



Series 2 **Air Server**

Option for UNITY 2



**A robust, cryogen-free solution for
round-the-clock on-line air monitoring**



Series 2 Air Server

Three-channel option for UNITY offering round-the-clock monitoring of vapour-phase organic chemicals in on-line air or gas streams.

Air Server for UNITY

The Series 2 Air Server module adds to any Series 2 (ULTRA-)UNITY system to allow a controlled flow of whole-air or gas to be introduced directly into the electrically-cooled focusing trap of the desorber. The combined system operates **cryogen-free** (to minimise running costs/maintenance), is fully automated and offers optimum analytical performance/sensitivity.

Key applications include:

- Continuous monitoring of **ozone precursors** (C₂ to C₁₀ hydrocarbons) in ambient air.
- On- or off-line **odour monitoring** e.g. measuring reduced sulfur species such as H₂S, mercaptans and sulfides in canisters, bags or on-line air streams at sub- to low-ppb levels.

- Monitoring trace ultra-volatiles with high global warming/ozone depletion potential (**greenhouse gases**).
- **Industrial process control** of gas purity and odour.
- **Atmospheric research**, e.g. global background pollution levels, pollution transport and kinetic studies, such as monitoring diurnal changes in urban air pollution or biogenic emission profiles.

Series 2 (ULTRA-)UNITY-Air Server systems connect to standard GC(-MS) technology and/or real-time process detectors.

The Air Server is available in a three-channel configuration, and is integrated with UNITY prior to shipment or during field installation. The combined system has a small footprint, minimising benchspace.

Low-cost, high-performance approach to on-line gas analysis

Air Server Main Features

- Adds **on-line air/gas monitoring** capability to any Series 2 (ULTRA-)UNITY thermal desorption (TD) system.
- **Cryogen-free** operation and low consumption of gas supplies for lower running costs and higher uptime.
- Three channels for sequencing between sample, zero and standard air/gas streams during **unattended on-line monitoring**.
- **Quantitative cryogen-free retention of ultra-volatiles**, such as acetylene from air/gas sample volumes up to 1.5 L, combined with peerless high-resolution capillary chromatographic performance, even under splitless conditions, ensure optimum sensitivity. Part per trillion (ppt) levels are readily detected.
- Series 2 UNITY-Air Server offers method-compliant **tube desorption capability** as standard, which can be automated by the addition of ULTRA.
- **Negligible sample carryover** plus versatile sampling flows and flexible splitting options allow analysis of both high- and low-concentration samples.
- **Small footprint**: Especially useful for installation in mobile labs.
- Versatile **water management** options for analysis of both dry and humid air/gas samples.

Overview of Air Server operation

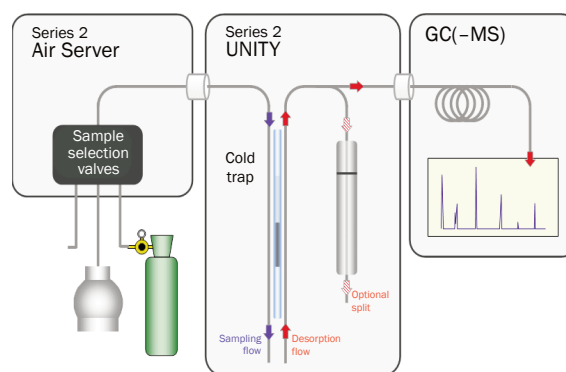
The Air Server module is available preconfigured with Series 2 (ULTRA-)UNITY, or as an add-on accessory. It contains three sample/stream selection valves uniquely configured to eliminate dead volumes and prevent carryover. The combined system is programmed to repeatedly introduce air/gas from the sample stream(s) and to automatically sequence calibration gas and zero air/gas at user-defined frequencies. Sequences may be recycled indefinitely to minimise system programming.

Each whole air/gas sample (pressurised or at (sub-)atmospheric pressure) is introduced directly into the electrically-cooled, sorbent-packed, focusing trap of the Series 2 UNITY thermal desorber for a user-specified sampling time. Conventional sorbent sampling tubes are not used in this process.

The sampling flow is regulated by an electronic mass flow controller (MFC) and pump located downstream of the trap to eliminate risk of contamination. Focusing trap sorbent and trapping temperatures are selected for quantitative retention of the compounds of interest and for selective purging of potential interferences such as CO₂ and water where applicable. No liquid cryogen is required and only inert, non-emitting components come into contact with the sample. All sampling parameters are monitored by system software as an integral part of the analytical method.

