AKASOL

HIGH PERFORMANCE
BATTERY SYSTEMS
FOR

BUSES


eCITARO
eCITARO
MA EV 1063

BUSES

ECONOMICAL, QUIET AND ENVIRONMENTALLY FRIENDLY.

Due to their inner city use, buses are virtually predestined for conversion to electric and/or hybrid engines. CO2 emission and noise pollution are considerably reduced by electric buses. In addition, the electrification of commercial vehicles is already economical today. As a result of usually clearly defined usage profiles, a clear energy and performance requirement can be determined, which provides information about the total cost of ownership (TCO). Furthermore a range of up to 400 kilometers can already be achieved with fully electric powertrains. Absolutely reliable in every respect – with AKASOL.

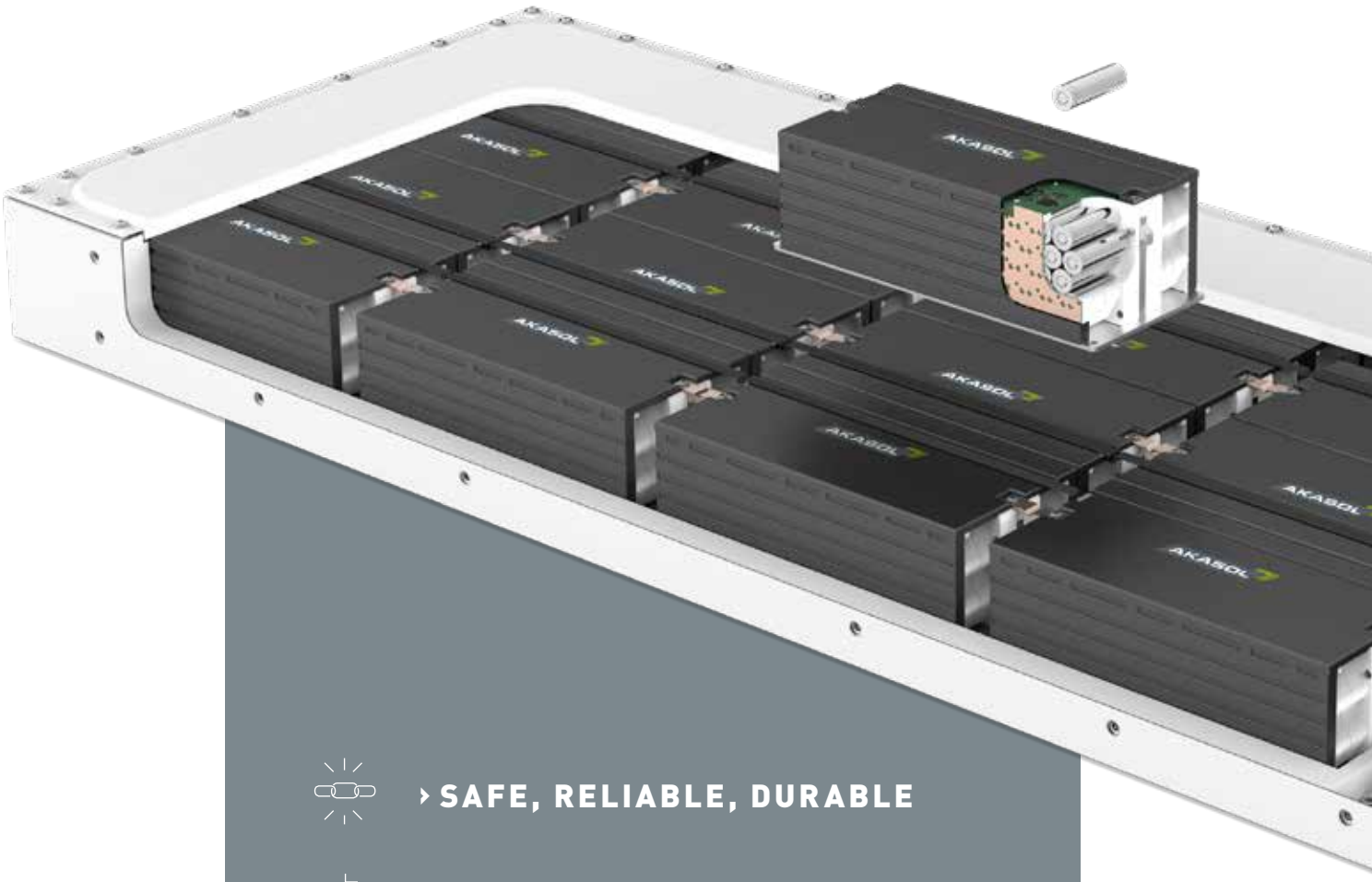
FROM A SOLAR MOBILE WORLD CHAMPION TO AN INTERNATIONAL TECHNOLOGY LEADER

Right from the outset, AKASOL was characterised by visions and the drive to conduct research and implementation of alternative powertrain concepts. The personal energy of all employees and the desire to create something pioneering in the field of modern battery storage systems has resulted in first-class products and market leadership.

