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LANDSAT-D
ORBITAL JITTER ANALYSIS

FINAL REPORT

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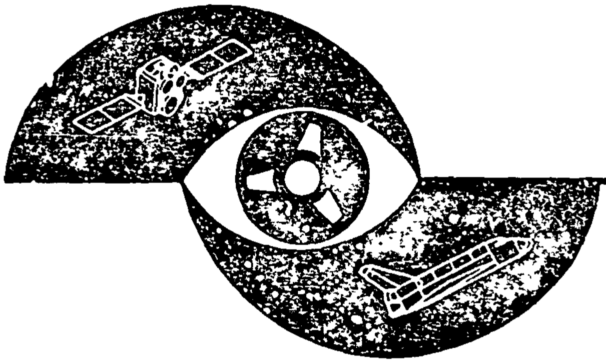

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LANDSAT-D FINAL MSS/TM TUNED
ORBITAL JITTER ANALYSIS
MODEL LSD900

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1.0 SUMMARY

The final Landsat-D orbital dynamic math model (LSD900), comprised of all test validated substructures, has been used to evaluate the jitter response of the MSS/TM experiments. The revisions to the previous analytical model, LSD801, include: (1) updated tuned MMS dynamic model to include dynamic test results from propulsion system testing; (2) test verified TDRSS boom/RF Compartment substructure with the boom 2nd Y-bending mode re-tuned to better match test data increasing the on-orbit frequency separation from the fundamental MSS forcing harmonic at 13.62 Hz; (3) updated coupling simulation between the MMS and Instrument Module substructures; and (4) updated IM dynamic model representing the design as shown on the released prints as of January 1981 and including the structural updates to the 36 and 55 bulkheads. No simulation updates were included in the TRW supplied RF Compartment and Ku/S-Band Antenna models over those of model LSD801. The appendage orientation used for this final analysis positions the Ku/S-Band antenna line-of-sight and deployed solar array solar cells along the Landsat-D -Z axis.

A dynamic forced response analysis was performed at both the MSS and TM locations on all structural modes considered (thru 200 Hz). The analysis determined the roll angular response of the MSS/TM experiments to impulsive excitation generated by component operation. Cross axis and cross experiment responses were also calculated. The excitations were analytically represented by seven and nine term Fourier series approximations, for the MSS and TM experiment respectively, which enabled linear harmonic solution techniques to be applied to response calculations.

For consistency in data presentation between previous and current orbital models, a damping value of 0.001 was assumed. However, recent spacecraft data acquisitions suggest larger damping values. Therefore, data is also presented herein for an assumed damping value of 0.01. The baseline orbital model has self-induced peak roll angular responses (damping = 0.001) of 2.0945 arc-seconds (MSS due to MSS) and 1.3725 arc-seconds (TM due to TM). These values translate, respectively, to rms values of 1.1673 and 0.8445 respectively.

Single mode worst case jitter was estimated by variations of the eigenvalue spectrum of model LSD900. These variations show the effect of possible structural frequency deviations from the best estimate of model LSD900 by modifying the modal spectrum so that the maximum resonant response of any one mode would be excited. Modes near each forcing harmonic which differed in frequency by more than 15% were not included in the analysis. Maximum worst case peak roll response for .001 damping was 94.55 arc-seconds which translates into a 65.54 arc-second rms response for the MSS. Third harmonic mode 105 exhibited this large response. Maximum worst case peak roll angular response for the TM experiment for all models considered and 0.001 damping was 6.63 arc-seconds or 3.99 arc-seconds rms. Since the peak response is within the capability of the adjustable gain ADS (angular displacement sensor), emphasis was shifted to MSS jitter amplitudes always noting, however, TM peak responses.

Since an analytical model cannot be tuned to exactly match all measured test modes and frequencies and the Landsat-D's structure may not exactly match the tested hardware, there is an uncertainty associated with the analytical predicted frequencies. A statistical analysis approach was implemented to examine the probability of any worst case mode occurance. The probability of exceeding the 1.5 arc-sec (.3 pixel error) in the θ_X direction is reduced from .34 to .093 if the allowable MSS RMS jitter is raised to 3.14 arc-sec (.4 pixel error), see Figure 5.3-3.

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2.0 CONCLUSIONS

1) All worst case TM jitter peak response amplitudes are within the capability of the ADS.

2) There is no requirement to modify the primary structure to detune structural resonances.

3) The Baseline MSS jitter meets the .3 pixel requirements.

4) Statistical analysis of MSS worst case jitter, using all test verified analytical substructure models shows a low probability of exceeding .3 pixel error ≈34% and an even lower probability of exceeding .4 pixel error ≈9% which meets the jitter criteria defined in SVS-9934 LSD Flight Segment Specification. The "probability" numbers noted indicate the probability that the given pixel error will be exceeded for any given flight when the TDRSS antenna and solar array are in their worst case orientation.

5) Simultaneous TM & MSS operation is feasible within the recommended jitter criteria.

6) Baseline jitter results are relatively insensitive to damping value changes between .001 and .01.

7) Statistical analysis results are highly sensitive to damping value changes between .001 and .01 for all pixel allowables.

3.0 RECOMMENDATIONS

1. The previously recommended all axis gain setting of 50 arc-seconds for the ADS should provide an ample error margin when [illegible]ing expected TM peak responses.

2. Should any major structural changes occur on the Landsat-D spacecraft, it is recommended that another orbital model be assembled to establish adherance to MSS jitter criteria values.

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4.0 DISCUSSION

4.1 MODEL DESCRIPTION

The latest Landsat-D orbital model used for evaluation of MSS/TM jitter has been LSD801 (Reference 1). To better assess MSS/TM orbital jitter predictions, an updated orbital model, LSD900, has been developed. This updated model differs from the previous model in that all test validated substructure models have been used. Also, the TDRSS boom modal test model was effectively retuned to match more closely the boom modal test. This increases the separation of the boom 2nd Y-bending mode from the first MSS forcing harmonic at 13.62 Hz. The test verified substructure models incorporated into model LSD900 include the IM centerbody, deployed solar array, deployed TDRSS boom/RF Compartment-Ku/S-Band Antenna, and NASA furnished MMS.

The Landsat-D Orbital Dynamic Math Model, LSD900, consists of six (6) primary substructures: Multi-Mission Modular Spacecraft (MMS); Instrument Module (IM) which includes Thematic Mapper (TM), Wideband Module (WB), and Multi-Spectral Scanner (MSS) components; deployed Solar Array (DS/A); and TDRSS boom which includes the RF Compartment (RFC) and Ku/S-Band Antenna. The dynamic math model consisting of 819 dynamic degrees of-freedom (DOF) and 257 nodes was obtained from a complex static model represented by 2700 nodes and 15187 static DOF. A node and DOF summary for each substructure is presented in Table 4.1-1. Figure 4.1-1 shows the orbital configuration (exploded at 3 structural interfaces, IM/MMS, RFC-Ku/S-Band Antenna, and TDRSS boom/RFC) for plotting clarity.

Table 4.1-1 Substructure Representation

Substructure	Before Reduction		After Reduction	
	Nodes	DOF's	Nodes	DOF's
MMS	659	3954	50	159
IM	957	5082	70	234
Deployed Solar Array	333	1951	60	150
Deployed TDRSS Boom With Detailed Outer Hinge	102	464	15	60
RF Compartment	323	1780	27	99
Ku/S-Band Antenna	326	1956	35	117
	Total Nodes:	2700	Total DOF:	15187
	Reduced Nodes:	2443	Reduced DOF:	14368
	Model Nodes:	257	Model DOF:	819

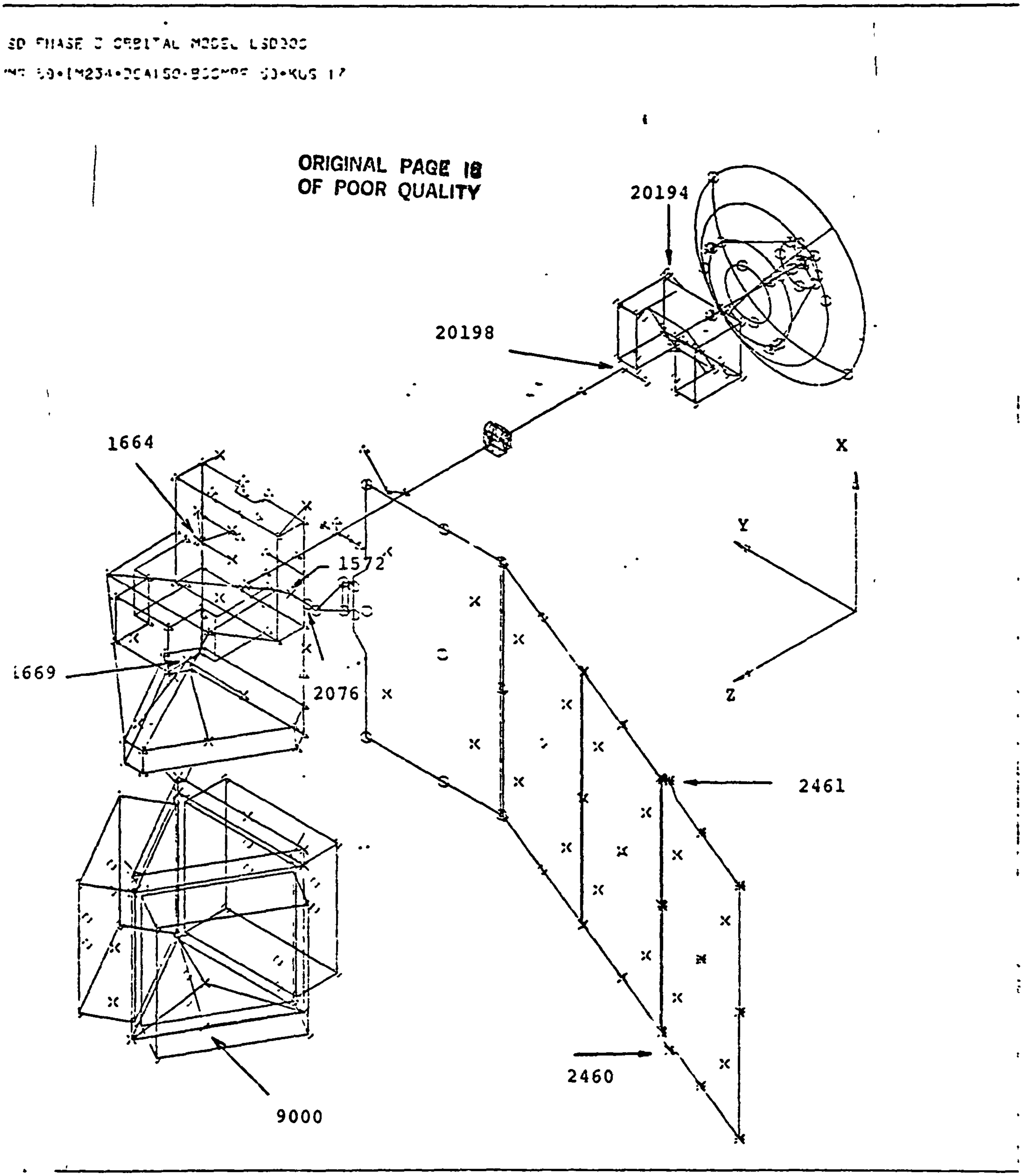

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Figure 4.1-1 Orbital Configuration

Stiffness coupling was used to assemble the 6 substructures. Table 4.1-2 summarizes nodes, node coordinates, DOF schedule, and nodal weights defined in the orbital model.

Substructure modeling changes reflect documented recommendations, released drawings and modal test results. Reference 2 documents the modal test results for the deployed solar array substructure. A representation of the deployed solar array structure is presented in Figure 4.1-2. Substructure DOF summary is shown in Table 4.1-3.

The original MMS substructure NASTRAN model as incorporated in model LSD801 was updated by NASA-Goddard for inclusion in the current configuration. The MMS substructure is described as three (3) primary modules, Power Module, Attitude Control Systems Module, and Command and Data Handling Module. The modules are connected to a triangular module support structure (MSS). The triangular transition adapter (TTA) located atop the MSS provides the interface attachment points for the Instrument Module structure. The Payload Attachment Fitting (PAF) is located beneath the MSS and provides the attachment to the launch vehicle. For the free-free orbital configuration, the PAF structure was deleted from the NASTRAN bulk data deck. Located within the MSS are the two primary propulsion tanks, PM1 and PM1A, and their associated attachment structures. The major improvement was the incorporation of dynamic test results to better represent the modeling simulation of the propulsion tanks and associated support structure. Also included is the earth sensor and the signal control and conditioning

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PHASE 3 JITTER ORBITAL MODEL
DYNAMIC MODEL SUMMARY TABLE

1 MS

DESC.	Syst. Node No.	Sigs Node No	COORDINATES X	Y	Z	DOF TABLE X	Y	Z	RX	RY	RZ	WX	WY	WZ	WEIGHT DATA IXX	IYY	IZZ
PM1A TANK	1	3000	-46.100	0.	0.	1	2	3	0	0	0	400.200	400.200	400.200	0.	0.	0.
	2	4600	-8.800	-25.981	-15.000	4	5	6	0	0	0	41.630	41.630	41.630	0.	0.	0.
	3	4650	-61.000	-25.981	-15.000	7	8	9	0	0	0	41.630	41.630	41.630	0.	0.	0.
	4	4682	-8.800	-21.075	-14.723	10	11	12	0	0	0	40.710	40.710	40.710	0.	0.	0.
MMS	5	4692	-8.800	21.075	-14.723	13	14	15	0	0	0	40.710	40.710	40.710	0.	0.	0.
SUPPORT	6	4700	-8.800	25.981	-15.000	16	17	18	0	0	0	41.630	41.630	41.630	0.	0.	0.
STRUCTURE	7	4750	-61.000	25.981	-15.000	19	20	21	0	0	0	41.630	41.630	41.630	0.	0.	0.
	8	4782	-8.800	23.288	-10.890	22	23	24	0	0	0	43 447	43.447	43.447	0.	0.	0.
	9	4792	-8.800	2.213	25.613	25	26	27	0	0	0	43.447	43.447	43.447	0.	0.	0.
	10	4800	-8.800	0.	30.000	28	29	30	0	0	0	41.630	41.630	41.630	0.	0.	0.
	11	4850	-61 000	0.	30.000	31	32	33	0	0	0	41.630	41 630	41.630	0.	0.	0.
SC and CU	12	4875	-24.900	0.	37.050	34	35	36	37	38	39	56.380	56.380	56.380	3600.00	2000.00	2500.00
Earth Sensor	13	4876	-43.810	0.	37.800	40	41	42	43	44	45	26.000	26.000	26.000	500.00	400.00	400 00
Support	14	4882	-8 800	-2.213	25.613	46	47	48	0	0	0	24 665	24.665	24.665	0.	0.	0.
Structure	15	4892	-8.800	-23.288	-10.890	49	50	51	0	0	0	24 665	24.665	24.665	0.	0.	0.
IM	16	5709	-3.200	0.	30.000	52	53	54	0	0	0	12.333	12.333	12.333	0.	0.	0.
	17	5737	-3.200	-25.981	-15.000	55	56	57	0	0	0	12.333	12.333	12.333	0.	0.	0.
ATTACH	18	5765	-3.200	25.981	-15 000	58	59	60	0	0	0	12.333	12.333	12.333	0.	0.	0.
	19	6200	-56 800	-23.000	-14.723	61	62	63	0	0	0	31.300	31.300	31.300	0.	0.	0.
	20	6208	-56.800	-23.000	-31.723	64	65	66	0	0	0	23.760	23.760	23.760	0.	0.	0.
	21	6228	-10.800	-23.000	-31.723	67	68	69	0	0	0	23.760	23.760	23.760	0.	0.	0.
ACS	22	6316	-38.400	-13.800	-31.723	70	71	72	0	0	0	34.435	34.435	34.435	0.	0.	0.
	23	6320	-29 200	-13.800	-31.723	73	74	75	0	0	0	34.435	34.435	34.435	0.	0.	0.
MODULE	24	6616	-38 400	13.800	-31.723	76	77	78	0	0	0	34.435	34.435	34.435	0.	0.	0.
	25	6620	-29.200	13.800	-31.723	79	80	81	0	0	0	34.435	34.435	34.435	0.	0.	0.
	26	6700	-56 800	23.000	-14.723	82	83	84	0	0	0	31.300	31.300	31.300	0.	0.	0.
	27	6708	-56 800	23 000	-31.723	85	86	87	0	0	0	23.760	23.760	23 760	0.	0.	0.
	28	6728	-10.800	23.000	-31.723	88	89	90	0	0	0	23.760	23.760	23.760	0.	0.	0.
	29	6999	-33 800	3.000	-20.723	91	92	93	0	0	0	50.000	50.000	50.000	0.	0.	0.
	30	7200	-56 800	24.250	-12.557	94	95	96	0	0	0	34.547	34.547	34.547	0.	0.	0.
	31	7208	-56.800	38.972	-4.057	97	98	99	0	0	0	49.949	49.949	49.949	0.	0.	0.
	32	7228	-10.800	38.972	-4.057	100	101	102	0	0	0	6.591	6.591	6.591	0.	0.	0.
POWER	33	7318	-38.400	34.372	3.910	103	104	105	0	0	0	128.046	128.046	128.046	0.	0.	0.
	34	7320	-29.200	34.372	3.910	106	107	108	0	0	0	27.663	27.663	27.663	0.	0.	0.
MODULE	35	7616	-38.400	20.572	27 812	109	110	111	0	0	0	146.583	146 583	146.583	0.	0.	0.
	36	7620	-29.200	20.572	27.812	112	113	114	0	0	0	19.772	19.772	19.772	0.	0.	0.
	37	7700	-56 800	1.250	27.280	115	116	117	0	0	0	34.547	34.547	34.547	0.	0.	0.
	38	7708	-56.800	15.972	35.780	118	119	120	0	0	0	46 682	46.682	46.682	0.	0.	0.
	39	7728	-10.800	15.972	35.780	121	122	123	0	0	0	9.220	9.220	9.220	0.	0.	0.
	40	8200	-56.800	-1.250	27 280	124	125	126	0	0	0	15 885	15.885	15.885	0.	0.	0.
	41	8208	-56.800	-15.972	35.780	127	128	129	0	0	0	13.681	13.681	13 681	0.	0.	0.
	42	8228	-10.800	-15.972	35.780	130	131	132	0	0	0	13.681	13.681	13.681	0.	0.	0.
C and DH	43	8316	-38.400	-20 572	27.813	133	134	135	0	0	0	41.044	41.044	41.044	0.	0	0.
MODULE	44	8320	-29.200	-20.572	27.813	136	137	138	0	0	0	41.044	41.044	41.044	0.	0.	0.
	45	8616	-38.400	-34.372	3.910	139	140	141	0	0	0	41.044	41.044	41.044	0.	0.	0.
	46	8620	-29.200	-34.372	3 910	142	143	144	0	0	0	41.044	41.044	41.044	0.	0.	0.
	47	8700	-56.800	-24.250	-12.557	145	146	147	0	0	0	15.885	15.885	15.885	0.	0.	0.
	48	8708	-56.800	-38.972	-4.057	148	149	150	0	0	0	13.681	13.681	13.681	0.	0.	0.
	49	8728	-10.800	-38.972	-4 057	151	152	153	0	0	0	13.681	13.681	13.681	0.	0.	0.
PM1 TANK	50	9000	-71.700	0.	0.	154	155	156	157	158	159	337.000	337.000	337.000	71170.00	45240.00	35290.00

Table 4.1-2

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RUN NO. LSD900

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PHASE 3 JITTER ORBITAL MODEL
DYNAMIC MODEL SUMMARY TABLE

DESC.	Syst. Node No.	Subs Node No	COORDINATES X	Y	Z	DOF TABLE X	Y	Z	RX	RY	RZ	WX	WY	WZ	WEIGHT DATA IXX	IYY	IZZ
Top	51	320	8.000	3.821	29.204	160	161	162	0	0	0	25.313	25.313	25.313	0.	0.	0.
Of	52	328	8.000	26.540	-10.390	163	164	165	0	0	0	17.125	17.125	17.125	0.	0.	0.
Mission	53	338	8.000	-26.540	-10.390	166	167	168	0	0	0	8.008	8.008	8.008	0	0.	0.
Adapter	54	346	8.000	-3.821	29.204	169	170	171	0	0	0	9.177	9.177	9.177	0.	0.	0.
	55	347	8.000	7.024	20.380	172	173	174	0	0	0	1.650	1.650	1.650	0.	0.	0.
TM/MA	56	348	8.000	16.180	-3.550	175	176	177	0	0	0	1.680	1.680	1.680	0.	0.	0.
Attach	57	349	8.000	-4.820	-11.580	178	179	180	0	0	0	3.200	3.200	3.200	0.	0.	0.
	58	350	8.000	-13.973	12.350	181	182	183	0	0	0	1.690	1.690	1.690	0.	0.	0.
	59	420	0.	3.821	29.023	184	185	186	0	0	0	23.123	23.123	23.123	0.	0.	0.
Bottom	60	446	0.	-3.821	29.023	187	188	189	0	0	0	7.785	7.785	7.785	0.	0.	0.
Of	61	460	0	23.224	-17.820	190	191	192	0	0	0	10.886	10.886	10.886	0.	0.	0.
Mission	62	461	0.	27.045	-11.202	193	194	195	0	0	0	13.653	13.653	13.653	0.	0.	0.
Adapter	63	470	0.	-23.224	-17.820	196	197	198	0	0	0	8.048	8.048	8.048	0.	0.	0.
	64	471	0.	-27.045	-11.202	199	200	201	0	0	0	7.053	7.053	7.053	0.	0.	0.
Top Of	65	1011	8.000	-21.000	-20.000	202	203	204	0	0	0	14.048	14.048	14.048	0.	0.	0.
MA	66	1020	8.000	21.000	-20.000	205	206	207	0	0	0	12.593	12.593	12.593	0.	0.	0.
	67	1034	19.250	-21.000	-20.000	208	209	210	0	0	0	11.426	11.426	11.426	0.	0	0.
	68	1043	19.250	21.000	-20.000	211	212	213	0	0	0	10.330	10.330	10.330	0.	0.	0.
Lwr Plate	69	1075	36.500	-21.000	-20.000	214	215	216	0	0	0	19.521	19.521	19.521	0.	0.	0.
	70	1079	36.500	-5.500	-20.000	217	218	219	0	0	0	8.167	8.167	8.167	0.	0.	0.
	71	1081	36.500	5.500	-20.000	220	221	222	0	0	0	7.194	7.194	7.194	0.	0.	0.
Lwr Plate	72	1085	36.500	21.000	-20.000	223	224	225	0	0	0	18.670	18.670	18.670	0.	0.	0.
S	73	1127	55.000	-21.000	-20.000	226	227	228	0	0	0	26.723	26.723	26.723	0.	0.	0.
T	74	1132	55.000	-5.500	-20.000	229	230	231	0	0	0	15.602	15.602	15.602	0.	0.	0.
TRUMENT R	75	1133	55.000	5.500	-20.000	232	233	234	0	0	0	19.651	19.651	19.651	0.	0.	0.
O	76	1136	55.000	21.000	-20.000	235	236	237	0	0	0	25.888	25.888	25.888	0.	0.	0.
DULE N G	77	1155	74.000	-21.000	-20.000	238	239	240	0	0	0	10.401	10.401	10.401	0.	0.	0.
B	78	1159	74.000	-5.500	-20.000	241	242	243	0	0	0	5.498	5.498	5.498	0.	0.	0.
A	79	1160	74.000	5.500	-20.000	244	245	246	0	0	0	13.359	13.359	13.359	0.	0.	0.
C K	80	1163	74.000	21.000	-20.000	247	248	249	0	0	0	17.135	17.135	17.135	0.	0.	0.
Lower	81	1200	36.500	-21.000	-9.000	250	251	252	0	0	0	8.581	8.581	8.581	0.	0.	0.
Strongback	82	1209	36.500	21.000	-9.000	253	254	255	0	0	0	10.535	10.535	10.535	0.	0.	0.
S T	83	1269	55.000	-21.000	-9.000	256	257	258	0	0	0	17.738	17.738	17.738	0.	0.	0.
R	84	1279	55.000	21.000	-9.000	259	260	261	0	0	0	14.309	14.309	14.309	0.	0.	0.
O	85	1298	74.000	-21.000	-9.000	262	263	264	0	0	0	4.405	4.405	4.405	0.	0.	0.
G	86	1302	74.000	-5.500	-9.000	265	266	267	0	0	0	12.322	12.322	12.322	0.	0.	0.
B	87	1303	74.000	5.500	-9.000	268	269	270	0	0	0	12.322	12.322	12.322	0.	0.	0.
A C K	88	1306	74.000	21.000	-9.000	271	272	273	0	0	0	4.482	4.482	4.482	0.	0.	0.
A Lower	89	1468	25.250	-18.000	-24.000	274	275	276	277	278	279	2.158	2.158	2.158	1.00	1.00	1.00
	90	1469	25.250	18.000	-24.000	280	281	282	283	284	285	2.158	2.158	2.158	1.00	1.00	1.00
ACH	91	1482	76.250	-18.000	-21.000	286	287	288	289	290	291	2.023	2.023	2.023	1.00	1.00	1.00
Upper	92	1495	76.250	18.000	-24.000	292	293	294	295	296	297	2.023	2.023	2.023	1.00	1.00	1.00
Truss	93	1526	75.375	-11.215	-10.485	298	299	300	0	0	0	0.800	0.800	0.800	0.	0.	0.
Boom	94	1528	75.375	7.215	-10.485	301	302	303	0	0	0	0.800	0.800	0.800	0.	0.	0.
Cup	95	1529	75.375	-4.960	-21.250	304	305	306	0	0	0	2.235	2.235	2.235	0.	0.	0.
Cones	96	1530	75.375	4.960	-21.250	307	308	309	0	0	0	2.235	2.235	2.235	0.	0.	0.
	97	1554	71.000	7.750	-5.000	310	311	312	0	0	0	2.528	2.528	2.528	0.	0.	0.
MSS	98	1555	60.500	7.750	-5.000	313	314	315	0	0	0	2.528	2.528	2.528	0.	0.	0.
Legs	99	1560	71.000	-6.250	-5.000	316	317	318	0	0	0	2.528	2.528	2.528	0.	0.	0.
	100	1561	60.500	-6.250	-5.000	319	320	321	0	0	0	2.528	2.528	2.528	0.	0.	0.

Table 4. [illegible] (Continued)

RUN NO. LSD900

DATE 070181
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
DYNAMIC MODEL SUMMARY TABLE

DESC	SYST. NODE NO.	SUBS. NODE NO.	COORDINATES X	Y	Z	DOF TABLE X	Y	Z	RX	RY	RZ	WEIGHT DATA WX	WY	WZ	IXX	IYY	IZZ
% Attach	101	1572	50.750	-21.000	-14.500	322	323	324	325	326	327	2.000	2.000	2.000	1.00	1.00	1.00
Truss	102	1621	53.920	-21.000	19 249	328	329	330	0	0	0	5.262	5.262	5.262	0.	0.	0.
Tubes	103	1633	53.920	21.000	19.249	331	332	333	0	0	0	6 415	6.415	6.415	0.	0.	0.
Boom Attach	104	1649	42 300	0.	-16.500	334	335	336	337	338	339	22.629	22.629	22.629	44.00	44.00	44.00
MSS C.G.	105	1664	67.250	0.	1.660	340	341	342	343	344	345	130.000	130.000	130.000	10181.00	7780 00	12724.00
TM C.G	106	1669	21 100	6.380	0 820	346	347	348	349	350	351	549.700	[illegible]	549.700	271300 00	95472.00	222617.00
Cup Cone	107	1679	75 375	0.	-16.250	352	353	354	0	0	0	2.971	2.971	2.971	0.	0.	0.
	108	30012	53 750	11 078	12 045	355	356	357	0	0	0	19.100	19.100	19.100	0.	0.	0.
	109	30014	53.750	-10.579	12.045	358	359	360	0	0	0	19.700	19.700	19.700	0.	0.	0.
	110	30019	53.750	11.078	25.465	361	362	363	0	0	0	3.935	3.935	3.935	0.	0.	0.
	111	30021	53 750	-10.579	25 465	364	365	366	0	0	0	3.300	3 300	3.300	0.	0.	0.
	112	30060	37.750	11.078	12.045	367	368	369	0	0	0	32.300	32.300	32.300	0.	0.	0.
Wideband	113	30064	37.750	-10.579	12 045	370	371	372	0	0	0	35.600	35.600	35.600	0.	0.	0.
Module	114	30077	37.750	11.078	25.465	373	374	375	0	0	0	3.635	3.635	3.635	0.	0.	0.
	115	30081	37.750	-10 579	25 465	376	377	378	0	0	0	3 000	3.000	3.000	0.	0	0.
S-Band	116	30152	46.250	0.250	28 986	379	380	381	0	0	0	5 000	5 000	5.000	0.	0.	0.
	117	30166	53.750	17.062	-9.500	382	383	384	0	0	0	7 200	7.200	7.200	0.	0.	0.
	118	30167	53.750	-16 563	-9.500	385	386	387	0	0	0	10 400	10.400	10.400	0.	0.	0.
	119	30168	37 750	17.062	-9 500	388	389	390	0	0	0	14 800	14 800	14 800	0.	0.	0.
	120	30169	37.750	-16.563	-9.500	391	392	393	0	0	0	18.900	18.900	18.900	0.	0.	0.
	121	2001	95 875	-97.875	-24 260	394	395	396	0	0	0	4.700	4.700	11.338	0.	0.	0.
	122	2005	50.750	-97.875	-24.260	397	398	399	0	0	0	3.252	3.252	2 012	0.	0.	0.
	123	2009	5.625	-97 875	-24.260	400	401	402	0	0	0	5 920	5 920	2.548	0.	0.	0.
	124	2012	76.250	-86.750	-24.260	0	0	403	0	0	0	0.	0.	4 140	0.	0.	0.
Inboard	125	2016	25.250	-86.750	-24.260	0	0	404	0	0	0	0.	0.	4 140	0.	0.	0.
	126	2019	95.875	-74.250	-24.260	0	0	405	0	0	0	0.	0.	1.885	0.	0.	0.
Panel	127	2023	50.750	-73 750	-24 260	406	407	408	0	0	0	7.160	7.160	3.896	0.	0.	0.
	128	2027	5.625	-74.250	-24.260	0	0	409	0	0	0	0.	0.	1.885	0.	0.	0.
	129	2039	76.250	-50.750	-24.260	0	0	410	0	0	0	0.	0.	4.024	0.	0.	0.
	130	2042	25.250	-50.750	-24.260	0	0	411	0	0	0	0.	0.	4.024	0.	0.	0.
	131	2048	95.875	-42.375	-24.260	412	413	414	0	0	0	4.126	4 126	0.860	0.	0	0.
	132	2053	50.750	-42.375	-24.260	415	416	417	0	0	0	7.343	7.343	5.002	0.	0.	0.
	133	2058	5.625	-42.375	-24.260	418	419	420	0	0	0	5.314	5.314	2.051	0.	0.	0.
EPLOYED	134	2060	56.890	-37.203	-24.260	421	422	423	0	0	0	3.208	3.208	3.208	0.	0.	0.
OLAR	135	2062	46 650	-37 203	-24.260	424	425	426	0	0	0	3.208	3.208	3.208	0.	0.	0.
RRAY Yoke	136	2071	56 000	-32 610	-24.440	427	428	429	430	431	432	4.476	4.476	4.476	1.00	1 00	1.00
+	137	2073	45.790	-32.610	-24.440	433	434	435	436	437	438	4.476	4.476	4.476	1.00	1.00	1.00
[illegible]	138	2074	50.750	-31.750	-13.920	439	440	441	442	443	444	4.071	4.071	4.071	1.00	1.00	1.00
	139	2076	50.750	-27 820	-14.500	445	446	447	448	449	450	3.269	3.269	3.269	1.00	1.00	1.00
	140	2101	95.875	-99.035	-24 034	451	452	453	0	0	0	4 200	4.200	1.323	0.	0.	0.
	141	2105	50 750	-99.035	-24.034	454	455	456	0	0	0	3.715	3.715	2.238	0.	0.	0.
	142	2109	5 625	-99.035	-24.034	457	458	459	0	0	0	4.757	4.757	1 882	0.	0.	0.
	143	2112	76 250	-109 350	-19.867	0	0	460	0	0	0	0	0	3 493	0.	0.	0.
	144	2116	25.250	-109 350	-19.867	0	0	461	0	0	0	0.	0.	3.522	0.	0.	0.
Center	145	2119	95.875	-126.040	-13.124	0	0	462	0	0	0	0.	0.	1.678	0.	0.	0.
Inboard	146	2123	50.750	-126.040	-13.124	463	464	465	0	0	0	6.844	6.844	3.908	0.	0.	0.
Panel	147	2127	5 625	-126 040	-13.124	0	0	466	0	0	0	0.	0.	1.677	0.	0.	0.
	148	2130	76.250	-142,729	-6.381	0	0	467	0	0	0	0.	0.	3 493	0.	0.	0.
	149	2134	25 250	-142.729	-6 381	0	0	468	0	0	0	0.	0.	3.522	0.	0.	0.
	150	2137	95.875	-153.044	-2.214	469	470	471	0	0	0	4.186	4.186	1.312	0.	0.	0.

Table 4.1-2 (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE IS
OF POOR QUALITY

RUN NO. LSD900

DATE 070181
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
DYNAMIC MODEL SUMMARY TABLE

DESC.	Syst. Node No	Subs. Node No.	COORDINATES			DOF TABLE						WEIGHT DATA					
			X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
	151	2141	50.750	-153.044	-2.214	472	473	474	0	0	0	3.398	3.398	1.923	0.	0.	0.
	152	2145	5.625	-153.044	-2 214	475	476	477	0	0	0	4.752	4.752	1.872	0.	0	0.
	153	220.	95.875	-207.864	19.935	478	479	480	0	0	0	4.910	4.910	1.960	0.	0.	0.
	154	2205	50.750	-207 864	19.935	481	482	483	0	0	0	3.486	3.486	1.918	0.	0.	0.
	155	2209	5.625	-207 864	19.935	484	485	486	0	0	0	4.280	4.280	1.330	0.	0.	0.
	156	2212	76.250	-197.549	15.768	0	0	487	0	0	0	0.	0.	3.623	0.	0.	0.
	157	2216	25.250	-197 549	15 768	0	0	488	0	0	0	0.	0.	3.623	0.	0.	0.
	158	2219	95 875	-180.860	9.025	0	0	489	0	0	0	0.	0	1.674	0.	0.	0.
Center	159	2223	50 750	-180.860	9.025	490	491	492	0	0	0	6.845	6 845	3.900	0.	0.	0.
Outboard	160	2227	5 625	-180 860	9.025	0	0	493	0	0	0	0.	0.	1.674	0.	0.	0.
Panel	161	2230	76.250	-164 171	2 282	0	0	494	0	0	0	0	0.	3.377	0.	0.	0.
	162	2234	25.250	-164.171	2.282	0	0	495	0	0	0	0	0.	.3.405	0.	0.	0.
	163	2237	95.875	-153.856	-1.885	496	497	498	0	0	0	4.680	4.680	1.917	0.	0.	0.
	164	2241	50 750	-153.856	-1.885	499	500	501	0	0	0	3.358	3.358	1.919	0.	0.	0.
	165	2245	5 625	-153.856	-1.885	502	503	504	0	0	0	4.110	4.110	1.336	0.	0.	0.
	166	2301	5.625	-208.677	20.263	505	506	507	0	0	0	6.120	6.120	2.448	0.	0.	0.
	167	2305	5.625	-235.681	31.174	0	0	508	0	0	0	0.	0.	1.250	0.	0.	0.
	168	2309	5 625	-262.685	42.C84	509	510	511	0	0	0	4.210	4.210	0.710	0.	0.	0.
	169	2339	25.250	-218.992	24 431	0	0	512	0	0	0	0.	0.	4.097	0.	0.	0.
	170	2343	25.250	-232.370	37 917	0	0	513	0	0	0	0.	0.	3.889	0.	0.	0.
Outboard	171	2373	50.750	-208.677	20.263	514	515	516	0	0	0	2.963	2.963	1.800	0.	0.	0.
Panel	172	2377	50.750	-235.681	31.174	517	518	519	0	0	0	4.973	4.973	3.132	0.	0.	0.
	173	2381	50.750	-262.685	42 084	520	521	522	0	0	0	2.963	2.963	1.800	0.	0.	0.
	174	2411	76.250	-218.992	24.431	0	0	523	0	0	0	0.	0.	4.168	0.	0.	0.
	175	2415	76 250	-252.370	37.917	0	0	524	0	0	0	0.	0.	3.889	0.	0.	0.
	176	2445	95.875	-208.677	20.263	525	526	527	0	0	0	6.120	6.120	2.448	0.	0.	0.
	177	2449	95.875	-235.681	31.174	0	0	528	0	0	0	0.	0.	1.250	0.	0.	0.
	178	2453	95.875	-262.685	42.084	529	530	531	0	0	0	4.210	4.210	0.710	0.	0.	0.
	179	2460	2.750	-213 549	22.232	532	533	534	535	536	537	1.816	1.816	1.816	1.00	1.00	1.00
	180	2461	98.750	-213.549	22.232	538	539	540	541	542	543	1.816	1.816	1.816	1.00	1.00	1.00
Outer	181	10272	42.300	0.	-117.380	544	545	546	547	548	549	14.073	14.073	14.073	516.00	516.00	80.00
Hinge	182	10273	42.300	0.	-123.380	550	551	552	553	554	555	12.815	12.815	12.815	355.00	355.00	73.00
	183	10500	42.300	0.	-25.150	556	557	558	559	560	561	12.477	12.477	12.477	160.00	160.00	160.00
	184	10501	42.300	0.	-54.450	562	563	564	0	0	0	13.140	13.140	13.140	0.	0.	0.
GDA Attach	185	10505	42.300	0.	-155.225	565	566	567	568	569	570	21.265	21.265	21.265	569.74	569.74	156.54
Inner Hinge At.	186	10515	42.300	0.	-17.700	571	572	573	574	575	576	10.017	10.017	10.017	160.00	160 00	160.00
	187	10516	42 300	0.	-82.750	577	578	579	0	0	0	12.403	12.403	12.403	0.	0.	0.
GTC Antenna	188	10517	42.300	24.000	-89.750	580	581	582	0	0	0	3.180	3.180	3.180	0.	0.	0.
	189	10519	46.350	0	-54.450	583	584	585	0	0	0	0.160	0.160	0.160	0.	0	0.
	190	10520	42.300	0.	-37.850	586	587	588	0	0	0	6.257	6.257	6.257	0.	0.	0.
PLOYED	191	10521	42 300	-4.960	-54 450	589	590	591	0	0	0	4.625	4.625	4.625	0.	0.	0.
DRSS	192	10522	42.300	4.960	-54.450	592	593	594	0	0	0	3.165	3.165	3.165	0.	0.	0.
OM/RF	193	10570	39 050	7.750	-82.933	595	596	597	0	0	0	3.130	3.130	3 130	0.	0.	0.
IPARTMENT	194	20001	32.550	-17.750	-167.139	598	599	600	0	0	0	3.460	3.460	3.460	0.	0.	0.
	195	20007	32.550	-17.750	-186.128	601	602	603	0	0	0	3.460	3 460	3.460	0.	0.	0.
	196	20018	42.300	-17.750	-177.427	604	605	606	0	0	0	29.230	29 230	29.230	0.	0.	0.
	197	20029	52 050	-17.750	-167.139	607	608	609	0	0	0	3 460	3 460	3.460	0.	0.	0.
	198	20035	52.050	-17.750	-186.127	610	611	612	0	0	0	4.080	4.080	4.080	0.	0.	0.
	199	20056	32.550	-9.500	-167.139	613	614	615	0	0	0	1.530	1.530	1.530	0.	0.	0.
	200	20061	32.550	-9.500	-183.028	616	617	618	0	0	0	6.020	6.020	6.020	0.	0.	0.

Table 4.1 (Continued)

RUN NO. LSD900

DATE 070181
RUN BY T.E.POLLAK

ORIGINAL PAGE IS
OF POOR QUALITY

PHASE 3 JITTER ORBITAL MODEL
DYNAMIC MODEL SUMMARY TABLE

DESC.	SYST NODE NO.	SUBS NODE NO.	COORDINATES			DOF TABLE								WEIGHT DATA			
			X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
	201	20063	37.420	-9.500	-167.140	619	620	621	0	0	0	2.114	2.114	2.114	0.	0.	0.
EL. T. Box	202	.0071	42.300	-9.500	-171.827	622	623	624	625	626	627	7.240	7.240	7.240	188.88	45.24	188.88
	203	20073	42.300	-9.500	-177.427	628	629	630	0	0	0	6.000	6.000	6.000	0	0.	0.
	204	20084	52.050	-9.500	-167.139	631	632	633	0	0	0	1.920	1.920	1.920	0.	0.	0.
	205	20099	42.300	-2.500	-177.427	634	635	636	0	0	0	7.110	7.110	7.110	0.	0.	0.
	206	20119	52.050	6.500	-167.139	637	638	639	0	0	0	2.120	2.120	2.120	0.	0.	0.
	207	20137	42.300	6.500	-177.427	640	641	642	0	0	0	5.690	5.690	5.690	0.	0.	0.
	208	20141	37.420	6.500	-167.140	643	644	645	0	0	0	2.114	2.114	2.114	0.	0.	0.
RF	209	20148	32.550	6.500	-167.139	646	647	648	0	0	0	1.530	1.530	1.530	0.	0.	0.
	210	20153	32.550	6.500	-183.028	649	650	651	0	0	0	5.800	5.800	5.800	0.	0.	0.
Compartment	211	20155	52.050	14.200	-167.139	652	653	654	0	0	0	4.280	4.280	4.280	0.	0.	0.
	212	20161	52.050	14.200	-186.127	655	656	657	0	0	0	4.850	4.850	4.850	0.	0.	0.
	213	20172	42.300	14.200	-177.427	658	659	660	0	0	0	9.360	9.360	9.360	0.	0.	0.
	214	20183	32.550	14.200	-167.139	661	662	663	0	0	0	2.230	2.230	2.230	0.	0.	0.
	215	20189	32.550	14.200	-186.128	664	665	666	0	0	0	2.230	2.230	2.230	0.	0.	0.
KUS	216	20191	30.279	-11.521	-186.127	667	668	669	670	671	672	1.340	1.340	1.340	1.00	1.00	1.00
Attach	217	20192	30.279	12.521	-186.127	673	674	675	676	677	678	1.340	1.340	1.340	1.00	1.00	1.00
	218	20193	54.321	-11.521	-186.128	679	680	681	682	683	684	1.340	1.340	1.340	1.00	1.00	1.00
	219	20194	54.321	12.521	-186.128	685	686	687	688	689	690	1.340	1.340	1.340	1.00	1.00	1.00
Attach	220	20198	42.300	0	-171.827	691	692	693	694	695	696	19.890	19.890	19.890	518.89	124.30	518.89
Yo	221	20509	42.300	-9.500	-54.450	697	698	699	0	0	0	2.210	2.210	2.210	0.	0.	0.
Ke	222	20512	42.300	6.500	-54.450	700	701	702	0	0	0	0.750	0.750	0.750	0.	0.	0.
	223	1	51.235	2.894	-190.160	703	704	705	0	0	0	2.696	2.696	2.696	0.	0.	0.
	224	2	33.365	-1.894	-190.160	706	707	708	0	0	0	2.696	2.696	2.696	0.	0.	0.
	225	3	49.029	-24.614	-196.993	709	710	711	0	0	0	2.451	2.451	2.451	0.	0.	0.
	226	4	35.571	25.614	-196.994	712	713	714	0	0	0	2.451	2.451	2.451	0.	0.	0.
	227	5	63.607	28.267	-203.347	715	716	717	0	0	0	2.155	2.155	2.155	0.	0.	0.
	228	6	20.993	-27.267	-203.347	718	719	720	0	0	0	2.155	2.155	2.155	0.	0.	0.
	229	7	54.321	12.521	-191.037	721	722	723	0	0	0	0.837	0.837	0.837	0.	0.	0.
	230	8	54.321	-11.521	-191.037	724	725	726	0	0	0	0.837	0.837	0.837	0.	0.	0.
	231	9	30.279	-11.521	-191.036	727	728	729	0	0	0	0.837	0.837	0.837	0.	0.	0.
	232	10	28.813	-9.849	-191.036	730	731	732	0	0	0	0.110	0.110	0.110	0.	0.	0.
	233	11	30.254	12.521	-191.054	733	734	735	0	0	0	0.837	0.837	0.837	0.	0.	0.
S-BAND	234	12	54.321	12.521	-187.116	736	737	738	0	0	0	0.145	0.145	0.145	0.	0.	0.
ANTENNA	235	13	54.321	12.521	-186.128	739	740	741	742	743	744	0.225	0.225	0.225	0.23	0.23	0.23
	236	14	54.321	-11.521	-187.116	745	746	747	0	0	0	0.145	0.145	0.145	0.	0.	0.
RF	237	15	54.321	-11.521	-186.128	748	749	750	751	752	753	0.225	0.225	0.225	0.23	0.23	0.23
ATTACH	238	16	30.279	-11.521	-187.116	754	755	756	0	0	0	0.145	0.145	0.145	0.	0.	0.
	239	17	30.279	-11.521	-186.127	757	758	759	760	761	762	0.225	0.225	0.225	0.23	0.23	0.23
	240	18	30.279	12.521	-187.116	763	764	765	0	0	0	0.145	0.145	0.145	0.	0.	0.
	241	19	30.279	12.521	-186.127	766	767	768	769	770	771	0.225	0.225	0.225	0.23	0.23	0.23
	242	20	47.293	5.493	-212.469	772	773	774	0	0	0	0.125	0.125	0.125	0.	0.	0.
	243	21	47.293	-4.493	-212.469	775	776	777	0	0	0	0.125	0.125	0.125	0.	0.	0.
	244	22	37.307	-4.493	-212.468	778	779	780	0	0	0	0.125	0.125	0.125	0.	0.	0.
	245	23	37.307	5.493	-212.468	781	782	783	0	0	0	0.125	0.125	0.125	0.	0.	0.
	246	24	43.184	-0.384	-212.469	784	785	786	0	0	0	0.040	0.040	0.040	0.	0.	0.
	247	25	41.416	1.384	-212.458	787	788	789	0	0	0	0.040	0.040	0.040	0.	0.	0.
	248	26	42.300	1.750	-212.469	790	791	792	0	0	0	0.140	0.140	0.140	0.	0.	0.
	249	27	42.866	1.066	-212.469	793	794	795	0	0	0	0.345	0.345	0.345	0.	0.	0.
	250	28	42.866	-0.066	-212.469	796	797	798	0	0	0	0.345	0.345	0.345	0.	0.	0.

Table 4.1-2 (Continued)

RUN NO. LSD900

DATE 070181
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
DYNAMIC MODEL SUMMARY TABLE

			COORDINATES			DOF TABLE						WEIGHT DATA					
ESC.	Syst Node No.	Subs. Node No.	X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
	251	29	41.735	-0.066	-212.469	799	800	801	0	0	0	0.345	0.345	0.345	0.	0.	0.
	252	30	41.735	1.066	-212.469	802	803	804	0	0	0	0 345	0.345	0.345	0.	0.	0.
	253	31	42.300	0.500	-208.324	805	806	807	0	0	0	0 120	0.120	0.120	0.	0.	0.
	254	32	42.300	8.166	-211.117	808	809	810	0	0	0	0.066	0.066	0.066	0.	0.	0.
	255	33	49 966	0.500	-211.117	811	812	813	0	0	0	0 066	0.066	0 066	0.	0.	0.
	256	34	42.300	-7.166	-211.117	814	815	816	0	0	0	0.066	0.066	0.066	0.	0.	0.
	257	35	34 634	0.500	-211 117	817	818	819	0	0	0	0.066	0 066	0 066	0.	0.	0.

Table 4.1-2 (Continued)

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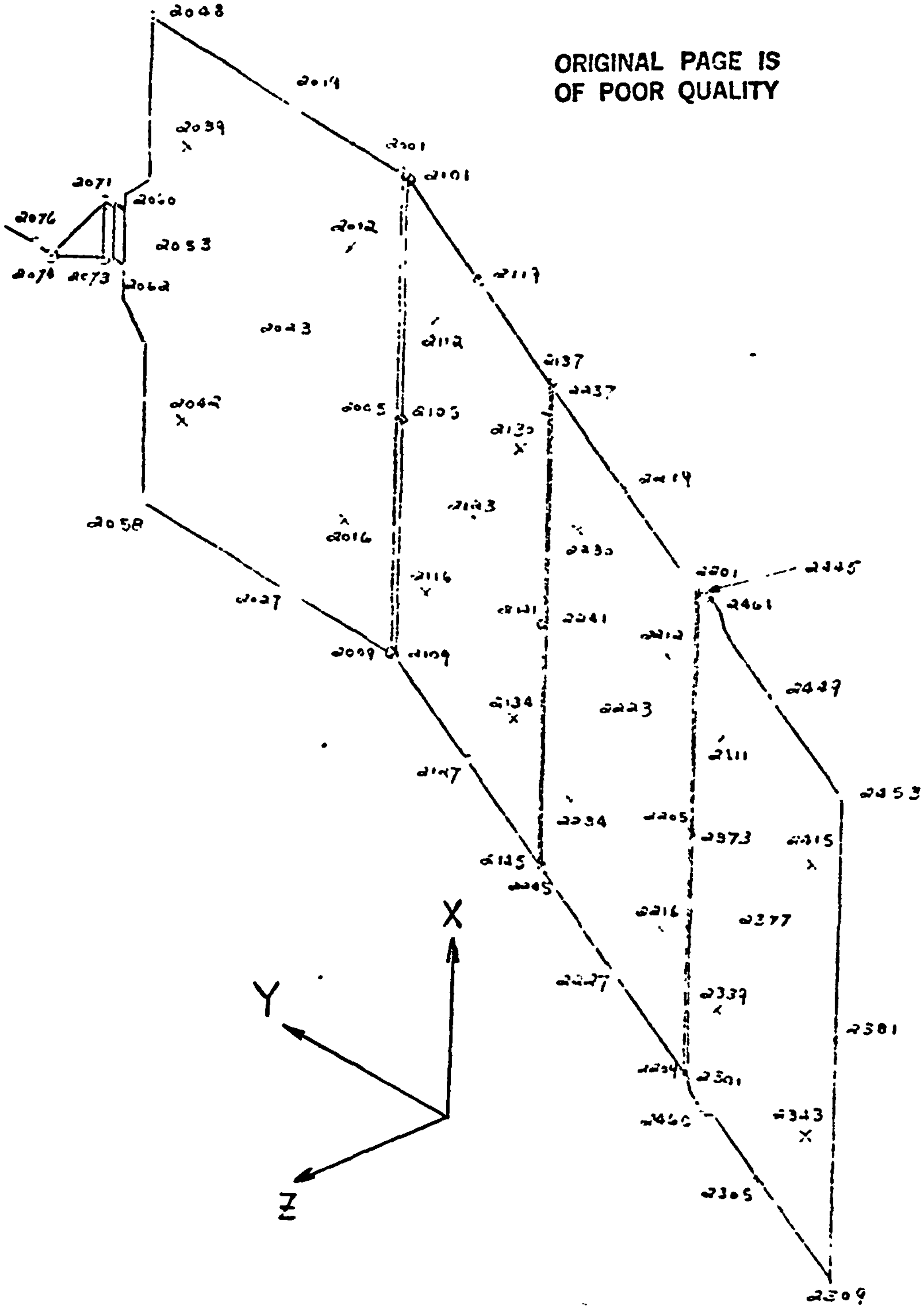

Figure 4.1-2 Deployed Solar Array Representation

RUN NO. DSA81F

DATE 071381
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
DSA FREE-FREE DYNAMIC MODEL SUMMARY TABLE

		X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
1	2001	95.875	-97.875	-24.260	1	2	3	0	0	0	4.700	4.700	1.338	0.	0.	0.
2	2005	50.750	-97.875	-24.260	4	5	6	0	0	0	3.252	3.252	2.012	0.	0.	0.
3	2009	5.625	-97.875	-24.260	7	8	9	0	0	0	5.920	5.920	2.548	0.	0.	0.
4	2012	76.250	-86.750	-24.260	0	0	10	0	0	0	0.	0.	4.140	0.	0.	0.
5	2016	25.250	-86.750	-24.260	0	0	11	0	0	0	0.	0.	4.140	0.	0.	0.
6	2019	95.875	-74.250	-24.260	0	0	12	0	0	0	0.	0.	1.885	0.	0.	0.
7	2023	50.750	-73.750	-24.260	13	14	15	0	0	0	7.160	7.160	3.896	0.	0.	0.
8	2027	5.625	-74.250	-24.260	0	0	16	0	0	0	0.	0.	1.885	0.	0.	0.
9	2039	76.250	-50.750	-24.260	0	0	17	0.	0	0	0.	0.	4.024	0.	0.	0.
10	2042	25.250	-50.750	-24.260	0	0	18	0	0	0	0.	0.	4.024	0.	0.	0.
11	2048	95.875	-42.375	-24.260	19	20	21	0	0	0	4.126	4.126	0.860	0.	0.	0.
12	2053	50.750	-42.375	-24.260	22	23	24	0	0	0	7.343	7.343	5.002	0.	0.	0.
13	2058	5.625	-42.375	-24.260	25	26	27	0	0	0	5.314	5.314	2.051	0.	0.	0.
14	2060	56.890	-37.203	-24.260	28	29	30	0	0	0	3.208	3.208	3.208	0.	0.	0.
15	2062	46.650	-37.203	-24.260	31	32	33	0	0	0	3.208	3.208	3.208	0.	0.	0.
16	2071	56.000	-32.610	-24.440	34	35	36	37	38	39	4.476	4.476	4.476	1.00	1.00	1.00
17	2073	45.790	-32.610	-24.440	40	41	42	43	44	45	4.476	4.476	4.476	1.00	1.00	1.00
18	2074	50.750	-31.750	-13.920	46	47	48	49	50	51	4.071	4.071	4.071	1.00	1.00	1.00
19	2076	50.750	-27.820	-14.500	52	53	54	55	56	57	3.269	3.269	3.269	1.00	1.00	1.00
20	2101	95.875	-99.035	-24.034	58	59	60	0	0	0	4.200	4.200	1.323	0.	0.	0.
21	2105	50.750	-99.035	-24.034	61	62	63	0	0	0	3.715	3.715	2.238	0.	0.	0.
22	2109	5.625	-99.035	-24.034	64	65	66	0	0	0	4.757	4.757	1.882	0.	0.	0.
23	2112	76.250	-109.350	-19.867	0	0	67	0	0	0	0.	0.	3.493	0.	0.	0.
24	2116	25.250	-109.350	-19.867	0	0	68	0	0	0	0.	0.	3.522	0.	0.	0.
25	2119	95.875	-126.040	-13.124	0	0	69	0	0	0	0.	0.	1.678	0.	0.	0.
26	2123	50.750	-126.040	-13.124	70	71	72	0	0	0	6.844	6.844	3.909	0.	0	0.
27	2127	5.625	-126.040	-13.124	0	0	73	0	0	0	0.	0.	1.677	0.	0	0.
28	2130	76.250	-142.729	-6.381	0	0	74	0	0	0	0.	0.	3.493	0.	0.	0.
29	2134	25.250	-142.729	-6.381	0	0	75	0	0	0	0.	0.	3.522	0.	0.	0.
30	2137	95.875	-153.044	-2.214	76	77	78	0	0	0	4.186	4.186	1.312	0.	0.	0.
31	2141	50.750	-153.044	-2.214	79	80	81	0	0	0	3.398	3.398	1.923	0.	0.	0.
32	2145	5.625	-153.044	-2.214	82	83	84	0	0	0	4.752	4.752	1.872	0.	0.	0.
33	2201	95.875	-207.864	19.935	85	86	87	0	0	0	4.910	4.910	1.060	0.	0.	0.
34	2205	50.750	-207.864	19.935	88	89	90	0	0	0	3.486	3.486	1.918	0.	0.	0.
35	2209	5.625	-207.864	19.935	91	92	93	0	0	0	4.280	4.280	1.330	0.	0.	0.
36	2212	76.250	-197.549	15.768	0	0	94	0	0	0	0.	0.	3.623	0.	0.	0.
37	2216	25.250	-197.549	15.768	0	0	95	0	0	0	0.	0.	3.623	0.	0.	0.
38	2219	95.875	-180.860	9.025	0	0	96	0	0	0	0.	0.	1.674	0.	0.	0.
39	2223	50.750	-180.860	9.025	97	98	99	0	0	0	6.845	6.845	3.900	0.	0	0.
40	2227	5.625	-180.860	9.025	0	0	100	0	0	0	0.	0.	1.674	0.	0.	0.
41	2230	76.250	-164.171	82	0	0	101	0	0	0	0.	0.	3.377	0.	0.	0.
42	2234	25.250	-164.171	2.282	0	0	102	0	0	0	0.	0.	3.405	0.	0.	0.
43	2237	95.875	-153.856	-1.885	103	104	105	0	0	0	4.680	4.680	1.917	0.	0.	0.
44	2241	50.750	-153.856	-1.885	106	107	108		0	0	3.358	3.358	1.919	0.	0.	0.
45	2245	5.625	-153.856	-1.885	109	110	111		0	0	4.110	4.110	1.336	0.	0.	0.
46	2301	5.625	-208.677	20.263	112		114	0	0	0	6.120	6.120	2.448	0.	0.	0.
47	2305	5.625	-235.[illegible]	31.174	0	0	115	0	0	0	0.	0.	1.250	0.	0.	0.
48	2309	5.625	-262.[illegible]	42.084	116	117	118	0	0	0	4.210	4.210	0.710	0.	0.	0.
49	2339	25.250	-218.992	24.431	0	0	119	0	0	0	0.	0	4.097	0.	0.	0.
50	2343	25.250	-252.370	37.917	0	0	120	0	0	0	0.	0.	3.889	0.	0.	0.

