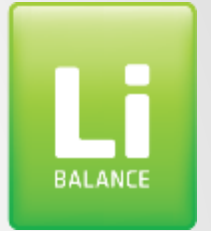




Sensata
Technologies

LiTHIUM BALANCE
BATTERY MANAGEMENT SYSTEMS



Sensata and Lithium Balance BMS

Introduction

February 2023

About Sensata

Global industrial technology company and a leading provider of sensor-rich solutions that create insights for customers

Key market player in automotive, appliance, aircraft, industrial, military, heavy vehicle, off-road, HVAC, data, telecom, RV, and marine markets



BY THE NUMBERS

\$3,9B

2022 revenue

20,000+

employees

15

countries

with Sensata sites

What are Sensata's products?

1.1 Billion

devices shipped each year,
each highly engineered

17 Brands

we own, manufacture and sell

47,000+

Unique products

Sensata Technologies | Airpax | BEI Kimco | BEI Sensors | Crydom | Cynergy3 | DeltaTech | GIGAVAC | Kavlico | Klixon
Lithium Balance | Magnum Dimensions | Newall | PRECO Electronics | Qinex | Schrader | SensorNITE | Swindon Silicon Systems



A Selection of Sensata's Customers



Sensata's Broad Global Footprint

- Manufacturing
- Business Site

Americas

Mexico, United States
(Arizona, California, Idaho, Maryland,
Massachusetts, Minnesota,
Washington)

Europe

Belgium, Bulgaria, Denmark, France, The Netherlands, UK

Asia

China
India
Japan
Korea Malaysia



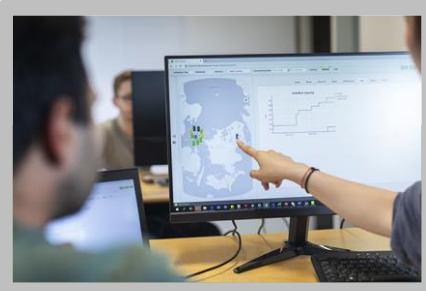
PLUS Sales & Engineering Support Offices Worldwide

Lithium Balance Facts



>1000

Customers served



17

Years of BMS
experience



>1 mill

Products shipped
/ year



>300

Man-years of BMS
engineering



2009

Date of first volume
supply



0

Functional Safety
incidents

The history

- 2006: Company established
- 2008: Ørsted Group Invest
- 2009: s-BMS Launch
- 2011: First OEM customer in production
- 2013: World first Manned Electric aircraft with Lithium Balance BMS
- 2015: ISO 9001 certificate
- 2017: c-BMS launch
- 2018: n-BMS launch
- 2018: First mass production orders to US, Japan and Switzerland
- 2019: First mass production contract for India
- 2020: TUV SUD Certification ISO 26262 ASIL C of new BMS platforms
- 2021: Sensata Technologies fully acquires Lithium Balance
- 2022: Launch of i-BMS
- 2023: Launch of c-BMS24X



WE MAKE BATTERIES WORK!

Products

Lithium Balance

Lithium Balance BMS Solutions

Over 700 applications in more than 25,000 operational vehicles since more than 15 years



Longevity

- Efficient and proven balancing
- Advanced Battery models

More than 3 OEMs with 10+ years of battery operation



Performance

- High measurement accuracy
- Advanced parameter setting

Proven up to 30% more range



Safety

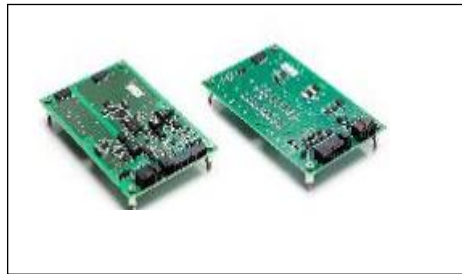
- Designed and tested to the highest safety standards
- Proven reliability and safety in real world

No safety incident since start of operation

Product range – off the shelf

1. GEN

s-BMS



- Scalable 6-256 cells
- 12 – 1000 V
- 8 cells per LMU
- Configurable CAN
- 3 configurable GPIO



