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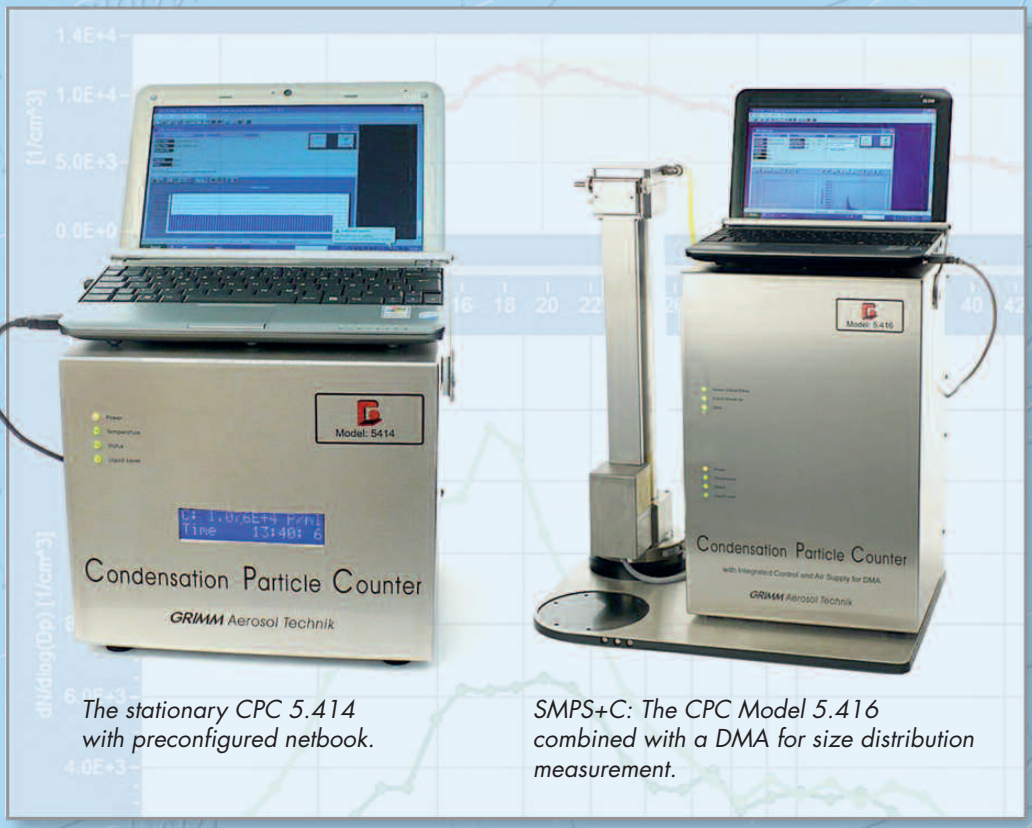
Stationary Condensation Particle Counters (CPCs) Models 5.410 – 5.421

High accuracy counters for airborne nanoparticles with versatile configuration options

Highlights:

- ✓ Six models optimized for laboratory and long-term use
- ✓ Improved detection limit with D50 = 4.0 nm for tungsten oxide particles
- ✓ Single particle counting up to 150.000 1/cm³
- ✓ Tolerates high ambient temperatures (40°C)
- ✓ Improved response time with T90 < 3 seconds
- ✓ With preconfigured software on a mini-PC
- ✓ Analog inputs for additional sensors
- ✓ Comprehensive self-tests assure highest reliability



The stationary CPC 5.414 with preconfigured netbook.

SMPS+C: The CPC Model 5.416 combined with a DMA for size distribution measurement.

Applications:

- ✓ Fundamental aerosol research
- ✓ Filter testing
- ✓ Environmental & climatic studies
- ✓ Nanotechnology process monitoring
- ✓ Printer emission studies
- ✓ Inhalation & Exposure studies

2012

With the new CPC line-up of models 5.410 to 5.421 GRIMM establishes a new standard for condensation particle counters. The new detection head enables single particle counting for concentrations up to 150.000 particles/cm³; moreover, it features an improved detection efficiency and response time. These new models are optimized for stationary use (for mobile applications see the datasheet of model 5.403).

All models feature the well established condensate removal pump and the anti-spill saturator design. In addition, a novel saturator shutter enables the transport of the CPC without the need of removing or drying the saturator.
We offer models with or without rugged internal pumps (the pumps fully meet the requirements of continuous long term measurements) and with or without built-in DMA controller. The photometric mode for high concentrations (up to 10^7 P/ccm) may be integrated optionally in all models 5.410–5.421.

