TCG Sensor Display + Handheld   XEN-5320-HAND

Preliminary datasheet – Beta Version

Features

- Display Modes
  - Helium 0-100%
  - Hydrogen 0-100%
  - Custom 23 point look up table
- Output data logging capability
- Manual Set Zero
- Touchscreen: 2.4 inch 320 x 240 pixel
- Digital communication via USB
- Temperature compensated
- Not Relative Humidity Compensated
- Temperature range: -15 ⁰C to +55 ⁰C
- Data refresh time: 0.3 second
- Resolution: 100 ppm
- Battery life: 2.5 or 9 hour (optional)

Applications

- Gas leak detection
- General gas concentration measurement (not RH compensated)

XEN-5320-HAND handheld sensor
(210 x 54 x 19 mm)

Xensor Integration bv

Smart Sensor Devices

Contents

1   Description

The XEN-5320-HAND display + handheld is an intelligent portable gas sensor for the detection of gas leakage. It has built-in curves for helium and hydrogen in air, and the possibility to enter a custom curve for other binary gas mixtures.

The sensor is based on the measurement of the thermal conductivity of the ambient gas, using the proven thermal conductivity sensor XEN-TCG3880.

The XEN-5320-HAND includes a 2.4 inch touchscreen display on which the measured gas concentration is displayed. On the display are buttons for data logging, zeroing and switching between different gasses. The display also shows the current date and time which is used for data logging.

XEN-5320-HAND display + handheld
1) The thermal conductivity sensor with built-in Pt100 temperature sensor.
2) LEDs:
    green (right) flashing when the XEN-5320-HAND is operational.
    red (middle) Lithium polymer battery is charging.
    yellow (left) battery full.
3) Touch screen.
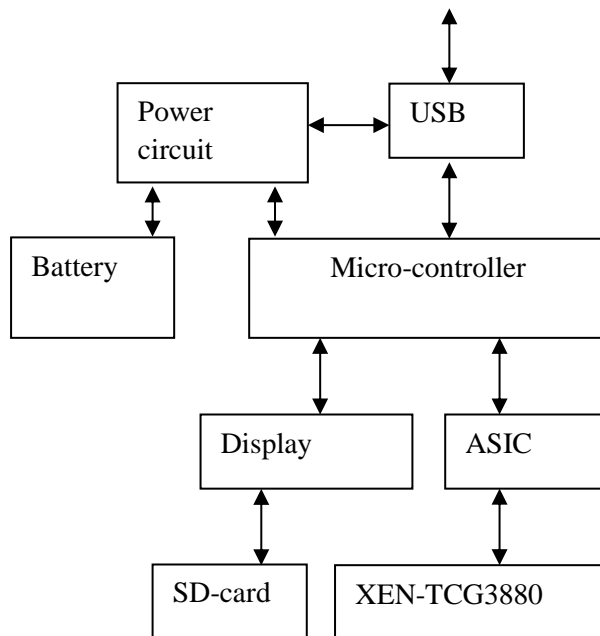4) On/off switch.
5) USB mini-connector.

Read out can also be performed by connecting the XEN-5320-HAND to a computer by USB connection.

Additional settings can be set by the supplied LabView software through USB connection, such as adding a custom look-up table, data logging settings and reading/deleting the log file, updating the system time.

Charging of the lithium polymer battery is also done by connecting the USB mini-connector to a charger or a computer.

Biasing and measurements of the thermal conductivity sensor is via a Xensor-designed ASIC. The XEN-5320-HAND performs 3 measurements per second. Temperature measurement is done using a PT100, which is used for a temperature correction on the output.

