X-671-64-298

NASA TMX-55172

INSTRUMENTATION REPORT ON NIKE-APACHE FLIGHT 14.127 GI

GPO PRICE $ _____

OTS PRICE(S) $ _____

Hard copy (HC) 2.00

Microfiche (MF) .50

N65-18959 (ACCESSION NUMBER) — (THRU)

26 (PAGES) — 1 (CODE)

TMX-55172 (NASA CR OR TMX OR AD NUMBER) — 31 (CATEGORY)

FACILITY FORM 602

OCTOBER 1964

NASA — GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

INSTRUMENTATION REPORT ON NIKE APACHE

FLIGHT 14.127 GI

By

R. W. Conrad

and

J. W. Cameron

National Aeronautics and Space Administration
Goddard Space Flight Center

SUMMARY

18959

This report is one of a series issued by the Sounding Rocket Instrumentation Section. The instrumentation and telemetry results of Flight No. 14.127 GI, fired from Wallops Island on 16 July 1964, are discussed. All pertinent engineering data on the actual flight instrumentation is also included. The experiment, carried by this vehicle, measured impedance characteristics of radiating sensors for support of future space radio astronomy missions.

Author

TABLE OF CONTENTS

INTRODUCTION..... 1

COMMITMENTS..... 1

Section Personnel..... 2
Range Project Engineer..... 2

SCIENTIFIC PAYLOAD..... 2

Instrumentation and Telemetry..... 2
Timer Sequence..... 4
Mechanical Layout..... 4
Integration..... 4

FIELD OPERATIONS..... 9

HORIZONTAL AND VERTICAL CHECKOUT PROCEDURE..... 10

FIRING DATA..... 10

SUPPORTING GROUND STATIONS..... 11

COMMENTS..... 11

LIST OF ILLUSTRATIONS

Figure Number	Title	Page
1	Standard FM/FM Telemetry Package.....	3
2	Payload for Flight 14.127 GI.....	5
3	Instrumentation for Flight 14.127 GI.....	6
4	Antenna Locations for Flight 14.127 GI.....	7
5	In-flight Configuration of Flight 14.127 GI Payload.....	8

INSTRUMENTATION REPORT ON NIKE APACHE

FLIGHT 14.127 GI

INTRODUCTION

The objective of Nike Apache Flight 14.127 GI was to measure impedance characteristics of radiating sensors for support of future space radio astronomy missions. Impedance characteristics will be related to ionospheric electron and ion densities. Instrumentation included two dipole antennas for impedance measurement and two monopole antennas for ion and electron density measurement.

COMMITMENTS

A conference was held at GSFC Beltsville on 7 May 1964 to discuss the implementation of the Nike Apache, Flight 14.127 GI.

The Sounding Rocket Instrumentation Section (SRIS) was responsible for providing the following telemetry and instrumentation:

1. A 10-channel telemetry system
2. Batteries for the experiment as well as the telemetry system - 2 packs; plus 28V and minus 28V
3. The ground control console and umbilical
4. Two magnetometers, which provide vehicle aspect data (see Appendix A)
5. In-flight calibration of all channels
6. Squib batteries (8 HR-1's)

Attendees at the Pre-shoot Conference included the following personnel:

Mr. Karl Medrow, Head, Sounding Rocket Branch, GSFC
Mr. E. E. Bissell, Section Head, Sounding Rocket Instrumentation Section, GSFC
Dr. R. Stone, Project Director, GSFC
Miss E. Pressly, Section Head, Sounding Rocket Vehicle Section, GSFC
Mr. J. Cameron, Sounding Rocket Instrumentation Section, GSFC
Mr. R. Kramer, Vehicle Section, GSFC
Mr. J. Rast, Vehicle Section, GSFC
Mr. J. Guthrie, Chief Engineer, GSFC
Mr. H. Galloway, Flight Performance Section, GSFC

SECTION PERSONNEL

John W. Cameron was initially assigned as the Telemetry Engineer, and was responsible for all instrumentation designs and operations through the integration tests. Other commitments for Mr. Cameron intervened (at Ft. Churchill on Flights 4.107 and 4.108 GE) and field support at Wallops Island was provided by R. W. Conrad. The payload technician throughout the entire operation was John Kite.

RANGE PROJECT ENGINEER - Harvey Needleman, NASA, Wallops Island, Va.

SCIENTIFIC PAYLOAD

INSTRUMENTATION AND TELEMETRY

A standard Nike Apache FM/FM telemetry package (without commutator) was adapted to this payload (see Figure 1).

Flight 14.127 GI telemetered data via an FM/FM RF link on 240.2 MCS over a 1/4-watt, Vector TRPT-250 transmitter. Frequency deviation was ± 125 KCS. The antenna system used was a standard Nike Apache section, 45°, swept-back turn-stiles, right-hand circular polarization.

Data Channel Allocations - Channel allocations as listed in the Flight Plan, dated 18 June 1964, are incorrect. Allocations are as follows:

FREQ	CHANNEL	ALLOCATION
70 KCS	E	RF Impedance Probe
40 KCS	16	Voltage for Impedance Probe #2
30 KCS	15	Current for Impedance Probe #2
22 KCS	14	Phase for Impedance Probe #2
14.5 KCS	13	Phase for Impedance Probe #1
10.5 KCS	12	Voltage for Impedance Probe #1
7.35 KCS	11	Current for Impedance Probe #1
5.4 KCS	10	Lateral Magnetometer
3.9 KCS	9	Longitudinal Magnetometer
3.0 KCS	8	Events monitor, switched to solar aspect at 70 seconds

Support Instrumentation

Experimenter supplied 18 squibs and 4 Altitude switches.

