

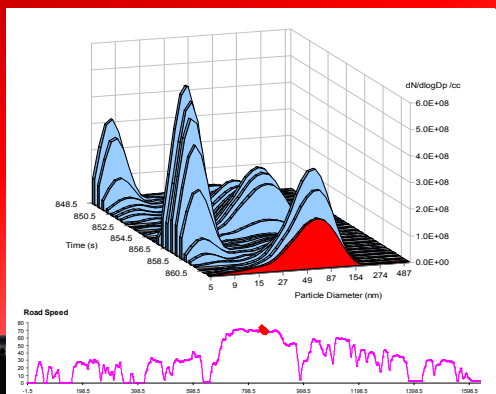


# DMS50 Fast Particle Analyser

Particle size, number and mass in real-time with mobile capability

## Key Features:

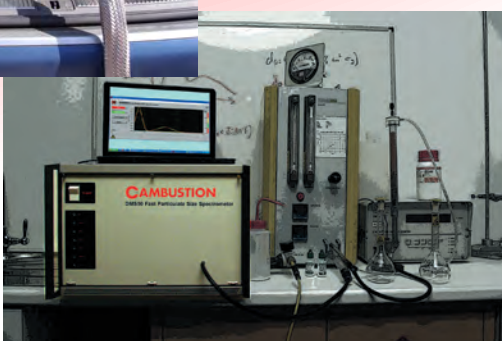
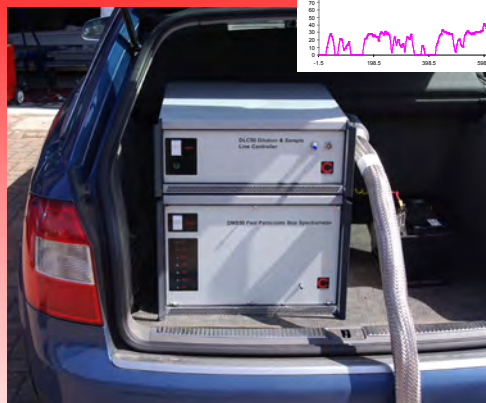
- Fast time response: 10 Hz data rate, 500 ms  $T_{10-90\%}$
- Size range: 5 – 560 nm
- 12 VDC/AC mains operation for mobile sampling
- Optional fully integrated 1- or 2- stage dilution, allowing direct engine exhaust sampling
- Separation of aerosol modes for “PMP” solid particle number correlation
- Ideal for dilution tunnel, mobile, ambient / drive-by or laboratory aerosol measurements



## Introduction

The Cambustion DMS50 offers real-time measurement of aerosol particle number, mass and the full size spectrum from 5–560 nm, with a data rate of 10 Hz and a  $T_{10-90\%}$  response time of 500 ms. Suitable for test cell or laboratory use; mains or 12 VDC operation (along with fully integrated dilution options and data logging ability) make it ideal for mobile use. It is available in three configurations:

1. Without dilution, suitable for ambient or dilute laboratory aerosol work.
2. With fully integrated internal rotating disc diluter, for engine sampling from a dilution (CVS) tunnel or concentrated laboratory aerosol sampling.
3. As option 2, but with the DLC50 (Dilution and Line Controller) accessory box, which provides metered compressed air primary dilution and controls a heated sampling line. This configuration allows direct sampling from an engine exhaust, pre- or post- aftertreatment.



**CAMBUSTION**

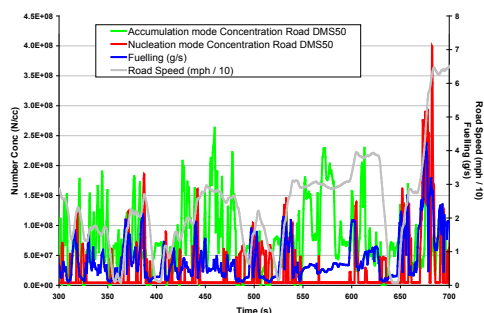
## Applications

### Raw, Mobile Engine Exhaust Sampling

The DMS50 with the DLC50 accessory and heated sample line makes mobile aerosol measurements easy. With the addition of a deep-cycle battery, split-charger and the supplied laptop, measurement of the particle number, mass and size spectrum directly from the vehicle's exhaust (pre- or post- aftertreatment) is possible during real-world driving.



