

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

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

TSI's SMPS™ spectrometer is widely used as the standard for measuring airborne particle size distributions. This system is also routinely used to make accurate nanoparticle size measurements of particles suspended in liquids. The National Institute of Standards and Technology (NIST) uses a TSI DMA to size 60 nm and 100 nm standard size reference materials. SMPS spectrometer sizing is a discrete technique in which number concentrations are measured directly without assuming the shape of the particle size distribution. The method is independent of the refractive index of the particle or fluid, and has 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.



## Applications:

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

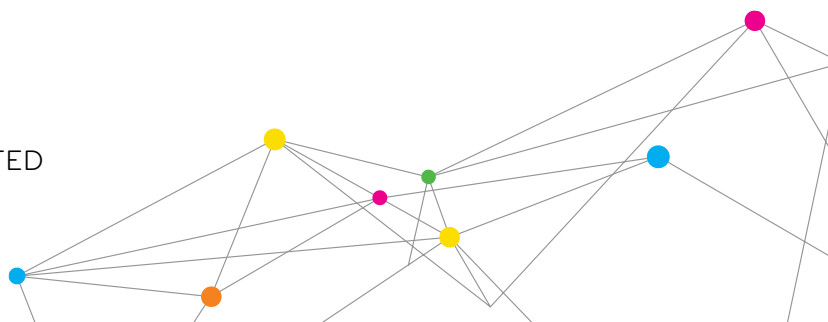
- + Nanotechnology research and materials synthesis
- + Atmospheric studies
- + Environmental monitoring
- + Combustion and engine exhaust studies
- + Indoor air quality measurements
- + Nucleation/condensation studies
- + Inhalation toxicology studies

## Features and Benefits

- + High resolution data: up to 192 channels
- + Broad size range: from 1 nm to 1,000 nm
- + ISO 15900:2009 compliant
- + Fast measurements: <10 second scans
- + Wide concentration range up to  $10^7$  particles/cm<sup>3</sup>
- + Component design for maximum flexibility
- + Touch screen control with no computer needed for operation†
- + Easy setup with tool-less installation and auto discovery of components
- + Discreet particle measurement: works well for multi-mode samples
- + Independent of optical properties of the particles and fluid
- + Wide range of system options: choice of water or butanol CPC; choice of traditional or non-radioactive neutralizer; long, Nano or 1 nm DMA



