

Dekati® eFilter™

Gravimetric Filter holder with real time detection

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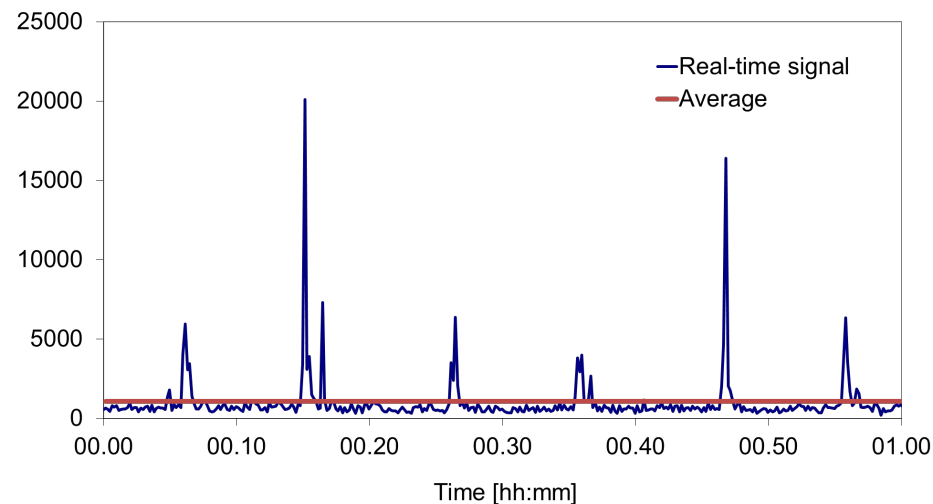


Background

- Gravimetric PM measurement is and will be the required metric for current and future emission standards
- Real-time PM emission information is needed for multiple reasons, but without typical PM measurement complexity
- New emission limits, standards and directives challenge measurement needs for monitoring and for development

Dekati[®] eFilter[™]

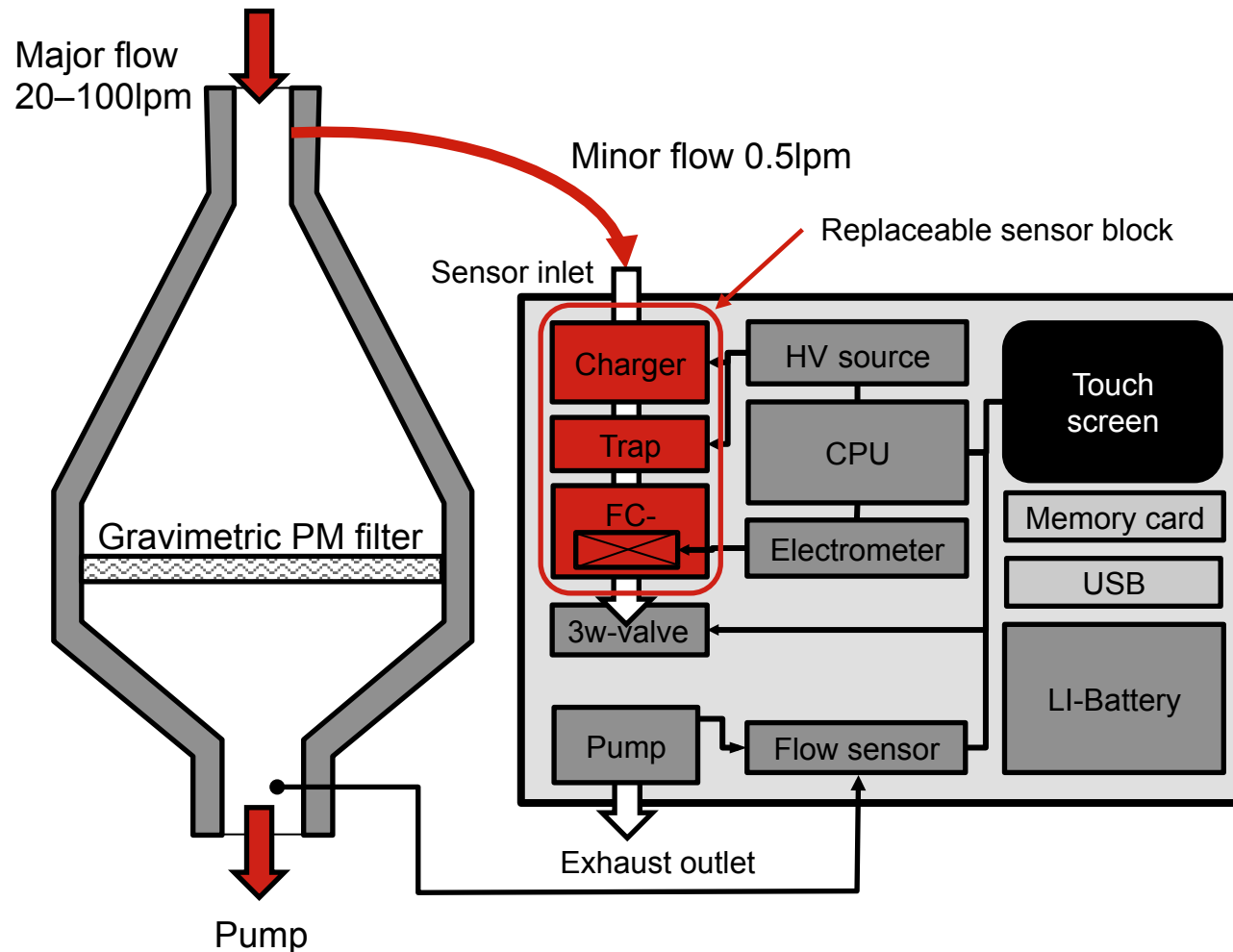
- Standard gravimetric PM filter holder
- Real-time measurement of PM accumulation on the filter
- Both standard and gravimetric measurements integrated in one instrument
- Fully automated operation



