**SM_H2_LC**

**Hydrogen Gas Detector Kit with replaceable semiconductor sensor**

*For battery charging rooms and other hydrogen producing environments*

SM_H2_LC Standard Edition

- Quick installation
- Easy maintenance
- Reliable
- Flexible
- Compatible with external relays

**General safety information**

Please read the following safety instructions carefully

- This detector is not a substitute for general safety measures for detecting hydrogen gas. It is an additional device to enhance operation safety.

- When operating inside large sensitive zones, we recommend to install additional sensors to cover up the entire operating space.

- The hydrogen sensor is not suitable to run or trigger fire or hydrogen explosion prevention measures directly – the potential-free contacts are designed to contact safety management systems for alarm and notification behavior, automatic ventilation or emergency system shutdown procedures.

- Ensure your installation meets the local safety and health regulations. If you are unsure, contact the local authorities in your country.

- If waring or alarm state is active, an imminent risk of combustion or explosion is pending:

  - Leave this area immediately!
  - Contact the responsible department!

- This sensor is calibrated to operate in environments with air – when operating in environments with other gas, the sensor may not work as expected:

  - Inaccurate measuring / altered measuring behavior
  - False alarm / No Alarm
  - Damage the sensor itself permanently

Do not place the sensors next to uncured silicone compounds – Due to the fact they will gassing off, measured values may be corrupted.

General information

*Function*

The sensor is designed to detect dangerous hydrogen concentrations (H2) in the interior of a system in good time. The SM_H2_LC hydrogen sensor is not designed for installation and use in open or large locations. The sensor head can be replaced during regular maintenance work. On request, a specially sealed version that fits to EX-i requirements for designated areas at risk of explosion is available.

*Connection types*

The contacts of both sensor types (Standard and EX-i version) are standardized, they can be combined within a daisy chain as well as operated individually. The additional hardware required for using the sensors varies depending on which connection type is to be used.

The power connection can be done either via its own 12 V power supply unit directly via the terminal strip or via the RJ45 connector, provided by a suitable power source.

Direct power supply is also available via the CON_R_AUX4. For GX_R_AUX, an external power source is recommended.

*Alarm behavioural*

LEL describes the **L**ower **E**xplosive **L**imit,

In gas detection systems, the amount of gas present can be described with a specific percentage (%) of the LEL. The zero percent lower explosion limit (0% LEL) denotes an atmosphere that is completely free from flammable gases.  A one hundred percent lower explosion limit (100% LEL), on the other hand, describes an atmosphere in which the gas concentration has reached the flammability limit. From this point onwards, the air / gas mixture can form up dynamically a high explosive environment.

The relationship between percent in LEL and volume percent differs depends on the gas – for the SM_H2_LC hydrogen detector, the value 100% LEL (LEL) for hydrogen is defined with 4% volume.

This allows to calculate an estimated hydrogen concentration and take them in direct relation with the pre-selected alarm thresholds:


4/100*20 = 0,8% VOL
4/100*40 = 1,6% VOL

The warning will be active at 20% LEL / 0,8% VOL

The alarm wll be active at 40% LEL/ 1,6% VOL

**Area coverage**

A sensor can cover an area of up to 50 m² (in normal rooms with flat horizontal and non-suspended ceiling and gas source in the center). In critical areas, more sensors with overlapping coverage should be installed to increase operational safety.

Notes for installation with irregular ceiling structures, e.g. for smoke protection, sound and pressure breakers, cross beams, etc.

- Install the sensor at the highest point in upward sloping rooms.
- In case of an irregular ceiling structure, it may be necessary to install multiple sensors at the highest points.
- If necessary, install additional sensors directly above the battery or hydrogen sensor.
- For suspended ceilings, please note that hydrogen can accumulate unnoticed in the gaps between the actual ceiling and the suspended ceiling. In this case, multiple sensors may be required.

For highly critical areas, the installation of two sensors with overlapping sensor configuration* is recommended to increase operational safety, especially in areas where inspections by specialists are not provided.

The test was conducted in a room of approximately 4x4m (flat horizontal ceiling), and the hydrogen concentration was the same at all points (center and edge).

**Sensor Features:**

Please note that the standard model is not designed for using in areas classified as hazardous for explosive gases, vapors, or dust.

Features:

- Own operating display
- Alarm and error display
- Calibration alarm
- Replaceable sensor head
- Independent relays for direct control of external signal generators, ventilation systems, etc.
- Interface for direct communication with freely configurable SNMP cards
- Integrated heat exchanger for protection against operation-related overheating.

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*) Overlapping sensor configuration: The sensors are arranged in such a way that there are 2 sensor zones: the standard zone and the critical core zone. While the standard zone is monitored by one sensor depending on the orientation, the critical core zone is monitored independently by both sensors. How to define the critical and standard zones is determined by an individual hazard assessment.

