FORM L-83-59 (REV. 4-65)

220

DOUGLAS

MISSILE & SPACE SYSTEMS DIVISION
DOUGLAS AIRCRAFT CO., INC.

ENGINEERING LABORATORIES & SERVICES
TECHNICAL MEMORANDUM

CATALOG NO. PDL 71415-1

TO: J. L. Whittaker, A-290

FROM: T. J. Sereno, A-270; ext. 2461

SUBJECT: LH_2 ORBITAL COAST VENT INITIATION PRESSURE SWITCH (S/N 105) VIBRATION AND SHOCK TESTS

COPIES TO: J. L. Holmgren, N. Mincks, H. B. Mitchel, G. Cameron, B. R. Wyatt, Jr., B. Thomas, J. Hilman, A3-860; P. Sellers, A2-253; T. J. Sereno (2), I. M. Williamson, A-270 C. W. Wilson A3-860 (11) NASA

REPORT NO. TM-DSV4B-ENV-R5050-1

DATE 10/17/66

REQUESTED BY J. L. Holmgren

E.W.O. 27761 TCD 1T06343-A

TEST PLAN & ITEM NO. U-5L 41412

SALES ORDER 5879-6302

CLASSIFICATION OR RESTRICTION: Unclassified

INTRODUCTION

Sinusoidal vibration, random vibration, and mechanical shock tests were performed as a part of the qualification testing of an LH_2 orbital coast vent initiation pressure switch S/N 105. Testing was accomplished at the vibration and shock testing facility of the Douglas Dynamics Laboratory, Santa Monica, California, from February 17, through February 24, 1966.

An LH_2 low pressure switch, S/N 101, was tested concurrently with switch, S/N 105; documentation for testing of switch, S/N 101, is provided in technical memorandum DSV4B-ENV-R5049-1.

PURPOSE

The purpose of the tests was to qualify the operation of the test specimen under the imposed environmental conditions of vibration, mechanical shock, and temperature which simulated the conditions to be encountered in flight.

The purposes of this technical memorandum are to describe and document the vibration and shock portions of the tests and to transmit the vibration and shock data obtained from the tests.

N70-76226
(ACCESSION NUMBER)
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(PAGES)
CR-113235
(NASA CR OR TMX OR AD NUMBER)
(THRU)
none
(CODE)
(CATEGORY)
FACILITY FORM 602

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DOUGLAS	DOUGLAS AIRCRAFT CO, INC. MISSILE & SPACE SYSTEMS DIVISION SANTA MONICA, CALIFORNIA	QUALIFICATION STATEMENT	[X] DE/Q TEST [ ] FORMAL QUAL

PROGRAM SATURN	MODEL DSV-4B	TEST PLAN LINE ITEM NUMBER U5L

TEST PLAN LINE ITEM TITLE	SWITCH, PRESSURE LH_2 TANK ORBITAL COAST VENT INITIATION	PART NO. 1A67005-507

TECHNICAL MEMORANDUM NUMBER(S): TM-DSV-4B-LE-R-5050

REFERENCE TECHNICAL MEMO. NUMBER(S): TM-DSV-4B-ENV-R-5050-1

FAILURE AND REJECTION REPORT (FARR) TAG NUMBER(S) AND DISPOSITION

see Page 2.

(USE CONTINUATION SHEET AS NECESSARY)

ENGINEERING RESOLUTIONS AND CONCLUSIONS

Specimen S/N 104 had no out-of-tolerance conditions subsequent to the pre-environmental test. See FARR A185930 above for details. Actuation pressures however, were marginal on tests conducted above the temperature limits of the switch. Specimen S/N 105 had no out-of-tolerance condition after the initiation of the 250 v insulation resistance tests. See FARR A185969 above for details. Qualification was completed on the 1A67005-507 configuration by using S/N 104 in conjunction with S/N 105.

(USE CONTINUATION SHEET AS NECESSARY)

STATEMENT OF QUALIFICATION

Based on the results of Design Qualification Tests presented in the attached reports, it is the conclusion of the Douglas Aircraft Company, Inc., that pressure switch Part Number 1A67005-507 is qualified for its intended use on Saturn S-IVB.

ORIGINATOR	DESIGN TECHNOLOGY BRANCH CHIEF	DESIGN TECHNOLOGY CHIEF ENGINEER
11-8-66 E. Frye 11-7-6 Earl Frye TITLE	11-7-6	
RELIABILITY ENGINEERING	PROJECT OFFICE TEST BRANCH	
1-11-67		

FAILURE AND REJECTION REPORT: S/N 104 FARR A185930

Failure Analysis (Vendor) Insulation resistance tests were performed on Pressure Switch S/N 104 by applying 500 VDC between all open contact and between all contacts and case (ground). Insulation resistance measurements failed to meet the specified requirements. The capilliary tube seal was removed allowing the 1.25 psia internal pressure to reach atmospheric pressure. When the test was again performed, the insulation resistance measurements were infinite. The welded joint around the connector was machined off and the connector removed. Solder balls were found clinging to the wires and to the inner walls of the switch case. (Ref. FARR A-185930).

Conclusion (Vendor) Pressure Switch S/N 104 failed insulation resistance due to solder balls.

Conclusion (Douglas Aircraft Company, Inc.) Insulation resistance measurements for pressure switch S/N 104 were infinite when the evacuated condition inside the switch was relieved. Insulation resistance failure was due to corona discharge due to low internal cavity pressure.

Corrective Action (Vendor) The pressure switch capilliary tube was lengthened and crimped in two places before soldering.

Corrective Action (Douglas Aircraft Company, Inc.) See corrective action S/N 105

FAILURE AND REJECTION REPORT: S/N 105 FARR A185969

Failure Analysis (Vendor) Insulation resistance tests were performed on Pressure Switch S/N 105 by applying 500 VDC between all open contacts and between all contacts and case (ground) insulation resistance measurements failed to meet the specified requirements. The capilliary tube seal was removed allowing the 1.25 psia internal pressure to reach atmospheric pressure. When the test was again performed, the insulation resistance measurements were infinite. (Ref. FARR A185969)

Conclusion (Vendor) Pressure Switch S/N 105 failed due to corona discharge and Douglas Aircraft Company overtest (500 VDC).

Corrective Action (Vendor) None.

Corrective Action (Douglas Aircraft Company, Inc.) Voltage application on all insulation resistance tests were reduced on Part Number 1A67005-507, from 500 volts to 250 volts. The switches were retested using the reduced voltage and met the specified test requirements.

EQUIPMENT

Test Specimen

The test specimen consisted of the following:

- LH_2 Orbital Coast Vent Initiation Pressure Switch, P/N 1A67005-507M, manufactured by Frebank Company, Glendale, California, P/N 8295-1, S/N 105, Test Plan Item U-5L

- LH_2 Low Pressure Switch, P/N 7851360-537AE, manufactured by Frebank Company, Glendale, California, P/N 8292-3, S/N 101, Test Plan Item U-5K

- Support Assembly

- Dummy Pipe Assembly

- Barry Mount Isolators (4), P/N 91091-3

- Mounting Structure

These components were assembled and mounted on a vibration test fixture, P/N 1T022562, in a manner which dynamically simulated the vehicle installation. The test fixture weighed approximately 35 pounds.

Test Equipment

ITEM	MANUFACTURER	MODEL	SER. OR TAG NO.
Vibration System	MB	C-70	--
Control Console	Dynamics Lab.	1	--
Oscillator	Technical Products	TP626	611595-2
Analyzer	Technical Products	TP627	611595-3
Integrator	Technical Products	TP633	611595-1
Equalizer/Analyzer	Ling	ASDE-80	61
X-Y Recorder	Moseley	2	986
Tape Recorder	Precision Instrument	PS-207A	460
Waveform Synthesizer	Exact	200	634060
Memoscope	Hughes	105A	632152

Instrumentation equipment is itemized on the channel assignment sheet presented on page A1.

Accuracy and repeatability were verified by standard calibration procedures during the periodic calibration and certification of the test equipment.

PROCEDURE

The test specimen was attached to the shaker head, and accelerometers were mounted as shown on page B4. The accelerometers were oriented as specified on page A1.

Tests consisting of sinusoidal sweeps, random excitation, and shock pulses were then conducted in each of the three mutually perpendicular axes shown on page A2.

Sinusoidal sweeps were performed at ambient temperature from 20 to 2000 to 20 cps with the frequency changing at the rate of one octave per minute. Input levels were as follows:

FREQUENCY (cps)	LEVEL
20 - 250	1.8g (0 - peak)
250 - 950	.000560 inch D.A. Disp.
950 - 2000	26g (0 - peak)

Sinusoidal data were recorded on oscillograph charts.

Random vibration tests were performed for each axis in the following steps:

1. The specified spectrum was shaped on the equalizer and the level brought to 1/4 power. Adjustments were made as necessary with the use of the individual meters in the analyzer.

2. When the setting appeared satisfactory, a brief full-power run was made, during which time the signal generated by the control accelerometer was recorded on a magnetic tape loop and analyzed.

3. When the tape loop analysis showed a satisfactory spectrum (as approved by the Task Force representative), the remainder of the full-power run was completed.

Random vibration tests were performed at -55°F for a total duration of 12 minutes in each axis. The test specimen was enclosed in a chamber box, and LN_2 was utilized by the prime laboratory to produce the required low temperature. Input levels were as follows:

FREQUENCY (cps)	LEVEL
20 -	.002 g^2/cps
20 - 200	+7 db/octave
200 - 1000	.38 g^2/cps
1000 - 2000	-10 db/octave

Random data were recorded on magnetic tape.

PROCEDURES (continued)

Before the shock tests were performed, system accuracy was checked as follows:

1. Horizontal scale (time) accuracy was verified by standard calibration procedures during the periodic calibration and certification of the memoscope.

2. Vertical input deflection (acceleration) was adjusted by the insertion of a calibration signal corresponding to a known acceleration level and the adjustment of the memoscope potentiometer until the trace coincided with the desired vertical scale divisions.

Shock pulses were shaped by a waveform synthesizer, displayed on a memoscope, and photographed by a Polaroid camera. The input level for all axes was as follows:

Number	Three pulses per axis
Input Shape	Half Sine Wave
Acceleration	20g (0 - peak)
Duration	10 ± 2 milliseconds.

Functional requirements were monitored by the prime laboratory before and after vibration and shock testing.

RESULTS AND DISCUSSION

Sinusoidal sweep data are presented as plots of Acceleration versus Frequency on the following pages:

AXIS	PAGE NUMBER
A	A3 through A9
B	A10 through A16
C	A17 through A23

Sinusoidal inputs were within specification requirements except for momentary servo control loss at approximately 100 cps range, resulting in acceleration levels in excess of the required value during B-axis testing. The momentary servo loss was the result of a faulty capacitor in the compressor rate network within the cycling oscillator. Repairs were made before testing was initiated in the next axis.

(REV. 12-64)

INSTRUMENTATION CHANNEL ASSIGNMENT — DYNAMIC TEST

REPORT No. [illegible]
PAGE 11

TEST TITLE LH2 Low Pressure Switches (USK & USL)
USL 5879-6302 27761 1T06846
USK S/C 5769-6304 EWO 27302 TCD 1T00391
JWO
P/N SPECIMEN USL, 7851860-537 AE ; 1A67005-507W
ENGINEER R Morgan EXT 4507
TECHNS. J. Webb D. Petersen
STANDARD ACCEL. TYPE _____ S/N _____ CAL. DUE _____

TAPE REC. MODEL CP100 S/N 611827 FACILITY C70 UNIT 143
RECORD SPEED _____ IN/SEC _____ TAPE REEL No. 3037-9-10-2
OSCILLOGRAPH TYPE _____ S/N _____
PAPER SPEED _____ mm/IN/SEC _____
TIMING LINES _____ SEC. PAPER _____

SHEET 1 OF 2
DATE 2-24-66
LINE ITEM [illegible]
RUN No. _____
AXIS _____

CHAN. NO.	TAPE REC. CHAN.	OSC. CHAN.	XDCR CABLE NO.	MEASUREMENT LOCATION SEE SKETCH ON SHEET 3	RESP. AXIS	XDCR MODEL	SERIAL NO.	XDCR AMP. MODEL	SERIAL NO.	OSC. GALVO MODEL	SERIAL NO.	TAPE REC. AMP. MODEL	SERIAL NO.	FULL SCALE g's	INSERT mv_r	$\frac{P_c P_c}{P_{cs}}$	CHAN. NO.
1	1	2	1	CONTROL	SHAKE DIRECTION	2242C	H388	8PC	11424C	7-326	2780N	76	46270	26/30		1.94	1
2	2	4	2	USK, FACE OF SWITCH, FLOW DIRECTION	A	2226	LA77	2711	HA57		12867	83	46270	10/30		2.47	2
3	3	6	3	USK, TOP OF SWITCH	C	2242C	FA85	2711	HA80		8463	1689	46270-1	10/30		1.66	3
4	4	8	4	USK, SIDE OF SWITCH	B	2226	CC97	2711	HA55		5146	824	46270	10/30		5.42	4
5	5	10	5	USL, FACE OF SWITCH, FLOW DIRECTION	C	2226	JC46	2711	HA83		13659	823	46270	10/30		2.55	5
6	6	12	6	USL, SIDE OF SWITCH	A	2226	LB14	2711 *	HA28		13611	1176	46270-1	10/30		2.46	6
7	7	14	7	USL, SIDE OF SWITCH	B	2226	H388	8PC *	42890		14763					2.73	7
8	14																8
9		1								7-315							9
10																	10
11																	11
12																	12
13																	13
14																	14
15																	15
16																	16
17																	17
18																	18

NOTES & SKETCHES:

1) ACCELEROMETER LOCATION SKETCH IS PROVIDED ON SHEET 2.

* FOLLOWING ARE INSTRUMENTATION CHANGES AFTER ALL TESTING HAD BEEN COMPLETED IN THE "C" AXIS, AND THE SHOCK & SINESWEEP PORTION OF TESTING IN THE "B" AXIS.

CHAN.	XDCR AMPL	S/N
6	2713	KA89
7	2713	KA90

RESULTS AND DISCUSSION (continued)

Random vibration data are presented as plots of Acceleration Density versus Frequency on the following pages:

AXIS	TYPE	PAGE NUMBER
A	Equalization Analysis	A24
A	Control & Response Data	A25 through A31
B	Equalization Analysis	A32
B	Control & Response Data	A33 through A39
C	Equalization Analysis	A40
C	Control & Response Data	A41 through A47

Mechanical shock data are presented as photographic plots of Acceleration versus Time on page A48.

Visual examination revealed no damage to the test specimen as a result of vibration and shock testing.

ORIGINATOR H. R. Morgan

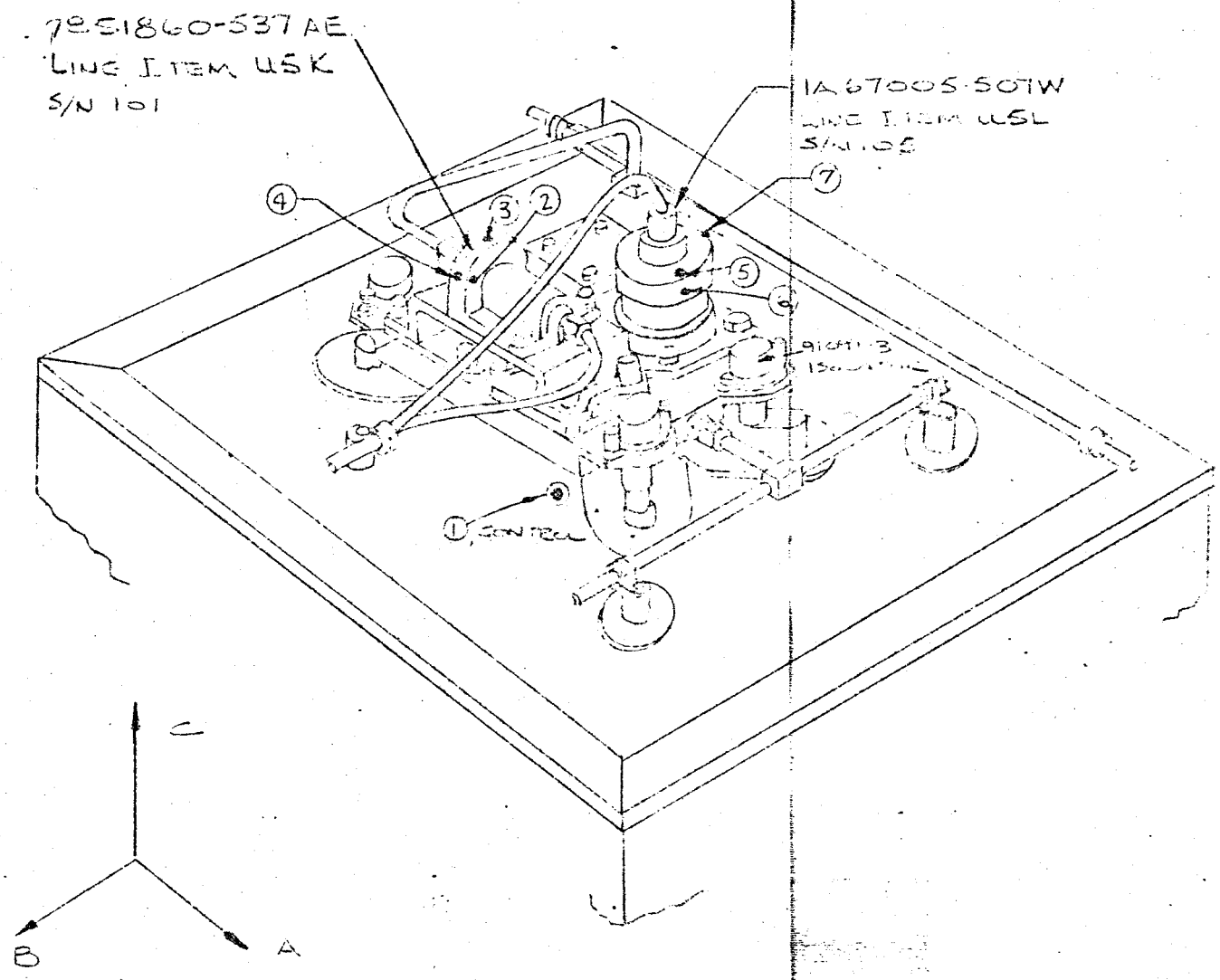
T. J. Sereno, Section Chief
Acoustics and Dynamics
Environmental Laboratories

ATTACHMENTS

Pages A1 through A48

Pages B1 through B5

INSTRUMENTATION CHANNEL ASSIGNMENT



MEASUREMENT LOCATION

⊕ INDICATES ACCELEROMETER CABLE NO.

DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A3
REPORT NO. E5050-1

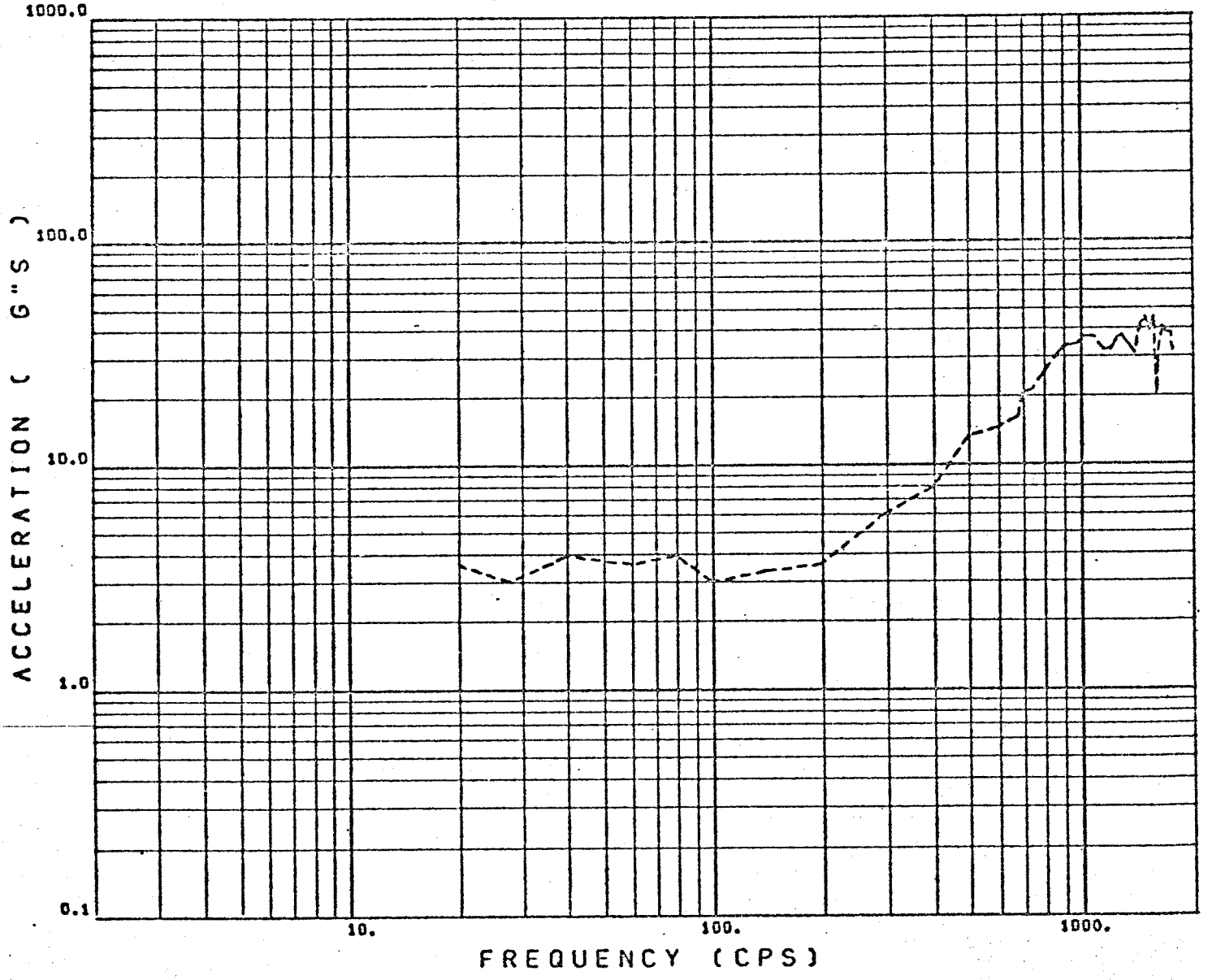
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/24/66
AXIS OF EXCITATION.... A
PICK UP NUMBER (1)... 1 HB88 CONTROL
PICK UP RESPONSE..... A
INPUT ACCEL.PER PAGE.. A2



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A4
REPORT NO. R5050-1

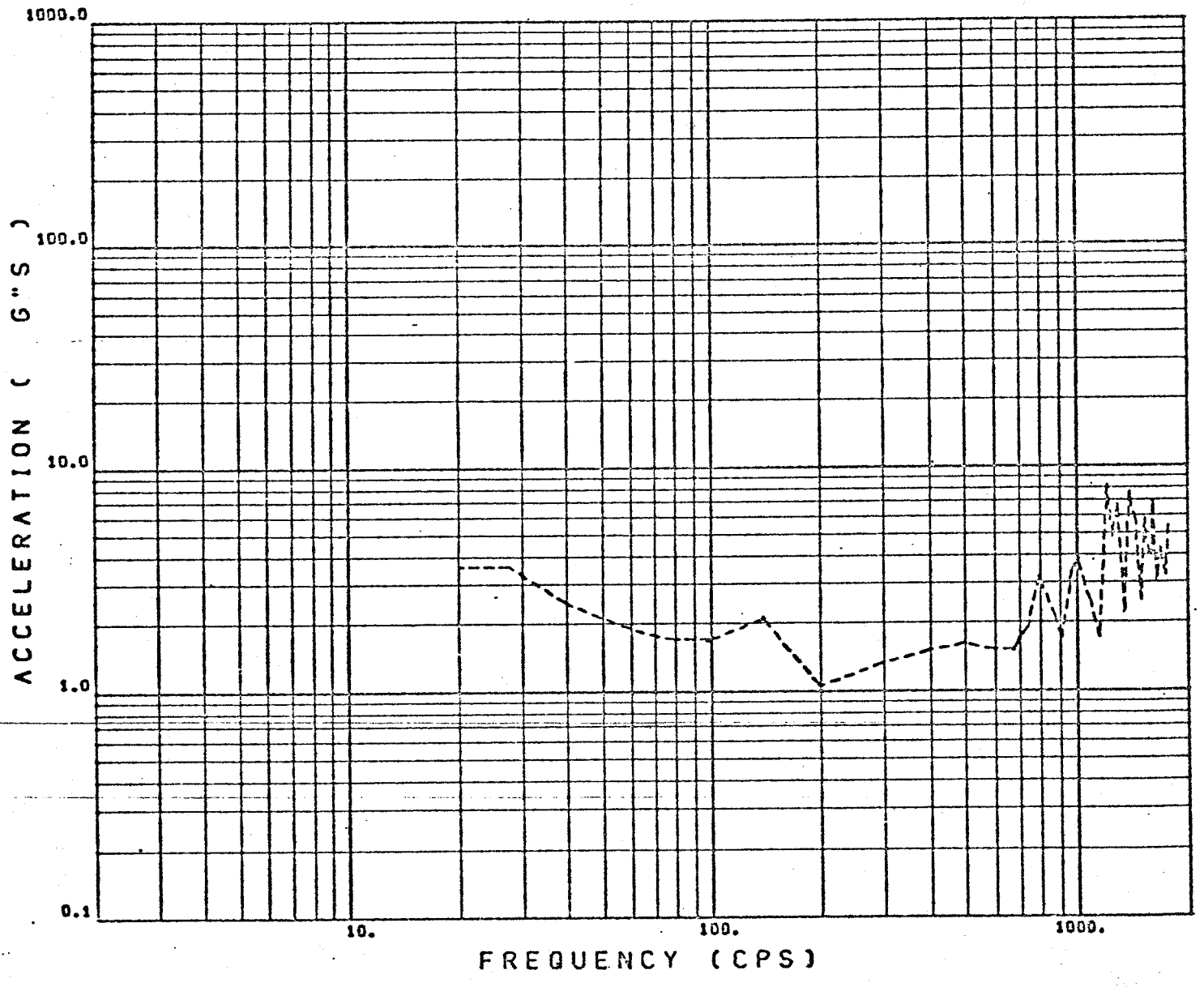
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/24/66
AXIS OF EXCITATION.... A
PICK UP NUMBER (2)... 2 LA77
PICK UP RESPONSE..... A
INPUT ACCEL.PER PAGE.. A



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. 45
REPORT NO. [illegible]

SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/24/66
AXIS OF EXCITATION.... A
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PICK UP RESPONSE..... [illegible] C
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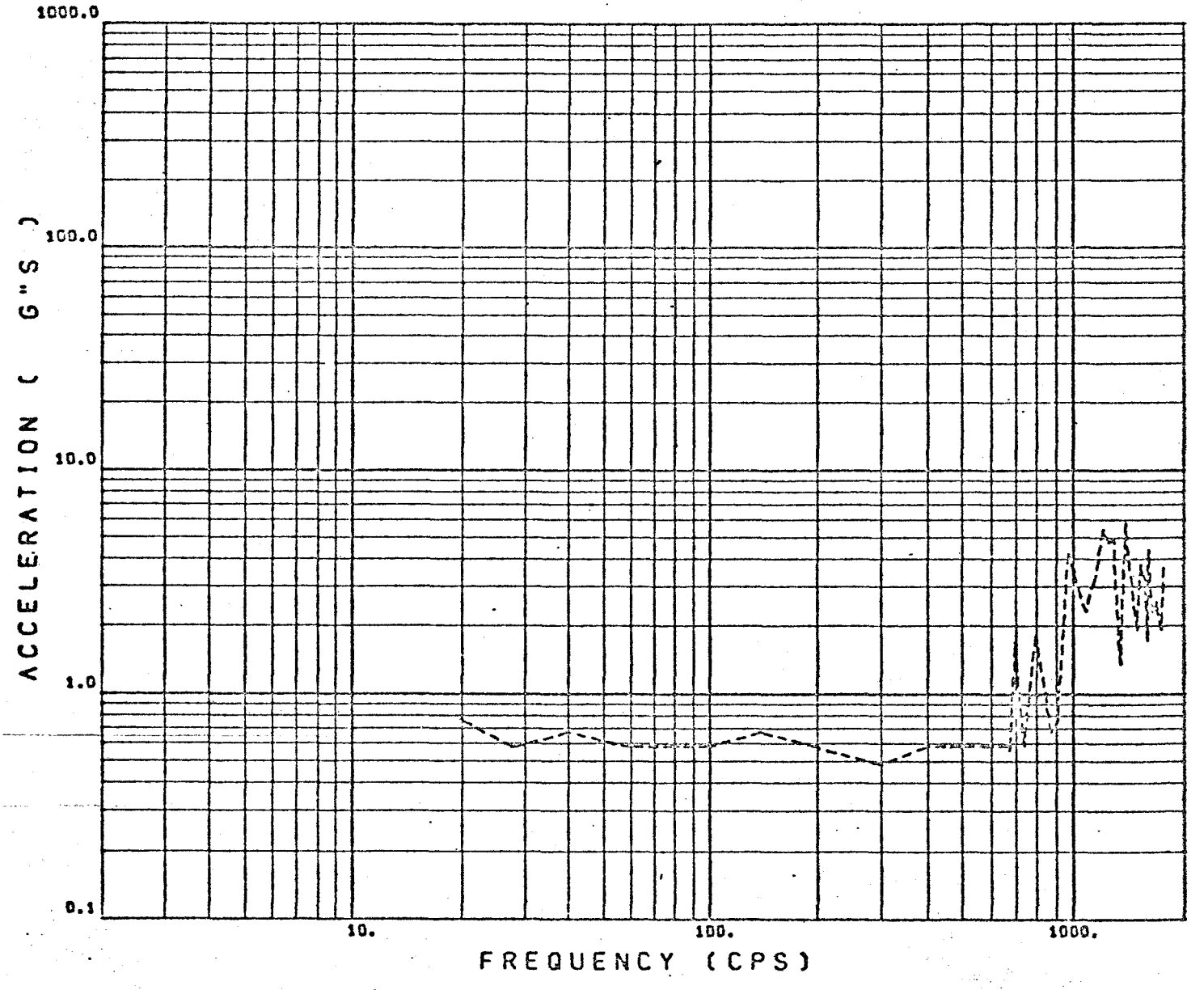


DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A6
REPORT NO. R5050-1

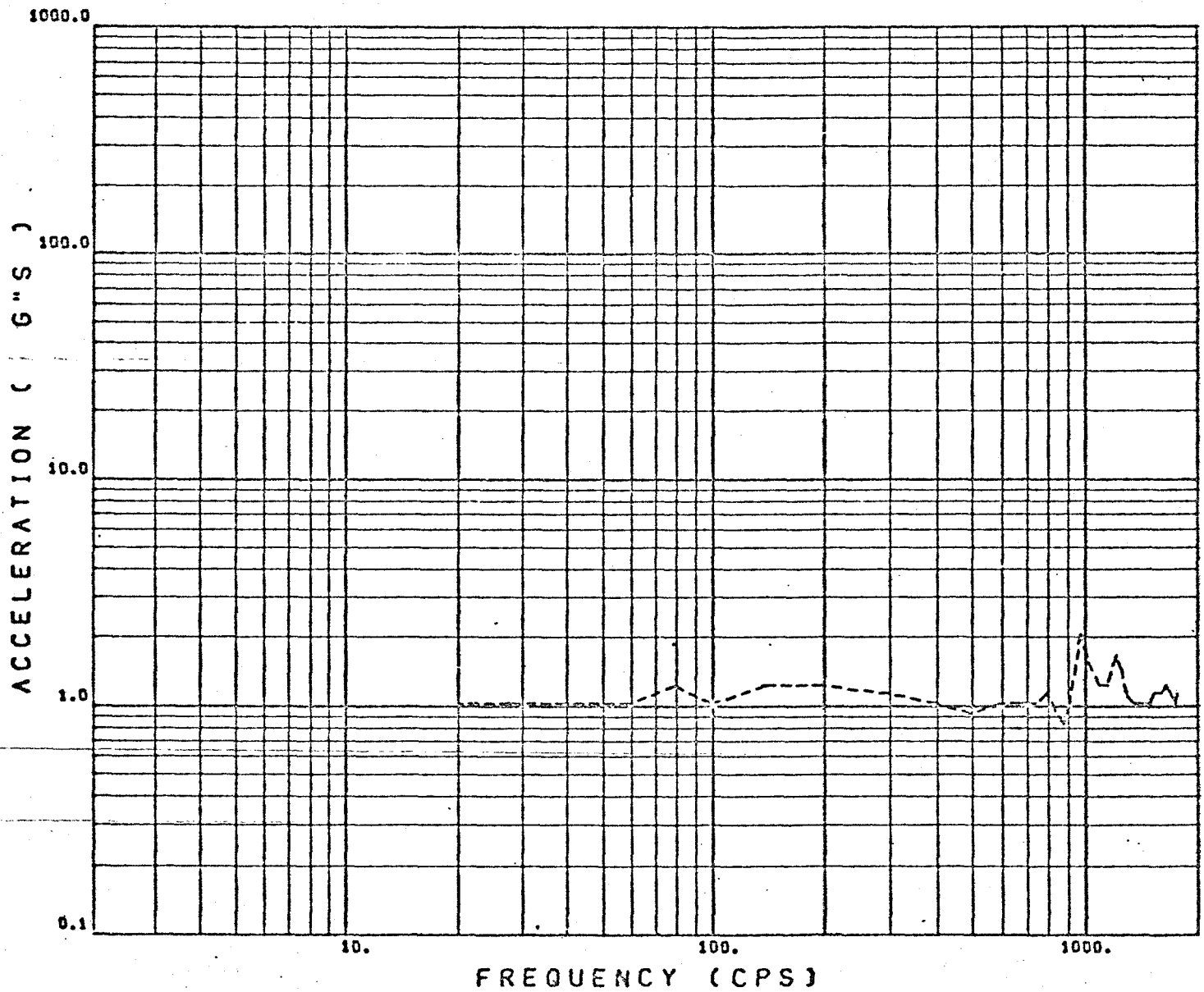
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/24/66
AXIS OF EXCITATION.... A
PICK UP NUMBER (4)... 4 CC97
PICK UP RESPONSE..... B
INPUT ACCEL.PER PAGE.. A3



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A7
REPORT NO. R-5050-1

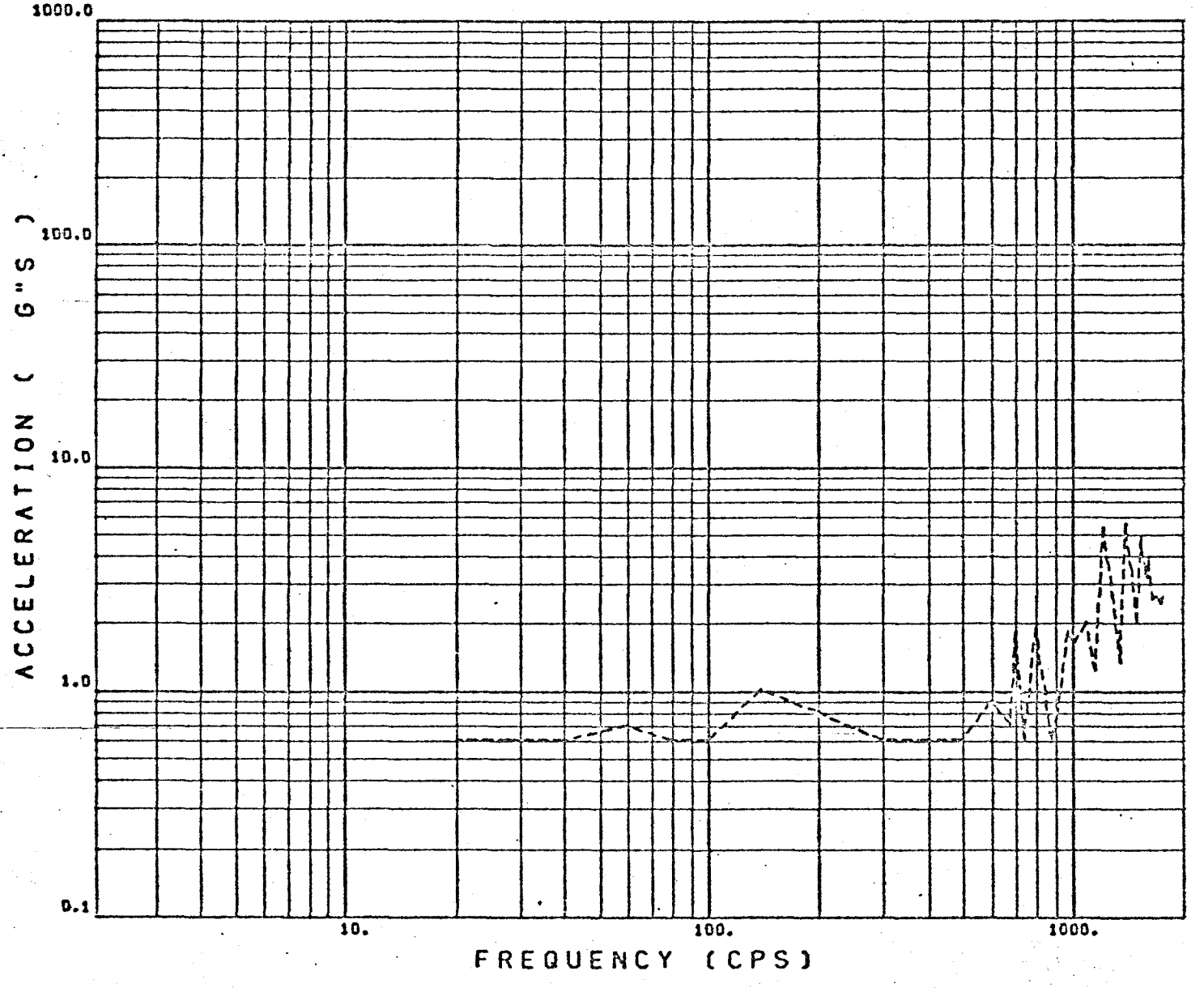
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/24/66
AXIS OF EXCITATION.... A
PICK UP NUMBER (5)... 5' JC46
PICK UP RESPONSE..... C
INPUT ACCEL.PER PAGE.. A3



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A8
REPORT NO. [illegible]

SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/24/66
AXIS OF EXCITATION.... A
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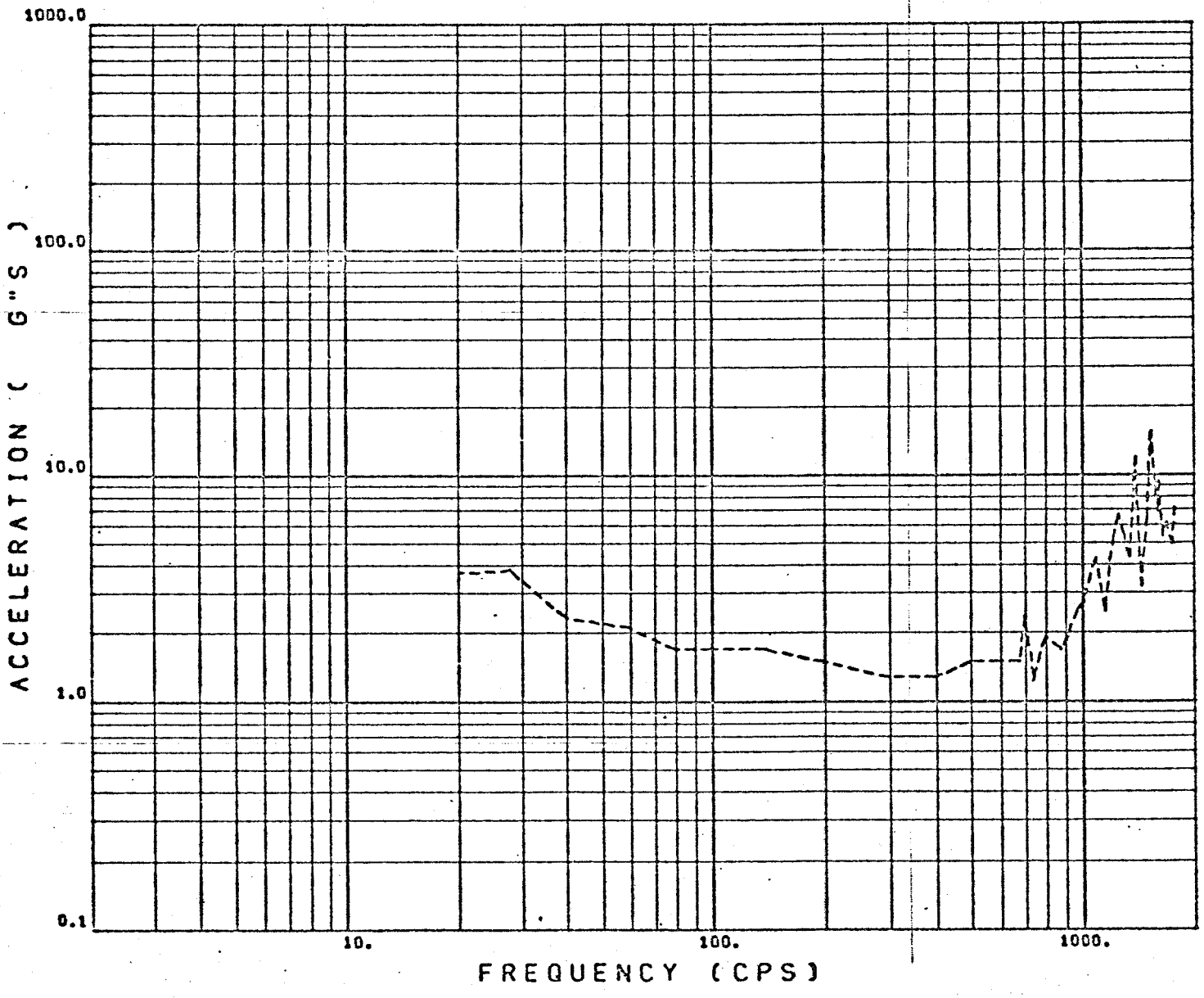


DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A7
REPORT NO. [illegible]

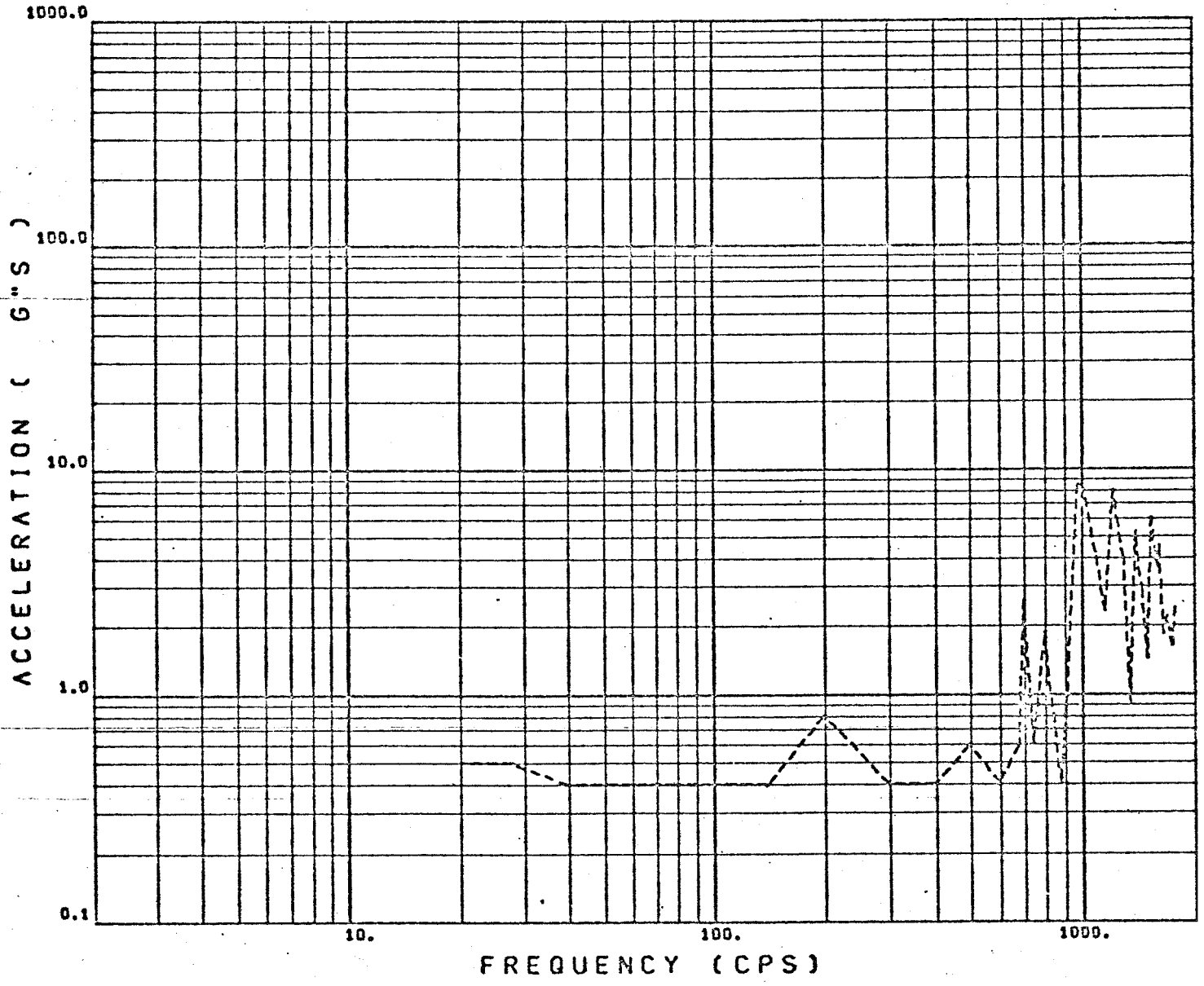
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A7-
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/24/66
AXIS OF EXCITATION.... A
PICK UP NUMBER (7)... 7 HB88
PICK UP RESPONSE..... B
INPUT ACCEL.PER PAGE.. A3



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A10
REPORT NO. R2650-1

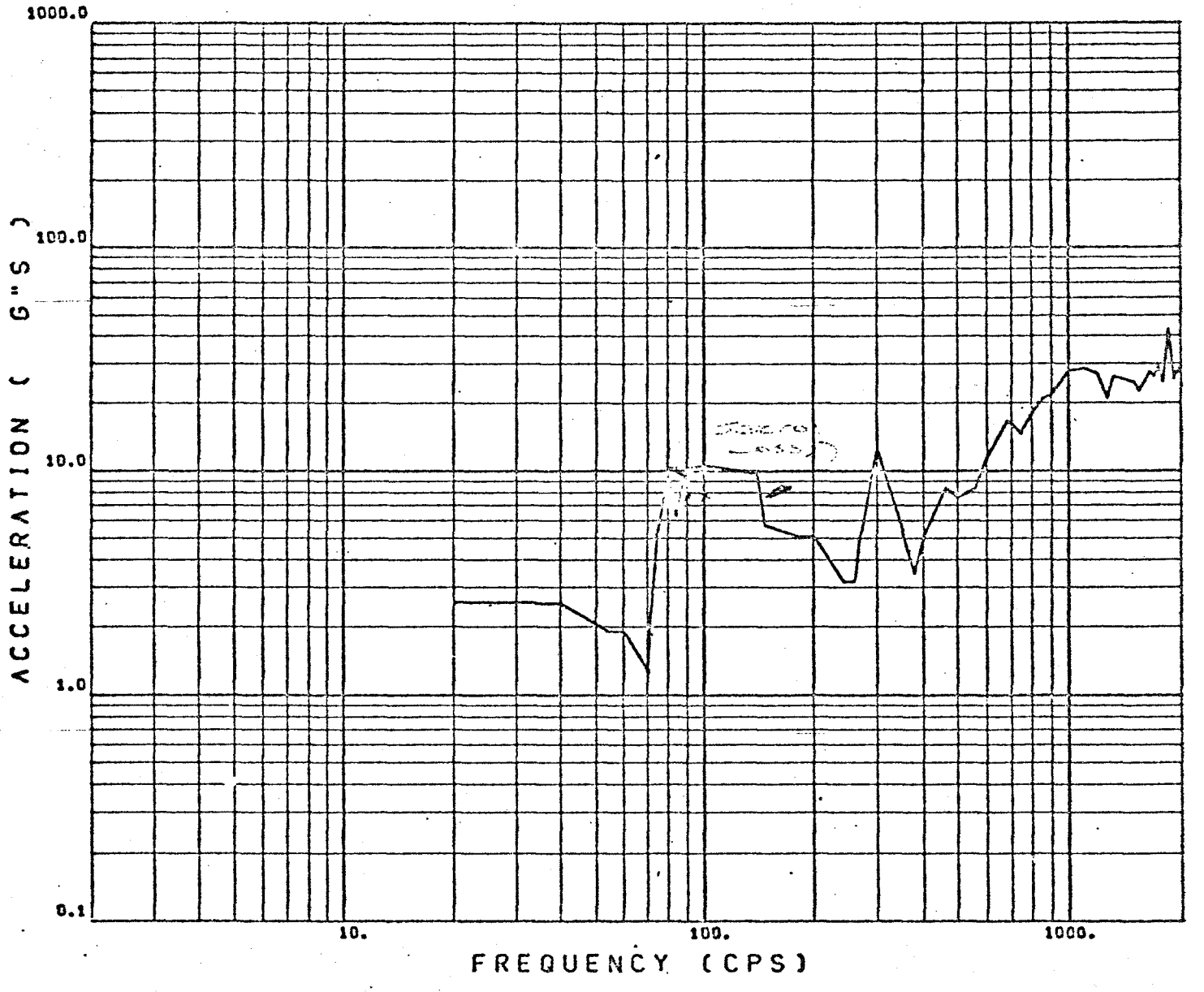
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/18/66
AXIS OF EXCITATION.... B
PICK UP NUMBER (1)... 1 HB88 CONTROL
PICK UP RESPONSE..... B
INPUT ACCEL.PER PAGE.. A10



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PAGE NO. A-11
REPORT NO. [illegible]

SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A-2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/18/66
AXIS OF EXCITATION.... B
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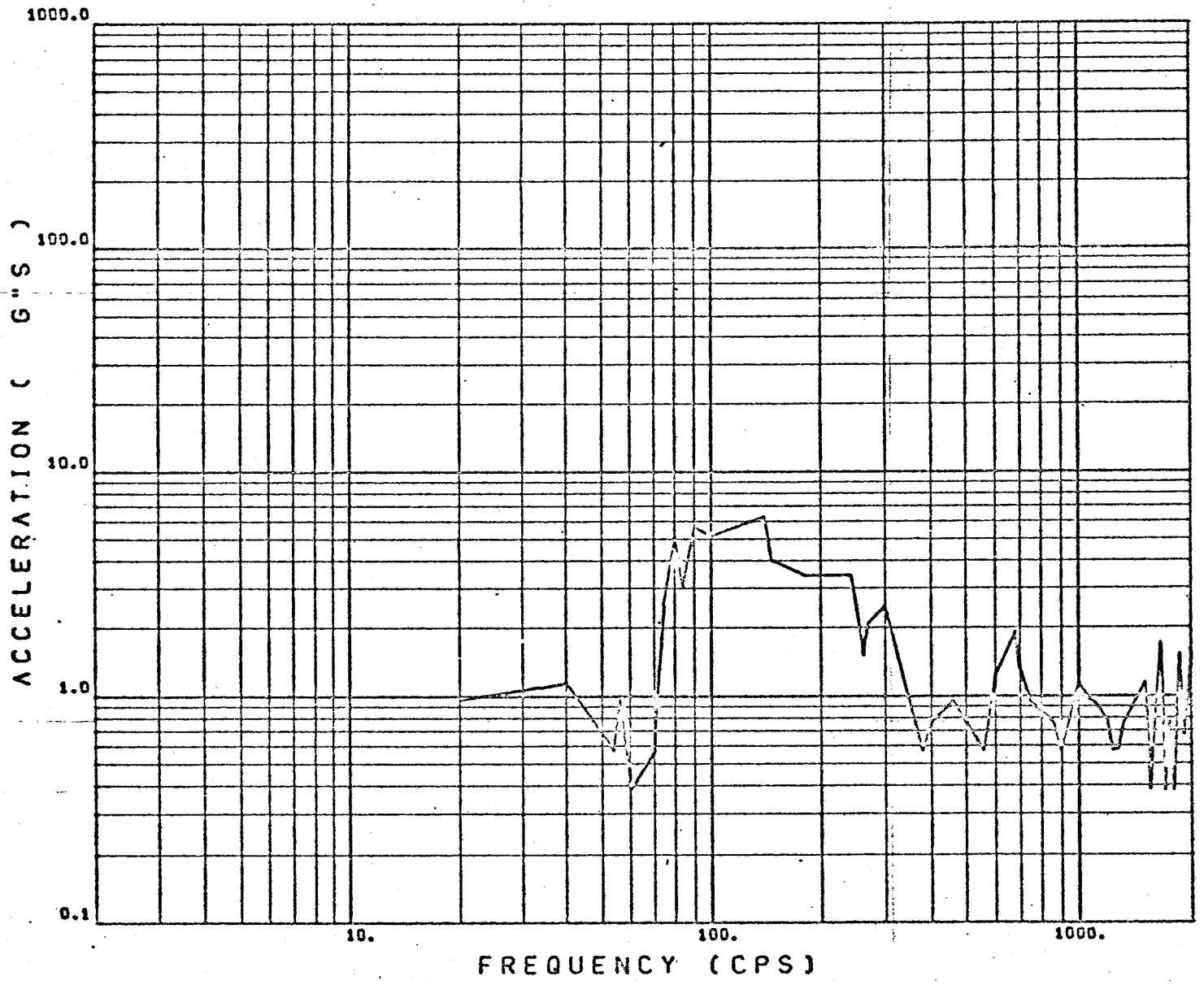

DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A12
REPORT NO. Z-56-SD-1

SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/18/66
AXIS OF EXCITATION.... B
PICK UP NUMBER (3)... 3 FA85
PICK UP RESPONSE..... C
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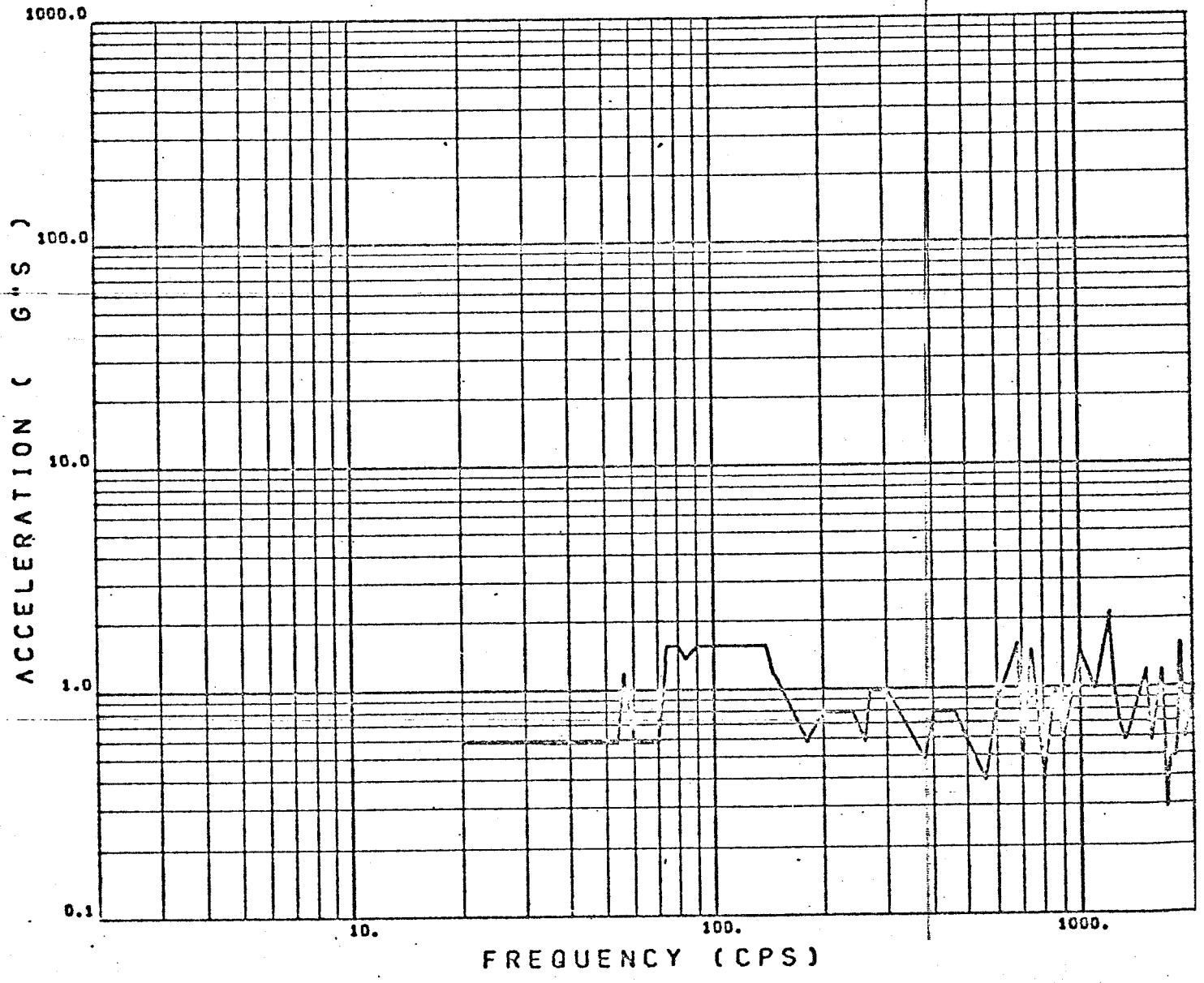

DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A13
REPORT NO. [illegible]

SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/18/66
AXIS OF EXCITATION.... B
PICK UP NUMBER (4)... 4 CC97
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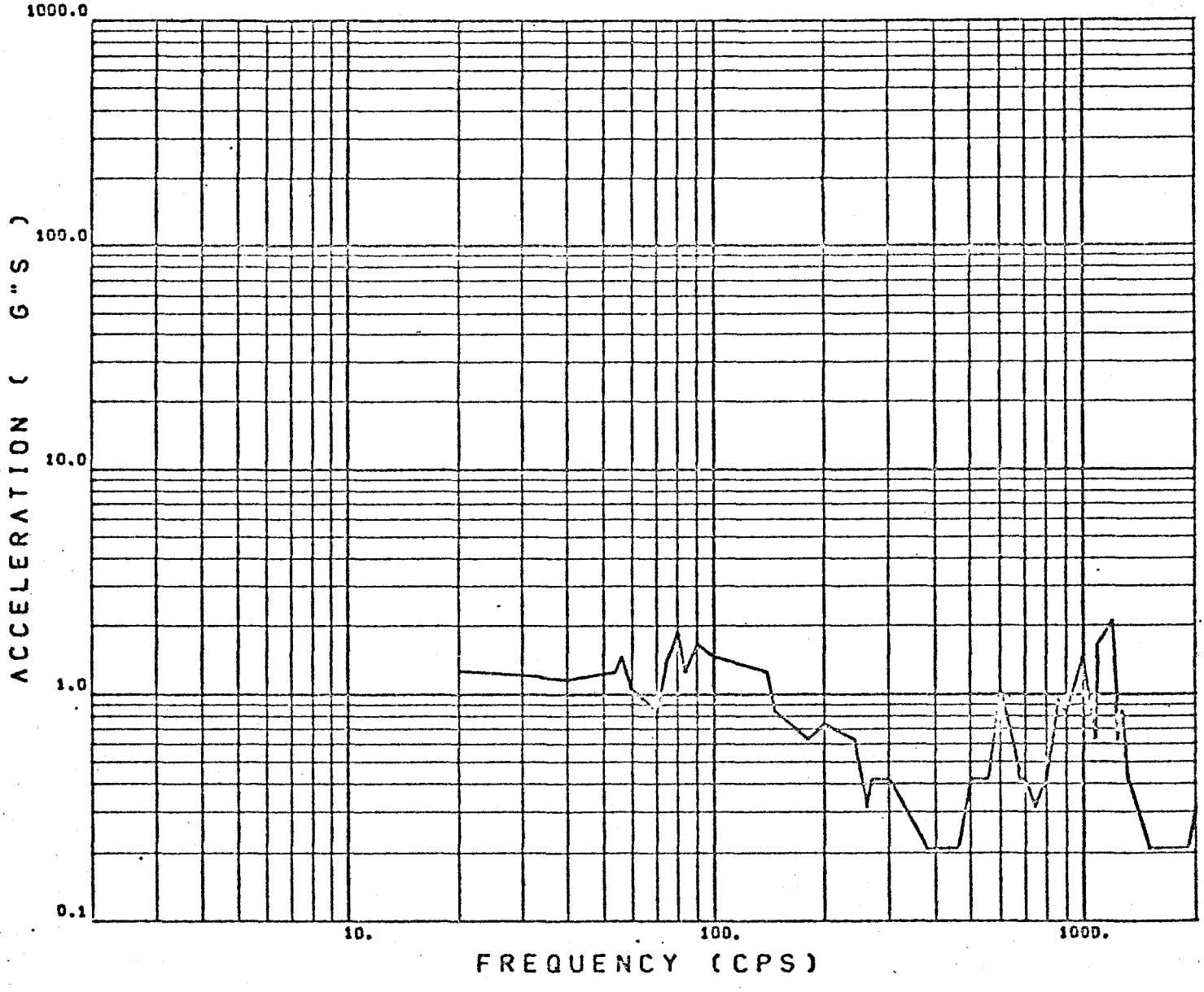

DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A14
REPORT NO. [illegible]

SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....

TEST DATE.....	2/18/66
AXIS OF EXCITATION....	B
PICK UP NUMBER (5)...	5 JC46
PICK UP RESPONSE.....	[illegible]
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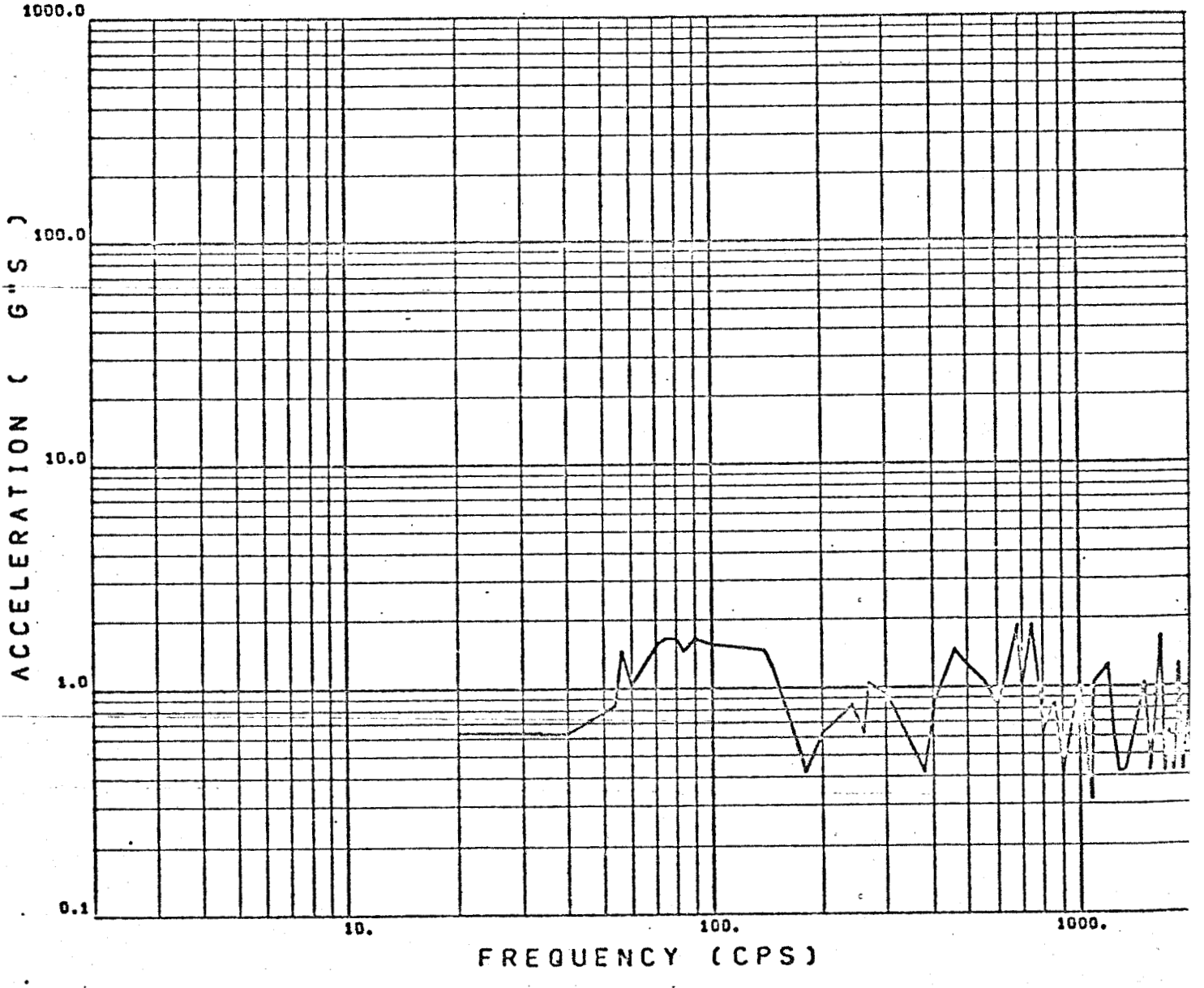


DOUGLAS AIRCRAFT COMPANY , INC.

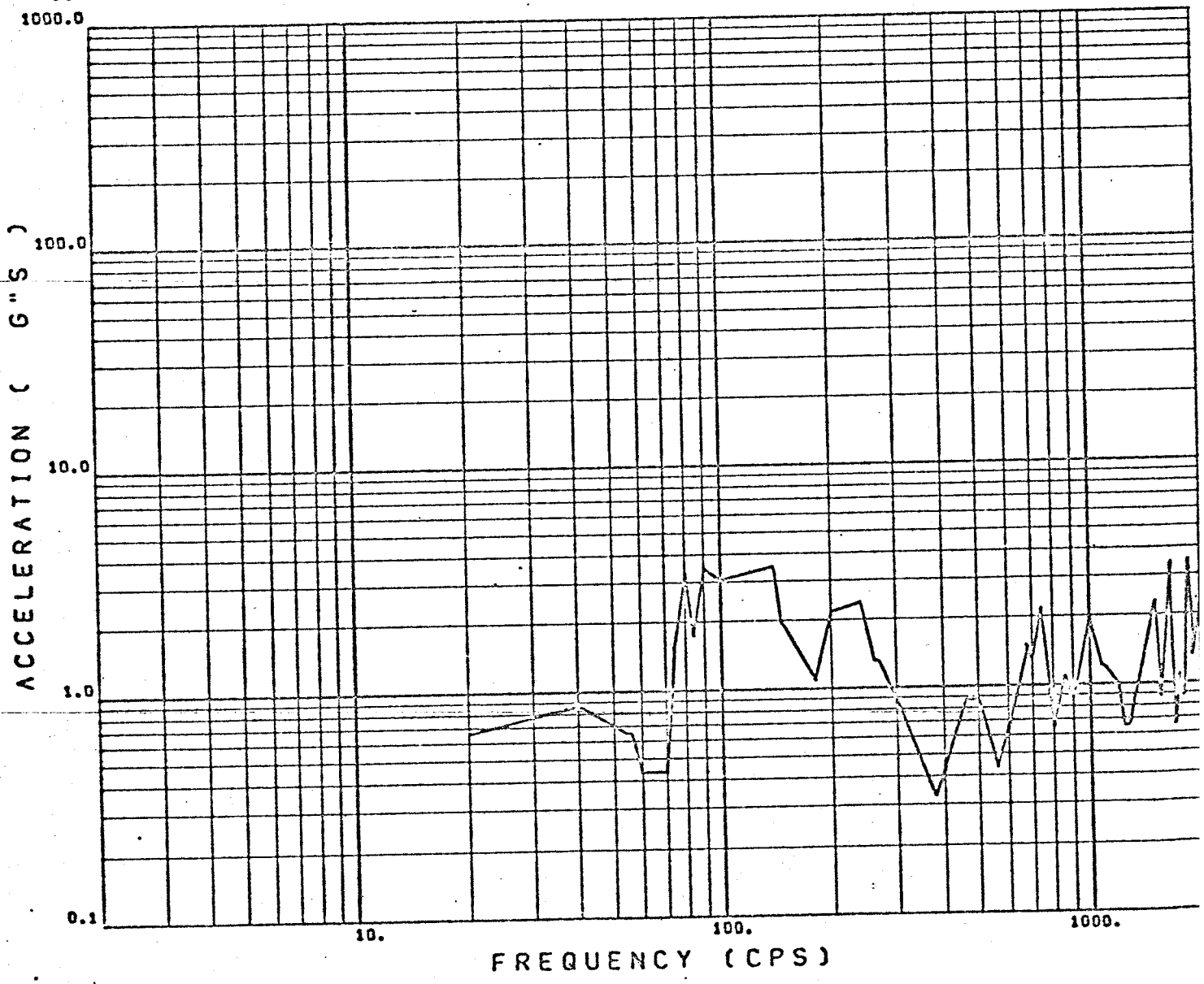
PAGE NO. A15
REPORT NO. R5050-1

SINUSOIDAL FREQUENCY SWEEP
SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/18/66
AXIS OF EXCITATION.... B
PICK UP NUMBER (6)... 6 KA89
PICK UP RESPONSE.....
INPUT ACCEL.PER PAGE.. A10



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. 216
REPORT NO. [illegible]

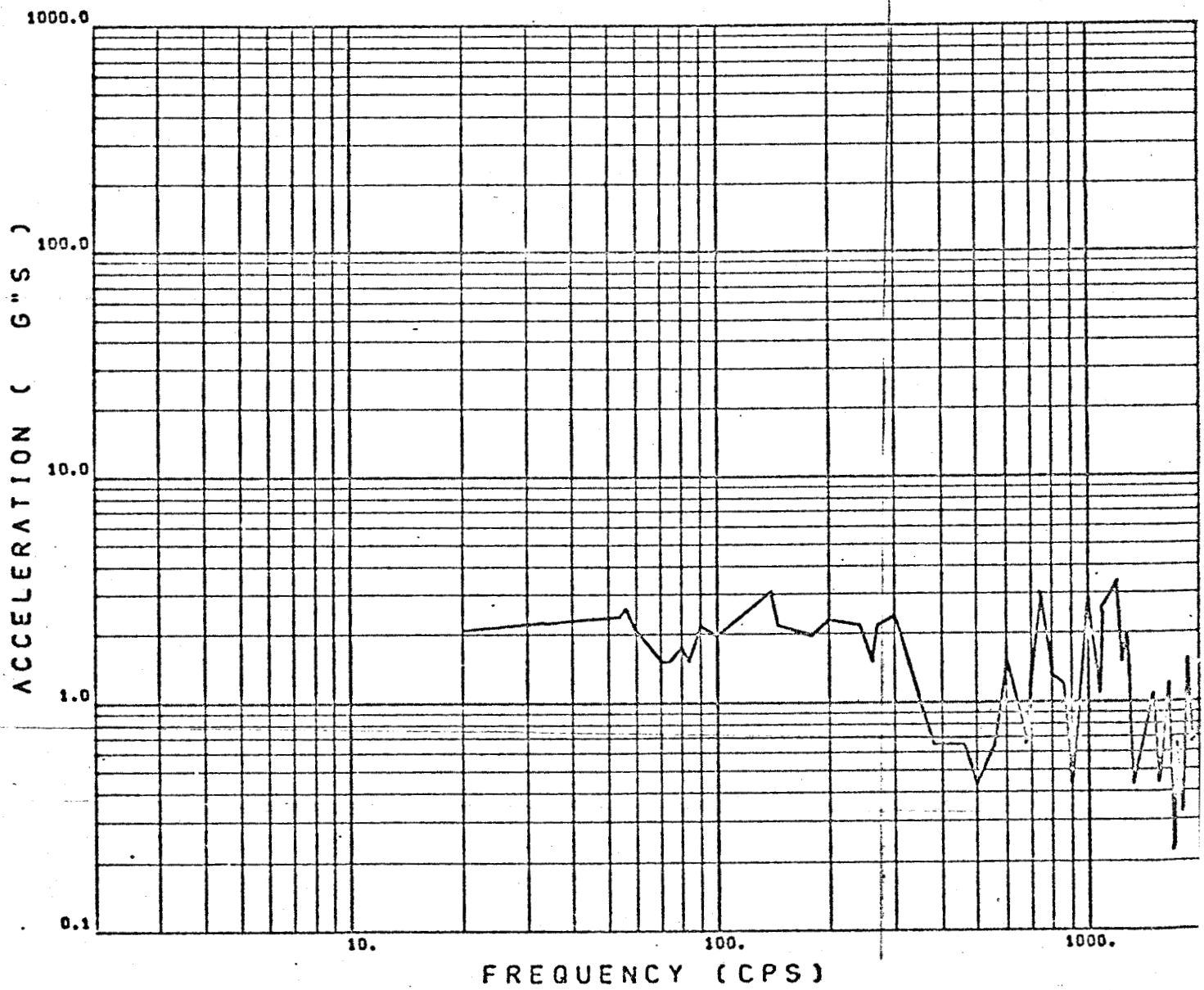
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/18/66
AXIS OF EXCITATION.... B
PICK UP NUMBER (7)... 7 KA90
PICK UP RESPONSE..... B
INPUT ACCEL.PER PAGE.. .015



DOUGLAS AIRCRAFT COMPANY , INC.

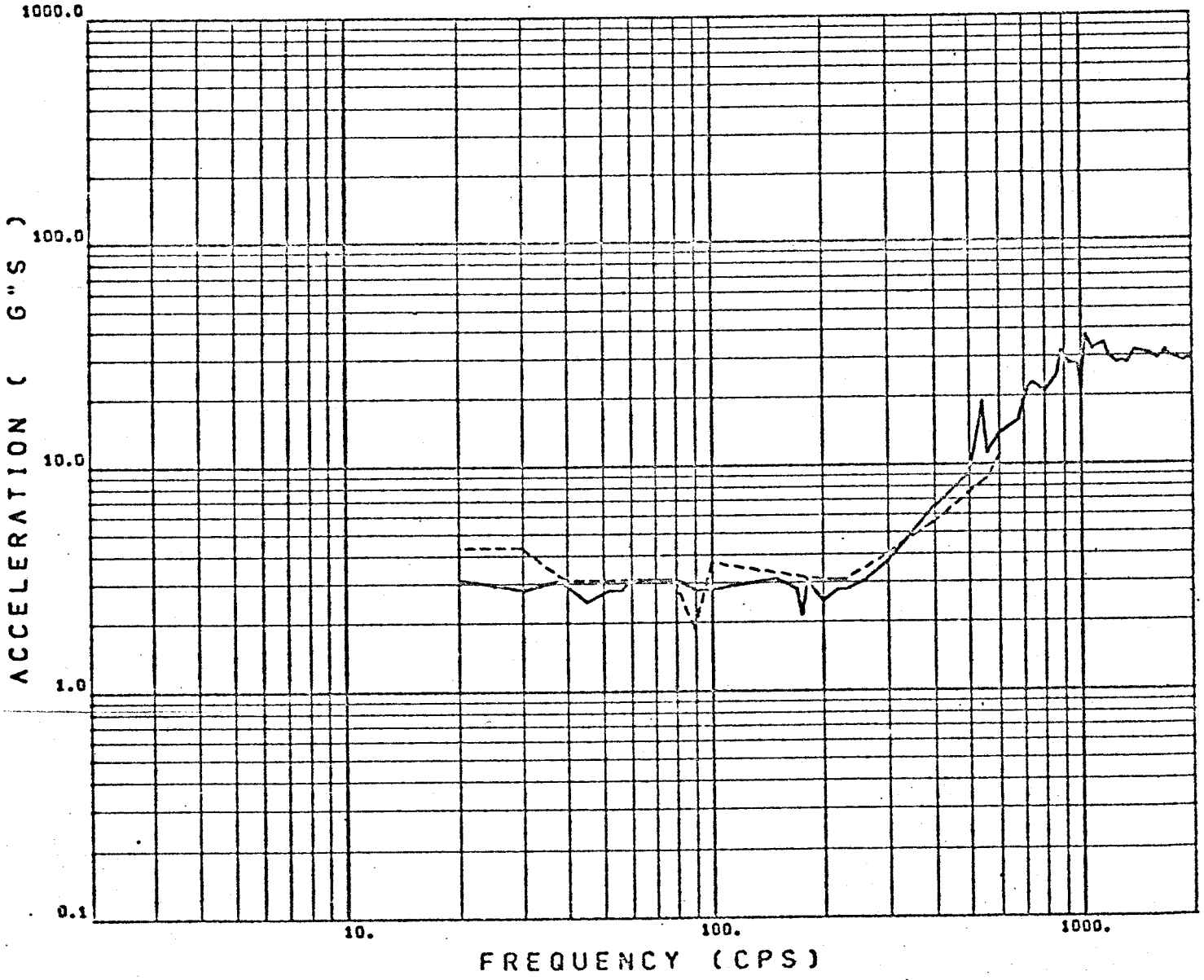
PAGE NO. A17
REPORT NO. [illegible]

SINUSOIDAL FREQUENCY SWEEP
SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/17/66
AXIS OF EXCITATION.... C
PICK UP NUMBER (1)... 1 HB88 CONTROL
PICK UP RESPONSE..... C
INPUT ACCEL.PER PAGE.. A17



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A 12
REPORT NO. [illegible]

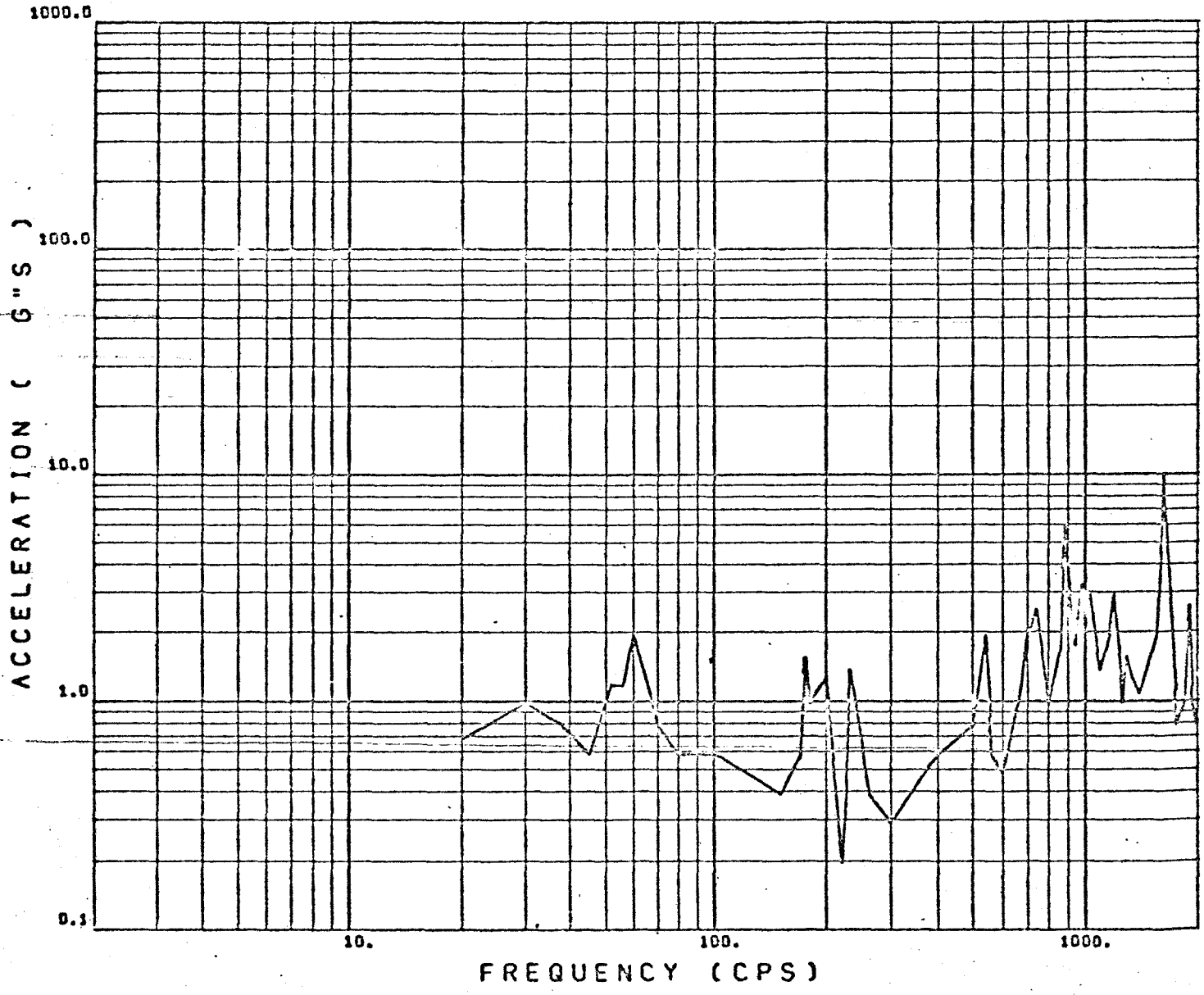
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE [illegible]
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/17/66
AXIS OF EXCITATION.... C
PICK UP NUMBER (2)... 2 LA77
PICK UP RESPONSE..... A
INPUT ACCEL.PER PAGE.. A 17



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A19
REPORT NO. [illegible]

