

~~CONFIDENTIAL~~

CLASSIFICATION CHANGE
To **UNCLASSIFIED**
By authority of GDS-GP-4 Date 10-75
Changed by L. Shirley
Classified Document Master Control Station, NASA
Scientific and Technical Information Facility

4160-6047-TC000

NAS9-2938

NASA-MSC-G-R-65-2

Supplemental Report 4

GEMINI GT-3

INERTIAL GUIDANCE SYSTEM EVALUATION

TRAJECTORY RECONSTRUCTION (I)

(NASA-TM-X-61009) GEMINI GT-3 INERTIAL
GUIDANCE SYSTEM EVALUATION TRAJECTORY
RECONSTRUCTION (NASA) 102 p

N79-76309

Unclas

00/18 11087

FF No. 602A	(PAGES)	(CODE)
	TMX 61009	
	(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)
	CONFIDENTIAL	ONLY

17 MAY 1965

Published as Supplemental Report 4
to the Gemini Program Mission Report GT-3
(Gemini 3) MSC-G-R-65-2 by:

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

TRW SPACE TECHNOLOGY LABORATORIES
THOMPSON RAMO WOOLDRIDGE INC.

~~CONFIDENTIAL~~

C68-3653

~~CONFIDENTIAL~~

4160-6047-TC000

NAS9-2938

Total Pages: 102

NASA-MS-C-G-R-65-2

Supplemental Report 4

GEMINI GT-3

INERTIAL GUIDANCE SYSTEM EVALUATION

TRAJECTORY RECONSTRUCTION (U)

~~GROUP 1
Downgraded at 3 year
intervals; declassified
after 12 years~~

17 MAY 1965

Published as Supplemental Report 4
to the Gemini Program Mission Report GT-3
(Gemini 3) MSC-G-R-65-2 by:

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOOLDRIDGE INC.

~~DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10~~

~~CONFIDENTIAL~~

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Section 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

~~CONFIDENTIAL~~

4160-6047-TC000

-ii-

NAS9-2938

Total Pages - 102

GEMINI GT-3
INERTIAL GUIDANCE SYSTEM EVALUATION
TRAJECTORY RECONSTRUCTION

4160-6047-TC000

17 May 1965

By

P. M. Jackson

W. R. Anders

Approved By:

Robert J. Boyles
R. J. BOYLES

Approved By:

W. Schroeder
W. SCHROEDER

~~DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10~~

~~CONFIDENTIAL~~

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
1.0	Introduction	1
2.0	Summary	3
3.0	Ascent Analysis	5
4.0	Re-Entry Analysis	29
5.0	Trajectory Reconstruction	39
6.0	Tracking System Performance	59
7.0	References	71
 <u>Table</u>		
I	Guidance Error At SECO	10
II	GT-3 Navigation Errors	11
III	Ascent Phase IMU Analysis Recovered Coefficients	15
IV	Accelerometer Bias And Scale Factor Summary	24
V	Errors At SECO	25
VI	Azimuth Update	27
VII	Indicated Position Summary	30
VIII	Re-Entry Analysis Recovered Error Source Coefficients ...	38

TABLE OF CONTENTS

(Continued)

<u>Appendix</u>		<u>Page</u>
I	Ascent Thrust Profile	72
II	Re-Entry Thrust Profile	84
III	Ascent Gimbal Angles And Attitude Errors	94

Total Pages: 102

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	GE Final And LOOK MISTRAM ΔV , Thrust Coordinates	6
2	GE Final And LOOK MISTRAM ΔP , Thrust Coordinates	7
3	GE Final And LOOK MISTRAM ΔV , Guidance Inertial Coordinates	8
4	Navigation Velocity Error	9
5	LOOK MISTRAM ΔV , Thrust Coordinates, Calibration Comparison	13
6	LOOK MISTRAM ΔV , Thrust Coordinates, Calibration Comparison	14
7	Free-Flight Velocity Errors, Thrust Coordinates	19
8	Pitch Malfunction Error Propagation Curves	22
9	Re-Entry Mode ΔP State Vector Initialized Guidance Trajectory	32
10	Re-Entry Mode ΔV State Vector Initialized Guidance Trajectory	33
11	Re-Entry Mode ΔP , Radar Initialized Guidance Trajectory ...	35
12	Re-Entry Mode ΔV , Radar Initialized Guidance Trajectory ...	36
13	Re-Entry Mode Special Parameters	53
14	GE/Burroughs And LOOK MISTRAM ΔV , Thrust Coordinates	62
15	1OK MISTRAM And LOOK MISTRAM ΔV , Thrust Coordinates	64

LIST OF FIGURES

(Continued)

<u>Figure</u>		<u>Page</u>
16	Final MISTRAM And LOOK MISTRAM ΔV , Thrust Coordinates	66
17	Passive MISTRAM And LOOK MISTRAM ΔV , Thrust Coordinates	67
18	BET And LOOK MISTRAM ΔV , Thrust Coordinates	68
19	Ascent Phase Thrust Profile	73
20	Inertial Flight Path Angle	74
21	Re-Entry Mode Thrust Profile	82
22	Gimbal Angles And Attitude Errors	95

~~CONFIDENTIAL~~

4160-6047-TC000
-vii-

Acknowledgements

The authors wish to thank R. J. Boyles for his contribution to this report and the computer programming staff headed by S. F. Needham and J. N. Bausch for the efficient and timely reduction of the data.

~~CONFIDENTIAL~~

1.0 INTRODUCTION

GEMINI flight GT-3 was successfully launched on 23 March 1965 from Complex 19 at Cape Kennedy, Florida. This was the first manned orbital flight and the second to carry an inertial guidance system in the GEMINI spacecraft.

The purpose of this report is to present the results of the inertial guidance system analysis performed during ascent and re-entry and to provide a trajectory reconstruction of the spacecraft during ascent and re-entry.

The contents of this report are as follows:

- Section 2.0 - Provides a summary of the significant analysis results determined from this flight.
- Section 3.0 - Provides a detailed description of the analysis performed during the ascent portion of flight. This includes a discussion of; a) inertial measurement unit (IMU) accelerometer and platform errors, b) the radio guidance - inertial guidance update procedure, and c) airborne computer computation errors.
- Section 4.0 - Provides a description of the IMU error analysis performed during re-entry and the correlation between the ascent and the re-entry IMU analyses.

Section 5.0 - Provides tabular listings of the trajectory reconstruction during ascent and re-entry.

Section 6.0 - Describes the external tracking system performance and quality.

Appendix - Contains listings and plots of the thrust acceleration profile for ascent and re-entry and plots of the ascent gimbal angles and attitude errors.

~~CONFIDENTIAL~~

4160-6047-TC000

-3-

2.0 SUMMARY

The following is a brief summary of the major results from analysis of the data from this flight:

2.1 Excessive pitch type errors were noted during the ascent and re-entry modes of flight with magnitudes equivalent to the following constant pitch drift rates:

- a. 1 deg/hr for the first 180 seconds of ascent.
- b. 23 deg/hr after 180 seconds and at least until SECO.
- c. 4.6 deg/hr during the entire post-retro phase of the re-entry mode.

Analyses of the observed errors and concurrent postflight tests on the GT-3 platform by Honeywell indicate the observed pitch errors are attributable to a malfunctioning Y gyro.

2.2 The major guidance system errors other than the pitch errors resulted from X and Z accelerometer scale factor errors of approximately 700 and 600 parts per million and bias errors of 340 and 180 ppm g respectively. Comparisons of calibration data indicated that the large scale factor errors would not have been present, resulting in considerable improvement in guidance velocity magnitude accuracy, had the latest preflight calibration data been used.

2.3 Analysis of the update procedure indicated negligible azimuth drifts during the ascent phase and successful accomplishment of the RGS/IGS update procedure.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

4160-6047-TC000

-4-

- 2.4 There was no evidence of an accelerometer count gain malfunction as observed on the GT-2 flight (see Reference 3).
- 2.5 The best estimate of the re-entry trajectory based upon corrected guidance data indicates that the spacecraft was 14 nautical miles North and 59 nautical miles West of the desired impact point at 799 seconds after retrofire. (This was at approximately 50,000 feet altitude and corresponds to the last available guidance or tracker trajectory point.) The IMU error while large made a relatively small contribution to the total impact miss.
- 2.6 In general, the quality of the tracking data was excellent. The quick look MISTRAM data was much improved compared to GT-2.

The principal discrepancy in the data received on this flight was a large systematic error, amounting to 2-3 feet per second in \dot{X} and 10-20 feet per second in \dot{Y} , noted between MISTRAM and GE Mod III late in flight.

Re-entry radar data was, in general, adequate with the exception of 3.18 data which exhibited very large systematic errors.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

4160-6047-TC000

-5-

3.0 ASCENT ANALYSIS

3.1 Introduction

Flight time history comparisons were made between guidance system telemetered quantities and external tracking data for the purpose of evaluating the Inertial Measurement Unit (IMU) accuracies and the navigation performance on GT-3. The IMU evaluation is based on thrust velocity comparisons (Figure 1) between the telemetered accumulated accelerometer count data properly scaled and biased and external tracking data converted to guidance thrust velocities (gravity removed). The guidance coordinate system is an inertial, orthogonal, right-handed system aligned with the launch site at inertial T_0 and referenced to the center of the earth. The X and Z axes lie in a plane parallel to the geodetic tangent plane with the X axis defined by the launch azimuth positive downrange. The Y axis is positive down along the geodetic vertical and Z is directed so as to complete the right-handed X, Y, Z set.

Comparisons were also made between the telemetered total inertial position and velocity output of the airborne computer and external tracking data (Figures 2, and 3). These are called inertial or total comparisons and include airborne computer navigation errors such as caused by gravity approximations, truncation errors, etc. The difference between this set of comparisons and the thrust comparison set (DELTA-DELTA Comparisons, Figure 4) provides a measure of the airborne computer navigation error.

~~CONFIDENTIAL~~

Figure 1

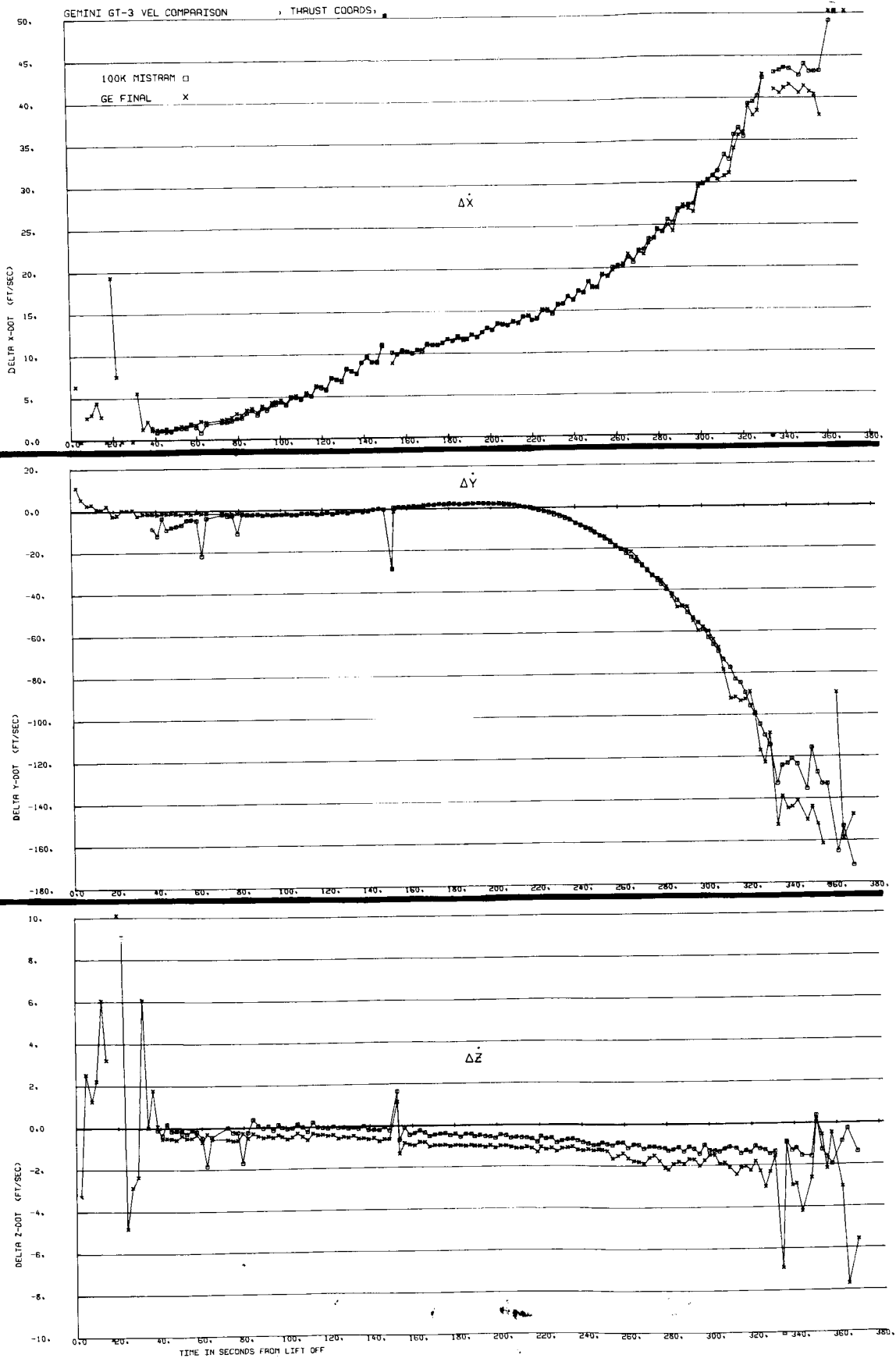


Figure 2

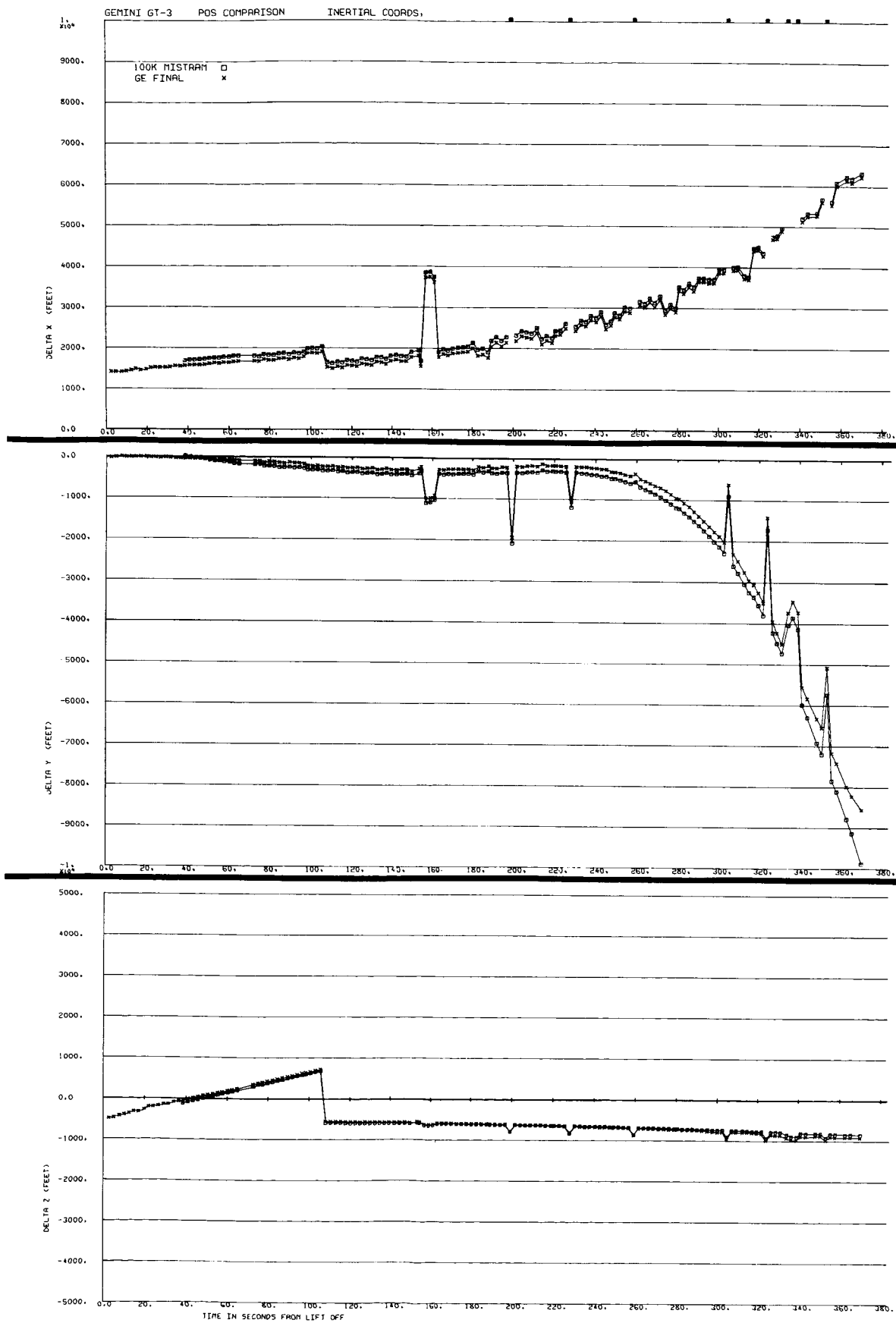


Figure 3

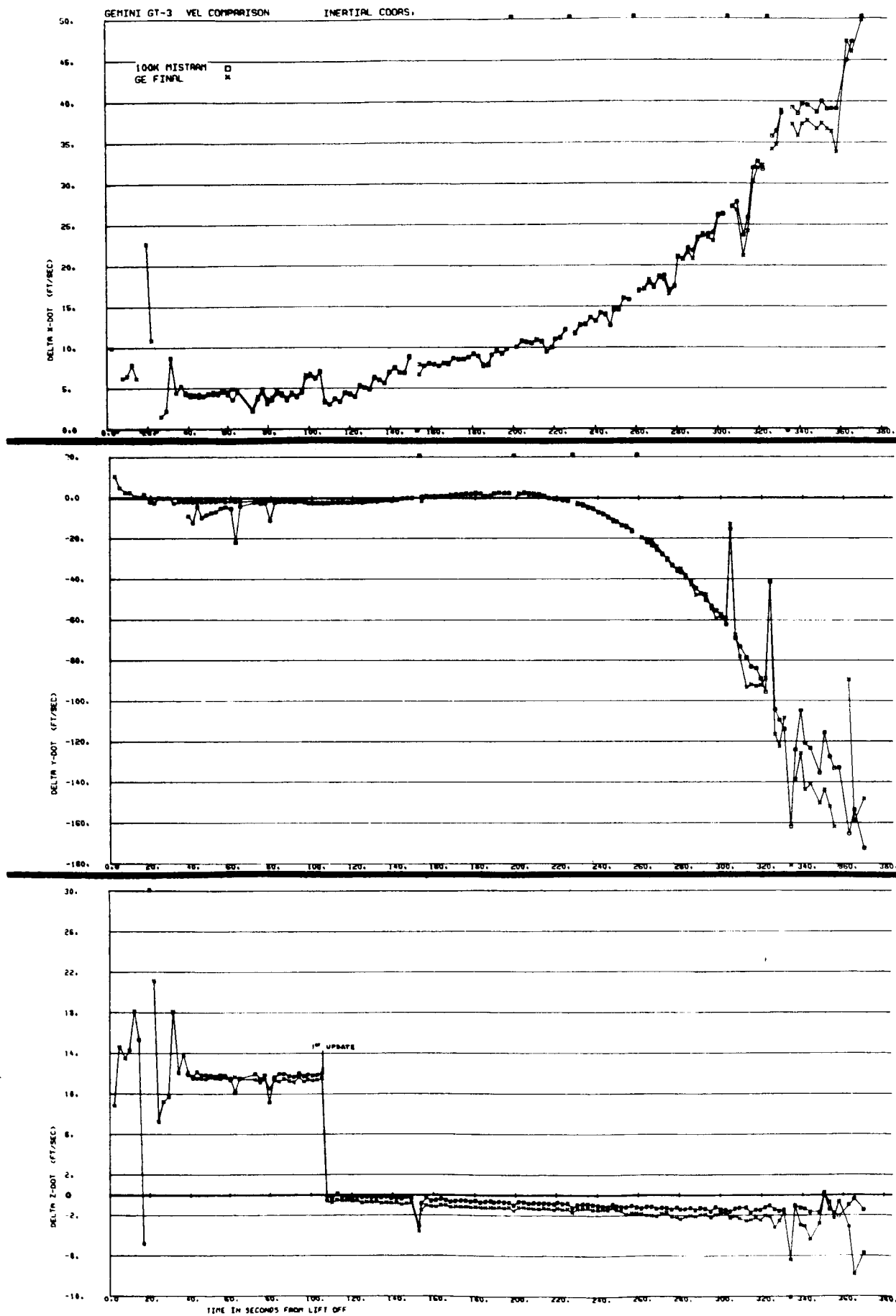
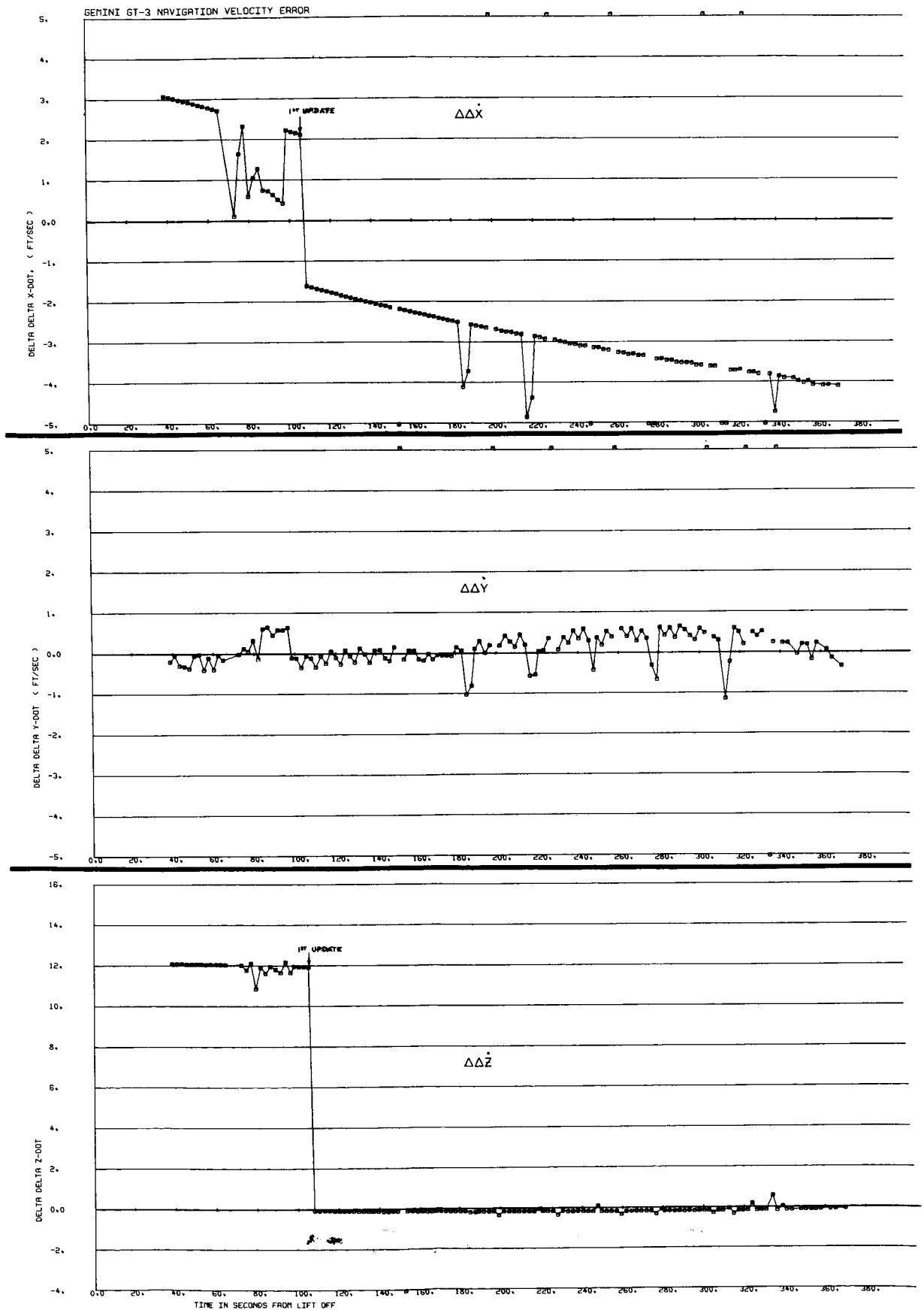


Figure 4



Comparisons were made using several sources of external tracking data including quick look MISTRAM I 10K and 100K, GE/Mod III/Final, GE Mod III/Burroughs, final MISTRAM, passive MISTRAM II and BET. The relative merits of these data sources are described in Section 6.0. The ascent analysis was based primarily on quick look MISTRAM I 100K data because of its superior quality. Details of the data processing required to obtain these comparisons are given in Reference 1.

The plots enclosed are referenced to liftoff which occurred 3.452 seconds after go inertial.

3.2 Guidance Error

The indicated guidance system error at SECO (334 seconds from liftoff) and equally valid at separation (359 seconds from liftoff) are given below. These values were obtained by examination of the position and velocity comparisons (Figures 1-4).

TABLE I
GUIDANCE ERROR AT SECO

<u>IMU Error</u>	<u>Navigation Equation Errors</u>	<u>Total Guidance Error</u>
$\Delta \dot{X}$ 41.0 \pm 1	-3.7 \pm .1	37.3 \pm 1
$\Delta \dot{Y}$ -162.0 \pm 1.5	+ .50 \pm .1	-161.5 \pm 1.5
$\Delta \dot{Z}$ -2.5 \pm .1	- .15 \pm .1	-2.6 \pm .1
ΔX 5100 \pm 200	452	5552 \pm 200
ΔY -5200 \pm 50	111	-5089 \pm 50
ΔZ -1000 \pm 50	-568	-1568 \pm 50

The column headed IMU ERROR represents the error contributed by the accelerometer and gyro sources, that headed NAVIGATION EQUATION ERRORS is the contribution due to various approximations within the airborne computer as observed from the Delta Delta Comparisons* and that titled TOTAL GUIDANCE ERROR is the sum of the two and represents the total IGS error. These total errors result in velocity magnitude and flight path angle errors at release of the following amounts

$$\Delta |V| = 12 \text{ fps}$$

$$\Delta \gamma = .38 \text{ deg}$$

The following table is a comparison between the navigation errors observed on this flight and those predicted by preflight simulation.**

TABLE II

GT-3 NAVIGATION ERRORS

	<u>Position (ft)</u>			<u>Velocity (ft/sec)</u>		
	X	Y	Z	\dot{X}	\dot{Y}	\dot{Z}
Actual	452	111	-568	-3.7	.5	-1.5
Simulated	51	0	-160	-3.25	1.45	-.45

The observed differences are most likely attributable to computational errors caused by the large position errors observed on this flight.

* Level changes at 106 seconds in the \dot{X} and \dot{Z} curves are due to updating the initial earth rate conditions by the onboard computer as a result of the RGS/IGS update routine.

** The preflight simulation values were obtained by telephone from IBM.

~~CONFIDENTIAL~~

4160-6047-TC000

-12-

3.3 IMU Analysis

The thrust coordinate velocity comparison plots (Figures 5 and 6) indicate large steadily increasing X axis velocity errors throughout flight; and rapid negatively increasing Y velocity errors, beginning approximately 180 seconds from liftoff, abruptly reversing an increasing positive trend prior to that time. These anomalies are attributable primarily to excessive X and Z accelerometer bias and scale factor errors, and a pitch drift malfunction error occurring at approximately 180 seconds.

Preliminary observations of the data revealed that the major portion of the X error prior to 180 seconds could be attributable to an X accelerometer scale factor error; however, the velocity error trend beyond this period suggested the presence of an additional large magnitude error source. Since both the X and Y axis velocity comparisons indicated the presence of a large magnitude error source beginning mid-flight while the Z axis seemed unaffected, it was concluded that a pitch type malfunction must have occurred during the latter period of the ascent phase.

Because of this apparent malfunction it was necessary to perform a separate analysis before and after this occurrence. Table III summarizes the results of this analysis by listing error coefficients that could account for the ascent IMU error. This partitioning of the flight into time intervals lessened the accuracy with which the IMU errors could be isolated, but permitted the identification of the type of errors present (i.e., gyro versus accelerometer or drift versus measurement) and approximate equivalent magnitudes.

~~CONFIDENTIAL~~

Figure 5

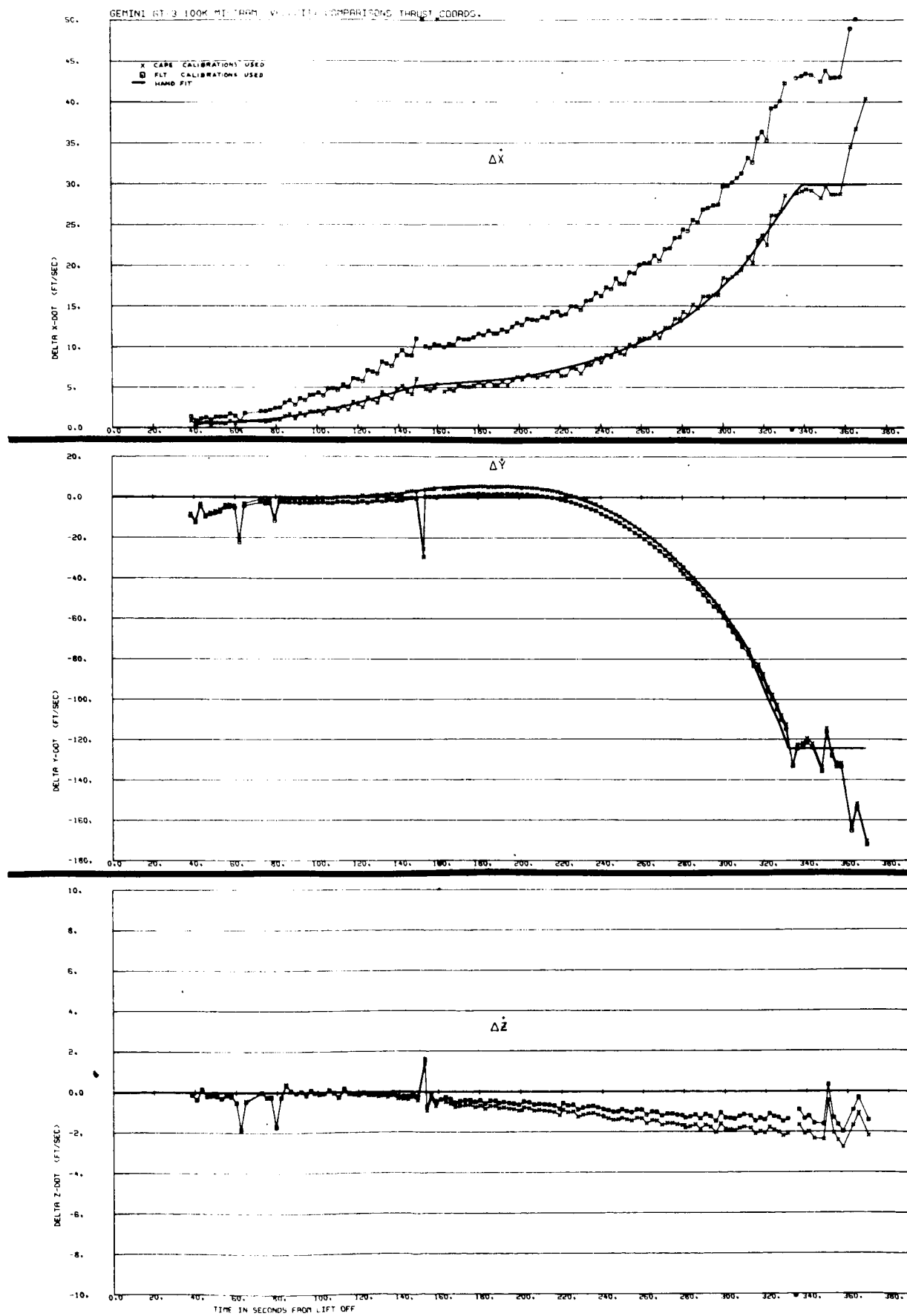


Figure 6

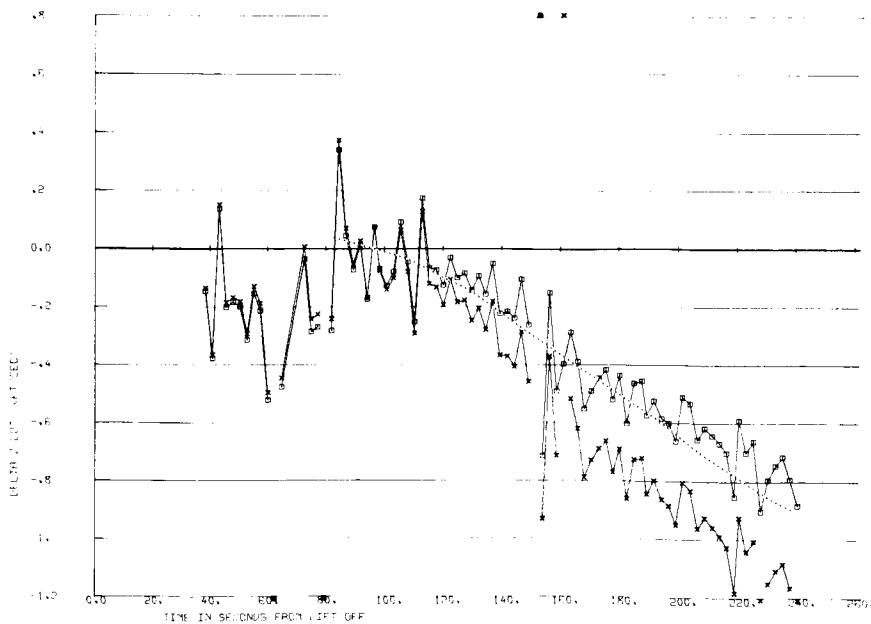
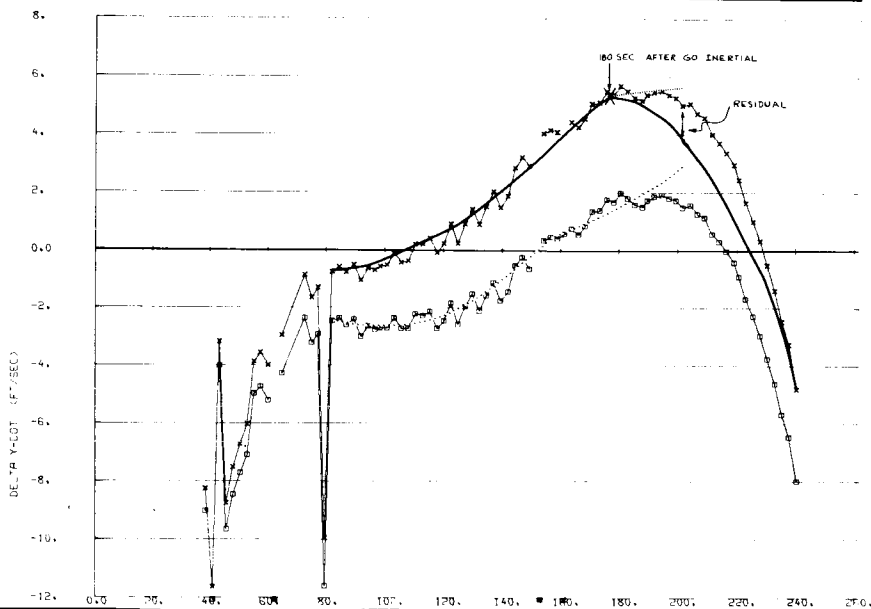
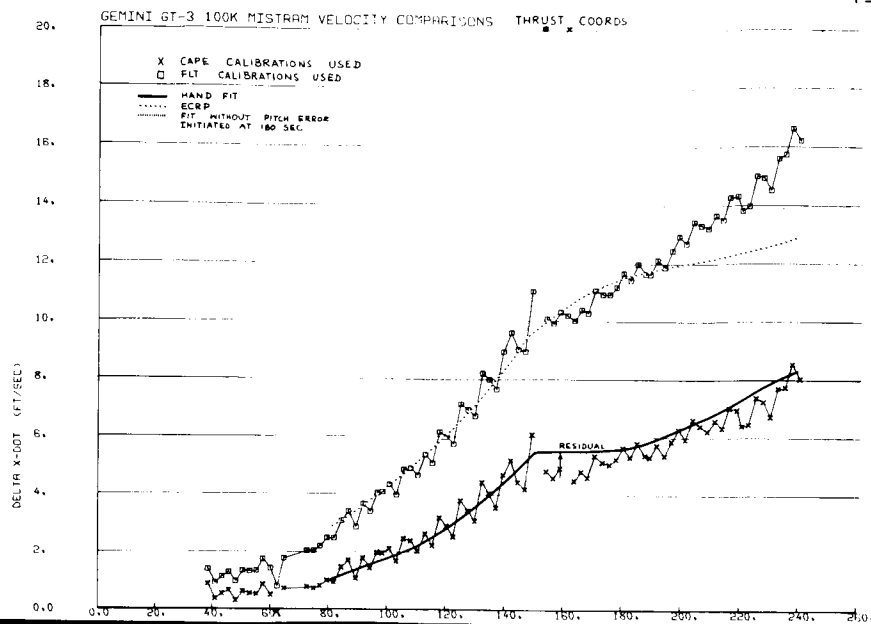


