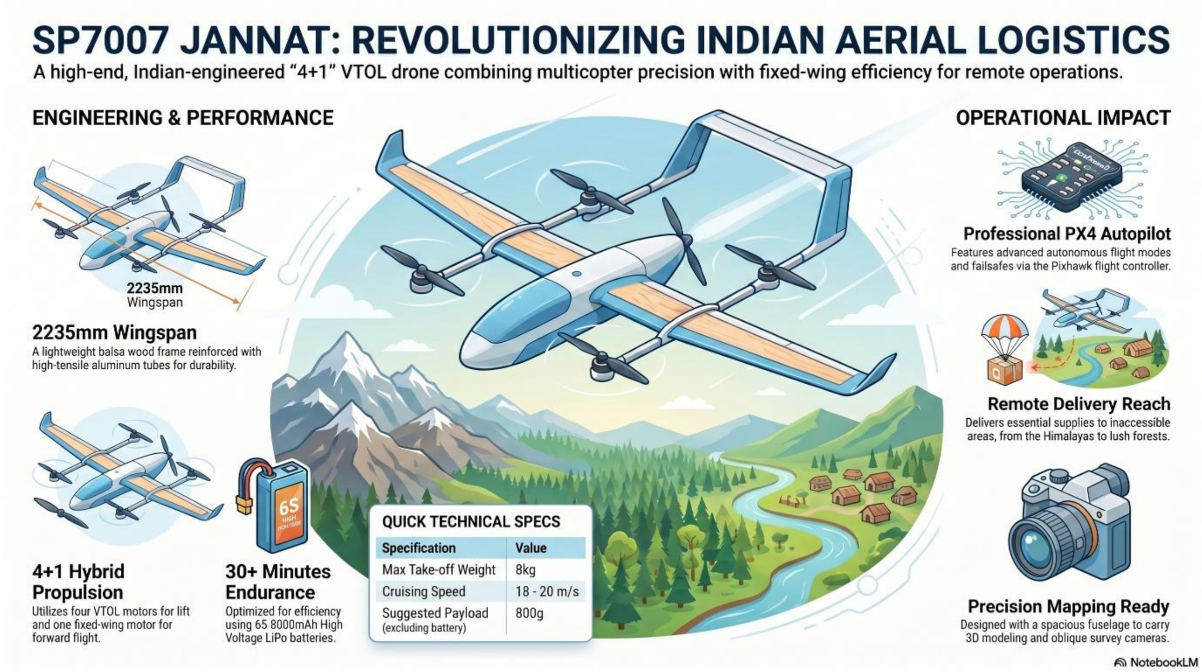
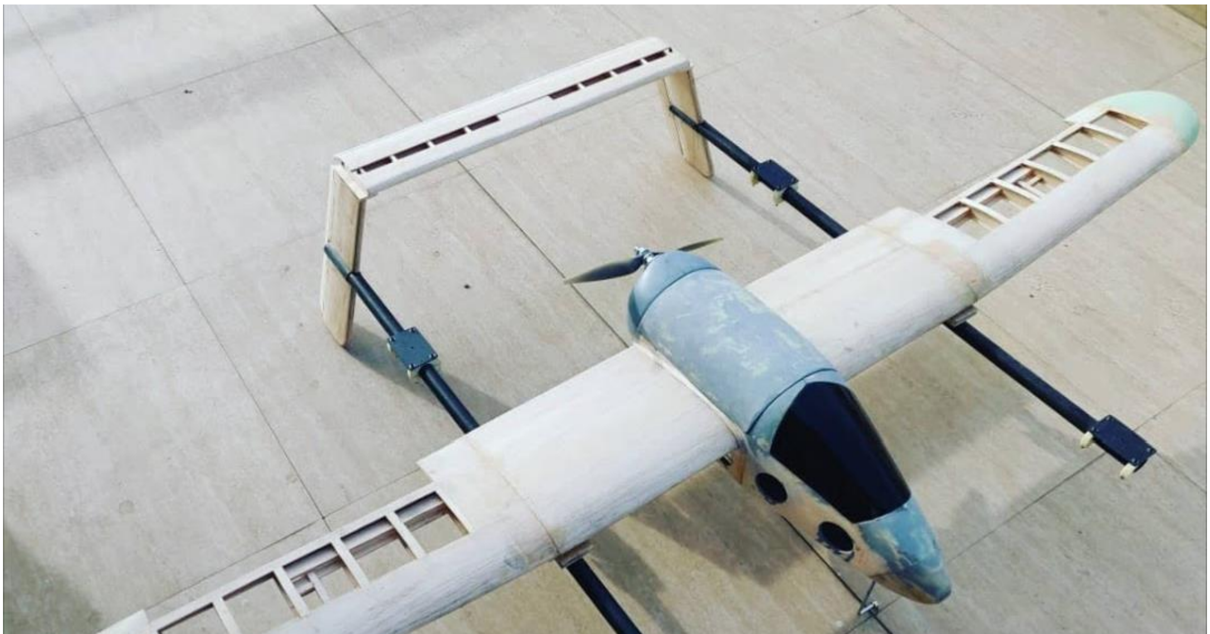
Technical Specification Manual: Jannat SP7007 VTOL UAS




