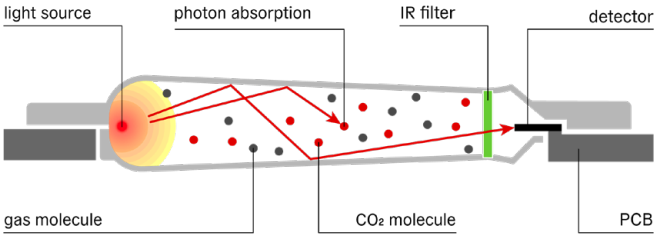
Carbon dioxide sensors

Precise monitoring in any environment

SENSIRION

Bringing value through CO_2 sensing

CO_2 sensors enable the development of smart devices that enhance comfort, health, and energy efficiency in a variety of HVAC, consumer and medical applications. Utilizing the latest advancements of different measurement principles, we offer solutions for a wide range of use cases and requirements. From initial idea to product launch, we support the entire development process, offering expertise in prototype construction, design-in support, and in-line testing during mass production. Our sensor portfolio also includes sensor solutions to monitor environmental parameters such as humidity, temperature, volatile organic compounds (VOCs), particulate matter (PM), formaldehyde, and nitrogen oxide (NOx).



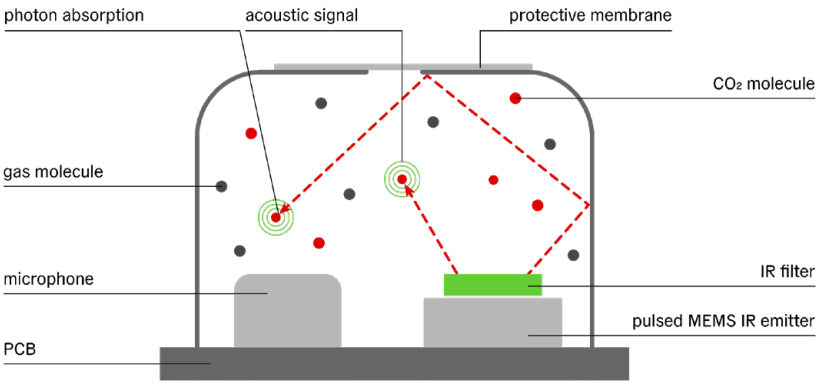
Measurement principles for CO_2 sensing

Transmissive non-dispersive infrared (NDIR)

CO_2 molecules absorb specific wavelengths of infrared (IR) light. NDIR CO_2 sensors pass IR light through a measurement cell, using a detector to measure how much light is transmitted through it (i.e. not absorbed by CO_2 molecules). By comparison to a reference light intensity, a CO_2 concentration is derived. Two types of NDIR CO_2 sensors exist: single and dual channel. The reference measurement channel in dual channel NDIR enhances long-term stability.

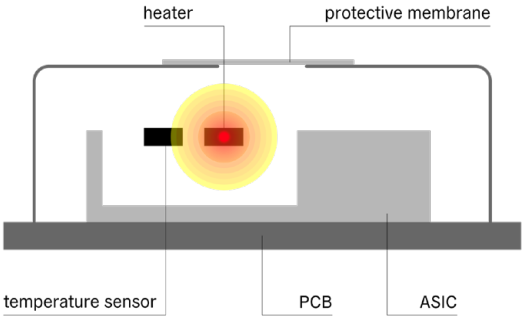
Photoacoustic NDIR (PA)

PA uses a pulsed IR light source that emits wavelengths absorbed by CO_2. Absorption of light by CO_2 molecules leads to additional molecular vibration, increasing the pressure in the measurement cell. As the light source is pulsed, this pressure increase occurs periodically, creating an acoustic wave. The more CO_2 molecules present, the larger the amplitude of the acoustic wave. This is measured by a microphone to calculate the CO_2 concentration.



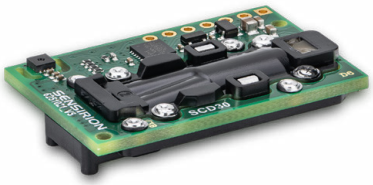
Thermal conductivity (TC)

TC is based on the inherent thermal conductivity of all gases. With a thorough understanding of the gas composition in ambient environments, subtle changes in gas concentrations can be detected. The measurement principle is based on heating the air within a measurement cavity and sensing the heat transfer with a temperature sensor.



SCD30

SCD30 is our state-of-the-art transmissive NDIR CO_2, relative humidity and temperature sensor module. The module's dual-channel optical measurement principle enables best-in-class CO_2 measurement accuracy and excellent long-term stability. An ultra-thin package size and UART, I²C or PWM interface allows for easy, space-saving integration. Applications requiring compatibility with building codes or IAQ standards – such as California Title 24, EN50543, RESET® or WELL Building Standard® – are well served by SCD30.



