

SECTION 15

DEFINITIONS

15.1 INTRODUCTION

This section contains two reference listings for use with the text and equations of Parts I and II of this document. The first listing is a summary of all abbreviations; the second listing contains descriptions of all variables in this document.

15.2 ABBREVIATIONS

Abbreviations for terms related to the Saturn Program, vehicle hardware, flight program software, etc., are listed alphabetically in Table 15-1.

15.3 VARIABLE DICTIONARY

The variable dictionary, contained in Table 15-2, defines the variables used in the text and equations of this document. For each variable there is an identifying symbol, a definition, and, where appropriate, the dimensional unit to be used in the flight program. (Variables used in Eq. 5.4.2 through 5.4.7 and in Section 13 are dummy variables and are not defined in this listing. Their meaning is conveyed by the appropriate discussion in the text.)

Symbols with vincula identify mathematically defined vectors. In general, only this symbol is given in the dictionary. The identical symbol, without the vinculum, denotes the magnitude of the vector. Unless otherwise noted, any of the subscripts A, B, E, G, S, V, or 4 may be added to a vector symbol to

indicate the appropriate coordinate system to which the vector is referenced (see Section 2). A component of a vector is denoted by adding the additional subscripts x, y, or z, corresponding to the coordinate system axis.

Note 1: The definition provided by the dictionary consists only of the primary event which occurs at the corresponding time. Refer to the Event Sequence Timeline Table in Part II.

15.4 MAXIMUM VALUES OF SELECTED VARIABLES

Table 15-3 contains the maximum expected values of selected variables. These maxima were derived from a series of simulations designed to force each variable to its maximum value.

The flight program scaling of these variables and the associated quantities must be capable of accommodating the values given in the table.

TABLE 15-1 ABBREVIATIONS

AP	Accelerometer Processing
BML	Boost Major Loop
BR	Buffer Register
BTC	Beginning of Telemetry Cycle
CCS	Command Communications System
CIU	Computer Interface Unit
CM	Command Module
CO	Cutoff
COD	Crossover Detector
CRP	Computer Reset Pulse
CSM	Command and Service Modules
D/A	Digital to Analog Conversion
DB	Disagreement Bit
DCS	Digital Command System
DI	Discrete Input (may have numerical suffix)
DIR	Discrete Input Register
DIS	Discrete Input Spares (may have numerical suffix)
DO	Discrete Output (may have numerical suffix)
DOM	Data Output Multiplexer
DOR	Discrete Output Register
EBW	Exploding Bridge Wire
EC	Expected Change
ECS	Environmental Control System
EDD	Equation Defining Document
EDS	Emergency Detection System
EMR	Error Monitor Register
EMRC	Engine Mixture Ratio Change
EOM	End of Mission
ESE	Electrical Support Equipment
ETC	End of Telemetry Cycle
ETW	Error Time Word
FCC	Flight Control Computer
G&C	Guidance and Control
GFP	Generalized Flight Program

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TABLE 15-1 ABBREVIATIONS (CONTINUED)

GMT	Greenwich Mean Time
GRF	Guidance Reference Failure
GRR	Guidance Reference Release
GRRA	Guidance Reference Release Alert
HOP	Transfer of program flow in LVDC
HSL	High Speed (Cutoff) Loop
IA	Input Axis
ICD	Interface Control Document
ICR	Internal Control Register
ID	Identification
IGM	Iterative Guidance Mode
INT	Interrupt (may have numerical suffix)
IR	Interrupt Register
IRN	Interface Revision Notice
ISR	Interrupt Storage Register
IU	Instrument Unit
KSC	Kennedy Space Center
LCC	Launch Control Computer
LES	Launch Escape System
LH2	Liquid Hydrogen
LM	Lunar Module
L.N.	Line of Nodes
LO	Liftoff
LOX	Liquid Oxygen
LSB	Least Significant Bit
LUT	Launch Umbilical Tower
LV	Launch Vehicle
LVDA	Launch Vehicle Data Adapter
LVDC	Launch Vehicle Digital Computer
MCC	Mission Control Center (Houston, Texas)
MC24	Mode Code 24
MC25	Mode Code 25
MC27	Mode Code 27

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TABLE 15-1 ABBREVIATIONS (CONTINUED)

ML	Minor Loop	
MLC	Mobile Launch Computer	
MLS	Minor Loop Support	
MSB	Most Significant Bit	
MSFC	Marshall Space Flight Center (Huntsville, Alabama)	
NM	Nautical Mile	*
N.P.	North Pole	
NPV	Non-Propulsive Vent	*
OA	Output Axis	
OM/D	Orbital Mode-Data Bit in DCS word transmitted from ground	
OML	Orbital Major Loop	
ON	Orbital Navigation	
PCM	Pulse Code Modulation	
PIO	Process Input-Output	
PTL	Prepare to Launch	
PU	Propellant Utilization	
QMS	(qms) Quarter Milliseconds	
RCA-110A	Designation for ground computer used in checkout and prelaunch	
RTC	Real Time Clock (as used in Parts III & IV)	
RTC	Reasonableness Test Constant (as used in Parts I & II)	
S-IB	Designation for Saturn IB vehicle first stage	
S-IVB	Designation for Saturn IB vehicle second stage	
S/C, SC	Spacecraft	
SLA	Spacecraft Lunar Module Adapter	
SM	Service Module	
SMC	Steering Misalignment Correction	
SRA	Spin Reference Axis	
SS	Switch Selector Command	
ST-124M	Designation for the launch vehicle inertial platform	
TBD	To be determined	

TABLE 15-1 ABBREVIATIONS (CONTINUED)

TB0	Time Base 0
TB1	Time Base 1
TB2	Time Base 2
TB3	Time Base 3
TB4	Time Base 4
TLC	Temporary Loss of Control (LVDC simultaneous memory error)
TM	Telemetry

