



# FES FCU Master and Repeater

User Manual, Version 1.0

For instrument type: **FES-FCU 57**, firmware version **3.16**



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**Table of content**

1. Important notices .....	3
1.1 Limited Warranty .....	3
2. General.....	4
2.1 Technical specifications .....	4
2.2 Firmware version .....	4
3. FCU installation .....	5
4. General layout of front FCU panel.....	7
5. Power switch.....	8
6. Ventilation lever .....	9
7. Using the FCU .....	10
7.1 Switching ON the instrument.....	10
7.2 Initial screen .....	10
7.2.1 CANOPY Warning .....	11
7.2.2 Check Power switch! Warning .....	12
7.2.3 Battery packs energy consumption.....	13
7.3 Screen at Power switch turned ON.....	14
7.3.1 Screen during motor run.....	15
7.3.2 Power settings during flight .....	16
7.3.3 Propeller stop with electronic braking .....	17
7.3.4 Propeller aligning .....	18
8. Warnings .....	20
8.1 Different levels of warnings .....	20
8.2 LED lights.....	21
8.3 Screen messages.....	22
8.3.1 Voltage warnings .....	22
8.3.2 Temperature warnings .....	25
8.3.3 Other warnings .....	26
9. Settings .....	27
9.1 Info page .....	28
9.2 Battery page.....	29
9.3 Password .....	30
10. FCU firmware updates .....	31
10.1 Equipment.....	31
10.2 FCU update procedure.....	32
10.3 After update .....	34
11. Revision history .....	34

## 1. Important notices

Please read this FCU Instrument Manual thoroughly. It contains important information about FES 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.



**Warning:** *Means that the non-observation of the corresponding procedure leads to an immediate or important degradation of the flight safety.*



**Caution:** *Means that the non-observation of the corresponding procedure leads to a minor or to a more or less long-term degradation of the flight safety.*



**Note:** *Draws the attention on any special item not directly related to safety by which is important or unusual.*

### 1.1 Limited Warranty

This LZ design FCU 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 repairs or replacement will be made at no charge to the customer for parts and labour, 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 firmware, 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 local dealer of your sailplane manufacturer or contact LZ design directly.

## 2. General

FCU instrument and its firmware was developed for FES propulsion system by LXNAV, well known company in gliding community by their excellent flight computers (LX8000, LX9000) and electronic variometers.

LXNAV produces FCU instrument exclusively for FES system. For any information or service of FCU instruments, please contact LZ design.

### 2.1 Technical specifications

FCU instrument was designed to fit into the standard Ø 57 mm hole. Its length is 50 mm, with 4 cm of additional space required for connectors on the back side of the unit (see photos in next chapter). It is equipped with sunlight readable LCD colour display QVGA (resolution 320\*240). Current consumption is approximately 100 mA, at 12 V power supply.

- ON/OFF switch
- rotary encoder (for throttle and brake) and push button (for resetting messages)
- analogue input for external throttle
- RPM input
- LED light input 2x
- analog output for throttle
- digital output for brake
- temperature indications (Motor, Controller, 2x battery pack)
- audio signal
- analog input for measurement of 12V power supply voltage
- RS232 input for firmware update
- analogue input for "Canopy" switch
- CAN bus (current, voltage, RPM, etc.)

FCU instrument can be used also as repeater unit for second seat of FES two-seater gliders. Repeater unit differs from hardware point of view only in configuration of CAN bus terminating resistor. Repeater unit do not have installed 120 Ohm terminating resistor. Firmware is the same, but in the settings front FCU must be set as Master and rear FCU as Repeater.

### 2.2 Firmware version

New features in version 3.16 (compared to previous version 3.08):

- Support for FES two-seaters (in System setup is possible to set FCU as Master or as Repeater unit)
- Support for ESC circuit boards (in System setup is possible to set e-paper display and shock watch monitoring, if used)
- Support for Isometer (in System setup is possible to check status of isolation monitoring electronic, if used)
- Start Throttle (in System setup is new parameter 1-15 used to adjust soft starting of the motor on the first notch of the throttle knob)
- Batt Type (in System setup is possible to choose between two types of cells: SLPB Kokam or VT6-Sony)

Update instructions are described in section 10.

### 3. FCU installation

FCU instrument is to be installed into a standard 57 mm hole on the instrument panel. Most instrument panels of modern sailplanes do not have a lot of space available, so this is the reason why we chose this form factor.

It is recommended to place the FCU on left side of instrument panel, so that the screen is easily visible and throttle knob accessible to the pilot. Length of the instrument should not present a problem for installation as instrument is very short.



**Note:** We recommend you to remove screen plastic cover protection foil only after installation into the instrument panel is complete!



There are two male connectors on the back side of the instrument. Carefully plug into the FCU, signal cable female plug with 9 pins and signal cable plug with 15 pins, and fasten each plug with 2 fastening springs over plates on sides of each plug.