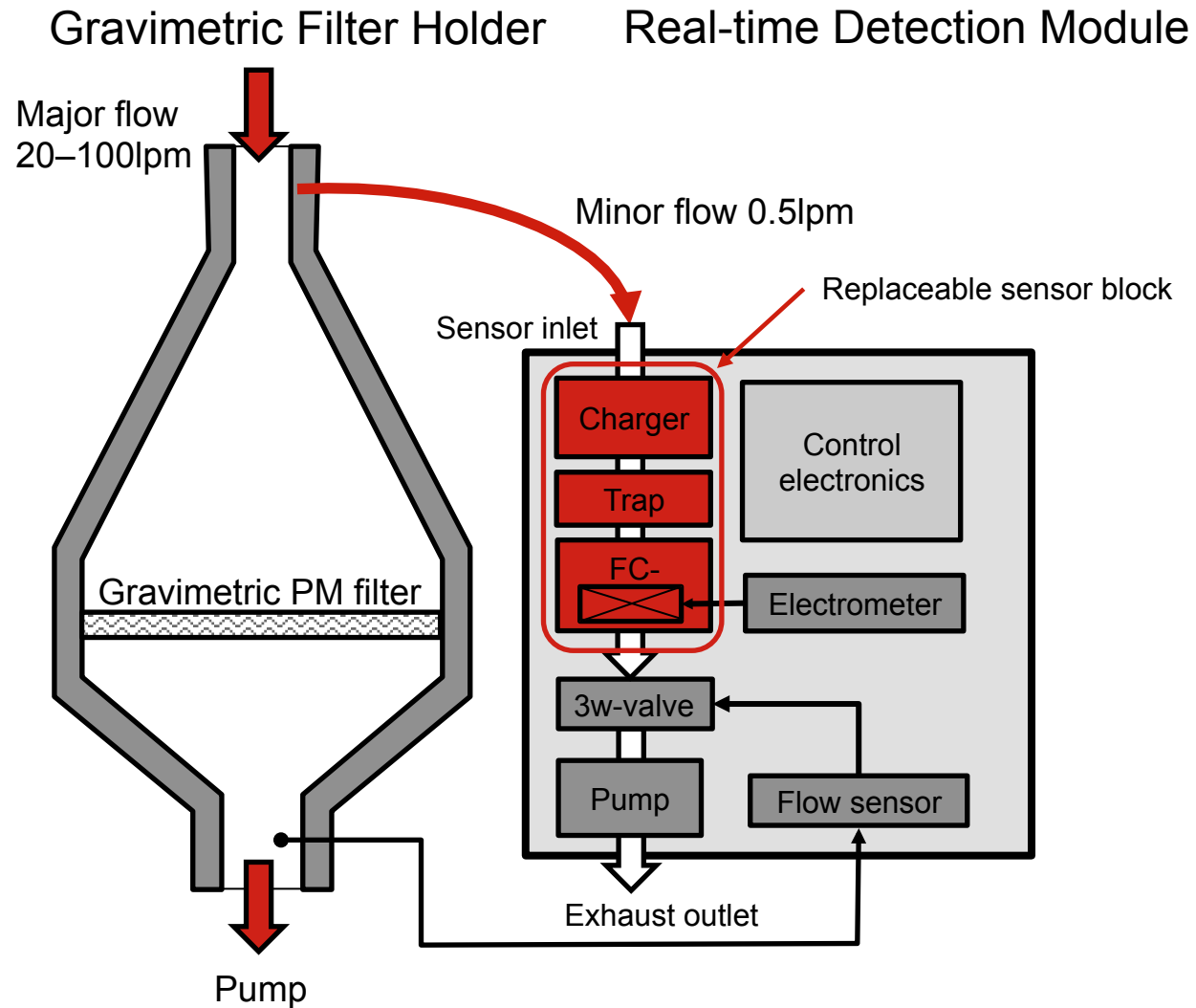
Dekati[®] eFilter[™] Operation

Gravimetric Filter Holder

Real-time Detection Module



Dekati[®] eFilter[™] Operation



Dekati[®] eFilter[™] Design

Standard inlet/outlet connectors

PM filter holder according to US EPA requirements

Touch screen UI

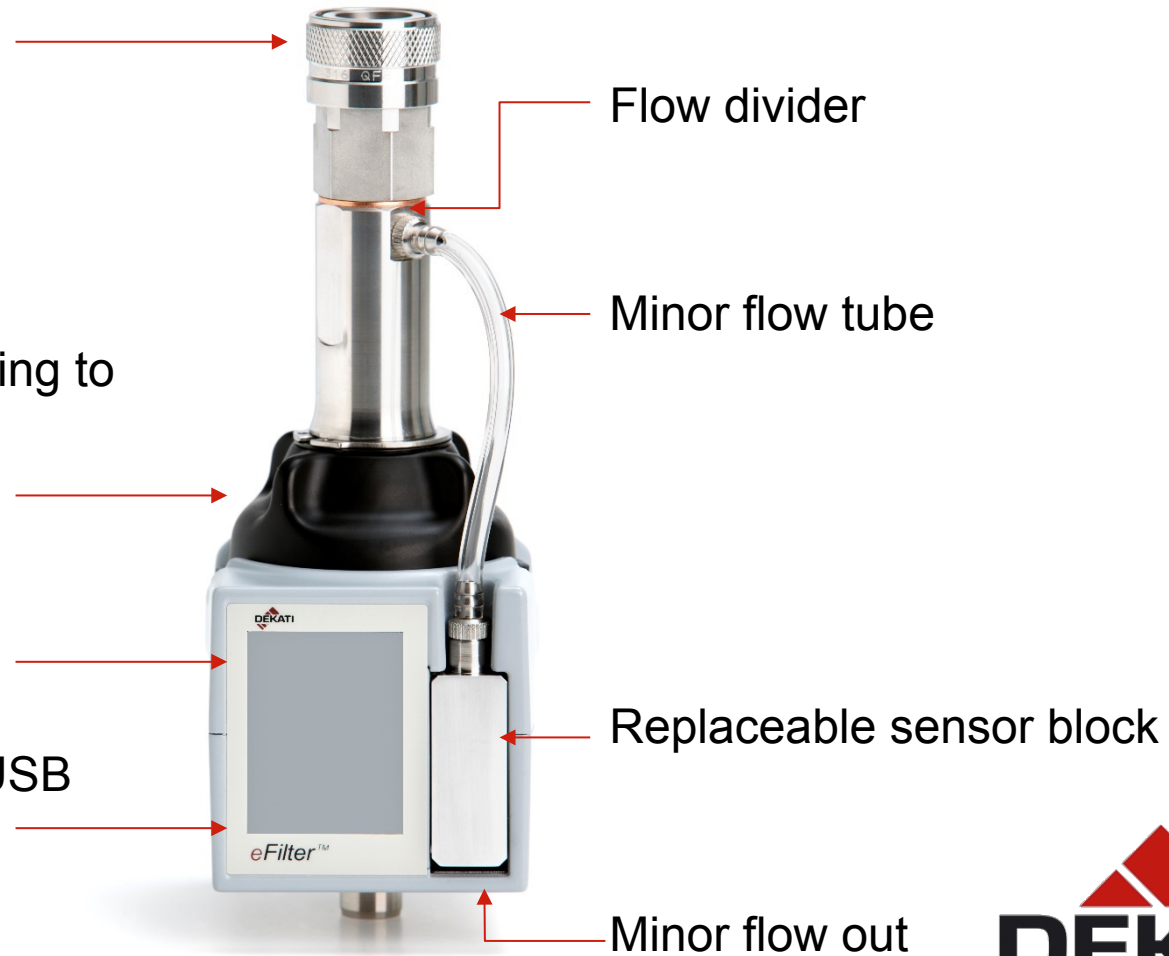
SD card and RS-232/USB interface

Flow divider

Minor flow tube

Replaceable sensor block

Minor flow out



Dekati® eFilter™: Filter Holder



