NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

* APOLLO 17

ALL LAUNCH DATES

BASIC

FLIGHT CREW G&N DICTIONARY

PREPARED BY

FLIGHT PLANNING BRANCH
CREW PROCEDURES DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

JUNE 15, 1972

APOLLO 17

LM FLIGHT CREW G&N DICTIONARY

JUNE 15, 1972

PREPARED BY: T. H. Kaiser
T. H. KAISER
BOOK MANAGER

APPROVED BY: D. W. Holloway
T. W. HOLLOWAY, CHIEF
MISSION OPERATION SECTION
CREW PROCEDURES DIVISION

It is requested that any organization having comments, questions, or suggestions concerning this document contact T. H. Kaiser, Flight Planning Branch, CG5, Building 4, room 231, telephone 483-4271.

This document is under the configuration control of the Crew Procedures Control Board (CPCB). All proposed changes should be submitted to the Apollo Flight Data File Manager, T. W. Holloway, CG5, Building 4, room 230, telephone 483-4271.

Distribution of this document is controlled by Flight Data File Manager, T. W. Holloway, Flight Planning Branch, Crew Procedures Division.

FLIGHT CREW G&N DICTIONARY

LIST OF EFFECTIVE PAGES

Basic 6/15/72

LIST OF EFFECTIVE PAGES (CONT)

PAGE	DATE
1-60	6/15/72
1-61	6/15/72
1-62	6/15/72
1-63	6/15/72
1-64	6/15/72
1-65	6/15/72
1-66	6/15/72
1-67	6/15/72
1-68	6/15/72
1-69	6/15/72
1-70	6/15/72
1-71	6/15/72
1-72	6/15/72
1-73	6/15/72
1-74	6/15/72
1-75	6/15/72
1-76	6/15/72
2-1	6/15/72
2-2	6/15/72
2-3	6/15/72
2-4	6/15/72
2-5	6/15/72
2-6	6/15/72
2-7	6/15/72
2-8	6/15/72
2-9	6/15/72
2-10	6/15/72
2-11	6/15/72
2-12	6/15/72
2-13	6/15/72
2-14	6/15/72
2-15	6/15/72
2-16	6/15/72
2-17	6/15/72
2-18	6/15/72
2-19	6/15/72
2-20	6/15/72
2-21	6/15/72
2-22	6/15/72
2-23	6/15/72
2-24	6/15/72
2-25	6/15/72
2-26	6/15/72
3-1	6/15/72
3-2	6/15/72
3-3	6/15/72
3-4	6/15/72
3-5	6/15/72
3-6	6/15/72
4-1	6/15/72
4-2	6/15/72

CONTENTS

DATE 6/15/72

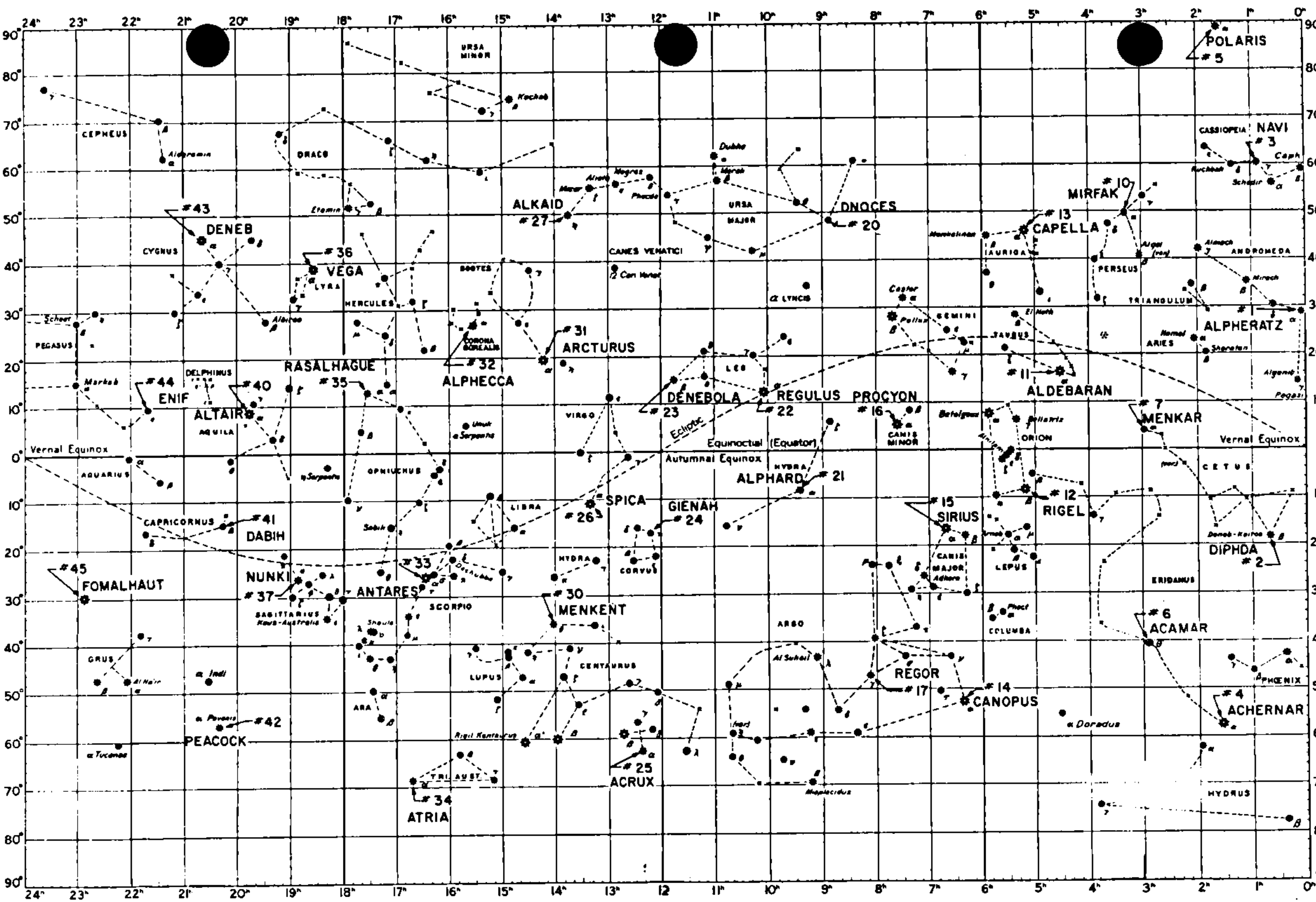
1. PGNS

CONTENTS (CONT)

DATE 6/15/72

CONTENTS (CONT)

DATE 6/15/72



POLARIS
5
NAVI
3
CASSIOPEIA
Caph
Schedir
URSA MINOR
Kochab
CEPHEUS
Alderamin
DRACO
Etamin
Dubhe
Merak
URSA MAJOR
Megrez
Alioth
Mizar
Phecda
ALKAID
27
DNOCES
20
MIRFAK
10
13
CAPELLA
Menkalinan
AURIGA
PERSEUS
Algol
ANDROMEDA
Almach
Mirach
TRIANGULUM
1
ALPHERATZ
ARIES
Hamal
Sheratan
Algenib
Pegasi
43
DENEB
CYGNUS
Albireo
36
VEGA
LYRA
HERCULES
BOOTES
CORONA BOREALIS
31
ARCTURUS
32
ALPHECCA
CANES VENATICI
12 Can Venat
α LYNCIS
Castor
Pollux
GEMINI
El Nath
TAURUS
11
ALDEBARAN
Scheat
PEGASUS
Markab
44
ENIF
DELPHINUS
40
ALTAIR
AQUILA
RASALHAGUE
35
LEO
23
DENEBOLA
REGULUS
22
PROCYON
16
CANIS MINOR
Betelgeuse
Bellatrix
ORION
7
MENKAR
Unuk
α Serpentis
VIRGO
Ecliptic
Equinoctial (Equator)
Autumnal Equinox
Vernal Equinox
AQUARIUS
η Serpentis
OPHIUCHUS
HYDRA
ALPHARD
21
CETUS
15
SIRIUS
12
RIGEL
CAPRICORNUS
41
DABIH
LIBRA
26
SPICA
GIENAH
24
CORVUS
Sabik
Deneb Kaitos
DIPHDA
2
CANIS MAJOR
Adhara
LEPUS
45
FOMALHAUT
NUNKI
37
SAGITTARIUS
Kaus Australis
33
ANTARES
SCORPIO
HYDRA
30
MENKENT
ERIDANUS
Phact
COLUMBA
ARGO
6
ACAMAR
Shaula
GRUS
Al Nair
α Indi
LUPUS
CENTAURUS
Al Suhail
REGOR
17
PHOENIX
4
ACHERNAR
ARA
14
CANOPUS
α Pavonis
42
PEACOCK
Rigil Kentaurus
α Doradus
α Tucanae
25
ACRUX
TRI. AUST.
34
ATRIA
Miaplacidus
HYDRUS

DATE 6/15/72

STAR LIST

NO	STAR NAME (Numerical)
00	Planet
1	Alpheratz
2	Diphda
3	Navi
4	Achernar
5	Polaris
6	Acamar
7	Menkar
10	Mirfak
11	Aldebaran
12	Rigel
13	Capella
14	Canopus
15	Sirius
16	Procyon
17	Regor
20	Dnoces
21	Alphard
22	Regulus
23	Denebola
24	Gienah
25	Acrux
26	Spica
27	Alkaid
30	Menkent
31	Arcturus
32	Alphecca
33	Antares
34	Atria
35	Rasalhague
36	Vega
37	Nunki
40	Altair
41	Dabih
42	Peacock
43	Deneb
44	Enif
45	Fomalhaut
46	Sun
47	Earth
50	Moon

STAR NAME (Alphabetical)	NO
Acamar	6
Achernar	4
Acrux	25
Aldebaran	11
Alkaid	27
Alphard	21
Alphecca	32
Alpheratz	1
Altair	40
Antares	33
Arcturus	31
Atria	34
Canopus	14
Capella	13
Dabih	41
Deneb	43
Denebola	23
Diphda	2
Dnoces	20
Earth	47
Enif	44
Fomalhaut	45
Gienah	24
Menkar	7
Menkent	30
Mirfak	10
Moon	50
Navi	3
Nunki	37
Peacock	42
Planet	00
Polaris	5
Procyon	16
Rasalhague	35
Regor	17
Regulus	22
Rigel	12
Sirius	15
Spica	26
Sun	46
Vega	36

VERBS

01	Display Octal Comp 1 in R1
02	Display Octal Comp 2 in R1
03	Display Octal Comp 3 in R1
04	Display Octal Comp 1&2 in R1&R2
05	Display Octal Comp 1,2&3 in R1,R2&R3
06	Display Decimal in R1 or R1,R2 or R1, R2,R3
07	Display DP Decimal in R1&R2
11	Monitor Octal Comp 1 in R1
12	Monitor Octal Comp 2 in R1
13	Monitor Octal Comp 3 in R1
14	Monitor Octal Comp 1&2 in R1&R2
15	Monitor Octal Comp 1,2&3 in R1,R2&R3
16	Monitor Decimal in R1 or R1,R2 or R1,R2,R3
17	Monitor DP Decimal in R1&R2
21	Load Component 1 in R1
22	Load Component 2 in R2
23	Load Component 3 in R3
24	Load Component 1&2 in R1&R2
25	Load Component 1&2&3 in R1&R2&R3
27	Display Fixed Memory
30	Request Executive
31	Request Waitlist
32	Recycle
33	Proceed Without DSKY Inputs
34	Terminate
35	Test Lights (P00 only)
36	Request Fresh Start
37	Change Program
40	Zero CDU's (Specify N20 or N72)
41	Coarse Align CDU's (Specify N20 or N72)
42	Fine Align IMU
43	Load FDAI Error Needles (Test; P00 Only)
44	Terminate Continuous Designate (V41N72 Option 2)
47	Initialize AGS
48	Load DAP Data
49	Start Crew Defined Maneuver (P00 Only)
50	Please Perform

DATE 6/15/72

52 Mark Cursor
53 Mark Spiral
54 Mark X or Y
55 Increment LGC Time (Decimal)
56 Terminate RR Tracking (P20,P22,&P25)
57 Enable LR Update
58 Inhibit LR Update
59 Command LR To Pos. 2
60 Display Attitude Rates On Error Needles (NON AGS)
61 Display DAP Attitude Error (Mode 1)
62 Display Total Attitude Error (Mode 2)
63 Start RR/LR Self-Test
64 Start S-Band Antenna Routine
65 Disable U,V Jets During DPS Burns
66 Set LM State Vector Into CSM State Vector
67 W-Matrix RSS Error Display
68 Terminate LR Terrain Model
69 Cause Restart
70 Update Liftoff Time (P27)
71 Universal Update Load Block Addresses (P27)
72 Universal Update Load Singular Addresses (P27)
73 Update LGC Time (Octal) (P27)
74 Initialize Erasable Dump via Downlink (42 sec)
75 Enable U,V Jets During DPS Burns
76 Set Min Impulse Mode in DAP
77 Set Rate Command/Attitude Hold Mode in DAP
78 Start LR Spurious Test
79 Stop LR Spurious Test
80 Update LM State Vector
81 Update CSM State Vector
82 Request Orbit Parameter Display
83 Rendezvous Parameter Display
85 Display RR LOS Az and El
89 Start Rendezvous Final Attitude Maneuver (P00 Only)
90 Request Rendezvous Out of Plane Display (Non Ave G)
91 Display Banksum (P00 Only)
92 Start IMU Performance Test (non-flight) (OPR ERR)
93 Enable W-Matrix Initialization (Clear Rendwflg)
95 Inhibit State Vector Update (via Navigation)
96 Interrupt Integration and Go To P00
97 Perform Engine Fail Procedure
99 Enable Engine Ignition

DATE 6/15/72

NOUNS V - Can Be Called At Any Time For Valid Or Partially Valid Data

01V	Address To Be Specified (Frac)		.XXXXX
02V	Address To Be Specified (Whole)		XXXXX.
03V	Address To Be Specified (Degree)		.01°
04	Gravity Error Angle		.01°
05	Angular Error/Difference		.01°
06	Option Code		Octal
	Desired Option		Octal
	Data		Octal
07	Chan/E-Memory Operator:	Identifier	Octal
		Bit ID	Octal
		Action	Octal
08V	Alarm Data		Octal
09V	Alarm Codes		Octal
10V	Channel To Be Specified		Octal
11	TIG CSI/T(APOAPSIS)		h,m,.01s
12	Option Code (Extended Verbs Only)		Octal
	Desired Option		Octal
13	TIG CDH		h,m,.01s
15V	Increment Address		Octal
16	Time of Event (Extended Verbs Only)		h,m,.01s
18	Desired Maneuver To FDAI R,P,Y Angles		.01°
20V	ICDU Angles Y,P,R (OG,IG,MG)		.01°
21V	PIPA Pulses		XXXXX.
22	New ICDU Angles Y,P,R,(OG,IG,MG)		.01°
24	Delta Time For LGC Clock		h,m,.01s
25	Checklist (Used With V50)		Octal
	(R2 Valid For Code 00016)		Octal
26V	Prio/Delay, ADRES, BBCON		Octal
27V	Self Test ON/OFF		Octal
32	Time From Perigee		h,m,.01s
33	TIG		h,m,.01s
34	Time of Event		h,m,.01s
35	Time From Event		h,m,.01s
36V	LGC Clock Time		h,m,.01s
37	TIG TPI		h,m,.01s
38V	Time of State Being Integrated		h,m,.01s
40	Time From Ignition/Cutoff		m-s
	VG		.1fps
	ΔV (Accumulated)		.1fps

DATE 6/15/72

41	Target Azimuth (V92 Only)	.01°
	Elevation	.001°
42	Pre-Burn Apogee	.1nm
	Pre-Burn Perigee	.1nm
	ΔV (Required)	.1fps
43	Latitude (+North)	.01°
	Longitude (+East)	.01°
	Altitude	.1nm
44	Apogee	.1nm
	Perigee	.1nm
	TFF	m-s
45V-R1	Marks	XXXXX.
	TFI Of Next/From Last Burn	m-s
	MGA	.01°
46V-R2	Digital Autopilot Configuration	Octal
	Switch Function Fail Code	Octal
47V	LM Weight	lbs
	CSM Weight	lbs
48	Engine Gimbal Pitch Trim (+ Only)	.01°
	Engine Gimbal Roll Trim (+ Only)	.01°
49	ΔR	.01nm
	ΔV	.1fps
	Source Code (1:R,2:Ṙ,3:SHFT,4:TRUN)	0000X.
51	S-Band Antenna: Pitch	.01°
	Yaw	.01°
52	Central Angle of Active Vehicle	.01°
54	Range (Calc From S.V.)	.01nm
	Range Rate	.1fps
	Theta	.01°
55	No. of Apsis Crossings P32/72 Or Precision Offsets P34/74	0000X.
	Elevation Angle	.01°
	Central Angle of Passive Vehicle	.01°
56	RR LOS Azimuth	.01°
	Elevation	.01°
58	Perigee Alt. (Post TPI)	.1nm
	ΔV TPI	.1fps
	ΔV TPF	.1fps
59	ΔV1 LOS (+I) If Heads-up (+ Fwd)	.1fps
	ΔV2 LOS (+(HXI)XI) Facing Tgt, (+ Rt)	.1fps
	ΔV3 LOS (+HXI) Below, Behind (+ Dn)	.1fps

(H=Orbital Momentum Vector of Active Vehicle)
(I=LOS Vector To Target)

