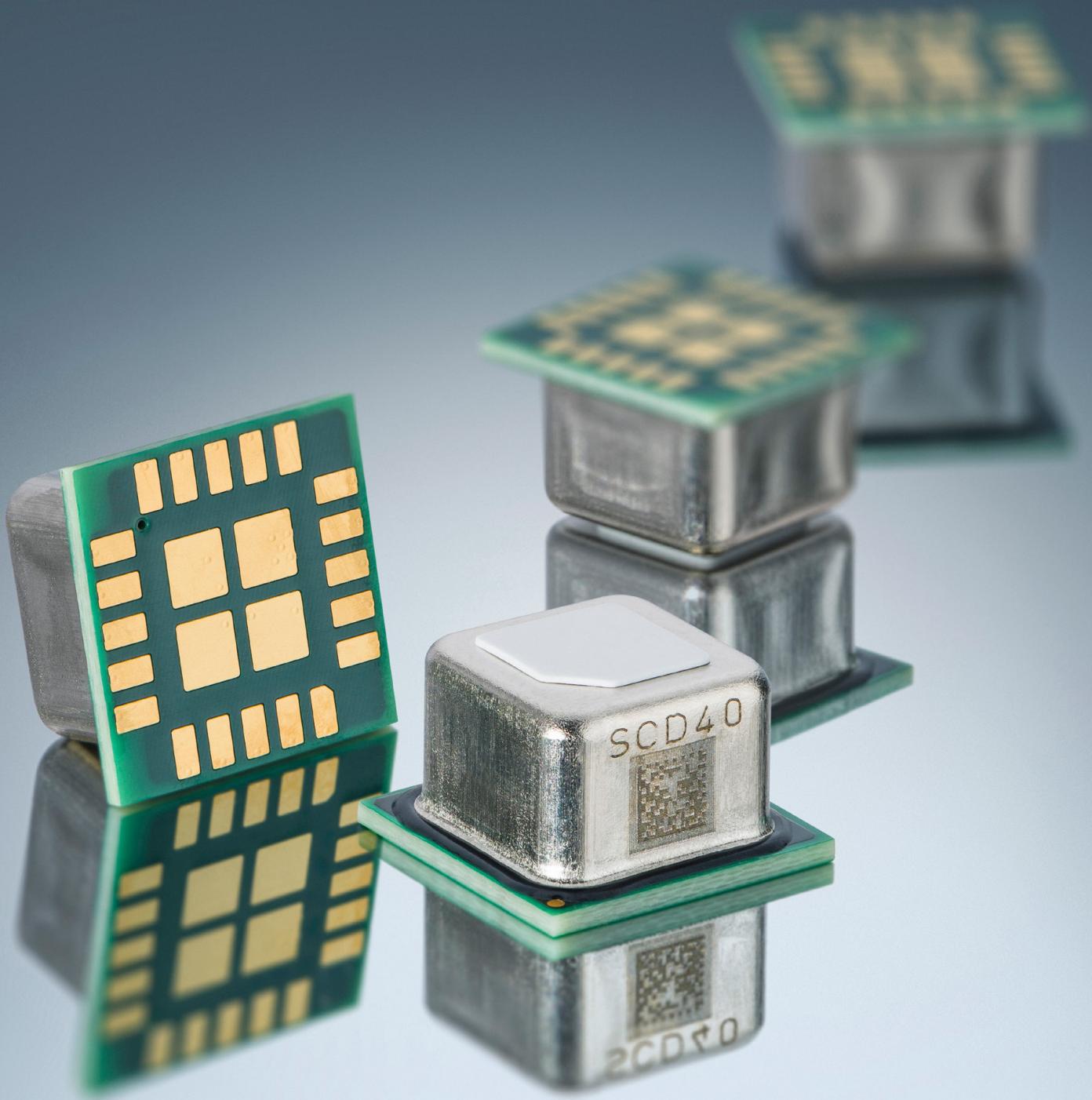


# Carbon dioxide sensors

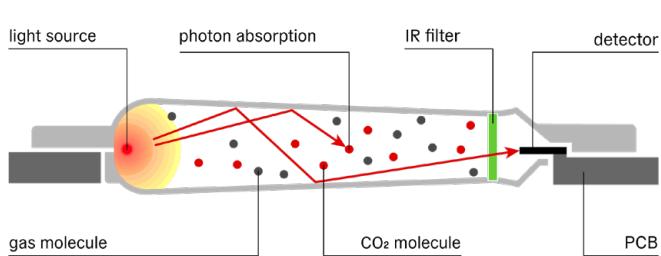
## Precise monitoring in any environment