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TABLE 15-2 DEFINITIONS

<u>Symbol</u>	<u>Definition and Comments</u>
\bar{A} ($\overline{A_p}$)	Vehicle acceleration vector (predicted) [m/sec ²]
A'	Intermediate parameter used in HSL time-to-go calculations [m/sec ²]
A''	Intermediate parameter used in HSL time-to-go calculations [m/sec ³]
A _{c0}	Estimated uncertainty in the expected velocity change computation [m/sec]
\bar{A}_D ($\overline{A_{Dp}}$)	Drag acceleration vector (predicted) [m/sec ²]
a _e	Semi-major axis of the earth-model ellipsoid [m]
A _z	Platform azimuth, computed in Preflight routines [pirads]
A _{zL}	Position I azimuth at launch [pirads]
A ₀₀	Constant term of variable azimuth polynomial, used by Preflight routines [deg]
A ₀₁	Coefficient of inclination i in variable azimuth polynomial, used by Preflight routines
A ₁₀	Coefficient of descending node angle λ in variable azimuth polynomial, used by Preflight routines

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
A_{11}	Coefficient of product of inclination i and descending node angle λ in variable azimuth polynomial, used by Preflight routines [deg^{-1}]
A_1-A_6	Coefficients used to compute pitch, yaw, and roll attitude correction commands

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TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
<u>B</u>		
b	Semi-minor axis of the earth-model ellipsoid [m]	
B ₁₁	Coefficient used to calculate delta freeze time (ΔT_f) for S-IB engine out during first S-IB engine failure interval	*
B ₁₂	Coefficient to calculate delta freeze time (ΔT_f) for S-IB engine out during first S-IB engine failure interval [sec]	*
B ₂₁	Coefficient used to calculate delta freeze time (ΔT_f) for S-IB engine out during second S-IB engine failure interval	*
B ₂₂	Coefficient used to calculate delta freeze time (ΔT_f) for S-IB engine out during second S-IB engine failure interval [sec]	*
BN ₁	The time (referenced to T*) to start building velocity history for S-IVB cutoff [sec] (see note 1)	
BN ₅	Time in TB4 to begin orbital navigation [sec] (see note 1)	
BU1	Time in TB3 to start checking DI22 and release inhibit on INT6 [sec] (see note 1)	
BU2	Time in TB0 to begin search for liftoff acceleration [sec] (see note 1)	
BU3	Time in TB0 to prevent TB1 initiation if liftoff has not been detected [sec] (see note 1)	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>C</u>	
\bar{C}	Telemetry station radius vector [m]
C_{ar1}	Constant time bias used to modify T_{ar} for an S-IB engine failure during Time Base 1 [sec] * *
C_D	Computed vehicle ballistic coefficient
$C_{D1}-C_{D5}$	Coefficients for the polynomial used to compute C_D
C_2	IGM intermediate parameter used in calculation of position correction terms
C_4	IGM intermediate parameter used in calculation of position correction terms
$CP_{M1}-$ CP_{M5}	Orbital attitude (pitch) variables for maneuvers 1 thru 5
CPITCH	In-plane attitude parameter used in orbital guidance
$CY_{M1}-$ CY_{M5}	Orbital attitude (yaw) variables for maneuvers 1 thru 5
CYAW	Out-of-plane attitude parameter used in orbital guidance

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>D</u>	
D	Coefficient of fourth zonal harmonic in expansion of earth's gravitational potential
d_A	Altitude of the vehicle above the horizon of a telemetry station [m]
D_p	IGM parameter used in calculation of pitch attitude correction term
D_y	IGM parameter used in calculation of yaw attitude correction term
DCRTC	Real time clock reading associated with $\Delta\chi$ updating [qms]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>F</u>	
\bar{F}	Thrust Vector
\bar{F}'	Unit thrust vector
F_k	Current predicted average thrust; used to compute $(F/M)_c$ [kg]
F_1	Predicted average S-IB thrust; used to compute $(F/M)_c$ [kg] *
F_2	Predicted average S-IVB thrust before EMRC; used to compute $(F/M)_c$ [kg]
F_{2I}	Predicted average S-IVB buildup thrust; used to compute $(F/M)_c$ [kg]
F_3	Predicted average S-IVB thrust after EMRC; used to compute $(F/M)_c$ [kg]
$F_{10} - F_{13}$	Coefficients of first segment time tilt polynomial [pirads, pirads/sec, pirads/sec ² , pirads/sec ³]
$F_{20} - F_{23}$	Coefficients of second segment time tilt polynomial. [pirads, pirads/sec, pirads/sec ² , pirads/sec ³]
$F_{30} - F_{33}$	Coefficients of third segment time tilt polynomial [pirads, pirads/sec, pirads/sec ² , pirads/sec ³]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
(F/M)	Total measured vehicle acceleration computed from accelerometer readings [m/sec ²]
(F/M) _c	Backup acceleration computed from prestored values [m/sec ²]
FM0	Initial (F/M) for S-IB burn [m/sec ²]
FM2	Constant (F/M) during TB2 [m/sec ²]
FM4	Initial (F/M) for S-IVB burn [m/sec ²]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>G</u>	
\bar{G} (\bar{G}_p)	Gravitational acceleration vector (predicted) [m/sec ²]
\bar{G}^*	Average \bar{G} for remaining boost flight path [m/sec ²]
G_H	Huntsville gravity value used in flight simulation [m/sec ²]
\bar{G}_L	Gravitational acceleration vector at the launch site [m/sec ²]
\bar{G}_T	Terminal gravitational acceleration vector [m/sec ²]
GANTRY	Height of the launch umbilical tower [m]
GOMTYP	Parameter used by execute generalized maneuver, execute special maneuver, and return to nominal time-line DCS commands, indicating orbital maneuver type. *
	*
	*

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>H</u>	
h	Altitude of the vehicle above the oblate spheroid of the earth [m]
H	Coefficient of third zonal harmonic in the expansion of earth's gravitational potential
h_1	Lower limit of h for atmospheric density polynomial [m]
h_2	Upper limit of h for atmospheric density polynomial [m]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>I</u>	
i	Inclination of the orbit [pirads]
i_S	Unit vector along X_S axis

