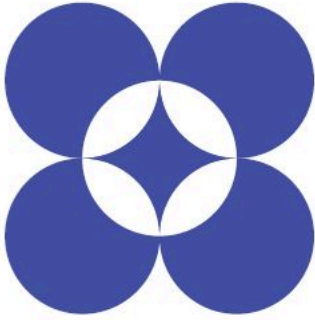


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Pavaman
Aviation

TEJA-S
MAINTENANCE MANUAL

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1. Introduction:

1.1. Purpose of the maintenance manual

Regular or constant usage of components with moving parts and electronics causes wear and tear. To ensure that drones continue to offer optimal performance and flight safety, it is recommended that comprehensive maintenance be performed after every flight or after certain flight hours. This manual is intended to advise to implement a routine maintenance programme on a per-flight basis rather than set dates in the calendar and maximise its continued reliability. This manual gives detailed instructions on inspection and maintenance procedure, response to damage of drone.

1.2. Drone make and model:

PAVAMAN AVIATION / TEJAS

1.3. Serial number:

PA202301HYD

1.4. Date of manufacture:

12/09/2023

1.5. Owner/operator:

PAVAMAN AVIATION

1.6. DGCA registration number:

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

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2. Technical data:

2.1. Dimensions and weight

2.1.1. Dimensions

Summary of all Dimensions in TEJAS

Sr No.	Measurement	Reading
1	TEJAS Folded Length	678 mm ± 10 mm
2	TEJAS Folded Breadth	762 mm ± 10 mm
3	TEJAS Folded Height	581 mm ± 10 mm
4	TEJAS unfolded Length	1844 mm ± 10 mm
5	TEJAS unfolded Breadth	2037 mm ± 10 mm
6	TEJAS unfolded Height	581 mm ± 10 mm
7	M1 to M2 folded	861 mm ± 10 mm
8	M1 mid to M2 mid, unfolded	1413 mm ± 10 mm
9	M1 LED to M2 LED, unfolded	1510 mm ± 10 mm
10	Propeller to GPS horizontal distance	165 mm ± 10 mm
11	Propeller to GPS vertical distance	45 mm ± 5 mm
12	Propeller to Arm rod clearance	42 mm ± 5 mm
13	Propeller ground clearance	511 mm ± 10 mm
14	Propeller to hub distance	231 mm ± 10 mm
15	GPS to ground clearance	568 mm ± 10 mm
16	GPS to arm clearance	79 mm ± 5 mm

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17	GPS to Hub distance	25 mm ± 5 mm
18	GPS to motor edge	442 mm ± 10 mm
19	Tank elbow to ground clearance	55 mm ± 10 mm
20	Propeller P1 to P4	82 mm ± 10 mm
21	Propeller P1 to P2	2037 mm ± 10 mm

2.1.2. Weight

Summary of all weight measurements in TEJAS

Sr No.	Weight	Reading
1	Empty weight of UAS without battery and without payload	13.24 Kg ± 150g
2	Weight of battery pack (2 nos)	3.66 Kg ± 50g
3	Weight of UAS with battery and fixed payload (without variable payload)	16.9 Kg ± 150g
4	Fixed payload weight	2.28 kg ± 50g
5	Variable Payload	8 Kg ± 50g
6	Weight of the UAS with payload (fixed + variable) and without battery	21.24 Kg ± 150g
7	All Up Weight (AUW)	24.9 kg ± 50g
8	Maximum take-off weight (MTOW = All up weight + tolerances)	24.95 kg

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2.2. Motor and power specifications

Motor	Hobbywing X6 Plus, 150 rpm/v
Max Thrust	11.8 kg/Axis (48V, Sea Level)
Recommended LiPo Battery	12 – 14S LiPo
Recommended Takeoff Weight	3.5-5.5 kg/Axis (48V, Sea Level)
Waterproof Rating	IPX6
Operating Temperature	-20°C to + 50 °C
Stator Size	62 x 18 mm
O.D of Carbon Fiber Tube	Ø30 mm
Propeller (dia x pitch)	24 inch x 8.0
ESC	X-Rotor/80A-FOC
Max. Input Voltage	61 V
Max. Input Current (Cont.)	80A(w/ Good Heat Dissipation)
Product Weight (ESC/Motor/Prop)	790 gm

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2.3. Battery specifications

Brand	Tattu
Capacity(mAh)	16000
Voltage(V)	22.2
Discharge Rate(C)	15
Max Burst Discharge Rate(C)	30
Configuration	6S1P
Net Weight ($\pm 20g$)	1.830
Length(± 5 mm)	190
Width(± 2 mm)	75
Height(± 2 mm)	63
Connector type	XT90 ANTI SPARK

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2.4. Control and communication specifications

FC	Pixhawk cube orange plus
Processor	32bit STM32H757, 400 MHz 1 MB RAM 2 MB Flash (fully accessible)
Servo outputs	14 PWM servo outputs (8 from IO, 6 from FMU)
Sensors	IMU 1 (isolated) ICM42688 IMU 2 (isolated) ICM20948 or ICM42688 IMU 3 (Fixed) ICM20649 or ICM45686 Barometric Pressure Sensor: MS5611
Input voltage	4.1V - 5.7V
Rated input current	2.5A
Input/output	14
Dimensions	Cube: 38.4mm x 38.4mm x 22mm Carrier: 94.5mm x 44.3mm x 17.3mm
Operating Temp	-10 C to +55C
IP rating/Waterproofing	Not waterproof
Servo rail input voltage	3.3V / 5V
USB port input voltage	4V - 5.7V
Transmitter/Receiver	Skydroid T12
Weight of transmitter	560g
Weight of receiver	55g
Frequency band	2.400-2.4833GHz

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2.5. Payload specifications

Components of Payload	Specifications	Quantity/capacity
Nozzle bar kit	High pressure, fan shaped atomization.	4 Nos
Pneumatic connectors	ø6 x ø6 mm coupler	4 Nos
Pneumatic connectors	ø6 x ø6 x ø8 mm T-connector	2 Nos
Pneumatic connectors	ø8 x ø8 x ø12 mm T-connector	1 Nos
Pneumatic connectors	ø12 x ø12 mm Elbow Connector	1 Nos
Pump	5liter, Max Voltage : 50.4V	1 Nos
Liquid flow metre & level sensor	5V	1 Nos (each)
Pneumatic tubes	ø6mm, ø8mm & ø12mm	8(4+2+2) Nos
Tank with battery plate Containing water & pesticide mixture	Varies with crop	8 litres

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2.6. Environmental specifications

Temperature	-10°C to +50°C
Relative humidity	90% ± 5%

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3. Safety information:

Safety Precautions for Drone Maintenance

To ensure safe maintenance procedures, it is essential to follow these safety precautions. Prioritise your safety and the safety of those around you by adhering to the following guidelines:

3.1. Personal Protective Equipment (PPE):

- Always wear safety goggles to protect your eyes from potential debris or splashing fluids.
- Use gloves to shield your hands from sharp edges, electrical components, or chemicals.
- Wear appropriate protective clothing and footwear to minimise the risk of injuries.

3.2. Power Isolation:

- Before starting any maintenance or repair tasks, disconnect the drone's power source.
- Ensure the drone is completely powered off and remove the battery to prevent accidental activation of motors or electrical components.

