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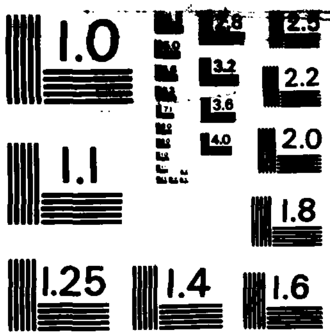

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AFGL-TR-83-0320

AN IMPROVED ION DRIFT METER

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Center for Space Sciences
The University of Texas at Dallas
Box 830688
Richardson, Texas 75083-0688

Final Report
24 May 1982 - 23 Nov 1983

November 1983

Approved for public release; distribution unlimited

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

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This report provides the necessary operation, diagnostic and repair information for using and maintaining the Improved Ion Drift Meter (IDM). The report is divided into four sections. Section 1 contains the instrument description and theory of operation. Section 2 contains a description of planned spacecraft-level instrument testing, stimulation requirements and procedure, and instrument handling and safety. Section 3 contains a copy of the End-Item Acceptance Test (EIAT) that describes test results and presents calibration data and procedures. Any recalibration of the instrument will be performed per the EIAT calibration test [over]

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) procedure. Section 4 contains a list of the schematics, drawings, parts lists and wiring lists that describe the as-built configuration of the instrument. This documentation is available to AFGL upon request.

Preface

This report provides the necessary operating, diagnostic and repair information for using and maintaining the Improved Ion Drift Meter (IDM). The report is divided into four sections. Section 1 contains the instrument description and theory of operation. Section 2 contains a description of planned spacecraft-level instrument testing, stimulation requirements and procedure, and instrument handling and safety. Section 3 contains a copy of the End-Item Acceptance Test (EIAT) that describes test results and presents calibration data and procedures. Any recalibration of the instrument will be performed per the EIAT calibration test procedure. Section 4 contains a list of the schematics, drawings, parts lists and wiring lists that describe the as-built configuration of the instrument. This documentation is available to AFGL upon request.

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SECTION 1

INSTRUMENT DESCRIPTION

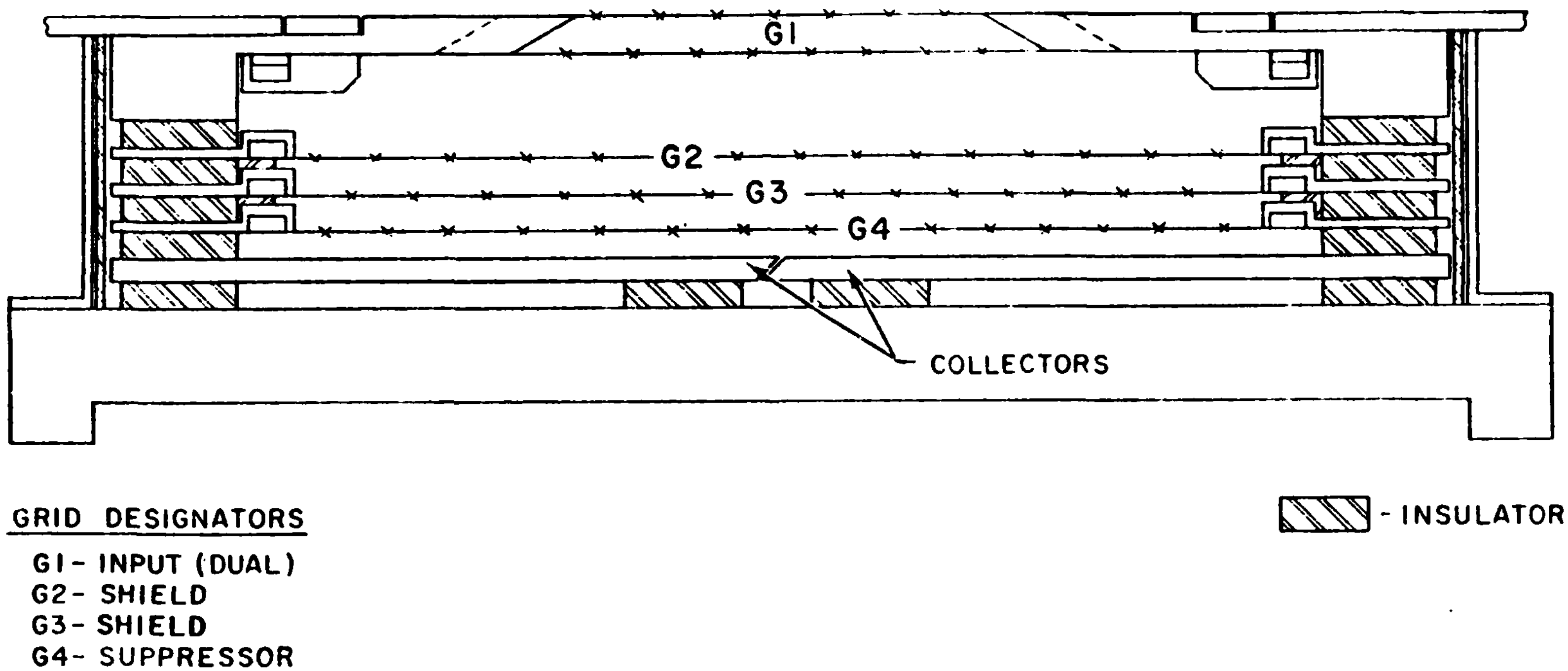
1.0 GENERAL

The IDM is designed to be combined with a retarding potential analyzer (RPA) built by the Air Force Geophysics Laboratory (AFGL). The combined IDM/RPA is part of the instrument complement designed for the DNA/TRANSIT HILAT satellite. The IDM provides all telemetry and timing signal interface to the spacecraft, timing signals to RPA, data storage and read-out. Since the positive potentials exposed on the spacecraft solar array are expected to drive the spacecraft potential negative, the IDM provides a scheme for electrically isolating the sensors and actively maintaining the sensor potential near the plasma potential.

2.0 THEORY OF OPERATION

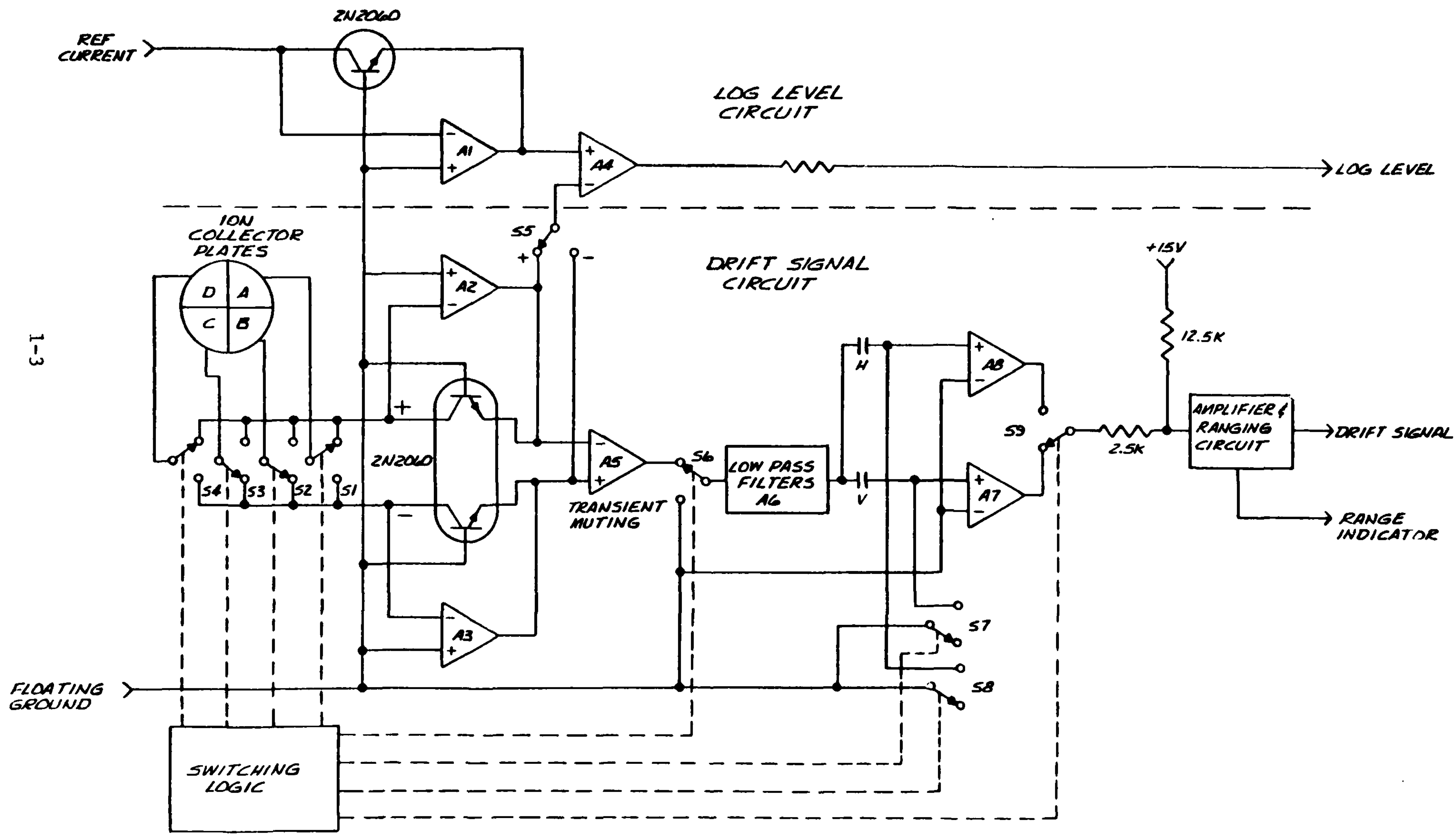
The drift meter sensor is illustrated in Figure 1. The sensor consists of a square aperture placed in front of a collector that is segmented into quadrants. The first four grids are fixed at the floating ground potential to provide a field free drift space for the ions. The last grid is biased negatively and serves as an electron suppressor for the collector and also as an electron repeller for ambient electrons.

