LEAM DYNAMIC ANALYSIS
AND TESTING RESULTS
DVT MODEL

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1.0 INTRODUCTION AND SUMMARY

This ATM presents the results of the dynamic analysis and testing performed on the DVT model of the LEAM Experiment Package. The interface of this package is with the Array E - Subpack No. 2 pallet.

A number of tests were performed early in the program to establish tolerable random and sinusoidal vibration limits (see Reference 1, ATM 1011, dated 6/11/71) for the film frames. Further tests were carried out on the assembled DVT model with various film frame support methods, and damping material applications. The most satisfactory arrangement here turned out to be one in which strips of urethane foam were applied along all edges of the frame openings and outer edges. This essentially reduced to unity the vibration amplification factors between the frame support edge and the center of the film..

Thus the analysis model is regarded as a 5 mass arrangement, each mass having six degrees of freedom. Responses, loads and displacements are caluulated for those 30 generalized coordinates which correspond to the center of gravity motions of the five masses.

In this report the analysis model is described first along with the physical description data. This is followed by a discussion and presentation of the output plots and data. Vibration test results are also incorporated here. Finally, a discussion and presentation of load and displacement data is given.

The analysis model gives a much larger array of output results than the DVT vibration tests since in those tests the output channels are limited to about eight. Therefore by adjusting the analysis model damping to correspond to the actual hardware test results a quite extensive survey of the vibration and load characteristics can be obtained.

2.0 ANALYSIS MODEL

The assembled LEAM Package in the stowed position is shown in Figure 1 as it is mounted on the Subpack No. 2 pallet. Internally the assembly consists of 2 dual sensors, 1 single sensor, and a central electronics package mounted on an internal structure. An outer case mounted at points near the attachment locations surrounds the entire package. The internal structure is machined out of a solid piece of aluminum to form an array of thin plates and beams with mounting bosses for the four internal sensor and electronic packages. Four short beams extend in the z-axis direction for connections to the main pallet. Figure 2 shows two internal section views. The complete structure was modeled using the EASE structural analysis program by dividing it into a network of nodes connected by plate and beam elements. This nodal representation is shown in Figure 3.

The detailed description of the LEAM structural beams and plates as they were set up for the EASE structural analysis program are given in Appendix A in the Tables A-1 through A-5.

The attachment locations are shown on the figure. The internal packages are nearly rigid bodies; therefore they were represented as stiff beams connected between the attachment points to the internal structure. Another stiff beam was connected between the intersection of the cross beams to a location corresponding to the c.g. of the package.

The flexibility influence coefficients were obtained by successively loading the c.g. points with three unit force loads and three moment loads giving a 30 x 30 flexibility influence coefficient matrix in all including the outer case which was also represented as a set of stiff beams.

The mass matrix was obtained by including the mass of the distributed internal structure with the masses of the internal packages. Thus all the mass was referred to the 5 mass c.g.'s and the computed responses are also referred to the c.g.'s. The natural frequencies of the model tend to be somewhat higher than actual, but the analysis is simplified considerably.

The masses of the various components of the package are shown in Table 1. The coordinate designations and correspondence to the ALSEP axes are shown in Table 2 of the following sections.

3.0 METHOD OF ANALYSIS AND INPUT LEVELS

The method of analysis used is the normal mode method as it is presently programmed in the Bendix DYNLOAD program. Details of the method are given in Reference 2. The program computes the natural frequencies and mode shapes of a structure and, using this information, determines sine and random frequency responses at specified locations in the structure as well as dynamic loads and displacements.

In the present case of the LEAM structure the input values to the program are given in Appendix B. These inputs are the stiffness matrix and the mass matrix of Appendix B as well as other supplementary matrices used in the computations as described in Reference 2.

The acceleration input levels to the dynamic response calculations are shown in Figures 4 and 5 for the sine and random vibrations respectively. These levels have been taken from References 3 and 4. The x and y axes are interchanged between the ALSEP axis system and the dynamic analysis model axis system.

TABLE I
LEAM WEIGHT SUMMARY

WEST SENSOR	1.05 lbs.
EAST SENSOR	2.13
UP SENSOR	2.11
CENTRAL ELECTRONICS	3.25
INTERNAL STRUCTURE ASSY. AND SHIELD	2.13
CABLE AND ASTROMATE CONN. ASSY.	1.30
THERMAL BAG AND MASKING	.69
OUTER HOUSING ASSY.	1.31
LEG ASSEMBLIES AND RELEASE	.60
BUBBLE LEVEL	.02
GNOMON ASSY.	.02
UHT SOCKET AND RELEASE	.29
THERMAL RADIATOR ASSY.	.32
DUST COVER AND RELEASE	.18
MISC. HARDWARE	.26
LEAM TOTAL WEIGHT (INCL. ASTROMATE CONN.)	15.66 lbs.

4.0 COMPUTED RESPONSES AND TEST RESULTS

Computed frequency responses are presented in the form of overall response at all locations due to random excitation and in the form of detailed frequency plots at selected coordinate locations.

The coordinate locations and definitions in relation to the internal packages are shown in Table 2. The six coordinates of the c.g. motion of each of the six component packages are grouped together with the three translations being given first. These response coordinates and their locations are shown in the following table:

TABLE 2 - Coordinate Definitions

Analysis Location No.	Component Package	Analysis Coordinate	ALSEP Axis
1	Up Sensor	X_1	Y
2	Up Sensor	Y_1	X
3	Up Sensor	Z_1	Z
4	Up Sensor	ϕ_1	
5	Up Sensor	θ_1	
6	Up Sensor	ψ_1	
7	West Sensor	X_2	Y
8	West Sensor	Y_2	X
9	West Sensor	Z_2	Z
10	West Sensor	ϕ_2	
11	West Sensor	θ_2	
12	West Sensor	ψ_2	
13	Central Electronics	X_3	Y
14	Central Electronics	Y_3	X
15	Central Electronics	Z_3	Z
16	Central Electronics	ϕ_3	
17	Central Electronics	θ_3	
18	Central Electronics	ψ_3	
19	East Sensor	X_4	Y
20	East Sensor	Y_4	X
21	East Sensor	Z_4	Z
22	East Sensor	ϕ_4	
23	East Sensor	θ_4	
24	East Sensor	ψ_4	
25	Outer Case	X_5	Y
26	Outer Case	Y_5	X
27	Outer Case	Z_5	Z
28	Outer Case	ϕ_5	
29	Outer Case	θ_5	
30	Outer Case	ψ_5	

The angle definitions here are ϕ- rotation about the X axis, θ- rotation about the Y axis, and ψ- rotation about the Z axis.

Table 3 presents the overall rms response of each of the thirty coordinates to Launch and Boost random base excitation in each of three axes X, Y, and Z. A modal damping value of .05 is used throughout as this agrees fairly well with the DVT vibration tests on the LEAM package. The calculated values are slightly higher than the test values and should therefore be somewhat conservative.

Detailed plots of transmissibility, sine response and random response are shown in the three part Figures 6 through 21. These plots are only given for the large linear c.g. responses indicated by Table 2. The remaining responses are of smaller overall value or are considered not to be of prime importance. The most important packages and directions are the Up Sensor in the Y direction and the East Sensor in the X direction as these are the directions perpendicular to the film planes.

The lowest natural frequencies for the analysis model are 131 Hz in the X direction, 178 Hz in the Z direction, and 250 Hz in the Y direction. The remaining 27 modes and natural frequencies are various combinations of component rotations and translations. The first 12 mode shapes and frequencies are shown in Table 4.

Vibration test results indicate somewhat lower frequencies than the analysis model results, but they are similar. These frequencies are 110 Hz in the X direction 145 Hz in the Z direction, and 210 Hz in the Y direction. Acceleration responses were measured on the internal structure frame and thus would only be expected to be similar to the analyses c.g. responses in the same direction. Three representative test curves are included in this report to compare this similarity. These curves are included in the analysis response curves in the appropriate location and are as follows:

	Analysis Figure		Vibration Test Figure	
Up Sensor	7c	c.g.	7d	frame
West Sensor	9c	c.g.	9d	frame
Central Elect	15c	c.g.	15d	frame
East Sensor	16c	c.g.	16*d	frame

*Same test figure as 9d above

	X - AXIS			Y - AXIS		Z - AXIS	
	LOCATION	RMS RESPONSE		LOCATION	RMS RESPONSE	LOCATION	RMS RESPONSE
UP	1	0.10450E 02	G-RMS	1	0.17383E 01	1	0.19683E 01
	2	0.32533E 01	"	2	0.17487E 02	2	0.56412E 01
	3	0.29569E 01	"	3	0.26971E 01	3	0.10611E 02
	4	0.14362E 01	G-RMS/IN	4	0.13854E 01	4	0.62178E 01
	5	0.18148E 00	"	5	0.16005E 00	5	0.57929E 00
	6	0.58538E 01	"	6	0.53976E 00	6	0.10135E 01
WEST	7	0.79340E 01	ETC	7	0.32427E 01	7	0.47129E 01
	8	0.12759E 02		8	0.13964E 02	8	0.61669E 01
	9	0.65517E 01		9	0.57597E 01	9	0.78458E 01
	10	0.38443E 00		10	0.11712E 01	10	0.43628E 01
	11	0.23020E 01		11	0.60742E 00	11	0.19114E 01
	12	0.47133E 01		12	0.37255E 00	12	0.16921E 01
C.E.	13	0.53916E 01		13	0.16057E 01	13	0.24895E 01
	14	0.32298E 01		14	0.12073E 02	14	0.65395E 01
	15	0.83904E 00		15	0.72286E 01	15	0.72634E 01
	16	0.53161E 00		16	0.38754E 01	16	0.27020E 01
	17	0.11710E 01		17	0.14740E 01	17	0.19536E 01
	18	0.26871E 01		18	0.29608E 00	18	0.22138E 00
EAST	19	0.74087E 01		19	0.33901E 01	19	0.26634E 01
	20	0.44562E 01		20	0.19357E 02	20	0.79596E 01
	21	0.19642E 01		21	0.87585E 01	21	0.89037E 01
	22	0.15360E 00		22	0.25890E 01	22	0.37279E 01
	23	0.11401E 01		23	0.20502E 01	23	0.39276E 01
	24	0.37307E 01		24	0.63948E 01	24	0.34525E 01
OUTER C.	25	0.93697E 01		25	0.10986E 01	25	0.88073E 00
	26	0.75316E 00		26	0.25254E 02	26	0.16461E 01
	27	0.85693E 00		27	0.21335E 01	27	0.19660E 02
	28	0.15770E 00		28	0.43194E 00	28	0.39336E 01
	29	0.14840E-01		29	0.17268E-02	29	0.13118E-01
	30	0.21567E 01		30	0.21546E 00	30	0.19711E 00

TABLE 3. RMS RESPONSE VALUES

TABLE 4 MODAL DATA

```
MODE   1                           MODE   2                           MODE   3                           MODE   4

EIGENVALUE=  1.46879E-06           EIGENVALUE=  7.96584E-07           EIGENVALUE=  6.87790E-07           EIGENVALUE=  5.43566E-07
FREQUENCY=   1.31323E+02           FREQUENCY=   1.78322E+02           FREQUENCY=   1.91908E+02           FREQUENCY=   2.15871E+02

EIGENVECTOR                        EIGENVECTOR                        EIGENVECTOR                        EIGENVECTOR
    1      2.17779E-01   X             1      1.79591E-02                 1      1.16551E-01                 1     -1.19588E-01
    2      2.42387E-02                 2     -1.81428E-01                 2      2.46696E-02                 2     -4.64226E-02
    3      1.32577E-02                 3      1.44853E-01  Z              3     -1.15834E-03                 3     -1.27123E-03
    4      1.01709E-02                 4      1.19829E-01                 4     -4.10247E-03                 4      4.12419E-03
    5      6.50643E-03                 5      7.88598E-04                 5      1.99208E-03                 5     -6.14214E-03
    6     -1.48731E-01                 6     -9.26163E-03                 6     -7.43828E-02                 6      7.30941E-02
    7      9.78846E-01   X             7      1.03235E-01                 7      4.86579E-01                 7     -4.90207E-01
    8      4.08163E-01                 8     -1.37118E-01                 8      2.08917E-01                 8     -2.23638E-01
    9      6.60192E-02                 9      7.44560E-01  Z              9     -1.31198E-02                 9      8.83616E-03
   10      7.05009E-03                10      1.35949E-01                10     -2.24226E-03                10      4.10485E-03
   11      6.18040E-03                11     -2.94590E-02                11     -4.78918E-03                11     -5.10029E-04
   12     -1.56016E-01                12     -2.04227E-02                12     -7.43180E-02                12      7.44329E-02
   13      7.67622E-01   X            13     -6.68843E-02                13      4.10302E-01                13     -4.68475E-01
   14     -1.06330E-02                14     -6.81797E-01                14      4.73553E-02                14     -1.02604E-01
   15      4.82788E-02                15      7.78360E-01  Z             15     -8.26318E-03                15      2.27351E-02
   16      1.12062E-02                16      3.87161E-01                16     -1.07628E-02                16      5.21109E-02
   17      4.13474E-02                17     -5.17911E-02                17      5.08834E-02                17     -9.34532E-02
   18     -3.17136E-01                18      5.50930E-02                18      3.43083E-01                18     -2.49328E-01
   19      1.00000E+00   X            19      8.82266E-02                19      5.20655E-01                19     -5.34821E-01
   20     -2.43209E-01                20     -2.06783E-01                20     -1.28644E-01                20      1.17525E-01
   21      5.02565E-02                21      1.00000E+00  Z             21     -3.99692E-03                21      2.88037E-02
   22      1.19527E-02                22      2.17789E-01                22     -1.70787E-03                22      6.49596E-03
   23      3.23726E-03                23     -1.20585E-01                23     -3.37686E-03                23     -6.92773E-03
   24     -1.77389E-01                24     -3.50308E-02                24     -1.03043E-01                24      1.12119E-01
   25      1.10977E-01   X            25     -8.16851E-02                25      1.00000E+00   X             25      1.00000E+00   X
   26      5.66607E-03                26     -1.80670E-02                26      3.62997E-02                26      4.06957E-02
   27     -9.70394E-03                27      9.25917E-02  Z             27     -6.33529E-02                27     -7.22470E-02
   28     -1.55134E-03                28      1.51350E-02                28     -1.04119E-02                28     -1.20306E-02
   29      6.32883E-06                29      1.10610E-05                29     -3.05698E-05                29     -6.68566E-05
   30     -2.49614E-02                30      1.55606E-02                30     -1.44599E-01                30     -1.79355E-01
```

TABLE 4 (CONT.)

```
MODE   5                         MODE   6                         MODE   7                         MODE   8

EIGENVALUE=  4.05903E-07         EIGENVALUE=  3.57725E-07         EIGENVALUE=  3.04679E-07         EIGENVALUE=  2.81799E-07
FREQUENCY=   2.49809E+02         FREQUENCY=   2.66100E+02         FREQUENCY=   2.88336E+02         FREQUENCY=   2.99813E+02

EIGENVECTOR                      EIGENVECTOR                      EIGENVECTOR                      EIGENVECTOR
     1      6.15139E-02               1      4.09304E-02               1     -6.65176E-02               1     -1.70309E-01
     2      8.59405E-01  Y            2      7.77789E-01  Y            2     -7.68730E-03               2     -1.63873E-01
     3      1.79291E-01               3      2.16233E-02               3     -9.94391E-02               3      1.18624E-01
     4      4.76772E-02               4     -4.39376E-02               4      2.70772E-02               4      1.00477E-01
     5     -3.37438E-03               5      1.69750E-02               5      5.16650E-02               5      1.24123E-01
     6      2.02547E-03               6      7.76760E-03               6      2.34125E-02               6      6.47219E-02
     7      5.93802E-02               7     -4.02337E-02               7     -2.61394E-01               7     -6.23342E-01
     8      7.42230E-01  Y            8      6.37381E-01  Y            8     -7.86603E-02               8     -3.19745E-01
     9      4.72610E-01               9     -1.29043E-01               9     -5.04191E-02               9      5.70503E-01
    10      8.10943E-02              10     -3.16421E-02              10     -4.10448E-03              10      1.07300E-01
    11     -3.25908E-02              11      2.28760E-02              11      4.56450E-02              11      6.05801E-02
    12     -5.14309E-03              12      1.61786E-02              12      4.55966E-02              12      1.01057E-01
    13     -1.26920E-01              13      1.74870E-01              13      3.29893E-01              13      7.23397E-01
    14      7.04618E-01  Y           14      3.56521E-01  Y           14     -5.05225E-02              14     -2.53813E-01
    15      7.35893E-01              15     -2.96864E-01              15     -3.45565E-01              15      4.99037E-01
    16     -2.28507E-01              16      4.45947E-01              16      4.65008E-02              16     -1.82135E-01
    17     -1.03289E-01              17      1.33592E-01              17      3.91927E-01              17      1.00000E+00  Φ
    18     -7.09398E-03              18      4.90539E-03              18     -1.16358E-02              18     -3.74533E-02
    19      1.19175E-01              19      4.14259E-03              19     -2.93159E-01              19     -7.21614E-01
    20      1.00000E+00  Y  EAST     20      1.00000E+00  Y           20      1.27637E-01              20      1.58745E-01
    21      8.87299E-01              21     -3.66819E-01              21     -5.27172E-01              21      5.00682E-01
    22      3.14661E-01              22     -2.66983E-01              22      1.00000E+00  Φ           22     -5.00977E-01
    23     -2.34434E-01              23      1.30650E-01              23      2.62597E-01              23     -6.82049E-02
    24      1.94467E-01              24      2.72201E-01              24      1.13346E-01              24      2.41051E-01
    25      3.54256E-02              25     -2.05564E-02              25      2.00648E-02              25      8.28427E-02
    26      1.16948E-01  Y           26      9.14545E-02  Y           26     -1.43667E-03              26     -9.70628E-03
    27      1.35582E-01              27      2.69525E-02              27     -1.20149E-02              27      1.24213E-01
    28      2.30913E-02              28      4.65132E-03              28     -2.08661E-03              28      2.19058E-02
    29     -4.65970E-06              29      9.26729E-06              29      4.62680E-05              29      1.46320E-04
    30     -6.46169E-03              30      3.96316E-03              30     -4.73197E-03              30     -1.87976E-02
```

TABLE 4 (CONT.)

```
MODE   9                      MODE  10                      MODE  11                      MODE  12

EIGENVALUE=  2.38417E-07      EIGENVALUE=  2.17177E-07      EIGENVALUE=  1.96115E-07      EIGENVALUE=  1.92113E-07
FREQUENCY=   3.25950E+02      FREQUENCY=   3.41518E+02      FREQUENCY=   3.59389E+02      FREQUENCY=   3.63113E+02

EIGENVECTOR                   EIGENVECTOR                   EIGENVECTOR                   EIGENVECTOR
     1    -1.31912E-02             1     2.77730E-02             1    -1.01996E-01             1    -2.23812E-01
     2     1.55065E-02             2    -4.15995E-03             2     1.51575E-01             2     1.94680E-01
     3     3.39706E-02             3     9.96114E-02             3     4.67920E-02             3     1.00000E+00
     4    -1.15079E-02             4    -1.53441E-01             4    -3.08521E-02             4    -6.42228E-01
     5     1.00000E+00             5     2.18968E-01             5     8.79073E-03             5    -3.68317E-02
     6    -1.98672E-02             6     3.99552E-02             6    -3.38235E-02             6    -9.75888E-02
     7     3.69816E-02             7    -7.45963E-02             7    -1.12948E-01             7    -1.47108E-01
     8     3.38449E-02             8    -4.14909E-02             8     8.02040E-02             8     1.07168E-01
     9     1.07796E-01             9    -3.11722E-01             9    -1.46801E-02             9     6.44202E-02
    10     7.48214E-03            10    -7.39842E-02            10    -8.34200E-03            10    -1.65547E-02
    11     2.81506E-02            11    -4.16076E-02            11     8.75499E-04            11    -2.61716E-02
    12    -5.38245E-03            12     9.32108E-03            12     8.33484E-03            12     6.28325E-03
    13    -5.68557E-02            13    -5.51063E-03            13    -3.51257E-02            13    -2.54919E-02
    14    -1.37043E-04            14     1.09163E-01            14     8.90834E-02            14     1.62169E-01
    15     1.98005E-01            15    -9.29336E-01            15    -2.19305E-01            15     2.29506E-01
    16    -9.93461E-03            16     5.71802E-02            16     2.10701E-02            16     3.27628E-02
    17    -1.21390E-01            17     1.10695E-01            17     1.27632E-02            17     6.68269E-02
    18     4.35846E-03            18    -7.04012E-03            18    -4.71617E-03            18    -4.61469E-03
    19     2.33267E-02            19    -1.15115E-02            19    -1.25201E-01            19    -2.04149E-01
    20    -2.45857E-02            20    -9.64206E-02            20    -2.68434E-01            20    -2.98086E-01
    21    -2.33357E-01            21     1.00000E+00            21     5.35694E-02            21    -8.14637E-02
    22    -2.25914E-02            22     8.17718E-02            22     7.19713E-03            22     2.37277E-02
    23     1.99088E-01            23    -8.95575E-01            23    -5.30565E-02            23     1.02178E-01
    24    -2.24405E-02            24    -7.47843E-02            24    -2.71300E-01            24    -3.17852E-01
    25     2.56689E-03            25    -2.20265E-02            25     7.30953E-02            25    -9.98169E-03
    26     2.42388E-03            26    -2.37506E-02            26     1.09091E-01            26     1.72802E-03
    27     1.71842E-02            27    -2.43996E-01            27     1.00000E+00            27    -1.75060E-01
    28     3.10721E-03            28    -4.47772E-02            28     1.86818E-01            28    -3.28830E-02
    29    -3.17418E-06            29    -1.72445E-05            29    -6.81147E-06            29     3.25838E-05
    30     5.30158E-04            30     2.74414E-03            30    -1.38358E-02            30     7.72066E-04
```

The response levels at various locations throughout the structure are fairly high as might be expected since it is a stiff structure with few riveted or bolted joints and the input levels are fairly high, i.e., on the order of 8 to 12 grms. However, the Up and East Sensor films have survived these environments with few film perforations, and it is expected that the actual Subpack 2 environment for the LEAM will be somewhat less than the input levels used here for Launch and Boost.

The QUAL operating environment was applied to the vibration test model in the ALSEP Y direction and there was little significant difference in the response characteristics as compared to the Launch and Boost environment tests in the same direction. Therefore these curves are not included in this report.

5.0 FUTURE EFFORTS

The flight model hardware is presently considered to be the same as the DVT model hardware with the exception of the interface mounting bracket which will be of fiberglass and of slightly different configuration than the present titanium bracket on the DVT model. While the dynamic response effects due to this change are not considered to be large, some computations should be made to evaluate the situation.

Another variation considered but not used due to lack of dynamic motion envelope space for the Up Sensor was the use of small rubber grommet isolators at the four attachment points of the UP and East Sensors. This condition should also be investigated analytically as a possible back up method of alleviating the vibration environment at these two sensors if required.

6.0 DYNAMIC LOADS AND DISPLACEMENTS

The loads and displacements for the c.g. coordinates were computed and are given in Table 5 for the random loading cases since these are the highest set of loads when sinusoidal and random responses are compared.

The values in the table are root mean square or 1 sigma value and should be multiplied by 3 to obtain the 3 sigma loads. The values represent the c.g. motion of the internal packages and outer case relative to the base attachment. The deflections are all quite small in spite of the large load rms values, some in excess of a 30 g, 3 sigma value. These load values were fed back to the EASE structural model and the resulting internal beam and triangular plate stresses observed. No critically large stresses were indicated. This was borne out by the vibration testing also in that no structural failures occurred. The loads associated with the outer case are mostly the result of the high frequency portion of the response curves, Figures 19 through 21, and are thus of less structural significance than if they occurred down around 100 Hz and below.

X - AXIS

INTERNAL LOADS		DEFLECTIONS
0.2825349E 02	1	0.6845302E-03
0.8795664E 01	2	0.3918058E-03
0.7994294E 01	3	0.1550504E-03
0.1206966E 02	4	0.9908059E-04
0.2391932E 01	5	0.2173625E-04
0.4919626E 02	6	0.4593071E-03
0.1210924E 02	7	0.2085163E-02
0.1947432E 02	8	0.9923163E-03
0.9999577E 01	9	0.3413153E-03
0.2866839E 01	10	0.5235481E-04
0.9072808E 01	11	0.4396190E-04
0.1857635E 02	12	0.3327921E-03
0.2189574E 02	13	0.1633752E-02
0.1311630E 02	14	0.4774127E-03
0.3407360E 01	15	0.2660847E-03
0.1622781E 02	16	0.1356334E-03
0.1583687E 02	17	0.1770414E-03
0.1110964E 03	18	0.1008426E-02
0.1749121E 02	19	0.2146726E-02
0.1052075E 02	20	0.6561673E-03
0.4637220E 01	21	0.3817060E-03
0.1768686E 01	22	0.5716970E-04
0.8347819E 01	23	0.8801372E-04
0.2731744E 02	24	0.4222288E-03
0.3352380E 02	25	0.1827696E-02
0.2694865E 01	26	0.8174051E-04
0.3066154E 01	27	0.1071970E-03
0.1517333E 02	28	0.1740908E-04
0.1232824E 01	29	0.2181407E-06
0.1770895E 03	30	0.2976460E-03

Y - AXIS

INTERNAL LOADS		DEFLECTIONS
0.4699725E 01	1	0.2598662E-03
0.4727887E 02	2	0.1382366E-02
0.7291987E 01	3	0.2391258E-03
0.1164324E 02	4	0.1756889E-03
0.2109453E 01	5	0.1712376E-04
0.4536253E 01	6	0.1743730E-03
0.4949179E 01	7	0.1120074E-02
0.2131302E 02	8	0.1111410E-02
0.8790855E 01	9	0.1004559E-02
0.8733991E 01	10	0.1782779E-03
0.2393989E 01	11	0.3662964E-04
0.1468319E 01	12	0.1781652E-03
0.6520692E 01	13	0.8367000E-03
0.4902934E 02	14	0.1751774E-02
0.2935559E 02	15	0.1129871E-02
0.1183002E 03	16	0.7800923E-03
0.1993475E 02	17	0.1473202E-03
0.1224118E 02	18	0.2030496E-03
0.8003691E 01	19	0.1127143E-02
0.4569955E 02	20	0.1717666E-02
0.2067805E 02	21	0.1335605E-02
0.2981126E 02	22	0.3759705E-03
0.1501229E 02	23	0.2483798E-03
0.4682443E 02	24	0.6805772E-03
0.3930743E 01	25	0.2763718E-03
0.9036000E 02	26	0.6688009E-03
0.7633794E 01	27	0.1707270E-03
0.4155867E 02	28	0.2948986E-04
0.1434556E 00	29	0.4381979E-07
0.1769173E 02	30	0.4412694E-04

Z - AXIS

INTERNAL LOADS		DEFLECTIONS
0.5321449E 01	1	0.2147176E-03
0.1525167E 02	2	0.5383282E-03
0.2868764E 02	3	0.5577032E-03
0.5225534E 02	4	0.3768525E-03
0.7635056E 01	5	0.5420594E-04
0.8518024E 01	6	0.1399258E-03
0.7193100E 01	7	0.8780633E-03
0.9412331E 01	8	0.5635072E-03
0.1197484E 02	9	0.9024052E-03
0.3253540E 02	10	0.1878311E-03
0.7533287E 01	11	0.4616115E-04
0.6668978E 01	12	0.1391113E-03
0.1011016E 02	13	0.6934039E-03
0.2655748E 02	14	0.1035016E-02
0.2949701E 02	15	0.1074332E-02
0.8247992E 02	16	0.5369184E-03
0.2642085E 02	17	0.1934168E-03
0.9152935E 01	18	0.1528865E-03
0.6288037E 01	19	0.8700886E-03
0.1879195E 02	20	0.7594300E-03
0.2102080E 02	21	0.1265072E-02
0.4292569E 02	22	0.4986881E-03
0.2875888E 02	23	0.3204360E-03
0.2528046E 02	24	0.3363488E-03
0.3151155E 01	25	0.2719031E-03
0.5889771E 01	26	0.9656223E-04
0.7034299E 02	27	0.1120440E-02
0.3784680E 03	28	0.2089016E-03
0.1089766E 01	29	0.1669216E-06
0.1618489E 02	30	0.4321655E-04

TABLE 5

ROOT MEAN SQUARE LOADS AND DEFLECTIONS

Key to Any Set of Six Values:

Internal Loads	Deflections
xxx lb.	xxx inch
xxx lb.	xxx inch
xxx lb.	xxx inch
xxx in-lb	xxx radians
xxx in-lb	xxx radians
xxx in-lb	xxx radians

Numbers 1 - 6: Up Sensor
" 7 - 12: West Sensor
" 13 - 18: Central Electronics
" 19 - 24: East Sensor
" 25 - 30: Outer Case

7.0 REFERENCES

1. ATM 1011 - LEAM Film Development Vibration Test Report - dated 11 June 1971.
2. BSR 3095 DYNLOAD - An Integrated Dynamics and Loads Analysis Program - March, 1971.
3. LTR - 9712-76 - Array E Subpack No. 2 Subsystem Dynamic Environment - dated 2 Nov. 1971.
4. ATM 964 - ALSEP Array E Component Non-Operating Vibration Specifications Dated 2 Feb. 1971.