- Standard gravimetric filter measurement (47 mm filter holder)
- Meets US EPA requirements
- Flow rate 20 – 100 lpm



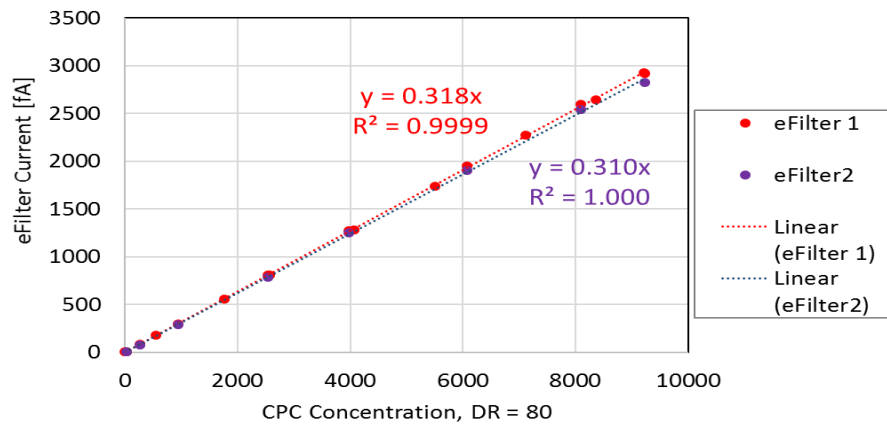
Dekati[®] eFilter[™]: Real-time Sensor

- Includes:
 - Diffusion charger with trap
 - Electrometer for real-time electrical detection of particles
- Saving interval 1s
- Separate pump is used for real-time detection
- Measurement starts when major flow is switched ON
- Does NOT affect gravimetric filter sampling