In all products, AKASOL implements its comprehensive experience acquired in the development of e-mobility solutions and here, with equal intensity, pursues the basic thought of efficient, environmentally-friendly powertrains.

OUR INDUSTRY SECTORS

_BUSES
_COMMERCIAL VEHICLES
_INDUSTRIAL VEHICLES
_RAIL VEHICLES
_MARINE APPLICATIONS
_PASSENGER VEHICLES



- SAFE, RELIABLE, DURABLE
- LIQUID COOLING
- MODULAR & FREELY SCALEABLE
- CAPABLE OF FAST CHARGING
- AUTOMOTIVE, MARINE AND RAIL CERTIFIED
- HIGHEST ENERGY DENSITY
- FULLY VALIDATED

QUALITY

MADE IN GERMANY

MORE POWER AT LESS SPACE.
With very high energy densities on system level and the most compact liquid cooling in the market, AKASOL battery systems have very low space requirements and emit only little heat. These are the ideal preconditions for a long battery life with a maximum power output for a safe, reliable and durable operation.

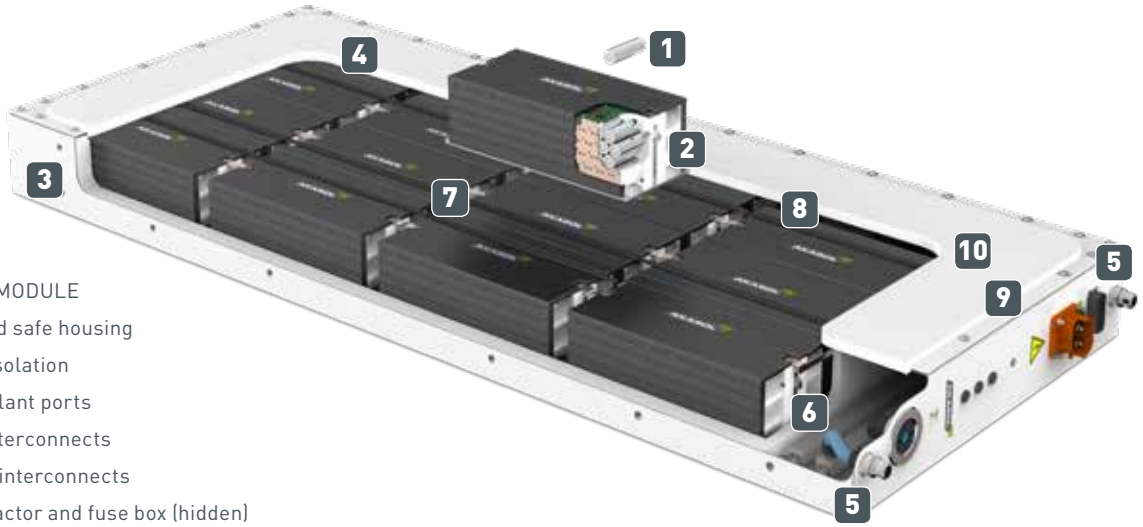
CERTIFIED & VALIDATED SOLUTIONS.
At AKASOL experts for system development, mechatronics, electronics, software and cell chemistry research together on innovative solutions for the best electrical energy storage system. All of our serial systems for buses, commercial vehicles, railway and marine applications are tested and can be certified according to the specific standards and requirements of each branch.