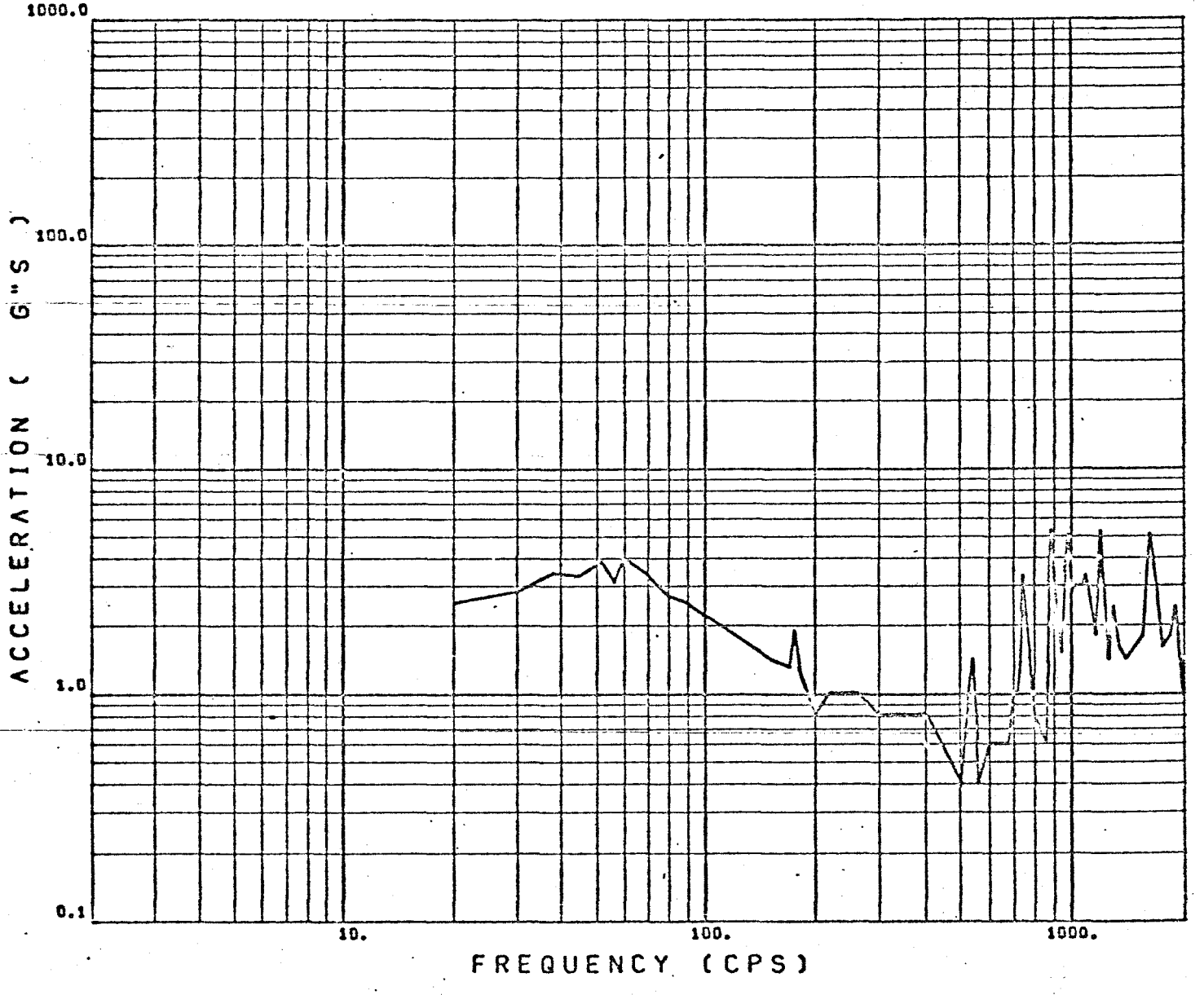
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/17/66
AXIS OF EXCITATION.... C
PICK UP NUMBER (3)... 3 FA85
PICK UP RESPONSE.....
INPUT ACCEL.PER PAGE.. A17



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. [illegible]
REPORT NO. [illegible]

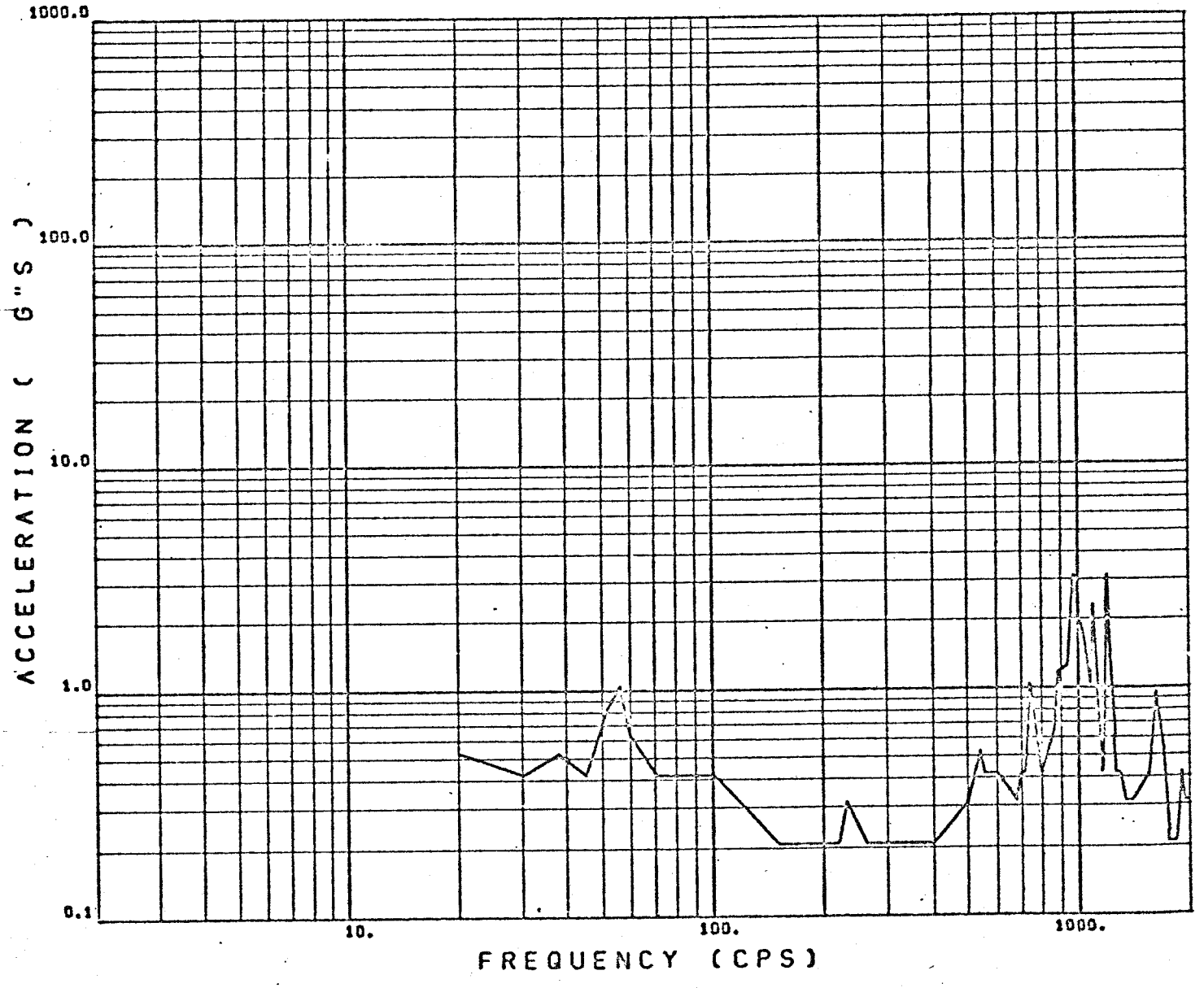
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE [illegible]
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ——
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/17/66
AXIS OF EXCITATION.... C
PICK UP NUMBER (4)... 4 CC97
PICK UP RESPONSE..... [illegible]
INPUT ACCEL.PER PAGE.. [illegible]



DOUGLAS AIRCRAFT COMPANY , INC.

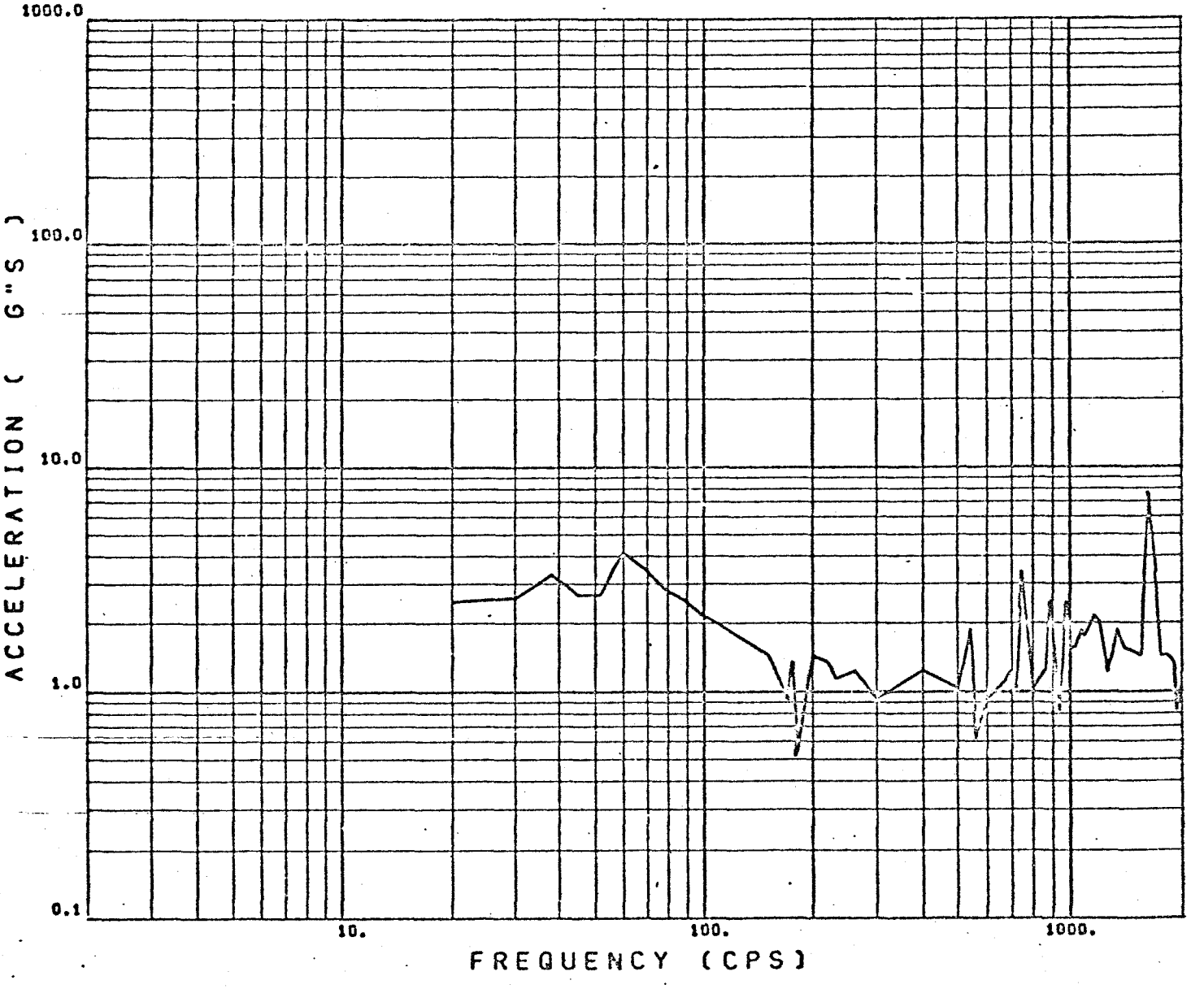
PAGE NO. A21
REPORT NO. R5050-1

SINUSOIDAL FREQUENCY SWEEP
SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/17/66
AXIS OF EXCITATION.... C
PICK UP NUMBER (5)... 5 JC46
PICK UP RESPONSE.....
INPUT ACCEL.PER PAGE.. A17



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A22
REPORT NO. SL-50-1

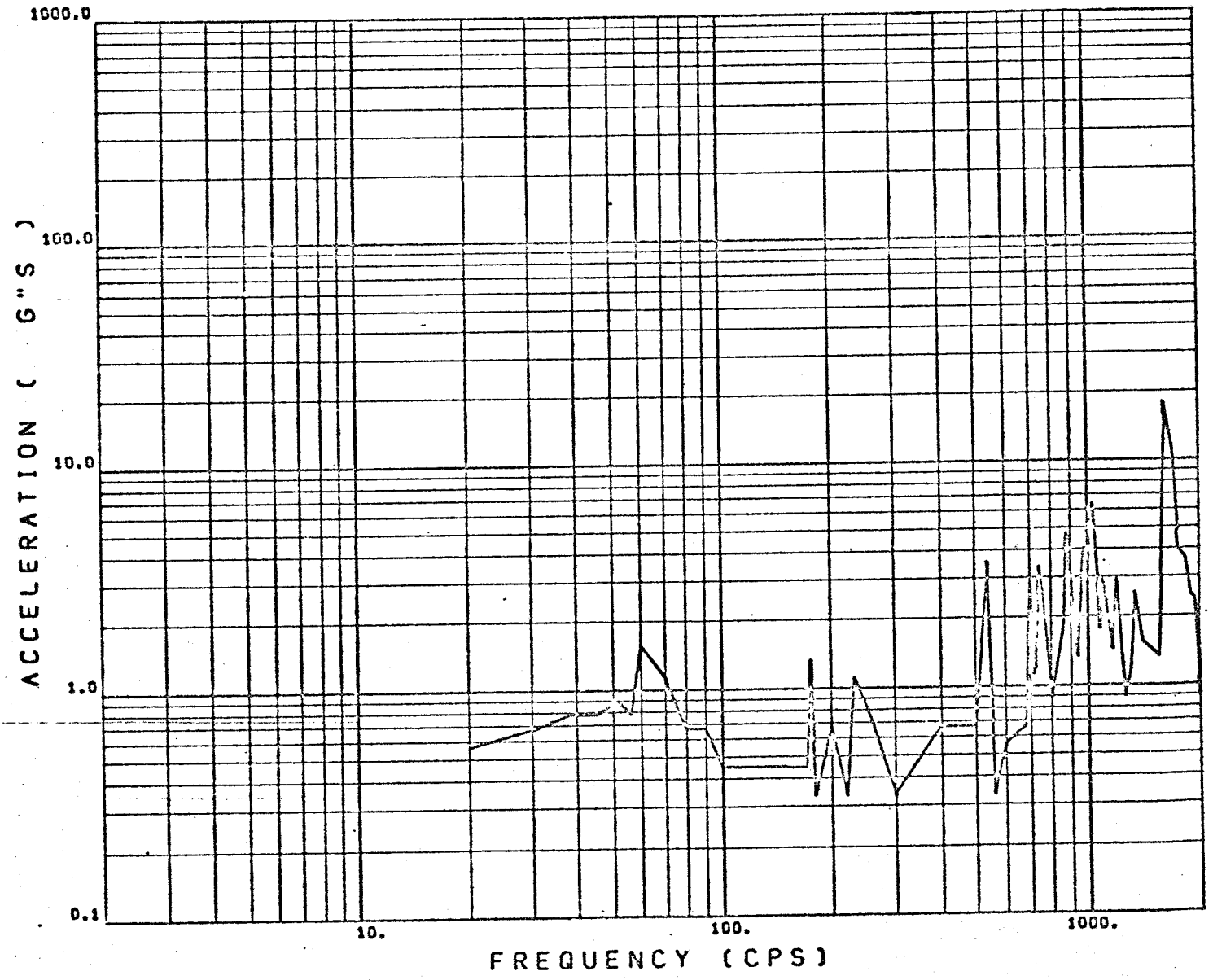
SINUSOIDAL FREQUENCY SWEEP

SIV-B LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (U5L)

CONFIGURATION ---
NOTE... SEE PAGE A23
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 2/17/66
AXIS OF EXCITATION.... C
PICK UP NUMBER (6)... 6 KA89
PICK UP RESPONSE..... A
INPUT ACCEL.PER PAGE.. A17



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. A23
REPORT NO. [illegible]

SINUSOIDAL FREQUENCY SWEEP

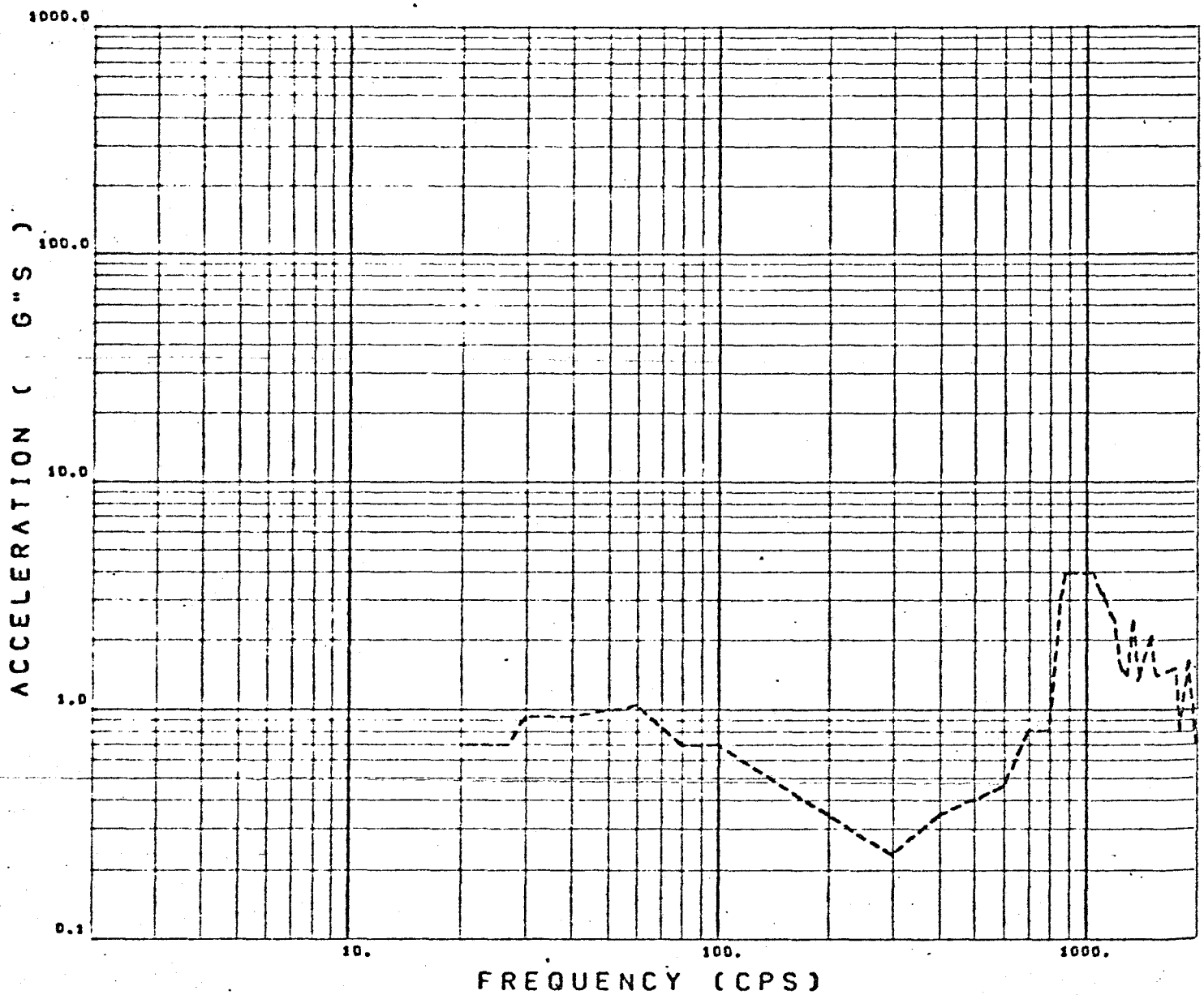
SIV-B LH2 LOW PRESSURE SWITCH

(U5L)

CONFIGURATION ---
NOTE... SEE PAGE A2
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 02/17/66
AXIS OF EXCITATION.... C
PICK UP NUMBER (7)... 7 HB88
PICK UP RESPONSE..... B
INPUT ACCEL.PER PAGE.. A17

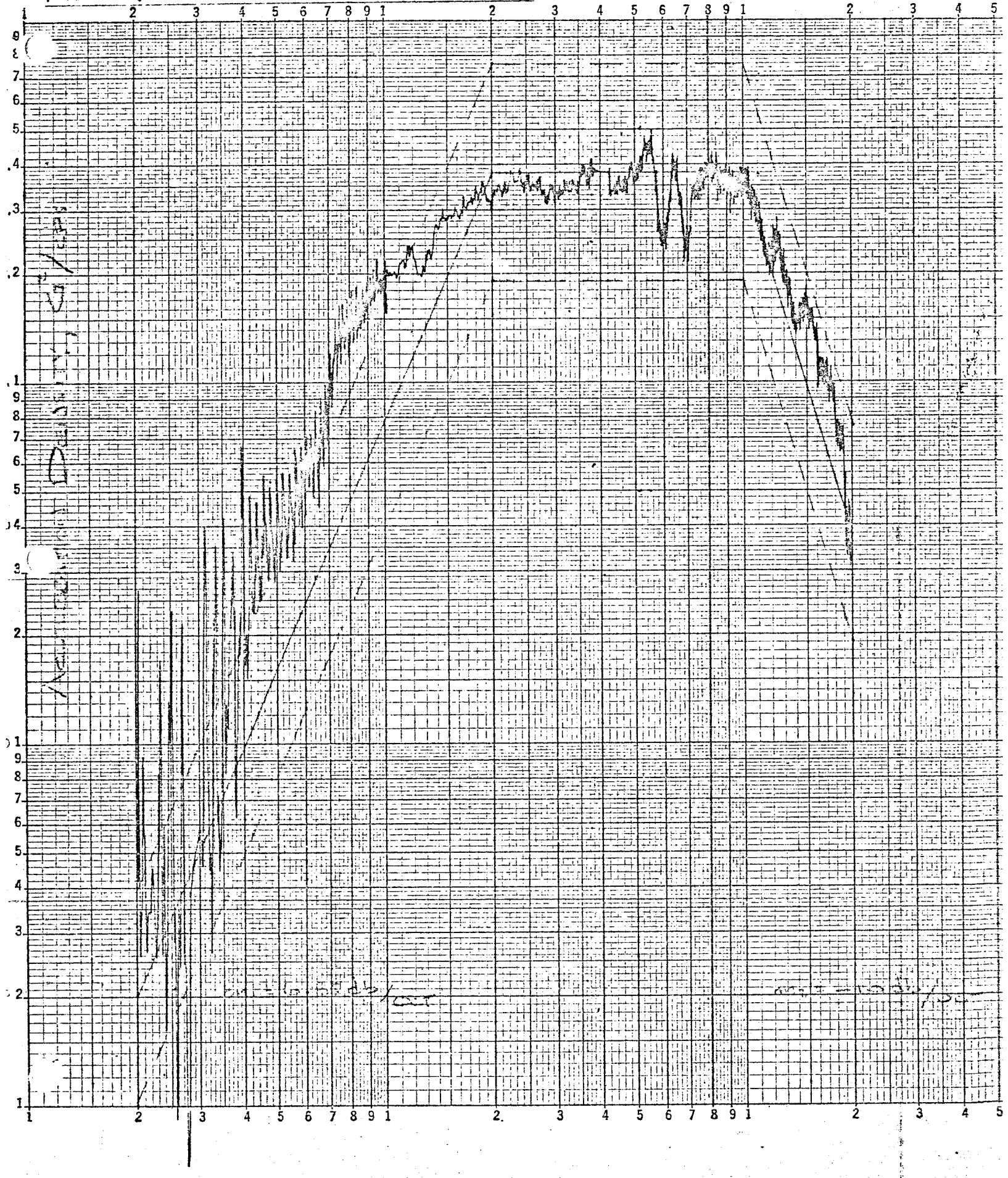


L.Hz Low Pressure Switch, Line 1 Item USL Page A24

Axis: A Feb. 24, 66 Grms = 21.5

Area (20-2000) cps = 21.0 Grms

Report No. R5050-1



DSV-4B RANDOM VIBRATION TEST

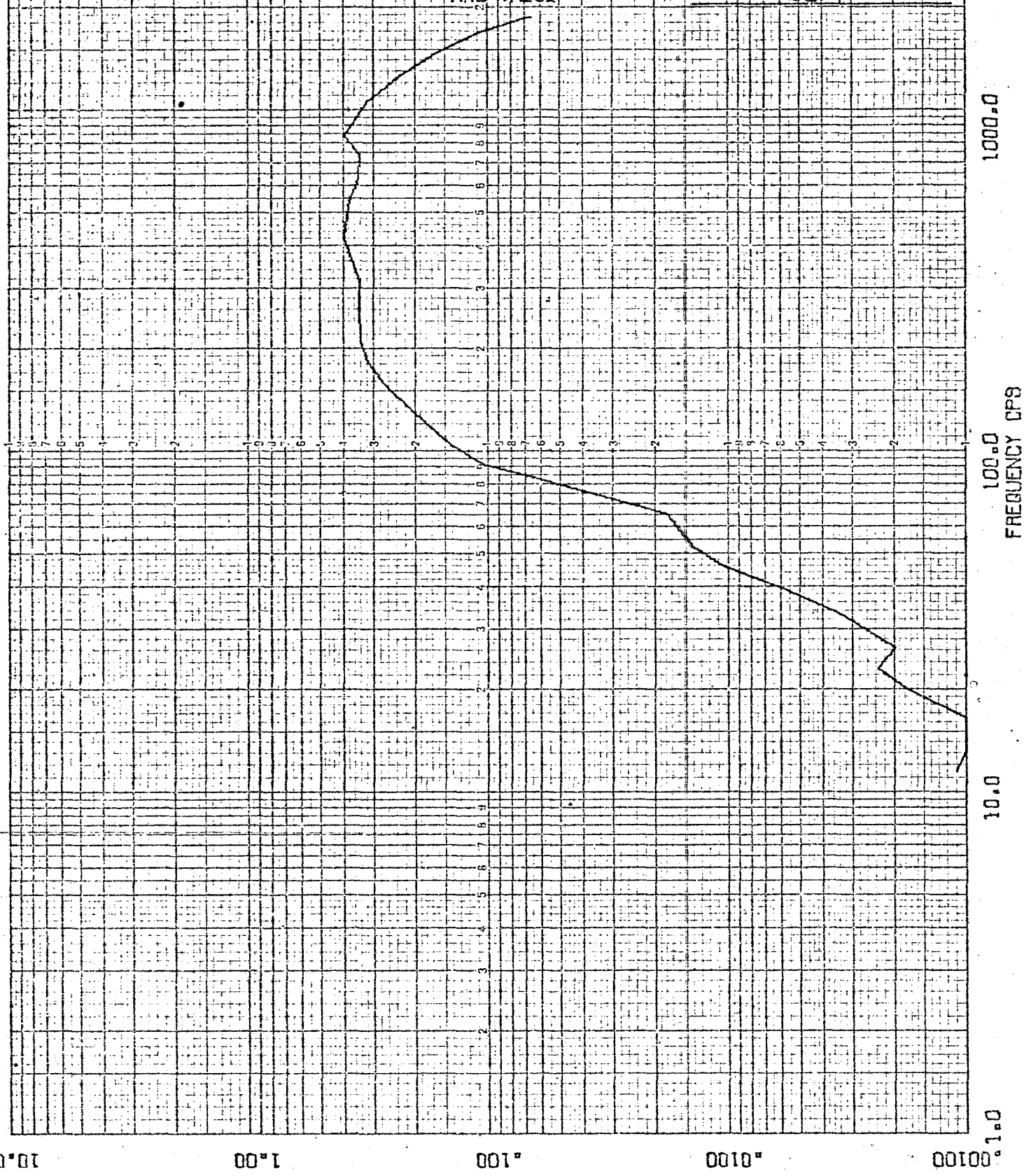
LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK UP LOCATION

TEST CONDITIONS

TEST DATE	2-17-66
AXIS OF EXCITATION	A
PICK-UP NUMBER	1
PICK-UP RESPONSE	A CONTROL
INPUT ACCELERATION PER PAGE	A25
RMS VALUE	22.9



