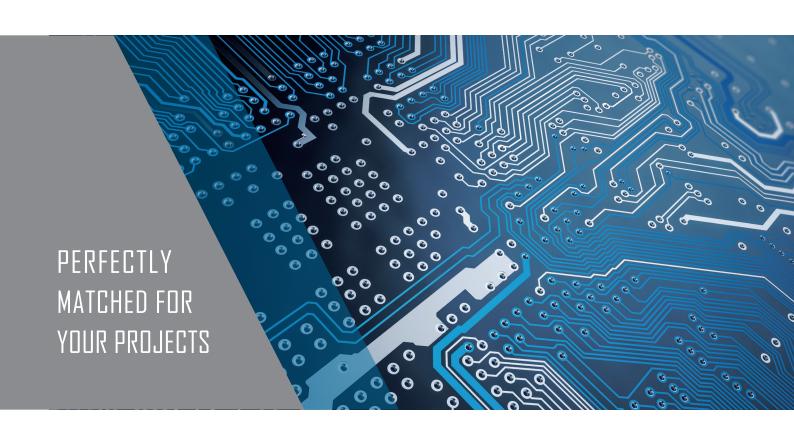


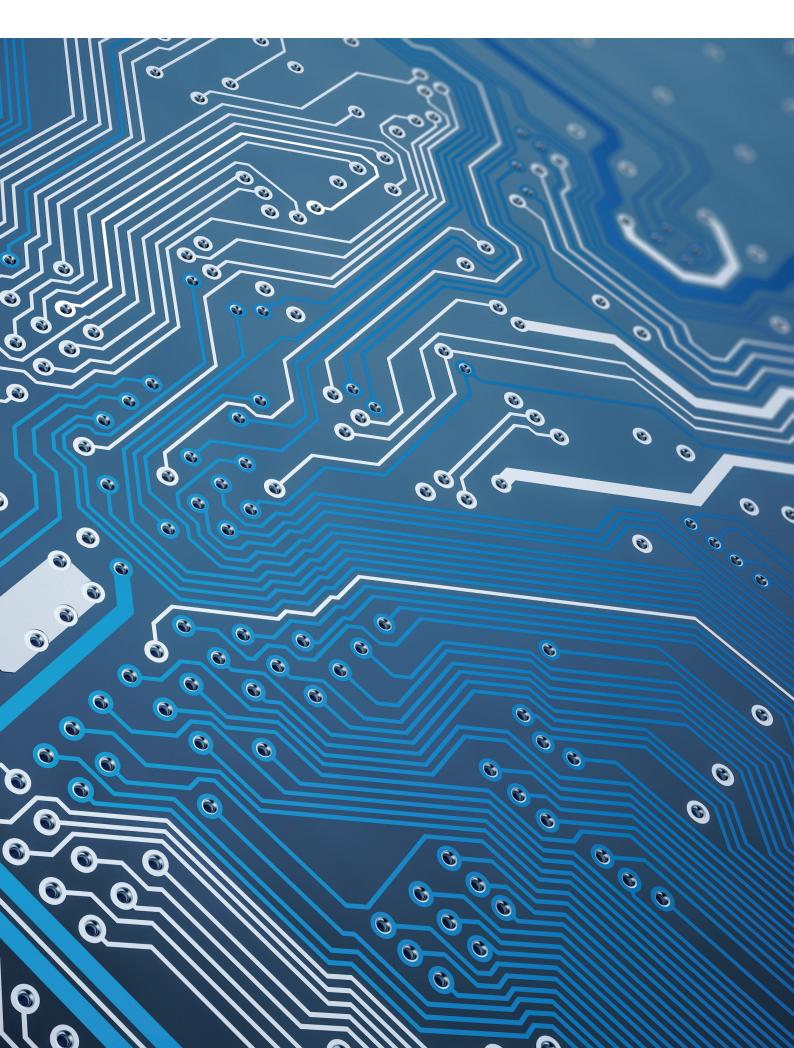
# SMART ENERGY SOLUTIONS





www.rkb-ag.de

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# **CONTENTS**

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### THE COMPANY



### Success through our innovation and determination

#### Being successful together

Your competitive advantage is our concern, or in other words, our success is also your success.

With this philosophy we face the difficult challenge to produce our unique and outstanding products, which more than meet the requirements of our customers. We see our high level of competence, speed, flexibility and our efficient and economical actions in the interest of the customer as the key to our success. Our activities are not only focused on the individual subsections, but they are focused on the entire value chain. With the ambition to become one of the most efficient system suppliers for the customized accumulator and battery systems in Europe in mind, we do our best every day to get closer to this goal.

#### **Made in Germany**

At our production site in Germany, we develop, produce and distribute our innovative and high-quality products with about 50 employees. More than twenty years of experience in the field of customer-specific battery and cable assembly as well as our in-house development department help us to implement any task, no matter how difficult it is, quickly and according to your requirements.