Suitable position for the FCU instrument Master on front panel of Duo Discus FES



Suitable position for the FCU instrument Repeater on the rear panel of Duo Discus FES

#### 4. General layout of front FCU panel



1. FCU ON/OFF switch – turns the FCU ON or OFF
2. Throttle/brake knob (Rotary encoder button)
  - motor power is set from 0 – 100% power by rotating the knob clockwise,
  - counter-clockwise rotation of the knob acts as an electronic propeller brake and reduces the set power
  - menus can be navigated and alarms reset by pressing the knob
3. **Red ERROR LED** – indicates different alarm codes from the motor controller – by blinking a certain number of times followed by a pause.
4. **Green OK LED** – shows normal operation of the controller – illuminates when power switch is turned ON
5. **Red ALARM LED** – illuminates if a red and/or yellow level warning messages from the FCU are active (blinking or constant illuminated), (engraved ALARM nearby)

### 5. FES Power switch

The “**FES Power switch**” enable or disable motor power. On two-seater gliders there are two FES power switches. One in front cockpit and one in rear cockpit.



On Duo Discus FES, front “Power switch” is located on the left side of lower console.

It is a toggle type switch protected by a red safety guard. On the safety guard is glued red sticker “FES POWER SWITCH” as below. Nearby or below is located black sticker with description:



Proper actuation of the guarded “FES Power switch”:

1. To enable FES motor power, first open the red safety guard and then flip the toggle switch forward/upward.
2. To disable FES motor power, close the safety guard. Apply sufficient force so that the toggle switch lever will move downward.



**Note:** In case of emergency, you can close safety guard quickly, which will also push the toggle switch to OFF position!



## 6. Ventilation lever

During powered flight, ventilation should be always opened. A sticker on the instrument panel near the ventilation lever clearly identifies the closed and opened positions of the ventilation valve. Pilot can easily recognize if the ventilation is opened by the amount of fresh air coming into the cockpit and the increased noise. The **FCU** does not monitor the position of the ventilation valve, however the motor temperature gradient is monitored by the **FCU**.

If the motor temperature is rising faster than usual, yellow warning message "Check ventilation!" appears on the screen, to remind you to check if the ventilation is opened.



**Warning:** *If the motor temperature rises too rapidly, check if ventilation valve is opened*

## 7. Using the FCU

### 7.1 Switching ON the instrument

To switch ON both FCU instruments, simply toggle the "FCU ON/OFF switch" to upward position – labelled with "ON" on the instrument. To toggle the switch, pull on it gently to release the switch guard. The instrument screen illuminates, and an internal check procedure is started. After the check has been completed LXNAV and FES logos are displayed together with the firmware version for 1 second. All 3 LEDs illuminate in red and green for a short time, so that you can check they are working properly.



**Warning:** Front FCU must be always switched ON during flight!

### 7.2 Initial main screen

A few seconds after the FCU has been turned on, the initial main screen is displayed. Please find the description of the screen below:

RPM (rotation per minute)

CANOPY or power supply voltage

Throttle line and brake indicator 0-100%

Voltage difference between the highest and the lowest cell voltage

Remaining usable energy in the battery

Electrical power from batteries

Motor temperature

Remaining time of endurance at 4kW or current power setting

Controller temperature

Battery pack temperature, first and second

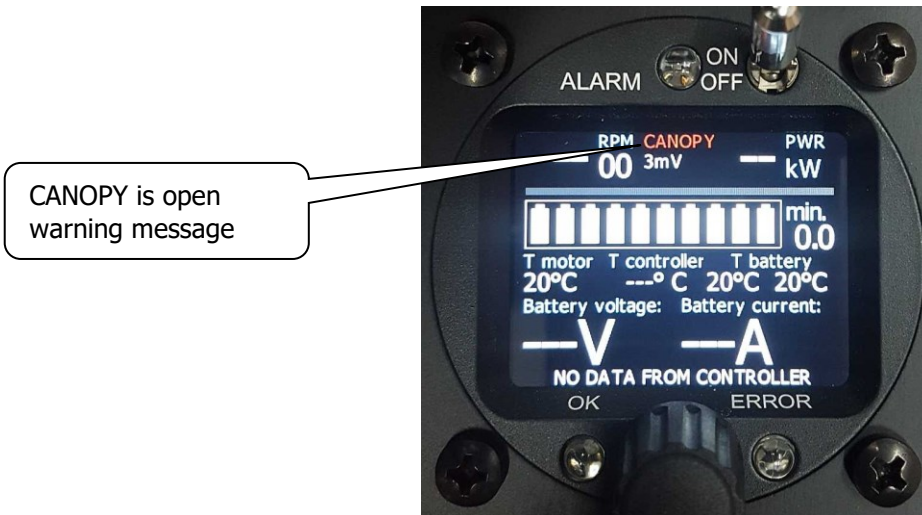
Battery packs total voltage

Current from batteries

Temperature of the motor and each of the battery packs should be visible. It is normal that the temperature of the controller is not visible when the "Power switch" is OFF. A white message "NO DATA FROM CONTROLLER" appears on bottom line of the screen. If the canopy is open, red "CANOPY" label is visible at the top of screen.

### 7.2.1 CANOPY Warning

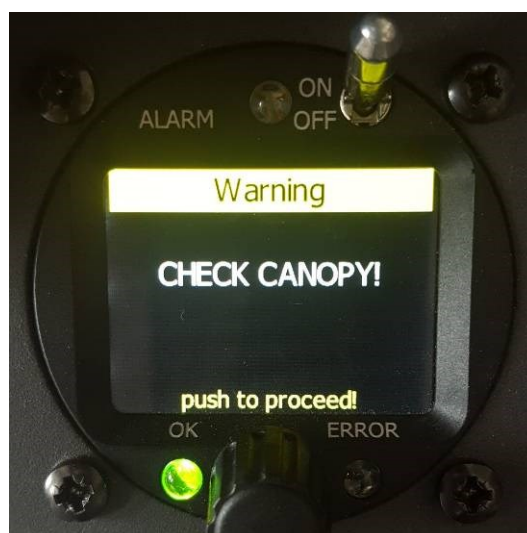
It is not permitted to run the motor with an open canopy, as the propeller and canopy could be damaged. For this reason, a canopy safety switch is installed. It prevents the motor to start if the canopy is not closed.