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>J</u>	
J	Coefficient of second zonal harmonic in the expansion of earth's gravitational potential
J_p	IGM parameter used in calculation of pitch attitude correction term
j_s	Unit vector along Y_s axis [m]
J_y	IGM parameter used in calculation of yaw attitude correction term
J_1	Estimated position-to-be-gained in first IGM phase used in calculation of total IGM position-to-be-gained [m]
J_3	Corrected position-to-be-gained in second IGM phase used in calculation of total IGM position-to-be-gained [m]
J'_3	Estimated position-to-be-gained in second IGM phase used in the calculations of J_3 and the predicted terminal range angle ϕ_T [m]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>K</u>	
K_D	Orbital drag model constant, dependent on the mass and average presentation area of the vehicle [m^2/kg]
K_p	IGM parameter used in calculation of pitch attitude correction term
k_S	Unit vector along Z_S axis
K_y	IGM parameter used in calculation of yaw attitude correction term
K_1	Altitude constraint for determining pitch steering angle [radians]
K_2	Altitude rate constraint for determining pitch steering angle [radians/sec]
K_3	Altitude constraint for determining yaw steering angle [radians]
K_4	Altitude rate constraint for determining yaw steering angle [radians/sec]

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TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>L</u>	
L_p	Component in the pitch plane of the total corrected velocity-to-be-gained by IGM, used in the calculation of position correction terms K_1 and K_2 [m/sec]
L_y	Total corrected velocity-to-be-gained by IGM, used in calculation of position correction term [m/sec]
L'_y	Total estimated velocity-to-be-gained by IGM, used in calculation of the predicted terminal range angle ϕ_T [m/sec]
L_1	Velocity-to-be-gained in first phase IGM, used in calculation of the predicted terminal range angle ϕ_T [m/sec]
L_3	Corrected velocity-to-be-gained in second phase IGM, used in calculation of the pitch guidance command χ_y [m/sec]
L'_3	Estimated velocity-to-be-gained in second phase IGM, used in calculation of the predicted terminal range angle ϕ_T [m/sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>M</u>	
M	Current mass of the vehicle [kg-sec ² /m]
\dot{M}	Current mass flow rate used in computing (F/M) _c [kg-sec/m]
M _{cb}	Current total backup mass used in computing (F/M) _c [kg-sec ² /m]
M _{GR}	Estimated mass of S-IVB at IGM initiation [kg-sec ² /m]
M ₁	Mass of the vehicle at liftoff; used to compute (F/M) _c [kg-sec ² /m]
\dot{M}_1	S-IB backup mass flow rate used to compute (F/M) _c [kg-sec/m]
M ₂	Mass of the vehicle (not including LES) at T3+T3 _{FMC} ; used to compute (F/M) _c [kg-sec ² /m]
\dot{M}_2	S-IVB backup mass flow rate prior to EMRC; used to compute (F/M) _c [kg-sec/m]
\dot{M}_3	S-IVB backup mass flow rate after EMRC; used to compute (F/M) _c [kg-sec/m]
(M/F)	Reciprocal of the total measured acceleration (1/(F/M)) [sec ² /m]
(M/F) _S	Current smoothed (filtered) value of (M/F) [sec ² /m]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
(M/F) _{S1} ⁻ (M/F) _{S4}	First through fourth consecutive past values of (M/F) _S [sec ² /m]	
(M/F) ₁ ⁻ (M/F) ₄	Present through third past consecutive values of (M/F) [sec ² /m]	
(M/F) ₀	Predicted M/F at T3+T3 _{FM} : used to initialize the smoothing filter at T0+0 [sec ² /m]	
[MBS]	Transformation matrix from B-system to S-system	
[MEG]	Transformation matrix from E-system to G-system	*
[MES]	Transformation matrix from E-system to S-system	*
MFK1-MFK8	(M/F) _S filter coefficients	
[MGA]	Transformation matrix from G-system to A-system	
[MG4]	Transformation matrix from G-system to 4-system	
MLKRC1	Gimbal angle RTC used on first pass on the backup gimbal only (all channels) [deg]	
MLKRC3	Gimbal angle RTC used after first pass on the backup gimbal (pitch and yaw channels) [deg/ML]	
MLKRC5	Gimbal angle RTC used after first pass on the backup gimbal (roll channel) [deg/ML]	
MLK2	Fine gimbal angle RTC (pitch and yaw channels) [deg/ML]	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
MLK12	Fine gimbal angle RTC (roll channel) [deg/ML]
MLR	Minor Loop rate [sec^{-1}]
ML6HUN	Zero gimbal angle test constant (all channels) [deg]
[MSA]	Transformation matrix from S-system to A-system
[MSG]	Transformation matrix from S-system to G-system
MSK5	Ladder rate limit (all channels) [deg/ML]
MSK6	Ladder magnitude limit (pitch and yaw channels) [deg]
MSK16	Ladder magnitude limit (roll channel) [deg]
MSLIM1	Attitude command (χ) rate limit (roll channel) [deg/ML]
MSLIM2	Attitude command (χ) rate limit (pitch and yaw channels) [deg/ML]
[MSV]	Transformation matrix from S-system to V-system
MS04DT	The reciprocal of MS25DT
MS15DT	Number of permissible unreasonable backup resolver read- ings per computation cycle before setting D04 and D06

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
MS25DT	Number of minor loops per ΔT_N through minor loop support
[MS4]	Transformation matrix from S-system to 4-system
[M4V]	Transformation matrix from 4-system to V-system

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>N</u>	
\bar{N}	Unit vector perpendicular to the orbital plane
NTSTB2	Nominal time in Time Base 1 to start Time Base 2 in repeatable flight simulation [sec] * *
NTSTB3	Nominal time in Time Base 2 to start Time Base 3 in repeatable flight simulation [sec] * *
NUPTIM	Time from GRR at which a DCS Navigation Update is to be implemented [sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>P</u>	
\bar{P}	Pointing vector along the longitudinal axis of the vehicle
P	Parameter used in calculation of gravitational acceleration vector
P_C	Elapsed time in artificial τ mode at EMRC [sec]
P_{CMR}	Preset length of artificial τ mode after EMRC [sec]
\bar{P}_1	Unit vector perpendicular to plane of \bar{N} and \bar{R}_1
P_1	IGM parameter used in calculation of range angle
P_3	IGM parameter used in calculation of pitch attitude correction term
P_{34}	Parameter in harmonic expansion of earth's gravitational potential
PITCH	Pitch attitude error correction command [ladder bits]

