



FES KOP2300 High Power Charger

Suitable for charging FES 14S Battery packs

User manual, Version 1.1



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1. Important notices

This user manual contains important information about proper and safe usage of FES KOP2300 charger. If you need more information, please contact LZ design company.

Information in this document are subject to change without notice. LZ design reserves the right to change or improve this product and to make changes in the content of this material without obligation to notify any person or organization of such changes or improvements.



Caution: A Yellow triangle is shown for parts of the manual which should be read carefully and are important.



Warning: Notes with a red triangle describe procedures that are critical and may result in reduced safety or may lead to critical situation.



Note: A bulb icon is shown when a useful hint is provided to the reader.

1.1 Limited Warranty

This product is warranted to be free from defects in materials or workmanship for two years from the date of purchase. Within this period, LZ design will, at its sole option, repair or replace any components that fail in normal use. Such repair or replacement will be made at no charge to the customer for parts and labour, however the customer shall be responsible for any transportation cost.

Usage of device is at user's own risk. LZ design will not under any circumstances accept any responsibility or will be liable for possible damage on people, animals or things, which might directly or indirectly happen from using the charger.

To obtain warranty service, please contact LZ design directly.

1.2 Invalid Warranty

The warranty does not cover failures due to abuse, misuse, accident, or unauthorised alterations or repairs.

The warranty becomes invalid in the case of connecting and charging any other unauthorized batteries.

The device is not waterproof in anyway.

2. Introduction

FES KOP2300 battery charger is modern fully automatic device suitable not only for charging but also for maintaining and monitoring the batteries. The charger stores data about charging times and Ah charged. This data can be accessed for further analysis. The device is protected against reverse polarity and short circuit, has adjustable time limitations for every charging phase, battery temperature monitoring and compensation and current reduction at elevated ambient temperatures.

Required input voltage is 110 V or 230 V~ 50/60 Hz, so it is suitable for EU and also US owners of FES battery packs without usage of voltage converter.

FES KOP2300 High Power Charger is programmed with suitable settings and equipped with suitable connectors for charging FES 14S battery packs.

3. Technical characteristics

	FES KOP2300
Nominal charging voltage	48 V
Max charging current	45 A (currently reduced to 30 A for FES application)
Min. starting voltage set to	40 V
Max charging voltage set to	59,5 V
Typical efficiency at 230 V	96 %
Charger power supply voltage range	90 V – 264 V AC / 47 - 63 Hz
Output power	max 2300 W (currently reduced to 2000 W for FES application)
Dimensions (L x W x H)	407 x 159 x 140 mm
Weight	5,6 kg
Environmental protection grade	IP65
Approvals	EN55022 Class B; EN 60905 Class; EN61000-3-2; EN61000-3-3; EN61000-4-2; EN61000-4-5; EN61000- 4-6; EN61000-4-11; EN61000-6-2; EN61000-6-3

3.1 Mains current limiter

The mains current is limited to max. 13 A for 230 V systems and to max. 16 A for 120 V systems. FES KOP2300 automatically detects the mains voltage.

Comment: For 230 V mains voltage and full output power the charger needs approx. 10.5 A from the socket. At low mains voltage, the mains current would increase at the same power, but this would be reduced to max. 13 A. In the short term, the current can also be somewhat higher than 13 A in the case of very fast mains voltage fluctuations.

If the mains voltage drops below approx. 90 VAC, the KOP2300 charger is switched off. After the mains voltage rises again, the charging is restarted where it was interrupted.



Note: *Before using the charger, check that the fuse on the grid is suitable. For 2300 W charger it should be minimum 16 A fuse (for 230 V grid) or minimum 20 A (for 110 V grid). Always try to connect charger directly to inlet, without extension cables and splitters.*



Warning: *If you have another pair of Battery pack, make sure that you do not mix packs between the two sets. The same two packs of one set (first marked as A, second marked as B) must be always used in pair!*

4. Mechanical installation

Before the installation, please consider the following:

a) Ensure the distance from the walls or other objects

Ensure the distance from the walls or other objects. Leave enough space (at least 10 cm) between the cooling openings and other objects or walls.

b) Avoid the heat build-up

Despite very high efficiency quite a lot of heat arises. Therefore, the charger must only be installed in places with enough air exchange. Otherwise, the air temperature rises in the vicinity of the device and the charging current may be reduced or the device may turn off.

c) Horizontal mounting

Mount the charger on a flat surface.
The device can withstand higher stress due to vibration and shock in the horizontal position.