An optional mobile 19" rack is available to contain the DMS50 and DLC50, or they can be used free standing. The DMS50 can act as a 4-channel data logger for external signals. In the example below, road speed and fuelling are logged alongside particle number by the instrument:



Mains→12 V “hot swap” allows for heated line warm-up on AC power to increase battery life.

### Automotive Test Cell Use

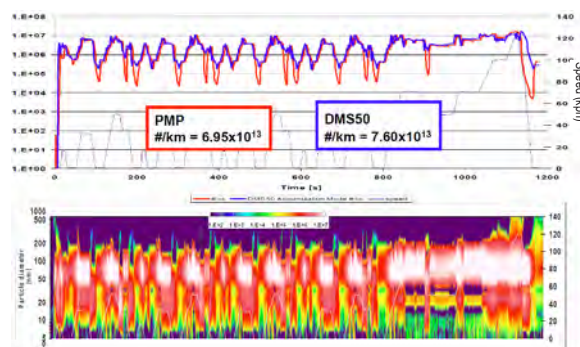


The DMS50 is 19" rack mountable and adds fast response particle number, mass and size capabilities to your analysis suite, complementing existing gas instrumentation for engine calibration applications. The sample inlet can be re-configured to the rear of the instrument, and all that is required in addition is the power lead, computer connection via Ethernet and flexible, electrically conductive tubing (available from Cambustion, 10mm o.d.) to connect to your CVS system. An internal HEPA filter provides an automatic zero check, and there is an internal inlet cyclone.

Four analogue inputs and four analogue outputs are available; the software can perform highly configurable real-time calculations with these e.g. to calculate specific emissions

if tunnel flow / vehicle speed signals are provided. A digital remote input allows for control of many instrument functions by a test cell. The dilution ratio may be set via an analogue input if required.

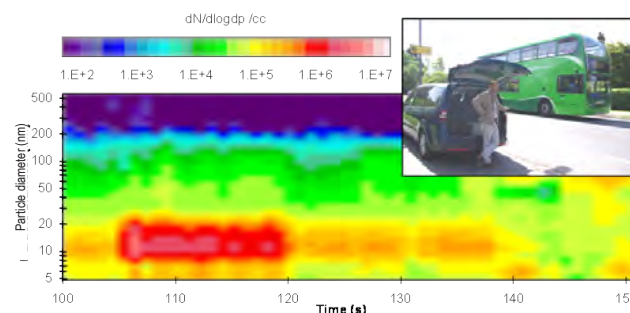
The unique real-time “lognormal fit” splits the aerosol spectrum into constituent modes. This can be used to separate the accumulation mode from the volatile mode, to give absolute correlation with the “PMP” solid particle number metric proposed for forthcoming emissions legislation, as shown below:



(Note that in this example the concentration range is shifted above the minimum sensitivity because the rotating disc diluter was used)

The DLC50 accessory can provide raw exhaust sampling capability in a test-cell. This is useful for engine-out emissions measurement, and DPF efficiency or regeneration behaviour characterisation.

### Roadside Sampling

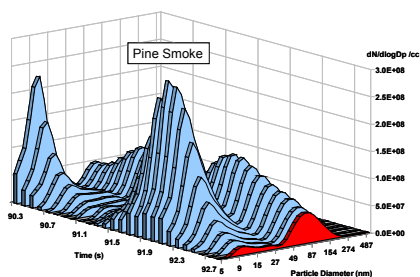


Twelve volt operation of the DMS50 makes it easy to set up a mobile laboratory in any vehicle for roadside monitoring. The digital trigger output can be used to operate a camera to record vehicles exceeding a certain concentration threshold. Scheduled and programmed operation allows unattended file logging and operational sequences.

