FES FCU instrument manual
Version 1.80, (for FCU software version 3.06)

For instrument type: FES-FCU 57

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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.

**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.

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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

FCU instrument and its software was developed for LZ design’s FES system by LXNAV company, very well known in gliding community by their excellent flight computers (LX8000, LX9000) and electronic variometers. LXNAV produce FCU instrument as it is, exclusively for FES system of LZ design.

2.1 Technical specifications

FCU instruments was designed small in order to fit into standard fi57mm hole. Its length is only about 50mm + 4cm for connectors on the back side (see photos in next chapter). It is equipped with sunlight readable LCD colour display QVGA (resolution 320*240). Current consumption is only about 100mA, at 12V power supply.

- ON/OFF switch
- rotary encoder (for throttle and brake) and push button (for reseting 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...)

2.2 Software version

This manual is valid for FCU software version 3.06. Earlier software versions have a bit less features, but in general is more or less the same. New features in version 3.06 (compared to previous version 3.02):
- priority of red warning messages over yellow warning messages
- automatic engine strop after 30 seconds if not overided by pilot
- possibility to choose between selflaunch and sustainer settings
- introduction of 3 different types of acoustic signals

Update instructions are described in section 10. Update procedure.
3. FCU installation

Install FCU into a standard small hole (diameter of 57mm) on instrument panel. Most instrument panels of modern sailplanes do not have much space available so this is the reason that we chose small size of instrument.

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

We recommend you to remove protective plastic cover protection foil only when installation into the final instrument panel is complete!

On back side of instrument are two male connectors. Carefully plug in FCU marked female 9 and 15 pins plugs which are on the end of signal cables, and fix them with 2 fixation springs which are on sides of each plug.
FCU data can be displayed also on LXNAV range of flight computers through FES bridge (optional).

- Suitable position for FCU instrument on panel of Ventus 2cxa FES

- Suitable position for FCU instrument on panel of Silent 2 Electro
4. General layout of front FCU panel

1. ON/OFF switch - for FCU power supply (engraved ON/OFF position)
2. Throttle/brake knob (Rotary encoder button)
   - by rotation clockwise is used as throttle from 0-100% of Power
   - by rotation counter clockwise is used as electronic propeller brake
   - by pressing is used for changing menus and resetting alarms
3. Red LED - indicates different alarm codes from motor controller (by different number of blinks between longer pause), (engraved ERROR above)
4. Green LED - shows normal operation of controller (illuminate when power switch is turned ON), (engraved OK above)
5. Red LED - appears when some red or yellow warning messages from the FCU are active (blinking or constant illuminated), (engraved ALARM nearby)
6. There are engraved some basic info about switch

5. Power switch

Important component of the FES system is a **“Power switch”**, which provides 12V power supply to the main contactor, which serves to connect batteries to the motor controller! It also provides power supply to the motor controller.

Sometimes pilots think that this is a “Master switch”, and so they switch it ON first and FCU as second! This is wrong procedure.

**Make sure that FCU instrument is always switched ON, before “Power switch” is switched ON!**

**FCU instrument should be anyway always switched ON during flight, so that a pilot is able to monitor temperatures of battery packs.**
At LAK17A&B FES sailplanes, “Power switch” is located on right side of cockpit. Toggle switch type is used and additionally protected by red safety guard.

At Ventus 2cxa FES, Discus 2c FES, “Power switch” is located on console below instrument panel. Toggle switch type is used which is additionally protected by red safety guard.

1. To turn it ON, open first safety guard and than flip toggle switch forward.
2. To turn it OFF, just close safety guard, and apply sufficient press so that you feel that toggle switch lever is moved downward.

⚠️ In case of emergency, you can just close safety guard quickly, which will also push toggle switch lever downward to OFF position!
“Power switch” at Silent 2 Electro (FES) is located on left side of instrument panel console. Due to space restrictions it is used a key switch, instead of standard toggle switch with safety guard!

