JS3 RES

RES Maintenance Manual

JONKER SAILPLANES

JS-MD 3 RES MAINTENANCE MANUAL SUPPLEMENT

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0 GENERAL

This Maintenance Manual has been prepared to provide maintenance personnel with the necessary information to maintain the JS-MD 3 RES System. All the data required to be furnished to the pilot and the maintenance personnel, by the Airworthiness Requirement CS-22, is contained in this manual. Supplementary data is also provided by the sailplane manufacturer.

0.1 Record of Revisions

Issue	Date	Reason for Change
00	23.05.2022	Initial Issue

0.2 List of effective sections

Section	Revision	Date	Number of Pages	Reference
0	00	23.05.2022	10	
1	00	23.05.2022	2	
2	00	23.05.2022	6	
3	00	23.05.2022	2	
4	00	23.05.2022	54	
5	00	23.05.2022	8	
6	00	23.05.2022	18	
7	00	23.05.2022	2	
8	00	23.05.2022	12	
9	00	23.05.2022	4	
10	00	23.05.2022	8	
11	00	23.05.2022	4	
12	00	23.05.2022	2	
13	00	23.05.2022	2	
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C	00	23.05.2022	2	
D	00	23.05.2022	2	

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

AMO	-	Approved Maintenance Organisation
CAN	-	Controller Area Network
DCU	-	Display and Control Unit
EGT	-	Exhaust Gas Temperature
HV	-	High Voltage (typically 400V in this configuration)
IMD	-	Insulation Monitoring Device
LE	-	Leading Edge
LiFePO	-	Lithium Ferrite Phosphate
M&D	-	M&D Flugzeugbau GmbH & Co. KG
MCP	-	Maximum continuous power
MOP	-	Means of Propulsion
MP	-	Maximum power
NAA	-	National Aviation Authority
OAT	-	Outside Air Temperature
OEM	-	Original Equipment Manufacturer
PRS	-	Power Rail Supply
RCB	-	RES control box
RFU	-	Retraction and Fuses Unit
RPM	-	Revolutions Per Minute
SOC	-	State of charge
TCDS	-	Type Certificate Data Sheet
TE	-	Trailing Edge
VFR	-	Visual flight rules
VMC	-	Visual meteorological conditions

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1 GENERAL

1.1 Descriptive data

The JS-MD 3 RES System is an electric propulsion system used for self take-off or sustained flight when soaring conditions become unfavorable. Propulsion is made possible using a 2-bladed propeller powered by an electric motor mounted on a retractable pylon in the rear section of the fuselage.

The normal performance of the sailplane continues when the pylon is retracted.

1.2 Technical data

System technical data	
Propulsion system	SOLO Electric Propulsion System 80400
Propeller Type	Technoflug KS-1C-120-R-065-S
Battery type	EMECTRIC BM 384 (96S4P)
Maximum RPM	4350
Max power for take-off (2 batteries)	40 kW
Max continuous climb power (2 batteries)	25 kW
Max power (1 battery)	25 kW
Max continuous power (1 battery)	12.5 kW
Complete system mass – no batteries	~24 kg (53 lbs)
Maximum Motor temperature	120 °C
Maximum Controller temperature	85 °C
Maximum HV Batteries temperature	70 °C

Table 1-1 RES Technical Data

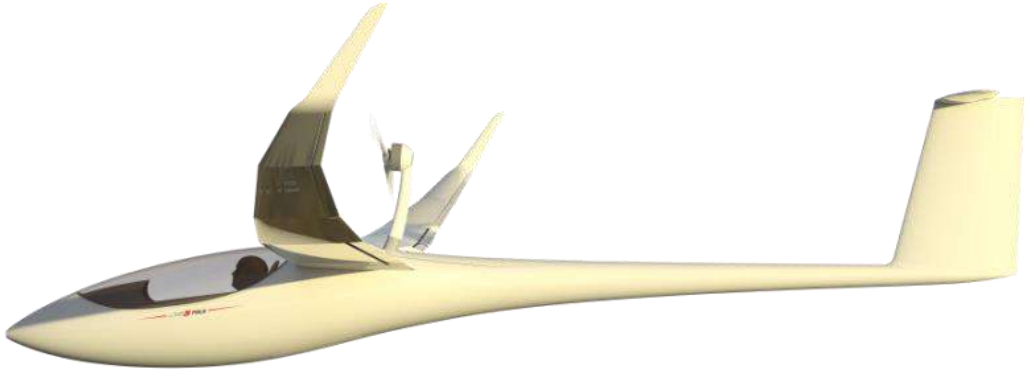

Figure 1-1 JS3 with RES pylon extended

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2 DESCRIPTION OF SYSTEMS AND COMPONENTS

2.1 Introduction and overview

The RES system can be divided into two main systems, the kinematic system, and the electrical system.

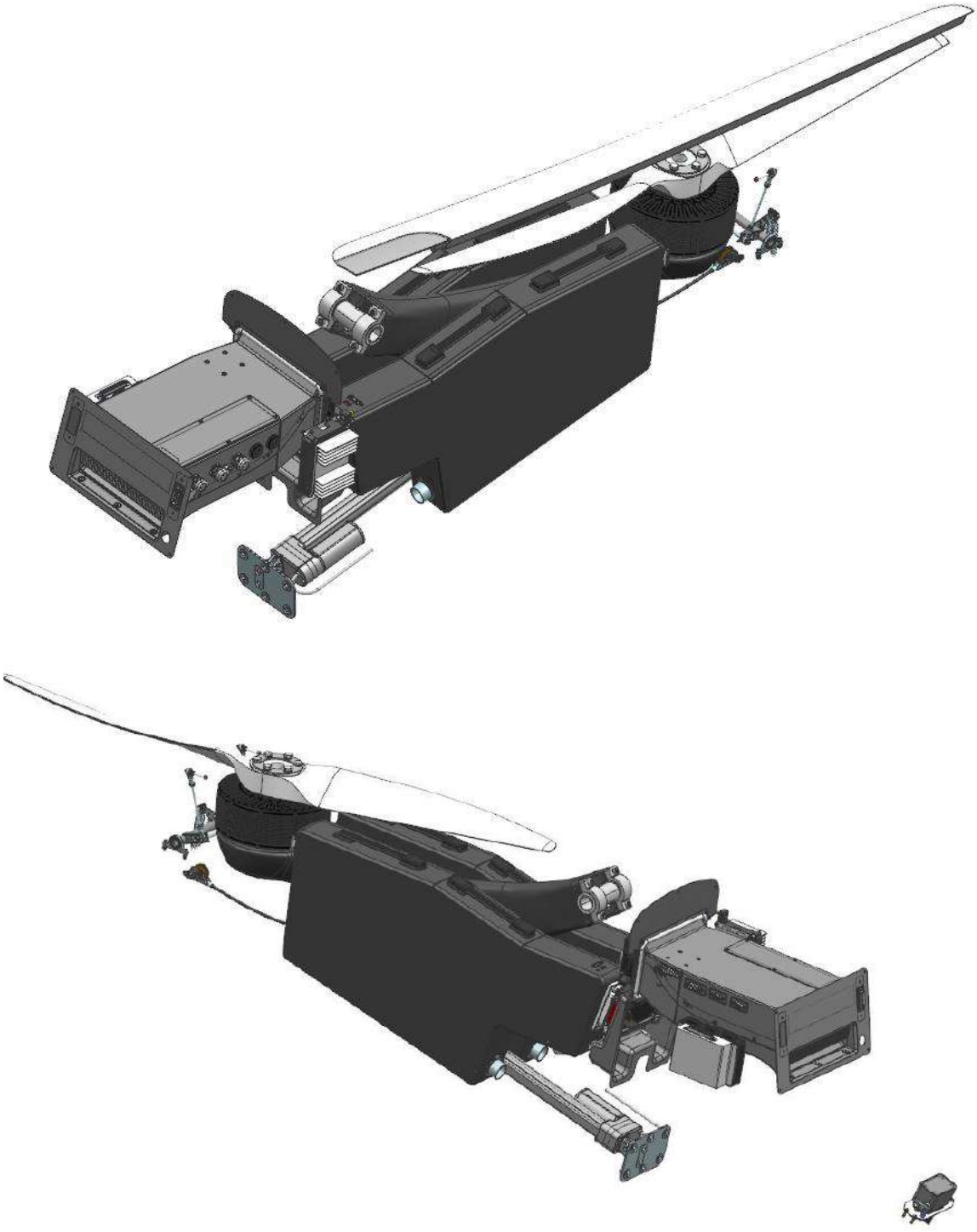

Figure 2-1 RES System overview

2.2 RES kinematics overview

2.2.1 Kinematics layout overview

The pylon extension/retraction kinematic system is contained inside the fuselage bay and controls the pylon position as well as the operation of the main doors.

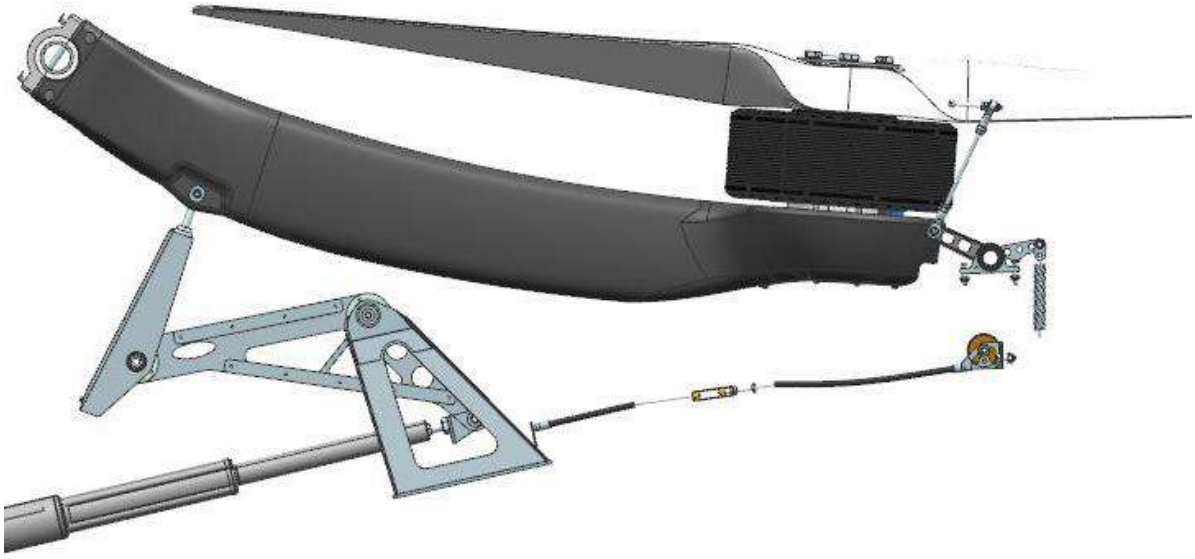

Figure 2-2 Kinematics layout overview

This system is comprised of a single pylon, for the mounting of the motor, driven by an electromechanical actuator. The doors open in sequence with the movement of the pylon and are closed when the pylon is fully extended.

2.2.2 Kinematics components

The RES system consists of the following kinematic components:

- Actuator assembly
- Pylon Assembly
- Main Doors Assembly
- Battery latches

2.3 Electrical system overview

2.3.1 Electrical overview

The electrical system consists of various components as illustrated in Figure 2-3:

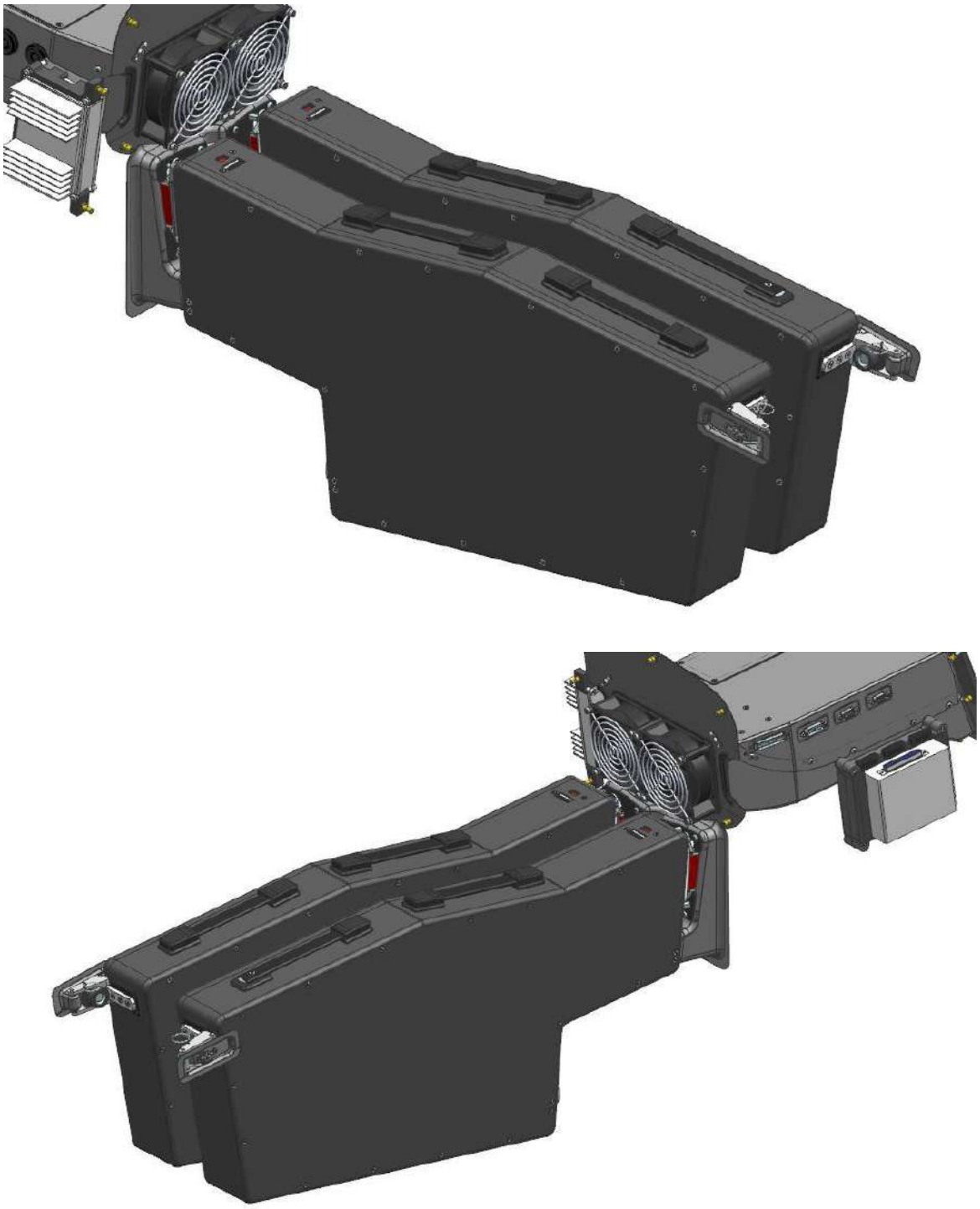

Figure 2-3 Electrical system overview

2.3.2 Electrical components

The electrical system consists of the following electrical components:

- HV Batteries (removable)
- Avionic Batteries (removable)
- Display and control unit (DCU)
- Motor Controller assembly
- Cooling system
- RES Control Board (RCB)
- DC-DC converter (400 V - 12 V)
- Retraction and Fuses Unit (RFU)
- Insulation monitoring device (IMD)
- Charging Port (Optional)
- HV Connectors
- Wiring Looms

The electrical components interact with each other as illustrated in Figure **2-4**:

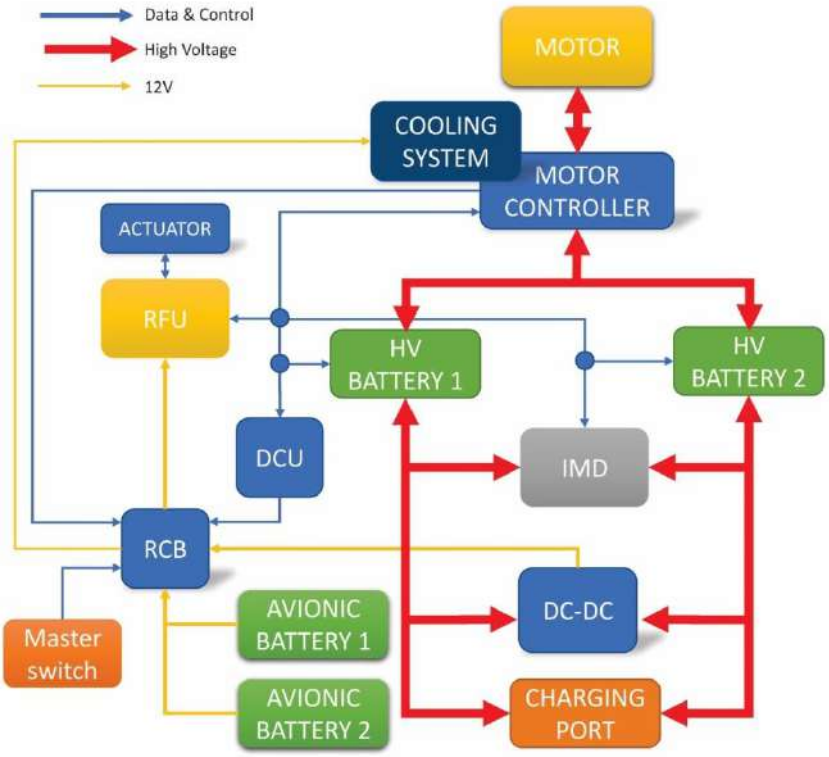

Figure 2-4 **Electrical interaction overview**

2.3.3 Electrical loads

Electrical loads protection required for the system is given in Table 2-1.

Component	Operating Voltage (V)	Peak Current (A)
RES propulsion system	270-400	125
Motor controller	12	4
Motor controller cooling fans	12	8
Actuator	12	11.5
DC-DC converter (400V-14.4V)	12	8

Table 2-1 Electrical loads

2.3.4 Control system

The pilot controls the system via the Display and Control Unit (DCU) installed on the instrument panel. Data from the DCU is sent to the Retraction and Fuse Unit (RFU) and inverter where the data is processed. Various control inputs include extension/retraction and desired power setting. RPM is regulated by the motor controller by adjusting the AC power supplied to the motor.

NOTE: The DCU contains pre-loaded default settings preventing the pilot from operating the system outside of its envelope. RPM and the temperatures (controller, motor, and battery) are restricted within the operational limits by lowering the output power.

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3 AIRWORTHINESS LIMITATIONS AND INSPECTIONS

3.1 Airworthiness limitations

Table 3-1 lists the life limits that should not be exceeded. When these limits have been reached, the affected component must be returned to the manufacturer or an approved maintenance organisation so that the required maintenance activities or inspections can be performed.

Component / System	RES system life limits			
	Cycle	Hours	Years	NOTES
Propeller		300		Or as limited by the manufacturer
Batteries	TBD	-		
Motor		300		Or as limited by the manufacturer

Table 3-1 Life Limits Durations

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4 MAINTENANCE SCHEDULE

WARNING: Before any maintenance, the HV batteries should be removed.

WARNING: Only OEM and authorised organisations are allowed to maintain high voltage components.

4.1 Annual inspection

A mandatory annual inspection is required for issuing the Airworthiness Review Certificate.

NOTE: Some regulating authorities require one-year or 100 hour-interval inspections.

General inspection guidelines

- Inspect all bolted connections and locking devices i.e. locknuts, split pins, etc.
- Check all metal parts for adequate greasing and rust prevention.
- Check for signs of damage

Use the inspection checklist given in APPENDIX A – Annual inspection checklist to perform the annual inspection. The maintenance requirements schedule is illustrated in Table 4-1.

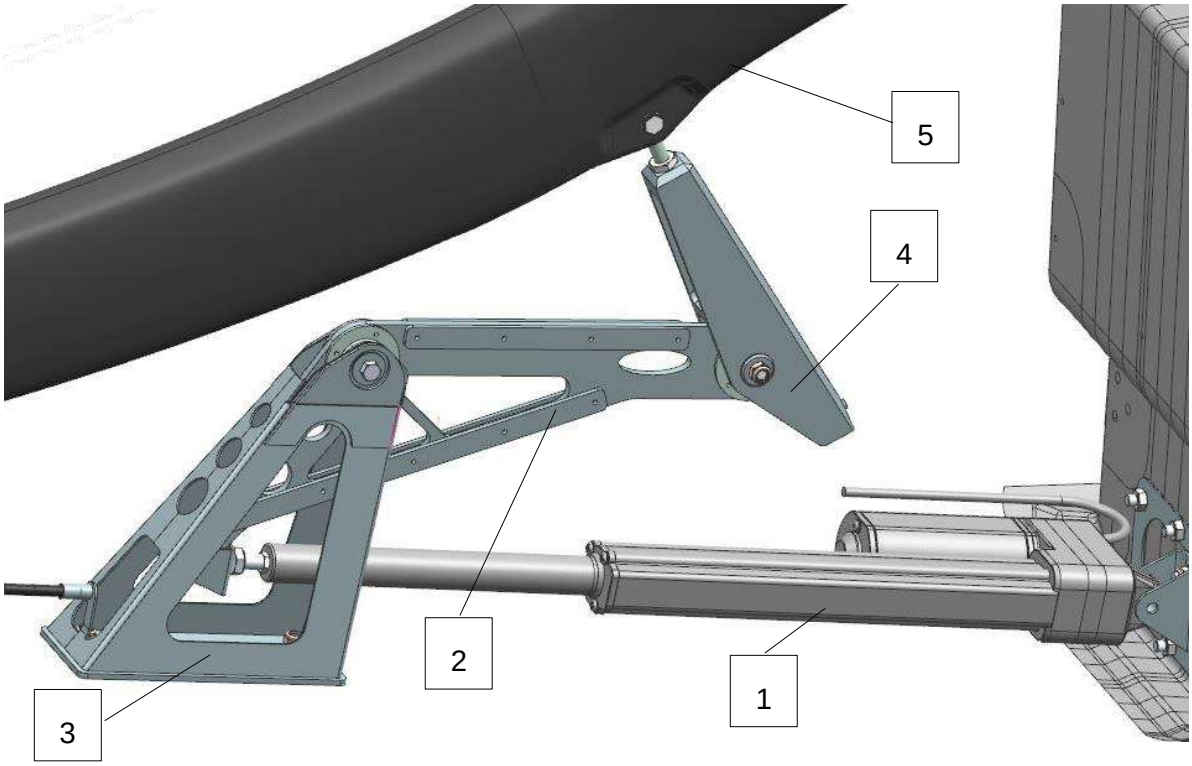
* *Whichever comes first (Refer to Appendix A on the Annual inspection checklist.)*

Maintenance requirements	OWNER Every 2 years		AMO Every 300 engine hours or 15 years	OWNER Every 25 hours
	Who may perform the Maintenance	Maintenance interval		
Motor overhaul by manufacturer (Refer to Solo 80400 manual)			X	
Controller fan replacement (Refer to section 4.11.1.2.3)			X	
Controller check (Refer to Solo manual)			X	
System Annual Inspection (Refer to APPENDIX A – Annual inspection checklist)		X		
Propeller & functional check (Refer to section 4.4.2 and Solo 80400	X			
Propeller overhaul by manufacturer			X	
Replace fire warning 9 V battery (Refer to section 4.17)				X

Table 4-1 Maintenance Requirement Schedule

4.2 RES actuator assembly

The actuator assembly is responsible for the retraction and extension of the pylon. It consists of the following components as illustrated in Figure 4-1.



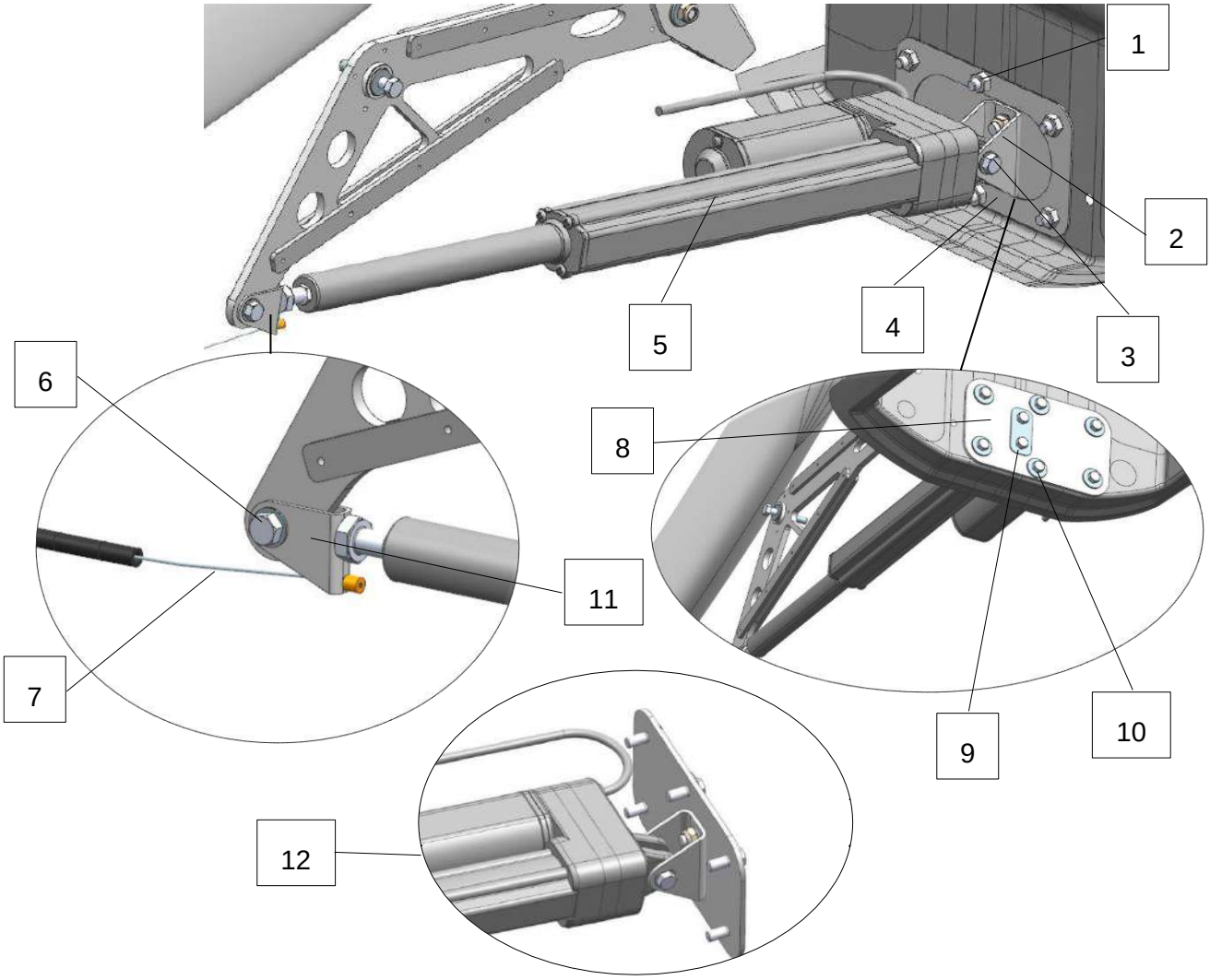
No	Description	No	Description
1	Actuator	2	Pylon bell crank
3	Pylon bell crank bracket	4	Pylon driver arm
5	Pylon assembly		

Figure 4-1 RES Actuator Assembly

4.2.1 Actuator

The assembly is driven by a 12 V actuator which is controlled by the DCU and RFU. The actuator has built-in limit switches and a hall effect sensor to monitor the extension and retraction of the pylon.

4.2.1.1 Overview



No	Description	No	Description
1	Actuator bracket bolt	2	Actuator bracket
3	Actuator bolt	4	Wheelbox actuator cover blackplate
5	Actuator	6	Bell crank bolt
7	Door close cable	8	Wheelbox actuator cover plate
9	Wheelbox actuator back plate	10	Wheelbox cover plate bolts
11	Actuator front	12	Sub assembly

Figure 4-2 Actuator assembly

4.2.1.2 Specification

Table 4-2 Actuator specifications

Parameter	Value
Part Number	107 09 230 00
Input voltage	12V
Maximum current	11.6A

4.2.1.3 Removal

1. Extend the pylon to a position slightly below the extended position.
2. Switch off the RES master switch.
3. Remove the main doors.
4. Support the pylon slightly below the extended position.
5. Remove **Bell crank bolt (6).**
6. Remove the **Actuator front (11)** from the actuator by unscrewing it.
7. Disconnect the actuator wiring.
8. Loosen the six **Wheelbox cover plate bolts (10).**
9. The actuator **Sub assembly (12)** can now be removed from the fuselage through the wheelbox. The hole inside the wheelbox is big enough for the actuator to pass through.
10. The **Actuator (5)** can be removed from the **Wheelbox actuator cover plate (8)** by loosening the two **Actuator bracket bolts (1).**

4.2.1.4 Installation

1. Fasten the **Actuator (5)** to the **Wheelbox actuator cover plate (8)** by fastening the two **Actuator bracket bolts (1).**
2. Install the actuator **Sub** a**ssembly (12)** into the aircraft by inserting it through the hole in the wheelbox.
3. Fasten the six **Wheelbox cover plate bolts (10).**
4. Connect the actuator wiring.
5. Fasten the **Actuator front (11)** to the actuator.
6. Install and fasten the **Bell crank bolt (6).**

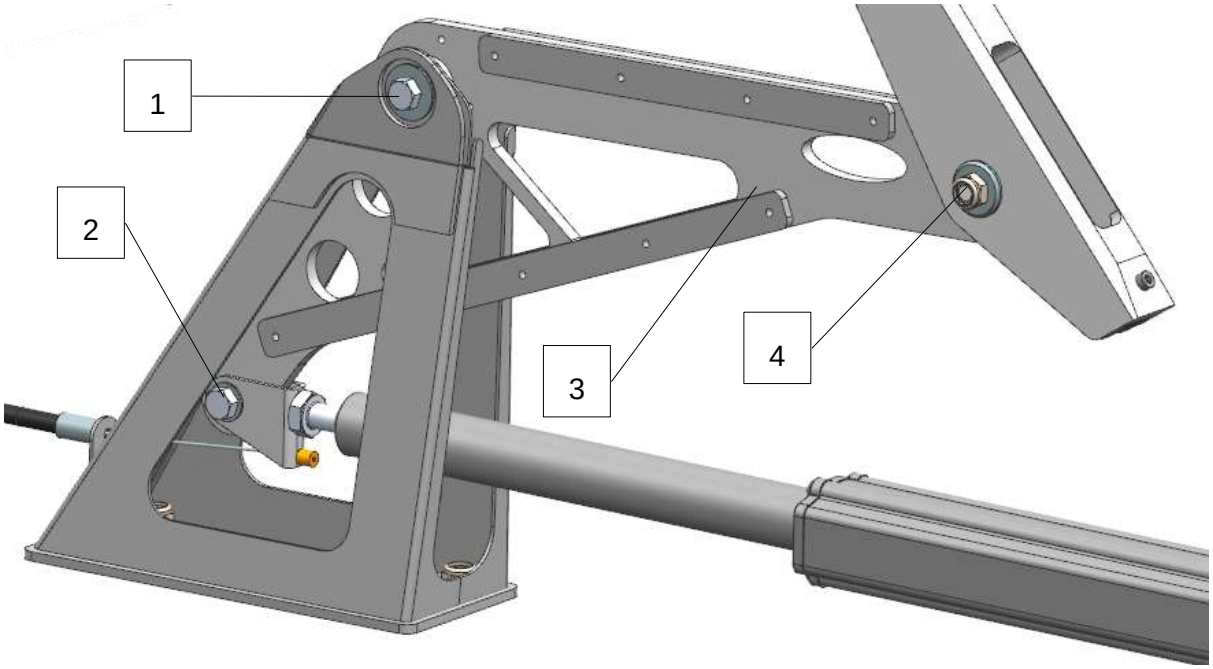
7. Remove the pylon support.
8. Install the main doors.

NOTE: The actuator system and main door setup must be done again to ensure the kinematic system is working correctly. Refer to the **Calibration & setup** section.

4.2.2 Pylon bell crank

The pylon bell crank is connected to the actuator and pylon driver arm. The pylon bell crank is held in place by the pylon bell crank bracket as illustrated in Figure 4-3.

4.2.2.1 Overview



No	Description	No	Description
1	Pylon bell crank bracket bolt	2	Actuator bolt
3	Pylon bell crank	4	Pylon driver arm bolt

Figure 4-3 Pylon bell crank assembly

4.2.2.2 Removal

1. Extend the pylon to a position slightly below the extended position.
2. Switch off the RES master switch.
3. Remove the main doors.
4. Support the pylon slightly below the extended position.

5. Remove the **Actuator bolt (2).**
6. Remove the **Pylon driver arm bolt (4).**
7. Remove the **Pylon bell crank bracket bolt (1).**

4.2.2.3 Installation

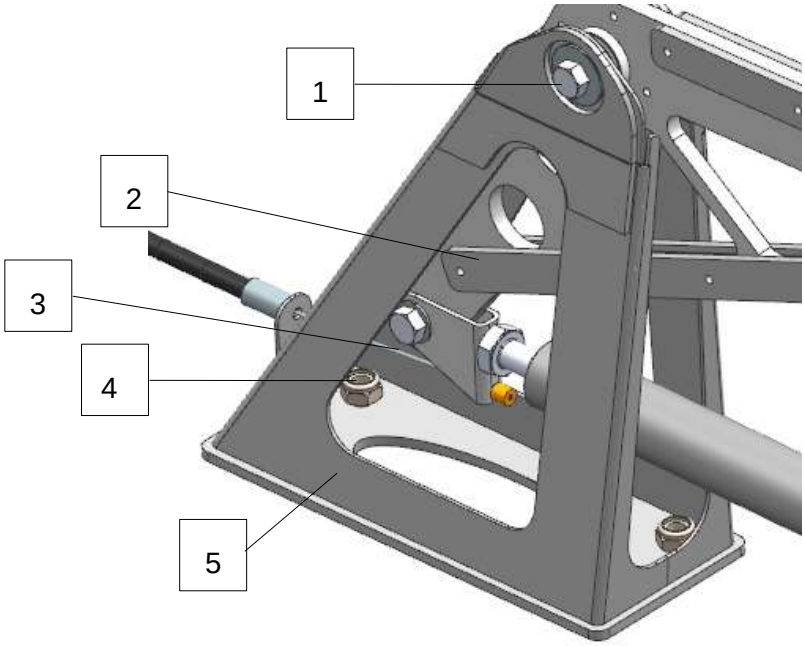
1. Install the **Pylon bell crank bracket bolt (1).**
2. Install the **Pylon driver arm bolt (4).**
3. Install the **Actuator bolt (2).**
4. Remove the pylon support.
5. Install the main doors.

NOTE: The actuator system and main door setup must be done again to ensure the kinematic system is working correctly. Refer to the **Calibration & setup** section.

4.2.3 Pylon bell crank bracket

The pylon bell crank bracket is located at the bottom of the rear fuselage compartment and fastened to the bottom of the fuselage using four fastening nuts as illustrated in Figure 4-4.

4.2.3.1 Overview



No	Description	No	Description
1	Pylon bell crank bracket bolt	2	Pylon bell crank
3	Door close cable	4	Pylon bell crank bracket bolts
5	Pylon bell crank bracket		

Figure 4-4 Pylon bell crank bracket assembly

4.2.3.2 Removal

1. Extend the pylon to a position slightly below the extended position.
2. Switch off the RES master switch.
3. Remove the main doors.
4. Support the pylon slightly below the extended position.
5. Cut the **Door close cable (3).**
6. Remove the **Pylon bell crank bracket bolt (1).**
7. Remove the four **Pylon bell crank bracket bolts (4).**
8. Remove the **Pylon bell crank bracket (5).**

4.2.3.3 Installation

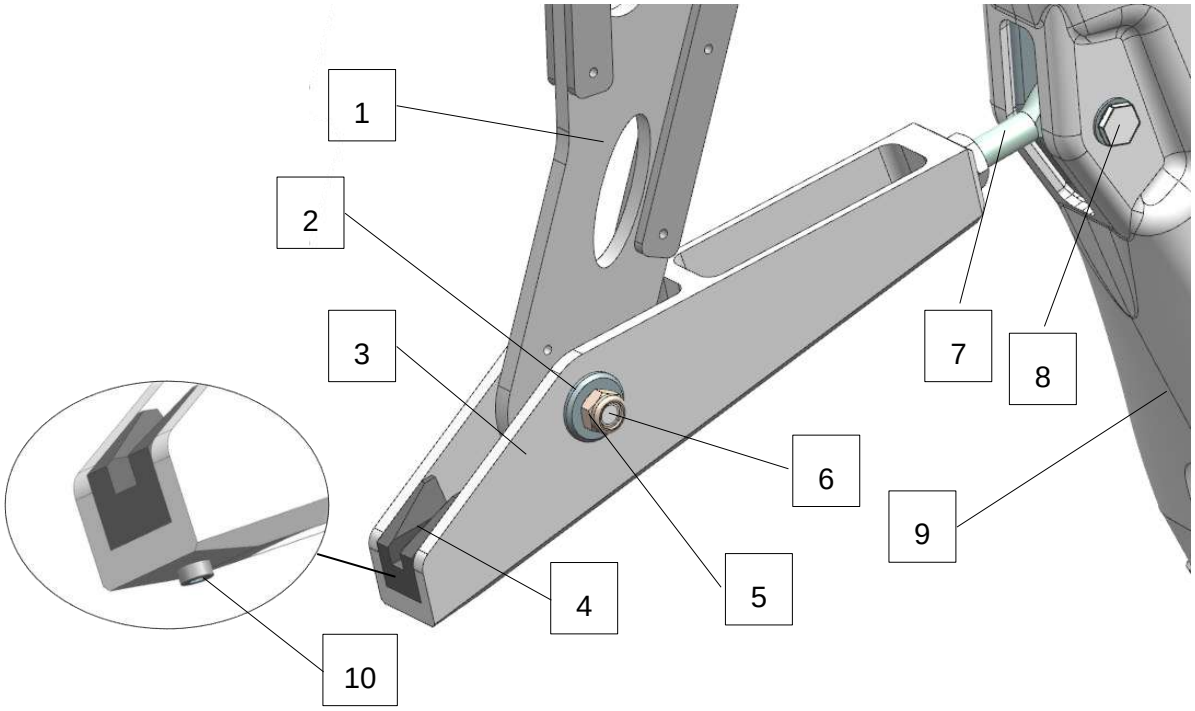
1. Install the **Pylon bell crank bracket (5)** by fastening the four **Pylon bell crank bracket bolts (4).**
2. Install the **Pylon bell crank bracket bolt (1).**
3. Install a new **Door close cable (3).**
4. Remove the pylon support.
5. Install the main doors.