Furthermore, we have made it our business to keep our delivery program always at the pulse of time, to pick up the novelties and the innovations in order to always be one step ahead. The unburdening of your purchase, production and technical department through the implementation of our know-how and our knowledge of the industry, makes RKB electronic AG the optimal partner for you in the world of electromechanics.

#### Mission

With our intelligent developments in the field of the electromechanics, we pursue the goal of offering innovative and high-quality system solutions. They are developed in a close cooperation with the customer and in correspondence to his ideas. Accordingly, the development, the production and the sales shall also be transparent and close to the customer.

#### Vision

Our vision is to always have our finger on the pulse of the latest trends and to incorporate the latest technologies into our developments. By this way, we want to cater for the new generation of e-mobility and we want to grow with this.

### QUALITY



### Our values

#### Quality with system

Our products do not simply meet the standards, they also satisfy the highest quality demands. Our understanding of quality means- leaving nothing to chance. Therefore, our DIN EN ISO 9001:2015 certified quality management system ensures flawless deliveries as well as an absolute transparency and traceability in all our processes. The satisfaction of our customers is our top priority. The satisfaction of our customers is our top priority. Our holistic quality thinking encompasses all employees in all departments. Quality is therefore also an obligation for every employee.

#### Sustainable conduct

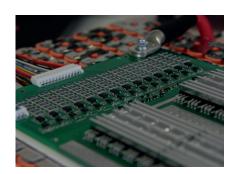
As a customer-oriented provider of services and products, we strive to achieve the best possible quality in our work at all times. To this end, we define the new quality targets for ourselves at regular intervals. Since a quality management system is never perfect due to the changing requirements, we operate a continuous improvement process. For us, this means the continuous improvement of all of our activities with the most sustainable effect as possible.



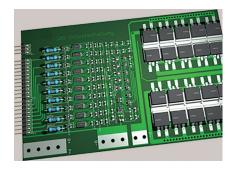
### DEVELOPMENT



### Protection circuits and battery management systems







#### **Customized electronics**

In our development department, our engineers and our technicians implement customized customer solutions that comply with the current legal requirements. These solutions include not only the protection circuits and management systems, but they include also the battery pack itself as well as possible additional system components. The computer aided development guarantees the highest quality standards. The series production of our electronics takes place in Germany.

#### **Protection circuits**

Lithium ion battery packs always require a protective circuit that effectively prevents the overcharging, the deep discharging, the overcurrent and all possible short circuits. At the same time, the electronics used should consume as little power as possible so as not to additionally discharge the battery pack. For this reason, we develop the state of the art protection circuits exclusively with series of proven brand name components.

#### **Battery management systems**

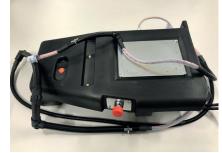
Our battery management systems can be seen as a consistent further development of the classic protection circuit. In addition to the standard functions of the protection circuit, a BMS provides further relevant data such as the current state of charge, the current temperature, the number of charging cycles as well as the numerous other information for further processing. This data can be read out via an SM, I<sup>2</sup>C or CAN bus.

### DEVICE CONSTRUCTION



### Mechanical and electromechanical assemblies







#### The assembly of the components

In the assembly of subassemblies, individual components are combined to form the complete subassemblies or only a partial assembly is carried out. For the assembly of components, the customer provides the individual parts, which are assembled and tested in the assembly department in accordance with the assembly instructions and the test instructions. All process steps are always been documented and can always be traced back by the customers.

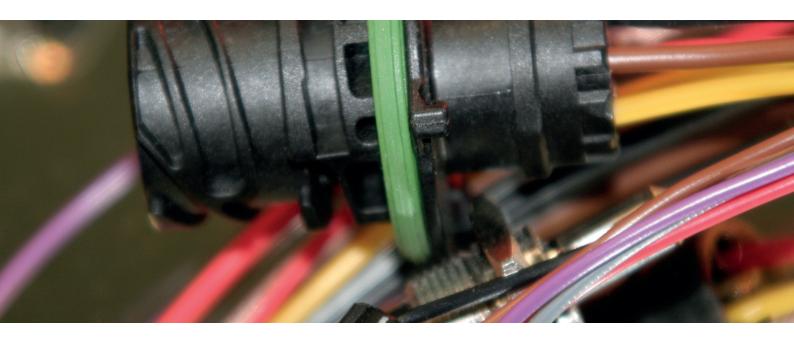
#### The production process

A high quality result or end product is achieved by precise and exact work with the most modern technology. In the production process, the following operations are possible: the screwing, the nailing, the welding, the gluing, the soldering or the clipping. With a final testing process, the assemblies are checked for their 100% functionality.

#### Assembly examples

Basically and first of all, the totality of all operations for the assembly of subassemblies are offered in different versions (lengths, angles). A suitable solution is sought individually to the needs of the customer, always accompanied by the technicians and by the engineers. These are also available to advise the costumer and, if necessary, jointly develop new solution models.

