JS-MD 3 RES

Aircraft Flight Manual Supplement

JONKER SAILPLANES

M+D FLUGZEUGBAU

JS-MD 3 RES Flight Manual Supplement

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0 Document Management

0.1 Record of Revisions

Issue	Date	Reason for Change
00	16.05.2022	Initial Issue
01	13.12.2022	Grammar improvements made to entire document Added Rescue card and Propeller warning Decal Minimum RES system temperature corrected to -15˚C EXT/RETR toggle switch or command knob to be used, instead of RES guarded master switch, to immediately remove power when system is drawing high amps Warning added that no person should be within proximity of pylon/propeller when extended Added check for operation of fan at a controller temperature of 40˚C (104 ˚F) and higher Caution added to always verify vertical alignment of propeller via the rear-view mirror Maximum current of DC-DC Converter added Note added regarding battery ventilation through exhaust in battery and fuselage during thermal event Winter charging changed to storage charging Charger manual removed and reference to charging instruction sheet added
02	24.03.2023	Added SOC check to Pre-flight Test run Added flap position to Self-launch procedure Added power automatically reduces when controller temperature exceeds 75˚C. Open storm window added to Self-launch procedure Aerotow Assisted Self-launch limitation and procedure added

0.2 List of Effective Sections

Section	Revision	Date	Number of Pages	Reference
0	00	24.03.2023	10	Issue 2
1	00	24.03.2023	2	Issue 2
2	00	24.03.2023	10	Issue 2
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0.3 Record of Amendments

Date of Issue/ Revision	Date of Insertion	Signature

0.4 Table of Contents

0.5 List of Figures

0.6 List of Tables

0.7 List of Abbreviations

AMM	Aircraft Maintenance Manual
CAN	Controller Area Network (communications bus)
DCU	Display and Control Unit
DC-DC	Direct current to direct current (power conversion)
EASA	European Aviation Safety Agency
HOA	Head of Airworthiness
HV	High Voltage (typically 400V in this configuration)
IAS	Indicated Airspeed
IMD	Insulation Monitoring Device
HP	Horsepower
ISA	International Standard Atmosphere
kW	Kilowatt
LiPo	Lithium Polymer
Li-ion	Lithium-ion
LED	Light-Emitting Diode

MCP	Maximum Continuous Power
MP	Maximum Power
MTOW	Maximum Take-Off Weight
OAT	Outside Air Temperature
PRS	Power Rail Supply
RES	Rear Electric System
RFU	Retraction and Fuse Unit
RPM	Revolutions per Minute
SB	Service Bulletin
SOC	State of Charge
STC	Supplemental Type Certificate
TAS	True Airspeed
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

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1 General

1.1 Introduction

This manual has been prepared to provide pilots, instructors, and maintenance personnel with necessary information for the safe and efficient operation of JS-MD 3 sailplanes equipped with the RES (Retractable Electric System).

The marketing name for model JS-MD 3 RES is the JS-3 RES and is referred to in this manual as the JS-3 RES.

1.2 Certification Basis

Refer to the JS-MD 3 RES Aircraft Flight Manual Section 1.2.

1.3 Warnings, Cautions, and Notes

The following definitions apply to Warnings, Cautions, and Notes used in this Flight Manual Supplement.

WARNING: This means that the non-observation of the corresponding procedure leads to an immediate or important degradation of flight safety.

CAUTION: This means that the non-observation of the corresponding procedure leads to a minor or a more or less long-term degradation of the flight safety.

NOTE: This draws attention to any special item not directly related to safety, but which is important or unusual.

1.4 Descriptive Data

The JS-3 with the RES is a sustainer and self-launch version of the pure sailplane. A RES is fitted in the rear fuselage. The system is completely retractable and does not impact the normal operation of the aircraft during conventional soaring flights.

1.5 Technical Data

System Technical Data	
Propulsion System	SOLO Electric Propulsion System 80400
Propeller Type	Technoflug KS-1C-120-R-065-S
Max Propeller Speed	4350 RPM
Max Power for Take-Off (2 batteries)	40 kW (53.6 hp)
Max Continuous Power (2 batteries)	25 kW (33.5 hp)
Max Power (1 battery)	25 kW (33.5 hp)
Max Continuous Power (1 battery)	12.5 kW (16.8 hp)
Installed System Weight (without batteries)	~24 kg (53 lbs)

Table 1-1 System Technical Data

1.6 RES Illustration

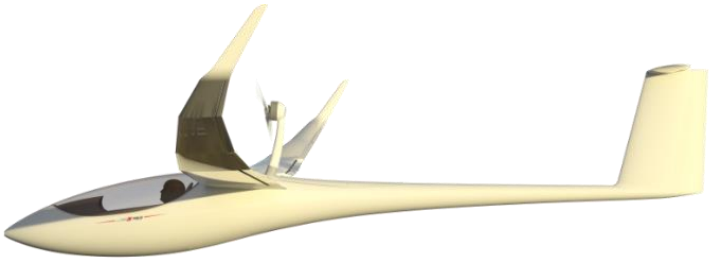

Figure 1-1 JS3 with RES pylon extended

2 Limitations

Section 2 includes operating limitations, instrument markings, and basic placards necessary for the safe operation of the aircraft equipped with a RES.

The limitations included in this section are approved by the EASA.

2.1 Airspeed Limits

Table 2-1 gives the speed limitations and their operational significance.

Speed		IAS	Remarks
V_{max}	Maximum speed to operate the RES	150 km/h (80.9 kts)	Do not exceed this speed with the motor running
V_{PE}	Powerplant extended maximum permitted speed	150 km/h (80.9 kts)	Do not exceed this speed with the pylon extended.

Table 2-1 Airspeed Limits

2.2 Airspeed Indicator Markings

The airspeed indicator requires the following additional markings when fitted with the RES:

Marking		IAS	Significance
Blue line	—	110 km/h (59.3 kts)	Best rate-of-climb speed V_Y (if RES is fitted)

Table 2-2 Airspeed Indicator Markings

2.3 Powerplant Instrument Markings

The RES powerplant has a dedicated DCU (Display and Control Unit) mounted in the instrument panel.

Horizontal graphics bars with overlaid numerical values display critical operation information to the pilot.

RPM

Power supplied by batteries

Battery State of Charge (SOC)

Battery temperature

Motor temperature

Controller temperature

Operating limits are displayed in green when in the normal operating range, in yellow when in the caution range, and in red indicating the maximum limit has been exceeded:

	Green	Yellow	Red
RPM	0-4000	4000 - 4350	4350
Power	0 - 25 kW (0 - 33.5 hp)	25 - 40 kW (33.5 - 53.6 hp)	40 kW (53.6 hp)
Motor temperatures	-15 – 105 °C (5 – 221 °F)	105 – 120 °C (221 – 248 °F)	120 °C (248°F)
Controller temperatures	-15 – 75 °C (5 – 167 °F)	75 – 85 °C (167 – 185 °F)	85 °C (185 °F)
HV battery temperatures	0 – 60 °C (32 – 140 °F)	60 – 70 °C (140 – 158 °F)	70 °C (158 °F)

Table 2-3 Display of Limitations for Dual Battery Operation

NOTE: For single-battery operation, the warning threshold automatically changes to 16kW. Motor / Controller & HV battery limitations are unchanged.

Refer to Section 4.3 for a detailed description of the powerplant instrument markings.

2.4 Powerplant Limitations

Parameter	Limitation
Maximum propeller speed	4350 RPM
Maximum propeller speed (Rain conditions)	3800 RPM
Maximum motor temperature	120 °C (248 °F)
Maximum controller temperature	85 °C (185°F)
Maximum HV battery temperature	70 °C (158 °F)
Maximum operating altitude (AMSL)	Same as airframe
Minimum HV battery temperature for take-off	0 °C (32 °F)
Maximum HV battery temperature for take-off	32 °C (90 °F)
Maximum time for MP	60s (2 battery configuration) 240s (1 battery configuration)

Table 2-4 Powerplant Limitations

CAUTION: When applying power, the battery temperature will continuously increase until the maximum allowable temperature is reached.

CAUTION: Operation of the RES system is prohibited if component temperatures are less than -15°C (5°F)

2.5 Approved Manoeuvres

This aircraft is certified in the Utility category (U). Aerobatic manoeuvres with RES system installed are not permitted.

2.5.1 Approved Flight Rules

Operation of the JS-3 RES in sustained flight is approved for VFR flight by day in VMC conditions only.

2.5.2 Motor Start, Run-Up, Taxi Procedures

Taxiing is permitted with the RES, but no provision is made in the JS-3 RES for a steerable tail wheel. Motor operation may also be performed on the ground for maintenance purposes.

2.5.3 Self-Launch

Dual battery self-launch with the RES is permitted with the following limitations:

Parameter	Limitation
Maximum take-off weight (MTOW)	18 m: 575 kg (1267.7 lbs) 15 m: 525 kg (1157.4 lbs)
Minimum HV Battery State of Charge (SOC) for take-off	60%
Minimum pre-take off HV Battery temperature	0 °C (32 °F)
Maximum pre-take off HV Battery temperature	32 °C (90 °F)
12V battery supply minimum voltage	12.8 V

Table 2-5 Dual Battery Self-launch Limitations

NOTE: Self-launch with one HV battery is not allowed.

2.5.4 Approach and Landing

Approaches and landing with the RES running are approved.

NOTE: Operation of the RES over unlandable terrain is not approved.

NOTE: Cloud flying with the pylon extended is not approved.

CAUTION: Operating the RES in heavy rain is not recommended, as it may cause damage to the propeller blades.

2.6 Minimum Equipment List

Additional instrumentation and equipment required if RES is fitted:

- Display and Control Unit (DCU)
- RES master switch guard
- Rear view mirror
- Supplemental (independent) fire warning system
- Limitations and operations placards or booklet
- Magnetic direction indicator

2.7 Aerotow Assisted Self Launch

Maximum approved towing speeds and maximum weak link ratings for assisted aerotow launching are listed in and **Error! Reference source not found.**.

Configuration	Minimum safe launch speed		Recommended launch speed	
	15m	18m	15m	18m
Empty	115 km/h / 62.0 kts		130 km/h / 70.2 kts	
MTOW	125 km/h / 67.5 kts		140 km/h / 75.6 kts	

Table 2-6 Assisted aerotow limitations

NOTE: The maximum power allowed during an assisted take-off is 20 kW.

NOTE: Only textile ropes may be used for assisted aerotow launching.

Launch method	Maximum speed	Maximum weak link rating
Assisted Aerotow	150 km/h / 80.9 kts	600 daN (E.g. Tost weak link #4, Blue)

Table 2-7 Assisted aerotow limitations

2.8

2.8 Temperature restrictions when flying with the RES

System operation is certified for an air temperature range of -15 °C to +38 °C (5 °F to 100 °F).