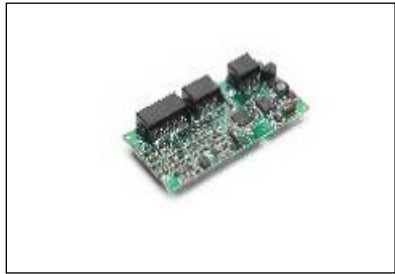
2. GEN

i-BMS



- Fixed 14 or 15 cells
- 20 – 60 V
- Integrated shunt/relay
- Advanced SoX
- 6 Parallel pack config

c-BMS



- Fixed 6 to 24 cells
- 12 – 100 V
- Scalable current (external relay/shunt9)
- Auto-off

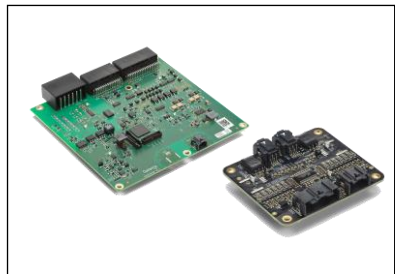
n-BMS



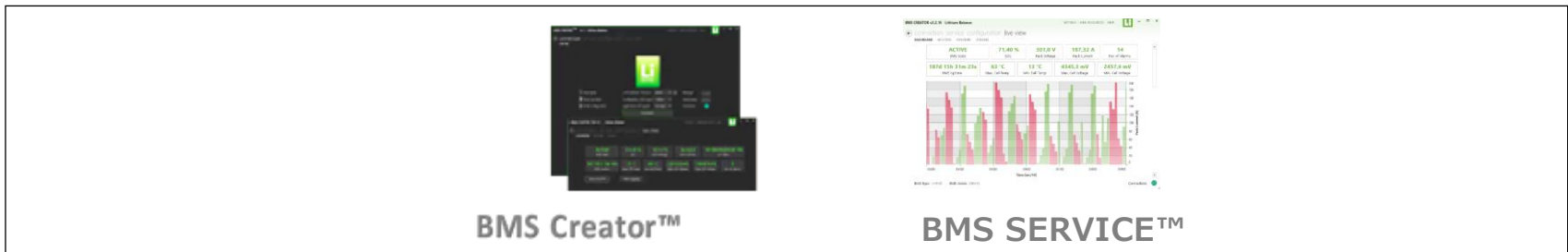
- Scalable 6 to 384 cells
- 12 – 1000 V
- 12 cells per CMU
- CAN post processor
- 2 CAN bus
- 16 GP IO

3. GEN

n3-BMS



- ISO26262 ASIL C
- 12 – 1000 V
- 12/15 cells per CMU
- E-SW (Open API)
- 3 CAN bus
- 16 GP IO



End markets and Partners

Lithium Balance

WW leading Integrators/Battery Packers

 **FORSEE POWER**


Forsee Power

- n3/c/i/n-BMS
- Truck/Busses
- Material Handling
- Micro cars




Kubota





 **HEXAGON PURUS**

Hexagon

- n-BMS (CMU15)
- Truck/Busses




TOYOTA



 **BMZ**
THE INNOVATION GROUP

BMZ Poland

- n3-BMS
- Truck/Busses
- Material handling



 **SOLARIS**
A CAF GROUP COMPANY



 **IMPACT**

ICPT

- n3-BMS
- Truck/Busses




ALEXANDER DENNIS



Industrial Application



CARGOTEC

Forklift


- LFP battery
- 48 V / 180 Ah
- s-BMS
- In production since 2016
- Delivered >100 batteries




Banke
ACCESSORY DRIVES

Garbage Compressor


- s-BMS boxed
- 600 V Battery
- 70 Ah LFP cells
- In production since 2010

GREEN MACHINES
From Tennant Company

First electric streetsweeper

- **LFP** cells, 72V /400 Ah
- 2 parallel packs
- SOP 2009
- s-BMS
- Delivered more than 1000





Speciality Vehicles







Train traction battery

- LTO cells
- n-BMS up to 288 cells in series
- 0-series in 2019


E-wakeboard

- NMC battery
- 48 V / 20 Ah
- c-BMS24
- SOP 2019
- Delivered 400 systems

Sports Car

- NMC battery
- 600 V
- s-BMS
- Fast Charge capability
- OEM: Arcfox



Material Handling



Lift/Crane

- s-BMS
- 600 V Battery
- 20/72 Ah LFP cells
- In production 2019



Battery kits

- s-BMS / BPU
- 24, 36, 48 and 80V
- From 100 to 1200 Ah
- In production since 2016
- >500 systems supplied




