ELECTROSTATIC
CLASSIFIER
MODEL 3082

THESE INSTRUMENTS HAVE BEEN USED IN A BROAD VARIETY OF RESEARCH AND HAVE EARNED A WELL-DESERVED REPUTATION FOR BEING HIGHLY RELIABLE AND EXTREMELY VERSATILE.

UNDERSTANDING, ACCELERATED

HIGHLY RELIABLE AND EXTREMELY VERSATILE

Since 1976, TSI Electrostatic Classifiers have been helping scientists generate and size submicrometer particles. These instruments have been used in a broad variety of research and have earned a well-deserved reputation for being highly reliable and extremely versatile. Our latest Electrostatic Classifier – the Model 3082 - continues that tradition, but with expanded capabilities and an easy-to-use interface. The current design offers tool-free installation and auto detection of configurable components. The controller platform includes a touch-screen display and graphical user interface control that enables size distribution measurements with data logging, greatly expanding your research possibilities!

Collectively, our Electrostatic Classifiers select highly monodisperse, submicrometer aerosols in the range from 2 to 1000 nanometers in diameter. The Electrostatic Classifier is most often used as an integral part of a monodisperse-aerosol generation system or a submicrometer-particle sizing system.

INNOVATIVE DESIGN

The Model 3082 Electrostatic Classifier offers a modern design consisting of two basic components: a controller platform and a differential mobility analyzer (DMA). The platform (Model 3082) contains the power supply, blowers, aerosol neutralizer, touch-screen display, and all instrument controls. The 3082-series allows you to interchange aerosol neutralizers, DMAs, and impactors, with an improved design to provide tool-free installation and auto detection of these configurable components.

You have a choice of two DMAs with Model 3082:
+ Long DMA (Model 3081A) for the broadest particle size range, from 10 to 1000 nanometers
+ Nano DMA (Model 3085A) for the high-resolution sizing of ultrafine particles from 2 to 150 nanometers

You have a choice of two types of aerosol neutralizers with Model 3082:
+ Aerosol Neutralizer (Models 3077, 3077A) is a radioactive Kr-85 bipolar diffusion charger
+ Advanced Aerosol Neutralizer (Model 3088) is a non-radioactive, soft x-ray bipolar diffusion charger

The DMAs and aerosol neutralizers must be purchased individually. You may also use your own custom DMA with our Electrostatic Classifier.

The Electrostatic Classifier separates particles by electrical mobility for high-resolution measurements of particle size distribution. When used in TSI Scanning Mobility Particle Sizer™ (SMPS™) spectrometers, monodisperse aerosol exiting the Electrostatic Classifier passes to a Condensation Particle Counter (CPC), which measures particle number concentration. By scanning quickly through the size range from 2 to 1000 nanometers collectively (size range varies by SMPS configuration), the SMPS measures the size distribution of the aerosol precisely. The Model 3082 auto detects the CPC and enables fast scanning for SMPS measurements with less than 10 seconds scanning time, even without connecting to a computer!

The standard power supply has negative polarity at the center electrode of the DMA, but Model 3082 can be configured with both negative and positive polarity, allowing you to simply switch polarity as your research requires. The graphical user interface enables stand-alone operation – data logging lets you store more than 200,000 size distribution measurements! Logged data can be transferred easily via the USB port on the Electrostatic Classifier.

Aerosol Neutralizer
Model 3088

Aerosol Neutralizer
Model 3077

ADVANTAGES OVER PREVIOUS DESIGN

+ Smaller and lighter
+ Convenient front-panel touch-screen display with graphical user interface control
+ Tool-free installation and auto detection of configurable components
+ Data logging of size distribution measurements
+ Higher maximum sheath flow for increased size resolution
+ Precision dynamic DMA high-voltage supply for faster scanning (<10 sec)
+ Switchable DMA voltage polarity (optional, negative polarity is standard)

APPLICATIONS

The Model 3082 classifier is a primary-standard aerosol instrument. That means its performance is based on basic physical principles, and results are highly repeatable. The United States Department of Commerce, National Institute of Standards and Technology (NIST) uses a TSI Long DMA for sizing 0.1-micrometer standard reference materials (Kinney et . 1991). TSI SMPS was verified to measure NIST traceable particles accurately (Vasiliou, 2004). Our Electrostatic Classifiers are suitable for a variety of applications.