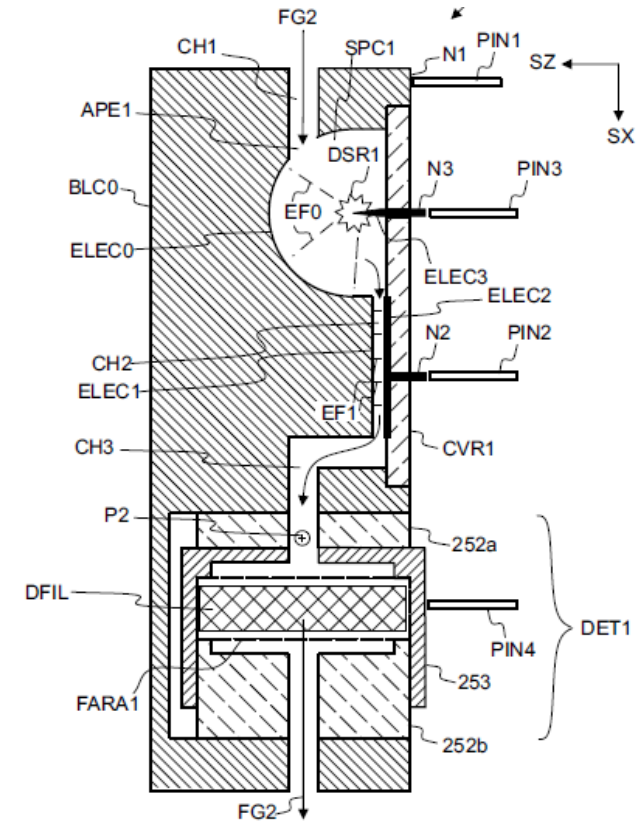
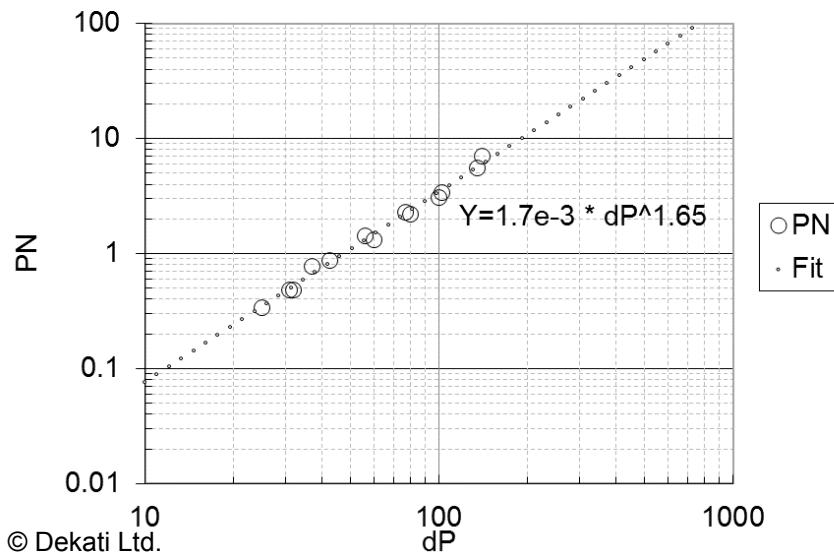


Miniature Diffusion Charger: Construction, Linearity and Calibration

eFilter Linearity, repeatability, sensitivity



eFilter DC charging efficiency



Dekati® eFilter™ Charging Station



- eFilter™ battery charging
- Automated monitoring of eFilter™ operation
- Real-time sensor flow control and adjustment

Dekati® eFilter™ Maintenance

- No cleaning or maintenance
- Real-time sensor block replaced whenever needed
- Easy calibration procedure



Dekati[®] eFilter[™] Features

- Gravimetric PM filter holder that meets US EPA requirements
 - Compatible with existing filter holders and sampling systems
- Unaffected gravimetric PM measurement result
 - Total particle mass
- Electrical current from the diffusion charger electrometer
 - Fast response second-by-second data
- Real-time data benefits:
 - Repeatable
 - Sensitive
 - Detects DPF regeneration events and other anomalies
 - Real-time signal is more repeatable than gravimetric PM result, therefore it can also be used for PM measurement quality control



Dekati® eFilter™ Features

- Max 50 °C
- Fully automated operation
 - Real-time measurement starts/stops based on gravimetric PM filter flow
- Battery operated
 - Charging station for charging
- Touch screen user interface for instrument control
- Data saved on a SD card, USB interface for data transfer