UNDERSTANDING, ACCELERATED

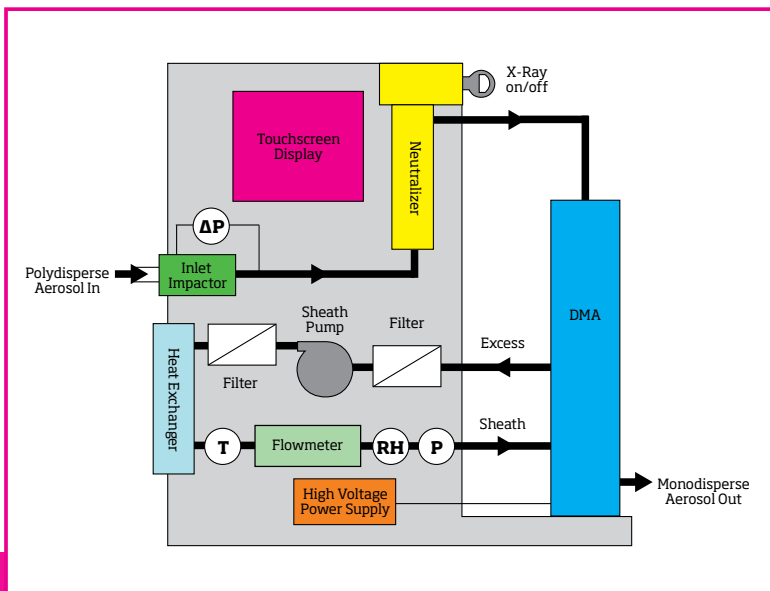
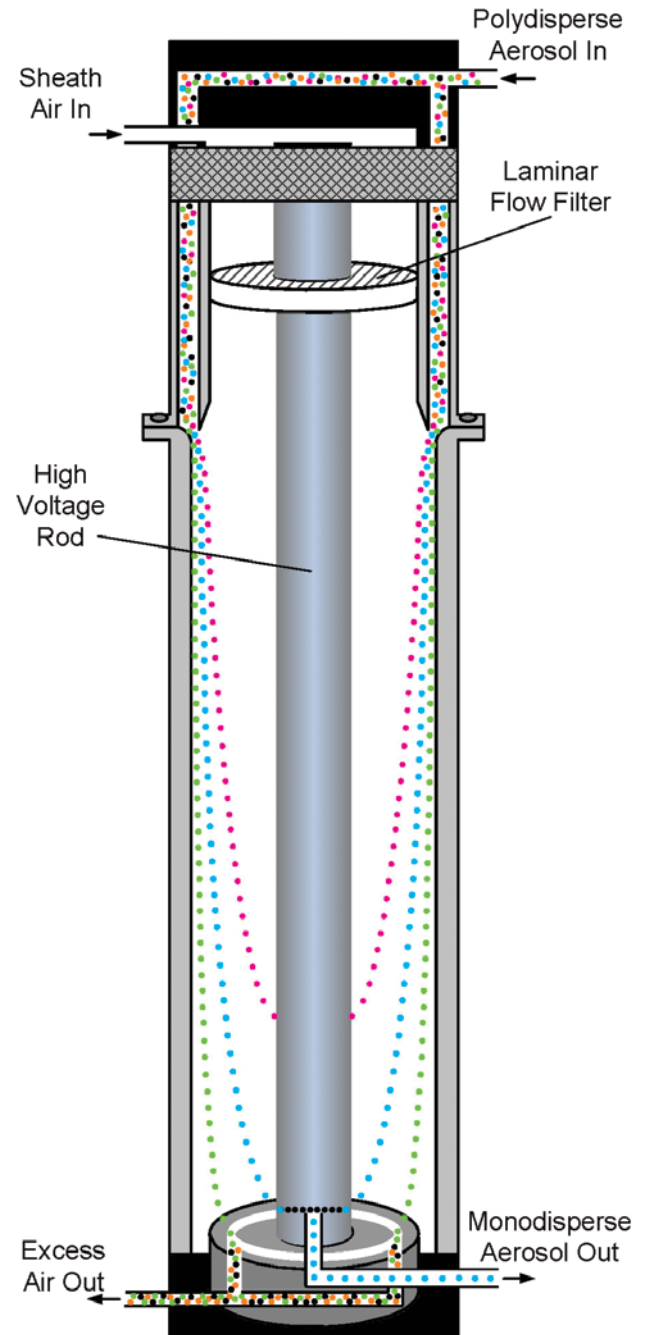


# PROVEN TECHNOLOGY FOR HIGHLY RESOLVED PARTICLE SIZING

## Differential Mobility Analysis

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. 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). 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. This method is independent of the particle zeta potential.

Sizing limitations of surface techniques include low sample sizes (non-representative), image edge definition problems, 3D to 2D image distortion, and operator bias. Rigorous peer reviewed uncertainty analyses have been performed indicating TSI's DMA has a sizing uncertainty of approximately <2%.



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)

### + 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.



for analysis and fits a set of data to unimodal, bimodal or trimodal distributions functions.

- + **Built in SMPS Functionality:** The 3938 SMPS includes resident firmware to execute measurement without the need for an attached PC†.



### + Nano Differential Mobility Analyzer

**Model 3085A:** Improves size resolution over the particle size range of 2.5 - 150 nm and NDMA 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

TSI also offers a choice in aerosol neutralization. All of the options feature bipolar diffusion charging to bring the aerosol to a steady-state charge distribution.