SP7007


PROTOTYPE


SP7007



1. Platform Architecture and Structural Composition

Engineering Philosophy

The Jannat SP7007 is a high-performance Vertical Take-Off and Landing (VTOL) platform engineered to balance structural rigidity with rapid field deployment capabilities. The airframe utilizes a "high-tensile, low-weight" design philosophy, optimized specifically for long-range mapping and delivery missions. A key feature of this architecture is its **quick-assemble** nature, allowing field engineers to transition from transport to operational status with minimal downtime. The selection of materials is strategically calculated to damp high-frequency vibrations from the propulsion system while maintaining the aerodynamic integrity required for high-speed fixed-wing cruise.

Structural Analysis

The SP7007 airframe is a hybrid composite structure, leveraging the specific strengths of traditional and modern materials:

- **Balsa Wood:** Utilized as the primary core material for aerodynamic surfaces, providing a superior strength-to-weight ratio and natural resonance dampening.
- **Aluminum Tubes:** High-tensile reinforcement integrated into the wing spars and motor mounts, ensuring the skeletal frame can withstand the 11.5kg thrust loads generated during vertical ascent.
- **PVC & Aluminum-plastic Film:** Used for localized structural hardpoints and external skinning to provide environmental protection and durability without the weight penalty of traditional composites.

Physical Specifications

Specification	Detail
Model	Jannat SP7007 VTOL
Wingspan	2235 mm
Assembly Profile	Quick-assemble modular design
Airframe Configuration	"4+1" Aerodynamic VTOL
Material Composition	Balsa wood, Aluminum-plastic Film, PVC, Aluminum Tubes
Actuation System	4x Futaba S3001 Standard Analog Airplane Servos

This robust structural rigidity is designed specifically to handle the dynamic loads of the "4+1" propulsion ecosystem, ensuring the frame remains stable during the high-stress transition phases between vertical lift and forward flight.

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2. Propulsion System and "4+1" Ecosystem Dynamics

The "4+1" Propulsion Strategy

The SP7007 employs a decoupled "4+1" propulsion architecture, separating vertical lift requirements from longitudinal thrust. This configuration utilizes four high-torque motors for VTOL phases and one high-efficiency motor for fixed-wing cruising. This separation optimizes energy consumption by allowing the VTOL array to remain dormant during cruise, significantly extending flight endurance and providing mechanical redundancy during takeoff and landing.

VTOL Subsystem Specifications

The vertical lift array is engineered for extreme reliability and environmental resilience, featuring an IP45 protection rating for operation in diverse climates.

Component	Technical Specification
VTOL Motors	4x T-Motor MN501S KV240
VTOL ESCs	4x T-Motor Alpha 60A V2
ESC Throttle Response	300ms
ESC Throttle Range	1000–1900µs
Propellers	4x T-Motor 22x6.6 inch (Carbon Fiber + Epoxy)
Combined Thrust Limit	11.5 kg

Fixed-Wing Propulsion Profile

The forward flight system is optimized for high-speed cruise and efficient energy management, utilizing a specialized motor-ESC combination capable of sustaining high continuous amperage.

Component	Technical Specification
Forward Motor	Turnigy G60 KV400
Internal Resistance	0.06 ohm
Shaft Diameter	6 mm
Idle Current	10V / 2.7A
Current Capacity	40A Continuous / 60A Peak (15s)

Fixed-Wing ESC	Castle 75A Phoenix Edge (Max 33.6V)
Propeller	14-inch Glass Fiber Nylon

This specialized propulsion hardware is governed by a sophisticated avionics suite that manages the high-current distribution and logic-level communication required for stable flight.

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3. Avionics, Autopilot, and Electronic Ecosystem

The CubePilot Ecosystem

The SP7007 centers on the Pixhawk Cube Black (2.1), a professional-grade autopilot chosen for its triple-redundant IMU architecture and flight-proven reliability. This ecosystem is essential for managing the complex mixing required for VTOL transitions and autonomous mission logic.

Flight Controller Deep-Dive

- **Primary Processor:** 32-bit STM32F427 Cortex M4 core with FPU (168 MHz / 252 MIPS).
- **Memory:** 256 KB RAM and 2 MB Flash.
- **Fail-safe Co-processor:** 32-bit STM32F103, ensuring secondary control in the event of primary processor hang.
- **Interfaces:** 5x UART (serial ports), 2x CAN, I2C, SPI, and multiple signal inputs (S.BUS, DSM, PPM).