Table 4.1-3

RUN NO. DSA81F

DATE 071381
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
DSA FREE-FREE DYNAMIC MODEL SUMMARY TABLE

		X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
51	2373	50.750	-208 677	20 263	121	122	123	0	0	0	2.963	2.963	1.800	0.	0.	0.
52	2377	50.750	-235.681	31.174	124	125	125	0	0	0	4.973	4.973	3.132	0.	0.	0.
53	2381	50.750	-262.685	42.084	127	128	129	0	0	0	2.963	2.963	1.800	0.	0.	0.
54	2411	76 250	-218.992	24.431	0	0	130	0	0	0	0.	0.	4 168	0.	0.	0.
55	2415	76.250	-252 370	37.917	0	0	131	0	0	0	0.	0.	0 889	0.	0.	0.
56	2445	95.875	-208.677	20.263	132	133	134	0	0	0	6.120	6.120	2.448	0.	0.	0.
57	2449	95 875	-235 681	31.174	0	0	135	0	0	0	0	0.	1 250	0	0.	0.
58	2453	95 875	-262.685	42.084	136	137	138	0	0	0	4.210	4.210	0 710	0.	0.	0.
59	2460	2.750	-213.549	22.232	139	140	141	142	143	144	1.816	1.816	1 816	1.00	1.00	1.00
60	2461	98.750	-213.549	22.232	145	146	147	148	149	150	1.816	1.816	1.816	1.00	1 00	1.00

Table 4.1-3 (Continued)

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unit (SC-CU). A representation of the MMS structure is presented in Figure 4.1-3. A weight breakdown is shown in Table 4.1-4. A substructure DOF summary is presented in Table 4.1-5. An acceptable equilibrium check in the free-free configuration was used for model acceptance. Reference 3 describes the efforts of the Stress group in determining free-free acceptability.

The TDRSS boom assembly defined in the current model is a modal test verified structure incorporating all structural changes to reflect test correlation as presented in Reference 4. A representation of the boom structure is presented in Figure 4.1-4.

The TRW supplied RF Compartment NASTRAN model and SAP formulated Ku/S-Band Antenna model were those assembled in models LSD700 (Reference 5) and LSD801 (Reference 1). Gimbal drive assembly stiffness properties (tuned from modal test results) associated with the RF Compartment math model are presented in Table 4.1-6. Representations of the RF Compartment and Ku/S-Band substructures are presented in Figures 4 1-5 and 4.1-6. Respective boom/RF Compartment and Ku/S-Band Antenna substructure DOF summaries are shown in Tables 4.1-7 and 4.1-8.

The Instrument Module (IM) used for orbital model LSD900 is a completely revised model incorporating the numerous modifications to the free-free model as assembled in model LSD801. The previous free-free static model represented by 642 nodes and 3065 degrees-of-freedom is currently represented by 957 nodes and 5082 degrees-of-freedom. References 6 and 7 detail the modification analysis undertaken by the Stress Analysis Group to make the previous baseline IM reasonably compatible with the

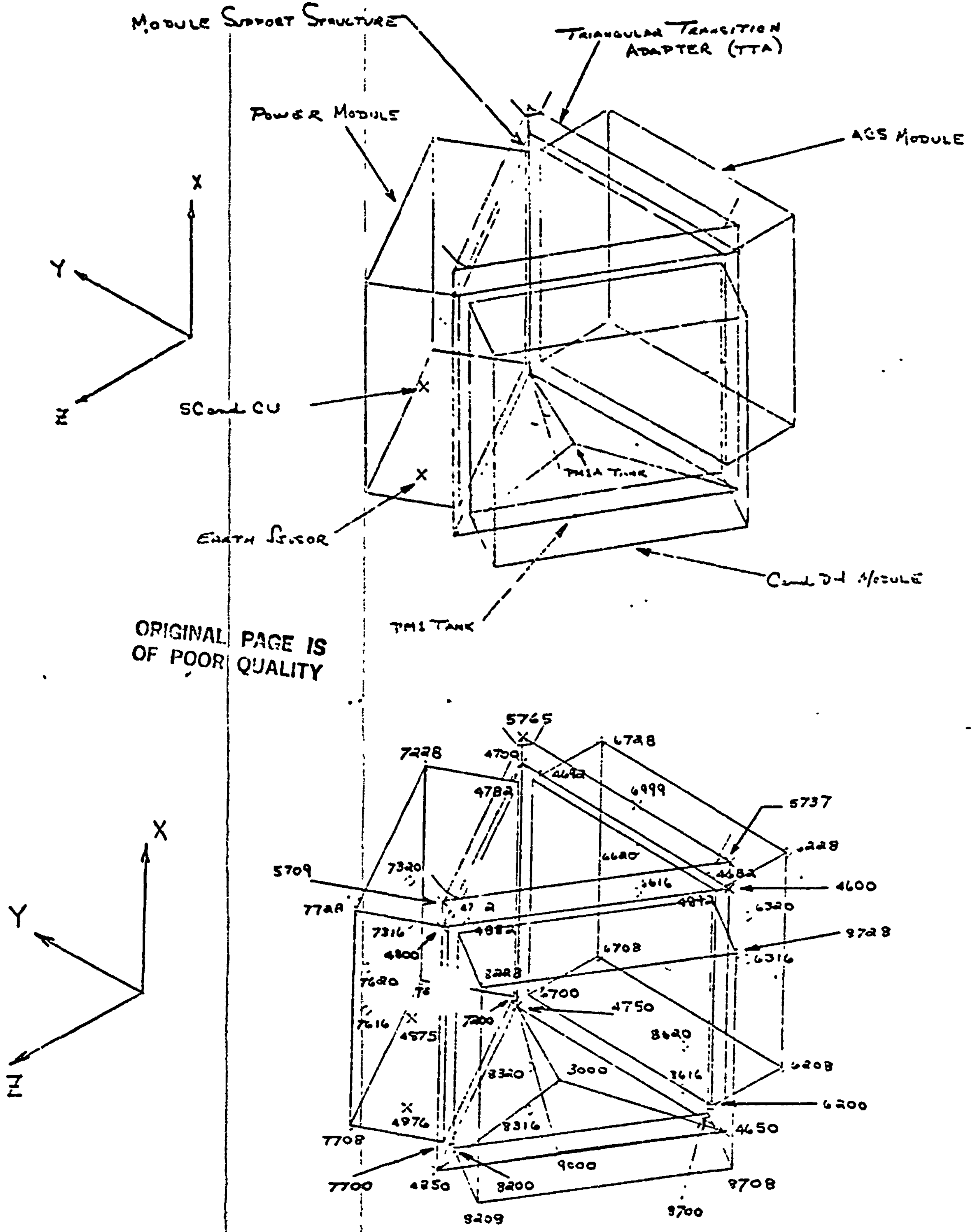

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Figure 4.1-3 Updated HMS Representation

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Table 4.1-4 Weight Breakdown For Updated MMS (Tuned)

Component	Total Weight	Remarks
ACS Module	345.38	
Power Module	503.6	Includes 3rd Battery
C and DH Module	250.67	Includes Tape Recorders
Propulsion Tank (PM1)	337.0	Includes Fuel + Pressurant
Propulsion Tank (PM1A)	400.2	Includes Fuel + Pressurant
Earth Sensor	26.00	
SC-CU	56.38	
PAF	150.77	Not in Free-Free Model
MSS	504.423	Includes Harness, Thermal Subsystem, Grappler, Misc. Electrical, Propulsion Tank Support Structure

Total Substructure Wt. = 2574.423

2423.653 W/O PAF

RUN NO. MMS301

DATE 071301
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
MMS FREE-FREE DYNAMIC MODEL SUMMARY TABLE

		X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
1	3000	-46.100	0.	0.	1	2	3	0	0	0	400.200	400.200	400.200	0.	0.	0.
2	4600	-8.800	-25.981	-15.000	4	5	6	0	0	0	41.630	41.630	41.630	0.	0.	0.
3	4650	-61.000	-25.981	-15.000	7	8	9	0	0	0	41.630	41.630	41.630	0.	0.	0.
4	4682	-8.800	-21.075	-14.723	10	11	12	0	0	0	40.710	40.710	40.710	0.	0.	0.
5	4692	-8.800	21.075	-14.723	13	14	15	0	0	0	40.710	40.710	40.710	0.	0.	0.
6	4700	-8.800	25.981	-15.000	16	17	18	0	0	0	41.630	41.630	41.630	0.	0.	0.
7	4750	-61.000	25.981	-15.000	19	20	21	0	0	0	41.630	41.630	41.630	0.	0.	0.
8	4782	-8.800	23.288	-10.890	22	23	24	0	0	0	43.447	43.447	43.447	0.	0.	0.
9	4792	-8.800	2.213	25.613	25	26	27	0	0	0	43.447	43.447	43.447	0.	0.	0.
10	4800	-8.800	0.	30.000	28	29	30	0	0	0	41.630	41.630	41.630	0.	0.	0.
11	4850	-61.000	0.	30.000	31	32	33	0	0	0	41.630	41.630	41.630	0.	0.	0.
12	4875	-24.900	0.	37.050	34	35	36	37	38	39	56.380	56.380	56.380	3600.00	2000.00	2500.00
13	4876	-43.810	0.	37.800	40	41	42	43	44	45	26.000	26.000	26.000	500.00	400.00	400.00
14	4882	-8.800	-2.213	25.613	46	47	48	0	0	0	24.665	24.665	24.665	0.	0.	0.
15	4892	-8.800	-23.288	-10.890	49	50	51	0	0	0	24.665	24.665	24.665	0.	0.	0.
16	5709	-3.200	0.	30.000	52	53	54	0	0	0	12.333	12.333	12.333	0.	0.	0.
17	5737	-3.200	-25.981	-15.000	55	56	57	0	0	0	12.333	12.333	12.333	0.	0.	0.
18	5765	-3.200	25.981	-15.000	58	59	60	0	0	0	12.333	12.333	12.333	0.	0.	0.
19	6200	-56.800	-23.000	-14.723	61	62	63	0	0	0	31.300	31.300	31.300	0.	0.	0.
20	6208	-56.800	-23.000	-31.723	64	65	66	0	0	0	23.760	23.760	23.760	0.	0.	0.
21	6228	-10.800	-23.000	-31.723	67	68	69	0	0	0	23.760	23.760	23.760	0.	0.	0.
22	6316	-38.400	-13.800	-31.723	70	71	72	0	0	0	34.435	34.435	34.435	0.	0.	0.
23	6320	-29.200	-13.800	-31.723	73	74	75	0	0	0	34.435	34.435	34.435	0.	0.	0.
24	6616	-38.400	13.800	-31.723	76	77	78	0	0	0	34.435	34.435	34.435	0.	0.	0.
25	6620	-29.200	13.800	-31.723	79	80	81	0	0	0	34.435	34.435	34.435	0.	0.	0.
26	6700	-56.800	23.000	-14.723	82	83	84	0	0	0	31.300	31.300	31.300	0.	0.	0.
27	6708	-56.800	23.000	-31.723	85	86	87	0	0	0	23.760	23.760	23.760	0.	0.	0.
28	6728	-10.800	23.000	-31.723	88	89	90	0	0	0	23.760	23.760	23.760	0.	0.	0.
29	6999	-33.800	3.000	-20.723	91	92	93	0	0	0	50.000	50.000	50.000	0.	0.	0.
30	7200	-56.800	24.250	-12.557	94	95	96	0	0	0	34.547	34.547	34.547	0.	0.	0.
31	7208	-56.800	38.972	-4.057	97	98	99	0	0	0	49.949	49.949	49.949	0.	0.	0.
32	7228	-10.800	38.972	-4.057	100	101	102	0	0	0	6.591	6.591	6.591	0.	0.	0.
33	7316	-38.400	34.372	3.910	103	104	105	0	0	0	128.046	128.046	128.046	0.	0.	0.
34	7320	-29.200	34.372	3.910	106	107	108	0	0	0	27.663	27.663	27.663	0.	0.	0.
35	7616	-38.400	20.572	27.812	109	110	111	0	0	0	146.583	146.583	146.583	0.	0.	0.
36	7620	-29.200	20.572	27.812	112	113	114	0	0	0	19.772	19.772	19.772	0.	0.	0.
37	7700	-56.800	1.250	27.280	115	116	117	0	0	0	34.547	34.547	34.547	0.	0.	0.
38	7708	-56.800	15.972	35.780	118	119	120	0	0	0	46.682	46.682	46.682	0.	0.	0.
39	7728	-10.800	15.972	35.780	121	122	123	0	0	0	9.220	9.220	9.220	0.	0.	0.
40	8200	-56.800	-1.250	27.280	124	125	126	0	0	0	15.885	15.885	15.885	0.	0.	0.
41	8208	-56.800	-15.972	35.780	127	128	129	0	0	0	13.681	13.681	13.681	0.	0.	0.
42	8228	-10.800	-15.972	35.780	130	131	132	0	0	0	13.681	13.681	13.681	0.	0.	0.
43	8316	-38.400	-20.572	27.813	133	134	135	0	0	0	41.044	41.044	41.044	0.	0.	0.
44	8320	-29.200	-20.572	27.813	136	137	138	0	0	0	41.044	41.044	41.044	0.	0.	0.
45	8616	-38.400	-34.372	3.910	139	140	141	0	0	0	41.044	41.044	41.044	0.	0.	0.
46	8620	-29.200	-34.372	3.910	142	143	144	0	0	0	41.044	41.044	41.044	0.	0.	0.
47	8700	-56.800	-24.250	-12.557	145	146	147	0	0	0	15.885	15.885	15.885	0.	0.	0.
48	8708	-56.800	-38.972	-4.057	148	149	150	0	0	0	13.681	13.681	13.681	0.	0.	0.
49	8728	-10.800	-38.972	-4.057	151	152	153	0	0	0	13.681	13.661	13.681	0.	0.	0.
50	9000	-71.700	0.	0.	154	155	156	157	158	159	337.000	337.000	337.000	71170.00	45240.00	35290.00

Table 4.1-5

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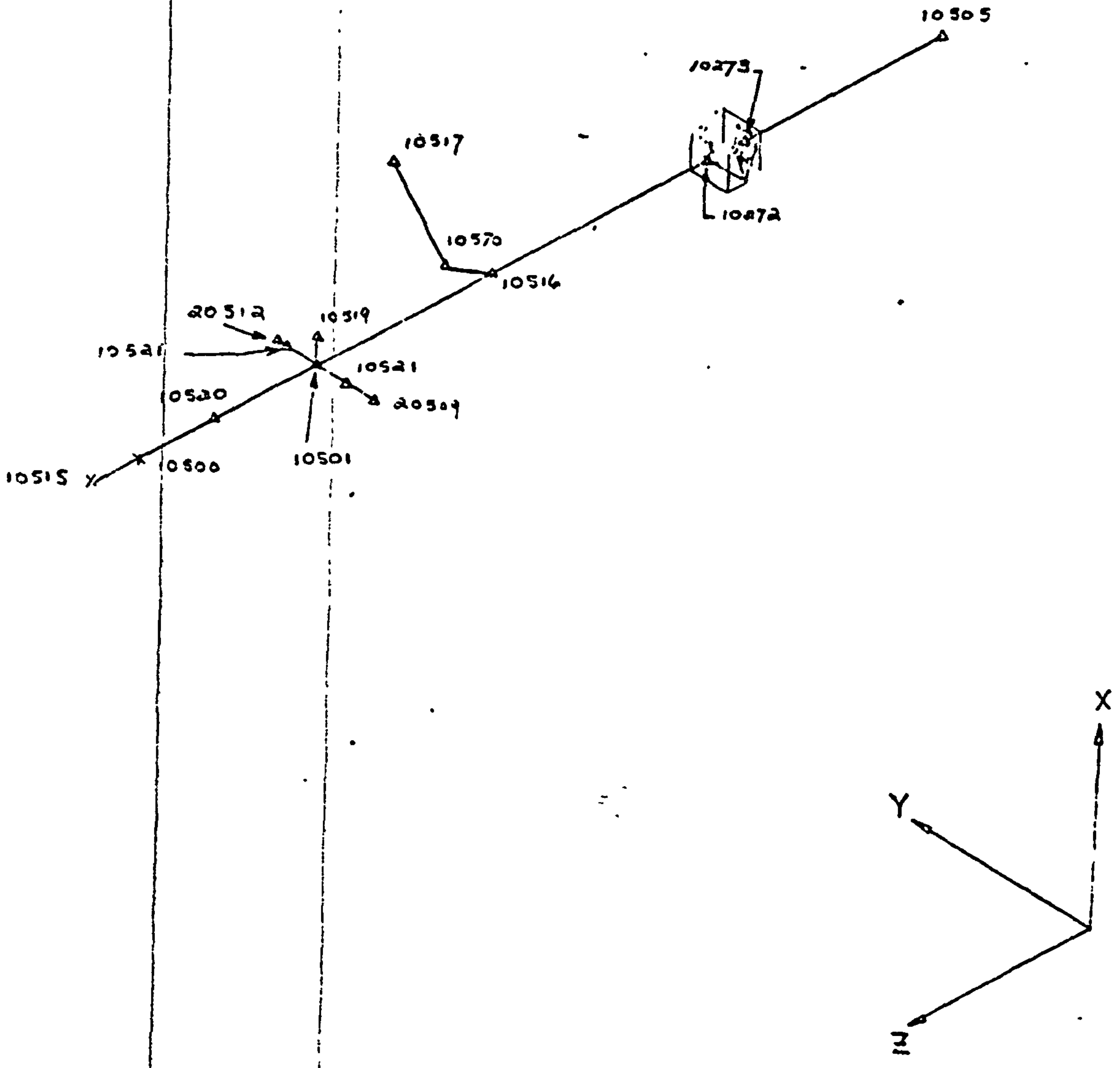
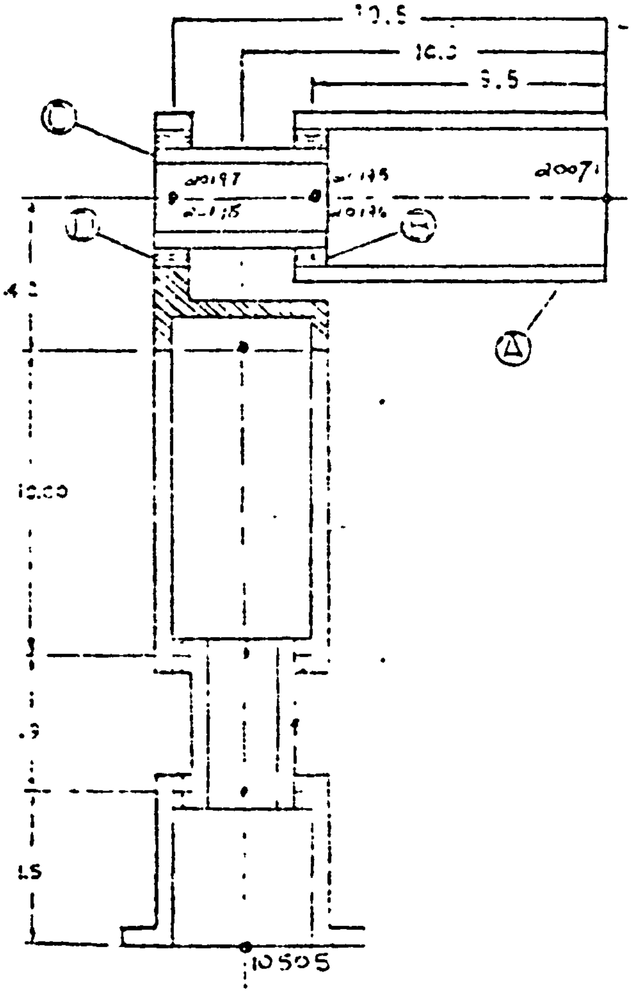


Figure 4.1-4 Deployed TDRSS Boom Representation

Table 4.1-6 GDA Stiffness Properties for Orbital Model LSD900

GIMBAL DRIVE ASSEMBLY

LANDSAT D



ELEVATION AXIS

Ⓐ
$EI/L = 1.507 \times 10^6$ LB-IN/RAD
$AE/L = 2.314 \times 10^6$ LB/IN
$AG/L = .897 \times 10^6$ LB/IN
$GJ/L = 1.155 \times 10^5$ LB-IN/RAD

Ⓔ & Ⓓ
$EI/L = 1.93 \times 10^6$ LB-IN RAD
$AE/L = 1.38 \times 10^6$ LB/IN
$AG/L = 2.03 \times 10^6$ LB/IN

Ⓒ
$EI/L = 12 \times 10^6$ LB-IN/RAD
$AE/L = 17.03 \times 10^6$ LB/IN
$AG/L = 6.6 \times 10^6$ LB/IN

AZIMUTH AXIS (20198-10505)

NASTRAN CBAR ELEMENT

AREA = .730403
I_1 = .738391
I_2 = 1.10759
J = 0.175

NOTE. The overall torsional stiffness of each axis of the GDA will be revised by the incorporation of the spring constant of the harmonic drive in series with the other structural components shown above. The effective GJ/L of the harmonic drive assemblies for each axis with tuning modifications incorporated is 25094. in-lb/rad for the elevation axis and 21035 in-lb/rad for the azimuth axis

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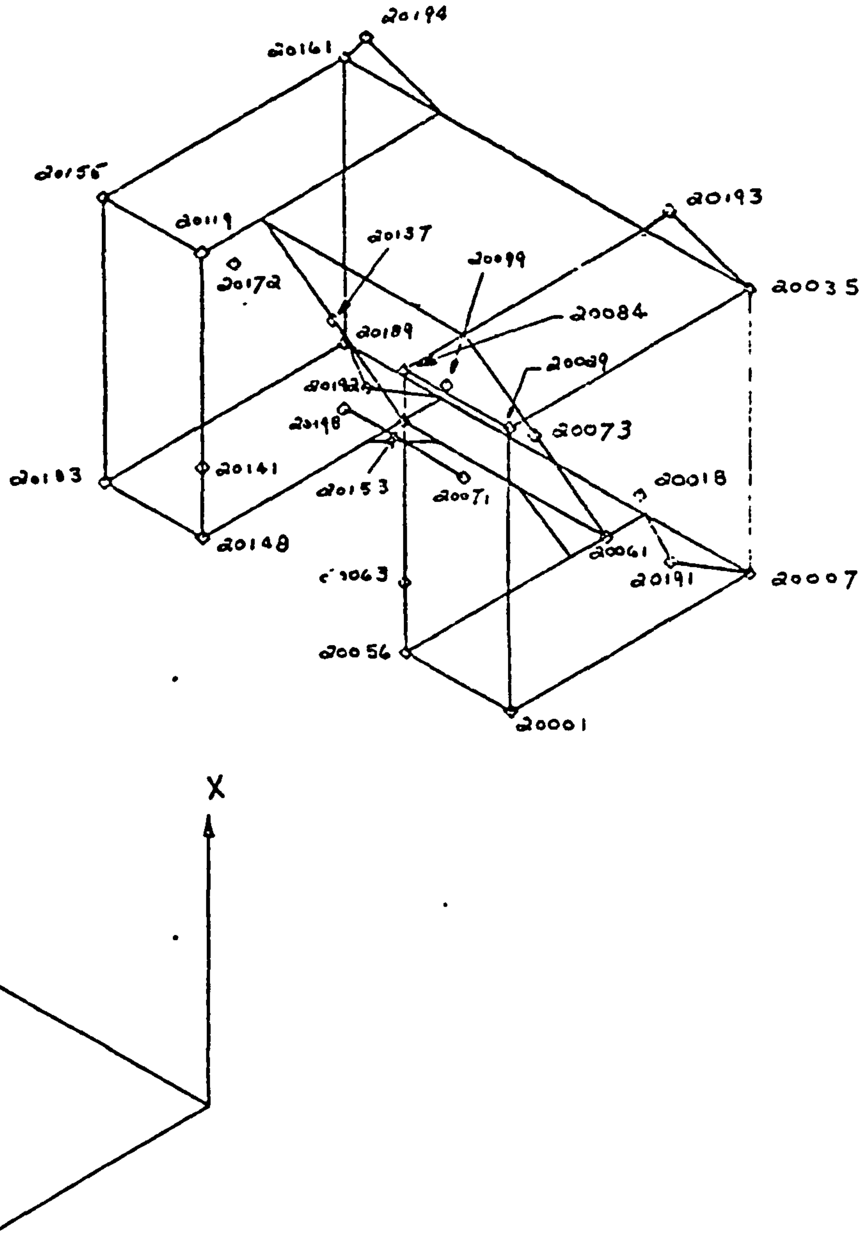

Figure 4.1-5 Deployed RF Compartment Representation

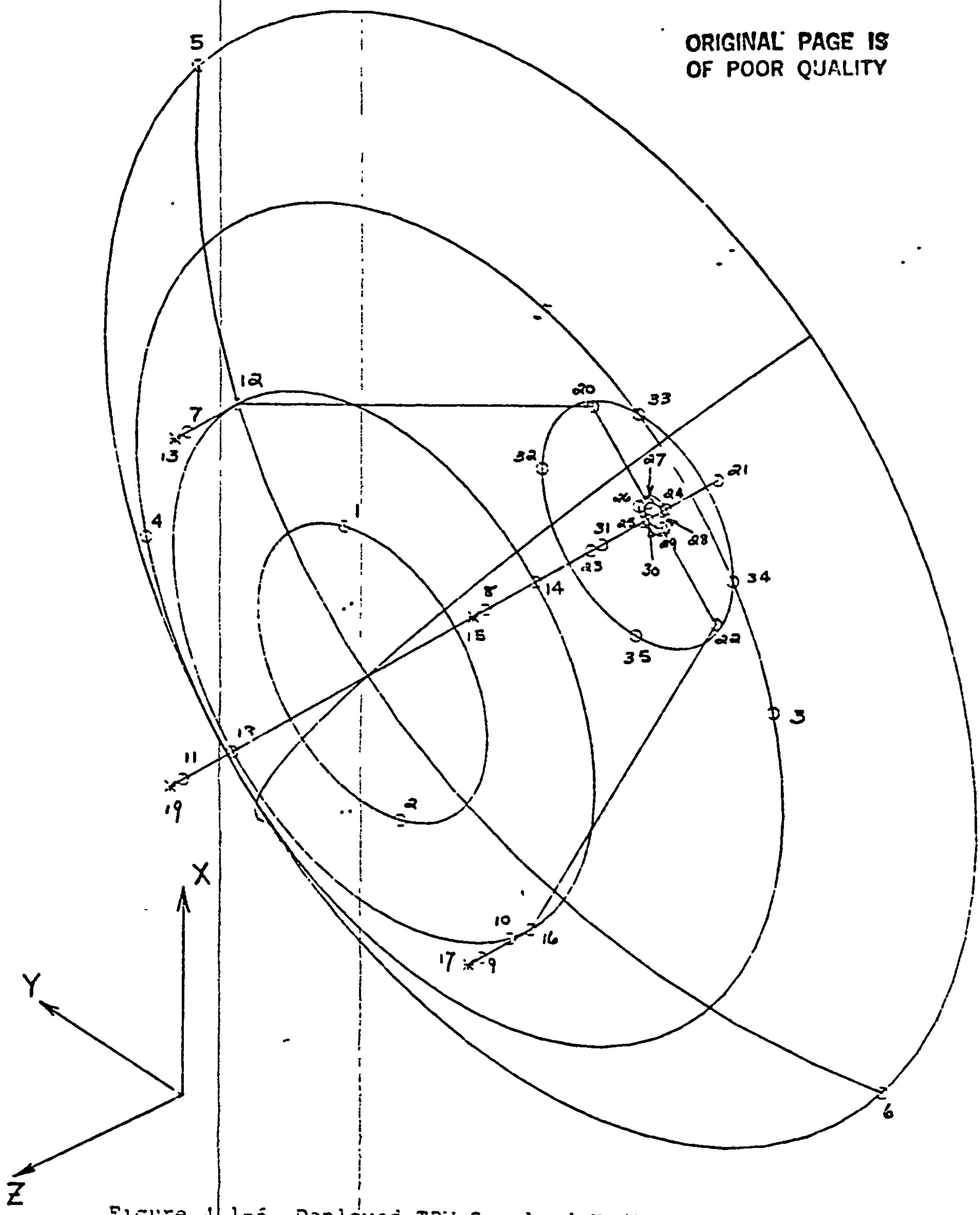

Figure 4.1-6 Deployed TRW Supplied Ku/S-Band Antenna

RUN NO. BRFT01

DATE 071381
RUN BY T E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
BOOM/RFC FREE-FREE DYNAMIC MODEL SUMMARY TABLE

		X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
1	10272	42.300	0.	-117.380	1	2	3	4	5	6	14.073	14.073	14.073	516.00	516.00	80.00
2	10273	42.300	0.	-123.380	7	8	9	10	11	12	12.815	12.815	12 815	355.00	355.00	73 00
3	10500	42.300	0.	-25.150	13	14	15	16	17	18	12.477	12.477	12.477	160.00	160.00	160.00
4	10501	42.300	0.	-54.450	19	20	21	0	0	0	13.140	13.140	13.140	0.	0.	0.
5	10505	42.300	0.	-155.225	22	23	24	25	26	27	21.265	21.265	21.265	569.74	569.74	156.54
6	10515	42.300	0.	-17 700	28	29	30	31	32	33	10.017	10.017	10.017	160.00	160.00	160.00
7	10516	42.300	0.	-82.750	34	35	36	0	0	0	12.403	12.403	12.403	0.	0.	0
8	10517	42 300	24 000	-89.750	37	38	39	0	0	0	3.180	3.180	3 180	0.	0.	0.
9	10519	46 350	0.	-54.450	40	41	42	0	0	0	0.160	0.160	0.160	0.	0.	0.
10	10520	42.300	0.	-37.850	43	44	45	0	0	0	6.257	6.257	6 257	0.	0.	0.
11	10521	42.300	-4 960	-54.450	46	47	48	0	0	0	4 625	4.625	4.625	0.	0.	0.
12	10522	42.300	4 960	-54.450	49	50	51	0	0	0	3.165	3.165	3.165	0.	0	0.
13	10570	39 050	7 750	-82.933	52	53	54	0	0	0	3.130	3.130	3.130	0.	0.	0.
14	20001	32 550	-17.750	-167.139	55	56	57	0	0	0	3.460	3.460	3 460	0.	0.	0.
15	20007	32 550	-17.750	-186.128	58	59	60	0	0	0	3 460	3.460	3.460	0.	0.	0.
16	20018	42 300	-17 750	-177.427	61	62	63	0	0	0	29.230	29.230	29.230	0.	0.	0.
17	20029	52 050	-17 750	-167 139	64	65	66	0	0	0	3.460	3.460	3.460	0.	0.	0.
18	20035	52.050	-17 750	-186.127	67	68	69	0	0	0	4 080	4.080	4 080	0.	0.	0.
19	20056	32 550	-9 500	-167.139	70	71	72	0	0	0	1.530	1 530	1.530	0.	0.	0.
20	20061	32 550	-9.500	-183.028	73	74	75	0	0	0	6.020	6.020	6.020	0.	0.	0.
21	20063	37 420	-9.500	-167.140	76	77	78	0	0	0	2 114	2.114	2.114	0.	0.	0.
22	20071	42.300	-9.500	-171.827	79	80	81	82	83	84	7 240	7.240	7.240	188.88	45.24	188.88
23	20073	42.300	-9 500	-177.427	85	86	87	0	0	0	6 000	6.000	6.000	0.	0.	0.
24	20084	52.050	-9 500	-167.139	88	89	90	0	0	0	1.920	1.920	1.920	0.	0	0.
25	20099	42 300	-2 500	-177.427	91	92	93	0	0	0	7.110	7.110	7.110	0.	0.	0.
26	20119	52.050	6.500	-167.139	94	95	96	0	0	0	2.120	2.120	2.120	0.	0.	0.
27	20137	42.300	6 500	-177 427	97	98	99	0	0	0	5 690	5 690	5 690	0.	0.	0.
28	20141	37.420	6.500	-167.140	100	101	102	0	0	0	2.114	2.114	2.114	0.	0.	0.
29	20148	32.550	6.500	-167.139	103	104	105	0	0	0	1.530	1.530	1.530	0.	0.	0.
30	20153	32 550	6.500	-183.028	106	107	108	0	0	0	5.800	5.800	5.800	0.	0.	0.
31	20155	52 050	14 200	-167 139	109	110	111	0	0	0	4 280	4.280	4.280	0.	0.	0.
32	20161	52 050	14 200	-186.127	112	113	114	0	0	0	4.850	4.850	4.850	0.	0.	0.
33	20172	42 300	14 200	-177 427	115	116	117	0	0	0	9.360	9.360	9 360	0.	0.	0.
34	20183	32 550	14.200	-167.139	118	119	120	0	0	0	2.230	2.230	2 230	0.	0.	0.
35	20189	32 550	14.200	-186.128	121	122	123	0	0	0	2 230	2.230	2.230	0.	0.	0.
36	20191	30 279	-11 521	-186.127	124	125	126	127	128	129	1.340	1.340	1.340	1.00	1.00	1.00
37	20192	30 279	12 521	-186.127	130	131	132	133	134	135	1.340	1.340	1.340	1.00	1 00	1.00
38	20193	54 321	-11.521	-186.128	136	137	138	139	140	141	1.340	1.340	1.340	1.00	1.00	1.00
39	20194	54 321	12.521	-186.128	142	143	144	145	146	147	1.340	1.340	1.340	1.00	1.00	1.00
40	20198	42 300	0.	-171.827	148	149	150	151	152	153	19.890	19.890	19.890	518.89	124.30	518.89
41	20509	42 300	-9.500	-54.450	154	155	156	0	0	0	2.210	2.210	2 210	0.	0.	0.
42	20512	42.300	6 500	-54.450	157	158	159	0	0	0	0.750	0.750	0.750	0.	0.	0.

Table 4.1-7

RUN NO. KUANT2

DATE 071381
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
KU/S-BAND FREE-FREE DYNAMIC MODEL SUMMARY TABLE

		X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
1	1	51.235	2.894	-190.160	1	2	3	0	0	0	2.696	2.696	2.696	0.	0.	0.
2	2	33 365	-1.894	-190.160	4	5	6	0	0	0	2.696	2.696	2.696	0.	0.	0.
3	3	49.029	-24.614	-196 993	7	8	9	0	0	0	2 451	2.451	2 451	0.	0.	0.
4	4	35.571	25.614	-196.994	10	11	12	0	0	0	2.451	2.451	2.451	0.	0.	0.
5	5	63.607	28.267	-203.347	13	14	15	0	0	0	2.155	2.155	2.155	0.	0.	0.
6	6	20.993	-27 267	-203.347	16	17	18	0	0	0	2.155	2.155	2.155	0.	0.	0.
7	7	54 321	12.52	-191.037	19	20	21	0	0	0	0 837	0.837	0 837	0.	0.	0.
8	8	54.321	-11.521	-191.037	22	23	24	0	0	0	0.837	0 837	0.837	0.	0.	0.
9	9	30.279	-11.521	-191.036	25	26	27	0	0	0	0 837	0.837	0.837	0.	0.	0.
10	10	28 813	-9 84	-191.036	28	29	30	0	0	0	0.110	0.110	0.110	0.	0.	0.
11	11	30 254	12.5	-191.054	31	32	33	0	0	0	0 837	0 837	0.837	0.	0.	0.
12	12	54 321	12.5	-187.116	34	35	36	0	0	0	0 145	0.145	0.145	0.	0.	0.
13	13	54.321	12.571	-186.128	37	38	39	40	41	42	0.225	0.225	0.225	0.23	0.23	0.23
14	14	54 321	-11.521	-187.116	43	44	45	0	0	0	0.145	0.145	0.145	0.	0.	0.
15	15	54.321	-11.521	-186.128	46	47	48	49	50	51	0.225	0 225	0.225	0.23	0 23	0.23
16	16	30 279	-11.521	-187.116	52	53	54	0	0	0	0.145	0.145	0.145	0.	0.	0.
17	17	30 279	-11.521	-186.127	55	56	57	58	59	60	0.225	0.225	0.225	0.23	0.23	0.23
18	18	30.279	12.521	-187.116	61	62	63	0	0	0	0 145	0.145	0.145	0.	0.	0.
19	19	30.279	12.521	-186.127	64	65	66	67	68	69	0.225	0.225	0.225	0.23	0.23	0.23
20	20	47 293	5 493	-212.469	70	71	72	0	0	0	0.125	0.125	0.125	0.	0.	0.
21	21	47.293	-4.493	-212.469	73	74	75	0	0	0	0.125	0.125	0.125	0.	0.	0.
22	22	37 307	-4 493	-212 468	76	77	78	0	0	0	0 125	0.125	0.125	0.	0.	0.
23	23	37 307	5.493	-212 468	79	80	81	0	0	0	0 125	0.125	0 125	0.	0.	0.
24	24	43.184	-0.384	-212.469	82	83	84	0	0	0	0.040	0.040	0 040	0.	0.	0.
25	25	41.416	1.384	-212 468	85	86	87	0	0	0	0.040	0.040	0 040	0.	0.	0.
26	26	42.300	1.750	-212.469	88	89	90	0	0	0	0.140	0.140	0.140	0.	0.	0.
27	27	42 866	1.066	-212.469	91	92	93	0	0	0	0.345	0.345	0 345	0.	0.	0.
28	28	42.866	-0 066	-212.469	94	95	96	0	0	0	0.345	0.345	0.345	0.	0.	0.
29	23	41.735	-0.066	-212.469	97	98	99	0	0	0	0.345	0.345	0.345	0.	0.	0.
30	30	41.735	1 066	-212.469	100	101	102	0	0	0	0.345	0.345	0.345	0.	0.	0.
31	31	42.300	0.500	-208 324	103	104	105	0	0	0	0.120	0.120	0.120	0.	0.	0.
32	32	42.300	8.166	-211.117	106	107	108	0	0	0	0.066	0.066	0.066	0.	0.	0.
33	33	49.966	0.500	-211.117	109	110	111	0	0	0	0.066	0.066	0.066	0.	0.	0.
34	34	42.300	-7.166	-211.117	112	113	114	0	0	0	0.066	0.066	0.066	0.	0.	0.
35	35	34 634	0 500	-211.117	115	116	117	0	0	0	0.066	0.066	0 066	0.	0.	0.

Table 4.1-8

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current design. References 8 thru 10 detail the analysis to update the design as shown on the released prints as of January 1981. The mission adapter is essentially the same as the previous model but updated to reflect the current configuration. The upper support structure represents a totally new model due to extensive differences between the old version and the current configuration. A major refinement to the previous model is the inclusion of a detailed SADAPTA simulation incorporating the bearing compliances of the SADAPTA shaft bearings. Another modification, found during the MTM vibration testing, was that the mono-ball bearings used at the ends of the 2.5 in. O.D. struts needed to be simulated. This simulation is included in the current substructure model. Two structural updates occured in the TM area. First, the thematic mapper (TM) simulation was altered. Originally, the TM C.G. was modeled on a structurally tuned H-truss framework to insure a fundamental frequency of 100 Hz or greater. This simulation was modified to position the TM C.G. on a CBAR quadrupod (Q-pod) with element properties ensuring a fundamental frequency of greater than 250 Hz. Secondly, stiffnesses for the TM feet were included. Various TM foot NASTRAN models were generated by the stress group for this analysis and their results are presented in Reference 7. Table 4.1-9 presents the TM and TM foot simulation used in the current IM model. Improved support structure detail was incorporated into the baseline MSS experiment Q-pod simulation. The translational degrees-of-freedom at the four (4) attachment locations of the MSS Q-pod to the IM USS are still retained in the analysis set.

Table 4.1-9 TM and TM Foot Simulation

TM C.G. Modeled On Q-Pod

CBEAM	1871	1124	1669	1670		
CBEAM	1872	1124	1669	1671		
CBEAM	1873	1124	1669	1672		
CBEAM	1874	1124	1669	1673		
PBEAM	1124	1004	0.80	945.0	945.	100.0
MAT1	1004	29.E+6	11.E+6	0.29		

TM Influence Foot Coefficients

CELAS1	41347	1	347	1	1671	1
CELAS1	42347	2	347	2	1671	2
CELAS1	43347	3	347	3	1671	3
CELAS1	41348	1	348	1	1672	1
CELAS1	42348	2	348	2	1672	2
CELAS1	43348	3	348	3	1672	3
CELAS1	41349	1	349	1	1673	1
CELAS1	42349	2	349	2	1673	2
CELAS1	43349	3	349	3	1673	3
CELAS1	41350	1	350	1	1674	1
CELAS1	42350	2	350	2	1674	2
CELAS1	43350	3	350	3	1674	3
PELAS	1	3225806.				
PELAS	2	729395.				
PELAS	3	729395.				

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To accurately define dynamic behavior, a detailed weight distribution was performed resulting in the current dynamic analysis set. Since this dynamic model incorporates in detail the changes associated with the previous free-free model (also used for modal tuning, Reference 11), a cross orthogonality check was performed between analytical and test data yielding acceptable results. This was the final step in substructure verification and led to its inclusion in the current analysis. Figure 4.1-7 shows a representation of the current IM structure with Table 4.1-10 defining the substructure DOF summary table. Table 4.1-11 presents a comparative summary of modeling revisions between models LSD801 and LSD900.

The detailed orbital model, LSD900, was assembled entirely on the VAX mini-computer using the SCAMP analysis code. Free-free MMS and IM substructures were coupled through the Triangular Transition Adapter (TTA). The TTA structure was represented by an updated (27x27) stiffness matrix derived from the simulation incorporated in the current MMS NASTRAN model. The RF Compartment is connected to the TDRSS boom through the azimuth drive and forms one complete NASTRAN assembly. The RF Compartment is rotated 90° CCW in NASTRAN from its modal test position (mounting feet along -X axis) to configure the structure in its worst case orbital mode. The Ku/S-Band Antenna was point-to-point coupled to the RFC at the four (4) attachment feet. This complete assemblage was in turn coupled to the MMS/IM using the fitting stiffness defined from the inner powered hinge to the IM attachment point. Lastly, the deployed solar array was attached to the MMS/IM at the SADAPTA interface using the aluminum jettison shaft from the SADAPTA to the jettison assembly apex as the

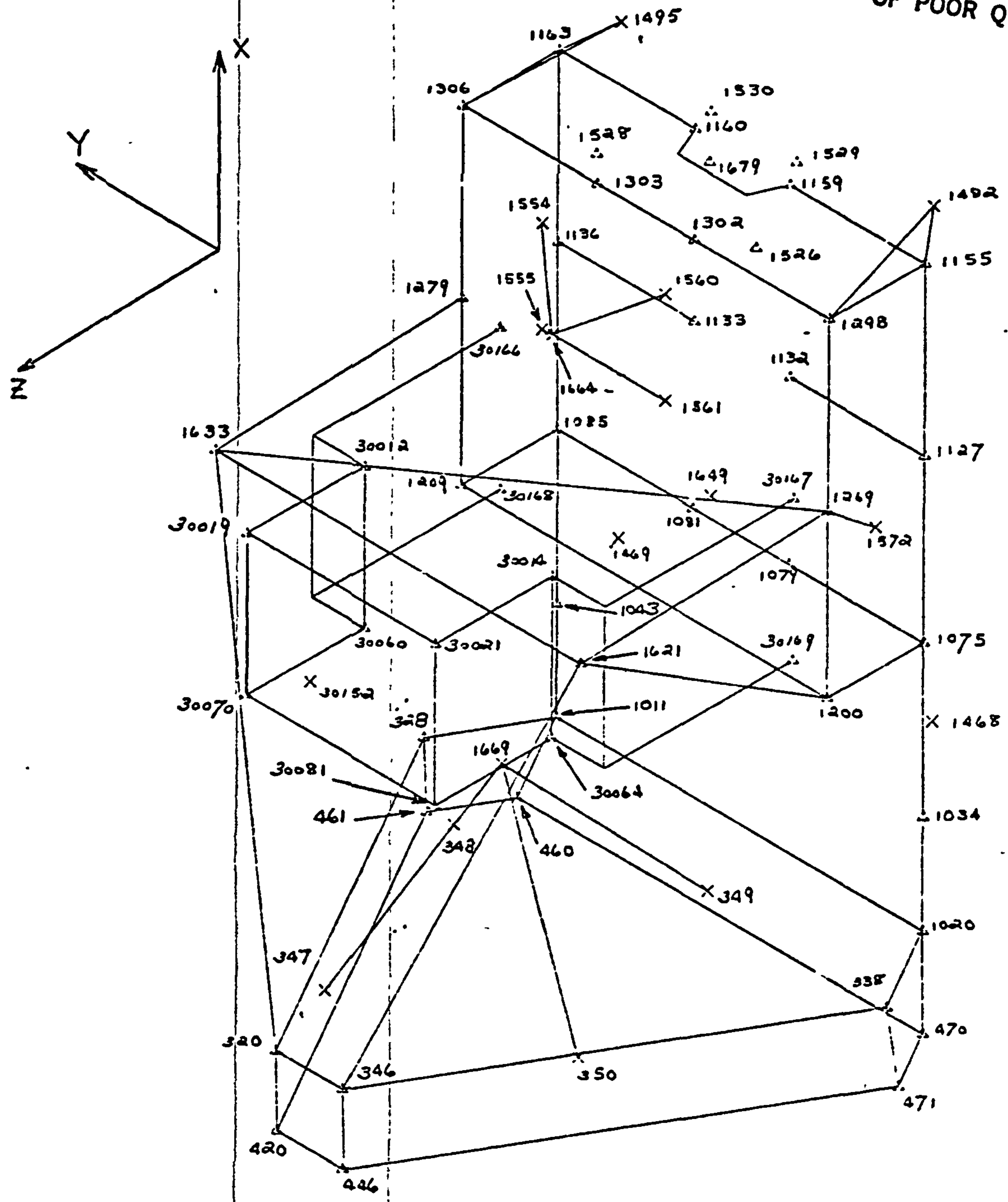

Figure 4.1-7 Updated Instrument Module Representation

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RUN NO. IM81FF

DATE 071381
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
IM FREE-FREE DYNAMIC MODEL SUMMARY TABLE

		X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
1	320	8.000	3.821	29.204	1	2	3	0	0	0	25.313	25.313	25.313	0.	0.	0.
2	328	8.000	26.540	-10.390	4	5	6	0	0	0	17.125	17.125	17.125	0.	0.	0.
3	338	8.000	-26.540	-10.390	7	8	9	0	0	0	8.008	8.008	8.008	0.	0.	0.
4	346	8.000	-3.821	29.204	10	11	12	0	0	0	9.177	9.177	9.177	0.	0.	0.
5	347	8.000	7.024	20.380	13	14	15	0	0	0	1.650	1.650	1.650	0.	0.	0.
6	348	8.000	16.180	-3.550	16	17	18	0	0	0	1.680	1.680	1.680	0.	0.	0.
7	349	8.000	-4.820	-11.580	19	20	21	0	0	0	3.200	3.200	3.200	0.	0.	0.
8	350	8.000	-13.973	12.350	22	23	24	0	0	0	1.690	1.690	1.690	0.	0.	0.
9	420	0	3.821	29.023	25	26	27	0	0	0	23.123	23.123	23.123	0.	0.	0.
10	446	0.	-3.821	29.023	28	29	30	0	0	0	7.785	7.785	7.785	0.	0.	0.
11	460	0.	23.224	-17.820	31	32	33	0	0	0	10.886	10.886	10.886	0.	0.	0.
12	461	0	27.045	-11.202	34	35	36	0	0	0	13.653	13.653	13.653	0.	0.	0.
13	470	0	-23.224	-17.820	37	38	39	0	0	0	8.048	8.048	8.048	0.	0.	0.
14	471	0.	-27.045	-11.202	40	41	42	0	0	0	7.053	7.053	7.053	0.	0.	0.
15	1011	8.000	-21.000	-20.000	43	44	45	0	0	0	14.048	14.048	14.048	0.	0	0.
16	1020	8.000	21.000	-20.000	46	47	48	0	0	0	12.593	12.593	12.593	0.	0.	0.
17	1034	19.250	-21.000	-20.000	49	50	51	0	0	0	11.426	11.426	11.426	0	0.	0.
18	1043	19.250	21.000	-20.000	52	53	54	0	0	0	10.330	10.330	10.330	0.	0.	0.
19	1075	36.500	-21.000	-20.000	55	56	57	0	0	0	19.521	19.521	19.521	0.	0.	0.
20	1079	36.500	-5.500	-20.000	58	59	60	0	0	0	8.167	8.167	8.167	0.	0.	0.
21	1081	36.500	5.500	-20.000	61	62	63	0	0	0	7.194	7.194	7.194	0.	0.	0.
22	1085	36.500	21.000	-20.000	64	65	66	0	0	0	18.670	18.670	18.670	0.	0.	0.
23	1127	55.000	-21.000	-20.000	67	68	69	0	0	0	26.723	26.723	26.723	0.	0.	0.
24	1132	55.000	-5.500	-20.000	70	71	72	0	0	0	15.602	15.602	15.602	0.	0	0.
25	1133	55.000	5.500	-20.000	73	74	75	0	0	0	19.651	19.651	19.651	0.	0.	0.
26	1136	55.000	21.000	-20.000	76	77	78	0	0	0	25.888	25.888	25.888	0.	0.	0.
27	1155	74.000	-21.000	-20.000	79	80	81	0	0	0	10.401	10.401	10.401	0	0.	0.
28	1159	74.000	-5.500	-20.000	82	83	84	0	0	0	5.498	5.498	5.498	0.	0.	0.
29	1160	74.000	5.500	-20.000	85	86	87	0	0	0	13.359	13.359	13.359	0.	0.	0.
30	1163	74.000	21.000	-20.000	88	89	90	0	0	0	17.135	17.135	17.135	0.	0.	0.
31	1200	36.500	-21.000	-9.000	91	92	93	0	0	0	8.581	8.581	8.581	0	0.	0.
32	1209	36.500	21.000	-9.000	94	95	96	0	0	0	10.535	10.535	10.535	0.	0.	0.
33	1269	55.000	-21.000	-9.000	97	98	99	0	0	0	17.738	17.738	17.738	0.	0.	0.
34	1279	55.000	21.000	-9.000	100	101	102	0	0	0	14.309	14.309	14.309	0.	0.	0.
35	1298	74.000	-21.000	-9.000	103	104	105	0	0	0	4.405	4.405	4.405	0.	0.	0.
36	1302	74.000	-5.500	-9.000	106	107	108	0	0	0	12.322	12.322	12.322	0.	0	0.
37	1303	74.000	5.500	-9.000	109	110	111	0	0	0	12.322	12.322	12.322	0.	0.	0.
38	1305	74.000	21.000	-9.000	112	113	114	0	0	0	4.482	4.482	4.482	0.	0.	0.
39	1468	25.250	-18.000	-24.000	115	116	117	118	119	120	2.158	2.158	2.158	1.00	1.00	1.00
40	1469	25.250	18.000	-24.000	121	122	123	124	125	126	2.158	2.158	2.158	1.00	1.00	1.00
41	1482	76.250	-18.000	-24.000	127	128	129	130	131	132	2.023	2.023	2.023	1.00	1.00	1.00
42	1495	76.250	18.000	-24.000	133	134	135	136	137	138	2.023	2.023	2.023	1.00	1.00	1.00
43	1526	75.375	-11.215	-10.485	139	140	141	0	0	0	0.800	0.800	0.800	0.	0.	0.
44	1528	75.375	7.215	-10.485	142	143	144	0	0	0	0.800	0.800	0.800	0.	0.	0.
45	1529	75.375	-4.960	-21.250	145	146	147	0	0	0	2.235	2.235	2.235	0.	0.	0.
46	1530	75.375	4.960	-21.250	148	149	150	0	0	0	2.235	2.235	2.235	0.	0.	0.
47	1554	71.000	7.750	-5.000	151	152	153	0	0	0	2.528	2.528	2.528	0.	0.	0
48	1555	60.500	7.750	-5.000	154	155	156	0	0	0	2.528	2.528	2.528	0.	0	0.
49	1560	71.000	-6.250	-5.000	157	158	159	0	0	0	2.528	2.528	2.528	0.	0.	0.
50	1561	60.500	-6.250	-5.000	160	161	162	0	0	0	2.528	2.528	2.528	0.	0	0.

