Cambustion

UDAC Mk2

Unipolar Diffusion Aerosol Charger

Places a high level of charge on aerosol particles, using a corona discharge

Automatic operation with touchscreen interface & remote control options to regulate the charging process

Use with the CPMA as part of an aerosol mass concentration standard

Use as a general purpose unipolar charger

Multiple sheath flows to keep charging wire and surfaces clean

Introduction

The Cambustion Unipolar Diffusion Aerosol Charger (UDAC) places a high level of electrical charge on aerosol particles.

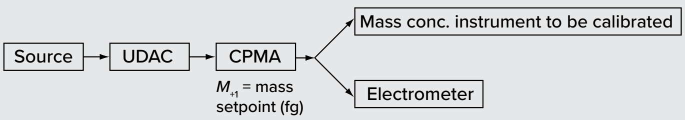
Based on the successful charger used in the Cambustion DMS500 Fast Aerosol Size Spectrometer since 2002 (Biskos et al., 2005), it offers automatic operation, multiple sheath flows to keep the charging wire and interior clean, and a touchscreen interface for control of the charging process, as well as a range of remote control capabilities.

Applications

The UDAC can be used as a stand-alone unipolar aerosol charger for aerosol science experiments (note: as it is a unipolar charger, it is not suitable for charge neutralization).

Aerosol Particle Mass Standard

The UDAC may also be used in conjunction with a Cambustion Centrifugal Particle Mass Analyzer (CPMA) and an aerosol electrometer as a suspended particle mass concentration standard (Symonds et al., 2013). In this scheme, the UDAC places a high level of charge on aerosol particles. These are then classified according to mass:charge ratio

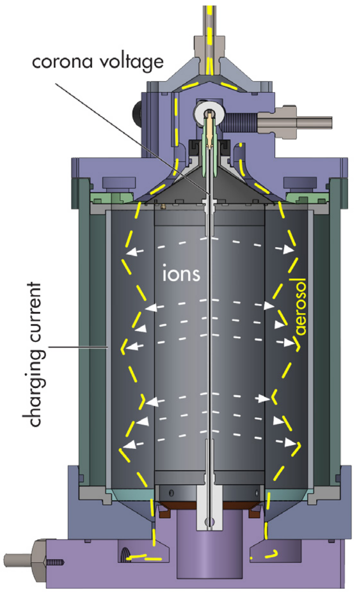


m_{total} = mass *setpoint* × indicated electrometer *concentration* + zero charge correction

by the CPMA, such that each singly charged particle has 1 unit of the CPMA mass setpoint, each doubly charged particle has 2 units of the CPMA mass setpoint etc. An aerosol electrometer then measures the charge concentration downstream of the CPMA, which is multiplied by the CPMA mass setpoint to give the mass concentration. The post-CPMA flow can then be split to provide a source of calibration aerosol for other instrumentation.

Technical Description

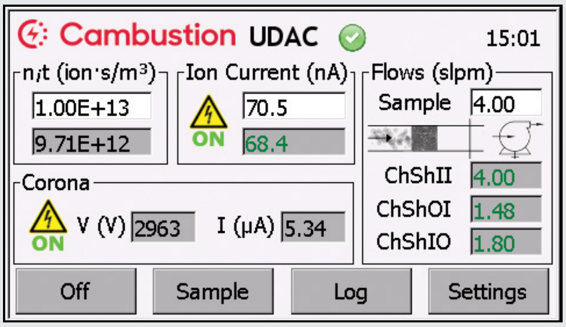
The UDAC uses a fine wire at a voltage of up to 4500 V to create ions in the air. These highly mobile ions are moved into the charging region of the charger by an AC field, where they impart their charge to the aerosol sample. The corona voltage is controlled to maintain the desired charging (ion) current. Recirculating HEPA-filtered sheath flows prevent particle deposition (including diffusion loss) on the corona wire and walls of the charger, and also maintain a faster time response.



