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ELECTRONIC TEST PROCEDURES FOR THE ENVIRONMENTAL DESIGN QUALIFICATION AND FLIGHT TESTING OF THE UK-2/S-52

FEBRUARY 15, 1963

GODDARD SPACE FLIGHT CENTER

GREENBELT, MD.

DCC. NO.

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Test and Evaluation Division
Office of Technical Services
Goddard Space Flight Center

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NASA/GSFC
Test and Evaluation Division
Electronics Test Branch

ELECTRONIC TEST PROCEDURES FOR THE ENVIRONMENTAL DESIGN AND FLIGHT QUALIFICATION TESTING OF THE UK-2/S-52

February 15, 1963

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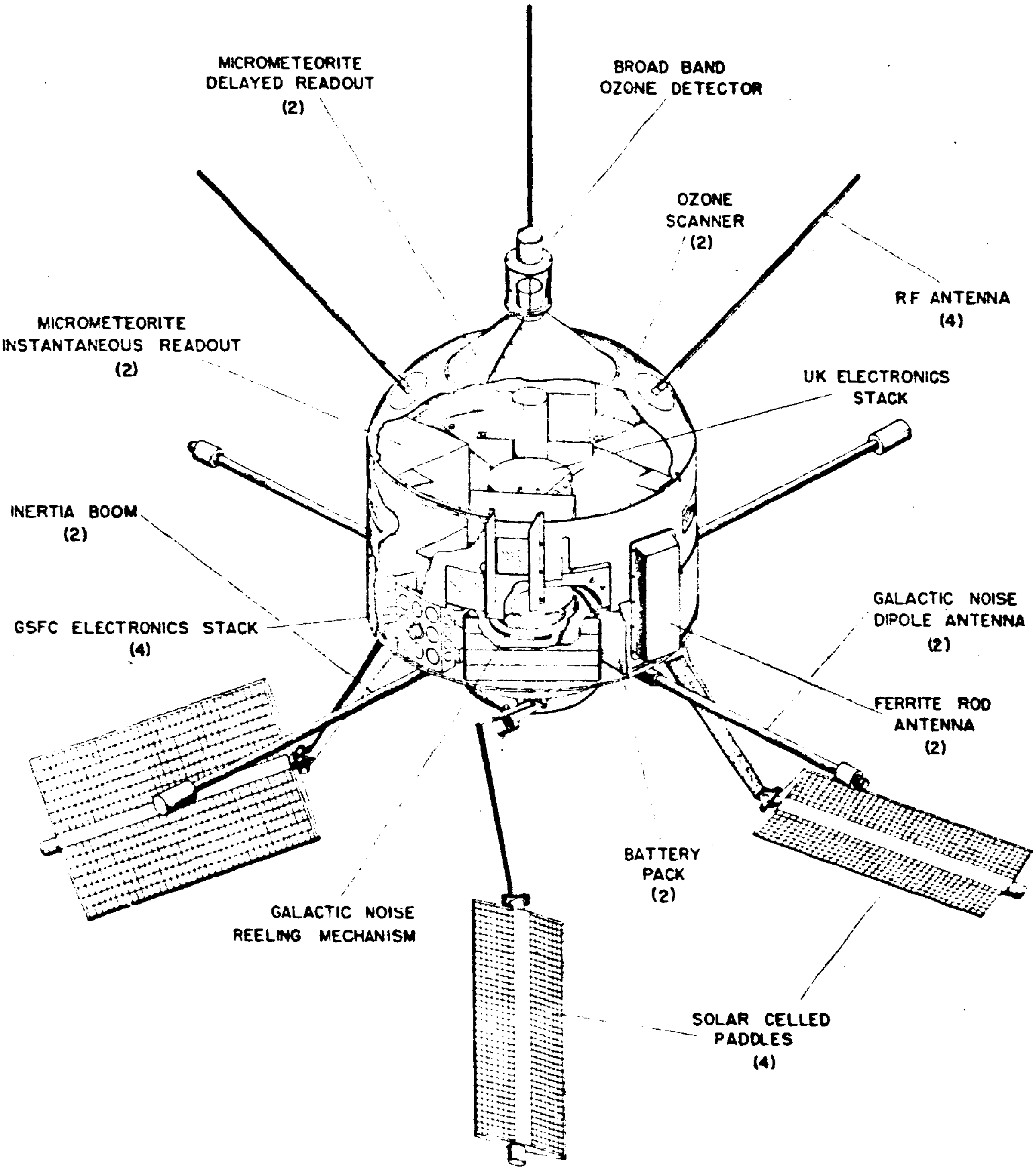
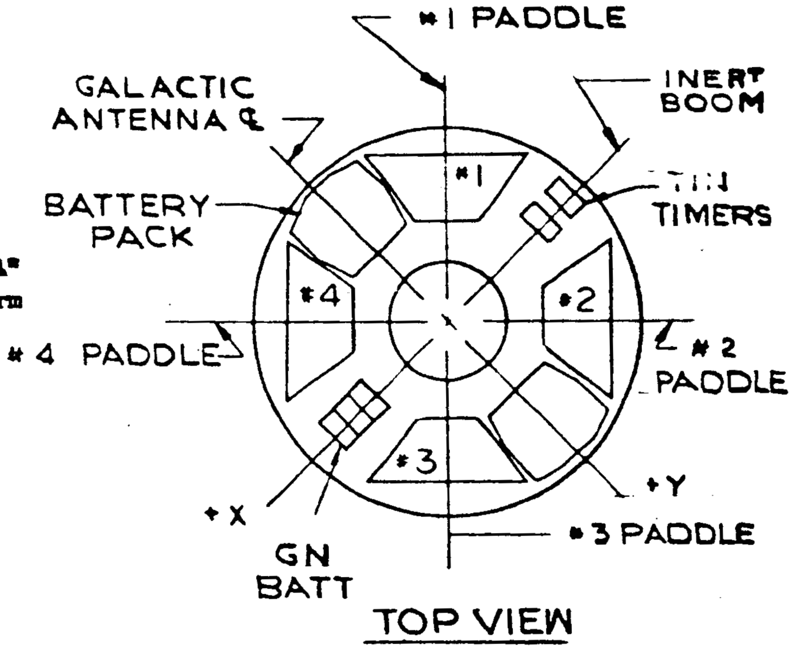


Figure 1a. UK-2/S-52 International Satellite No. 2



Stacks start with Delta Pack "A" mounted directly on the platform and continue upward.

Stack #1

A - Transmitter
B - Decoder
C - Receiver
D - Sample and Hold Circuit

Stack #2

A - Power Supply, + Regulator
B - Recorder Converter
C - Data Storage Control
D - Programmer #1

Stack #3

A - Programmer #2
B - Telemetry Encoder #3
C - Telemetry Encoder #2
D - Telemetry Encoder #1

Stack #4

A - Power Supply, Inverter
B - Battery Switching Network
C - Undervoltage Detector and Recycle Timer
D - Power Supply, - Regulator

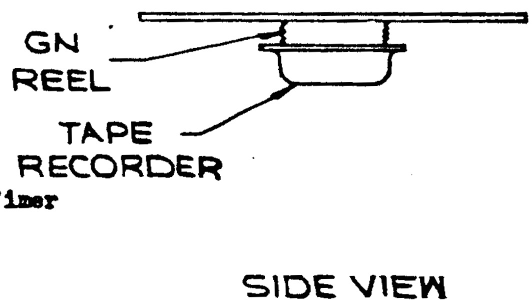


Figure 1b. S-52/UK-2 Equipment Layout, Lower Platform

SECTION I

A. INTRODUCTION

International Spacecraft UK-2/S-52 is the result of a joint effort between the British National Committee on Space Research and the United States National Aeronautics and Space Administration. This is the second of a series of united effort Spacecraft and is designed to complement the functions of its predecessor, the UK-1/S-51.

Basically, the object of such Spacecraft is to collect data and transmit that data back to earth. A close-knit electronics organization, with a thorough knowledge of the Spacecraft and the equipment utilized in testing the Spacecraft, is essential to a successful conclusion of the project. The Electronics Test Branch has established a test team to examine, in conjunction with experimenters and designers, the performance of the Spacecraft electronics for deviations in any mode of operation under environmental exposure, to collect data for verification of performance characteristics under test, and to intelligently apply this information to benefit this and subsequent projects.

To proficiently perform electrical tests of the Spacecraft, the Electronics Test Team, under the direction of an Electronics Test Coordinator, will maintain an organized effort throughout the environmental test program. The test team is composed of capable personnel assigned to the project from Electronics Test Branch, Systems Integration Branch, Experimenter Group, Design Group or Contractor personnel. A team of this composition has the advantage of experience and know-how in all phases of Spacecraft testing.

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B. ABSTRACT

The UK-2/S-52 Spacecraft, will produce three experiments complementing the experiments of the first Spacecraft, UK-1/S-51. These experiments are Galactic Noise, Ozone Measurement and the Micrometeorite experiment.

To qualify the reliability of the Spacecraft and its ability to perform the intended experiments, a series of environmental tests will be accomplished. During these tests, the Spacecraft will be operated to establish the reliability of the operating parameters and to provide data

in support of these findings. An instrumentation Complex has been developed to stimulate the experiment sensors and exercise the power and programmer functions for observation of their respective responses to determine that the performances are as intended, within allowable limitations. Also, to determine the levels required to initiate performance and the consistency of these levels.

It is the intent of this document to establish the fundamentals required for proper testing and accumulation of data. These fundamentals are: (a) A review of the instrumentation required for the tests; (b) the establishment of a test team to set up and perform the tests, to facilitate the acquisition of test data and performance characteristics, and(c) to establish the test procedures necessary to assure readiness of the Spacecraft to perform as intended during flight.

In testing the Spacecraft, it is expected that deviations from normal performance will occur due to the variations between theory and the practical. Operational testing within anticipated environments provides a means of obtaining data for information purposes. The proper application of this information will improve the reliability of the Spacecraft in flight and enable greater accuracy in the interpretation of final flight data.

SECTION II

A. INSTRUMENTATION COMPLEX - GENERAL

A complete instrumentation Spacecraft Flow Chart, Figure 2-1, shows the Instrumentation Complex, researched and designed by the authors, H. Leverone and N. Mandell, which consists of the control, measuring, recording, and display equipment with their associated interconnections necessary to provide for: (a) Exercise of the Spacecraft power and programmer functions; (b) stimulation of Spacecraft experiments; (c) monitoring, recording and display of subsequent operational responses; and (d) surveillance of other available operating test point parameters for the purpose of evaluating that the Spacecraft is electrically performing as intended throughout its tenure of environmental exposures.

The overall instrumentation complex contains all the equipment and wiring required to accomplish the above for the entire series of environmental tests and launch. Various combinations of equipment or instrumentation configurations may be set up, as required, for each individual requirement. However, the most intricate configuration is involved during Thermal-Vacuum testing, which entails the use of most of the equipment. For this reason, the Thermal-Vacuum instrumentation configuration is explained herein.

The complete complex is very versatile and may be used to perform electrical tests on the Spacecraft and subassemblies. A description of the GSFC subassembly capabilities is included to show the rapidity in which suspect GSFC subassemblies may be tested.

The control and monitoring instrumentation required at the test area are shown in Figure 2-2.

The complete Instrumentation Schematic is shown in Figure 2-3.

Instrumentation Complex Checkout Procedure

The cabling necessary for electrical testing of the S-52 spacecraft, shown in figure 2-3, interconnects the Monitor panel, S-52 Control Panel, Spacecraft Simulator, and the Vacuum Chamber flange.

1. The Spacecraft Simulator provides for checkout of the instrumentation complex connections prior to connection to the spacecraft for the following:

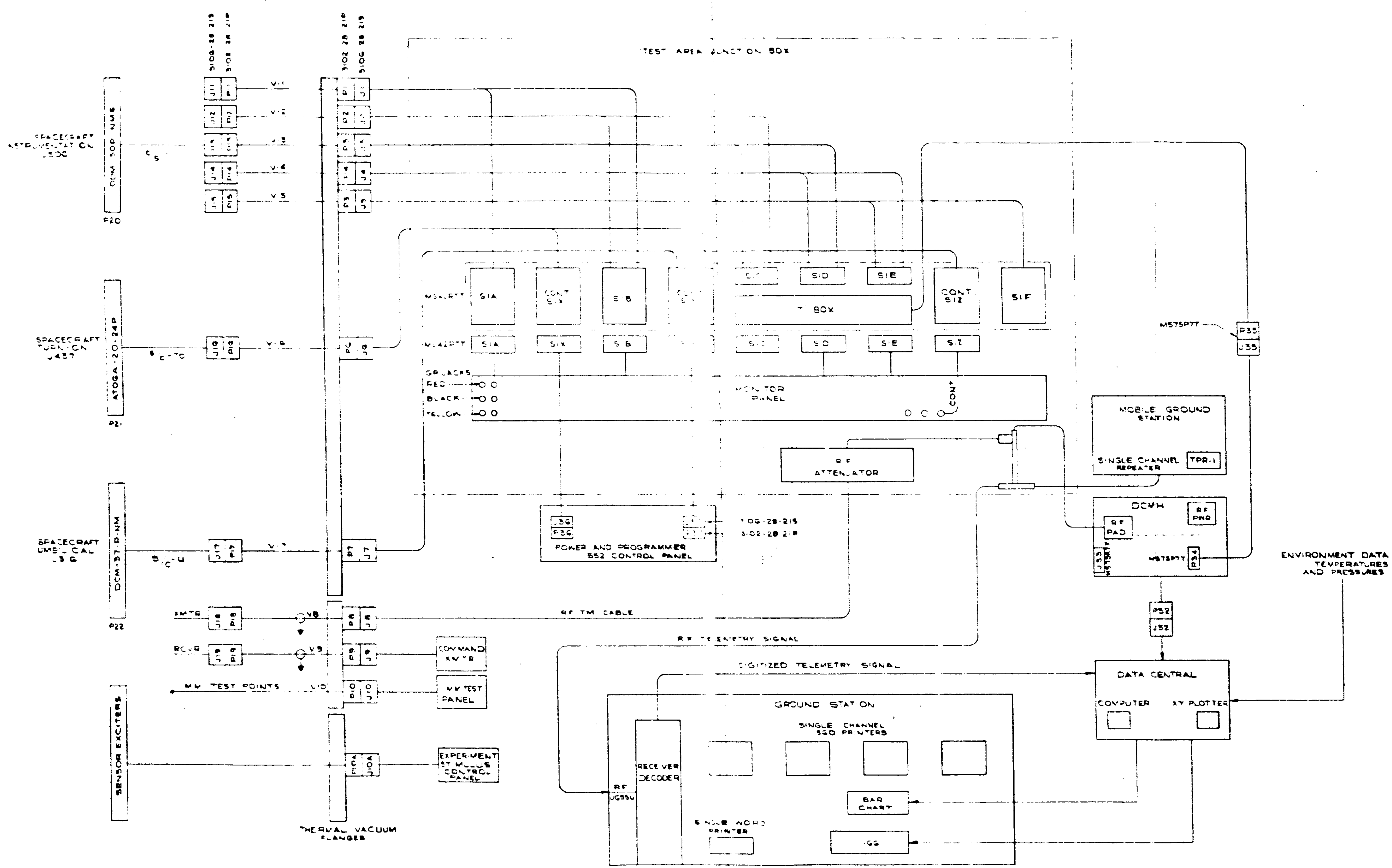

Figure 2-1. S-52/UK-2 Spacecraft Flow Chart

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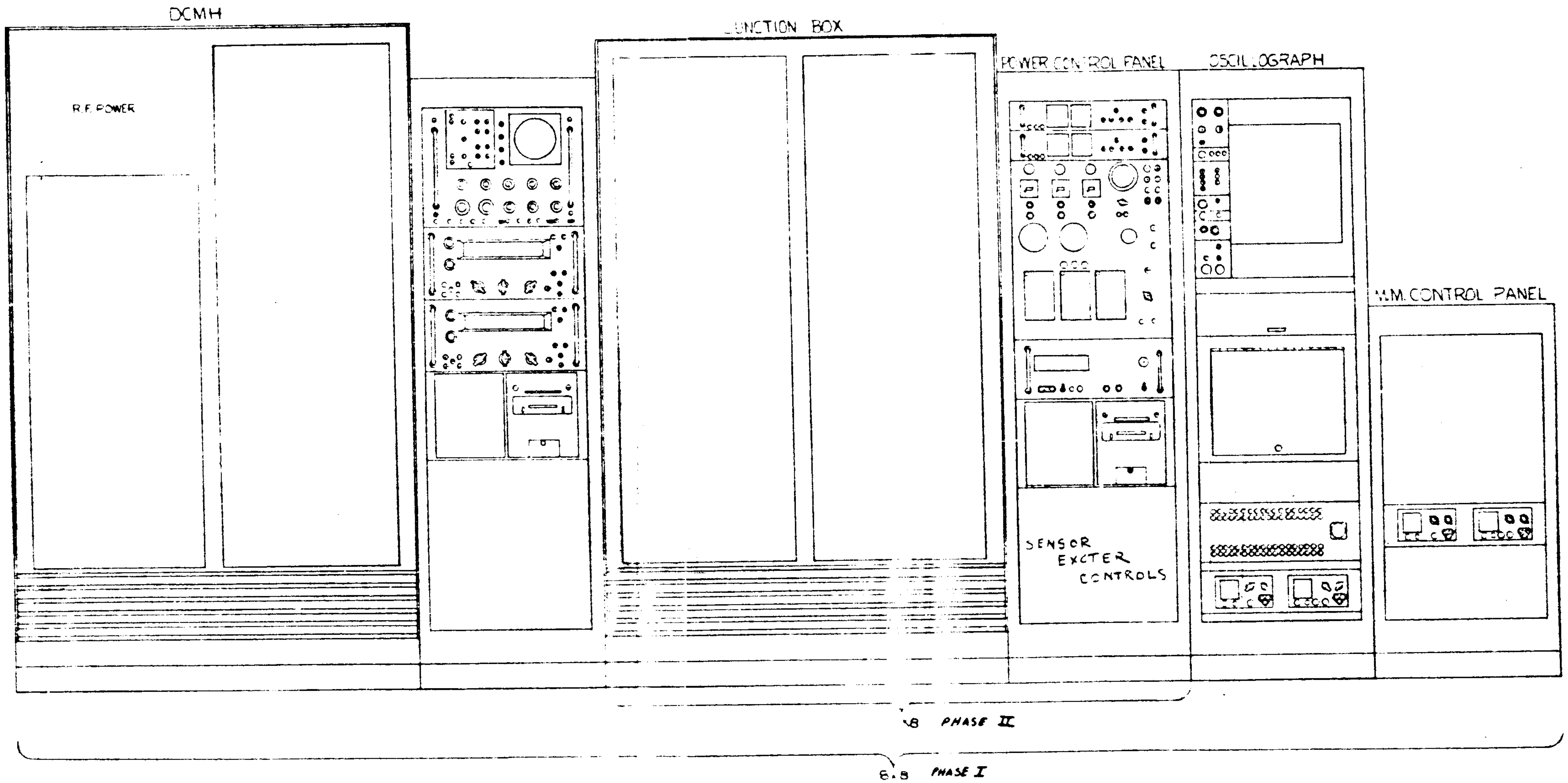

Figure 2-2. S-52 Spacecraft Accept. Area-Systems Test

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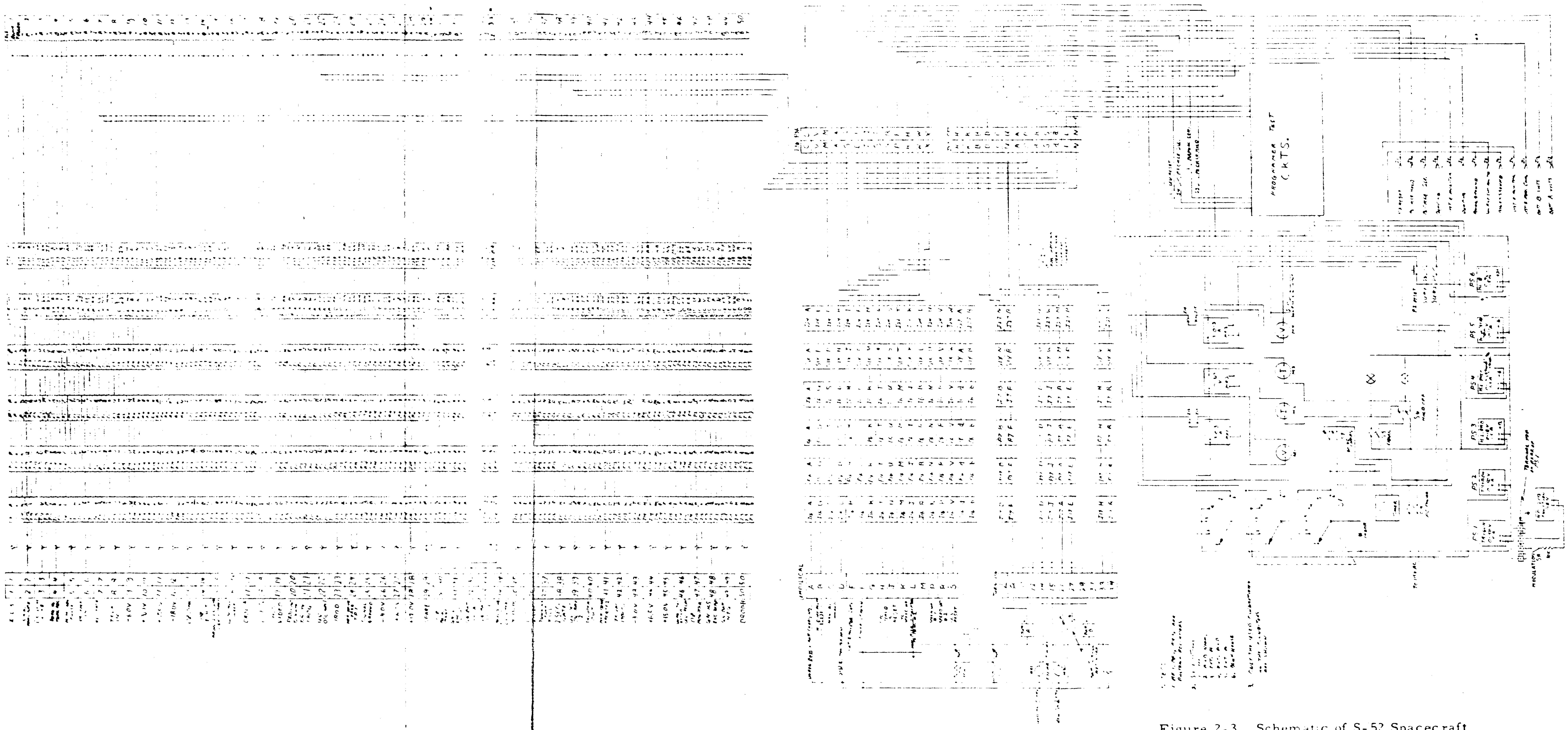

Figure 2-3. Schematic of S-52 Spacecraft Instru. Connections

a. Correct pin assignments

b. Continuity

c. Insulation resistance (greater than 100 megohms)

In addition, the simulator is used to determine the compatibility of certain spacecraft surface connector pins prior to connecting the spacecraft to the instrumentation complex; e.g., presence of battery voltages and circuit impedances.

2. The Umbilical Checkout Box shown in figure 2-33, accepts the umbilical cable which connects to the spacecraft and provides means for verification of proper pin numbers, polarities, and amplitudes of all umbilical functions generated by the S-52 Control Panel during environmental testing and at the launch site.

3. The S-52 Control Panel, used throughout environmental testing and at the launch site, performs the following functions:

a. Operation of the holdoff relay circuit

b. Charge into a simulated Spacecraft load.

c. Evidence of manual command.

d. Evidence of Recycle Timer Speedup 1.

e. Evidence of Recycle Timer Speedup 2.

f. Evidence of Recycle Timer Reset.

g. Mode hold.

h. Mode speedup.

i. Mode reset.

j. Sunrise Simulation.

B. INSTRUMENTATION COMPLEX DESCRIPTION

The following description of the instrumentation for the thermal-vacuum configuration commences with the instrumentation plug (upper left hand corner) on the Spacecraft Flow Chart, Figure 2-1. Brief descriptions are provided of the interconnections and equipment encountered as the flow progresses to the right and terminates in the

Monitor Panel. Each connection on the left is taken in turn, except for R-F Telemetry which is described last to facilitate the description of the DCMH, Data Central, also Ground Station connections, and followed to its termination.

Configuration changes required for other test facilities are also briefly explained.

1. Instrumentation Plug

The instrumentation test points and power and control lines are available at three surface mounted receptacles on the S-52 Spacecraft. The Instrumentation receptacle J500, the Turn-On receptacle J437, and the Umbilical receptable J316.

The respective wiring lists of these three connectors are shown in Tables 2-1, 2-2, and 2-3. All cabling is shielded and is kept at a minimum in length.

Commencing with the instrumentation test points available on J500, a mating plug P20 extends the test points out through Spacecraft cable-instrumentation to five (37 pin) connectors J-11 through J-15 which provide for distribution through an existing Thermal-Vacuum connector penetration flange and its integral cable terminations V-1 through V-5.

Cables mating with the receptacles on the thermal-vacuum flanges extend the test points to (42 pin) receptacles (S1A through S1E) mounted in a stationary junction box, one of which is available at each test facility. The Spacecraft instrumentation test points are then made available for instrument and recorder connections through mating plugs, and cables to the Monitor Panel and a "T" box which will be described later.

A schematic of the instrumentation connection from P20 to the junction box is shown in Figure 2-4.

2. Monitor Panel

The Monitor Panel shown in Figure 2-5, designed by the authors, provides accessible terminations of the test points (listed in Tables 2-1) brought out through the S-52 Instrumentation Plug J500 for the purpose of monitoring the operational performance of the Spacecraft.

TABLE 2-1

J500 S-52 Instrumentation Plug Cannon DDM-50S-MM-6		
PIN	FUNCTION	SOURCE
1	HS Reset (MSB-LS)	Encoder 1
2	LS Envelope	Encoder 1
3	Low Speed Video	Encoder 1
4	LS to Tape Recorder	Prog. # 1
5	MM Foil Advance Pulse	Prog. # 2
6	Decoder Input	Decoder
7	Osc. Rate	DSC
8	15V AC 1700 cps	BCP
9	–6V	TB202
10	3V	TB201
11	7.5V	TB203
12	–18V	One Year Timer A
13	Ozone Spectrum	Sample and Hold
14	Ozone EHT	Ozone Elect.
15	LS Gate B (–6V M1)	Prog. # 2
16	GN Sweep Monitor	ON Radiometer
17	DROD A	P190
18	L(MSE-MS)	Encoder 2
19	High Speed Video	Encoder 3
20	Transmitter Modulation	TX
21	Tape Recorder Playback	Prog. # 1
22	Osc. ÷ 10	UV Det. & RT
23	IROD	J190
24	Motor Drive Freq. TP1	DSC
25	Signal Ground	TB201
26	–4V	TB203
27	6V	TB202
28	12V	TB203
29	Spare	
30	Ozone Amplifier (01)	Sample and Hold
31	GN LS	P190
32	GN Battery Charge Point A	GN Battery
33	GN Battery Charge Point B	GN Battery
34	HS Gate C (0V M1)	Prog. # 2
35	T(55 cps)	Encoder 1
36	Low Speed before 48	Encoder 1
37	Tuning Fork Kill	Encoder 3
38	2 Second Gate	Prog. # 1
39	Osc 2 ÷ 10	UV Det. & RT
40	Decoder Output	Decoder
41	Motor Drive Frequency TP2	DSC
42	15 V AG 1700 cps	DCP
43	–3V	TB201
44	6.5V	TB202
45	15V	Inverter
46	Unregulated Bus after UV relay	Inverter
47	Monitor Amplifier (02)	Sample and Hold
48	GN HS	Encoder 3
49	GN Battery Negative (Gnd)	GN Battery
50	DROD B	P1OP
	1 Spare Pin	

TABLE 2-2

J437 S-52 Turn On Plug Cannon DCM-37S-NM	
PIN	FUNCTION
1	Spare
2	Battery A IN
3	Spare
4	Battery A IN
5	Spare
6	Battery B IN
7	Spare
8	Battery B IN
9	Spare
10	Solar Paddle Current IN
11	Spare
12	Solar Paddle Current IN
13	Spare
14	One Year Timer A IN
15	One Year Timer B IN
16	Spare
17	Galactic Noise IN
18	Galactic Noise IN
19	Spare
20	Spare
21	Battery A OUT
22	Spare
23	Battery A OUT
24	Spare
25	Battery B OUT
26	Spare
27	Battery B OUT
28	Spare
29	Solar Paddle Current OUT
30	Spare
31	Solar Paddle Current OUT
32	Spare
33	One Year Timer A OUT
34	One Year Timer B OUT
35	Spare
36	Galactic Noise OUT
37	Galactic Noise OUT
	17 Spare Pins

TABLE 2-3

J316 S-52 Umbilical Plug Bendix PT00-P-20-24S		
PIN	FUNCTION	SOURCE
A	Solar Bus	TB101
B	Hold Off Relay Activate	BCP
C	Manual Command	Prog. #1
D	Solar Bus (Monitor Only)	TB101
E	Power Gnd (Monitor Only)	TB102
F	Power Gnd	TB102
G	Spare	
H	Cycle Hold	Prog. #2
J	Cycle Reset	Prog. #2
K	Cycle Speed-Up	Prog. #2
L	Sunrise Simulate	Prog. #2
M	Spare	
N	Spare	
P	Recycle Timer Speed-Up 17	UV Det. & RT
R	Recycle Timer Speed-Up 22	UV Det. & RT
S	OSC Reset	UV Det. & RT
T	Spare	
U	Spare	
V	Spare	
W	Spare	
X	Spare	
Y	Spare	
Z	Spare	
a	Spare	
	11 Spare Pins	

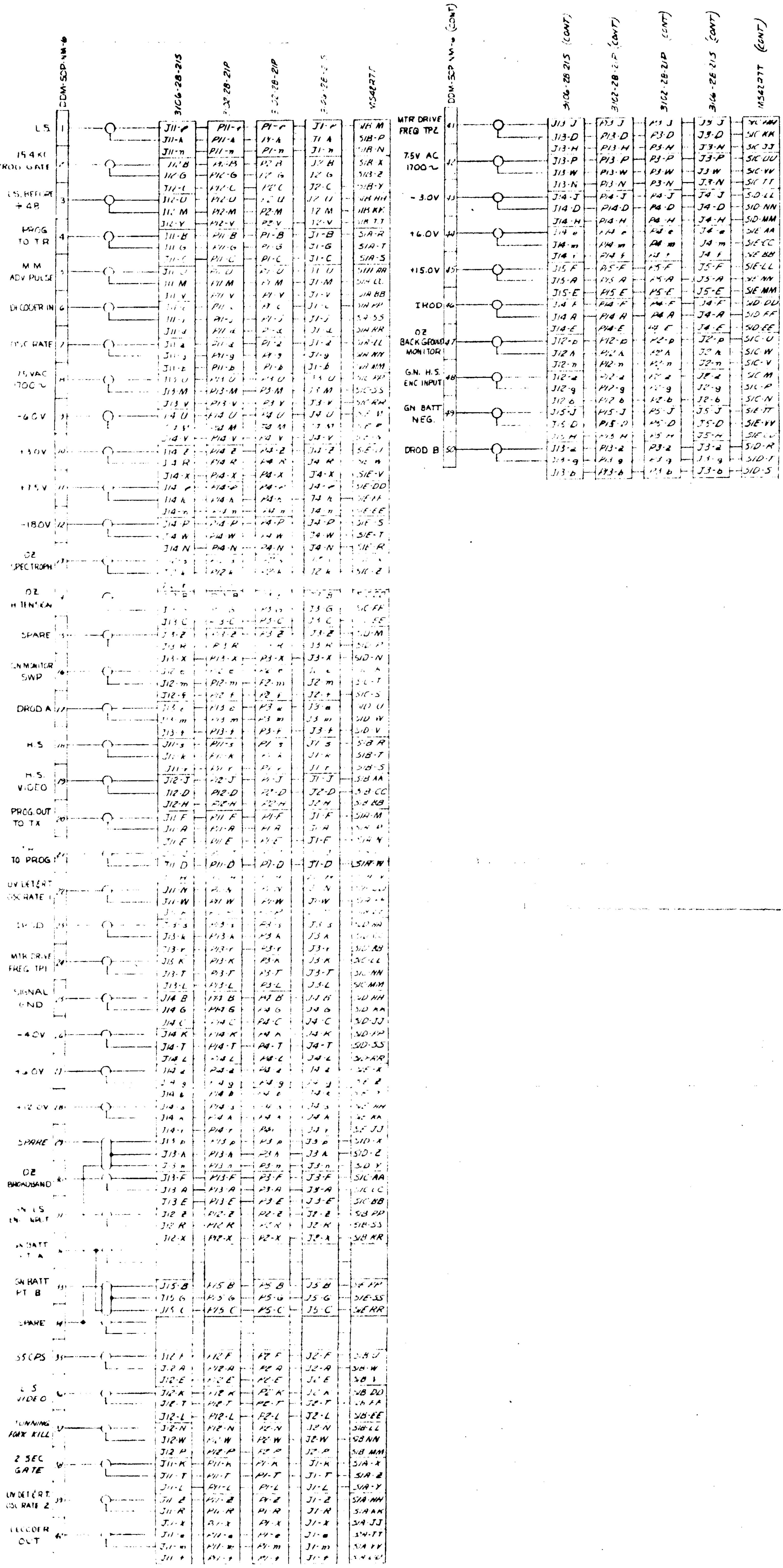

Figure 2-4.

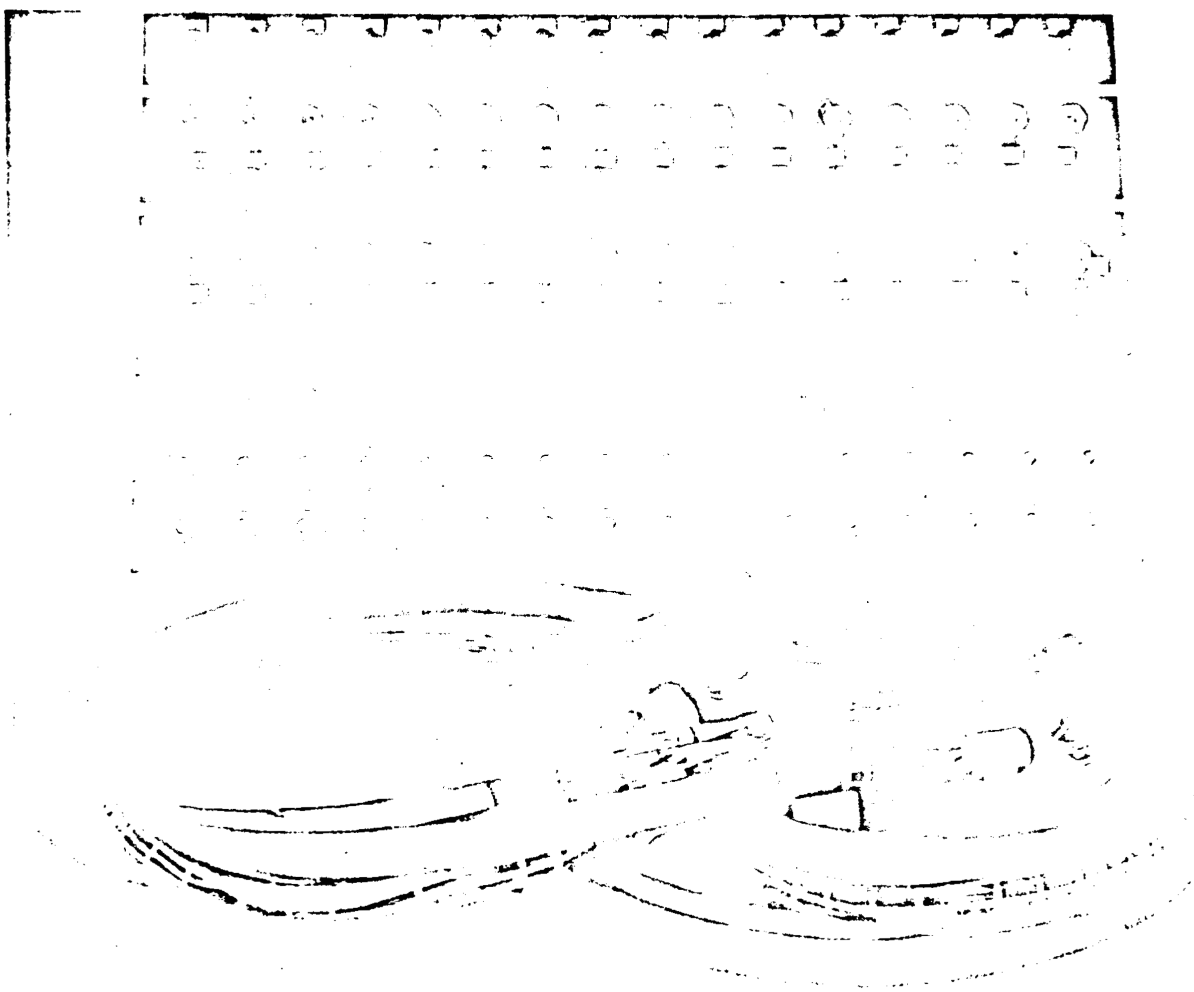

Figure 2-5. Monitor Panel

Terminations are made in GR banana jacks mounted 3/4" on center to permit single lead connections or use of the shielded pair GR connectors for connecting measuring instruments.

The terminals are labeled consistent with the instrumentation plug pin assignments. The enumerated terminals prefixed by a "C" are used for the control connections of the sensor exciters for stimulating the Spacecraft experiments.

All wiring is twisted pair, shielded. One of the twisted pair is designated the signal lead for each test point and is connected to the red jack. The other unused lead is connected to the yellow jack. All shields terminate in the black jacks and are single-point grounded at the Monitor Panel.

Three monitor panels have been fabricated and installed for the duration of S-52 testing, one in each junction box located in the following areas: Acceptance Area (500), Temperature Humidity Area (234), and Thermal-Vacuum Area (237). The associated monitor panel cables readily mate with the existing area junction box facility cables.