6. Ventilation lever

During powered flight, front ventilation valve in center of the spinner, should be opened. This is important as during powered flight, especially at high power settings, motor needs sufficient amount of cooling air, especially in hot summer conditions.

On the instrument panel, close to the handle which operates ventilation valve, is located a sticker, which clearly identifies in which position of control handle, ventilation is closed and opened.

When knob is pushed forward, ventilation is opened! Also from amount of air coming into cockpit and its noise, is quite easy for the pilot to recognize when ventilation is opened and when is closed. On FCU, there is no indication about position of ventilation lever, however FCU instrument monitors how quickly motor temperature is rising in time.

If motor temperature is rising faster than it is usual, yellow warning message “Check ventilation!” appears on the screen, to remind pilots to check if he maybe forget to open ventilation.

If motor temperature rise too fast, check if ventilation valve is opened - ventilation lever should be pushed fully forward during powered flight!
7. Using the FCU

7.1 Switching ON the instrument

To switch ON the FCU instrument, simply set the main FCU pull-switch to upward position. To do this slightly pull handle out, as it has protection for unintended switching off-on. The instrument screen illuminates starting with an internal check procedure. Than LXNAV and FES logo is shown, together with software version for about 1 second. All 3 LEDs illuminate in red and green color for a short time, so that you can check that all three LEDs are working properly.

Make sure that during flight FCU instrument is always switched ON! It should be switched ON, before “Power switch” is turned ON!

7.2 Initial screen

After a few seconds from turning on FCU, the initial main screen appears as below. Please find a description of the indications:
There should be visible temperature of motor and each battery pack. It is normal that temperature of controller is not visible when “Power switch” is OFF. There is white message “NO DATA FROM CONTROLLER” on bottom line of the screen. If canopy is open there is also small red “CANOPY” message visible at the top of screen.

**7.2.1 CANOPY Warning**

It is not allowed to run motor with open canopy, as propeller blades and canopy could be damaged. For this reason there is installed a canopy safety switch which prevent motor to start if canopy is not closed.

If canopy is opened there is a red **CANOPY** message on top middle part of the screen! When canopy is closed, **CANOPY** message disappears. On the same location it becomes visible power supply voltage measurement.

**VERY IMPORTANT:**

If pilot will try to run motor with open canopy, motor will not start but a yellow message: **Warning, CHECK CANOPY!** will appear on a FCU screen, to remind the pilot to close the canopy!

Pilot should close the canopy and push **throttle knob** to proceed!
After canopy is closed, red **CANOPY** disappear and motor could be started normally!

However if canopy is still opened, and despite that, pilot would anyway try to run the motor once more, a second red message: **Warning, Canopy is still open!** will appear on a FCU screen, and motor will still not start.

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

In third try, after confirming yellow and also red warning message, motor will start, despite that safety switch “**CANOPY**” message is still active!

The reason that FES system is designed in such a way, is that pilot would be **still able to run the motor** in case of canopy safety **switch failure**!

### 7.2.2 Check Power switch! Warning

In case when pilot would rotate a throttle knob clockwise in order to start the motor, but he would simply forget to switch ON “**Power switch**”, a yellow warning message appears: **“Check Power Switch!”**, to remind a pilot.
By pressing throttle knob, message will disappear! After “Power switch” is switched ON, throttle bar will go back to zero setting automatically and pilot will be able to start motor without any further action required!

On very early software versions, it was necessary to manually reduce throttle bar to zero (otherwise motor did not start).
When throttle was reduced to zero, than motor started normally!

7.2.3 Battery packs energy consumption

Each of 10 small batteries on the screen represents 10% of total 100% of available energy. Illuminated batteries represents remaining energy, which is calculated by comparing total theoretical available energy of battery packs (we calculate with 3,8kWh), and consumed energy in time. Consumed energy depends from used power settings and duration of powered flight.
Calculation is quite accurate when lower power settings are used. At high power settings, voltage drop on battery packs is more significant, and actually usable battery capacity is reduced.
For this reason, yellow warning message: “Low Voltage! Reduce power!” might appear, even when there are still a few illuminated batteries available on the screen.

