

ESP-Drone System Manual: Operation, Maintenance, and Safety Guide

1. Introduction

Welcome to the ESP-Drone System Manual. This guide is crafted to help you operate, maintain, and test your drone safely and effectively, whether you're a beginner or an experienced user. Our goal is to provide clear, straightforward instructions that prioritize safety, clarity, and responsible use, ensuring compliance with ethical and regulatory standards. Follow these steps to enjoy a seamless and secure flying experience.

2. System Overview

The ESP-Drone System is a user-friendly, versatile platform designed for both manual and automated flight. It consists of two primary components:

- **Drone Unit:** Equipped with an ESP32 flight controller, motor drivers, and sensors including an Inertial Measurement Unit (IMU), Time-of-Flight (ToF), barometer, and magnetometer. LED indicators provide real-time status updates.
- **Control Interface:** Choose between a physical joystick controller or a mobile app (available for iOS) that connects via Bluetooth or Wi-Fi.

The system supports two operating modes:

- **Manual Mode:** Gives you full control using the joystick or app.
- **AutoNav Mode:** Enables automated flight along predefined paths (Square, Triangle, Rectangle, Circle) with built-in obstacle detection and safe landing features.

3. Operating Instructions

3.1 Pre-Flight Setup

To ensure a safe and successful flight, follow these steps before takeoff:

1. Place the drone on a flat, stable surface in an open area, clear of people, reflective surfaces, or obstacles.
2. Inspect all propellers to confirm they are securely attached and undamaged.
3. Turn on the drone by pressing and holding the power switch until the LED flashes green.
4. Open the ESP-Drone app on your iOS device and select **Connect Drone**.
5. Wait for the LED to turn solid blue, indicating a successful connection.

Tip: Ensure your flying area is free from power lines, water, or crowded spaces to avoid hazards.

3.2 Manual Control Mode

For hands-on flying, Manual Mode puts you in the driver's seat:

1. In the ESP-Drone app, select **Manual Mode**.
2. Use the controls as follows:

- **Left Stick:** Adjusts altitude (up/down) and yaw (rotation).
- **Right Stick:** Controls forward, backward, and side-to-side movement.
- 3. If AutoNav is active, press the **Override Button** to instantly regain manual control.
- 4. In emergencies, press **Emergency Land** to bring the drone down safely.

Safety Note: Always keep the drone in your line of sight. Avoid flying near power lines, crowded areas, or bodies of water to prevent accidents.

3.3 AutoNav Mode

AutoNav Mode allows the drone to fly autonomously along preset paths while avoiding obstacles:

1. In the app, select **AutoNav Mode**.
2. Choose a flight path:
 - **Square Path** (■): Flies in a square with stable hovers at each corner.
 - **Triangle Path** (▲): Navigates a smooth three-point route.
 - **Circle Path** (○): Follows a continuous curved trajectory.
 - **Rectangle Path** (□): Covers a wider rectangular pattern.
3. The drone uses its sensors to detect obstacles and adjust its path or hover as needed.
4. To interrupt an AutoNav mission, press the **Manual Override** button.

Ethical Reminder: Do not use AutoNav to capture images or data in restricted areas. Always comply with local aviation and privacy regulations.

3.4 Safety and Fail-Safe Features






The ESP-Drone is equipped with robust safety features to protect both the drone and its surroundings:

Feature	Description
Auto-Landing	Automatically lands the drone if the signal is lost or the battery is critically low.
Obstacle Avoidance	ToF sensors (front and bottom) detect obstacles, triggering hover or slowdown.
Throttle Limiter	Prevents sudden speed surges during takeoff for smoother control.
Manual Override	Allows instant switch to manual control, overriding AutoNav.
Failsafe Timeout	If no commands are received for over 3 seconds, the drone hovers safely.

These features are preconfigured in the firmware and require no user setup, ensuring reliable operation.