- + The traditional Kr<sup>85</sup> 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:** Data Collection and Data Management TSI's SMPS spectrometer includes the Aerosol Instrument Manager® software, a program designed for use with Microsoft® Windows® operating systems. It features pull-down menus and dialogue boxes to simplify set up, operation, data collection, and analysis.
- + **Data Merge:** Enables merging of SMPS and APS data files to produce a wide-range particle size distributions (0.0025 to 20 µm)

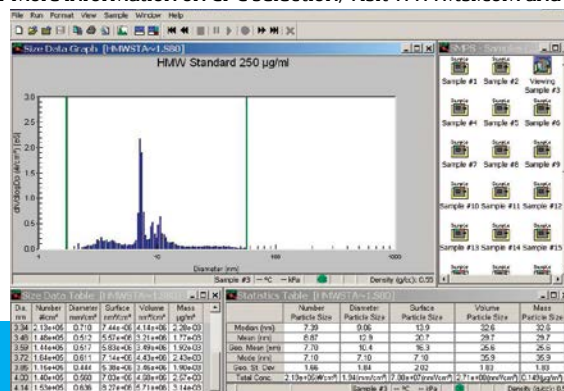
## Condensation Particle Counters (CPCs)

- + **Butanol CPCs:** TSI has extensive experience in the design and engineering of reliable, research quality Condensation Particle Counters (CPCs). The SMPS compatible instruments feature extended single particle counting range and on-board live-time coincidence correction for superior data accuracy for measuring particles down to 2.5 nm.



- + **Water-based CPCs:** TSI also offers a line of precision water-based CPCs as a VOC-free alternative to alcohol based instruments. Using a patented\* laminar flow water condensation technique these instruments count particles can measure down to 2.5 nm at concentrations up to 400,000 particles/cm<sup>3</sup> using single particle counting.
- + **Diethylene Glycol (DEG) Nano Enhancer**  
The Nano Enhancer (NE) Model 3777 uses diethylene glycol as a working fluid to allow the growth of particles from 1 nm. Paired with the Model 3772 CPC, the 1nm CPC system can measure concentrations up to 1.65 x 10<sup>5</sup> particles/cm<sup>3</sup> (165,000) using single particle counting.

- + For more information on CPC selection, visit [www.tsi.com](http://www.tsi.com) and



# SPECIFICATIONS

## SCANNING MOBILITY PARTICLE SIZER MODEL 3938

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

### SMPS Settings and Requirements

Data Averaging (Scans per Sample)	1 to 999, user-selectable
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 Temperature	10 to 40°C
Storage Temperature	-10 to 55°C
Aerosol-Inlet Temperature	10 to 40°C
Humidity	0 to 90%, noncondensing
Pressure	70 to 125 kPa

### Data Logging

Up to two weeks via internal storage or via ethernet with PC.

### File Size per Sample

Varies by sample time 5.7 kilobyte (120 sec upscan, 15 sec downscan time)

### Aerosol Neutralizer Options - Ordered Separately

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

### DMA Voltage - Negative Standard

308202 Dual voltage version

### Display

640×480 pixel color touchscreen LCD for Electrostatic Classifier

### Communications

RS-232 and USB for data; RS-232, USB, and Ethernet for status

### Inlets

Three single-stage, inertial impactors (each with a different cut size)

### Power Requirements

3772 CPC	210 W
3775/6/7 CPC/NE	335 W
3787/8 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
3772	26 × 18 × 25 cm / 5.5 kg
3775/6/7	25 × 32 × 37 cm / 9.9 kg
3787/8	31 × 16 × 28 cm / 5.5 kg

DMA	CPC	Working Fluid	Particle Size Range (nm)	Particle Concentration (#/cm <sup>3</sup> )	Measurement time (sec)	Particle Resolution	Total Size channels
3081A	3772	Butanol	10* to 1,000	1 to 10 <sup>7**</sup>	<10 to 300 (selectable)	64 Channels per decade	Varies by configuration; spans 192 channels from 1 to 1,000 nm collectively
	3775						
	3776						
	3787	Water					
	3788						
3085A	3776	Water	2.5 to 150				
	3788						
3086	3777 +	Diethylene Glycol + Butanol	1 to 50				
	3772						
3081A and 3085A	3776	Butanol	2.5 to 1,000				
	3788	Water					
3081A and 3086	3777 +	Diethylene Glycol + Butanol	1 to 1,000				
	3772						

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.

Microsoft and Windows are either registered trademarks of Microsoft Corporation in the United States and/or other countries

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

\*\* Upper end of concentration specification determined by Aerosol Neutralizers Models 3077, 3077A, 3088, specifications

† Computer needed for 1nm SMPS

Neutralizer ordered separately



UNDERSTANDING, ACCELERATED

TSI Incorporated - Visit our website [www.tsi.com](http://www.tsi.com) for more information.

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