DATE 6/15/72

60	V (Fwd)(+Along +Z)	.1fps
	H DOT (+ Increasing H)	.1fps
	H (+H > RLS)	ft
61	TG Next Target	m-s
	TFI	m-s
	Crossrange (+ S/C Is South of L.S.)	.1nm
62	VI	.1fps
	TFI	m-s
	ΔV Accumulated	.1fps
63	ΔH (+LR > LGC)	ft
	H DOT (+ Increasing H)	.1fps
	H (+H > RLS)	ft
64	TR/LPD	sec/deg
	H DOT (+ Increasing H)	.1fps
	H (+H > RLS)	ft
65V	Sampled LGC Time	h,m,.01s
66V-R2	LR Slant Range	ft
	LR Position	00001/00002
67	LR VX | V63 Only	fps
	VY |	fps
	VZ |	fps
68	Ground Range to L.S.	.1nm
	TG Next Target	m-s
	VI	.1fps
69	Ldg Site Correction Comp Z (+ Dnrng)	ft
	Y (+ Rt of RLS)	ft
	X (+ Alt > RLS)	ft
70	AOT Detent/Star Code	Octal
71	AOT Detent/Star Code (R1 Only With V01)	Octal
	Mark X/Cur Cntr [Indicator A; Cntr E	Octal
	Mark Y/Spir Cntr [(A000E) Max E=5	Octal
72	RR Trunnion Angle [Req's. RR MODE-LGC	.01°
	RR Shaft Angle [For Validity	.01°
73	Desired RR Trunnion Angle	.01°
	Desired RR Shaft Angle	.01°
74	TFI	m-s
	Yaw	.01°
	Pitch	.01°
75	ΔH (CDH)	.1nm
	ΔT (CDH-CSI/TPI-CDH)(Modular 60)	m-s
	ΔT (TPI-CDH/TPI-Nom TPI)(Modular 60)	m-s
76	FINAL HORIZ VEL	.1fps
	FINAL H DOT	.1fps
	Crossrange(+ Post Insert Orb North of L.S.)	.1nm

DATE 6/15/72

77	ΔT to Engine Cutoff (TFC)	m-s
	VGY (LM) (+Rt)	.1fps
	VI	.1fps
78	RR Range	.01nm
	RR Range Rate	.1fps
	TFI	m-s
79	Cursor Angle	.01°
	Spiral Angle	.01°
	Detent Position	0000X.
80	Data Indicator (0:No Lock, 1:Lock)	XXXXX.
	Omega (⊀ Between RR LOS & S/C +Z)	.01°
81	ΔVX (LV) (+ Fwd) [(N81 Is P30 ΔV Increment)]	.1fps
	ΔVY (LV) (+ Rt)	.1fps
	ΔVZ (LV) (+ Dn)	.1fps
82	ΔVX (LV) (+ Fwd)	.1fps
	ΔVY (LV) (+ Rt)	.1fps
	ΔVZ (LV) (+ Dn)	.1fps
83	ΔVX (LM) (+ Up)	.1fps
	ΔVY (LM) (+ Rt)	.1fps
	ΔVZ (LM) (+ Fwd)	.1fps
84	ΔVX (Other Vehicle) + (RXV)XR	.1fps
	ΔVY (Other Vehicle) + (VXR)	.1fps
	ΔVZ (Other Vehicle) + (-R)	.1fps
85	VGX (LM) (+ Up)	.1fps
	VGY (LM) (+ Rt)	.1fps
	VGZ (LM) (+ Fwd)	.1fps
86	ΔVX (LV) (+ Fwd) [N86 Is P40-42 ΔV After	.1fps
	ΔVY (LV) (+ Rt) N81 Has Been Rotated	.1fps
	ΔVZ (LV) (+ Dn) By Half The Central ⊀]	.1fps
87	Backup Optics LOS Azimuth (+ Rt)	.01°
	Elevation (+ Up)	.01°
88	Celestial Body Vector X,Y,Z	.XXXXX
89	Latitude (+ North)	.001°
	Longitude/2 (+ East)	.001°
	Altitude	.01nm
90	Rndz Out of Plane Param:	
	Y (+LM Rt of CSM)	.01nm
	YDOT (+ Increasing Y)	.1fps
	PSI (⊀ Between S.V. LOS & L.V. Fwd)	.01°
91	Alt	10nm
	Vel	fps
	Flt Path Angle	.01°

DATE 6/15/72

92	LGC Guidance Throttle Command	%
	H DOT (+ Increasing H)	.1fps
	H (+H > RLS)	ft
93	ΔGyro Torquing Angles X,Y,Z	.001°
94	VGX (LM) (+Up)	.1fps
	H DOT (+Increasing H)	.1fps
	H (+H > RLS)	ft
97	System Test Inputs (V92 Only)	XXXXX.
98	System Test Results (V92 Only)	XXXXX. .XXXXX XXXXX.
99	W-Matrix: Position Error	ft
	Velocity Error	.1fps
	Radar Bias Angle Error	mr

V50 N25 CHECKLIST CODES

PROG	R1 CODE	DEFINITION	OPTIONS
52	00013	C/A or Gyro Torque	(C/A) PRO (TORQ) PGNS-MIN IMP ENTR
52 57	00014	Check or Exit Align	(CHECK) PRO (EXIT) ENTR
52	00015	Align Type	(MAN) ENTR (PICAPAR) PRO (CUR/SPIR) V32E
52 57	00016	Unused Mark Sets (R2 Contains No.)	(REMARK) ENTR (ACCEPT) PRO
06	00062	Pwr Dn LGC	(STBY) PRO (OPR) V96E
20 22 V63	00201	RR Acq Mode	(MAN) ENTR (P20 Only) (LGC) RR MODE - LGC PRO
12 40	00203	Sel PGNS Auto	(BYPASS) ENTR (AUTO) GUID CONT - PGNS

DATE 6/15/72

42 63 70 71			MODE CONT (P) - AUTO THR CONT - AUTO (Unless Masked or P12, 42 , 71) PRO
20	00205	Perform RR Acq Manually	(LOCK) Verify SIG STG NO TRACK Lt - Out RR MODE - LGC PRO (LGC MNVR) ENTR (Go To 00201)
63	00500	Position LR To DESCENT	(DES) LDG ANT - DES Wait 10s,AUTO,PRO (BYPASS) ENTR

N06 or N12 OPTION CODES

R1 CODE	DEFINITION	R2 CODE
00001	Specify IMU Orientation	1 = Preferred 2 = Nominal 3 = REFSMMAT 4 = Landing Site
00002	Specify Vehicle	1 = LM 2 = CSM
00003	Specify Tracking Attitude	1 = Preferred (+Z) 2 = Other (+X)
00004	Specify Radar	1 = RR, 2 = LR
00006	Specify RR Coarse Align Option	1 = Lock On 2 = Continuous Designate
00010	Specify Alignment Mode	0 = REFSMMAT or Stored Att 1 = REFSMMAT + 1G 2 = 2 Bodies 3 = 1 Body + 1G
00012	Specify CSM Orbit Option	1 = No Orbit Change 2 = Change Orbit To Pass Over LM

DATE 6/15/72

V05 N09 ALARM CODES

00111 P Mark Missing (Marks Lost)
Restart Mark Sequence

00112 P LGC Not Expecting Mark, Mark Reject, or ROD Attempt
Cont Prog

00113 P/H Markrupt But No Inbits or Wrong Inbits
Cont Prog; If Recurs Notify MSFN

00115 P Mark Reject Ignored
Cont Prog

00206 P CDU Zero Not Allowed With Coarse Align & Gimbal Lock
V41N20E, E,E,E; V40N20E

00207 P/H ISS Turn-On Request Not Present For 90 Sec
CB(11) IMU OPR - Open, Wait 3 Min, Reclose; If Recurs and No ISS Warn, Continue

00210 P/H IMU Off When Should Be On
CB(11) IMU OPR - Open, Wait 3 Min, Reclose; If Recurs, V36E, Notify MSFN

00211 H Coarse Align Error >2°
If P52 or P57, Record N93, PRO On V50N25 (00014), Recheck; If Other Prog, Reduce S/C Drift And Cont

00212 H PIPA Fail But PIPA Not Being Used
Go to ISS Malf

00213 H Turn-On Request Present But IMU Pwr Off
CB(11) IMU OPR - Open, Wait 3 Min, Reclose; If Recurs,V36E, Notify MSFN

00214 P/H LGC Using IMU When Power Removed
See 00210 Or Term Prog

00217 H Coarse Align Or Pulse Torque Difficulty Has Occurred
If Also 00211, Perform 00211 Only; Reinitiate PROG, If Alarm Recurs Terminate Use Of IMU

00220 P No Known REFSMMAT
Align Or If Aligned, V25N07E,77E,10000E,1E

00401 I Desired MGA Is Excessive
V06N22E, MNVR If MGA <85°; Or Realign IMU

GEN SYS C/O

DATE 6/15/72

00402 P DAP Steering Lost
Control Attitude Manually

00404 I Defined Star Not In Any AOT Detent
Crew Picked Star, PRO; LGC New Star, V32E

00405 I Two Stars Not In Fwd Detent At Present Attitude
Crew Specify, PRO; PICAPAR, Mnvr & V32E

00421 I W-MATRIX Overflow
Automatically Reinitialized, Continue

00501 I RR Ant Out Of Mode Limits
V32E, Mnvr, Reacquire

00502 I Non-Valid N73 Input
Redo V41N72E

00503 I RR Ant Designate Fail
LGC Search, PRO;
Redesig, V32E; If V41, Redo

00510 P RR Auto Discrete Not Present For V40 N72
CB(11) RR(2) - Close, RR-LGC,
Redo V40 N72

00511 H Both Or Neither LR Ant Pos Present
LDG ANT - Hover, No ΔH (N63)
Update (10 sec): LDG ANT - DES,
RSET

00514 P RR Auto Removed During Read Sequence
Check CB, RR MODE-LGC Or Terminate (V56E)

00515 H RR CDU Failed (Non-Transient)
RR Mode - Auto Track; Use AGS Or CSM For Delta V

00520 P/H Unexpected Radar Rupt
Continue

00522 P LR Ant Pos Changed After V63E
Continue

00523 P LR Ant Not In Pos 2 After V59E
Continue

00525 I SV/RR LOS Angle >3°
PRO For Angle. Side Lobe, V32E;
Main, Align COAS, PRO

00526 I RNG To CSM >400 NM
V16N54E, RNG, RNG RT

DATE 6/15/72

00527 I Mnvr Req In P20; LOS Not In Mode II In P22
Mnvr If P20, Term If P22

00530 I P22 Called At Least 10 Min Early
PRO (F37); Recall 5 Min Prior To Acq Time

00600 I No CSI Soln On First Iteration
V32E, Adjust Inputs

00601 I Post CSI HP <35,000 FT
V32E, Adjust Inputs

00602 I Post CDH HP <35,000 FT
V32E, Adjust Inputs

00603 I CSI To CDH Time <10 MIN
V32E, Adjust Inputs

00604 I CDH To TPI Time <10 MIN
V32E, Adjust Inputs

00605 I 15 Iterations And No CSI Soln
V32E, Adjust Inputs

00606 I CSI ΔV >1000 FPS
V32E, Adjust Inputs

00611 I No TIG For Given Elev Angle
P33, PRO Or V32E & Retarget; P34, PRO & Reselect Option

00701 I Illegal Align Tech Selected
V32E & Reselect Align Tech

00777 H PIPA Fail Caused ISS Lt
Go To ISS Malf

01102 H LGC Self Test Error
Copy N08, Perform V91E; Notify MSFN

01105 H Downlink Too Fast
If Alarm Recurs, Downlink Failed

01106 H Uplink Too Fast
If Alarm Recurs, Uplink Failed

01107 H Phase Table Discrepancy (Fresh Start Has Occurred)
If Time Critical, GUID CONT - AGS; Notify MSFN Then V74E, P27 & V48 As Necessary, V37E51E,PRO,V37E00E; If Recurs, LGC Failed

01301 I Arcsine/Arccos Input Too Large (> One)
Notify MSFN, Continue

01406 I TGO Comp Fail (P63/64)
If Recurs, P66 Or GUID CONT - AGS

DATE 6/15/72

01407 P VG Increasing
GUID CONT - AGS Or Term Burn

01410 P/I DES Guid Eqn's Overflow (P63/64/66)
If Recurs, P66 Or GUID CONT - AGS

01412 I Non Converging PDI TIG (P63)
MSFN Uplink New S.V. And Tgt

01466 P/I Insufficient Throt Servicing (P66)
If Recurs, Man Thr + Att Hold (Or AGS)

01520 P V37 Not Presently Allowed
Reselect V37

01703 P TIG Slip Due To Integration, Cont Or If PDI,
Check For Blank DSKY At DET = +20s
If Blanked, (Man Ign), TTCA Up At DET = +26s
If Not Blanked, Slip PDI

01706 P Prog/Engine Mismatch
Change Prog Or Reload DAP; If P42,
PRO, Man Stage At T-10

02001 I Y/Z Trans Have Been Disabled
Re-Enable Jets Or Use Alternate
Cont Mode

02002 I X-Trans Has Been Disabled
Re-Enable Jets Or Use Alternate
Cont Mode

02003 I Yaw Has Been Disabled
Re-Enable Jets Or Use Alternate
Cont Mode

02004 I Pitch/Roll Have Been Disabled
Re-Enable Jets Or Use Alternate
Cont Mode

03777 H ICDU Fail Caused ISS Lt
Go To ISS Malf

04777 H ICDU/PIPA Fail Caused ISS Lt
Go To ISS Malf

07777 H IMU Fail Caused ISS Lt
Go To ISS Malf

10777 H IMU/PIPA Fail Caused ISS Lt
Go To ISS Malf

13777 H IMU/ICDU Fail Caused ISS Lt
Go To ISS Malf

14777 H IMU/ICDU/PIPA Fail Caused ISS Lt
Go To ISS Malf

DATE 6/15/72

20430 I Orbit Integration Overflow
GUID CONT - AGS Or MSFN Uplink S.V.

20607 I No Soln From Conic Subroutine
In Rndz, Burn CSM Or AGS Soln

21103 I Unused CCS Branch Executed
If AVE-G On & F37, GUID CONT - AGS;
Otherwise Reselect Prog Or Ext Verb

21204 P/I Zero Or Neg Time Waitlist Call
If AVE-G On & F37, GUID CONT - AGS;
Otherwise Reselect Prog Or Ext Verb

21302 I Sqrt Called With Neg Argument
If AVE-G On & F37, GUID CONT - AGS;
Otherwise Reselect Prog Or Ext Verb

21406 I Bad Return From Time To Tgt Routine (P63)
MSFN Uplink New S.V. & Recall P63

21501 H LGC Attempt To Use Illegal Pinball Info
If AVE-G On & F37, GUID CONT - AGS;
Otherwise Reselect Prog Or Ext Verb

31104 H Delay Routine Busy
Reselect Ext Vb, Notify MSFN

31201 P Exec Overflow (NO VAC)
Reselect Ext Vb, Notify MSFN

31202 P Exec Overflow (NO CORE)
Reselect Ext Vb, Notify MSFN

31203 P/I Waitlist Overflow (Too Many Tasks)
Reselect Ext Vb, Notify MSFN

31206 P Second Job Attempts To Sleep In Pinball
Reselect Ext Vb, Notify MSFN

31207 P NO VAC Area For Marks
Continue

31210 P Two Routines Using AOT, IMU, Or RDR At Same Time
Reselect Ext Vb Or Prog When Device Not Being Used By LGC

31211 P Illegal Interrupt Of Ext Vb
Continue; Reselect Ext Vb After Marks Complete

31502 P Illegal Flashing Display
Continue

32000 P DAP In Progress At Next DAP Request
Continue; If Recurs, Evaluate Vehicle Dynamics, V36E

DATE 6/15/72

3XXXX —— Generates Software Restart
2XXXX —— Abort Code, Program Goes To R00 (F 37)

NOTE: All 2XXXX Codes (If AVE-G Is On) Leave AVE-G On But Discontinue Guidance (F 37). Also If 2XXXX Code Is Generated While An Ext. Verb (With Displays) Is Active, The Code Will Act As 3XXXX (No F 37).

