



LITHIUM-ION STARTER BATTERY (LISB)

INFORMATION DOCUMENT

**BMW
GROUP**



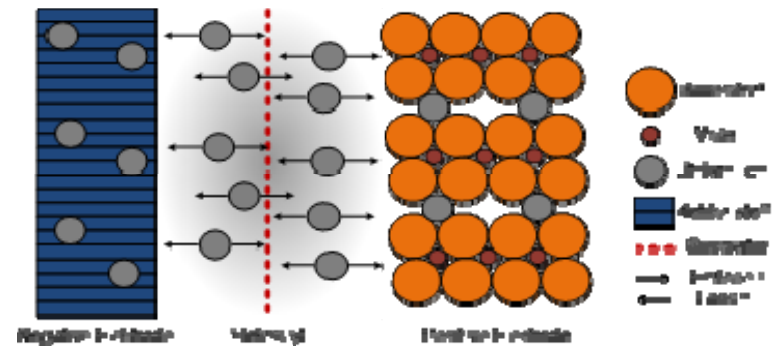
LITHIUM-ION TECHNOLOGY

Lithium-ion batteries are used in electric vehicles as state-of-the-art technology. They are also increasingly being used in low-voltage applications.

Lithium-ion batteries have a higher life cycle, improved energy density and corresponding weight reduction.

For that reason, BMW M GmbH implemented a “lighthouse” project.

The project’s objective was to develop a lithium-ion starter battery for the F80, F82 and F83.