If canopy is opened, a red **CANOPY** message appears at top middle part of the display! When the canopy is closed, CANOPY message disappears. Power supply voltage value is shown instead.



**VERY IMPORTANT:** The motor will not start if you try to run it with an open canopy. A yellow message: **Warning, CHECK CANOPY!** Appears on a FCU display to remind the pilot to close it!



The pilot must close the canopy and push the **throttle knob** to proceed.

After the canopy is closed, red **CANOPY** message disappears and the motor can be started normally.



**Warning:** If canopy is still open and pilot tries to run the motor anyways, a second red message: *"Warning, Canopy is still open!"* will appear on a FCU screen. The motor will not start.



Pilot should close the canopy and push **throttle knob** to proceed.



**Note:** The motor will start in the third attempt, after confirming yellow and red warning messages, in spite of active *"CANOPY"* message! **This enables the pilot to run the motor in case of canopy safety switch failure.**

### 7.2.2 Check Power switch! Warning

When the throttle knob is rotated clockwise, with the "Power switch" in the OFF position, a yellow warning message is displayed: **"Check Power Switch!"** to remind the pilot.



Pressing the throttle knob confirms the message and the warning disappears. After the **"Power switch"** is switched ON, throttle will be set to 0% automatically and the pilot can start the motor without any further action required.



**Note:** *Early versions of the FCU firmware required the pilot to set the throttle back to zero as it would not start otherwise. After resetting the throttle, the motor could be started normally.*

### 7.2.3 Battery packs available energy and consumption

The number of illuminated battery icons on the screen, represents the remaining usable energy. There are 10 battery icons, each represents 10%.

Calculation of remaining usable energy is quite accurate at **lower power settings**. At high power settings, voltage drop is deeper, and thus usable battery capacity reduced.

Bellow 50% of remaining usable energy try to avoid usage of high-power setting, otherwise Yellow warning message: **"Low Voltage! Reduce power!"** might appear, even if a few battery icons are still displayed.



**Note:** *The FES system is most efficient at low power settings. Due to very low aerodynamic drag of the FES system under power, it is possible to cover long distances in level flight, using just 7-8kW of power in case of two-seater glider. This is different compared to climb and glide (saw tooth) profile, which is usually more efficient for retractable systems, due to their higher aerodynamic drag.*



**Warning:** *Minimum total voltage of both battery packs is 90V! (This is 3.2V per cell in a 14 cell battery pack). If the minimum total voltage is reached, a red critical warning message: **"Critical Voltage! Stop FES motor!"** is displayed. By pressing the throttle knob the message disappears, however the "Alarm LED" continues to glow red. When power switch is turned OFF, red "Alarm LED" also disappears.*



**Note:** *For the best climb performance, climb should be initiated first and transition to level flight with reduced power after a safe altitude has been reached. The climb rate is reduced due to the voltage drop in an opposite scenario.*

Detailed information about warnings and their behaviour is available in chapter 8.

### 7.3 Screen with the "Power switch" turned ON

When the Power switch is turned ON the temperature of the controller becomes visible, and green "**CONTROLLER READY**" message appears on the bottom line of the display. After a few seconds, Voltage and Current measurement values also appear.



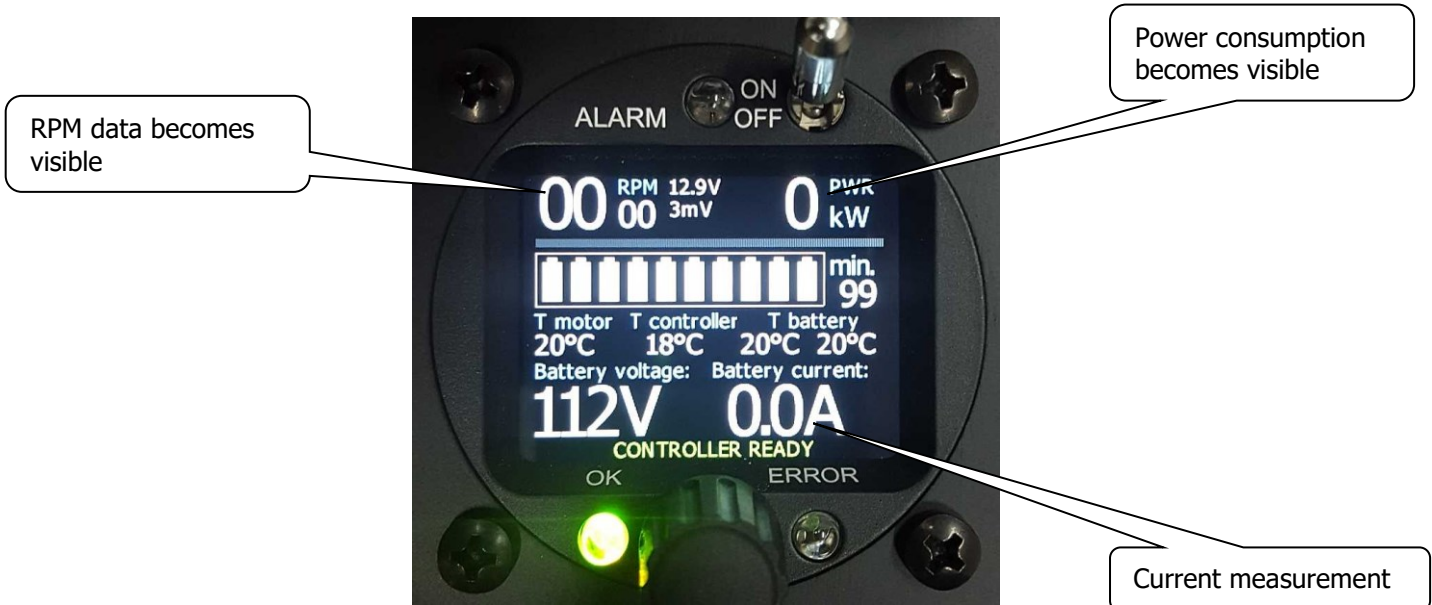
**Green OK LED** (left bottom) lights up and glows continuously. This indicates that the motor controller is operating normally and is ready to start the motor. You can proceed to start the motor by rotating the throttle knob clockwise. The motor starts and the centrifugal force opens the propeller blades immediately.