TABLE III

ASCENT PHASE IMU ANALYSIS RECOVERED COEFFICIENTS

<u>Symbol</u>	<u>Error Source</u>	<u>Recovered Coefficient</u>	
VOX	X accel initialization	-.25	fps
VOZ	Z accel initialization	-1.2	fps
XSF	X accel scale factor	687	ppm
ZSF	Z accel scale factor	522	ppm
B _x	X accel bias	340	ppm g
B _y	Y accel bias	-22	ppm g
B _z	Z accel bias	180	ppm g
YGCDR	Y gyro constant drift rate	1.0	deg/hr
DT	Time correlation error	-.005	sec
YGCDR (180)	Y gyro constant drift rate initiated (180 seconds from go inertial)	23	deg/hr

3.3.1 Ascent Flight Prior to 180 Seconds

The first attempts at error source isolation involved the use of the Error Coefficient Recovery Program (ECRP) described in Reference 1. However, regressions using large error models such as that recommended in the GEMINI Accuracy Prediction Study, Reference 2, would not yield satisfactory results due to the similarity of error source propagations over this short time span. The usable data interval for regression which was very short (115 seconds) necessitated the making of a series of regressions using 5 to 10 term error models. The terms used in the regression were selected primarily because of their representative types of propagations. These included the following:*

- 1. BX X accelerometer bias
- 2. BY Y accelerometer bias
- 3. BZ Z accelerometer bias
- 4. XSF X accelerometer scale factor
- 5. ZSF Z accelerometer scale factor
- 6. PHIY Platform misalignment about Y accel axis
- 7. PHIZ Platform misalignment about Z accel axis
- 8. YGCDR Y gyro constant drift rate
- 9. YGIAU Y gyro input axis unbalance
- 10. XQUAD X accelerometer quadratic non-linearity
- 11. ZXMSL Z accelerometer misalignment toward X
- 12. VOZ Z accelerometer initialization error

* Error source notations refer to the hardware definition of the axes which has the Y accelerometer and gyro along the negative Z computer direction; the Z accelerometer and gyro along the Y computer direction and the X accelerometer and gyro axes coinciding with the computer X axis.

~~CONFIDENTIAL~~

4160-6047-TC000

-17-

Figure 6 shows a fit obtained from one of the regression solutions. The error coefficients recovered from that solution which is typical of the regressions performed are indicated below.

X accelerometer scale factor	339 ppm
Z accelerometer scale factor	611 ppm
X accelerometer bias	467 ppm g
Y accelerometer bias	92 ppm g
Z accelerometer bias	-414 ppm g
Platform misalignment about Y accelerometer axes	80 $\widehat{\text{sec}}$
Platform misalignment about Z accelerometer axes	-6.9 $\widehat{\text{sec}}$
Y gyro constant drift rate	1.6 deg/hr
Z accelerometer initialization	.613 fps

The above coefficients are similar to those recovered from other regressions with the exception of the X and Z accelerometer biases which varied between large positive and negative values with successive error model variations. This is attributable to their high correlation with the pitch type error sources. The above coefficients were used in the trajectory reconstruction discussed in Section 5 because they provided the best fit to the early data.

Most significant among the regressions was the consistent indications of X and Z accelerometer scale factor errors of approximately 500 and 600 ppm and Y gyro constant drift rates between 1 and 1.6 degrees per hour. Discussions of these results at the Honeywell Company revealed that the above scale factor errors were consistent with the differences noted between successive calibrations (see Section 3.5). It was also noted that the Y gyro demonstrated constant drift rates of approximately 1 degree per hour during postflight tests of the GT-3 platform.

~~CONFIDENTIAL~~

Based upon the above results, further attempts to isolate the IMU errors were accomplished by using what was considered to be the best available set of calibrations. These were the accelerometer scale factor and misalignment values of the Cape calibrations and the accelerometer biases obtained from the analysis of the free flight velocity errors. These velocity errors during portions of the catch-up and re-entry mode are shown in Figure 7.

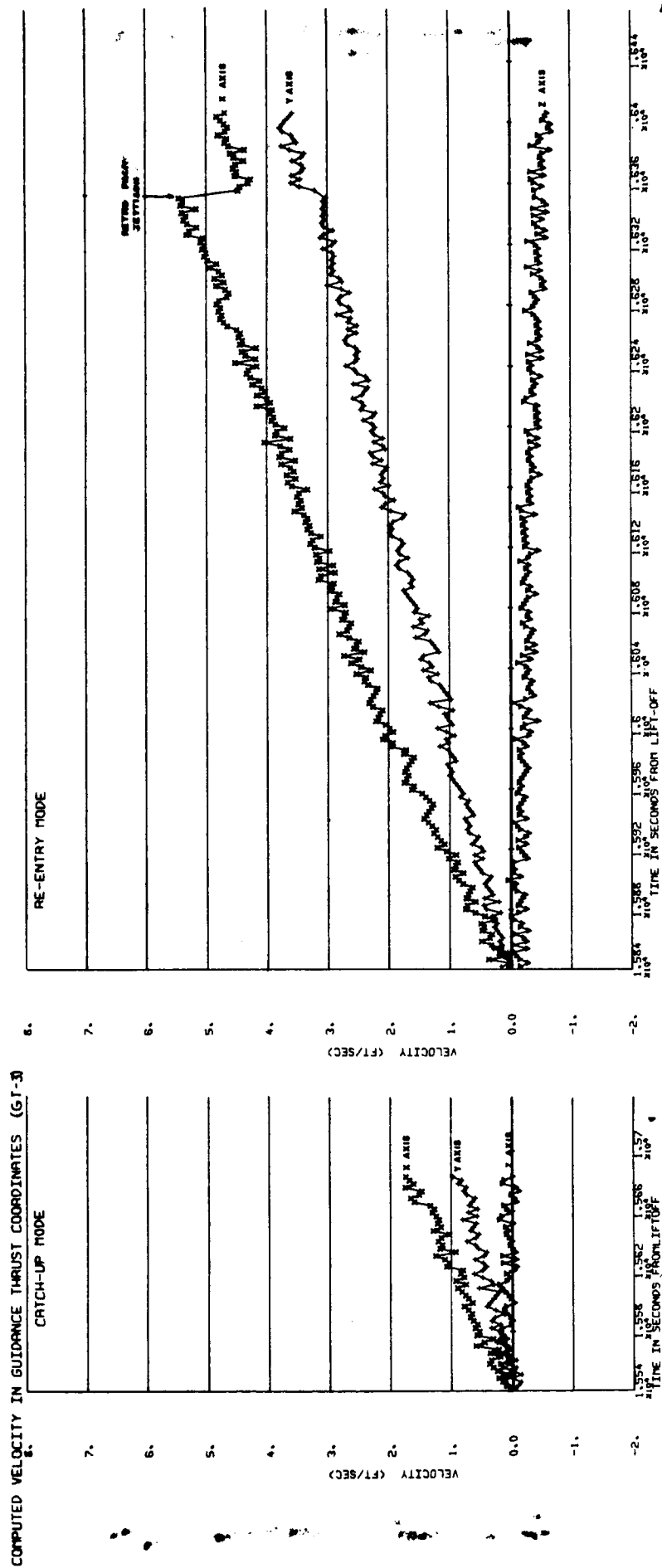
Figure 7 is a plot of scaled and corrected thrust velocity during time intervals of flight where the spacecraft is in virtual free flight. Since there should be no net accelerometer velocity output, all the indicated trends were assessed to be incorrect accelerometer biases.

The velocity comparisons resulting from the new set of calibration data are shown in Figures 5 and 6 where the term CAPE CALIBRATIONS refers to the combined set mentioned above. With the removal of the apparent calibration errors, hand fits of the new comparison curves were accomplished. These resulted in the following error source coefficients.

Z accelerometer initialization	-1.2 fps
Y gyro constant drift rate	1.0 deg/hr
X accelerometer initialization	-.25 fps
X accelerometer scale factor	267 ppm

The residuals indicated in Figures 5 and 6 show approximately .6 fps difference between the hand fit curve and the data at 160 and 340 seconds. This difference is attributed to a 5 millisecond time correlation error. The hand fit results are not as exact a fit to the observed error as could be expected consistent with MISTRAM accuracies; however, they do substantiate the drift type errors recovered by the regression and also indicate the presence of additional X accelerometer scale factor error.

Figure 7



3.3.2 Ascent Flight After 180 Seconds from Go-Inertial

The analysis of the later portion of the ascent flight consisted of determination of the time of malfunction occurrence, and isolation of the type of malfunction which caused the excessive Y axis velocity error.

Figure 6 which is a velocity comparison of the early portion of the ascent flight, shows a Y velocity error trend reversal beginning at approximately 180 seconds after go inertial. The X axis errors also show a rapid departure from the extension of the ECRP fit at this time. Observing the extension of the hand fit results between 180 and 200 seconds, it can be seen that the occurrence could have initiated at any time during that interval. Attempts to correlate this interval with flight events revealed only a rapid change in Y acceleration between 180 and 190 seconds from liftoff corresponding to the pitch down maneuver at that time (see Appendix I, Figure 19). Because of the uncertainties in establishing the exact time by visual means, the time the occurrence initiated was considered in the analysis to be between 165 and 200 seconds from go inertial with close establishment of the time to result from attempts to provide curve fits to the data.

-
- * Honeywell is conducting studies to determine the behavior of the Y gyro response to the observed acceleration profile. Preliminary information indicates peculiar but not completely consistent gyro drift when the acceleration changes sign along the Y gyro spin axis.

Efforts to isolate the type and magnitude of the malfunction were based upon the assumption that the malfunction could be approximated by a single stationary error source initiated at one instant of time. Therefore, based upon this assumption, the IMU error simulation program (see Reference 1) was modified to generate unit error propagations at discrete times after go inertial. Figure 8 presents plots of three of the error source propagations generated by the program. These are pitch type error sources including Y gyro constant drift rate, Y gyro input axis unbalance and platform misalignment about the Y accelerometer axis. These were considered the more probable based upon comparing their propagations with the observed flight X and Y axis velocity errors.

A composite hand fit to the Cape calibration velocity comparisons was accomplished resulting in the following recovered coefficients from the entire ascent phase.

Z accelerometer initialization	-1.2 fps
Y gyro constant drift rate (from go inertial)	1.0 deg/hr
X accelerometer initialization	-.25 fps
X accelerometer scale factor	267 ppm
Y gyro constant drift rate beginning at 177 seconds (180 from go inertial)	23 deg/hr
Time correlation	-.005 seconds

Figure 8

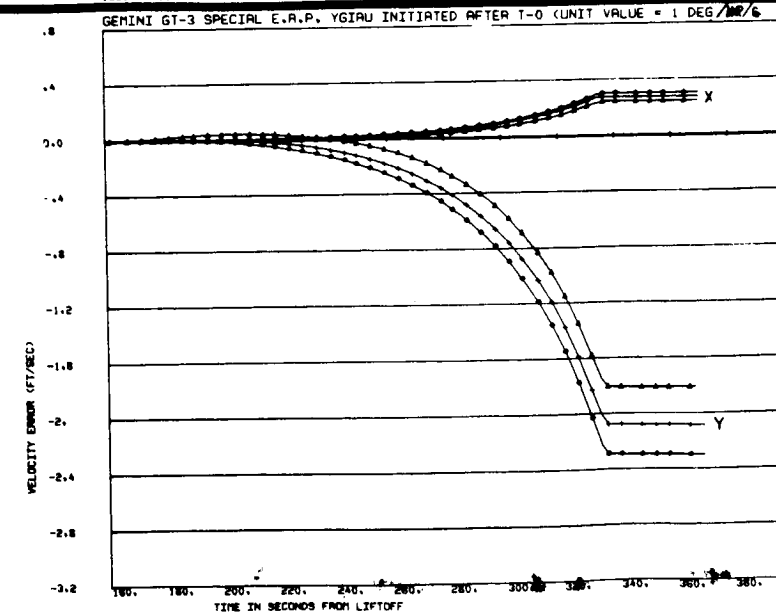
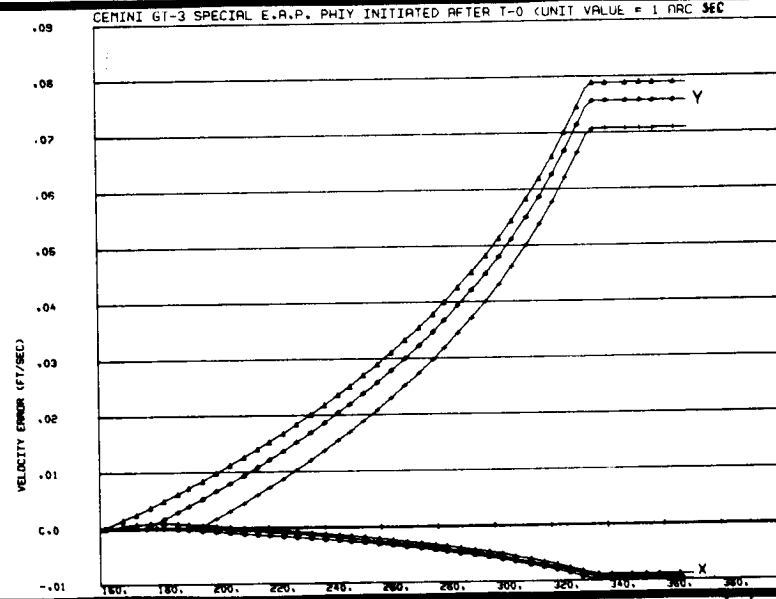
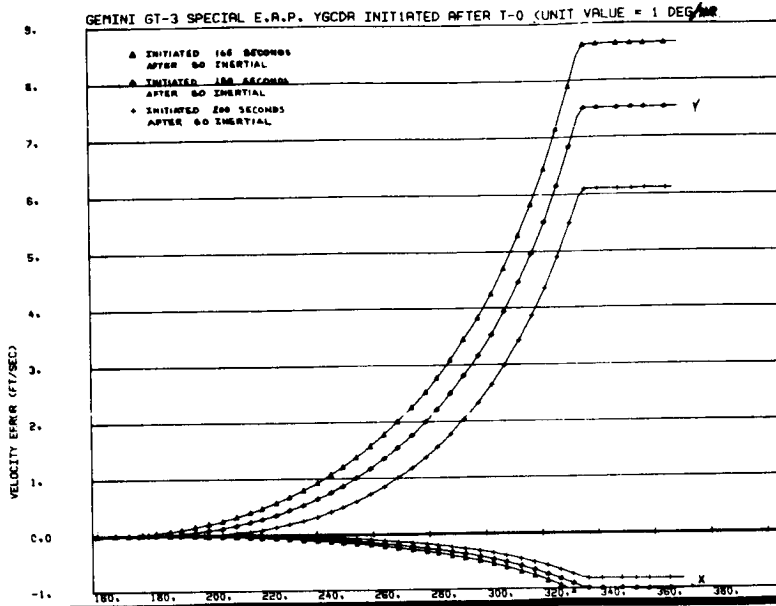


Figure 7

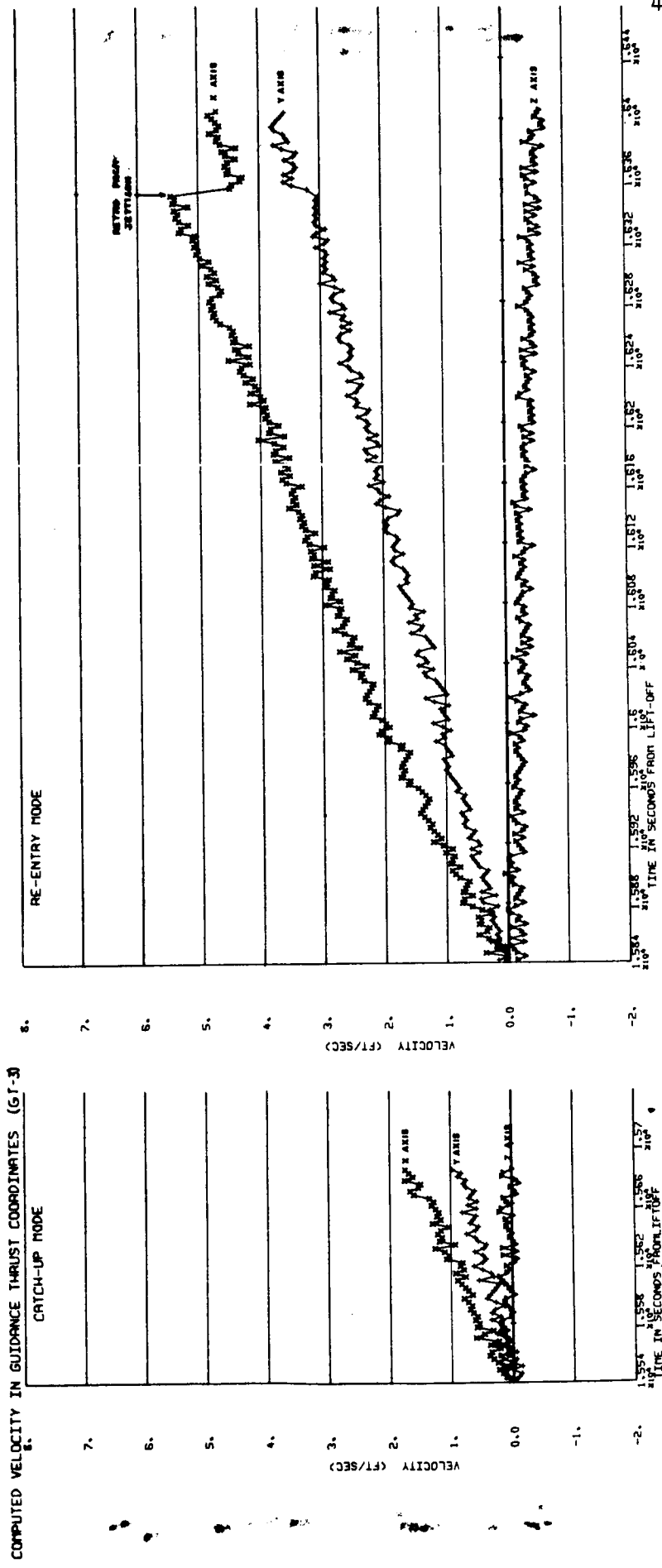
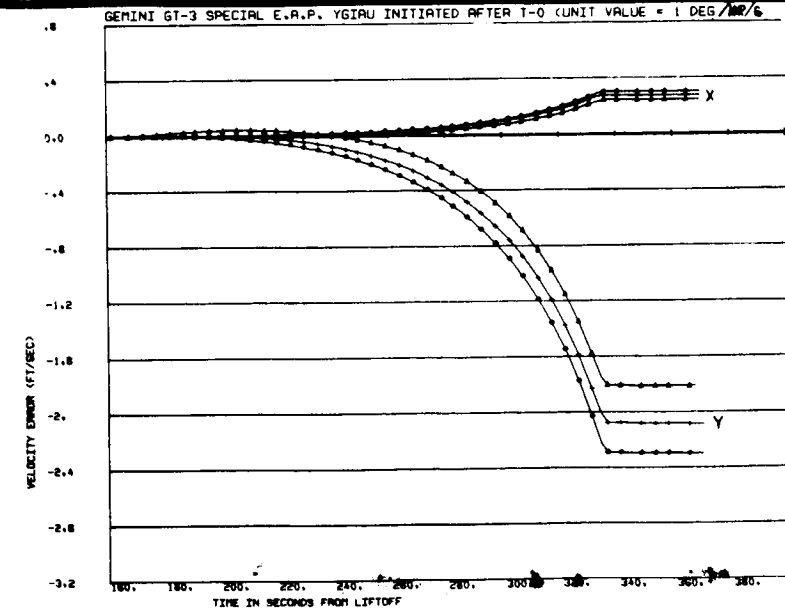
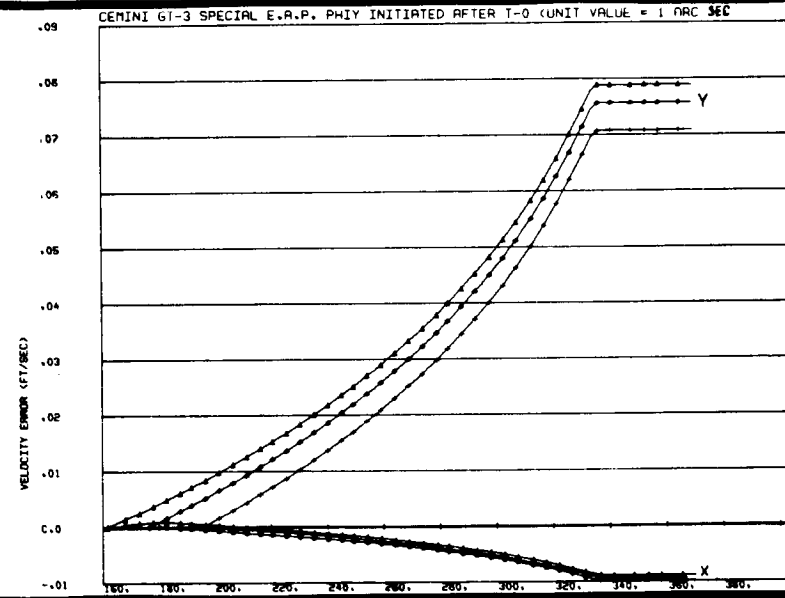
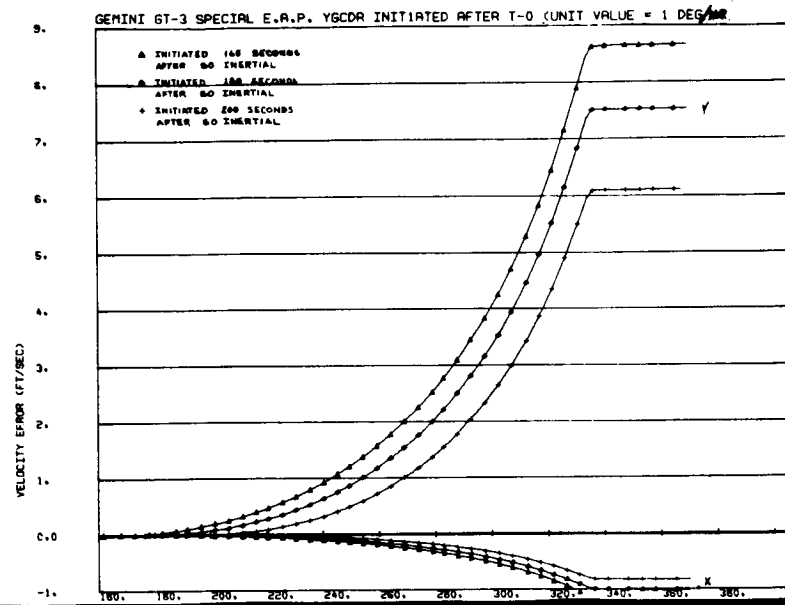


Figure 8

3.3.2



* Hon
res
ind
acc

The hand fit curve shown in Figures 5 and 6 resulted from the above coefficients with the exclusion of time correlation error which accounts for the residuals at 160 and 340 seconds. The residual at 200 seconds undoubtedly is due to the non-stationary nature of the malfunction and is a direct measure of the inadequacy of the basic stationary error assumption.

3.4 Preflight Calibrations

With the exception of X accelerometer bias, the calibrations used during flight, were those obtained at Honeywell on 26 February 1965. Another set of calibrations were obtained at Cape Kennedy prior to flight. These calibrations showed all the scale factor and X accelerometer bias values considerably different from those of the earlier set; however, only the X accelerometer bias value of the original (2-26-65) set was changed. Later X axis accelerometer calibrations showed additional large shifts in the X accelerometer bias and although the latest value was not flown, it was used in the ground alignment of the platform. The Honeywell and Cape calibration bias and scale factor values are shown in Table IV which also presents the accelerometer bias values determined from the postflight analysis of free flight velocity errors (Figure 7).

Table IV also indicates the difference between the Cape and Flight values the most significant of which are large magnitude scale factor changes of the three accelerometers. The X accelerometer was modified during the period between calibrations in an attempt to prevent the recurrence of the accelerometer malfunction noted on the GT-2 mission. This modification may provide an explanation for the observed variations of X accelerometer bias and scale factor; however, there are no obvious explanations for the 500 and 650 ppm Y and Z accelerometer scale factor differences between measurements. (1σ specification is 130 ppm).

TABLE IV
ACCELEROMETER BIAS AND SCALE FACTOR SUMMARY

	Flight	Honeywell 2-26-65	Cape 3-12-65	FF Analysis	Flt-Cape
X accel. SF	.10009750 fps/pulse	same as flt.	.10005550	Not Determined	420 ppm
Y accel. SF	.09029480 fps/pulse	same as flt.	.09023550	Not Determined	522 ppm
Z accel. SF	.09749790 fps/pulse	same as flt.	.09744700	Not Determined	657 ppm
X accel. bias	-.2616580 pulse/sec	+ .18 (approx.)	same as flt.	-.1523	0
Y accel. bias	.2300020 pulse/sec	same as flt.	.218250	.223	-36.2 ppm g
Z accel. bias	.2233280 pulse/sec	same as flt.	.248254	.281	77.6 ppm g

Except as otherwise noted, position and velocity comparisons were made by using the Flight calibrations. A set consisting of Cape calibration scale factors and misalignment terms and free flight determined biases was also used in the analysis of IMU performance. Figures 5 and 6 present velocity error curves resulting from the two sets of calibrations. These show a considerable decrease in the X axis velocity error due to using a later set of calibrations. A significant change in the early Y velocity error is also evident. Although the bias values used in generating the curves were obtained from postflight analyses, the major improvement in IMU errors is attributable to having the latest determined accelerometer scale factors. Table V shows the improvement in the error at SECO by using these Cape values.

TABLE V

<u>ERROR AT SECO DUE TO CALIBRATIONS</u>		<u>VELOCITY ERROR AT SECO</u>		
		X	Y	Z
Error at SECO (Flight Calibrations) 2/26/65		43	-127	-1.4
X accel. scale factor	-420 ppm	-10.4	0	0
Y accel. scale factor	-652 ppm	0	0	+ .23
Z accel. scale factor	-522 ppm	0	+3.6	0
X accel. bias	0	0	0	0
Y accel. bias	+36.6 ppm g	0	0	- .59
Z accel. bias	-77.6 ppm g	<u>0</u>	<u>+ .84</u>	<u>0</u>
Error at SECO (Cape Calibrations) 3/12/65		32.6	-122.6	- 1.77

The improvements resulting from Cape calibrations correspond to 11 fps total velocity and negligible difference in flight path angle.

3.5 Azimuth Update

An azimuth alignment correction is calculated at three separate times by the onboard computer. On the first pass through the navigation equations after platform release, the roll gimbal angle reading is compared with the desired value and the difference is used as a correction to the intended flight azimuth. This correction is called $\Delta\eta_x$ where a positive value implies that the platform is rotated clockwise from the desired azimuth.

The additional azimuth corrections are calculated during flight at 100 and 140 seconds after liftoff. These are calculated by comparing the crossrange (Z direction) velocity as measured by GE/Burroughs with that derived from the airborne system and attributing the residual to a platform misalignment.

The calculated updates are not telemetered; however, they are obtained quite accurately from the data analysis. Table VI summarizes the updates determined by the following methods:

1. Calculated by simulating the inflight calculations.
2. Calculated from the jumps in the inertial velocity comparisons or the DELTA DELTA curve.
3. Derived by IBM during their postflight simulation.

TABLE VI

AZIMUTH UPDATE

<u>Time</u> <u>(sec)</u>	<u>Flt Calc.</u> <u>Simulation</u>	<u>DELTA DELTA</u>	<u>IBM</u>	<u>Units</u>
0	.0004264	.000176	.000176	radians
100	-.009244	-.009182	-.009257	radians
140	+.000164	0	+.000106	radians
Total (100 and 140)	-.009080 .52	-.009182 .525	-.009151 .525	radians degrees

The calculated update values show agreement to within the .1 fps velocity least count accuracy which is equivalent to .00008 radians. The values indicated at 100 seconds include those at 0 seconds. The value for zero seconds in the DELTA DELTA column is that of IBM.

The Z axis velocities at 100 and 140 seconds were determined from the MISTRAM I data and compared to the GE/Burroughs telemetered values. The MISTRAM velocities were 348.39 and 198.55 at 100 and 140 seconds, respectively, which are in good agreement with the GE/Burroughs values of 348.5 and 199.0 at the corresponding times. The net azimuth update corrections have been applied in all the plots included in this report.

The history of initial alignment error is

$$\text{GT-2} \quad \eta_x = -.29^\circ$$

$$\text{GT-3} \quad \eta_x = -.52^\circ$$

$$1 \sigma(\text{specification}) \quad \eta_x = .25^\circ$$

It is understood that the major contribution to the specification value is due to the inaccuracy in slewing the platform to a new azimuth as a result of updating the Agena orbit. On these two non-rendezvous flights a fixed azimuth was flown and the misalignment angles reflect only the basic inability to align the inertial platform with the outside world, not the slewing error. Since the errors observed on these two flights are already as large or larger than would be expected, it appears that when the slewing error is added, the total alignment uncertainty will be considerably larger than the present specification value.

4.0 RE-ENTRY ANALYSIS

4.1 Introduction

Analysis of the IMU performance during re-entry was based primarily on position comparisons in re-entry guidance coordinates. The guidance coordinate system, during re-entry is defined by the DCS inserted state vector (spacecraft position and velocity) valid at the intended time of retrofire. The guidance X axis is directed along the total inertial velocity vector, the Y axis is positive downward along the position vector from the earth's center and the Z axis completes the right handed set.

The tracking data, available for the analyses, were obtained from four C-band tracking radars. These covered the time interval between 455 and 800 seconds after retrofire or the whole atmospheric re-entry period. The lack of tracking data prior to this interval limited the isolation of re-entry mode initialization errors. It is expected that this problem will be solved on future flights by the timely arrival of high rate tracking data during intervals just prior to and following retrofire.