4. LED Indicator Guide

The drone's LED provides clear visual cues about its status:

LED Color	Status Description
 Green (Blinking)	System powering up
 Blue (Solid)	Connected and ready to fly
 Yellow (Blinking)	AutoNav mode active
 Red (Fast Blinking)	Obstacle detected or manual override active
 White (Blinking)	Low battery – land immediately

5. Maintenance Procedures

Regular maintenance keeps your ESP-Drone in top condition. Perform these checks as indicated:

Frequency	Task	Description
Before Each Flight	Propeller Inspection	Check for cracks, chips, or loose screws. Replace damaged propellers immediately.
After Each Flight	Sensor Cleaning	Gently clean ToF lenses and IMU casing with a dry microfiber cloth.
Weekly	Firmware Update	Connect via USB or app to install the latest safety and performance updates.
Monthly	Battery Health Check	Fully charge and discharge the battery to maintain its health.
As Needed	Motor Calibration	Use the app's built-in calibration tool to correct any drift or imbalance.

Safety Tip: Always disconnect the power source before maintenance. Allow motors to cool after flights, as they may be hot.

6. Recommended Tests

To ensure your drone performs reliably, conduct these tests periodically in a safe, open area:

- Propulsion Test:**
 - Remove propellers and power on the drone.
 - Test throttle inputs to confirm each motor responds correctly.
- Sensor Response Test:**
 - Place your hand in front of the drone to verify that ToF sensors trigger slowdown or hover.
- AutoNav Pattern Test:**
 - Run each AutoNav path (Square, Triangle, Circle, Rectangle) to ensure accurate navigation and smooth transitions.
- Override and Recovery Test:**
 - Start an AutoNav mission, then press the **Override Button**. Confirm manual control resumes instantly.
- Emergency Landing Test:**
 - Simulate signal loss by disconnecting the app. Verify the drone lands safely and stably.

7. Ethical and Environmental Guidelines

Responsible drone operation is critical for safety and compliance:

- Fly only in approved areas, adhering to Civil Aviation Safety Authority (CASA) regulations.
- Respect privacy by avoiding unauthorized recording or data collection.
- Dispose of batteries and electronic components through certified e-waste recycling programs.
- Avoid flying in areas where the drone could disturb wildlife or public spaces.

8. Troubleshooting Guide

If your ESP-Drone does not operate as expected, use the table below to identify and correct common issues. Always power off the drone before inspecting hardware components.

Issue	Possible Cause	Recommended Action
Drone does not power on	Low or disconnected battery	Ensure the Li-Po battery is fully charged and properly connected. Check for loose connectors or damaged leads.
Drone not connecting to iOS app	Bluetooth not enabled or drone not in pairing mode	Turn on Bluetooth in your iPhone settings, relaunch the ESP-Drone app, and confirm LED is blinking green (pairing mode).
Motors spin unevenly or not at all	Propeller jammed, motor wire loose, or calibration needed	Power off immediately, remove debris, reseal propeller, and use the app's Motor Calibration tool under "Maintenance."
Drone drifts during hover	Uneven surface or misaligned sensors	Recalibrate sensors in a flat area. Ensure ToF and IMU lenses are clean. Run "Stabilizer Calibration" from the app.
Drone fails to hold altitude	Faulty ToF sensor or low battery voltage	Inspect bottom sensor lens for dust, ensure stable lighting, and recharge battery to full.
AutoNav not starting	GPS lock delay or mission conflict	Wait 10 seconds for system initialization, confirm LED is solid blue, and retry the selected path.
Drone stops mid-flight	Safety timeout or obstacle detected	If obstacle detected, remove it and allow AutoNav to resume. If 30 s timeout triggered, restart flight plan.
LED flashing red continuously	Critical error (e.g., sensor or communication fault)	Land immediately, power off, and reconnect to the app for diagnostics under "System Logs."
App commands unresponsive	CRTP packet loss	Move closer to the drone, ensure stable Bluetooth connection, and avoid strong Wi-Fi interference.

Issue	Possible Cause	Recommended Action
Battery drains too fast	Aging cell or excessive load	Replace with a new Li-Po battery of equal rating. Avoid continuous flight beyond 3 minutes.

Tip: For persistent issues, connect the drone via USB-C to a computer and check diagnostic logs using the command:

```
idf.py monitor
```

to observe live sensor and flight status feedback.

9. Summary

This manual equips you with everything you need to operate, maintain, and test your ESP-Drone System safely and effectively. By following these guidelines, you'll maximize performance, extend the drone's lifespan, and ensure responsible use in line with ethical and regulatory standards. Fly smart, stay safe, and enjoy your ESP-Drone experience!