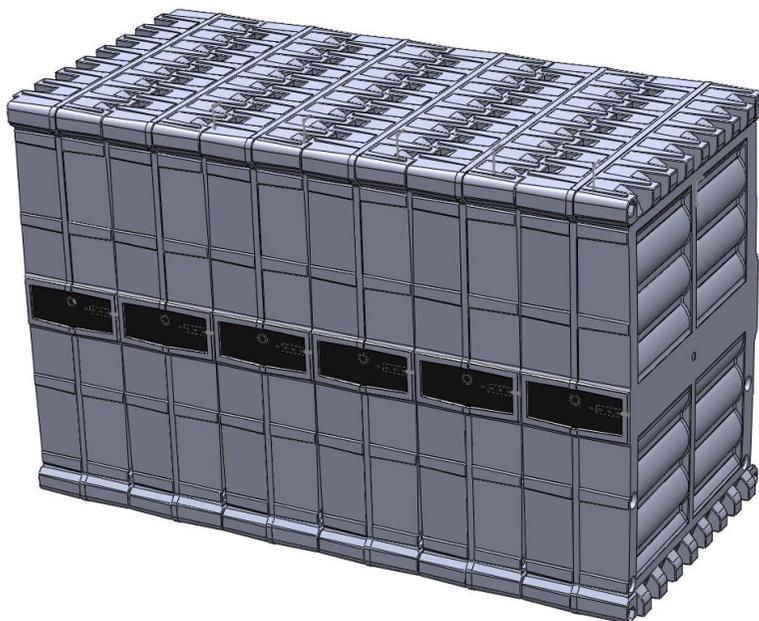


LITHIUM EXTENSION BATTERY

LE300



Installation & User Manual



EN

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Package contents

- ⊙ Device LE300 Lithium Extension Battery
- ⊙ Power cable connector RAST 5
- ⊙ User manual
- ⊙ Fuse 15 A (1x)

Optional accessories

- ⊙ Power cable set 1 – for connection of one LE300 to lead acid battery (1 m, with M6 cable shoe) **Art. No.**
- ⊙ Power cable set 2 – for connection of two LE300 to lead acid battery (1 m, with M6 cable shoe) **Art. No.**
- ⊙ RS485 parallel connection cable **Art. No.**
- ⊙ LCD-State-of-Charge-Monitor **Art. No.**
- ⊙ Signal out plug with cables Mini-Fit Jr.™ TPA Cable assembly 45135 **Art. No.**
- ⊙ Parallel mechanic mounting kit (threaded bolt and nuts, for max. 6 LEs in parallel) **Art. No.**

1 General information

Thank you for purchasing a high quality, German made product from BOS Balance of Storage Systems AG. We worked according to strict engineering standards in order to deliver valuable energy services for our customers. In case of technical problems or comments of any kind, please contact the local distributor for support.

LE300 Lithium Extension Batteries are a fully scalable solution to enhance performance and add capacity to lead-acid batteries in solar and any other kind of energy storage systems. They can be used with new or existing 12 V lead-acid batteries. Just stack them in parallel to meet your specific system specs.

Like in all BOS AG Hybrid battery systems the Lithium Extension Battery takes most of the charging cycles while the lead acid battery provides inexpensive backup capacity. The lead acid battery is charged with higher priority, the lithium battery takes all surplus energy. This helps to increase the lead acid battery life.

The system recognizes the lead acid battery voltage and automatically starts to support the lead acid battery with a maximum current of 12.5 A per unit. Bigger loads get supplied by the lead acid and the lithium battery in parallel, resulting in smaller currents for each battery.