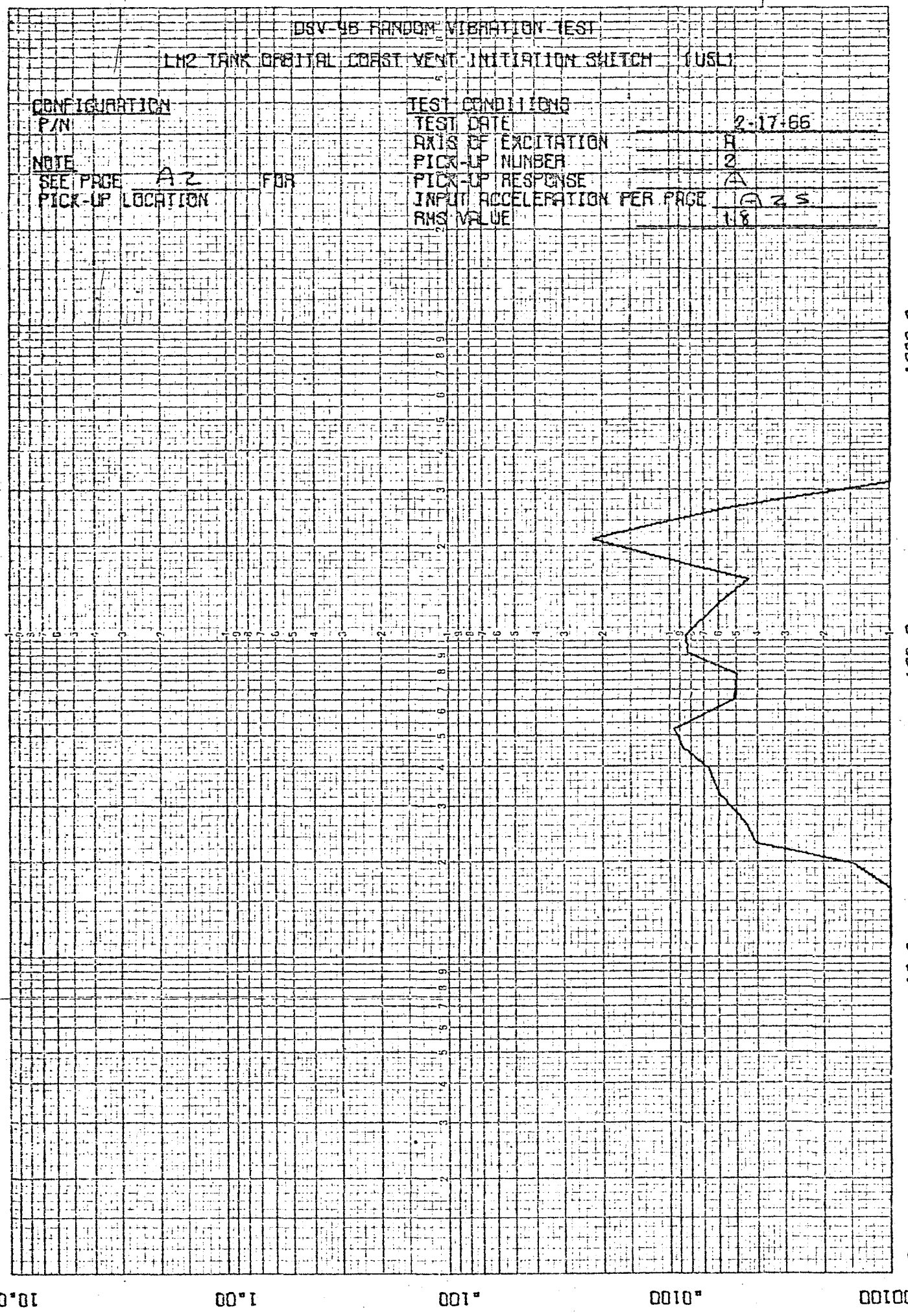
DSV-4B RANDOM VIBRATION TEST

LM2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION A
PICK-UP NUMBER 2
PICK-UP RESPONSE A
INPUT ACCELERATION PER PAGE A2S
RMS VALUE 1.8



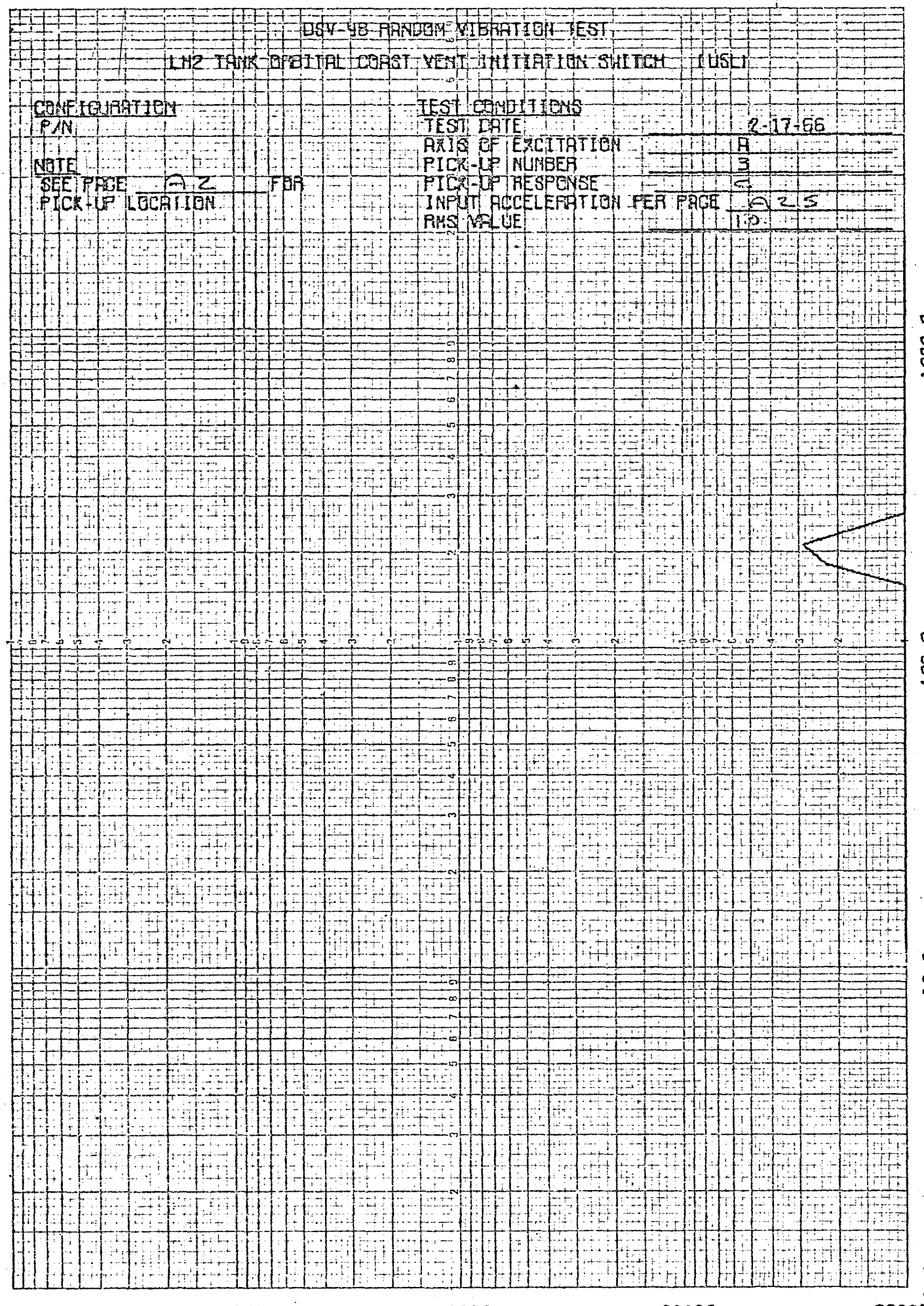
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION A
PICK-UP NUMBER 3
PICK-UP RESPONSE A
INPUT ACCELERATION PER PAGE A25
RMS VALUE 1.0



DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

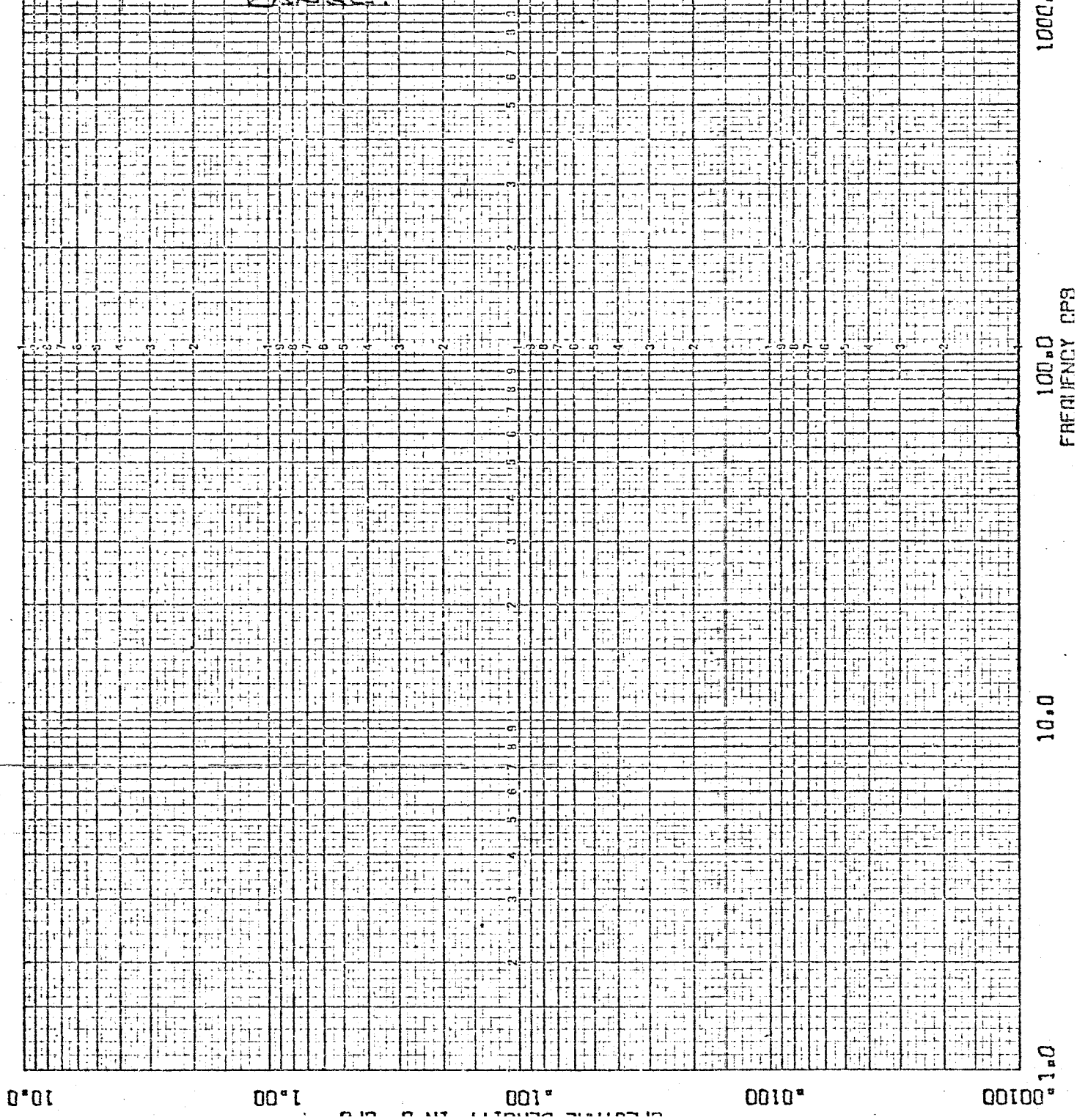
CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	2-17-66
AXIS OF EXCITATION	A
PICK-UP NUMBER	4
PICK-UP RESPONSE	B
INPUT ACCELERATION PER PAGE	A25
RMS VALUE	0.3

NOTE: ACCELERATION DENSITY LEVEL DOWN IN THE SYSTEM NOISE RANGE.



DSV-4B RANDOM VIBRATION TEST

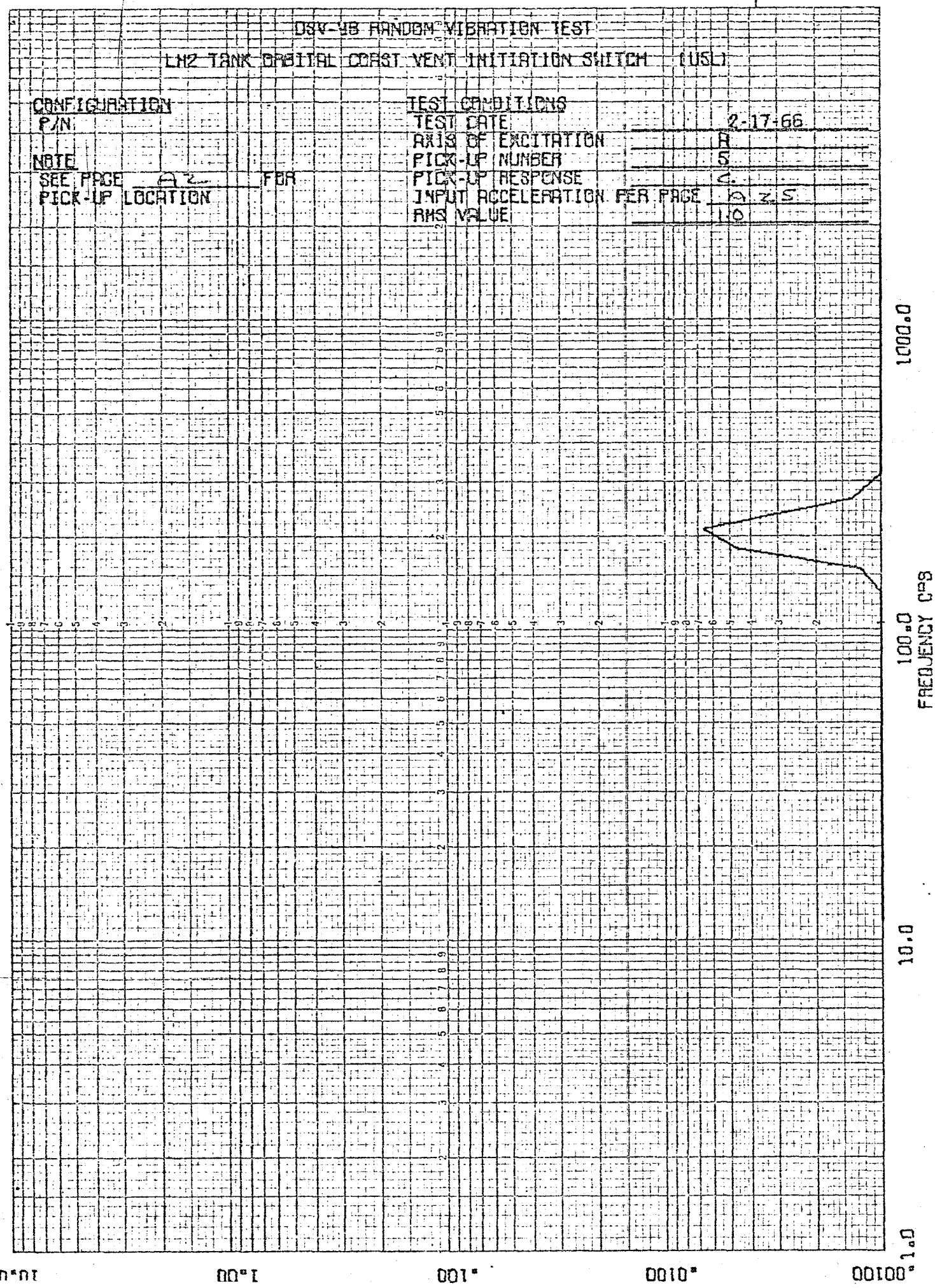
LM2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	2-17-66
AXIS OF EXCITATION	A
PICK-UP NUMBER	5
PICK-UP RESPONSE	G.
INPUT ACCELERATION PER PAGE	A25
RMS VALUE	1.0



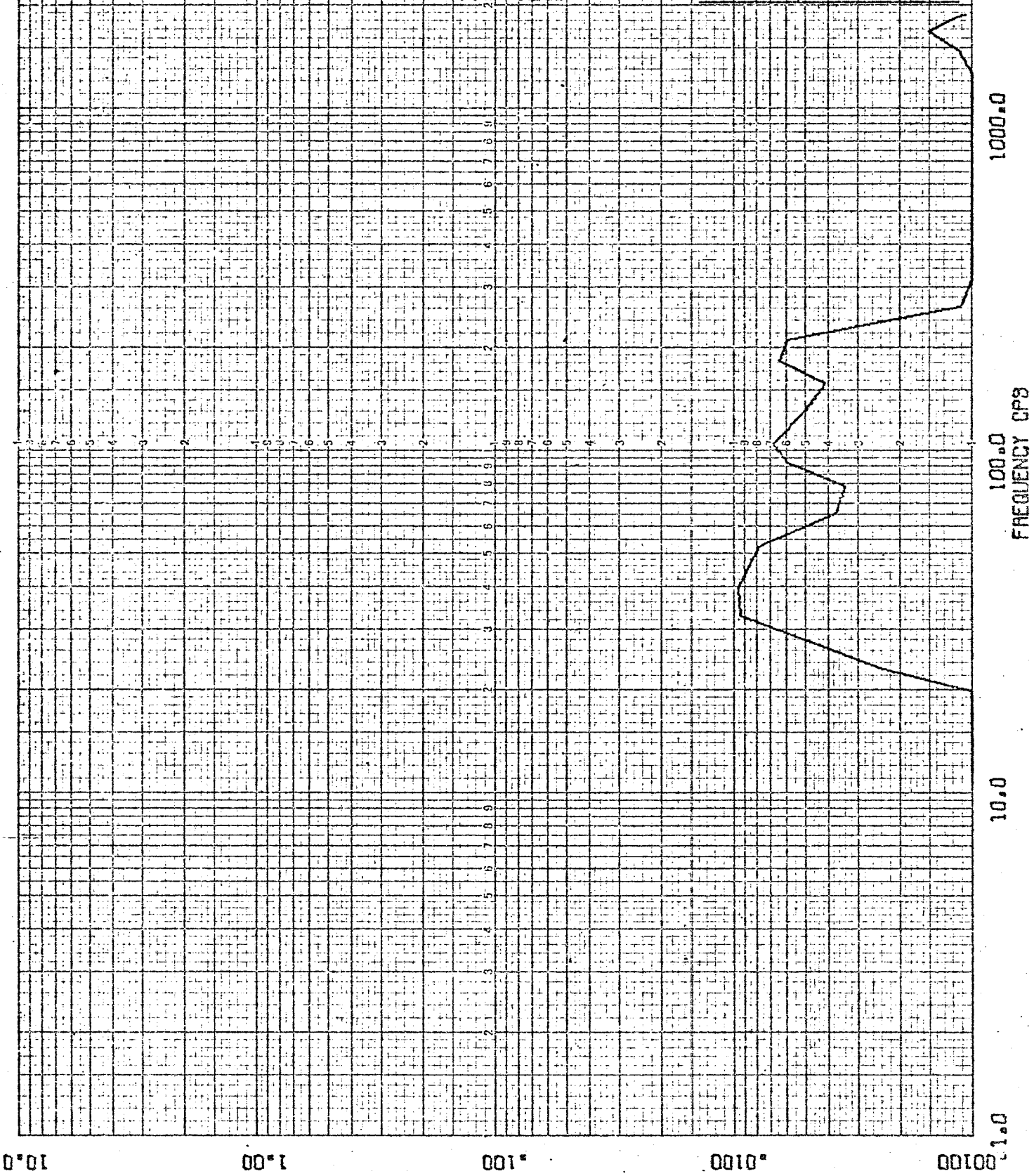
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION R
PICK-UP NUMBER 6
PICK-UP RESPONSE A
INPUT ACCELERATION PER PAGE A25
RMS VALUE 16



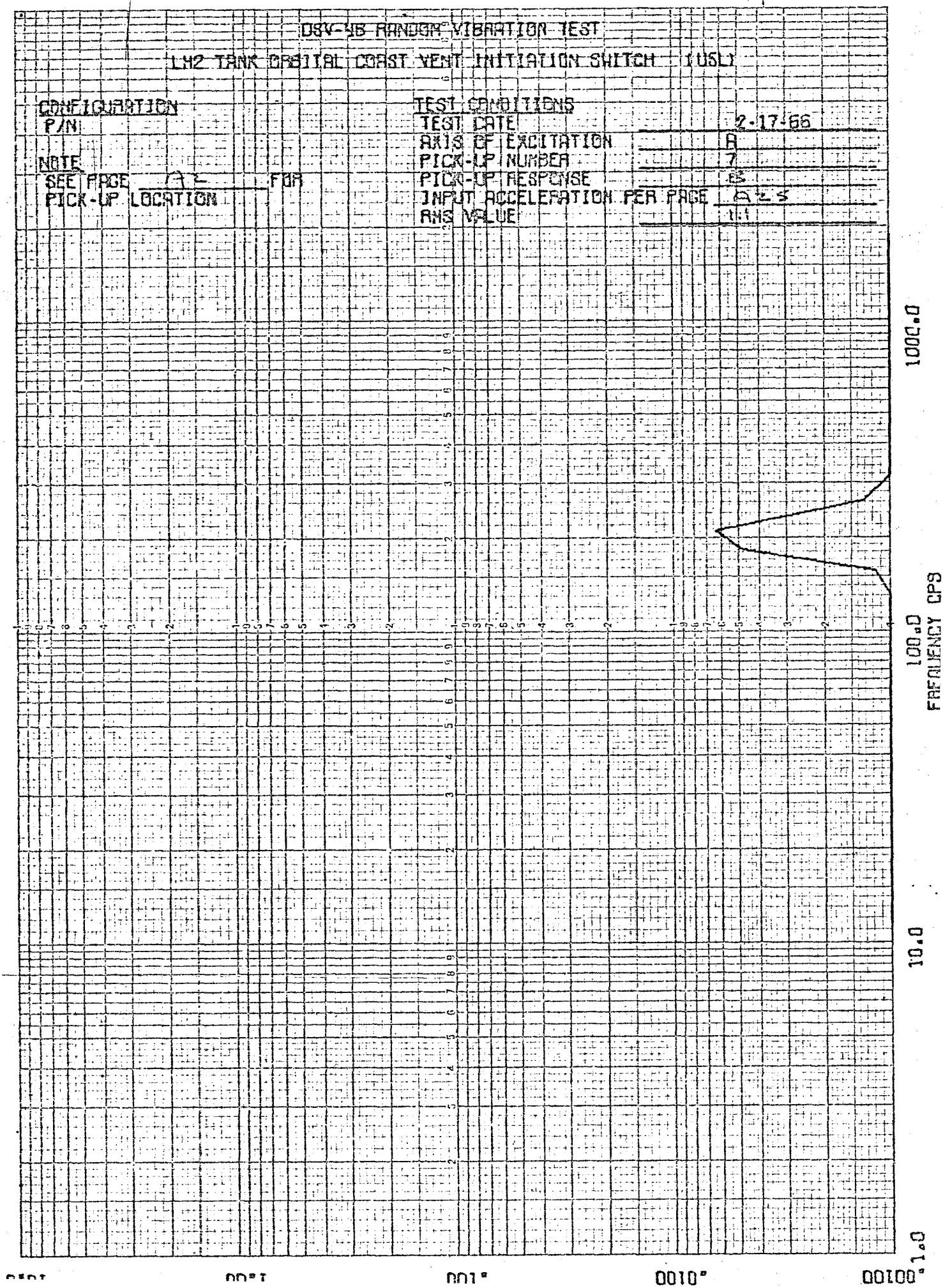
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A 2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION A
PICK-UP NUMBER 7
PICK-UP RESPONSE
INPUT ACCELERATION PER PAGE A 2 5
RMS VALUE

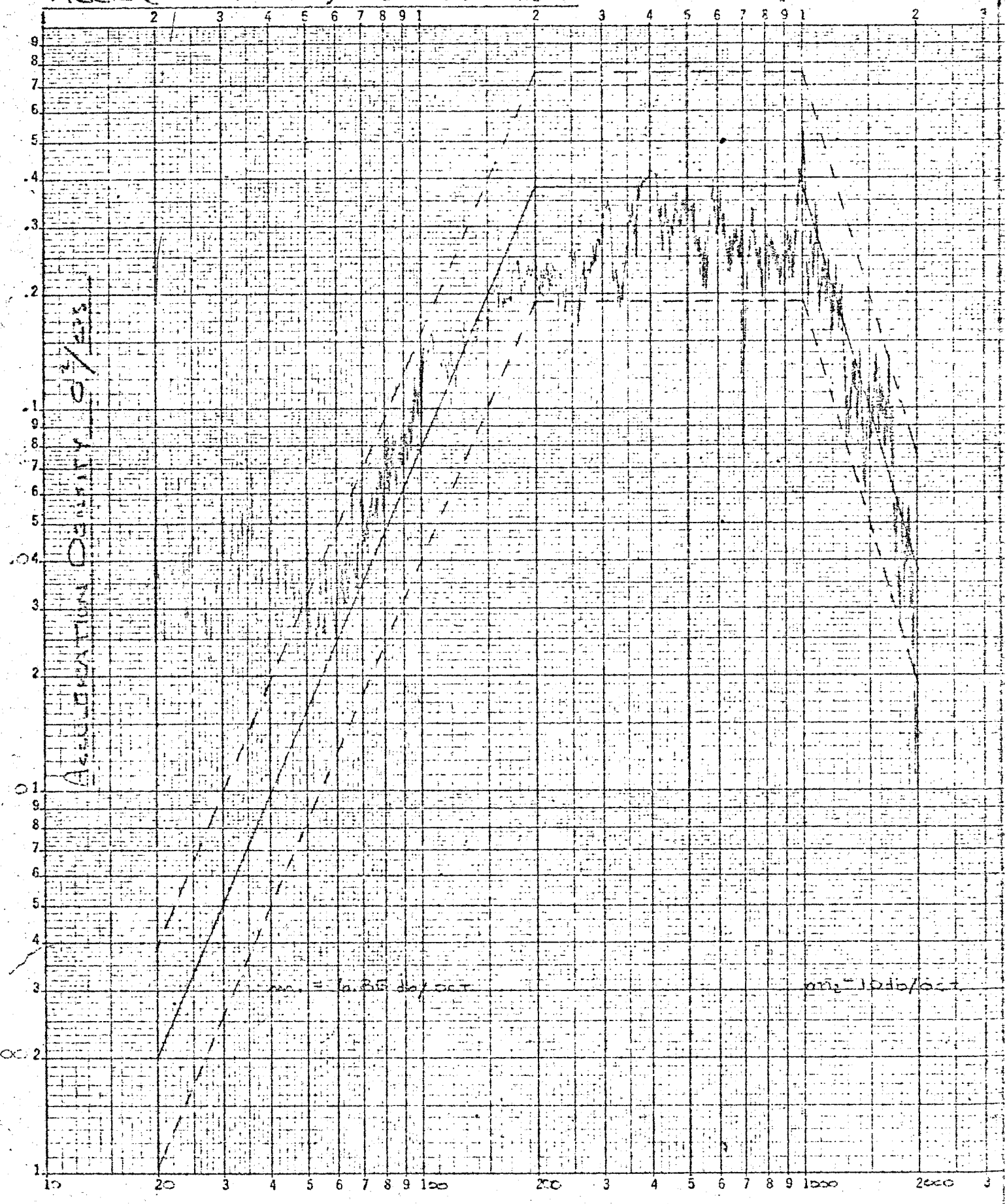


LH2 LOW PRESSURE [illegible]

AXIS: B FEB. 24, 66 GRMS = 21.5

REPORT NO. 5050[illegible]

