

ICAD NO₂ / NO_x / NO Analyzer

PATENTED, FAST, ACCURATE AND DIRECT NITROGEN DIOXIDE DETECTION
ADDITIONAL NO_x / NO MEASUREMENT WITH CONVERTER (OPTIONAL)



Figure 1 ICAD 200-D series featuring 19" rack housing and OLED display.



Figure 2 ICAD 200-DM series features compact, waterproof housing for mobile field measurements.

The ICAD (*Iterative CA*vity enhanced *DOAS*) NO₂ / NO_x / NO measurement system uses direct optical absorption spectroscopy in the spectral range between ~ 430 to 465 nm. By measuring the absorption spectrum and applying the ICAD algorithm, the unique and characteristic absorption structure of NO₂ is directly identified and separated from other overlapping absorptions like water vapour (H₂O) or Glyoxal (CHOCHO). This gives the advantage of direct NO₂ measurements (in comparison to CLD) without interferences to other substances or the need of drying mechanism which introduce new interferences (e.g., CLD, CRD, CAPS).

As the ICAD system relies not on absolute intensities, but rather characteristic differential absorption structures, it has no absolute zero-point drift and is insensitive to

temperature variations, vibrations and light source degradation like other optical instruments. It is thus the perfect tool for accurate and precise long-term measurements, but also for mobile applications, especially where high precision and fast response times are required. An internal converter for NO to NO₂ (optional) based on gas phase titration (GPT) with a NO_x free O₃ source allows measuring also NO_x / NO with the same system (patent pending). The operation is simple as no consumable gases are required. Data display is directly available with any WiFi or LAN device.

Patents: EP3329251, US15/748,923, China patent pending

SPECIFICATIONS

Measurement range* ¹	0 - 5000 ppb	Cross sensitivity	None (from physical principle)
Limit of Detection (@ 30 s) * ¹	0.3 ppb	Power consumption	< 30 W, 12 V (typ.)
Precision (1σ @30s)	0.15 ppb or 2%	Start-up time	< 1 min
Detection of NO ₂	Direct (without converter)	Temperature range	-10 - 40°C
Detection of NO _x / NO	By conversion to NO ₂ (GPT)	Temperature sensitivity	< 0.01 ppb/ °C
Response Time (10% - 90%)* ²	2 s @ 1 l/min or 1 s @ 2 l/min	Weight	< 10 kg (adjustable)
Zero Drift	< 0.1 ppb/month ³	Dimensions	Waterproof: 40 x 40 x 14 cm ³ 19" Rack housing: 48.3 x 38 x 14 cm ³
Sample flow	0.5 - 2 l/min	Consumable gases	None
Calibration	„Intrinsically“ calibrated, no calibration gas needed	Other Gases	H ₂ O, CHOCHO, CO ₂ (optional)
Characterization of absorption path	With helium gas	Computer system	Internal embedded PC, with data analysis & measurement software
Mechanical stability	Insensitive to vibrations	Data communication	LAN / WiFi / Machine2Machine/ OPCUA; Bayern/Hessen (RS232); Analogue Voltage/Current output

COMMENTS:

*¹ Custom specifications with different measurement range are possible. By reducing the measurement range better precision and LOD can be achieved.