At the end of sample introduction, the flow path is purged with carrier gas to prevent carryover and eliminate oxygen from the focusing trap. The trap then heats rapidly in a reverse stream of carrier gas to inject/transfer retained compounds into the measurement system and trigger the analysis. This transfer/injection may be performed splitless for **maximum sensitivity** (see Series 2 UNITY brochure for more details).

Once the focusing trap has desorbed, it cools and re-equilibrates at the trapping temperature. Focusing of the next air/gas sample in the sequence may begin while analysis of the previous sample is ongoing, to optimise throughput.

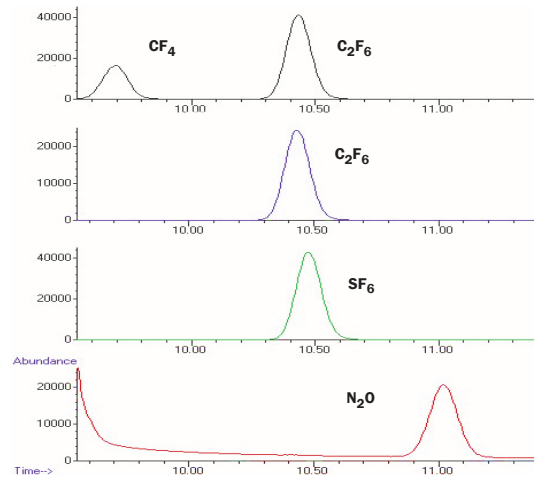


Schematic of three-channel Air Server operation



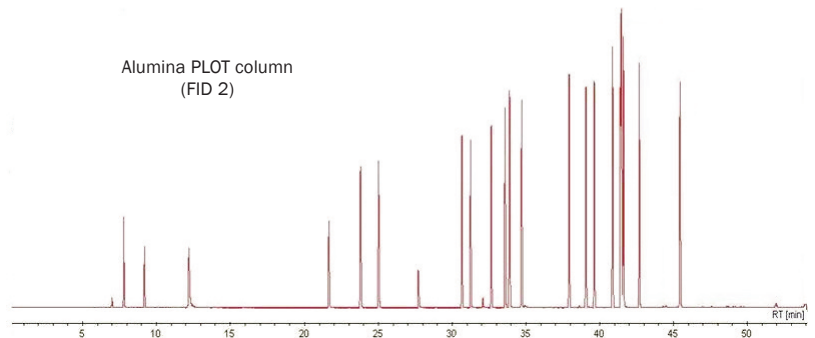
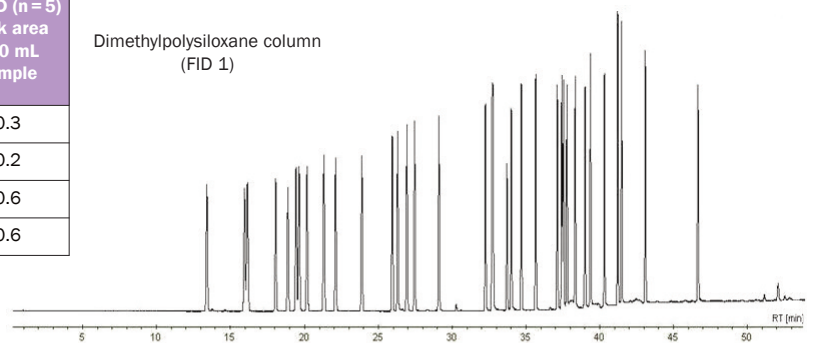
Applications

With unmatched cryogen-free retention of ultra-volatile target analytes and automated sequencing from three channels, Series 2 UNITY-Air Server offers the analytical performance and robust operation required for round-the-clock air monitoring in unattended field monitoring stations.



Greenhouse gases: Extracted ions 69 (black), 119 (blue), 127 (green) and 30 (red) from a full scan analysis of 25 mL of a 100 ppb gas standard

Compound	Detection limit (ppb) 500 mL sample	Column	%RSD (n=15) R_t 500 mL sample	% RSD (n=5) peak area 500 mL sample
Ethane	0.05	AI PLOT	0.04	0.3
Butane	0.03	AI PLOT	0.11	0.2
Hexane	0.03	DB1	0.01	0.6
Octane	0.03	DB1	0.01	0.6



Splitless desorption of 56-compound US EPA mix of ozone precursors using Series 2 UNITY-Air Server with dual column/dual FID GC with Deans switch