### CABLE ASSEMBLY



### Cable sets, cable harnesses, device cabling







#### Always a good connection

Since 2000, we have been developing, producing and distributing high quality cable harnesses and cable assemblies in our cable assembly business. These are primarily used in agricultural and construction machinery, in special machine constructions and in civil aviation. The latter example best illustrates the very high quality requirements for our cable products. Furthermore, we also assemble standardized cable sets and cable harnesses for connecting the various electronic assemblies.

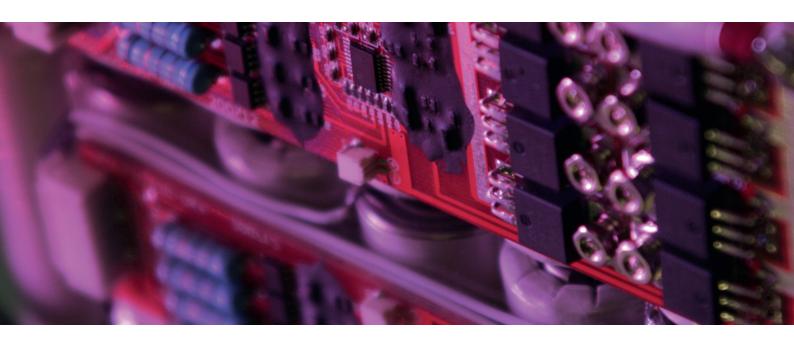
#### **Cable sets**

Due to the ever increasing automation in all the branches of the industry, the demand for our cable sets is increasing day by day. In this area we assemble for you: LiYY, LiYCY, Cat5-7, flat ribbon, modular and many other data cables. There are almost no limits for the variety of application specific connectors. With the help of our cable sets, every electrical signal is optimally forwarded to the next assembly. A 100% electrical final test is always a matter of course for us.

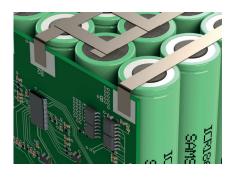
#### **Cable harnesses**

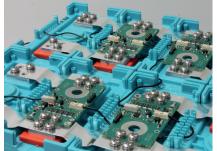
For applications with several point to point or point to area connections, our cable harnesses are often used. Due to their design, they are also capable of transmitting greater electrical power than, for example, a cable set. Furthermore, our cable harnesses also withstand stronger mechanical loads. As with our cable sets, we primarily use brand connectors from Molex, AMP, Deutsch and from many other brand manufacturers.

### BATTERY ASSEMBLY



### Intelligent battery systems







#### **Battery technologies**

As an innovative system supplier in the field of the battery assembly, we can offer you all the common cell technologies that are available on the market. Our main focus is on lithium ion technology with its various sub-classifications. Currently, the percentage of manufactured lithium ion battery packs is more than 90%. We purchase our portfolio of battery cells from brand manufacturers such as Samsung SDI and as LG Chemical. Furthermore, we also assemble NiCd, NiMH and various other battery technologies.

#### **Versions**

The standard versions of our battery packs cover the range from 1S to 14S (3.7V-51.8V nominal voltage). The capacities within this range are freely selectable due to the individual design of the parallel circuits. We also manufacture any other required configuration upon the request of the costumer. Furthermore, we subdivide our battery systems into the High Power and the High Energy versions. This results from the different requirements of the current demand in the combination with the desired runtime of the battery pack.

#### **Trendsetting**

Due to the rapidly increasing number of the mobile applications, our battery systems open up an infinite variety of application areas. Mainly our battery packs are used in: communication devices, power tools, household devices and garden equipment, measuring devices, industrial applications, med-tech applications, electric vehicles, electric bicycles, golf trolleys, diving lamps, and the lighting and the sound engineering.

### STANDARDS



### Quality assurance guidelines







#### **UN Transport Test**

Our company offers the UN transport test as an individual service. The UN transport regulations for the lithium batteries are regulated in the ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road). Each type of battery must pass a UN transport test according to Chapter 38.3 of the Manual of Tests and Criteria Part III. Only then the transport of lithium batteries is possible at all. A distinction must be made between the lithium metal batteries, the lithium ion batteries and the different types of the packaging.

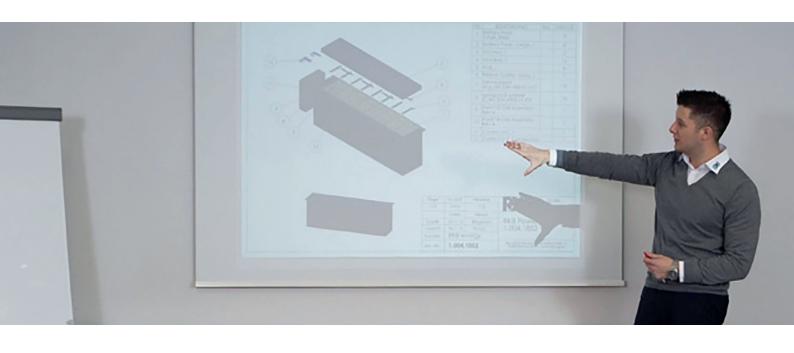
#### IEC 62133 testing and CB certification

We test your cells and batteries according to IEC 62133 and are also able to issue a cb-certificate for them. The CB procedure (CB scheme) has been set up by the International Electrotechnical Commission (IEC) to simplify the approval and the international trade of electro technical products. For CB certification of products containing batteries, it may be necessary for them to be certified according to IEC 62133. There are selected tests, which are required in the course of this certification.