3.3. Propeller Safety:

- Remove propellers or install propeller guards before conducting any maintenance or repairs.
- This precaution prevents accidental propeller rotation, reducing the risk of injuries caused by spinning propellers.

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3.4. Workspace Safety:

- Maintain a clean and well-organised workspace, free of clutter and potential tripping hazards.
- Work in a well-lit area with adequate ventilation to promote a safe and comfortable environment.

3.5. Battery Handling:

- Handle batteries with care, following the manufacturer's guidelines for safe handling and storage.
- Use caution when inserting or removing batteries to avoid electrical shorts or damage to connectors.

3.6. Component Inspection:

- Before performing maintenance tasks, visually inspect all components, connectors, and cables.
- Look for signs of wear, damage, or loose connections. Address any issues promptly to maintain optimal performance and safety.

3.7. Secure Work Surface:

- Always work on a stable and secure surface, such as a workbench or table, to minimise the risk of accidental drops or falls.

3.8. Chemical Handling:

- If maintenance requires the use of cleaning agents or lubricants, carefully follow the instructions provided.

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- Handle and store chemicals properly, and dispose of them in accordance with local regulations.

3.9. Authorised Personnel:

- Complex repairs or modifications should only be performed by authorised personnel or individuals with appropriate training and experience.
- Discourage unauthorised or untrained individuals from attempting repairs that may compromise safety or drone performance.

3.10. Documentation and Record-Keeping:

- Maintain detailed records of maintenance activities, including dates, tasks performed, and observed issues.
- Keep a log of any maintenance-related observations, repairs, or modifications made to the drone.
- Documenting maintenance history helps track performance, aids in troubleshooting, and ensures proper maintenance intervals are followed.





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4. Maintenance schedule:

Inspections that are performed before and after every flight need not require a maintenance team. But after every 10 flights, it is recommended to consult the maintenance team if you have encountered a hard landing or crash. If there is a smooth flight, the drone can be sent to maintenance after 50 flights. Below is the table on what interval the inspections can be done, which will be followed by the maintenance team.

Sr No.	NAME OF THE COMPONENT	EVERY FLIGHT	AFTER 1 DAY	AFTER 1 MONTH
1	Frame (body, hood)	✓		✓
2	Arms (carbon tube, aluminium tubes, folding parts, locking cap, arm accessories kit)	✓		✓
3	Landing gear (vertical, horizontal, fixed seat of landing gear)	✓		✓
4	Motors	✓		✓
5	Propellers	✓		✓
6	Flight controller			✓
7	Transmitter & receiver	✓		✓
8	GPS	✓		✓
9	FCS sensor			✓
10	Battery, battery plate, Velcro tape	✓		✓
11	pneumatic connectors (6*6, 8*6, 12*8)	✓		✓

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12	XT connectors (60,90), BEC			
13	Tank, pump, water tube, Liquid Level sensor, Liquid flow meter			
14	Screws			

 - Scheduled Maintenance by Manufacturers

 - Scheduled Maintenance by Operators

Note: Battery must be replaced after 250 cycles.

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4.1. Daily maintenance:

Maintenance that takes place daily or after every flight is termed as daily maintenance. Visual Inspection should be carried out on a drone after every flight. Components that needs to undergo daily maintenance are

- Motors
- Propellers
- Battery
- Battery plate and velcro tape
- Screws
- Tank

4.2. Weekly maintenance

- Frame
- Arms
- Landing gear
- Pneumatic connectors
- XT connectors

4.3. Monthly maintenance

- Pump,water level sensor,Flow metre, tank & water tube
- Flight controller
- Transmitter & Receiver
- GPS,FCS Sensor

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4.4. Periodic maintenance

Regular maintenance of TEJAS must be done in order to ensure that UAV is in good condition. It is most efficient to perform maintenance on a per-flight basis, rather than a set timeframe. That way, UAVs always remain in better condition.

4.5. Pre-flight maintenance

Pre - flight inspection and maintenance procedure is given below. The Pilot shall inspect the aircraft before the start of the flight operation:

- Verify that all arms are securely attached to the centre frame and that the Arm waterproof rings are locked in place.
- Check for any motion between the locking cap of the arm and the folding mechanism.
- Inspect the centre airframe for structural anomalies and loose or missing parts.
- Inspect the Locking cap of arm for any damage or wear to the carbon fibre tubes, paying close attention to the junctions at each end.
- Check for any motion between each motor mount and boom, and between the motor bell and base.
- Spin the motors by hand to check for smooth rotation and inspect the motor bells for any dents or scratches.
- Inspect the propellers for correct attachment to the hub with respect to the rotation of the motor, e.g, (CW Propeller- to- CW motor), pitch play and wear.
- Verify that the propellers are clear of surrounding structures and other propellers as they rotate through their full range of motion.
- Test and log the voltage of each battery pack and inspect the batteries for signs of damage or swelling.

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- Inspect the battery connectors and leads for wear or damage and ensure all batteries are securely attached to the battery tray.
- Verify that the battery plate is securely attached to the airframe and that the landing gear is correctly oriented and attached to the airframe.
- Check that the GPS and control link antennas are securely fastened and correctly oriented.
- Verify that the RPA indication lights on the end of each boom are functioning properly.
- Inspect the payload attachment points and ensure that clamps are in place, if used.
- Check the payload level.
- Verify that all antennas are in good condition and correctly oriented.
- Inspect the control sticks of the transmitter for free movement and check for dust or debris.
- With LiPo Checker, check the voltage of the Batteries. Ensure the batteries are fully charged.

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5. Maintenance procedures:

5.1. Battery maintenance

5.1.1. Charging

The following guidelines should always be followed when handling and charging the LIPO-battery.

- Always charge LiPo batteries on fire-resistant surfaces such as cement, steel, ceramic, or stone.
- Do not leave the LiPo battery fully charged for more than 3 days (72 hours).
- Do not charge the battery near flammable products or liquids.
- LiPo batteries should be charged within a temperature range of 0°C to 30°C.
- Do not leave Lithium Polymer batteries unattended while they are being charged.
- Do not charge in a car, especially while driving.
- Do not store the battery inside the vehicle.
- Do not charge Lithium Polymer battery packs at rates greater than 1C.
- Do not charge LiPo packs that have been overcharged, undercharged, or swollen.
- Do not charge damaged or accidentally damaged lithium polymer batteries.
- Have a fire extinguisher near the loading area or a large bucket of dry sand. Do not try to extinguish the fire with water. Use Class D Fire Extinguisher
- If you notice the LiPo battery pack swelling, stop charging immediately, place the battery in a safe container and observe for 15 minutes.

