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			Transit Satellite Doppler Polar Positions

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The Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC) performs precise orbit computations for Navy Navigation Satellite System (NNSS) satellites, also called TRANSIT, using Doppler observations collected by a worldwide network of stations. Equipment at these sites is configured around either a Tranet II or a Magnavox 1502 DS receiver. Table 1 lists the current stations while Figure 1 shows the tracking network configuration. Recorded Doppler counts, surface weather measurements, and other appropriate data are transmitted via satellite communications or over other telecommunication links to DMAHTC for processing, time corrections, and orbit determination. There are two classes of NNSS satellites -- the "Oscar" and the "Nova" The Nova satellites represent the latest generation of TRANSIT satellites. For Nova satellite 30480 and Oscar satellites 30110, 30130, 30200, 30240, and 30300, data were processed in two-day fits. For Nova satellite 30500, data were processed in one-day fits.

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DMA ORBIT DETERMINATION OF THE NAVY NAVIGATION SATELLITE SYSTEM 1987

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WASHINGTON, DC 20305-3000

ANNUAL REPORT ON

DMA ORBIT DETERMINATION OF THE

NAVY NAVIGATION SATELLITE SYSTEM

1987

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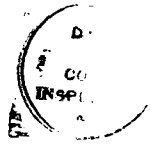


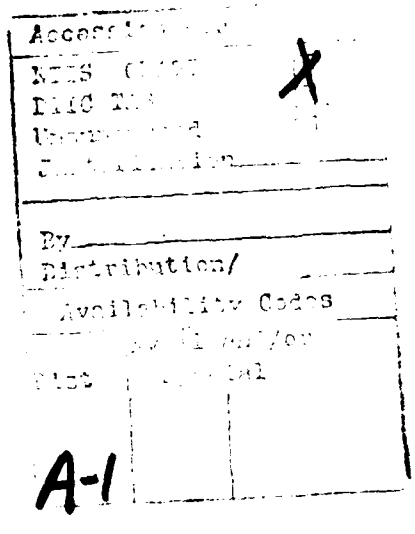


TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC) performs precise orbit computations for Navy Navigation Satellite System (NNSS) satellites, also called TRANSIT, using Doppler observations collected by a worldwide network of stations. Equipment at these sites is configured around either a Tranet II or a Magnavox 1502 DS receiver. Table 1 lists the current stations while Figure 1 shows the tracking network configuration. Recorded Doppler counts, surface weather measurements, and other appropriate data are transmitted daily via satellite communications or over other telecommunication links to DMAHTC for processing, time corrections and orbit determination. There are two classes of NNSS satellites - the "Oscar" and the "Nova". The Nova satellites represent the latest generation of TRANSIT satellites. For Nova satellite 30480 and Oscar satellites 30110, 30130, 30200, 30240 and 30300, data were processed in two-day fits. For Nova satellite 30500, data were processed in one-day fits. Table 2 and Figure 2 provide additional information on these satellites.

TABLE 1: 1987 TRACKING STATIONS

1502 DS Stations

Station Number	Station Location
30690	Herndon, Virginia
35000	Ascension Island
35004	St. Helena Island
35006	Dhekelia, Cyprus
35010	Diego Garcia Island
35011	Cambridge Bay, Canada
35012	Bahrain, Persian Gulf
35013	Asuncion, Paraguay
35015	Wichita Falls, Texas
35017	Sioux City, Iowa
35018	Shemya, Alaska
35021	Las Cruces, New Mexico
35022	Quito, Ecuador
35024	Sigonella, Italy
35025	Santiago, Chile
35026	Kinshasa, Zaire
35027	Aurora, Colorado
35028	Bangkok, Thailand
35029	Rapid City, South Dakota
35036	Idaho Falls, Idaho
35037	Flagstaff, Arizona
35038	NAS Fallon, Nevada
35039	NAS Meridian, Mississippi
35047	Grissom AFB, Indiana
35048	Hickam AFB, Hawaii

Tranet II Stations

545	Smithfield, Australia
547	Brussels, Belgium
548	Mizusawa, Japan
550	Herndon, Virginia
552	Las Cruces, New Mexico
553	Guam (U.S.)
554	Pretoria, South Africa
555	Sao Jose, Brazil
556	Anchorage, Alaska
557	Thule, Greenland
558	Mahe, Seychelles
559	San Miguel, Philippines
560	Tafuna, American Samoa
561	Austin, Texas
562	McMurdo, Antarctica
563	Calgary, Canada
564	Ottawa, Canada
565	Wettzell, West Germany

567	Kerguelen Island
568	Papeete, Tahiti
569	Toulouse, France
570	Hermitage, United Kingdom
590	San Fernando, Spain
591	Kourou, French Guiana

FIGURE 1: 1987 TRACKING NETWORK

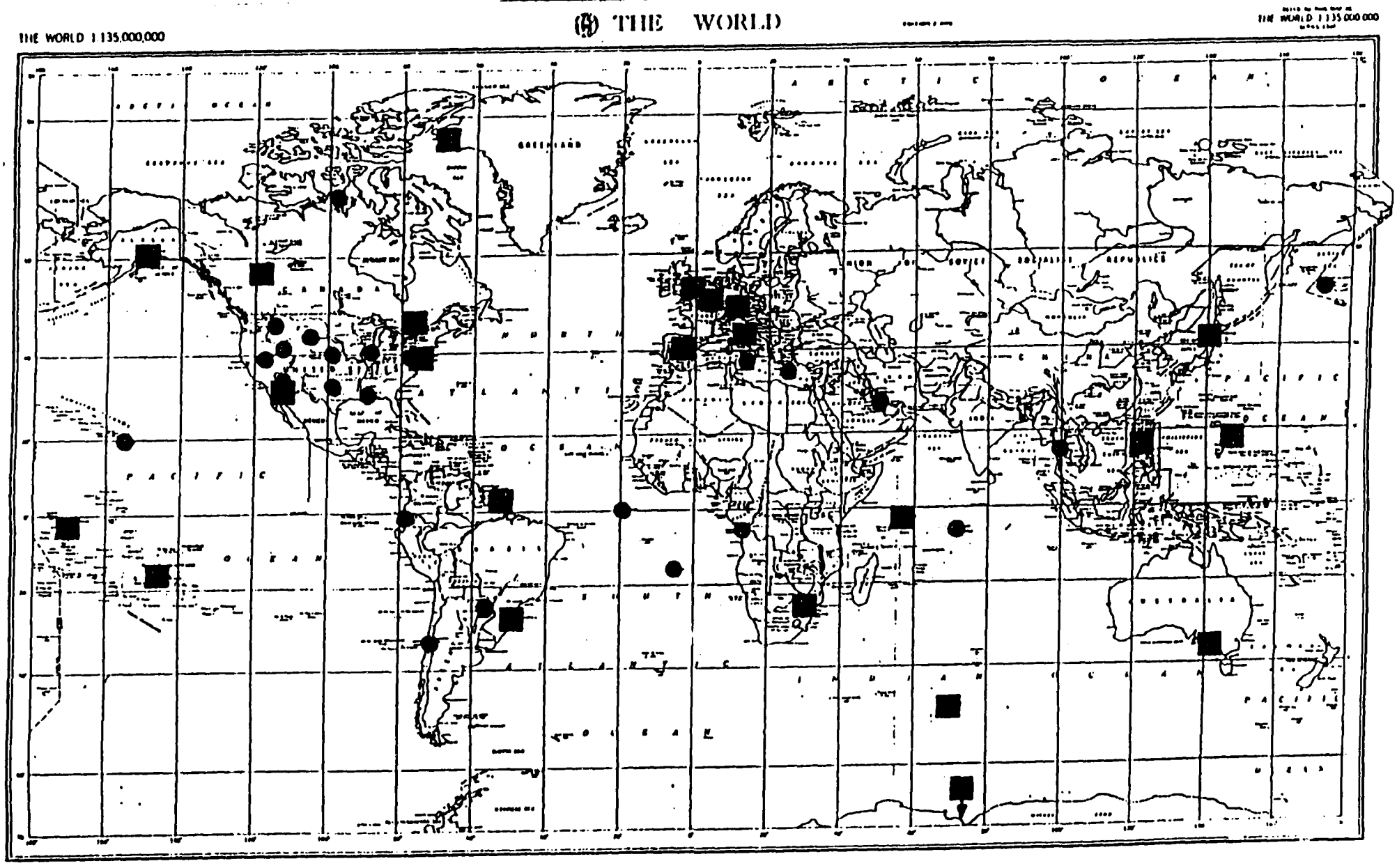
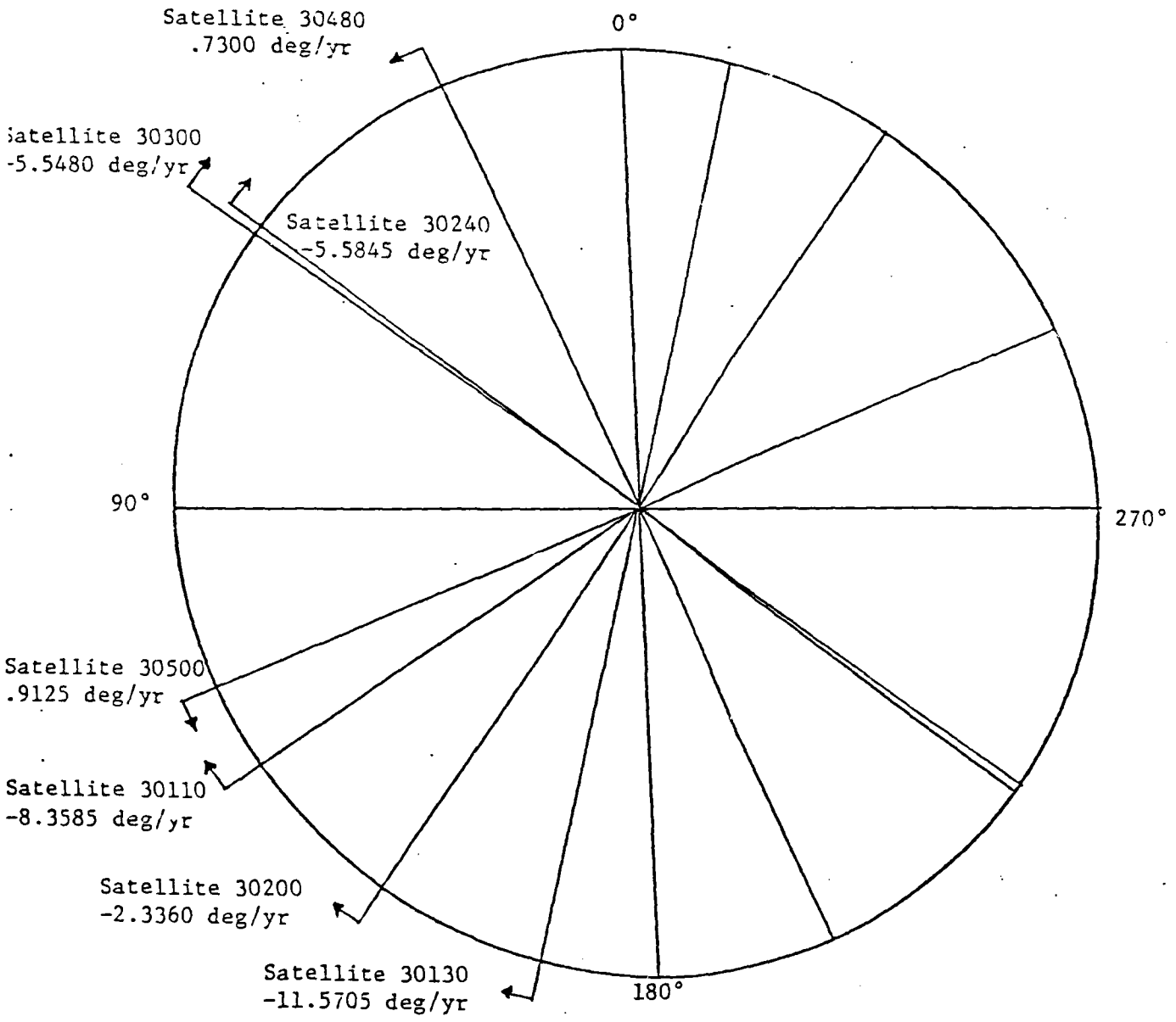


TABLE 2: STATUS REPORT ON USABLE SATELLITES AS OF DECEMBER 1987

TRANSIT Satellite Number	Launch Date	Status
30110	28 Oct 1987	Operational 121 months
30130	18 May 1967	Operational 246 months
30[illegible]0	29 Oct 1973	Operational 169 months
30240	3 Aug 1985	Operational 28 months
30300	3 Aug 1985	Operational 28 months
30480	15 May 1981	Operational 76 months
30500	12 Oct 1984	Operational 36 months

These satellites are controlled by the Navy Astronautics Group (NAG) headquartered at Point Mugu, California.