NOTE: The actuator system and main door setup must be done again to ensure the kinematic system is working correctly. Refer to the **Calibration & setup** section.

4.2.4 Pylon driver arm

The pylon driver arm is connected to the pylon and pylon bell crank as illustrated in Figure 4-5.

4.2.4.1 Overview



No	Description	No	Description
1	Pylon bell crank	2	Pylon driver arm bush
3	Pylon driver arm	4	Pylon driver arm lock
5	Pylon driver arm nut	6	Pylon driver arm bolt
7	Rod end	8	Pylon bolt
9	Pylon	10	Pylon driver arm lock bolt

Figure 4-5 Pylon driver arm assembly

4.2.4.2 Removal

1. Extend the pylon to a position slightly below the extended position.
2. Switch off the RES master switch.
3. Remove the main doors.
4. Support the pylon slightly below the extended position.
5. Disconnect the **Pylon driver arm (3)** from the **Pylon (9)** by unfastening the **Pylon bolt (8).**

6. Loosen the **Pylon driver arm bolt (6)** and **nut (5)** to free the **Pylon driver arm (3).**
7. The **Pylon driver arm lock (4)** can be replaced by loosening the **Pylon driver arm lock bolt (10**).

4.2.4.3 Installation

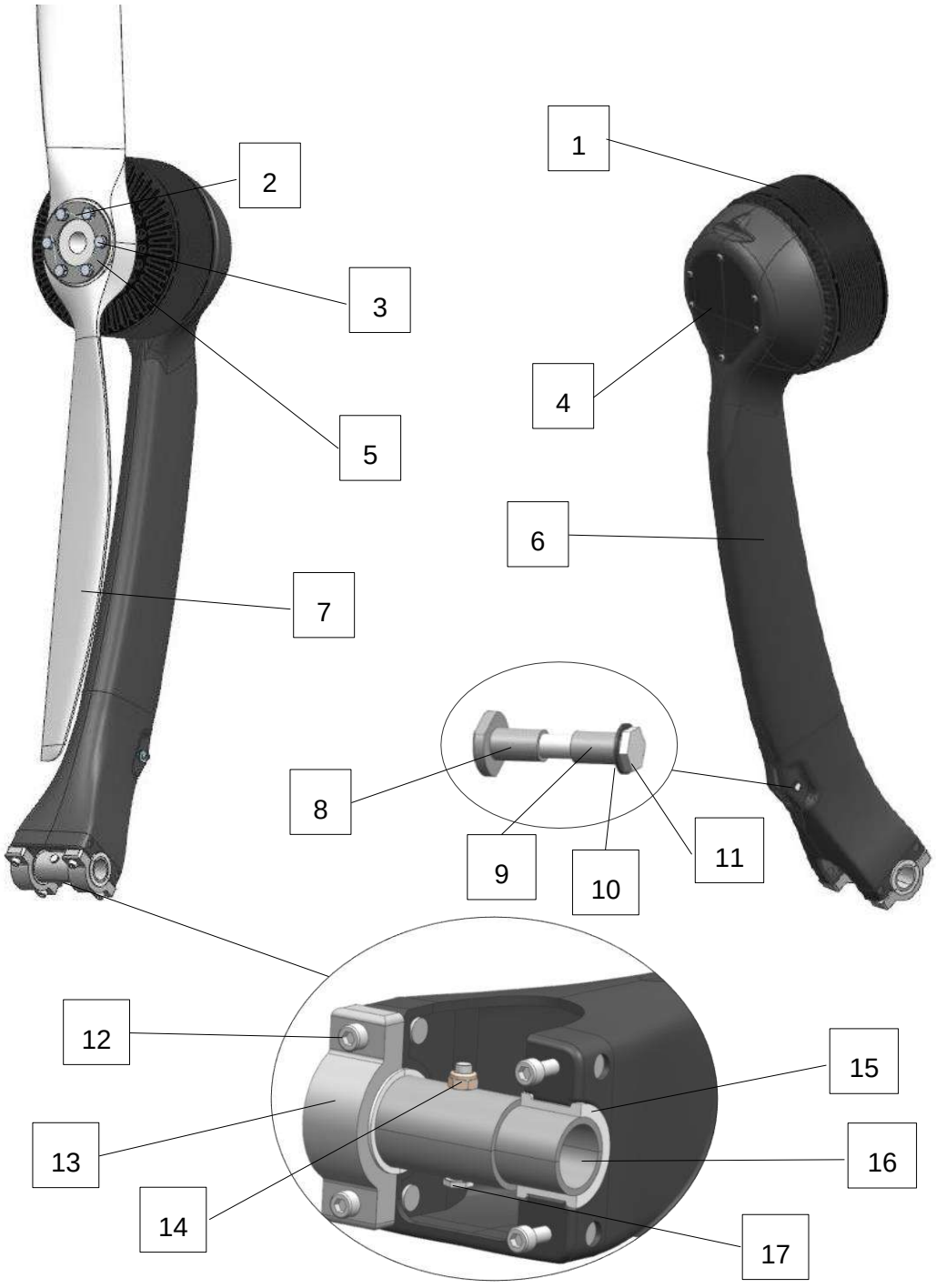
1. Insert the **Pylon driver arm lock (4)** and fasten it into place using the **Pylon driver arm lock bolt (10**).
2. Fasten the **Pylon driver arm bolt (6)** and **Nut (5)** to install the **Pylon driver arm (3).**
3. Connect the **Pylon driver arm (3)** to the **Pylon (9)** by fastening the **Pylon bolt (8).**
4. Remove the pylon support.
5. Install the main doors.

NOTE: The actuator system and main door setup must be done again to ensure the kinematic system is working correctly. Refer to the **Calibration & setup** section.

4.3 RES Pylon

The pylon is the main structural component connecting the motor to the fuselage of the aircraft. The pylon is a dynamic component that is extended and retracted into the fuselage of the aircraft by the actuator assembly.

4.3.1 Overview



No	Description	No	Description
1	EMRAX 208 Electrical motor	2	Locking wire
3	Propeller bolt	4	Pylon cover
5	Propeller ring	6	Pylon
7	Propeller	8	Pylon nut
9	Pylon driver bush	10	Washer
11	Pylon driver bolt	12	Pylon base bracket bolt
13	Pylon base bracket	14	Pylon Sleeve nut
15	Pylon base bush	16	Pylon sleeve
17	Pylon Sleeve bolt		

Figure 4-6 Pylon assembly

4.3.2 Maintenance & Checks

- Before any run-up of the system be sure to check the pylon for any cracks, chips, or any visible signs of stress or delamination.
- The pylon can be cleaned of any bugs and dirt after every flight using a damp cloth.
- If the pylon has any visible damage ensure that is inspected and repaired by a qualified maintenance organisation, to prevent further damage or failure.

4.3.3 Removal

1. Extend the pylon to a position slightly below the extended position to ensure the main doors are fully open.
2. Switch off the RES master switch.
3. Disconnect the motor wires (HV, resolver, and ground wires). Refer to the

4. Electrical **motor** section.

NOTE: It is advisable to remove the motor as it makes the handling of the pylon easier.

5. Disconnect the pylon driver arm by loosening the **Pylon driver bolt (11)**
6. Detach the **Pylon (6)** by loosening the four **Pylon base bracket bolts (12)**

NOTE: Be careful not to drop or damage the pylon when removing the bolts.

7. Remove the **Pylon base brackets (13)**
8. Remove the **Pylon (6)** from the fuselage.

NOTE: Be careful not to damage the various motor wires when removing the pylon.

9. The four **Pylon base bushes (15)** can now be removed.
10. The **Pylon sleeve (16)** can be removed by loosening the **Pylon Sleeve bolt (17)** and nut **(14)**.

4.3.4 Installation

1. Route the various motor wires through the pylon (refer to the

2. Electrical **motor** section).

NOTE: The motor wires should pass the pylon sleeve on the front side of the pylon for a neater installation.

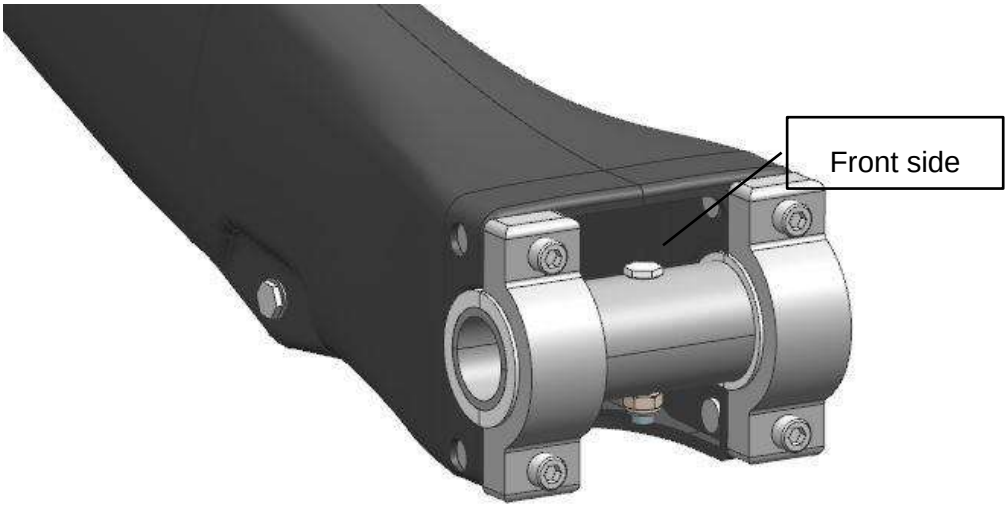


Figure 4-7 Motor wires routing

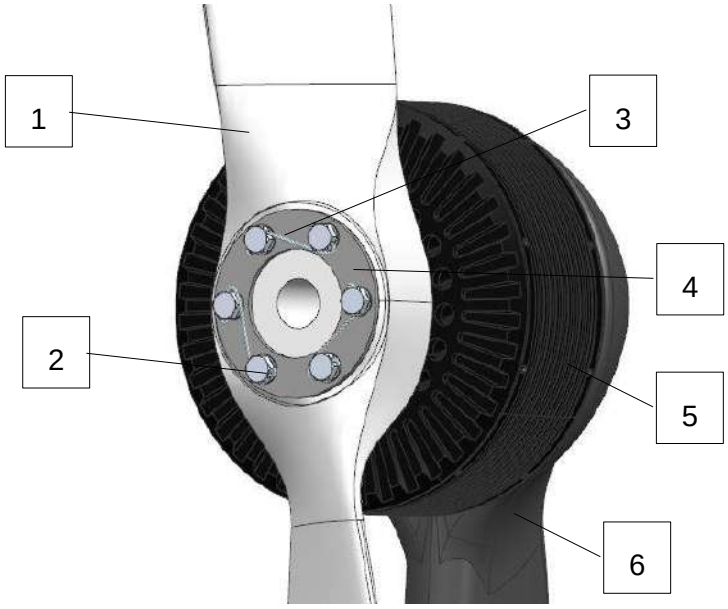
3. Fasten the **Pylon sleeve (16)** using the **Pylon Sleeve bolt (17)** and **Pylon sleeve nut (14).**
4. Place the four **Pylon base bushes (15)** over the **pylon sleeve (16).**
5. Place the **Pylon (6)** in the correct position against the **Pylon base bushes (15).**
6. Place the **Pylon base brackets (13)** in the correct position against the **Pylon base bushes (15).**
7. Fasten the pylon using the four **Pylon base bracket bolts (12).**
8. Attach the pylon driver arm to the pylon using the **Pylon driver bolt (11).**
9. Connect the various motor wires (refer to the

10. Electrical **motor** section).

4.4 Propeller

The RES propeller is manufactured by Technoflug. The KS1 is a two-blade fixed-pitch propeller. The propeller is fastened directly to the EMRAX 208 Electrical motor by six fastening bolts as illustrated Figure 4-8.

4.4.1 Overview



No	Description	No	Description
1	Propeller	2	Propeller fastening bolts
3	Locking wire (Ø 0.025” Stainless steel)	4	Propeller ring
5	EMRAX 208 HV	6	Pylon

Figure 4-8 Propeller assembly

4.4.2 Maintenance & checks

4.4.2.1 Checks

- Before any run-up of the propeller be sure to check the propeller for any cracks, chips, or any visible signs of stress or delamination. Verify that the locking wire is still in place and not damaged.
- The propeller can be cleaned of any bugs and dirt after every flight using a damp cloth or with water and car shampoo.

WARNING: Avoid aggressive media like acetone as this could ruin the surface finish.

4.4.2.2 Inspections

After 25 hours of operation the operator or AMO must inspect the propeller after washing it thoroughly for any cracks and raptures. Chips and cracks could cause the propeller to become unbalanced which will increase vibrations.

The following cracks can be tolerated:

1. Cracks on the surface with a distance greater than 5 mm if they cannot be felt
2. Cracks in cobweb form or with concentric rings if they are smaller than 10 cm
3. Bumps due to small stones smaller than 5 mm
4. Swelling smaller than 10 mm
5. Cracks in the erosion protection at the nose, if smaller than 5 mm
6. Yellowed erosion protection
7. Inspect the locking wires between the screws on the hub to ensure there are no frayed or broken wires

Greater flaws, especially cracks and holes where ends of fibers become visible or crack in the trailing edge must be repaired. If there is any doubt, send the propeller to Technoflug for repair.

WARNING: The propeller must be statically balanced after repair and before fitment and it is recommended to verify the vibrations caused by the propeller by having it dynamic balanced. Excessive vibrations could cause damage or destroy the propeller and other components.

4.4.3 Removal

1. Extend the pylon to the extended position.
2. Switch off the RES master switch.
3. Remove the **Locking wire (3).**
4. Remove the six **Propeller fastening bolts (2).**
5. Remove the **Propeller (1)** and **Propeller ring (2).**

NOTE: Before removing the propeller, note or mark the relative position of the propeller to the motor. If the relative orientation is changed with the propeller installation,

the propeller alignment must be recalibrated (refer to the **Calibration & setup** section).

4.4.4 Installation

WARNING: The propeller must be statically balanced before fitment and it is recommended to verify the vibrations caused by the propeller by having it dynamic balanced. Excessive vibrations could cause damage or destroy the propeller and other components.

1. Fit the six **Propeller fastening bolts (2)** through the **Propeller ring (2)** and **Propeller (1).**

CAUTION: The orientation of the propeller should be as indicated in the figure above. The Techoflug balancing washer should face forward.

2. Fasten the propeller to the EMRAX 208 HV (5), by fastening the six **Propeller Fastening bolts (2)** [20-25Nm].

CAUTION: Be sure to have the same propeller-motor orientation when installing the propeller as when it was removed, otherwise the propeller alignment must be recalibrated (Refer to the **Calibration & setup** section).

CAUTION: If the propeller alignment is wrongly set, the propeller could cause damage to the main doors or fuselage.

3. Use **Locking wire (3)** to lock the six **Propeller fastening bolts (2)** into position by using an appropriate locking wire plier.
4. Verify that the motor assembly rotates freely after propeller installation.

CAUTION: If the wrong bolts are used, they could bottom out, preventing the motor to rotate freely.

4.4.5 Change of leading-edge protection

The following procedure can be followed if a new protection tape is necessary.

(M3 Scotch 8562, 25 mm Artikel-Nr. 3856225300)

It is also available at the manufacturer. Do not use other materials.

1. Remove the old leading edge protection tape.
2. Clean the bonding surfaces thoroughly with Acetone.

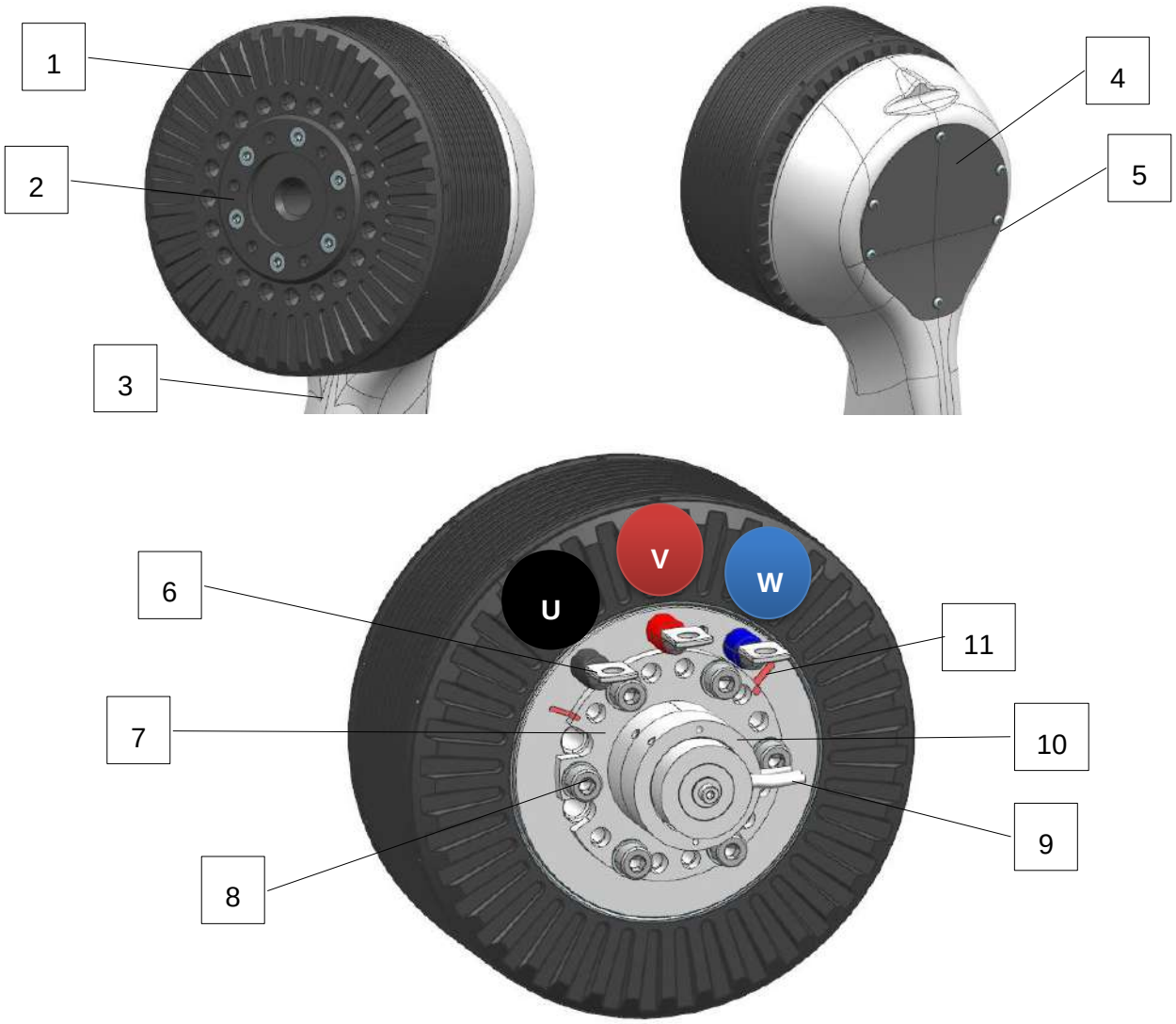
CAUTION: Never touch the clean surface.

3. Fix the new tape first directly at the leading edge.
4. Cut the ends to the correct length and round them.
5. Use a hairdryer to fix the tape without wrinkles, then press the tape thoroughly to the surface.

4.5 Electrical motor

The Emrax 208 HV is located at the top of the pylon and is fastened using 6x M8 bolts. The motor has three High voltage terminals and a tandem motor resolver setup.

4.5.1 Overview



No	Description	No	Description
1	EMRAX 208 HV	2	Propellor bolt fastening point
3	Pylon	4	Pylon cover
5	Pylon cover fastening bolts	6	High voltage terminal
7	Resolver plate	8	Motor fastening bolts
9	Resolver wires	10	Resolvers
11	Alignment marks		

Figure 4-9 Electrical motor

4.5.2 Maintenance & checks

The Emrax 208 motor and controller must be maintained according to Solo Flugzeugbau Motor Overhaul Manual.

Servicing must be done at maintenance organisations approved to perform the maintenance.

4.5.3 Removal

1. Extend the pylon to the extended position.
2. Switch off the RES master switch.
3. Remove the **Pylon rear cover (4),** by loosening the six **Pylon cover fastening bolts (5).**
4. Disconnect the high voltage wires which are connected to **The high voltage terminals (6)** of the motor.
5. Disconnect the **Resolver wires (9).**
6. Disconnect the motor ground wire which is held in place by one of the six **Motor fastening bolts (8).**
7. To free the motor from the pylon, remove the six **Motor fastening bolts (8).**
8. Remove the motor from the pylon.

WARNING: The **Resolver plate (7)** has a specific orientation to the Motor. If this orientation is changed, the calibration of the resolvers will be out. The resolvers must be recalibrated (refer to the **Calibration & setup** section). When the calibration is out, the motor could behave unpredictably and start rotating even if no power is requested by the DCU.

4.5.4 Installation

1. Make sure the **Resolver plate (7)** is fitted to the **Emrax 208 HV (1)** motor and in the correct orientation. The **Alignment marks (11)** must lign up.

WARNING: The **Resolver plate (7)** has a specific orientation to the Motor. If this orientation is changed, the calibration of the resolvers will be out. The resolvers must be recalibrated (refer to the **Calibration & setup** section). When the calibration is out, the motor could behave unpredictably and start rotating even if no power is requested by the DCU.

2. Fasten five out of the six **Motor fastening bolts (8).** Do not fasten the motor fastening bolt indicated in Figure 4-8 yet.
3. Fasten the motor ground wire using the remaining **Motor fastening bolt (8).**
4. Fasten the three high voltage wires to the corresponding **High voltage terminals (6).** Be sure to match the colour markers on the wires and the terminals.

WARNING: If the colours are not in the correct sequence, the motor will not turn in the correct direction or could cause damage to the system**.**

5. Connect the motor **Resolver wires (9)**.
6. Install the **Pylon rear cover (4)** by fastening the six **Pylon cover fastening bolts (5).**

4.6 RES doors

The RES doors consist of the main doors and the front doors. During full extension, the main doors close for aerodynamic purposes, and the front doors serve as the opening for the pylon. The main doors are operated by the main door bell crank. The front doors are spring-loaded into the normally closed position.

4.6.1 Overview

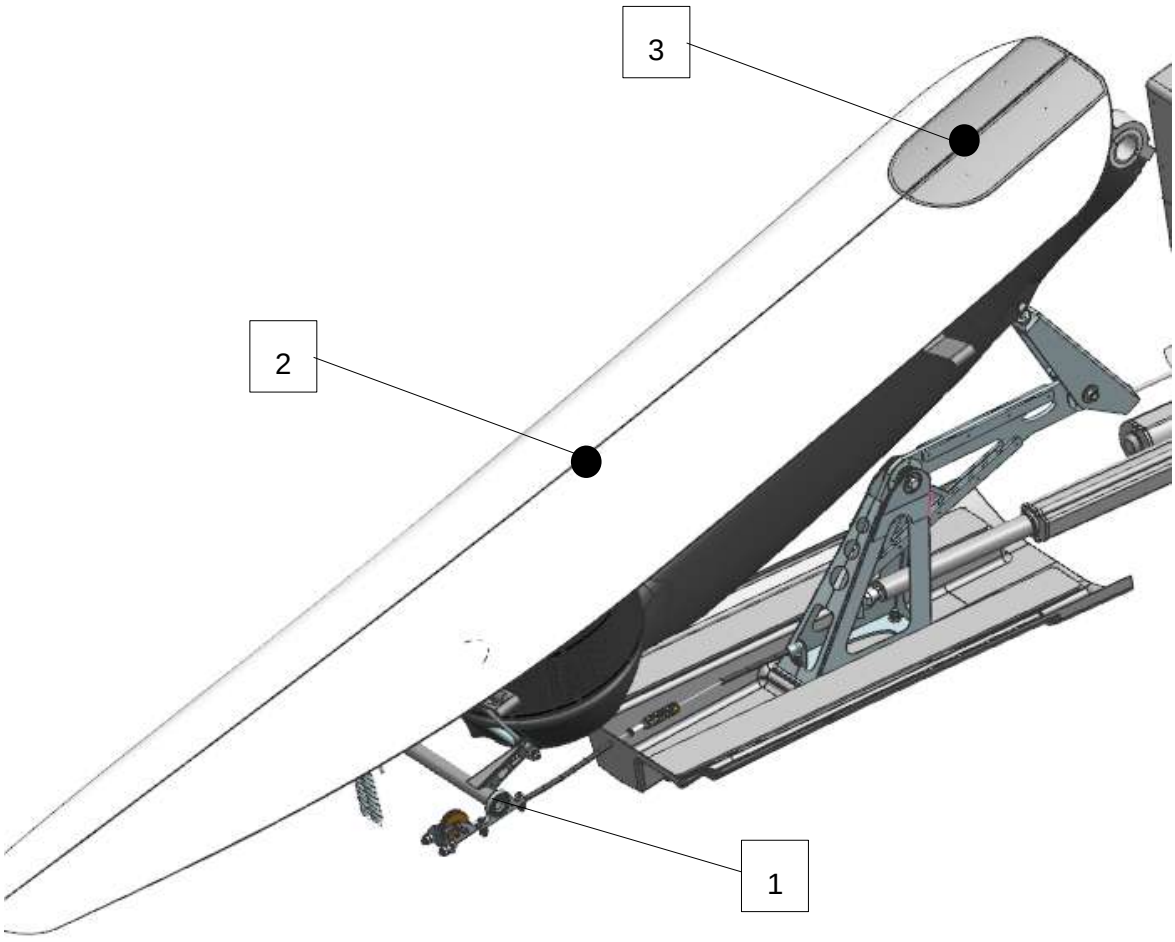


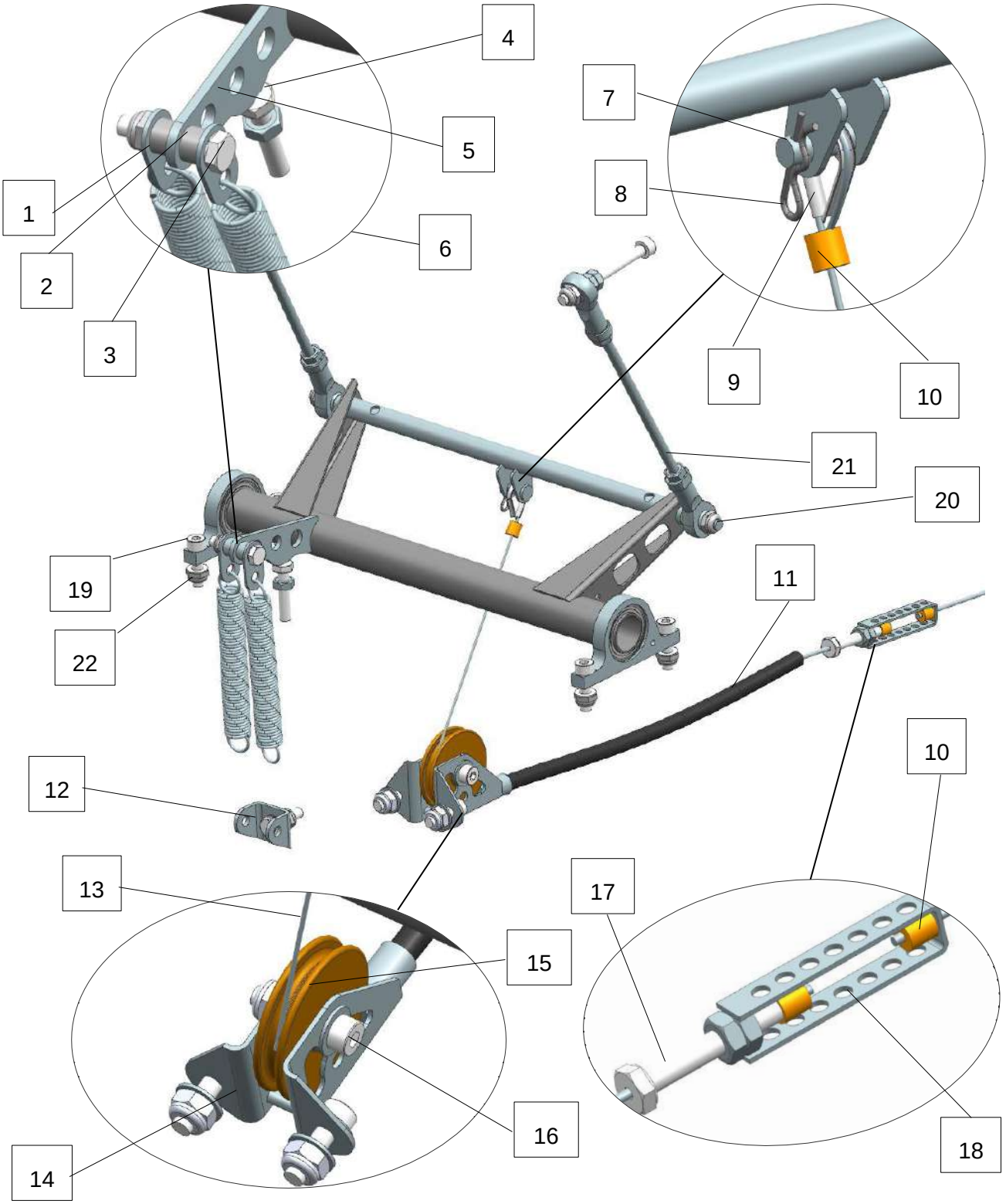
Figure 4-10 Doors assembly

No	Description	No	Description
1	Main door bell crank	2	Main Doors
3	Front Doors		

4.6.2 Main door bell crank

The main door bell crank consists of multiple assemblies as illustrated in Figure 4-11.

4.6.2.1 Overview



No	Description	No	Description
1	Spring link	2	Spring bush
3	Spring bolt	4	Bell crank stop
5	Spring arm	6	Spring
7	Bell crank pin	8	R-pin
9	Thimble	10	Crimp
11	Sleeve	12	Spring lug
13	Door close cable	14	Pully bracket
15	Pulley	16	Pulley bolt
17	Cable adjuster bolt	18	Cable adjuster
19	Bell crank fastening bolt	20	Pushrod fastening nut
21	Pushrod	22	Bell crank fastening nut

Figure 4-11 Main door bell crank assembly

4.6.2.2 Removal

1. Extend the pylon to a position slightly below the extended position to ensure the main doors are fully open.
2. Switch off the RES master switch.
3. Disconnect the **Door close cable (13)** by removing the **R-pin (8)** and **Bell crank pin (7).**
4. Disconnect the **Pushrod (21)** from the bell crank by undoing the **Pushrod fastening nut (20)**, or by disconnecting the pushrod from the main door hinge.

CAUTION: Removing and installing the pushrod, could result in a length adjustment. In this case, the door setup should be done again (refer to the **Calibration & setup** section).

5. Disconnect the Springs (6) from the bell crank by unclipping the springs, loosening the **Spring bolt (3),** or undoing the **Spring lug (12).**
6. Remove the bell crank from the fuselage by undoing the four **Bell crank fastening bolts (19).**

4.6.2.3 Installation

1. Install the bell crank by fastening the four **Bell crank fastening bolts (19).**
2. Connect the springs to the bell crank by clipping in the springs, installing the **Spring bolt (3),** or fastening the **Spring lug (12).**

3. Connect the **Pushrod (21)** to the bell crank and fix it in place using the **Pushrod fastening nut (20).**

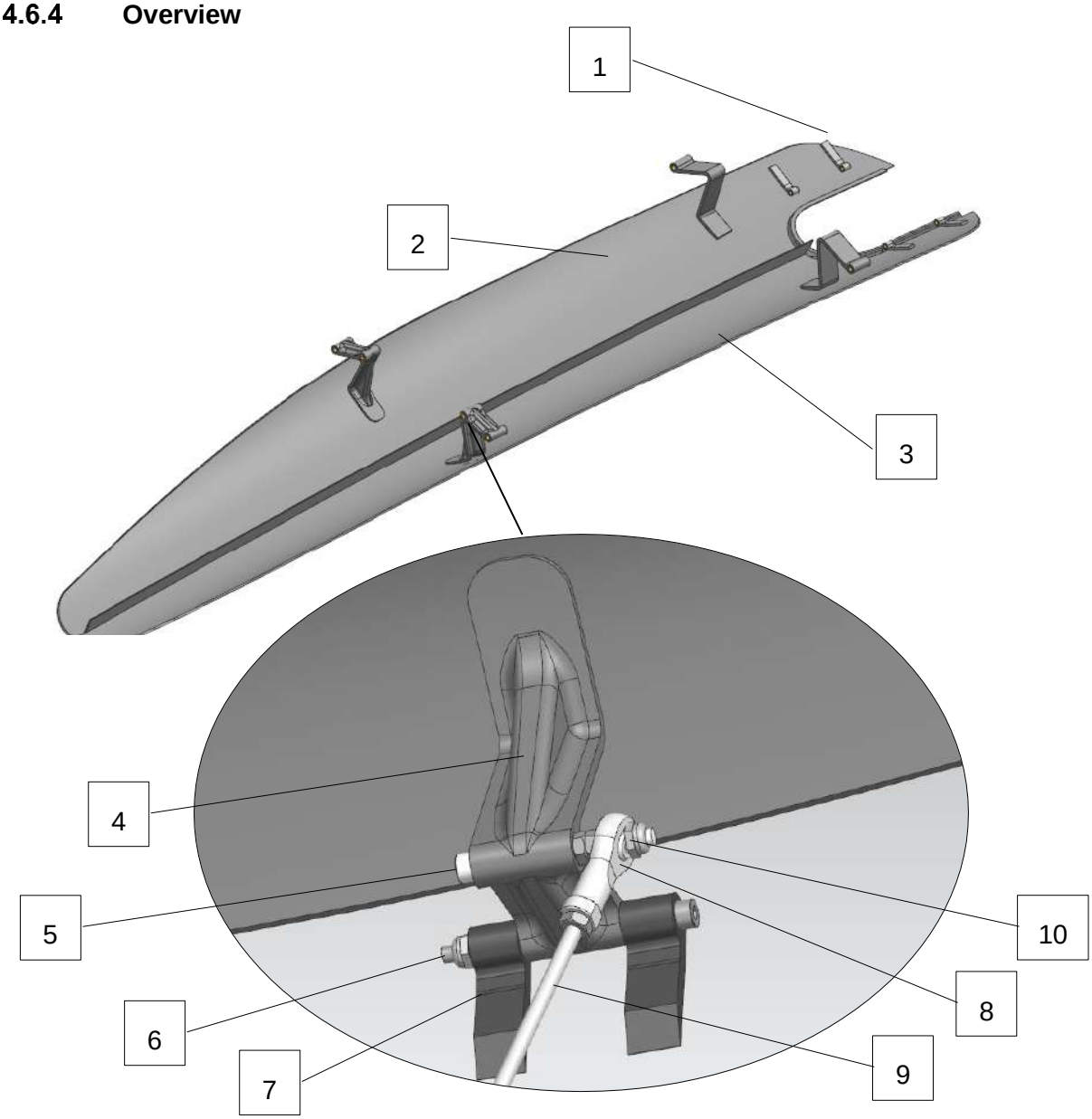
CAUTION: Removing and installing the pushrod, could result in a length adjustment. In this case, the door setup should be done again (refer to the **Calibration & setup** section).

4. Connect the **Door close cable (13)** by installing the **Bell crank pin (7)** and **R-pin (8).**

4.6.3 Main doors

The main doors consist of a left and right door as illustrated in Figure 4-12.

4.6.4 Overview



No	Description	No	Description
1	Front door hinges	2	Right main door
3	Left main door	4	Door hinge top
5	Pushrod bolt	6	Hinge bolt
7	Door hinge bottom	8	Rod end
9	Pushrod	10	Pushrod fastening nut

Figure 4-12 Main doors assembly

4.6.4.1 Maintenance & Checks

The main doors are should seat properly during full pylon retraction and extension. The main doors should not touch the outside of the fuselage when they are fully open. The doors should open and close smoothly – this could be verified by cycling the pylon in and out. If this is not the case, refer to the **Calibration & setup** section.

4.6.4.2 Removal

1. Extend the pylon to a position slightly below the extended position to ensure the main doors are fully open.
2. Switch off the RES master switch.
3. Disconnect the pushrod from the **Door hinge top (4)** by undoing the **Pushrod fastening nut (10).**

CAUTION: Removing and installing the pushrod, could result in a length adjustment. In this case, the door setup should be done again (refer to the **Calibration & setup** section).

4. Undo the **Hinge bolt (6)** of both the front and rear door hinges.
5. Remove the main door from the fuselage of the aircraft.

4.6.4.3 Installation

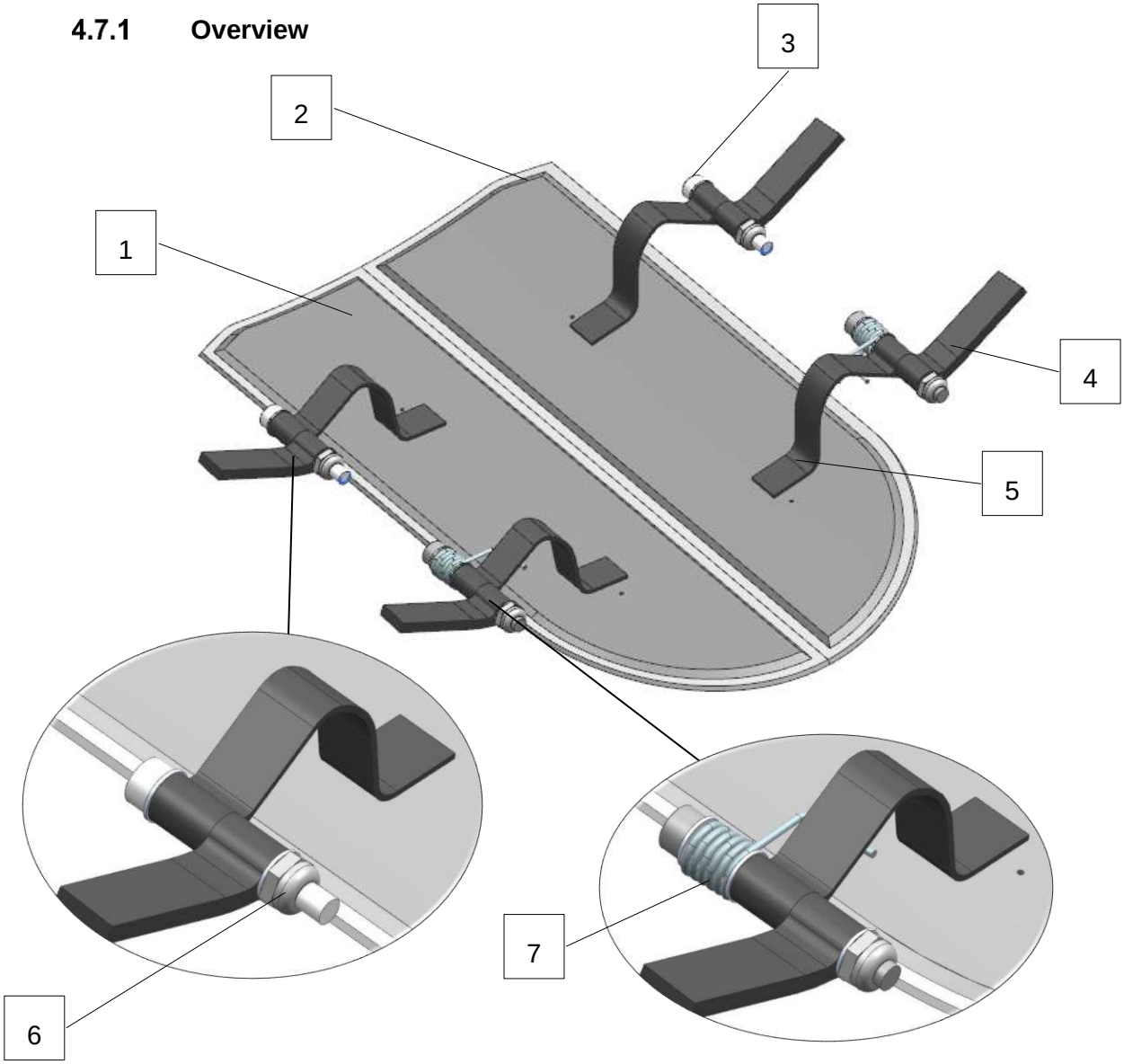
1. Install the main door to the fuselage by fastening the **Hinge bolts (6)** of the front and rear hinges.
2. Connect the pushrod to the **Door hinge top (4)** by fastening the **Pushrod fastening nut (10).**

CAUTION: Removing and installing the pushrod, could result in a length adjustment. In this case, the door setup should be done again (refer to the **Calibration & setup** section).

