



# FES MOTOR MANUAL

Version 1.2

Type: **FES-DIS-M100**



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**Table of Content**

1. Important notices .....	3
1.1 Limited Warranty .....	3
2. General.....	4
3. Model designation .....	4
4. Technical data and limitations of motor .....	5
5. Drawing of motor .....	7
6. Maintenance .....	8
7. Removal of motor.....	9
8. Installation of motor .....	11
9. Repair and service.....	12
10. Revision history .....	12

## **1. Important notices**

Please read this manual thoroughly. It contains important information about your system, 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.

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED OR STATUTORY, INCLUDING ANY LIABILITY ARISING UNDER ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, WHICH MAY VARY FROM STATE TO STATE.

IN NO EVENT SHALL LZ DESIGN BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE, OR INABILITY TO USE THIS PRODUCT OR FROM DEFECTS IN THE PRODUCT. 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 your local LZ design dealer or contact LZ design directly.

February 2013

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## 2. General

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

The drive was developed and very elaborately tested by Ing. Matija Žnidaršič and Ing. Luka Žnidaršič.

The development objective was to build suitable motor for FES application which must be light and small enough to fit into sailplane front part of fuselage, but very powerful providing specific performance at highest efficiency.

This motor allows a gearless drive without the usually essential gear unit which cause power losses, additional weight, complexity and maintenances. Because of the little internal resistance of the motor, very good performances are achieved in a wide range and at an excellent efficiency.

Though many intensive tests had already been made and though the parts were produced by modern CNC machines, the drive is still not a real series product. Some manufacturing processes like windings are made by hand, what makes every drive of the first series unique.

## 3. Model designation

Motor model designation is the following:

FES-DIS-M100

(1) (2) (3)

where:

- (1) motor application
- (2) designed for sailplane model; Discus-2c FES
- (3) 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.

**NOTE:** Motor type FES-DIS-M100 is identical like FES-HPH-M100. It is marked differently due to different manufacturer of the sailplane.

#### 4. Technical data and limitations of motor

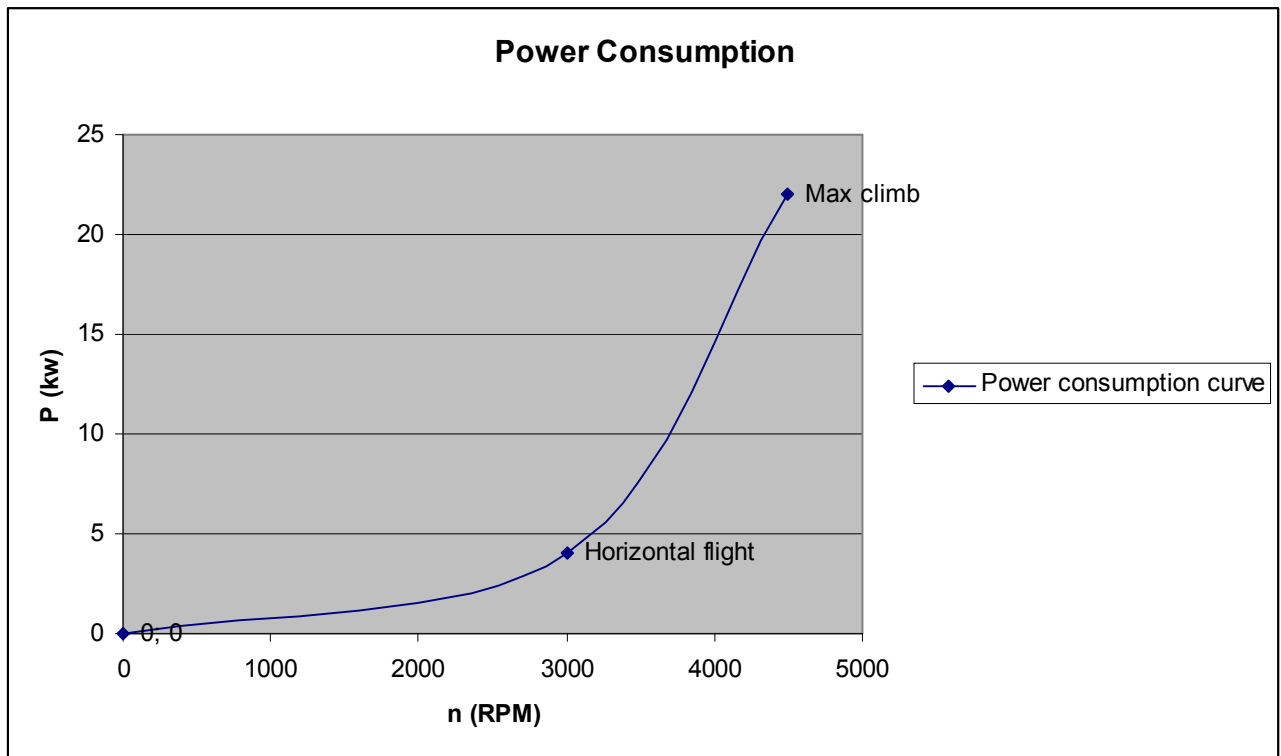
Motor construction is outrunner BLDC brushless synchronous permanent magnet motor with electronically controlled commutation system 3 phase. Rotor position is determined by 3 hall sensors and additional 4th hall sensor for automatic propeller positioning.