Dekati[®] eFilter[™] Specifications

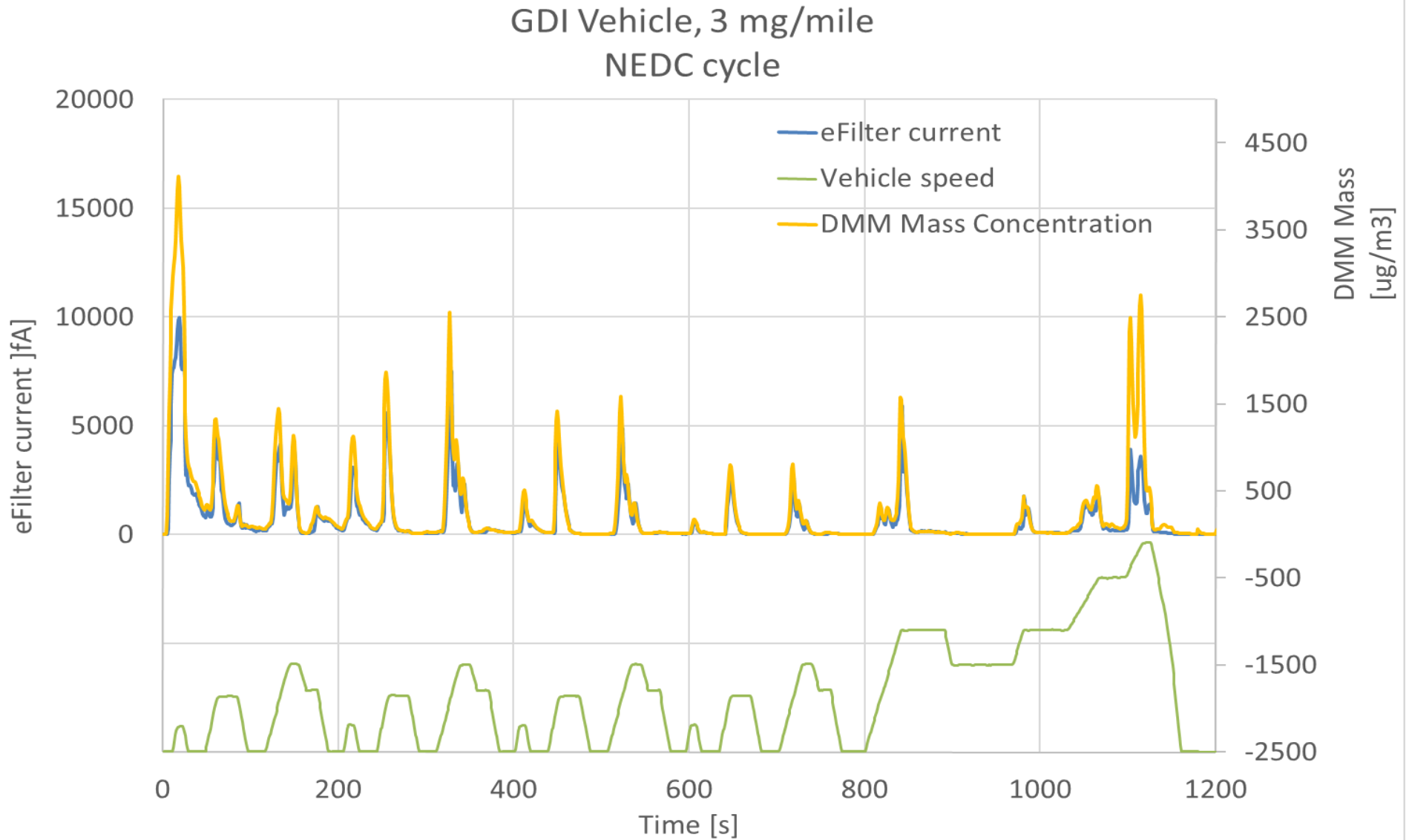
Electrical detection sensitivity	About 3 fA electrical current With 70nm particles this corresponds to about 1000 #/cm ³ , 1 ug/m ³
Particle material & size	Total PM (Solid / semivolatile / liquid) up to 10µm
Battery life	About 7 hours
Minor flow rate	0.50 lpm, automatically adjusted in charging station
Major flow rate	20–100 lpm
Operating conditions	10-50°C, RH 0-99% (non-condensing)
Filter holder specifications	US EPA 40 CFR part 1065/1066
Data transfer	SD card, USB port
Maintenance	No user maintenance required