Table .-10

RUN NO. IMB'FF

DATE 071381
RUN BY T.E.POLLAK

PHASE 3 JITTER ORBITAL MODEL
IM FREE-FREE DYNAMIC MODEL SUMMARY TABLE

		X	Y	Z	X	Y	Z	RX	RY	RZ	WX	WY	WZ	IXX	IYY	IZZ
51	1572	50 750	-21.000	-14.500	163	164	165	166	167	168	2.000	2.000	2.000	1.00	1.00	1 00
52	1621	53 920	-21.000	19.249	169	170	171	0	0	0	5.262	5.262	5.262	0.	0.	0.
53	1633	53.920	21.000	19.249	172	173	174	0	0	0	6.415	6.415	6.415	0	0.	0.
54	1649	42 300	0	-16 500	175	176	177	178	179	180	22.629	22.629	22.629	44.00	44.00	44.00
55	1664	67.200	0	1 660	181	182	183	184	185	186	130 000	130.000	130.000	16181.00	7780.00	12724.00
56	1669	21.100	6.380	0 820	187	188	189	190	191	192	549.700	549 700	549.700	271300.00	95472.00	222617.00
57	1679	75 375	0	-16 250	193	194	195	0	0	0	2 971	2.971	2.971	0.	0.	0.
58	30012	53.750	11 078	12.045	196	197	198	0	0	0	19.100	19.100	19 100	0	0.	0.
59	30014	53.750	-10.579	12 045	199	200	201	0	0	0	19.700	19.700	19.700	0.	0.	0.
60	30019	53 750	11.078	25.465	202	203	204	0	0	0	3 935	3.935	3.935	0.	0.	0.
61	30021	53.750	-10.579	25.465	205	206	207	0	0	0	3.300	3.300	3 300	0.	0.	0.
62	30060	37.750	11 078	12.045	208	209	210	0	0	0	32.300	32.300	32.300	0.	0.	0.
63	30064	37.750	-10.579	12.045	211	212	213	0	0	0	35.600	35.600	35.600	0.	0.	0.
64	30077	37.750	11 078	25.465	214	215	216	0	0	0	3.635	3.635	3.635	0.	0.	0.
65	30081	37.750	-10 579	25.465	217	218	219	0	0	0	3 000	3 000	3.000	0.	0.	0.
66	30152	46.250	0.250	28.986	220	221	222	0	0	0	5.000	5.000	5.000	0.	0	0.
67	30166	53.750	17.062	-9.500	223	224	225	0	0	0	7.200	7.200	7.200	0.	0.	0.
68	30167	53 750	-16.563	-9.500	226	227	228	0	0	0	10 400	10.400	10.400	0.	0.	0.
69	30168	37.750	17 062	-9.500	229	230	231	0	0	0	14.800	14.800	14 800	0.	0.	0.
70	30169	37 750	-16 563	-9 500	232	233	234	0	0	0	18 900	18.900	18 900	0.	0.	0.

Table 4.1-10 (Continued)

Table 4.1-11 Orbital Jitter Models Comparative Summary

ITEM	LSD801	LSD901
MMS	12/80 Updated Model From NASA-Goddard	06/81 Tuned Model From NASA-Goddard
MSS USS Grids In Aset	Yes	Yes
TDRSS Boom	Tuned Analytical Model	Modal Model With Re-Tuned 2nd Y-Bending Mode
Deployed Solar Array	NASTRAN Verified Modal Test Model	NASTRAN Verified Modal Test Model
Instrument Module	NASTRAN Verified Modal Test Model	Updated NASTRAN Verified Modal Test Model
Ku/S-Band Antenna	Modified Antenna With Feed Corrections	As Per LSD801
RF Compartment	Per TRW-99DOF/6DOF At Node 20071 Original Detailed Elevation Drive	As Per LSD801
GDA Stiffness Properties	TRW Beam Equivalent Properties For Azimuth Drive	Modification For Azimuth Drive
Total Number of Assembled Substructures	5	5
Total Nodal Locations	228	257
Total Dynamic Degrees-of-Freedom	723	819

coupling link. This shaft was tuned to represent the SADAPTA torsional stiffness of 30,000 in-lb/rad. Appendage coupling stiffness values are presented in Table 4.1-12.

4.2 TDRSS BOOM RE-TUNING

In the series of models associated with the previous orbital analysis, concern was expressed over the proximity of the TDRSS boom second Y-bending mode to the fundamental forcing harmonic of the MSS experiment at 13.62 Hz.

In the previous modal tuning effort, the 2nd boom Y-bending mode was tuned to a frequency of 13.407 Hz compared to the test validated frequency of 14.47. To effect a re-tuning of this mode, a parametric variation on the previously tuned modal test model (Reference 4) was performed. The shifted on-orbit 2nd Y-bending frequency to 14.142 Hz. better meets the test acceptance criteria for an analytical model.

All the NASTRAN model changes incorporated in re-tuning the analytical model are shown in Table 4.2-1. Using the changes shown, a new set of analytical frequencies and mode shapes was determined. A comparison of the measured test modes and the updated analytical modes is shown in Table 4.2-2.

The analytical model used for the re-tuning effort contained 306 degrees-of-freedom (DOF) including 54 DOF's on the suspension system. To estimate the effect of having a finite number of measurement points in the test set-up, the 306 DOF mode shapes were used to extract only

Table 4.1-12 Appendage Coupling Stiffnesses

DESCRIPTION	CONNECTION NODES	LENGTH	STIFFNESS VALUES			
			TORSION	BENDING	SHEAR	AXIAL
KU/S-BAND ANTENNA TO RF COMPARTMENT	13 TO 20194 15 TO 20193 17 TO 20191 19 TO 20192	0.0	185,000	26,000	185,000	26,000
KU/S-BAND ANTENNA - RF COMPARTMENT - TDRSS BOOM TO IM	1649 TO 10515	1.20 IN	103,720,000	8,705,400	134,770,000	22,275,000
DS/A TO IM	1572 TO 2076	6.82 IN	30,000	181,030	3,085,200	1,672,000

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Table 4.2-1 Changes For Pe-Tuning 2nd Y-Bending Mode Of Boom/RFC NASTRAN Model

```
[illegible] EQUIPPED HINGE JOINT FLEXIBILITY SIMULATION
  (TUNING OF TEST MEASURED MODES 1 AND 2)

  [illegible] 30000   50      42.30   0.0     -21.425 52
  [illegible] 20100   50      42.30   0.0     -21.425 52
  [illegible] 101     7500    10515   90000   1154                        2
  [illegible] 102     106172  80100   10500   10503                       2
  [illegible] 7500    501     2.70    15.9562 15.9562 31.9125
  [illegible] 106172  6023    3.7310  10.5510 10.5510 21.100
  MPC     300     80000   1       1.0     80100   1       -1.00
  MPC     300     30000   2       1.0     80100   2       -1.00
  MPC     300     80000   3       1.0     80100   3       -1.00
  MPC     300     80000   6       1.0     80100   6       -1.00
  CELAS2  50400   1.50E6  80000   4       80100   4
  CELAS2  50401   8.0E5   90000   5       80100   5

UPPER EQUIPPED HINGE REVISIONS
  (TUNING OF TEST MEASURED MODE 6)

  OLD CARDS
   MPC    200     10207   3       1.0     10264   3       -1.00
   MPC    200     10208   3       1.0     10265   3       -1.00

  NEW CARDS
   CELAS1 110207  110207  10207   3       10264   3
   CELAS1 [illegible] 110207 10208 [illegible] 10265 3
   PELAS  110207  80312.

AZIMUTH DRIVE REVISIONS
  (TUNING OF TEST MEASURED MODES 4 AND 7)

  OLD CARDS
   CBAR   25000   85000   20198   10525   10503                     2
   PBAR   85000   1201    .730483 .735394 .736394 .052522                 +PBAR850

  NEW CARDS
   PBAR   85000   1201    .730488 .735394 1.10759 .1750                   +PBAR850

ELEVATION DRIVE REVISIONS
  (TUNING OF TEST MEASURED MODE 3)

  OLD CARDS
   CELAS2 26040   2.83E4  20195   5       29156   5
   CELAS2 26140   2.86E4  20197   5       20198   5

  NEW CARDS
   CELAS2 26040   50197.  20195   5       20196   5
   CELAS2 26140   50187.  20197   5       20198   5
```

Table 4.2-2 Comparison of Measured To Tuned NASTRAN Modal Frequency Values

Mode Number	Measured Frequency (Hz)	Excitation Axis	Predicted Frequency (Hz)	Frequency Difference (%)
1	1.20	X	1.173	-2.25
2	1.23	Y	1.235	+.407
3	2.72	SPS	2.806	+3.16
4	3.01	Y	2.968	-1.40
5	6.930	Y	7.416	+7.01
6	11.90	X	12.408	+4.27
7	14.47	Y	14.124	-2.39

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the 42 modal amplitudes which were measured in the test. An orthogonality check was performed on this truncated mode set. The results of this check are shown in Table 4.2-3. The analytical tuned modes associated with this model are tabulated in Table 4.2-4 and shown in Figures 4.2-1 thru 4.2-7. A cross orthogonality check between the re-tuned analytical model and test data is presented in Table 4.2-5.

4.3 RESPONSE DATA

To aid ACS engineering in their simulation studies to determine orbital control responsiveness of the Landsat-D spacecraft, modal torque admittance data for various spacecraft nodal locations are provided. The nodes shown in Figure 4.1-1 and presented in Table 4.3-1 represent the locations for which data, thru 25 Hz, is to be supplied. Table 4.3-2 presents the structural transfer function coefficient data (Damping = 0.001) for the current orbital configuration model, LSD900. This data is also preserved on the following accessible dynamics data base permfile:

1R400492/TP/ORBIT/PICKOUT4/LS900ACS

Table 4.3-3 presents the coefficients to be used for an assumed damping of 0.01. This data is preserved on the following dynamics data base permfile:

1R400492/TP/ORBIT/PICKOUT4/LS901ACS

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Table 4.2-3

Self-Ortho Check Of Tuned Analytical Model (306 DOF) Truncated To 42 DOF Test Set

PHI(T)*M*PHI

		1	2	3	4	5	6	7
	FREQ	1 173	1 235	2 806	2 968	7 416	12 403	14 124
	DAMP.	0	0	0	0	0	0.	0.
	FREQ.							
1	1 173	1.000	0.001	0 000	0.002	0 000	-0 000	-0.001
2	1.235	0 001	1.000	-0 003	-0 018	-0 001	-0 001	0 006
3	2 805	0 000	-0 003	1 000	0 005	0 001	0 001	-0 001
4	2 968	0 002	-0 018	0 005	1 000	-0.000	0 001	0.001
5	7.415	0 000	-0 001	0 001	-0 000	1 000	0 000	-0 013
6	12 408	-0 000	-0.001	0 001	0 001	0.000	1.000	0 000
7	14 124	-0 001	0 006	-0 001	0 001	-0 013	0 000	1 000

MODAL DOT PRODUCT MATRIX

		1	2	3	4	5	6	7
	FREQ.	1 173	1.235	2 806	2 968	7 416	12.403	14 124
	DAMP.	0.	0	0	0.	0	0	0.
	FREQ							
1	1 173	1.000	0 035	0 092	0 090	0 004	-0 100	0 009
2	1.235	0.035	1 000	0 026	0 094	-0 097	0 004	0 136
3	2 806	0 092	0 026	1 000	0 013	-0 055	0 031	0 021
4	2.968	0 090	0 094	0 013	1 000	0 103	0 042	0 018
5	7 416	0 004	-0 097	-0 055	0 103	1 000	0 009	-0 092
6	12 403	-0 100	-0 004	0 031	0 042	0 009	1 000	0 010
7	14.124	0.009	0 136	0 021	0 018	-0 092	0 010	1 000

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Table 4.2-4 Re-Tuned TDRSS Boom Mode Identification

Mode Number	Frequency	Description
1	1.173	1st X-Bending
2	1.235	1st Y-Bending
3	2.806	Elevation Drive
4	2.968	Azimuth Drive
5	7.416	GDA Bending
6	12.408	2nd X-Bending
7	14.124	2nd Y-Bending

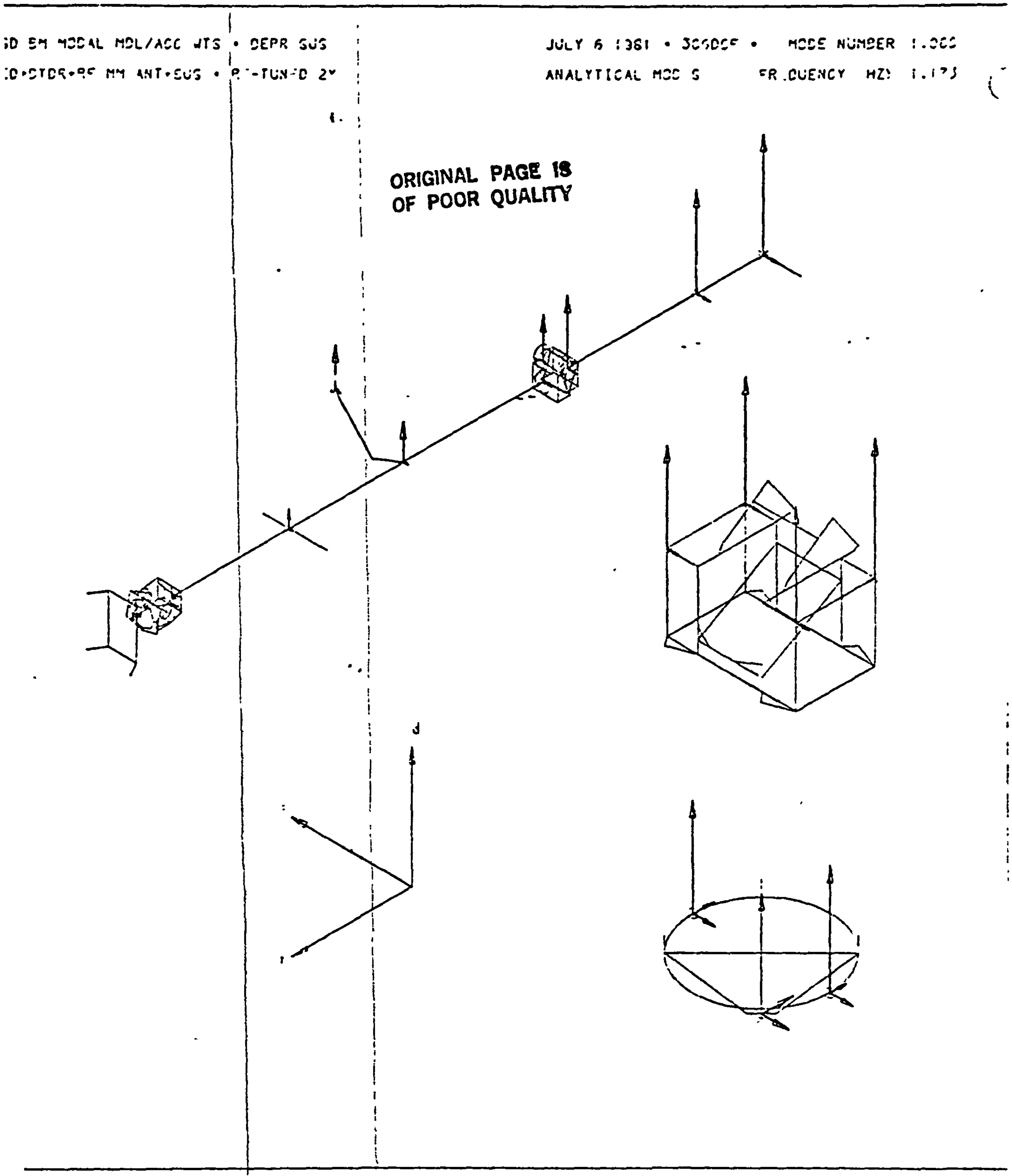
3D EM MODAL MDL/ACC WTS • DEPR SUS
ID+STOR+RF MM ANT+SUS • RT-TUNED 2Y
JULY 6 1981 • 306DOF • MODE NUMBER 1.000
ANALYTICAL MODES FREQUENCY (HZ) 1.173

Figure 4.2-1

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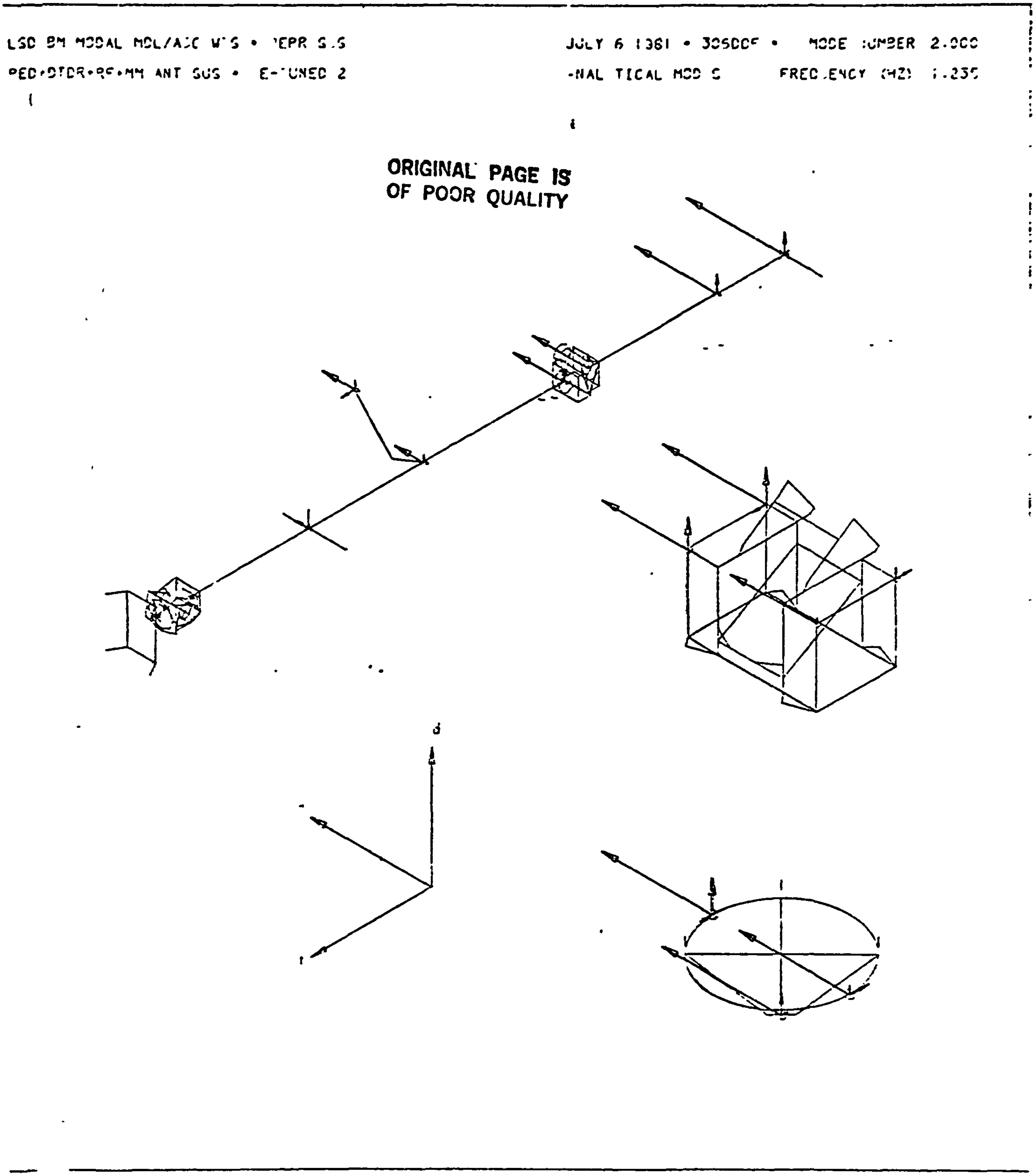

Figure 4.2-2

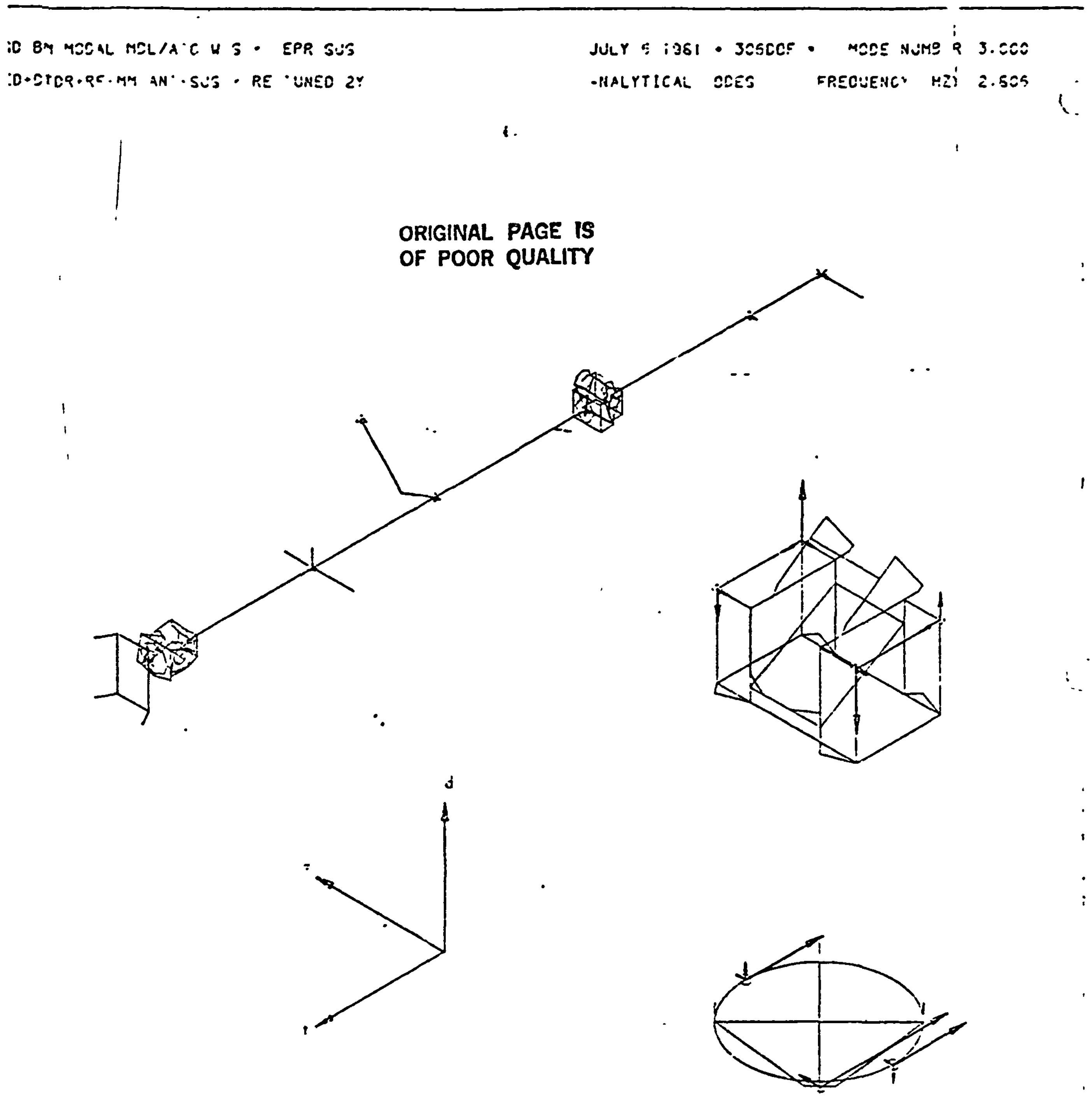
3D BM MODAL MDL/A/C W/S • EPR SUS
3D+STOR+RF+MM ANT+SUS • RETUNED 2Y
JULY 9 1981 • 306DOF • MODE NUMBER 3.000
ANALYTICAL MODES FREQUENCY (HZ) 2.606

Figure 4.2-3

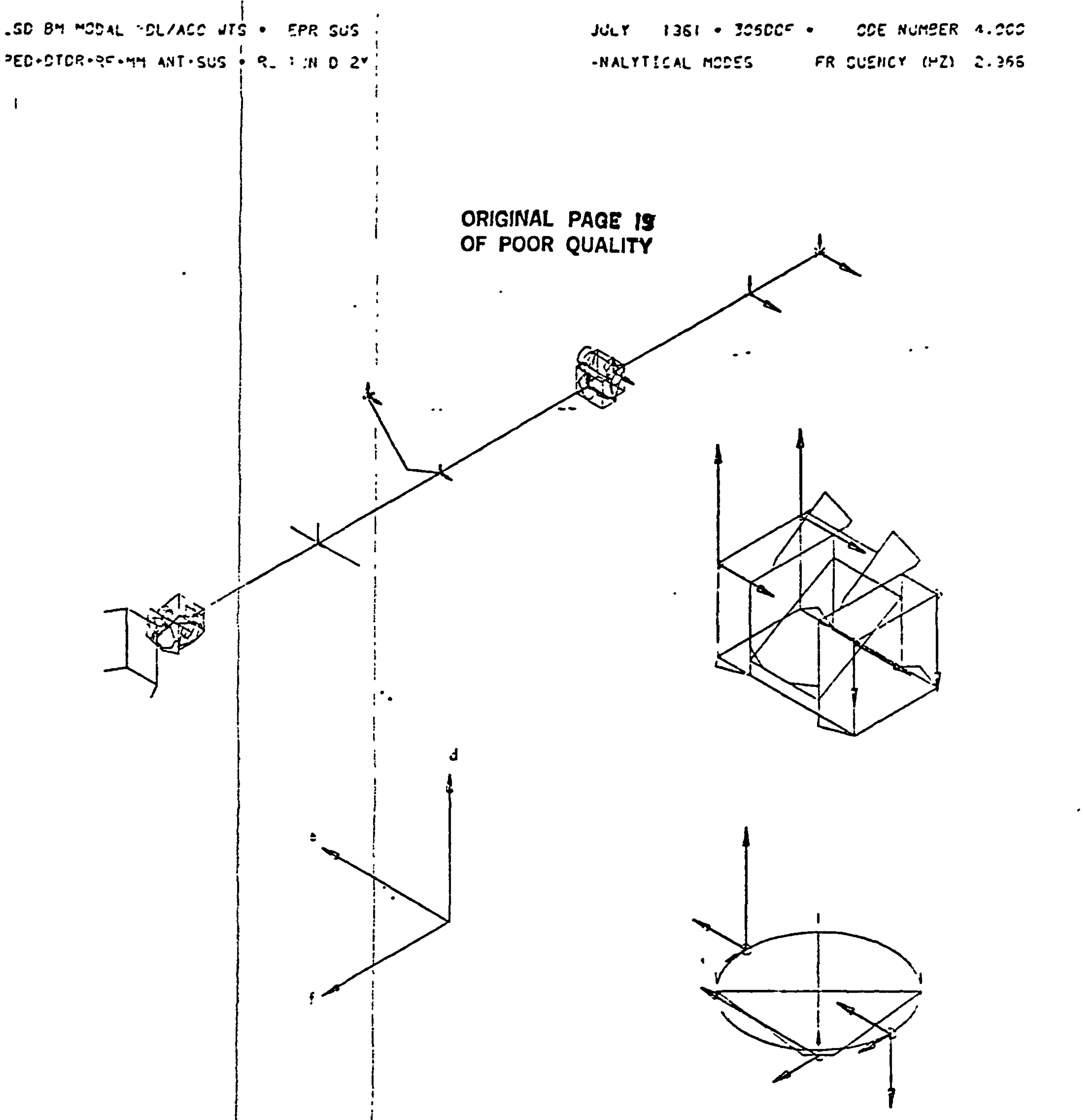

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Figure 4.2-4

LSD M ODAL L/ACC 4 S • DEPR SUS JULY 5 1981 • 305DOF - ODE NUMBER 3.000

PED-STOR-RF MM ANT+S-S • RE TUNED 2X ANALYTICAL MODES FREQUENCY (HZ) .415

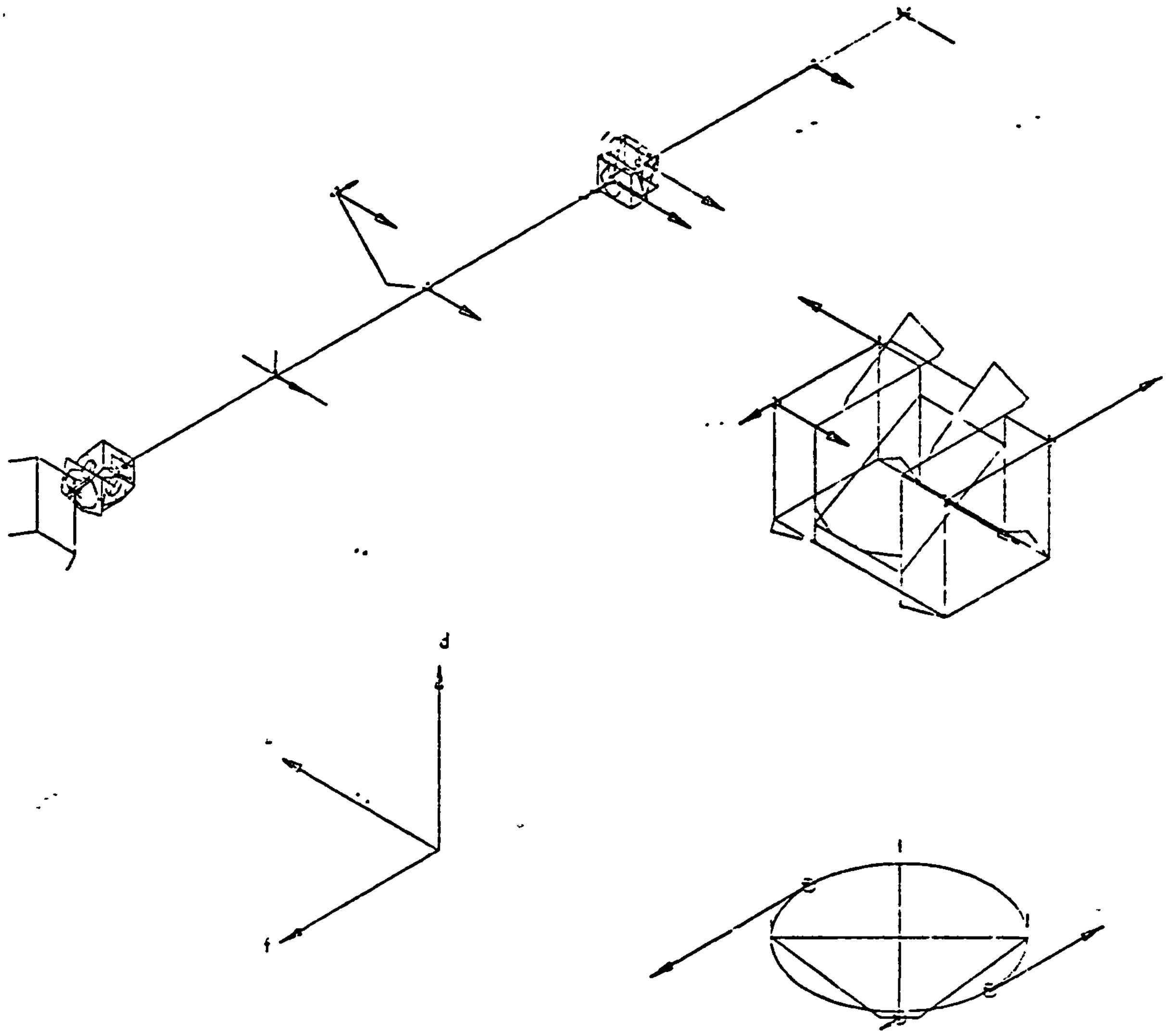

Figure 4.2-5

) BM MODAL MDL/ADC WTS • EPR SUS
)•DTDR•RF•MM ANT•SUS • PE TUNED 2Y

JULY 6 1981 • 30SDOF • MODE NUMBER 6.000
ANALYTICAL MODES FREQUENCY (HZ) 12.405

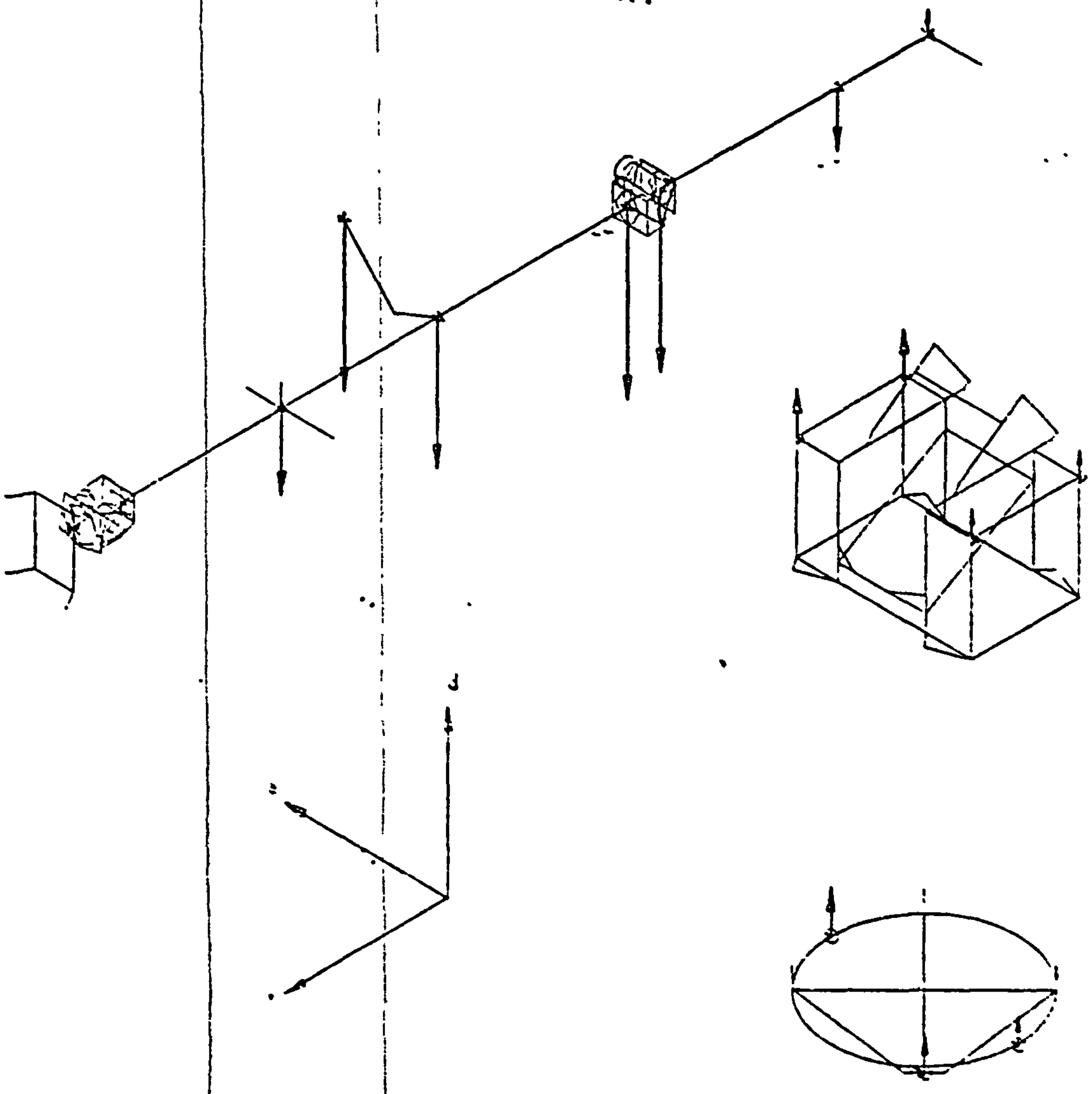

Figure 4.2-6

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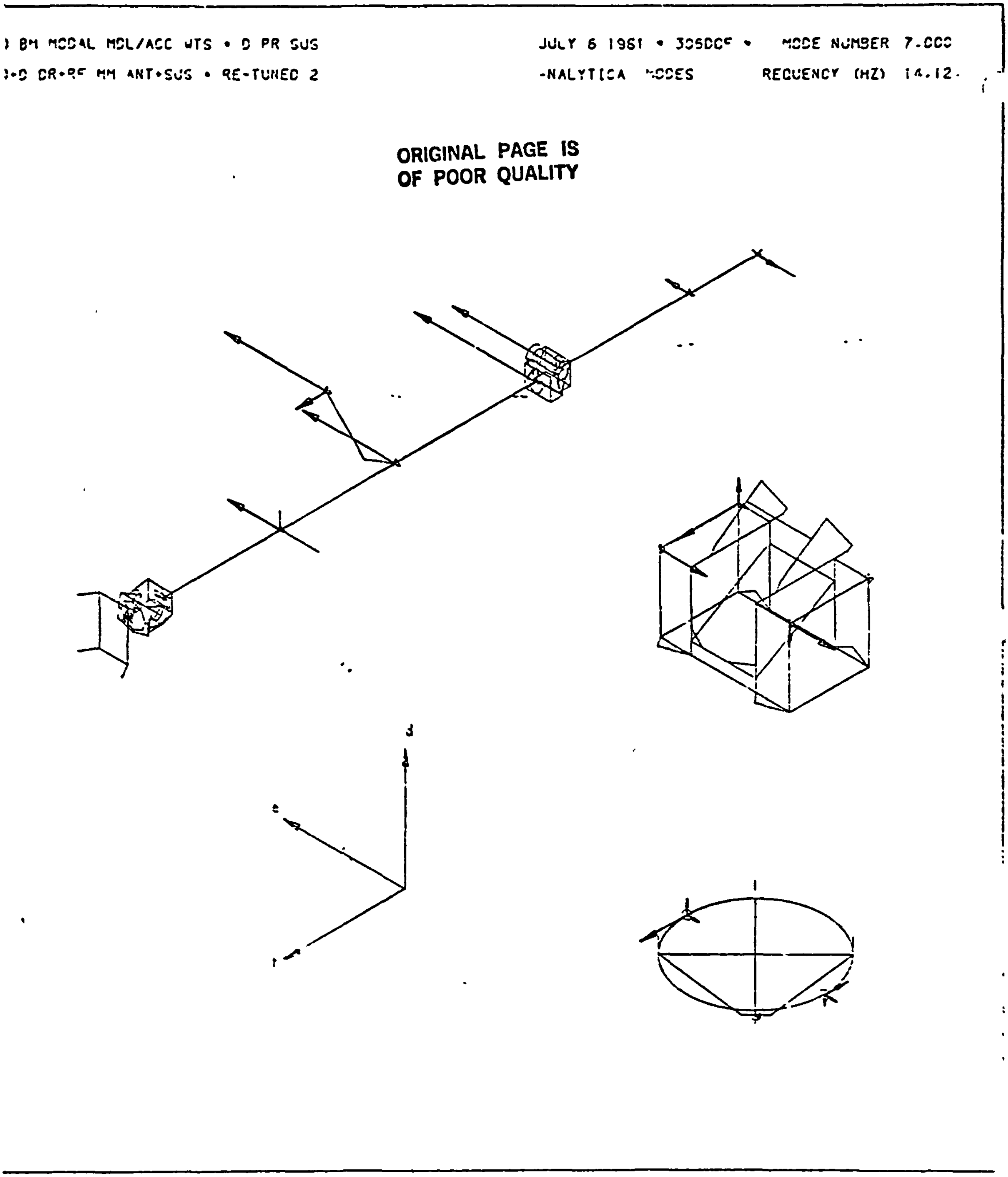

Figure 4.2-7

Table 4.2-5

Landsat-D Deployed TDRSS Boom Cross Orthogonality Between Measured Modes And Tuned Analytical Model

PHI(T)*M*PHI

		1 X1.20H	2 Y1 23H	3 SPS2 7	4 Y3 01H	5 Y6 93H	6 X11 9H	7 Y14 5H
FREQ		1 200	1.230	2 720	3 010	6 930	11.900	14.470
DAMP.		0 094	0 033	0.090	0 033	0 011	0 071	0.018
	FREQ.							
1	1.173	0 933	-0 178	-0 053	-0 007	-0.019	-0 035	-0 089
2	1.235	0.096	0.985	0 018	-0 025	0 106	-0.042	-0 035
3	2 806	-0 109	-0 009	0 955	-0 176	0 005	0 098	-0 018
4	2 969	0 018	-0 022	-0 247	-0 997	0 001	-0 025	0 025
5	7 416	-0.035	0 004	-0 005	-0 010	-0 992	-0 000	0 067
6	12 408	-0 015	-0 006	0 012	0 006	-0 013	-0 982	-0 004
7	13 124	0 053	0 050	0 014	-0 010	-0 110	0 003	0 979

MODAL DOT PRODUCT MATRIX

		1 X1.20H	2 Y1 23H	3 SPS2 7	4 Y3 01H	5 Y6 93H	6 X11.9H	7 Y14.5H
FREQ		1 200	1 230	2 720	3 010	6 930	11 900	14 470
DAMP		0 084	0 033	0 090	0 033	0 0.1	0 071	0.018
	FREQ.							
1	1 173	0 934	-0.151	0 019	-0.106	-0 013	0 037	-0 052
2	1 235	0 136	0 990	0 028	-0 133	0 175	-0 034	0 083
3	2 806	-0 079	-0 101	0 953	-0 176	0 073	0.048	0 016
4	2 949	0 110	0 079	-0 154	-0.355	-0 101	-0 035	0 050
5	7 416	-0 026	-0 031	-0 020	-0 095	-0 979	-0 025	0 018
6	12 409	-0 113	0 004	0 031	-0 041	-0 026	-0 989	-0 003
7	14 124	0.031	0 173	0 019	-0 038	-0 030	-0 007	0 964

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Table 4.3-1 Representative Nodes in Data Transmittal To ACS

Substructure Node Number	Description	Nodal* Degrees-of-Freedom
9000	PM1 Propulsion Tank	6
1572	C/B Side of DS/A Shaft	6
1669	TM C.G.	6
1664	MSS C.G.	6
2076	DS/A Side of DS/A Shaft	6
2460	Sun Sensor (-X)	6
2461	Sun Sensor (+X)	6
20194	Ku/S-Band +X, +Y Mounting Foot	6
20198	Azimuth Drive Attachment To Elevation Drive	6
	Total DOF:	54

*Structural transfer coefficient data for rotational DOFS only are supplied to ACS engineering.

```
RUN NO. LSD900                                      DATE 072081
                                                RUN BY T.E.POLLAK

        LSD PHASE 3 ORBITAL JITTER MODEL LSD900 • ALL TUNED • 819 DDOF'S
        TRANSFER COEFFICIENTS • 9000-1572-1664-1669-2076-2460-2461-20194-20198
```

TABLE 4-3-2 STRUCTURAL TRANSFER FUNCTION COEFFICIENT VALUES FOR ORBITAL MODEL LSD900.