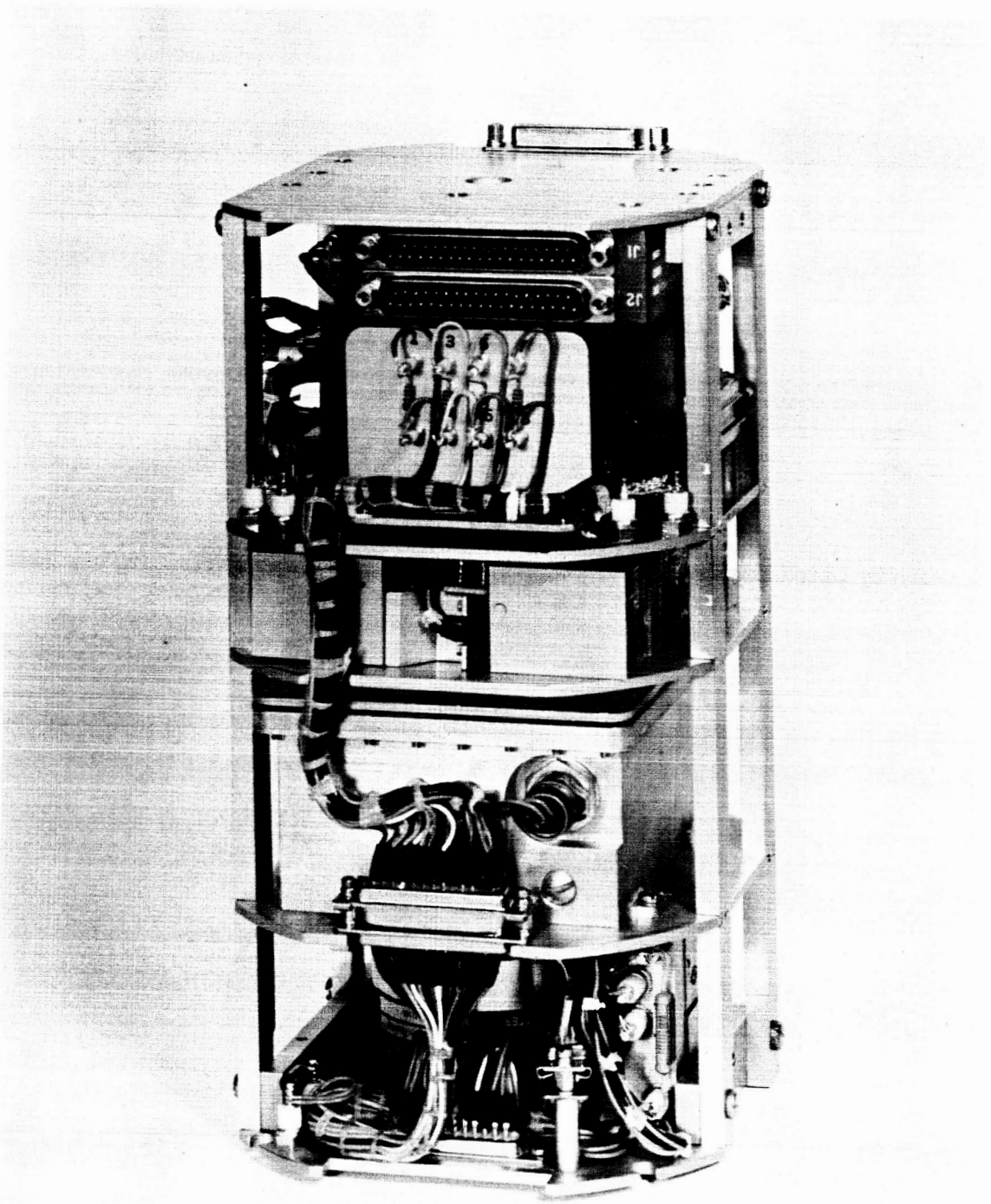


Figure 1. Standard FM/FM Telemetry Package

TIMER SEQUENCE

Two redundant G-timers were used to initiate the pyrotechnics that released the four boom antenna doors and split the nose cone. Altitude switches provided ground safety. The status of all timer functions was monitored by voltage summation on the input of the 3.0 KCS VCO. At the completion of all antenna erecting, input to this channel was switched over to solar aspect.

The sequence of operation was as follows:

Time from L.O.	Action	VCO Input (Volts)
0	Timers cocked, altitude switch open	0
+25 sec (approx)	50K altitude switch arms pyrotechnic circuits	+5.0 V
+53 sec	Antenna doors (4) blown off	+3.5 V
+70 sec	Channel switch to solar aspect	0 + mod.

MECHANICAL LAYOUT

Figures 2 through 5 depict the payload in various exposures. The standard Nike Apache/Cajun telemetry package is shown integrated with the payload, as are the altitude switches and the G-timers.

INTEGRATION

Integration tests were run on the complete payload at GSFC Beltsville on 9-10 July 1964. Checks included mechanical and electrical compatibility, a simulated countdown, and launch on internal power, and ejection of doors and nose cone. Prior to integration, the payload had passed mechanical integrity tests at Test and Evaluation, GSFC, including spin tests to 12 rps.

No major problems were encountered during integration, and all minor problems were corrected on the spot.