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5.1.2. Storage

- Store the batteries in the fireproof aluminium battery box when not in use this protects the pack from damage.
- Place the storage box on a cement concrete floor and horizontal clearance radius should be at least 2ft and vertical clearance should be at least 10ft.
- Store the Battery packs in a low temperature room (less than 30°C).
- Damage to a cell in a pack will permanently damage the pack and may cause a fire.
- Store the Fired battery in a cool, dry chamber to avoid smoke or flame.
- Fire extinguishers must be available during storage, transportation, and loading.
- Store the battery pack in nominal voltage 3.7V (22.2V across the pack). This makes the pack last longer and less volatile.
- Keep LiPo battery packs out of children's reach.
- Do not put batteries in pockets or near conducting metal where they can short out.
- Do not store, transport, or carry the battery where it can encounter sharp or metallic objects.
- Do not store LiPo batteries in extreme temperatures below 0°C or above 30°C.
- Always store LiPo packs in safe, non-flammable containers and away from combustible materials.
- Avoid bulk-storage in non-laboratory areas such as offices.
- Always store LiPo batteries partially charged. They maintain their level of performance over time and do not need to be cycled unless stored for more than 3-6 months ideally.

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- Visually inspect battery storage areas at least weekly.

5.1.3. Replacement

- Once the battery has completed more than 250 cycles, it should be retired and cannot be used for flight operations.
- If the battery is swollen, damaged, or has a high internal resistance reading, the battery may become unusable before reaching 250 cycles.

5.2. Motor and Propeller maintenance

5.2.1. Inspection

- There should not be any bend in the power supply wire while folding arms.
- There should not be any cuts on wire coatings/insulation.
- After every flight the temperature of the motor should be checked.
- Check the motor resistance with a multimeter. If the resistance is high, replace the motor.
- Check for deformities by confirming that the gap between the motor and motor base is even.
- Ensure that the screws used to secure the motor base are tight and the plastic components around the motors are in good condition. Check the rotors to confirm that they have not become loose.
- Check if soldered lead in the connector is proper with the help of pull.

5.2.2. Replacement

- Once the battery has completed more than 250 cycles, it should be retired and cannot be used for flight operations.
- If the battery is swollen, damaged, or has a high internal resistance reading, the battery may become unusable before reaching 250 cycles.

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5.2.3. Payload maintenance

Payload comprises Nozzles (4), Pneumatic connectors (8), pump (1), water & pesticide mixture.

- Pesticides when stored for a long-time, results in corrosion. To prevent it, payload maintenance should be done after every flight.
- Wear protection gear while handling pesticides.
- Clean tank, nozzles, pneumatic connectors, and pump with fresh water.
- This cleaning is done by filling fresh water in the tank and allowing it to spray. This will eliminate pesticides and dust present in the payload system.
- Using a clean cloth, dry the tank and sprayers.
- Remove the nozzles from the connected tube. Clean the filter of the nozzles with a thin brush and water. Dry it before storage.

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5.3. Inspection

5.3.1. Calibration

Calibration is the process of configuring an instrument to provide a result for a sample within an acceptable range. Calibration of sensors (accelerometer, compass, barometer & RC).

5.3.2. Replacement

Replacement Of Pixhawk Cube+ Orange Flight Controller:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove BEC from POWER 1 port of the controller.
- Remove Servo Main-out signal wires of the motor from the controller.
- Remove Servo AUX – out signal wire of pump from the controller.
- Remove Receiver wires from RC signal port and TELEMETRY port of the controller.
- Remove GPS signal wire from CAN 1 Port of the controller.
- Remove flow meter and Liquid level sensor wire from the AUX port of the controller.
- After removing all signal wires remove the controller from the mounting plate.
- Place the new Flight controller on the mounting plate and follow the process.
- Connect BEC to POWER 1 port of the controller.
- Connect Servo Main-out signal wires to the controller from Motor.
- Connect Servo AUX – out signal wire of the controller to the Pump.

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- Connect Receiver wires to RC signal port and TELEMETRY port of the controller.
- Connect GPS signal wire to CAN 1 Port of the controller.
- After connecting all signal wires, Fix the cowling part with a 2.5 Allen key.

Replacement Of Here-3+ Gps:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove GPS signal wire from CAN 1 Port of the controller.
- Remove the GPS module from the GPS stand.
- Mount the new GPS module on the GPS stand.
- Connect GPS signal wire to CAN 1 Port of the controller.
- Fix the cowling part with a 2.5 Allen key.

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5.4. Electrical and electronic maintenance

5.4.1. Inspection

- Ensure that there are no obstacles on or around the GPS module or around the antennas on the landing gear. Remove any obstacles (such as tapes with conductive material) that might affect or block the signal.
- Ensure that there is no loose attachment on the receiver antenna. If any loose attachment, do not rotate the antenna without holding the back end of the antenna holder.
- If there is any damage on the receiver wire or antenna. Replace the antenna in case the antenna is damaged. Replace wire in case the receiver is damaged.
- If the power supply for the drone is fluctuating, then we need to check the source to the end. The source is battery and FC (flight controller) is the end. check and replace BEC and In line wires, if needed.
- Check the current Sensor, if the voltage reading in GCS is not showing properly. Replace the current Sensor if required.
- Check Pump and inline wiring If the pump is not spraying pesticide properly. Replace if required.
- check the FC if calibration failure happens frequently. Replace if required.
- Check the motor for any malfunction. Replace the motor if required.

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5.4.2. Replacement

Replacement Of Receiver:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove the T12 receiver's connector from the Receiver.
- Remove the 2 Antennas connected to the receiver.
- Take a new Receiver and connect it to the T12 Receiver's Connector.
- Take the 2 new Antennas and connect it to the receiver wire carefully without twisting the wires.
- Fix the cowling part with a 2.5 Allen key.

Replacement Of BEC:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove BEC module from POWER 1 port of the controller.
- Remove Sense wire in the BEC module coming from the FCS Sensor.
- Remove the Flight Controller mounting plate using 2.5 Allen key and remove the XT60 connector of BEC from the Power Distribution Board.
- Solder a new XT60 connector with the new BEC module.
- Connect the XT60 connector to the Power Distribution Board and fix the mounting plate using the 2.5 Allen key.
- Connect BEC to POWER 1 port of the controller.
- Connect the Sense wire of the FCS sensor to the BEC module.
- Fix the cowling part with a 2.5 Allen key.

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Replacement Of FCS Sensor:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove the Sense wire in the BEC module coming from FCS Sensor.
- Remove the Red wire which is passing through the FCS sensor.
- Take a new FCS Sensor, Check the current flow direction indicated with an arrow symbol, crimp one side with Battery’s positive terminal wire and the other side with Power Distribution Board’s positive terminal wire.
- Connect Sense wire to BEC module coming from FCS Sensor.
- Fix the cowling part with a 2.5 Allen key.

Replacement Of Water Pump:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove Servo AUX – out signal wire of pump from the controller.
- Remove the Flight Controller mounting plate using 2.5 Allen key and remove the XT60 connector of Pump from the Power Distribution Board.
- Solder a new XT60 connector with the new Pump’s power cable.
- Connect the XT60 connector of the pump to the Power Distribution Board and fix the mounting plate using the 2.5 Allen key.
- Connect Servo AUX – out signal wire to the controller from Pump.
- Fix the cowling part with a 2.5 Allen key.

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Replacement Of Liquid Level Sensor:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove Servo AUX2 – out signal wire of water level sensor from the controller.
- Connect Servo AUX2 – out signal of the water level sensor.
- Fix the cowling part with a 2.5 Allen key.