**Installing the sensor**



Board layout of the SM_H2_LC standard senssor device

LEDs:

| General function | |
|---|---|
| PWR | General opration |
| A1 | Low H2 Threshold: Warning |
| A2 | High H2 Threshold: Alarm |
| Advanced LED notification | |
| A1 and A2 flashing alternately | Sensor initialisation / boot in progress |
| ERR static on | Sensor error, missing sensor head |
| ERR flashing | Sensor head callibration error / replace sensor head |

*J2 connector - relay output:*

Relay outputs for A1 and A2 alarms, normally open (NO) and normally closed (NC) contacts are available.

| Pin number | alarm | function |
|---|---|---|
| 1 | A2 | NO contact |
| 2 | | COM contact (common) |
| 3 | | NC contact |
| 4 | A1 | NO contact |
| 5 | | COM contact (common) |
| 6 | | NC contact |

*Relay behavior in case of an alarm*

The relays are switched depending on the corresponding alarm state. If alarm state is active, both relays are triggered.

| state | Relay A1 | Relay A2 |
|---|---|---|
| No alarm | Not active | Not active |
| Active alarm A1 (exceeding the first alarm threshold) | active | Not active |
| Active alarms A1 and A2 (exceeding the second alarm threshold) | active | active |
| Active only alarm A2 | System error, invalid switching state* | |

*\*) If this switching status is encountered, there is a defect because this alarm status is not possible.*

### J1, J5, J9 connectors – Power and communication interface

The sensor communicates via relay circuits.

The communication interface available at J1 and RJ45 connections is not potential-free. The outputs are 12 V or the outputs are in a high-resistance state (these are typical transistor outputs that are configured for high-side control). Please note that the communication interface (J1, J5, J9) was specially developed for easy connection of GENEREX devices. If the detector needs to be connected to 3rd party systems, it is recommended to use relay contacts (these are potentially free outputs). By doing so, the relay contacts may be used for independent control of light and sound alarms, fans, etc. (max. Parameters 0.5 A 125 VAC, 1 A 24 VDC).

The following PIN assignment defines how to wire potential-free contacts:

*J1 connector:*

| Pin number | Function |
|---|---|
| 1 | Communication interface – alarm A2 |
| 2 | Communication interface – alarm A1 |
| 3 | Communication interface – required calibration (CAL) |
| 4 | Communication interface – sensor error (ERR) |
| 5 | Power VCC |
| 6 | Ground GND |

*J5, J9 connector (RJ45):*

The RJ45 connection is not a LAN connection for use on routers and switches!

If necessary, the contacts can be patched to a central administration room of a standardized patch field is in use.

| Pin number | function |
|---|---|
| 1 | Communication interface  – alarm A2 |
| 2 | Communication interface  – alarm A1 |
| 3 | Communication interface  – required calibration (CAL) |
| 4 | Ground GND |
| 5 | Ground GND |
| 6 | Communication interface  – sensor error (ERR) |
| 7 | Power VCC |
| 8 | Power VCC |

*Output connector circuit:*
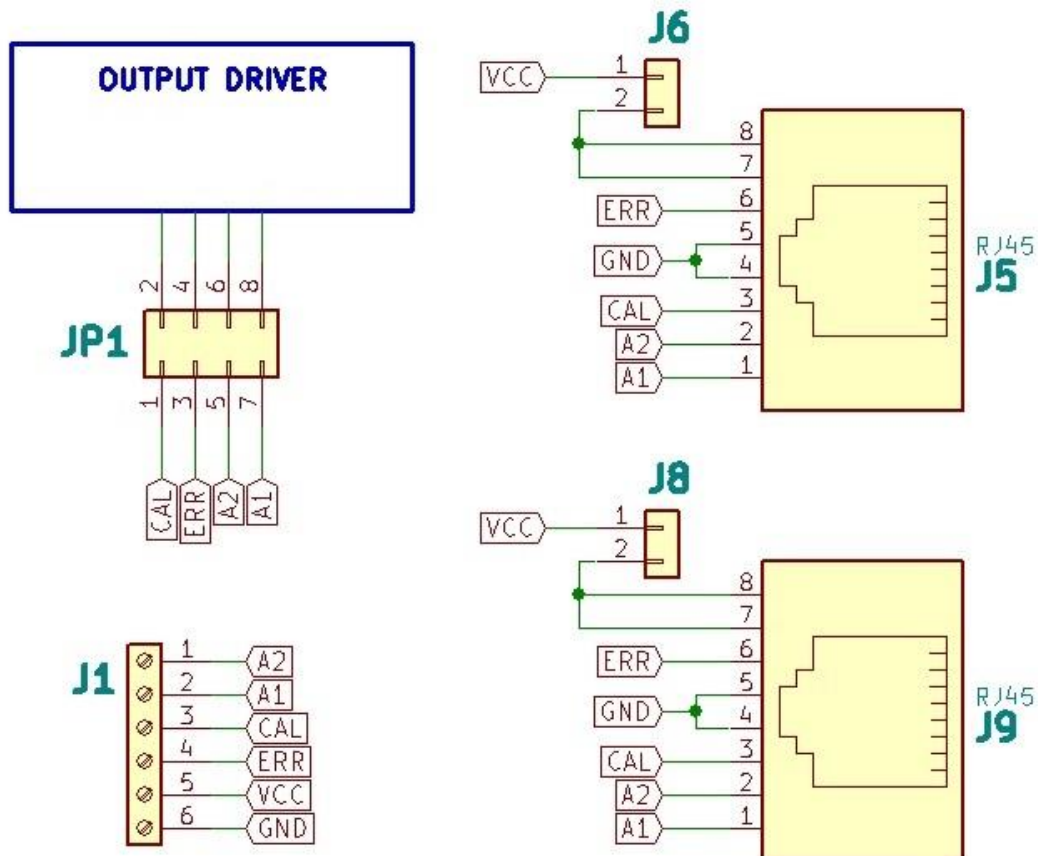
**Jumper description**