Safety instructions

- ⦿ Please read the whole user manual before installation and usage of the LE300 Extension Battery.
- ⦿ Only connect to 12 VDC batteries of the following types:
 - Lead storage batteries with liquid electrolytes
 - Sealed lead-acid batteries – GEL or AGM
- ⦿ Use the device only in combination with a lead acid battery and a lead acid charge controller, do NOT connect loads or power sources directly to the lead acid battery nor to the LE300 battery.
- ⦿ Lead acid batteries can generate explosive gases during operation. Never smoke, allow flames or sparks near the battery. Make sure to keep sufficient ventilation around the battery and read the lead acid battery user manual.
- ⦿ Do NOT use with nickel cadmium batteries, nickel metal hydride batteries or other battery types.
- ⦿ Do NOT mix up the + (plus) and - (minus) poles of the battery.
- ⦿ Do NOT connect anything to a damaged battery. It could heat up, catch fire or explode.
- ⦿ Do NOT open the battery pack. Danger of short-circuiting. Opening the battery pack voids any and all warranty claims.
- ⦿ Best operating temperature is between 15 and 25 °C. Higher temperatures shorten the lifespan of the batteries. Do NOT place device in direct sunlight!
- ⦿ Protect the battery against heat (e.g. prolonged sun exposure) and fire and from water. Do NOT store or operate the battery near hot or flammable objects.
- ⦿ Install and use the device only after reading & understanding this manual.
- ⦿ Install this device step by step as written in this manual for best results.
- ⦿ After installation, the device needs to be fully charged.
- ⦿ Do NOT charge the device over an extended period, if the device is unused.

- ⦿ After prolonged storage period, it may be necessary to charge and discharge the device numerous times to achieve the full performance capability.
- ⦿ Follow all safety precautions during installation of device & handling batteries.
- ⦿ Improper handling of batteries may introduce a risk of battery explosion.
- ⦿ Keep batteries and acid away from children & animals.
- ⦿ During handling of batteries no smoking or exposure to naked light & fire.
- ⦿ Wear eye protection during installation process.
- ⦿ When working with a battery remove all personal metal items like watches, rings, necklaces and bracelets. Metal items in contact with the battery terminals might cause a short circuit with a very high electric current, which may heat up and melt nearby objects and cause severe burns.
- ⦿ Keep the battery pack not being used away from paper clips, coins, keys, nails, screws or other small metal objects, that can make a connection from one terminal to another. Shorting the battery-pack terminals together may cause burns or a fire. For short-circuiting damage caused in this manner, any and all warranty claims shall be invalid.
- ⦿ Use electrically insulated tools for connecting cables.
- ⦿ The mounting and the electrical connection may only be carried out by trained specialists.
- ⦿ Use only properly functioning test equipment with this device.
- ⦿ Internal voltage of device may be higher than the rated level, take care to avoid being zapped during installation.
- ⦿ Keep this document in a safe place for the entire service life of the device. Pass the document on to subsequent owners and operators of the device.
- ⦿ Incorrect operation can damage system components.
- ⦿ The device must not be connected to a lead acid battery if it has a damaged casing.
- ⦿ Factory labels and markings must never be altered, removed or rendered unreadable.
- ⦿ This device contains sensitive electronics, so take care during installation and use.
- ⦿ Consider all relevant official safety instructions during transportation of the device. Safety instructions might vary depending on the mode of transport and on local country regulations.
- ⦿ Check the recycling information at the end of the user manual for disposal of device.

Application Scope

- ⦿ The primary application of the LE300 is the stationary storage of renewable energy in the area of solar energy.
- ⦿ This device is for residential, recreational & small commercial operations.
- ⦿ This device is for operation with 12 V lead acid batteries only. A lead acid charge controller is needed for correct operation.
- ⦿ The device is not permitted to be mounted in outdoors, underside, engine compartment or exposed areas of interior spaces (e.g. side pockets in the trunk, outer wet chamber, spare wheel recess).
- ⦿ Failure to follow this precaution can cause damage to this device and the energy source to which it is connected.
- ⦿ Consult authorized supplier if device is to be connected in nonstandard configuration.