The ion collector consists of four pie-shaped segments fitted together into a circle. Each 90° sector is insulated from the others and from the sensor housing. For reference purposes, the collector plates are labeled A, B, C, and D (Figure 2). Pairs of collector plates are selectively coupled to the electrometers (log-amps) by means of the four switches labeled S1 through S4. (Actually, all switches in this diagram are FET transistors with appropriate gate bias voltages.) The log-amps are labeled + (A2) and - (A3) for reference purposes. For the switch settings shown, plates A and D are connected to the + log-amp while plates B and C are connected to the - log-amp. When



IDM SENSOR CROSS-SECTION

FIGURE 1



DRIFT METER FUNCTIONAL DIAGRAM

FIGURE 2

the spacecraft is properly oriented, and the ions are drifting upward go through the aperture, plates A and D receive more ions than plates This causes more positive current to flow into the + log-amp than into amp. The outputs of both A2 and A3 are negative but A2 is more negati cause of the extra current. (A2 and A3 are inverting feedback amplifi The 2N2060 dual NPN transistor between A2 and A3 is a logarithmic feed device; therefore the output voltages of A2 and A3 are proportional to logarithm of the input currents.

The outputs of the log-amps are compared in the difference ampli A5. The output of A5 then, depends only on the ratio of input current the log amps,and the polarity of the A5 output corresponds to the dire of the ion drift.

The 2N2060 transistor used as a logarithmic element contains tw matched transistors in one case. Since the units are matched and are same temperature, the non-logarithmic constant and temperature effect well cancelled over the input current range and temperature range. T remains a temperature effect on logarithmic sensitivity. This is eas compensated by sensistors in the circuitry associated with A5. The o error from these effects is well less than one percent over the total range of the instrument.

The transient muting circuit (S6) is needed to eliminate large transients from the signal path of the instrument during the time whe collector plates are being switched from one input to the other. The die out rather rapidly (milliseconds) but their presence at the filte could cause appreciable error in the resulting output without this mu

The log-level circuit at the top of the figure monitors the ion level at the input collector plates. Switch S5 selects either the +

or the - log-amp and compares this to a reference voltage developed by A1. The reference log amp (A1) has a fixed input current. Difference amplifier A4 subtracts the output of the lower log amp from the reference voltage and amplifies the difference to produce an output corresponding to the amplitude of the ion input current. S5 is switched such that the + and - log amps are alternately sampled. This data is used primarily to monitor the behavior of the individual log-amps over the mission lifetime but also provides a measurement of N_i.

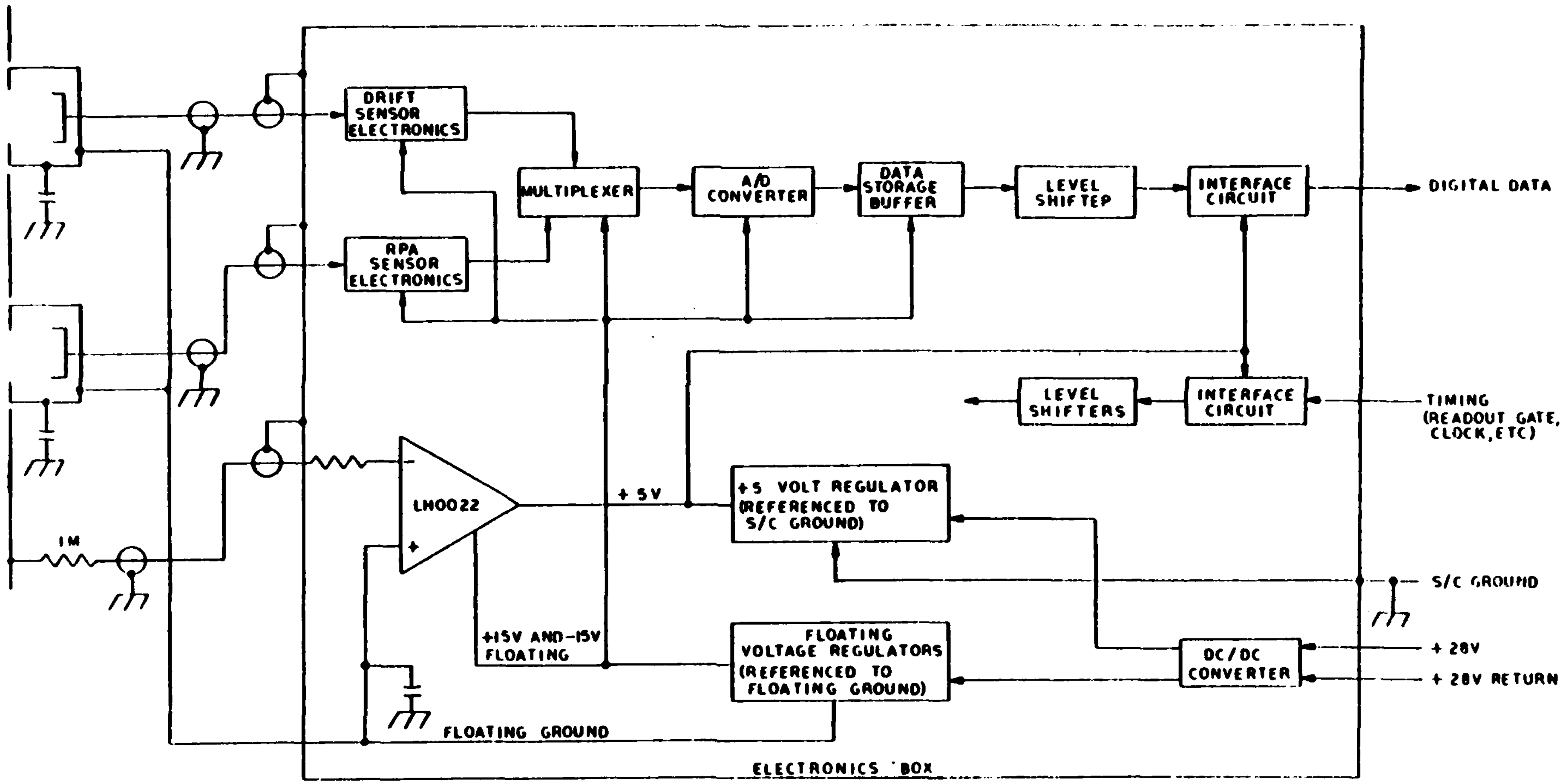
The drift signal, which is proportional to the tranverse components of the ion convection velocity, is developed by first filtering the output of A5 to limit the band width to prevent aliasing at the telemetry sample rate. A three pole low-pass Butterworth filter is used. The signal is then capacitively coupled into amplifiers A7 and A8. The capacitive coupling allows amplifier rezeroing to compensate for imbalances in the amplifiers and for amplifier drift due to temperature and aging.

Amplifier A8 and the associated input capacitor are used for horizontal (H) measurements while A7 and its capacitor are used for vertical (V) measurements.