FIGURE 2: TRANSIT ORIENTATION CHART



Right Ascension Epoch 87236

EPHEMERIDES

Orbits for the six TRANSIT satellites were computed in 1987 on a one-day or two-day basis as previously mentioned, using the CELEST orbit determination program. Ephemerides were computed for the days provided in Table 3.

The orbit computation program provides sufficient diagnostic information to judge the overall quality of estimated ephemerides, the stability of satellite and tracking station clocks, and the performance of the tracking network. One quantity computed within the CELEST program, used as a measure of ephemeris quality, is the station navigation solution. After the satellite ephemeris is estimated, each individual pass of Doppler data acquired during the fit span is used to adjust the geodetic coordinates of the tracking station in directions along and perpendicular to the slant range vector to the satellite at its time of closest approach during the pass. These individual two - parameter station adjustments provide a measure of the consistency of the data with the estimated ephemeris. From these station navigation estimates, a weighted root mean square (RWS) is computed, where the weighting factor for each pass is chosen as the variance of the pass navigation solution.

Table 4 provides the average of the RWS station navigation results for all orbit determinations computed during 1987. These average values, labeled tangential (along - track direction) and radial (slant - range direction), are a measure of the internal consistency of computed ephemerides with the acquired Doppler data.

A measure of orbit repeatability can be obtained by comparing the estimated satellite position at the beginning of each fit span with the estimated satellite postion at the end of the previous span. These comparisons are made in the radial, tangential, and normal directions using the satellite positon and velocity vectors to define the coordinate system. Averages for these quantities for the year 1987 are found in Table 4 under orbit consistency.

TABLE 3: 1987 TRANSIT EPHEMERIS AVAILABILITY

TRANSIT Satellite Number	Day Number
30110	1-265,267-365
30130	1-365
30200	1-365
30240	189-365
30300	1-259
30480	1-289,295-365
30500	1-365

TABLE 4: SUMMARY OF EPHEMERIS QUALITY

UNITS: METERS

	Satellite 30110			Satellite 30130			Satellite 30200			Satellite 30240		
	Tangential	Radial	Normal	Tangential	Radial	Normal	Tangential	Radial	Normal	Tangential	Radial	Normal
Data Consistency	1.8	1.4		1.4	1.3		1.4	1.4		1.0	0.8	
Orbit Consistency	7.7	3.3	1.0	2.6	0.7	1.4	3.6	0.9	1.3	2.5	1.0	0.8

	Satellite 30300			Satellite 30480			Satellite 30500		
	Tangential	Radial	Normal	Tangential	Radial	Normal	Tangential	Radial	Normal
Data Consistency	0.8	0.7		0.9	0.7		0.6	0.6	
Orbit Consistency	2.3	0.8	0.8	1.9	0.8	1.3	1.3	0.4	0.6

TIME STABILITY

Time stability for the Navy Navigation Satellite System is maintained through the operations of the Naval Astronautics Group at Point Mugu, California. Time is maintained for Oscar satellites through the deletion of cycle counts generated by a satellite crystal oscillator operating at a frequency slightly above a nominal frequency. Fractional frequency fluctuations are compensated for by estimating oscillator instability and by adjusting cycle counts appropriately. An actual time drift will still occur; however, the time error will be maintained within prescribed limits. For Nova satellites time stability is maintained by varying the frequency of the satellite crystal oscillator. This frequency steering occurs daily, as necessary, for satellite 30500 but is not used on satellite 30480 due to a partial failure of the frequency steering mechanism.

As part of the DMAHTC orbit determination solution, satellite frequency bias and drift are estimated. Frequency bias causes a time drift to occur equal to the ratio of the frequency bias to oscillator base frequency multiplied by the effective time span of the bias. Frequency drift causes a quadratic time error equal to the ratio of the frequency drift to oscillator base frequency multiplied by one - half the square of the effective time span of the drift. The long - term frequency stability for the Navy navigation satellites was calculated using the estimated daily frequency bias from CELEST orbit processing. Since this value is readily available on a one-day or two-day basis, long term trends in frequency stability were obtained. Figures 3 through 7 give the plots of estimated frequency bias for Oscar satellites 30110, 30130, 30200, 30240 and 30300 respectively. Figure 8 gives similar results for Nova satellite 30480.

Based on these data, average annual frequency drifts for each satellite were computed and are given in Table 5.