3. Programmable Strip Chart Recorder

To automate the recording of the experiment output signals to the Spacecraft encoder which are available at the Monitor Panel, a Programmable Strip Chart Recorder, Figures 2-6 and 2-7, has been set up. Shielded cabling is used in the system to transfer the signals from the Spacecraft to a Programmable Input Selector located at the Monitor Panel and to galvanometer amplifiers and galvanometers for recording. The Programmable Input Selector provides for push button selection and connection of groups of related signals. A Voltage Calibrator is provided in the Programmable Strip Chart Record for Calibrating each recording prior to and/or after the signals are recorded.

The efficiency of this system is apparent since it eliminates the hazards of connecting and disconnecting test leads from the Monitor Panel to the Galvanometer Amplifiers.

The Programmable Strip Chart Recording System consists of a Programmable Input Selector, thirty-six galvanometer amplifiers, a thirty-six channel Strip Chart Recorder, and a Voltage Calibrator.

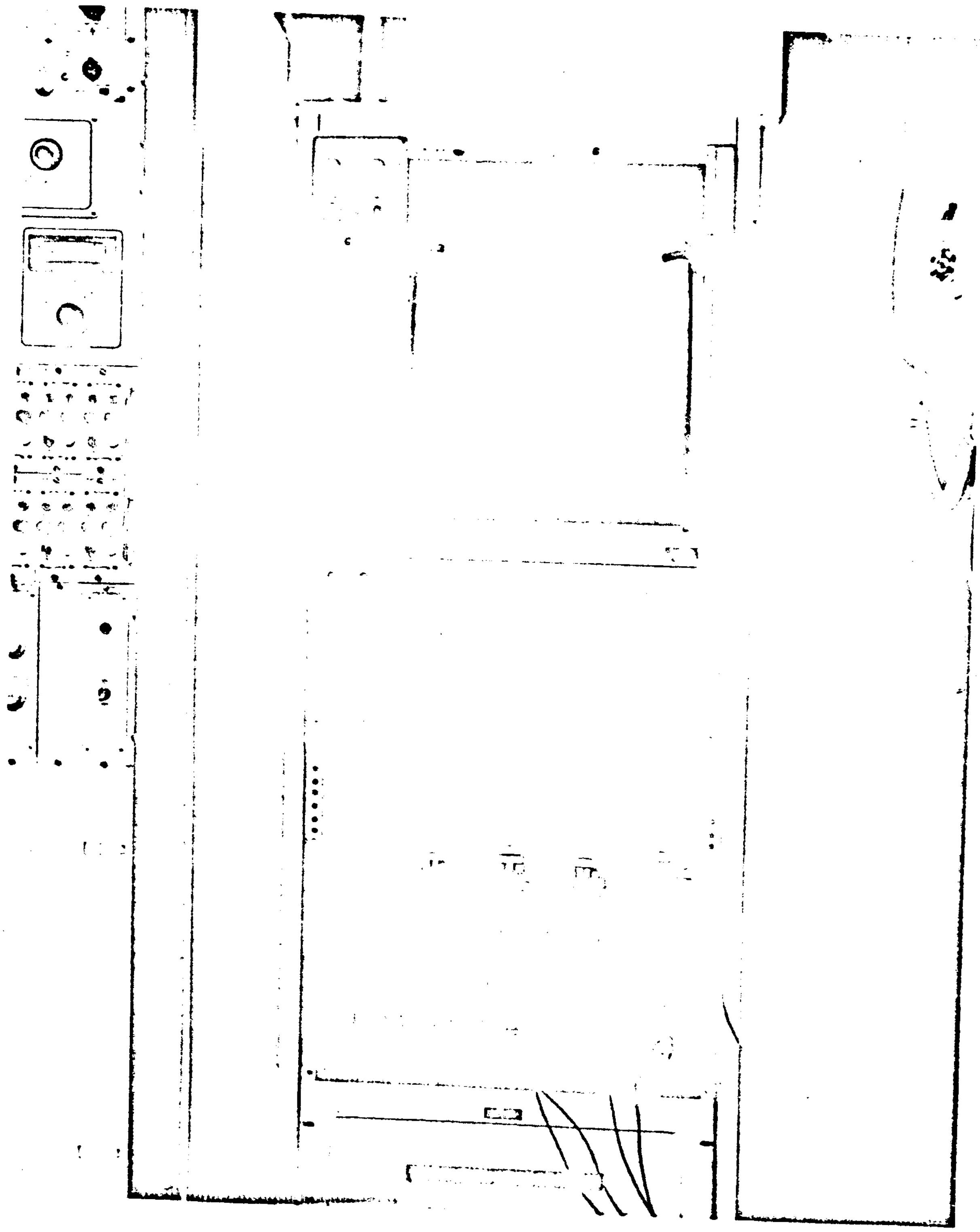

Figure 2-6. Programmable Strip Chart Recorder and Voltage Calibrator

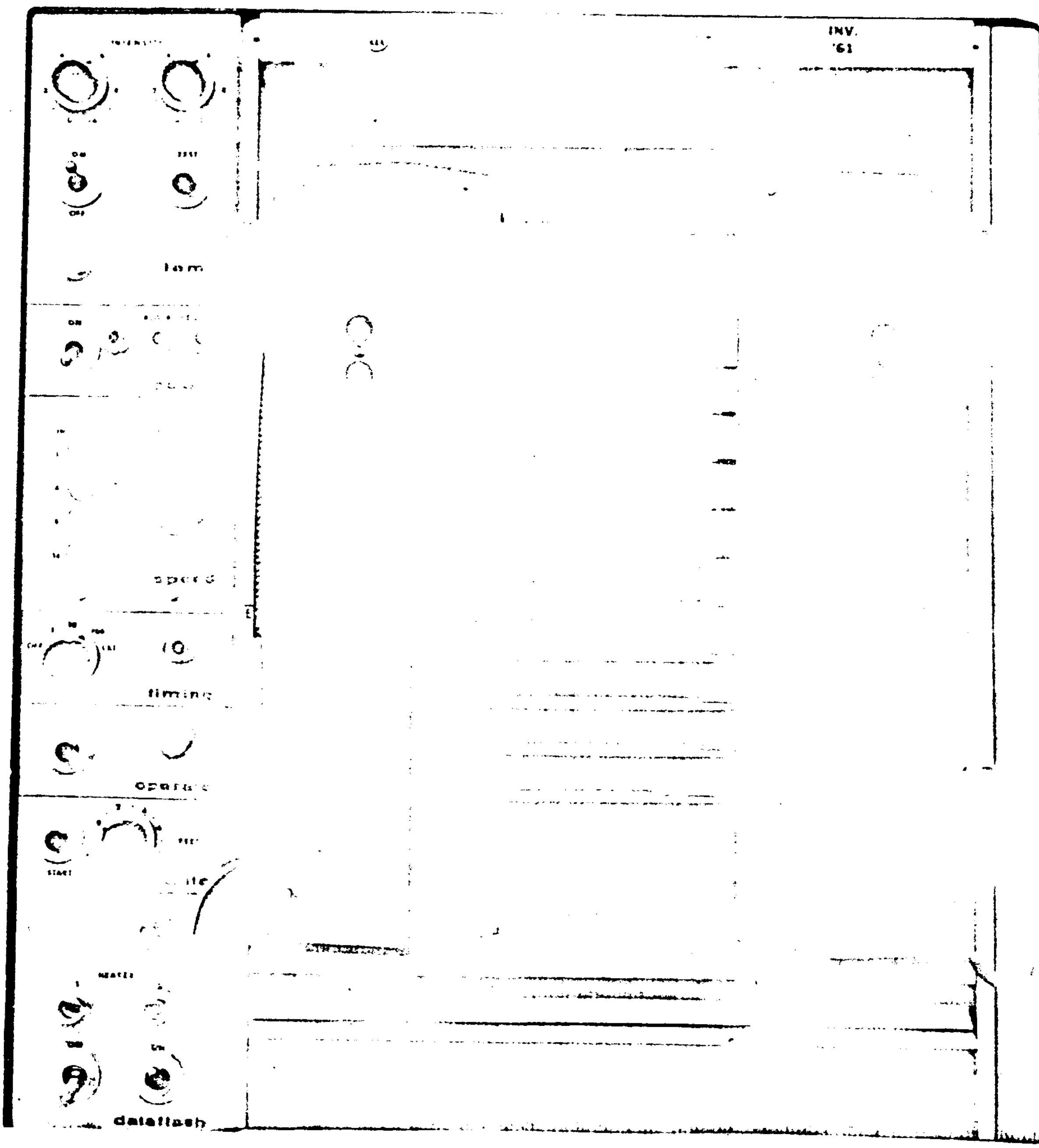

Figure 2-7. Programmable Strip Chart Recorder

Though only four channels of the recorder are set up for the programmable system, thirty-two channels are available for recording other inputs either separately or concurrently with the selected signals.

The graphic record of each experiment, after removal from the oscillograph recorder, will be examined by concerned test personnel for its proximity to anticipated results. It will then be identified and any unusual variations with probable explanations will be noted thereon for the benefit of the appropriate experimenter who will then receive it for examination.

a. Programmable Input Selector

The Programmable Input Selector located in the junction box just above the Monitor Panel was designed by H. Leverone and N. Mandell, Figure 2-8. Spacecraft experiment outputs are transferred via shielded cable to the junction box and distributed to the Monitor Panel. A pre-wired arrangement from the GR connectors on the Monitor Panel to the Input Selector enables the operator to select any of six positions for contact with the oscillograph galvanometer amplifiers by actuating the "Advance" button switch which picks up the experiment data as shown on Figure 2-8. A light will appear on the panel with the name of the position in contact. The six positions on the Input Selector and their functions are, from left to right:

"Home" - All instrumentation is disconnected from the test points at the input of the selector.

"Calibrate" - Provisions for calibration of all four traces on the oscillograph either prior to and/or following a recording, see Figures 2-6 and 2-9.

"MM" - Micrometeorite experiment for recording on the oscillograph chart.

"GN" - Galactic Noise experiment for recording on the oscillograph chart.

"OZ" - Ozone experiment for recording on the oscillograph chart.

"Spare" - Permits the assignment of additional inputs which may be required.

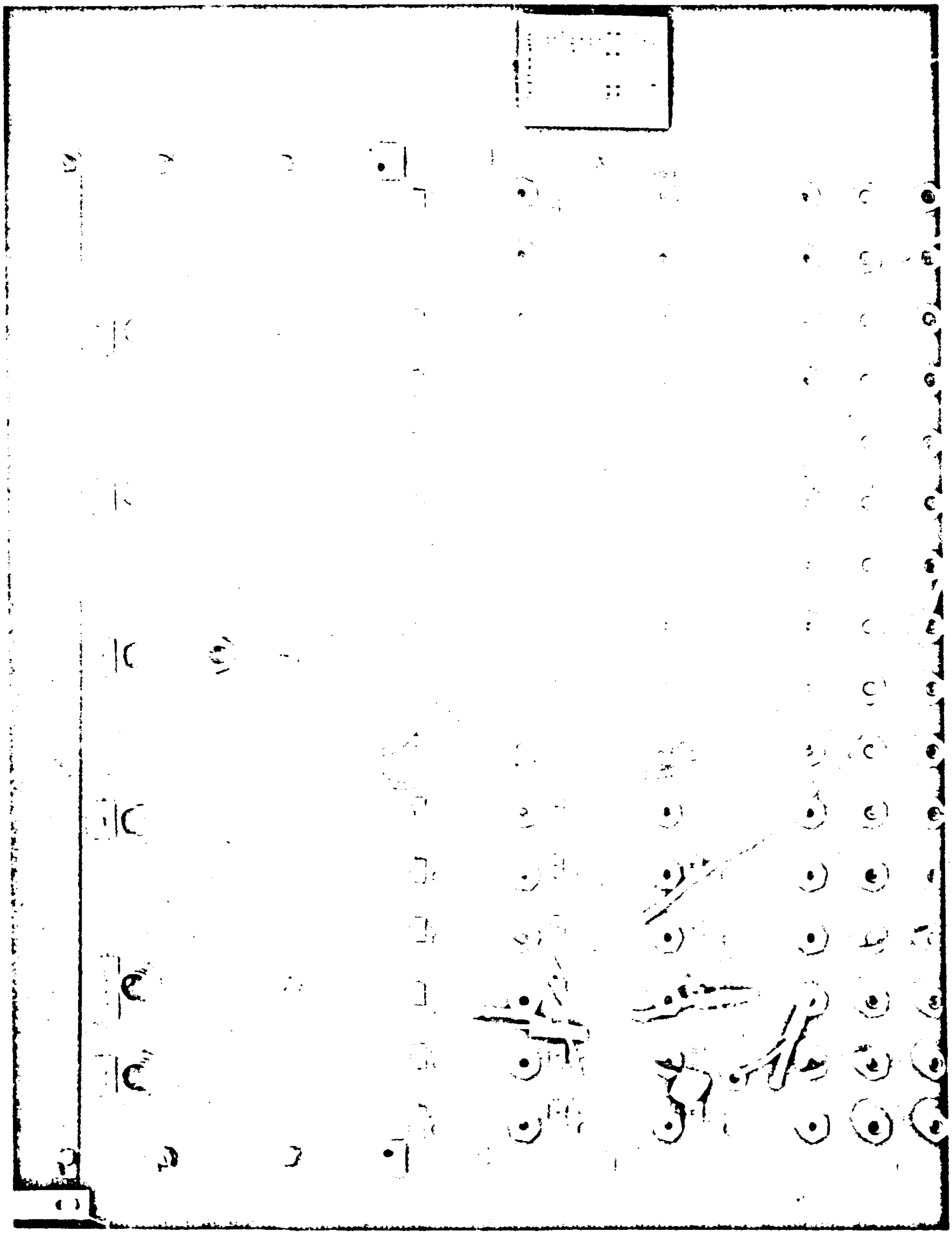

Figure 2-8. Monitor Panel and Programmable Input Selector

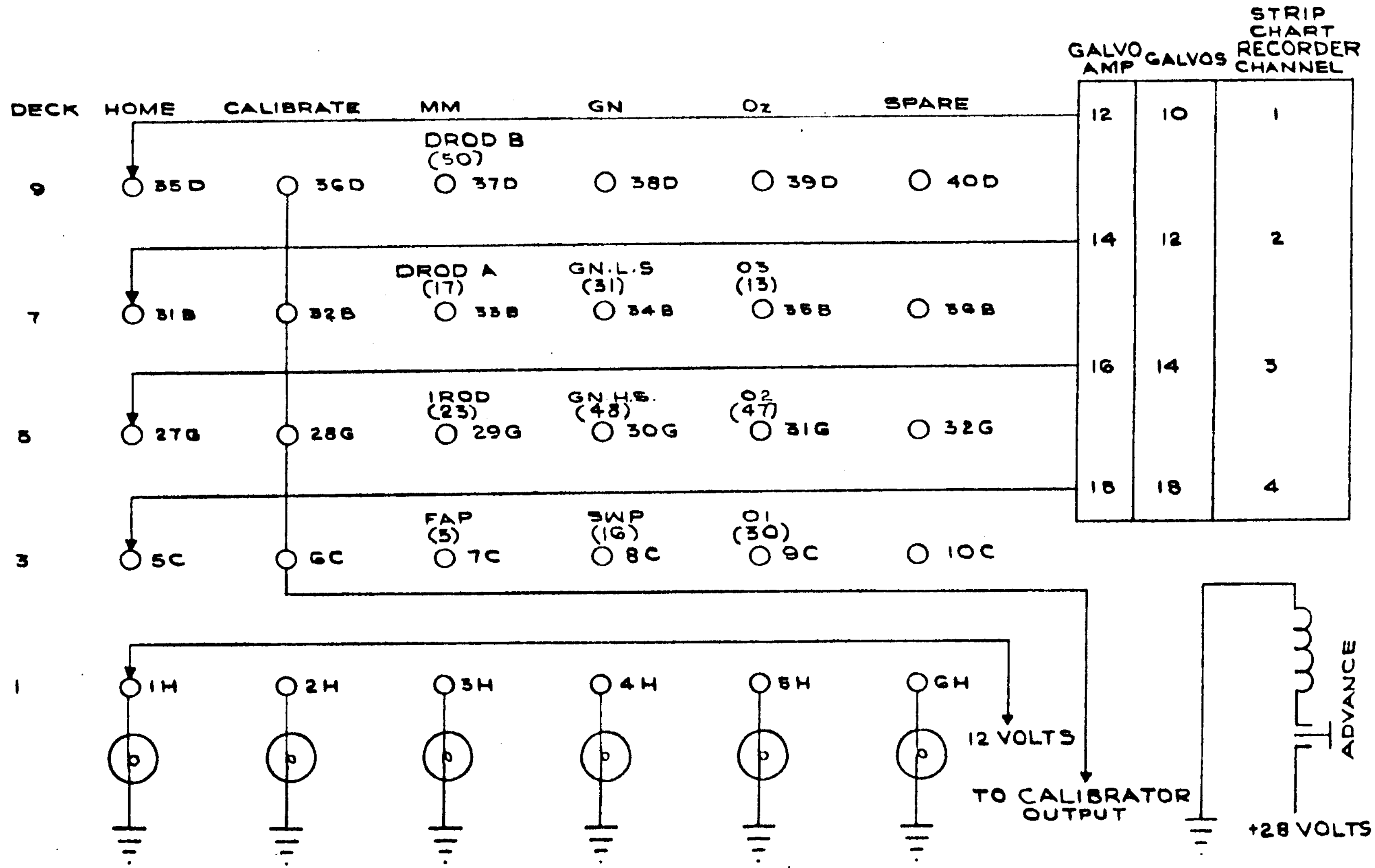

Figure 2-9. Programmable Input Selector Position Assignments

b. Galvanometer Amplifiers

Thirty-six galvanometer amplifiers, designed by the authors, (Figure 2-10), have been added to the Strip Chart Recorder by ETB personnel in order to provide the necessary gain to amplify the low level input signals to drive the low impedance galvanometers. The input impedance of these amplifiers is greater than one megohm, the frequency response exceeds 100 KC and their sensitivity can be adjusted over a wide range of values. Currently the sensitivity is 1 volt/inch.

c. Strip Chart Recorder

A 36 channel CEC 5-123 Strip Chart Recorder shown in Figures 2-6 and 2-7, has been provided to make recordings of the signal outputs from the Spacecraft experiments.

The recorder chart speeds range from 0.1 inches/second to 160 inches/second with timing lines at 1, 10 or 100/second. 7-364 model galvanometers whose frequency response extends to 0.6 KC are used. Four galvanometers are set up as shown in Figure 2-6 to provide the active signal traces. Four more galvanometers are set up mechanically to provide traces coincident with the four signal traces giving a zero reference trace and also serve as a spare.

d. Voltage Calibrators

The voltage calibrators located on the recorder may be used to calibrate all channels at once with 0-5V in 1/2 and/or 1 volt steps and 0-1V in 0.1 volt steps, see Figures 2-11 and 2-12. Voltage is set with a digital voltmeter and resistors used are accurate to within 0.1%.

4. Turn-on Plug

Plug P21 mates to the Spacecraft Turn-On (J437) receptacle and brings out the Spacecraft power and control lines through the Spacecraft Turn-On cable to the thermal-vacuum flange connection V-6. The lines are extended to the junction box mounted receptacles S1X and S1Y. From mating S1X and S1Y plugs, the lines are terminated at their appropriate control and monitor points on the S-52 Power and Programmer Control Panel through 37 pin amphenol connections J36 and J37.

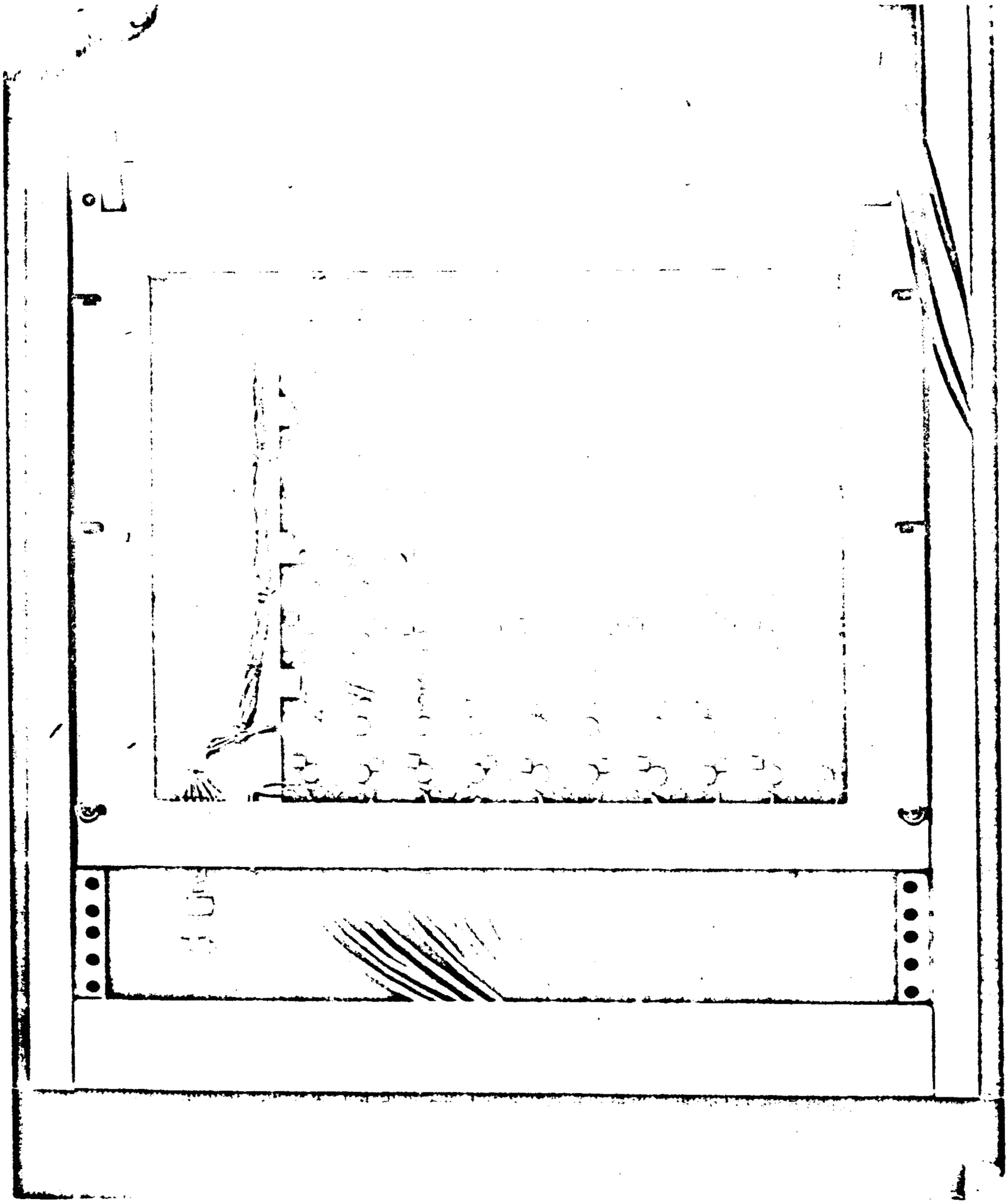

Figure 2-10. Galvanometer Amplifiers

INSTRUMENTATION PREPARATION

STC Setup Strip Chart Recorder, Programmable Input Channel Selector and Calibrator.

Verify Input connections.

Selector Positions / Signal Inputs	Home	Cal.	MM	GN	Ozone
1		2V/in.	FAP	Swp	O_3
2		2V/in.	IROD	HS	O_2
3		2V/in.	DROD A	LS	O_1
4		2V/in.	DROD B		
5		2V/in.	Timing	Timing	Timing

Chart Cal speed 0.4 in/sec.

Chart Sig. speed 1.6 in/sec.

NOTE: Chart speed selectable .1 inch/sec. to 160 in/sec. Calibration selectable 0-5V in 1V steps, 0-5V in 1/2V steps, and 0-1V in 0.1 volt steps.

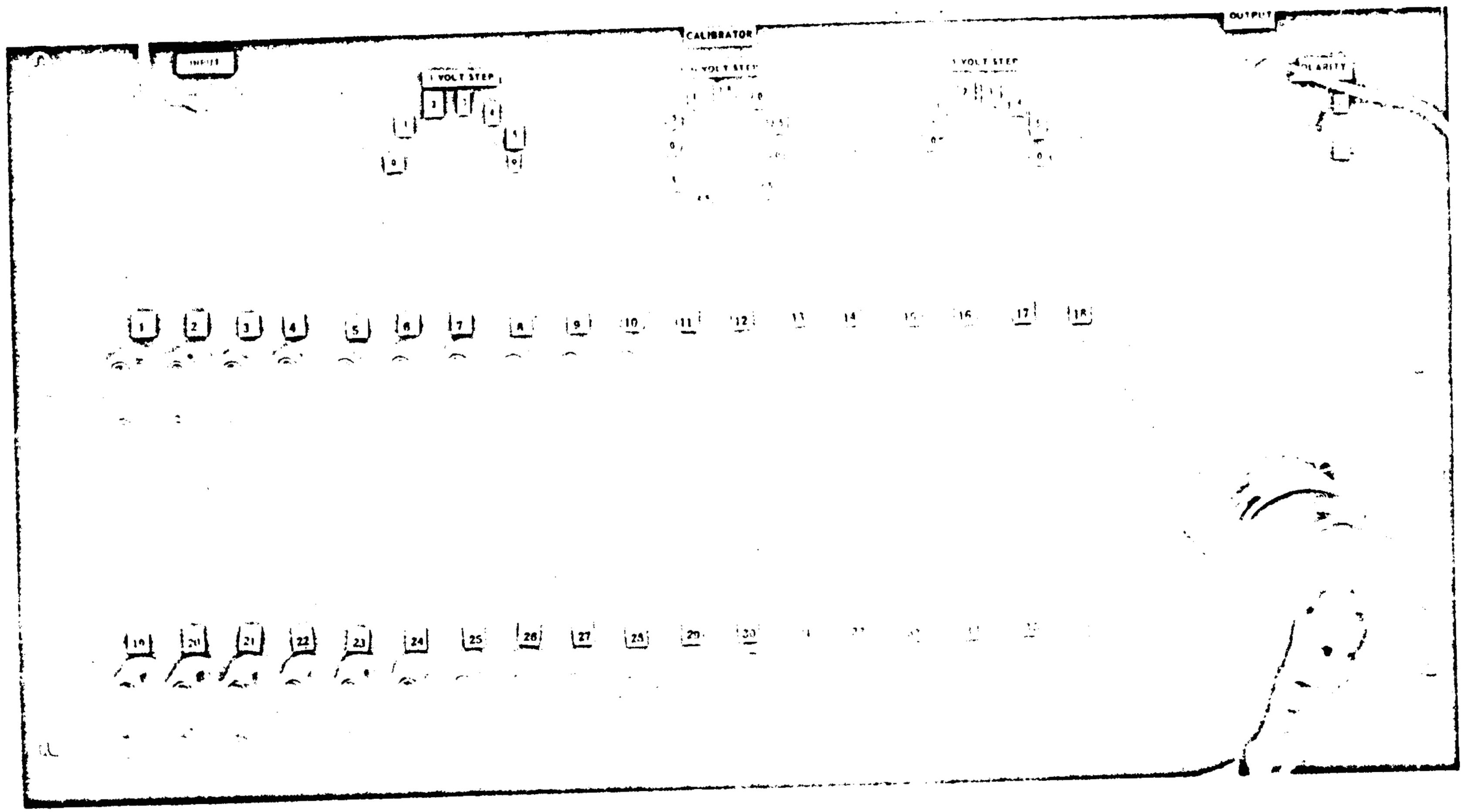

Figure 2-11. Voltage Calibrators

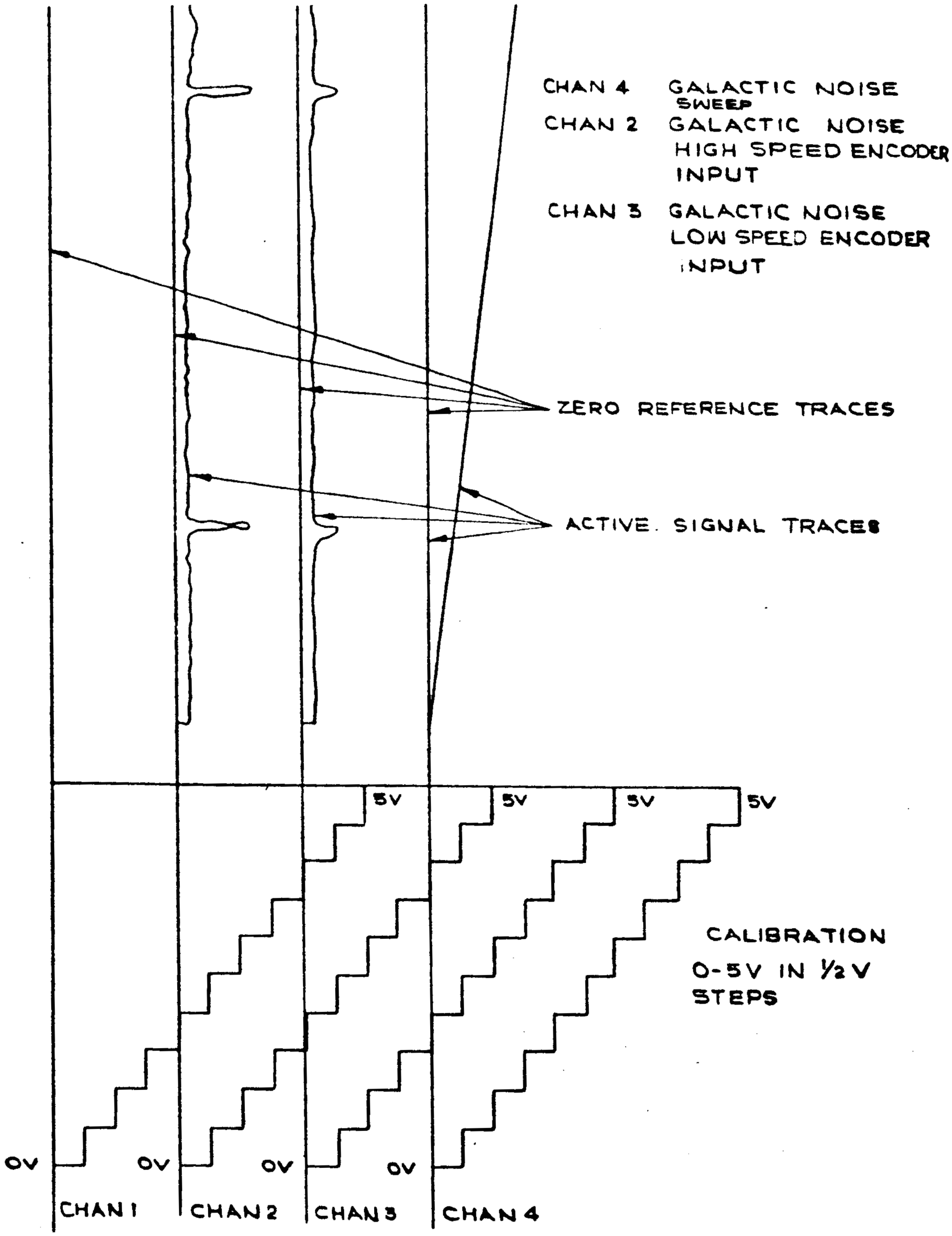

Figure 2-12. Sample Strip Chart Using Programmable Strip Chart Recording System

5. Umbilical Plug

Plug P22 mates to the Spacecraft Umbilical receptable, (J316) and brings the programmer control lines through the Spacecraft Umbilical cable to the thermal-vacuum flange connection V-7. The lines are extended from this point in the same manner as the lines of the Turn-On Plug as indicated above.

6. S-52 Power and Programmer Control Panel

The Operational S-52 Power and Programmer Control Panel referred to as the "Control Panel," pictured in Figure 2-13, provides for the exercise and monitoring of the subsequent responses of the following S-52 Spacecraft functions which are briefly described. The 21 inch Control Panel is mounted in a mobile rack with the required power supplies, a digital voltmeter and its associated printer as shown in Figure 2-14. The schematic diagram of the Control Panel, its associated power supplies and their connections to the S-52 Spacecraft Umbilical (J316) and Turn-On (J437) connections are shown in the Spacecraft Flow Chart, Figure 2-1.

The Control Panel designed and fabricated by H. Leverone and N. Mandell was completed on 27 July 1962 for use throughout integrations, environmental testing and in the blockhouse during the launch phase.

FUNCTIONS

a. On-Off Control of Spacecraft

The toggle switch labeled "Payload ON - Payload OFF" connects plus 12 volts from an external power supply to actuate the Spacecraft Hold-off relay. An in line "Hold Off Relay Current" meter monitors the relay current. A red lamp illuminates indicating payload "ON" condition.

b. Battery Current Recording

A continuous recording of the behavior of the charge and discharge currents of each Spacecraft battery "A" and "B" is provided by a pair of Rustrak chart recorders respectively wired in series with each spacecraft battery through the Turn-On plug (J437), pins 2 and 8 respectively.

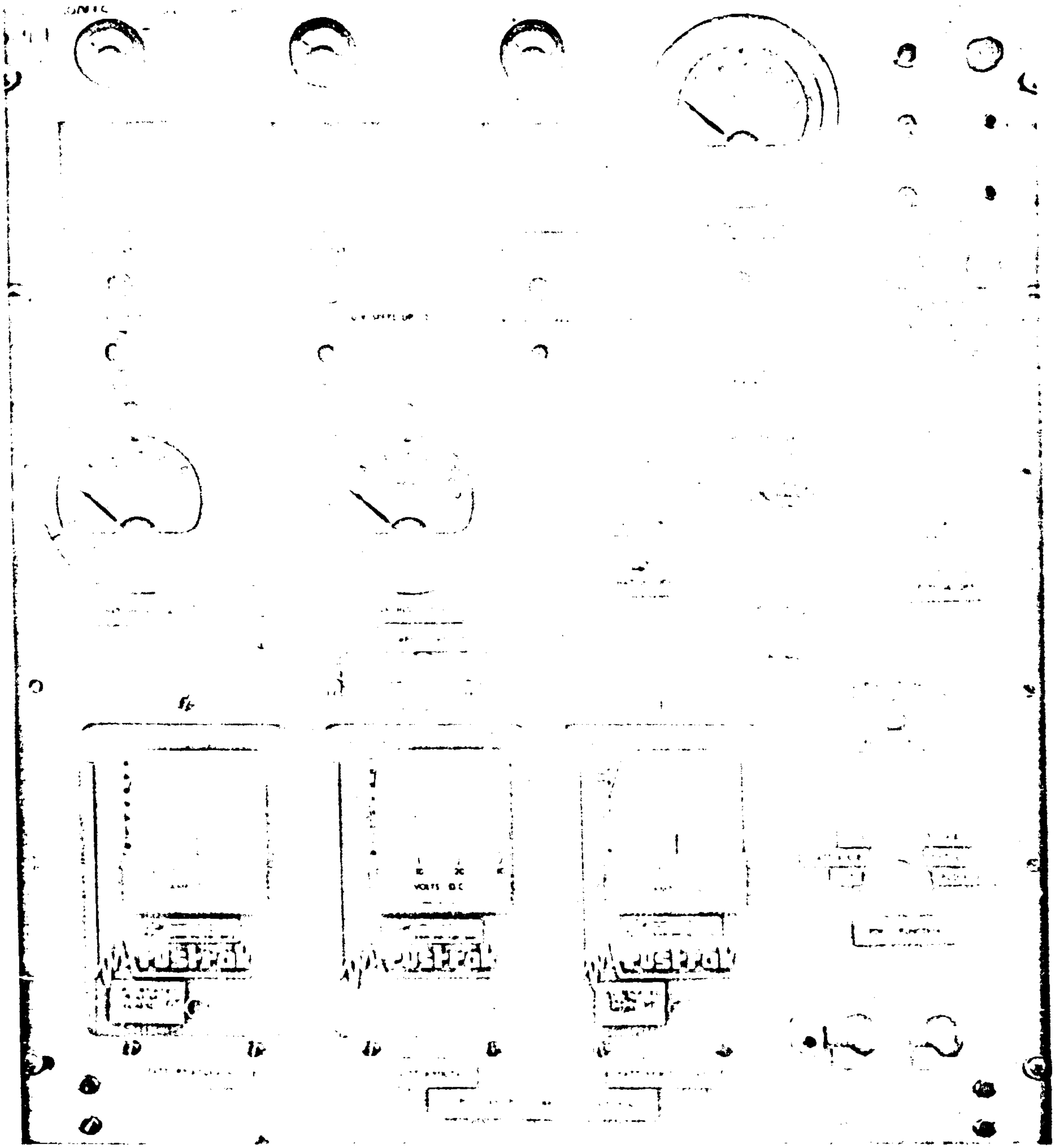

Figure 2-13. S-52 Power and Programmer Control Panel
"Control Panel"

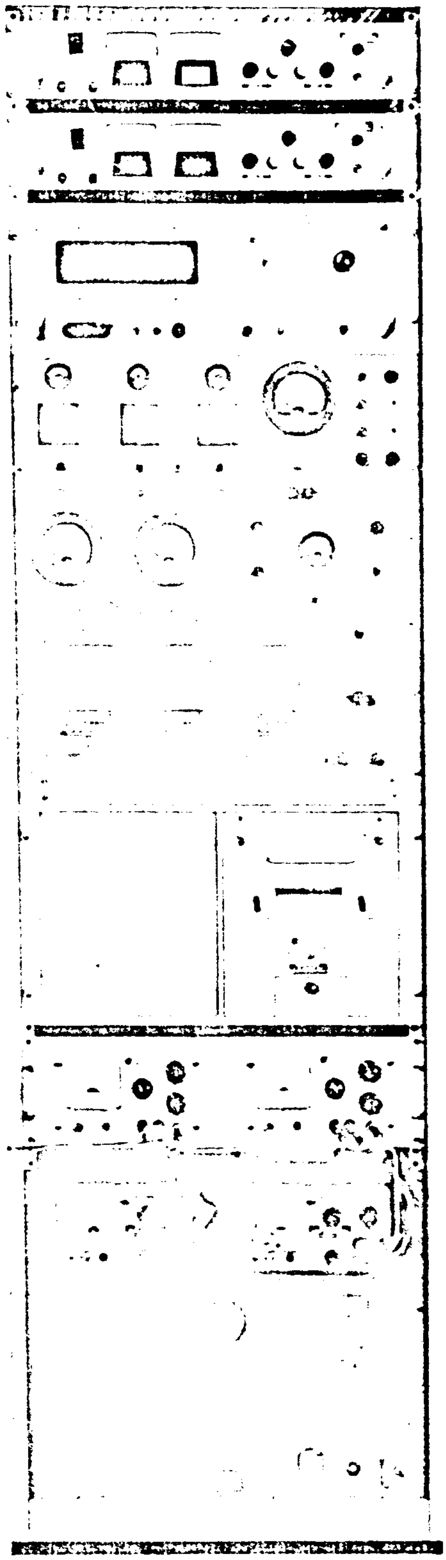

Figure 2-14. Power Control Panel

c. System Voltage Recording

A continuous recording of the behavior of the spacecraft system voltage is made on a third Rustrak recorder (so labeled) connected to the unregulated buss through the Umbilical isolated voltage monitoring circuit at pins "D" (plus voltage) and "E" (Ground). Provisions for Int Battery voltage monitoring is available plus current through use of current probes and HP 428B.

