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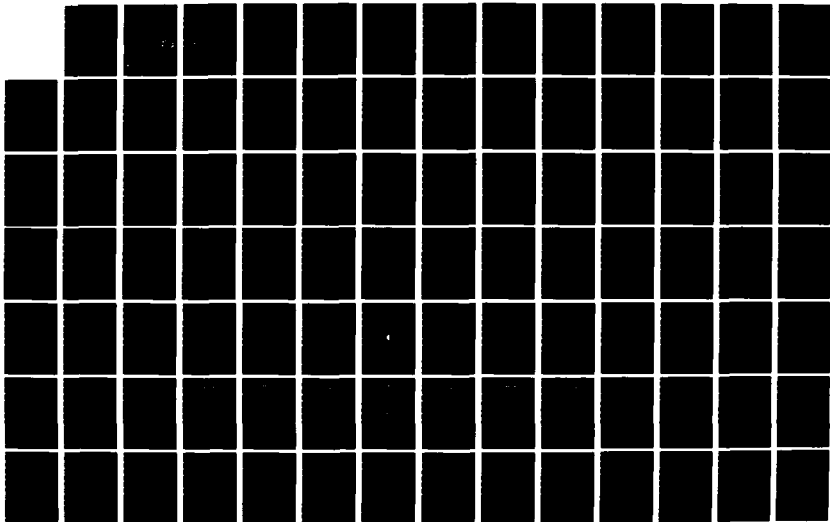
BAMM II FLIGHT 30 APRIL 1982 ENGINEERING EVALUATION
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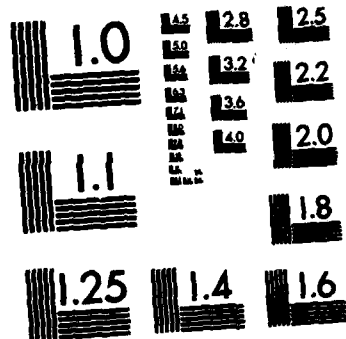
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BAMM II FLIGHT
30 APRIL 1982
ENGINEERING EVALUATION REPORT

R.W. Brooke
O. Shepherd
W.P. Reidy

Visidyne, Inc.
5 Corporate Place
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Burlington, Massachusetts 01803

Scientific Report No. 1

1 July 1982

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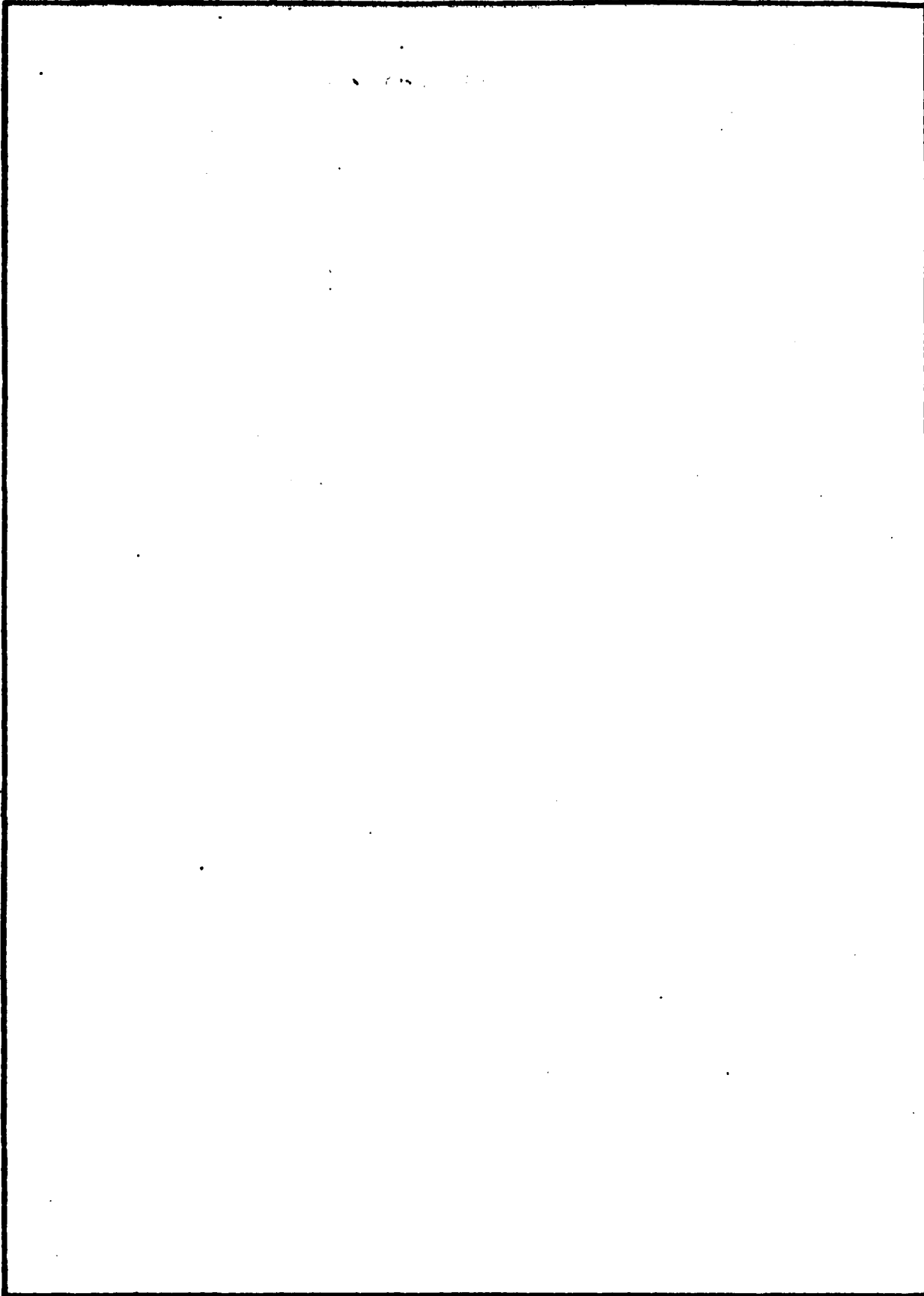
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1.0 INTRODUCTION

→ The objectives of the BMM II flight of 30 Apr 1982 were as follows:

1. Infrared earth/atmosphere background at sunrise and low angle solar specular reflection;

2. Infrared earth background - snow fields; AND

3. Infrared earth background - mountains.

Data was obtained from three types of scenes. However, due to a command system malfunction, the number of scene measurements was reduced.

During the flight, the command link was subjected to frequent intermittent disruption. The cause of this command problem is under investigation. In spite of the command link disruption, it appears that all the objectives of the flight were realized. When it could be commanded, the pointing system operated without problems.

In the following sections, payload testing, flight operations and recovery will be discussed. A daily summary of activities during the field expedition is presented in Appendix A. Summary reports on the batteries and command system problems are included as Appendixes B and C. An evaluation of the payload system is made with recommendations for additional system improvements. ←

1.1 Payload Description

The BMM payload has been designed and constructed to carry an optical instrumentation payload to an altitude of 100,000 feet. The payload is carried by a five (5) million cubic foot balloon. At 100,000 feet, the pointing system is instructed via ground control to "stare" at a selected scene on the ground for three (3) minutes. The staring is accomplished using an inertially stabilized platform with inputs of altitude, magnetic heading variation, and latitude being supplied on a timely basis from ground control. Drift velocity compensation was supplied by the onboard Doppler radar.

The payload structure, designed and constructed by Visidyne, Inc. can withstand accelerations of 10 g's in any direction. Each of the three major sections of the payload is a welded aluminum truss structure for great strength at the lightest possible weight. Critical areas of the

Visidyne supplied structure have been analyzed and adequate structural safety margins maintained.

Electrical power is supplied by silver/zinc batteries located in the upper section of the payload through a set of 48 slip rings to the lower two sections of the payload. There is sufficient power for flights up to ten (10) hours in duration.

The pointing system is inertially controlled in three (3) axes using an orthogonal integrating gyro system. This system controls the fine roll, elevation, and azimuth rotations during a three (3) minute "stare" period. Coarse elevation and azimuth are controlled by commands from the ground to aim the system at the selected target. Figure 1 shows a schematic of the BAMM II payload.

1.2 Program Technical Requirements

The BAMM system uses an inertially stabilized pointing system to "stare" at an area on the earth's surface for a period of three minutes. During this period of time, the requirements are that the scene cannot be "smeared" by more than 10 percent at "look" angles of 0° to 60° (vertically down is 0°). In order to meet the stare requirements, a pointing system stabilization of one arc-second-per-second is required.

Observations are made from an altitude of 30 km (100,000 ft) suspended from a balloon. Drift rates of the balloon may be up to 48 km/hr (30 mph). The experiment package is controlled from the ground using the TV camera for initial scene acquisition.

The image smear requirement is critical. If compensation was not provided for the balloon drift velocity extreme image smearing would occur. For example, consider an observation in the nadir where the entire image smear requirement would be exceeded at a balloon velocity of only 1.82 feet per second. Since the balloon drift velocities can be up to 30 mph, (51 ft. per sec), the effects of balloon drift must be compensated. A doppler radar and a microprocessor are used to provide proper rates to the gyro system to null out drift velocity effects.

2.0 BAMM II FLIGHT TEST

2.1 Operations

Operations for the BAMM flight began on 6 April at Chico Municipal

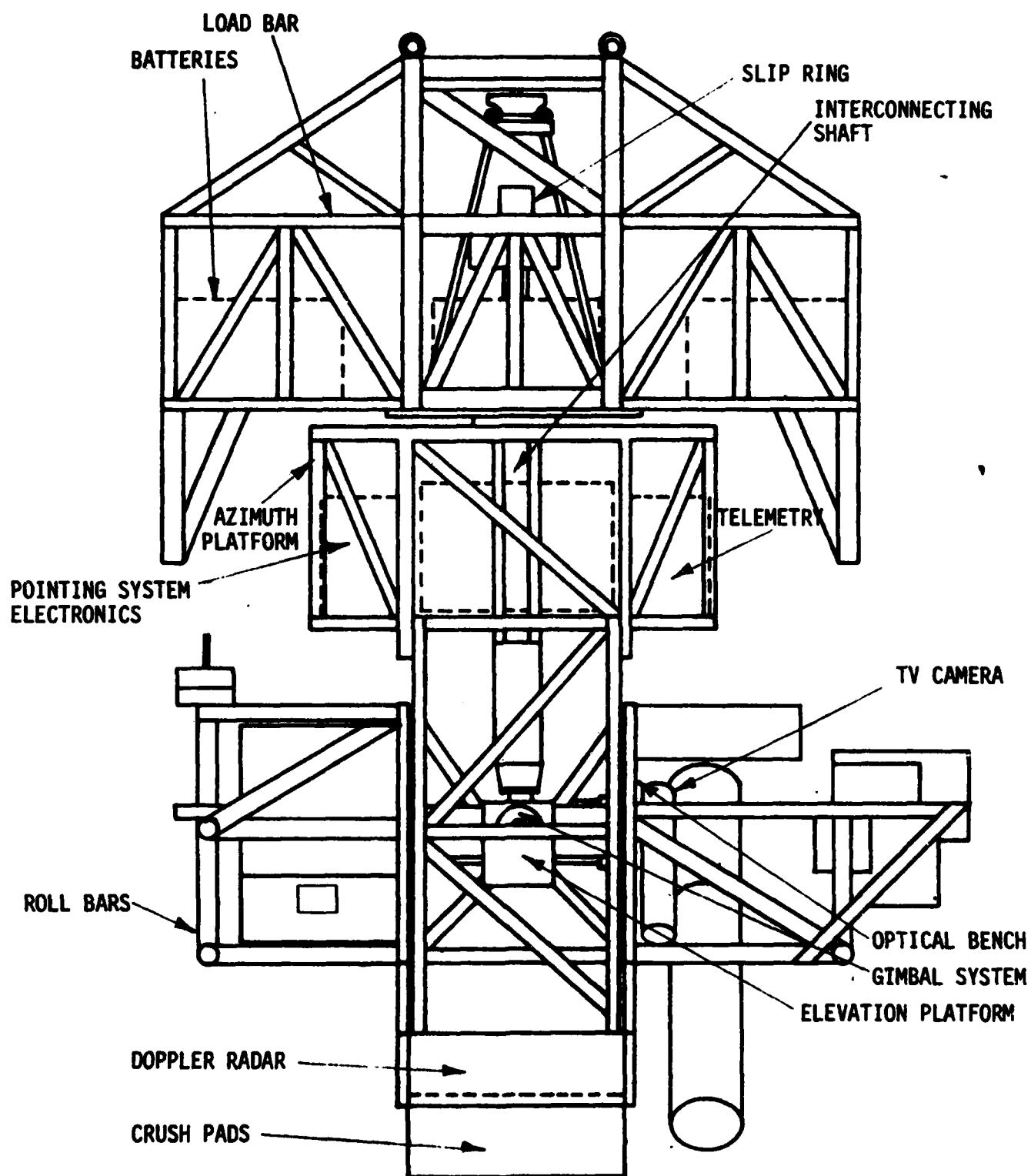


Figure 1. BMM Payload Schematic

Airport with work being initiated in the assembly of the payload. The BMM payload is shipped in four major sections.

1. The azimuth bearing assembly which includes the main inter-connecting shaft and slip rings.

2. The elevation platform.

3. The azimuth platform.

4. The load bar.

Payload assembly was completed on 9 April. The payload was installed on a supporting cradle ready for system test on 12 April.

Payload testing was initiated using external power and followed the Countdown and system check plan. A copy of this plan is included as Appendix D to this report. The batteries were installed on 20 April and an internal power test accomplished with the payload suspended from a crane outside on the launch pad on 24 April. This test was also a dry run of operational communications.

The L-3 operational test was conducted on Tuesday, 27 April. The payload was taken outside the hanger and launch countdown procedures were rehearsed.

The scheduled launch day was Friday, 30 April. The pre-flight weather briefing held on 24 April indicated a high probability of acceptable winds for launch and float at 100,000 feet. All personnel arrived at 1930 hours on 29 April to begin launch operations. The payload was moved to the launch area by 2200. Payload checks were complete by 2400. Balloon inflation began at 0200. All payload power was turned on at 0245. Launch occurred at 0305. The payload reached float at 0545 and remained there until 0800 at which time the balloon was valved down to an altitude of 80000 ft. At 0945, all instrumentation was turned off.

As there was no place close by to land the payload, the balloon was valved down to about 60000 feet to pick up the easterly winds. The payload finally landed near Honey Lake, in Nevada about 100 miles east of Chico, California.

2.2 System Testing and Launch Preparation

Payload launch preparation began at Visidyne, Inc. in late 1981 and continued until the payload was shipped to Chico, Calif., on 2 April 1982. Immediately upon arrival at Chico, payload buildup began and testing was

continued in preparation for the flight. Important aspects of payload preparation are summarized in the following sections.

2.2.1 EMI/RFI Testing - Visidyne, Inc., Burlington, Mass., EMI/RFI tests were performed at Visidyne during February and March 1982. These tests were designed to test all functions of each system in an environment where all other systems are functioning. In order to accomplish the EMI/-RFI testing, desired procedures were established and specified in detail. These plans were formatted into a single document which evolved into the launch countdown procedure (See Appendix D).

2.2.2 Payload Buildup - The BMM payload arrived at Chico Municipal Airport on 7 April 1982. Buildup, final integration, rigging, and individual system checkout was performed from 7 April through 28 April.

Testing of the payload systems was done on a daily basis to thoroughly familiarize all personnel with the systems and the actual countdown procedures to be used prior to launch. All systems; command, telemetry, balloon control, TV, housekeeping, and the pointing system operated with only minor problems arising.

2.2.3 Power - Until 20 April, all payload testing was accomplished using external power supplies. One 25 amp supply was used for the pointing system; two 5 amp supplies were used for the telemetry system, one 5 amp supply for housekeeping, one 5 amp supply for the radiometer and two 5 amp supplies for the interferometer.

Ten 28V battery packs were filled, discharged and charged again to full capacity by Visidyne personnel. These became available for installation into the payload battery boxes on 20 April. One day was spent installing the batteries and the cell monitoring system wiring. The cell monitoring system allows each cell to be monitored during battery charging to ensure full battery capacity at launch. See Appendix B for complete documentation of battery operations.

2.2.4 Pointing System - The pointing system was thoroughly tested at Visidyne prior to shipment to Chico, Calif. Testing continued at Chico as part of the overall payload system tests.

In order to obtain the pointing accuracy of less than 1 arc sec/-sec, it is necessary to null out the bias in gyro drift in all three axes. This was accomplished on 26 April by the use of lasers mounted on the

payload roll and elevation axes, a mirror mounted on a tripod on the floor, and observations of the laser spot movements on a nearby wall. Adjustments were made inside the pointing system electronics box. See Appendix E for gyro bias correction procedures.

The performance of the pointing system was excellent throughout the systems testing.

2.2.5 Command System - The command system used for the BAMM II flight consisted of two command boxes, one on the azimuth platform and one on the elevation platform. The command system was completely checked out during the RFI testing at Visidyne prior to being shipped. The command system is described in Appendix F.

2.2.6 Telemetry - The telemetry system for the BAMM II payload is described in Appendix G.

2.2.7 TV Camera - The TV camera for this flight employed a new zoom optics system and required some calibration to match the proper zoom location with the detector array. The TV performed without problems during all system checkouts and operational countdowns.

2.2.8 Housekeeping - The housekeeping system consists of temperature monitors at various points in the payload structure and on critical electronic components. Battery voltages are also monitored. The housekeeping system worked well during the system testing.

2.2.9 Payload Ground Control - Payload ground control consisted of electronic racks containing transmitter power, TV control, command system, pointing system data input, a TV monitor and IR instrumentation control. In addition, a PDP-11/44 computer was utilized with software to output pointing system data onto a monitor screen and update it once a second. The computer also allowed real time viewing of IR data.

The housekeeping data was printed out at about ten minute intervals.

In addition to monitoring all payload functions, a tracking system output was available which indicated payload altitude, tracker azimuth angle from true north, tracker elevation angle, slant range to payload, latitude and longitude of payload, of payload, and wind vector.

2.2.10 Parachute Rigging - Originally the BAMM payload was intended to be air-snatched using the MAR system. For this flight however,

funding was not available for helicopter support so the payload was rigged for a parachute landing. The original MARS parachute, which is a gliding chute, was exchanged for a non-gliding parachute. This parachute was tested in July 1981 and deployed as the load bar separated from the lower section of the payload. Separation was to occur at about 25,000 feet by means of an explosive bolt on command from the chase aircraft. Figure 2 indicates the complexity of the rigging required.

2.3 System Testing

The L-3 Testing sequence was utilized many times during the period 4/12/82 through 4/29/82. By repetition of the testing sequence several minor changes were made to streamline the activities and reduce the time consumed. More details on system testing are included in Appendix A (daily log of field expedition activities.)

Minor problems were uncovered during system tests. These are included as Appendix H. Magnetic deviation for the BMM II magnetic heading sensor was determined after the final L-3 day test (see Appendix N).

2.4 Flight Operations

The BMM II payload was launched at 0305 hrs on 29 May 1982 from the Chico, California Municipal airport. Ground winds at launch were virtually zero. Flight altitude of 98000 feet was reached at 0545 hours local time. At approximately 0445 hours commands to the payload became unreliable and shortly thereafter it became impossible to command any item on the payload. A partial command log is included as Appendix I. This log, although it does not list all the commands, indicates those commands that were printed in real time by the PDP 11/44 computer and shows a great many commands that either were not sent, or are not defined. The reason for the command system malfunction is not known and is subject to an investigation.

Later in the flight, at about 0600 hours, a few commands to the payload were received, and it was possible to move the pointing system to a limited extent and obtain some good stare data. It was determined later (approximately 0800 hrs) that, during operation of the elevation platform locking mechanism, commands from the ground would be received and the payload could be operated normally. This method of payload operation was utilized from about 0800 hours until system shutdown at 0956 hours.