J3 connector:                          manufacturing diagnostic connector (do not use)

J4 SENS connector:                  for connect semiconductor replaceable sensor.

J7 connector:                        configure the device.

| position 1-6 | reserved (for future use) | |
|---|---|---|
| position 7 | Selection of the detector work mode | |
| | Jumper J7-7 not fitted | Jumper J7-7 fitted |
| | Communication interface working in negative logic | Communication interface working in positive logic |
| | Active = high impedance state (HiZ) | Active = 12V (max 40mA) |
| | Not Active = 12 V (max 40mA) | Not Active = high impedance state (HiZ) |

Interface behavior in case of an alarm

*Basic behavior*

| State | A1 | A2 | CAL | ERR |
|---|---|---|---|---|
| No alarm | OFF | OFF | OFF | OFF |
| Active alarm A1 (exceeding the first alarm threshold) | ON | OFF | OFF | OFF |
| Active alarms A1 and A2 (exceeding the second alarm threshold) | ON | ON | OFF | OFF |

*Advanced behavior:*

| State | A1 | A2 | CAL | ERR |
|---|---|---|---|---|
| Active only alarm A2 | forbidden state (never occurs) | | X | X |
| Sensor error or no present in system | Active | | x | Active |
| Calibration required | x | | active | x |

**Connecting the Sensor to CS141**

The sensor cannot be connected directly to the CS141 - the hardware required for wiring varies depending on the type of connection you choose for your installation:

*Connection Example: CON_R_AUX4*
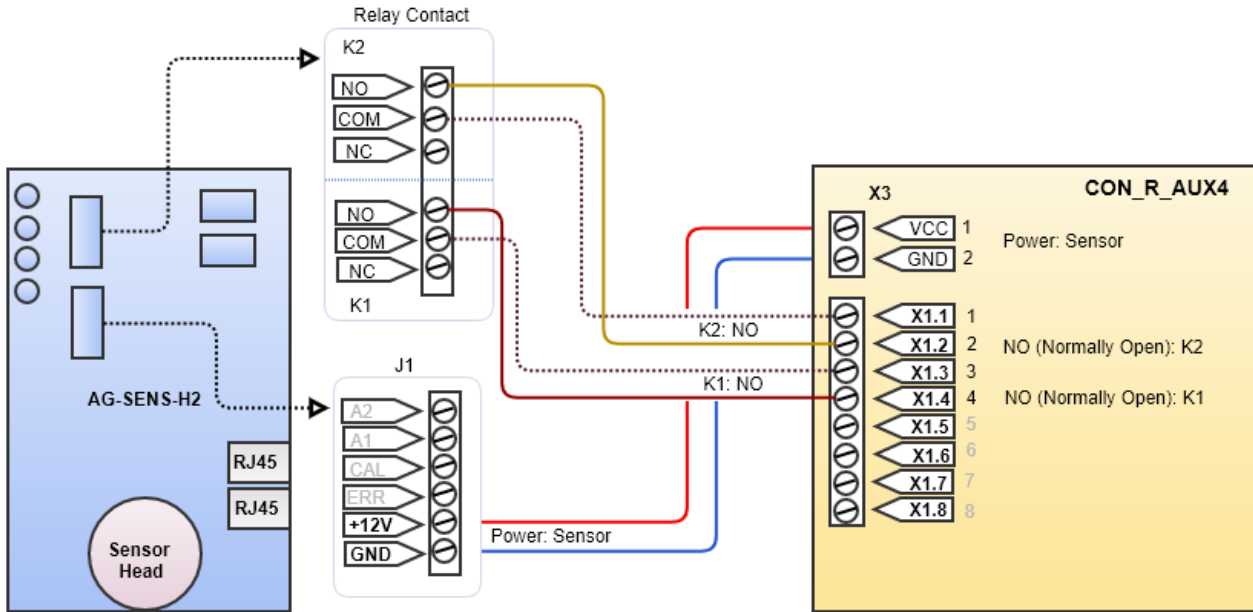


The *CON_R_AUX4 Relay Board* is a good method to connect the sensor to the CS141. The board provides either inputs or can switch outputs via its own relays if required.

