



FES MOTOR MANUAL

Version 1.1

Type: **FES-M130**



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1. Important notices

Please read this manual thoroughly. It contains important information about your motor, having a vital importance to the 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.

1.1 Limited Warranty

This motor 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 labor; 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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To obtain warranty service, contact your local LZ design dealer or contact LZ design directly.

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2. General

Congratulations on your purchase. This is a high-end product of brushless synchronous permanent magnet motor, with 3 phases and electronically controlled commutation system, which will keep its capability for a long time if treated the right way.

The drive was developed and tested by Ing. Matija Žnidaršič and Ing. Luka Žnidaršič. The development objective was to build more powerful version of motor for FES (Front Electric Sustainer/Selflauncher) application, to be suitable for heavier two-seater sailplanes and also for RES applications (Retractable Electric Sustainer/Selflauncher) or Ultra light airplanes, which are usually equipped with larger propeller diameter, rotating at lower RPM. Motor is able to provide more torque and power, at relatively small increase of weight and dimensions, compared to our standard motor version (FES-M100).

Due to its high torque characteristic, this motor can be very suitable also for other direct drive applications, without otherwise essential gear unit, which causes power losses, additional weight, complexity and maintenances costs.

Because of very little internal resistance of the motor, good performances are achieved in a wide range of RPM, and with excellent efficiency.

Most of the motor parts are produced by modern CNC milling machines. All aluminum parts are black anodized.

3. Model designation

Motor model designation is the following:

FES-M130
(1) (2)

where:

- (1) motor application
- (2) approximate motor length in mm

Motor serial-number is identified as number which follows model designation

sn: XXX

Motor identification numbers are engraved into rear Aluminum plate of motor.

4. Technical data and limitations of motor

Motor construction is outrunner brushless synchronous permanent magnet motor (BLDC) with electronically controlled commutation system 3 phase.

This motor type can work only in combination with suitable BLDC controller of different producers. Its task is to transform DC current from Battery packs to 3 phases of suitable frequency and amplitude to supply motor.

Motor can work with different types of sensorless motor controllers, or with controllers which need information about rotor position from hall sensors as it is equipped with 3 hall sensors. Position of hall sensors can be mechanically adjusted to most suitable position.

There is also an additional 4th hall sensor which is used for automatic propeller positioning.

Due to high torque characteristic, at lower RPM, this motor is mostly suitable for applications with relatively big propellers!

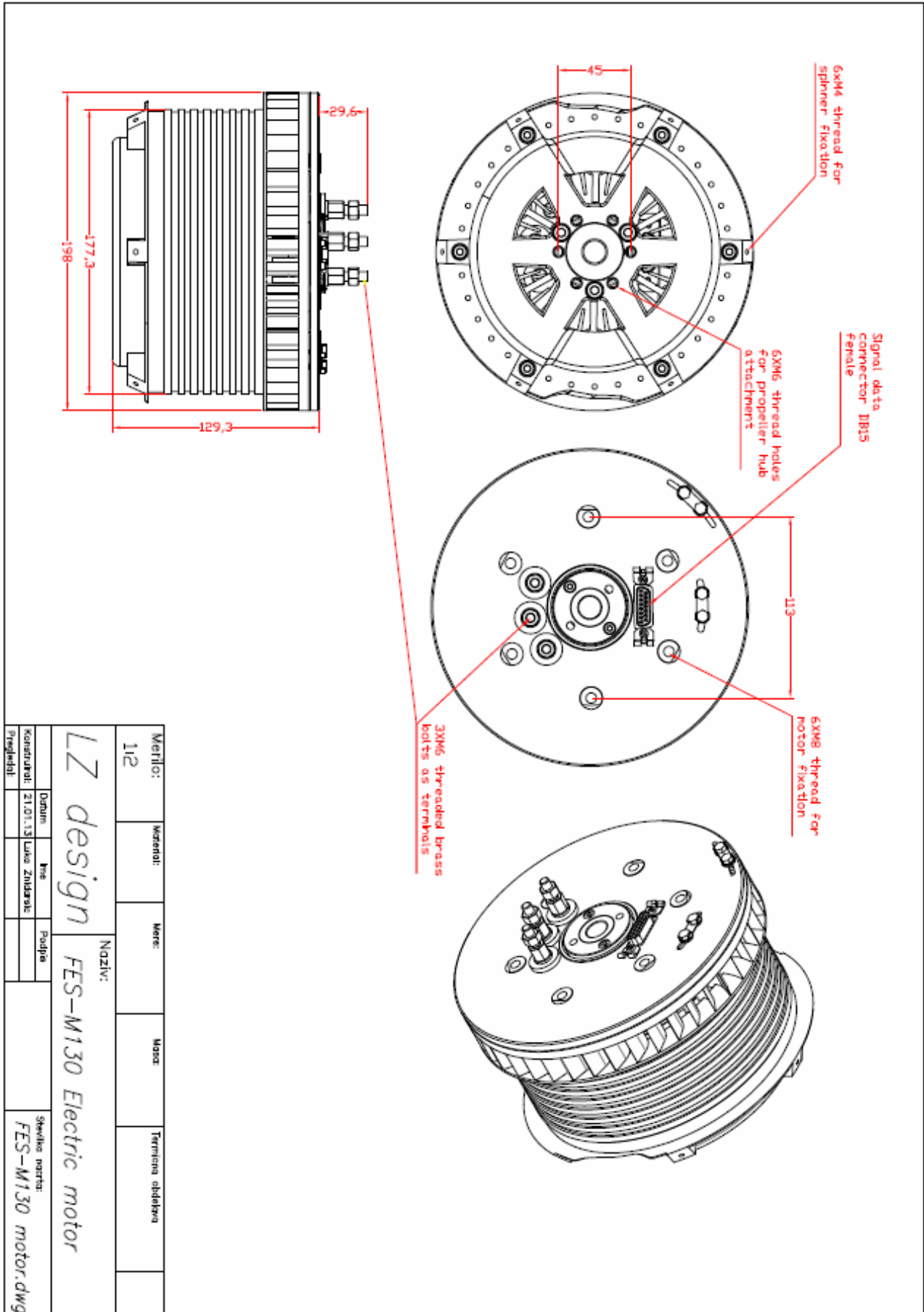
Power load on motor P (kW) is dependant on propeller diameter, geometry, pitch and its rotation speed n (RPM-rotation per minute). However rotation speed of motor is more dependant on available Voltage on controller. Higher Voltage, higher rpm!