At the beginning of a measurement sequence the collectors are configured to, say, the V configuration, the V zero switch (S7) is closed and the output of A7 is connected to the ranging circuit by S9. The resistor network at the output of A7 established the drift signal zero level. The zero level is nominally +2.5 V which corresponds to the center of the telemetry band. The V coupling capacitor is charged to a voltage which represents the drift angle during the re-zero time. After the V zero measurement is made, the zero switch is opened and a measurement is made with the collector plates reversed. The voltage out of the filter goes to the opposite polarity but with the same amplitude. Since the V capacitor has its original charge that was established during the re-zero measurement, and the new voltage from the filter is equal but opposite, the voltage into amplifier A7 is twice the voltage corresponding to the drift angle. This is referred to as the V offset or double angle measurement. The automatic ranging circuit adjusts the gain of the amplifier for maximum drift signal amplification while maintaining the output within the telemetry band.

After the V offset measurement is made, the collectors are set to the horizontal configuration and H rezero and offset measurements are made using A8 and the H capacitor to preclude disturbing the charge on the V capacitor. Both capacitors are now charged to voltages proportional to the V and H ion angle of arrival at the times that the offset measurements were made. The capacitor and amplifier circuits are designed such that the capacitor charges can be maintained for several seconds, so by setting the collectors to either the H or V rezero configuration (without closing S7 or S8), and connecting S9 to the appropriate amplifier (A7 or A8), small changes in ion arrival angle can be observed relative to the "zeroed" angle on the most sensitive amplifier range. Either V or H arrival angle changes can be observed for several seconds at the available TM sample rate or alternate V and H measurements can be made using S9 to switch between the A7 and A8 outputs.

The scheme used for maintaining the sensor and associated electronics near the plasma potential is illustrated in Figure 3. The ground plane, sensor housings, electronics box and outer bundle shield of the sensor-to-electronics box cable are isolated from the spacecraft chassis. The "floating ground" potential on these elements of the instrument is established in-flight when equal ion and electron currents are being collected by the forward-looking sensor faces and ground plane. (This equilibrium should occur at ≅ 1 volt



NOTE:
ELECTRONICS BOX AND SENSOR MOUNT ARE IN ELECTRICAL CONTACT WITH S/C CHASSIS. SENSORS ARE INSULATED FROM THE MOUNT AND GROUND PLANE IS INSULATED FROM SENSORS.

DNA / SAT DRIFT METER BIAS DIAGRAM

FIGURE 3

below the plasma potential.) The instrument is powered by floating power supplies referenced to the floating ground potential. Level shifters are used for interfacing digital signals with the spacecraft and DC isolation of the power system is obtained through the DC to DC converter transformer. A low-leakage zener diode is used between floating ground and spacecraft ground to preclude large floating ground potentials during ground operations.

3.0 INSTRUMENT DETAILS

3.1 Telemetered Data

- RPA electrometer (RPA)
- RPA sweep monitor (SWP)
- Ion Drift Meter angle of arrival measurements (IDM)
- Frame Counter (COUNT) - counts TM frames in modulus 128 (0 to 127)
- IDM log electrometer outputs (LLA and LLB)
- Electron probe electrometer (ELECT)
- Temperature monitor (TEMP)
- Sensor potential monitor (SENPOT)
- 4 bandpass filter outputs (F1, F2, F3, F4)

3.2 Data Storage/Readout

• The data format is given in Figure 4. Each telemetry frame is divided into 64 equal time slots by a 128.0625 hz word counter. The telemetry words are numbered according to the time slot in which they occur. The data is sampled and stored 5.06 msecs after the beginning of the time slot as indicated in Figure 5. The 512 bits/frame are allocated as follows:

FIGURE 4

DNA/SAT DATA SAMPLING FORMAT (Nov. 3, 1982)

COUNT	SUBCOM	ELECT	IDM	RPA	SWP
0	0				
1		1			
2			2		
3				3	
4					
5		5			
6			6		
7				7	
8					8
9		9			
10			10		
11				11	
12					
13		13			
14			14		
15				15	
16	16				
17		17			
18			18		
19				19	
20					
21		21			
22			22		
23				23	
24					24
25		25			
26			26		
27				27	
28					
29		29			
30			30		
31				31	
32	32				
33		33			
34			34		
35				35	
36					
37		37			
38			38		
39				39	
40					40
41		41			
42			42		
43				43	
44					
45		45			
46			46		
47				47	
48	48				
49		49			
50			50		
51				51	
52					
53		53			
54			54		
55				55	
56					56
57		57			
58			58		
59				59	
60					
61		61			
62			62		
63				63	

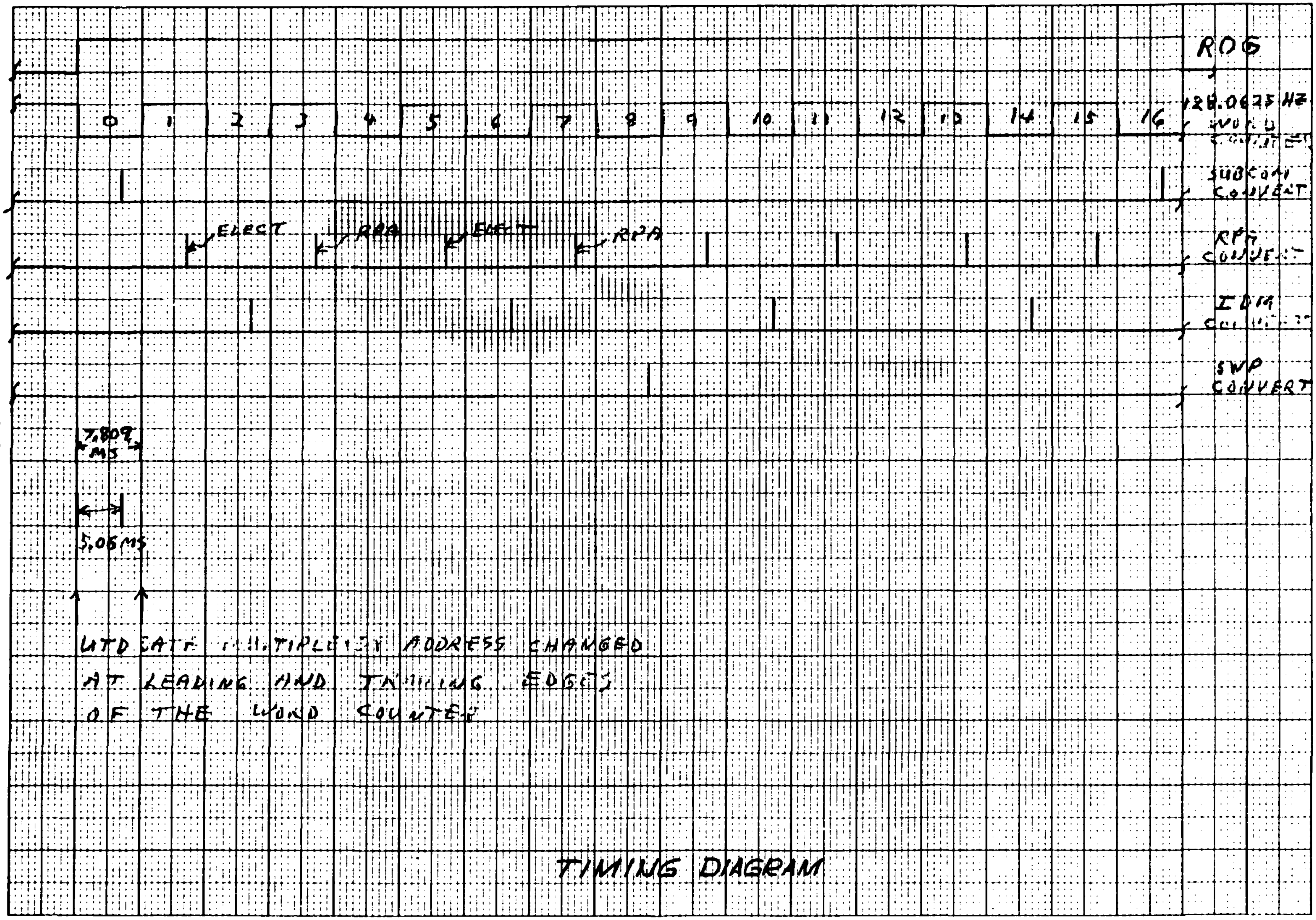

ROG
128.0625 HZ
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
SUBCOM
CONVERT
ELECT
RPA
RPA
SWP
CONVERT
7.809 MS
5.06 MS
AT LEADING AND
OF THE WORD
TIMING DIAGRAM

FIGURE 5

Word Content	# Words/frame	# Bits/word	Total # bits
RPA	32	9	288
SWP	4	8	32
IDM	16	10	160
SUBCOM	4	8	32
TOTALS	56		512

• The data content of the subcom words is multiplexed as follows:

Word #	Frame # 0,4,8 ...124	Frame # 1,3,5...127	Frame # 2,6,10...126
0	COUNT	F1	COUNT
16	LLA	F2	LLA
32	LLB	F3	LLB
48	TEMP	F4	SENPOT

• Two data storage registers are used so that one register may be loaded while the other is read by the telemeter. Data readout will lag data store by 0.49976 secs. (1 frame). Each word is serially stored as it occurs in the data format. Since the telemeter is an 8 bit system, the 8,9 and 10 bit word patterns will have to be reconstructed on the ground.