P - Procedure Caused Alarm
I - Input Data Caused Alarm
H - Hardware Caused Alarm

Alarms For V05N09
R1 First Alarm After RSET
R2 Second Alarm After RSET
R3 Most Recent Alarm

GENERAL SYSTEMS CHECKOUT

1 Go To P00 By One Of The Following As Necessary:
- a. V37E 00E
- b. V96E
- c. V36E (NO DAP Lt - On For 11 Sec)
  Wait 11 sec, Then
  V96E
- d. Force A Freshstart By Simultaneously Pressing & Holding RSET And MARK REJECT Until Prog Register Blanks (Possible PROG Alarm 00115)
  Wait 11 sec, Then
  V37E 00E
  Notify MSFN Then V74E (42 sec)

(If (c) or (d) Performed: V21 N01E, 30000E, 2324E Sets HIASCENT Back To Pad Value)

2 Perform State Vector Checks:
V82 (Both Options)
V83
P21

3 Check REFSMMAT Validity:
P52 (Check Auto Optics Positioning)

4 Perform LGC Self Test If Time Permits

5 If Steps 2 Or 3 Not Nominal, Perform P27 Update; Otherwise Continue

DATE 6/15/72

P06-P27

P06 PGNS PWR DOWN

1 V37E 06E
F 50 25 00062 POWER DOWN LGC
(TO GO TO STBY)
CB(11) IMU OPR - Open (NO DAP Lt-On)
PRO, Hold In Until STBY Lt - On
(TO STAY IN OPR) V96E
If IMU Desired & CB(11) IMU OPR - Open:
CB(11) IMU OPR - Close (NO ATT - On For 90 sec)
V25N07E, 77E, 10000E, 1E
V37E51E, PRO, V96E

P12 POWERED ASCENT
DAP - Set (12102)

1 V37E 12E
F 06 33 TIG(ASC) (h,m,.01s)
PRO

2 F 06 76 FINAL VH, FINAL H DOT, CROSSRANGE
PRO (.1fps,.1nm)

F 50 25 R1 00203 PGNS AUTO
* NOT SELECTED *
* (AUTO) GUID CONT - PGNS*
* MODE CONT (PGNS) -*
* AUTO *
* PRO *
* (BYPASS) ENTR *

3 06 74 TFI, FINAL FDAI YAW, PITCH ANGLES (m-s,.01°)
Record YAW _____°
PITCH _____°
Set DET To TFI

CMPTR ACTY Lt - On

*PROG Lt - On *
V05N09E 01703 TIG SLIPPED
* RSET, KEY REL *

CMPTR ACTY Lt - Off

DATE 6/15/72

-2:00 MASTER ARM - ON

-:35 DSKY Blanks

-:30 (AVE G ON)
06 74 TFI, FINAL FDAI YAW, PITCH ANGLES
(m-s,.01°)

-:10 ABORT STAGE - Push
ENG ARM - ASC

-:05 F 99 74 ENGINE ON ENABLE
(AUTO) PRO (Ign When TFI=:00)
(BYPASS) ENTR To APS OFF

*F 97 74 ENGINE FAIL *
* (RECYCLE ΔV MON) PRO *
* (RECYCLE) ENTR To TIG-5 *

4 06 74 TFI, FINAL FDAI YAW, PITCH ANGLES
(m-s,.01°)

IGN 06 94 VGX, H DOT, H (.1fps, ft)
ENG START - Push
Monitor Attitude Maneuver
To Recorded Ball Angles

X-axis override restored
at HDOT = 40 fps plus 12 sec

VGX Decreasing
H DOT Increasing Then Decreasing
H Increasing

5 To Check FINAL VH, FINAL H DOT, & CROSSRANGE
N76E (.1fps,.1nm)
To Monitor TFC, VGY, & VI (m-s,.1fps)
V16 N77E
KEY REL

DATE 6/15/72

6 06 94 VGX,H DOT,H (.1fps,ft)
VGX=200fps, ENG ARM - OFF

APS OFF F 16 94 VGX,H DOT,H (.1fps,ft)
ABORT STAGE - Reset
ENG STOP - Push Then Reset
PRO

⑦ F 16 85 VG XYZ (LM) (.1fps)
Null Components
(TERM) PRO
(DISP ORB PARAM) V82E
F 16 44 HA,HP,TFF (.1nm,m-s)
Record HA _____
HP _____
TFF _____
PRO To ⑦

8 F 37

P20 RENDZ NAV

1 CB(11) RR (2) - Close, Wait 10 sec
V37E 20E
(TO TERM-V56E)
(SV OPTION, V80E LM, V81E CSM, V95E NONE)
*PROG Lt - On *
*V05 N09E 00526 RNG > 400 nmi *
* V16 N54E Rng, Rng Rt(.01nm,.1fps)*
* N54 Is Updated Every 5 sec *
* When Rng < 400nm, Go To Step ②*

② (If MODE CONT (P) - ATT HOLD, Go To ③)
(If MODE CONT (P) - AUTO & Pointing Error <15°, To ③
Auto Mnvr With No Display)
F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT (PGNS)-AUTO
PRO(F50 18 Returns Upon Completion Of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR To ③ (To ⑧ If Entered From
⑧ Via V32E)
(To ⑤ If Entered From
⑤ Via ENTR or 501 Alarm)

DATE 6/15/72

③ RR MODE- LGC To ⑥
(To ⑦ If Entered From ⑤
or ⑧ via PRO)
- SLEW or AUTO TRACK To ④

④ F 50 25 00201 RR ACQ MODE
(AUTO) RR MODE-LGC
PRO To ③
(MAN) ENTR

⑤ F 50 25 00205 SLEW RR For Lock-On
(LOCK) RR MODE-LGC
NO TRACK Lt - Off In ~ 12 sec
PRO To ③
(NO LOCK) MNVR
ENTR To ②

F 05 09 501 RR OUT OF MODE LIMITS
* (REQUEST MNVR) V32E To ②*

F 50 72 TRUN, SHFT (.01°)
Confirm Main Lobe Lock-On
(ACQ MAIN LOBE) RR MODE - SLEW
Slew To Peak AGC
RR MODE - LGC (NO TRACK Lt - Off In 12 sec)
(ACCEPT) Align COAS On CSM
Check FDAI/RR Needles
PRO To ⑦ (If RR Needles Are Non-Zero
Possible 00525 Alarm)

DATE 6/15/72

⑦ NO TRACK Lt - Off

DSKY BLANKS, RR Taking Marks
(RAW RR DATA) V16 N78E R,RDOT,TFI
(.01nm,.1fps,m-s)

```
* F 05 09 00525 SV/RR LOS ∢ >3°                    *
*      PRO For Value                                *
* F 06 05 SV/RR LOS ∢                        (.01°)*
*   N05 Can Be Caused By S.V. or                    *
*     Radar Errors                                  *
*   If P20 Just Called And:                         *
*    a) If S.V. Err Is Cause,                       *
*       V67E, Load N99 +10000,+100,+0,PRO           *
*    b) If Radar Err Is Cause,                      *
*       Allow Update (See NOTE Below)               *
*   If P20 Has Been Running (Assume S.V.            *
*      Error)                                       *
*    Perform RR BIAS INITIAL (pg 1-65)              *
*      Then V67E,Load N99 +10000,+100,+0,           *
*        PRO (Subsequently N05's Should             *
*        Decrease)                                  *
*    NOTE:  If Radar Bias Is Known, Perform         *
*           KNOWN RR BIAS LOADING(pg 1-65)          *
*   Software Opts To N05                            *
*   (REJECT) If Side Lobe                           *
*            RR MODE - LGC                          *
*            V32E To (6)                            *
*   (UPDATE) PRO To (7)                             *
```

DATE 6/15/72

```
* F 06 49 ΔR,ΔV,CODE      (.01nm,.1fps,0000X)*
*         X = 1 - Range;   2 - Range Rate    *
*             3 - Shaft ⟩; 4 - Trunnion ⟩    *
*                                            *
*     N49 Can Be Expected If:                *
*     a) Initial Nav Updates (~ 10 min),     *
*          Reject 1st Mark If >2nm or 12 fps*
*          Check Value With CSM, Thereafter *
*          If Agree Accept Update           *
*     b) After Long No Track Intervals,      *
*          Reject 1st Mark If >2nm or 12 fps,*
*          Then Accept Subsequent Updates   *
*     c) After Mnvrs or V93's (2-3 Marks),   *
*          Reject If >0.8nm or 5 fps         *
*   In All Other N49 Cases, Reject 1st       *
*     Mark Then Accept Up to 0.8nm &         *
*     5 fps                                  *
*   Software Opts To N49                     *
*   (REJECT PART MARK) V32E To (7)           *
*   (REJECT TOTAL MARK) V34E To (7)          *
*   (ALLOW UPDATE) PRO To (7)                *
*         [If Bad Mark Accepted,]            *
*         [V93E, Cont.          ]            *


* F 50 18 Mnvr Request, Go To (2)            *

NO TRACK LITE - On

F 05 09   00503 RR NO DATA GOOD 30 SEC(or Desig.
    (REDESIG)V32E To (3)                  Fail)
    (SEARCH) PRO To (8)

        *PROG Lt-On, V05 N09E                *
        *  00515 RR CDU Failed               *
        *        (P20 Will Not Update S.V.)  *
        *              KEY REL To (6) or     *
        *              RR MODE - AUTO TRACK  *

        *TRACKER Lt(Only)Could Not Read RR,To (6) *
```

DATE 6/15/72

⑧ F 16 80 RR AUTO SEARCH, SEARCH CODE (.01°)
R1 00000-SEARCH (42 sec/scan)
11111-LOCK ON
R2 LOS/+Z }
(LOCK) PRO To ②
(NO LOCK OR MAN ACQ) SLEW RR For LOCK ON
RR MODE - LGC
NO TRACK Lt-Out, To ⑧
(MNVR) V32E To ②

P21 GROUND TRACK DETERMINATION

1 V37E 21E
F 04 06 R1 00002, SPECIFY VEHICLE
R2 00001 LM
00002 CSM
PRO

② F 06 34 GET LAT, LONG (h,m,.01s)
(Zero For Present Time)
PRO

3 F 06 43 LAT, LONG, ALT (.01°,.1nm)
(N91 CALL) N91E
F 06 91 ALT, VEL, FLT PATH }
KEY REL (10nm,fps,.01°)
(INCREMENT GET 10 min) V32E To ②
(TERM) PRO

4 F 37

DATE 6/15/72

P22 LUNAR SURFACE NAV

LGC Starts Sequence At ~ 130 nm
NO TRACK Lt - Out ~ 103 nm
MARKS Every 3.5 sec If V95E
NO TRACK Lt - On (After TCA) ~ 80 nm
RR Antenna Designated 180,270

1 CB(11) RR(2) - Close, Wait 10 sec
V37E22E
(To TERM-V56E)
(SV OPTION, V81E CSM, V95E NONE)

F 04 06 R1 00012 CSM ORBIT OPTION
R2 00001 CSM WILL NOT CHANGE ORBIT
00002 CSM WILL CHANGE ORBIT

(OPT 1) PRO (Note Rng Check Step ②,Then Go To ③)
(OPT 2) PRO To ②

② F 06 33 TIG ASC (h,m,.01s)
PRO
(If Rng >400 nm & Rng Rt >0, Exit P22
If Rng >400 nm & Rng Rt <0:
16 54 Rng, Rng Rt (.01nm,.1fps)
N54 Is Updated Every 5 Sec
When Rng <400nm, Go To Step ③)

③ RR MODE - LGC To ⑤
- SLEW or AUTO TRACK To ④

④ F 50 25 R1 00201 RR AUTO REQUEST
RR MODE - LGC
PRO

*PROG Lt-On *
*F 05 09 00530 P22 Called At Least *
* 10 Min Early *
* (WAIT FOR CSM) PRO, Recall*
* P22 5 Min Prior To P22 *
* Acq. Time *

DATE 6/15/72

⑤ NO TRACK Lt-OFF DSKY Blanks, RR Taking Marks
(P22 Continues To Run In Background)

(RAW RR DATA) V16N78E R,RDOT,TFI
(.01nm,.1fps,m-s)
(RR TRUN, SHFT) V16N72E (.01°)

```
*F 05 09 00525 SV/RR LOS ≮ >3°      *
*        PRO                        *
*F 06 05 SV/RR LOS ≮ (.01°)         *
*        (REJECT) If Side Lobe      *
*                 RR MODE - LGC     *
*                 V32E To ⑤         *
*        (UPDATE) PRO To ⑤          *
*                                   *
*F 06 49 ΔR,ΔV,Code(.01nm,.1fps,    *
*                        0000X)     *
*                  X=1, RANGE       *
*                  X=2, RDOT        *
*        (UPDATE) PRO To ⑤          *
*        (REREAD) V32E To ⑤         *
```

NO TRACK Lt-ON; If R > 80nm & $\dot{R}$ > 0, POOE

F 05 09 00503 RR ANT DESIG FAIL
(REDESIG) V32E To ③
(SEARCH) PRO To ⑥
(TERM) V56E

⑥ F 16 80 RR AUTO SEARCH, SEARCH CODE (.01°)
R1 00000-Search (42 sec/scan)
11111-LOCK ON
R2 LOS/+Z ≮
(NO LOCK) V56E
(LOCK) PRO To ③

```
*PROG Lt-On              *
*V05N09E 00527 CSM OUT   *
*        OF MODE II LIMITS*
*        (TERM) V56E      *
```

DATE 6/15/72

P25 PREF TRACK ATT

1 V37E 25E
(To TERM - V56E)
(If Pointing Error <15°, To ② Mnvr with no Display)
F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT (PGNS)-AUTO
PRO(F50 18 Returns Upon Completion Of Mnvr)
(MAN) MODE CONT (PGNS)-ATT HOLD
MNVR
(BYPASS) ENTR To ②

② P25 Continues To Run
In Background Until Terminated
If RR On and Tracking
(RAW RR DATA) V16N78E R,RDOT,TFI
(.01nm,.1fps,m-s)

P27 LGC MANUAL UPDATE

■ (NOTE: For Auto Update, If V33 NO2
Displayed Key ENTR; If V21 NO2
or NO1 Displayed Key V34E)

2 V37E 00E

3 IF AGS OPERATING, 563 + 00000E
(Prevents Inadvertent Update of
AGS S.V. From PGNS Downlink)

4 V70E Update Lift Off Time
or V71E Load Consec Data
or V72E Load Singular Data
or V73E Increment LGC Time
(Update Form Will Format Index Number,
Address, Data & Component Identifier
To Be Usable With The Following Pro-
cedure)

⑤ F 21 01 R3 ADDRESS (Initially 1173)
Load P27 PAD Data IN R1 E (R3 Increments)

Repeat Step ⑤ For All PAD Data

DATE 6/15/72

⑥ F 21 02 R3 Goes To 1166 When Data Load Complete

TO REVIEW DATA
V01 NO1E, 1173E
R1 Data
N15E (R3 1174)
ENTR Verify Data For Remaining Comps.
(Note COMP I.D. Containing Erroneous Data)
KEY REL To ⑥

TO CHANGE DATA
Load COMP I.D., XX E
Correct Data E, Go To ⑥

TO ACCEPT UPDATE
V33E (or Key VERB Then PRO)

7 P00 Displayed

DATE 6/15/72

P30 EXTERNAL ΔV

1		V37E 30E	
	F 06 33	TIG	(h,m,.01s)
		PRO	
2	F 06 81	ΔV XYZ(LV)	(.1fps)
		PRO	
3	F 06 42	HA, HP, ΔV	(.1nm,.1fps)
		PRO	
4	F 16 45	MARKS,TFI,MGA (-00002 If No REFSMMAT)	
		SET DET TO TFI	(marks,m-s,.01°)
		PRO	
5	F 37		

P32 CSI PRETHRUST (P72 CSM)

①		V37E 32E (72E)	
	F 06 11	TIG (CSI)/T(APOAPSIS)	(h,m,.01s)
		To Calc T(APOAPSIS) Verify N11=0 (or Neg.)	
		PRO	
2	F 06 55	APSIS CROSSINGS (CDH), TPI ELEV ANGLE,	
		R3,0000Y	(+0000X,.01°)
		For Y≠0,CDH At CSI+	
		Multiple Of 180° Specified	
		By R1(X)	
		PRO	
3	F 06 37	TIG (TPI)	(h,m,.01s)
		PRO	
④	F 16 45	MARKS, TFI,-00001	(marks,m-s)
		(RECYCLE) V32E	
		(TERM MARKING) PRO	

DATE 6/15/72

PRETHRUST P3X/P7X

```
*F 05 09 00600 No Intersection On      *
*              First Iteration         *
*        00601 POST CSI ALT <35,000 ft*
*        00602 POST CDH ALT <35,000 ft*
*        00603 TIG(CDH)-TIG(CSI)<10min*
*        00604 TIG(TPI)-TIG(CDH)<10min*
*        00605 NO SOL IN 15 TRIES      *
*        00606 ΔV CSI >1000fps IN 2    *
*              ITERATIONS              *
*           V32E To ① Adjust Inputs    *
```

5 F 06 75 ΔH(CDH),ΔT (CDH-CSI),ΔT(TPI-CDH) (.1nm,m-s)
PRO

6 F 06 81 ΔV XYZ (LV) (CSI) (.1fps)
(For Out-of-Plane Corr In Final Comp ONLY)
V90E
F 06 16 GET EVENT (h,m,.01s)
PRO
F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
Record YDOT_____
PRO
(Insert Neg YDOT In R2 Of ΔV CSI)
PRO

7 F 06 82 ΔV XYZ (LV) (CDH) (.1fps)
(TIG CDH) N13E, KEY REL
PRO (If Recycling To ④)

8 F 16 45 MARKS,TFI,MGA (marks,m-s,.01°)
(MGA = -00002 If No REFSMMAT or If P72)
SET DET TO TFI
PRO

9 F 37 P72 - Transmit Mnvr Parameters To CSM

DATE 6/15/72

P33 CDH PRETHRUST (P73 CSM)

PRETHRUST
P3X/P7X

① V37E 33E (73E)
F 06 13 TIG (CDH) (h,m,.01s)
PRO

② F 16 45 MARKS,TFI, -00001 (marks,m-s)
(RECYCLE) V32E
(TERM MARKING) PRO

*F 05 09 00611 NO TIG FOR *
* GIVEN ELEV ANGLE *
* (REDO)V32E To ① *
* (CONTINUE) PRO To ③ *

③ F 06 75 ΔH(CDH),ΔT(TPI-CDH),ΔT(TPI-NOMTPI)
PRO (.1nm,m-s)

4 F 06 81 ΔV XYZ (LV) (CDH) (.1fps)
(For Out-of-Plane Corr in Final Comp ONLY)
V90E
F 06 16 GET EVENT (h,m,.01s)
PRO
F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
Record YDOT
PRO
(Insert Neg YDOT in R2 of ΔV CDH)
PRO (If Recycling To②)

5 F 16 45 MARKS,TFI,MGA (marks,m-s,.01°)
(MGA = -00002 If No REFSMMAT or If P73)
SET DET TO TFI
PRO

6 F 37 P73 - Transmit Mnvr Parameters To CSM

P34 TPI PRETHRUST (P74 CSM)