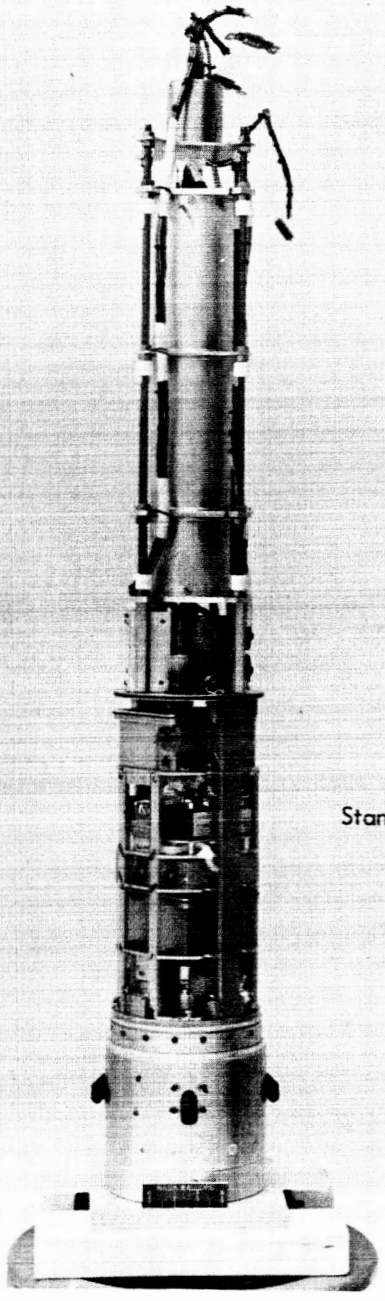


Figure 2. Payload for Flight 14.127 GI

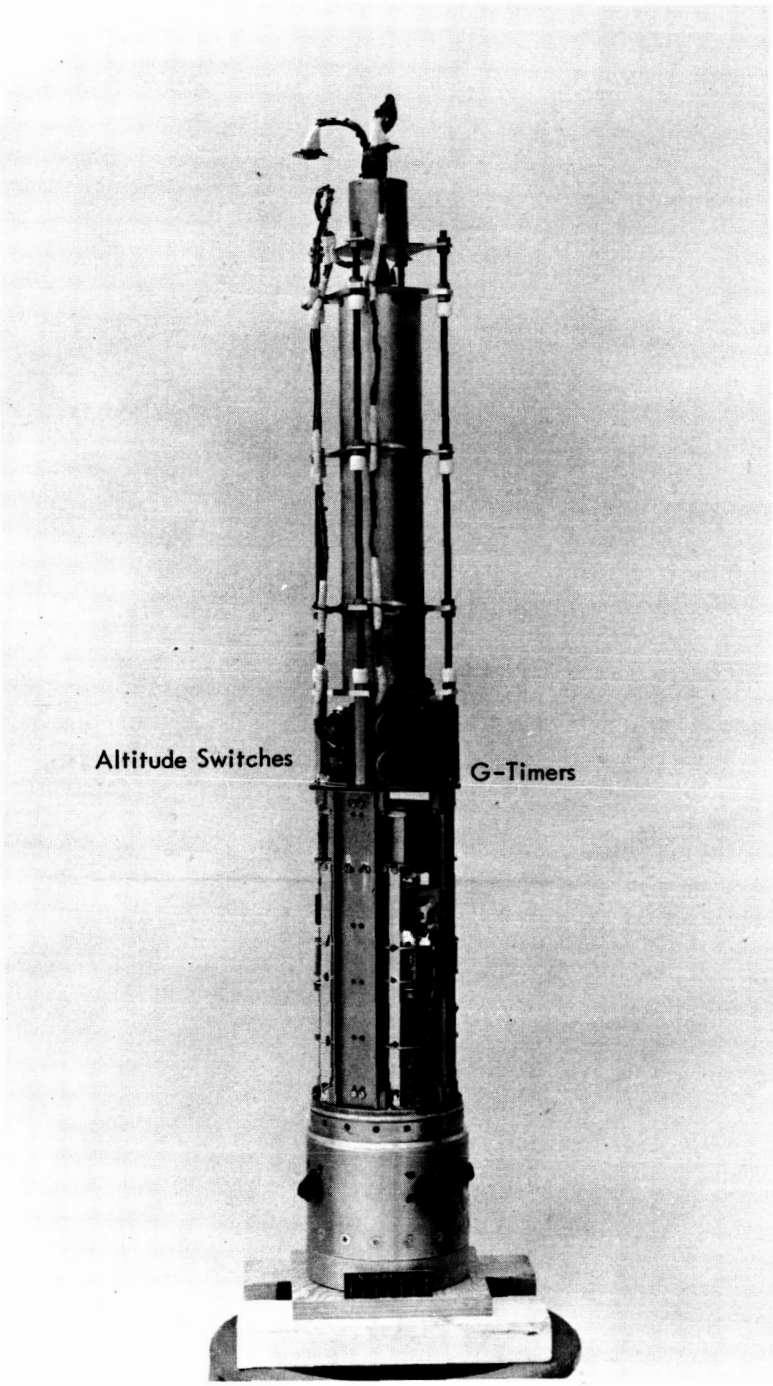


Figure 3. Instrumentation for Flight 14.127 GI

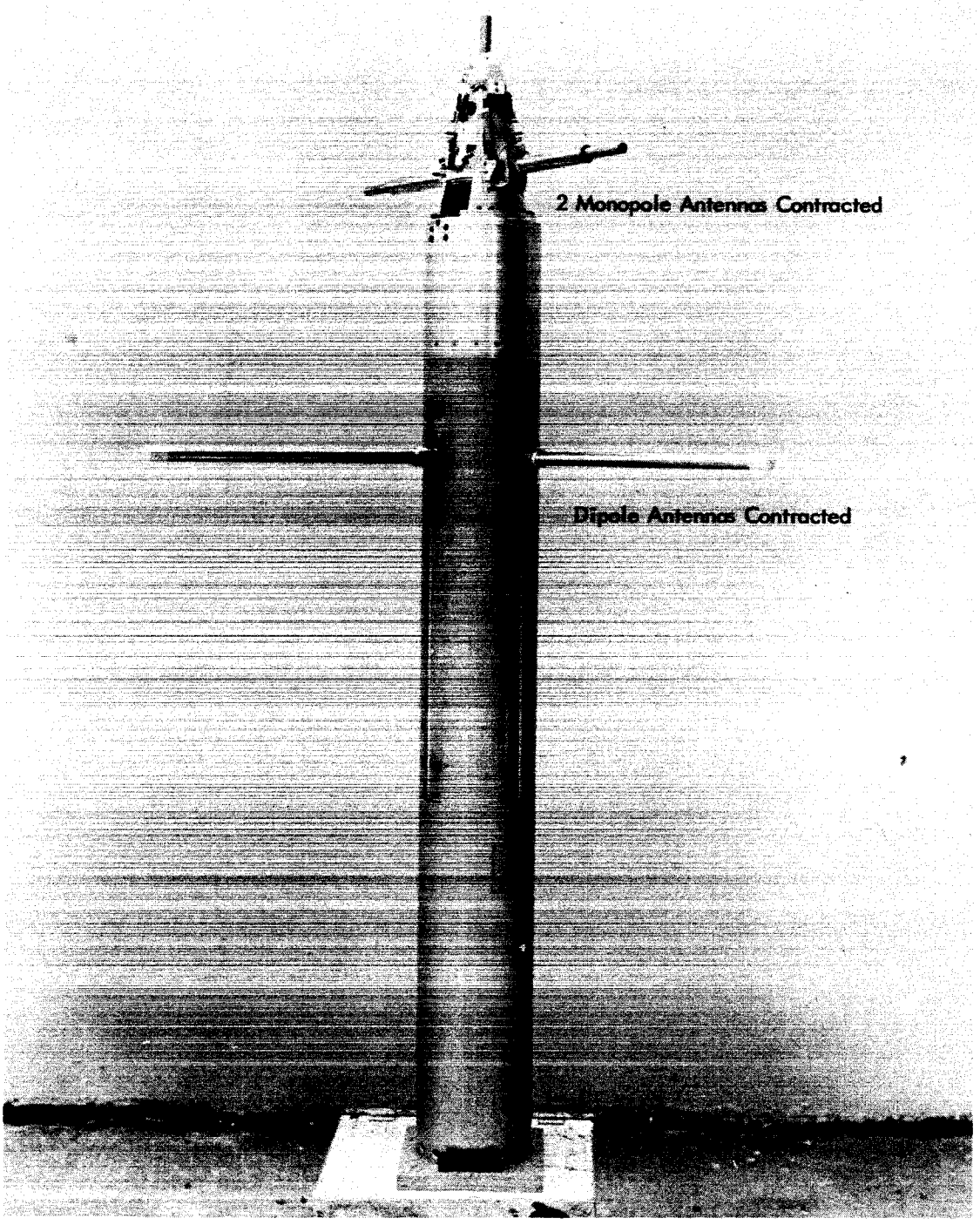


Figure 4. Antenna Locations for Flight 14.127 GI

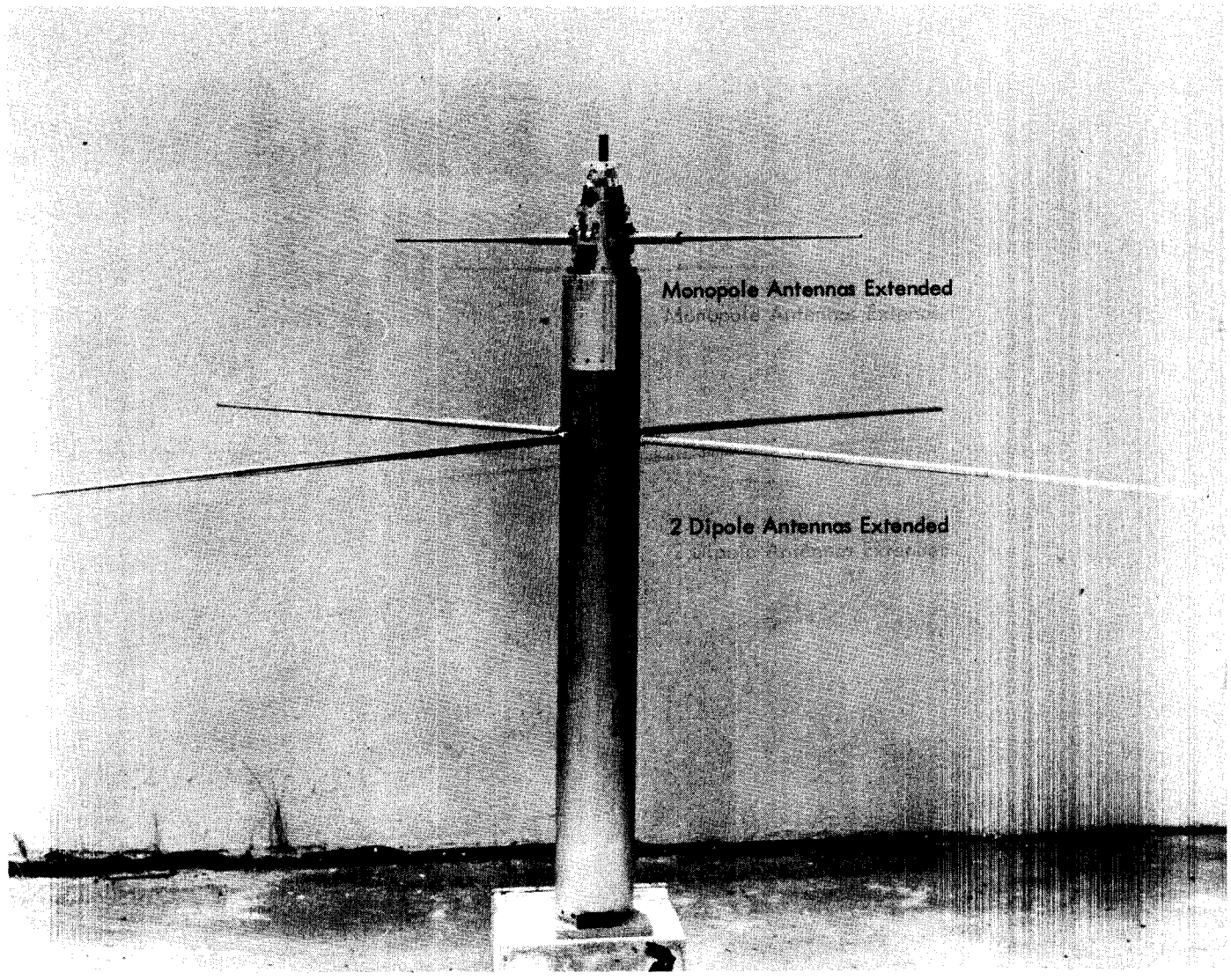


Figure 5. In-flight Configuration of Flight 14.127 Payload

FIELD OPERATIONS

13 July 1964 (Monday)

J. Cameron departed GSFC for Fort Churchill on Sunday, 12 July. W. J. Kite arrived at Wallops Island about 1300Q, Monday, 13 July. R. W. Conrad was already there in support of University of Illinois Nike Apaches 14.144 UI through 14.148 UI. J. Guthrie and company arrived with the payloads during the afternoon of 13 July. The remainder of the evening was spent in unpacking.

14 July 1964 (Tuesday)

The morning was spent checking the individual experiments and assembling the payload. Door and nose cone ejection tests were made in the afternoon. A short telemetry check with GSFC Telemetry Station A was also conducted. RF air time was extremely limited due to Scout and University of Illinois checks being conducted (four payloads) in this period.

15 July 1964 (Wednesday)

Wallops Island had fired seven Nike Apache rockets in the period from 2100Q Tuesday night to 0625Q Wednesday morning. The Island was quite dead except for administrative personnel and Scout payload checks.