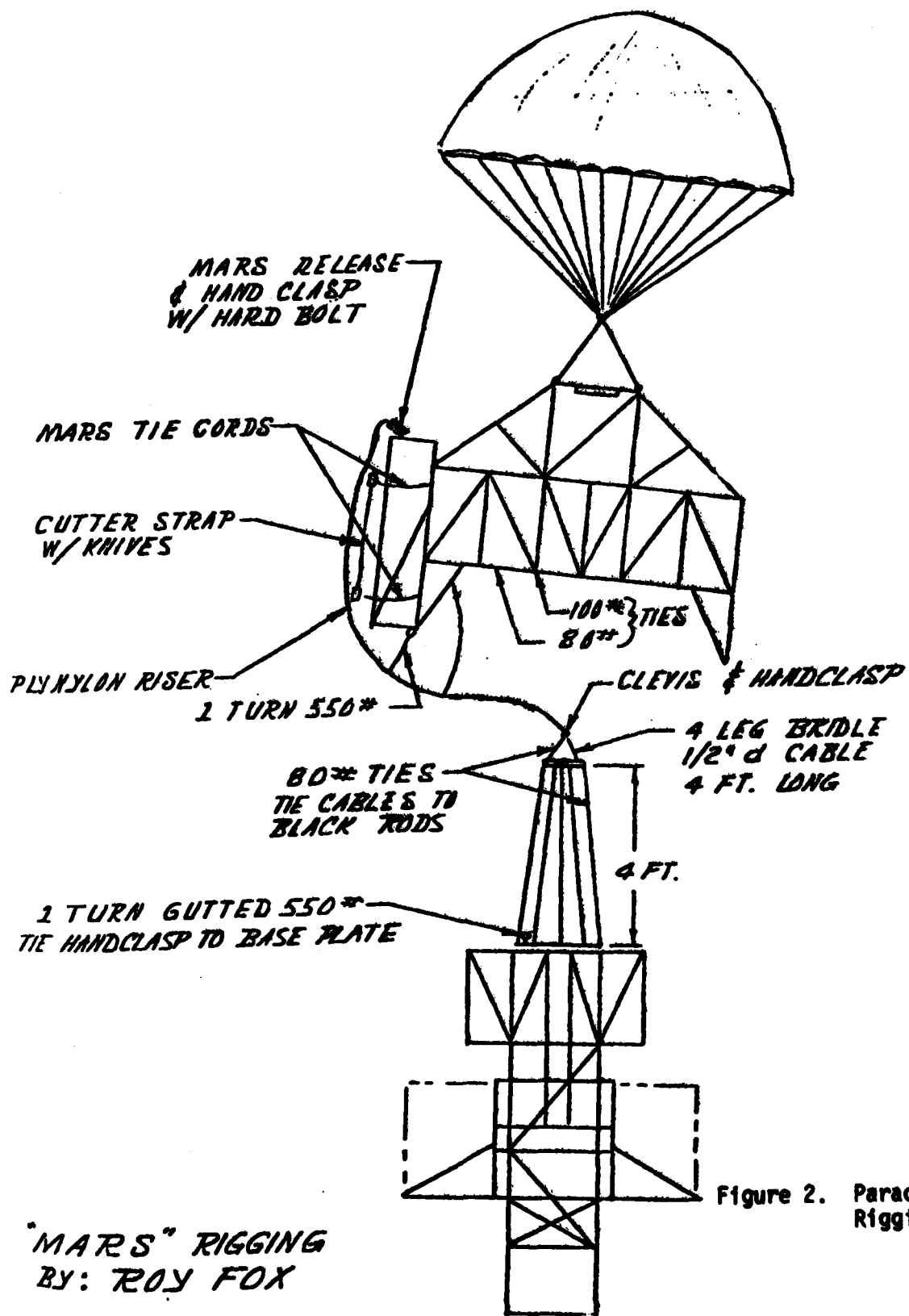


Figure 2. Parachute Rigging

When the proper commands were received, the entire payload operated as planned. The following sections summarize the performance of major payload and ground control systems during the flight.

2.4.1 Power - Power was turned on to the telemetry, housekeeping, radiometer, and interferometer at about 2000 hours 28 Apr 82. The pointing system gyros had been wired such that they could be run up and maintained on housekeeping power during system pre-launch checkout until just prior to launch thereby saving pointing system power. Just prior to launch, the gyros were switched to pointing system power. All power was maintained at very low levels except during the system countdown procedures. At launch the payload retained enough battery power for about ten (10) hours of flight.

The voltage monitoring system is discussed in Appendix J.

2.4.2 Pointing System - The pointing system, when it received commands, worked very well during the flight. Comments regarding radar operation are included in Appendix K. A listing showing pointing system azimuth, coarse elevation, fine elevation, roll, and pointing system commands versus time (every 2 minutes) is given in Appendix L.

2.4.3 TV - The TV was aligned with the two infrared instruments (see Appendix M). Just prior to flight, the TV zoom position was matched to the two instruments mosaic field of view. This position was not intended to be changed during the flight. However, according to the AFGL BAMM Flight Assessment Report dated 21 May 82, "...spurious undetected signals may have caused the TV field to be unmatched to those of the infrared instruments." Otherwise, the TV operated as expected throughout the flight.

2.4.4 Telemetry - The telemetry system functioned normally during the flight with no major problems encountered.

2.4.5 Instrumentation - No data available.

2.4.6 Ground Control Station - The primary system for payload control and housekeeping information used the PDP-11/44 computer on a time sharing basis. The operation of the pointing system was from the pointing system control electronics box. The operator was given a display of mode heading, coarse elevation, fine elevation and roll angles which were updated at a rate of about once a second. The rest of the information re-

quired to operate the pointing system was displayed on a monitor at one end of the command trailer. This display contained the platform angles, weight shifter position, torque currents, pointing system mode, and radar status (i.e., number of beams locked up, doppler reliable, all track and mode; ground or radar). Because of the slow update rate - once every 10 to 20 seconds, the display was not very useful for pointing system control.

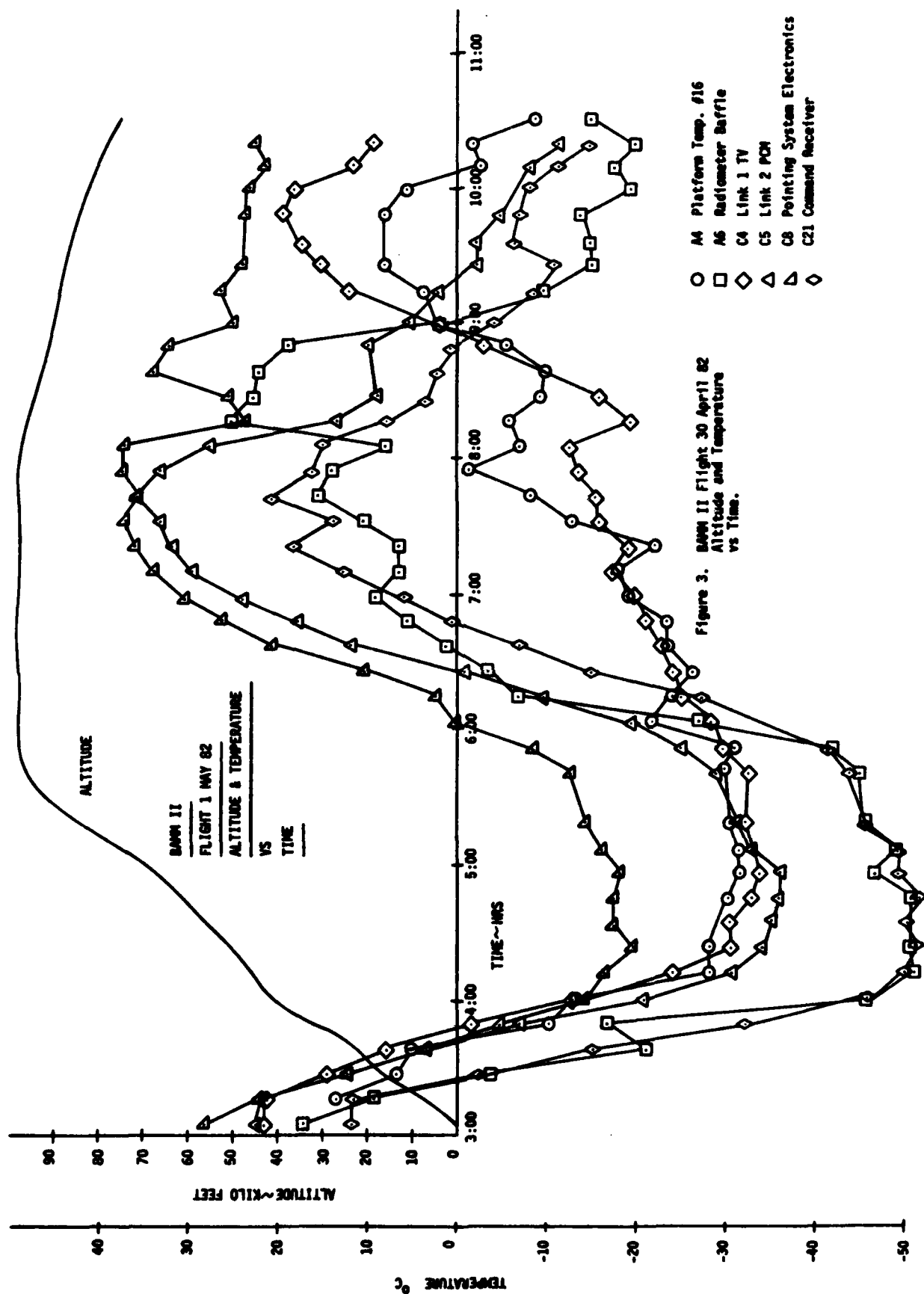
The housekeeping data from three commutators was printed out every 10-12 seconds throughout the flight. A few selected temperatures and the payload altitude versus time (local) are shown on Figure 3. The radiometer baffle temperature is a good representation of the ambient air temperature. The command receiver temperature is the temperature of the thin aluminum box that surrounds the command receiver which is also protected with about a half-inch of foam insulation. The effects of the sun on the two temperatures is readily apparent. The temperature sensors on the TV transmitter (link 1) and the PCMA transmitter (line 2) which are on opposite sides of the azimuth platform also show the effects of the sun's heat input.

3.0 CONCLUSIONS AND RECOMMENDATIONS

From the Flight Assessment Report on the BAMM II Flight of 30 April 1982, it is concluded that the flight was a success. Measurements were made of the three types of scenes as planned, although the number of measurements was reduced. Problems were encountered during the flight with the command system. Ground testing is required to determine what went wrong with the command system in order to correct the system for subsequent flights to preclude the problem from occurring again. If the command system problems are discounted, the payload worked extremely well. The pointing system operated properly as did the TV and all IR instrumentation.

The following recommendations are made regarding system improvements for better flight operation.

1. The pointing system should be controlled from one station in the command trailer and not have two as is now the case.
2. The pointing system mode (i.e., cage, standby, slew, stare, dither) should be printed out on the housekeeping data. This will aid in the post flight data reduction.
3. The elevation platform weight shifters, which are a measure of



platform readiness for a stare period, should be displayed as to whether they are on and running or not.

4. The TV tracking system should be added to the command trailer for uplinking velocity data to the platform.

5. A backup coarse elevation motor should be purchased.

APPENDIX A

BAMM II FIELD TRIP LOG

APPENDIX A

MEMORANDUM

TO: W. P. REIDY
FROM: R. W. BROOKE *RWB*
DATE: 20 MAY 82
SUBJECT: BMM II FIELD TRIP LOG

The following log was maintained during the April 1982 BMM II Field Trip.

- 6 Apr Arrived Chico.
Command Trailer and Payload van had not arrived.
- 7 Apr Missing trailers arrived.
Payload van off loaded.
Assembled azimuth shaft, elevation platform, and azimuth platform.
Installed explosive bolt after electrically checking the bridge-wires.
Three 28 vdc batteries filled.
- 8 Apr Installed pointing system electronics, two command boxes, FM command receiver, -28 vdc power supply and temperature monitor electronics.
Ready to add load bar to payload.
Four 28 vdc batteries filled.
Assembled cradle.
Struts between azimuth platform and radar platform installed.
Shorting plug on explosive bolt installed.
Electronics board in load bar power input panel checked out and installed.
- 9 Apr Finished routing cables.
Mounted load bar on payload - 500 FT.-LBS. torque on explosive bolt.
Bolted payload to cradle, also attached payload to 2 ton chain fall which was attached to one of the hangar main structural beams.
All temperature sensors installed along with the radar control electronics and radar isolation transformer.
The roll bar extension was also installed.

- Battery filling was completed.
- 12 Apr Connected pull-away connectors.
Installed radiometer and dummy interferometer.
Attached the TV heater blanket onto the TV.
Attached the transmitter heat sinks to the azimuth frame.
Installed the alignment lasers.
All external power was connected and checked out.
Battery charging was initiated.
Radar ready for testing.
Attached simulated radiometer baffle and did a preliminary platform balance.
Tested radar and pointing system successfully.
- 13 Apr Continued work on batteries. Problems with individual cells not taking a charge. Called Eagle Pitcher - 1978 batteries are nearing the end of their shelf life and may require a longer than normal soak time. Keep on charge/discharge cycle and the batteries may come along alright.
Installed radar and radar control onto the azimuth platform.
Completed program on HP 41CV calculator for converting magnetic heading and wind vector into radar coordinates of heading and drift velocity.
- 14 Apr Installed ballast hoppers and dispensing tubes.
Laced in wires to temperature sensors, etc.
Batteries will not take a full charge. The maximum they will take is about 25 amp hrs. instead of 70 amp hrs. Eagle Pitcher indicated that they have seen this before with batteries approaching their maximum useable shelf life if the storage conditions have been too hot.
Only one set of batteries available at Chico. The Air Force is flying in a complete, new set of batteries from Holloman tomorrow morning.
- 15 Apr BMM II meeting in a.m.
Payload test from command trailer this p.m.
Payload commands interfaced with and commanded the interferometer alignment motor.
Batteries doing better after much shaking and shock treatments.
- 16 Apr Batteries will be good enough to use.

Payload lifted out of cradle for full scale testing in a.m. Platform azimuth command caused alignment system of interferometer to operate. Lots of drop-outs of the command system.

Afternoon testing done after antenna and transmission cables lifted to roof of hangar. No more drop-outs.

Still show interference with platform and interferometer.

19 Apr Testing revealed that the interference was caused in the pointing system command box located in the trailer. A delay in the output signal was added and no more interference was noted. Removed radiometer and interferometer battery boxes to enable installation of batteries.

Another balloon flight is supposed to go off tomorrow. If it does, tomorrow will be a down-day for BAMM testing.

20 Apr Other payload flew today.

Installed batteries and check internal power.

Small battery weight incl. box = 53 lbs.

Large battery weight incl. box = 99 lbs.

Continued lacing wires.

21 Apr Balloon control box installed

Two hundred (200) lbs. of ballast put in each of the two hoppers.

Checked on housekeeping data in control trailer.

Meeting at 1300 hrs.

Make payload ready for L-4 day check.

Payload will be placed on crane and taken to launch area for testing.

22 Apr Pointing system computer displays finally up and useable.

Payload moved outside hangar door at noon. Crane will not lift payload.

Payload must first be lifted to proper height by BST on forklift, and then crane can hold it up.

On internal power in p.m. for L-4 test.

Cannot put velocity inputs into radar - fix tomorrow. Azimuth crush pads had to be reduced in size to fit under load bar. L-4 day test will be done again on Saturday morning.

Went to compass rose to swing compass.

23 Apr Battery charging.

Fix radar inputs in pointing system control box.

Payload weight = 3450 lbs. Launch weight for entire system = 5570 lbs.

The pointing system data console in the forward section of the trailer is of limited usefulness because of the very slow update rate - sometimes 20 seconds!

Actual pointing system control must be done using only the azimuth, elevation fine roll and fine elevation angles on the main display.

24 Apr Bob had to go to the hangar at 3 a.m. to attach payload to BST. BST was used to launch other payload at about 2:30 a.m.

Purpose - look at sunrise.

System test countdown practice

Target situation practice. Looks like a one day delay in the launch date.

25 Apr Battery charging.

Checked on compass rose - compass rose at Chico is based on magnetic north.

Aligned gyros using lasers and mirrors.

Weather briefing at Safari Hotel at 1400 hrs.

26 Apr Meeting at 0800.

External power - all up testing starts at 1000.

System check out procedures until noon.

Target situation practice in p.m.

27 Apr Meeting at 0800.

L-3 test all the way through to launch.

Radiometer was off and dummy radiometer could not be balanced.

Weights were added and the platform partially balanced. Final balloon briefing at 1430.

Roll out Wednesday night at 8 p.m.

Alignment between compass and instruments off by 2.4°.

Dither 0.125 Hz by 10% of pixel.

28 Apr Morning meeting - new countdown sheets issued.

Continued attempts to record interferometer data.

Classified filter on radiometer.

Both instruments mounted and used today.

TV camera alignment.

29 Apr Determination of where TV zoom matches the mosaic sensors.

30 Apr More testing in a.m. on interferometer and radiometer. Put entire system except pointing system on internal power for 18 minutes.

1 May Weather briefing was GO for tonight's launch.
 On station at 7:30 p.m. Lift-off at 2 - 3 a.m.
 Check outs completed at midnight.
 Two hour hold prior to laying out balloon.
 Housekeeping link up. Gyros running on housekeeping power.
 Additional hour used for balloon inflation. At launch, shortly after 3 a.m., as the balloon was released and come up above the crane, the release pin was pulled. The tri-plate jammed in the crane jaws and it was not until the crane had backed up and turned slightly that the balloon was released.
 Slow ascent rate through troposphere - long cold soak condition.
 Platform exercises were initiated.
 During the platform maneuvers, the command system stopped working except intermittantly.
 Orr Shepherd began running the command system using the basic controller. The suggestion was made to try raising the locking mechanism to see if that made any change. During raising or lowering of the locking mechanism, commands were able to get through to the platform, radio-meter and interferometer.
 Balloon was brought down to 80,000 ft. at about 9 a.m.
 Winds did not bring payload back over Chico as expected, but died and left the payload over the mountains. After bringing balloon down to 60,000 feet to get into the easterlies, the hunt was on for a good landing spot.
 Final landing was attempted in a valley. The payload landed on the side of a 7000 foot hill covered with large boulders. The load bar rolled part way down after landing. Just as people started work on it, it started rolling again. Most of the load bar contents were distributed over the mountainside as it rolled. The azimuth platform slammed into the side of the hill, rolled once, and came to a rest on a bush.

Preliminary damage estimate:

Radar - new radome and possibly antenna

Gimbal - looked better than either of the other two landings

Pointing System - several dents on cover

Azimuth Platform - replace

Elevation Platform - looks OK

Roll bars - replace

Radiometer - some damage to electronics

Interferometer - no external damage

Load bar - needs some replacement of structural members.

Center section undamaged. Some cable replacements

kag

cc: O. Shepherd

APPENDIX B
BAMM II FLIGHT BATTERIES

For the 30 Apr 82 BAMM II Flight, ten 28 VDC 80 amp-hr batteries were required. Visidyne was supplied with 200 Ag-Zn cells (BB-66B/U) which were assembled into 20 cell batteries at Visidyne. These batteries were shipped to Chico in the dry uncharged condition.

The batteries were filled with electrolyte using an Eagle-Pitcher supplied vacuum activator. The vacuum activator permitted a vacuum to be applied simultaneously to 20 cells and then using the ambient air pressure to force the proper amount of the electrolyte into each cell. From 7 Apr 82 to 9 Apr 82, 200 cells were filled with electrolyte with the activator. The filled batteries were soaked until 10 Apr 82.

On 10 Apr 82, charging of the batteries was started. The charging technique used was that of a constant current charge. A 6 amp constant current was fed into the battery and the individual cell voltages monitored to determine when full charge has been attained. Full charge is indicated by a charging cell voltage of 2.05 volts. This charging technique was recommended by the cell manufacturer, Eagle Pitcher.

After the batteries had been on charge for approximately 4 hours, cell measurements indicated that they were fully charged. On 11 Apr 82 all batteries were discharged at approximately the 10 hour rate. The measured battery capacity ranged from 5 amp-hours to 25 amp-hours as compared to a specified 80 amp-hours. On 12 Apr 82, Visidyne informed A. Ginnetti, AFGL/LC, of the charging problem and recommended that new batteries be obtained. As a result, an additional set of unfilled cells were shipped from Holloman AFB to Chico.

Eagle-Pitcher was informed of this charging problem and initially offered no explanation. Eagle-Pitcher suggested that a set of cells be charged beyond the 2.05 volt limit and note the results.

The 2.05 volt cell charging voltage indicates the onset of cell electrolyte bubbling. Higher voltages are indicative of more violent bubbling. Extended periods of electrolyte to bubbling will cause a reduction in cell amp-hour capacity.