FES system is most efficient at low power settings. Due to very low aerodynamic drag of FES system under power, is possible to cover long distance, when using the low power setting, which is just sufficient for level flight. This is just opposite compared to climb and glide (saw tooth mode) which is usually more efficient for retractable systems due to their higher aerodynamic drag.

Minimum total voltage of both battery packs is 90V! (In 14 cells per pack configuration, this is at 3,2V per cell). Pilot is informed about with red critical warning message: “Critical Voltage! Stop FES motor!”
By pressing throttle knob, message will disappear, however upper red LED light will continuously illuminat. When power switch is turned OFF also red LED will dissapear.

In order to have the best climb performance, you should always climb first and then reduce power for level flying. The opposite will decrease the climbing rate due to the voltage drop.

Energy consumption is calculated only during powered flight, and do not take into account relatively small consumption of instruments during soaring flight (when “power switch” is OFF).

More detailed information about warnings and its behaviour is available in chapter 8.
7.3 Screen at “Power switch” turned ON

After turning ON Power switch, temperature of controller will become visible, and green “CONTROLLER READY” message will appear on bottom line. In time of a few seconds also Voltage and Current measurements will appear.

Green LED (left-bottom) light up and illuminates continuously. This is a message from motor controller that everything is OK and it is ready for motor start. Now you can start gently rotating throttle in clockwise direction. Motor will start and centrifugal force will open propeller blades immediately.

When battery packs are fully charged and installed back to the glider, FCU will recognize them as fully charged (condition is that measured total voltage is above 114V), however “Power switch “ must be turned ON. After that just wait a few seconds and bottles will be refilled back to 100% of charge. New charge level will be stored to the memory of the FCU, only if motor will be started for a short time (standard procedure during preflight check).

If battery packs were already self-discharged below total voltage of 114V, FCU will not recognize them as fully charged!
7.3.1 Screen during motor run

Make sure that nobody is around propeller, in front of the glider or in line of the propeller disk. Only when you are sure that it is safe, you can gently turn throttle knob in clock-wise direction, in order to start motor.

When motor is working screen shows RPM, Current consumption and Power

Until there is not enough power consumption, remaining time endurance (in minutes) is not visible, as it is more than 99 minutes. It must be set at least 3kW of power so that remaining time becomes less than 99 minutes.
7.3.2 Power settings during flight

Power is increased by rotating the Throttle knob in clockwise direction and reduced by rotating Throttle knob in counter-clockwise direction!

**Fine adjustments of power are possible by rotating throttle knob pressed.**

There is no mechanical stop when increasing power setting, so when throttle bar reach 100%, power will not be further increased even if pilot rotate throttle knob a few more turns! To reduce RPM, rotate the Throttle knob in counter-clockwise direction.

One steps counter-clockwise from minimum RPM, power bar indication starts blinking red. At this state, electronic brake and propeller aligning is activated.

1. On the ground propeller will just stop slowly if brake is activated below 1500RPM
2. In the air propeller will always stop softly, if there more than 1500RPM when brake is activated. Usually there is always enough RPM during flight, except after initial starting with low power setting, but also in this case RPM of propeller increase itself due to wind milling.

**The only way to stop propeller in the air is to use electronic braking! By switching OFF the “Power switch”, is not possible to stop propeller from wind milling.**

To reduce RPM you need to rotate Throttle knob in counter-clockwise direction. If you rotate it over zero level, then throttle line will start blinking red!

**This means that regenerative braking of propeller is active. However regenerative braking work only if there is still enough RPM, otherwise induced voltage is too low and does not work.**

In flight there is nearly always enough RPM, as even at zero power setting, propeller starts wind-milling and RPM increase.