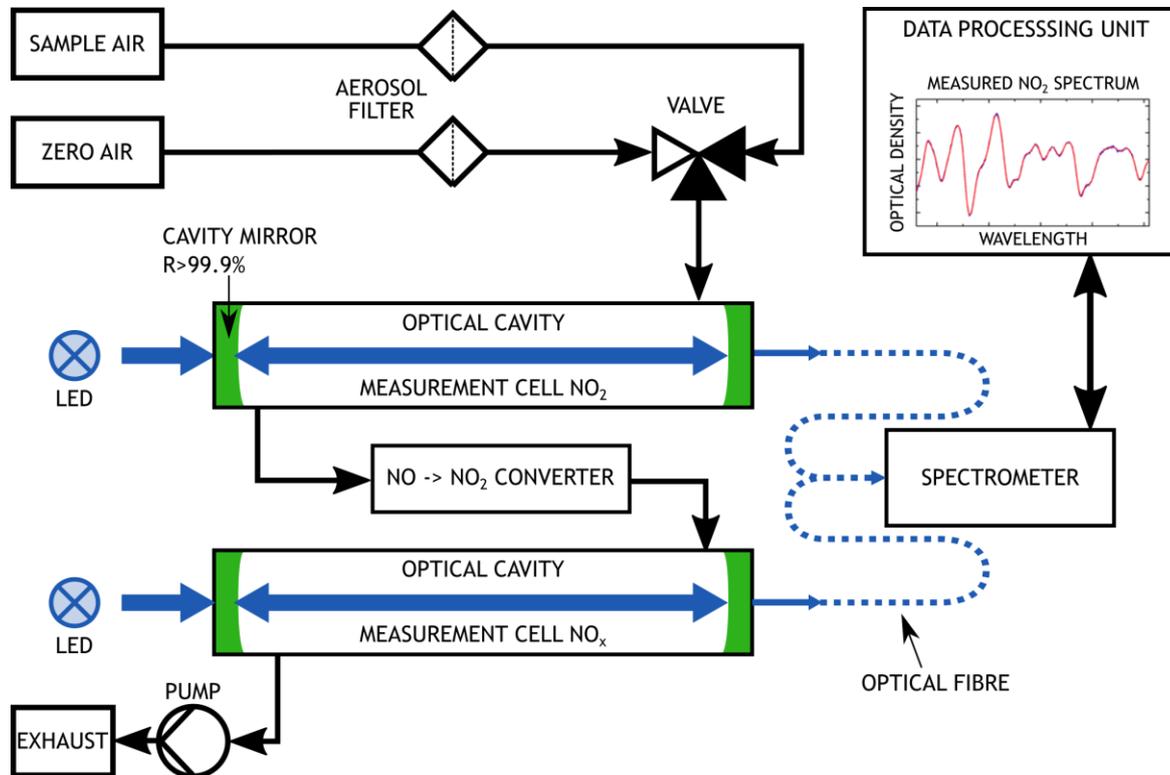
*² Response: Different measurement cell types are available, allowing different response times. Smaller measurement cells allow a much faster response time, but result typically in a lower precision.

*³ Upper limit. Drift is negligible due to regularly automated reference measurements.

APPLICATIONS

- High precision NO₂ / NO_x measurements (science, research, background air pollution monitoring)
- Urban air quality monitoring (outdoor, streets, tunnels, street canyons, mobile measurements)
- Indoor air quality monitoring
- Mobile, quick & precise NO₂ / NO_x pollution study, mobile personal exposure studies for workspace, pedestrians etc.
- Emission monitoring (e.g., stacks)
- Real Driving Emission Measurement of vehicles (RDE): requires extra CO₂ option to derive NO_x / NO₂ per km or kWh

THEORY OF OPERATION



Flow scheme and Measurement Principle of the ICAD NO₂ / NO_x / NO measurement system (incl. additional NO to NO₂ converter for NO_x measurement).

ADVANTAGES

BENEFITS

High measurement accuracy

INNOVATION

- Direct NO₂ measurement
- High sensitivity, low measurement error
- Measurement range adaptable
- No zero-point or calibration drift, 100% reproducibility
- No interferences
- No water dryer needed

Favourable initial and operating costs

- Parallel NO-Measurement (with converter)
- Simple and robust setup
- No consumables (e.g., gases)
- Long lifetime
- Fast response within seconds

Simple operation

- No calibration with gases
- High stability (not sensitive to shocks, vibration, temperature)
- Light weight
- Low power consumption and 12V operation
- Multiple Data Transfer Interfaces (Machine2Machine, RS232, Analogue Volt./Cur.)