The method used in the analyses consisted of computing the guidance thrust velocities, as was done during the ascent data reduction. A re-entry trajectory reconstruction program was then used to generate the S/C trajectory using the guidance system output. This program has the capability of adjusting thrust data for gravity to form total inertial positions and velocities. These quantities were then compared with radar data to form the comparisons shown in Figures 9 and 10.

4.2 Impact Point Determination

Table VII shows the spacecraft position at 798.9 seconds as indicated from PCM telemetry, radar, STL reconstructed guidance data, and the STL reconstructed trajectory using corrected guidance data (see Sections 4.3 and

5.0). The time chosen corresponds to the last available reconstructed trajectory data point. The intended impact point is also presented.

Table VII

INDICATED POSITION SUMMARY

	Deg. Latitude		Deg. Long.	Altitude
	<u>(Geocentric)</u>	<u>(Geodetic)</u>	<u>(Geodetic)</u>	<u>(feet)</u>
T = 798.9				
1. Radar (7:18)	22.364	22.499	-70.840	51148
2. Reconstructed Trajectory (Corrected)	22.373	22.508	-70.838	50270
3. Guidance Telemetry	22.355	22.490	-70.848	359
4. Reconstructed Trajectory (Uncorrected)	22.369	22.504	-70.880	12338
5. Intended Impact	21.89*	22.025	-69.88*	0

*Obtained from Canarvon MDIU print.

The corrected trajectory (2) which provides the best estimate of the spacecraft position indicates that the difference between the spacecraft position at 799 seconds and the intended impact was .483 degrees in latitude and -.958 degrees in longitude. The altitude at this time was 50,270 feet. This difference corresponds to the following:

POSITION ERROR AT 799 SECONDS RELATIVE TO INTENDED IMPACT

<u>North</u>	<u>West</u>	<u>Downrange</u>	<u>Crossrange</u>
29 ± .6 n.mi.	53 ± .2 n.mi.	59 n.mi. short	13.6 n.mi. left

The down and crossrange values are based upon a 115.7 degree heading from North which was that determined just prior to re-entry. The uncertainties assigned are combinations of the differences between the reconstructed trajectory and radar positions and rough estimates of radar accuracy.

The difference in Table VII between the reconstructed guidance (2) and the onboard computed value (3) is attributable to errors in either the airborne computations or the reconstruction initialization. Since the longitude difference was nearly constant over the entire time interval, an initialization error is suspected.

The altitude difference between the uncorrected sources (3 or 4) and the actual trajectory (1 or 2) is due primarily to the pitch error contained in the guidance data.

4.3 IMU Analysis

Figures 9 and 10 present comparisons of IGS data with positions and velocities obtained from the four radars. The following table gives the position and velocity errors at 455 and 800 seconds from retrofire as indicated by the comparisons. These times correspond approximately to the beginning and end of atmospheric re-entry (see Figure 21).

Figure 9

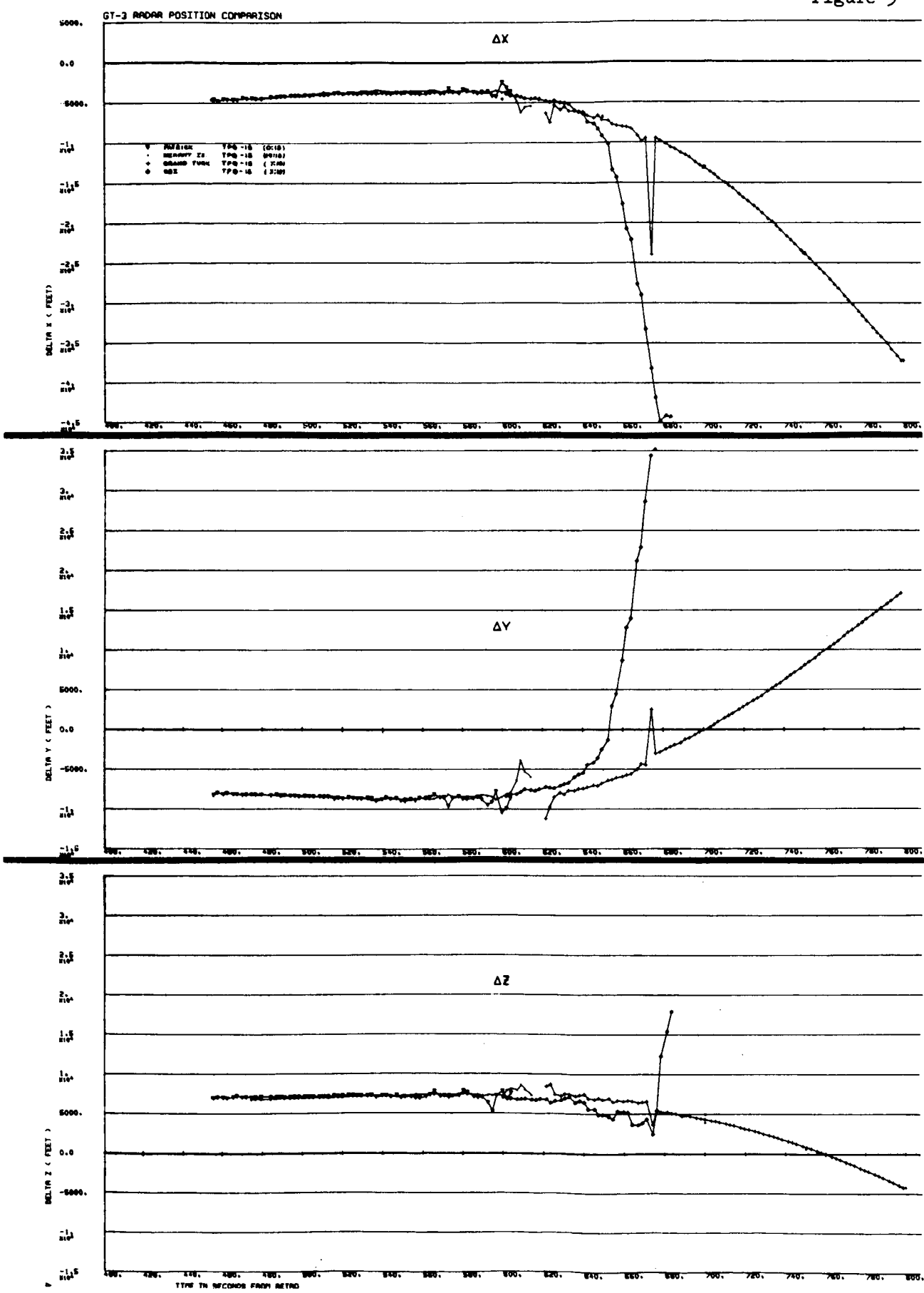
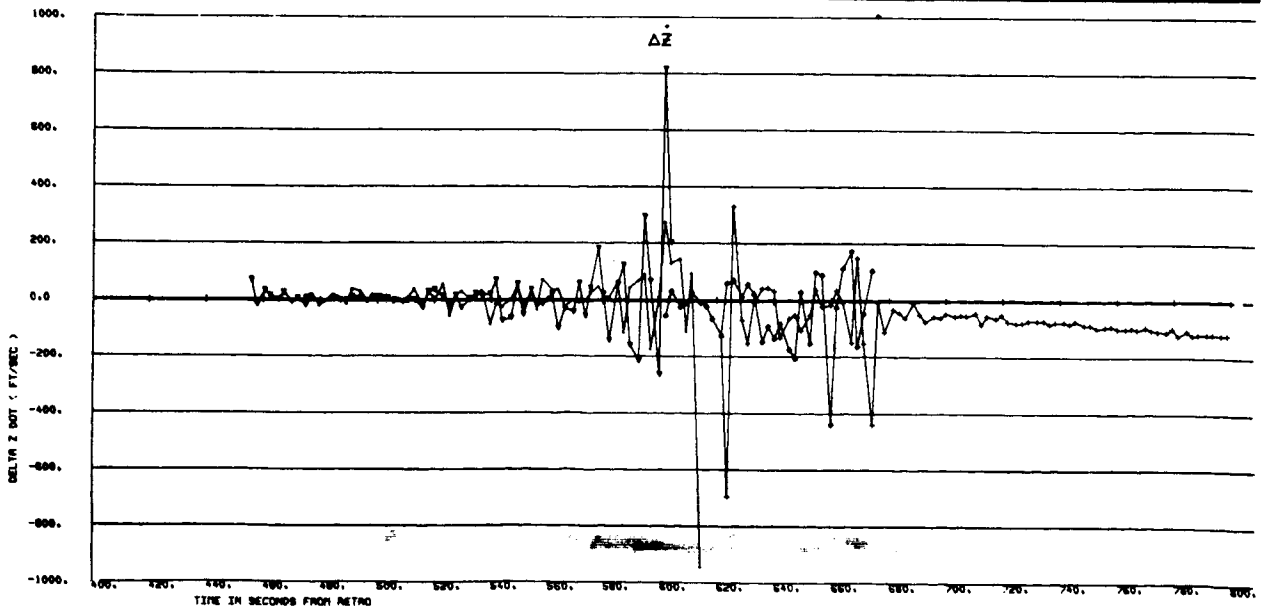
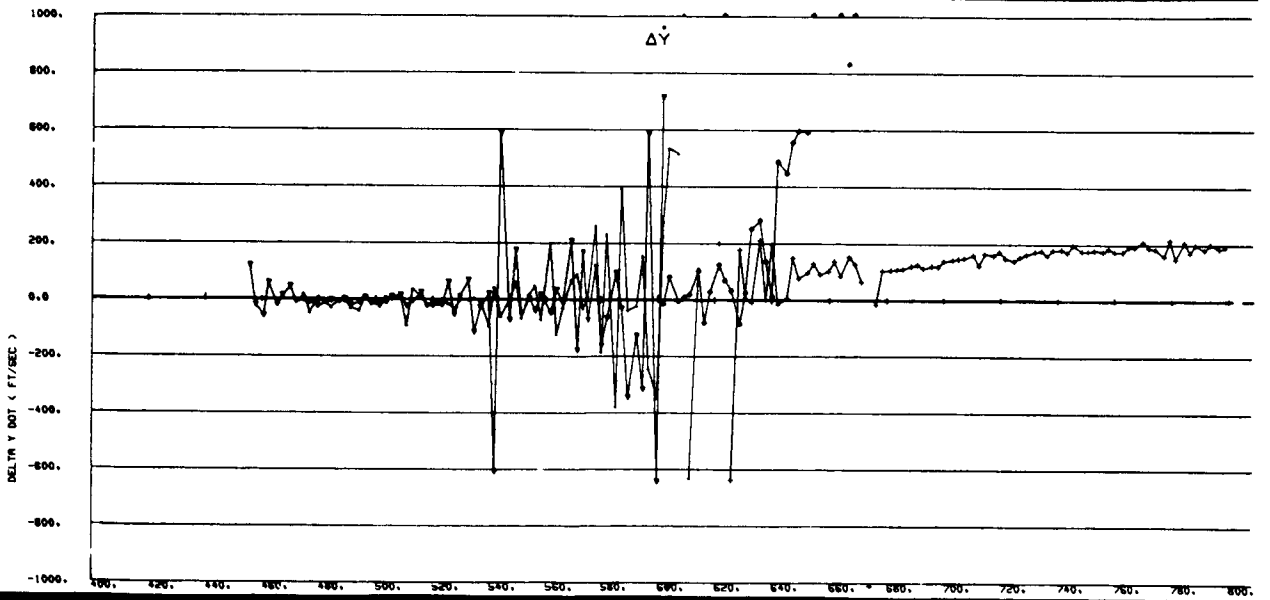
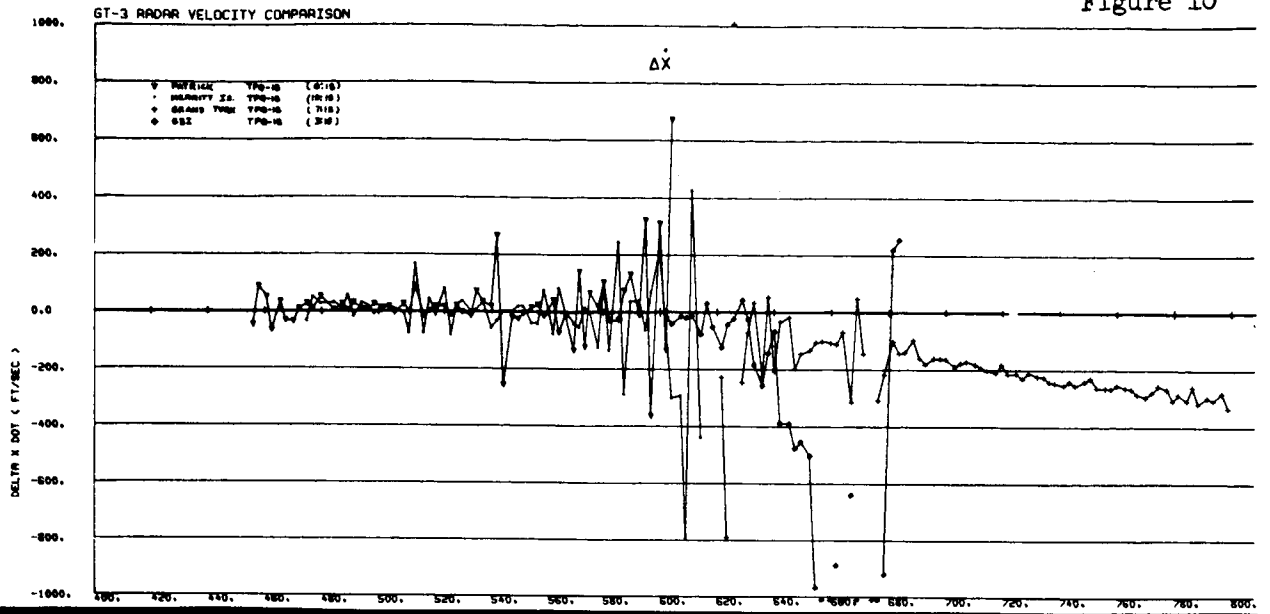


Figure 10



INERTIAL GUIDANCE SYSTEM ERROR DURING RE-ENTRY

Time From Retrofire (sec)	Position (ft)			Velocity (ft/sec)		
	X	Y	Z	\dot{X}	\dot{Y}	\dot{Z}
455	-4750	-8000	+7000	9	-6.5	0
800	-37500	+17500	-4500	-300	200	-120

The major portion of the error indicated at 455 seconds is due to one or more of the following causes:

- a. The initialization state vector, calculated on the ground and transmitted to the S/C is incorrect.
- b. The platform is incorrectly aligned, leading to a directional error in the retromaneuver impulse.
- c. There is a data processing error, the most likely of which is a time correlation error.

Figures 11 and 12 were obtained by initializing the guidance data, at the time of the first radar data point (455 seconds), with radar positions and velocities. These were generated in order to determine the secondary effects of initialization errors upon the gravity computations. Comparison of the data indicates that the secondary effects were minor relative to the total error.

Figure 11

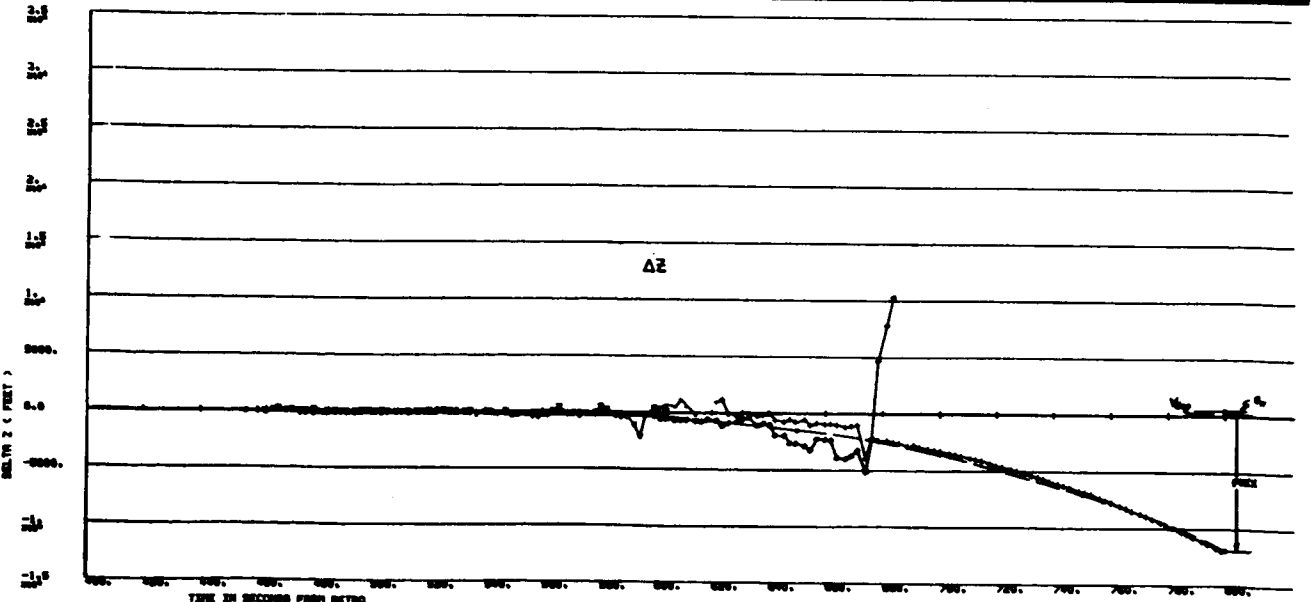
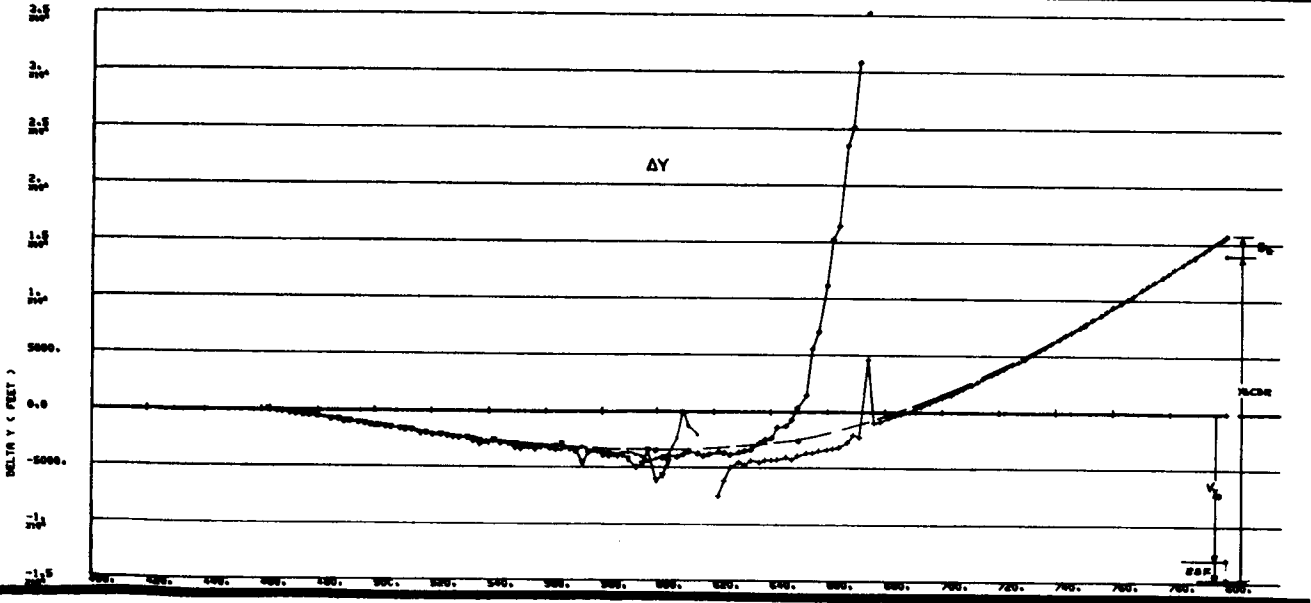
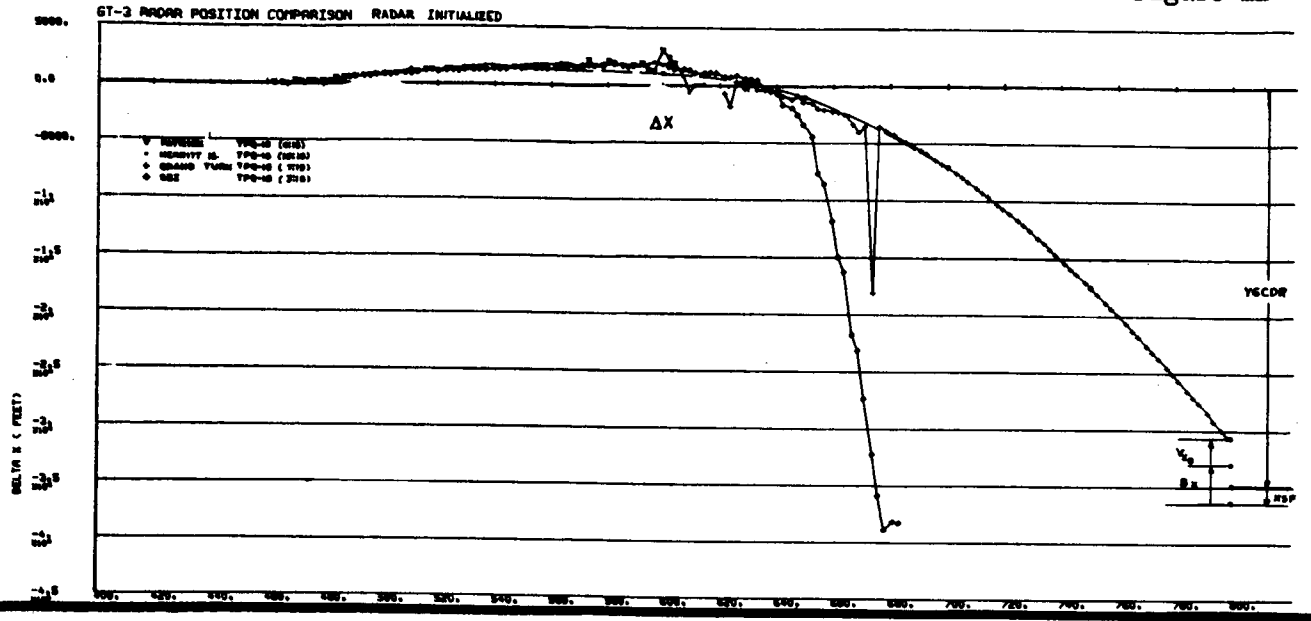
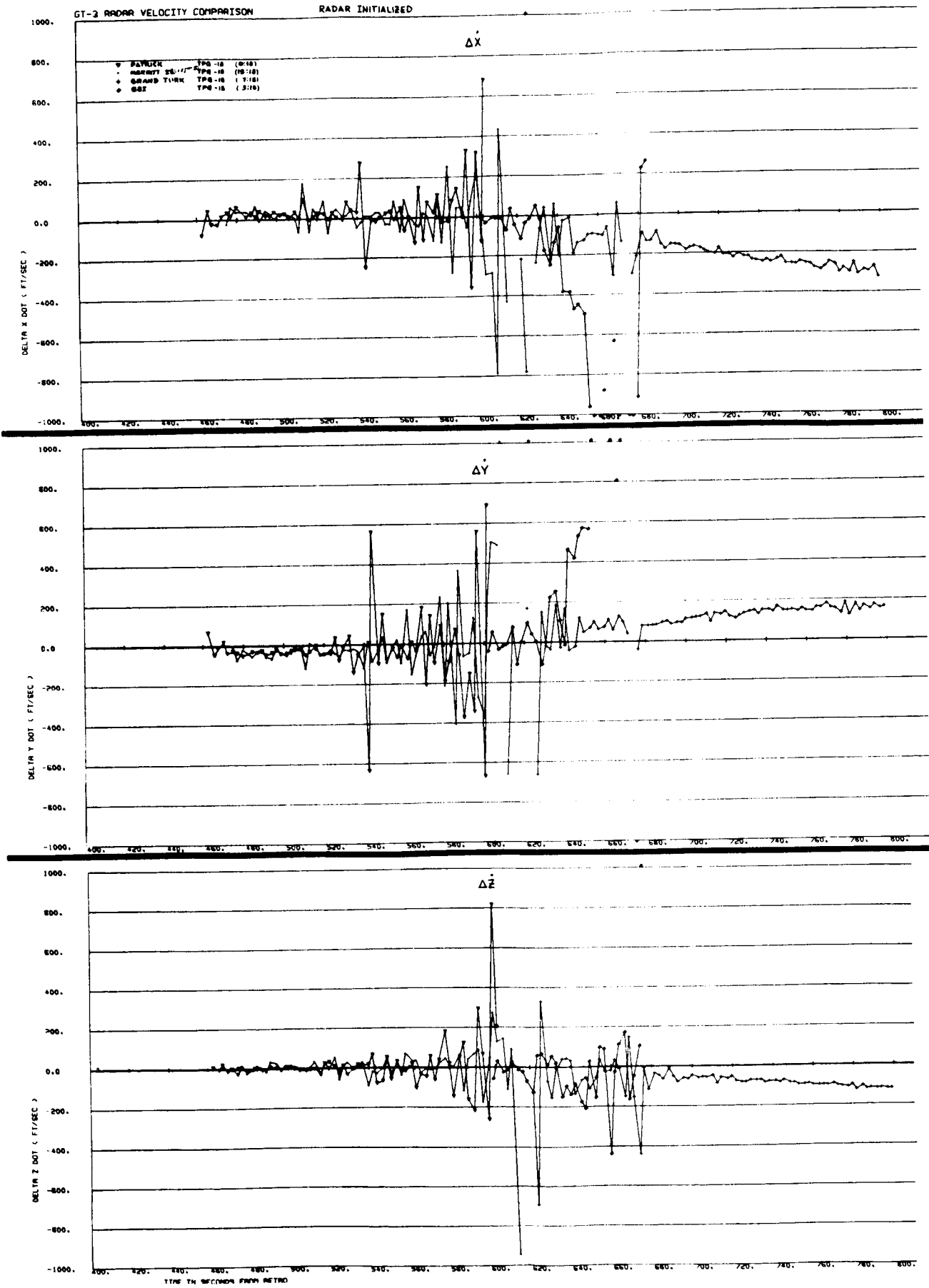


Figure 12



~~CONFIDENTIAL~~

4160-6047-TC000

-37-

The manner in which the errors increase after 455 seconds is indicative of guidance system IMU and/or alignment errors. A pitch type error was suggested by the approximately asymmetric X and Y position error propagations. The philosophy involved in isolating the major contributing error sources was to first extract, from the error curves, the effects of those IMU errors which were considered as "known". These consisted of accelerometer bias and Z accelerometer scale factor errors recovered from the ascent analysis and verified somewhat by the preflight calibration differences. A fit to the residual position error was then accomplished from which a -4.6 degree per hour Y gyro constant drift rate was recovered as the major pitch error. An alternate hand fit was accomplished which recovered an initial pitch misalignment of -2900 sec as the major pitch error. Either of these recovered coefficients or combinations of the two could provide an explanation of the observed errors; however, isolation of the exact error source is difficult due to high correlation among error sources.

The drift rate error is considered the more probable because it and other recovered coefficients of the fit from which it was derived are somewhat closer in agreement with the ascent analysis results. The recovered coefficients from both fits are summarized in Table VIII.

Alternate fits were also accomplished for the Z axis error. However, both indicated a large initial platform misalignment about the X accelerometer axis as the major error source.

The fits to the re-entry data are tabulated in Table VIII. The coefficients labeled FIT 1 and FIT 2 are associated with the X and Y axes and those labeled FIT 3 and FIT 4 are associated with the Z axis error. The coefficient sets represented by FIT 1 and FIT 3 were used to compensate the IGS data for reconstruction of the re-entry trajectory. The position error propagation of these are shown as a dashed curve on the plots of Figure 11.

~~CONFIDENTIAL~~

TABLE VIII

RE-ENTRY ANALYSIS RECOVERED ERROR SOURCE COEFFICIENTS

(1) <u>X and Y Axis Error Source</u>		<u>FIT 1</u>	<u>FIT 2</u>	<u>UNITS</u>
<u>(A) Knowns from Ascent Analysis</u>				
X accelerometer bias	(BX)	340	340	ppm g
Z accelerometer bias	(BZ)	180	180	ppm g
Z accelerometer scale factor	(ZSF)	611	611	ppm
<u>(B) Recovered From Re-Entry Analysis</u>				
Y gyro constant drift rate	(YGCDR)	-4.59	-	deg/hr
Platform misalignment about Y accelerometer axis	(PHIY)	-	-2920	sec
X accel scale factor	(XSF)	712	455	ppm
<u>Initial Errors at Retro</u>				
X guidance position	(XO)	-7816	-7870	ft
Y guidance position	(YO)	-4475	-4475	ft
X guidance velocity	(V _{XO})	4.8	3.7	fps
Y guidance velocity	(V _{YO})	-9.1	-5.2	fps
<u>(2) Z Axis Error Source</u>				
<u>(A) Known From Ascent Ascent Analysis</u>				
Y accelerometer bias	(BY)	-22	-22	ppm g
<u>(B) Recovered from Re-Entry Analysis</u>				
Platform misalignment about X accelerometer axis	(PHIX)	-1080	-886	sec
Platform misalignment about Z accelerometer axis	(PHIZ)	-	200	sec
<u>Initial Errors at Retro</u>				
Z position	(ZO)	4443	4443	ft
Z velocity	(V _{ZO})	-4.74	-4.74	fps

5.0 TRAJECTORY RECONSTRUCTION

This section provides a trajectory reconstruction for ascent from liftoff to 370 seconds (11 seconds after separation) and for re-entry from 462 seconds to 799 seconds after retro (16865 to 17202 seconds after liftoff).

The data is provided in an ECIG coordinate system which is a right-handed inertial Cartesian coordinate system with the origin at the center of the earth. The Z axis is the North polar axis, the X-Y plane is the equatorial plane with the X-Z plane containing the Greenwich meridian at Go Inertial ($14^{\text{h}} 23^{\text{m}} 56.612^{\text{s}}$) time for the ascent segment, and time of retrofire ($18^{\text{h}} 47^{\text{m}} 47.612^{\text{s}}$ GMT) for re-entry.

The ascent reconstruction consists of corrected guidance data from 0 to 86.687 seconds and quick look 100K MISTRAM data from 89.109 until 369.765 seconds. Section 3.0 provides a description of the corrections that were applied to the guidance data.

The re-entry reconstruction was derived from corrected guidance data. Section 4.0 provides a description of the corrections applied. Special parameters are also provided for the re-entry trajectory reconstruction. These consist of velocity magnitude, relative flight path angle, altitude and geodetic latitude and longitude. The first three special parameters are plotted in Figure 13.

~~CONFIDENTIAL~~

4160-6047-TC000
-40-

ASCENT TRAJECTORY RECONSTRUCTION

~~CONFIDENTIAL~~

GEMINI TRAJECTORY IN ECIG

TIME IN SECONDS FROM LIFTOFF

TIME	X	Y	Z	X-DOT	Y-DOT	Z-DOT
2.484	3027992	-18152002	9927987	1326.885	200.566	11.306
4.781	3031043	-18151565	9928026	1329.632	180.405	22.484
7.515	3034634	-18151105	9928107	1333.128	155.342	36.873
9.812	3037749	-18150774	9928206	1336.440	133.107	49.839
12.124	3040843	-18150493	9928337	1339.448	109.718	63.216
14.437	3043945	-18150267	9928499	1342.911	85.502	77.408
16.765	3047075	-18150096	9928696	1346.206	60.717	92.016
19.515	3050783	-18149973	9928975	1350.367	29.136	110.694
21.828	3053909	-18149937	9929249	1354.248	1.853	127.177
24.093	3056981	-18149964	9929556	1358.389	-26.010	144.062
25.499	3060257	-18150063	9929925	1365.822	-56.110	162.950
28.906	3063556	-18150235	9930342	1377.088	-86.521	183.594
31.276	3066967	-18150478	9930808	1392.539	-117.188	206.232
33.703	3070241	-18150797	9931332	1412.670	-147.999	229.416
36.109	3073667	-18151191	9931913	1436.096	-179.037	253.860
33.484	3077109	-18151653	9932546	1463.448	-210.169	279.889
40.874	3080645	-18152192	9933248	1495.249	-241.092	307.595
43.265	3084262	-18152805	9934018	1531.444	-271.128	336.416
45.624	3087922	-18153480	9934846	1571.629	-301.384	366.372
48.015	3091731	-18154237	9935761	1615.514	-331.603	398.507
50.390	3095624	-18155061	9936747	1663.508	-362.117	432.189
52.749	3099609	-18155951	9937806	1715.720	-392.065	466.097
55.124	3103751	-18156917	9938954	1772.590	-421.135	500.577
57.499	3108033	-18157951	9940189	1834.178	-448.922	539.479
59.906	3112527	-18159061	9941534	1901.784	-473.994	578.603
62.281	3117129	-18160214	9942956	1973.939	-497.443	618.990
64.687	3121970	-18161439	9944494	2051.107	-519.616	660.155
72.343	3138691	-18165689	9950053	2325.759	-588.052	795.163
74.718	3144329	-18167106	9951995	2422.123	-605.243	841.046
77.093	3150201	-18168564	9954047	2523.341	-621.711	888.857
79.484	3156357	-18170069	9956235	2627.766	-637.121	942.354
81.890	3162808	-18171619	9958576	2735.290	-650.043	1002.538
84.281	3169480	-18173186	9961051	2847.167	-661.448	1067.712
86.687	3176471	-18174789	9963700	2965.124	-670.829	1134.754

TRW SPACE TECHNOLOGY LABORATORIES

THE WILSON BRANG WOODBRIDGE INC.