A set of 4 cells were set on charge and after approximately four hours a single-cell voltage of 2.56 volts was observed. At this time, the cell charging

set was shut down and the test set-up brought back to the motel for overnight charging. When the test was restarted, approximately 45 minutes later, the cell charging voltage was less than 2.00 volts and it remained so for the next 12 hours of charging.

Thus the test cells had accepted a full charge. It was concluded that the physical agitation associated with changing set-ups had conditioned the cells for charging. Eagle-Pitcher stated that it was possible that gas bubbles on the plates had reduced the effective plate area and thus the cell capacity. Agitation of the cell would have released these bubbles permitting full charging. Eagle-Pitcher stated that the presence of these bubbles could have been caused by the relatively old age of the cells (manufactured in Nov 78).

As a result of these tests, the flight batteries were agitated and put onto charge. A full charge, 15 hours at 6 amperes, was accepted by each battery. A few cells indicated that they were fully charged prior to the 15 hours, but these cells were marked and were bussed out of the flight battery. Of the 20 cells in each battery assembly, only 18 were used to provide the 28 VDC power for each system.

Upon completion of charging, three batteries, Interferometer A and B and Radiometer, were selected for a capacity test. These batteries were discharged at approximately the 10 hour rate and a 70 amp-hour capacity for each battery was verified.

No further battery problems were encountered, and all batteries performed satisfactorily during flight. The spare cells were never used.

Visidyne acknowledges the assistance and guidance of Dan Stanley, Eagle-Pitcher Industries, Inc., in the solution of this charging problem.

APPENDIX C

MEMORANDUM

TO: W. P. REIDY
FROM: O. SHEPHERD 
DATE: 17 MAY 82
SUBJECT: BMM II FLIGHT, COMMAND SYSTEM OPERATIONAL PROBLEMS

During the subject flight, the payload uplink command system operated in an intermittent and unreliable manner. This operation is discussed.

The platform was initially tested by performing a complete 360° azimuth slew. Then the elevation axis was slewed from an initial position at 45 degrees to approximately -10° degrees relative to the nadir. With the platform in this position, I was informed by R. Murphy that the platform was no longer responding to uplinked commands from the Pointing System Control panel. I requested, and was given, permission to input command data in binary format by toggle switches on the Command System manual input panel. Using the appropriate pointing system codes, I was able to slew the platform to the approximate position designated by R. Murphy. It should be noted that the slewing motion was intermittent and some of the transmitted azimuth commands were received as elevation commands thus correction was required after each command sequence. It was assumed that only a fraction of the transmitted commands were received by the pointing system and of those received, some were false commands.

During the flight there were: (1) periods of time when no transmitted commands were received by the pointing system (2) periods when a small fraction of the transmitted commands were received and (3) a short period during the flight when the command system appeared to operate properly.

Later in the flight, when the command system was operating very poorly, in an attempt to circumvent the malfunction, the platform locking mechanism was activated. During activation uplink command transmission was improved. During prelaunch testing, it had been observed that locking mechanism activation caused RFI in the instrument data. Since the locking mechanism activation for a normal flight is only performed immediately after launch and prior to termination, this interference has no effect on

BAMM systems performance. Activation of the locking mechanism during flight was a shot in the dark. Command transmission was improved, and the nature of the problem is presently under evaluation.

During the flight the following tests were performed:

- (1) Verifications that data was being transmitted on the command link.
- (2) Shutting off the ranging transmitter.
- (3) Changing the antenna of the uplink command system.
- (4) Verification that other (interferometer radiometer T/V) on board systems were not receiving reliable commands.

It is recommended that the complete ground and payload uplink command system be bench tested initially under ambient laboratory conditions, to see if the command problem observed during flight, occurs during testing. If the observed malfunction cannot be duplicated under ambient laboratory conditions, then a thermal vacuum test of the payload part of the system is recommended. For this thermovac test the temperature pressure profile observed during the flight should be duplicated.

APPENDIX D

BAMM II COUNTDOWN AND SYSTEM CHECKS

LIST OF SYSTEM CHECKS

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EXPERIMENT (COMPUTER CONTROL VAN)
 AFGL TELEMETRY VAN
 WHITE SANDS TELEMETRY VAN (WSTM)
 INSTRUMENT COMMAND SYSTEM
 TELEMETRY SYSTEM (PAYLOAD)
 TELEVISION CAMERA SYSTEM
 RADIONETER SYSTEM PART 1
 PLATFORM CHECK
 INTERFEROMETER SYSTEM
 RANGING SYSTEM
 RADIONETER SYSTEM PART 2
 PLATFORM CHECK

L - TIME	ITEM	DIR OF	ACTION BY	OPERATION	DRESS	ACTUAL
L - 18 HRS	1	TC	RH	INSTALL AND COOL INTERFEROMETER	---	---
	2	TC	RC	INSTALL RADIOMETER (COOLED DOWN)	---	---
	3	TC	CVC	PERFORM VAN CHECK A	---	---
	4	TC	WSTM	PERFORM VAN CHECK B	---	---
	5	TC	OSUTH	PERFORM VAN CHECK C	---	---
	6	TC	PLTH	INSTALL BATTERIES	---	---
	7	TC	OSUTH	TURN ON INSTRUMENT COMMAND TRANSMITTER	---	---
	8	TC	PTV	PERFORM INSTRUMENT COMMAND SYSTEM CHECK D	---	---
	9	TC	ICC	TURN ON LINK 1, 2, 3 & 4	---	---
	10	TC	WSTM	PERFORM TM SYSTEM CHECKS (SYS CHK E)	---	---
	11	TC	OSUTH	PERFORM TM SYSTEM CHECKS (SYS CHK E)	---	---
	12	TC	WSTM	PERFORM RANGING SYSTEM CHECKS (SYS CHK K)	---	---
	13	TC	OSUTH	PERFORM RANGING SYSTEM CHECKS (SYS CHK K)	---	---
	14	TC	PTV	PERFORM TV SYSTEM CHECKS (SYS CHK F) TURN OFF TV LINK WHEN COMPLETE	---	---
	15	TC	RC	TRANSFER RADIOMETER TO BATTERY POWER (SYS CHK G)	---	---
	16	RC	PRC	PERFORM RADIOMETER SYSTEM CHECKS (SYS CHK L)	---	---
	17	TC	RH	PERFORM INTERFEROMETER CHECKS (SYS CHK J)	---	---
	18	TC	PTV	PERFORM PLATFORM SYSTEM CHECKS (SYS CHK H)	---	---

NOTE: REPORT TO TC AS SOON AS CHECKS HAVE BEEN COMPLETED

L - TIME	ITEM	DIR OF	ACTION BY	OPERATION	DRESS	ACTUAL
	19	TC	ALL	TURN ALL SYSTEMS OFF	_____	_____
	20	TC	ALL	CHECK FOR NEGATIVE ITEMS	_____	_____
	21	PS	TC	REPORT PAYLOAD STATUS TO PS	_____	_____
	22	TC	PLTM	REMOVE BATTERIES & TOP OFF FOR FLIGHT	_____	_____
	23	TC	RC	COOL RADIOMETER BEFORE PAYLOAD TRANSFER TO LAUNCH AREA	_____	_____
	24	TC	RH	COOL INTERFEROMETER BEFORE TRANSFER TO LAUNCH AREA	_____	_____
L - 6 1/2 HRS	25	MC	ALL	ALL PERSONNEL ON STATION	_____	_____
	26	P0	CVC	PERFORM VAN CHECK A REPORT WHEN READY	_____	_____
	27	P0	WSTM	PERFORM VAN CHECK B REPORT WHEN READY	_____	_____
	28	P0	OSUTH	PERFORM VAN CHECK C REPORT WHEN READY	_____	_____
	29	P0	PLTM	INSTALL BATTERIES FOR FLIGHT	_____	_____
	30	TC	OSUTH	TURN ON COMMAND TRANSMITTER	_____	_____
L - 5 1/4 HRS	31	TC	ICC	COMMAND LINK 4 ON	_____	_____
	32	P0	RC	TRANSFER RADIOMETER TO BATTER POWER	_____	_____
	32A	P0	RH	INTERFEROMETER PREPARED FOR TRANSPORT	_____	_____
	33	TC	WSTM	MONITOR ACCELEROMETERS DURING PAYLOAD TRANSPORT	_____	_____
	34	TC	PLTM	PREPARE MECHANICAL ACCELEROMETERS FOR FLIGHT	_____	_____
	35	P0	LCC	TRANSPORT PAYLOAD TO LAUNCH AREA	_____	_____

L - TIME	ITEM	DIR OF	ACTION BY	OPERATION	DRESS	ACTUAL
	36	PS	PO	INFORM PS WHEN PAYLOAD IN PLACE	—	—
	37		PS	INFORM TC TO BEGIN PAYLOAD SYSTEM CHECKS	—	—
	38	TC	PLTM	MOUNT ALL ANTENNAS FOR FLIGHT CONFIGURATION	—	—
	39	PS	TC	START PAYLOAD SYSTEM CHECKS	—	—
	40	TC	ICC	TURN LINKS 1, 2 & 3 ON (LINK 4 ALREADY ON)	—	—
				NOTE: ADVISE TC WHEN EACH CHECK HAS BEEN COMPLETED		
	41	TC	WSTM	PERFORM TM CHECKS	—	—
	42	TC	OSUTM	PERFORM TM CHECKS	—	—
	43	TC	WSTM	PERFORM RANGING SYSTEM CHECKS-COORDINATE	—	—
	44	TC	OSUTM	PERFORM RANGING SYSTEMS CHECKS & COORDINATE	—	—
	45	TC	ICC	PERFORM TV SYSTEM CHECKS	—	—
	46	TC	RC	PERFORM RADIOMETER SYSTEM CHECK	—	—
	47	TC	RH	PERFORM INTERFEROMETER SYSTEM CHECK	—	—
	48	TC	PS	PERFORM PLATFORM SYSTEM CHECKS	—	—
	49	TC	ICC	TURN OFF LINK 1, 2, 3 & 4	—	—
	50	TC	OSUTM	TURN OFF INSTRUMENT COMMAND TRANSMITTER	—	—
	51	TC	ALL	CHECK FOR NEGATIVE ITEMS	—	—
	52	PS	TC	NOTIFY PS & PO WHEN ALL CHECKS HAVE BEEN COMPLETED AND REPORT PAYLOAD STATUS	—	—

L - TIME	ITEM	DIR OF	ACTION BY	OPERATION	DRESS	ACTUAL
L - 2 1/2 HRS	53		PS	REPORT PAYLOAD STATUS TO PO & READY FOR BALLOON LAYOUT	---	---
L - 1 3/4 HRS	54	TC	OSUTM	TURN ON INSTRUMENT COMMAND TRANSMITTER	---	---
	55	PS	TC	BRING PAYLOAD UP FOR STATUS CHECK	---	---
	56	TC	ICC	TURN ON LINKS 1, 2, 3, & 4	---	---
	57	TC	WSTM	REPORT TM SYS STATUS	---	---
	58	TC	OSUTM	REPORT TM & RANGING SYSTEM STATUS	---	---
	59	PS	PLC	REPORT PAYLOAD STATUS	---	---
	60	PS	CC	REPORT HOUSEKEEPING STATUS, COMMUTATOR A	---	---
	61	TC	RC	REPORT RADIOMETER SYSTEM STATUS	---	---
	62	TC	RH	REPORT INTERFEROMETER STATUS	---	---
	63	TC/PO	RC	START LN ₂ TOP OFF	---	---
	64	TC/PO	RH	START LN ₂	---	---
	64A	TC	RH	CONFIRM INTERFEROMETER IN FLIGHT CONFIGURATION	---	---
	65	PS	TC	CHECK FOR NEGATIVE ITEMS	---	---
	66	TC	ICC	TURN OFF LINK 1, 2, 3 & 4	---	---
	67		TC	NOTIFY PS PAYLOAD STATUS	---	---
L - 1 1/4 HRS	68		PS	NOTIFY PO READY FOR BALLOON INFLATION	---	---
L - 20 MIN	69	PO	RC	CONFIRM THAT CRYOGENIC OPERATIONS ARE COMPLETE	---	---
	70	TC	ICC	TURN ON COMMAND, TM RANGING & TM XMTRS	---	---

L - TIME	ITEM	DIR OF	ACTION BY	OPERATION	DRESS	ACTUAL
	71	TC	PLC	PREPARE PLATFORM FOR FINAL CHECKS	---	---
	72	TC	ALL	CHECK ALL SYSTEMS FOR BALLOON LAUNCH	---	---
	73	TC	ALL	REPORT STATUS	---	---
				OSUTM WSTM OSU TRACKING		
				RADAR COMPUTER VAN		
				COMPUTER IISKP COMMAND SYS		
				TV SYS PLATFORM SYS		
				INTERFEROMETER RADIOMETER SYS		
33	74	PS	TC	CHECK FOR NEGATIVE ITEMS	---	---
L - 5 MIN	75		TC	REPORT PAYLOAD STATUS TO PS	---	---
	76		PS	REPORT PAYLOAD STATUS TO P0	---	---
L - 2 MIN	77	TC	WSTM	START TAPE RECORDERS	---	---
	78		OSUTM	START TAPE RECORDERS	---	---
L + 0	79	P0	ALL	STANDBY FOR BALLOON LAUNCH	---	---

SYSTEM CHECK A

EXPERIMENT (COMPUTER) CONTROL VAN

L - TIME	ITEM	DIR OF	ACTION BY	OPERATION	DRESS	ACTUAL
	1	TC	CVC	BEGIN EXPERIMENT CONTROL VAN CHECKOUT	—	—
	2		CVC	POWER ON ALL SYSTEM. STATUS _____	—	—
	3		CVC	CHECK VOLTAGES AND FREQUENCIES (MAIN PANEL)	—	—
	4		CVC	CHART RECORDERS - RECORD TM CALIBRATION AND LABEL CHARTS	—	—
	5		CVC	CONFIRM OSCILLOSCOPE AND DIGITAL DISPLAYS OPERATION USING OSU/AFGTM CALIBRATION	—	—
	6	CVC	CC	ACTIVATE COMPUTER	—	—
	7		CC	RUN OPERATIONAL CHECKS ON DATA AND HOUSEKEEPING PROGRAMS (HARD COPY)	—	—
	8		ICC	PROGRAM PCM DECODING SYSTEM	—	—
	9		CVC	ACTIVATE TV MONITORS	—	—
	10		CVC	CHECK CONFD TO PAYLOAD	—	—
				OTHER STATIONS		
	11		ICC	CALIBRATE SCD'S	—	—
	12		CVC	CALIBRATE CHART RECORDERS	—	—
	13		CVC	CHECK MONITORS, DIGITAL READOUTS FOR RADIONETER	—	—
	14		CVC	RETURN SCD'S TO INPUT SIGNALS	—	—
	15		CVC	SUPPORT EXPERIMENTERS AS REQUIRED AND NOTIFY TC CHECKS ARE COMPLETE	—	—

SYSTEM CHECK B
AFGL TELEMETRY VAN

L - TIME	ITEM	DIR OF	ACTION BY	OPERATION	DRESS	ACTUAL
T - 6 1/2 HRS	1		OSUTM	TURN ON CIRCUIT BREAKERS 1 THRU 10	—	—
	2		OSUTM	TURN ON TRACKER CIRCUIT BREAKERS	—	—
	3		OSUTM	POWER UP ALL TM EQUIPMENT	—	—
	4		OSUTM	VERIFY PATCH PANEL ACCORDING TO PATCH PANEL LAYOUT	—	—
	5		OSUTM	VERIFY TIME CODE GENERATOR IN SYNC WITH WWV.	—	—
	6		OSUTM	VERIFY IRIG B TIMING TO STA MULTIPLEX AND TO EXPERIMENT VAN	—	—
	7		OSUTM	CHECK SENSITIVITY, DEVIATION & SIG STRENGTH OF ALL RECEIVERS	—	—
	8		OSUTM	VERIFY AGC SIGNALS TO STA MULTIPLEX	—	—
	9		OSUTM	SLEW TRACKER IN AZIMUTH & ELEVATION	—	—
	10		OSUTM	SLEW TRACKER WITH 2° OF BORE SITE SOURCE IN AZIMUTH & ELEVATION. SWITCH TRACKER TO AUTO MODE: REPEAT OPERATION TO INSURE TRACKING FROM RIGHT & LEFT AND UP AND DOWN	—	—
	11		OSUTM	CHECK TRACKER ORIENTATION	—	—
	12		OSUTM	CHECK RANGING SYS (TRADAT) WITH PRINTER & EXPERIMENT VAN NAVIGATOR	—	—
	13		OSUTM	VERIFY PROPER SIG LEVELS AT TAPE RECORDER INPUTS & OUTPUTS	—	—
	14		OSUTM	VERIFY TV SIG TO EXPERIMENT VAN & CONTROL CENTER	—	—

L - TIME	ITEM	DIR OF	ACTION BY	OPERATION	DRESS	ACTUAL
	15		OSUTM	CHECK PCM BIT SYNC FOR PROPER INPUT SELECTION (DIRECT/RECORDED) CHECK DISCRIMINATOR CALIBRATION	—	—
	16		OSUTM	CHECK PCM SYSTEM & COMPUTER W/TEST TAPE (COORDINATE WITH EXPERIMENT VAN)	—	—
	17		OSUTM	NOTIFY TC WHEN TM VAN CHECK COMPLETE. REPORT ANY NEGATIVE ITEMS	—	—

SYSTEM CHECK C
WHITE SANDS TELEMETRY VAN

<u>L-TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	1		WSTM	TURN ON ALL TM CIRCUIT BREAKERS	—	—
	2		WSTM	TURN ON TRACKER	—	—
	3		WSTM	POWER UP ALL THE EQUIPMENT	—	—
	4		WSTM	VERIFY EQUIPMENT PATCH ACCORDING TO PLANNED DATA DISTRIBUTION	—	—
	5		WSTM	VERIFY TIME CODE GENERATOR IN SYNC W/MWV	—	—
	6		WSTM	VERIFY IRIG B TIMING TO STA MULTIPLEX	—	—
	7		WSTM	CHECK SENSITIVITY, DEVIATION & SIG STRENGTH OF ALL RECEIVERS	—	—
	8		WSTM	VERIFY AGC(S) TO STATION MULTIPLEX	—	—
	9		WSTM	PERFORM SOLAR CALIBRATION, SLEW AND TWANG TESTS.	—	—
	10		WSTM	PLUNGE & ROTATE TRACKER	—	—
	11		WSTM	CHECK TRACKER ORIENTATION	—	—
	12		WSTM	PERFORM BIT ERROR RATE TESTS AND DOCUMENT	—	—
	13		WSTM	VERIFY PROPER SIG LEVELS AT TAPE REC'DR INPUT & OUTPUTS	—	—
	14		WSTM	CHECK PCM BIT SYNCs	—	—

<u>L-TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	15		WSTM	CHECK DISCRIMINATOR CALIBRATION	—	—
	16		WSTM, CVC	CHECK PCM SYSTEM & COMPUTER W/TEST TAPE (COORDINATE WITH WSTM & EXPERIMENT VAN.)	—	—
	17		WSTM	NOTIFY TC WHEN VAN CHECK COMPLETE. REPORT ANY NEGATIVE ITEMS.	—	—

SYSTEMS CHECK D
INSTRUMENT COMMAND

<u>L-TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	1	ICC	CVC	VERIFY POWER ON COMMAND RACK AND SCD RACK	---	---
	2	ICC	PLTM	VERIFY POWER ON INSTRUMENT COMMAND SYSTEM AT	---	---
	3	PTV	OSUTM	SELECT OSUTM INSTRUMENT COMMAND TRANSMITTER	---	---
	4	ICC	PTV	SELECT CORRECT MODULATION POLARITY AND SELECT LED VERIFY COMMAND	---	---
	5	PTV	PLTM	VERIFY THAT LED BLINKS	---	---
	6	PTV	OSUTM	DESELECT OSUTM TRANSMITTER	---	---
	7	ICC		REPORT RESULTS TO TC	---	---