When used as an aerosol generator to produce highly monodisperse particles:
+ Aerosol research, including the study of particle transport, diffusion, coagulation, nucleation, and condensation
+ Particle-charge and electrical-mobility studies
+ Filter-media tests for filter efficiency
+ Calibration of particle instruments such as optical particle counters – enhancing the monodispersity of polystyrene latex (PSL) or other aerosols by removing residue particles and multiplets

When used in a TSI SMPS™ spectrometer for high-resolution sizing of submicrometer particles:
+ Aerosol research, including the study of nucleation and condensation
+ Atmospheric and climate studies
+ Nanotechnology research and materials synthesis
+ Combustion and engine exhaust studies
+ Characterization of sprays, powders, and other generated aerosols and much more

When used in tandem:
Measuring small and large changes in particle size due to coagulation, evaporation, condensation, humidification, and chemical reactions

When used with a TSI Model 3068B Aerosol Electrometer:
Primary size and concentration calibration of Condensation Particle Counters (ISO 27891) and other aerosol instruments
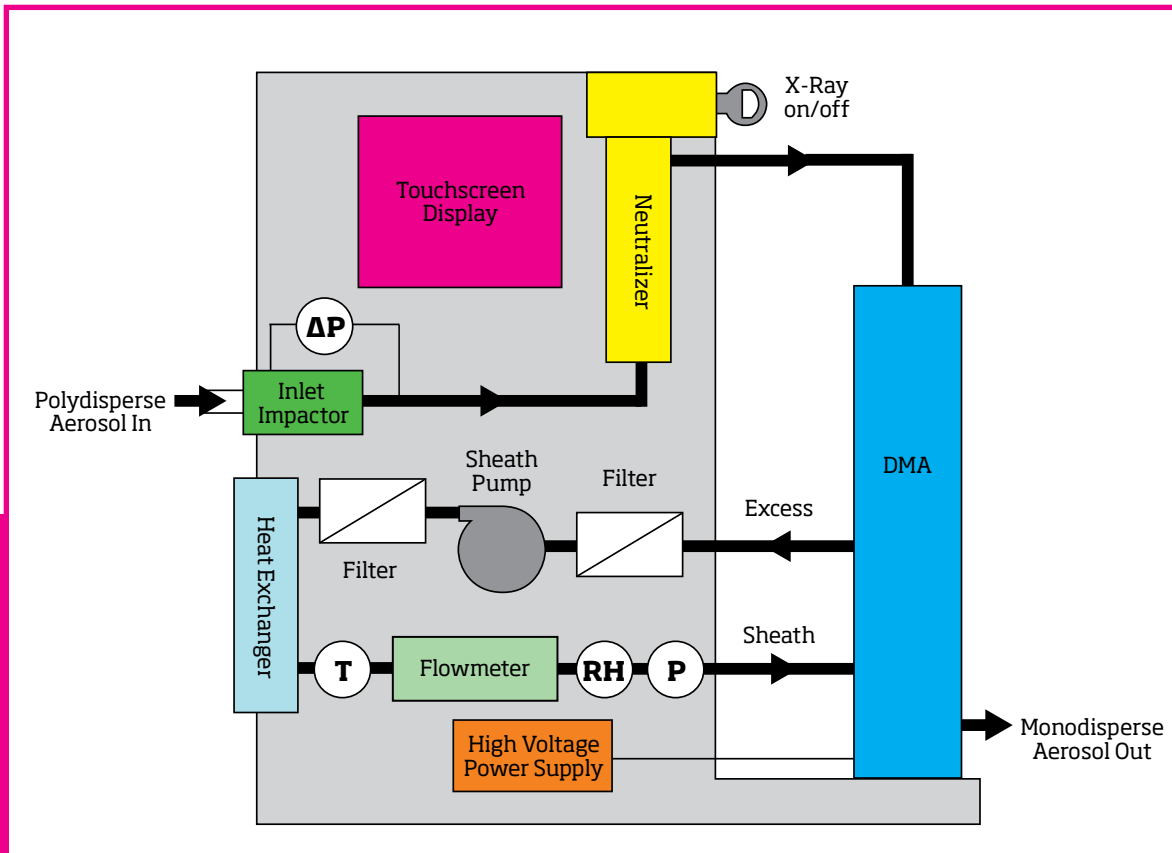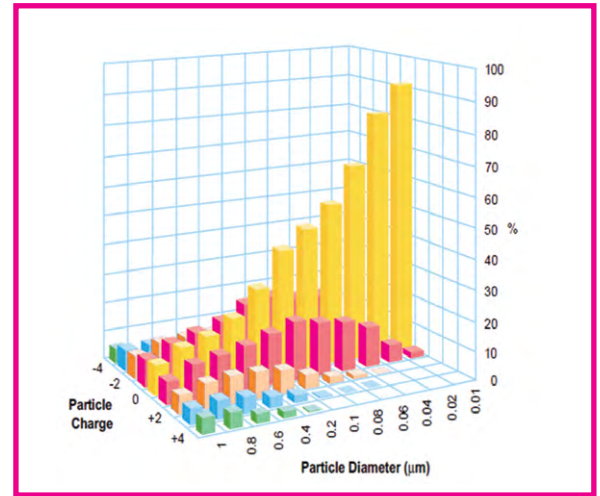