If you want that regenerative braking will work also on the ground, you need at least 1500RPM and then you just need to rotate throttle button, in counter-clockwise direction, until throttle line start blinking red.

Note that throttle knob (rotary encoder), have additional press 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 in counter-clockwise direction until, throttle line on display starts blinking red!

Electronic braking can works only if there is enough RPM, about 1500 as minimum. If there is not enough RPM, electronic braking will not work, as there is simply too small induced voltage (for electronic braking is used regeneration function of motor controller).
When there is no power (or very little power) from the motor, propeller would still rotate as a windmill and can not be used for climbing, as there is no power. Wind-milling propeller creates small drag, but glider flies normally. Propeller will not stop, and will still rotate even if you will reduce speed to stall speed of the glider!

**If you want to test electronic braking on the ground, make sure there is at least 2000 RPM, and rotate throttle knob quickly in counter-clockwise direction! If rotation of throttle knob in counter-clockwise direction is too slow, then RPM of the motor could become too small (below 1500 RPM) for successful electronic braking.**

During powered flight, there is nearly always enough RPM for successful electronic braking. However if pilot starts motor with very little throttle, propeller RPM will slowly increase to about 1500-2000RPM, due to the wind-milling effect (actual RPM depends on flying speed, and type of propeller - glider). In such case just wait until RPM will reach more then 1500 RPM, and then rotate throttle knob in counter-clockwise direction in order to activate electronic brake. Propeller should then stop normally!

After propeller is stopped wait 2-3 seconds so that positioning of the propeller starts as described in next chapter.

**If you are somehow not able to stop the propeller, do not forget to fly the glider! Switch OFF “Power switch” and land as usual, just with rotating prop! (Reducing flying speed close to stalling speed will not stop windmilling of the propeller).**

At landing prop will eventually stop in random position before glider will standstill.
Do not use too much brake to the main wheel, in order to avoid touching the ground with the rotating propeller tips.
If prop stops vertically, just carefully open the canopy, and manually position it horizontally (check that “Power switch” is OFF)
7.3.4 Propeller aligning

When motor is stopped, just leave the throttle knob at braking position (throttle bar must blinking red), and wait 2 or 3 seconds, until propeller stops and RPM data shows zero RPM. After that automatic propeller aligning starts! During propeller aligning grey message appear “Aligning propeller!”

💡 Pilot can always stop propeller aligning, by pressing throttle knob!

💡 Propeller aligning does not work, if canopy is opened and so Canopy message is active!

When correct aligned position is found green “Propeller parked!” message appears for short time:
Maximum aligning time is usually set to 20 seconds. If correct propeller position is not found in this time, a red message is shown for about 2 seconds:

![Message](image)

This message might appear only with FCC firmware version higher than 3.0

If aligning do not work very well is possible to adjust next parameters in the settings:

- time between steps from 50ms to 1 sec (usually 60-80 ms)
- % of power used for positioning at 115V and at 90V (4.2% at 115, and 5.2% at 90V)
- number of steps required after hall sensor for position is detected (usually 0 steps)
- maximum positioning time is seconds (20 seconds is maximum time)
8. Warnings

8.1 Different levels of warnings

In general there are two levels of warnings:

YELLOW Warning: This is 1st level of warning, which means that the pilot need to take care to the parameter indicated in Warning message and to manage the suggested solution to solve the problem. In any case the YELLOW warning means that there isn’t an immediate danger.

RED Warning: This is 2nd level of alarm which means that the pilot has to manage the solution of the indicated problem IMMEDIATELY.

Different warnings and reminders are presented to the pilot by:

1. Appearance of LED lights

See section 8.2 LED lights for further details.

2. Appearance of messages on the screen and their priorities

Reset of warning messages: When any warning message appears on the instrument, the pilot has to push the throttle knob, as confirmation, that he is aware of the message, and the warning message will disappear!