AREA (20 - 2000) CPS = 21.0 GRMS



108V-9B RANDOM VIBRATION TEST

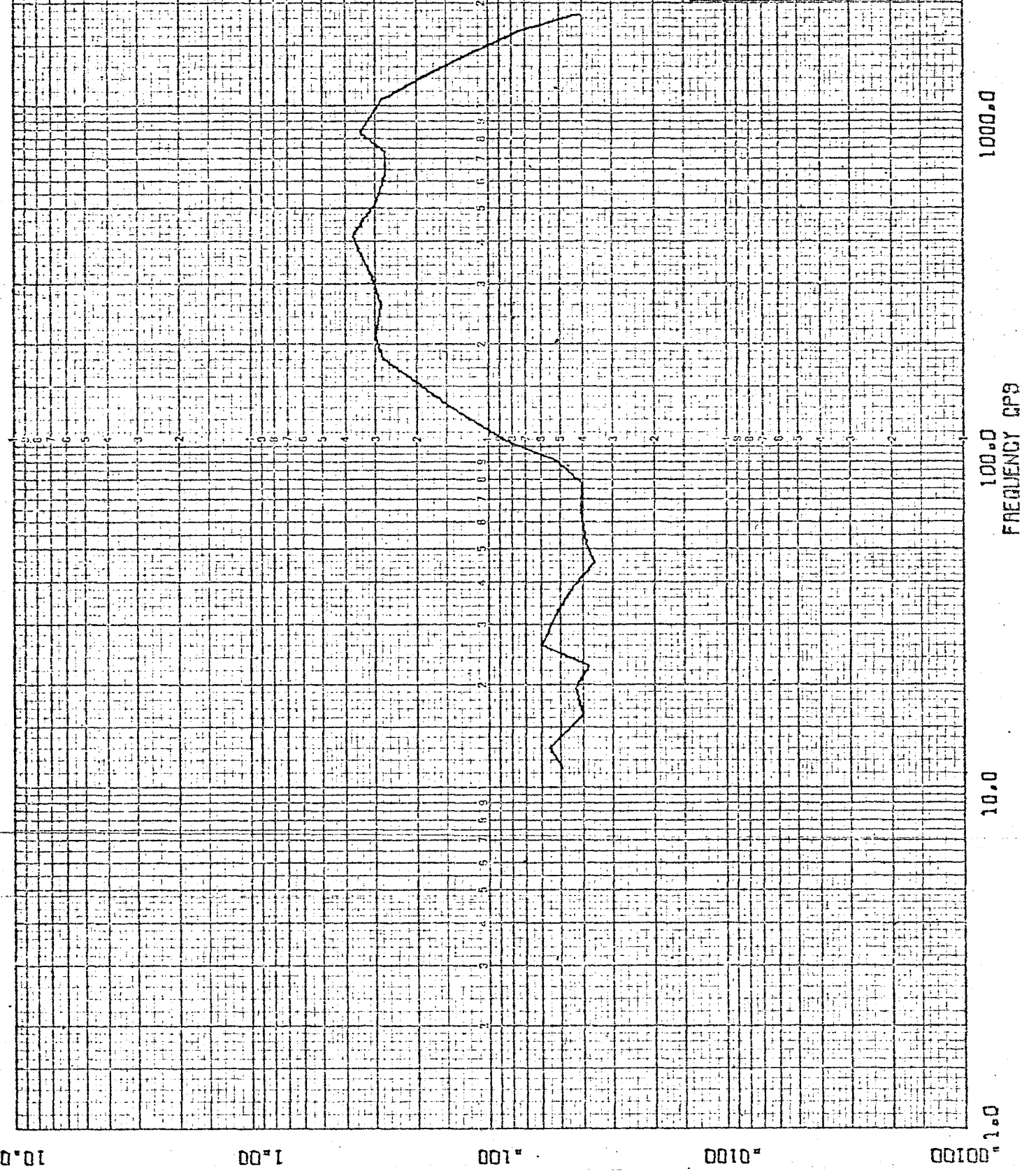
LM2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	2-17-66
AXIS OF EXCITATION	B
PICK-UP NUMBER	1
PICK-UP RESPONSE	B, CONTROL
INPUT ACCELERATION PER PAGE	A3B
RMS VALUE	20.8



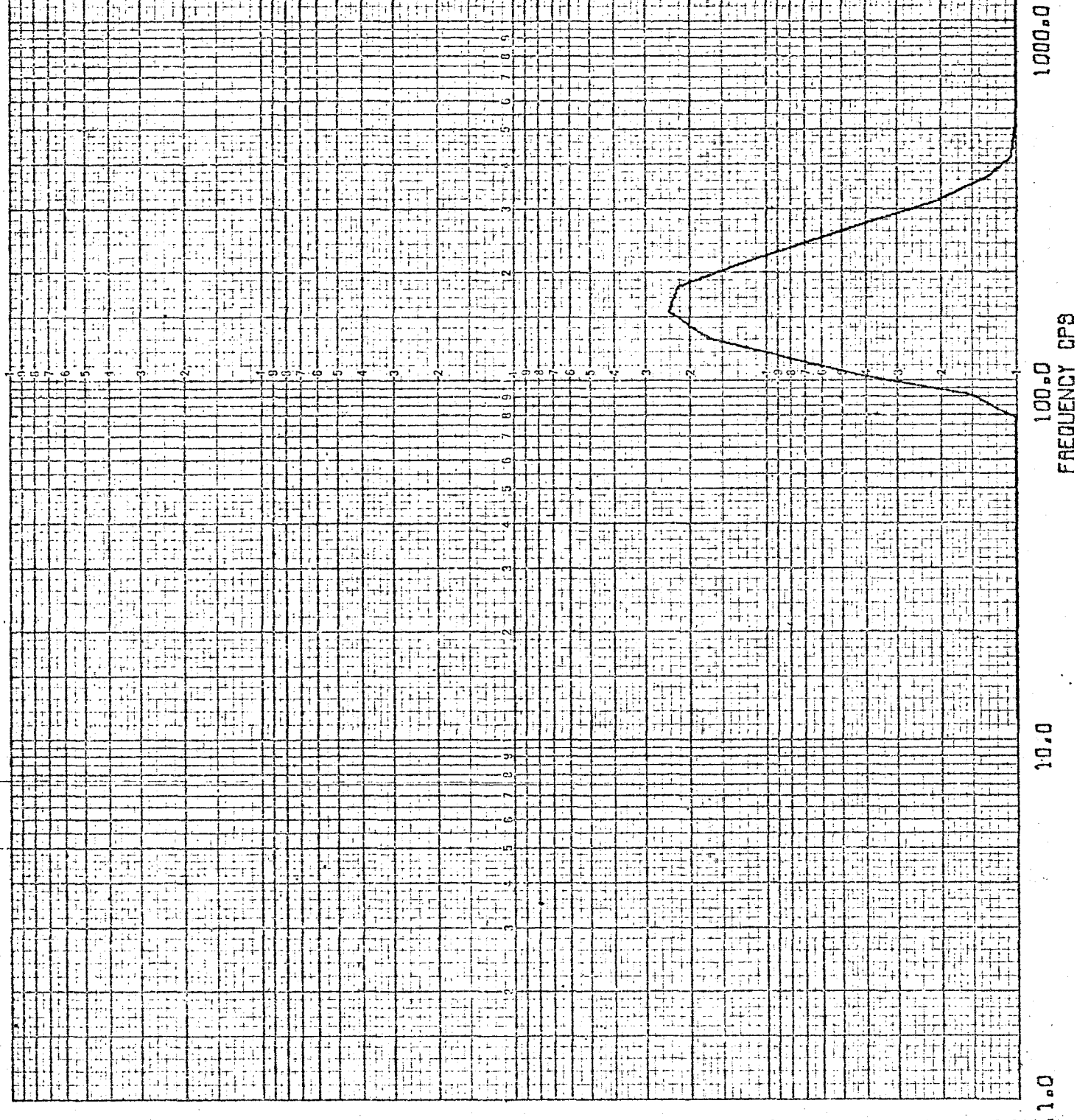
DSV-4B RANDOM VIBRATION TEST

LN2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A-2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION B
PICK-UP NUMBER 2
PICK-UP RESPONSE A
INPUT ACCELERATION PER PAGE A-3
RMS VALUE 1.8



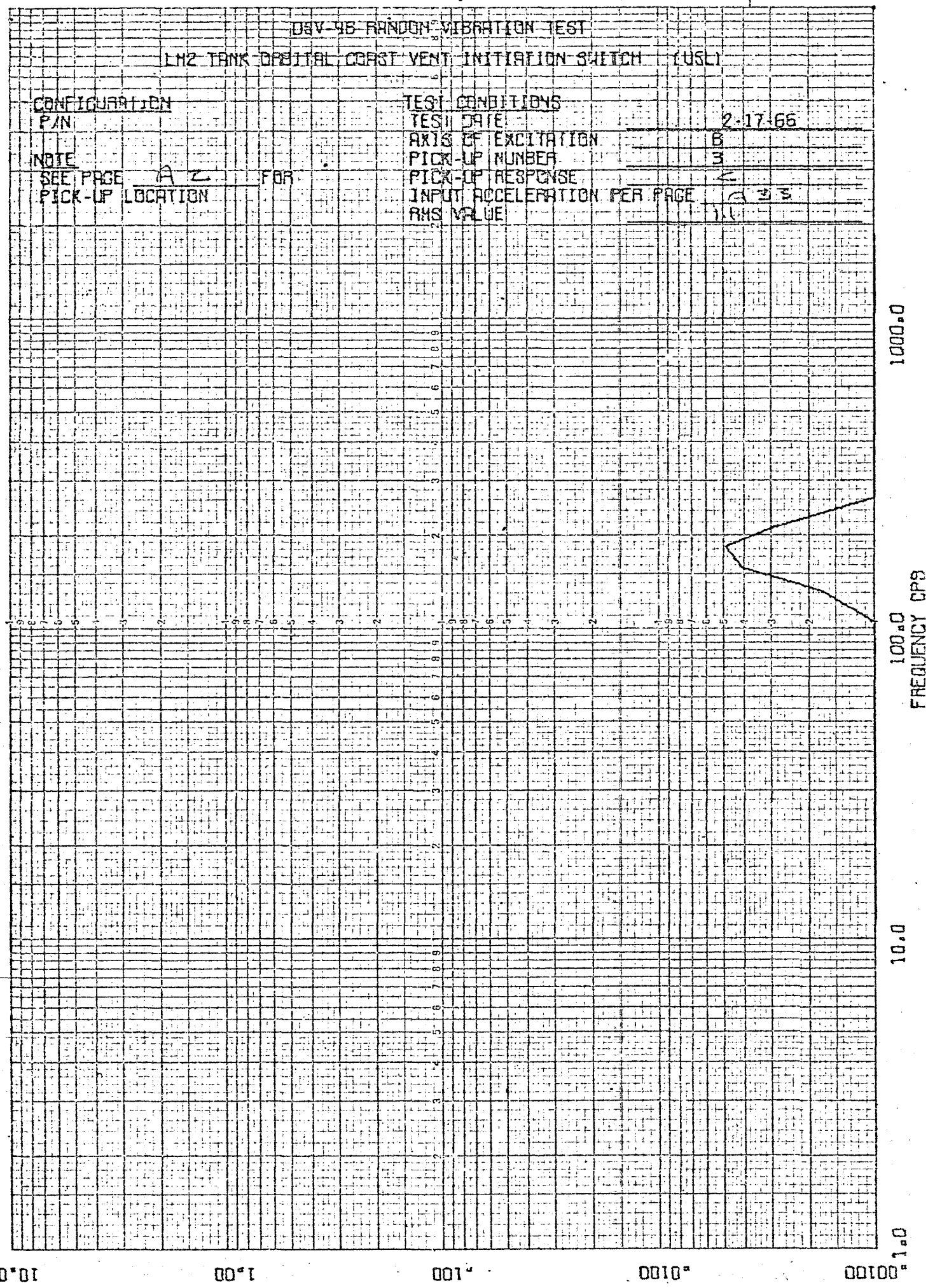
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION B
PICK-UP NUMBER 3
PICK-UP RESPONSE Z
INPUT ACCELERATION PER PAGE A33
RMS VALUE 11.1



DSV-4B RANDOM VIBRATION TEST

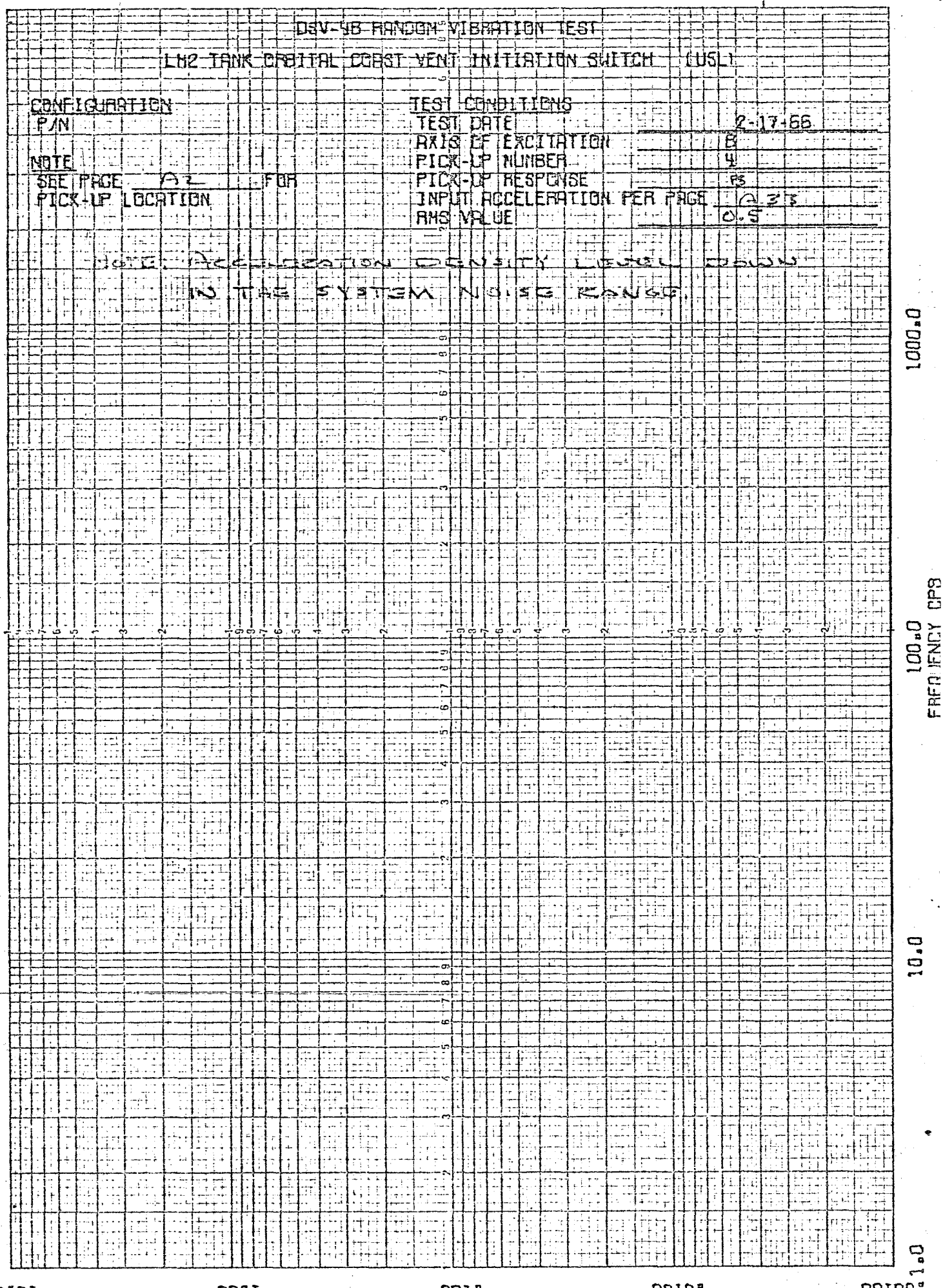
LN2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION B
PICK-UP NUMBER 4
PICK-UP RESPONSE RS
INPUT ACCELERATION PER PAGE A33
RMS VALUE 0.5

NOTE: ACCELERATION DENSITY LEVEL DOWN IN THE SYSTEM NOISE RANGE.



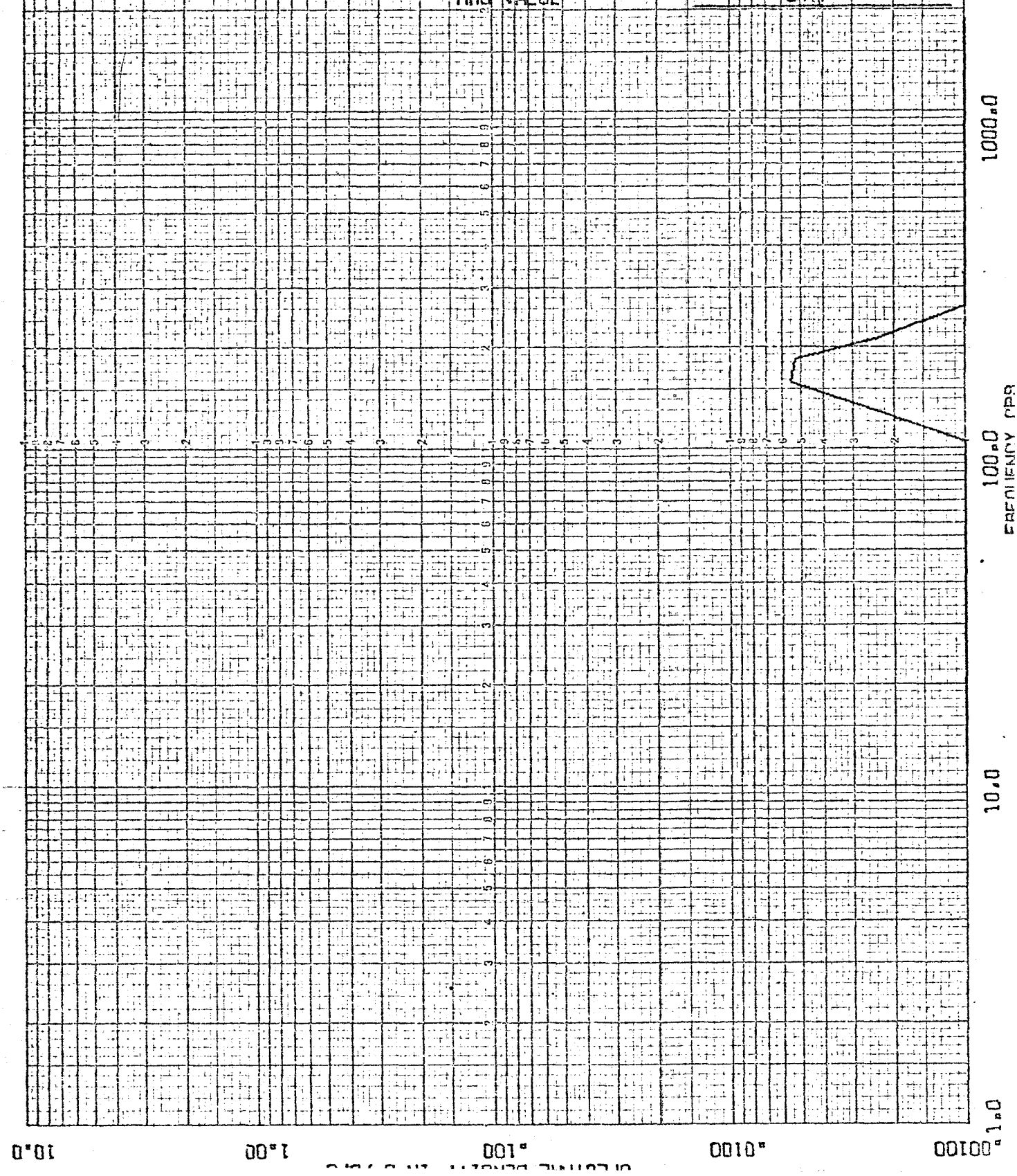
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION B
PICK-UP NUMBER 5
PICK-UP RESPONSE C
INPUT ACCELERATION PER PAGE A33
RMS VALUE 0.9



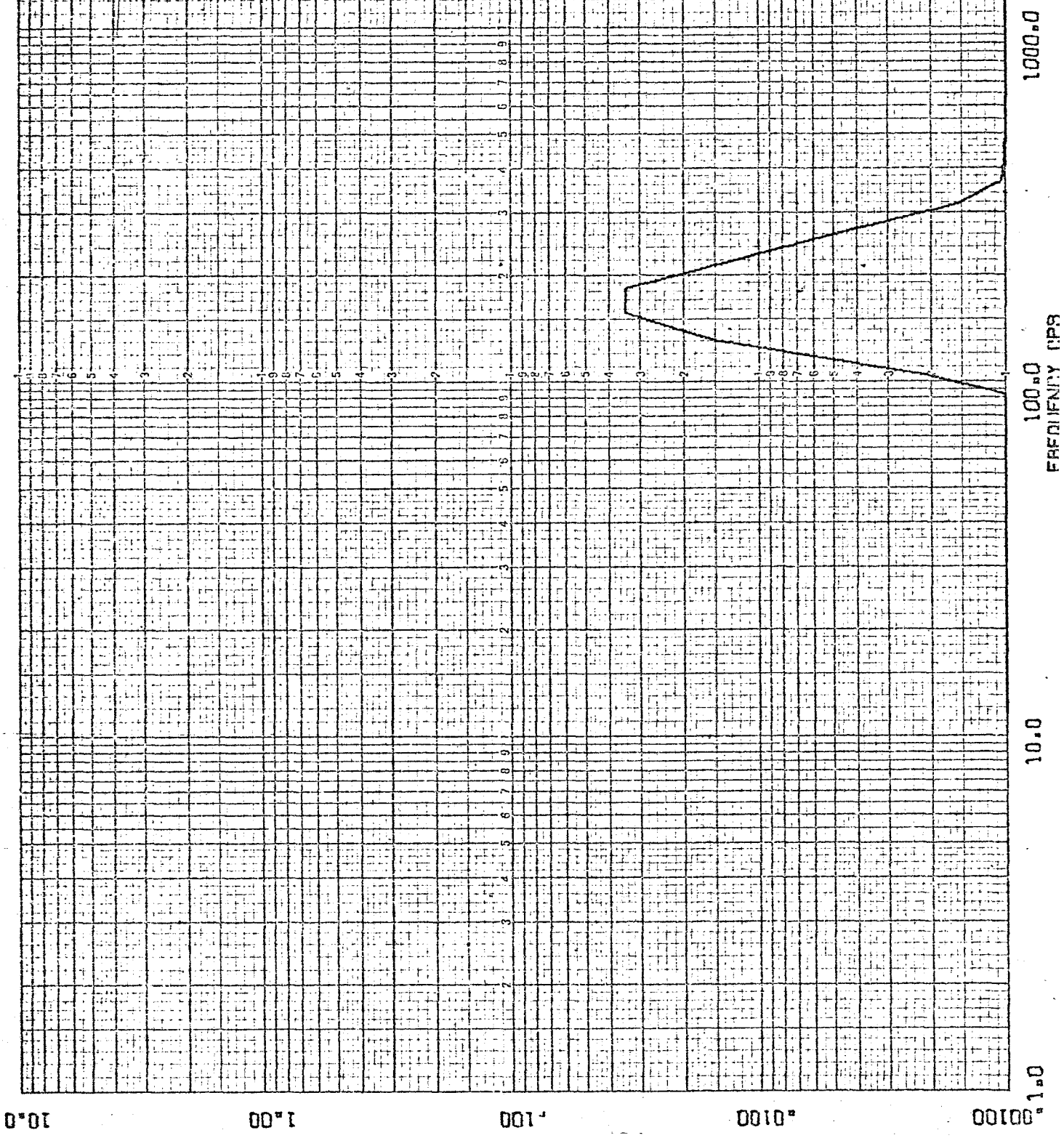
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A 2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION B
PICK-UP NUMBER 6
PICK-UP RESPONSE A
INPUT ACCELERATION PER PAGE A 33
RMS VALUE 2.1



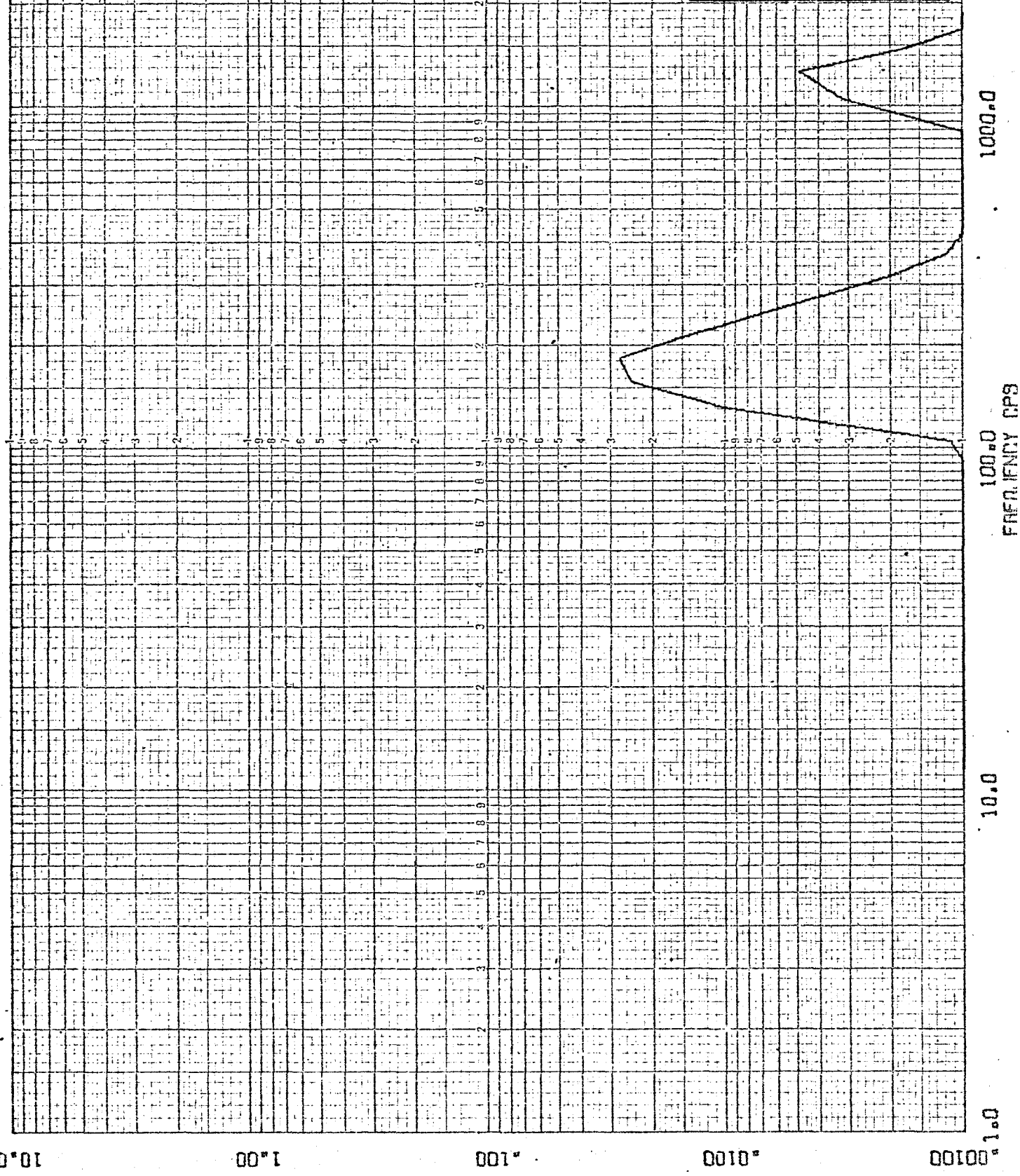
DSV-4B RANDOM VIBRATION TEST

LH2 TANK CRITICAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

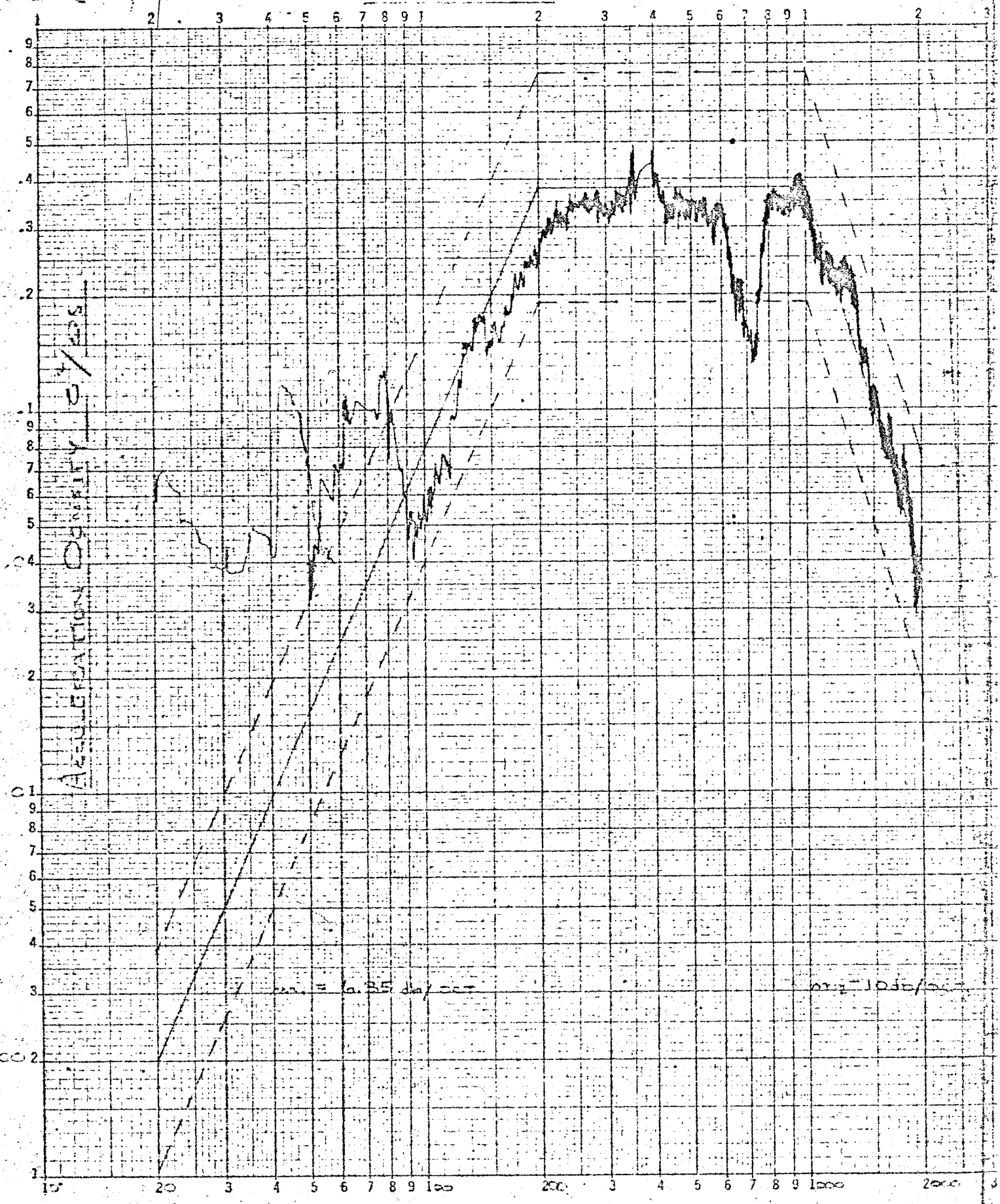
TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION B
PICK-UP NUMBER 7
PICK-UP RESPONSE G
INPUT ACCELERATION PER PAGE A33
RMS VALUE 2.3



LH2 LOW PRESSURE SWITCH, LINE ITEM VSL PAGE A90

AXIS: G FEB. 17, 66 Grms = 21.5 REPORT NO. R-5050-1

AREA (20 - 2,000) CPS = 21.0 Grms



K&E LOGARITHMIC 47 7523 3 X 9 CYCLES MADE IN U.S.A. KEUFFEL & ESSER CO.