2.9 Altitude limitations

The aircraft has no additional altitude limitations whilst operating the RES. Refer to Section 7.1 for propeller RPM warning.

2.10 Limitations and RES Operation Placards or Decals

Limitation placards can be fixed decals either on the cockpit side walls, the canopy frame, or the instrument panel face. Placards may alternatively be furnished as a single Placard Booklet located in a cockpit sidewall storage pocket within reach of the pilot.

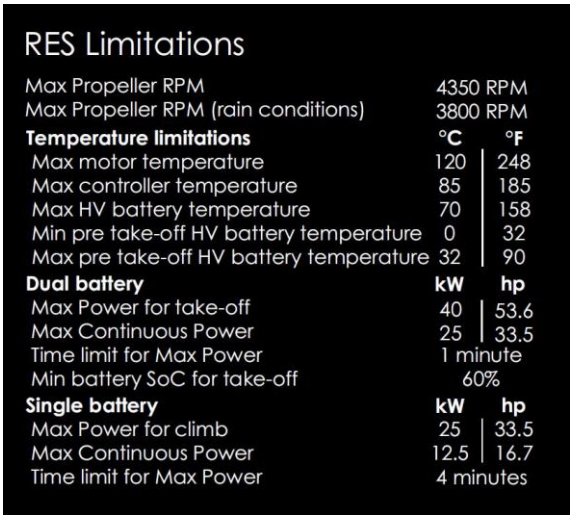

Figure 2-1 RES limitations placard

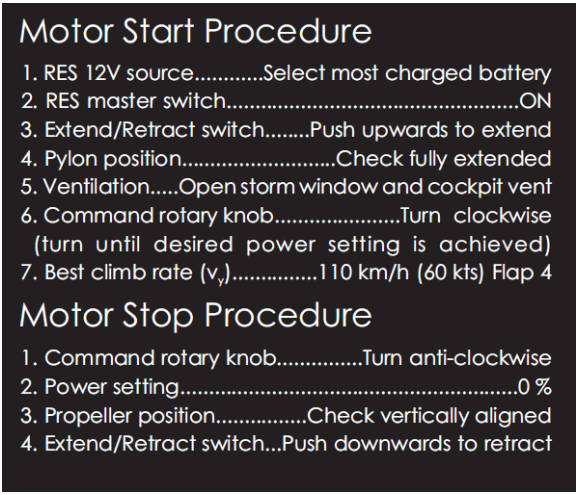

Figure 2-2 Motor start and stop procedure placard

An emergency high voltage danger decal (see Figure 2-3) is applied to the fuselage exterior surface just forward of the motor and battery bay to warn ground personnel and rescue teams that a high voltage system is present and to point rescue teams to a Rescue Card (see Figure 2-5) located in the cockpit or accessible by scanning the QR code on the decal.

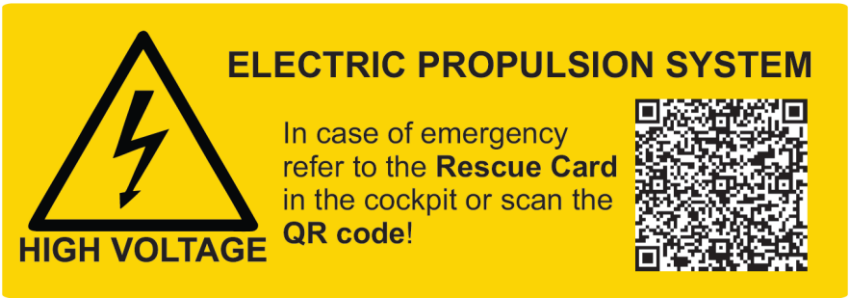

Figure 2-3 High voltage warning placard

A propeller warning decal (see Figure 2-4) located on either side of the pylon warns persons to stay clear of the pylon when extended.

Figure 2-4 Propeller warning placard

Figure 2-5 Rescue Card

3 Inspections

3.1 Pre-Flight Inspection

Before the first flight of the day, the RES must be inspected to ensure reliable operation. Extend the pylon using maintenance mode (see Section 6.6) and check the following:

Propeller attachment bolts	-	Secured and safety wire intact
Propeller structure	-	No cracks, delamination, or signs of impact damage
Pylon structure	-	No cracks, delamination, or signs of impact damage
Motor bay	-	Clean, no obstructions
Retraction mechanism	-	All fasteners secured
Door hinges	-	All connected and intact
Exhaust nozzles and elbows	-	Clear on batteries and in fuselage
Batteries	-	In position, secured and charged
	-	Ensure both batteries have similar SOC
Termination plug	-	Secured in battery charge socket (if fitted)
Terminal connector – single battery operation	-	Secured in removed battery's connection plug
Controller cooling inlet (if air cooled)	-	No blockage or obstructions
Controller liquid cooling system (if fitted)	-	No leaks observed near radiator and tubes
Fire warning	-	Circuit tested (LED illuminates and buzzer activates)

After completion of the pre-flight inspection retract the pylon, exit the maintenance (service) mode, and move the guarded RES master switch to the OFF position.

NOTE: If the RES is not serviceable, the aircraft is still deemed airworthy for normal gliding operation. In this case, the HV batteries should be removed.

CAUTION: Weight and balance is affected by battery configuration changes – ensure within limits before take-off.

CAUTION: The propeller is free to rotate during maintenance (service) mode. Ensure that the propeller does not touch the bay doors during pylon retraction, as propeller tip and/or door damage may occur.

3.2 Propeller Alignment Test

1. Switch the guarded RES master switch ON
2. Activate the HV power by pushing the EXT/RETR toggle switch upwards once. The message “Power Bus PreCharge” should appear on the DCU. Once the pre-charge process is completed the pylon is automatically extended.
3. Check propeller positioning is operational – push the lower tip of the propeller out of position by hand and visually check that its position returns to 0 degrees upon release.
4. Verify the presence of the two yellow arrows at each side of the propeller graphic on the DCU display screen.
5. Push the EXT/RETR toggle switch downwards once to retract the pylon.
6. Observe that the propeller stays aligned and that the doors close properly.
7. Switch the guarded RES master switch OFF.

CAUTION: Do not press or rotate the DCU command knob during the function test and do not allow any bystanders near the cockpit while checking the propeller alignment function.

3.3 Pre-flight test run

After recharging and installing the batteries a brief motor test run is highly recommended.

Perform the ground run with the aircraft fully assembled, main wheel chocked, and while seated in the cockpit with the canopy closed.

1. Select the alternate 12 V power supply source.
2. Switch the guarded RES master switch ON.
3. Ensure no people are within the proximity of the pylon or propeller.
4. Extend the pylon by pushing the EXT/RETR switch upwards once (the pre-charge process will occur first and then the pylon will extend).
5. If the aircraft is fitted with an anti-collision strobe light, energise the light.
6. Apply the wheel brake, hold the joystick aft, and announce PROP CLEAR.
7. Advance the propeller slowly by gradually rotating the command knob clockwise once it is safe to do so.
8. Verify numeric and graphic screen values are displayed as expected.
9. Verify proper motor RPM control by advancing and returning the rotary knob.
10. Check for any unusual noises or vibrations.
11. Verify that batteries have a SOC within 10%.

12. Verify propeller aligns vertically (via the screen graphics and the rear-view mirror) after reducing power to 0%.
13. If the propeller does not align vertically, momentarily apply power, and check propeller again to verify vertical alignment.
14. Verify that cooling fans are activated at a controller temperature of 40˚C (104 ˚F) or higher.
15. Perform extension and retraction of the pylon using MANUAL mode.

NOTE: MANUAL mode is entered from AUTO mode by simply pressing the EXT/RETR toggle switch in the opposite direction of travel.

If the pylon is extending in AUTO mode, press the EXT/RETR toggle switch downwards once – pylon movement will immediately pause and the DCU will automatically change to MANUAL mode.

If the pylon is retracting in AUTO mode, press the EXT/RETR toggle switch upwards once – the pylon movement will immediately pause and the DCU will automatically change to MANUAL mode.

CAUTION: Always disarm the propulsion system by turning off the guarded RES master switch prior to any bystanders approaching. Circuit breakers of the 12 V battery supply batteries may also be pulled if leaving the aircraft unattended.

CAUTION: Applying full power on the ground may produce enough pitch-down moment from the pylon to push the aircraft's nose to the ground. Apply only enough power during the stationary ground run to verify proper RES function.

CAUTION: Ensure the propeller blast will not impinge or blow dust towards other aircraft, equipment, persons, or structures.

WARNING: Only perform the ground run with a fully-assembled aircraft positioned well away from obstacles. Never perform the ground run with the fuselage (assembled or disassembled aircraft) placed in the trailer cradle on the extension rails.

WARNING: No person should be in the proximity of the pylon or propeller when extended as power to the system can result in immediate rotation of the propeller.

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4 Control and Display

The RES is operated by the following:

- Guarded RES master switch
- 12V battery selector switch
- Display and Control Unit (DCU)

4.1 Guarded RES Master Switch

The guarded RES master switch is a toggle switch fitted with a spring-loaded guard located on the instrument panel. The switch controls the 12 V power supply to the RES. An adjacent battery selector toggle switch enables the pilot to select the 12 V supply from either of the removable 12 V batteries.

Figure 4-1 Guarded RES master switch and battery selector switch

NOTE: The HV batteries cannot be enabled without the external 12 V power supply to the system. When the HV power rail has been activated, the selected 12 V battery can be charged with the built-in DC-DC converter.

When the guarded RES master switch is switched ON, the built-in test procedure is initiated and the system will enter standby mode with the

HV batteries not activated (until the EXT/RETR toggle switch is pushed downwards once whilst in standby mode to activate the HV batteries).

When the guarded RES master switch is switched OFF power to all RES systems, including DCU temperature monitoring, is disconnected. The supplemental fire warning system (Section 8.4) is independent and remains active.