GEMINI TRAJECTORY IN ECIG

PAGE

2

TIME IN SECONDS FROM LIFTOFF

TIME	X	Y	Z	X-DOT	Y-DOT	Z-DOT
89.109	3183655	-18176355	9966505	3090.277	-679.161	1203.650
91.515	3191226	-18177939	9969487	3219.434	-686.421	1275.146
93.937	3199186	-18179670	9972665	3355.215	-693.305	1349.392
96.343	3207428	-18181347	9976003	3496.326	-700.193	1424.980
98.187	3213977	-18182641	9978684	3608.523	-703.706	1484.320
100.609	3222901	-18184350	9982375	3761.970	-707.851	1563.739
103.031	3232205	-18186067	9986261	3922.407	-709.511	1645.516
105.437	3241842	-18187775	9990319	4089.211	-709.273	1728.228
107.874	3252022	-18189504	9994636	4253.927	-710.143	1814.295
110.296	3262565	-18191226	9999137	4443.830	-711.495	1902.349
112.703	3273482	-18192936	10003820	4632.099	-709.267	1990.389
115.124	3284939	-18194645	10008749	4830.472	-701.387	2080.419
117.531	3296808	-18196319	10013865	5036.057	-689.265	2172.344
119.953	3309264	-18197970	10019241	5251.440	-673.371	2267.675
122.374	3322251	-18199579	10024853	5475.004	-654.238	2367.101
124.781	3335701	-18201129	10030671	5705.528	-634.446	2469.348
127.203	3349809	-18202641	10036780	5946.483	-613.630	2576.340
129.624	3364512	-18204101	10043153	6196.803	-591.745	2687.034
132.031	3379732	-18205497	10049755	6455.401	-568.715	2801.181
134.453	3395692	-18206846	10056683	6726.578	-544.517	2920.578
136.874	3412324	-18208134	10063905	7009.513	-518.945	3044.758
139.281	3429541	-18209350	10071386	7303.112	-491.903	3173.402
141.703	3447599	-18210508	10079234	7611.552	-463.391	3308.612
144.124	3466422	-18211594	10087416	7934.751	-433.272	3449.806
146.562	3486175	-18212610	10096005	8275.750	-400.567	3598.664
148.968	3506509	-18213533	10104848	8628.445	-365.902	3752.379
152.788	3540668	-18214420	10119702	9159.232	-301.524	3917.606
153.812	3549965	-18215112	10123734	9182.355	-275.256	3976.840
156.187	3571867	-18215695	10133187	9262.441	-215.075	3983.901
158.593	3594254	-18216138	10142783	9345.355	-153.133	3992.048
160.999	3616843	-18216431	10152399	9430.332	-90.455	4000.459
163.390	3639490	-18216572	10161973	9516.754	-27.299	4009.273
165.765	3662194	-18216562	10171506	9604.327	35.720	4018.702
168.093	3684658	-18216407	10180874	9691.674	97.293	4028.571

4160-6047-TC000

-42-

CONFIDENTIAL

CONFIDENTIAL

TIME IN SECONDS FROM LIFTOFF

TIME	X	Y	Z	X-DOT	Y-DOT	Z-DOT
170.499	3708099	-18216096	10190580	9783.346	161.225	4039.317
172.906	3731743	-18215626	10200311	9877.588	231.542	4047.922
175.312	3755626	-18214975	10210058	9974.125	311.052	4052.910
177.718	3779744	-18214121	10219812	10071.872	400.124	4053.577
180.124	3804098	-18213042	10229562	10170.203	498.447	4049.890
182.593	3829330	-18211676	10239551	10270.721	609.540	4041.100
185.046	3854648	-18210039	10249449	10370.578	725.875	4029.167
187.515	3880375	-18208100	10259331	10472.015	845.195	4016.686
189.187	3897941	-18206619	10266089	10541.427	926.693	4008.321
191.640	3923926	-18204138	10275907	10644.452	1047.111	3996.173
194.109	3950334	-18201462	10285758	10749.454	1159.083	3984.348
196.562	3976833	-18198445	10295518	10855.305	1291.061	3973.044
199.015	4003594	-18195128	10305251	10962.791	1413.507	3962.301
201.434	4030734	-18191485	10315021	11072.707	1537.535	3952.072
203.937	4058092	-18187562	10324704	11183.698	1661.060	3942.559
206.406	4085842	-18183307	10334426	11297.188	1785.930	3933.645
208.874	4113874	-18178744	10344127	11412.567	1911.392	3925.315
211.328	4142013	-18173901	10353746	11529.110	2036.661	3917.677
213.796	4170622	-18168717	10363409	11648.399	2163.297	3910.616
216.249	4199344	-18163255	10372995	11769.007	2289.959	3904.148
218.718	4228551	-18157444	10382626	11892.492	2418.006	3898.336
220.406	4248692	-18153289	10389201	11976.159	2506.025	3894.670
222.874	4278419	-18146942	10398810	12105.351	2635.573	3889.763
225.328	4308273	-18140318	10408347	12234.014	2764.930	3885.528
227.796	4338638	-18133331	10417934	12366.023	2895.983	3881.893
230.265	4369332	-18126019	10427514	12500.617	3027.801	3878.851
232.718	4400164	-18118430	10437026	12636.878	3159.753	3876.343
235.187	4431533	-18110464	10446593	12776.500	3293.577	3874.475
237.640	4463048	-18102220	10456096	12917.785	3427.715	3873.111
240.109	4495117	-18093590	10465657	13062.676	3564.321	3872.208
242.562	4527341	-18084678	10475155	13209.395	3701.594	3871.886
245.031	4560137	-18075367	10484714	13359.904	3841.359	3871.979
247.484	4593097	-18065722	10494213	13512.431	3981.913	3872.702
249.171	4615989	-18058970	10500749	13619.054	4079.470	3873.436

CONFIDENTIAL

GEMINI TRAJECTORY IN EGIS

TIME IN SECONDS FROM LIFTOFF

TIME	X	Y	Z	X-DOT	Y-DOT	Z-DOT
251.640	4649806	-18048721	10510313	13777.758	4223.989	3875.045
254.033	4683801	-18038181	10519822	13938.727	4369.149	3877.224
256.562	4718416	-18027212	10529397	14104.122	4517.642	3880.002
259.015	4753221	-18015947	10538920	14272.053	4666.692	3883.622
261.484	4788667	-18004239	10548513	14444.551	4818.793	3887.968
263.953	4824544	-17992153	10558117	14621.113	4972.785	3893.046
266.406	4860631	-17979764	10567674	14800.589	5127.943	3898.932
268.874	4897397	-17966910	10577308	14983.450	5286.177	3905.758
271.328	4934388	-17953746	10586898	15173.556	5446.037	3913.366
273.796	4972086	-17940101	10596570	15367.515	5608.674	3922.154
276.249	5010026	-17926141	10606203	15565.211	5773.287	3931.731
278.718	5048704	-17911682	10615923	15769.384	5941.155	3942.758
280.390	5075186	-17901653	10622521	15910.810	6056.370	3950.927
282.859	5114728	-17886490	10632292	16124.452	6228.372	3964.213
285.312	5154550	-17870999	10642034	16342.787	6401.707	3978.919
287.781	5195174	-17854976	10651877	16568.771	6579.732	3994.966
290.234	5236102	-17838615	10661698	16800.054	6759.420	4012.424
292.687	5277605	-17821803	10671564	17038.493	6942.629	4031.559
295.124	5319433	-17804661	10681416	17282.898	7127.948	4052.409
297.562	5361866	-17787059	10691321	17535.195	7316.168	4074.956
299.984	5404645	-17769106	10701218	17793.932	7508.696	4098.710
302.343	5446934	-17751165	10710917	18054.495	7700.758	4123.436
304.656	5488988	-17733136	10720483	18318.553	7892.542	4149.750
306.968	5531664	-17714657	10730111	18591.670	8089.326	4177.957
309.281	5574983	-17695718	10739807	18874.566	8291.559	4207.915
312.328	5633078	-17670042	10752694	19263.106	8565.054	4251.331
314.640	5677078	-17649987	10762565	19571.225	8781.103	4286.505
316.937	5723294	-17629568	10772454	19889.937	8997.747	4325.673
319.249	5769674	-17608502	10782506	20224.157	9224.165	4367.690
321.578	5817164	-17586751	10792726	20575.512	9459.753	4413.167
323.874	5864837	-17564753	10802919	20938.058	9697.551	4462.782
326.187	5913694	-17542042	10813300	21320.131	9946.352	4516.316
328.499	5963457	-17518747	10823811	21720.689	10204.293	4573.874
330.812	6014168	-17494838	10834457	22141.975	10471.623	4636.126

CONFIDENTIAL

TRW SPACE TECHNOLOGY LABORATORIES

THOMSON DATA WORKS/304155

GEMINI TRAJECTORY IN ECIG

PAGE

5

TIME IN SECONDS FROM LIFTOFF

TIME	X	Y	Z	X-DOT	Y-DOT	Z-DOT
333.998	6085685	-17460860	10849374	22734.015	10858.632	4736.303
336.187	6135479	-17437029	10859701	22746.550	10918.350	4637.050
338.703	6192683	-17409476	10871469	22730.853	10982.843	4660.210
340.828	6240969	-17386072	10881334	22715.718	11035.290	4628.967
343.343	6298087	-17358220	10892925	22695.220	11100.823	4589.737
347.984	6403313	-17306420	10914049	22653.730	11226.987	4512.082
350.499	6460276	-17278123	10925361	22633.502	11271.120	4480.314
353.015	6517182	-17249678	10936576	22606.751	11344.092	4436.857
355.249	6567673	-17224252	10946443	22587.259	11404.117	4399.545
357.656	6621996	-17196740	10956984	22564.495	11463.536	4362.185
362.498	6731176	-17140915	10977915	22512.519	11610.074	4269.463
364.921	6785679	-17112794	10988243	22490.562	11659.948	4235.637
359.765	6894506	-17056053	11008588	22440.515	11794.488	4152.201

4160-6047-TC000

-45-

~~CONFIDENTIAL~~

4160-6047-TC000
-46-

RE-ENTRY TRAJECTORY RECONSTRUCTION

~~CONFIDENTIAL~~

SPACE TECHNOLOGY LABORATORIES

GEMINI GI-3 FREE FLIGHT AND REENTRY RECONSTRUCTION

EARTH CENTERED INERTIAL GREENWICH
COORDINATE SYSTEM

TIME (SEC)	X (FT)	Y (FT)	Z (FT)	XDOT (FT/SEC)	YDOT (FT/SEC)	ZDOT (FT/SEC)
462.4	2374275.00	-18613390.00	9838713.00	24377.34	14.53	-7233.43
465.3275	2443579.87	-18613290.25	9818115.37	24364.56	55.56	-7252.75
467.2494	2490393.84	-18613133.25	9804151.00	24352.42	107.78	-7279.31
470.0932	2559618.91	-18612717.75	9783395.00	24333.35	184.51	-7318.35
472.0150	2606371.50	-18612313.00	9769304.75	24319.76	236.58	-7344.60
474.8588	2675501.28	-18611531.25	9748363.25	24298.99	313.20	-7383.51
476.7807	2722186.66	-18610879.75	9734148.12	24284.16	364.86	-7409.48
479.6244	2791211.87	-18609733.25	9713022.75	24261.06	441.45	-7447.89
484.4057	2907110.81	-18607316.75	9677261.75	24219.55	569.42	-7510.94
487.2338	2975568.75	-18605600.00	9655967.75	24192.68	644.60	-7547.87
489.1713	3022423.37	-18604301.00	9641319.50	24173.39	696.30	-7572.87
491.1713	3070749.56	-18602855.25	9626147.87	24152.79	749.52	-7598.76
494.2494	3145043.66	-18600422.75	9602698.00	24119.52	830.99	-7637.67
496.3275	3195142.91	-18598639.00	9586799.12	24096.29	885.61	-7663.58
498.4213	3245569.37	-18596727.50	9570726.50	24072.29	940.31	-7689.30
501.4994	3319608.91	-18593709.00	9547000.37	24034.62	1021.00	-7726.68
503.5775	3369528.19	-18591530.75	9530917.75	24007.99	1075.20	-7751.34
505.6557	3419391.09	-18589240.25	9514784.37	23980.39	1129.16	-7775.47
508.7338	3493139.22	-18585642.25	9490796.50	23937.16	1208.61	-7810.60
510.8275	3543224.72	-18583055.75	9474418.00	23905.72	1262.20	-7834.45
512.9057	3592869.84	-18580377.25	9458113.25	23873.03	1315.70	-7857.34
515.9838	3666274.16	-18576208.00	9433876.87	23821.15	1393.23	-7890.20
518.0775	3716110.50	-18573235.75	9417334.37	23783.72	1445.77	-7911.58
520.1557	3765495.75	-18570177.25	9400871.37	23744.93	1497.81	-7932.47
523.2182	3838121.94	-18565474.50	9376533.50	23684.42	1573.45	-7961.70
525.3119	3887665.41	-18562127.00	9359843.50	23640.69	1624.15	-7981.01
527.3900	3936747.00	-18558699.25	9343230.87	23595.75	1674.60	-7999.39
529.4682	3985733.62	-18555167.50	9326596.87	23549.25	1724.54	-8016.91
532.5463	4058109.31	-18549747.25	9301801.62	23476.58	1797.15	-8041.76

GEMINI GI-3 FREE FLIGHT AND REENTRY RECONSTRUCTION

EARTH CENTERED INERTIAL GREENWICH
COORDINATE SYSTEM

TIME (SEC)	X (FT)	Y (FT)	Z (FT)	XDOT (FT/SEC)	YDOT (FT/SEC)	ZDOT (FT/SEC)
534.6244	4106843.03	-18545961.50	9285153.50	23425.03	1846.41	-8057.40
536.7025	4155467.75	-18542074.50	9268393.62	23371.69	1894.30	-8072.47
539.7963	4227645.69	-185336104.50	9243387.00	23288.81	1965.15	-8093.40
541.8744	4275981.25	-18531971.75	9226554.75	23229.61	2012.14	-8106.01
543.9525	4324190.56	-18527742.50	9209694.87	23167.37	2058.09	-8120.12
547.0463	4395710.06	-18521270.75	9184548.87	23067.47	2125.69	-8135.87
549.1244	4443573.56	-18516807.50	9167631.25	22996.66	2169.71	-8145.70
551.2025	4491286.75	-18512254.25	9150695.00	22922.79	2212.54	-8153.83
554.2963	4562024.44	-18505310.75	9125453.37	22806.64	2276.21	-8164.03
556.3900	4609690.06	-18500501.75	9108353.12	22724.66	2317.26	-8170.57
558.4682	4656825.81	-18495642.75	9091370.12	22639.11	2359.14	-8173.95
561.5463	4726309.50	-18488293.50	9066199.87	22507.64	2416.08	-8180.27
563.6400	4773335.50	-18483194.50	9049072.25	22412.70	2454.44	-8180.47
565.7182	4819807.62	-18478055.00	9032071.00	22312.34	2491.96	-8181.70
568.7963	4888247.75	-18470302.50	9006890.62	22156.40	2545.26	-8179.11
570.8900	4934523.31	-18464937.75	8989769.50	22047.13	2579.12	-8175.40
572.9838	4980565.19	-18459501.75	8972658.25	21933.17	2613.57	-8169.65
575.0619	5026024.75	-18454039.75	8955689.62	21817.39	2643.01	-8161.06
578.1400	5092904.62	-18445832.25	8930591.50	21637.53	2689.75	-8146.34
580.2182	5137737.19	-18440212.25	8913673.12	21509.60	2719.09	-8136.01
582.2963	5182301.31	-18434533.75	8896780.50	21379.20	2746.04	-8121.66
585.3744	5247799.75	-18426019.50	8871814.25	21178.14	2786.02	-8100.02
587.4682	5291991.87	-18420156.00	8854871.37	21035.25	2814.96	-8084.17
589.5463	5335554.62	-18414282.50	8838096.87	20889.82	2837.62	-8069.34
592.6244	5399506.56	-18405489.75	8813293.62	20662.72	2876.11	-8039.99
594.7025	5442279.12	-18399489.00	8796609.50	20501.85	2898.14	-8017.87
596.7807	5484712.00	-18393444.00	8779970.25	20335.77	2919.46	-7994.97
599.8588	5546916.56	-18384416.75	8755426.62	20081.43	2945.98	-7952.11
601.9525	5588776.69	-18378233.50	8738814.00	19904.43	2960.43	-7916.66

CONFIDENTIAL

GEMINI GT-3 FREE FLIGHT AND REENTRY RECONSTRUCTION

EARTH CENTERED INERTIAL GREENWICH
COORDINATE SYSTEM

TIME (SEC)	X (FT)	Y (FT)	Z (FT)	XDOT (FT/SEC)	YDOT (FT/SEC)	ZDOT (FT/SEC)
604.0150	5629643.69	-18372116.25	8722525.75	19724.22	2971.42	-7878.00
607.1088	5690240.50	-18362897.75	8698254.25	19449.48	2988.01	-7812.65
609.1869	5730459.94	-18356679.25	8682068.87	19257.95	2996.85	-7764.35
611.2650	5770278.31	-18350443.75	8665984.75	19063.49	3004.16	-7715.03
614.3432	5828505.94	-18341180.75	8642358.87	18769.69	3014.46	-7635.82
616.4213	5867300.56	-18334911.75	8626550.62	18566.52	3018.81	-7578.16
618.4994	5905668.31	-18328633.75	8610865.75	18358.82	3023.17	-7517.00
621.5775	5961699.50	-18319321.50	8587875.37	18047.22	3027.47	-7420.92
623.6557	5998981.87	-18313027.57	8572525.37	17833.62	3029.66	-7352.05
625.7338	6035818.25	-18306728.25	8557321.37	17617.91	3032.94	-7280.38
628.7963	6089278.75	-18297436.25	8535195.37	17295.05	3035.31	-7169.21
630.8744	6124990.69	-18291129.75	8520379.37	17074.36	3034.31	-7089.87
632.9525	6160239.37	-18284822.00	8505729.50	16849.20	3036.11	-7009.16
636.0150	6211327.94	-18275529.50	8484460.12	16514.76	3032.57	-6881.10
638.0932	6245405.75	-18269229.00	8470249.00	16281.89	3031.06	-6795.79
640.1713	6278996.44	-18262934.75	8456213.50	16046.00	3026.54	-6711.96
642.2494	6312096.31	-18256653.00	8442351.25	15809.57	3019.03	-6629.16
645.3275	6360714.00	-18247374.25	8422132.00	15454.70	3009.73	-6508.26
647.4057	6392083.81	-18241130.25	8408694.12	15216.97	2999.75	-6424.40
649.4838	6423460.94	-18234907.00	8395433.00	14980.61	2989.54	-6338.24
652.5619	6469026.19	-18225718.00	8376128.56	14625.23	2980.88	-6204.75
654.6244	6498943.31	-18219581.50	8363428.62	14385.33	2969.64	-6110.30
656.7025	6528586.94	-18213422.25	8350831.44	14143.86	2958.16	-6013.31
659.7807	6571562.00	-18204337.00	8332544.06	13779.03	2944.97	-5868.84
661.8588	6599937.19	-18198229.75	8320454.37	13529.41	2932.68	-5766.40
663.9213	6627583.62	-18192195.25	8308666.81	13279.26	2918.79	-5663.95
666.9994	6667881.19	-18183245.50	8291466.25	12903.94	2896.28	-5512.03
669.0775	6694435.12	-18177239.75	8280122.12	12651.69	2883.75	-5405.64
671.1400	6720270.37	-18171305.25	8269083.37	12400.72	2870.94	-5298.62

4160-6047-TC000

-49-

CONFIDENTIAL

CONFIDENTIAL

GEMINI GT-3 FREE FLIGHT AND REENTRY RECONSTRUCTION

EARTH CENTERED INERTIAL GREENWICH
COORDINATE SYSTEM

TIME (SEC)	X (FT)	Y (FT)	Z (FT)	XDOT (FT/SEC)	YDOT (FT/SEC)	ZDOT (FT/SEC)
674.2182	6757861.56	-18162510.00	8253009.31	12024.01	2843.70	-5145.41
676.2963	6782581.44	-18156620.25	8242420.94	11766.53	2824.64	-5044.92
678.3744	6806764.75	-18150770.00	8232040.81	11507.62	2805.75	-4944.95
681.4369	6841422.62	-18142224.00	8217126.06	11126.11	2775.24	-4795.33
683.5150	6864278.69	-18136477.25	8207271.87	10870.72	2755.50	-4688.40
685.5932	6886605.06	-18130771.25	8197642.56	10616.29	2736.01	-4578.90
688.6557	6918540.62	-18122440.50	8183865.19	10239.60	2704.42	-4418.58
690.7494	6939710.75	-18116802.75	8174727.50	9982.60	2681.00	-4309.92
692.8119	6960035.19	-18111299.25	8165952.75	9725.95	2655.71	-4198.93
695.8900	6989379.44	-18103189.00	8153271.81	9340.34	2613.94	-4040.46
697.9682	7008513.06	-18097790.25	8144986.12	9073.96	2581.86	-3933.77
700.0463	7027094.69	-18092458.75	8136919.25	8809.11	2549.21	-3829.87
703.1244	7053612.81	-18084684.75	8125379.12	8420.93	2501.81	-3668.28
705.2025	7070839.37	-18079518.50	8117873.06	8158.02	2470.19	-3555.57
707.2807	7087520.62	-18074417.75	8110605.75	7896.17	2439.04	-3438.50
710.3432	7111116.69	-18067018.25	8100342.12	7513.49	2393.15	-3264.28
712.4213	7126462.62	-18062077.75	8093681.62	7255.53	2361.81	-3145.88
714.4838	7141162.00	-18057240.50	8087318.50	6998.44	2328.65	-3024.38
717.5619	7162130.81	-18050145.25	8078277.75	6625.99	2281.61	-2849.84
719.6400	7175643.00	-18045436.25	8072481.00	6378.20	2250.20	-2728.96
721.7182	7188645.94	-18040790.00	8066933.44	6135.89	2221.68	-2610.05
724.7963	7206989.50	-18034014.75	8059163.94	5782.79	2180.65	-2438.15
726.8744	7218762.81	-18029508.50	8054218.00	5547.89	2156.24	-2321.87
728.9525	7230048.06	-18025051.75	8049511.00	5313.11	2133.04	-2208.16
732.0307	7245879.06	-18018536.75	8042956.50	4973.01	2099.95	-2050.58
734.1088	7255982.00	-18014193.75	8038796.06	4750.12	2079.77	-1953.48
736.1869	7265628.37	-18009891.50	8034832.50	4533.63	2060.96	-1861.09
738.2650	7274835.44	-18005633.25	8031063.75	4327.30	2037.14	-1765.96
741.3432	7287708.37	-17999455.25	8025832.06	4036.84	1976.89	-1633.33

4160-6047-TC000

CONFIDENTIAL

CONFIDENTIAL

GEMINI GT-3 FREE FLIGHT AND REENTRY RECONSTRUCTION

EARTH CENTERED INERTIAL GREENWICH
COORDINATE SYSTEM

TIME (SEC)	X (FT)	Y (FT)	Z (FT)	XDOT (FT/SEC)	YDOT (FT/SEC)	ZDOT (FT/SEC)
743.4057	7295839.37	-17995427.00	8022549.12	3847.77	1929.40	-1550.11
745.4994	7303701.81	-17991438.75	8019380.62	3662.63	1880.37	-1476.48
748.5775	7314570.25	-17985754.75	8015006.00	3399.06	1812.70	-1365.94
750.6557	7321462.44	-17982035.00	8012242.62	3234.03	1767.36	-1293.53
752.7338	7328024.06	-17978403.50	8009626.00	3080.92	1727.42	-1224.71
755.8119	7337185.69	-17973172.25	8006019.81	2871.84	1671.61	-1118.42
757.8900	7343014.75	-17969735.25	8003760.44	2738.09	1636.29	-1056.04
759.9682	7348577.44	-17966370.75	8001627.62	2615.44	1601.72	-996.54
763.0463	7356362.44	-17961507.00	7998699.81	2442.85	1558.36	-905.81
765.1244	7361326.06	-17958299.00	7996874.25	2334.15	1529.07	-851.10
767.1713	7366001.06	-17955198.00	7995184.00	2233.80	1500.90	-800.49
770.2182	7372597.44	-17950679.25	7992857.19	2096.12	1465.30	-726.82
772.2807	7376833.62	-17947679.25	7991400.06	2011.75	1443.82	-686.15
774.3432	7380907.00	-17944724.25	7990025.81	1938.17	1421.69	-646.49
777.3744	7386615.31	-17940458.00	7988150.06	1828.12	1393.19	-591.10
779.4369	7390321.81	-17937608.50	7986960.50	1766.06	1369.89	-562.45
781.4994	7393893.87	-17934809.00	7985819.06	1697.78	1344.85	-544.41
784.5307	7398902.44	-17930769.50	7984224.62	1606.83	1320.89	-507.58
786.5932	7402158.62	-17928074.00	7983193.81	1550.68	1292.02	-491.94
788.6557	7405305.37	-17925428.75	7982194.75	1500.76	1273.16	-476.87
791.7025	7409777.69	-17921584.75	7980772.44	1434.91	1249.98	-456.74
793.7650	7412698.75	-17919026.00	7979941.69	1397.58	1231.45	-445.80
796.7963	7416869.62	-17915339.25	7979518.56	1354.35	1201.06	-427.20
798.8588	7419638.06	-17912880.50	7979651.19	1330.20	1182.95	-413.86

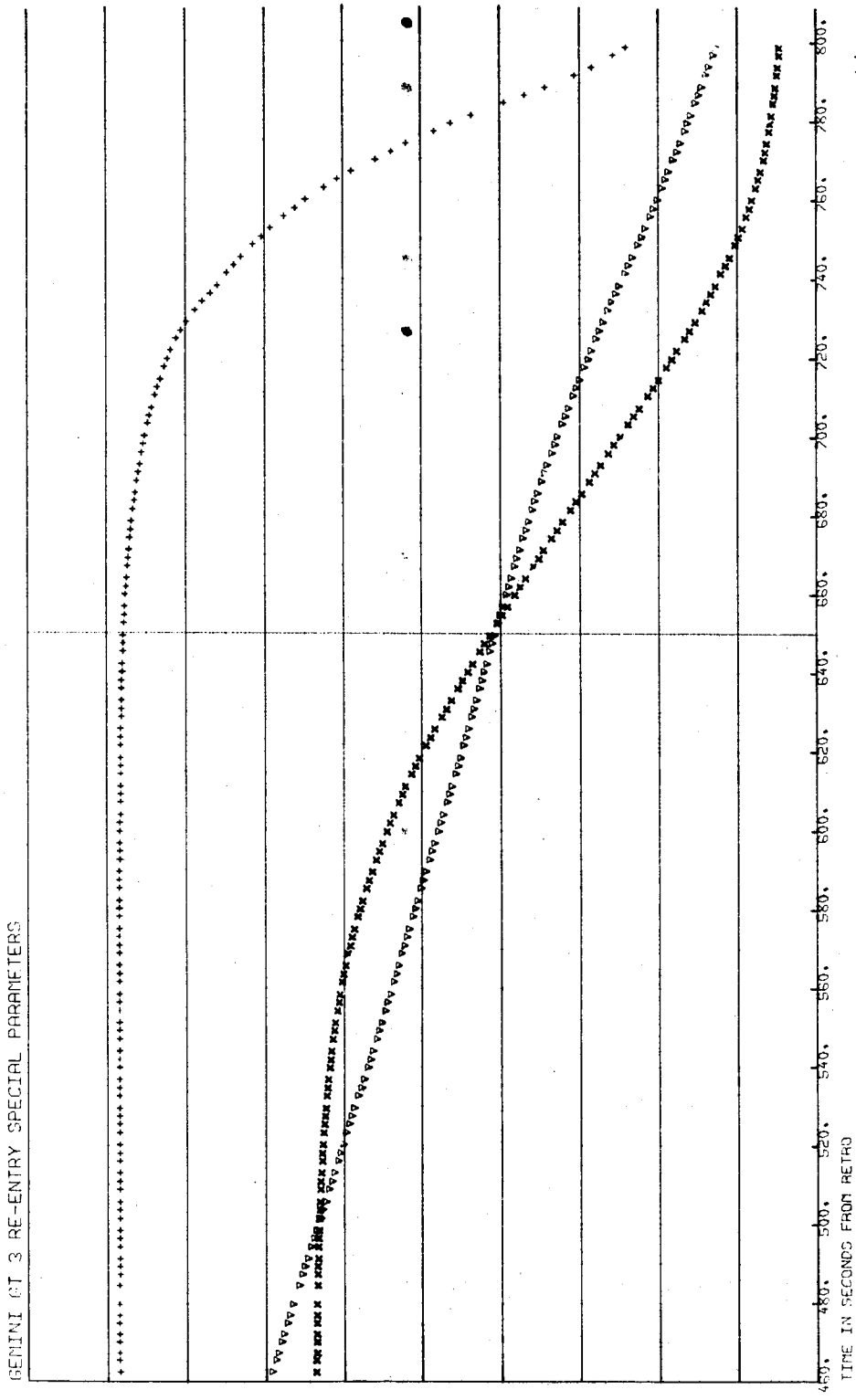
~~CONFIDENTIAL~~

4160-6047-TC000
-52-

RE-ENTRY TRAJECTORY RECONSTRUCTION
SPECIAL PARAMETERS

~~CONFIDENTIAL~~

Figure 13



GENINI CT 3 RE-ENTRY SPECIAL PARAMETERS

4.0
x10⁵

3.6
x10⁵

3.2
x10⁵

2.8
x10⁵

2.4
x10⁵

2.0
x10⁵

1.6
x10⁵

1.2
x10⁵

3000.

4000.

0.0

10.0

0.0

-10.0

-20.0

-30.0

-40.0

-50.0

-60.0

ALTITUDE FEET

FLIGHT PATH ANGLE (DEGREES)

VELOCITY MAGNITUDE (FT/SEC)

TIME IN SECONDS FROM RETRO

450. 480. 500. 520. 540. 560. 580. 600. 620. 640. 660. 680. 700. 720. 740. 760. 780. 800.