Features	Benefits
Transmissive NDIR sensing technology	High accuracy, selective optical CO_2 measurement
Dual-channel measurement principle	Superior long-term stability by reference-channel compensation
All-in-one CO_2, RH and T sensor module	Three measurement outputs with on-board temperature and humidity compensation
Sensirion CMOSens® IR-Detector	Excellent performance-to-price ratio
UART, I²C and PWM interface	High flexibility for interfacing and read-out
Thinnest NDIR sensor module	Streamlined design, ideal for wall-mounted devices

Applications

- Commercial and residential HVAC systems
- Demand-controlled ventilation (DCV)
- Energy recovery ventilation (ERV)
- Wall-mounted thermostats
- Duct-mounted CO_2 sensors

SEK-SCD30 Evaluation Kit

- 1× SCD30 on SEK-adapter PCB with RJ45 connector and pinout (female 2.54 mm)
- 1× RJ45 adapter cable (1-meter length)
- 1× SEK-SensorBridge required (must be bought separately)

Learn more

about the **SCD30**

about the **SEK-SCD30**

SCD4x

SCD4x offers high accuracy at attractive prices and a small form factor using the photoacoustic NDIR sensing principle and Sensirion's patented PASens® and CMOSens® technologies.

SCD4x is available in three different variants: SCD40 for cost-sensitive applications at standard accuracy, SCD41 for more demanding use-cases requiring compatibility with California Title 24, RESET® and WELL Building Standard™, and SCD43 for applications additionally requiring compatibility with ASHRAE 62.1-2022 Draft Addendum d and/or high accuracy. SCD41 and SCD43 also feature a single shot operation mode.

Features	Benefits
Photoacoustic NDIR sensing technology	High accuracy, selective CO_2 measurement
Small footprint of 10.1 × 10.1 × 6.5 mm^3	Space saving integration
Fully encapsulated sensor package	Long lifetime of >10 years Robust against dust, water ingress and mechanical force
SMD solderable, tape & reel packaging	Allows for highly automated, cost-effective on-board assembly
On-chip compensation and self-calibration	Calibrated and linearized sensor output with long-term drift compensation (ASC)
Supply voltage range of 2.4–5.5 V	Operable in wide variety of applications
Multiple operation and reduced power modes	Flexible trade-off between power-consumption and performance
Digital I^2C interface	Straight-forward design-in and interfacing

Applications

- Commercial or residential HVAC systems
- Wall-mounted thermostats
- Air purifiers
- Indoor air quality monitors

SEK-SCD43 Evaluation Kit

- 1× SCD43 development board
- 1× adapter cable
- 1× jumper wire set
- 1× SEK-SensorBridge required (must be bought separately)

Learn more

about the SCD40

about the SCD41

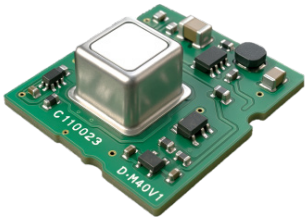
about the SEK-SCD43

about the SCD43

SCD53

Coming soon in Q4 2026

The SCD53 enables worry-free CO_2 sensing even under demanding conditions through excellent intrinsic stability, best-in-class accuracy and robustness. Furthermore, it is designed to address an increasingly relevant challenge in gas sensing: maintaining accuracy long-term without relying on costly manual recalibration and/or self-calibration algorithms requiring regular exposure to outdoor fresh air (i.e., “ABC” or “ASC”).



SCD53 combines Sensirion’s leading expertise in photoacoustic NDIR sensing with advanced laser technology for selective, stable and accurate CO_2 measurements. The sensor is highly robust against dust and vibrations. Integrated humidity and temperature compensation, as well as optional pressure correction, enable reliable readings across a demanding range of environmental conditions. The on-demand measurement mode, compact sensor size and a reflow solderable LGA package make integrating SCD53 simple, flexible and cost-efficient.

Features	Benefits
Laser-based photoacoustic NDIR sensing technology	Highly accurate and selective CO_2 measurement
Excellent intrinsic stability	Reliable measurements independent of costly manual recalibration or required exposure to outdoor fresh air
Wide RH/T operating range with robustness against dust and vibration	Worry-free performance even under demanding conditions
Average current consumption below 1 mA	Enables reduced power applications
On-demand measurement mode	Flexible power consumption yet full accuracy with every measurement
Compact form factor	Facilitates space-efficient design-in
SMD soldering, tape & reel packaging	Allows for highly automated, cost-effective on-board assembly
Digital I²C interface	Simple sensor communication