- ⦿ Sizing of lead acid battery needs to fit to the overall system design. For long lifetime lead acid battery must frequently be charged to 100%.
 - ⦿ If sizing of the system is not done within the specification warranty becomes void.
 - ⦿ The battery connection in the KFZ range need to be chosen < 3 m.
 - ⦿ Failure to comply with correct product usage or neglecting the user manual, the warranty and guarantee becomes void.
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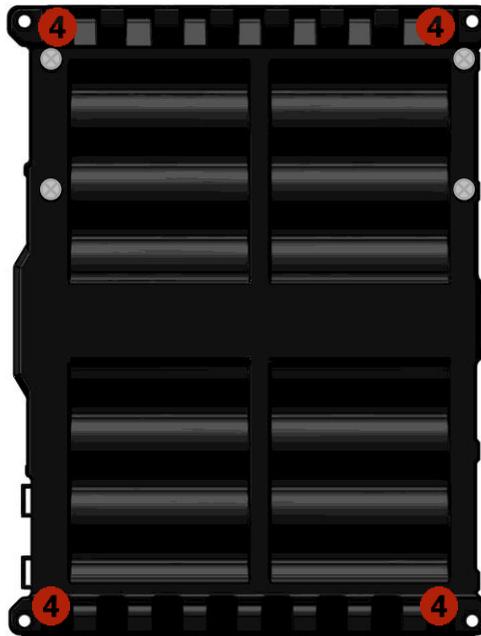
2 Technical specifications

	LE300
System voltage	12 VDC
Nominal voltage	12.8 VDC
Voltage range	11 – 15 VDC
Battery packs used in LE300	4x 11R26/65 – 8 LiFePO ₄ rechargeable battery
Nominal lithium capacity	25.6 Ah/328 Wh
Usable lithium capacity	90 % (23 Ah/295 Wh)
Recommended lead acid capacity for each LE300 (not included)	70 – 125 Ah @ 12 VDC
Recommended lithium/lead acid capacity ratio (net)	1/3 in solar home applications. Values vary depending on needed autonomy and on application.
Continuous charging current	Max. 12.5 A between 5 and 40 °C, at higher and lower temperatures current is limited
Continuous discharging current	Max. 12.5 A between 5 and 40 °C, at higher and lower temperatures current is limited
Battery efficiency	> 90 %
Housing dimensions	175x229x67 mm
Weight	3.4 kg
Connection terminals	RAST 5 power/mini module 4 pin RS485
Recommended wire size	1.5 – 4 mm ²
Ambient temp. (operation & warehousing)	-20 – 50 °C ambient temperature with maximum battery life at 15 - 25 °C. Warehousing temperature 10 – 35 °C.
Low and high temperature protection, heating, charging & discharging	Temp. sensor prevents lithium battery charge under -5 °C or above 55 °C cell temp. Charging starts once cell temp. is higher than -5 °C. Device has an integrated heating that is active between -20 °C and 10 °C cell temp. Discharge possible between -10 °C and 60 °C cell temp. At cell temp. below -10 °C system is running in pure lead acid mode for higher battery lifetime.
Lithium cell balancing	included
Protection features	Overcurrent, overvoltage, short circuit, deep discharge, wrong polarity protection.
Operation mode/compatible external batteries	Works in combination with any 12 V lead acid battery & lead acid charge controller.

Connection possibilities	Packs can be connected in parallel with each other (see exemplary configurations in the table on the next page).
Max. parallel LE300s	In standard version, a maximum of 24 LE300 can be connected in parallel, higher quantities possible after consulting BOS partner.
Exemplary parallel combination	Parallel
Qt. in parallel	4
Total nominal voltage	12.8 VDC
Total lithium capacity	102.4 Ah/1.3 kWh
Continuous charging current to LEs	Max. 50 A
Continuous discharging current from LEs	Max. 50 A
Recommended lead acid capacity (not included)	4 - 12 kWh

3 Overview

Front:



Back:



1	State of charge display and torchlight
2	Push button
3	Mounting shape for standard lead acid mounting clamp

4	Holes for mechanical parallel mounting/mounting on mounting plate (optional)
5	Cable connector plugs
6	Cable strain relief connectors

4 System functions

Charging

The electronic system controls the charging current such that the lead-acid battery is charged almost without affecting the charging voltage. A lowering of the charging voltage of the lead acid battery of up to 0.3 V is however possible. The energy that is not charged in the lead acid battery because of the voltage drop is charged in the LE300s.

Up to a voltage level of 13.5 V only the lead acid battery is charged. Hence the lead acid battery is charged with higher priority. Starting from 13.5 V the LE300 starts being charged in parallel to the lead acid battery, still leaving sufficient energy for the lead acid battery to be properly fully charged. The charging currents rise linear with the lead acid voltage.