① V37E 34E (74E)
F 06 37 TIG (TPI) (h,m,.01s)
PRO

2 F 06 55 PRECISION OFFSETS, ELEV ∢, CENTRAL ∢
(+00000 In R2 To Calc Elev (0000X,.01°)
Angle At TIG Time)
PRO

③ F 16 45 MARKS, TFI, -00001 (marks,m-s)
(RECYCLE) V32E
(TERMINATE MARKING) PRO

DATE 6/15/72

F 05 09 00611 NO TIG
* FOR SPECIFIED ANGLE*
* PRO To ① *

4 F 06 37 TIG (TPI) (h,m,.01s)
PRO
(If Elevation Angle Computed By LGC,
This Display Will Be Replaced By
F 06 55, PRO To ⑤)

⑤ F 06 58 HP,ΔV(TPI),ΔV(TPF) (.1nm,.1fps)
PRO

6 F 06 81 ΔV XYZ (LV) (TPI) (.1fps)
PRO (If Recycling To ③)

7 F 16 45 MARKS,TFI,MGA (marks,m-s,.01°)
(MGA = -00002 If No REFSMMAT or If P74)
(ΔV LOS) N59E, KEY REL
SET DET TO TFI
PRO

8 F 37 P74 - Transmit Mnvr Parameters To CSM

P35 TPM PRETHRUST (P75 CSM)

① V37E 35E (75E)
F 16 45 MARKS, TFI, -00001 (marks,m-s)
(RECYCLE) V32E
(TERM MARKING) PRO

2 F 06 81 ΔV XYZ (LV) (TPM) (.1fps)
PRO (If Recycling To ①)

3 F 16 45 MARKS,TFI,MGA (marks,m-s,.01°)
(MGA = -00002 If No REFSMMAT or If P75)
(ΔV LOS) N59E, KEY REL
SET DET TO TFI
PRO

4 F 37 P75 - Transmit Mnvr Parameters To CSM

DATE 6/15/72

P40 DPS THRUST

ENG GMBL-ENABLE
DAP-Set Docked 32021; Undocked 22102: Typ

1 V37E 40E

F 05 09 01706 LM Staged
* (TERM) V34E, 42E or *
* Reload DAP, 40E *

F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion Of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR

*F 50 25 R1 00203 *
* GUID CONT - PGNS *
* MODE CONT (PGNS) - AUTO*
* THR CONT-AUTO *
* PRO *
*(BYPASS) ENTR *

2 06 40 TFI,VG,ΔVM (m-s,.1fps)
MASTER ARM - ON (1st DPS BURN)
DET - SET

*PROG Lt - On *
V05 N09E 01703 TIG SLIPPED
* RSET,KEY REL *

-:35 DSKY Blanks

-:30 ENG ARM - DES
06 40 (AVE G ON)

-:15 VERIFY ΔVM (R3) <00005

DATE 6/15/72

-:07.5 Verify +X ULLAGE

(-:05) F 99 40 ENG ON ENABLE
(AUTO) PRO (IGN WHEN TFI=:00sec)
(BYPASS) ENTR To (DPS OFF)

IGN 06 40 TFC, VG,ΔVM (m-s,.1fps)

*F 97 40 ENGINE FAIL *
* (RECYCLE ΔV MON) PRO *
* (RECYCLE) ENTR To (TIG-5) *
* (TERM) ENG ARM-OFF,V34E To ④*

* PROG Lt-On *
* V05N 09E 01407 VG INCREAS- *
* ING *
* Term Burn or Switch To AGS *

(DPS OFF) F 16 40 TFC, VG,ΔVM (m-s,.1fps)
ENG ARM - OFF
PRO

3 F 16 85 VG XYZ (LM) (.1fps)
Null Components
PRO

④ F 37 MASTER ARM-OFF

P41 RCS THRUST

TTCA (2) - JETS
DET - Set
DAP - Set (11012) or (22102): Typ

1 V37E 41E
(TFI Available via N40, 45, or 35)
F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion Of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR To ②

DATE 6/15/72

② 16 85 VG XYZ (LM) (.1fps)
*PROG Lt - On *
V05N 09E 01703 TIG SLIPPED
*RSET, KEY REL *

MODE CONT (PGNS) - ATT HOLD

-:35 DSKY Blanks

-:30 16 85 (AVE G ON)

-:00 F 16 85 VG XYZ (LM) (.1fps)
NULL COMPONENTS
PRO

3 F 37

P42 APS THRUST

DAP - Set (11002): Typ

1 V37E 42E
F 05 09 01706 LM NOT STAGED
* (TERM) V34E *
* (BYPASS) PRO To ② *

② F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion Of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR

*F 50 25 R1 00203 *
* GUID CONT-PGNS *
* MODE CONT (PGNS) - AUTO *
* (If Step 1, BYPASS: *
* THR CONT - AUTO) *
* PRO *
*(BYPASS) ENTR *

DATE 6/15/72

3 06 40 TFI,VG, ΔVM (m-s,.1fps)

*PROG Lt - On *
V05N 09E 01703 TIG SLIPPED
* RSET, KEY REL *

DET - Set
MASTER ARM - ON (Unstaged)

-:35 DSKY Blanks

-:30 06 40 (AVE G ON)

-:15 Verify ΔVM (R3) <00005

If Unstaged:
-:14 MANUAL ULLAGE
-:10 STAGE - FIRE
(MASTER ARM - OFF When Desired)

-:10 ENG ARM - ASC

-:06 Verify +X ULLAGE

(-:05) F 99 40 ENG ON ENABLE
(NO ULLAGE) V34E, ENG ARM-OFF, To ⑤
(AUTO)PRO (IGN WHEN TFI=:00 sec)
(BYPASS) ENTR To (APS OFF)

IGN 06 40 TFC, VG, ΔVM (m-s,.1fps)

*F 97 40 ENGINE FAIL *
*(RECYCLE ΔV MON) PRO *
*(RECYCLE) ENTR TO (TIG-5) *
*(TERM) ENG ARM - OFF *
* V34E To ⑤ *

*PROG Lt - On *
* V05 N09E 01407 VG *
* INCREASING *
* Term Burn Or Switch *
* To AGS *

(APS OFF) F 16 40 TFC, VG,ΔVM (m-s,.1fps)
ENG ARM - OFF
PRO

DATE 6/15/72

4 F 16 85 VG XYZ (LM) (.1fps)
Null Components
PRO

⑤ F 37 MASTER ARM - OFF

P47 ΔV MONITOR

1 V37E 47E
(20 sec Delay Minimum)
F 16 83 ΔV XYZ (LM) (.1fps)
(EXIT) PRO
(RECYCLE) V32E (Zeroes N83 Display)

2 F 37

P51 IMU ORIENTATION

① CB(11) AC BUS B: AOT LAMP-Close
V37E 51E
F 50 25 R1 00015 MNVR TO ACQ STARS
(To Coarse Align IMU To 0,0,0-ENTR)
41 22 All Zeroes
PRO

② F 01 71 R1 00CDE (C)DETENT (DE)STAR CODE
C 1-L, 2-F, 3-R, 4-RR, 5-CL, 6-LR
7-COAS(+00000, +00000)FWD
(+00000, +09000)OVHD
PRO
(For C=7
F 06 87 AZ,EL (.01°)
PRO)

3 F 54 71 CODE, X, Y MARK COUNTERS (Octal)
(REDEFINE STAR) V32E To ②
(Last Mark Defined By Digit A=1 In R2/3)
(To Change A=1 From R2↔R3) ENTR
(MARK) Position Star, MARK X/Y
(TERM MARKS) PRO

DATE 6/15/72

(For DE=00
F 06 88 CELESTIAL BODY VECTOR
Load Vector Values
PRO)
(After 1st Star) Go To ②
(After 2nd Star) Go To ④

④ F 06 05 R1 STAR ANGLE DIFFERENCE (.01°)
(RECYCLE) V32E To ①
PRO (For Nom. N05 Values See P52/11)

5 F 37 CB(11) AC BUS B: AOT LAMP-Open

P52 IMU REALIGN

1 CB(11) AC BUS B: AOT LAMP-Close
V37E 52E
F 04 06 R1 00001 IMU ALIGN OPT
R2 00001 PREF (0,0,0 Specified Attitude)
PRO To ④
2 NOM (LV At Specified Time)
PRO To ②
3 REFSMMAT PRO To ⑥
4 LANDING SITE PRO To ②

② F 06 34 GET ALIGN (h,m,.01s)
(0,0,0 For Present Time)
(TLAND FOR OPT 4)
(OPT 2) PRO To ④
(OPT 4) PRO To ③

③ F 06 89 LAT,LONG/2, ALT (.001°,.01nm)
PRO

④ F 06 22 NEW ICDU ANGLES OG,IG,MG (.01°)
(IF MGA NEAR GIMBAL LOCK, MNVR, Then V32E To ④)
PRO

5 F 50 25 R1 00013 COARSE ALIGN
(NORMAL) PRO To ⑥
NO ATT & NO DAP Lts-On Then Off
(GYRO TORQUE) MODE CONT (PGNS)-ATT HOLD, V76E
ENTR (NO DAP Lt-On)

P51-P57

DATE 6/15/72

16 20 PRESENT ICDU ANGLES OG,IG,MG (.01°)
When Torquing Complete To (13)

(6) F 50 25 R1 00015 SELECT STAR ACQUISITION MODE
Mnvr To Place 2 Nav Stars In Fwd Detent
& Verify AOT ∢ = 0°
(MAN ACQ) ENTR
(PICAPAR) PRO
*F 05 09 00405 NO PAIR *
*(CREW SPECIFY) PRO To (7) *
*(PICAPAR) V32E To (6) *
(CUR/SPIR) V32E To (7A & 8A)

(7) F 01 70 R1 00CDE (C)DETENT (DE)STAR CODE
C 0-COAS/LPD CALIBRATION
1-L, 2-F, 3-R, 4-RR, 5-CL, 6-LR
7-COAS(+00000, +00000)FWD
(+00000, +09000)OVHD
(TERM) V34E
PRO
(For C=0 or 7
F 06 87 AZ,EL (.01°)
PRO)
(For DE=00
F 06 88 CELESTIAL BODY VECTOR
Load Vector Values
PRO)

8 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO OR TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion Of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS)ENTR To (9) (If COAS/LPD CALIB,Go to (7))

DATE 6/15/72

```
(7A)  F 01 70   R1 00CDE (C) DETENT (DE) STAR CODE
                (DETENT) 1-L, 2-F, 3-R, 4-RR, 5-CL, 6-LR
                PRO

                     (For DE = 00
                     F 06 88 CELESTIAL BODY VECTOR
                          Load Vector Values
                          PRO)

                          *PROG Lt - On                *
                          *F 05 09  00404 DEFINED STAR*
                          *         NOT AVAILABLE IN  *
                          *         ANY DETENT        *
                          *(CREW SPECIFY) PRO To (9)  *
                          *(LGC CALC N79) V32E To (7A) *

(8A)  F 06 79   CUR, SPIR, POSITION CODE    (.01°,0000X)
      (REDEFINE STAR) V32E To (7A)
                PRO To (9)

(9)   F 01 71   R1 00CDE (C)DETENT (DE)STAR CODE
                PRO
                   (For C=7
                    F 06 87 AZ,EL                (.01°)
                         PRO)
                   (For DE=00 & CUR/SPIR Opt.
                    F 06 88 CELESTIAL BODY VECTOR
                         Verify Vector Values
                         PRO)

10          (For CUR/SPIR Opt Go To (10A/B/C))
      F 54 71   CODE,X,Y MARK COUNTERS              (Octal)
      (REDEFINE STAR) V32E To (9)
                (Last Mark Defined By Digit A=1 In R2/3)
                (To Change A=1 From R2←→R3) ENTR
      (MARK) Position Star, MARK X/Y
      (TERM MARKS) PRO

                     (For DE=00
                     F 06 88 CELESTIAL BODY VECTOR
                          Verify Vector Values
                          PRO)
      (After 1st Star) Go To (7)
      (After 2nd Star) Go To (11)
```

DATE 6/15/72

(10A) F 52/3 71 CODE, 52 CUR, 53 SPIR COUNTERS (Octal)
(REDEFINE STAR) V32E To (9)
(Last Mark Defined By Digit A=1 In R2/3)
(To Change V52↔V53) ENTR
(V52) Position CUR, MARK X/Y/ROD
(V53) Position SPIR, MARK X/Y/ROD
(TERM MARKS) PRO

F 50 25 00016 Unused Mark Sets
* R2=Number Of Unused Sets *
* (CONT) PRO *
* (NEW MARKS) ENTR To (9) & *
* Repeat Marking *

(For DE = 00
F 06 88 CELESTIAL BODY VECTOR
Verify Vector Values
PRO)

(After 1st Star) Go To (7A)
(After 2nd Star) Go To (11)

(10B) F 21/2 79 LOAD CUR or SPIR (.01°)
(V21) Cur Data ENTR
(V22) Spir Data ENTR

(10C) F 06 79 CUR or SPIR ANGLES (.01°)
PRO To (10A) (Mark Counter
Increments By 1)

DATE 6/15/72

(11) F 06 05 STAR ANGLE DIFFERENCE (.01°)
Nominal Values for N05:
AOT: Two Stars ≤ |.12| | COAS: Two Stars ≤ |.71|
: Star & Planet ≤ |.21| | : Star & Planet ≤ |.73|

(REJECT) V32E To (13)
(ACCEPT) PRO

12 F 06 93 GYRO ANGLES X,Y,Z (.001°)
(TORQUE) MODE CONTROL (PGNS) - ATT HOLD
V76E (NO DAP Lt-On)
PRO
(NO TORQUE) V32E To (13)

⑬ F 50 25 R1 00014
(RECHECK) PRO To ⑥
(TERM) ENTR (V77E, NO DAP Lt-Off)

14 F 37 CB(11) AC BUS B: AOT LAMP-Open

P57 LUNAR SURFACE ALIGNMENT

1 V37E57E
F 04 06 R1 00001 IMU ALIGN OPT
R2 00001 PREF PRO To ③
3 REFSMMAT PRO To ③
4 LANDING SITE PRO To ②

② F 06 34 T ALIGN (h,m,.01s)
(LDG SITE) T ALIGN = 0,0,0 For Present Time
PRO

③ F 05 06 R1 00010 SPECIFY ALIGNMENT TECHNIQUE (A/T)
R2 0000X
X = 0 Stored Attitude or REFSMMAT
1 REFSMMAT & Gravity
2 Celestial Bodies (2)
3 Gravity & Celestial Body (1)
R3 00CD0
C = 0 No REFSMMAT Defined
1 REFSMMAT Defined
D = 0 No Stored Attitude
1 Stored Attitude Available

(A/T 1 or 3) ATT MON - PGNS, PRO To ④
(IMU ON & ALIGNED & A/T 0) PRO To ⑭
(IMU ON & ALIGNED & A/T 2) PRO To ⑥
(IMU NOT ALIGNED & A/T 0 or 2) PRO To ⑭

*PROG Lt - On *
*F 05 09 00701 ILLEGAL ALIGN *
* TECH SELECTED *
*(CHANGE A/T) V32E To ③ *
*(TERM) V34E, Select New Prog *

DATE 6/15/72

④ Monitor of Lunar Gravity Measurement
V16N20E Monitor Coarse Align (.01°)
R1 +04200
R2 +31800
R3 +03526
NO ATT Lt - On Then Off (Twice)
*PROG Lt - On *
V05N09E 00211 & 00217
KEY REL

5 F 06 04 (+) GRAVITY ERROR ANGLE (.01°)
(RECYCLE) V32E To ④
(TERM) V34E, Select New Prog
PRO To (14)

⑥ F 01 70 R1 00CDE (C) DETENT (DE) STAR CODE
(DETENT) 1-L, 2-F, 3-R, 4-RR, 5-CL, 6-LR
PRO

(For DE = 00
F 06 88 CELESTIAL BODY VECTOR
Load Vector Values
PRO)

*PROG Lt - On *
F 05 09 00404 DEFINED STAR
* NOT AVAILABLE IN *
* ANY DETENT *
*(CREW SPECIFY) PRO To ⑧ *
*(LGC CALC N79) V32E To ⑥ *

⑦ F 06 79 CUR, SPIR, POSITION CODE (.01°,0000X)
Note: If This Star Is Also Visible In A
Detent Adjacent To The One In R3
& New Cur/Spir Are Desired:
V21 N01E, 373E, 32533E, PRO To ⑦
(REDEFINE STAR) V32E To ⑥
PRO

⑧ F 01 71 R1 00CDE (C) DETENT (DE) STAR CODE
PRO

DATE 6/15/72

⑨ F 52/3 71 CODE, 52 CUR, 53 SPIR COUNTERS (Octal)
(REDEFINE STAR) V32E To ⑧
(Last Mark Defined By Digit A=1 In R2/3)
(To Change V52←→V53) ENTR
(V52) Position CUR, MARK X/Y/ROD
(V53) Position SPIR, MARK X/Y/ROD
(TERM MARKS) PRO

```
* F 50 25 00016 Unused Mark Sets *
*      R2=Number Of Unused Sets  *
*   (CONT) PRO                   *
*   (NEW MARKS) ENTR To ⑧ &      *
*          Repeat Marking        *
```

(For DE = 00
F 06 88 CELESTIAL BODY VECTOR
Verify Vector Values
PRO)
(After 1st Star) Go To ⑥ (If Opt 00003, Go To ⑫)
(After 2nd Star) Go To ⑫