For more accurate measurements of system voltage, the isolated voltage monitoring circuit is available at GR jacks J10 (plus) and J11 (negative). GR jack J9 is connected to the spacecraft power ground.

The toggle switch "A. C. Power" controls the 110 VAC supply to the three Rustrak chart drive motors.

d. Power Function Switch

The six position wafer switch provides for the following control:

"OFF" position - no power connections are made to the Spacecraft.

"Battery 'A' and 'B'" position - The spacecraft batteries "A" and "B" connections are brought out of the Turn-On plug pins 2 and 8 respectively through their respective Rustrak recorders and returned to the spacecraft battery switching network on pins 21 and 27 respectively on the Turn-On plug. These connections permit observance of Spacecraft performance on internal battery operation and under the various imposed external charging current conditions.

"Ext. A" position - External power supply "A" only is supplying the Spacecraft system power through pin 21 of the Turn-On Plug, the spacecraft batteries "A" and "B" are disconnected. The purpose for this connection is to permit certain tests which require variation of the spacecraft system voltage for example, the undervoltage test, wherein the supply voltage must be lowered below the normal battery voltage. Also provides means of calibrating PP-7.

"Ext. B" position - permits the use of external power supply "B" in like manner to external power supply "A".

"Ext. A and B" position - Both internal spacecraft batteries "A" and "B" are respectively replaced by external power supplies "A" and

"B". The required lowering of spacecraft system voltage is now permitted and exercise of battery switching, for example, can be made.

"Blockhouse" position - This position is identical to "Batt A & B" position. However, at the launch site the Turn-On plug connections are not brought back to the blockhouse. Therefore, in this position, external power supply "A" is connected to the Spacecraft solar buss through pin A of the umbilical connector to provide the charging capability.

e. Battery Charging

Charge of the Spacecraft batteries may be exercised through the actuation of the "Charging ON-Charging OFF" toggle switch to "ON" and when the Power Function switch is in the "Batt A and B" or "Blockhouse" position, a lamp illuminates indicating the charging switch is "ON".

A pair of 3 inch panel meters continuously monitor the charging voltage and current respectively.

External power supply "A" is connected through pin A of the Umbilical plug to the unregulated buss for charging exercises. The specific charge rate is adjustable by the voltage control and current limit control on external power supply "A".

A toggle switch "100 Percent Charge - 60-40 Charge" is provided to permit exercise of the two extreme orbital charge conditions, "100%" where the Spacecraft is in full sunlight orbit and receives charging energy continuously, and the "60-40" rate in which charging current is available 60 minutes and the Spacecraft must operate solely on batteries for 40 minutes. An electrical timer in the Control Panel provides the "60-40" charging cycle automatically.

Modulation of the charging power of the magnitude and perturbation rate experiences by the spacecraft solar paddle in orbit is accomplished through the "Modulated" position of the "Modulated-Normal" toggle switch. In the "Modulated" position, a function generator (HP 202A) is connected to the remote programming circuitry of external power supply "A", which permits controlled modulation of the output power. The "Normal" position of this switch permits charging under constant power conditions.

f. Dumping

The Spacecraft dissipates excessive charging current across a pair of 10 ohm "Dumping" resistors. The voltage drop across these resistors under this conditions is available for measurement at GR jacks J4 (resistor A), J6 (resistor B), and J5 (common positive).

NOTE: This measurement is above spacecraft common and must be measured with an instrument having an isolated input.

g. Programmer #2

Controls for "Programmer #2" functions available through the Spacecraft Umbilical connector for use in testing and at the launch site.

"Hold" toggle switch supplies +12 volts to hold the Spacecraft telemetry in mode 2 status (ozone) in the t + 60 minute portion of 110 minute cycle.

"Speedup" toggle switch supplies +12 volts to reduce the telemetry mode cycle from 110 minutes to approximately 11 minutes.

h. Solar Paddle Voltage

Solar paddle voltage toggle switch applies 10 volts (HP 7214) to the sunrise sensing circuitry to permit the initiation of the mode 2-1 cycle. A 3 inch panel meter "Solar Paddle Voltage" monitors the voltage applied. A pair of GR jack "S. P. V. " are provided to accept connections to a digital voltmeter in order to determine the trigger level of the sunrise reusing circuitry by adjustment of the power supply voltage control.

To permit a realistic simulation of spacecraft sunrise, two 10 ohm resistors will be soldered between terminals E28 and E6 on one solar paddle arm and between E30 and E12 on the other solar paddle arm. No solar paddles on at this time.

i. Programmer #1

To provide a more comprehensive evaluation of the "Programmer #1" functions available through the spacecraft Umbilical connector, the design on the bench test unit, by Dave Clem of Flight R-F Systems, was incorporated in the S-52 Control Panel.

"Manual Command" push button initiates the playback mode of the Spacecraft (tape recorder playback).

"Playback Timer" – A one inch meter indicates the pulsing of the playback timing oscillator and a course measurement of the oscillator rate is indicated.

"Playback Timer Decade Counter" – indicates the total number of counts the oscillator makes during the playback period.

"P. B. Osc. Bnc." connector – provides for the connection of a counter to observe the playback timer oscillator period more accurately.

j. Undervoltage Detector and Recycle Timer

Oscillator Rates 1 and 2 are indicated on the one inch panel meters respectively labeled.

"Oscillator Decade Counters" – indicates the total number of respective oscillator counts experienced during an undervoltage period.

"Bnc" connections are provided for each undervoltage oscillator to permit more accurate measurement of the oscillator periods.

"U V Speedup" – a pair of toggle switches permits independent speedup of each undervoltage detector oscillator from 18 hours to approximately 5 minutes.

k. External Power Supplies

(1) External Power Supplies A and B
Trygon M36-5
0-50 Volts 0-5 amps
0.05% regulation
0.05% stability
1.0 millivolt maximum ripple
Current limiting, adjustable
Overvoltage protection
Remote voltage control

(2) +25 Volt and +6 Volt supplies
Hewlett Packard 721-A
0.3% regulation
0.15 millivolt ripple
Current limiting
0-30V 0-150 ma

(3) +12 Volt and -6 Volt supplies
Harrison Labs 855B
0-18V 0-1.5 amp
0.03% regulation
0.5 millivolt ripple
Overload protection
Current limiting

7. Spacecraft Simulator

The Spacecraft Simulator shown in Figures 2-15 and 2-16 provides mating spacecraft receptacles which accept the Instrumentation, Turn-On, and Umbilical connections to the Spacecraft, from the Instrumentation Complex. All the leads are appropriately labeled and terminated in GR jacks mounted on a suitable chassis. The Spacecraft Simulator provides protection for the Spacecraft by permitting a complete compatibility checkout of the Instrumentation Complex prior to making the first cable connections to the Spacecraft.

The proper operation of the Instrumentation Complex by the application of appropriate Spacecraft simulated signals through a set of cables provided to connect the Spacecraft Simulator to the S-52 Spacecraft.

This feature of making the Spacecraft connections readily available will be beneficial in those test areas where the Monitor Panel is not normally available and where the flight Turn-On plug is used.

The S-52 Control Panel, Monitor Panel, S/C Signal Simulator, and interconnecting cables thus far described are shown in Figure 2-16 after a pre-installation checkout utilizing the Spacecraft Simulator. All cables were fabricated by the ETB S-52 personnel with the exception of the Thermal-Vacuum flange and its integral cables V-1 through V-7 which are supplied by Mr. Dave Wiener of 322.

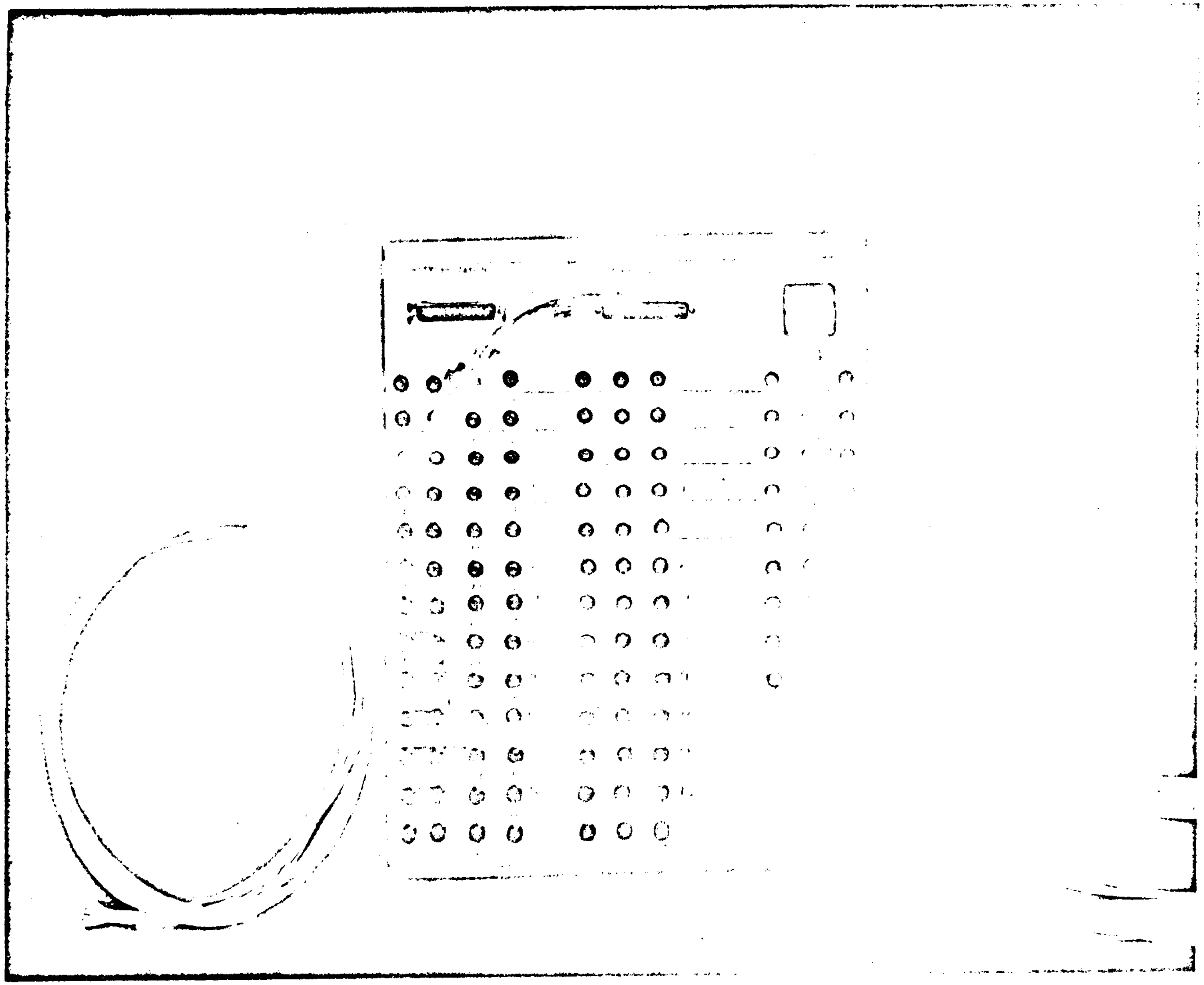

Figure 2-15. Spacecraft Simulator

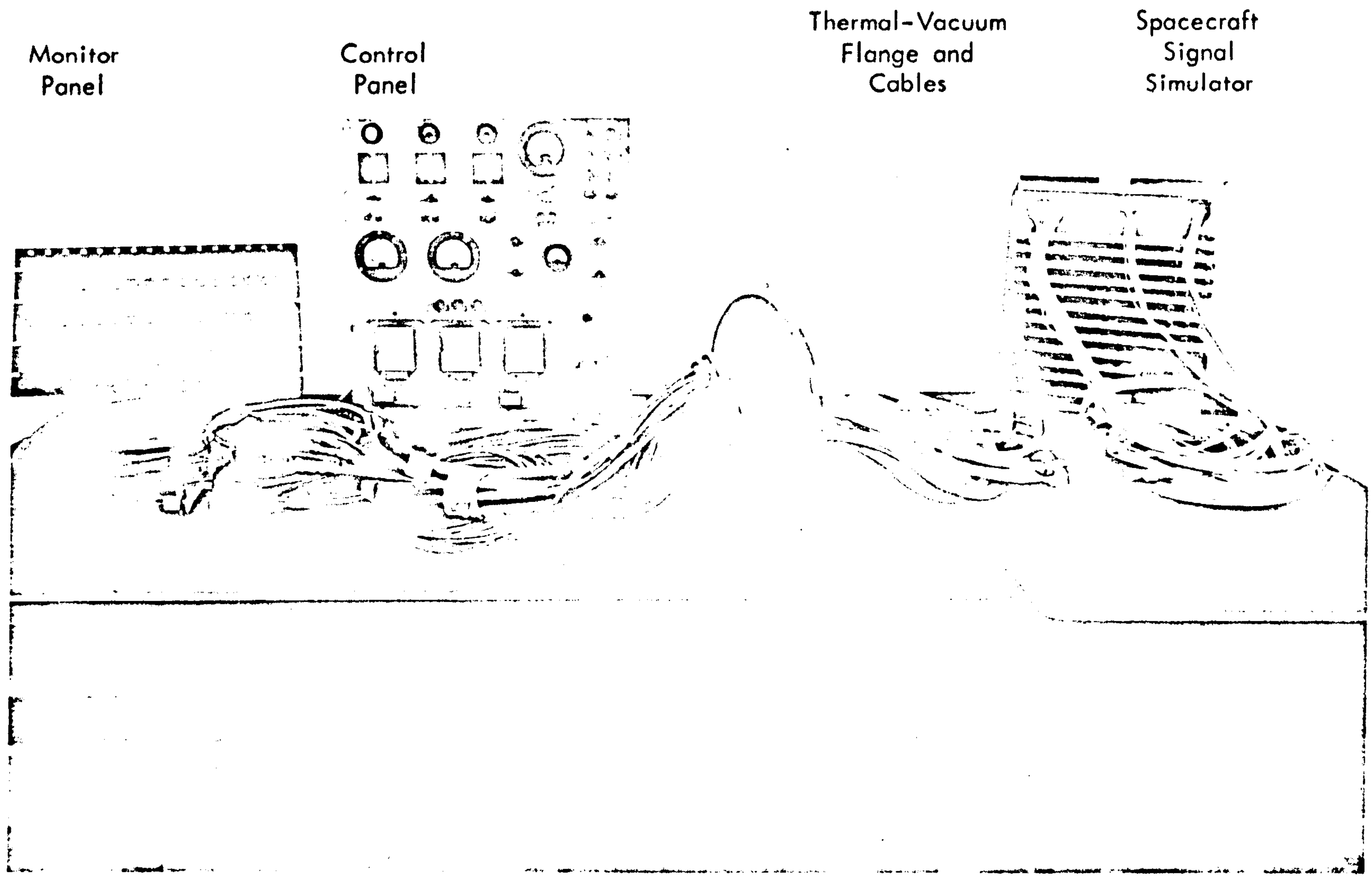

Figure 2-16. Spacecraft Simulator

8. Instrument Rack

The following Instrument Rack was assembled to readily provide the instruments required to monitor, measure and record the available Spacecraft parameters at the Monitor Panel. To preclude burdening the reader, a very brief description of the instruments capabilities will be given with reference to its use for a typical measurement.

a. Oscilloscope - (Tektronics Type RM35A with Type CA Vertical Amplifier

Characteristics -

Dual trace - DC wide-band high gain
Vertical deflection - 50 mv/cm to 20 v/cm
Rise time and passband - 25 usec dc to 14 mc
Sweep Range - 0.1 usec/cm to 5 sec/cm
Input Impedance - 1 meg. 20 uuf

This oscilloscope is used for observing the waveforms of, (a) both phases of the spacecraft motor drive signals; (b) measure of encoder synchronization; (c) experiment output signals; and (d) other functions.

b. Counters - Hewlett-Packard Type 523CR

Characteristics -

Measures - frequency, period, time interval
Frequency Range - 10 cps to 1.2 mc
Display - 6 digit nixie tubes and printer output
Accuracy - ±0.3%

These instruments provide for: (a) Accurate measurement of the phase shift between phase I and phase II of the Spacecraft tape recorder motor drive frequency; (b) both periods of concurrent counting under-voltage timers; and (c) frequency of Programmer #1 oscillator, etc.

c. Printer - Hewlett-Packard Type 561B

A continuous permanent record is provided by this instrument of any parameter monitored by the counters or digital voltmeter.

d. Frequency Counter – Hewlett-Packard Type 524C with Type 525C Converter Plug-In

Characteristics –

Frequency Range – 90 to 510 mc
Accuracy – ±0.03% ten period average

e. Type 526 Time Interval Plug-In

Characteristics –

Time Interval – 1.0 usec to 100 days
Accuracy – 0.1 usec ± time base accuracy

This instrument is used to measure: (a) The Spacecraft transmitter carrier frequency; (b) time interval of Programmer #2 functions, etc.

f. Oscilloscope – Tektronics Type RM 561 with Type 3A74 Vertical Amplifier and Type 2B67 Time Base

Characteristics –

4 trace – DC to 2 mc
Sweep Range – 1 usec/cm to 5 sec/cm
Input impedance – 1 meg 47 uuf
Use Time – 0.17 usec

Use of this scope is made in: (a) Observing the operational modes of Programmer #2 for both high speed and low speed functions (2 traces each); (b) composite display of related experiment signals, etc.

g. Power Meter – Hewlett-Packard Type 430CR with Thermistor Mount 477B with 20db Attenuator

Characteristics –

Measurement – r-f power
Range – 10 mw to 1 watt
Accuracy – ±5%

The Spacecraft transmitter r-f power is measured by this instrument.

h. Clip-On D. C. Ammeter - Hewlett-Packard Type 428B

Characteristics -

Range - 1 ma to 10 amperes
Accuracy - ±3%

This instrument is used to measure: (a) the various package load currents within the Spacecraft; (b) the dumping current, etc.

i. Ink Pen Recorder - Brush Type Mark II

Characteristics -

Range - 0 to 400 VDC
Speeds - 1-5-25-125 MM per inch
Input impedance - 10 meg. - D. C.
Capacity - 2 channel with 2 edge event markers

While the Strip Chart Recorder is sampling the experiment outputs the pen recorder will: (a) record the performance of Programmer #2; (b) provide continuous longtime observance of experiment output signals, etc.

For convenience of description, the Spacecraft Command Receiver connections are presented prior to the presentation on the Transmitter connections, which will appear later.

9. Command Receiver

Direct connection is made to the Spacecraft command receiver through coaxial cable to connector J19. Penetration through the thermal-vacuum chamber is through flange connection P19 to P9. The Command Transmitter located in the test area is connected to P9 through a fixed length of coax cable.

10. Command Transmitter

A two-tone (address and execute) modulated fixed frequency transmitter furnished by the Flight R. F. Systems group (D. Hepler) is provided for r-f interrogation of the S-52 Spacecraft command receiver and decoder for initiation of the Spacecraft playback mode of operation. Built-in r-f attenuators used with a fixed length of interconnecting coax cable provides for a consistent relative measurement of command receiver sensitivity throughout testing, Figure 2-17.

11. The Micrometeoroid Experiment Instrumentation

At the request of the experimenter, twenty-two test leads have been connected through the penetration flange for insertion in available surface mounted test jacks on the Micrometeorite experiment. The Micrometeorite Test Panel is cabled to the appropriate test points through J10.

a. The Micrometeorite Test Panel - consists of an adjustable Repetition Rate Pulse Generator, designed by the authors and fabricated by the ETB S-52 personnel, Figures 2-18a, b, and c. A pair of power supplies (HP 521) completes the panel. The adjustable Repetition Rate Pulse Generator provides for functionally testing the S-52 Micrometeorite experiment not only on the bench but through Spacecraft environmental exposures and integration, since the Micrometeorite experiment has available surface mounted test points.

b. The Adjustable Repetition Rate Pulse Generator - consists of nine independent pulse generators each with isolated outputs which permit the experimenter a wide latitude in signal variation required for functionally testing the Micrometeorite experiment.

The rear view is shown in Figure 2-18b and the schematic of one of the nine duplicate pulse generators is shown in Figure 2-18c.

12. Sensor Exciter Rack

a. Top Unit - Control Panel, Ozone Spectrometers

Contains: (a) A selector switch to select the mercury zeone lights supplying them with 50 volt DC and TH 3,000 volts RF start pulse. Each position has an indicator light; (b) the meter reads the voltage drop across a variable resistor 0-7 ohms; (c) a push button, normally open, is for the lamp start pulse; (d) an ozone monitor and broadband; (e) a switch for "ON" and "OFF" with an indicator lamp; and (f) a meter reading voltage drop across a variable resistor 0-5 ohms.

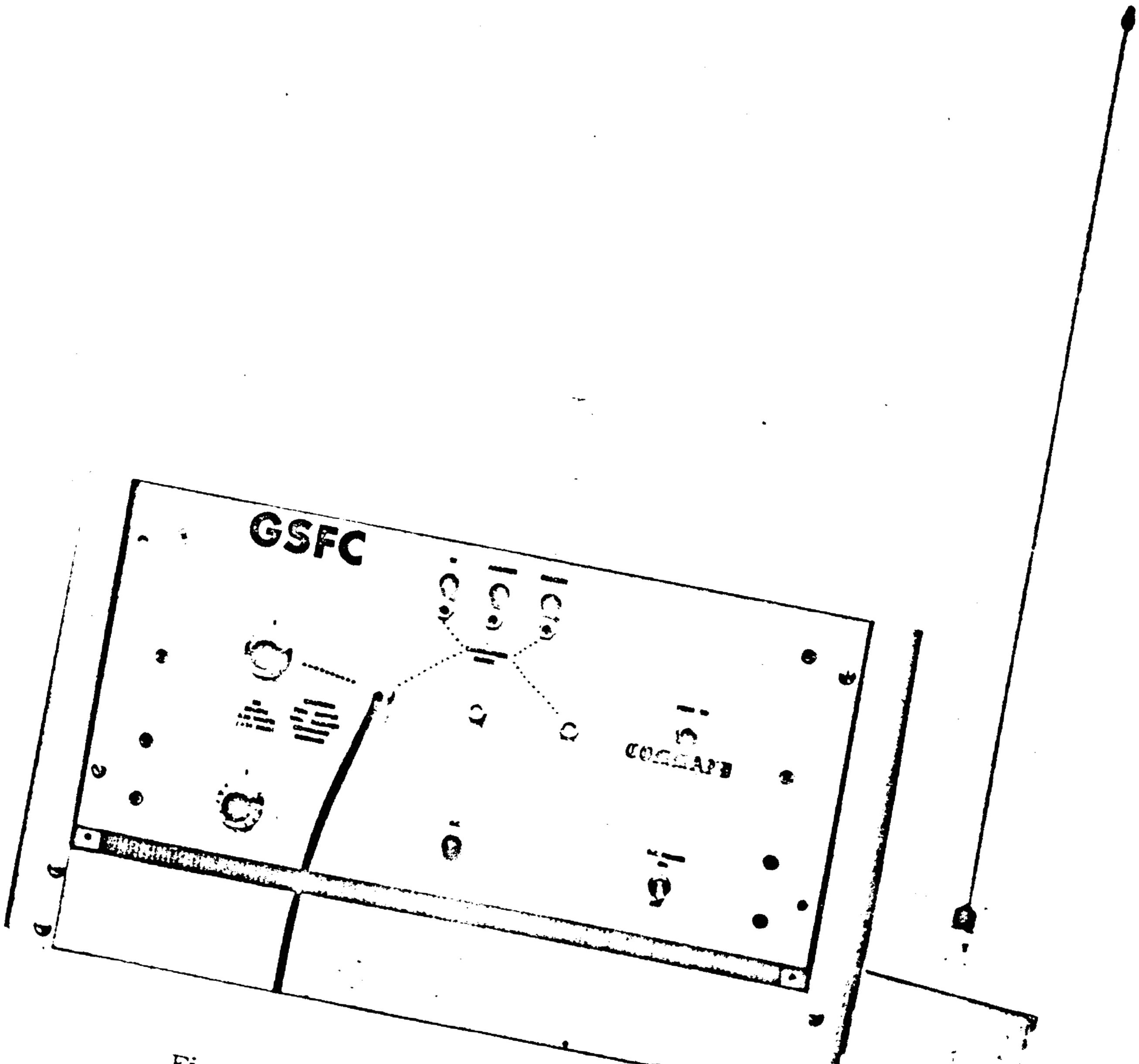

Figure 2-17. Command Receiver with Antenna

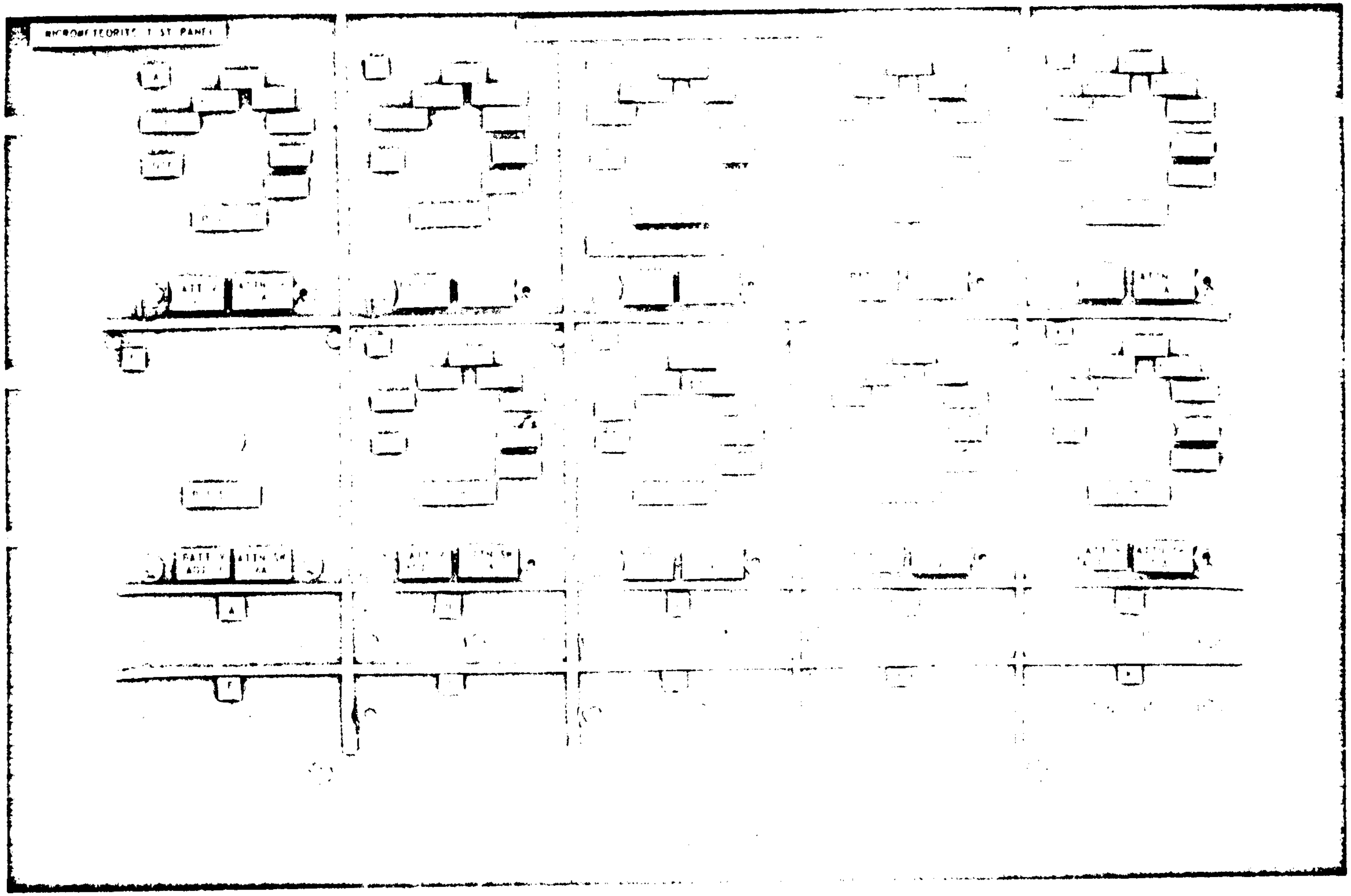

Figure 2-18a. Micrometeorite Test Panel
Adjustable Repetition Rate Pulse Generator
Front View

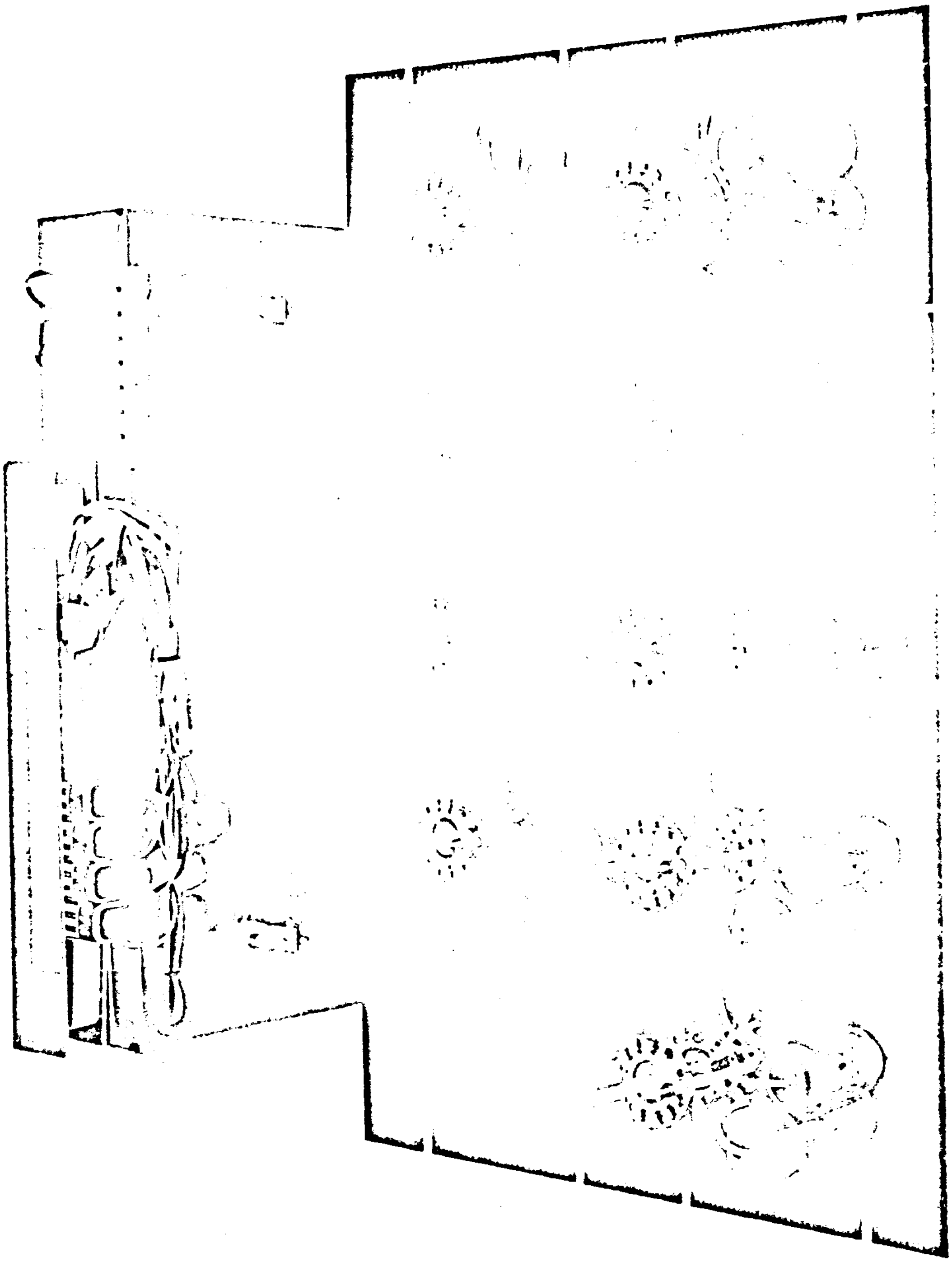

Figure 2-18b. Micrometeorite Test Panel
Adjustable Repetition Rate Pulse Generator
Rear View

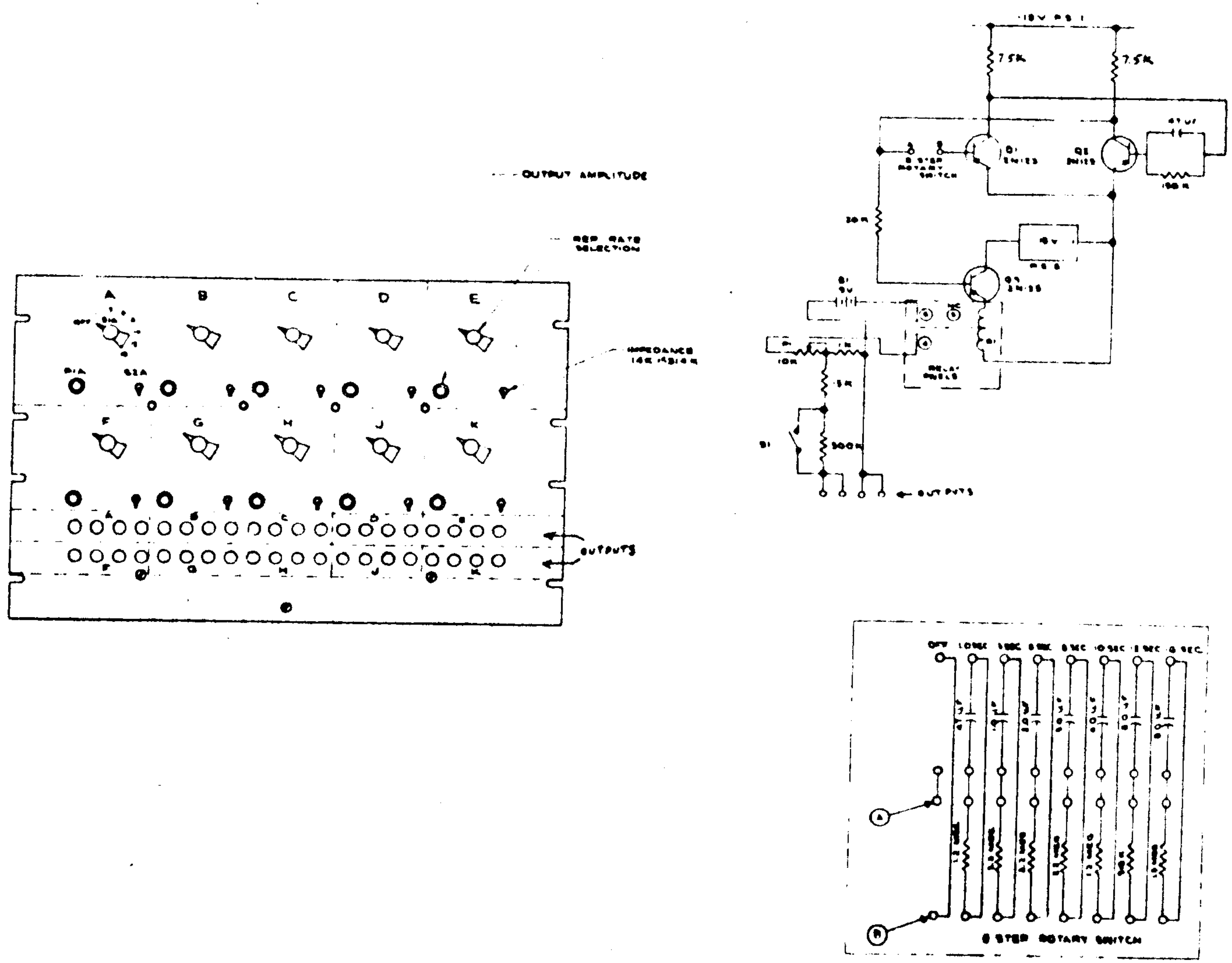

Figure 2-18c. Micrometeorite Test Panel
Adjustable Repetition Rate Pulse Generator
Schematic

The Spacecraft r-f telemetry signal is cabled direct from the selected test area junction box and is applied to the receiver input of the T&E ground station, Figure 2-19, (Room 133) through a patch panel. The receiver demodulates the telemetry signal and provides an output to the decoder and the patch panel. The receiver also supplies an output to an associated panoramic adapter which presents a visual display of the energy distribution in the r-f carrier and sidebands. The detected receiver output is applied to the decoder which recognizes frame synchronization, measures the ten period average of the frequency burst of each sequential telemetry data sample and provides for the display of the average period on a single channel printer.

a. Single Channel Printer

The single channel printer shown in Figure 2-20 will print out continuously repetitive, the sixteen words in any channel selected by the Channel Select switch on the panel shown in Figure 2-20. Four single channel printers are available for use on S-52 and they can be programmed to print the channels preselected by their associated Channel Select switch.

b. Single Channel Printout

A sample single channel printout of channel 8 is shown in Figure 2-21. Using the eleven printwheels available at each printer, the following assignments, Table 2-4, are made for identifying and displaying the data.

