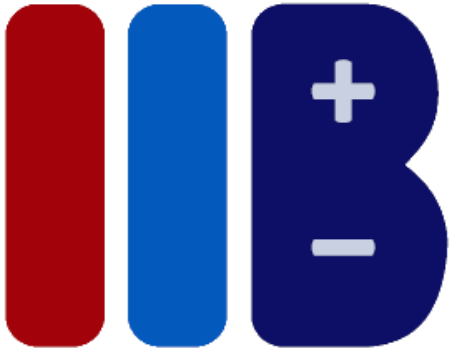
Li ion Traction Batteries



Lithium Traction Batteries

Technical Features & Benefits

LiFePO4 - One of the safest Lithium-Ion technologies

Maintenance-free with no topping-up deionized water needs

High Energy Density

Excellent voltage stability during discharge

Multi-shift operation - High operation availability of the vehicle

HIGH SAFETY STANDARDS

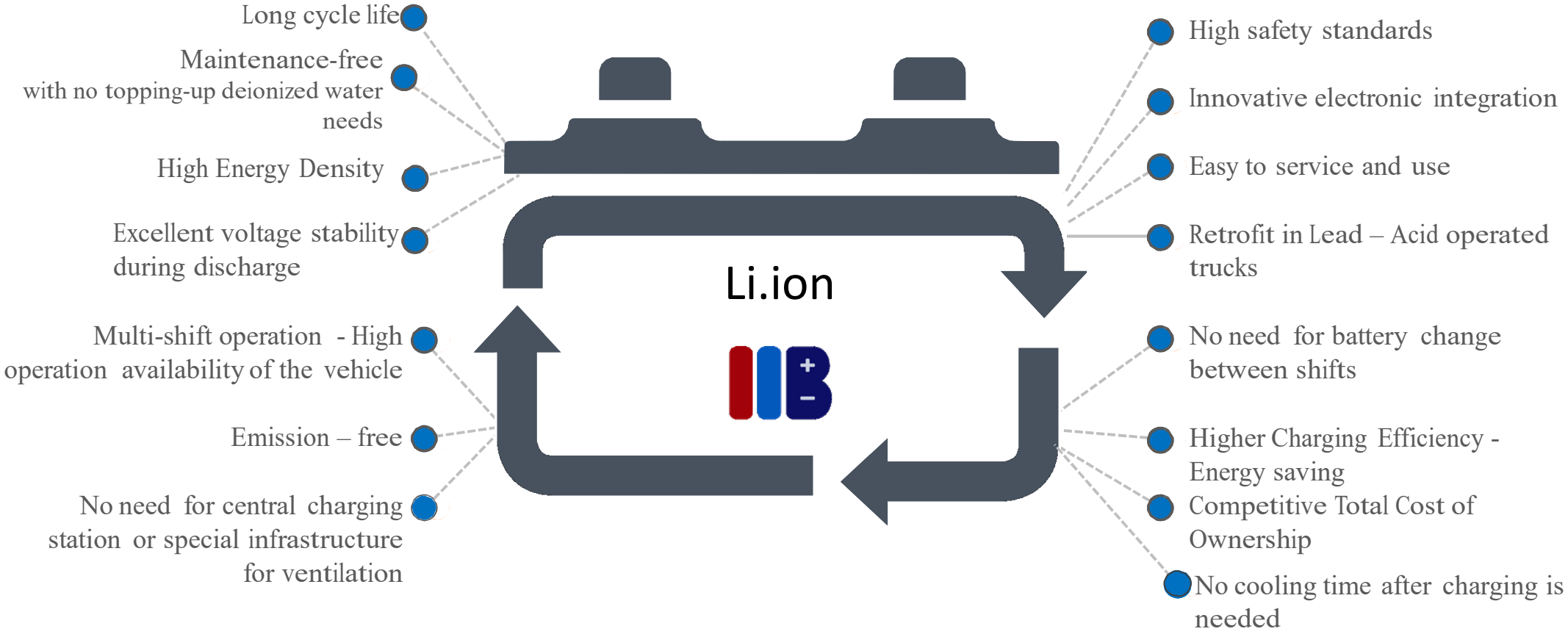
AVAILABILITY 24/7

MAINTENANCE FREE

Retrofit in Lead – Acid operated trucks

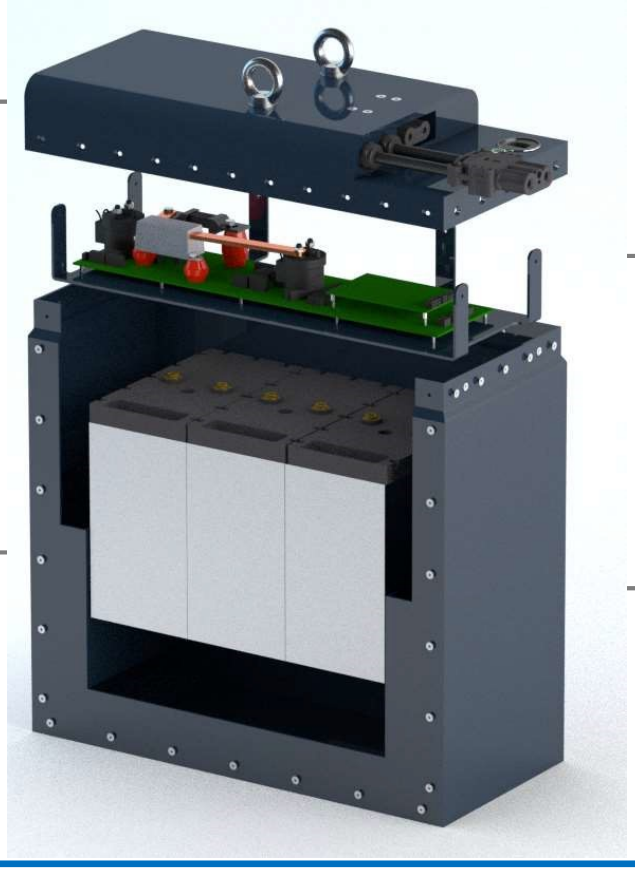
Lithium Traction Batteries

Technology - Design – Operational Advantages



Lithium Traction Batteries

NEW design approach



Lithium Traction Batteries

Modular design_ New design approaching for cells connection & balancing

Module approach is utilized ensuring:

- Maximum safety
  - Space & Interconnection Efficiency
- Robust construction
  - Full monitoring per cell
- Serviceability
  - Balancing per cell

Lithium Traction Batteries

Battery Interface

On-board state of charge (SoC) display (external display available as option)

Sleep mode to minimize even more the self-consumption of the system

Single power – ON mounted on the battery

Two integrated power plugs for easier recharging without removing the battery from the forklift