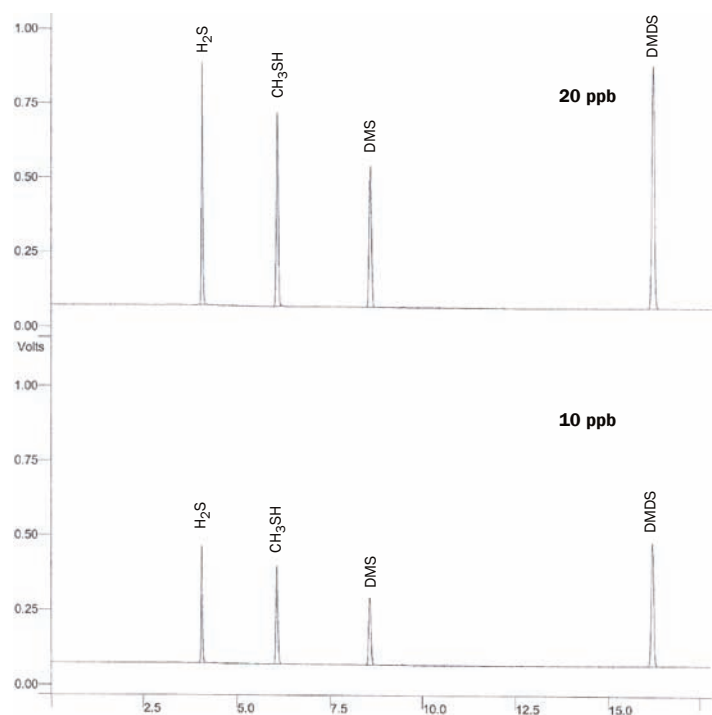
Round-the-clock, cryogen-free monitoring

Key applications include:

- Continuous monitoring of **ozone precursors** (C₂ to C₁₀ hydrocarbons) as required by European¹ and US² regulations (see Application Note 016).
- Monitoring ultra-volatile **perfluorinated compounds** and other species with high greenhouse gas and/or global warming potential (see Application Note 087).
- Monitoring **odorous sulfur compounds** in urban and industrial air (see Application Note 032).

1. Council Directive 96/62/EC: On ambient air quality assessment and management, and the daughter directive - 2002/3/EC relating to ozone in ambient air.

2. 1990 US Clean Air Act Amendment.



Compound	Minimum detection limit (ppb)	%RSD (n = 10, 20 ppb)
Hydrogen sulfide (H ₂ S)	0.15	4.1
Methyl mercaptans (CH ₃ SH)	0.15	1.8
Dimethyl sulfide (C ₂ H ₆ S)	0.15	0.8
Dimethyl disulfide (C ₂ H ₆ S ₂)	0.10	0.8

Data courtesy of ITC, South Korea



Field-proven, robust on-line monitoring of H₂S and other reduced sulfur compounds down to sub-ppb levels in ambient air using Series 2 UNITY-Air Server



Intuitive user interface

Series 2 Air Server control is intuitive and integrated with the Series 2 UNITY TD software to provide one comprehensive and easy-to-understand user interface. This offers a specific mode for on-line operation and, once selected, users are prompted to enter the relevant sampling parameters such as sampling time, flow rate and purge times.

Automated sequences for on-line monitoring are easily constructed using the sequence builder. Samples may be assigned individual desorption methods. Each sample is classified as sample, calibrant or blank, and all sequences may be stored and recalled for future reference or repeat use. Information associated with each analysis, such as the time, date and any deviations, are all recorded in the sequence reporter.

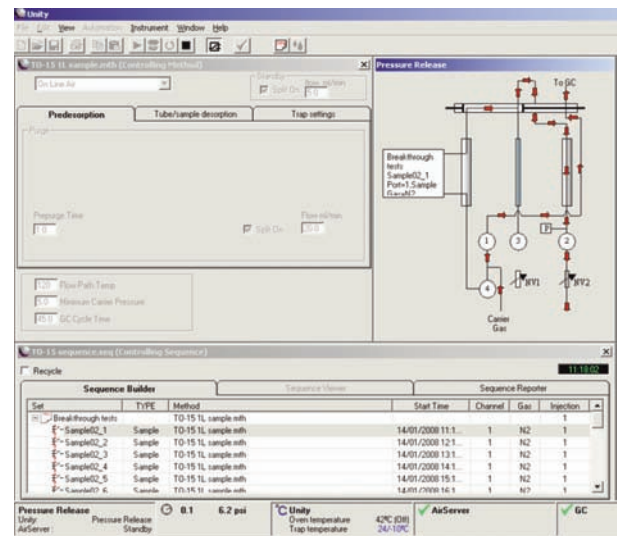
Air Server versatility

Unattended operation for extended periods

Cryogen-free operation and low consumption of gases simplify installation in mobile labs and offer extended periods of unattended operation in remote field monitoring stations. Markes' cryogen-free Series 2 UNITY-Air Server consumes only 40 mL/min dry gas/air when configured without a Nafion dryer and less than 200 mL/min when a dryer is configured. This means the duty cycle of every dry gas cylinder is 3-10 times longer with Series 2 UNITY-Air Server than it is with any other cryogen-free on-line air monitoring system.