This motor can work only in combination with suitable electronic Controller which transform DC current from Battery packs to 3 phase current which supply motor. We use controller type which needs hall position sensors in motor, but this motor can work also with some sensorless controllers.

Electrical motor type FES-DIS-M100 power ratings at 116V on motor controller and loaded with FES-DIS-P1-102 propeller:

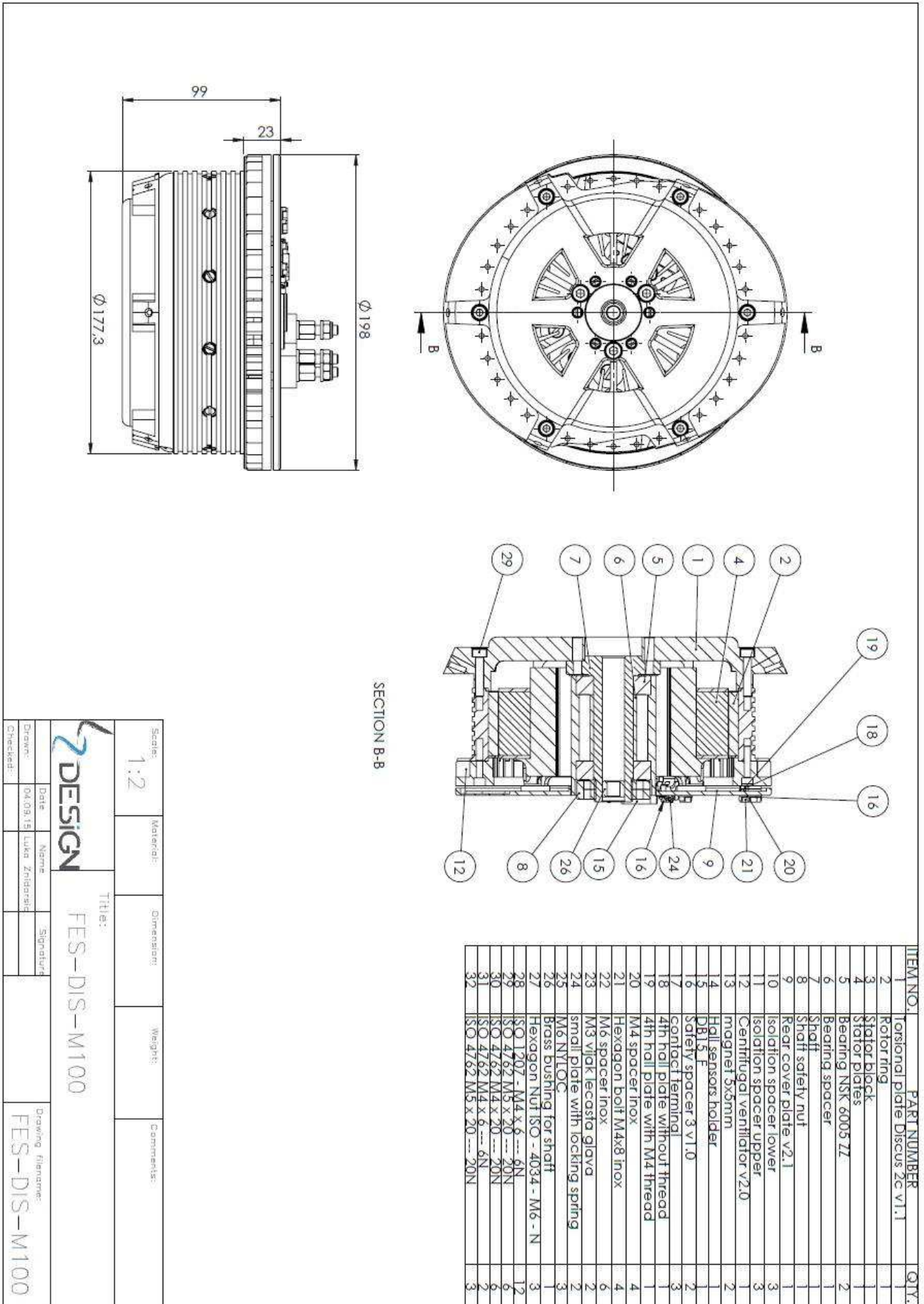
Maximum torque	75 Nm
Maximum current	200A
Maximum Voltage	116V
Rpm non loaded	45 rpm/V
Rpm non loaded (at 116V DC on Controller)	5300 rpm
Non loaded motor current (at 5300 rpm)	16-18 A
Rpm loaded with FES-DIS-P1-100 propeller (1m diameter)	4500 rpm
Battery current loaded (4500 rpm, 116V) with FES-DIS-P1-102	Up to 200 A
Rotor rink diameter	182mm
Motor length	100mm
Motor weight cca.	8,0 kg
Motor efficiency	82-95 %
Maximum allowed temperature	90 °C
Minimum allowed starting temperature	-20 °C

