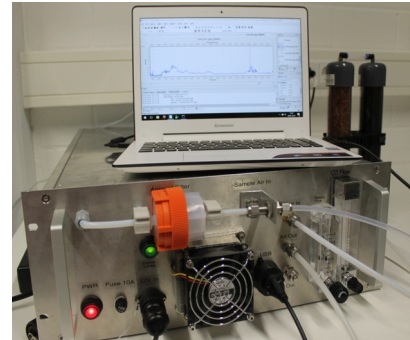


ICAD NO₂ / NO_x / NO Monitor

**Fast, accurate and direct
Nitrogen Dioxide Detection**

**Additional NO_x / NO measurement
with converter**



The ICAD (Iterative CAvity 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) (patent pending). 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. 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 allows measuring also NO_x / NO with the same system (patent pending). The operation is simple as no consumable gases are required.

PROPERTIES (TYPICALLY)

Measurement range * ¹⁾	0 – 5000 ppb	Cross sensitivity	None (from physical principle)
LOD (@ 2 s) * ¹⁾	0.2 ppb	Power consumption	< 30 W, 12 V
Precision (1σ @2 s) * ¹⁾	0.1 ppb or 2%	Start-up time	< 1 min
Detection of NO₂	Direct (without converter)	Temperature range * ⁴⁾	-10 – 45° C
Detection of NO_x / NO	By conversion to NO ₂	Temperature Sensitivity	None
Response Time NO₂ / NO_x (10% - 90%) * ²⁾	4 s @ 4 l / min / 10 s @ 4 l / min	Weight	< 10 kg (adjustable)
Zero Drift	None (from physical principle) <0.1 ppb / month	Size	Rackhousing: 6.7" x 19" x 24" waterproof PC: 7" x 16" x 25"
Sample flow	1 – 5 l/min	Consumable gases	None
Calibration	„Intrinsically“ calibrated, no calibration gas needed, only characterization of absorption path	Dryer	Not required
Characterization of absorption path * ³⁾	With Helium gas or optical methods (ICOM, IOK, NB-CRD)	Other Gases * ⁵⁾	H ₂ O, CO ₂
Calibration Drift	< 1% month	Computer system	Internal Embedded PC, with data analysis & measurement software
Mechanical stability	Insensitive to vibrations	Data communication * ⁶⁾	LAN / WLAN

Comments:

*¹⁾ Custom specifications with different measurement range are possible. By reducing the measurement range better precision and LOD can be achieved. Measurement range can also be increased with slightly lower precision and LOD.

*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⁾ Depends on the system which method is applied (patents pending)

*⁴⁾ Adaptable, if measurement requires different temperatures. Hot gas measurements possible with modifications.

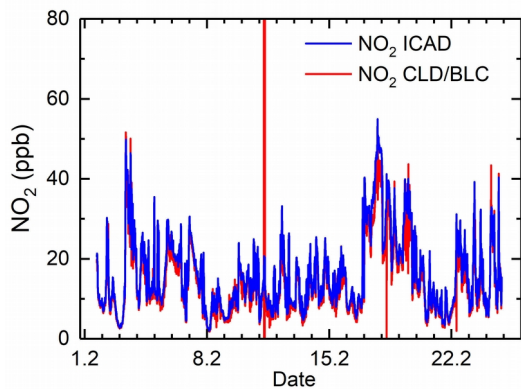
*⁵⁾ System measures also humidity (H₂O). System can be added with a CO₂ Sensor. ICAD instruments for other gases are under development.

*⁶⁾ Other data transmission is in principle possible (RS 232)

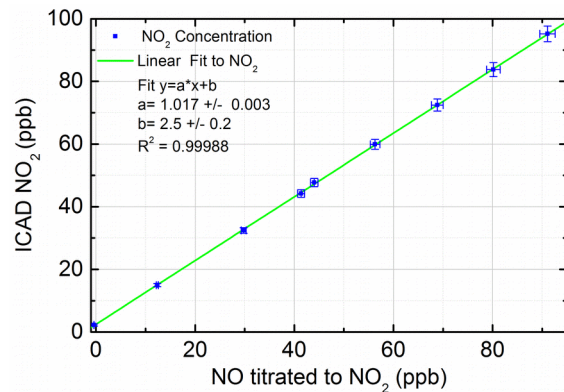
APPLICATIONS

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

EXAMPLE MEASUREMENTS



Field measurements of the ICAD NO₂ system in comparison to an ECO Physics CLD (770 AL ppt)



Comparison of ICAD NO₂ data to NO₂ produced from NO titration

ADVANTAGES

Benefits	Innovation
High measurement accuracy	<ul style="list-style-type: none"> • Direct NO₂ measurement • Low measurement error • Measurement range adaptable • No zero-point or calibration drift, 100% reproducibility • No interferences
Favorable initial and operating costs	<ul style="list-style-type: none"> • Parallel NO-Measurement (with converter) • Simple and robust setup • No consumables (e.g. gases) • Long lifetime • Fast response within seconds
Simple operation	<ul style="list-style-type: none"> • No heating time • No calibration with gases • High stability (not sensitive to shocks, vibration, temperature) • Light weight

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