

SCANNING MOBILITY PARTICLE SIZER™ SPECTROMETER (SMPS™) MODEL 3938

HIGHLY ACCURATE, REAL-TIME NANOPARTICLE
SIZING SYSTEMS YOU CAN RELY ON FOR YEARS

The TSI SMPS™ spectrometer is a standard for counting and sizing nanoparticles in air. The method is described in the ISO standard 15900:2009 and hundreds of scientific publications from national metrology institutions and other leading academic and industrial researchers. The results are independent of the refractive index of the solid or liquid aerosol, and have a high degree of absolute sizing accuracy and measurement repeatability. TSI's Model 3938 is the 3rd generation of SMPS; trusted by researchers for over 30 years.



Features and Benefits

- + High resolution nanoparticle sizing with discreet size channels and single particle counting
- + Independent of optical properties of the aerosol
- + Wide size range: from 1 nm to 1,000 nm depending on configuration
- + High resolution data: up to 128 channels/decade
- + Dynamic concentration range up to 10^7 particles/cm³
- + Fast measurements: <10 second scans
- + Component design for maximum flexibility with a selection of 5 CPCs, 3 DMAs and traditional or non-radioactive neutralizer
- + Easy setup with tool-less installation and auto discovery of components
- + ISO 15900:2009 compliant
- + PC or Touch screen control†

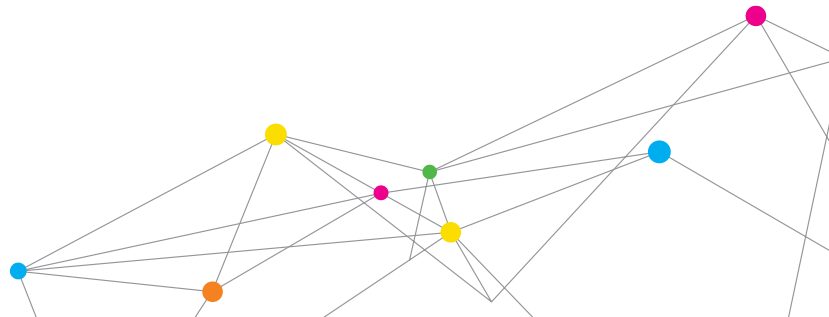
Applications:

The Model 3938 is used for a wide variety of applications, a few of which are listed below.

- + Environmental monitoring and atmospheric research
- + Nucleation and new particle formation studies
- + Combustion and engine exhaust studies
- + Indoor air quality measurements
- + Inhalation toxicology studies
- + Nanomaterial research and synthesis



UNDERSTANDING, ACCELERATED



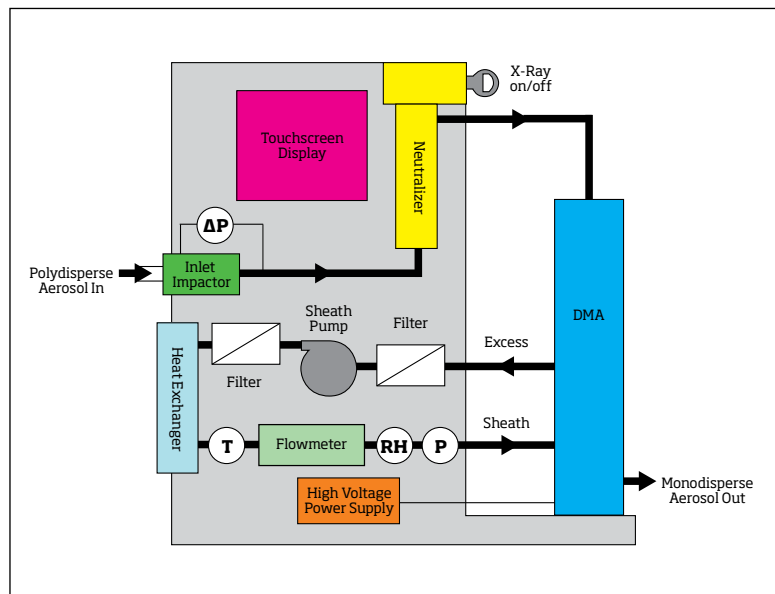
PROVEN TECHNOLOGY FOR HIGHLY RESOLVED PARTICLE SIZING