Proceeding from left to right across the printed tape, the numeral in the left column designates one of the four Spacecraft operational modes described in Table 2-4. The Spacecraft operational mode identification will be printed automatically since it is derived from the mode of telemetry received by the ground station.

c. Test Code

The authors have devised a unique environmental test code which uses the next three digits from the left. The purpose of this code is to provide on the data printout, a legible automatic identification of the test configuration and the conditions of the environmental exposure. The task of handwriting the information and its inherent inadequacies

Contains: (a) 8 "ON-OFF" switches with indicator lights for 60 ohm AC lamps; and (b) one "ON-OFF" switch with indicator as a master AC switch for Control Panel.

b. Second Panel

Contains: One Sola power supply, Cat. M285140, to furnish power for the monitor and broadband exciter.

c. Third Panel

Contains: (a) One Harrison Lab 865B power supply to furnish power to the indicator lamps; (b) one battery charger and control panel; (c) a meter 0-10 volt reading voltage drop across 1 ohm resistor with switch to read either charge or discharge current; (d) one variable 1/2 wave rectified power source for charging battery pack; and (e) one switch for switching battery pack between charge and use.

d. Bottom Panel

Bottom panel is blank but behind these panels is a 50.4 amp/hr. battery pack composed of four 12 volt batteries wired in series.

To provide for the detection of the mechanical advancement of the foils in the Micrometeorite Experiment sensors, the authors designed an Optical Foil Advance detector. The Optical Foil Advance Detector consists of a photocell which is energized by the reflected light from the sensor foil emitted by a prefocused flashlight lamp. The output of the photocell is indicated at the test stand. The sensor foils are striped with 1/16" bands of black paint to provide the required change in reflected light, thus indicating the foil movement.

13. Spacecraft Transmitter

The Spacecraft transmitter output is cabled through the penetration flange connections of 18 and 8 to a fixed 20 lb. attenuator located in the junction box to provide a fixed load for the transmitter. The output of the attenuator is then connected to a pair of "T" coax connections which provide connection to the mobile ground stations and the power meter in the DCMH.

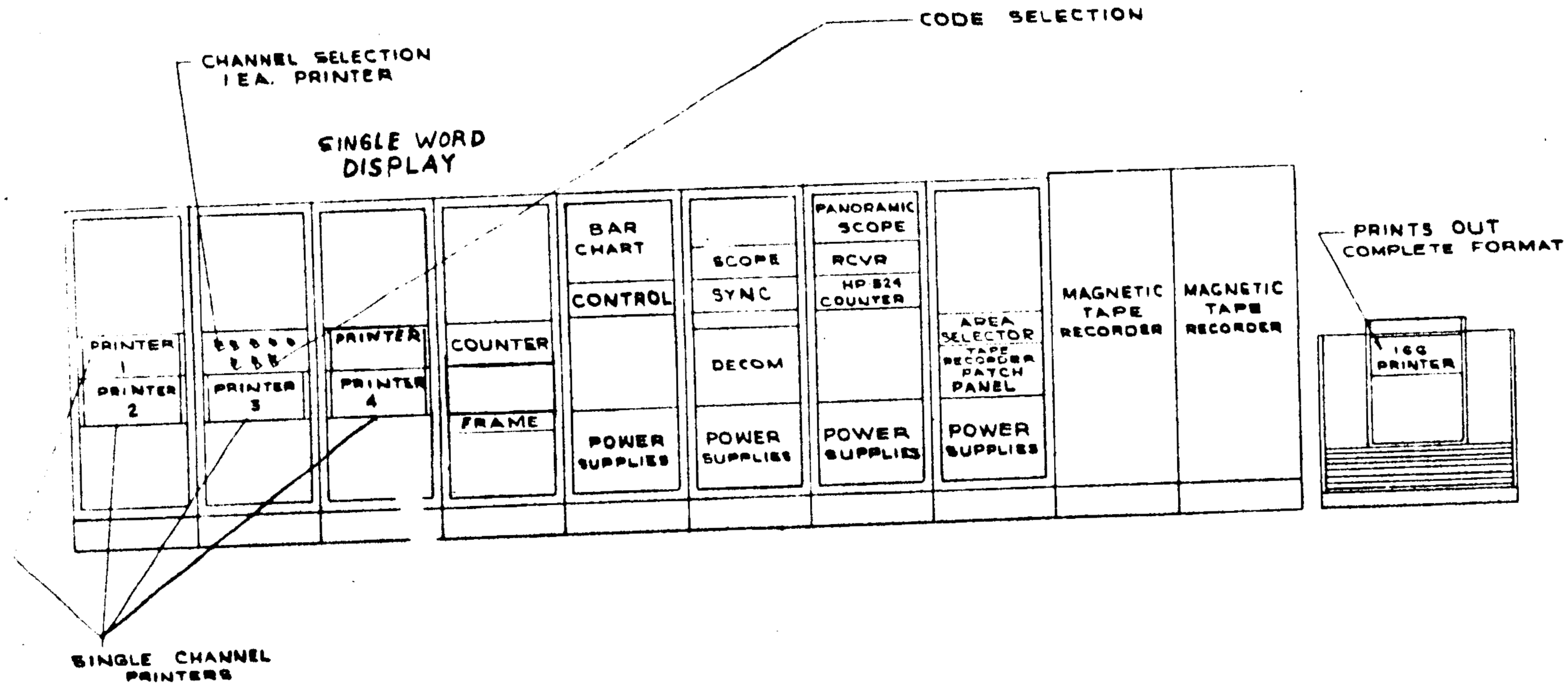

Figure 2-19. Ground Station

TABLE 2-4

S-52 Mode 1 High Speed Telemetry Format

CHAN. O FREQ.	FRAME	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
5.1 KC	0	000	MM-IROD A or B	G_1	MM-IROD A or B	MM-DROD A Pre or Post exposure	MM-IROD A or B	G_1	MM-IROD A or B	PP0-Om1	MM-IROD A or B	G_1	MM-IROD A or B	MM-DROD B Pre or Post exposure	MM-IROD A or B	G_1	MM-IROD A or B	LS CHANNEL 0 FRAME 0 SYNCED TO
4.5 KC	1	SYNC								PP1-Om2								
6.3 KC	2	001								PP2-Om3								
4.5 KC	3	S								PP3-Om4								
7.5 KC	4	010								PP4-GN1								
4.5 KC	5	S								PP5-MMm1								
8.7 KC	6	011								PP6-MMm1								
4.5 KC	7	S								PP7-PS								
9.9 KC	8	100								PP8-PS								
4.5 KC	9	S								PP9-PS								
11.1 KC	10	101								PP10-PS								
4.5 KC	11	S								PP11-PS								
12.3 KC	12	110								PP12-PS								
4.5 KC	13	S								PP13-TEMP								
13.5 KC	14	111								PP14-TEMP								
4.5 KC	15	S								PP15-GN2								

PP0 – Temp. Snout Oz
PP1 – Temp. Upper Deck Oz
PP2 – Temp. Oz Spect
PP3 – EHT Monitor
PP4 – +15V
PP5 – Foil Advance B (DROD)
PP6 – Foil Advance A (DROD)
PP7 – Unreg Buss

PP8 – GN Reel – +12V
PP9 – Solar Paddles Currents
PP10 – Battery Current
PP11 – Battery A Temp.
PP12 – Solar Paddle 4 Temp.
PP13 – Dome Temp. # 1
PP14 – Skin Temp. # 2
PP15 – GN-SW Mon

MM-IROD A – Micrometeorite Instantaneous Readout Detector A
MM-IROD B – Micro. Inst. Readout Det. B
MM-DROD CAL – Micro. Delayed Readout Detector Calibrate
MM-IROD A – Micro. Del. Readout Det. A
MM-IROD B – Micro. Del. Readout Det. B
G_1 – Galactic Noise Detector Output

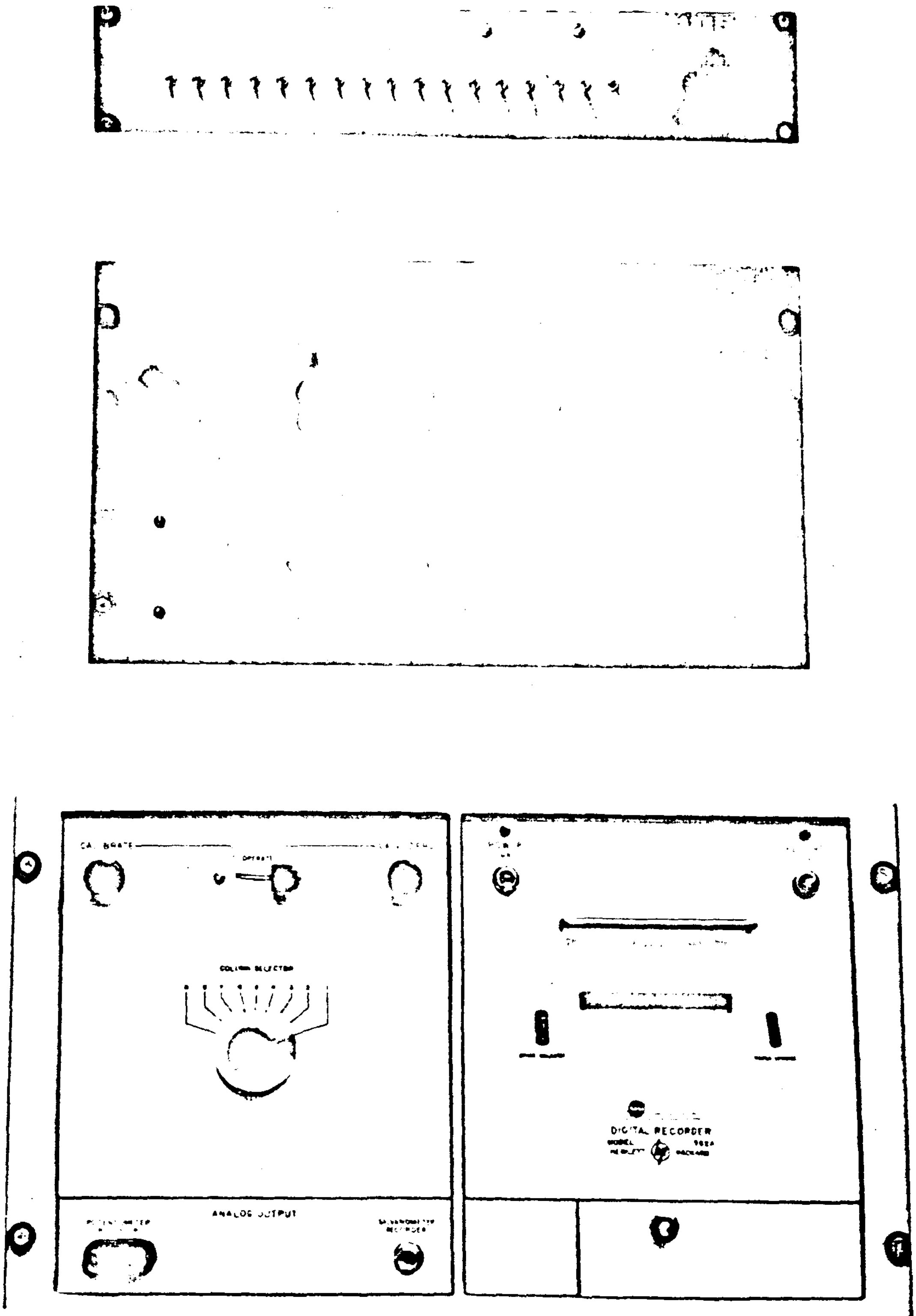

Figure 2-20. Single Channel Printer With Frame and Channel Selectors

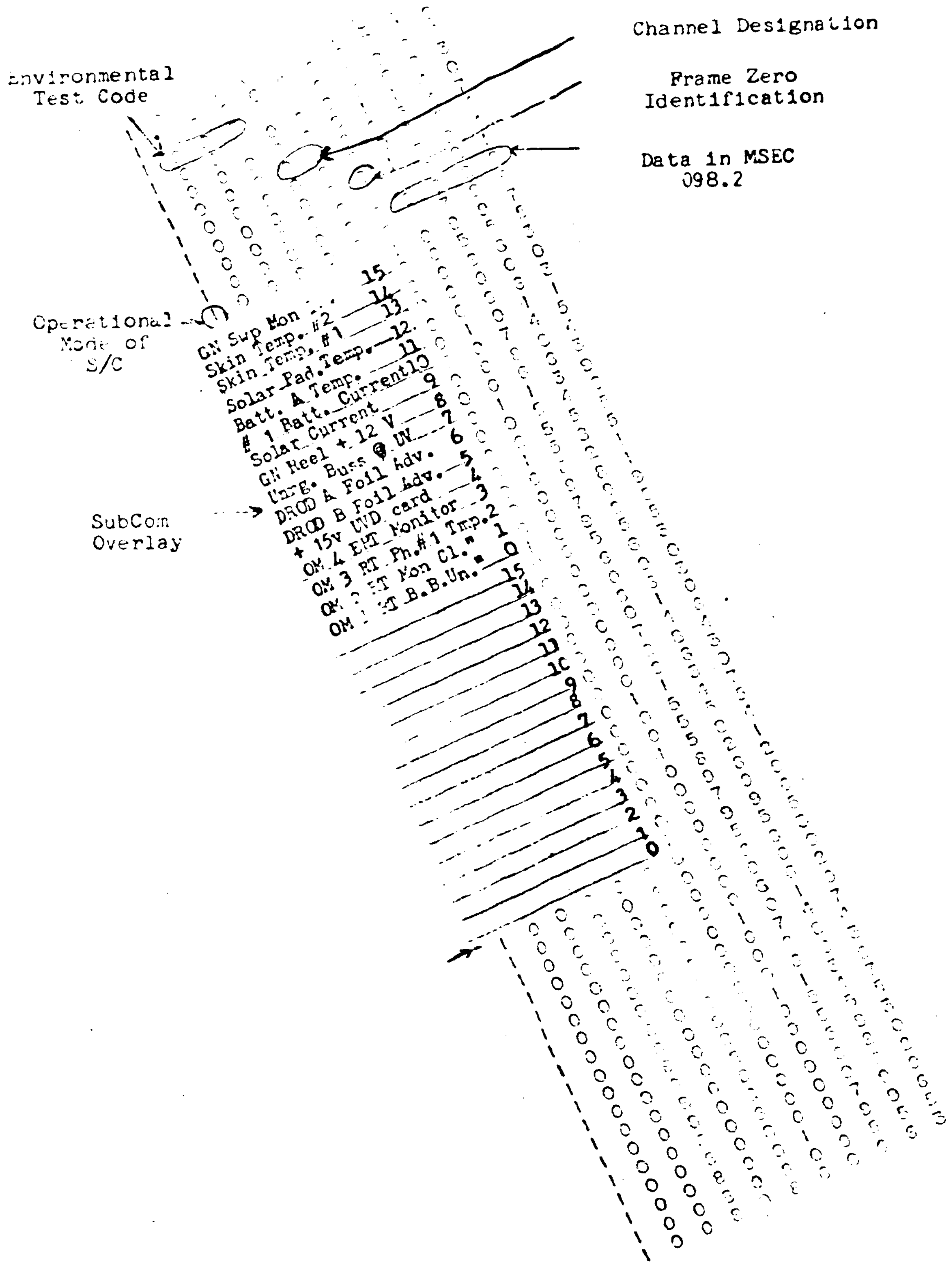

Figure 2-21. Sample Single Channel Printout of Channel 8

TABLE 2-4a

Channel Allocations H.S. & P.B.

CHAN.	MODE 1 H.S.	MODE 2	MODE 1 L.S.	MODE 2 L.S.
0	Sync	All 4.5 Kc	4.5 Kc	4.5 Kc
1	IROD A or B (1)	03 Spect.	G2 (2)	01
2	G1	03 Spect.	G2 (2)	02
3	IROD A or B	03 Spect.	G2 (2)	01
4	DROD Pre or Post	03 Spect.	G2 (2)	02
5	IROD A or B	03 Spect.	G2 (2)	01
6	G1	03 Spect.	G2 (2)	02
7	IROD A or B	03 Spect.	G2 (2)	01
8	P.P.	03 Spect.	G2 (2)	02
9	IROD A or B	03 Spect.	G2 (2)	01
10	G1	03 Spect.	G2 (2)	02
11	IROD A or B	03 Spect.	G2 (2)	01
12	DROD Pre or Post	03 Spect.	G2 (2)	02
13	IROD A or B	03 Spect.	G2 (2)	01
14	G1	03 Spect.	G2 (2)	02
15	IROD A or B	03 Spect.	4.5 Kc	01

(1) IROD A or B: On alternate orbits (All A or all B)
(2) G2 equals 10X (time constant of G1)

are eliminated. All that is required to provide the code on the print-outs of all four single channel printers is to dial the selected code in on the three panel mounted switches on the panel shown in Figure 2-20.

The following examples indicate the manner in which the code will be used:

Setup for vibration thrust axis
096

Vibration sine sweep lateral axis
914

Setup for temperature cold
040

Operation for temperature cold -10°C
410

NOTE: The 4 indicates cold temperature and the 10 now indicates the temperature in centigrade degrees.

Operation for temperature hot + 50°C
350

Spin 110 rpm
611

NOTE: Here the right hand two digits are used to designate the rpm × 10.

95% Humidity
895

The next pair of digits from the left indicate from 0 to 16 inclusive, the channel selected for printout.

The next digit moving to the right is a zero except that a one is printed in the position of frame zero for the identification of the beginning of each frame.

The last four digits are used for the display of data in microseconds from 66.0 to 200.0.

This versatile code system has the flexibility of describing any conceivable environmental condition and configuration that a Spacecraft or subassembly would encounter. The environmental test code will be applied on all data collected for purposes of identification and its use will reduce the task of handwriting.

d. Subcom Overlay

A Subcom Overlay shown in position in Figure 2-21 indexes on the flag for frame zero on the printout thus permitting ready identification of each of the individual data measurements.

e. Single Work Selection

A counter and associated printer provide for the display of any single telemetry data sample (word) from the entire telemetry format. Control for the single word selection is accomplished on the Frame and Channel Selector Panel, Figure 2-20. The ability to select a single word from the entire telemetry format (described later) is particularly valuable when observing the behavior of a single word with time as found on a subcommutated channel such as channel 8 of the S-52 telemetry format.

f. Magnetic Tape Recorder

A magnetic tape recorder located in the ground station provides for recording the receiver detector output signal for a chronological history of the Spacecraft performance during setup, test exposure and post test exposure.

g. Recorder Patch Panel

The Patch Panel, Figure 2-22, makes available at the front panel all seven Record and Playback channels of the magnetic tape recorder including the receiver output and the decoder input. The assessibility of these functions at the front panels promotes efficiency in changing from recording a telemetry signal to playback of the telemetry signal through the ground station for data reduction, for rapidly switching test areas, and for recording inputs from more than one Spacecraft under concurrent test schedules.

h. Ground Station Decoder

The Ground Station Decoder simultaneously provides a digitized signal of the received telemetry signal to Data Central.

14. Data Central

Early in the S-52 program, the authors found plotting of the behavior of the experiment output telemetry signals versus their respective hardline signals provided the optimum display for correlation and evaluation of stimulated Spacecraft performance. Discussions

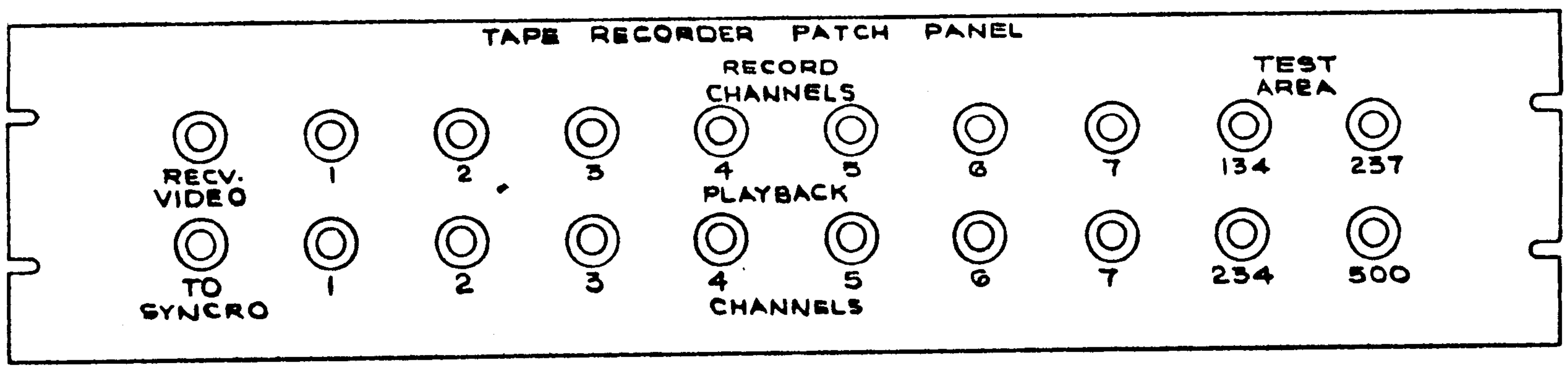

Figure 2-22. Tape Recorder Patch Panel

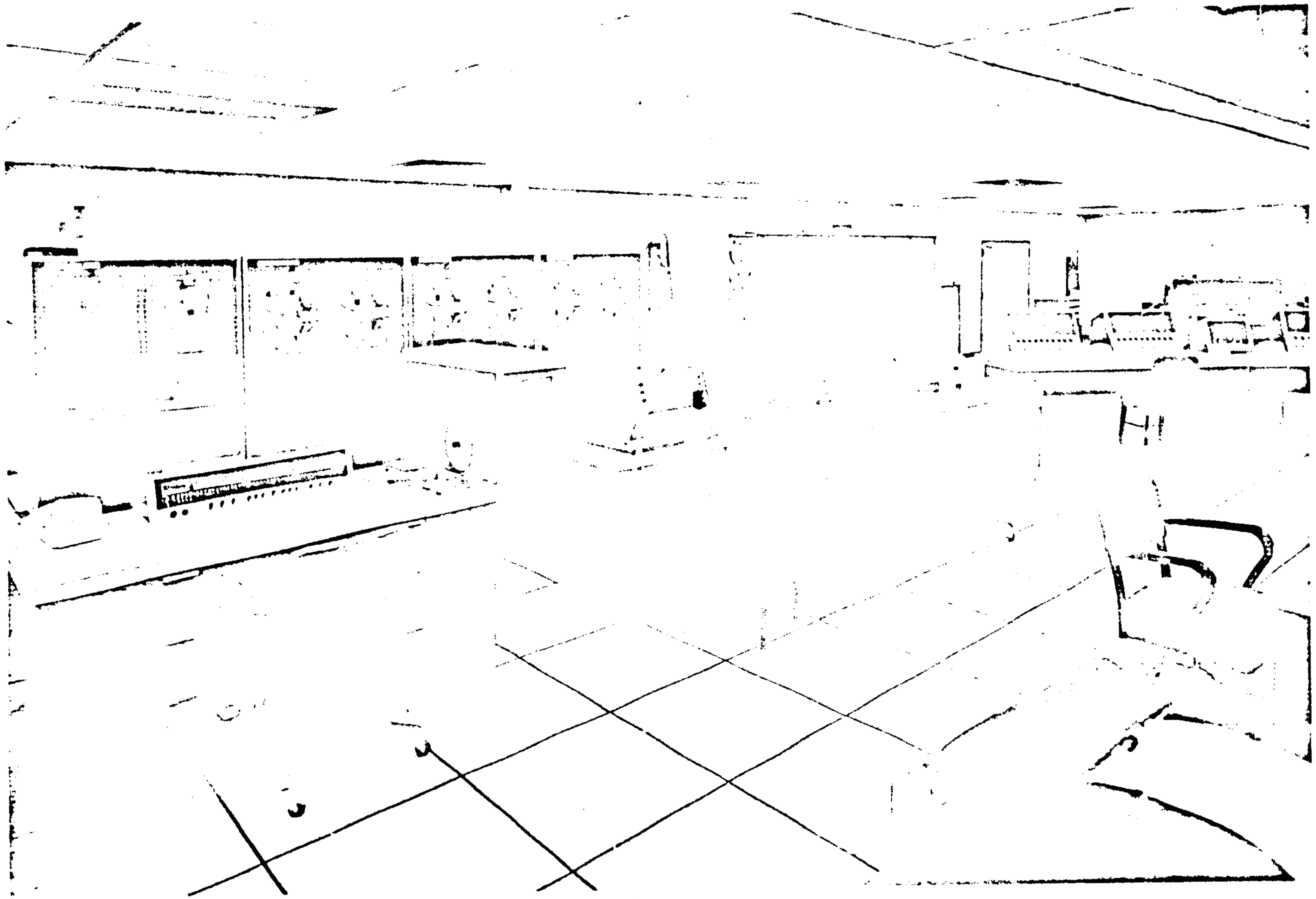

Figure 2-23. Data Central

with experimenters found them in concurrence, as they would have to convert the single channel microsecond printouts to volts and hand plot the data.

The services of the Data Central Computer System, Figure 2-23, and its peripheral display devices were enlisted to provide for plotting, analysis and display of the available S-52 Spacecraft data.

a. Hardline and Telemetry Signals

The hardline and telemetry signals available for plotting are:

0_1	Ozone Broadband
0_2	Ozone Monitor
0_3	Ozone Spectrometer
G_1	Galactic Noise HS output
G_2	Galactic Noise LS Output
G_3	Micrometeorite
DROD A	Galactic Noise Sweep Output
DROD B	Micrometeorite
IROD	Micrometeorite

Data Central receives the digitized telemetry signal from the ground station (Room 133) and the hardline signals are acquired by the DCMH through the "T" box connection at the test area junction box (Figures 2-24, 2-25 and 2-26). A program patch board in the DCMH provides for commutation of the hardline signals.

The "T" box, mounted in the test area junction box is electrically connected in line with instrumentation connections S1C, S1D and S1E and provides a tap on the following hardline test points which are cabled to the Data Collection Module High Speed (DCMH), Figure 2-27.

b. Hardline Signals to DCMH

Hardline Signals available to the DCMH, hence Data Central:

-6.0	Volts	0_3	Spectrometer Output
-3.0	Volts	0_1	Ozone Output
-7.5	Volts	0_2	Monitor Output
-18.0	Volts	GN	Monitor Sweep
-4.0	Volts	GN	HS Output

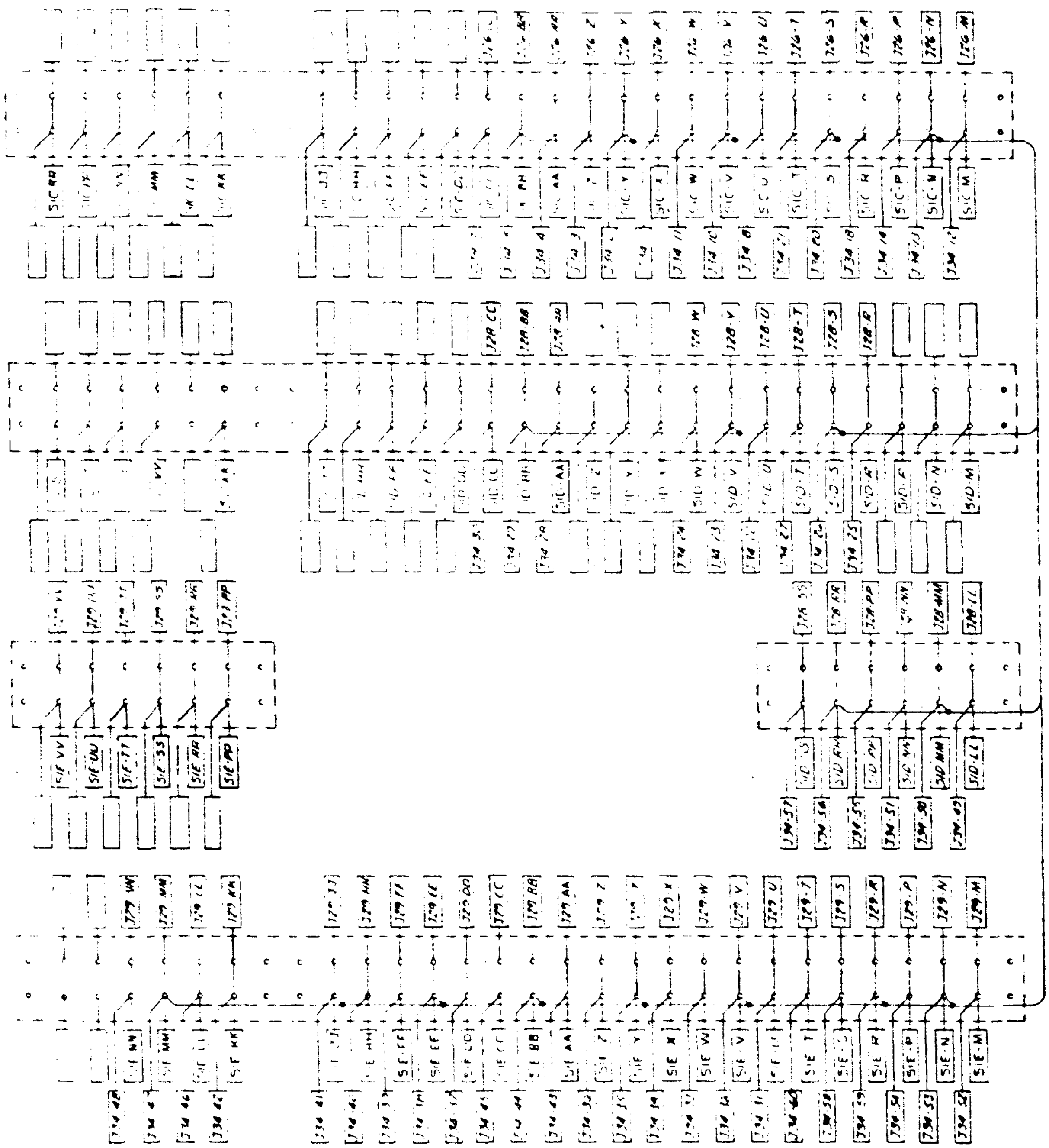

Figure 2-24. "T" Box Flow Chart

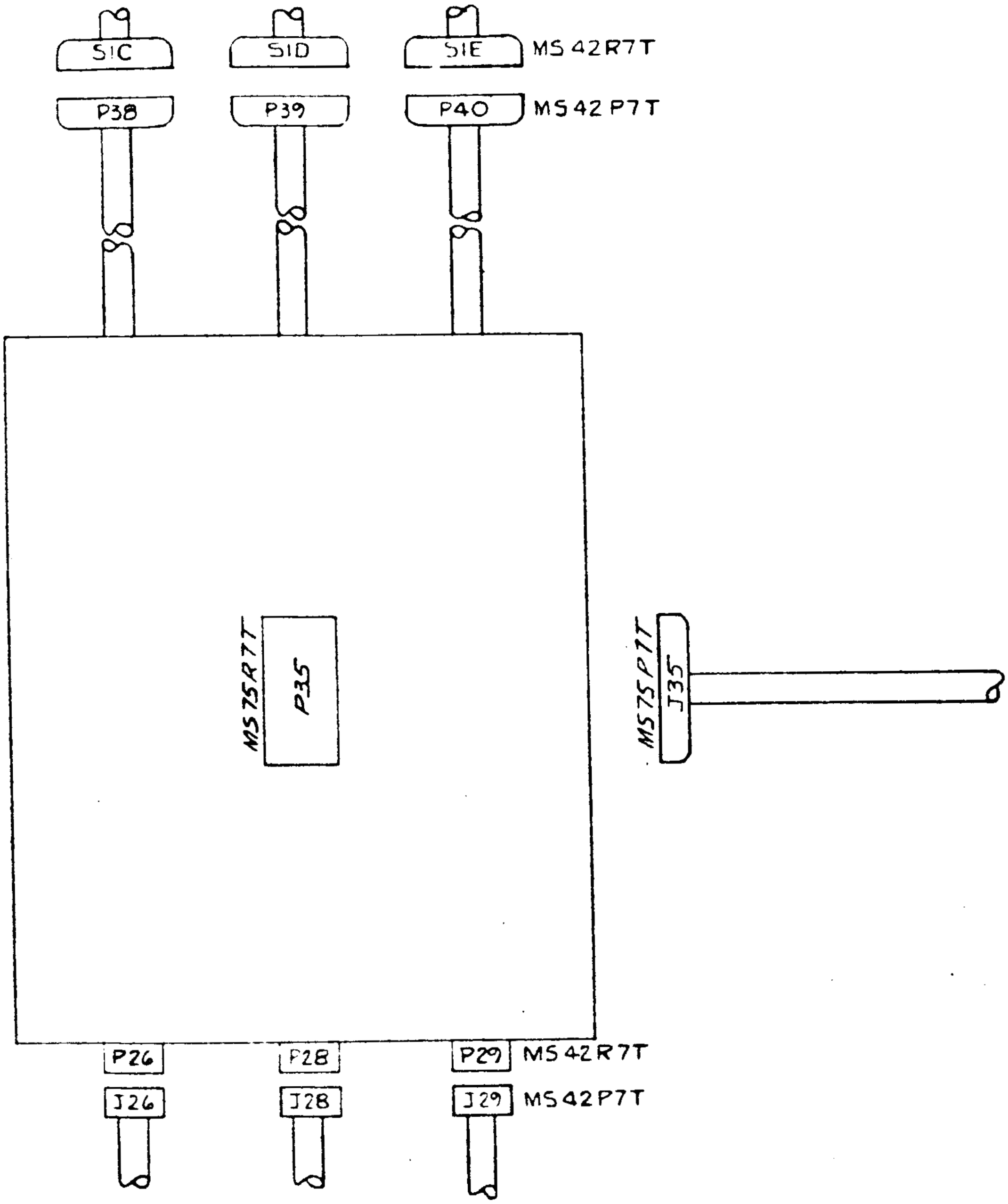

Figure 2-25. "T" Box Connections

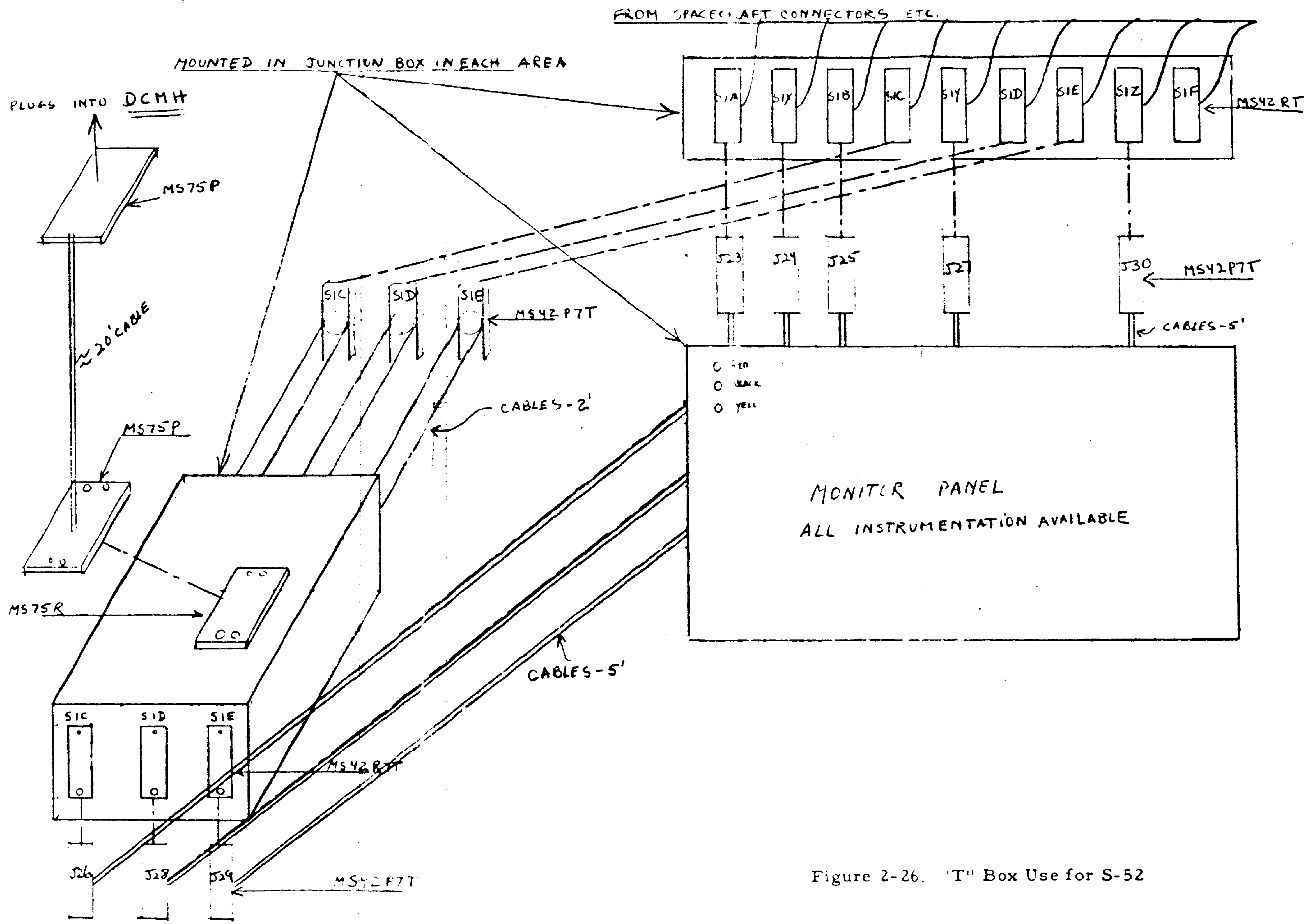

Figure 2-26. 'T" Box Use for S-52

57

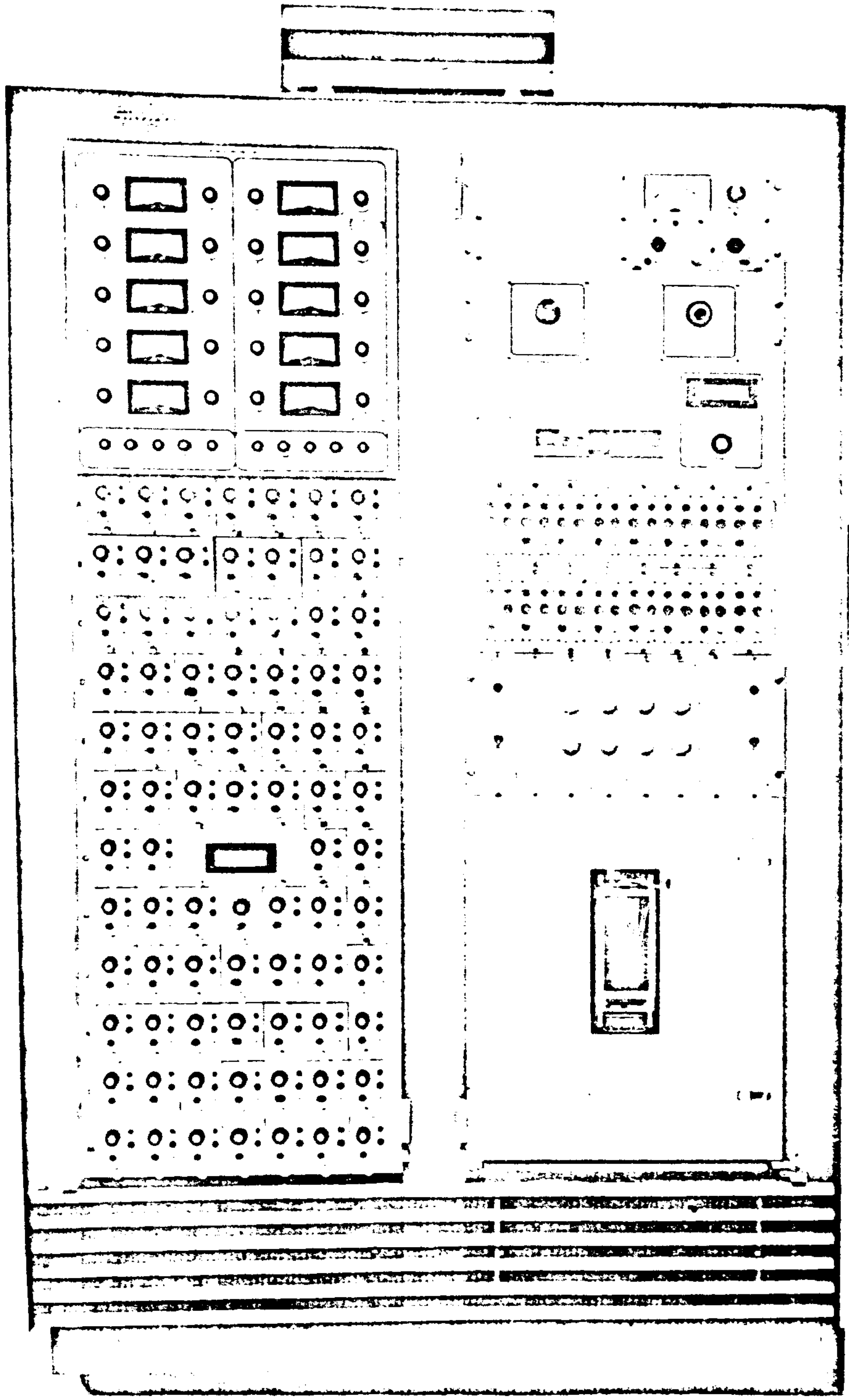

Figure 2-27. DCMH

+6.0	Volts	GN	LS Output
+12.0	Volts	DROD A	Output
-3.0	Volts	DROD B	Output
+6.5	Volts	IROD	Output

Spacecraft Transmitter power.

