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Standby Battery Life Management: Breaking the Price Barrier

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Background

- Electronics based battery monitoring and management systems are pedestrian in technology and highly priced.
- High pricing makes the payback times on systems too long for all except the most critical installations.
- New approaches can result in better management systems, giving longer service life.
- In parallel, high volume manufacturing techniques can provide more comprehensive systems at a fraction of the current ownership cost.
- These two advances may result in a long awaited leap forward in battery life management.

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Current VRLA Assessment Techniques

- **A significant proportion of VRLA cells randomly fail well before design life predictions indicate**

- **Chemistry and charging environment dictates a shorter than predicted service life. Discharge testing is costly and disruptive**

- **Although the more expensive systems have impedance, continuous monitoring is still mainly based on terminal voltage, discharge current and ambient temperature.**

Is this enough ?

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Maintenance techniques: Case Study

1200 cell 10-12 year design life, 450Ah VRLA battery in controlled environment

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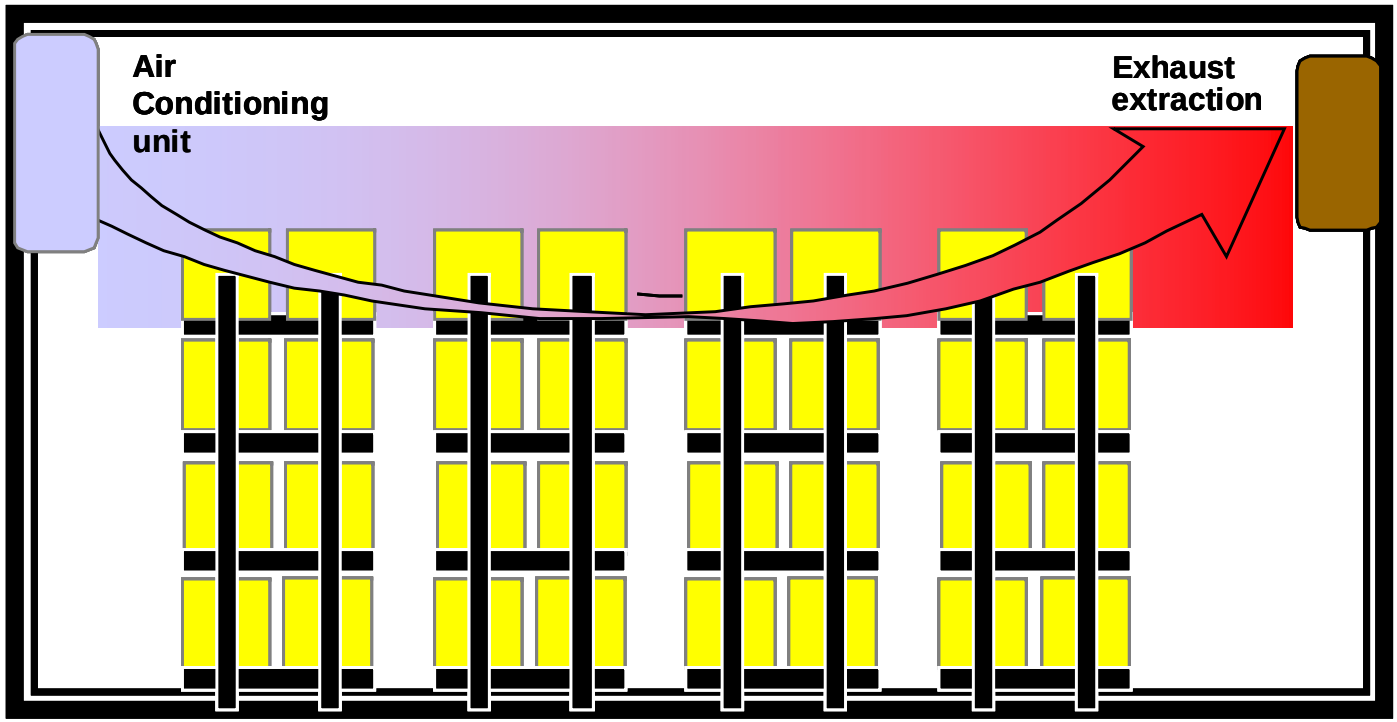
Maintenance techniques: Case Study