### 7.3.1 Screen with motor running



**Warning:** Before starting the motor, make sure nobody is close to the propeller, in the propeller disk line or in the front of the glider. Only then it is safe to proceed with the start procedure.

When motor is working, the RPM, Current consumption and Power are visible on the screen.



**Note:** The remaining endurance time calculation depends on power setting.



### 7.3.2 Power settings during flight



**Note:** Power is increased by rotating the Throttle knob clockwise and reduced by rotating the Throttle knob counter-clockwise! **Fine power adjustments are possible by holding throttle knob pressed and rotating it at the same time.**

There is no mechanical stop when the set power reaches 100%. Power cannot be increased by rotating the knob further. To reduce the motor RPM, rotate the Throttle knob counter-clockwise.

When the minimum RPM is reached and the throttle knob is turned counter-clockwise for one more step, the power bar indicator starts blinking red. At this stage, the electronic brake and automatic propeller alignment is activated.

**The only way to stop the propeller in the air is to use electronic braking! Switching the "Power switch" OFF will not stop the propeller from turning due to wind milling.**

To reduce the RPM, you need to rotate the Throttle knob counter-clockwise. If you rotate it past the minimum RPM setting, the throttle bar indicator will start **blinking red!**



**Caution:** This means that the regenerative braking of the propeller is active. Regenerative braking works only if the propeller RPM is high enough; otherwise, the induced voltage is too low and the braking does not work.

In flight, the propeller RPM is almost always high enough, even at zero power setting, as the propeller starts wind-milling and RPM increases.



**Note:** If you want to test regenerative braking on the ground, you need to spin the motor up to at least 500 RPM and then to quickly rotate the throttle knob counter-clockwise until the throttle bar on the FCU starts blinking red.

Note that throttle knob (rotary encoder), has an additional **push button function!**



### 7.3.3 Propeller stop with electronic braking

Rotation of the propeller during flight can be stopped only with electronic braking. Electronic braking becomes active when pilot rotates Throttle knob counter-clockwise until the throttle bar on the FCU display starts **blinking red!**



**Note:** *Electronic braking works only if the RPM are high enough (minimum 500 RPM). Electronic braking does not work, with very low RPM because the **induced voltage is too small**. Regeneration function of the motor controller is used for electronic braking.*



**Warning:** *With no power coming from the motor, the propeller will still rotate due to the wind-milling effect. This creates a small drag, but otherwise has no effect on flying characteristics of the glider. The rotation of the propeller will continue even at the glider's stall speed. Wind-milling propeller cannot be used for climbing, as there is no power from the motor.*



**Caution:** *If you want to test regenerative braking on the ground, you need to spin the motor up to at least 500RPM (about 2000 RPM was required with some previous single-seat FES gliders) and then briefly rotate the throttle knob counter-clockwise until the throttle bar on the FCU starts blinking red.*

During powered flight, there is almost always enough RPM for successful electronic braking. However, if the motor is started with low throttle, the propeller RPM increases to about 1500-2000 RPM slowly, due to the wind-milling effect (actual RPM depends on flying speed and type of propeller – glider). In this case wait until the RPM reaches more than 500 RPM. Afterwards rotate the throttle knob counter-clockwise in order to activate the electronic brake. Propeller should stop normally.

After propeller is stopped wait for 2-3 seconds, until automatic positioning of the propeller starts, as described in the next chapter.



**Warning:** *If you are unable to stop the propeller, do not forget to fly the glider! Switch OFF the "Power switch" and land as usual, despite the rotating prop! Flying close to stalling speed of the glider will not stop a wind-milling propeller.*

*During landing, propeller will eventually stop in a random position, before the glider will come to a standstill.*

*Avoid using excessive braking to prevent the rotating propeller blades from touching the ground.*

*If the prop stops vertically, open the canopy carefully and manually position the propeller horizontally (check that "Power switch" is OFF).*

### 7.3.4 Propeller alignment

When motor stops, leave the throttle knob in the “braking” position – throttle bar should be blinking red. Wait 2 or 3 seconds until propeller stops and RPM data shows zero RPM. After that, automatic propeller alignment starts! During propeller alignment a grey message “Aligning propeller!” appears on the screen.



