LOUDOUN AMATEUR RADIO GROUP

HIGH ALTITUDE BALLOON PROJECT

MASTER FLIGHT PROCEDURES MANUAL

FLIGHT 2004A

HIGH ALTITUDE BALLOON CARRYING AMATEUR TELEVISION

FLIGHT 03

(HABCAT-3)

Prepared by

Tom Dawson

WB3AKD

FLIGHT DESCRIPTION

HABCAT-3 is LARG's first flight of 2004. The flight train will consist of a new Amateur TV (ATV) payload with a 70 cm. downlink, an instrumentation payload with a 2 meter downlink, a 4 foot parachute and a 1500 gram latex balloon.

The launch site will be selected so as to produce a predicted touchdown point near Berryville, VA.

Based on sea level launch conditions and 2.5 kg total payload weight, the estimated ascent rate is 1500 ft/min and the estimated burst altitude is 84000 ft. for a total flight time of approximately 80 minutes.

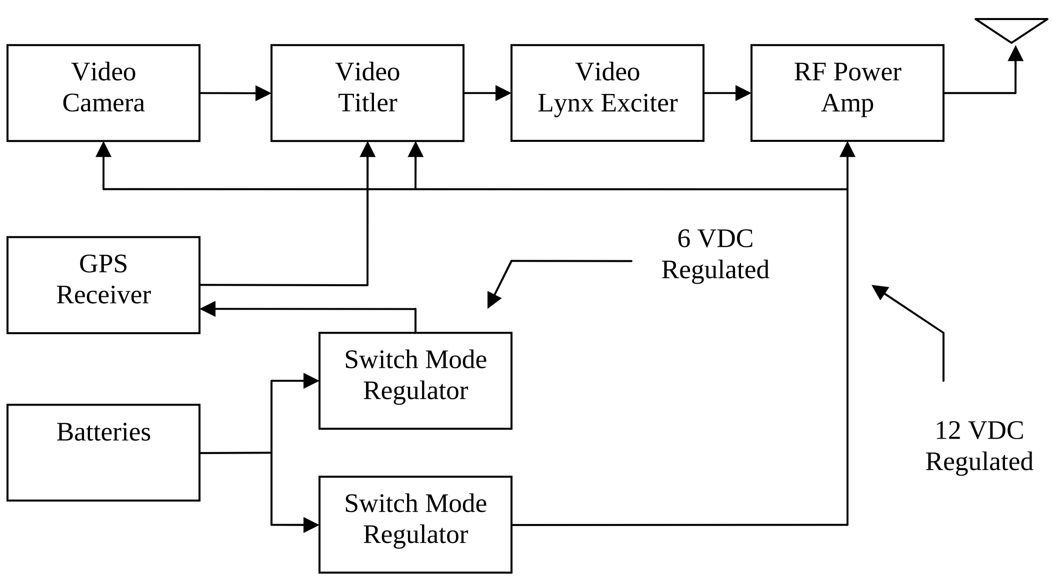
PAYLOAD DESCRIPTIONS

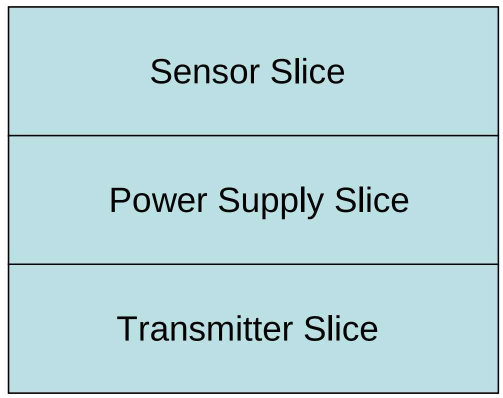
HABCAT-3 ATV Payload

The ATV Payload consists of a B&W Video Camera Card, a "Video Lynx" exciter and a Mitsubishi Power amplifier.

The video is passed through a titler circuit which adds on-screen GPS and Call Sign information. A block diagram of the ATV payload is shown below.

The ATV Transmitter Frequency is 433.97 MHZ, which can be received by configuring a "Cable Ready" TV or VCR for Cable channel 59, and connecting it to a horizontally polarized high-gain beam antenna.





HABCAT-3 Video Payload Physical Layout

Instrumentation Payload

The instrumentation payload is the veteran “Hot Chips” payload (so called because of the high internal temperatures caused by the use of linear voltage regulators). This payload measures air pressure, battery voltage, and internal and external temperatures and downlinks via the data via 2 meters FM MCW at about 20 WPM. The payload transmits on 145.65 MHz and emits about 1 frame per minute. This is the primary tracking beacon for recovery.

The TLM Frame structure is “DE K4LRG/B <Frame Number> / <Baro Counts> / <Battery millivolts> / <internal temp (K)> / <external temp (K)> / <reference count> / AR”

Total battery life exceeds 10 hours.

OPERATIONAL PROCEDURES

General
Flight operations are conducted by Two groups Launch, and Tracking/Recovery.