4.7 Front doors

The front doors are fixed to the main doors and are spring operated as illustrated in **Error! Reference source not found.**:

4.7.1 Overview



No	Description	No	Description
1	Right front door	2	Left front door
3	Front door hinge bolt	4	Front door bottom hinge
5	Front door top hinge	6	Front door hinge nut
7	Front door spring		

Figure 4-13 Front doors assembly

4.7.1.1 Removal

1. Extend the pylon to a position slightly below the extended position to ensure the main doors are fully open.
2. Switch off the RES master switch.

NOTE: The main doors could be removed first to improve the ease of access.

3. Loosen the two **Front door hinge bolts (3)** to free a front door from the corresponding main door.

4.7.1.2 Installation

1. Fasten a front door to the main door by fastenings the two **Front door hinge bolts (3).**

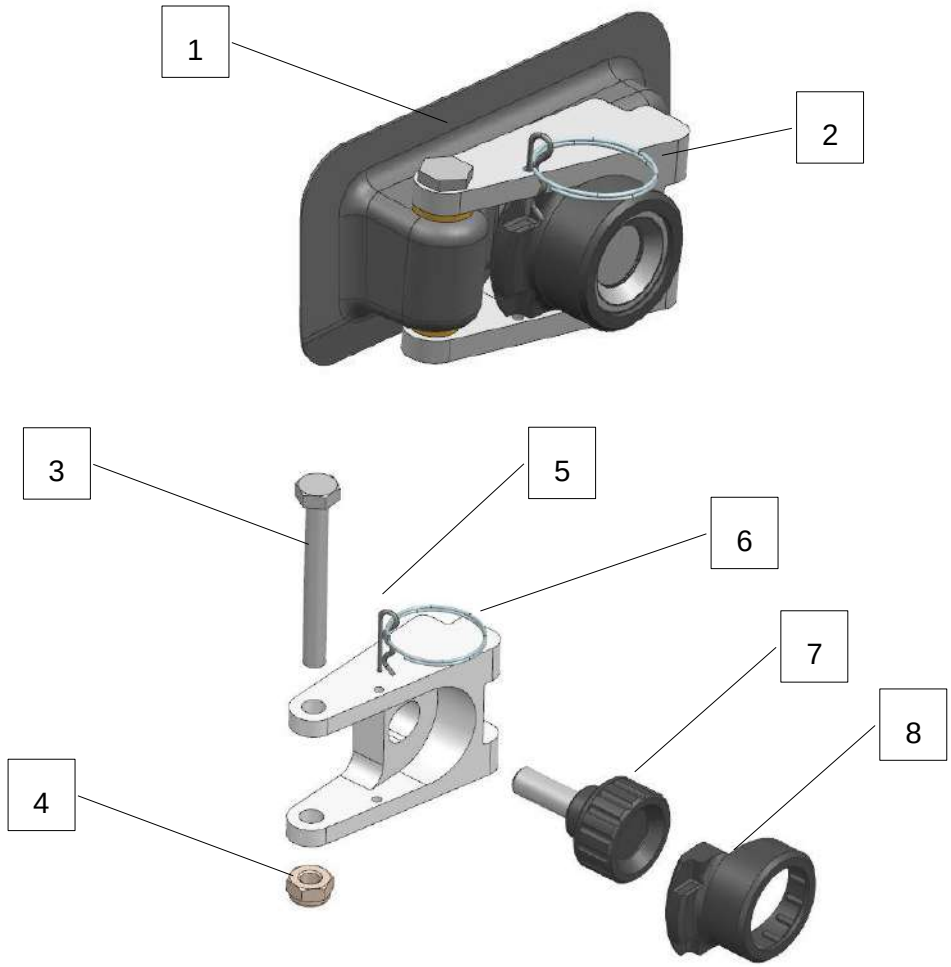
CAUTION: The order of washers and the other components should match the overview figure.

2. Ensure that one end of the **Front door spring (7)** is hooked behind the Front door top hinge as indicated in the overview figure.

4.8 Battery latches

The battery latches are located within the rear fuselage compartment. There are two battery latches, one for the left battery and the other for the right battery. They are critical in ensuring that the HV batteries are fastened in flight.

4.8.1 Overview



No	Description	No	Description
1	Battery latch composite assembly	2	Battery latch
3	Battery latch hinge bolt	4	Battery latch hinge nut
5	R-pin	6	Key ring 20mm
7	Grip knob	8	Battery latch thumb screw lock

Figure 4-14 Battery latches

4.8.2 Removal

1. Extend the pylon to a position slightly below the extended position to ensure the main doors are fully open.
2. Switch off the RES master switch.
3. Remove the **R-pin (5).**
4. Remove the **Battery latch thumb screw lock (8).**
5. Unscrew the **Grip knob (7).**
6. Remove the **Battery latch (2)** by unfastening the **Battery latch hinge bolt (3)** and **Battery latch hinge nut (4).**

4.8.3 Installation

1. Install the **Battery latch (2)** by fastening the **Battery latch hinge bolt (3)** bolt and **Battery latch hinge nut (4).**
2. Fasten the **Grip knob (7).**
3. Install the **Battery latch thumb screw lock (8).**
4. Install the **R-pin (5).**

CAUTION: The battery latches should always be locked, if not, the motor will crash into the battery latch during retraction, preventing full retraction.

4.9 Display and Control Unit (DCU)

The Display and Control Unit (DCU) is located on the instrument within the cockpit. The DCU provides the interface between the Pilot and the system. The DCU provides commands to the RFU and Motor controller to control the system.

4.9.1 Overview

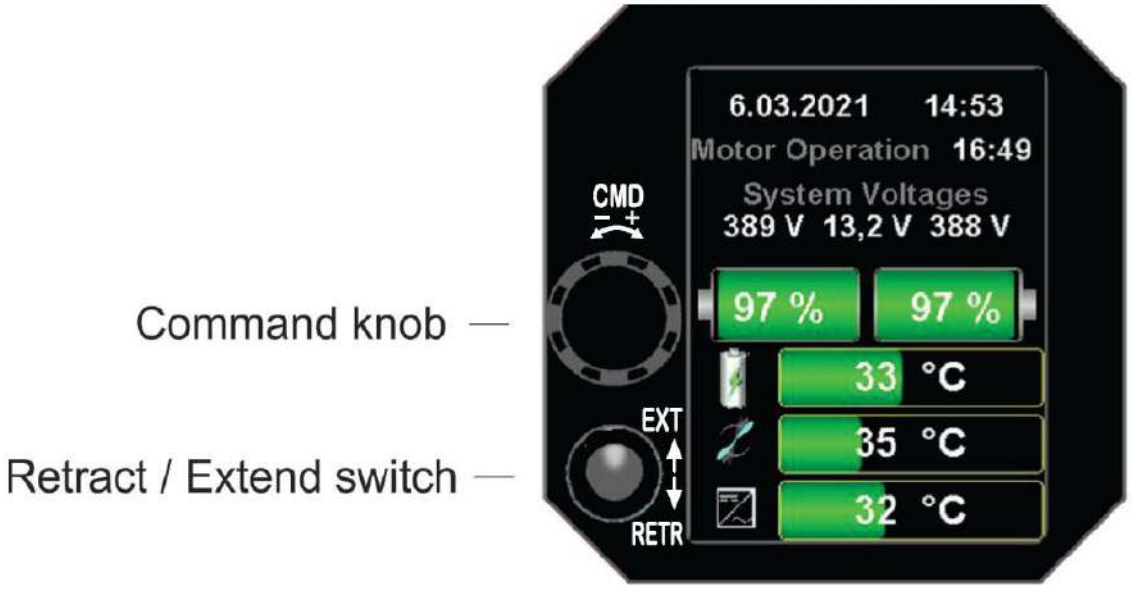


Figure 4-15 DCU

4.9.2 Removal

1. Ensure the master switch of the system is switched off.
2. Disconnect the Microphone plug located on the binnacle cover.
3. Remove the canopy of the aircraft.
4. Remove the binnacle cover and unplug the microphone plug located in the binnacle.
5. Disconnect the DCU connector by unclipping the D-sub clips and removing the connector.
6. Remove the four fastening screws located in the corners of the DCU.
7. Remove the DCU from the instrument panel and binnacle.

CAUTION: Be careful not to disturb or damage other wires within the binnacle when removing the DCU.

4.9.3 Installation

1. Install the DCU into the instrument panel and fastening it using the four fastening screws located in the corners of the DCU.

CAUTION: Be careful not to disturb or damage other wires within the binnacle when installing the DCU.

2. Connect the wiring loom to the DCU by plugging in the connector and fasten it into place by latching the D-sub clips.
3. Plug in the binnacle cover microphone plug.
4. Fasten the binnacle cover.
5. Plug in the microphone.
6. Install the canopy.

4.10 LXNAV Bridge

4.10.1 Overview

The LXNAV bridge is an optional extra. The bridge provides an interface between the DCU and LXNAV flight computers. This enables the LXNAV flight computer to be able to display various parameters of the RES system like HV battery SOC, RPM, Motor controller temperature, etc.

4.10.2 Removal

1. Ensure the master switch of the system is switched off.
2. Disconnect the Microphone plug located on the binnacle cover.
3. Remove the canopy of the aircraft.
4. Remove the binnacle cover and unplug the microphone plug located in the binnacle.
5. Disconnect both d-sub connectors on both ends of the bridge.
6. Remove the bridge from the aircraft.

4.10.3 Installation

1. Connect the two d-sub connectors to the bridge. If there are no bridge d-sub connectors installed, refer to the **Wiring loom** section.
2. Verify the orientation of the bridge. It should match the sticker on the bridge.

CAUTION: Be careful not to disturb or damage other wires within the binnacle when installing the Bridge.

3. Plug in the binnacle cover microphone plug.
4. Fasten the binnacle cover.
5. Plug in the microphone.
6. Install the canopy.

4.11 Motor controller assembly

The motor controller regulates the operation of the electrical motor. The motor controller assembly consists of the motor controller unit and the controller cooling assembly. There are two variants avaible, namely the air cooled system and the water cooled system.

WARNING: Only OEM or authorised persons are allowed to maintain high voltage components like the motor controller assembly.

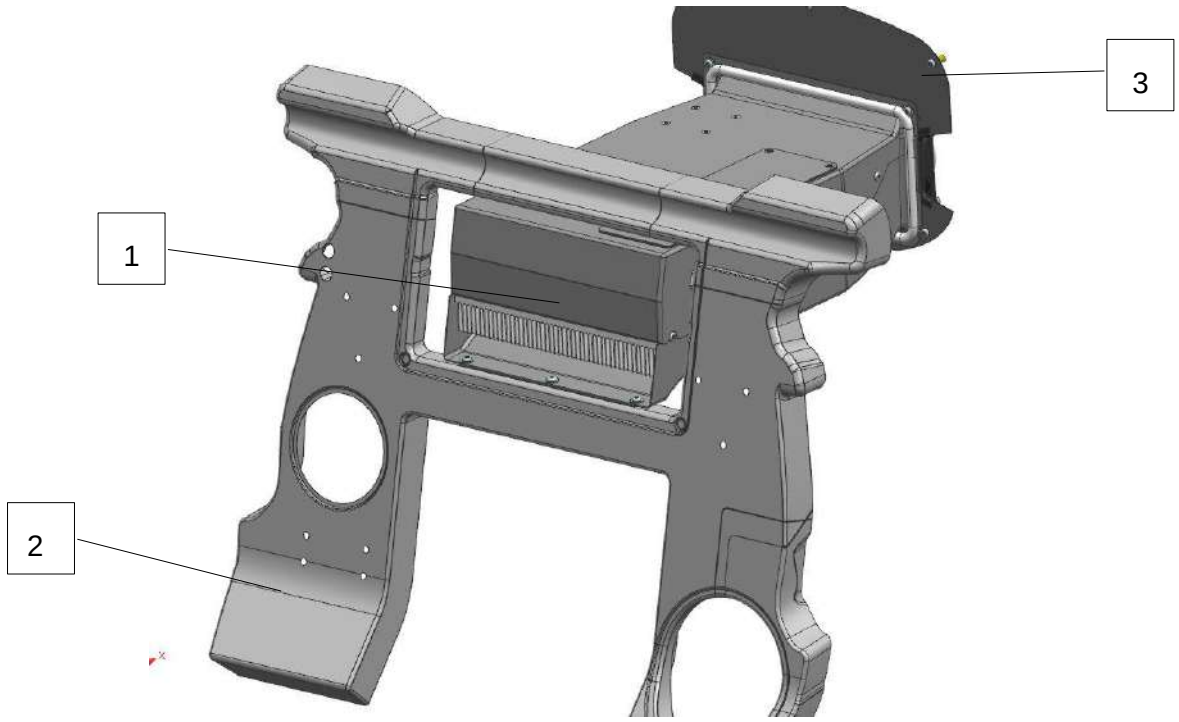
4.11.1 Air cooled Motor controller assembly

The air cooled motor controller assembly is installed between Bulkhead B7 and B8 below the wing spars.

The controller board is housed in a carbon enclosure. High voltage wiring is connected to the sides of the motor controller assembly. Two air cooling fans are attached to the rear of the controller unit.

4.11.1.1 Overview

Figure 4-16 illutrates the position of the air cooled motor controller system.

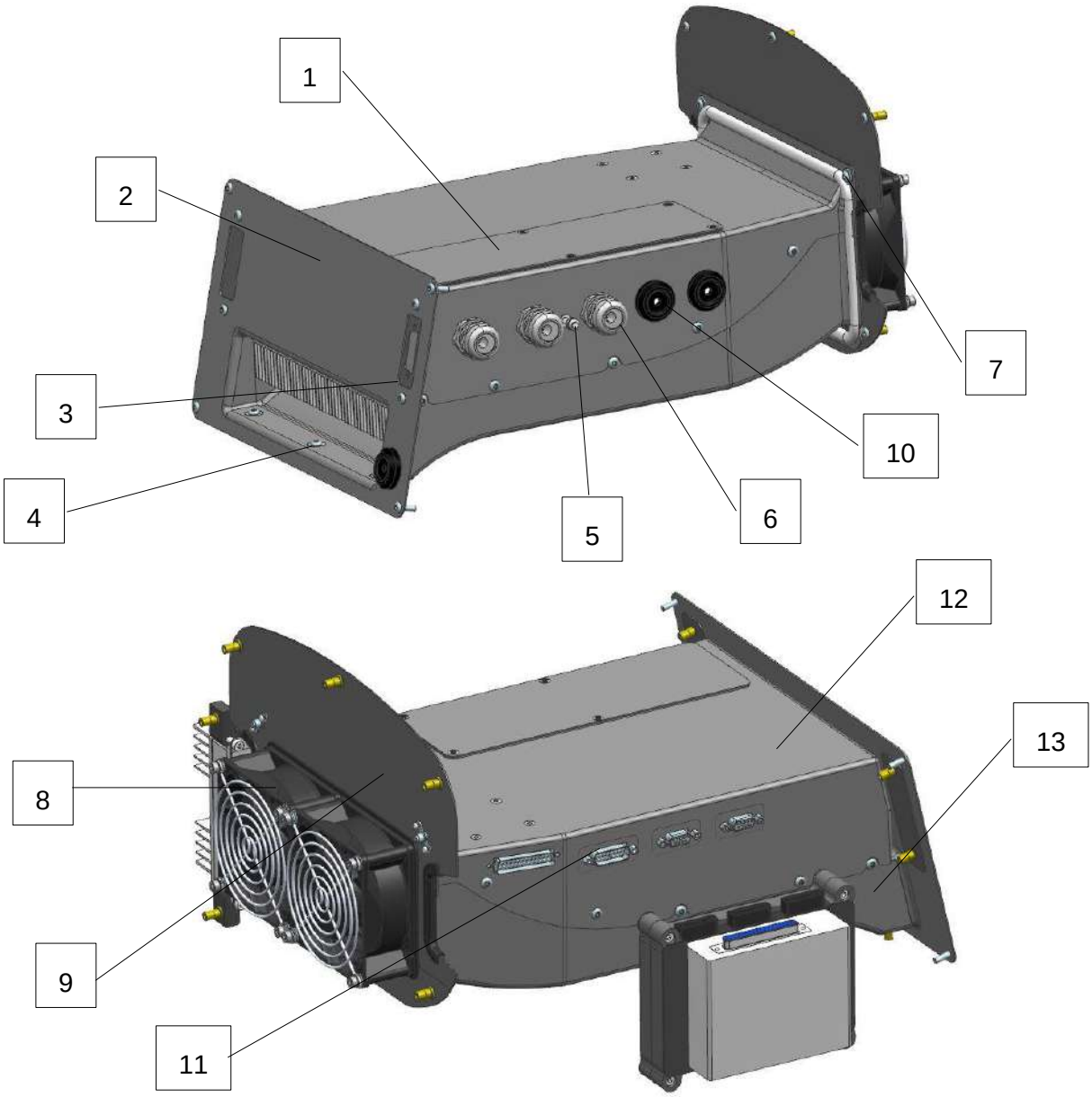


No	Description	No	Description

1	Motor controller assembly	2	B5 bulkhead
3	Controller cooling fan plate		

Figure 4-16 Motor controller overview

4.11.1.2 Removal



No	Description	No	Description
1	Motor Controller box cover	2	B5 Cover
3	Bugwiper connector back plate	4	Front fastening bolt
5	Ground bolt	6	Cable glands

7	Rear fastening bolt	8	Cooling fan
9	Controller cooling fan plate	10	Grommet
11	D-sub connectors	12	Box top
13	Box bottom	14	High voltage ring terminals

Figure 4-17 Motor controller assembly

4.11.1.2.1 Removal of the motor controller assembly from the fuselage

1. Ensure the master switch of the system is switched off.
2. Remove the **B5 Cover (2)** by unscrewing the four bolts located in the corners of the cover.
3. Undo the **Bug wiper connector back plate (3)** by loosening its two fastening bolts.
4. The battery cable can be pulled through the grommet and the **B5 Cover (2)** is completely removed.
5. Remove the four **D-sub connectors (11)** located on the right side of the motor controller assembly.
6. Remove the **Motor controller box cover (1).**
7. Loosen the three **Cable glands (6)** to ensure they are not clamping the wires anymore.
8. Remove the **Ground bolt (5).**

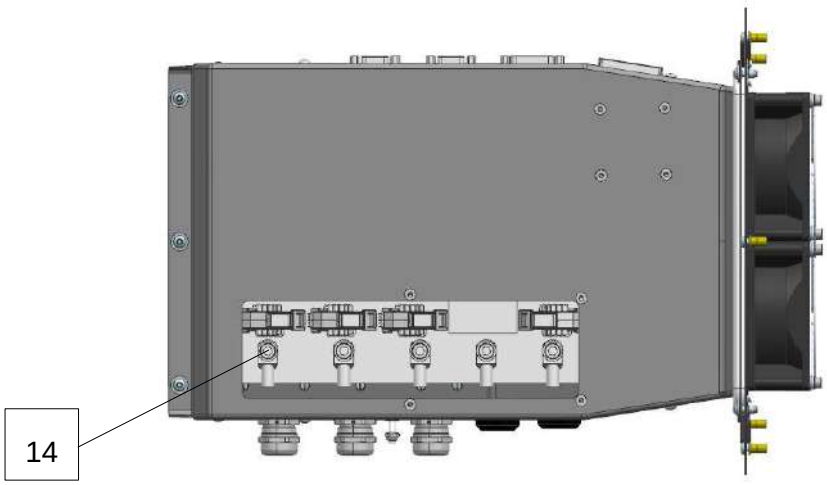


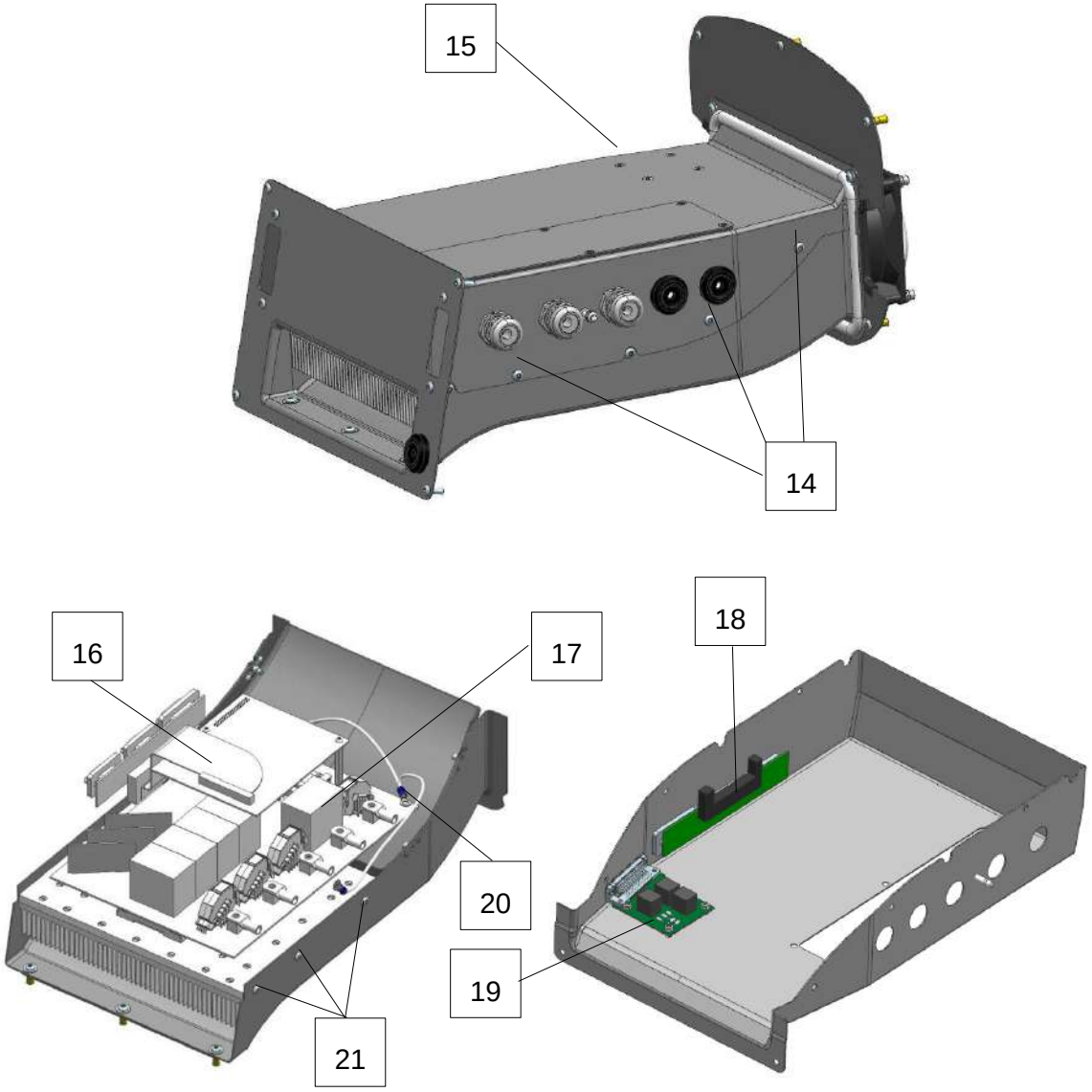
Figure 4-18 Motor controller assembly top view

9. Loosen the five bolts retaining the **High voltage ring terminals (14)** and remove the high voltage wires from the box.

10. Loosen the two **Rear fastening bolts (7)** and three **Front fastening bolts (4).**
11. Remove the motor controller assembly from the fuselage. Be careful to clear all wiring while removing the assembly as the wiring loom can be damaged.

4.11.1.2.2 Removal of the motor controller assembly PCBs

Three PCBs are located within the motor controller assembly as illustrated in Figure 4-19:



No	Description	No	Description
14	Box top fasterning bolts	15	RCB PCB Fastening bolts
16	Ribbon cable	17	Motor controller PCB
18	D-sub assembly	19	RCB PCB
20	PCB ground wiring	21	Motor controller PCB fastening bolts

Figure 4-19 Motor controller PCBs

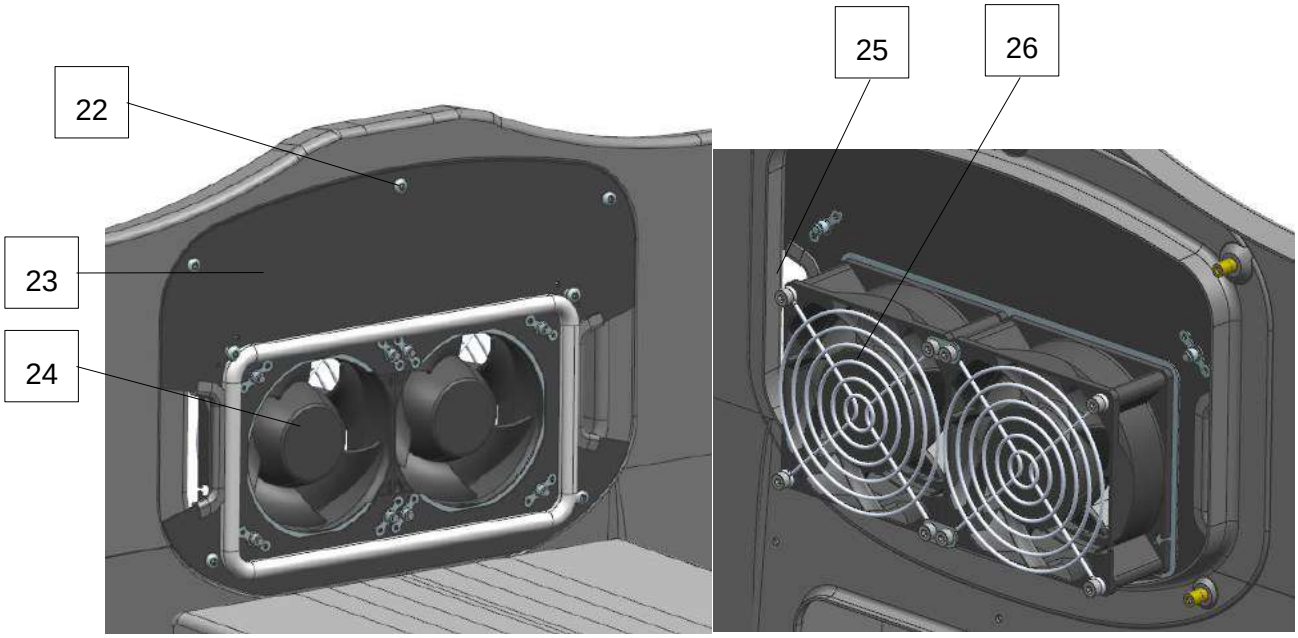
1. Remove the motor controller **Box Top (12)** by removing the six **Box top fastening bolts (14).**
2. Lift the **Box Top (12)** from the bottom assembly.

CAUTION: Do not lift it too far away, as the **Ribbon cable (16)** must be disconnected from the D-sub assembly first. The **D-sub assembly (18)** is fastened to the **Box Top (12).**

3. Removed the **PCB ground wiring (20)** from the **Box Top (12)** by pulling it through the grommet located in the **Box Top (12).**
4. Remove the **RCB PCB (19)** by unfastening the four **RCB PCB bolts (15).**
5. Remove The **Motor controller PCB (17)** by unfastening the six **Motor controller PCB bolts (21).**

4.11.1.2.3 Removal of the cooling fans

There are two cooling fans located behind the motor controller assembly. These fans can be accessed from the rear fuselage compartment or the cockpit if the motor controller assembly is removed.



No	Description	No	Description
22	Fan plate fastening bolts	23	Fan plate
24	Cooling fan	25	Cooling fan fastening bolts
26	Fan finger guard		

Figure 4-20 Cooling fans

The **Cooling fans (24)** can be removed with the motor controller assembly installed or after it has been removed. If the motor controller assembly is removed, the Fan plate (23) can also be removed.

1. Ensure the master switch of the system is switched off.
2. Disconnect the wiring of the fans.
3. Loosen the five **Fan plate fastening bolts (22).**
4. Remove the **Fan plate (23)** from the fuselage.

NOTE: Steps 2-3 can be skipped if the motor controller assembly is installed.

5. Loosen the eight **Cooling fan fastening bolts (25).**
6. Remove the **Cooling fans (24).**

4.11.1.3 Installation

The installation of the motor assembly consists of the following three installation procedures:

- Installation of the cooling fans
- Installation of the motor controller assembly PCBs
- Installation of the motor controller assembly into the fuselage

4.11.1.3.1 Installation of the cooling fans

1. Fasten the **Cooling fans (24)** to the **Fan plate (23)** using the eight **Cooling fan fastening bolts (25).**
2. Fasten the **Fan plate (23)** to the fuselage using the five **Fan plate fastening bolts (22)**. This step can be skipped if the **Fan plate (23)** was not removed from the fuselage.
3. Connect the fan wires.

4.11.1.3.2 Installation of the motor controller assembly PCBs

1. Fasten the **Motor controller PCB (17)** to the **Box bottom (13)** using the six **Motor controller PCB fastening bolts (21).**
2. Fasten the **RCB PCB (19)** to the **Box Top (12)** by fastening the four **RCB PCB Fastening bolts (15)**. Do not forget to include the spacers.

WARNING: If the spacers are not included, the **RCB PCB (19)** could short circuit and causes an electrical failure and fire hazard.

3. Make sure the **PCB ground wiring (20)** is connected to the **Motor controller PCB (17)** firmly at both connection points. Ensure the **PCB ground wiring (20)** passes through the grommet in the **Box Top (12).**

WARNING: If the ground wiring is not connected to the **Motor controller PCB (17)** the motor and motor controller will not operate correctly. This will increase EMF interference and could cause permanent damage to the Motor Controller.

4. The ribbon cable of the **Motor controller PCB (17)** should be connected to the **D-sub assembly (18).**

WARNING: If the ribbon cable is not connected, the motor controller will not work.

5. The **Box Top (12)** can now be lowered onto the **Box Bottom (13)** and fastened using the six **Box top fastening bolts (14).**

6. Insert the motor controller assembly back into the fuselage. Be sure not to disturb any wiring when inserting the motor controller assembly.

WARNING: There are wires which are routed from the right side of the fuselage to the left by passing underneath the motor controller. Do not pinch these wires between the motor controller assembly and the **Controller cooling fan plate (9)**.

7. Fasten the motor controller assembly to the fuselage using the two **Rear fastening bolts (7)** and three **Front fastening bolts (4).**

WARNING: If the original motor controller PCB was replaced by a new motor controller PCB, the resolvers must be recalibrated (Refer to the Calibration & setup section). When the calibration is out, the motor could behave unpredictably and start rotating even if no power is requested by the DCU.

4.11.1.3.3 Installation of the motor controller assembly into the fuselage

1. Install the motor controller assembly into the fuselage. Be careful to clear all the wiring in the fuselage while installing the assembly as the wiring loom can be damaged.
2. Fasten the assembly using the two rear **Fastening bolts (7)** and three **Front fastening bolts (4).**
3. Install the five high voltage wires into the box. The wire colour identifications should be matched as illustrated in Figure 4-21:

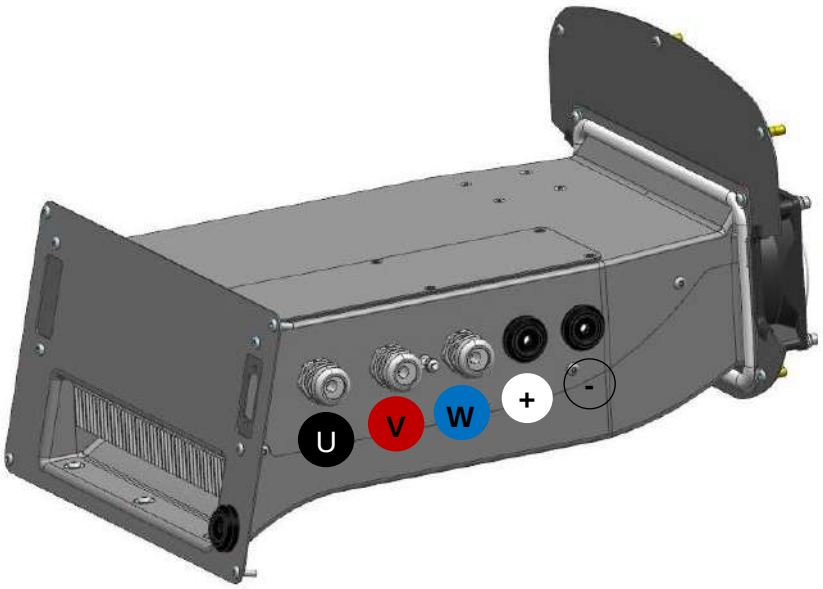


Figure 4-21 Motor controller HV wire sequence

WARNING: The high voltage wires should be installed in the correct sequence, if not – the system could be damaged.

4. Fasten the five bolts retaining the **High voltage ring terminals (12).**

WARNING: The high voltage terminals should be fastened correctly. Ensure the washers are installed, if not the bolt could bottom out and not retain the ring terminal. This will destroy the motor controller.

5. Tighten the three **Cable glands (6).**
6. Fasten the four ring terminals:
   - Cooling Fans ground
   - Motor ground
   - PCB ground
   - Ground bus wire

   Using the **Ground bolt (5).**

WARNING: If any one of these four wires are excluded, the system will not work properly and can cause a major fire risk or damage to the system.

7. Ensure the ground bus wire is connected to the ground bus and the ground bolt.
8. Verify the continuity between the ground bus of the aircraft and the shielding of the HV wires U, V, and W. A needle can be used to protrude the external insulation of the wire.

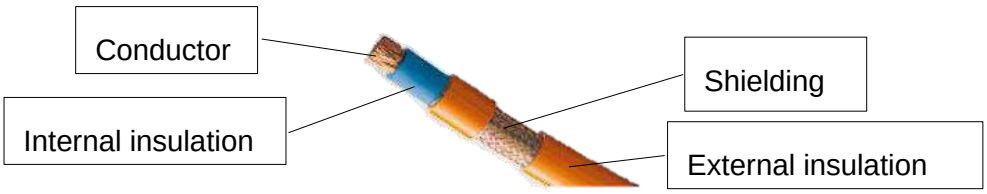


Figure 4-22 HV wire

9. Install the **Motor controller box cover (1).**
10. Install the four **D-sub connectors (11)** located on the right side of the motor controller assembly.
11. Route the battery cable through the **Grommet (10)** which is located in the **B5 cover (2).**
12. Install the **Bug wiper connector back plate (3).**

13. Install the **B5 cover (2)** by fastening the four bolts located in the corner of the cover.

14. The system can now be switched on to verify that there are no errors.

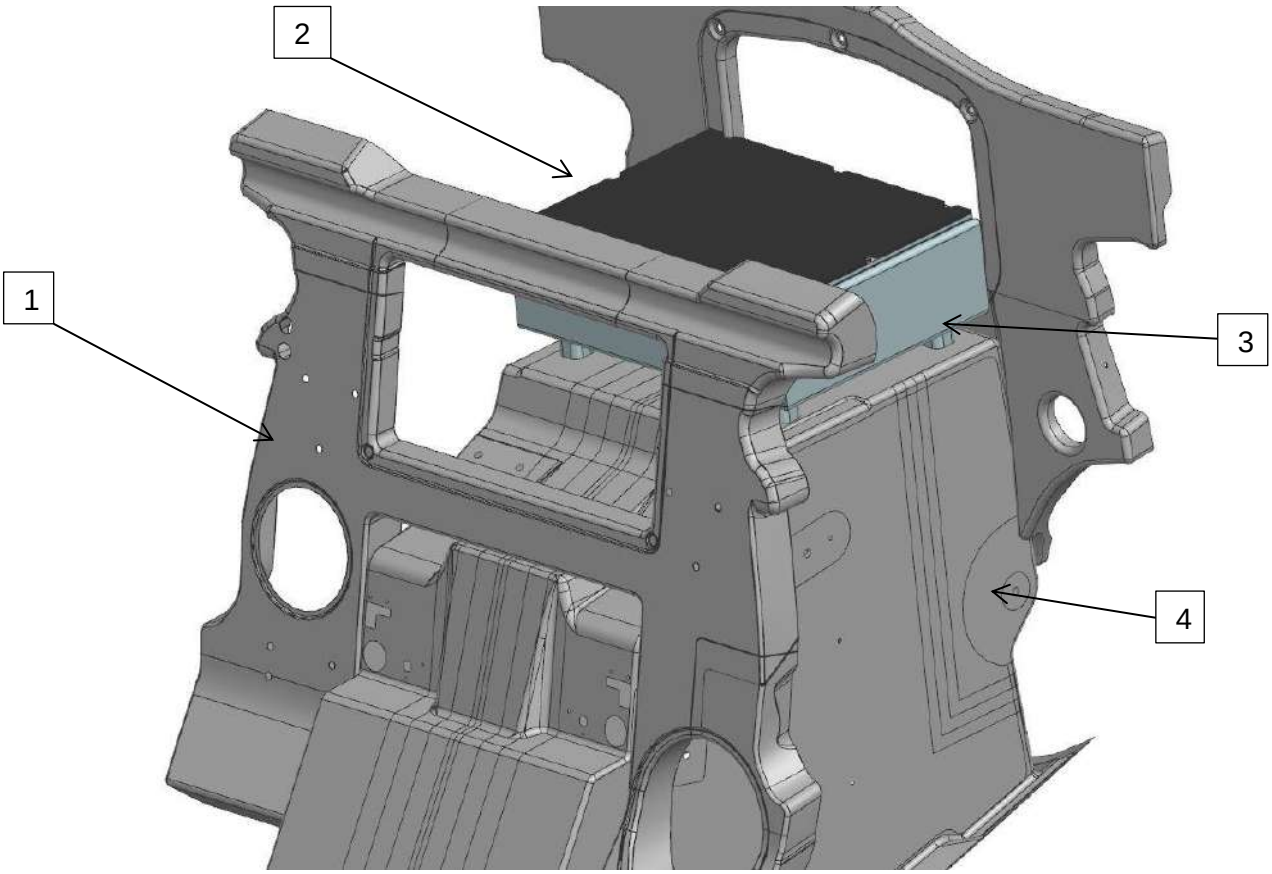
WARNING: No warning will be displayed if the cooling fans are not connected correctly. It is best to verify that the Cooling fans work by doing a ground run.