FIGURE 3: SATELLITE 30110 FREQUENCY ERROR

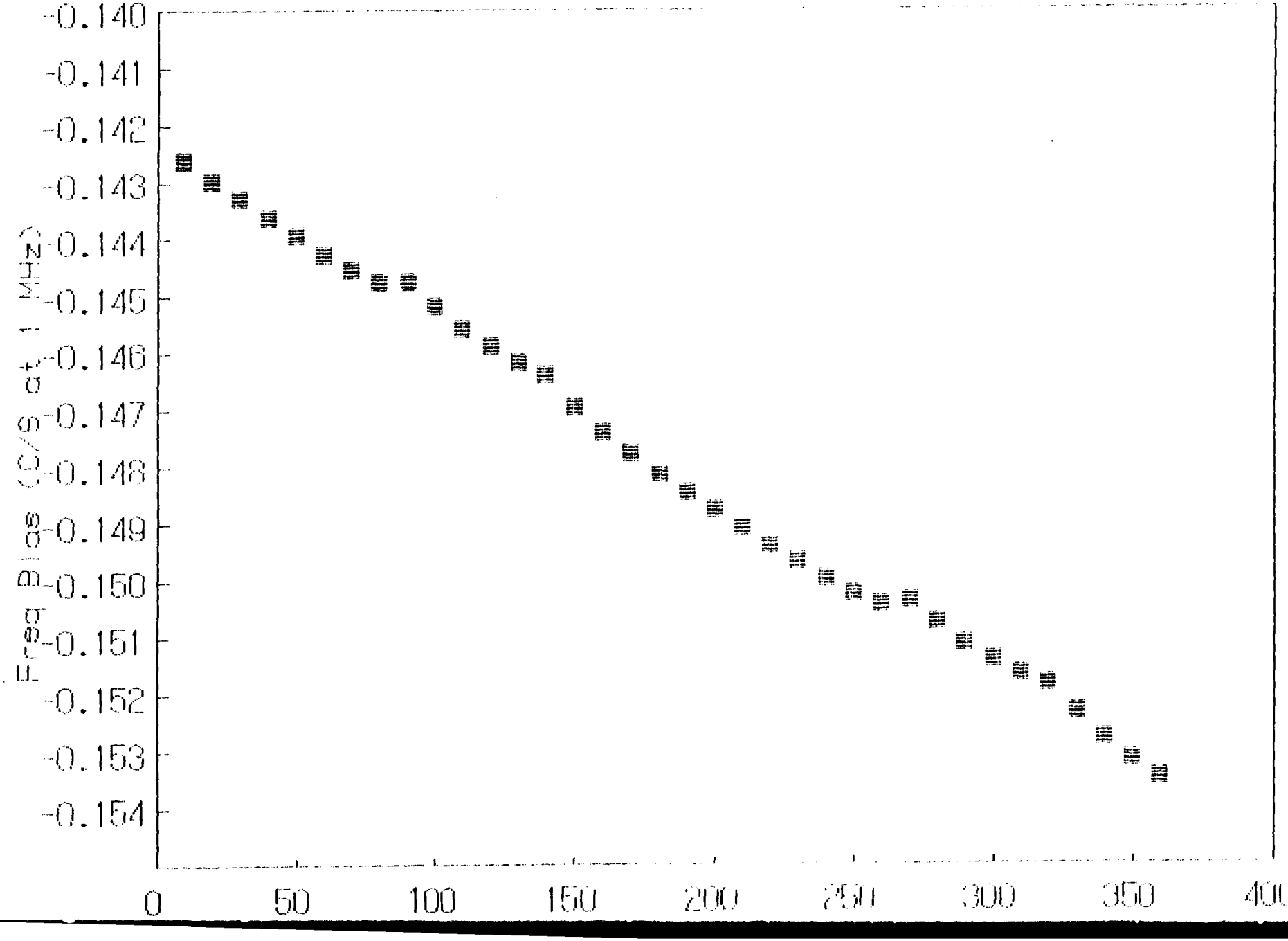


FIGURE 4: SATELLITE 30130 FREQUENCY ERROR

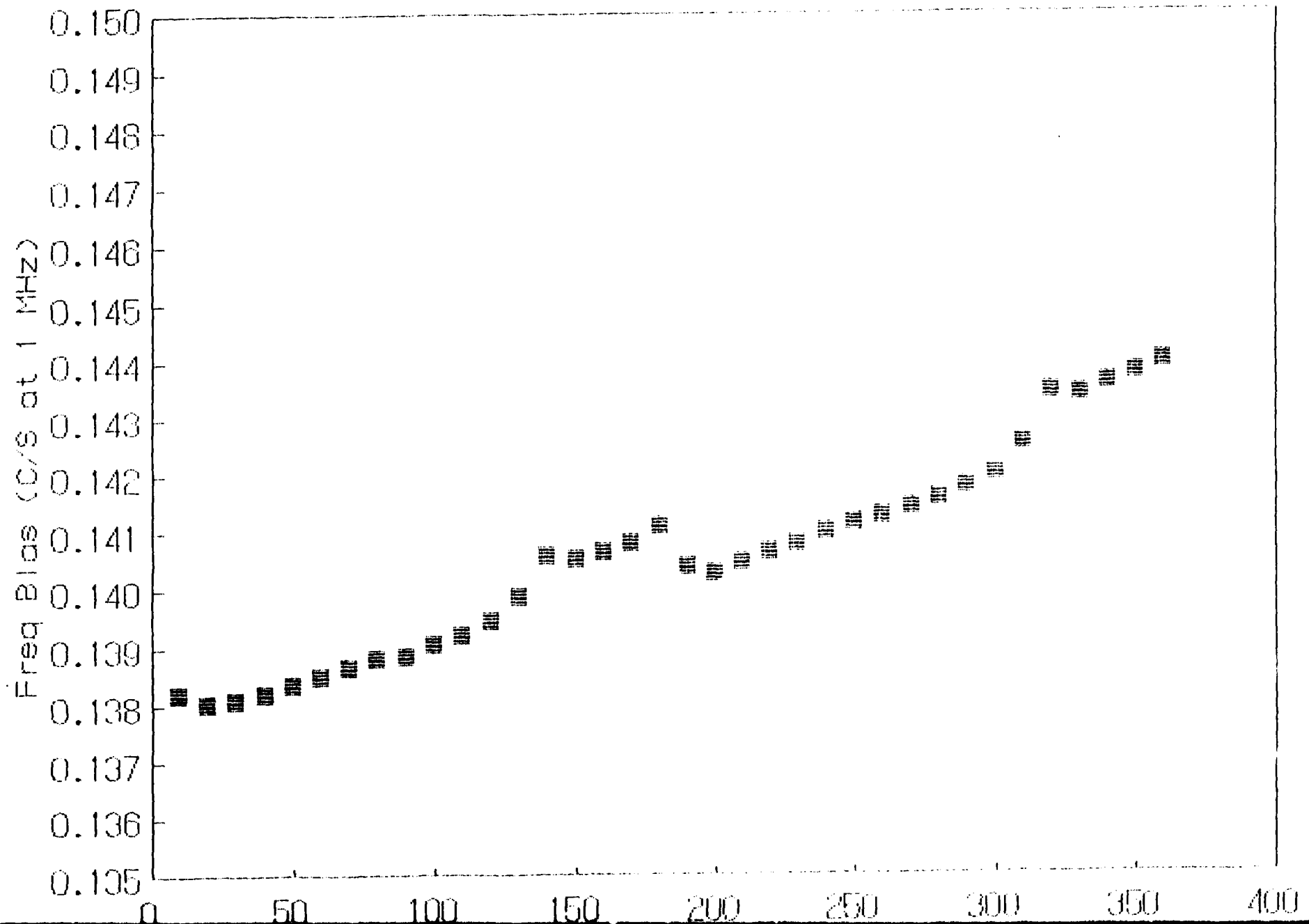


FIGURE 5: SATELLITE 30200 FREQUENCY ERROR

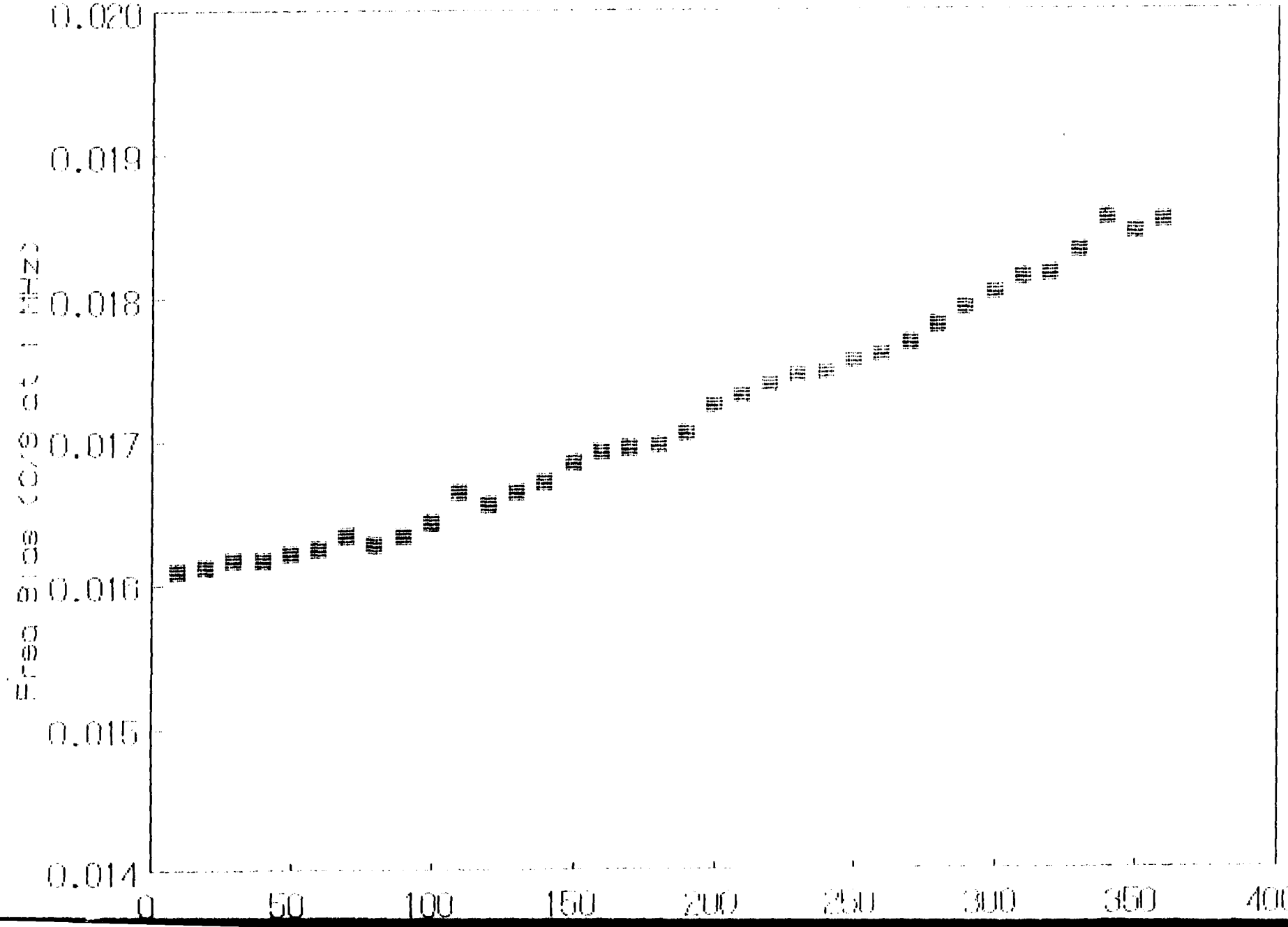


FIGURE 6: SATELLITE 30240 FREQUENCY ERROR

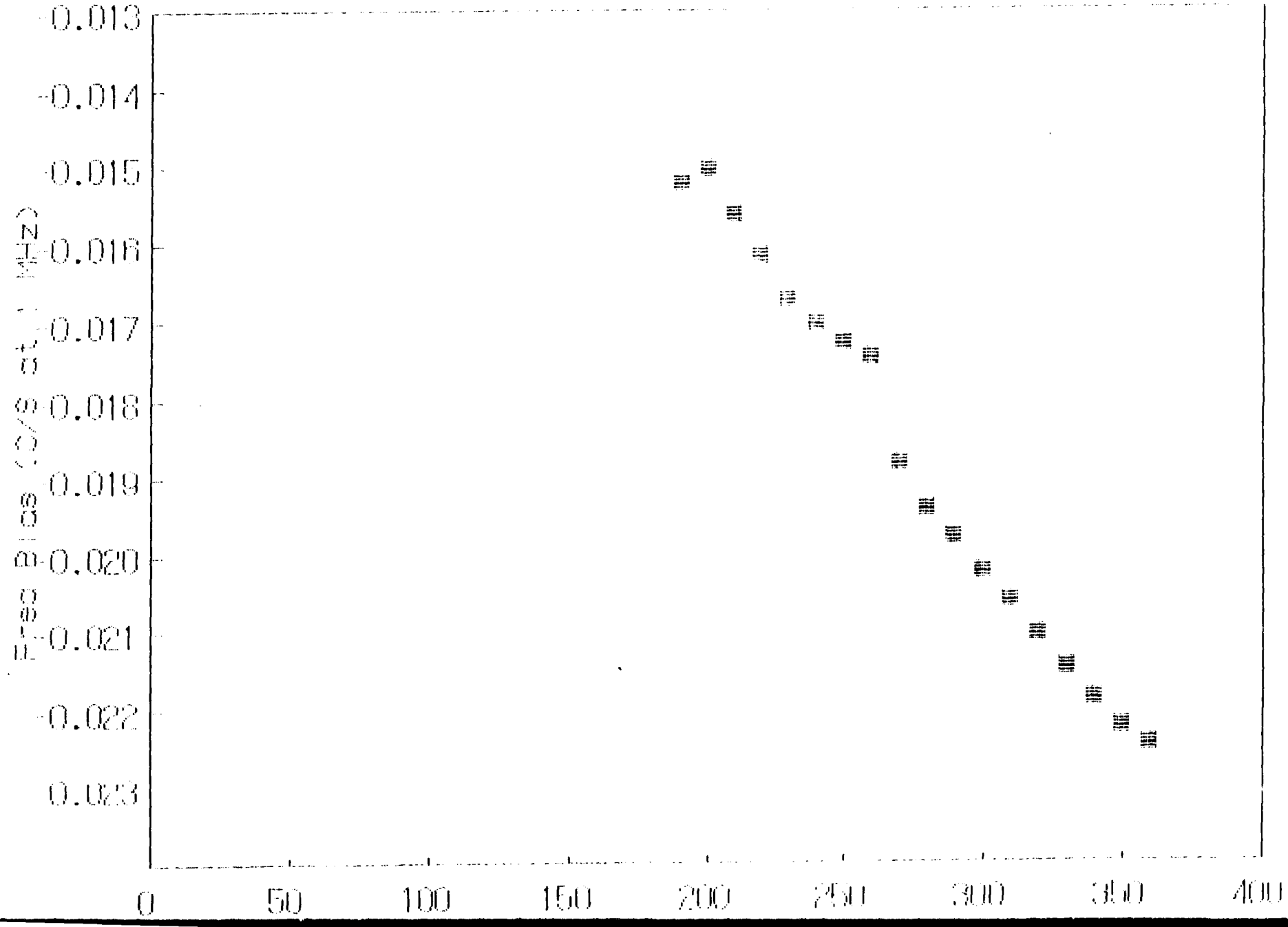


FIGURE 7: SATELLITE 30300 FREQUENCY ERROR

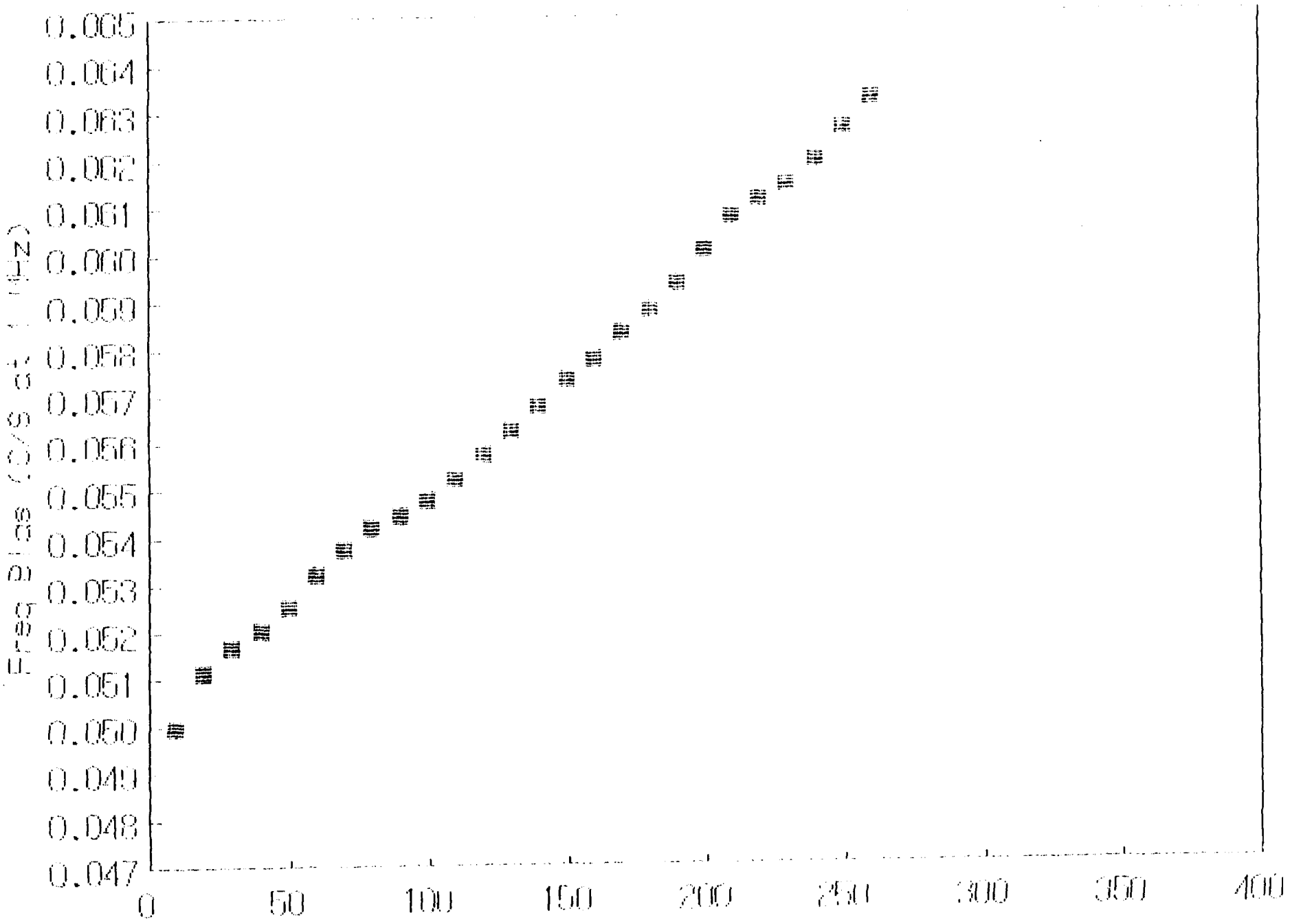


FIGURE 8: SATELLITE 30480 FREQUENCY ERROR

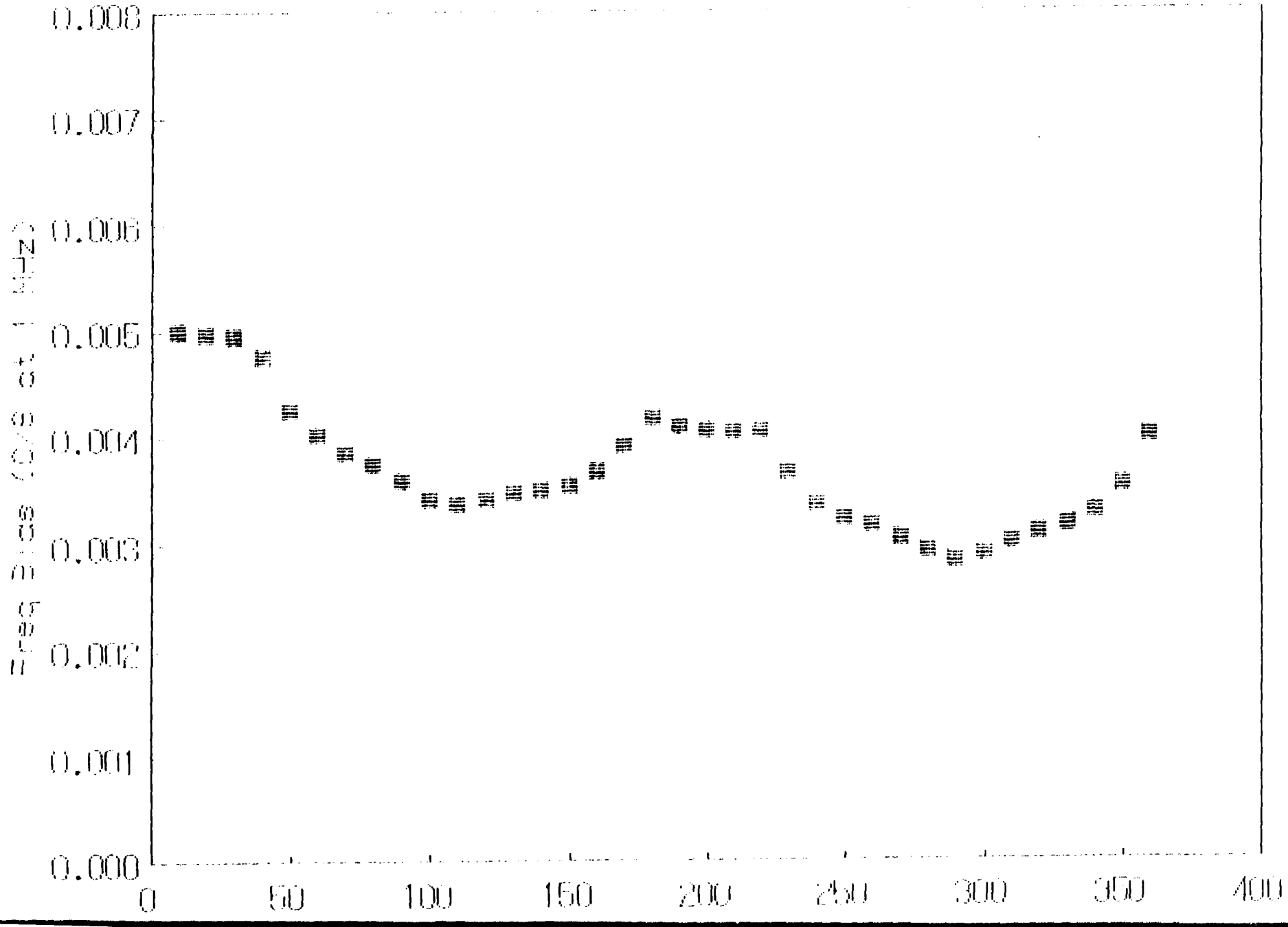


TABLE 5: 1987 MEAN FREQUENCY STABILITY

TRANSIT Satellite Number	Daily Mean Drift *
30110	-30×10^{-6}
30130	13×10^{-6}
30200	70×10^{-7}
30240	-20×10^{-6}
30300	53×10^{-6}
30480	-30×10^{-7}
30500	**

* Units: Cycles per second per day at 1 MH_Z

** Stability is maintained by active frequency steering.

POLAR MOTION

Included among the parameters estimated in the orbit determination program is the position of the Earth's spin axis with respect to the pole of the adopted Defense Mapping Agency WGS-84 terrestrial frame. The scheme used to compute daily pole values is as follows: each satellite for which two-day spans of data are used for orbit determination is designated to have an odd or even starting day number. Consequently, for each day of the year, pole positions are determined using less than seven satellites. The fit span and two-day designator are provided in Table 6 for each satellite. Satellite data processed daily produce pole position estimates on both odd and even days. Figures 9 through 15 are plots of the 1987 DMAHTC Doppler pole position values for each NNSS satellite. Much of the detail of the plot for Nova satellite 30500 is lost due to the density of data points and their scatter. Table 7 is a comparison of Doppler and BIH polar motion values for 1987.

TABLE 6: 1987 POLAR MOTION PROCESSING SCHEME

TRANSIT Satellite Number	Processing Interval (Days)		Designator
	One-Day	Two-Day	
30300	-	1-259	Even
30130	-	1-364	Even
30200	-	1-364	Odd
30240	-	189-364	Odd
30110	-	1-265 267-364	Even
30480	-	1-289 295-365	Odd
30500	1-364	----	Even, Odd