A meeting was held around 1000Q at Chincoteague, which included R. Long, H. Needleman, R. Stone, J. Guthrie, R. Kramer, and R. Conrad, to set the checkout and firing schedule for Flight 14.127 GI. With Scout scheduled for Electronics checks between 0830Q and 1130Q on 16 July (firing date), and needing radar support, scheduling for our horizontal, vertical, and RFI checks looked dim. Wallops Island steadfastly maintained that Scout did not have priority, although they readily admitted that Scout tied up their facilities quite effectively. It was decided to schedule launch for 1215Q, approximately Dr. Stone's optimum time, and to fit the other checks in around Scout checks. H. Needleman was supposed to make this arrangement with Scout.

The remainder of the working day was spent in final inspection and assembly, and installation of flight batteries. Another telemetry check was made with GSFC Telemetry Station A at 1900Q to verify payload integrity.

16 July 1964 (Thursday)

Payload turned over to Small Scale personnel at 0600Q for weighing, c.g. measurement, and mating to the Apache rocket motor. Assembly on the pad was completed by 0800Q. The horizontal check was performed immediately because Scout electronics checks were scheduled at 0830Q. No difficulties were encountered.

At approximately 0930Q, Scout had completed part of their checks when they detected problems which would require a few hours to repair. Arrangements were made with Frank White, Scout Systems Manager (Langley Research Center), to utilize this time for Nike Apache vertical checks and RFI. This is the first that Scout people really knew that we were trying to fire. Mr. White was quite cooperative; he relinquished the 240.2 MC RF link, the radars, and even the intercom channel. Vertical checks were completed satisfactorily. The payload was not disturbed by any of the four radars.