The DCMH is part of the data acquisition equipment of Data Central.

c. Data Collection Module High Speed

The DCMH conditions the input signals, providing the required amplification or attenuation, and samples the selected signals at a rate (7.5 KC) at a preselected rate programmed by a plug-in patch panel. The signal samples then distributed to Data Central for further processing as will be described later.

To preclude transcient electrical interference, the S-52 Spacecraft telemetry transmitter is hardline connected and brought out through the appropriate cabling to a 20 lb. fixed load whose output is made available to the following: The mobile ground station located either at the test area or in the mobile trailer; the T&E ground station in Room 133, and to a power meter in the DCMH.

On request by the Electronics Test Team, Data Central can supply off-line in approximately 30 minutes, in the form of an X-Y plot of the related experiment signals telemetry versus hardline sampled during the same time segment as shown in Table 2-5.

The hardline signals are sampled at the rate of 150 samples per second. All of the available telemetry samples as shown in Table 2-5, are plotted. The amplitude resolution of the plots is one volt per inch. The record length will be selected to provide an appropriate resolution of the signals displayed.

d. High Speed Printer

Located in the ground station, Room 133, is a 166 CDC High Speed Printer shown in Figure 2-28, which is a peripheral display device operated by the Data Central Computer System. The 166 printer was located in the ground station area to permit the Electronics Test Team to make rapid correlation and evaluation of the Spacecraft performance.

TABLE 2-5

PLOT	SIGNAL	RATE	VERSUS	SIGNAL	RATE
X-Y	Telemetry	Samples/sec		Hardline	Samples/sec
A.	H.S. Galactic Noise	13.8		H.S. Galactic Noise Galactic Noise Sweep	150
B.	Micrometeorite IROD	27.6		IROD	150
C.	Micrometeorite DROD A	3.4		DROD A	150
D.	Micrometeorite DROD B	3.4		DROD B	150
E.	Ozone Spectrometer	51.7		Ozone Spectrometer	150
F.	Playback			Ozone Monitor	150

The telemetry and hardline signals available to Data Central can be displayed on the 166 Printer in the form of mapping or print plots, Figure 2-29. The print plots are available on request by the Electronics Test Team within a few minutes after the acquisition of the data sampling period. Any one or more of the preselected available signals can be printed simultaneously. Each signal is printed with an appropriate identifying numeral or letter as shown below. Should points from two or more signals coincide, a preselected signal will dominate and its character will be printed.

SIGNAL DESCRIPTION	TELEMETRY PRINT DESIGNATION	HARDLINE PRINT DESIGNATION
IROD	I	3
DROD A	A	1
DROD B	B	2
GN. H.S.	G	4
GN. SWP.	S	5
Ozone Spect	O	6
Playback (Tape Recorder)	P	

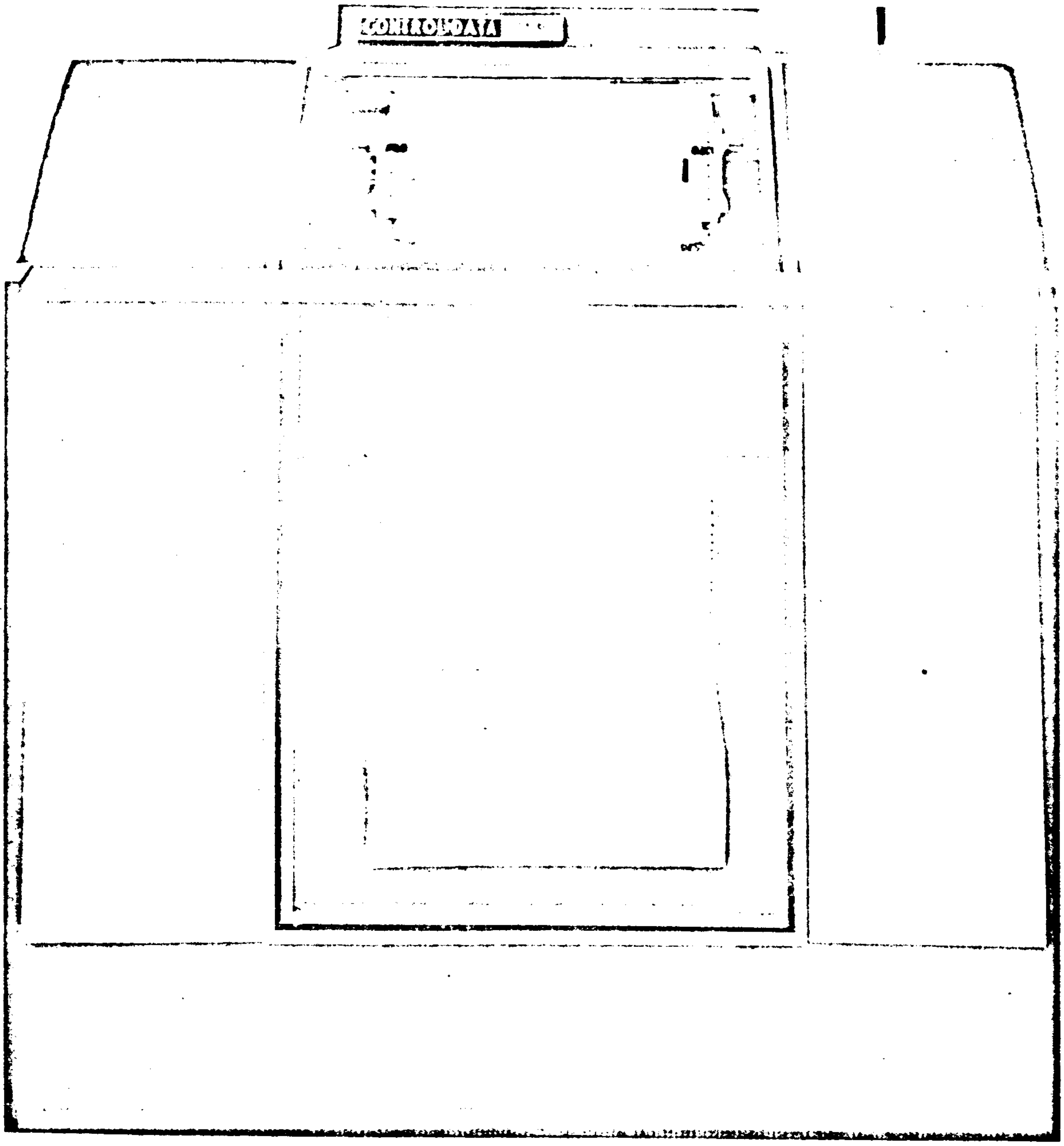

Figure 2-28. 166 Printer

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The time in millisec of each data sample printed is shown in Figure 2-30, commencing from the beginning of the data sampling period. A continuous row of dots indicates zero volts. The 0-5 volt range is divided among 100 print-wheels providing a resolution of 50 millivolts per point over a paper space of ten inches.

All of the available telemetry words are printed. About three hard-line points are printed for each telemetry point printed.

The 166 printer is also capable of printing continuously, in real time, the entire 16 x 16 Mode 1 telemetry format, as shown in Tables 2-6a and 2-6b.

A heading is provided on each printed sheet as requested by the authors which provides for the following identification: Day, Time, Environmental Test Code, which is supplied by the Electronics Test Team at the time of printout request, numeration of the telemetry channels horizontally across the page, numeration of the telemetry frames vertically down the page, identification of telemetry mode (left hand column under M), identification of each channel across the page. The sync channel, zero, is always printed in frequency. The data channels 1 through 15 can be printed in microseconds or volts. A space is left adjacent to channel 8, the performance parameter, which will provide for printing the performance parameters in engineering units when the calibration curves and scaling factors are determined. Should Data Central fail to receive a specific channel zero sync pulse during a printout, a numeral one will appear on the extreme left hand side of the paper adjacent to the missing pulse so indicating the omittance.

TABLE 2-6a

166 Voltage Printout

DAY 040 HR 00 MIN 43 SEC 14 TEST CODE 002

N	F	0 SYNC KC	1 IR T-V	2 GI T-V	3 IR T-V	4 DF T-V	5 IF T-V	6 GI T-V	7 IH T-V	8 PP T-V	9 IF T-V	10 CI T-V	11 IH T-V	12 DR T-V	13 IP T-V	14 GI T-V	15 IR T-V
1	0	05.0	0.00	0.20	0.00	0.09	0.00	0.11	0.00	[illegible]	0.00	0.11	0.00	0.23	0.00	0.15	0.00
1	1	04.5	0.00	0.11	0.00	0.32	0.00	0.11	0.00	5.03	0.00	0.20	0.00	0.35	0.00	0.20	0.00
1	2	06.2	0.00	0.15	0.00	0.00	0.00	0.13	0.00	5.01	0.00	1.15	0.00	0.44	0.00	0.15	0.00
1	3	04.5	0.00	0.11	0.00	0.00	0.00	0.11	1.52	1.44	3.34	0.11	0.00	0.32	0.00	0.11	0.00
1	4	07.4	0.00	0.11	0.00	0.00	0.00	0.21	1.44	1.36	1.00	0.20	0.29	0.52	0.40	0.20	0.33
1	5	04.5	0.05	0.20	0.06	0.11	0.11	0.15	0.28	2.02	1.03	0.11	0.43	0.44	0.48	0.11	0.36
1	6	03.0	0.56	0.11	0.75	0.56	1.13	0.11	1.35	1.72	0.52	0.11	1.76	0.26	3.25	0.11	3.24
1	7	04.5	1.35	0.11	0.93	0.56	0.60	0.11	0.30	3.01	0.03	0.11	0.80	0.23	0.36	0.11	0.80
1	8	03.9	1.00	0.11	1.41	1.41	1.5	0.11	1.70	0.11	3.45	0.15	5.00	0.26	2.93	2.05	0.79
1	9	04.5	2.00	2.40	2.02	1.52	1.72	0.23	1.41	2.12	1.35	0.11	1.38	0.20	1.44	0.11	1.59
1	10	11.0	1.58	0.15	1.64	0.66	1.72	0.11	1.27	0.44	1.80	0.15	1.50	0.24	1.37	0.15	3.07
1	11	04.5	2.14	0.15	2.23	0.24	2.40	0.34	2.75	2.95	3.24	0.24	3.38	0.32	3.33	0.28	3.77
1	12	12.2	4.98	1.36	4.06	0.00	4.74	0.23	5.01	[illegible]	5.01	3.40	5.01	0.40	5.01	0.36	5.31
1	13	04.5	5.00	0.11	4.75	3.00	4.75	0.73	[illegible]	1.30	4.01	0.60	4.83	0.49	4.01	0.36	2.39
1	14	13.3	2.54	0.15	2.40	0.00	2.16	0.15	2.0	0.10	1.93	0.20	1.85	0.44	1.73	0.20	1.55
1	15	04.5	1.33	0.15	1.19	0.15	1.00	0.11	1.34	[illegible]	0.63	0.15	0.78	0.36	0.71	0.15	0.67

TABLE 2-6b

166 usec Printout

DAY 040 HR 00 MIN 43 SEC 14 TEST CODE 002

N	F	0 SYNC USEC	1 IR USEC	2 GI USEC	3 IR USEC	4 DR USEC	5 IF USEC	6 GI USEC	7 IH USEC	8 PP USEC	9 IF USEC	10 CI USEC	11 IH USEC	12 DR USEC	13 IP USEC	14 GI USEC	15 IH USEC
1	0	0196	0066	0069	0166	0174	0075	0067	0070	0200	0066	0068	0066	0068	0066	0068	0066
1	1	0222	0065	0067	0066	0081	0066	0063	0066	0202	0066	0068	0066	0068	0066	0067	66
1	2	0159	0065	0068	0066	0083	0066	0063	0074	0200	0106	0067	0149	0067	0169	0067	0136
1	3	0222	0143	0067	0142	0076	0148	0063	0138	0082	0132	0067	0127	0063	0174	0068	0125
1	4	0173	0127	0068	0126	0069	0120	0067	0116	0159	0113	0067	0110	0068	0109	0067	0109
1	5	0222	0108	0068	0105	0066	0103	0063	0100	0090	0093	0068	0097	0069	0095	0067	0093
1	6	0115	0099	0067	0087	0166	0064	0063	0079	0086	0079	0067	0078	0070	0073	0067	0072
1	7	0222	0070	0067	0068	0066	0067	0063	0066	0111	0066	0067	0066	0069	0066	0067	0066
1	8	0100	0065	0067	0066	0067	0072	0063	0073	0067	0068	0067	0066	0069	0065	0067	0066
1	9	0222	0066	0068	0066	0072	0066	0067	0066	0092	0066	0067	0066	0068	0066	0067	0066
1	10	0090	0066	0068	0066	0076	0066	0067	0066	0070	0066	0067	0067	0068	0147	0068	0113
1	11	0222	0067	0067	0066	0063	0066	0063	0066	0101	0066	0068	0066	0068	0066	0067	0066
1	12	0081	0066	0065	0066	0081	0077	0063	0201	0066	0200	0066	0095	0068	0077	0063	0074
1	13	0222	0075	0068	0077	0072	0079	0063	0051	0066	0082	0068	0082	0068	0092	0068	0080
1	14	0074	0077	0068	0075	0067	0074	0061	0072	0066	0072	0070	0072	0069	0072	0069	0072
1	15	0222	0072	0070	0073	0066	0074	0071	0074	0093	0073	0072	0072	0070	0073	0072	0074

TABLE 2-6a

166 Voltage Printout

DAY 040 HR 00 MIN 43 SEC 14 TEST CODE 039

M	F	0 SYNC KC	1 IR T-V	2 GI T-V	3 IR T-V	4 DR T-V	5 IR T-V	6 GI T-V	7 IR T-V	8 PP T-V	9 IR T-V	10 GI T-V	11 IR T-V	12 DR T-V	13 IR T-V	14 GI T-V	15 IR T-V
1	0	05.0	0.00	0.20	0.00	0.09	0.00	0.15	0.00	5.01	0.00	0.11	0.00	0.23	0.00	0.15	0.00
1	1	04.5	0.00	0.11	0.00	0.32	0.00	0.11	0.00	5.01	0.00	0.20	0.00	0.35	0.00	0.10	0.00
1	2	06.2	0.00	0.15	0.00	0.00	0.00	0.15	0.00	5.01	0.00	0.15	0.00	0.43	0.00	0.15	0.00
1	3	04.5	0.00	0.11	0.00	0.00	0.00	0.11	1.32	1.44	[illegible]	0.11	0.00	0.32	0.00	0.11	0.00
1	4	07.4	0.00	0.11	0.00	0.00	0.00	0.21	1.44	4.36	1.90	0.20	0.28	0.52	0.40	0.20	0.32
1	5	04.5	0.05	0.20	0.06	0.11	0.11	0.15	0.23	2.02	1.03	0.11	2.47	0.44	0.43	0.11	0.36
1	6	04.0	0.56	0.11	0.75	0.56	1.13	0.11	1.35	1.72	[illegible]	0.11	3.75	0.35	3.35	0.11	3.24
1	7	04.5	1.35	0.11	0.93	0.96	[illegible]	0.11	[illegible]	3.01	0.91	0.11	[illegible]	0.23	0.95	0.11	0.92
1	8	[illegible]	1.03	0.11	1.41	1.41	[illegible]	0.11	[illegible]	2.11	3.45	0.15	5.07	0.24	2.84	2.05	0.72
1	9	04.5	2.07	2.40	2.02	1.52	1.72	0.23	[illegible]	2.12	1.35	0.11	1.38	0.20	1.44	0.11	1.52
1	10	11.0	1.58	0.15	1.56	0.66	1.72	0.11	[illegible]	2.34	1.85	0.15	1.40	0.24	1.77	0.15	2.97
1	11	04.5	2.14	0.15	2.23	0.24	2.40	0.24	[illegible]	[illegible]	3.24	0.24	3.38	0.32	3.77	0.28	3.77
1	12	12.2	4.05	0.36	4.06	0.00	4.76	0.23	5.01	[illegible]	5.01	0.40	5.01	0.42	5.01	0.36	5.01
1	13	04.5	5.01	0.15	4.75	0.00	[illegible]	[illegible]	[illegible]	[illegible]	5.01	0.40	[illegible]	0.49	4.01	0.36	2.28
1	14	13.3	2.64	0.15	2.40	0.06	2.16	0.15	2.05	[illegible]	1.05	0.20	1.85	0.44	1.77	0.20	1.58
1	15	04.5	1.33	0.15	1.19	0.15	1.00	0.15	1.03	1.69	0.80	0.15	0.74	0.35	0.71	0.15	0.57

TABLE 2-6b

166 usec Printout

DAY 040 HR 00 MIN 43 SEC 14 TEST CODE 039

M	F	0 SYNC USEC	1 IR USEC	2 GI USEC	3 IR USEC	4 DR USEC	5 IR USEC	6 GI USEC	7 IR USEC	8 PP USEC	9 IR USEC	10 GI USEC	11 IR USEC	12 DR USEC	13 IR USEC	14 GI USEC	15 IR USEC
1	0	0196	0066	0069	0066	0174	0075	0067	0070	0200	0066	0068	0066	0063	0066	0068	0066
1	1	0222	0066	0067	0066	0181	0066	0063	0066	0202	0066	0068	0066	0063	0066	0067	66
1	2	0159	0065	0064	0066	0083	0066	0063	0074	0200	0106	0067	0148	0067	0163	0067	0156
1	3	0222	0143	0067	0142	0076	0148	0063	0138	0082	0132	0067	0127	0063	0124	0068	0125
1	4	0173	0127	0068	0126	0069	0120	0067	0116	0159	0113	0067	0110	0063	0118	0067	0109
1	5	0222	0139	0068	0105	0066	0103	0063	0100	0090	0093	0068	0097	0069	0095	0067	0093
1	6	0115	0090	0067	0087	0066	0064	0063	0079	0086	0079	0067	0078	0070	0073	0067	0072
1	7	0222	0070	0067	0068	0066	0067	0063	0066	0111	0066	0067	0066	0069	0066	0067	0066
1	8	0100	0065	0067	0066	0067	0072	0063	0073	0067	0068	0067	0066	0063	0066	0067	0066
1	9	0222	0066	0068	0066	0072	0066	0067	0064	0092	0066	0067	0066	0068	0066	0067	0066
1	10	0090	0065	0065	0066	0076	0066	0067	0066	0070	0066	0067	0067	0063	0147	0068	0113
1	11	0222	0067	0067	0066	0083	0066	0063	0066	0101	0066	0068	0066	0068	0066	0067	0066
1	12	0081	0065	0065	0066	0061	0077	0063	0201	0066	0200	0063	0095	0068	0077	0063	0074
1	13	0222	0075	0068	0077	0072	0079	0063	0081	0066	0082	0068	0082	0063	0082	0068	0080
1	14	0074	0077	0068	0075	0067	0074	0063	0072	0066	0072	0070	0072	0069	0072	0069	0072
1	15	0229	0072	0070	0073	0066	0074	0071	0074	0093	0073	0072	0072	0070	0073	0072	0074

```
15780                  .        I
15816                  .        I
15852                  .          I
15889                  .        I
15925                  .          I
15962                  .        I
15998                  .        I
16034                  .          I
16071                  .        I
16107                  .          I
16143                  .        I
16180                  .        I
16216                  .          I
16252                  .        I
16289                  .        I
16325                  .          I
16362                  .        I
16398                  .          I
16434                  .        I
16471                  .        I
16507                  .          I
16543                  .        I
16580                  .        I
16616                  .          I
16652                  .        I
16689                  .        I
16725                  .        I
16761                  .        I
16798                  .        I
16834                  .        I
16871                  .        I
16907                  .        I
16943                  .          I
16980                  .        I
17016                  .        I
17052                  .        I
17089                  .        I
17125                  .          I
17161                  .        I
17198                  .        I
17234                  .        I
17271                  .        I
17307                  .        I
17343                  .        I
17380                  .        I
17416                  .        I
17452                  .        I
17489                  .        I
17525                  .        I
17561                  .        I
17598                  .        I
17634                  .        I
17670                  .        I
17707                  .          I
17743                  .        I
17780                  .        I
17816                  .        I
17852                  .        I
17889                  .        I
17925                  .        I
17961                  .          I
17998                  .        I
```

Figure 2-30.

Additional hardline data, the Spacecraft system voltages and r-f power, are also provided through the DCMH. Data Central will perform a means and variance analysis on these parameters and provides the following printout on request:

	Mean	Variance
+3	______	________
+6	______	________
+7.5	______	________
+15.0	______	________
-3	______	________
-6	______	________
-4	______	________
-18	______	________
R-F power	______	________

Further, Data Central will provide for the display of the parameter collected by the DCMH hardline system on another peripheral Device "A Bar Chart" (Figure 2-31), located in the ground station to permit the operators to maintain a continuous surveillance of these parameters.

Another computer system in Data Central collects and performs analysis of environmental data. Environmental data derived from the monitoring sensors of the exposures of the S-52 Spacecraft is collected by this system. Environmental temperature sensors purposely placed adjacent to existing temperature sensors built into spacecraft electronics provide for calibration of the Spacecraft temperature sensors throughout environmental testing. The outputs of the Spacecraft temperature sensors are available on channel 8 of the Mode 1 telemetry format as performance parameters. Data Central will correlate the related telemetry and environmental measurements and provide the following printout, Table 2-7.

15. Mobile Control Console

In the Acceptance Area 500 (Figure 2-32) and the Temperature Humidity Area 234, the Instrumentation Complex will be essentially as that described for thermal-vacuum with the exception that the penetration flange connections are not required.

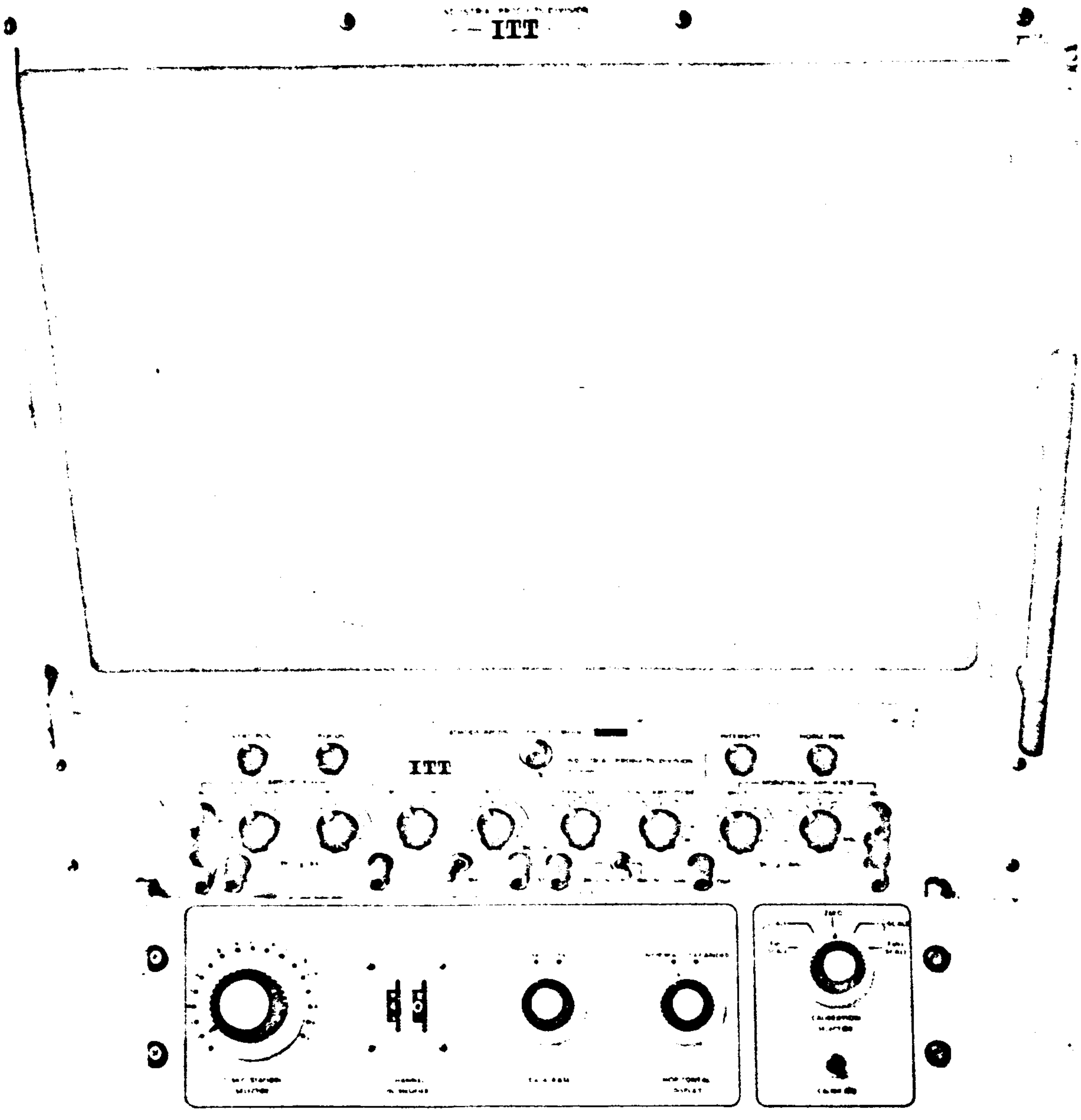


Figure 2-31. Bar Chart

TABLE 2-7

			Environmental Temperature	Telemetry Temp.	Telemetry Volts	Correlation
PP_0	Oz Temp 1	Monitor Cell	____ T° C	____ T°C	____	____
PP_1	Oz Temp 2	Ozone Cell	____	____	____	____
PP_2	Oz Temp 3	Spectrometer	____	____	____	____
PP_{11}	Batt A Temp		____	____	____	____
PP_{12}	Solar Paddle Temp		____	____	____	____
PP_{13}	Dome Skin Temp		____	____	____	____
PP_{14}	Skin Temp		____	____	____	____

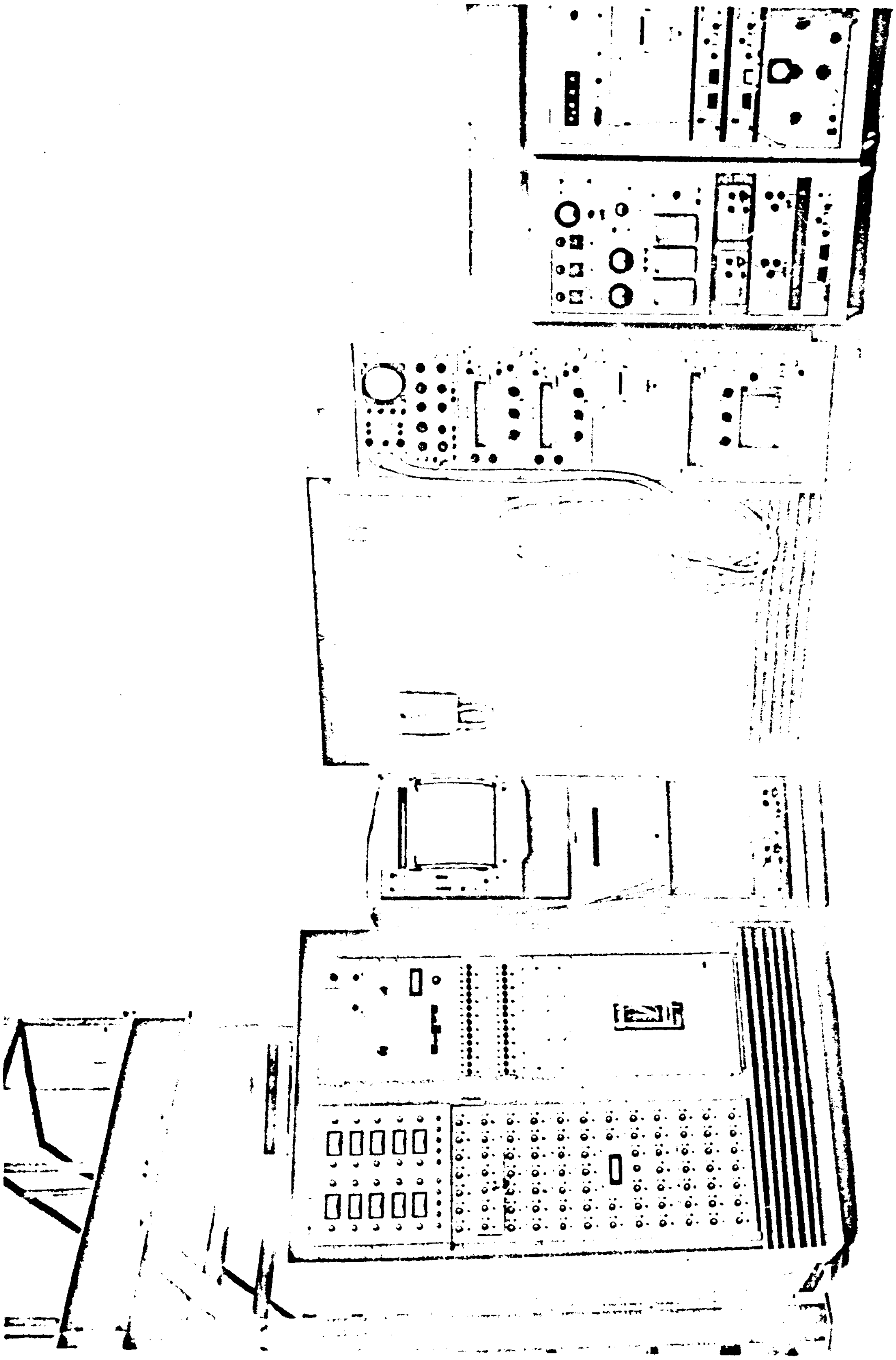


Figure 2-32. Acceptance Area Instrumentation

In the following test areas: Spin, Acceleration, Vibration, Dynamic Test Chamber and Solar Simulation, only the Umbilical connection is available for power and programmer control as shown in Figure 2-33.

A mobile Control Console shown in Figure 2-34, has been designed and fabricated by ETB S-52 personnel to provide for the required control of the Spacecraft under the above named exposures.

In addition, an Umbilical Checkout box is provided to permit checkout of the Control Console prior to connection to the Spacecraft. The Umbilical Checkout Box is utilized at the launch site for pre-checkout of the Umbilical cable connections which extend from the blockhouse through more than 700 feet of cable to the Spacecraft at the top of the launch tower.

The Micrometeorite Test Panel, Figure 2-13, along with the Control Console gives the experimenter the capability of connecting hardline to the surface test points on the Micrometeorite experiment for prior and post test checkouts.

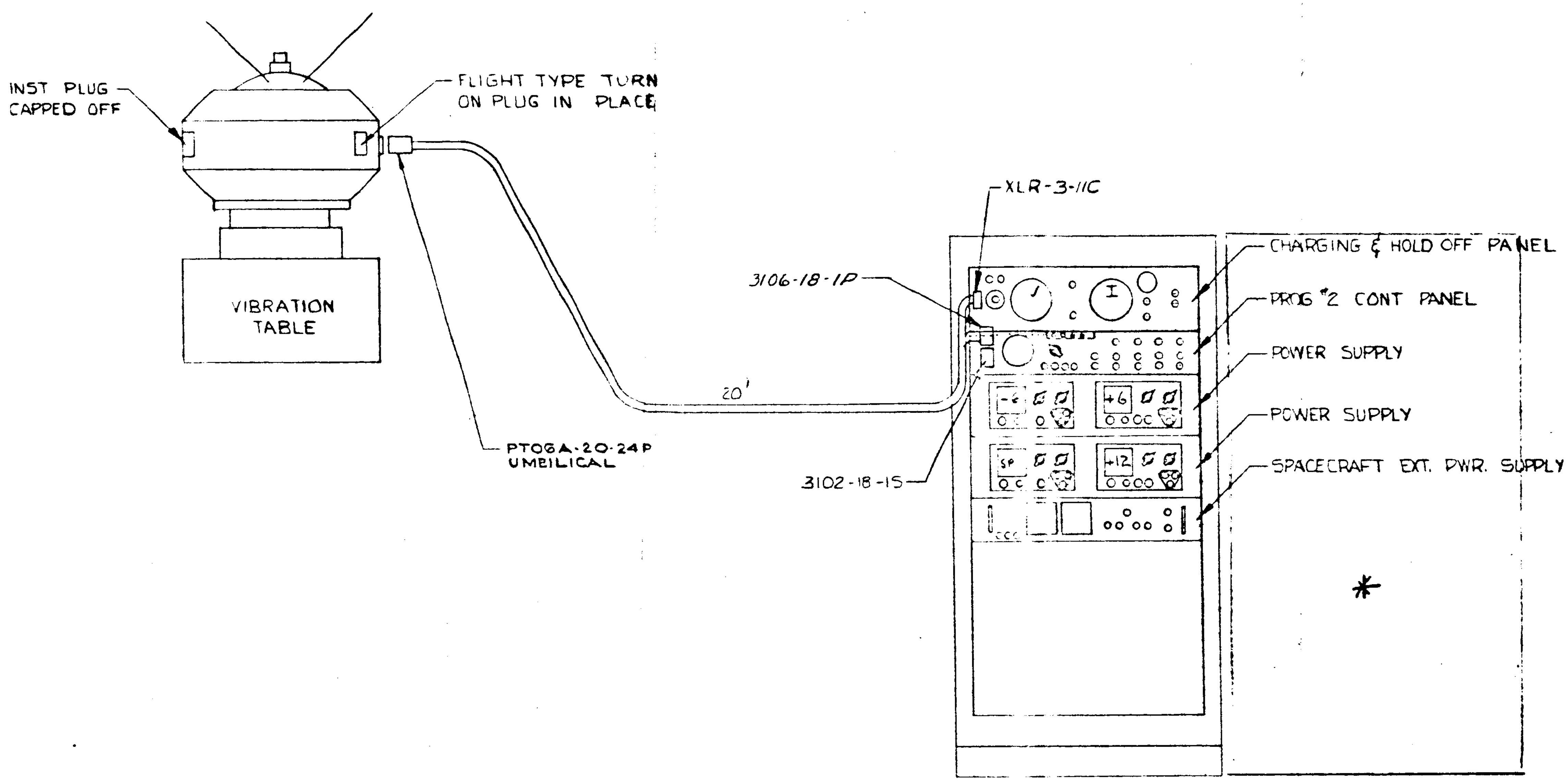
A Stub Antenna provides for acquisition of the telemetry signal by the ground station and, hence, their data reduction capabilities including that of Data Central.

16. Umbilical Checkout Box

The Umbilical Checkout Box (Figure 2-35) provides for a compatible check that the indicated functions are present and proper whether originating from the Control Console or the S-52 Control Panel and whether connected by the instrumentation Umbilical cable or the launch site Umbilical cable. The cable line resistance and insulation resistance can also be checked with this device.

Functions

Spacecraft Simulate – a toggle switch connects 30 ohm resistor simulating Spacecraft impedance across pins A and F which provides for load the external power supply approximately 1/2 ampere simulating Spacecraft normal load current.



FUNCTIONS

PROG 2 CONTROL PANEL

- CYCLE HOLD
- CYCLE SPEEDUP
- CYCLE RESET
- SUNRISE SIM.
- U.V. RESET
- R.C. TIMER SPEEDUP #1
- R.C. TIMER SPEEDUP #2
- MANUAL COMMAND

CHARGING & HOLD OFF PANEL

- PAYLOAD ON-OFF (HOLDOFF RELAY)
- CHARGING CURRENT (MONITOR)
- CHARGING VOLTAGE (MONITOR)

* MICROMETEORITE CONTROL PANEL

Figure 2-33.