SYSTEM CHECK E
TELEMETRY SYSTEM

RECEIVING & DATA DISTRIBUTION

<u>L-TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
T -	1	TC	WSTM OSUTH	PERFORM TELEMETRY SYSTEM CHECK	---	---
	2		WSTM OSUTH	CHECK TV LINK SIG STRENGTH _____ PIX _____	---	---
	3		WSTM OSUTH	CHECK PCM A LINK SIG ST _____ DEV _____	---	---
	4		WSTM OSUTH	CHECK PCM B LINK SIG ST _____ DEV _____	---	---
	5		WSTM OSUTH	CHECK HKPG LINK SIG ST _____ DEV _____ TAPER _____	---	---
	6		WSTM OSUTH	CHECK PCM A BIT SYNC LOCK DIRECT	---	---
	7		WSTM OSUTH	CHECK PCM B SYNC LOCK DIRECT	---	---
	8		WSTM OSUTH	VERIFY HKPG TH DATA TO COMPUTER VAN	---	---
	9		WSTM OSUTH	VERIFY PCM A DECOM LOCK DIRECT	---	---
	10		WSTM OSUTH	VERIFY PCM B DECOM LOCK DIRECT	---	---
	11	TC	WSTM	VERIFY PCM A & PCM B DECOM LOCK FORM TAPE RECORDERS	---	---

<u>L - TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	12	OSUTM	WSTM CVC	VERIFY TV PIX TO COMPUTER VAN	---	---
	13	OSUTM	WSTM OSUTM	CHECK RANGING SYSTEM LOCK	---	---
	14	OSUTM	WSTM OSUTM CC	VERIFY RANGING PRINTOUT TO COMPUTER VAN	---	---
	15		WSTM OSUTM	VERIFY TV VIDEO RECORDING SATISFACTORY	---	---
	16		WSTM OSUTM	VERIFY TIME CODE, MAX, VOICE SIGNALS, RECORDING SATISFACTORY	---	---
	17		WSTM OSUTM	NOTIFY TC WHEN TM SYSTEM CHECKS COMPLETED	---	---

SYSTEM CHECK F

TELEVISION CAMERA SYSTEM

<u>L-TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	1	TC	PLTM CREW CHIEF	RAISE PAYLOAD 6 FT ABOVE GROUND OPEN IRIS	—	—
	2	TC	PTV-PS	PERFORM TV CAMERA SYSTEM CHECKS	—	—
	3		PTV	CLOSE IRIS FOR OPTIMUM PICTURE	—	—
	4		PTV	ZOOM LENSE IN	—	—
	5		PTV	ZOOM LENSE OUT FOR OPTIMUM PICTURE	—	—
	6		PTV	FOCUS NEAR	—	—
	7		PTV	FOCUS FAR FOR OPTIMUM PICTURE	—	—
	8	TC	CC	CHECK TV CAMERA TEMP & PRESS MON'S	—	—
	9		CC	NOTIFY TC/PS IF NOT WITHIN LIMITS	—	—
	10	TC	PTV/PS	NOTIFY TC WHEN TV CAMERA CHECKS COMPLETED	—	—

SYSTEM CHECK G
RADIOMETER SYSTEM PART 1

<u>L-TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATIONS</u>	<u>DRESS</u>	<u>ACTUAL</u>
	1	TC	PLC	TURN ON HSK, TM BATTERIES	---	---
	2	TC	OSUTH	TURN ON INSTRUMENT COMMAND TRANSMITTER	---	---
	3	TC	ICC	TURN ON HOUSEKEEPING LINK	---	---
	4	TC	RC	TC HANDS RC THE VOICE NET FOR RAD SYSTEM POWER UP	---	---
	5	RC	TC	RECEIVE CONFIRMATION THAT PAYLOAD POWER IS "ON" COMMAND TRANSMITTER IS "ON", INSTRUMENT COMMAND SYSTEM IS "ON", AND HOUSEKEEPING LINK IS "ON".	---	---
	6	TC	PRC	CONFIRM RAD OPERATING IN EXT MODE AND RAD PAYLOAD BATTERY "OFF"	---	---
	7	RC	PRC	POWER DOWN RAD EXT POWER AND REMOVE EXT CABLES	---	---
	8	RC	PRC	INSTALL PLATFORM CABLES	---	---
	9	RC	PRC	TURN PLATFORM RAD BATT. POWER "ON"	---	---
	10	RC	PRC	CONFIRM RAD FCE POWER "ON" AND CARSON POWER "ON"	---	---
	11	RC	PRC	CONFIRM RAD SCE POWER "ON"; BOX HTR POWER "ON"; MOTOR POWER "ON"; (AND ANY OTHER OPERATIONS REQUIRED FOR THE TEST IN PROGRESS)	---	---
	12	RC	PRC	RETURN RADIOMETER TO STANDBY	---	---
	13	RC	TC	RETURN VOICE NET TO TC	---	---

SYSTEMS CHECK H

PLATFORM CHECK

<u>L - TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	1	PS	PLC	VERIFY THAT PLUGS ARE IN AND PLATFORM SYSTEM READY TO TEST	---	---
	2	PS	PLC	RAISE PAYLOAD	---	---
	3	PS	PLC	TURN ON SYSTEM POWER	---	---
	4	PS	PTV	OPERATE AZIMUTH BOTH SPEEDS, BOTH DIRECTIONS, VERIFY READOUTS	---	---
	5	PS	PTV	OPERATE ELEVATION BOTH SPEEDS, BOTH DIRECTIONS, VERIFY READOUTS	---	---
	6	PS	PTV	OPERATE CROSS ELEVATION, BOTH SPEEDS BOTH DIRECTIONS, VERIFY READOUTS	---	---
	7	PS	PTV	TURN SYSTEM OFF	---	---
	8	PS	PTV	LOWER PLATFORM	---	---
	9	PS		REPORT STATUS TO TC	---	---

SYSTEMS CHECK J

INTERFEROMETER CHECK

<u>L - TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	1	RH	PRH	VERIFY THAT ALL PLUGS ARE IN AND INTERFEROMETER IS READY TO CHECK	—	—
	2	RH	PRH	POWER UP INTERFEROMETER ON BATTERIES	—	—
	3	RH		COMMAND 5 SCANS/SEC, HOT CAL, 4 KHz FILTER	—	—
	4	RH		CHECK LASER REFERENCE. IRIG 21: OUTPUT = 1.3 V OR GREATER	—	—
	5	RH		ALIGN INTERFEROMETER AS REQUIRED	—	—
	6	RH		CHECK WHITE LIGHT REFERENCE. IRIG 19: OUTPUT = 0 V OR 5 V	—	—
	7	RH		CHECK MAIN CHANNELS. IRIG 16: DET 7, G = G4 V = 5 V P/P (SATURATES) IRIG 17: DET 7, G = 4, V = 3.25 V P/P IRIG 20: DET 10, G = 4, V = 2.7 V P/P	—	—
	8	RH		CHECK SCAN RATE, LOCK POSITION, PIEZO ADJUSTMENTS	—	—
	9	RH	ICC	SELECT PCM B FOR BLUE BOX #2	—	—
	10	RH		COMMAND 5 SCANS/SEC AND CHECK FLAG BITS AS FOLLOWS:	—	—
				BIT 7 - SCAN DIRECTION	—	—
				BIT 8 - WHITE LIGHT POSITION	—	—
				BIT 9 - BUFFER OVERFLOW	—	—
				BIT 10 - ADC SAMPLE TIME ERROR	—	—

<u>L - TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
				BIT 11 - TURN AROUND	—	—
				BIT 12 - 8 OR 2 DETECTORS	—	—
				BIT 13 - AUTO OR COMMAND GAIN	—	—
	11	RH		COMMAND 20 SCANS/SEC AND CHECK ALL FLAG BITS	—	—
	12	RH	ICC	SELECT PCM A FOR BLUE BOX #2	—	—
	13	RH		COMMAND 5 SCANS/SEC AND CHECK ALL FLAG BITS	—	—
	14	RH		COMMAND 20 SCANS/SEC AND CHECK ALL FLAG BITS	—	—
	15	RH	ICC	COMMAND LOW SCAN RATE, MANUAL GAIN, GAIN = 4	—	—
	16	RH		COMMAND 5 SCANS/SEC, FILTERS 4 KHZ, HOT CAL	—	—
	17	RH	WSTM OSUTH	RECORD 3 MINUTES OF DATA	—	—
	18	RH	CC	OBTAIN INTERFEROGRAMS AND FFT'S OF:	—	—
				DET 6 (WORD 4, PCM A)	—	—
				DET 10 (WORD 4, PCM B)	—	—
				DET 2 (WORD 8, PCM A)	—	—
				DET 7 (WORD 5, PCM A)	—	—
	19	RH	ICC	COMMAND GAIN = 1	—	—
	20	RH		COMMAND COLD CAL	—	—
	21	RH	WSTM OSUTH	RECORD 3 MINUTES OF DATA	—	—

<u>L - TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	22	RH	CC	OBTAIN PLOT OF INTERFEROGRAM WINGS FOR DET 6 AND DET 10	—	—
	23	RH	ICC	COMMAND GAIN - 64	—	—
	24	RH		VERIFY COLD CAL	—	—
	25	RH	WSTM	RECORD 3 MINUTES OF DATA	—	—
	26	RH	ICC	COMMAND AUTO GAIN	—	—
	27	RH		VERIFY 5 SCANS/SEC, 4 KHZ FILTER	—	—
	28	RH		COMMAND HOT CAL	—	—
	29	RH	WSTM	RECORD 3 MINUTES OF DATA	—	—
	30	RH	CC	OBTAIN INTERFEROGRAMS AND FFT'S OF DET 6 AND DET 10	—	—
	31	RH	ICC	COMMAND MANUAL GAIN, GAIN = 4, HIGH SCAN RATE	—	—
	32	RH		COMMAND 20 SCANS/SEC, FILTER = 16 KHZ. VERIFY HOT CAL	—	—
	33	RH	CC	OBTAIN INTERFEROGRAMS AND FFT'S OF DET 6 AND DET 10	—	—
	34	RH	ICC	COMMAND AUTO GAIN	—	—
	35	RH	CC	OBTAIN INTERFEROGRAMS AND FFT'S OF DET 6 AND DET 10	—	—
	36	RH		POWER DOWN OR STANDBY MODE	—	—
	37	RH		REPORT STATUS TO TC/PS	—	—

SYSTEM CHECK K

RANGING SYSTEM CHECKOUT PROCEDURE

<u>L - TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	1	TC	OSUTM	PERFORM RANGING CHECKS	—	—
	2		OSUTM	SWITCH TO RANGING DATA	—	—
	3	OSUTM	OSUTM	TURN ON OSUTM RANGING XMTR	—	—
	4		OSUTM	CHECK HKPG IRIG CH 5 RANGE RCVR SIG STRENGTH	—	—
	5		OSUTM	CHECK RANGE LOCK — KM	—	—
	6		OSUTM	CHECK PRINTER TIME, RANGE, AZ, EL	—	—
	7	OSUTM	OSUTM	VERIFY DATA IN OSUTM VAN	—	—
	8	OSUTM	HW/CC	VERIFY DATA IN COMPUTER VAN	—	—
	9		OSUTM	TURN OFF OSUTM RANGING XTMR	—	—
	10	OSUTM	OSUTM	SWICH TO OSUTM RANGING DATA	—	—
	11		OSUTM	ADVISE TC THAT RANGING CHECKS COMPLETE	—	—

SYSTEM CHECK L
RADIOMETER SYSTEM PART 2

<u>L - TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	1	TC	RC	BEGIN RADIOMETER PRE-LAUNCH CHECKS	_____	_____
	2	RC	PRC	CHECK MOUNTING ALL BOLT ON HARDWARE	_____	_____
	3	RC	PRC	INSPECT ALL CABLING AND CONNECTORS	_____	_____
	4	RC	PRC	CHECK FOR UNOBSTRUCTED APERTURE	_____	_____
	5	RC	PRC	PERFORM ALL COMMAND FUNCTION CHECKS	_____	_____
				SHUTTER CLOSE/OPEN	_____	_____
				FILTER POSITION 1	_____	_____
				2	_____	_____
				3	_____	_____
				CHOPPER OFF/ON, MONITOR MOTOR	_____	_____
				HEATER: OFF/ON	_____	_____
				FUNCTION CONTROL ELECTRONICS: OFF/ON	_____	_____
				SIGNAL CONDITIONING ELECTRONICS: OFF/ON	_____	_____
				FILTER MOTOR ENABLE	_____	_____
				OBSERVE 1.67 VOLTS #1	_____	_____
				3.40 VOLTS #2	_____	_____
				4.95 VOLTS #3	_____	_____
	6	RC	ICC	REQUEST ICC TO TURN ON PCM LINK A OR B	_____	_____

<u>TIME</u>	<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	7	RC	RC	RECORD FM DISPLAY OF DETECTORS 6 & 10	---	---
	8	RC	CC	OBTAIN PCM COMPUTER RADINACE, 16 DETECTORS, 3 GAINS	---	---
	9	RC	PRC	MECHANICAL CHECK OF DEWAR CABLES & VENT LINE	---	---
	10	RC	CC	OBTAIN HOUSEKEEPING DATA FOR RADIOMETER CONFIRM OK STATUS	---	---
	11	RC	RC	RETURN RADIOMETER TO STANDBY	---	---
	12	TC	RC	NOTIFY TC/PS - RADIOMETER CHECKS COMPLETE	---	---

SYSTEM CHECK M
PLATFORM CHECK

<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
1.	VPM	PLC	VERIFY THAT PLATFORM IS READY FOR TEST	_____	_____
2.			POWER UP ALL SYSTEMS:		
			POINTING SYSTEM	_____	_____
			TELEMETRY	_____	_____
			HOUSEKEEPING	_____	_____
			INTERFEROMETER	_____	_____
			RADIOMETER	_____	_____
3.			GYRO RUN UP - 5 MINUTES (NO MOVEMENT OF PAYLOAD IS PERMITTED DURING THIS RUN UP PERIOD.)	_____	_____
4.			INITIAL PLATFORM HOUSEKEEPING		
			FINE ROLL	_____	_____
			FINE ELEVATION	_____	_____
			COARSE ELEVATION	_____	_____

PLATFORM CHECK

<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
4	VPM	PLC	TRUE HEADING	—	—
			WEIGHT SHIFTER - ROLL	—	—
			WEIGHT SHIFTER - ELEVATION	—	—
			MAGNETIC HEADING	—	—
			HEADING VELOCITY	—	—
			DRIFT VELOCITY	—	—
			VERTICAL VELOCITY	—	—
			POINTING SYSTEM +28V MON.	—	—
			POINTING SYSTEM -28V MON.	—	—
			TELEMETRY A +28V MON.	—	—
			TELEMETRY B +28V MON.	—	—
			HOUSEKEEPING A +28V MON.	—	—
			HOUSEKEEPING B +28V MON.	—	—
			INTERFEROMETER +28V MON.	—	—
			INTERFEROMETER -28V MON.	—	—

PLATFORM CHECK

<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	VPM	PLC	RADIOMETER +28V MON.	—	—
			POINTING SYSTEM MODE 2	—	—
			POINTING SYSTEM MODE 1	—	—
			POINTING SYSTEM MODE 0	—	—
			AZIMUTH TORQUER 1	—	—
			ELEVATION TORQUER 1	—	—
			LOCKING MECHANISM 28V MON.	—	—
5.	VPM	PLC	LOWER LOCKING MECHANISM (TOTAL TIME 70 sec)	—	—
			LOCK MON HIGH-LOCK	—	—
			UNLOCK MON HIGH-UNLOCK	—	—
			DOR MON HIGH-UNLOCK	—	—
			CURRENT MON	—	—
			AFTER 10 SEC. TRANSMIT STANDBY TO	—	—
			PLATFORM	—	—
			CONFIRM RADAR ON	—	—

PLATFORM CHECK

<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
	VPM	PLC	NOTE: FINE ELEV _____ WGT SHIFT-ELEV _____ FINE ROLL _____ WGT SHIFT/ROLL _____	_____	_____
6.	VPM	PLC	INPUT ALTITUDE (102.3 K FT) AND LATITUDE	_____	_____
7.			TRANSMIT GROUND CONTROL TO RADAR AND INPUT $V_H = 0$, $V_D = 0$	_____	_____
8.			TRANSMIT STARE TO PLATFORM AND VERIFY ANGLE	_____	_____
			CHANGE OVER A 3 MINUTE PERIOD	_____	_____
9.			TRANSMIT STANDBY TO PLATFORM AND NOTE:		
			FINE ELEV _____ WGT SHIFT-ELEV _____		
			FINE ROLL _____ WGT SHIFT-ROLL _____		

PLATFORM CHECK

<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
10	VPM	PTV	OBTAIN CLEARANCE FROM INSTRUMENTATION AND THEN SLEW COARSE ELEVATION TO 75°	_____	_____
11.			TRANSMIT STANDBY TO PLATFORM AND NOTE: FINE ELEV _____ WGT SHIFT - ELEV _____ FINE ROLL _____ WGT SHIFT - ROLL _____ WHEN WGT SHIFTERS STABILIZE, SLEW COARSE ELEVATION TO -10°	_____	_____
12.			TRANSMIT STANDBY TO PLATFORM AND NOTE: FINE ELEV _____ WGT SHIFT - ELEV _____ FINE ROLL _____ WGT SHIFT - ROLL _____ WHEN WGT SHIFTER STABILIZE, SLEW COARSE ELEV TO 45°	_____	_____
13.				_____	_____
14.				_____	_____

PLATFORM

<u>ITEM</u>	<u>DIR OF</u>	<u>ACTION BY</u>	<u>OPERATION</u>	<u>DRESS</u>	<u>ACTUAL</u>
15.	VPM	PTV	TRANSMIT STANDBY TO PLATFORM AND NOTE: FINE ELEV _____ WGT SHIFT - ELEV _____ FINE ROLL _____ WGT SHIFT - ROLL _____ WHEN WGT SHIFTERS STABILIZE, SLEW PLATFORM + 30° IN AZIMUTH AND OBSERVE HEADING SLEW PLATFORM -30° IN AZIMUTH AND OBSERVE MAG HEADING INPUT RADAR HEADING VELOCITY, $V_H = 31.7$ KNOTS AND DRIFT VELOCITY, $V_D = 0$ KNOTS TRANSMIT STARE AND NOTE: INITIAL FINE ELEV _____ INITIAL FINE ROLL _____	_____	_____
16.		PTV		_____	_____
17.		PTV		_____	_____
18.		PTV		_____	_____

APPENDIX E

GYRO DRIFT ADJUSTMENT

The pointing system gyro drift rate errors were measured at Chico. The errors measured were typically 4 deg/hr/axis. It was concluded that these drift rates were significantly greater than these measured prior to field deployment and thus readjustment was required. The final drift rates after adjustment were:

Elevation Axis	1.4	Deg/hour
Roll Axis	.8	Deg/hour
Azimuth Axis	.8	Deg/hour

It should be noted that the elevation axis could not be reduced further because the drift adjustment potentiometer for that axis was at the limit of its adjustment range. The gyro drift compensation procedure is detailed below

1. Mount one He-Ne laser on pointing platform roll axis and one on the elevation axis.
2. Disconnect the input connector to the azimuth amplifiers.
3. Align the payload elevation axis to the true north heading vector so as to eliminate the earth's rate errors.
4. Project the laser beam onto a screen set a minimum of 20 feet from the payload. This will provide a beam deflection of .070 in/arc min. Thus a 1 arc sec/sec gyro drift error will result in .210 inches of laser beam deflection over a time period of three minutes.
5. Center the laser beam on the screen and put the pointing system into the STARE mode. Place the doppler radar into the GND mode and input velocities $VH = 0.00$ knots and $VD = 0.00$ knots.
6. Measure the integrated drift over a three minute stare period. If the measured drift is greater than the specified value (typically 1 arc sec/sec), then input the velocity value of VD which minimizes the observed drift. When the drift is within the specified limits,

- measure the voltage at Test Point-4 (TP-4) on board A8 using a DVM.
7. Input VD = 0.00 knots and again measure the TP-4 voltage. Adjust potentiometer R41 to set the TP-4 voltage equal to that measured in Step 4.
 8. Again measure the laser beam deflection over a three minute STARE mode period to confirm that the gyro drift is within specification.
 9. Repeat Steps 3 through 8 for the platform roll axis and VH respectively.
 10. Reconnect the azimuth amplifier input connector and slew the platform elevation to the maximum elevation angle.
 11. Align the elevation axis along the north vector. For this axis the potentiometer adjustment must be used to directly null the azimuth axis drift observed. Inputting velocities to compensate for gyro drift is not feasible because of the cross-coupling between axis.