Sizing Nanoparticles with Differential Mobility Analysis

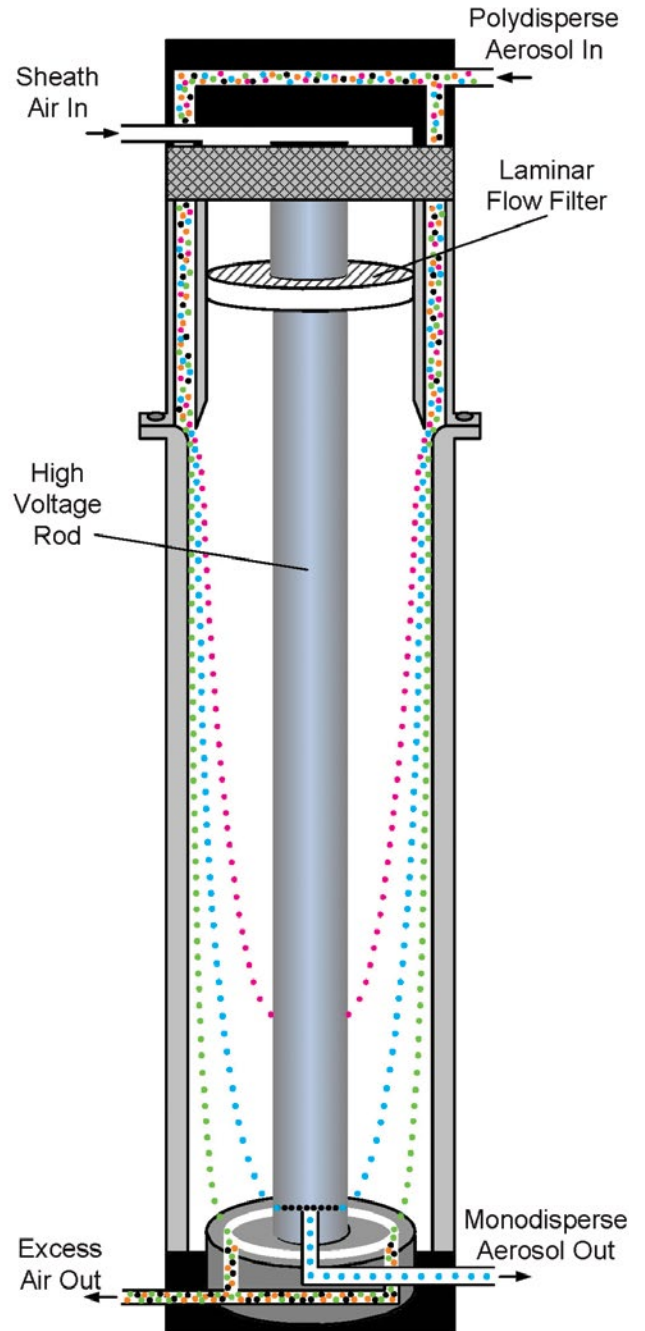
This method is based on the physical principle that the ability of a particle to traverse an electric field (electrical mobility) is fundamentally related to particle size – no size calibration is necessary (first principle measurement).

TSI's Scanning Mobility Particle Sizer™ Spectrometer (SMPS) measures the size distribution and concentration of particles in the size range of 1 nm to 1 μm using differential mobility analysis. In a Differential Mobility Analyzer (DMA), an electric field is created and the airborne particles drift in the DMA according to their electrical mobility. Particle size is then calculated from the mobility distribution. Rigorous peer reviewed uncertainty analyses have been performed indicating TSI's DMA has a sizing uncertainty of approximately <2%.

This method is described in the ISO 15900:2009 guidelines and TSI's SMPS and DMAs comply with this standard.