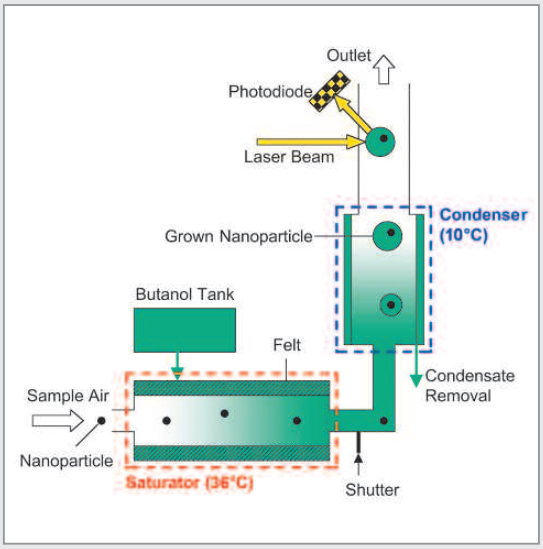
The CPCs can be combined with a GRIMM DMA for measurements of size distributions (see datasheet for the Scanning Mobility Particle Sizer, SMPS+C). Furthermore, a GRIMM Optical Particle Counter expands the SMPS+C system to a Wide Range Aerosol Spectrometer (WRAS) that measures size distributions up to a particle size of 32 µm.

The CPC line includes also 19" rack versions. GRIMM offers also mini-containers with additional meteorological sensors and online data transfer via mobile networks for unattended long term measurements at remote sites.

Measuring Principle

The sample air is continuously drawn into the CPC and saturated with Butanol vapour in the heated (36°C) saturator chamber. Then aerosol particles and Butanol vapour pass through the cooled (10°C) condenser unit, where the Butanol vapour condenses on the particles that act as condensation nuclei. This process increases the size of each individual nanoparticle to ~10 µm and such large droplets can be conveniently detected by light scattering. The CPC supervises the size of the Butanol droplets to ensure a proper condensation process.

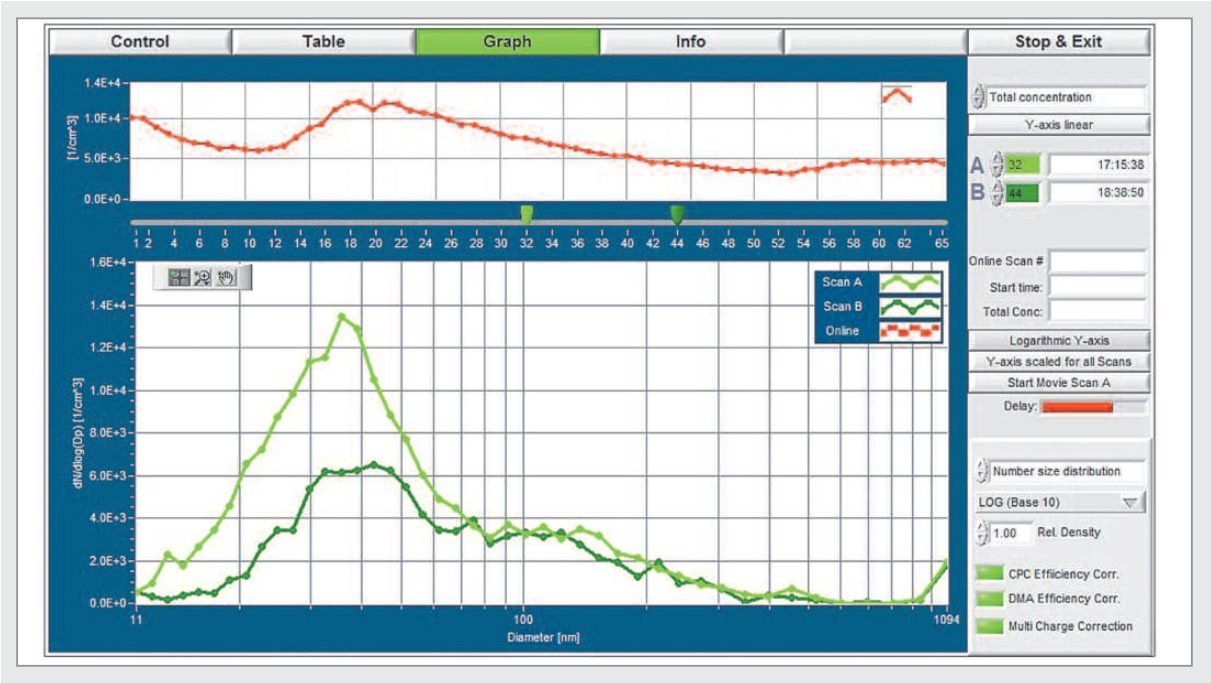
For standard concentrations (up to 100.000 1/cm³ at 0.6 lpm, up to 150.000 1/cm³ at 0.3 lpm sample flow) each particle is counted individually with real time coincidence correction (single count mode). Higher concentrations (up to 10^7 P/ccm) can be measured with the photometric mode, where concentrations are calculated from the calibrated total scattered light intensity of all particles in the detection zone.