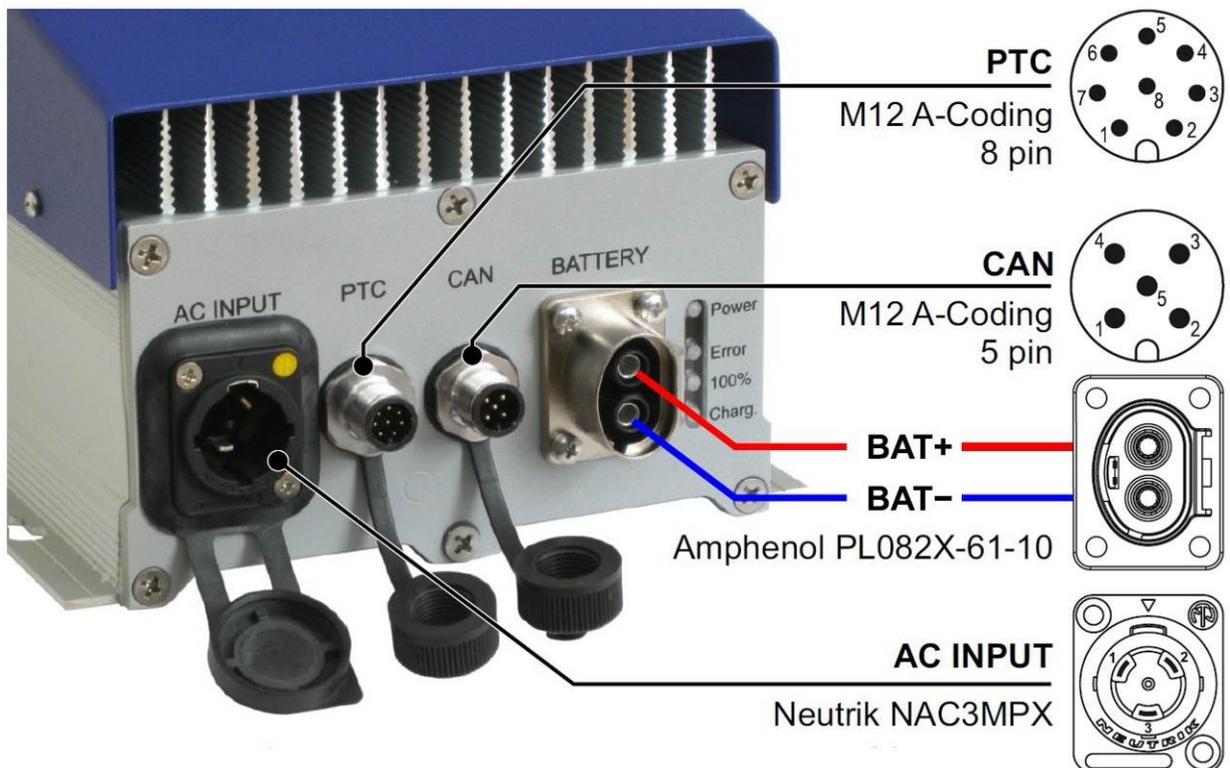
d) Vertical mounting

The cables and terminals must be on the lower side as shown on the image.



Caution: Do not make any holes on the chassis, as components can be damaged.

5. Connections



All contact arrangements shown from the mating side.

5. LED Functions

Power	100 %	Charging	Error	Function
Flashing	OFF	OFF	OFF	No firmware loaded or bad firmware version (bootloader is active).
ON	OFF	OFF	OFF	No battery connected or battery completely empty.
ON	OFF	Flashing	Flashing	Battery voltage under the minimal parameter value. The Charging and Error LED's are flashing intermittently.
ON	ON	OFF	OFF	Charger waits for the programmed automatic restart or battery voltage under the minimal parameter value.
ON	OFF	ON*	OFF	*Charging with full current.
ON	OFF	Flashing*	OFF	*Charging with reduced current – the battery is almost completely charged.
ON	OFF	OFF	Flashing	Error – see the table in Chapter 8. Number of consecutive LED flashes defines the error number.

*This LED functions depend on the settings of charger parameters

6. Charger to FES Battery pack connection and charging



Caution: Place charger on a safe, secure position. Keep away from dust, direct sunlight, fire, smoke, children and any unattended person!



Warning: Before charging, physical condition inspection of the battery packs should be done. Any sign of mechanical damage, such as a puncture, dents, scratches, must be evaluated and reported to manufacturer before charging.

Battery to charger connection procedure:

1. Connect RED + and BLUE - cables from charger to first battery pack.
2. Connect the charger and the battery pack with FES KOP2300 BMS-Charger-PC cable.