**SENSIRION**

# Bringing value through CO<sub>2</sub> sensing

CO<sub>2</sub> 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 (NO<sub>x</sub>).



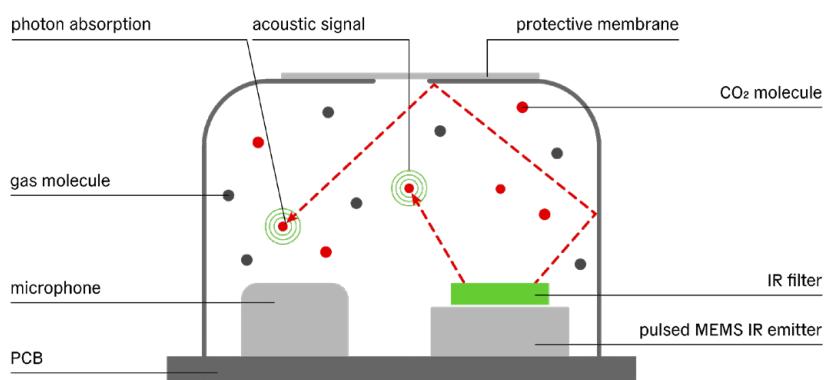
## Measurement principles for CO<sub>2</sub> sensing

### Transmissive non-dispersive infrared (NDIR)

CO<sub>2</sub> molecules absorb specific wavelengths of infrared (IR) light. NDIR CO<sub>2</sub> 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<sub>2</sub> molecules). By comparison to a reference light intensity, a CO<sub>2</sub> concentration is derived. Two types of NDIR CO<sub>2</sub> sensors exist: single and dual channel. The reference measurement channel in dual channel NDIR enhances long-term stability.

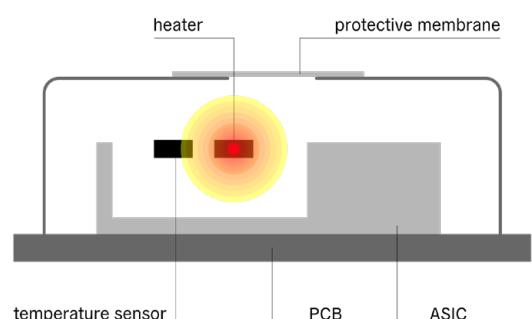
### Photoacoustic NDIR (PA)

PA uses a pulsed IR light source that emits wavelengths absorbed by CO<sub>2</sub>. Absorption of light by CO<sub>2</sub> 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<sub>2</sub> molecules present, the larger the amplitude of the acoustic wave. This is measured by a microphone to calculate the CO<sub>2</sub> concentration.



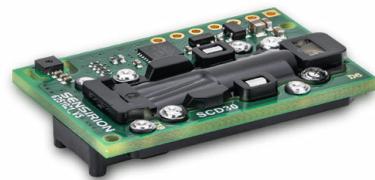
### Thermal conductivity (TC)

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<sub>2</sub>, relative humidity and temperature sensor module. The module's dual-channel optical measurement principle enables best-in-class CO<sub>2</sub> measurement accuracy and excellent long-term stability. An ultra-thin package size and UART, I<sup>2</sup>C 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 <sub>2</sub> measurement
Dual-channel measurement principle	Superior long-term stability by reference-channel compensation
All-in-one CO <sub>2</sub> , 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, I <sup>2</sup> C 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<sub>2</sub> 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 <sub>2</sub> measurement
Small footprint of 10.1 × 10.1 × 6.5 mm <sup>3</sup>	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 <sup>2</sup> C 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**

