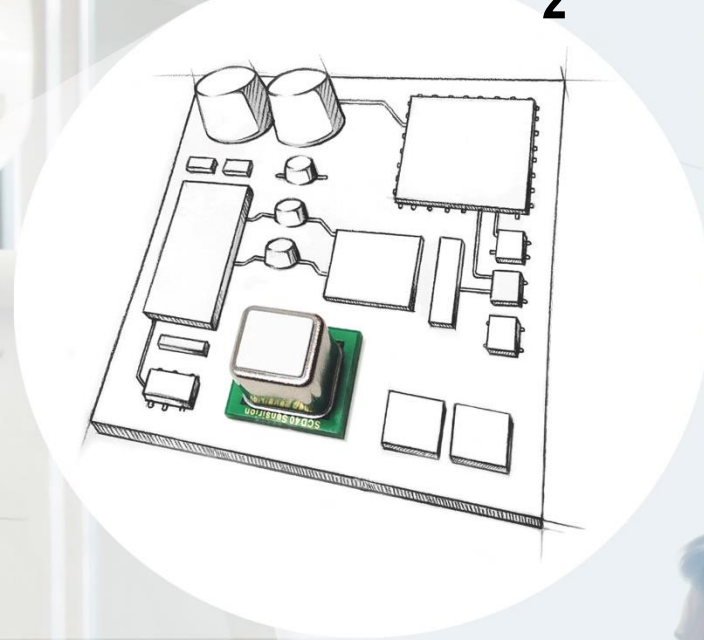


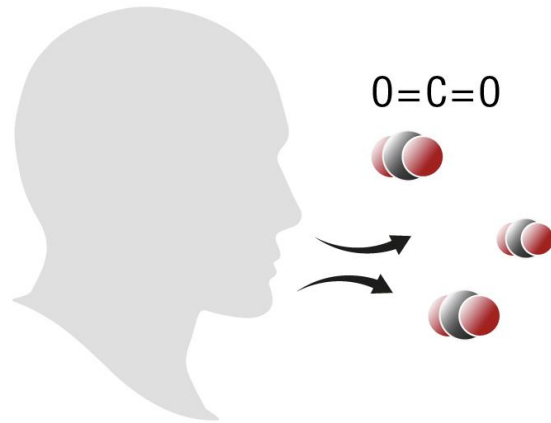
Breaking The Size Barrier: SCD40 - Photoacoustic CO₂ Sensor AMA Award Finalist

Marco Gysel, Product Manager CO₂ Sensors
Stäfa CH, June 2020

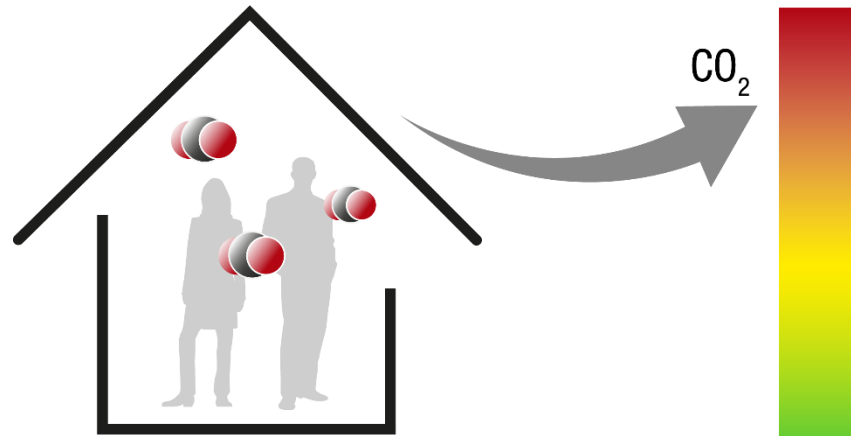


Why measure CO₂? – Indoor Air Quality

Humans exhale CO₂



Human presence increases CO₂ concentration in confined spaces such as Indoors



Consequences

High CO₂ levels cause health symptoms, reduced concentrations and low well-being

SCD40 to measure, counteract and control elevated CO₂ concentrations.

CO₂ Implications on Human Health and Productivity

The New York Times

Is Conference Room Air Making You Dumber?

A small body of evidence suggests that when it comes to decision making, indoor air may matter more than we have realized.

[...]

The higher the carbon dioxide, the worse the test-takers did; at 2,500 ppm, their scores were generally much worse than at 1,000 ppm.

[...]

But the variations in performance at different levels of ventilation suggest that a typically recommended minimum air flow for a conference room, which is 6 cubic feet per minute per person, might not be optimal, said Dr. Allen.