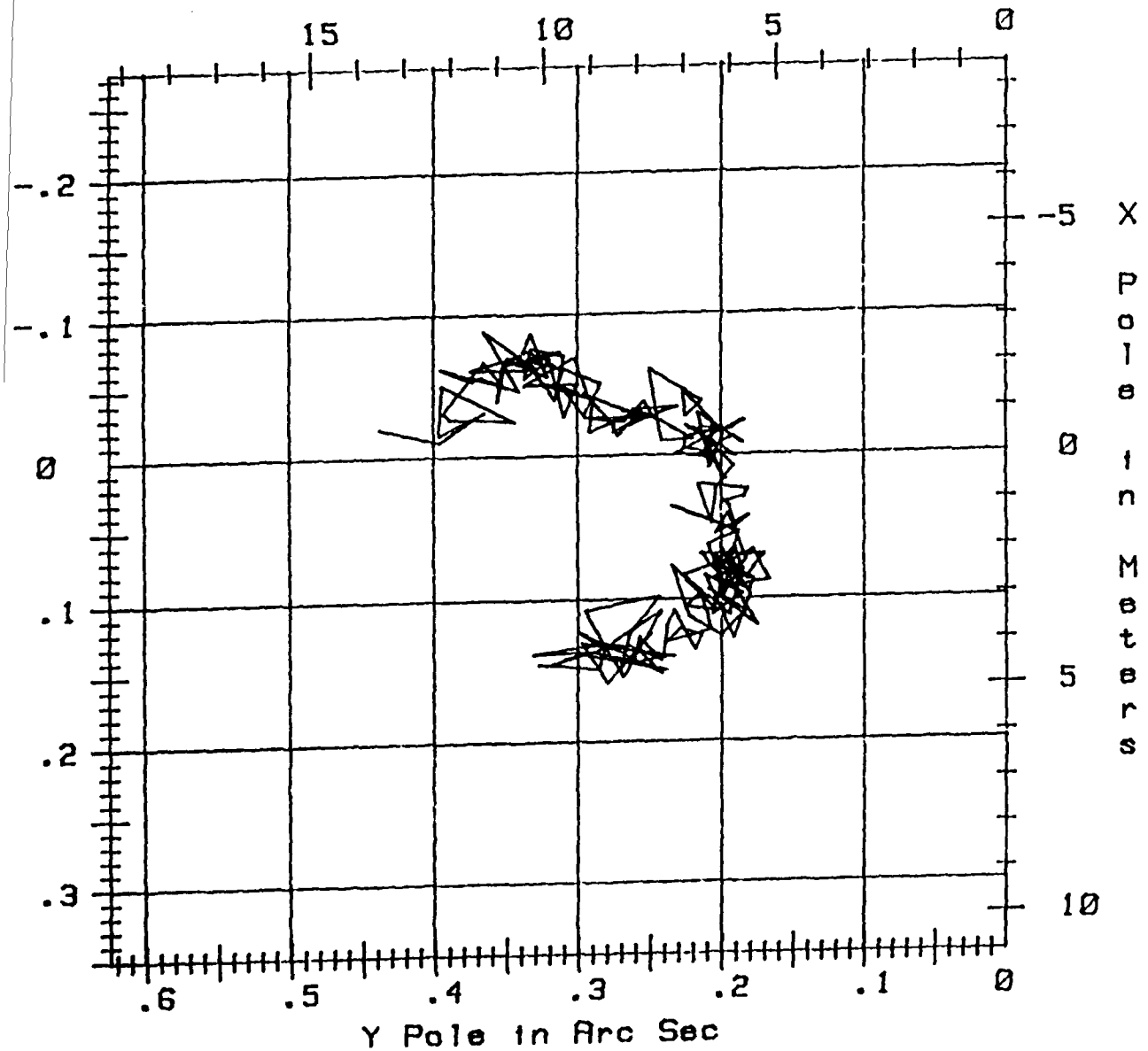


FIGURE 9:
SATELLITE 30110
DOPPLER POLAR MOTION
RESULTS DURING
1987

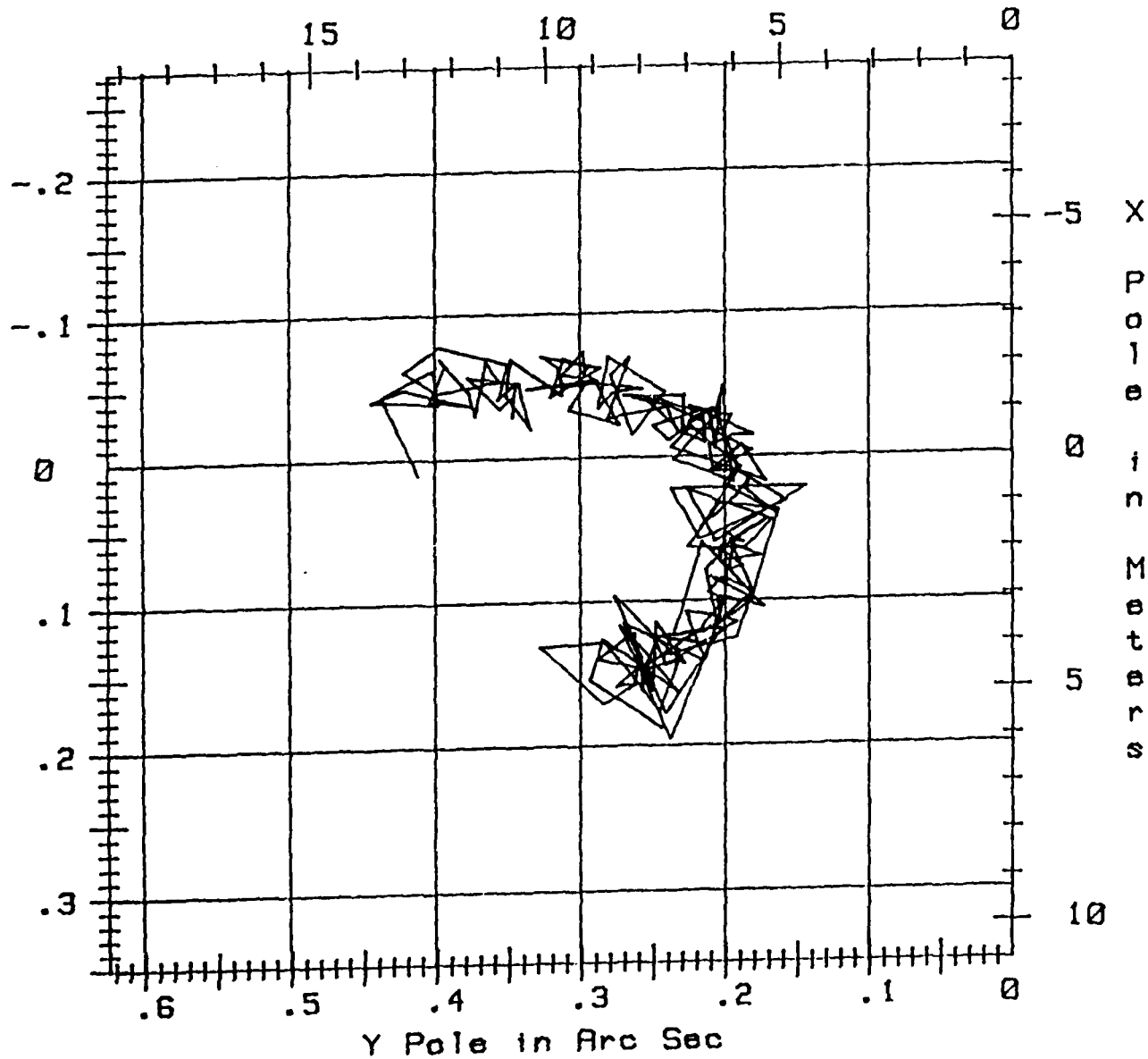


FIGURE 10:

SATELLITE 30130
DOPPLER POLAR MOTION
RESULTS DURING
1987

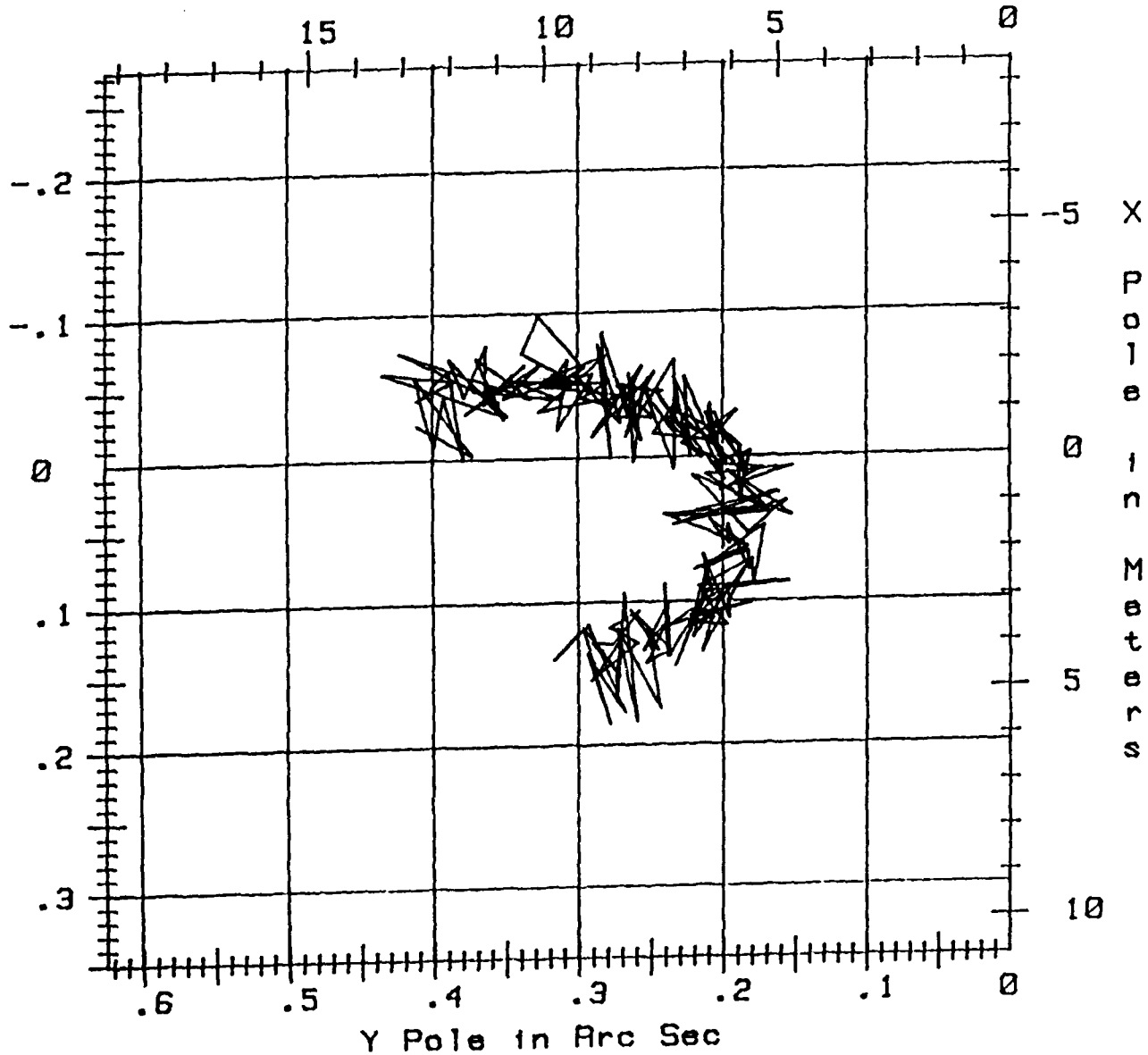


FIGURE 11:

SATELLITE 30200
DOPPLER POLAR MOTION
RESULTS DURING
1987

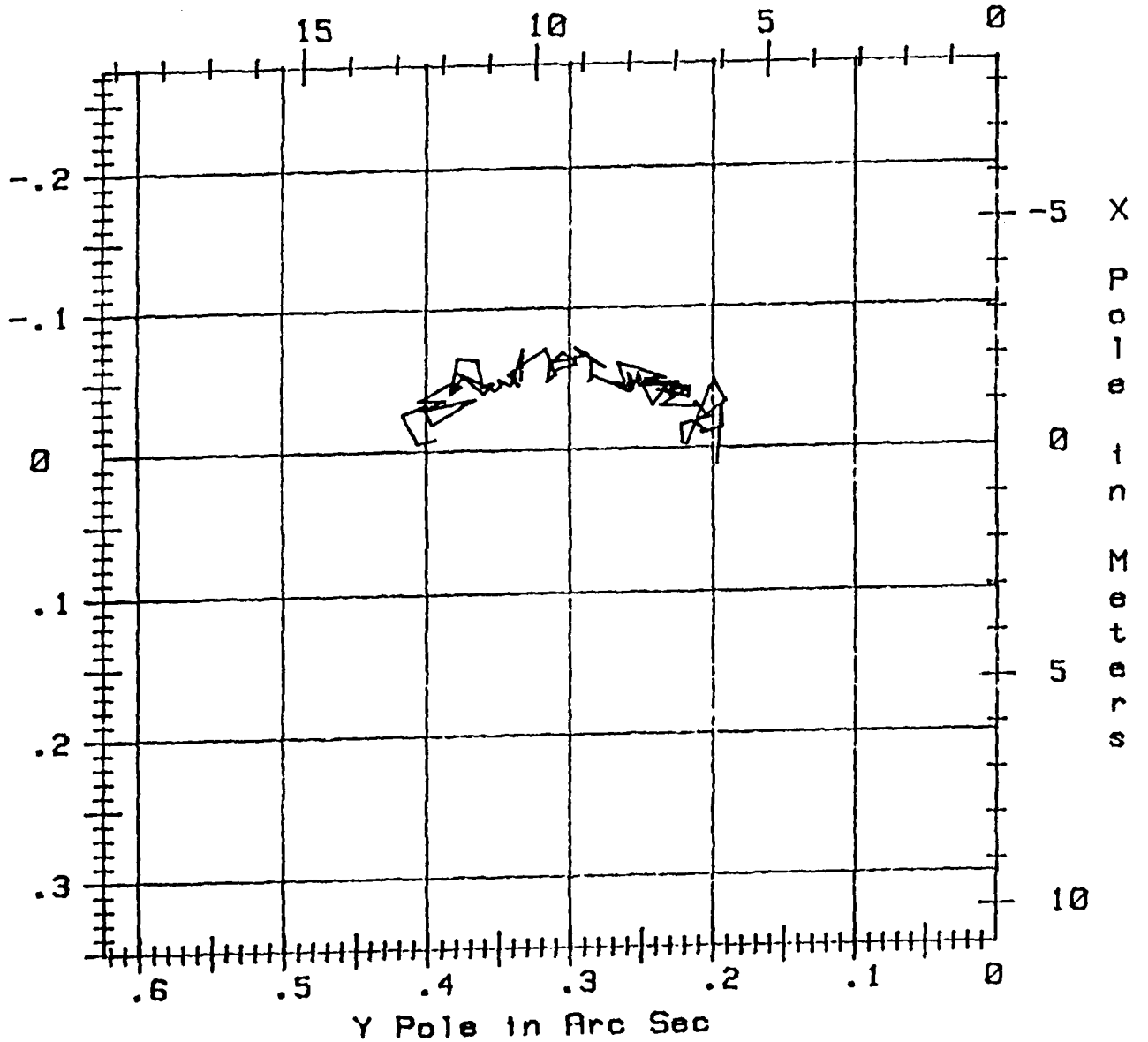


FIGURE 12:

SATELLITE 30240
DOPPLER POLAR MOTION
RESULTS DURING
1987

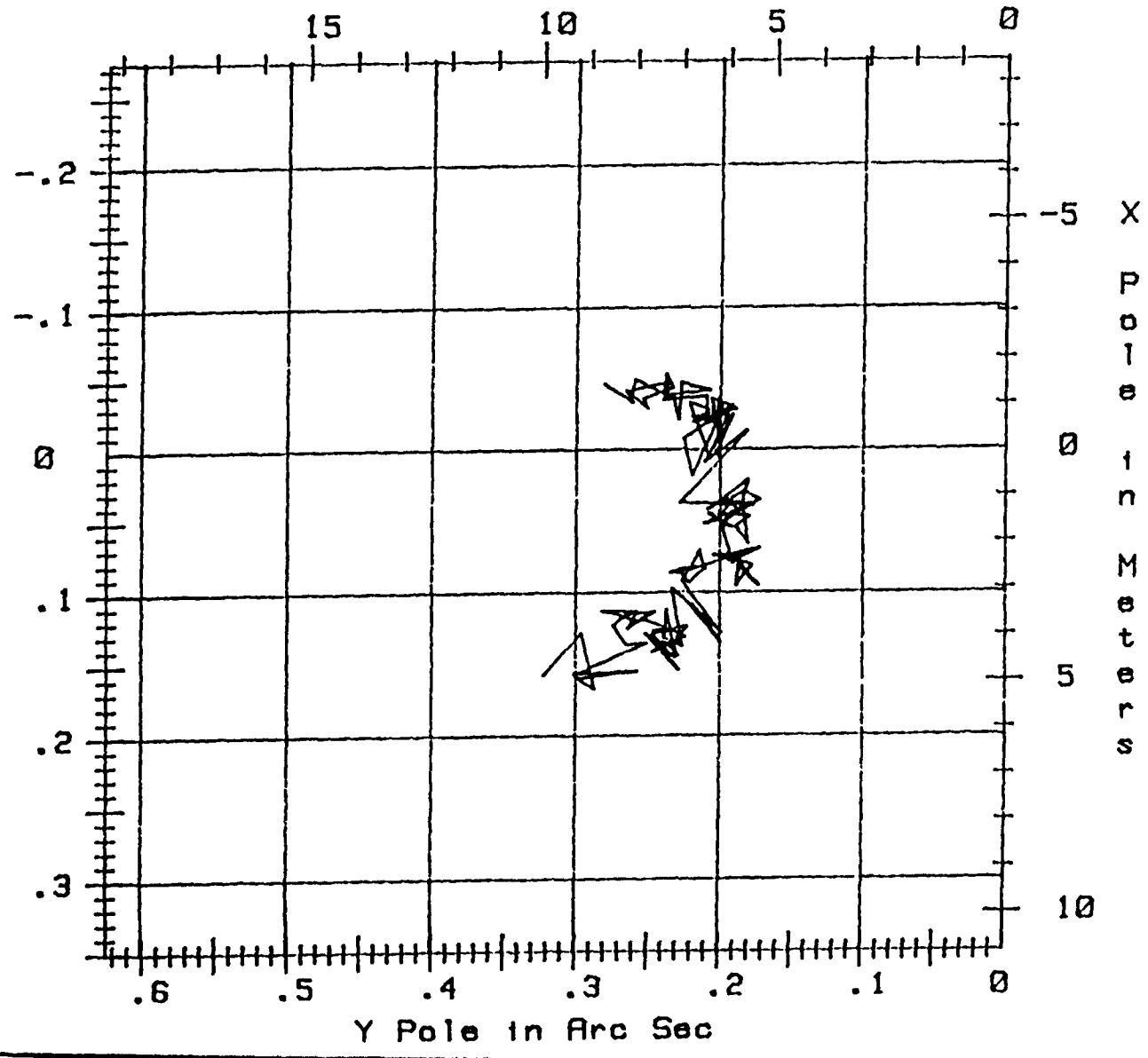


FIGURE 13:

SATELLITE 30300
DOPPLER POLAR MOTION
RESULTS DURING
1987

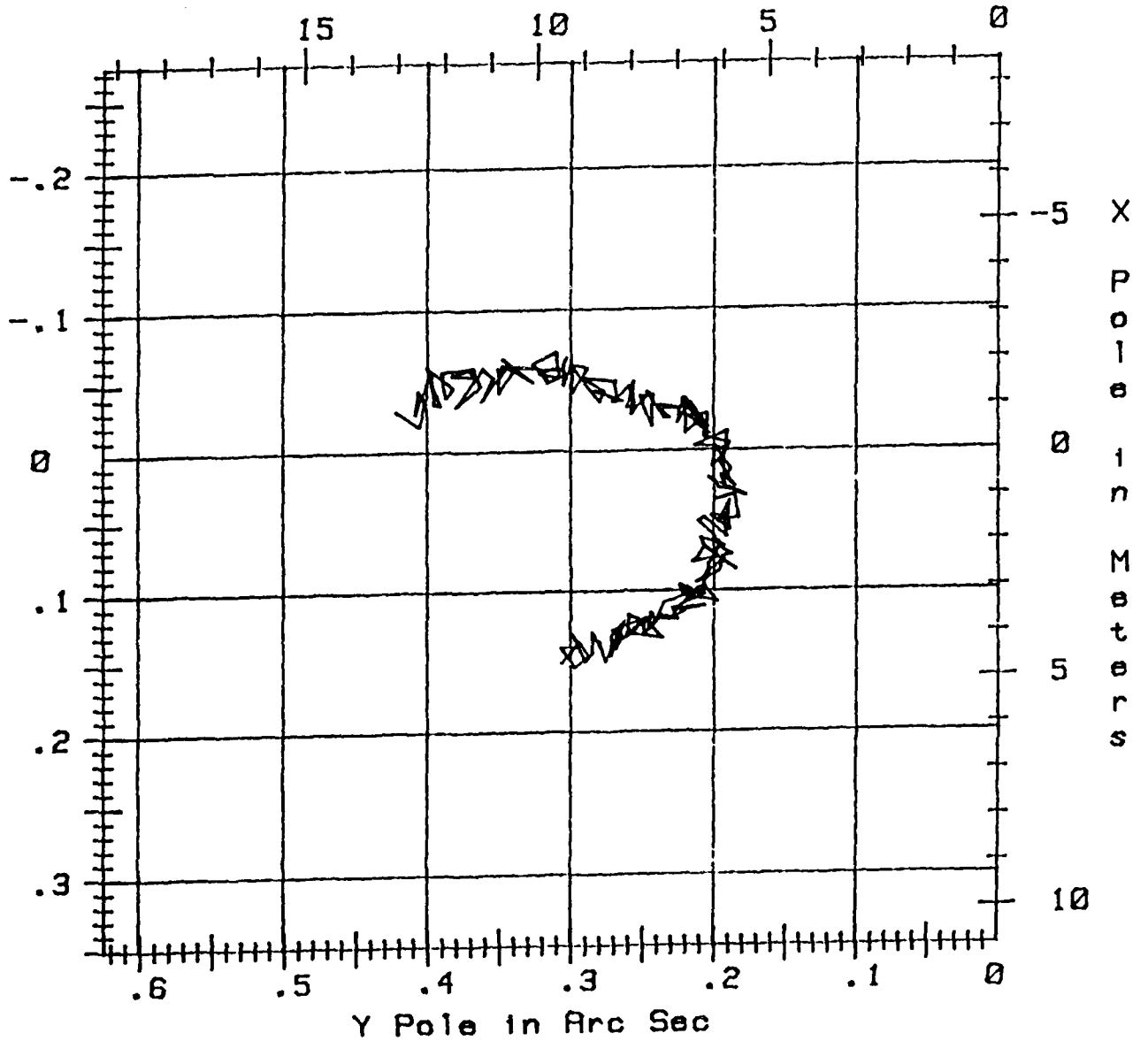


FIGURE 14:

SATELLITE 30480
DOPPLER POLAR MOTION
RESULTS DURING
1987

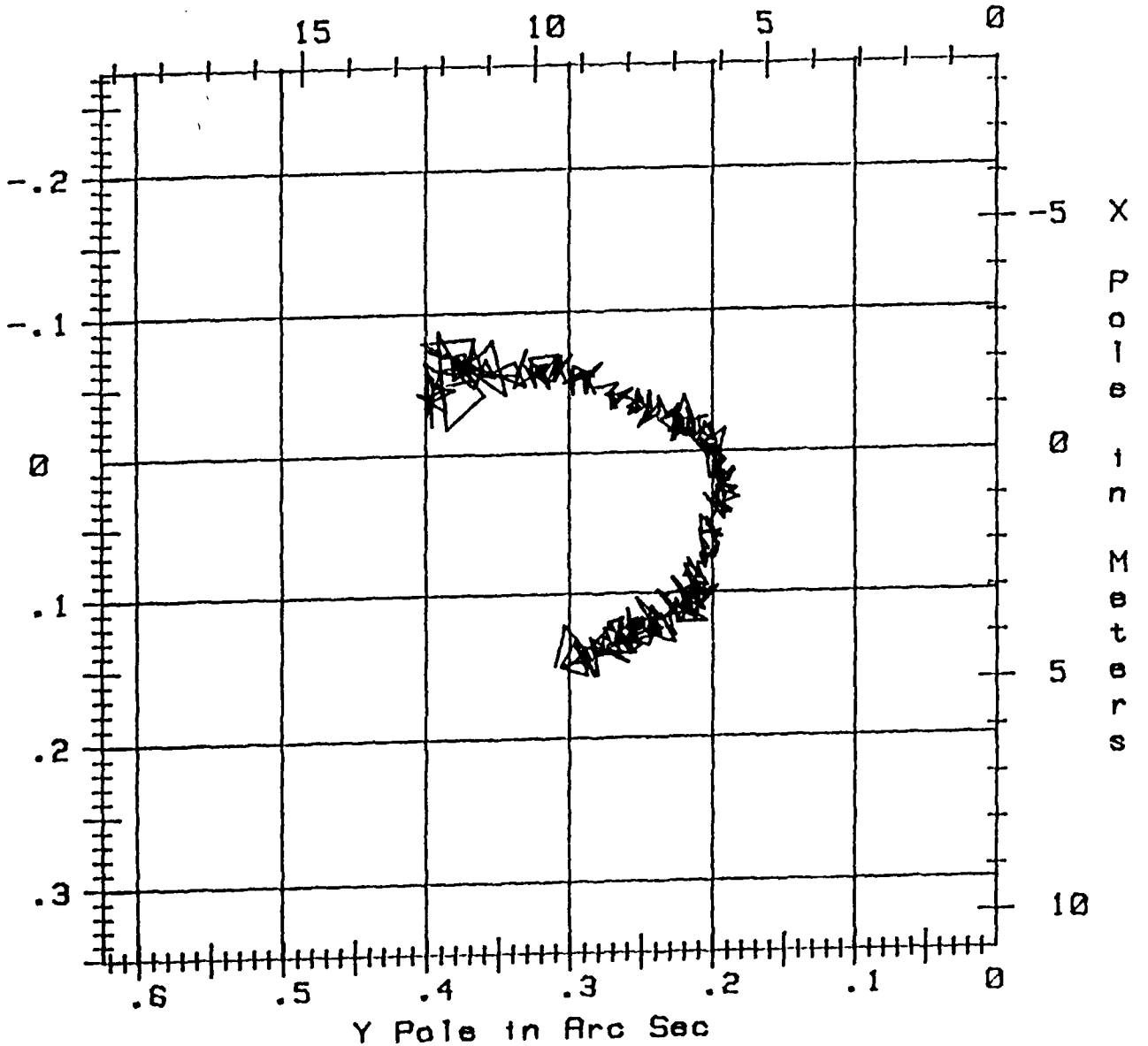


FIGURE 15:

SATELLITE 30500
DOPPLER POLAR MOTION
RESULTS DURING
1987

TABLE 7: COMPARISON OF DOPPLER AND BIH POLAR MOTION 1987

	X - Component		Y-Component		
TRANSIT Satellite Number	Mean*	RMS	Mean*	RMS	Number of Spa
30110	.0078	.0183	-.0094	.0197	182
30130	.0093	.0198	-.0138	.0241	153
30200	.0023	.0200	-.0098	.0196	153
30240	.0023	.0104	-.0130	.0170	89
30300	.0021	.0137	-.0119	.0190	129
30480	.0008	.0074	-.0065	.0102	151
30500	.0010	.0090	-.0068	.0119	364

* Mean of Doppler - BIH

Units are in arc seconds.

ACKNOWLEDGEMENTS

The authors wish to acknowledge Mr. Milo Robinson for his contributions to the polar motion section of this report, Mrs. Carol Finn for the frequency error plots, and Ms. Tracy Wingfield for her preparation of the manuscript.