Only under deep discharge conditions (LI-single-cell-voltage < 2.9 V) a small current is flowing to the LE300 in order to charge it if the lead acid battery has at least a voltage of 13.2 V. This is just for safety reasons to keep the electronics of the LE300 active.

Discharging

As long as the LE300 is not empty, there is a discharge at a higher voltage level than the lead acid battery. Therefore, the LE300 is preferably discharged.

The current is limited to about 12.5 A per device, for instance 4x LE300 can thus together support the lead acid battery with up to 50 A. Currents higher than the nominal rated currents of the LEs are supported by both, the LEs and the lead acid batteries, resulting in smaller C-rates for both batteries

At the beginning of each discharge phase, the LE300 will be discharged first (given that the LE300 has not been empty). Depending on the load, the LE300 is doing all the work until the LE300 is almost completely discharged. Once the LEs are discharged the lead acid battery is being discharged (if load continuous). Therefore, in charging & discharging phases the LE300 is supporting the lead acid battery.

Protection:

Due to the intelligent battery management, the LE300 is fully protected against overload and deep discharge as well as overcurrent, short circuits, wrong polarity and too high or too low temperatures.

Under cold conditions (<10 °C cell temperature) the integrated heater heats up the LE300 to operating temperature to avoid damage to the cells. At cell temperatures below -10 °C no discharge of the battery is possible. At cell temperatures below -5 °C no charge is possible. Once the integrated heater has warmed up the LE300 and the thresholds of -5 °C for charging, respectively -10 °C for discharging are passed, the LE300 starts charging/discharging. Full charging and discharging power is available between 5 °C and 40 °C, at cell temperatures lower than 5 °C and higher than 40 °C the charging and discharging currents are limited.

The device is short circuit protected, in case of short circuit the device will show an error code. See details under display & operation.

The device is wrong polarity protected, in case of connection with wrong polarity the device will show an error code. See details under display & operation.

Sleep mode:

An internal sleep mode protects against a complete discharge of the Li-cells.

When idle, under normal conditions the LE300 goes into a standby/sleep mode, waking up every 128 seconds to check if LE300 is needed for charging/discharging.

If one of the Li-cells falls under deep discharge, caused by self-discharge, the LE300 goes into a deep sleep mode. In this mode, the LE300 can only be woken up by pressing the push button or by recharging the battery (this is checked every 4 mins). After wake-up, a charging phase is possible.

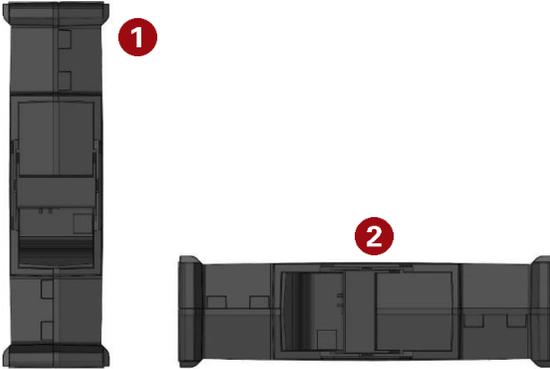
If one of the Li-cells is critically deep discharged, the LE300 system shuts down completely into a safety mode to protect from potential dangers that could occur when recharging depleted lithium cells. The LE300 cannot be woken up anymore. Neither charging nor discharging is possible anymore. Please contact your BOS dealer for support.

5 Installation

Please read and understand our general information before starting the installation.

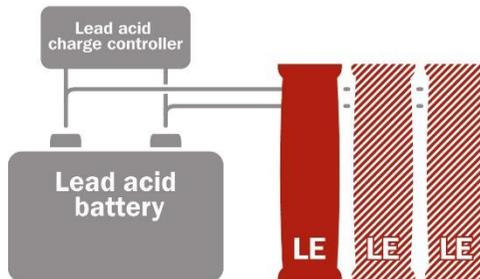
Mechanical installation

In general, LE300s can be installed in any mounting direction. Recommended mounting directions are (1) mounting in upright position using the standard lead acid battery clamps and (2) mounting flat on biggest area using direct mounting to a mounting plate with screws/bolts. See graphics below for details.