HORIZONTAL AND VERTICAL CHECKOUT PROCEDURE

Horizontal and Vertical checkout procedures were performed on 16 July 1964, as follows:

Payload External Power ON

Ground Station A verify telemetry parameters

Recorders on SLOW

Recorders on FAST

Send CAL

Recorders SLOW

Payload to EXT PWR

Payload OFF

Recorders OFF

FIRING DATA

Flight 14.127 GI was launched from Wallops Island, Virginia, on 16 July 1964 at 1622+16Z. Splash time was 6 minutes, 19 seconds after launch. No telemetry dropouts were noted during the flight. (Note: Launch countdown sheet is provided at end of the report.)

SUPPORTING GROUND STATIONS

GSFC Telemetry Station A and Wallops Island Telemetry Station provided ground station support. Magnetic tape recordings and real time paper records were made of the flight. The Project Scientist was provided with real time and playback paper records from both stations. GSFC Station A and WIMB magnetic tapes were sent to R. Conrad for permanent retention.

COMMENTS

Rocket and Instrumentation performance was considered good. Preliminary data indicate that the antenna impedance is modulated as a result of the rocket spin (antenna orientation) in the magnetoionic medium. Investigation of this area was desired. The impedance showed a decided real component under proper conditions in the medium. Investigation of this area was also desired. Preliminary results seemed more than satisfactory.