Replacement Of Liquid Flow meter:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove Servo AUX5 – out signal wire of water flow meter sensor from the controller.
- Connect Servo AUX 5– out signal of the new water flow meter sensor.
- Fix the cowling part with a 2.5 Allen key.

Replacement Of Motor:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove the Flight Controller mounting plate using 2.5 Allen key and remove the XT60 connector of Motor from the Power Distribution Board.
- Remove Servo Main-out signal wire of motor from the controller.
- Solder a new XT60 connector with the new motor’s power cable.
- Connect the XT60 connector of the motor to the Power Distribution Board and fix the mounting plate using 2.5 Allen key.
- Connect Servo Main-out signal wire to the controller from Motor.
- Fix the cowling part with a 2.5 Allen key.

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Replacement Of Pixhawk Cube Orange+ Flight Controller:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove BEC from POWER 1 port of the controller.
- Remove Servo Main-out signal wires of the motor from the controller.
- Remove Servo AUX – out signal wire of pump, water level sensor, and water flow meter from the controller.
- Remove Receiver wires from RC signal port and TELEMETRY port of the controller.
- Remove GPS signal wire from CAN 1 Port of the controller.
- Subsequently, remove the controller from the mounting plate.
- Place the new Flight controller on the mounting plate.
- Connect BEC to POWER 1 port of the controller.
- Connect Servo AUX – out signal wire of pump, water level sensor and water flow meter from the controller.
- Connect Servo Main-out signal wires to the controller from Motor.
- Connect Receiver wires to RC signal port and TELEMETRY port of the controller.
- Connect GPS signal wire to CAN 1 Port of the controller.
- After connecting all signal wires, Fix the cowling part with a 2.5 Allen key.

Replacement Of Here 3+ GPS:

- First, Battery should be disconnected from the drone.
- Remove the cowling part with 2.5 Allen key.
- Remove GPS signal wire from CAN 1 Port of the controller.

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- Remove the GPS module from the GPS stand.
- Mount the new GPS module on the GPS stand.
- Connect GPS signal wire to CAN 1 Port of the controller.
- Fix the cowling part with a 2.5 Allen key.

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5.5. Mechanical maintenance

5.5.1. Inspection

Airframe:

- Even the smallest crack can cause critical problems if left unnoticed.
- During maintenance, check each component extremely carefully and make a note of the damage to the authorised service centre immediately and await further instructions.
- Confirm that all the screws are still adequately tightened.
- Check the aircraft for breaks or damage. If there is any reason to believe that detectable damage might affect flight safety, Replace that part of the airframe.
- Check the carbon tubes of the arms for damage.

Landing gear:

- Check whether there is any deformation on the Horizontal landing gear when it is placed at flat surface. If there is any critical deformation the horizontal landing gear needs to be changed.
- Check whether there is any deformation on the vertical landing gear when it is placed at flat surface. If there is any critical deformation the vertical landing gear needs to be changed.
- Check the dampers on the landing gears. If they are loose, secure them with Loctite.

5.5.2. Replacement

Frame assembly:

- Remove the fixing screws (M3*8) of the top frame, then flight control board mounting plate.
- Turn the frame over and remove the fixing screws (M3*10) of the bottom plate.
- Pass the XT90 power cord through the three-hole protective coil.

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- Use M6*8 screws to fix the power cord on the terminals of the power distribution board, paying attention to distinguish the positive and negative poles.
- Customers can choose the left and right sides of the outlet.
- Restore the M3*10 self-tapping screws of the PDB cover.

Landing gear installation:

- Put the XT90 fixed seat on the diagonal brace, and then insert it into the tripod fixed seat to reach the bottom.
- The positioning hole of the diagonal brace is flush with the positioning hole of the landing gear mount.
- Fix the limit hole M3*8 screw and the fixing seat M4*12 screw.
- Insert the diagonal brace into the tripod crossbar tee until it reaches the bottom. Tighten two M3*10 screws and one M3*20 screw.

Arm installation:

- Fix the carbon tube into the folding part with M6*60 screws + locknut.
- Use the L-shaped Allen key for fixing.
- Insert the arm into the body locking buckle.
- Reach the fuselage limit.
- First fix the locking buckle limit M3*8 screw.
- Then fix the locking button M4*20 screws.
- Install 40 mm arm pipe clamp.
- Install the pipe clamp fixture.
- Pass the M4*45 screw through the arm pipe clamp.
- Use an M4 lock nut to fix the reverse side.
- Install the finished fixture.

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5.6. Software maintenance

5.6.1. Updating

Need for Software Upgradation:

Software upgradation is required because of the following situations:

- To fix the bugs
- To avoid hacks
- Rolling out the new features
- Security improvement
- Interaction with new media
- To prevent the loss of a drone
- Optimise the performance of the device.

Standard Operating Procedure (SOP) _ Downloading POST log file

Introduction:

Power-On Self-Tests are an essential part of system troubleshooting because the boot-up can only proceed if the software is working correctly; if the software isn't working, the BIOS produces an error message. This is important because numerous essential programs are loaded when systems boot up.

A POST operation might also perform other tasks, such as verifying the firmware, validating hardware configurations or initializing the hardware.

A POST operation includes calculation of checksums of the firmware (code and data part) and the checksum should be matched with the registered checksum stored in the flight module which was supplied at the time of certification.

The result of the POST is logged. The POST logs are stored in the root folder of SD Card in the flight controller.

File name: boot.log (json file)

Download option of POST logs is restricted to manufacturers and OEM only.

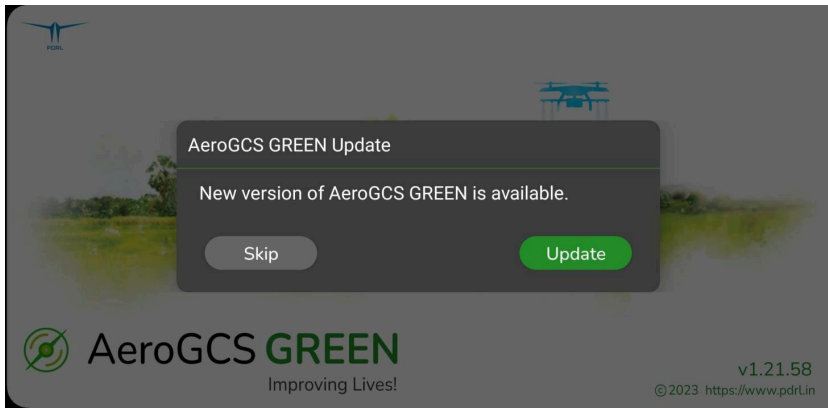
Download of POST logs may be required during maintenance or during compliance audits.

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Process of Upgradation

The software upgrade will overwrite the existing microcode with the new program, which may be incompatible with the model of your device. Installing the incorrect software upgrade could harm your device. AeroGCS-GREEN provides manual as well as automatic software upgradation.

Automatic Firmware Upgradation:.



Update Alert

Click on the "Update" button to get the updated version of AeroGCS-GREEN GREEN. Then the user can use the app smoothly.

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5.7. Troubleshooting:

5.7.1. Common issues:

- The compass is not healthy.
- After the compass calibration is done. The UAS will not arm.
- The vehicle's home position is not visible in GCS.
- The AeroGCS-GREEN will show bad gps.
- RC2 is not neutral.