4.2 DCU primary controls

The Display and Control Unit (DCU) has two primary controls:

- Command knob which can be rotated and pushed
- EXT/RETR toggle switch to extend or retract the pylon

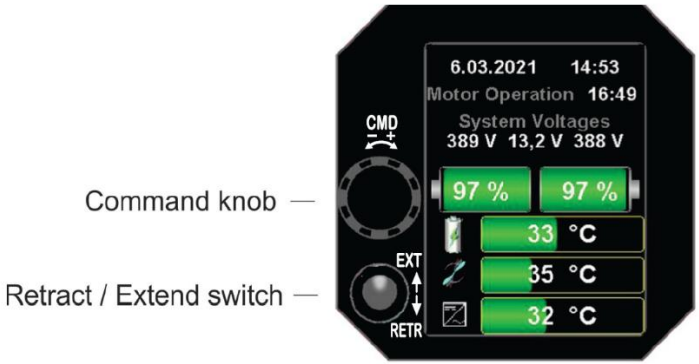


Figure 4-2 DCU Primary Controls

The Command knob is used to:

- Operate the DCU
  - Rotate – move the selected window or change values
  - Push – select or enter a value
- Control/change the desired power in the propulsion mode

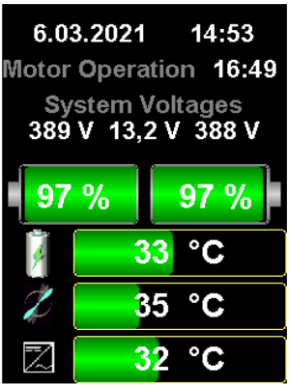
The EXT/RETR toggle switch is used to:

- Raise and lower the pylon
- Activate the DC-DC converter when in Standby mode to charge selected 12 V battery

4.3 Normal Operation Screens

4.3.1 Standby Mode

Standby mode is entered when the system is powered up (RES master switch turned ON) and the built-in-test procedure has been completed successfully.



- Date and time (dd.mm.yyyy)
- Motor total time (hh:mm)
- Battery voltages (HV-L / 12 V / HV-R)
- State of Charge of left and right HV batteries
- Maximum cell temperature in HV battery
- Motor temperature
- Controller temperature

When pushing the EXT/RETR toggle switch upwards once whilst in standby mode, the following actions are triggered:

1. The motor controller is switched ON and pre-charged
2. HV batteries are switched ON and connected to the power rail
3. The propeller alignment function of the motor controller becomes active
4. The electromechanical actuator (spindle drive) extends the pylon (the system will therefore transition out of standby mode into extended mode as discussed below)

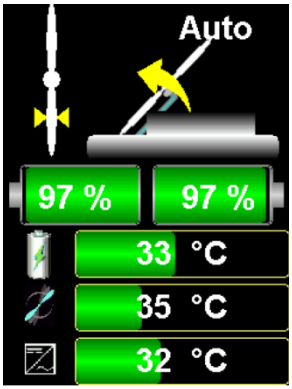
NOTE: The capacitors inside the inverter must be charged before the batteries are connected to the power rail. The message “Power Bus PreCharge” is displayed. This action takes a few seconds to complete.

When pushing the EXT/RETR toggle switch downwards once whilst in standby mode, the following actions are triggered:

1. The motor controller is switched ON and pre-charged
2. HV batteries are switched ON and connected to the power rail
3. The DC-DC converter is activated and the selected 12 V battery is charged at a higher rate and the second 12 V battery is charged at a reduced rate. See section 4.3.5.

4.3.2 Extension / Retraction Modes

Extension/retraction modes are entered from the standby or extended modes when the EXT/RETR toggle switch is pushed upwards/downwards.



- “AUTO” indicates that the pylon operation is done in automatic mode
- The yellow triangles indicate that the propeller is stopped and in an aligned position
- The yellow blinking arrow indicates the movement of the pylon
- A flashing arrow in the upper right corner of the display indicates manual mode operation.

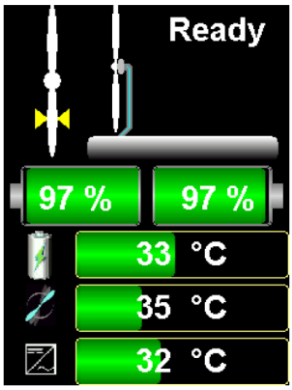
The EXT/RETR toggle switch is used to operate the pylon actuator as follows;

- A single push upwards is used to initiate the AUTO extension mode whilst retracted.
- A single push downwards is used to initiate the AUTO retraction mode whilst extended at any power setting including full power. See Take-Off Abort Procedure in Section 5.2.5.
- Manual pylon operation is entered by a single push in either the upwards or downward opposite direction whilst in AUTO mode.

CAUTION: When the pylon is operated in manual mode, the system will allow retraction/extension regardless of the position of the propeller or the temperatures of components.

4.3.3 Extended Mode

When the pylon is fully extended the propulsion system is ready for operation.



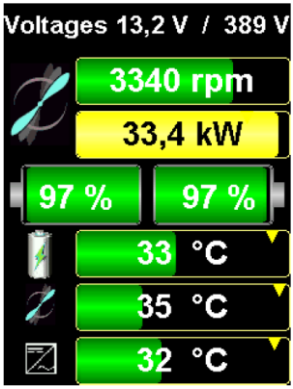
- "Ready" indicates that the propulsion system is ready for operation
- The yellow triangles indicate that the propeller alignment is active and the propeller is kept aligned

Propulsion mode is entered when the rotary command knob is rotated clockwise.

Retraction mode is activated when the EXT/RETR toggle switch is pushed downwards.

4.3.4 Propulsion

When rotating the command knob clockwise propulsion power is increased.



- Battery voltages (12 V / HV)
- RPM
- Power delivered by batteries
- State of Charge of HV batteries
- Maximum cell temperature in HV battery
- Motor temperature
- Controller temperature

The desired power can be adjusted in the propulsion mode as follows:

- Clockwise rotation – increase power
- Anti-clockwise rotation – decrease power

When the power is set to 0 kW, the Extended Mode is entered and the propeller automatically aligns vertically.

The pylon retraction mode is activated when the EXT/RETR toggle switch is pushed downwards.

NOTE: The rotary knob is incremental based on its initial position when the RES is powered ON. It does not

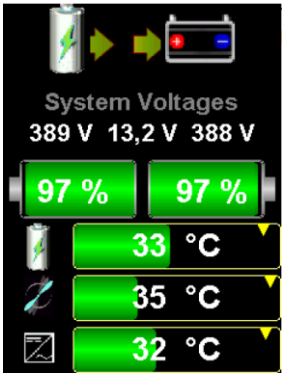
have an absolute position for 0 kW and Maximum Power (MP).

CAUTION: Always verify the vertical alignment pf the propeller via the rear-view mirror, in addition to the triangular yellow graphics on the DCU screen.

4.3.5 12V Battery On-Board Charging

The HV batteries can be used for on-board charging of the 12 V control supply batteries via the built-in DC-DC converter.

The following screen image illustrates that 12 V charging is in progress.



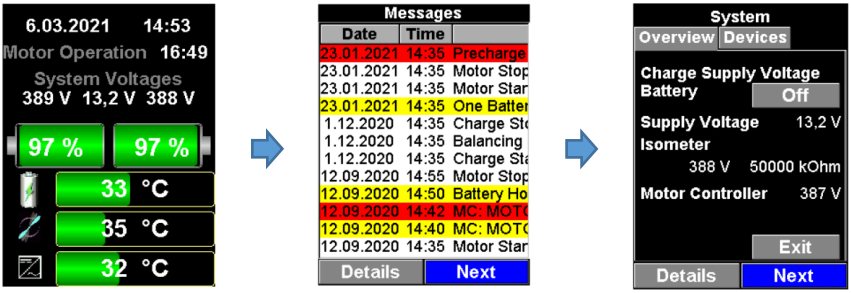
- Charging is activated by entering the System Screen and setting Charge Supply Voltage to ON. When pressing the rotary command knob during boot-up or operation mode, the display cycles through the screens.
- The pilot can change the screens by turning the rotary command knob at any time.
- It is also possible to activate the HV batteries and enable charging by pushing the EXT/RETR toggle switch downwards whilst in Standby mode.

NOTE: The on-board DC-DC converter provides a maximum current of 15 A. Excess power is used to charge the 12 V supply batteries.

NOTE: The selected 12 V supply battery is charged at a rate up to 4 A and the second 12 V supply battery is charged at a rate up to 2 A.

4.4 Other Information Screens

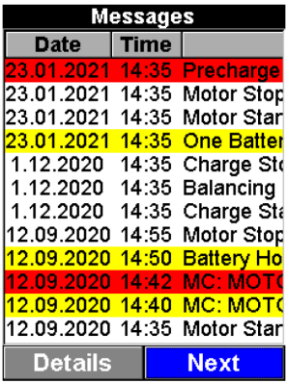
When pressing the command knob during boot-up or operation mode, the display cycles through the screens as follows:



Standby screen | Messages screen | System screen

4.4.1 Messages Screen

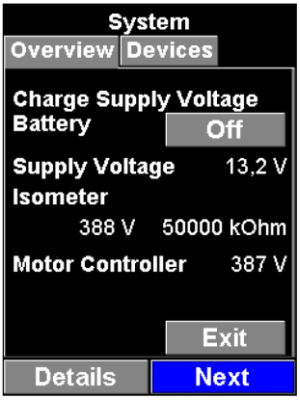
Errors/warnings, cautions and information messages are stored by the DCU and can be viewed by the pilot in the message screen. (See section 4.5 for colour codes)



To see the details of a specific listed message:

- Select “Details” using the command knob
- Scroll to the selected message
- Select message
- Observe message detail by rotating the command knob to the right

4.4.2 System Screen



The system screen has the following functionality:

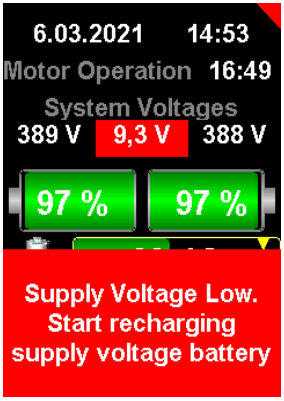
- Enable/disable charging of the 12 V supply battery from the HV batteries
- Provide information from the Insulation Monitor Device (IMD) and system voltages
- Calibrate the pylon actuator travel (see JS-MD 3 RES AMM Supplement for more detail)

NOTE: When the message or service screen is shown, the monitoring of the motor operation remains running in the background.

4.5 Warning Caution and Information Messages

All **warning/ error, caution, or information** messages are stored by the DCU. Messages are prioritized and coloured as follows:

Message type	Background color	Audio warning
Warnings	RED	Loud repeated beep until acknowledged
Cautions	YELLOW	1-second beep
Information	WHITE	½ second beep



Warning/caution/info messages cover the lower part of the screen

- A small triangle in the top right corner will be displayed as a reminder that a message exists. The triangle has the same colour as the original message.
- A message is acknowledged (and cleared) by pressing the command knob.

CAUTION: If an operation limit is exceeded, the pilot is required to take the required action. Only limited automatic system control is implemented to protect the RES if used outside its design limitations.

NOTE: Only the unacknowledged message with the highest priority will be displayed.

A list of messages is provided in the Appendix (Section 10).

5 Emergency Procedures

This section lists the emergency procedures that may occur during operation.

5.1 400 V Insulation Failure

Batteries are of high voltage (400 V). An Insulation Monitoring Device (IMD or Isometer) is installed to detect any high voltage leak to the airframe.