SERIAL PRODUCTION ACCORDING TO IATF 16949.
To fulfill our clients automotive standards, AKASOL battery systems for bus applications are developed and produced in an automotive IATF 16949 compliant environment at our production facility in Langen/Germany. And if necessary we even adopt additional requirements that come up with our clients projects.

AKASYSTEM

AKM CYC

HIGH ENERGY TECHNOLOGY FOR LONG DISTANCE TRAFFIC.



1 Cell
2 AKM CYC MODULE
3 Robust and safe housing
4 Thermal isolation
5 Liquid coolant ports
6 Coolant interconnects
7 Electrical interconnects
8 Main contactor and fuse box (hidden)
9 High voltage connector
10 Battery Management Unit (integrated)

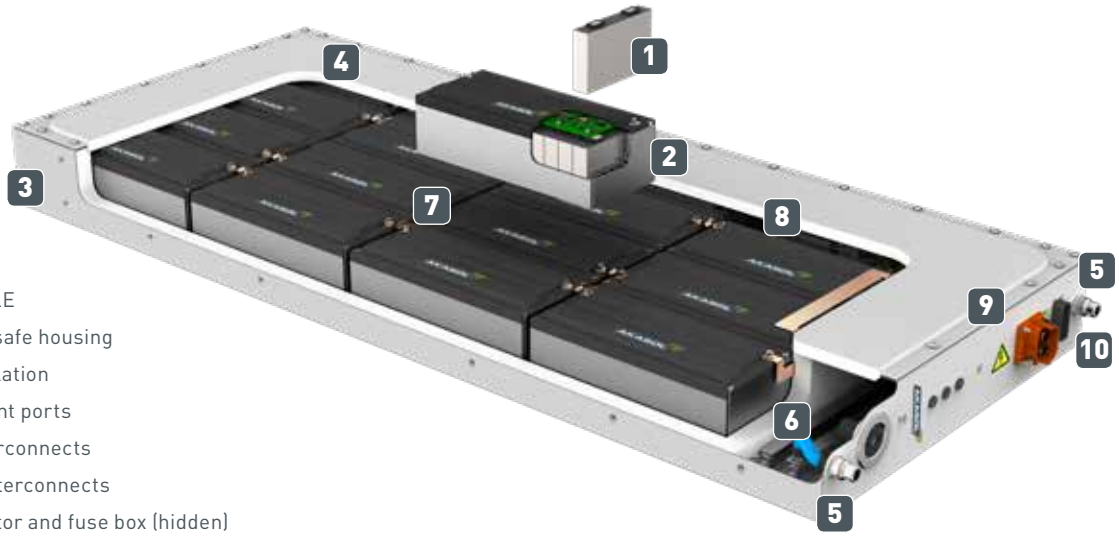
The latest high-energy battery system AKASystem CYC uses the new cylindrical cell battery modules with very high energy density. It's robust and scalable, and acquisition costs per kWh are comparatively low. In comparison to what current technology permits, this new technology will allow electric vehicles to increase their range by more than 60 percent. This system is developed for long distance traffic, e.g. buses using overnight charging facilities, intercity coaches and trucks.