GEMINI GT-3 FREE-FLIGHT AND RE-ENTRY RECONSTRUCTION

| TIME
(SEC) | VELOCITY MAGNITUDE
(FT/SEC) | FLIGHT PATH ANGLE
(DEGREES) | ALTITUDE
(FEET) | GEODETIC LAT.
(DEGREES) | GEODETIC LONG.
(DEGREES) |
|---------------|--------------------------------|--------------------------------|--------------------|----------------------------|-----------------------------|
| 462.4838 | 25427.9 | -1.5198 | 276605.5 | 27.8281 | -84.6630 |
| 465.3275 | 25421.2 | -1.4246 | 274781.5 | 27.7675 | -84.4651 |
| 467.2494 | 25417.3 | -1.4272 | 273586.5 | 27.7264 | -84.3314 |
| 470.0932 | 25410.7 | -1.4302 | 271815.7 | 27.6652 | -84.1339 |
| 472.0150 | 25405.7 | -1.4328 | 270616.2 | 27.6237 | -84.0005 |
| 474.8588 | 25397.9 | -1.4363 | 268838.5 | 27.5621 | -83.8035 |
| 476.7807 | 25392.0 | -1.4384 | 267635.2 | 27.5202 | -83.6705 |
| 479.6244 | 25382.4 | -1.4424 | 265851.0 | 27.4581 | -83.4739 |
| 484.4057 | 25363.9 | -1.4474 | 262843.5 | 27.3529 | -83.1441 |
| 487.2338 | 25351.0 | -1.4501 | 261061.2 | 27.2902 | -82.9494 |
| 489.1713 | 25341.4 | -1.4526 | 259838.2 | 27.2472 | -82.8162 |
| 491.1713 | 25331.0 | -1.4554 | 258574.2 | 27.2026 | -82.6789 |
| 494.2494 | 25313.6 | -1.4587 | 256625.5 | 27.1337 | -82.4680 |
| 496.3275 | 25301.1 | -1.4603 | 255308.2 | 27.0869 | -82.3258 |
| 498.4213 | 25288.0 | -1.4614 | 253980.7 | 27.0397 | -82.1827 |
| 501.4994 | 25266.7 | -1.4644 | 252027.5 | 26.9700 | -81.9727 |
| 503.5775 | 25251.2 | -1.4662 | 250707.5 | 26.9228 | -81.8312 |
| 505.6557 | 25234.7 | -1.4675 | 249387.0 | 26.8754 | -81.6899 |
| 508.7338 | 25208.2 | -1.4695 | 247430.7 | 26.8050 | -81.4811 |
| 510.8275 | 25188.4 | -1.4712 | 246099.2 | 26.7570 | -81.3393 |
| 512.9057 | 25167.2 | -1.4737 | 244777.2 | 26.7091 | -81.1988 |
| 515.9838 | 25132.5 | -1.4750 | 242818.2 | 26.6380 | -80.9912 |
| 518.0775 | 25106.7 | -1.4761 | 241486.2 | 26.5895 | -80.8503 |
| 520.1557 | 25079.7 | -1.4778 | 240164.7 | 26.5413 | -80.7107 |
| 523.2182 | 25036.3 | -1.4790 | 238217.7 | 26.4699 | -80.5056 |
| 525.3119 | 25004.3 | -1.4789 | 236888.0 | 26.4210 | -80.3657 |
| 527.3900 | 24971.1 | -1.4795 | 235570.0 | 26.3724 | -80.2272 |
| 529.4682 | 24936.2 | -1.4795 | 234253.2 | 26.3236 | -80.0890 |

GEMINI GT-3 FREE-FLIGHT AND RE-ENTRY RECONSTRUCTION

| TIME
(SEC) | VELOCITY MAGNITUDE
(FT/SEC) | FLIGHT PATH ANGLE
(DEGREES) | ALTITUDE
(FEET) | GEOGETIC LAT.
(DEGREES) | GEOGETIC LONG.
(DEGREES) |
|---------------|--------------------------------|--------------------------------|--------------------|----------------------------|-----------------------------|
| 532.5463 | 24880.7 | -1.4786 | 232307.0 | 26.2512 | -79.8849 |
| 534.6244 | 24840.8 | -1.4795 | 230995.7 | 26.2022 | -79.7475 |
| 536.7025 | 24799.0 | -1.4785 | 229686.5 | 26.1531 | -79.6105 |
| 539.7963 | 24733.2 | -1.4778 | 227742.7 | 26.0799 | -79.4073 |
| 541.8744 | 24685.4 | -1.4774 | 226440.2 | 26.0307 | -79.2712 |
| 543.9525 | 24635.3 | -1.4790 | 225140.5 | 25.9813 | -79.1356 |
| 547.0463 | 24552.4 | -1.4799 | 223209.0 | 25.9077 | -78.9344 |
| 549.1244 | 24493.0 | -1.4801 | 221914.5 | 25.8582 | -78.7999 |
| 551.2025 | 24430.2 | -1.4788 | 220624.2 | 25.8087 | -78.6658 |
| 554.2963 | 24330.5 | -1.4804 | 218709.7 | 25.7349 | -78.4672 |
| 556.3900 | 24259.8 | -1.4802 | 217418.0 | 25.6849 | -78.3334 |
| 558.4682 | 24184.9 | -1.4830 | 216138.5 | 25.6353 | -78.2011 |
| 561.5463 | 24069.7 | -1.4829 | 214250.0 | 25.5617 | -78.0063 |
| 563.6400 | 23984.9 | -1.4830 | 212970.5 | 25.5117 | -77.8745 |
| 565.7182 | 23895.4 | -1.4883 | 211703.5 | 25.4620 | -77.7443 |
| 568.7963 | 23754.6 | -1.4942 | 209829.2 | 25.3885 | -77.5527 |
| 570.8900 | 23655.1 | -1.4951 | 208557.7 | 25.3385 | -77.4233 |
| 572.9838 | 23550.7 | -1.5001 | 207289.7 | 25.2885 | -77.2945 |
| 575.0619 | 23443.3 | -1.4950 | 206037.2 | 25.2390 | -77.1675 |
| 578.1400 | 23276.2 | -1.5016 | 204192.2 | 25.1658 | -76.9807 |
| 580.2182 | 23157.1 | -1.5078 | 202949.7 | 25.1165 | -76.8555 |
| 582.2963 | 23034.2 | -1.5081 | 201711.2 | 25.0672 | -76.7312 |
| 585.3744 | 22844.8 | -1.5180 | 199863.7 | 24.9944 | -76.5486 |
| 587.4682 | 22710.3 | -1.5352 | 198639.0 | 24.9450 | -76.4255 |
| 589.5463 | 22573.2 | -1.5443 | 197401.0 | 24.8962 | -76.3042 |
| 592.6244 | 22357.6 | -1.5750 | 195560.2 | 24.8240 | -76.1262 |
| 594.7025 | 22203.9 | -1.5932 | 194309.2 | 24.7754 | -76.0073 |
| 596.7807 | 22045.1 | -1.6161 | 193052.0 | 24.7271 | -75.8894 |

GEMINI GT-3 FREE-FLIGHT AND RE-ENTRY RECONSTRUCTION

| TIME
(SEC) | VELOCITY MAGNITUDE
(FT/SEC) | FLIGHT PATH ANGLE
(DEGREES) | ALTITUDE
(FEET) | GEODEIC LAT.
(DEGREES) | GEODEIC LONG.
(DEGREES) |
|---------------|--------------------------------|--------------------------------|--------------------|---------------------------|----------------------------|
| 599.8588 | 21798.6 | -1.6403 | 191181.5 | 24.6557 | -75.7167 |
| 601.9525 | 21624.5 | -1.6483 | 189909.7 | 24.6075 | -75.6006 |
| 604.0150 | 21446.1 | -1.6520 | 188663.7 | 24.5602 | -75.4873 |
| 607.1088 | 21171.9 | -1.6593 | 186809.5 | 24.4897 | -75.3195 |
| 609.1869 | 20979.4 | -1.6635 | 185573.7 | 24.4427 | -75.2083 |
| 611.2650 | 20783.7 | -1.6689 | 184346.7 | 24.3961 | -75.0982 |
| 614.3432 | 20486.4 | -1.6803 | 182543.7 | 24.3275 | -74.9374 |
| 616.4213 | 20279.5 | -1.6853 | 181336.0 | 24.2817 | -74.8304 |
| 618.4994 | 20067.2 | -1.6942 | 180137.0 | 24.2362 | -74.7247 |
| 621.5775 | 19746.8 | -1.7063 | 178376.0 | 24.1696 | -74.5704 |
| 623.6557 | 19526.1 | -1.7159 | 177196.7 | 24.1251 | -74.4679 |
| 625.7338 | 19302.7 | -1.7314 | 176023.2 | 24.0811 | -74.3667 |
| 628.7963 | 18966.5 | -1.7536 | 174303.2 | 24.0171 | -74.2200 |
| 630.8744 | 18735.2 | -1.7636 | 173144.2 | 23.9742 | -74.1221 |
| 632.9525 | 18499.8 | -1.7892 | 171989.0 | 23.9319 | -74.0256 |
| 636.0150 | 18146.2 | -1.8088 | 170296.0 | 23.8704 | -73.8859 |
| 638.0932 | 17901.7 | -1.8395 | 169151.7 | 23.8293 | -73.7928 |
| 640.1713 | 17654.6 | -1.8721 | 168005.0 | 23.7888 | -73.7012 |
| 642.2494 | 17407.0 | -1.9032 | 166856.7 | 23.7489 | -73.6109 |
| 645.3275 | 17037.1 | -1.9732 | 165145.7 | 23.6906 | -73.4800 |
| 647.4057 | 16787.7 | -2.0110 | 163982.5 | 23.6519 | -73.3934 |
| 649.4838 | 16538.7 | -2.0488 | 162816.0 | 23.6138 | -73.3082 |
| 652.5619 | 16164.2 | -2.1354 | 161073.7 | 23.5583 | -73.1847 |
| 654.6244 | 15908.9 | -2.1783 | 159896.0 | 23.5219 | -73.1037 |
| 656.7025 | 15651.2 | -2.2243 | 158707.0 | 23.4858 | -73.0236 |
| 659.7807 | 15263.6 | -2.3268 | 156928.5 | 23.4334 | -72.9076 |
| 661.8588 | 14996.6 | -2.3905 | 155713.7 | 23.3989 | -72.8311 |
| 663.9213 | 14728.8 | -2.4574 | 154499.2 | 23.3652 | -72.7568 |

CONFIDENTIAL

CONFIDENTIAL

GEMINI GT-3 FREE-FLIGHT AND RE-ENTRY RECONSTRUCTION

| TIME
(SEC) | VELOCITY MAGNITUDE
(FT/SEC) | FLIGHT PATH ANGLE
(DEGREES) | ALTITUDE
(FEET) | GEODETTIC LAT.
(DEGREES) | GEODETTIC LONG.
(DEGREES) |
|---------------|--------------------------------|--------------------------------|--------------------|-----------------------------|------------------------------|
| 666.9994 | 14327.7 | -2.5698 | 152668.7 | 23.3162 | -72.6486 |
| 669.0775 | 14057.1 | -2.6580 | 151416.7 | 23.2839 | -72.5774 |
| 671.1400 | 13787.5 | -2.7516 | 150159.2 | 23.2525 | -72.5082 |
| 674.2182 | 13384.3 | -2.8909 | 148255.7 | 23.2069 | -72.4078 |
| 676.2963 | 13110.3 | -3.0050 | 146951.2 | 23.1770 | -72.3420 |
| 678.3744 | 12835.5 | -3.1341 | 145625.0 | 23.1477 | -72.2776 |
| 681.4369 | 12429.3 | -3.3295 | 143629.7 | 23.1056 | -72.1857 |
| 683.5150 | 12155.1 | -3.4640 | 142250.2 | 23.0780 | -72.1252 |
| 685.5932 | 11881.0 | -3.6049 | 140851.7 | 23.0510 | -72.0662 |
| 688.6557 | 11475.5 | -3.8284 | 138755.7 | 23.0125 | -71.9821 |
| 690.7494 | 11198.9 | -3.9904 | 137299.0 | 22.9870 | -71.9265 |
| 692.8119 | 10921.4 | -4.1530 | 135846.0 | 22.9626 | -71.8732 |
| 695.8900 | 10507.1 | -4.4253 | 133646.5 | 22.9275 | -71.7966 |
| 697.9682 | 10221.4 | -4.6257 | 132138.2 | 22.9046 | -71.7469 |
| 700.0463 | 9938.1 | -4.8441 | 130610.7 | 22.8824 | -71.6987 |
| 703.1244 | 9519.8 | -5.1811 | 128313.7 | 22.8508 | -71.6303 |
| 705.2025 | 9235.6 | -5.4315 | 126741.0 | 22.8303 | -71.5861 |
| 707.2807 | 8951.1 | -5.6947 | 125151.2 | 22.8106 | -71.5434 |
| 710.3432 | 8534.3 | -6.1158 | 122779.7 | 22.7828 | -71.4834 |
| 712.4213 | 8253.3 | -6.4295 | 121151.0 | 22.7649 | -71.4446 |
| 714.4838 | 7971.7 | -6.7507 | 119521.0 | 22.7479 | -71.4077 |
| 717.5619 | 7565.1 | -7.2877 | 117065.7 | 22.7239 | -71.3553 |
| 719.6400 | 7293.3 | -7.6759 | 115391.5 | 22.7086 | -71.3218 |
| 721.7182 | 7028.3 | -8.1099 | 113704.5 | 22.6940 | -71.2898 |
| 724.7963 | 6643.8 | -8.8425 | 111175.0 | 22.6738 | -71.2450 |
| 726.8744 | 6389.0 | -9.4159 | 109443.2 | 22.6611 | -71.2165 |
| 728.9525 | 6136.4 | -10.0759 | 107686.7 | 22.6492 | -71.1893 |
| 732.0307 | 5774.6 | -11.2054 | 105029.0 | 22.6327 | -71.1517 |

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

GEMINI GT-3 FREE-FLIGHT AND RE-ENTRY RECONSTRUCTION

| TIME
(SEC) | VELOCITY MAGNITUDE
(FT/SEC) | FLIGHT PATH ANGLE
(DEGREES) | ALTITUDE
(FEET) | GEODEIC LAT.
(DEGREES) | GEODEIC LONG.
(DEGREES) |
|---------------|--------------------------------|--------------------------------|--------------------|---------------------------|----------------------------|
| 734.1088 | 5541.2 | -12.0960 | 103191.5 | 22.6225 | -71.1280 |
| 736.1869 | 5316.5 | -13.0802 | 101312.7 | 22.6129 | -71.1055 |
| 738.2650 | 5098.4 | -14.0294 | 99400.7 | 22.6038 | -71.0843 |
| 741.3432 | 4782.5 | -15.2377 | 96559.2 | 22.5915 | -71.0551 |
| 743.4057 | 4575.0 | -16.0565 | 94670.2 | 22.5839 | -71.0370 |
| 745.4994 | 4373.9 | -16.9691 | 92770.2 | 22.5767 | -71.0198 |
| 748.5775 | 4087.2 | -18.5018 | 90006.7 | 22.5668 | -70.9967 |
| 750.6557 | 3905.9 | -19.5675 | 88163.2 | 22.5607 | -70.9824 |
| 752.7338 | 3738.4 | -20.7238 | 86340.0 | 22.5550 | -70.9691 |
| 755.8119 | 3506.1 | -22.4918 | 83679.2 | 22.5473 | -70.9511 |
| 757.8900 | 3360.0 | -23.8659 | 81909.7 | 22.5426 | -70.9400 |
| 759.9682 | 3224.8 | -25.2454 | 80160.2 | 22.5383 | -70.9297 |
| 763.0463 | 3035.9 | -27.6119 | 77604.2 | 22.5325 | -70.9159 |
| 765.1244 | 2917.3 | -29.3385 | 75901.0 | 22.5290 | -70.9074 |
| 767.1713 | 2807.7 | -31.1282 | 74241.7 | 22.5258 | -70.8997 |
| 770.2182 | 2658.8 | -34.0617 | 71803.0 | 22.5217 | -70.8894 |
| 772.2807 | 2569.5 | -36.1849 | 70168.5 | 22.5192 | -70.8831 |
| 774.3432 | 2489.1 | -38.1551 | 68548.7 | 22.5170 | -70.8772 |
| 777.3744 | 2373.3 | -41.6865 | 66192.5 | 22.5140 | -70.8695 |
| 779.4369 | 2304.8 | -43.7853 | 64607.2 | 22.5123 | -70.8648 |
| 781.4994 | 2233.3 | -46.3926 | 63036.5 | 22.5107 | -70.8605 |
| 784.5307 | 2141.1 | -50.5371 | 60739.5 | 22.5086 | -70.8550 |
| 786.5932 | 2077.5 | -53.0684 | 59191.5 | 22.5072 | -70.8517 |
| 788.6557 | 2025.0 | -55.6715 | 57660.2 | 22.5060 | -70.8487 |
| 791.7025 | 1957.0 | -59.4415 | 55411.7 | 22.5043 | -70.8449 |
| 793.7650 | 1915.3 | -61.6316 | 53902.2 | 22.5033 | -70.8426 |
| 796.7963 | 1859.9 | -64.2692 | 51722.2 | 22.5018 | -70.8397 |
| 798.8588 | 1827.6 | -65.8823 | 50270.2 | 22.5009 | -70.8380 |

4160-6047-TC000

CONFIDENTIAL

CONFIDENTIAL

6.0 TRACKING SYSTEM PERFORMANCE

6.1 Introduction

Many sets of tracking data were used in the Velocity Comparison Program during the course of the GT-3 analysis. These sets of data are obtained from essentially two different tracking systems for the ascent phase - the GE Mod III system which is used as the primary ascent guidance system and the MISTRAM (Valkyria and Eleuthera) tracking system. During the re-entry phase, tracking data was received from four radar tracking stations.

The purpose of this section is to discuss the relative merits of the different sets of data and to present velocity comparison plots using this data which have not been included in previous sections of this report.

The tracking data received on this flight included:

For Ascent

- GE Burroughs
- GE Final
- MISTRAM I Quick Look 10K and 100K
- MISTRAM II Passive
- MISTRAM Final
- BET

For Re-Entry

Patrick AFB TPQ-18 Radar (0:18)
Merritt Island TPQ-18 Radar (19:18)
Grand Turk TPQ-18 Radar (7:18)
Grand Bahama Island TPQ-18 Radar (3:18)

Delivery dates on most of the data were timely and considerably better than GT-2. For the ascent phase the GE Burroughs data was available on time to complete the quick look analysis. Quick Look MISTRAM data and GE Final data were received about 4 calendar days after the flight and were used to perform the final ascent guidance analysis.

For convenience all of the velocity comparisons using the different sets of data are displayed with those using quick look LOOK MISTRAM data as a reference. It is felt that the LOOK Quick Look MISTRAM data represented the best tracking data received on GT-3 based principally on its low noise content.

6.2 GE Mod III

The GE Mod III radio guidance system is used as primary guidance on GEMINI. The tracking portion of this system consists of a monopulse radar tracker which measures position and an interferometer rate system which measures range rate and two lateral rates. The data from this system is available from two data extraction systems - the Burroughs, where the data is sampled at a 2 per second rate, and the GE FDR (Flight Data Recording) unit, where the data is sampled at a 10 per second rate.

GE Mod III/Burroughs

The Burroughs data at a 2 per second rate is recorded on the intermediate punched paper tape. This data which consists of raw counts is available

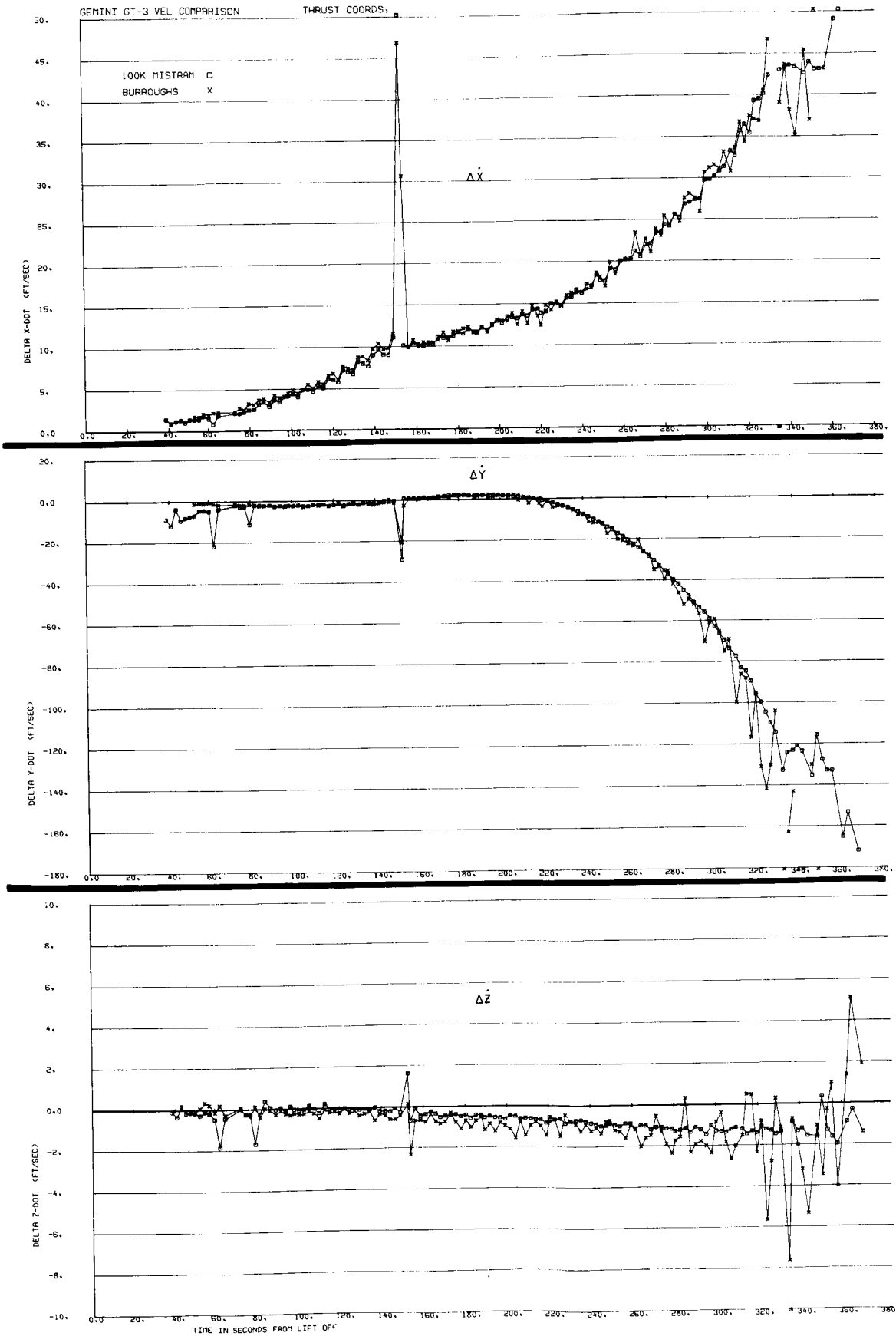
within a few hours after the flight and is processed in the STL data reduction programs and used for the quick look analysis. Figure 14 shows the velocity comparisons using Burroughs (and LOOK MISTRAM) data. There is generally good agreement between the two sets of tracking data except toward the end of flight where the Burroughs data is noisy. This is expected since the elevation angle during the noisy region from 320 seconds to end of powered flight ranges from 10 degrees to less than 4 degrees and the range varies from 2.5 million feet at 320 seconds to over 3.5 million feet at 370 seconds. The timing error noted on this flight was 5 milliseconds compared to a value of 25 milliseconds noted on GT-2; an accuracy of 1 millisecond is expected.

GE Mod III/Final

GE/Final data is processed by GE/Syracuse from the 10 per second FDR output. The velocity comparisons using this data are shown in Figure 1 of Section 3.0 of this report. The principal difference between this data and the STL processed Burroughs data in addition to the sampling rate is the smoothing and refraction corrections applied. The GE/Final Syracuse processed data has significantly more smoothing applied as can be observed by comparing it with the Burroughs data of Figure 14 late in flight. The differences in refraction correction methods did not appear to have any significant effect on this flight as there are no significant systematic differences between the Burroughs and the GE Final data.

However, there are some significant systematic differences noted between the GE final data and the LOOK MISTRAM. These differences have propagated to the following values toward the end of flight; 2-3 feet per second in \dot{X} , 10-20 feet per second in \dot{Y} , and 1 foot per second in \dot{Z} . These differences also seem to exist between the Burroughs and LOOK MISTRAM data although it is less obvious due to the higher Burroughs noise content.

Figure 14



These errors are quite large especially in the Y (vertical) direction. The ratio and sense of the X to Y velocity error suggests an error in the measurement of elevation rate (\dot{E}) by one or both systems as opposed to an elevation type error. This suggests an error in the GE \dot{P} measurement and/or the MISTRAM P measurement. The error in either case is very much larger than expected even for the low elevation angles encountered.

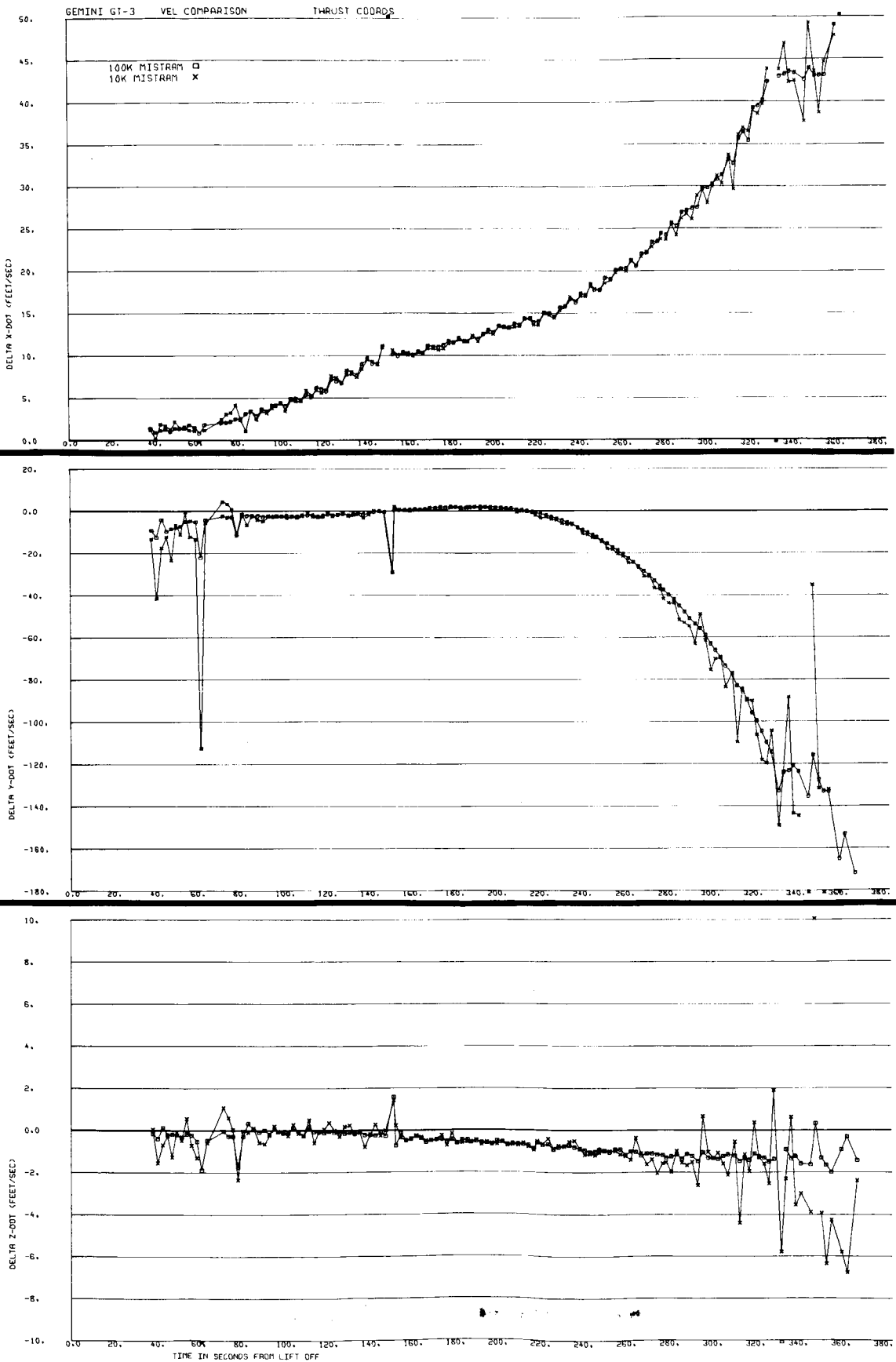
6.3 MISTRAM Data

MISTRAM Quick Look Data

The quick look MISTRAM I data received is fully scaled and corrected but unsmoothed and in the system's measurement coordinates. This consists of R, P_{10K} , Q_{10K} , P_{100K} , Q_{100K} position data where R is a range sum measurement, P_{10K} , and Q_{10K} are range difference measurements from the 10,000 foot baselines and P_{100K} and Q_{100K} are range difference measurements from the 100,000 foot baselines. The two sets of range difference measurements along with the range sum measurement were processed to give essentially two redundant sets of tracking data. This data is differentiated and rotated into the proper coordinate system by the STL programs. Figure 15 shows the multiple plot of 10K MISTRAM and 100K MISTRAM used in velocity comparisons. There is good agreement between these two sets of data except for noise content. The MISTRAM 100K data is far superior to the 10K data as far as noise content is concerned as expected. Most of the noise indicated by the velocity comparisons until late in flight is caused by the large PCM timing quantizing error.

There does not appear to be any significant ambiguities in the quick look data as were observed on GT-2. The general quality of this data is excellent.

Figure 15



Final MISTRAM And Passive MISTRAM

The Range (ETR) generates final MISTRAM data which consists of a merge of MISTRAM 10K, 100K and passive MISTRAM II. Comparisons using final MISTRAM data are shown plotted along with 100K MISTRAM I in Figure 16.

Comparisons using MISTRAM II passive data are shown in Figure 17. There appears to be a bias in this data of about 10 feet per second toward the end of flight in \dot{Y} . This difference is also seen in the final MISTRAM comparisons and is presumably caused by the use of the passive MISTRAM II data in the final solution. An example of the passive MISTRAM influence on the final MISTRAM solution can be seen just before 300 seconds in Figures 16 and 17 where a systematic perturbation of like magnitude and duration is noted in both sets of data.

On this flight MISTRAM I actively tracked throughout the entire powered portion of flight. MISTRAM II passively tracked from about 190 seconds until the end of powered flight. The range sum measurements from this passive mode of tracking is ambiguous and must be zero set by the ETR in the data processing.

In summary the final MISTRAM data was disappointing and in fact degraded in comparison with the quick look data. The differences between the final and quick look MISTRAM data are extremely large from the standpoints of MISTRAM specifications although they appear small with relation to the guidance error.

BET

The BET (Best Estimate Trajectory) data is a merge of range tracking systems to produce the ETR best estimate tracking data for the flight. Comparisons using this data are shown in Figure 18. Since only the accurate ETR systems used on GEMINI are the MISTRAM systems the BET data should and does