In case the IMD detects any voltage leakage, one of the following warnings will be displayed to the pilot:

- No Data from Isometer
- Isometer defect!
- Isometer Ground Failure!
- Insulation Problem!!!

If any of these messages are received, switch off the RES master switch immediately to avoid the risk of electric shock.

When on the ground, perform the following actions:

1. Stand clear of the glider and only operate the DCU
2. Switch guarded RES master switch ON while pressing the DCU rotary command knob to enter maintenance mode
3. Extend pylon manually
4. Switch guarded RES master switch OFF
5. Remove HV batteries. Contact an approved maintenance station to rectify the problem

WARNING: Do not operate the RES if an Isometer warning has been given.

WARNING: After the batteries have been powered OFF, the high voltage will only dissipate over the next 10 s.

5.2 Propulsion System Failures in Flight

5.2.1 Pylon extended but power cannot be applied

If the pylon is extended but all safety checks required to allow operation have not been met, the system does not allow power to be applied. In this case, the pilot has two options:

- Retract the pylon to reduce the additional drag and continue the flight as a pure glider.
- Recycle the system in an attempt to clear the failure mode:
    1. Select a suitable landing field to perform a safe landing
    2. Set attitude for a minimum safe flying speed
    3. Switch the guarded RES master switch OFF. The propeller will start windmilling and the rate of descent will increase
    4. Switch the guarded RES master switch ON
    5. Push the EXT/RETR switch in the EXT direction (upwards)

WARNING: Do not push the toggle switch downwards unless the propeller is oriented vertically!

    6. Confirm the status changes to “OK”
    7. Turn the command knob clockwise to apply power
    8. If no power is available, perform a retraction procedure (ensure propeller is oriented vertically) or land with the pylon extended

5.2.2 Motor fails to deliver power

Propulsion system failure may occur due to the batteries being depleted or due to an electrical failure that may have occurred.

If the propeller remains in the vertically aligned position, it means the HV power is still available. Retract the pylon and continue the flight as a pure glider.

If the propeller windmills it is an indication that HV power to the motor is interrupted. The pilot may attempt to restore power as described in the next section.

5.2.3 Power loss during flight

If the 12 V supply power or HV battery power is lost during flight, the propeller will windmill. The following action can be attempted to restore power:

1. Change the 12 V system power to the alternate battery
2. Switch the guarded RES master switch OFF and back ON
3. If the HV power is restored after being powered up, the automatic propeller brake will be activated. Normal operation can then be attempted
4. If HV power is not restored and the propeller continues to windmill, land as soon as possible

CAUTION: Drag increases significantly with the propeller windmilling.

WARNING: Do not retract the pylon while the propeller is windmilling.

5.2.4 Component Temperature Limits Exceeded

Temperatures of components increase with the application of power. At power settings above the MCP, components may reach their limitations.

CAUTION: The controller needs sufficient energy from the 12 V batteries to power its cooling fans. When the 12 V battery charge becomes low, the cooling fan speed will be reduced resulting in the controller temperature increasing and the HV system may shut down when maximum controller temperatures are reached.

WARNING: The system overrides the requested rotary know value shuts OFF power to the motor when limit temperatures are exceeded.

5.2.5 Take-Off Abort Procedure

When it is required to abort a take-off the following procedure is recommended:

1. To remove power immediately either:
    - Turn command knob fully ant-clockwise, or
    - Push the EXT/RETR toggle switch downwards
2. If the take-off must be aborted during ground roll, apply wheel brake as required
3. If the take-off must be aborted when airborne, it is critical to ensure a safe approach speed is maintained while the power is cut. Immediately lower the nose of the aircraft from the powered climb attitude to the unpowered glide attitude. Use the airbrake and the wheel brake as required.

NOTE: Switching off the RES master switch while the system is drawing high amperage leads to a very abrupt disconnection of the HV relays which could damage the HV batteries.

CAUTION: The propeller will be windmilling when power is immediately removed. As a result, the drag increases significantly with a noticeable decrease in glide performance.

CAUTION: If take-off must be aborted when airborne it is critical to ensure a safe approach speed is maintained while the power is cut. Immediately lower the nose of the aircraft from the powered climb attitude to the unpowered glide attitude.

5.3 Fire

5.3.1 Fire on the Ground

1. Switch OFF the RES master switch
2. Switch OFF all instruments and the avionics master switch
3. Get out of the cockpit
4. Extinguish the fire

NOTE: A Li-ion battery fire is considered a Class B fire. Therefore, a standard ABC or dry chemical fire extinguisher should be used.

5.3.2 Fire Inflight

An independent fire warning system (see Section 8.4) is installed to detect excessive heat in the motor bay. The system uses a bright red LED situated on the instrument panel and an audible buzzer to warn the pilot of heat detected and a possible fire.

When the LED is illuminated or a fire smell is recognized:

1. Stop the motor immediately by rotating the command knob anti-clockwise to 0% power
2. Switch OFF the RES master switch
3. Descend rapidly and land as soon as possible

4. If a burning odour is evident, open the cockpit ball-vent and the canopy side window
5. Bail out if the fire spread endangers the life of the pilot
6. Extinguish the fire after landing

NOTE: The independent fire warning system detects excessive heat in the motor bay via heat-trace wires and temperature switches. The red LED warns the pilot of a thermal event in the motor bay and does not necessarily confirm the presence of flames or burning.

NOTE: Each battery is fitted with a metal exhaust that automatically plugs into corresponding exhaust elbows in the belly of the fuselage. Fumes and gasses from a thermal event inside the battery case are directed out via the exhaust nozzles/elbows and vented overboard. Fumes and gasses will only enter the motor bay if the integrity of the hard-shell battery case is compromised.

6 Normal Operating Procedures

6.1 Charging and Battery Installation

6.1.1 Charging HV Batteries in the Aircraft

The HV batteries can be charged at the pilot's own risk inside the aircraft using the following procedure:

1. Remove the terminal connector (located in the charge port behind the pilot's left elbow as shown in Figure 6-2) and connect the Cable A charger plug to the charge port in the fuselage (see Figure 6-1).
2. Insert a terminal connector to the unused Cable B of the battery charger
3. Turn charger ON
4. Once the charging process is initiated, the DCU offers two additional charge options that may be selected within 20 sec:
   - Selection of the charging power value; or
   - Selection of storage charging

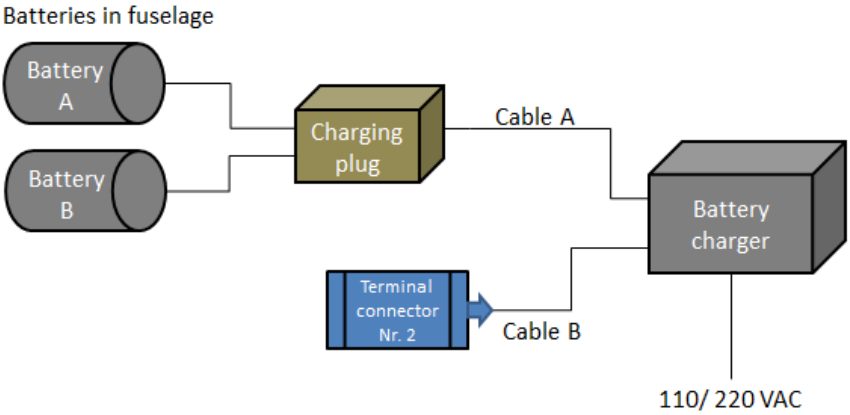


Figure 6-1 Inside aircraft charging diagram (dual battery)

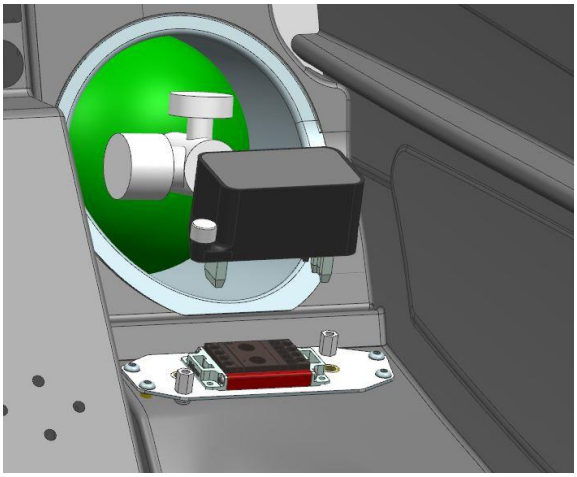


Figure 6-2 Terminal connector and charging port in cockpit

Once the charger is connected, 12V power is supplied to the battery manager, IMD, and DCU. The battery manager starts the charging process by activating the HV relays with the DCU monitoring the process.

Once batteries are fully charged, the battery manager switches off the charging process and the DCU displays the standby screen.

If a single battery is charged inside the fuselage, the terminal connector must also be inserted in the male receptacle at the location of the removed battery, as illustrated in Figure 6-3 and Figure 6-4.

NOTE: Adjust the charging power according to the voltage of the electrical utilities grid (lower charging rate for 120 VAC and higher charging rate for 240 VAC) and/or select storage charging when required.

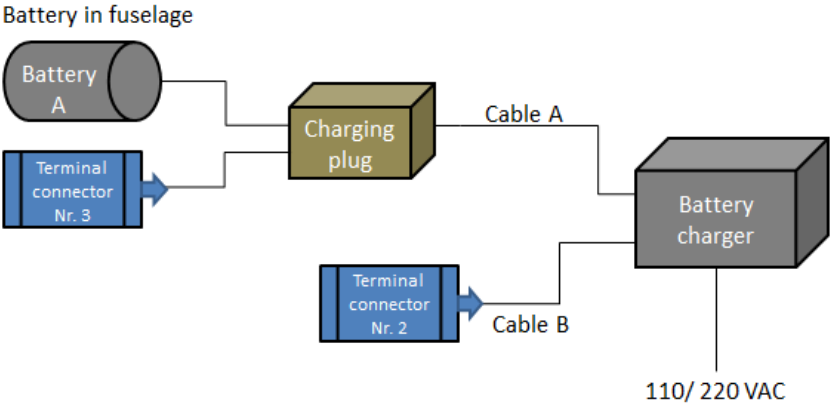


Figure 6-3 Inside aircraft charging diagram (single battery)

Figure 6-4 Single battery with terminal connector

6.1.2 Charging the Batteries Outside the Aircraft

The HV batteries should be charged under supervision or where the risk of a battery fire will cause minimum damage to the surroundings.