In case that there are conditions for more warnings to become active at the same time, they will appear according their priority:

- RED warnings have priority over YELLOW warnings
- Battery pack warnings have priority over motor and motor over controller
- At Battery warnings, high temperature warnings have priority over voltage warnings

After confirmation of all currently active warnings, normal screen will come back.

Recall possibility of warning messages: By pressing a throttle knob again and again, all currently active RED or YELLOW Warning messages will reappear on the screen according their priority, and after appearance of the the last one normal screen will come back.

See section 8.3 Screen messages for further details.

3. Acoustical beeping signals

Together with messages are activated three different acoustical beeping signals:
- one beep (with informative messages)
- three beeps (with yellow warning messages, active until confirmation)
- long consistent beep (with red warning messages, active until confirmation)
8.2 LED lights

FCU instrument is equipped with three very bright LED (Light Emitted Diode) lights, which can illuminate or blinking in red or green color. One LED light is located above display, and two LED lights are located below display. After FCU is turned ON, all three LEDs first blink in red and then in green color, so that is possible to check that all three LEDs are working properly.

Single LED above display indicates FES system status of messages:

- together with appearance of Yellow warning messages, single LED above display, starts blinking in red. After reset by pressing throttle knob, warning message goes away, and also red LED stops blinking.

- together with appearance of Red warning messages, single LED above display, starts illuminating continuously in red. After reset by pressing throttle knob, warning message disappears, however red LED still illuminate, so that pilot is aware that something is out of approved boundary.

For instance that reason for red LED is motor or motor controller extremely high temperature (Tm>90°C), then red LED will disappear only when temperature will drop below 90 °C, even if "Power switch" will be turned OFF.

However when the reason for red LED is critical battery voltage (Bat<90V), red LED blinking will not disappear even if Voltage will rise above 90V, without motor load. When "Power switch" will be turned OFF, continuously red LED will disappear so that it will not disturb the pilot during further flight.

Two lower LEDs indicate the status of motor controller:

- lower left green LED should become visible when “Power switch” is turned ON; this indicate that motor controller is ready for operation, and there is no errors.

- lower right LED, starts blinking red, if there are some errors recognized by motor controller. Number of quick blinks before and after short pause represent different error codes, which can be helpful for manufacturer to recognize the reason of the error.
8.3 Screen messages

8.3.1 Voltage warnings

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

1\textsuperscript{st} level: **Yellow warning** (which in most cases always appears as first message):

**Appearance:** When total Voltage of battery packs (under load) drops below **95 Volts**.

**Required action:**
- if power is set to more than 8kW, than also required action “Reduce power!” is indicated.
- if power is set already below 8kW, than no action is required so there will be indicated just “Low Voltage”.

When using high power settings and batteries are cold, this message might appear, even if bottels indicate 50\% of charge. Try to avoid using high power settings with cold battery packs.

2\textsuperscript{nd} level: **Red warning** (which in most cases appears as second message after yellow):

**Appearance:** When total Voltage of battery packs (under load) drops below **90 Volts**, and motor is running.

**Required action:** Pilot should stop motor, due to reached Critical Voltage limit
Warning: If pilot do not stop motor, red warning message appears, counting down 30 seconds. After 30 second FCU will stop motor automatically, in order to protect batteries from overdischarge.

During 30 seconds of count-down pilot can decide to press throttle knob to override automatic motor stop. Message will dissapear and motor will continue to run. Each override action is saved to the memory of FCU instrument.

It is always pilot decision to stop the motor! For instance if he is in critical situation, and his life might be dependable on a few more minutes of engine run, he can decide to override automatic motor stop and discharge battery packs more than is appropriate.

However if battery packs will be discharged too low, charging system will refuse to charge them again (if any of the cells unloaded voltage is below 2,8V then BMS will not send suitable signal to charger to start charging), as it is not safe to charge such battery packs, which were discharged below critical voltage level !!!