- Longterm technology roadmap based on standardized cells
- 21700 standard battery cells
- Multiple battery packs mountable per vehicle
- Excellent price-performance ratio as a result of the development for serial production
- Designed and validated for automotive serial applications
- Flexible packaging (conversion design, purpose design)
- Easy system connectivity / ready-to-install (aligned connection points, standardized CAN bus, optional VDA / SAE cooling connections)
- Compact and lightweight solution, significant volume reduction due to liquid cooling
- Long service life due to active and passive thermal management
- Additional operating safety due to redundant battery management system
- Robust and proven control unit BMS master
- Protection classes IP67 up to IP6K9K
- Up to 1 C continuous
- Up to 2 C peak rating (discharge)
- Up to 1,000 V DC

AKASYSTEM

OEM PRC

SERIAL TECHNOLOGY FOR BUS APPLICATIONS.



1 Cell
2 OEM MODULE
3 Robust and safe housing
4 Thermal isolation
5 Liquid coolant ports
6 Coolant interconnects
7 Electrical interconnects
8 Main contactor and fuse box (hidden)
9 High voltage connector
10 Battery Management Unit (integrated)

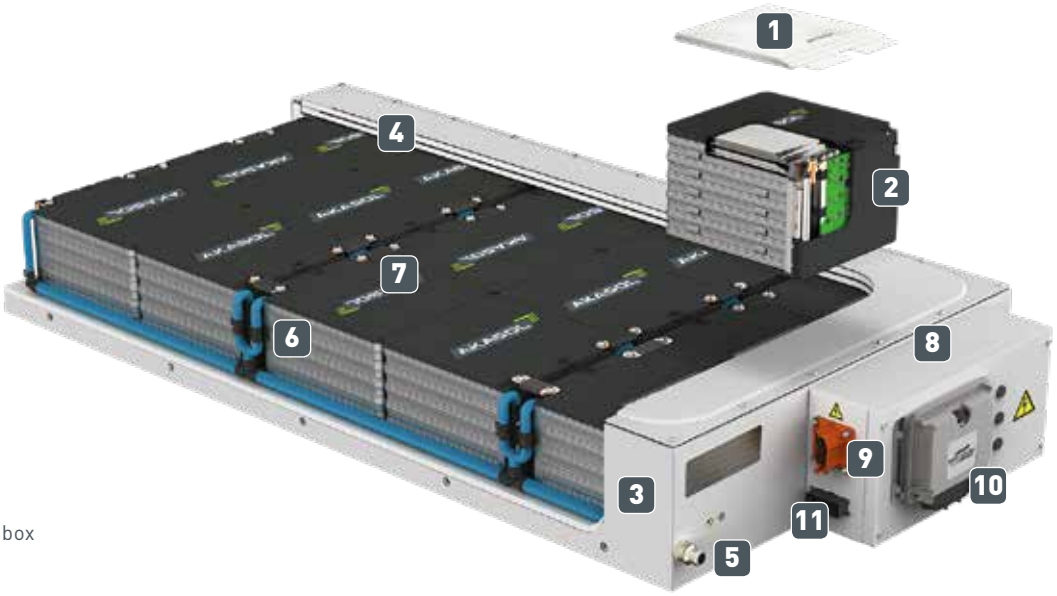
The AKASystem OEM lithium-ion battery system proves: powerful, specifically adapted lithium-ion battery systems for automotive applications can be both high-quality and affordable at the same time. AKASOL is the leading European battery manufacturer to offer a system that is compatible with the standardised automotive PHEV modules of all major producers. This means that even automotive applications for series production are ideally equipped for their demanding tasks and, at the same time, remain flexible should the module supplier change at any point.