The connection example illustrates a standard case in which the sensor can quickly and easily transmit status information about the hydrogen content in the air using a "NO - Normally Open" contact.



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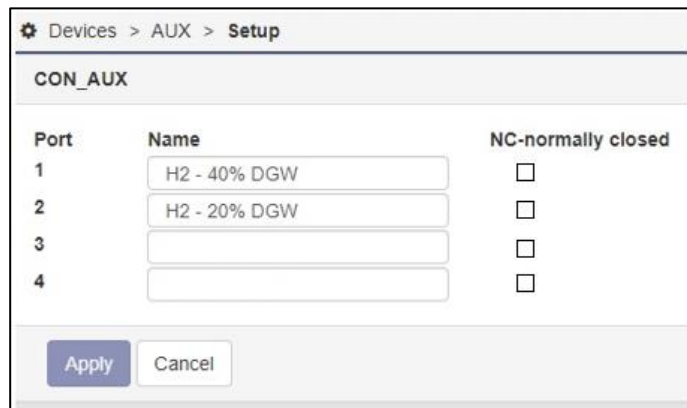
**Tipp: Connect 2 Independent Sensors**

With this wiring example, connections X1.2 and X1.4 were used to trigger warning and alarm. Since the CON_R_AUX4 can manage up to 4 inputs, contacts X1.6 and X1-8 can be used for a second sensor.

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*Installation Example: SENSORMANAGER*

For use in conjunction with a SENSORMANAGER, you can use the RJ45 / RJ12 adapter. The outputs are then redirected to the inputs of the sensor manager according to the switching states. The configuration is done via the function menu of the SENSORMANAGER.

In this case, the power is provided directly by the SENSORMANAGER.

In addition to warning and alarm behavior, this configuration can also display the Calibration Error (sensor head must be replaced) and a general sensor error. The alarm configuration will be carried out via the SENSORMANAGER configuration interface:
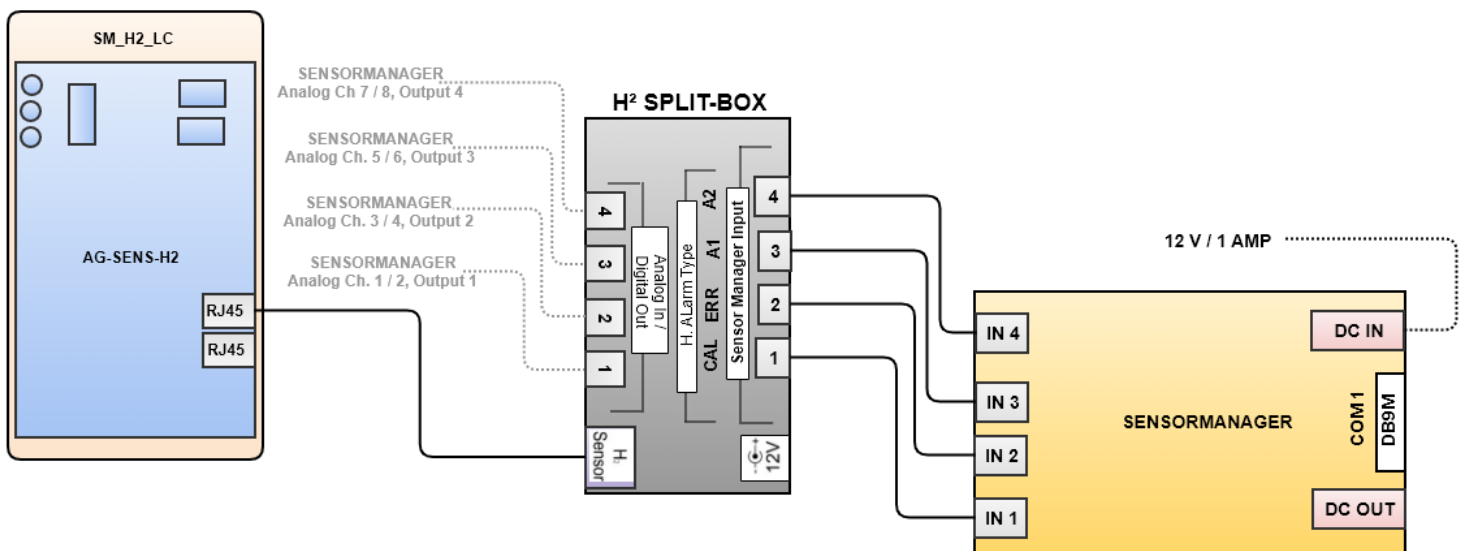