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APPENDIX

DMAHTC POLE POSITION VALUES

1987

DMAHTC POLE POSITION VALUES
UNITS: ARC SECONDS

YEAR	DAY	X POLE (ARCSECS) 30110	30130	30200	30240	30300	30480	30500	Y POLE (ARCSECS) 30110	30130	30200	30240	30300	30480	30500
87	1	.145	.187	.120			.150	.150	.328	.244	.298			.307	.310
87	2	.149	.154			.157		.122	.286	.294			.322		.304
87	3			.140			.139	.146			.317			.296	.284
87	4	.131	.128			.128		.151	.280	.285			.296		.306
87	5			.115			.140	.133			.293			.307	.297
87	6	.138	.131			.167		.157	.331	.328			.287		.287
87	7			.177			.154	.151			.268			.297	.305
87	8	.137	.171			.159		.142	.291	.284			.298		.289
87	9			.136			.145	.157			.294			.287	.282
87	10	.150	.159			.155		.141	.239	.263			.258		.293
87	11			.185			.130	.136			.278			.299	.283
87	12	.138	.147			.157		.157	.296	.261			.301		.280
87	13			.117			.150	.137			.297			.290	.296
87	14	.146	.159			.135		.140	.323	.275			.251		.283
87	15			.152			.144	.144			.271			.285	.282
87	16	.134	.157			.136		.131	.281	.258			.264		.286
87	17			.129			.129	.142			.290			.285	.268
87	18	.123	.163			.123		.143	.298	.256			.275		.280
87	19			.129			.140	.131			.276			.279	.276
87	20	.152	.122	.107		.115	.135	.142	.242	.263	.258		.265	.280	.263
87	21			.118			.150	.140			.278			.276	.278
87	22	.136	.140			.113		.136	.257	.288			.245		.277
87	23			.129			.129	.148			.259			.267	.259
87	24	.140	.147			.125		.136	.233	.258			.264		.284
87	25			.155			.130	.122			.291			.266	.271
87	26	.130	.141			.113		.142	.297	.232			.258		.254
87	27			.127			.146	.140			.271			.272	.283
87	28	.159	.176			.112		.132	.280	.245			.282		.263
87	29			.155			.131	.140			.274			.271	.259
87	30	.124	.126			.120		.121	.249	.285			.257		.273
87	31			.127			.121	.117			.271			.262	.263
87	32	.149	.164			.118		.137	.271	.232			.254		.270
87	33			.167			.141	.124			.273			.269	.276
87	34	.123	.130			.131		.132	.264	.260			.224		.256
87	35			.094			.131	.136			.268			.263	.267
87	36	.098	.117			.138		.125	.244	.273			.240		.264
87	37			.184			.119	.119			.259			.245	.247
87	38	.108	.195			.128		.123	.295	.238			.247		.264
87	39			.118			.128	.119			.273			.271	.266
87	40	.155	.141			.126		.135	.269	.215			.233		.249
87	41			.174			.134	.143			.243			.263	.257
87	42	.108	.115			.126		.110	.242	.270			.246		.259
87	43			.117			.122	.134			.252			.248	.254
87	44	.133	.162			.123		.131	.279	.251			.223		.256
87	45			.133			.116	.120			.245			.260	.252
87	46	.133	.115			.138		.128	.264	.248			.234		.243
87	47			.106			.130	.118			.264			.259	.259
87	48	.143	.144			.144		.117	.242	.228			.229		.249
87	49			.134			.133	.123			.236			.236	.247
						.139		.132	.257	.277			.243		.264

DMAHTC POLE POSITION VALUES
UNITS: ARC SECONDS

		X POLE (ARCSECS)								Y POLE (ARCSECS)						
YEAR	DAY	30110	30130	30200	30240	30300	30480	30500		30110	30130	30200	30240	30300	30480	30500
87	53			.111			.131	.134				.237			.249	.258
87	54	.140	.119			.135		.129		.240	.202			.234		.239
87	55			.134			.127	.125				.255			.246	.236
87	56	.118	.125			.134		.118		.238	.246			.246		.242
87	57			.100			.115	.129				.238			.244	.236
87	58	.108	.145			.145		.125		.233	.256			.231		.239
87	59			.137			.119	.104				.237			.241	.253
87	60	.135	.127			.142		.115		.218	.229			.238		.240
87	61			.088			.126	.123				.241			.244	.242
87	62	.125	.130			.154		.115		.214	.214			.229		.236
87	63			.138			.117	.134				.238			.237	.227
87	64	.120	.123			.128		.127		.228	.250			.251		.245
87	65			.095			.120	.109				.212			.226	.243
87	66	.129	.144			.140		.129		.237	.241			.231		.226
87	67			.144			.119	.115				.233			.240	.230
87	68	.121	.115			.111		.113		.207	.191			.237		.215
87	69			.097			.108	.117				.214			.235	.213
87	70	.096	.110			.132		.102		.215	.209			.239		.236
87	71			.116			.101	.096				.197			.215	.217
87	72	.105	.107			.138		.112		.225	.227			.226		.205
87	73			.115			.120	.105				.222			.231	.218
87	74	.109	.141			.097		.104		.203	.214			.233		.215
87	75			.111			.112	.120				.207			.218	.221
87	76	.077	.099			.112		.098		.234	.201			.217		.239
87	77			.109			.110	.110				.222			.206	.227
87	78	.112	.120			.108		.119		.223	.217			.219		.236
87	79			.101			.114	.107				.181			.228	.222
87	80	.126	.138			.135		.120		.201	.245			.199		.204
87	81			.117			.112	.121				.238			.229	.224
87	82	.108	.125			.107		.105		.183	.192			.221		.226
87	83			.092			.102	.116				.201			.207	.215
87	84	.093	.096			.128		.096		.209	.182			.199		.197
87	85			.135			.096	.094				.215			.224	.210
87	86	.119	.114			.092		.117		.175	.204			.226		.211
87	87			.077			.104	.104				.184			.221	.219
87	88	.071	.097			.071		.089		.203	.205			.214		.228
87	89			.124			.107	.108				.220			.198	.210
87	90	.092	.105			.083		.098		.201	.173			.211		.201
87	91			.074			.096	.097				.210			.207	.213
87	92	.111	.060			.093		.114		.207	.216			.221		.218
87	93			.116			.103	.098				.224			.220	.223
87	94	.096	.124			.084		.103		.186	.236			.228		.220
87	95			.089			.102	.100				.196			.209	.207
87	96	.083	.121			.082		.094		.212	.214			.216		.205
87	97			.111			.081	.096				.195			.204	.217
87	98	.127	.101			.086		.104		.191	.188			.234		.204
87	99			.068			.089	.080				.214			.205	.219
87	100	.097	.094			.086		.093		.180	.212			.230		.215
87	101			.094			.094	.095				.208			.212	.203
		.073	.084			.075		.076		.195	.203			.191		.217

DMAHTC POLE POSITION VALUES
UNITS: ARC SECONDS

		X POLE (ARCSECS)								Y POLE (ARCSECS)						
AR	DAY	30110	30130	30200	30240	30300	30480	30500		30110	30130	30200	30240	30300	30480	30500
7	105			.086			.078	.079				.154			.193	.217
7	106	.111	.061			.081		.089		.195	.196			.187		.221
7	107			.090			.090	.089				.217			.208	.208
7	108	.079	.079			.095		.079		.185	.214			.189		.210
7	109			.071			.069	.080				.180			.197	.206
7	110	.086	.117			.080		.072		.206	.205			.178		.207
7	111			.087			.075	.068				.179			.187	.203
7	112	.094	.099			.074		.072		.180	.180			.204		.209
7	113			.048			.080	.075				.171			.215	.198
7	114	.086	.084			.073		.075		.178	.210			.189		.203
7	115			.078			.069	.082				.214			.207	.205
7	116	.071	.087			.070		.074		.204	.199			.177		.208
7	117			.064			.085	.063				.184			.185	.206
7	118	.083	.054			.078		.072		.195	.201			.194		.201
7	119			.078			.067	.066				.219			.207	.196
7	120	.086	.061			.069		.073		.181	.187			.173		.198
7	121			.066			.063	.074				.182			.209	.206
7	122	.066	.058			.080		.055		.199	.193			.191		.209
7	123			.078			.069	.057				.182			.193	.207
7	124	.090	.079			.053		.061		.188	.197			.199		.194
7	125			.048			.051	.061				.197			.211	.200
7	126	.087	.076			.054		.056		.167	.188			.192		.195
7	127			.061			.048	.059				.195			.207	.208
7	128	.066	.064			.045		.046		.178	.205			.207		.208
7	129			.045			.062	.055				.209			.191	.199
7	130	.080	.073			.047		.065		.205	.203			.180		.197
7	131			.063			.047	.053				.183			.193	.203
7	132	.080	.069			.055		.047		.186	.175			.189		.204
7	133			.040			.047	.053				.240			.202	.204
7	134	.064	.061			.066		.037		.190	.198			.180		.194
7	135			.036			.057	.042				.176			.189	.187
7	136	.078	.045			.037		.046		.206	.172			.184		.194
7	137			.047			.044	.036				.234			.190	.192
7	138	.085	.067			.039		.039		.183	.209			.199		.195
7	139			.025			.036	.034				.161			.189	.203
7	140	.069	.097			.039		.034		.170	.181			.190		.197
7	141			.042			.050	.044				.233			.197	.187
7	142	.068	.037			.039		.035		.214	.163			.182		.201
7	143			.039			.048	.030				.170			.182	.206
7	144	.083	.032			.041		.048		.202	.204			.185		.192
7	145			.041			.032	.040				.195			.186	.193
7	146	.062	.064			.038		.030		.209	.226			.177		.191
7	147			.031			.035	.024				.156			.199	.197
7	148	.053	.065			.052		.029		.188	.186			.211		.192
7	149			.054			.031	.033				.182			.185	.182
7	150	.098	.044			.050		.039		.200	.167			.201		.196
7	151			.013			.033	.024				.220			.178	.196
7	152	.072	.023			.034		.026		.183	.226			.192		.183
7	153			.037			.019	.032				.169			.203	.193
								.024		.196	.207			.184		.193

DMAHTC POLE POSITION VALUES
UNITS: ARC SECONDS

		X POLE (ARCSECS)							Y POLE (ARCSECS)						
YEAR	DAY	30110	30130	30200	30240	30300	30480	30500	30110	30130	30200	30240	30300	30480	30500
87	157			.041			.030	.019			.152			.183	.194
87	158	.043	.022			.052		.023	.181	.237			.198		.192
87	159			.027			.027	.031			.191			.192	.199
87	160	.052	.058			.042		.025	.193	.218			.188		.192
87	161			.039			.017	.029			.167			.195	.185
87	162	.036	.031			.035		.021	.235	.157			.195		.196
87	163			.012			.026	.012			.212			.185	.186
87	164	.053	.009			.042		.021	.190	.193			.209		.189
87	165			.007			.007	.018			.152			.197	.202
87	166	.036	.020			.021		.014	.194	.201			.181		.185
87	167			.023			.004	.022			.202			.194	.193
87	168	.033	.040			.041		.014	.198	.165			.186		.195
87	169			.007			.021	.014			.172			.192	.193
87	170	.029	.023			.038		.029	.184	.185			.178		.196
87	171			.005			.013	.005			.208			.188	.194
87	172	.024	.016			.037		.003	.182	.183			.228		.194
87	173			.004			.003	.014			.181			.199	.200
87	174	.020	.029			.013		.001	.216	.193			.182		.198
87	175			.031			.012	.007			.188			.202	.191
87	176	.048	.050			.009		.019	.207	.217			.211		.202
87	177			.007			.002	.003			.189			.193	.204
87	178	.023	.007			.025		.005	.203	.189			.192		.194
87	179			.007			.014	.005			.185			.191	.209
87	180	.008	.021			.002		.016	.192	.223			.203		.192
87	181			.030			.004	.017			.210			.214	.198
87	182	.017	.007			.006		.003	.216	.237			.200		.199
87	183						.002	.003						.191	.204
87	184	.017	.018			.024		.004	.197	.171			.201		.204
87	185			.030			.006	.014			.206			.190	.210
87	186	.002	.008			.018		.021	.211	.188			.219		.202
87	187			.013			.010	.001			.183			.207	.195
87	188	.000	.010			.008		.009	.216	.210			.226		.210
87	189			.033	.011		.012	.009			.233	.197		.207	.198
87	190	.013	.011			.031		.014	.192	.191			.192		.207
87	191			.007	.030		.012	.021			.188	.194		.203	.206
87	192	.008	.018			.003		.006	.185	.201			.208		.197
87	193			.030	.014		.025	.000			.212	.193		.218	.205
87	194	.030	.028			.033		.018	.216	.196			.222		.221
87	195			.006	.010		.027	.013			.197	.208		.205	.206
87	196	.009	.035			.023		.013	.208	.224			.195		.209
87	197			.010	.011		.013	.025			.228	.204		.206	.210
87	198	.018	.014			.012		.025	.198	.181			.202		.204
87	199			.032	.018		.030	.021			.191	.213		.213	.217
87	200	.013	.014			.036		.023	.225	.194			.206		.214
87	201			.009	.020		.033	.020			.209	.209		.216	.213
87	202	.004	.008			.028		.031	.226	.211			.190		.218
87	203			.036	.033		.017	.020			.209	.191		.204	.213
87	204	.001	.010			.023		.012	.190	.208			.219		.212
87	205			.011	.048		.029	.016			.206	.200		.213	.219
87	206	.021	.004			.017		.025	.225	.182			.201		.223
87	[illegible]			[illegible]			[illegible]	[illegible]			.210	.218		.220	.227