4.11.2 Water cooled motor controller assembly

The water cooled motor controller assembly is installed above the wheel box between Bulkhead B7 and B8 below the wing spars.

The controller board is housed in a aluminium enclosure. High voltage wiring is connected to the rear of the motor controller assembly, facing the tail of the aircraft. Liquid cooling system tubes are connected controller unit.

4.11.2.1 Overview



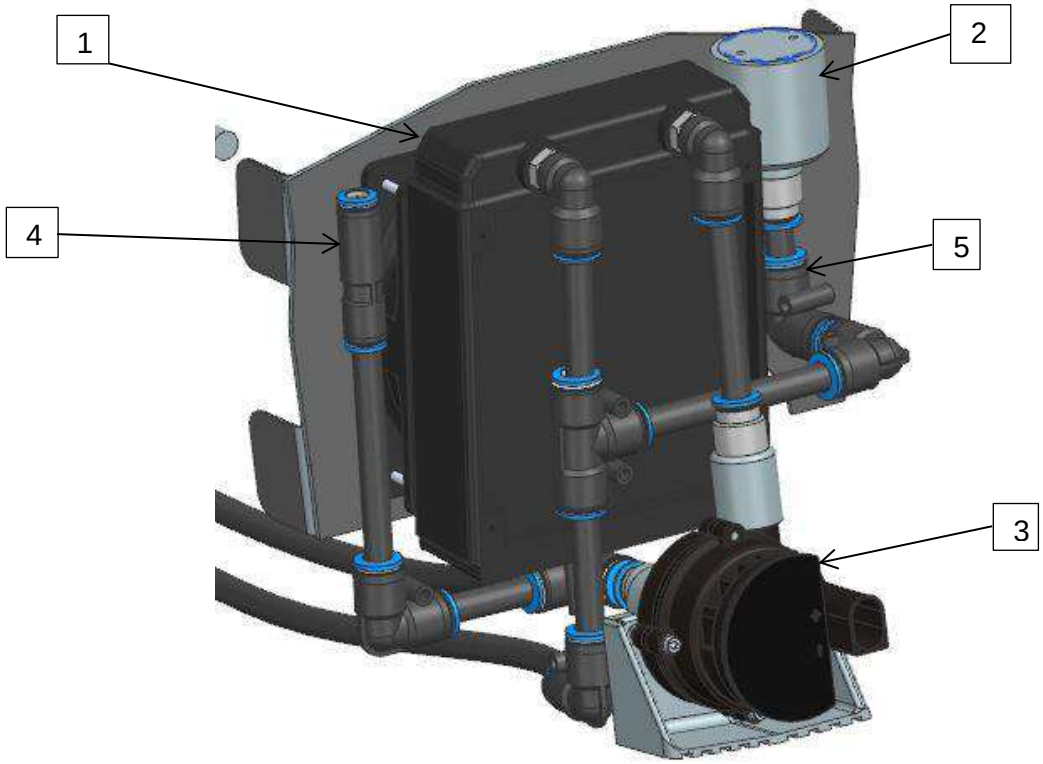
No.	Description	No.	Description
1	B5 Bulkhead	2	Motor controller assembly
3	Controller box stands	4	Wheel Box

Figure 4-23 Aluminium motor controller overview

4.11.2.2 Removal

Removal of the Liquid Cooling System consists of the draining of the liquid out of the cooling system, removal of the radiator system and the removal of the motor controller box from the fuselage.

4.11.2.2.1 Liquid system draining

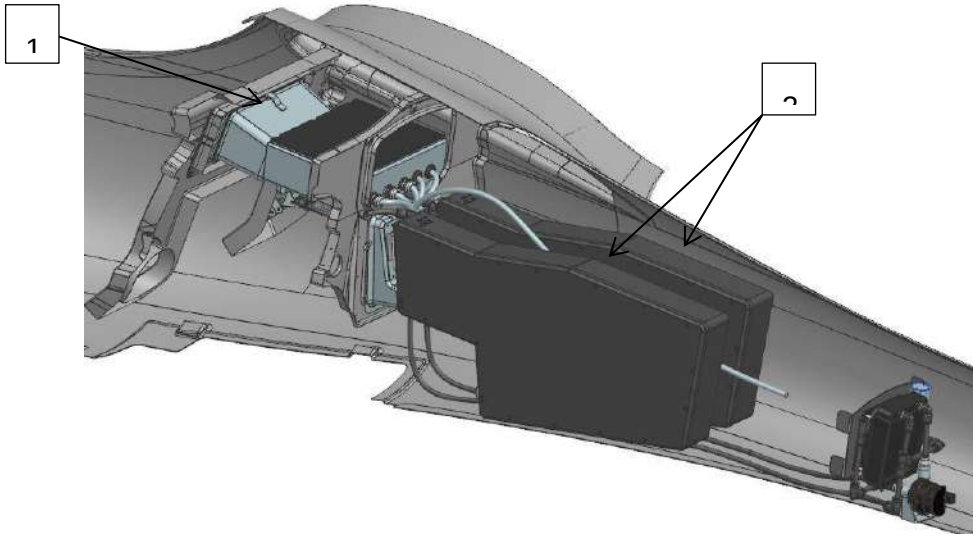


No.	Description	No.	Description
1	Radiator	2	Expansion Cylinder
3	12V Water Pump	4	No-spill Fitting
5	Elbow Fitting		

Figure 4-24 Radiator assembly

1. Ensure the master switch of the system is switched OFF.
2. Remove the Expansion Cylinder (2) from the Elbow fitting (5).
3. Connect an external pipe to the Elbow fitting (5) to avoid spillage.
4. Drain the system by connecting an external 12V power supply to the Water pump (3)
5. Ensure the system is drained.

4.11.2.2.2 Removal of the motor controller assembly from the fuselage

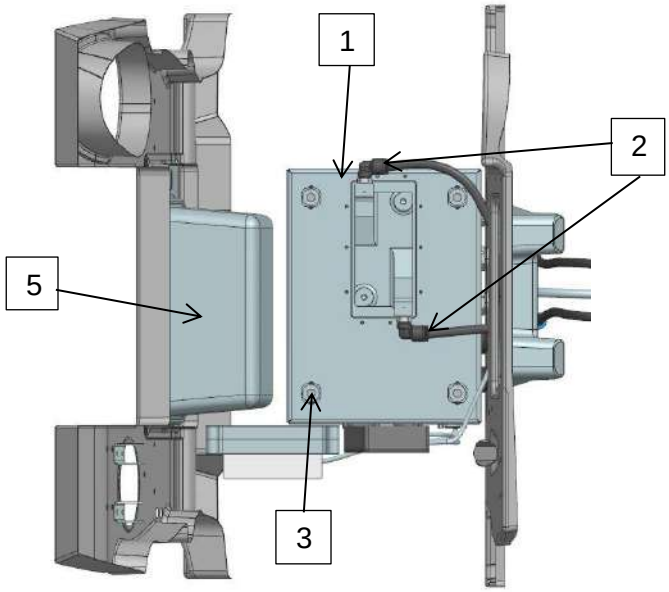


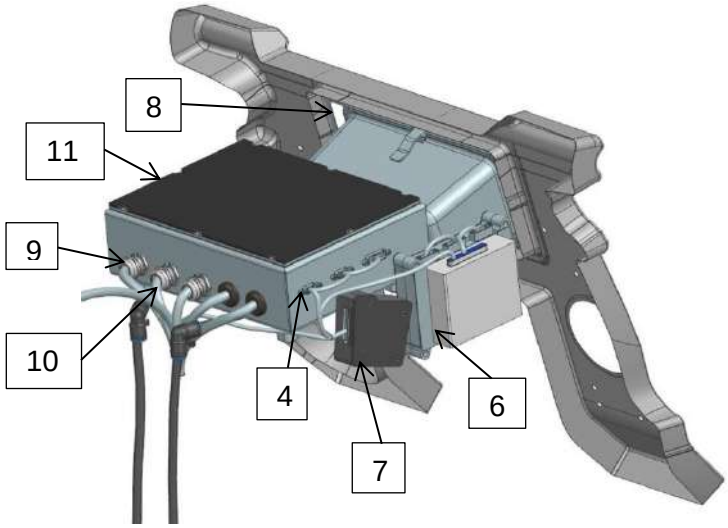
No.	Description	No.	Description
1	Glove box assembly	2	Master batteries

Figure 4-25 Glove box and battery removal

1. Disconnect the Bug wiper connector back plate (8) by loosening its two fastening bolts.
2. Pull the battery cable through the grommet and the Glove box assembly (5)
3. Remove the Glove box assembly (1) by removing the four bolts that holds the assembly in position.
4. Ensure both Master batteries (2) are removed from the aircraft.

4.11.2.2.3 Motor controller box removal





No.	Description	No.	Description
1	Motor controller assembly	2	Elbow fitting
3	Mounting bolt	4	D-sub connectors
5	Glove box assembly	6	RFU-Isometer assembly
7	RCB PCB assembly	8	Bug wiper connector back plate
9	Cable glands	10	High voltage wires
11	Motor controller Lid	12	High voltage ring terminals
13	Motor Controller PCB	14	Water lines

Figure 4-26 Motor controller assembly view

1. Ensure the HV batteries are removed and RES master switch is OFF.
2. Remove the connectors to the RFU-Isometer assembly (6) and the RCB PCB assembly (7).
3. Remove the D-sub connectors (4) from the controller box assembly.
4. Undo the eight bolts of the Motor controller lid (11) and remove the lid.
5. Loosen the three Cable glands (9) to ensure they are not clamping the wires.
6. Remove the bolts retaining the high voltage ring terminals (12) to the Motor controller PCB (13).
7. Remove the high voltage wires from the box.

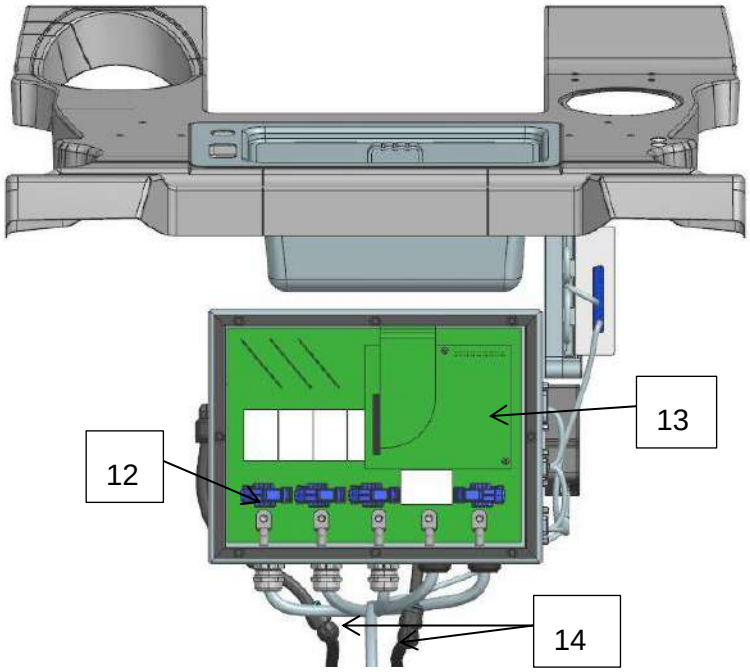


Figure 4-27 Motor controller top view

8. Remove the Water Lines (14) from Elbow fittings (2).

Caution: Do not spill undrained coolant. Spilled liquid may cause damage to the connectors and other components.

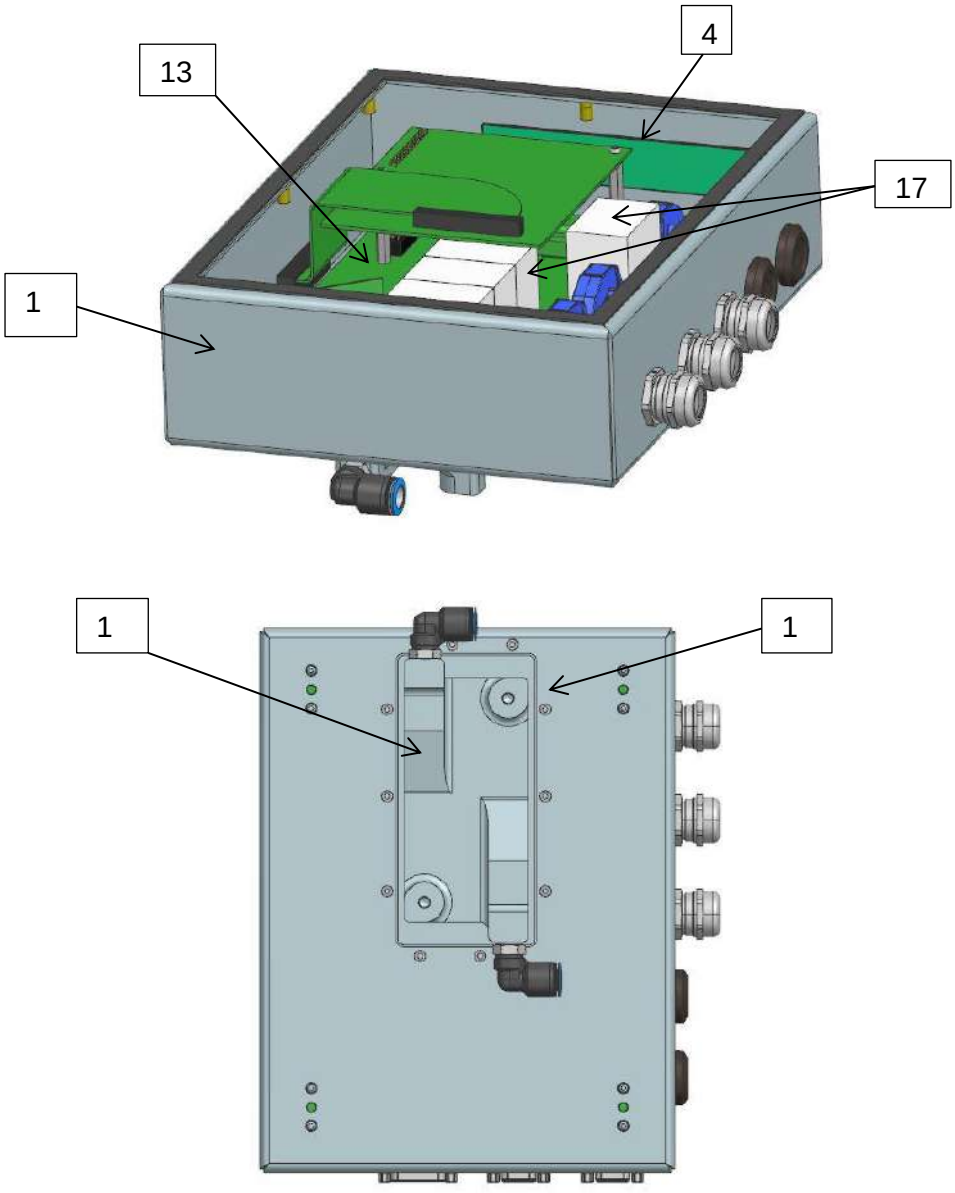
9. Loosen and remove the Mounting bolts (3) within the wheel box, located at the top of the wheel box.
10. Remove the motor controller assembly from the fuselage.

Caution: Clear all wiring while removing the assembly as the wiring loom can be damaged.

4.11.2.2.4 Removal of the motor controller assembly PCBs

Two PCBs are located within the motor controller assembly:

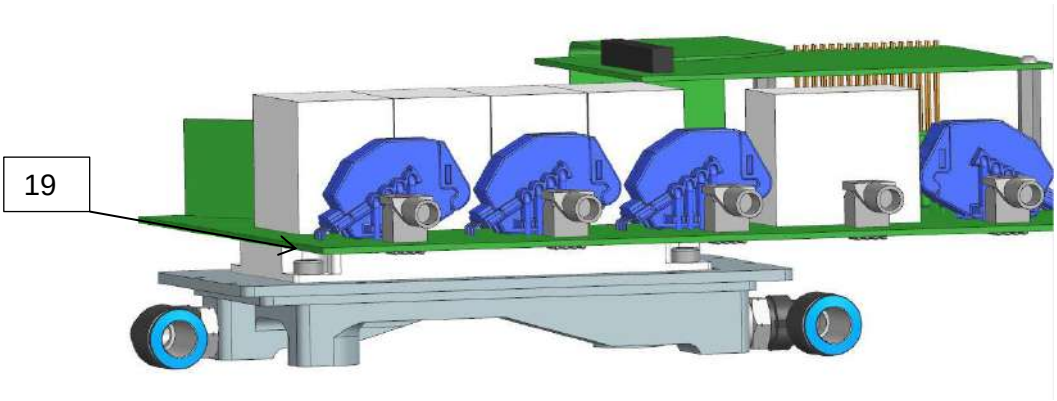
- Motor controller PCB
- D-sub assembly



No.	Description	No.	Description
15	Cold Plate	16	Cold plate mount bolts
17	Position to hold motor controller assembly	18	Box assembly

Figure 4-28 Motor controller assembly bottom view

1. Disconnect the ribbon cable from the D-sub assembly (4).
2. Remove the D-sub assembly to be able to gain access to the motor controller PCB.
3. Unfastened the Cold Plate mount bolts (16).
4. Lift the motor controller box and remove the motor controller from the Box assembly (18).

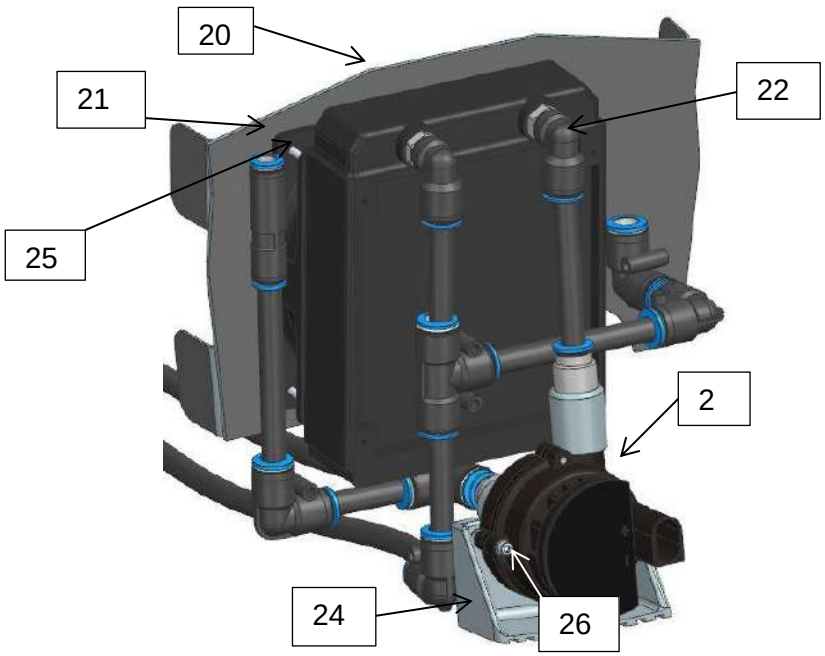


No.	Description	No.	Description
19	Cold Plate mounting bolts		

5. Remove the motor controller PCB from the cold plate by unfastening the Cold plate mounting bolts (19).

4.11.2.2.5 Removal of radiator assembly

The radiator assembly is supported by the Radiator support plate (1)



No.	Description	No.	Description
20	Radiator support plate	21	Fan
22	Radiator	23	Water pump
24	Water pump bracket	25	Radiator mounting bolts
26	Water pump mounting bolt		

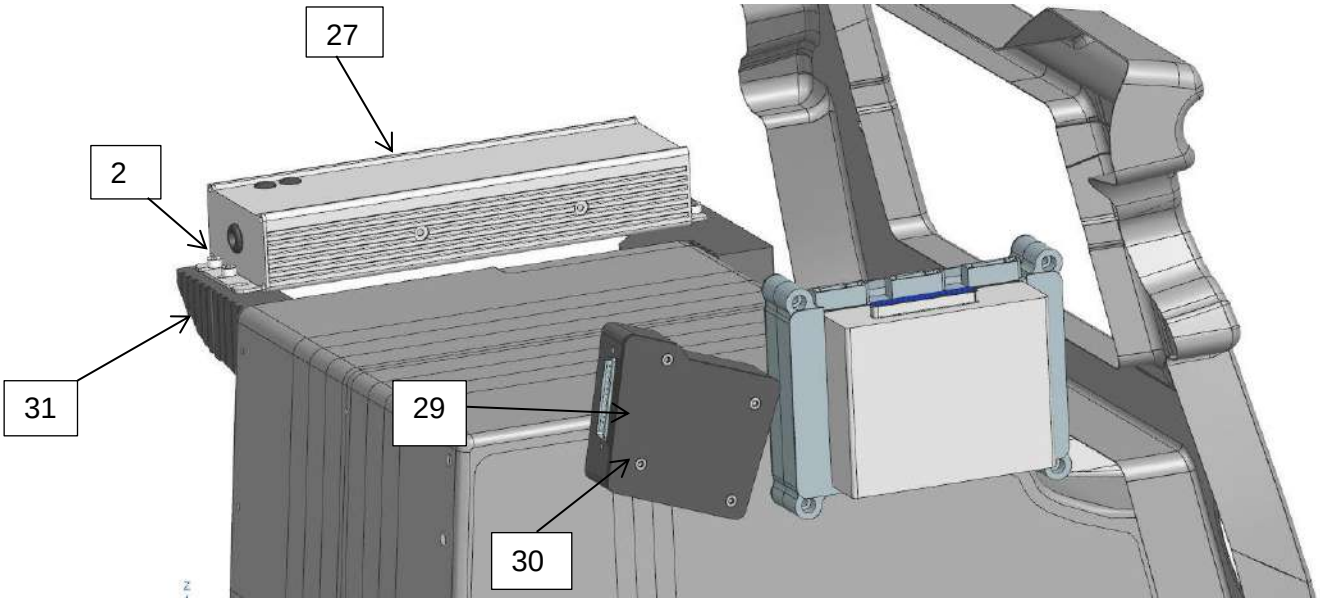
Figure 4-29 Radiator assembly

1. Disconnect water lines from Radiator (22) fittings.

Caution: Avoid water spillage.

2. Loosen and remove the Radiator mounting bolts (25).
3. Remove the Radiator (22), Fan guard and Fan (21) from the aircraft.
4. Remove the water lines from the Water pump (24).
5. Loosen the Water pump mounting bolt (26) from the bracket. DO NOT remove the bolt from the water pump.
6. Remove the water lines from the aircraft.

4.11.2.2.6 Removal of DC-DC converter and RCB PCB



No.	Description	No.	Description
27	DC-DC converter	28	DC-DC converter mounting bolts
29	RCB PCB assembly	30	RCB PCB mounting bolt
31	DC-DC converter brackets		

Figure 4-30 DC-DC Converter and RCB PCB assembly

1. Unfasten the DC-DC converter mounting bolts (28).
2. Unfasten the RCB PCB mounting bolts (30) from the RCB PCB assembly (29) to lid to gain access to the RCB PCB.

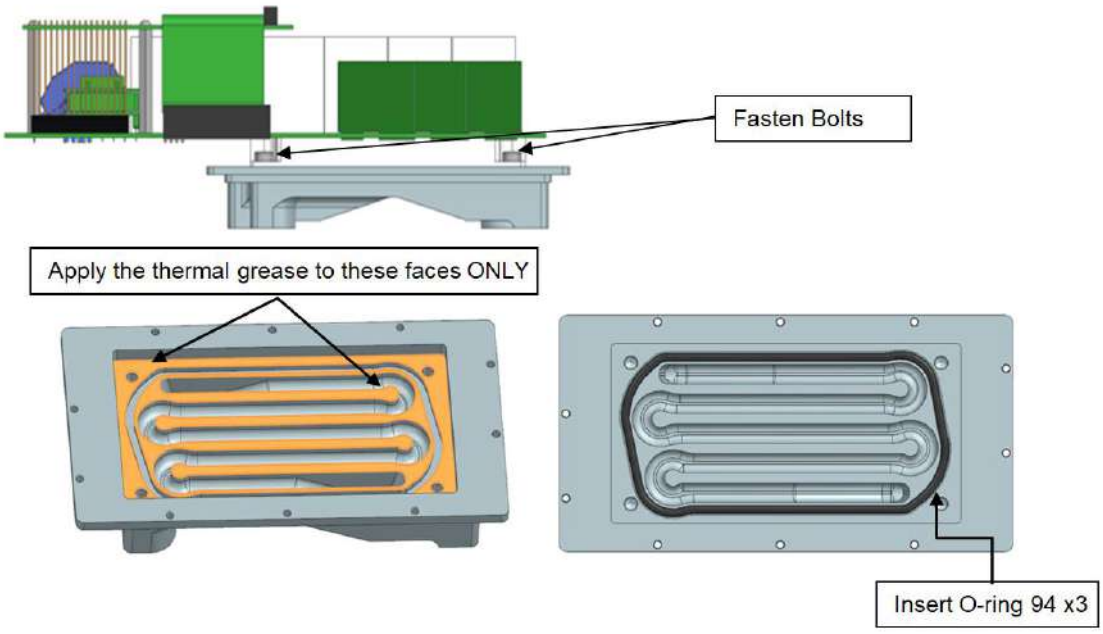
4.11.2.3 Installation

Installation of the liquid cooling system and the motor controller assembly consists of the following installation procedures:

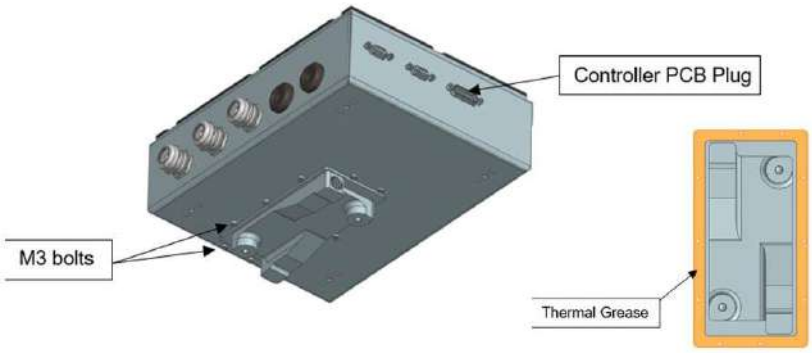
- Installation of the motor controller system, DC-DC converter and RCB PCB assembly into the fuselage.
- Installation of the radiator and piping system into the fuselage.
- Bleeding of the liquid cooling system.

4.11.2.3.1 Installation of the controller system, DC-DC converter and RCB PCB assembly

1. Apply a thin film of thermal paste onto the cold plate ribs, as indicated in the illustration below.
2. Install the O-ring into groove, as indicated below



3. Fasten the motor controller PCB to the cold plate.
4. Apply a thin layer of thermal paste onto the bottom of the cold plate as illustrated in the below figure,

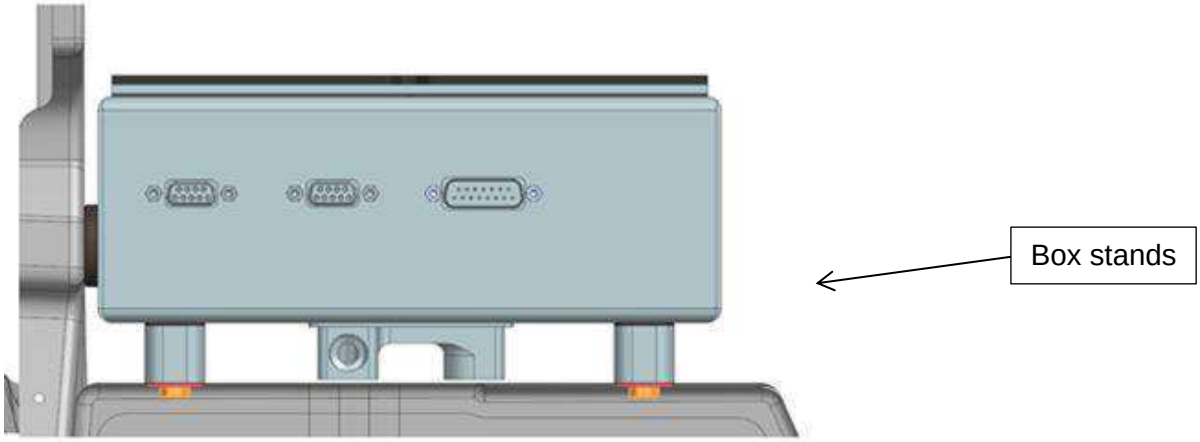


5. Fasten the cold plate to the motor controller box with M3 size bolts.
6. Install the D-sub assembly (4) into the box and fasten into position.
7. Connect the ribbon cable from the Motor controller PCB (13) to the D-sub assembly.

WARNING: If the ribbon cable is not connected, the motor controller will not work.

8. Install Elbow fitting (2) to Cold plate (15).
9. Install box stands into fuselage and fasten Box assembly (18) into position.

CAUTION: Do not disturb any wiring when inserting the motor controller assembly.



10. Install DC-DC converter (27) to DC-DC converter brackets (31).
11. Install RCB into PCB housing and fasten with RCB PCB mounting bolts (30).
12. Fit High voltage wire (10) through Cable glands (9) and Grommets and connect High voltage terminals (12) to Motor controller PCB (13). The wire colour identifications should be matched as illustrated in Figure 4-31.

WARNING: The high voltage terminals should be fastened. Ensure the washers are installed, if not the bolts could bottom out and not retain the ring terminal. This will destroy the motor controller.

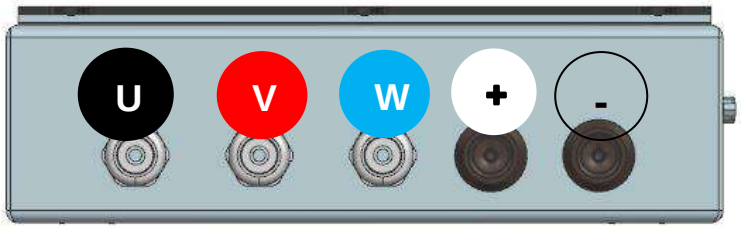
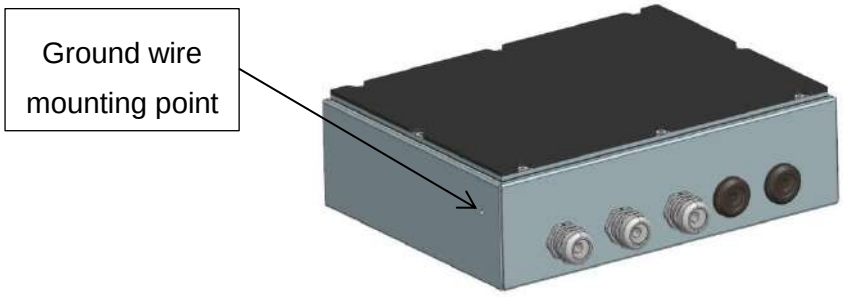


Figure 4-31 Motor controller HV wire sequence

13. Tighten the three Cable glands (9).



14. Install ground wire to motor controller PCB and ground bolt, connecting to the box.

WARNING: If the ground wiring is not connected to the **Motor Controller PCB (13)** the motor and motor controller will not operate correctly. This will increase EMF interference and could cause permanent damage to the motor controller.

15. Fasten the five ring terminals:
    - Cooling fans ground
    - Motor ground
    - PCB ground
    - Ground bus wire
    - Water pump ground

WARNING: If any one of these five wires is excluded, the system will not work properly and can cause a major fire risk or damage to the system.

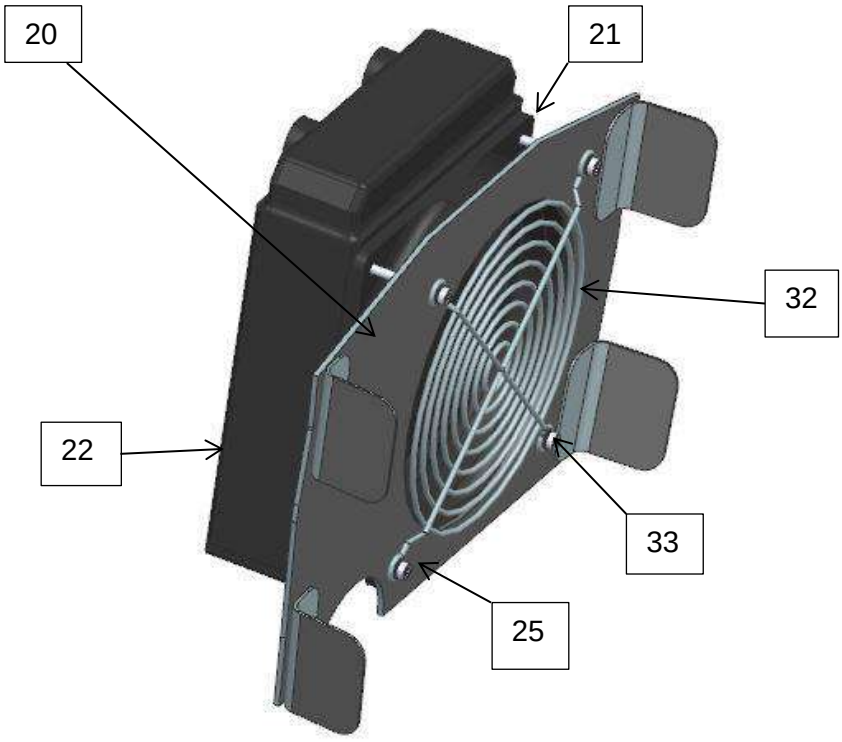
16. Ensure the ground bus wire is connected to the ground bus and the ground bolt.
17. Verify the continuity between the ground bus of the aircraft and the shielding of the HV wires U, V and W. A needle can be used to protrude the external insulation of the wire.

Figure 4-32

18. Install the D-sub connectors located on the left and right side of the motor controller assembly.
19. Install the Glove box assembly (5)
20. Route the battery cable through the grommet which is located in the glove box assembly.
21. Install the Bug wiper connector back plate.
22. Install and fasten the Glove box assembly into position with the four bolts located in the corner of the assembly.
23. Installing the Motor controller lid (13) and fastening into position with M4 bolts.
24. The system can now be switched on to verify that there are no errors.

WARNING: No warning will be displayed if the cooling fan and water pump is not connected correctly. It is best to verify that the cooling fan and water pump works by doing a ground run.