Maximum continuous current depends on amount of air which is provided for efficient cooling of the motor.

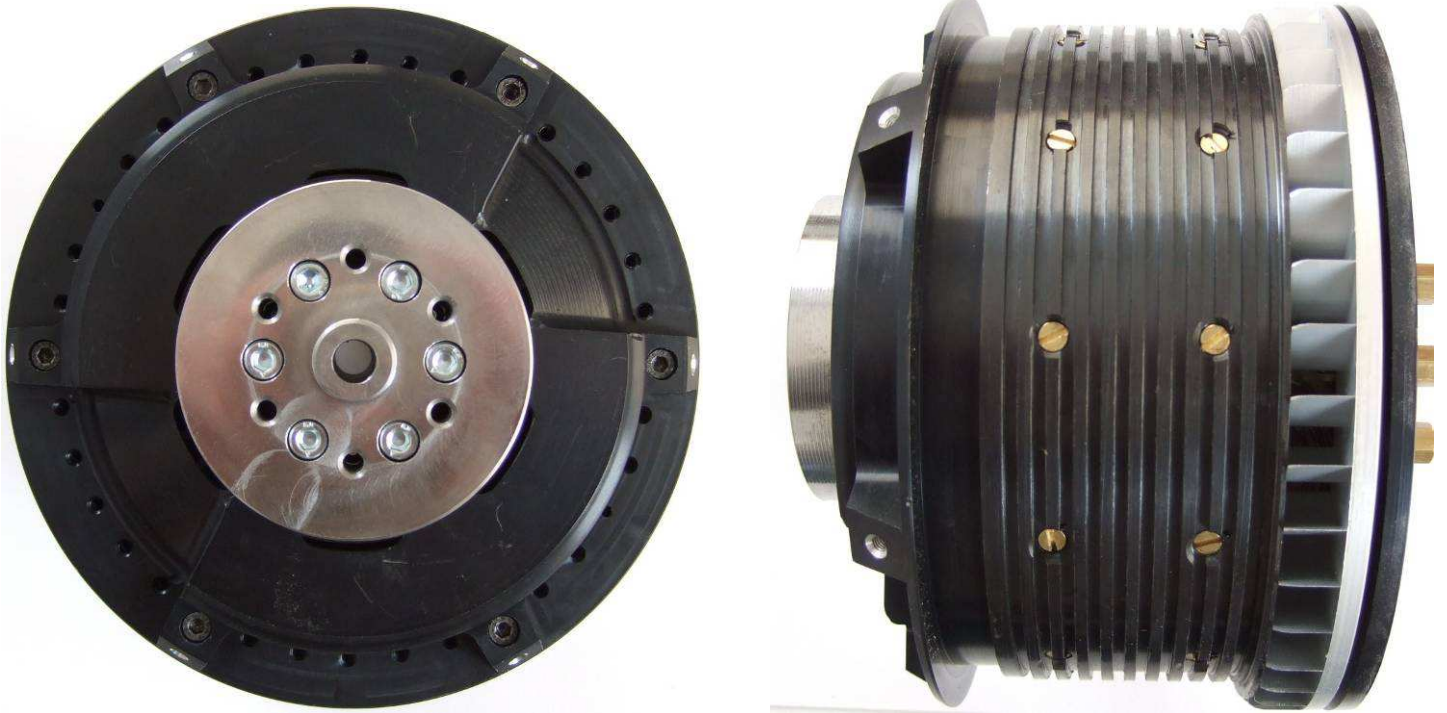
Basic technical data of FES-M130 motor:

Motor type	Brushless, outrunner with permanent magnets, 3 phases
Ingress protection	IP21
Motor weight cca.	11,0 kg
Motor efficiency	93-98 %
Cooling	Air cooled
Ventilator type	Centrifugal
Suitable external motor controlers	Kelly controls, Piktronik, Unitek, Sevcon...
Hall sensors available	3 sensors + 4th
Maximum peak power	36kW
Maximum continious power	30kW
Maximum Voltage	180 V
Maximum torque	120 Nm
Maximum peak current	200 A
Maximum continious current	170 A
Number of pole pairs	6
Rpm non loaded	31 rpm/V
Rpm non loaded at 115V	3600 rpm
Non loaded motor current at 3600 rpm	12A
Rotor diameter	183 mm
Motor length	130 mm
Main shaft diameter at bearings	25 mm
Main shaft hole diameter	14 mm
Number of bearings	2 (NSK 6005 ZZ)
Maximum allowed working temperature	90 °C
Minimum allowed starting temperature	-20 °C
Temperature sensor type	DS18S20 (TO-92)
Contact terminal dimesions	3x M6 bolts, suitable for 35-6 cable shoes
Signal cable connector	Spring lockable DB15 female, with two pins per wire
Fixation of motor provided trough	6 x M8 threaded holes (113mm distance)
Fixation of propeller holder or flange	6 x M6 threaded holes (45mm distance)
Fixation of spinner	Directly to front plate with 6 x M4 threaded holes

5. Drawing and photos



Drawing of motor with main dimensions



Front and side view of motor with a flange to mount propeller



Front and side view of motor without flange



Motor mounted on test bench with a wooden propeller

6. Maintenance

The motor do not need any maintenance. Opening or disassembling of the motor would cause a forfeit of warranty claims! It could be also very dangerous, due to very strong magnets on rotor!

Though, it has to be considered that no foreign objects at all can enter the interior of the drive.

Further, it is necessary to protect the motor from humidity, dirt, paint, glues etc. If this is ignored, a proper functionality of the motor can not be guaranteed and irreparable damages are possible. In case of damage, ship the drive back to the manufacturer for repairs. Unintended handling leads to secondary damages.

Keep magnetic memory cards or electronic devices out of the rotor's close-up range, because the alternating magnetic field can cause a delete of data. Be also careful with medical devices (e.g. pacemakers) which are sensitive to alternating magnetic fields.

The small gap between the stator and the magnets of the rotor function-bound has a thickness of only a few tenth millimeters. Here, the danger of foreign objects accumulating in this gap exists but can be heard by scratching-sounds. In this case spinner should be removed and the motor should be blown-out with compressed air. Do not at all simply keep on using the drive. Be especially aware of cuttings which can almost irremovably stick to the magnets. In this case, the only thing that helps is a disassembly of the drive by the manufacturer

7. Removal of motor

Removal of motor from sailplane is only allowed in case of **written permission** from manufacturer otherwise warranty is not valid any more!

Warning!

It is not allowed to fly with removed motor from the sailplane, as C.G. position can change significantly and can be outside of approved safety margin!

To remove the motor (used as FES) (complete with spinner and propeller)

1. Open ventilation (fully forward position)
2. Remove round laminated cover from center of front motor mounting rib (from cockpit side)
3. Unlock springs which hold DB15 cable connector and than carefully unplug connector from motor rear wall.
4. Unscrew 3 self-locking nuts from rear motor wall and disconnect 3 power cables. Before disconnection is recommended to mark them as A, B, C, and draw their position against each other on list of paper.
5. Unsecure six M8 bolts and unscrew them out. One of M8 bolts which is below powers wires have lower head. Hold motor assembly, and carefully take it out of fuselage.

8. Installation of motor

To install motor (when used at FES application) follow the reverse order.

Take care about additional steps:

1. Open ventilation fully-lever pushed forward.
2. It is recommended to use new bolt securing plates to secure M8 motor fixation bolts.
3. Make sure that power cables are connected in the same order A, B, C like before and use only new M6 self-locking nuts. Make sure that there is no contact between cable shoes aluminum mounting wall or M8 fixing bolts. Below cables must be M8 bolt with shorter head.

4. Carefully plug in signal wires connector into motor rear wall connector. Lock springs which hold connector in place.

After motor is reinstalled, check the following:

- Spinner is in the center of fuselage.
- Gap between spinner and fuselage is 0,5-1mm
- All bolted connections assembled correctly and secured properly
- Start the motor on a ground and run it for a few seconds to check:
- Motor rotating direction, smooth run of motor
- Braking of propeller works OK
- FCU instrument is functioning properly;

9. Repair and service

In case of a fault or damage(s), contact manufacturer.

10. Revision history

February 2013	Initial release of manual, Version 1.0
January 2015	Added some photos, Version 1.1