### SensorMan2 Inputs

| Input | Name | NC Contact | Active |
|-------|------|------------|--------|
| 1 | H2 - 40% DGW | ☐ | ☑ |
| 2 | H2 - 30% DGW | ☐ | ☑ |
| 3 | Calibration Required | ☐ | ☑ |
| 4 | Sensor Error | ☐ | ☑ |

[Apply]

*Wiring exampel: BACS / GX-R-AUX*

The GX-R-AUX is connected via relays like the CON_R_AUX4. The power supply can be provided either via the BACS bus or an external power supply. Please note that:

- When powered via the BACS bus, a stronger power supply must be planned or the number of BACS modules must be reduced in the case of a fully expanded BACS system.

- An external power supply for the sensor has no effect on the existing BACS system, as the sensor does not draw power from the BACS bus in this case.

- In a daisy chain, all connected sensors are powered via the BACS bus. The choice between a stronger power supply for the BACS system or an external power supply for the sensors must
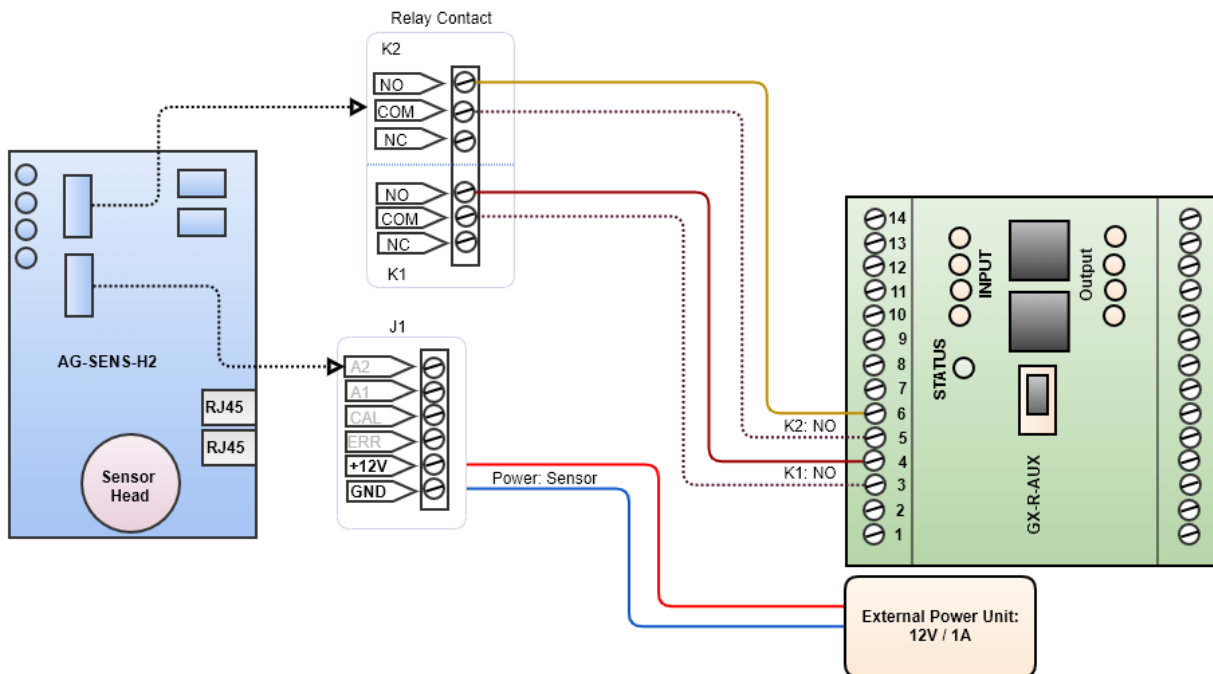


be checked and decided on site.

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**Note: Additional system information via alarm wires**

The BACS bus offers the possibility to manage 20% LEL (warning) or 40% LEL (alarm) directly via the BACS web manager. If you want to receive all status messages, it is recommended to connect via a sensor manager - this offers not only full integration into a BACS system, but also the possibility to connect up to 8 analog sensors, massively expanding the monitoring capabilities.