APPENDIX F

**BAMM PAYLOAD
COMMAND SYSTEM**



**AIR FORCE GEOPHYSICS LABORATORY
AEROSPACE INSTRUMENTATION DIVISION
BEDFORD, MASS.**

**Alan R. Griffin
Floyd H. Cook**

25 Feb 82

**Electronics Engineer
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1.

A BRIEF DESCRIPTION OF THE BMM PAYLOAD COMMAND SYSTEM

The BMM Command System is designed to control the scientific instruments and other elements of the payload such as the TV camera and the platform from the ground control station. The commands are originated on the ground at various control panels, encoded, uplinked to the balloon payload via a RF link, decoded, and sent to the appropriate instrument or device.

The Command System is a multiple-user single service system. That is, each control panel has a pair of push buttons labeled "SELECT and "DESELECT". The Command System is normally in the deselect mode. If a user presses the "SELECT" button, he is connected and all other user panels are locked out until that user presses his "DESELECT" button, and then the system is available to another user.

The system provides two modes of transmitting commands. If the button marked "XMIT" is pressed, a single command is transmitted containing the states of the control switches on that panel. This is used where the issue of a single command would be appropriate, such as to turn a payload transmitter on or off. (When this is accomplished by a single command, it establishes confidence in the performance of the system). If the button marked "XMIT CONT" is pressed, continuous commands at the rate of about 10 commands a second are issued each containing the states of the panel control switches at that time. This is used where it is appropriate to sample switch states, for instance, to zoom the TV camera in or out.

There are separate control panels for each instrument and major component. This includes the Radiometer, the Interferometer, the Data Encoder, the Payload Transmitters, the TV camera, and the Platform. The various Command panels are custom designed for each user and his experiment. This makes each panel easy to use and minimizes the chance of a mistake. The control panels each contain their own unique identification code, which is transmitted with each command. A panel issues the 4 bit ID code and 12 parallel bits of control in each command. All panels are connected to a central command encoder over identical connecting cables and may be plugged into any of the input connectors on the command encoder.

The command encoder changes the command bits from a user form of 16 parallel bits into a serial bit stream of 32 bits including redundant parity bits, plus an ending pulse. The encoder also changes the bits into a self synchronizing modulation form utilizing a 1/3, 2/3, 3/3 coding. A bit cell is 3 milliseconds long. If the cell is a high signal for 1 millisecond and low for 2, it is considered a binary zero. If it is high for 2 milliseconds and low for 1 it is considered a binary one. If it is high for the full 3 milliseconds, it is considered the ending pulse for one transmitted command.

The modulation is sent to the uplink transmitter and transmitted to the receiver on the balloon payload. The receiver output is sent to the payload command decoder. There the command is checked for parity, and is rejected if all parity bits are not correct. A valid command is then entered into 16 latch flipflops where it is stored until replaced by another valid command. The outputs of these latches are entered into the PCM data downlinks where they may be examined during data reduction.

The 16 command bits are defined and used as follows. 4 of the bits are used as an address code and are wired into each ground station control panel as its unique ID code. At the payload, each ending pulse for a valid command enters the 16 bits into latches. 4 of the bits are decoded into 1 of 16 possible addresses to determine where the remaining 12 command bits will be sent. Any command bit which is a binary one will be sent to the specified address as a pulse lasting 50 milliseconds. A continuous train of commands issuing consecutive binary ones will be sent to a receiving destination as 50% duty cycle pulses. All payload commands have been isolated with optical isolators to prevent possible ground loop interference through the Payload Command Decoder.

2.

PAYLOAD COMMAND LINK SPECIFICATIONS

Frequency	423.6 MHz
Deviation	+/- 125 KHz
Modulation Frequency	330 Baud
Power out	10 Watts
Antenna	Multiple-turn Helical (approx. 10 db gain)
Transmitter Type	3dbm, Inc. Mod. No. FMD-10W
Receiver	Loral Data Systems Mod. No CCR-210

3.

COMMAND FORMAT

Bit Number															
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
(-ADDRESS-)				-----CONTROL-----											
OR DATA															

INTERFEROMETER CONTROL

	BIT NO.	ASSIGNMENT
ADDRESS CODE 1	16	0
	15	0
	14	0
	13	1
CONTROL OR DATA FUNCTION	12	OPTICAL MODE (ATMOSPHERE)
	11	OPTICAL MODE (CALIBRATE)
	10	CALIBRATE HOT
	9	CALIBRATE COLD
	8	SCAN RATE 1
	7	SCAN RATE 2
	6	SCAN RATE 3 } SPARE
	5	SCAN RATE 4 }
	4	AMP POWER ON
	3	AMP POWER OFF
	2	AMP FILTER 16 KHZ
	1	AMP FILTER 4 KHZ

INTERFEROMETER ALIGN

	BIT NO.	ASSIGNMENT
ADDRESS CODE 2	16	0
	15	0
	14	1
	13	0
CONTROL OR DATA FUNCTION	12	ALIGN 01A START
	11	ALIGN 01A STOP
	10	ALIGN 01B START
	9	ALIGN 01B STOP
	8	ALIGN 02A START
	7	ALIGN 02A STOP
	6	ALIGN 02B START
	5	ALIGN 02B STOP
	4	ALIGN 03A START
	3	ALIGN 03A STOP
	2	ALIGN 03B START
	1	ALIGN 03B STOP

INTERFEROMETER CONTROL

	BIT NO.	ASSIGNMENT
ADDRESS CODE 3	16	0
	15	0
	14	1
	13	1
CONTROL OR DATA FUNCTION	12	MAIN POWER ON
	11	MAIN POWER OFF
	10	W. L. & REF. POWER ON
	9	W. L. & REF. POWER OFF
	8	HEATER TEMP. 1
	7	HEATER TEMP. 2
	6	} NOT USED
	5	
	4	
	3	
	2	
	1	

RADIOMETER CONTROL

	BIT NO.	ASSIGNMENT
ADDRESS CODE 4	16	0
	15	1
	14	0
	13	0
CONTROL OR DATA FUNCTION	12	LOG - RESET ON-OFF
	11	BOARD POWER ON-OFF (AMPLIFIER)
	10	SHUTTER HEATER ON-OFF
	9	FILTER MOTOR ENABLE ON-OFF
	8	BOX HEATER ON-OFF
	7	SIGNAL CONDITIONING ELECTRONICS (SCE) ON-OFF
	6	FUNCTION CONTROL ELECTRONICS (FCE) ON-OFF
	5	CHOPPER MOTOR ON-OFF
	4	SHUTTER OPEN - CLOSE
	3	FILTER POSITION #3
	2	FILTER POSITION #2
	1	FILTER POSITION #1

DATA ENCODER & RF LINK CONTROL

	BIT NO.	ASSIGNMENT
ADDRESS CODE 6	16	0
	15	1
	14	1
	13	0
CONTROL OR DATA FUNCTION	12	PCM LINK #1 ON
	11	PCM LINK #1 OFF
	10	PCM LINK #2 ON
	9	PCM LINK #2 OFF
	8	HOUSEKEEPING LINK ON
	7	HOUSEKEEPING LINK OFF
	6	NOT USED
	5	PCM ENCODER SCAN RATE: 1=HIGH, 0=LOW
	4	PCM ENCODER GAIN CONTROL MODE: 1=AUTO, 0=MANUAL
	3	PCM ENCODER MANUAL GAIN SELECT 64X 00 16X 10
	2	PCM ENCODER MANUAL GAIN SELECT 4X 01 1X 11
	1	NOT USED

TV CAMERA CONTROL

	BIT NO.	ASSIGNMENT
ADDRESS CODE 7	16	0
	15	1
	14	1
	13	1
CONTROL OR DATA FUNCTION	12	TV TRANSMITTER ON
	11	TV TRANSMITTER OFF
	10	NOT USED
	9	NOT USED
	8	TV CAMERA ZOOM IN
	7	TV CAMERA ZOOM OUT
	6	TV CAMERA FOCUS FAR
	5	TV CAMERA FOCUS NEAR
	4	TV CAMERA IRIS OPEN
	3	TV CAMERA IRIS CLOSE
	2	NOT USED
	1	NOT USED

PLATFORM DOPPLER RADAR

	BIT NO.	ASSIGNMENT
ADDRESS CODE 8	16	1
	15	0
	14	0
	13	0
CONTROL OR DATA FUNCTION	12	SEL EXTERNAL 011010
		SEL RADAR 010000
	11	VH 11 + HEADING DATA
		VD 10 + DRIFT DATA
	10	SIGN
	9	MSB
	8	↑ ↓
	7	
	6	
	5	
	4	↑ ↓
	3	
	2	
	1	
		LSB
		VH DATA 0.0622 KNOTS/LSB VD DATA 0.119 KNOTS/LSB 10 BIT OFFSET BINARY

PLATFORM DATA

	BIT NO.	ASSIGNMENT
ADDRESS CODE 9	16	1
	15	0
	14	0
	13	1
CONTROL OR DATA FUNCTION	12	} MAGNETIC VARIATION
	11	
	10	
	9	
	8	
	7	
	6	
	5	
	4	
	3	} 2'S COMPLEMENT
	2	
	1	
		NOT USED

PLATFORM DATA

	BIT NO.	ASSIGNMENT
ADDRESS CODE 10	16	1
	15	0
	14	1
	13	0
CONTROL OR DATA FUNCTION	12	ALTITUDE
	11	
	10	
	9	
	8	
	7	
	6	
	5	
	4	
	3	
	2	NOT USED
	1	

0=>0

1=>1

CODE NATURAL

BINARY

PLATFORM DATA

	BIT NO.	ASSIGNMENT
ADDRESS CODE 11	16	1
	15	0
	14	1
	13	1
CONTROL OR DATA FUNCTION	12	LATITUDE 0=>0 1=>1 2's COMPLEMENT
	11	
	10	
	9	
	8	
	7	
	6	
	5	
	4	
	3	
	2	NOT USED
	1	

PLATFORM CONTROL

	BIT NO.	ASSIGNMENT
ADDRESS CODE 14	16	1
	15	1
	14	0
	13	0
CONTROL OR DATA FUNCTION	12	NOT USED
	11	STANDBY = 00
	10	CAGE = 10
	9	STORE = 01 DITHER = 11
	8	
	7	
	6	NOT USED
	5	
	4	
	3	
	2	
	1	

PLATFORM CONTROL

	BIT NO.	ASSIGNMENT
ADDRESS CODE 15	16	1
	15	1
	14	1
	13	1
CONTROL OR DATA FUNCTION	12	SELECT
	11	HIGH
	10	MEDIUM
	9	LOW
	8	DIRECTION
	7	SELECT
	6	HIGH
	5	MEDIUM
	4	LOW
	3	DIRECTION
	2	NOT USED
	1	

APPENDIX G

TECHNICAL DATA

FOR

BAMM II TELEMETRY SYSTEMS

AIR FORCE GEOPHYSICS LABORATORY
AEROSPACE INSTRUMENTATION DIVISION

BEDFORD, MA

The telemetry system for the Balloon Altitude Mosaic Measurements Program (BAMM) consists of five (5) 'S' Band Frequency down links (2200-2300 MHz) of FM signals.

- (1) Link 1 is devoted to television signals
- (2) Link 2 and 3 are for Pulse Code Modulation (PCM) data
- (3) Link 4 is the main housekeeping link plus several channels of Radiometer and Interferometer data.
- (4) Link 5 is devoted to balloon command verification and balloon housekeeping data.

There are three (3) uplink signals being transmitted to the instrumented payload. They are:

- (1) Ranging Signal - 430 MHz
- (2) Instrument Command - 423.6 MHz
- (3) Balloon Command - 437.5 MHz.

The BMM PCM encoder is designed to convert the analog data from an interferometer and a radiometer, multiplex these data together with digital housekeeping data, and channel identification codes into two constant rate serial bit streams.

It is required to sample the analog output of sixteen infrared sensors during each interferometer scan. Each sensor is monitored by four amplifiers with gains of 1, 4, 16, and 64 respectively. The output from the highest gain amplifier which is not approaching saturation is automatically selected to be converted to digital (12 bit binary) data. Since the interferometer scan varies some in sweep rate, this data is stored in a 1024 word memory buffer together with a two bit binary identification of the selected amplifier for transmission at a steady bit rate. Each time the memory buffer is emptied during a scan, these words in the bit stream are filled with "zeros" for eight frames before returning to data. These words are also filled with "zeros" during the dead time between sweeps.

The sixteen interferometer words are divided between two RF links for transmission in order to provide the frequency response required and not to exceed the bit rate capability of available ground station equipment.

A provision is also made to override the automatic gain selection with a command selection of any of the four available amplifier gains. Two of the eight interferometer sensors accommodated on each link may be selected by command to be supercommutated at four times the normal scan rate.

The radiometer data together with some housekeeping data is multiplexed into a 64 subframe subcommutator. This information together with an identification word is duplicated in two words of each RF link. For greater detail on the BMM encoder see Technical Report No. 1, Design of a PCM Telemetry Encoder for Balloon Altitude Mosaic Measurements by Claude M. Gwinn, dated 1 April 1978.

Link 1 - Television Data Transmission

Frequency - 2215.5 MHz FM

Deviation - MHz

Modulation Frequency - 4 MHz

Power Output - 10 watts min.

Antenna Type - NU ground plane

Transmitter - AACOM AT-1410S-V SH

Power Input 28VDC _____ AMPS _____ Watts

Link 2 - PCM Data Transmission (Section A)

Frequency - 2251.5 MHz

Deviation - 550 KHz

Modulation Frequency - 672 KHz (See Note 1)

Power Output - 5 watts min.

Antenna Type - NU ground plane

Transmitter - Vector T-105S SH

Power Input 28 VDC 2.2 Amps _____ Watts

Link 3 - PCM Data Transmission (Section B)

Frequency - 2279.5 MHz

Deviation - 550 KHz

Modulation Frequency - 672 KHz

Power Output - 10 watts min

Antenna Type - NU ground plane

Transmitter - Vector T-105S SH

Power Input - 28 VDC 2.2 Amps _____ Watts

Link 4 - Housekeeping Transmission

Frequency - 2241.5 MHz

Deviation - KHz

Modulation Frequency IR16 CH 2 thru 21 KHz

Power Output - 5 watts min.

Antenna Type - NU ground plane

Transmitter

Power Input - 28 VDC 2.1 Amps _____ Watts

PCM ENCODER

ENCODER TECHNICAL DATA

SYNC PATTERN: SECTION A 111 001 101 000 00
 SECTION B 111 011 001 010 00

CODE FORMAT: NRZ-S

BIT RATE: 1.34 MBS

BITS/WORD: 14

WORDS/MINOR FRAME: 11 (EACH SECTION)

WORDS/MAJOR FRAME: 704 (EACH SECTION)

SUBFRAME LENGTH: 64

SUBFRAME LOCATION: MINOR FRAME WORD 3

SUBFRAME SYNC PATTERN: SFID OR FRAME COUNTER LOCATED IN 1ST 6 BITS OF
 MINOR FRAME WORD 2

FLAG BITS MINOR FRAME WORD(S) 2:

- BIT 7 - Scan Direction (DIR)
- BIT 8 - White Light Position (WLT)
- BIT 9 - Buffer Overflow (BVF)
- BIT 10 - ADC Sample Time Error (STE)
- BIT 11 - Turn Around Time - Up-to-Speed (TAT)
- BIT 12 - 8 or 2 Detectors (NOD)
- BIT 13 - Automatic or Command Gain (ACG)
- BIT 14 - Data or Filled Bits (DAT)

DATA FORMAT

SECTION A

WORD	1	Sync Pattern 111 001 101 000 00	
	2	Frame Counter +8 Flag Bits	
	3	Subframe	
	4	Interferometer Detector	6 or 6 (Super Comm)
	5	Interferometer Detector	7 or 7
	6	Interferometer Detector	8 or 6
	7	Interferometer Detector	1 or 7
	8	Interferometer Detector	2 or 6
	9	Interferometer Detector	3 or 7
	10	Interferometer Detector	4 or 6
	11	Interferometer Detector	5 or 7

SECTION B

WORD	1	Sync Pattern 111 011 001 010 00
	2	Frame Counter +8 Flag Bits
	3	Subframe
	4	Interferometer Detector 10 or 10 (Super Comm)
	5	Interferometer Detector 11 or 11
	6	Interferometer Detector 12 or 10
	7	Interferometer Detector 13 or 11
	8	Interferometer Detector 14 or 10
	9	Interferometer Detector 15 or 11
	10	Interferometer Detector 16 or 10
	11	Interferometer Detector 9 or 11

SUBFRAME DATA FORMAT SECTION A & SECTION B

WORD	1	Radiometer Low G	17	Radiometer Med G	33	Radiometer Hi G
	2	Radiometer Low G	18	Radiometer Med G	34	Radiometer Hi G
	3	Radiometer Low G	19	Radiometer Med G	35	Radiometer Hi G
	4	Radiometer Low G	20	Radiometer Med G	36	Radiometer Hi G
	5	Radiometer Low G	21	Radiometer Med G	37	Radiometer Hi G
	6	Radiometer Low G	22	Radiometer Med G	38	Radiometer Hi G
	7	Radiometer Low G	23	Radiometer Med G	39	Radiometer Hi G
	8	Radiometer Low G	24	Radiometer Med G	40	Radiometer Hi G
	9	Radiometer Low G	25	Radiometer Med G	41	Radiometer Hi G
	10	Radiometer Low G	26	Radiometer Med G	42	Radiometer Hi G
	11	Radiometer Low G	27	Radiometer Med G	43	Radiometer Hi G
	12	Radiometer Low G	28	Radiometer Med G	44	Radiometer Hi G
	13	Radiometer Low G	29	Radiometer Med G	45	Radiometer Hi G
	14	Radiometer Low G	30	Radiometer Med G	46	Radiometer Hi G
	15	Radiometer Low G	31	Radiometer Med G	47	Radiometer Hi G
	16	Radiometer Low G	32	Radiometer Med G	48	Radiometer Hi G
	49	Doppler VHM				
	50	Doppler VDM				
	51	Doppler VZM				
	52	P/S Mag Heading				
	53	Spare				
	54	Spare				
	55	Spare				
	56	Spare				
	57	Coarse Elev. Angle (10 bits)				
	58	Fine Roll Angle (bits)				
	59	Fine Elevation Angle (10 bits)				
	60	True Heading (10 bits)				

WORD 61

BITS	
1	Spare
2	Spare
3	Spare
4	Spare
5	Spare
6	Spare
7	Spare
8	Spare
9	Doppler Reliable
10	Doppler Mode
11	All Track
12	2 Beam
13	T1
14	T2

WORD 63

BITS	
1	V-16 Address Bit 1
2	V-15 Address Bit 2
3	V-14 Address Bit 3
4	V-13 Address Bit 4
5	V-12 Command Bit 12
6	V-11 Command Bit 11
7	V-10 Command Bit 10
8	V-9 Command Bit 9
9	V-8 Command Bit 8
10	V-7 Command Bit 7
11	V-6 Command Bit 6
12	V-5 Command Bit 5
13	V-4 Command Bit 4
14	V-3 Command Bit 3

WORD 62

BITS	
1	T3
2	T4
3	P/S Mode 0
4	P/S Mode 1
5	P/S Mode 2
6	Spare
7	"
8	"
9	"
10	"
11	"
12	"
13	"
14	"

WORD 64

BITS	
1	V-2 Command Bit 2
2	V-1 Command Bit 1
3	Select 1
4	Select 2
5	MS-52
6	Spare
7	"
8	"
9	"
10	"
11	"
12	"
13	"
14	"

FORMAT SECTION B WORDS ARE IDENTICAL TO SECTION A

NOTE: The encoder has been designed with a command controllable super commutation feature. Upon command, two detector (627) on Section A and two detectors 10, and 11 on Section B will be super commutated at 4 times normal rate.