3.3 Power

The UTD-built portion of the instrument (IDM) requires the following voltages (F = floating):

+ 12 VF @ 35 ma

- 12 VF @ 45 ma

+ 5 VF @ 15 ma
+ 5 V @ 10 ma

3.4 Timing Signals from S/C to IDM

• 4098 Hz clock (CLK)

• Read Out Gate (ROG)

• SOF - This signal probably will not be used.

3.5 Analog Data Lines from RPA to IDM

• RPA - A single line connected to the RPA electrometer during frames 0-123 and to the electron probe electrometer during frames 124-127. Multiplexing is done within the RPA electronics.

• SWP - A single line connected to the RPA sweep monitor continuously.

• ELECT - A single line connected continuously to the electron probe electrometer.

• TEMP - A single line connected continuously to the RPA temperature monitor.

• FILTERS - A single line that is sequentially connected to the filter outputs such that filters F1, F2, F3 and F4 are sequentially sampled by words 0, 16, 32 and 48. This multiplexing is done in the RPA electronics. Additional multiplexing in the IDM electronics will allow the filter data to be sampled only during odd numbered frames.

3.6 Timing Signals from IDM to RPA (Logic level 1 = + 5 volts)

• RPA CONVERT - (See Figure 3) A line with ≈ 32 Hz pulses of ≈ 25 μsec duration. The pulses are high during each A/D conversion of the RPA line.

• RPA SYNC - A line with a single pulse of ≈ 60 μsec duration during frame 0 only.

• POR - A power on reset pulse that goes high at power on and goes low at the next ROG. An RPA SYNC pulse is always generated after the POR pulse as shown in Figure 6.

3.7 S/C Interface Circuits

Interface circuit sketches are attached. (Figure 7)

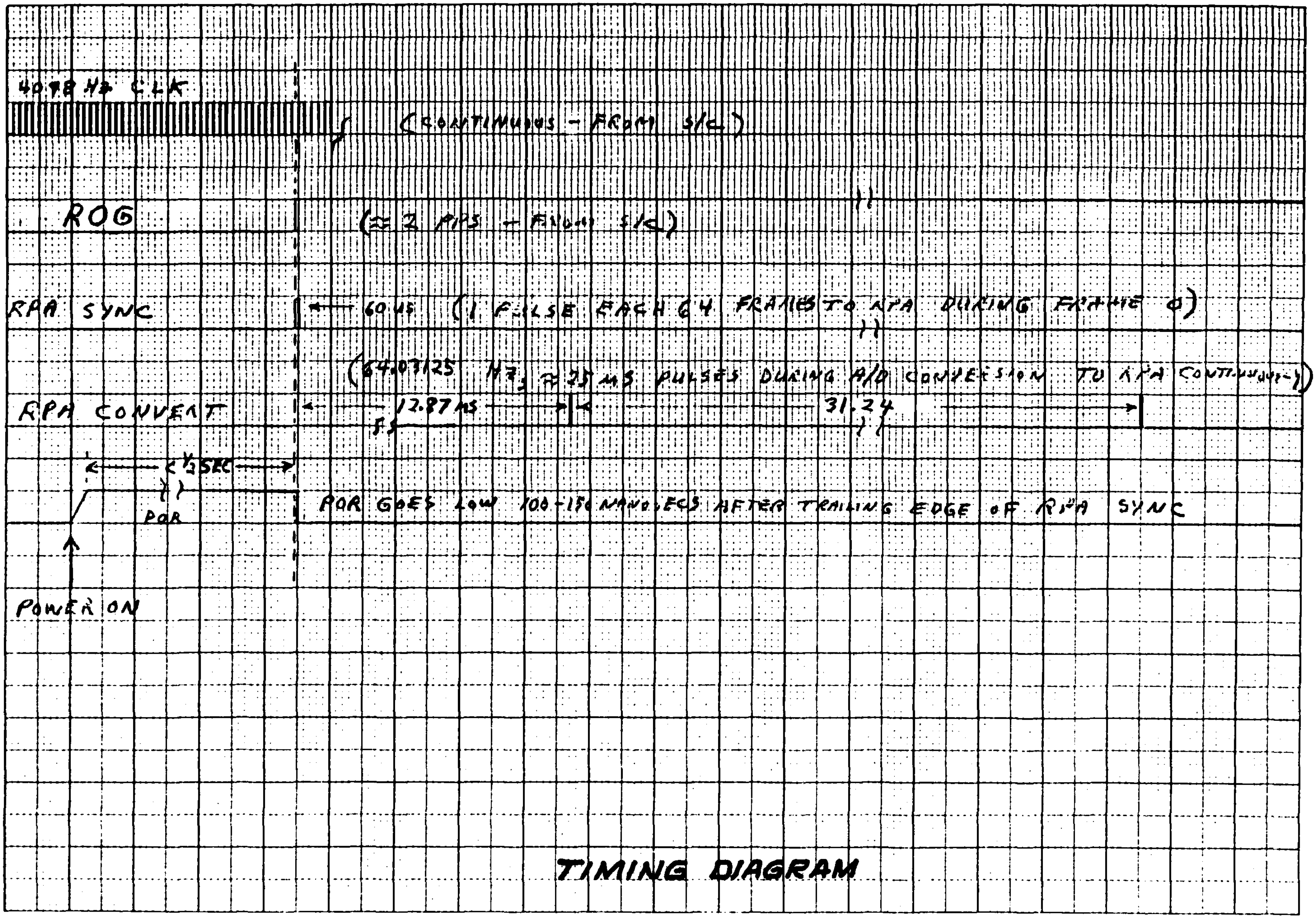
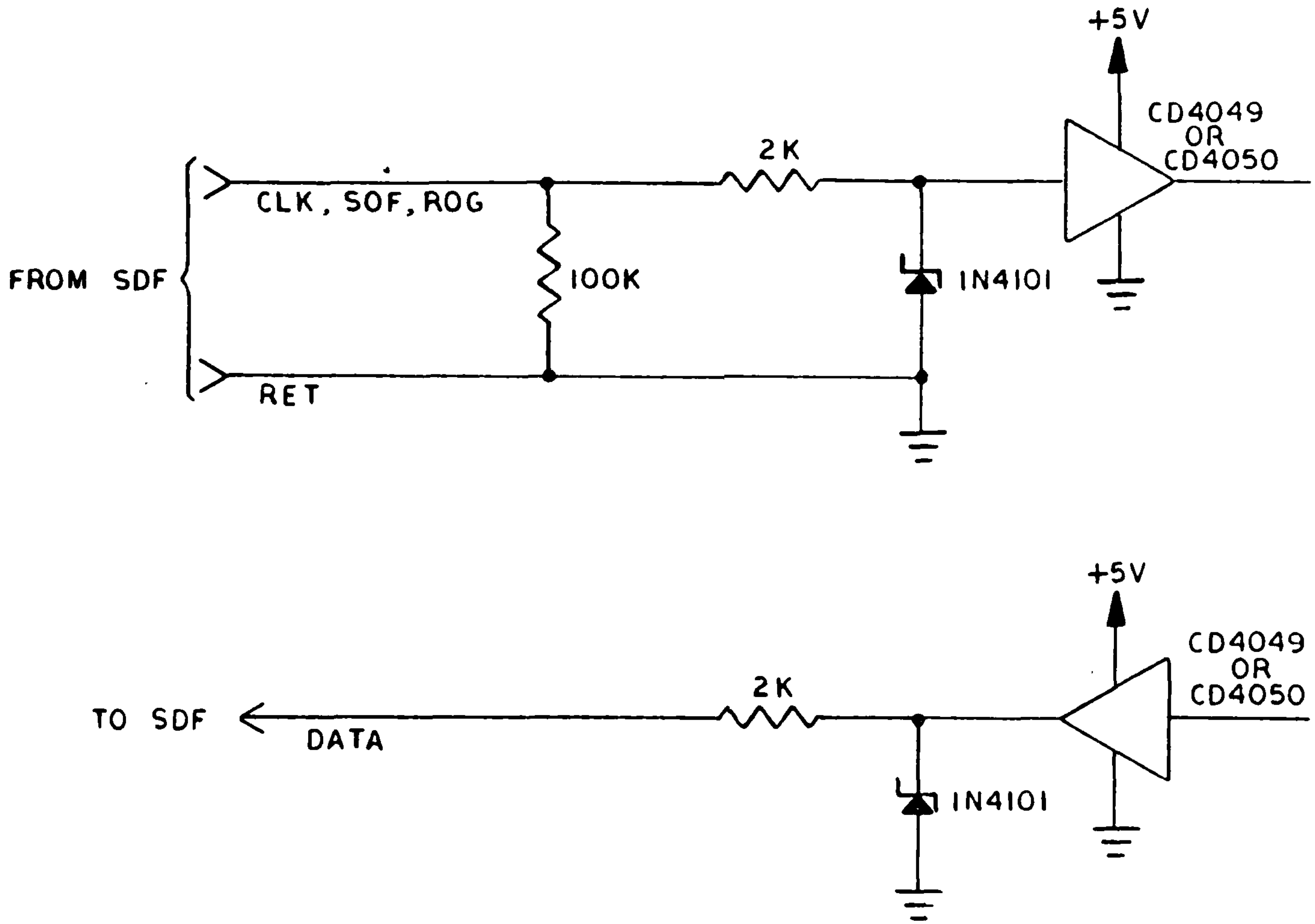