4.11.2.3.2 Radiator system installation



No.	Description	No.	Description
20	Radiator support plate	21	Fan
22	Radiator	25	Radiator mounting bolts
32	Fan guard	33	Washers

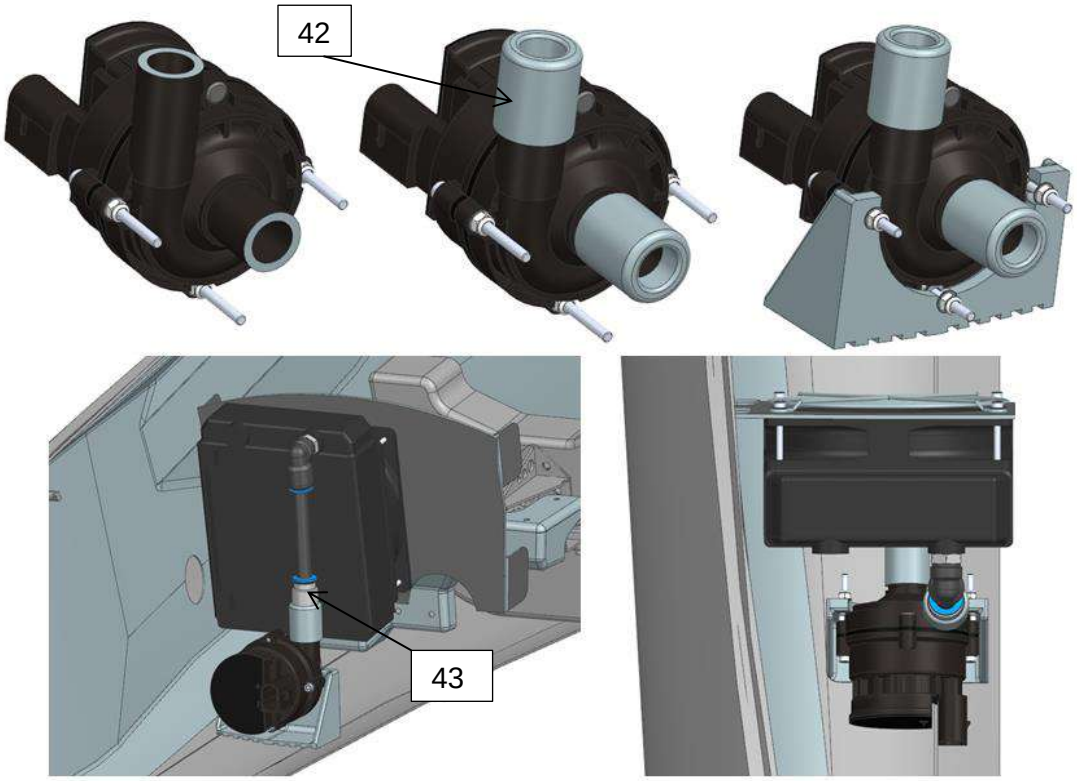
Figure 4-33 Radiator system installation

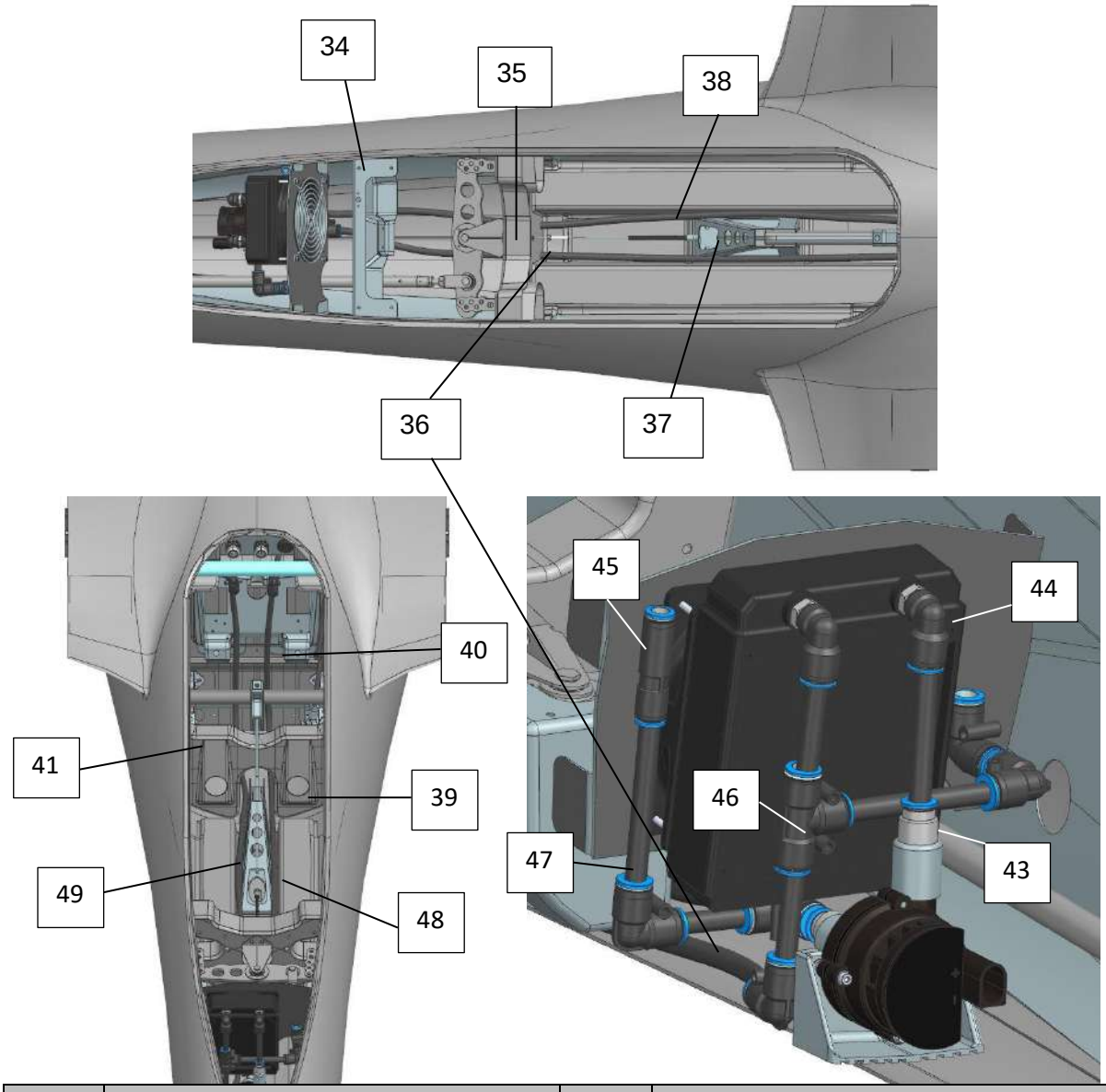
1. Install Fan guard (32), Washers (33) and Radiator mounting bolts (25) to Radiator support plate (20).
2. Install Fan (21) and faster mounting bolt to Radiator (22).

Caution: Do not damage the threaded holes in radiator as radiator is manufactured from aluminium.

4.11.2.3.3 Piping system installation

This section focusses on the correct installation of the piping system of the liquid cooling system. The piping system includes the pump assembly, the expansion cylinder and transfer tubes.





No.	Description	No.	Description
34	B9-1	35	B9
36	Engine bay water lines	37	Pylon tower
38	Battery bed	39	B8
40	Battery latch	41	Mixer system
42	Water pump reducer	43	Threaded inline fitting
44	Threaded elbow fitting	45	No-spill fitting
46	Tee fitting	47	Elbow fitting
48	Water line from cold plate	49	Water line to cold plate

Figure 4-34 Radiator and water pump connections

WARNING: Make sure that all water transfer pipes are correctly installed into the fittings to avoid leakages that can cause damage to the motor controller.

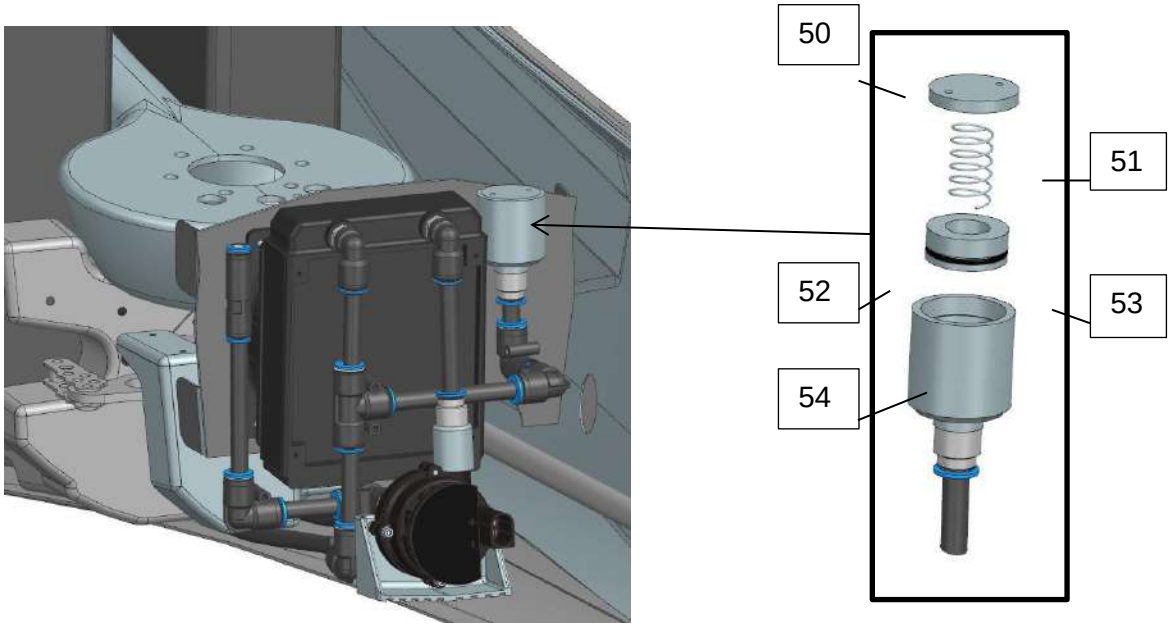
1. Install Water pump (23) to Water pump bracket (24).
2. Bond Water pump reducer (42) into position. If the pump has not been reworked, make sure to remove the thicken part of the pump in and outlet.

WARNING: The radial tube on the water pump is the water outlet and the axial tube is the water inlet. Connect water lines accordingly. The liquid cooling system will not bleed properly and the cooling system will not function as intended otherwise.

3. Apply sealing tape to the threaded part of both fittings.
4. Install the Threaded elbow fitting (44) to the Radiator (22).
5. Install the threaded inline fitting (43) to the Water pump reducer (42).
6. Install Tee fitting (46) on water line from cold plate (48) and connect to Threaded inline fitting (43).
7. Connect the rest of the piping system as shown in Figure 4-34 Radiator and water pump connections.

Caution: Make sure not to have components pass the top of the Radiator (22) to allow space for the propeller when the pylon system is retracted.

8. Fasten the No-spill fitting (45) and the Expansion cylinder Assembly (Figure 35) to the Radiator support plate (20) with zip ties.



No.	Description	No.	Description
50	Expansion cylinder lid	51	Spring (OD15x60x1)
52	Expansion cylinder piston	53	O-ring 25x2.5
54	Expansion cylinder sleeve		

Figure 35 Expansion cylinder assembly

9. Install the Expansion cylinder assembly according to Figure 40.

4.11.2.4 Maintenance

4.11.2.4.1 Bleeding of the system

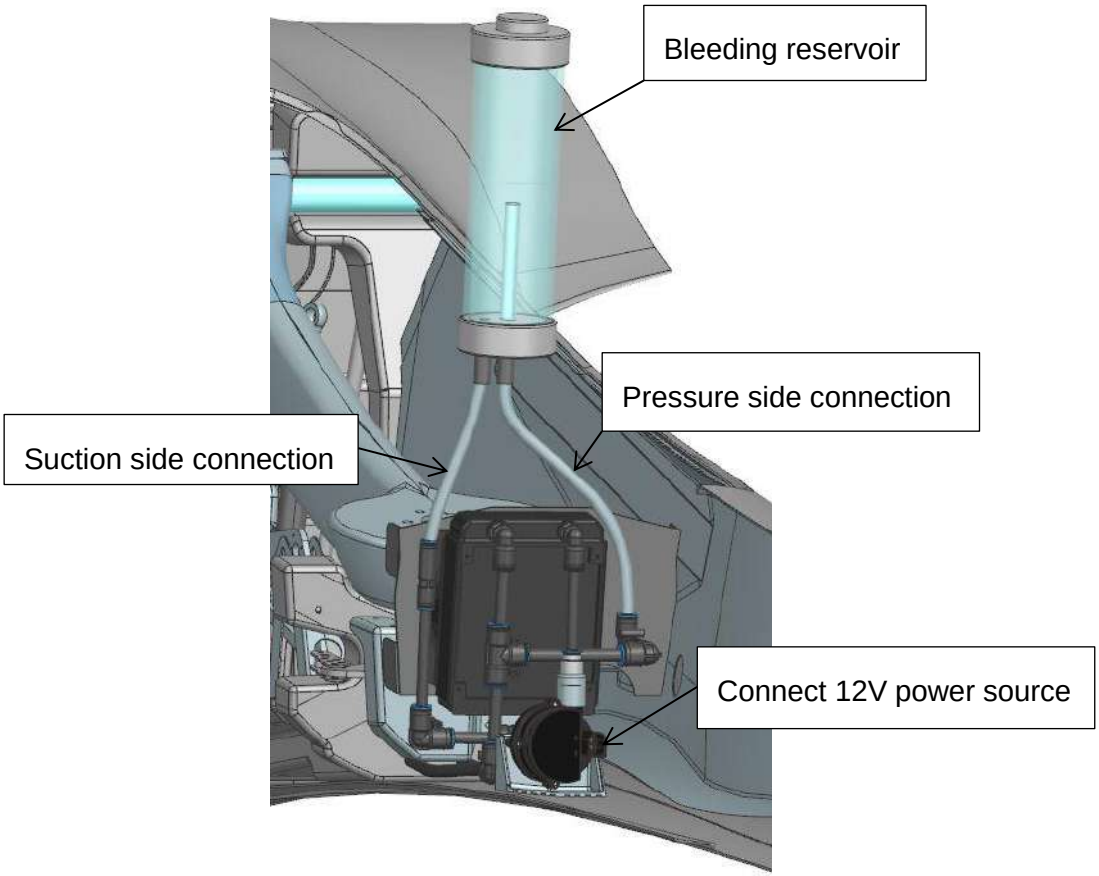
In this section, the bleeding process of the liquid cooling system is described. Ensure the electrical system is switched OFF and the High Voltage batteries have been removed. When bleeding the liquid cooling system, avoid spilling water onto the electrical system. Also, ensure that all the pipes and fittings have been connected into the correct positions and are sealing correctly.

The liquid system is sensitive to changes in ambient temperature. To avoid freezing of the coolant, it is advised to add an “anti-freeze” (Propylene Glycol is preferred) to the liquid system. Mixing ratios are indicated in this section. When in ambient temperature is always above 0°C, no mixed coolant in required.

4.11.2.4.2 Coolant Mixture

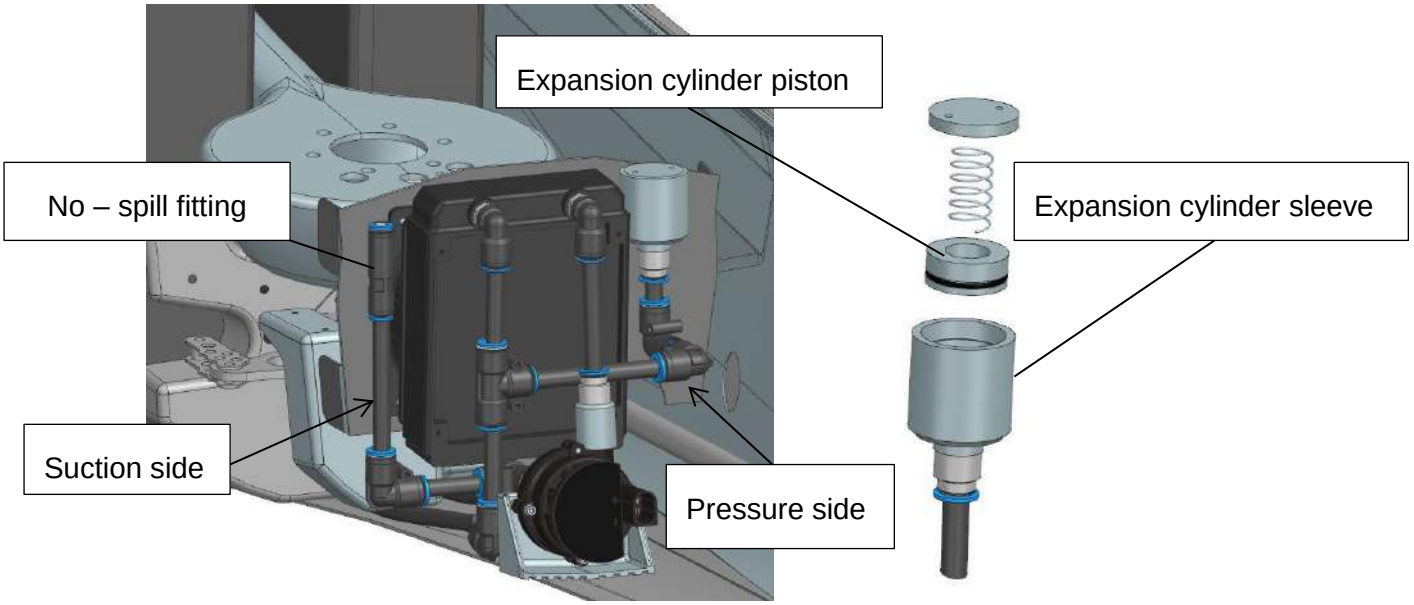
Ambient Temperature during operation / storage	Propylene Glycol (Coolant)	Distilled Water
>0°C	Not required	1
Between 0°C and -12°C	1	3
Between -12°C and -18°C	1	2.2
Between -15°C and -21°C	1	1.3

4.11.2.4.3 Inserting Coolant to the water system



1. Unclip the expansion cylinder assembly from its bracket and disconnect from the elbow fitting.
2. Connect the bleeding reservoir as illustrated above.

3. Place the bleeding reservoir above the liquid cooling system.
4. Add coolant to the bleeding reservoir (ensure that the coolant fills the suction hose of the pump)
5. When the suction hose of the pump is filled, fill the reservoir with coolant
6. Follow section 4.11.2.4.4 to fully bleed the liquid system.



4.11.2.4.4 Repeat the following steps until the system is bled

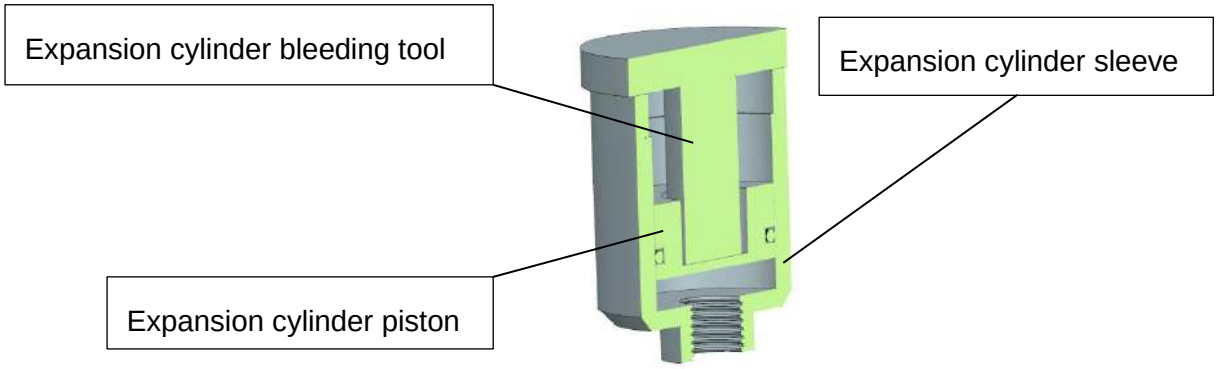
1. Elevate the fuselage nose by lowering the tail (ensure the pump is the lowest component in the liquid cooling system).
2. Turn on the pump.
3. Lightly tap the radiator to ensure all the air is removed from the radiator.
4. Turn off the pump.
5. Level out the fuselage by elevating the tail.
6. Turn on the pump for 1 min.
7. Compress and decompress the silicone pipes attached to the bleeding reservoir.
8. Elevate the tail of the fuselage (ensure that the pump is the highest component of the water system).
9. Turn on the pump.
10. Lightly tap the radiator.

11. Lightly tap the pipes.
12. Turn off the pump.
13. Level out the fuselage.

The system is completely bled when the pump is turned on and no cavitation noises are present. The coolant entering the bleeding reservoir from the pump should be clear and not contain air bubbles of any size.

Repeat steps 1 to 13 until the system is bled.

14. Remove the bleeding pipe on the pressure side and install the Expansion cylinder sleeve.
15. Completely, fill the sleeve, take care to avoid spilling.
16. Insert the O-ring over the expansion cylinder piston and install to the expansion cylinder sleeve.
17. Use Expansion cylinder bleeding tool (T 234 32 080 00) to press down on the piston. The water will pour out of the suction side, allow this to happen.



18. While pressing down on the Expansion cylinder bleeding tool (T 234 32 080 00), remove the bleeding pipe, on the suction side, from the no-spill fitting.
19. Remove the Expansion cylinder bleeding tool (T 234 32 080 00) and install the spring and lid.
20. Fasten the lid into position with Expansion cylinder bleeding tool (T 234 32 080 00).

4.11.2.4.5 Liquid Cooled system inspection

It is important to ensure the system has a sufficient level of coolant i.e. the pump should run without cavitation noises. This inspection should be done every 100 hours of operation to ensure the product operates as intended.

Inspection steps:

1. Inspect the coolant tubes, radiator and cold plate for leakage.

Warning: If leakage is present, it is an indication that the coolant level is not at the required level for operation. This can cause damage to the motor controller as the motor controller will over heat.

2. Disconnect the pump from the aircraft's electrical system.
3. Connect pump to an external 12V power supply.
4. Listen for cavitational noises from the pump.
5. In the case of cavitational noises being present refer to 4.11.2.4.4.

4.12 DC-DC converter

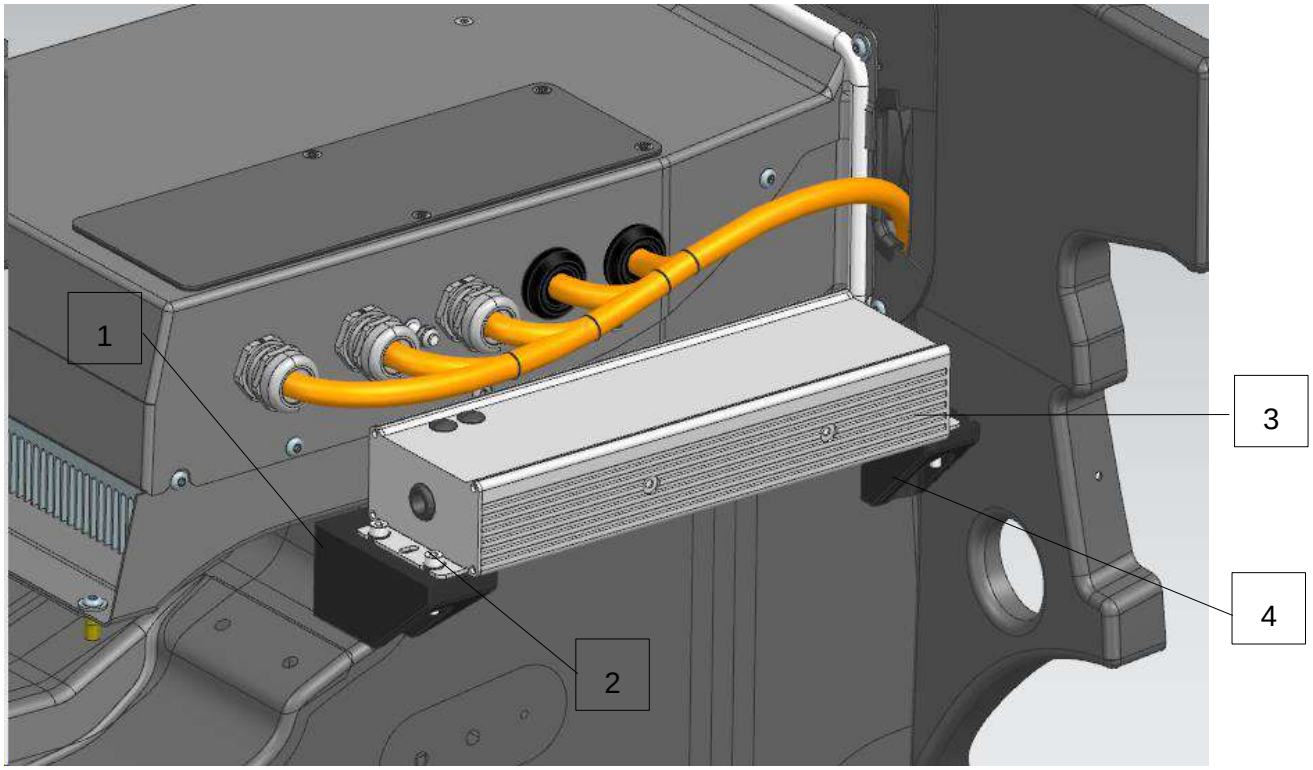
The DC-DC converter converts the HV (400V) to 12 V to supplement the 12 V avionic batteries. The DC-DC converter is located on the left side of the wheel box and motor controller assembly. The DC-DC converter is fastened to two brackets which is bonded to B8 and the wheelbox.

4.12.1 Specification

Table 4-3 DC-DC converter specifications

Parameter	Value
Part number	107 02 075 00
Input Voltage	400 V
Output Voltage	14-16V
Max output current	15A

4.12.2 Overview



No	Description	No	Description
1	DC-DC front bracket	2	DC-DC fastening bolts
3	DC-DC converter	4	DC-DC rear bracket

Figure 4-36 DC-DC converter

4.12.3 Removal

1. Ensure the master switch of the system is switched off.
2. Derig the glider.
3. Disconnect the DC-DC converter wires.
4. Loosen and remove the four **DC-DC fastening bolts (2)**.
5. Remove the **DC-DC converter (3)** from the fuselage.

4.12.4 Installation

1. Insert the **DC-DC converter (3)** into the fuselage.
2. Fasten the **DC-DC converter (3)** to the front and rear DC-DC brackets using the four **DC-DC fastening bolts (2)**.

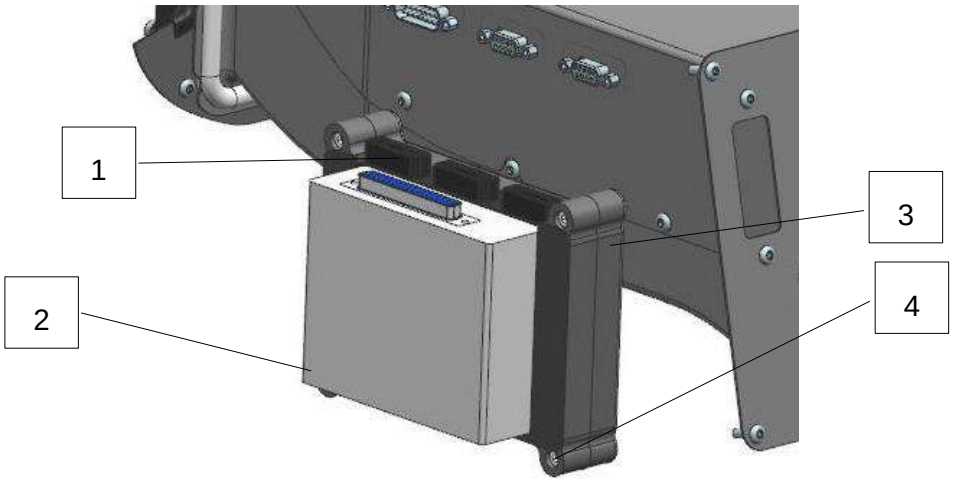
CAUTION: Be careful not to push out the captive nuts while inserting the fastening bolts.

3. Connect the **DC-DC converter (3)** wires.

4.13 Retraction and Fuses Unit (RFU)

The Retraction and Fuses Unit is responsible for the power distribution. Smart fuses are used in the RFU to protect the system from electric overload. The RFU is fastened to the same bracket as the IMD, which is located on the right side of the wheel box and motor controller.

4.13.1 Overview



No	Description	No	Description
1	IMD	2	RFU
3	IMD/RFU Bracket	4	IMD/RFU bracket bolts

Figure 4-37 RFU

4.13.2 Removal

1. Ensure the master switch of the system is switched off.
2. Disconnect the wires of the **IMD (1)** and **RFU (2).**
3. Loosen the four **IMD/RFU bracket bolts (4)** to split the bracket.
4. Remove the **RFU (2)** and one side of the **IMD/RFU Bracket (3).**

4.13.3 Installation

1. Install the **RFU (2)** into the one half of the **IMD/RFU Bracket (3)** and fasten the bracket to the other side of the bracket using the four **IMD/RFU bracket bolts (4).**

CAUTION: Be careful not to push out the top captive nuts while inserting the fastening bolts.

2. Connect the wires of the **IMD (1)** and **RFU (2).**

4.14 Insulation Monitoring Device (IMD)

4.14.1 Overview

The Insulation Monitoring Device (IMD) is used to protect the system against high voltage leaks. If a high voltage leak is detected by the IMD, the HV system will be interrupted.

The IMD is fastened to the same bracket as the RFU, which is located on the right side of the wheel box and motor controller. The bracket consists of two halves, one side is removable, and the other side is bonded to the wheel box.

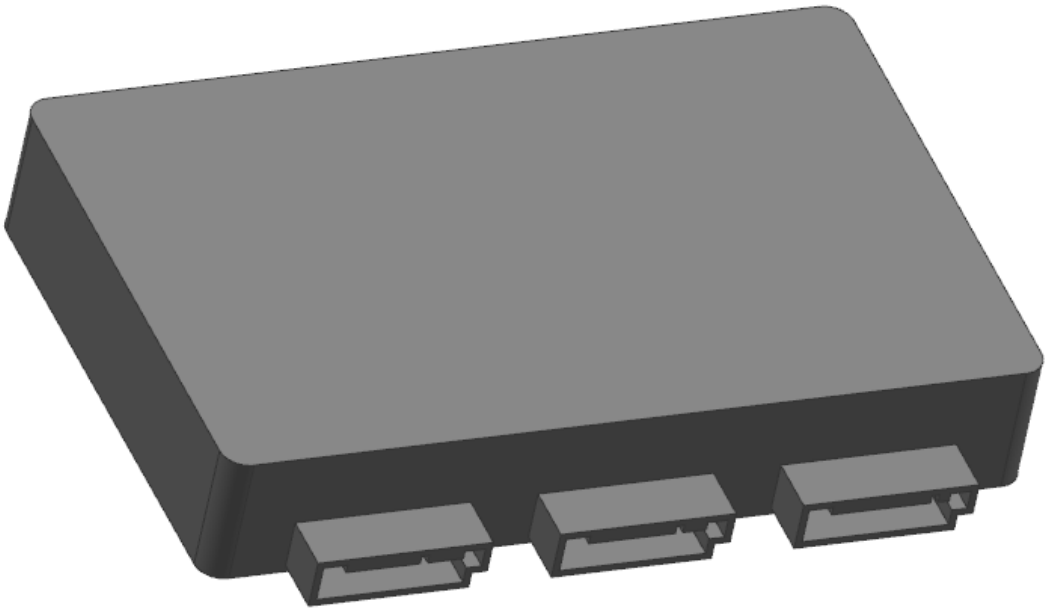


Figure 4-38 Insulation monitoring device

4.14.2 Removal

The removal process is the same as when removing the RFU (refer to the **Retraction and Fuses Unit (RFU)** section).

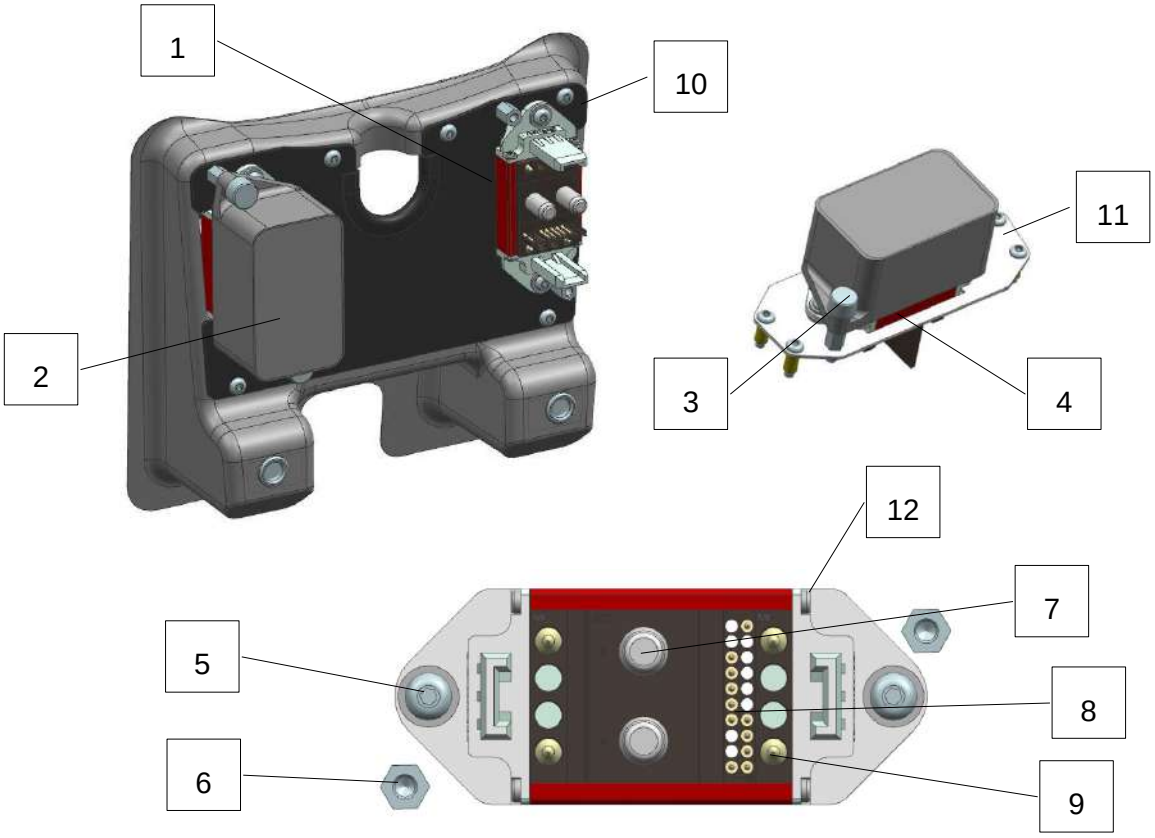
4.14.3 Installation

The installation process is the same as when installing the RFU (refer to the **Retraction and Fuses Unit (RFU)** section).

4.15 HV Connectors

4.15.1 Overview

There are three high voltage connectors within the aircraft. One is located in the cockpit, on the left side of the seat (Charge connector). The other two connectors (HV Battery connectors) are located in the rear section of the fuselage. The gender of the HV Battery connectors and charge connector are opposite.



No	Description	No	Description
1	HV Battery connectors	2	Termination Plug
3	Thumb Screw	4	Charge Connector
5	HV Connector fastening bolts	6	Standoff
7	HV Pins	8	Communication Pins
9	Interlock Pins	10	Battery connector bracket base plate
11	Cockpit charging port plate	12	HV connector

Figure 4-39 High Voltage Connectors

The **Charge connector (4)** is used to charge either one or both of the HV batteries without removing them from the aircraft. Refer to **Wiring loom** section. When the charge plug is not used to charge the batteries, the correct **Termination plug (2)** should be used, if not – the system will not be able to power up.

HV battery connectors (1) provide the interface between the aircraft HV system and the batteries. If only one battery is used, the correct **Termination plug (2)** should be used, if not – the system will not be able to power up. Refer to **Wiring loom** section.

The termination plug should be securely fastened to the **Standoff (6)** using the two **Thumb screws (3).**

4.15.2 Maintenance & Checks

The battery connectors must be kept clean, as dirt can contribute to malfunctions or damage to the connectors.

4.15.3 Removal

1. Remove the **Termination plug (2)** if installed.
2. Remove the **Battery connector bracket base plate (10)** by loosening the relative bolts.

   Skip this step if working on the charge connector.

CAUTION: Be careful to not damage any wires or wedge any wiring between the plate and the supporting structure.

3. Remove the **Cockpit charging port plate (11**), by loosening the four bolts located in the corners of the plate.

   Skip this step if working on any one of the battery connectors.

CAUTION: Be careful to not damage any wires or wedge any wiring between the plate and the supporting structure.

4. Step 2/3 grants access to the fastening nuts located at the rear of the connector.
5. Loosen the two **HV connector fastening bolts (5).**
6. The HV connector can now be removed from the surrounding structure/plate.

7. Use the Pin removal tool to remove the **Communication pins (8).** The removal tool is slid over the communication pin from the front side - the pin can then be removed to the rear of the connector
8. The interlock pins are removed by disassembling the HV connector by removing the four **HV connector bolts (12).** The block containing the interlock pins can then be removed and the rear retaining block unclipped – freeing the interlock pins.
9. The **HV Pins (7)** wires can be removed by loosening the bolt in the rear of the pin. The pin itself is pressed into the connector block.

4.15.4 Installation

The installation of a high voltage connecter consists of assembling the connecter and then fitting it to the aircraft.

4.15.4.1 Communication pins

1. The **Communication pins (8)** should be crimped to the correct wire.

   Refer to the **Wiring loom** section.
2. The **Communication pins (8)** can now be slid into the correct position within the connector block until it bottoms out. Pull on the wire to confirm the pin has locked into place.

4.15.4.2 Interlock pins

1. The **Interlock Pins (9)** should be crimped to the correct wire.

   Refer to **Wiring loom** section.
2. The **Interlock Pins (9)** can now be inserted into the correct position within the connector block and held in place by clipping in the retaining block.
3. Slide the connector block into the connector and fasten the four **HV connector fastening bolts (5).**

4.15.4.3 HV pins

1. The **HV Pins (7)** are pressed into the connector block.
2. Connect the corresponding wires to the **HV Pins (7)** by fastening the rear bolt

   Refer to **Wiring loom** section.

4.15.4.4 HV connector

1. Fasten the HV connector to the corresponding plate using the two **HV Connector fastening bolts (5).**
2. Fasten the **Battery connector bracket base plate (10)** to the supporting structure by fastening the relevant bolts.

   Skip this step if working on the charge connector.

CAUTION: Be careful to not damage any wires or wedge any wiring between the plate and the supporting structure.

3. Install the **Cockpit charging port plate (11**), by fastening the four bolts located in the corners of the plate.

   Skip this step if working on any one of the battery connectors.

CAUTION: Be careful to not damage any wires or wedge any wiring between the plate and the supporting structure.

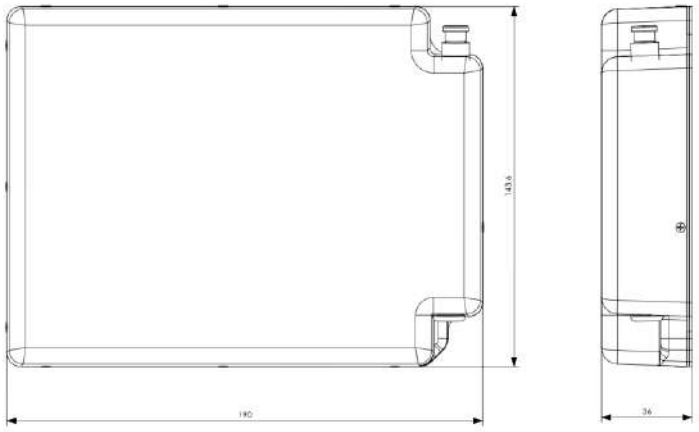
4. Install the relevant **Termination plug (2)**

4.16 Avionic Batteries

There are two avionic batteries located within the aircraft. The one battery is located within a hatch in the seatpan, aft of the control stick. The other avionic battery is located behind the seatback.

4.16.1 Seatback battery

The seatback battery has a built-in circuit breaker.



Specification	Rating
Type	LiFePO4
Voltage	12.8V
Capacity	9.9Ah
Charge current max	3A
JS Part number	231 19 188 00

Figure 4-40 Seatback specification

4.16.2 Seatpan battery

The seat pan battery has the following specification as indicated in the table below:

Specification	Rating
Type	LiFePO4
Voltage	12.8V
Capacity	9.9Ah
Charge current max	3A
Dimensions	80mmx54mmx138mm
JS Part number	107 05 055 00

Table 4-4 Seatpan battery specification

NOTE: It is good practice to unplug both avionic batteries during aircraft storage.

4.17 Fire warning system

The fire warning system is independent of the RES system. It consists of two thermal switches, a heat-sensitive cable section located in the rear fuselage compartment, a 9 V battery, test button, LED, and buzzer.

The 9 V battery is located on the bottom right side of the binnacle (Figure 4-42) and can be removed by prying the battery holder with a screwdriver.