1. Remove the HV batteries from the fuselage
2. Connect the charger plugs to the batteries
3. Turn charger ON. If the toggle switch is operated while the charger is switched on, the storage charging mode is activated (batteries must be below 50% SOC for storage charge to occur)

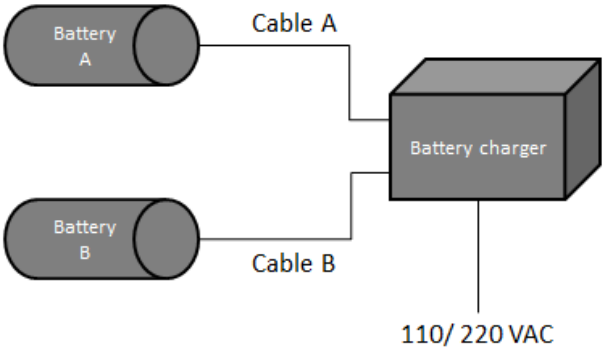


Figure 6-5 Outside aircraft battery charging diagram (dual battery)

Once the charger is connected, 12V power is supplied to the battery manager. The battery manager starts the charging process by activating the HV relays.

When batteries are fully charged (or charged to 50% for storage), the battery manager switches off the charging process.

If a single battery is charged outside the fuselage, the terminal connector must be inserted in the connector of Cable B of the battery charger, as illustrated in the next figure.

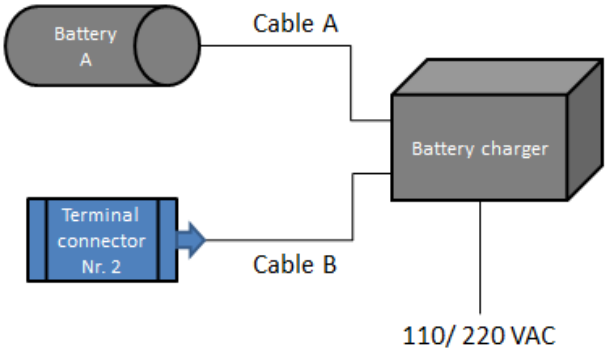


Figure 6-6 Outside aircraft charging diagram (single battery)

NOTE: Batteries should be charged at temperatures between 23 °C and 45 °C (73 °F and 113 °F). Charging at lower temperatures will result in batteries not being charged to the maximum capacity (cell temperatures of 0 °C can be charged to 85% of their available capacity).

6.1.3 Installing the HV Batteries

1. Select a 12 V battery to power the RES system
2. Enter maintenance mode by pressing and holding the command knob on the DCU while switching the RES master switch to ON. See section 6.6.1 for maintenance (service) mode
3. Whilst in maintenance (service) mode the pylon can be extended by pushing the EXT/RETR toggle switch upwards until the pylon is sufficiently clear.

CAUTION: When the HV system is not activated, the propeller alignment function is inactive. Take care that the propeller is aligned when extending the pylon to avoid damage to the propeller or doors.

4. Switch the RES master switch OFF
5. Insert each battery into its respective battery compartment and slide forward into the secured position (note that batteries are physically identical except for their latch orientations). See Chapter 9 for battery specific inspections
6. Secure each battery with its latch and tighten the retainer thumbscrews, install the retainer sleeves, and safety clips
7. Insert or ensure that a terminal connector is installed in the charge port, as illustrated in Figure 6-7

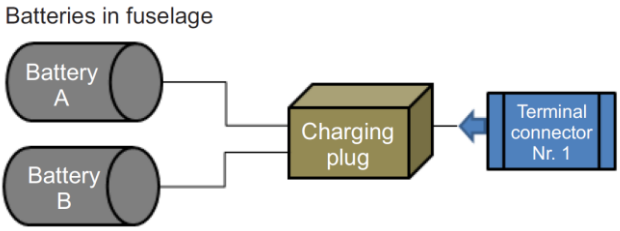


Figure 6-7 Terminal connector installation (dual battery)

8. If only one HV battery is being used, additionally insert or ensure that a terminal connector is installed in the unused receptacle, as illustrated in Figure 6-8

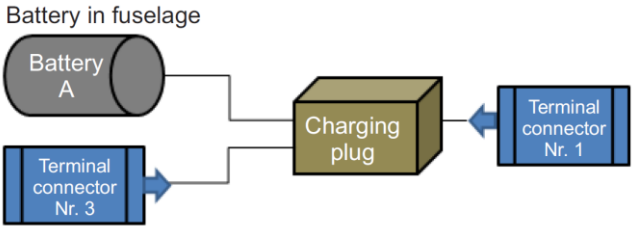


Figure 6-8 Terminal connector installations (single battery)

9. Switch the RES master switch ON
10. Verify the propeller is vertically oriented
11. Retract pylon by pushing the EXT/RETR toggle switch downwards

6.2 Aerotow Assisted Self-launch Procedure

Aerotows are performed using the nose release hook. Refer to the JS-MD 3 RES Aircraft Flight Manual Section 2.12 for rope lengths.

Initiate the ground run in negative flap (Flap setting 1). This will increase aileron efficiency at low speeds. In a crosswind take-off, keep the stick aft during the initial acceleration. This prevents the aircraft from weather-cocking into wind.

As soon as positive aileron control is available, set the flap to the setting indicated in .

Aerotow speed table	Flap setting	Airspeed km/h / (kts)
Recommended aerotow speed (No water ballast)	4	130 km/h (70.2 kts)
Recommended aerotow speed (MTOM)	4	140 km/h (75.6 kts)
Minimum safe aerotow speed (No water ballast, calm conditions)	4	115 km/h (62.1 kts)
Minimum safe aerotow speed (MTOM, calm conditions)	4-5	125 km/h (67.5 kts)
Minimum safe aerotow speed (MTOM, turbulent conditions)	3-4	140 km/h (75.6 kts)
Maximum aerotow speed (V_T)	3	180 km/h (97.1 kts)

Table 6-1 Aerotow speed table

Retracting the landing gear on aerotow is not recommended.

To release, pull the yellow release handle all the way. If the low tow position is used, it is recommended to release only after moving into the slipstream of the tow plane. The swirling rope end may cause damage to the aircraft when released in the low tow position.

NOTE: With the CG in the aft position the launch should be commenced with the trim in the full forward setting. Adjust the trim during the tow as required.

For an assisted aerotow, the procedure is similar to the one used for conventional aerotows. Aerotowing behind towplanes with less power, e.g. ultra light aircraft or touring motorgliders or taking off from short runways may be conducted with the electric power plant running. The take-off distance is significantly reduced if the motor is extended and running at a, maximum allowed, power of 20 kW during the aerotow.

Once the ground run starts, the glider pilot can start to apply power. Only level tow position is permitted, with the rope length equal to the conventional aerotow rope lengths. The speed and flap range is equal to **Error! Reference source not found.** with the difference that the minimum safe speed is 125 km/h (67.5 kts) and the maximum speed is limited to 150 km/h (81 kts).

Should at any time during the assisted tow a significant amount of slack in the towrope occur, it is advised to release immediately and continue the climb as a normal self-launch. Once the sailplane is clear of the rope, the power can be increased to more appropriate settings, depending on the temperature of the components.

NOTE: This take-off procedure is only permitted if the conditions are such that a tow with pylon retracted can be executed safely.

To ensure good communication with the tow pilot the use of a headset is highly recommended. The power plant must be retracted during cross country aero tows with speeds exceeding V_{PO}.

Procedure:

1. Complete normal pre-take off checks
2. Extend motor and test motor operation while applying wheel brake
3. Initiate the aerotow take-off without power

4. Slowly advance power to 20 kW while ensuring the tow rope remains under tension.
5. Remain in the level-tow position.

WARNING: If power is lost or temperature readings are increasing abnormally during the ground run the tow must be terminated by releasing the towing rope.

WARNING: The pilot must keep his left hand near the RES master switch to cut power immediately in case of an aborted take-off.

WARNING: In case of an aborted take-off while the glider is still on the ground, switch the Master RES switch immediately off, release the towing cable and apply the wheel brake as required.

WARNING: In case of an aborted take-off when the glider is airborne release the towing cable and continue the climb at MCP.

WARNING: If the tow speed approaches V_{PO} the propeller may over speed if power is not reduced.

Maximum speed for assisted-take-off is 150 km/h (V_{PO}). Minimum speed is selected as 125 km/h for all configurations (15m & 18m, regardless of the weight).

The maximum power allowable during an assisted take-off is 20 kW.

6.3 Self-Launch Procedure

The self-launch procedure is as follows:

1. Select 12 V supply battery – sufficiently charged, and preferably not the same battery powering the avionics
2. Switch the guarded RES master switch ON. The system self-test will be initiated and the DCU changes to the operation screen
3. Push the EXT/RETR toggle switch on the DCU upwards once. The HV system will power up and the pylon will raise to the extended position
4. When the system is fully extended and the DCU shows the status as READY, the system is ready for power to be applied
5. Ensure all pre-take-off checks have been performed and the parameters are within limits
6. If an air-cooled system is installed, open the cockpit ball-vent and the canopy side window
7. If the aircraft is fitted with an anti-collision strobe light, energise the light.
8. Apply the wheel brake, hold the joystick aft, and announce PROP CLEAR
9. Select flap setting 4 to ensure best climb rate is achieved
10. Turn the command knob clockwise until full power is reached – the power setting changes to yellow above the Maximum Continuous Power (MCP) setting. The rotary command knob does not have a physical hard stop and there is no risk of it being rotated too far. Reduce power to MCP as soon as a safe altitude has been reached, or before temperatures approach their maximum limitations.

NOTE: Power is automatically reduced when the controller temperature exceeds 75˚C. The pilot may override this protection by increasing the power again. When the controller temperature reaches 80%, the power is reduced by another 25% and a RED warning is displayed on the DCU.

WARNING: While turning the rotary command knob clockwise observe in the rear-view mirror until the propeller starts spinning. Observe all parameters are in limits and no warning messages are displayed

WARNING: The EXT/RETR toggle switch is used to immediately remove power in an emergency (see Take-Off Abort Procedure in Section 5.2.5). Take care to not unintentionally bump the toggle switch when adjusting the rotary command knob from MP to MCP.

WARNING: Ensure the batteries are sufficiently charged and that sufficient runway is available to perform a safe take-off.

WARNING: If two HV batteries are installed and there is a difference in the voltages of the batteries, only the higher voltage battery will be connected to the HV bus. The warning message “One battery disconnected: NO TAKE-OFF!!” will be displayed. Do not perform a take-off in this case.

CAUTION: It is not allowed to take off if the difference in SOC of the HV batteries exceeds 10%. The SOC of the batteries can be checked by conducting a static full-power test.

NOTE: In case the system has only allowed one battery to become connected to the HV bus, battery equalization can be performed by temporarily running the motor at a low power setting to reduce that battery’s SOC. After drawing-down the SOC, switch the system OFF then

back ON and observe battery voltages in the STANDBY screen. If the voltages are within 2 V, a normal take-off can be performed with both batteries now connected to the HV bus.