LEAM STOWED CKAGE

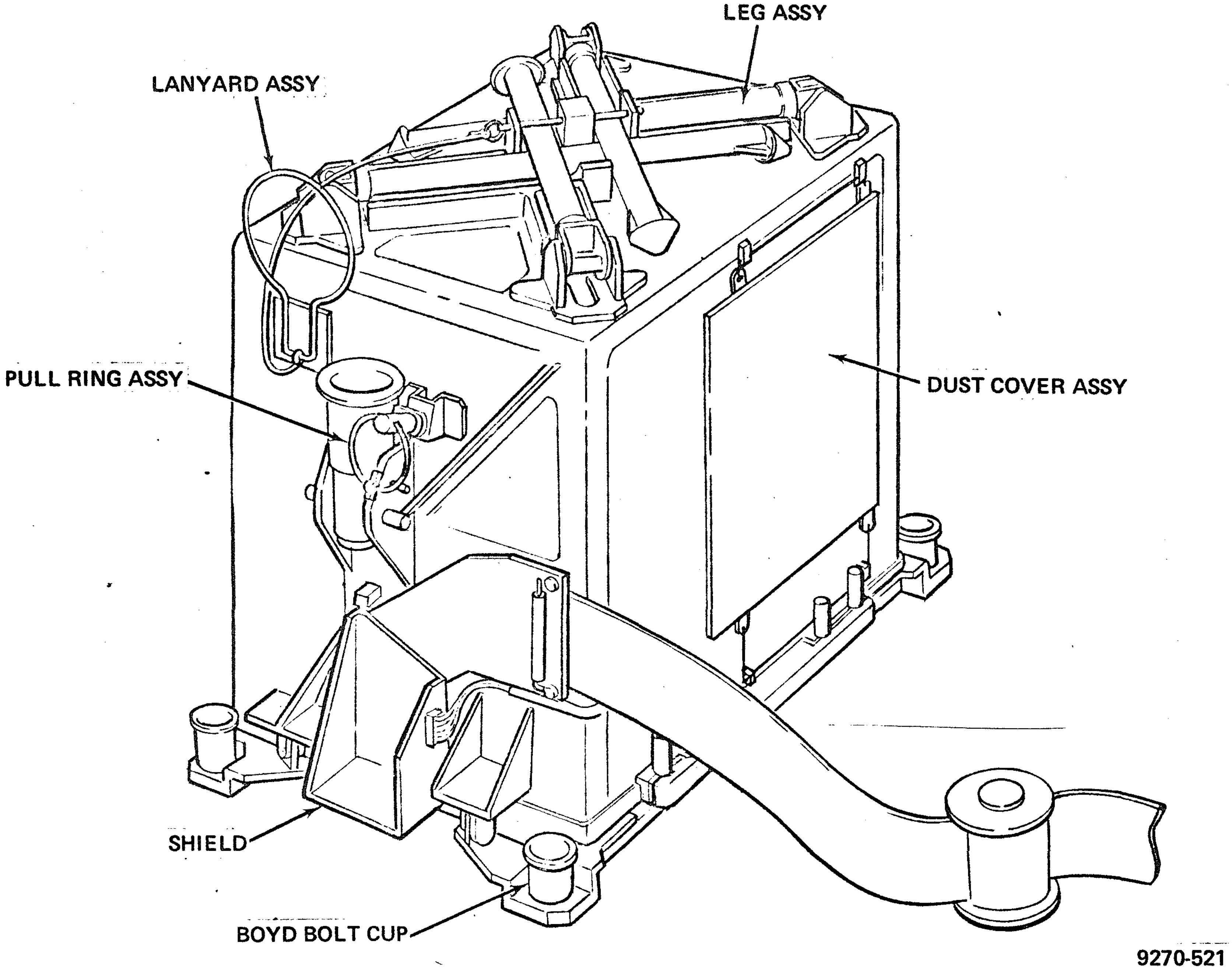


FIGURE 1

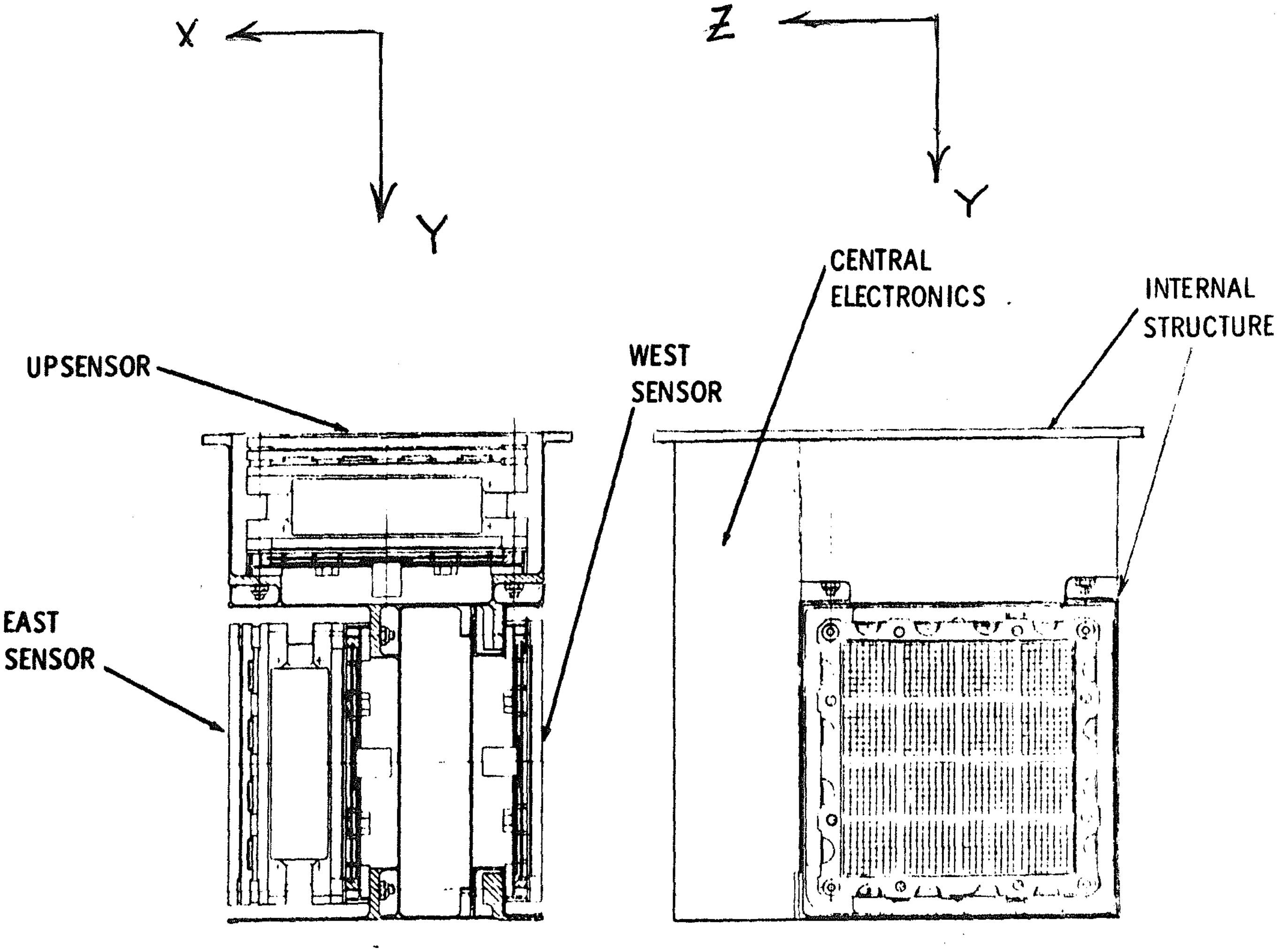


FIGURE 2 LEAM INTERNAL VIEWS

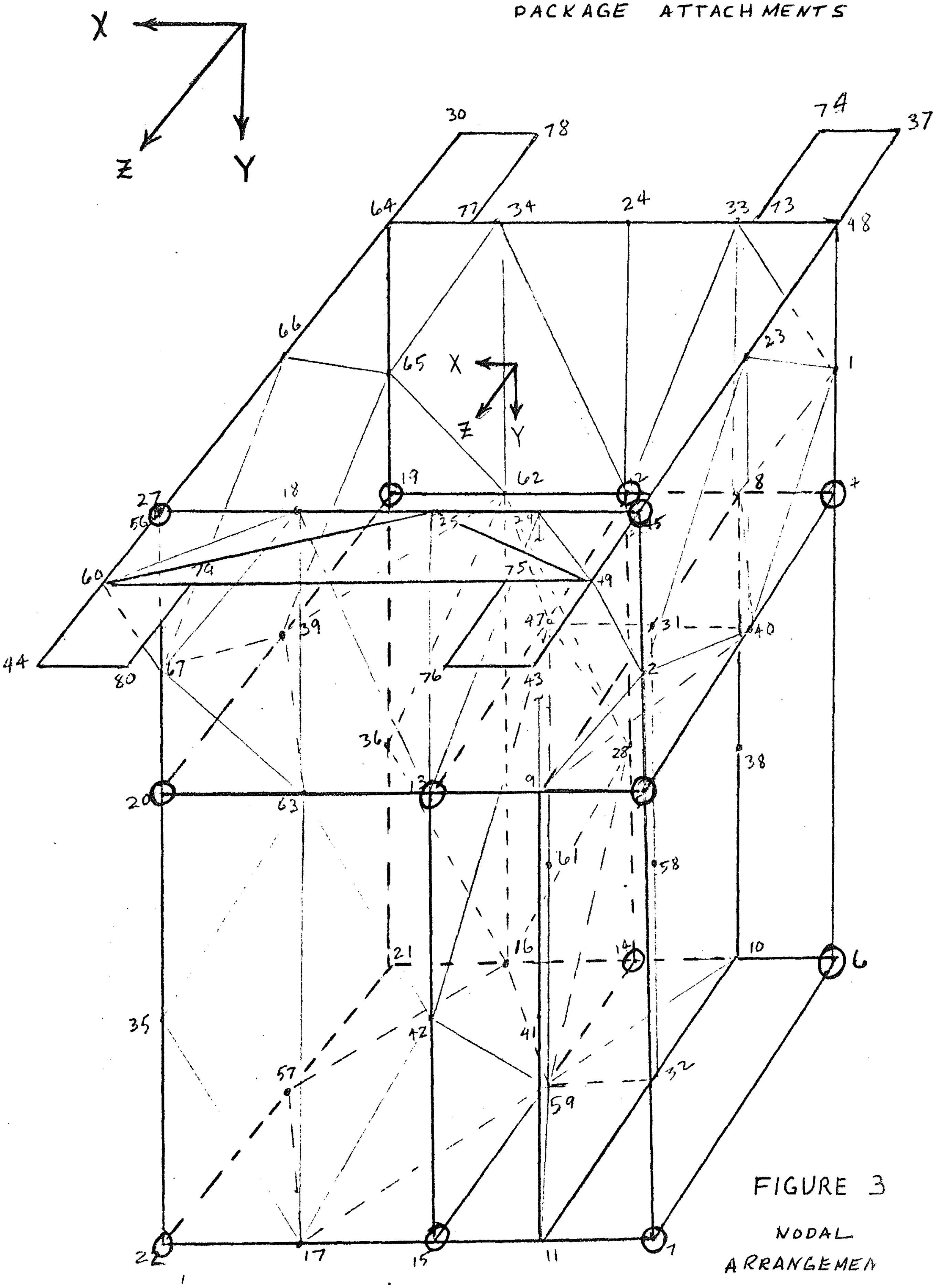


FIGURE 3

NODAL
ARRANGEMEN

Figure 4

SINUSOIDAL VIBRATION (INPUTS)

Axis:

Sweep Rate:

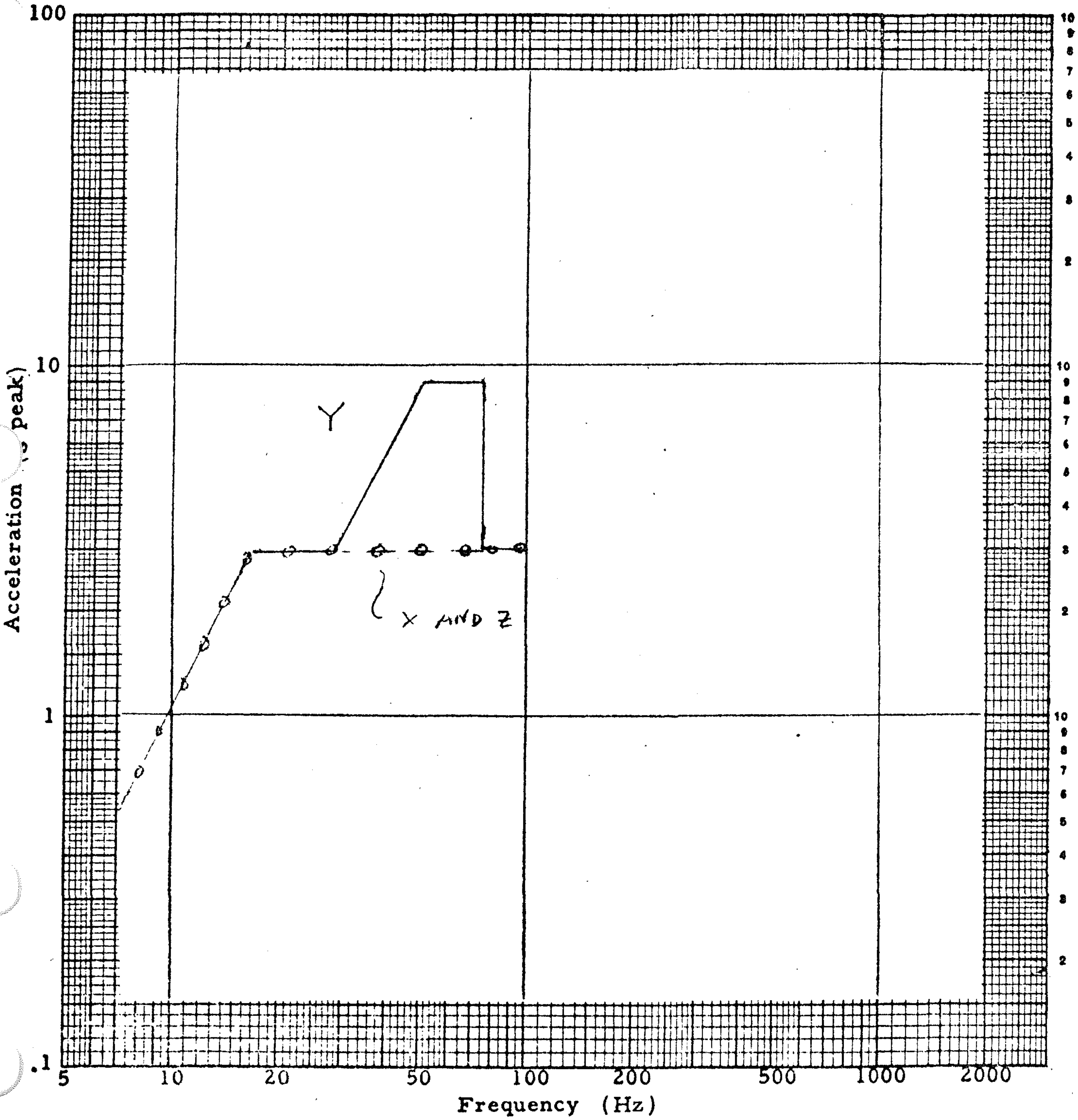
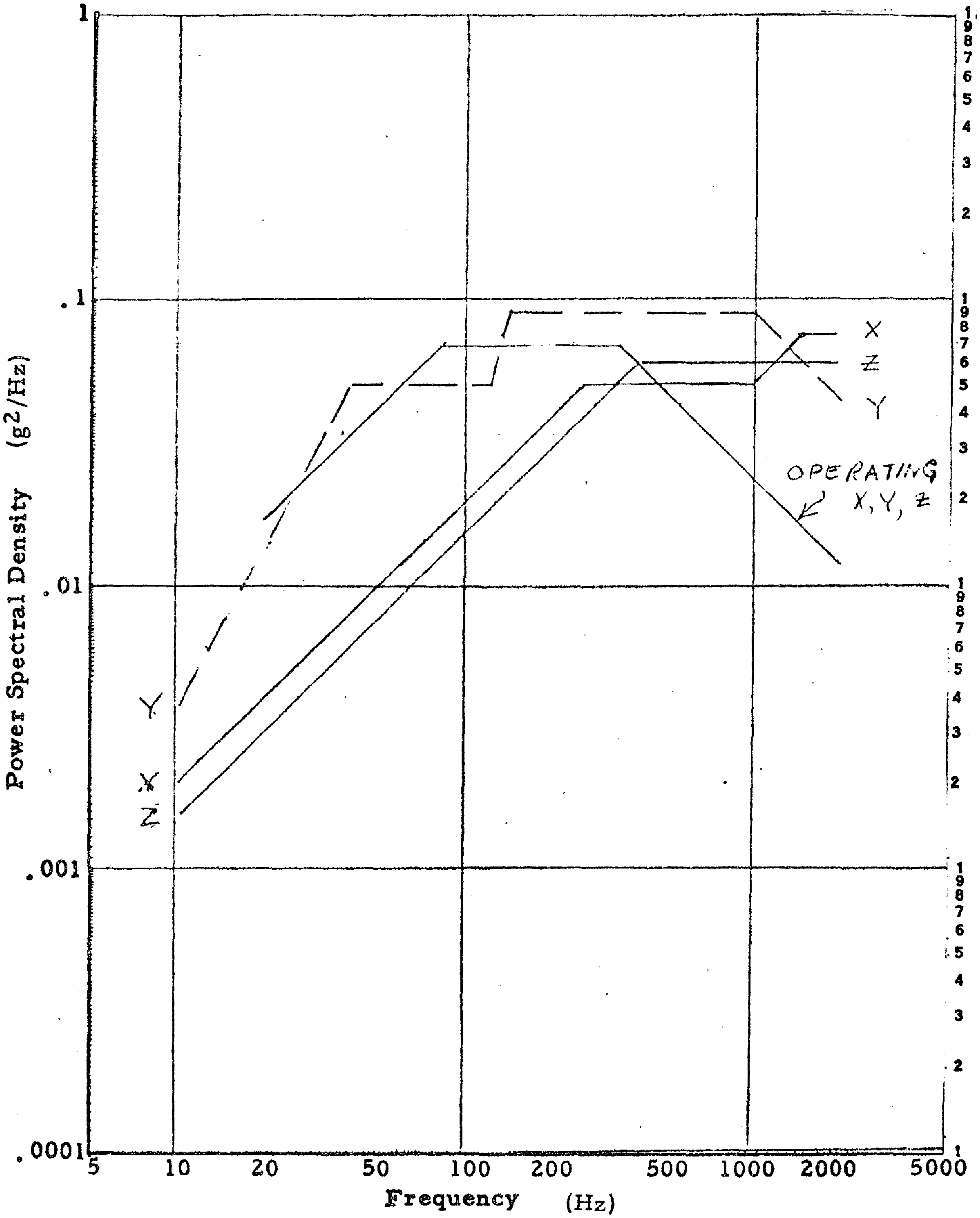


Figure 5

Axis:

RANDOM VIBRATION SPECTRUM (INPUTS)

Duration:

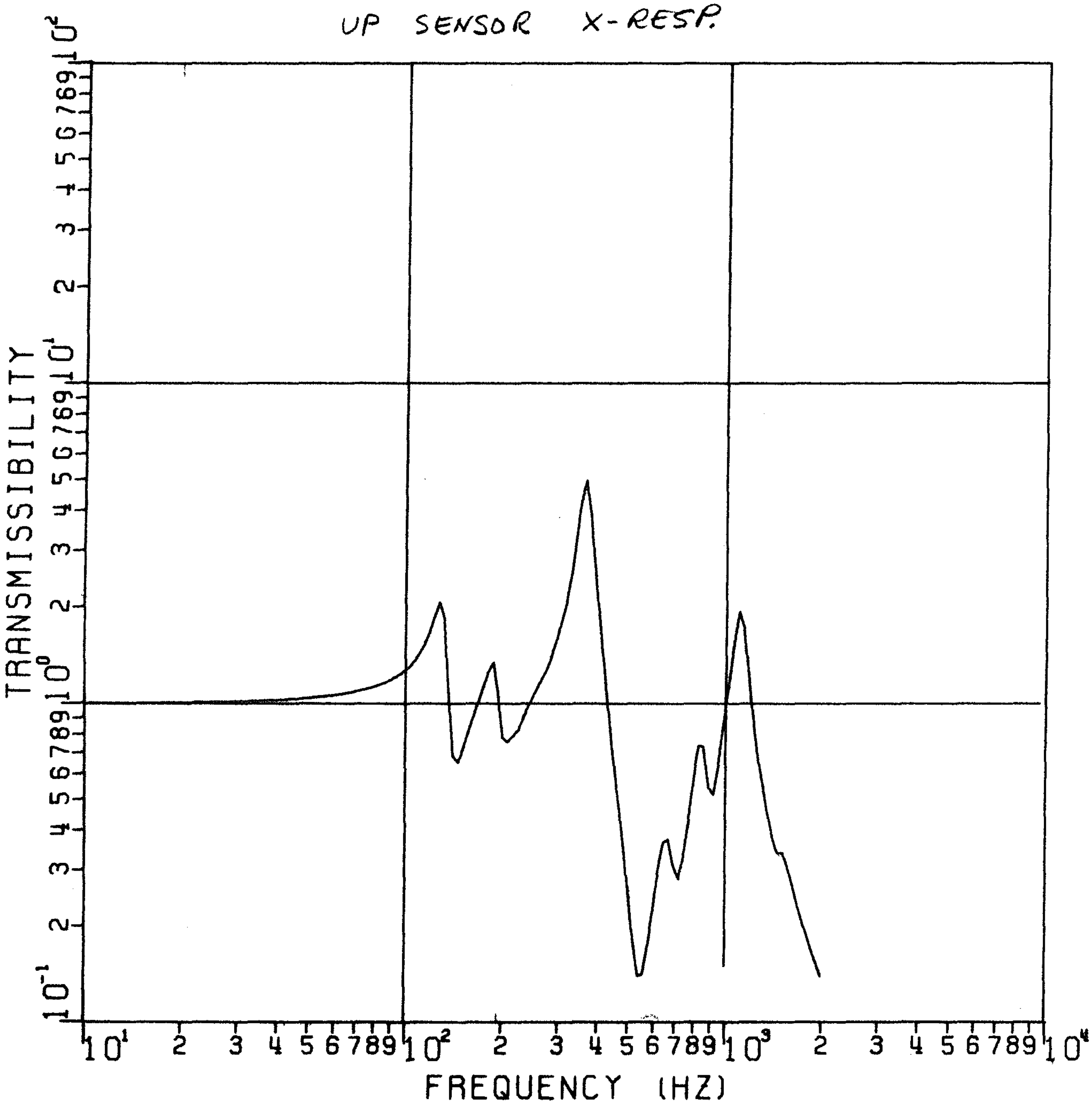


LEAM DVT FREQ. RESP., X-AXIS FORCING, L&B

FIGURE 6a TRANSMISSIBILITY

LOCATION 1

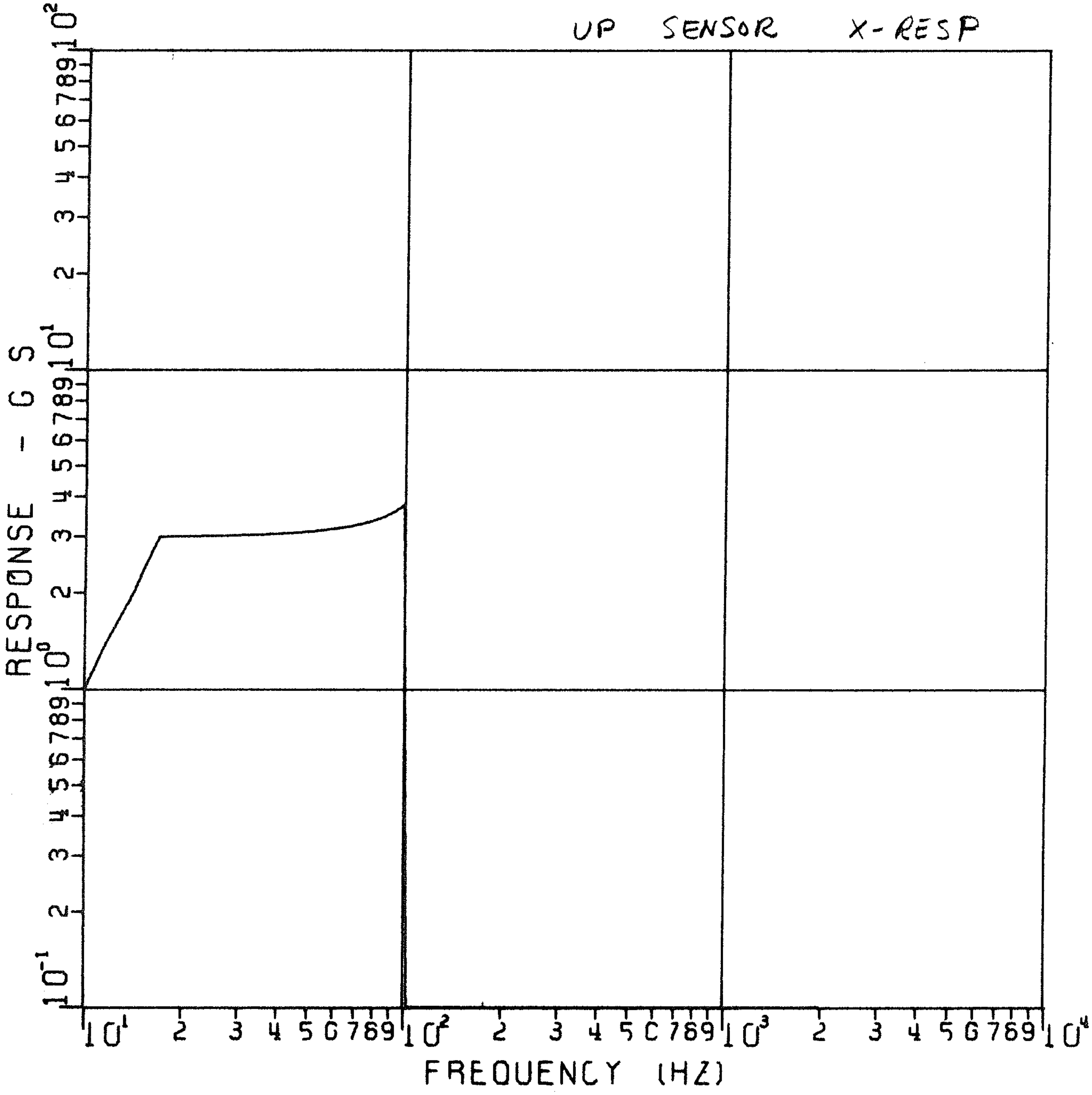
UP SENSOR X-RESP.



LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 6 b SINE RESPONSE

LOCATION 1

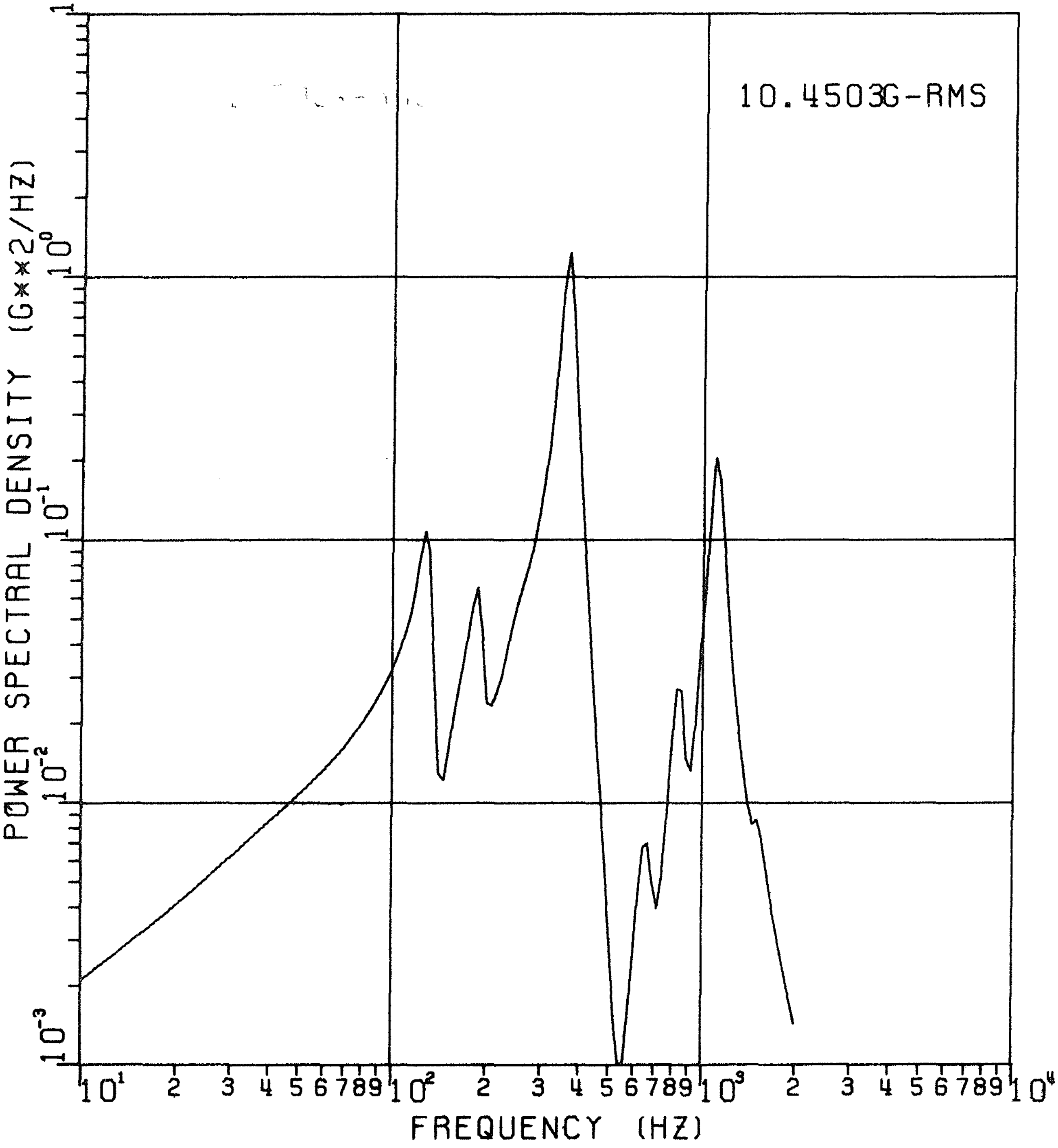


LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 6c RANDOM VIBRATION SPECTRUM

LOCATION 1

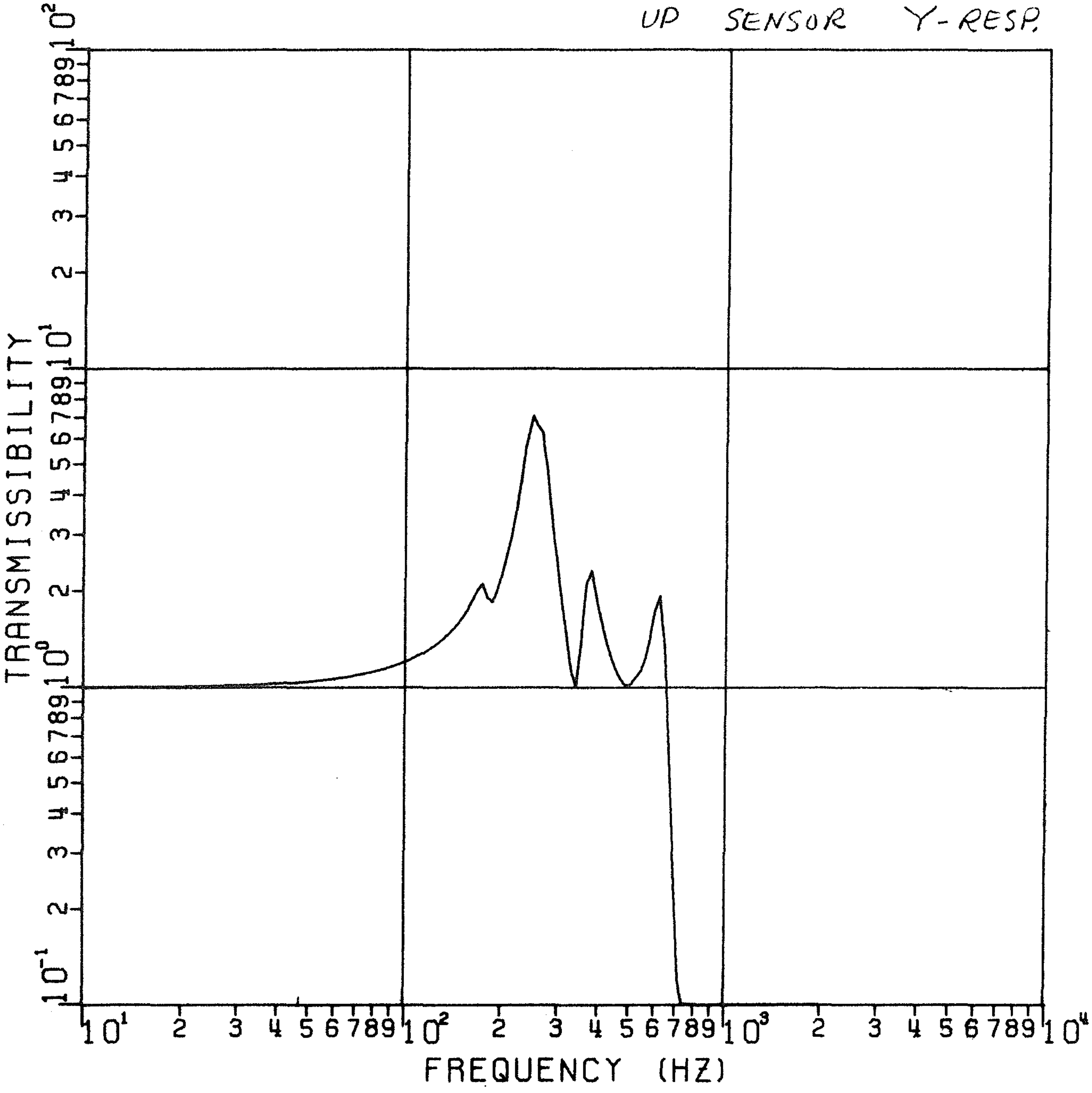
UP SENSOR X-RESP.



LEAM DVT FREQ. RESP.,Y-AXIS FORCING,L&B

FIGURE 7a TRANSMISSIBILITY

LOCATION 2

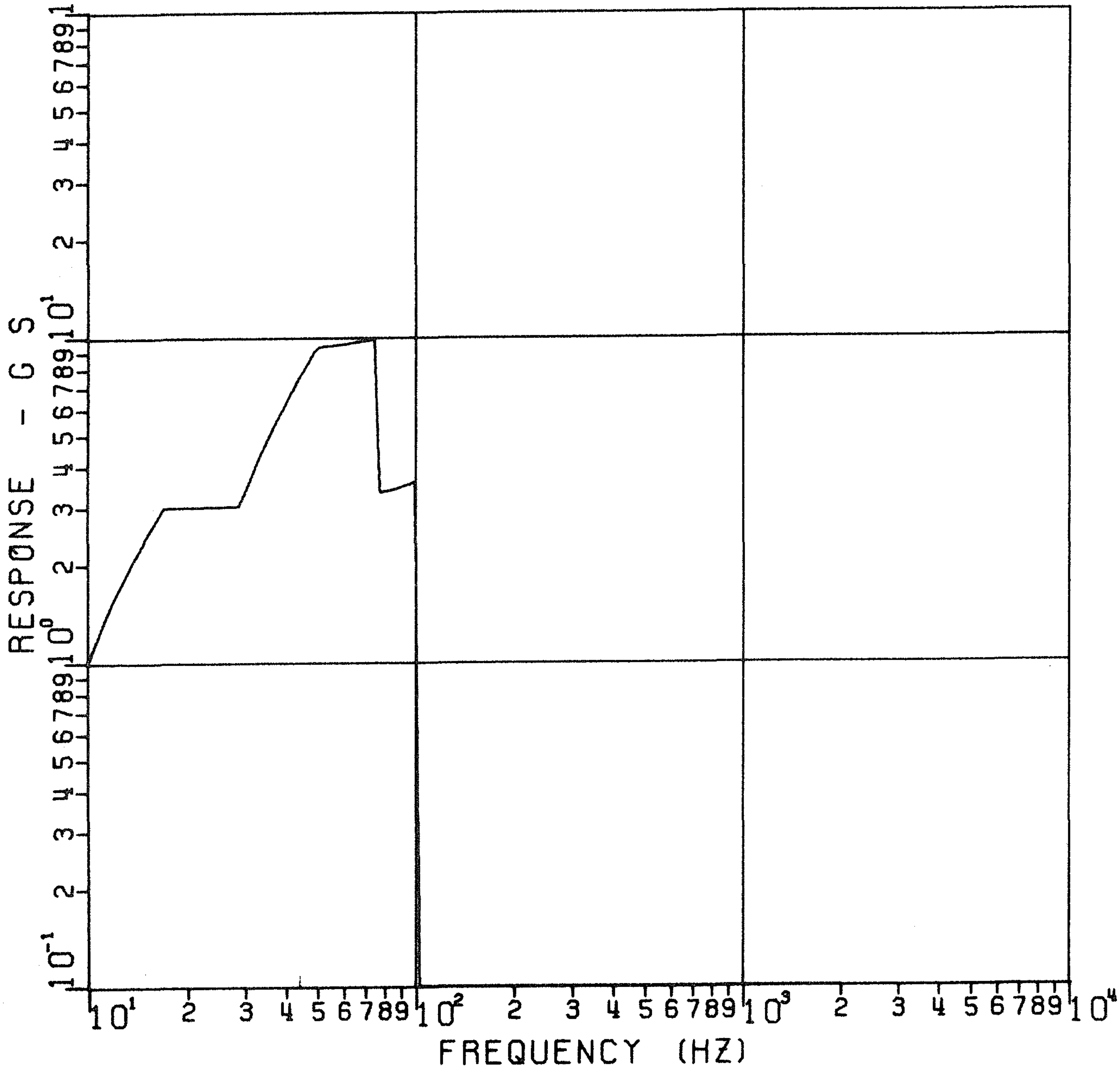


LEAM DVT FREQ. RESP., Y-AXIS FORCING, L&B

FIGURE 7b SINE RESPONSE

LOCATION 2

UP SENSOR Y-RESP

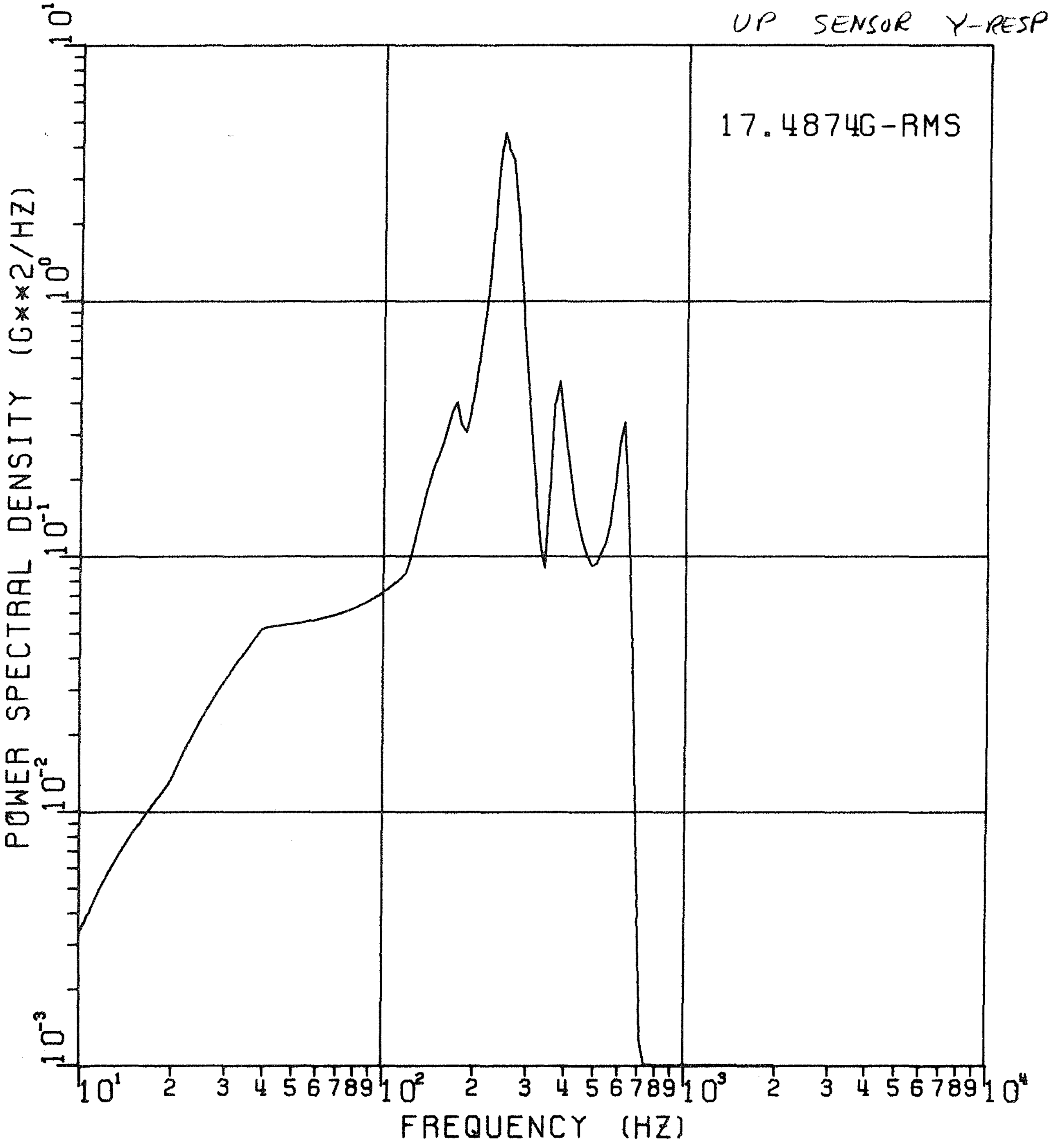


LEAM DVT FREQ. RESP., Y-AXIS FORCING, L&B

FIGURE 7c RANDOM VIBRATION SPECTRUM

LOCATION 2

UP SENSOR Y-RESP



Bendix Aerospace Systems Division

SYSTEMS TEST DEPARTMENT

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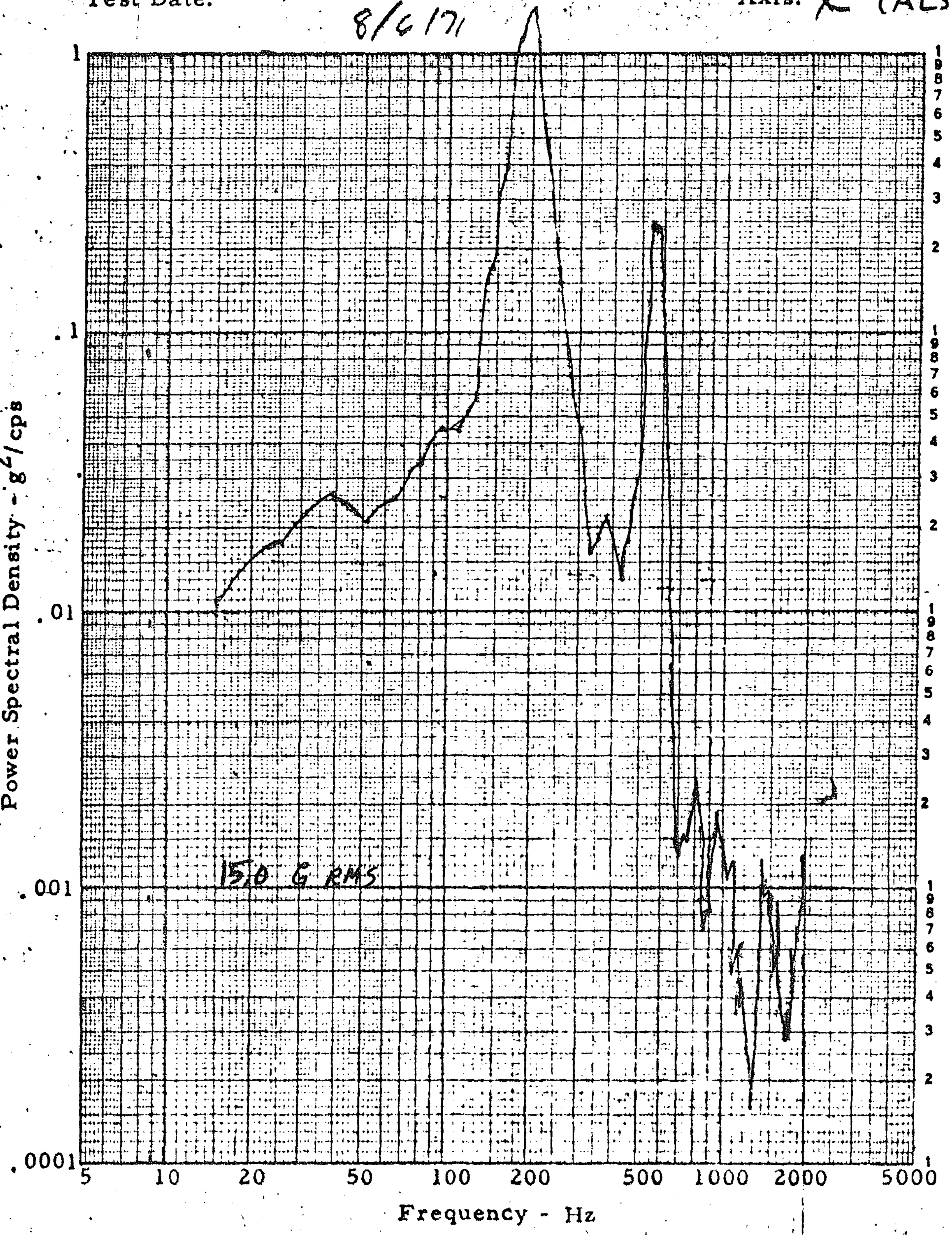
Figure 7d