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TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>Q</u>	
Q_p	IGM parameter used in calculation of position correction term *
Q_y	IGM parameter used in calculation of position correction term
Q_1	IGM parameter used in calculation of position correction term
Q_3	IGM parameter used in calculation of position correction term

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>R</u>	
$\overline{R} (\overline{R}_p)$	Vehicle geocentric radius vector (predicted) [m]
\overline{R}_L	Geocentric radius to the center of the IU on the launch pad. Used to calculate initial conditions [m]
\overline{R}_{OG}	Radius vector for use in orbital guidance [m]
R_{STA}	Mean radius of telemetry stations [m]
\overline{R}_T	Terminal radius vector [m]
\overline{R}_1	Unit vector along \overline{R}
RA_{M1} RA_{M5}	Roll angle for orbital guidance maneuvers 1-5 [pirads]
ROLL	Roll attitude error correction command [ladder bits] *
ROLLA	Presetting for χ_x for orbital guidance [pirads]
ROV	Constant used to bias terminal range angle prediction
RTCX	Reasonableness test constant (RTC) for X accelerometer channel [m/sec ²] *

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
RTCY	RTC for Y accelerometer channel [m/sec ²]
RTCZ	RTC for Z accelerometer channel [m/sec ²]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>S</u>	
S	Parameter used in calculation of gravitational acceleration vector
S _p	IGM parameter used in calculation of position correction term
S _y	IGM parameter used in calculation of position correction term
S ₁	IGM parameter used in intermediate calculation of position correction term
S ₃	IGM parameter used in calculation of position correction terms
S ₃₄	Parameter representing the third and fourth zonal harmonics in the expansion of earth's gravitational potential
SEQNUM	Four bit indicator selecting one of fifteen different preprogrammed DCS alternate sequences *
SF	Scale factor (which includes conversion from pirads to ladder bits and multiplication by attitude error gain)
SMCG	Steering misalignment correction (SMC) gain [rad/sec] *
SMCY	Pitch SMC term [pirads]
SMCZ	Yaw SMC term [pirads]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
SP _{M1} ⁻ SP _{M5}	In-plane attitude parameters of orbital guidance maneuvers 1-5
SPITCH	Pitch angle presetting for orbital guidance
SQ1	First guess at $\text{sqrt} (\Delta \dot{Z}_V^2 + \Delta \dot{X}_V^2)$ for S-IVB burn [m/sec]
SQ2	First guess at $\text{sqrt} (1 - (F'_{Sy})^2)$
	*
SY _{M1} ⁻ SY _{M5}	Out-of-plane attitude parameters for orbital guidance maneuvers 1-5
SYAW	Current maneuver yaw angle presetting used in orbital guidance
S4IGTM	Time in TB3 to look for S-IVB cutoff conditions (see note 1) [sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
<u>I</u>		
T^*	Predicted IGM total time-to-go to reach insertion conditions [sec]	
T_{ar}	Tilt arrest time (based on T_c) [sec] (see note 1)	
T_{as}	Time (from T_0) of last accelerometer sampling in boost mode or of initiation of orbit navigation pass in orbit [sec]	
T_c	Time (from T_1) biased by T_d [sec]	
T_{CO}	Time (from T_1) for S-IVB cutoff [sec]	
T_d	Time bias to compensate for delays between computing and commanding attitude (used to compute T_c) [sec]	
T_D	Difference between T_{GRR} and T_{GRR0} used to compute λ [sec]	
T_{EO}	Time (from T_1) of engine failure [sec]	
T_{far}	Partition time constant used to determine a time bias for T_{ar} in case of an S-IB engine failure [sec]	* * *
$T_{f1}-T_{f2}$	Partition times for time tilt freeze time polynomial [sec]	
T_{GMT}	Universal time or Greenwich mean time (GMT) [sec]	
T_{GRR}	Time of GRR in universal time (T_{GMT}) [sec]	
T_{GRR0}	Nominal value of T_{GRR} [sec]	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
T_{HSL}	Time (referenced to T^*) to begin HSL calculations [sec]	
T'_L	Predicted time of liftoff (in GMT) as transmitted to the LVDC from the RCA-110A [sec]	*
T_{RNTL}	Time in current time base to implement the DCS return to nominal timeline [sec] (see note 1)	
T_{RTC}	Time in TB1 to change accelerometer RTC's [sec]	
T_{SEQ}	Time in current time base to start a DCS alternate sequence; referenced to TBB, the current time base time biased by any time base updates received [sec] (see note 1)	*
T_{SMC}	Time in TB3 to enable SMC calculations [sec] (see note 1)	
T_{SOM}	Time in current time base to start the DCS generalized maneuver or DCS special maneuver [sec] (see note 1)	*
T_{SON}	Time since last orbital navigation pass [sec]	
T_{SO}	Backup time (based on T_c) to start roll maneuver and begin using first segment of time tilt coefficients [sec] (see note 1)	
T_{S1}	Time (based on T_c) to begin using second segment of time tilt coefficients [sec] (see note 1)	
T_{S1EO}	Time in TB1 to enable DI14 and DI15 check for S-IB engine out [sec] (see note 1)	
T_{S2}	Time (based on T_c) to begin using third segment of time tilt coefficients [sec] (see note 1)	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
T_{T2}	Earliest time (based on T_c) for χ freeze initiation if S-IB engine failure is detected [sec] (see note 1)
T_{1i}	Time-to-go in first phase of IGM [sec]
T_{10}	Nominal duration of first phase IGM [sec]
T_{3i}	Time-to-go in second phase of IGM [sec]
T_{4M2} T_{4M5}	Preset times in TB4 to execute maneuver 2-5 [sec] (see note 1)
TB	Elapsed time in prevailing time base [sec]
TBA	Time of station acquisition in TB4 [sec]
TBB	Value of TB biased by any time base updates received [sec]
TBL	Time of station loss in TB4 [sec]
TI	Time (from T_{GRR}) of initiation of the current time base [sec]
TLCK	Target load checksum factor set to the two's complement of the sum of the other seven target load variables
TLPAST	Extrapolated real time clock value during orbit for telemetry [qms]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
TLTSEC	Time of the once per second position extrapolation during orbit mode, measured from GRR [sec]	
TM	Time (from T ₀) to activate ECS water valve logic [sec] (see note 1)	
TMEFRZ	Time (based on T _c) to end χ_y freeze following an S-IB engine failure [sec] (see note 1)	
TYAW01- TYAW25	Table of times associated with the S-IB stage yaw guidance commands [sec]	* *
TYP _{M1} - TYP _{M5}	The type of orbital maneuver to be executed (for maneuvers 1-5) (+1: inertial reference, 0: chi freeze, -1: local reference, -2: inertial hold of local reference)	* * *
T0	Time (from T _{GRR}) of initiation of TB0 [sec]	
T1	Time (from T _{GRR}) of initiation of TB1 [sec]	
T1BIAS	Bias by which T1 is adjusted if TB1 was initiated by the backup criteria [sec]	
T2	Time (from T _{GRR}) of initiation of TB2 [sec]	
T3	Time (from T _{GRR}) of initiation of TB3 [sec]	
T3 _{FM}	Time in TB3 to begin (F/M) computations [sec] (see note 1)	
T3 _{FMC}	Time in TB3 to begin (F/M) _c computations [sec] (see note 1)	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
$T3_{IGM}$	Time in TB3 to initiate IGM guidance [sec] (see note 1)
$T4$	Time (from T_{GRR}) of initiation of TB4 [sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
U	
U_1	IGM parameter used in calculation of position correction term
U_3	IGM parameter used in calculation of position correction term