Environmental Control: Air flow arrangement

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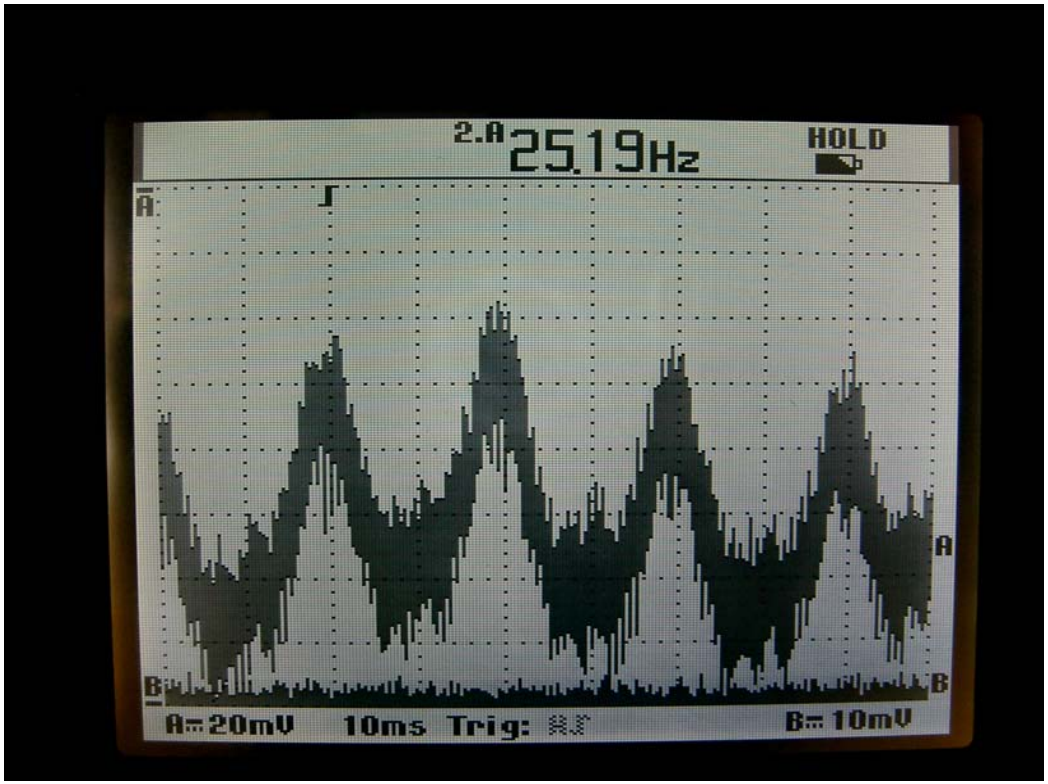
Maintenance techniques: Case Study



100A p/p electrical noise & ripple in a single 204 cell string

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Maintenance techniques: Case Study

- **Regular maintenance did not detect the problems**
- **The temperature of several cells began to rise in years 4 / 5.**
- **Several cell discharge performances dropped**
- **To save the battery, cell changeout began in year 5**

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Maintenance techniques

Many papers are presented at battery conferences every year giving instances of problems in even well maintained standby battery installations

Example: United Parcel Service, Winward Data Center

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Are current Monitoring Systems effective ?

- **Periodic maintenance did not detect the problems in the two examples**

- **Are we monitoring the right parameters ?**

  -- or enough parameters ?