Additionally there are four different voltage warnings, based on voltage measurement of single cell by BMS electronic in each battery pack. They are described on next page.
### List of all Voltage warnings:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Level</th>
<th>Message, required action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Battery packs warning messages, based on total Voltage measurements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Voltage level is low, below 95V</td>
<td>Yellow</td>
<td>Low Voltage, Reduce power!</td>
</tr>
<tr>
<td>Total Voltage level is critical, below 90V</td>
<td>Red</td>
<td>Critical Voltage, Stop FES motor!</td>
</tr>
<tr>
<td>30 seconds after appearance of Critical Voltage motor is not stopped by pilot</td>
<td>Red</td>
<td>Automatic motor Stop in 30-0 seconds!</td>
</tr>
<tr>
<td><strong>Battery pack warning messages, based on each cell Voltage measurements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell difference in single pack more than 150mV</td>
<td>Yellow</td>
<td>Cells diff. &gt; 150mV, Reduce power!</td>
</tr>
<tr>
<td>Cell difference in single pack more than 300mV</td>
<td>Red</td>
<td>Cells diff. &gt; 300mV, Stop FES motor!</td>
</tr>
<tr>
<td>Difference between total voltage of each pack is more than 1.0V</td>
<td>Yellow</td>
<td>Battery diff. &gt; 1.0V, Reduce power!</td>
</tr>
<tr>
<td>Single cell Voltage level below 2.8V</td>
<td>Red</td>
<td>Cell critical &lt; 2,8V, Stop FES motor!</td>
</tr>
<tr>
<td><strong>Warning message, based on power supply (12V) circuit Voltage measurements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply is low, below preset 11V</td>
<td>Red</td>
<td>Low 12V power supply!</td>
</tr>
</tbody>
</table>

*When motor is not running, there is no indicated action “Reduce power” or “Stop FES motor”, but only message.*

*If power settings is below 8kW, there is no indicated action “Reduce power!”, but only message.*
8.3.2 Temperature warnings

There are three different temperature warnings:

- regarding Battery packs temperatures
- regarding Motor temperature
- regarding Controller temperature

List of all temperature warnings:

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

*When motor is stopped, there is no indicated action Stop FES motor, or Reduce power.
**When power settings is below 8kW, there is no indicated action Reduce power.

**Only appears if in the settings submenu is set to Selflaunch. If is set to Sustainer, message would not appear.
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:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Level</th>
<th>Message, required action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ventilation lever</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor temperature is rising too fast!</td>
<td>Yellow</td>
<td>Warning, Check ventilation!</td>
</tr>
<tr>
<td><strong>Canopy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canopy is opened</td>
<td>Yellow</td>
<td>Warning, CHECK CANOPY!</td>
</tr>
<tr>
<td>Canopy is still not closed</td>
<td>Red</td>
<td>Warning, Canopy is still open!</td>
</tr>
<tr>
<td><strong>Power switch</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor do not start immediately</td>
<td>Yellow</td>
<td>Warning, Check Power switch!</td>
</tr>
</tbody>
</table>
9. Settings

FCU instrument has additional Settings page. You can reach it by long (about 3 seconds) press of Throttle knob.

You can choose there INFO, Battery or PASSWORD page.

💡 When motor is running, function of long press to reach Settings page is disabled!
9.1 Info page

Choosing Info by pressing throttle knob, next display appears:

When powers switch is OFF

When power switch is ON

Firmware: FCU software version (version 3.06 is visible)
Serial number: serial number of the instrument (00152 visible), settings arranged for Sustainer
LXUI: it shows serial number (00002 visible) and software version (0.96-1) of LXUI (box which is used for measurement of voltage and current) - N.C. if is not active, when power switch is OFF;
LX Prop. brake: it shows software version of LX Prop brake electronic (3.1 visible) used for alignment of propeller - N.C. if is not active, when power switch is OFF
Consumed energy: calculated consumed energy from last recharge
Totalizer: counted motor operation time in hours, minutes and seconds (here 0 hours 18 minutes, 42 second)
Charge Cycle Count: number of batteries charge cycles (here 1). Ex(0), indicates how many times pilot override automatic motor stop.