10 F 21/2 79 LOAD CUR or SPIR (.01°)
(V21) Cur Data ENTR
(V22) Spir Data ENTR

11 F 06 79 CUR or SPIR ANGLES (.01°)
PRO To ⑨ (Mark Counter
Increments By 1)

⑫ F 06 05 STAR ANGLE DIFFERENCE (.01°)

Nominal Values For N05:	
Two Stars ≤ .10	Grav. & Star ≤ .10
Star & Planet ≤ .21	Grav. & Planet ≤ .13

(REJECT) V32E To ⑮
(ACCEPT) PRO
(TERM) V34E

13 F 06 93 GYRO TORQUING ANGLES X,Y,Z (.001°)
(REJECT) V32E To ⑮
(ACCEPT) PRO To ⑮
(TERM) V34E

DATE 6/15/72

⑭ (This Noun Only Displayed If Angle > 5.0°)
F 06 22 ICDU ANGLES OG, IG, MG (.01°)
PRO, NO ATT Lt - On Then Off
(If A/T 2 or 3) Go To ⑥
(If A/T 1) Go To ⑫

⑮ F 50 25 R1 00014 RECHECK or EXIT FINE ALIGN
(RECHECK, A/T 00002 or 00003 Only) PRO To ⑥
(TERM) V34E To ⑰

Note: If Present A/T Is 00002 & A Previous
P57 Used A/T 00001 or 00003,
ENTR To ⑯ For L.S. Coordinates

⑯ F 06 89 LAT, LONG/2, ALT (.001°,.01nm)
(TERM) V34E
(ACCEPT) PRO

⑰ F 37

P63 BRAKING PHASE

V37E 63E
*PROG Lt-On *
*V05N09E 01412 NON *
* CONVERGING PDI TIG *
* MSFN Uplink New S.V.*
* & Target, Recall P63*

2 F 06 61 TG NEXT TGT,TFI, CROSSRANGE
SET DET TO TFI (m-s,.1nm)
N33E
F 06 33 TIG (h,m,.01s)
KEY REL
PRO

3 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR

DATE 6/15/72

P63-P68
P70-P76/P77

```
                                *F 50 25    00500 LR        *
                                *     TO DESCENT POS        *
                                *LDG ANT-DES, 10 sec, AUTO* *
                                *     PRO                   *
                                *(BYPASS) ENTR              *

                                *F 50 25  00203             *
                                *     GUID CONT - PGNS      *
                                *     MODE CONT(PGNS)-AUTO* *
                                *     THR CONT - AUTO       *
                                *     PRO                   *
                                *(BYPASS) ENTR              *
          *PROG Lt - On                                     *
          *V05 N09E 01703 TIG SLIPPED                       *
          * Check For Blank DSKY At DET = +20s;             *
          *  If Has Blanked, (Man Ign), TTCA Up At*         *
          *  DET = +26s; If Not Blanked, Slip PDI *

4      06 62   VI,TFI,ΔVM                  (.1fps,m-s,.1fps)

-2:00          MASTER ARM - ON
                 (STAGE RELAY Lts (2) - On)

 -:35          DSKY Blanks

 -:30          ENG ARM-DES
       06 62   (AVE G ON)

 -:15          Verify ΔVM (R3) <00005

 -:07.5        VERIFY +X ULLAGE
          (NO ULLAGE) Apply Man. Ullage

(-:05) F 99 62 ENG ON ENABLE
               PRO

 IGN  F 06 63  ΔH (Initially +99999, + LR > LGC)    (ft)
               H DOT(-Decreasing H)                (.1fps)
               H(+H> RLS)                            (ft)
          (NO IGN & AUTO ULLAGE) ENGINE START - Push
          (NO ULLAGE & NO IGN) - NO-GO PDI
               Release Manual Ullage
```

P63-P68
P70-P76/P77

DATE 6/15/72

```
*F 97 63 ENGINE FAIL          *
* (RECYCLE ΔV MON) PRO         *
* (RECYCLE) ENTR To TIG-5      *
```

+:05 DES ENG CMD OVRD - ON
MASTER ARM - OFF

```
ABORTS:
(DPS) ABORT - Push (or V37E 70E)
  If Masked:
  MODE CONT (P) - ATT HOLD
  Throttle Up Manually
  V37E70E(or V22 N46E,E)

(APS) ABORT STAGE - Push (or V37E 71E)
  If Masked:
  MODE CONT (P) - ATT HOLD
  V37E 71E(or V22 N46E, E)
```

~42,000 ft ALT Lt - Off
V57E (06 63)

Verify ΔH Decreasing
~25,000 ft VEL Lt - Off
(N68 On-Call Via N68E)
(STOP UPDATE) V58E (F 06 63)

```
*ALT &/or VEL Lt - On          *
*  RANGE/VELOCITY DATA NOT GOOD *
```

(MAN THROT) TTCA - Advance Until Cmd = 10%
THR CONT - MAN
V16 N92E
(To Return to Auto Throttle
THR CONT - AUTO
TTCA - Min
KEY REL)

(MAN ATT CHECK) MODE CONT (PGNS)-ATT HOLD

DATE 6/15/72

*PROG Lt - On *
* V05N09E 00511 *
* Neither or Both LR Ant *
* Discretes Present *
* LDG ANT - HOVER, If No ΔH *
* Update In 10 sec *
* LDG ANT - DES *

∿+09:30 P64 Displayed

P64 APPROACH PHASE

1 F 06 64 R1 TR/LPD, (sec-deg)
R2 H DOT(-Decreasing H) (.1fps)
R3 H(+H> RLS) (ft)

Monitor Attitude Change
To Enable Landing Site
Visibility.

(MAN THROT) TTCA - Advance Until Cmd = 10%
THR CONT - MAN
V16N92E
(To Return To Auto Throttle
THR CONT - AUTO
TTCA - Min
KEY REL)

(MAN ATTITUDE CHECK) MODE CONT (PGNS)-ATT HOLD
(TO USE LPD) Verify MODE CONT(PGNS)-AUTO
PRO
(Nominal Landing Site) To ④ When TR=0
(MAN ROD) MODE CONTROL (PGNS)-ATT HOLD
Activate ROD, To P66 Step 1

2 06 64 Observe Nominal Landing Site
Using LPD And N64 LPD Display.

3 Redesignate Landing Site
As Desired (+Pitch Redesignates
Landing Site Toward LM. Each ROLL/
PITCH Input Changes The Landing Site
Position By 1°Az/El)

④ P66 Displayed

DATE 6/15/72

P66 LANDING PHASE (ROD)

① F 06 60 V(FWD) (.1fps)
H DOT(-Decreasing H) (.1fps)
H(+ H > RLS) (ft)
ROD - Input ROD As Desired
(To Manually Null Forward & Lateral Velocities,
MODE CONTROL (PGNS) - ATT HOLD
Null Pitch (Fwd) & Roll (Lat)
Attitude Error Needles)

(MAN THROT) TTCA - Advance Until Cmd = 10%
THR CONT - MAN
V16N92E

2 H(Actual)=5.6 ft LUNAR CONTACT Lt - On
ENGINE STOP - Push
PRO
ENG ARM - OFF
TD+3:00 V37E 68E To P68 Step 2

P68 LANDING CONFIRMATION

1 V37E 68E

② F 06 43 LAT(+NORTH),LONG(+EAST),ALT (.01°,.1nm)

RECORD LAT _____°
LONG _____°
ALT _____nm (Nominally zero)
PRO
(MIN IMP) MODE CONT(PGNS)-ATT HOLD
NO DAP Lt-On

P70 DPS ABORT

1 From P63,64, or 66 via ABORT-Push or V37E 70E

```
*F 50 25 R1 00203          *
*    GUID CONT - PGNS      *
*    MODE CONT (PGNS) - AUTO*
*    THR CONT - AUTO       *
*    PRO                   *
*(BYPASS)ENTR               *
```

DATE 6/15/72

2 06 94 VGX,H DOT,H (.1fps,ft)

VGX Decreasing
H DOT Remains Positive
H Increasing

*F 97 94 ENGINE FAIL *
* (RECYCLE ΔV MON) PRO *
* (RECYCLE) ENTR To (F 99 63)*
* *
*(F 99 63) ENG ON ENABLE *
* (AUTO) PRO *
* (BYPASS) ENTR To (DPS OFF)*

H<25000 & H<00400-Monitor Att. Mnvr To LV With Windows Downrange. X-OVRD Inhibited. After H>00400 Monitor Mnvr To Abort Att; X-OVRD Restored 12 sec After Initiation of Mnvr.

H>25000-Monitor Att. Mnvr To Abort Att. With Windows Downrange. X-OVRD Restored.

3 To Monitor TFC, VGY, VI (m-s,.1fps)
V16 N77E
KEY REL

If APS Desired:
ABORT STAGE - Push (or V37E 71E)

If Masked:
MODE CONT (P) - AUTO
V37E 71E (or V22 N46E, E)

06 94 When VGX = 100 fps:
DES ENG CMD OVRD - OFF
ENG ARM - OFF

(DPS OFF) F 16 94 VGX,H DOT,H (.1fps,ft)
ENG STOP - Push
ABORT - Reset
PRO

DATE 6/15/72

④ F 16 85 VG XYZ (LM) (.1fps)
Null Components
(TERM) PRO
(DISP ORB PARAM) V82E
F 16 44 HA,HP,TFF (.1nm,m-s)
Record HA _____
HP _____
TFF _____
PRO To ④

5 F 37

P71 APS ABORT

1 From P63,64,66, or 70 via ABORT STAGE - Push or V37E 71E

*F 50 25 R1 00203 *
* GUID CONT - PGNS *
* MODE CONT (PGNS) - AUTO*
* PRO *
*(BYPASS)ENTR *

APS IGN 06 94 VGX,H DOT,H (.1fps,ft)
ENG ARM - ASC
If ENG STOP Lt - On
ENG STOP - Reset
ENG START-Push

VGX Decreasing
H DOT Remains Positive
H Increasing

*F 97 94 ENGINE FAIL *
* (RECYCLE ΔV MON) PRO *
* (RECYCLE) ENTR To (F 99 63)*
* *
*(F 99 63) ENG ON ENABLE *
* (AUTO) PRO *
* (BYPASS) ENTR To (APS OFF)*

DATE 6/15/72

H<25000 & H<00400-Monitor Att. Mnvr To LV With Windows Downrange. X-OVRD Inhibited. After H>00400 Monitor Mnvr To Abort Att; X-OVRD Restored 12 sec After Initiation Of Mnvr.

H>25000-Monitor Att. Mnvr To Abort Att. With Windows Downrange. X-OVRD Restored.

2 To Monitor TFC,VGY,VI (m-s,.1fps)
V16 N77E
KEY REL

06 94 When VGX = 200 fps, ENG ARM - OFF
*No Cutoff *
* ABORT STAGE - Reset*

(APS OFF) F 16 94 VGX,H DOT,H (.1fps,ft)
PRO

③ F 16 85 VG XYZ (LM) (.1fps)
Null Components
(TERM) PRO
(DISP ORB PARAM) V82E

F 16 44 HA,HP,TFF (.1nm,m-s)
RECORD HA _____
HP _____
TFF _____
PRO To ③

4 F 37

DATE 6/15/72

P76/P77 S.V. UPDATE

1 V37E (CSM) 76E/(LM) 77E

F 06 33 TIG (h,m,.01s)
PRO

2 F 06 84 ΔV XYZ (LV) (CSM) [If from P72 N84 Is ΔV CDH] (.1fps)
PRO

or

F 06 81 ΔV XYZ (LV) (LM) (.1fps)
PRO
(TO RECALL ΔV) V06N84E

3 F 37

V40 N20 ICDU ZERO

1 V40 N20E (NO DAP Lt - On)

```
*PROG Lt - On                *
*V05 N09E  00206 CDU ZERO    *
*   NOT ALLOWED IN COARSE    *
*   ALIGN & GIMBAL LOCK      *
*Coarse Align To 0,0,0 Then  *
*   Reselect V40 N20         *
```

NO ATT Lt - Off

2 (NO DAP Lt-Off) Wait 11 sec Before V37 Attempt

V41 N20 ICDU COARSE ALIGN

1 V41N20E

F 21 22 NEW ICDU ANGLES O,I,M (.01°)
Load Desired ICDU Angles

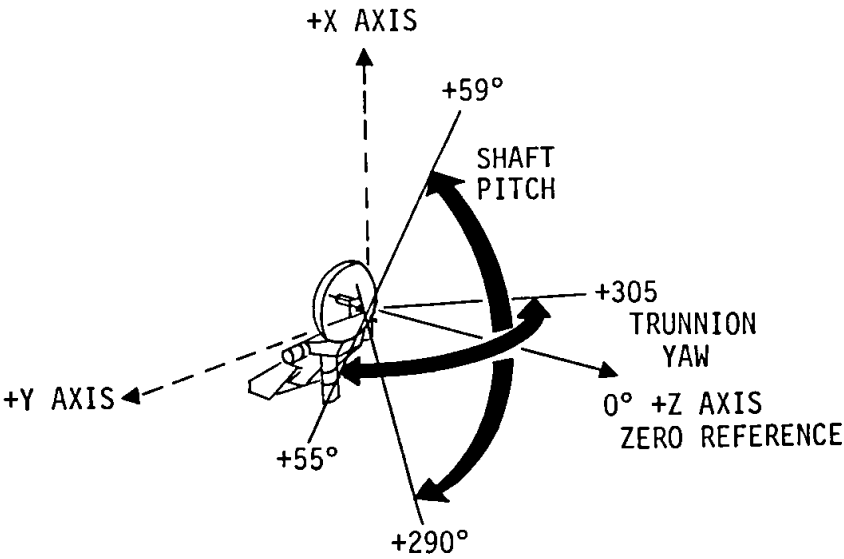
2 41 COARSE ALIGN
NO ATT & NO DAP Lts - On
FDAI Torques

Accuracy May Be Increased By V41N20E, V33E

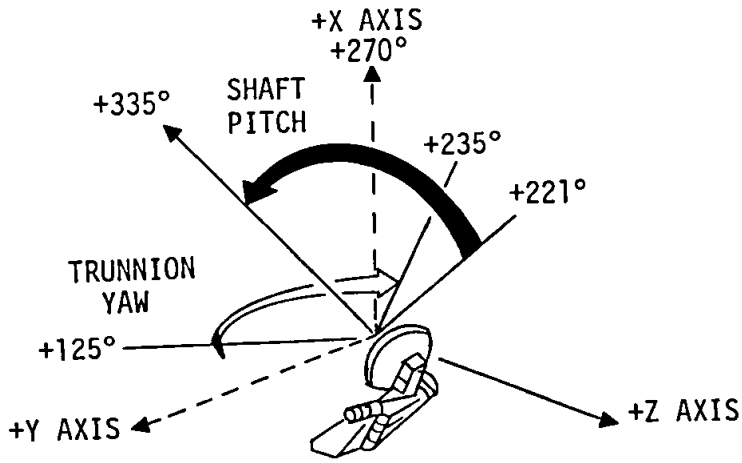
```
*PROG Lt - On              *
*V05N09E   00211 COARSE    *
*          ALIGN ERROR >2° *
*V16N22E Compare N22 With  *
* N20, Reduce S/C Drift &  *
* Repeat V41N20            *
```

To Release Platform, Perform ICDU Zero Above

DATE 6/15/72



RR ANTENNA MODE I COVERAGE (OPERATIONAL LIMITS)
(IN N73 FORMAT)



RR ANTENNA MODE II COVERAGE (OPERATIONAL LIMITS)
(IN N73 FORMAT)

DATE 6/15/72

V40-V91

V41 N72 RR CDU COARSE ALIGN

1 RR MODE - LGC

2 V41N72E
F 21 73 RR TRUN,SHAFT (.01°)
Load Desired Trun and Shaft Angles

3 F 04 12 R1 00006 SPECIFY RR FUNCTION
R2 00001 LOCK ON CSM
00002 CONT DESIG
PRO

4 41 COARSE ALIGN
(To Monitor Driving In CONT DESIG MODE)
V16N72E RR TRUN, SHAFT (.01°)

```
*PROG Lt - On                    *
*V05N09E 00502 BAD N73 INPUT     *
*        00503 RR ANT DESIG      *
*              FAIL              *
*          V44E, Redo V41N72E    *
*        00515 RR CDU FAILED     *
*                                *
*(TERM) V44E                     *
```

V42 GYRO TORQUING

1 MODE CONT (PGNS) - ATT HOLD
V76E (NO DAP Lt-On)
V42E
F 21 93 ΔGYRO ANGLES (XYZ) (.001°)
Load Desired Angles

2 42 FINE ALIGN
Gyro Torquing (NO ATT Lt - Off)
V77E (NO DAP Lt-Off)

V43 FDAI BIAS CHECK

1 MODE CONT (PGNS) - OFF
(NO DAP Lt-On)

2 V37E00E

DATE 6/15/72

3		V43E
	F 21 22	NEW ICDU ANGLES YPR (.01°)
	43	Load Desired ICDU Angles & Verify Needles Deflect
4		ENTR
	F 21 22	NEW ICDU ANGLES YPR (.01°)
	43	Load (-) New ICDU Angles & Verify FDAI Needles Return To Initial Pos.
5		MODE CONTROL (PGNS) - AUTO or ATT HOLD (NO DAP Lt-Off)