DAMPING = 0.001

```
 MODES**   FREQ     DAMPING      BJ            CJ
   J       (HZ)     C/CRIT
   1      0 0053   0 0010   6.70674E-05   1.12451E-03
   2      0 0169   0 0010   2 12761E-04   1.13168E-02
   3      0 0177   0.0010   2.21853E-04   1.23047E-02
   4      0 0256   0 0010   3 21880E-04   2 59018E-02
   5      0 0304   0.0010   3.82176E-04   3.65146E-02
   6      0 0504   0 0010   6.32912E-04   1.00145E-01
   7      0.4279   0.0010   5 37752E-03   7.22944E 00
   8      0.7627   0 0010   9 58475E-03   2.29669E 01
   9      1 2091   0 0010   1.51935E-02   5.77106E 01
  10      1.3212   0.0010   1 66022E-02   6 89081E 01
  11      1.6147   0 0010   2 02908E-02   1 02929E 02
  12      2.1454   0.0010   2.69595E-02   1.81703E 02
  13      2.8692   0 0010   3.60558E-02   3.25006E 02
  14      3.0802   0.0010   3 87072E-02   3.74562E 02
  15      3.2717   0.0010   4.11139E-02   4.22588E 02
  16      4.1520   0.0010   5.21763E-02   6.80592E 02
  17      6 4704   0.0010   8.13101E-02   1.65283E 03
  18      6.9147   0 0010   8 68925E-02   1.88758E 03
  19      7.3855   0.0010   9 28093E-02   2.15339E 03
  20     10.8891   0 0010   1.36837E-01   4 68107E 03
  21     11 3794   0 0010   1.42998E-01   5 11211E 03
  22     12 6360   0 0010   1 58789E-01   6 30351E 03
  23     12.7815   0 0010   1 60617E-01   6.44948E 03
  24     14 0760   0.0010   1.76884E-01   7.82202E 03
  25     14.1420   0 0010   1.77714E-01   7.89556E 03
  26     14.9920   0 0010   1.88395E-01   8 87319E 03
  27     16.7710   0 0010   2.10751E-01   1 11040E 04
  28     18 1626   0 0010   2 28238E-01   1 30232E 04
  29     19.4022   0 0010   2.43815E-01   1.48615E 04
  30     20.0658   0 0010   2 52155E-01   1 58956E 04
  31     21.1241   0 0010   2 65454E-01   1.76165E 04
  32     23.3963   0 0010   2 94008E-01   2.16101E 04
  33     23.5055   0.0010   2.95380E-01   2.18123E 04
  34     24.2761   0 0010   3 05064E-01   2 32660E 04
  35     25.0166   0 0010   3.14369E-01   2.47070E 04
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**MODES 1—6 ARE RIGID BODY MODES

ORIGINAL PAGE IS OF POOR QUALITY

RUN NO LSD900

DATE 072081
RUN BY T.E.POLLAK

LSD PHASE 3 ORBITAL JITTER MODEL LSD900 • ALL TUNED • 819 DDOF'S
TRANSFER COEFFICIENTS • 9000-1572-1664-1669-2076-2460-2461-20194-20198

	MMS	MMS	MMS	% Side Of DS/A Shaft				MSS C.G.	
*	#9000	#9000	#9000	#1572	#1572	#1572	#1664	#1664	#1664
MODE	THETA X	THETA Y	THETA Z	THETA X	THETA Y	THETA Z	THETA X	THETA Y	THETA Z
1	3.71443E-05	-2.88435E-03	-4.06397E-03	3.71608E-05	-2.88425E-03	-4.06388E-03	3.71455E-05	-2.88435E-03	-4.06397E-03
2	3.65704E-03	2.59987E-03	-2.31467E-03	3.65605E-03	2.59996E-03	-2.31432E-03	3.65698E-03	2.59986E-03	-2.31466E-03
3	-1.50608E-03	1.98927E-03	-2.49725E-03	-1.50646E-03	1.98881E-03	-2.49800E-03	-1.50612E-03	1.98928E-03	-2.49725E-03
4	-4.83677E-04	1.95114E-05	-6.1387[illegible]E-04	-4.83810E-04	1.90095E-05	-6.14553E-04	-4.83666E-04	1.95176E-05	-6.13866E-04
5	-3.765[illegible]8E-03	2.44198E-03	-2.09883E-04	-3.76432E-03	2.44123E-03	-2.10406E-04	-3.76580E-03	2.44195E-03	-2.09909E-04
6	1.62784E-03	-5.54310E-05	-1.24704E-03	1.62225E-03	-5.27613E-05	-1.24316E-03	1.62756E-03	-5.54878E-05	-1.24697E-03
7	3.15886E-03	4.26277E-04	-7.81014E-04	2.09413E-03	1.83810E-04	-9.32825E-04	3.15477E-03	4.24845E-04	-7.82447E-04
8	9.14252E-04	-4.28835E-04	-2.70547E-03	8.19443E-04	6.32665E-03	5.03922E-05	9.12500E-04	-4.20836E-04	-2.69211E-03
9	2.78334E-04	-3.50092E-03	-1.08837E-03	-1.63876E-04	-5.45791E-03	1.86483E-03	2.90359E-04	[illegible]29E-03	-1.07824E-03
10	-8.67439E-04	-1.76466E-03	2.23711E-03	-1.10463E-03	4.41737E-03	-4.52032E-03	-8.46673E-04	-[illegible]2114E-03	2.20433E-03
11	3.45007E-03	-1.20493E-03	2.64361E-04	7.59459E-03	-3.52475E-04	-2.16435E-04	3.24453E-03	-1.16981E-03	2.99145E-04
12	-9.01038E-03	-1.68986E-04	7.66708E-05	-4.43379E-03	1.31010E-05	2.50152E-05	-8.27815E-03	-1.80802E-04	-2.12326E-05
13	2.28062E-04	-1.79046E-05	4.34427E-04	2.88832E-04	-5.77789E-04	3.20016E-04	1.73420E-04	-1.78262E-05	-[illegible].13968E-04
14	-1.14018E-05	-2.18919E-04	5.23542E-04	7.40843E-05	1.66274E-02	-5.36943E-03	-2.57978E-05	-1.98943E-04	4.91221E-04
15	2.19660E-04	-6.93614E-04	-3.27037E-05	7.07785E-05	4.54810E-04	-4.01003E-04	1.92888E-04	-6.01880E-04	-2.18633E-05
16	-2.72118E-03	-4.89796E-04	-4.43497E-04	1.13471E-02	1.08427E-03	-4.46405E-04	-2.07813E-03	-4.63580E-04	-4.86810E-04
17	1.74066E-03	-1.33684E-04	2.06058E-04	2.52412E-03	8.41951E-05	9.41071E-05	5.07561E-04	-9.70976E-05	3.78999E-04
18	1.68245E-03	2.68456E-04	4.79990E-04	-1.55801E-02	-2.91209E-04	4.94619E-04	6.54449E-04	2.42052E-04	5.32337E-04
19	4.37286E-05	6.32152E-05	-5.19373E-05	-5.55651E-04	-1.76503E-02	-3.65071E-04	3.20046E-05	4.40534E-05	-3.02675E-05
20	6.54092E-04	1.52617E-04	1.85271E-04	-1.37470E-02	3.00913E-03	1.20880E-03	-2.43635E-04	1.20845E-04	2.16009E-04
21	4.07187E-05	5.87437E-06	5.89657E-06	-7.25256E-04	2.10254E-02	4.23249E-03	-6.40879E-05	1.61075E-05	6.12073E-06
22	-5.22594E-05	-2.15620E-04	-2.64273E-05	-2.96932E-04	3.85671E-04	1.07689E-04	-2.72264E-05	3.25198E-04	5.43579E-05
23	2.01924E-05	-2.43016E-05	1.08046E-04	-3.98223E-04	-1.10847E-03	-2.55462E-04	9.64327E-05	-1.23552E-05	5.15194E-05
24	1.53099E-03	-3.21801E-04	-1.17112E-04	-1.80669E-02	1.79442E-02	7.13059E-03	-3.00856E-03	-1.59358E-04	5.68695E-04
25	-9.73736E-04	1.16190E-03	9.18029E-05	-8.35132E-03	1.21284E-02	4.06861E-03	2.64263E-03	6.80393E-04	-5.60974E-04
26	-7.17726E-04	-3.01634E-04	-2.08446E-05	2.02891E-02	1.20977E-02	2.46385E-03	1.14175E-03	-1.47450E-04	-1.85820E-04
27	2.22122E-03	1.61331E-03	-5.79623E-04	-4.71933E-02	-2.06411E-02	-7.44890E-04	-5.25401E-03	5.35568E-04	6.86435E-04
28	-2.17249E-03	-7.16312E-03	3.81918E-04	-1.44909E-02	-5.28088E-03	6.71631E-04	4.91304E-06	-3.09936E-04	4.58220E-05
29	-6.20187E-04	3.84300E-04	6.34430E-04	7.73178E-03	2.28534E-03	-1.27033E-03	4.15434E-03	-2.26127E-04	-7.66456E-04
30	2.75034E-03	-9.85035E-04	-3.89155E-03	1.24174E-02	4.51586E-03	4.16494E-03	-2.21004E-02	1.22990E-03	4.72680E-03
31	1.60806E-03	-3.64448E-04	1.65135E-04	-4.09750E-02	3.09612E-02	-1.78132E-02	-7.43154E-03	-1.01947E-04	1.68900E-04
32	1.67525E-04	1.45640E-03	-1.03999E-03	-8.98719E-04	-2.92126E-04	-4.99772E-04	-3.61050E-03	-9.84369E-04	-1.22873E-03
33	4.25423E-05	3.56392E-04	-2.41027E-04	7.14161E-03	-4.06695E-03	5.05944E-03	-7.56290E-04	5.96391E-05	2.59599E-04
34	-2.13136E-03	1.30100E-04	-6.74714E-04	3.11560E-02	2.3[illegible]868E-02	-2.71625E-02	1.97173E-03	-2.99214E-04	-3.78849E-04
35	5.49178E-03	-3.39855E-03	-7.25376E-06	6.33439E-03	-9.09982E-04	-2.72686E-03	-4.47891E-03	-5.14870E-03	-8.52928E-04

Table 4.3-2 (Continued)

* Modal Dimensions Are In The Inch-Pound-Second System

RUN NO. LSD900

DATE 072081
RUN BY T.E.POLLAK

LSD PHASE 3 ORBITAL JITTER MODEL LSD900 • ALL TUNED • 819 DDOF'S
TRANSFER COEFFICIENTS • 9000-1572-1664-1669-2076-2460-2461-20194-20198

	TM C.G.			DS/A SIDE OF DS/A SHAFT			SUN SENSOR (-X)		
	* #1669	#1669	#1669	#2076	#2076	#2076	#2460	#2460	#2460
MODE	THETA X	THETA Y	THETA Z	THETA X	THETA Y	THETA Z	THETA X	THETA Y	THETA Z
1	3.71440E-05	-2.88435E-03	-4.06397E-03	3.71675E-05	2.88402E-03	-4.06384E-03	3.72933E-05	-2.88386E-03	-4.06382E-03
2	3.65704E-03	2.59987E-03	-2.31467E-03	3.65562E-03	2.60035E-03	-2.31417E-03	3.63808E-03	2.60031E-03	-2.31389E-03
3	-1.50608E-03	1.98927E-03	-2.49725E-03	-1.50662E-03	1.98770E-03	-2.49833E-03	-1.51203E-03	1.98694E-03	-2.49861E-03
4	-4.83675E-04	1.95151E-05	-6.13870E-04	-4.83872E-04	1.77898E-05	-6.14856E-04	-4.89131E-04	1.68142E-05	-6.15058E-04
5	-3.76598E-03	2.44198E-03	-2.09879E-04	-3.76363E-03	2.43924E-03	-2.10623E-04	-3.73159E-03	2.43779E-03	-2.10694E-04
6	1.62781E-03	-5.54598E-05	-1.24703E-03	1.61981E-03	-4.52569E-05	-1.24148E-03	1.51847E-03	-4.07366E-05	-1.23979E-03
7	3.15774E-03	4.26339E-04	-7.81371E-04	1.60892E-03	-2.26906E-04	-1.00066E-03	-2.33077E-02	-7.28502E-04	-9.29262E-04
8	9.12050E-04	-4.27673E-04	-2.70549E-03	7.45303E-04	2.28526E-02	1.27888E-03	-2.83632E-03	3.63888E-02	1.57854E-04
9	2.84630E-04	-3.48853E-03	-1.08959E-03	-3.33986E-04	-1.03840E-02	3.16538E-03	6.33782E-03	-1.76890E-02	6.79274E-03
10	-8.55193E-04	-1.75906E-03	2.23571E-03	-1.24315E-03	1.94502E-02	-7.50693E-03	2.94852E-03	4.27158E-02	-1.75633E-02
11	3.43518E-03	-1.20172E-03	2.59037E-04	9.47030E-03	9.38500E-04	-4.41346E-04	-4.50305E-02	2.81301E-03	-1.29126E-03
12	-2.92835E-03	-1.68182E-04	9.57139E-05	-2.65116E-03	-9.13094E-06	5.09059E-05	3.50131E-02	-1.07411E-03	3.53363E-04
13	2.28030E-04	-1.94019E-05	4.32428E-04	3.31493E-04	-1.96064E-03	2.66704E-04	3.42823E-04	1.93284E-03	-1.28408E-03
14	-2.98364E-06	-2.15608E-04	5.20653E-04	4.17029E-05	5.77526E-02	-7.67624E-03	2.12792E-02	-4.21996E-02	2.81982E-02
15	2.25496E-04	-6.77660E-04	-3.57263E-05	2.95010E-05	3.01990E-03	-5.60327E-04	1.78636E-04	-2.14990E-03	1.32528E-03
16	-2.63246E-03	-4.82073E-04	-4.34158E-04	1.70761E-02	3.04609E-03	-3.47504E-04	5.40893E-02	4.21072E-03	-8.69154E-04
17	1.60389E-03	-1.36844E-04	1.85616E-04	3.26104E-03	3.52242E-05	-2.43688E-05	3.29571E-03	1.70891E-04	-7.15827E-05
18	1.53937E-03	2.53365E-04	4.75720E-04	-2.23161E-02	4.06163E-04	3.42734E-04	1.40633E-02	-2.23550E-03	5.12475E-04
19	3.09004E-05	5.40866E-05	-4.66762E-05	-7.65031E-04	-6.08362E-02	-1.42322E-03	9.11065E-02	-1.13629E-02	7.86397E-04
20	5.18807E-04	1.37427E-04	1.83576E-04	-1.90808E-02	1.15256E-02	1.63760E-03	6.45994E-03	6.66549E-03	-1.19761E-03
21	3.69193E-05	1.70329E-05	-4.88921E-06	-9.23320E-04	7.23935E-02	7.36704E-03	9.31560E-02	3.86863E-02	-1.75065E-02
22	3.49134E-05	-6.40331E-05	-6.15557E-05	-2.66358E-04	3.71594E-04	1.50146E-03	7.30960E-05	2.02848E-03	-9.54725E-04
23	2.90329E-05	-2.94878E-05	1.26868E-04	-8.23040E-04	-3.54977E-03	-4.82925E-04	2.40983E-02	-2.53473E-01	9.99936E-02
24	9.50961E-04	-2.82520E-04	-2.35696E-04	-2.32259E-02	6.24851E-02	1.01815E-02	-5.52933E-03	-2.50323E-02	5.58789E-03
25	-6.34156E-04	1.05997E-03	1.79069E-04	-1.24193E-02	4.20967E-02	6.42615E-03	-4.11926E-03	-1.30088E-02	2.65309E-03
26	-4.01527E-04	-2.59788E-04	1.19399E-05	2.74032E-02	4.03703E-02	4.61094E-03	-2.03807E-02	-4.94149E-02	2.05743E-02
27	8.20742E-04	1.44444E-03	-8.81653E-04	-6.09539E-02	-7.08109E-02	-4.65225E-03	-4.95881E-03	8.66659E-03	-3.19150E-03
28	-2.31322E-04	-5.87525E-03	5.14996E-04	-2.04158E-02	-1.40593E-02	-3.36992E-04	-2.54018E-03	6.67817E-03	-3.25783E-03
29	-1.66671E-05	1.22582E-04	9.78413E-04	8.36509E-03	9.28657E-03	-4.14286E-04	-6.93505E-02	4.29303E-02	-1.87768E-02
30	-5.80142E-04	5.25002E-04	-6.03295E-03	2.80170E-02	2.95837E-03	2.70354E-03	-1.42920E-02	-2.05429E-03	-6.67199E-04
31	5.63305E-04	-1.64461E-04	-1.21874E-04	-5.77836E-02	1.12431E-01	-9.95374E-03	3.31273E-03	8.15103E-03	5.55282E-03
32	4.24167E-04	-9.07099E-04	-2.81798E-03	6.35420E-04	1.11685E-04	-1.84924E-04	-1.93106E-02	-2.53839E-02	1.01409E-02
33	-1.09830E-05	-3.33557E-05	-5.29909E-04	9.28882E-03	-1.45963E-02	3.30144E-03	1.08137E-01	1.45387E-01	-6.01035E-02
34	-2.51708E-04	4.69646E-04	-1.09526E-03	4.81904E-02	7.54133E-02	-1.74726E-02	1.30661E-02	4.73848E-03	7.48239E-03
35	-2.03372E-04	-2.43853E-03	-3.33482E-03	1.18458F-02	5.10627E-03	-1.65123E-03	2.60184E-03	3.64147E-03	-7.19227E-04

Table 4.3-2 (Continued)

* MODAL DIMENSIONS ARE IN THE INCH-POUND-SECOND SYSTEM

RUN NO LSD900

DATE 072081
RUN BY T.E.POLLAK

LSD PHASE 3 ORBITAL JITTER MODEL LSD900 • ALL TUNED • 819 DDOF'S
TRANSFER COEFFICIENTS • 9000-1572-1664-1669-2076-2460-2461-20194-20198

	Sun Sensor (+X)			Ku/S-Band +X,+Y Attachment			Az Drive Attachment To El Drive		
	* #2461	#2461	#2461	#20194	#20194	#20194	#20198	#20198	#20198
MODE	THETA X	THETA Y	THETA Z	THETA X	THETA Y	THETA Z	THETA X	THETA Y	THETA Z
1	3 72952E-05	-2.88386E-03	-4 06382E-03	3.71963E-05	-2 88407E-03	-4 06398E-07	3.71887E-05	-2.88418E-03	-4 06398E-03
2	3 63799E-03	2 60063E-03	-2.31401E-03	3 65571E-03	2 59844E-03	-2 31433E-C3	3.65579E-03	2.59899E-03	-2 31433E-03
3	-1.51195E-03	1 98704E-03	-2.49866E-03	-1 50721E-03	1 99144E-03	-2.49754E-03	-1.50716E-03	1 99065E-03	-2.49755E-03
4	-4 89118E-04	1.68952E-05	-6 15090E-04	-4 82908E-04	2.08239E-05	-6 14123E-04	-4 82937E-04	2 03856E-05	-6 14124E-04
5	-3 73176E-03	2 43718E-03	-2.10456E-04	-3 76129E-03	2 43806E-03	-2.09714E-04	-3.76158E-03	2 43959E-03	-2.09672E-04
6	1 51831E-03	-3 89637E-05	-1.24048E-03	1 62563E-03	-5 95732E-05	-1 24593E-03	1.62574E-03	-5.83172E-05	-1.24595E-03
7	-2 33188E-02	-2 37028E-04	-1.11990E-03	3 94362E-03	6 55836E-04	-8.79449E-04	3 89581E-03	5.76569E-04	-8.76180E-04
8	-1 15681E-03	3 64686E-02	1.26850E-04	1 00863E-03	-1.18071E-03	-2 81497E-07	9 94345E-04	-8.59034E-04	-2 78807E-03
9	3.85578E-03	-1.78798E-02	6.86494E-03	9.80145E-04	1.97577E-02	-4.33353E-03	9.10095E-04	9 64464E-03	-4.42520E-03
10	1.01502E-02	4 24540E-02	-1.74655E-02	8 54236E-05	9.34777E-03	1 30090E-03	2.96830E-05	4 32447E-03	1.19073E-03
11	-4 39911E-02	5 10944E-03	-2 15003E-03	-8 33861E-03	4.48829E-03	8 05171E-04	-7.49038E-03	1.51321E-03	6.95387E-04
12	-3 48589E-02	1.41261E-03	-5 65708E-04	1.27150E-02	-5 65944E-04	-3 25536E-03	1 08866E-02	1.33333E-04	-2.99692F-03
13	2 06839E-03	1.79169E-03	-1 23222E-03	-1 38533E-03	-2.93673E-02	-9.84608E-02	-1.16376E-03	-1 85777E-03	-8.78376E-02
14	-2.43510E-02	-4 23188E-02	2 82526E-02	-5 55031E-04	5 54418E-03	-4 86782E-03	-4.30762E-04	3.43042E-04	-4.32696E-03
15	-2.34331E-03	-2.03736E-03	1.28498E-03	1.71250E-03	-1.18261E-01	2 69360E-02	6.18924E-04	-7 32324E-04	2.42518E-02
16	5.28288E-02	-3.91417E-03	2 05005E-03	4.52180E-03	-8 11859E-04	1.12043E-03	3.09932E-03	3 00809E-04	8 73936E-04
17	-4 67526E-03	-7 02959E-04	2.75605E-04	8 26483E-02	9.72067E-03	1.66871E-04	3.60508E-02	5.94777E-04	-9.48543E-04
18	2 45551E-02	4 84908E-03	-2.15207E-03	1 13249E-02	1.60380E-03	-1 83211E-04	4.34121E-03	-1.09946E-04	-2.38077E-04
19	-8 95282E-02	-1 05521E-02	4.85753E-04	-2 84420E-06	1 7056[illegible]-04	-3.35775E-05	2.69886E-05	-1.79240E-04	-6.96917E-06
20	-2 70022E-02	7 34744E-03	-5 60215E-03	4.30834E-04	2 26774E-04	-6 69198E-05	-3.07108E-05	-2 94038E-04	2.59096E-05
21	-8 59615E-02	5 61056E-02	-2.34965E-02	-3 38993E-05	-1 54853E-04	4.11635E-05	-2 05620E-05	3.18037E-04	-3.69123E-05
22	-6 47773E-05	-2 05645E-03	6 96661E-04	2.53034E-03	3 22251E-02	-9.31220E-03	1.03825E-03	-8.00501E-02	1.28625E-02
23	3 09562E-02	2.49014E-01	-9.78162E-02	5 44618E-04	2.70240E-04	-8.20748E-05	-3.93271E-04	-6.13274E-04	6.68540E-05
24	1.82533E-02	-3 58543E-02	1.11276E-02	-2.18055E-02	-7.73889E-04	3.46526E-04	2.39756E-02	2.64096E-04	2.00540E-03
25	1.01820E-02	-2.56121E-02	8.34933E-03	3 55791E-02	7 90581E-04	-4 38785E-04	-3.97055E-02	9.57440E-04	-3 56545E-03
26	-1.72112E-02	2 59665E-02	-1.35725E-02	-9.71730E-04	1 07733E-04	-2.18658E-05	1.27127E-03	-4.57204E-04	1 93549E-04
27	3.24301E-03	1.07488E-02	-4.34887E-03	1.04507E-03	-6.43315E-04	8 68836E-05	-3.70230E-03	1.10949E-03	-5.68348E-04
28	-8 34238E-04	-3 67622E-03	1 13491E-03	5.81945E-03	3.50990E-03	-4 05603E-04	4.52324E-03	-1.39106E-03	1.09531E-03
29	-7.07419E-02	-4 28795E-02	1.97579E-02	-1 02653E-03	-9 07458E-05	2 43786E-05	1 83763E-03	-1.96412E-04	1 30691E-04
30	-1.81057E-02	1.13511E-03	-1.43396E-03	3 77947E-03	-4.84040E-04	-5 03671E-05	-1.19999E-02	1.11252E-03	-9,76274E-04
31	5.19559E-03	-2 07279E-02	1.73022E-02	4.94098E-04	-1.35568E-06	-2.24890E-05	-2.01758E-03	-3.44353E-04	-4.15892E-05
32	-1 97109E-02	2.52692E-02	-1.01523E-02	4 36719E-04	3.28047E-04	-6 28666E-05	-7.71075E-04	-1.17254E-03	3.75551E-04
33	1 03410E-01	-1 43485E-01	5 55999E-02	-1 97307E-05	-1 52939E-04	2 01986E-06	-1 [illegible]346E-03	-7.95740E-05	-8.02187E-05
34	4 10423E-02	-1.59349E-02	1.52939E-02	1 26168E-04	3.02418E-04	-1 97859E-05	[illegible]495E-03	-1 29441E-05	2.36196E-04
35	5 24511E-03	-4.64200E-03	2.51270E-03	1 03728E-03	1.62854E-03	-[illegible] 06762E-04	[illegible]5182E-03	-1.71905E-03	1.91185E-03

Table 4.3-2 (Continued)

*Modal Dimensions Are In The Inch-Pound-Second System

RUN NO LSD900

DATE 072381
RUN BY T E.POLLAK

LSD PHASE 3 ORBITAL JITTER MODEL LSD900 • ALL TUNED • 819 DDOF'S
TRANSFER COEFFICIENTS • 9000-1572-1664-1669-2076-2460-2461-20194-20198

TABLE 4.3-3. STRUCTURAL TRANSFER FUNCTION COEFFICIENT VALUES FOR ORBITAL MODEL LSD900 DAMPING= 0.01

MODES J	FREQ (HZ)	DAMPING C/CRIT	BJ	CJ
1	0 0053	0.0100	6 70574E-04	1.12451E-03
2	0 0169	0 0100	2.12761E-03	1.13168E-02
3	0 0177	0 0100	2.21853E-03	1.23047E-02
4	0 0256	0 0100	3 21880E-03	2.59018E-02
5	0 0304	0 0100	3 82176E-03	3.65146E-02
6	0 0504	0 0100	6 32912E-03	1.00145E-01
7	0 4279	0 0100	5 37752E-02	7.22944E 00
8	0 7627	0 0100	9 58475E-02	2 29669E 01
9	1 2091	0.0100	1 51935E-01	5 77106E 01
10	1.3212	0 0100	1.66022E-01	6.89081E 01
11	1.6147	0.0100	2.02908E-01	1.02929E 02
12	2.1454	0 0100	2.69595E-01	1 81703E 02
13	2 8692	0 0100	3 60558E-01	3.25006E 02
14	3.0802	0 0100	3.87072E-01	3.74562E 02
15	3 2717	0.0100	4.11139E-01	4.22588E 02
16	4 1520	0 0100	5 21763E-01	6.80592E 02
17	6 4704	0 0100	8.13101E-01	1.65283E 03
18	6 9147	0 0100	8.68925E-01	1.88758E 03
19	7 3855	0.0100	9 28093E-01	2 15339E 03
20	10.8891	0.0100	1.36837E 00	4.68107E 03
21	11 9794	0 0100	1.42998E 00	5.11211E 03
22	12 6360	0 0100	1.59789E 00	6 30351E 03
23	12 7815	0 0100	1.60617E 00	6 44948E 03
24	14.0760	0 0100	1.76884E 00	7.82202E 03
25	14 1420	0 0100	1.77714E 00	7 89556E 03
26	14 9920	0 0100	1.88395E 00	8 87319E 03
27	16.7710	0.0100	2 10751E 00	1.11040E 04
28	18 1626	0 0100	2.28238E 00	1 30232E 04
29	19 4022	0 0100	2.43815E 00	1.48615E 04
30	20 0658	0 0100	2.52155E 00	1 58956E 04
31	21 1241	0 0100	2.65454E 00	1.76165E 04
32	23 3963	0 0100	2.94008E 00	2 16101E 04
33	23.5055	0 0100	2 95380E 00	2 18123E 04
34	24 2761	0.0100	3.05064E 00	2.32660E 04
35	25.0166	0.0100	3 14369E 00	2.47070E 04

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As refinements occur in the current orbital stack-up, except for parametric variations and study models, the data base files will be updated and applicable documentation released.

5.0 ORBITAL ANALYSIS

5.1 ORBITAL ANALYSIS APPROACH

Since TM image data correction through real time analysis of component orbital jitter will be accomplished by the ADS, the primary focal point of this analysis is still MSS induced jitter as a function of the MSS component itself or the TM. TM peak responses, however, were noted throughout the analysis and as shown in subsequent data summary tables, are well within the control range of the ADS.

In addition to generating baseline jitter values, worst case variations of the eigenvalue spectrum were generated and the corresponding MSS/TM responses computed. This approach sought to identify the effect of possible structural frequency deviations from the best estimate by modifying the modal spectrum so that the maximum resonant response would be excited. Modes near each forcing harmonic which differed in frequency by more than 15% were not considered in the analysis. Shifts were implemented for the first seven harmonics in the Fourier representation of the MSS experiment and the first nine harmonics of the TM. The shift value for a particular mode was applied only to that modal frequency. The bandwidths investigated are presented in Figure 5.1-1. For example, the 68.10 Hz MSS third harmonic has bandwidth limits of 59.217 Hz and 80.118 Hz as prescribed by the 15% tolerance premise. The modal spectrum for model LSD900 reveals 26 modes within this allowable 15% bandwidth. Each mode was then individually shifted to become coincident with the

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Figure 5.1-1 MSS/TM Bandwidth Considerations

Bandwidth = ±15%

Component = MSS

Harmonic	Frequency (Hz)	Lower Limit (Hz)	Upper Limit (Hz)	Force Coefficient
1	13.62	11.843	16.024	40.398
2	40.86	35.530	48.071	39.507
3	68.10	59.217	80.118	37.770
4	95.34	82.904	112.165	35.269
5	122.58	106.591	144.212	32.122
6	149.82	130.278	176.259	28.476
7	177.06	153.965	208.306	24.494

Bandwidth = ±15%

Component = TM

Harmonic	Frequency (Hz)	Lower Limit (Hz)	Upper Limit (Hz)	Force Coefficient
1	7.0	6.087	8.235	43.343
2	21.0	18.261	24.706	41.543
3	35.0	30.435	41.176	38.106
4	49.0	42.609	57.647	33.341
5	63.0	54.783	74.118	27.663
6	77.0	66.957	90.588	21.547
7	91.0	79.130	107.059	15.476
8	105.0	91.304	123.529	9.8845
9	119.0	103.478	140.00	5.12

68.10 Hz forcing function frequency. From a steady state response analysis on the altered modal spectrum, force coefficients for each forcing harmonic were obtained. The time-phased coefficients were then combined to produce a set of jitter values. The offensive mode(s) in that particular harmonic were identified by noting which responses exceeded the allotted jitter budget.

5.2 BASELINE ORBITAL MODEL - LSD900

The model presented herein incorporates all the revisions described in Sections 4.1 and 4.2. Table 5.2-1 describes the first twenty (20) elastic modes of the model with Figures 5.2-1 thru 5.2-20 presenting the corresponding modal plots. Table 5.2-2 tabularizes representative force/ response locations for the frequency response spectra graphs (C/C_{CRIT} = 0.001) presented herein, Figures 5.2-21 thru 5.2-32. For an assumed 1% damping (C/C_{CRIT} = 0.01), Table 5.2-3 tabularizes representative force/ response locations for the frequency response spectra graphs presented in Figures 5.2-33 thru 5.2-44. As depicted in Figures 5.2-27, 5.2-28 and 5.2-39, 5.2-40, resonant frequency placement precludes coincidence with the odd harmonic forcing stimulus of the MSS experiment. Worst case modal spectrum shifts, however, introduce jitter magnitudes in exceedance of MSS allowables. These established allowables are presented in Table 5.2-4. Tables 5.2-5 thru 5.2-11 present the results of TM and MSS single mode shift comparisons to MSS RMS allowables. Included are values for 15%-10%-5% bandwidth spreads about the forcing harmonic. If a particular data set is omitted then no worst cases appear in that

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Table 5.2-1 LS/D Final Tuned Orbital Model For Jitter - LSD900

Mode Number	Frequency (Hz)	Description
1-6	0.0	Rigid Body
7	0.428	1st Solar Array Bending
8	0.763	1st Solar Array Torsion
9	1.209	1st Boom X-Bending
10	1.321	2nd Solar Array Torsion
11	1.615	2nd Solar Array Bending + Boom Y
12	2.145	MMS ACS Module + S/A Bending
13	2.869	Elevation Drive
14	3.080	Solar Array 2nd Torsion
15	3.272	Azimuth Drive
16	4.152	Solar Array 3rd Bending
17	6.470	GDA Bending
18	6.915	Solar Array 4th Bending
19	7.386	Solar Array 3rd Torsion
20	10.889	Solar Array 3rd - 4th Panel Modes
21	11.379	Solar Array 4th Torsion
22	12.630	2nd Boom X-Bending
23	12.781	Solar Array Outboard Bending
24	14.076	Solar Array 5th Torsion + Inboard Local
25	14.142	2nd Boom Y-Bending
26	14.992	Solar Array 2nd-3rd Panel Bending

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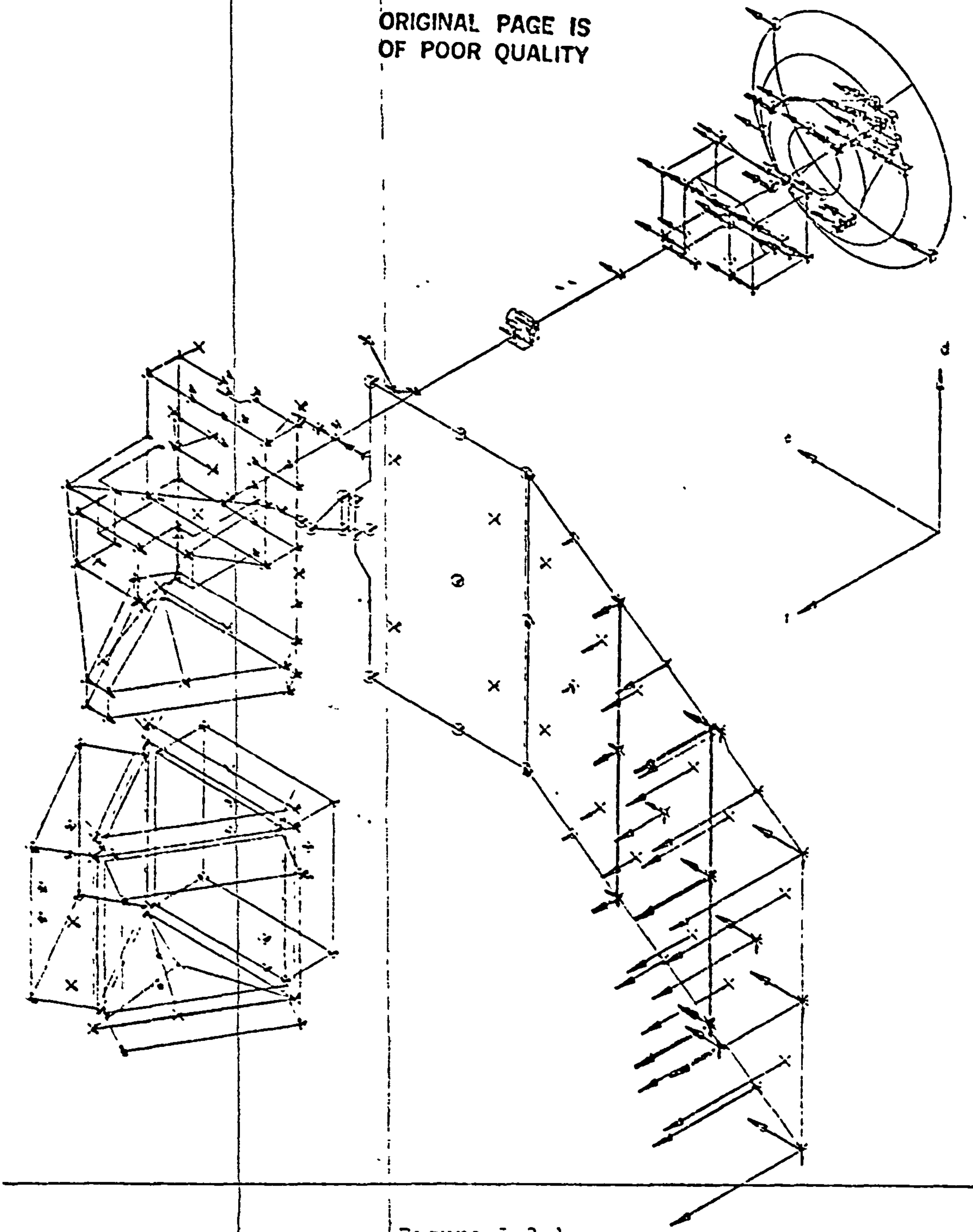

Figure 5.2-1

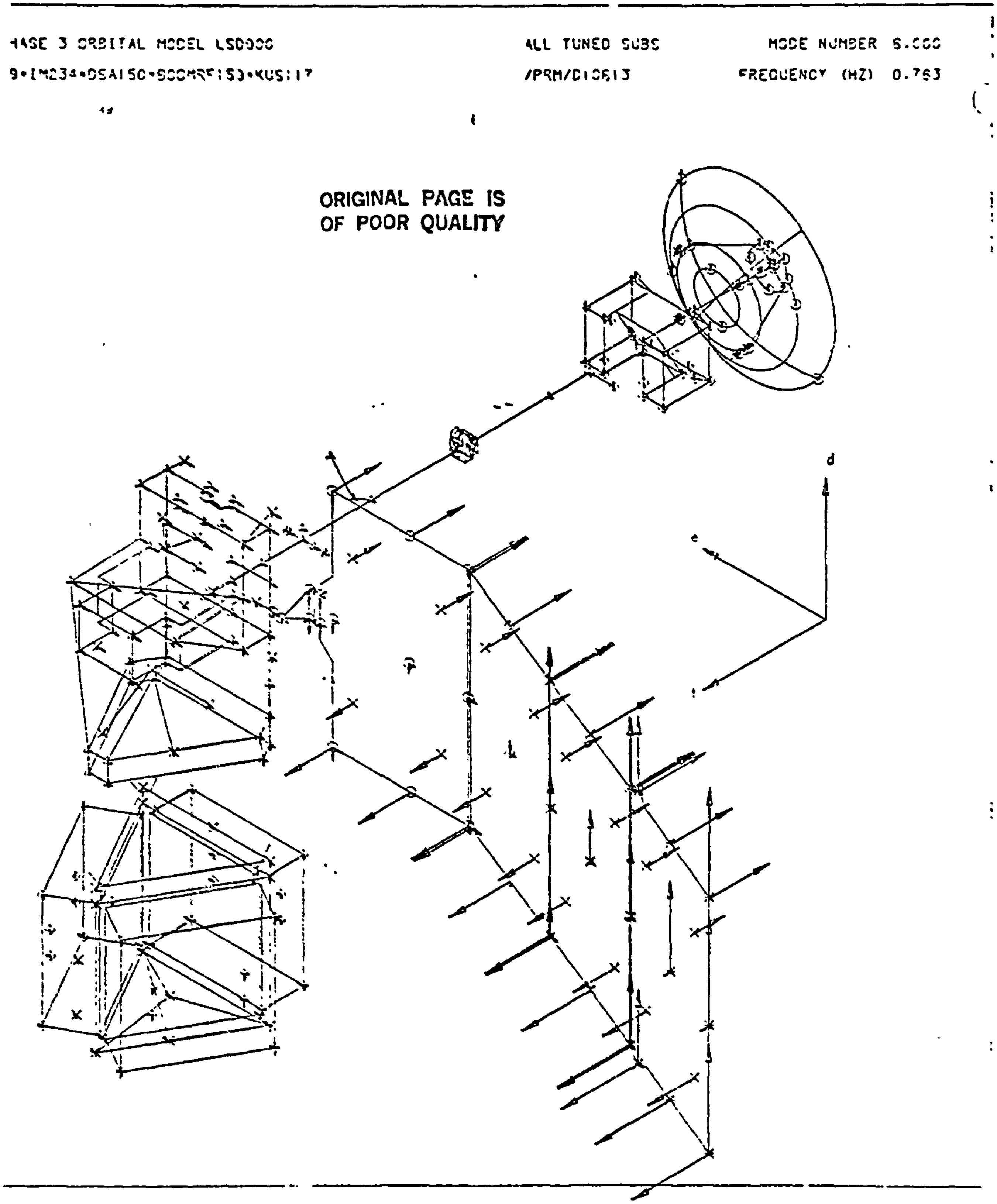

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Figure 5.2-2

PHASE 3 ORBITAL MODEL LSD900 ALL TUNED SUBS MODE NUMBER 9.000

T9•IM234•DSA150•BOOMRF150•KUS117 /PRM/010813 FREQUENCY (HZ) 1.203

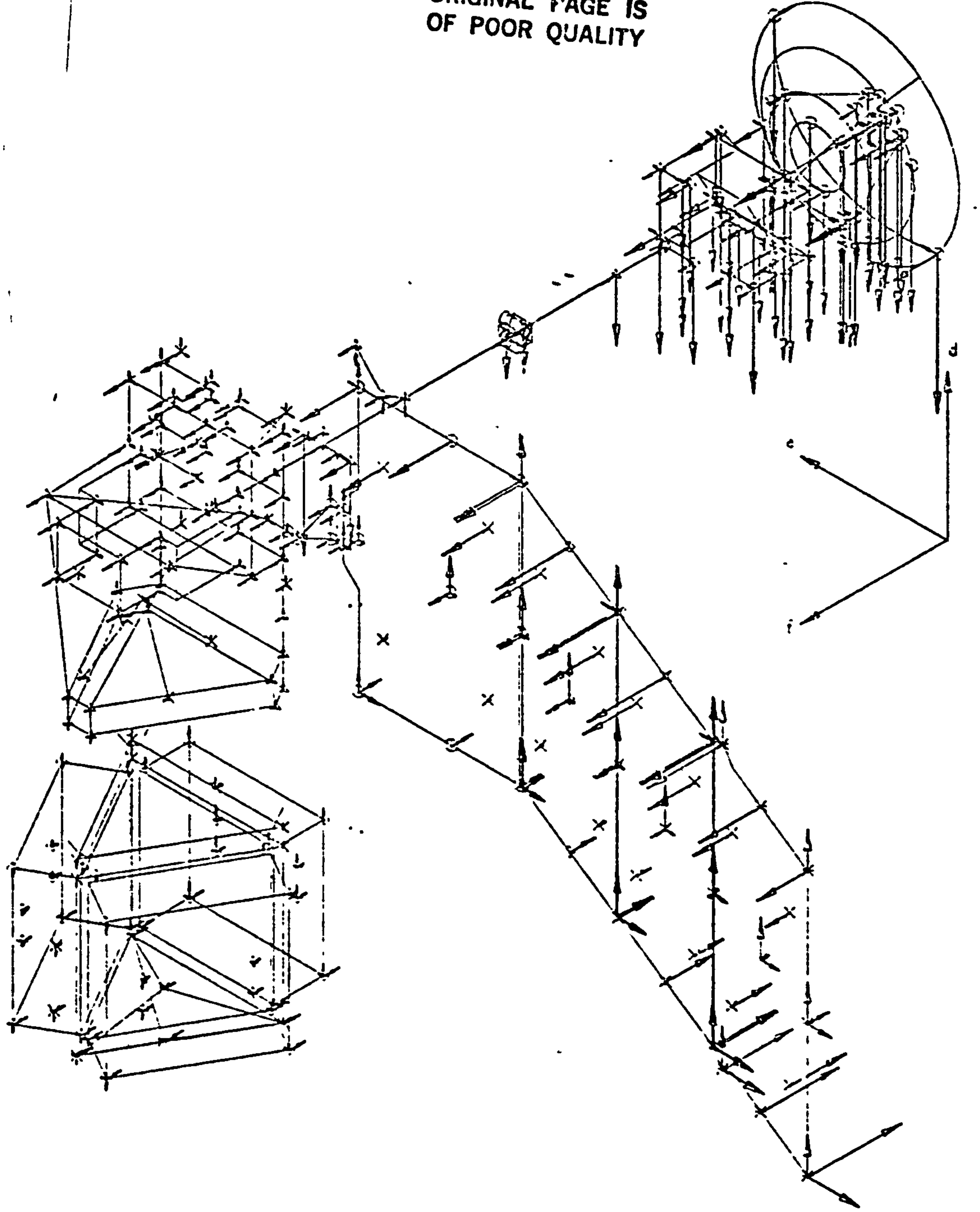

Figure 5.2-3

PHASE 3 ORBITAL MODEL LSD000 ALL TUNED SUBS MODE NUMBER 10.000

159•IM234•DSA150•SCOMRF159•KUS117 /PRM/010613 FREQUENCY (HZ) 1.321

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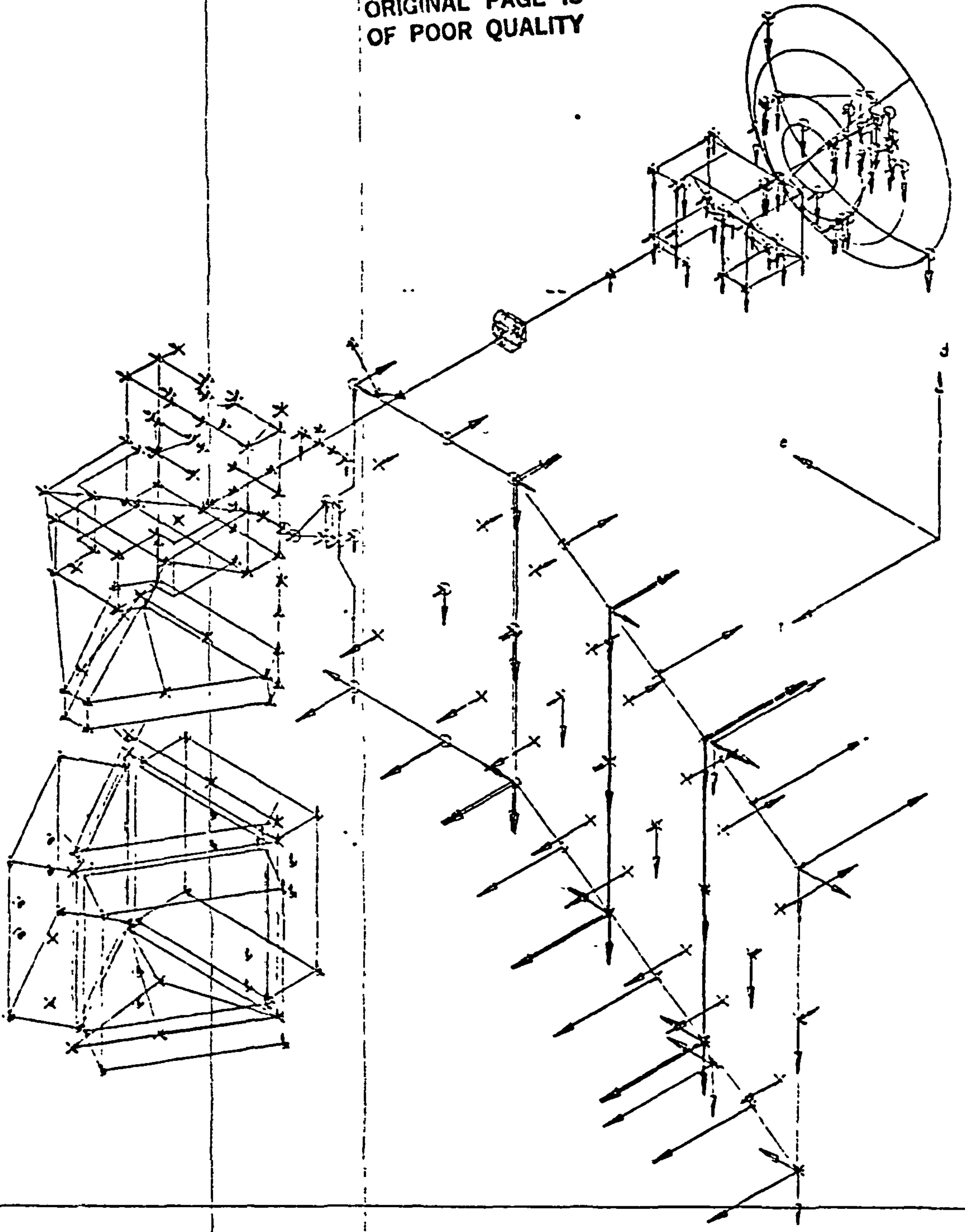

Figure 5.2-4

PHASE 3 ORBITAL MODEL LSD300 ALL TUNED SUBS MODE NUMBER 11.000

159•IM234•DSA150-B00MRF159•KUS117 /PRM/D10813 FREQUENCY (HZ) 1.515

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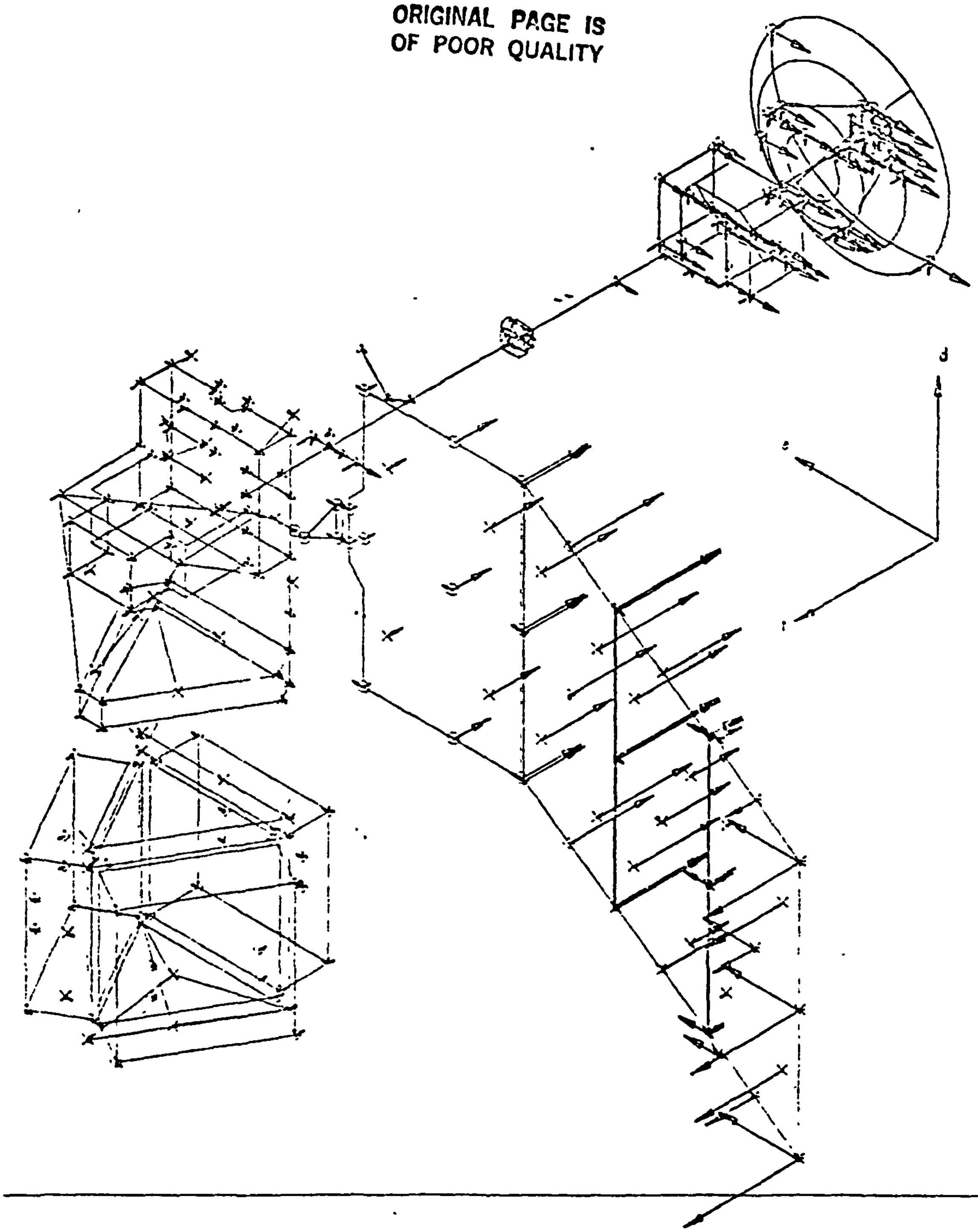

Figure 5.2-5

D PHASE 3 ORBITAL MODEL LSD300 ALL TUNED SUBS MODE NUMBER 12.000

S159•IM234•DSA150•500MRF159•KU3117 /PRM/010613 FREQUENCY (HZ) 2.145

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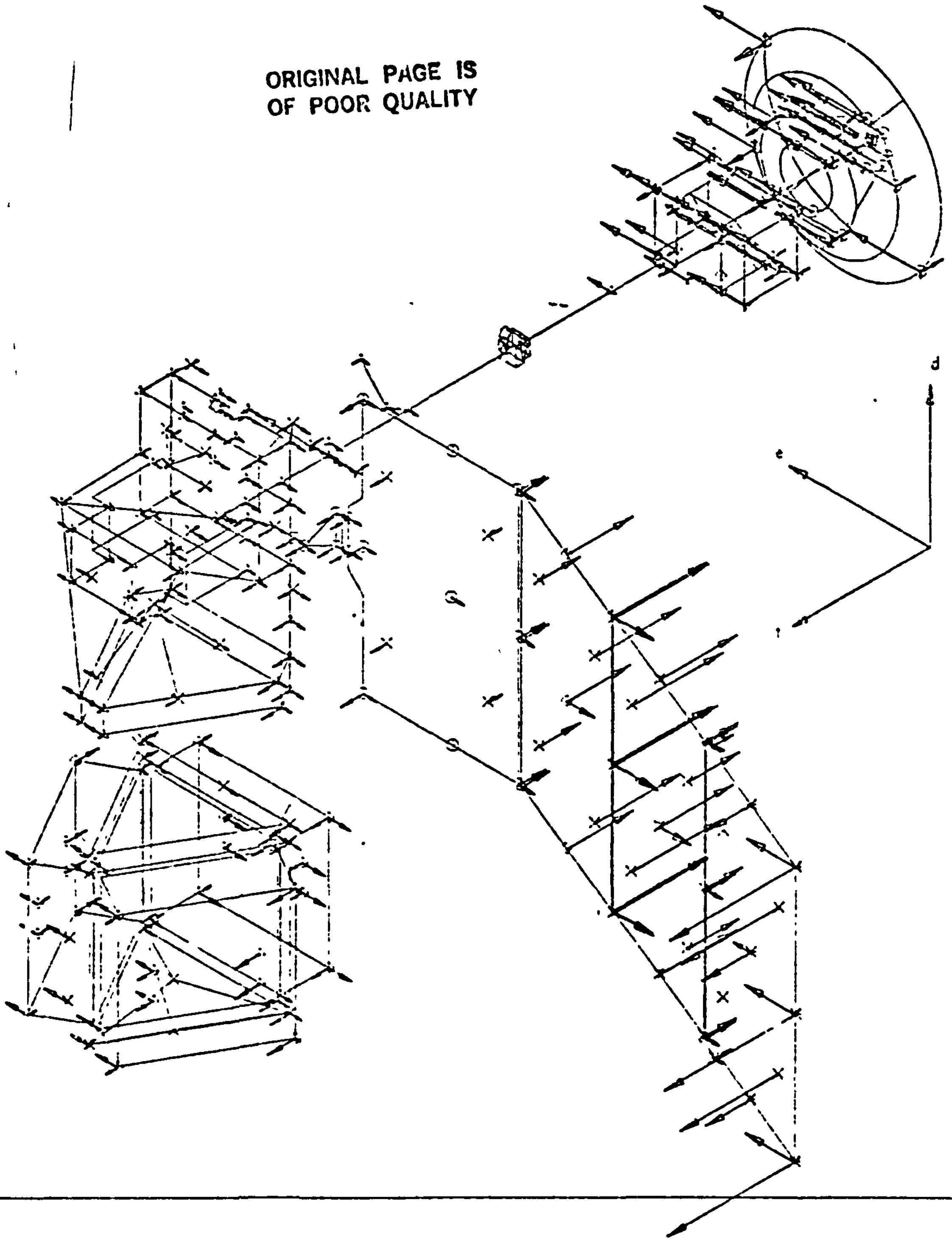

Figure 5.2-6

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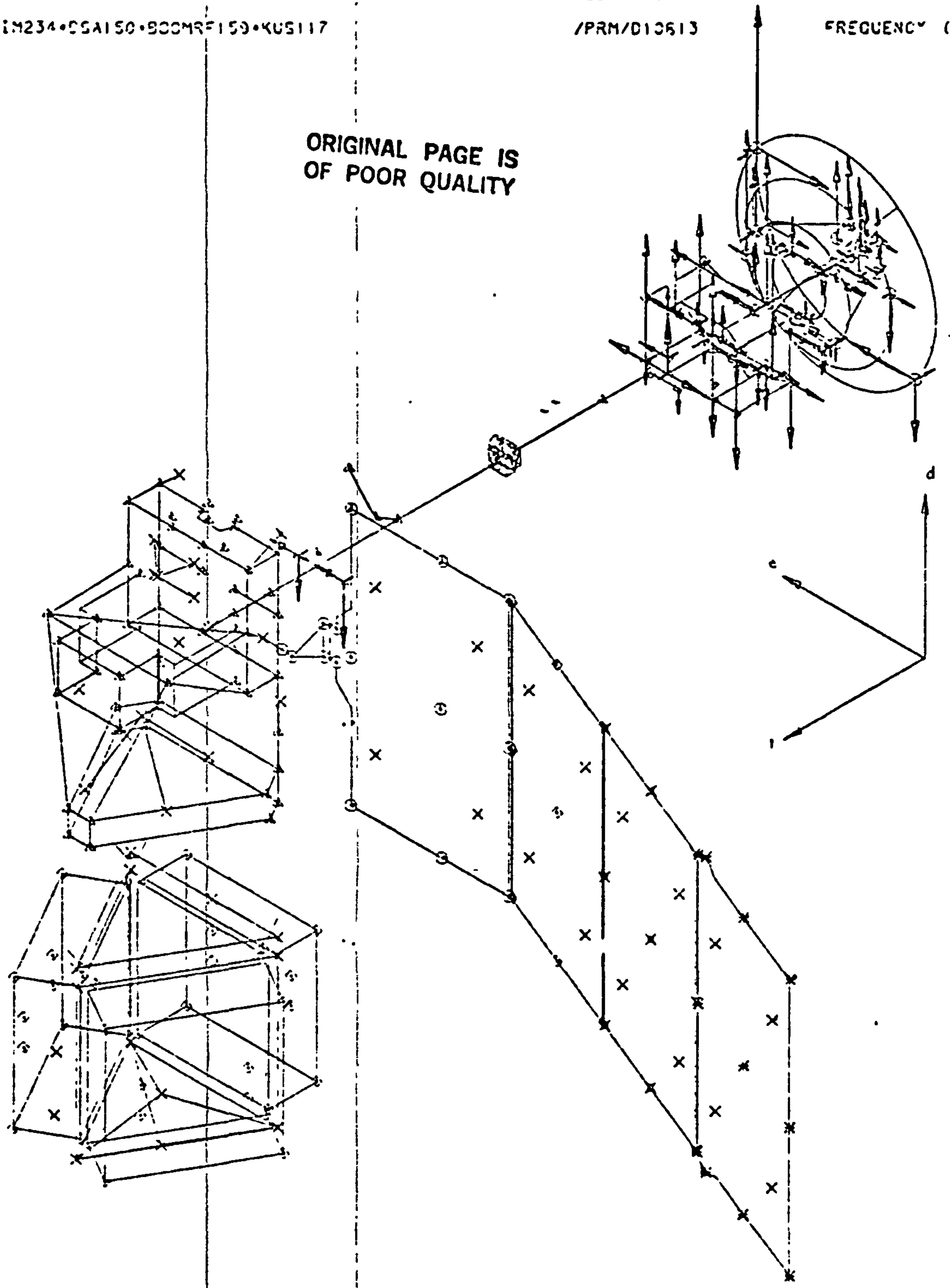

Figure 5.2-7

D PHASE 3 ORBITAL MODEL LSD300 ALL TUNED SUBS MODE NUMBER 14.000

S153•IM234•DSA150•BDDMR-153•KUS117 /PRM/D10613 FREQUENCY (HZ) 3 060

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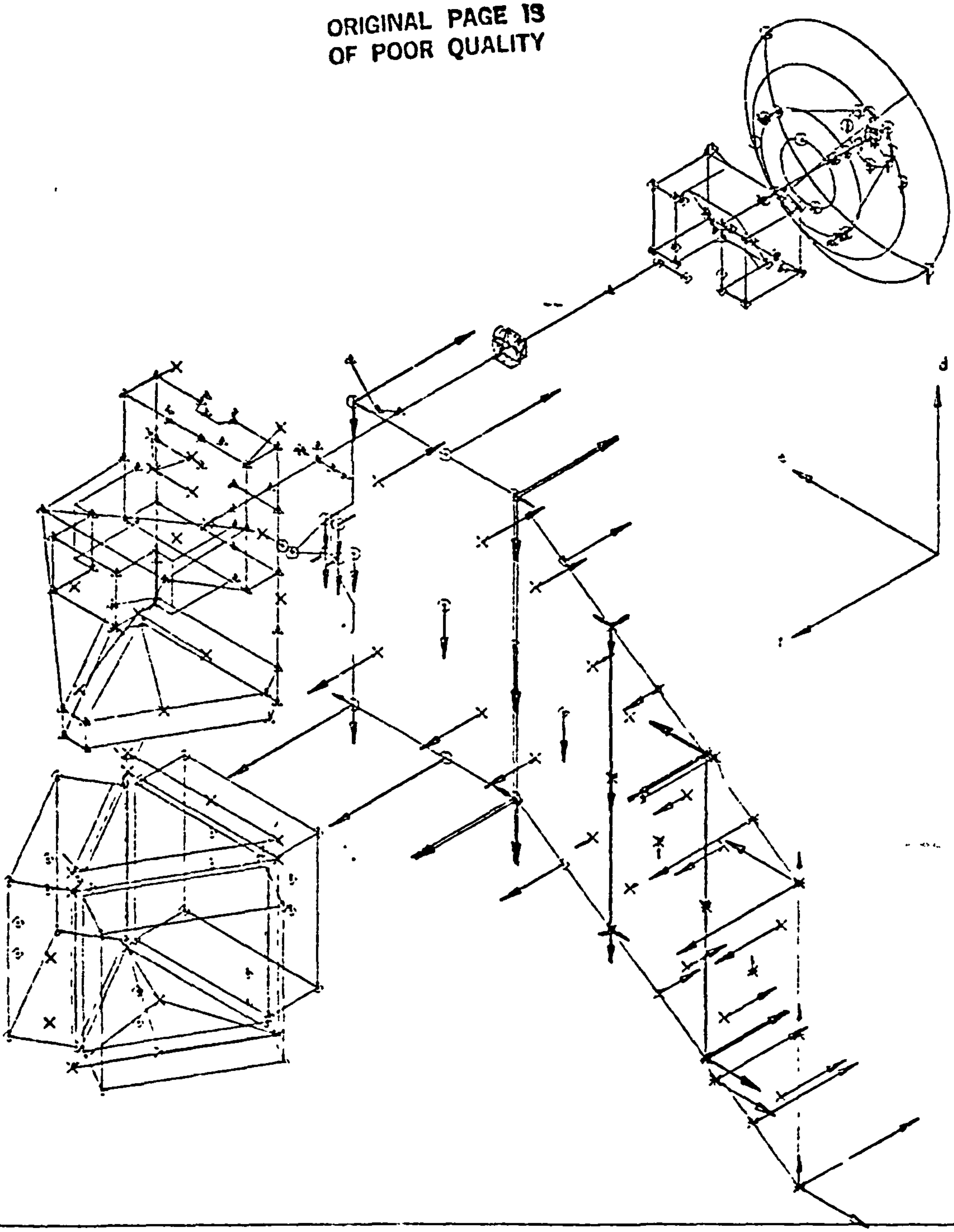

Figure 5.2-3

SC PHASE 3 ORBITAL MODEL LSC900 ALL TUNED SUBS MODE NUMBER 15 000

1MS159•IM234•DSA150•BOOMRF15)•KUS117 /PRM/010613 FREQUENCY (HZ) 3.272

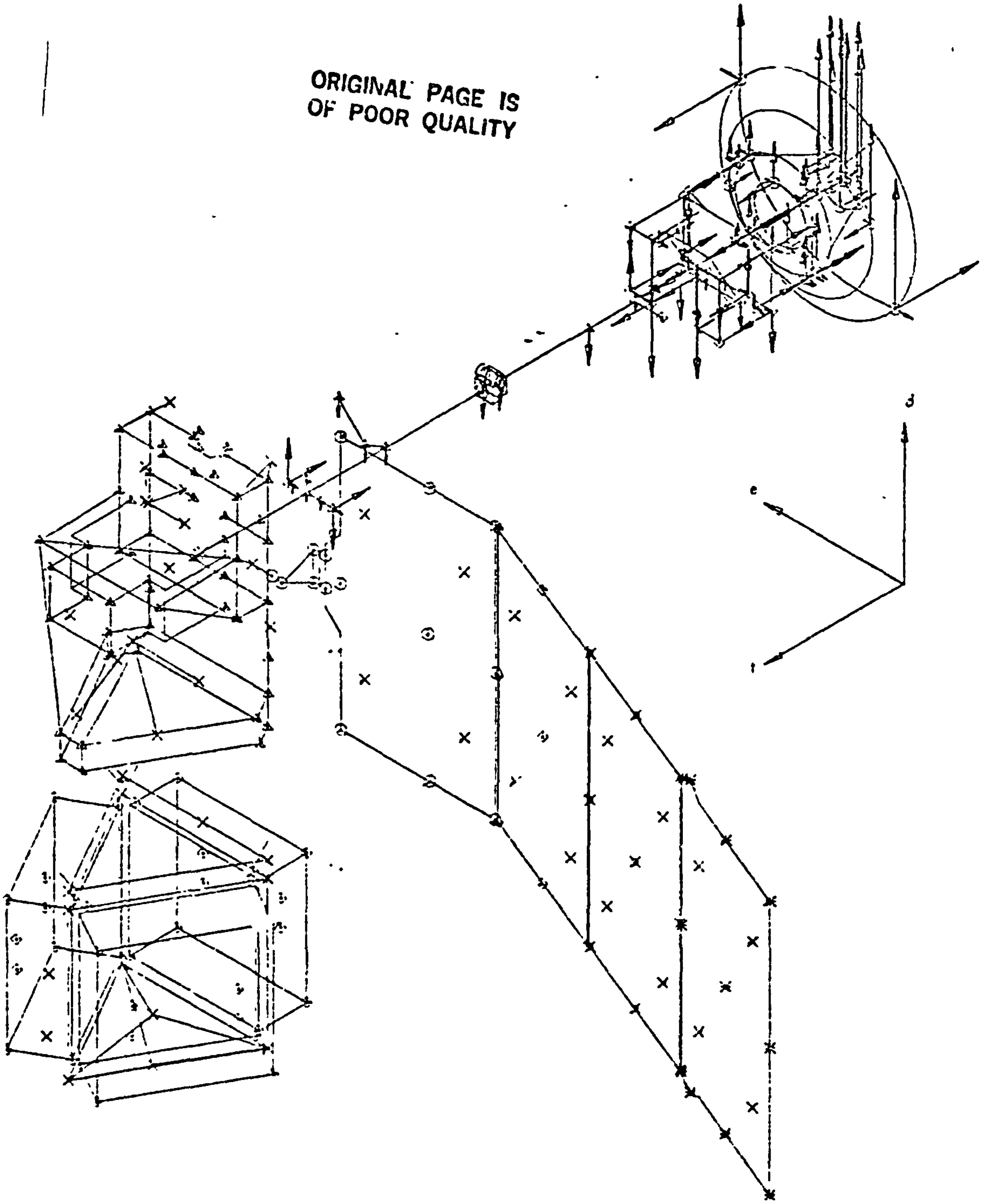

Figure 5.2-9

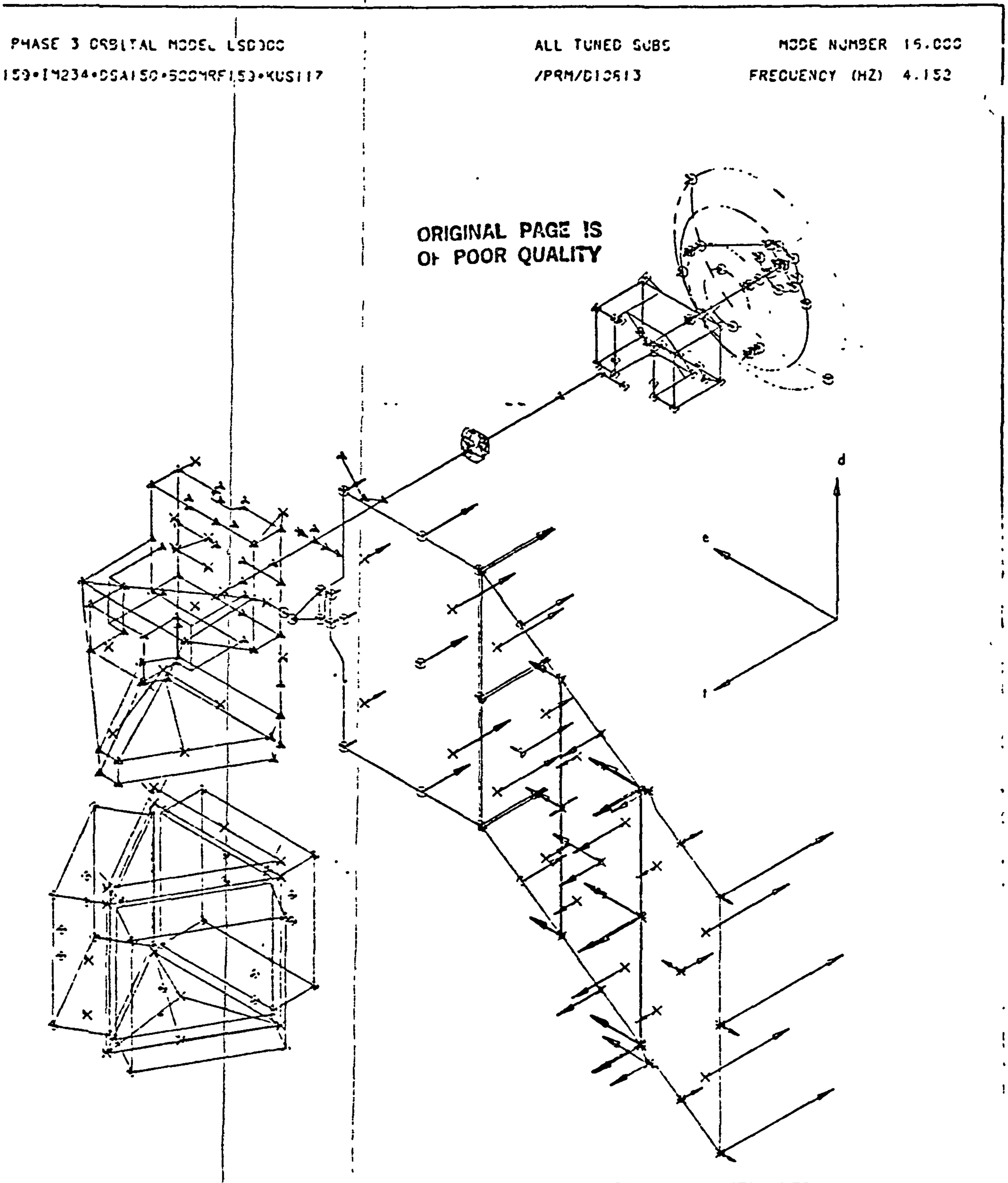
PHASE 3 ORBITAL MODEL LSD3CC
159•IM234•DSA150•500MRF153•KUS117
ALL TUNED SUBS
/PRM/D10613
MODE NUMBER 15.000
FREQUENCY (HZ) 4.152
d
e
f

Figure 5.2-10

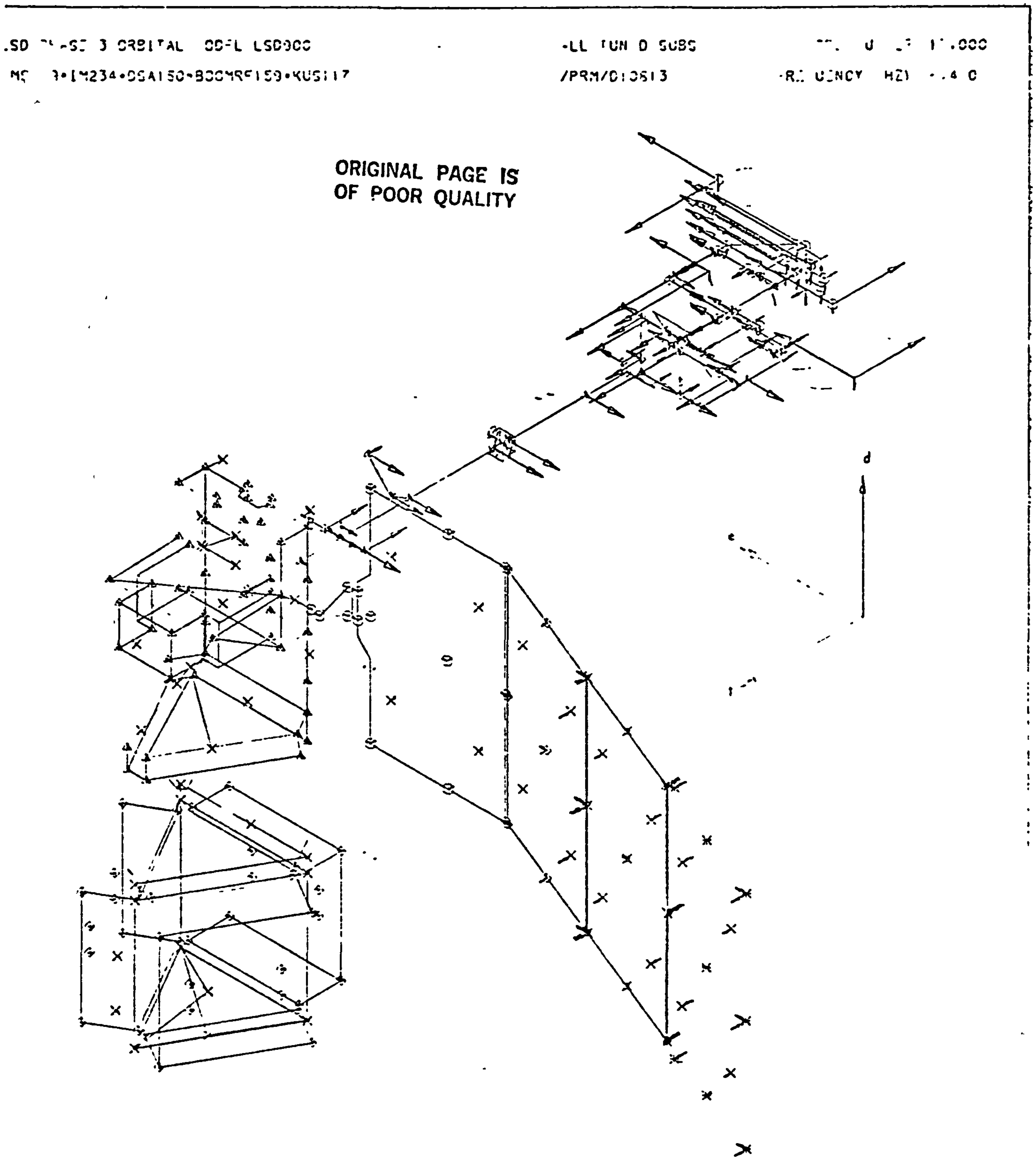
.SD ~ -S 3 ORBITAL ODEL LSD900
·LL TUN D SUBS
~. U . 1·.000
MS 3·IM234·DSA150·BOOMRF159·KUS117
/PRM/D10613
·R. U.NCY HZ) ·.4 0
d
e
f

Figure 5.2-11

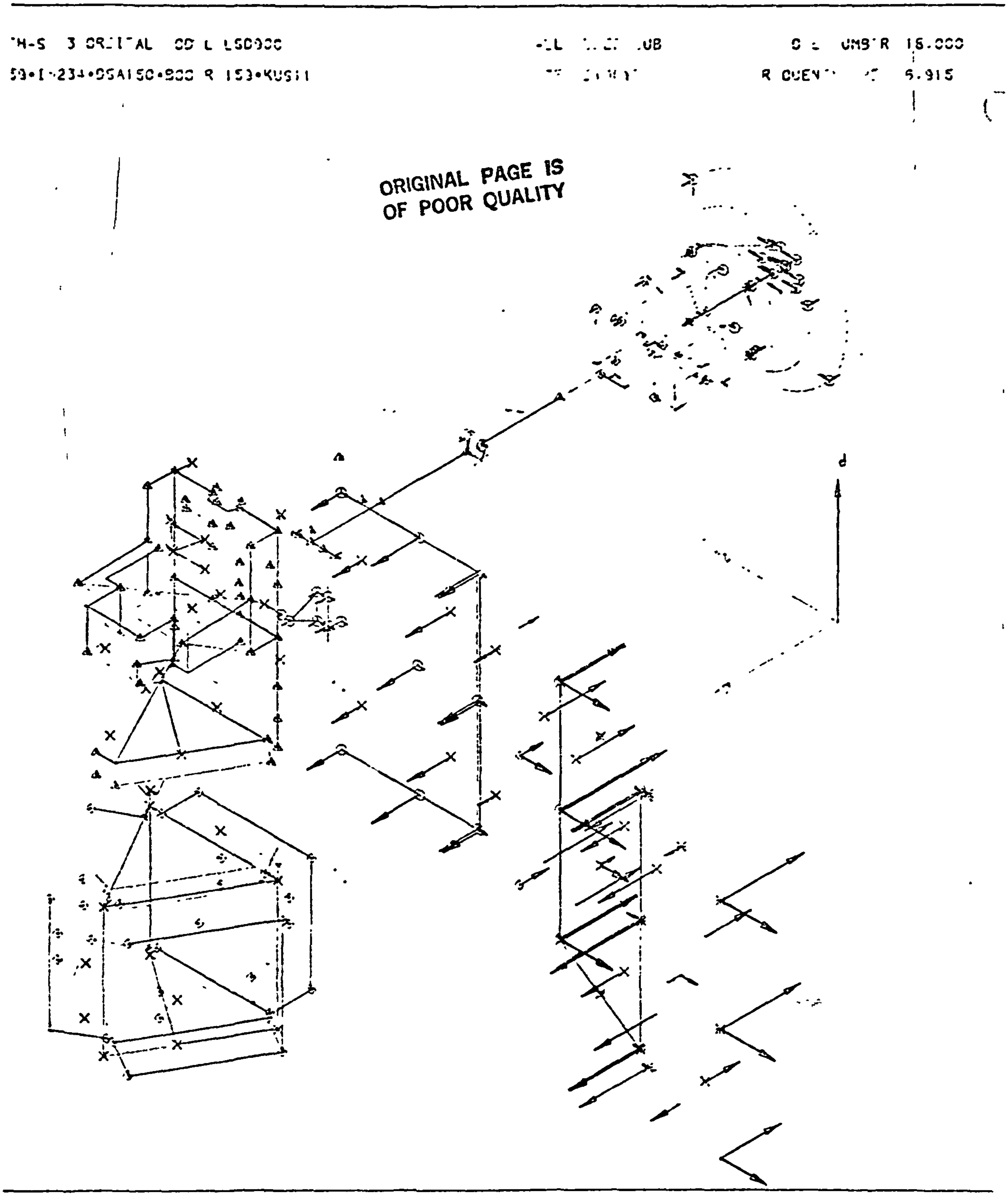
"H-S 3 OR:I"AL CD L LSD9CC
59•I-234•DSA150•9CC R 153•KUSII
MODE NUMBER 16.000
FREQUENCY 5.915
d

Figure 5.2-12

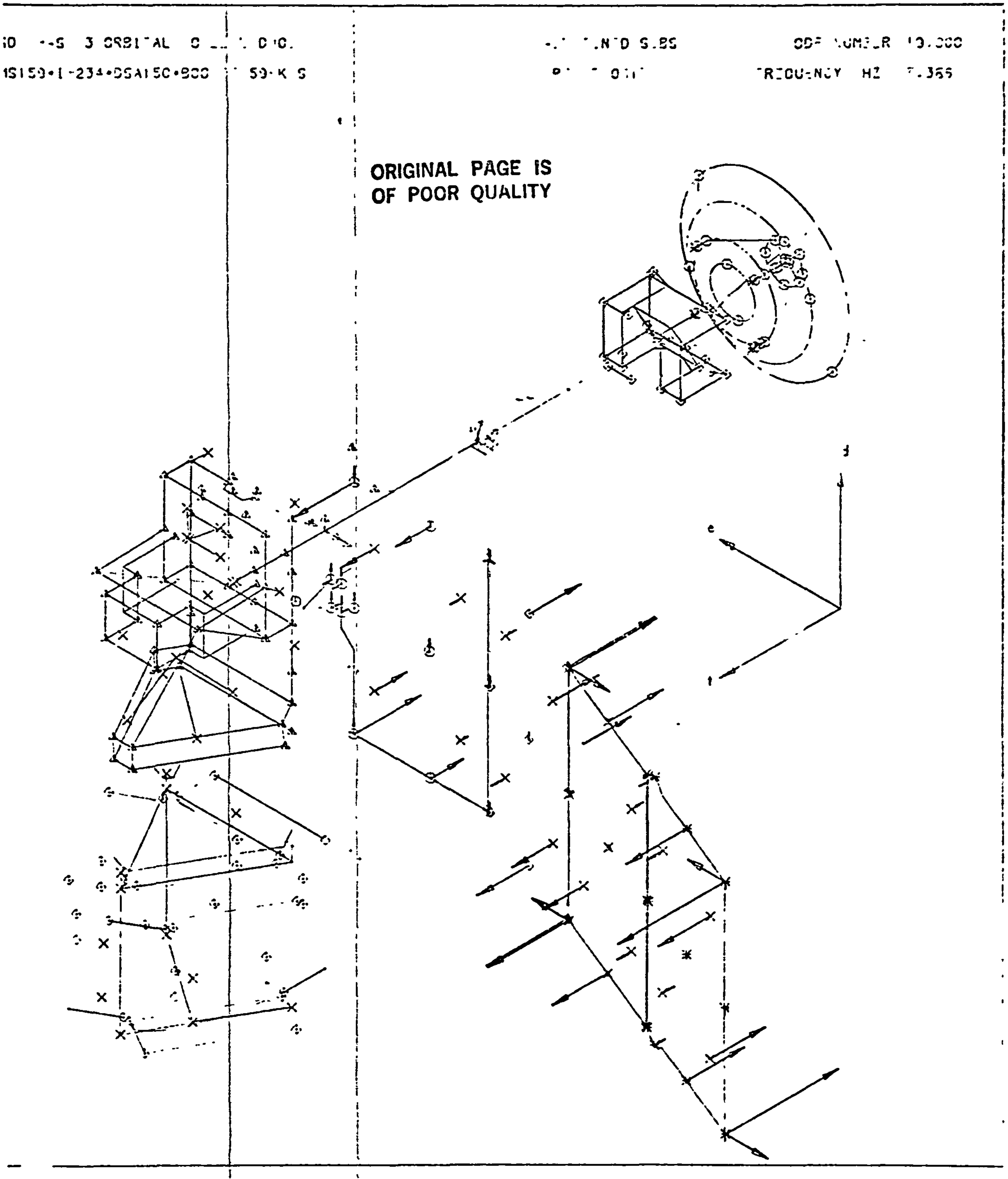
3 ORBITAL
1S159-1-234-DSA150-800
59-K S
NUMBER 13.000
FREQUENCY HZ 7.365

Figure 5.2-13

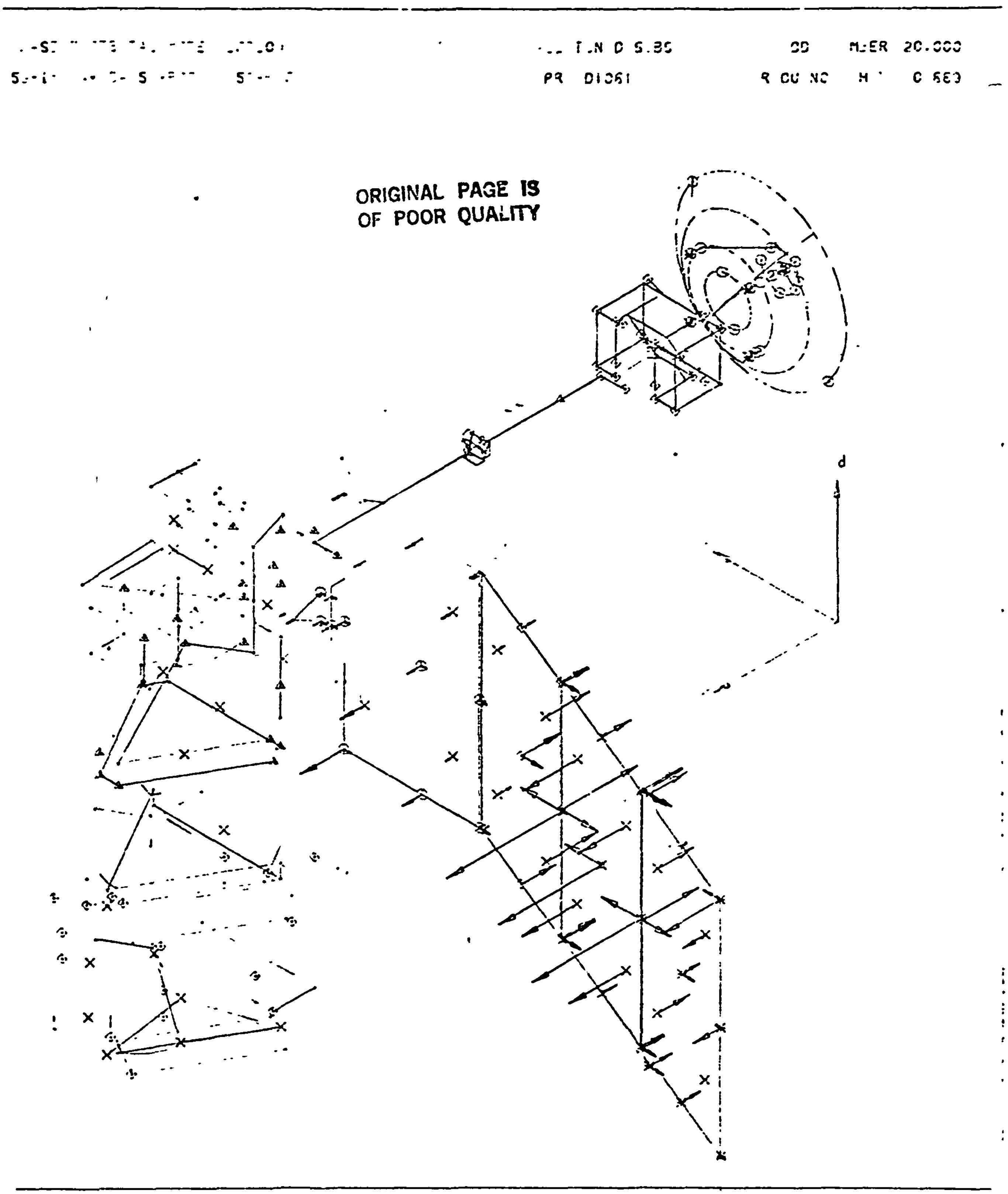

Figure 5.2-14

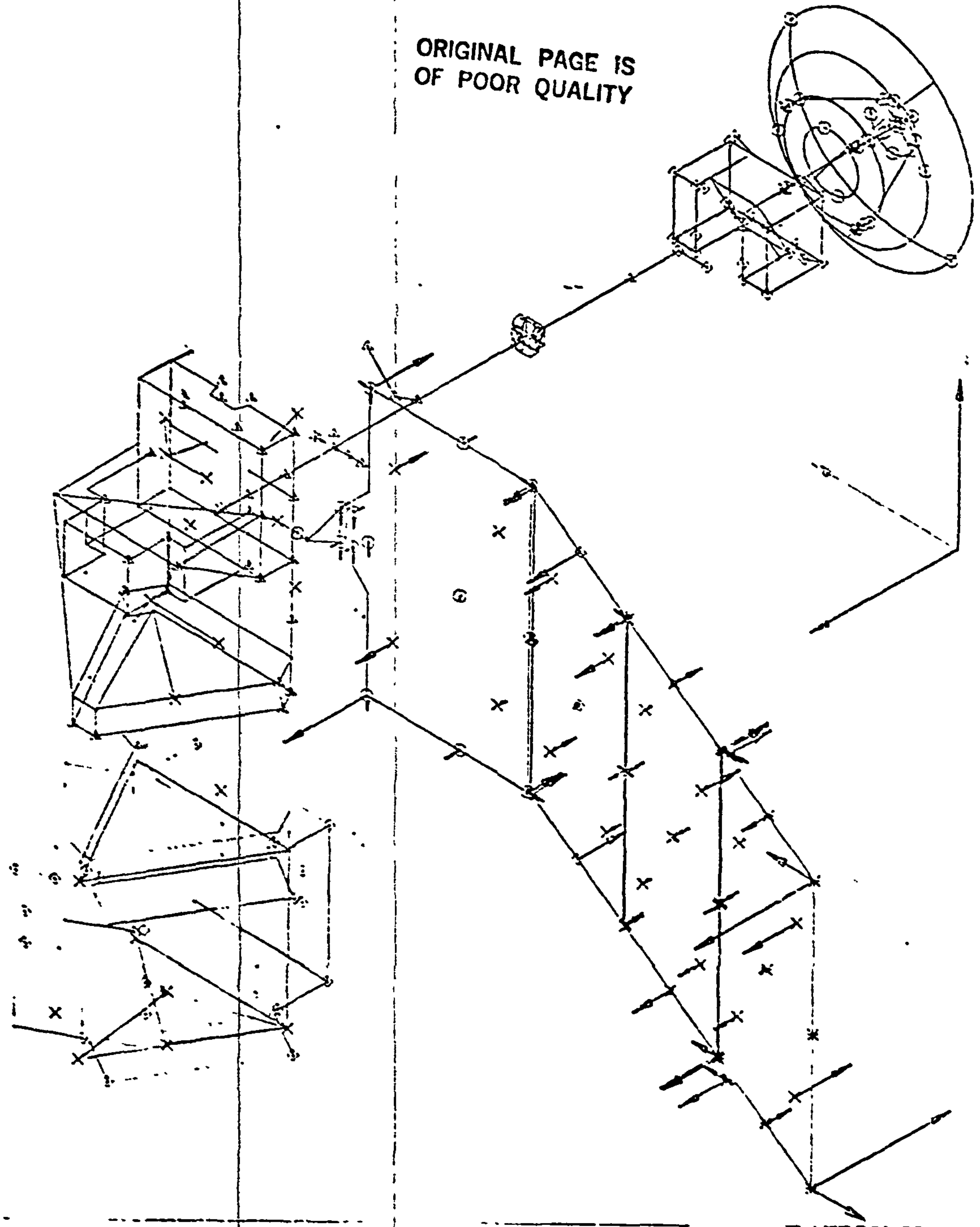

Figure 5.2-15

PHASE 3 ORBITAL MODEL LSD300 ALL TUNED SUBS MODE NUMBER 22.000

59•IM234•DSA150•BOOMRF153•KUS117 /PRM/D10613 FREQUENCY (HZ) 12.539

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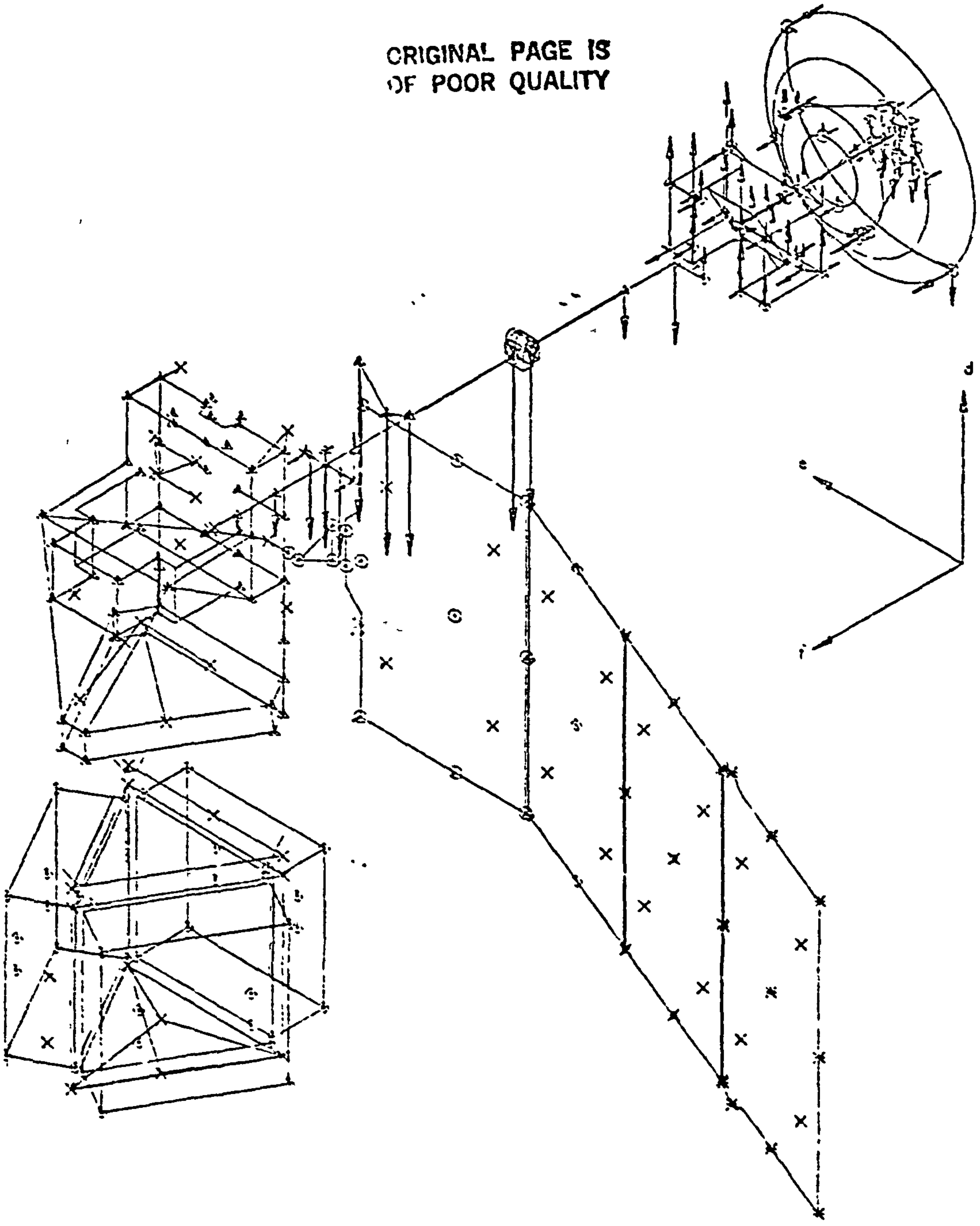

Figure 5.2-16

PHASE 3 ORBITAL MODEL LSD300 | ALL TUNED SUBS | MODE NUMBER 23 000

59•IM234•DSAI53•B00MRF159•KUSI17 | /PRM/D10613 | FREQUENCY (HZ) 12.761

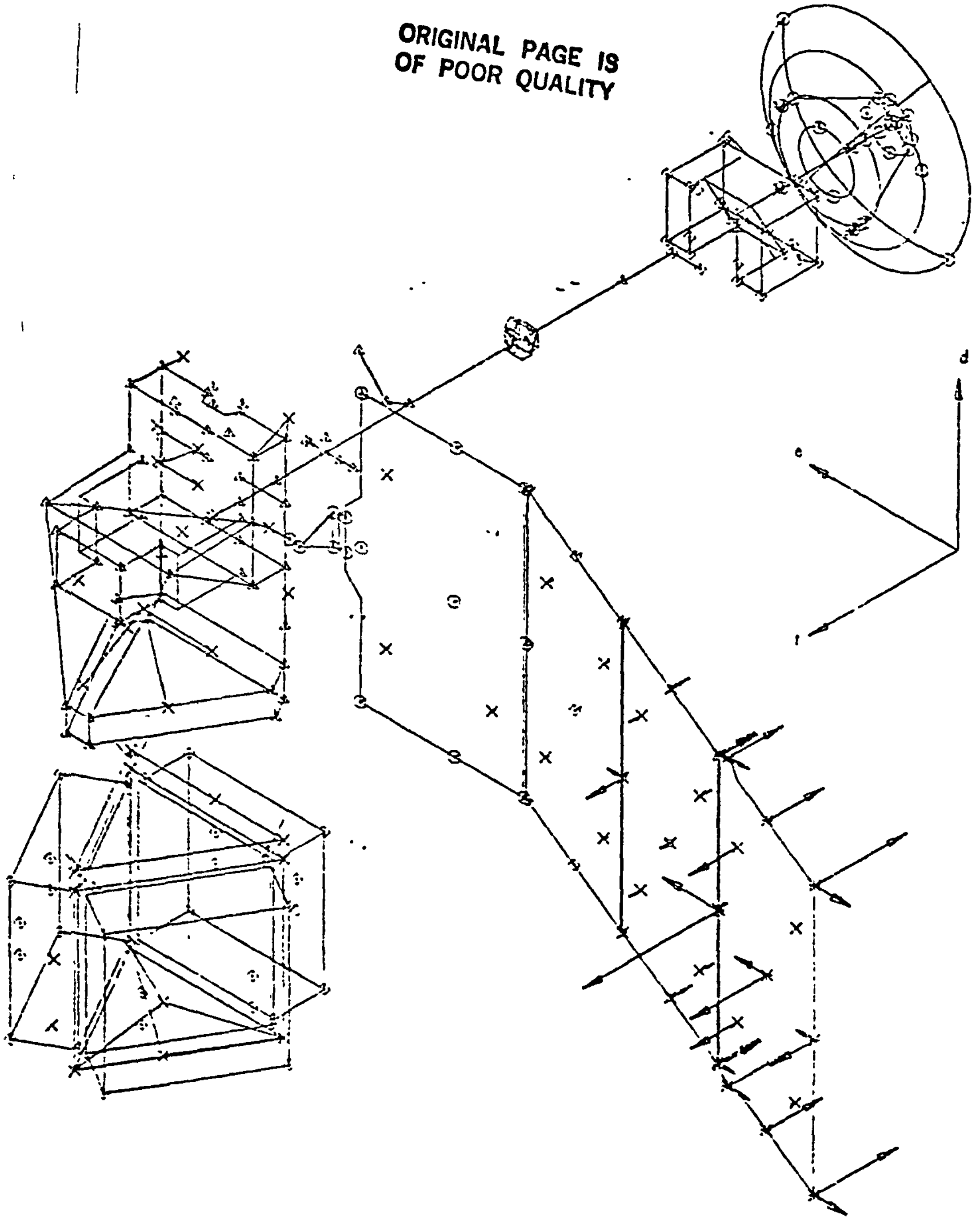

Figure 5.2-17