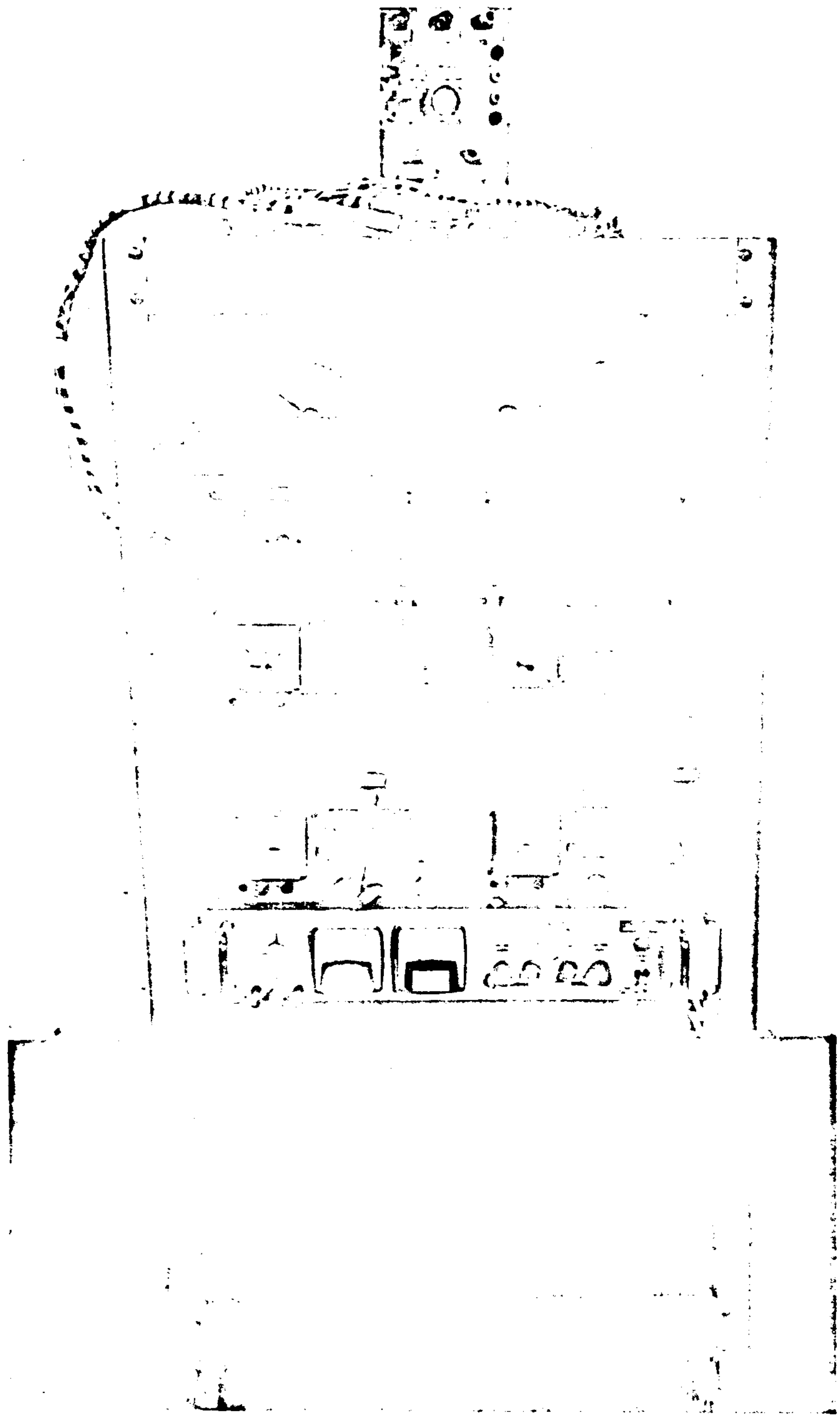


Figure 2-34. Control Console

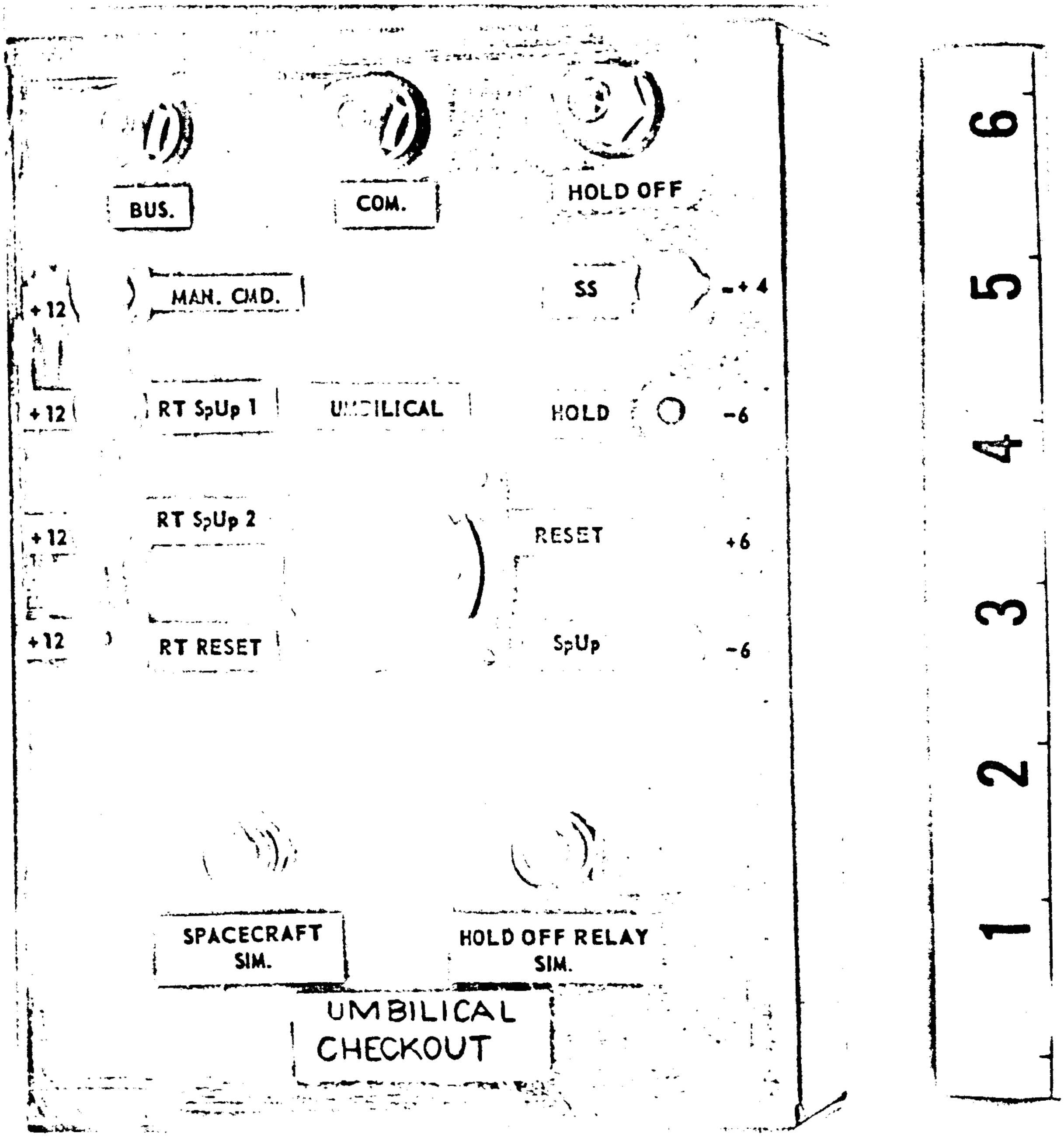

BUS.
COM.
HOLD OFF
+12
MAN. CMD.
SS
+4
+12
RT SpUp 1
HOLD
-6
+12
RT SpUp 2
RESET
+6
+12
RT RESET
SpUp
-6
SPACECRAFT SIM.
HOLD OFF RELAY SIM.
UMBILICAL CHECKOUT
1
2
3
4
5
6

Figure 2-35.

An Environmental Stimulator as shown in Figure 2-36 and its associated control panel, Figure 2-37, were designed by the authors to provide for stimulating the S-52 Spacecraft Ozone and Micrometeorite experiment sensors throughout the tenure of environmental exposures.

In order to determine that a sensor and its associated circuitry are functioning properly, it is necessary to dynamically (where feasible) stimulate the sensor with a calibrated or reproducible excitation which will produce a predictable output from the sensor circuitry.

The Stimulator Control Panel provides for power control of ultraviolet lamps required to excite the Ozone experiment. Power control is also provided for the sun gun lamps to provide excitation in the Micrometeorite experiment. The lamps and associated cabling are appropriately positioned to excite the sensors on a cage (provided by E. Travis of Mechanical Systems) which fits over the Spacecraft.

Excitation of the Galactic Noise Experiment will be provided by use of a calibrated external signal generator radiating through a stub antenna at precise frequencies within the bandpass of the Galactic noise receiver. The Signal Generator provides for a marker pulse at selectable frequencies and for change in amplitude to permit exercise of the Galactic Noise Receiver. Observation of the performance of the Galactic noise receiver will be made at the test stand and through the telemetry link.

A Turn-On Measurement Box is shown in Figure 2-38. This box was designed by the authors to connect into the Spacecraft turn-on receptacle and permit accurate measurements of the Spacecraft battery currents and Solar Buss Currents. The Turn-On Measurement Box also has utility in providing a method of charging the Spacecraft batteries while the Spacecraft is turned off.

Holdoff Relay Sim - a toggle switch connects 150 ohm resistor simulating holdoff relay impedance across pins B and F which provides for the proper indication of 80 ma on the Holdoff Relay Current Meter on the Control Panel.

17. Interrupter Boxes

The Interrupter Boxes, Figure 2-39, were designed and built by ETB S-52 Personnel for the purpose of closer observation of the performance of any given Delta Pack. There is one for each type of connector on the Delta Packs and they provide a "T" connection extending the connections to the interconnections in GR jacks for observation and measurement.

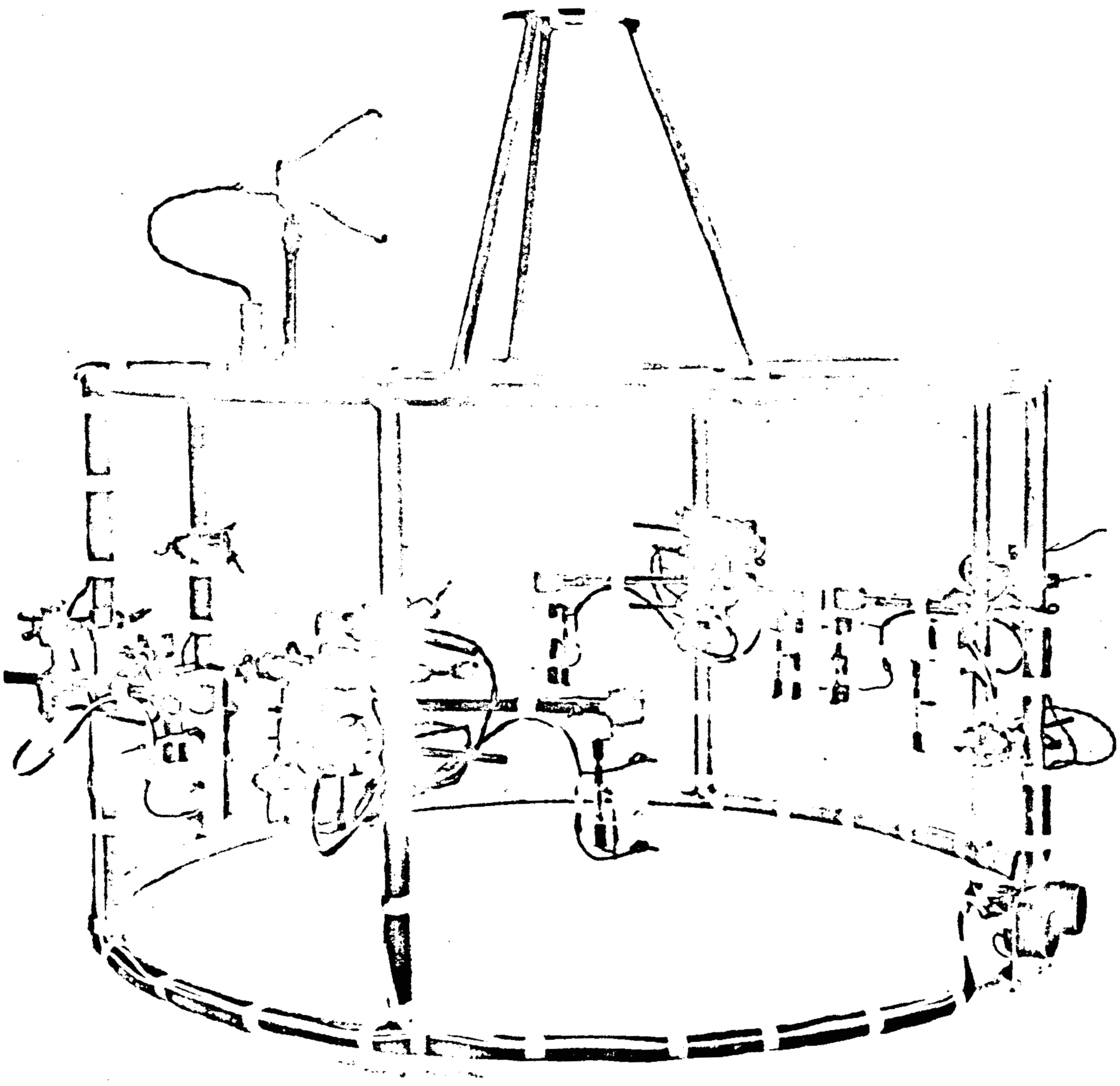


Figure 2-36. Ozone and Micrometeorite Stimulation Lamps mounted on the cage

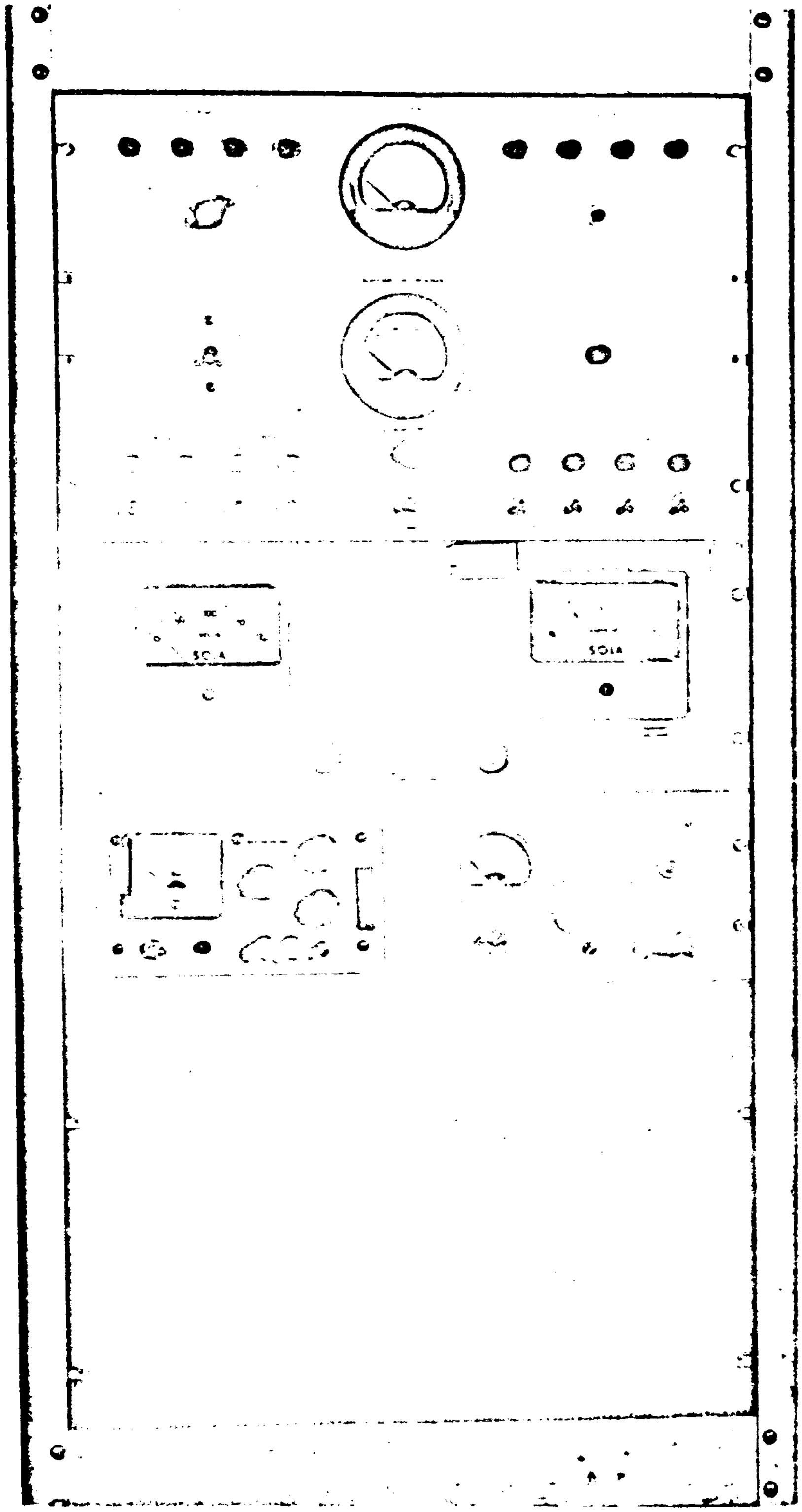


Figure 2-37. Control Panel and associated Power Supplies for exercising the Stimulation Lamp

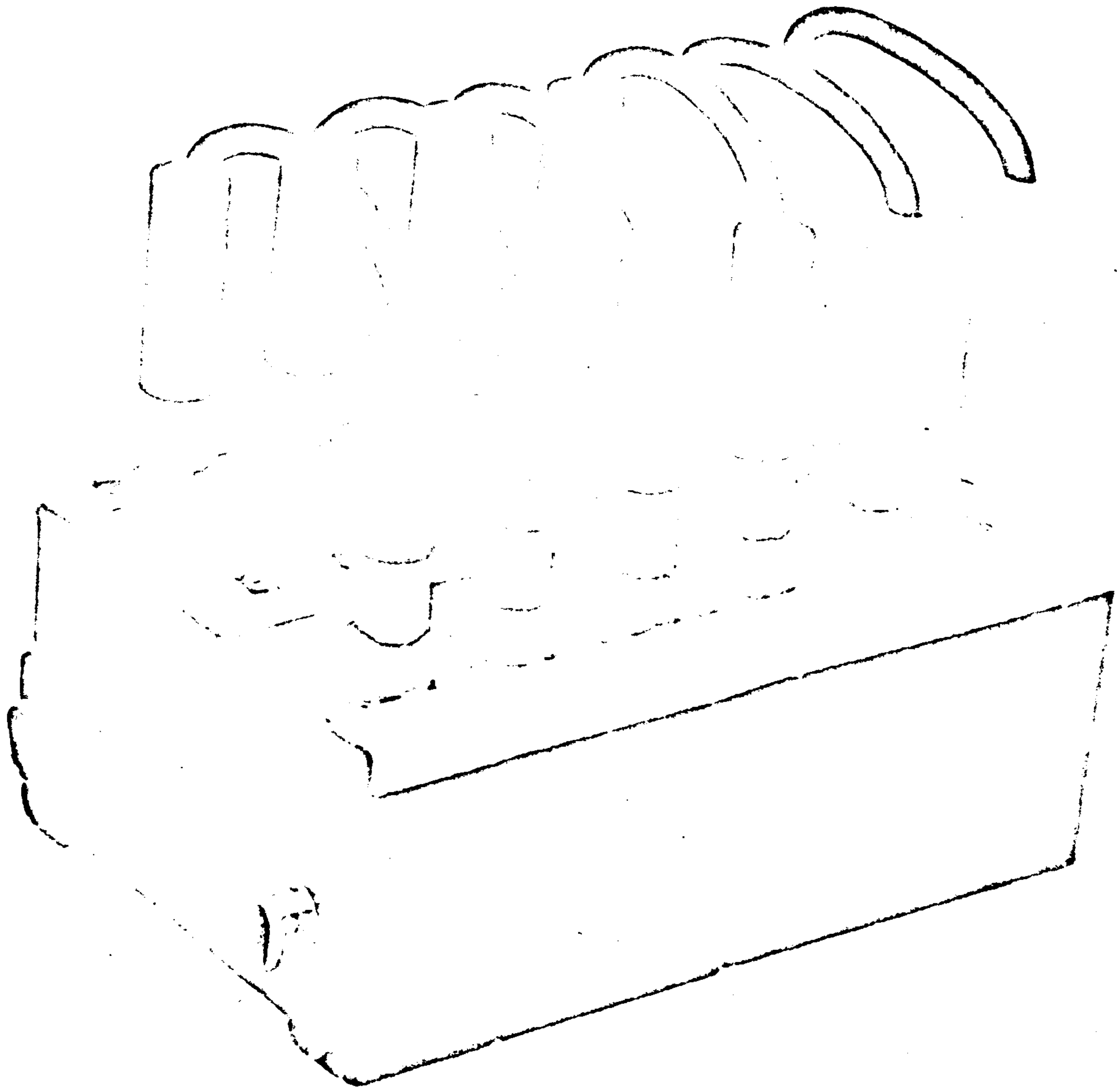


Figure 2-38. Turn-On Measurement Box

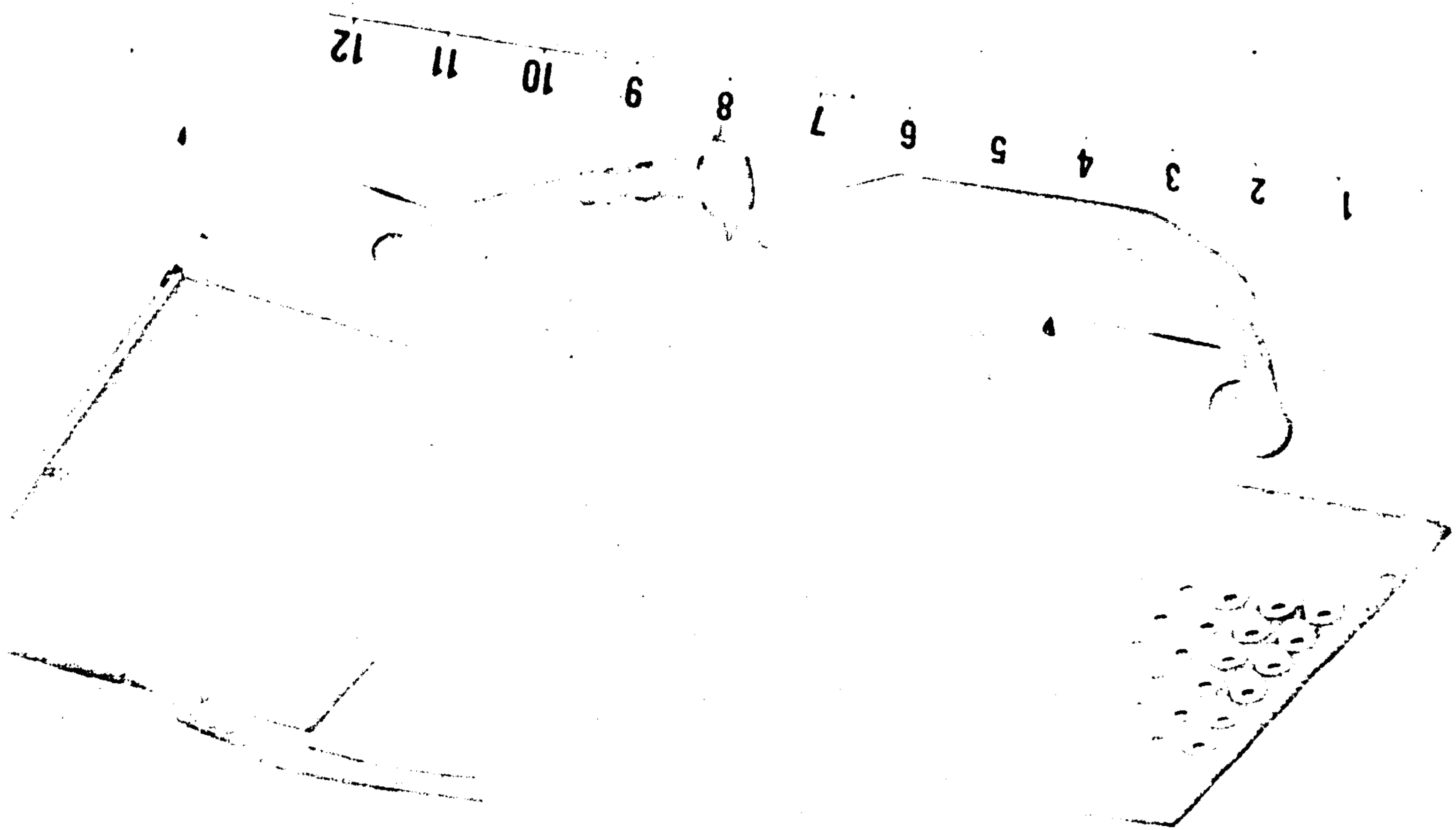


Figure 2-39. Interrupt Boxes

POWER AND PROGRAMMER CONTROL RACK

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
Spacecraft on-off control Battery charging	S-52 Power and Programmer Control	ETB S-52 Personnel			
Battery selection External Supply operation	Panel.				
Monitor of Power System Control and Monitor of					
Programmers 1 and 2 Undervoltage Detector and Recycle Timer					
External A	Power Supply	Trygon Electronics	M-36 50CVS412	5854	27500
External B	Power Supply	Trygon Electronics	M-36 50CVS412	5852	27530
+12V Control Panel and Gate Functions	Power Supply	Harrison Lab.	855B	864	19364
-6V Control Panel	Power Supply	Harrison Lab.	855B	817	19367
+25 Prog. #2 Sunrise Simulation	Power Supply	H-P	721A	024-09347	16982
+6 Control Panel Functions	Power Supply	H-P	721A	024-09345	16996

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
To modulate charging voltage	Low Freq. Function Generator	H-P	202A	2666	6436
Voltage Monitor	Automatic Digital Voltmeter	H-P	405CR	120-01380	24358
Voltage Print Outs	DIGITAL Recorder	H-P	561B		28683
Recorder System Voltage	Rustrak 0-30V Recorder	Rustrak	0-30V	13577	27112
Record Current A	Rustrak Batt A Amp. 3-0-3	Rustrak	3-0-3 Ammeter	13566	27111
Record Current B	Rustrak Batt B Amp. 3-0-3	Rustrak	3-0-3 Ammeter	13578	27110
INSTRUMENTATION RACK Instrumentation Rack with Control Panel Rack					
	Oscilloscope	Tektronix	RM45A	001893	15619
	Plug In Unit	Tektronix	CA	022543	15416
	Oscilloscope	Tektronix	RM561	000691	30901
	Time Base Unit Four-Trace Pre-amp.	Tektronix Tektronix	67 3A74	002262 000430	26688 30902
	Electronic Counter	H.P.	523CR	139-01742	28771
	Digital Recorder	H.P.	561B		28682
	Electronic Counter Freq. Converter	H.P. H.P.	524C 525C	052-00275	25348

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
RECORDING RACK					
Recording of spacecraft Experiment Outputs	Recording Oscillograph	C.E.C.	5-123	5004	19827
Used for Plotting	0-5. OV Calibrator	ETB S-52 Personnel			
Voltage Levels	36 Channel Patch Panel	ETB S-52 Personnel			
Waveforms, Etc.	36 Channel Galvanometer Amp.	ETB S-52 Personnel			
From Instrumentation Plug Pins	Power Supply Power Supply	H.P. H.P.	721A 721A	02409432 02408429	70051 15407
Stepping Switch Supply for Calibrator	Power Supply	Harrison Lab.	865B	2152	25932
Oscillograph signal input selection	Programmable Input Selector	ETB S-52 Personnel			
Monitor Instrumentation Plug Pins	Monitor Panels (3) 1 in each area J.B.	ETB S-52 Personnel			
Taps of Inst. Plug to DCMH	T-Box	ETB S-52 Personnel			

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
+25V Prog. 2 Sunrise Volts	Power Supply	Hewlett-Packard	721A	OL4-08559	15404
+12V Reset & S.U. Prog. 2 Reset & S.U. U.V.D. Man. Command Volt.	Power Supply	Harrison Lab.	865B	2181	25929
+15V P.S. for charging batteries	Power Supply	Trygon Electronics	M36-5COVS412	5853	27489
PORTABLE GROUND STATION (WESTINGHOUSE)					
S/N Wave Form Observation	Telemetry Display Unit	Defense Electronics	TDU3	119	1411
Reception of Telemetry Signal	Telemetry Receiver	Defense Electronics	TMR-6	163	1405
Period Measurement	Electronic Counter	Hewlett-Packard	523CR	139-01574	1424
Display Selection	Data Reduction Control Center	Westinghouse			
Time on Records	Digital Clock	H-P	571B	214-00432	1439
Data Printout	Digital Recorder	H-P	H24562A		1459
Orient Data	Decommutator	Westinghouse			
Interconnections	Patch Panel	Westinghouse			

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
ACCESSORY EQUIPMENT					
Signal Simulation and Programming	Function Generator	Exact Electronics, Inc.	251	1-2	30635
Xmtr. Power Monitor	Microwave Power Meter	H.P.	430CR	005-11377	19661
Used to R.F. Command S-52 into Playback	Command Transmitter	GSFC FIT R-F Systems			
Current Monitor	Clip-On D.C. Milliammeter	H.P.	328B	131-00341	20657
Signal Simulation	Low Frequency Oscillator	H.P.	202C	303	10800
Used in Conj. with Power Meter	Thermistor Mount	H. P.	477B	6370	
Monitor of Spacecraft waveform parameters	Oscilloscope	Tektronix, Inc.	535	3863	12068
	Dual Trace Plug In Unit	Tektronix, Inc.	CA	042343	23701
Misc. 2 Channel High Imp. Strip Chart Monitor	Brush Recorder Mark II	Brush Instruments	Mark II	411	23148
Monitor Perivos, Freq. etc.	Electronic Counter	Hewlett-Packard	523	139-01756	28772
A means of checking out control Voltages to S/C at S/C end of Umbilical	Umbilical Check-Out Box	ETB			

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
Load for XMTR. when antennae are disconnected	Transmitter 20DB Load	Micro Lab.	AD-20B		
Power Source for Ken-Rad Mercury Lamp	Power Supply	Sola	285140	DO 11	19575
R-F Test Area Pick-Up λ/4	Antenna Boxes (4)	ETB S-52 Personnel			
Recording of S/C Rec. Video Signals	Tape Recorder	Precision Inst. Co.	PI-207	288	30926
EXPERIMENT STIMULI					
Experiment Stimulation	Stimulus Control Panel	ETB S-52 Personnel			
for exciter lamp for Ozone Broadband	Power Supply	Sola			19575
for exciter lamp for Ozone Spectrometer	4 ea 12V Auto Battery Supply	Willard			
support sensor exciters and wiring	Space environment simulator	ETB S-52 Personnel & Structures			
Power for Sensor Control Panel	Power Supply	Hewlett-Packard	721A		
Control and charge of Battery Supply	Battery Control Panel	ETB S-52 Personnel			
Control S/C Off-On Condition & external charging of batteries	S-52 Blockhouse Control Panel	ETB S-52 Personnel			

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
To control functions of Prog. 2, U.VD. & RCT. and Man. command to playback	S-52 Prog. 2, U.VD. & Man. Comm. Control Panel	ETB S-52 Personnel			
Decom Supply	Power Supply	Trygon Electronics	T20-2	4691	1465
Decom Supply	Power Supply	Power Designs, Inc.	2050	F1081	1466
ETB (S-52 Personnel) Peripheral Equipment to Ground Station					
Selection of data for strip chart plat.	PFM Decommutator	GSFC Data Instru.Devel.		6	
Frequency to analog conversion	Discriminator	GSFC Data Instru.Devel.			
Misc. Uses	Recorder 1-0-1 DC Amp.	Rustrak	A	10671	
Misc. Uses	Recorder 3-0-3 DC Amp.	Rustrak	A	13579	27108
Misc. Uses	Recorder 3-0-3 DC Amp.	Rustrak	A	13576	27109
Misc. Uses	Recorder 0-30 Volts D. C.	Rustrak	A	13567	27113
Misc. Uses	Wide Range Osc.	H.P.	200CD	103-31483	16073
Misc. Uses	Power Supply	Harrison Labs.	814A	372	25921
Misc. Uses	Automatic Voltage & Current Monitor	ETB			

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
	Dual-Beam Oscillo-scope	Tektronix	555	002979	23700
	Time Base Unit	Tektronix	21	002989	
	Time Base Unit	Tektronix	22	003009	
	Dual Trace Preamp.	Tektronix	CA	025911	15621
	Dual Trace Preamp.	Tektronix	CA	042344	23702
	Scopemobile	R.D. In-struments			24305
Stimulus for Micro-meteorite Exp.	Adjustable Repitition Rate Pulse Generator				
Supply for above	Power Supply	Harrison	855B		24796
Supply for above	Power Supply	Harrison	865B		25933
	Subassembly orbital Ratator	ETB S-52 Personnel			
Calactic Noise signal stimulus	Oscillator 3/4 to 3 mc				
Misc. Testing Uses	Pulse Generator	Rutherford Elex Co.	B7B		16215

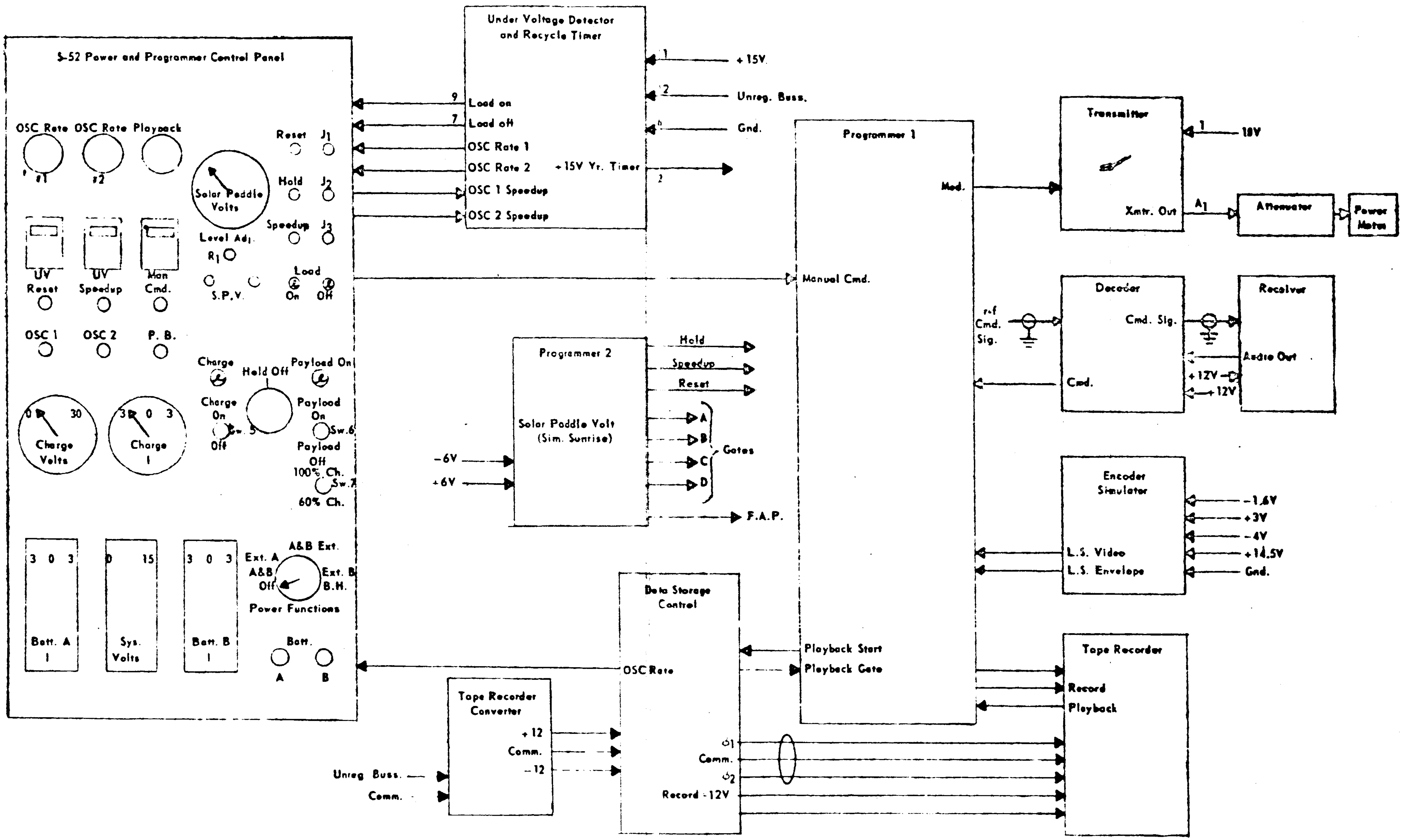
FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
Misc. Testing Uses	0-1K Decade Resistor	General Radio Co.	1432-T	32337	21901
	0-1M Decade Resistor	General Radio Co.	1432-P	28136	18113
Excite Micrometeorite Experiment	Adjustable Repetition Rate Pulse Generator	ETB			
Misc. Uses	Power Supply	Harrison Labs.	865B	2059	25934
Misc. Uses	Power Supply	Harrison Labs.	855B	1595	25944
Used for Anode Voltage on Photomultiplier Tube	High Voltage Power Supply	ETB			
	Automatic Programmer Scanner	ETB			
General Purpose	Oscilloscope	Tektronix	535	3863	12068
	Dual-Trace Preamp.	Tektronix	CA	042343	23701
General Purpose used with word selector for plotting	Power Supply Freq. to Voltage	Harrison Labs.	865B	2151	25930
out-put of experiments	Discriminator				

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
spectral display of telemetry signal	Telemetry Display Unit	Defense Electronics, Inc.	TDU-4	109	25215
Detection of telemetry signal	Telemetry Receiver	Defense Electronics, Inc.	TMR-5A	121	26781
Detection of telemetry signal	Tuning Unit	Defense Electronics, Inc.	TMH-C5		24976
Detection of telemetry signal	Video Unit (Demodulator)	Defense Electronics, Inc.	TMM-A5		24977
Measures periods of TM signal bursts	Electronic Counter	Hewlett-Packard	524C		17161
Modulates PFM Simulator	Low Freq. Oscillator	Hewlett-Packard	202C	183	10797
Viewing input-output signals to tape recorder	Oscilloscope	Tektronix	RM45A	001936	15618
R-F signal attenuation	.5W 5056 0-120DB VHF Attenuator	Hewlett-Packard	355B		
Viewing ground station waveforms	Oscilloscope	Tektronix	RM561	003-22	22165
Viewing ground station waveforms	Time-Base Unit	Tektronix	67	001695	22166
Viewing ground station waveforms	Dual Trace Plug In Pre-Amp	Tektronix	72	000891	22169
Recognizes telemetry sync for decoder	Digital Signal Synchronizer	Telemetrics, Inc.	DSS6103	115	25796

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
Cooling	Blower Unit	M. McLean Engineering Labs.	2EB408A	24315	17427
EQUIPMENT IN OPERATIONS CENTER (GRD. STATION CONT.)					
Count Signal bursts	Electronic Counter	H.P.	523CR	139-01494	23214
Display data by channel	Digital Recorder	H.P.	560A	206-02837	23901
Display data by channel	Digital Recorder	H.P.	562A	214-00534	27082
Display data by channel	Digital Recorder	H.P.	562A	214-00533	
Display data by channel	Digital Recorder	H.P.	562A	214-00574	
Display data by channel	Digital Recorder	H.P.	562A	214-00554	27083
Power for Printer	Power Supply	Harrison Labs.	855B	19922	25937
Control Unit	Power Supply	Harrison Labs.	855B	850	19362
General Use	Power Supply	Mid-Eastern Electronics			25706
	Single Channel and Frame Selector	ETB Rhodes			

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
	Channel Selector and Code Inserter Unit	ETB Rhodes			
Power Source for Decom.	Power Supply	Harrison Labs.	865B	879	19370
Power Source for Decom.	Power Supply	Harrison Labs.	865B	898	19372
Power Source for Decom.	Power Supply	Harrison Labs.	808A		24793
Power Source for Decom.	Regulated Power Supply	Harrison Labs.	814A	373	25926
Power Source for Decom.	Power Supply	Harrison Labs.	890A	381	25398
Power Source for Decom.	Power Supply	Harrison Labs.	855B	854	19361
Used for Patching in-puts from test areas into selected tape recorder channels.	Tape Recorder Patch Panel	ETB S-52 Personnel			
Used with VR 2300 Tape Recorder	McIntosh Audio Amp.	McIntosh	40		27072
Magnetic Recording of Spacecraft telemetry	Tape Recorder	C.E.C.	VR2600		30149
Intercom. Power	Power Supply	Harrison Labs.	855B	1978	29538

FUNCTION	EQUIPMENT	MFG	TYPE NO.	SERIAL NO.	NASA NO.
GSFC DATA INSTRUMENT					
Used to set-up and test Decommutator	PFM Signal Simulator	Development			
Channel selection for printouts	Printer Control Unit	ETB Rhodes			
Orients data for display devices	GRD. Station (Decommutator)	ETB Rhodes			
Magnetic recording of spacecraft telemetry	Tape recorder	C.E.C.	GK 2500		25675
Complete matrip printout, printplots	Printer	CDC	166		
Visual Display of System voltages and experiment output signals	Bar Graph	Epsco ITT	2135D	2127	
Acquisition of bordline data for Data Control	DCMH	Epsco			



Block Diagram, Instrumentation

18. Equipment List

Control and Instrumentation equipment required in the test area for electrical testing of the S-52 Spacecraft in the Acceptance Area 500, Temperature-Humidity Area 234 and Thermal-Vacuum Area 237.