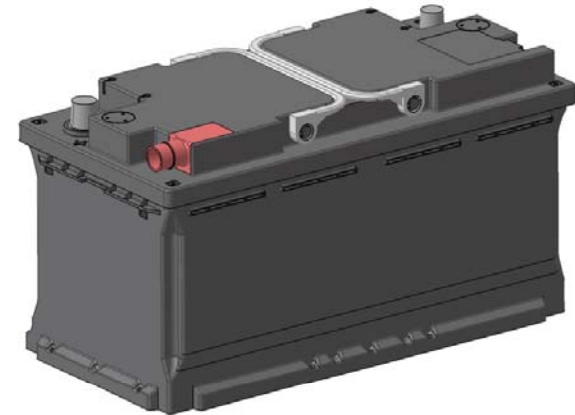


BATTERY PROFILE

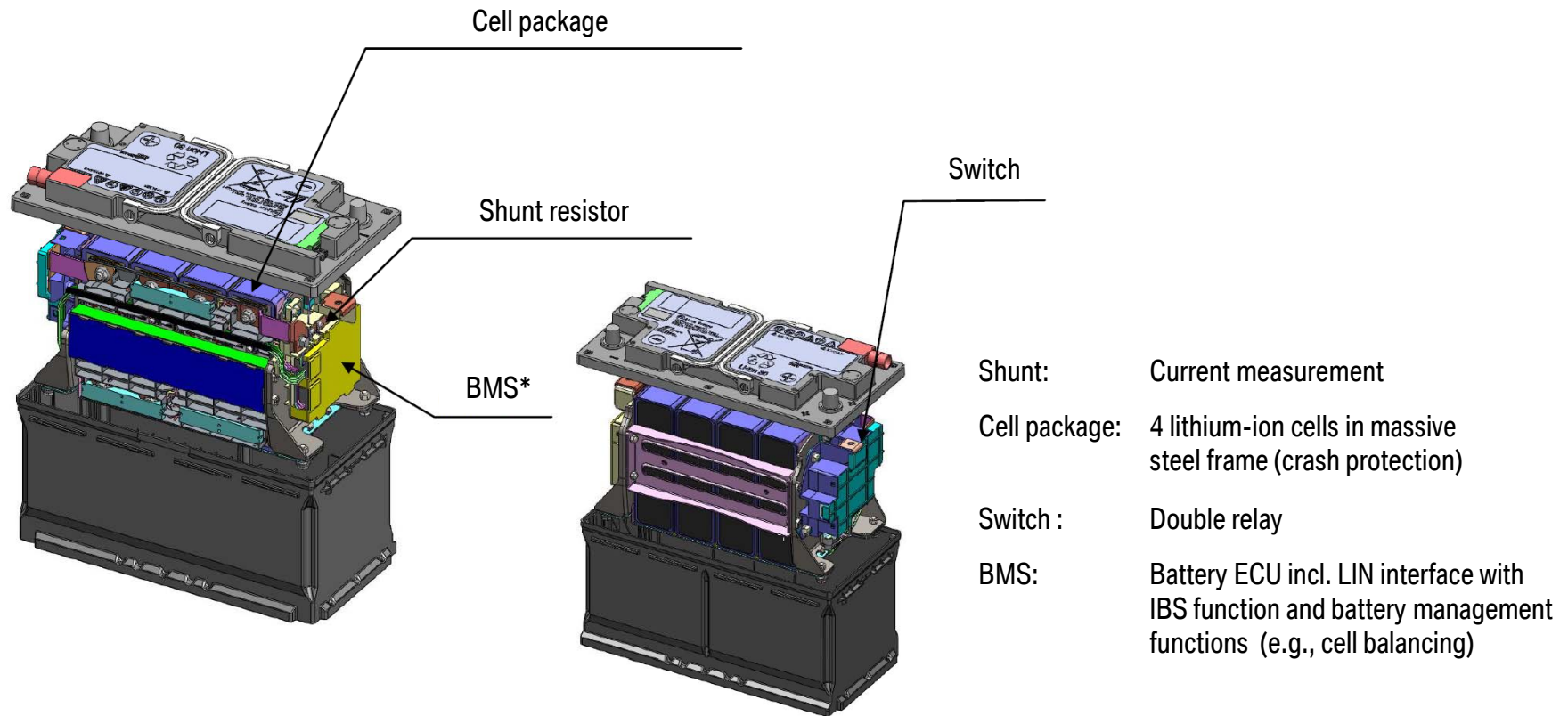
Capacity: 69Ah
Nominal voltage: 13.2V
Housing: LN5 (corresponds to 90Ah AGM)
Weight: 13.6 kg
Design: 4 lithium iron phosphate cells
Target vehicles: F80, F82, F83
Cost: Approximately five times as expensive as a lead-acid battery

Documents: GS95xxx Handling specifications in TEREK (draft)
GS95001-7 Battery chargers in TEREK (draft)
Request transport guidelines from CoCs
Vehicle Owner's Manual
Safety data sheet in ZEUS
Various documents from HO dealer organization (e.g., Repair Instructions, info pages in ISTA)

Special features: Integrated switch
Integrated ECU with LIN interface
Use of special battery chargers
Degassing hose with greater diameter