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
<u>V</u>		
V	Total space-fixed velocity [m/sec]	*
\bar{V} (\bar{V}_p)	Vehicle velocity vector (predicted) [m/sec]	
v'	Velocity at end of past computation cycle, used in HSL time-to-go calculations [m/sec]	
v''	Velocity at end of second past computation cycle, used in HSL time-to-go calculations [m/sec]	
V _{ex1}	Engine exhaust velocity during first IGM phase [m/sec]	
V _{ex3}	Engine exhaust velocity during second IGM phase [m/sec]	
V _{GRD}	Velocity guard for HSL [m/sec]	
\bar{V}_r	Velocity vector relative to the earth's atmosphere [m/sec]	
\bar{V}_T	Terminal velocity vector [m/sec]	
VENT _{1A} - VENT _{8A}	First through eighth vent accelerations [m/sec ²]	
VENTNO	Number of vent accelerations	
VTIM2- VTIM8	Time (from T4) to start using second through eighth vent acceleration [sec]	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
<u>X</u>		
X_A	Component of \bar{R} along X_A axis [m]	
X_B	Component of \bar{R} along X_B axis [m]	
\ddot{X}_{DS}	Component of \bar{A}_D along X_S axis [m/sec ²]	
X_G	Component of \bar{R} along X_G axis [m]	
\ddot{X}_{Gg}	Component of \bar{G} along X_G axis [m/sec ²]	
X_{LS}	Component of \bar{R}_L along X_S axis [m]	
\dot{X}_m	Measured platform velocity along X_S axis [m/sec]	
\ddot{X}_m	Average platform acceleration along X_S axis [m/sec ²]	
\dot{X}_0	Initial value of \dot{X}_S [m/sec]	
X_P	Component of the non-orthogonal inertial platform gimbal system, identical to the X_B axis [m]	* *
X_{ref}	X reference angle of execute generalized maneuver commanded attitude [pirads]	
X_S	Component of \bar{R} along X_S axis [m]	
\dot{X}_S	Component of \bar{V} along X_S axis [m/sec]	
\ddot{X}_S	Component of \bar{A} along X_S axis [m/sec ²]	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
\dot{X}_{Sg}	Component of \bar{V} along X_S axis due to gravitational acceleration [m/sec]
\ddot{X}_{Sg}	Component of \bar{G} along X_S axis [m/sec ²]
X_V	Component of \bar{R} along X_V axis [m]
\dot{X}_V	Component of \bar{V} along X_V axis [m/sec]
\ddot{X}^*_{Vg}	Component of \bar{G}^* along X_V axis [m/sec ²]
\ddot{X}_{VgT}	Component of \bar{G}_T along X_V axis [m/sec ²]
X_{VT}	Component of \bar{R}_T along X_V axis [m]
\dot{X}_{VT}	Component of \bar{V}_T along X_V axis [m/sec]
X_4	Component of \bar{R} along X_4 axis [m]
\dot{X}_4	Component of \bar{V} along X_4 axis [m/sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
<u>Y</u>		
Y_A	Component of \bar{R} along Y_A axis [m]	
Y_B	Component of \bar{R} along Y_B axis [m]	
\ddot{Y}_{DS}	Component of \bar{A}_D along Y_S axis [m/sec ²]	
Y_G	Component of \bar{R} along Y_G axis [m]	
\ddot{Y}_{Gg}	Component of \bar{G} along Y_G axis [m/sec ²]	
Y_{LS}	Component of \bar{R}_L along Y_S axis [m]	
\dot{Y}_m	Measured platform velocity along Y_S axis [m/sec]	
\ddot{Y}_m	Average platform acceleration along Y_S axis [m/sec ²]	
\dot{Y}_0	Initial value of \dot{Y}_S [m/sec]	
Y_P	Component of the non-orthogonal inertial platform gimbals system, identical to the Y_S axis [m]	*
Y_{ref}	Y reference angle of execute generalized maneuver commanded attitude [pirads]	*
Y_S	Component of \bar{R} along Y_S axis [m]	
\dot{Y}_S	Component of \bar{V} along Y_S axis [m/sec]	
\ddot{Y}_S	Component of \bar{A} along Y_S axis [m/sec ²]	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
\dot{Y}_{Sg}	Component of \bar{V} along Y_S axis due to gravitational acceleration [m/sec]	* *
\ddot{Y}_{Sg}	Component of \bar{G} along Y_S axis [m/sec ²]	
Y_V	Component of \bar{R} along X_V axis. This is identical to Y_4 [m]	
\dot{Y}_V	Component of \bar{V} along Y_V axis [m/sec]	
\ddot{Y}_{Vg}^*	Component of \bar{G}^* along Y_V axis [m/sec ²]	
\ddot{Y}_{VgT}	Component of \bar{G}_T along Y_V axis [m/sec ²]	
Y_{VT}	Component of \bar{R}_T along Y_V axis [m]	
\dot{Y}_{VT}	Component of \bar{V}_T along Y_V axis [m/sec]	
Y_4	Component of \bar{R} along Y_4 axis. This is identical to Y_V [m]	
\dot{Y}_4	Component of \bar{V} along Y_4 axis [m]	*
YAW	Yaw attitude error command [ladder bits]	*
YAWC01-	Table of yaw commands for S-IB stage guidance associated with times in table TYAW [deg]	*
YAWC25		*
YAWLIM	Yaw guidance command limit [pirads]	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
<u>Z</u>		
Z_A	Component of \bar{R} along the Z_A axis [m]	
Z_B	Component of \bar{R} along the Z_B axis [m]	
\ddot{z}_{DS}	Component of \bar{A}_D along Z_S axis [m/sec ²]	
Z_G	Component of \bar{R} along Z_G axis [m]	
\ddot{z}_{Gg}	Component of \bar{G} along Z_G axis [m/sec ²]	
Z_{LS}	Component of \bar{R}_L along Z_S axis [m]	
\dot{z}_m	Measured platform velocity along the Z_S axis [m/sec]	
\ddot{z}_m	Average platform acceleration along the Z_S axis [m/sec ²]	
\dot{z}_0	Initial value of \dot{z}_S [m/sec]	
Z_P	Component of the non-orthogonal inertial platform gimbal system [m]	* *
Z_{ref}	Z reference angle of execute generalized maneuver commanded attitude [pirads]	
Z_S	Component of \bar{R} along Z_S axis [m]	
\dot{z}_S	Component of \bar{V} along Z_S axis [m/sec]	
\ddot{z}_S	Component of \bar{A} along Z_S axis [m/sec ²]	
\dot{z}_{Sg}	Component of \bar{V} along Z_S axis due to gravitational acceleration [m/sec]	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
\ddot{z}_{Sg}	Component of \bar{G} along Z_S axis [m/sec ²]
z_V	Component of \bar{R} along Z_V axis [m]
\dot{z}_V	Component of \bar{V} along Z_V axis [m/sec]
\ddot{z}_{Vg}^*	Component of \bar{G}^* along the Z_V axis [m/sec ²]
\ddot{z}_{VgT}	Component of \bar{G}_T along the Z_V axis [m/sec ²]
z_{VT}	Component of \bar{R}_T along the Z_V axis [m]
\dot{z}_{VT}	Component of \bar{V}_T along the Z_V axis [m/sec]
z_4	Component of \bar{R} along the Z_4 axis [m]
\dot{z}_4	Component of \bar{V} along the Z_4 axis [m/sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>ALPHA</u>	
α	Angle of attack [pirads]
α_f	Weighting factor based on first phase IGM performance used in adjusting τ_3 computations
α_{LH}	Angle between desired \bar{P} and the local horizontal [pirads]
<u>DELTA</u>	
δ_2	Intermediate parameter used in terminal range angle prediction
ΔA	Measured velocity change from accelerometer optisyn A
ΔB	Measured velocity change from accelerometer optisyn B
ΔL_3	Correction to velocity-to-be-gained L_3 [m/sec]
$\bar{\Delta R}$	Radius-to-be-gained vector [m]
$\overline{\Delta R}_{SAV}$	Vector symbol for the low order bits of the computed position change during the past orbital navigation pass, saved to reduce truncation error [m/sec]
ΔT	Execution time of the last BML [sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
$\Delta T'$	Previous value of ΔT [sec]
$\Delta T'_a$	Adjusted value of ΔT for artificial tau calculations [sec]
ΔT_b	Time bias to compensate for S-IVB engine thrust decay after cutoff [sec]
ΔT_f	Duration of S-IB guidance freeze [sec]
ΔT_N	Nominal value of ΔT [sec]
ΔT_{N1}	Nominal ΔT from $T_0 + 0.0$ until $T_1 + 0.0$ [sec]
ΔT_{N2}	Nominal ΔT from $T_1 + 0.0$ until $T_3 + T_{3IGM}$ [sec]
ΔT_{N3}	Nominal ΔT from $T_3 + T_{3IGM}$ until $T_4 - \epsilon_2$ [sec]
ΔT_{N4}	Nominal ΔT from $T_4 - \epsilon_2$ to $T_4 - T_{HSL}$ [sec]
ΔT_{N5}	Nominal ΔT from $T_4 + 0.0$ until $T_4 + BN_5$ [sec]
ΔT_{N6}	Nominal ΔT from $T_4 + BN_5$ to EOM [sec]
$\Delta T'_3$	Time-to-go correction term based on vehicle performance during the past BML [sec]
ΔV	Actual change in velocity in S-system [pulses]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
$\overline{\Delta V}$	Velocity-to-be-gained vector [m/sec]
$\overline{\Delta V'}$	Approximation for $\overline{\Delta V}$ [m/sec]
ΔV_b	Velocity bias to allow for engine thrust decay after cutoff [m/sec]
ΔV_{cx}	Change in velocity along X_S from velocity counter [m/sec]
ΔV_{cy}	Change in velocity along Y_S from velocity counter [m/sec]
ΔV_{cz}	Change in velocity along Z_S from velocity counter [m/sec]
ΔV_f	Expected change in velocity in the S-coordinate system [pulses]
ΔV_{fx}	Expected change in velocity along X_S due to thrust [pulses]
ΔV_{fy}	Expected change in velocity along Y_S due to thrust [pulses]
ΔV_{fz}	Expected change in velocity along Z_S due to thrust [pulses]
ΔV_{gx}	Change in velocity along X_S due to gravity [m/sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
ΔV_{gy}	Change in velocity along Y_S due to gravity [m/sec]	
ΔV_{gz}	Change in velocity along Z_S due to gravity [m/sec]	
$\overline{\Delta V}_{SAV}$	Vector symbol for the low order bits of the computed velocity change during the past orbital navigation pass, saved to reduce truncation error [m/sec]	
ΔV_x	Change in velocity along X_S [m/sec]	
ΔV_y	Change in velocity along Y_S [m/sec]	
ΔV_z	Change in velocity along Z_S [m/sec]	
ΔX	Attitude error about roll gimbal axis [pirads]	*
ΔX_{mf}	Change in X_S in ΔT seconds due to thrust [m]	
ΔX_{Sg}	Change in radius vector along X_S axis due to gravitational acceleration [m]	
ΔX_V	Component of $\overline{\Delta R}$ along X_V axis [m]	
$\dot{\Delta X}_V$	Component of $\overline{\Delta V}$ along X_V axis [m/sec]	
$\dot{\Delta X}'_V$	Component of $\overline{\Delta V}'$ along X_V axis [m/sec]	
ΔY	Attitude error about pitch gimbal axis [pirads]	*

