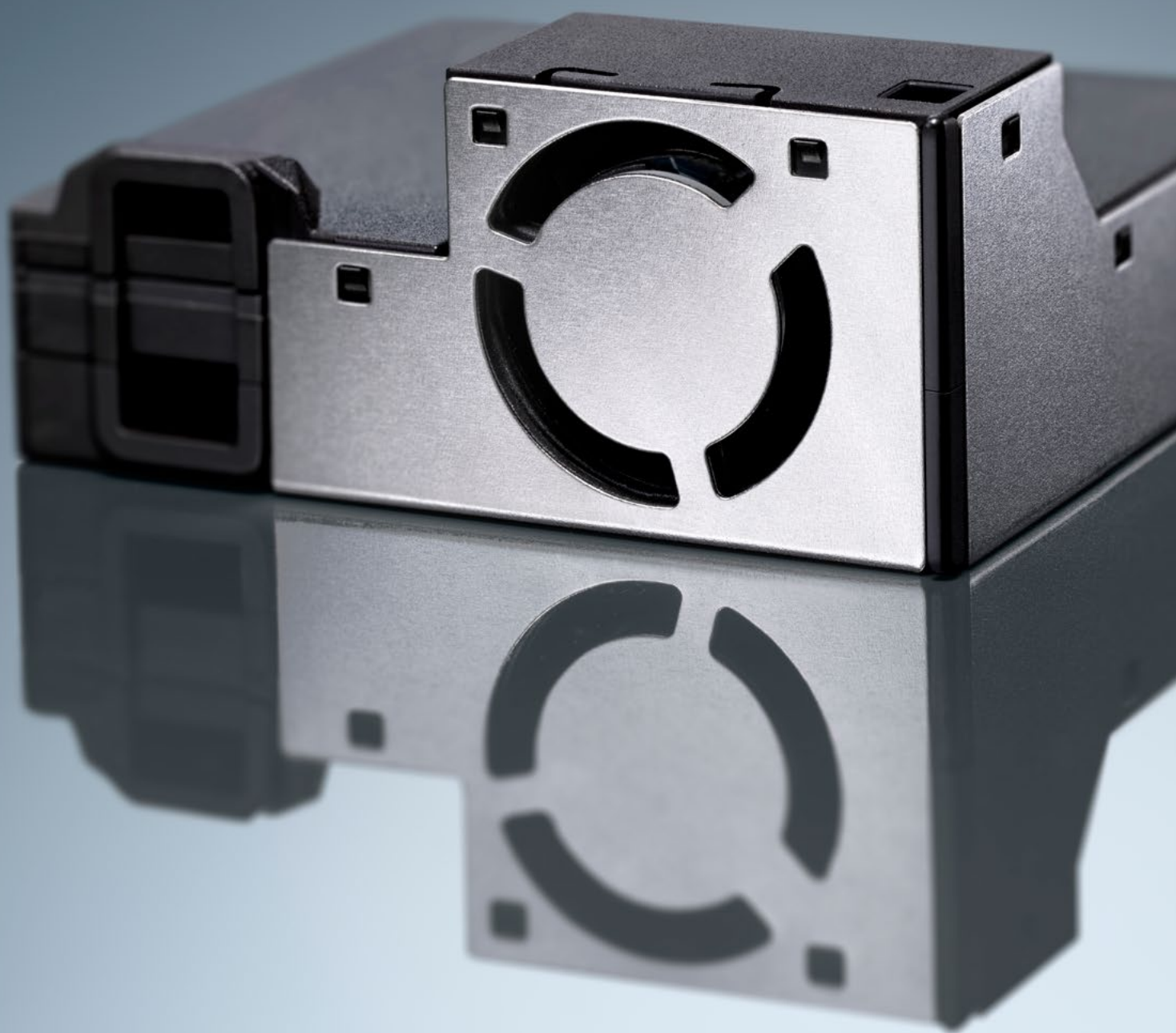# Environmental Sensor Node SEN5x

All-in-one air quality sensing

Combo sensor module for air quality measurements

The SEN5x environmental node is a straightforward, all-in-one sensor solution platform for the accurate measurement of various environmental parameters, such as particulate matter, volatile organic compounds (VOCs), oxidizing gases, such as nitrogen oxide compounds (NO_x), as well as humidity and temperature. Thanks to proprietary algorithms, the module enables straightforward integration into various applications. This allows device manufacturers to save valuable project time and personnel resources and focus on their core competencies. End customers receive reliable air quality measurement data based on the SEN5x and benefit from improved air quality to increase health and comfort.

Applications:

- Air purifiers
- Air quality monitors
- Air conditioners
- HVAC / ventilation systems

STAR engine

When SEN5x is integrated into an end-user product, the resulting thermal behavior can be very complex. A tiny temperature sensor on an unenclosed flex PCB has a negligible thermal mass and couples perfectly to ambient air. It can accurately measure ambient temperature and will be able to react quickly to changes in temperature. In contrast, a built-in sensor module like the SEN5x usually couples weakly to ambient air, has a larger thermal mass and is prone to additional self-heating due to other heat sources close by. This results in slow reaction times when reading changes in ambient temperature, typically in the order of 20–25 minutes for typical air quality monitors when the ambient temperature changes by 5–10°C.