```
PHASE 3 ORBITAL MODEL LSD300                ALL TUNED S BS        MODE NUMBER 24.000
S150•IM234•DSA150•300MRF150•KUS117          /PRM 010613           FREQUENCY (HZ) 14.075
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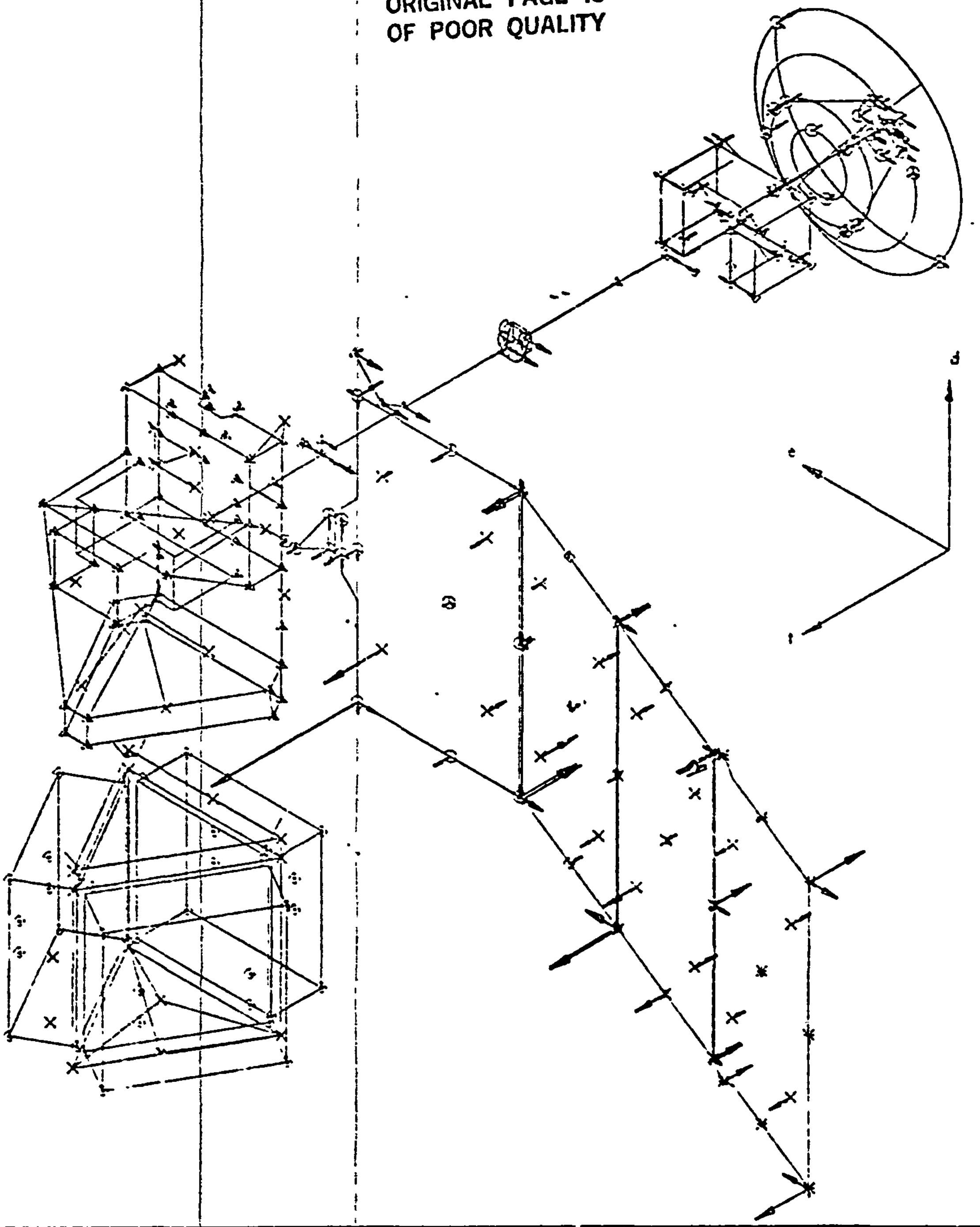

Figure 5.2-13

PHASE 3 ORBITAL MODEL LSD000 ALL TUNED SUBS MODE NUMBER 25 000

59•IM234•OSA150•800MRF159•KUS117 .PRM/010613 FREQUENCY (HZ) 14.142

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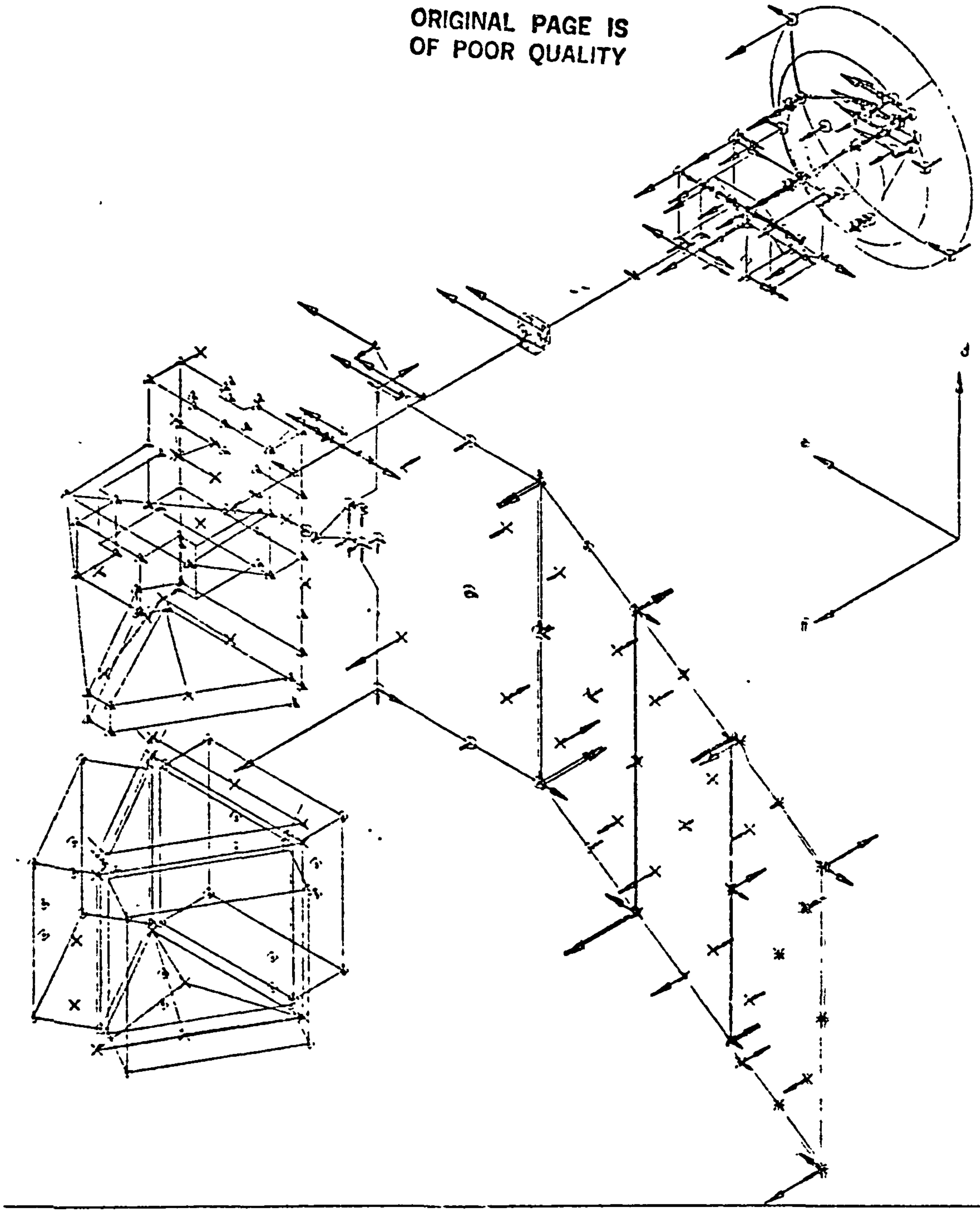

Figure 5.2-19

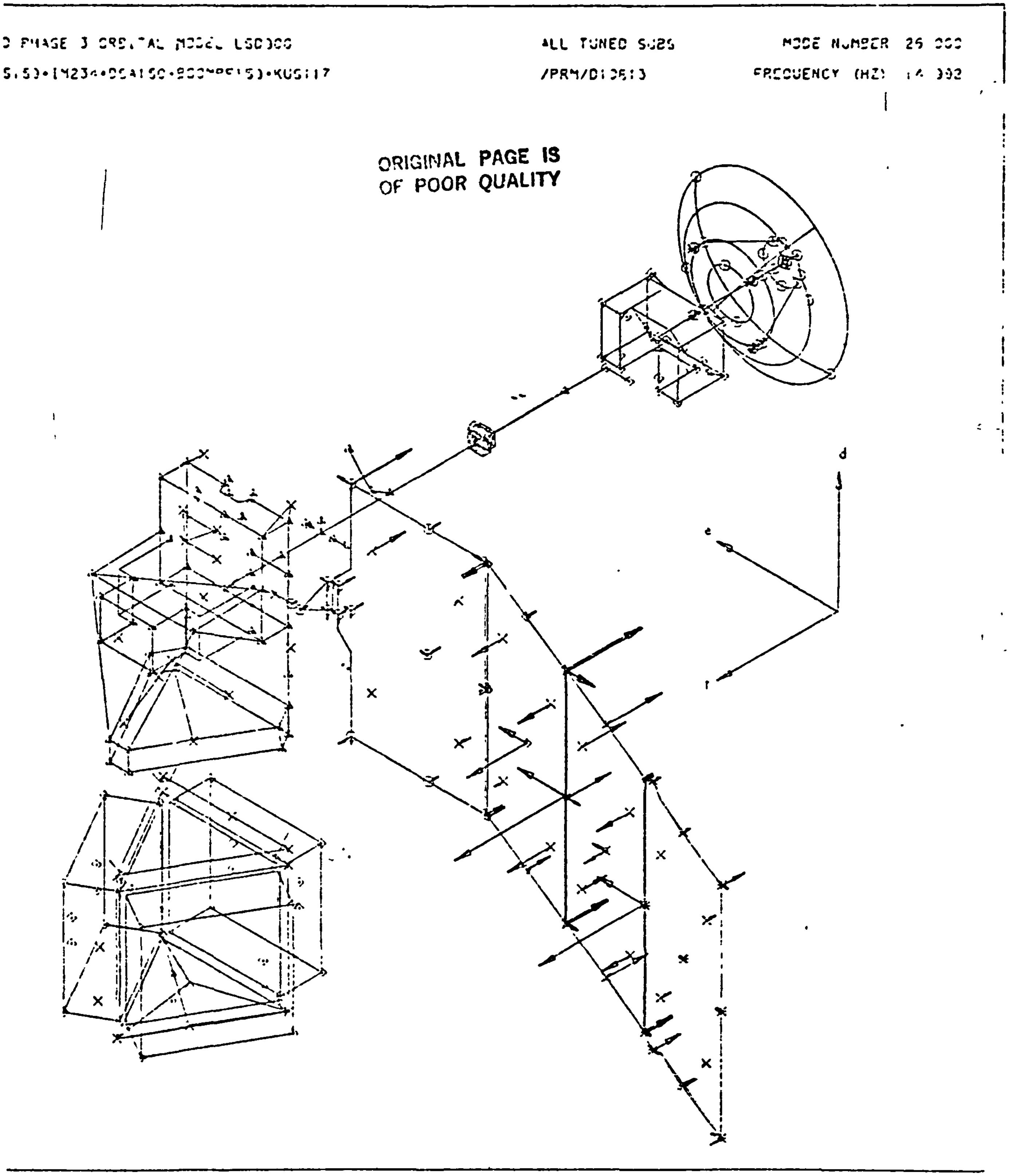
D PHASE 3 ORBITAL MODEL LSD300
5.5)•(M234•DSA150•BOOMPE15)•KUS117
ALL TUNED SUBS
/PRM/D10513
MODE NUMBER 25 000
FREQUENCY (HZ) 14 392
d
e
f

Figure 5.2-20

Table 5.2-2 LSD900 Transfer Function Data Presentation

Damping = 0.001

Excitation Grid Point	Response Grid Point	Response Spectrum Graph to 100 Hz	Response Spectrum Graph 100-200 Hz
TM θ_X #1669	MSS θ_X	5.1-21	5.1-22
	θ_Y	5.1-23	5.1-24
	θ_Z	5.1-25	5.1-26
MSS θ_X #1664	MSS θ_X	5.1-27	5.1-28
	θ_Y	5.1-29	5.1-30
	θ_Z	5.1-31	5.1-32

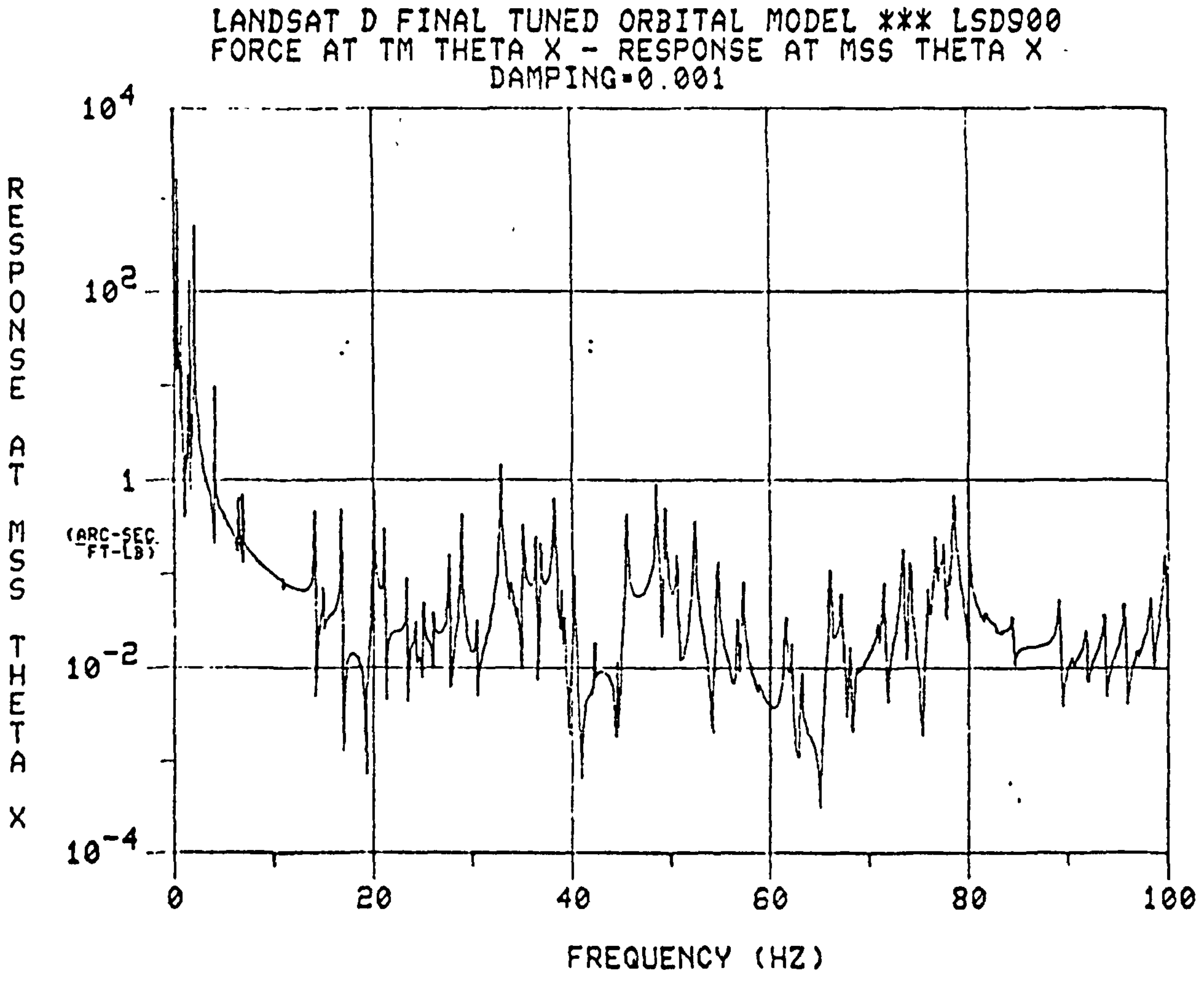

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Figure 5.2-21

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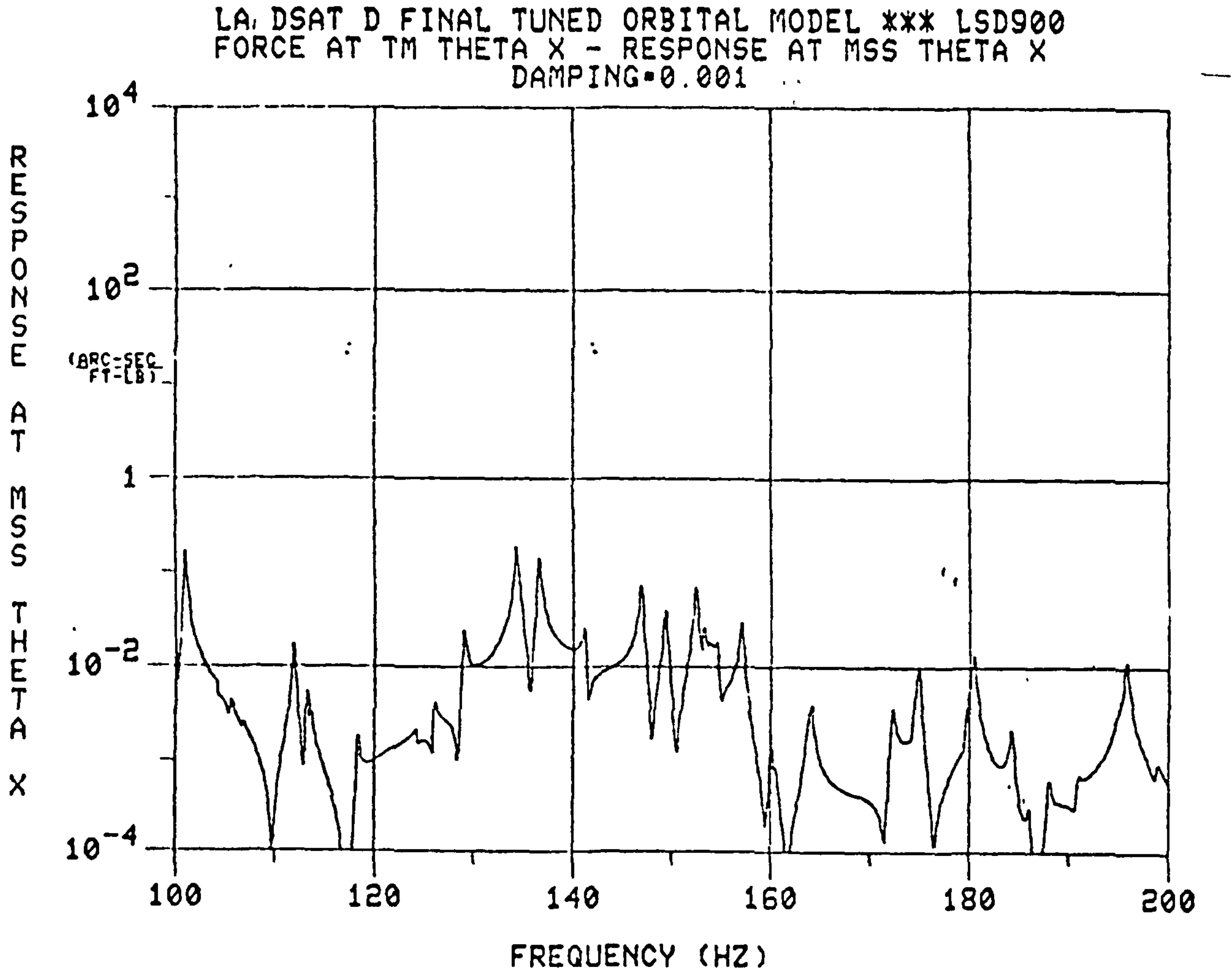

Figure 5.2-22

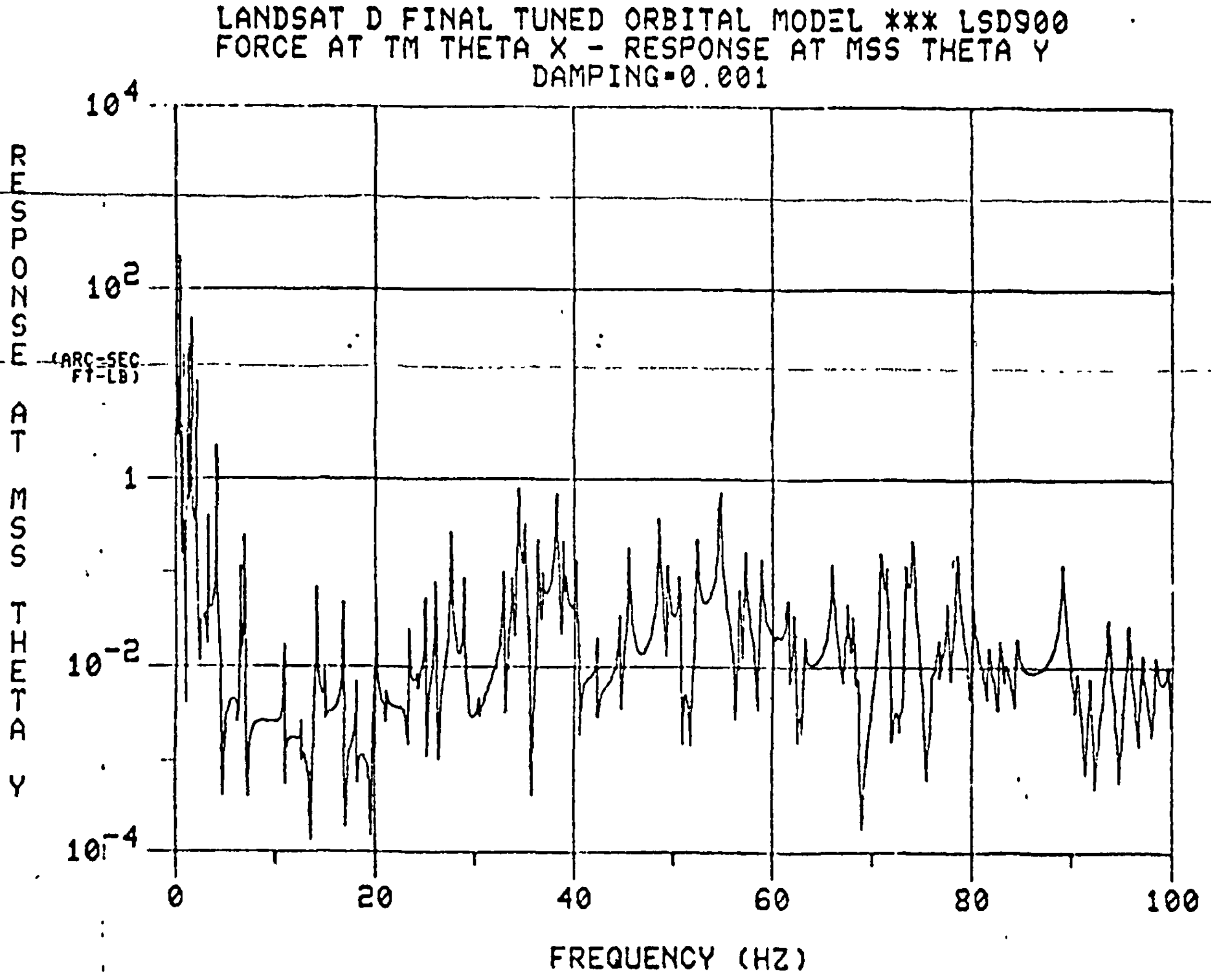

Figure 5.2-23

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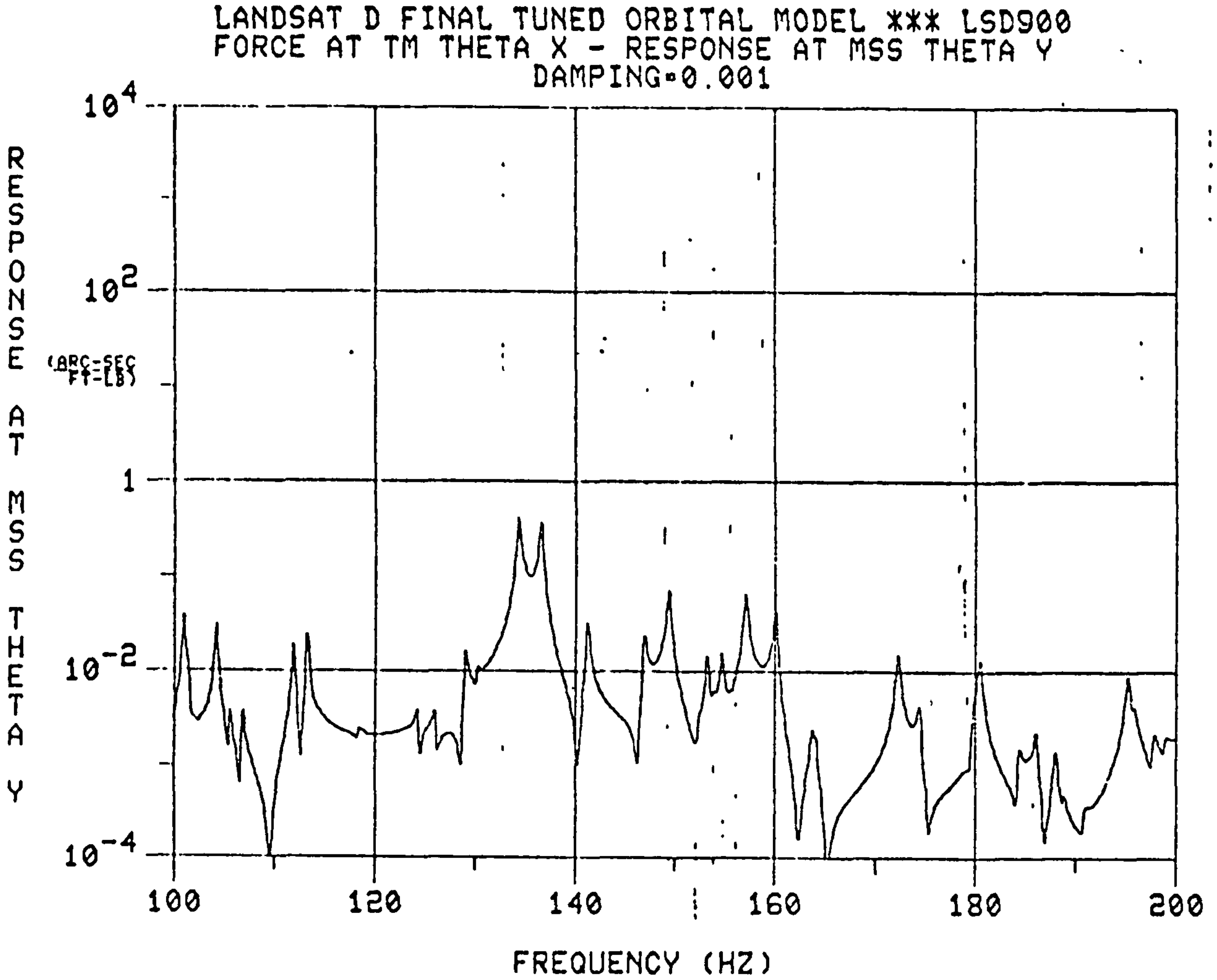