Figure 16

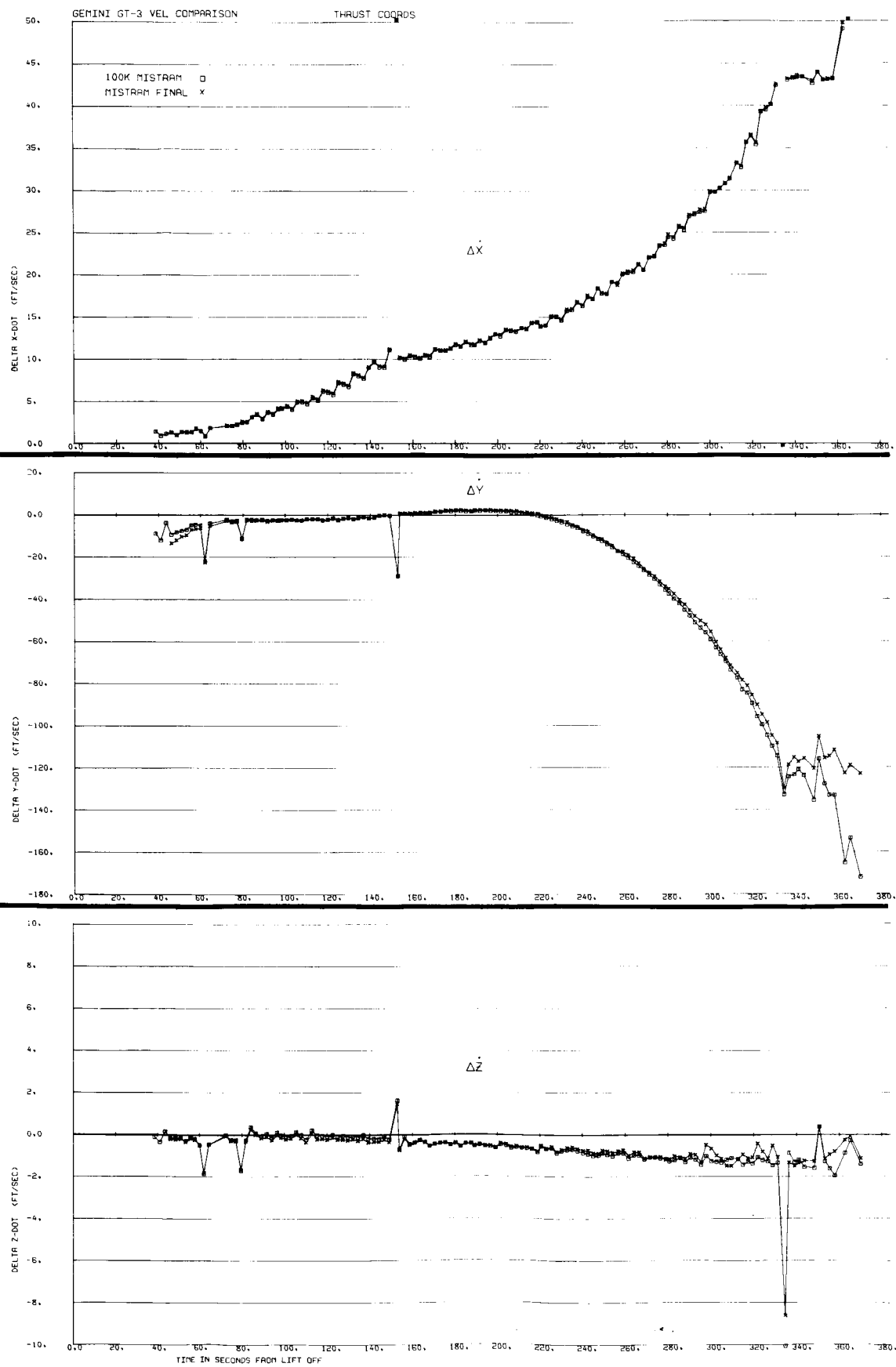


Figure 17

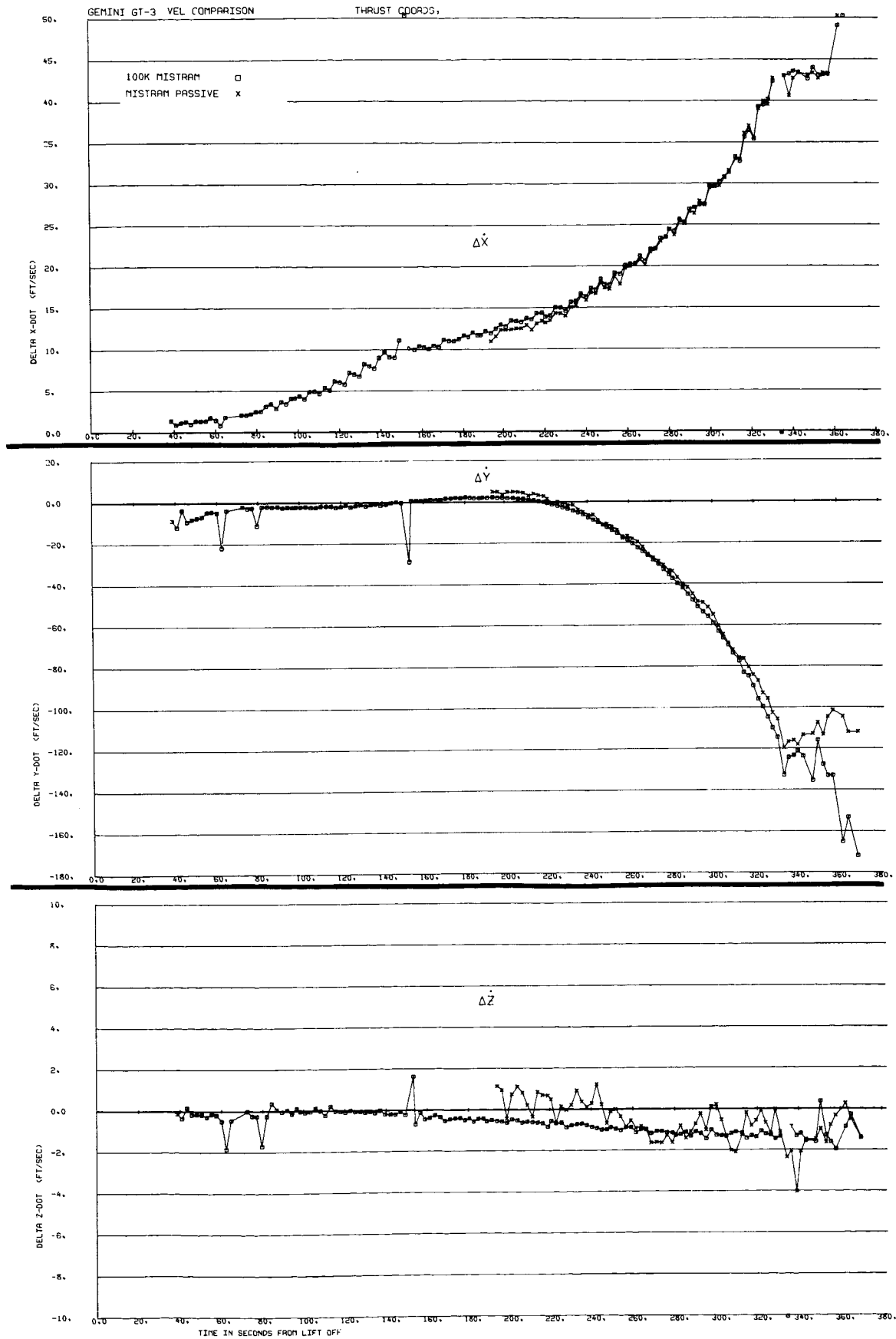
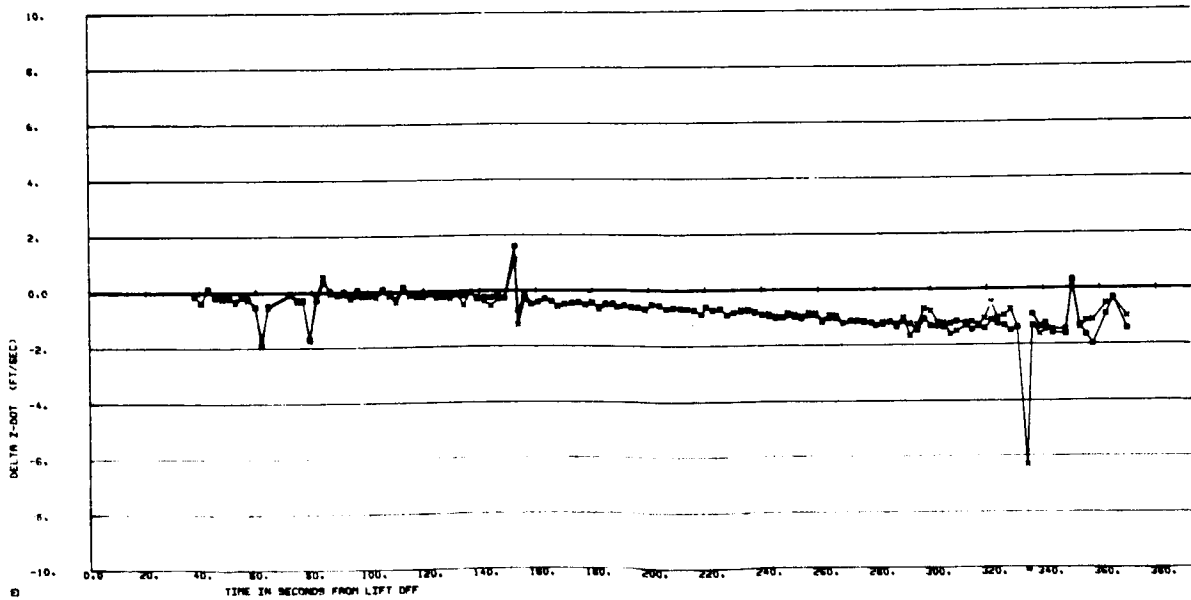
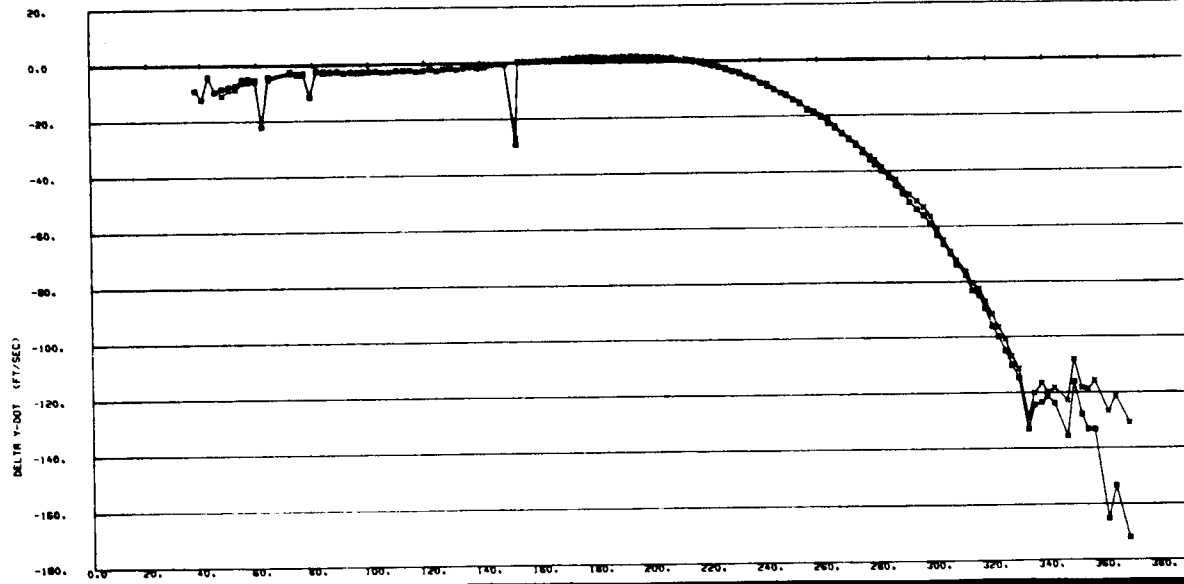
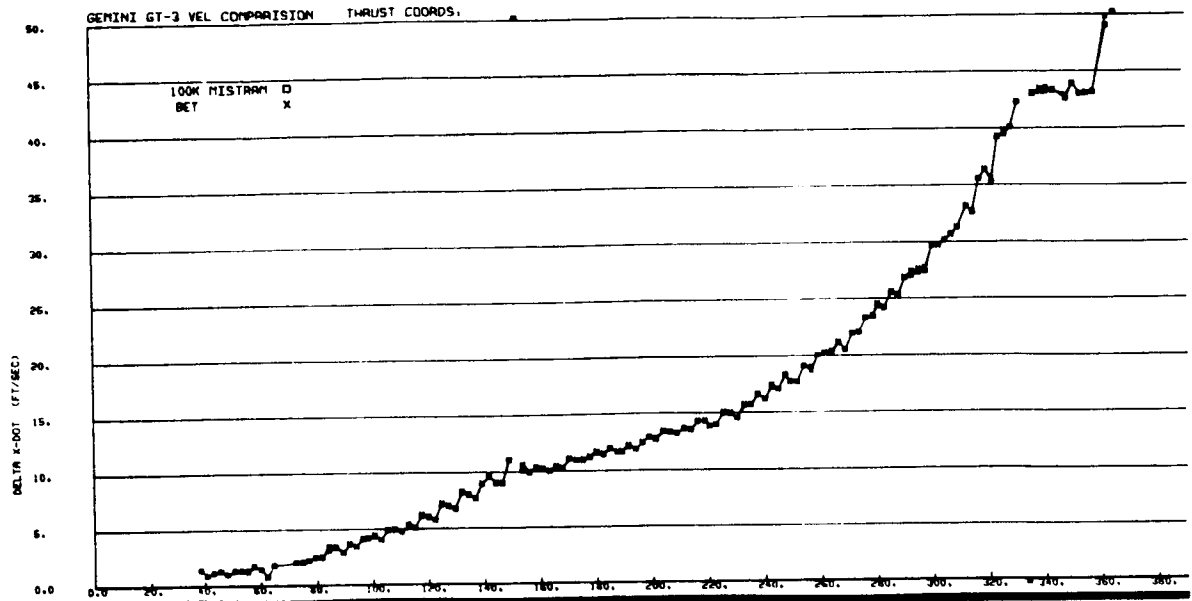


Figure 18



agree with the final MISTRAM solution. GE Mod III is not operated by the ETR and is generally not available for this purpose.

The BET like the final MISTRAM was of limited use on this flight because of the weight placed on the passive MISTRAM data.

6.4 Radar Data

Radar data from four stations were used for the re-entry analysis. MISTRAM and GE tracking are not available during this period because the beacon transponders for these systems are located in the Titan GLV. The GEMINI spacecraft does carry a radar beacon and track was accomplished with the following radars for the following time spans. Times are referenced to retro fire which occurred 16403 seconds after liftoff.

| <u>Radar</u> | <u>Time Span</u> | <u>Track Mode</u> |
|----------------------------|------------------|-------------------|
| Patrick (0:18) | 450 - 609 | Beacon |
| Merritt Island (19:18) | 469 - 513 | Beacon |
| | 513 - 617 | Skin |
| Grand Turk (7:18) | 614 - 674 | Skin |
| | 675 - 899 | Beacon |
| Grand Bahama Island (3:18) | 595 - 686 | Beacon |

Position and velocity comparisons using this data are shown in Section 4.0.

The data from the GBI (3:18) radar is poor as can be especially noted from the position comparison plots. The ETR had no explanation for this performance except that the tracking geometry from that station was very

poor. Elevation angles ranged from about 8 degrees at 595 seconds to less than 2 degrees at 686 seconds.

There is a marked discontinuity in the position comparisons around 675 seconds. At this time the velocity residuals settle down and the noise level is relatively low until end of tracking. The time of this discontinuity corresponds with the time that the Grand Turk station switched from skin to beacon mode track. The data is expected to be better in the beacon track mode. Therefore, the data from about 600 seconds to 675 seconds has to be discounted because of the combination of poor quality GBI tracking and Grand Turk skin tracking during that region.

In the Z (crossrange) direction there is about a 1,000 foot bias between the beacon track 7.18 data (after 675 seconds) and the earlier data described by the 0.18 and 19.18 radars. This error is quite large and is suspected to be in the 7.18 radar data.

6.5 Summary

In general the quality of the tracking data was excellent. It was especially gratifying to note the improved quality of MISTRAM quick look data compared to GT-2.

The principal discrepancy in the data received on this flight is the large systematic error noted between MISTRAM and GE data late in flight.

Radar data received was, in general, adequate with the exception of 3.18 data which exhibited very large systematic errors.

7.0 REFERENCES

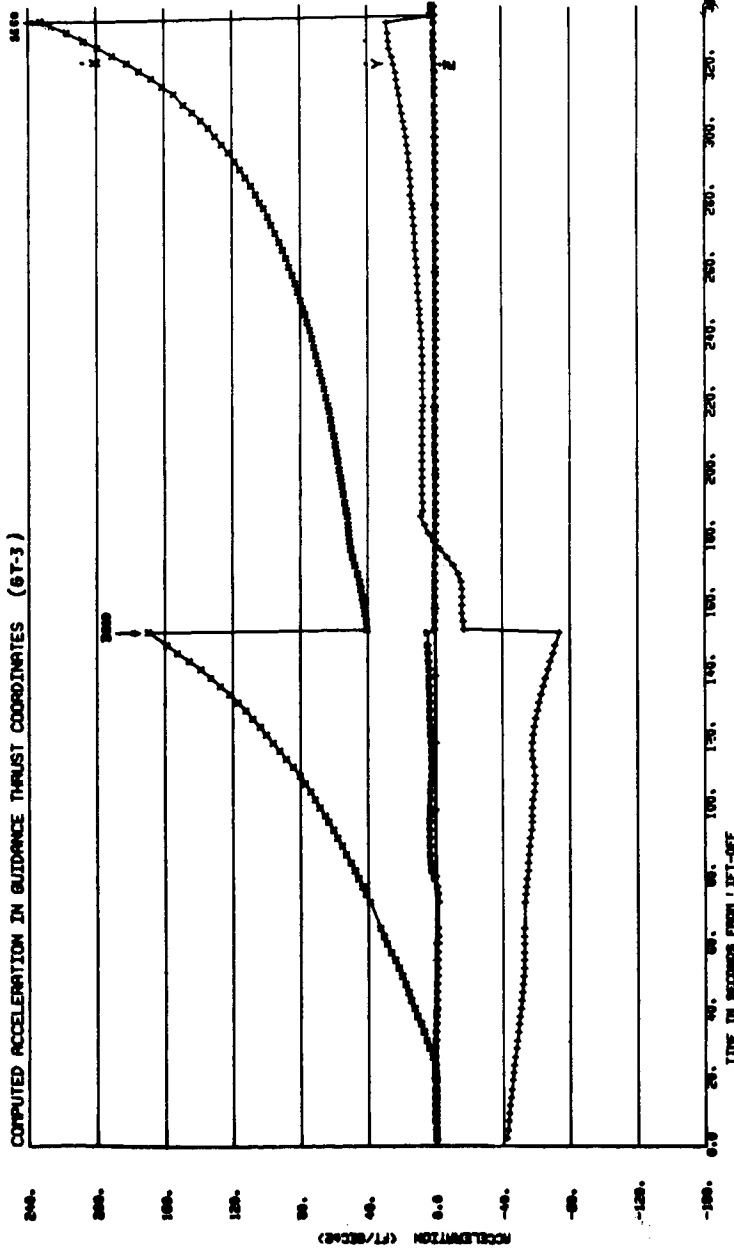
1. 4160-6009-TU000, "Preliminary GEMINI G And C Data Reduction And Analysis Plan," by F. B. Lavenhar, dated 30 October 1964. (U)
2. 4160-6016-TU000, "GEMINI Inertial Measuring Unit Accuracy Prediction Study," by R. E. Sansom, dated 8 February 1965. (U)
3. 4160-6029-TC000, "GEMINI GT-2 Inertial Guidance System Evaluation Trajectory Reconstruction (U)," by R. J. Boyles, dated 10 March 1965. (C)

Appendix I

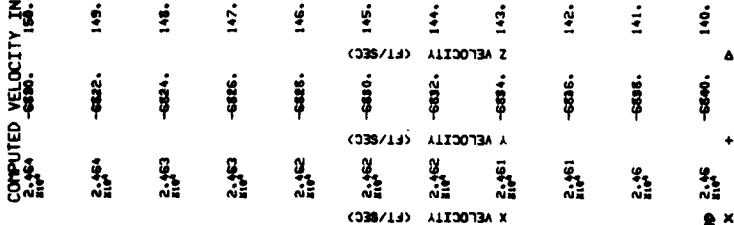
ASCENT THRUST PROFILE

Guidance thrust, position, velocity, and acceleration quantities during ascent are listed along with plots of the thrust accelerations and the inertial flight path angle.

COMPUTED ACCELERATION IN GUIDANCE THRUST COORDINATES (GT-3)



COMPUTED VELOCITY IN GUIDANCE THRUST COORDINATES



INERTIAL FLIGHT PATH ANGLE (GT-3)

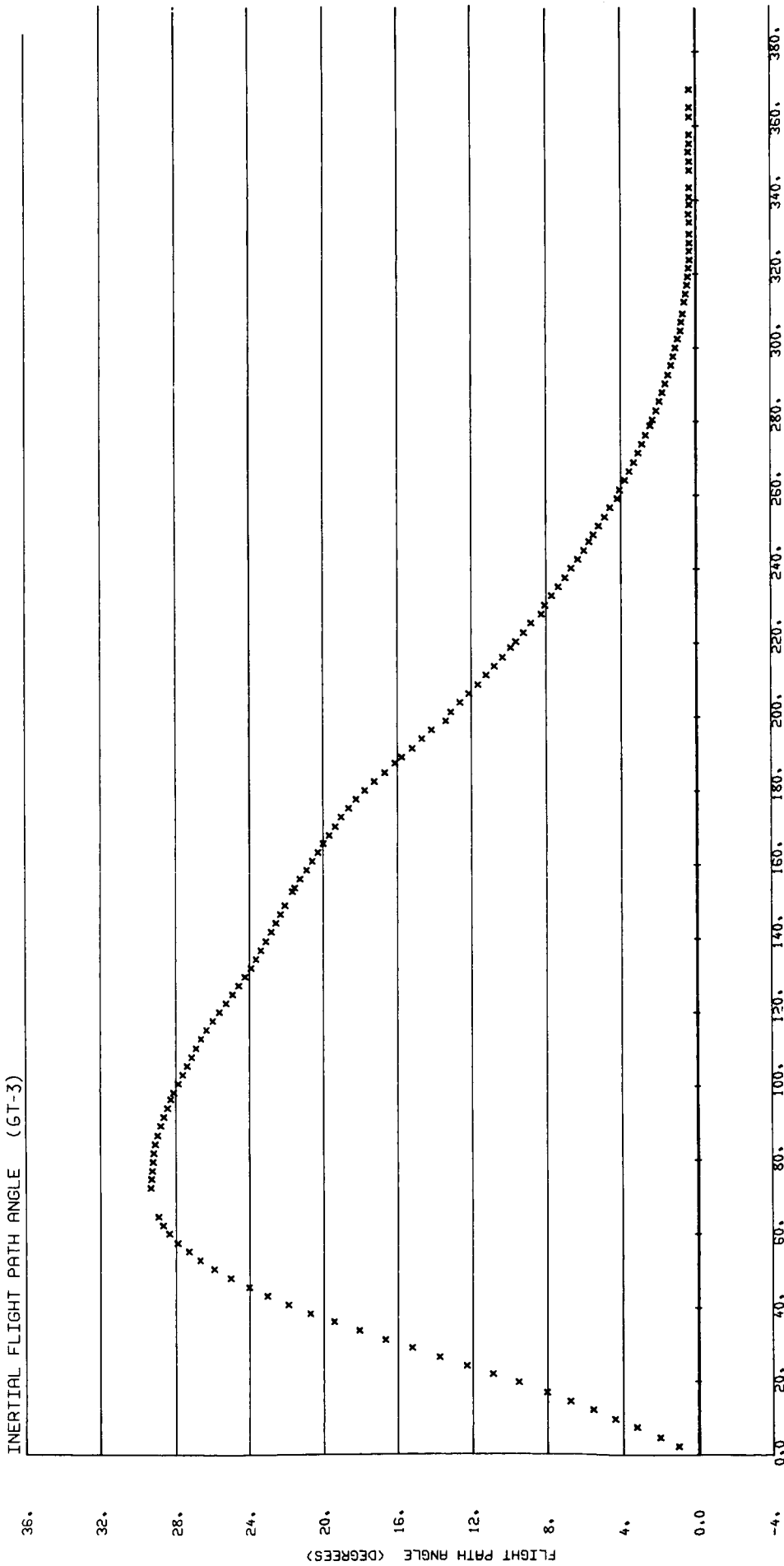


Figure 20

TRW SPACE TECHNOLOGY LABORATORIES
INPUT PARAMETERS WORLDWIDE INC.

ACCELEROMETER BIASES (PULSES/SEC)

BU# 26165000 BV# 23000200 BW# 22332800

MISALIGNMENT AND SCALE FACTOR MATRIX

.10009750 .00015980 .00005860
.00005920 .00003415 .09749790
.00004420 -.09029480 .00013660

STAGING TIMES

LIFTOFF# .000 BOOSTER ENGINE CUTOFF# 156.250 SUSTAINER ENGINE CUTOFF# 337.450

SUM CF ACCUMULATOR COUNT DATA AT TIME ZERO

SFX0# 119.000 SFY0# -449.000 SFZ-548604.000

INTENDED AZIMUTH IN DEG.# 17.140 NUMBER OF TAPES INPUT# 1

TIME BIAS 3.452 TIME 999999.000 TIME 999999.000

←-TIME ADJUSTED

→-POSITION ADJUSTED

***-POS.-VEL.- ADJUSTED

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAND WOODBRIDGE INC.

GEMINI EDIT PROGRAM

TIME IN SECONDS FROM LIFTOFF

COMPUTED POSITION VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC*2) | YDDOT (FT/SEC*2) | ZDDOT (FT/SEC*2) |
|-------------|--------|---------|--------|---------------|---------------|---------------|------------------|------------------|------------------|
| 2.484 | - | -596 | | .03 | -214.92 | .18 | -.11 | -42.11 | .09 |
| 4.781 | -1 | -1201 | 1 | -.67 | -312.17 | .37 | -.12 | -42.62 | .16 |
| 7.515 | -2 | -2214 | 3 | -.87 | -429.43 | .98 | -.15 | -43.22 | .23 |
| 9.812 | -5 | -3315 | 6 | -.95 | -529.41 | 1.61 | -.14 | -43.72 | .28 |
| 12.124 | -8 | -4657 | 10 | -1.58 | -631.05 | 2.24 | -.15 | -44.16 | .33 |
| 14.437 | -11 | -6235 | 16 | -1.78 | -733.87 | 3.04 | -.17 | -44.65 | .38 |
| 16.765 | -16 | -8064 | 24 | -2.19 | -837.85 | 4.03 | -.14 | -45.18 | .45 |
| 19.515 | -23 | -10540 | 37 | -2.69 | -963.39 | 5.36 | -.09 | -45.85 | .53 |
| 21.828 | -30 | -12891 | 51 | -2.80 | -1070.01 | 6.70 | .24 | -46.44 | .52 |
| 24.093 | -38 | -15435 | 68 | -2.71 | -1175.84 | 8.04 | .93 | -46.99 | .47 |
| 26.499 | -42 | -18401 | 88 | .29 | -1289.58 | 8.93 | 2.17 | -47.66 | .39 |
| 28.906 | -33 | -21643 | 111 | 7.19 | -1404.97 | 9.72 | 3.82 | -48.30 | .22 |
| 31.296 | -3 | -25141 | 136 | 18.39 | -1521.62 | 10.52 | 5.49 | -48.90 | .03 |
| 33.703 | 59 | -28944 | 160 | 34.00 | -1639.83 | 9.96 | 7.17 | -49.49 | -.19 |
| 36.109 | 162 | -33033 | 183 | 52.91 | -1759.31 | 9.13 | 8.86 | -50.04 | -.38 |
| 38.484 | 314 | -37354 | 204 | 75.82 | -1879.17 | 8.11 | 10.60 | -50.54 | -.48 |
| 40.874 | 528 | -41991 | 222 | 103.34 | -2000.78 | 6.92 | 12.47 | -51.03 | -.61 |
| 43.265 | 812 | -46920 | 236 | 135.47 | -2122.79 | 5.37 | 14.27 | -51.48 | -.72 |
| 45.624 | 1174 | -52072 | 246 | 171.49 | -2245.08 | 3.19 | 16.00 | -52.02 | -.80 |
| 48.015 | 1631 | -57689 | 252 | 211.52 | -2369.90 | 1.45 | 17.74 | -52.58 | -.94 |
| 50.390 | 2184 | -63367 | 254 | 255.65 | -2495.80 | -.64 | 19.52 | -52.95 | -1.18 |
| 52.749 | 2843 | -69403 | 247 | 303.89 | -2621.40 | -3.91 | 21.49 | -53.30 | -1.26 |
| 55.124 | 3627 | -75780 | 233 | 356.84 | -2747.67 | -8.07 | 23.63 | -53.36 | -1.25 |
| 57.499 | 4543 | -82457 | 212 | 415.68 | -2875.61 | -9.80 | 25.93 | -53.34 | -1.14 |
| 59.906 | 5621 | -89530 | 186 | 480.94 | -3003.15 | -12.52 | 28.25 | -53.22 | -1.11 |
| 62.281 | 6846 | -96812 | 153 | 551.20 | -3129.52 | -15.24 | 30.28 | -53.13 | -1.41 |
| 64.687 | 8262 | -104496 | 112 | 626.66 | -3256.85 | -18.67 | 32.21 | -53.22 | -1.71 |
| 72.343 | 14050 | -130996 | -100 | 895.31 | -3666.15 | -36.31 | 38.98 | -53.58 | -2.12 |
| 74.718 | 16290 | -139853 | -193 | 991.20 | -3793.09 | -41.00 | 41.22 | -53.91 | -1.56 |
| 77.093 | 18763 | -149014 | -297 | 1092.29 | -3920.99 | -45.60 | 43.38 | -54.26 | -.66 |
| 79.494 | 21500 | -158543 | -408 | 1198.18 | -4051.63 | -46.22 | 45.46 | -54.88 | .79 |
| 81.890 | 24515 | -168452 | -513 | 1309.46 | -4184.22 | -41.44 | 47.72 | -55.40 | 2.21 |
| 84.281 | 27785 | -178615 | -601 | 1426.54 | -4317.97 | -33.49 | 50.15 | -55.72 | 2.99 |

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOOLDRIDGE INC.

GEMINI EBIT PROGRAM

TIME IN SECONDS FROM LIFTOFF

COMPUTED POSITION VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC*2) | YDDOT (FT/SEC*2) | ZDDOT (FT/SEC*2) |
|-------------|--------|---------|--------|---------------|---------------|---------------|------------------|------------------|------------------|
| 86.687 | 31365 | -189166 | -673 | 1550.33 | -4452.21 | -25.44 | 52.76 | -56.06 | 3.27 |
| 89.109 | 35277 | -200113 | -726 | 1681.03 | -4587.61 | -18.21 | 55.27 | -56.38 | 3.30 |
| 91.515 | 39485 | -211316 | -759 | 1817.62 | -4724.27 | -9.71 | 57.81 | -55.92 | 3.32 |
| 93.937 | 44058 | -222925 | -772 | 1960.03 | -4862.40 | -1.49 | 60.39 | -57.42 | 3.34 |
| 96.343 | 48953 | -234793 | -767 | 2108.64 | -5001.89 | 6.29 | 63.05 | -57.81 | 3.20 |
| 98.187 | 52949 | -244113 | -750 | 2226.73 | -5108.33 | 12.28 | 65.27 | -56.00 | 3.13 |
| 100.609 | 58536 | -256656 | -711 | 2388.15 | -5249.37 | 19.43 | 68.30 | -58.12 | 3.04 |
| 103.031 | 64523 | -269538 | -655 | 2556.78 | -5390.01 | 27.03 | 71.29 | -58.48 | 2.88 |
| 105.437 | 70888 | -282677 | -581 | 2733.32 | -5530.56 | 33.91 | 74.08 | -59.01 | 2.67 |
| 107.874 | 77772 | -296334 | -491 | 2916.86 | -5675.38 | 39.89 | 77.08 | -59.55 | 2.34 |
| 110.296 | 85063 | -310257 | -388 | 3105.31 | -5821.28 | 45.33 | 80.35 | -59.62 | 2.02 |
| 112.703 | 92772 | -324437 | -274 | 3303.47 | -5965.32 | 49.69 | 84.27 | -59.22 | 1.85 |
| 115.124 | 101024 | -339056 | -150 | 3512.15 | -6107.11 | 53.52 | 88.42 | -58.55 | 1.85 |
| 117.531 | 109737 | -353920 | -16 | 3730.63 | -6247.34 | 58.16 | 92.38 | -58.01 | 2.13 |
| 119.953 | 119047 | -369218 | 132 | 3958.92 | -6386.97 | 63.44 | 96.42 | -58.05 | 2.49 |
| 122.374 | 128921 | -384855 | 294 | 4196.72 | -6526.50 | 70.54 | 100.27 | -58.44 | 2.80 |
| 124.781 | 139315 | -400731 | 472 | 4443.63 | -6668.66 | 77.45 | 104.15 | -59.19 | 3.00 |
| 127.203 | 150336 | -417056 | 667 | 4699.94 | -6812.76 | 84.99 | 108.28 | -60.17 | 3.08 |
| 129.624 | 162391 | -433733 | 884 | 4966.26 | -6959.20 | 92.45 | 112.53 | -61.09 | 3.17 |
| 132.031 | 174374 | -450657 | 1116 | 5243.19 | -7107.97 | 100.27 | 117.12 | -62.13 | 3.24 |
| 134.453 | 187421 | -468054 | 1368 | 5531.83 | -7259.37 | 108.09 | 122.15 | -63.28 | 3.32 |
| 136.874 | 201180 | -485822 | 1639 | 5832.78 | -7413.58 | 116.28 | 127.47 | -64.46 | 3.43 |
| 139.281 | 215588 | -503849 | 1929 | 6146.74 | -7570.72 | 124.55 | 133.15 | -65.73 | 3.56 |
| 141.703 | 230871 | -522379 | 2241 | 6476.11 | -7731.35 | 133.46 | 139.27 | -67.05 | 3.74 |
| 144.124 | 246968 | -541301 | 2575 | 6819.69 | -7894.91 | 142.55 | 145.91 | -68.45 | 3.94 |
| 146.562 | 264034 | -560750 | 2935 | 7183.09 | -8063.52 | 152.55 | 152.64 | -69.93 | 4.14 |
| 148.968 | 281770 | -580358 | 3314 | 7561.30 | -8234.07 | 162.73 | 159.28 | -71.39 | 4.33 |
| 152.758 | 311917 | -612421 | 3970 | 8190.12 | -8511.69 | 179.88 | 169.85 | -73.72 | 4.64 |
| 153.812 | 320167 | -621024 | 4151 | 8158.33 | -8494.24 | 178.62 | 40.41 | -16.77 | .03 |
| 156.187 | 339655 | -641242 | 4576 | 8253.26 | -8531.68 | 178.84 | 40.93 | -16.20 | .02 |
| 158.593 | 359635 | -661819 | 5006 | 8352.30 | -8569.60 | 178.70 | 41.47 | -15.63 | .01 |
| 160.999 | 390835 | -682484 | 5436 | 8453.03 | -8607.03 | 178.74 | 42.41 | -15.58 | -.01 |
| 163.390 | 400186 | -703105 | 5853 | 8555.37 | -8643.88 | 178.79 | 43.23 | -15.59 | -.04 |

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOOLDRIDGE INC.

GENIUM EDIT PROGRAM

TIME IN SECONDS FROM LIFTOFF

COMPUTED POSITION VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC*2) | YDDOT (FT/SEC*2) | ZDDOT (FT/SEC*2) |
|-------------|---------|----------|--------|---------------|---------------|---------------|------------------|------------------|------------------|
| 165.765 | 420629 | -723679 | 6288 | 8659.52 | -8681.11 | 178.65 | 44.09 | -15.65 | -.06 |
| 168.093 | 440910 | -743933 | 6703 | 8762.66 | -8717.76 | 178.33 | 44.98 | -15.24 | -.08 |
| 170.499 | 462127 | -764956 | 7132 | 8871.80 | -8755.58 | 178.29 | 46.08 | -13.71 | -.12 |
| 172.906 | 483612 | -786056 | 7561 | 8983.85 | -8787.64 | 177.98 | 47.42 | -10.94 | -.18 |
| 175.312 | 505368 | -807236 | 7989 | 9093.82 | -8809.85 | 177.42 | 48.76 | -7.17 | -.27 |
| 177.718 | 527410 | -828464 | 8415 | 9219.09 | -8822.41 | 176.60 | 49.85 | -3.00 | -.35 |
| 180.124 | 549742 | -849694 | 8839 | 9342.77 | -8824.44 | 175.71 | 50.57 | 1.00 | -.41 |
| 182.593 | 572957 | -871464 | 9271 | 9466.37 | -8815.64 | 174.56 | 51.23 | 4.24 | -.44 |
| 185.046 | 596334 | -893068 | 9698 | 9592.97 | -8800.22 | 173.43 | 51.69 | 6.29 | -.47 |
| 187.515 | 620186 | -914813 | 10124 | 9720.97 | -8782.45 | 172.29 | 51.96 | 8.93 | -.41 |
| 189.987 | 645147 | -936866 | 10551 | 9850.81 | -8769.66 | 171.48 | 52.89 | 7.56 | -.42 |
| 192.460 | 669737 | -959277 | 10978 | 9982.61 | -8750.53 | 170.53 | 53.59 | 7.76 | -.38 |
| 194.939 | 694441 | -982559 | 11405 | 10072.22 | -8731.00 | 169.59 | 54.32 | 7.91 | -.35 |
| 197.422 | 719316 | -1005955 | 11832 | 10208.63 | -8711.48 | 168.82 | 55.05 | 7.95 | -.30 |
| 199.909 | 744420 | -1029673 | 12259 | 10342.84 | -8691.95 | 168.06 | 55.89 | 7.97 | -.25 |
| 202.399 | 769749 | -1053623 | 12686 | 10481.25 | -8672.23 | 167.66 | 56.65 | 7.96 | -.23 |
| 204.893 | 795303 | -1077806 | 13113 | 10621.76 | -8652.60 | 167.07 | 57.46 | 7.93 | -.21 |
| 207.391 | 821082 | -1102214 | 13540 | 10764.38 | -8633.26 | 166.49 | 58.34 | 7.87 | -.20 |
| 209.893 | 847087 | -1126847 | 13967 | 10909.20 | -8613.73 | 166.09 | 59.17 | 7.82 | -.18 |
| 212.399 | 873319 | -1151705 | 14394 | 11058.82 | -8594.78 | 165.69 | 60.15 | 7.83 | -.16 |
| 214.909 | 900080 | -1176788 | 14821 | 11205.04 | -8575.45 | 165.30 | 61.13 | 7.83 | -.17 |
| 217.422 | 927284 | -1202096 | 15248 | 11358.67 | -8556.10 | 164.90 | 62.00 | 7.86 | -.15 |
| 219.939 | 954939 | -1227629 | 15675 | 11510.89 | -8536.76 | 164.41 | 62.93 | 7.87 | -.14 |
| 222.460 | 983054 | -1253386 | 16102 | 11667.25 | -8523.67 | 164.42 | 63.80 | 7.80 | -.14 |
| 224.987 | 1010729 | -1279367 | 16529 | 11827.88 | -8504.33 | 163.94 | 64.74 | 7.75 | -.17 |
| 227.515 | 1038964 | -1305582 | 16956 | 11991.91 | -8484.98 | 163.55 | 65.93 | 7.88 | -.22 |
| 230.046 | 1067759 | -1332031 | 17383 | 12160.75 | -8465.44 | 162.79 | 67.08 | 7.91 | -.25 |
| 232.577 | 1097114 | -1358724 | 17810 | 12327.09 | -8445.99 | 162.22 | 68.22 | 7.94 | -.28 |
| 235.109 | 1127039 | -1385661 | 18237 | 12496.73 | -8426.44 | 161.47 | 69.49 | 8.02 | -.30 |
| 237.640 | 1157534 | -1412842 | 18664 | 12669.38 | -8406.70 | 160.73 | 70.69 | 8.14 | -.34 |
| 240.171 | 1188599 | -1440267 | 19091 | 12844.63 | -8386.37 | 159.80 | 71.91 | 8.33 | -.35 |
| 242.702 | 1219334 | -1467936 | 19518 | 12962.88 | -8365.84 | 158.87 | 73.18 | 8.59 | -.36 |
| 245.233 | 1250749 | -1495849 | 19945 | 13144.74 | -8344.34 | 158.04 | 74.57 | 8.88 | -.35 |

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOOLDRIDGE INC.

