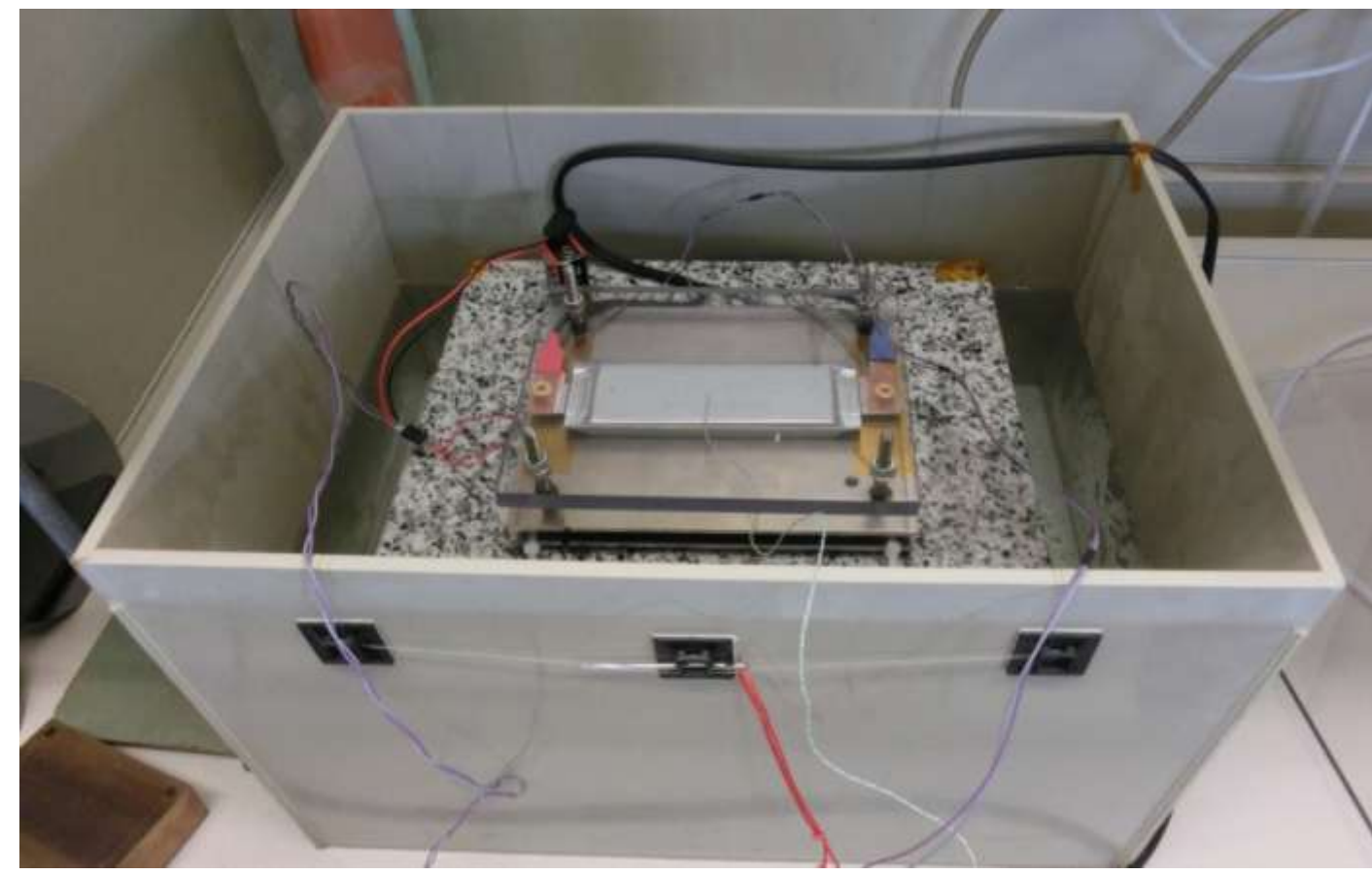


Battery Emission