To improve the reaction time and provide a better user experience, Sensirion has developed the "Sensirion Temperature Acceleration Routine" (STAR) engine. This algorithm, which is implemented in the SEN5x range, estimates the value of the temperature dynamically and before the end product reaches a thermally stable state. This allows end users to obtain 2–3x faster and more reliable temperature readings from their products.

The SEN5x offers three pre-defined settings for the STAR engine to address different design-in situations, covering air purifiers and indoor air quality monitors.
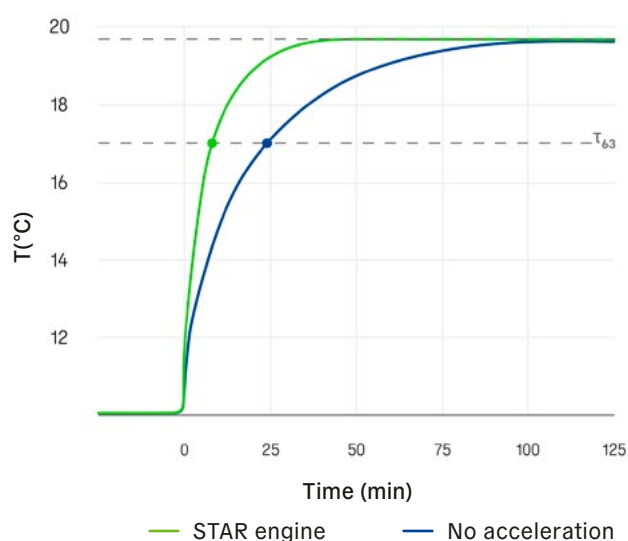
Technology and benefits

Technology	Benefits
All-in-one environmental node: no co-integration of separate sensor components required	Faster time-time-to-market, less R&D expenses, bill of material and assembly costs
Integrated algorithms: temperature and humidity compensation, VOC/NO$_x$ Index calculation	Reliable and trustworthy measurements
Optimized and tested air flow channel geometry and proven design-in examples	Fast hardware design
Sheath-flow technology combined with high-quality components (incl. SHT4x and SGP40)	Dust-protection and long life-time

Sensor module specifications

Sensor module specifications	
Lifetime[1]	>10 years operating continuously 24h/day
Operating conditions	−10–50 °C

Particulate matter specifications	
Mass concentration range	0–1,000 µg/m³
Mass concentration accuracy[2,3] for PM2.5[4]	± 5 µg/m³ AND 5% m.v. @ 0–100 µg/m³ ± 10% m.v. @ 100–1000 µg/m³

Temperature and humidity specifications	
Typical accuracy temperature	± 0.45 °C @ 15–30 °C, 50 %RH
Typical accuracy relative humidity	± 4.5 %RH @ 25 °C, 30–70 %RH

Gas specifications	VOC	NOx
Output signals	1–500 VOC Index points	1–500 NO$_x$ Index points
Device-to-device variation[5,6]	< ± 15 VOC Index points or % m.v. (whichever is larger)	<± 50 NO$_x$ Index points or % m.v. (whichever is larger

Electrical specifications	
Supply voltage	4.5–5.5 V
Average supply current in measurement-mode (after first 60 seconds)	63 mA

[1] Lifetime is based on mean-time-to-failure (MTTF) calculation. Lifetime might vary depending on different operating conditions.
[2] Also referred to as "between-parts variation" or "device-to-device variation".
[3] For further details, please refer to the document "Sensirion Particulate Matter Sensor Specification Statement".
[4] Verification Aerosol for PM2.5 is a 3% atomized KCl solution. Deviation to reference instrument is verified in end-tests for every sensor after calibration.
[5] 95% of the sensors will be within the typical tolerance corresponding to 2 assuming a normal distribution for ≥100 sensors.
[6] Evaluated using the calibration and test sequence according to the application note SGP41 – Testing Guide.

SEK-SEN5x Evaluation Kit

The SEK-SEN5x evaluation kit has been designed to help you evaluate Sensirion's SEN5x environmental nodes easily and cost-efficiently. The kit contains the SEN5x sensor node, which is equipped with particulate matter sensing technology, an SGP41, an SHT4x humidity sensor and a microcontroller featuring VOC and NOx Index, relative humidity and temperature outputs via I²C interface.

The SEK-SEN5x evaluation kit includes two cable sets. The "adapter cable" allows you to connect to a computer via the SEK-SensorBridge, which must be bought separately and can be ordered via one of our distribution partners. Sensirion's SEK-ControlCenter viewer software can be used for evaluating the sensor. In addition, the kit includes a jumper cable that enables fast prototyping, e.g., through integration into existing platforms (like Arduino, RaspberryPi, etc.). The software and relevant documentation can be downloaded from our website.

Learn more: www.sensirion.com/my-sen-ek

Environmental sensing

Environmental conditions have a major impact on our well-being, comfort, and productivity. Sensirion's sensor solutions provide detailed and reliable data on key environmental parameters such as humidity, temperature, volatile organic compounds (VOCs), particulate matter (PM2.5), formaldehyde, NO_x and CO_2. Environmental sensing opens up new possibilities to create smarter devices that improve our comfort and well-being as well as increase energy efficiency in a wide variety of applications. We accompany you through the entire product development process, from the initial idea to product launch and beyond. Our expertise ranges from prototype construction, design-in support and use-case development to inline testing at the mass production stage.

www.sensirion.com/sen5x