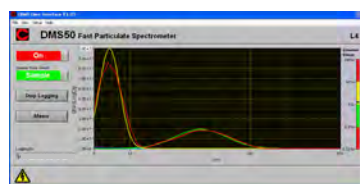
### Ambient / Laboratory Aerosol Sampling

The DMS50 is in use for occupational ambient aerosol sampling. Its fast response time allows quick and accurate measurement of rapidly changing aerosol sources, for example wood or tobacco smoke, or pyrotechnics in situations

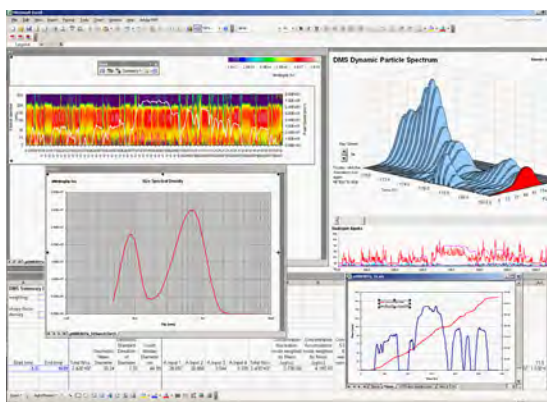
where slow scan instruments would lead to spectral smearing or failure to correctly resolve peak concentrations:



## Software and Data Handling

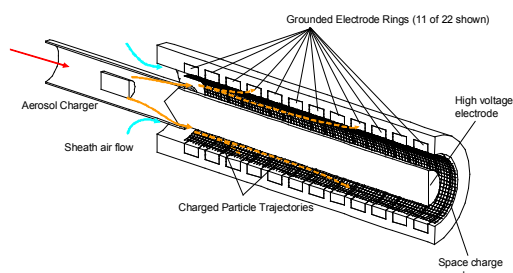


The instrument is controlled by a laptop connected via an Ethernet interface. A 34-channel size spectrum is produced alongside the bimodal lognormal parameterisation. Data files are plain text and can be opened with most data processing packages, including MS Excel and Matlab. A freely-distributable set of data presentation macros for Excel allow easy generation of spectral animations, contour plots and summary snapshots of data:



## Operating Principles

The DMS50 is based upon the patented technologies introduced with the DMS500 Transient Engine Particulate Analyser in 2002, housed in a compact enclosure with integrated sample pump.



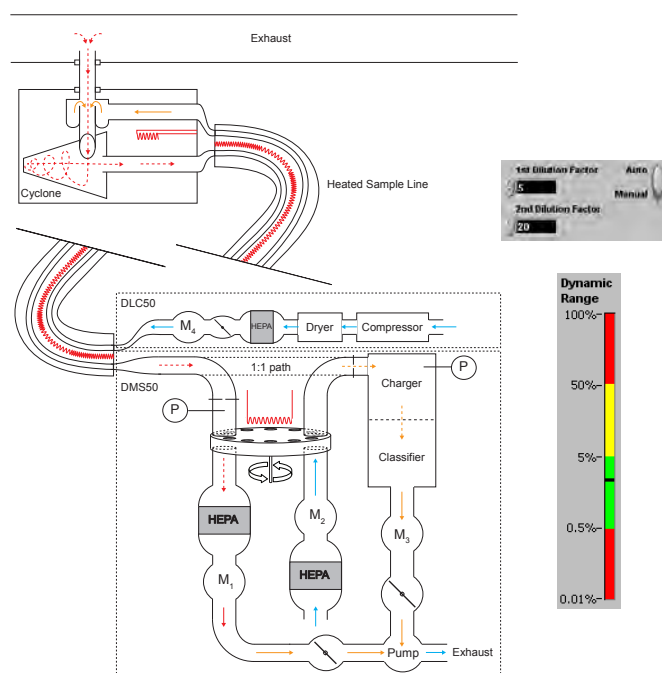
Particles enter a unipolar diffusion charger where they gain a controlled amount of charge, and then pass into a classification column where they are carried by a sheath flow

of air. A central high voltage electrode provides an electric field which deflects the particles so that they land on any of 22 detection electrometer rings and cause a current to be registered. Software algorithms then combine this electrical mobility measurement with the charging model to produce a size spectrum. Each instrument is traceably calibrated for size and number with real aerosols (e.g. NIST certified PSL spheres, DMA selected NaCl/H<sub>2</sub>SO<sub>4</sub>/soot) before dispatch.