2   Block Diagram

```
                        ↕
   ┌──────────┐      ┌──────────┐
   │ Power    │ ←──→ │   USB    │
   │ circuit  │      │          │
   └──────────┘      └──────────┘
      ↕      ↕            ↕
 ┌─────────┐ ┌───────────────────┐
 │ Battery │ │  Micro-controller │
 │         │ │                   │
 └─────────┘ └───────────────────┘
               ↕              ↕
        ┌───────────┐  ┌───────────┐
        │  Display  │  │   ASIC    │
        └───────────┘  └───────────┘
               ↕              ↕
        ┌───────────┐  ┌───────────────┐
        │  SD-card  │  │ XEN-TCG3880   │
        └───────────┘  └───────────────┘
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3   Preliminary Specifications

Preliminary Specifications (at 23 ⁰C, 101 kPa, 50 %RH)

Item	Typical	Unit	Remarks
General			
Sensitivity for traces of H_2	-2.0	%/%	Signal change for concentration in air
Sensitivity for traces of He	-1.1	%/%	Signal change for concentration in air
Sensitivity for traces of CO_2	+0.4	%/%	Signal change for concentration in air
Noise	0.04	%	Of signal in air
Offset drift	0.2	%/yr	Of signal in air
Operating limits			
Temperature operating range	-15 to + 55	⁰C	For full accuracy
Temperature changes	<1	⁰C/min	Maximum rate of change
Operation speed			
System start up time	<4	Seconds	
T_{90} response time	<1	Second	For 0% to 2% hydrogen in air.
T_{10} recovery time	<1	Second	For 2% to 0% hydrogen in air.
Data update rate	3	Hz	Maximum
Electrical			
Current consumption	330	mA	
Charging current	475	mA	
Battery life	2.5	hrs	950 mAh battery
	8	Hrs	3000 mAh battery
Dimensions and weight			
Dimensions	210 x 54 x 19	mm^3	950 mAh battery
	210 x 54 x 23	mm^3	3000 mAh battery
Weight	150	g	950 mAh battery
	195	g	3000 mAh battery
Storage			
Temperature storage limits	10-40	⁰C	
Humidity storage limits	20-70	%RH	

4 Functional Description

The XEN-5320-HAND determines the concentration of a specified gas in air. This is done by measuring the thermal conductivity of the ambient air using a thermal conductivity gauge (TCG), and comparing this to the factory calibration measurement. To eliminate the influence of temperature, this is measured separately, and a compensation is made by the micro-controller. The remaining difference between the measured and calibrated value of the thermal conductivity is then a measure of the gas concentration.

Note: the influence of Relative Humidity (RH) is not compensated for. This can lead to deviations in the offset, which can easily be eliminated by pushing the set zero button.

4.1 Range and Poisoning

Since the TCG is not poisoned by an overdose of gas, the operating range is 0-100% for non-corrosive and non-condensing gases. When measuring other gases than He and H_2, the correct output will be displayed if a custom look-up table is used for the binary gas mixture to be detected.

4.2 Selectivity

The TCG-based device is non-selective in that it will give an output in the presence of any gas having a thermal conductivity different than air.
The sensor is especially useful for the measurement of *helium* and *hydrogen*, which have thermal conductivities that are 6x respectively 7x as high as that of air at room temperature. Most other gases have much lower thermal conductivities than helium, with *neon* at 2x the thermal conductivity of air as the highest of the others.
So, other gases give much smaller signal changes. *Methane* has a thermal conductivity of about 40% higher than that of air, and CO_2 (*carbon-dioxide*) nearly 40% lower. These gases can still easily be measured using the XEN-5320-D.
However, CO (*carbon-monoxide*), for example, has about the same thermal conductivity as air, so this gas is very difficult to detect with a thermal conductivity measurement.

4.3 Response time and Transients

The TCG has a response time (0% to 90%) of about 0.6 s, see Fig. 2, in which the time is measured in increments of 0.3 s. The recovery time is approximately the same. For other gases, different times may be valid, depending on the diffusivity of the gases.

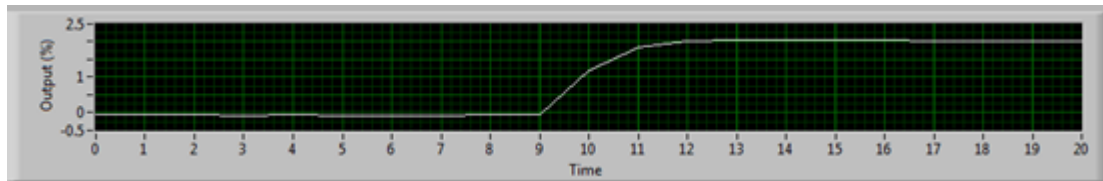Figure 2: Response of the thermal conductivity sensor to a 2%-change in hydrogen concentration. Each increment of time is 0.3 s. The t90 response time (rise to 90% of final value) is of the order of 0.6 s

4.4   Accuracy and Noise

The XEN-5320-HAND is not primarily intended for accurate gas concentration measurements. Its intended use is the detection of gas leaks in cases where a gas different than air is enclosed but wants to escape!

Important is here the zero when measuring in air, and deviations when the escaping gas becomes present. Then, usually the accuracy with which the concentration is measured is less important. Thus, a set zero button is present to be able to zero the sensor before performing a leak-detection action.

The influence of temperature changes is compensated, but not the influence of RH effects. The main influence will be a change in the zero, and that can be corrected by pushing the set zero button. At temperatures well above room temperature the presence of humidity can change the composition from a binary gas (taking dry air as one component) to a ternary gas system with the addition of humidity. Then, the fundamental question occurs, whether we calculate the concentration of helium or hydrogen in the dry gas or in the humid gas. In the look-up table used in the XEN-5320-D, the concentration of helium or hydrogen in the overall gas composition is calculated using the look up table for these gases in dry air/nitrogen at room temperature, only compensating for zero shift.