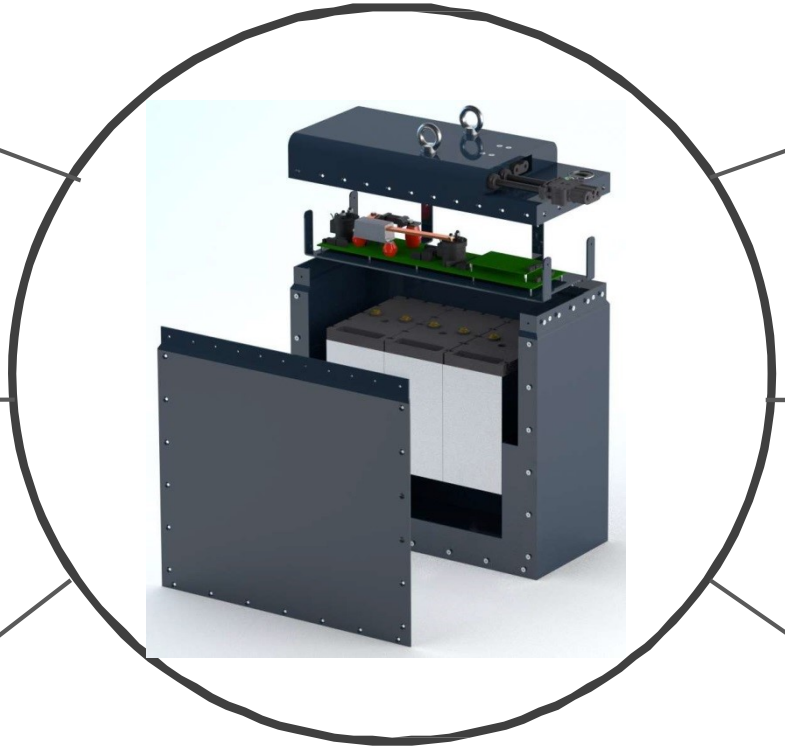
Lithium Traction Batteries

Battery Housing – Retrofit Solution

Matches the dimensions of the traditional Lead-acid trays

Serviceability
Productivity growth

Flexibility on special demand



Additional compartment is designed for counterweight for meeting weight requirements

Durable housing allowing easy handling

SUNLIGHT Li ion battery is the ideal alternative for replacement Lead Acid

Lithium Traction Batteries

BMS _ Passive

What is a BMS
(Battery Monitoring System)

An electronic controller used for the following purposes:

SAFETY FUCTIONS

Overvoltage
Overcharge
Overdischarge
Overcurrent
Undervoltage
Short-circuit
Temperature (under/ over)

CELLS BALANCING

Performs a balancing function (usually during charging) by ensuring that all cells have the same voltage and thus extending battery life

CHARGING CONTROL

Communicates charging parameters (Voltage, Current, SOC etc.) to the charger (typically via CAN-BUS)

USER INTERFACE

Provide information to the end-user about SoC, SoH, warning and error messages

Lithium Traction Batteries

BMS _ Passive

BMS (Battery Monitoring System)	Quality features

Industrial design that optimizes cable management and allows easy access to all compartments of the battery.

Power Circuit designed for maximum safety and low self-consumption

Automatic sleep mode when the battery remains idle

Lithium Traction Batteries

BMS _ Passive and Active

What is a BMS (Battery Monitoring System)?

An electronic controller used for the following purposes:

- SAFETY FUCTIONS
- CELLS BALANCING
- CHARGING CONTROL
- USER INTERFACE

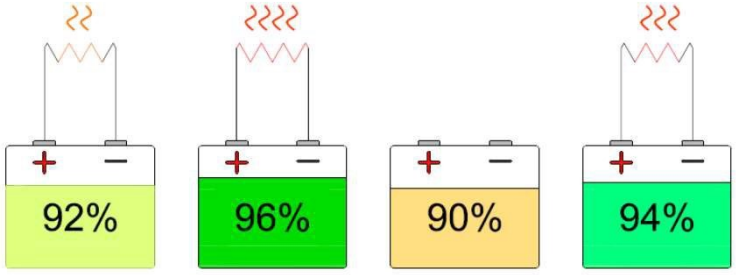
Balancing can be:

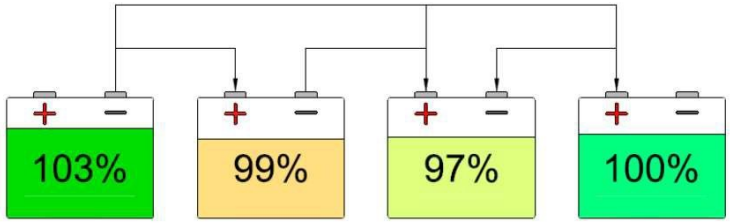
Passive (Dissipative)

Energy is removed from the most charged cell and is wasted in heat

Active (Non-dissipative)