Electrical installation

The LE300 Lithium Extension Battery is connected in parallel to the lead acid battery. Please note that a standard lead acid battery charge controller is needed. No special additional charge controller is needed for the LE300. It is important to choose the right size of connection cable, depending on the maximum currents. Several sets of connecting cables might be required. Make sure that wiring is done according to DIN VDE 0298-4.



The picture above is a basic visualization of the system connection, details on the electrical connection are explained in the following:



(1) LEAD ACID IN/OUT		(2) FUSE	(3) RS485 COM	(4) RS485 COM	(5) DISPLAY OUT
-	+				
to lead acid -	to lead acid +	15 A mini fuse	<i>Optional to next LE</i>	<i>Optional to next LE</i>	<i>Optional to display</i>

Simply connect the LE300 system directly in parallel to the lead acid battery at the RAST 5 power connector (1). Therefore, either use the supplied plug connector, fix cables to it, plug it to the back of the LE300 at the power connector (1) and mount the other side of the cables to your lead-acid battery. Pay attention to right polarity and proper cable connection! It is recommended to use the optional power cable sets.

Check if the supplied 15 A fuse is inserted at (2). If fuse is missing, insert a new one.

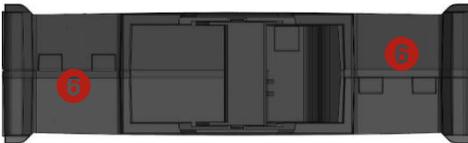
In case of parallel connection of several LEs, make sure that LE enclosures are mounted firmly together. It is recommended to use a threaded bolt and nuts to tighten LEs with each other (optional mechanical parallel mounting kit). It is recommended to connect all LE300 with each other through RS485 communication (3) and (4). LE300s would also work in parallel mode without the RS485 communication, however one common state of charge signal couldn't be generated anymore. Maximum number of LEs in parallel configuration is 24 as standard version, please get in touch with your BOS dealer if more LEs in parallel are needed.

(5) Optional signal outlet for display connection. 0 - 10 V state of charge signal to be connected to displays with 0 - 10 V signal input. It is recommended to use the following plug

with cables at the signal outlet: Mini-Fit Jr.™ TPA Cable Assembly 45135 (plug not included).
Optionally a LCD state of charge display is available.



Pin	Name	Description
1	ANOUT	Analog OUT 0- 10 V SOC (0 V = 0 % 10 V = 100 %)
2	DIN1	Digital IN 1 (Wake up)
3	DIN2	Digital IN 2
4	GND	Ground



(6) Tighten the installed cables with a cable tie to the strain relief connectors to avoid damages to the electronics from moving cables.

Optional wiring sets

Set: Two LE300

A-FSH 6.3 x0.8 AWG 12-16
Faston POS LOCK
Hedi Nr. NEU

G-FSH 6.3 2pol. POS-LOK
HSG 250.2 POS RAST5
Hedi Nr. NEU



FLRY 4⁺ sw 120mm

FLRY 4⁺ braun 120mm



FLRY 4⁺ sw 180mm

FLRY 4⁺ braun 180mm

Ultraschallschweißpunkte
mit Schrumpfschlauch 18,0/6,0
sw m. K. Länge 40mm
Hedi Nr. 40311

FLRY 6⁺ sw 1100mm

FLRY 6⁺ braun 1300mm

FLRY 6⁺ sw 250mm

Iso B10 200mm

Sicherungshalter 25A, UNI VAL,
anreihbar 30A
Hedi Nr. NEU
A-Kontakt für Sicherungshalter UNI VAL
4-6mm², CuNi, mit Edelstahl Federclip
Hedi Nr. 40288
Sicherung FKZ, 30 A hellgrün
Hedi Nr. 40465



A-Ring M6 4-6mm²
Quatschkeilschuh
Hedi Nr. 40405
Schrumpfschlauch 12,0/4,0
o.K. sw. Zuschnitt 30mm
Hedi Nr. 40318

For parallel connection of more than 2 LEs, use respective numbers of wiring sets 1 and 2 to match number of LEs. Make sure that wiring is done according to DIN VDE 0298-4.