- Automotive PHEV battery modules from various OEMs available
- Up to 3,000 cycles
- Freely scalable system with any given number of OEM SYSTEMs
- Excellent price-performance ratio
- Flexible package options
- Integrated main contactor and fuse box
- Easy system connectivity (flexible connection points, standardized CAN bus)
- Compact and lightweight design
- Long service life due to active and passive thermal management
- High safety due to redundant battery management system (up to SIL 2 / ASIL C)
- Automotive BMS technology for reliability and safety
- Environmental rating IP67 up to IP6K9K
- Automotive NMC lithium-ion technology with long cycle life
- High peak C rate capability
- Up to 2 C continuous
- Up to 8 C peak rating (discharge)
- Up to 1,000 V DC

AKASYSTEM

AKM POC

HIGH POWER TECHNOLOGY FOR FAST CHARCHING APPLICATIONS.



1 Cell
2 AKM POC MODULE
3 Robust and safe housing
4 Thermal isolation
5 Liquid coolant ports
6 Coolant interconnects
7 Electrical interconnects
8 Main contactor and fuse box
9 High voltage connector
10 BMS Master
11 Safety Control Unit

High power automotive applications benefit from a liquid-cooled and freely scalable system that not only fulfills the highest safety standards, but also currently belongs to one of the most powerful battery solutions in the world. Robust, maintenance-free and fast charging AKASystem AKM is ideal for use in the variety of automotive applications with very high requirements when it comes to cycle life, performance and high system voltage.

- Freely scalable system with any given number of AKAMODULEs
- More than 3,100 cycles (NMC) and more than 7,000 cycles (NANO)
- Excellent Total Cost of Ownership (TCO)
- Flexible package options
- Easy system connectivity (flexible connection points, standardized CAN bus)
- Compact and lightweight design
- Long service life due to active and passive thermal management
- High safety due to redundant battery management system (up to SIL 2 / ASIL C)
- Extremely effective liquid cooling on module level
- Automotive BMS technology for reliability and safety
- Environmental rating IP67 up to IP6K9K
- Automotive high performance NMC lithium-ion technology with very long cycle life
- High peak C rate capability
- Up to 3 C continuous
- Up to 8 C peak rating (discharge)
- Up to 1,000 V DC

WHY IS LIQUID COOLING INDISPENSIBLE?

BATTERY CHEMISTRY NEEDS

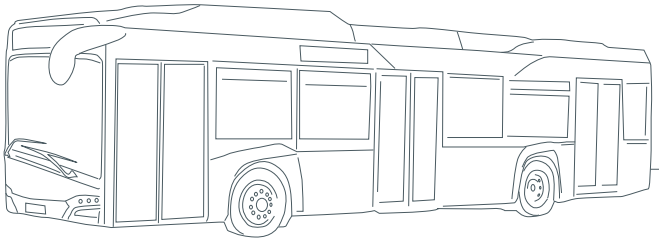
- Even temperature distribution
- Optimum absolute temperature level
- Fast thermal conditioning
- Compact and robust design

BENEFITS FOR BATTERY OPERATION

- Slow aging and long life
- High availablity of power and energy
- Safety
- High power use possible

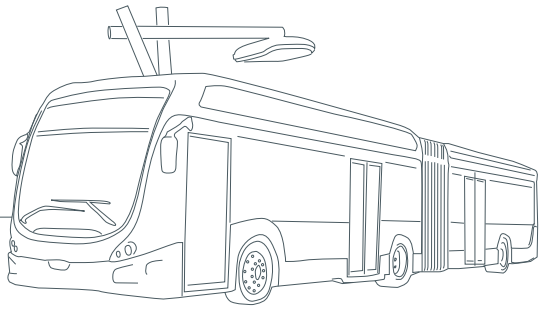
TEMPERATURE CHARACTERISTIC FOR VARIOUS COOLING MODES.

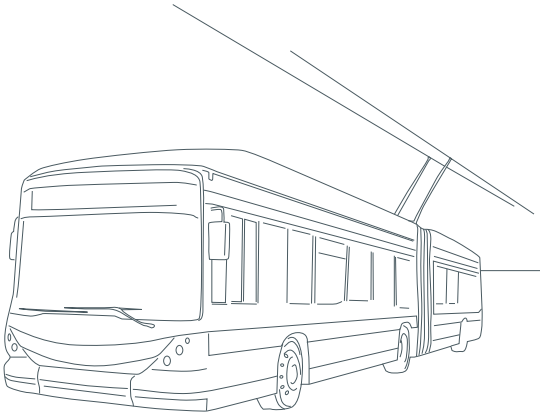
SCALABLE.
VALIDATED.
READY FOR
SERIAL USE.