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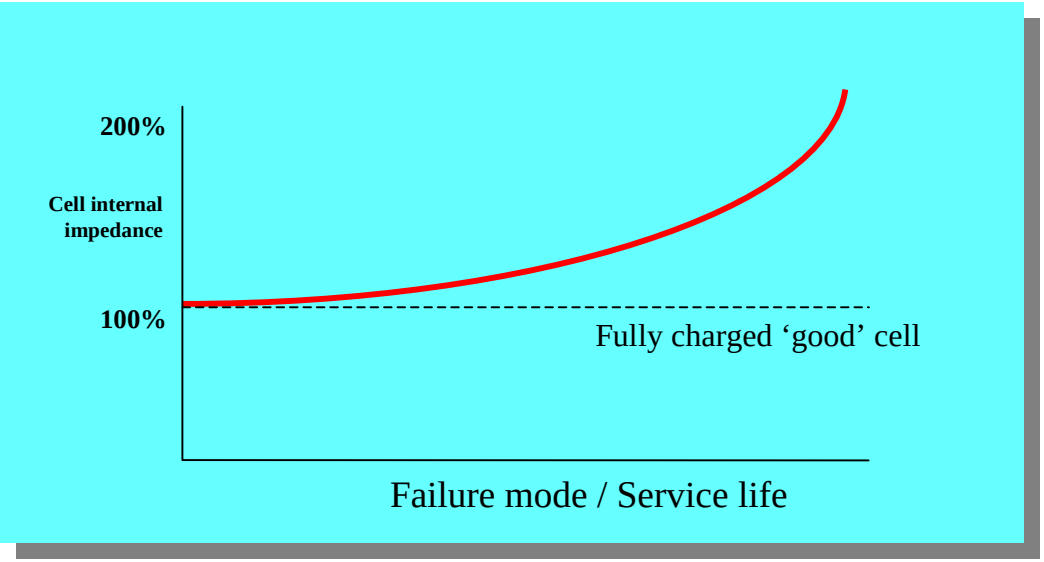
Are current Monitoring Systems effective ?

- **Terminal voltage: not effective except in discharge, or in very advanced (catastrophic) failure modes**

- **Impedance / resistance / conductance:**



Representation of cell impedance characteristic

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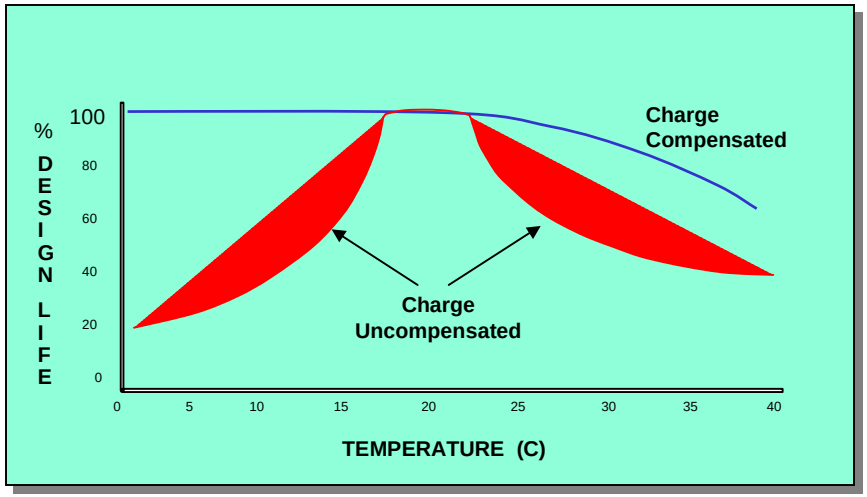
Are current Monitoring Systems effective ?

Temperature



VRLA Batteries; Life Vs Temperature
(Graph courtesy of Hawker Batteries)

Current Systems ?

Not nearly comprehensive enough

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Recent Developments in Battery Management

- **In-situ FRA developed by Guardian Link with first 'True State of Health' patent in 1997**
- **Equivalent circuit now accepted as effective representation of electrochemical process**