Last two lines are used for CAN bus errors detections, and for error codes decryption in case of troubles.
9.2 Battery page

On Battery page is graphical presentation of voltage levels:
- First set of 14 vertical lines represent relative voltage differences of cells in the first pack
- Second set of 14 vertical lines, represent relative voltage differences of cells in second pack

Numbers on right side shows:
- minimum cell voltage (on pictures above 3654mV = 3,654 V)
- maximum cell voltage (on pictures above 3660mV = 3,660 V)
- voltage difference between the lowest and the highest cell (on pictures above 6mV = 0,006 V)

First line shows:
- first and second battery pack temperature
- first and second BMS temperature
9.3 Password

⚠️ Do not try to enter into these menus if you are not authorized by manufacturer!

Choosing Password, next display appears:

With entering proper password code is possible to access to System setup menus of FCU. System setup has a few submenus which are accessible by rotation of throttle knob in clockwise direction. With short press to throttle knob, is possible to enter to each submenu to modify settings.

List of System setup submenus:
- Encoder type (1 or 2, default 2)
- Isrc: (source for current measurements: LXUI or HALL; default is LXUI)
- Usrc: (source for voltage measurements: LXUI, DivFcu Kelly; default is Kelly)
- Current adj. (setting of zero, when HALL set as source; now not used any more)
- Voltage adj. (setting of divider; default setting is 1,01, when Kelly is set as source)
- Temp sensors (assigning of digital sensors; now not used any more)
- Prop. align offset (number of steps; default is now 0)
- Prop. align speed (step delay; default is 80ms for LAK and Silent, 60ms for Ventus, Discus, HPH)
- Prop. align power, (default is 4,1% at 115V and 5,1 at 90V)
- Prop. align time, (default is 20 seconds)
- Voltage warnings, (default values; critical 90V, low 95V, reset 105V, battery full 114V, battery capacity 3,8kWh)
- Int. encoder or Ext. poti, (default is Int. encoder)
- Cal.Ext.Thr. (page for calibration when used external potentiometer)
- BaTemp: (DS or BMS, default for GEN2 is BMS)
- Current factor (for HALL only, now not used any more)
- Battery (Graphic representation, values of each cell and BMS)
- Temp Gradient, (default is 10 deg/min)
- BMS type (14C is default)
- Low voltage, (default setting is 11V)
- Info (more detailed info page)
- Sustainer or Selflaunch
- RPM colours (at which RPM number indication would become yellow and red, default yellow at 4300 RPM, and red at 4500 RPM)
- Save data (saving changes) short press is required!
10. FCU software updates

Some operational and functional improvements of the FCU software, might become available in the future. Always consult with manufacturer of the glider and with LZ design, regarding compatibility of new version of software, for specific glider type and its serial number.

Update file can only be received from LZ design, and is not allowed to share it with other owners. It is not allowed to use file which you might receive from other owners.

When update is approved, follow the procedures in Section 9. It is strongly recommended to document the FCU settings prior and after update.

10.1 Equipment

For FCU update you need:
- The FlashLoader485App.exe software is required to perform FCU updates (the software can be obtained via the Download page of the FES website).
  http://www.front-electric-sustainer.com/download.php

  Available download is .zip file, which you need to extract first.
  After extraction, run file FlashLoader485App.exe, and window will appear as bellow

- Update file App_FES_2.XX.lxfw (number XX is version of file)
- PC (preferred a notebook) with Windows operating system
- Standard USB-RS 232 cable, (you can use also COM to COM if your PC still have a COM port)
10.2 FCU update procedure

1. Plug in USB connector of update cable to free USB port of your PC. Wait until cable will be recognized and ready for use. It is recommended that you go to Control panel->System-> Device manager->Ports (COM and LPT) in order to check to which virtual COM port your USB-COM cable is assigned.