Energy is transferred between cells and therefore it is not wasted





Passive

Active

Lithium Traction Batteries

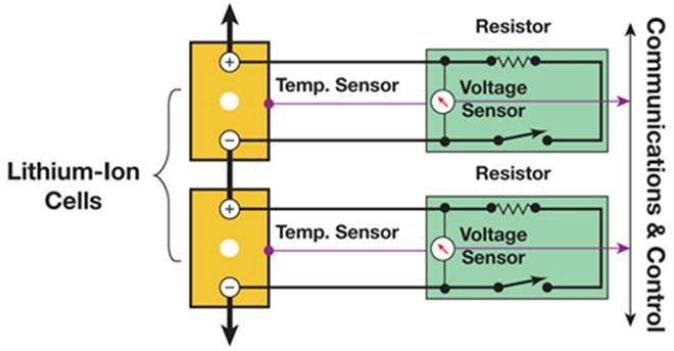
BMS _ Passive

BALANCING METHODS — PASSIVE — RESISTIVE

Function Energy is removed from the most charged cell and is wasted in heat

Advantages Lower effort and cost of implementation Less components and board space

Disadvantages Heating in battery Loss of efficiency



Lithium Traction Batteries

BMS _ Active

BALANCING METHODS

ACTIVE_SUNLIGHT's BMS

- CAPACITIVE
- INDUCTIVE
- TRANSFORMER – BASED

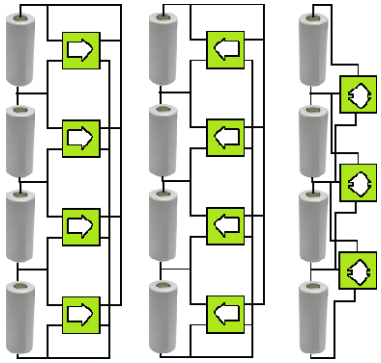
Function – Goal Instead of converting energy to heat, transfer it to a lower – charged cell

Advantages Guarantees optimized

- cycle life of the cell High efficiency
- High balancing currents possible Zero
- wasted energy & zero heat generation Fast
- balancing
- Balancing during charging & discharging

State-of-the-art in-house BMS:

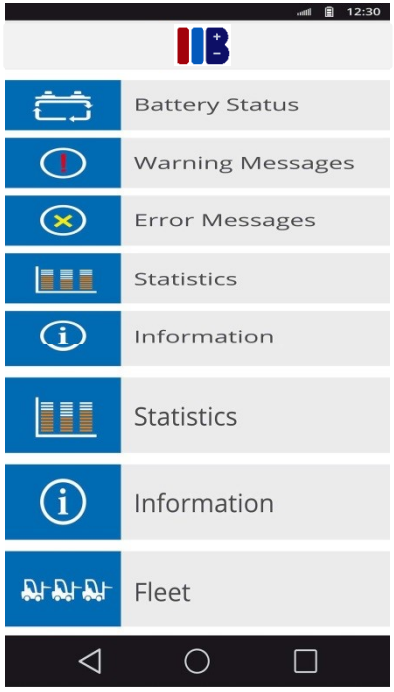
Fully customized design for motive power applications with optimized functions for large batteries in terms of voltage and capacity.

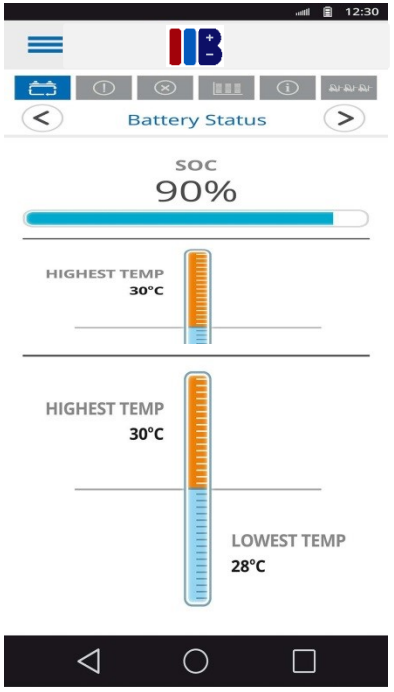


Lithium Traction Batteries

Launch 04/2019

- Real Time monitoring,
  via external Display or WiFi
  (smartphone, tablet, etc)
- Safety
  Precise insulation testing
- Embedded Data logger
- CAN bus protocol utilized for communication:
  Between the BMS units
  With external devices such as display, battery charger, forklift truck etc.
- Flexibility
  parameters settings
  up to 25 parallel connections





Thank you!