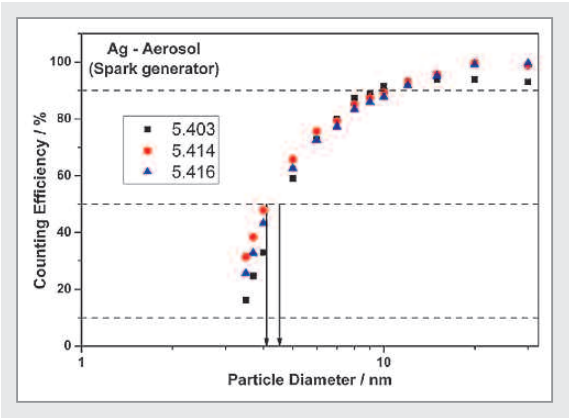
Schematic of a thermal diffusion – laminar flow CPC.

Software

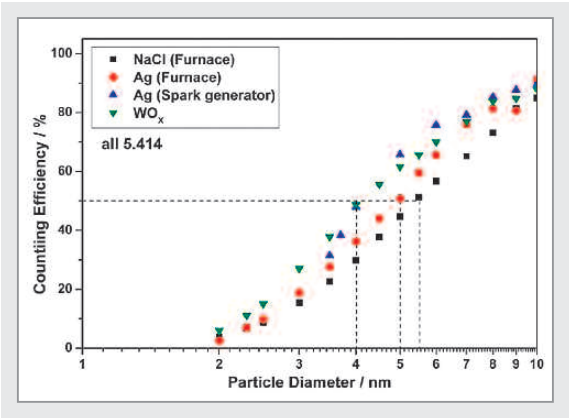
The GRIMM universal software for nanoparticle instruments records measured data and a complete set of instrument parameters. Results are shown as graph or as table, and can be exported to common file formats. The use of data loggers and the online transfer of data to internet servers via mobile networks is supported.
The software operates CPCs as counters, Differential Mobility Analyzers (DMAs) in generator mode, or SMPS systems for measuring size distributions. SMPS systems can be used as SMPS+C (with CPC as detector) or as SMPS+E (with Faraday Cup Electrometer, FCE). Data inversion is done in real time and the algorithms, developed by Professor Reischl (University of Vienna), were adapted to the new standard for calculating size distributions from mobility spectrometers, ISO 15900. The software calculates number, surface, and mass size distributions, optionally with or without corrections, and a variety of statistical parameters.



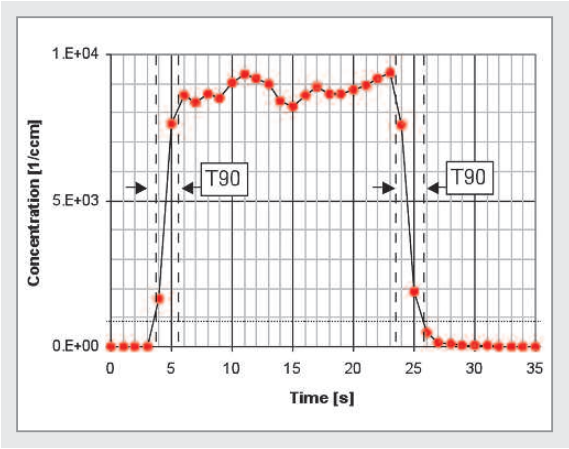
Screenshot of the software for nanoparticle instruments.