PROJECT BMM
COMMUTATOR ASSIGNMENTS
HOUSEKEEPING COMMUTATOR A

<u>CHANNEL NO. TEMP SENSOR NO.</u>	<u>DATA ASSIGNMENT</u>	<u>SIGNAL VDC</u>
1	Platform temp mon No. 13	0-5
2	Platform temp mon No. 14	0-5
3	Platform temp mon No. 15	0-5
4	Platform temp mon No. 16	0-5
5	Platform temp mon No. 17	0-5
6	Platform temp mon No. 18	0-5
7	Platform temp mon No. 19	0-5
8	Platform temp mon No. 20	0-5
9	Lock mech mon 28 Volt	0-5
10	Lock Mon	0-5
11	Unlock Monitor	0-5
12	DOR Monitor	0-5
13	LM Current Monitor	0-5
14	Spare	0-5
15	Spare	0-5
16	Spare	0-5
17	Spare	0-5
18	Interferometer temp mon No. 1	0-5
19	Interferometer temp mon No. 2	0-5
20	Spare	0-5
21	Spare	0-5
22	Radiometer temp mon 4 - Baffle	0-5
23	Radiometer temp mon 3 - Cold Finger	0-5
24	Radiometer temp mon 2 - Motor	0-5
25	Radiometer temp mon 1 - Detector	0-5
26	0 VDC	
27	5 VDC	
28	5 VDC SYNC PATTERN	
29	5 VDC	
30	2.5 VDC	

PROJECT BMM
COMMUTATOR ASSIGNMENTS
HOUSEKEEPING COMMUTATOR B

<u>CHANNEL NO.</u>	<u>DATA ASSIGNMENT</u>	<u>SIGNAL VDC</u>
2	Gyro Roll/Elev. Temp Monitor	0-5
3	Gyro AZ Temp Monitor	0-5
4	Gimbal Temp Monitor	0-5
5	Spare	0-5
6	Spare	0-5
7	Spare	0-5
8	Spare	0-5
9	Doppler Temp Monitor #2	0-5
10	Spare	0-5
11	Doppler Status Bit	0-5
12	Spare	0-5
13	Weight Shifter Pos. Left-Right	0-5
14	Weight Shifter Pos. Fore-Aft	0-5
15	Spare	0-5
16	Spare	0-5
17	Elev. Torque Motor Current	0-5
18	Roll Torque Motor Current	0-5
19	Azimuth Torque Motor Current	0-5
20	Spare	0-5
21	Spare	0-5
22	Spare	0-5
23	Pointing System + 28 volt mon	0-5
24	Pointing System - 28 volt mon	0-5
25		
26	0 VDC	
27	5 VDC	
28	5 VDC SYNC PATTERN	
29	5 VDC	
30	2.5 VDC	

PROJECT BMM
COMMUTATOR ASSIGNMENTS
HOUSEKEEPING COMMUTATOR C

<u>CHANNEL NO.</u>	<u>TEMP SENSOR #</u>	<u>DATA ASSIGNMENT</u>	<u>SIGNAL VDC</u>
1		TM Battery No. 1 Volt Monitor	0-5
2		TM Battery No. 2 Volt Monitor	0-5
3	1	TM Batteries Temp Mon	0-5
4	2	Link 1 Trans Temp Monitor	0-5
5	3	Link 2 Trans Temp Monitor	0-5
6	4	Link 3 Trans Temp Monitor	0-5
7	5	Link 4 Trans Temp Monitor	0-5
8	6	Pointing Sys Elect Temp Mon	0-5
9		Spare	0-5
10		Housekeeping Battery No. 1 Volt Monitor	0-5
11		Housekeeping Battery No. 2 Volt Monitor	0-5
12	7	Housekeeping Batteries Temp Mon	0-5
13	8	Power Monitor Box Temp Mon	0-5
14	9	AZ Amplifier Temp Mon	0-5
15		Spare	0-5
16		TV Camera Temp Monitor	0-5
17		TV Camera Pressure Monitor	0-5
18		Spare	0-5
19		Interferometer Battery Volt Mon (+28V)	0-5
20		Spare	0-5
21	12	Command Receiver Temp Mon	0-5
22	11	Radiometer Battery Temp Mon	0-5
23	10	Interferometer Battery Temp Mon	0-5
24		Radiometer Battery Voltage Mon (+28V)	0-5
25		Interferometer Battery Voltage Mon (-28V)	0-5
26		0 VDC	
27		5 VDC	
28		5 VDC SYNC PATTERN	
29		5 VDC	
30		2.5 VDC	

HOUSEKEEPING CHANNEL ASSIGNMENTS

<u>CH.</u>	<u>SCD</u>	<u>BW</u>	<u>INPUT</u>		<u>FIL</u>	<u>FUNCTION</u>	<u>LOCATION</u>	
1	0.400	4	0	+5	6	Radiometer Fil Pos.	Deck A	J-14
2	0.560	4	0	+5	8	Accelerometer	Deck B	J-11
3	0.750	4	0	+5	11	Accelerometer	Deck B	J-12
4	.960	4	0	+5	14	Accelerometer	Deck B	J-10
5	1.300	4	0	+5	25	Rang Rec'r Sig. Str	Deck B	J-4
6	1.700	4	0	+5	25	Radiometer Fil Pos	Deck A	J-14
7	2.300	4	0	+5	35	Radiometer 1A (Med)	Deck A	J-9
8	3.000	4	0	+5	45	Radiometer 1B (Med)	Deck A	J-8
9	3.900	4	0	+5	59	Radiometer 2A (Hi)	Deck A	J-7
10	5.400	4	0	+5	81	Radiometer 2B (Hi)	Deck A	J-6
11	7.350	5	0	+5	110	Instrument Com. Ver	Deck B	J-7
12	10.50	7	0	+5	220	PAM Comm. A	Deck A	J-12
13	14.50	10	0	+5	790	Radiometer Chopper	Deck A	J-10
14	22.00	15	0	+5	330	PAM Comm. B	Deck B	J-6
15	30.00	21	0	+5	450	PAM Comm. C.	Deck B	J-5
16	40.00	28	-2.5	+2.5	600	Spare	Deck B	J-9
17	52.50	37	-2.5	+2.5	4000	Inter Det 10	Deck A	J-5
18	70.00	50	-2.5	+2.5	1000	Ranging Rec. Video	Deck B	J-3
19	93.00	65	-5	+5	10000	White Light Ref.	Deck A	J-2
20	124.0	87	-2.5	+2.5	10000	Inter. Det. 7	Deck A	J-4
21	165.0	115	-2.5	+2.5	12000	Inter. Monocrom. Ref	Deck A	J-3

12	X	2.5	30	2.5	25	VCO deck A is modified Vector H-19UA
14	X	2.5	30	2.5	25	VCO Deck B is modified Sony Tex 405 ()
15	X	2.5	30	2.5	25	

BALLOON CONTROL

TECH DATA

PCM-2 PACKAGE

FLIGHT NO. _____

DATE April 82

PROJECT BAMM

PRIMARY PACKAGE

PACKAGE SERIAL NO.----- 004
 SIG CONDITIONING UNIT----- 002
 PCM-2 TIMER----- 005
 CONTROL UNIT----- 004
 COMMAND DECODER----- 009
 UHF RECEIVER----- 104
 BURST/IMPACT UNIT----- 030
 ACCELEROMETER UNIT----- 005
 RECOVERY BEACON----- 200B190
 PCM ENCODER----- 1063
 S BAND TRANSMITTER----- 4021275
 CIC TRANSDUCER NO. 1----- 0-15 02401-3
 CIC TRANSDUCER NO. 2----- 0-2 02397-43
 CIC TRANSDUCER NO. 3----- 0-.5 50629-3

BACK-UP PACKAGE

PACKAGE SERIAL NO.----- 005
 CONTROL UNIT----- 004
 BACK-UP TIMER----- 015
 COMMAND DECODER----- 022
 UHF RECEIVER----- 137
 S BAND TRANSMITTER----- (External) 109

G.C.

BALLOON CONTROL

TECH DATA

LINK 1--- Balloon Control PCM Data Transmission (primary)

FREQUENCY--- 2258.5 Mhz F.M.

DEVIATION--- 89.6Khz

POWER OUTPUT--- 2 Watts Min.

ANTENNA TYPE--- Quarter Wave Monopole

TRANSMITTER--- CONIC CTS-402 S/N 4021275

LINK 2--- Balloon Control PCM Data Transmission (back-up)

FREQUENCY--- 2233.5 Mhz F.M.

DEVIATION--- 89.6Khz

POWER OUYPUT--- 5 Watts Min.

ANTENNA TYPE--- Quarter Wave Monopole

TRANSMITTER--- CONIC CTS-705 S/N 109

LINK 3--- Balloon Control Command Transmission (primary)

FREQUENCY--- 437.5 Mhz

DEVIATION--- 30 Khz Peak (each channel)

ANTENNA TYPE--- Quarter Wave Monopole

RECEIVER--- CONIC CCR-210-3 S/N 104

LINK 4--- Balloon Control Command Transmission (back-up)

FREQUENCY--- 437.5 Mhz

DEVIATION--- 30 Khz Peak (each channel)

ANTENNA TYPE--- Quarter Wave Monopole

RECEIVER--- CONIC CCR-210-3 S/N 137

G.C.

PCM-2 UHF COMMANDS

LINK NO. #3 (PRIMARY)

PROJECT BAMM

FREQUENCY 437.5 MHz

FLIGHT NO. _____

COMMAND	FUNCTION
1	TM 1 ON
2	TM 1 OFF
3	ADD TIME
4	BURST SWITCH ARM
5	BURST SWITCH DISARM
6	IMPACT SWITCH ARM
7	IMPACT SWITCH DISARM
8	BLOW BALLAST
9	LOCK PLATFORM--VISIDYNE
10	UNLOCK PLATFORM--VISIDYNE
11	TM 2 ON
12	TM 2 OFF
13	ARM LOWER PAYLOAD RELEASE
14	DISARM LOWER PAYLOAD RELEASE
15	RELEASE LOWER PAYLOAD (PACK-UP)
16	RELEASE LOWER PAYLOAD
17	LATCH GAS VALVE OPEN
18	POUR FINE BALLAST
19	OPEN GAS VALVE (FAILSAFE) UNLATCH GAS VALVE
20	FLIGHT TERMINATION
21	FLIGHT TERMINATION

G.C.

1 OF 1

DATE APRIL 82

PCM-2 UHF COMMANDS

LINK NO. #0 (BACK-UP)

PROJECT BAMM

FREQUENCY 437.5 MHz

FLIGHT NO. _____

COMMAND	FUNCTION
1	
2	
3	
4	
5	
6	
7	
8	
9	LOCK PLATFORM -- VISIDYNE
10	UNLOCK PLATFORM -- VISIDYNE
11	
12	
13	ARM LOWER PAYLOAD RELEASE
14	DISARM LOWER PAYLOAD RELEASE
15	RELEASE LOWER PAYLOAD
16	RELEASE LOWER PAYLOAD (PRIMARY)
17	LATCH GAS VALVE OPEN
18	POUR FINE BALLAST
19	OPEN GAS VALVE (FAILSAFE) UNLATCH GAS VALVE
20	FLIGHT TERMINATION
21	FLIGHT TERMINATION

G.C.

1 OF 1

DATE APRIL 82

PCM ENCODER

SYNC PATTERN----- 11111101011 1100110010

CODE FORMAT----- NRZ-L

BIT RATE----- 128K Bits Per Sec.

BITS PER WORD---- 10

FRAME RATE----- 474.07 FPS

WORDS PER FRAME--- 25 (data)

MANUFACTURE----- CONIC Data Systems

MODEL----- PCM-410-2

PART NUMBER----- 19033162-1

SERIAL NUMBER----- 1063

DIGITAL WORD-

32 16 8 4 2 1 | 1 1 1 1 3 2 1

OPEN (O)

(1) 35073

SW. NO. →

OPEN (O)

(1) 3507

SW. NO. 1 →

BITS/WORD

EVEN PARITY -

BIT RATE

၆၂

**AIR FORCE GEOPHYSICS LABORATORY
BALLOON INSTRUMENTATION BRANCH
HANSCOM AFB MASSACHUSETTS**

^EPCM 410-2 PROGRAM SWS.

DRAWING NO. 1-7

DATE 4 Dec 80	CK'D. BY
---------------	----------

BIT RATE		128K
WORDS/FRAME		25 (data)
BITS/WORD		10
FRAME RATE		474.07 FPS
PARITY		None
NO. OF DIGITAL WORDS		3
OUTPUT		NRZ-L

AD-A124 292

BAMM II FLIGHT 30 APRIL 1982 ENGINEERING EVALUATION
REPORT(U) VISIDYNE INC BURLINGTON MA R W BROOKE ET AL.
01 JUL 82 VI-644 AFGL-TR-82-0189 F19628-82-C-0043

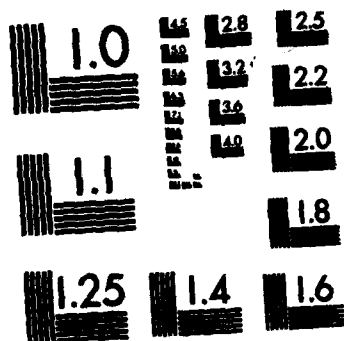
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UNCLASSIFIED

F/G 1/3

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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

PCM TELEMETRY DATA

MAIN FRAME

LINK NO. 1 & 2

PIT RATE 128K BIT

FREQ. 2233.5 MHz & 2258.5 MHz

BITS/WORD 10 BITS

RF POWER 2 & 5 WATTS

WORDS/FRAME 25 (DATA)

WORD NO	FUNCTION
001	DIGITAL WORD 1
002	DIGITAL WORD 2
003	DIGITAL WORD 3
004	
005	EXTERNAL TRANSMITTER TEMPERATURE
006	UPPER GONDOLA TEMPERATURE
007	PRIMARY RECEIVER SIGNAL STRENGTH
008	0-15 PSIA ALTITUDE TRANSDUCER
009	0-2. PSIA ALTITUDE TRANSDUCER
010	0-.5 PSIA ALTITUDE TRANSDUCER
011	PRIMARY 30 VOLT BATTERY MONITOR
012	PRIMARY 12 VOLT BATTERY MONITOR
013	ACCELEROMETER -Z- AXIS $\pm 7.5g$
014	ACCELEROMETER -Z- AXIS $\pm 2.5g$
015	ACCELEROMETER -Y- AXIS $\pm 2.5g$
016	ACCELEROMETER -X- AXIS $\pm 2.5g$
017	10K LOAD CELL
018	BACK-UP PACKAGE RECEIVER SIGNAL STRENGTH
019	BACK-UP 30 VOLT BATTERY MONITOR
020	BACK-UP PACKAGE TEMPERATURE
021	BATTERY TEMPERATURE
022	PRIMARY PACKAGE TEMPERATURE

G.C..

PAGE OF

DATE

PROJECT

PCM TELEMETRY DATA

MAIN FRAME

LINK NO. 1 & 2

PIT RATE 128K BIT

FREQ. 2233.5 MHz & 2258.5 MHz

BITS/WORD 10 BITS

RF POWER 2 & 5 WATTS

WORDS/FRAME 25 (DATA)

WORD NO	FUNCTION
023	INTERNAL TRANSMITTER TEMPERATURE
024	PCM ENCODER TEMPERATURE
025	SIGNAL CONDITIONING UNIT TEMPERATURE
G.C. .	
PAGE ____ OF ____ DATE _____ PROJECT _____	

PCM TELEMETRY DATA

DIGITAL BIT INPUTS

LINK NO. 1 & 2PIT RATE 128K BITFREQ. 2233.5 MHz & 2258.5 MHzBITS/WORD 10 BITSRF POWER 2 & 5 WATTSWORDS/FRAME 25 (DATA)

WORD NO	BIT NO	FUNCTION
001	01	FLIGHT TIME REMAINING -TENS - 2^3
	02	" " " " 2^2
	03	" " " " 2^1
	04	" " " " 2^0
	05	" " " UNITS- 2^3
	06	" " " " 2^2
	07	" " " " 2^1
	08	" " " " 2^0
	09	PRIMARY TERMINATION
	10	BACK-UP TERMINATION
002	01	NOT USED
	02	" "
	03	" "
	04	" "
	05	" "
	06	" "
	07	" "
	08	" "
	09	" "
	10	" "
G.C. .		
PAGE <u>1</u> <u>2</u>		DATE <u>APRIL 82</u>
		SUBJECT <u>RAMM</u>

PCM TELEMETRY DATA

DIGITAL BIT INPUTS

LINK NO. 1 & 2PIT RATE 128K BITFREQ. 2233.5 MHz & 2258.5 MHzBITS/WORD 10 BITSRF POWER 2 & 5 WATTSWORDS/FRAME 25 (DATA)

WORD NO	BIT NO	FUNCTION
003	01	BALLAST HOPPER #1 POUR
	02	BALLAST HOPPER #2 POUR
	03	HELIUM VALVE #1 OPEN
	04	HELIUM VALVE #2 OPEN
	05	BURST SWITCH ARM / DISARM
	06	BURST PIN PULLED ABOVE 10K FEET
	07	BURST PIN PULLED BELOW 10K FEET
	08	IMPACT SWITCH ARM / DISARM
	09	COMMAND 15 ARM / DISARM
	10	COMMAND 16 ARM / DISARM
004	-----	NOT USED
G.C. .		
PAGE <u>2</u> <u>2</u>		DATE <u>APRIL 82</u>
		PROJECT <u>BAMM</u>

PALLOON CONTROL

TECH DATA

COMMAND RECEIVER CALIBRATION

MANUFACTURE. CONIC

SERIAL NO. 104

DATE. APRIL 82

FLIGHT NO. _____

FREQUENCY. 437.5 MHz (Primary)

Command 21 1.2uv

INPUT SIG.LEVEL	0-5VOLT OUTPUT	0-10VOLT OUTPUT	INPUT SIG.LEVEL	0-5VOLT OUTPUT	0-10VOLT OUTPUT
OPEN	.250	.500	200uv	3.764	7.528
.5uv	.560	1.120	300	3.768	7.536
1	1.130	2.260	600	3.768	7.536
1.5	1.589	3.178	1000	3.768	7.536
2	1.936	3.868	2000	3.768	7.536
2.5	2.233	4.466			
3	2.367	4.734			
4	2.561	5.122			
5	2.688	5.376			
6	2.775	5.550			
7	2.845	5.690			
8	2.899	5.798			
9	2.950	5.900			
10	2.994	5.988			
20	3.290	6.580			
40	3.562	7.124			
60	3.642	7.284			
100	3.724	7.448			

G.C.

PALLOON CONTROL

TECH DATA

COMMAND RECEIVER CALIBRATION

MANUFACTURE. CONIC

SERIAL NO. 137

DATE. APRIL 82

FLIGHT NO.

FREQUENCY. 437.5 MHz (Back-Up)

Command 21 1.1uv

INPUT SIG.LEVEL	0-5VOLT OUTPUT	0-10VOLT OUTPUT	INPUT SIG.LEVEL	0-5VOLT OUTPUT	0-10VOLT OUTPUT
OPEN	.445	.890	200uv	4.197	8.394
.5uv	.595	1.190	300	4.284	8.568
1	.889	1.778	600	4.383	8.766
1.5	1.219	2.438	1000	4.426	8.852
2	1.558	3.116	2000	4.426	8.852
2.5	1.876	3.752			
3	2.176	4.352			
4	2.438	4.876			
5	2.623	5.246			
6	2.746	5.492			
7	2.838	5.676			
8	2.916	5.832			
9	2.995	5.990			
10	3.070	6.140			
20	3.498	6.996			
40	3.875	7.750			
60	3.930	7.860			
100	4.076	8.152			G.C.

BALLOON CONTROL

TECH DATA

0-15 PSIA CIC ALTITUDE TRANSDUCER CALPRATIONSERIAL NO. 02401-3DATE. APRIL 82

FLIGHT NO. _____

PROJECT. BAMM

ALTITUDE (K FEET)	0-5 VOLT OUTPUT	0-10 VOLT OUTPUT
0	4.684	9.369
5k	3.932	7.864
10k	3.296	6.592
15k	2.748	5.496
20k	2.295	4.590
25k	1.906	3.813
30k	1.576	3.153
35k	1.310	2.621
40k	1.082	2.165
45k	.906	1.813
50k	.765	1.530
55k	.659	1.318
60k	.578	1.156
65k	.510	1.021

BALLOON CONTROL

TECH DATA

0-2 PSIA ALTITUDE TRANSDUCER CALPRATIONSERIAL NO. 02397-43DATE. APRIL 82

FLIGHT NO. _____

PROJECT NO. BAMM

ALTITUDE (K FEET)	0-5 VOLT OUTPUT	0-10 VOLT OUTPUT
45k	4.997	9.995
46k	4.888	9.776
48k	4.460	8.921
50k	4.081	8.163
55k	3.291	6.582
60k	2.674	5.348
65k	2.163	4.326
70k	1.760	3.521
75k	1.445	2.890
80k	1.198	2.397
85k	1.015	2.031
90k	.858	1.716
95k	.741	1.483
100k	.652	1.305
105k	.572	1.144

BALLOON CONTROL

TECH DATA

0-.5 PSIA CIC ALTITUDE TRANSDUCER CALBRATIONSERIAL NO. 50629-3DATE. APRIL 82

FLIGHT NO. _____

PROJECT. BAMM

ALTITUDE (K FEET)	0-5 VOLT OUTPUT	0-10 VOLT OUTPUT
75k	4.931	9.862
76k	4.680	9.361
78k	4.302	8.604
80k	3.946	7.892
85k	3.242	6.485
90k	2.623	5.247
95k	2.125	4.251
100k	1.758	3.517
105k	1.470	2.940
110k	1.254	2.509
115k	1.080	2.160
120k	.966	1.932
125k	.843	1.687
130k	.753	1.506
135k	.669	1.338

BALLOON CONTROL

TECH DATA

VT-20 TEMPERATURE SLIDOR

FUNCTION. Upper Gondola
TM 2 Transmitter

ENCODER WORD NO. 005
006

DATE. April 82

FLIGHT NUMBER.