Without a specialized sensor, you can't realistically know how much carbon dioxide is building up while you hunker down in a small room for a long meeting.

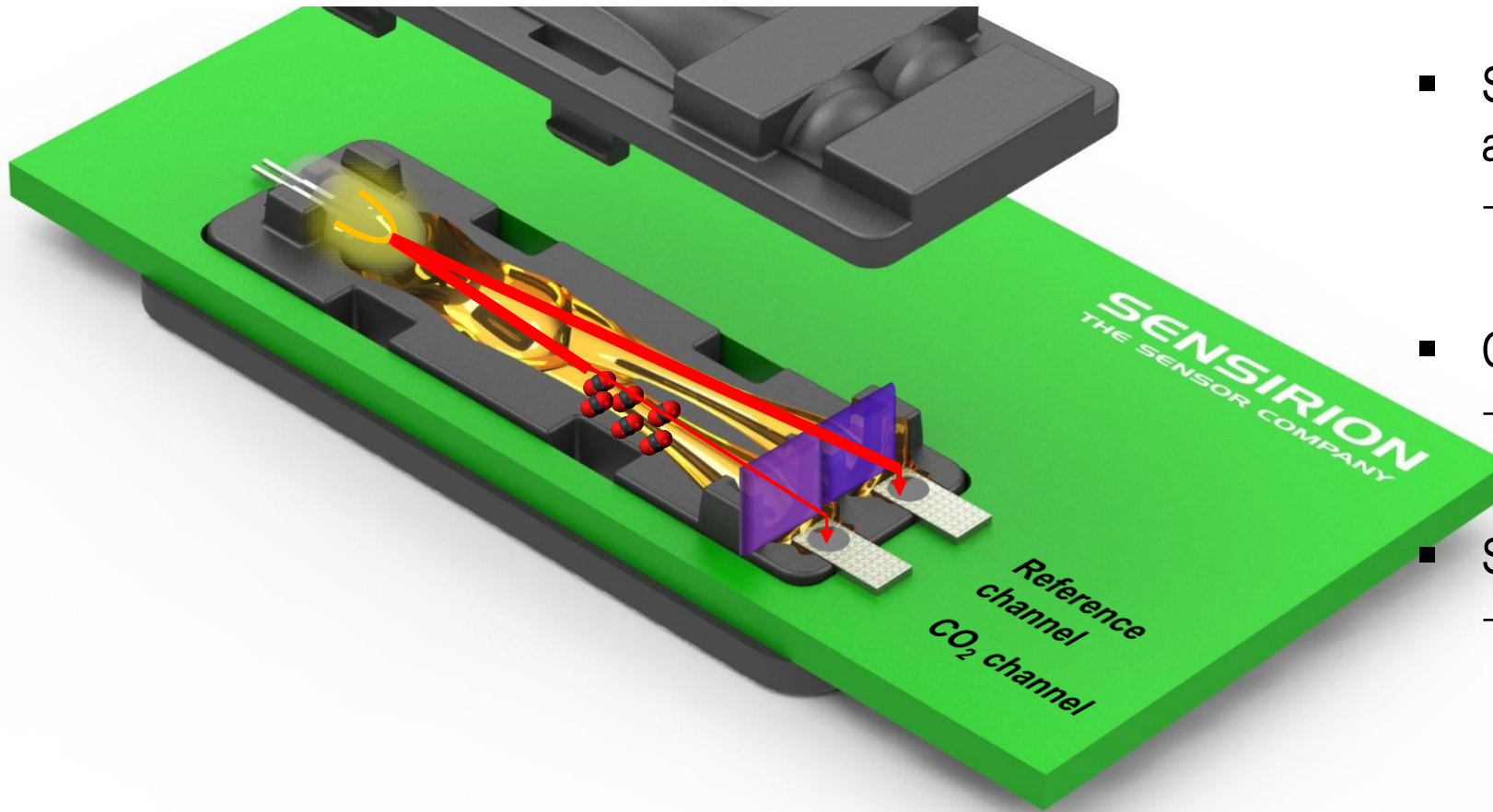
It might be a generally good practice, when possible, to crack open a door (or a window when possible, and when outside air pollution isn't a major concern). Letting some fresh air in might even help keep good ideas flowing during your meeting, and prevent the discussion from getting too stale.

“The higher the carbon dioxide, the worse the test-takers did; at 2,500 ppm, their scores were generally much worse than at 1,000 ppm.”

“Without a specialized sensor, you can't realistically know how much carbon dioxide is building up while you hunker down in a small room for a long meeting.”