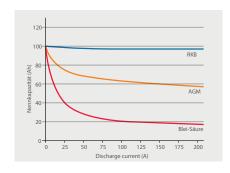
#### **Battery disposal**

As a manufacturer and distributor of batteries and accumulators, we are obliged to take back and to properly dispose of them in accordance with BattG § 7. To ensure the proper disposal, we have joined CCR Rebat as a take-back system for device batteries in Germany. The collection and the transport containers provided are collected by CCR Rebat, which sorts and disposes of the batteries and the accumulators.

### LITHIUM BASED SOLUTIONS



### Lithium-based solutions – An alternative to the classic lead battery







### The advantages of the lithium technology

The lithium ion technology is an equivalent replacement for the former lead technology with many advantages. A significant reduction in weight, enormous energy reserves and a stable voltage even under extreme loads are the decisive advantages of the lithium ion technology. The now possible energy storage of lithium ion batteries was developed with the aim of replacing lead batteries "one-to-one". The high demands placed on storage batteries today can be realised with the lithium ion technology.

#### **E-Mobility**

In e mobility, lithium ion battery technology is one of the key growth factors today. Efficient energy storage solutions based on lithium are continuously optimised and they advance the development in the field of e mobility by constantly adapting the production costs to the expected ranges of the consumers.

#### **Customer specific production**

RKB electronic AG is the ideal partner to realise the developments based on the lithium ion technology. Solution oriented and customer focused cooperation is the top priority here. Develop your individual project together with your direct partners from the sales and the technology.

### USER SPECIFIC BATTERY SOLUTIONS



### Examples of the application areas







#### Cargo bikes

Cargo bikes are an excellent addition to our everyday life. The range of an electric cargo bike is determined by its battery. The range also depends on the weight with which the cargo bike is loaded. Experience has shown that about 50-60 km can be covered with one battery charge. RKB electronic AG develops different models with different battery capacities for this purpose. An easy attachment to the cargo bike and a fast charging process speak in favour of the RKB electronic AG battery, whereby the lithium ion technology used achieves an enormous weight saving.

#### Drones

Nowadays, the model making and the use of drones are trendier than ever before. The popularity of the small, remote controlled flying objects is growing rapidly and the demand for the suitable batteries is increasing. RKB electronic AG has developed a suitable battery for this purpose, which has a sufficient capacity for a maximum flight time. In this way, the battery meets the necessary requirements of the power demand in combination with the desired runtime of the battery pack, which are essential when it comes to using these drones.

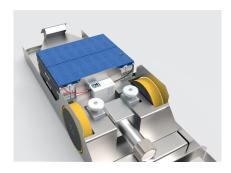
#### Leisure: Golf

As an innovative system supplier in the field of the battery assembly, our product portfolio also includes a high-quality lithium ion battery for the electric golf trolleys. The battery combines endurance and weight saving with a sophisticated safety management. The battery is protected against any splash water by a special isolation material and the integrated electronics maintain and protect the cells to ensure a long service life.

### INDUSTRIAL SYSTEM SOLUTIONS



### Tailored applications







#### **Automated guided vehicles**

We design customised solutions for high performance packs in the field of the driverless transport systems exactly to your needs. Benefit from the new lithium technology and optimise the service life of your systems by up to five times faster charging and by an up to twice as long driving time compared to the standard lead systems. Benefit from the powerful and the lightweight lithium technology when you develop your new systems.

#### **Charging technology**

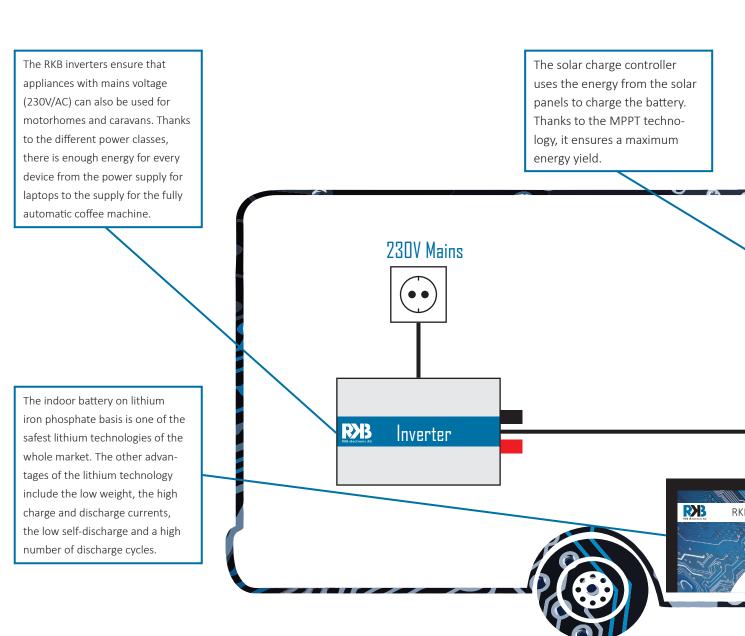
We can offer you a great variety of different chargers to match our battery packs. These usually have a large range input (110-240VAC) as well as an exchangeable primary mains cable, which allows the chargers to be used everywhere in the world without any problems at all. Depending on the power class, our chargers have a plastic or an aluminium housing. The charging is microprocessor controlled according to the charging method required (e.g. CC/CV for Li-lon).