Figure 5.2-24

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ORIGINAL PAGE IS
OF POOR QUALITY

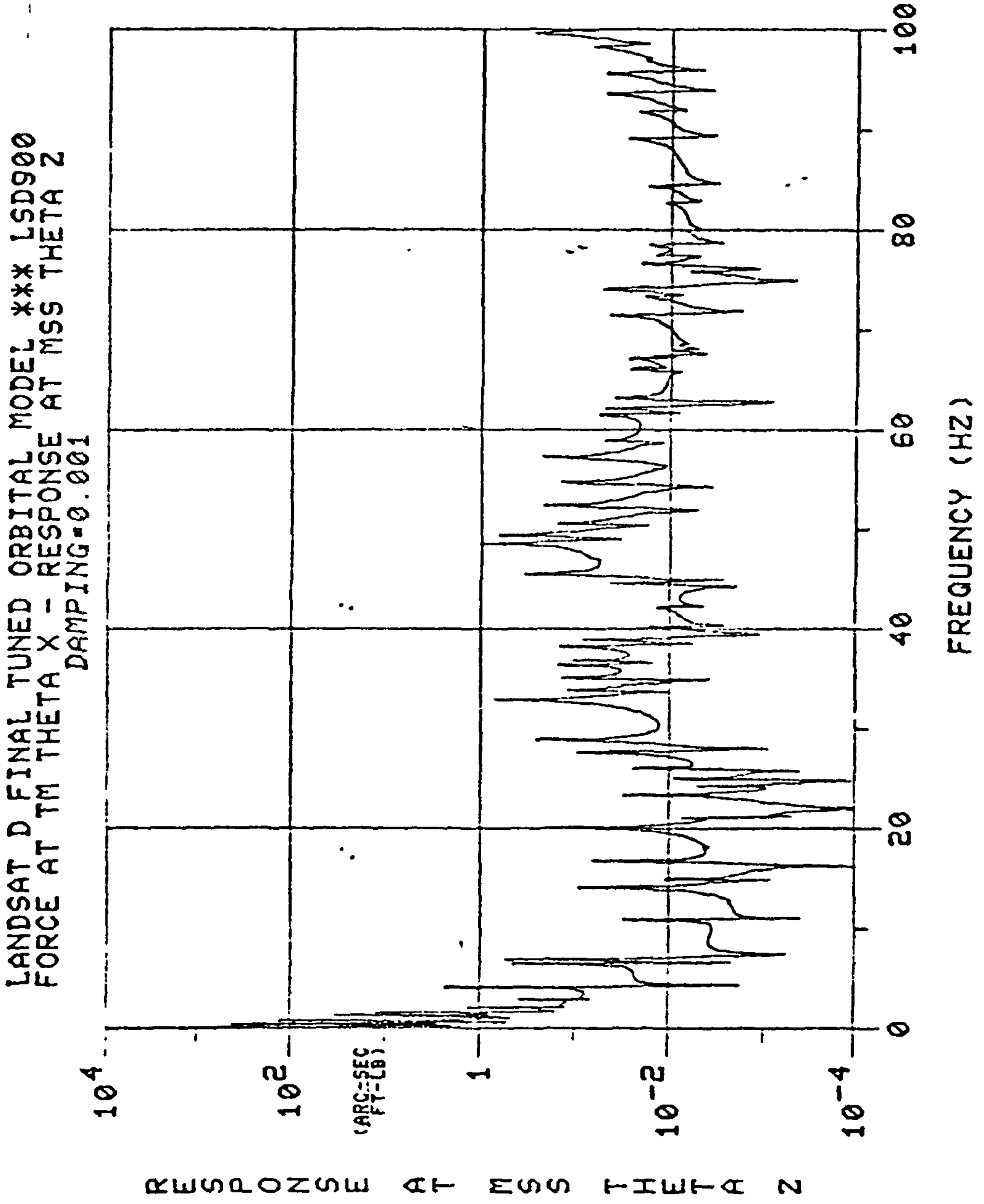
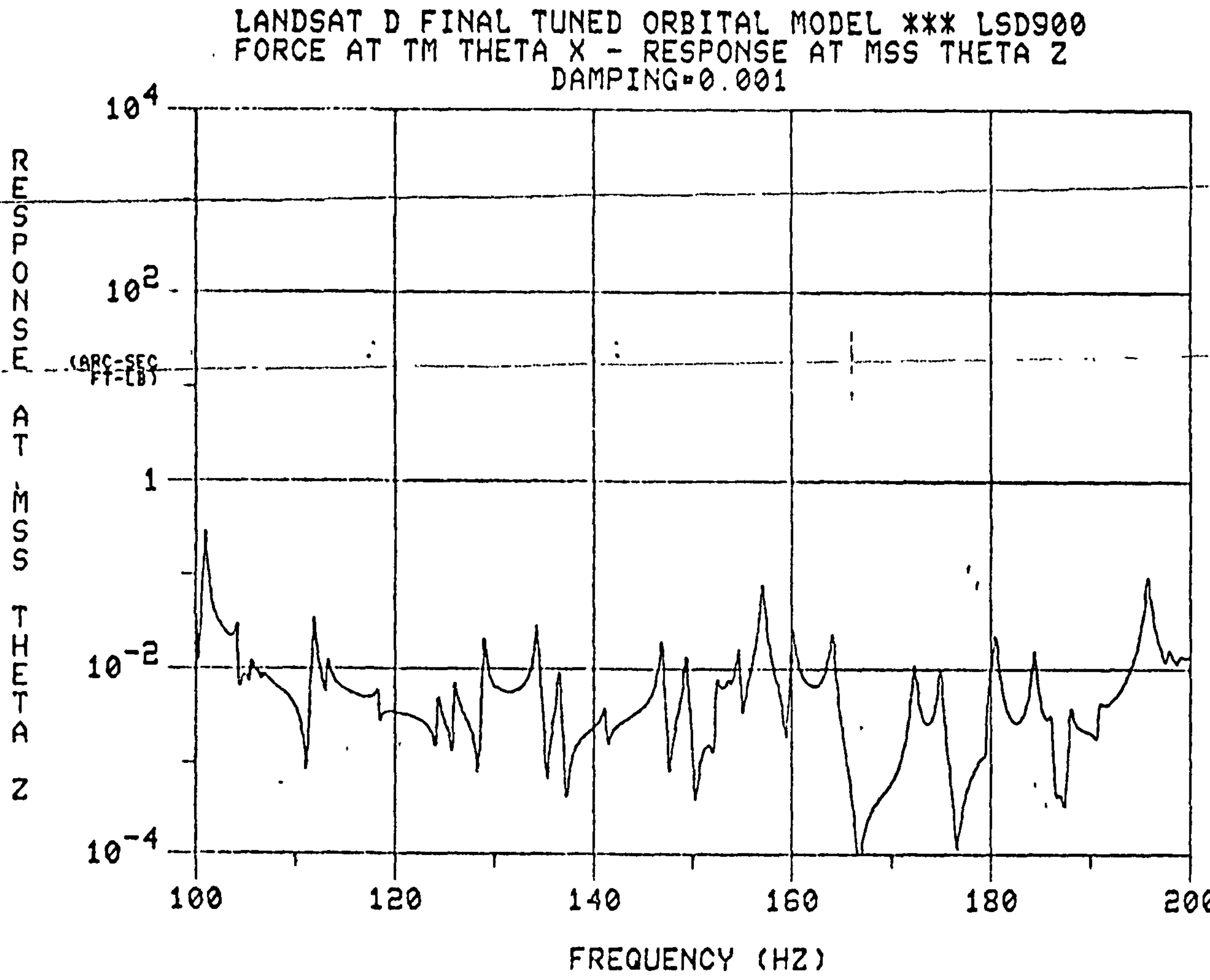


Figure 5.2-25



LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT TM THETA X - RESPONSE AT MSS THETA Z
DAMPING=0.001

Figure 5.2-26

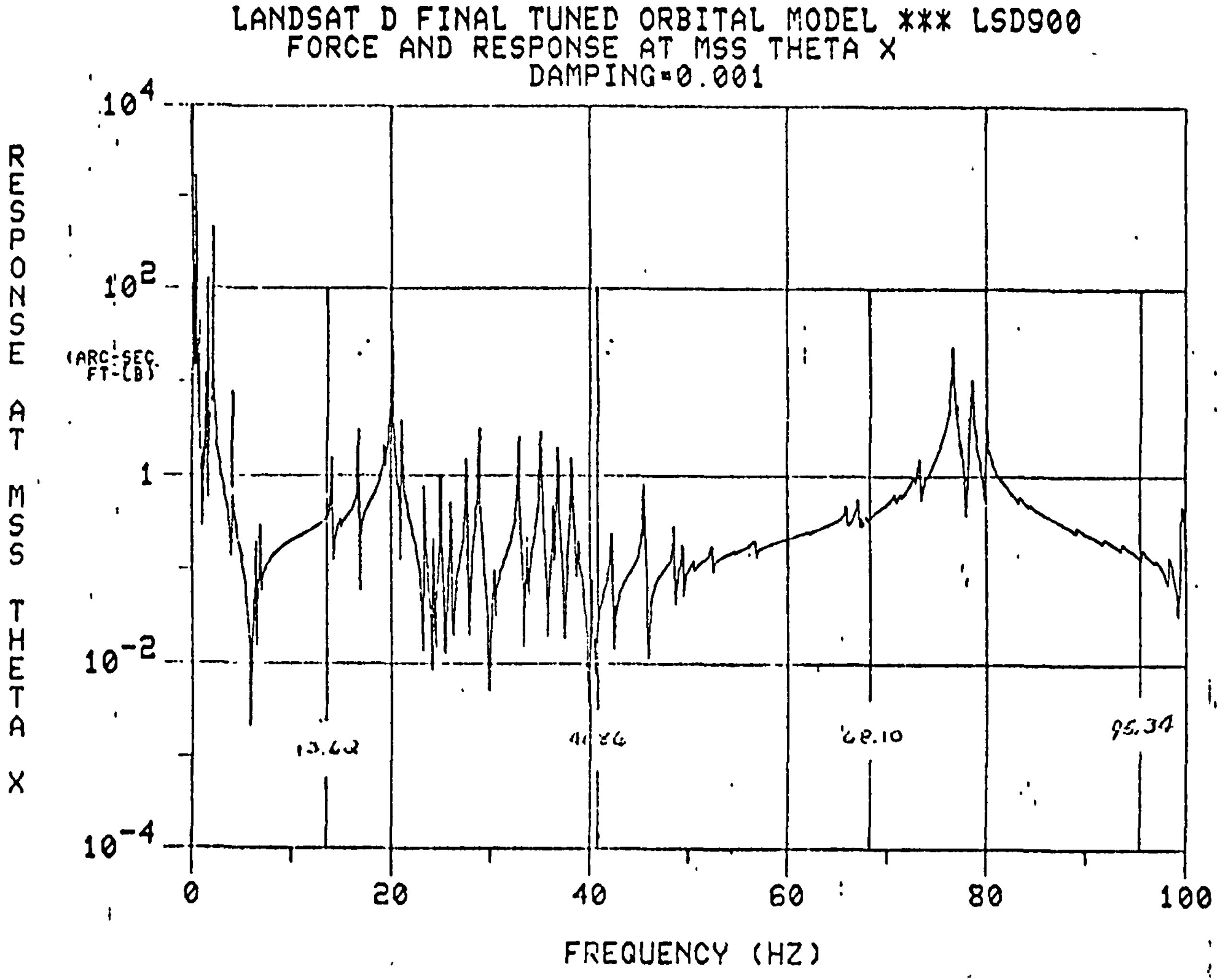

LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AND RESPONSE AT MSS THETA X
DAMPING=0.001
RESPONSE AT MSS THETA X
(ARC-SEC / FT-LB)
10^4
10^2
1
10^-2
10^-4
0
20
40
60
80
100
FREQUENCY (HZ)
13.62
40.86
68.10
95.34

Figure 5.2-27

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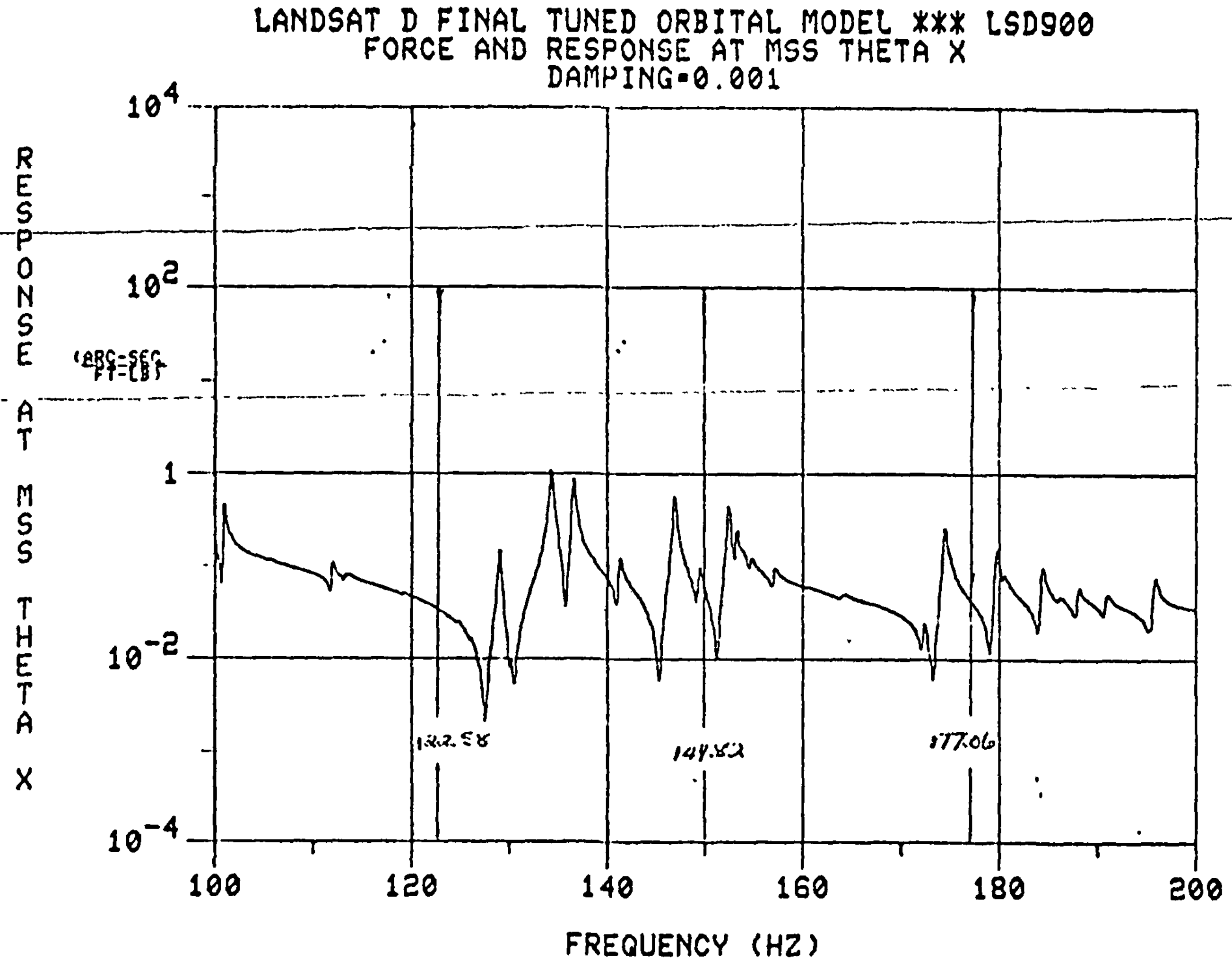

Figure 5.2-28

C-2

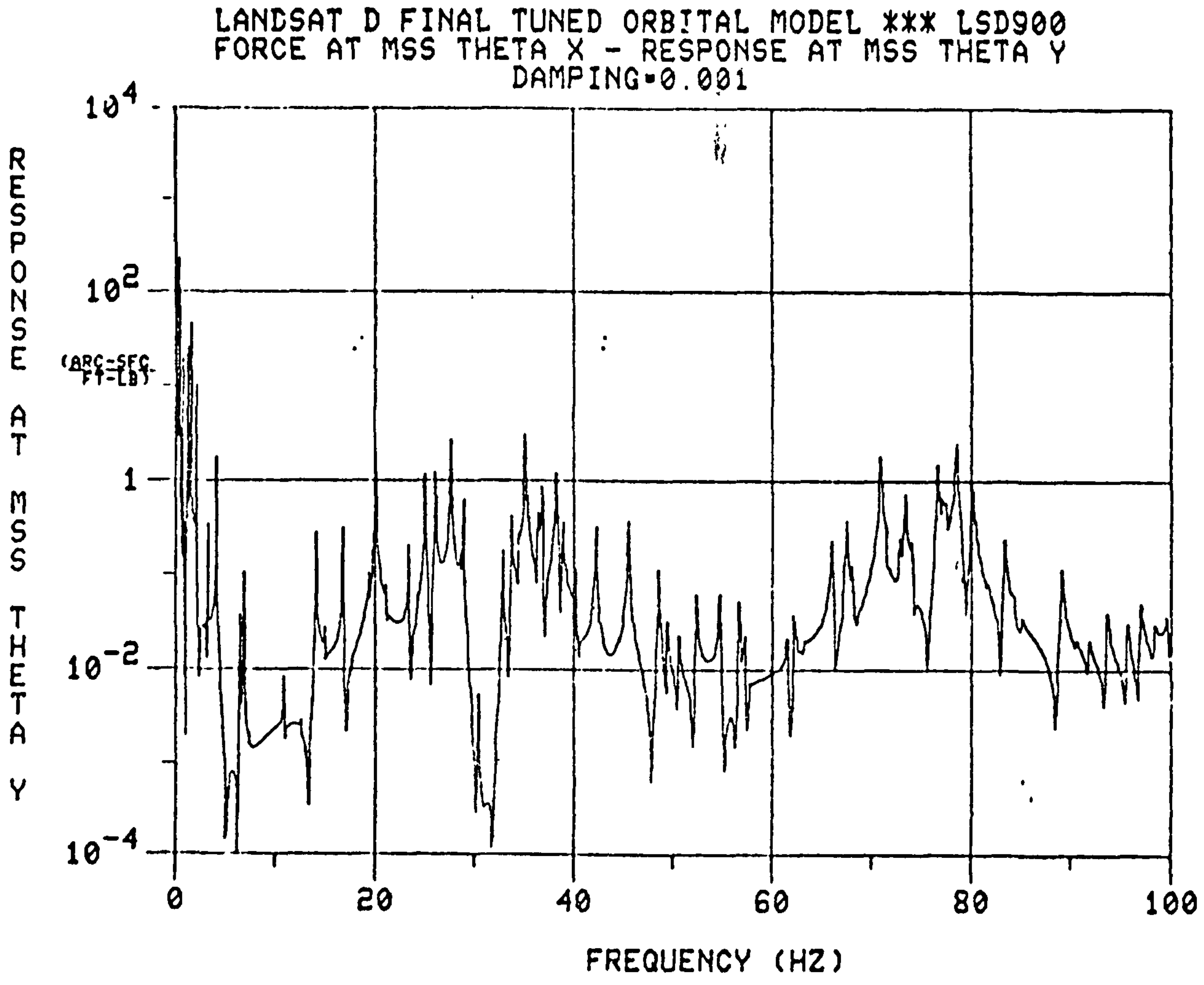

Figure 5.2-29

ORIGINAL PAGE IS
OF POOR QUALITY

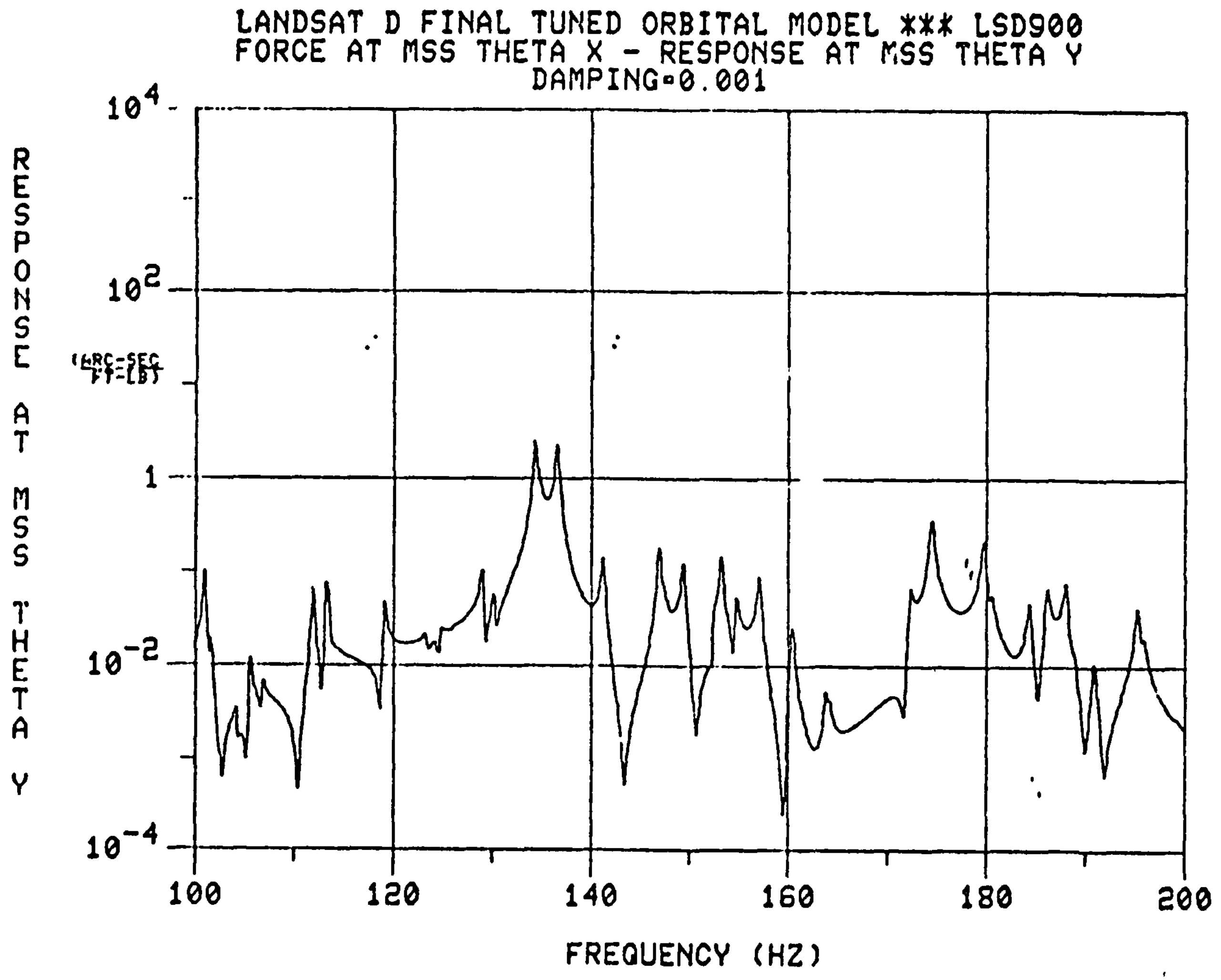
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT MSS THETA X - RESPONSE AT MSS THETA Y
DAMPING=0.001
RESPONSE AT MSS THETA Y
(ARC-SEC/FT-LB)
10^4
10^2
1
10^{-2}
10^{-4}
100
120
140
160
180
200
FREQUENCY (HZ)

Figure 5.2-30

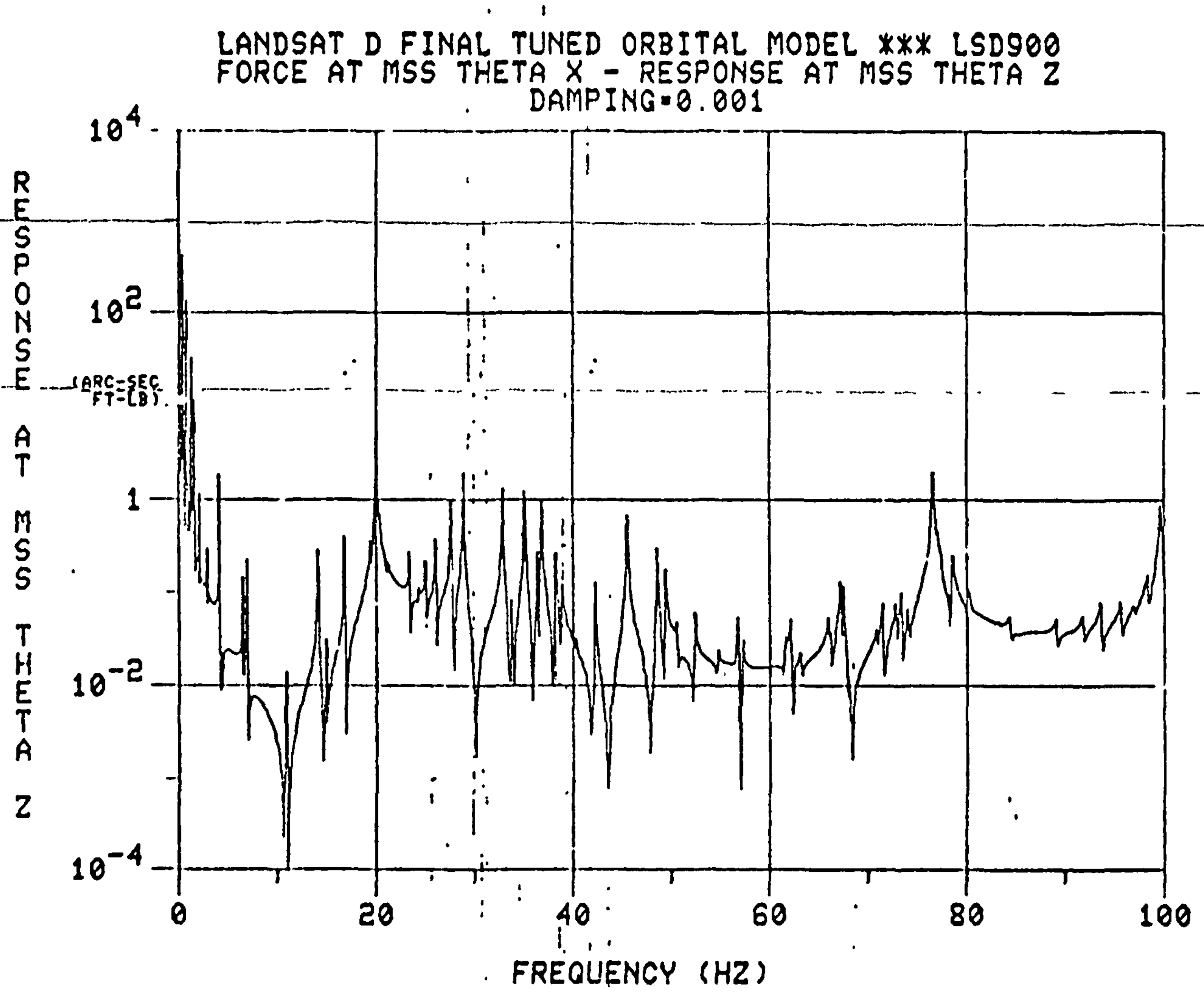
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT MSS THETA X - RESPONSE AT MSS THETA Z
DAMPING=0.001
RESPONSE AT MSS THETA Z
(ARC-SEC/FT-LB)
10^4
10^2
1
10^-2
10^-4
0
20
40
60
80
100
FREQUENCY (HZ)

Figure 5.2-31

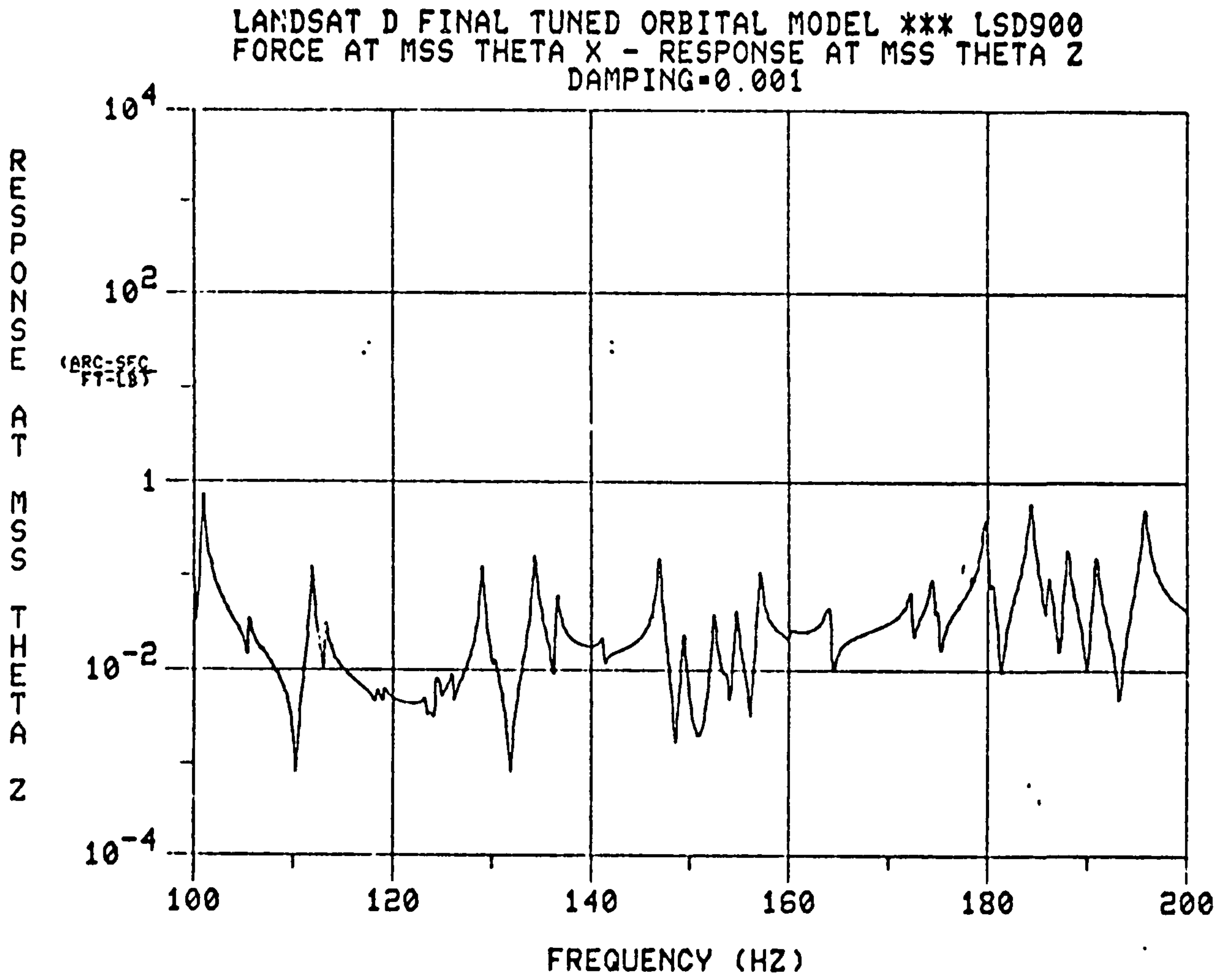

Figure 5.2-32

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Table 5.2-3 *LSD900 Transfer Function Data Presentation*

Damping = 0.01

Excitation Grid Point	Response Grid Point	Response Spectrum Graph to 100 Hz	Response Spectrum Graph 100-200 Hz
TM θ_X #1669	MSS θ_X	5.1-33	5.1-34
	θ_Y	5.1-35	5.1-36
	θ_Z	5.1-37	5.1-38
MSS θ_X #1664	MSS θ_X	5.1-39	5.1-40
	θ_Y	5.1-41	5.1-42
	θ_Z	5.1-43	5.1-44

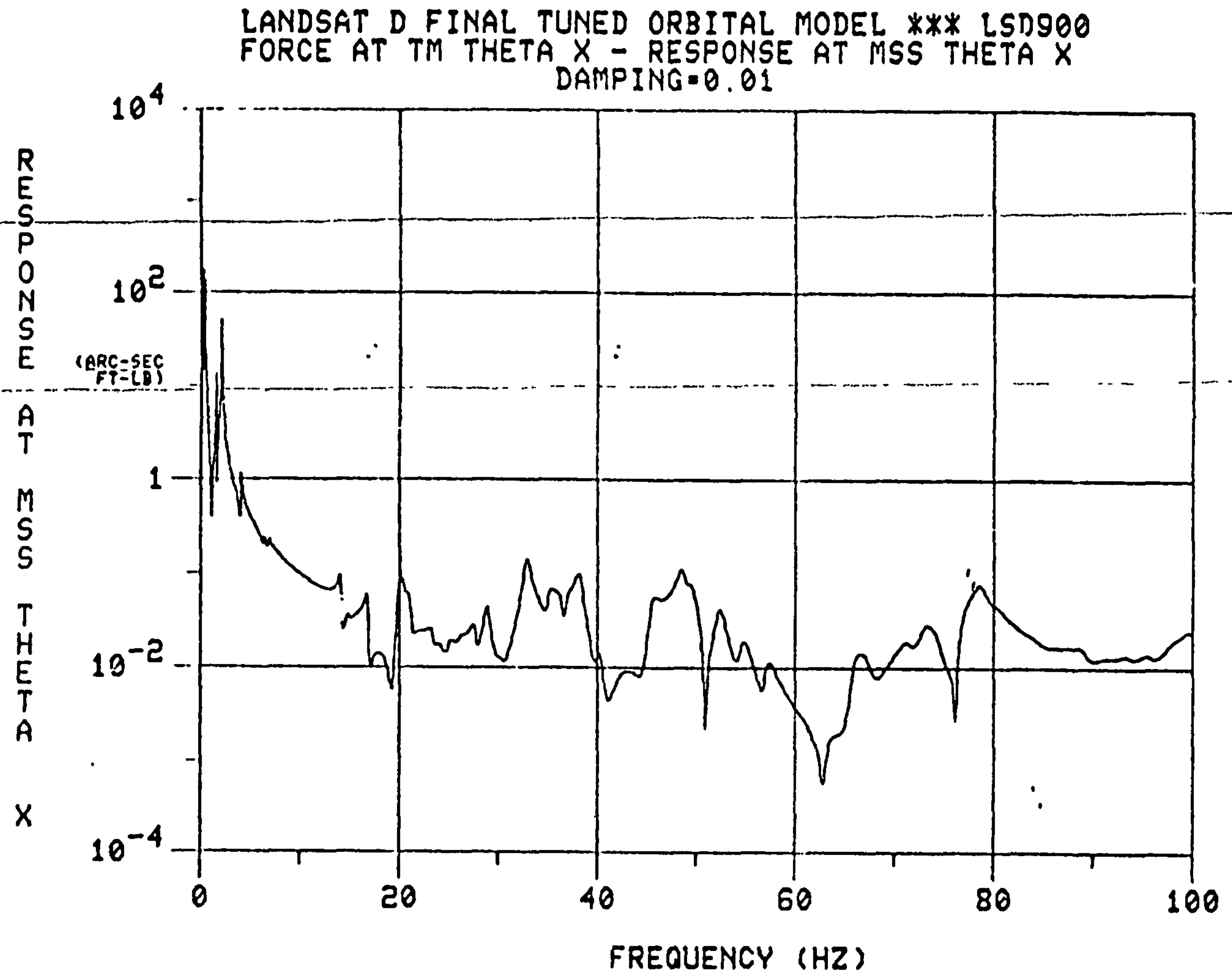
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT TM THETA X - RESPONSE AT MSS THETA X
DAMPING=0.01
RESPONSE AT MSS THETA X
(ARC-SEC FT-LB)
10^4
10^2
1
10^{-2}
10^{-4}
0
20
40
60
80
100
FREQUENCY (HZ)

Figure 5.2-33

ORIGINAL PAGE IS OF POOR QUALITY

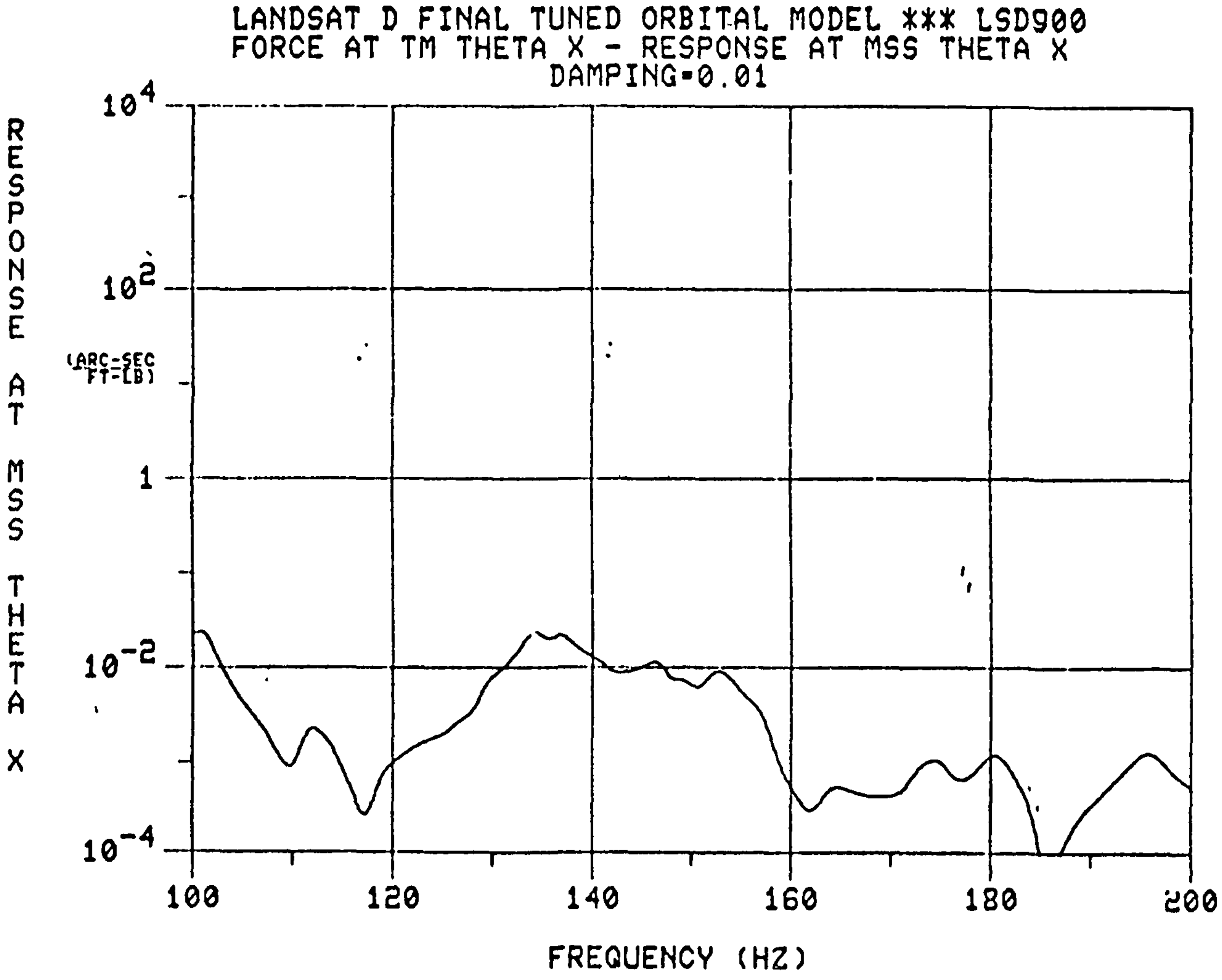

Figure 5.2-34

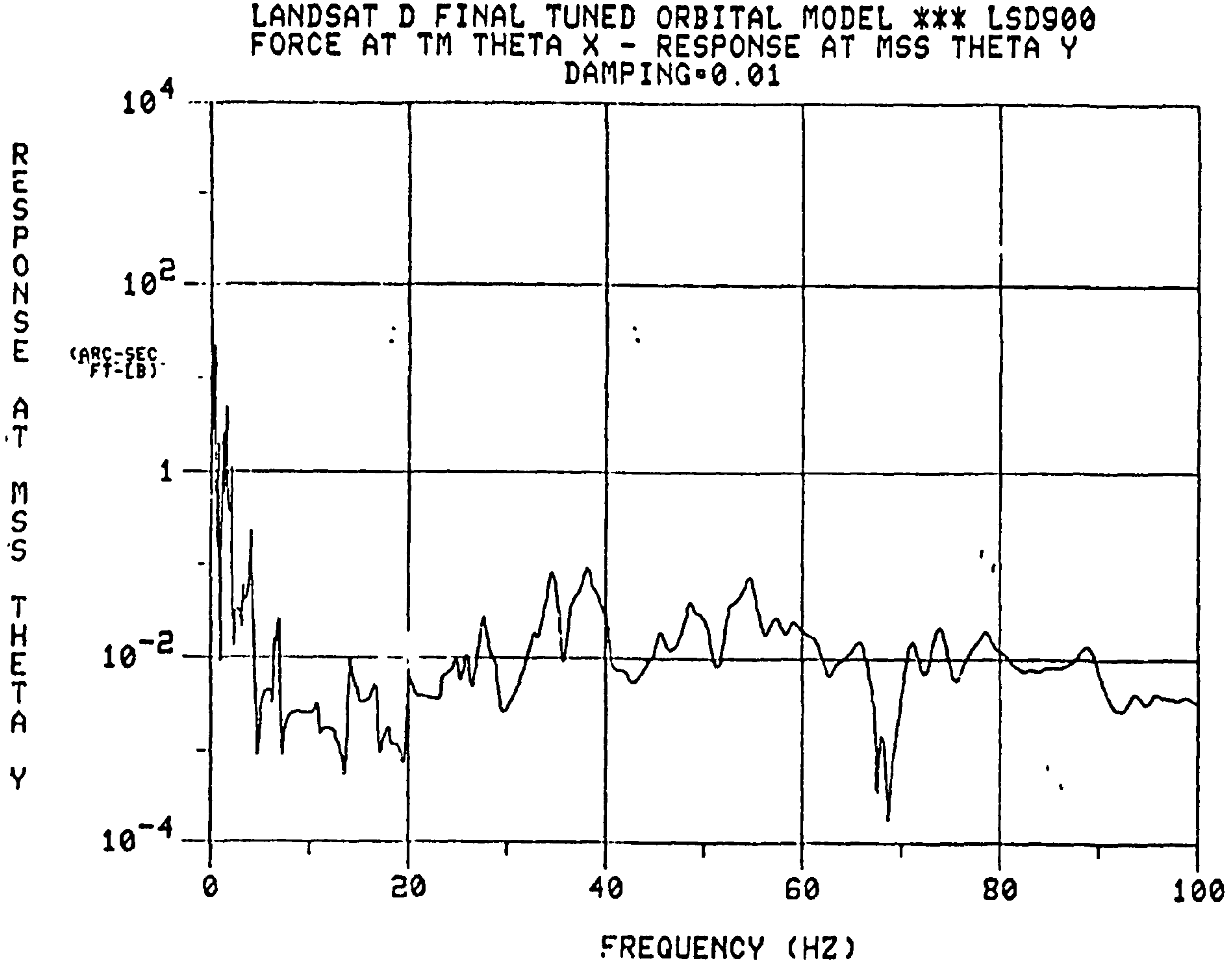
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT TM THETA X - RESPONSE AT MSS THETA Y
DAMPING=0.01
RESPONSE AT MSS THETA Y
(ARC-SEC FT-LB)
10^4
10^2
1
10^{-2}
10^{-4}
0
20
40
60
80
100
FREQUENCY (HZ)

Figure 5.2-35

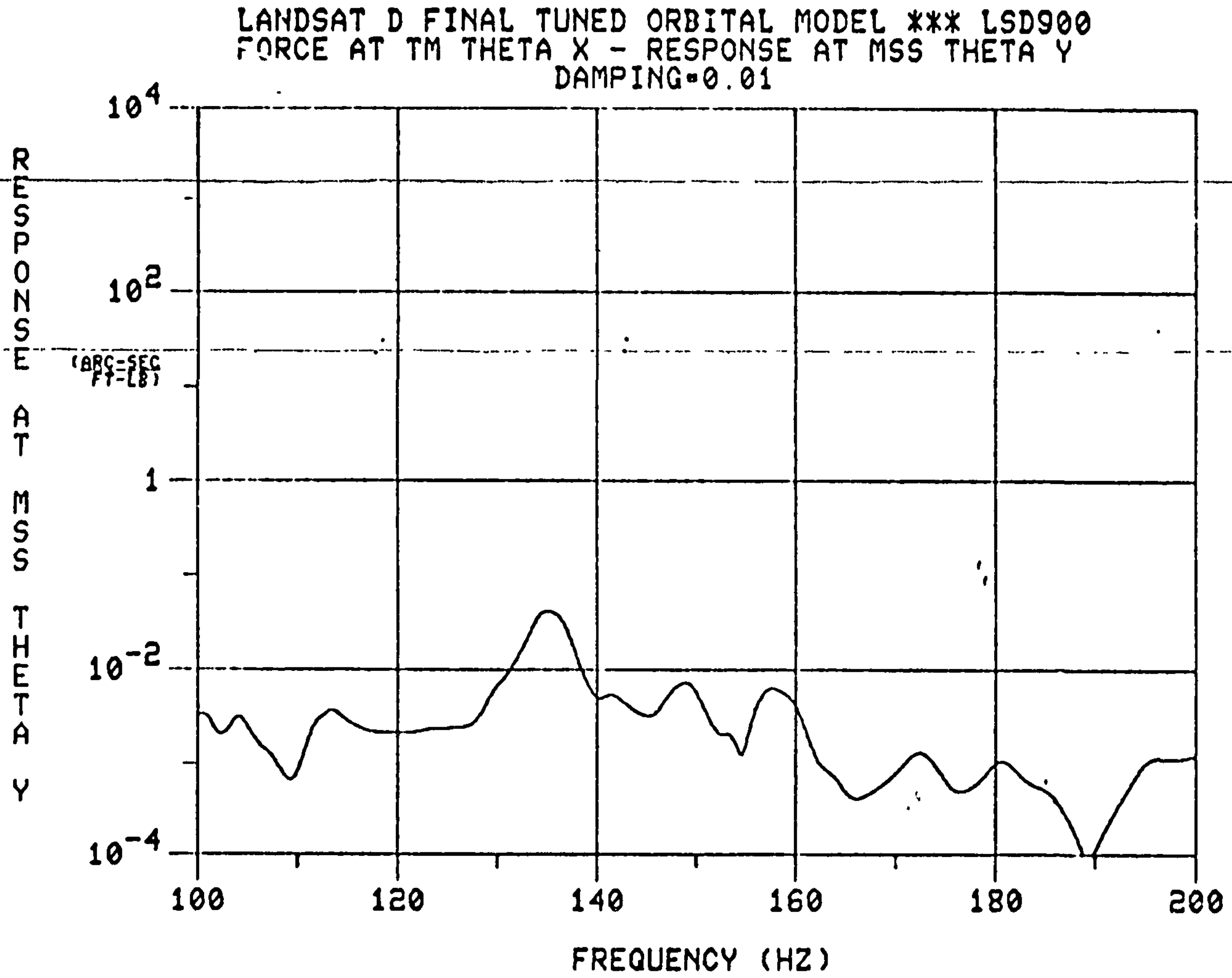
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT TM THETA X - RESPONSE AT MSS THETA Y
DAMPING=0.01
RESPONSE AT MSS THETA Y
(ARC-SEC
FT-LB)
10^4
10^2
1
10^-2
10^-4
100
120
140
160
180
200
FREQUENCY (HZ)

Figure 5.2-36

ORIGINAL PAGE IS
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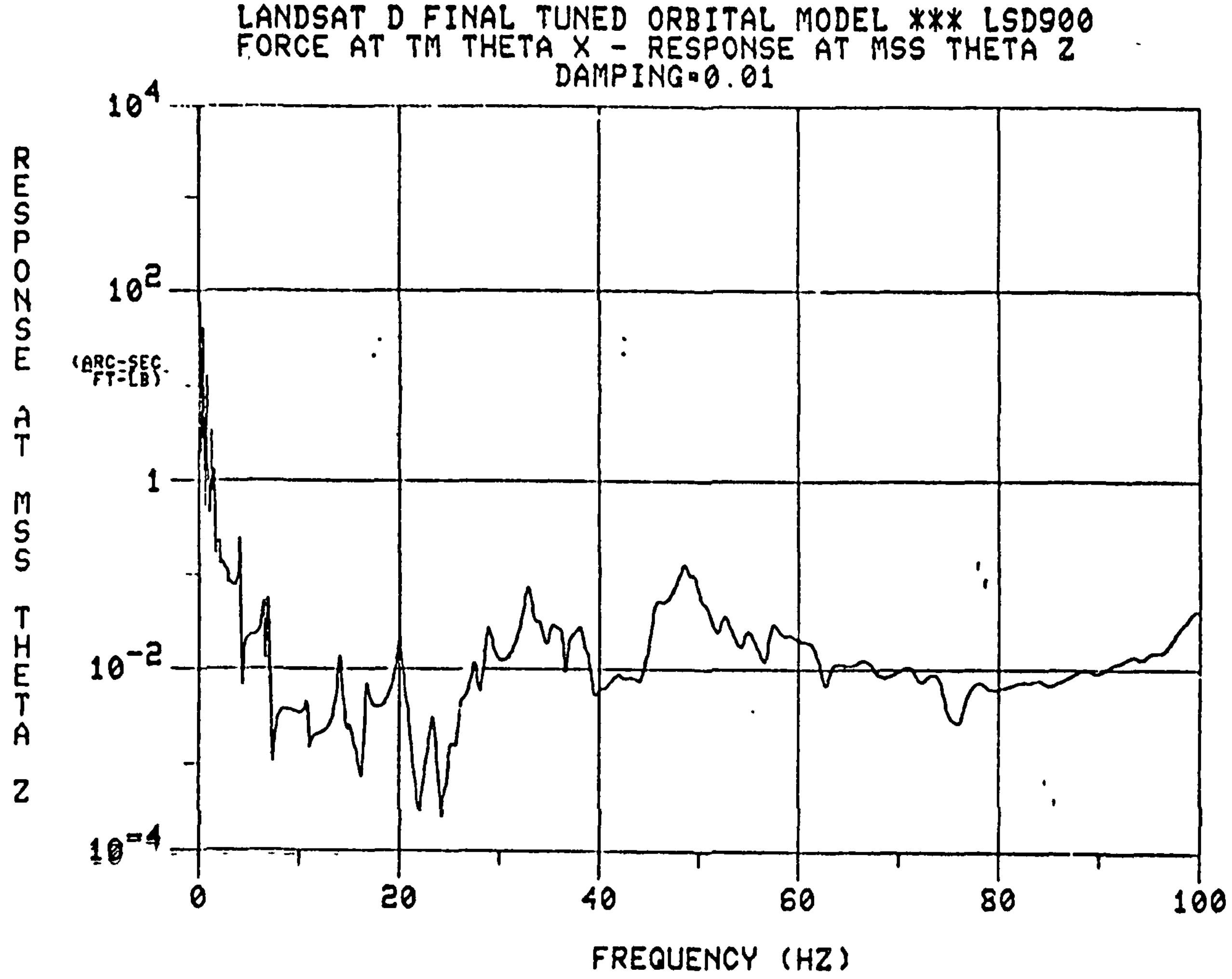