GERINI EDIT PROGRAM

TIME IN SECONDS FROM LIFTOFF

COMPUTED POSITION VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FY/SEC) | YDOT (FY/SEC) | ZDOT (FY/SEC) | XDDOT (FY/SEC*2) | YDDOT (FY/SEC*2) | ZDDOT (FY/SEC*2) |
|-------------|---------|----------|--------|---------------|---------------|---------------|------------------|------------------|------------------|
| 245.031 | 1276671 | -1406904 | 19601 | 13329.80 | -8322.05 | 157.12 | 75.85 | 9.20 | -0.33 |
| 247.484 | 1309603 | -1427292 | 19985 | 13518.66 | -8298.99 | 156.39 | 77.19 | 9.54 | -0.33 |
| 249.171 | 1332527 | -1441286 | 20249 | 13648.04 | -8282.95 | 155.87 | 78.48 | 9.55 | -0.32 |
| 251.640 | 1366467 | -1461704 | 20633 | 13843.91 | -8258.71 | 155.05 | 80.00 | 10.01 | -0.32 |
| 254.093 | 1400675 | -1481937 | 21012 | 14042.79 | -8233.69 | 154.14 | 81.59 | 10.37 | -0.30 |
| 256.562 | 1435591 | -1502244 | 21392 | 14245.46 | -8207.69 | 153.59 | 83.25 | 10.70 | -0.30 |
| 259.015 | 1470755 | -1522355 | 21768 | 14452.15 | -8180.90 | 152.87 | 84.82 | 10.99 | -0.29 |
| 261.484 | 1506698 | -1542518 | 22144 | 14663.54 | -8153.44 | 151.97 | 86.68 | 11.30 | -0.29 |
| 263.953 | 1543170 | -1562612 | 22519 | 14879.23 | -8125.28 | 151.43 | 88.44 | 11.59 | -0.30 |
| 266.406 | 1579880 | -1582517 | 22890 | 15099.13 | -8096.35 | 150.72 | 90.43 | 11.91 | -0.28 |
| 268.874 | 1617439 | -1602468 | 23261 | 15323.83 | -8066.63 | 149.83 | 92.54 | 12.25 | -0.29 |
| 271.323 | 1655319 | -1622220 | 23628 | 15554.34 | -8036.13 | 149.30 | 94.74 | 12.58 | -0.28 |
| 273.794 | 1694015 | -1642021 | 23996 | 15790.25 | -8004.65 | 148.59 | 97.05 | 12.90 | -0.26 |
| 276.249 | 1733052 | -1661618 | 24359 | 16031.57 | -7972.58 | 147.89 | 99.18 | 13.18 | -0.27 |
| 278.718 | 1772938 | -1681260 | 24724 | 16279.30 | -7939.72 | 147.29 | 101.67 | 13.49 | -0.26 |
| 280.390 | 1800304 | -1694515 | 24970 | 16451.53 | -7917.04 | 146.80 | 103.94 | 13.68 | -0.23 |
| 282.859 | 1847242 | -1714302 | 25331 | 16703.66 | -7882.82 | 146.29 | 106.55 | 14.67 | -0.24 |
| 285.312 | 1882565 | -1733297 | 25690 | 16974.61 | -7848.20 | 145.78 | 109.21 | 14.34 | -0.22 |
| 287.781 | 1924815 | -1752633 | 26049 | 17246.76 | -7812.41 | 145.10 | 112.29 | 14.69 | -0.22 |
| 290.234 | 1967474 | -1771755 | 26404 | 17526.72 | -7775.83 | 144.69 | 115.44 | 15.10 | -0.23 |
| 292.687 | 2010631 | -1790784 | 26758 | 17813.49 | -7738.47 | 144.11 | 118.80 | 15.53 | -0.22 |
| 295.124 | 2054619 | -1809601 | 27109 | 18106.96 | -7700.03 | 143.44 | 122.43 | 16.06 | -0.24 |
| 297.562 | 2099132 | -1828321 | 27458 | 18409.04 | -7660.42 | 143.05 | 126.26 | 16.65 | -0.24 |
| 299.984 | 2144102 | -1846824 | 27804 | 18720.84 | -7619.14 | 142.30 | 130.25 | 17.26 | -0.25 |
| 302.343 | 2188644 | -1864753 | 28139 | 19032.13 | -7577.77 | 141.73 | 134.40 | 17.94 | -0.24 |
| 304.656 | 2233027 | -1882227 | 28466 | 19343.42 | -7535.80 | 141.08 | 138.70 | 18.64 | -0.20 |
| 306.968 | 2278158 | -1899600 | 28792 | 19673.23 | -7491.79 | 140.79 | 144.08 | 19.57 | -0.17 |
| 309.281 | 2324056 | -1916871 | 29117 | 20010.24 | -7445.81 | 140.42 | 149.06 | 20.36 | -0.14 |
| 312.328 | 2387555 | -1934457 | 29544 | 20473.31 | -7381.94 | 139.96 | 154.96 | 21.30 | -0.13 |
| 314.640 | 2433531 | -1956470 | 29868 | 20838.26 | -7331.76 | 139.70 | 161.41 | 22.05 | -0.10 |
| 316.937 | 2481849 | -1973250 | 30189 | 21217.72 | -7279.91 | 139.44 | 167.95 | 22.67 | -0.01 |
| 319.200 | 2531385 | -1990028 | 30511 | 21613.20 | -7227.08 | 139.47 | 175.06 | 23.37 | 0.07 |
| 321.500 | 2582110 | -2006786 | 30837 | 22026.50 | -7172.29 | 139.96 | 182.48 | 24.21 | 0.17 |

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOODBRIDGE INC.

GEMINI EDIT PROGRAM

TIME IN SECONDS FROM LIFTOFF

COMPUTED POSITION VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC*2) | YDDOT (FT/SEC*2) | ZDDOT (FT/SEC*2) |
|-------------|---------|----------|--------|---------------|---------------|---------------|------------------|------------------|------------------|
| 323.874 | 2633322 | -2023192 | 31159 | 22456.61 | -7115.53 | 140.27 | 190.62 | 25.34 | .23 |
| 326.187 | 2685797 | -2039574 | 31684 | 22905.84 | -7055.75 | 140.97 | 199.59 | 26.66 | .29 |
| 328.499 | 2739340 | -2055814 | 31811 | 23376.00 | -6992.54 | 141.67 | 201.49 | 27.18 | .29 |
| 330.812 | 2793961 | -2071909 | 32140 | 23871.18 | -6925.99 | 142.57 | 203.39 | 27.70 | .30 |
| 333.990 | 2870998 | -2073840 | 32595 | 24506.25 | -6838.60 | 143.38 | 206.01 | 28.42 | .30 |
| 336.187 | 2924841 | -2108784 | 32913 | 24600.59 | -6827.69 | 145.13 | 2.89 | -.05 | .02 |
| 338.703 | 2986736 | -2125959 | 33278 | 24607.86 | -6827.16 | 145.00 | 2.21 | -.01 | .02 |
| 340.828 | 3039031 | -2140467 | 33586 | 24611.92 | -6826.62 | 145.14 | 1.64 | -.07 | .02 |
| 343.343 | 3100949 | -2157641 | 33951 | 24614.59 | -6826.67 | 145.28 | .95 | -.00 | .02 |
| 347.984 | 3215184 | -2189322 | 34625 | 24616.31 | -6826.38 | 145.20 | .17 | -.05 | -.00 |
| 350.499 | 3277101 | -2206498 | 34990 | 24616.98 | -6826.44 | 145.25 | .75 | -.21 | -.01 |
| 353.015 | 3339031 | -2223670 | 35356 | 24615.94 | -6826.59 | 145.13 | -.05 | -.01 | -.01 |
| 355.249 | 3394037 | -2238923 | 35680 | 24617.30 | -6826.35 | 145.08 | .49 | -.05 | .03 |
| 357.656 | 3453275 | -2255350 | 36029 | 24617.46 | -6826.30 | 145.22 | .72 | -.12 | .05 |
| 362.499 | 3572525 | -2288414 | 36734 | 24622.00 | -6825.43 | 145.60 | .78 | -.16 | .06 |
| 364.921 | 3632162 | -2304945 | 37086 | 24623.76 | -6824.02 | 145.56 | .94 | -.03 | .05 |
| 365.755 | 3751444 | -2338005 | 37794 | 24627.99 | -6824.61 | 146.02 | .54 | -.07 | .07 |

CONFIDENTIAL

~~CONFIDENTIAL~~

4160-6047-TC000

-81-

Appendix II

RE-ENTRY THRUST PROFILE

Guidance thrust, position, velocity, and acceleration quantities during re-entry are listed along with a plot of the thrust accelerations.

~~CONFIDENTIAL~~

TRW SPACE TECHNOLOGY LABORATORIES
INPUT PARAMETERS

ACCELEROMETER BIASES (PULSES/SEC)

BU = .26165800 BV = -.23002000 BR = -.22332800

MISALIGNMENT AND SCALE FACTOR MATRIX

.10009750 .00015980 .00005860
.00005520 .00003415 .09749790
.00004420 -.09029480 .00013660

STAGING TIMES

LIFTOFF = .000 BOOSTER ENGINE CUT 100000.000 SUSTAINER ENGINE CUT 1000000.000

SUM OF ACCUMULATOR COUNT DATA AT TIME ZERO

SFX0 = -103.000 SFY0 = 139.000 SFZ0 = 167.000

INTENDED AZIMUTH IN DEG. = 17.100 NUMBER OF TAPES INPUT = 1

TIME BIAS = .000 TME 999999.000 TME 999999.000

*-TIME ADJUSTED

**-POSITIONAL ADJUSTED

***-FLS.-VEL. ADJUSTED

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOLFE AND COMPANY

April 3, 1965

GEMINI EDIT PROGRAM

COMPUTED POSITION, VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME
(SECS) | X
(FT) | Y
(FT) | Z
(FT) | XDOT
(FT/SEC) | YDOT
(FT/SEC) | ZDOT
(FT/SEC) | XDDOT
(FT/SEC^2) | YDDOT
(FT/SEC^2) | ZDDOT
(FT/SEC^2) |
|----------------|-----------|-----------|-----------|------------------|------------------|------------------|---------------------|---------------------|---------------------|
| 1.890 | -27.5 | 18.8 | 4.6 | -25.88 | 18.17 | 4.02 | -14.62 | 9.24 | 1.99 |
| 3.780 | -88.4 | 94.1 | 21.0 | -82.24 | 40.42 | 8.43 | -15.18 | 5.76 | .34 |
| 5.670 | -149.4 | 199.7 | 39.7 | -143.50 | 47.36 | 5.94 | -15.68 | 3.89 | -1.24 |
| 7.560 | -210.4 | 321.9 | 49.2 | -146.67 | 50.40 | 1.11 | -16.14 | 3.66 | -2.76 |
| 9.450 | -271.4 | 467.4 | 38.4 | -188.42 | 62.42 | -8.05 | -14.89 | 4.59 | -3.20 |
| 11.340 | -332.4 | 601.1 | 10.9 | -218.67 | 75.33 | -16.41 | -14.39 | 4.98 | -2.12 |
| 13.230 | -393.4 | 805.7 | -37.5 | -246.02 | 87.15 | -22.67 | -14.20 | 4.43 | .16 |
| 15.120 | -454.4 | 1038.9 | -16.9 | -283.80 | 95.85 | -12.96 | -12.87 | 3.11 | 1.98 |
| 17.010 | -515.4 | 1294.7 | -100.0 | -327.79 | 104.54 | -4.06 | -8.36 | 1.78 | 1.85 |
| 18.900 | -576.4 | 1495.3 | -108.2 | -331.24 | 105.37 | -3.39 | -4.76 | 1.01 | 1.00 |
| 20.790 | -637.4 | 1763.5 | -116.8 | -331.57 | 105.32 | -3.34 | -.31 | .07 | -.06 |
| 22.680 | -698.4 | 2030.1 | -125.4 | -331.21 | 105.36 | -3.29 | .02 | .01 | .00 |
| 24.570 | -759.4 | 2298.4 | -134.0 | -331.14 | 105.30 | -3.51 | .02 | .00 | .00 |
| 26.460 | -820.4 | 2567.0 | -142.9 | -331.07 | 105.44 | -3.27 | .00 | .02 | .01 |
| 28.350 | -881.4 | 2767.6 | -148.9 | -331.12 | 105.30 | -3.32 | .00 | .02 | .01 |
| 30.240 | -942.4 | 3036.2 | -157.3 | -331.16 | 105.54 | -3.27 | .00 | .01 | -.02 |
| 32.130 | -1003.4 | 3304.8 | -165.8 | -331.09 | 105.49 | -3.40 | .03 | .01 | -.01 |
| 34.020 | -1064.4 | 3571.8 | -174.4 | -331.02 | 105.43 | -3.44 | -.00 | -.01 | -.01 |
| 35.910 | -1125.4 | 3774.4 | -181.1 | -330.87 | 105.49 | -3.40 | -.00 | .01 | .03 |
| 37.800 | -1186.4 | 4033.1 | -189.7 | -331.21 | 105.43 | -3.43 | -.02 | .02 | .06 |
| 39.690 | -1247.4 | 4310.4 | -197.7 | -331.04 | 105.67 | -3.02 | -.02 | -.00 | .07 |
| 41.580 | -1308.4 | 4579.3 | -205.1 | -331.17 | 105.61 | -2.79 | .02 | -.02 | .03 |
| 43.470 | -1369.4 | 4846.4 | -212.3 | -331.11 | 105.36 | -2.82 | -.00 | -.06 | -.02 |
| 45.360 | -1430.4 | 5050.5 | -218.0 | -330.96 | 105.42 | -3.05 | .01 | -.04 | -.05 |
| 47.250 | -1491.4 | 5341.6 | -226.5 | -331.18 | 105.06 | -3.09 | .00 | -.01 | -.04 |
| 49.140 | -1552.4 | 5632.7 | -234.1 | -331.02 | 105.30 | -3.22 | .01 | -.01 | -.04 |
| 51.030 | -1613.4 | 5851.4 | -242.0 | -331.06 | 105.35 | -3.26 | .03 | .03 | -.03 |
| 52.920 | -1674.4 | 6106.3 | -250.1 | -330.89 | 105.20 | -3.48 | .01 | .03 | -.02 |
| 54.810 | -1735.4 | 6361.6 | -258.3 | -330.53 | 105.44 | -3.34 | .02 | .04 | -.02 |
| 56.700 | -1796.4 | 6617.2 | -266.5 | -330.97 | 105.68 | -3.38 | .01 | .03 | -.01 |
| 58.590 | -1857.4 | 6859.7 | -274.4 | -330.81 | 105.53 | -3.51 | .01 | .01 | -.02 |
| 60.480 | -1918.4 | 7113.7 | -282.9 | -330.84 | 105.58 | -3.46 | .03 | .01 | .02 |
| 62.370 | -1979.4 | 7369.5 | -291.2 | -330.88 | 105.62 | -3.50 | .02 | .01 | .04 |

4160-6047-TC000

CONFIDENTIAL

NAVY SPACE TECHNOLOGY LABORATORIES
 TRIMON MONITORING REENTRY

April 3 1965

GEMINI EDIT PROGRAM

COMPUTED POSITION, VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDCT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDT (FT/SEC*2) | YDDT (FT/SEC*2) | ZDDT (FT/SEC*2) |
|-------------|----------|---------|--------|---------------|---------------|---------------|-----------------|-----------------|-----------------|
| 81.624 | -23624.7 | 7625.4 | -299.2 | -330.62 | 105.76 | -3.18 | .02 | .02 | .03 |
| 84.046 | -24225.5 | 7881.4 | -307.0 | -330.65 | 105.61 | -3.22 | .02 | .02 | .01 |
| 86.468 | -25026.4 | 8137.5 | -314.8 | -330.63 | 105.85 | -3.26 | .00 | .02 | .03 |
| 88.755 | -25785.9 | 8380.6 | -322.5 | -330.63 | 105.80 | -3.30 | .00 | .02 | .01 |
| 91.078 | -26550.5 | 8625.3 | -330.1 | -330.67 | 105.85 | -3.43 | .01 | .00 | .02 |
| 93.578 | -27377.2 | 8889.8 | -338.6 | -330.60 | 105.80 | -3.29 | .01 | .01 | .01 |
| 95.999 | -28177.8 | 9146.2 | -346.9 | -330.64 | 105.84 | -3.51 | .02 | .01 | .00 |
| 98.421 | -28978.4 | 9402.5 | -355.2 | -330.48 | 105.89 | -3.37 | .02 | .00 | .01 |
| 100.343 | -29778.9 | 9658.8 | -363.4 | -330.51 | 105.74 | -3.41 | .00 | .02 | .02 |
| 102.255 | -30579.3 | 9915.0 | -371.5 | -330.45 | 105.88 | -3.27 | .01 | .01 | .00 |
| 105.362 | -31338.5 | 10157.9 | -379.0 | -330.59 | 105.83 | -3.51 | .01 | .00 | .00 |
| 107.171 | -31870.5 | 10328.2 | -384.3 | -330.55 | 105.79 | -3.28 | .00 | .01 | .02 |
| 110.374 | -32929.0 | 10666.9 | -395.2 | -330.36 | 105.82 | -3.39 | .02 | .02 | .02 |
| 112.735 | -33729.2 | 10723.1 | -403.5 | -330.40 | 105.67 | -3.52 | .02 | .00 | .01 |
| 115.218 | -34529.4 | 11177.2 | -411.9 | -330.44 | 105.91 | -3.38 | .01 | .02 | .01 |
| 117.540 | -35329.5 | 11435.5 | -420.1 | -330.27 | 105.76 | -3.42 | .00 | .03 | .02 |
| 120.082 | -36129.8 | 11692.1 | -428.2 | -330.51 | 106.00 | -3.28 | .01 | .02 | .00 |
| 122.458 | -36924.8 | 11747.2 | -436.2 | -330.35 | 106.04 | -3.32 | .01 | .01 | .01 |
| 124.874 | -37719.7 | 12202.2 | -444.3 | -330.28 | 105.99 | -3.45 | .03 | .00 | .02 |
| 127.171 | -38478.4 | 12445.6 | -452.2 | -330.32 | 105.84 | -3.41 | .02 | .01 | .00 |
| 129.593 | -39278.2 | 12702.2 | -460.5 | -330.16 | 106.08 | -3.45 | .01 | .01 | .00 |
| 132.015 | -40078.0 | 12958.9 | -468.7 | -331.20 | 105.93 | -3.31 | .01 | .02 | .00 |
| 136.059 | -41677.6 | 13472.5 | -485.0 | -330.27 | 106.02 | -3.48 | .02 | .02 | .02 |
| 139.156 | -42436.0 | 13716.0 | -493.0 | -330.11 | 106.07 | -3.43 | .03 | .01 | .01 |
| 141.671 | -43268.3 | 13982.9 | -501.8 | -330.04 | 105.82 | -3.55 | .02 | .00 | .00 |
| 143.768 | -44024.4 | 14225.9 | -509.7 | -329.98 | 105.97 | -3.42 | .01 | .00 | .00 |
| 146.390 | -44823.7 | 14482.6 | -518.2 | -330.12 | 106.11 | -3.46 | .01 | .03 | .01 |
| 148.812 | -45623.1 | 14739.4 | -526.5 | -329.96 | 105.96 | -3.50 | .01 | .01 | .01 |
| 151.234 | -46422.5 | 14996.3 | -534.8 | -330.19 | 106.20 | -3.36 | .02 | .01 | .01 |
| 153.656 | -47222.2 | 15253.4 | -543.1 | -330.23 | 106.05 | -3.40 | .00 | .02 | .01 |
| 155.140 | -47712.4 | 15410.9 | -548.1 | -330.19 | 106.21 | -3.37 | .02 | .01 | .01 |
| 156.468 | -48811.0 | 15764.4 | -559.3 | -330.01 | 106.24 | -3.39 | .03 | .01 | .01 |
| 160.765 | -49568.9 | 16008.4 | -567.2 | -329.94 | 106.19 | -3.43 | .01 | .01 | .00 |
| 162.157 | -50368.1 | 16265.8 | -575.5 | -329.98 | 106.23 | -3.47 | .02 | .01 | .01 |

4160-6047-TC000

CONFIDENTIAL

CONFIDENTIAL

TRW SPACE TECHNOLOGY LABORATORIES
 THOMPSON RAND WOOD-BRE-11191

April 3 1965

GEMINI EDIT PROGRAM

COMPUTED POSITION, VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDGT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC*2) | YDDOT (FT/SEC*2) | ZDDOT (FT/SEC*2) |
|-------------|----------|---------|--------|---------------|---------------|---------------|------------------|------------------|------------------|
| 165.609 | -51167.3 | 16522.7 | -583.7 | -330.02 | 106.08 | -3.33 | .01 | .01 | .01 |
| 168.031 | -51965.4 | 16779.9 | -591.9 | -329.75 | 106.22 | -3.37 | .01 | .01 | .01 |
| 170.453 | -52763.3 | 17037.2 | -600.1 | -329.99 | 106.27 | -3.41 | .01 | .01 | .01 |
| 172.875 | -53561.0 | 17294.5 | -608.2 | -329.83 | 106.31 | -3.36 | .01 | .01 | .01 |
| 175.297 | -54358.9 | 17548.6 | -616.4 | -329.87 | 106.16 | -3.40 | .01 | .01 | .01 |
| 177.719 | -55156.8 | 17792.5 | -624.0 | -329.91 | 106.21 | -3.35 | .01 | .01 | .01 |
| 179.141 | -55954.7 | 18049.9 | -632.2 | -329.94 | 106.25 | -3.30 | .01 | .01 | .01 |
| 181.563 | -56752.6 | 18307.2 | -640.5 | -329.78 | 106.30 | -3.52 | .01 | .01 | .01 |
| 183.985 | -57550.5 | 18564.6 | -649.1 | -329.81 | 106.15 | -3.38 | .01 | .01 | .01 |
| 186.407 | -58348.4 | 18822.0 | -657.1 | -329.85 | 106.39 | -3.51 | .01 | .01 | .01 |
| 188.829 | -59146.3 | 19079.3 | -665.8 | -329.79 | 106.14 | -3.37 | .01 | .01 | .01 |
| 191.251 | -59944.2 | 19336.6 | -674.3 | -329.83 | 106.38 | -3.59 | .01 | .01 | .01 |
| 193.673 | -60742.1 | 19593.9 | -682.8 | -329.87 | 106.43 | -3.54 | .01 | .01 | .01 |
| 196.095 | -61540.0 | 19851.2 | -691.1 | -329.70 | 106.28 | -3.40 | .01 | .01 | .01 |
| 198.517 | -62337.9 | 20108.5 | -699.4 | -329.74 | 106.32 | -3.44 | .01 | .01 | .01 |
| 200.939 | -63135.8 | 20365.8 | -707.8 | -329.58 | 106.37 | -3.48 | .01 | .01 | .01 |
| 203.361 | -63933.7 | 20623.1 | -713.0 | -329.74 | 106.34 | -3.45 | .01 | .01 | .01 |
| 205.783 | -64731.6 | 20880.4 | -724.5 | -329.55 | 106.36 | -3.47 | .01 | .01 | .01 |
| 208.205 | -65529.5 | 21137.7 | -733.0 | -329.59 | 106.41 | -3.51 | .01 | .01 | .01 |
| 210.627 | -66327.4 | 21395.0 | -741.1 | -329.53 | 106.36 | -3.55 | .01 | .01 | .01 |
| 213.049 | -67125.3 | 21652.3 | -749.6 | -329.56 | 106.40 | -3.42 | .01 | .01 | .01 |
| 215.471 | -67923.2 | 21909.6 | -757.8 | -329.50 | 106.35 | -3.46 | .01 | .01 | .01 |
| 217.893 | -68721.1 | 22166.9 | -766.1 | -329.54 | 106.39 | -3.32 | .01 | .01 | .01 |
| 220.315 | -69519.0 | 22424.2 | -774.3 | -329.57 | 106.63 | -3.45 | .01 | .01 | .01 |
| 222.737 | -70316.9 | 22681.5 | -782.6 | -329.41 | 106.48 | -3.49 | .01 | .01 | .01 |
| 225.159 | -71114.8 | 22938.8 | -790.8 | -329.35 | 106.43 | -3.35 | .01 | .01 | .01 |
| 227.581 | -71912.7 | 23196.1 | -798.7 | -329.49 | 106.58 | -3.39 | .01 | .01 | .01 |
| 230.003 | -72710.6 | 23453.4 | -806.9 | -329.32 | 106.62 | -3.43 | .01 | .01 | .01 |
| 232.425 | -73508.5 | 23710.7 | -815.1 | -329.56 | 106.47 | -3.47 | .01 | .01 | .01 |
| 234.847 | -74306.4 | 23968.0 | -823.0 | -329.40 | 106.71 | -3.42 | .01 | .01 | .01 |
| 237.269 | -75104.3 | 24225.3 | -831.7 | -329.53 | 106.66 | -3.46 | .01 | .01 | .01 |
| 239.691 | -75902.2 | 24482.6 | -840.1 | -329.37 | 106.70 | -3.50 | .01 | .01 | .01 |
| 242.113 | -76700.1 | 24739.9 | -848.4 | -329.41 | 106.75 | -3.36 | .01 | .01 | .01 |

4160-6047-TC000

-86-

SPRASE TECHNOLOGY LABORATORIES
 100 BROADWAY SUITE 3, NEW-BRITAIN, CT 06053

April 3 1965

GEMINI EDIT PROGRAM

COMPUTED POSITION, VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC*2) | YDDOT (FT/SEC*2) | ZDDOT (FT/SEC*2) |
|-------------|-----------|---------|---------|---------------|---------------|---------------|------------------|------------------|------------------|
| 244.765 | -77261.9 | 24945.8 | -856.2 | -329.25 | 106.60 | -3.51 | .00 | -.01 | .00 |
| 247.187 | -79059.7 | 25204.1 | -864.5 | -329.48 | 106.64 | -3.53 | -.01 | -.00 | -.00 |
| 249.609 | -78858.7 | 25462.9 | -872.8 | -329.32 | 106.69 | -3.39 | .05 | -.02 | -.01 |
| 251.093 | -79347.7 | 25621.2 | -877.9 | -329.48 | 106.66 | -3.36 | .03 | -.01 | -.00 |
| 254.045 | -80320.2 | 25936.0 | -888.0 | -329.10 | 106.50 | -3.48 | .01 | -.00 | -.03 |
| 255.968 | -80953.0 | 26140.9 | -894.7 | -329.25 | 106.65 | -3.53 | .01 | -.00 | -.00 |
| 256.796 | -81385.3 | 26442.9 | -905.2 | -329.28 | 106.68 | -3.65 | -.01 | -.01 | -.00 |
| 261.624 | -82319.8 | 26744.5 | -915.3 | -329.30 | 106.52 | -3.50 | .00 | -.00 | -.01 |
| 253.546 | -83449.5 | 26947.4 | -922.3 | -329.25 | 106.68 | -3.55 | -.03 | -.01 | -.00 |
| 256.390 | -84386.0 | 27252.7 | -932.3 | -329.29 | 106.71 | -3.49 | -.02 | -.03 | -.01 |
| 258.235 | -85013.3 | 27455.1 | -939.0 | -329.33 | 106.57 | -3.54 | -.01 | -.02 | -.00 |
| 271.140 | -85953.3 | 27751.7 | -949.5 | -329.46 | 106.90 | -3.57 | .01 | -.01 | -.00 |
| 273.052 | -86586.8 | 27967.3 | -956.4 | -329.31 | 106.76 | -3.53 | .02 | -.01 | -.01 |
| 275.890 | -87520.7 | 28271.5 | -967.5 | -329.33 | 106.60 | -3.57 | .03 | -.04 | -.01 |
| 277.812 | -88153.4 | 28475.4 | -974.3 | -329.08 | 106.56 | -3.44 | -.01 | -.02 | -.01 |
| 280.640 | -89084.7 | 28777.9 | -984.2 | -329.31 | 106.60 | -3.56 | -.03 | -.02 | -.01 |
| 282.562 | -89715.4 | 28982.6 | -991.5 | -329.45 | 106.55 | -3.43 | -.02 | -.02 | -.01 |
| 285.390 | -90647.1 | 29284.2 | -1001.4 | -329.48 | 106.79 | -3.46 | -.01 | -.02 | -.00 |
| 287.312 | -91280.2 | 29489.5 | -1008.3 | -329.33 | 106.65 | -3.60 | -.02 | -.01 | -.00 |
| 290.140 | -92212.1 | 29791.4 | -1018.1 | -329.45 | 106.78 | -3.45 | -.04 | -.01 | -.01 |
| 292.062 | -92845.6 | 29996.5 | -1024.8 | -329.71 | 106.64 | -3.50 | -.06 | -.00 | -.01 |
| 294.905 | -93783.2 | 30299.8 | -1034.7 | -329.73 | 106.68 | -3.44 | -.03 | -.03 | -.01 |
| 296.812 | -94411.8 | 30503.1 | -1041.4 | -329.89 | 106.64 | -3.49 | .01 | -.00 | -.00 |
| 299.655 | -95349.5 | 30806.4 | -1051.3 | -329.71 | 106.48 | -3.52 | .02 | -.02 | -.01 |
| 301.562 | -95978.0 | 31009.5 | -1058.0 | -329.54 | 106.73 | -3.48 | .03 | -.00 | -.01 |
| 304.406 | -96915.6 | 31312.6 | -1068.0 | -329.69 | 106.47 | -3.52 | -.02 | -.01 | -.01 |
| 307.234 | -97848.2 | 31614.1 | -1078.0 | -329.91 | 106.70 | -3.64 | -.03 | -.01 | -.00 |
| 309.156 | -98482.1 | 31819.0 | -1084.9 | -329.75 | 106.56 | -3.51 | -.05 | -.00 | -.00 |
| 311.986 | -99415.3 | 32120.4 | -1094.9 | -329.89 | 106.50 | -3.54 | -.04 | -.03 | -.01 |
| 313.906 | -100049.7 | 32325.1 | -1101.7 | -330.34 | 106.56 | -3.50 | -.04 | -.01 | -.01 |
| 316.740 | -100788.6 | 32628.0 | -1111.7 | -330.14 | 106.40 | -3.53 | -.03 | -.01 | -.01 |
| 318.671 | -101623.4 | 32832.7 | -1118.5 | -330.11 | 106.55 | -3.58 | -.01 | -.00 | -.01 |
| 321.459 | -102556.0 | 33133.3 | -1128.6 | -330.34 | 106.59 | -3.61 | -.04 | -.00 | -.00 |