Vehicle Test Information

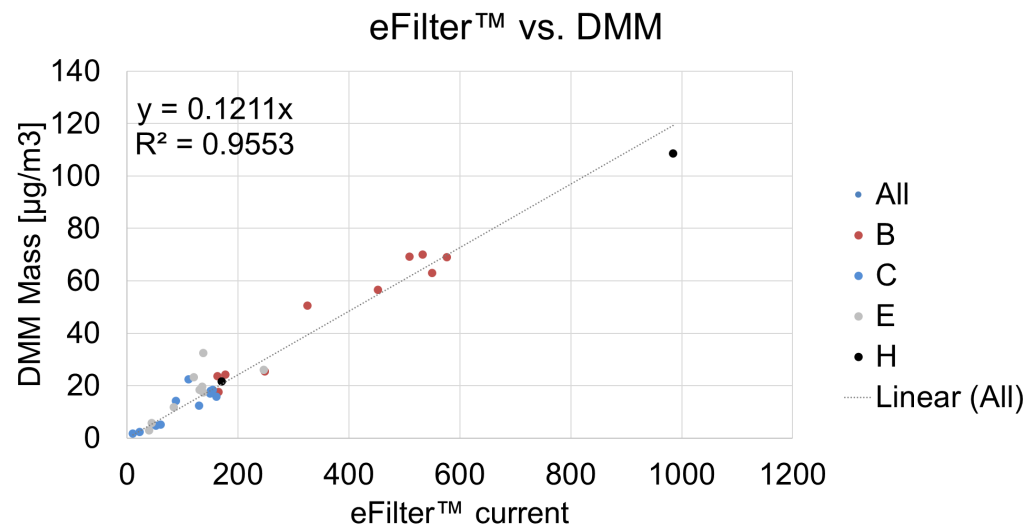
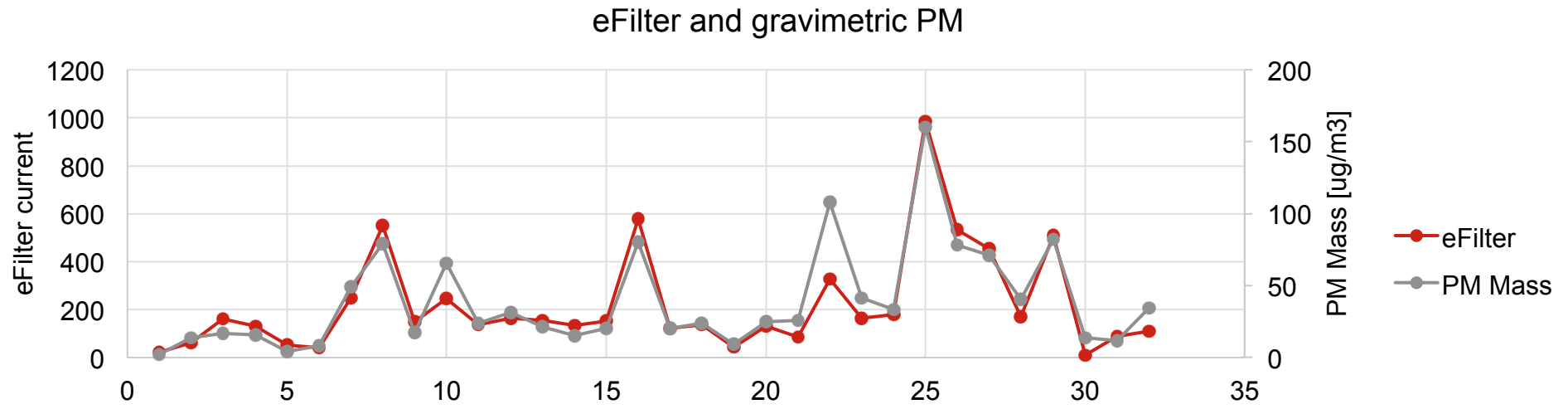
- Total of 88 test cycles at Ford RIC:
 - 10 * EPA75
 - 40 * US06
 - 4 * 4BagFTP
 - 34 * NEDC
- 8 different gasoline vehicles: 7 GTDI, 1 PFI ranging from about 0.1 to 5 mg/mile
- HF47 and room temperature sampling from CVS tunnel
- Instruments: Dekati® eFilter™, Dekati® DMM-230, Gravimetric PM measurement, AVL CPC, AVL MSS, TSI EEPS