INPUT VOLTAGE 3.000v

TEMP. C	0-5VOLT OUTPUT	0-10VOLT OUTPUT	TEMP. C	0-5VOLT OUTPUT	0-10VOLT OUTPUT
-50	.44	.88	25	2.24	4.48
-45	.56	1.12	30	2.36	4.72
-40	.68	1.36	35	2.48	4.96
-35	.80	1.60	39	2.57	5.14
-30	.92	1.84			
-25	1.04	2.08			
-20	1.16	2.32			
-15	1.28	2.56			
-10	1.40	2.80			
-5	1.52	3.04			
0	1.64	3.28			
5	1.76	3.52			
10	1.88	3.76			
15	2.00	4.00			
20	2.12	4.24			
					G.C.

BALLOON CONTROL

TECH DATA

VT-30 TEMPERATURE SENSORFUNCTION. Internal Temps.ENCODER WORD NO. 020,021,022
023,024,025DATE. April 82

FLIGHT NUMBER. _____

INPUT VOLTAGE 3.000v

TEMP. C	0-5VOLT OUTPUT	0-10VOLT OUTPUT	TEMP. C	0-5VOLT OUTPUT	0-10VOLT OUTPUT
-20.0	.61	1.22	19.9	1.40	2.80
-18.0	.65	1.30	22.3	1.45	2.90
-15.5	.70	1.40	24.8	1.50	3.00
-12.9	.75	1.50	27.4	1.55	3.10
-10.4	.80	1.60	29.9	1.60	3.20
-7.9	.85	1.70	32.4	1.65	3.30
-5.4	.90	1.80	34.9	1.70	3.40
-2.9	.95	1.90	37.4	1.75	3.50
-.4	1.00	2.00	40.0	1.80	3.60
2.2	1.05	2.10	42.5	1.85	3.70
4.7	1.10	2.20	45.0	1.90	3.80
7.2	1.15	2.30	50.0	2.01	4.02
9.7	1.20	2.40	55.0	2.11	4.22
12.2	1.25	2.50			
14.8	1.30	2.60			
17.3	1.35	2.70			

G.C.

APPENDIX H

POINTING SYSTEM CONTROL

On 18 Apr 82, during payload testing it was found that platform azimuth slew commands caused false interferometer alignment commands to be transmitted. This was caused by an error in the Pointing System Control chasis located in the trailer. The error was caused by the command address bits and data bits being set simultaneously with a transmit continuous command. Thus the first command transmitted was that of the address and data bits in transition.

The solution to this condition was the addition of a time delay in the transmit continuous command path so that transmission occurred only after all bits were set.

A problem which occurred with the Pointing System Control panel after the above modification problem with the Pointing System Control panel was that incorrect radar control commands were being transmitted. This error was found to be caused by bit 8 in the command word always being zero. This was found to be caused by an intermittent connection in the chasis connector. This was corrected. It is recommended that these connectors be replaced.

APPENDIX I

BAMM II COMMAND LOG

TIME	COMMAND CODE	COMMAND	COMMENTS
0:35:56	17100	T/V	
0:35:58	17102		
0:36: 6	17101		
0:36: 8	17100 -		
0:36:10	17110		
0:36:22	17100 -		
0:36:36	17102		
0:36:38	17100 -		
0:36:40	17101		
0:36:46	17100 -		
0:36:48	17102		
0:36:52	17100 -		
2:29:44	17100	RAD	
2:30:10	10410		
2:33:12	10430		
2:33:14	10434		

BAMM II COMMAND LOG

PAGE 1 OF 16

TIME	COMMAND CODE	COMMAND	COMMENTS
2:58:44	17100	T/V	LAUNCH
2:58:46	17102		
2:58:58	17100		
2:59:00	17101		
2:59:16	17100		
2:59:26	17102		
2:59:28	17100		
3:14:38	34000	P/S STANDBY	
3:47:40	3221	INT	
3:47:58	17100	T/V	
3:48:00	17102		
3:48:22	17100		
3:48:30	15240	T/M	
3:50:56	15240		
3:51:02	2621	INT	
3:52:46	15240	T/M	
3:52:54	2521	INT	
3:56:44	2621		
3:56:50	3221		
3:57:46	2621		
3:57:50	15240	T/M	
4:16:54	15241		
4:16:56	15240		
4:22:06	15241		
4:22:08	15240		
4:24:12	4525	INT ALIGN	
4:24:14	5125		
4:24:16	4625		
4:24:24	4525		
4:24:34	4625		
4:24:44	4525		
4:24:48	4531		
4:24:58	4545		
4:25:02	4525		
4:25:50	2621	INT	
4:26:08	4525	INT ALIGN	

PRELIMINARY PRINT

BAMM II COMMAND LOG

PAGE 2 OF 16

TIME	COMMAND CODE	COMMAND	COMMENTS
4:26:18	2621	INT	
4:26:28	4525	INT ALIGN	
4:26:34	2621	INT	
4:26:48	4525	INT ALIGN	
4:26:52	2621	INT	
4:27:28	4525	INT ALIGN	
4:27:36	2621	INT	
4:28:14	10436	RAD	
4:28:48	10437		
4:28:50	10436		
4:30: 8	10437		
4:30:10	10436		
4:31:10	10437		
4:31:12	10436		
4:31:30	10437		
4:31:34	10436		
4:32:24	10437		
4:32:26	10436		
4:32:52	4525	INT ALIGN	
4:32:56	2621	INT	
4:34:18	2521	I	
4:34:22	15240	T/M	
4:34:42	15241		
4:34:44	15240		
4:35:12	15241		
4:35:14	10476	RAD	
4:35:42	10477		
4:35:44	10476		
4:35:48	15240	T/M	
4:35:52	2621	INT	
4:37: 4	15240	T/M	
4:37: 8	15241		
4:37:10	15240		
4:37:14	15241		
4:37:16	3221	INT	
4:37:44	34000	P/S STANDBY	DATA TAKE
4:37:50	34001	NOT DEFINED	

PRELIMINARY PRINT

BAMM II COMMAND LOG

PAGE 3 OF 16

TIME	COMMAND CODE	COMMAND	COMMENTS
4:37:54	34000	P/S STANDBY	
4:37:58	34001	NOT DEFINED	
4:38:0	37240	P/S AZ CW HS	
4:38:4	37241	NOT DEFINED	
4:38:12	37240	P/S AZ CW HS	
4:38:16	37241	NOT DEFINED	
4:38:18	37240	P/S AZ CW HS	
4:38:38	37241	NOT DEFINED	
4:38:40	37240	P/S AZ CW HS	
4:38:44	37241	NOT DEFINED	
4:38:46	37240	P/S AZ CW HS	
4:39:8	37241	NOT DEFINED	
4:39:10	37240	P/S AZ CW HS	
4:39:14	37241	NOT DEFINED	
4:39:16	37240	P/S AZ CW HS	
4:39:22	37241	NOT DEFINED	
4:39:24	37240	P/S AZ CW HS	
4:39:38	37241	NOT DEFINED	
4:39:40	37240	P/S AZ CW HS	
4:40:2	37241	NOT DEFINED	
4:40:4	37240	P/S AZ CW HS	
4:40:14	37241	NOT DEFINED	
4:40:20	37775	NOT DEFINED	
4:40:26	37240	P/S AZ CW HS	
4:40:30	25000	P/S ALT DATA	
4:40:32	37240	P/S AZ CW HS	
4:40:44	37241	NOT DEFINED	
4:40:46	37240	P/S AZ CW HS	
4:40:50	37241	NOT DEFINED	
4:40:52	37240	P/S AZ CW HS	
4:41:2	37241	NOT DEFINED	
4:41:4	37240	P/S AZ CW HS	
4:41:10	37241	NOT DEFINED	
4:41:12	37240	P/S AZ CW HS	
4:41:28	37241	NOT DEFINED	
4:41:30	37240	P/S AZ CW HS	

BAMM II COMMAND LOG

PAGE 4 OF 16

TIME	COMMAND CODE	COMMAND	COMMENTS
4:41:34	37241	NOT DEFINED	
4:41:38	37240	P/S AZ CW HS	
4:41:42	37241	NOT DEFINED	
4:41:46	37240	P/S AZ CW HS	
4:41:52	37241	NOT DEFINED	
4:41:54	37240	P/S AZ CW HS	
4:41:56	37241	NOT DEFINED	
4:42:0	37240	P/S AZ CW HS	
4:42:2	37241	NOT DEFINED	
4:42:4	37240	P/S AZ CW HS	
4:42:8	37241	NOT DEFINED	
4:42:12	37240	P/S AZ CW HS	
4:42:16	37241	NOT DEFINED	
4:42:18	37240	P/S AZ CW HS	
4:42:28	37241	NOT DEFINED	
4:42:36	37241	NOT DEFINED	
4:42:40	36500	NOT DEFINED	
4:42:42	37240	P/S AZ CW HS	
4:42:54	37241	NOT DEFINED	
4:42:56	37240	P/S AZ CW HS	
4:43:28	37241	NOT DEFINED	
4:43:30	37240	P/S AZ CW HS	
4:43:42	37241	NOT DEFINED	
4:43:46	37240	P/S AZ CW HS	
4:43:50	32401	NOT DEFINED	
4:43:52	37240	P/S AZ CW HS	
4:43:58	37241	NOT DEFINED	
4:44:0	36000	P/S SLEW ϕ	
4:44:6	1	NOT DEFINED	
4:44:8	0		
4:44:10	1		
4:44:14	0		
4:44:20	1		
4:44:22	0		
4:44:30	1		
4:44:32	0		
4:44:58	37200	P/S AZ CW HS	

PRELIMINARY PRINT

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
4:45:00	36000	P/S SLEW Ø	
4:45:02	37100	P/S AZ CCW LS	
4:45:16	36000	P/S SLEW Ø	
4:45:18	37101	NOT DEFINED	
4:45:20	37100	P/S AZ CCW LS	
4:45:22	37101	NOT DEFINED	
4:45:24	37100	P/S AZ CCW LS	
4:45:26	22001	P/S MAG VARIATION DATA	
4:45:28	22000		
4:45:38	22001		
4:45:42	22000		
4:45:44	22001		
4:45:46	22000		
4:45:52	22001		
4:46:14	22001		
4:46:16	22000		
4:46:34	22001		
4:46:36	22000		
4:46:38	22001		
4:46:40	22000		
4:46:50	22001		
4:46:52	22000		
4:47:02	22001		
4:47:04	22000		
4:47:06	22001		
4:47:08	22000		
4:47:38	22001		
4:47:40	22000		
4:48:06	22001		
4:48:10	22000		
4:48:16	22001		
4:48:18	22000		
4:48:30	22001		
4:48:32	22000		
4:48:36	22001		
4:48:38	22000		

PROBABLY NOT
TRANSMITTED

PRELIMINARY PRINT

BAMM II COMMAND LOG

PAGE 6 OF 16

TIME	COMMAND CODE	COMMAND	COMMENTS
4:48:48	22001	P/S MAG VARIATION DATA	PROBABLY NOT TRANSMITTED
4:48:52	22000		
4:49:12	22001		
4:49:14	22000		
4:49:26	22001		
4:49:28	22000		
4:50: 0	22001		
4:50: 2	22000		
4:50:26	22001		
4:50:28	22000		
4:50:32	22001		
4:50:34	22000		
4:50:48	22001		
4:50:52	22000		
4:51: 0	22001		
4:51: 2	22000		
4:51:16	22001		
4:51:20	22000		
4:51:30	22001		
4:51:32	22000		
4:51:50	22001		
4:51:54	22000		
4:52: 6	22001		
4:52: 8	22000		
4:52:16	22001		
4:52:18	22000		
4:53:18	22001		
4:53:20	22000		
4:53:34	22001		
4:53:36	22000		
4:53:48	22001		
4:53:50	22000		
4:53:54	22001		
4:53:56	22000		
4:54:54	22001		
4:54:56	22000		

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
4:55:22	22001	P/S MAG VARIATION DATA	PROBABLY NOT TRANSMITTED
4:55:26	22000		
4:55:40	22001		
4:55:42	22000		
4:56:16	22001		
4:56:18	22000		
4:56:30	22001		
4:56:32	22000		
4:57: 0	22001		
4:57: 2	22000		
4:57:38	22001		
4:57:40	22000		
4:57:50	22001		
4:57:52	22000		
4:57:58	22001		
4:58: 0	22000		
4:58:16	22001		
4:58:20	22000		
4:58:34	22001		
4:58:36	22000		
4:58:50	22001		
4:58:52	22000		
4:59:46	22001		
4:59:48	22000		
5: 0:54	22001		
5: 0:56	22000		
5: 1:36	22001		
5: 1:38	22000		
5: 2:10	22001		
5: 2:12	22000		
5: 2:18	22001		
5: 2:20	22000		
5: 2:26	22001		
5: 2:28	22000		
5: 2:38	22001		
5: 2:40	22000		

PRELIMINARY PRINT

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
5: 3: 0	22001	P/S MAG VARIATION DATA	PROBABLY NOT TRANSMITTED
5: 3: 2	22000		
5: 3: 10	22001		
5: 3: 12	22000		
5: 3: 36	22001		
5: 3: 40	22001		
5: 3: 42	22000		
5: 4: 8	22001		
5: 4: 10	22000		
5: 4: 26	22001		
5: 4: 28	22000		
5: 4: 34	22001		
5: 4: 36	22000		
5: 5: 0	22001		
5: 5: 2	22000		
5: 5: 18	22001		
5: 5: 22	22000		
5: 5: 38	22001		
5: 5: 40	22000		
5: 5: 56	22001		
5: 5: 58	22000		
5: 6: 36	22001		
5: 6: 38	22000		
5: 6: 56	22001		
5: 6: 58	22000		
5: 7: 30	22001		
5: 7: 48	22001		
5: 8: 2	22001		
5: 8: 4	22000		
5: 9: 48	22001		
5: 9: 50	22000		
5: 10: 10	22001		
5: 10: 12	22000		
5: 10: 22	22001		
5: 10: 24	22000		
5: 10: 50	22001		

PRELIMINARY PRINT

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
5:10:52	22000	P/S MAG VARIATION DATA	PROBABLY NOT TRANSMITTED
5:11: 8	22001		
5:11:10	22000		
5:11:56	22001		
5:11:58	22000		
5:12: 4	22001		
5:12: 6	22000		
5:12:14	22001		
5:12:16	22000		
5:12:40	22001		
5:12:42	22000		
5:12:44	22001		
5:12:46	22000		
5:13: 8	22001		
5:13:10	22000		
5:13:34	22001		
5:13:36	22000		
5:13:50	22001		
5:13:52	22000		
5:14:18	22001		
5:14:20	22000		
5:14:48	22001		
5:14:50	22000		
5:15: 2	22001		
5:15: 4	22000		
5:15:20	22001		
5:15:22	22000		
5:16: 8	22001		
5:16:10	22000		
6: 6:24	37650	NOT DEFINED	
6: 7:48	37000		
6: 7:50	20000	DOP RAD	
6: 7:52	34000	P/S STANDBY	
6: 7:54	37777	NOT DEFINED	
6: 7:56	34000	P/S STANDBY	
6: 7:58	0	NOT DEFINED	
6: 8: 0	37777		

PRELIMINARY PRINT

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
6: 8: 4	37770	NOT DEFINED	
6: 8: 6	37600		
6: 8: 8	37777		
6: 8: 10	37776		
6: 8: 14	34000	P/S STANDBY	
6: 9: 16	37701	NOT DEFINED	
6: 9: 22	34050		
6: 9: 42	37012		
6: 9: 44	30102		
6: 9: 46	36024	P/S ELEV CW HS	
6: 10: 8	20240	DOP RAD	
6: 10: 10	36024	P/S ELEV CW HS	
6: 10: 20	27701	P/S LAT DATA	
6: 10: 22	36024	P/S ELEV CW HS	
6: 10: 48	37602	NOT DEFINED	
6: 10: 50	36024	P/S ELEV CW HS	
6: 11: 28	37602	NOT DEFINED	
6: 11: 30	36024	P/S ELEV CW HS	
6: 12: 46	37240	P/S AZ CW HS	
6: 13: 0	36000	P/S SLEW ϕ	
6: 13: 2	30000	NOT DEFINED	
6: 13: 10	34000	P/S STANDBY	
6: 13: 16	36024	P/S ELEV CW HS	
6: 13: 40	37240	P/S AZ CW HS	
6: 13: 42	37140	P/S AZ CW LS	
6: 13: 52	36000	P/S SLEW ϕ	
6: 14: 0	37140	P/S AZ CW LS	
6: 14: 10	36000	P/S SLEW ϕ	
6: 14: 12	37200	P/S AZ CCW HS	
6: 14: 28	36000	P/S SLEW ϕ	
6: 14: 30	37240	P/S AZ CW HS	
6: 15: 2	36000	P/S SLEW ϕ	
6: 16: 10	37240	P/S AZ CW HS	
6: 17: 42	36024	P/S ELEV CW HS	
6: 19: 52	37200	P/S AZ CCW HS	
6: 20: 34	36424	NOT DEFINED	

PRELIMINARY PRINT

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
6:21: 2	34200	P/S STARE	NO SCAN DIR. ON I/F
6:25:38	34000	P/S STANDBY	
6:25:50	37140	P/S AZ CW LS	
6:25:58	36000	P/S SLEW Ø	RC OUT FILTER
6:27:48	34200	P/S STARE	
6:27:58	10576	RAD	
6:28:24	10476		
6:29:20	34000	P/S STANDBY	
6:29:34	36024	P/S ELEV CW HS	
6:29:54	36025	P/S ELEV CCW HS	
6:30:12	36025		
6:30:28	22013	P/S MAG VARIATION DATA	
6:31: 0	34200	P/S STARE	
6:34: 6	34000	P/S STANDBY	
6:34:32	25715	P/S ALT DATA	
6:34:34	22013	P/S MAG VARIATION DATA	
6:34:40	37100	P/S AZ CCW LS	
6:34:52	31000	NOT DEFINED	
6:34:54	36000	P/S SLEW Ø	
6:34:58	36022	P/S ELEV CW LS	
6:35: 8	34000	P/S STANDBY	
6:35:28	22013	P/S MAG VARIATION DATA	
6:35:48	34000	P/S STANDBY	
6:35:50	0	NOT DEFINED	
6:35:58	34200	P/S STARE	
6:39:18	34000	P/S STANDBY	
6:39:56	36023	P/S ELEV CCW LS	
6:40: 2	36000	P/S SLEW Ø	
6:40: 8	34000	P/S STANDBY	
6:41: 0	37240	P/S AZ CW HS	
6:41:34	36024	P/S ELEV CW HS	
6:42:14	36025	P/S ELEV CCW HS	
6:42:12	37200	P/S AZ CCW HS	
6:43:30	10476	RAD	
6:43:38	36024	P/S ELEV CW HS	
6:44: 8	37240	P/S AZ CW HS	

PRELIMINARY PRINT

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
6:44:30	34200	P/S STARE	
6:44:42	0	NOT DEFINED	
7: 1:34	1		
7: 1:36	0		
7: 7:44	1		
7: 7:46	0		
7:11:36	1		
7:11:38	0		
7:15:8	1		
7:15:10	0		
7:16:54	1		
7:16:56	0		
7:22:8	34000	P/S STANDBY	
7:23:28	34001	NOT DEFINED	
7:23:30	34000	P/S STANDBY	
7:28:46	37240	P/S AZ CW HS	
7:28:48	37200	P/S AZ CW HS	
7:30:4	24000	P/S ALT DATA	
7:57:18	34000	P/S STANDBY	
7:58:26	37240	P/S AZ CW HS	
7:58:36	12000	NOT DEFINED	
7:58:38	37240	P/S AZ CW HS	
7:58:56	25000	P/S ALT DATA	
7:58:58	37240	P/S AZ CW HS	
7:59:28	36000	P/S SLEW Ø	
7:59:38	34200	P/S STARE	
8: 4:36	34000	P/S STANDBY	
8: 4:48	37240	P/S AZ CW HS	
8: 7:32	36000	P/S SLEW Ø	
8: 7:34	34000	P/S STANDBY	
8: 7:44	0	NOT DEFINED	
8: 7:48	25715	P/S ALT DATA	
8: 7:58	36023	P/S ELEV CCW LS	
8: 8:14	36000	P/S SLEW Ø	
8: 8:18	34000	P/S STANDBY	
8: 8:22	34200	P/S STARE	