6.4 Inflight Start Procedure

The inflight start procedure is as follows:

1. Select 12 V supply battery – sufficiently charged, and preferably not the same battery powering the avionics
2. Switch guarded RES master switch ON. The system self-test will be initiated and the DCU changes to the operation screen
3. Push the EXT/RETR toggle switch on the DCU upwards. The HV system is powered up and the pylon is extended
4. In case of an air-cooled system, open the cockpit ball-vent and the canopy side window
5. When the system is fully extended and DCU shows the status READY, the system is now ready to apply power
6. Verify the pylon is raised via the rear-view mirror and then turn the rotary command knob clockwise to the desired power setting
7. Reduce power to MCP as soon as a safe altitude has been reached, or before temperatures approach their maximum limitations

NOTE: The time duration from initiating pylon extension until motor power becomes available is approximately 16 seconds.

WARNING: Although the extended pylon with the propeller stopped adds very little additional drag when extended, the pilot must ensure, enough height is available to land on a suitable field before attempting an in-flight motor start.

6.5 Inflight motor Stop Procedure

The inflight shutdown procedure is as follows:

1. Turn the command knob anti-clockwise until power shows 0 kW

   The RPM will reduce and the propeller will automatically orient into a vertical position – two yellow arrows on each side of the propeller will be displayed on the DCU

2. Using the rear-view mirror, visually verify the propeller is in the vertical position

NOTE: If the prop is not aligned in the vertical position, momentarily apply power - the propeller performs a re-alignment procedure and should stop in the vertical position.

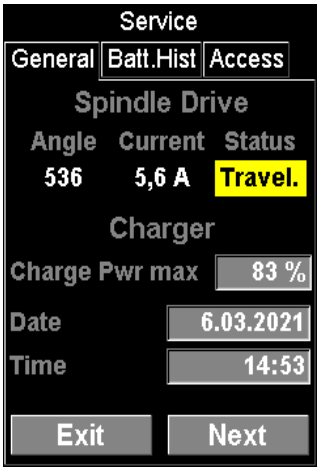
3. Push the EXT/RETR toggle switch downwards once - the system will retract automatically

4. When the retraction process is completed, the guarded RES master switch can be switched OFF

NOTE: The RES can remain switched ON during flight in order to monitor battery temperatures, or to activate the onboard charging of the 12 V batteries

6.6 Ground Operation Procedures

6.6.1 Maintenance Mode



Enter maintenance mode (or service mode) by pressing and holding the rotary command knob on the DCU while switching the RES master switch to ON.

Whilst in maintenance mode (service screen displayed on the DCU) the pylon can be raised/lowered by pushing the EXT/RETR toggle switch upwards/downwards.

NOTE: The electromechanical actuator (spindle drive) movement is monitored by the DCU and the calculated pylon position is stored by the DCU when the system is shut down. Powering OFF the DCU during maintenance and then powering ON the DCU will not result in the pylon automatically moving to an extended or retracted “home” position. It will remain in place since its original position is stored. Retraction errors may indicate that the system has to be re-calibrated (refer to JS-MD 3 RES AMM Supplement for procedure).

CAUTION: When the HV system is not ON, the propeller alignment function is inactive. Take care that the propeller is centred when extending or retracting the pylon to avoid damage to the propeller or doors.

Current drawn by the electromechanical actuator (spindle drive) is shown as well as the identified status of the retraction mechanism.

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7 Performance

Performance data provided in this section assume an 80% battery drain and are corrected for ISA conditions at sea level.

Reductions in take-off performance due to environmental conditions or other factors can be assumed as described in Table 7-1:

Take off distance correction factors	
Weight:	- 1% increase in weight: add 2% T/O distance
Density Altitude:	- Add 1% T/O distance for every degree Celsius above ISA conditions (corrected to airfield altitude with 6.5°C per 1000 m).
Headwind:	- 10 km/h (5 kt) headwind: subtract 7.5% T/O distance
Tailwind:	- 10 km/h (5 kt) tailwind: add 25% T/O distance - 20 km/h (10 kt) tailwind: add 55% T/O distance
Slope:	- 2% uphill slope: add 15% T/O distance - 2% downhill slope: subtract 10% T/O distance
Surface:	- Dry and short grass: add 15% to T/O distance

Table 7-1 Take off distance correction factors

CAUTION: Wet and tall grass increases the T/O distance significantly. Take extreme care when taking off from soft and/or wet unpaved surfaces.

7.1 Take-Off Performance (dual battery)

Table 7-2 provides performance data for take-off with dual HV battery operation.

Take-off performance at maximum weight	
Max aircraft take-off mass (dual battery)	575 kg (1268 lbs)
Climb rate at MP (40 kW for 1 minute)	Refer to Figure 7-1
Climb rate at MCP (25 kW)	Refer to Figure 7-1
Take off distance - hard surface, 15m obstacle	430 m (1410 ft)
Peak power to clear 15m obstacle	40 kW for 1 min
Energy used to climb 500 m (1640 ft)	2.1 kWh
Max altitude gain	1700 m (5577 ft)
Sustained range after self-launch	120 km (75 mi)

Table 7-2 Take-Off Performance at Maximum Weight

NOTE: A take-off distance of 430 m was obtained during ideal conditions (ISA, MSL, no wind and level runway surface). The take-off distance is affected by factors as described in Table 7-1.

NOTE: The maximum altitude gain and sustained range after self-launch is affected by atmospheric conditions, aircraft weight, wind, leading edge contamination and age/condition of batteries.

The rate of climb at Maximum Power (MP) and Maximum Continuous Power (MCP) in relation to aircraft weight is illustrated in Figure 7-1.

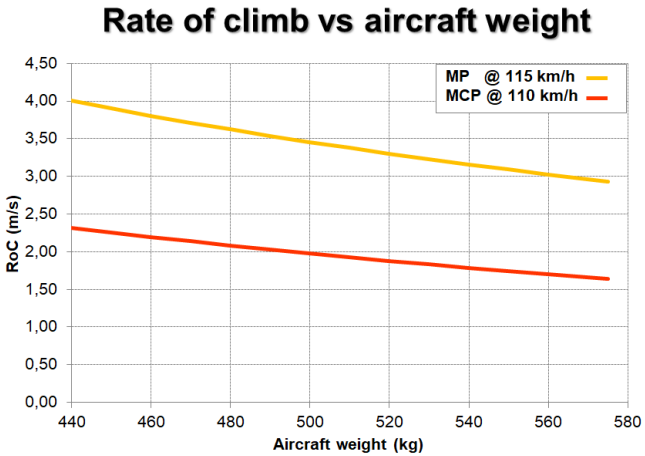

Figure 7-1 Rate of climb vs aircraft weight at ISA conditions

Figure 7-2 illustrates the recommended take-off profile for the JS-3 RES in 18m configuration at maximum weight.

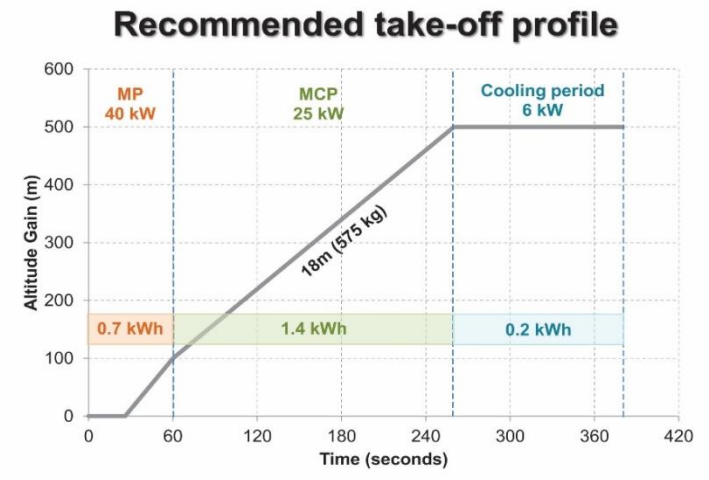

Figure 7-2 Recommended Take-off profile at maximum weight

WARNING: The data presented are for sea-level standard atmospheric conditions. With reduced air-density (higher temperature or higher altitude) the propeller RPM will increase with the risk of exceeding the maximum propeller RPM. Ensure the RPM remains within the operating limits at all times.

7.2 Take-Off Performance (single battery)

Take-off with a single battery is not allowed due to the high electrical current requirement on the battery that will reduce battery life.

7.3 Sustained Performance (dual battery)

Table 7-3 provides performance data for sustained flight with dual HV battery operation when fully charged.

Sustained performance with dual batteries	
Reference Mass	480 kg (1058 lbs)
Max Continuous Power (MCP)	25 kW (33.5 hp)
Rate of Climb at MCP	2.4 m/s (472 ft/min)
Max altitude gain (approx.)	2000 m (6562 ft)
Max sustained range in 18m (approx.)	157 km (98 mi)

Table 7-3 Sustained Performance (dual battery)

Figure 7-3 illustrates the flight profile including RES HV battery temperature variation.

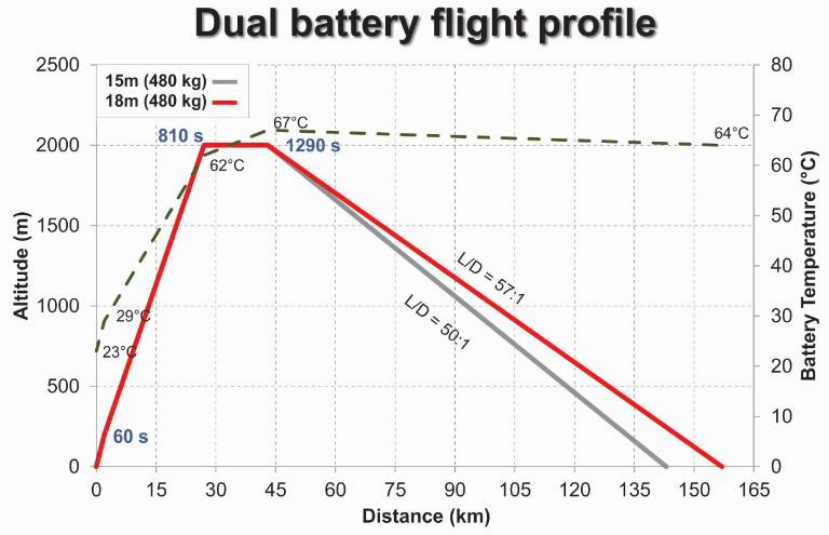

Figure 7-3 Optimum flight profile for dual battery operation

NOTE: The sustained range is reduced by approximately 25% following a self-launch to 450 m.

7.4 Sustained Performance (single battery)

Table 7-4 provides performance data for sustained flight with single HV battery operation.