**Note:** Pilot can always stop propeller alignment by pressing throttle knob!



**Note:** Propeller alignment does not work if the canopy is opened and the *Canopy* message is active!

When the alignment process is done, a green “**Propeller parked!**” message appears for a short time:



Maximum alignment time is set to 20 seconds by default. If a correct propeller position is not found in this time, a red message is shown for about 2 seconds:



This message will appear only with the FCU firmware version 3.0 or higher.

If aligning does not work properly, it is possible to adjust the following parameters in the settings menu:

- time between steps from 50ms to 1s (usually 60 – 80 ms);
- % of power used for positioning at 115 V and at 90 V (Default values are 4.2 % at 115 V, and 5.2 % at 90 V);
- number of steps required after the hall sensor is triggered (default is 0 steps);
- maximum positioning time (maximum 20 s).

## 8. Warnings

### 8.1 Levels of warnings

There are two levels of warnings:

**YELLOW Warning:** is the 1<sup>st</sup> level of warnings. It cautions and directs the pilot's attention to the parameter, that needs special consideration. It is the pilot's job to manage and solve the problem. YELLOW warning message does not indicate an immediate danger.

**RED Warning:** is the 2<sup>nd</sup> level of warning. A RED warning means the indicated problem needs to be taken care of **IMMEDIATELY**.

Warnings are presented by:

#### 1. LED lights

See section 8.2 *LED lights* for further details.

#### 2. Warning messages on the screen of the FCU



***Resetting of warning messages:*** When a warning message appears on the instrument the pilot must confirm the message by pushing the throttle knob, to make the message disappear.

In case multiple warning messages are active at the same time, they will be prioritized and displayed as follows:

- RED warnings have a higher priority than YELLOW warnings;
- Battery pack warnings have a higher priority than motor or motor controller warnings;
- Battery pack temperature warnings have a higher priority than other battery pack related warnings;
- Motor warnings have a higher priority than controller warnings

After all active warnings have been confirmed, the normal FCU screen is displayed.



***Warning message recall:*** All currently active warning messages can be recalled by pushing the throttle knob multiple times in a quick succession. The warning messages will reappear on the screen according to their priority.

See section 8.3 *Screen messages* for further details.

#### 3. Acoustic alerts

Warning messages are accompanied with acoustic alerts. Three different beeping sounds are used:

- one beep (with information messages);
- three beeps (with yellow warning messages, active until confirmed);
- long constant beep (with red warning messages, active until confirmed).

## 8.2 LED lights

FCU instrument is equipped with three bright LED lights, which can glow or blink in **red** or **green**. The "ALARM" LED is located above and the "OK" and "ERROR" LEDs are located below the display. When the FCU is turned ON, all three LEDs first blink in red followed by green, so that it is possible to confirm that all three LEDs are working.



The "ALARM" LED above the display indicates FES system's warning messages:

- the LED blinks in red when a **Yellow warning** message is displayed. After the warning message has been confirmed by pushing the throttle knob, the message disappears and the LED stops blinking.
- the LED glows in red when a **Red warning** message is displayed. After the warning message has been confirmed by pushing the throttle knob, the message disappears but the LED will continue glowing, to remind the pilot that a parameter is out of bounds.



**For example:** A red warning message appears, notifying the pilot that the motor temperature is above the critical motor temperature of 90°C ( $T_m > 90^\circ\text{C}$ ). The "ALARM" LED will stop glowing only after the temperature drops below 90°C, even if the "Power switch" is turned OFF and the message has been confirmed.



**Warning:** If a critical battery voltage ( $Bat < 90\text{ V}$ ) is the reason for the red warning, the "ALARM" LED will extinguish if the "Power switch" is turned OFF.

**The OK and ERROR LEDs on the bottom of the instrument indicate the status of the motor controller:**

- The "OK" LED should light up **green** when the "Power switch" is turned ON, indicating that the motor controller is ready for operation no errors were detected.
- The "ERROR" LED starts blinking red if an error has been detected by the controller. The error detected is represented by the number of blinks. This information can be helpful for the manufacturer when diagnosing the cause of the error.

## 8.3 Screen messages

### 8.3.1 Voltage warnings

There are two important Voltage warnings based on total voltage measurement:

- 1<sup>st</sup> level: **Yellow warning** (which appears as the first message in most cases):



Is shown when total voltage of battery packs drops below **95 Volts, under load**.

“**Reduce power!**” is displayed only when the power is set to more than 8 kW.

**Recommended action:** Reduce power below 8 kW, if possible.



**Note:** *This message might appear when batteries are cold and power demand is high, even if the battery charge indicator is above 50%. Avoid using high power settings with cold battery packs.*

- 2<sup>nd</sup> level: **Red warning** (appears as a second message in most cases):



Is shown when total voltage of battery packs drops below **90 Volts under load**.