OVERNIGHT CHARGING BUS

OPPORTUNITY CHARGING BUS

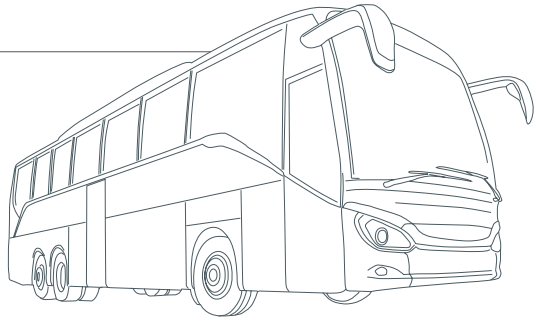




TROLLEY BUS

As an ideal energy supplier for plug-in hybrid buses AKASystems are being used in London's double-deckers.

FUEL CELL BUS



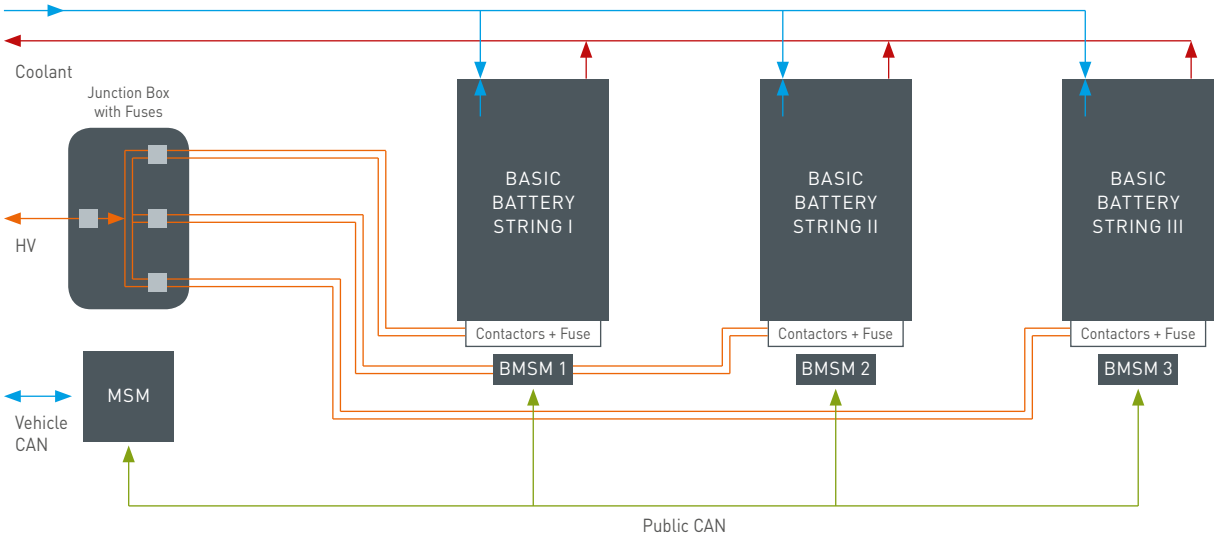
AKASYSTEMS
SCALABLE. VALIDATED.
READY FOR USE.