The technology used in the SMPS Spectrometer is protected by US Patents 4,790,650 and 5,118,959



A BROAD RANGE OF OPTIONS TO MEET YOUR MEASUREMENT NEEDS

Differential Mobility Analyzers (DMAs)

DMAs are the core of the SMPS, selecting monodisperse size fractions of the nanoparticles to be quantified in the CPCs. The Electrostatic Classifier 3082 identifies the attached DMA model automatically.



+ Long Differential Mobility Analyzer Model 3081A:

This classic DMA has been relied upon by aerosol researchers for over 40 years. Data from the DMA Model 3081A is well known to be precise, repeatable, and comparable to results measured by the luminaries in the field of aerosol science.

+ Nano Differential Mobility Analyzer Model 3085A:

Improves size resolution over the particle size range of 2.5 - 150 nm and also features increased nanoparticle transmission efficiency through the DMA.

+ 1nm Differential Mobility Analyzer Model 3086:

Expands high resolution measurements down to 1 nm. Optimized for minimal diffusion losses and improved resolution over the size range of 1-50 nm.

Aerosol Neutralizers

The neutralizers utilize bipolar diffusion charging to bring the aerosol to a defined, steady-state charge distribution.

+ The traditional ⁸⁵Kr neutralizers have been used in the industry for decades. (Model 3077A)

+ The **Advanced Aerosol Neutralizer**: Provides a nonradioactive option, and features virtually identical sizing to radioactive sources when used in a sizing system with built-in power from the classifier for easy integration. (Model 3088)

Software

Aerosol Instrument Manager® Software for SMPS is an easy-to-use tool to control the hardware settings, collect, visualize and export the data.

Condensation Particle Counters (CPCs)

CPCs are the single-particle counters used in SMPS to quantify the nanoparticles in each monodisperse size fraction classified in the DMA.



TSI's first CPC was released 1968. Today TSI has 5 SMPS-compatible CPCs to match the application's need.

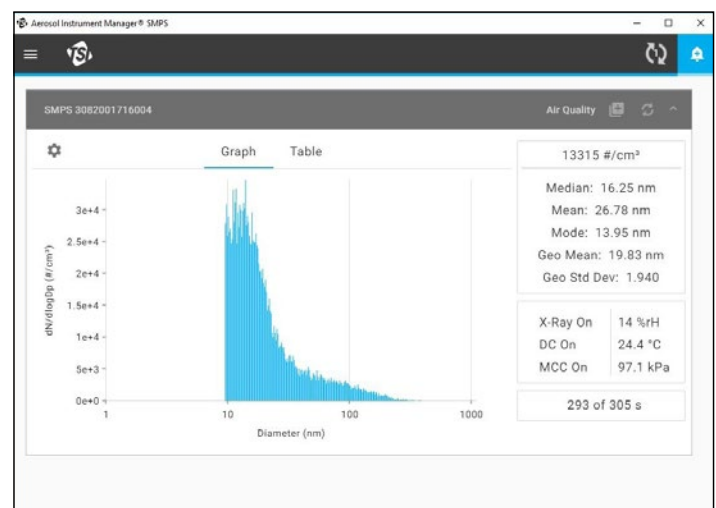
+ **Butanol CPCs**: The 4th generation features extended single particle counting range superior data accuracy and signal control for measuring particles down to 2.5 nm.

+ **Water-based CPCs**: deliver accurate concentrations of particles in gases while making use of safe, eco-friendly and easily available distilled water. The 3rd generation has a selectable cut-off particle size and can detect particles down to 1.x nm.



+ 1 NM CPC

The Nano Enhancer (NE) Model 3757 uses diethylene glycol as a working fluid to allow the growth of particles from 1 nm. Paired with the Model 3750 CPC, the 1nm CPC system can measure concentrations up to 300,000 particles/cm³.



SPECIFICATIONS

SCANNING MOBILITY PARTICLE SIZER MODEL 3938

Refer to separate product sheets for descriptions and specifications of individual components

SMPS Settings and Requirements

Aerosol Flow Rate 0.2 to 5 L/min, user-adjustable
 Sheath Flow Rate 2 to 30 L/min, user-adjustable
 Working Fluid n-butyl alcohol (butanol), distilled water, diethylene glycol (depends on CPC)

Operating and Aerosol Inlet

Temperature 10 to 40°C
 Humidity 0 to 90%, noncondensing
 Pressure 70 to 125 kPa

DMA Voltage - Negative Standard

308202 Dual voltage version optional; included with 3938E57, 3938EL57, 3938E89, 3938EL89

Data Acquisition

Internal memory for up to two weeks or continuous via with PC.