The Launch team carries all equipment to the launch site, assembles the flight train, activates the payloads and releases the flight train in coordination with the Tracking/Recovery Teams

The Tracking and Recovery team establishes mobile tracking stations, usually on high ground, and measures the bearings to the balloon and relays this information to Mission Control for plotting. When the flight is terminated, they travel to the last known location of the balloon and DF to the touch down site via the VHF beacon signal.

A Stationary Net Control will Coordinate communications between the Launch and Tracking and Recovery Teams.

FLIGHT OPERATIONS PROCEDURES

Step 1:
TIME 05:00
Launch Team:
Depart for Launch Site.

Step 2:
TIME 08:00

Launch Team:
Arrive at Launch Site-begin equipment preparation.
Prepare to fill balloon and notify Net Control
Stand By for Clearance to fill the balloon.

Tracking/Recovery Teams:
Arrive on sites
Notify Net Control
Prepare and verify equipment

Step 3:
TIME 08:30

Launch Team:
When cleared, fill balloon and attach to flight train

Step 4:
Time 08:55

Net Control:
Poll racking recovery teams for readiness
If 2 of three stations are ready, notify Launch Team Clear for Launch
Hold Frequency Clear Launch Announcement
Notify Tracking Recovery of Launch

Launch Team:
Verify Safe conditions and release the flight train.

Tracking/Recovery:
Stand by for Launch announcement
Stand by for Acquisition of Signal (AOS)

Step 4:
Time : Various

Tracking/Recovery:
Monitor bearings to the VHF Beacon.
Monitor Video if so equipped.
Log Time and Bearing every 15 minutes

Launch Team:
Recover Launch equipment
Travel toward expected touchdown vicinity
Monitor/Record flight telemetry (if equipped)
Monitor/Record flight video (if equipped)

Step 5:
Time: Flight Termination/LOS
Net Control:
Determine if any stations still have the signal.
Poll Video Ground Stations for Final GPS LAT/LONG
Plot final fix
Relay all final data to outstations.

Tracking/Recovery:
Stations with LOS breakdown and travel to vicinity of last known fix.
Station (if any) with strongest signal remains on station until signal is acquired by other T/R stations.

Launch Team:
Travels to T/D vicinity
Participate in T/R operations

Step 6:

Time: Payload(s) Found/Recovered
Mission Control:
Announce find/recovery to all stations
Terminate operations

Tracking/recovery:
Launch Team:

Recover payload(s)

Step 7:

Time: Operations Terminated

All Teams RTB

LAUNCH OPERATIONS PROCEDURE
LOUDOUN AMATEUR RADIO GROUP

FLIGHT 2004A (HABCAT-3)

LAUNCH OPERATIONS PROCEDURE

7 August 2004

Tom Dawson, Chairman, LARG Balloon Committee

1. Launch Schedule:

    1.1. Arrive Launch site at or about 08:00 EDT
    1.2. Schedule Balloon Release about 09:00 EDT

2. Personnel:
Bill Tincher WB4ACC
Evan Alford KQ4CI
Jacob Dawson KF4VLQ

3. Equipment:

    3.1. Ground Support Equipment (GSE):
        3.1.1. Launch Team Procedure data 7 AUGUST 4
        3.1.2. 2 Tanks Helium
        3.1.3. Helium Regulator
        3.1.4. Fill Tube with ball valve
        3.1.5. Paper strip 2” wide 7 “ long
        3.1.6. 2” screw type hose clamp
        3.1.7. Tarp and Pad
        3.1.8. 1-gallon paint can for holding sand
        3.1.9. Cotton Gloves
        3.1.10. Snap clips

    3.2. Flight Equipment:
        3.2.1. 1500g Balloon
        3.2.2. Instrumentation payload
        3.2.3. ATV Payload
        3.2.4. 3 lengths of cotton string pre-cut and wrapped on separate marked cardboard
        3.2.5. tubes, 15, 30 and 55 feet.
        3.2.6. 2 6-foot lengths of cotton string for tying the neck of the balloon.
        3.2.7. 4-foot Parachute.

3.3. Communications Equipment:

3.3.1. HF Transceiver

3.3.2. VHF Transceiver programmed for communication frequencies

3.3.3. VHF Receiver for 145.65 Verification

3.3.4. Portable TV for ATV Verification

1. Procedures:

1.1. Arrive on Site and establish Communications with Mission Control.

1.2. Prepare Filling Apparatus: Attach Regulator to tank, close fill valve.

2. Prepare Flight Train:

2.1. Flight train is pre-assembled. Stretch out flight components in a line down wind from the fill site.

3. Prepare To Fill Balloon:

3.1. Lay out tarp and pad for filling.

3.2. Unroll Balloon on pad

3.3. Put neck of balloon over filler tube, wrap protective paper strip around neck and clamp with hose clamp.

3.4. Verify Fill Valve Closed: Open He Tank valve. Set Regulator to 8-9 PSI.

3.5. Advise Net Control that the balloon is ready to fill and wait for clearance to fill.

4. **BALLOON INFLATION**

4.1. When cleared to fill the balloon, open Fill Valve. Stabilize balloon as it fills. Insure no twisting or bulging of neck.