BATTERY PROFILE – DESIGN

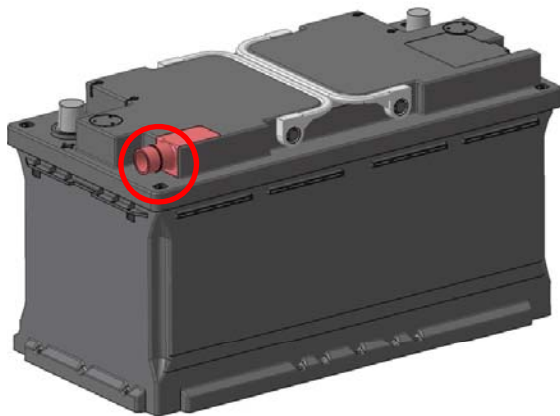


*BMS = **B**attery **M**onitoring **S**ystem

SPECIAL FEATURES – HOUSING

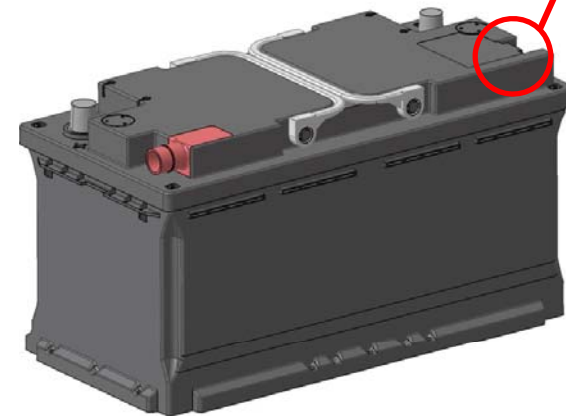
The external dimensions of the battery do not differ from those of a 90Ah lead-acid battery. Mounting and terminals are identical.

Battery vent hose



The battery vent hose and corresponding connection have a very big diameter compared to a lead-acid battery.

LIN connection



The battery features a LIN Bus connection, since the ECU is integrated inside the battery cover.