4098 Hz CLK
(CONTINUOUS - FROM S/C)
ROG
(≈ 2 PPS - FROM S/C)
RPA SYNC
60 µS (1 PULSE EACH 64 FRAMES TO RPA DURING FRAME 0)
(64.03125 Hz, ≈ 25 µS PULSES DURING A/D CONVERSION TO RPA CONTINUOUSLY)
RPA CONVERT
12.87 mS
31.24
< ½ SEC
POR
POR GOES LOW 100-150 NANOSECS AFTER TRAILING EDGE OF RPA SYNC
POWER ON
TIMING DIAGRAM

FIGURE 6



DRIFT METER/SDF INTERFACE

FIGURE 7

3-22-82

3.8 IDM Data Interpretation

• There are two drift signal amplifier channels, each channel having 4 sensitivity ranges differing by a factor of 4. At the beginning of each 4 second period, H and V rezero (H_Z,V_Z) and offset (H_o,V_o) measurements are made with the repeller grid bias set at $\sim$+ 2 volts. The grid is then set to zero and the H and V rezero and offset measurements are repeated. The H and V rezero values are stored independently and deviations (H,V) from these values are telemetered in the following manner:

Beginning at	BIAS ON	BIAS OFF	
Frame 0	$H_Z H_o V_Z V_o$	$H_Z H_o V_Z V_o$	H H H H ...
Frame 8	$H_Z H_o V_Z V_o$	$H_Z H_o V_Z V_o$	H V H V ...
Frame 16	$H_Z H_o V_Z V_o$	$H_Z H_o V_Z V_o$	H H H H ...
Frame 24	$H_Z H_o V_Z V_o$	$H_Z H_o V_Z V_o$	H V H V ...

• Each sample is 10 bits, 2 bits for range data and an 8 bit A/D conversion of the drift signal.

• The LLA and LLB TM Samples always occur in the horizontal rezero configuration, i.e. collectors A & B are connected to LLB and collectors C & D are connected to LLA.

SECTION 2

SPACECRAFT-LEVEL INSTRUMENT TESTING, INSTRUMENT HANDLING AND SAFETY

1.0 General

This section defines the electrical tests planned for the Driftmeter/RPA after installation on the spacecraft.

2.0 Electrical Performance Evaluation Test (EPET)

The EPET provides an automated test procedure for accumulating up to 64 consecutive seconds of instrument data and printing the data in a specified format. The instrument performance evaluation will be based on visual observation of the printed data. The EPET can be performed either with or without stimulation. The detailed procedure for performing the EPET utilizing the HP9825 computer is given in 8.0 below.

3.0 Stimulation

Battery powered stimulation units are used to provide test currents to the sensors. The test currents are injected by probes that screw into the front face of the sensor and make contact with the collectors. The stimulation unit requires ~6 inches clearance in front of the sensor aperture plane for installation. The planned usage of the stimulation unit is limited to tests performed with attending UTD/AFGL personnel. Installation or removal of the stimulation unit will require approximately 30 minutes.

4.0 Sensor Grid Test

The sensor grid test is performed by UTD/AFGL personnel after final instrument installation on the spacecraft, after completion of S/C environmental testing, and during S/C checkout at WTR. The test consists of attaching test probes to the internal sensor grids and verifying the correct grid potentials.

5.0 Instrument Handling and Safety

5.1 Protective sensor covers should be utilized whenever se installed (except during EMI and vibration testing) to prevent parti contamination from entering the sensor entrance apertures and to pre physical damage to the exposed entrance grids. Stimulus probes may with the protective covers in place.

5.2 Always minimize instrument handling and utilize approve when handling is necessary.

6.0 Red Tag Items

The protective covers over the sensor apertures will be at the latest practical time at WTR. Captive hardware is used for a the protective covers to the sensor face. After removal of the prot covers, gold plated screws must be installed in the sensor face to f holes.

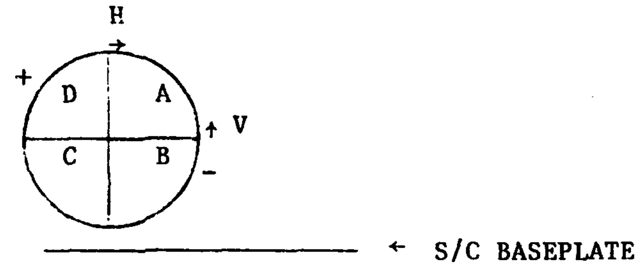
7.0 STIMULATION PROCEDURE

7.1 If sensor assy is not connected to the E-box, connect stimulation unit to E-box as follows:

- Stimulation connector "C" to J3 (SENPOT) connector
- Stimulation connector "-" to J4 - A1 (collector B)
- Stimulation unit connector "+" to J4 - A3 (collector D)

7.2 If sensor assy is connected to E-box, connect stimulation unit as follows:

- Install stimulation probes in sensor face to collectors B and D.



- Connect stimulation unit connector "C" center conductor to the sensor ground plane and connect "C" shield to S/C chassis.
- Connect stimulation unit connector "+" to collector D and "-" to collector B.

7.3 Set "FIX/CYCLE" switch on stimulation unit to "FIX".

7.4 Set "ON/OFF" switch to "ON"

7.5 Record and print 16 frames of IDM data.

7.6 Compare data to sample print-out. In particular, note the following

(1) LLA ≅ 3.48
    LLB ≅ 3.22
(2) H offset = 1.68/4
    V offset = 3.40/4
    H rezero = 2.54/1
    V rezero = 2.54/1
(3) SENPOT LOW = 4.52
    SENPOT HIGH = 2.38

[battery voltage = 18-4 (SENPOT voltage)]

8.0 Instrument Checkout Procedure

Step 1: Connect power cords on each unit to 110 V A.C. (9876A, 9825, AGE)

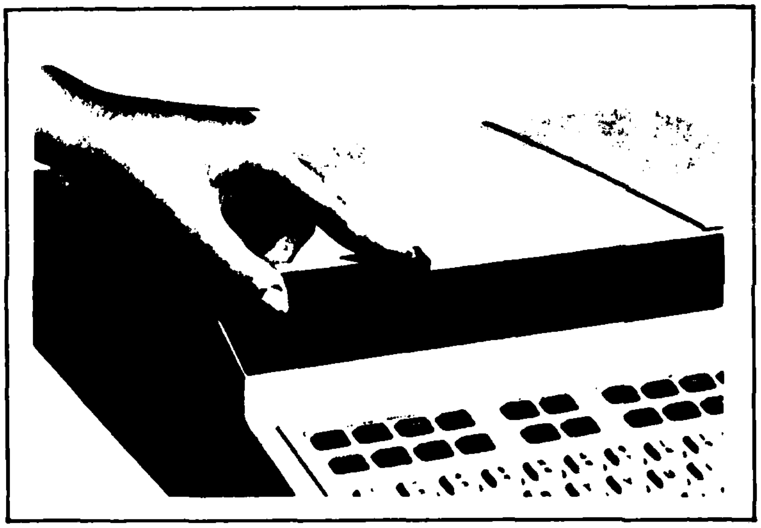
Step 2: Connect 98032A interface cable between 9825 computer and AGE. (top connector on back of AGE unit)

Step 3: Connect 98034A interface cable between 9825 computer and 9876A printer.