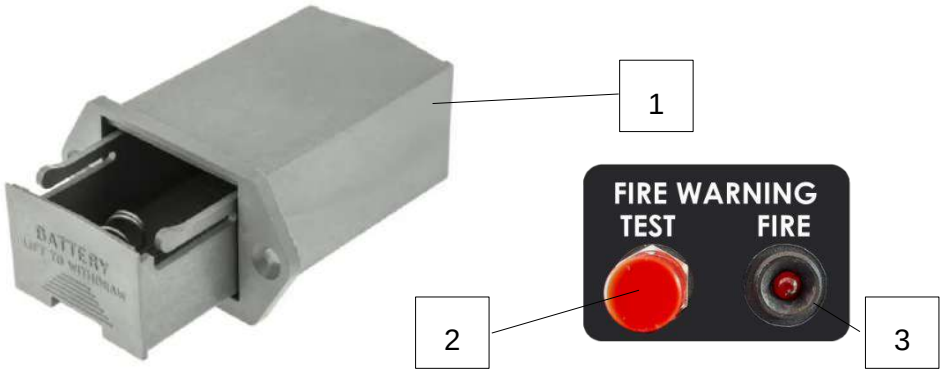


Figure 4-41 Fire warning system

No	Description	No	Description
1	Battery holder	2	Test button
3	LED		

NOTE: The 9 V 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.

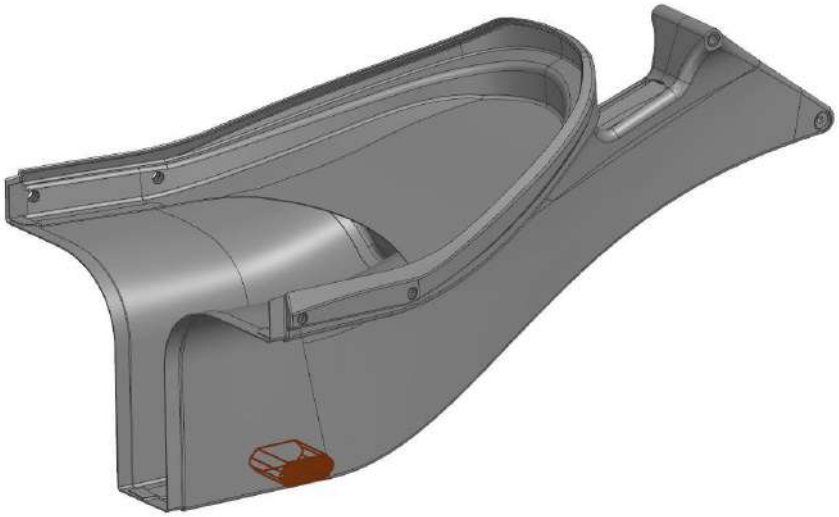


Figure 4-42 Location of 9 V Battery

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5 CALIBRATION & SETUP

5.1 Actuator system setup

The actuator system must be set up to ensure the Pylon bell crank locks in the extended position and the pylon completely retracts during retraction.

1. Extend the pylon to a position slightly below the extended position to ensure the main doors are fully open.
2. Switch off the RES master switch.
3. Disconnect the actuator from the Pylon bell crank.
4. Disconnect the pylon driver arm from the pylon.
5. Disconnect the door drivers from the main doors.
6. Boot the DCU into Maintenance mode.

WARNING: The motor and motor controller are not activated in maintenance mode. If the actuator is cycled, the propeller will not auto-align, creating the risk of propeller misalignment during retraction or extension which could damage the actuator system or propeller.

7. Fully retract the actuator.
8. Connect the Pylon bell crank to the actuator.
9. Extend the actuator 20 – 50 mm.
10. Connect the Pylon driver arm to the pylon.
11. Extend the pylon and ensure that the Pylon driver arm locks into place and that the pylon clears the fuselage by adjusting the length of the actuator front and pylon driver arm.

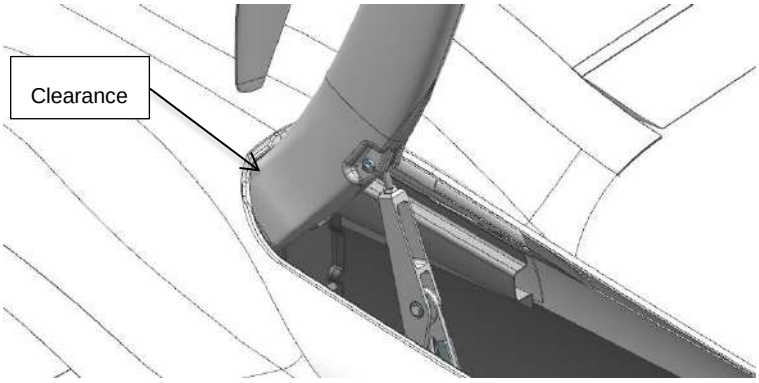

Figure 5-1 Fuselage clearance

WARNING: The pylon driver arm must lock into the pylon driver arm lock. If the joint does not fully extend it could overload the supporting structures causing mechanical failures.

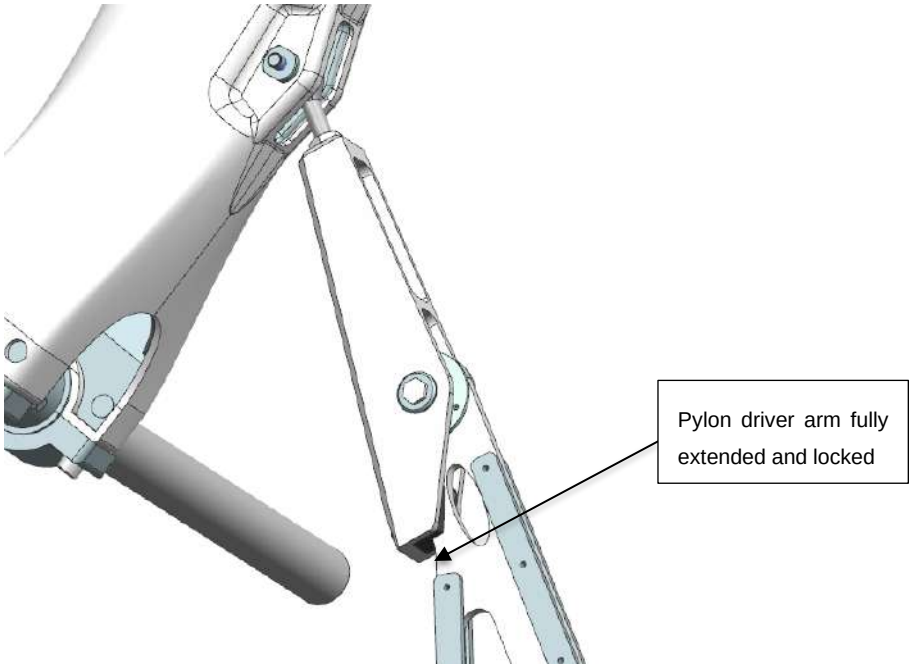

Figure 5-2 Pylon driver arm extension

12. Slowly retract the pylon. The pylon should fully retract and lightly touch the bulkhead. The pylon should not press too hard into the bulkhead as illustrated in Figure 5-3.

CAUTION: The battery latches should always be locked, if not, the motor will crash into the battery latch during retraction, preventing full retraction.

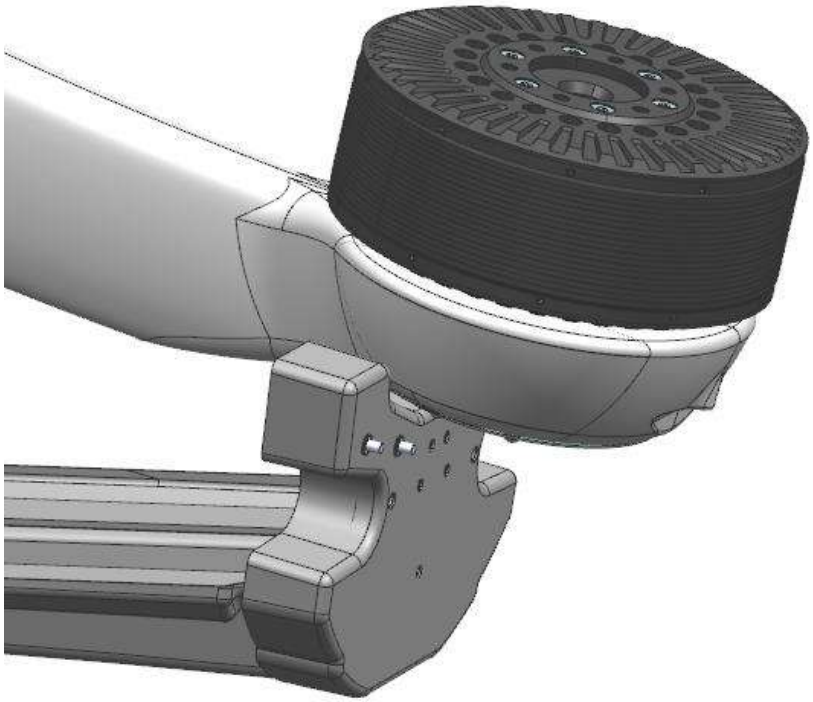

Figure 5-3 B9 Bulkhead

13. If the Pylon does not touch the bulkhead, adjust the pylon driver arm length

NOTE: The pylon driver arm length should not have to be adjusted if all of the geometry lengths were matched before replacement and if they were not adjusted during removal and installation.

14. Reconnect the main door drivers.
15. Cycle the actuator to ensure the pylon fully extends and retracts without any interference.
16. Should the main doors not close properly refer to the **Main door setup** section.

5.2 Actuator calibration

If the actuator, RFU, or DCU were replaced or any of the mechanics of the actuator system were changed or adjusted – it is advisable to recalibrate the actuator.

WARNING: The motor and motor controller are not activated in maintenance mode. If the actuator is cycled, the propeller will not auto-align, creating the risk of propeller misalignment during retraction or extension which could damage the actuator system or propeller.

1. Switch off the RES main switch.
2. Boot the DCU into Maintenance mode.
3. Cycle the actuator until it is fully retracted and then fully extended.

CAUTION: The battery latches should always be locked, if not, the motor will crash into the battery latch during retraction, preventing full retraction.

4. Switch off the RES main switch.

5.3 Main door setup

The main door setup must be done to ensure the main doors completely close during full retraction and extension.

NOTE: Before any component change, be sure to match the component lengths – this will simplify the setup.

1. Switch off the RES main switch.
2. Remove one main door.
3. Boot the DCU into Maintenance mode.

WARNING: The motor and motor controller are not activated in maintenance mode. If the actuator is cycled, the propeller will not auto-align, creating the risk of propeller misalignment during retraction or extension which could damage the actuator system or propeller.

4. Fully extend the pylon.
5. Retract the pylon to a +- 45˚ angle with the fuselage as reference.

CAUTION: The battery latches should always be locked, if not, the motor will crash into the battery latch during retraction, preventing full retraction.

6. Adjust the door driver length to ensure the door fully closes when the pylon is completely extended. The door should close firmly and be pulled into position, deflecting the door inward into the fuselage (2-3mm) at the centre point.

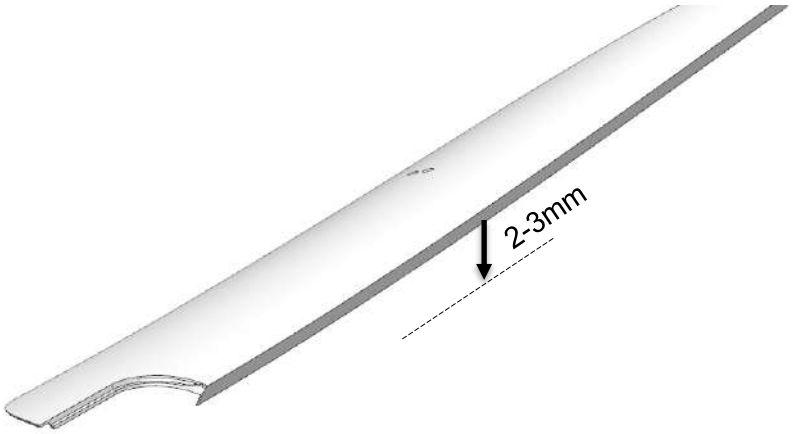

Figure 5-4 Main door setup

7. Disconnect the door that was set up.
8. Install the other main door and adjust its door driver to ensure it fully closes as well as per step 6.
9. Adjust the bell crank stop bolt to ensure the doors do not touch the fuselage during full extension and also not touch the motor while the pylon is retracted or retracted.

5.4 Motor resolver calibration

The motor resolvers must be recalibrated if either the motor or motor controller were replaced. Each motor is matched to the motor controller. Changing any one of these two components creates a miss-match in settings, causing poor motor performance or could cause the motor to not work at all. It is advisable to remove the propeller before calibration.

WARNING: If the resolver calibration is out, the motor could start rotating by itself. Be sure to clear the propeller during the start-up of the system until the calibration has been completed.

1. Switch off the RES main switch.
2. Install both HV batteries.
3. Boot the DCU into Maintenance mode.

WARNING: The motor and motor controller are not activated in maintenance mode. If the actuator is cycled, the propeller will not auto-align, creating the risk of propeller misalignment during retraction or extension which could damage the actuator system or propeller.

4. Fully extend the pylon to ensure the propeller clears the front and main doors.
5. Access the setup menu.
6. In the setup menu, scroll to the MotorCtl tab.
7. Move to the command field and enter it.
8. In the command field scroll unit “Motor resolver” is displayed.
9. Enter this command, nd the field will change to red.

WARNING: The motor will start to oscillate, be sure to clear the propeller.

10. Once the calibration is completed the field will return to yellow.
11. The system can be switched off and switched on normally.

5.5 Propeller alignment

The propeller alignment must be redone if a new motor or motor controller was installed or if the orientation of the propeller relative to the motor was changed during propeller removal/replacement.

WARNING: If the propeller alignment is wrongly set, the propeller could cause damage to the main doors or fuselage. Be sure to clear the propeller during the start-up of the system until the calibration has been completed.

1. Switch off the RES main switch.
2. Install both HV batteries.
3. Boot the DCU into Maintenance mode.

WARNING: The motor and motor controller are not activated in maintenance mode. If the actuator is cycled, the propeller will not auto-align, creating the risk of propeller misalignment during retraction or extension which could damage the actuator system or propeller.

4. Fully extend the pylon to ensure the propeller clears the front and main doors.

5. Access the setup menu.
6. In the setup menu, scroll to the MotorCtl tab.
7. Move to the command field and enter it.
8. In the command field scroll unit “Propeller position” is displayed.
9. Enter this command, and the field will change to red.
10. Rotate the DCU command knob to adjust the alignment position of the propeller.
11. Complete the setup by pressing the command knob, the field will change back to yellow.
12. The system can be switched off and switched on normally.

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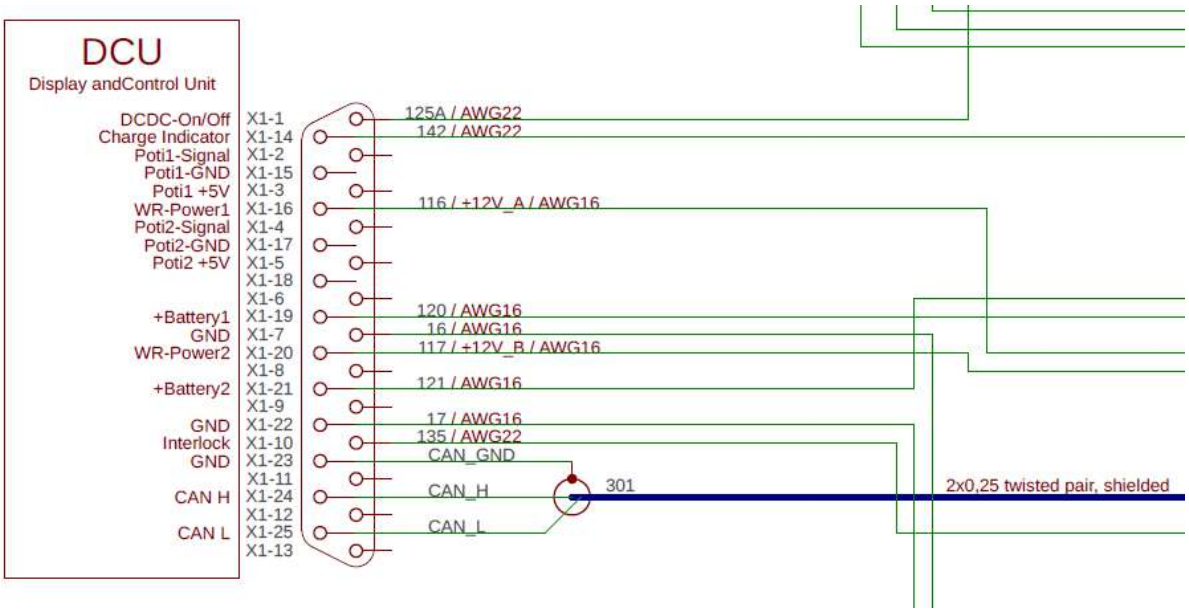
6 WIRING LOOM

The wiring loom of the RES is connected in parallel to the normal aircraft wiring loom. The control system RES is powered by the two avionic batteries installed in the aircraft. There is also a standalone fire warning system. The various electrical components should be wired according to the wiring diagrams illustrated below.

NOTE: Each wire has a wire number that can be traced to the origin and destination of the wire.

6.1 Display And Control Unit (DCU)

The DCU is located on the instrument panel within the cockpit of the aircraft. The DCU is responsible for the human-machine interface.



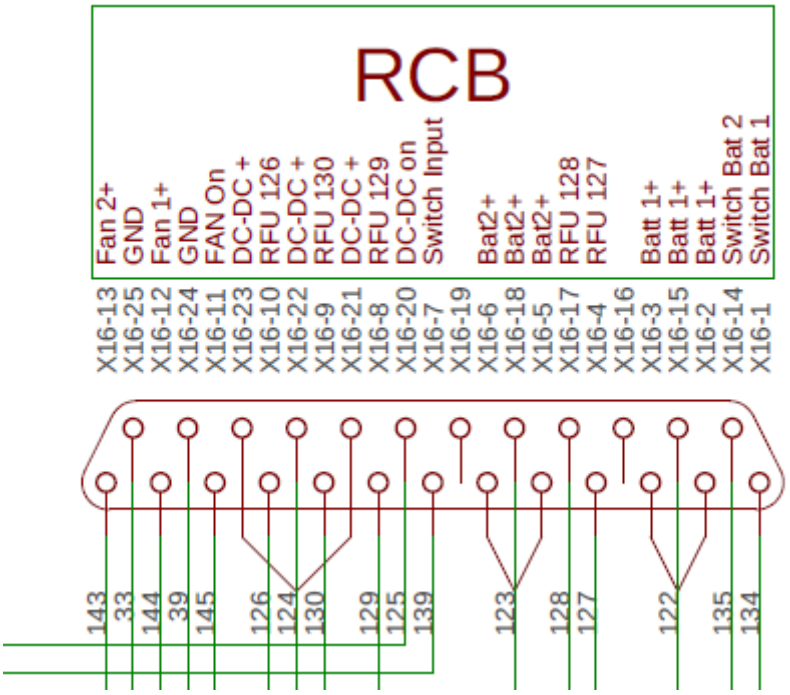
Wire number	Destination	Wire number	Destination
125	DC-DC on/off	**121**	RFU
142	Charge plug	**17**	GND
116	Motor controller	**135**	Left battery
120	RFU	**CAN GND**	Refer to 6.17
16	GND	**CAN_H**	Refer to 6.17
117	Motor controller	**CAN_L**	Refer to 6.17

Figure 6-1 DCU wiring

NOTE: The wires used for the CAN communication should be a shielded twisted pair that is only grounded at the DCU.

6.2 RES Control Board (RCB)

The RES control board (RCB) is located within the motor controller assembly. The RCB is responsible for the switching and supply of avionic battery power to the RFU. The RCB is controlled by the battery selection switch located on the instrument panel within the cockpit of the aircraft. The RCB can also power the motor controller cooling fans.

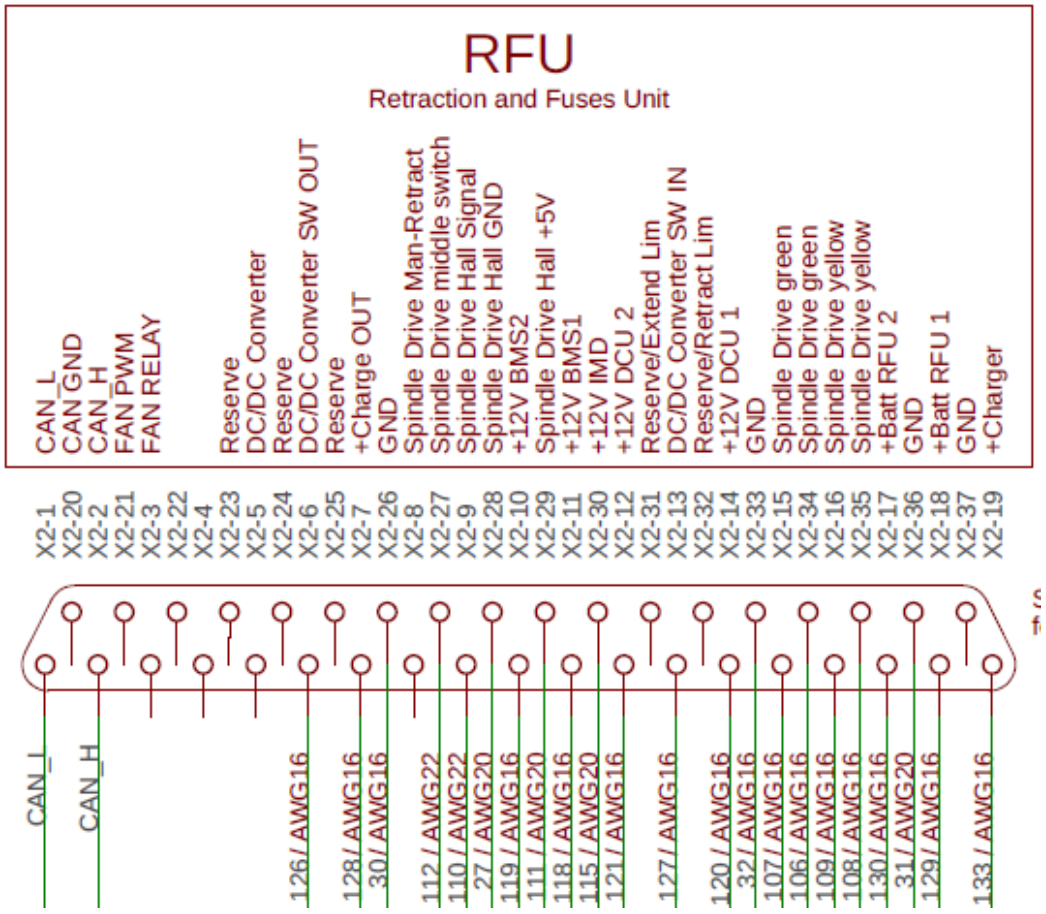


Wire number	Destination	Wire number	Destination
143	FAN 2	**125**	Master switch
33	GND	**139**	Master switch
144	FAN 1	**123**	Battery 2
39	GND	**128**	RFU
145	Motor controller	**127**	RFU
126	RFU	**122**	Battery 1
124	DC-DC	**135**	Main selector
130	RFU	**134**	Main selector
129	RFU		

Figure 6-2 RCB Wiring

6.3 Retraction And Fuses Unit (RFU)

The retraction and fuses unit (RFU) is located on the right side of the wheelbox. The RFU is responsible for all power distribution of the RES system and is controlled by the DCU.

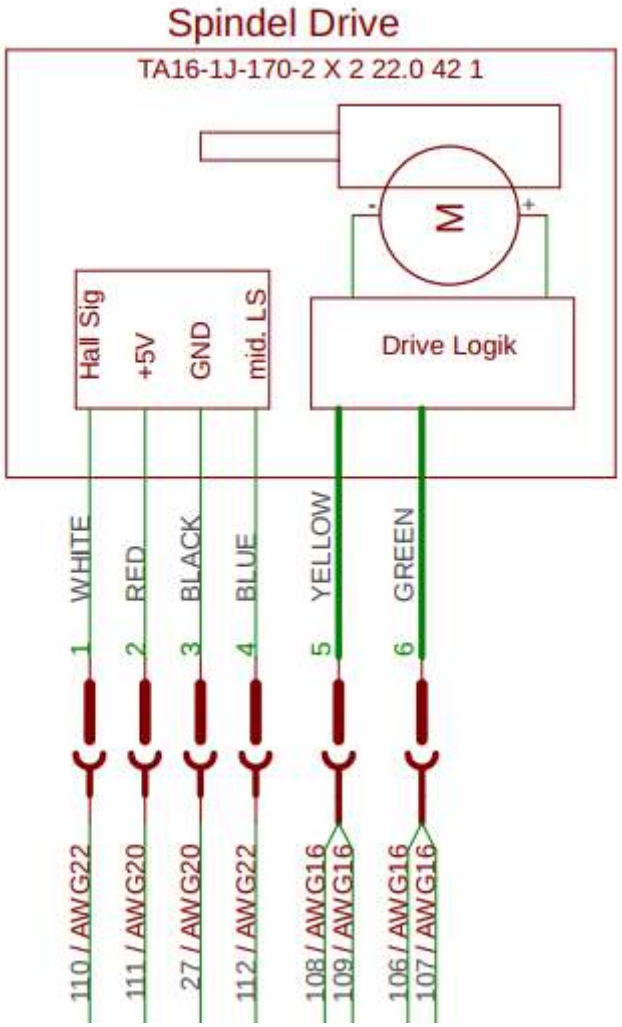


Wire number	Destination	Wire number	Destination
126	RCB	**32**	GND
128	RCB	**107**	Actuator
30	GND	**106**	Actuator
112	Actuator	**109**	Actuator
110	Actuator	**108**	Actuator
27	Actuator	**130**	RCB
119	Right battery con	**31**	GND
111	Actuator	**129**	RCB
118	Left battery con	**133**	Charger con
115	IMD	**CAN_L**	Refer to 6.17
121	DCU	**CAN_H**	Refer to 6.17
120	DCU		
127	RCB		

Figure 6-3 RFU Wiring

6.4 Actuator

The actuator has an operating voltage of 12 V which is supplied by the RFU, which is controlled by the DCU. The actuator has built-in limit switches and a hall effect sensor to monitor the extension and retraction of the pylon.

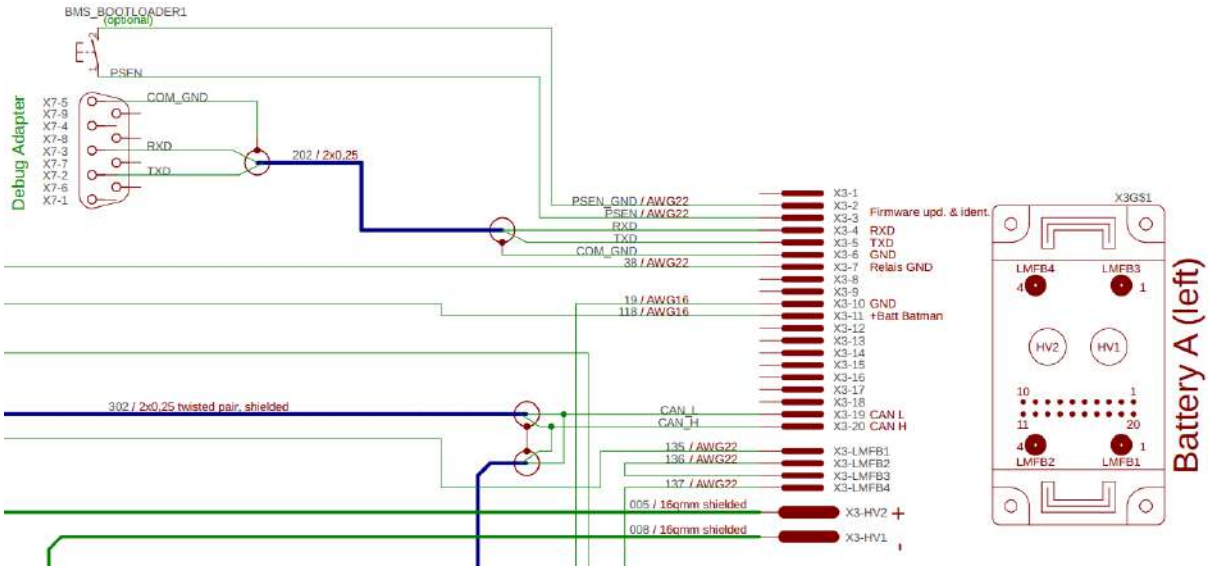


Wire Number	Destination	Wire Number	Destination
110	RFU	**108**	RFU
111	RFU	**109**	RFU
27	RFU	**106**	RFU
112	RFU	**107**	RFU

Figure 6-4 Actuator Wiring

6.5 Left battery connector

The left battery connector is located in the rear fuselage compartment and is the connector interface for the left high voltage battery.



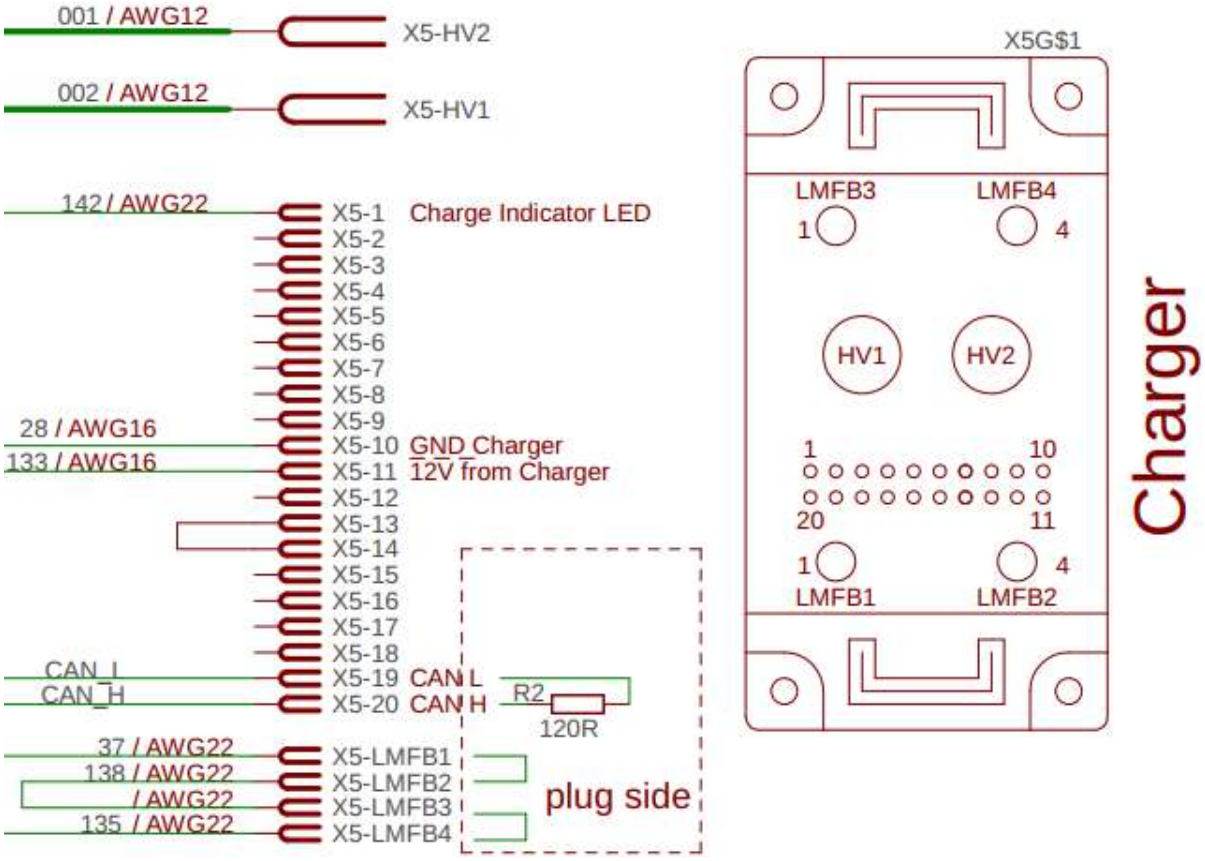
Wire number	Destination	Wire number	Destination
PSEN_GND	BMS Bootloader (Optional)	118	RFU
P_SEN	BMS Bootloader (Optional), 118	CAN_L	Refer to 6.17
RXD	Debug adapter	CAN_H	Refer to 6.17
TXD	Debug adapter	135	DCU
COM_GND	Debug adapter	136	Left battery
38	GND	137	Right Battery
19	GND	005	Motor Controller
008	Motor Controller		

Figure 6-5 Left battery connector wiring

NOTE: The debug adapter and bootloader switch is optional.

6.6 Charger connector

The charge connector is located to the left of the seatback, in front of the oxygen bottle holder. The charger connecter provides the connector interface for the high voltage charger to be able to charge both or either high voltage batteries without removing the batteries from the fuselage.



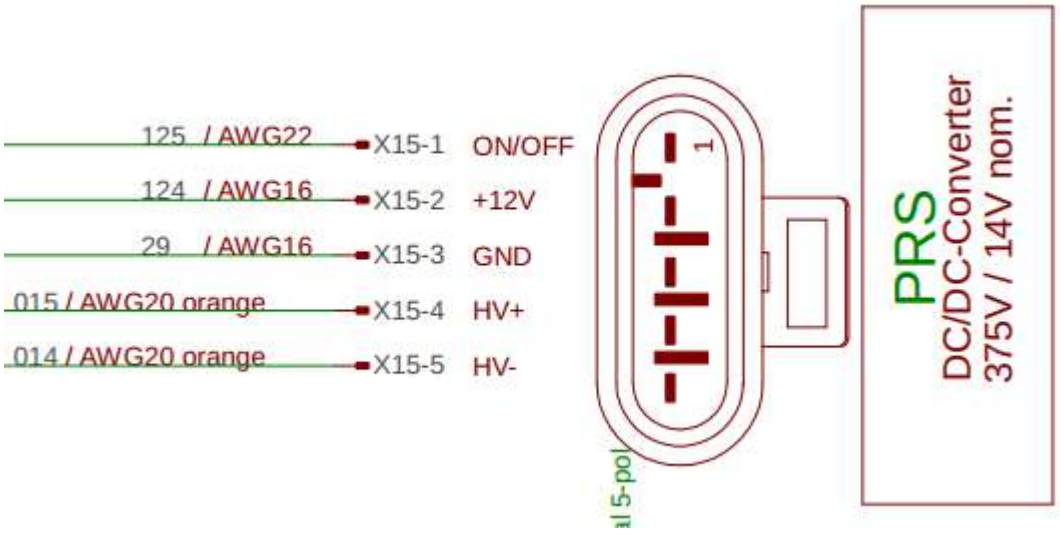
Wire number	Destination	Wire number	Destination
001	Motor Controller	CAN_L	Refer to 6.17
002	Motor Controller	CAN_H	Refer to 6.17
142	DCU	37	GND
28	GND	138	Charge connector
133	RFU	135	Right Battery

Figure 6-6 Charger connector wiring

CAUTION: Remember to include bridge between pin X5-13 and X5-14. Without this bridge it will not be possible to charge the batteries in the aircraft.

6.7 DC-DC converter

The DC-DC converter converts the HV (400 V) to 12 V to supplement the 12 V avionic batteries. The DC-DC converter is located on the left side of the wheel box and motor controller assembly.

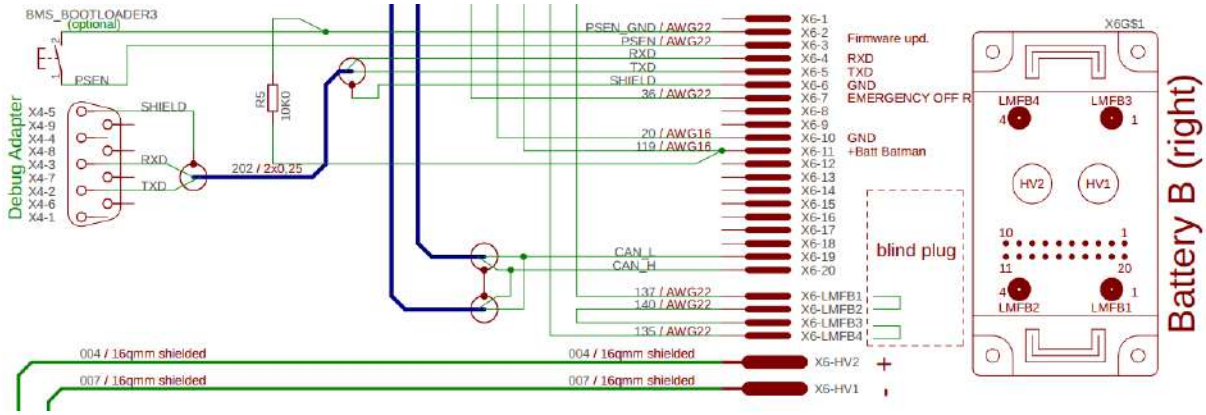


Wire Number	Destination	Wire Number	Destination
125	DCU	**015**	Motor controller
124	RFU	**014**	Motor controller
29	GND		

Figure 6-7 DC-DC Converter

6.8 Right battery connector

The right battery connector is located in the rear fuselage compartment and is the connector interface for the right high voltage battery.



Wire number	Destination	Wire number	Destination
PSEN_GND	BMS Bootloader (Optional)	CAN_L	Refer to 6.17
P_SEN	BMS Bootloader (Optional), 118	CAN_H	Refer to 6.17
RXD	Debug adapter	137	Left Battery Connector
TXD	Debug adapter	140	Right Battery Connector
SHIELD	Debug adapter	135	Charger Connector
36	GND	004	Motor controller
20	GND	007	Motor controller
119	RFU		

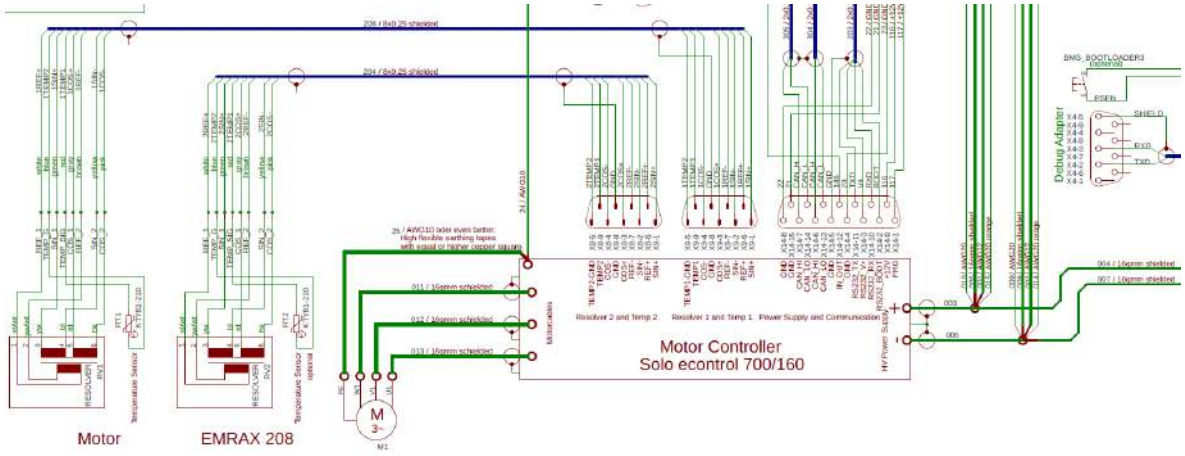
Figure 6-8 Right battery connector wiring

NOTE: The debug adapter and bootloader switch is optional.