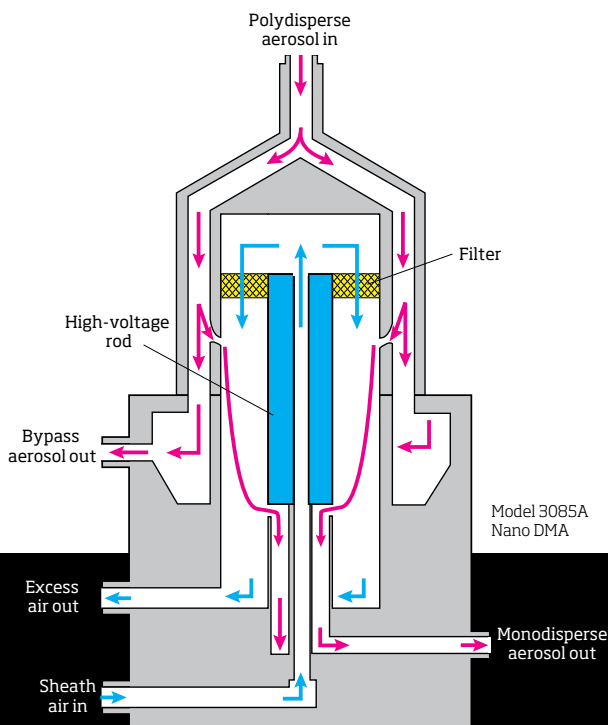3082 Electrostatic Classifier Flow Diagram

OPERATION

Polydisperse, submicrometer aerosol passes through a bipolar charger, establishing a bipolar equilibrium charge level on the particles. Nearly all particles from 2 to 30 nanometers in diameter receive either a single positive, single negative, or zero charge. Larger particles may carry more than one positive or negative charge. (The equilibrium charge distribution is shown in the figure at the right.) The particles then enter the DMA and are separated according to their electrical mobility. This parameter is inversely related to particle size, and it is also proportional to the number of charges on a particle.

An electric field inside the DMA influences the flow trajectory of the charged particles. The DMA contains an inner cylinder that is connected to a negative (optional: negative or positive) power supply (10 to 10,000 VDC). The outer cylinder is grounded. This creates a precise, axially homogeneous electrical field inside the DMA. Particles with negative charge are repelled towards and deposited on the outer wall. Particles with a neutral charge exit with the excess air. Particles with a positive charge move towards the negatively charged element. Only particles within a narrow range of electrical mobility have the correct trajectory to pass through an open slit near the DMA exit. When the optional positive power supply is used for the inner cylinder of the DMA, negatively instead of positively charged particles are selected by the DMA. The electrical mobility and the corresponding size of the particles is selected by adjusting the DMA voltage.