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>	
ΔY_{mf}	Change in Y_S in ΔT seconds due to thrust [m]	
ΔY_{Sg}	Change in radius vector along Y_S axis due to gravitational acceleration [m]	
ΔY_V	Component of $\overline{\Delta R}$ along Y_V axis [m]	
$\Delta \dot{Y}_V$	Component of $\overline{\Delta V}$ along Y_V axis [m/sec]	
$\Delta \dot{Y}'_V$	Component of $\overline{\Delta V'}$ along Y_V axis [m/sec]	
ΔZ	Attitude error about yaw gimbal axis [pirads]	*
ΔZ_{mf}	Change in Z_S in ΔT seconds due to thrust [m]	
ΔZ_{Sg}	Change in radius vector along Z_S axis due to gravitational acceleration [m]	
ΔZ_V	Component of $\overline{\Delta R}$ along Z_V axis [m]	
$\Delta \dot{Z}_V$	Component of $\overline{\Delta V}$ along Z_V axis [m/sec]	
$\Delta \dot{Z}'_V$	Component of $\overline{\Delta V'}$ along Z_V axis [m/sec]	*
$\Delta \theta_{xe}$	Expected change in θ_x [pirads]	
$\Delta \theta_{ye}$	Expected change in θ_y [pirads]	
$\Delta \theta_{ze}$	Expected change in θ_z [pirads]	