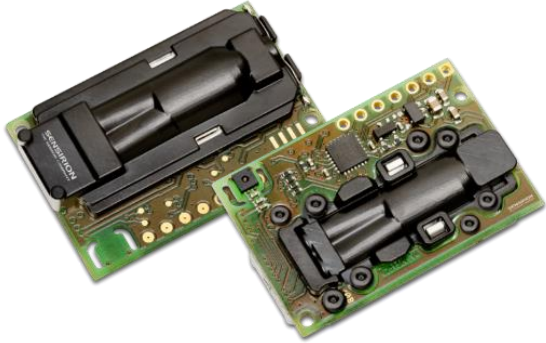
Source: <https://www.nytimes.com/2019/05/06/health/conference-room-air.html>

State-of-the-art NDIR CO₂ Sensor: Great but...



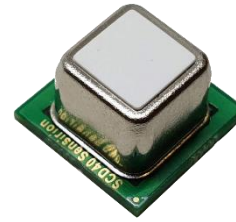
- Sensor sensitivity proportional to optical absorption path length
→ miniaturization intrinsically limited
- Costly components required
→ BOM structure not cost-effective
- Susceptible to deformation
→ Through-hole soldering

SCD40 how? - Before Breaking the Rules You Must Master Them



SCD30 success story

- Dual channel NDIR CO₂ sensor
- Highest performance and superior long-term stability
- Integrated temperature and humidity sensor
- Thinnest package on the market



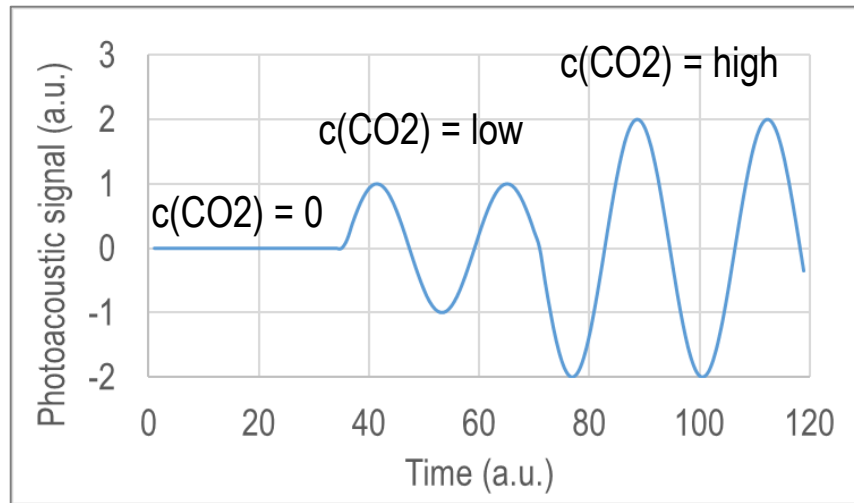
SCD40 miniature CO₂ sensor

- SCD40 mission: deliver same performance at a fraction of the size and cost-effective pricing
- Revolutionize the CO₂ sensing market to enable new use-cases
- Integrated temperature and humidity sensor

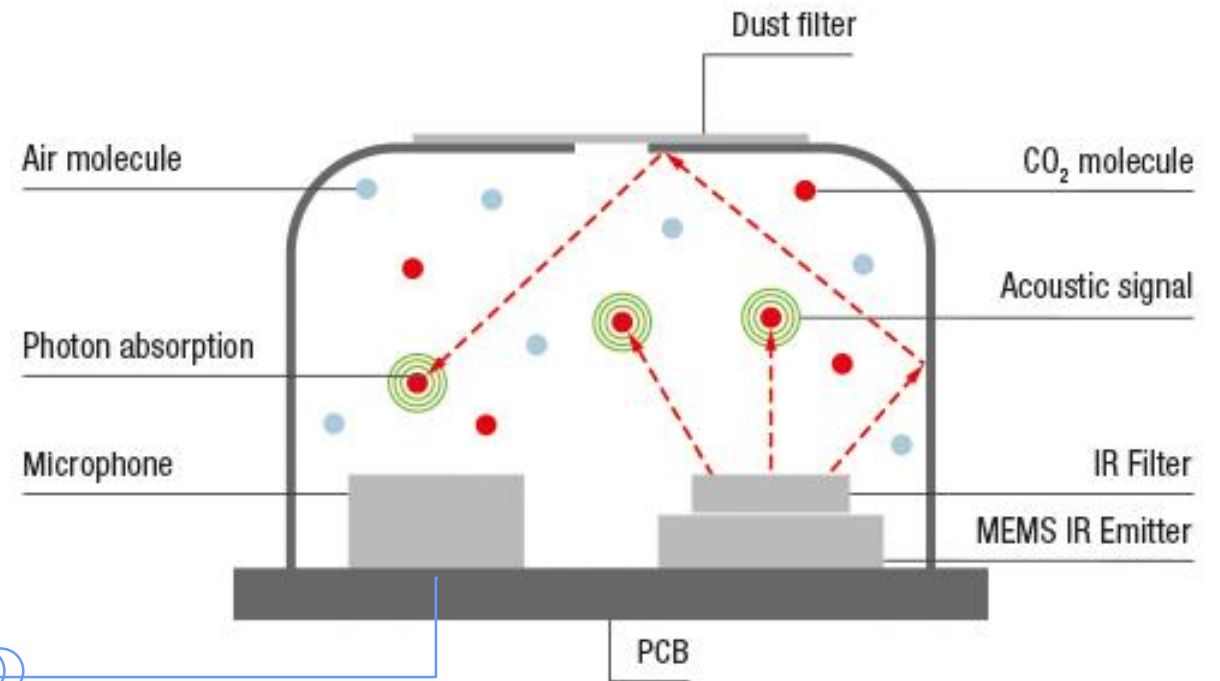
Photoacoustic Sensing Technology:

Photoacoustic measurement principle

- **Fast & Efficient IR emitter** excites CO_2 molecules
- Optical Absorption generates an acoustic wave
- CO_2 conc. proportional to **sound** amplitude



PA Sens[®] Technology



Photoacoustic sensing, a well established technology

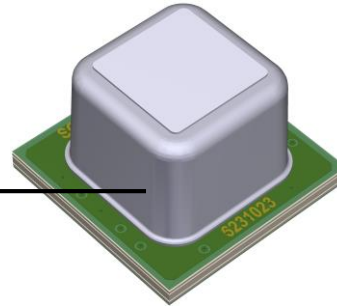


- Photoacoustic sensing principle established for several decades
- In the past reserved for expensive and bulky lab-scale instruments

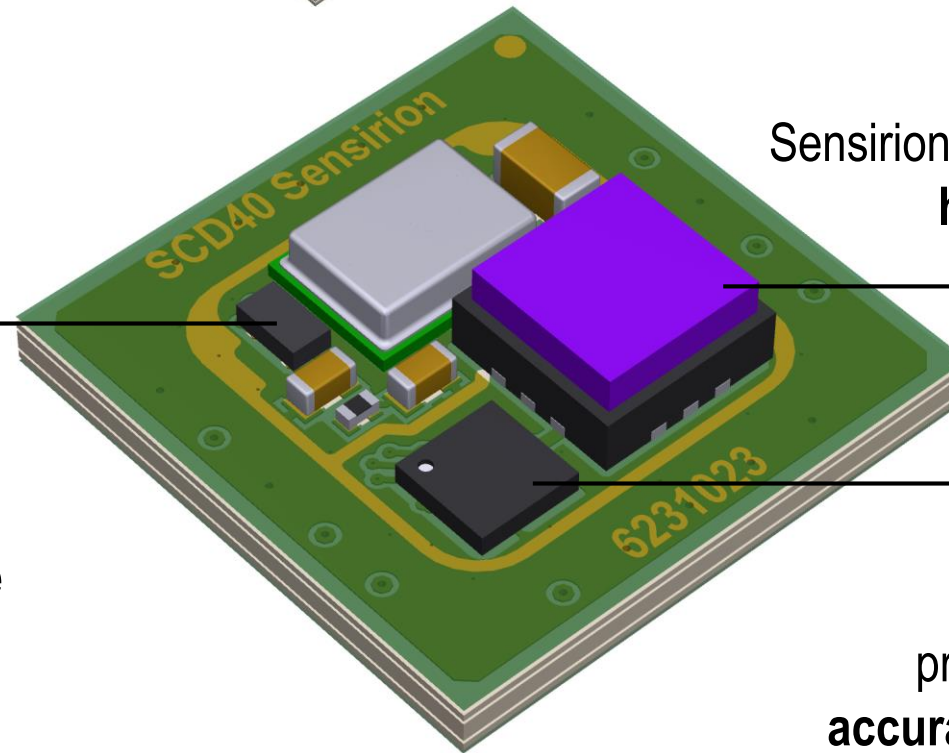


- Sensirion's MEMS and packaging expertise enabled miniaturizing CO₂ Sensors based on the photoacoustic sensing principle.
- Economy of scale and in-house key components