### These are the advantages of the lithium batteries:

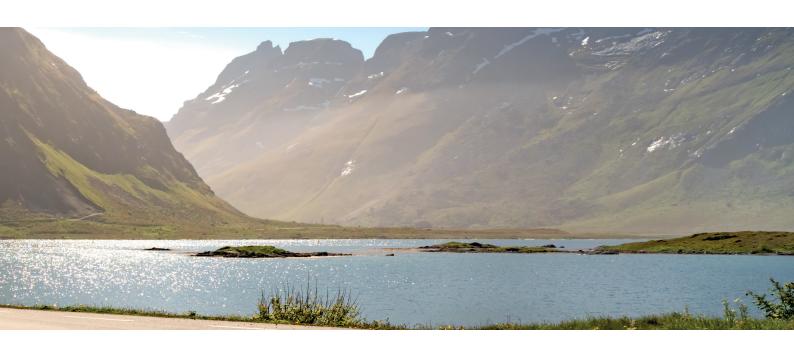
- Service life optimisation
- Increase of the productivity
- Low self discharge
- High number of cycles
- High energy density ensures space-saving design
- High current carrying capacity
- Large temperature range
- Low weight

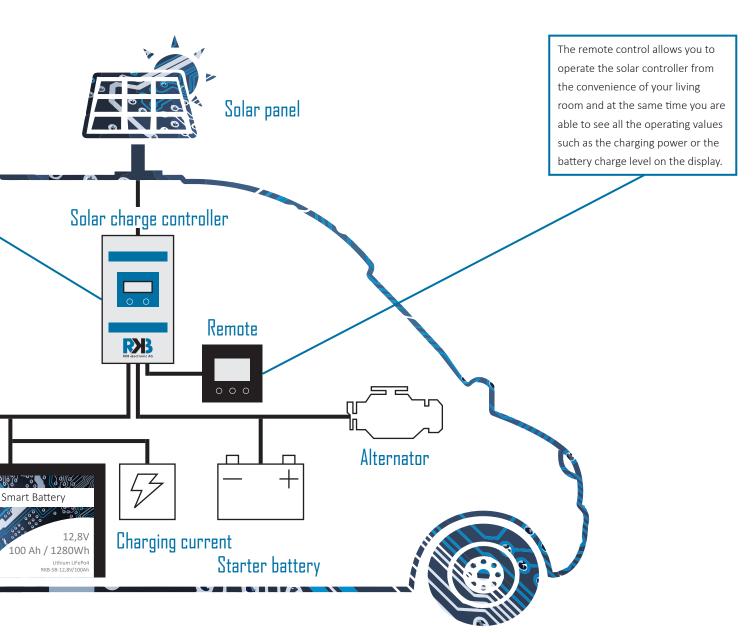
### ENERGY MANAGEMENT FOR MOTORHOMES





### ENERGY MANAGEMENT FOR MOTORHOMES





### CARAVAN SYSTEM SOLUTIONS



### Individually tailored products according to the customer requirements





#### **Energy made to measure**

From the family of the lithium ion battery types, the lithium iron phosphate battery (LiFePO4) is the safest. It is highly current-resistant, it is universally applicable and has a low weight compared to the lead, gel or AGM batteries. In addition, the newest lithium iron phosphate technology offers a high degree of intrinsic safety, so that this is guaranteed even in the most extreme conditions. A 12.8V LiFePO4 battery consists of 4 single cells connected in series, each with a nominal voltage of 3.2V. However, other voltage ranges such as 24V and 48V can also be configured. Due to our long experience in the industry, we have a wide product portfolio of the modularly combinable components. This makes it possible to produce many customised solutions with maximum performance and with energy density economically for you.