monitoring Sensor

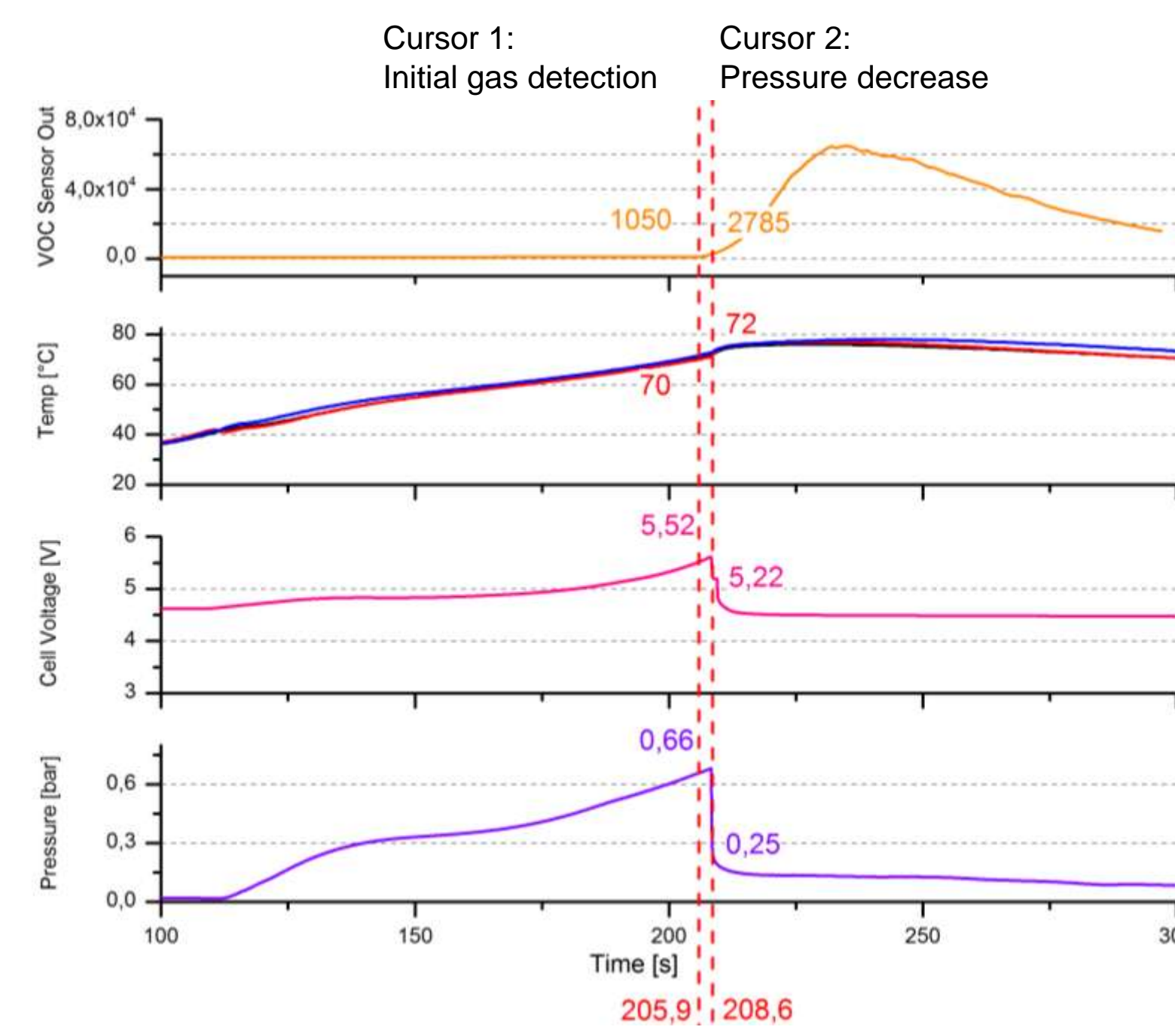