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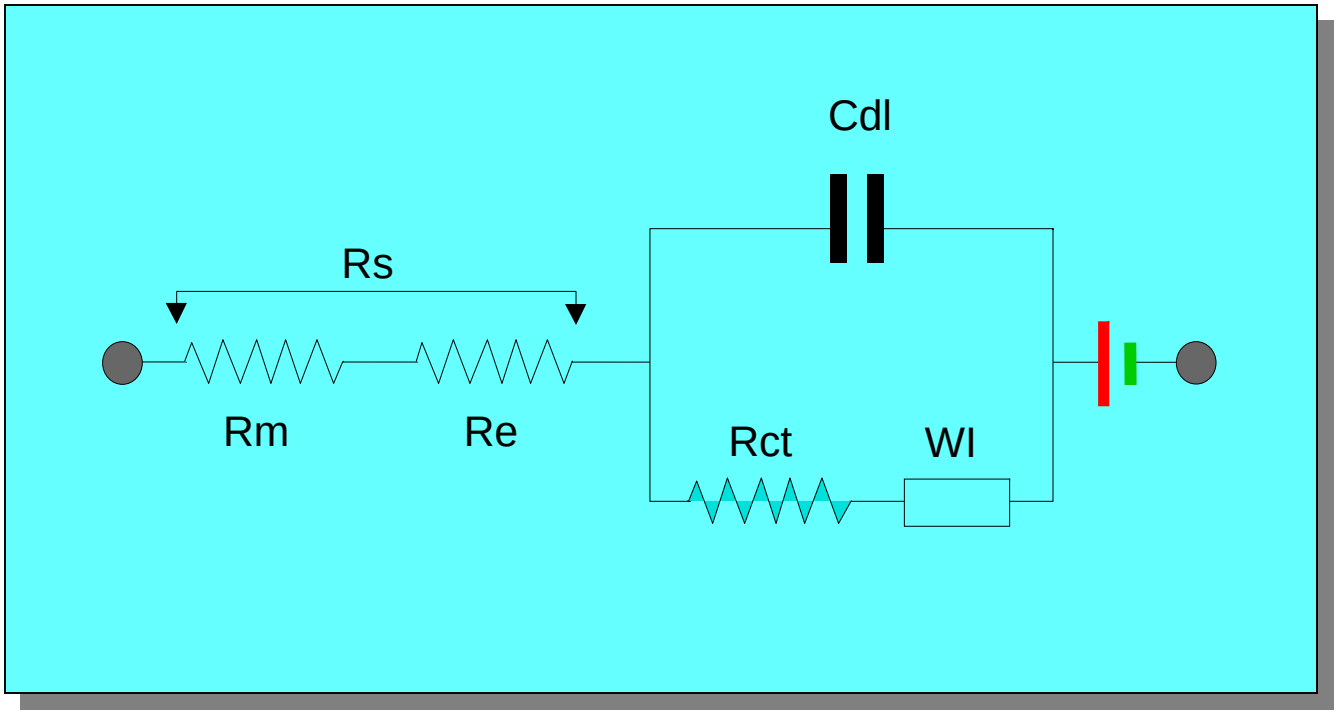
Recent Developments in Battery Management



The Randles equivalent circuit for an electrochemical cell

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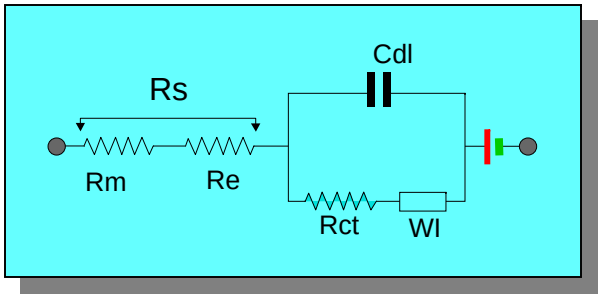
Recent Developments in Battery Management



Where:

Rm	≈	Metallic resistance	(Post, Bus bar, Grid & Paste)
Re	≈	Electrolyte resistance	
Rct	≈	Charge transfer resistance	(Electrolyte / Plate interface)
Cdl	≈	Double layer capacitance	(Plate/Electrolyte/Plate)
Wl	≈	Warburg impedance	(mass transport impedance)