5.7.2. Solutions:

- The Compass needs to be calibrated on all orientations.
- The issue for compass calibration can be solved by removing the battery so that the compass is calibrated and again plugging it in the drone.
- The vehicle home position is necessary before flying. To get the home position of the drone you require to close the app and unplug the battery and again plug it in the drone.
- To prevent bad Gps, the machine should not be under the tree/obstacles.
- To rectify the RC2 value issue, you need to check in AeroGCS-GREEN whether the RC values are neutral.

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6. Inspection and testing:

6.1. Inspection procedure

- Clean frame of mud and dirt.
- Inspect frame for cracks.
- Check for any loose screws. If loose, tighten them.
- Check propellers for damage like cracks or deformation.
- Check propellers whether they are free spinning.
- Check motors for dust, debris, and obstructions.
- Check the state of wiring and solder joints.
- Check whether the landing gear has any deformation or cracks.
- Inspect antennae.
- Check whether any error displays in the control station.

6.2. Testing procedure

- Check the battery voltage before plugging it into the drone.
- Turn on the transmitter and plug the battery to the Drone.
- Open the AeroGCS-GREEN -GREEN software and connect the software to the transmitter through USB or Bluetooth.
- Check the AeroGCS-GREEN whether the data are displayed to the pilot.
- Check each value of the displayed data in AeroGCS-GREEN .
- Initially arm the drone without a propeller and check all the motors are spinning and disarm the drone using a transmitter.
- Remove the battery and then attach the propeller to the motor.
- Arm the drone and take-off the flight in altitude mode without payload.
- Switch the flight mode from Altitude to GPS using a transmitter.

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- Hover the drone for a few minutes without giving pilot input.
- Pilot needs to give all the motion commands (pitch,roll and yaw) to the drone in low altitude.
- Trigger RTL switch checks whether the drone lands on the home position.
- Fill the tank with liquid and check the sprayer system whether the sprayer is working till it is emptied.
- In AeroGCS-GREEN , we need to map the layout of the area and proceed with the flight test. Refill the liquid again.
- Arm the drone and take-off the flight in altitude mode with payload.
- Switch the flight mode from Altitude to GPS using a transmitter.
- Trigger the autonomous mode switch to fly the predefined path.
- Once the Drone completed the predefined path.
- Switch the mode to altitude or Gps and land the drone.
- Unplug the battery from the drone and close the app.
- Turn off the transmitter.

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6.3. Acceptance criteria

Warranty Service:

You can apply for our product warranty service if there is a performance failure during the effective warranty period.

Replacement Service will not be provided where:

Service is requested more than 15 calendar days after receiving a product.

- Legal proof-of-purchase, receipts, or invoices are not provided, or are reasonably believed to have been forged or tampered with.
- A product sent to us for replacement does not include all original accessories, attachments, and packaging, or contains items damaged by user error.
- A product is found to have no defects after all appropriate tests are conducted by us.
- Any fault or damage of the product is caused by unauthorised use or modification of the product, including exposure to moisture, entry of foreign bodies (water, oil, sand, etc.) or improper installation or operation.
- Product labels or serial numbers show signs of tampering or alteration.
- Damage is caused by uncontrollable external factors, including fires, floods, high winds, or lightning strikes.
- Received product has not been sent back for 7 calendar days after replacement confirmation from us.
- **Proof of damage during transit issued by the carrier cannot be provided.**

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7. Service and support:

7.1. Service centre locations

All the services and advanced maintenance will be done in the TEJAS by PAVAMAN AVIATION

Address: 2nd Floor, Kapil Kavuri hub, financial district, nanakaramguda, Rangareddy, Telangana, 500032

7.2. Warranty information

7.3. Contact information:

PAVAMAN AVIATION,
Contact no: +91 8465859571.
Email id: vijay.veeramallu@pavaman.in

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8. Calibration:

8.1. Accelerometer calibration

Gyroscopes and accelerometers are small mechanical components integrated into the sensors. Motion leads these components to expand and contract at various temperatures, affecting the raw sensor signal. For this reason, if we want to achieve the best level of accuracy, proper calibration must be carried out at various temperatures.

- Calibrate the accelerometer on the first-time use and recalibration on the change in the orientation of the flight controller.
- Pre-arming checks will check whether the accelerometer is properly calibrated or not.
- It is recommended not to calibrate the accelerometer when the drone is armed.
- Accelerometer:
 - Accelerometer measures the acceleration forces. Therefore, calibration of these sensors is a must before every flight.
 - To calibrate the accelerometer in AeroGCS GREEN, click on the "Calibrate" button and follow the instructions displayed on the screen.
 - When completed the process it will give an intimation regarding the completion of the calibration process

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- Accelerometer Calibration
- Click on the "Start" button to start the process of accelerometer calibration.