Sustained performance with single battery	
Reference mass	460 kg (1014 lbs)
Climb rate at MP (25 kW for 4 min)	2.0 m/s (394 ft/min)
Climb rate at MCP (12.5 kW)	0.8 m/s (157 ft/min)
Max altitude gain (approx.)	900 m (2953 ft)
Max sustained range in 18m (approx.)	81 km (50 mi)

Table 7-4 Sustained Performance (single battery)

Figure 7-4 illustrates the flight profile including RES HV battery temperature variation.

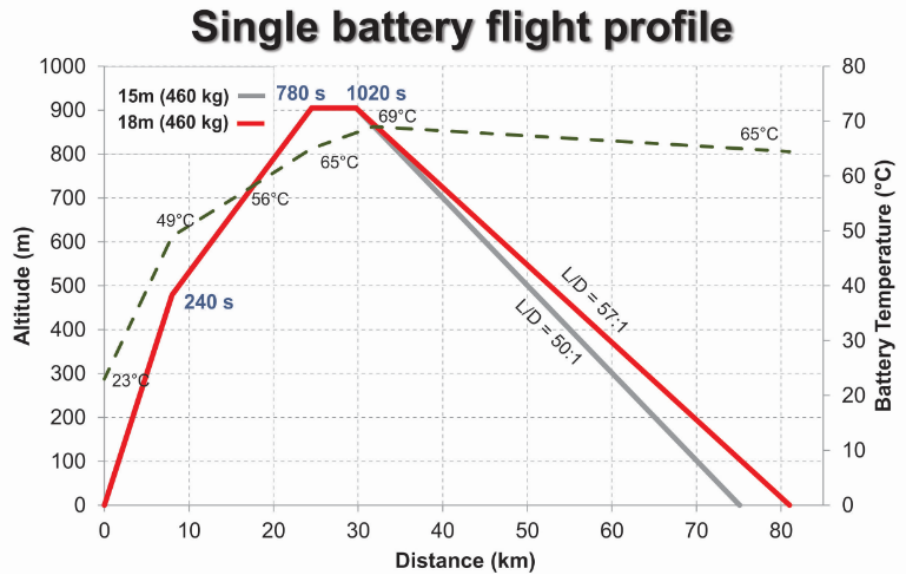

Figure 7-4 Optimum flight profile for single battery operation

7.5 Cruise flight – level flight minimum power

Table 7-5 provides level flight performance data. Optimum cruise speed is 120 km/h (65 kts) with flap in position three.

Cruise flight performance	
Reference mass	480 kg (1058 lbs)
Rate of Climb (8 kW)	Level Flight
Power setting	~ 8 kW (10.7 hp)
Cruise Speed (TAS)	120 km/h (65 kts)
Sustained range – 2 batteries	~ 120 km (74.5 mi)
Sustained range – 1 battery	~ 55 km (34.2 mi)

Table 7-5 Cruise Flight Performance

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8 System Description

This chapter describes the sailplane, its systems and provides standard equipment with instructions for use.

8.1 Kinematic System

The kinematic system is driven by a 12-volt electromechanical linear actuator (spindle drive) with integral limit switches. The actuator, which is located in the bottom of the fuselage aft of the landing gear, is controlled by the Retraction and Fuse Unit (RFU) and operates the pylon via a pushrod link. The motor bay door opening/closing mechanism is linked to the pylon.

8.2 Powerplant

8.2.1 Electric Propulsion System

The SOLO Electric Propulsion System 80400 powerplant consists of the following main components:

- Emectric BM 384 HV batteries
- Emrax 208 electric motor
- Motor Controller
- Display and control unit (DCU)
- Retraction and Fuse Unit (RFU)

8.2.2 Propeller

Manufacturer:	Technoflug
Model:	KS-1C-120-R-065-S
Maximum RPM:	4350

8.2.3 Batteries

The JS-3 RES can be operated as a pure glider without batteries, one battery for sustained flight only, or two batteries for self-launching capability. Batteries are identical except for the locking bracket – therefore, left and right batteries shall be installed with their brackets towards their respective latches at the sides of the motor bay walls.

Figure 8-1 Emectric HV battery

Batteries are sealed to minimize the risk of a battery fire. The type of Li-Ion cell used in the batteries is sensitive to excessive heat and may spontaneously ignite at temperatures above 150 °C (302 °F). Cell life is also reduced with high temperatures. Operation above 60 °C (140 °F) should be avoided.

The battery pack is designed to prevent the propagation of fire between adjacent cells. If a cell ignites, approximately 12 litres (0.4 ft^3) of high temperature, toxic gasses will be released instantaneously. These gasses are directed via the battery exhaust nozzles and fuselage elbows to the outside of the aircraft.

CAUTION: Weight and Balance is affected by battery configuration changes – ensure within limits before take-off.

WARNING: Do not inhale any fumes or gasses resulting from a battery fire.

Table 8-1 provides technical data of the RES HV batteries.

Batteries technical data	
Manufacturer	Emectric GmbH
Type	BM 384
Configuration	96S4P
Battery Voltage	270V-400V
Nominal Voltage	350V
Max continuous current	60 A
Usable Energy (available energy decreases with high power settings)	3.4 – 4.2 kWh per battery
Battery Weight (each)	~ 24.9 kg (54.8 lbs)
Dimensions (each)	725 x 347 x 82 mm (28.5 x 13.7 x 3.2 in)

Table 8-1 Battery Technical Data

NOTE: When operating the RES at higher power settings, the voltage drop is greater and the minimum cell voltage will be reached, even though more energy is still available in the battery. Reducing the electrical load (via power setting) will result in a rise in the measured cell voltage.

8.3 Electrical System

A detailed description of the RES electrical system can be found in the JS-MD 3 RES AMM Supplement.

8.3.1 System Overview

The RES consists of the components illustrated in the following schematic diagram.

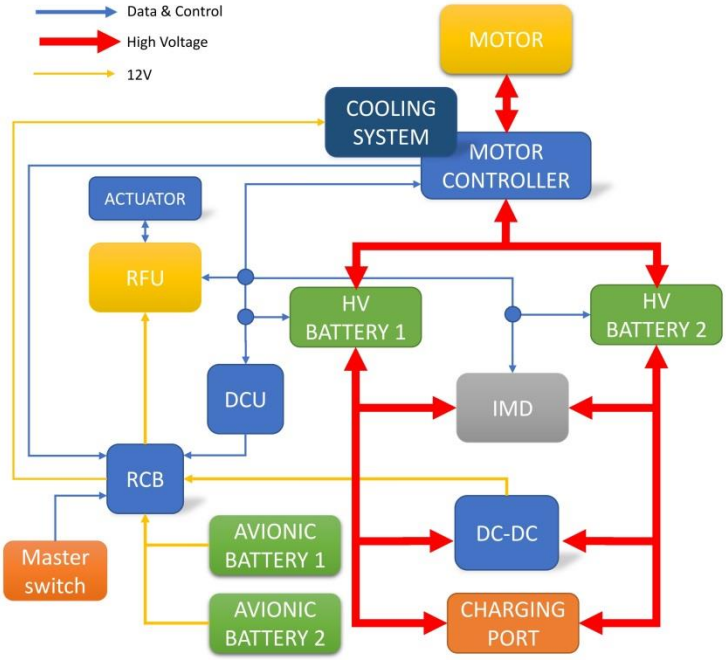

Figure 8-2 System Overview

8.4 Fire Warning System

The independent system is powered by a 9 V battery in a dedicated compartment, located at the right side of the binnacle below the instrument panel. The battery must be replaced every two years (as part of the documented maintenance) or any time it fails a pre-flight test - whichever occurs sooner.

The red LED on the panel illuminates and the audible buzzer activates by one of three methods:

- Closing the circuit by pressing the TEST momentary push button located next to the LED on the instrument panel
- Closing of the temperature switch(es) in the motor compartment by exposure to heat
- Closing the circuit via one (or both) of the heat trace cables in the motor compartment being exposed to enough heat to melt the separation material within the cable core and allowing the internal conductor wires to make contact

NOTE: LED and buzzer activation via the temperature switches is reversible – once the switch cools the circuit will simply re-open and the LED will turn off. During annual inspection, the function of each switch must be tested via local warming of each switch using a hair-dryer (or heat gun on a low setting).

NOTE: LED and buzzer activation via the heat trace cable(s) is permanent. Do not apply artificial heat to the cables. Only the cable connections should be inspected during annual maintenance. If unintentionally heated, they must be replaced.

NOTE: The fire warning system audible buzzer can be silenced via the dedicated circuit breaker or via removal of the 9 V battery from its compartment.

8.5 Miscellaneous Equipment

8.5.1 Battery Charger

The battery charger is specifically configured for the SOLO 80400 RES system. Refer to Section 6.1 for battery charging.

Figure 8-3 RES HV battery charger

Refer to the battery charging instruction sheet located inside the lid of the charger case for additional information.

8.5.2 Termination Plugs

Refer to Section 6.1 for the use of terminal connectors to ensure no HV live terminal connectors are exposed and cause a risk of electrical shock.

WARNING: Always assume and treat the RES connectors and terminals as electrically “live” even when the system is off.

9 HV Battery Handling, Care, and Transport

This chapter contains the manufacturer's recommended procedures for proper handling and care of the RES batteries. It also identifies certain inspection and maintenance activities, which are needed to retain performance and reliability.

9.1 Battery Care

Batteries should be treated with care to obtain the designed performance and expected life from the battery.

- Always store the batteries in a safe location away from temperature extremes, solar radiation and precipitation (Do not leave batteries inside a car on a sunny day or outside exposed to rain!)
- Handle the batteries with extreme care
- Do not expose the batteries to high acceleration (Do not drop the batteries!)
- High rates of discharge shorten the life of the cell
- Do not discharge the cells below 2.5 V per cell
- Do not store batteries fully charged or empty
- Do not charge the batteries too fast
- Comply with long term storage specifications

NOTE: Single battery take-offs are not allowed as the high discharge rate will reduce battery life noticeably.

9.1.1 Ground Handling/Road Transport

Batteries should be left inside the fuselage during transportation or carried in suitable safe transport containers. Batteries should not be transported unprotected laying in the beds of all-terrain vehicles, golf carts, or pick-up trucks!

WARNING: HV batteries are sensitive to ground handling. Exposure to shock loads or mishandling must be avoided, as this may lead to battery failures or fires and void the warranty.

WARNING: Do not leave the batteries inside a glider parked outside unless the aircraft is covered with water-proof all-weather covers or the motor bay door gaps are fully taped to prevent water intrusion. Light-weight outdoor covers and hangar dust covers provide inadequate outdoor protection from the elements.

9.1.2 Long Term Storage

It is recommended to remove RES batteries and store them in a dry place with the following conditions:

State of Charge:	35 - 50%
Temperature:	10 – 23 °C (50 – 73 °F)
Humidity:	< 75%

Check the state of charge of the batteries at least every 60 days to ensure the cell voltage does not drop below the minimum limit.