FES KOP2300 BMS-Charger-PC cable

3. Plug in the charger to the outlet (90 – 264 V AC / 47 - 63 Hz).
4. Turn on the BMS switch on top of the battery pack cover.

Immediately after BMS is switched ON, the BMS starts a test procedure - a check of all 14 cells, one by one. Red »Error LED« turns ON during system's test procedure and turns OFF again when the test is completed without error.

After the test procedure, several LEDs turn ON for about 1 second. The number of the LEDs that light up, represent a state of charge (SOC) of the battery pack. Each LED represents around 7% SOC, for example:

- 2 LEDs are lit: SOC is approximately 14 %;
- 7 LEDs are lit: SOC is approximately 50 %;
- 14 LEDs are lit: SOC is approximately 100 %.

5. When the test procedure is completed the green »Power LED« starts blinking indicating that the BMS is working in the normal mode. At this time, BMS sends a signal to the charger to start charging. Orange LED on front panel of the charger lights up, which indicates charging. It is also possible to hear the contactor "click" inside of the charger. Charging current increases slowly to the maximum value of 30 A and charger cooling fans turn on after a while.

6. In normal mode, the green »BMS Power« LED is flashing. This means that the BMS is turned ON, but not necessary balancing. Balancing starts when one cell reaches a pre-set balancing voltage value, usually 4.1 (this can be changed using BMS Control Software). If any of 14 green LED cell balancing indicators is ON, this means that the corresponding cell has a slightly higher voltage compared to the cell with the lowest voltage.
- If one or more cells have higher voltage than the others, they will be discharged and the BMS temperature rise will be minimal.
 - In case that one cell has lower voltage than the others, all cells with higher voltage will need to be discharged to reach a balanced stat. This leads to higher BMS temperature rise, even if the voltage difference is only 0.010 V (10 mV).

The cooling fans turn on when the BMS cooling plate reaches 50°C.



Caution: Cooling fans may not be able to cool down the BMS sufficiently in hot conditions and the temperature of the BMS cooling plate can continue rising. In this case, charging is interrupted automatically when the BMS cooling plate reaches 55°C, until it drops to 45°C and charging resumes.

7. The red »Error LED« is ON only during the initial test procedure. After the test is finished it turns OFF. If a system error is detected the LED blinks a certain number of times followed by a pause. Number of blinks identifies the error.
8. When the first cell reaches 4.160 V, charging current is reduced. If there is a big difference between the cells (more than 50 mV), it can take long for all of them to reach 4,16 V, as charging current is reduced to 1 A.
9. When all cells reach 4.160 V (+/- 2mV), **BMS sends a signal to the charger to stop charging.**

The **Green** "Power LED" stops flashing and starts **glowing Green**.

This indicates that the charging cycle was completed properly.

10. Switch OFF BMS on top of the Battery pack. Unplug charger from the outlet. Unplug charging cables and signal cable from the battery pack.
11. Charge second FES GEN2 battery pack!



Warning: Both battery packs **must have** approximately the same cell voltage levels (close to 4.16 V per cell), before usage. Using two packs with too much difference in voltage is not allowed!
Maximum 1V difference between total voltages of both packs is acceptable.
For instance, Pack 1: 58,1V (average 4.150 per cell), Pack 2: 57,1V (4,080V per cell), this is just acceptable! Bigger voltage difference is not acceptable!



Caution: *If there is a risk of a lightning strike by an approaching thunderstorm, stop charging immediately and disconnect the charger from the outlet.*

7. Error codes

List of red error codes:

Number of red blinks	Error description
1	Charger temperature sensor or cooling fan failed.
2	Charging time limit has been exceeded.
3	Battery temperature sensor failed or not connected or shorted.
4	Internal charger temperature too high.
5	Battery voltage too high at the start of the charging.
6	Battery temperature too low during charging < -1°C.
7	Battery temperature too high during charging.
8	Charger disconnected from the battery during charging.
9	Incorrect parameter checksum.
10	Bad value from the power module.
11	Incorrect parameter values.
12	Internal problem with the power module.
13	The charging current measurement is outside of the tolerances.
14	Internal problem with measurement or voltage regulation.

8. Troubleshooting

Issue	Remedy
LED's on the charger do not turn on after connection to the mains socket.	Check the mains connection. Check if the mains voltage is present.
Charging does not start.	Check the battery connection, battery voltage, fuses and connection to the BMS.
Battery voltage is very low.	The battery voltage is lower than the minimum set voltage level at which the charger is allowed to start. Contact local dealer of LZ design directly.

9. Revision history

August 2019	Initial release of user manual, v1.0
May 2020	Minor corrections, v1.1