#### **Key Features RKB-Lithium Batterie**

- Customised and robust aluminium housing
- Integrated fuse and relay output
- Low development costs thanks to the modular system
- Digital inputs and digital outputs for controlling the battery and the external components
- Long-term data logbook with a recording on SD card
- Communication interface CAN or CAN-Open

#### **Battery management system**

Our battery management systems can be seen as a consistent further development of the classic protection circuit. In addition to the standard functions of the protection circuit, a BMS provides many further relevant data such as the current residual charge, the state of the individual battery segments, the current temperature, the number of the charging cycles as well as numerous other information for any further processing. This data can be read out via a serial, I<sup>2</sup>C or CAN bus. But even without an interface, information can be exchanged via an IO port. For example, the battery can be controlled via the ignition signal.

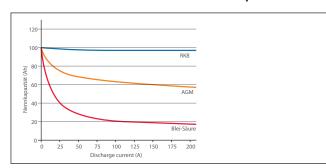
#### **Key Features RKB Smart BMS**

- Monitors the individual cell voltages / the cell segments
- Protects against the over- or the undercharging of the battery system
- Adjusts the individual cell voltages
- Determines SOC, SOH and the other battery data
- Extensive temperature management
- Switches the battery power output
- Acquires data and sends it via CAN protocol
- Logs the data to the SD card

# CARAVAN SYSTEM SOLUTIONS



#### An alternative to the traditional lead battery



#### **Key Features of the RKB Lithium Technology**

- Weight saving up to 60%
- High charge and discharge currents
- Full capacity is usable
- Only small space is needed (small footprint)
- Up to 10x more cycles
- Low self-discharge
- Energy output at a high load

	LEAD BATTERY	RKB LITHIUM BATTERY
Energy density	40 Wh/Kg	120 Wh/ Kg
Energy volume	90 Wh/ I	150 Wh/ I
Cycles	500/ 80% DoD; 1.500/ 30% DoD	3.000/ 80% DoD
Charging efficiency	60 - 70%	90 - 95%
Quick-charge capability	no	yes
Charging current	0,1-0,2 C	to 1 C
Self-discharge	5 - 10% per month	< 2% per month
Battery evaluation	no	yes (CAN)

### **ON-BOARD BATTERIES**



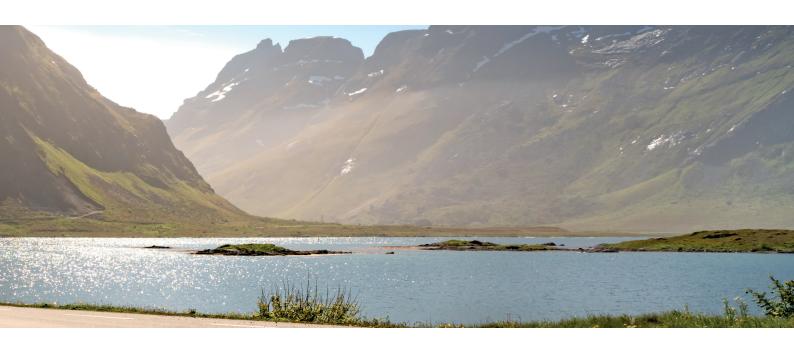
### On-board batteries for the motorhomes



Are you looking for a lithium battery for your camper that does not require a complicated installation process, that can be charged quickly and that is ideal for supplying the power to the major appliances? More and more motorhome owners are opting to convert and to use the lithium batteries. The many advantages of using these batteries in motorhomes - performance, low weight and durability- speak for themselves. These are ideal prerequisites if you want to be self-sufficient when you are travelling with your motorhome – being independent of any power sockets.

The batteries are equipped with lithium iron phosphate (LiFePO4) cells, which are considered very safe and resistant to cycling. In addition, the battery is protected against the overcurrent, the overcharging, the deep discharge, the short circuits and the overtemperature via an integrated Smart BMS.

# ON-BOARD BATTERIES



Electrical parameters	SMART BATTERY 50Ah	SMART BATTERY 100Ah	SMART BATTERY 150Ah	SMART BATTERY 200Ah
Nominal capacity	50Ah	100Ah	150Ah	200Ah
Energy content	640Wh	1280Wh	1920Wh	2560Wh
Cell technology	LiFePo4	LiFePo4	LiFePo4	LiFePo4
Nominal voltage	12,8V	12,8V	12,8V	12,8V
Operating range	10,0 to 14,8V	10,0 to 14,8V	10,0 to 14,8V	10,0 to 14,8V
Life cycles (100% DoD)	≥2000	≥2000	≥2000	≥2000
Life cycles (80% DoD)	≥3000	≥3000	≥3000	≥3000
Life cycles (55% DoD)	≥8000	≥8000	≥8000	≥8000
Self-discharge	<3% month	<3% month	<3% month	<3% month
Charging characteristics	CC/ CV	CC/ CV	CC/ CV	CC/ CV
Charging end voltage	14,2 to 14,4V	14,2 to 14,4V	14,2 to 14,4V	14,2 to 14,4V
Recommended charging current	10A	20A	30A	40A
Max. charging current	50A	100A	150A	200A
Final discharge voltage	10A	10A	10A	10A
Continuous discharge current	50A	100A	150A	200A
Peak discharge current	100A (5 sec.)	200A (5 sec.)	300A (5 sec.)	400A
Mechanical parameters				
Dimensions	200 x 170 x 170 mm	318 x 176 x 187mm	485 x 170 x 240 mm	525 x 240 x 220mm
Weight	5,5kg	11,9kg	16,5kg	22,5kg
Connection terminal	M8	KFZ Konus	M8	M8
Pole arrangement	Positive pole right	Positive pole right	Positive pole left	Both poles left
Device parameters				
Temperature range Discharge	-20°C to 60°C	-20°C to 60°C	-20°C to 60°C	-20°C to 60°C
Temperature range Charging	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C
Temp. range storage	-20°C to 60°C	-20°C to 60°C	-20°C to 60°C	-20°C to 60°C
Protection class	IP55	IP55	IP55	IP55