Step 4: Connect braided interface cable between AGE and DNA instrument.

Step 5: Turn on power to each unit. (switch locations: left front on 9876A, right side on 9825, center front on AGE and left front on AGE) Set both thumbwheel switches to "15,FF".

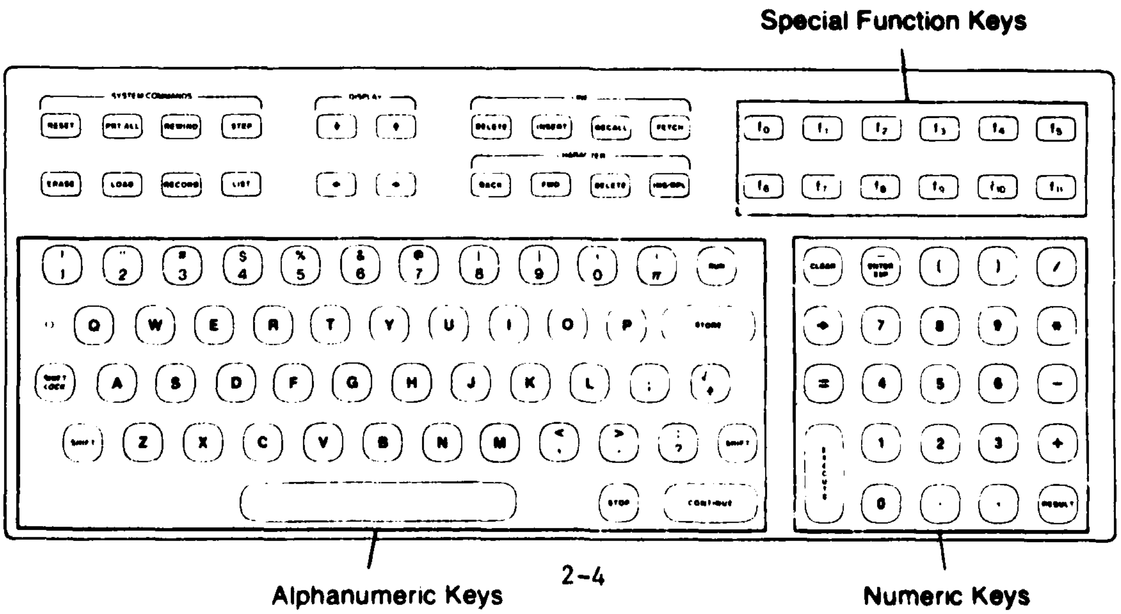
Step 6: Load magnetic tape cartridge (RAP009) into 9825 tape drive.



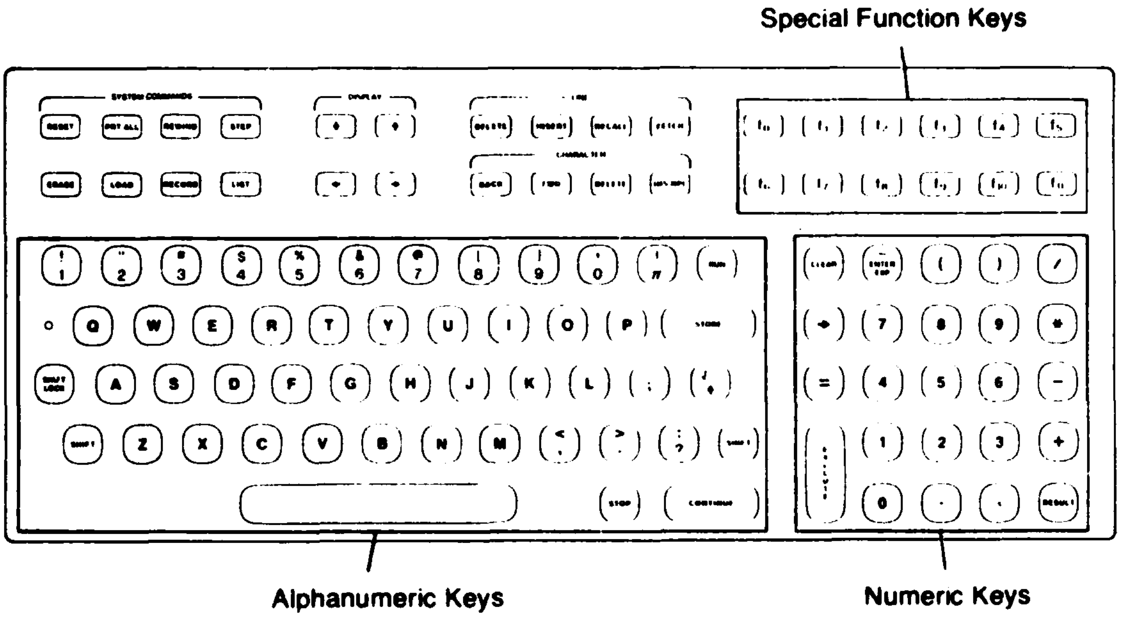
Insert the tape cartridge so the label on the cartridge faces the back of the calculator as shown.

Inserting the Tape Cartridge

Step 7: Press "LOAD" system command key. Press "EXECUTE" key. Checkout program will then load into computer memory.



Step 8: Press "RUN" key to start program. Flag definitons will be printed on twenty-column printer.



Step 9: Change flag settings, if desired, by using "sfg" and/or "cfg" commands. For example: to set flags 0 and 3, type

sfg 0,3

then press the "EXECUTE" key.

To clear flags 1 and 2, type

cfg 1,2

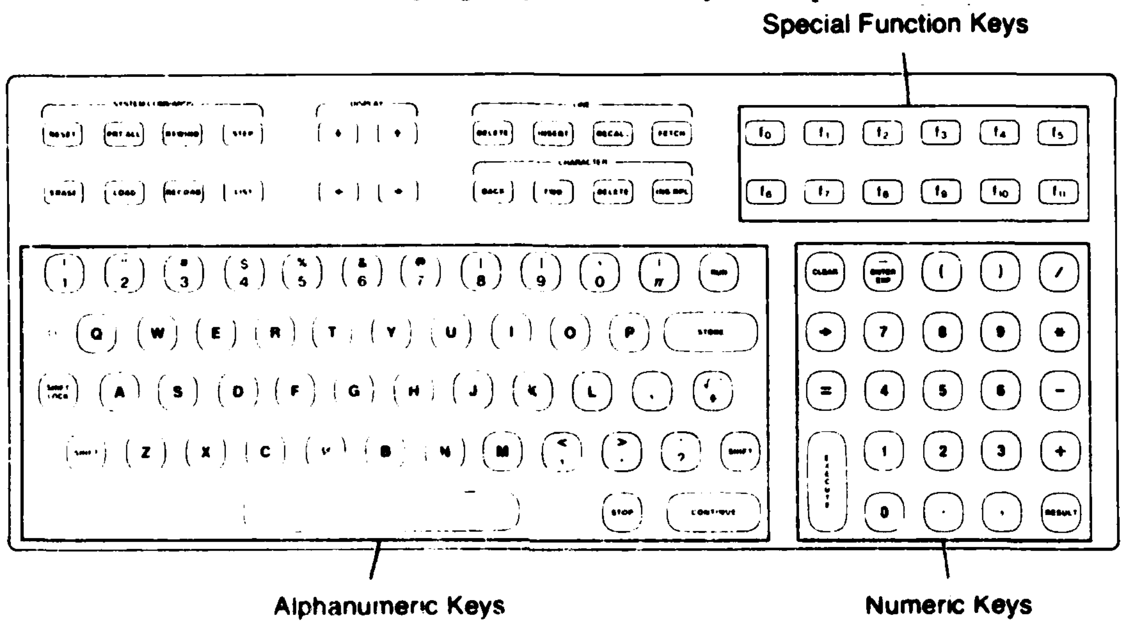
then press the "EXECUTE" key.

See Appendix A for flag definitions.

Step 10: Enter date, time, and operational comments by typing in as desired from keyboard followed by "CONTINUE". Each line of input is printed on the 9876A printer when the "CONTINUE" key is pressed. As many lines of comment may be entered as desired. Terminate the input session by again pressing "CONTINUE" without entering any further comments. (If a mistake is made press "CLEAR" key to clear the input.)