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**Connecting multiple sensors in series (Daisy Chain)**

Up to 5 SM_H2_LC can be connected in series. In this operating mode, an alarm is triggered in the CS141, with each of the connected devices being the trigger following the Daisy Chain. Please note the following parameters during installation:

- All sensors must be set to positive switching logic (jumper J7-7 is ON).
- A maximum of 5 sensors may be connected in a Daisy Chain.
- The maximum cable length for the Daisy Chain is 50m, and the cable length between the sensors may be a maximum of 15m. A UTP/FTP CAT 5e Ethernet cable is recommended for connection in a Daisy Chain."
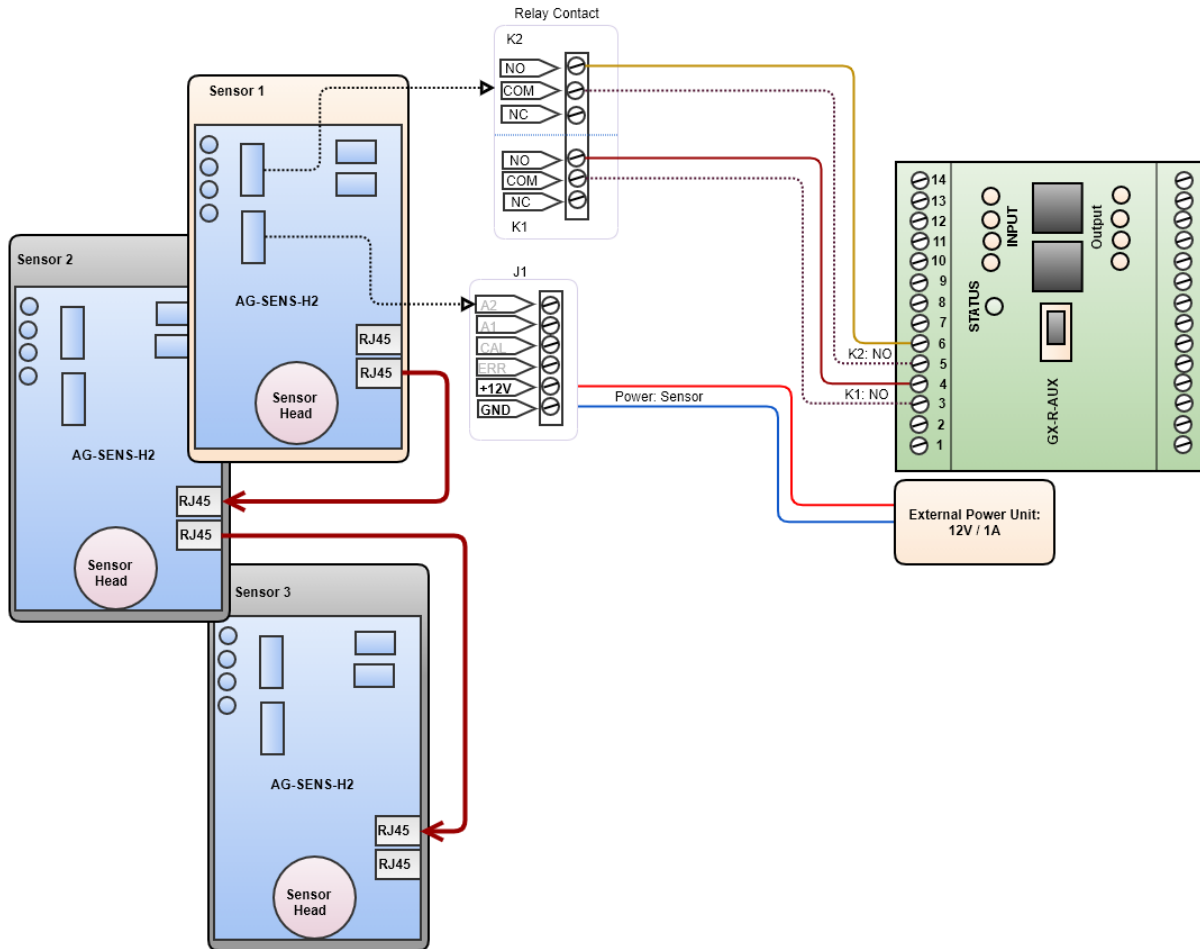
*Daisy – Chain: CON_R_AUX4*
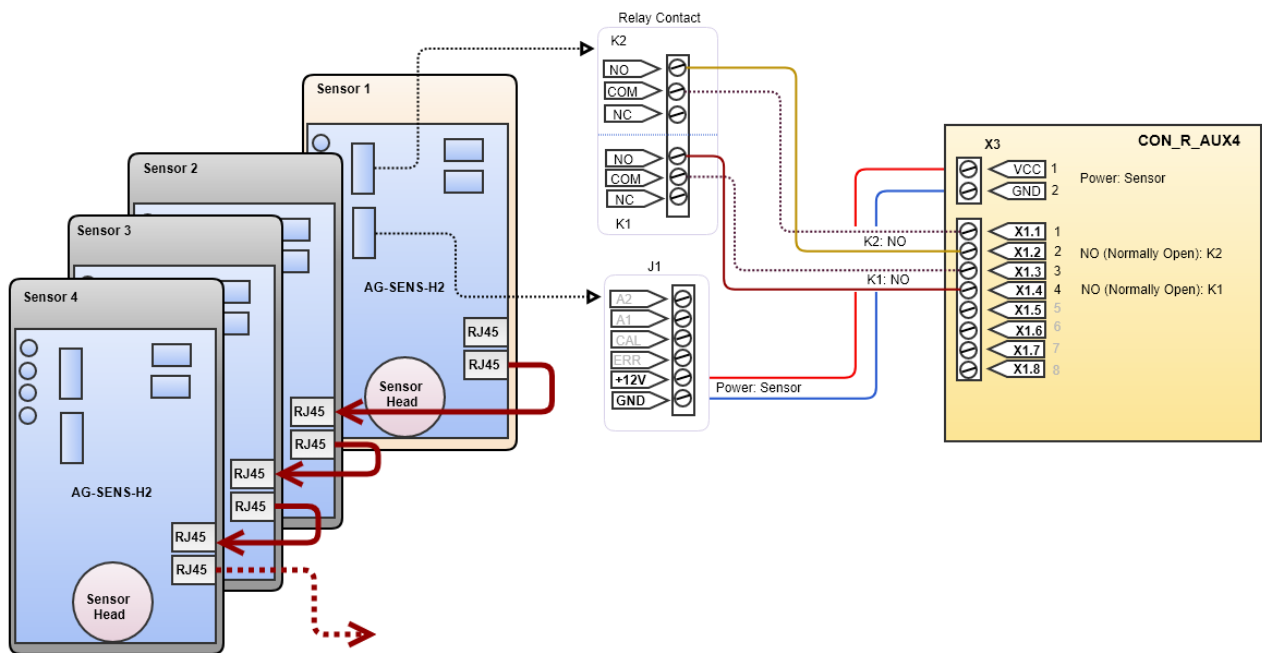