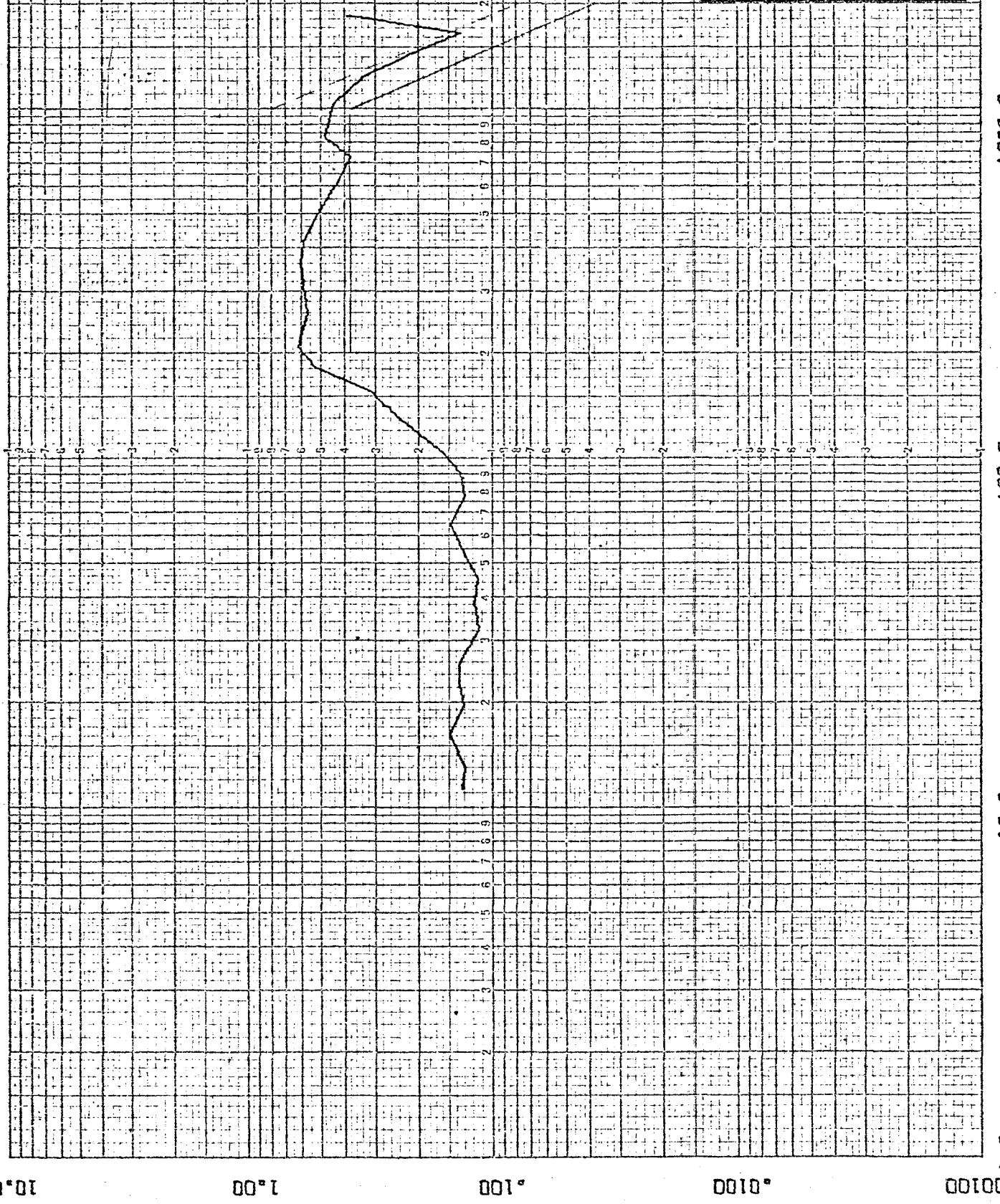
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION C
PICK-UP NUMBER 1
PICK-UP RESPONSE [illegible]
INPUT ACCELERATION PER PAGE A41
RMS VALUE 356



DSV-4B RANDOM VIBRATION TEST

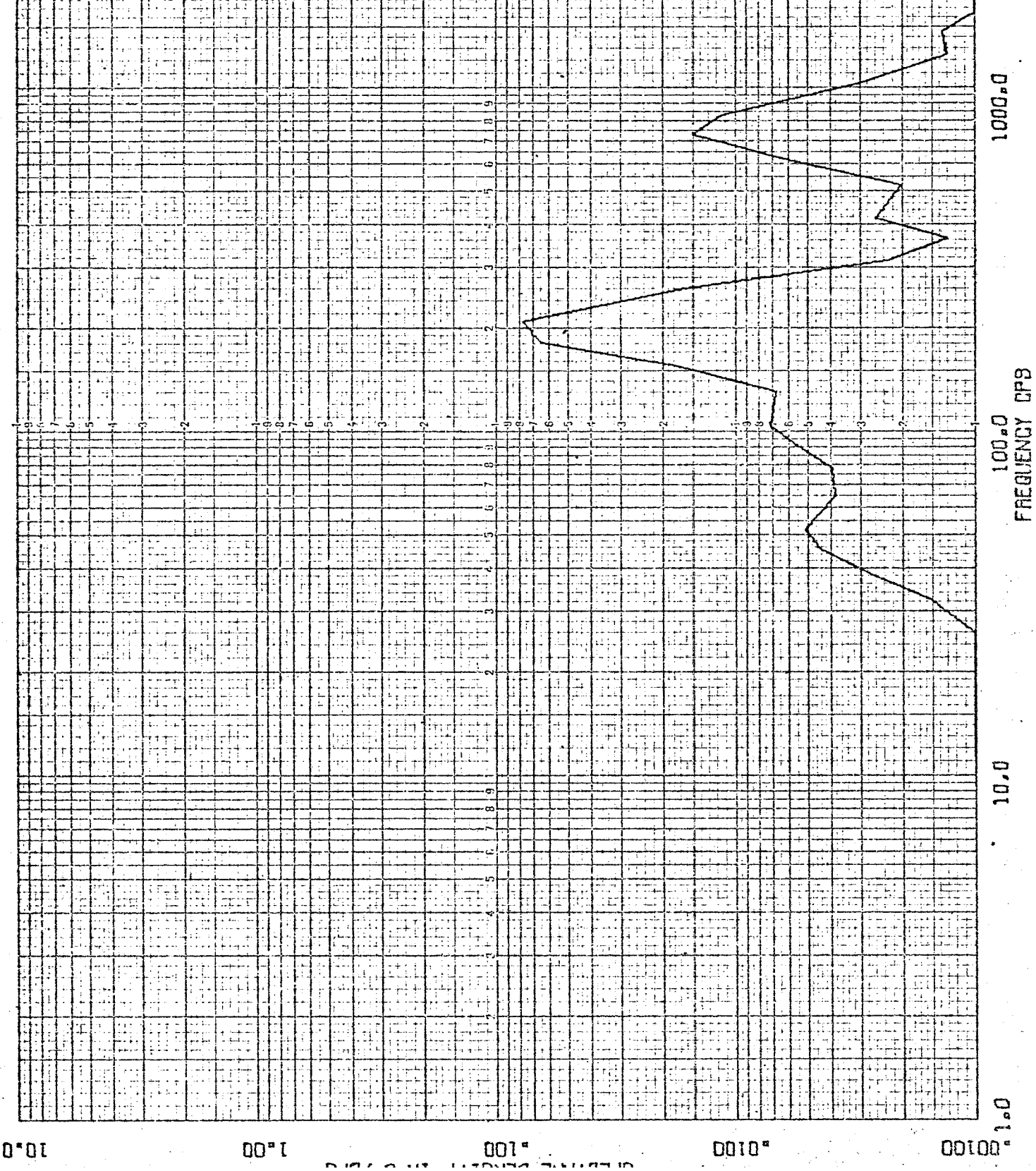
LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	2-17-66
AXIS OF EXCITATION	C
PICK-UP NUMBER	2
PICK-UP RESPONSE	A
INPUT ACCELERATION PER PAGE	A42 A41
RMS VALUE	3.7



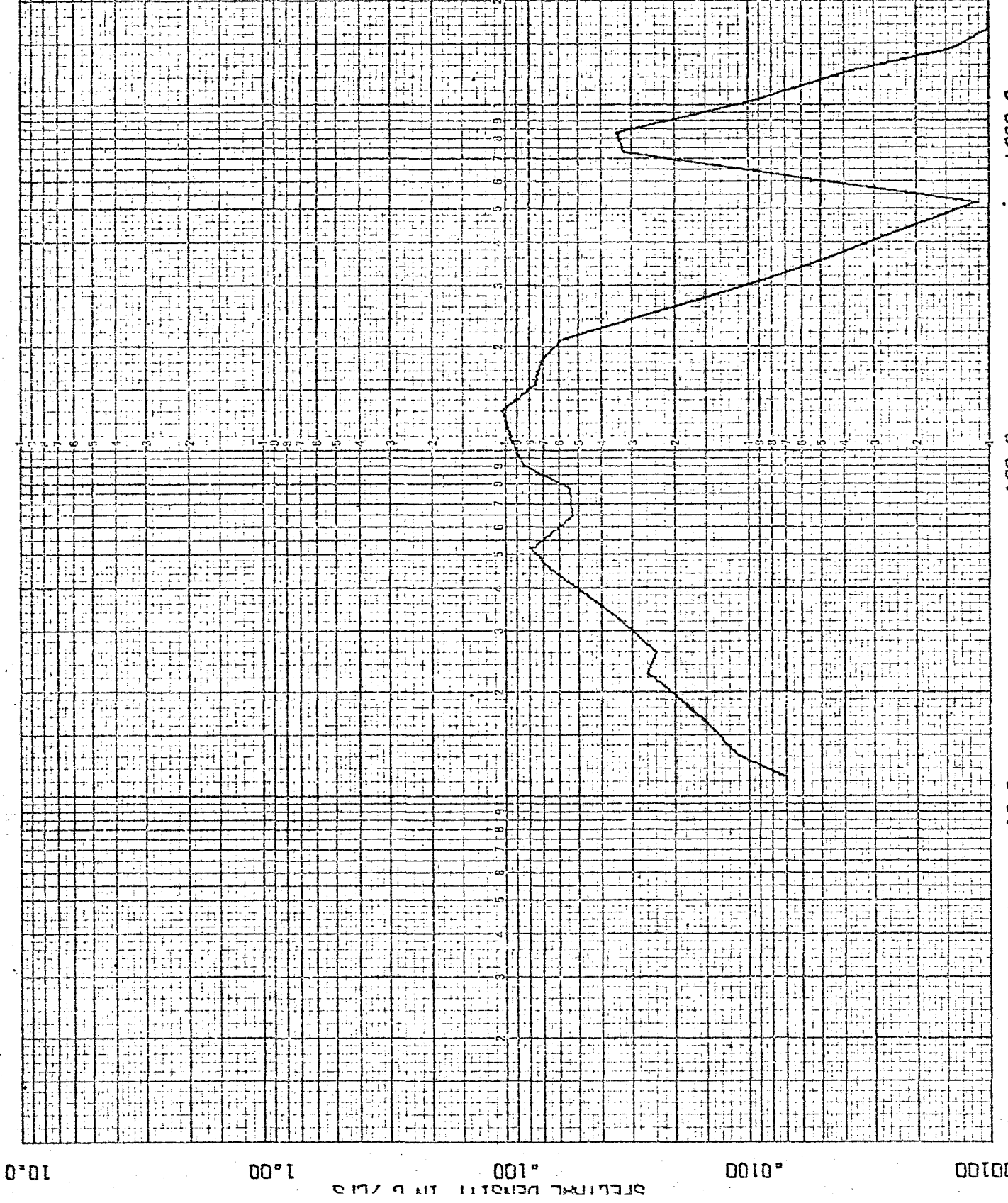
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION C
PICK-UP NUMBER 3
PICK-UP RESPONSE C
INPUT ACCELERATION PER PAGE A40 - A41
RMS VALUE 5.7



DOUGLAS AIRCRAFT COMPANY, INC.

DSV-4B RANDOM VIBRATION TEST

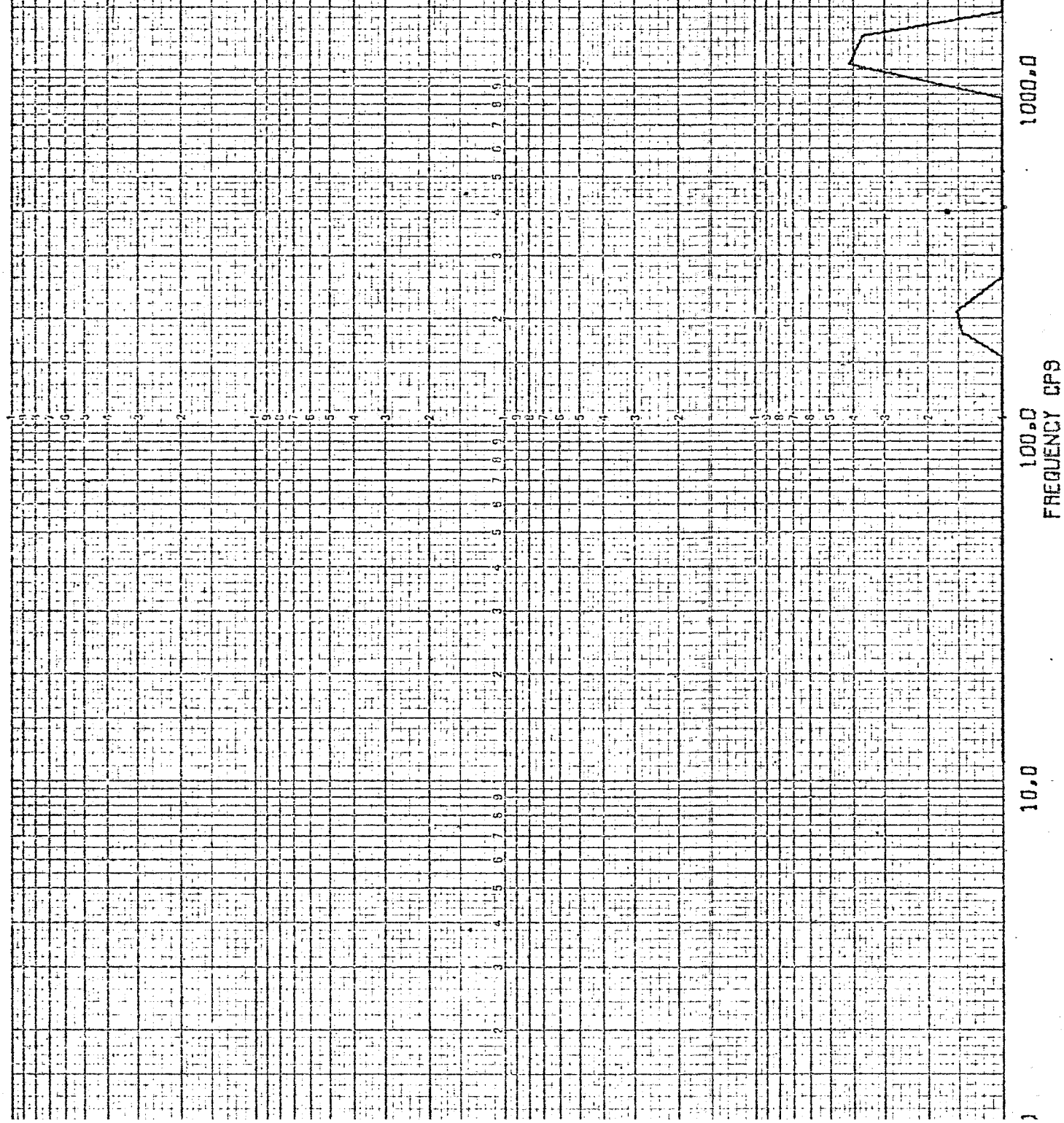
LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	2-17-66
AXIS OF EXCITATION	C
PICK-UP NUMBER	4
PICK-UP RESPONSE	B
INPUT ACCELERATION PER PAGE	A42-A41
RMS VALUE	1.6



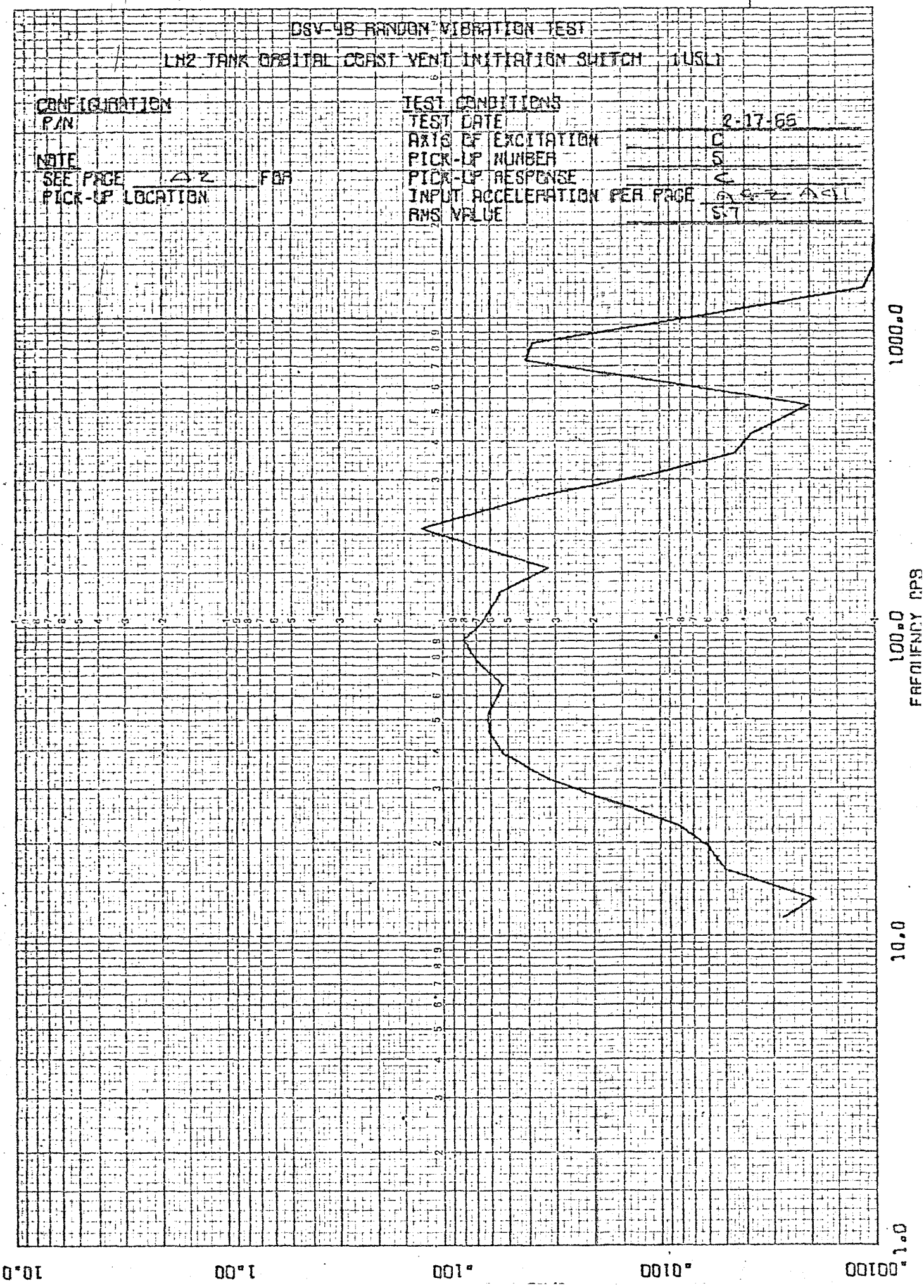
DSV-4B RANDOM VIBRATION TEST

LN2 TANK ORBITAL COAST VENT INITIATION SWITCH 1USL1

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 8-17-66
AXIS OF EXCITATION C
PICK-UP NUMBER 5
PICK-UP RESPONSE C
INPUT ACCELERATION PER PAGE A42-A51
RMS VALUE 5.7



DSV-4B RANDOM VIBRATION TEST

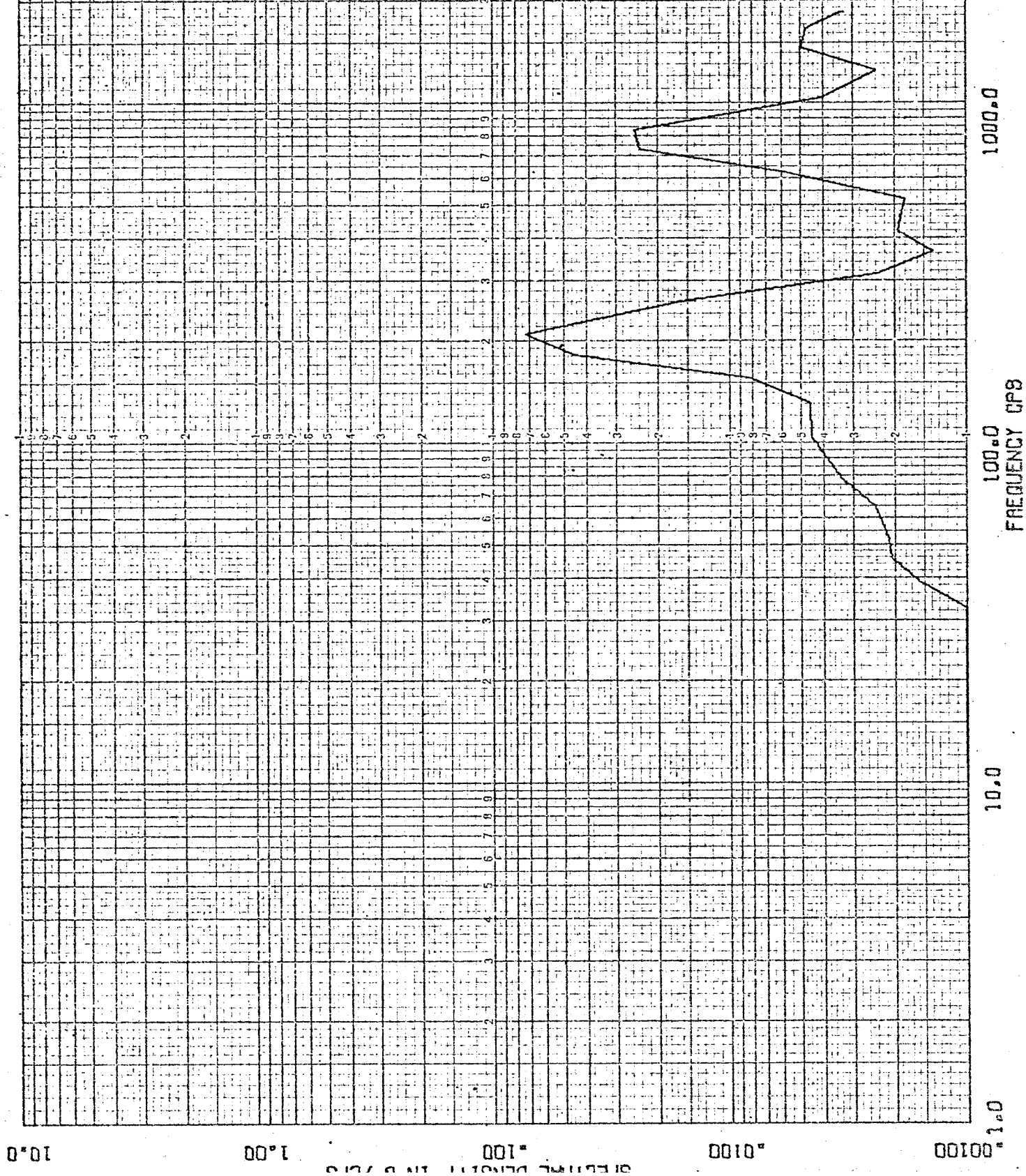
LH2 TANK ORBITAL CORST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE [illegible] FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	2-17-66
AXIS OF EXCITATION	C
PICK-UP NUMBER	6
PICK-UP RESPONSE	[illegible]
INPUT ACCELERATION PER PAGE	[illegible]
RMS VALUE	4.6