Positioning and Telemetry Systems

- **Here2 GNSS:** Integrated unit featuring a 72-channel u-blox M8N engine with 10Hz update rates. The unit provides multi-constellation support (GPS, GLONASS, Galileo, BeiDou) and incorporates an internal **MS5611 Barometer** and ICM20948 sensors for redundant altitude and orientation data.
- **RFD900+ Telemetry Modem:** Operates on 902-928 MHz with 1W (+30dBm) output power. It features air data transfer rates up to **250 kbit/sec** and a receive sensitivity of **>121 dBm**, critical for maintaining stable telemetry links at extended ranges.

Control Linkage

- **Transmitter:** FrSky Taranis X9D+ (670g without battery), 24-channel capacity, OpenTX OS.

- **Receiver:** FrSky X8R, supporting 16 channels with a full-range capability exceeding 1.5km.

These electronic components interface with the PX4 software stack to execute precision autonomous maneuvers based on real-time sensor feedback.

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4. Performance Envelope and Operational Limits

Strategic Capability

Designed for the "Aatmanirbhar Bharat" initiative, the SP7007 provides a domestic solution for navigating India's most challenging terrains. Its performance envelope allows it to operate effectively in high-altitude regions like the Himalayas or dense tropical environments like the Andaman forests.

Flight Dynamics Table

Metric	Specification
Max Take-off Weight (MTOW)	8.0 kg
Max Payload Capacity	800 g (excluding battery)
Cruising Speed	18 – 20 m/s
Stall Speed	12 – 14 m/s
Endurance	+30 minutes
Primary Battery	1x 6S 8000mAh **High Voltage (HV) LiPo**
Operating Voltage Range	18.5V – 33.6V (ESC limits)

Environmental Constraints

The SP7007 is optimized for a suggested take-off altitude of 0–500m above sea level. By utilizing VTOL capability, the platform bypasses the need for runways, enabling deployment in confined or rugged spaces. To maintain these flight standards, strict adherence to the following integration and calibration protocols is mandatory.

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5. Systems Integration and Configuration Protocol

Sensor Calibration Strategy

Autonomous mission success is predicated on precise sensor calibration within the QGroundControl (GCS) environment. Any deviation in magnetometer or airspeed data can lead to catastrophic navigation errors during fixed-wing transitions.

PX4 Configuration Workflow

1. **Compass/Magnetometer:** Calibration must occur away from metallic interference. Users must rotate the vehicle through six orientations as prompted by the GCS until the UI indicates completion.
2. **Gyroscope and Accelerometer:** The airframe must remain perfectly still on a level surface. The system captures offsets for multiple orientations to ensure an accurate inertial solution.
3. **Airspeed Sensor:** Critical for detecting stall conditions. To calibrate, the operator must shield the pitot tube from wind to establish a 0-airspeed baseline. The operator must then **blow into the tip of the pitot tube** to signal the end of the calibration sequence to the autopilot.

Safety and Failsafe Matrix

The PX4 stack allows for granular configuration of safety triggers to protect the hardware and surroundings:

Trigger	Configured Action
Low Battery	RTL (Return to Launch) or Land based on HV capacity.
RC Loss	Automated Return or Hold (configurable).
Data Link Loss	Mission-specific RTL if GCS telemetry is severed.
Geofence Breach	Forced RTL or Land if virtual cylinder boundaries are crossed.

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6. Mission Planning and Specialized Applications

Multi-Role Versatility

The SP7007 is a multi-role asset designed for precision data acquisition and logistics. Its bay is designed to accommodate various sensor payloads for professional-grade mapping and survey missions.

Mapping and Survey Capabilities

Utilizing the "Pattern" tools in QGroundControl, operators can execute automated surveys:

- **Mission Setup:** Define polygonal survey areas; the GCS calculates optimal grid patterns.

- **Recommended Payloads:** The system supports the **Map-01**, **Map-A7R**, or **3D Modeling Oblique Camera**.
- **Optimization:** Using "Known Camera" specifications allows for automated calculation of effective overlap and survey altitude.

Operational Execution

1. **Pre-Arming:** The operator must first **disengage the physical safety switch** (typically integrated into the GPS/GNSS unit).
2. **Arming:** Move the RC throttle/yaw stick to the bottom right for one second (Mode 2).
3. **Takeoff:**
    - **Automatic:** Triggered via GCS Takeoff mode.
    - **Manual:** Position mode is recommended. When the throttle is raised above 62.5%, **all flight controllers are enabled**, and the vehicle transitions to the required hover throttle.
4. **Landing:** Accomplished via RTL command or manual throttle decrease until the vehicle automatically disarms upon touchdown.

Application Synthesis

The SP7007 serves as a critical infrastructure bridge:

1. **Healthcare:** Rapid delivery of medical supplies to impassable mountain regions.
2. **Agriculture:** High-resolution crop mapping and faster market access for rural farmers.
3. **Connectivity:** Bridging the logistics gap between urban centers and remote villages.

The Jannat SP7007 represents the pinnacle of Indian-engineered UAS technology, setting a new benchmark for cost-effective, high-performance VTOL operations globally.