RANDOM VIBRATION SPECTRUM

ACC # 5

Test: L. D. RANDOM
Test Item: LEAM ENG
Test Date: 8/6/71
SN:
Axis: X (ALSEP)



15.0 G RMS

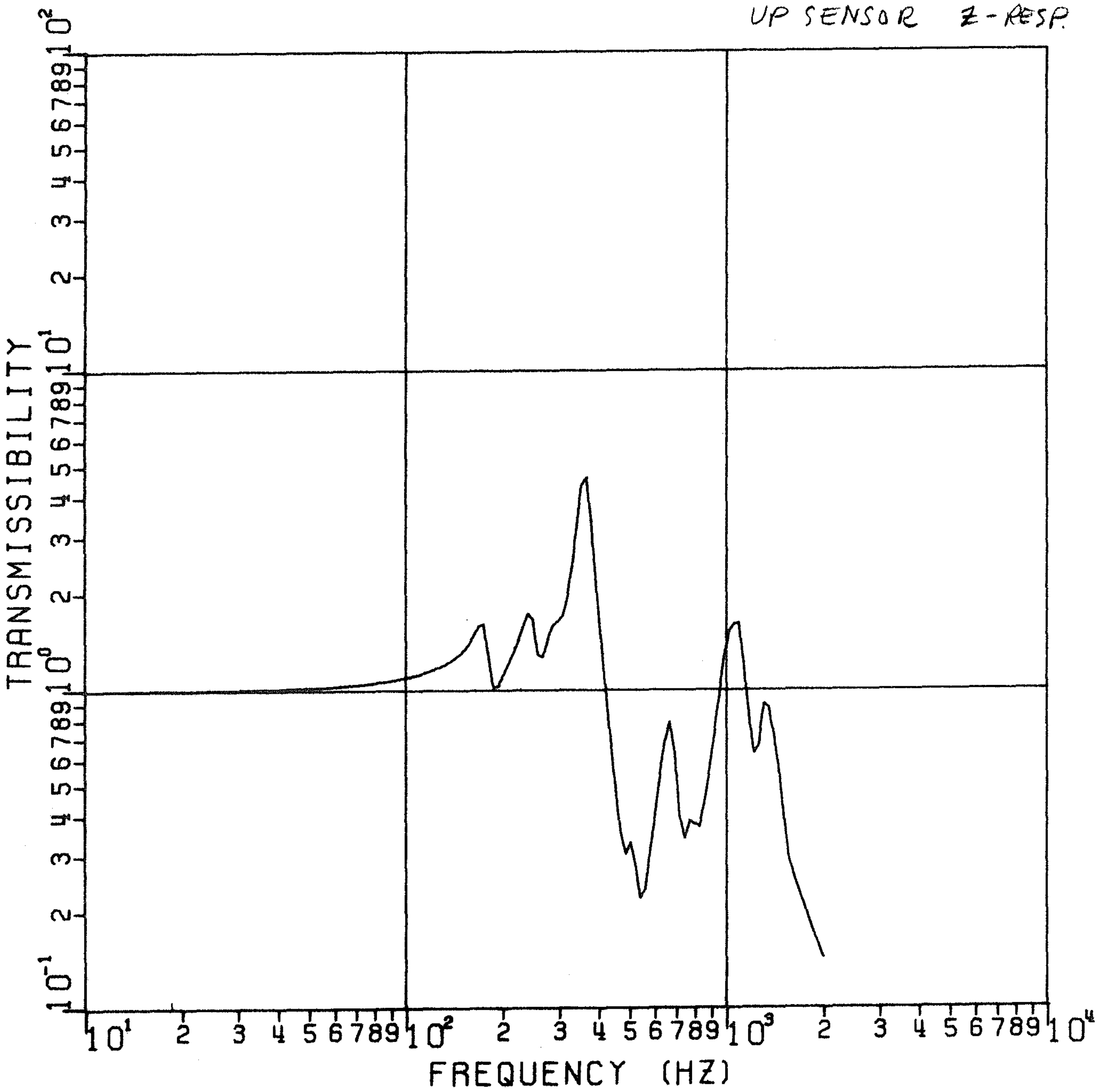
150

LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 8 a TRANSMISSIBILITY

LOCATION 3

UP SENSOR Z-RESP.

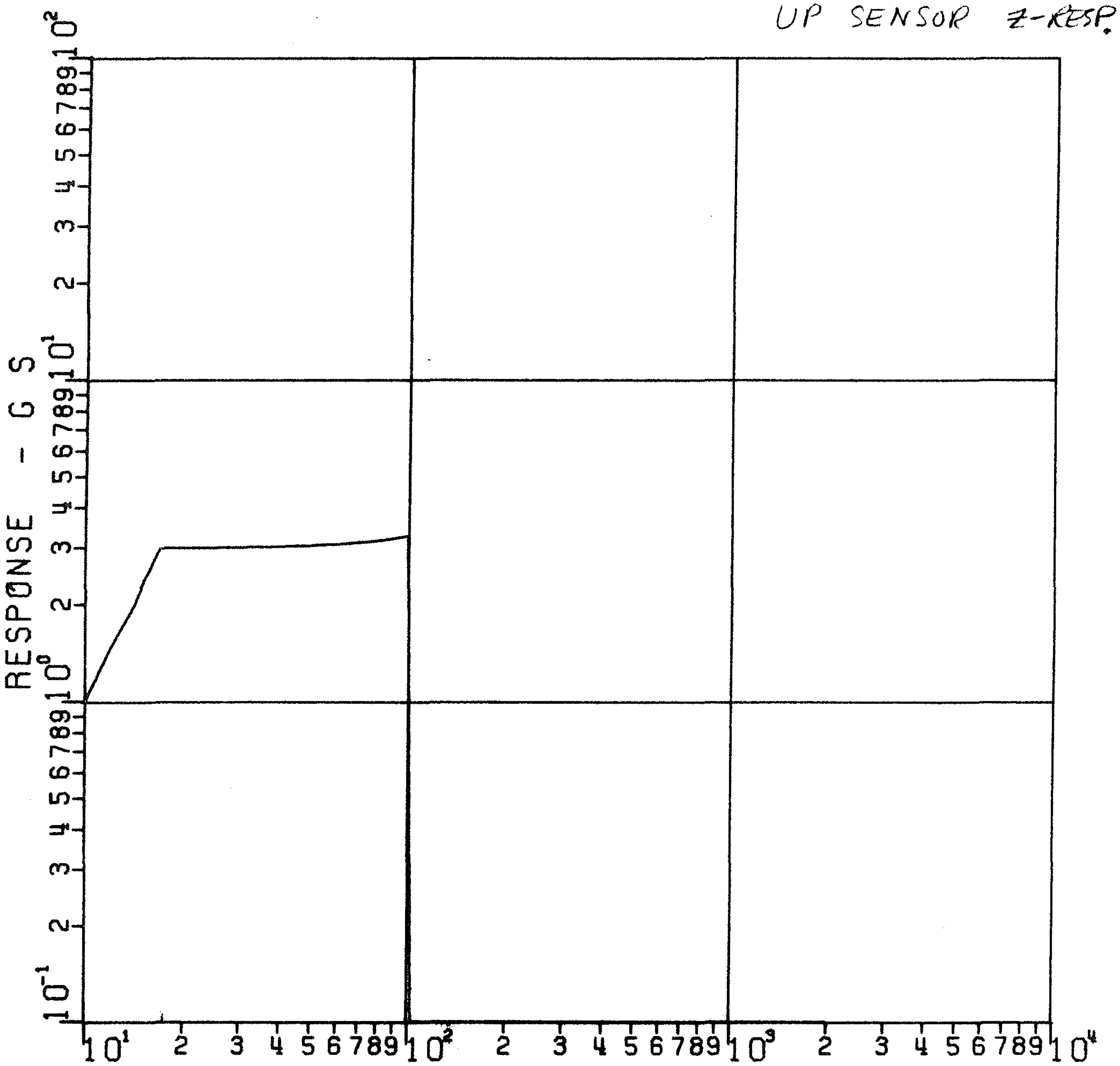


LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 8b SINE RESPONSE

LOCATION 3

UP SENSOR ~~Z~~-RESP.

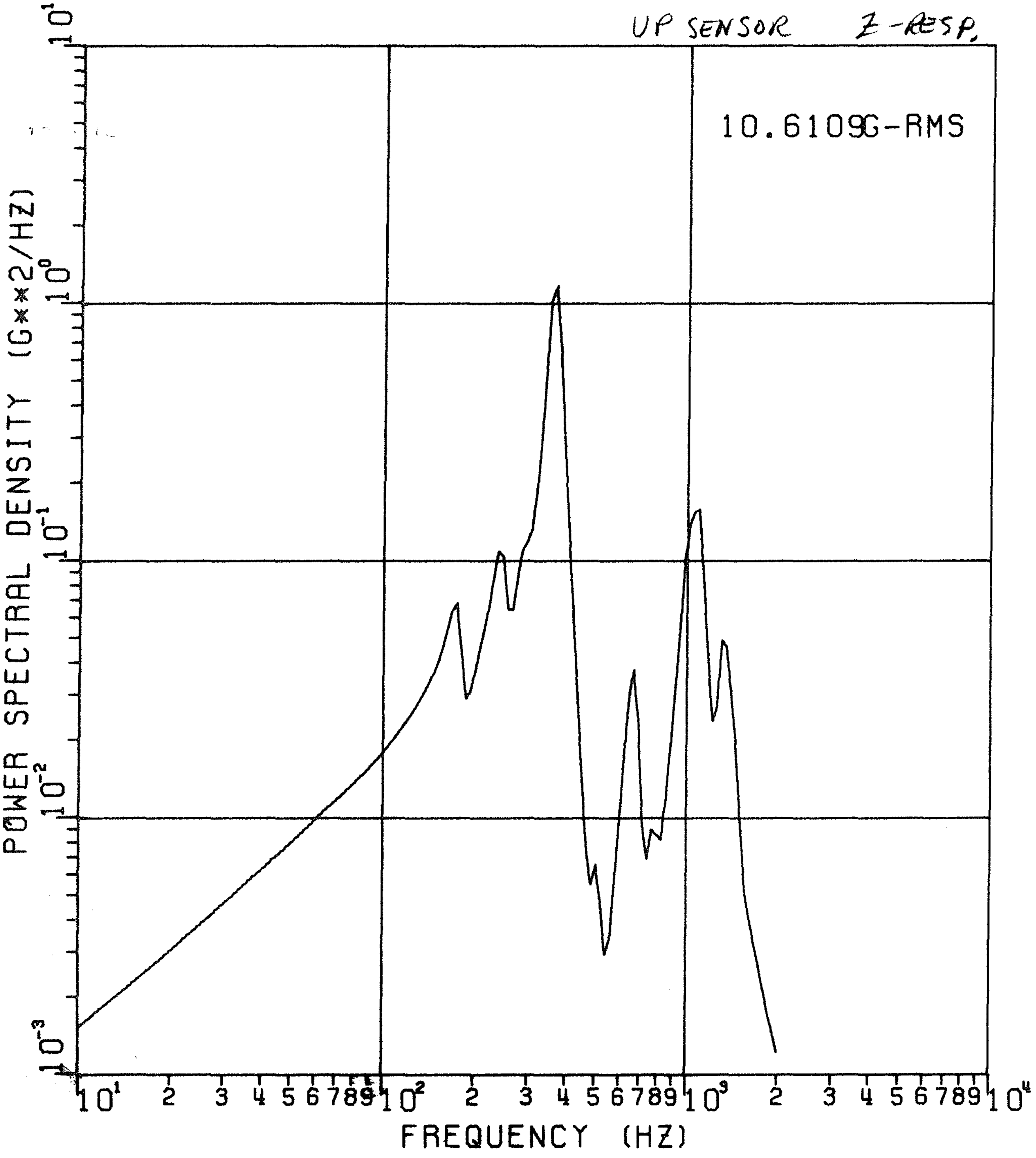


LEAM DVT FREQ. RESP., Z-AXIS FORCING, L&B

FIGURE 8c RANDOM VIBRATION SPECTRUM

LOCATION 3

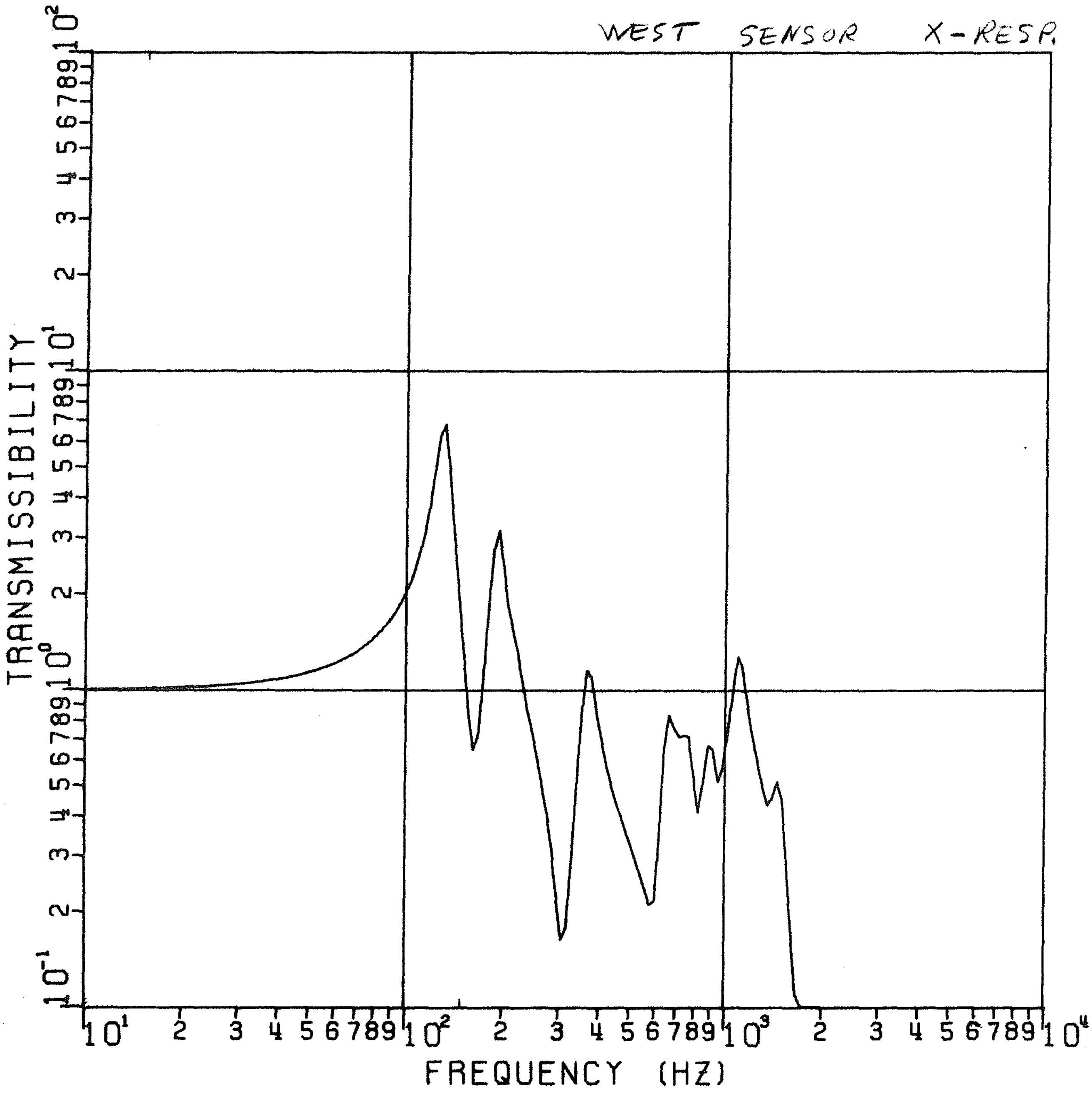
UP SENSOR Z-RESP.



LEAM DVT FREQ. RESP., X-AXIS FORCING, L&B

FIGURE 9a TRANSMISSIBILITY

LOCATION 7

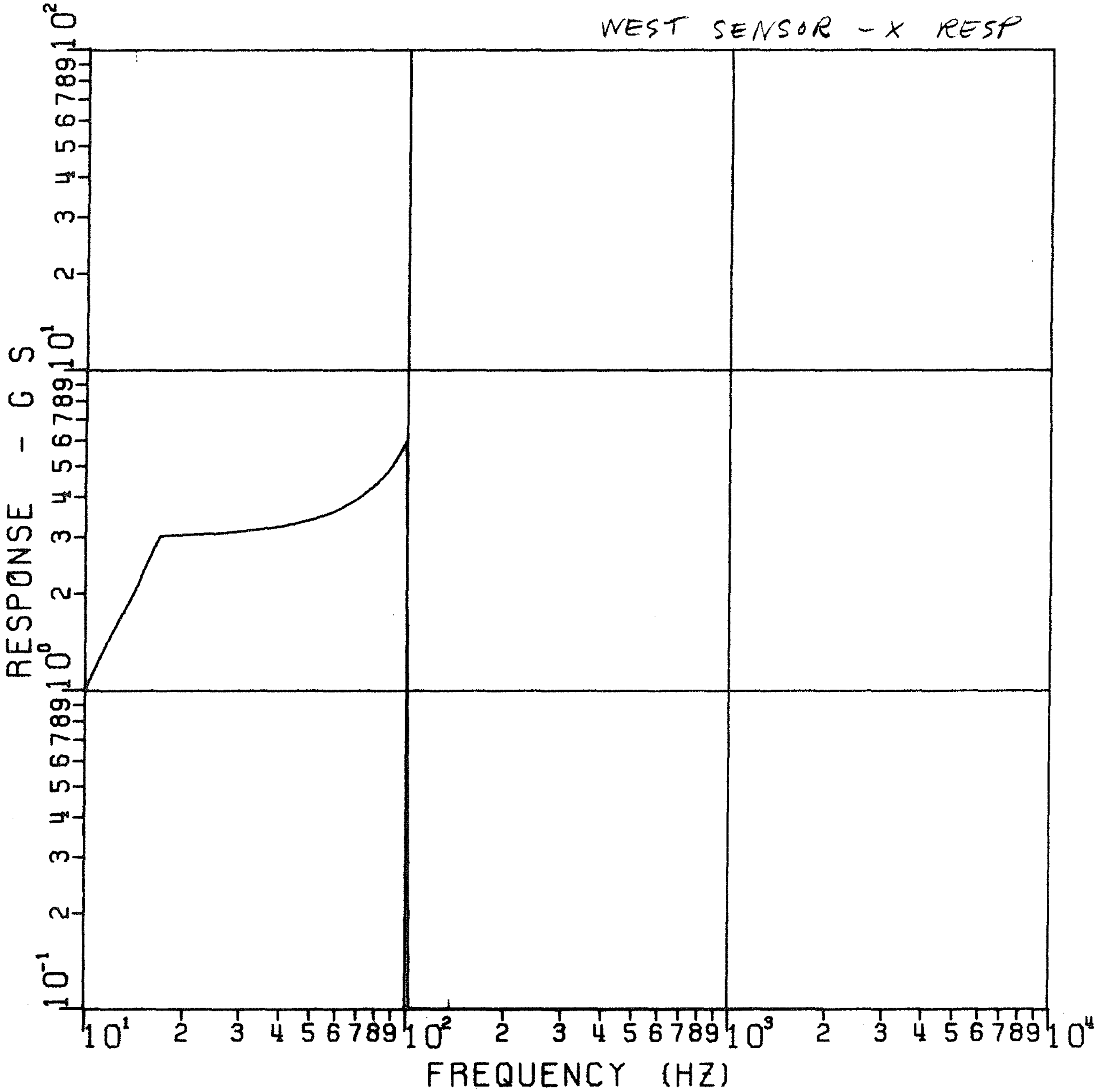


LEAM DVT FREQ. RESP., X-AXIS FORCING, L&B

FIGURE 96 SINE RESPONSE

LOCATION 7

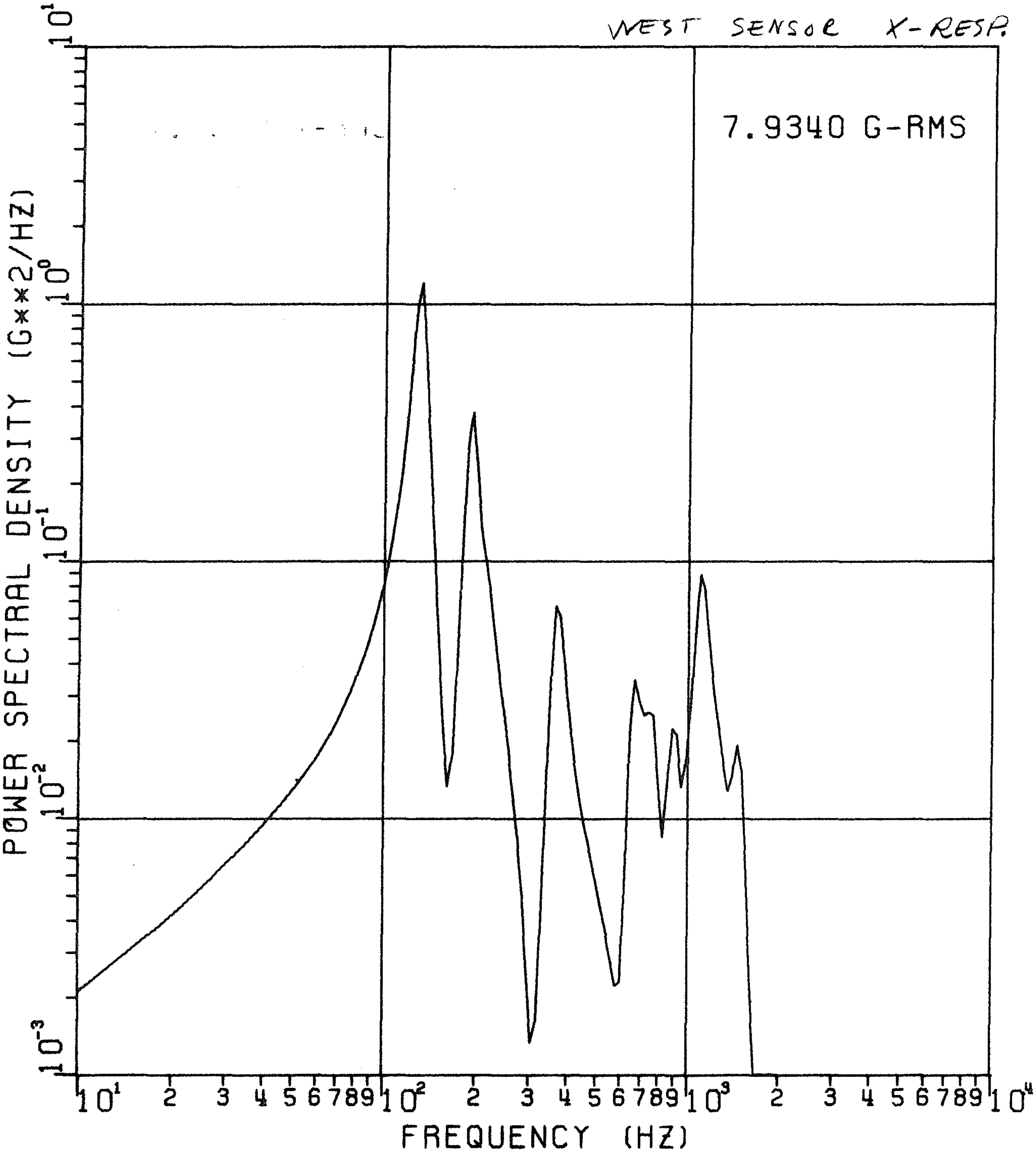
WEST SENSOR - X RESP



LEAM DVT FREQ. RESP., X-AXIS FORCING, L&B

FIGURE 9c RANDOM VIBRATION SPECTRUM

LOCATION 7



Bendix Aerospace Systems Division

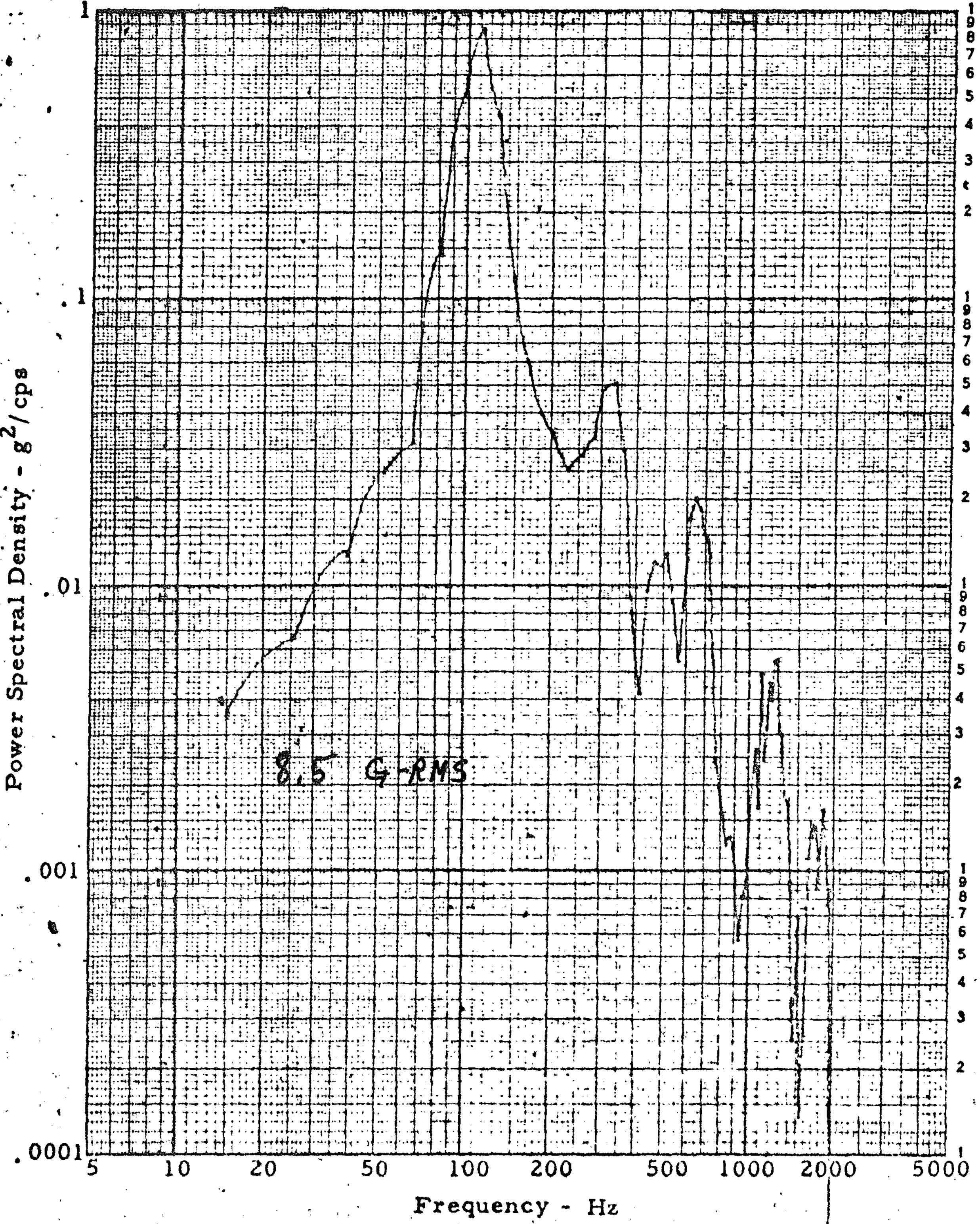
SYSTEMS TEST DEPARTMENT

TR
Figure 9d

RANDOM VIBRATION SPECTRUM

ACC# 4

Test: L&B RANDOM
Test Item: LEAM ENG.
Test Date: 8/6/71
SN:
Axis: Y (ALSEP)