DMAHTC POLE POSITION VALUES
UNITS: ARC SECONDS

		X POLE (ARCSECS)								Y POLE (ARCSECS)						
YEAR	DAY	30110	30130	30200	30240	30300	30480	30500		30110	30130	30200	30240	30300	30480	30500
87	209			.006	.004		.012	.022				.199	.221		.220	.213
87	210	.018	.029			.020		.013		.194	.210			.219		.215
87	211			.055	.017		.022	.015				.227	.222		.211	.230
87	212	.024	.006			.025		.024		.184	.207			.197		.226
87	213			.002	.022		.037	.018				.223	.203		.221	.227
87	214	.001	.049			.037		.040		.232	.202			.201		.220
87	215			.055	.032		.020	.023				.234	.212		.226	.213
87	216	.003	.027			.029		.009		.208	.207			.202		.228
87	217			.016	.029		.026	.024				.198	.211		.223	.226
87	218	.023	.002			.019		.034		.206	.236			.209		.224
87	219			.044	.030		.031	.025				.245	.237		.217	.230
87	220	.046	.018			.038		.026		.227	.194			.210		.222
87	221			.001	.041		.030	.011				.215	.217		.234	.218
87	222	.027	.035			.035		.015		.225	.205			.240		.227
87	223			.029	.041		.030	.024				.239	.238		.226	.237
87	224	.038	.026			.039		.025		.214	.222			.234		.229
87	225			.011	.036		.030	.030				.206	.217		.224	.226
87	226	.061	.018			.042		.028		.250	.231			.207		.230
87	227			.017	.043		.033	.027				.248	.215		.241	.227
87	228	.010	.018			.047		.023		.242	.203			.227		.237
87	229			.040	.046		.023	.030				.231	.240		.231	.223
87	230	.012	.037			.022		.025		.220	.241			.229		.231
87	231			.019	.044		.024	.039				.235	.228		.234	.238
87	232	.025	.017			.038		.029		.242	.232			.233		.237
87	233			.045	.036		.041	.026				.253	.228		.247	.238
87	234	.033	.010			.037		.021		.261	.214			.239		.248
87	235			.008	.040		.040	.036				.234	.232		.243	.237
87	236	.034	.029			.046		.030		.231	.215			.239		.242
87	237			.067	.044		.018	.041				.233	.224		.244	.245
87	238	.029	.012			.053		.024		.244	.238			.238		.246
87	239			.015	.045		.039	.018				.268	.244		.252	.252
87	240	.016	.022			.044		.036		.275	.250			.233		.243
87	241			.047	.046		.038	.044				.255	.225		.248	.244
87	242	.026	.031			.036		.042		.256	.219			.254		.244
87	243			.003	.044		.026	.038				.262	.251		.258	.243
87	244	.027	.041			.030		.029		.248	.245			251		.242
87	245			.058	.053		.045	.027				.265	.260		.256	.244
87	246	.031	.040			.039		.044		.268	.255			.262		.252
87	247			.012	.041		.049	.028				.256	.256		.257	.258
87	248	.028	.017			.050		.029		.247	.229			.260		.256
87	249			.051	.052		.031	.032				.272	.253		.261	.252
87	250	.038	.043			.038		.029		.254	.228			.237		.253
87	251			.046	.031		.032	.033				.242	.242		.255	.246
87	252	.023	.043			.047		.037		.268	.270			.237		.252
87	253			.050	.046		.046	.031				.273	.230		.259	.253
87	254	.027	.035			.041		.033		.295	.237			.265		.259
87	255			.028	.048		.035	.038				.248	.254		.271	.249
87	256	.026	.027			.034		.038		.254	.281			.261		.256
87	257			.028	.046		.036	.041				.273	.256		.264	.268
														.280		.256

DMAHTC POLE POSITION VALUES
UNITS: ARC SECONDS

		X POLE (ARCSECS)								Y POLE (ARCSECS)						
YEAR	DAY	30110	30130	30200	30240	30300	30480	30500		30110	30130	30200	30240	30300	30480	30500
87	261			.015	.043		.043	.032				.291	.260		.284	.267
87	262	.014	.015					.032		.272	.264					.268
87	263			.059	.060		.037	.042				.248	.266		.267	.271
87	264	.031	.046					.041		.256	.242					.263
87	265			.028	.049		.050	.037				.265	.233		.269	.266
87	266		.070					.042			.281					.275
87	267			.087	.048		.052	.047				.284	.259		.293	.268
87	268	.017	.034					.041		.292	.288					.271
87	269			.002	.040		.042	.049				.277	.257		.277	.266
87	270	.041	.045					.047		.289	.277					.276
87	271			.078	.051		.035	.048				.286	.283		.280	.287
87	272	.049	.048					.053		.311	.258					.286
87	273			.025	.048		.061	.042				.270	.286		.300	.288
87	274	.029	.053					.047		.296	.295					.289
87	275			.056	.052		.059	.053				.301	.285		.289	.290
87	276	.051	.033					.043		.284	.308					.282
87	277			.035	.063		.042	.053				.274	.285		.299	.287
87	278	.066	.022					.064		.319	.273					.277
87	279			.042	.057		.061	.053				.298	.275		.300	.293
87	280	.028	.054					.050		.309	.290					.304
87	281			.052	.071		.065	.057				.280	.297		.300	.286
87	282	.049	.048					.058		.301	.337					.286
87	283			.050	.066		.047	.055				.326	.288		.305	.298
87	284	.050	.052					.060		.301	.285					.301
87	285			.043	.061		.060	.042				.268	.313		.306	.297
87	286	.050	.058					.062		.323	.297					.297
87	287			.033	.068		.067	.055				.327	.305		.303	.283
87	288	.040	.073					.051		.292	.298					.302
87	289			.070	.062		.052	.065				.281	.296		.310	.309
87	290	.069	.057					.065		.302	.313					.308
87	291			.055	.059			.054				.323	.296			.309
87	292	.050	.056					.070		.337	.303					.299
87	293			.058	.060			.065				.290	.296			.304
87	294	.051	.063					.052		.314	.293					.311
87	295			.019	.055		.055	.069				.314	.311		.322	.306
87	296	.061	.069					.051		.310	.312					.316
87	297			.068	.058		.060	.052				.307	.314		.309	.310
87	298	.068	.042					.068		.336	.321					.308
87	299			.050	.058		.070	.055				.319	.314		.311	.314
87	300	.039	.063					.055		.316	.286					.327
87	301			.062	.047		.062	.062				.296	.316		.327	.320
87	302	.071	.071					.047		.310	.327					.314
87	303			.065	.053		.049	.068				.315	.310		.316	.328
87	304	.076	.062					.070		.333	.315					.308
87	305			.073	.071		.057	.056				.339	.317		.298	.318
87	306	.055	.050					.052		.337	.313					.318
87	307			.052	.052		.061	.063				.303	.343		.348	.331
87	308	.068	.043					.048		.320	.313					.323
87	309			.054	.045		.055	.063				.346	.335		.337	.327
								.064		.336	.348					.313

DMAHTC POLE POSITION VALUES
UNITS: ARC SECONDS

		X POLE (ARCSECS)								Y POLE (ARCSECS)						
YEAR	DAY	30110	30130	30200	30240	30300	30480	30500		30110	30130	30200	30240	30300	30480	30500
87	313			.047	.049		.066	.056				.372	.334		.348	.337
87	314	.056	.021					.057		.321	.334					.359
87	315			.055	.071		.059	.065				.308	.333		.339	.338
87	316	.087	.052					.048		.333	.343					.330
87	317			.042	.045		.043	.080				.351	.341		.350	.403
87	318	.065	.057					.082		.343	.378					.366
87	319			.064	.050		.059	.064				.326	.350		.351	.372
87	320	.065	.035					.074		.337	.356					.359
87	321			.032	.045		.057	.081				.377	.348		.347	.354
87	322	.074	.044					.042		.313	.345					.344
87	323			.065	.042		.036	.068				.337	.352		.362	.379
87	324	.064	.029					.042		.353	.347					.359
87	325			.038	.055		.052	.018				.364	.379		.354	.386
87	326	.039	.053					.088		.356	.345					.392
87	327			.078	.040		.059	.052				.363	.360		.362	.373
87	328	.070	.041					.047		.350	.357					.366
87	329			.044	.047		.032	.068				.379	.353		.380	.359
87	330	.070	.066					.055		.344	.350					.352
87	331			.069	.045		.047	.059				.389	.361		.363	.371
87	332	.060	.078					.076		.375	.397					.367
87	333			.028	.063		.059	.060				.351	.365		.368	.360
87	334	.061	.060					.063		.329	.422					.374
87	335			.070	.065		.054	.072				.370	.379		.383	.372
87	336	.089	.046					.069		.365	.398					.387
87	337			.042	.040		.053	.075				.333	.383		.367	.399
87	338	.046	.054					.064		.341	.355					.369
87	339			.074	.045		.059	.059				.423	.375		.372	.369
87	340	.056	.067					.071		.368	.365					.382
87	341			.039	.045		.056	.063				.354	.381		.390	.367
87	342	.053	.030					.057		.373	.372					.380
87	343			.052	.050		.039	.061				.374	.376		.387	.394
87	344	.062	.046					.062		.395	.376					.362
87	345			.030	.041		.046	.054				.349	.383		.382	.380
87	346	.048	.070					.069		.350	.397					.382
87	347			.060	.048		.060	.053				.435	.381		.401	.367
87	348	.066	.064					.047		.366	.394					.394
87	349			.054	.035		.033	.066				.386	.405		.390	.401
87	350	.031	.040					.058		.394	.404					.390
87	351			.041	.035		.035	.042				.411	.387		.395	.397
87	352	.026	.037					.047		.389	.374					.389
87	353			.062	.029		.057	.046				.389	.404		.398	.380
87	354	.024	.049					.036		.344	.421					.400
87	355			.000	.036		.047	.058				.379	.366		.401	.398
87	356	.051	.040					.047		.395	.443					.389
87	357			.043	.019		.028	.037				.393	.396		.408	.387
87	358	.015	.038					.054		.397	.398					.389
87	359			.009	.032		.044	.031				.400	.402		.406	.386
87	360	.031	.062					.043		.365	.401					.405
87	361			.056	.025		.037	.044				.413	.417		.402	.394
87	362	.010	.044					.028		.396	.437					.400
				.003	.005		.018	.040				.373	.406		.405	.397

DMAHTC POLE POSITION VALUES
UNITS: ARC SECONDS

YEAR	DAY	X POLE (ARCSECS)								Y POLE (ARCSECS)							
		30110	30130	30200	30240	30300	30480	30500		30110	30130	30200	30240	30300	30480	30500	
87	365						.029								.421		

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