PA Sens® technology – competitive edge through innovation



Component protection through metal cap ensures **highest robustness against dust, condensation and mechanical impact**



Sensirion humidity and temperature sensor - Superior RH and T compensation to **realize accurate readings across entire RH and T range**

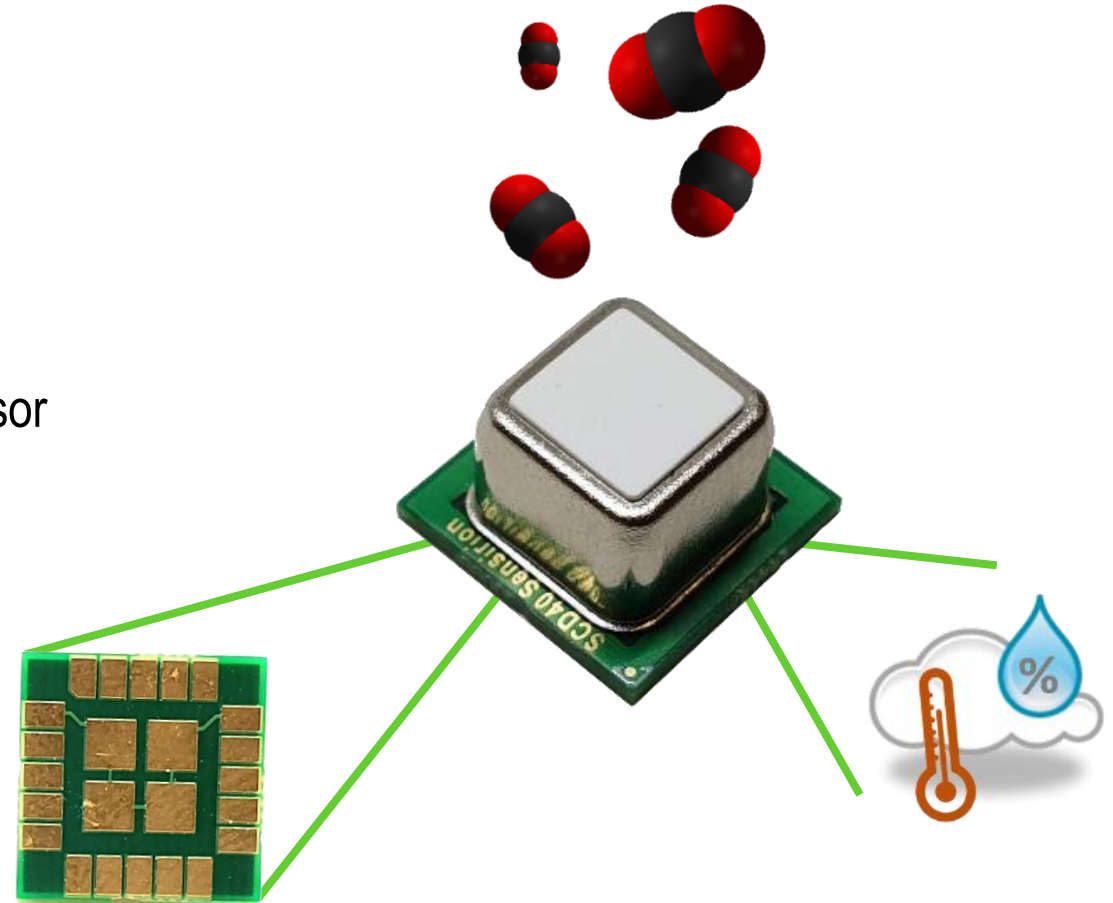
Sensirion MEMS IR emitter to realize **highest long-term stability**

Sensirion signal processor leverages advanced signal processing to ensure **highest accuracy and lowest noise level**

SCD40: A true game-changer for the CO₂ sensing market

A glimpse on SCD40 Features

- Smallest form factor: 10 x 10 x 7 mm³
- Outstanding CO₂ accuracy $\pm(30 \text{ ppm} + 3\% \text{ MV})$
- Integrated ambient temperature and humidity sensor
- SMD for cost and space-saving integration
- Cost-optimized BOM structure



Summary

- Photoacoustic sensing technology allows miniaturization without compromising on performance
- Based around Sensirion's innovative PASens® Technology, superb performance is combined with a high level of integration and a cost-effective BOM structure
- Braking the size barrier with SCD40 opens the pathway to a new CO₂ sensing cost regime
- SCD40 CO₂ sensor enables and inspires new applications and never seen design freedom