- Freely scalable system with any number of AKAMODULEs or OEM SYSTEMs
- Flexible packaging (conversion design, purpose design)
- High energy and/or high energy and power density
- Easy system connectivity / ready-to-install (aligned connection points, standardized CAN bus, optional VDA/SAE cooling connections)
- Excellent price-performance ratio as a result of the development for serial production
- Liquid cooling for consistent temperature
- Compact and lightweight solution, significant volume reduction due to liquid cooling
- Long service life due to active and passive thermal management
- Exceptionally robust, maintenance-free operation
- EMI compliant

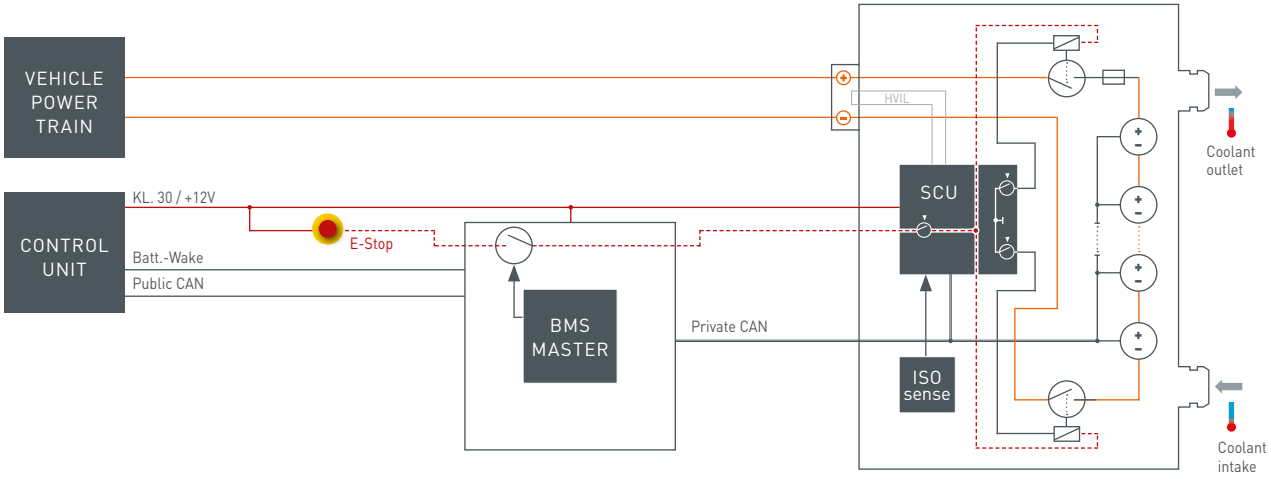
CERTIFIED & STANDARDIZED FOR AUTOMOTIVE APPLICATIONS.

- Development according to ISO 26262 up to ASIL C / EN 61508 SIL 2 possible
- Tested safety (USABC, IEC, SAE, UN 38.3) and "real world" experience
- Multi-level short circuit protection on cell, module and system level
- Additional operating safety by a redundant battery management system architecture
- Suitable for multi-tray systems with full monitoring on single-tray and system level
- Protection classes IP67 up to IP6K9K
- Rugged and well-tried control unit BMS master (SIL2 compatible hardware TTC90)
- Local, redundant safety control unit in all trays
- Voltage and temperature monitoring SOC/SOH analysis
- Voltage balancing between the modules

AKASYSTEM – MULTI STRING CONCEPT



AKASYSTEM – SAFETY CONCEPT



AKASYSTEM **AKM 60 CYC**	**Energy**	**Power max. (10s)***	**Power cont. (RMS)**	**Voltage (nom.)**	**Weight**	**Dimension** (LxWxH) in mm
AKASYSTEM 12 AKM 60 CYC	31.5 kWh	64 kW	16...32 kW	529 V	ca. 195 kg	1,340 x 700 x 150
AKASYSTEM 15 AKM 60 CYC	39.5 kWh	80 kW	20...40 kW	662 V	ca. 250 kg	1,700 x 700 x 150
AKASYSTEM 16 AKM 60 CYC	42.0 kWh	84 kW	21...42 kW	705 V	ca. 262 kg	1,700 x 700 x 150
AKASYSTEM **n AKM 60 CYC: freely scalable according to your application**						