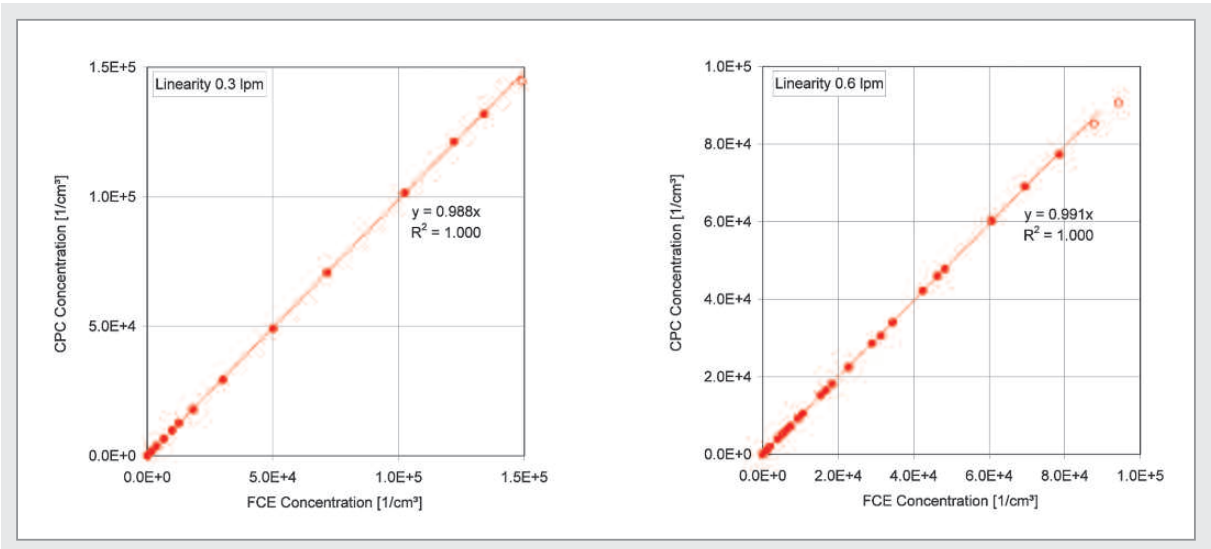
Counting efficiency as a function of particle size, measured with silver particles, for the CPCs 5.414 and 5.416. Both models feature the same new detection head. The efficiency of the mobile CPC 5.403 is shown for comparison. Data from Rennecke 2010.



Efficiency of the CPC 5.414, measured with four different particle materials. A Faraday Cup Electrometer was used as reference (Rennecke 2010).



Measured concentrations for a stepwise concentration change at 0.6 lpm. The rise time of the CPCs in terms of T10-90 is below 3 s.



Linearity of the CPC in single count mode for a sample flow of 0.3 (left) and 0.6 lpm (right). Faraday Electrometer (FCE) concentrations serve as a primary standard.

Overview and Specifications

GRIMM Model 5.410 – 5.421: Stationary Condensation Particle Counters

	5.410	5.412	5.414	5.416	5.420	5.421
	Standard CPC	Professional CPC With sample pump	Universal CPC With SMPS and sample pump	Advanced CPC All inclusive	19" rack version	19" rack version counter only
Max. Conc. [1/ccm] Single count mode	100000	100000	150000 (0.3 lpm) 100000 (0.6 lpm)	150000	150000	150000
Sample Flow [lpm]	0.6	0.6	0.3 & 0.6	0.3	0.3	0.3
SMPS option	-	-	yes	yes	yes	no
Internal pump	-	yes	yes (sample air)	yes	yes	yes
Port for external sensors	-	-	yes	yes	yes	yes
Size (h x w x d) [cm]	23 x 25 x 22	23 x 25 x 22	23 x 25 x 22	40 x 25 x 22	19"	19"

Particle Detection System	
Particle Size Range	4.0 nm (D50 measured with tungsten oxide particles) to greater than 3 µm. Adjustable to 7.0 nm for compliance with the coming standard for determination of the particle number concentration of atmospheric aerosols.
Particle Concentration Accuracy	5% for single particle counting (up to 100.000 p/cm³ at 0.6 lpm, up to 150.000 p/cm³ at 0.3 lpm 10% for optional photometric mode, up to 10^7 P/ccm (at specified conditions).
Rise Time	T10-90 < 3 s
Air Flow System	
Flow Rate Sample Air	0.6 lpm for counter models 5.410, 5.412 0.3 and 0.6 lpm for model 5.414 as counter 0.3 lpm for model 5.416, 5.420, 5.421 and for 5.414 as SMPS.
Flow Rate Sheath Air	3.0 lpm
Flow Control	Critical orifice with stabilized temperature. Constant volume flow independent from ambient conditions.
Aerosol Carrier Gas	Air and inert gases
Liquid System	
Working Fluid	Reagent-grade 1-Butanol for activation of hydrophobic and hydrophilic particles
Condensate Removal	Continuous drain with micro-pump
Communications	
CPC Control	USB or Serial
Data Recording	Directly on PC, optionally on USB stick
Status Indication	Display and 4 LEDs with 3 colors
Analog Inputs	Port for 3 optional analog climatic or gas sensors, plug and play
Operating Conditions	
Ambient Temperature	10 to 40°C (50 to 104°F)
Ambient Humidity	0 to 95% RH, non-condensing
Pressure	0 to - 200 mbar relative to ambient pressure
Power Requirements	85-264 VAC wide range power supply, 47-440 Hz, 80 – 130 W

Publications

Rennecke, S. and Weber, A. (2010). Counting efficiency of condensation particle counters. Report by Institut für Mechanische Verfahrenstechnik, TU Clausthal.

Dealer:

The European Leader in Particle Measurement Technology

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