Applications

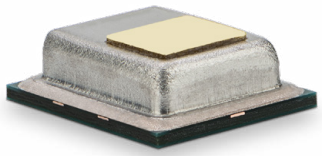
- Wall and duct mount sensors for commercial demand-controlled ventilation (DCV)
- Ventilation control for energy-efficient, exclusively mechanically ventilated buildings
- Indoor air quality monitoring for permanently occupied buildings/spaces
- Smart greenhouses
- Grain storage monitoring

Learn more

about the
SCD53

STCC4

STCC4 is our next generation CO_2 sensor based on the thermal conductivity sensing principle. With one of the world's smallest form factors on the market for direct measurement of CO_2 gas concentrations, it is designed for seamless integration into compact electronic devices, setting a new standard for versatility and adaptability.



The key features of STCC4 open up opportunities for CO_2 monitoring in applications previously limited by size and cost constraints. The sensor will officially be launched in May 2025.

Features	Benefits
Thermal conductivity sensing technology	Direct measurement of CO_2 concentration
Small footprint of 4 × 3 × 1.2 mm³	Facilitates space-efficient design-in
Current consumption of 950µA	Enables low power applications
Low number of components	High reliability
SMD soldering, tape & reel packaging	Straight-forward design-in
Digital I²C interface	Simple sensor communication

Applications

- Smart speakers
- Smart thermostats
- Air conditioners
- Indoor air quality monitors

SEK-STCC4 Evaluation Kit

- 1× STCC4 development board
- 1× adapter cable
- 1× jumper wire set
- 1× SEK-SensorBridge required (must be bought separately)

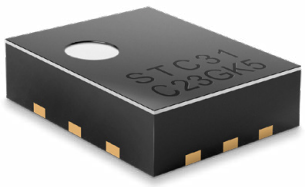
Learn more

about the **STCC4**

about the **SEK-STCC4**

STC31-C

STC31-C is a chip-sized gas concentration sensor based on the thermal conductivity sensing principle that delivers high-range, accurate CO_2 measurements with superior repeatability and long-term stability. This makes it the perfect choice for applications where reliability is key. STC31-C introduces a new low-cross-sensitivity measurement mode with smart humidity and oxygen compensation, allowing new applications like measuring CO_2 in breath.



Features	Benefits
Thermal conductivity sensing technology	Ultra-low power consumption
Small footprint of only 4 × 3 × 1mm³	Fits into every device
Low number of components	High reliability
Fast response time	Allows measurement of CO_2 in breath
Voltage range of 2.7–5.5 V	Flexibility for battery and wired applications
Automatic self-calibration (ASC)	Enables autonomous drift compensation
Low-power mode	Potential for battery-powered applications
SMD soldering, tape & reel packaging	Straight-forward design-in
Smart humidity and O_2 compensation	On-chip signal compensation
Digital I²C interface	Simple sensor communication

Applications

- Controlled atmosphere storage systems
- CO_2 measurement in breath
- CO_2 measurement in medical ventilation
- CO_2 leakage detection