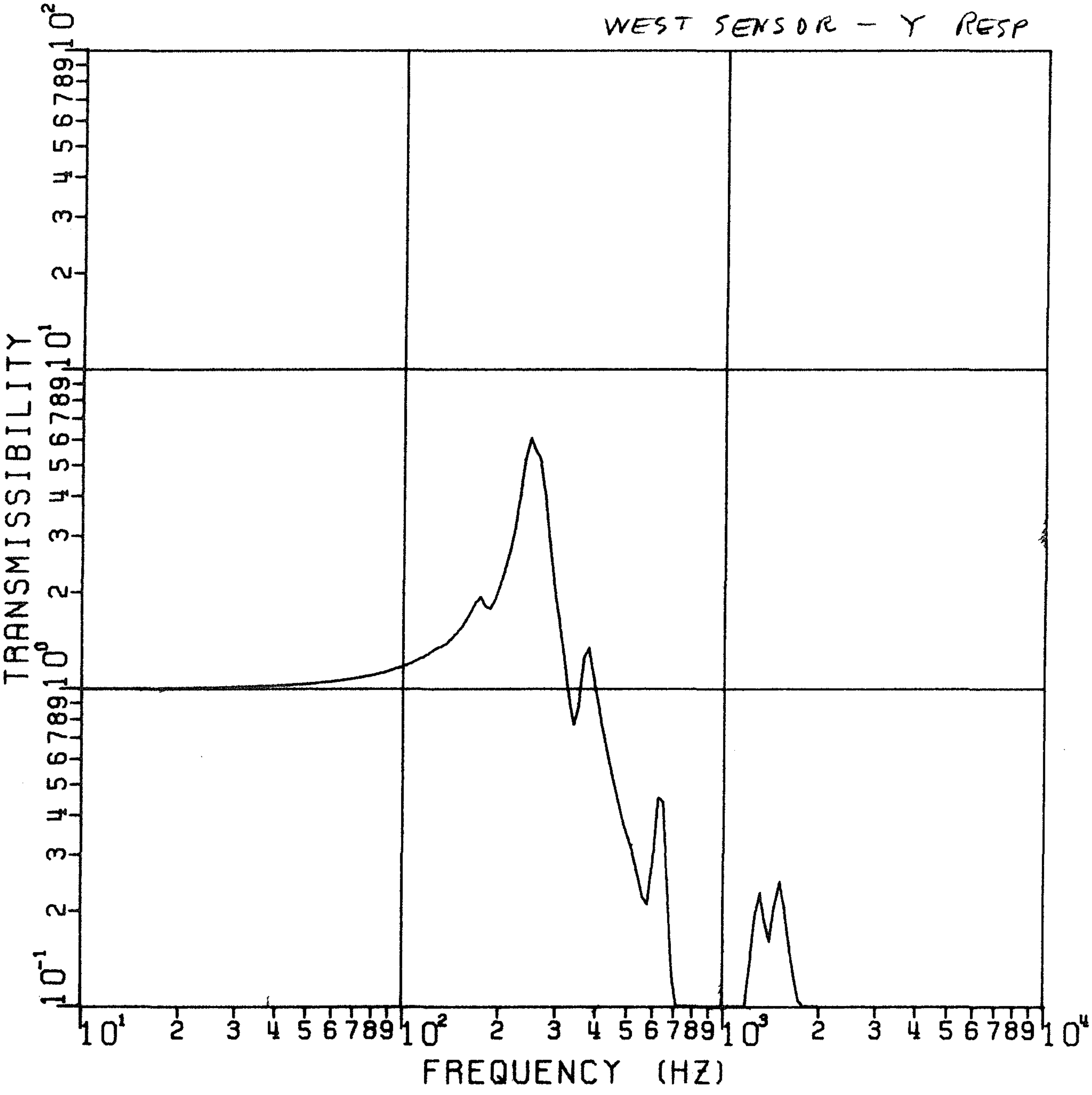


440-13A

LEAM DVT FREQ. RESP.,Y-AXIS FØRCING,L&B

FIGURE 10a TRANSMISSIBILITY

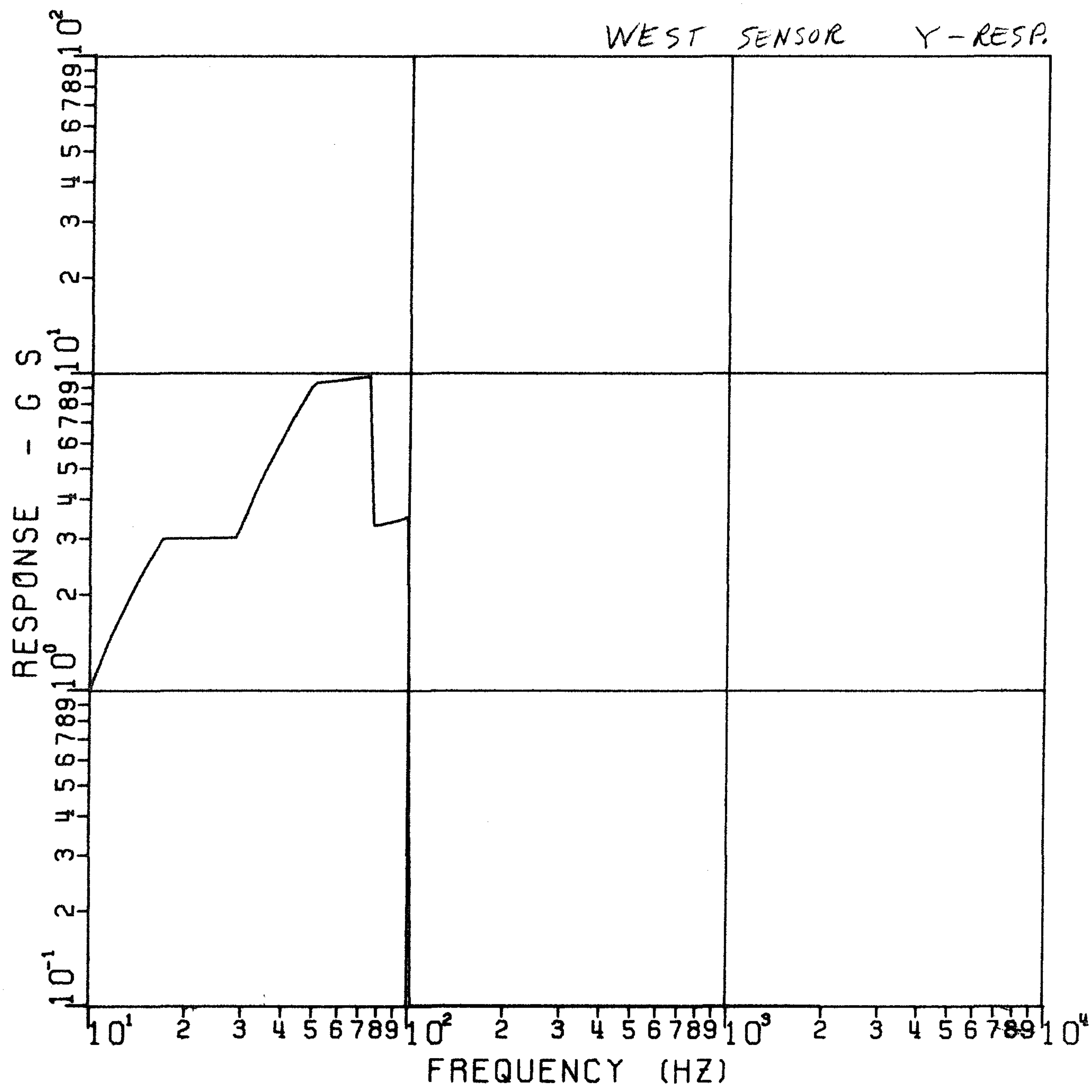
LOCATIØN 8



LEAM DVT FREQ. RESP.,Y-AXIS FORCING,L&B

FIGURE 10b SINE RESPONSE

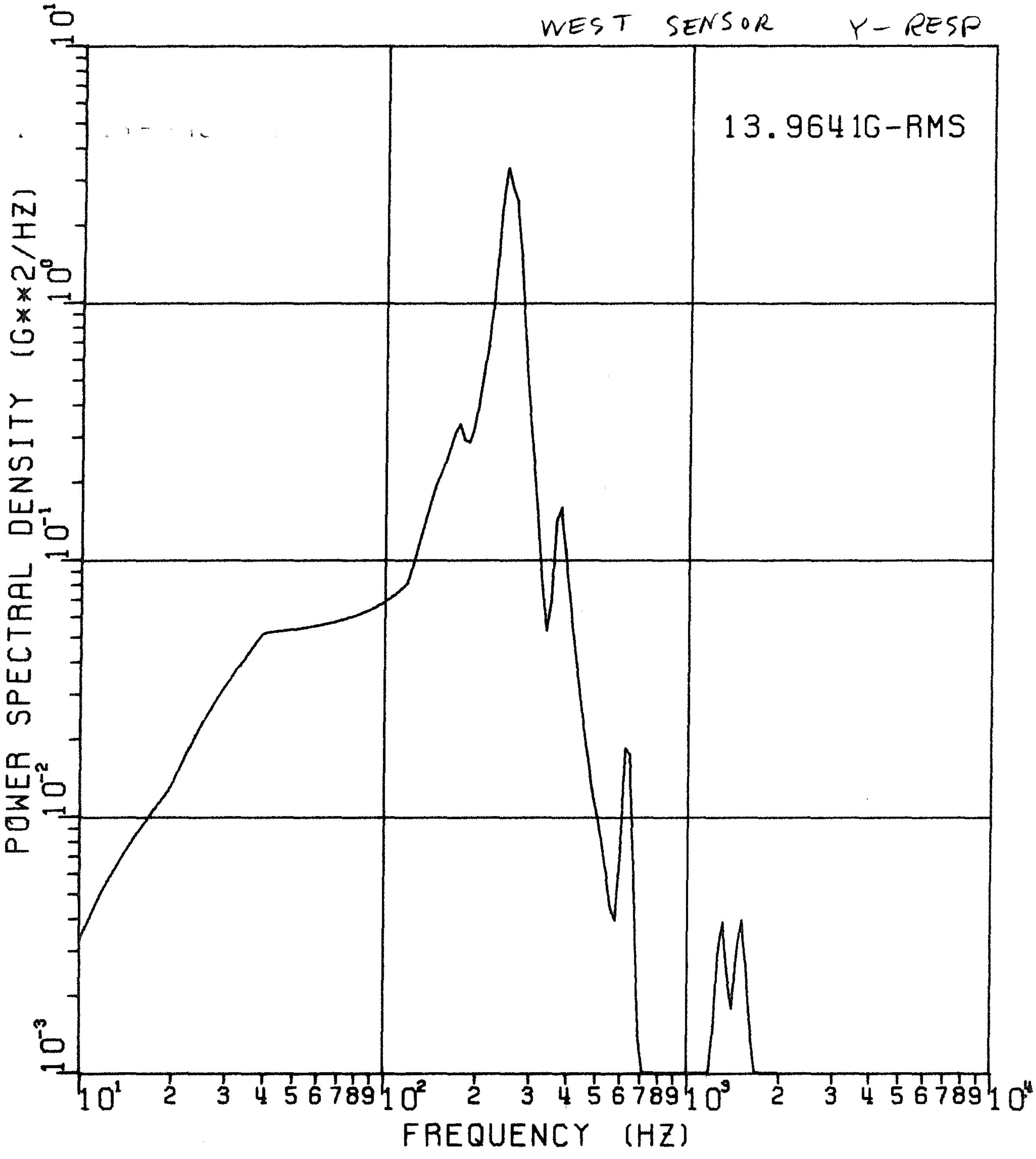
LOCATION 8



LEAM DVT FREQ. RESP.,Y-AXIS FORCING,L&B

FIGURE 10c RANDOM VIBRATION SPECTRUM

LOCATION 8

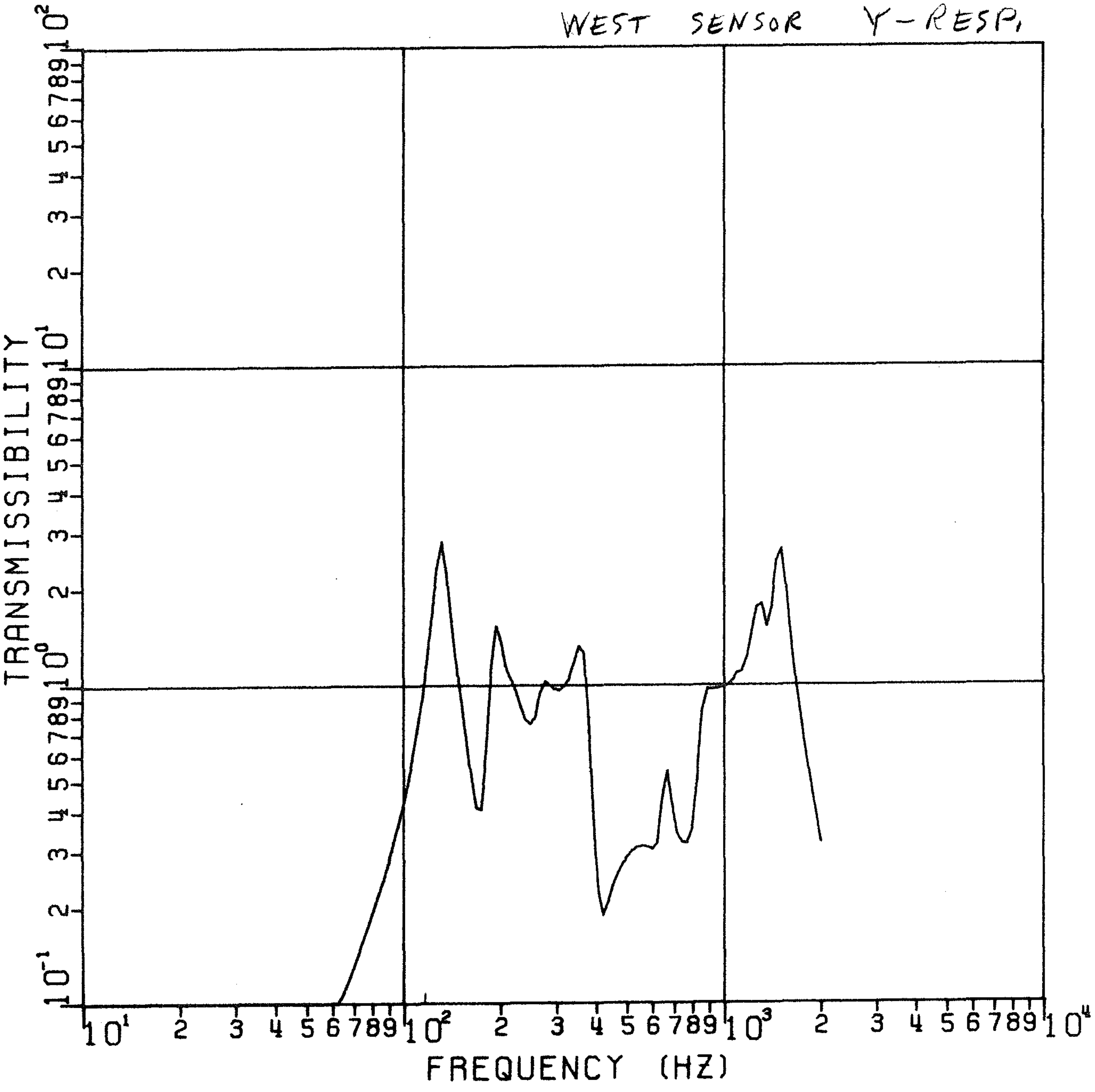


LEAM DVT FREQ. RESP., X-AXIS FORCING, L&B

FIGURE 11 a TRANSMISSIBILITY

LOCATION 8

WEST SENSOR Y-RESP.

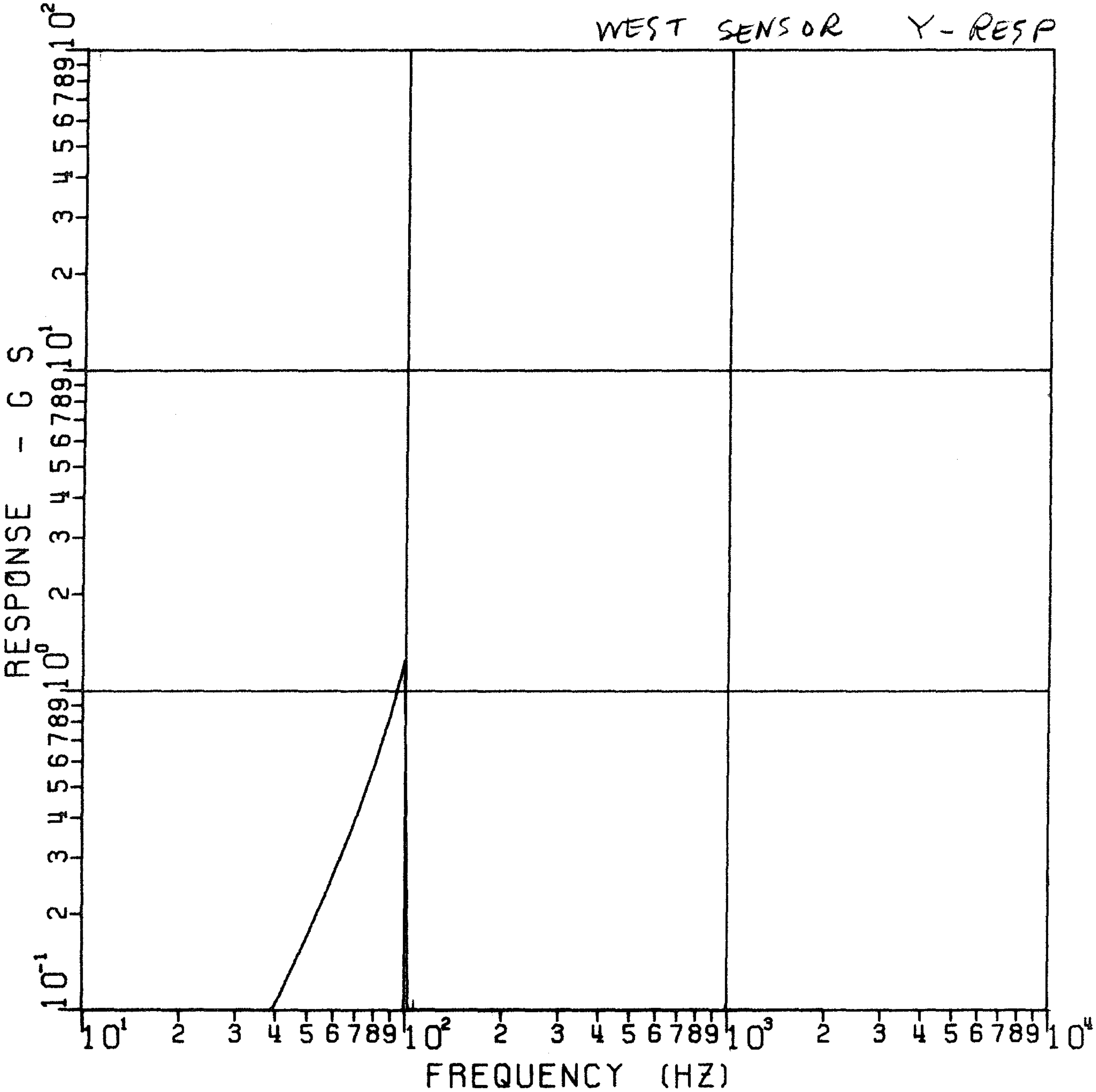


LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 11 b SINE RESPONSE

LOCATION 8

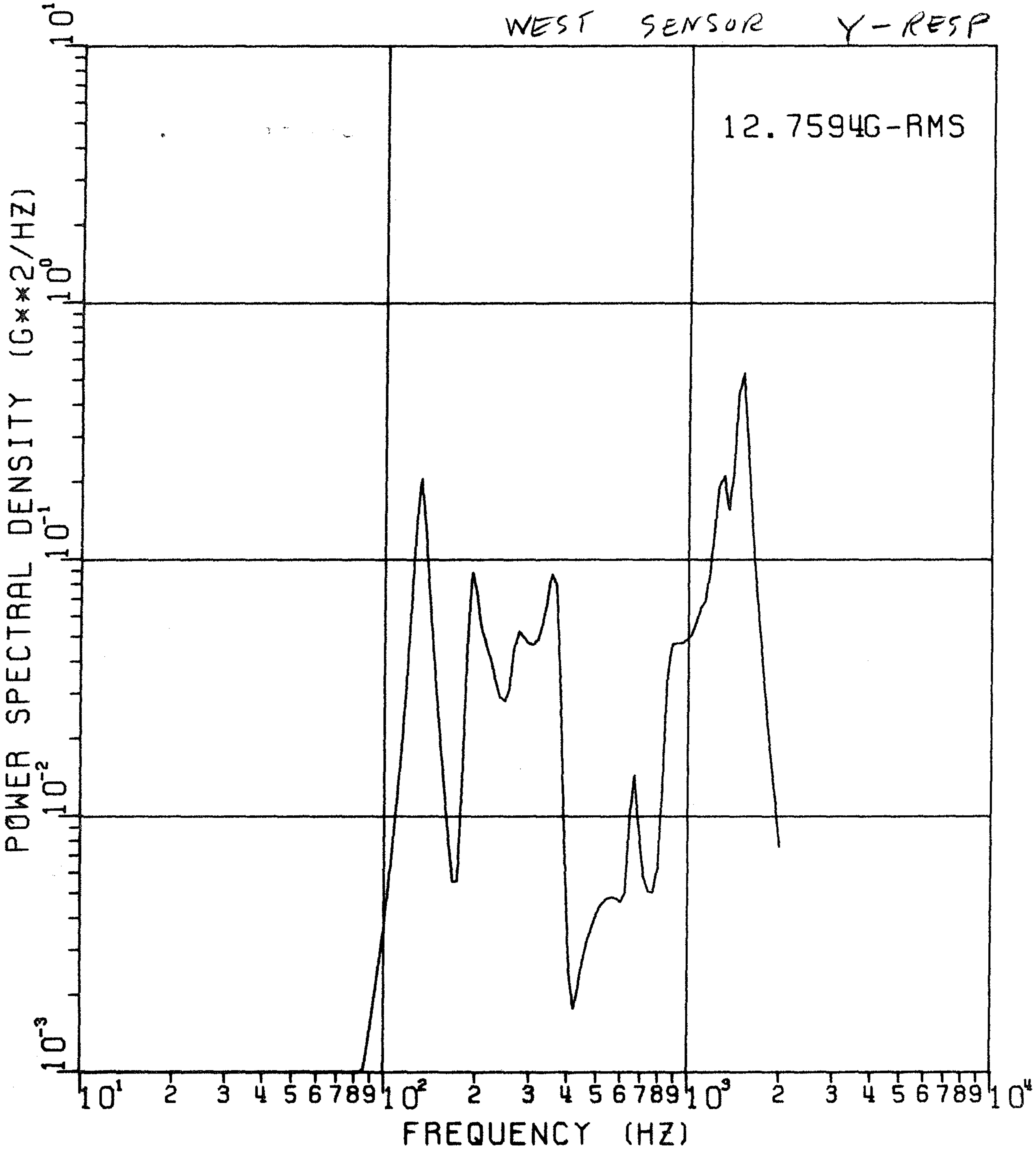
WEST SENSOR Y-RESP



LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 11c RANDOM VIBRATION SPECTRUM

LOCATION 8 (CROSS AXIS)

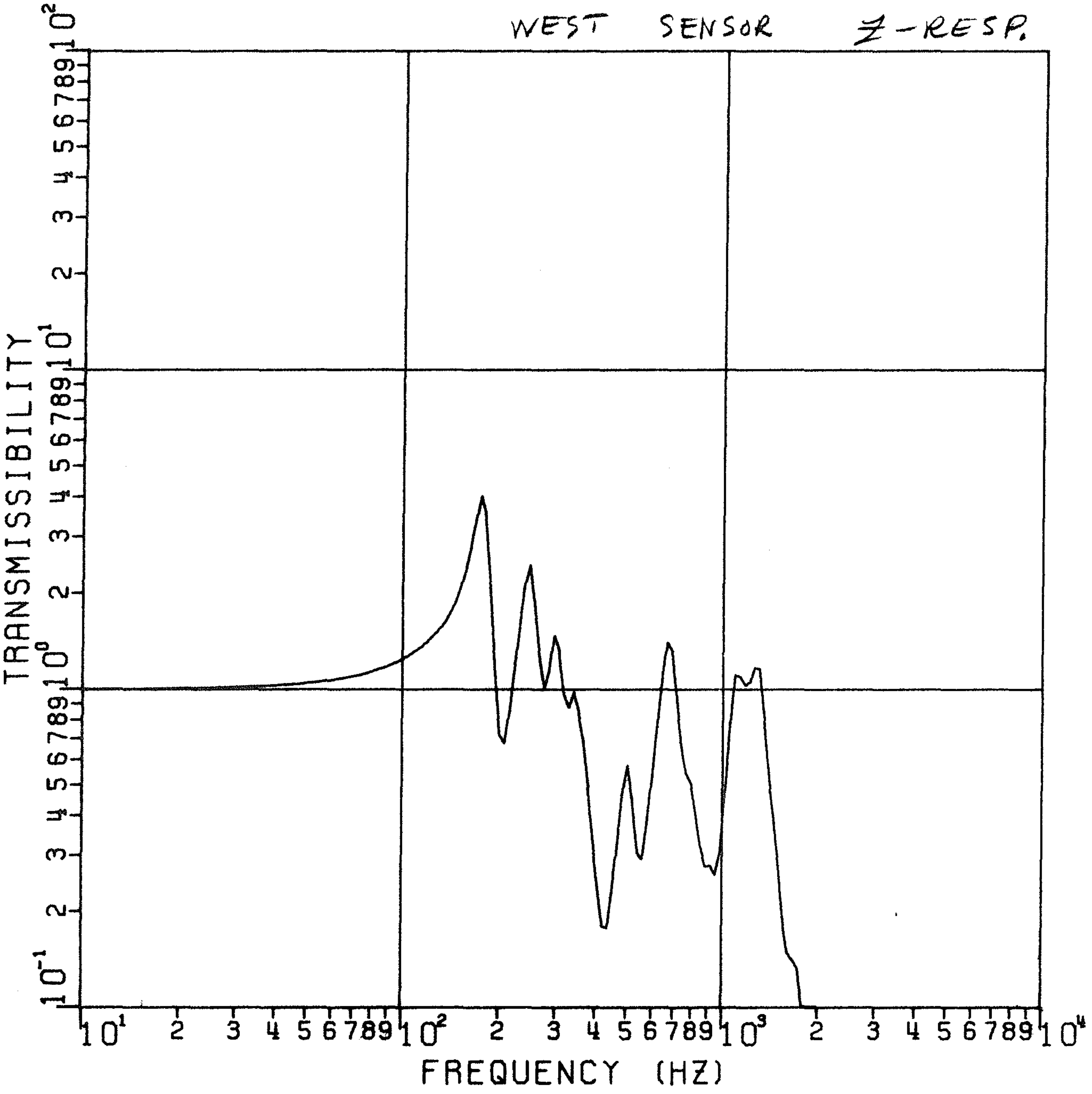


LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 12a TRANSMISSIBILITY

LOCATION 9

WEST SENSOR Z-RESP.

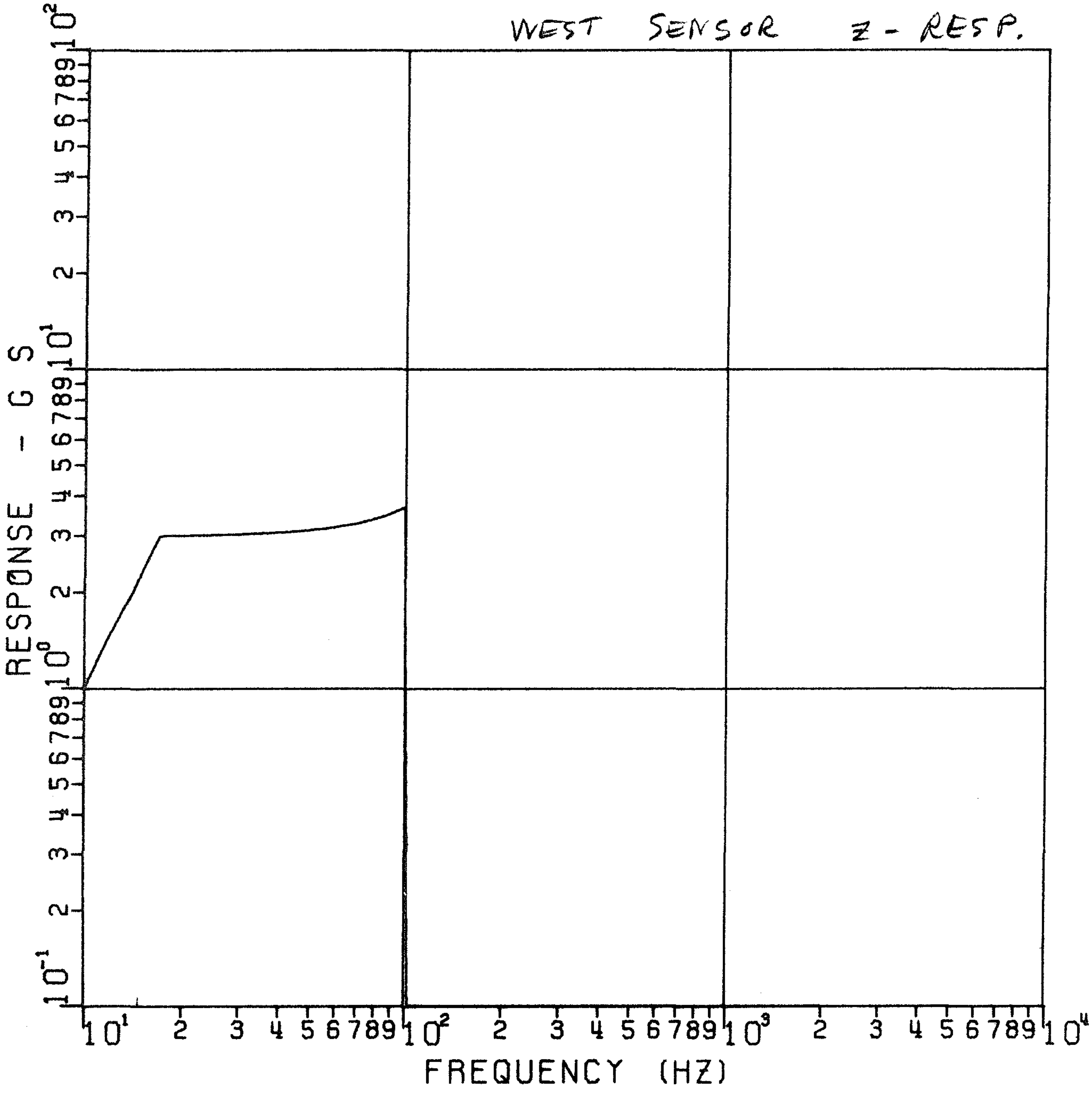


LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 12b SINE RESPONSE

LOCATION 9

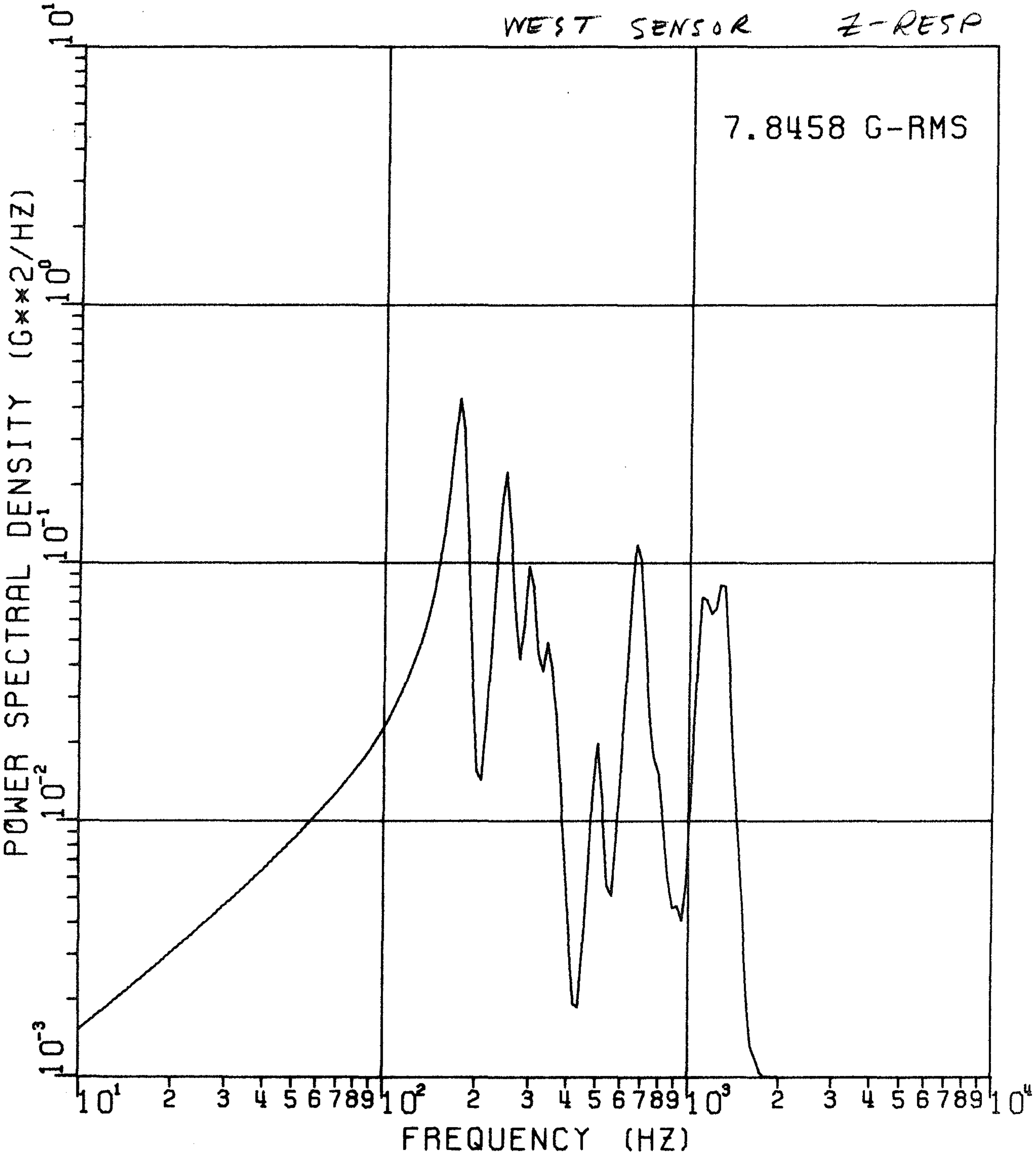
WEST SENSOR Z - RESP.



LEAM DVT FREQ. RESP., Z-AXIS FORCING, L&B

FIGURE 12c RANDOM VIBRATION SPECTRUM

LOCATION 9

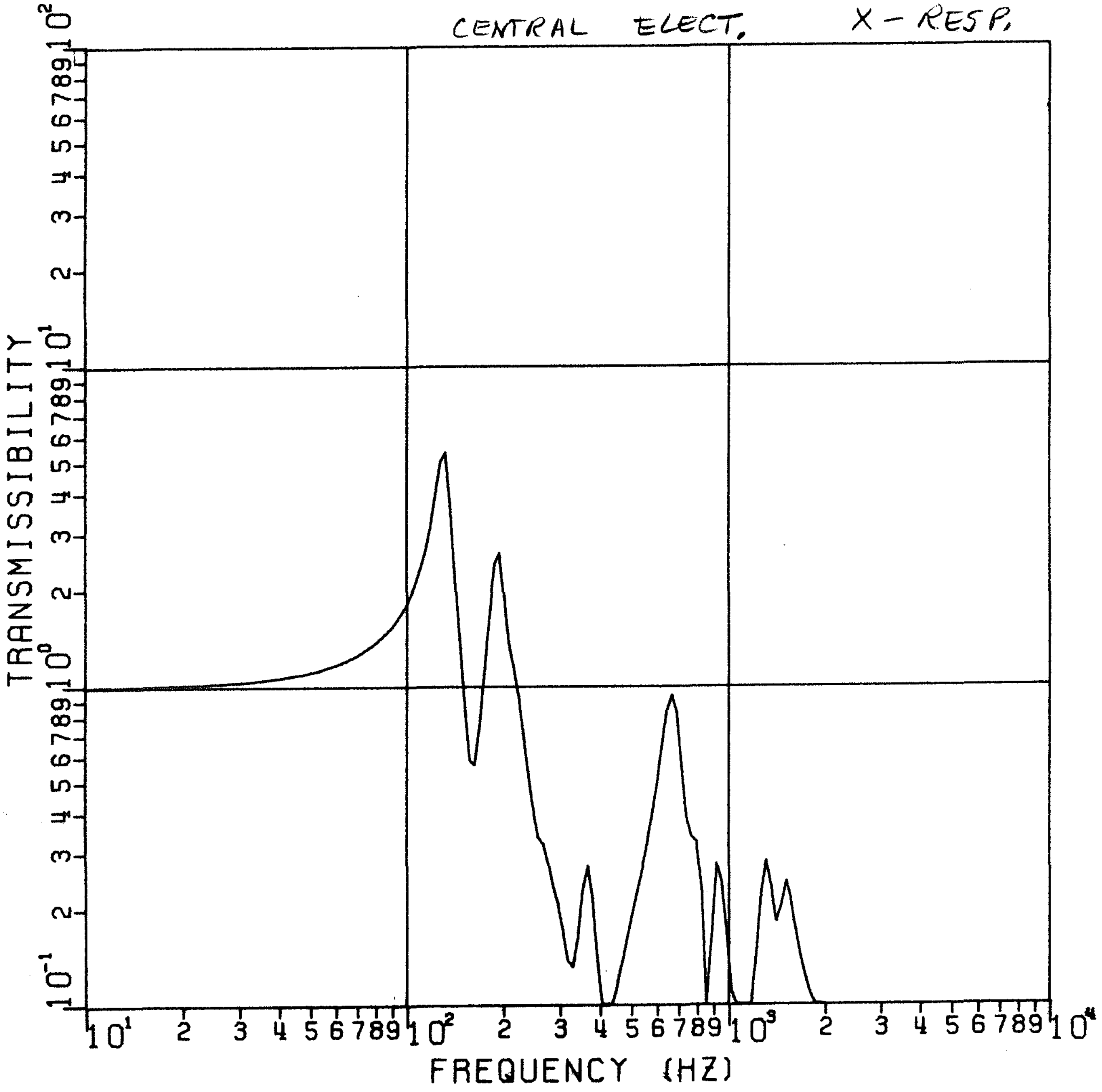


LEAM DVT FREQ. RESP., X-AXIS FORCING, L&B

FIGURE 13a TRANSMISSIBILITY

LOCATION 13

CENTRAL ELECT. X-RESP.