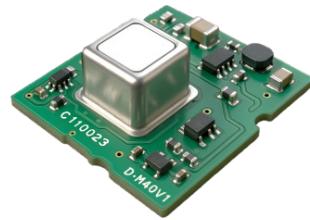


about the  
**SCD43**

# SCD53

Coming soon in Q4 2026

The SCD53 enables worry-free CO<sub>2</sub> 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<sub>2</sub> 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 <sub>2</sub> 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 1mA	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 I <sup>2</sup> C 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

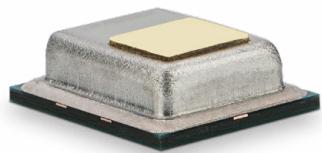
## Learn more



about the  
**SCD53**

# STCC4

STCC4 is our next generation CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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 <sub>2</sub> concentration
Small footprint of 4 × 3 × 1.2 mm <sup>3</sup>	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 I <sup>2</sup> C 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<sub>2</sub> 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<sub>2</sub> in breath.



Features	Benefits
Thermal conductivity sensing technology	Ultra-low power consumption
Small footprint of only 4 × 3 × 1mm <sup>3</sup>	Fits into every device
Low number of components	High reliability
Fast response time	Allows measurement of CO <sub>2</sub> 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 <sub>2</sub> compensation	On-chip signal compensation
Digital I <sup>2</sup> C interface	Simple sensor communication

## Applications

- Controlled atmosphere storage systems
- CO<sub>2</sub> measurement in breath
- CO<sub>2</sub> measurement in medical ventilation
- CO<sub>2</sub> 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

	<b>SCD30</b>	<b>SCD40</b>
Measurement principle	NDIR	
Measurement accuracy	± (30 ppm + 3%) @ 400-10,000 ppm	± (50 ppm + 5% of reading) @ 400-2,000 ppm
CO <sub>2</sub> output range	0-40,000 ppm	
Minimum sampling interval	2 s	
Response time (τ <sub>63%</sub> )	20 s	
Size	35 × 23 × 7 mm <sup>3</sup>	
Assembly	Through-hole	
Interface	I <sup>2</sup> C, PWM, Modbus	
Lifetime	15 years	
Supply voltage range	3.3-5.5 V	
Average current for periodic measurement mode	19 mA	
Temperature operating conditions	0 to 50 °C	
Humidity operating conditions	0-95% RH	
Low power modes	Variable sampling interval	Low power periodic
Compatibility with IAQ standards	EN50543, RESET, WELL, California Title 24	WELL

SCD41	SCD43	STCC4	STC31-C
Photoacoustic NDIR		Thermal conductivity	
± (50 ppm + 2.5% of reading) @ 400–1,000 ppm			
± (50 ppm + 3% of reading) @ 1,001–2,000 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%
± (40 ppm + 5% of reading) @ 2,001–5,000 ppm			
0–40,000 ppm		380–32,000 ppm	0–100 vol%
5 s		1 s	0.066 s
60 s		20 s	0.5 s
10.1×10.1×6.5 mm <sup>3</sup>		4×3×1.2 mm <sup>3</sup>	4×3×1 mm <sup>3</sup>
SMD		SMD	SMD
I <sup>2</sup> C		I <sup>2</sup> C	I <sup>2</sup> C
>10 years		>10 years	>10 years
2.4–5.5 V		2.7–5.5 V	2.7–5.5 V
3.3 V = 15 mA, 5 V = 11 mA		950 µA @ 1 Hz	150 µA @ 1 Hz
-10 to +60 °C		10 to 40 °C	-10 to +50 °C
0–95% RH		20–80% RH	0–95% RH
Low power periodic Single shot	Low power periodic Single shot	Single shot	Variable sampling interval
RESET, WELL, California Title 24	RESET, WELL, California Title 24, ASHRAE 62.1-2022 incl. Draft Addendum d		Not for IAQ applications

Technology at heart,  
future in mind.