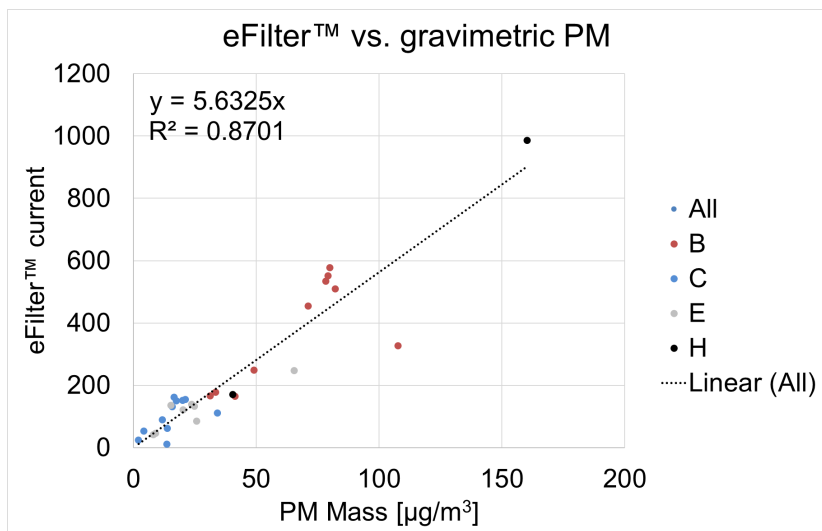
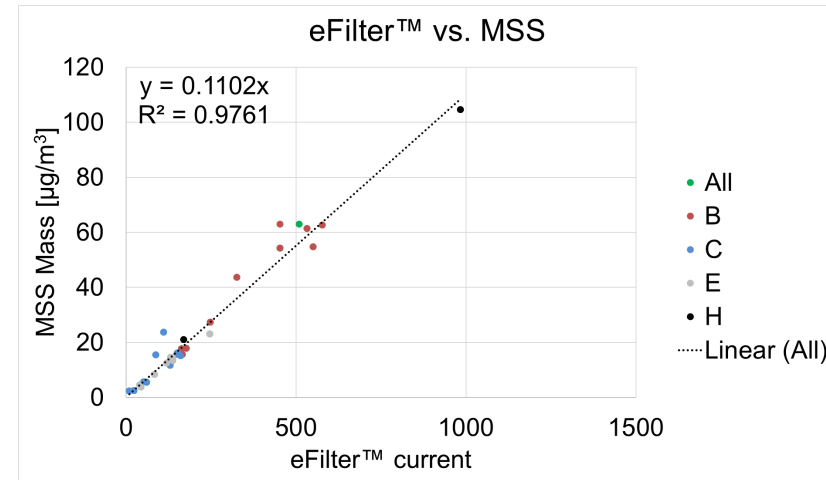
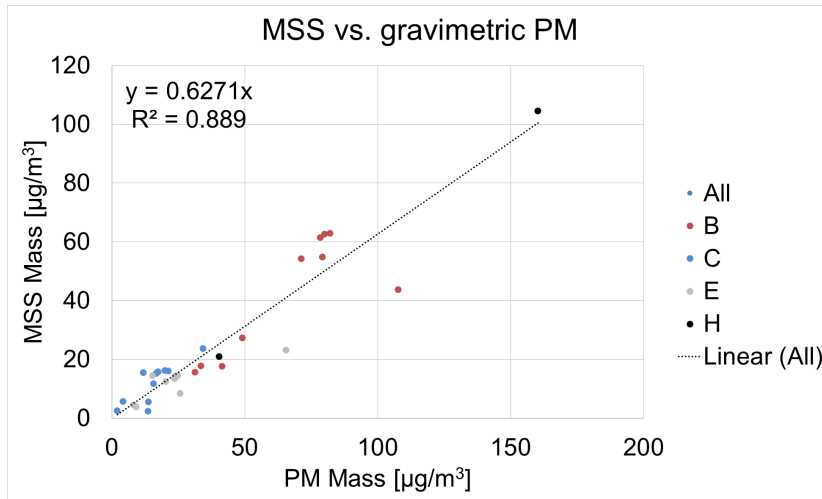
Vehicle Tests: Example Data