Equilibrium Charge Distribution

Model 3085A
Nano DMA
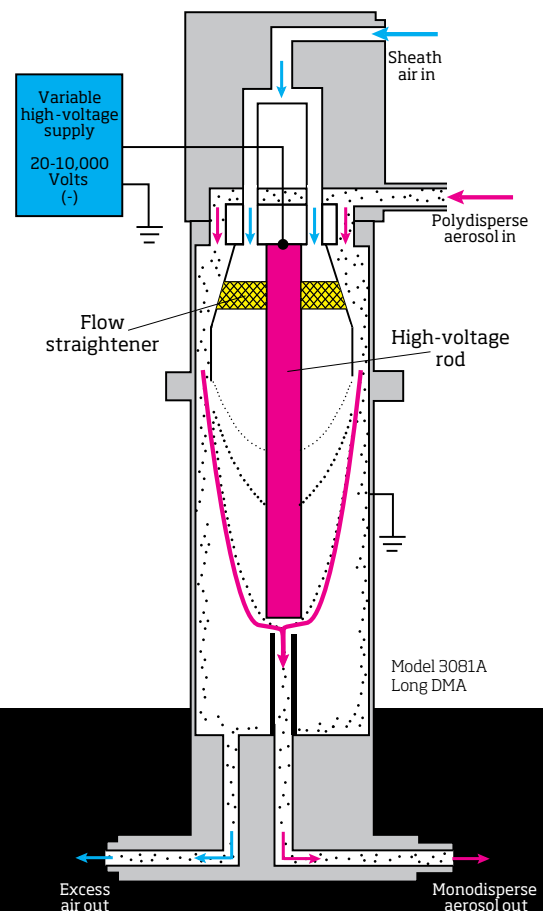
Model 3081A
Long DMA

SPECIFICATIONS

ELECTROSTATIC CLASSIFIER
MODEL 3082

Mode of Operation

Bipolar charge neutralization and differential mobility analysis (requires installation of Neutralizer and DMA)

Flow Rates

Aerosol	0.2 to 5 L/min
Sheath Air and Excess Air	2 to 30 L/min volumetric, selectable
DMA Voltage Range	10 to 10,000 VDC, negative (optional: switchable, positive and negative)
Particle Type	Solid particles and non-volatile liquid particles

Particle Size Range

Classifier Operation Mode

Long DMA 3081A	8 nm to 1150 nm
Nano DMA 3085A	1.5 nm to 200 nm

SMPS Operation Mode

Long DMA 3081A	10 nm to 1000 nm
Nano DMA 3085A	2 nm to 150 nm

Maximum Inlet Concentration

Neutralizers 3088 and 3077A	10^7 cm^{-3} at 10 nm
Neutralizer 3077	10^5 cm^{-3}

Aerosol Ranges

Temperature	10 to 40°C (Aerosol must be within 3°C of instrument temperature)
Pressure	70 to 125 kPa
Humidity	0 to 90%, non-condensing
Altitude	Up to 3000 m (10,000 ft)

Aerosol Neutralizers

Model 3088

Advanced Aerosol Neutralizer	Bipolar, soft x-ray <9.5 keV, ~8760 operating hours

Models 3077 and 3077A

Aerosol Neutralizers	Bipolar, Kr-85, half-life of 10.8 years,
Model 3077	74 MBq (2 mCi);
Model 3077A	370 MBq (10 mCi)

Physical Features

Front Panel Display	Color touchscreen VGA
Front Panel Display Size	11.4 cm x 9.9 cm (4.5 in. x 3.5 in.)
Calibration	NIST-traceable voltage, flow and particle size standards, calibration procedure according to ISO 15900
Size Accuracy	Better than 1% at 100 nm with 10:1 sheath air flow to aerosol air flow ratio
Dimensions (HWD)	40.5 cm x 28.2 cm x 40.5 cm (16 in. x 11 in. x 16 in.)
Resolution	≤ 2.9% at 100 nm for 10:1 sheath/aerosol flow ratio
Weight	14.2 kg (31.2 lb)

Ports

Polydisperse and Monodisperse Aerosol	1/4-in. OD
Sheath Air Inlet/Outlet	3/8-in. OD
Power Requirements	100–240 VAC, 50/60 Hz
Communication	RS-232, USB, and Ethernet
Storage Temperature	-10 to 55° C
Power Consumption	200 W maximum