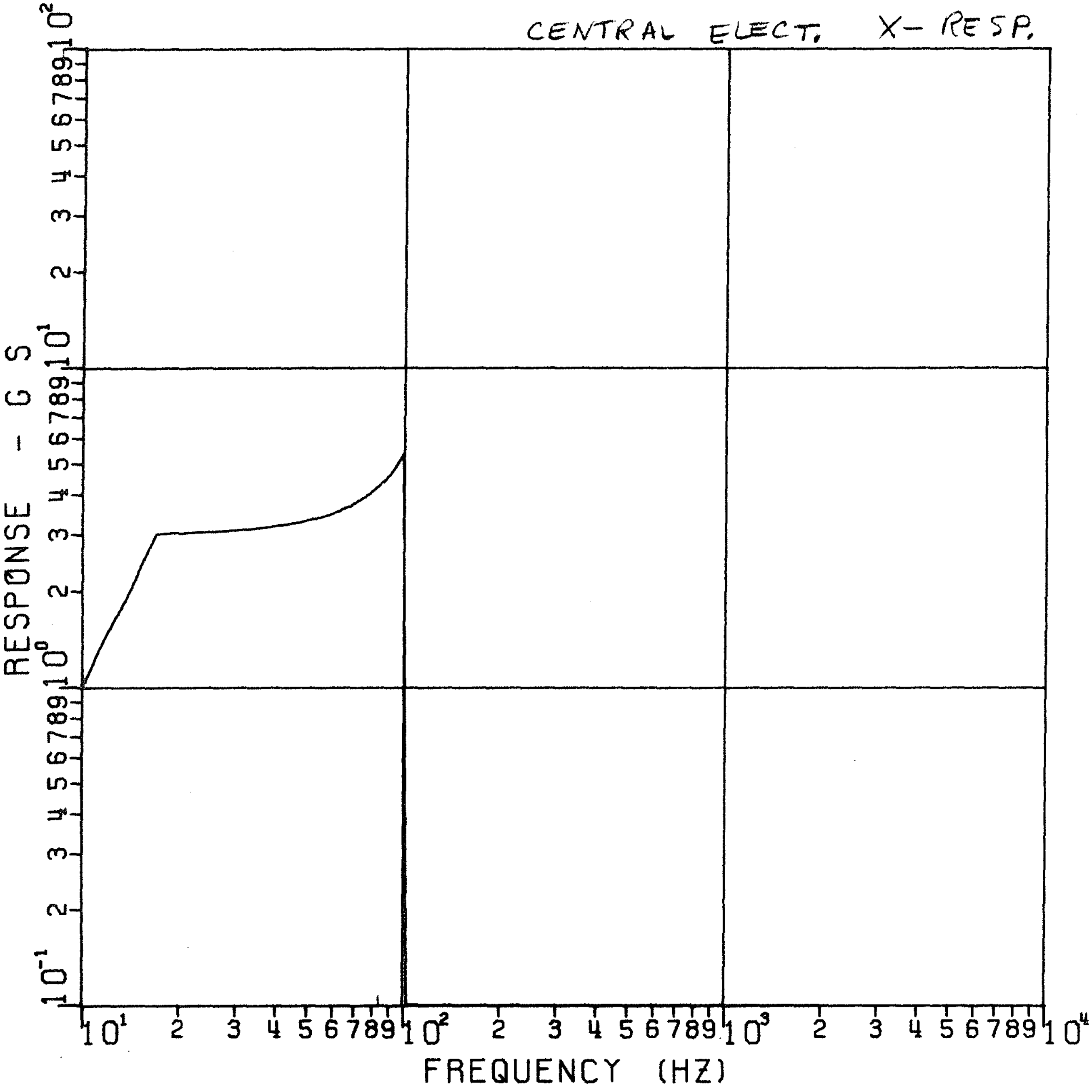


LEAM DVT FREQ. RESP., X-AXIS FORCING, L&B

FIGURE 13b SINE RESPONSE

LOCATION 13

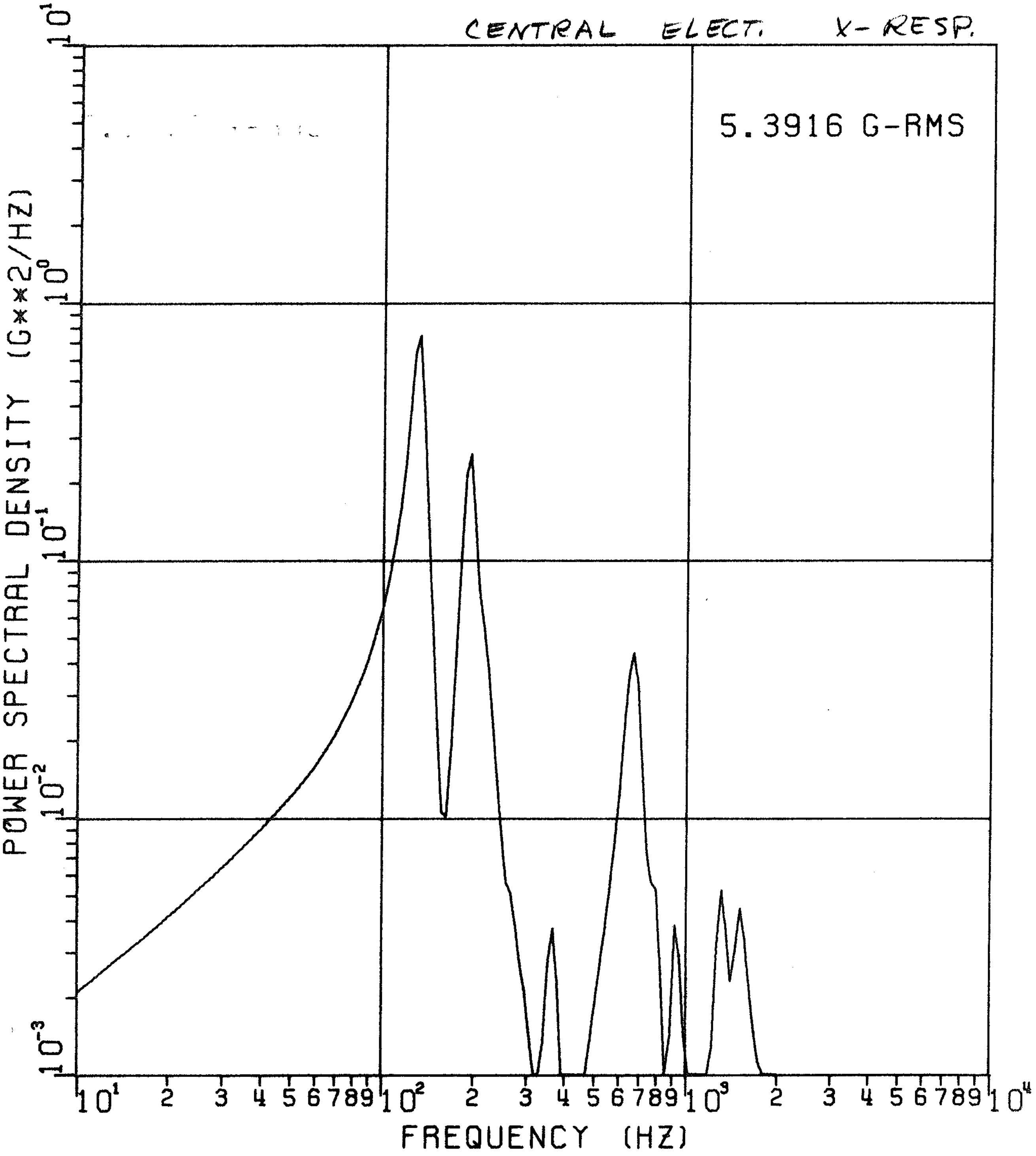
CENTRAL ELECT. X- RESP.



LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 13c RANDOM VIBRATION SPECTRUM

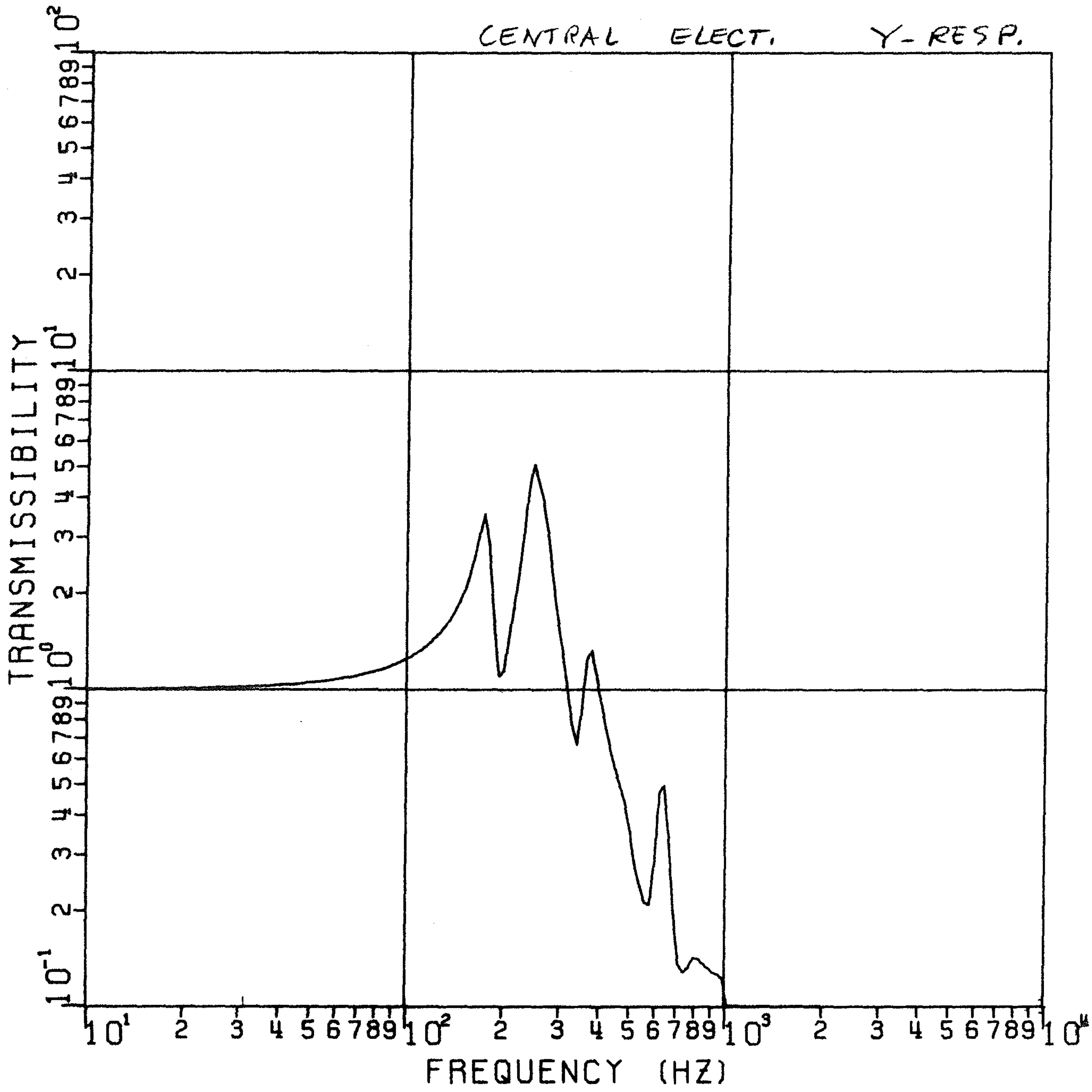
LOCATION 13



LEAM DVT FREQ. RESP., Y-AXIS FORCING, L&B

FIGURE 14 a TRANSMISSIBILITY

LOCATION 14

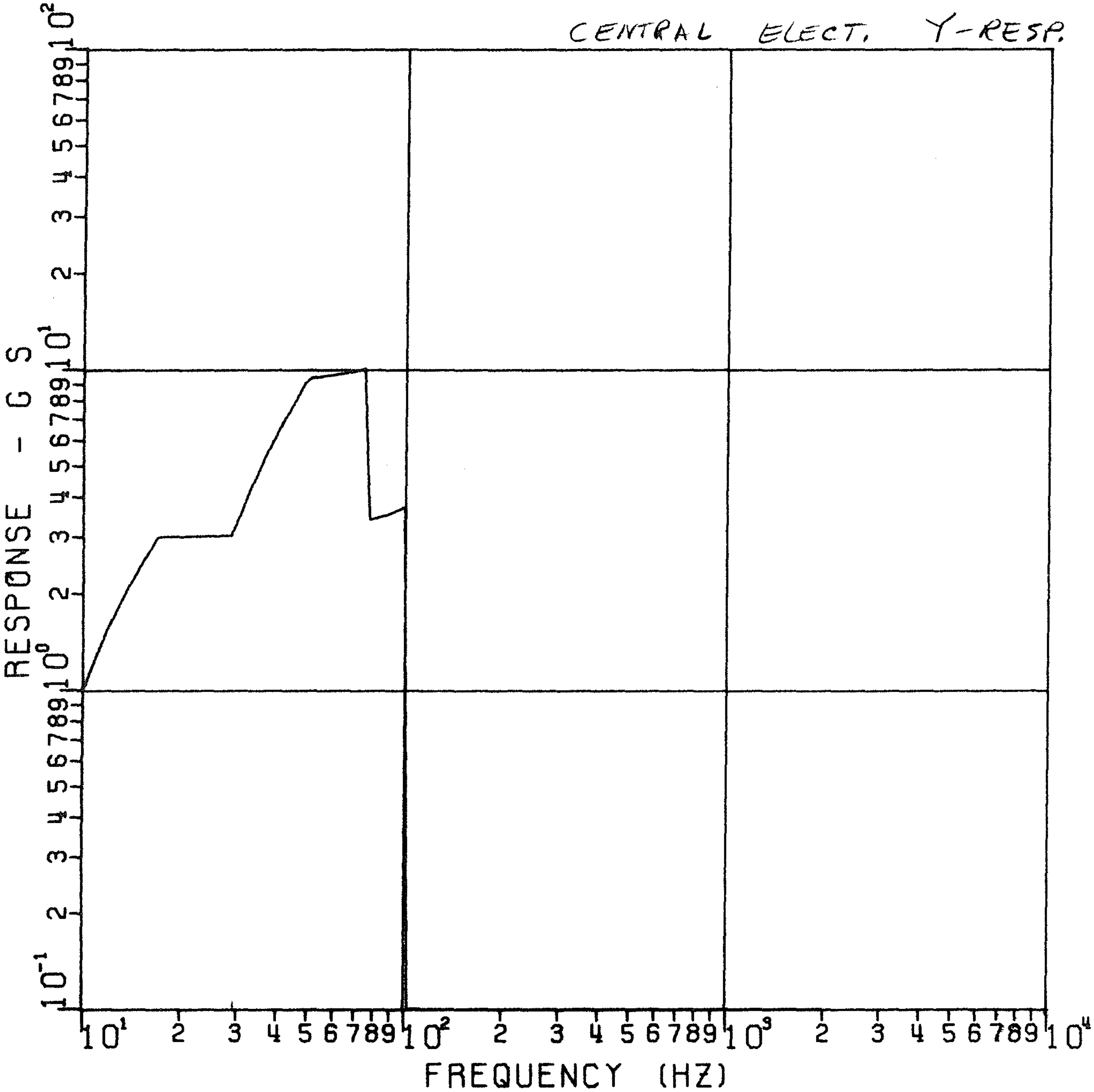


LEAM DVT FREQ. RESP.,Y-AXIS FORCING,L&B

FIGURE 14 b SINE RESPONSE

LOCATION 14

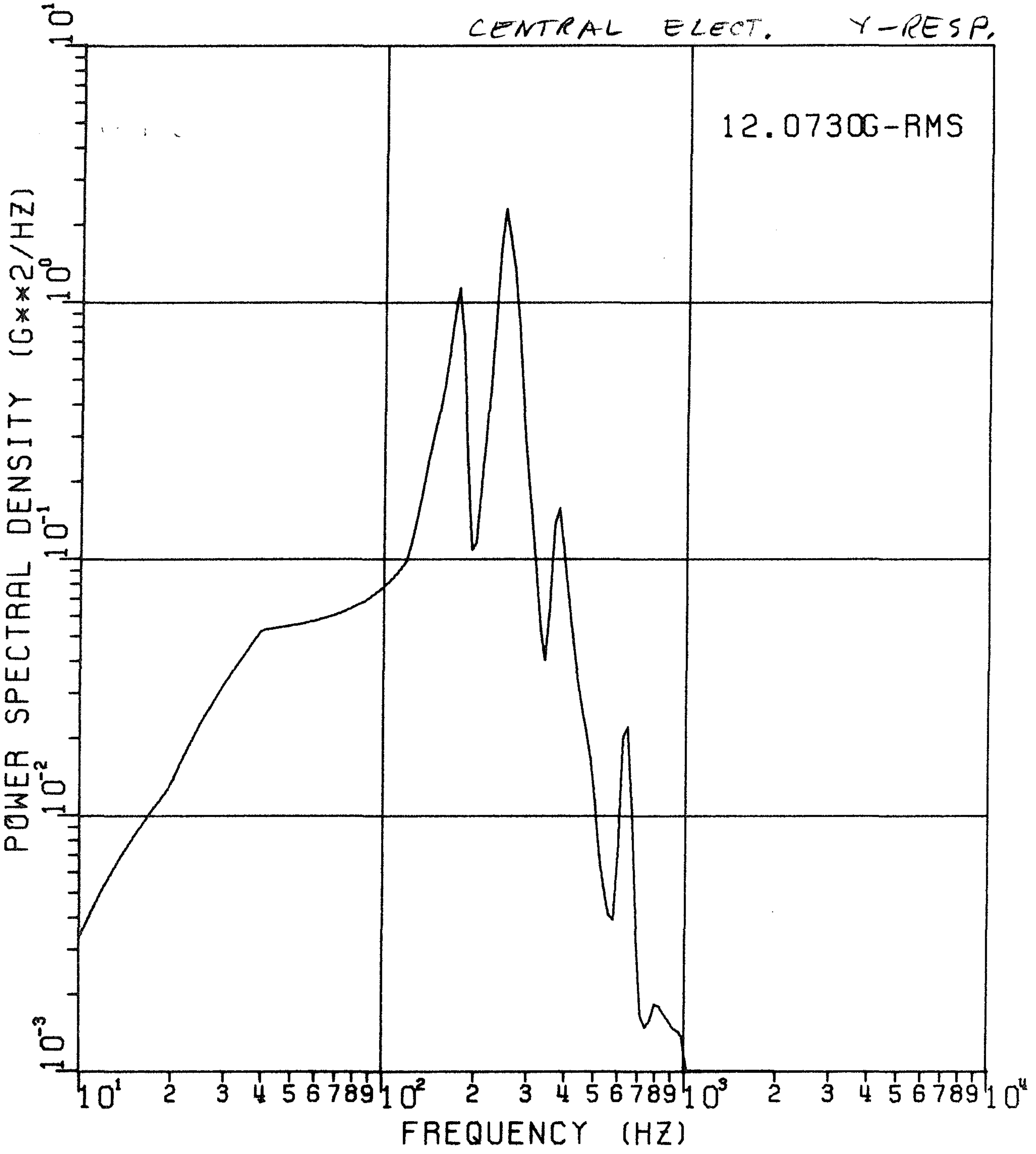
CENTRAL ELECT. Y-RESP.



LEAM DVT FREQ. RESP.,Y-AXIS FORCING,L&B

FIGURE 14c RANDOM VIBRATION SPECTRUM

LOCATION 14

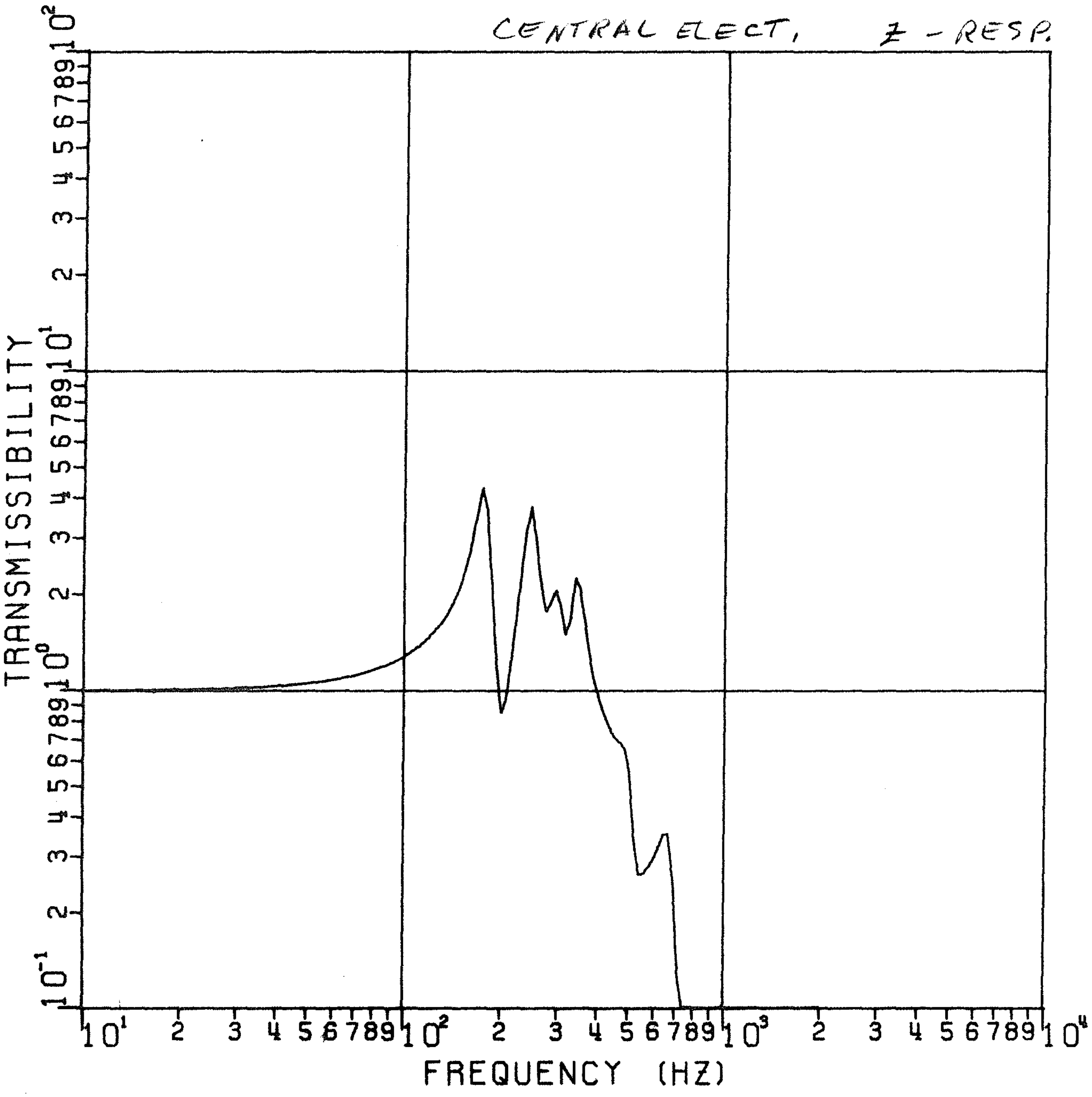


LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 15a TRANSMISSIBILITY

LOCATION 15

CENTRAL ELECT, Z-RESP.

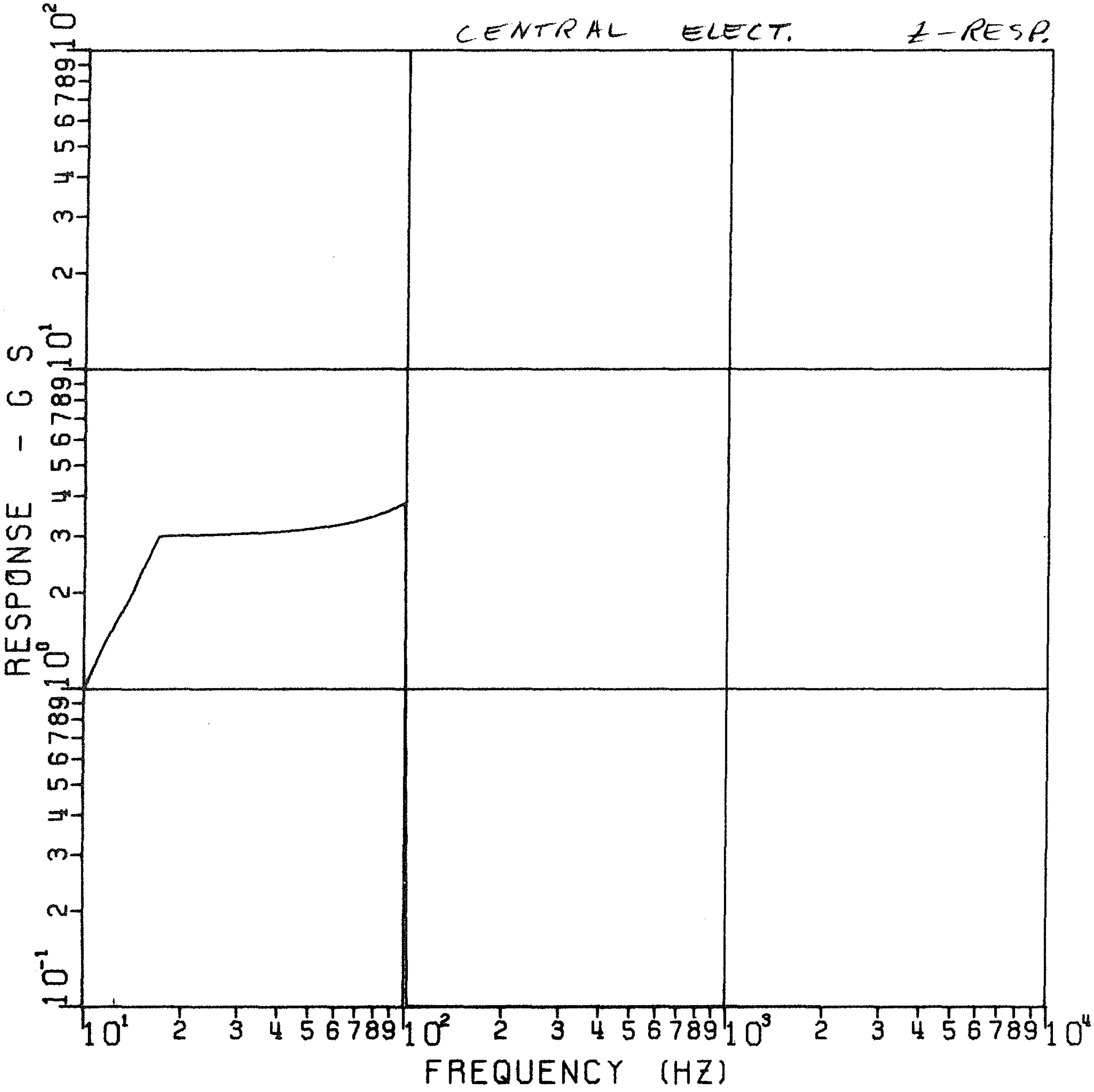


LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 15b SINE RESPONSE

LOCATION 15

CENTRAL ELECT. Z-RESP.

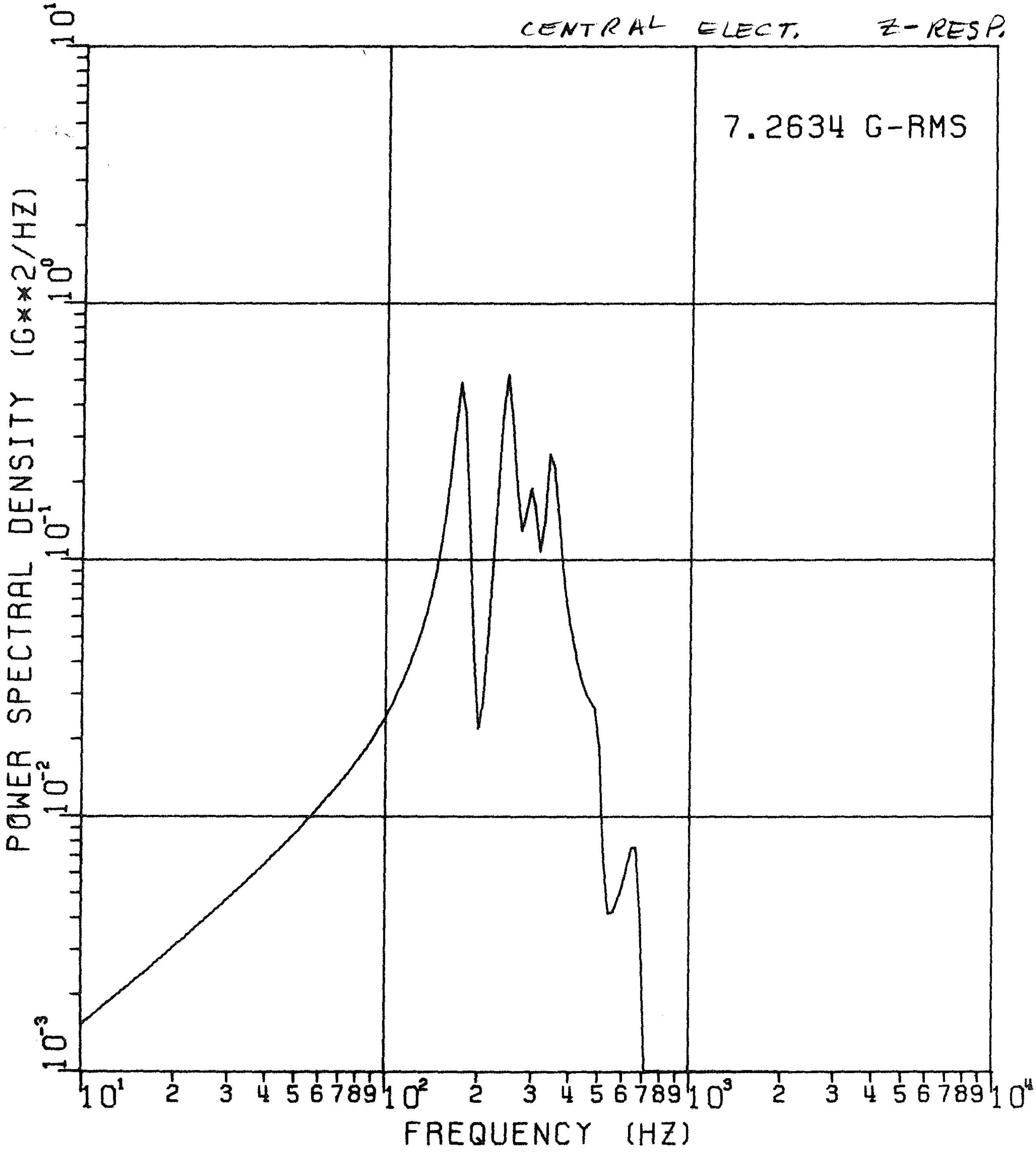


LEAM DVT FREQ. RESP., Z-AXIS FORCING, L&B

FIGURE 15c RANDOM VIBRATION SPECTRUM

LOCATION 15

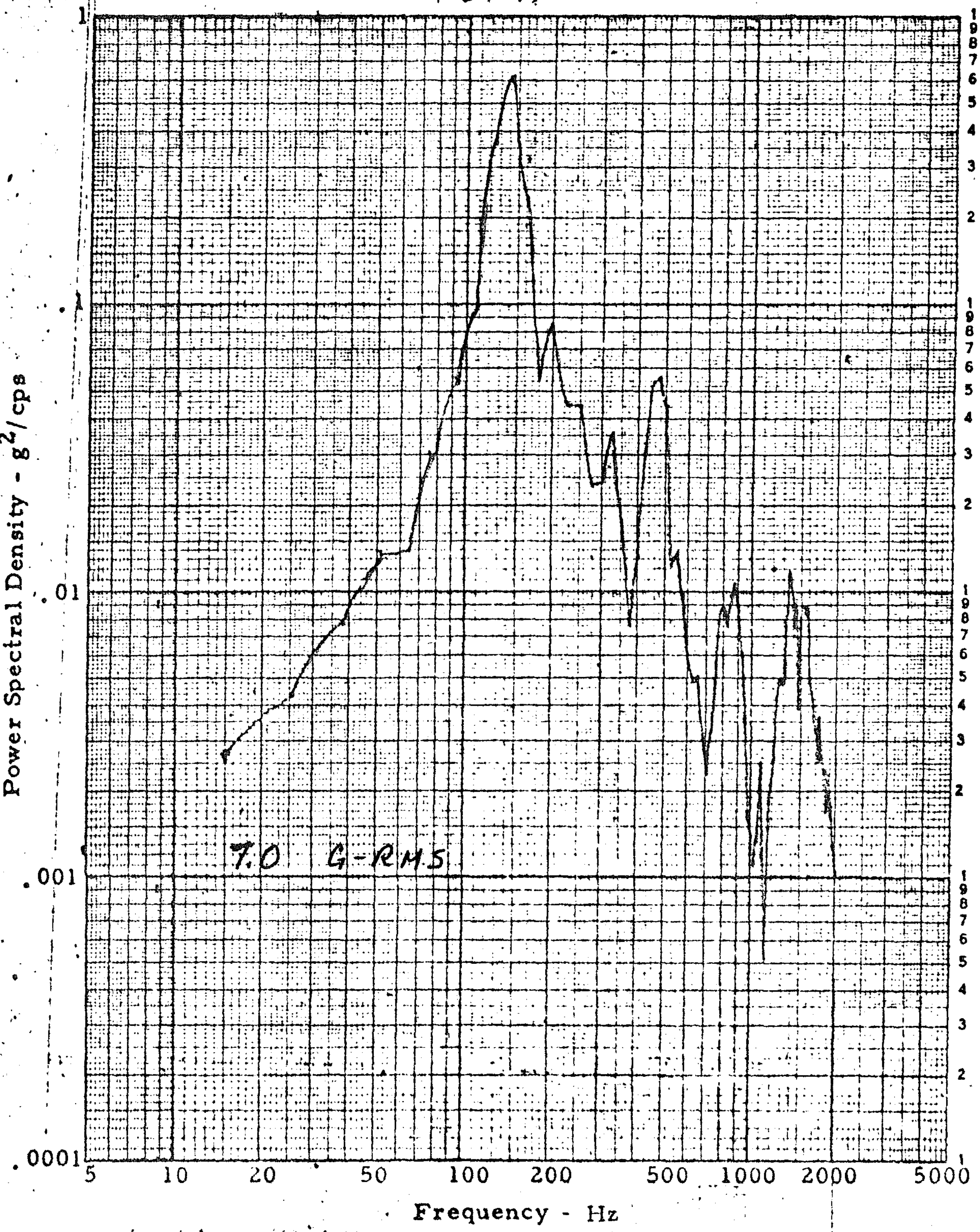
CENTRAL ELECT. Z-RESP.