**Required action:** The motor should be shut down immediately, due to low voltage.



**Warning:** *If the pilot ignores the message and the motor is not shut down, a 30 s countdown begins. At the end of the countdown the FCU will stop the motor automatically to protect the batteries from deep discharge.*



**VERY IMPORTANT:** *The automatic shutdown can always be overridden during the countdown, by pushing the throttle knob. In this case, the message will disappear, and the motor will continue running. Every critical battery override will be stored in the FCU permanently.*



**Note:** *It is always the pilot's decision to stop the motor! Never hesitate to continue running the motor in critical situations if you need it for your safety.*



**Warning:** *If the battery packs are discharged too much, the charging system will refuse to charge them again. If the unloaded voltage of any of the cells is below 2.8 V the BMS will prevent the cells from charging. It is not safe to charge battery packs that were discharged below the critical voltage.*

Additionally, four more voltage warnings exist, that are based on single cell voltage measurement by the BMS in each battery pack. They are listed in the table below:

### List of all Voltage warnings:

Condition	Level	Message, required action *
<b>Battery packs warning messages, based on total voltage measurement</b>		
Total Voltage level is low, below <b>95V</b>	Yellow	<b>Low Voltage, Reduce power!</b>
Total Voltage level is critical, below <b>90V</b>	Red	<b>Critical Voltage, Stop FES motor!</b>
30 seconds after the Critical Voltage error the motor has not been shut down.	Red	<b>Automatic motor Stop in 30-0 seconds!</b>
<b>Battery pack warning messages, based on each cell's voltage measurement</b>		
Cell difference in single pack above 150mV	Yellow	<b>Cells diff. &gt; 150 mV, Reduce power!</b>
Cell difference in single pack above 300mV	Red	<b>Cells diff. &gt; 300 mV, Stop FES motor!</b>
Difference between total voltage of each pack is above 1.0V	Yellow	<b>Battery diff. &gt; 1.0 V, Reduce power!</b>
Single cell Voltage level below 2.8V	Red	<b>Cell critical &lt; 2,8 V, Stop FES motor!</b>
<b>Warning message, based on power supply (12V) circuit Voltage measurements</b>		
Power supply is below 11V	Red	<b>Low 12 V power supply!</b>

\* If the motor is not running, the required actions "Reduce power" or "Stop FES motor" are not displayed with the warning message.

\* If power is set below 8kW, recommended action "Reduce power!" is not displayed with the warning message.



### 8.3.2 Temperature warnings

Temperature warnings fall into three categories:

- Battery pack temperatures,
- Motor temperature,
- Controller temperature.

#### List of all temperature warnings:

Condition	Level	Message, required action *
<b>Battery pack warning messages, based on temperature measurements of each pack</b>		
Battery pack temperature is below 5°C	Yellow	<b>Battery Low &lt; 5°C, Do not self-launch! **</b>
Temperature difference between each Battery pack is above 3°C	Yellow	<b>Battery temp. diff. &gt; 3°C, Reduce power!</b>
Temperature difference between each Battery pack is above 6°C	Red	<b>Battery temp. diff. &gt; 6°C, Stop FES motor!</b>
Battery pack temperature is high, above 45°C	Yellow	<b>Battery High &gt; 45°C, Reduce power!</b>
Battery pack temperature is extremely high, above 55°C	Red	<b>Batt. Ext. High &gt; 55°C, Stop FES motor!</b>
Battery pack temperature is critical, above 75°C	Red	<b>Batt. Critical &gt; 75°C, Land immediately!</b>
<b>Motor temperature warning messages</b>		
Motor temperature is high, above 70°C	Yellow	<b>Motor High &gt; 70°C, Reduce power!</b>
Motor temperature is extremely high, above 90°C	Red	<b>Motor Ext. High &gt; 90°C, Stop FES motor!</b>
<b>Controller temperature warning messages</b>		
Controller temperature is high, above 70°C	Yellow	<b>Controller High &gt; 70°C, Reduce power!</b>
Controller temperature is extremely high, above 90°C	Red	<b>Contr. Ext. High &gt; 90°C, Stop FES motor!</b>

\* If the motor is not running, the required actions "Reduce power" or "Stop FES motor" are not displayed with the warning message.

\* If power is set below 8kW, recommended action "Reduce power!" is not displayed with the warning message.

\*\* Appears if "Self-launch" mode is set in the settings.

### 8.3.3 Other warnings

There are three other warnings:

- **Ventilation** (check section 6. Ventilation lever),
- **Canopy** (check section 7.2.1 CANOPY Warning),
- **Power switch** (check section 7.2.2 Check "Power Switch" Warning).

#### List of other warnings:

Condition	Level	Message, required action
<b>Ventilation lever</b>		
Motor temperature is rising too fast!	Yellow	<b>Warning, Check ventilation!</b>
<b>Canopy</b>		
Canopy is opened	Yellow	<b>Warning, CHECK CANOPY!</b>
Canopy is still not closed	Red	<b>Warning, Canopy is still open!</b>
<b>Power switch</b>		
Motor does not start immediately	Yellow	<b>Warning, Check Power switch!</b>

## 9. Settings

Settings menu can be accessed by a long (approximately 3 seconds) push of the throttle knob, but only when motor is stopped.