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
$\Delta\chi_x$	Computed change in χ'_x for present major loop [pirads]
$\Delta\chi'_x$	Computed χ_x guidance command increment for minor loop [pirads]
$\Delta\chi_y$	Computed change in χ'_y for present major loop [pirads]
$\Delta\chi'_y$	Computed χ_y guidance command increment for minor loop [pirads]
$\Delta\chi_z$	Computed change in χ'_z for present major loop [pirads]
$\Delta\chi'_z$	Computed χ_z guidance command increment for minor loop [pirads]
<u>EPSILON</u>	
ϵ_2	Time prior to S-IVB cutoff to begin $\tilde{\chi}$ -steering [sec] (see note 1)
<u>THETA</u>	
θ_R	Total angular rotation of earth since GRR [pirads]
θ_T	Desired terminal flight path angle [pirads]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
θ_x	Platform gimbal angle about X_p axis [pirads]
θ'_x	Value of θ_x used in minor loop [pirads]
θ_{xa}	Average value of θ_x during next major loop pass [pirads]
θ_{xe}	Expected value of θ_x [pirads]
$\dot{\theta}_{xe}$	Expected rate of change of θ_x [pirads/sec]
θ_y	Platform gimbal angle about Y_p axis [pirads]
θ'_y	Value of θ_y used in minor loop [pirads]
θ_{ya}	Average value of θ_y during next major loop pass [pirads]
θ_{ye}	Expected value of θ_y [pirads]
$\dot{\theta}_{ye}$	Expected rate of change of θ_y [pirads/sec]
θ_z	Platform gimbal angle about Z_p axis [pirads]
θ'_z	Value of θ_z used in minor loop [pirads]
θ_{za}	Average value of θ_z during next major loop pass [pirads]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
θ_{ze}	Expected value of θ_z [pirads]
$\dot{\theta}_{ze}$	Expected rate of change of θ_z [pirads/sec]
<u>LAMBDA</u>	
λ	Angle from launch meridian to the descending node of the desired orbit computed as a function of λ_0 , $\dot{\lambda}$, and T_D .
λ_0	Value of λ valid for a GRR time of T_{GRR0} [pirads]
	*
	*
$\dot{\lambda}$	Time rate of change of λ_0 [pirads/sec]
<u>MU</u>	
μ	Product of the universal gravitational constant and the mass of the earth [m^3/sec^2]
<u>PI</u>	
π	3.14159265