4.2. Fill until test weight just lifts off of the ground. Close Fill Valve.

5. **SECURE BALLOON AND ATTACH FLIGHT TRAIN**

5.1. Turn on Video camera/GPS module.

5.1.1. This Allows the GPS receiver to acquire satellites

5.2. Tie off neck of balloon just above the fill tube, wrap twice and tie twice.

5.3. Tie additional safety line around neck of balloon; wrap and tie twice then tie free end to a firm anchor.

5.4. Close all tank valves.

5.5. Remove hose clamp and protective paper from neck of balloon and remove filler tube.

5.6. Fold neck back once or twice and wrap twice and tie three times.

5.7. Attach free end of string from the flight train.

6. ACTIVATE PAYLOADS/FINAL LAUNCH PREPARATIONS

6.1. On the minute, activate Instrumentation Payload, and then the video transmitter P/L's by plugging in umbilical connectors and tightening the tie-wraps.

6.2. Advise Net Control that the team is ready to launch.

6.3. With one launch team member holding each payload, move train out down wind of the balloon and await clearance to launch.

7. LAUNCH

7.1. When cleared to launch, verify visually that no aircraft are in the vicinity of the launch site.

7.2. When Airspace is clear, remove the safety weight, and holding the balloon by the neck walk toward the payload. Release the balloon prior to reaching the first payload.

7.3. The team members holding the payloads should hold them above their heads and let the balloon lift them out of their hands.

7.4. Record launch time and relay to Net Control.

8. Post Launch Actions:

8.1. Monitor flight visually and confirm flight train is clear of all ground obstacles.

8.2. Verify Telemetry and Video are running normally and being recorded.

8.3. Disassemble and secure all fill gas apparatus.

8.4. When released by Mission control, Terminate Launch ops. Head for flight estimated destination.

8.5. Monitor and record telemetry and video continuously.

APPENDIX -I

Receiving and Decoding Telemetry

The instrumentation payload transmits a normal FM signal on 145.65 MHz and can be received by any 2 meter ham receiver or scanner. The tone is keyed by Morse Code at about 20 WPM. This greatly simplifies the ground station requirements for receiving the signal. The telemetry may be copied by hand, or a soundcard application called CWGET (available from http://ua9osv.da.ru/) may be employed for decoding and saving the Morse telemetry to a text file for later conversion and analysis.

The Instrumentation Payload Transmits the following information about once every minute.

- Identification text “DE K4LRG/B”
- Telemetry Frame Number- a sequential number starting at 00000 when the instrument is powered up.
- Pressure sensor Raw Counts (see below to interpret)
- Battery voltage directly in millivolts
- Interior temperature in Kelvin (subtract 273 for Celsius)
- Exterior temperature in Kelvin (subtract 273 for Celsius)
- Reference voltage counts. 10*counts/4095 should always be 6.24 Volts.

A complete frame looks like this:

DE K4LRG/B / 00012 / 02961 / 16660 / 00308 / 00281 / 02556 / AR

This Frame is the 12th frame received from the SKYEYE-2 payload on 21 July, 2002 and shows that the unit was powered up 12 minutes, the barometer count is 2961 (translates to 10770 feet using formulas below), battery voltage is 16.66 volts, the interior temperature is 35 C, the exterior temperature is 8 C and the reference voltage is 6.24 Volts.

Barometer counts may be converted to pressure in millibars as follows:

Pressure (mb) = ((Baro_Counts * 6/4095)-1)*(1013/5)

Pressure is converted to altitude in feet as follows (1976 standard atmosphere)

For P (mb) > 222.27

Alt = (1 – 10^(log10(P/1013)/ 5.2558797))/ 0.000006875586

And for P < 222.27

Alt = 36089.24+(ln(P/(1013*0.2233609))/-0.00004806346))

A spreadsheet is useful in converting the TLM to engineering units.

APPENDIX-II

RECEIVING THE TELEVISION SIGNAL

HABCAT-3 carries a 4 watt video transmitter that operates on 433.75 MHz (Cable Channel 59)

An ATV down converter or a Cable ready TV may be used to receive the signal. The down converter translates the ATV signal to Channel 3 or 4 and it can then be received by a normal TV set.

A cable ready TV or VCR can be used by connecting the RF input if the receiver to the antenna and programming the receiver to use the Cable Channel. Cable channel 59 picture carrier corresponds to 433.25 MHz.

Note that the receiver must be connected to an antenna. You will not receive ATV signals through your cable system.

Some portable TV receivers have a continuously variable tuner and you may be able to pick up the ATV signal by tuning the UHF tuner around channel 75 or so. This may be reception of an image frequency, however, so the sensitivity could be significantly degraded.

The transmitter emits an amplitude modulated TV signal. Peak Envelope Power occurs only on the Sync tips. The average power is about 0.4 watts. Thus you will almost certainly need a beam antenna to receive the signal. The antenna should be horizontally polarized.

A low noise preamp is almost essential, too, as the noise figure of typical TV/VCR receivers is about 7 dB.

The HABCAT-3 camera will be pointed downward at about a 45-degree angle. This will allow good ground image near the ground and good horizon image at altitude.