Step 11: Enter starting major frame no. and ending major frame no. to be printed. Separate the frame numbers with a comma. Press "CONTINUE" key to proceed. (If a mistake is made press "CLEAR" key to clear the input.)

Data transfer will then be initiated by program, followed by data print-out on 9876A.



Step 12: Program cycles back to step 11 for next test if desired. To terminate session at any time press "RESET" system command key.

Step 13: To re-start program after a termination (see step #12), proceed from step #8 in instructions.

Step 14: Remove magnetic tape cartridge by pressing eject button directly below cartridge.

Step 15: Turn off power to each unit.

Appendix A

flag no.	definition	default
0	record data on magnetic tape	off
1	print RPA data	on
2	print IDM data	on
3	off = major frame no. input in step #11 refers to the data transfer frame no., i.e. frame no. 1 is the first frame recorded by the program on = major frame no. input in step #11 refers to the data frame count generated by the instrument	off
9	program test pattern generator	off

SECTION 3

CALIBRATION DATA AND PROCEDURES

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL

AUTHENTICATION	
NAME	DATE
DRN.	
CHK.	
DSGN [illegible]	[illegible]
APP.	
APP.	
APP.	
APP.	

THE UNIVERSITY OF TEXAS AT DALLAS

HILAT ION DRIFT METER

END-ITEM ACCEPTANCE TEST

SIZE	CODE IDENT		REV
A	14614	133-004	

SCALE	WT	SHEET 1 OF 10

1.0 SCOPE

This document establishes the acceptance performance test criteria for end-item testing (EIAT) at UTD of the ION DRIFT METER (IDM) for the DNA HILAT satellite.

2.0 APPLICABLE DOCUMENTS

UTD 131-012 Test Requirements, General
IDM Schematics, Current Shop Copy
UTD 133-003 HILAT IDM Interface Document

3.0 GENERAL REQUIREMENTS

3.1 PERSONNEL

The GSE shall be operated and the testing performed by the IDM Electronics Engineer and/or qualified personnel designated by him.

3.2 TEST ENVIRONMENT

The Electrical Performance Evaluation Test (EPET) shall be performed at +60±4°C, +25±4°C(RT), and -20±4°C at room pressure. The Calibration Test shall be performed at +50±4°C, +25±4°C, and 0±4°C.

The vacuum source tests shall be performed at room temperature and at pressures less than 2×10^{-5} torr (nominal) as measured on the ionization gauge. There is no requirement for calibrating the ionization gauge.

3.3 DATE TEST PERFORMED

11-18-82 THROUGH 11-22-82.

3.4 SAFETY

The safety requirements of UTD 131-012 shall be observed.

3.5 EQUIPMENT REQUIREMENTS

A listing of all test equipment used for measuring the recorded data during the test, model and serial numbers, and calibration due dates shall be maintained.

The IDM GSE unit will be used to simulate the S/C interface. The GSE unit, in conjunction with the HP9825A computer, is used to provide functional testing of the instrument during the EIAT. All data print-outs will be marked with the date and test temperature and maintained in the IDM data file.

The GSE Stimulator unit will be used to provide sensor stimulation during the EPET.

3.5.1 DUAL CURRENT SOURCE CALIBRATION

a. Apply power to the current source.
b. Monitor the + and - output jacks with a calibrated Keithley pico-ammeter.
c. The measured currents versus current source switch settings shall agree with the following data within ±5% from 10^{-6} to 10^{-10} amps and within ±8% at 10^{-11} amps. (The dual current source will not be used as an absolute calibration of the log amps. It is used to provide relative differences between the two test currents by precisely varying the input voltage to two matched hi-meg resistors.)

VOLTAGE	RESISTANCE	DEVIATION	AMPS +	AMPS -
1 V	10^{-6}	None	10^{-6}	10^{-6}
"	10^{-7}	"	10^{-7}	10^{-7}
"	10^{-8}	"	10^{-8}	10^{-8}
"	10^{-9}	"	10^{-9}	10^{-9}
"	10^{-10}	"	10^{-10}	10^{-10}
"	10^{-11}	"	10^{-11}	10^{-11}

d. Measure the change in current at the + jack while depressing each of the "deviation" switches. The change in current shall correspond to the nominal deviation within ±2%.

Verify ____________

3.6 TEST DESCRIPTION

The EIAT will consist of the three separate tests described below.

a. EPET

The Electrical Performance Evaluation Test (EPET) provides a functional test of the instrument including instrument response to simulated ion currents and data multiplexing in the various modes. The EPET provides formatted print-outs of all test data.

b. Calibration Test

The Calibration Test provides for measurement of instrument parameters critical to the electrical calibration of the instrument. Parameter values obtained in the Calibration Test performed prior to conformal coating the circuit boards are compared to the EIAT values to assure that there has been no circuit degradation during the conformal coating process.

c. Vacuum Test

The Vacuum Test verifies correct instrument response to an ion beam in a simulated near-flight environment.

4.0 PREPARATION FOR TEST

4.1 EPET

a. Place the test chassis in the test chamber. Connect cables as follows:

GSE J1 to TEST CHASSIS J1

b. Place the stimulation unit outside the test chamber. (Stimulation unit chassis is at sensor potential and must be isolated.)

c. Connect collector D to the (+) stimulation jack and B to the (-) jack.

d. Connect the GSE to the HP9825A via the HP98032A interface cable. Perform EPET test per section 5.0.

4.2 CALIBRATION TEST

a. Disconnect cables from the stimulation unit.

b. Connect coax cables (electrometer inputs) to the Keithley Pico-amp source and the dual current source as required. (The chassis of each current source must be isolated.) Connect test leads to the repeller and suppressor grids and a coax to the reference potential connector and route them out of the chamber access port.

c. Allow at least 30 minutes soak time at each temperature after TEMP monitor stabilizes.

d. Perform Calibration test per section 6.0.

4.3 VACUUM TEST

a. Place the sensor head assembly and the ion source in the vacuum chamber and fasten to the vacuum test fixture. Adjust the source vertically until the center of the source output grid is aligned with the center of the sensor input apertures.

b. Connect the source to the source control unit.

c. Connect the GSE unit to the test chassis.

d. Connect the vacuum test cable through the vacuum chamber feedthrough. Verify pin to pin connections.

e. Connect the sensor cable to the sensor under test and then to the electronics box located outside the vacuum chamber.

f. Verify that sensor potential is not shorted to the vacuum chamber housing and that the sensor is floating.

h. Perform the vacuum test per section 7.0.

5.0 EPET

5.1 Load the IDM EPET program into the HP9825 from the tape cartridge. Enter the date, test temperature and comments.

+60° ✓ RT ✓ -20° ✓

5.2 Record and print 64 frames of data at each temperature.

5.2.2 Verify the following on the data print-outs:

a. SENPOT switches between two voltage levels of ∿9 volts and 0 volts.

b. LLB remains at a fixed current level of $\sim 4.5 \times 10^{-8}$ amps while LLA switches between $\sim 9 \times 10^{-8}$ amps and $\sim 4.5 \times 10^{-8}$ amps.

c. IDM/RNG indicates deviation levels of 100% and 50%.

d. Data multiplexing is as indicated in UTD 133-003, Figure 1.

6.0 CALIBRATION TEST

+60° ✓ RT ✓ -20° ✓

6.1 GRID POTENTIALS

Measure and record the suppressor grid potential with a DVM. Using an oscilloscope, verify that the repeller grid is at 0 volts most of the time and switches to +2 volts at the beginning of each 8-frame sequence as indicated in UTD 133-003.

		0°	+25°	+50°
SUPPGRID		-11.87	-11.86	-11.76
REPGRID	LOW	0.00	0.00	+0.11
REPGRID	HIGH	+1.9 ✓	+1.9 ✓	+1.9

6.2 DATA SHEET 1

a. Drive the reference potential input through a 100 Meg resistor to the levels indicated and record the resulting sensor potentials and TLM outputs.

b. Connect pico-amp source to collector A. Connect one output of the dual current source to collector C. Set dual current source to 10^{-8} amps. Set pico-amp source to the currents indicated and record LLB data. Reverse the connections to A and C and repeat the calibration procedure for LLA.

c. Record the Drift Signal zero level.

d. Record the RPA analog data levels.

6.3 DATA SHEET 2

a. Connect the dual current source + output to A and - output to C. Record drift signal offset readings for the input current setting and + deviations given on data sheet 2.

b. Reverse the + and - current source cables and repeat data sheet 2 for - deviations.