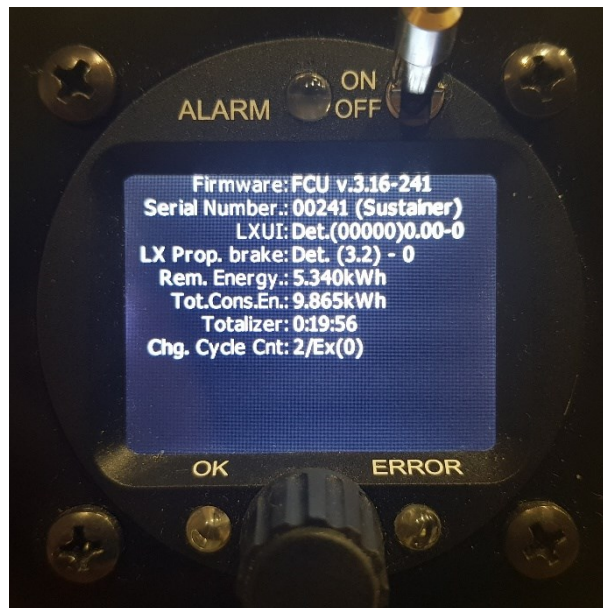
You can choose between: Info, Battery or Password page by rotating the knob. The individual pages can be accessed by pushing the knob.



**Note:** Settings cannot be accessed while motor is running.

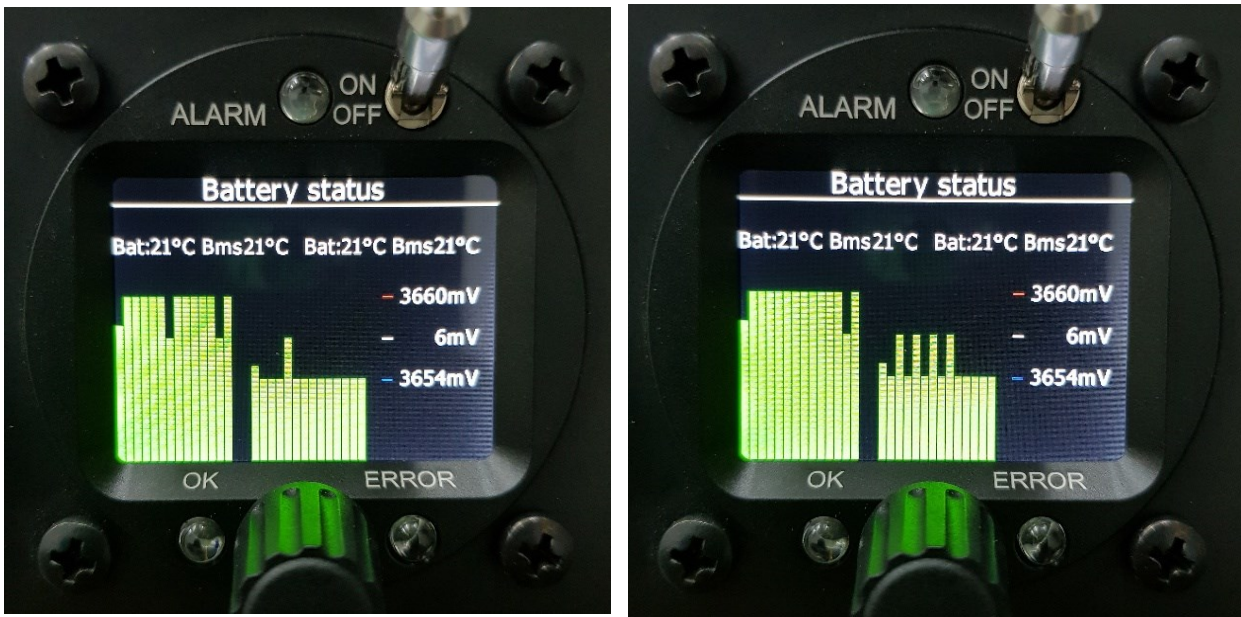
## 9.1 Info page

Info page displays the following information, described below:



- Firmware: *FCU version (above: 3.16).*
- Serial number: *Serial number of the instrument (above: 00222) and the instrument mode (above is set as "Sustainer").*
- LXUI: *Serial number and firmware version of the LXUI – voltage and current measurement unit. Values shown only when the "Power switch" is ON.*
- LX Prop. brake: *Firmware version of the LX Prop brake circuit board. Value "N.C." is shown when the "Power switch" is OFF.*
- Remaining energy: *Remaining usable energy (above: 5.340 kWh).*
- Tot. Cons. En: *Total consumed energy (above: 9.865 kWh).*
- Totalizer: *Total Motor operation time (above: 0h 19min 56 s).*
- Charge Cycle Count: *Number of charge cycles of the battery (above: 2) and the total count of the automatic motor shutdown overrides "Ex" (here: 0).*

## 9.2 Battery page



Battery page displays measured battery parameters.

The first line after the title of the page shows:

- "Bat": temperature in the first and second battery pack,
- "BMS": temperature of the first and second battery pack BMS units.

A graphical representation of the relative voltage differences of the cells in each battery pack is shown:

- Left 14 vertical lines represents the relative voltage difference of the cells in A pack
- Right 14 vertical lines represents the relative voltage difference of the cells in B pack

The values on the right side of the page, display the following parameters in order:

- maximum cell voltage (here: 3660 mV = 3,660 V)
- maximum voltage difference between the cells (here: 6mV = 0,006 V)
- minimum cell voltage (here: 3654 mV = 3,654 V)

## 9.3 Password



**Warning:** Do not try to access these menus if you are not authorized by the manufacturer!

Choosing Password, next display appears:



By entering the correct password, it is possible to access the System setup menu of FCU. There are a few submenus which are accessible by rotation of throttle knob in clockwise direction. With short press of throttle knob, it is possible to enter each submenu to modify the settings. Long press is required to get out of submenus.