Aerosol Neutralizer Options - Ordered Separately

3077 74 MBq (2 mCi), ⁸⁵Kr 1/2 life 10.8-year
 3077A 370 MBq (10 mCi), ⁸⁵Kr 1/2 life 10.8-year
 3088 Soft X-ray <9.5 keV ~8,760 operating hours
 6005931 Lead shielding column for 3077/3077A

Accessories

3772200 Environmental Sampling Inlet

Communication Interfaces

Embedded touch-display.
 RS-232 for CPC to Classifier.
 USB, and Ethernet for Classifier to PC.
 USB type B for external memory drives

Included Accessories

Set of three single-stage, inlet impactors.
 Conductive tubing.
 Flow equalizer.

Power Requirements

3750 CPC 200 W
 3752/6/7 335 W
 3789 WCPC 200 W
 3082 200 W

Dimensions (HWD/Weight)

3081A 61 × 8 × 8 cm / 5.4 kg
 3085A 21 × 10 × 10 cm / 2.2 kg
 3086 19 × 10 × 10 cm / 2 kg
 3082 40 × 28 × 40 cm / 14.2 kg
 3750 27.5 × 18.3 × 29.9 cm / 6.6 kg
 3752 30.0 × 30.3 × 34.3 cm (9.1 kg)
 3756 30.1 × 28.1 × 35.4 cm (9.1 kg)
 3757 33.2 × 28.1 × 36.3 cm (9.1 kg)
 3789 31 × 18 × 40 cm / 8 kg

CPC Working Fluid	Particle Size Range (nm)	Model #	CPC	DMA
Butanol	10* to 1,000	3938L50	3750	3081A
		3938L52	3752	
		3938L56	3756	
	2.5 to 150	3938N56		3085A
	4 to 50 and 10* to 1,000	3938NL52	3752	3085A and 3081A
2.5 to 50 and 10* to 1,000	3938NL56	3756		
Diethylene Glycol and Butanol	1 to 50	3938E57	3757-50	3086
	1 to 50 and 10* to 1,000	3938EL57		3086 and 3081A
Water	10* to 1,000	3938L89	3789	3081A
	2.5 to 150	3938N89		3085A
	2.2** to 50	3938E89		3086
	2.2** to 50 and 10* to 1,000	3938EL89		3086 and 3081A

Concentration range: 1 to 10⁷ particles/cm³. The upper end of concentration specification is determined by Aerosol Neutralizer's specifications

Measurement time: <10 to 300 s selectable

Particle resolution: up to 128 channels per decade

Number of total size channels varies by configuration; spans over 200 channels from 1 nm to 1,000 nm collectively. SMPS model# consists of the series ID ('3938'), followed by the letter identifying the DMA model ('L', 'N', 'E', 'NL', 'EL') and the last two digits of the CPC model (37XX).

Specifications reflect typical performance and are subject to change without notice.

Aerosol Instrument Manager, TSI and the TSI logo are registered trademarks, and Scanning Mobility Particle Sizer and SMPS are trademarks of TSI Incorporated.

* Low end of particle size range determined by DMA Model 3081A specifications.

** Lower end of WCPC in standard configuration is 2.2 nm (sucrose aerosol). Cut-off particle size can be adjusted by customer to lower values.

† Computer needed for 1nm SMPS



UNDERSTANDING, ACCELERATED

TSI Incorporated - Visit our website www.tsi.com for more information.

USA Tel: +1 800 874 2811 **India** Tel: +91 80 67877200
UK Tel: +44 149 4 459200 **China** Tel: +86 10 8219 7688
France Tel: +33 1 41 19 21 99 **Singapore** Tel: +65 6595 6388
Germany Tel: +49 241 523030