*Daisy – Chain: SENSORMANAGER*
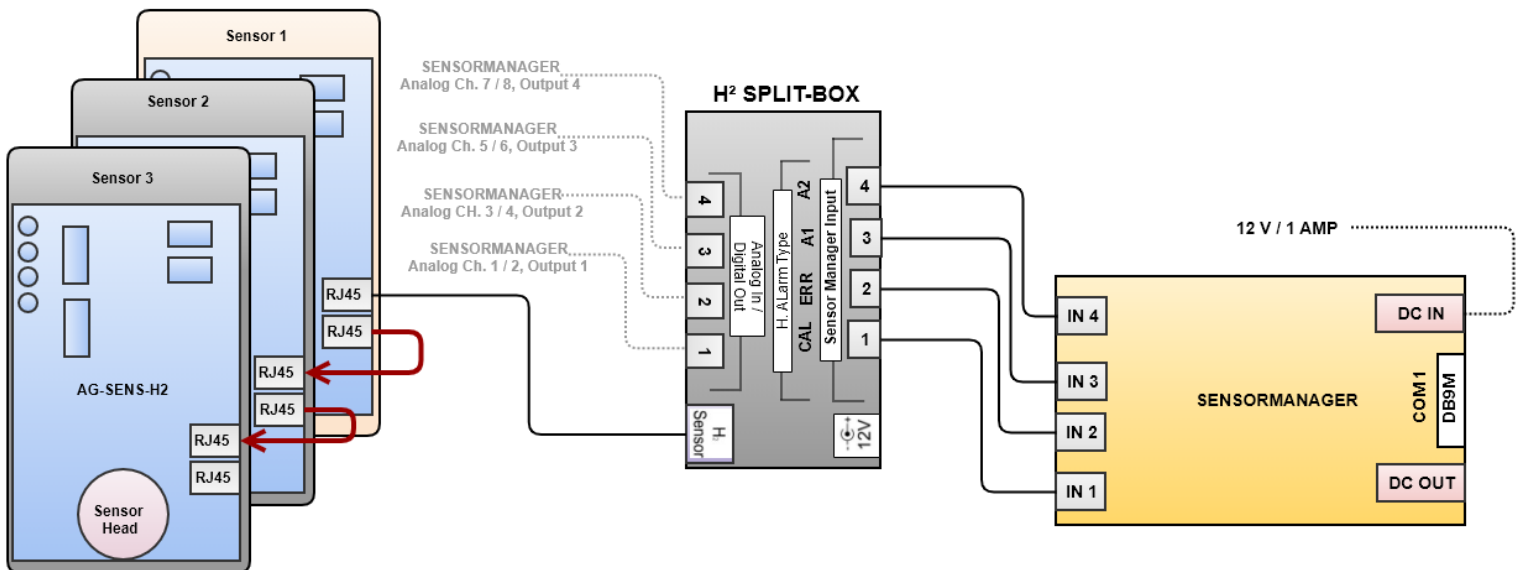
*Daisy-Chain: GX-R-AUX*



Please note that when using a Daisy Chain over the BACS bus, each additional sensor is powered directly by the BACS bus. If you want to upgrade your system, you should check whether a stronger power supply for the BACS system or an external power supply as indicated in this installation example is required.

