230