SPECIAL FEATURES – LID

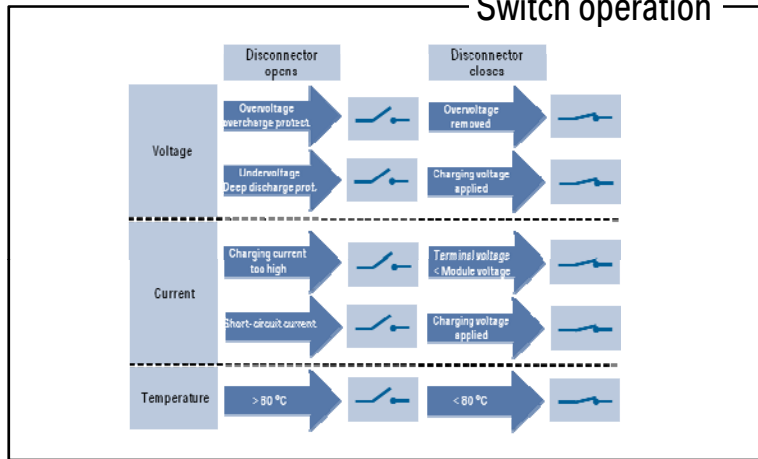
Reference to lithium-ion battery

Recycling information for lithium-ion batteries

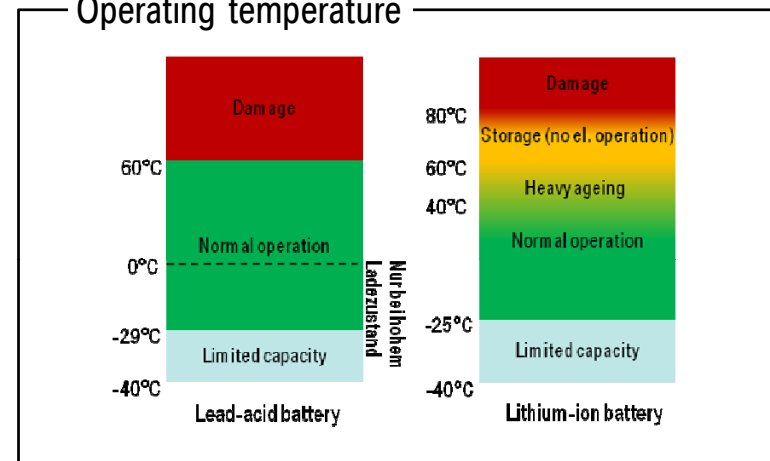


DIFFERENCES COMPARED TO LEAD-ACID BATTERY – OVERVIEW

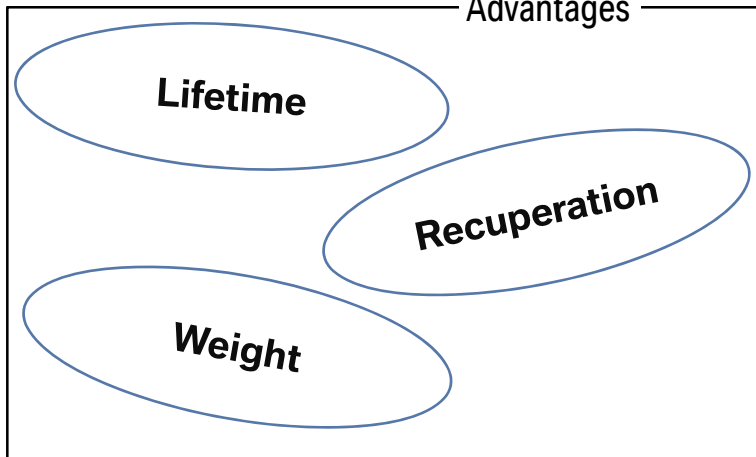
Switch operation



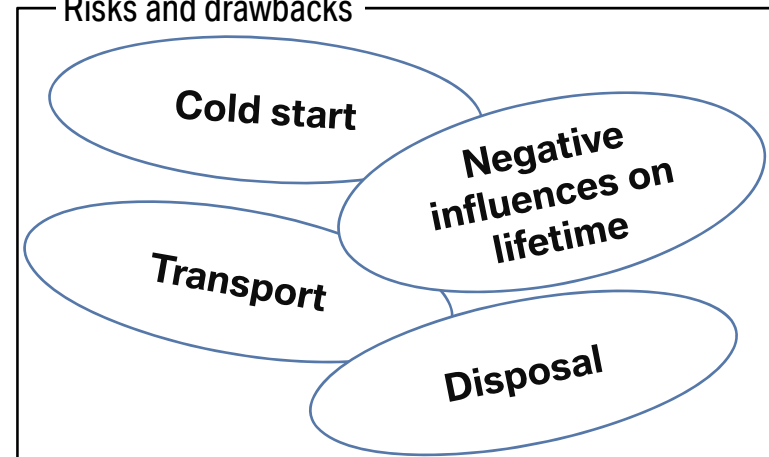
Operating temperature



Advantages



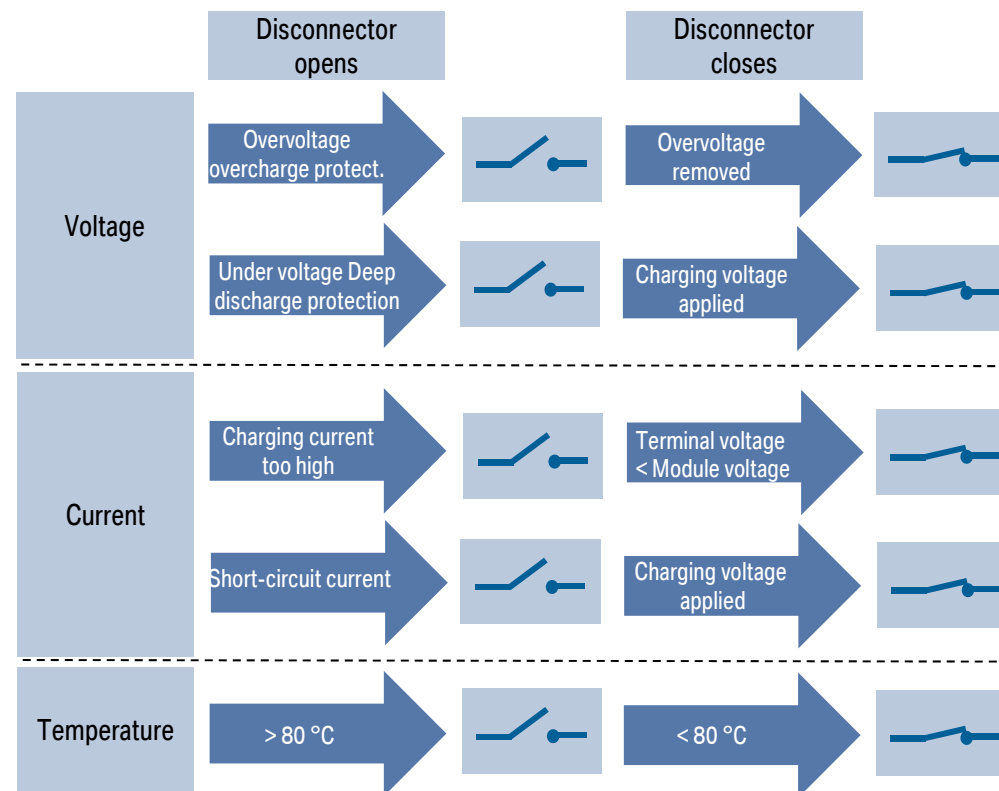
Risks and drawbacks



DIFFERENCES COMPARED TO LEAD-ACID BATTERY—DISCONNECTOR

The lithium-ion battery has a disconnecter that opens in critical situations as a protective mechanism. In this situation, no voltage can be measured at the battery terminals. The disconnecter closes automatically after the battery is no longer in a critical condition.

If the disconnecter opens due to voltage/current being too low, it will close again after charging voltage is applied (only possible for battery chargers in accordance with BMW Group standards).