CAUTION: The 10k ohm resistor has to be included for the system to work with both HV batteries. The 10k resistor is used to identify the connected battery.

6.9 Motor, motor controller and resolvers

The resolvers provide position and rotation feedback to the motor controller which powers the motor.

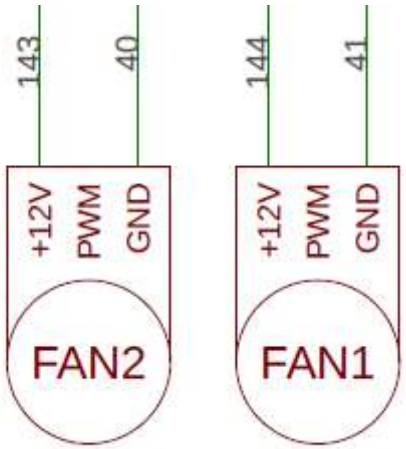


Wire number	Destination	Wire number	Destination
010	IMD	004	Right battery connector
005	Left Battery connector	007	Right battery connector
001	Charger connector	22	GND
015	DC-DC	21	GND
009	IMD	23	GND
008	Left Battery connector	116	DCU
002	Charge connector	117	DCU
014	DC-DC	24	GND
CAN_L	Refer to 6.17	CAN_H	Refer to 6.17
145	RCB		

Figure 6-9 Motor, motor controller, and resolvers wiring

CAUTION: The motor controller PCB ground wire should be connected to the ground bolt as indicated in the removal and installation section of the motor controller assembly.

6.10 Cooling fans

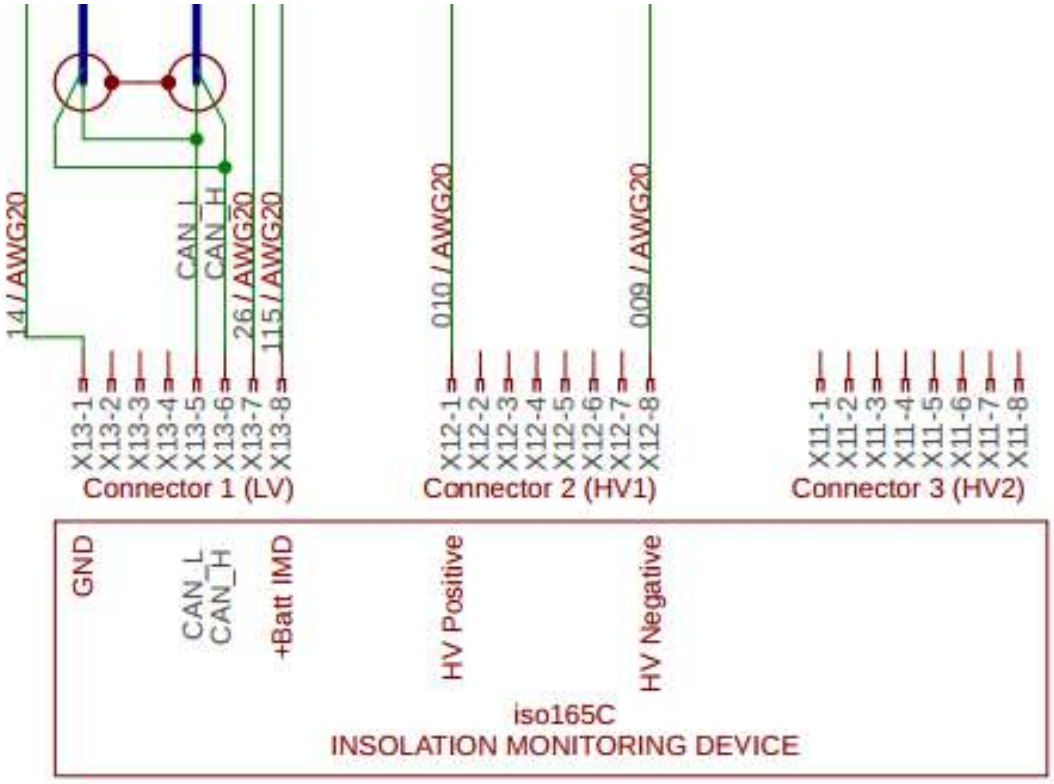


Wire Number	Destination	Wire Number	Destination
143	RCB	**144**	RCB
40	GND	**41**	GND

Figure 6-10 Cooling Fans wiring

6.11 Insulation Monitoring Device (IMD)

The insulation monitoring device (IMD) is fastened to the right side of the wheelbox. The IMD is used to detect any high voltage leaks.

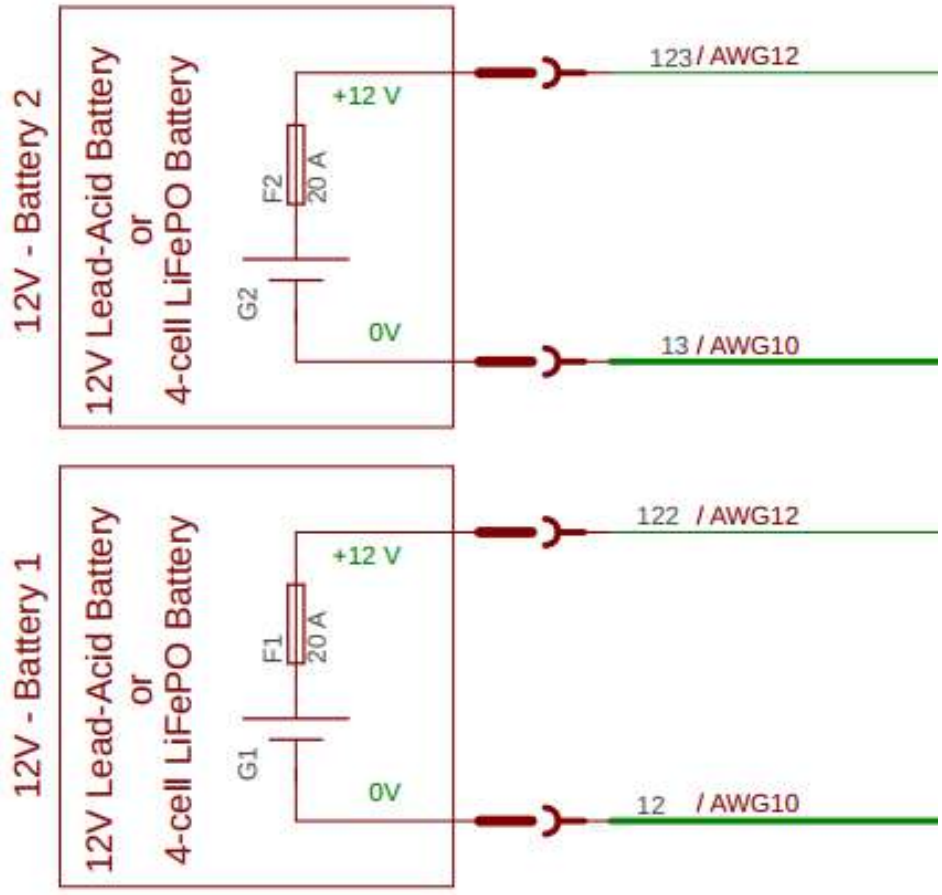


Wire Number	Destination	Wire Number	Destination
14	GND	**009**	Motor controller
26	GND	**CAN_L**	Refer to 6.17
115	RFU	**CAN_H**	Refer to 6.17
010	Motor controller		

Figure 6-11 IMD Wiring

6.12 Avionic batteries

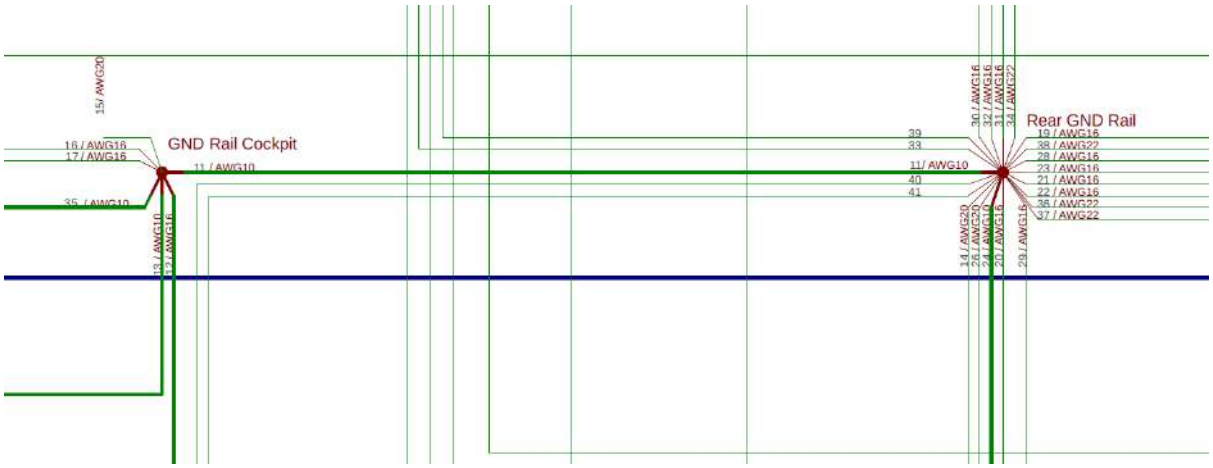
There are two avionic batteries located within the aircraft. The one battery is located within a hatch in the seat pan, aft of the control stick. The other avionic battery is located behind the seatback.



Wire Number	Destination	Wire Number	Destination
123	RCB	**122**	RCB
13	GND	**12**	GND

Figure 6-12 Avionics battery wiring

6.13 Ground bus



Wire number	Destination	Wire number	Destination
39	RCB	19	Left battery connector
33	RCB	38	Left battery connector
16	DCU	28	Charger connector
17	DCU	23	Motor controller
35	Avionic ground	21	Motor controller
13	Battery 2	22	Motor controller
12	Battery 1	36	Right battery connector
30	RFU	37	Charge connector
32	RFU	40	Cooling fan 2
31	RFU	41	Cooling fan 1
34	Fire warning		

Figure 6-13 Ground bus wiring

NOTE: The **GND rail cockpit** and **Rear GND rail** wires are interchangeable.

6.14 Supplementary fire warning system

The fire warning system is independent of the RES system. It consists of two thermal switches, a heat-sensitive cable section located in the rear fuselage compartment, a 9 V battery, test button, LED, and buzzer. The thermal switch(s) is located in the front corner of the fuselage compartment and the heat-sensitive cbale is located within the rear fuselage are above the high voltage batteries underneath the lip of the engine doors opening. See Figure 6-15

The 9 V 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.

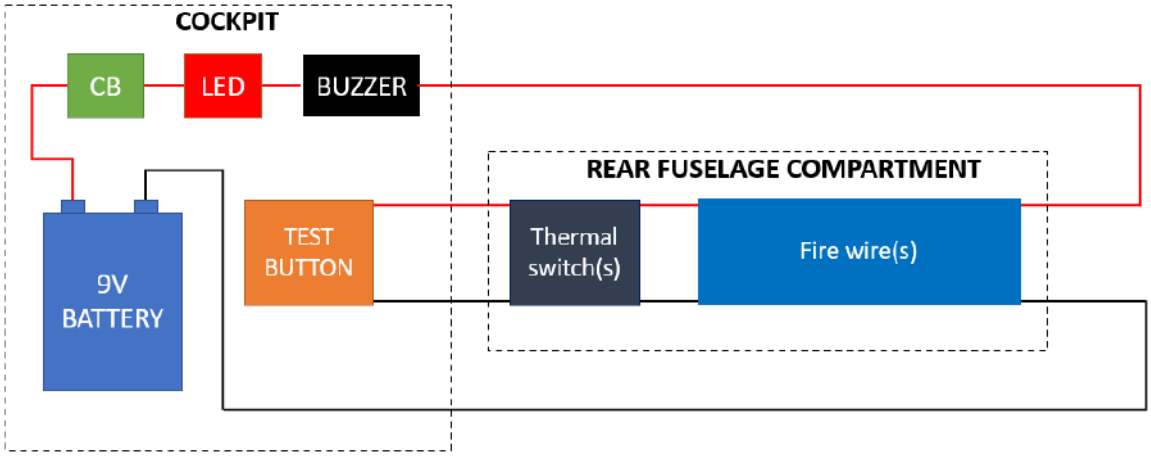


Figure 6-14 Supplementary fire warning system wiring

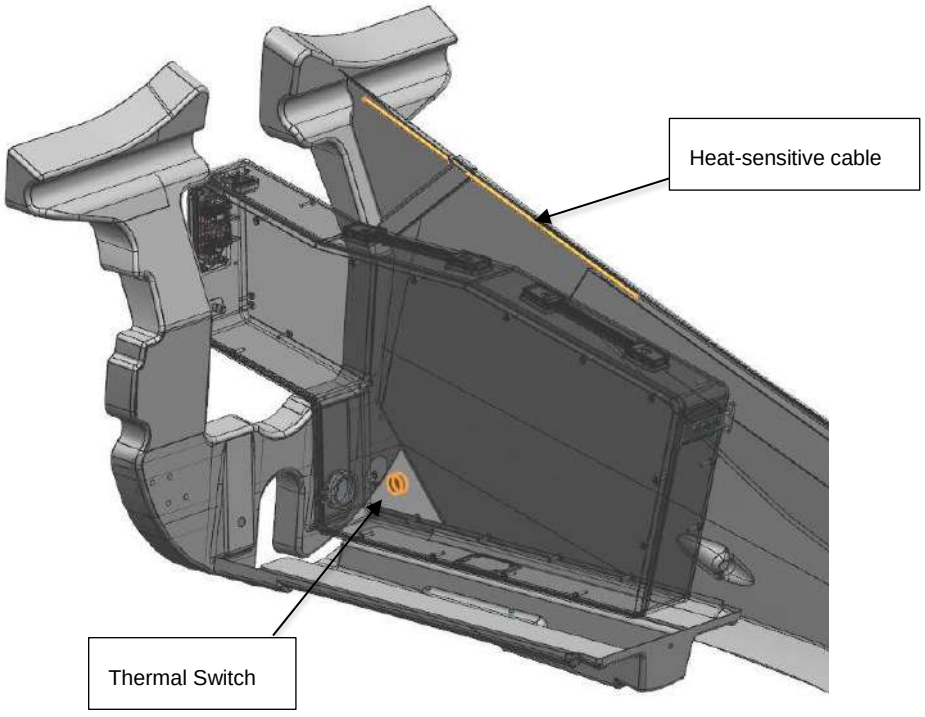


Figure 6-15 Location of thermal switch and heat-sensitive cable

6.15 LXNAV bridge

The LXNAV bridge is an optional extra. The bridge provides an interface between the DCU and LXNAV flight computers. This enables the LXNAV flight computer to be able to display various parameters of the RES system like HV battery SOC, RPM, motor controller temperature, etc.

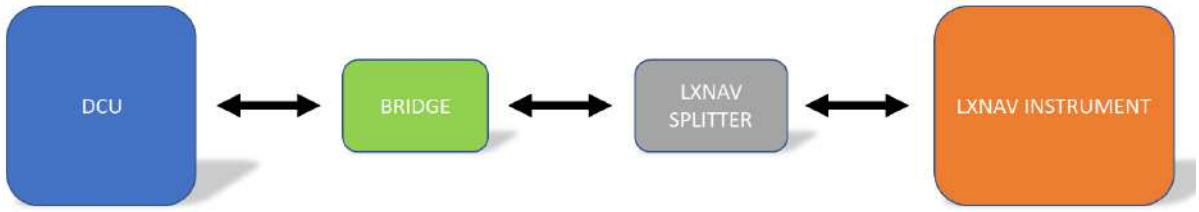
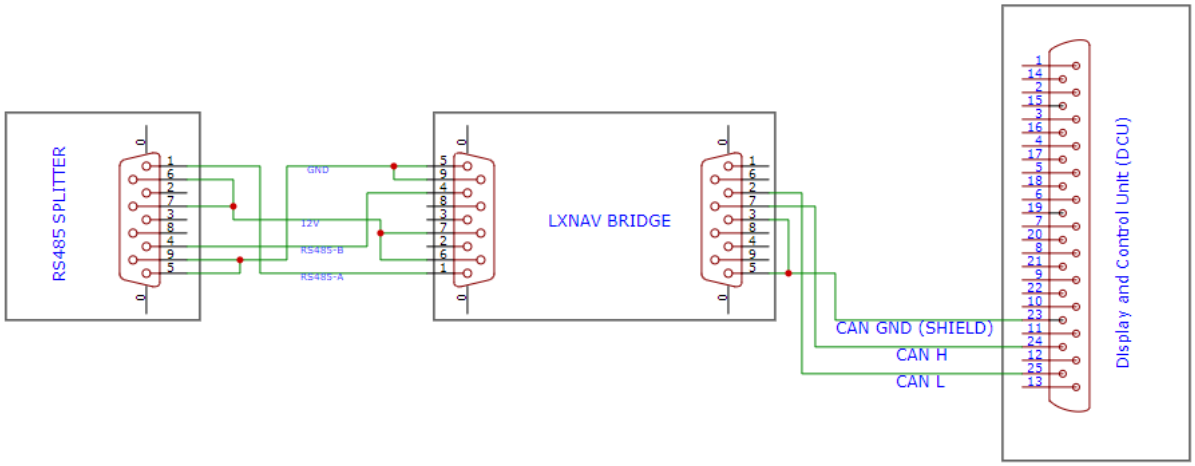


Figure 6-16 LXNAV bridge

The bridge has two nine-pin d-sub connectors. On one side is the standard LXNAV RS45 connector and on the other side is a standard CAN bus connector. The connectors have the following pinouts:

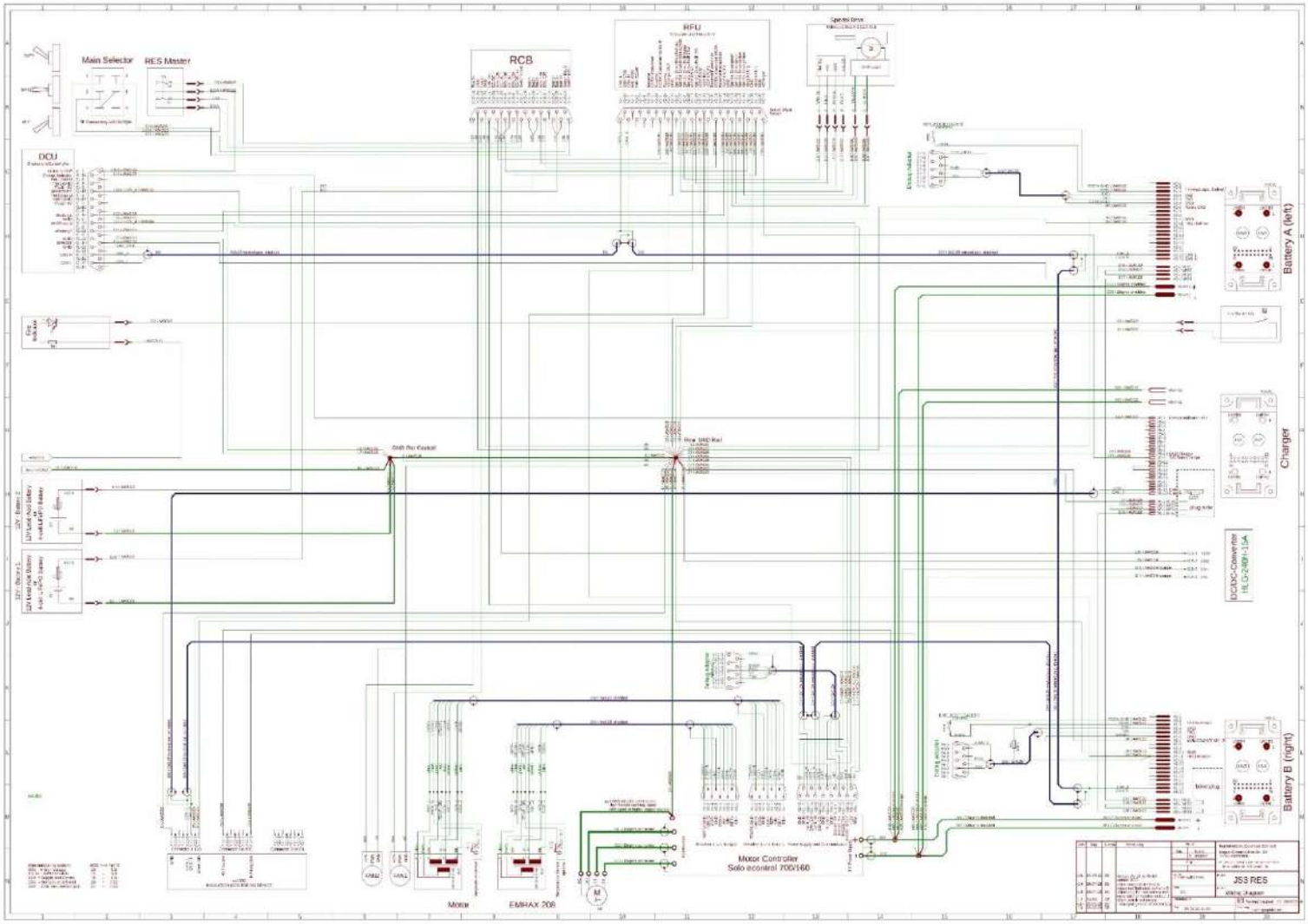


CAN BUS SIDE		RS485 SIDE	
Pin Number	**Description**	**Pin Number**	**Description**
2	**CAN L**	**1**	**RS485-A**
3	**GND**	**4**	**RS485-B**
5	**GND**	**6/7**	**12 V**
7	**CAN H**	**5/9**	**GND**

Figure 6-17 LXNAV bridge wiring

NOTE: The orientation of the bridge should be correct as indicated on the sticker located on the bridge itself:

6.16 Complete schematic



6.17 Supplementary information and pictures

6.17.1 Interlocks & HV wiring

The diagrams illustrated in Figure 6-18 can be used to verify continuity between the illustrated pins.

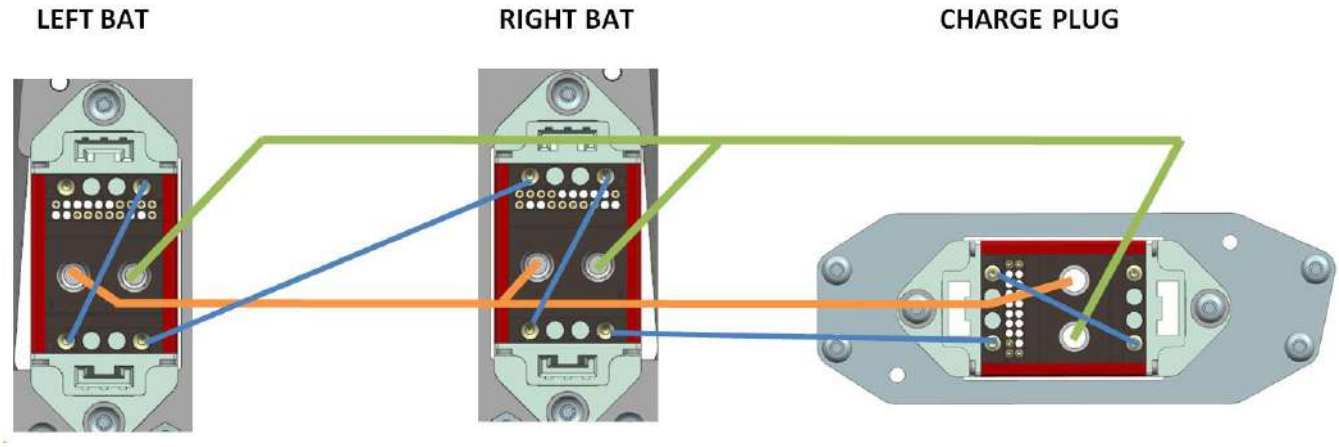


Figure 6-18 Interlock and HV wiring

6.17.2 Termination plugs

Two termination plugs are used on the aircraft as described below:

6.17.2.1 Charge socket termination plug

The charge socket termination plug is only removed to charge the HV batteries in the aircraft or to disable the system.

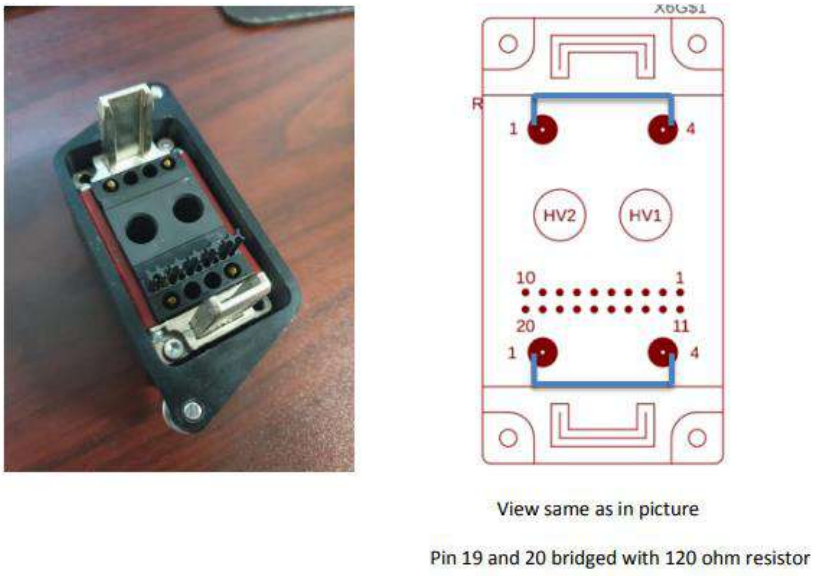


Figure 6-19 Charge connector termination plug

6.17.2.2 Battery connector termination plug

The battery connector termination plug is used for single high voltage battery operation. The termination plug is inserted and fastened to the aircraft side battery connector of the absent battery.

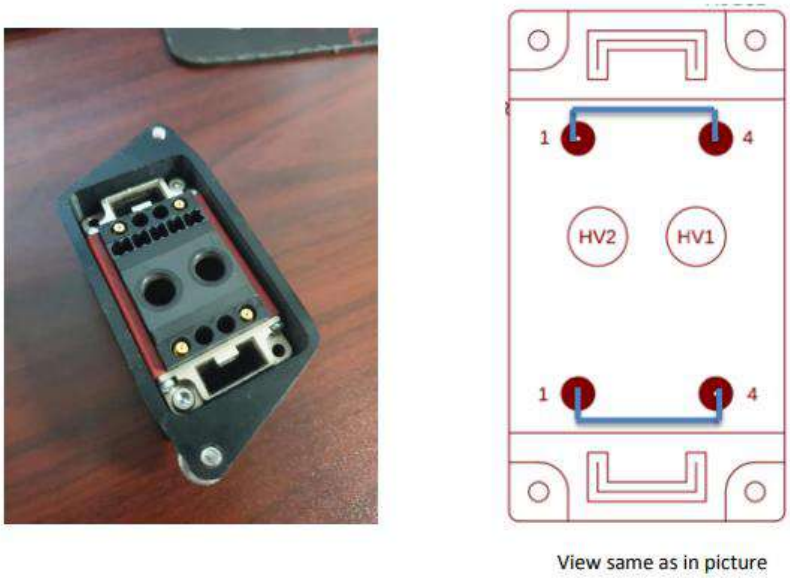


Figure 6-20 Battery connector termination plug

6.17.3 Can wiring

The sequence of components connected to the CAN does not matter as long as the charge connector and DCU are at the ends of the daisy chain. The DCU is used to provide ground to the shielding. The termination resistors are located in the DCU and Charge termination plug/charger.

CAUTION: It is crucial for the CAN wiring to be shielded all the way to each connector. The CAN wiring is very susceptible to EMI caused by the motor and motor controller.

CAUTION: The wires used for the CAN communication should be a shielded twisted pair that is only grounded at the DCU.

7 LUBRICATION

7.1 Introduction

Hinge points and metal-to-metal contact points in the RES must be lubricated according to the lubrication schedule. All these points are initially lubricated in the factory but will need additional lubrication during the lifespan of the sailplane. This section describes the lubrication requirements of the RES.

7.2 Lubricants

The bearing surfaces must be lubricated with good quality grease. Most automobile greases are suitable. The following should not be used on the system:

- Thin spray penetrating oils, as these evaporate off fairly quickly.
- Any oils and greases containing silicon.
- Oils and greases containing Molybdenum Disulphide MoS_2 are unsuitable on copper and brass bearings.

7.3 Lubrication plan

The lubrication is required annually as listed. See illustrations below:

- Door hinges.
- Ball links on the ends of the door pushrods.
- Bushes on the end of the actuator.

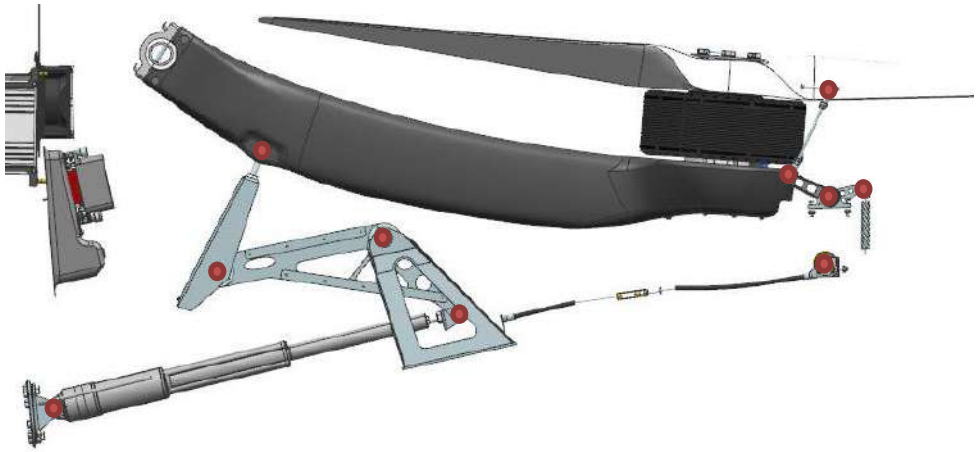


Figure 7-1 Lubrication points

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8 SYSTEM OPERATION

The RES is controlled by the following:

- Guarded RES master switch.
- Display and Control Unit interface.
- Battery selection switch.

8.1 Guarded RES master switch

The guarded RES master switch is a guarded switch on the instrument panel controlling the 12 V power supply to the RES. A battery selector switch enables the pilot to select 12 V from either of the removable 12 V batteries.

Figure 8-1 Guarded RES master 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 a built-in DC-DC converted.

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.

When the guarded RES master switch is switched OFF power to all RES systems except temperature monitoring is disconnected.

8.2 Display and control unit interface

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

- Command Button which can be rotated and pushed.
- Retract/Extend toggle switch to extend or retract the pylon.

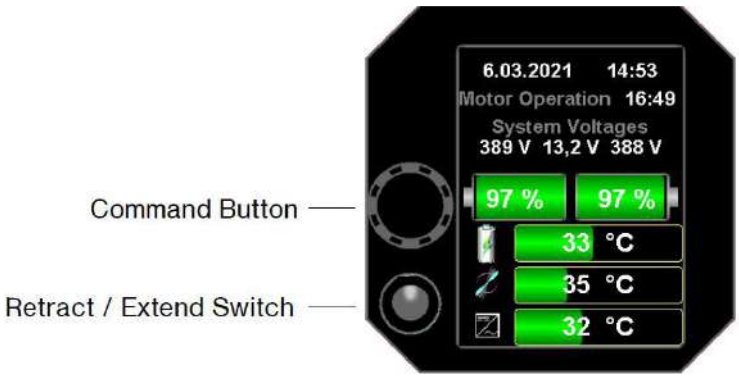


Figure 8-2 DCU Primary Controls

The Command Button is used to:

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

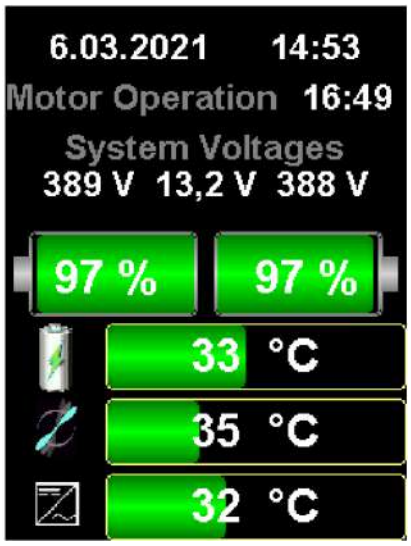
8.3 Battery selection switch

The RES system can be powered from either avionic battery. The battery selection is made by the battery selection switch, which is located next to the guarded RES master switch.

8.4 Operational mode

8.4.1 Standby

Standby mode is entered when the system is powered up 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 HV batteries
- Maximum cell temperature in HV battery.
- Motor temperature
- Controller temperature

Figure 8-3 Standby screen.

When pushing the EXT/RETR switch upwards 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 motor controller activates the propeller alignment.
4. The pylon spindle motor extends the pylon.

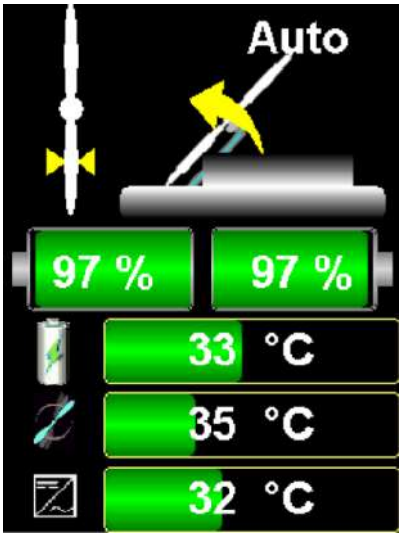
NOTE: The capacitors inside the inverter must be charged before the batteries are connected to the power rail. The message “Power bus Precharge” is displayed. This action takes a few seconds to complete.

NOTE: The battery latches should always be locked, if not, the motor will crash into the battery latch during retraction, preventing full retraction.

When pushing the EXT/RETR switch downwards whilst in standby mode the HV batteries are activated and the 12 V charging process starts.

8.4.2 Extension / Retraction Modes

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



- "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 mo the pylon.

Figure 8-4 Extension/retraction screen

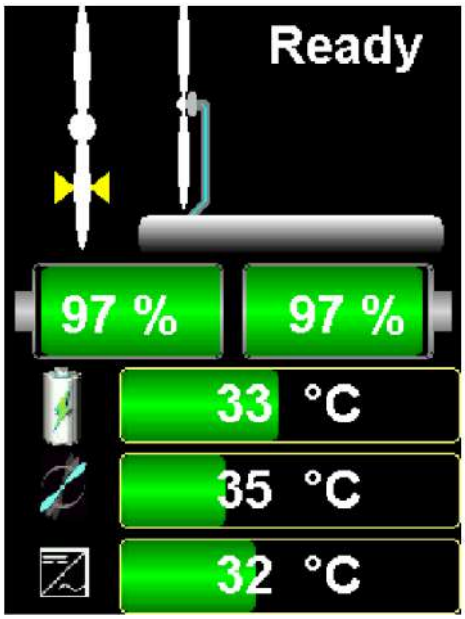
The EXT/RETR switch is used to operate the pylon actuator as follows:

- A single click upwards is used to initiate the AUTO extension mode whilst retracted.
- A single click downwards is used to initiate the AUTO retraction mode whist extended (any power setting).
- Manual pylon operation is entered by a single click in any direction whilst 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. A flashing arrow in the upper right corner of the display indicates manual mode operation.

8.4.3 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 stop is active and the propeller is kept aligned.

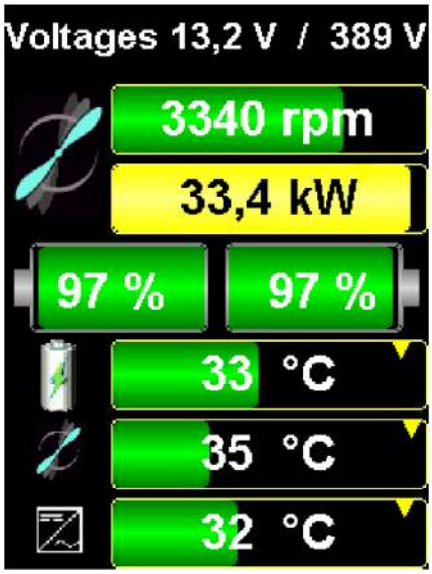
Figure 8-5 Extended screen

Propulsion mode is entered when the command button is rotated clockwise.

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

8.4.4 Propulsion

When rotating the command button 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

Figure 8-6 Propulsion screen

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 aligned vertically.

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

8.4.5 12 V Battery charging

The HV batteries can be used to charge the 12 V control supply battery via a built-in DC-DC converter.

The following picture illustrates that 12 V charging is in progress.