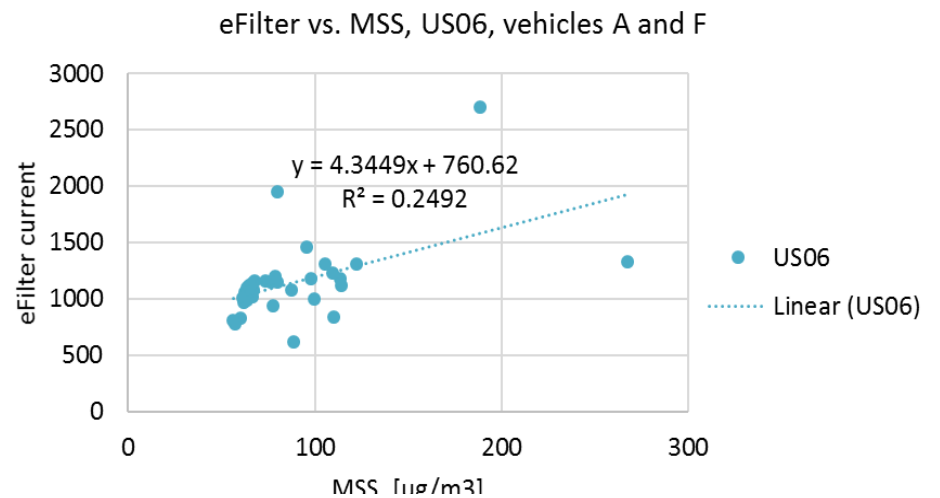
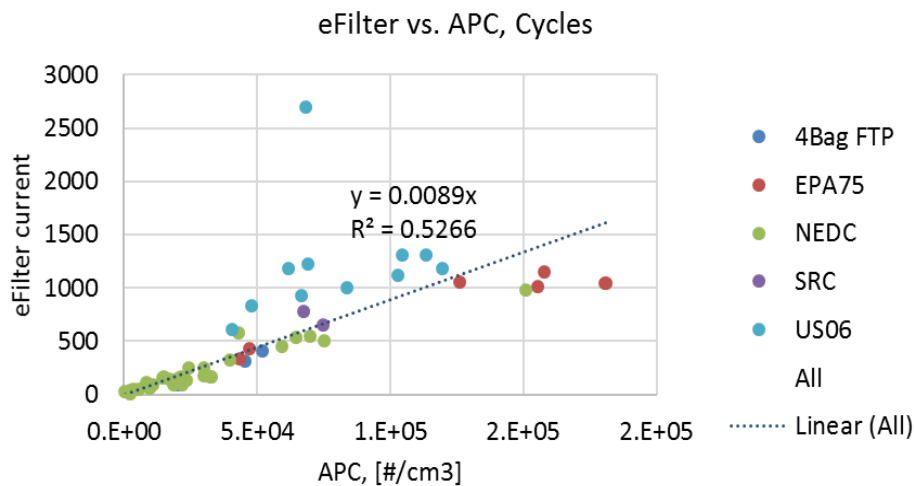
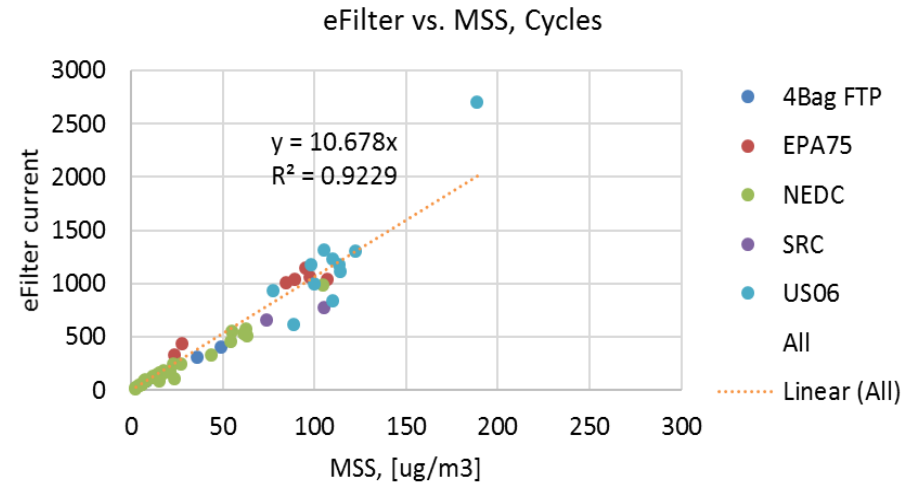
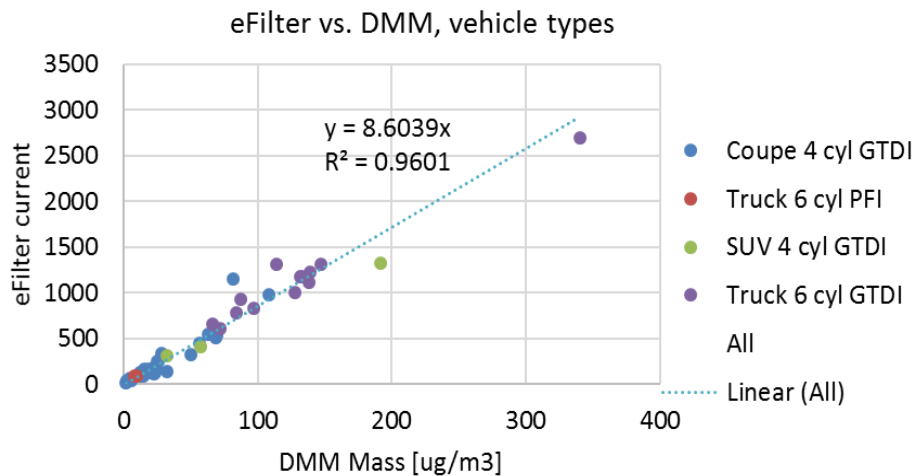
Vehicle tests: Stability and Correlation to Other Instruments, NEDC



Vehicle tests: Stability and Correlation to MSS, NEDC



Vehicle Tests: Effect of Vehicle and Cycle Type



Good correlation to DMM (Total PM), more scatter in MSS correlation due to soot only measurement . US06 causes scattering due to aggressive driving and higher temperatures.

What Affects eFilter™ Signal Comparisons?

- Changes in particle size
- Nucleation mode - depends on the trap voltage
- Filter artefact - gas phase volatile material adsorption to PM filter
- Volatile PM evaporation from filter paper

Dekati® eFilter™

- The new Dekati® eFilter™ provides both standard gravimetric PM result and real-time information about PM accumulation to a filter
- Filter holder integrated miniature diffusion charger provides repeatable, fast and sensitive signal on PM concentration in different phases of the gravimetric sample collection
- Diffusion charger response remains stable over long periods of time with different vehicle and cycle types
- eFilter™ real-time signal is more repeatable and more sensitive than gravimetric weighing result especially at low emission levels



Thank you for your attention!

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