Sensitivity

Quantitative retention of ultra-volatiles such as acetylene from up to 1.5 L air sample volumes combined with efficient splitless desorption at low (<2 mL/min) flows ensures best possible detection limits (typically 1-50 ppt levels).



Complete user interface screen

Reliably excellent chromatographic performance

Great resolution, stable retention times and repeatable concentration data minimise measurement uncertainty and simplify data interpretation/validation.

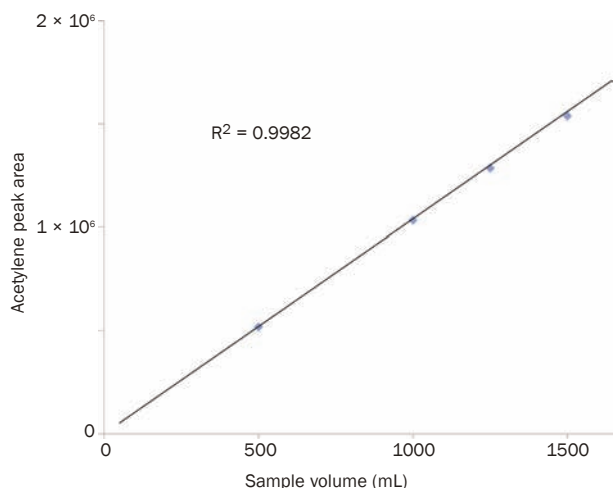
Small footprint

The Series 2 UNITY with integrated Air Server is only 22 cm (9") wide, making it suitable for installation in mobile laboratories.

Timed start

Series 2 UNITY-Air Server allows the start of a monitoring sequence to be programmed for a specific date and time, and for the period between each sampling cycle to be fixed. The sampling cycle used for ozone precursor monitoring, for example, is typically 1 hour. In this case air is usually sampled into the Series 2 UNITY focusing trap for 40 minutes of every hour starting on the hour.

Canisters, bags and sorbent tubes

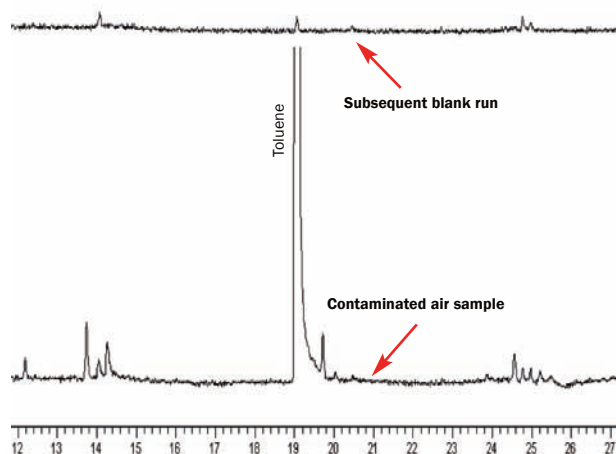


Cryogen-free trapping of ultra-volatile compounds including acetylene (ethyne) from up to 1.5 L of air

No sample carryover

The inert stream selection valves and narrow-bore flow path **minimise sample carryover** even when monitoring over a wide concentration range. This allows ambient air samples to be calibrated with small volumes of relatively concentrated standard gas. It also allows automated sequencing of samples varying widely in concentration over 2–3 orders of magnitude without fear of contamination.

Compatibility with samples over a wide concentration range is further enhanced by sophisticated, electronically-controlled sample splitting (2–500 mL/min) during trap desorption.



Negligible carryover with Series 2 UNITY–Air Server

On-line monitoring and tube desorption

All Markes' systems incorporating Series 2 Air Server technology offer complementary tube desorption. This can be further automated for high-throughput laboratories by the addition of an ULTRA autosampler (see accompanying brochures for Series UNITY and Series 2 ULTRA).

Measurement system

The majority of TD systems incorporating Series 2 Air Server technology are connected to standard or portable GC(–MS) systems. However, it is also possible to configure the system with real-time detector technology, either in parallel with the GC(–MS) or as an alternative to GC(–MS).

Most environmental monitoring applications require the resolution of capillary GC(–MS) because of the diversity and variability of organic vapour profiles that can occur in most atmospheres. However, for some industrial process applications or for monitoring well-characterised atmospheres (where the various failure modes are known), it can be advantageous to combine the on-line TD system with simpler real-time detection technologies – process MS, sensor arrays, infra-red, etc.



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