Battery kits

- s-BMS / BPU
- 48/200 Ah
- In production since 2018
- >10 systems supplied




Material Handling

 **HOEFLON**

Mini Crane

- LFP battery
- 48 V / 180 Ah
- c-BMS24
- Up to 6 parallel packs
- In production since 2019
- Annual production: 400




 **becker**
WARKOP
SYSTEMY DLA GÓRNICICTWA
A PART OF THE BECKER MINING SYSTEMS GROUP OF COMPANIES

Mining Equipment


- LFP battery
- s-BMS
- In production since 2019




 **stow**
storage solutions
Averyis group


Shuttle robot

- NMC battery
- 48 V / 30 Ah
- s-BMS and c-BMS24
- In production since 2014
- Delivered >500 systems




Truck/Bus







First Indian E-bus

- s-BMS
- 6 x 48V battery in parallel
- In production since 2017
- >50 systems supplied










E-Truck

- **NMC** cells
- Up to 4 parallel packs
- 600 V
- n-BMS
- In production since 2018








Utility vehicles

- s-BMS for 400V conversion vehicle
- **NMC** cells
- Partner with PSA
- In production since 2009



2/3 wheeler






Golf car battery

- LFP and NMC
- c-BMS24
- 48 V / 200 Ah battery
- SOP 2018




World fastest E-Superbike

- High performance **NMC** based motor bike
- Patented battery pack with standard s-BMS HW and SW
- SOP 2016







Mass produced golf cart

- **NMC** cells from AESC
- 48 V battery from TOCAD
- SOP 2019
- c-BMS24
- Production: 1500-2000





Automotive Application

  Jiangling Motors Co., Ltd. | JV with Ford 

JMC-FORD Territory


- 330 km range
- 57 kW battery, 88s1p
- SOP: July 2020
- Annual volume: 20k
- Customized BMS platform



First Indian E-bus

- s-BMS
- 6 x 48V battery in parallel
- In production since 2017
- >50 systems supplied





LEV Application


Electrike Japan
日本エレクトライク


First Li-ION e-trike


- NMC battery
- 48 V / 60 Ah
- s-BMS
- In production since 2011
- Delivered >100 systems



E-Scooter

- **NMC** cells
- 48 V battery
- SOP 2014
- s-BMS
- >1000 systems supplied



LEV Application




No 1 luxury Golf cart

- LFP cells, 48V
- Co-brand with Mercedes
- SOP 2019
- s-BMS
- Retail price: 75.000 USD






Quad EV

- series hybrid
- high power NCA cells
- c-BMS24
- 48V / 10 kWh battery



LEV Application




Indian e-trike


- LFP battery
- 48 V / 60 Ah
- c-BMS24
- In production since 2018
- Delivered >300 systems








Golf car battery


- LFP >100km range
- c-BMS24
- 48 V / 180 Ah battery
- SOP 2019








E-motorbike

- c-BMS24
- c-BPU
- 48 V battery
- >200 systems
- SOP 2018






LEV Application

2/3 wheeler Concept


- 48 V battery
- Hot-swappable
- c-BMS24
- Concept vehicle




 

2/3 wheeler platform

- 48 V battery
- Hot-swappable
- i-BMS15
- SOP 2020.12





Marine Application



U-Boat Worx

Leisure Submarine


- High performance **NMC**
- **n-BMS**
- 4 batteries per unit
- SOP 2018



HYDROSTA

Marine battery

- **LFP** cells
- s-BMS
- Up to 250 kWh
- Fully DNV certified BMS
- SOP 2018



ESS Application




Time Shift
energy storage




Modular ESS

- LFP
- 860V per string
- 50kWh – 5MWh
- s-BMS

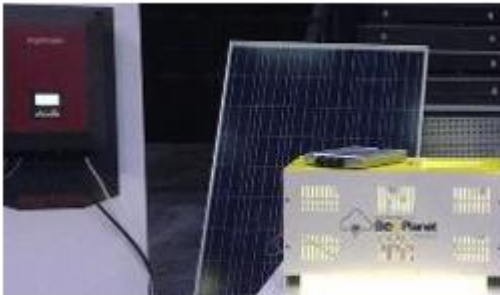




BeePlanet
factory




Second-life ESS

- Residential ESS
- Industrial Grid tied ESS
- LFP and NMC
- c-BMS/n-BMS
- 48V – 850V per string

XOLTA



Industrial ESS

- **NMC** cells
- 79 kWh racks
- SOP 2018
- n-BMS / c-BMS/ i-BMS