3081A

Particle Type	Solids and nonvolatile liquids
Particle Size Range (generation mode)	Adjustable from 10 to 1000 nm
Maximum Input Concentration	10^8 particles/cm³ at 10 nm
Voltage	10 to 10,000 VDC

Flow Rate

Sheath Air	2 to 30 L/min
Aerosol	0.2 to 2 L/min

Physical Measurements

Long DMA

Height	61 cm (24 in.)
Outside Diameter	7.6 cm (3 in.) excluding ports
Weight	5.5 kg (12 lb)
Polydisperse and Monodisperse Aerosol Ports	1/4-in. OD
Sheath and Excess Air Ports	3/8-in. OD

Complete Instrument

Dimensions (HWD)	64.3 cm x 28.2 cm x 40.5 cm (25.3 in. x 11.1 in. x 15.8 in.)
Weight	19.5 kg (43.0 lbs)

3085A

Particle Type	Solids and nonvolatile liquids
Particle Size Range (generation mode)	Adjustable from 2 to 150 nm
Maximum Input Concentration	10^8 particles/cm³ at 10 nm
Voltage	10 to 10,000 VDC

Flow Rate

Sheath Air	2 to 30 L/min
Aerosol	0.2 to 5 L/min

Physical Measurements

Nano DMA

Height	20.3 cm (8 in.)
Outside Diameter	7.9 cm (3.1 in.) excluding ports
Weight	2.2 kg (4.9 lb)
Polydisperse and Monodisperse Aerosol Ports	1/4-in. OD
Sheath, Excess, and Bypass Ports	3/8-in. OD

Complete Instrument

Dimensions (HWD)	40.1 cm x 28.2 cm x 40.0 cm (15.8 in. x 11.1 in. x 15.8 in.)
Weight	16.4 kg (36.1 lb)

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Vasiliou J., An Evaluation of a Scanning Mobility Particle Sizer with NIST Traceable Particle Size Standards, Technical Note-012A, Duke Scientific Corporation (2004).

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

TO ORDER

Electrostatic Classifier Components

Specify	Description
3077	Aerosol Neutralizer Kr-85, 74 MBq (2 mCi)
3077A	Aerosol Neutralizer, Kr-85, 370 MBq (10 mCi)
3081A	Long DMA (10 to 1000 nm)
3082	Controller Platform without Aerosol Neutralizer and DMA, includes inlet impactor with three interchangeable impactor nozzles
3082-HVPOS	Second high voltage (positive)
3085A	Nano DMA (2 to 150 nm)
3085A-HI FLOW	Top cover with 3/8-inch inlet for 3085A DMA, for sample flow >1.5 LPM
3088	Advanced Aerosol Neutralizer (Soft X-ray)

6005931 Shielding Column (Lead) for use with 3077/3077A neutralizers with 3082 Classifier.

Systems

Model 3938 Scanning Mobility Particle Sizer™ (SMPS™) spectrometer is available in multiple configurations. All include an Electrostatic Classifier with 3081A Long DMA and/or 3085A Nano DMA, 3088 Advanced Aerosol Neutralizer or 3077, 3077A Aerosol Neutralizer, Condensation Particle Counter (CPC), and SMPS software. There are five CPCs to choose from: Model 3776, 3775, 3772 CPCs and Model 3787, 3788 Water-based CPCs. See SMPS Spectrometer brochure for additional information.

Optional Accessories

Specify	Description
3012	Aerosol Neutralizer
3062	Diffusion Dryer
3063	Mass Flowmeter
3068B	Aerosol Electrometer
3074B	Filtered Air Supply
3076	Constant Output Atomizer (recommended to be used with 3074B, 3012, and 3062)
3089	Nanometer Aerosol Sampler
3480	Electrospray Aerosol Generator (recommended to be used with 3074B and 348002 Po-210 Aerosol Neutralizer)
3708	Flow Splitter
3772 / 3775	Condensation Particle Counter
3776	Ultrafine Condensation Particle Counter
3787	Water-based Condensation Particle Counter
3788	Ultrafine Water-based Condensation Particle Counter
3001788	1/4-inch Conductive Tubing
3001789	3/8-inch Conductive Tubing

These optional accessories are available in several system configurations. Ask your TSI representative about recommended Electrostatic Classifier / Condensation Particle Counter combinations.

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