List of System setup submenus:

- Encoder type (1 or 2, default 2)
- Isrc: LXUI or HALL (source for current measurement; default LXUI)
- Usrc: LXUI, DivFcu or Kelly (source for voltage measurement; default is Kelly)
- Current adj. (zero current adjustment when HALL set at Isrc; deprecated)
- Voltage adj. (setting of divider; usually setting is 1.01, when Kelly is set as source)
- Temp sensors (assigning of digital sensors; deprecated)
- Prop. align offset (number of steps; default for newer gliders is 0, for older gliders can be more than 0)
- Prop. align speed (step delay; default 80ms for LAK and Silent, 60ms for Ventus, Discus, HPH...)
- Prop. align Power (default is 4.1% at 115 V and 5,1 at 90 V)
- Prop. align Time (default is 20 seconds)
- Voltage warnings (default values for GEN2 40Ah 14S; critical 90V, low 95V, reset 105V, battery full 114V, battery capacity 3,8 kWh)
- Int. encoder or Ext. poti (default is Int. encoder)
- Cal.Ext.Thr. (calibration page when external potentiometer is used)
- BatTemp: DS or BMS (for GEN1 packs DS, for GEN2 packs BMS),
- Current factor (effective only when Isrc is set to HALL, deprecated)
- Battery (1<sup>st</sup> page graphic representation of relative voltage levels of each cell in both battery packs, 2<sup>nd</sup> page Battery shock monitor status)
- Temp Gradient, motor temperature rising gradient at which yellow message "Check ventilation" appears (default for Sustainers 8°/min, default for Selflaunchers 10°/min)
- !!!BMS type!!! 14S, 15S or 16S (number of cells in serial per pack)
- Low voltage (threshold at which "Low 12V power supply" appears, default is 11V)

- Info (more detailed info page)
- Sustainer or Self Launch (FCU settings suitable for sustainer or selflaunching powered glider)
- Master Unit or Repeater Unit (support for two-seat FES powered sailplanes)
- RPM colours (to set at which RPM number indication turns yellow or red)
- ESC info (information about for E-paper display and shocks monitoring electronic)
- ISO info (information about Isometer values)
- Start Throttle (1-15, for fine adjustment of soft motor start on first notch; 7 or 8 usually)
- Save data (save changes) – short press of throttle knob to save data, long press to get out of System setup

## 10. FCU firmware updates

FCU firmware updates might become available in the future. Always consult with the glider manufacturer and LZ design, regarding the compatibility of new firmware versions for the specific glider type and its serial number.

On two-seaters always update both FCU instruments, and check that all the settings are identical on both units. Front FCU must be set as Master and rear FCU as Repeater.

Update file can only be obtained from LZ design directly and it is prohibited to share it with other owners. Do not update your instrument with not confirmed suitability of firmware version (for instance provided by 3<sup>rd</sup> parties) by LZ design, as improper functioning of the system might occur.

Only if the firmware update is approved for your glider, follow the update procedure in Section 10.2. It is strongly recommended to document the FCU settings prior and after update, for both FCU instruments.

### 10.1 Equipment

For FCU update you will need:

- The FlashLoader485App.exe software (download it from: <http://www.front-electric-sustainer.com/download.php>)



**Note:** The software is delivered as a .zip file, which needs to be extracted first. Run the FlashLoader485App.exe after extraction.

- Update file App\_FES\_3.XX.lxfw (number XX is version of file)
- A computer with Windows operating system
- Standard USB-RS 232 cable (COM to COM cable can be used, if your PC has a COM port)



Standard USB-RS232 cable

## 10.2 FCU update procedure

1. Plug in the USB connector of the update cable to a free USB port of your PC. Wait until the cable is recognized and ready for use. Check which virtual COM port your cable was assigned to under Control panel->System-> Device manager->Ports (COM and LPT).
2. Find location of the FCC (FES connection circuit) box:
  - On DG1001-e, it is accessible on the right side of landing gear box. Cover of the box has an access hole to plug in the Sub-D connector of the RS232-USB cable.
  - On Duo Discus FES, the FCC box is located behind a small hatch on the left side of the rear cockpit seat pan, the cover has an access hole to plug in the Sub-D connector of the RS232-USB cable.
3. Plug in the SUB-D connector of RS232-USB cable through the hole of the FCC box into the FCU update connector.



FCC (FES connecting circuit) view with cover removed.



## 4. Run the Flash loader application



5. Choose the correct COM port and set the Baudrate to 115200
6. Browse for the FCU firmware update file ending with `***.fw`
7. Press the Flash button and turn ON one FCU only.

**Note: Update front FCU first, and then proceed with rear FCU update. Make sure that only one FCU is turned ON during updated otherwise update might not be completed properly.**

If FCU is already turned ON, wait until message "Connected" is displayed. When the update procedure starts a progress, blue bar is shown.



It takes about 1 minute for the update to finish.

8. FCU restarts automatically. You should see a new firmware version on the start-up screen!



**Note:** LXUI unit (used for current and voltage measurements) can be updated with almost the same procedure, if necessary!

### **10.3 After update**

After the update, all the settings in the updated FCU should remain the same. Some versions might require you to enter a password and/or to adjust some settings – if advised to do so by the manufacturer before the update. If you experience any problems before, during or after the update, please contact the LZ design directly.

### **11. Revision history**

March 2021	Initial manual for FES two-seaters, Version 1.0
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