### INVERTER



### Inverter 400W, 1.200W, 3.000W



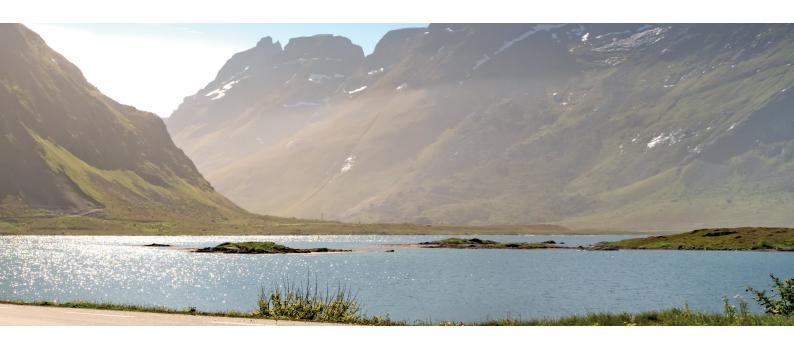




The RKB inverter is a pure sine wave inverter that ensures that all 230V mains consumers in the motorhomes can be operated at any time with a power consumption of up to 3000W at the maximum efficiency. The specially developed design enables a virtually independent installation environment: operating temperatures down to-20°C are possible without any problems. In addition, the electrical isolation of the output and the input ensures that defective loads do not have a negative effect on the on board network. The inverter can be quickly adapted to the different mains frequencies via an integrated switch, so that the AC consumers of all types can be used.

The USB output and another serial communication interface are optionally available, for example if you want to charge smartphones or if you want to communicate with the other RKB devices. To protect the batteries, both input and output are equipped with the various protective functions – the overload protection, the undervoltage protection, the short-circuit protection and the overvoltage protection. They always prevent the battery from becoming defective.

# INVERTER



The electrical parameters	400-12/ 400W V1	1200-12/ 1200W V1	3000-12/ 3000W V1
Nominal voltage	12VDC	12VDC	12VDC
Input voltage range	10,8 bis 16VDC	10,8 bis 16VDC	10,8 bis 16VDC
Output voltage	220VAC (± 5%) 230VAC (-10% to + 5%)	220VAC (± 5%) 230VAC (-10% to + 5%)	220VAC(±3%) 230VAC(-7%~+3%)
Output frequency	50/ 60±0.1Hz	50/ 60±0.1Hz	50/ 60Hz ±0.2%
Output power (continuous)	400W	1200W	3000W bei 35°C/nominal voltage
Output power (15 min.)	500W	1500W	3000W
Peak power (5 sec.)	1000W	2400W	6000W
Power factor	0,2-1	0,2-1	0,2 bis 1 (VA ≤ Continuous output power)
Output	Pure sine wave	Pure sine wave	Pure sine wave
Distortion factor THD	THD≤3%¹	THD≤3%¹	THD≤3%¹
Max. Efficiency	92%	93%	>94% (bei 900W)
Standby current	<0,9A	<1A	<1,6A
USB output	5VDC/ Max. 1A	5VDC/ Max. 1A	5VDC/ Max. 1A
The mechanical parameters			
Connection terminal	M6	M10	M10
Dimensions	232 x 132 x 75 mm	330 x 323 x 100 mm	557 × 231,5 × 123mm
Mounting dimension (the hole spacing)	205 x 102 mm	208 × 220 mm	532 × 145mm
Mounting hole diameter	Ø 5,2mm	Ø 5,5mm	Ø 6mm
Weight	1,4kg	3,9kg	10,5kg
Device parameters			
Temperature range (operation)	-20 °C to +45 °C	-20 °C to +45 °C	-20 °C to +50 °C
Temperature range (storage)	-35 °C to +70 °C	-35 °C to +70 °C	-35 °C to +70 °C
Relative humidity	<95%, non-condensing	<95%, non-condensing	<95%, non-condensing
Housing	IP20	IP20	IP20
Altitude	< 5000m	< 5000m	< 5000m

<sup>&</sup>lt;sup>1</sup> The test conditions: Nominal voltage, continuous output power, resistive load.