V47 AGS INITIALIZATION

		TLM-HI
1		V16N65E
	16 65	LGC TIME (h,m,.01s)
		377 + GET-PGNS/AGS BIAS TIME (.1min)
		ENTR-(At Correct PGNS Time)
2		V47E
	F 06 16	GET OF AGS CLOCK (h,m,.01s)
		Load PGNS/AGS TIME BIAS
3		414 +1
		414R (+0 Indicates AGS Acceptance Of S.V.)
4		PRO
	06 16	NO DAP Lt-On For 11 sec If Auto ICDU Zero Issued
5	F 50 16	Downlink Complete
		PRO
6		400+3 AGS/PGNS ALIGN
7		V83E
	F 16 54	R,RDOT,THETA (.01nm,.1fps,.01°)
8		Rng (317) Must Be <690.28 nm For Valid 440 Readout
		440R RANGE RATE ($\Delta R \leq 1.0$ fps) (.1fps)
		PRO

DATE 6/15/72

V48 DAP CONFIG & DPS TRIM

1 V48E

F 04 46 DAP CODE, FUNCTION FAIL CODE (Octal)

R1
- (CONFIG) A 1- ASCENT, 2- DESCENT, 3- DOCKED
- (X-TRANS) B 0- 2JET,M.I/RCS A; 1-2JET,M.I/RCS B
2- 4JET,M.I/RCS A; 3-4JET,M.I/RCS B
- (SCALE) C 0-Fine(4°/sec) (.4°/sec If Docked)
1-Normal(20°/sec) (2°/sec If Docked)
- (ATTDB) D 0-.3°, 1-1°, 2-5°, 3-5°
- (RATE) E 0-.2°/sec, 1-.5°/sec,2-2°/sec
3-10°/sec (Use 0 or 1 Docked)

R2
- A=B=C=0
- D=1,3,5,7 Bypasses Auto Thr Check of Code 00203, & P66
- E=1,3,5,7 Bypasses (R11) Monitor of Abort/Abort Stage Pb's

PRO (R2 Can Be Changed Directly By V22)

2 F 06 47 LM WT, CSM WT (lb)
PRO (Terminates If Staged)

3 F 06 48 ENG GIMBAL TRIM (+)PITCH,(+)ROLL (.01°)
(TRIM) ENG GMBL - ENABLE
ENG STOP - PUSH
ENG ARM - DES
GUID CONT - PGNS
MODE CONT (PGNS) - ATT HOLD or AUTO
PRO (ENG GMBL Lt - On When Gimbals Reach Limits)
(EXIT) V34E

4 F 50 48 TRIM COMPLETE
PRO
ENG ARM - OFF (ENG GMBL Lt-Off)
ENG STOP - Reset

V49 CREW DEFINED MNVR

1 V37E00E

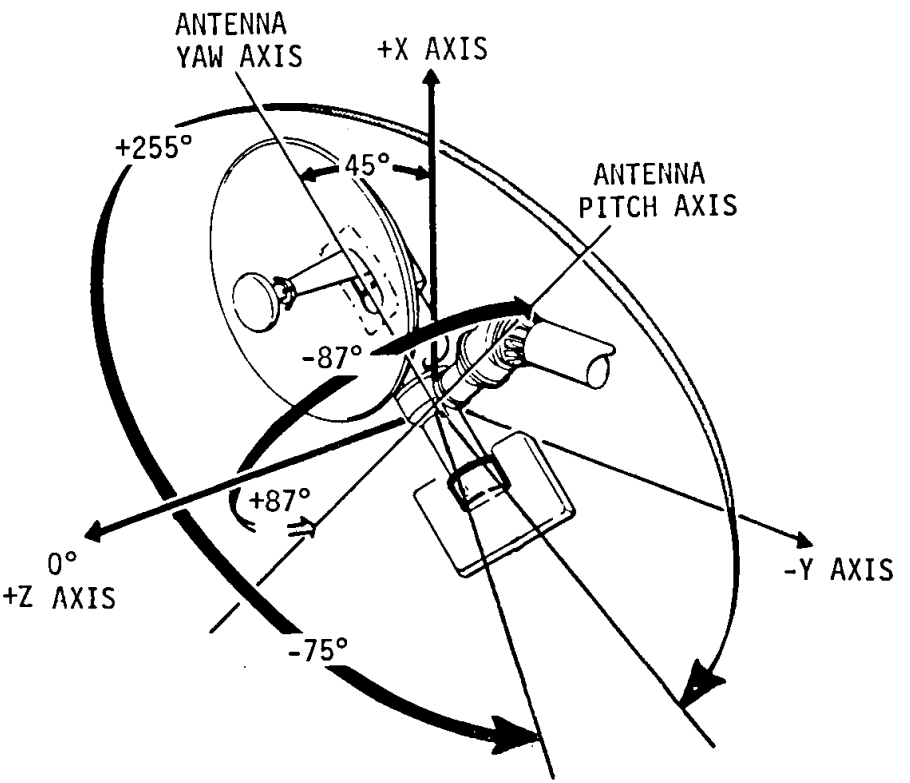
2 V49E
F 06 22 NEW ICDU ANGLES YPR (.01°)
PRO

DATE 6/15/72

3 F 50 18 REQUEST MNVR TO FDAI RPY (.01°)
(AUTO OR TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR (Exit V49)

V64 S-BD ANT POINTING

1 V64E
F 06 51 S-BD PITCH, YAW (.01°)
PRO



S-BD STEERABLE OPERATIONAL LIMITS

DATE 6/15/72

V67 W-MATRIX ERROR DISP

1 V67E
F 06 99 POS ERR, VEL ERR, RADAR BIAS ERR
(REINITIAL) V25E, Load Values (ft,.1fps,mr)
PRO

V82 ORB PARAM DISP

1 V82E (GO To ② If AVE G-On)
F 04 12 R1 00002 SPECIFY VEHICLE
R2 00001 LM
00002 CSM
PRO

② F 16 44 HA,HP,TFF (.1nm,m-s)
(UPDATE) V32E (Not Required If AVE G-On)
(If TFF= -59:59) N32E Time From Perigee
PRO (h,m,.01s)

V83 RENDZ PARAM DISP

1 V83E
F 16 54 R,RDOT,THETA (.01nm,.1fps,.01°)
(EXIT) PRO

V85 RR LOS DISP

1 RR MODE - LGC

2 V85E
F 16 56 AZ, ELEV (.01°)
(TERM) PRO

V89 RENDZ FINAL ATT

1 V37E00E

2 V89E
F 04 12 R1 00003 SPECIFY TRACKING ATTITUDE
R2 00001 (+Z AXIS)
00002 (+X AXIS)
PRO

DATE 6/15/72

③ F 06 18 FINAL FDAI RPY ANGLES (.01°)
(AUTO MNVR) PRO
(RECALCULATE) V32E To ③

4 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO OR TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR (Exit V89)

V90 OUT-OF-PLANE DISP

① V90E
F 06 16 GET EVENT (TIG) (h,m,.01s)
(0, PRESENT TIME)
PRO

2 F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
(RECYCLE) V32E To ①
(EXIT) PRO

V91 SHOW BANKSUM
V37E00E (or V96E)
1 V91E BANKSUM
F 05 01 R1 SUM OF BANK
R2 BANK NO.
R3 BUGGER WORD
(NEXT BANK) PRO (If R2 ≠ |R1|, Record For MSFN)
(TERM) V34E

PGNS TURN-ON AND SELF TEST

1 If STBY Lt - On, PRO (Hold In Until
STBY Lt - Off, Repeat If Necessary)
Possible M.A., LGC Warn, RESTART, &
PROG Lts-On; Code 1105 or 1106
RSET

DATE 6/15/72

2 V96E
V35E
F 88 88 DSKY LIGHT CHECK
(M.A., LGC & ISS Warn, And ALL DSKY Lts - On, 8's In All Registers, Lts Reset In 5 sec Except NO DAP; LGC Warn Resets Within 20 sec)

3 CB(11) IMU OPR - Close
(NO ATT Lt - On For 90 sec)

4 V25NO1E 1365E
F 21 01 E,E,E

5 V15 NO1E 1365E
15 01 R1, R2, R3 All Zero

6 V21 N27E 10E (Test Fixed & Erasable Memory)
15 01 R1 Number Of Errors
R2 Number Of Tests Started
R3 Number Of Erasable Tests Successful
Test Successful If R2≥3 (Minimum 78 sec)

```
*PROG Lt - On              *
*     V05N09E 01102 SELF-*
*           TEST ERROR   *
*N08E Record For MSFN     *
*     R1 _____________    *
*     R2 _____________    *
*     R3 _____________    *
```

DATE 6/15/72

7 V21 N27E 0E Terminate Self Test

ORDEAL INITIALIZATION

1 CB(11) AC BUS B: ORDEAL - Close
FLIGHT DISPLAYS: ORDEAL - Close
FDAI 1 or 2 - ORB RATE
EARTH/LUNAR - LUNAR

2 V82E
F 04 12 R1 00002 SPECIFY VEHICLE
R2 00001 LM
PRO

PGNS T/O,LR,RR TEST
RR BIAS, RCS INHIBIT

3	F 16 44	HA,HP,TFF (.1nm,m-s) (If AGS) 315R(HA);403R (HP) (.1nm) Average HA & HP ALT SET - Set PRO
4	F 16 54	V83E R, RDOT, THETA (.01nm,.1fps,.01°) (If AGS) 277R (THETA) 0-360P (.01°) MODE - HOLD/FAST SLEW - To THETA MODE - OPR/SLOW PRO

PIPA BIAS CHECK

1		DET - Zero Rates <.1°/sec With No Thruster Firing
2		V25N21E, E, E, E/DET - START
3	06 21	V06E XYZ PIPA COUNTS (±XXXXX.)
④		At T+80sec - ENTR T+80sec (X)R1___ (Y)R2 ___ (Z)R3 ___
5		Calculate X,Y,Z Bias: Take Last 3 Digits Of Displayed Bias And Add 2 Zeroes X _____ Y _____ Z _____
6		V06N01E, 1452E (Review X Bias) E 1454E (Review Y Bias) E 1456E (Review Z Bias)
7	F 21 01	V21N01E LOAD 1452E(Calc X BIAS)E,E 1454E(Calc Y BIAS)E,E 1456E(Calc Z BIAS)E Same Sign As In Measured Bias of Step ④

DATE 6/15/72

LGC CLOCK INITIALIZATION

1		(Get Time From CSM, Mission Timer, or MSFN)
		V25 N36E
	F 21 36	Load Hrs
	F 22 36	Load Min
	F 23 36	Load Sec (.01) Do Not ENTR
		On Source's "Mark" - ENTR
②		V06 N65
		On Source's "Mark" - ENTR
		Calculate LGC/Source Time Difference
		____:____:____ (h,m,.01s)
3		V55E (h,m,.01s)
	F 21 24	Load Difference From Step ②

LR SELF TEST

1		CB(11) PGNS: LDG RDR - Close
		X-POINTERS(Both) - HI MULT
		TEMP MON - LDG RDR(+60°to+95°F)
		RATE/ERR MON - LDG RDR/CMPTR
		RNG/ALT MON - ALT/ALT RATE
		LDG ANT - DES
		MODE SEL - LDG RDR
2		RADAR TEST - LDG(Alt And Alt Rt Tapes Drive)
		TEST MONITOR - ALT XMTR (2.1 To 5.0) (3.5v)
		- VEL XMTR (2.1 To 5.0) (3.6v)
		ALT/ALT RT MON - +7900 To +8100 ft/-478 To -482 fps
3		XPOINTER - UP, LFT
4		V63E INITIATE RDR SELF TEST
	F 04 12	R1 00004 SPECIFY RDR
		R2 00001 RNDZ RDR
		V22E 2E LDG RDR
		PRO

DATE 6/15/72

5	F 16 66	SLANT RANGE, ANT POSITION (ft) R1 + 08276 To +08296 (+08286) R2 + 00001 PRO
6	F 16 67	VX,VY,VZ (fps) R1 -00495 (±2) R2 +01862 (±2) R3 +01331 (±2) V34E
7		LDG ANT - AUTO (If LR Ant Not Commanded To POS 2 via V59E, Go To (13))
8		V59E COMMAND ANT TO POS 2 (11 sec, PROG Lt-On, 00523)
9	F 04 12	V63E INITIATE RDR SELF TEST R1 00004 SPECIFY RDR R2 00001 RNDZ RDR V22E 2E LDG RDR PRO
10	F 16 66	SLANT RANGE, ANT POSITION R1 +08276 To +08298 R2 +00002
11	F 16 66	LDG ANT - DES (10 sec) R2 +00001 (PROG Lt-On, V05N09E,00522 RSET)
12	F 16 66	LDG ANT - AUTO R2 +00001 V34E
(13)		RDR TEST - OFF CB(11) PGNS: LDG RDR - Open

DATE 6/15/72

RR SELF TEST

1 VERIFY: CSM RCS THRUSTER B3 - OFF (Docked)
: RADAR XPONDER - OFF
: RNDZ RDR ANT - Released
X-POINTERS (Both)-HI MULT
RATE/ERR MON (Both) - RNDZ RADAR
ATTITUDE MON (Both) - PGNS
RNG/ALT MON - RNG/RNG RATE
SHFT/TRUN - +50°
RR MODE - SLEW
TEMP MONITOR - RNDZ (+10° To +75°)
RR GYRO SEL - SEC

2 CB(11) AC BUS A: RNDZ RDR - Close
: RNG/RNG RT/ALT/ALT RT-Close(Wait 30 sec)
CB(11) PGNS: RNDZ RDR - Close
(NO TRACK Lt-On)
FLIGHT DISPLAYS: RNG/RNG RT/ALT/ALT RT-Close

3 Slew Rate - HI
Slew Left To Mode I Region (18 sec)
Slew Right, Down, Left, Up (FDAI Needles Right, Down, Left, Up)
SLEW RATE - LO
SHAFT/TRUN - ±5°
Slew Right, Down, Left, Up (FDAI Needles Right, Down, Left, Up)

4 RR MODE - AUTO TRACK
RADAR TEST - RNDZ RDR (Rng Rt Tape Drives, X-Pointers Oscillate and FDAI Needles Vary Between ±5°. After 12 sec, Rng Tape Drives, NO TRACK Lt - Out)
(If Ant Mode II, No FDAI Needles)

5 TEST MONITOR - AGC (1.5 To 1.9)
- XMTR PWR (2.8 To 3.2)
- SHAFT ERR(2.2 To 2.6@1/2cps)
- TRUN ERR (2.2 To 2.6@1/2cps)
- AGC

DATE 6/15/72

6		Set NORRMON Flag V25 N07E 101E, 10E, 1E RR MODE - LGC(NO TRACK & Pwr Fail Lts - On)
7	F 04 12	V63E START RNDZ RDR SELF TEST R1 00004 SPECIFY RADAR R2 00001 RNDZ RADAR PRO (TRACKER Lt - On) (TRACKER, NO TRACK & Pwr Fail Lts - Off After 12 sec)
8	F 16 72	RR TRUN, SHAFT (.01°) R1 Varying @1/2 cps R2 Varying @1/2 cps PRO
9	F 16 78	RNG, RNG RT, TFI (.01nm,.1fps,m-s) R1 +195.10 To +195.50 (TM 193 To 197) R2 -0470.5 To -0510.5 (TM 478 To 528)
10		V34E (NO TRACK & Pwr Fail Lts - On, X-Pntr-Center)
11		RADAR TEST - OFF
12		V40N72E RRCDU ZERO (10 sec)
13		SHFT/TRUN - ±50° V41N72E N73 R1 +04000 R2 +04000 N12 R2 00002 V16N72E (Verify FDAI Needles Up & Right)
14		SHFT/TRUN - ±5° RR GYRO SEL - PRIM V41N72E N73 R1 +35600 R2 +35600 N12 R2 00002 V16N72E (Verify FDAI Needles)

DATE 6/15/72

15 V41N72E
N73 R1 +00000
R2 +28300
N12 R2 00002
V16N72E

16 CB(11) PGNS: RNDZ RDR - Open
AC BUS A: RNDZ RDR - Open
V44E
Notify CSM To Enable Thruster B3 If Docked

RR BIAS INITIAL

1 V24N01E
1700E
E, E
V24N01E
1702E
E, E
V93E

KNOWN RR BIAS LOADING

1 V21 N01E
(SHAFT) 1700E, XXXXXE (See Table)
(TRUN) 1702E, XXXXXE (See Table)

(+) TRUN = Needle Left
(+) SHAFT = Needle Up

DATE 6/15/72

(±) DEG	(+) OCT	(-) OCT	(±) DEG	(+) OCT	(-) OCT
0.5	22	77755	4.5	241	77536
1.0	44	77733	5.0	263	77514
1.5	66	77711	5.5	305	77472
2.0	107	77670	6.0	326	77451
2.5	131	77646	6.5	350	77427
3.0	153	77624	7.0	372	77405
3.5	175	77602	7.5	414	77363
4.0	217	77560			

LGC THRUSTER INHIBIT/RE-ENABLE

1 V25N07E
(VERTICAL JET) 1257E
(HORIZONTAL JET) 1260E
XXXE (See Codes Below)

A1U - 100E	B4U - 1E
B1D - 200E	A4D - 2E
A1F - 4E	B4F - 2E
B1L - 200E	A4R - 100E
B2U - 20E	A3U - 4E
A2D - 40E	B3D - 10E
A2A - 10E	B3A - 1E
B2L - 20E	A3R - 40E

2 CAUTION
Affected Quad Pair(s) Must Be
*Enabled Before Next Step *
1E (To Re-enable, 0E This Step)

3 V48E,PRO,V34E

CREW DEFINED DOCKED DB

1 V21N01E
3011E
(DB = 5.0°) 44E
(DB = 1.4°) 200E

LPD BIAS LOAD

1 V21 N01E, 3373E
(AZBIAS - Octal) ENTR

2 ENTR, 1353E
(ELBIAS - Octal) ENTR

ALTERNATE LPD BIAS LOAD

1 V21 N03E, (ADD) E
ADD = 3373 For AZBIAS
= 1353 For ELBIAS

DATE 6/15/72

2 Load New Value: (ie ± XXX.XXE)
New Val (AZBIAS) = Old Val + 1.3 (Δ Az)
(+ΔAz =LPD is Right of L.S.)
(ELBIAS) = Old Val + Δ Elev
(+ Δ Elev =LPD is Above L.S.)