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



Rpm versus Power

5. Drawing of motor



## 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!

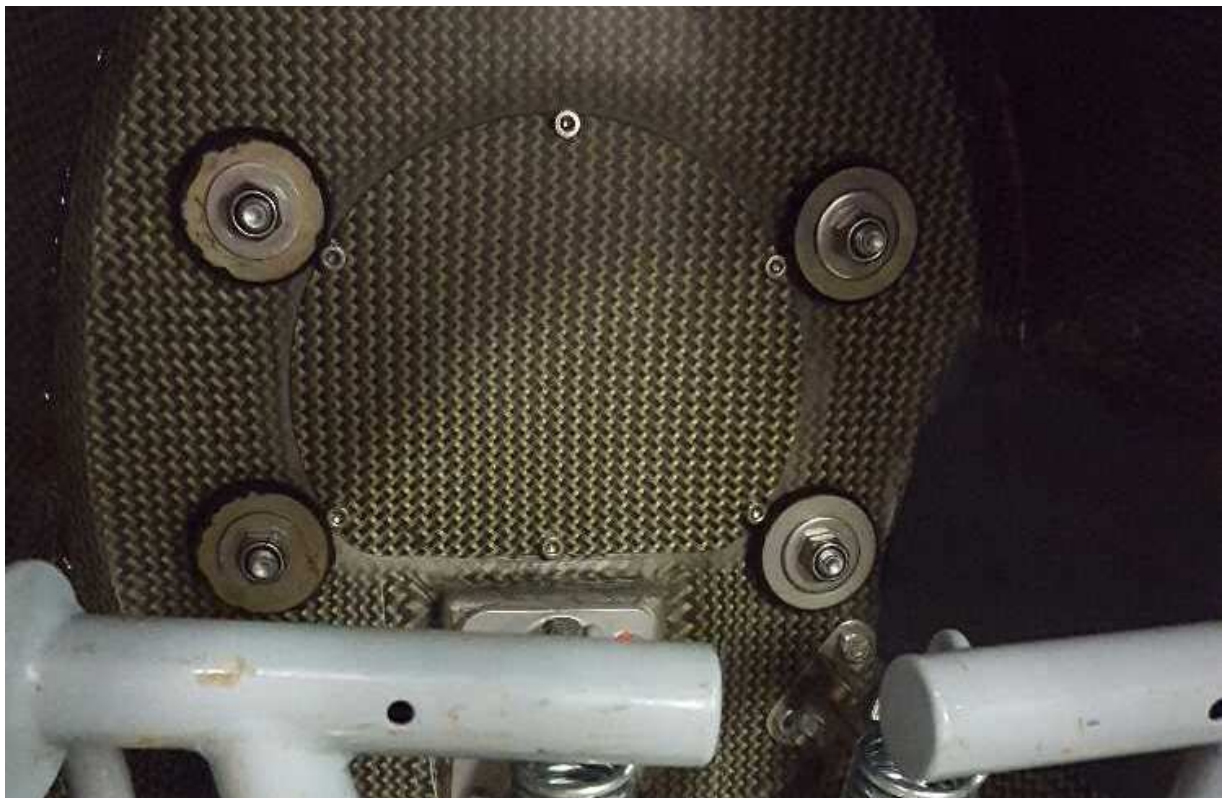
### Warning!