19. Subassemblies

a. Mobile Subassembly Test Stand

A mobile Subassembly Test Stand has been designed and fabricated by ETB S-52 personnel, Figure 2-40, to provide the ability to electrically test all of the following S-52 GSFC Delta Packs, one at a time or in any appropriate interconnected combination:

Programmer #1	Tape Recorder
Programmer #2	Transmitter
Delta Storage Card	Command Receiver
Tape Recorder Converter	Decoder
	Sample and Hold

This equipment also permits substituting any external delta pack(s) being tested.

Included in the test stand are the necessary power supplies to furnish required voltages to opera e the packs. An attenuator pad and dummy load are provided for the transmitter card.

All connections to each delta pack are accessible at identified banana jacks on the patch board. Three banana jacks are wired in parallel for each connection providing easy independent connections for power suplies, inter-delta pack connections, and instrumentation connections. All signal leads are coax lines (PVC 17 HU) to minimize the effects of transients and interference. Connections are made to the delta packs through the appropriate mating connectors shown in Figures 2-41 and 2-42.

Provisions exist for the expansion of the Subassembly Test Stand to accommodate any or all of the S-52 delta packs, merely by insertion of the banana jacks and connection of the appropriate cables.

The Subassembly Test Stand is available for testing any suspect delta pack as a unit at any time during the period of S-52 Spacecraft testing. This test stand has already been in use for the electrical testing of the GSFC subassemblies throughout their environmental exposures.

SUB-ASSEMBLY TEST PROCEDURES

1. Programmer #1
2. Programmer #2
3. Data Storage Control
4. Tape Recorder Converter
5. Tape Recorder
6. Transmitter
7. Receiver
8. Decoder

More detailed test procedures for these units may be found in modular test procedures A through E, pages 108 through 127.

UNDERVOLTAGE DETECTOR AND RECYCLE TIMER

This sub-assembly may be tested as a unit because of its now dependence on other modules. The following tests are usually performed to measure this sub-assembly's performance.

1. Detection of undervoltage condition.
2. Proper functioning of 18-hour undervoltage timer.
3. Switching and charging spacecraft batteries in proper sequence.
4. Dumping circuit operation.

DATA STORAGE CONTROL

Because this unit, together with the tape recorder and tape recorder converter make up a sub-system, it is usually tested together with the other two units as a sub-system.

The following tests are usually performed to measure this subassembly's performance.

1. Length of gates sent to tape recorder in playback and record modes.
2. Quality of tape recorder drive voltage.
3. Ability to respond to playback command via telemetry.

TEST PROCEDURE - TAPE RECORDER

To test the operation of the tape recorder, four sub-assemblies must be interconnected; the Data Storage Control, Programmer #1, and the Tape Recorder Converter, and the Tape Recorder itself. The following tests are usually performed to measure tape recorder performance.

1. Degree of quadrature of tape recorder motor phases.
2. Time required to play back.
3. Ability of tape recorder to faithfully reproduce recorded signals.
4. Ability of tape recorder to respond to functional commands.

DECODER

To test the operation of the decoder, tape recorder playback is commanded via the transmitter in the test rack. Proper response indicates correct decoder functioning.

COMMAND RECEIVER

The receiver is usually tested together with the transmitter and decoder.

The following tests are performed to measure the sub-assembly's performance.

1. Sensitivity
2. Ability to command tape recorder into playback together with decoder.

TRANSMITTER

Transmitter power output and frequency are observed and recorded at appropriate intervals.

PROGRAMMER #1

Aside from its sub-assembly tests together with tape recorder and tape recorder's supporting sub-assemblies, Programmer #1 is tested alone.

Under these conditions, the following tests are performed:

1. Availability of gates normally sent to tape recorder upon receipt of manual or decoder routed commands.
2. Quality of modulation to and from programmer.

PROGRAMMER #2

This unit is tested alone. The following tests are usually performed.

1. Quality of Foil-Advance Pulse to micrometeoroid experiment.
2. Response to sunrise and sunset.
3. Switching into modes 1 and 2 at proper times.
4. Functioning of speedup cycle under test conditions.

b. Experiment Rotation Simulator

The Experiment Rotation Simulator shown in Figure 2-43 simulates orbital rotation requirements of 5 rpm in either direction and may be tilted. It was designed and fabricated by ETB S-52 personnel primarily for Micrometeorite checks and an IROD sensor is shown in the photo as it was tested for light leaks.

The simulator can be used indoors with a fixed light source or outdoors utilizing sunlight. It can check performance and light leaks of the Ozone sensors in addition to those of the Micrometeorite sensors. It has the capacity to handle complete experiments including all sensors and associated electronics.

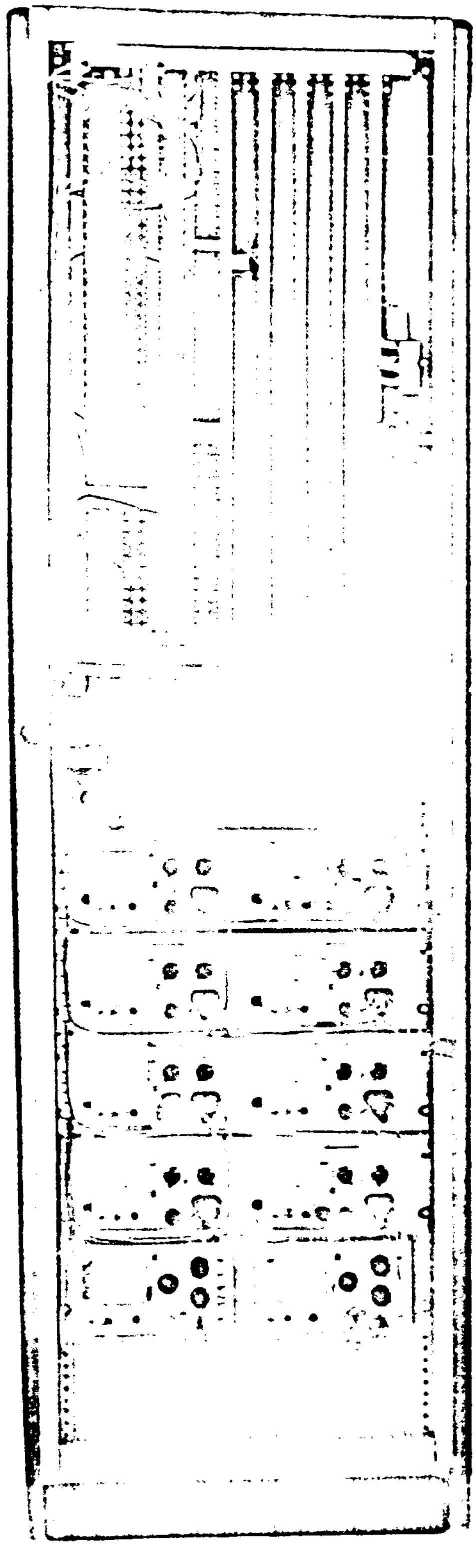


Figure 2-40. Subassembly Test
Stand Front View

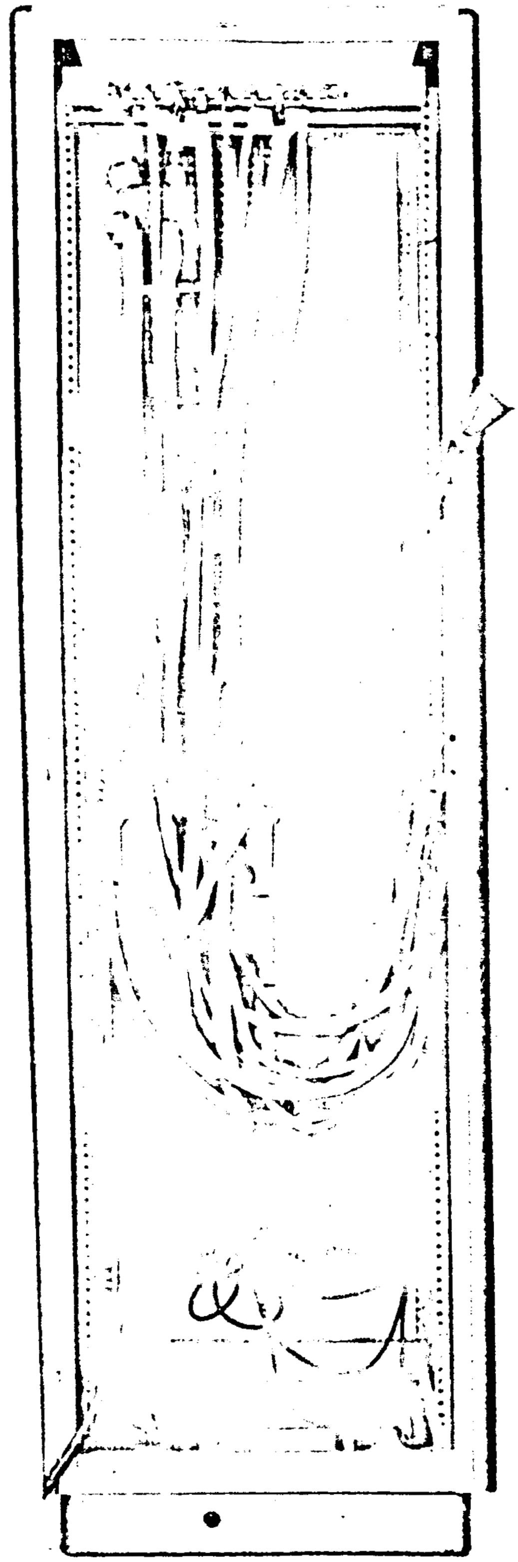


Figure 2-41. Subassembly Test
Stand Rear View

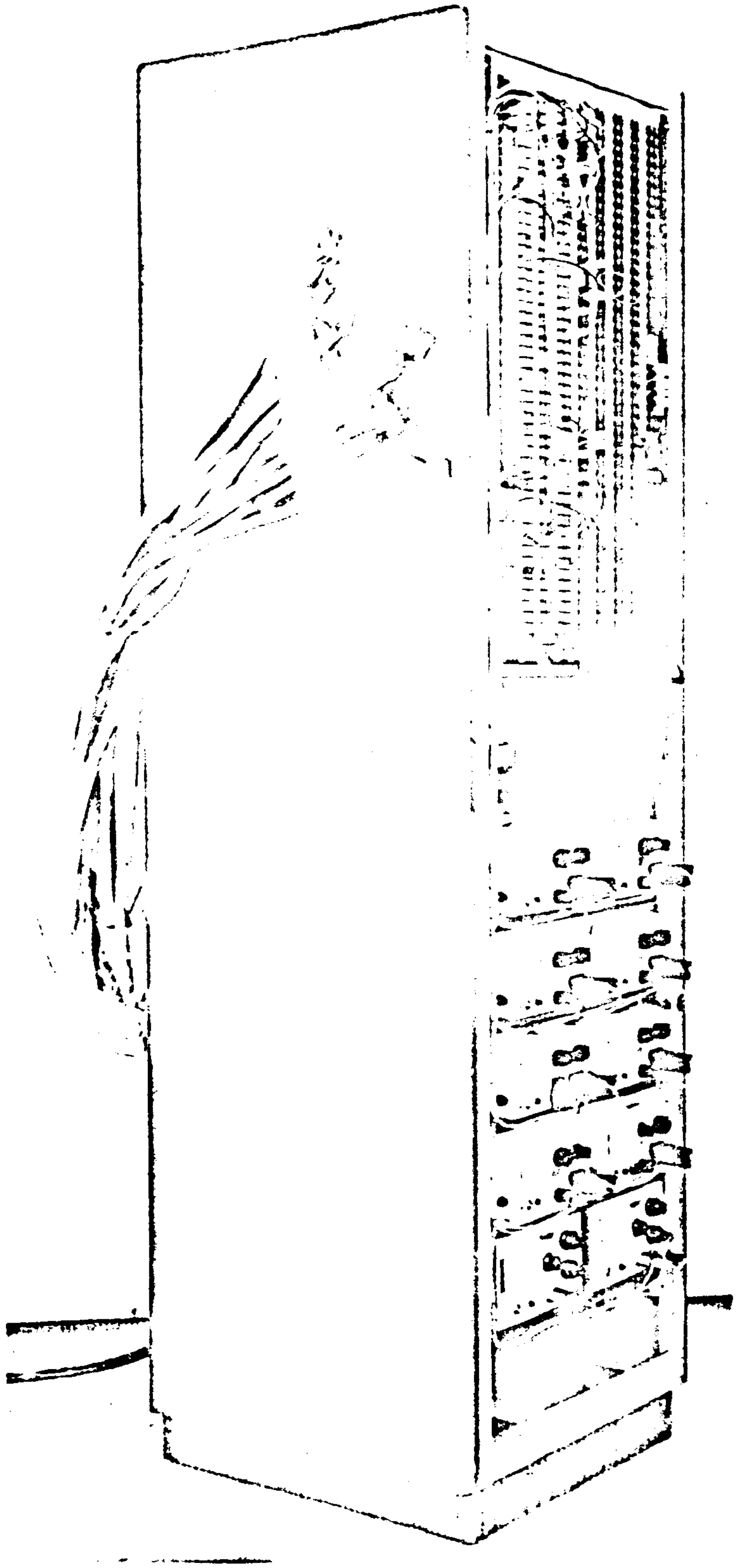


Figure 2-42. Subassembly Test Stand
(Aspect) View

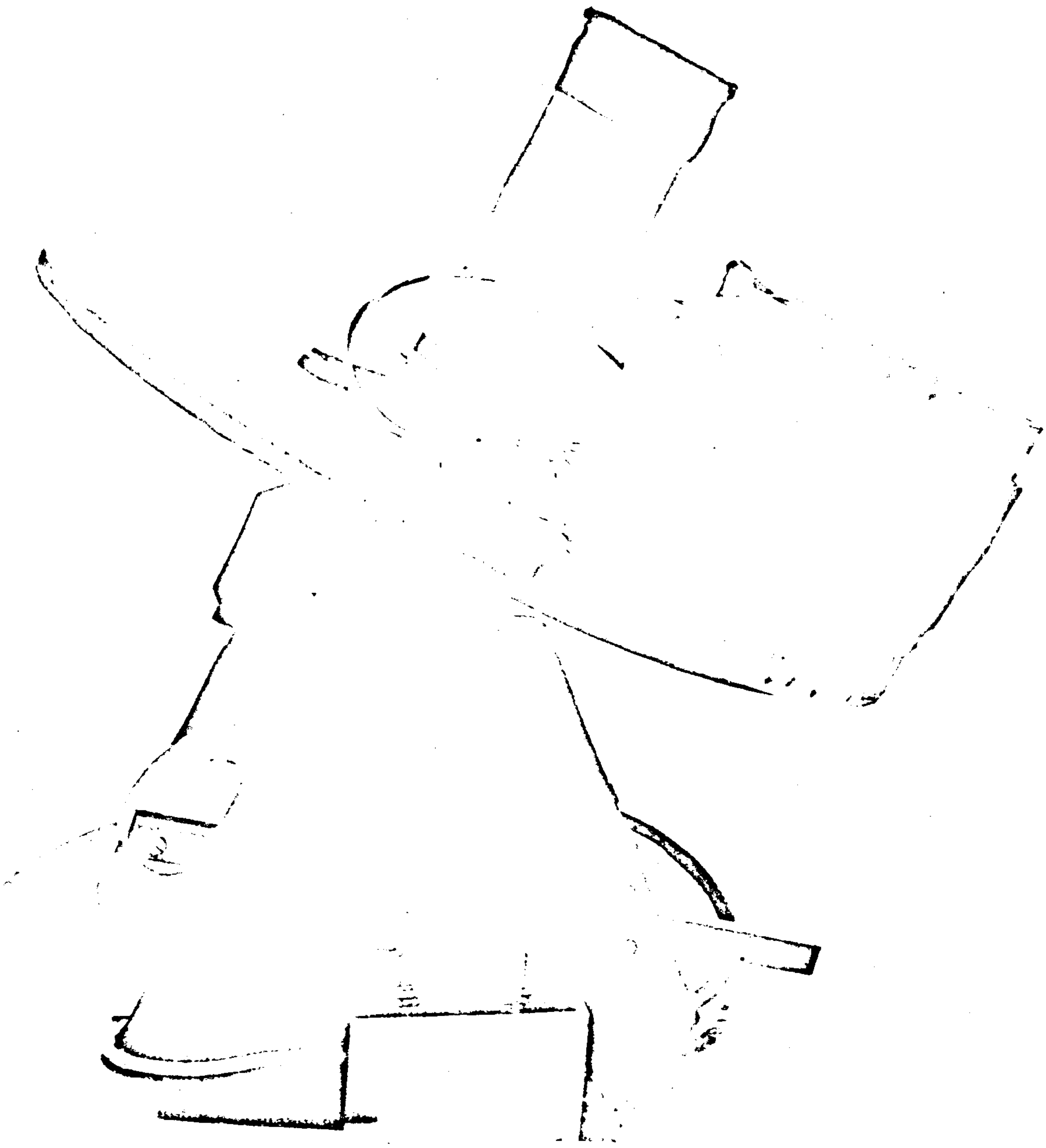


Figure 2-43. Experiment Rotation Simulator

CONTROL AND INSTRUMENTATION EQUIPMENT
REQUIRED FOR GSFC SUB-ASSEMBLY TESTS

FUNCTION	EQUIPMENT	MFG.	TYPE NO.	SERIAL NO.	NASA NO.
Conduct Tests on the following sub-systems	S-52 Spacecraft Sub-System Test	ETB S-52 Personnel			
Programmer #1 Programmer #2	Console and associated cables and interconnections	324.1			
Transmitter Command Receiver					
Decoder Data Storage Card					
Undervoltage Detector and Recycle Timer					
Tape Recorder Converter Tape Recorder					
Control for Programmers 1 and 2	S-52 Power and Programmer Control Panel	ETB S-52 Personnel			
Simulate Encoder	Encoder Simulator	Flight R-F Systems			
-1.6 Volts Encoder Simulator	Power Supply	Hewlett Packard	721A		15406

FUNCTION	EQUIPMENT	MFG.	TYPE NO.	SERIAL NO.	NASA NO.
+3 Volts Encoder Simulator	Power Supply	Hewlett Packard	721A		24408
-4 Volts Encoder Simulator	Power Supply	Hewlett Packard	721A		24404
+14.5 Volts Encoder Simulator	Power Supply	Hewlett Packard	721A		15397
+15 V UVD & RT	Power Supply	Hewlett Packard	721A	024-13400	24406
Unreg. Bus. UVD & RT	Power Supply	Hewlett Packard	721A	024-09432	17017
+6V Prog. 2	Power Supply	Hewlett Packard	721A	024-08462	15403
-6V Prog. 2	Power Supply	Hewlett Packard	721A	024-13392	24407
+6V Prog. 1	Power Supply	Hewlett Packard	721A	024-08433	15397
-6V Prog. 1	Power Supply	Hewlett Packard	721A	024-13410	24404
+12V Prog. 1	Power Supply	Hewlett Packard	721A	024-13503	24408
-18V Xmtr.	Power Supply	Hewlett Packard	721A	024-08466	15406
Unreg. Bus. T.R.C.	Power Supply	Harrison Labs.	855B	863	19360

FUNCTION	EQUIPMENT	MFG.	TYPE NO.	SERIAL NO.	NASA NO.
+12 Volts for S-52 Control Panel	Power Supply	Harrison Labs.	855B		19364
+12 V Decoder and Command Rec.	Power Supply	Harrison Labs.	855B	813	19363
Transmitter Load and Attenuator Pad	355B VHF Attenuator 120DB 50 ohms .5W	Hewlett Packard	355B	219-00156	None
Measure Voltages	Digital Voltmeter	HP	405CR		25403
Record Voltages	Digital Printer	HP	560A		17160
Measure Waveforms	Scope	Tektronix	555	002979	23700
Measure Frequency and Period	Counter	HP	524C		25348
Frequency-Time Interval	Head Head	HP HP	525C 526B		24401 76024
	Square Wave Generator	HP	211AR		18218
R-F Command	Command XMTR	GSFC	S-52		
Measure R-F Power	Power Meter	HP	430CR		19661
	Thermister Mount	HP	477B		6370

FUNCTION	EQUIPMENT	MFG.	TYPE NO.	SERIAL NO.	NASA NO.
Detect R-F Signal	Receiver	General Electronics	13C1	115	16587
	Head	General Electronics	200	152	
R-F Spectrum Display	Frequency Display Unit	General Electronics	14G1	104	16588
	Signal Generator	HP	608D	0106413	17166
Transmitter Load	UFG Attenuator	HP	355D		
Record Programmer 2 Mode Changes	Brush Recorder	Brush Instruments	Mark II	411	23148
Recording of S/C Receiver video & modulation signals	Tape Recorder	Precision Instruments Co.	PI-207	288	30926

20. Operational Test Procedures

INTRODUCTION

Modular Type Test Procedures are provided for collection and evaluation of data substantiating the performance and responses of the spacecraft to electrical exercise and experiment stimulation.

The Modular Type Test Procedures conceived by the authors constitute a complete electrical systems test of the spacecraft performance. However, by segmenting the complete systems test procedure into Modular form, each in itself an entity, the Electronics Test Conductor acquires a wide latitude of flexibility by the ability to institute, at his discretion, test Modules commensurate with the status, configuration and exposure of the spacecraft.

Also are included procedures for checkout of the Instrumentation Complex, Spacecraft preparation, Spacecraft turn-on, and operation during environmental testing and launch.

All Module Data Sheets include a heading which provides the following information: Time, date, spacecraft condition, Test Code, and a space prefixed, By, for the initials of the test team member performing the test.

A continual chronological history of the normal as well as the abnormal events which are experienced by the spacecraft throughout its stay in the T&E Complex will be maintained in a log book assigned to each spacecraft.

All Systems Tests performed will be kept in the Systems Test Notebook for each Spacecraft. The hourly A_1 Data Sheets will be recorded in the Hourly Tests Notebook for the respective Spacecraft.

The values of the performance parameters taken will be recorded in the Performance Parameter Data Sheet. The following temperature parameters available on the Mode 1 channel 8 printout will be concurrently plotted to maintain close surveillance of their performance:

PP0	Temp. Snout Oz	PP11	Batt A Temp
PP1	Temp. Upper Deck Oz	PP12	Solar Paddle 4 Temp.
PP2	Temp. Oz. Spect.	PP13	Dome Temp #1
		PP14	Skin Temp #2

A correlation check of the respective environmental temperature monitors with the spacecraft temperature monitors will be maintained during exposures in which temperature is a factor.

This plot of the temperature parameters then becomes a calibration for use during solar simulation and orbit.

Six sequential values of PP15, the Galactic Noise sweep monitor will be recorded on the Performance Parameter Data Sheet converted from usec to voltage values and correlated with the hardline strip chart and X-Y plot monitor of the Galactic Noise Sweep.

The following channel 8 parameters should correlate directly with the respective hardwire voltage and current measurements:

PP3 - EHT Monitor

PP4 - + 15 volts

PP9 - Solar Paddle Currents

PP10 - Battery Current

PP7 - Unreg. Bus

PP8 - +12 mon.

PP15 - GN Sweep

Electronic Test Team

To proficiently implement the following test procedures, perform the electrical tests on the spacecraft, and assimulate and evaluate meaningful data; an Electronics Test Team, under the direction of an Electronics Test Conductor, who reports directly to the Project Office and the T&E Coordinator, is necessary to maintain an organized effort throughout the environmental series. The test team is composed of capable personnel assigned to the S-52 project who may originate from the Electronics Test Branch, Experimenter Group, Design Group, Systems Integration Branch or Contractor personnel. Obviously, a composite team has the advantage of full capability in all phases of spacecraft testing derived from the collective experience of all members. The team members will be rotated between the ground station and the test area to develop and maintain the capability and flexibility to handle any circumstance which may arise as required by the idiosyncrasies of spacecraft testing.

In order to maintain continuity of the test effort, it is required that notification for special tests or variations in the test procedures be coordinated through the Electronics Test Conductor. For the purpose of assigning areas of responsibilities to team members during test periods, the following organizational chart is given.

Electronics Test Team

Position Title	Symbol	Assigned Area
Electronics Test Conductor	ETC	All
Spacecraft Test & Control	STC	Test Area
Area Monitor	AM	Test Area
Ground Station Monitor	GSM	Ground Station
Data Central Monitor	DCM	Data Central
Trailer Monitor (Portable Ground Station)	TM	Trailer
Data Recorder	DR	Ground Station

A list of coordinating test teams follows to provide a composite view of the overall effort employed in spacecraft testing.

Coordinating Test Teams

Position Title	Symbol	Assigned Area
Experimenters	EXP	All
Test Conductor (T&E Coordinator)	TC	All
Systems Engineer (Project Office)	SE	All
Condition Test Conductor	CTC	Test Area as Applicable
Mechanical Engineer	ME	Test Area
Spacecraft Mechanic	SM	With Spacecraft

MODULE A

Module A Data Sheet, shown on page 112, provides for the recording of all internal Spacecraft system voltages available at the Monitor Panel. All measurements are made with an isolated input digital voltmeter. All system voltages are recorded with the charging current off to minimize the effects of ground currents. In addition, the transmitter power, frequency and the one-year timer currents are recorded in the Module A Data Sheet.

The Module A Data Sheet designates the Monitor Panel pin (Synonymous with the Spacecraft instrumentation pin designations) on which the described voltages are found and the high and low tolerance within which the voltage should be. The measured values are recorded in their appropriate spaces. The length and type of coax cable and the attenuation used between the Spacecraft and the measuring instruments are recorded under "Method of Test."

MODULE A - PROCEDURE

Check of Spacecraft System Voltages:

a. Turn off Spacecraft charging voltage.

b. Check calibration of isolated input digital voltmeter.

c. Connect negative lead of Digital voltmeter input to pin 25 on the Monitor Panel.

d. Measure and record the d-c voltage values in the Module A Data Sheet

   (1) If available, operate the Automatic Programmable Scanner to obtain a printout of the system voltages.

   (2) Record the date and the Environmental Test Code on the tape and attach to the Module A Data Sheet.

e. Measure and record the amplitude and frequency of the 15 VAC on the scope and counter respectively.

   (1) Chan. A input pins 8 and 42.

   (2) Scope vert. output to Counter input frequency.

Check of One-Year Timer Currents:

f. Using Simpson 269 as microammeter between C19 and 25 and C20 and 25, measure and record respective one-year Timer currents.

Check of Transmitter Power & Frequency:

g. Measure and record transmitter power. Under "Method of Test," record type and length of cable and attenuation used.

(1) Check power meter zero before connection for measurement.

h. Measure and record transmitter frequency.

(1) Check counter calibration prior to measurement.

Module A Data Sheet

S/C Condition: Code: By: Date: Time:

PIN	DESCRIPTION	TOLERANCE Lo	%	+%	Hi	VALUE
25	Sig Gnd					
10	+ 3.00	3.15	5	5	2.85	
11	+ 7.50	7.51	1/4	1/4	7.48	
27	+ 6.00	6.06	1	1	5.94	
28	+12.00	12.1	1	1	11.8	
45	+15.0	15.1	1	1	14.8	
44	+ 6.50	6.82	5	5	6 17	
46	Unreg Bus	16.5	5	5	12.5	
43	- 3.00	3.07	1/4	1/4	2.92	
26	- 4.00	4.2	5	5	3.8	
12	- 18.0	18.1	1	1	17.8	
9	- 6.00	6.06	1	1	5.94	
14	- E.H.T.					
49	GN Batt Neg					
32	GN Batt A					
33	GN Batt B					
8	) 15 VAC	15.7	5	5	14.2	
42	) 1700 cps					
C19	1 yr Timer A Current					
C20	1 yr Timer B Current					

XMTR PWR

250 mw Nom (Measured at Spacecraft)

Value

Method of Test

XMTR Frequency
136.56 ± 0.002%

+ =

Value

MODULE A_1

Module A_1 also provides for the measurement and recording of the Spacecraft system voltages, transmitter power and frequency and in addition, a recording of the High Speed and Low Speed Sync and the performance Parameters.

Module A_1 is normally performed every hour the Spacecraft is in continuous operation. This provides a profile of Spacecraft performance and readily displays performance trends.

MODULE A_1 - PROCEDURE

Check of Spacecraft System Voltages:

a. See Module A Procedure

Check of Transmitter Power & Frequency:

a. See Module A Procedure.

Check of Spacecraft Performance Parameters:

a. Adjust system charging current to the value consistent with the test made, if applicable.

b. Measure and record Batt current, charging current and charging voltage.

c. Operate the ground station for a 30-second printout of Mode 1 Channel 8.

d. Time, Date and Code the printout.

e. Record the values of the Performance Parameters in the appropriate spaces in the Performance Parameter Data Sheet.

f. Record under "Remarks" six sequential values of frame 15 of Channel eight, the Galactic Noise Sweep Monitor.

g. Verify that the performance parameters are proper with respect to the spacecraft operational mode and exposure.

h. Correlate the performance parameter temperature measurements with the environmental temperature measurements if applicable.

i. Correlate the telemetry performance parameter voltage and current measurements with the hardline measurements.

Module A_1 Data Sheet

S/C Condition: Code: By: Date: Time:

PIN	DESCRIPTION	TOLERANCE Lo	%	+%	Hi	VALUE	
25	Sig Gnd						FRAME 0 (191.4-197.6)
10	+ 3.00	3.15	5	5	2.85		FRAME 1 (220.9-223.4)
11	+ 7.50	7.51	1/4	1/4	7.48		FRAME 2 (175.6-181.6)
27	+ 6.00	6.06	1	1	5.94		FRAME 3 (220.9-223.4)
28	+12.00	12.1	1	1	11.8		FRAME 4 (157.8-163.6)
45	+ 15.0	15.2	1	1	14.8		FRAME 5 (220.9-223.4)
44	+ 6.50	6.82	5	5	6.17		FRAME 6 (140.9-146.7)
46	Unreg Bus	16.5	5	5	12.5		FRAME 7 (220.9-223.4)
43	- 3.00	3.07	1/4	1/4	2.92		FRAME 8 (122.2-127.4)
26	- 4.00	4.2	5	5	3.8		FRAME 9 (220.9-223.4)
12	- 18.0	18.1	1	1	17.8		FRAME 10 (105.6-110.6)
9	- 6.00	6.06	1	1	5.94		FRAME 11 (220-9-223.4)
14	- E.H.T.						FRAME 12 (86.7- 92.1)
49	GN Batt Neg						FRAME 13 (220.9-223.4)
32	GN Batt A						FRAME 14 (68.5- 72.9)
33	GN Batt B						FRAME 15 (220.9-223.4)
8	) 15 VAC	15.7	5	5	14.2		L.S. Sync
42	) 1700 cps						FRAME 0 (220.9-223.4)
	Batt A Current ________ Charging V ________						
	Chrging Current ________						
A	Channel 8 & 0 Recorded Check						XMTR Freq. ________
B	Rustraks Time-Date Check						XMTR Pwr. ________
C	Brush Recorder Time-Date Check						

PERFORMANCE	P/L CONDITION			P/L CONDITION			P/L CONDITION			P/L CONDITION			P/L CONDITION			P/L CONDITION		
PARAMETERS	DATE	TIME		DATE	TIME		DATE	TIME		DATE	TIME		DATE	TIME		DATE	TIME	
DATE SHEET PP	µSEC	VOLTS	ENG. UNITS	µSEC	VOLTS	ENG. UNITS	µSEC	VOLTS	ENG. UNITS	µSEC	VOLTS	ENG. UNITS	µSEC	VOLTS	ENG. UNITS	µSEC	VOLTS	ENG. UNITS
FRAMES 0																		
TEMPS 1																		
2																		
12																		
13																		
14																		
POWER 7																		
9																		
10																		
11																		
3																		
4																		
8																		
15																		
6																		
5																		
	TEST CONDITION			TEST CONDITION			TEST CONDITION			TEST CONDITION			TEST CONDITION			TEST CONDITION		
	PERFORMED BY			PERFORMED BY			PERFORMED BY			PERFORMED BY			PERFORMED BY			PERFORMED BY		
	CODE																	
	REMARKS			REMARKS			REMARKS			REMARKS			REMARKS			REMARKS		

MODULE B

Module B provides forthe recording and evaluation of available waveform measurements which are indicative of the proper operation of the Spacecraft telemetry and recording system. The designated measured values are appropriately recorded in the Module B Data Sheet.

Typical waveform patterns recorded at the Monitor Panel, using the provided scope probe, are shown in Table

A check of the frequencies in the high speed sync channels is provided by a printout of ten sequences of channel zero (Mode 1) from which the average values are compared and recorded in the Module B Data Sheet.

A measurement of the 320. cps applied to the tape recorder is made for correlation with the 15.4 KC recorded during playback to provide an indication of tape recorder speed.

REFERENCE SETUPS FOR MODULE B

Sync

(a) Setup Oscilloscope

Channel A - DC Input $\overline{A}$
Channel B - DC Input $\overline{L}$
Gain
Trigger negative external on $\overline{A}$
Sweep 1/2 sec/cm until triggers
Sweep 1 ms/cm
Mode chopped
Increase intensity if necessary

(b) Measure and record delay of $\overline{L}$from $\overline{A}$ (less than 5 ms) in Module A Data Sheet.

(c) Record periods of $\overline{A}$ and $\overline{L}$.

(d) Exercise encoder tuning fork kill. (if applicable.)

(e) Repeat steps (b) and (c).

(f) Measure and record period of $\overline{T}$.

Ø1 and Ø2 Measurements

A. Waveform and Amplitude Measurements.

1. Test Scope Setup

(a) Channel A input Ø1 (pin 24 on the Monitor Panel).

(b) Channel B input Ø2 (pin 41 on the Monitor Panel).

(c) Sweep 1 ms/cm.

(d) Amplitude volt/cm.

(e) Trigger internal.

2. Observe waveforms are proper and record amplitude.

B. Phase Differential Measurement.

PRECAUTION: Place input switch on counter (HP 523) on Separate before connecting counter to Ø1 and Ø2 to preclude shorting the phases together.

1. Counter Setup (HP 523CR)

(a) Counter input switch on Separate.

(b) Function selector on Timer Interval

(c) Trigger Slope

Start Positive
Stop Positive

(d) Time unit - usec

(e) Trigger Level

Start - positive (DC $\times$ 1) (0. 5)
Stop - positive (DC $\times$ 1) (0. 5)

2. Connect:

Ø1 (pin 24) into start input
Ø2 (pin 41) into stop input

3. Record counter reading in Module A Data Sheet.

4. Determine and record phase difference in Module A Data Sheet.

Discussion: Since the frequency of Ø1 and Ø2 is 100 cps., their periods are 10 milliseconds.