RANDOM VIBRATION SPECTRUM

Acc# 8

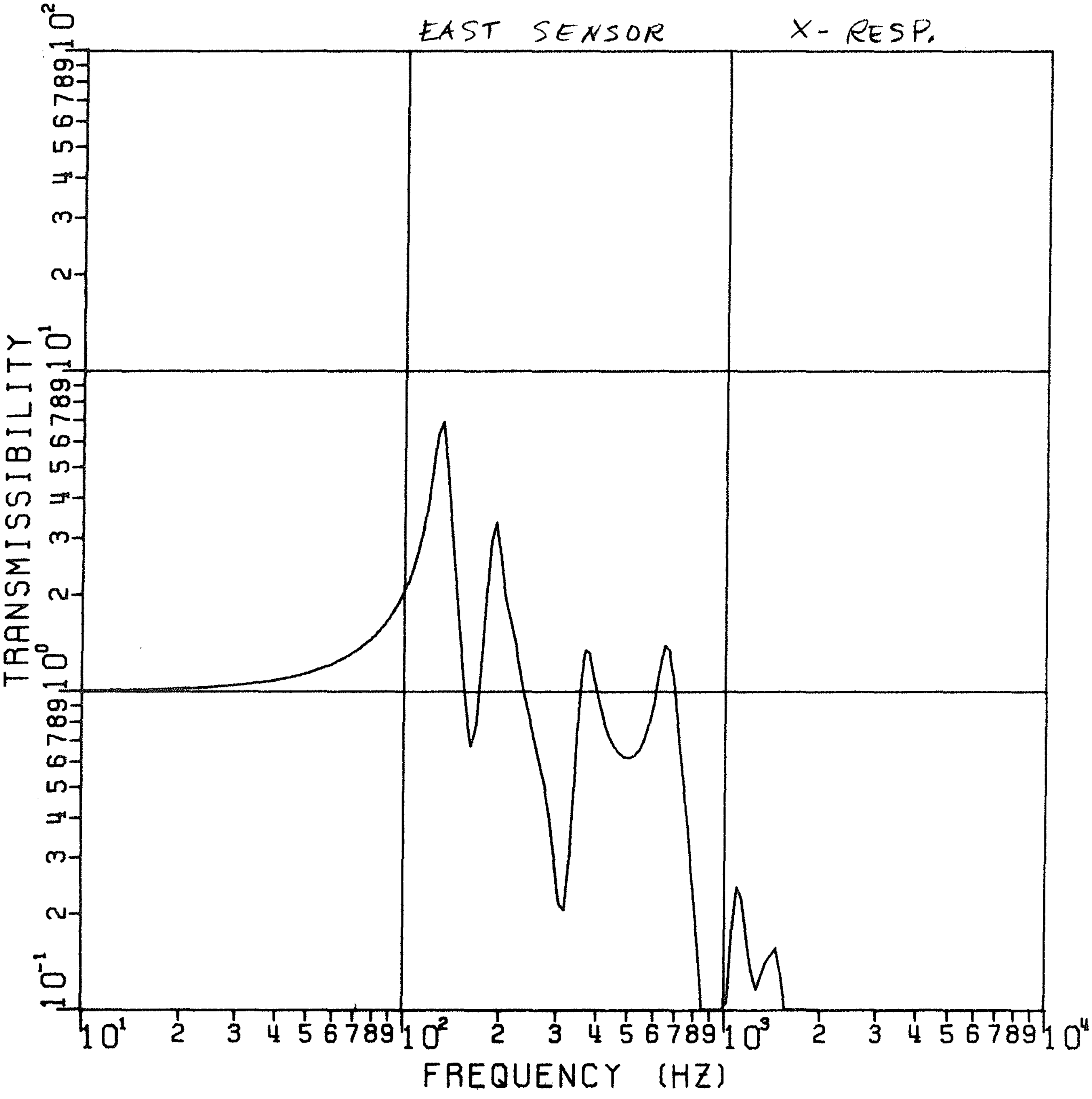
Test: L&B RANDOM
Test Item: LEAM ENG
Test Date: 8/6/71
SN:
Axis: Z



LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 16 a TRANSMISSIBILITY

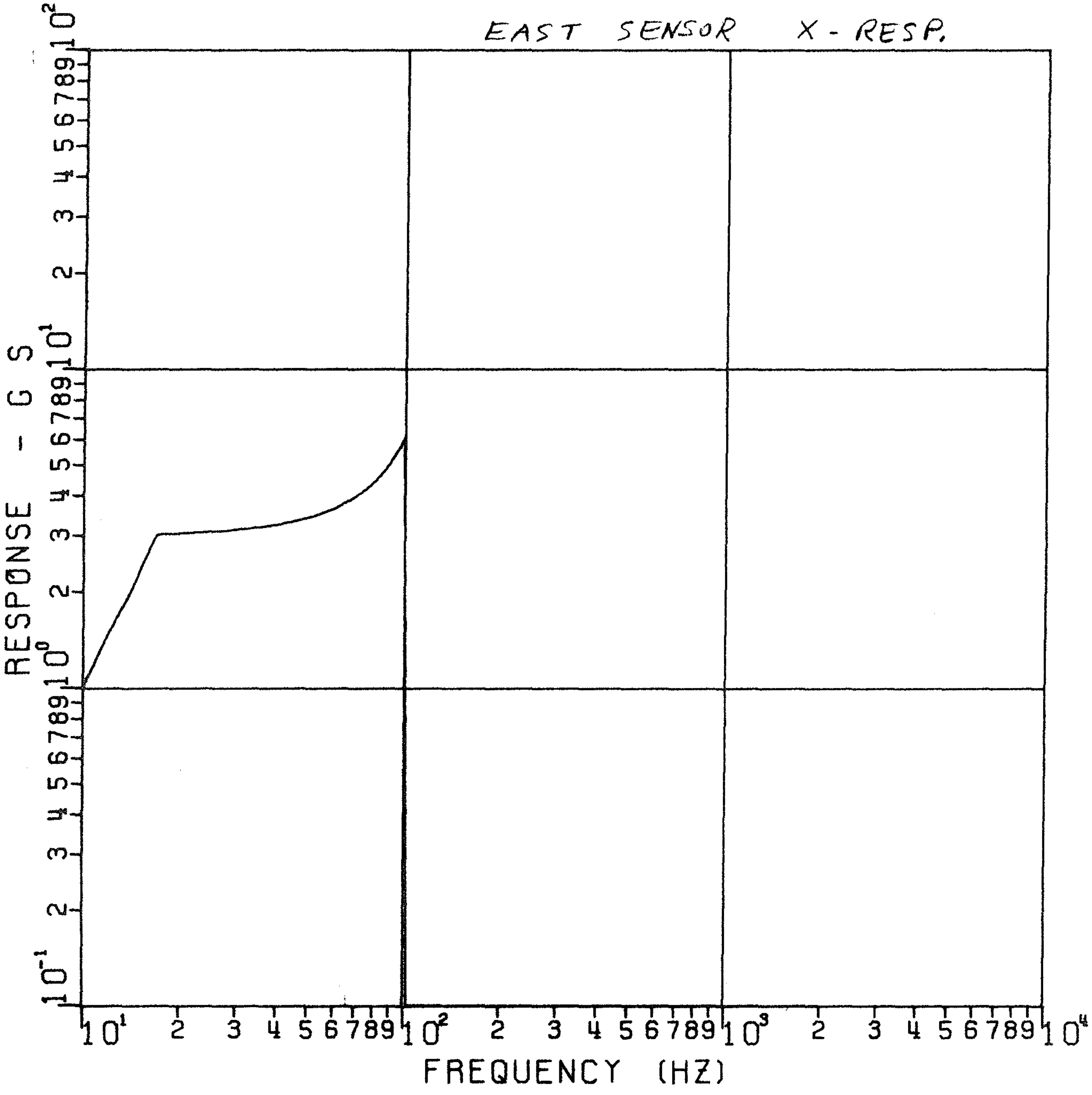
LOCATION 19



LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 16 b SINE RESPONSE

LOCATION 19



LEAM DVT FREQ. RESP., X-AXIS FORCING, L&B

FIGURE 16c RANDOM VIBRATION SPECTRUM

LOCATION 19

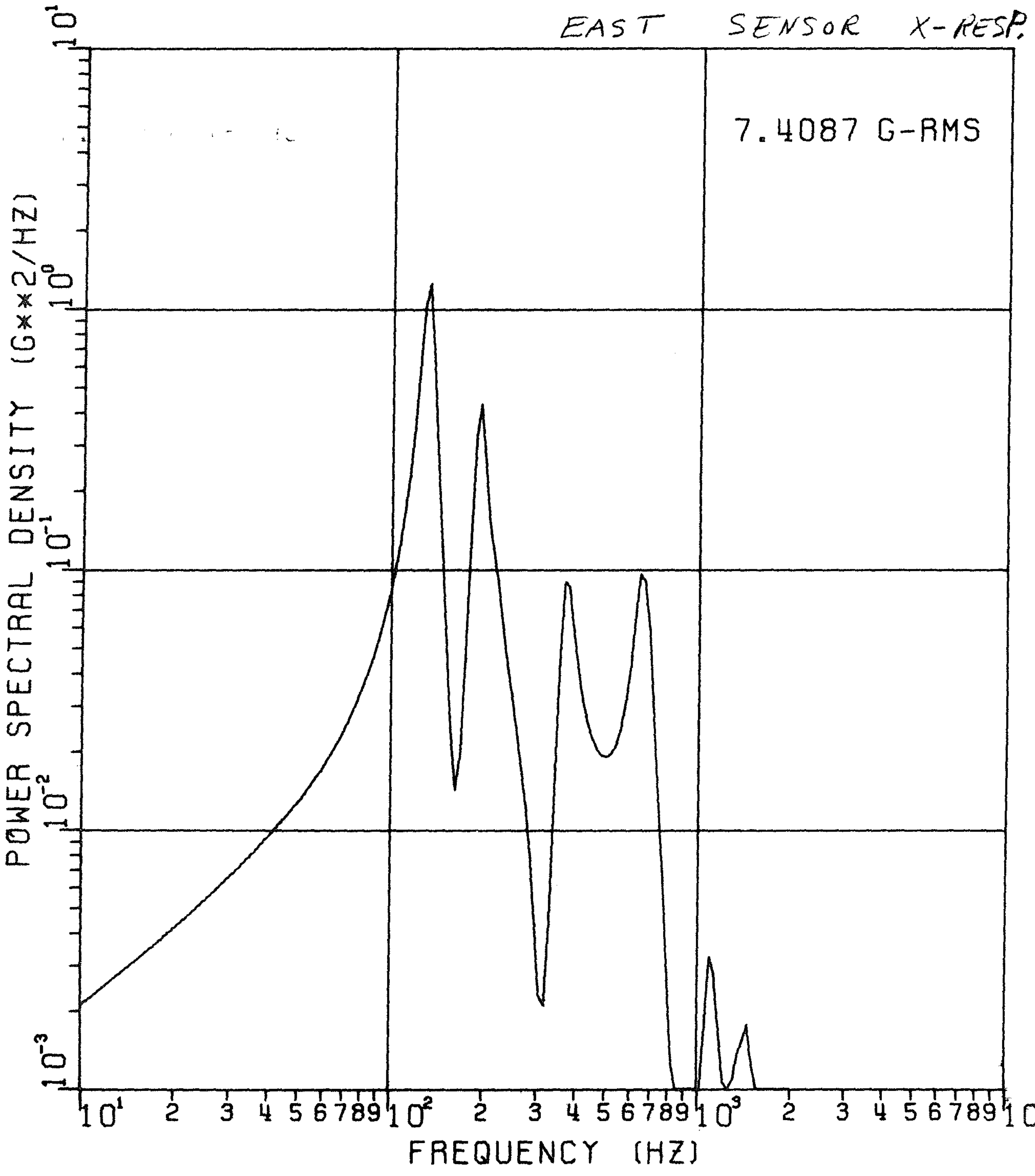
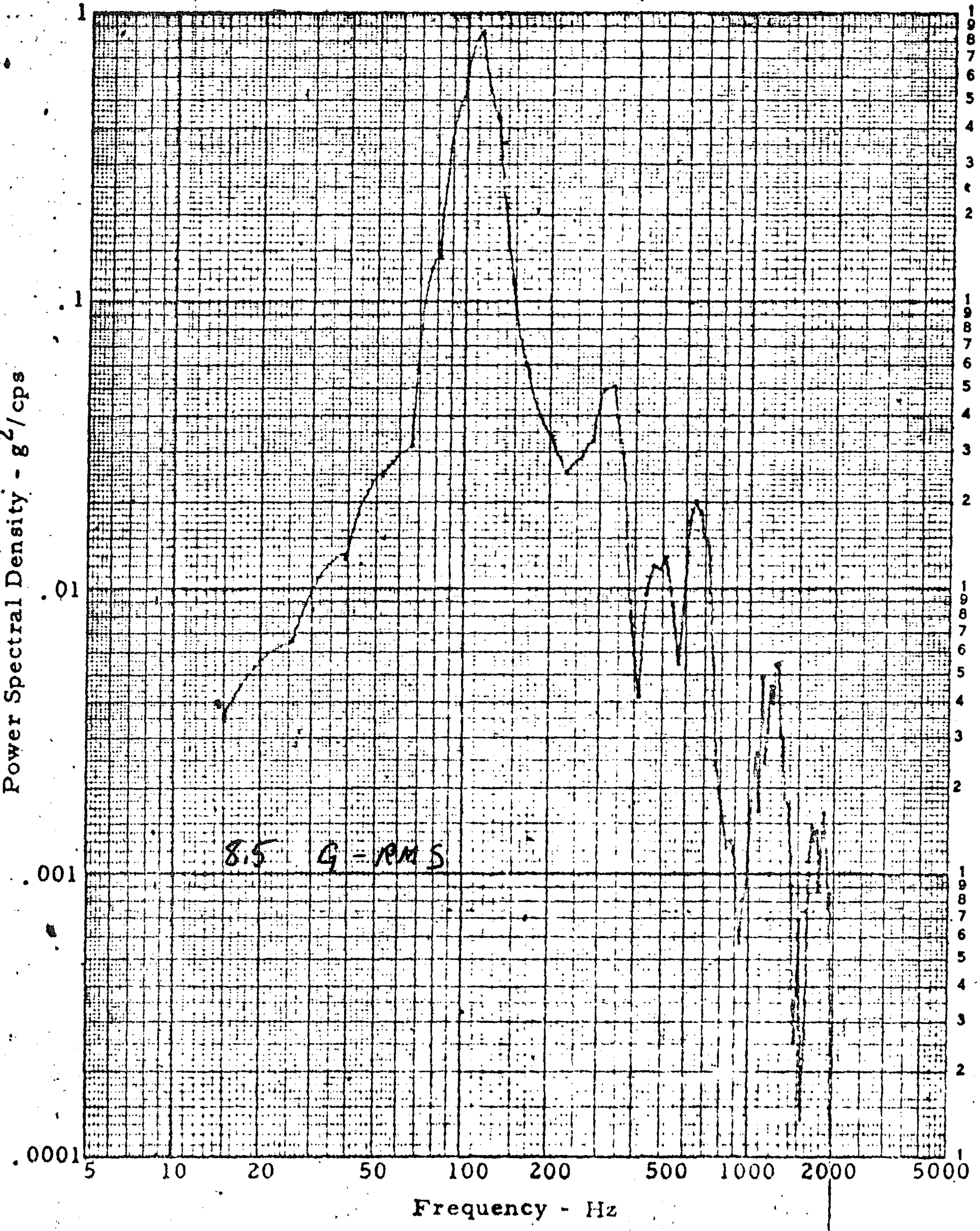


Figure 16d

RANDOM VIBRATION SPECTRUM

ACC#4

Test: C&B RANDOM
Test Item: LEAM ENG.
Test Date: 8/6/71
SN:
Axis: Y

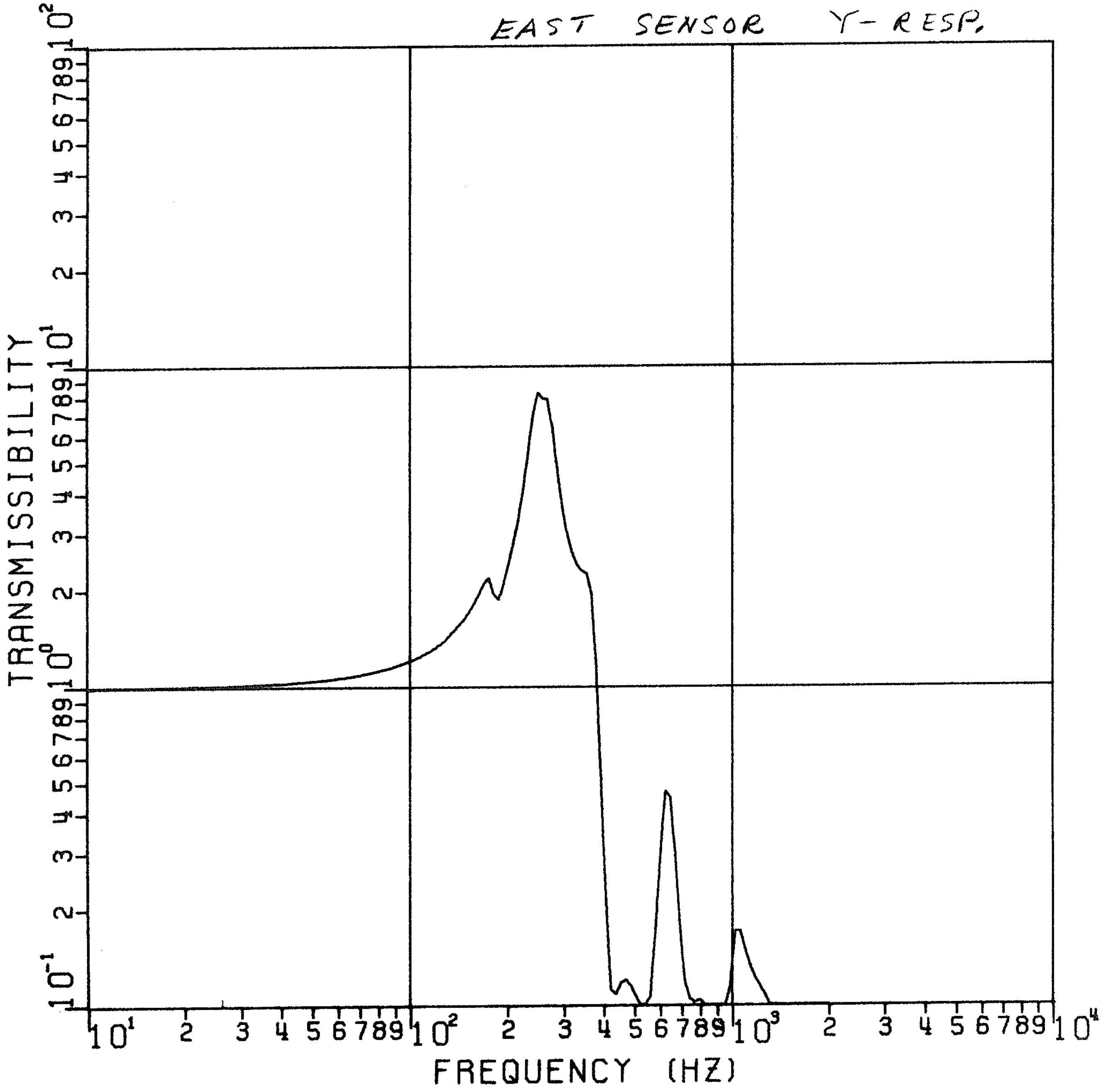


LEAM DVT FREQ. RESP., Y-AXIS FORCING, L&B

FIGURE 17 a TRANSMISSIBILITY

LOCATION 20

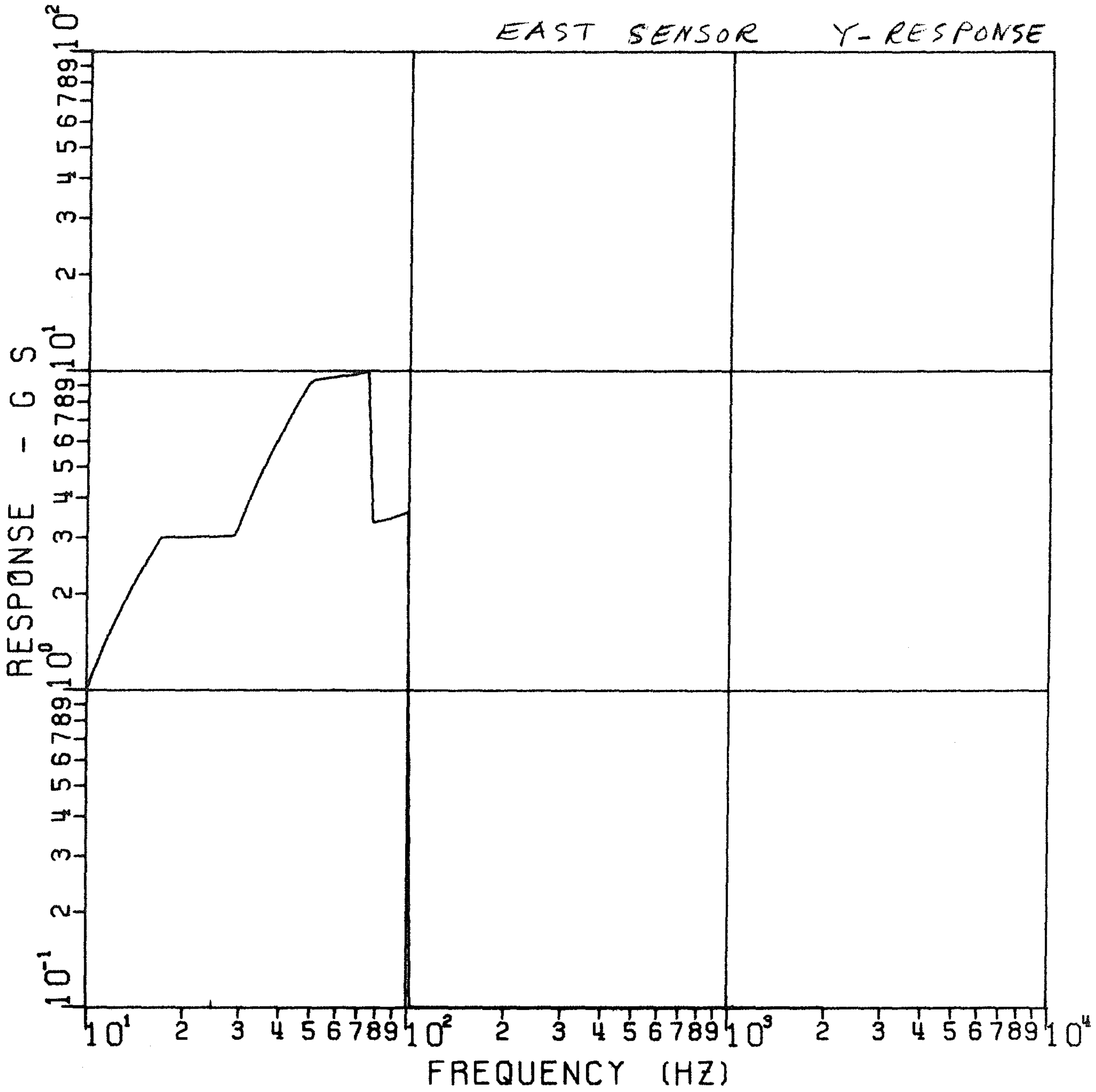
EAST SENSOR Y- RESP.



LEAM DVT FREQ. RESP., Y-AXIS FORCING, L&B

FIGURE 17b SINE RESPONSE

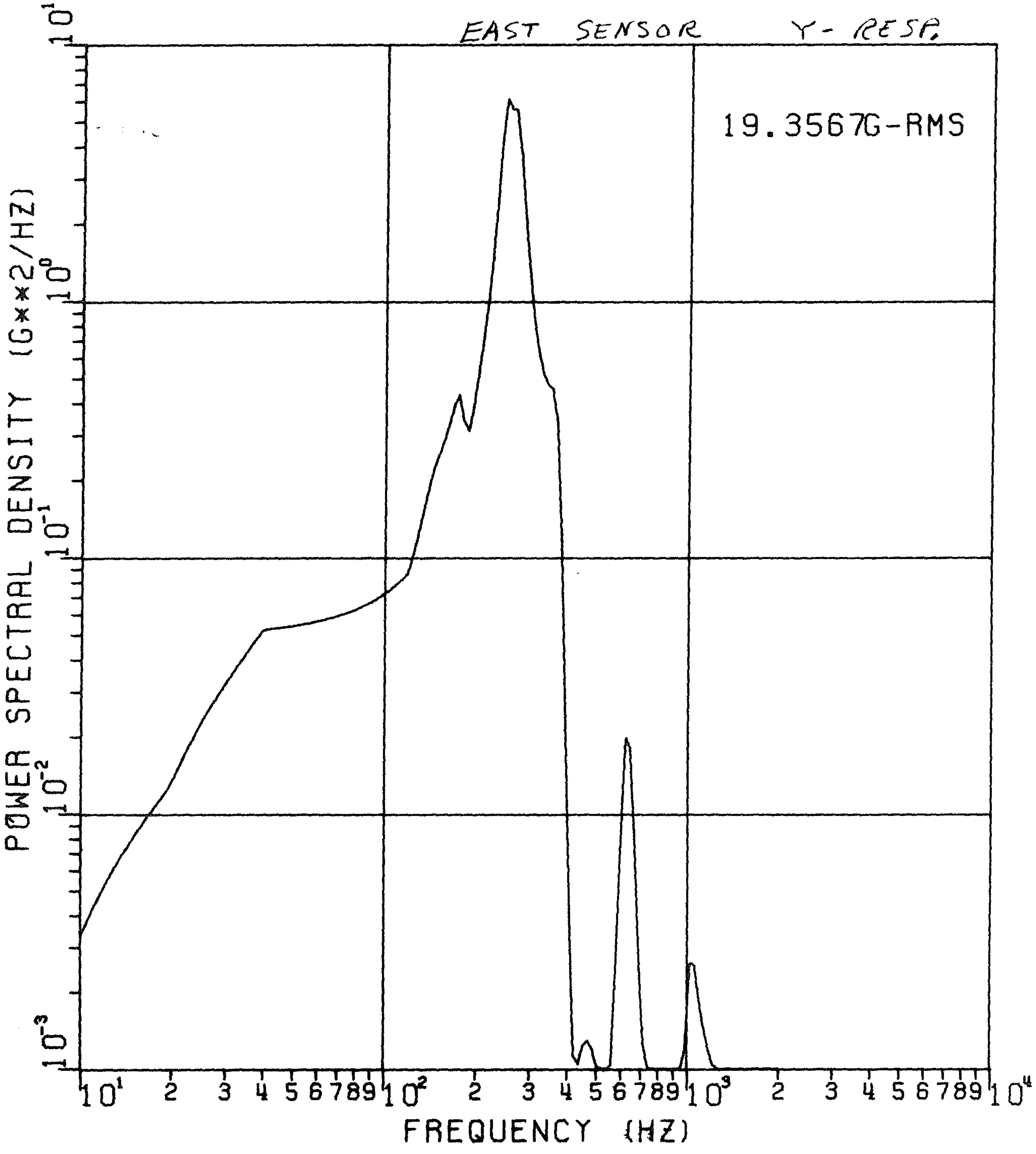
LOCATION 20



LEAM DVT FREQ. RESP., Y-AXIS FORCING, L&B

FIGURE 17c RANDOM VIBRATION SPECTRUM

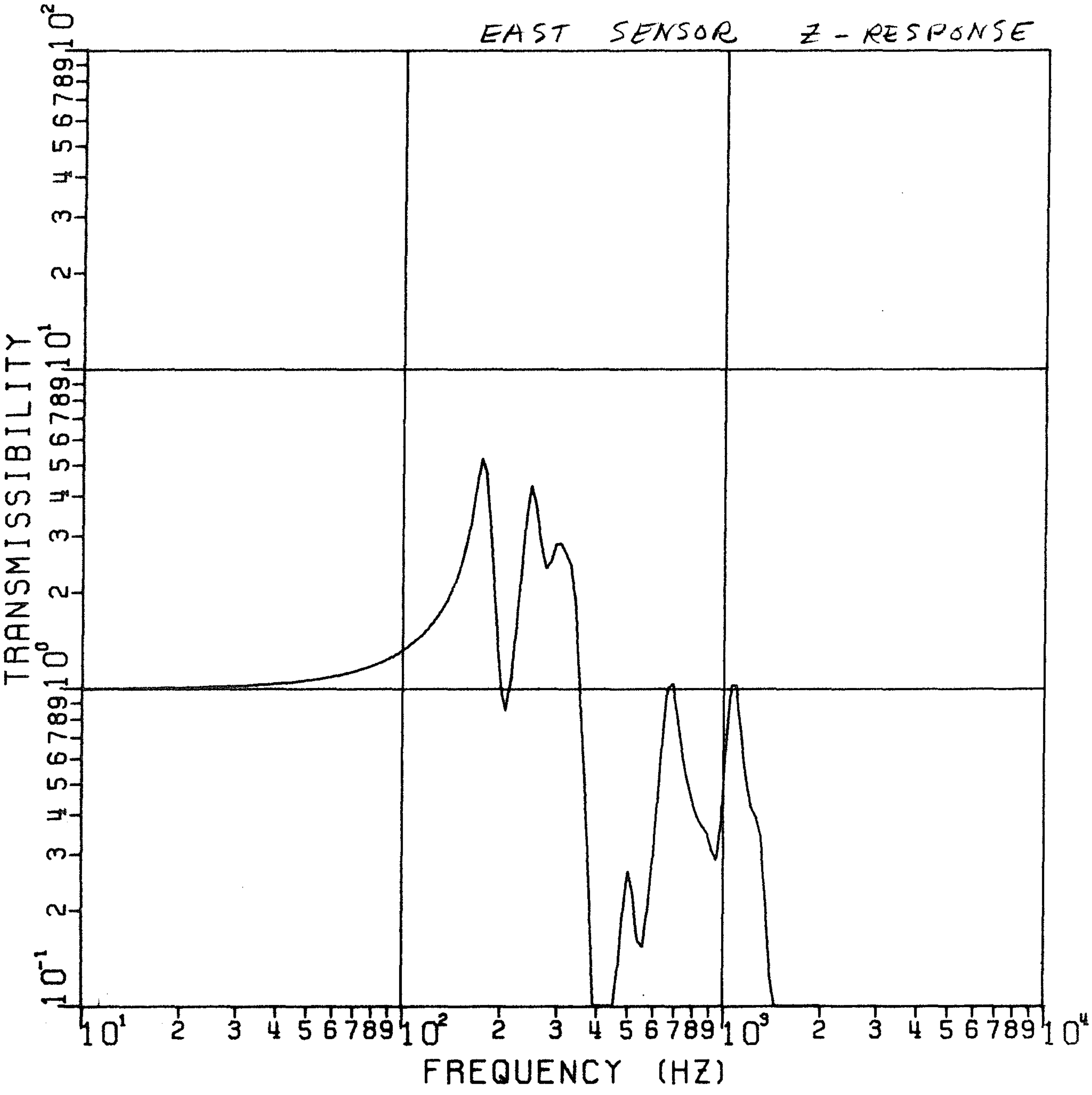
LOCATION 20



LEAM DVT FREQ. RESP., Z-AXIS FORCING, L&B

FIGURE 18a TRANSMISSIBILITY

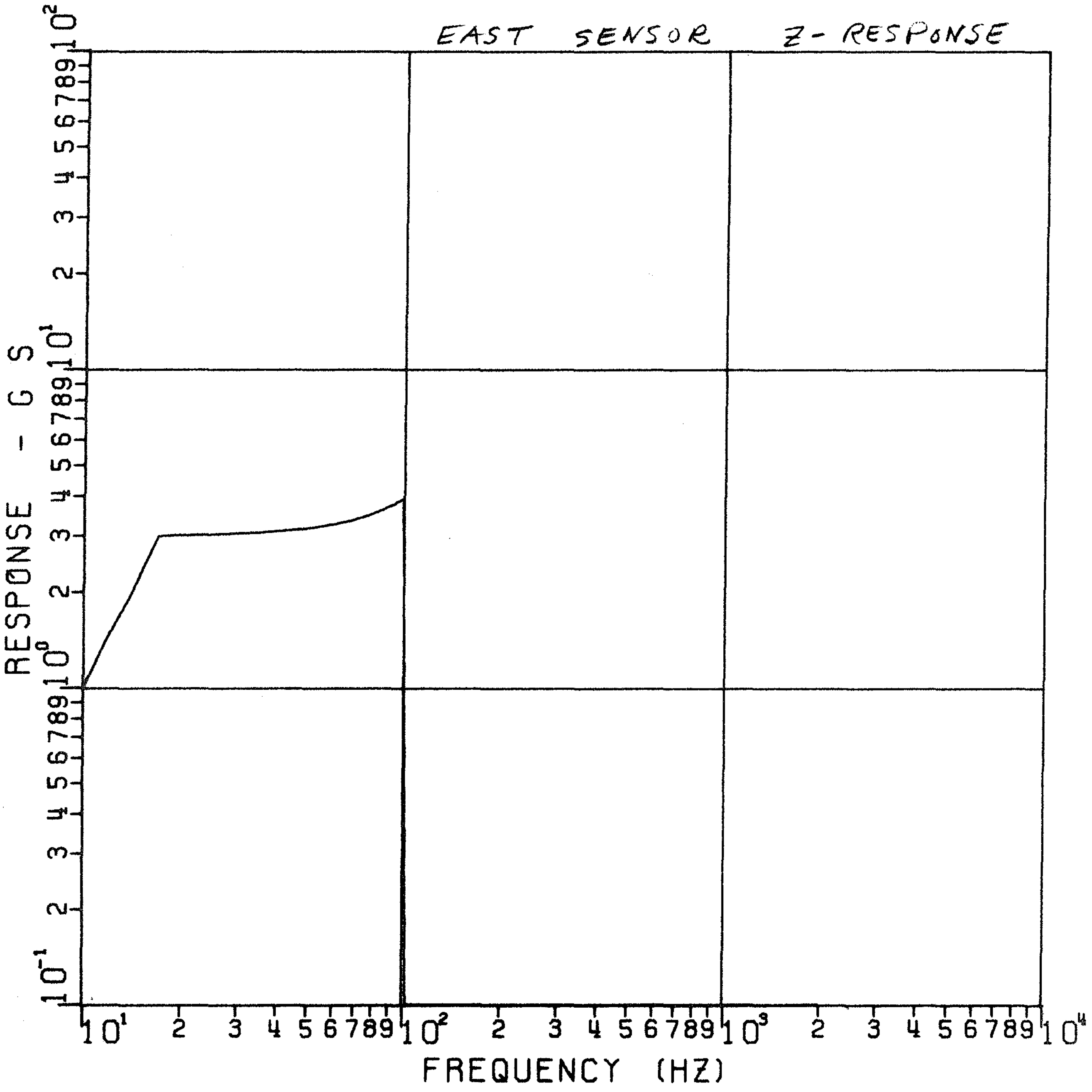
LOCATION 21



LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 18 b SINE RESPONSE

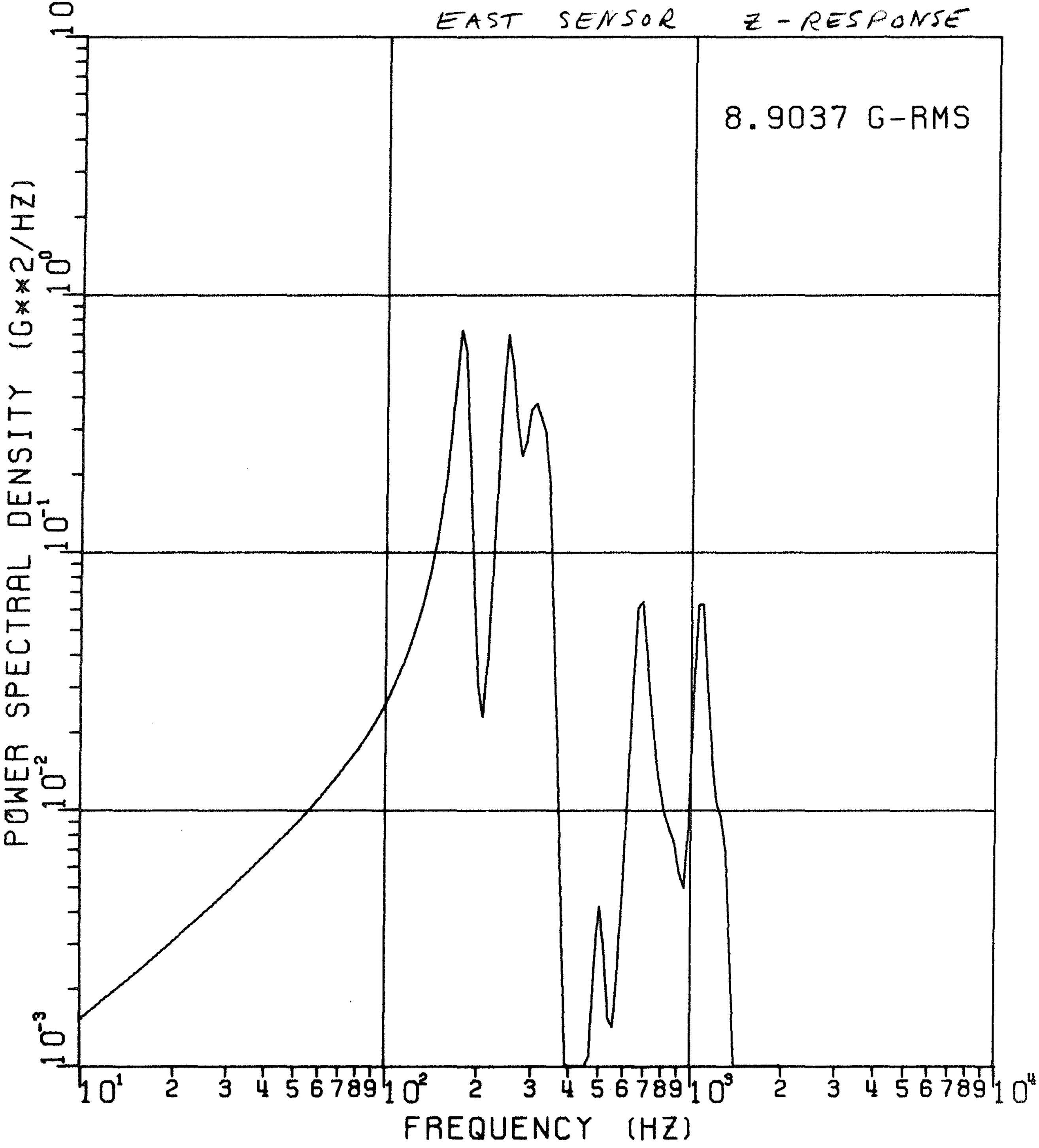
LOCATION 21



LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 18c RANDOM VIBRATION SPECTRUM