**It is not allowed to fly with removed motor from the sailplane, as C.G. position change significantly!**

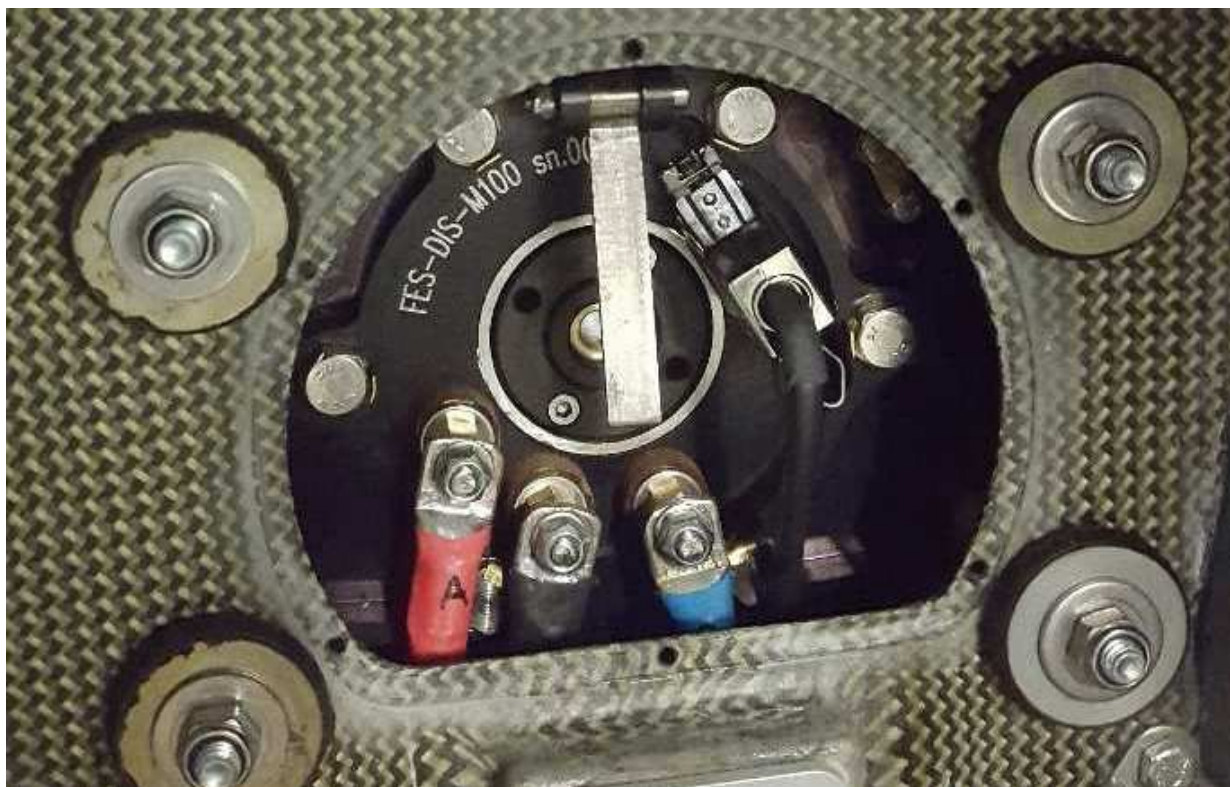
**On back side of mounting wall are visible four M8 nuts tightened over big spacer and rubber silen blocks. Please leave them at they are. Proper way of removing motor is to follow next steps.**