Ionosphere and earth's magnetic field conditions were very quiet and normal for midday at this season of the year. The critical frequency of the F_2 region was approximately 5.1 MCS over Wallops Island at the time the rocket reached apogee - about 1625Z.

LAUNCH COUNTDOWN FOR FLIGHT 14.127 GI

"T" MINUS: Hr-Min-Sec.	ITEM	OPERATION
03-30-00	1	Release balloon with corner reflector attached and track to 70,000 feet (MPS-19 radar).
03-00-00	2	Release radiosonde balloon and track to maximum altitude.
02-30-00	3	Vehicle is completely assembled on launcher.
02-15-00	4	Clear area.
	5	Turn on external power and perform payload checks in horizontal position.
02-05-00	6	Turn on internal power.
02-00-00	7	Payload checks completed.
	8	Surveillance aircraft on Station:
		Frequencies: Primary..... 326.3 MC Secondary.... 3105 KC AM
	9	Begin releasing theodolite balloons on a 15-minute schedule.
	10	Photographers take documentary stills.
01-30-00	11	Begin releasing theodolite balloons on a 10-minute schedule.
01-15-00	12	Clear Area.
	13	Perform payload checks in vertical position.
	14	Radars radiate on pad for interference checks.
01-00-00	15	Payload check completed.
	16	Launch chaff balloon and track to a 6,000-foot altitude (MPS-19 radar).

LAUNCH COUNTDOWN FOR FLIGHT 14.127 GI (continued)

"T" MINUS: Hr-Min-Sec.	ITEM	OPERATION
00-45-00	17	Clear area and launch standard 2 3/4-inch test rocket from Launch Area No. 2.
00-30-00	18	Release "Danger Zone" warning kytoon.
00-25-00	19	Begin final launcher settings.
00-15-00	20	Time Count.
00-10-00	21	Final launcher settings completed (azimuth and elevation).
00-05-00	22	Clear area for launching (acknowledge) and set up road blocks (announce launch area and launcher).
		Blockhouse No. 2 Radar 1 Radar 2 Radar 4 Radar 5 Doppler Camera 1 Camera 2 Camera 5 Camera 10 Goddard Telemetry Wallops Telemetry Payload Control Main Base Ionosphere Sounding Station Pad Supervisor Range Clearance Control Center
	23	Turn payload on external power.
00-04-00	24	Time Count.
00-03-00	25	Time Count.
00-02-00	26	Payload on internal power.
00-01-00	27	Time Count.
00-00-30	28	Pull umbilical cable after "O.K." from Payload Control.
	29	Hold count until pad is clear.
00-00-15	30	Time Count.

LAUNCH COUNTDOWN FOR FLIGHT 14.127 GI (continued)

"T" MINUS: Hr-Min-Sec.	ITEM	OPERATION
00-00-10	31	Time Count.
00-00-09	32	Time Count.
00-00-08	33	Time Count.
00-00-07	34	Time Count.
00-00-06	35	Time Count.
00-00-05	36	Time Count.
00-00-04	37	Time Count.
00-00-03	38	Time Count.
00-00-02	39	Time Count.
00-00-01	40	Bomb tone ON. Audio heard on 3105 KC.
00-00-00	41	Bomb tone OFF.
	42	First stage (NIKE) ignites.
	43	Second stage (APACHE) 20-second delay squibs ignited via Maypole circuit.
"T" PLUS Hr-Min-Sec.		
00-00-01	44	Time Count.
00-00-02	45	Time Count.
00-00-03	46	First stage (NIKE) burns out and drag separates (3.5 seconds at a 5,356 foot altitude).
00-00-04	47	Time Count.
00-00-05	48	Time Count.

LAUNCH COUNTDOWN FOR FLIGHT 14.127 GI (continued)

"T" PLUS Hr-Min-Sec.	ITEM	OPERATION
00-00-06	49	Time Count.
00-00-07	50	Time Count.
00-00-08	51	Time Count.
00-00-09	52	Time Count.
00-00-10	53	Time Count.
00-00-15	54	Time Count.
00-00-20	55	Second stage (APACHE) ignites - 39,154-foot altitude.
00-00-25	56	Time Count.
00-00-26	57	Second stage (APACHE) burns out (26.4 seconds) at a 60,956-foot altitude.
00-00-27	58	Time Count.
00-00-28	59	Time Count.
00-00-29	60	Time Count.
00-00-30	61	Time Count.
00-00-35	62	Time Count.
00-00-40	63	Time Count.
00-00-45	64	Time Count.
00-00-50	65	Time Count.
00-00-51	66	Time Count.
00-00-52	67	Time Count.
00-00-53	68	Clam-shell ejection (2 nose-cone antennae extend).

LAUNCH COUNTDOWN FOR FLIGHT 14.127 GI (continued)

"T" PLUS: Hr-Min-Sec.	ITEM	OPERATION
00-00-54	69	Four antennae doors eject (2 dipole antennae extend).
00-00-55	70	Time Count.
00-01-00	71	Time count - continued in 30-second intervals until impact.
	72	Apogee (190.2 seconds) at a 474,393-foot altitude.
	73	Impact (373.0 seconds) at a 508,837-foot horizontal range.
		NOTE: FPQ-6 and SPANDAR radars make post-flight calibration.

APPENDIX A

Appendix A contains the calibration data and their respective curves for the Schonstedt RAM-3 magnetometers.