CAUTION: Do not leave the battery SOC condition unchecked for extended periods. Comply with the minimum SOC checking interval listed above.

CAUTION: Exposing the batteries to temperatures above 35 °C (95 °F) or below 5 °C (41°F) for prolonged periods will shorten the battery life and reduce the capacity.

9.1.3 Inspections

The following inspections should be performed on a regular basis – typically prior to installing the batteries into the fuselage:

- Verify the lifting handles on top of each battery are securely attached to the hard-shell case with no indication of detaching or signs of loose fasteners
- Verify the latch plate at the rear of each battery is firmly attached to the hard-shell case and its fasteners are secure
- Visually inspect the multi-pin connector at the front of the shell for any sign of contact pin damage or debris. Clean with filtered compressed air and/or electrical contact cleaner spray. Additionally inspect the fasteners that secure the connector to the shell
- Verify the locator guide pin at the front of the shell is without any play and rigidly attached to the case
- Verify the integrity of the exhaust port sleeve at the lower front region of the shell
- Visually check that the low-profile fasteners around the edge of the shell are secure
- Inspect the entire shell (especially the bottom sliding surface and the corners) for any indication of wear, cracks, or puncturing through the walls

9.2 Trailer Considerations

Batteries have a mass of approximately 50 kg (110 lbs) for the pair. Their placement in the trailer (if stored outside the fuselage) can therefore affect the CG of the trailer noticeably. The trailer behaviour on roads and motorways can be made unstable rendering the towing vehicle unsafe to drive.

CAUTION: Always observe trailer manufacturer's guidelines for trailer tongue (drawbar) weight as a percentage of total trailer weight.

10 APPENDIX – List of Warnings/Cautions

The following table shows the priority of the messages.

WARNINGS / ERRORS	
Propeller overspeed !!! Reduce Power	RPM >4350 U/Min. Reduce power or speed
Supply Voltage too high!	Voltage exceeds 15.0 V. Wrong battery type used or charge control inside PRS is damaged.
Interlock Circuit not closed!!! Check Connectors	During system startup, the interlock circuit is not closed. Check connectors to charger and batteries.
Battery DRAINED Connect charger!	The battery is in safety state. No motor operation is possible.
Battery Empty Stop Motor	The state of charge of one battery is below 2 %.
Battery TOO HOT Stop Motor	Battery temperature is too high for operation. Danger of permanent damage to the battery.
No Data from the charger	No CAN message from the charger.
No Data from Isometer	No CAN message from isometer. Danger of electric shock.
Isometer defect!	Self test of isometer unsuccessful. Danger of electric shock.
Isometer Ground Failure!	Isometer has a bad connection to LV-ground rail. The danger of electric shock.
Insulation Problem!!!	Insulation between high voltage rail and low voltage rail below the minimum of 100 kΩ. Danger of electric shock.
No Data from RFU!	No CAN message from RFU
No Data from the Motor controller	No CAN message from Motor Controller
No Data from Battery A	No CAN message from left battery.

No Data from Battery B	No CAN message from right battery.
Watchdog Reset	Software error detected. DCU restarted automatically.
No Communication	CAN-Bus Fault. Check wiring.
Supply Voltage Low. Start recharging supply voltage battery	The supply voltage is below 10.0 V. Switch on the recharging process via the System Screen.
Retraction Mechanism Error!	Possible causes: • Current to spindle exceeds OEM-adjustable limit. • The spindle is switched on but there is no feedback.→ The spindle seems to be blocked.
Retraction Mechanism Timeout! Spindle blocked?	Spindle was powered for more seconds that OEM Adjustable limit.
Precharge Timeout! Service Disconnect?	Voltage on high voltage rail does not reach battery voltage in time. Main relay cannot be closed.
MC: BAD PARAMETER	Damaged Parameter
MC: POWER FAULT	Overall message of hardware monitoring 1
MC: RFE FAULT	Safety circuit faulty (only active with RUN)
MC: BUS TIMEOUT	CAN-Bus timeout
MC: FEEDBACK	Resolver signal faulty or missing
MC: POWER VOLTAGE	Power voltage missing
MC: MOTOR TEMP Reduce Power Instantly!	Motor temperature too high (> 115 °C)
MC: DEVICE TEMP	Device temperature too high (> 80°C)

Power Reduced	
MC: OVERVOLTAGE	Overvoltage (power voltage)
MC: I_PEAK	Overcurrent or strongly oscillating current detected
MC: RACEAWAY	Drive races (without command value, wrong direction)
MC: MOTOR TEMP 2	Motor temperature too high (second sensor) not used
MC: I Sensor	Current measurement error
MC: BALLAST	Ballast circuit overloaded
BATTERY A: Modul Timeout Discharge Only Maintenance!	Error during selftest. Discharge only. Maintenance necessary.
BATTERY A: Cell Connection Discharge Only Maintenance!	Error during selftest. Discharge only. Maintenance necessary.
BATTERY A: Temperature Reg. Discharge Only Maintenance!	Error during selftest. Discharge only. Maintenance necessary.
BATTERY A: Cell Voltage Reg. Discharge Only Maintenance!	Error during selftest. Discharge only. Maintenance necessary.
BATTERY A: No Module Data Discharge Only Maintenance!	Error during selftest. Discharge only. Maintenance necessary.
BATTERY A: Battery TOO HOT Reduce Power !!!	Battery > 70°C.
BATTERY A: Battery Empty !!!	SOC < 3%
BATTERY A: Off! Precharge Error Check wiring and try again!	Only when charger is connected: BMS tries to precharge the power bus, but charger shows no voltage data.
BATTERY A: Off! Cell Overvoltage Reset Power Maintenance	Can only happen if charger is connected. Maintenance may be necessary.
BATTERY A:	The battery cell voltage difference is higher that

Cell voltage difference. Maintenance Required	50mV during boot time and the maximum cell voltage is higher that 4,0 V. Motor can be used after confirming the message.
BATTERY A: Off! Charger Error Check Wiring	Can only happen if charger is connected. Reasons may be: - Communication problem between both batteries - One battery is connected after power on.
BATTERY A: Off! Cell Overvoltage New Precharge. Maintenance	At least one battery cell is higher that 4,2 V. Reset by a new precharge after problem is solved.
BATTERY A: Off! Cell Drained Connect Charger!	At least one battery cell voltage is below 2,3 V. It is possible to reset this state by a new precharge event.
BATTERY A: Off! -Overcurrent- Reset Power	Hardware shutoff due to high current. Reset by power cycle.
BATTERY A: Off! -Permanent Shutoff- Maintenance Required	At least one battery cell voltage is < 2,0 V. Battery is permanently shutoff. Reset only by maintenance personal.
BATTERY A: Off! Critical Overtemperature\ Possible Fire! Maintenance	Battery temperature > 85°C. Battery is permanently shutoff. Reset only by maintenance personal.
BATTERY A: Current too high Decrease power setting immediately!	Battery current > 80 A. Maybe only one battery is connected to the power bus. Probably only one battery is connected unintentionally. Connect only one battery and check which one is working. Maintenance necessary.
CHARGER: Hardware Error Remove Charger and try again!	General hardware error. Can only be cleared by power reset.
CHARGER: Overtemperature	Charger too hot. Switch charger off until it cools down.
CHARGER: No Battery	Charger cannot detect valid battery voltage.
CHARGER:	Charger didn't receive control message for five

Communication Timeout	seconds.
CAUTIONS	
Retraction Mechanism not calibrated. Service Screen!	Pylon angle does not correspond to spindle current or pylon angle values are not valid.
Interlock Warning! Battery or Charger not Connected!	Connectors not fully closed.
Battery A not Connected	DCU does not get any data from Battery A
Battery B not Connected	DCU does not get any data from Battery B.
All Batteries low !	Remaining motor operation time < 5 minutes.
Battery voltage difference too high. NO TAKE-OFF !!!	Battery voltage difference is > 30 V. Battery with lower voltage is disabled, so no take-off is possible.
Battery Cell Voltage Low Motor LIMITED !	At least one battery cell voltage gets down to the low level.
Remove Charger !	If in standby motor operation is demanded but the charger is still connected.
Motor Current Limit! Temperature Motor Controller	Motor controller limits power to the motor. This message shouldn't show up in a system with correct parameter setup
Motor Current Limit!\ Motor Temperature	Motor controller limits power to the motor. This message shouldn't show up in a system with correct parameter setup
Motor Current Limit! Propeller Speed limit	Motor controller limits power to the motor. This message shouldn't show up in a system with correct parameter setup
Supply Voltage Low. Recharge supply voltage battery	Supply voltage below 10,5 V
Insulation Resistance low. Check Insulation!	Insulation resistance between HV-rail and supply voltage rail below 200kΩ.
One Battery disconnected NO TAKE-OFF !!!	One battery operation. Battery power is limited to about 19 kW, so no take-off is possible.

CAN Buffer full	This message shouldn't show up in a system with correct parameter setup
MC: WARNING_0	No device identification
MC: ILLEGAL STATUS	RUN signal disturbed, EMI
MC: MOTOR TEMP Reduce Power!	Motor temperature high (> 105 °C)
MC: DEVICE TEMP Power Reduced	Device temperature high (> 75 °C)
MC: insufficient Battery Power	Battery voltage too low to set the motor current that is rated.
MC: I_PEAK	Overcurrent 200%
MC: RACEWAY	Resolution range of the speed measurement reached
MC: 2.Supply Fail	12V second voltage supply missing
MC: Secondary Feedback Fail	Secondary resolver signal faulty or missing. Primary resolver signal active.
MC: BALLAST	Ballast circuit > 87 % overloaded
BATTERY A: Battery Hot !	Maximum battery cell temperature > 60 °C
BATTERY A: Battery Low !	SOC < 10%
BATTERY A: Cell voltage difference too big. Connect Charger!!!	Battery cell voltage difference > 20 mV. Connect charger and let balancing process be finished.
BATTERY A: One or more Temperature Sensors failed	More than 5 temperature sensors are defect Maintenance necessary.
BATTERY A: Flash Memory Error Maintenance	No further effect. Maintenance necessary.
BATTERY A: Cell Monitor Chip too hot Balancing is paused.	Wait until chip is cooled down and balancing resumes.

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11 Service Bulletins

This section starts with an overview table of all optional SBs, in which the owner or operator should record which SBs were voluntarily implemented and which not.

All implemented optional SBs must be printed and added to this section by the owner or operator. Non-implemented SBs do not need to be added to this section.

SB No.	Rev	Date	Description	SB implemented	
				Yes	No

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12 STCs and Minor Change Approvals

Reference No.	Rev.	Date	Description

Intentionally left blank

13 Contact

13.1 Type Certificate Holder

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