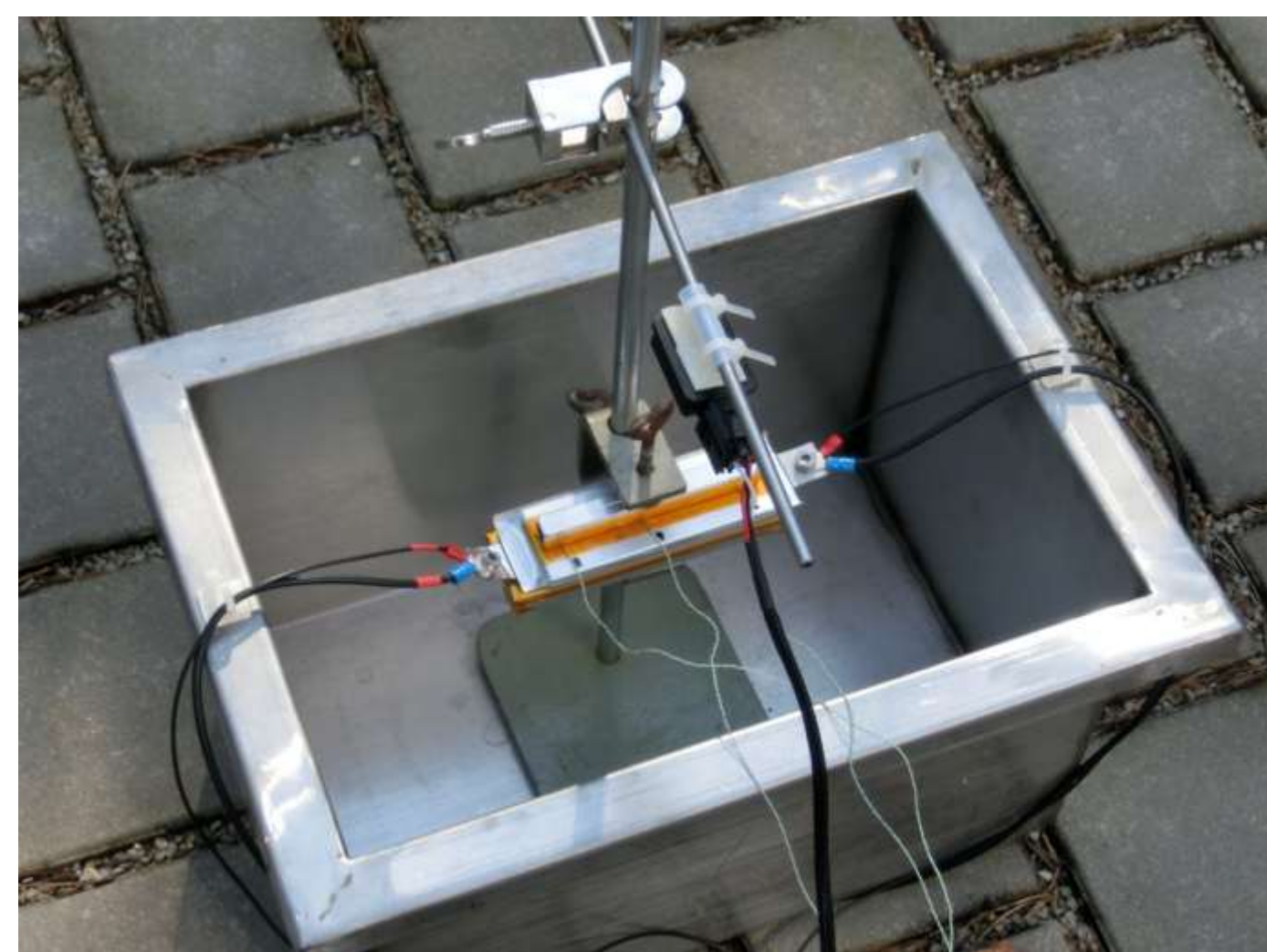
Test Set Up 1:

- NMC Li-Ion Cell
- 12C overcharge
- Cell Mechanically fixed
- Manual shut down after gas detection
- Measurement of:
 - Gas (VOC/CO₂) with AppliedSensor BEM-100
 - Cell voltage
 - Cell temperature
 - Gas pressure
- Camera Documentation
- In case of any failure the cell can be immersed in water



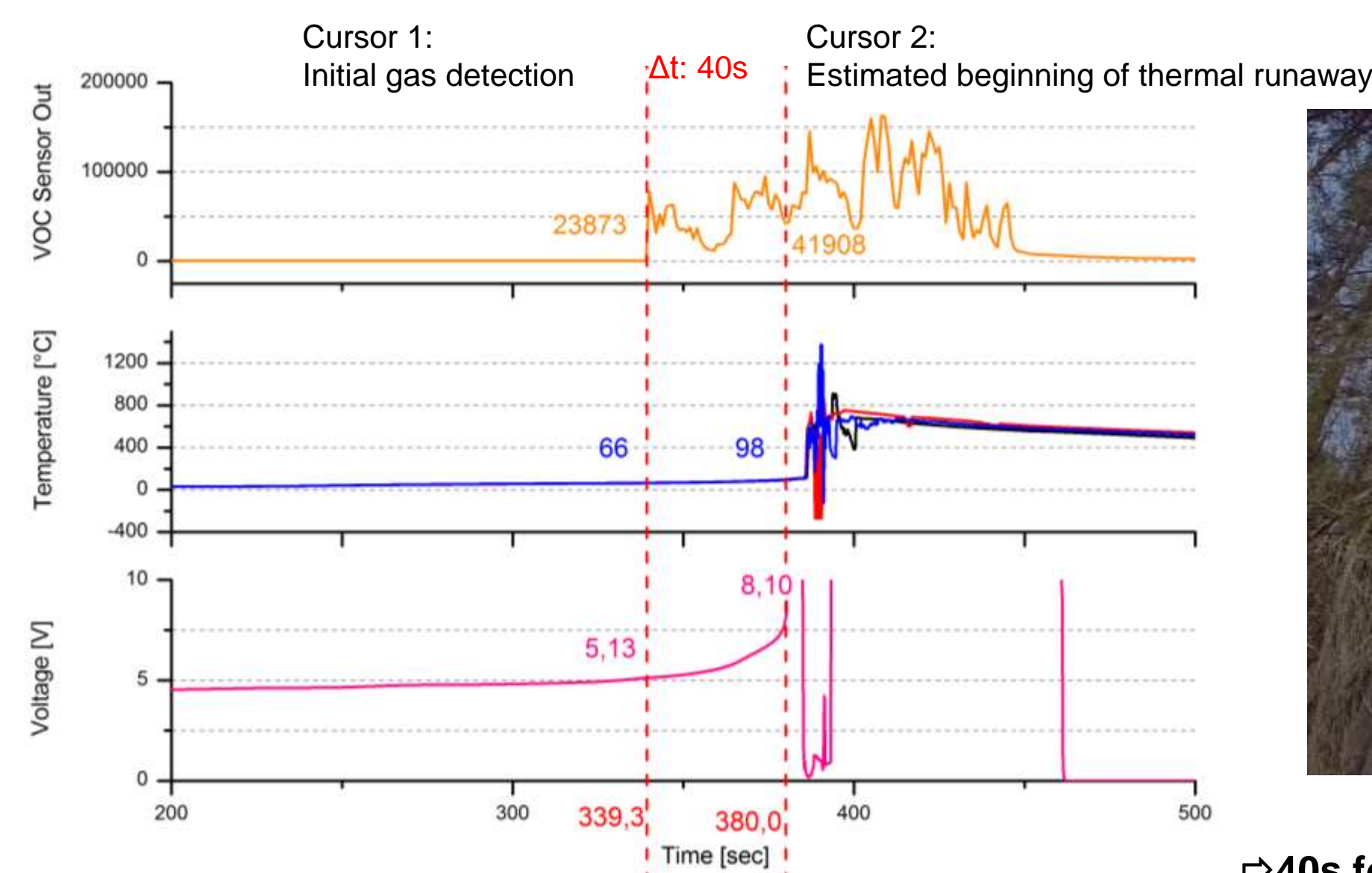
Test Set Up 2:

- NMC Li-Ion Cell
- 12C overcharge
- Cell Mechanically fixed
- No shut down after gas detection
- Measurement of:
 - Gas (VOC/CO₂) with AppliedSensor BEM-100
 - Cell voltage
 - Cell temperature
- Camera Documentation



Battery Emission Monitor BEM-100

- Time difference between the cursors: 3s
- ⇒ **NO thermal runaway!**



⇒ **40s for early warning**

Summary:

Gas sensors in large lithium-ion battery systems provide additional safety functions to conventionally used means of battery monitoring. An undetected electrolyte leak in a cell can pose a serious threat to potential users and maintenance personnel. Experimental investigations show that the used gas sensor is capable of increasing safety in large lithium-ion battery systems without adding much additional cost.

It can easily detect electrolyte leaks that are hard to detect with common monitoring measures. In the various use cases it is able to detect gas venting from a cell under abuse conditions in order to warn users and perform an emergency shutdown to prevent further damage. It even appears that the gas sensor can detect a rise in volatile organic compounds VOC concentration even before a bloated cell fully opens.

Investigation of gas sensing in large lithium-ion battery systems for early fault detection and safety improvement
M. Wenger¹, R. Waller¹, V.R.H. Lorentz¹, M. März¹, M. Herold²
¹ Fraunhofer IISB, Erlangen, Germany ² AppliedSensor GmbH, Reutlingen, Germany
Accepted for presentation at IECON'2014 Dallas, TX, USA from October 29-November 1, 2014