Figure 5.2-37

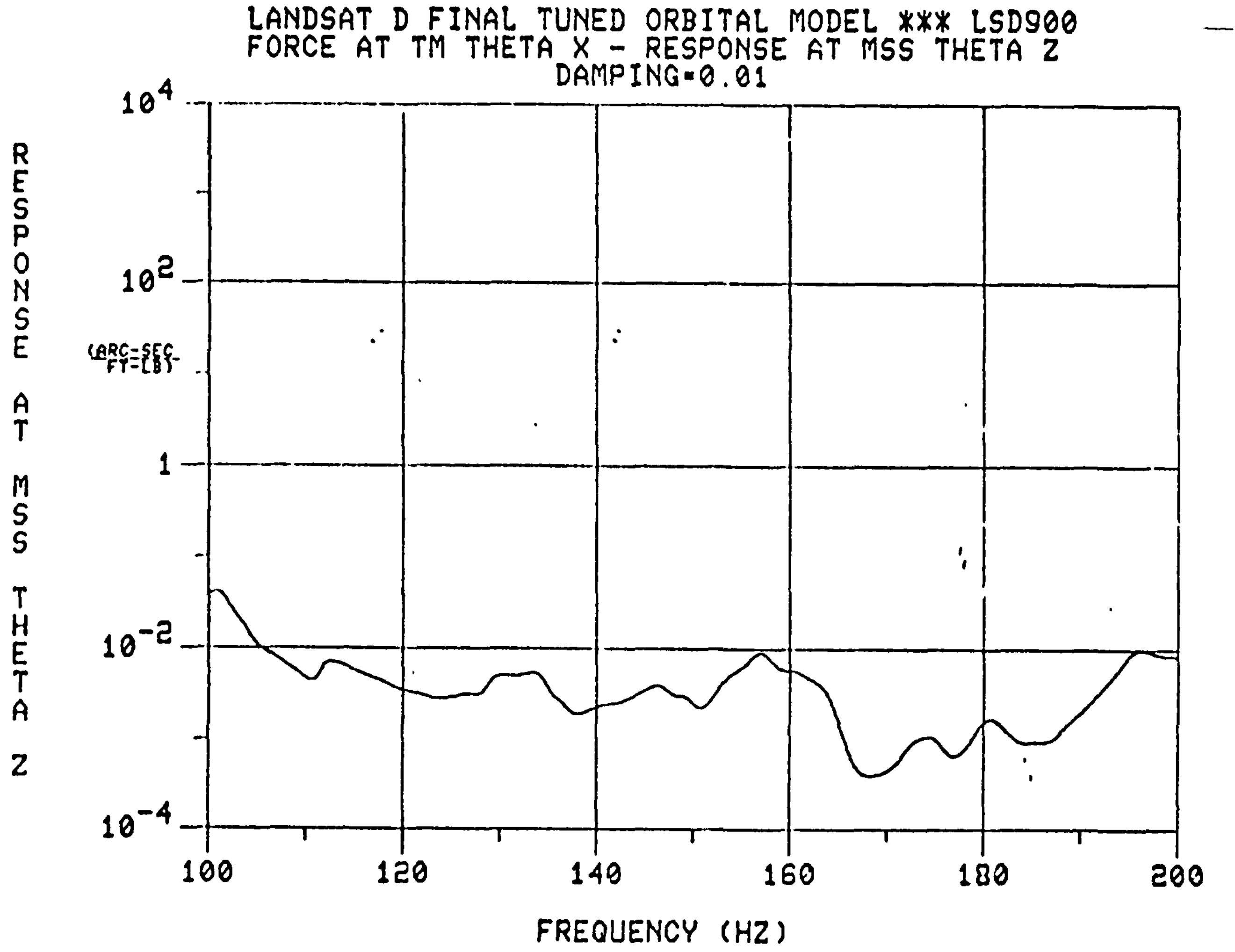
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT TM THETA X - RESPONSE AT MSS THETA Z
DAMPING=0.01

Figure 5.2-38

ORIGINAL PAGE IS
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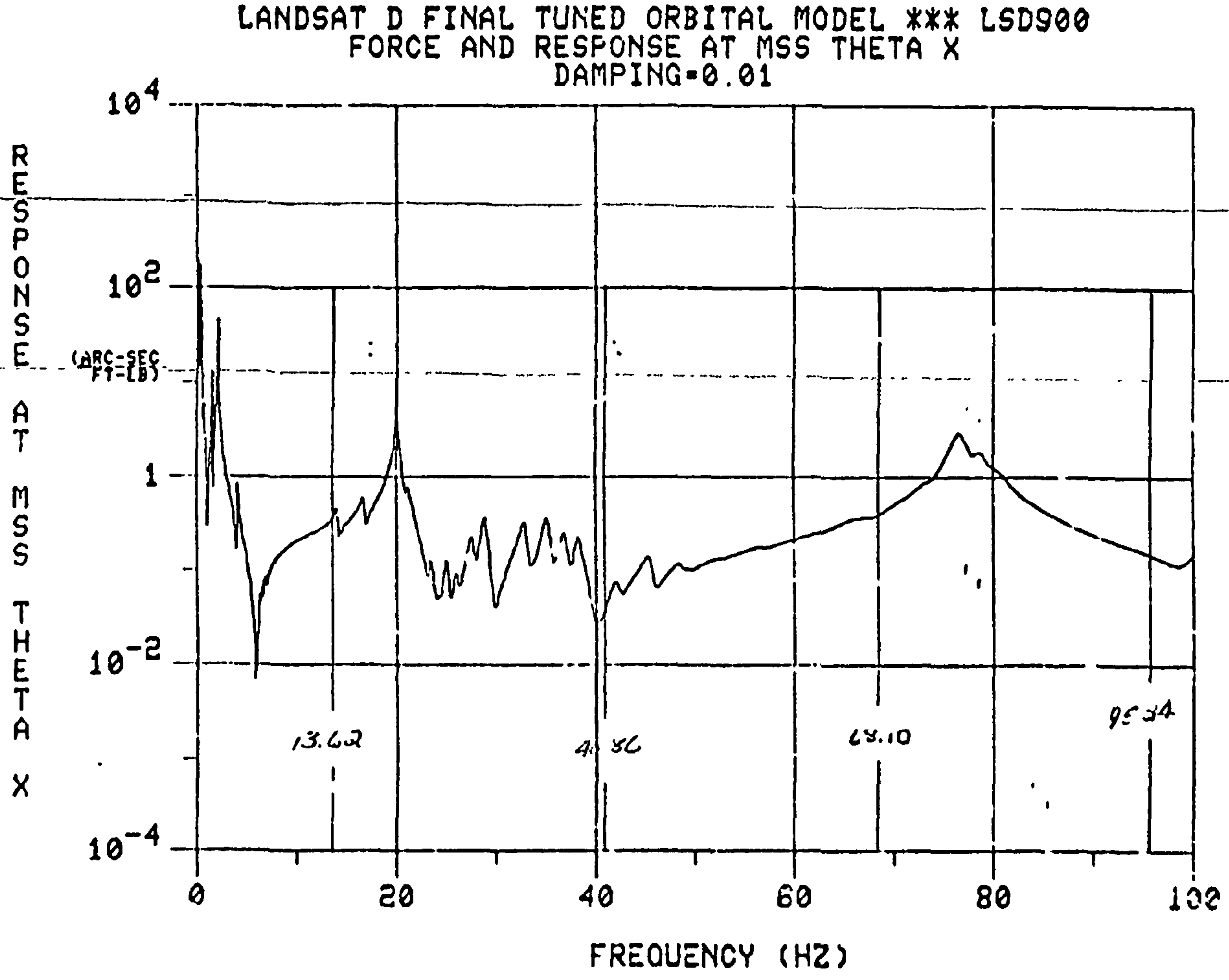
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AND RESPONSE AT MSS THETA X
DAMPING=0.01
RESPONSE AT MSS THETA X
(ARC-SEC/FT-LB)
10^4
10^2
1
10^-2
10^-4
0
20
40
60
80
100
FREQUENCY (HZ)
13.62
40.86
68.10
95.34

Figure 5.2-39

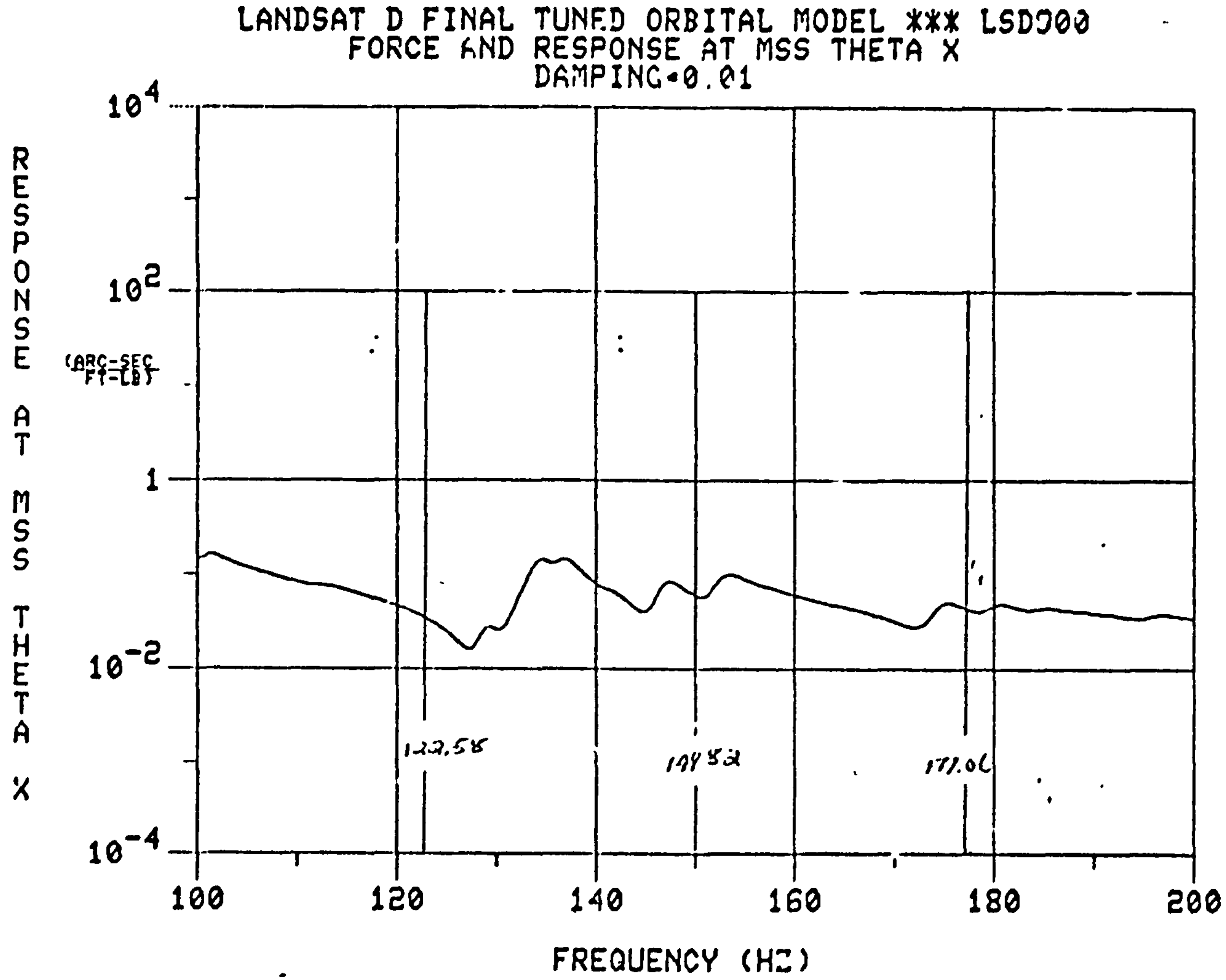

Figure 5.2-40

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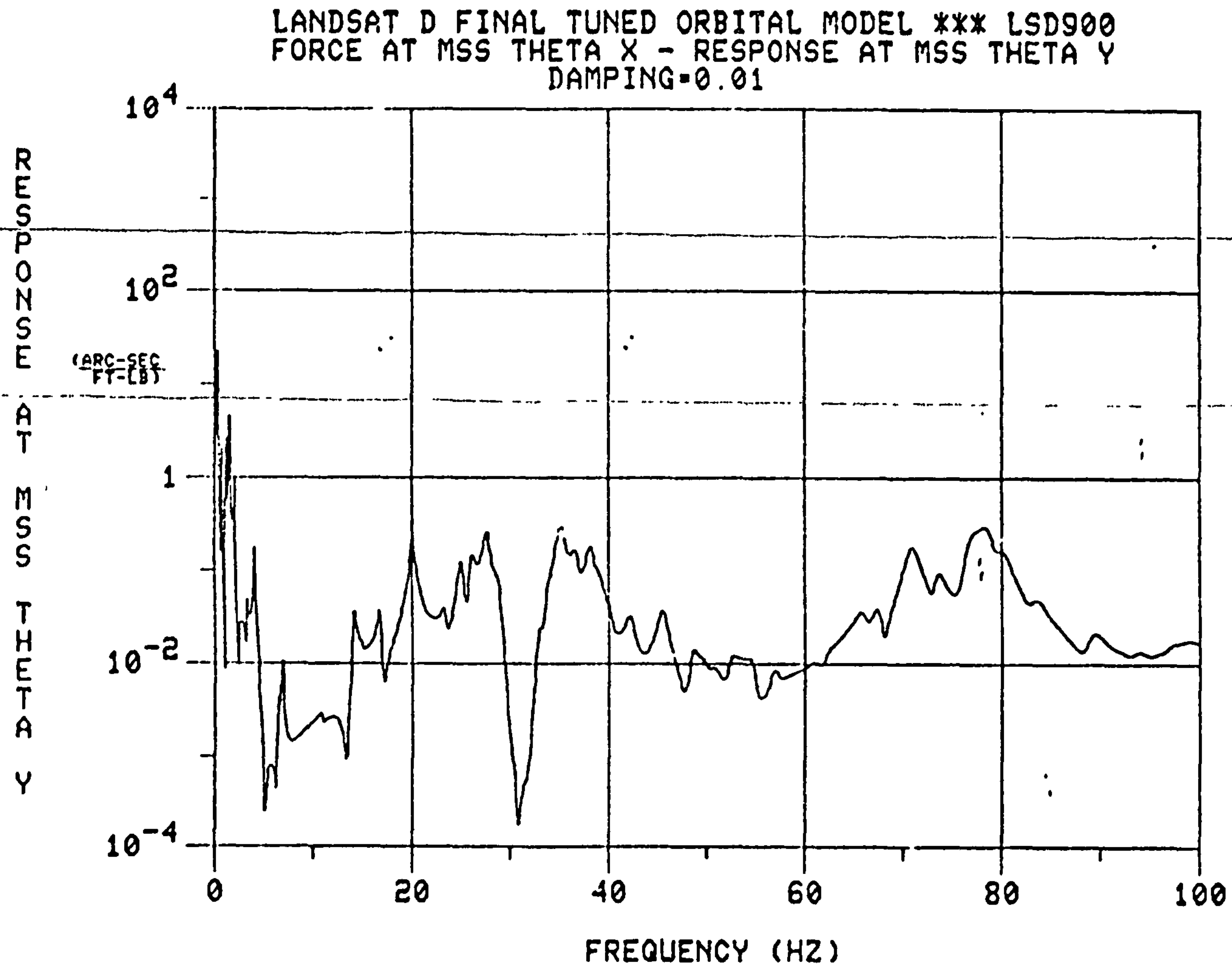
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT MSS THETA X - RESPONSE AT MSS THETA Y
DAMPING=0.01
RESPONSE AT MSS THETA Y
(ARC-SEC/FT-LB)
10^4
10^2
1
10^-2
10^-4
0
20
40
60
80
100
FREQUENCY (HZ)

Figure 5.2-41

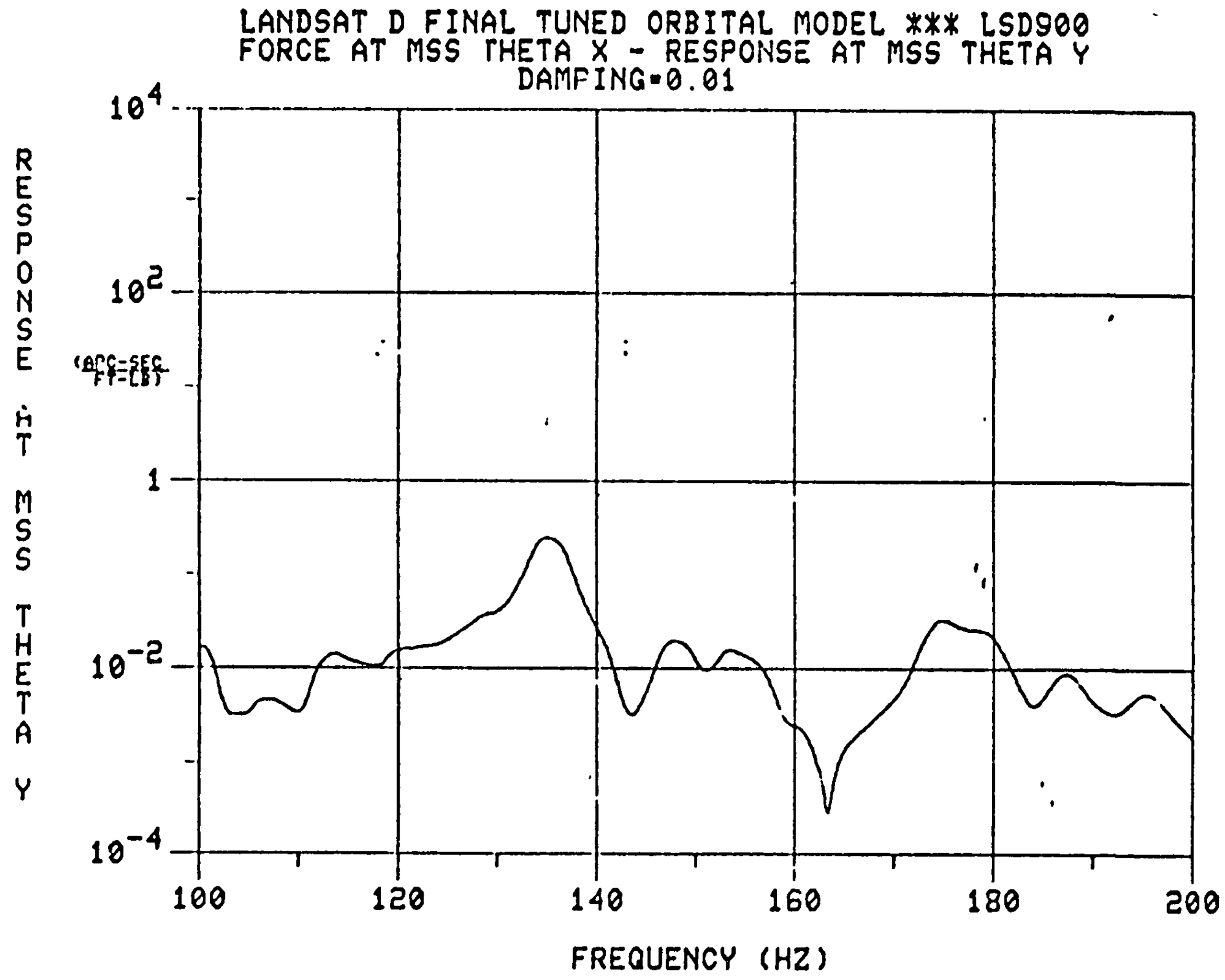
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT MSS THETA X - RESPONSE AT MSS THETA Y
DAMPING=0.01
RESPONSE AT MSS THETA Y
(ACC=SEC FT=LB)
10^4
10^2
1
10^-2
10^-4
100
120
140
160
180
200
FREQUENCY (HZ)

Figure 5.2-42

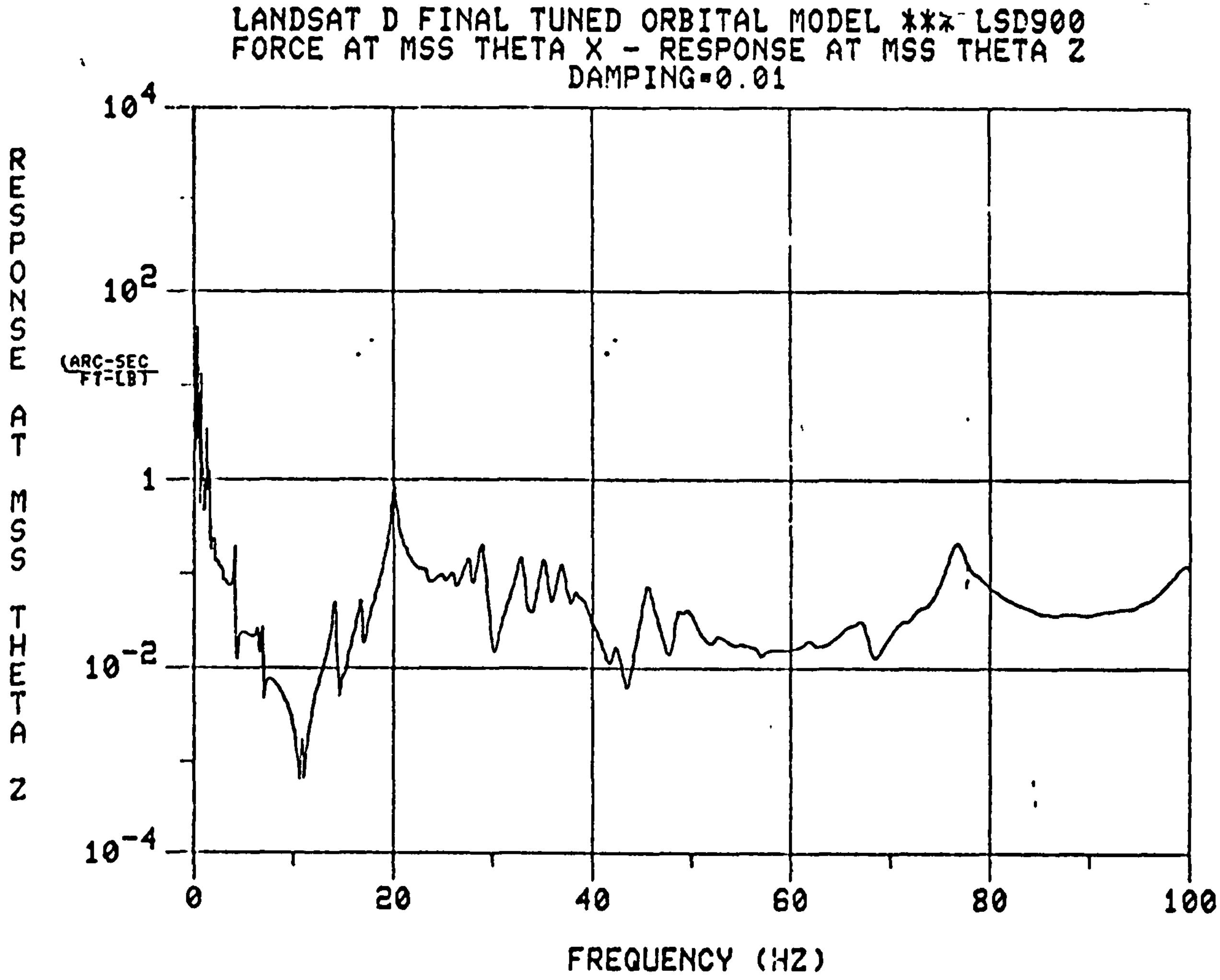
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT MSS THETA X - RESPONSE AT MSS THETA Z
DAMPING=0.01
RESPONSE AT MSS THETA Z
(ARC-SEC/FT-LBT)
10^4
10^2
1
10^{-2}
10^{-4}
0
20
40
60
80
100
FREQUENCY (HZ)

Figure 5.2-43

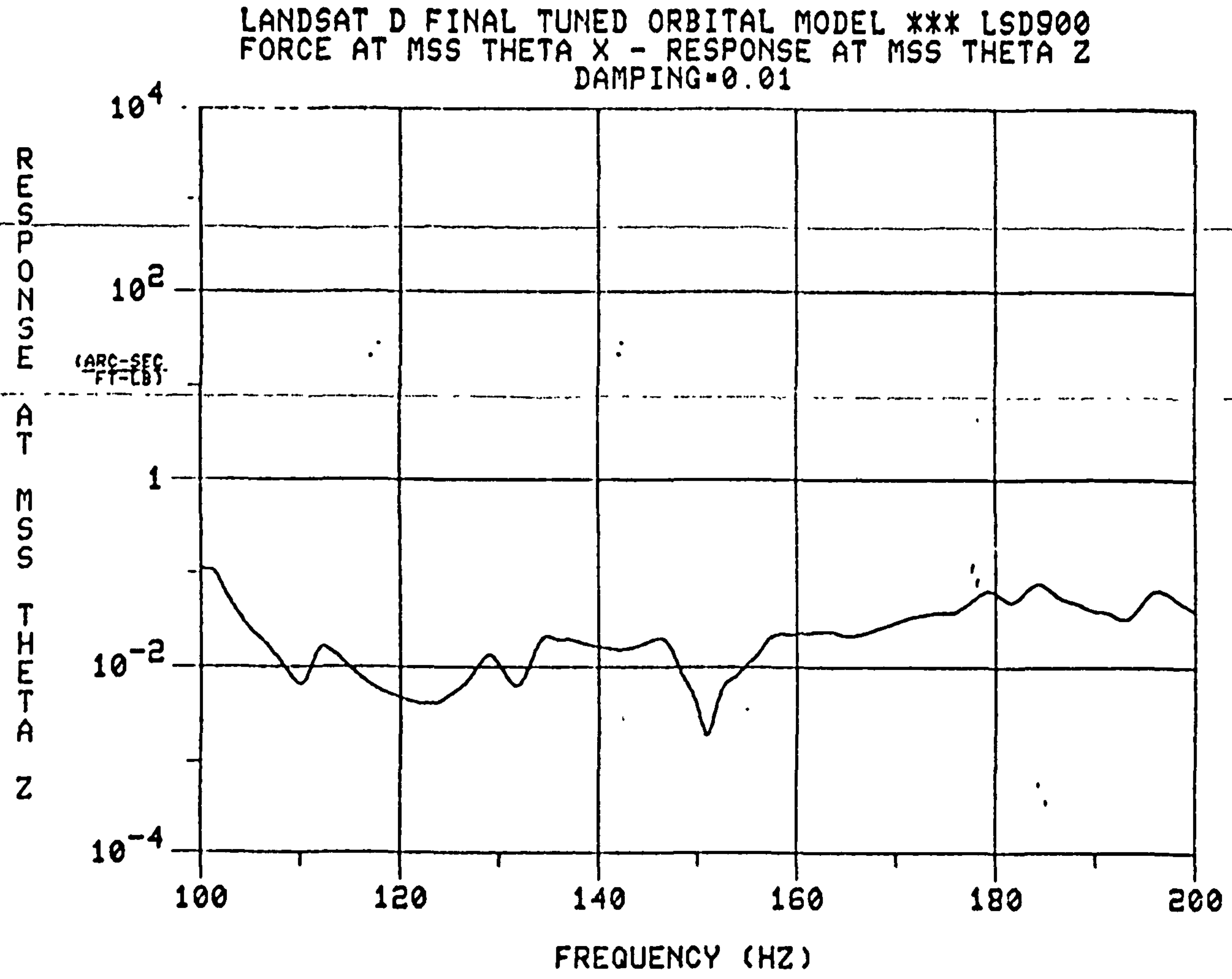
LANDSAT D FINAL TUNED ORBITAL MODEL *** LSD900
FORCE AT MSS THETA X - RESPONSE AT MSS THETA Z
DAMPING=0.01
RESPONSE AT MSS THETA Z
(ARC-SEC / FT-LB)
10^4
10^2
1
10^{-2}
10^{-4}
100
120
140
160
180
200
FREQUENCY (HZ)

Figure 5.2-44

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Table 5.2-4 Jitter Allowables

		RMS Allowables (Arc-Sec)		
Experiment	Axis	.30 Pixel	.40 Pixel	.50 Pixel
MSS	θ_X	1.50	3.14	4.42
	θ_Y	1.3	3.0	4.3
	θ_Z	8.2	10.8	12.3
TM*	θ_X	20.0	-	-
	θ_Y	3.6	-	-
	θ_Z	6.0	-	-

*Values For TM Experiment Are Expressed in Peak Arc-Sec.

RUN NO. ORB900

DATE 072381
RUN BY T.E.POLLAK

JITTER MODEL LS0900 PRCERR=15 ZG=.001
TM FORCES MSS/RMS ALLOWABLES

Model Number → LS0900

Bandwidth → PRCERR=15

ZG=.001 ← Damping

Forcing Location → TM FORCES

MSS/RMS ← Response Location/Type Response

COEFF	MODE	FCPS	RATIO	P4TM	P5TM	P6TM	R4TM	R5TM	R6TM	P4MSS	P5MSS	P6MSS	R4MSS	R5MSS	R6MSS
1	17	7.00	1.0818	5.95	0.76	0.88	4.29	0.41	0.51	2.24	0.97	1.53	1.51	0.44	1.01
1	18	7.00	1.0123	5.38	1.21	1.83	3.90	0.67	1.20	2.69	1.37	2.00	1.75	0.70	1.34
2	30	21.00	1.0466	1.39	0.40	1.02	0.85	0.21	0.62	4.29	0.68	0.82	2.31	0.38	0.49
3	41	35.00	1.0641	3.23	1.03	3.06	1.79	0.58	2.08	4.95	0.63	2.20	2.99	0.38	1.47
3	44	35.00	1.0157	1.41	0.76	0.33	0.85	0.41	0.17	1.22	2.40	0.25	0.72	1.66	0.12
3	50	35.00	0.9153	2.21	1.78	4.46	1.18	1.10	3.06	2.72	2.48	0.64	1.37	1.69	0.32
4	67	49.00	1.0087	9.68	2.17	3.15	6.12	1.44	2.09	3.[illegible]3	1.47	3.00	1.89	0.81	2.01
4	76	49.00	0.8952	6.63	5.74	1.72	3.99	3.97	1.14	[illegible]	2.96	0.72	0.80	1.78	0.40

COEFF ← Harmonic

MODE ← Mode No.

FCPS ← Harmonic Frequency

RATIO ← Shift Value To Have Modal f_N = Harmonic f_N

P4TM … R6TM: TM Response Amplitudes

P4MSS … R6MSS: MSS Response Amplitudes

NOMENCLATURE:

P5MSS

P ← Type Of Response
P = Peak
R = RMS

5 ← Direction
4 = θ_x
5 = θ_Y
6 = θ_Z

MSS ← Location Of Response

Table 5.2-5

```
RUN NO. ORB900                                DATE 072381
                                           RUN BY T.E.POLLAK

       JITTER MODEL LSD900   PRCERR=107  ZG=.001
       TM FORCES   MSS/RMS ALLOWABLES

COEFF MODE    FCPS   RATIO    P4TM   P5TM   P6TM   R4TM   R5TM   R6TM  P4MSS  P5MSS  P6MSS  R4MSS  R5MSS  R6MSS
    1   17    7.00  1.0818    5.95   0.76   0.88   4.29   0.41   0.51   2 24   0.97   1.53   1.51   0.44   1.01
    1   18    7.00  1.0123    5.38   1.21   1.83   3.90   0.67   1 20   2.69   1.37   2.00   1.75   0.70   1 34
    2   30   21.00  1.0466    1.39   0.40   1.02   0 85   0 21   0.62   4.29   0.68   0.82   2.31   0 38   0.49
    3   41   35.00  1 0641    3.23   1.03   3.06   1.79   0.58   2.08   4.95   0.63   2.20   2.99   0.38   1.47
    3   44   35.00  1.0157    1.41   0.76   0.33   0.85   0 41   0.17   1.22   2.40   0 25   0.72   1 66   0 12
    3   50   35 00  0.9153    2.21   1.78   4.46   1.18   1.10   3.06   2.72   2.48   0.64   1.37   1.69   0.32
    4   67   49.00  1.0087    9.68   2.17   3.15   6.12   1.44   2.09   3.33   1.47   3.00   1.89   0.81   2.01
```

Table 5.2-6

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```
RUN NO. ORB900                                    DATE 072381
                                                  RUN BY T.E.POLLAK

        JITTER MODEL LSD900   PRCERR=5   ZG=.001
        TM FORCES    MSS/RMS ALLOWABLES

COEFF MODE   FCPS  RATIO    P4TM   P5TM   P6TM   R4TM   R5TM   R6TM  P4MSS  P5MSS  P6MSS  R4MSS  R5MSS  R6MSS
    1   18   7.00 1.0123    5.38   1.21   1.83   3 90   0.67   1.20   2.69   1.37   2.00   1.75   0.70   1.34
    2   30  21.00 1 0466    1.39   0.40   1.02   0 85   0 21   0 62   4.29   0.68   0.82   2.31   0.38   0.49
    3   44  35 00 1.0157    1 41   0.76   0.33   0.85   0.41   0.17   1.22   2.40   0.25   0.72   1.66   0.12
    4   67  49.00 1 0087    9.68   2.17   3 15   6 12   1.44   2.09   3.33   1.47   3.00   1.89   0.81   2.01
```

Table 5.2-7

RUN NO. ORB900

DATE 072381
RUN BY T.E.POLLAK

JITTER MODEL LSD900 PRCERR=15 ZG=.001
MSS FORCES MSS/RMS ALLOWABLES

COEFF	MODE	FCPS	RATIO	P4TM	P5TM	P6TM	R4TM	R5TM	R6TM	P4MSS	P5MSS	P6MSS	R4MSS	R5MSS	R6MSS
1	24	13 62	0.9676	1 75	0 63	0 58	1.16	0.36	0.37	6 57	0.51	1 11	3.80	0.26	0 71
1	25	13 62	0.9631	1.09	1.63	0 48	0 69	1.13	0.30	5.45	1.23	0.98	3 02	0 74	0 62
2	48	40 86	1 1091	0 84	3 58	2 85	0.43	2 48	1 89	6 25	2 57	2.79	3 89	1.61	1.87
2	49	40 86	1 0700	1 52	1 62	5 17	0 88	1 09	3 52	4 90	2 35	0 65	2.79	1 49	0.38
2	50	40 86	1 0686	1 63	1 86	5.22	0.96	1 27	3 56	3.51	2.84	0 69	1.83	1.83	0 41
2	64	40 86	0.8987	1 99	0 99	1.90	1 22	0 66	1.23	4 58	1.74	3 00	2.65	1.06	2.02
3	99	68.10	0.9613	0.37	0.37	0 49	0.19	0 19	0 24	2 60	6.17	0.38	1.25	4.23	0.18
3	102	68 10	0 9289	0.95	0 32	0 49	0 50	0 16	0 24	5 87	2 70	0.63	3.08	1.78	0.29
3	104	68 10	0.8981	0 58	0.73	0.74	0 28	0 43	0 38	3.69	0.28	0.47	1.73	0.16	0.21
3	105	68 10	0 8891	1 25	6 62	4 13	0 68	4.59	2 72	94 55	5.71	7.92	65 54	3.90	5 38
3	106	68 10	0 8845	0 53	1.98	2 48	0 23	1.31	1.56	15 67	1.41	1.05	9.86	0.88	0 56
3	107	68 10	0 8788	1.12	2.91	1.77	0 62	1 97	1.06	7.31	1 57	0.58	4.03	0 97	0.26
3	108	68 10	0 8674	3 15	6.05	4.75	2.04	4.19	3.15	46 86	10.75	1 26	31.85	7.43	0.70
3	109	68.10	0 8507	0 38	0.23	0.82	0.46	0.10	0 43	14.74	4.41	0 54	9 20	2.76	0 24
4	126	95.34	0.9572	0.75	0.70	0.95	0.41	0 36	0 46	3 53	0.37	2 90	1 59	0 19	1 94
4	127	95 34	0 9441	0.80	0 79	0.77	0 44	0 42	0 35	3 46	0 53	2 54	1 53	0 29	1.68
5	145	122.58	0 9127	0.88	1.01	0 84	0 45	0 62	0 39	5 53	8 30	0.77	2.72	5.63	0.40
5	147	122 58	0 8978	0 75	0 65	0 77	0 37	0 37	0 36	4 85	7.77	0 44	2.29	5.27	0 21
6	145	149.82	1 1156	0 66	0 65	0 68	0 30	0.37	0.30	4 03	4 96	0.61	1 88	3.33	0.27
6	147	149 82	1 0973	0 59	0 45	0 65	0 26	0 24	0 28	3 64	4.78	0.42	1.66	3.15	0 18

Table 5.2-8

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```
RUN NO. ORB900                                    DATE 072381
                                                  RUN BY T.E.POLLAK

      JITTER MODEL LSD900   PRCERR=10   ZG=.001
      MSS FORCES   MSS/RMS ALLOWABLES

COEFF MODE   FCPS   RATIO   P4TM  P5TM  P6TM  R4TM  R5TM  R6TM  P4MSS P5MSS P6MSS R4MSS R5MSS R6MSS
    1   24  13.62  0.9676   1.75  0.63  0.58  1.16  0.36  0.37  6.57  0.51  1.11  3.80  0.26  0.71
    1   25  13.62  0.9631   1.09  1.63  0.48  0.69  1.13  0.30  5.45  1.23  0.98  3.02  0.74  0.62
    2   49  40.86  1.0700   1.52  1.62  5.17  0.88  1.09  3.52  4.80  2.35  0.65  2.79  1.49  0.38
    2   50  40.86  1.0686   1.63  1.86  5.22  0.96  1.27  3.56  3.51  2.84  0.69  1.83  1.83  0.41
    3   99  68.10  0.9613   0.37  0.37  0.49  0.19  0.19  0.24  2.60  6.17  0.38  1.25  4.23  0.18
    3  102  68.10  0.9289   0.95  0.32  0.49  0.50  0.16  0.24  5.87  2.70  0.63  3.08  1.78  0.29
    4  126  95.34  0.9572   0.75  0.70  0.95  0.41  0.36  0.46  3.58  0.37  2.90  1.59  0.19  1.94
    4  127  95.34  0.9441   0.80  0.79  0.77  0.44  0.42  0.35  3.46  0.53  2.54  1.53  0.29  1.68
    5  145 122.58  0.9127   0.88  1.01  0.84  0.45  0.62  0.39  5.53  8.30  0.77  2.72  5.63  0.40
    6  147 149.82  1.0973   0.59  0.45  0.65  0.26  0.24  0.28  3.64  4.78  0.42  1.66  3.15  0.18
```

Table 5.2-9

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```
RUN NO. ORB900                                        DATE 072381
                                                     RUN BY T.E.POLLAK

          JITTER MODEL LSD900   PRCERR=5   ZG=.001
          MSS FORCES   MSS/RMS ALLOWABLES

COEFF MODE   FCPS   RATIO    P4TM   P5TM   P6TM   R4TM   R5TM   R6TM  P4MSS  P5MSS  P6MSS  R4MSS  R5MSS  R6MSS
    1   24  13.62  0.9676    1.75   0.33   0.58   1 16   0.36   0.37   6.57   0.51   1.11   3 80   0.26   0.71
    1   25  13.62  0.9631    1.09   1.63   0.48   0.69   1.13   0.30   5.45   1.23   0.98   3.02   0.74   0.62
    3   99  68.10  0.9613    0.37   0.37   0.49   0.19   0.19   0.24   2.60   6 17   0.38   1.25   4.23   0.18
    4  126  95.34  0 9572    0.75   0.70   0.95   0.41   0 36   0.46   3 58   0 37   2 90   1.59   0.19   1.94
```

Table 5.2-10

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```
RUN NO. ORB900                                          DATE 072381
                                                        RUN BY T.E.POLLAK

        JITTER MODEL LSD900   PRCERR=15   ZG=.01
        MSS FORCES   MSS/RMS ALLOWABLES

COEFF MODE   FCPS   RATIO   P4TM   P5TM   P6TM   R4TM   R5TM   R6TM   P4MSS  P5MSS  P6MSS  R4MSS  R5MSS  R6MSS
    3  105  68 10  0.8891   0.34   0.76   0.75   0.18   0.46   0.36   11.27   0.72   1.03   6.72   0.44   0.58
    3  106  68.10  0.8845   0.26   0 31   0.53   0.18   0 16   0.28    3.56   0.30   0.34   1.63   0.15   0.16
    3  108  68.10  0.8674   0.55   0 77   0 74   0.27   0.44     39    6.57   1.10   0.36   3 49   0.70   0.17
    3  109  68.10  0 8507   0 32   0 18   0 44   0 18   0.10   0 23    3.49   0.49   0.29   1.60   0 26   0.15
```

Table 5.2-11

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particular bandwidth. A detailed explanation of table format appears on Table 5.2-5. A derivation of the MSS experiment forcing function can be found in Reference 12. Considering the data presented, the impact of the predicted MSS response values can be reduced by an alteration of the allowable pixel error specification (see Table 5.2-4) from the current 0.30 values. Tables 5.2-12 and 5.2-13 present the only worst case single mode shift summaries which exist for TM peak allowables. These responses are representative of the order of magnitude of responses expected and confirmed in subsequent model configurations. Since these responses are within the capability of the ADS, future discussion of TM jitter magnitudes will be brief.

To consider the impact of single mode shifts, consider Figures 5.2-45a-b, 5.2-46a-b, and 5.2-47a-b. Depicted here are typical frequency response plots for a force/response at the MSS in the Theta X (θ_X) direction for three bandwidth conditions, 5% 10%, and 15%. As can be seen, with increasing bandwidth (error) spreads an overlap condition (shaded area) develops, predominately at the higher harmonics due to the larger frequencies associated with the forcing harmonic. In evaluating placement of an offensive mode of the eigenvalue spectrum outside the respective harmonics, the overlap conditions and narrow corridors preclude effective movement. Reducing bandwidth spread compromises the structural unknowns associated with each spacecraft. Therefore, a statistical approach was implemented to ascertain the likelihood of any worst case occurrance. A discussion of the statistical approach method in jitter analysis follows.

```
RUN NO. ORB900                                        DATE 072381
                                                      RUN BY T.E.POLLAK

         JITTER MODEL LSD900   PRCERR=15   ZG=.001
         TM FORCES   TM/PEAK ALLOWABLES

COEFF MODE    FCPS   RATIO    P4TM    P5TM    P6TM    R4TM    R5TM    R6TM   P4MSS   P5MSS   P6MSS   R4MSS   R5MSS   R6MSS
    4   76   49 00  0.8952    6 63    5.74    1.72    3 99    3.97    1 14    1 50    2.96    0.72    0.80    1.78    0.40
    4   81   49 00  0.8553    3 74    3 13    1.12    2.04    2 13    0.68    1 37    1.13    1.09    0.76    0.56    0.65
```

Table 5.2-12

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```
RUN NO. ORB900                                          DATE 072381
                                                        RUN BY T.E.POLLAK