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>RHO</u>	
ρ	Atmospheric density [kg/m ³]
ρ_c	Constant ρ for use when altitude is less than h_1 [kg/m ³]
ρ_0 - ρ_5	Coefficients for atmospheric density polynomial [kg/m ³ , kg/m ⁴ , kg/m ⁵ , kg/m ⁶ , kg/m ⁷ , kg/m ⁸]
<u>TAU</u>	
τ	Ratio of mass to mass flow rate [sec]
τ_1	Value of τ during first IGM phase [sec]
τ_{10}	Initial value of τ_1 used in artificial τ calculations [sec]
τ_3	Value of τ during second IGM phase [sec]
τ_{3K}	Intermediate τ_3 based on performance of the first phase burn; used in computing weighted artificial τ_3 [sec]
τ_{3M}	IGM τ_3 based on $(M/F)_S$ and V_{ex3} used in computing weighted artificial τ_3 [sec]
τ_{3N}	Nominal value of τ_3 used in computing artificial τ_3 [sec]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
<u>PHI</u>	
ϕ_H	Geodetic latitude of Huntsville used in flight simulation [pirads]
ϕ_i	Range angle traveled since liftoff [pirads]
$\dot{\phi}_i$	Rate of change of ϕ_i [pirads/sec]
ϕ_{iT}	Predicted range angle-to-go [pirads]
ϕ_L	Geodetic latitude of launch site [pirads]
ϕ'_L	Geocentric latitude of launch site [pirads]
ϕ_P	Angle between \bar{P} and X_4 axis [pirads]
ϕ_{SO}	Range angle at control return from SC to IU [pirads]
ϕ_T	Predicted terminal range angle [pirads]
$\dot{\phi}_T$	Rate of change of predicted terminal range angle [pirads/sec]
<u>CHI</u>	
χ	Desired vehicle attitude (steering angle) [pirads]
$\tilde{\chi}$	Desired vehicle attitude (steering angle) neglecting position correction terms [pirads]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
χ_x	Desired platform gimbal angle about X_p axis [pirads]
χ'_x	Rate limited value of χ_x in minor loop [pirads]
χ''_x	Value of χ'_x used for flight simulation [pirads]
χ'_{xp}	Predicted value of χ'_x at end of present major loop [pirads]
χ_y	Desired platform gimbal angle about Y_p axis [pirads]
$\tilde{\chi}_y$	Desired pitch attitude neglecting position correction terms [pirads]
χ'_y	Rate limited value of χ_y used in minor loop [pirads]
χ''_y	Value of χ'_y used for flight simulation [pirads]
χ'_{yp}	Predicted value of χ'_y at end of present major loop [pirads]
χ_{y4}	Desired pitch attitude in 4-system calculated by IGM [pirads]
χ_z	Desired platform gimbal angle about Z_p axis [pirads]
$\tilde{\chi}_z$	Desired yaw attitude neglecting position correction terms [pirads]

TABLE 15-2 DEFINITIONS (CONTINUED)

<u>Symbol</u>	<u>Definition and Comments</u>
χ'_z	Rate limited value of χ_z used in minor loop [pirads]
χ''_z	Value of χ'_z used for flight simulation [pirads]
χ'_{zp}	Predicted value of χ'_z at end of present major loop [pirads]
χ_{z4}	Desired yaw attitude in 4-system calculated by IGM [pirads]
<u>OMEGA</u>	
ω_E	Rotation rate of the earth [pirads/sec]

TABLE 15-3 MAXIMUM VALUES OF SELECTED VARIABLES

Variable	Expected Maximum	Variable	Expected Maximum
(M/F)	0.40 E 00	J_y	0.20 E 07
$(M/F)_S$	0.40 E 00	J_1	0.10 E 07
$\Delta \dot{X}'_V$	0.40 E 04	J_3	0.10 E 07
$\Delta \dot{Y}'_V$	0.20 E 04	J'_3	0.10 E 07
$\Delta \dot{Z}'_V$	0.80 E 04	K_P	0.10 E 01
1/R	0.20 E-06	K_y	0.10 E 01
G_T	0.10 E 02	K_1	0.10 E 01
G_{Sx}	0.10 E 02	K_2	0.10 E 01
G_{Sy}	0.10 E 02	K_3	0.10 E 01
G_{Sz}	0.10 E 02	K_4	0.10 E 01
C_2	0.19 E 01	L_P	0.80 E 04
C_4	0.19 E-02	L_y	0.80 E 04
Δ_{L3}	0.20 E 04	L'_y	0.80 E 04
D_P	0.10 E 07	L_1	0.80 E 04
$\Delta T'_3$	0.12 E 03	L_3	0.80 E 04
$\Delta \dot{X}_V$	0.40 E 04	L'_3	0.80 E 04
ΔX_V	0.50 E 06	P_1	0.25 E 09
D_y	0.10 E 07	P_3	0.10 E 10
$\Delta \dot{Y}_V$	0.20 E 04	Q_P	0.50 E 09
ΔY_V	0.25 E 06	Q_y	0.50 E 09
$\Delta \dot{Z}_V$	0.80 E 04	Q_1	0.13 E 09
J_P	0.20 E 07	Q_3	0.64 E 08

TABLE 15-3 MAXIMUM VALUES OF SELECTED VARIABLES (CONTINUED)

Variable	Expected Maximum
SMCY	0.10 E 01
SMCZ	0.10 E 01
S _p	0.40 E 07
S _y	0.40 E 07
S ₁	0.10 E 07
S ₃	0.10 E 07
τ ₁	0.10 E 04
τ ₃	0.10 E 04
T*	0.10 E 04
T _{1i}	0.50 E 03
T _{3i}	0.10 E 04
U ₁	0.80 E 11
U ₃	0.68 E 11
V _T	0.16 E 05
\ddot{X}_{VgT}	0.10 E 02
\dot{X}_V	0.80 E 04
\dot{X}_{VT}	0.40 E 04
\dot{X}_4	0.16 E 05
F' _{Sx}	0.10 E 01
X _V	0.80 E 07
\ddot{X}_{Vg}^*	0.10 E 02
X _{VT}	0.80 E 07

Variable	Expected Maximum
X ₄	0.80 E 07
\ddot{Y}_{VgT}	0.10 E 02
\dot{Y}_V	0.40 E 04
F' _{Sy}	0.10 E 01
Y _V	0.40 E 07
\ddot{Y}_{Vg}^*	0.10 E 01
\ddot{Z}_{VgT}	0.10 E 02
\dot{Z}_V	0.16 E 05
\dot{Z}_{VT}	0.16 E 05
\dot{Z}_4	0.16 E 05
F' _{Sz}	0.10 E 01
Z _V	0.40 E 07
\ddot{Z}_{Vg}^*	0.10 E 02
Z ₄	0.80 E 07
\dot{X}_S	0.16 E 05
X _S	0.80 E 07
\dot{Y}_S	0.40 E 04
Y _S	0.80 E 07
\dot{Z}_S	0.16 E 05
Z _S	0.80 E 07
R	0.80 E 07