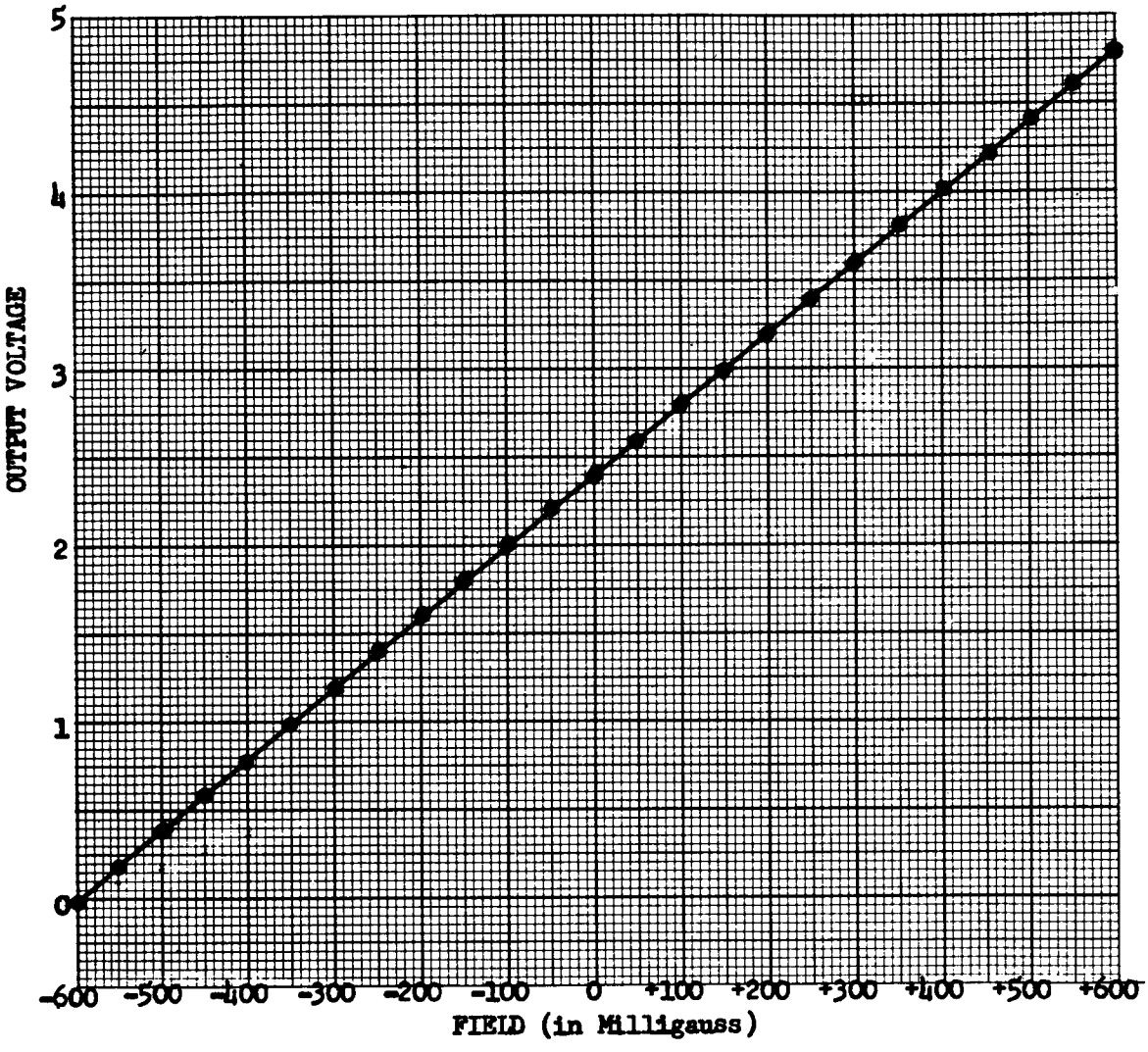


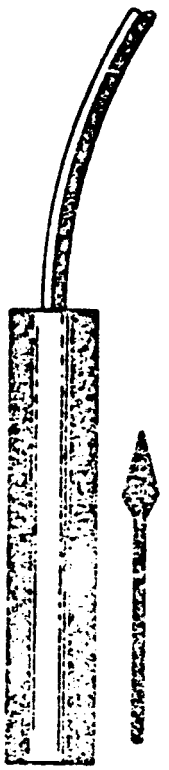
Figure A-1. Schonstedt RAM-3 Magnetometer (S/N 939) Longitudinal Calibration Data Curve

CALIBRATION DATA

MAGNETIC ASPECT SENSOR
TYPE RAM-3

SERIAL NO 939

FIELD IN MILLIGAUSS	OUTPUT SIGNAL IN VOLTS D C	
600	4.80	
550	4.62	
500	4.43	
450	4.23	
400	4.03	
350	3.82	
300	3.61	
250	3.40	
200	3.19	
150	2.99	
100	2.79	
50	2.59	
0	2.40	(BIAS LEVEL)
-50	2.21	
-100	2.01	
-150	1.81	
-200	1.61	
-250	1.41	
-300	1.20	
-350	.99	
-400	.77	
-450	.57	
-500	.37	
-550	+.18	
-600	-.01	



DIRECTION OF MAGNETIC FIELD FOR VOLTAGE SIGNALS ABOVE BIAS LEVEL

NOTE:
CALIBRATION MADE WITH A 100K OHM RESISTOR FROM SIGNAL OUTPUT TO NEGATIVE TERMINAL OF BATTERY SOURCE, AND A 100K OHM RESISTOR FROM BIAS OUTPUT TO NEGATIVE TERMINAL OF BATTERY SOURCE

SCHONSTEDT INSTRUMENT COMPANY
SILVER SPRING, MARYLAND

CALIBRATION MADE WITH BATTERY SUPPLY OF 6.3 VOLTS DATE 4-11-63

Figure A-2. Schonstedt RAM-3 Magnetometer (S/N 939) Longitudinal Calibration Data