## Dilution and Sampling System

The DMS50 is available with or without an internal rotating disc diluter. This allows the concentration of aerosol to be brought within the measurement range of the instrument. The diluter is of a through-flow design for better scavenging and to reduce losses. Ambient air is drawn from a port at the rear of the instrument and filtered. The rotating disc adds pockets of concentrated aerosol to this clean stream, before entering the classifier. In this configuration both diluter and classifier performance are independent of sample flow fluctuations.

The performance of each instrument's diluter is quantified and losses corrected for. The dilution factor is simply selected from the instrument's user interface and the data is automatically corrected; a range indicator provides guidance as to the optimum level of dilution to use.



For direct engine sampling, the optional DLC50 accessory provides compressed air dilution at the point of sampling (to eliminate condensation, and reduce agglomeration) and provides the power for a heated sampling line. When the DLC50 is used, the rotating disc diluter and sample entry to the classifier within the main DMS50 unit are also heated.



The DLC50 requires no external air supply, contains an air dryer, and is operable from 12 VDC. The primary dilution system is designed to respond rapidly to transients in flow caused by exhaust pressure fluctuations. The air flow meter is matched with the internal sample flow meters of the DMS50 for accurate dilution.



## Maintenance

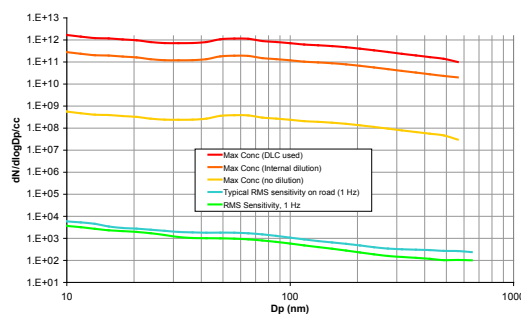
The classifier, rotating disc diluter and cyclone are all accessible from the drop down front panel for cleaning when necessary, as is the sample HEPA filter. Cleaning the classifier takes around 10 minutes (tool provided), and diligent use of the dilution system greatly minimises the cleaning frequency.

## DMS50 Main Unit Specifications:

Size range	5 nm – 560 nm
Spectral output	16/decade (34 classes) & bimodal lognormal
Data rate	10 Hz – 1 sample per min
T <sub>10-90%</sub> time response	500 ms
Sample flow (0 °C, 1 atm)	3–13 slpm (with diluter) ~ 6.5 slpm (without diluter)
Transient sample pressure fluctuation tolerance	±500 mbar (with diluter) ±50 mbar (without diluter)
Classifier pressure	800 mbar absolute
Internal dilution factor range (optional)	5–500
Max internal diluter heater temperature	70 °C (only with DLC connected)
Analogue inputs	4, differential ±10 V, int. or ext. referenced
Analogue outputs	4, 0–10 V, int. or ext. referenced. Output of any parameter or weighting
Remote control	25-way D connector, TTL signalled. Trigger output.
Operating temperature	0–40 °C
Communications protocol	UDP over Ethernet
Remote Control	AK protocol
Classification method	Electrical mobility
Charger type	Unipolar diffusion
Detection electrometers	22
Calibration interval	12 months
Warranty period	12 months (extendable)

Mass sensitivity	~2 µg m <sup>-3</sup> (60 nm accumulation mode)
Power supply	110/220 VAC 50/60 Hz or 12–14 VDC auto-switching
Power consumption	400 W maximum 280 W typical with diluter 250 W typical without diluter
Dimensions	44.5 w × 52 d × 31 h cm (19" × 7 u)
Weight	37 kg (without diluter) 40 kg (with diluter)

## Dynamic Range / Sensitivity:



## DLC50 and Heated Sample Line Specifications:

Primary Dilution Factor Range	1–6 (5 recommended)
Air Supply	Internal compressor and dryer (or external supply @ 2 bar)
Heated sample line length	5 m standard, or as required
Max line temperature	100 °C
Power supply	110/220 VAC 50/60 Hz or 12–14 VDC auto-switching
Maximum power consumption	700 W
Dimensions (DLC)	44.5 w × 54 d × 19 h cm (19" × 4 u)
Weight (DLC)	22 kg
Max Sample Temperature	800 °C

Key features of the DMS50 classifier are protected by Cambustion patents: GB2,374,671 (2003), GB2,378,510 (2003) and US6,828,794 (2004).

All specifications subject to change without notice

For more information and application notes, please contact:

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