6.4 DATA VERIFICATION

The EIAT Calibration Test data shall agree within ±2% with the corresponding data from the preconformal coating Calibration Test for all tests with input currents greater than 10^{-9} amps.

7.0 VACUUM TEST

7.1.1 After the chamber reaches a pressure below 2×10^{-5} Torr turn on the instrument.

7.1.2 The following tests will be performed as a minimum:

a. Make records of the Log Level and DM outputs.

RT

b. Rotate the ion source and verify that the sensor responds to changes in the ion beam angle.

RT

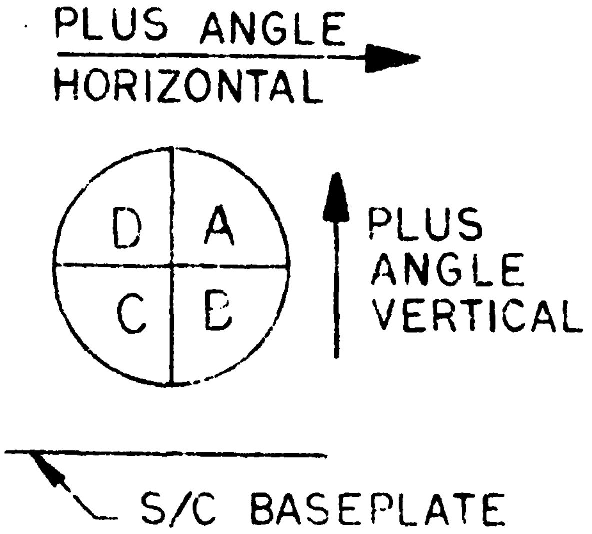
HP [illegible] DVM #24139 CAL DUE 9/83

KEITHLEY PICO AMP SOURCE MODEL 261 #10755 1-1-83

HP 1703A SCOPE # 3213 1-2-83

KEITHLEY 615 ELECTROMETER #09695 1-1-83

HILAT IDM COLLECTOR CONFIGURATION



A PLUS ANGLE YIELDS A VOLTAGE ABOVE 2.5 VOLTS WHEN MAKING OFFSET (DOUBLE ANGLE) MEASUREMENTS.

HILAT IDM CALIBRATION DATA

SHEET 1

DATE 11-19-82

BY [illegible]

(FGW-STPS)

REFERENCE POTENTIAL (VOLTS)	SENSOR POTENTIAL 0°	+25°	+50°	SENPOT FI 0°	+25°
0	.003	.004	.005	4.48	4.4[illegible]
2	2.00	2.00	+2.00	3.98	3.98
4	4.00	4.00	+4.00	3.50	3.5[illegible]
6	6.00	6.00	+6.00	3.00	3.0[illegible]
8	8.00	8.00	+8.01	2.50	2.50
10	10.00	10.00	+10.01	2.00	2.00
12	12.00	12.00	+12.01	1.50	1.50
14	14.00	14.00	+14.00	1.00	1.00

I_{in}	0° LLA	0° LLB	+25° LLA	+25° LLB	+5[illegible] LLA
10^{-6}	4.56	4.50	4.56	4.60	4.54
10^{-7}	3.54	3.56	3.56	3.58	3.52
10^{-8}	2.54	2.54	2.54	2.56	2.52
10^{-9}	1.52	1.48	1.54	1.54	1.50
10^{-10}	0.52	0.52	0.52	0.52	0.51

	0° H	0° V	+25° H	+25° V	H
DRIFT SIGNAL ZERO	2.50	2.50	2.52	2.52	2.54

	0°	+25°	+50°
FILTERS	0.98	0.98	0.98
TEMP	1.94	1.94	1.94
RPA	2.94	2.94	2.94
SWP	3.96	3.96	3.94
ELECT	4.98	4.97	4.97

BILAT IDM CALIBRATION DATA

SHEET 2

DATE 11-22-82

BY [illegible]

DEVIATION POLARITY +

I_{in}	% DEVIATION	0°	125°	150°	RNG
10^{-6}	100	3.38	3.38	3.38	4
"	70	3.18	3.20	3.18	4
"	50	4.55	4.55	4.55	3
"	30	3.83	3.83	3.83	3
"	20	3.42	3.42	3.42	3
"	10	4.40	4.42	4.42	2
"	0	2.40	2.44	2.46	1
10^{-7}	100	3.38	3.38	3.[illegible]	4
"	70	3.18	3.20	[illegible]	4
"	50	4.56	4.56	4.56	3
"	30	3.84	3.84	3.94	3
"	20	3.44	3.44	3.44	3
"	10	4.44	4.44	4.44	2
"	0	2.52	2.54	2.57	1
10^{-8}	100	3.38	3.38	3.38	4
"	70	3.18	3.20	3.18	4
"	50	4.54	4.54	4.54	3
"	30	3.82	3.82	3.82	3
"	20	3.42	3.42	3.42	3
"	10	4.38	4.40	4.39	2
"	0	2.30	2.37	2.42	1
10^{-9}	100	3.38	3.38	3.38	4
"	70	3.18	3.20	3.18	4
"	50	4.56	4.56	4.54	3
"	30	3.84	3.84	3.82	3
"	20	3.44	3.44	3.42	3
"	10	4.46	4.43	4.42	2
"	0	2.64 *	2.60	2.54	1
10^{-10}	100	3.38	3.38	3.33	4
"	70	3.18	3.20	3.14	4
"	50	4.55	4.36	4.40	3
"	30	3.85	3.84	3.74	3
"	20	3.44	3.45	3.36	3
"	10	4.34 *	4.52	4.42	2 *
"	0	*	*	*	1 *

HILAT IDM CALIBRATION DATA

DATE 11-27-82

BY DCP

SHEET 2

DEVIATION —

POLARITY

I_{in}	% DEVIATION	0	425°	450°	RNG
10^{-6}	100	1.66	1.65	1.64	4
"	70	1.86	1.85	1.85	4
"	50	0.48	0.48	0.47	3
"	30	1.20	1.20	1.20	3
"	20	1.60	1.60	1.60	3
"	10	0.60	0.60	0.60	2
"	0	2.50	2.52	2.56	1
10^{-7}	100	1.64	1.65	1.64	4
"	70	1.86	1.85	1.85	4
"	50	0.48	0.47	0.46	3
"	30	1.20	1.20	1.19	3
"	20	1.60	1.60	1.60	3
"	10	0.58	0.58	0.58	2
"	0	2.46	2.48	2.51	1
10^{-8}	100	1.66	1.65	1.65	4
"	70	1.86	1.86	1.85	4
"	50	0.50	0.48	0.48	3
"	30	1.22	1.20	1.20	3
"	20	1.62	1.61	1.60	3
"	10	0.65	0.64	0.64	2
"	0	2.70	2.66	2.68	1
10^{-9}	100	1.66	1.65	1.66	4
"	70	1.86	1.86	1.86	4
"	50	0.48	0.48	0.49	3
"	30	1.20	1.20	1.20	3
"	20	1.60	1.60	1.60	3
"	10	0.59	0.61	0.63	2
"	0	2.49 *	2.57	2.64	1
10^{-10}	100	1.67	1.66	1.71	4
"	70	1.88	1.87	1.90	4
"	50	0.56 *	0.52	0.64	3
"	30	1.26 *	1.28	1.32	3
"	20	1.67 *	1.66	1.70	3
"	10	0.88 *	0.80 *	0.88	2
"	0	*	*	*	1 NO

SECTION 4

DIAGRAMS, SCHEMATICS, DRAWINGS

IDM DRAWING LIST

- TOP ASSEMBLIES -

133-500	SENSOR HEAD ASSY
PL133-500	SENSOR HEAD ASSY
133-506	SENSOR INSTALLATION
133-565	SENPOT R.F. BYPASS ASSY (PL INCLUDED ON ASSY DWG)
D1293	INTERCONNECTION DIAGRAM (AFGL DRAWING)

- SUBASSEMBLIES -

DNA-1	MUX/DRIFT SIGNAL AMPLIFIER	
	BOARD ASSY	133-570
	PART LIST	PL133-570
	SCHEMATIC	133-572
	WIRE LIST	133-573
DNA-2	DATA STORE	
	BOARD ASSY	133-575
	PART LIST	PL133-575
	SCHEMATIC	133-577
	WIRE LIST	133-578
DNA-3	ELECTROMETER/AMPLIFIER	
	BOARD ASSY	133-580
	PART LIST	PL133-580
	SCHEMATIC	133-582
	WIRE LIST	133-583

END

FILMED

5-84

DTIC