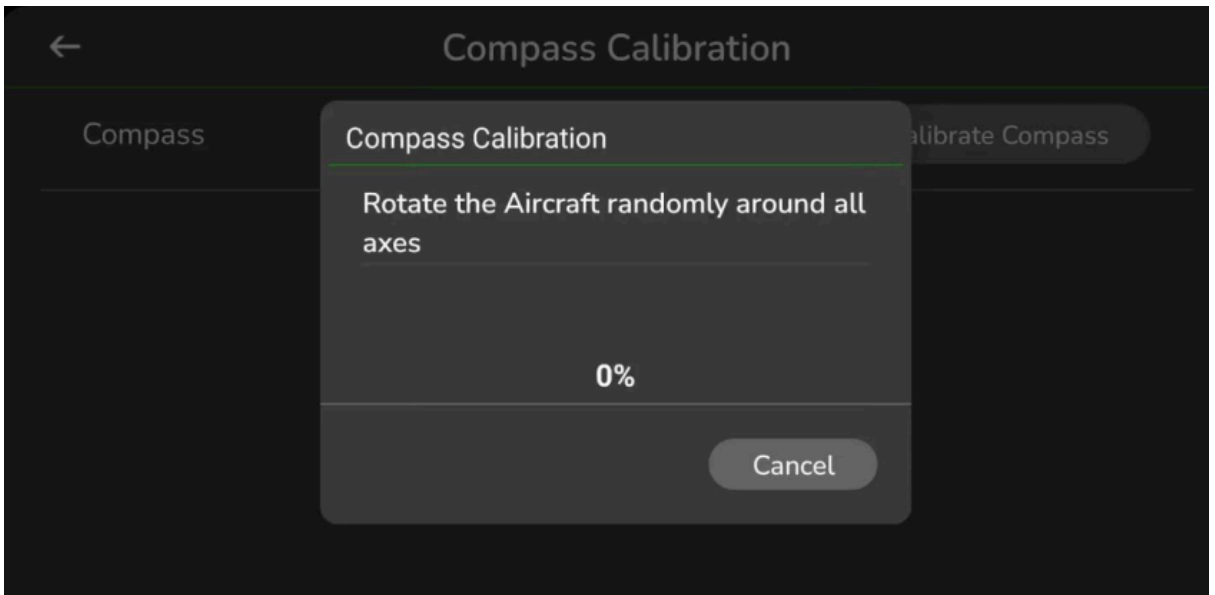
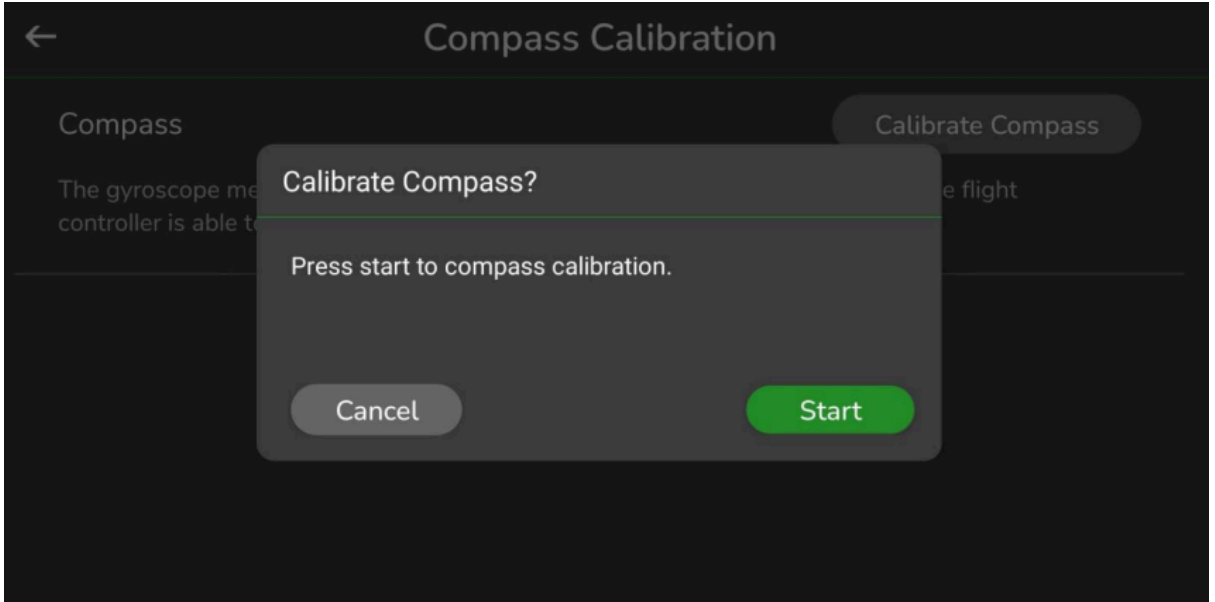
8.2. COMPASS calibration

Each external and internal magnetometer connected to the compass is set up during the calibration process. Calibrate the compass on the first use and recalibrate when exposed to a strong magnetic field. Calibration of compass is required to find the true north. Calibration of compass is required for the drone to fly in a new location (more than 6 miles away) or if error messages appear. Multicopter circling while hovering or veering off the path when attempting to fly straight are all signs of a misaligned compass. It is recommended to avoid metal surfaces while calibrating the compass.

- AeroGCS-GREEN Compass Calibration Settings:
 - Calibrate the compass through these settings.
 - The gyroscope measures rotational forces. By combining these measurements, the flight controller is able to calculate the current altitude of the drone. Therefore, compass calibration is important before the flight.
 - Click on the "Calibrate Compass" button to calibrate it.

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Follow all the instructions displayed on the screen for proper calibration of the compass.



Calibration of Compass

Click on the "Start" button to start the procedure of calibration of compass. Follow the instructions that popped up on the screen to complete the process of calibration of the compass.

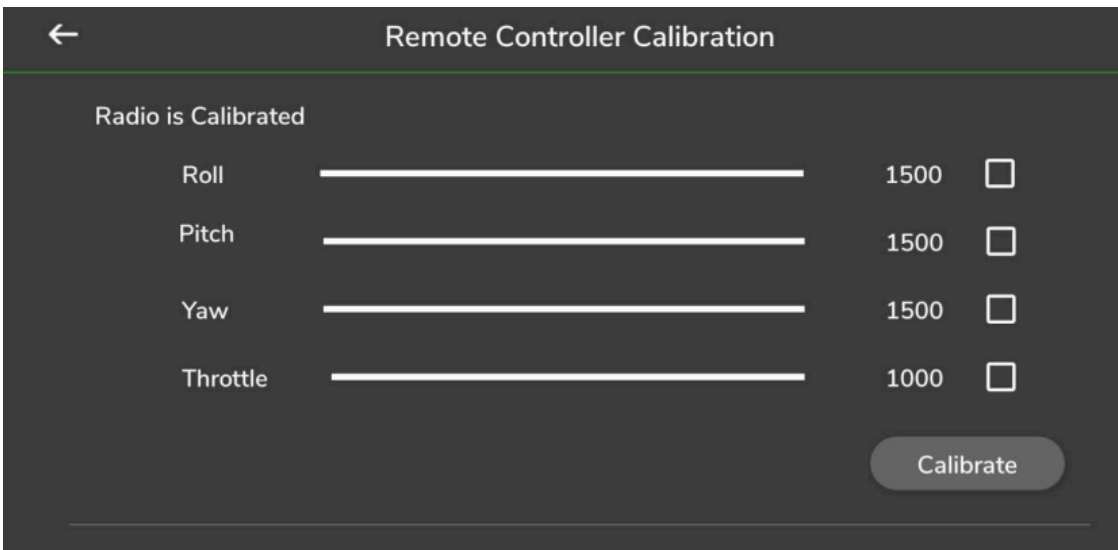
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Starting of Calibration of Compass After successful completion of compass calibration, the message will be displayed accordingly with 100% as a progress value.

8.3. Radio calibration

In RC configuration (RPA Configuration > RC Config), RC transmitters allow the pilot to set the flight mode, control the vehicle’s movement and orientation and turn on/off auxiliary functions (i.e., raising and lowering landing gear, etc.).

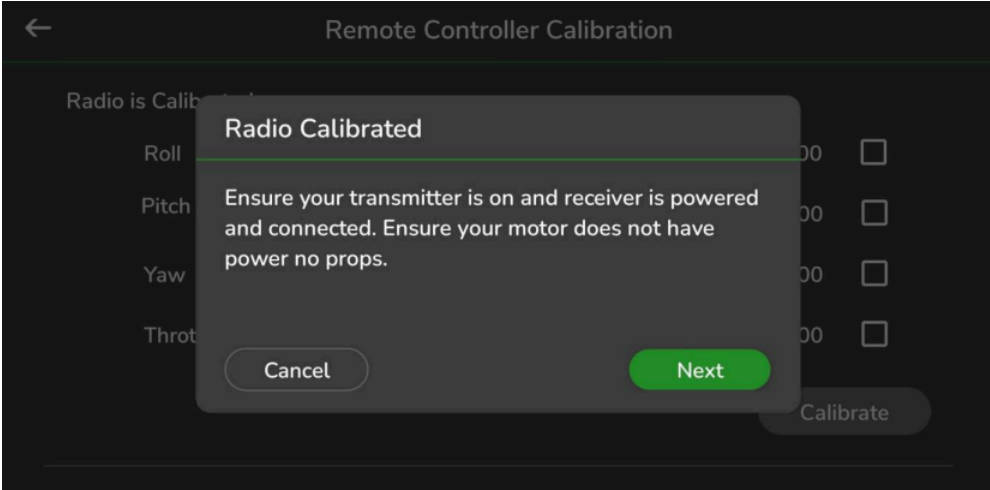
- Ensure that the transmitter and receiver are connected properly.
- Ensure that the propellers are not connected to the motors. Also, make sure that the motors are not powered ON.
- RC Calibration involves capturing each RC input channel’s minimum, maximum and “trim” values so that AeroGCS-GREEN can correctly interpret the input.
- These are the settings that are related to Remote Controller Calibration.
- The radio is calibrated for roll, pitch, yaw, and throttle by clicking on the "Calibrate" button.