### SOLAR CHARGE CONTROLLER



### Solar charge controllers & accessory



MPPT solar controllers (maximum power point tracking) are needed as a link between the solar panels and the batteries. With the MPP technology, the controller automatically determines the maximum power output of the solar panels at all times. This reduces the charging time of the battery significantly compared with the conventional solar chargers. The MPPT solar controllers work fully automatically, with a charging current of up to 30A or 40A and they are maintenance free.



The Duo regulator charges the starter battery as well as the on board battery.

External display panels are optionally available for both chargers. With these, you also have a full overview and full control of your energy management in the living room-regardless of the installation location of the solar controller.

# SOLAR CHARGE CONTROLLER

Electrical parameters	Solar-Duo 12V30A	Solar-Triron 12V40A
BATT1 Nominal voltage	12/ 24VDC	12/ 24VDC Auto <sup>1</sup>
BATT2 Rated voltage	12/ 24VDC Auto	_
Rated charge current	30A	40A
Battery input voltage range	8,5 bis 32V	8,5 bis 32V
Max. PV open circuit voltage	100V1; 92V2	150V <sup>2</sup> ; 138V <sup>3</sup>
MPP voltage range	(battery voltage +2V) bis 72V	(battery voltage +2V) bis 108V
Max. Charging power	390W/ 12V; 780W/ 24V	520W/ 12V; 1040W/ 24V
Max. Efficiency	98%	98%
Full load efficiency	96%	96%
Self consumption	26mA/ 12V; 15mA/ 24V 19mA/ 12V; 10mA/ 24V(energy saving mode)	≤14mA(12V); ≤15mA(24V)
Temperature compensation coefficient <sup>3</sup>	3mV/°C (Standard)	-3mV/°C (Standard)
BATT2 Charge end voltage	13,8V/ 12V; 27,6V/ 24V (Standard)	-
BATT2 Lade-Neustart	13V/ 12V; 26V/ 24V (Standard)	_
RS485-interface	5VDC/ Max. 200mA	-
LCD-backlight	60S (Standard)	Preset: 60 Sek., range: 0 bis 999 sec. (0 sec.: backlight always on)
Mechanical parameters		
Dimensions	247,2 x 165 x 68,5mm	183 × 256.8 × 66.7mm
Mounting dimension (hole spacing)	180 x 156mm	174 × 220mm
Mounting hole diameter	Ø 5mm	Ø 5mm
Cable connection	6AWG/16mm <sup>2</sup> (BATT1) 12AWG/4m- m <sup>2</sup> (BATT2)	6AWG/ 16mm <sup>2</sup>
The recommended cable size	8AWG/10mm <sup>2</sup> (BATT1) 12AWG/4mm <sup>2</sup> (BATT2)	6AWG/ 16mm²
Weight	1,4kg	2,06kg
Device parameters		
Temperature range (operating)	-20°C to +45°C	-20°C to +55°C
Relative humidity	≤95%, non condensing	≤95%, non condensing
Protection class	IP33	IP30

 $<sup>^{\</sup>mbox{\tiny 1}}$  If a lithium battery is used, the system voltage cannot be identified automatically.

<sup>\*</sup> With Triron: The controller can operate under load in the specified temperature range. If the internal temperature is >80°C, the charging mode is activated with a reduced power.

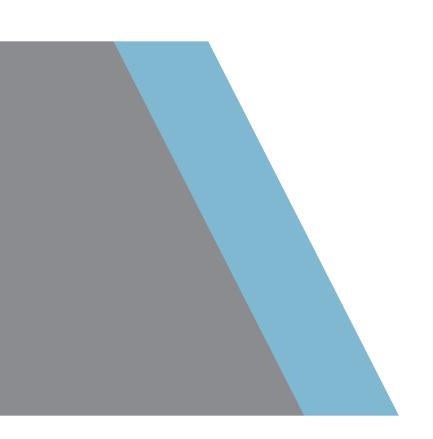
Electrical parameters	MT11 (SOLAR-DUO)	MT50 (SOLAR-TRIRON)
Self-consumption (switched on)	13mA/ 5Vdc	23mA/ 5Vdc
Power consumption (standby)	4mA	65mA
Type of communication	RS485	RS485
Mechanical parameters		
The dimensions of the front panel	98.4 x 98.4mm	98 x 98mm
The dimensions of the frame	114 x 114mm	114 x 114mm
Communication port	3.81-4P	RJ45
Cable length	Standard 1,50m	Standard 2m, max. 50m
Weight	0,11kg	0,344kg
Device parameters		
Ambient temperature	-20°C to +70°C	-20°C to +70°C
Protection class	IP20	IP20

<sup>&</sup>lt;sup>2</sup> At minimum operating ambient temperature

<sup>&</sup>lt;sup>3</sup> At 25°C ambient temperature

<sup>&</sup>lt;sup>4</sup> When a lithium battery is used, the temperature compensation coefficient is 0 and it cannot be changed.





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