POWER REQUIREMENTS

1. Propulsion System

- **Component:** T100 Thrusters (x2)
- **Voltage:** 12V (nominal)
- **Current (per thruster):** 11.5A (maximum, continuous)
- **Current (both thrusters):** 23A (maximum, continuous; up to 25A for short bursts)
- **Power (per thruster):** 135W (maximum, continuous)
- **Power (both thrusters):** 270W (maximum, continuous)
- **Purpose:** Provides primary propulsion and maneuvering capability for the catamaran.

2. Electronics and Sensors

- **Components:**
  - Raspberry Pi 3B
  - ESP32 Module
  - GNSS/GPS Module
  - IMU (Accelerometer, Gyroscope, Magnetometer)
  - Ultrasonic Sensor
  - LIDAR Module
  - Telemetry Module
  - Voltage/Current Sensor
  - Servo Motors (x2)
- **Voltage:** 5V or 3.3V (supplied via voltage regulators from main battery)
- **Current (total, estimated):** ~3.6A @ 5V (18W)
- **Power (total, at 12V):** ~1.5A @ 12V (18W, after conversion from 5V)
- **Purpose:** Powers onboard computation, navigation, sensing, and communication systems.

3. Main Battery Specification

- **Type:** LiFePO4 (Lithium Iron Phosphate)
- **Nominal Voltage:** 12.8V
- **Capacity:** 40Ah (minimum recommended)
- **Continuous Discharge Current:** 32A (minimum; 40A recommended for safety and peaks)
- **Peak Discharge Current:** 40A (for short-term load spikes)
- **Charging Voltage:** 14.6V
- **Discharge Cut-off Voltage:** 10V (typical)
- **Cycle Life:** >2000 cycles
- **Battery Management System (BMS):** Built-in (recommended for safety)
- **Weight:** ~5–7 kg (for 40Ah capacity)
- **Dimensions:** ~220 x 155 x 180 mm (example; check specific battery datasheet)
- **Purpose:** Supplies power to all onboard systems, ensuring safe and reliable operation.

4. Total System Power Requirements

Component Group	Voltage	Current (max)	Power (max)	Notes
T100 Thruster (x2)	12V	23–25A	270–300W	Full throttle
Electronics (all)	5V/3.3V	~3.6A	~18W	Converted from 12V, ~1.5A @12V
Total System	12V	~26.5A	~318W	At full throttle

5. Battery Runtime Estimation

- **Battery Capacity:** 40Ah @ 12.8V = 512Wh
- **Total System Power (full throttle):** ~318W
- **Theoretical Runtime:**
  - 512Wh / 318W ≈ **1.6 hours**
- **Practical Runtime:**
  - **1 hour at full throttle is a safe, conservative estimate** (accounts for voltage drop, inefficiencies, and not running at 100% efficiency).

6. Summary

- **Main Power Consumers:** T100 thrusters (260–300W for both at full throttle).
- **Electronics:** Minimal compared to thrusters (~18W).
- **Battery Requirements:**
  - **12.8V, 40Ah LiFePO4 battery** (minimum, for 1 hour at full throttle with margin).
  - **Continuous discharge rating:** 32A (minimum; 40A recommended for safety and peaks).
- **Charging:** 14.6V charger for LiFePO4.