RC Calibration

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- Calibrate the radio for roll, pitch, yaw, and throttle values.
- Follow the instructions displayed on the screen.



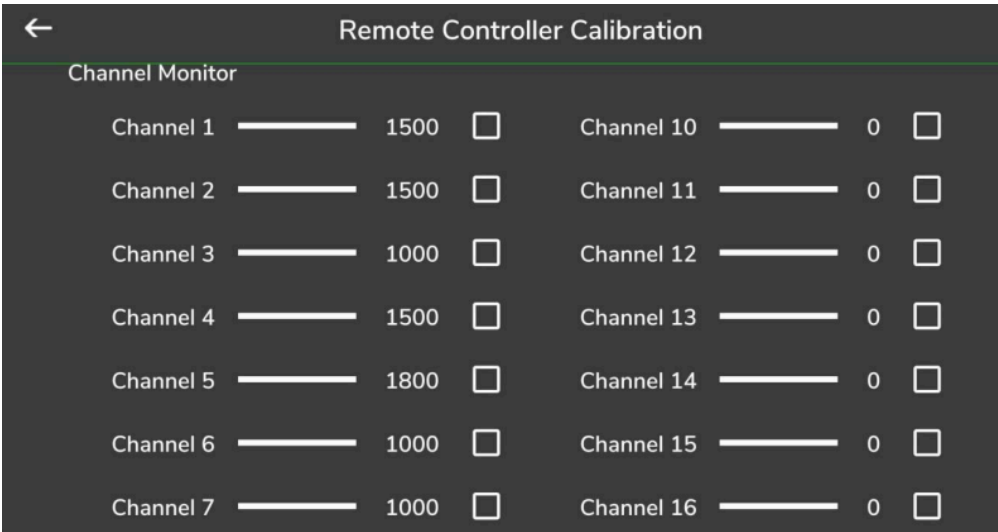
Radio Calibration

- Once the calibration is done it will display all the values collectively as shown in the image.



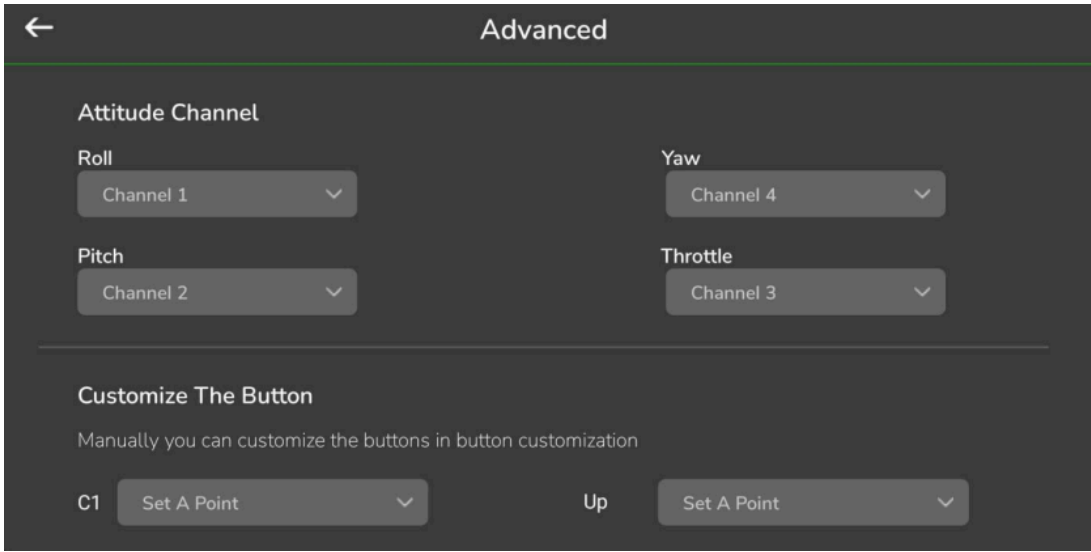
Radio Calibrated

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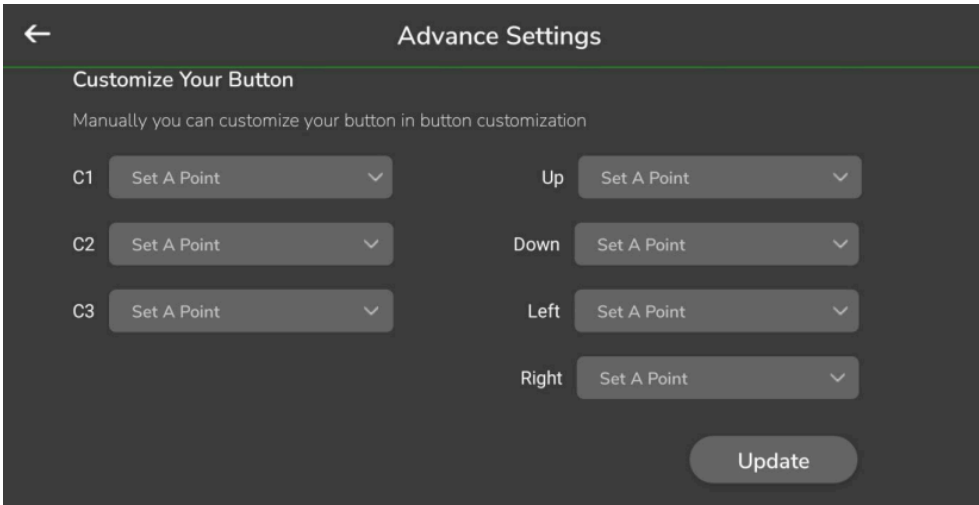
Remote Controller Calibration

Advance settings allow customizing the buttons of RC as shown in the image below.



Advanced Settings

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Advance Settings

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9. Appendices:

9.1. Glossary of terms

Term	Definition
Troubleshoot	trace and correct faults in a mechanical or electronic system
Calibration	the process of configuring an instrument to provide a result for a sample within an acceptable range
Payload	load carried by a vehicle exclusive of what is necessary for its operation.

