Ground Control Station (GCS)

The GCS consists of the following components: External Pilot (EP) control box, Internal Pilot (IP) control box, GCS computer with monitor, Real Time Controller (RTC), UHF uplink transmitter/antenna, S-Band uplink transmitter, L-band downlink receiver, associated datalink antennas, downlink video monitor, and the IP/Payload control panel with knobs and switches.

The IP and EP control boxes are manufactured by Futaba and modified by the aircraft system manufacturer by by-passing the RF module and taking operator inputs directly to the RTC. The RTC produces dual uplink messages from inputs received from the pilot control boxes, control panel and the GCS software running on a computer. These messages are sent through the UHF and S-Band command and control links to the air vehicle. The downlink receiver outputs the air vehicles payload video to a monitor and the aircraft data to the GCS computer for display to the IP and payload operator. The CGS software may operate on any Windows based PC that is capable of executing, at a minimum, Windows 2000.

GCS Software

Aircraft data is displayed as shown in figure 1. The IP monitors the following data parameters:

- Aircraft position and heading is displayed on a moving map. In addition to aircraft position, the map is capable of displaying airspace boundaries, targets of interest, programmed routes, programmed return home routes and the return home waypoint.
- Aircraft health data includes engine RPM, engine cylinder head temperature, fuel quantity and bus voltage.
- Aircraft avionics data includes current altitude (both GPS and barometric), airspeed (Pitot / Static system) and pitch and roll.
- Data link health for the S-Band and UHF command and control links and GPS status.

In addition, the software is capable of calculating winds aloft, average fuel burn and range and bearing from the aircraft to the GCS. This system is capable of operating in three primary modes:

- Sticks – Either EP or IP utilizes the Futaba control boxes to effect change in the aircrafts attitude, airspeed and altitude. EP or IP control is selectable via the control panel by the IP.
- Knobs – IP control mode; the IP utilizes knobs on the control panel to effect changes in heading, airspeed or altitude. This mode may also be coupled with Sticks mode.
- Program – the aircraft autonomously flies a pre-programmed waypoint route.

One final mode, Disco, is only utilized in extreme emergencies. In Disco mode operator inputs are uncoupled from the autopilot and directly routed to the aircrafts control surfaces.

(b) (3)

Datalinks

The GCS utilizes 2 command and control uplinks to communicate with the air vehicle. The primary uplink operates in the S – Band, (b) (3) and is tunable in (b) (3) steps. This datalink is comprised of the baseband and a subcarrier. Command and control of the air vehicle and payload are accomplished using the baseband. A subcarrier provides an independent (non-flight critical) RS-232 compatible uplink for project support. The secondary uplink provides backup air vehicle and payload command and control, and operates in the UHF – Band at (b) (3) and is frequency fixed. The air vehicle utilizes 1 telemetry downlink (L - Band (b) (3) MHz tunable in (b) (3) steps) to relay video, report UAV health and position information, and a RS-232 compatible downlink, for project support, to the GCS. The L and S – Band datalinks in the GCS are housed within the Ground Data Terminal (GDT), which also consists of three dual band (L and S – Band) antennas and a 360⁰ rotating pedestal unit, see figure 2. The antenna array includes an omni, low gain horn, and a high gain parabolic antenna. The UHF uplink is housed in the payload control panel and uses an omni directional antenna. The datalinks for this system have been flight tested under NAVAIR Test Plan UAV-TP-024/03 to a range of (b) (3) The maximum range of this system has yet to be determined.
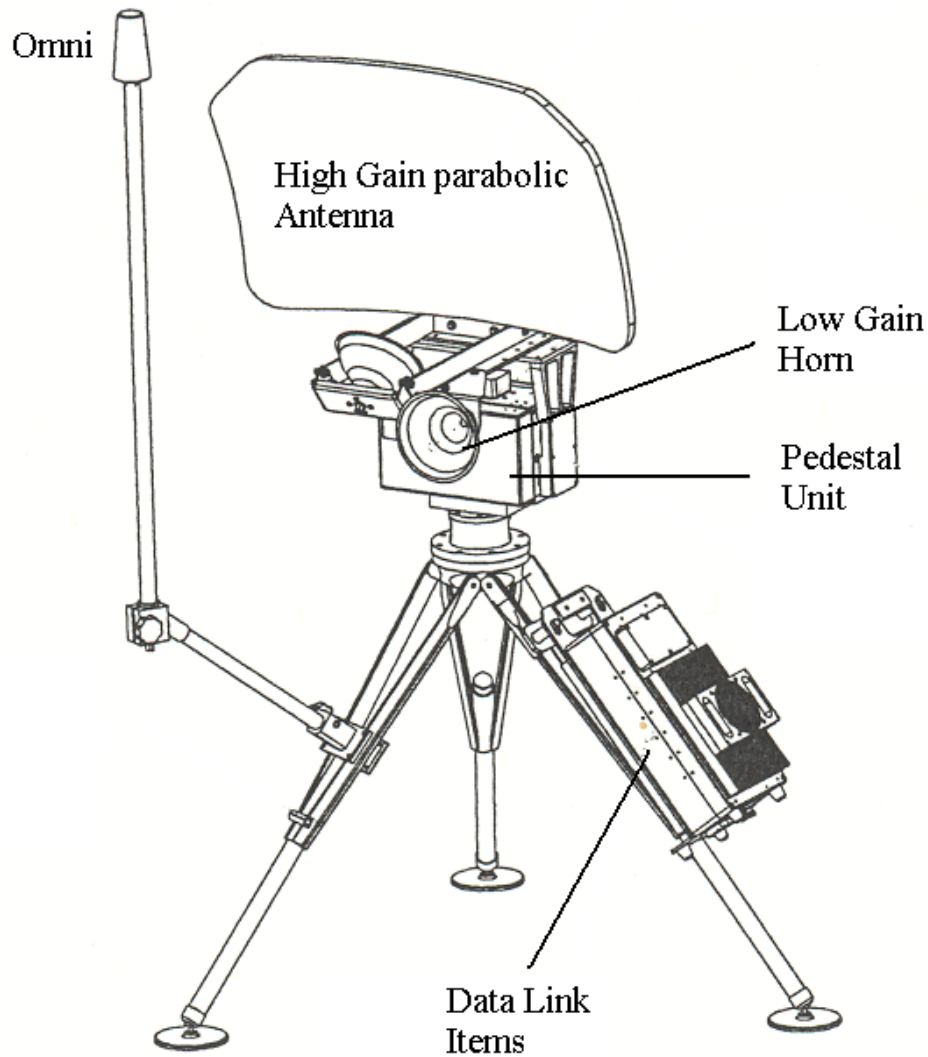
Omni

High Gain parabolic
Antenna

Low Gain
Horn

Pedestal
Unit

Data Link
Items

Figure 2

Remote Operations

Typical operations utilize only one GCS. Additional GCS's may be utilized in the event
multiple operator sites are required. In this type of operational environment, the
controlling IP cycles the GCS uplinks to OFF, while the receiving IP cycles the GCS
uplinks ON. In addition, a tertiary uplink in the UHF frequency band (b) (3) allows a
remote site operator to control the aircrafts payload.