**To remove the motor from the glider** (complete with spinner and propeller)

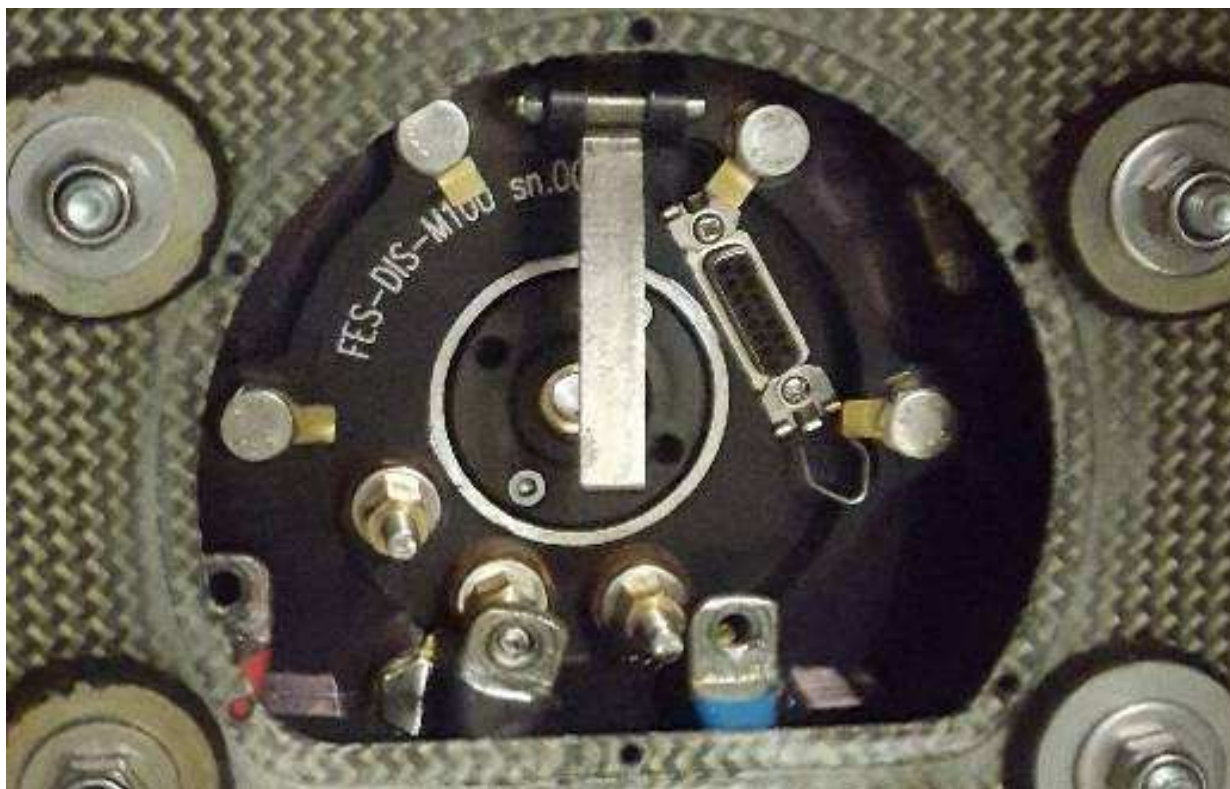
1. Open ventilation (knob fully forward position)



2. Unscrew 6 M4 inbus bolts and remove composite cover from center of front motor mounting rib (from cockpit side)



3. Unlock springs which hold DB15 cable connector and then carefully unplug connector from motor rear wall.



4. Unscrew 3 self-locking nuts from rear motor wall and disconnect 3 power cables. Each is marked with different colour of isolation over cable shoe (red, blue and black). Take a photo so that you will know their proper order for assembly.

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.

Centrifugal ventilator on back side of has bigger diameter than rotor rink, so motor will not go out straight, as opening is now wide enough. You needs to rotate it about 30 degrees to one side in order to get it out. Be careful not to damage spinner, or plastic covers below spinner.

## 8. Installation of motor

**To install motor back on glider**, follow the reverse order of previous chapter.

Take care about additional steps:

1. Open ventilation fully - knob 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 as before (check taken photo for reference), as otherwise motor will not run or it might run in wrong direction. Use only new complete metal M6 self-locking nuts. Make sure that there is no contact between cable shoes and aluminum mounting wall or M8 fixing bolts. Air gap distance between each of these elements and each cable shoe should be at least 3mm. Below the middle cable, should be placed M8 bolt which has more shallow head (one of 6 bolts which holds motor).
4. Carefully plug in male DB15 connector (with signal wires) into motor rear wall female connector. Fix connector on both sides with lock springs.

After motor is reinstalled, check that:

- Spinner is nicely located in the center of the fuselage when spinner is in stop position. This means that surface of the spinner is as much as possible tangent to the fuselage contour in area of gap between spinner and fuselage.
- Gap between spinner and fuselage should be between 0,5-1mm. Gap should be equal all around (on top should be the same as on bottom side, on left side should be equal as on right side). If gap is wider than 1mm is not nice.
- All bolted connections assembled correctly and secured properly. Below six M8 bolts which hold motor in place are thin brass safety spacers, which needs to be bend 90 degrees against one of the 6 vertical surfaces of M8 hex head bolts.
- Start the motor on a ground and run it for a few seconds to check:

- that motor rotating direction is counter clockwise (looking in front of the propeller), and that motor is running smoothly
- that electronic braking of propeller works (above 1500 RPM)
- FCU instrument is functioning properly (check about all functions of the FCU in its dedicated FCU manual)

## 9. Repair and service

In case of a fault or damage, please contact manufacturer.

## 10. Revision history

July 2015	Initial release of manual, v1.0
September 2016	More info in chapter 7 and 8, v1.1
November 2016	New drawing of motor, v1.2