The noise of the handheld is of the order of 300 ppm peak-peak, at a resolution of 100 ppm. In this case, medium to large leaks can easily be detected.

5   Instructions for use

5.1   Proper ventilation

Above all other measures, the user must take care that the sensing element is properly ventilated so that the gas to be measured can access the sensing element through diffusion into the cap via the hole in the cap. Blocking this hole or proper ventilation of the instrument in general will make the device non-functional, while still it will indicate values that appear to be proper.

5.2   Condensing and water dropping onto the sensors

Precaution must be taken against condensing of water vapour in the sensor or water drops falling onto the sensor, as this may lead to (irreversible) malfunctioning.

5.3   Using the touchscreen

The display shows the battery charge in percentage, the current date and time, the measured value in % and the buttons Set Zero, Log Data and Mode.

Close-up view of the screen of the XEN-5320-D

The battery charge shows 100% for a fully charged battery and 0 % for an almost depleted battery.

The current date and time is given in the following format YYYY-MM-DD HH:MM:SS. The supplied software in LabView has the option to synchronize the date and time with the computer system date and time.

The XEN-5320-HAND automatically starts measuring when the device is turned on. The display shows which calibration is used for the shown output, and can be:
- H_2 (hydrogen).
- He (helium).
- Cu (custom curve).
The user has to load the desired custom curve into the XEN-5320-D.

The Set Zero button can be used to zero the output. The Log Data button can be used to Log data on the internal SD-card. The Mode button can be used to switch between different output modes (H_2, He or Cu).

5.4   Logging data

The XEN-5320-HAND has the capability to log data. During logging the measured output, date and time and which calibration curve (H_2, He or Cu) is used, is saved on an internal SD-card.
In the tab "Handheld" on the Calibration and settings page in the LabView software the following options are possible:
- Loading the log file from sensor.
- Saving the log file on the computer.
- Deleting the log file on the sensor.
- Changing logging settings.

5.4.1   Loading the log file from sensor

By pressing this button the log file is loaded from the sensor and is shown in the "Log file" box. During loading the Busy loading light is turned on. Loading the log file from the device to a computer can take a long time, especially when the log file is large.

5.4.2   Saving the log file on the computer

By pressing this button the log file is saved on the computer, in the directory selected in the connection setup page.

5.4.3   Deleting the log file on the sensor

By pressing this button the log file on the internal SD-card in the sensor is deleted. When the file is deleted the light "Successful" will light up. If any error occurred while deleting the file (eg. the log file does not exists) the light "Error deleting file" will light up.

5.4.4   Changing logging settings

It is possible to change the settings for when to log data. The following settings are possible:
- Every 0.3 s (Data is logged every 0.3 s).
- Every 1.0 s (Data is logged every 1.0 s).
- Every 3.0 s (Data is logged every 3.0 s).
- When output > 0.5% (Data is logged when the output is larger than 0.5%).
- When output > 1.0% (Data is logged when the output is larger than 1.0%).
- When output > 2.0% (Data is logged when the output is larger than 2.0%).
- When output > 10.0% (Data is logged when the output is larger than 10.0%).

After selecting the desired setting press "Send setting to sensor" button to save the settings on the sensor.

5.5   Charging the battery

The battery of the XEN-5320-HAND automatically starts charging when it is connected to a USB port. During charging a red LED lights up, when charging is finished the red LED turns off and a yellow LED turns on. It is recommended to turn off the device during charging, this will speed up the charging of the battery. However, it is perfectly all right to leave the device on during charging, for instance to keep on monitoring for leakage. The charging of the battery will then go slower, as the device keeps on using power.

When the 0% battery charge has been reached it is strongly recommended to turn the device off and charge the battery. By doing so data loss is prevented and the battery is kept in optimal condition.
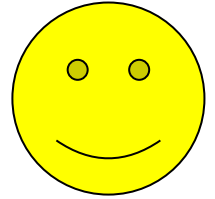
Note: During charging, the battery charge indicator can show a higher percentage than the actual battery charge.

6 Trouble shooting

For any questions, problems or remarks, please contact Xensor Integration or search the website for updated information:

Tel   +31 15 257 80 40
Email   info@xensor.nl
Web   www.xensor.nl

7 Order Information and Accessories

Order codes for the XEN-5320-HAND sensor

Option	Code	Content	Remarks
XEN-5320-HAND 950 mAh battery	XEN-5320-DS		(a)
XEN-5320-HAND 3000 mAh battery	XEN-5320-DL		(a)
Other gas curve	-	Calibration curve for other gas	On request

(a)   Housing color depending on availability.