Battery Management IC AS8506

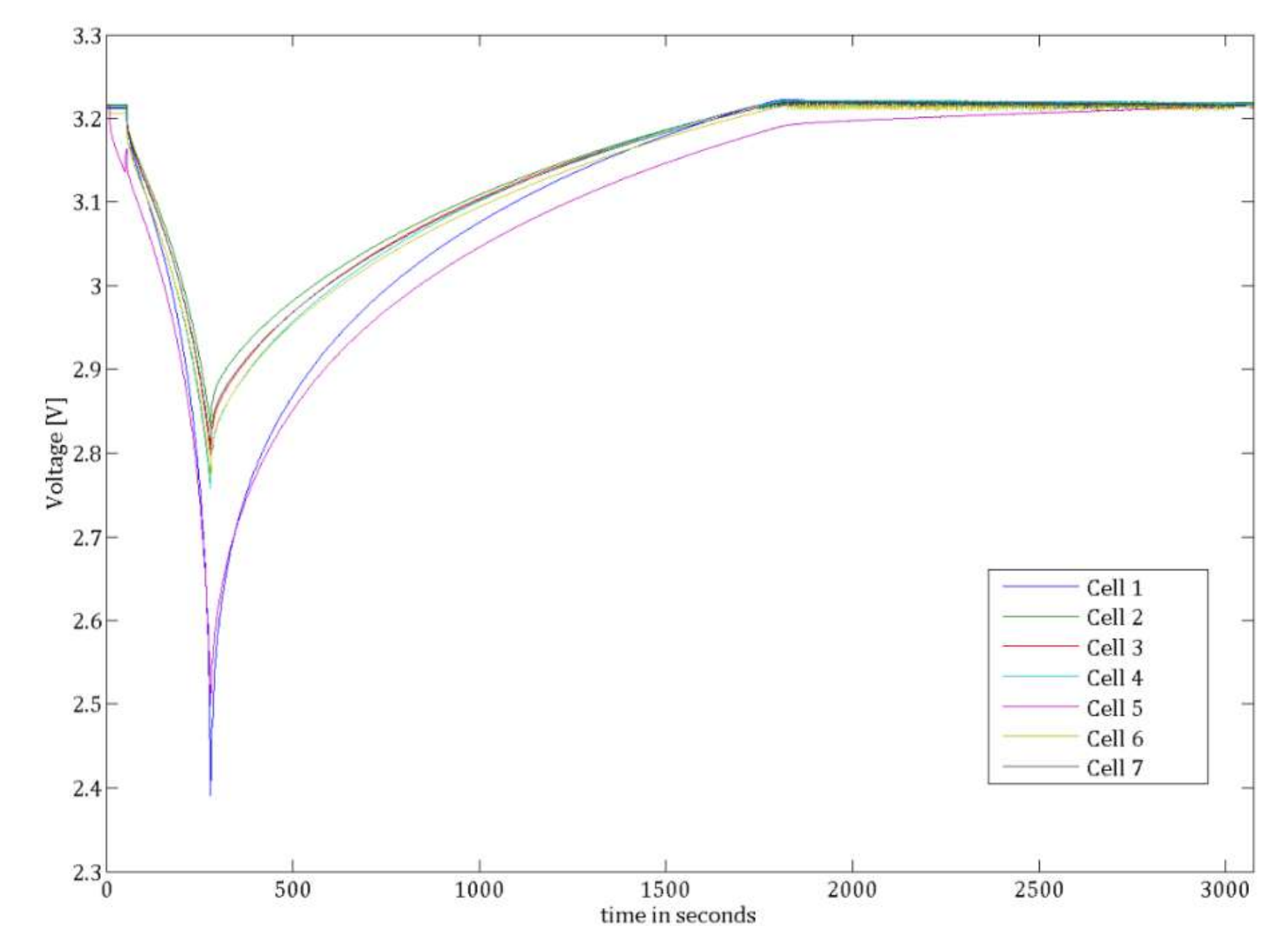
Cell Balancer / Monitor

- Supports 3-7 cells for cell voltages from 1,8V to 4,5V
- Simultaneous and autonomous cell monitoring - digital or analog reference
- Autonomous balancing through simultaneous cell voltage capture and comparison with reference
- Either passive balancing or active balancing through small external fly back converter
- 40pin QFN package

Diagnosis functions:

- Connected cells
- cell voltage ok
- balance done
- temperature ok
- absolute temperature
- absolute cell voltage
- status data

Operating Supply Range [V]	6 to 32
Operating Temperature [°C]	-40 to +85 Ambient
Number of cells per IC	3-7
Typical standby quiescent current [µA]	10
Balancing current [mA]	typically 100
Balancing target accuracy over full temperature range [mV]	10
Cell voltage target accuracy [mV]	10
2 temperature monitoring thresholds	
Cell voltage range [V]	1,5 – 4,5
12 bit ADC for cell voltage capture. Accuracy target [mV]	±5
8 bit ADC for temperature capture. Accuracy target [°C]	±3



Test boards for with AS8506; Stackable or standalone board for autonomous battery balancing

Functions and specifications of cell balancer and monitor IC for enabling passive and active balancing with reduced communication between cell groups

Autonomous passive balancing of 7 cells

(Cost)-efficient system solutions e.g. integrated battery management, communication and module supply for the 48V power supply in passenger cars.
Harald Gall, Manfred Brandl, Martin Jaiser, Johann Winter, Wolfgang Reinprecht, Josef Zehetner, ams AG
Presented at 18th Int. Forum on Advanced Microsystems for Automotive Applications (AMAA 2014), June 23-24, 2014

Ultracapacitor cells



	Corning Materials	Control Cells
Capacitance (F)	> 2800	~ 2000
ESR (mΩ)	~ 0.35	~ 0.35
Energy Density (Wh/L)	10.0	7.0
Self-discharge (%)	8.5	10.0

> 40%

Li-Ion battery pack



Module assembly

E-kart demonstrator



Electro kart: Complete daisy-chain communication demonstrated

European Green Vehicles Initiative - Expert Workshop

Testing of Electrical Vehicle Performance and Safety

Thursday 3 July 2014 / Fondation Universitaire, Rue d'Egmont 11 - Brussels