Then 360 degrees is equal to 10 milliseconds. Therefore, 90 degrees equal to 2.5 milliseconds.

Hence, if Ø2 went positive exactly 90° after Ø1 went positive the counter would read 2.5 milliseconds.

Conversely, as another example, if we had 2.35 milliseconds on the counter, this indicates Ø2 leads Ø1 by 0.15 milliseconds. Then Ø2 leads Ø1 by (0.15 milliseconds × 3.6 degrees) equal to 5.4°.

5. Determine and record the symmetry of phase shift in the Module A Data Sheet.

   (a) Interchange Ø1 and Ø2 input connections to counter

   Ø2 to start input
   Ø1 to stop input

   (b) Trigger level

   Start – negative (DC × 1) (0.5)
   Stop – negative (DC × 1) (0.5)

   (c) Trigger slope

   Start – negative
   Stop – negative

6. Record counter reading in Data Sheet.

7. Determine phase difference and record.

Module B Data Sheet

S/C Condition: Code: By: Date: Time:

PIN	DESCRIPTION	AMPLITUDE	PERIOD	H.S. SYNC	PERIOD
1	$\overline{A}$ H.S. Reset			FRAME 0 (191.4-197.6)	
18	$\overline{L}$			FRAME 1 (220.9-223.4)	
	Sync $\overline{A} \rightarrow \overline{L}$ (5ms)			FRAME 2 (175.6-181.6)	
35	$\overline{T}$			FRAME 3 (220.9-223.4)	
2	L.S. Env.			FRAME 4 (157.8-163.6)	
3	L.S. Video			FRAME 5 (220.9-223.4)	
4	L.S. to T.R.			FRAME 6 (140.9-146.7)	
15	L.S. Gate B			FRAME 7 (220.9-223.4)	
19	H.S. Video			FRAME 8 (122.2-127.4)	
20	XMTR MOD			FRAME 9 (220.9-223.4)	
36	L.S. ÷ 48			FRAME 10 (105.6-110.6)	
36	L.S. Sync 10 P.A.			FRAME 11 (220.9-223.4)	
24	Ø1			FRAME 12 (86.7- 92.1)	
41	Ø2			FRAME 13 (220.9-223.4)	
	Ø Shift (.1ms = 3.6°)			FRAME 14 (68.5- 72.9)	
	Symmerty			FRAME 15 (220.9-223.4)	

OPERATIONAL MODULE C

A check of the functions of undervoltage, battery switching, battery charging and dumping are provided in Module C. Module C Data Sheet provides for appropriately recording the measured values.

During actual 18 hour undervoltage cycle, Module C_1 Data Sheet is used at least every hour to provide for the recording and evaluation of the performance of those parameters in operation.

MODULE C PROCEDURE

I. Check of Undervoltage & Battery Switching:

a. Setup counter A (HP 523) on time interval to measure UV Osc rate 1 period.

b. Setup counter B (HP 523) on time interval to measure UV rate 2 period.

c. Setup digital voltmeter (HP 405) and associated printer, if used, to monitor and record system voltage at Monitor Panel, pin 46.

d. Check calibration of digital voltmeter.

e. Set the current limit of external power supplies A and B to 3/4 amperes.

f. Set output voltages of external power supplies A and B to 14.0 volts.

g. Set up S-52 control panel:

1. Function switch on External A and B.
2. Undervoltage oscillator speedup off.

h. Verify Spacecraft system operating on external power supply A (load current indicated on External Power supply A panel meter.)

i. Reset all counters.

j. Monitor digital voltmeter displaying Spacecraft system voltage to determine potential at which Undervoltage occurs.

k. Slowly lower external power supply A output voltage in 0.1 volt increments dwelling about five seconds at each increment.

l. Observe and record the Spacecraft system voltage at the loss of full load Spacecraft system current.

m. Observe that all Undervoltage counters are operating.

n. Record average of three consecutive period measurements of each undervoltage oscillator rates 1 and 2.

o. Verify that all Spacecraft system voltages are Zero except +15 volts D.C. and 15.0 volts A.C.

p. Place undervoltage speedup of Osc 1 "ON". (Period of the oscillator will change to 0. 4 seconds.) Record speedup period.

q. Observe and record that in about five minutes the Spacecraft returns to normal operation and all Spacecraft system voltages are present and proper.

r. Check and record the Spacecraft system switched from external power supply A to B (Spacecraft system current displayed on External power supply A panel meter).

s. Return external power supply A to 14.0 volts.

t. Depress UV Reset to reset osc rate 2

u. Repeat steps (i) through (o), using external Power Supply B and check that the readings are same as the recorded values.

II. Check of Battery Switching:

a. Status: In undervoltage on External Power Supply A, load current indicated on panel meter.

b. Set External Power Supply B to 14.0 volts.

c. Return Digital voltmeter to pin 46 on Monitor Panel.

d. Slowly lower External Power Supply A output voltage.

e. Observe and record the Spacecraft system voltage at the change of system load current to External Power Supply B.

f. Record the switching potential from A to B.

g. Set External Power Supply A to 14.0 volts.

h. Slowly lower External Power Supply B output voltage

i. Observe and record the Spacecraft system voltage at pin 46 on Monitor Panel at the Change of system load current to External power supply A.

j. Record the switching potential from B to A.

k. Reset External Power Supply B to 14.0 volts.

III. Conclusion of UV Test:

a. Set osc rate 2 in speedup.

b. Place Undervoltage speedup of Osc rate 2 "ON".

c. Observe and record that in approximately five minutes the Spacecraft returns to normal operation and that all spacecraft system voltages are present and proper.

d. Reset Osc Rate 1.

IV. Dumping

Precaution: This measurement is above Spacecraft ground of common return, therefore, the digital voltmeter and printer must be a completely isolated (floating) electrical system to preclude damage to Spacecraft circuitry. The ground strap on the digital voltmeter shall not be connected to the negative input terminal. The associated printer, if used, shall be an isolated unit such as an HP 561 printer.

a. Set the current limit of external power supply A to one ampere.

b. Connect digital voltmeter to S-52 Control Panel jacks J11 (-) and J10 (+).

c. Place Spacecraft on internal batteries (S-52 control panel function switch on A and B.)

d. Slowly raise the voltage of external power supply A until a current of one ampere is being supplied to the Spacecraft system as noted on charging current meter on S-52 control panel.

e. Measure and Record:

1. Solar Paddle Voltage
2. Battery A charging current.
3. Battery B Trickle charging current.
4. Voltage drop across dumping resistor A from jack J5 (+) to jack J4 (- above ground) on the S-52 control panel (about 5 volts across 10 ohms, therefore 500 ma).

5. Voltage drop across dumping resistor B from jack J5 (+) to jack J6 (- above ground) on S-52 control panel (about 5 volts across 10 ohms, therefore 500 ma).

f. Verify that the sum of the Spacecraft system current, the dumping currents, and the charging currents equal the Spacecraft input current.

g. Repeat steps (a) to (f) at two amperes.

h. Readjust A to the required input and record systems current.

i. Turn charging current to OFF position. Observe and record the system current and voltage.

j. Turn ON charging current if required.

Module C Data Sheet

S/C Condition: Code: By: Date: Time:

PIN	DESCRIPTION	VALUE	
	U V Level		Chrgin E
22	Osc Rate 1 a		Batt A I
	b		Batt B I
	c		R_1 E
39	Osc Rate 2 a		R_2 E
	b		
	c		
45	15 VDC		Chrgin E
8/42	15 VAC amp.		Batt A I
	freq.		Batt B I
22	Osc Rate 1 S.U.		R_1 E
	S/C return		R_2 E
	Load on B		
	UV on B		
	Sw A to B		
	Sw B to A		
22	Osc Rate 2, S.U.		

Module C_1 Data Sheet

S/C Condition: Code: By: Date: Time:

TIME	DUMPING I		BATT V		BATT I		EXT. CHARGE		+15V	15 VAC(8&42)		OSC COUNT		OSC PERIOD		
	J4	J6	A	B	A	B	Volts	Curr	Pin45	Amp.	Freq.	1	2	1	2	

OPERATIONAL MODULE D

The evaluation of the performance of the Spacecraft Tape Recording System is provided by Module D. With the exception of the recording of known inputs to experiments, for example, the measurements recorded in Module D Data Sheet are only available during the Spacecraft playback mode.

Periodically, during continuous testing, measured inputs will be applied through the experiments and correlated against their respective outputs recovered during the Spacecraft playback mode.

A check of the Spacecraft tape recorder speed is made by measurement of the 320.83 cps (Module B) applied to the tape recorder and a comparison with the period of the 15.4 KC recovered during the playback mode.

MODULE D - PROCEDURE

1. Setup oscilloscope for measurements of

   Decoder in
   Decoder out
   T.R. P.B.
   XMTR MOD

2. Setup Counter for measurement of Osc period.

3. Setup stop watch for P. B. Time.

4. If r-f command obtain Command Receiver Sensitivity.

5. Observe and record the indicated measurements appropriately in the Module D Data Sheet.

Command Receiver Sensitivity

a. Ensure Command Transmitter attenuator is set at maximum attenuation (132 db.)

b. Turn on primary A.C. power to Command Transmitter chassis.

c. Depress Command button on Command Transmitter.

d. Observe reception of Command as evidenced by break in telemetry signal followed by presence of 320 cps. modulation for 2 seconds and then the playback telemetry modulation.

e. Record the setting of the Command Transmitter attenuator.

> NOTE: The same r-f cable interconnecting the Command Transmitter and the Command Receiver is used for all measurements; exceptions must be noted in the module D Data Sheet.

f. If playback is not initiated, reduce the Command Transmitter attenuator setting by 2 db. and after a two minute delay, repeat steps from (d) above.

Module D Data Sheet

S/C Condition: Code: By: Date: Time:

PIN	DESCRIPTION	AMPLITUDE	PERIOD	TYPE OF DATA RECORDED		
				Input	P.B. Output	
	Manual Cmd.					
	r-f Cmd.					
	Cable Configuration					
	Cmd. Rcvr. Sens.					
6	Decoder In					
40	Decoder Out					
	Horn Duration					
21	T.R. P.B.					
20	XMTR MOD					
	Osc Period					
	15.4KC Period					
	P.B. Time					
	P.B. Count					
	Recovered L.S. Sync					
	Type of Data Recorded					

Operational Module E

The evaluation of the performance of Programmer #2 and the responses of the experiments to applied stimuli make up test Module E.

The module is divided into three test sequences: (a) P-2 in Speedup or Normal sunrise simulation and functional outputs monitored; (b) P-2 in Speedup cycle, sunrise simulation, functional outputs monitored, and data storage and readout cycle via telemetry and hardline; (c) P-2 in normal 110 minute cycle, sunrise simulation, functional outputs monitored, and data storage and readout cycle via telemetry and hardline. The test sequences are modified to environmental conditions, e. g. no hardline monitoring during rotating tests, etc.

Module E, test A verifies, via hardline, the operation of the H. S. and L. S. gates which determine the encoder's mode of operation, and presence of the foil advance pulse to the micrometeoroid experiment. See Figure 2-44 "Sequence of Operational Modes"; see also Module E Data Sheet.

Test B, performed with P-2 in speedup cycle, in addition to those parameters observed in test A, observes: the performance of the experiments as these are stimulated; the operation of the data storage and playback functions; and the telemetry format at the ground station. Data is transmitted via R. F. telemetry format to the ground station, and via hardline to adjacent instrumentation. Frequent comparisons of concurrent data samples obtained via hardline and telemetry aid in establishing a continuous indication of data collection effectiveness. See Figures 2-44, 2-45, 2-46, 2-47, 2-48 and 2-49.

Test C is the same as test B with Programmer #2 in "Normal" cycle instead of "Speedup".

MODULE E DATA SHEET

S/C Condition: Code: By: Date: Time:

PIN	DESCRIPTION	LEVELS HL	LEVELS TM	EXCITOR	RCVD	AMPLIFIER SELECTED	MECHANICAL ADVANCE
17	DROD-A-PRE						
	DROD-A-POST						
50	DROD-B-PRE						
	DROD-B-POST						
23	IROD-A						
	IROD-B						
5	FAP						

Remarks:

GALACTIC NOISE

PIN	DESCRIPTION	LEVELS HL H.S.	LEVELS HL L.S.	LEVELS TM	10 Per Avg	EXCITOR
48 and 31	1 mc					
	2 mc					
	WB					
16	Sig					
	Swp					

Remarks:

OZONE

PIN	DESCRIPTION	LEVELS HL	LEVELS TM	10 Per Avg.	EXCITOR
13	Spect A				
13	Spect B				
30	Oz				
47	Mon				

Remarks:

PROGRAMMER #2

PIN	DES.	AMP.	TIME OF OCCURRENCE M1	TIME OF OCCURRENCE M2	TIME OF OCCURRENCE M1
	SR				
	SS				
34	HS				
15	LS				

Remarks: (Prog. #2)

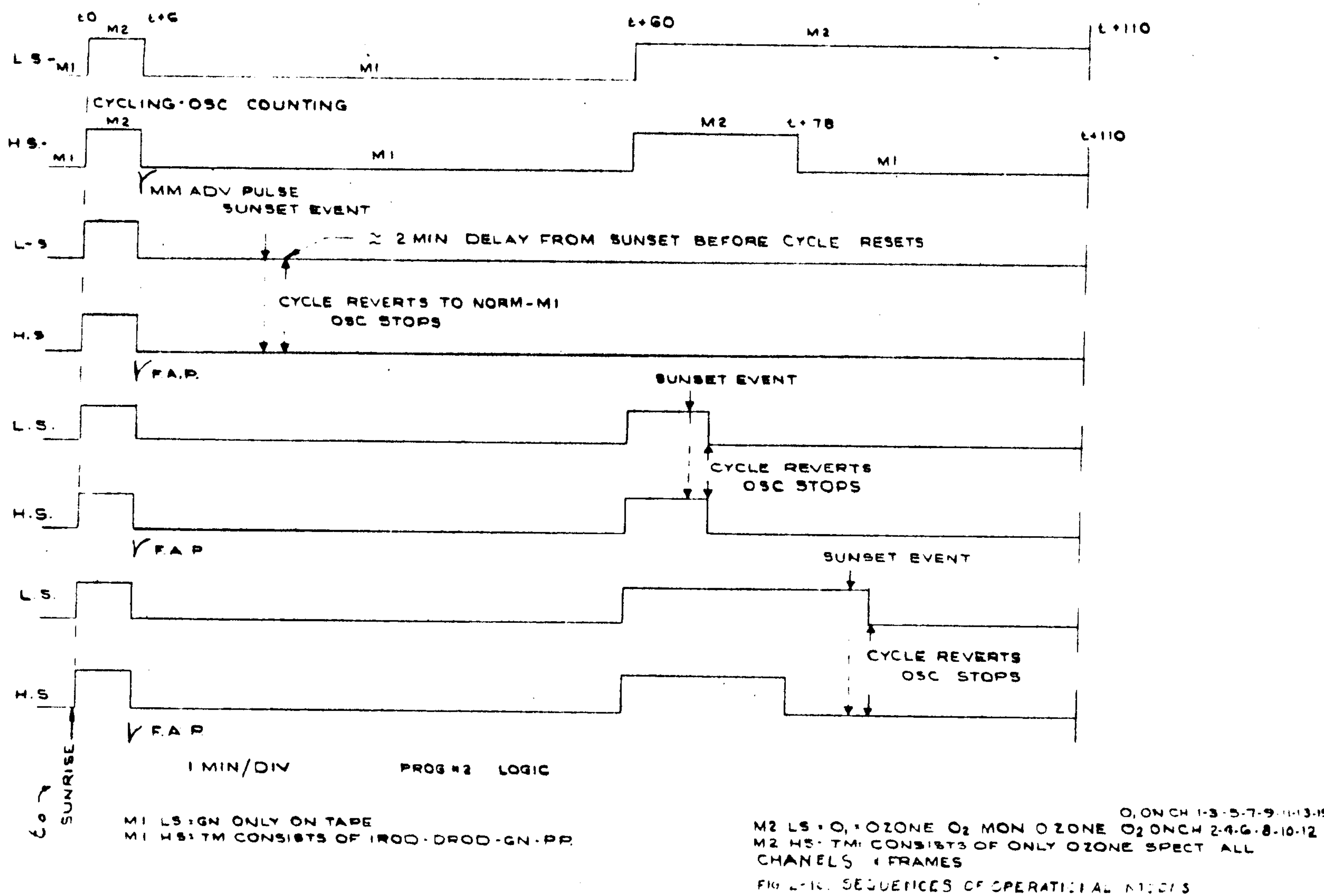
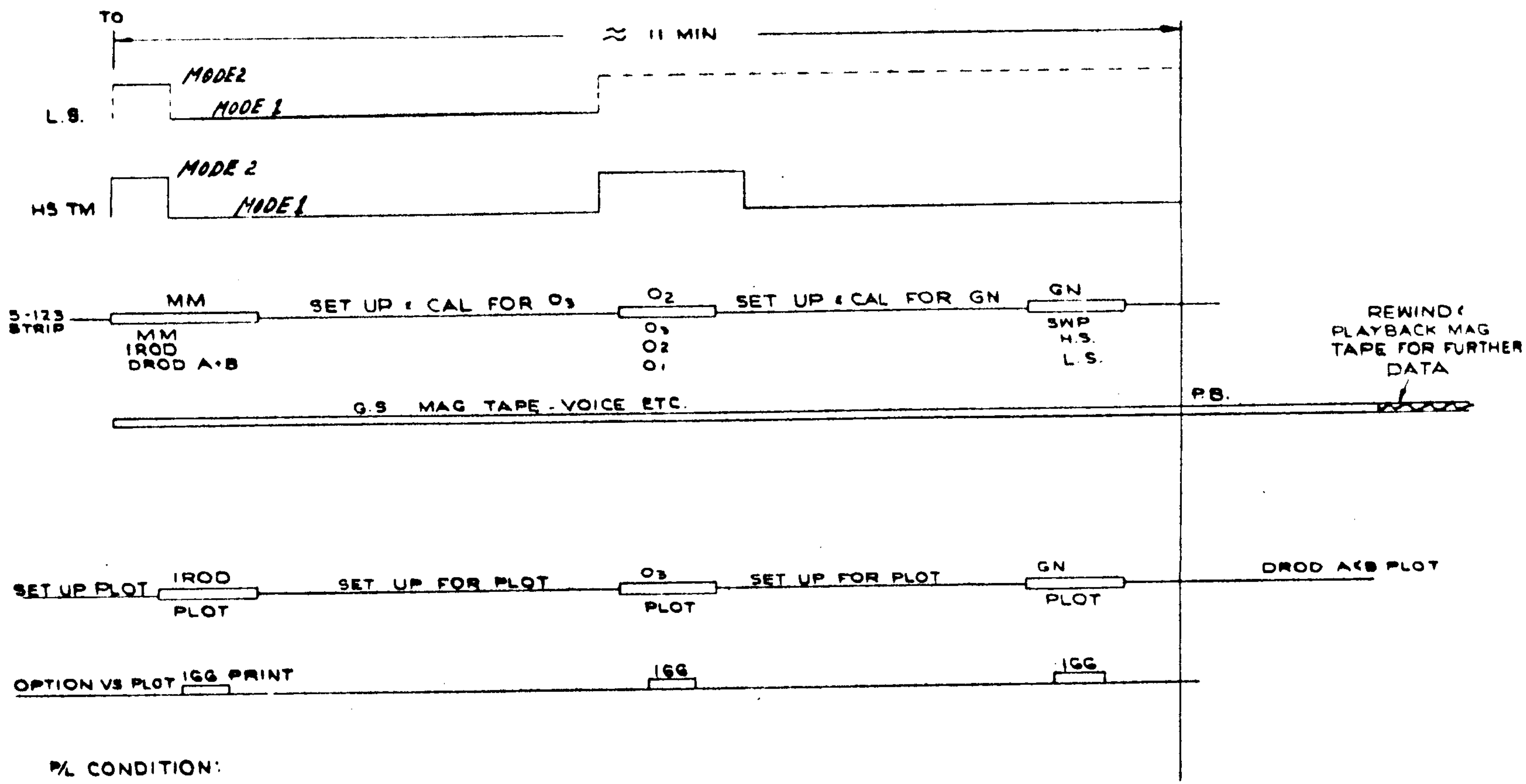


Figure 2-44. Sequences of Operational Modes



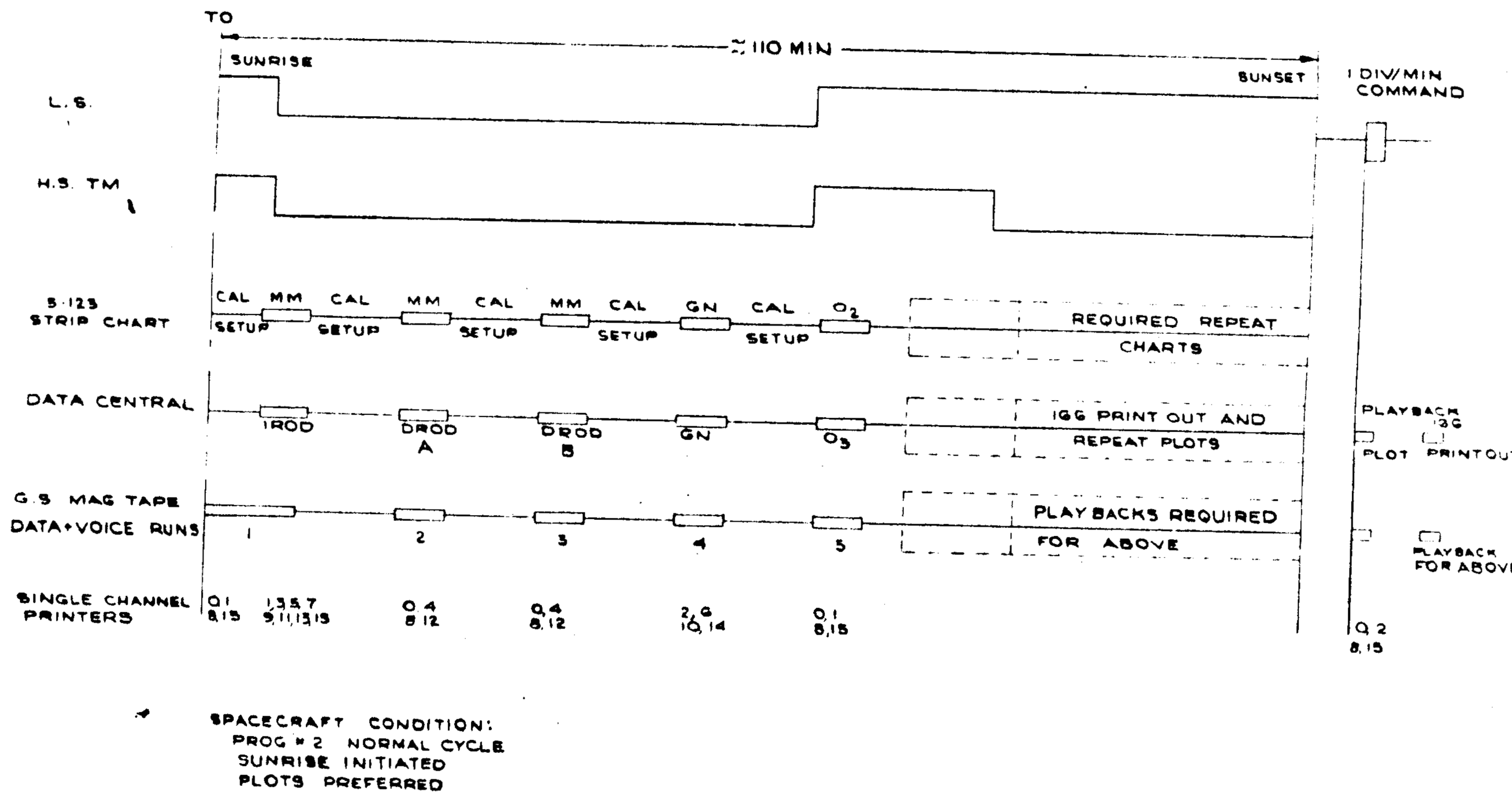
P/L CONDITION:

PROG #2 IN SPEED UP MODE:

EXPERIMENTS: EXCITED OR NOT

PLOTS WILL BE PREFERRED

Figure 2-45.



TO
≈110 MIN
SUNRISE
SUNSET
1 DIV/MIN COMMAND
L.S.
H.S. TM
5-123 STRIP CHART
CAL MM CAL MM CAL MM CAL GN CAL O2
SETUP SETUP SETUP SETUP SETUP
REQUIRED REPEAT CHARTS
DATA CENTRAL
IROD DROD A DROD B GN O3
IGG PRINT OUT AND REPEAT PLOTS
PLAYBACK 13G
PLOT PRINTOUT
G.S MAG TAPE DATA+VOICE RUNS
1 2 3 4 5
PLAYBACKS REQUIRED FOR ABOVE
PLAYBACK FOR ABOVE
SINGLE CHANNEL PRINTERS
0,1 8,15
1,3,5,7 9,11,13,15
0,4 8,12
0,4 8,12
2,6 10,14
0,1 8,15
0,2 8,15
SPACECRAFT CONDITION:
PROG # 2 NORMAL CYCLE
SUNRISE INITIATED
PLOTS PREFERRED

Figure 2-46.

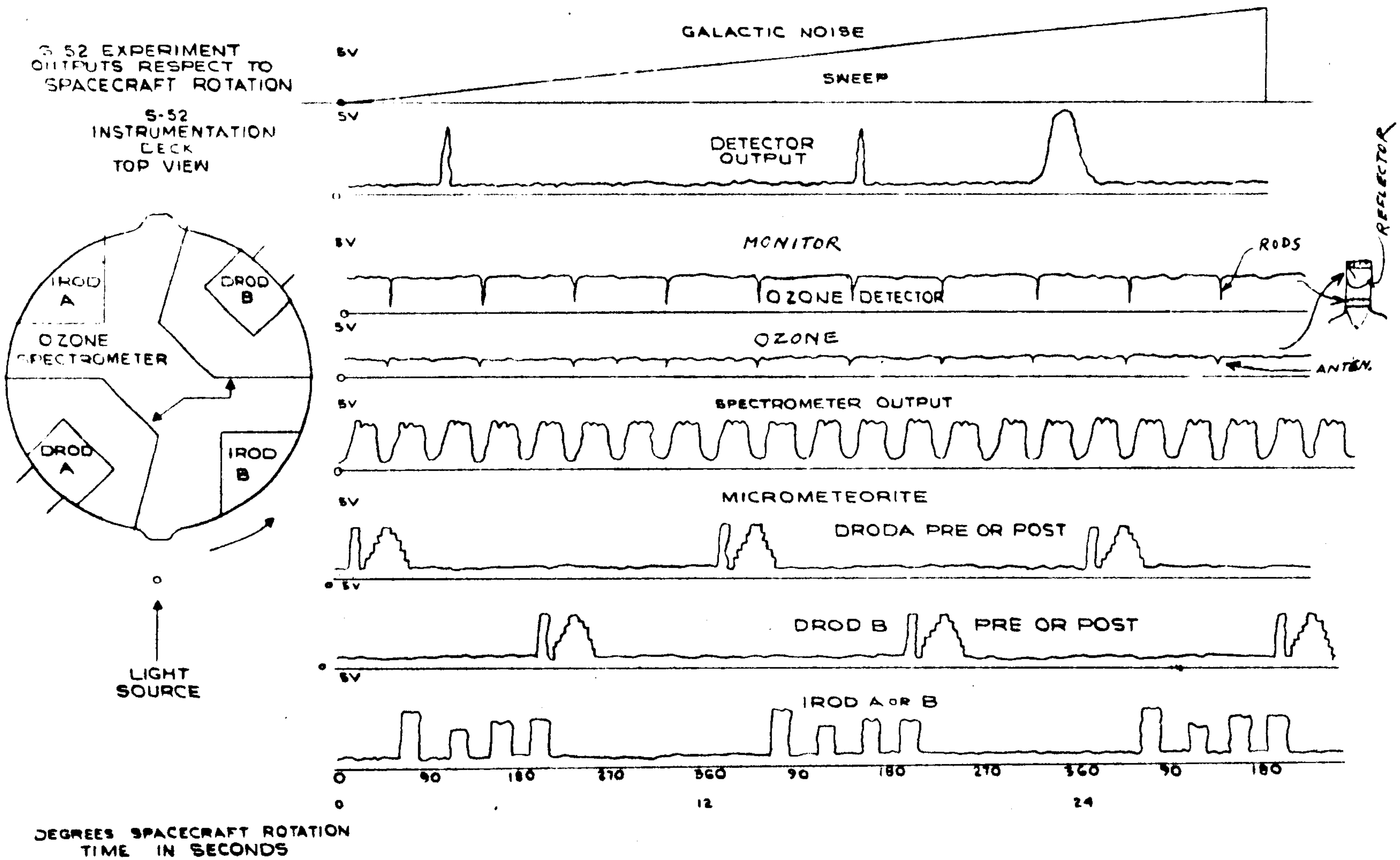


Figure 2-47. Experiment Outputs

TEST PROCEDURE, S-52

Separation System Test Set

GENERAL DESCRIPTION

An S-52 Separation System test set provides for testing the performance of the S-52 separation system throughout environmental exposures and at the launch site.

The S-52 separation system consists of a pair of identical independent subsystems whose electronic timers are initiated by switches actuated at the separation of the launch vehicle third and fourth stages during flight. Each subsystem battery supplies the energy for operating its timer and actuating the redundantly wired propellant devices. The electronic timers connect the batteries to the various propellant devices at the proper times to permit the functions of despin, boom erection, paddle erection, and separation of the S-52 spacecraft from the launch vehicle.

The S-52 separation system test set provides for:

a. Simulation of the initiation switches

b. Continuous metering of each battery voltage.

c. Measurement of the time intervals from initiation to performance of each of the four functions of despin, boom release, paddle release, and separation.

d. Monitoring the presence of all propellant device bridge wiring firing pulses.

e. Monitoring the proper sequence of events.

f. Continuously monitoring the susceptibility of the S-52 separation system circuitry to electromagnetic and electrostatic transient impulses.

The physical description, circuit operation, and test procedure for use of the S-52 separation system test set are given herein. Complete fabrication of the test set is pending component delivery.

PHYSICAL DESCRIPTION

The portable test set shown in Figure 2-50 for use with the S-52 separation system will be housed in an aluminum suitcase approximately 20" X 18" X 3" and weigh about 12 to 15 pounds.

The test set will consist of a pair of duplicate independent test units combined beneath a divided instrumentation panel mounted in the suitcase. The purpose of this layout is to facilitate independently testing either S-52 separation system subsystem or simultaneously testing both subsystems.

Each test unit will consist of an initiation switch, a test indicator lamp, a voltmeter, a battery, four elapsed time meters, a timer speed-up switch, eight bridge wire indicator lamps, a reset switch, and sixteen hermetically sealed relays.

The test unit battery supplies the power for operating the elapsed time meters and indicator lamps. Negligible energy is required of the S-52 separation system to operate the voltmeter and pulse the test set relays. The coils of the test set relays substitute for the propellant device bridge wires in test.

Cables extend from the test set to the S-52 Separation system and provide the connections for the simulated initiation switches and all of the timer output firing pulses to the propellant device bridge wires.

TEST PROCEDURE, S-52

Separation System

Status -

1. Shorting plug P505 installed.
2. Battery Connectors P503 and P504 disconnected.
3. All other connectors are disconnected.

Test Set

Status -

1. All interval timer meters reset to zero by thumb dial.
2. Initiation switches off.
3. Test set switches off.

Procedure -

For external power, connect external power supply through test set external power supply cable.

Adjust power supply for 12.5 volts.

For internal power, check battery supply volt at internal-external power plug pin 4 (-) pin 1 (+) for 12.5 ± .1 volt. Insert test set internal power plug.

Setup -

Turn both power switches "ON"

Actuate both subsystems. Reset switches.

Check all bridge wire indicator lamps. Depress all 16 lamps in turn and observe illumination. Verify all interval timers reset to zero. (Use thumb dial.)

Connections to Separation System -

Mate the following test set connectors with their corresponding receptacles on the Separation System.

Test Set Plug	to	Separation System
P507		J507
P508		J508
P509		J509
P510		J510
P511		J511
P512		J512
P513		J513
P514		J514

NOTE: If spacecraft is not joined to Separation System, connections to despin circuits will be made at the fly-away connectors.

P515A	to	J515A
P516A	to	J516A

If spacecraft is joined to Separation System, connections to despin circuits will be made through

P515	to	J515
P516	to	J516

Remove System Shorting plug P505. Insert Separation System Arming plug P505.

Observe indication of Battery A and Battery B voltage on respective test set meters. This voltage should be 14.5 V. Observe this voltage throughout test.

Observe that no test set indicators are lighted and that no interval timers are counting for a period of 20 minutes.

NOTE: This is check of transient initiation and presence of voltage check.

Test Run –

Actuate initiation switches momentarily.

> NOTE: Observe a few tenths of a Volt change in battery voltage that indicates Separation timer loading.

> NOTE: If only desired to check one system at a time, then only actuate the switch for that system.

Observe:

1. Both test lights are lighted on despin.

2. Interval timers T1A and T1B only are counting. At end of 900 seconds, Observe

1. Behavior of battery voltage at firing
2. Illumination of despin lights.
3. Interval timers T1A and T1B cease.
4. Interval timers T2A and T2B commence.

At end of approximately 60 seconds, observe:

1. Behavior of battery voltages at firing.
2. Illumination of boom lights.
3. Interval timers T2A and T2B stop.
4. Interval timers T3A and T3B start.

At end of additional 60 seconds, observe:

1. Battery voltage.
2. Paddle lights.
3. Paddle meters stop.
4. Separation Nut meters start.

At end of a final 60 seconds, observe:

1. Battery voltage.
2. Paddle lights.
3. Paddle meters stop.

Status -

All indicators lighted. Record readings on meters in data sheet.

900 sec ±2%

60 sec ±2 sec.

Battery voltage.

Reset test set. Reset SpS System by removing P503 and P504.

At launch -

Reconnect P503 P504 to assure reset.
Disconnect P503 P504
Disconnect P505 Arming
Connect P505 Shorting
Disconnect all test set wires.

Remove individual shorting bars from propellant devices one at a time. Check for bridge wire R insulation with impulse checker.

Record values. Replace if not within tolerance. Connect to Separation System after each measurement. Connect P503 and P504.

Arming -

Remove P505 shorting
Insert P505 Arming

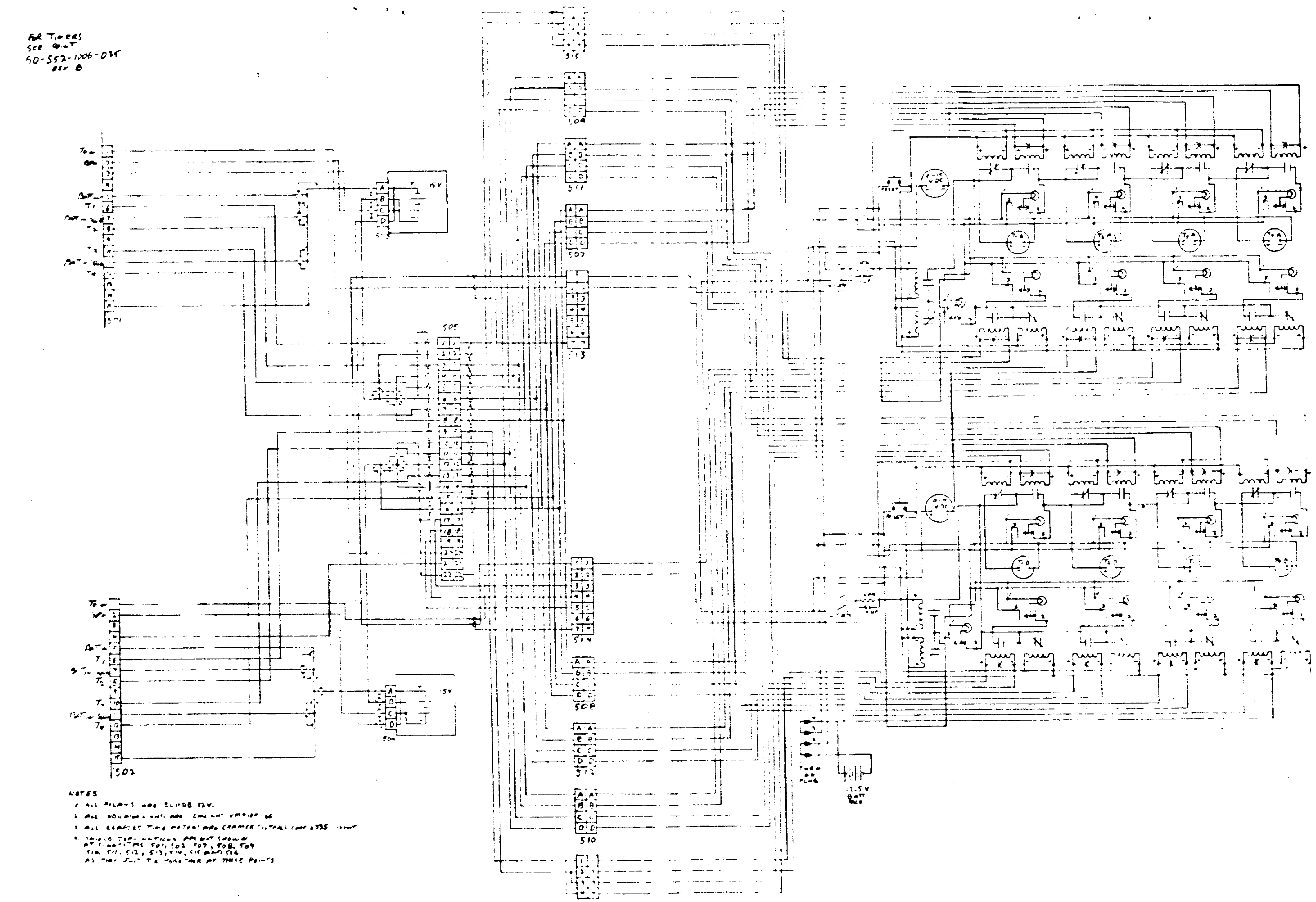


Figure 2-48. Test Set for S-52 Separation System