6 Commissioning

Once mechanical and electrical connection is done according to chapter 6, the LE300 will automatically start working and supporting the lead acid battery system. Please push the pushbutton of LEs to check the status of the products (see details in chapter 8). In case of wrong connection, LEs will show error messages. In case of correct installation, LEs will give their state of charge only without showing an error message.

It is recommended to fully charge the system once LEs were connected. A full system charge is needed in order to give accurate information on the state of charge of the system.

For devices which are stored over a longer period of time, several charging cycles might be necessary. This is done to balance each lithium-cells and to show an accurate state of charge display.

7 Display & Operation

The display is off by default, to save power. To activate just press the push button. It consists of 4 status LEDs and one push button. The display turns off, once the push button is no longer pressed.

Once the push button is pressed, the device shows whether it is charging or discharging (in case of errors in the LE or the set-up, error codes are shown as described in chapter 9):



Chaser light from red to green indicate that the lithium battery is being charged.



Chaser light from green to red indicate that the lithium battery is being discharged.



If green LED flashes whilst the push button is pressed, the LE is neither charged nor discharged but in idle mode.

Once the push button is released the device shows the state of charge:



Green LED indicates, that lithium battery is full, SOC > 90 % (SOC = State of charge)



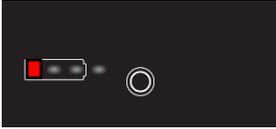
Green and yellow LED indicates, that the battery is between 61 – 90 % SOC



Yellow LED indicates, that the battery is half-full, SOC between 31 – 60 %



Yellow and red LED indicates, that the battery is at low SOC between 1 – 30 %.



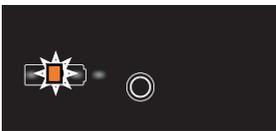
Red LED indicates, that lithium battery is empty. Deep discharge protection is switched on.

If the push button is pressed for 5 seconds an emergency light turns on:



White sun shaped LED is an emergency light and can be activated by pressing the push button for 5 seconds. It turns off automatically after 30 seconds.

8 Troubleshooting and FAQ

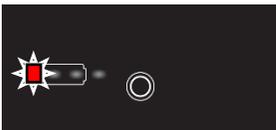


If yellow LED flashes once the push button is pressed the LE itself is fine. However, there is some problem in the operation of the LE, which is linked to either of the following events: the connection to the lead acid battery is not working (tripped fuse or bad/no connection to lead acid battery or wrong polarity); temperature too high; temperature too low; short circuit.

Please first check if the temperature of the LE might be too high or too low. Please check if the LE is properly connected to the lead acid battery with the right polarity and if the lead acid battery voltage is higher than 10.5 V. Please also check if the 15 A fuse at the LE and any other fuse in the line between the LE and the lead acid battery is tripped. Exchange tripped fuses and recheck status once it is assured that connection to lead acid battery is done properly (no short circuit, right polarity, properly connection at lead acid and LE). Once issue is resolved, restart the LE by pushing the push button.

In case of low temperature connection, the LE is heated up once the system gets charged. In case of too high temperatures, the LE will reactivate once temperatures are lower.

The LE itself is fine, but either the short circuit or the wrong polarity protection was triggered. Please check the wiring for short circuits or wrong polarity connection.



If red LED flashes once the push button is pressed, the LE300 has an error that needs to be checked by a BOS service partner. Please contact your BOS dealer.

If no LED turns on once the push button was pushed and released the system is most likely in a deep discharge protection mode. Please contact your BOS dealer.

Why is there no voltage at the power connector of the LE?

As long as the LE is not connected to a lead acid battery, the power connector of the LE is deactivated. Connect to a 12 V lead acid battery to use the LE.

9 Maintenance

The device is basically maintenance-free. Cable connections should be checked frequently. Clean the device from dust when necessary with a dry cloth. Avoid any contact with water or other liquids.

The LE300 life can be prolonged when being properly maintained and especially when being operated and stored at the right temperatures.