4160-6047-TC000
 -87-

TRAC SPACE TECHNOLOGY LABORATORIES
THOMPSON RAMO WOODS-300-ENTR

April 3, 1965

GEMINI EDIT PROGRAM

COMPUTED POSITION, VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME
(SECS) | X
(FT) | Y
(FT) | Z
(FT) | XDOT
(FT/SEC) | YDOT
(FT/SEC) | ZDOT
(FT/SEC) | XDDOT
(FT/SEC*2) | YDDOT
(FT/SEC*2) | ZDDOT
(FT/SEC*2) |
|----------------|-----------|-----------|-----------|------------------|------------------|------------------|---------------------|---------------------|---------------------|
| 323.421 | -103191.7 | 33338.1 | -1135.4 | -330.39 | 106.45 | -3.39 | -0.04 | -0.01 | -0.01 |
| 325.249 | -104125.5 | 33639.0 | -1145.3 | -330.41 | 106.48 | -3.60 | -0.04 | -0.02 | .00 |
| 326.171 | -104761.8 | 33843.6 | -1152.1 | -330.54 | 106.44 | -3.66 | -0.05 | -0.02 | .00 |
| 331.015 | -105702.2 | 34146.1 | -1162.1 | -330.79 | 106.28 | -3.42 | -0.08 | -0.02 | .02 |
| 332.921 | -106332.8 | 34348.8 | -1168.8 | -330.84 | 106.34 | -3.47 | -0.07 | -0.03 | -0.00 |
| 335.765 | -107274.1 | 34651.0 | -1178.8 | -331.17 | 106.27 | -3.50 | -0.07 | -0.03 | -0.01 |
| 337.667 | -107910.6 | 34855.1 | -1185.5 | -331.22 | 106.14 | -3.64 | -0.05 | -0.03 | -0.01 |
| 345.515 | -108947.7 | 35155.2 | -1195.5 | -331.44 | 105.98 | -3.49 | -0.06 | -0.03 | -0.00 |
| 342.437 | -105484.7 | 35359.1 | -1202.4 | -331.39 | 106.13 | -3.54 | -0.07 | -0.01 | .02 |
| 345.281 | -110427.8 | 35560.6 | -1212.3 | -331.82 | 105.97 | -3.57 | -0.08 | .00 | .00 |
| 347.187 | -111050.3 | 35862.7 | -1219.0 | -331.87 | 106.03 | -3.35 | -0.09 | -0.02 | .01 |
| 350.031 | -112004.5 | 36164.1 | -1228.9 | -332.09 | 106.06 | -3.56 | -0.07 | -0.02 | -0.00 |
| 352.959 | -112944.0 | 36463.8 | -1238.6 | -332.22 | 105.80 | -3.42 | -0.09 | -0.03 | -0.01 |
| 354.781 | -113522.9 | 36667.2 | -1245.3 | -332.47 | 105.85 | -3.55 | -0.09 | -0.03 | .01 |
| 357.603 | -114525.1 | 36967.7 | -1255.2 | -332.80 | 105.80 | -3.41 | -0.12 | -0.06 | .01 |
| 355.531 | -115164.8 | 37170.9 | -1261.9 | -332.85 | 105.66 | -3.45 | -0.13 | -0.08 | .01 |
| 352.374 | -116112.3 | 37470.9 | -1271.7 | -333.47 | 105.30 | -3.40 | -0.13 | -0.08 | -0.02 |
| 364.296 | -116751.6 | 37674.4 | -1278.9 | -333.72 | 105.15 | -3.45 | -0.11 | -0.05 | -0.03 |
| 367.124 | -117653.7 | 37971.9 | -1288.9 | -333.85 | 105.10 | -3.65 | -0.10 | -0.03 | -0.04 |
| 365.062 | -118342.9 | 38175.6 | -1296.0 | -334.10 | 105.16 | -3.71 | -0.12 | -0.03 | -0.03 |
| 371.905 | -119293.6 | 38474.3 | -1305.6 | -334.52 | 105.00 | -3.74 | -0.12 | -0.06 | -0.02 |
| 372.326 | -119935.6 | 38675.7 | -1313.8 | -335.77 | 104.86 | -3.79 | -0.11 | -0.07 | -0.01 |
| 376.671 | -120989.0 | 38973.6 | -1324.6 | -335.00 | 104.50 | -3.83 | -0.13 | -0.06 | -0.02 |
| 376.591 | -121532.3 | 39174.6 | -1332.0 | -335.25 | 104.56 | -3.79 | -0.15 | -0.07 | -0.01 |
| 381.437 | -122480.1 | 39464.2 | -1344.2 | -335.88 | 104.40 | -4.00 | -0.22 | -0.05 | -0.02 |
| 382.359 | -123125.8 | 39652.4 | -1352.0 | -336.13 | 104.07 | -3.87 | -0.21 | -0.19 | -0.03 |
| 386.203 | -124062.7 | 39947.8 | -1353.4 | -336.75 | 103.71 | -4.08 | -0.24 | -0.16 | -0.03 |
| 388.124 | -124730.5 | 40146.7 | -1371.2 | -337.30 | 103.28 | -4.13 | -0.25 | -0.17 | -0.05 |
| 390.963 | -125650.7 | 40439.3 | -1383.2 | -338.13 | 102.92 | -4.17 | -0.25 | -0.18 | -0.06 |
| 392.890 | -126340.8 | 40637.1 | -1391.5 | -338.38 | 102.39 | -4.40 | -0.24 | -0.17 | -0.08 |
| 395.734 | -127305.5 | 40929.0 | -1404.4 | -339.21 | 102.04 | -4.61 | -0.27 | -0.19 | -0.10 |
| 397.671 | -127962.3 | 41125.2 | -1413.6 | -339.64 | 101.70 | -4.93 | -0.31 | -0.20 | -0.10 |
| 400.515 | -128929.8 | 41413.4 | -1427.9 | -340.68 | 101.15 | -5.14 | -0.34 | -0.23 | -0.10 |
| 402.437 | -129583.2 | 41607.1 | -1438.0 | -341.33 | 100.43 | -5.38 | -0.36 | -0.24 | -0.09 |

SPACE TECHNOLOGY LABORATORIES
THOMPSON RAND WOODS REENTRY

April 3, 1965

GEMINI EDIT PROGRAM

COMPUTER POSITION, VELOCITY AND ACCELERATION IN GUIDANCE TARGET COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | IXDOT (FT/SEC) | YIDOT (FT/SEC) | ZIDOT (FT/SEC) | IXDDOT (FT/SEC*2) | YIDDOT (FT/SEC*2) | ZIDDOT (FT/SEC*2) |
|-------------|-----------|---------|---------|----------------|----------------|----------------|-------------------|-------------------|-------------------|
| 405.281 | -133557.4 | 41892.1 | -1453.5 | -342.34 | 99.88 | -5.59 | -.38 | -.26 | -.08 |
| 407.203 | -131216.0 | 42083.3 | -1464.4 | -343.11 | 99.45 | -5.82 | -.37 | -.25 | -.07 |
| 410.046 | -132193.3 | 42364.8 | -1481.0 | -344.34 | 98.51 | -5.85 | -.41 | -.29 | -.07 |
| 411.969 | -132855.8 | 42553.7 | -1492.6 | -344.75 | 98.17 | -6.09 | -.47 | -.32 | -.09 |
| 414.812 | -133839.1 | 42831.0 | -1510.2 | -346.41 | 97.04 | -6.30 | -.50 | -.34 | -.10 |
| 417.558 | -134825.4 | 43105.7 | -1528.8 | -348.04 | 96.10 | -6.70 | -.55 | -.37 | -.11 |
| 419.578 | -135456.2 | 43299.6 | -1541.8 | -348.89 | 95.37 | -6.84 | -.58 | -.39 | -.12 |
| 422.421 | -136451.4 | 43559.0 | -1561.9 | -350.72 | 94.24 | -7.23 | -.64 | -.44 | -.11 |
| 424.343 | -137185.9 | 43739.9 | -1575.9 | -351.97 | 93.32 | -7.46 | -.72 | -.48 | -.14 |
| 427.187 | -138171.1 | 44002.2 | -1597.7 | -354.10 | 91.89 | -7.68 | -.77 | -.54 | -.15 |
| 429.103 | -139853.4 | 44177.7 | -1613.1 | -355.75 | 90.77 | -8.27 | -.82 | -.58 | -.15 |
| 431.753 | -139381.5 | 44433.1 | -1636.8 | -357.98 | 89.05 | -8.67 | -.89 | -.65 | -.15 |
| 433.874 | -14058.6 | 44602.9 | -1653.6 | -353.83 | 87.74 | -8.72 | -.95 | -.70 | -.14 |
| 436.718 | -141585.1 | 44949.2 | -1679.5 | -362.66 | 85.63 | -9.30 | -1.05 | -.76 | -.17 |
| 438.640 | -142257.4 | 45012.2 | -1697.7 | -364.91 | 84.13 | -9.62 | -1.09 | -.80 | -.18 |
| 441.484 | -143327.5 | 45247.9 | -1725.8 | -367.54 | 81.82 | -10.20 | -1.16 | -.87 | -.19 |
| 443.421 | -144042.9 | 45404.5 | -1745.9 | -370.19 | 80.12 | -10.44 | -1.21 | -.92 | -.21 |
| 446.247 | -145055.4 | 45626.9 | -1775.7 | -373.82 | 77.23 | -11.20 | -1.32 | -.99 | -.23 |
| 448.187 | -145822.4 | 45774.7 | -1758.8 | -375.37 | 75.43 | -11.61 | -1.40 | -1.05 | -.25 |
| 451.031 | -146599.2 | 45784.2 | -1832.0 | -380.60 | 72.34 | -12.37 | -1.50 | -1.14 | -.25 |
| 452.953 | -147633.6 | 46120.7 | -1857.0 | -383.46 | 70.06 | -12.79 | -1.57 | -1.23 | -.24 |
| 455.796 | -148721.1 | 46314.3 | -1894.4 | -388.09 | 66.39 | -13.55 | -1.69 | -1.35 | -.25 |
| 457.718 | -149480.5 | 46439.1 | -1920.9 | -391.34 | 63.71 | -13.87 | -1.79 | -1.44 | -.27 |
| 459.582 | -150501.7 | 46613.7 | -1961.9 | -395.77 | 59.45 | -14.82 | -1.94 | -1.55 | -.30 |
| 462.494 | -151388.2 | 46724.6 | -1990.9 | -400.43 | 56.39 | -15.41 | -2.05 | -1.63 | -.31 |
| 465.328 | -152516.3 | 46877.8 | -2035.0 | -405.65 | 51.54 | -16.36 | -2.18 | -1.70 | -.30 |
| 467.247 | -153302.4 | 46972.8 | -2067.8 | -410.82 | 48.19 | -16.78 | -2.30 | -1.90 | -.30 |
| 470.093 | -154480.9 | 47100.9 | -2117.1 | -417.45 | 42.37 | -17.72 | -2.46 | -2.06 | -.34 |
| 472.015 | -155289.7 | 47178.1 | -2152.0 | -422.51 | 38.33 | -18.32 | -2.62 | -2.21 | -.39 |
| 474.859 | -156501.8 | 47277.2 | -2206.2 | -430.14 | 31.92 | -19.63 | -2.88 | -2.38 | -.45 |
| 476.781 | -157324.4 | 47333.7 | -2244.3 | -435.80 | 27.10 | -20.50 | -3.11 | -2.59 | -.48 |
| 479.624 | -158588.1 | 47399.1 | -2305.3 | -445.03 | 19.72 | -21.99 | -3.47 | -2.93 | -.51 |
| 484.406 | -160799.6 | 47455.3 | -2416.3 | -461.93 | 5.18 | -24.27 | -3.73 | -3.17 | -.55 |

SPACE TECHNOLOGY LABORATORIES
 WASHINGTON, D.C. 20546-SP-3 RE-ENTRY

April 3, 1965

SEMI-EDIT PROGRAM

COMPUTED POSITION, VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME
(SECS) | X
(FT) | Y
(FT) | Z
(FT) | XDOT
(FT/SEC) | YDOT
(FT/SEC) | ZDOT
(FT/SEC) | XDDOT
(FT/SEC ²) | YDDOT
(FT/SEC ²) | ZDDOT
(FT/SEC ²) |
|----------------|-----------|-----------|-----------|------------------|------------------|------------------|---------------------------------|---------------------------------|---------------------------------|
| 487.234 | -150094.7 | 47454.2 | -2423.1 | -473.37 | -4.74 | -24.12 | -4.02 | -3.41 | -5.59 |
| 488.171 | -163911.7 | 47437.1 | -2540.0 | -431.93 | -11.90 | -27.27 | -4.52 | -3.80 | -6.68 |
| 491.171 | -153385.5 | 47405.0 | -2595.1 | -491.13 | -19.35 | -28.75 | -4.73 | -4.07 | -7.70 |
| 494.243 | -165521.4 | 47324.3 | -2697.9 | -506.33 | -32.30 | -30.91 | -4.97 | -4.34 | -7.72 |
| 498.323 | -157453.4 | 47245.2 | -2755.5 | -516.87 | -41.71 | -32.42 | -5.25 | -4.55 | -7.72 |
| 498.421 | -167450.4 | 47147.3 | -2823.3 | -518.91 | -51.91 | -33.93 | -5.50 | -5.00 | -7.74 |
| 501.473 | -163134.1 | 46942.5 | -2931.2 | -545.63 | -67.49 | -35.24 | -5.94 | -5.31 | -7.73 |
| 502.578 | -170422.3 | 46708.7 | -3003.0 | -558.35 | -78.94 | -37.75 | -6.38 | -5.72 | -7.74 |
| 505.655 | -171650.9 | 46630.8 | -3089.1 | -572.01 | -91.18 | -39.18 | -6.93 | -6.17 | -7.80 |
| 508.734 | -173454.1 | 46319.1 | -3213.0 | -593.56 | -110.76 | -41.53 | -7.35 | -6.61 | -7.88 |
| 510.823 | -174715.3 | 46070.1 | -3302.7 | -605.63 | -125.15 | -43.92 | -7.73 | -7.15 | -7.99 |
| 512.906 | -176003.4 | 45791.9 | -3396.3 | -626.83 | -140.12 | -45.80 | -8.72 | -7.85 | -1.08 |
| 515.984 | -177974.5 | 45318.5 | -3543.1 | -654.45 | -165.35 | -49.40 | -9.23 | -8.40 | -1.10 |
| 518.078 | -179372.9 | 44950.4 | -3543.8 | -674.82 | -193.94 | -51.85 | -10.02 | -9.13 | -1.15 |
| 520.155 | -180759.6 | 44546.0 | -3758.9 | -695.30 | -203.20 | -54.08 | -10.75 | -9.88 | -1.20 |
| 523.218 | -182586.9 | 43972.1 | -3930.5 | -730.15 | -234.39 | -57.69 | -11.34 | -10.50 | -1.26 |
| 525.317 | -184537.7 | 43355.5 | -4056.5 | -754.74 | -257.65 | -50.67 | -11.91 | -11.15 | -1.28 |
| 527.39 | -186140.6 | 42792.4 | -4193.1 | -780.42 | -281.60 | -63.29 | -12.74 | -12.09 | -1.33 |
| 528.468 | -187733.3 | 42177.3 | -4317.5 | -807.10 | -306.91 | -55.82 | -13.44 | -12.78 | -1.32 |
| 532.546 | -190346.0 | 41166.9 | -4527.0 | -843.08 | -347.37 | -70.25 | -14.02 | -13.42 | -1.36 |
| 534.624 | -192144.9 | 40412.3 | -4675.7 | -879.57 | -376.00 | -72.79 | -14.82 | -14.28 | -1.42 |
| 536.703 | -194027.4 | 39576.5 | -4830.6 | -910.96 | -404.58 | -75.97 | -15.63 | -15.19 | -1.44 |
| 538.795 | -195905.2 | 38750.4 | -5003.2 | -940.04 | -434.44 | -80.51 | -16.43 | -15.96 | -1.67 |
| 541.874 | -19843.5 | 37275.8 | -5245.3 | -995.74 | -489.12 | -83.51 | -17.33 | -17.15 | -1.87 |
| 542.953 | -201056.6 | 36216.0 | -5456.2 | -1033.53 | -524.57 | -89.04 | -19.27 | -19.49 | -2.12 |
| 547.045 | -204339.1 | 34917.0 | -5708.8 | -1095.54 | -584.25 | -95.04 | -21.07 | -20.53 | -2.29 |
| 548.124 | -206506.3 | 33253.1 | -5912.2 | -1135.64 | -626.93 | -100.05 | -21.83 | -21.18 | -2.26 |
| 551.203 | -209036.5 | 31899.1 | -6125.3 | -1185.74 | -672.53 | -104.96 | -23.12 | -22.56 | -2.49 |
| 554.296 | -212874.1 | 29733.7 | -6452.2 | -1253.57 | -743.81 | -112.25 | -24.34 | -23.70 | -2.50 |
| 556.390 | -215570.5 | 28037.8 | -6704.3 | -1311.39 | -774.97 | -118.72 | -25.64 | -25.06 | -2.79 |
| 558.463 | -219357.2 | 26375.0 | -6956.4 | -1366.91 | -848.19 | -123.02 | -27.03 | -26.65 | -2.97 |
| 561.548 | -222700.6 | 23529.7 | -7353.7 | -1450.75 | -931.76 | -134.12 | -28.50 | -28.02 | -3.18 |
| 563.640 | -225811.5 | 21606.6 | -7641.0 | -1512.28 | -993.16 | -139.75 | -30.48 | -29.87 | -3.51 |

FREE SPACE TECHNOLOGY LABORATORIES
THOMPSON SAO WIDE-ANGLE ENTRY

April 3, 1965

GEMINI EDIT PROGRAM

COMPUTER POSITION, VELOCITY AND ACCELERATION IN GRAVITY TARGET COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC ²) | YDDOT (FT/SEC ²) | ZDDOT (FT/SEC ²) |
|-------------|-----------|-----------|----------|---------------|---------------|---------------|------------------------------|------------------------------|------------------------------|
| 565.719 | -229028.5 | 19472.1 | -7941.4 | -1578.41 | -1056.33 | -148.08 | -32.45 | -31.77 | -3.65 |
| 568.795 | -234052.1 | 16056.3 | -8414.3 | -1621.47 | -1155.58 | -159.56 | -33.85 | -33.21 | -3.78 |
| 570.850 | -237651.2 | 13554.8 | -8756.6 | -1753.12 | -1228.91 | -167.71 | -34.98 | -35.12 | -3.72 |
| 572.984 | -241404.9 | 10898.0 | -9115.0 | -1623.07 | -1303.58 | -175.02 | -35.63 | -37.22 | -3.60 |
| 575.052 | -245289.0 | 8130.9 | -9485.8 | -1904.42 | -1383.72 | -182.80 | -38.22 | -38.75 | -3.69 |
| 579.140 | -251345.0 | 3650.4 | -10066.9 | -2024.71 | -1504.35 | -193.25 | -39.66 | -40.44 | -3.82 |
| 580.213 | -255647.2 | 427.2 | -10479.1 | -2110.48 | -1590.15 | -202.67 | -41.50 | -42.15 | -3.99 |
| 582.295 | -260177.7 | -2975.8 | -10903.1 | -2197.15 | -1680.72 | -210.47 | -43.37 | -43.89 | -4.16 |
| 585.374 | -267109.6 | -8365.6 | -11573.5 | -2332.36 | -1818.05 | -223.65 | -44.82 | -45.21 | -4.51 |
| 587.463 | -272103.0 | -12274.1 | -12053.5 | -2432.44 | -1913.11 | -232.37 | -47.19 | -46.86 | -4.82 |
| 589.546 | -277252.1 | -16353.8 | -12553.2 | -2528.02 | -2012.75 | -245.80 | -49.59 | -48.37 | -5.09 |
| 592.624 | -28251.6 | -22797.3 | -13331.1 | -2684.95 | -2165.20 | -259.54 | -51.87 | -51.25 | -5.33 |
| 594.703 | -290394.1 | -27421.5 | -13893.9 | -2795.56 | -2275.18 | -270.81 | -54.06 | -53.74 | -5.18 |
| 596.781 | -296377.4 | -32275.3 | -14457.9 | -2910.36 | -2338.10 | -283.07 | -55.88 | -55.85 | -5.04 |
| 599.859 | -306159.9 | -39917.1 | -15347.7 | -3085.13 | -2567.07 | -298.24 | -57.15 | -59.56 | -4.58 |
| 601.953 | -31270.2 | -45441.6 | -15974.7 | -3270.74 | -2696.37 | -306.01 | -58.55 | -62.83 | -3.56 |
| 604.015 | -319458.4 | -51161.8 | -16611.3 | -3327.99 | -2830.35 | -313.52 | -60.44 | -66.64 | -2.56 |
| 607.107 | -32001.3 | -60248.3 | -17586.9 | -3515.21 | -3036.83 | -319.70 | -61.43 | -68.08 | -2.16 |
| 609.187 | -32521.6 | -66718.3 | -18293.7 | -3645.86 | -3182.32 | -322.99 | -63.09 | -70.32 | -1.55 |
| 611.265 | -34525.2 | -73490.7 | -18927.3 | -3778.32 | -3330.55 | -326.21 | -64.65 | -72.64 | -1.09 |
| 614.343 | -35720.1 | -84099.0 | -19933.2 | -3979.16 | -3555.95 | -329.24 | -65.96 | -74.48 | -0.59 |
| 616.421 | -36538.4 | -9161.3 | -20515.8 | -4117.64 | -3714.12 | -329.75 | -67.41 | -75.74 | .27 |
| 618.499 | -374326.8 | -99553.1 | -21295.0 | -4240.02 | -3875.90 | -328.46 | -68.77 | -78.94 | 1.14 |
| 621.577 | -38771.8 | -111863.3 | -22295.0 | -4473.21 | -4121.50 | -323.95 | -69.83 | -80.39 | 1.95 |
| 623.656 | -39723.4 | -120615.6 | -22958.3 | -4615.51 | -4291.18 | -318.71 | -70.92 | -82.08 | 3.00 |
| 625.734 | -406980.1 | -129716.0 | -23607.6 | -4768.11 | -4462.33 | -311.12 | -71.85 | -83.84 | 4.03 |
| 628.796 | -421923.9 | -143785.1 | -24538.4 | -4990.13 | -4721.20 | -297.70 | -72.83 | -85.21 | 4.71 |
| 630.874 | -43243.3 | -153780.4 | -25142.5 | -5140.65 | -4901.41 | -286.76 | -73.70 | -87.13 | 5.63 |
| 632.953 | -443301.8 | -164156.4 | -25723.6 | -5296.78 | -5082.02 | -274.87 | -74.85 | -88.80 | 6.26 |
| 635.031 | -455677.6 | -180159.0 | -26533.6 | -5525.73 | -5358.54 | -252.99 | -76.13 | -90.16 | 6.15 |
| 638.093 | -471522.3 | -191492.5 | -27052.0 | -5686.68 | -5546.96 | -240.55 | -76.89 | -91.31 | 5.39 |
| 640.171 | -483518.0 | -203219.5 | -27546.9 | -5848.80 | -5737.90 | -231.55 | -78.04 | -92.01 | 3.79 |
| 642.249 | -495840.4 | -215343.9 | -28023.8 | -6005.93 | -5930.61 | -224.98 | -78.17 | -92.67 | 3.07 |
| 644.328 | -514711.3 | -234038.7 | -28703.9 | -6253.47 | -6215.51 | -217.03 | -78.08 | -93.35 | 2.98 |

TRW SPACE TECHNOLOGY LABORATORIES
 THOMPSON RAND W-88-3 RE-ENTRY

April 3, 1965

GEMINI EDIT PROGRAM

COMPUTED POSITION, VELOCITY AND ACCELERATION IN GUIDANCE TARGET COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC ²) | YDDOT (FT/SEC ²) | ZDDOT (FT/SEC ²) |
|-------------|------------|------------|----------|---------------|---------------|---------------|------------------------------|------------------------------|------------------------------|
| 647.406 | -527870.4 | -247159.9 | -29145.0 | -5414.40 | -6410.94 | -211.10 | -78.16 | -93.88 | 3.87 |
| 645.484 | -541367.9 | -260486.9 | -29570.2 | -6573.94 | -6607.16 | -203.00 | -78.12 | -94.94 | 5.06 |
| 652.562 | -561979.6 | -281477.9 | -30160.7 | -6817.80 | -6898.21 | -184.31 | -78.62 | -96.24 | 6.07 |
| 654.624 | -576207.3 | -295916.7 | -30524.9 | -6986.05 | -7100.57 | -170.63 | -79.40 | -97.45 | 6.92 |
| 656.703 | -590864.6 | -310885.3 | -30862.1 | -7143.21 | -7305.36 | -155.32 | -80.03 | -96.97 | 7.50 |
| 655.751 | -613211.3 | -333845.7 | -31302.4 | -7392.89 | -7609.10 | -131.96 | -81.03 | -100.23 | 7.84 |
| 661.859 | -628802.0 | -345883.8 | -31558.3 | -7552.66 | -7820.53 | -114.49 | -81.93 | -101.70 | 7.82 |
| 662.921 | -644577.3 | -362237.0 | -31778.1 | -7732.43 | -8032.99 | -97.94 | -82.41 | -103.16 | 8.09 |
| 668.959 | -658768.7 | -391451.8 | -32040.8 | -7985.63 | -8351.39 | -75.61 | -82.66 | -103.48 | 8.49 |
| 665.078 | -685543.2 | -409030.0 | -32174.2 | -8158.41 | -8565.94 | -55.42 | -82.54 | -103.86 | 8.41 |
| 671.140 | -702544.3 | -426913.2 | -32272.6 | -8325.19 | -8780.11 | -34.72 | -82.54 | -104.27 | 7.80 |
| 674.218 | -729511.7 | -454441.9 | -32357.6 | -8582.09 | -9102.75 | -13.73 | -82.95 | -104.83 | 6.59 |
| 676.296 | -745587.4 | -473594.4 | -32378.3 | -8755.25 | -9321.01 | -3.14 | -83.22 | -105.20 | 5.42 |
| 678.374 | -764961.7 | -493181.8 | -32374.3 | -8923.71 | -9539.17 | 6.72 | -83.28 | -105.52 | 5.42 |
| 681.437 | -782654.5 | -522822.9 | -32323.0 | -9185.41 | -9863.77 | 21.93 | -83.01 | -106.12 | 6.34 |
| 682.515 | -811955.6 | -543620.4 | -32254.1 | -9356.18 | -10084.75 | 38.11 | -82.33 | -106.62 | 7.45 |
| 685.593 | -831576.9 | -564810.6 | -32155.4 | -9526.16 | -10306.52 | 56.82 | -81.92 | -107.23 | 8.17 |
| 688.655 | -861132.0 | -596277.6 | -31946.4 | -9775.76 | -10635.51 | 81.69 | -81.76 | -107.90 | 8.08 |
| 690.749 | -831773.4 | -619387.5 | -31761.4 | -9746.74 | -10850.97 | 97.14 | -81.85 | -108.86 | 7.19 |
| 692.812 | -902469.8 | -642024.3 | -31548.5 | -10116.12 | -11089.20 | 113.77 | -82.23 | -110.04 | 6.01 |
| 695.850 | -936000.0 | -676580.0 | -31183.5 | -10363.32 | -11427.32 | 129.95 | -82.87 | -111.15 | 4.82 |
| 697.968 | -955724.2 | -700671.5 | -30909.4 | -10543.69 | -11661.37 | 137.26 | -82.82 | -111.72 | 4.09 |
| 700.046 | -977815.7 | -725145.3 | -30615.6 | -10716.45 | -11893.66 | 142.32 | -82.63 | -112.30 | 4.35 |
| 703.124 | -1011188.2 | -752265.6 | -30144.3 | -10755.05 | -12239.42 | 157.77 | -82.42 | -112.86 | 5.53 |
| 705.203 | -1034159.4 | -787969.5 | -29795.5 | -11140.43 | -12474.83 | 171.23 | -81.93 | -113.38 | 7.29 |
| 707.291 | -1057423.7 | -814141.8 | -29418.4 | -11311.01 | -12711.81 | 188.93 | -81.37 | -113.83 | 8.55 |
| 710.343 | -1072499.4 | -853604.3 | -28794.6 | -11559.54 | -13060.59 | 217.01 | -81.01 | -114.23 | 9.35 |
| 712.421 | -1114650.4 | -880990.1 | -28321.5 | -11726.52 | -13296.78 | 236.60 | -79.79 | -113.87 | 9.74 |
| 714.494 | -1141040.5 | -908655.1 | -27810.5 | -11892.11 | -13535.32 | 258.18 | -78.31 | -113.27 | 10.25 |
| 717.562 | -1178000.4 | -950841.4 | -26965.8 | -12135.57 | -13981.26 | 298.63 | -77.05 | -112.57 | 10.83 |
| 715.640 | -1203364.1 | -979233.3 | -26437.2 | -12288.31 | -14114.72 | 312.83 | -75.09 | -110.60 | 11.33 |
| 721.718 | -1229075.1 | -1009480.3 | -25656.5 | -12442.49 | -14342.92 | 338.04 | -74.27 | -108.54 | 12.22 |
| 724.796 | -1267713.7 | -1054130.0 | -24559.2 | -12686.49 | -14675.01 | 374.11 | -72.75 | -107.37 | 12.21 |

TRW SPACE TECHNOLOGY LABORATORIES
THOMPSON RAND WORTHINGTON ENTRY

April 3, 1965

GEMINI EDIT PROGRAM

COMPUTED POSITION, VELOCITY AND ACCELERATION IN GUIDANCE THRUST COORDINATES

| TIME (SECS) | X (FT) | Y (FT) | Z (FT) | XDOT (FT/SEC) | YDOT (FT/SEC) | ZDOT (FT/SEC) | XDDOT (FT/SEC*2) | YDDOT (FT/SEC*2) | ZDDOT (FT/SEC*2) |
|-------------|------------|------------|----------|---------------|---------------|---------------|------------------|------------------|------------------|
| 726.874 | -1294185.4 | -1084847.1 | -23754.9 | -12816.06 | -14895.60 | 401.05 | -71.78 | -105.19 | 11.73 |
| 728.973 | -1320967.7 | -1118018.8 | -27900.8 | -12988.03 | -15113.85 | 428.45 | -70.51 | -102.48 | 10.68 |
| 732.031 | -1361201.1 | -1163002.8 | -21550.7 | -13182.00 | -15427.22 | 457.50 | -69.16 | -100.04 | 9.29 |
| 734.109 | -1388729.0 | -1195258.2 | -20588.9 | -13322.93 | -15629.46 | 473.36 | -66.53 | -97.53 | 8.20 |
| 736.187 | -1416540.3 | -1227739.5 | -17992.4 | -13478.85 | -15825.86 | 487.51 | -60.30 | -95.91 | 6.17 |
| 738.265 | -1444619.6 | -1261036.1 | -18569.9 | -13583.37 | -16023.03 | 504.11 | -55.40 | -96.31 | 4.38 |
| 741.343 | -1486544.9 | -1310819.5 | -17023.2 | -13742.64 | -16323.29 | 513.53 | -50.97 | -96.54 | 1.89 |
| 743.408 | -1515076.1 | -1344583.7 | -15976.1 | -13841.11 | -16524.53 | 513.05 | -46.77 | -95.21 | -0.75 |
| 745.459 | -1544144.7 | -1379477.8 | -14911.9 | -13934.75 | -16720.89 | 504.75 | -43.21 | -92.80 | -2.06 |
| 746.578 | -1587221.2 | -1431366.4 | -13361.0 | -14066.75 | -17004.17 | 498.76 | -40.28 | -90.21 | -1.78 |
| 750.656 | -1615514.0 | -1456976.9 | -12321.2 | -14144.58 | -17188.82 | 496.25 | -35.72 | -86.51 | 0.03 |
| 752.734 | -1645947.9 | -1502764.4 | -11294.0 | -14214.40 | -17362.95 | 496.30 | -31.17 | -82.35 | 1.21 |
| 755.812 | -1685841.2 | -1556576.3 | -9740.5 | -14303.58 | -17513.44 | 506.08 | -27.88 | -79.35 | 1.69 |
| 757.890 | -1719508.5 | -159327.8 | -8688.9 | -14358.37 | -17772.93 | 507.77 | -24.37 | -75.70 | 2.29 |
| 759.968 | -1749484.3 | -1630410.8 | -7626.8 | -14403.66 | -17925.88 | 510.20 | -21.15 | -72.05 | 2.35 |
| 763.046 | -1793904.6 | -1685910.1 | -5037.4 | -14466.29 | -18144.48 | 522.03 | -18.73 | -69.78 | 2.60 |
| 765.124 | -1823971.1 | -1723747.3 | -4950.7 | -14501.67 | -18285.43 | 526.47 | -15.88 | -66.61 | 2.78 |
| 767.171 | -1853656.1 | -1761303.3 | -3868.1 | -14530.83 | -18419.36 | 530.10 | -12.80 | -62.99 | 2.34 |
| 770.218 | -1899009.5 | -1817492.9 | -2239.2 | -14565.82 | -18508.50 | 540.09 | -10.08 | -60.19 | 2.26 |
| 772.281 | -1928098.2 | -1856179.7 | -1125.3 | -14584.65 | -18726.14 | 542.58 | -7.35 | -56.96 | 2.03 |
| 774.343 | -1958140.4 | -1894912.2 | -2.7 | -14592.58 | -18839.38 | 546.61 | -4.20 | -53.92 | 1.12 |
| 777.374 | -2002389.4 | -1952257.3 | 1651.0 | -14607.73 | -19002.19 | 551.59 | -2.32 | -52.18 | -0.54 |
| 779.437 | -2032507.6 | -1991946.7 | 2774.3 | -14604.93 | -19105.77 | 548.68 | -1.20 | -50.00 | -1.92 |
| 781.495 | -2062632.6 | -2031051.5 | 3891.5 | -14606.81 | -19207.50 | 534.50 | .82 | -48.15 | -3.76 |
| 784.531 | -2106855.6 | -2089482.7 | 504.7 | -14607.21 | -19349.33 | 530.84 | 2.08 | -46.83 | -4.30 |
| 786.593 | -2151002.0 | -2129482.4 | 6579.3 | -14596.48 | -19447.74 | 515.85 | 4.45 | -44.36 | -6.09 |
| 788.656 | -2167051.1 | -2169673.0 | 7638.7 | -14584.95 | -19536.01 | 506.75 | 7.08 | -41.96 | -4.58 |
| 791.703 | -2211481.5 | -2229375.4 | 9166.4 | -14563.10 | -19658.71 | 495.72 | 9.70 | -40.07 | -3.88 |
| 793.765 | -2241479.2 | -2270901.0 | 10180.8 | -14540.56 | -19737.56 | 486.45 | 12.27 | -39.04 | -3.45 |
| 796.795 | -2285474.9 | -2330009.9 | 11643.9 | -14495.59 | -19857.47 | 476.35 | 15.26 | -38.07 | -3.33 |
| 798.855 | -2315304.9 | -2370913.9 | 12627.4 | -14461.54 | -19934.13 | 472.59 | 17.49 | -37.41 | -2.57 |

~~CONFIDENTIAL~~

4160-6047-TC000
-94-

Appendix III

ASCENT GIMBAL ANGLES AND ATTITUDE ERRORS

~~CONFIDENTIAL~~

Figure 22

