2.1 Air Vehicle

2.1.1 Vehicle General Description

The PA-01 Vapor S-UAV is a rotary wing small unmanned aerial vehicle. The AV is powered by an outrunner 8.5hp class brushless electric motor. The airframe consists of carbon fiber construction for the main frame and an aluminum rotor head and tail boom. Electrical power for the autopilot and payload is provided by an onboard 3 cell 11.1 volt lithium polymer battery. Power for the servos is provided by an onboard ___2____ cell ___7.4____v lithium polymer battery. Power for the electric motor is provided by two onboard ___6____ cell ___22.2____v lithium polymer batteries connected in parallel. Command and control is achieved through the use of the WeControl wePilot 1000 autopilot system. The PA-01 Vapor UAV is equipped with a _____2 blade______ type rotor head assembly and is controlled via a CCPM swash plate connection.

2.1.2 Overall Dimensions

Length........................................................................................................................................60”
Height........................................................................................................................................20”
Rotor Diameter.............................................................................................................................72”
Tail Rotor Diameter.....................................................................................................................12”
Tail Boom Length.........................................................................................................................38”
Width........................................................................................................................................12.5”

2.2 Motor

2.2.1 General specifications

The electric motor features a brushless outrunner design that includes a 6-pole outrunner stator-rotor and uses Ndfeb extra strong magnets. The motor is equipped with an integrated
cooling fan with ingress/egress vents which help to cool the motor continuously. This motor is essentially maintenance free only requires an inspection of the wiring and pinion gear for wear.

2.3 Battery Information

2.3.1 wePilot 1000 and Servo Batteries

The PA-01 Vapor AV is equipped with a ___3___ cell, __11.1___ volt ___3100___ mAh lithium polymer battery to provide power to the wePilot autopilot system. The AV is also equipped with a __2__ cell, __7.4__ volt, ___3100___ mAh lithium polymer battery to power the servos.

2.3.2 Flight Batteries

The PA-01 Vapor AV electric motor is powered by two _6_ cell, __22.2___v batteries which have the capacity for 35-55 minutes of hover flight.

2.3.3 Battery Charging and Storage

Lithium Polymer batteries were selected for the PA-01 Vapor S-UAV because they offer a much higher energy density than traditional battery which allows higher capacity at a lower weight. The newer batteries do require more attention than traditional batteries during the charging process. Lithium polymer batteries have a longer shelf life than traditional batteries and do not develop a memory when left at a specific voltage.

2.4 Avionics Description

Command and control of the PA-01 Vapor UAS is accomplished through the use of the wePilot 1000 autopilot and WeControl Ground Control Station (GCS).
2.4.1 wePilot 1000 Autopilot

The WeControl wePilot 1000 autopilot is the primary means of command and control for the PA-01 Vapor UAV. It features a fully integrated sensors and radio link housed in an EMI shielded billet aluminum enclosure. The wePilot 1000 is capable of fully autonomous flight with the use of a magnetometer and GPS antenna. During maintenance inspections, verify that the 25 pin connector is securely attached and the UHF and GPS antennas are tight. Inspect the case for any damage including cracks and scratches.

2.4.2 Magnetometer

The Honeywell HMR2300 digital compass is installed on the PA-01 Vapor AV to provide accurate heading information for navigation. The HMR2300 is equipped with three magnetic sensors arranged in an X, Y, and Z orientation to sense the earth’s magnetic field. The Magnetometer also includes an accelerometer to provide tilt and pitch sensing relative to the sensor’s flat position. When inspecting the magnetometer, visually inspect all connectors and wires for security.

2.4.3 GPS and UHF Antennas

The wePilot 1000 autopilot utilizes the Global Positioning System as the primary means of navigation in all flight conditions. The GPS antenna connects to the wePilot 1000 with an S-
SMA connector. The antenna is located on the top of the tail boom attached to the tail rotor housing.

Command and control of the PA-01 Vapor UAV is accomplished using a UHF radio transmitter and receiver over the commercially available 900 MHz frequency band. The UHF antenna connects to the wePilot 1000 with an S-SMA connector and is mounted via a BNCulkhead connector to a ground plane located on the tail boom.

### 2.4.4 Video Transmitter and Antenna

The video is transmitted via WiFi by an Ethernet enabled camera. Figures 2.4-1 shows the WiFi radio transmitter/receiver manufactured by Ubiquiti.

![Figure 2.4.4-1. The video WiFi transmitter/reciever unit.](image)

The following is the list of specifications for the Bullet WiFi Radio:

- **Processor Specs:** Atheros MIPS 4KC, 180MHz
- **Memory Information:** 16MB SDRAM, 4MB Flash
- **Networking Interface:** 1 X 10/100 BASE-TX (Cat. 5, RJ-45) Ethernet Interface
- **Approvals:** FCC Part 15.247, IC RS210
- **RoHS Compliance:** YES
- **Antenna:** Integrated antenna array
Power Supply: Up to 24V DC POE (Power Over Ethernet).

Power Method: Passive Power over Ethernet (pairs 4,5+; 7,8 return)

Operating Temperature: -20°C to +70°C

Weight: 0.18 kg

Transmitting Power: up to 1000mW

The transmitting antenna (on the aircraft) uses a 15” omni-directional 2.4Ghz antenna with +9dBi gain.