Otherwise, with an increasing number of sensors in operation (maximum 5 sensors), the number of possible BACS modules is affected. Which installation is the better choice must be checked on site in individual cases.
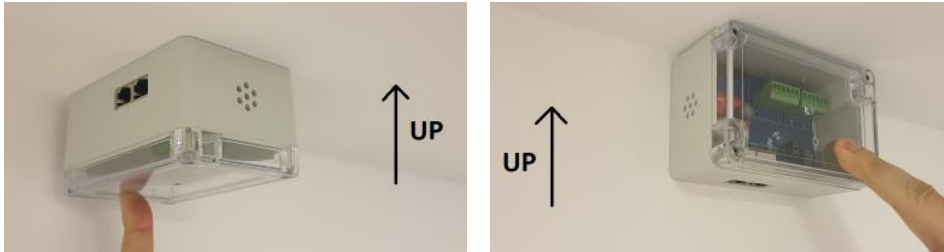
**Placing the sensor**

The location for mounting the sensor is not completely free form - the place will be defined by the monitored area:

Since hydrogen is lighter than air, it will rise and can be found in cavities, shelves, in control cabinets, ventilation outlets, etc.

It must be ensured that contact with hydrogen is possible for the sensor.



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**Note:**

The location and the exact alignment of the sensor strongly depend on the conditions on site. Since hydrogen is very volatile, the places hydrogen clusters can form dangerous concentrations depend on many individual factors.

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*Typical locations*

- *The highest Point*

   Hydrogen always rises to the highest point and accumulates at this location. If this location is a flat ceiling, hydrogen can move with the air flow if someone opens the door, a fan is put into operation, temperature differences generate air turbulence, etc.

   Due to this fact, an explosive air / hydrogen mixture can form and solve very dynamically.

- *Control cabinets*

   If control cabinets are located above hydrogen producing batteries, the hydrogen gas can enter the control cabinet via not sealed cable ducts. As a consequence, within a control cabinet a high explosive atmosphere can form up.

- *Shelves, cable bundles, cable ducts and maintenance channels, …*

   When hydrogen rises and hits an obstacle, it remains there as a so-called "nest". This can happen wherever installations are placed above hydrogen producing batteries. Typical locations are shelves, underneath cable bundles or in cable ducts and maintenance ducts protected from drafts.

- *Ventilation systems and concepts*



   Depending on the area of application, it is possible that a ventilation system should is installed for regularly solving the risk of hydrogen explosive concentration. Due to the design, a lot of hydrogen can accumulate very quickly in such places if the ventilation follows a time scheduled concept to save power.

   This place should be monitored specially.

**Specification**

| | |
|---|---|
| Supply Voltage | 9-12V DC (stabilized) |
| Supply Current | 300 mA max |
| Operating Temperature | 0 – 40 °C |
| Operating Humidity | < 90% |
| Dimension , Weight | 120mm x 80mm x 60mm , 0.25 kg |
| Alarm Thresholds A1, A2 | A1 – 20% LEL, A2- 40% LEL (100 % LEL – 4% VOL) |
| Relay -  Rated Load | 0.50A 125 VAC, 1 A 24 VDC |
| Communication Interface | Outputs with Open Emitter, maximum current 40 mA per output, High state – min. 0.8*VCC Low state – high impedance state (HiZ) |
| Sensor interference gases | Chlorine, nitrogen oxides, significant oxygen deficiency (<18% vol.), rapid increase in humidity |
| Factors limiting sensor durability | Silicone compounds, long-term operation in the concentration above 3..5% LEL, constant presence of strongly reducing gases such as acetylene, hydrogen sulphide, hydrogen, carbon sulphide, etc. |
| Response time | $T_{P50}$ 15 – 120 s. (without diffusion time to the detector), metrological readiness from 0.5hto 12h - depending on the time of power failure |
| Thresholds accuracy | +/- 20 % under calibration conditions (20 °C, 1013 hPa, hum. 65%) |
| Stability of alarm thresholds | +/- 20 % long-term in 1 year, but not worse than +/-30% in 3 years |
| Max. instantaneous hydrogen concentration $H_2$ | 100% LEL( <1min/30min) |
| Calibration period | Recommended – 2 years / Calibration Error Alarm after 3 years uptime |
| Max. areal monitoring | 1 single sensor can monitor up to 50m² (normal room height, flat ceiling and center hydrogen producer). |
| MTBF SM_H2_LC Main Board | 90000 |
| MTBF SM_H2_LC Sensor | 26300 |