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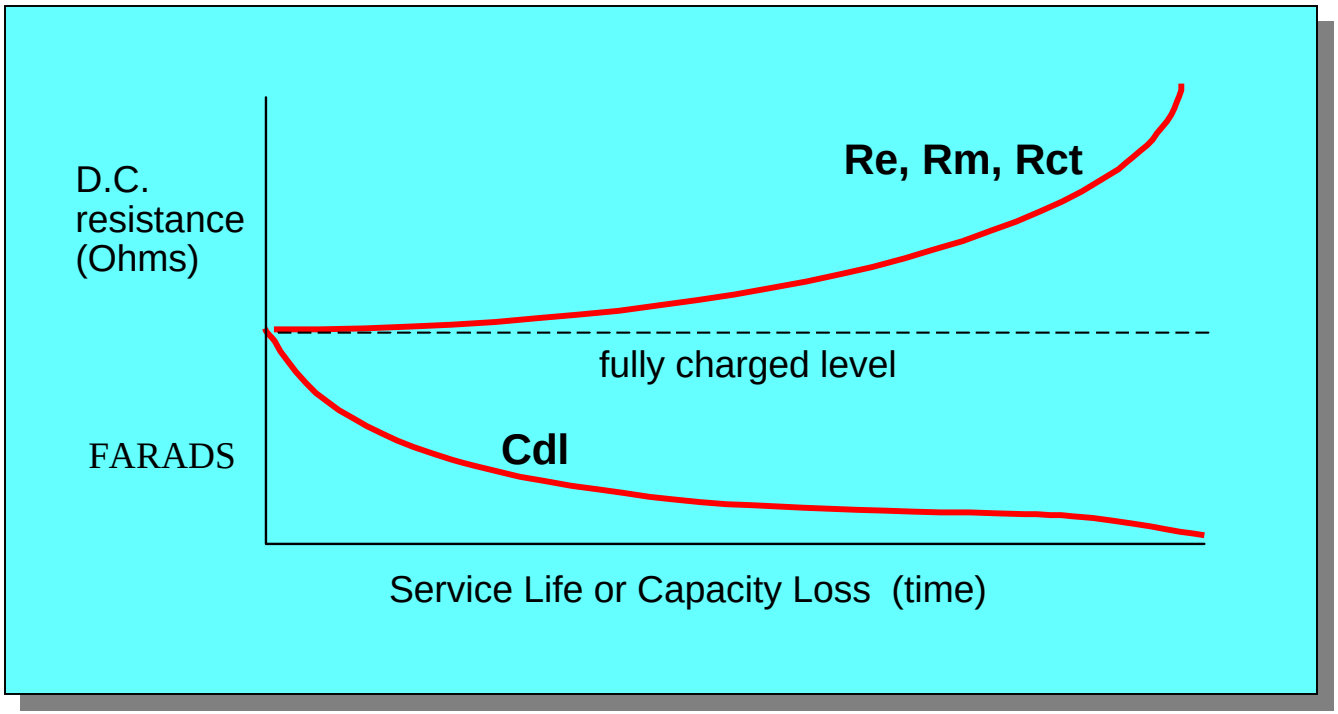
Recent Developments in Battery Management



Randles parameter progression over the cell lifetime or discharge.

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Recent Developments in Battery Management

Additional useful indicators not commonly available

- **Individual Cell Temperature**
- **Accurate measurement of Float Charge Current**
- **Many failure modes incur a rise in both cell temperature and float current**

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Recent Developments in Battery Management

How to incorporate these new techniques comprehensively in a truly cost-effective system ?

- **The most optimum system for cell management is a single IC integrated with the cell**
- **With the right techniques a single IC can be the cheapest solution**
- **Once true state of health can be determined at cell level, real benefits can be realised**

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Recent Developments in Battery Management

Realisable benefits with Integrated Cell Management (ICM) techniques:

- **Truly low cost monitoring & management**
- **Active optimisation of individual cell float voltage, preventing long term under / overvoltage.**
- **Active cycling of the float current, extending the life of the cell by up to 30%.**
- **Lifetime data log of cell voltage and temperature for extended warranty validation.**
- **Individual cell temperature and float charge profiles**

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Recent Developments in Battery Management