SEK-STC31-C Evaluation Kit

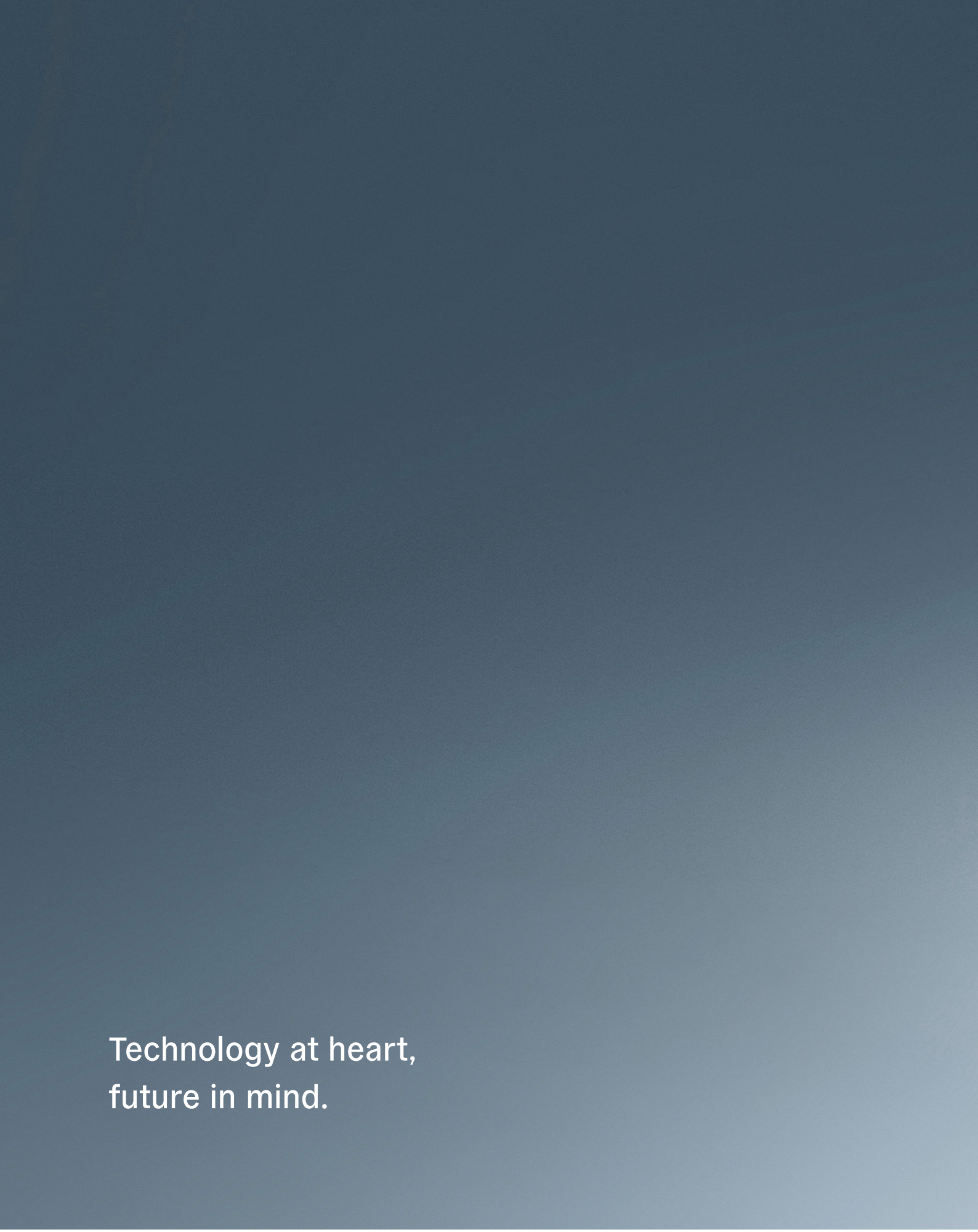
- 1× STC31-C and 1× SHT40 on FPCB
- 1× RJ45 adapter cable (1 meter length)
- 1× SEK-SensorBridge required (must be bought separately)

Learn more

about the
STC31-C

about the
SEK-STC31

	SCD30	SCD40	SCD41	SCD43	STCC4	STC31-C
Measurement principle	NDIR	Photoacoustic NDIR			Thermal conductivity	
Measurement accuracy	± (30 ppm + 3 %) @ 400-10,000 ppm	± (50ppm + 5 % of reading) @ 400–2,000 ppm	± (50 ppm + 2.5 % of reading) @ 400–1,000 ppm ± (50 ppm + 3 % of reading) @ 1,001–2,000 ppm ± (40 ppm + 5 % of reading) @ 2,001–5,000 ppm	± (30 ppm + 3 % of reading) @ 400–5,000 ppm	± (100 ppm + 10%) @ 400–5,000 ppm	± (0.2 ... 2.0 vol %) @ 0–100 vol%
CO_2 output range	0–40,000 ppm	0–40,000 ppm			380–32,000 ppm	0–100 vol %
Minimum sampling interval	2 s	5 s			1 s	0.066 s
Response time (τ63%)	20 s	60 s			20 s	0.5 s
Size	35 × 23 × 7 mm³	10.1 × 10.1 × 6.5 mm³			4 × 3 × 1.2 mm³	4 × 3 × 1 mm³
Assembly	Through-hole	SMD			SMD	SMD
Interface	I²C, PWM, Modbus	I²C			I²C	I²C
Lifetime	15 years	> 10 years			> 10 years	> 10 years
Supply voltage range	3.3–5.5 V	2.4–5.5 V			2.7-5.5 V	2.7–5.5 V
Average current for periodic measurement mode	19 mA	3.3 V = 15 mA, 5V = 11 mA			950µA @ 1 Hz	150 uA @ 1 Hz
Temperature operating conditions	0 to 50 °C	–10 to +60 °C			10 to 40 °C	–10 to +50 °C
Humidity operating conditions	0–95 % RH	0–95% RH			20–80 % RH	0–95 % RH
Low power modes	Variable sampling interval	Low power periodic	Low power periodic Single shot	Low power periodic Single shot	Single shot	Variable sampling interval
Compatibility with IAQ standards	EN50543, RESET, WELL, California Title 24	WELL	RESET, WELL, California Title 24	RESET, WELL, California Title 24, ASHRAE 62.1-2022 incl. Draft Addendum d		Not for IAQ applications



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