DIFFERENCES COMPARED TO LEAD-ACID BATTERY— TEMPERATURE OPERATING RANGES

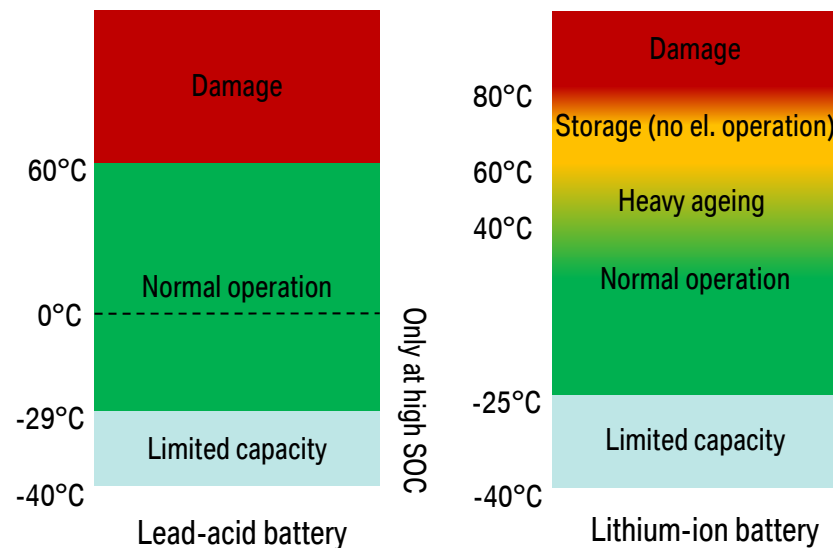
In warm environments, the LISB utilizes its high charge and discharge capacity. The higher current storage capacity results in higher recuperation.

At low temperatures, the lithium-ion battery's power is low.

This may have a negative impact when starting the engine at low temperatures.

Starting at approximately 45°C, battery aging is significantly accelerated.

Starting at 60°C, operation is prohibited.



DIFFERENCES COMPARED TO LEAD-ACID BATTERY – ADVANTAGES

Recuperation

In warm environments, a higher charge and discharge capacity is possible compared to lead-acid batteries. The battery can store more energy when decelerating, resulting in higher recuperation.