3 To Verify New Value:
V06 N03E, (ADD) E, Verify R1

RMAX LOAD TO MINUS ONE

1 V21 N01E
2004E (RMAX)
77776E (Sets RMAX To -1 Which Forces N49
For All MARKS)

RMAX/VMAX LOAD TO PAD VALUES

1 V24N01E
2004E (RMAX)
23E (Sets RMAX To 2,000 ft)
1E (Sets VMAX To 2 fps)

REVIEW DATA IN E-MEMORY

1 V01 N01E, OCTAL ADD E
01 01 R3 OCTAL ADD, R1 (DATA)

2 N15E (For Next Succeeding Address)
ENTR (For Each Succeeding Address)

CHANGE DATA IN E-MEMORY

1 V21 N01E ADD E
F 21 01 R3 ADD
Load New Data In R1 E

2 N15E For Next Succeeding Address
Load New Data E
ENTR And Load New Data For Each
Succeeding Address E

DATE 6/15/72

MONITOR OF INPUT/OUTPUT CHANNELS

1 V11N10E
F 11 10 Load Channel Add E
R1 Octal Contents Of Specified Channel

LOAD OUTPUT CHANNELS

1 V21N10E
F 21 10 LOAD CHANNEL ADD E
R1 Load Octal Data E

or

1 V25 N07E
F 21 07 (Load Channel Add) E
F 22 07 (Load Bit Code) E
F 23 07 (Load 1-Set/0-Reset) E

FLAGWORD SET/RESET

1 V25 N07E
F 21 07 (Load FLAGWORD ADD) E

2 F 22 07 (Load FLAGWORD BIT CODE)E

BIT	CODE	SET	RESET
1	1	E= 1,3,5,7	E= 0,2,4,6
2	2	E= 2,3,6,7	E= 0,1,4,5
3	4	E= 4,5,6,7	E= 0,1,2,3
4	10	D= 1,3,5,7	D= 0,2,4,6
5	20	D= 2,3,6,7	D= 0,1,4,5
6	40	D= 4,5,6,7	D= 0,1,2,3
7	100	C= 1,3,5,7	C= 0,2,4,6
8	200	C= 2,3,6,7	C= 0,1,4,5
9	400	C= 4,5,6,7	C= 0,1,2,3
10	1000	B= 1,3,5,7	B= 0,2,4,6
11	2000	B= 2,3,6,7	B= 0,1,4,5
12	4000	B= 4,5,6,7	B= 0,1,2,3
13	10000	A= 1,3,5,7	A= 0,2,4,6
14	20000	A= 2,3,6,7	A= 0,1,4,5
15	40000	A= 4,5,6,7	A= 0,1,2,3

3 F 23 07 (Load 1-Set/0-Reset) E

DATE 6/15/72

4 To Verify Load:
V01N01E, FLAGWORD ADD ENTR
01 01 R3 FLAGWORD ADD
R1 FLAGWORD CONTENT (See Table Above)

BINARY-TO-OCTAL CONVERSION

000-0	100-4
001-1	101-5
010-2	110-6
011-3	111-7

OCTAL-TO-DECIMAL CONVERSION

1-1	11-9	21-17	31-25	41-33
2-2	12-10	22-18	32-26	42-34
3-3	13-11	23-19	33-27	43-35
4-4	14-12	24-20	34-28	44-36
5-5	15-13	25-21	35-29	45-37
6-6	16-14	26-22	36-30	46-38
7-7	17-15	27-23	37-31	47-39
10-8	20-16	30-24	40-32	50-40

DATE 6. 5/72

FLAGWORD LIST

FLAG	ADD	CODE (BIT)	SET (1) / RESET(0)	
P25 FLAG	74	400 (9)	P25 Operating / P25 Not Oper.	C=4,5,6,7 / C=0,1,2,3
IMU	74	200 (8)	IMU In Use / IMU Not In Use	C=2,3,6,7 / C=0,1,4,5
Rendezvous	74	100 (7)	P20 Or P22 Initiated / P20 Or P22 Terminated	C=1,3,5,7 / C=0,2,4,6
Lock On	74	20 (5)	RR Lock-ON Desired / RR Lock-ON Not Desired	D=2,3,6,7 / D=0,1,4,5
Terrain Model	75	2000 (11)	Terrain Model Inhibited / Terrain Model Permitted	B=2,3,6,7 / B=0,1,4,5
State Vector	75	200 (8)	CSM S.V. Updated (V81) / LM S.V. Updated (V80)	C=2,3,6,7 / C=0,1,4,5
Update	75	100 (7)	S.V. Update by Marks Allowed / S.V. Update by Marks Not Allowed	C=1,3,5,7 / C=0,2,4,6

DATE 6/15/72

DATE 6/15/72

Track	75	20	Rndz Tracking Allowed	D=2,3,6,7
		(5)	Rndz Tracking Not Allowed	D=0,1,4,5
Manual Acquire	76	10000	Enable man acq of CSM by RR	A=1,3,5,7
		(13)	Enable auto acq of CSM by RR	A=0,2,4,6
Final	76	40	Final Pass Through Rndz Prog Comp	D=4,5,6,7
		(6)	Interim Pass Through Rndz Prog Comp	D=0,1,2,3
Active Veh	76	20	LM Active Veh	D=2,3,6,7
		(5)	CSM Active Veh	D=0,1,4,5
REFSMMAT	77	10000	REFSMMAT Good	A=1,3,5,7
		(13)	REFSMMAT Not Good	A=0,2,4,6
No Throttle	101	4000	Inhibit Full Throttle	B=4,5,6,7
		(12)	Permit Full Throttle	B=0,1,2,3
3 Axis	101	40	Mnvr Specified By 3 Axis	D=4,5,6,7
		(6)	Mnvr Specified By 1 Axis	D=0,1,2,3
NORRMON	101	10	Bypass RR Gmbl Monitor	D=1,3,5,7
		(4)	Perform RR Gmbl Monitor	D=0,2,4,6

Rendwflg	101	1 (1)	W Matrix Valid For Flt Nav W Matrix Not Valid For Flt Nav	E=1,3,5,7 E=0,2,4,6
Attitude	102	1 (1)	LM Att Stored In LGC LM Att Not Stored In LGC	E=1,3,5,7 E=0,2,4,6
SURFFLAG	104	200 (8)	LM On Surface LM Not On Surface	C=2,3,6,7 C=0,1,4,5
FLT59FLG	105	10 (4)	Cur/Spir Marks Enabled In P52 Cur/Spir Marks Not Enabled In P52	D=1,3,5,7 D=0,2,4,6
Remode	110	20000 (14)	Remode Requested No Remode Requested	A=2,3,6,7 A=0,1,4,5
Antenna	110	4000 (12)	RR Ant In Mode 2 RR Ant In Mode 1	B=4,5,6,7 B=0,1,2,3
Designate	110	1000 (10)	Designate Requested or In Progress Designate Not Requested or Not In Progress	B=1,3,5,7 B=0,2,4,6
ACA Mode	111	40000 (15)	Min Impulse Enabled (V76) Rate Command Enabled(V77)	A=4,5,6,7 A=0,1,2,3

DATE 6/15/72

CHANNEL LIST

CHANNEL	BIT	DSKY	FUNCTION
5	1	E=1,3,5,7	JET 1 ON (4U)
OUTPUT	2	E=2,3,6,7	JET 2 ON (4D)
	3	E=4,5,6,7	JET 5 ON (3U)
	4	D=1,3,5,7	JET 6 ON (3D)
	5	D=2,3,6,7	JET 9 ON (2U)
	6	D=4,5,6,7	JET 10 ON (2D)
	7	C=1,3,5,7	JET 13 ON (1U)
	8	C=2,3,6,7	JET 14 ON (1D)
6	1	E=1,3,5,7	JET 7 ON (3A)
OUTPUT	2	E=2,3,6,7	JET 3 ON (4F)
	3	E=4,5,6,7	JET 15 ON (1F)
	4	D=1,3,5,7	JET 11 ON (2A)
	5	D=2,3,6,7	JET 12 ON (2L)
	6	D=4,5,6,7	JET 8 ON (3R)
	7	C=1,3,5,7	JET 4 ON (4R)
	8	C=2,3,6,7	JET 16 ON (1L)
11	1	E=1,3,5,7	ISS WARNING
OUTPUT	13	A=1,3,5,7	ENGINE ON
	14	A=2,3,6,7	ENGINE OFF
12	1	E=1,3,5,7	ZERO RRCDU
OUTPUT	4	D=1,3,5,7	COARSE ALIGN ENABLE
	5	D=2,3,6,7	ZERO ICDU
	9	C=4,5,6,7	GMBL TRIM CMD (S/C Pitch Up)
	10	B=1,3,5,7	GMBL TRIM CMD (S/C Pitch Dn)
	11	B=2,3,6,7	GMBL TRIM CMD (S/C Roll Rt)
	12	B=4,5,6,7	GMBL TRIM CMD (S/C Roll Lt)
	13	A=1,3,5,7	LR POS CMD
	14	A=2,3,6,7	RR AUTO TRACK ENABLE
	15	A=4,5,6,7	ISS TURN ON DELAY COMPLETE
16	3	E=4,5,6,7	MARK X
INPUT	4	D=1,3,5,7	MARK Y
	5	D=2,3,6,7	MARK REJECT
	6	D=4,5,6,7	+RATE OF DESCENT
	7	C=1,3,5,7	-RATE OF DESCENT

DATE 6/15/72

30	1	E=0,2,4,6	ABORT
(INVERTED)	2	E=0,1,4,5	STAGE VERIFY
INPUT	3	E=0,1,2,3	ENG ARM
	4	D=0,2,4,6	ABORT STAGE
	5	D=0,1,4,5	AUTO THROTTLE
	6	D=0,1,2,3	DISPLAY INERTIAL DATA
	7	C=0,2,4,6	RR CDU FAIL
	9	C=0,1,2,3	IMU OPERATE
	10	B=0,2,4,6	G&N CONTROL OF S/C
	11	B=0,1,4,5	IMU CAGE
	12	B=0,1,2,3	ICDU FAIL
	13	A=0,2,4,6	IMU FAIL
	14	A=0,1,4,5	ISS TURN ON REQUEST
	15	A=0,1,2,3	TEMP IN LIMITS

31	1	E=0,2,4,6	+PITCH MIN IMPULSE/+EL LPD
(INVERTED)	2	E=0,1,4,5	-PITCH MIN IMPULSE/-EL LPD
INPUT	3	E=0,1,2,3	+YAW MIN IMPULSE
	4	D=0,2,4,6	-YAW MIN IMPULSE
	5	D=0,1,4,5	+ROLL MIN IMPULSE/+AZ LPD
	6	D=0,1,2,3	-ROLL MIN IMPULSE/-AZ LPD
	7	C=0,2,4,6	+X TRANSLATION
	8	C=0,1,4,5	-X TRANSLATION
	9	C=0,1,2,3	+Y TRANSLATION
	10	B=0,2,4,6	-Y TRANSLATION
	11	B=0,1,4,5	+Z TRANSLATION
	12	B=0,1,2,3	-Z TRANSLATION
	13	A=0,2,4,6	ATTITUDE HOLD
	14	A=0,1,4,5	AUTO STAB
	15	A=0,1,2,3	ACA OUT OF DETENT

32	1	E=0,2,4,6	JETS 2,4 INHIBITED (4D&R)
(INVERTED)	2	E=0,1,4,5	JETS 5,8 INHIBITED (3U&R)
INPUT	3	E=0,1,2,3	JETS 1,3 INHIBITED (4U&F)
	4	D=0,2,4,6	JETS 6,7 INHIBITED (3D&A)
	5	D=0,1,4,5	JETS 14,16 INHIBITED (1D&L)
	6	D=0,1,2,3	JETS 13,15 INHIBITED (1U&F)
	7	C=0,2,4,6	JETS 9,12 INHIBITED (2U&L)
	8	C=0,1,4,5	JETS 10,11 INHIBITED (2D&A)
	9	C=0,1,2,3	GIMBAL NOT ENABLED
	10	B=0,2,4,6	GIMBAL FAILED
	14	A=0,1,4,5	PROCEED

DATE 6/15/72

33	2	E=0,1,4,5	RR PWR ON/AUTO
(INVERTED)	3	E=0,1,2,3	RR RNG SCALE LOW
INPUT	4	D=0,2,4,6	RR DATA GOOD
	5	D=0,1,4,5	LR ALT DATA GOOD
	6	D=0,1,2,3	LR POSITION 1
	7	C=0,2,4,6	LR POSITION 2
	8	C=0,1,4,5	LR VELOCITY DATA GOOD
	9	C=0,1,2,3	LR RNG SCALE LOW
	10	B=0,2,4,6	BLOCK UPLINK
	11	B=0,1,4,5	UPLINK TOO FAST
	12	B=0,1,2,3	DOWNLINK TOO FAST
	13	A=0,2,4,6	PIPA FAIL
	14	A=0,1,4,5	LGC WARNING
	15	A=0,1,2,3	OSCILLATOR ALARM

77	1	E=1,3,5,7	ERASABLE OR FIXED MEMORY PARITY FAIL
OUTPUT	2	E=2,3,6,7	ERASABLE MEMORY PARITY FAIL
	3	E=4,5,6,7	TC TRAP
	4	D=1,3,5,7	RUPTLOCK
	5	D=2,3,6,7	NIGHT WATCHMAN
	6	D=4,5,6,7	VOLTAGE FAIL
	7	C=1,3,5,7	COUNTER FAIL
	8	C=2,3,6,7	SCALAR FAIL
	9	C=4,5,6,7	SCALAR DOUBLE FREQUENCY

(Chan 77 is Reset By V36E, P27 S.V.Update, or via N10)

DATE 6/15/72

LM OR CSM S.V. READOUT

1 V83E

2 After integration: V05N01E

CSM S.V.

2130E

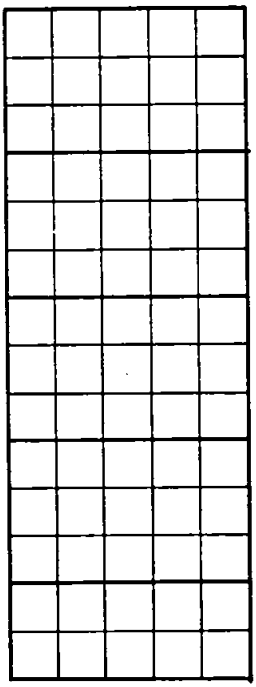
E,2133E

E,2171E

E,2174E

E,2112E

PRO



LM S.V.

2160E

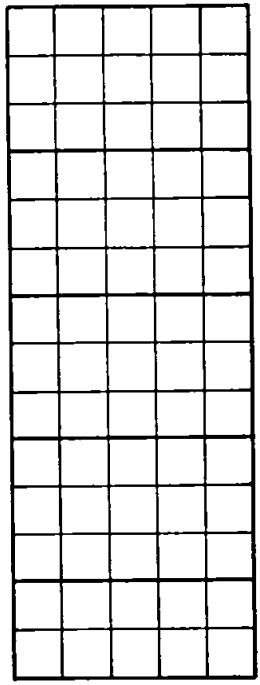
E,2163E

E,2103E

E,2106E

E,2112E

PRO



3 Transmit S.V. & Time Tag To CSM

DATE 6/15/72

LM OR CSM S.V. LOADING

1 V37E00E
V71E
21E
1501E
(CSM S.V.) 00002E, Plus Xmited Pad
(LM S.V.) 77775E, Plus Xmited Pad
V33E

AGS SELECTOR LOGIC LIST

Address	Entry	
400	+00000	Attitude Hold
	+10000	Auto Guidance Steering
	+20000	Z-Body Axis Steering
	+30000	IMU Align
	+40000	Lunar Align
	+50000	Body Axis Align
	+60000	Gyro and Accelerometer Calibration (302 sec,35 sec)
	+70000	Inflight Accelerometer Only Calibration (35 sec)
410	+00000	Orbit Insertion Routine
	+10000	CSI Routine
	+20000	CDH Routine
	+30000	TPI Search Routine
	+40000	TPI Execute Routine
	+50000	External ΔV
411	+00000	Disables AGS Auto S.V. Updating via Radar Data
	+10000	Enables AGS Auto S.V. Updating via Radar Data
412	+00000	Reinitiate Test
	+10000	Test Successful
	+30000	Logic Test Fail
	+40000	Memory Test Fail
	+70000	Logic & Memory Test Fail
413	+00000	Normal Position
	+10000	Store Lunar Az. & Set Surf. Flg.
414	+00000	Navigation Initialization Complete (AUTO)
	+10000	LM And CSM Navigation Initialization via PGNCS Downlink
	+20000	LM Navigation Initialization via DEDA
	+30000	CSM Navigation Initialization via DEDA
415	+00000	Normal Value
	+10000	Store Z-axis Direction Cosines & Rng/Rng Rt Data in RDR Filter