The charger is placed inline as for other aerosol chargers, and the sample flow used in the experiment is either entered on the touchscreen, or measured by the optional Aerosol Flowmeter accessory (see below). The user can specify a constant ion concentration - time product ($n_i t$), the charger will calculate and supply the optimum charging current for the given sample flow, temperature and pressure.

Touchscreen Interface & Remote Control

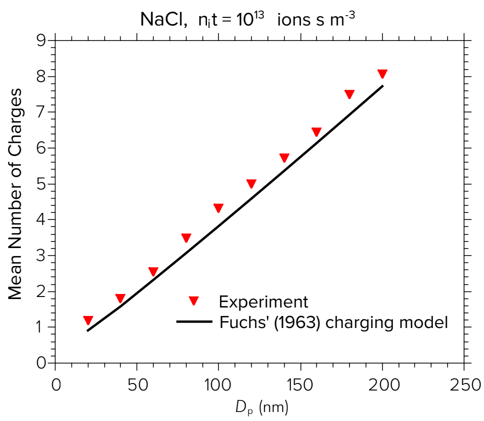
The UDAC's operation is fully controllable via the built-in touchscreen interface:



Remote control is possible via text commands to the serial port (or USB via the supplied adapter) or via Ethernet. A built-in webserver provides a Java or VNC based replication of the touchscreen interface to a computer or mobile device.

There are two analogue inputs — one to provide an input of the sample flow, and the other which is software configurable to control the charging level, charger operation or sample/zero selection. A software configurable analogue output can provide a signal of most charger parameters. A log file of charger parameters may be saved to a USB flash memory drive.

Typical Performance



Aerosol Flowmeter Accessory

The UDAC is available with an optional Aerosol Flowmeter accessory, which uses the pressure drop across an orifice plate to measure the flow of particle laden air. This is also suitable for use with the CPMA, or both the UDAC and CPMA when connected in series. This enables in-situ automatic setting of the sample flow through the charger for more accurate determination of n_it.

References

Unipolar diffusion charging of aerosol particles in the transition regime Biskos, G., Reavell, K., Collings, N. Journal of Aerosol Science, **36** 247–265 (2005)

The CPMA-electrometer system — a suspended particle mass concentration standard. Symonds, J.P.R., Reavell, K.St.J., Olfert, J.S. *Aerosol Science and Technology (Aerosol Research Letters)* **47** (8) i–iv (2013)

Specifications:

Polarity	Positive or negative switchable polarity now standard
Ion Concentration – Time Product (n_it)*	up to 3 × 10^{13} ions s m^{-3} @ 4 lpm sample flow (range scales linearly with flow)
Charging Current*	up to ~200 nA
Charging ("square wave") Voltage	600 VAC @ 30 Hz
Corona Voltage	2000 – 4500 VDC
Sample Flow	1.5 – 8 lpm
Sample / Zero control	Internal HEPA filter switched with solenoid valves
Sheath Flows	2, to protect charging wire and outer wall, filtered and recirculated by internal pump. These dilute the output by a factor of 2.
Sample Pressure Range	-50 – +200 mbar gauge
Max Sample Temp.	40 °C
Ambient Operating Conditions	0 – 40 °C, < 90% non-condensing relative humidity
Analogue Inputs	2 × 0 – 10 VDC: 1 × Sample flow input 1 × Control input (operation, current or n_it)
Analogue Output	1 × 2 – 10 VDC
Auxiliary DC Power Output	24 VDC, 1A
Remote Control	Ethernet / RS232 / USB via text commands Java Web Interface / VNC access Analogue input
Power Supply	90 – 240 VAC, 50/60 Hz, 150 W Max
Weight	~17 kg
Dimensions	305w × 430d × 325h mm

All specifications subject to change without notice

* for a new charger wire - replacement modules available from Cambustion

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To learn more, visit:
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