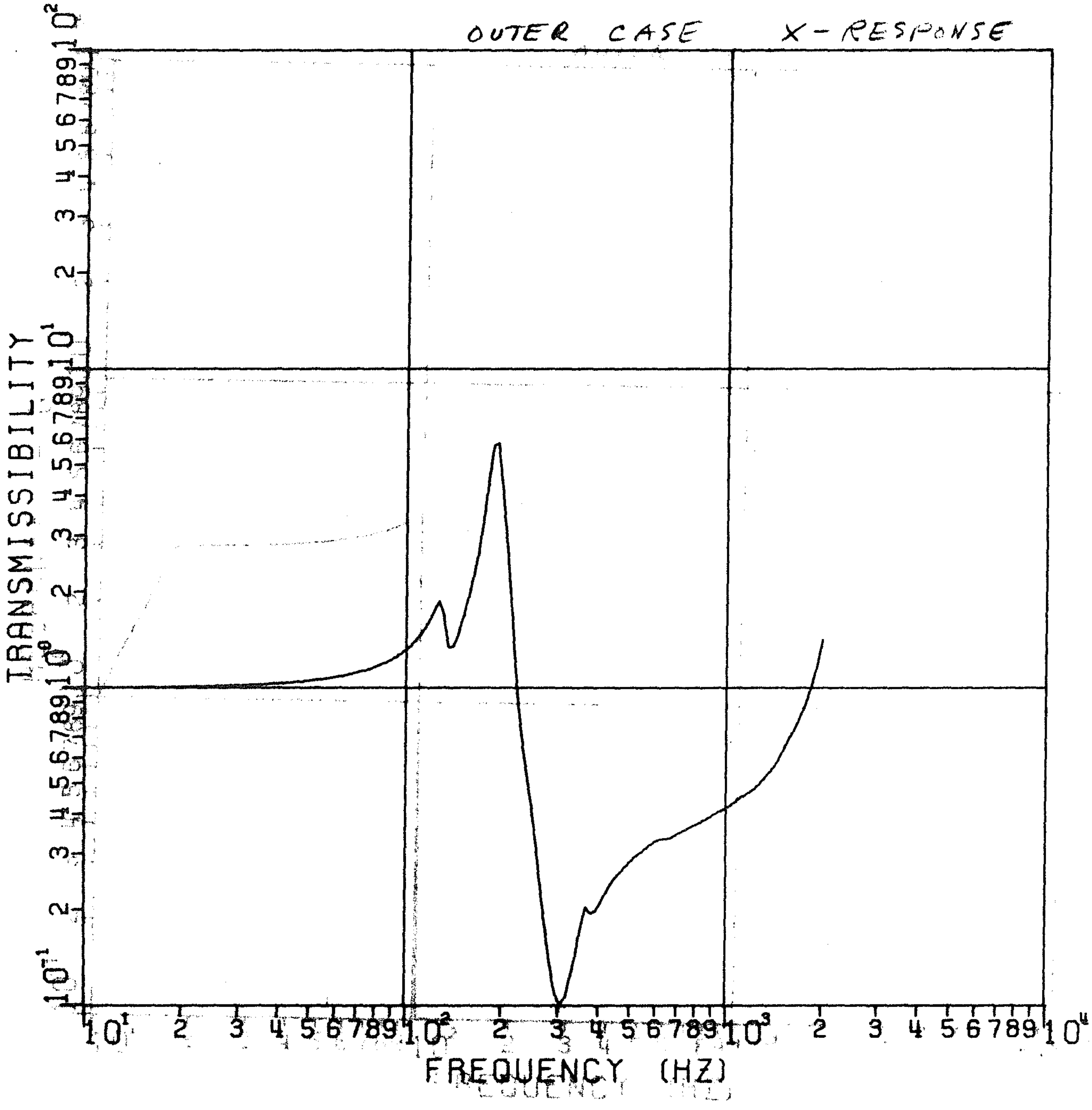
LOCATION 21



LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 19a TRANSMISSIBILITY

LOCATION 25

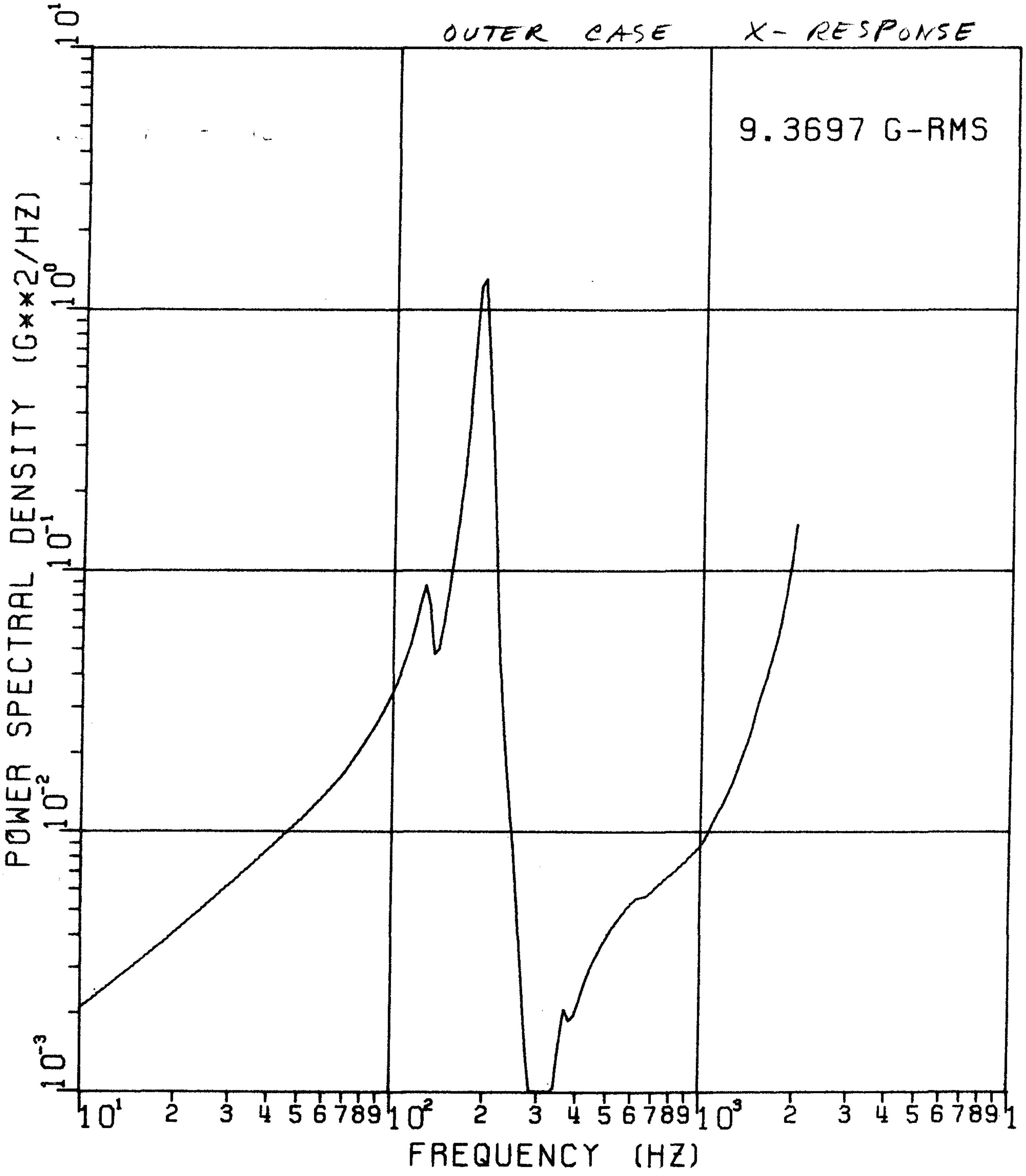


Page 64 of 80 is missing from this document.

LEAM DVT FREQ. RESP.,X-AXIS FORCING,L&B

FIGURE 19c RANDOM VIBRATION SPECTRUM

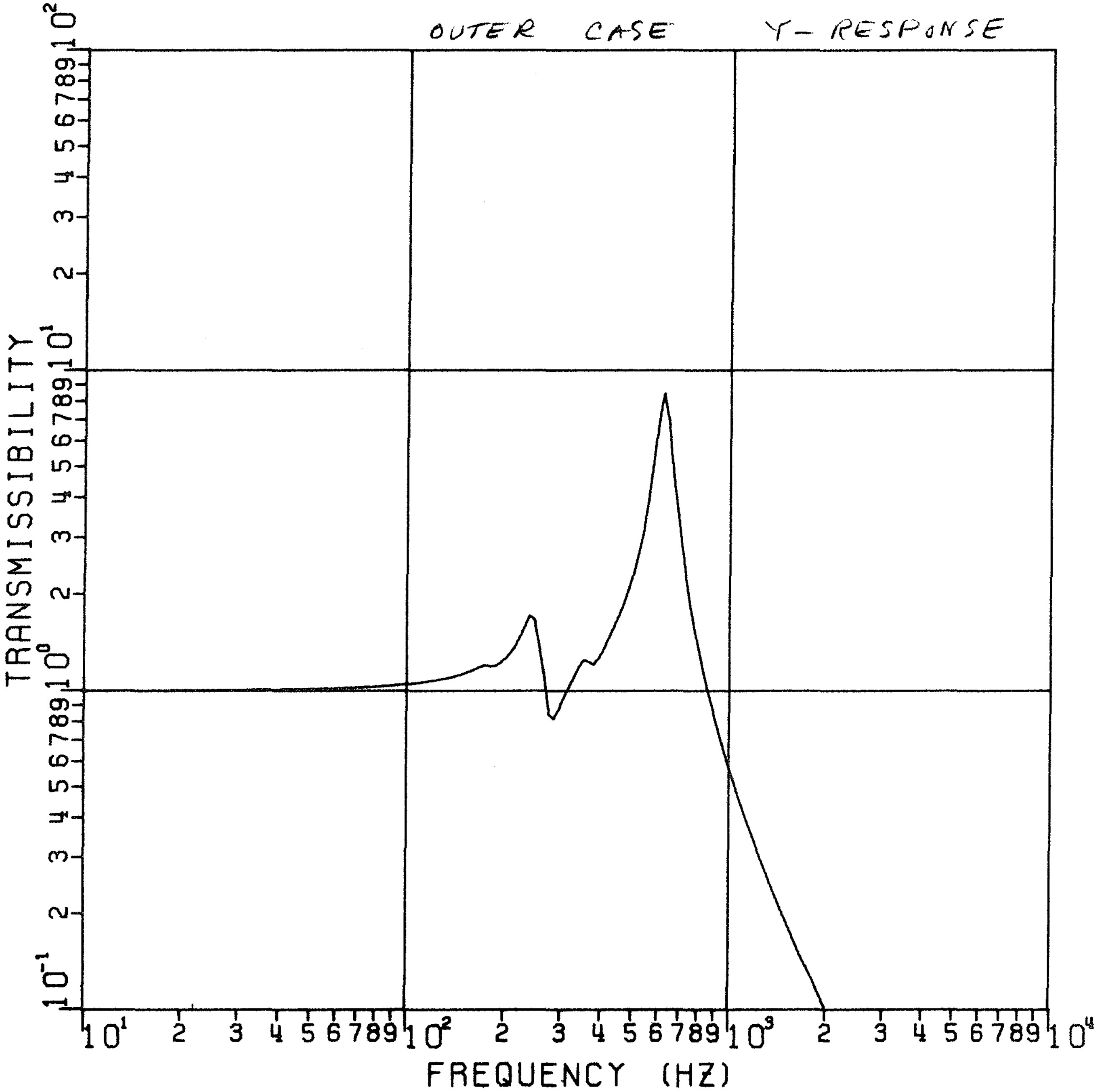
LOCATION 25



LEAM DVT FREQ. RESP.,Y-AXIS FORCING,L&B

FIGURE 20a TRANSMISSIBILITY

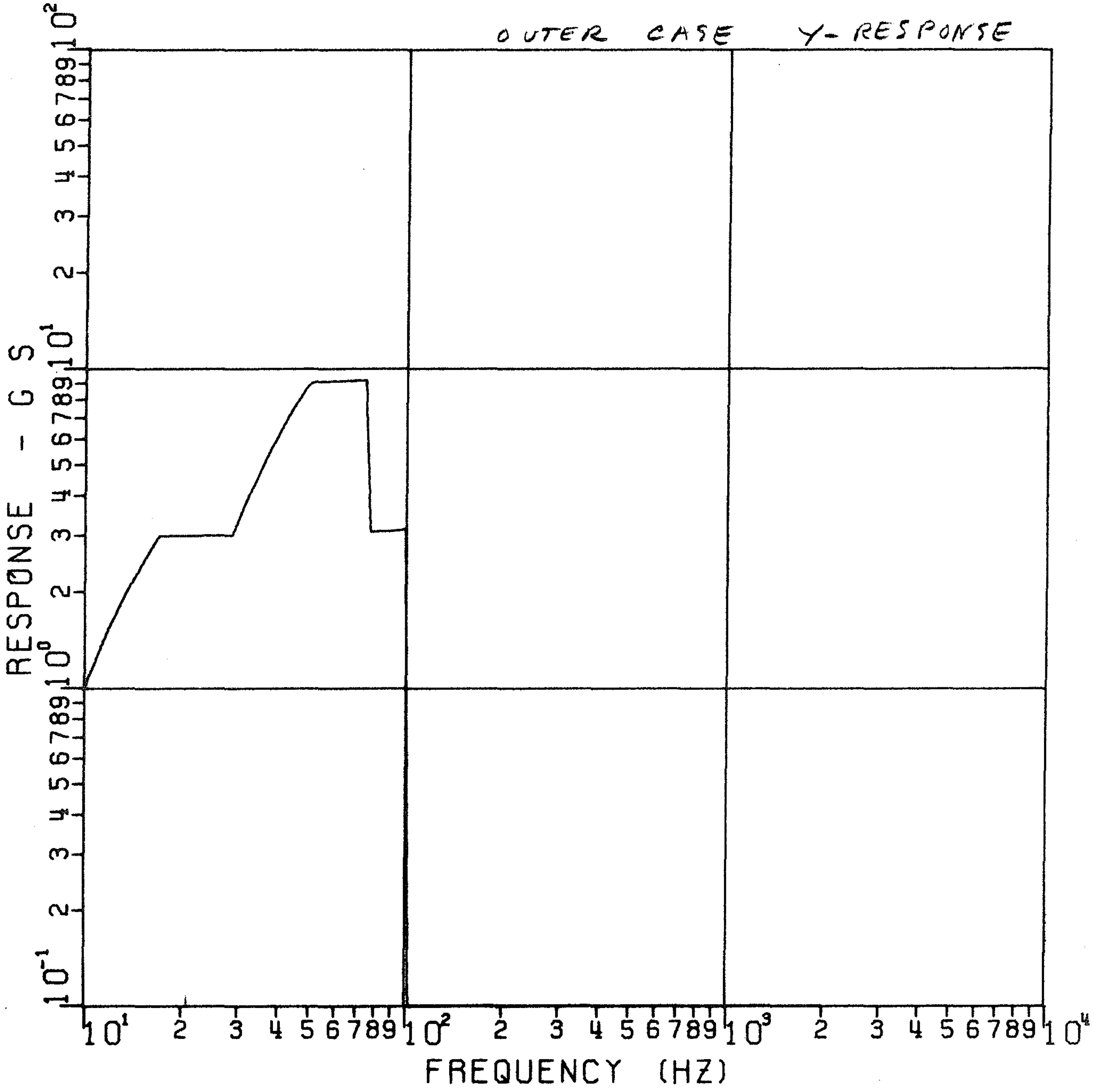
LOCATION 26



LEAM DVT FREQ. RESP., Y-AXIS FORCING, L&B

FIGURE 20b SINE RESPONSE

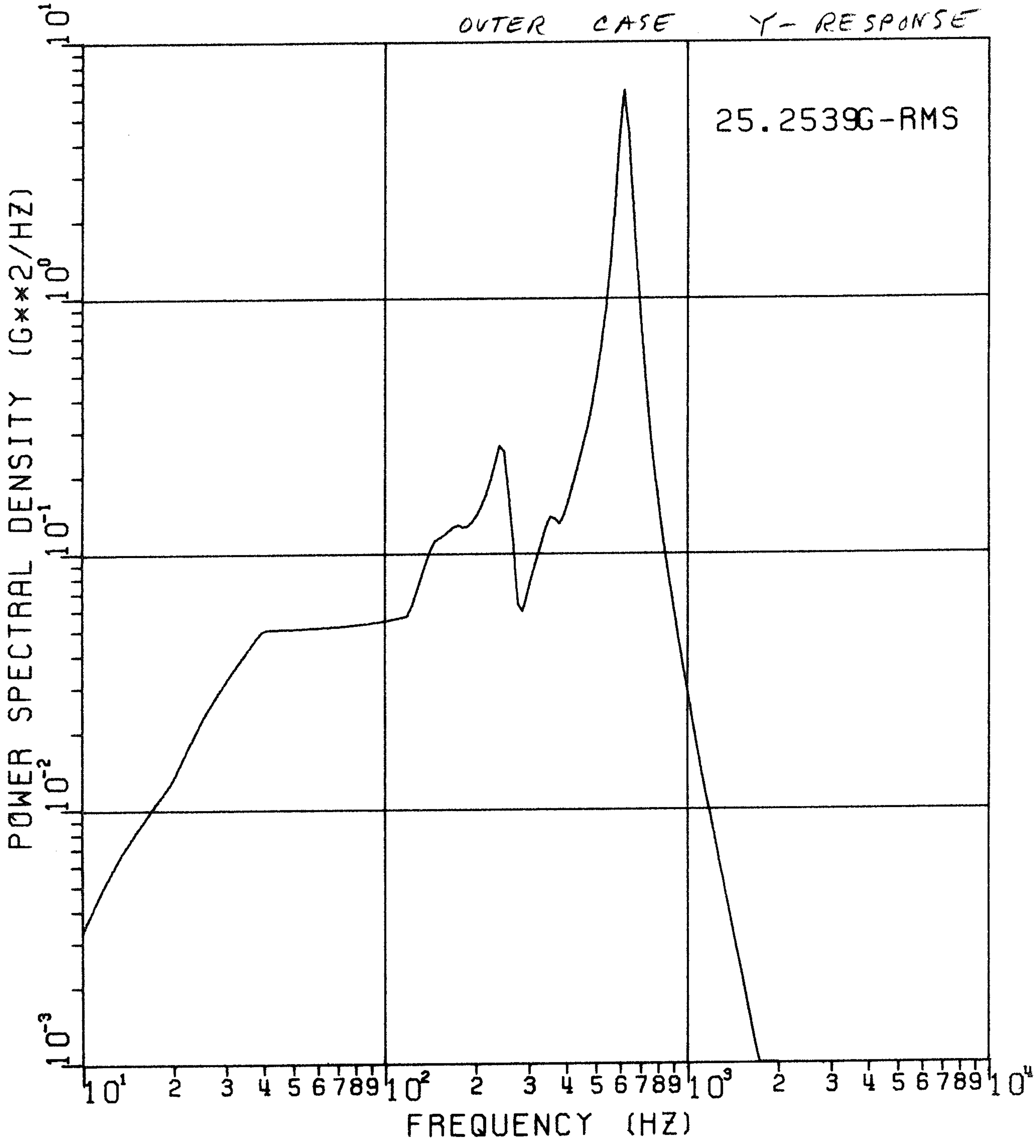
LOCATION 26



LEAM DVT FREQ. RESP.,Y-AXIS FORCING,L&B

FIGURE 20c RANDOM VIBRATION SPECTRUM

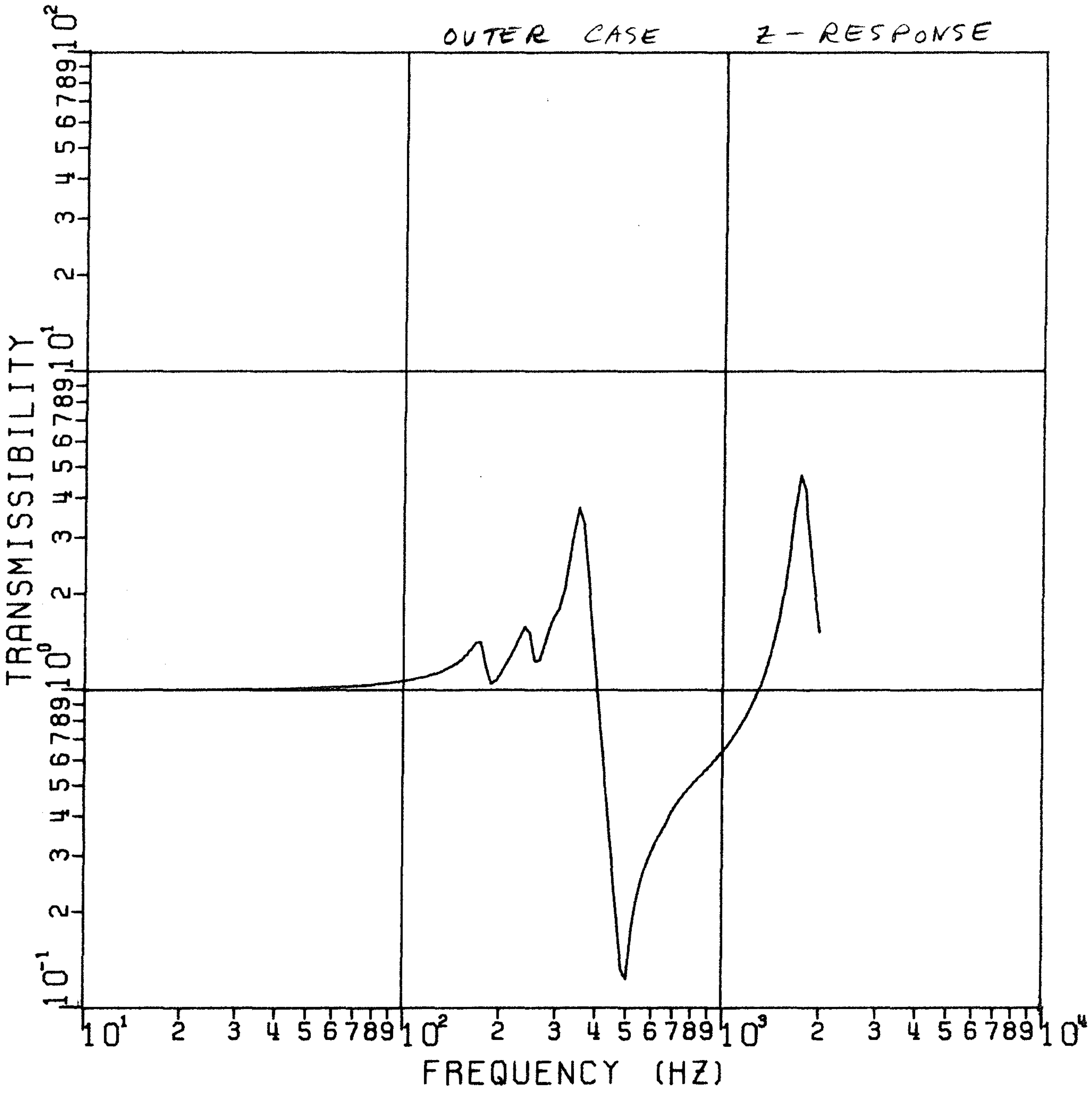
LOCATION 26



LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 21a TRANSMISSIBILITY

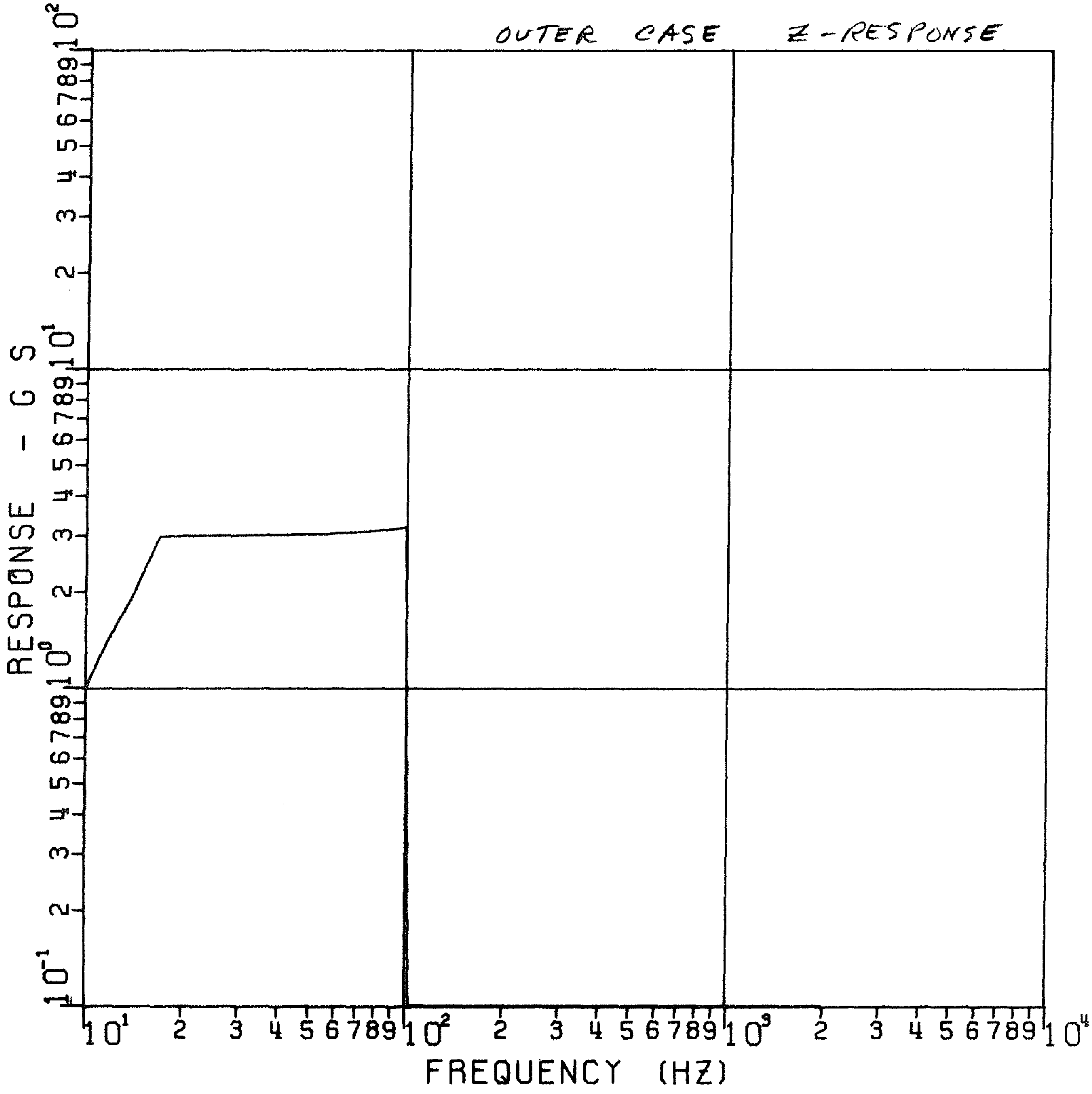
LOCATION 27



LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 21b SINE RESPONSE

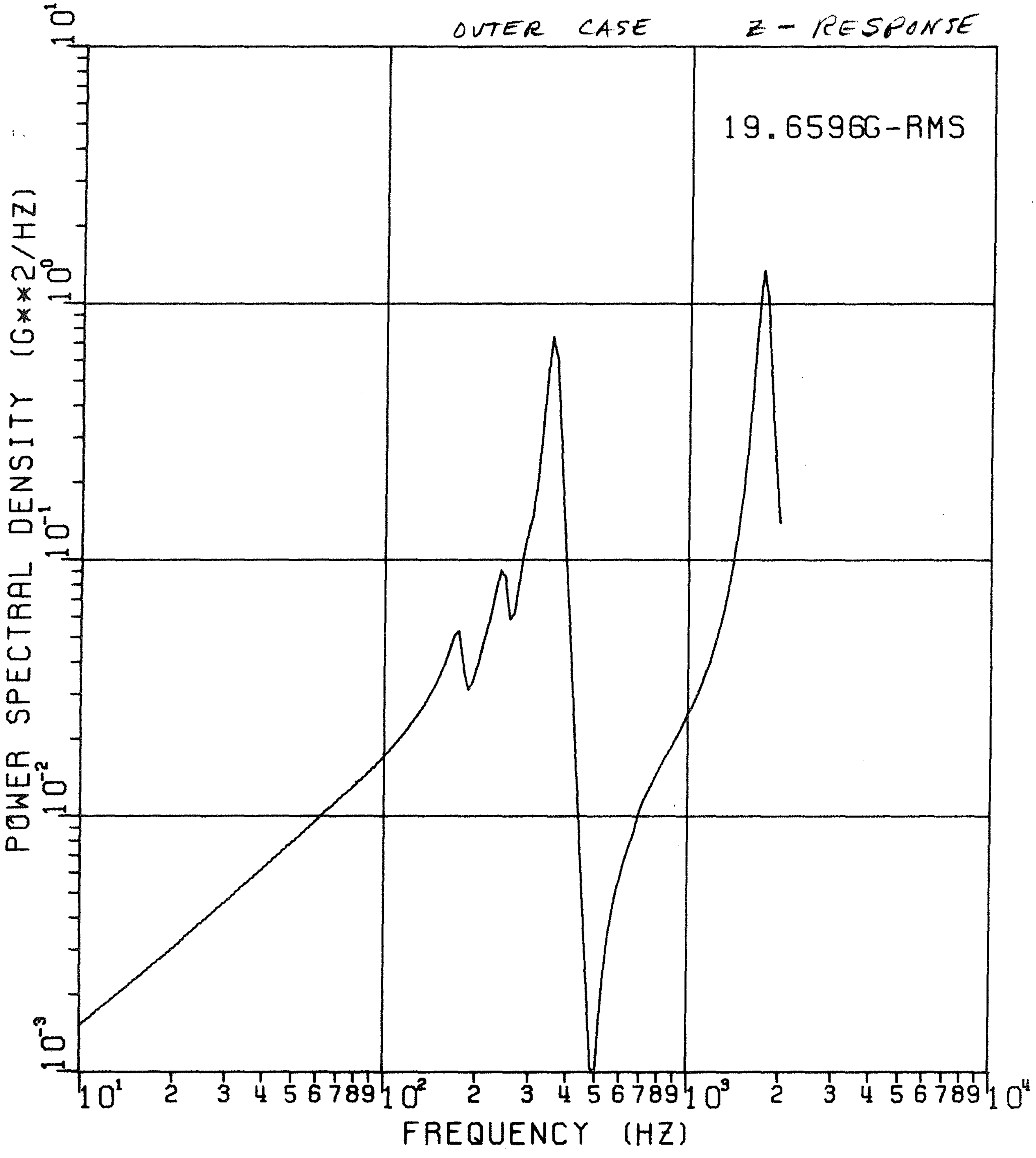
LOCATION 27



LEAM DVT FREQ. RESP.,Z-AXIS FORCING,L&B

FIGURE 21c RANDOM VIBRATION SPECTRUM

LOCATION 27



APPENDIX A

TABLE A-1

TABLE OF BEAM SECTION PROPERTIES

BEAM TYPE NUMBER	CROSS-SECTIONAL AREA	MOMENTS OF INERTIA			EFFECTIVE SHEAR AREAS	
		LOCAL Z-AXIS (MINOR)	LOCAL Y-AXIS (MAJOR)	LOCAL X-AXIS (TORSIONAL)	LOCAL Y-AXIS A(XY)	LOCAL Z-AXIS A(XZ)
1	.01023	.00002	.00001	.00001	-0.00000	-0.00000
2	.09051	.00483	.01555	.00010	-0.00000	-0.00000
3	.09240	.00136	.00037	.00100	-0.00000	-0.00000
4	.10898	.00245	.00048	.00075	-0.00000	-0.00000
5	.03648	.00023	.00006	.00016	-0.00000	-0.00000
6	.01983	.00009	.00003	.00005	-0.00000	-0.00000
7	.03348	.00018	.00006	.00011	-0.00000	-0.00000
8	.09000	.00024	.00188	.00081	-0.00000	-0.00000
9	.01273	.00011	.00006	.00003	-0.00000	-0.00000
10	.09500	.00008	.00715	.00030	-0.00000	-0.00000
11	.62500	.03200	.03200	.05500	-0.00000	-0.00000
12	.03740	.00007	.00748	.00026	-0.00000	-0.00000
13	.14148	.00663	.00048	.00124	-0.00000	-0.00000
14	.00700	.00001	.00000	.00000	-0.00000	-0.00000
15	.01600	.00021	.00000	.00006	-0.00000	-0.00000
16	.03922	.00716	.00001	.00005	-0.00000	-0.00000
17	.02413	.00090	.00006	.00001	-0.00000	-0.00000
18	.08010	.03357	.00004	.00014	-0.00000	-0.00000
19	.06153	.00838	.00013	.00026	-0.00000	-0.00000
20	.03622	.00716	.00001	.00006	-0.00000	-0.00000
21	.29440	.04184	.04184	.08000	-0.00000	-0.00000
22	.01338	.00030	.00001	.00006	-0.00000	-0.00000
23	.05522	.00737	.00001	.00012	-0.00000	-0.00000
24	.22800	.00007	.02740	.00246	-0.00000	-0.00000
25	.26600	.00008	.04340	.00292	-0.00000	-0.00000
26	.15322	.00254	.00500	.00154	-0.00000	-0.00000
27	.02026	.00882	.00283	.00003	-0.00000	-0.00000
28	.15386	.00204	.00781	.00169	-0.00000	-0.00000
29	.11136	.00380	.00278	.00077	-0.00000	-0.00000
30	.14169	.00554	.00344	.00120	-0.00000	-0.00000
31	.15636	.00226	.00801	.00126	-0.00000	-0.00000
32	.12000	.00010	.01440	.00038	-0.00000	-0.00000
33	2.07000	14.16000	10.85000	.50700	-0.00000	-0.00000

TABLE A-2

TABLE OF MATERIAL PROPERTIES

MATERIAL NUMBER	YOUNG*S MODULUS	POISSON*S RATIO	MASS DENSITY	EXPANSION COEFFICIENT
1	10000000.00	.3300	1.0100E-01	-0.
2	10989000.00	.4286	1.0100E-01	-0.
3	15500000.00	.3500	1.6300E-01	5.7000E-06
4	3200000.00	.1100	6.8700E-02	-0.