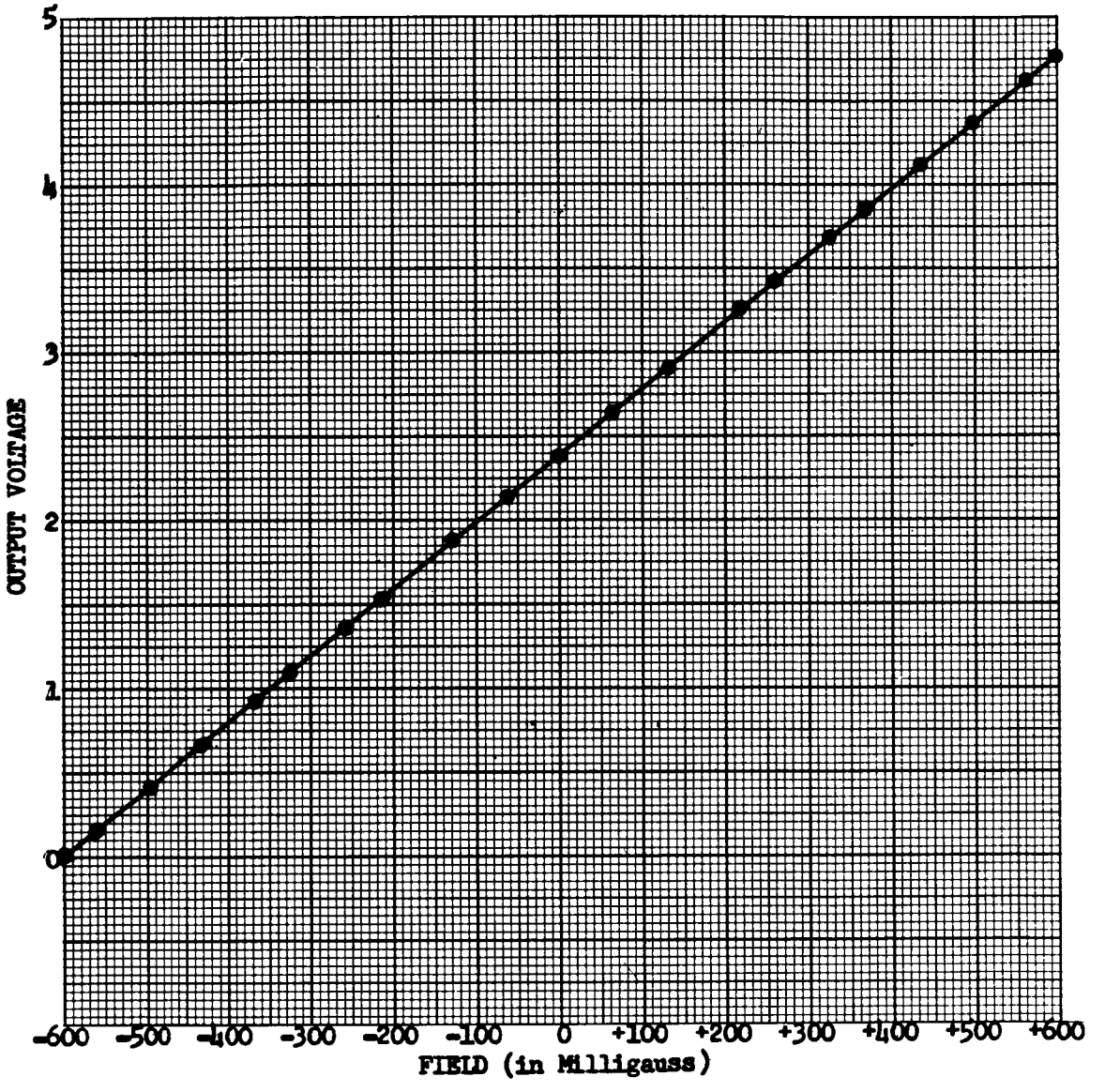


Figure A-3. Schonstedt RAM-3 Magnetometer (S/N 737) Lateral Calibration Data Curve

MAGNETIC ASPECT SENSOR
TYPE RAM-3

SERIAL Nº 737

CALIBRATION DATA

FIELD IN MILLIGAUSS	OUTPUT SIGNAL IN VOLTS D C	
600	4.77	
561	4.63	
497	4.39	
432	4.13	
367	3.87	
324	3.69	
259	3.43	
216	3.25	
130	2.90	
64.8	2.64	
0	2.39	(BIAS LEVEL)
-64.8	2.14	
-130	1.88	
-216	1.53	
-259	1.35	
-324	1.09	
-367	.92	
-432	.66	
-497	.40	
-561	.15	
-600	0	

DIRECTION OF MAGNETIC FIELD FOR VOLTAGE SIGNALS ABOVE BIAS LEVEL.

NOTE:
CALIBRATION MADE WITH A 100K OHM RESISTOR FROM SIGNAL OUTPUT TO NEGATIVE TERMINAL OF BATTERY SOURCE, AND A 100K OHM RESISTOR FROM BIAS OUTPUT TO NEGATIVE TERMINAL OF BATTERY SOURCE.

SCHONSTEDT INSTRUMENT COMPANY

SILVER SPRING, MARYLAND

CALIBRATION MADE WITH BATTERY SUPPLY OF 6.3 VOLTS DATE 6/22/62

Figure A-4. Schonstedt RAM-3 Magnetometer (S/N 737) Lateral Calibration Data