With increasing age however, the LE300 capacity will diminish even when properly maintained.

A significantly reduced operating period after charging indicates that the LE300 is worn out and must be replaced.

10 Storage

The lithium battery built into the device has been designed to last at least ten years of normal use. If the product is stored for a long period of time, please recharge the battery frequently. Therefore, connect the system to either a photovoltaic (PV) module or to a direct current (DC) power source (in each case the usage of a lead acid charge controller is mandatory). Please be aware that batteries will get damaged by deep discharge if not recharged regularly.

When not using the LE300 for a longer period, charge it to min. 60 % (green and yellow LED or only green LED lighting up at the display). Check the charge condition after 6 months. When only the red LED of the display lights up, recharge the battery pack again to min. 60 %.

Note: When the LE300 is stored empty for longer periods, it can become damaged despite the low self-discharge and the LE300 capacity may be strongly reduced.

Store the LE300 in a dry and well-ventilated location. Protect the product against moisture and water. Under unfavorable weather conditions, it is recommended to store the LE300 in an enclosed location until being used again.

The LE300 can be stored at temperatures between 10 °C and 35 °C. For a long battery-pack life, however, storing the battery pack at a room temperature of approx. 20 °C is of advantage.

Take care that the maximal storage temperature is not exceeded. As an example, do not leave the battery pack in a vehicle in summer and store it out of direct sunlight.

For storage, the optimal temperature should be between 10 °C and 25 °C and should not be over 30 °C. Avoid relative humidity over 95 % and under 40 % over a longer period as well as condensation.

11 Transportation

The LE300 is UN38.3 certified, nonetheless it is subject to the Dangerous Goods Legislation requirements. Private users can transport undamaged LE300 by road without further requirements.

When being transported by commercial users or third parties (e.g. air transport or forwarding agency), special requirements on packaging and labelling must be observed (e.g. ADR regulations). If necessary, an expert for hazardous materials can be consulted when preparing the item for shipping.

Dispatch LE300 only when the housing is undamaged. Tape or mask off open contacts and pack up the LE300 in such a manner that it cannot move around in the packaging.

Inform your parcel service that the package contains dangerous goods. Please also observe the possibility of more detailed national regulations.

In case of questions concerning transport of the LE300, please refer to an authorized BOS dealer. The BOS dealers can also provide suitable transport packaging.

12 Warranty & Legal notes

Warranty

The LE300 Lithium Extension Battery come with a two-year warranty on the product including the integrated lithium battery starting from the date of purchase. There is no warranty granted on other system components from other manufacturers that are used together with the LE300 Lithium Extension Battery. In case of problems, comments or a warranty claim or the need for spare parts please contact the local dealer or BOS AG headquarters for support.

Exclusion of liability

The manufacturer can neither monitor the compliance with this manual nor the conditions and methods during the installation, operation, usage and maintenance of the device. Improper installation of the device may result in damage to property and, as a result, to bodily injury.

Therefore, the manufacturer assumes no responsibility and liability for loss, damage or costs which result from or are in any way related to incorrect installation, improper operation, incorrect execution of installation work and incorrect usage and maintenance.

Similarly, we assume no responsibility for patent right or other right infringements of third parties caused by usage of this device.

The manufacturer reserves the right to make changes to the product, technical data or installation and operating instructions without prior notice.

Declaration of conformity

The LE300 Lithium Extension Battery comply with all applicable provisions of relevant directives and regulations and are in conformity with the relevant standards. The full declaration of conformity and the list of standards, directives and regulations is found for download at www.bos-ag.com/.

13 Recycling information



Recycling of the integrated lithium battery is handled in Germany by GRS Service GmbH.

Do not dispose in waste bin, but recycle electronics, batteries and packaging materials according to local regulations. Tape or mask off the contact surfaces of the battery pack's terminals with adhesive tape before disposing of battery packs.

Only for EC countries:

According to the European Guideline 2012/19/EU, electrical devices/tools that are no longer usable, and according to the European Guideline 2006/66/EC, defective or used battery packs/batteries, must be collected separately and disposed of in an environmentally correct manner.

Contact BOS AG headquarter

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