*peak rating depending on fuse and cable / connector configuration / SOC and temperature

AKASYSTEM **OEM 37 PRC NMC**	**Energy**	**Power max. (10s)***	**Power cont. (RMS)**	**Voltage (nom.)**	**Weight**	**Dimension** (LxWxH) in mm
AKASYSTEM 12 OEM NMC	19.6 kWh	60...120 kW	30...40 kW	529 V	ca. 185 kg	1,340 x 700 x 150
AKASYSTEM 15 OEM NMC	24.5 kWh	75...150 kW	37...50 kW	661 V	ca. 238 kg	1,700 x 700 x 150
AKASYSTEM 16 OEM NMC	26.1 kWh	80...160 kW	40...53 kW	705 V	ca. 249 kg	1,700 x 700 x 150
AKASYSTEM **n OEM 37 NMC: freely scalable according to your application**						

*peak rating depending on fuse and cable / connector configuration / SOC and temperature

AKASYSTEM **AKM 53 POC NMC**	**Energy**	**Power max. (10s)***	**Power cont. (RMS)**	**Voltage (nom.)**	**Weight**	**Dimension** (LxWxH) in mm
AKASYSTEM 12 AKM NMC	28.2 kWh	216 kW	48 kW	533 V	233 kg	1,593 x 600 x 216
AKASYSTEM 15 AKM NMC	35.3 kWh	270 kW	60 kW	666 V	333 kg	1,546 x 750 x 216
AKASYSTEM 18 AKM NMC	42.4 kWh	324 kW	72 kW	799 V	421 kg	1,844 x 750 x 216
AKASYSTEM **n AKM 53 NMC: freely scalable according to your application**						

*peak rating depending on fuse and cable / connector configuration / SOC and temperature

AKASYSTEM **AKM 46 POC NANO NMC**	**Energy**	**Power max. (10s)***	**Power cont. (RMS)**	**Voltage (nom.)**	**Weight**	**Dimension** (LxWxH) in mm
AKASYSTEM 12 AKM NMC NANO	24.5 kWh	325 kW	61 kW	533 V	289 kg	1,593 x 600 x 216
AKASYSTEM 15 AKM NMC NANO	30.6 kWh	406 kW	77 kW	666 V	372 kg	1,546 x 750 x 216
AKASYSTEM 18 AKM NMC NANO	36.8 kWh	487 kW	92 kW	799 V	445 kg	1,844 x 750 x 216
AKASYSTEM **n AKM 46 NMC: freely scalable according to your application**						

*peak rating depending on fuse and cable / connector configuration / SOC and temperature

THE WORLD OF AKASOL

HIGH PERFORMANCE LITHIUM-ION-BATTERY SYSTEMS FOR E-MOBILITY AND STORAGE OF RENEWABLE ENERGY

AKASOL AG has nearly 30 years of experience with lithium-ion battery systems – in a variety of different applications and under, severe conditions, our customers have already travelled millions of kilometres electrically with AKASOL battery systems.

With a comprehensive development team and locations in Darmstadt, Langen and Ravensburg, we are ideally prepared for the future. In one of the most modern test environments for analysis and validation procedures in the field of modern battery technology in Europe, we already find solutions today for the challenges of tomorrow.

PLEASE DO NOT HESITATE TO CONTACT US.

DARMSTADT

AKASOL AG
Head Office and R&D-Center

Landwehrstrasse 55
64293 Darmstadt
Germany

T +49 6151 800500
info@akasol.com

LANGEN

AKASOL AG
Serial Production Plant

Raiffeisenstrasse 5A
63225 Langen
Germany

T +49 6103 48567-0
info@akasol.com

RAVENSBURG

AKASOL AG
ESS Division

Theodor-Krumm-Str. 18
88213 Ravensburg
Germany

T +49 751 366560-400
info@akasol.com