PRELIMINARY PRINT

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
8: 9: 0	2521	INT	
8: 11: 28	2621	I	
8: 11: 44	15240	T/M	
8: 12: 42	10576	RAD	
8: 13: 14	34000	P/S STANDBY	
8: 13: 28	37777	NOT DEFINED	
8: 13: 40	27301	P/S LAT DATA	
8: 13: 42	33560	NOT DEFINED	
8: 13: 44	27341	P/S LAT DATA	
8: 13: 50	36267	NOT DEFINED	
8: 25: 56	7377	INT CNTRL	
8: 25: 58	3577	INT	
8: 26: 16	7377	INT CNTRL	
8: 31: 26	37777	NOT DEFINED	
8: 31: 38	34000	P/S STANDBY	
8: 35: 0	3376	INT	
8: 35: 24	33710	NOT DEFINED	
8: 40: 58	1777	I	
8: 41: 4	10177	RAD	
8: 41: 6	1752	NOT DEFINED	
8: 47: 24	36025	P/S ELEV CCW HS	
8: 48: 0	1753	NOT DEFINED	
8: 48: 28	34000	P/S STANDBY	
8: 48: 40	0	NOT DEFINED	
8: 49: 38	37200	P/S AZ CCW HS	
8: 50: 46	37240	P/S AZ CW HS	
8: 52: 50	10436	RAD	
8: 55: 48	3577	INT	
8: 55: 50	34200	P/S STARE	
9: 1: 6	20677	DOF RAD	
9: 1: 42	17100	T/V	
9: 2: 14	36024	P/S ELEV CW HS	
9: 2: 24	37701	NOT DEFINED	
9: 3: 38	1752	I	
9: 3: 58	3733	INT	
9: 4: 0	1755	NOT DEFINED	

PRELIMINARY PRINT

BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
9: 4: 4	1753	NOT DEFINED	
9: 4: 8	1755		
9: 4:10	1753		
9: 4:12	1755		
9: 4:18	1753		
9: 4:22	36024	P/S ELEV CW HS	
9: 5: 4	35000	NOT DEFINED	
9: 5:26	37240	P/S AZ CW HS	
9: 5:48	37752	NOT DEFINED	
9: 6:44	36025	P/S ELEV CCW HS	
9: 7:12	7120	INT CNTRL	
9: 7:16	7220		
9: 7:52	15240	T/M	
9: 8:10	34025	NOT DEFINED	
9: 9:28	35156		
9:11:58	22537	P/S MAG VARIATION DATA	
9:12: 6	15240	T/M	
9:12:20	2621	INT	
9:12:26	37777	NOT DEFINED	
9:13:28	33252		
9:13:44	34556		
9:14: 0	3221	INT	
9:14:28	34000	P/S STANDBY	
9:14:54	35240	NOT DEFINED	
9:15: 4	34000	P/S STANDBY	
9:15:22	36024	P/S ELEV CW HS	
9:15:32	36000	P/S SLEW 0	
9:15:36	34000	P/S STANDBY	
9:16:28	37240	P/S AZ CW HS	
9:17:10	36000	P/S SLEW 0	
9:17:12	37200	P/S AZ CCW HS	
9:17:24	36000	P/S SLEW 0	
9:17:28	37240	P/S AZ CW HS	
9:17:42	35200	NOT DEFINED	
9:18:12	36000	P/S SLEW 0	
9:18:14	34200	P/S STARE	

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BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
9:23:48	1753	NOT DEFINED	
9:24:24	34000	PS STANDBY	
9:24:48	36024	P/S ELEV CW HS	
9:25:26	37240	P/S AZ CW HS	
9:26:48	36024	P/S ELEV CW HS	
9:27:2	37200	P/S AZ CCW HS	
9:27:24	37764	NOT DEFINED	
9:27:26	577	I	
9:27:36	37200	P/S AZ CCW HS	
9:28:20	36400	NOT DEFINED	
9:28:22	37200	P/S AZ CCW HS	
9:28:42	10436	RAD	
9:28:54	36025	P/S ELEV CCW HS	
9:30:10	34200	P/S STARE	
9:30:28	3241	INT	
9:30:38	15240	T/M	
9:31:46	31517	NOT DEFINED	
9:35:38	3221	INT	
9:35:42	15240	T/M	
9:36:14	36024	P/S ELEV CW HS	
9:36:38	34000	P/S STANDBY	
9:36:50	37240	P/S AZ CW HS	
9:38:12	36000	PS SLEW Ø	
9:38:18	37200	P/S AZ CCW HS	
9:38:36	37772	NOT DEFINED	
9:38:40	36000	PS SLEW Ø	
9:39:44	37200	P/S AZ CCW HS	
9:39:2	37772	NOT DEFINED	
9:39:4	36000	PS SLEW Ø	
9:39:6	37200	PS AZ CCW HS	
9:39:34	20000	DOP RAD	
9:39:36	36000	PS SLEW Ø	
9:39:38	37240	PS AZ CW HS	
9:39:44	20001	DOP RAD	
9:39:46	34000	PS STANDBY	
9:39:58	36024	PS ELEV CW HS	
9:40:14	36000	PS SLEW Ø	

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BAMM II COMMAND LOG

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TIME	COMMAND CODE	COMMAND	COMMENTS
9:40:16	34200	P/S STARE	
9:40:34	10436	RAD	
9:44:48	34000	P/S STANDBY	
9:44:52	36024	P/S ELEV CW HS	
9:45:30	36000	P/S SLEW Ø	
9:45:32	36024	P/S ELEV CW HS	
9:45:34	36000	P/S SLEW Ø	
9:45:40	34000	P/S STANDBY	
9:49:28	34400	P/S CAGE	
9:50:2	10434	RAD	
9:50:16	2161	INT	
9:50:18	10434	RAD	
9:50:22	2161	INT	
9:50:24	10434	RAD	
9:56:8	37774	NOT DEFINED	RAD+I/F OFF
9:56:18	1377		
9:56:26	30900		
9:56:30	14000	T/M	
9:57:30	10000	RAD	
9:57:36	7120	INT CNTL	
9:57:42	6520		

PRELIMINARY PRINT

APPENDIX J

VOLTAGE MONITOR SYSTEM

At approximately L-10 minutes, it was found that the Radiometer voltage monitor was reading approximately 0 volts, which corresponds to a voltage of 0 volts. The open circuit battery voltage was measured directly on the payload and found to be 28 volts dc with no noticeable variation. Instrument operation was checked using the PCM data and it was concluded that only the monitor operation was intermittent and thus a go condition for launch existed. This voltage monitor continued to operate intermittently for the rest of the flight.

This problem could have been caused by a series voltage regulator in the voltage monitor circuit shutting off because the junction temperature attained 150°C

When the junction cooled off sufficiently, the regulator would turn on, thus the intermittent operation. The exact cause of this high junction temperature (or faulty operation of the thermal shutdown) will be investigated.

The voltage monitors for T/M A and T/M B power were found to indicate a voltage lower than the actual voltages being monitored. The magnitude of this error, was dependent on the load current being drawn. This was probably caused by a common mode error voltage, the result of connecting the voltage monitor grounds to a common point on the voltage monitor circuit board. It is recommended that isolation amplifiers be used for voltage monitors to eliminate common mode errors in the voltage monitor data.

APPENDIX K

POINTING SYSTEM DATA DISPLAY

The pointing system data was never properly evaluated prior to launch because of problems in the BMM trailer computer-display data interface. A summary of these problems is listed.

1) The pulse amplitude modulation (PAM) data available for readout in the trailer was not reliable until the day prior to launch because of changes being made in the FM discriminators and the PAM decoder chassis. Reliable data was available in the Telemetry trailer and these data were used to confirm proper system operation.

2) The Doppler radar was found to be fully operational during preflight testing. During ascent, the radar measured drift velocities and all four beams locked up on a valid doppler frequency. It was difficult to determine the measured velocity, because of noise in the data. This velocity data noise did not become apparent until after the Visidyne Payload Monitor (VPM) CRT display in the BMM trailer was operational. This did not occur until approximately L-5 days at which time no corrective action on the payload could be initiated. The doppler radar dropped lock on three of the four beams for no apparent reason prior to reaching float altitude. Since this indicated a low signal to noise and drift velocity at this time was low, approximately 5 knots, the effect on the STARE data was minimal. It is recommended that the doppler radar R.F. section be refurbished and the BITE sensitivity test velocity rechecked. In addition, it is also recommended that the radar be modified, if possible, to bring out a doppler signal to noise monitor such as an AGC monitor.

3) Several pointing system analysis data functions are sent to the PCM Encoder for A-D conversion and telemetry transmission to the ground. During preflight tests it was observed that these data contained a lot of noise. It is recommended that this be corrected.

APPENDIX L

BAMM II FLIGHT

POINTING SYSTEM DATA

30 APR 82

PLATFORM OPERATION

<u>LOCAL TIME</u>	<u>AZIMUTH ANGLE (DEG)</u>	<u>COARSE ELEVATION ANGLE (DEG)</u>	<u>PLATFORM COMMANDS</u>
2:59	197.7	45	
3:05	172.3	45	(Launch)
3:09	147.5	45	
3:11	316.2	45	
C3:13	149.3	45	
			Standby 3:14
3:15	59.2	45	
3:17	58.1	45	
19	56.3	45	
21	56.2	45	
23	56.2	45	
25	55.9	45	
27	55.8	45	
29	55.5	45	
31	55.4	45	
33	53.9	45	
35	56.6	45	
37	56.9	45	
39	55.2	45	
41	52.8	45	
43	52.4	45	
45	53.1	45	
47	52.4	45	
51	51.0	45	
53	52.5	45	
55	53.7	45	
57	52.9	45	
4:03	51.6	45	
05	51.6	45	
07	52.2	45	
09	50.5	45	
11	53.8	45	
13	50.2	45	
15	51.5	45	

17	49.4	45
19	81.5	45
21	50.8	45
23	51.3	45
25	51.3	45
27	50.4	45
29	50.1	45
31	51.4	45
33	50.5	45
35	52.0	45
37	49.4	45
39	122.9	45
41	256.5	45
43	33.4	45
45	271.4	13.7
47	266.4	-13.0
49	267.7	-13.0
51	265.0	-13.0
53	264.8	-13.0
55	267.7	-13.0
57	268.1	-13.0
59	267.9	-13.0
5:01	266.4	-13.0
03	266.7	-13
05	266.5	-13
07	265.1	-13
09	-	-13
11	270.1	-13
13	267.9	-13
15	266.7	-13

Standby Az CWHS 4:38
6/m

Az CCWHS 4:44 Az CCWLS

BAMM FLIGHT

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			<u>Fine Elevation Angle (DEG)</u>	<u>Fine Roll Angle (DEG)</u>	
5:21	269	-13	0	0	
:23	271	-13	.4	0	
:25	270	-13	0	-.4	
:27	270	-13	-.4	-.7	
:29	268	-13	0	0	
:33	269	-13	1.4	-.4	
:35	356	-13.7	5.6	-3.2	
:37	352	-9.8	5.3	-4.9	
:39	310	-9.8	5.3	-5.3	
:41	347	-9.8	5.3	-6.7	
:43	355	-9.8	4.9	-9.1	
:45	345	-9.8	4.9	-9.1	
:47	100	-9.8	4.9	-9.1	
:49	188	-9.8	4.9	-9.1	
:51	104	-9.8	4.9	-9.1	
:53	224	-9.8	4.9	-9.1	
:55	280	-9.8	4.9	-9.1	
:57	261	-9.8	4.9	-9.1	
6:01	352	-9.8	4.9	-9.1	
:03	289	-9.8	4.9	-9.1	
:05	280	-9.8	4.9	-9.1	
:07	332	-9.8	4.9	-9.1	Stdby
:09	291	-17.9	-.4	-5.3	EL CW HS
:11	183	33.8	-.4	-1.1	
:13	9.8	85.8	.4	0	
:15	216	-19.3	.4	-.4	
:17	260	-19.3	0	.4	
:19	85	79.1	0	0	AZ CCW HS
:21	74	83.3	-.4	-1.1	Stare
:23	73		-1.4	-2.8	
:25	73	83.3	-2.8	-4.6	Stdby
:27	74.8	75.9	0	-2.5	Stare
:29	75.2	75.9	-0.7	-3.5	Stdby
:31	74.4	77.7	-1.1	-2.8	Stare
:33	72.5	77.7	-1.8	-3.9	
:35	69.5	80.2	-.4	-3.5	Stdby
:37	68.7	80.2	-1.4	-4.9	Slew/Stare
:39	71.0	80.2	-1.1	-6.0	Stdby EL CCW
:41	97.1	64.7	-.7	-2.8	
:43	63.8	62.2	0	-1.4	EL CCW
:45	69.9	74.5	-.7	-2.1	E1 CM/Stare
:47	67.2	74.5	-2.1	-3.9	
:49	65.7	74.5	-3.5	-6.0	

:51	62.8	74.5	-4.9	-7.7	
:53	62.5	74.5	-6.7	-10.2	
:55	61.5	74.5	-8.4	-10.9	
:57	63.2	74.5	-9.8	-10.9	
:59	58.7	74.5	-9.8	-10.9	
7:01	57.6	74.5	-9.8	-10.9	
:03	60.1	74.5	-9.8	-10.9	
:05	57.6	74.5	-9.8	-10.9	
:09	57.4	74.5	-9.8	-10.9	
:11	55.7	74.5	-9.8	-10.9	
:13	57.4	74.5	-9.8	-10.9	
:21	54.4	74.5	-9.8	-10.9	Stdbby
:23	56.6	74.5	1.1	-10.2	
:25	56.5	74.5	0	-3.9	
:27	56.9	74.5	0	-1.8	
:29	56.7	74.5	0	-1.1	AZ CCW HS
:31	50.6	74.5	0	-.4	
:33	50.6	74.5	0	0	
:45	53.4	74.5	0	.4	
:47		74.5	10.2	-2.8	
:49	30.5	74.5	10.2	-2.8	
:51	20.6	74.5	10.2	-2.8	
:53	2.9	74.5	10.2	-2.8	
:55	341.6	74.5	10.2	-2.8	
:57	337.3	74.5	1.4	-2.5	Stdbby AZ CW HS Stare
:59	34.5	74.5	-.7	-1.1	
8:01	35.0	74.5	-2.1	-2.5	Stare AZ CW HS Stdbby E1 CCW LS Slew Stdbby Stare
:03	33.2	74.5	-3.9	-3.9	
:05	75.5	74.2	-1.1	-2.5	
:07	199.7	74.2	-.7	-.7	
:11	201.3	71.0	-3.5	-4.2	
:13	200.1	71.0	-1.4	-5.3	Stdbby
:15	174.3	70.3	-1.8	-3.9	
:17	164.5	70.3	-1.8	-3.9	
:19	168.0	70.3	-1.8	-4.2	
:21	160.8	70.3	-1.4	-4.2	
:23	204.9	70.3	-1.4	-4.2	
:25	214.9	70.3	-1.4	-4.2	
:27	183.4	70.	-1.4	-4.6	
:29	213.0	70.3	-1.4	-4.6	
:31		70.3	-1.4	-4.6	Stdbby
:33	221.8	70.3	-0.4	-3.2	
:35	224.3	70.3	-0.4	-1.8	
:37	223.5	69.6	-0.7	-1.1	
:39	224.5	69.3	-.07	-1.1	
:41	221.6	69.3	-0.7	-1.1	

:43	220.7	69.3	-0.7	-0.7	
:45	222.8	69.3	-0.7	-1.1	
:47	221.8	69.3	-0.7	-0.7	EL CCW HS
					Stdbby
:49	218.2	43.6	-0.7	-0.7	AZ CCW HS
					AZ CW HS
:51	283.1	39.4	-0.4	-0.4	
:53		37.6	-0.4	-0.7	
:55	291.7	37.6	-0.4	-0.7	Stare
:57	289.5	37.6	-0.7	-0.7	
:59	289.9	37.6	-0.7	-0.4	
9:01	292.1	49.9	-0.4	-0.4	
:03	283.2	49.9	-0.4	-0.4	
:05	285.6	55.5	-0.4	-0.4	AZ CW HS
					EL CCW HS
:07	304.6	42.5	-0.7	-0.4	
:09	306.9	42.5	-0.7	-1.1	
:11	306.1	42.5	-0.7	0	
:13	310.8	42.5	-0.4	0	
					Stdbby
:15	258.2	48.5	-0.7	-0.4	Stdbby
					EL CW HS
					Stdbby
					AZ CW HS
					AZ CCW HS
:17	295.2	48.5	-0.4	-0.7	AZ CW HS
					Stare 9:18
:19	330.4	49.2	-1.1	0.4	
:21	330.7	49.2	-1.4	0.7	
:23	330.2	49.2	-1.8	0.7	
					Stdbby
:25	317.1	71.4	-0.7	-1.1	EL CW HS
					AZ CW HS
:27	35.4	75.9	-0.7	-0.4	EL CW HS
					AZ CCW HS
:29	276.2	38.7	-0.4	-0.4	EL CWM HS
:31	279.8	30.6	-0.7	0.4	Stare
:33	276.8	30.6	-0.7	0	
:35	278.3	30.6	-1.1	0	
					EL CW HS
:37	5.8	45.4	-0.4	0.4	Stdbby
					AZ CW HS
					AZ CCW HS
:39	134.9	-9.5	-1.1	0	AZ CW HS
					Stdbby
:41	321.7	8.8	-1.1	0.4	Stare
:43	332.6	8.8	-1.4	0.4	
					Stdbby
:45	318.6	46.4	-0.4	0.4	EL CW HS
					Stdbby

:47	320.0	46.4	-0.7	0.4
:49	318.6	46.4	-0.7	-0.7
:51	356.2	46.4	-0.7	-0.7
:53	40.4	46.4	-0.7	-0.7
:55	50.9	46.4	-0.7	-0.7
:57	18.6			
:59	51.8			
10:01	53.3			
:03	53.3			
:05	53.3			
:09	53.3			

LOCK
CAGE 9:49:28

Appendix M

OPTICAL CO-ALIGNMENT

The optical alignment of the BAMM II instrumentation and platform was directed by A. Fairburn AFGL (OPR). The optical co-alignment of the platform instrumentation was done in the near field. A screen was positioned approximately 40 feet from the payload. The parallax correction was made by having separate targets for each instrument. The target location on the screen corresponded to the position of the projected optical axis of the co-aligned instruments. The technique used was:

- a. Elevate the instrument to an elevation angle of approximately 90 degrees.
- b. Position a blackbody point source at a distance of 40 feet on the interferometer optical axis as defined by the central 4 detectors.
- c. Move the blackbody to a position corresponding to the displacement of the radiometer optical axis from the interferometer optical axis.
- d. Adjust the radiometer mount until the optical axis is aligned to the source.
- e. Adjust the Television Camera mount so that the Vidicon faceplate reticle displayed on the T/V monitor is coincidal with the T/V marking on the alignment screen. This could not be done because the television alignment mount was at the limit of adjustment. The television camera optical axis was miss-aligned with the instrument axis by approximately a degree. It was concluded that this was within the limits required for the flight measurements.

APPENDIX N

MAGNETIC DEVIATION DETERMINATION

The magnetic deviation error was measured using the following technique. The payload was brought out to the Chico airport compass rose where the payload was rotated and the variation data taken. The payload 0° heading was aligned with the compass rose north vector. When the compass rose north vector was later compared to the Bearing of Polaris, it was determined that the compass rose north vector was aligned with the local magnetic north.

To calibrate the payload heading angle, a landmark (a grain elevator) on the horizon visible from the hangar was located. An absolute reference angle was established by measuring the solar azimuth at a known local time. The angular difference between the solar reference angle and that of the landmark was measured and a reference landmark true heading of 245 degrees established. The telemetry true heading data readout was 241 degrees. It was decided that this error could be removed by inputting a +4.0 degrees Magnetic Variation correction at the Pointing System Control Panel.