FES SYSTEM MANUAL

Version 1.26

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1. Important notices

Please read this manual thoroughly. It contains important information about your FES system, having vital importance to flight safety.

Information in this document is subject to change without notice. LZ design reserves the right to change or improve their products 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 a critical situation.*

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

1.1 Limited Warranty

This FES system 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 repairs or replacement will be made at no charge to the customer for parts and labour, and the customer shall be responsible for any transportation cost. This warranty does not cover failures due to abuse, misuse, accident, or unauthorized alterations or repairs.

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Some states do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you. LZ design retains the exclusive right to repair or replace the unit or software, or to offer a full refund of the purchase price, at its sole discretion. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

To obtain warranty service, contact manufacturer of FES equipped sailplane, your local LZ design dealer or contact LZ design directly.

2. General

Congratulations on your purchase. You purchased a high-end electric propulsion system for sailplanes, which will keep its capability and performance for a long time with proper maintenance and operation.

The FES system was developed by Ing. Luka Žnidaršič and his father Ing. Matija Žnidaršič. We set out to build a reliable glider sustainer system, which would add minimum additional weight and offer good climb performance and suitable range at the same time. Our expectations were surpassed as FES proved to be suitable as a self-launch system for lighter 13,5m, 15m as well as some 18m sailplanes.

We wish you safe and enjoyable flights with your new system and always happy landings.

3. Available FES manuals

FES System is well documented and comes with several separate manuals, which we strongly recommend reading.

The following manuals apply to all FES equipped sailplane types:

- **FES Quick Guide** – condensed important safety information & procedures to be reviewed before flying an FES equipped glider.
- **FES Flight manual** - vital procedural and performance-related information you should know before the first flight with an FES equipped sailplane - this information should also be included in the aircraft flight manual, published by the glider manufacturer.
- **FES Maintenance manual** - important information related to maintenance of the FES system - this information should also be in the aircraft maintenance manual, published by the glider manufacturer.
- **FES FCU INSTRUMENT manual** - detailed explanation of the **F**es **C**ontrol **U**nit operation.
- **FES BATTERY PACK GEN1 manual** - information about the 1st generation battery pack - with external BMS.
- **FES BATTERY PACK GEN2 manual** - information about the 2nd generation battery pack - with integrated BMS.
- **FES BATTERY PACK GEN3 manual** - information about the 3nd generation battery pack - with integrated e-ink display and G-sensor
- **FES KOP2300 charger manual** - information about optional high power charger
- **FES Satiator charger manual** - information about optional small travel charger
- **FES BMS CONTROL manual** - installation and use of "BMS Control" Windows PC program for monitoring battery and charging parameters.
- **FES BMS LCD Display manual** - information regarding the use of the BMS LCD display to monitor battery and charging parameters.
- **FES Wi-Fi modul manual** - information regarding the use of the Wi-Fi modul used to display and monitor battery and charging parameters.
- **FES Discharging assistant manual** - information about the device used for discharging battery packs for storage.
- **FES Discharger 2 manual** - information about the device used for discharging battery packs for storage.
- **FES Bridge manual** - information about bridge between FCU and LXNAV flight computers.

The electric motor manuals apply only to the listed aircraft types:

- **FES-LAK-M100 Motor manual** - for LAK17A FES, LAK17B FES, MiniLAK FES
- **FES-LAK-C100 Motor manual** - for LAK17C FES
- **FES-SIL-M100 Motor manual** - for SILENT 2 Electro
- **FES-AS-M100 Motor manual** - for AS13,5m FES
- **FES-VEN-M100 Motor manual** - for Ventus 2cxa FES, Ventus 3 FES
- **FES-DIS-M100 Motor manual** - for Discus 2c FES
- **FES-HPH-M100 Motor manual** - for HPH 304ES
- **FES-DIA-M100 Motor manual** - for Diana 2 FES
- **FES-LS8-M100 Motor manual** - for LS8-e
- **FES-DG-M100 Motor manual** - for DG1001-e
- **FES-DUO-M100 Motor manual** - for Duo Discus FES
- **FES-ANT-M130 Motor manual** - for Antares FES

Different sailplane types have dedicated propeller manuals as listed below:

- **FES-LAK-P10-100 Propeller manual** - for LAK17A FES, LAK17B FES, MiniLAK FES, AS13.5m FES, AS15m FES
- **FES-LAK-P11-100 Propeller manual** - for LAK17C FES
- **FES-SIL-P15-100 Propeller manual** - for SILENT 2 Electro
- **FES-VEN-P1-102 Propeller manual** - for Ventus 2cxa FES, Ventus 3 FES
- **FES-DIS-P1-102 Propeller manual** - for Discus 2c FES
- **FES-HPH-P1-102 Propeller manual** - for HPH 304ES
- **FES-DIA-P1-102 Propeller manual** - for Diana 2 FES
- **FES-LS8-P1-102 Propeller manual** - for LS8-e
- **FES-DG-P1-102 Propeller manual** - for DG1001-e
- **FES-DUO-P1-102 Propeller manual** - for Duo Discus FES
- **FES-ANT-P1-120 Propeller manual** - for Antares FES

Regular updates of most FES manuals are available on official FES website:
https://front-electric-sustainer.com/downloads/

The last update date is shown next to the link to the pdf file of the corresponding document – e.g. *FES System manual v1.0, pdf file updated 1.4.2013*

Note: *We recommend FES owners and users to regularly check the website for manual updates. Some glider manufacturers include only basic information regarding the FES in their official manuals. FES Manuals published on our FES website might provide more in-depth and up-to-date information, but newertheless they are not official manuals for your glider.*

4. Technical data

	FES System
Weight of all components	cca. 45kg (55kg)
Maximum power	22 kW (28 kW)
Time to full power	1-2 sec
Total energy stored in two GEN2 (GEN3) battery packs	4,2 kWh (5,5kWh)
Propeller diameter	1,02 m (1,2 m)
Maximum propeller speed	4500-4700 rpm (5100 rpm)
Cruising propeller speed	3000-3300 rpm (5100 rpm)
DC/DC converter power	60 W (100 W)
Maximum battery total voltage	118 V (133 V)
Minimum battery total voltage	90 V (102 V)
Maximum battery current	220 A (250 A)

Note: *Data can vary regarding sailplane type. FES system components are adjusted to each specific type of sailplane.*

5. FES drawings

Please refer to *FES Maintenance manual, FES Flight manual* and *FES Motor manual*.

6. Maintenance

Please refer to *FES Maintenance manual*.

7. Repair and service

In case of a fault or damage, contact manufacturer of the FES system (LZ design) or manufacturer of your sailplane.

8. Revision history

April 2013	Initial release of the manual, Version 1.0
June 2013	Added information about updates of manuals, Version 1.1
March 2015	Added info about new FES sailplane types, Version 1.2
September 2016	Added info about new FES sailplane types, Version 1.21
October 2016	Added information about FES Quick Guide, Version 1.22
September 2017	Minor updates, Version 1.23
September 2019	Minor updates, Version 1.24
May 2020	Proofreading, Version 1.25
January 2023	Added info about new FES sailplane types and new accessories, Version 1.26