2. Find location of FCC (FES connection circuit) box:
   - at LAK gliders is easily accessible at front wall of cooling rib just behind seat pan, cover do not have a hole so it needs to be removed to have access.
   - at V2cxa and D2c, is located behind small doors on right side of cockpit behind seat pan, cover already have a suitable hole so that you can easily plug in Sub-D connector of RS232-USB cable. At HPH304ES is located in behind the wing spars.
   - at Silent 2 with depth seat shell option, FCC box is located on front wall of landing gear box. At Silent with standard seat shell is located on right side of landing gear box. In both cases there is a hole in cover of FCC box, so that you can insert Sun D connector of RS232-USB cable. But in any-case you need to remove upper and lower composite part (about 10 screws to unscrew) behind the seat pan, to have access.
   - at Silent 2 with depth seat shell option, FCC box is located on front wall of landing gear box. At Silent with standard seat shell is located on right side of landing gear box. In both cases there is a hole in cover of FCC box, so that you can insert Sun D connector of RS232-USB cable. But in any-case you need to remove upper and lower composite part (about 10 screws to unscrew) behind the seat pan, to have access.

3. Plug in SUB-D connector of RS232-USB cable trough the hole of FCC box to FCU update connector (at LAK glider cover do not have a hole so cover need to be removed to have acces).
4. Run Flash loader

![Flash Loader Screenshot]

5. Choose proper COM port and Baudrate 115200
6. Browse for FES update file ***.fw
7. Press Flash button and turn ON FCU. If FCU is already turned ON wait a second or two so that message “Connected”, will appear on FCU and after that new screen with update line with progress and PROGRAMMING message as on picture below.

![FCU Update Screen]

It takes about 1 minute so that update is finished.

8. When FCU start again automatically, you should see a new software version on starting screen!

![New Software Screen]

With nearly the same procedure is possible to update also LXUI box, (which is used for accurate current and voltage measurements) if necessary!

10.3 After update

After update all settings in the FCU should remain the same. However some versions will need to insert some password codes or to adjust some new settings, if advised so by FES manufacturer before update. If you will have some problems before, between or after update, please contact FES manufacturer - LZ design company.
## 11. Revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2011</td>
<td>Initial release of manual, Version 1.0</td>
</tr>
<tr>
<td>February 2013</td>
<td>Updates for FCU software version 2.13, Version 1.5</td>
</tr>
<tr>
<td>March 2013</td>
<td>Update about automatic propeller positioning, Version 1.51</td>
</tr>
<tr>
<td>July 2014</td>
<td>Update about ventilation, and warnings, Version 1.52</td>
</tr>
<tr>
<td>October 2014</td>
<td>Update about recall possibility of red warnings, Version 1.53</td>
</tr>
<tr>
<td>December 2014</td>
<td>Updates about LED warnings, Version 1.54</td>
</tr>
<tr>
<td>January 2015</td>
<td>Update regarding FCU v2.29, Version 1.6</td>
</tr>
<tr>
<td>June 2015</td>
<td>Update regarding FCU v2.32, Version 1.61</td>
</tr>
<tr>
<td>December 2015</td>
<td>Update regarding FCU v2.33, Version 1.62</td>
</tr>
<tr>
<td>February 2016</td>
<td>Update regarding FCU v2.34, Version 1.63</td>
</tr>
<tr>
<td>October 2016</td>
<td>Update regarding FCU v3.02, Version 1.70</td>
</tr>
<tr>
<td>October 2017</td>
<td>Update regarding FCU v3.06, Version 1.80</td>
</tr>
</tbody>
</table>