USER acceptance criteria

- **COST !**
- **COST !**
- **COST !**

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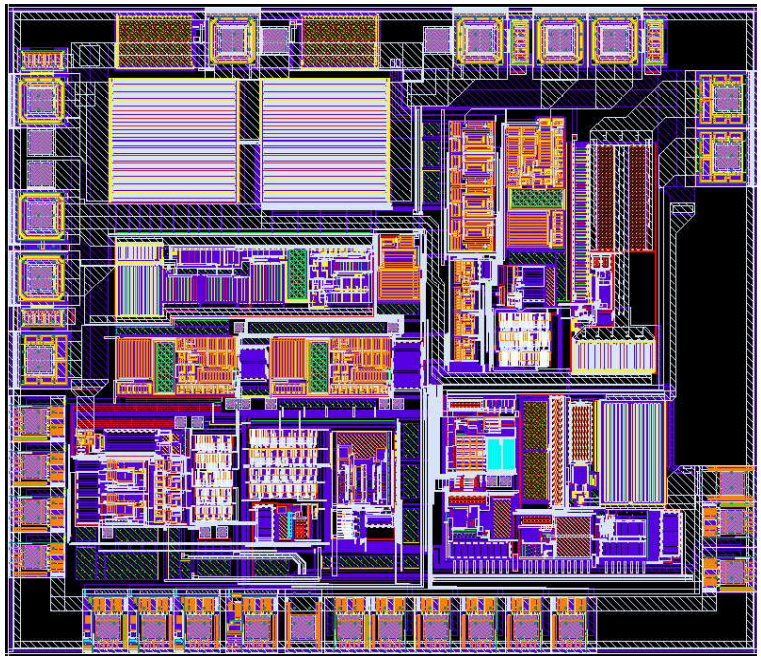
Recent Developments in Battery Management

High volume production methods to break the price barrier



ASIC System on Chip die designed by LEM Geneva

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Recent Developments in Battery Management

High volume production methods to break the price barrier

LEM components production facility in Geneva

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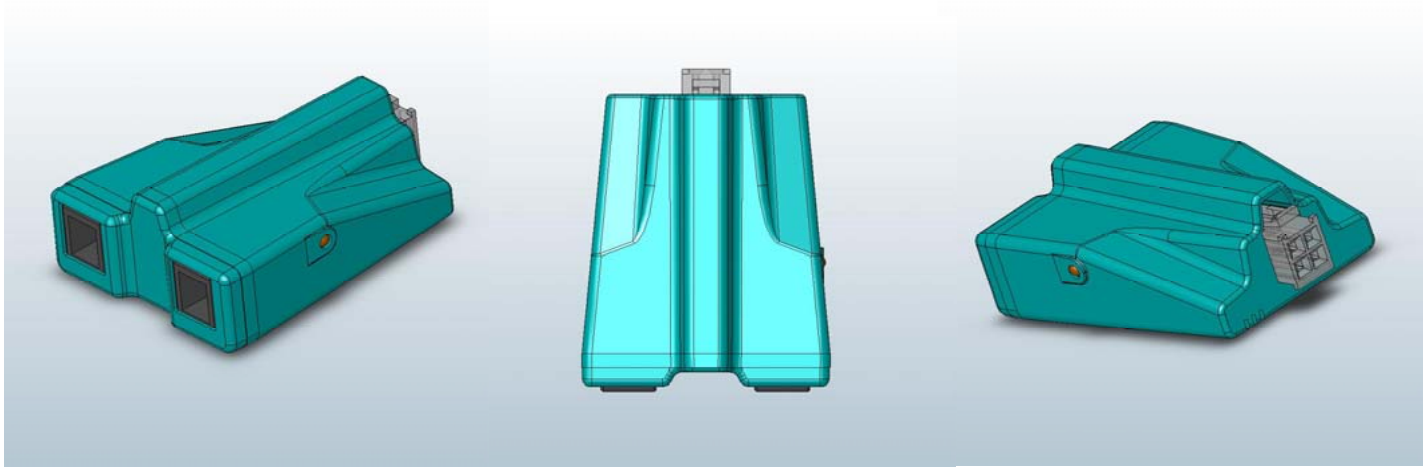
The future of Battery Management



Integrated Cell Management (ICM) Transducer

- **Integrates the system with the cell (ICM)**
- **Lowers the cost**
- **Changes battery monitoring from expensive addition to cost-effective management tool essential to the battery**

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