Lifetime

Maximum number of full lead-acid battery cycles: approx. 300-400
(e.g., yields 27,000Ah – 36,000Ah for a 90Ah battery)

Maximum number of full lithium-ion battery cycles: approx. 3,000
(e.g., yields 180.000Ah for a 60Ah battery)

Weight

Greater power and energy density compared to lead-acid batteries, due to lower weight

→Weight 69Ah LISB: approx. 13.6 kg

→Weight 90Ah AGM battery: approx. 26.0 kg

DIFFERENCES COMPARED TO LEAD-ACID BATTERY— RISKS/LIMITATIONS

Cold start

Power of lithium-ion cells very limited at low temperatures.
Cold start at -25°C for the battery's lifetime is a challenge.

Influences on lifetime

Permanently high temperatures can have a negative impact on the lifetime.

Disposal

Lithium-ion batteries are subject to special disposal requirements and currently cannot be recycled to the same degree as lead-acid batteries.

Transport

The transport of lithium-acid batteries on public roads is subject to the regulations governing the transport of hazardous goods.

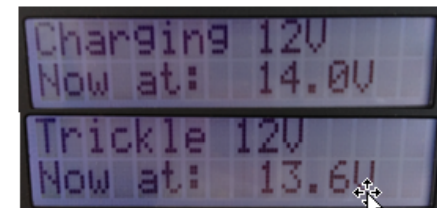
BATTERY CHARGERS

Lithium-ion batteries have different requirements for the charging process than lead-acid batteries. Therefore, updates are being developed for existing battery chargers which detect the type of battery technology automatically and adapt the charging parameters accordingly. These requirements are specified in the BMW Group standards.

	Most important changes
Charging current	14.0 volts
Trickle charger	13.6 volts
Open disconnecter	Special mode for reactivation of an open switch



Deutronic 800/1100/1600



V&H Multicharger

POWER MANAGEMENT AND DISPLAY CONCEPT

Power management

Power management of the vehicle (AEP) was adapted to the LISB and extended by some battery management functions.

Implementation of an LISB in a vehicle without an adapted AEP is not possible (AEP emergency mode, battery overcharging).





Implementation of a lead-acid battery without IBS in the M3 and M4 results in a permanent display of the “Electrical energy supply at risk” CC message.

Jump starting

Vehicles with the LISB can be jump-started like vehicles with a lead-acid battery.

POWER MANAGEMENT AND DISPLAY CONCEPT

Additional error memory and CC messages:

Description	CC-Symbol	CC-Text	Comment
Battery defect		Driving still possible. Have battery replaced at earliest opportunity and new battery registered with vehicle by BMW Service. Refer to Owner's Manual.	Is entered/displayed when deep discharge or cell defect is detected. Cell defect not yet substantiated by data. After battery replacement, register new battery with vehicle via "Manage Registration Battery Replacement" diagnostics job.
Batteries deeply discharged			Results in "battery defect" error.
LISB over-voltage			Is entered if cell voltage exceeds 3.75V and reset if cell voltage again drops below 3.5V.
LISB under-voltage			Is entered if cell voltage falls below 2.375V and reset if cell voltage exceeds 2.5V again.
Discharge current too high			Is entered if the maximum permitted discharge current is exceeded.
Charging current too high			Is entered if the maximum permitted charging current is exceeded.
LISB disconnecter open		Battery is not charged. Stop safely. Have battery checked immediately by nearest BMW Service.	Is entered/displayed if the battery disconnecter is open and the onboard electrical system is still being supplied with voltage (e.g., by running alternator or external charging device).
Over temperature			Is entered if the battery temperature exceeds 80°C.
Under temperature			Is entered if the battery temperature falls below -25°C.
LISB electronics defect		Energy supply Electrical energy supply at risk. Do not switch off engine. Have system checked by nearest BMW Service.	Is entered/displayed if the battery reports a battery electronics error (e.g., voltage measurement defect) or no communication with the battery is possible.
LISB in critical condition		Battery is not charged. Stop safely. Have battery checked immediately by nearest BMW Service.	Is entered/displayed if the battery is about to open the disconnecter, due to high charging voltage or high temperature.