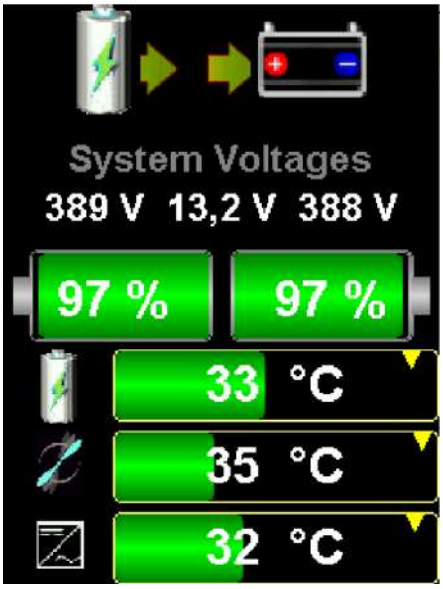


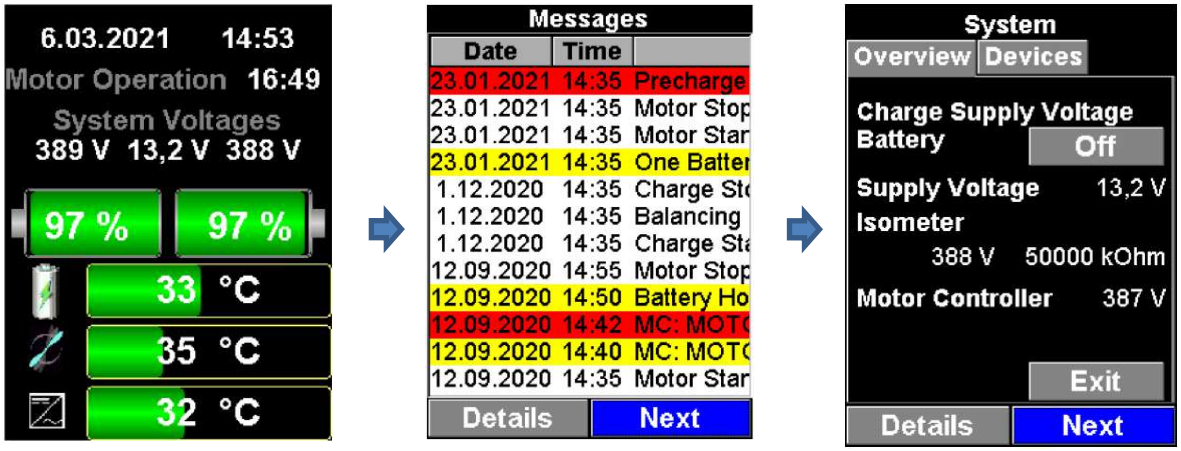
Figure 8-7 Battery charging screen

- Charging is activated by entering the System Screen and setting Charge Supply Voltage to ON. The System screen When pushing the command button during boot-up or operation mode, the display cycles through the screens.
- It is also possible to activate the HV batteries and enable charging by pushing the EXT/RETR switch downwards whilst in Standby mode.

NOTE: The DC-DC converter can provide a maximum of 8 A. The 12 V supply batteries can be charged at approximately 3 A.

8.5 Other Information screens

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

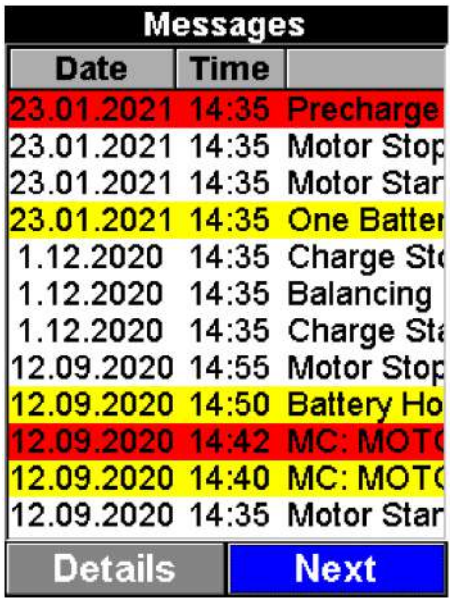


Standby screen Message screen System screen

Figure 8-8 Other information screens

8.5.1 Message Screen

Errors/warnings cautions and information messages are stored by the DCU and can be viewed by the pilot in the message screen.

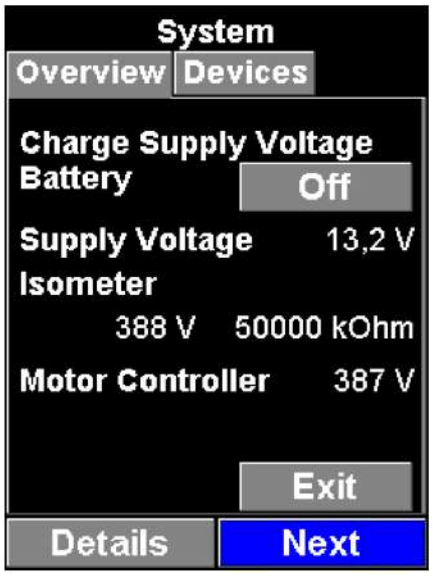


To see the detail of a specific listed message:

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

Figure 8-9 Message screen

8.5.2 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 and system voltages
- Calibrate the pylon actuator travel (see Maintenance Manual for more detail)

Figure 8-10 System screen

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

8.6 Warning Caution and Information messages

All **warning/error, caution, or information** messages are stored by the DCU. Messages are prioritized and colored 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

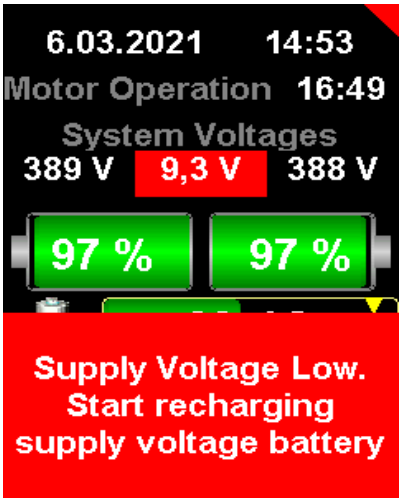


Figure 8-11 Warning screen

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 as the original message
- A message is acknowledged by pressing the command button

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 APPENDIX D – LIST OF WARNINGS/CAUTIONS.

8.7 Maintenance mode

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

Whilst in the Service Screen it is still possible to control the pylon extending / retraction using the “EXT/RETR” switch.

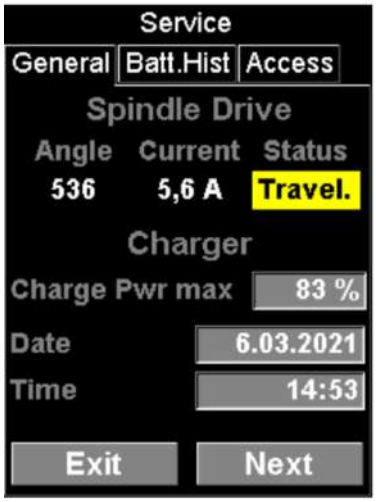


Figure 8-12 Service screen

NOTE: The spindle movement is monitored by the DCU and the calculated pylon position is stored by the DCU when the system is shut down. Retraction errors may indicate that the system has to be re-calibrated.

Current drawn by the spindle is shown as well as the identified status of the retraction mechanism.

8.8 Setup menu

The setup menu is accessed from the maintenance mode. When in maintenance mode, move from the general tab to the Access tab and enter the DCU password.

Figure 8-13 Setup screen

8.9 Charge mode

If the HV battery charger is connected to the aircraft and switched on, the DCU will enter a charging mode. Refer to the High Voltage batteries section.

8.10 Fire warning system

The fire warning system is independent of the RES system. It consists of two thermal switches, a heat-sensitive cable section located in the rear fuselage compartment, a 9 V battery, test button, LED, and buzzer.

The fire warning system can be tested by pressing the test button. When the test button is pressed, the system buzzer will sound and the indication LED will light up. If the 9 V battery is drained, the system will not work.

No	Description	No	Description
1	Test button	2	LED

Figure 8-14 Fire warning system

WARNING: The 9 V 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.

9 SOFTWARE/ FIRMWARE UPDATE

The RES allows for the updating of the RFU and DCU. The parameters of the motor controller can also be adjusted. The required cables to perform the updates can be ordered from Jonker Sailplanes.

NOTE: Only firmware updates that are approved and officially released by SOLO® Vertriebs- und Entwicklungs GmbH.

9.1 Requirements for firmware updated

For the update of the DCU and RFU firmware, the following is required:

- PC with Windows and a USB port
- USB cables required:
  - DCU - USB cable Type A/B
  - RFU - USB cable type A/miniB
- Download and install the software provided by the link below:
  https://www.flashmagictool.com/download.html&d=13.31/FlashMagic.exe
- Firmware required provided by SOLO
  - Project file (file suffix: fmx)
  - New firmware file (file suffix: hex)

9.2 DCU firmware update

DCU firmware is updated as follows:

1. Connect the computer and the DCU with the USB-cable
2. Open the flashMagic.exe software
3. File/Open Project and select "FlashMagic_DCU.fmx"
4. Switch on the RES main switch and observe the new COMM port displayed.
5. Perform the following configuration:

   Device:

   Device: LPC1788

   Serial Port: Select the new COM-port that appeared after the RES was switched ON.

   Baud rate: 57600 Baud

Erase:

Erase: Select “Entire Device”

Firmware:

File: Select the hex-file with the new firmware.

Options: - Verify after programming

- Go after Programming

6. Click the big button below **Start** to initiate the flashing process

NOTE: It takes up to 10 seconds before information in the footer of the flash magic window displays the memory address being updated. The initial count-down during programming is followed by a count-up during the verification process**.**

7. Reset the main switch after the message "Finished" is displayed in the footer

9.3 RFU firmware update

RFU firmware is updated as follows:

1. Connect the computer and the RFU with the USB-mini B cable.
2. Open the flashMagic.exe software.
3. File/Open Project and select "FlashMagic_RFU.fmx".
4. Switch on the RES main switch and observe the new COMM port displayed.
5. Perform the following configuration:

Device:

Device: LPC11C24/301 (LPC1000)

Serial Port: Select the new COM-port that appeared after the RES was switched ON.

Baud rate: 57600 Baud

Erase:

Erase: Select “Entire Device”

Firmware:

File: Select the hex file with the new firmware.

Options: - Verify after programming

- Go after Programming

- Patch Before Programming: click on “Settings…” and add a new line with Address = 0x7FFE and “Bytes” equals the serial number as a 16-bit integer in “Little Endian” format.

6. Click the big button below **Start** to initiate the flashing process.

NOTE: It takes up to 10 seconds before information in the footer of the flash magic window displays the memory address being updated. The initial count-down during programming is followed by a count-up during the verification process.

7. Reset the main switch after the message "Finished" is displayed in the footer.

9.4 Accessing the motor controller parameters

The motor controller needs to be switched on to access it using the N-drive software. This can be done by switching on the system normally or by using the Maintenance mode.

WARNING: Connecting to the motor controller using N-drive could cause the propeller to start rotating during connection for a short period. Be sure to always be clear of the propeller.

1. Switch off the RES main switch.
2. Install both HV batteries.
3. Disconnect the 15 pin D-sub of the motor controller.
4. Connect the adapter to the motor controller and wiring loom of the aircraft:

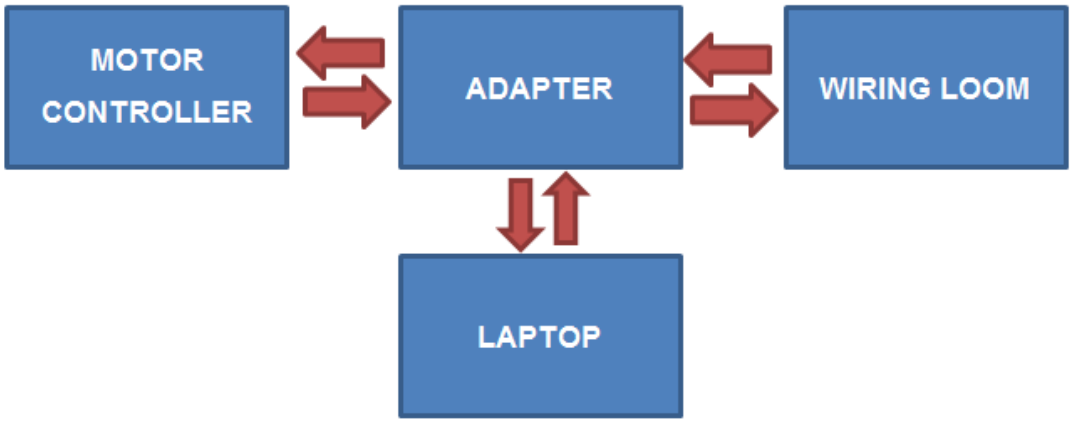


Figure 9-1 Adapter installation

5. Connect a PC to the adapter using an RS232 to USB cable.
6. Boot the DCU into Maintenance mode.
7. Fully extend the pylon to ensure the propeller clears the front and main doors.
8. Access the setup menu.
9. In the setup menu, scroll to the MotorCtl tab.

10. Move to the command field and enter it.
11. In the command field scroll unit “Motor controller setup” is displayed.
12. Enter this command, the field will change to red. The motor controller will switch on
13. Connect to the motor controller using the N-drive software.

NOTE: The NDrive software can be downloaded from the following link: https://www.unitek-industrie-elektronik.de/images/downloads/NDrive/NDrive2-Software.zip.

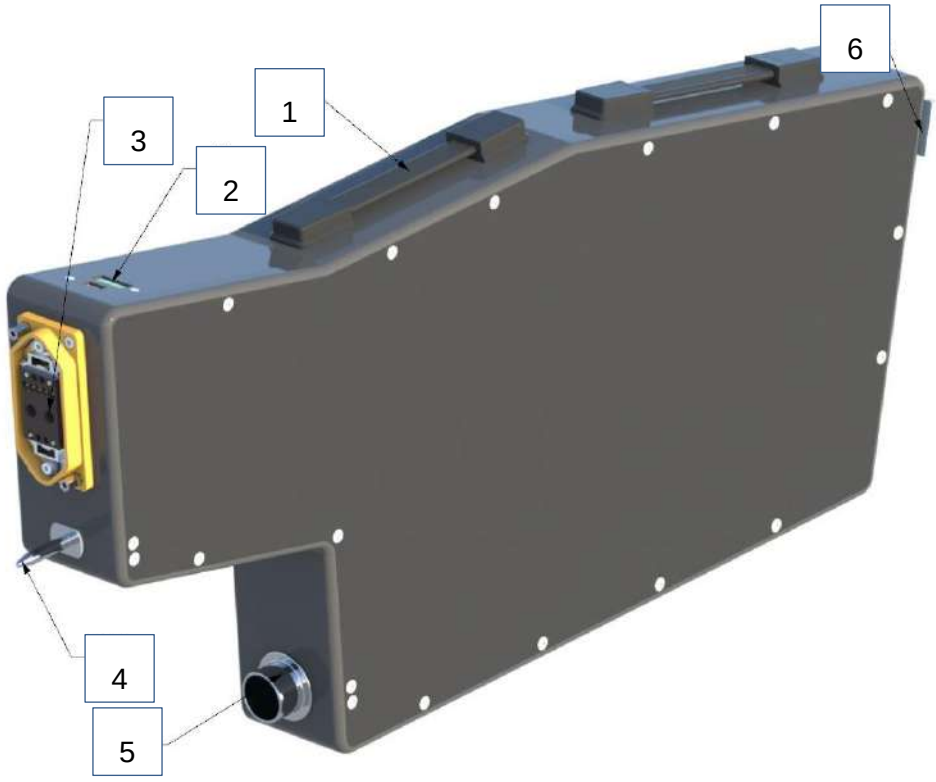
10 High Voltage batteries

The Emectric BM384 battery system consists of 384 cells per battery which have a total nominal voltage of 350 V, total nominal capacity of 11.2 Ah, and maximum usable energy of 4.2 kWh. Batteries are sealed to minimize the risk of a battery fire. The type of Li-Ion cells used in the batteries is sensitive to excessive heat and may spontaneously ignite at temperatures above 150°C. Cell life is also reduced with high temperatures. Operation above 60 °C should be avoided. The battery pack is designed to prevent the propagation of fire in a single cell. When a cell ignites, approximately 12 l of high temperature, poisonous gasses will be released instantaneously. These gasses are directed via the exhaust nozzle to the outside of the aircraft. Battery requires no internal maintenance.

WARNING: Do not inhale any gasses as the result of a battery fire.

WARNING: Battery maintenance must be done by the supplier or OEM.

10.1 Overview



No	Description	No	Description
1	Handle	2	Battery status indicators
3	Connector	4	Alignment pin
5	Exhaust vent	6	Battery latch

Figure 10-1 Battery overview

10.2 Inspections

The following inspections should be performed regularly – typically before installing the batteries into the fuselage:

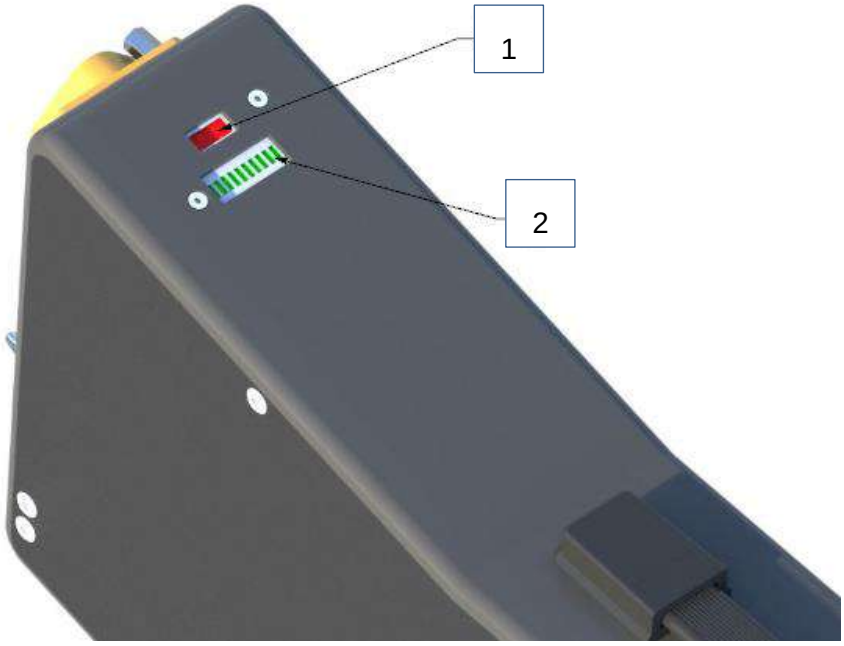
- Verify the lifting handles on top of each battery are securely attached to the hard-shell case with no indication of detaching or signs of loose fasteners.
- Verify the latch plate at the rear of each battery is firmly attached to the hard-shell case and that its fasteners are secure.
- Visually inspect 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 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.

10.3 Trailer considerations

Batteries have a mass of 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 behavior on roads and motorways can easily be made unstable rendering the towing vehicle unsafe to drive.

10.4 Battery status indicators

The high voltage status indicators are located on top of the battery close to the high voltage connector.



No	Description	No	Description
1	High voltage indicator	2	Status Indicator

Figure 10-2 Battery status indicators

10.4.1 High voltage indicator

The high voltage indicator only lights up when the battery is connected to the aircraft or charger. The high voltage indicator lights up when the high voltage pins are activated. When the battery is switched off, it can take up to 10 seconds for the high voltage to dissipate.

WARNING: The battery should never be handled if this indicator is on.

10.4.2 Status indicator

The status indicator only lights up when the battery is connected to the aircraft or charger. The individual lights indicate the state of charge (SOC) of the battery. Each indicial light corresponds to 10% capacity, if four bars are lit – the battery has a 40% state of charge.

CAUTION: An error is indicated when all of the bars light up and start to flash in approximately 1-second intervals.

10.5 Battery handling

The batteries should only be carried by using both handles.

WARNING: The connector should be treated as if it is always live – do not touch the connector.

The batteries should be left inside the fuselage or transported in suitable safe transport containers.

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

10.6 Installing the HV batteries

1. Select the 12 V battery to power the RES system.
2. Enter maintenance mode by pushing and holding the command button on the DCU while switching the RES master switch to ON.
3. Whilst in maintenance mode the motor can be extracted by pushing the EXT/RETR switch upwards.

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 the batteries in the battery compartment and slide forward into the secured position.
6. Secure batteries with latch and fastening of the thumb screw.
7. Insert or ensure that a terminal connector is inserted in the charge connector, as illustrated in Figure 10-3.
8. Switch the RES master switch ON.
9. Test operation.
10. Retract pylon by pushing the EXT/RET switch downwards

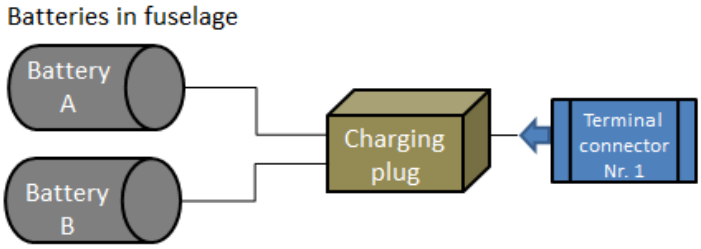


Figure 10-3 Dual battery operation

If a single battery is installed in the fuselage, the terminal plug must be inserted in the fuselage side connector of the 2nd battery, as illustrated in Figure 10-4.

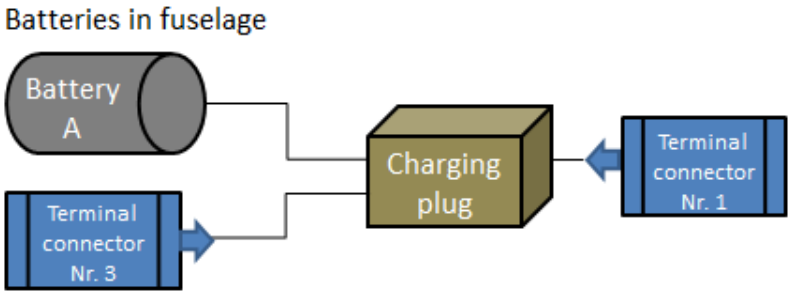


Figure 10-4 Single battery operation

10.7 Battery care

Batteries should be treated with care to get the designed performance from the battery. The cell manufacturer guarantees 300 charge/discharge cycles provided that good care is taken.

- Do not discharge the cells below 2.5 V per cell
- Do not expose the cells to high temperatures
- High rates of discharge shorten the life of the cell
- Do not store batteries fully charged or empty.
- Do not charge the batteries too fast
- Comply with long term storage specifications

10.8 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

Humidity: <75%

It is recommended to verify the state of the batteries every 3 months to ensure that the batteries do not go into a state of discharge. If the state of charge is less than 20-30%, top up the batteries with an adequate amount of charge.

NOTE: The winter charging mode can be used to achieve the acceptable SOC for storage.

10.9 Charging

10.9.1 In aircraft charging

The HV batteries can be charged at own risk inside the aircraft using the following process:

1. Remove the terminal plug and connect the charger plug to the charge port in the fuselage.
2. Insert a terminal connector to Cable B of the battery charger.
3. Turn charger ON.
4. Within 20 sec after the charging process is initiated, the DCU offers two additional charge options:
   - Limiting the charging power; or
   - Switching to winter charging

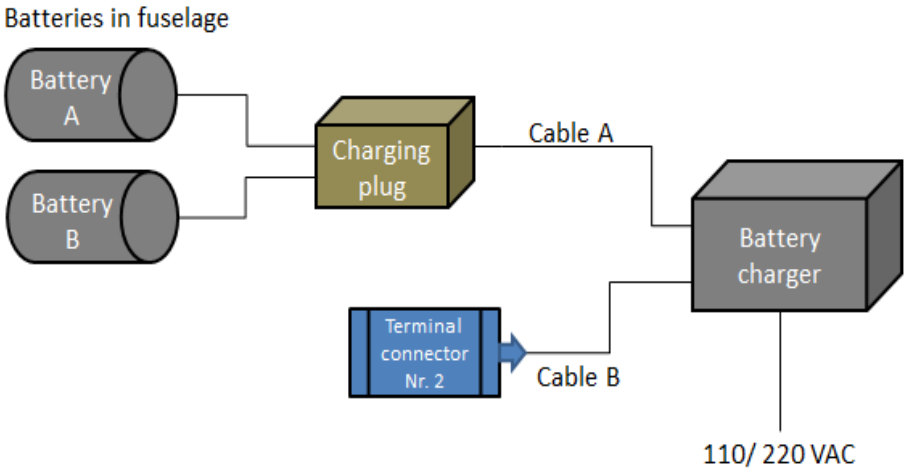


Figure 10-5 Dual battery in aircraft charging

Once the charger is connected, 12 V 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 plug must be inserted in the male connector of the removed battery, as illustrated in Figure 10-6.

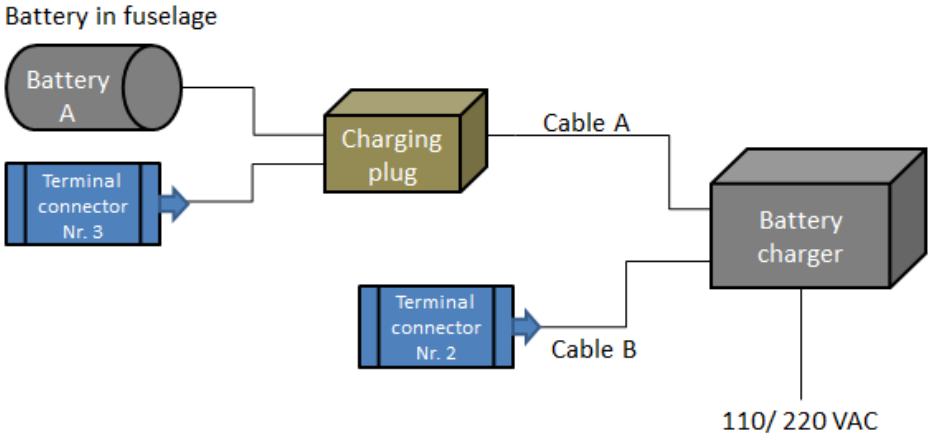


Figure 10-6 Single battery in aircraft charging

10.9.2 External charging

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 plug to the batteries.
3. Turn charger ON. If the toggle switch is operated while the charger is switched on, the winter charging mode is activated.

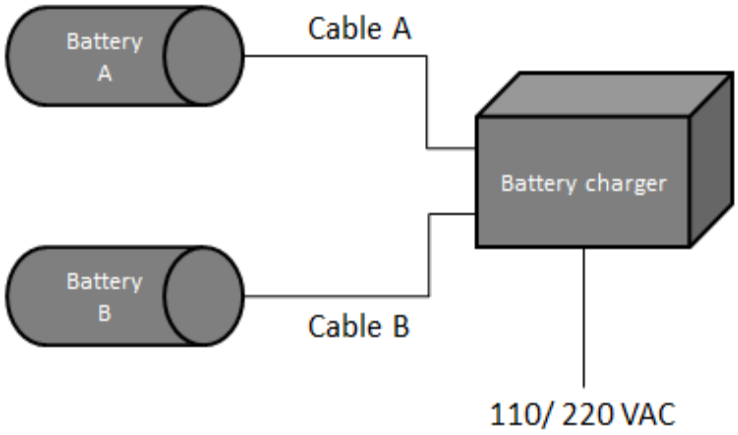


Figure 10-7 External dual battery charging

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

When batteries are fully charged the battery manager switches off the charging process.

If a single battery is charged outside the fuselage, the terminal plug must be inserted in the connector of Cable B of the battery charger, as illustrated in Figure 10-8.

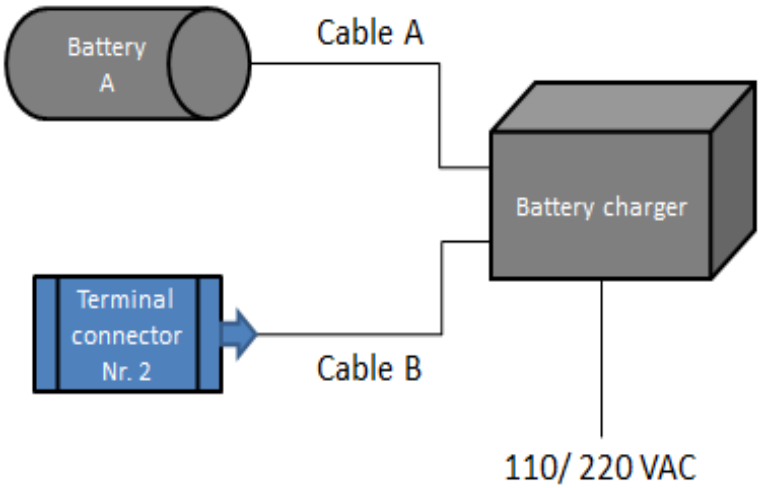


Figure 10-8 External single battery charging

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).

11 PLACARD BOOKLET

The RES has a placard booklet which can be found in the cockpit of the aircraft. Ensure the Placard booklet and the latest approved Aircraft Maintenance Manual has the same issue. Number. The complete Placard Booklet is provided in the Aircraft Maintenance Manual.

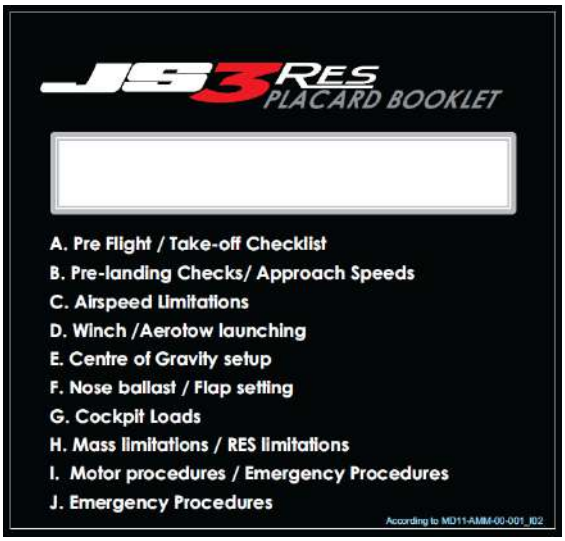


Figure 11-1 RES placard booklet

12 SPECIAL TOOL LIST

Some special tools required to maintain the RES system, are listed below:

12.1 Bleeding reservoir

The bleeding reservoir (T 234 32 101 00) is used to assist in the bleeding of RES system with the water cooled controller option (4.11.2).

The tool is consists of the following parts:

- Reservoir
- Connecting tubes
- 12V battery
- Pump connector
- Stand (any suitable stand to position reservoir above the controller)

Any suitable stand is required to hold the reservoir in place, ensure the reservoir is above the liquid cooling system. The connecting tubes are used to connect the bleeding reservoir to the liquid cooling system, as described in 4.11.2.4. It should be noted that the lower connecting point on the reservoir should be connected to the suction side of the liquid cooling system (connect to the no-spill fitting).

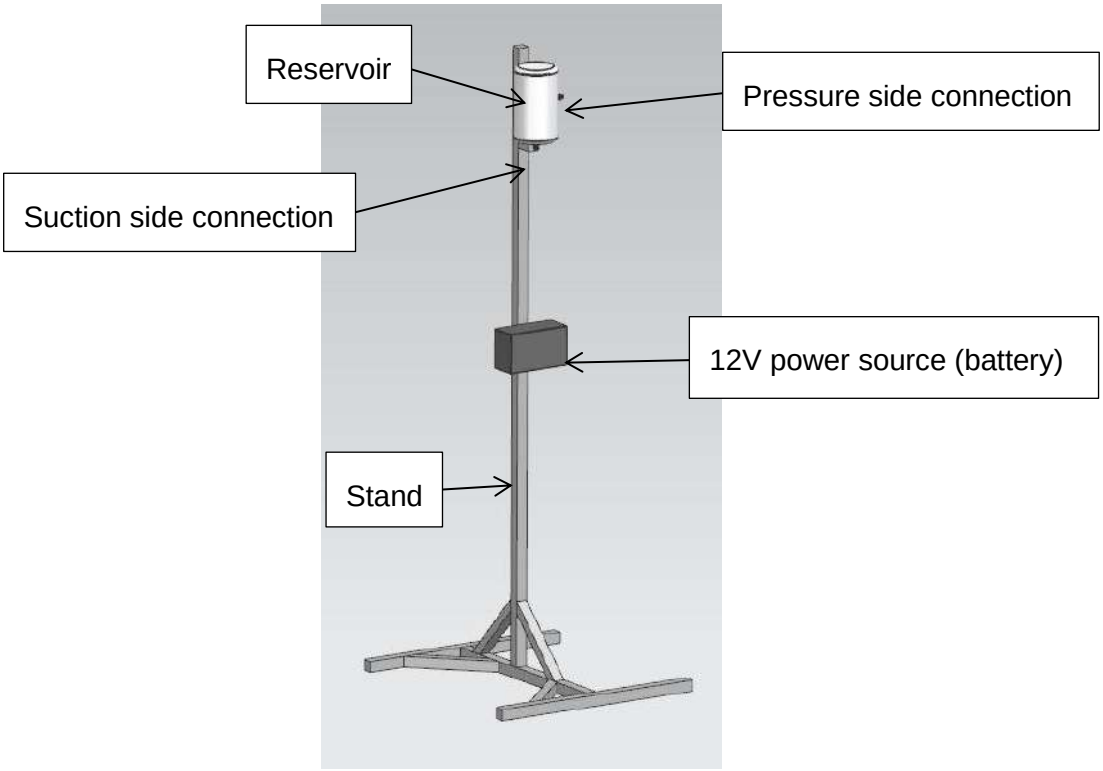


Figure 2 Bleeding reservoir (illustration only)

12.2 Expansion cylinder bleeding tool

The expansion cylinder bleeding tool (T 234 32 080 00) is a bifunctional tool, required to open and close the expansion cylinder lid and is used to hold the expansion cylinder piston into position during the bleeding of the system, as described in 4.11.2.4.

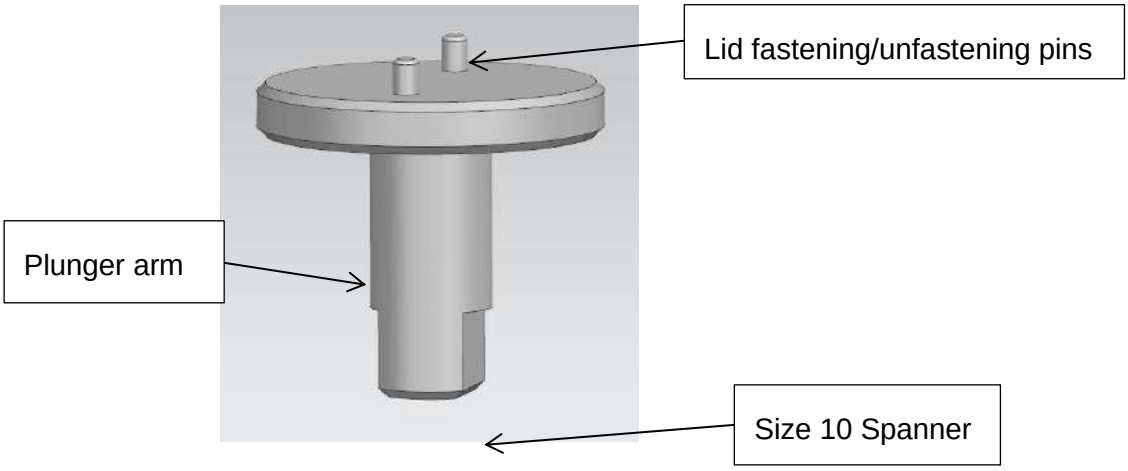


Figure 3 Expansion cylinder bleeding tool

13 SERVICE BULLETINS

This section starts with an overview table of all optional Service Bulletins (SB), in which the owner or operator should mark which SB's he voluntary implemented and which not.

All implemented optional SB's have to be printed and added to this section by the owner or operator. Non-implemented SB's do not need to be added to this section.

SB no:	Rev:	Date:	Description:	SB implemented	
				Yes	No

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14 Contact

14.1 Type Certificate Holder

M&D Flugzeugbau GmbH & Co. KG

Streeker Straße 5b

26446 Friedeburg

Germany

☎ +49 (0) 4465 / 97878 – 11

Mail: info@md-flugzeugbau.de

14.2 Manufacturer / Maintenance

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Streeker Straße 5b

26446 Friedeburg

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☎ +49 (0) 4465 / 97878 – 11

Mail: info@md-flugzeugbau.de

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APPENDIX A – ANNUAL INSPECTION CHECKLIST

JS-MD 3 ANNUAL (OR 100 HOUR MOTOR OPERATION) INSPECTION CHECKLIST	**SIGN** action completed	**SIGN** checked
Pylon		
Inspect pylon for play at its base when extended		
Inspect high voltage cables at pylon base for damage		
Inspect pylon base bolts and Brackets		
Motor		
Inspect Motor connection bolts		
Inspect high voltage motor connectors for damage		
Inspect All wiring for damage		
Propeller		
Inspect propeller bolts and locking wire		
Inspect propeller for cracks and chips		
Pylon Retraction/Extension mechanism		
Inspect all Bolts on Retraction/Extension Mechanism		
Inspect linear actuator wiring and connector for damage		
Main doors		
Inspect door edge clearance with fuselage (Doors should not catch on recess)		

JS-MD 3 ANNUAL (OR 100 HOUR MOTOR OPERATION) INSPECTION CHECKLIST	**SIGN** action completed	**SIGN** checked
Inspect door driver rod ends for damage (Lubricate)		
Inspect door BC springs and lug for damage		
Inspect door BC stop for damage (Doors should not touch Fuselage when open)		
Inspect door BC cable and crimps for damage		
Battery latches		
Inspect battery latch brackets and latch for damage		
Inspect battery latch bolt		
High voltage batteries		
Inspect battery latch plate for damage		
Inspect battery connectors for damage		
Inspect battery box for external damage		
Battery connector bracket		
Inspect cover for damage		
Inspect high voltage connectors for damage		
Inspect wiring entering connector bracket for damage		
Air cooled controller cooling fan assembly		

JS-MD 3 ANNUAL (OR 100 HOUR MOTOR OPERATION) INSPECTION CHECKLIST	**SIGN** action completed	**SIGN** checked
Inspect fan bolts		
Clean fans and fan finger guards		
Inspect wiring loom for damage on both sides where it passes through the fan plate		
Air cooled controller (if fitted)		
Inspect all Controller box fastening bolts		
Inspect high voltage cables for damage where they pass through the box		
Inspect Motor controller data connectors for damage		
Liquid cooled controller (if fitted)		
Inspect all Controller box fastening bolts		
Inspect high voltage cables for damage where they pass through the box.		
Inspect Motor controller data connectors for damage		
Inspect piping and radiator for water leakages.		
Inspect security of radiator, fan and water pump assembly		
Inspect coolant level (section 4.11.2.4.5)		
RFU- IMD assembly		
Inspect connectors to RFU and IMD for damage		

JS-MD 3 ANNUAL (OR 100 HOUR MOTOR OPERATION) INSPECTION CHECKLIST	**SIGN** action completed	**SIGN** checked
Seatback Battery		
Inspect the battery housing and wires for any damage		
Inspect the battery for any swelling or deformation		
Seatpan Battery		
Inspect the battery housing and wires for any damage		
Inspect the battery for any swelling or deformation		
Fire warning system		
Functional check of fire warning system and replace battery		

APPENDIX B – GENERAL TORQUE SPECIFICATIONS

The following torque specifications can be used as a guideline during maintenance of the various components unless specified otherwise:

Thread	Torque specification [Nm] - Dry
M4	3
M5	4.5
M6	10
M8	20

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APPENDIX C – STCS AND MINOR CHANGE APPROVALS

Reference No.	Rev.	Date	Description

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APPENDIX D – 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 Power Reduced	Device temperature too high (> 80°C)
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: Cell voltage difference. Maintenance Required	The battery cell voltage difference is higher that 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: Communication Timeout	Charger didn't receive control message for five 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.