PA-01 Vapor UNMANNED AIRCRAFT SYSTEMS

GROUND CONTROL STATION (GCS)
1.0 INTRODUCTION

Figure 1.0-1 shows several components of the WeGCS in an operational setup.

Figure 1.0-1: PA-01 Vapor GCS
2.0 HARDWARE LIST

The Ground Control Station (GCS) is composed of the following hardware.

2.1 AVO Workstation

The AVO workstation includes the following components:

1. Laptop (with power adapter)
2. Secondary monitor (with power cable and VGA cable)
3. Wireless mouse
4. Digi 900Mhz Modem
5. 2.4 GHz Transmitter (Redundant Communication link)
6. Transport case.

2.2 AVO/MPO Workstation (Optional)

The AVO/MPO workstation includes the following components:

1. Laptop (with power adapter)
2. Secondary monitor (with power cable and VGA cable)
3. Wireless mouse
4. Payload controller
5. Router (with power adapter)
6. 3 x 20' CAT5E cables
7. Bullet Wifi Radio
8. Cable with N-type Connector (to panel antenna)
9. Panel Antenna
10. Transport case

2.3 Control Data/Command Link

The AVO workstation uses a Digi Xstream 900MHz RF Modem link to transmit user commands and receive control data from the aircraft. This is the exact same modem and antenna that is on the aircraft. This modem connects to the computer via USB. The specifications for the modem is as follows:

Power supply voltage: 5 - 12V
Receive current: 90 mA @ 900 MHz and 115 mA @ 2.4 GHz
Transmit current: 185 mA @ 900 MHz and 200 mA @ 2.4 GHz
Power Down Current: 50 mA
Frequency: ISM 902 - 928 MHz or 2.4000 - 2.4835 GHz
Receiver sensitivity: 900MHz: -110 dBm (@9,600 bps throughput data rate), -107 dBm (@19,200 bps)
Interface data rate (software selectable): 10 - 57600 bps (including non-standard baud rates)
Throughput data rate: 9,600 or 19,200 bps
RF data rate: 10,000 bps (@9,600 bps throughput data rate) or 20,000 bps (@19,200 bps)
Spread Spectrum: FHSS (Frequency Hopping Spread Spectrum)

Modulation: FSK (Frequency Shift Keying)

Supported network topologies: Peer-to-peer (no master/slave dependencies), point-to-point, point-to-multipoint and multidrop

Channel capacity (software selectable): 7 hopping sequences

Network filtration layers: VID, Hopping Channel & Destination Address

Connector options: RPSMA (Reverse Polarity SMA)

Operating temperature: 0º C to 70º C (commercial)

FCC ID (U.S. Certification Part 15.247): OUR9XSTREAM (900 MHz)

Dimensions: Length: 2.75 in (6.99 cm)

Width: 5.50 in (13.97 cm)

Depth: 1.12 in (2.86 cm)

Weight: 7.10 oz (200.00 g)

Figure 2.3 shows the 900MHz modem.

2.4 Secondary Control Link

The Vapor utilizes a hobby JR 2.4 GHz 8 Channel transmitter and receiver system as a redundant link for command and control. The JR console can control the Vapor in either a complete manual or autopilot assist mode by the toggle of a switch configured on the transmitter. This allows for instantaneous interaction by an external pilot to maneuver the helicopter when safety becomes a factor.
2.5 Video Transmission System

The video is received via WiFi (802.11n) by an Ethernet enabled camera. Figures 2.3-1 shows the WiFi radio transmitter/receiver manufactured by Ubiquiti.

WiFi Radio Features:

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

2.6 WiFi Receiving Antenna Kit

Receiving the video over a WiFi network will be accomplished with a Bullet radio connected via cable to an antenna. The following are the components of the kit:

1. WiFi Bullet Radio
2. Panel Antenna
3. Cable with N-type Connector

The receiving radio will use a non-line-of-sight panel antenna from Radio Labs Inc. Below are the specifications for the panel antenna:

<table>
<thead>
<tr>
<th>Model # PAN15-CIRC</th>
<th>BackFire High Gain WiFi Antenna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>2400 - 2500 MHz</td>
</tr>
<tr>
<td>VSWR</td>
<td>&lt;1.5 @ 100MHz bandwidth</td>
</tr>
<tr>
<td>Impedance</td>
<td>50 Ω</td>
</tr>
<tr>
<td>Gain</td>
<td>15 dBi</td>
</tr>
<tr>
<td>Polarization</td>
<td>Circular</td>
</tr>
<tr>
<td>Half power beamwidth</td>
<td>E-Plane beamwidth = 33 °</td>
</tr>
<tr>
<td></td>
<td>H-Plane beamwidth = 33 °</td>
</tr>
<tr>
<td>Front to Back Ratio</td>
<td>&gt;12dB</td>
</tr>
<tr>
<td>Max. Power input</td>
<td>50 Watts</td>
</tr>
<tr>
<td>Ground</td>
<td>Direct Ground (not required but advised)</td>
</tr>
<tr>
<td>Connector type</td>
<td>N-Female</td>
</tr>
<tr>
<td>Dimensions</td>
<td>7.1&quot; length x 7.1&quot; height 1.7&quot; depth</td>
</tr>
<tr>
<td>Weight</td>
<td>4 pounds</td>
</tr>
<tr>
<td>Front-</td>
<td>0.299 feet square or (0.028m2)</td>
</tr>
<tr>
<td>Maximum wind velocity</td>
<td>130 MPH (210 km/h)</td>
</tr>
<tr>
<td>Supporting pole</td>
<td>≈30 – ≈60mm</td>
</tr>
</tbody>
</table>

The panel antenna is shown in figure 2.5.
Figure 2.5. WiFi Receiving Antenna.
3.0 WEGCS

The weGCS software provides the command and control interface for the User to execute all phases of preflight, flight, and post flight.