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SAMPLE MAINTENANCE LOG

Aircraft name	
UIN number	
UAV operator	
Date of previous maintenance	
Total number of flights	
Current maintenance date	
Location	

Sr. NO	DESCRIPTION	CHECK	DONE BY	REMARKS AFTER MAINTENANCE
1	Frame	Check for deterioration, cracks, & deformation. Replace if required.		Replaced frame due to cracks.
2	Arms	Check for deterioration, cracks, & deformation. Replace if required.		In good condition
3	Motors	Replace motor after 100 Hours of flight or replace if any friction occurred.		Inspection was done and all the motors are in good condition.
4	Propellers	Replace propeller after 100 Hours of flight or replace if any crack or bend occurred.		Replaced propellers due to their deformation.
5	Circuit inspection	Check if there is a high resistance and replace it every six months.		Inspection was done and is in good condition

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6	Tank	Replace tank for 1 year based on usage or replace it if any deformation occurs.		In good condition. No replacement needed.
7	Pump	Replace pump for every six months or replace when the flow pressure decreases.		In good condition. No replacement needed.
8	Sensor management	Replace sensor if any error occurred.		In good condition.
9	Calibration	Calibration needs to be done while inspecting the drone.		Calibrated the drone
10	Landing gear	Replace landing gear after 100 flights. Replace if any crack and bend occurred.		Replaced landing gear due to their deformation.
11	Battery	Replace battery after 250 cycles.		Inspection was done. In good condition.

MAINTENANCE NOTES (example)
<p>Inspection was held due to hard landing. Frame, propellers, and landing gears are replaced with new ones. Inspection of the whole drone was carried and in good condition.</p>

Signature of Operator

Signature of Maintenance authority

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ANNEXURES - A

UAS MAINTENANCE LOG (For Maintenance team)

Aircraft name	
UIN number	
UAV operator	
Date of previous maintenance	
Total number of flights	
Current maintenance date	
Location	

Sr No.	DESCRIPTION	CHECK	DONE BY	REMARKS AFTER MAINTENANCE
1	Frame	Check for deterioration, cracks, & deformation. Replace if required.		
2	Arms	Check for deterioration, cracks, & deformation. Replace if required.		
3	Motors	Replace the motor after 5555 hours or replace it if any friction occurs.		
4	Propellers	Replace propeller after 500 flights		

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		replace if any crack or bend occurred.		
5	Circuit inspection	Check if high resistance occurs between terminals or replace every six months.		
6	Tank	Replace tank for 1 year based on usage or replace it if any deformation occurs.		
7	Pump	Replace pump for every six months or replace when the flow pressure decreases.		
8	Sensor management	Replace sensor if any error occurred.		
9	Calibration	Calibration needs to be done while inspecting the drone.		
10	Landing gear	Replace landing gear after 5,555 flights hours. Replace if any crack and bend occurred.		
11	Battery	Replace battery after 250 cycles.		

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MAINTENANCE NOTES

Signature of Operator

Signature of Maintenance authority

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ANNEXURES - B

Maintenance program Checklist (for operators)

Sr No.	Procedure	Checklist	Remarks
Pre-flight inspection and maintenance procedure			
1	Verify that all arms are securely attached to the centre frame and that the Arm waterproof rings are locked in place.		
2	Check for any motion between the locking cap of the arm and the folding mechanism.		
3	Inspect the centre airframe for structural anomalies and loose or missing parts.		
4	Check for any motion between each motor mount and boom, and between the motor bell and base.		
5	Spin the motors by hand to check for smooth rotation and inspect the motor bells for any dents or scratches.		
6	Inspect the propellers for correct attachment to the hub with respect to the rotation of the motor, e.g. (CW Propeller-to- CW motor), pitch play and wear.		

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7	Verify that the propellers are clear of surrounding structures and other propellers as they rotate through their full range of motion		
8	Test and log the voltage of each battery pack and inspect the batteries for signs of damage or swelling.		
9	Inspect the battery connectors and leads for wear or damage and ensure all batteries are securely attached to the battery tray.		
10	Verify that the battery plate is securely attached to the airframe and that the landing gear is correctly oriented and attached to the airframe.		
11	Check that the GPS and control link antennas are securely fastened and correctly oriented.		
12	Verify that the RPA indication lights on the end of each boom are functioning properly.		
13	Inspect the payload attachment points and ensure that clamps are in place, if used.		
14	Check the payload level		
15	Verify that all antennas are in good condition and correctly oriented		

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16	Inspect the control sticks of the transmitter for free movement and check for dust or debris		
17	With LiPo Checker, check the voltage of the Batteries. Ensure the batteries are fully charged.		
Post-flight inspection and maintenance procedure			
1	Clean frame of mud and dirt.		
2	Inspect frame for cracks.		
3	Check for any loose screws. If loose, tighten them.		
4	Check propellers for damage like cracks or deformation.		
5	Check propellers whether they are free-spinning.		
6	Check motors for dust, debris and obstructions.		
7	Check the state of wiring and solder joints.		
8	Check whether the landing gear has any deformation or cracks.		
9	Inspect antennae.		
10	Check whether any error displays in the control station.		

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ANNEXURES - C

Component Monitoring Process

Objective

Monitoring the performance of components, pinpointing the underlying reasons for failures, and addressing deficiencies through corrective measures are crucial steps in enhancing product safety and reliability. A dedicated system for monitoring component performance is crafted to fulfil these objectives.

During maintenance, the manufacturer undertakes a verification process, examining operation logs and records from the component monitoring process. This thorough review yields valuable insights into the state of component monitoring. Subsequent actions are taken based on the assessment of the component's condition.

Procedure

The effectiveness of this procedure hinges on the meticulous collection of data, precise analysis, and the astute interpretation of the gathered information.

Following steps are involved:

- Each instance of failure, premature withdrawal of components, or replacement constitutes a data point, underscoring the necessity for meticulous and comprehensive recording.
- Relevant details such as drone lifespan, component longevity, names, specifications of the impacted components, and the duration or operating hours since installation are diligently documented.
- If there is a recurring failure within 10 sorties, it is classified as repetitive failure, signifying the component's critical status in terms of potential failures.
- If the user is unable to resolve the root cause of failure or premature withdrawal, the manufacturer will undertake the responsibility of conducting a thorough root cause analysis.
- The root causes of failures are categorized into distinct groups based on their underlying factors.
- Similar measures are implemented for the subsequent primary causal factors. Through consistent adoption of these measures over time, there is a notable enhancement in product safety and reliability.

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Parts of UAV and type of failures

Motor	Motor winding burning smell Motor screw loosening
Propeller	Propeller screw loosening Propeller tip breakages
Arm	Arm screw loosening Arm breakages
C-Clamp	C-clamp screw loosening
Shroud	Shroud screw loosening
GPS	GPS loosening
Landing Gear	LG Cap loosening Arm connector screw loosening Landing gear connector screw loosening Landing gear rod breakages LG connector screws loosening
Battery Connectors	XT 90 connector loosening
Battery Strap	Battery strap velcro grip deteriorate may not hold the battery securely

9. Maintenance Manual			
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Issue No.	04	Date	15/05/2024
Version No.	1.4	Document reference	PA-09

Component Monitoring Process (for operators)

Component Monitoring Records:

Sr. No.	Name of Component with specifications	Date of Defect	Component hours at defect	Cumulative failure (numbers)	Root Cause Analysis (Reason for defect)	Corrective Measure Implemented
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

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ANNEXURE - D

Life of UAS Critical components

Component Name	Life
Airframe	9000 hours
Propellers	500 hours
Battery	300 hours
Landing gear	5000 landings
Landing gear joint 1	9000 hours
Landing gear joint 2	9000 hours
Arm folding mechanism	9000 hours