         JITTER MODEL LSD900   PRCERR=15   ZG=.001
         MSS FORCES   TM/PEAK ALLOWABLES

COEFF MODE   FCPS   RATIO    P4TM    P5TM    P6TM    R4TM    R5TM    R6TM   P4MSS   P5MSS   P6MSS   R4MSS   R5MSS   R6MS
    2   48  40.86  1.1091    0.84    3 58    2.85    0.43    2.48    1.89    6.25    2.53    2.79    3.89    1.61    1.87
    3  105  68.10  0.8891    1 25    6.62    4 13    0.68    4.59    2.72   94 55    5.71    7.92   65.54    3.90    5.38
    3  107  68.10  0.8788    1.12    2.91    1.77    0 62    1.97    1.06    7.31    1.57    0 58    4.05    0.97    0.26
    3  108  68 10  0 8674    3 15    6 05    4 75    2.04    4 19    3.15   46 86   10.75    1 26   31.85    7.43    0 70
```

Table 5.2-13

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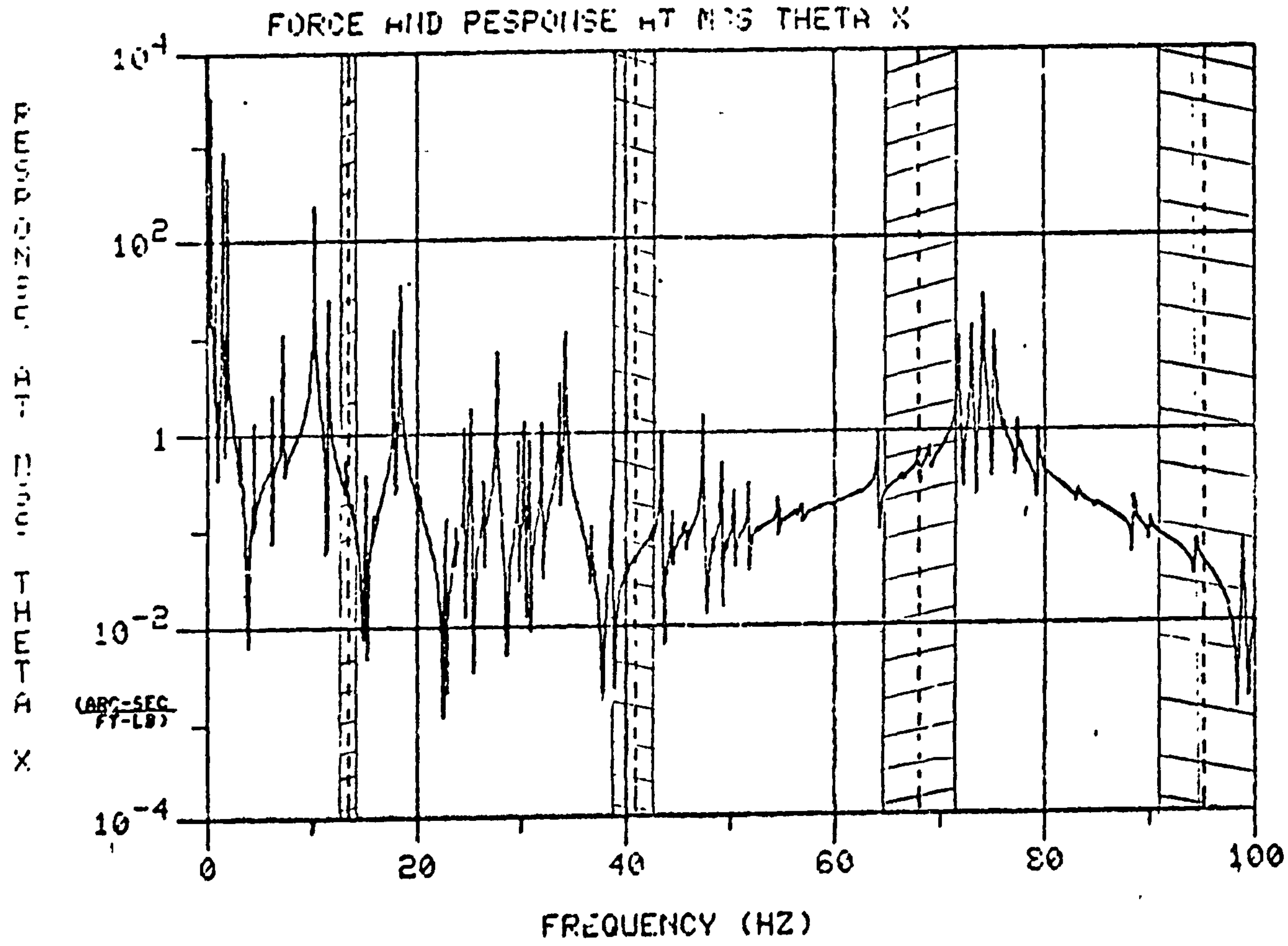
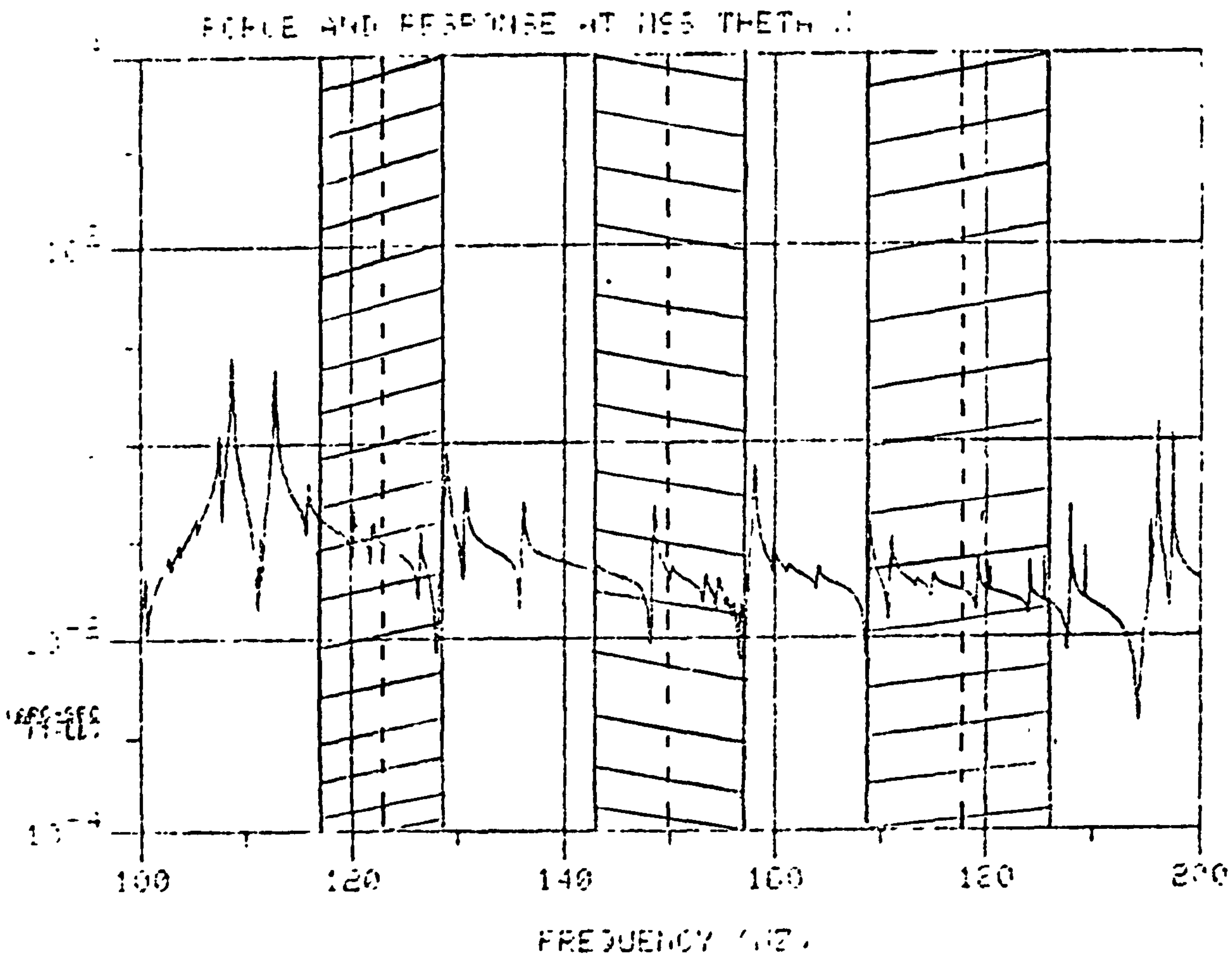


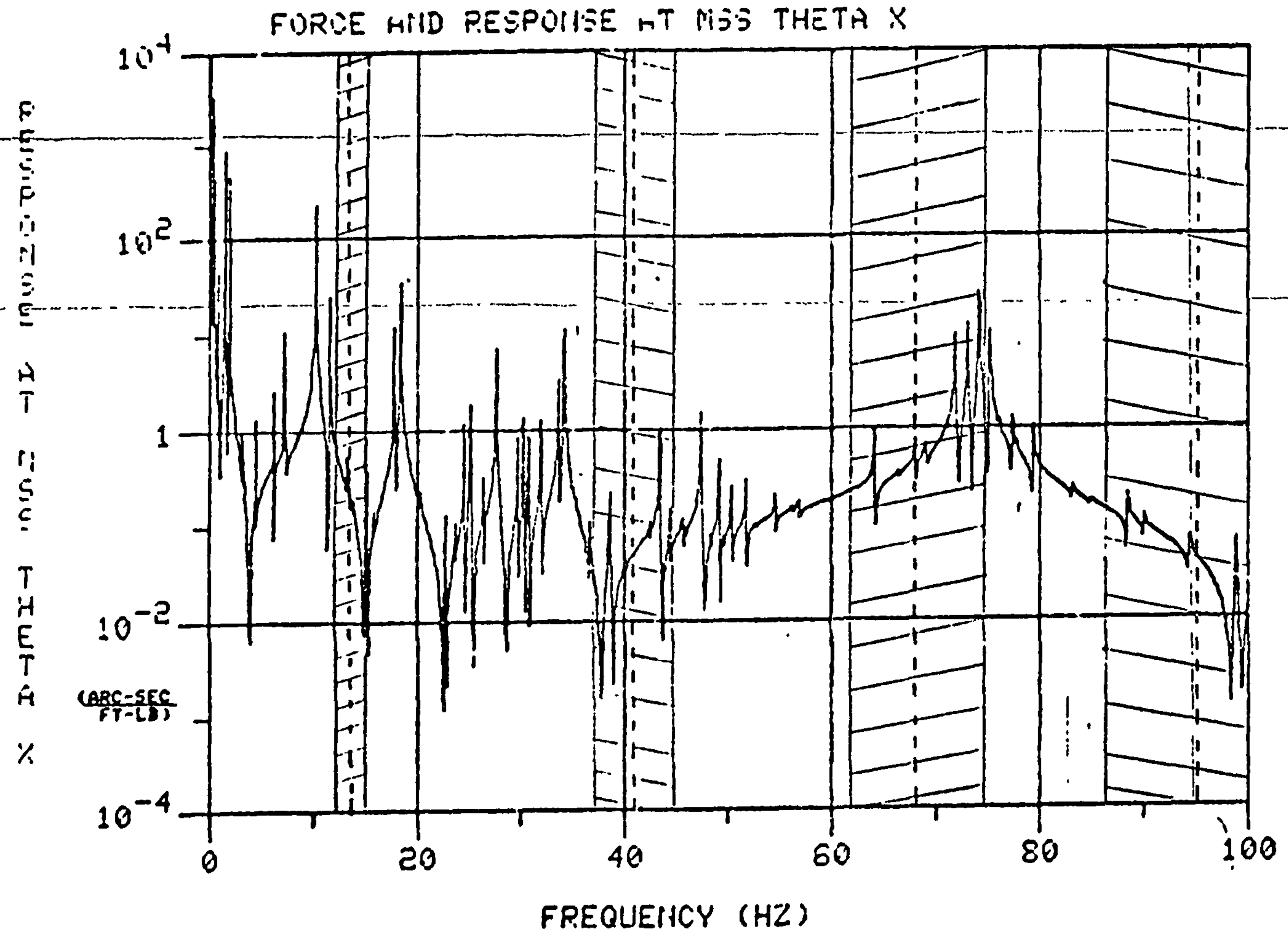
5% BANDWIDTH

Figure 5.2-45a Typical Response Showing 5% Bandwidth for MSS



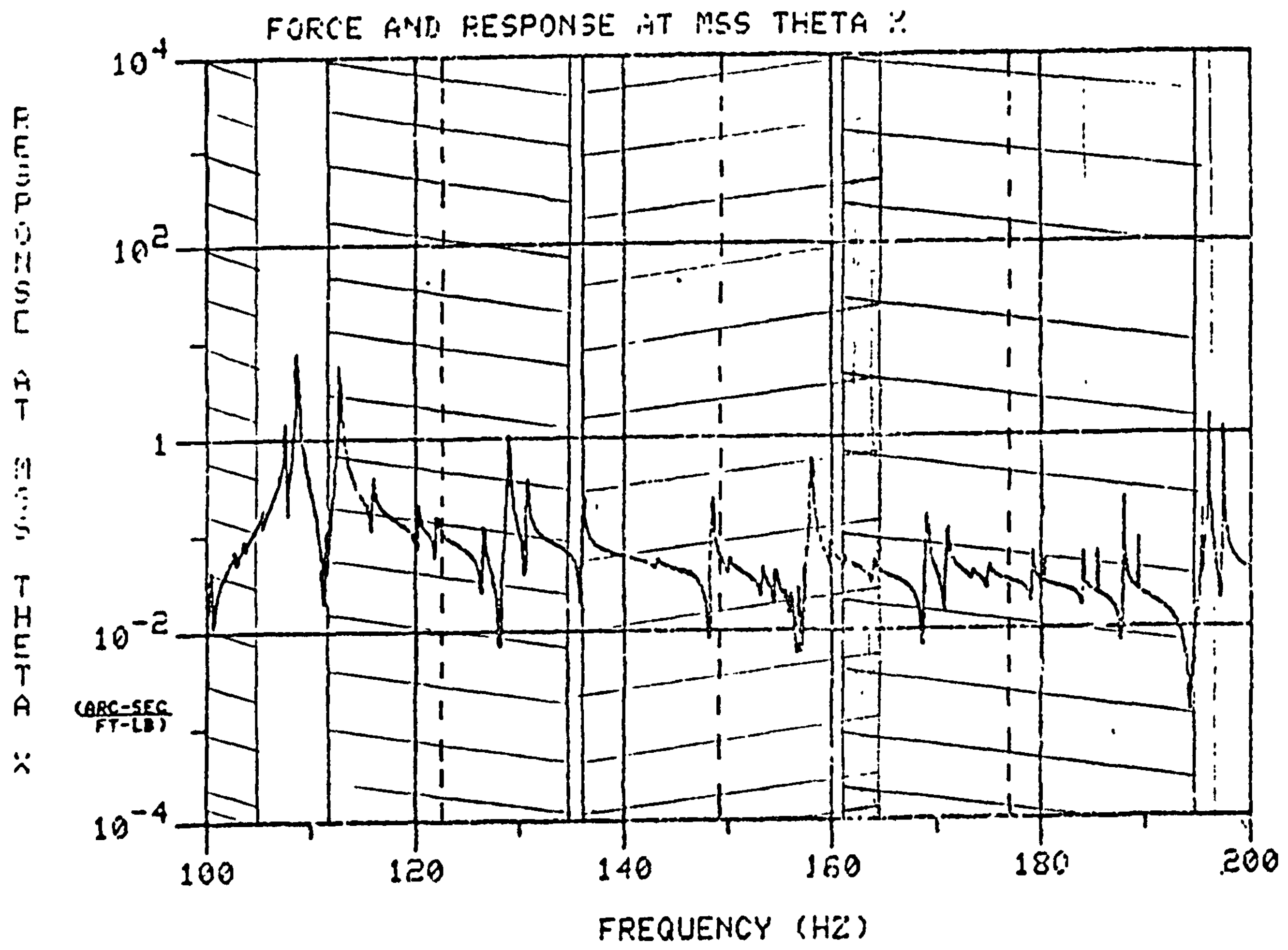
5% BANDWIDTH – – –

Figure 5.2-45b



10% Bandwidth

Figure 5.2-46a Typical Response Showing 10% Bandwidth for MSS



10% Bandwidth.

Figure 5.2-46b

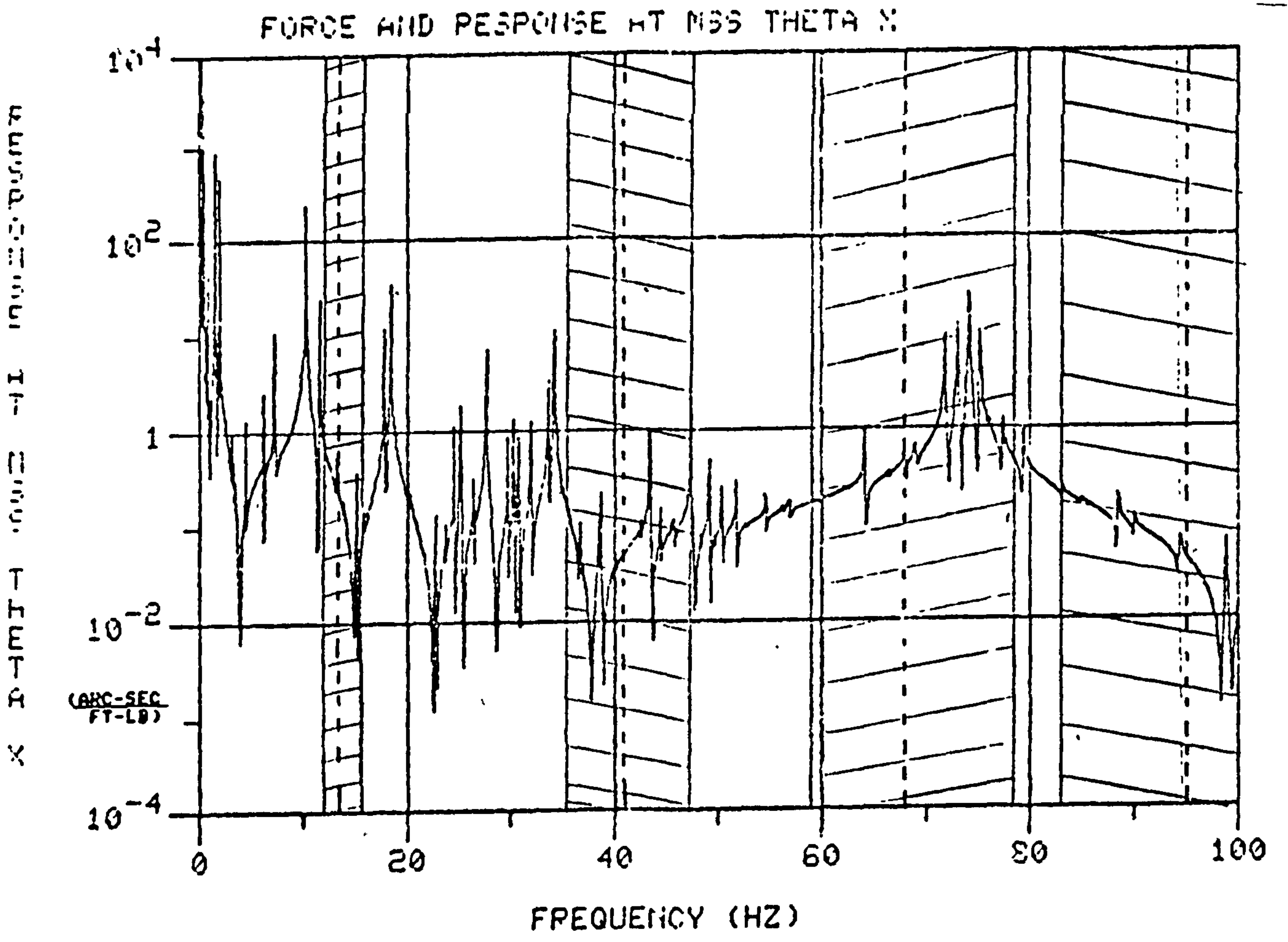
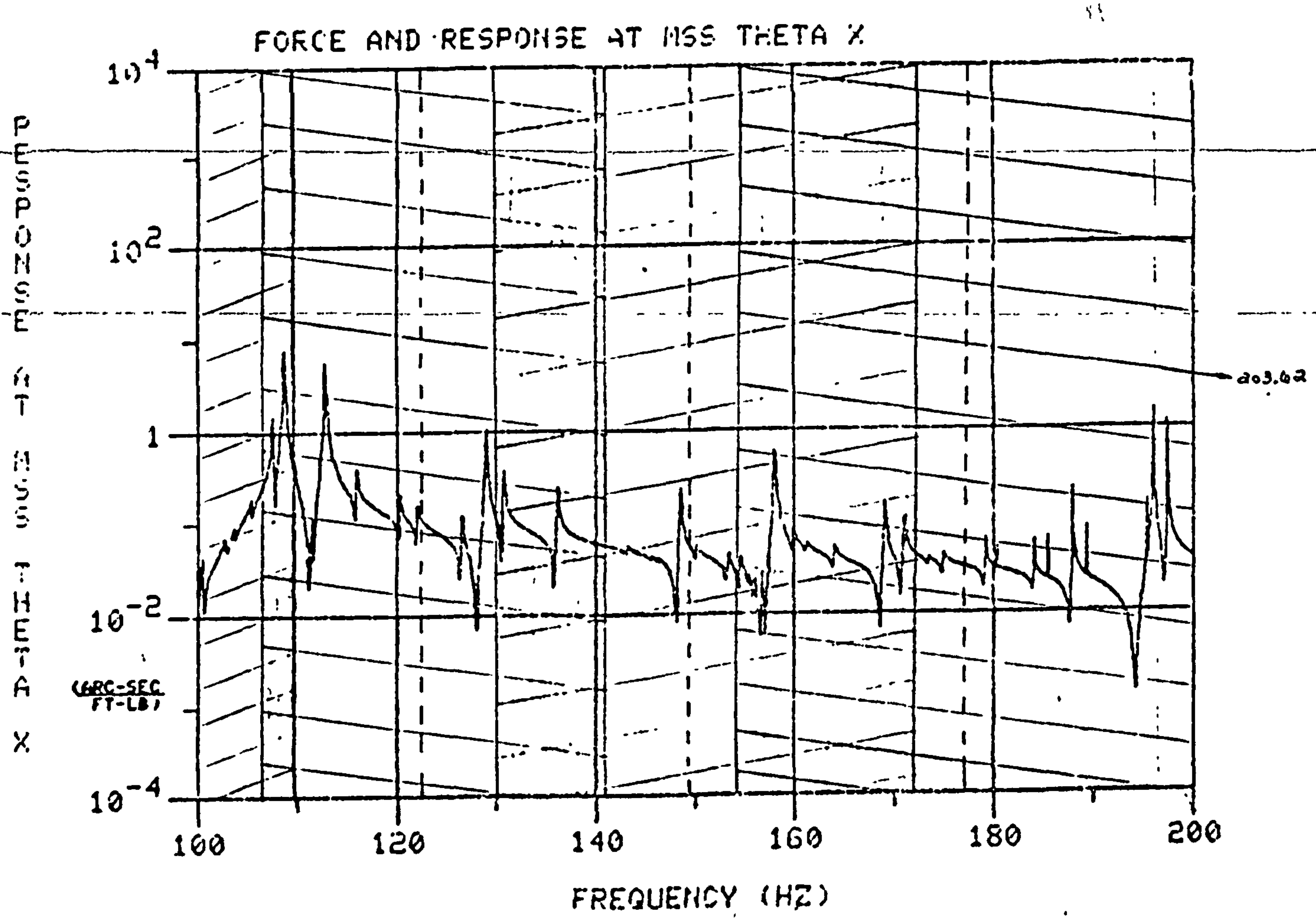


Figure 5.2-47a Typical Response Showing 15% Bandwidth for MSS

15% BANDWIDTH



15% BANDWIDTH

Figure 5.2-47b

A tabulation of LSD900 baseline jitter values (no mode shifts) is presented in Table 5.2-14 for C/C_C = 0.001 and in Table 5.2-15 for C/C_C = 0.01.

5.3 WORST CASE STATISTICAL ANALYSIS

Since a worst case analysis produces maximum jitter responses only when a modal frequency coincides exactly with a forcing harmonic frequency, a statistical analysis approach was developed to determine the probability of exceeding the MSS jitter budget. The analysis includes only those modes which both meet the ±15% bandwidth criteria and result in jitter RMS responses greater than the MSS allowables. From the selected set of worst cases, individual modes are shifted around each forcing frequency to obtain jitter responses and statistics in the θ_X, θ_Y, θ_Z directions at the MSS C.G.

Because an analytical model cannot be "tuned" to exactly match all measured test modes and frequencies, there is an uncertainty associated with the analytical predicted frequencies. Results from previous modal tests indicate that approximately 90% of the tuned model's modes were within 10% of the test frequencies. By assuming a Gaussian distribution for the predicted frequencies, this translates into predicting 98.6% of the modes to within 15% of the measured test frequencies, 90% of the modes to within 10% or 60% of the modes to within 5%. Figure 5.3-1 below shows the Gaussian probability density function for a single mode where 90% of the shaded area under the curve occurs between .9 f_m and 1.1 f_m where f_m is a predicted frequency. Definitions for the mean & standard deviation are also shown.

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Table 5.2-14 LSD900 Baseline Jitter Predictions

Damping = 0.001

Forcing Location	Response Location	Jitter Values	
		Peak	RMS
TM θ_X	TM θ_X	1.3725	0.8445
	θ_Y	0.3404	0.2041
	θ_Z	0.2805	0.1453
	MSS θ_X	1.2063	0.7140
	θ_Y	0.6233	0.3585
	θ_Z	0.2691	0.1273
MSS θ_X	TM θ_X	0.3203	0.1854
	θ_Y	0.2033	0.1015
	θ_Z	0.4862	0.2389
	MSS θ_X	2.0945	1.1673
	θ_Y	0.3492	0.1818
	θ_Z	0.3228	0.1679

Table 5.2-15 LSD900 Baseline Jitter Predictions

Damping = 0.01

Forcing Location	Response Location	Jitter Values	
		Peak	RMS
TM θ_X	TM θ_X	1.7215	0.9267
	θ_Y	0.3673	0.1638
	θ_Z	0.4895	0.2240
	MSS θ_X	1.2426	0.6459
	θ_Y	0.2682	0.1433
	θ_Z	0.3988	0.2144
MSS θ_X	TM θ_X	0.2636	0.1752
	θ_Y	0.1859	0.09626
	θ_Z	0.4465	0.2304
	MSS θ_X	2.3487	1.245
	θ_Y	0.1912	0.08936
	θ_Z	0.2711	0.1417

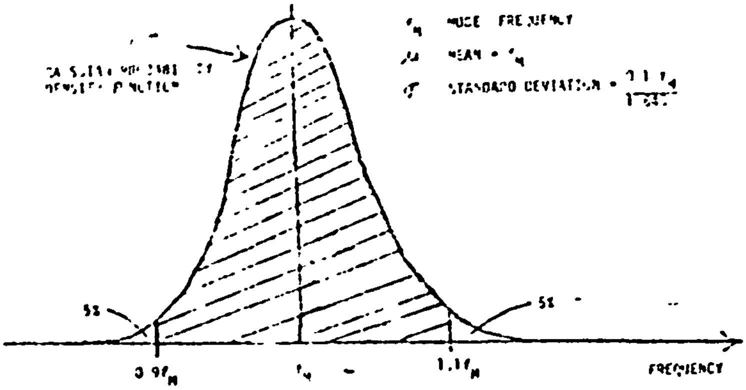

Figure 5.3-1

If the nominal orbital analysis (no shifted modes) results in no jitter responses greater than any of the allowable values, then for each selected worst case mode there can be found an upper (f_u), and lower (f_L) shifted frequency value which results in jitter equal to the allowables. As an example, let us assume that θ_{XO} is the maximum allowable RMS response for MSS response about the X-axis. When the modal frequency, f_M, shown in Figure 5.3-2 is shifted to the driving frequency, f_D, the response, θ_X, is much greater than θ_{XO}. When f_M is shifted to either the lower frequency, f_L, or the upper frequency, f_u, the response θ_X, exactly equals θ_{XO}. The probability that θ_X will be greater than θ_{XO} is given by the probability that f_M falls in the interval defined by f_L and f_u. This probability will be the shaded area under the normal density function shown in Figure 5.3-2.

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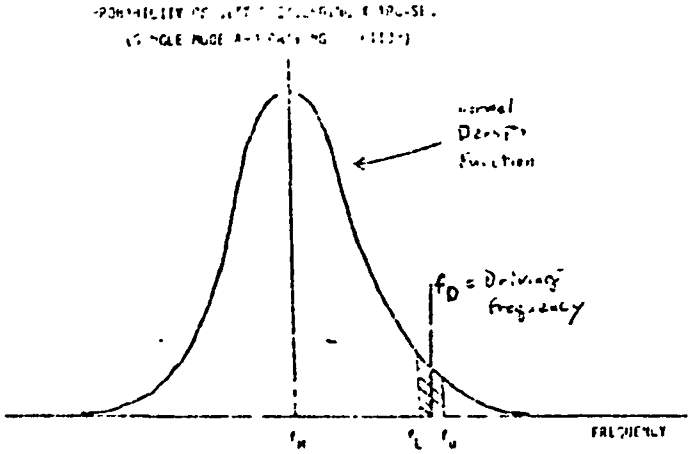

Figure 5.3-2

Now, let A_i be the ith event that one mode when shifted in a specific harmonic results in jitter greater than θ_{XO} in the bandwidth defined by $f_L \leq f_M \leq f_u$. Defining $g_i(f)$ as the Gaussian probability density function for mode j as a function of frequency, the probability, $P[A_i]$, will be given by

$$P[A_i] = \int_{f_1}^{f_2} g_j(X)\, dx$$

Letting n_k equal the number of worst cases at the kth forcing harmonic frequency, the total number of A_i events, n, will be given by

$$n = \sum_k n_k$$

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for k = 1 to maximum number of forcing harmonics used in the analysis. Note that in the higher frequency ranges (above 50 Hz for TM), the ±15% modal frequency error causes modes to be shifted both to the lower and upper forcing frequencies for worst case analyses. If any single mode results in jitter values greater than the allowable in both harmonics, it is counted as two distinct events for the statistical analysis.

Defining the complement of $P[A_i]$ as

$$P[A_i]^C = 1.-P[A_i]$$

where $P[A_i]^C$ represents the probability that event A_i will not occur, the probability that none of the A_i's will occur, $P[A]^C$, is given by the product of all the $P[A_i]^C$'s:

$$P[A]^C = \underset{i}{\pi} (P[A_i]^C)$$

The probability of at least one worst case occurring, P[A], is given by the complement of $P[A]^C$:

$$P[A] = 1.-P[A]^C.$$

Using this statistical approach to describe jitter results provides additional insight for evaluating worst case responses. It allows us to assess jitter as a function of modal frequency and its relative location near a forcing harmonic. The closer a frequency is to a forcing harmonic, the more likely a worst case will occur. At the same time, the magnitude of the jitter response for a particular mode and the overlapping shifts at higher frequencies is accounted for.

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For this report, statistics were calculated using MSS allowables for jitter at the MSS due to both TM and MSS forces. Probabilities were calculated based on the MSS/RMS allowables for each axis of response (θ_X, θ_Y, and θ_Z). Initially the statistics were calculated using a value of $C/C_C = .001$. These results are shown in Figures 5.3-3 to 5.3-8. In order to investigate the effects of damping, a final set of statistics was generated for $C/C_C = .01$ shown for MSS forcing in Figures 5.3-9 to 5.3-11. For $C/C_C = 0.01$ and TM forces, since no worst cases exist, no statistics are available.

Results show that jitter at the MSS due to TM forcing is highly unlikely to occur regardless of the damping values selected. Figure 5.3-6 shows the probability of exceeding the .3 pixel error in the θ_X direction due to TM forces to be .046. The probabilities for all other MSS responses due to TM are less than this value.

Results for jitter at the MSS due to MSS forcing show large changes in the probabilities when the jitter error is in the 1 to 4 arc-sec range. Figure 5.2-3 shows the probability of exceeding 1.5 arc-sec (.3 pixel error) in the θ_X direction is .34. If the allowable RMS jitter is raised to 3.14 arc-secs (.4 pixel error), the probability of exceeding this value is reduced to .093. A similar reduction is shown for the θ_Y responses in Figure 5.3-4. A change from the .3 to .4 pixel allowables reduces the probability of exceedance from .094 to .027.

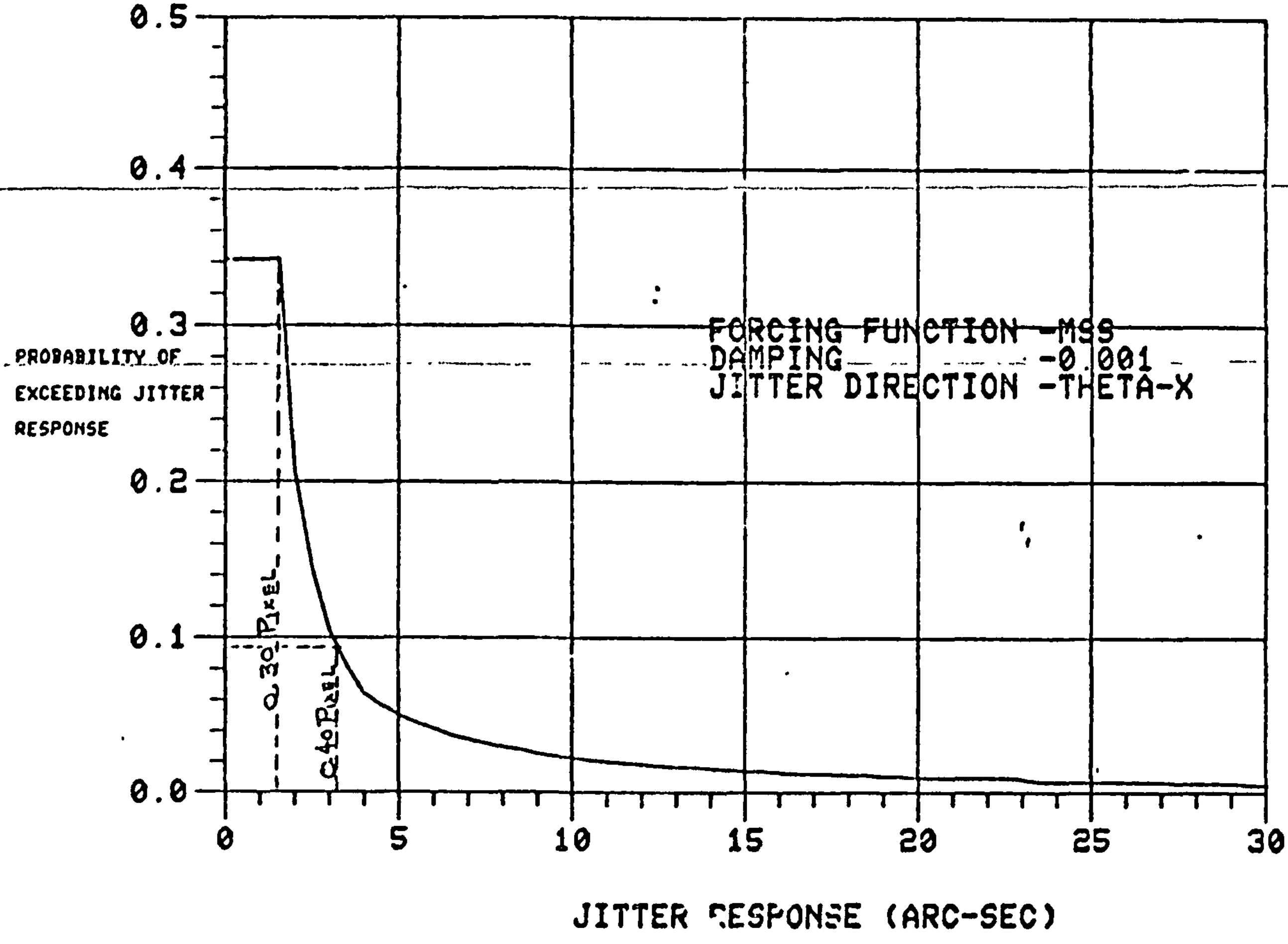
PROBABILITY OF EXCEEDING JITTER RESPONSE
0.5
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
25
30
JITTER RESPONSE (ARC-SEC)
FORCING FUNCTION -MSS
DAMPING -0.001
JITTER DIRECTION -THETA-X
0.30 Pixel
0.40 Pixel

Figure 5.3-3

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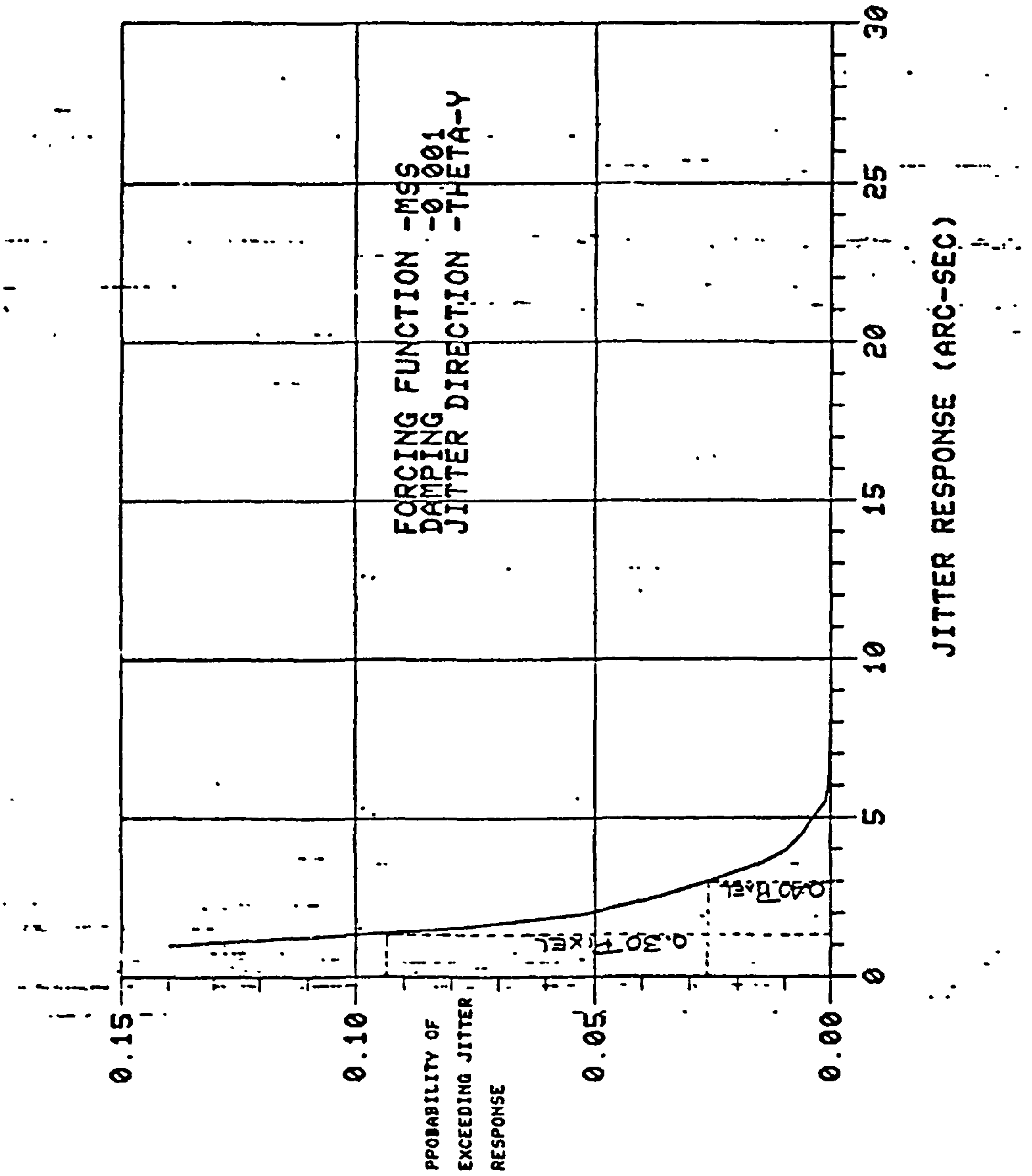

Figure 5.3-4

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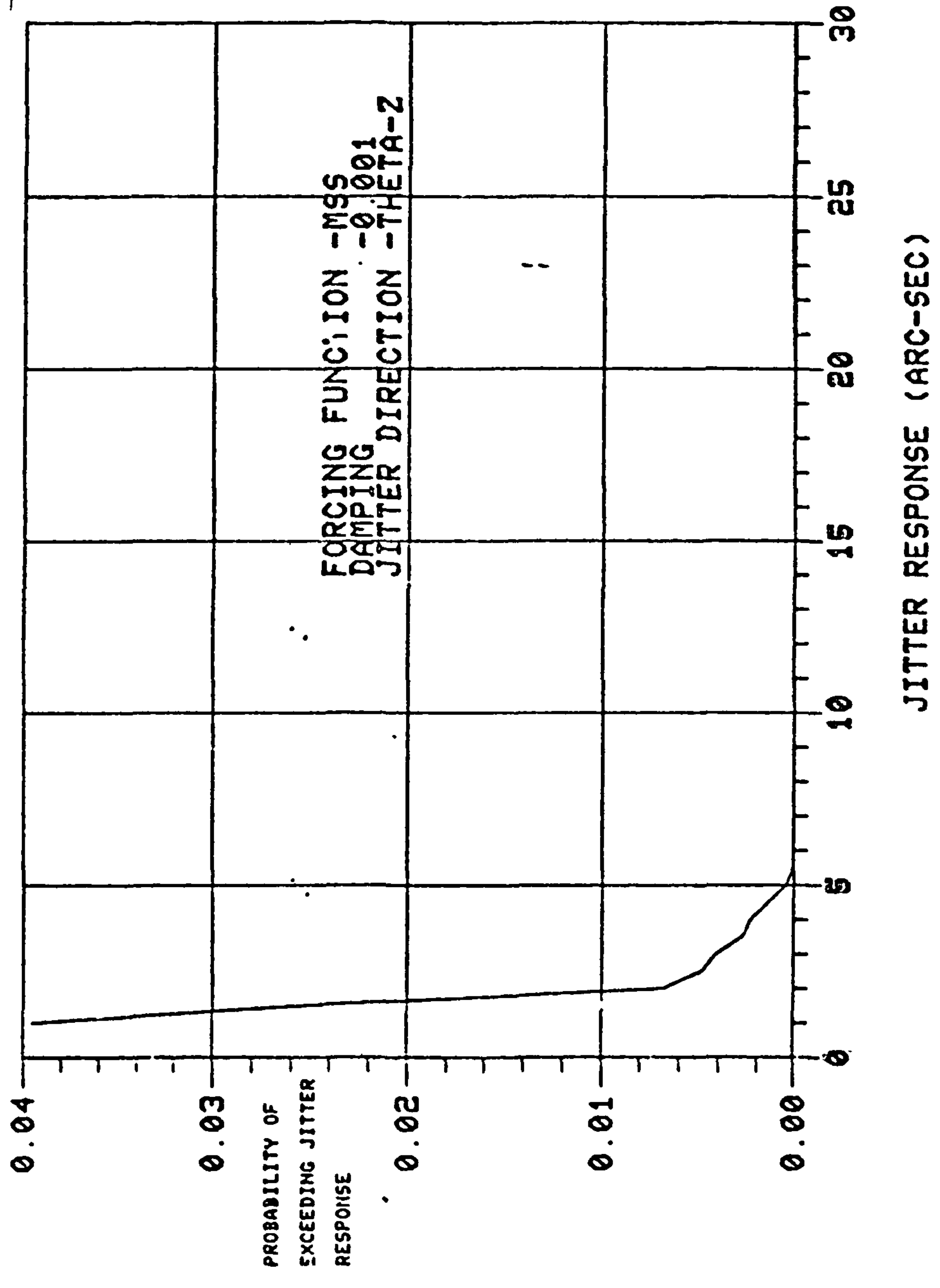

Figure 5.3-5

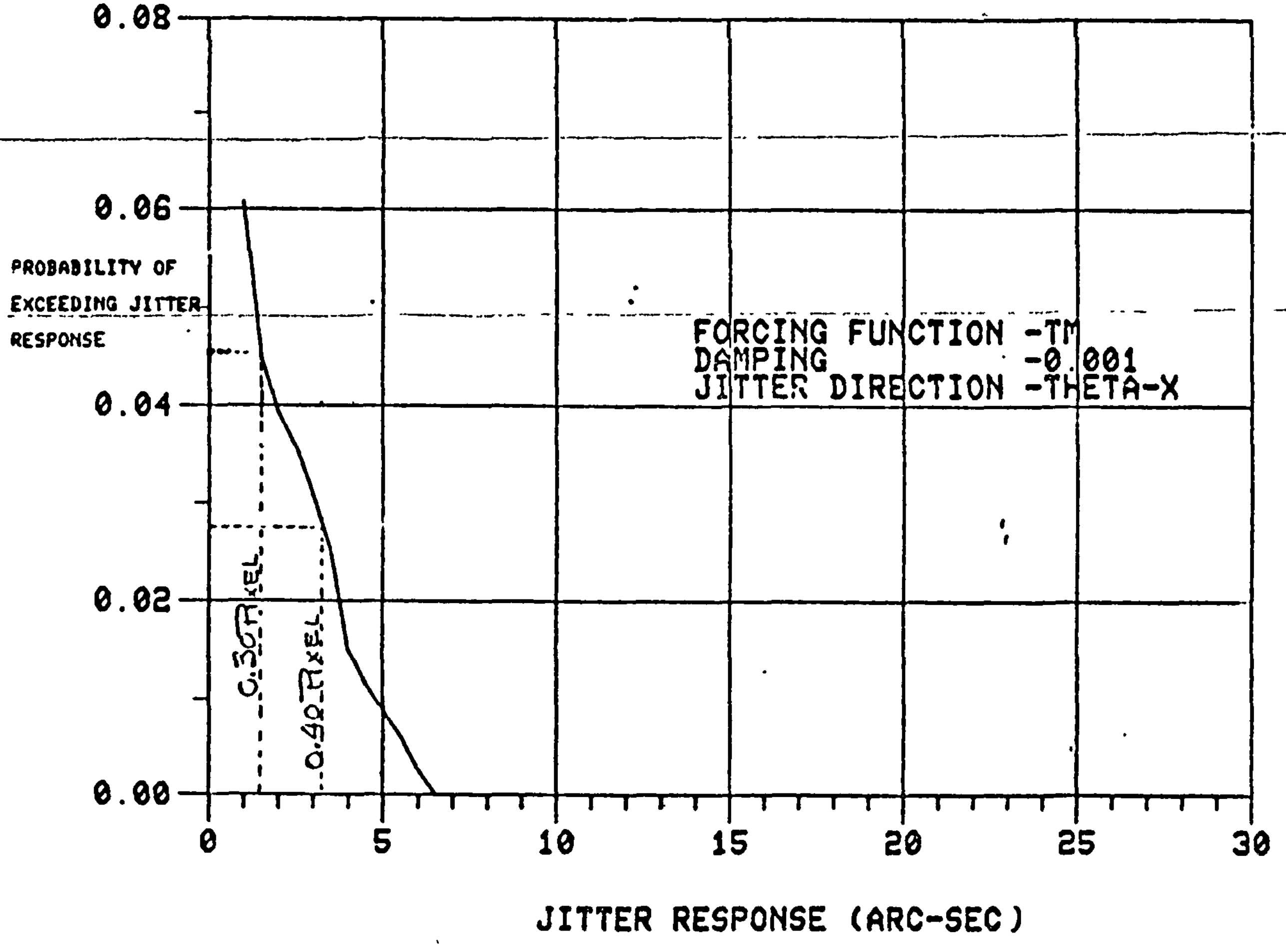
0.08
0.06
0.04
0.02
0.00
PROBABILITY OF EXCEEDING JITTER RESPONSE
0
5
10
15
20
25
30
JITTER RESPONSE (ARC-SEC)
FORCING FUNCTION -TM
DAMPING -0.001
JITTER DIRECTION -THETA-X
0.30 PIXEL
0.40 PIXEL

Figure 5.3-6

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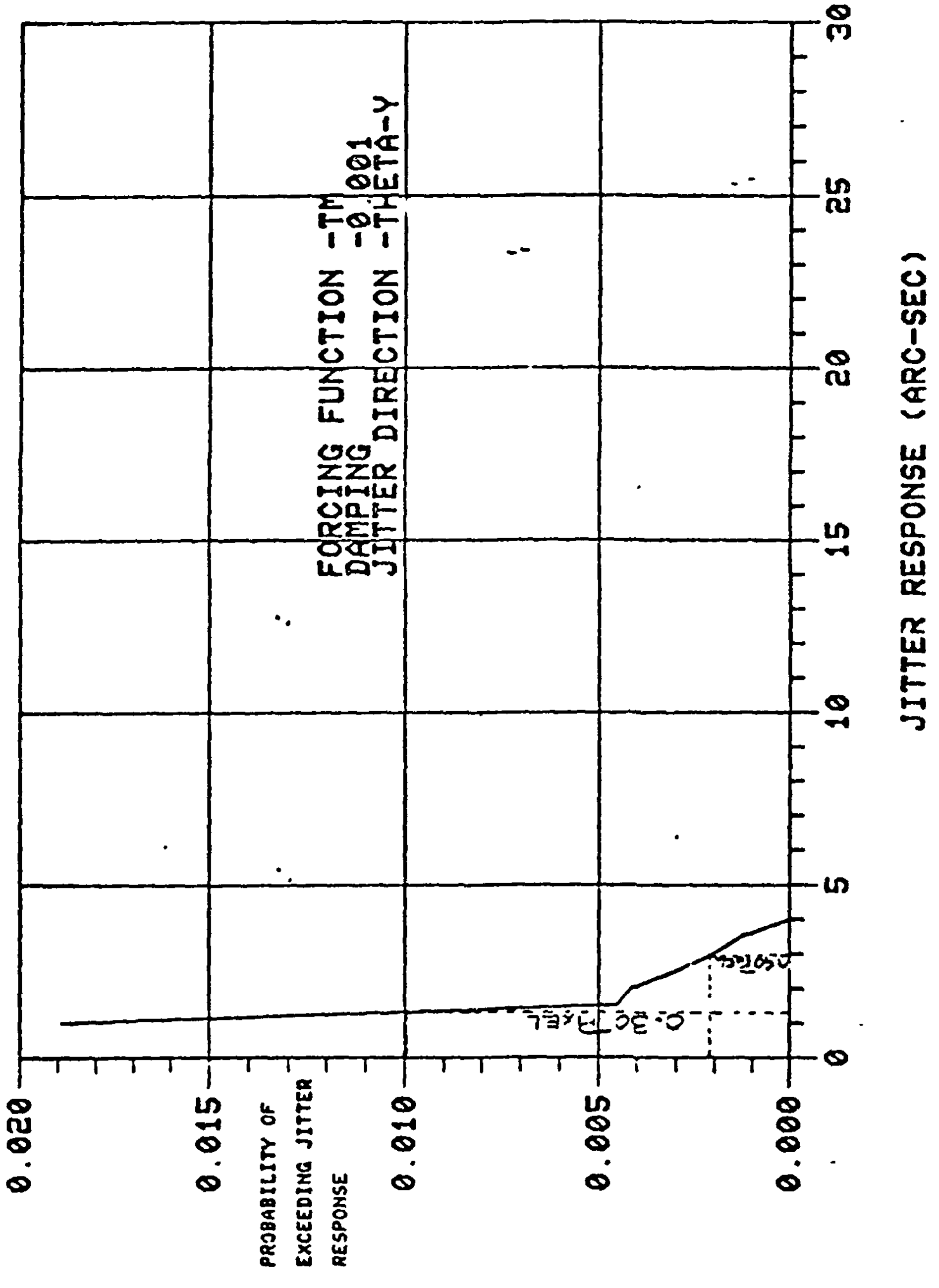

Figure 5.3-7

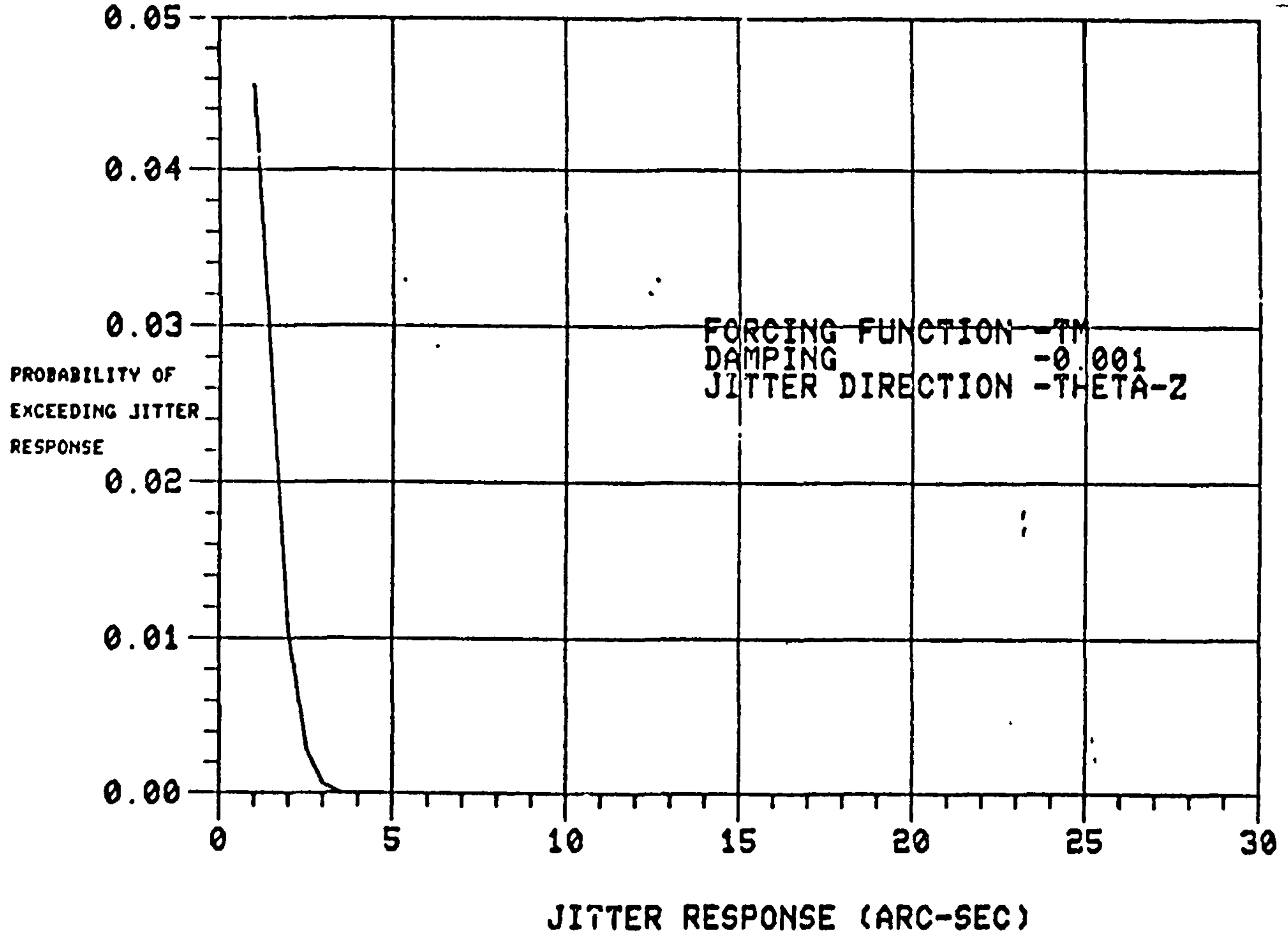
0.05
0.04
0.03
0.02
0.01
0.00
PROBABILITY OF EXCEEDING JITTER RESPONSE
0
5
10
15
20
25
30
JITTER RESPONSE (ARC-SEC)
FORCING FUNCTION -TM
DAMPING -0.001
JITTER DIRECTION -THETA-Z

Figure 5.3-8

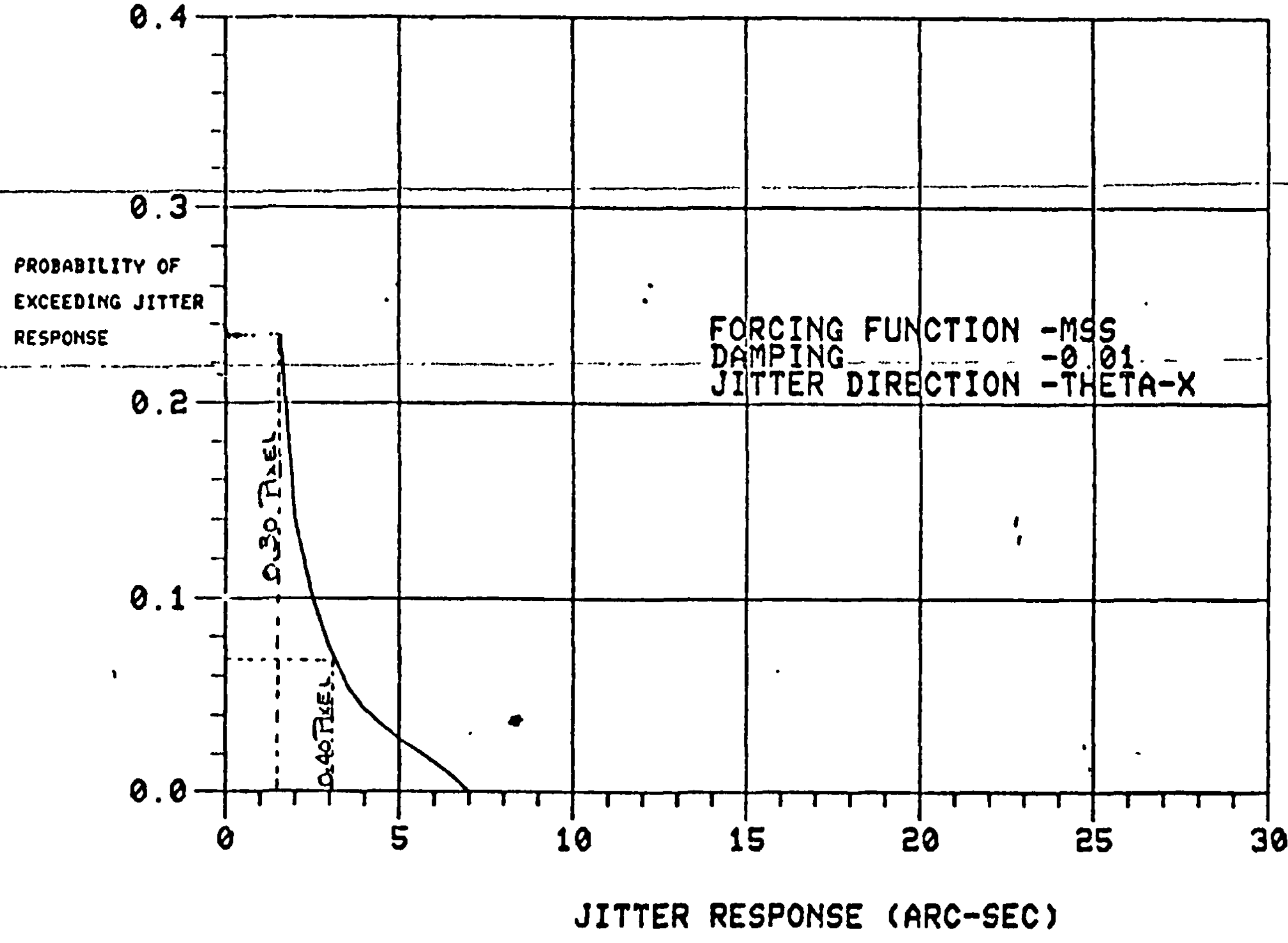

Figure 5.3-9

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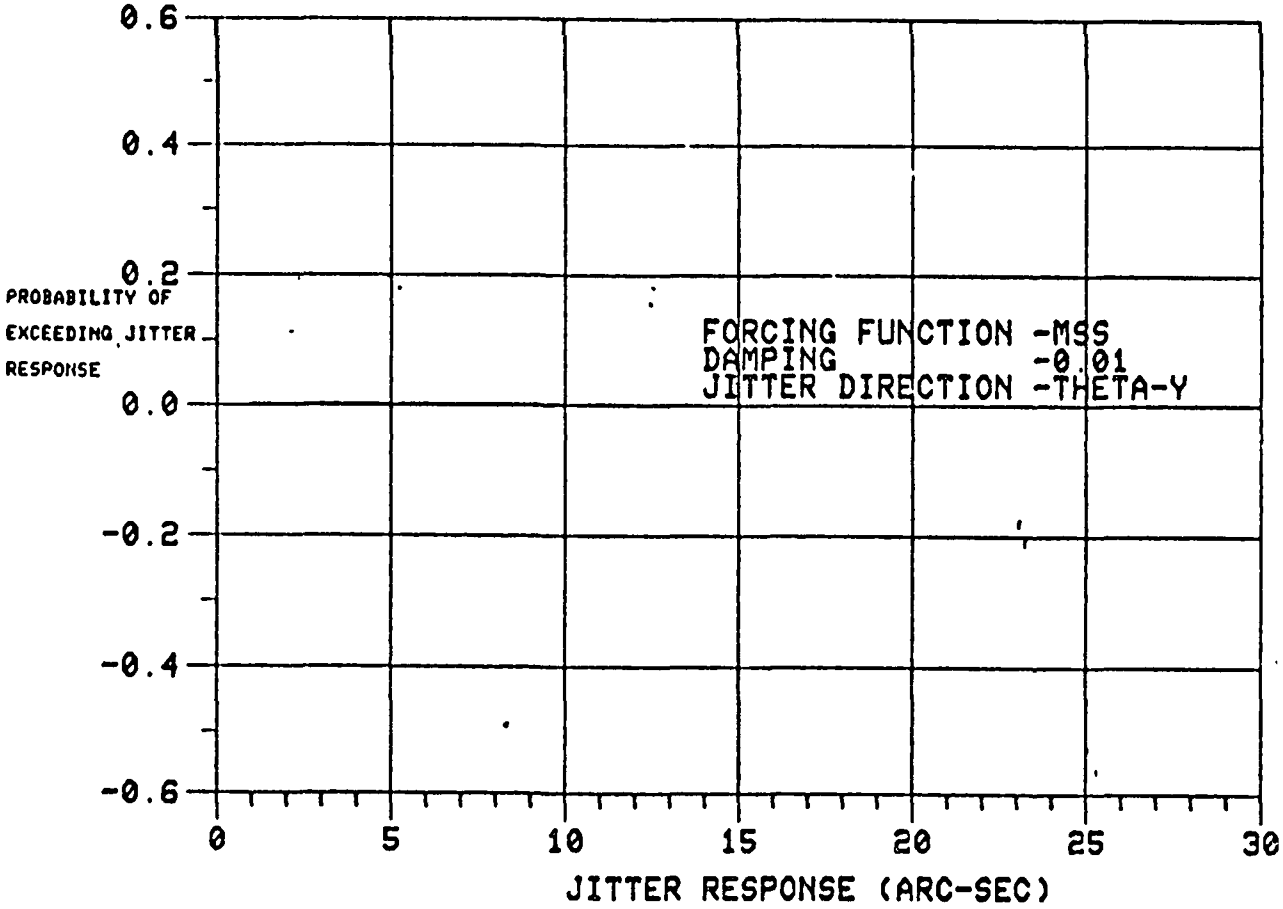
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
PROBABILITY OF
EXCEEDING JITTER
RESPONSE
FORCING FUNCTION -MSS
DAMPING -0.01
JITTER DIRECTION -THETA-Y
0
5
10
15
20
25
30
JITTER RESPONSE (ARC-SEC)

Figure 5.3-10

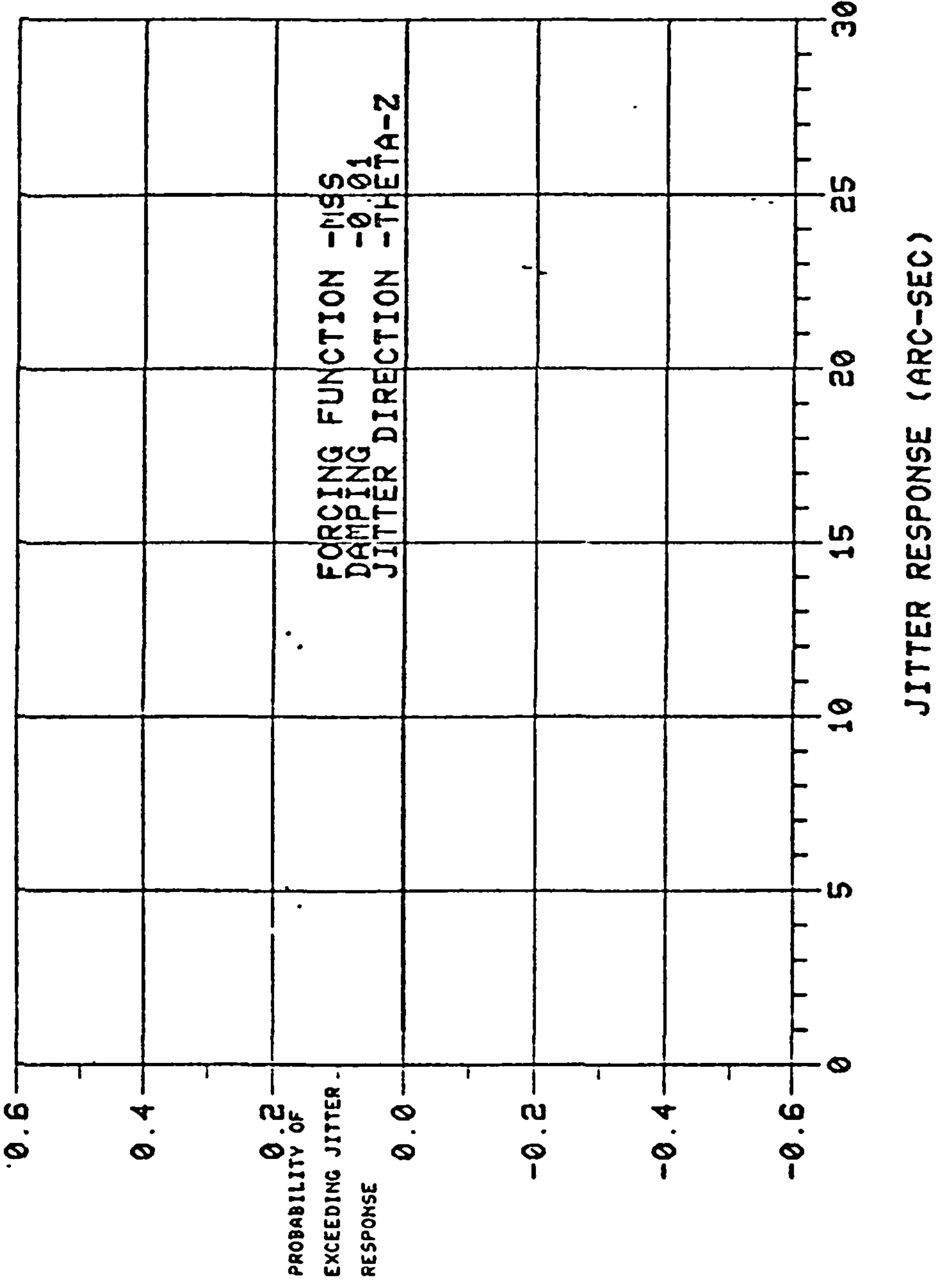
FORCING FUNCTION -MSS
DAMPING -0.01
JITTER DIRECTION -THETA-Z
JITTER RESPONSE (ARC-SEC)
0
5
10
15
20
25
30
PROBABILITY OF EXCEEDING JITTER RESPONSE
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6

Figure 5.3-11

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A comparison of the MSS due to MSS statistics for 0.001 and 0.01 damping values shows little change in the 1 to 4 arc-second region for 0.40 pixel allowables. The higher damping values affect the statistics in the response regions above 10 arc-seconds. Results show that damping effects are most pronounced in determining MSS due to MSS statistics for the 0.30 pixel allowables.

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