TABLE A-3

JOINT COORDINATES (ORDERED)

JOINT NO.	X	Y	Z	JOINT NO.	X	Y	Z
1	-3.000	1.650	-3.000	51	0.000	1.400	0.000
2	-3.000	2.200	3.000	52	-2.620	6.300	0.000
3	-3.000	6.300	0.000	53	0.000	4.650	4.280
4	-3.000	3.300	-3.000	54	1.670	6.300	0.000
5	-3.000	3.300	3.000	55	-3.000	9.300	3.100
6	-3.000	9.300	-3.000	56	3.000	0.000	3.100
7	-3.000	9.300	3.000	57	3.000	9.300	0.000
8	-1.650	3.300	-3.000	58	-1.650	6.300	0.000
9	-1.650	3.300	3.000	59	-.300	9.300	0.000
10	-1.650	9.300	-3.000	60	3.000	0.000	5.600
11	-1.650	9.300	3.000	61	-.300	6.300	0.000
12	-.300	3.300	-3.000	62	1.350	3.300	-3.000
13	-.300	3.300	3.000	63	1.350	3.300	3.000
14	-.300	9.300	-3.000	64	3.000	0.000	-3.500
15	-.300	9.300	3.000	65	3.000	1.650	-3.000
16	1.350	9.300	-3.000	66	3.000	0.000	-0.000
17	1.350	9.300	3.000	67	3.000	2.200	3.000
18	1.350	0.000	3.000	68	-3.000	4.650	3.100
19	3.000	3.300	-3.000	69	0.000	0.000	3.100
20	3.000	3.300	3.000	70	3.000	4.650	3.100
21	3.000	9.300	-3.000	71	0.000	9.300	3.100
22	3.000	9.300	3.000	72	3.000	9.300	3.100
23	-3.000	0.000	0.000	73	-2.150	0.000	-3.500
24	0.000	-0.000	-3.000	74	-2.150	0.000	-4.400
25	-0.000	0.000	3.000	75	-2.150	0.000	5.600
26	-3.000	0.000	3.100	76	-2.150	0.000	6.500
27	3.000	0.000	3.000	77	2.150	0.000	-3.500
28	-.300	6.300	-3.000	78	2.150	0.000	-4.400
29	-1.500	0.000	3.000	79	2.150	0.000	5.600
30	3.000	0.000	-4.300	80	2.150	0.000	6.500
31	-1.650	3.300	0.000	81	0.000	6.382	1.050
32	-1.650	9.300	0.000	82	0.000	0.000	1.050
33	-1.500	0.000	-3.000				
34	1.500	0.000	-3.000				
35	3.000	6.300	3.000				
36	3.000	6.300	-3.000				
37	-3.000	0.000	-4.300				
38	-1.650	6.300	-3.000				
39	3.000	3.300	0.000				
40	-3.000	3.300	0.000				
41	-1.650	6.300	3.000				
42	-.300	6.300	3.000				
43	-3.000	0.000	6.400				
44	3.000	0.000	6.400				
45	-3.000	0.000	3.000				
46	0.000	4.650	3.000				
47	-.300	3.300	0.000				
48	-3.000	0.000	-3.500				
49	-3.000	0.000	5.600				
50	0.000	3.300	0.000				

TABLE A-4

TABULATION OF DATA INPUT FOR BEAM MEMBERS

	BEAM NUMBER	NODES END-I	NODES END-J	MATL. NO.	CROSS-SECTIONAL AREA	SHEAR AREAS Y-AXIS A(XY)	SHEAR AREAS Z-AXIS A(XZ)	MOMENTS OF INERTIA Z-AXIS I(ZZ)	MOMENTS OF INERTIA Y-AXIS I(YY)	MOMENTS OF INERTIA X-AXIS J(XX)	Y-AXIS ANGLE (THETA)	END RELEASE CODE	BEAM LENGTH L(IJ)
*	1	1	4	1	.010	-0.000	-0.000	.000	.000	.000	354.400	-0	1.650
*	2	1	48	1	.010	-0.000	-0.000	.000	.000	.000	135.000	-0	1.724
*	3	2	5	1	.010	-0.000	-0.000	.000	.000	.000	315.000	-0	1.100
*	4	2	45	1	.010	-0.000	-0.000	.000	.000	.000	45.000	-0	2.200
*	5	3	4	1	.625	-0.000	-0.000	.032	.032	.055	0.000	-0	4.243
*	6	3	5	1	.625	-0.000	-0.000	.032	.032	.055	0.000	-0	4.243
*	7	3	6	1	.625	-0.000	-0.000	.032	.032	.055	0.000	-0	4.243
*	8	3	7	1	.625	-0.000	-0.000	.032	.032	.055	0.000	-0	4.243
*	9	3	52	1	.625	-0.000	-0.000	.032	.032	.055	0.000	-0	.380
*	10	4	5	1	.024	-0.000	-0.000	.001	.000	.000	90.000	-0	6.000
*	11	4	6	1	.024	-0.000	-0.000	.001	.000	.000	0.000	-0	6.000
*	12	4	8	1	.010	-0.000	-0.000	.000	.000	.000	135.000	-0	1.350
*	13	4	19	1	.062	-0.000	-0.000	.008	.000	.000	0.000	-0	6.000
*	14	4	40	1	.010	-0.000	-0.000	.000	.000	.000	215.000	-0	3.000
*	15	4	50	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	4.243
*	16	5	7	1	.024	-0.000	-0.000	.001	.000	.000	0.000	-0	6.000
*	17	5	9	1	.010	-0.000	-0.000	.000	.000	.000	315.000	-0	1.350
*	18	5	20	1	.062	-0.000	-0.000	.008	.000	.000	0.000	-0	6.000
*	19	5	40	1	.010	-0.000	-0.000	.000	.000	.000	215.000	-0	3.000
*	20	5	50	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	4.243
*	21	6	7	1	.024	-0.000	-0.000	.001	.000	.000	90.000	-0	6.000
*	22	6	10	1	.091	-0.000	-0.000	.005	.016	.000	151.600	-0	1.350
*	23	7	11	1	.091	-0.000	-0.000	.005	.016	.000	28.400	-0	1.350
*	24	7	46	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	5.534
*	25	7	55	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	.100
*	26	8	12	1	.010	-0.000	-0.000	.000	.000	.000	225.000	-0	1.350
*	27	8	31	1	.036	-0.000	-0.000	.007	.000	.000	0.000	-0	3.000
*	28	8	38	1	.039	-0.000	-0.000	.007	.000	.000	90.000	-0	3.000
*	29	9	13	1	.010	-0.000	-0.000	.000	.000	.000	45.000	-0	1.350
*	30	9	31	1	.036	-0.000	-0.000	.007	.000	.000	0.000	-0	3.000
*	31	9	41	1	.036	-0.000	-0.000	.007	.000	.000	90.000	-0	3.000
*	32	10	14	1	.091	-0.000	-0.000	.005	.016	.000	90.000	-0	1.350
*	33	10	32	1	.055	-0.000	-0.000	.007	.000	.000	0.000	-0	3.000
*	34	10	38	1	.039	-0.000	-0.000	.007	.000	.000	90.000	-0	3.000
*	35	11	15	1	.091	-0.000	-0.000	.005	.016	.000	331.600	-0	1.350
*	36	11	32	1	.055	-0.000	-0.000	.007	.000	.000	0.000	-0	3.000
*	37	11	41	1	.039	-0.000	-0.000	.007	.000	.000	90.000	-0	3.000
*	38	12	13	1	.062	-0.000	-0.000	.008	.000	.000	0.000	-0	6.000
*	39	12	14	1	.062	-0.000	-0.000	.008	.000	.000	0.000	-0	6.000
*	40	12	28	1	.010	-0.000	-0.000	.000	.000	.000	135.000	-0	3.000
*	41	12	47	1	.020	-0.000	-0.000	.000	.000	.000	180.000	-0	3.000
*	42	12	61	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	4.243
*	43	12	62	1	.020	-0.000	-0.000	.000	.000	.000	90.000	-0	1.650
*	44	13	15	1	.062	-0.000	-0.000	.008	.000	.000	0.000	-0	6.000
*	45	13	42	1	.010	-0.000	-0.000	.000	.000	.000	45.000	-0	3.000
*	46	13	47	1	.020	-0.000	-0.000	.000	.000	.000	180.000	-0	3.000
*	47	13	61	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	4.243
*	48	13	63	1	.020	-0.000	-0.000	.000	.000	.000	270.000	-0	1.650
*	49	14	15	1	.062	-0.000	-0.000	.008	.000	.000	0.000	-0	6.000
*	50	14	16	1	.010	-0.000	-0.000	.000	.000	.000	315.000	-0	1.650
*	51	14	28	1	.010	-0.000	-0.000	.000	.000	.000	225.000	-0	3.000
*	52	14	59	1	.020	-0.000	-0.000	.000	.000	.000	0.000	-0	3.000
*	53	14	61	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	4.243
*	54	15	17	1	.010	-0.000	-0.000	.000	.000	.000	315.000	-0	1.650
	55	15	42	1	.010	-0.000	-0.000	.000	.000	.000	315.000	-0	3.000
	6	15	59	1	.020	-0.000	-0.000	.000	.000	.000	0.000	-0	3.000

*	57	15	61	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	4.243
*	58	16	21	1	.010	-0.000	-0.000	.000	.000	.000	315.000	-0	1.650
*	59	17	22	1	.010	-0.000	-0.000	.000	.000	.000	45.000	-0	1.650
*	60	18	25	1	.033	-0.000	-0.000	.000	.000	.000	74.800	-0	1.350
*	61	18	27	1	.033	-0.000	-0.000	.000	.000	.000	74.800	-0	1.650
*	62	19	20	1	.062	-0.000	-0.000	.008	.000	.000	90.000	-0	6.000
*	63	19	36	1	.036	-0.000	-0.000	.000	.000	.000	28.510	-0	3.000
*	64	19	39	1	.010	-0.000	-0.000	.000	.000	.000	225.000	-0	3.000
*	65	19	50	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	4.243
*	66	19	62	1	.020	-0.000	-0.000	.000	.000	.000	270.000	-0	1.650
*	67	19	65	1	.010	-0.000	-0.000	.000	.000	.000	225.000	-0	1.650
*	68	20	35	1	.036	-0.000	-0.000	.000	.000	.000	151.490	-0	3.000
*	69	20	39	1	.010	-0.000	-0.000	.000	.000	.000	225.000	-0	3.000
*	70	20	50	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	4.243
*	71	20	67	1	.010	-0.000	-0.000	.000	.000	.000	45.000	-0	1.100
*	72	20	63	1	.020	-0.000	-0.000	.000	.000	.000	90.000	-0	1.650
*	73	21	36	1	.036	-0.000	-0.000	.000	.000	.000	28.510	-0	3.000
*	74	21	57	1	.036	-0.000	-0.000	.000	.000	.000	-0.000	-0	3.000
*	75	22	35	1	.036	-0.000	-0.000	.000	.000	.000	151.490	-0	3.000
*	76	22	46	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	5.534
*	77	22	57	1	.036	-0.000	-0.000	.000	.000	.000	208.510	-0	3.000
*	78	22	72	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	.100
*	79	23	45	1	.109	-0.000	-0.000	.002	.000	.001	174.400	-0	3.000
*	80	23	48	1	.109	-0.000	-0.000	.002	.000	.001	174.400	-0	3.500
*	81	24	33	1	.141	-0.000	-0.000	.007	.000	.001	105.200	-0	1.500
*	82	24	34	1	.141	-0.000	-0.000	.007	.000	.001	105.200	-0	1.500
*	83	25	29	1	.033	-0.000	-0.000	.000	.000	.000	74.800	-0	1.500
*	84	26	45	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	.100
*	85	26	68	1	.080	-0.000	-0.000	.034	.000	.000	0.000	-0	4.650
*	86	26	69	1	.080	-0.000	-0.000	.034	.000	.000	0.000	-0	3.000
*	87	27	46	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	5.534
*	88	27	56	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	.100
*	89	27	60	1	.090	-0.000	-0.000	.000	.002	.001	0.000	-0	2.600
*	90	27	66	1	.109	-0.000	-0.000	.002	.000	.001	185.000	-0	3.000
*	91	27	67	1	.010	-0.000	-0.000	.000	.000	.000	315.000	-0	2.200
*	92	29	45	1	.033	-0.000	-0.000	.000	.000	.000	74.800	-0	1.500
*	93	30	64	3	.095	-0.000	-0.000	.000	.007	.000	90.000	-0	.800
*	94	30	78	3	.120	-0.000	-0.000	.000	.014	.000	90.000	-0	.856
*	95	31	47	1	.016	-0.000	-0.000	.000	.000	.000	0.000	-0	1.350
*	96	31	58	1	.013	-0.000	-0.000	.000	.000	.000	90.000	-0	3.000
*	97	32	56	1	.013	-0.000	-0.000	.000	.000	.000	90.000	-0	3.000
*	98	33	48	1	.141	-0.000	-0.000	.007	.000	.001	105.200	-0	1.581
*	99	33	73	1	.141	-0.000	-0.000	.007	.000	.001	90.000	-0	.820
*	100	34	64	1	.109	-0.000	-0.000	.002	.000	.001	185.000	-0	1.581

TABLE A-4 (CONT.)

TABLE A-4 (CONT.)

TABULATION OF DATA INPUT FOR BEAM MEMBERS

				CROSS-	SHEAR AREAS		MOMENTS OF INERTIA			Y-AXIS	END	BEAM
BEAM	NODES		MATL.	SECTIONAL	Y-AXIS	Z-AXIS	Z-AXIS	Y-AXIS	X-AXIS	ANGLE	RELEASE	LENGTH
NUMBER	END-I	END-J	NO.	AREA	A(XY)	A(XZ)	I(ZZ)	I(YY)	J(XX)	(THETA)	CODE	L(IJ)
* 101	34	77	1	.154	-0.000	-0.000	.002	.008	.002	90.000	-0	.820
* 102	37	48	3	.095	-0.000	-0.000	.000	.007	.000	90.000	-0	.800
* 103	37	74	3	.120	-0.000	-0.000	.000	.014	.000	90.000	-0	.856
* 104	43	49	3	.095	-0.000	-0.000	.000	.007	.000	90.000	-0	.800
* 105	43	76	3	.120	-0.000	-0.000	.000	.014	.000	90.000	-0	.856
* 106	44	60	3	.095	-0.000	-0.000	.000	.007	.000	90.000	-0	.800
* 107	44	80	3	.120	-0.000	-0.000	.000	.014	.000	90.000	-0	.856
* 108	45	46	1	.294	-0.000	-0.000	.042	.042	.080	0.000	-0	5.534
* 109	45	49	1	.142	-0.000	-0.000	.006	.003	.001	90.000	-0	2.600
* 110	44	80	3	.228	-0.000	-0.000	.000	.027	.002	90.000	-0	.856
* 111	46	53	1	.625	-0.000	-0.000	.032	.032	.055	0.000	-0	1.280
* 112	48	73	1	.154	-0.000	-0.000	.002	.008	.002	90.000	-0	.850
* 113	49	75	1	.153	-0.000	-0.000	.003	.005	.002	90.000	-0	.850
* 114	50	51	3	.625	-0.000	-0.000	.032	.032	.055	0.000	-0	1.900
* 115	54	61	1	.625	-0.000	-0.000	.032	.032	.055	0.000	-0	1.970
* 116	55	68	1	.080	-0.000	-0.000	.034	.000	.000	0.000	-0	4.650
* 117	55	71	1	.080	-0.000	-0.000	.034	.000	.000	0.000	-0	3.000
* 118	56	69	1	.080	-0.000	-0.000	.034	.000	.000	0.000	-0	3.000
* 119	56	70	1	.080	-0.000	-0.000	.034	.000	.000	0.000	-0	4.650
* 120	60	79	1	.153	-0.000	-0.000	.003	.005	.002	90.000	-0	.850
* 121	64	65	1	.010	-0.000	-0.000	.000	.000	.000	225.000	-0	1.724
* 122	64	66	1	.142	-0.000	-0.000	.006	.003	.001	90.000	-0	3.500
* 123	64	77	1	.154	-0.000	-0.000	.002	.008	.002	90.000	-0	.850
* 124	70	72	1	.080	-0.000	-0.000	.034	.000	.000	0.000	-0	4.650
* 125	71	72	1	.080	-0.000	-0.000	.034	.000	.000	0.000	-0	3.000
* 126	73	74	3	.095	-0.000	-0.000	.000	.007	.000	90.000	-0	.900
* 127	74	82	1	2.070	-0.000	-0.000	14.160	10.850	.507	-0.000	-0	5.859
* 128	75	76	3	.095	-0.000	-0.000	.000	.007	.000	90.000	-0	.900
* 129	75	79	1	.154	-0.000	-0.000	.002	.008	.002	90.000	-0	4.300
* 130	76	82	1	2.070	-0.000	-0.000	14.160	10.850	.507	-0.000	-0	5.859
* 131	77	78	3	.095	-0.000	-0.000	.000	.007	.000	90.000	-0	.900
* 132	78	82	1	2.070	-0.000	-0.000	14.160	10.850	.507	-0.000	-0	5.859
* 133	79	80	3	.095	-0.000	-0.000	.000	.007	.000	90.000	-0	.900
* 134	80	82	1	2.070	-0.000	-0.000	14.160	10.850	.507	-0.000	-0	5.859
* 135	81	82	4	2.070	-0.000	-0.000	14.160	10.850	.507	90.000	-0	6.382

TABLE A-5

TABULATION OF DATA INPUT FOR TRIANGULAR MEMBERS

	TRIANGLE NUMBER	ELEMENT TYPE	NODE NUMBERS. NODE-I	NODE-J	NODE-K	MATERIAL NUMBER	TRIANGLE THICKNESS	STRESS-REFERENCE PLANE
*	1	SHELL	1	4	8	2	.025	-0
*	2	SHELL	1	4	40	2	.025	-0
*	3	SHELL	1	8	33	2	.025	-0
*	4	SHELL	1	23	40	2	.025	-0
*	5	SHELL	1	33	48	2	.025	-0
*	6	SHELL	1	23	48	2	.025	-0
*	7	SHELL	2	5	9	2	.025	-0
*	8	SHELL	2	5	40	2	.025	-0
*	9	SHELL	2	9	29	2	.025	-0
*	10	SHELL	2	23	40	2	.025	-0
*	11	SHELL	2	23	45	2	.025	-0
*	12	SHELL	2	29	45	2	.025	-0
*	13	SHELL	2	45	49	2	.040	-0
*	14	SHELL	4	8	40	2	.025	-0
*	15	SHELL	5	9	40	2	.025	-0
*	16	SHELL	8	12	33	2	.025	-0
*	17	SHELL	8	12	47	2	.025	-0
*	18	SHELL	8	31	40	2	.025	-0
*	19	SHELL	8	31	47	2	.025	-0
*	20	SHELL	8	31	58	2	.020	-0
*	21	SHELL	8	38	58	2	.020	-0
*	22	SHELL	9	13	29	2	.025	-0
*	23	SHELL	9	13	47	2	.025	-0
*	24	SHELL	9	31	40	2	.025	-0
*	25	SHELL	9	31	47	2	.025	-0
*	26	SHELL	9	31	58	2	.020	-0
*	27	SHELL	9	41	58	2	.020	-0
*	28	SHELL	10	14	59	2	.025	-0
*	29	SHELL	10	32	58	2	.020	-0
*	30	SHELL	10	32	59	2	.025	-0
*	31	SHELL	10	38	58	2	.020	-0
*	32	SHELL	11	15	59	2	.025	-0
*	33	SHELL	11	32	58	2	.020	-0
*	34	SHELL	11	32	59	2	.025	-0
*	35	SHELL	11	41	58	2	.020	-0
*	36	SHELL	12	24	33	2	.025	-0
*	37	SHELL	12	24	34	2	.025	-0
*	38	SHELL	12	28	47	2	.025	-0
*	39	SHELL	12	28	62	2	.025	-0
*	40	SHELL	12	34	62	2	.025	-0
*	41	SHELL	12	47	62	2	.025	-0
*	42	SHELL	13	25	29	2	.025	-0
*	43	SHELL	13	18	25	2	.025	-0
*	44	SHELL	13	18	63	2	.025	-0
*	45	SHELL	13	42	47	2	.025	-0
*	46	SHELL	13	42	63	2	.025	-0
*	47	SHELL	13	47	63	2	.025	-0
*	48	SHELL	14	16	28	2	.025	-0
*	49	SHELL	14	16	59	2	.025	-0
*	50	SHELL	14	28	59	2	.025	-0

TABLE A-5 (CONT.)

TABULATION OF DATA INPUT FOR TRIANGULAR MEMBERS

	TRIANGLE NUMBER	ELEMENT TYPE	NODE NUMBERS, NODE-I	NODE-J	NODE-K	MATERIAL NUMBER	TRIANGLE THICKNESS	STRESS-REFERENCE PLANE
*	51	SHELL	15	17	42	2	.025	-0
*	52	SHELL	15	17	59	2	.020	-0
*	53	SHELL	15	42	59	2	.025	-0
*	54	SHELL	16	21	36	2	.025	-0
*	55	SHELL	16	21	57	2	.020	-0
*	56	SHELL	16	28	62	2	.025	-0
*	57	SHELL	16	36	62	2	.025	-0
*	58	SHELL	16	57	59	2	.020	-0
*	59	SHELL	17	22	57	2	.020	-0
*	60	SHELL	17	22	35	2	.025	-0
*	61	SHELL	17	35	63	2	.025	-0
*	62	SHELL	17	42	63	2	.025	-0
*	63	SHELL	17	57	59	2	.025	-0
*	64	SHELL	18	25	60	2	.180	-0
*	65	SHELL	18	27	60	2	.180	-0
*	66	SHELL	18	27	67	2	.025	-0
*	67	SHELL	18	63	67	2	.025	-0
*	68	SHELL	19	36	62	2	.025	-0
*	69	SHELL	19	39	62	2	.025	-0
*	70	SHELL	19	39	65	2	.025	-0
*	71	SHELL	19	62	65	2	.025	-0
*	72	SHELL	20	35	63	2	.025	-0
*	73	SHELL	20	39	63	2	.025	-0
*	74	SHELL	20	39	67	2	.025	-0
*	75	SHELL	20	67	63	2	.025	-0
*	76	SHELL	25	29	49	2	.180	-0
*	77	SHELL	25	49	60	2	.180	-0
*	78	SHELL	26	68	69	2	.030	-0
*	79	SHELL	27	60	67	2	.040	-0
*	80	SHELL	27	66	67	2	.025	-0
*	81	SHELL	28	47	59	2	.025	-0
*	82	SHELL	28	47	62	2	.025	-0
*	83	SHELL	29	45	49	2	.180	-0
*	84	SHELL	34	62	65	2	.025	-0
*	85	SHELL	34	64	65	2	.025	-0
*	86	SHELL	39	47	62	2	.025	-0
*	87	SHELL	39	47	63	2	.025	-0
*	88	SHELL	39	67	66	2	.025	-0
*	89	SHELL	39	65	66	2	.025	-0
*	90	SHELL	42	47	59	2	.025	-0
*	91	SHELL	47	62	63	2	.025	-0
*	92	SHELL	55	68	71	2	.030	-0
*	93	SHELL	56	69	70	2	.030	-0
*	94	SHELL	64	65	66	2	.030	-0
*	95	SHELL	68	69	70	2	.030	-0
*	96	SHELL	68	70	71	2	.030	-0
*	97	SHELL	70	71	72	2	.030	-0

APPENDIX B

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30   30
 1    10.1824E 01-.1522E 000.5989E-020.1191E-010.2282E-02-.2173E 01-.3594E 00
 1    8-.1287E 000.5145E-010.7672E-020.4006E-01-.2617E 00-.2030E 000.8925E-01
 1   15-.3312E-020.6958E-010.1684E 000.3433E-02-.2025E 000.1544E 00-.1423E-01
 1   22-.8237E-04-.4761E-02-.2421E 00-.2545E-010.9622E-020.1550E-020.3572E-02
 1   290.1393E-01-.1326E 00
 2    20.9496E 000.7110E-02-.2498E-020.4178E-020.8066E-010.2386E 00-.5642E 00
 2    9-.5315E-01-.1246E-01-.1010E-010.2177E 000.3836E-01-.1916E 00-.7606E-02
 2   16-.1575E 00-.3072E-01-.1051E-010.2089E-01-.1339E 00-.2409E-01-.4996E-02
 2   23-.2631E-010.1457E 000.1176E-01-.1299E-01-.8861E-020.1690E-010.2518E-02
 2   300.5685E-01
 3    30.2171E 010.2690E 010.4974E-01-.8442E-020.5772E-020.1093E 00-.7664E 00
 3   100.1456E 00-.1087E 00-.2907E-01-.5547E-01-.2140E 00-.3419E-03-.1483E 00
 3   170.4568E-010.2175E-01-.4025E-020.2021E-01-.2321E 000.4110E-01-.2728E 00
 3   24-.2248E-01-.2607E-010.1761E-01-.1593E-010.4920E-010.1459E-01-.1440E 00
 4    40.5177E 010.8356E-01-.2150E-010.1500E-010.7302E-01-.1099E 010.1340E 00
 4   11-.2704E 00-.2395E-01-.6609E-01-.1227E 00-.5053E-02-.7652E-010.5444E-01
 4   180.2818E-010.3394E-02-.1353E-01-.3092E 000.4110E-01-.3623E 000.1426E-01
 4   25-.3357E-010.1490E-01-.2882E-010.7659E-010.2134E-01-.1896E 00
 5    50.1445E 01-.1353E-020.3392E-020.2181E-01-.1094E 000.1763E-01-.7581E-01
 5   12-.7892E-02-.2696E-01-.4388E-010.2934E-02-.3270E-010.2007E-010.4661E-02
 5   190.2718E-020.1230E-010.3829E-010.6920E-030.3337E-01-.1481E-01-.1399E-01
 5   260.1535E-020.4330E-02-.8531E-020.2664E-02-.8788E-01
 6    60.4473E 010.4514E 000.4554E 00-.7974E-01-.1629E-01-.5456E-010.1964E 00
 6   130.3242E 00-.1911E 000.2251E-02-.1532E 00-.2958E 00-.1919E-010.2826E 00
 6   20-.2692E 000.5166E-02-.2498E-02-.8256E-020.3780E 000.4786E-01-.1900E-01
 6   27-.7072E-020.5665E-02-.1683E-010.2456E 00
 7    70.8774E 00-.3744E 000.1161E 000.4236E-010.1808E 000.3350E 00-.3376E 00
 7   140.6643E-01-.5778E-010.1999E-010.3258E 000.7872E-01-.2102E 000.5127E-01
 7   21-.5307E-01-.5090E-02-.3424E-010.2490E-02-.8970E-010.4668E-020.2616E-02
 7   28-.5179E-020.4974E-02-.5075E 00
 8    80.2513E 01-.4079E 00-.2294E 00-.1754E 00-.6570E 00-.5293E 00-.1185E 01
 8   15-.1530E-01-.9861E 000.4559E 000.1398E 00-.1777E 00-.4769E 00-.1768E 00
 8   22-.3322E-01-.2171E 000.6462E 00-.1525E 00-.5517E-01-.2434E-010.4009E-01
 8   290.1083E-01-.8149E 00
 9    90.1862E 01-.2278E 000.3011E 000.4074E-02-.2180E 000.6889E 00-.2139E 00
 9   160.4211E 000.5016E-010.9268E-020.1361E 00-.1611E 00-.6817E 00-.4946E-01
 9   23-.9063E 000.1437E 000.5948E-03-.1185E-01-.6579E-010.1293E 00-.3219E-01
 9   30-.4191E-01
10   100.3374E 010.1722E-010.3933E-010.9514E-020.3142E 00-.7592E-010.2130E 00
10   17-.3730E-01-.2147E-010.3759E-01-.4405E-01-.9575E-01-.1944E-01-.1022E 00
10   240.3920E-010.2144E-01-.6979E-02-.7324E-020.1030E-010.5491E-020.1259E 00
11   110.3231E 01-.7534E-01-.3691E 000.2184E 00-.4119E-010.1607E 000.2422E 00
11   180.5971E-010.1163E 00-.2317E-01-.1719E-010.4118E-02-.1293E 00-.1553E-01
11   25-.5464E-010.2670E-03-.1951E-010.4109E-010.2802E-02-.3467E 00
12   120.3429E 010.3804E 000.2724E 000.5157E-010.2559E 00-.3566E 00-.9845E-01
12   190.2156E 000.9710E-010.1000E 000.1358E-010.9764E-01-.2271E 000.1046E 00
12   260.1367E-010.4404E-02-.4702E-02-.3927E-020.5787E 00
13   130.1548E 010.2329E 000.1021E 000.2572E 00-.1436E 010.1367E 00-.3180E 00
13   200.1953E 000.2739E 000.2370E-010.2123E 00-.1423E 00-.1689E 000.1563E-01
13   270.2299E-02-.3772E-03-.3603E-01-.9524E 00
14   140.2234E 010.4154E-010.1851E 01-.2178E 00-.7984E-010.1337E 00-.6189E 00
14   210.3192E 000.7152E-010.3833E 000.6829E 000.8623E-01-.4436E-010.3433E-01
14   28-.5393E-01-.1580E-010.4760E 00
15   150.5641E 000.1828E-01-.2584E-01-.1435E-01-.9770E-02-.1691E-01-.1450E 00
15   22-.1455E-01-.1532E 000.2397E-010.1622E-01-.3976E-02-.2738E-020.5062E-02
15   290.2231E-020.9183E-01
16   160.3398E 01-.2119E 00-.7785E-010.1054E 00-.5093E 000.1419E 000.4448E-01
16   230.1884E 000.5639E 000.8340E-01-.3691E-010.2494E-01-.4059E-01-.1136E-01
16   300.4648E 00
17   170.2857E 01-.1092E 000.3012E 00-.1615E 00-.1491E 00-.1257E-01-.9672E-01
17   240.1045E 000.1373E 00-.1115E-01-.2952E-020.3481E-020.3650E-010.7699E 00
18   180.1931E 010.4706E-01-.3800E-01-.4927E-01-.5840E-02-.4600E-010.2599E-01
18   25-.2055E 010.2893E-01-.4394E-010.1019E 00-.3617E-01-.1226E 02
19   190.6843E 00-.1339E-01-.7374E-01-.2121E-02-.4100E-010.4890E-01-.5556E-01
19   260.7517E-020.4746E-02-.9221E-020.4486E-02-.3045E 00
20   200.1424E 01-.8944E-01-.2101E-01-.1076E 00-.1691E 010.4620E-01-.5178E-01
20   27-.2948E-010.4891E-010.1622E-020.2236E 00
21   210.1183E 01-.5297E-010.1481E 010.1290E 000.5088E-01-.9240E-02-.2533E-01
21   280.4680E-010.9016E-020.2967E 00
22   220.9524E 00-.5325E-010.2632E-010.6657E-02-.3317E-02-.3686E-020.5093E-02
22   290.5767E-030.3667E-01
23   230.3115E 010.1418E 000.4797E-01-.1010E-01-.2933E-010.5466E-010.1552E-01
23   300.2759E 00
24   240.3287E 01-.3488E-010.5668E-010.3303E-01-.5365E-01-.2216E-02-.1544E 00
25   250.7466E 01-.1111E 000.1563E 00-.3643E 000.1261E 000.4451E 02
26   260.1434E 01-.1360E 000.2614E 00-.1871E-02-.3271E 00
27   270.5704E 01-.2795E 020.4136E-020.5337E 00
28   280.1622E 03-.9119E-02-.1411E 01
29   290.6850E 020.7494E 00
30   300.2747E 03
```

(10^5 FACTORED)

TABLE B-1

STIFFNESS MATRIX

TABLE B-2
MASS MATRIX

.6997E-02 LB-SEC^2/IN

.6997E-02

.6997E-02

.02175 LB-SEC^2-IN

.03411

.02175

.3950E-02

.3950E-02

.3950E-02

.0193

.0102

.0102

.1051E-01

.1051E-01

.1051E-01

.079

.035

.107

.6110E-02

.6110E-02

.6110E-02

.0298

.01895
.01895
.9260E-02
.9260E-02
.9260E-02
.249
.215
.2125