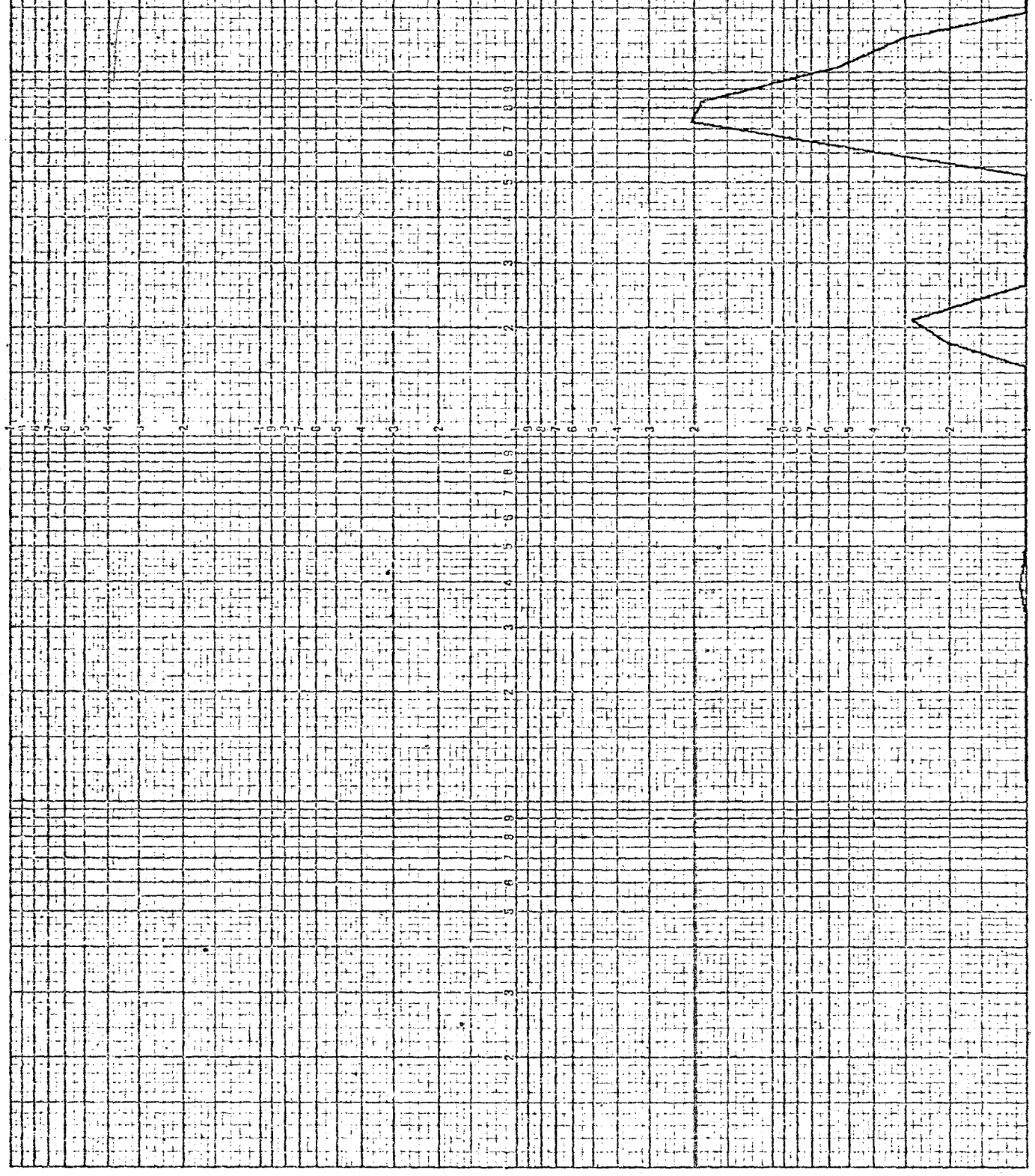
DSV-4B RANDOM VIBRATION TEST

LH2 TANK ORBITAL COAST VENT INITIATION SWITCH (USL)

CONFIGURATION
P/N

NOTE
SEE PAGE A2 FOR
PICK-UP LOCATION

TEST CONDITIONS
TEST DATE 2-17-66
AXIS OF EXCITATION C
PICK-UP NUMBER 7
PICK-UP RESPONSE B
INPUT ACCELERATION PER PAGE A41
RMS VALUE 2.9



FORM 25-S-1
(REV. 8-53)

PREPARED BY: W. SLACK
CHECKED BY:
DATE: 2-24-66
TITLE: LH2 Tank Orbital Vent Initiation Switch (U-5L)

DOUGLAS AIRCRAFT COMPANY, INC.
MISSILE & SPACE SYSTEMS DIVISION

PAGE:
MODEL: DSV-4B
REPORT NO.: R5050-1

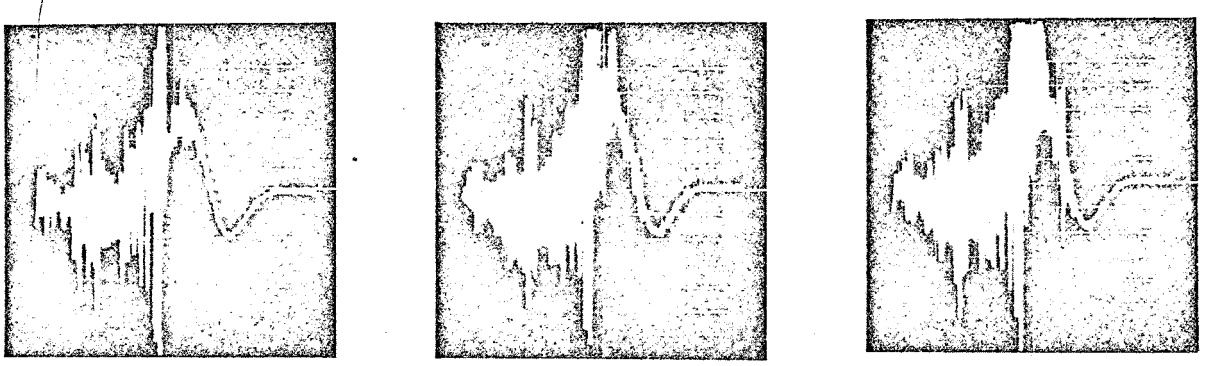
NOTE:

OSCILLOSCOPE
READING IS FROM
RIGHT TO LEFT.

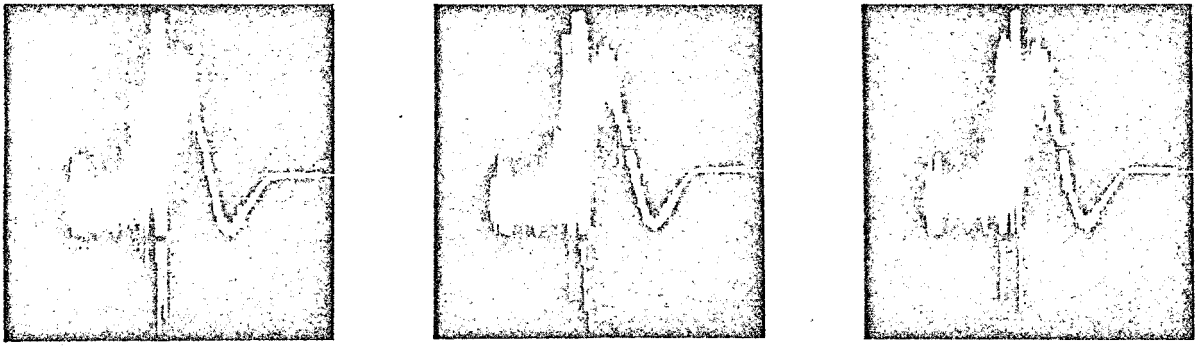
SHOCK PULSE

5879-6302
27761
1T06846

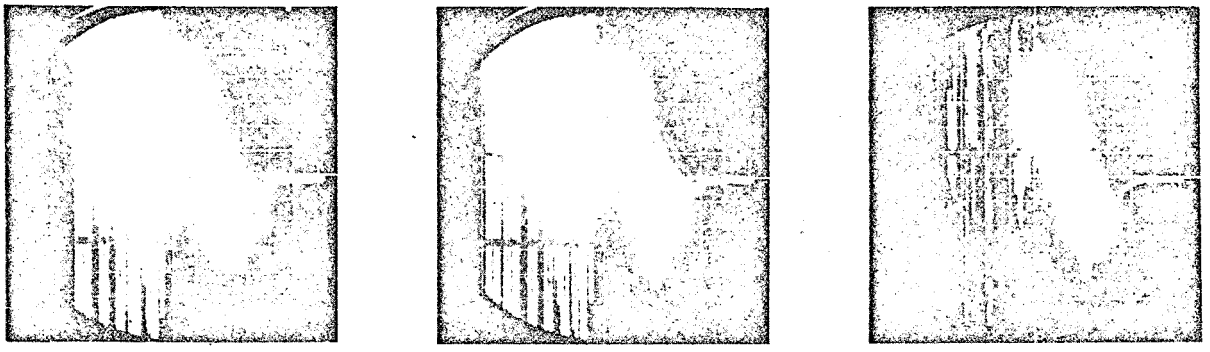
5 G/DIVISION 5 M SEC/DIVISION



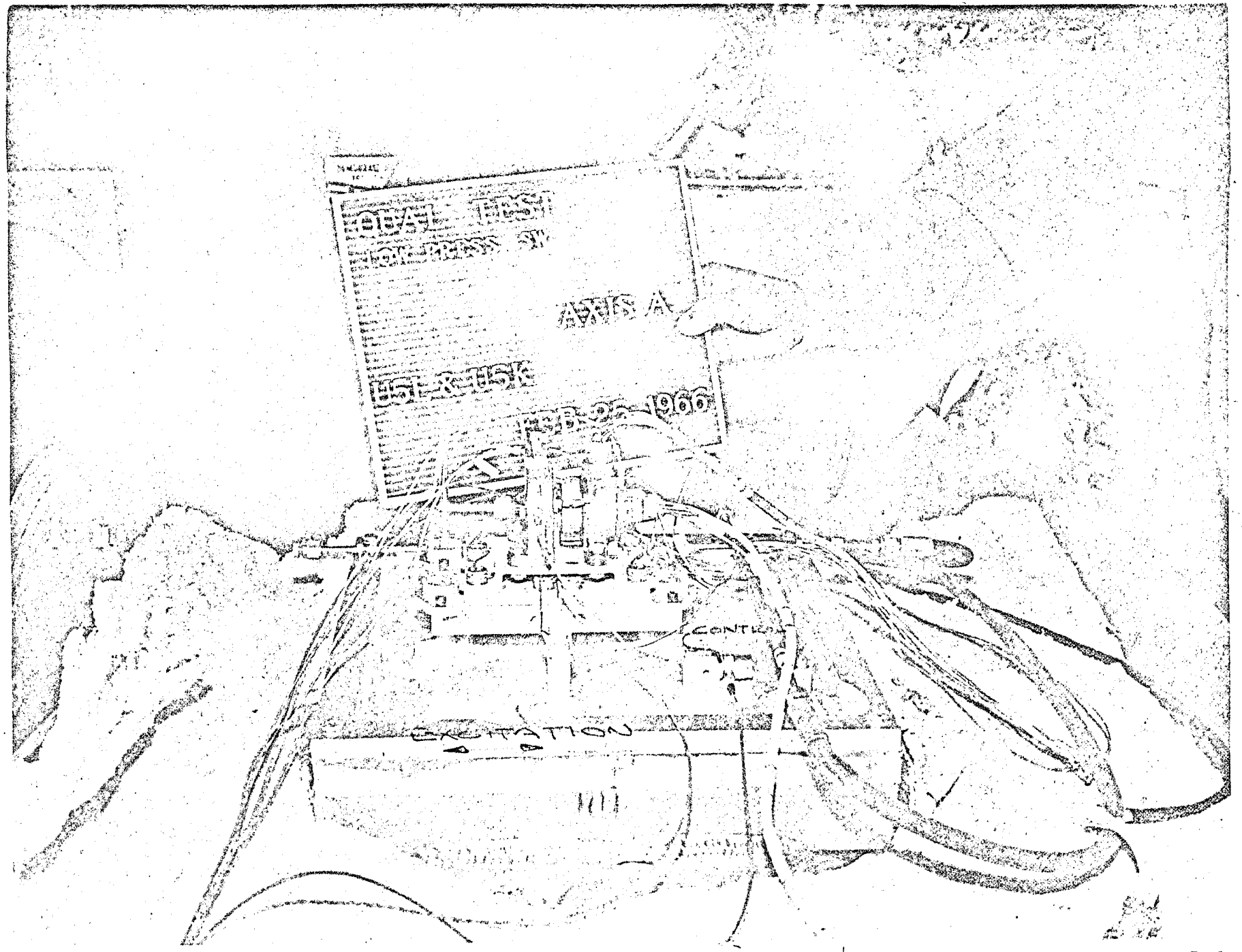
A AXIS



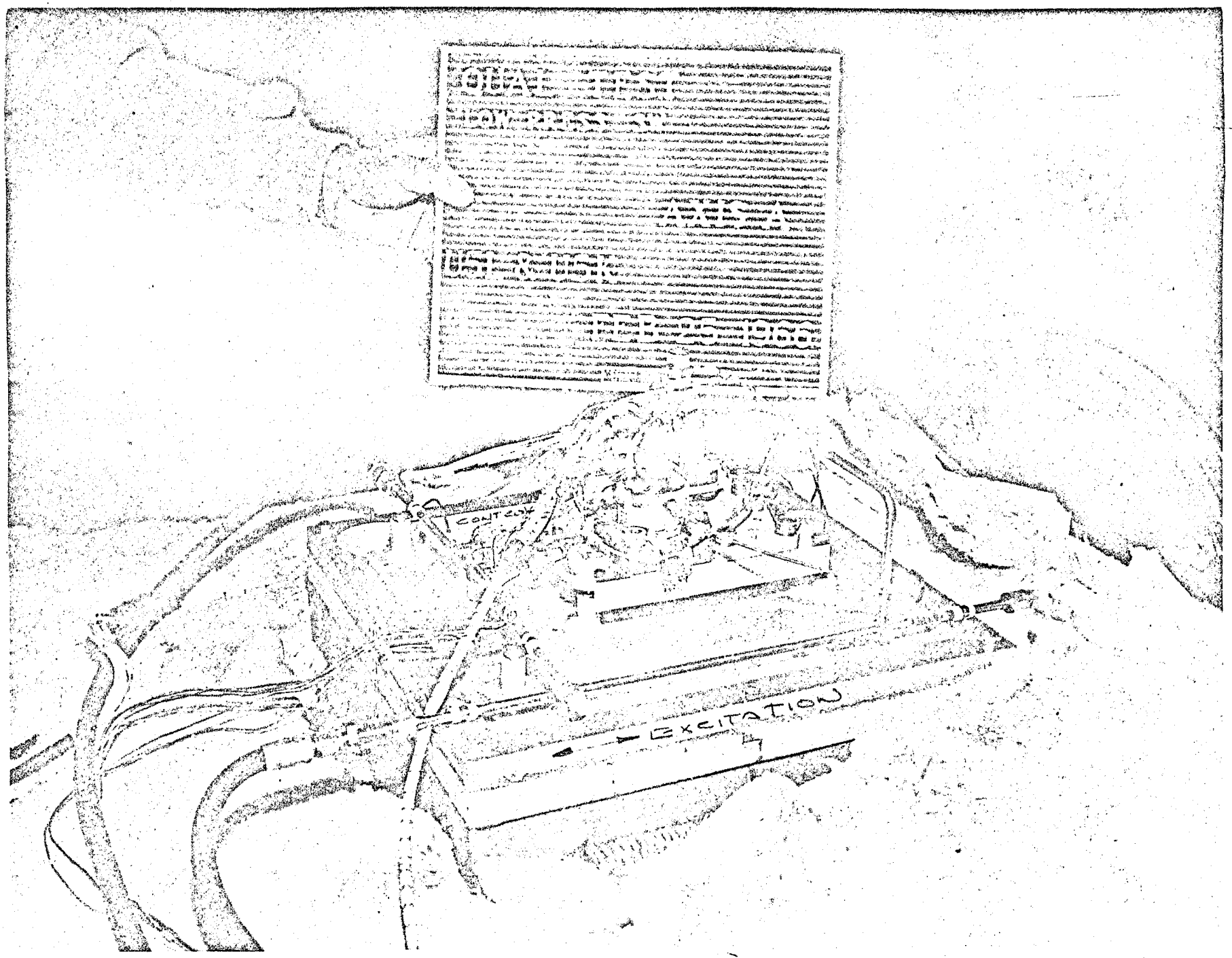
B AXIS



C AXIS

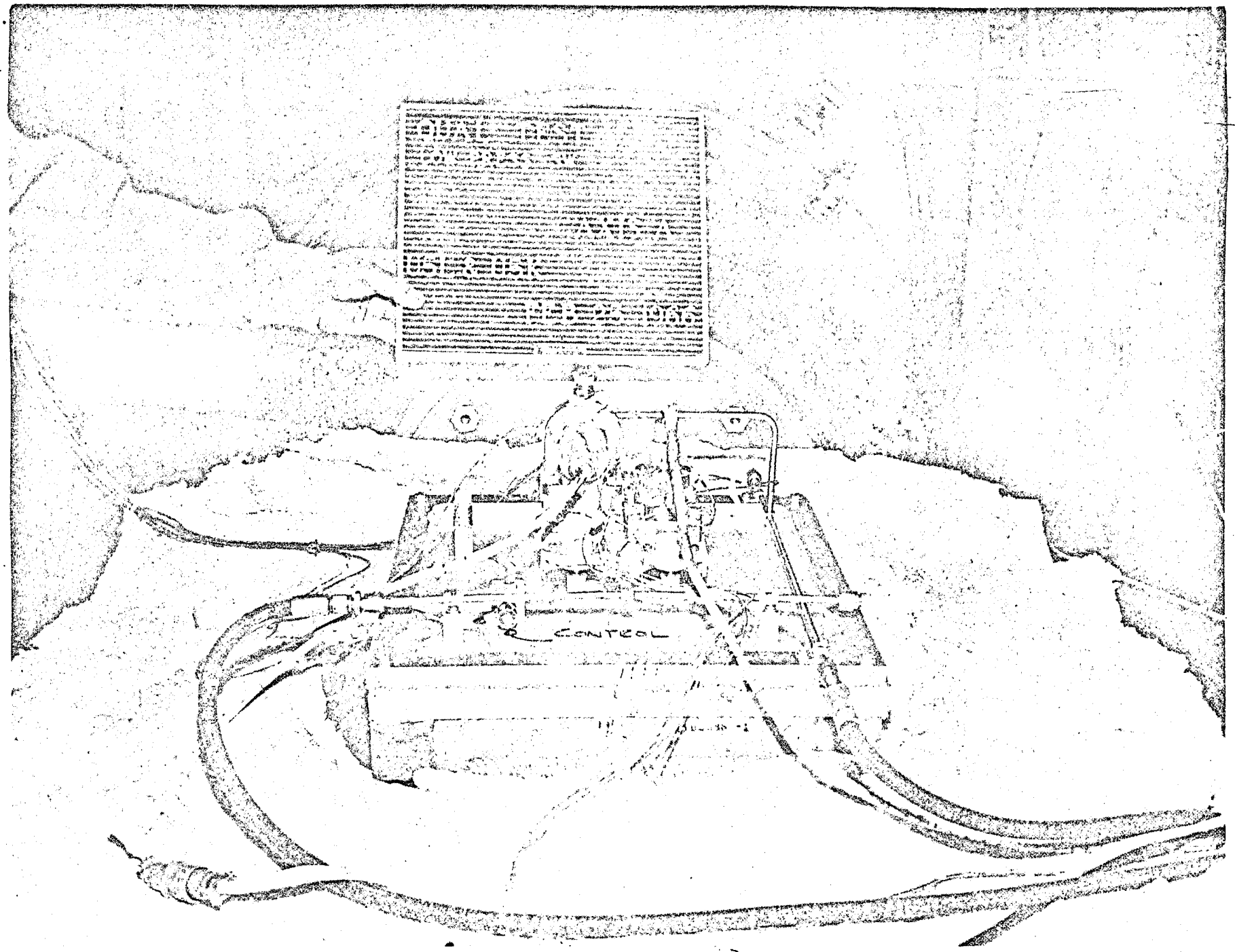


ACCELEROMETER LOCATIONS



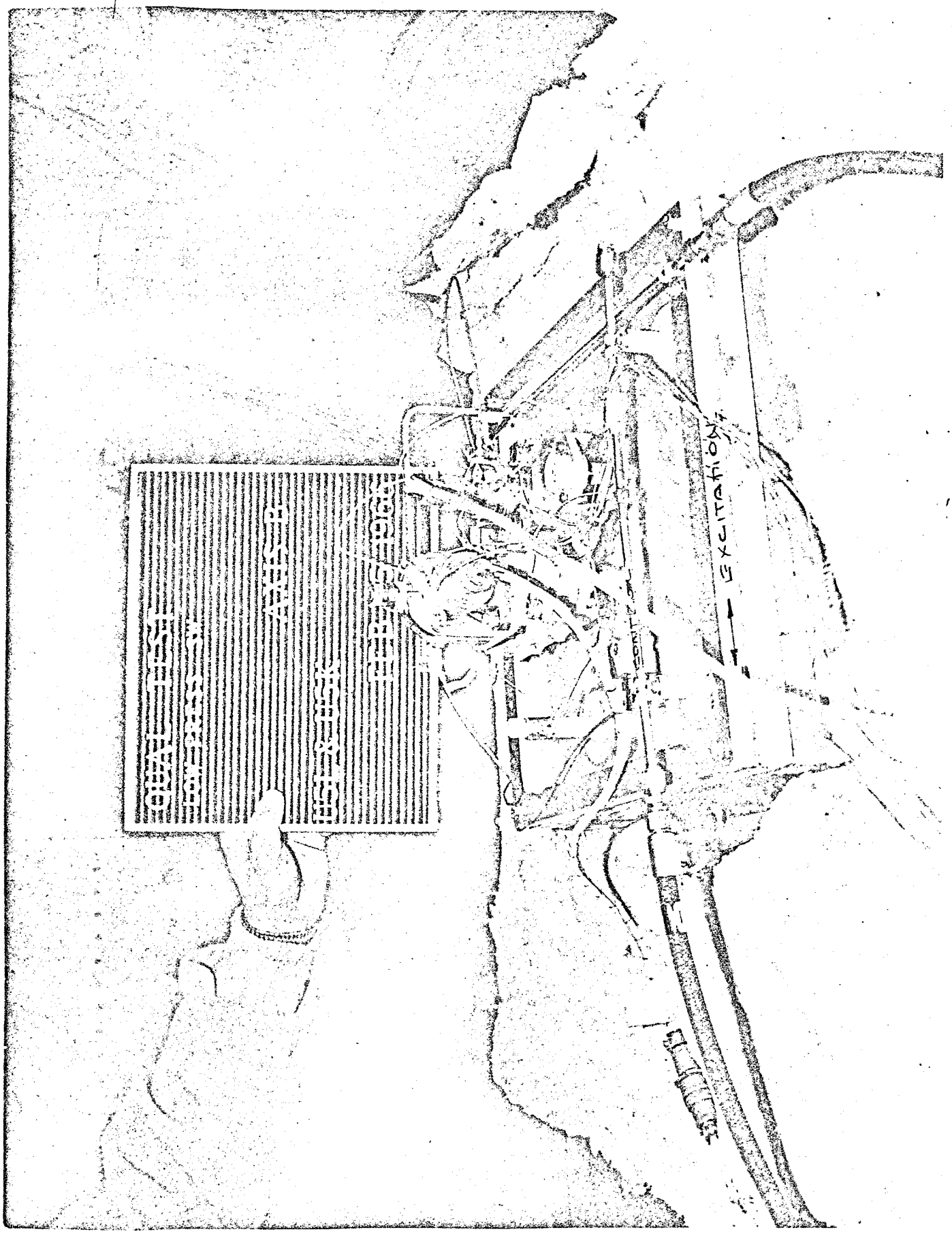
ACCELEROMETER Locations

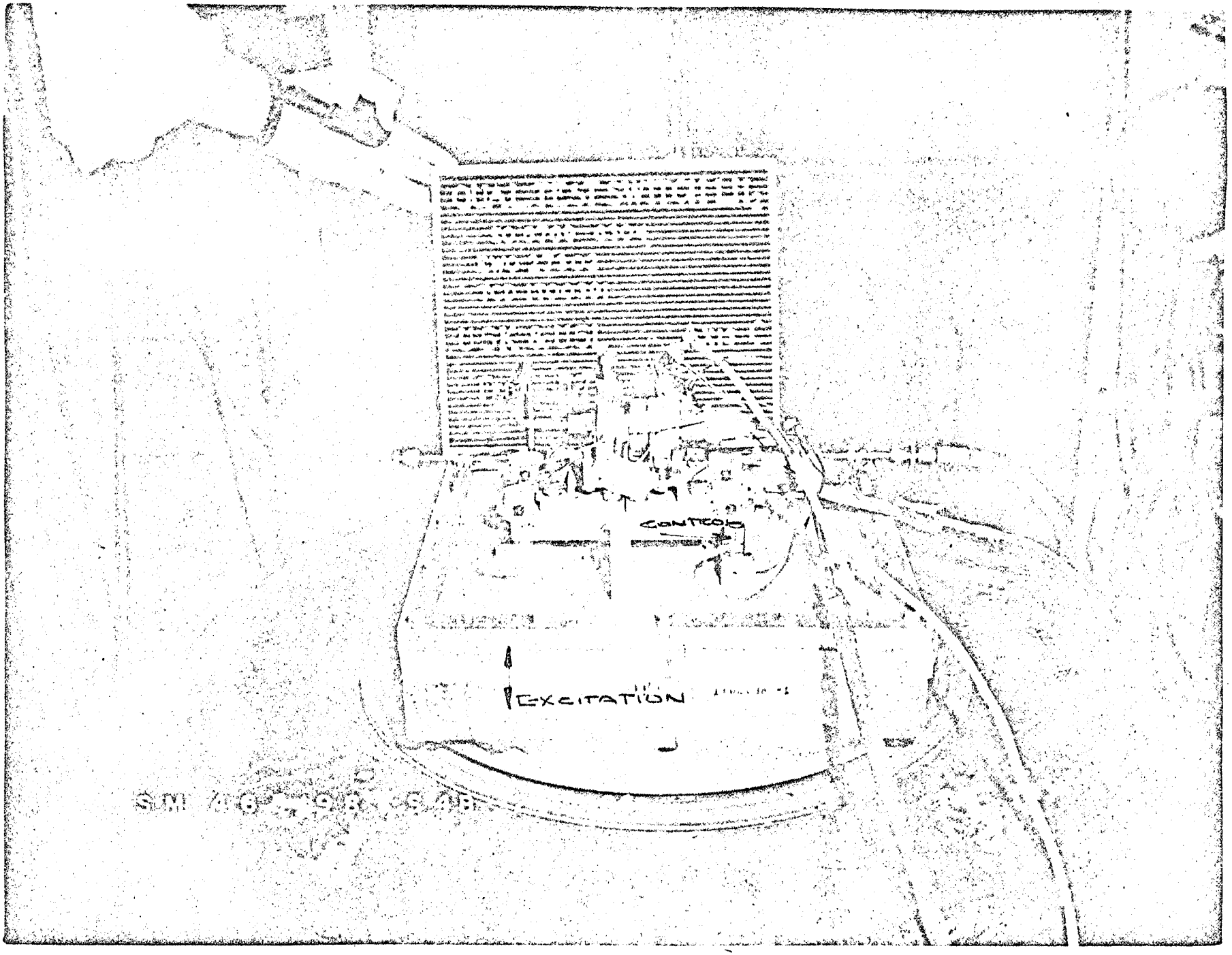
SM466.081



ACCELEROMETER LOCATIONS

SN 461879


EXCITATION



ACCELEROMETER LOCATIONS