

# ENS210 humidity and temperature sensor application note

ENS210 humidity and temperature sensor application note  
Car and truck HVAC energy control and comfort improvements while  
measuring temperature and humidity in cabin

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**Product: ENS210**

**Customer: Standard Product**

**Market: Transportation**

**Device: Integrated Temperature and Relative Humidity Sensors in CMOS**

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## Contents

1	Why using humidity & temperature sensing in a car or truck cabin ? .....	4
2	What type of humidity sensor must be designed in a car or truck HVAC / cabin ? .....	4
3	Why to design ENS210 from Sciosense ?.....	5

## 1 Why using humidity & temperature sensing in a car or truck cabin ?

For now almost 20 years, humidity sensing and control in car or truck cabins is recognized as an efficient way to better control HVAC energy consumption, improve safety and comfort, while increasing customer satisfaction. HVAC power consumption optimization becomes now even more critical when designing HVAC systems for Hybrids and EVs where the energy coming from the batteries must be directed as much as possible to power electrical motors and secure high mileage capability.

Various papers and reports are available to size HVAC impact on global car energy consumption. One report from Car & Driver organization, testing in March 2020 a Tesla Model 3 on FCA test loop, shows that depending on the way HVAC control is set up, final mileage can vary of +/- 13%. That demonstrates the need to better set up strict and smart HVAC control through numerous measurements in the HVAC system and in the cabin to comply either with CO2 regulations for ICE and Hybrids and announced mileage for EV and Hybrids.

In more details, HVAC designers are implementing humidity sensors to satisfy the need for :

- In relation with HVAC energy consumption optimization:
  - o Fine tune control of air damper (recirculation) position to optimize heating and cooling phases while preventing condensation (fogging) in the cabin.
  - o Evaporator temperature adjustment while using HVAC to control humidity (especially cooling) inside the cabin. That allows to better size and optimize HVAC variable compressor and heat pumps control.
  - o Better control of stop and start function and / or transition from electric to ICE power especially on hybrid vehicle while preventing condensation (fogging) and preserving battery levels.
- In relation with comfort zone monitoring and control :
  - o Adjustment of humidity and temperature levels in the cabin , similar to building comfort zone compliance.
  - o Better control (use) of Air Quality sensor inputs to preserve both air quality and manage condensation / too high humidity risks in the cabin.

Depending on car cabin design, engine types (ICE, hybrid or electrical), HVAC design, humidity and temperature sensing function can be located attached to the wind shield, combined or not with the rain sensor, close to the foot of the rear mirror (which is the most popular and validated solution) and / or at the outlet channel of the evaporator.

## 2 What type of humidity sensor must be designed in a car or truck HVAC / cabin ?

Due to the demanding environmental conditions in such application, only capacitive type humidity sensors are suitable to withstand large ranges of operation in humidity (0 to 100% RH) and temperature (-40°C to 85°C) associated with good reliability.

Some of the key characteristics that a humidity and temperature sensor has to comply with in such application :

- Operating temperature range from -40°C to 85°C
- Operating humidity range from 0% to 100%

- Measurement accuracies that can be optimized for both RH and T sensing functions at high humidity (> 70% RH) in the temperature range from 5°C to 40°C to allow fine tuning capability linked to the application.
- Capability to withstand repeated condensation and freezing phases with no permanent drift or damage associated by a fast condensation recovery to allow post condensation immediate and accurate measurements.
- Ultra-fast time constant to manage flash fogging risk.
- Excellent temperature measurement accuracy to allow high accuracy dew point computations, especially at high humidity.

All above associated with robust and qualified electrical characteristics.

### 3 Why to design ENS210 from Sciosense ?

ENS210 has demonstrated performances as requested on 2 above and associated validations to fully comply with truck and automotive performance and reliability needs . Offering a world class humidity accuracy and measurement range , ENS210 offers world leading performance in time constant and temperature accuracy which allow HVAC control systems designed with ENS210 to offer superior performance especially at high humidity. Please refer to ENS210 datasheet available on [ENS210 - ScioSensehttp://www.sciosense.com/](http://www.sciosense.com/)

In addition ENS210 has been successfully tested following appropriated AEC Q100 grade 2 test protocol , thus can be securely designed in car cabin and car HVAC systems. Its reliability is proven in the temperature range from -40°C to 85°C and humidity range from 0% to 100%, including repeated condensation stages. Please ask for report SC -000561-RP ENS210 Product Qualification Report External (QTY-1130).

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