DATE 6/15/72

416	+10000	For CSI Calculation Select CDH At 1/2 Orbital Period Following CSI
	+30000	For CSI Calculation Select CDH At 3/2 Orbital Period Following CSI
417	+00000	Normal Value
	+10000	Initialize Radar Filter (Zeros 621)
507	+00000	Z Body Points In Direction Of CSM When In Z-Body Axis Steering (400 set to +2)
	+10000	Z Body Points To Desired Thrust Direction When 400 Set To +20000
563	+00000	Disables AGS Update via Downlink (To Reenable AGS Update Via Downlink, 414 +1E)
623	+00000	Z Body Parallel To CSM Orbit Plane When In Guidance Steering (400 set To +1)
	+10000	Z Body Parallel To Plane Defined By WB When In Guidance Steering (400 set To +1)

DEDA INPUT/OUTPUT LIST

DATE 6/15/72

Address		
047	Sine of Landing Azimuth Angle	Octal
053	Cosine of Landing Azimuth Angle	Octal
223	Altitude Update Input	100 ft
224	Term In LM Desired Semi-major Axis αL Calculation (O.I.)	100 ft
225	One Half of the Lower Limit of Apolune Radius (O.I.)	100 ft
226	Retarget Value For Term In αL Calculation (O.I.)	100 ft
231	Landing Site Radius	100 ft
232	Targeted Orbit Insertion Altitude	100 ft
233	Vertical Pitch Steering Altitude Threshold	100 ft

240	X Position Comp (LM)	100 ft
241	Y Position Comp (LM)	100 ft
242	Z Position Comp (LM)	100 ft
244	X Position Comp (CSM)	100 ft
245	Y Position Comp (CSM)	100 ft
246	Z Position Comp (CSM)	100 ft
254	LM Ephemeris Data (Epoch Time)	.1 min
260	X Velocity Comp (LM)	.1fps
261	Y Velocity Comp (LM)	.1fps
262	Z Velocity Comp (LM)	.1fps
264	X Velocity Comp (CSM)	.1fps
265	Y Velocity Comp (CSM)	.1fps
266	Z Velocity Comp (CSM)	.1fps
272	CSM Ephemeris Data (Epoch Time)	.1 min
275	Desired Update Time For TIG TPI (For CSI Calc Only)	.1 min
304	Sine Of Central Angle Limit (TPI)	N/A
305	Retarget Phase Angle Limit (O.I.)	.01°
306	Target Time Of Node Prior To Rendezvous	.01 min
307	Time From TPI To Rendezvous	.01 min
310	TFI of Next Mnvr (<136 min)	.01 min
312	TPI Rendezvous Offset Time (Stable Orbit Rendezvous)	.01 min
316	Radar Range (R)	.01 nm
373	AGS TIG CSI, CDH, TPI, TPM, EXT ΔV	.1 min
377	AGS Computer Time (T)	.1 min
404	Set +0 For 470 Readout	N/A
405	Set +0 For 471 Readout	N/A
406	Set +0 For 472 Readout	N/A
450	ΔVX (LV) (+Fwd)	.1fps
451	ΔVY (LV) (+Rt)	.1fps
452	ΔVZ (LV) (+Dn)	.1fps
464	Vertical Pitch Steering Altitude Rate Threshold	.1fps
465	Targeted Radial Rate at Insertion (Lower Limit)	.1fps
503	Radar Range Rate (RDOT) Input	.1fps
514	Components of Unit Vector (X,Y,Z)	Octal
515	Used to Provide Yaw	
516	Steering Out of CSM Orbit Plane (400 +10000;623 +10000)	

DATE 6/15/72

534	Scale Factor for X Accelerometer	Octal
535	Scale Factor for Y Accelerometer	Octal
536	Scale Factor for Z Accelerometer	Octal
540	X Accel Bias Comp Coeff	.001 ft/sec2
541	Y Accel Bias Comp Coeff	.001 ft/sec2
542	Z Accel Bias Comp Coeff	.001 ft/sec2
544	X Gyro Drift Comp Coeff	.01°/hr
545	Y Gyro Drift Comp Coeff	.01°/hr
546	Z Gyro Drift Comp Coeff	.01°/hr
547	Lunar Align Azimuth Correction	Octal
574	Staging Flag(+ Not Staged)	Octal
575	Attitude Hold Flag (-Is Att Hold)	Octal
604	Lunar Surface Flag(+ Not On Lunar Surface)	Octal
605	Desired cotangent of LOS at TPI (COTAN LOS TPI)	Octal
607	HDOT Display Scale Factor	Octal
616	Counts For Ullage	(1ct=2sec)
640	X Comp of Lunar Rotation Vector	Octal
641	Y Comp of Lunar Rotation Vector	Octal
642	Z Comp of Lunar Rotation Vector	Octal
673	Retargeted Value For 4K10 When Central Angle Exceeds The Retarget Phase Angle Limit (See 305)	Octal

DEDA OUTPUT LIST

Address		
211	Present Out-of CSM Orbit Plane Position	100 ft
263	Predicted Out-Of-Plane Velocity At TIG (CSI, CDH, TPI), Present Out of Plane O.I.	.1fps
270	Present ΔVy Out-of-CSM Orbit Plane Velocity (Vyo)	.1fps
277	Angle Between Local Horizon & Z Body Axis (In Plane)	.01°
303	Predicted LOS At TIG TPI (TPI mode)	.01°
303	LM/CSM Phase Angle at TIG (CSI,CDH) Present O.I.	

DATE 6/15/72

310	Time To Next Maneuver (Except O.I.)	.01 min
311	Time To Rndz (TPI)	.01 min
312	Target Offset Time (TPI)	.01 min
314	ΔH At TIG CSI	.1 nm
315	Predicted Apogee Altitude Of Present LM Orbit	.1 nm
317	State Vector Range To CSM	.01 nm
337	LM Altitude (h)	.1 nm
340	X Comp of LM Position	100 ft
341	Y Comp of LM Position	100 ft
342	Z Comp of LM Position	100 ft
344	X Comp of CSM Position	100 ft
345	Y Comp of CSM Position	100 ft
346	Z Comp of CSM Position	100 ft
347	Predicted Altitude At TIG or Predicted Altitude At Burnout For O.I.	100 ft
357	Time To Burnout =[357]/160 sec)	.01 sec
360	X Comp of LM Velocity	.1fps
361	Y Comp of LM Velocity	.1fps
362	Z Comp of LM Velocity	.1fps
364	X Comp of CSM Velocity	.1fps
365	Y Comp of CSM Velocity	.1fps
366	Z Comp of CSM Velocity	.1fps
367	LM Altitude Rate (H DOT)	.1fps
370	ΔVG Magnitude (Except O.I.)	.1fps
371	Braking Velocity TPI(+60000 Invalid)	.1fps
372	CSI To CDH ΔT (CSI)	.1 min
402	ΔH In Coelliptic Orbit (CSI,CDH)	.1nm
402	Predicted Hp (TPI)	.1nm
403	LM Perigee Altitude (Hp)	.1nm
423	Desired Final HDOT (Except EXT ΔV)	.1fps
427	Present LM HOR Velocity	.1fps
433	LM Total Velocity Magnitude	.1fps
440	State Vector Range Rate Between LM and CSM (-Closing)	.1fps
470	ΔVX Measured (LM) (+ Up) (Use 404 to zero)	.1fps
471	ΔVY Measured (LM) (+ Rt) (Use 405 to zero)	.1fps
472	ΔVZ Measured (LM) (+ Fwd) (Use 406 to zero)	.1fps
477	Predicted HDOT At CSI, CDH, TPI or Present HDOT O.I.	.1fps

DATE 6/15/72

500	ΔVgx (LM) (+Up)	.1fps
501	ΔVgy (LM) (+Rt)	.1fps
502	ΔVgz (LM) (+Fwd)	.1fps
606	Next Update Flag (R + or $\dot{R}$ -)	N/A
612	Staging Sequence Counter	Octal
614	Ullage Counter Duration	2 sec
621	Radar Mark Counter R/$\dot{R}$ (XXOYY)	Cts

DEDA ACCESSIBLE CONSTANTS LIST

Address		
216 (2K3)	Value of LM Pericynthian If Overflow In Orbital Eccentricity	100 ft
227 (4K5)	Constant In Expression For Altitude Rate At Cutoff (O.I.)	100 ft
230 (2K19)	ΔP Limiter	100 ft
267 (5K18)	Lower Limit Of Radial Jerk For Unstaged Vehicle (Orbit Insertion)	N/A
274 (7K1)	TIG Time Bias (Ext ΔV)	.1 min
313 (6K12)	Range Scale Factor (Auto)	N/A
446 (4K25)	APS Tailoff ΔV	.1fps
453 (2K20)	P Iterator Convergence Check (TPI)	.1 sec
454 (4K26)	VG Engine Cutoff Threshold	.1fps
466 (5K26)	Vgx Pseudo Attitude Hold Threshold	.1fps
506 (4K12)	Acceleration Threshold for Radial Jerk Set (O.I.)	Octal
517 (6K14)	Range Rate Bias (Auto)	Octal
523 (5K20)	Lower Limit Of Radial Jerk For Staged Vehicle (O.I.)	Octal
526 (2K11)	Set Value Of VF (TPI)	Octal
527 (4K6)	Upper Limit Of Predicted Radial Rate At Insertion (O.I.)	Octal
537 (1K14)	X-Axis Gyro Mass Unbalance Compensation Constant	Octal
560 (5K14)	Upper Limit Of Radial Jerk (O.I.)	Octal
561 (5K16)	Upper Limit Of Out-Of-Plane Jerk (O.I.)	Octal
577 (6K13)	Range Rate Scale Factor (Auto)	
611 (5K17)	Lower Limit Of Out-Of-Plane Jerk (O.I.)	Octal

DATE 6/15/72

613 (1K37)	Accel. Calibration Time	Octal
617 (1K30)	Gyro Calbration Time	(1 Ct = 2sec)
622 (4K23)	Attitude Hold At Abort Staging Threshold	(1 Ct = 40msec)
627 (1K27)	Lunar Align Constant	Octal
630 (1K28)	Lunar Align Constant	Octal
631 (1K29)	Lunar Align Constant	Octal
634 (1K35)	Navigation Sensed Velocity Threshold	Octal
636 (2K1)	Lunar Gravitational Constant	Octal
637 (2K2)	Reciprocal Of Lunar Gravitational Constant	Octal
660 (4K34)	Lower Limit Of Thrust Acceleration	Octal
661 (4K35)	Ullage Counter Threshold	Octal
662 (4K10)	Factor In LM Desired Semi-Major Axis αL Calculation (O.I.)	Octal
666 (4K21)	Limit For Attitude Error	Octal

ADDRESS/DISCRETES

ADD	READOUT	DISC. DEF.
533	A = 1,3,5,7	Follow-Up Disc. Present
	B = 4,5,6,7	MODE CONT (A) - AUTO Disc.Present
	B = 2,3,6,7	Descent Eng On
	B = 1,3,5,7	Ascent Eng On
	C = 4,5,6,7	Abort Disc. Present
	C = 2,3,6,7	Abort Stage Disc. Present

DATE 6/15/72

THIS PAGE INTENTIONALLY BLANK

ORBIT INSERTION

1 MODE CONT (AGS) - AUTO
GUID CONT - PGNS
DET - SET

2
224+(Semi-Major Axis Targeting Term) (100ft)
225+(Apolune Radius/2) (100ft)
226+(Retarget Value For Term In αL) (100ft)
232+(Orbit Insertion Altitude) (100ft)
305+(Phase Angle Limit) (.01°)
373+(Load TIG LO or PDI) (.1min)
[Note: Present Time Must Be <136min Prior To TIG Loaded]
410+0 Orbit Insertion Routine
465+(Altitude Rate At Insertion) (.1fps)
616+0 Zero Ullage Counter Limit
662+(4K10) (Octal)
673+(Retarget Value For 4K10) (Octal)

3
623+0 Z-AXIS PARALLEL TO CSM ORBIT PLANE
+1 Z-AXIS PARALLEL TO SPECIFIED PLANE
If 623+1; Specify Plane:
514+(X Comp. of Unit Vector)
515+(Y Comp. of Unit Vector)
516+(Z Comp. of Unit Vector)

4
400+1 GUIDANCE STEERING
501R ΔVGY(LM) (.1fps)
502R ΔVGZ(LM) (.1fps)
500R ΔVGX(LM) (.1fps)

5

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANSL	4 JET	4 JET	2 JET
TTCA (CDR)	THROT	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT(STAGE)PB	Reset	Reset	Reset
ENG ARM	DES	ASC	OFF
ATT CONT(3)	MODE CONT	MODE CONT	MODE CONT

O.I.,CSI,CDH,TPI, TPM, EXT ΔV

DATE 6/15/72

MASTER ARM	ON(1st Burn Only)	ON(Un-staged)	OFF
PRPLNT QTY MON	DES 1	OFF	OFF
PRPLNT TEMP/PRESS MON	DES 1	ASC	-
HELIUM MON	SUPCRIT PRESS	PRESS 2	-
ENGINE STOP	-	-	PUSH

6 -:30 For DPS Burns:
CB(11) DECA PWR - Close
CB(16) DES ENG OVRD - Close
ENG GMBL - ENABLE
For APS Burns:
CB(11&16) AELD (2)- Close

7 -:20 GUID CONT - AGS

8 :00 IGN ABORT (STAGE) - Push
ENGINE START - Push

9 When ΔVGX=200 fps:
ENG ARM-OFF
When Burn Complete:
ABORT (STAGE) - Reset
ENG STOP - Push

6/15/72

For Over Burns:
(Out-of-Plane Comp):
Null 263R ΔVY (.1fps)
410+5

NULL 500,501,502 (.1fps)
(Null 501 After 502 for Out-of-Plane Trim)

10
ENG STOP - Reset
MASTER ARM - OFF
ENG ARM - OFF
BAL CPL - ON
TTCA (CDR) - JETS
DEADBAND - MAX
PRPLNT QTY MON - OFF
HELIUM MON - OFF

CSI

1 MODE CONT (AGS) - ATT HOLD
GUID CONT - AGS

2 Wait until TIG-136 min
275 + (TIG TPI) (.1 min)
373 + (TIG CSI) (.1 min)
410 + 1 CSI Routine
416 + 1 CDH 1/2 Orbital Period After CSI
+ 3 CDH 3/2 Orbital Periods After CSI
451 + OE (ΔVY CSI)
605 + (COTAN LOS TPI) (Octal)
616 + 00005 (10 sec of ullage)

3 477R HDOT CSI (.1fps)

4 310R ΔT To CSI (.01 min)
DET - SET

5 If Time Available:
303R LM/CSM Phase Angle (.01°)
314R ΔH At TIG (.1nm)
372R ΔT CSI To CDH (.1 min)
402R ΔH CDH (.1nm)
477R Predicted HDOT (.1fps)

6 410 + 5 EXT ΔV
450R ΔVX CSI (.1fps)
263R ΔVY CSI (.1fps)
451 (ΔVY CSI) (Sign As 263) (.1fps)
452R ΔVZ CSI (.1fps)
370R ΔVG Magnitude CSI (.1fps)

7 623 +0 Z-Axis Parallel to CSM Orbit Plane
+1 Z-Axis Parallel to Specified Plane
If 623 +1, Specify Plane:
514 + (X Comp. of Unit Vector)
515 + (Y Comp. of Unit Vector)
516 + (Z Comp. of Unit Vector)

8 400 +1 GUIDANCE STEERING (Z Axis Mnvr, 400+2, 507+1)

DATE 6/15/72

9 ATTITUDE CONTROL (3)-PULSE
MODE CONT (AGS) - AUTO
Maneuver To Burn Attitude
ATTITUDE CONTROL (3)-MODE CONT

10
500R ΔVGX (LM)	(.1fps)
501R ΔVGY (LM)	(.1fps)
502R ΔVGZ (LM)	(.1fps)

11

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANSL	2 JET	2 JET	2 JET
TTCA(CDR)	THROT (MIN THRUST)	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT(STAGE)	PUSH	PUSH	-
ENG ARM	DES	ASC	OFF
MASTER ARM	ON(1st Burn only)	ON(Un-Staged Only)	OFF
PRPLNT QTY MON	DES 1	OFF	OFF
PRPLNT TEMP/PRESS MON	DES 1	ASC	-
HELIUM MON	SUPCRIT PRESS	PRESS 2	-
ENGINE STOP	-	-	PUSH

12 -:30 For DPS Burns:
CB(11) DECA PWR-Close
CB(16) DES ENG OVRD-Close
ENG GMBL - ENABLE
For APS Burns:
CB(11&16) AELD (2) - Close

-:15 (X-Axis) 500R
(Z-Axis) 502R

13 -:10 Start Ullage
:00 Ignition
(RCS Burn) When ΔVG <15fps,
MODE CONTROL (AGS)-ATT HOLD

DATE 6/15/72

14 When Burn Complete:
ABORT (STAGE)-Reset
NULL 500,501,502 (.1fps)

15 MASTER ARM - OFF
ENG ARM - OFF
BAL CPL - ON
TTCA(CDR) - JETS
DEADBAND - MAX
PRPLNT QTY MON - OFF
HELIUM MON - OFF

CDH

1 MODE CONT (AGS) - ATT HOLD
GUID CONT - AGS

2 Wait Until TIG -136 min:
373R TIG CDH (Adjust AGS TIG CDH
As Desired For New Solution) (.1 min)
410 + 2 CDH ROUTINE
616 + 00005 (10 sec Ullage)

3 310R ΔT To CDH (.01 min)
DET - SET

4 If Time Available Check The Following:
402R ΔH CDH (.1nm)
423R HDOT CDH (Final) (.1fps)
477R HDOT CDH (.1fps)

5 410 +5 EXT ΔV
450R ΔVX CDH (.1fps)
263R ΔVY CDH (.1fps)
451 (ΔVY CDH) (Sign As 263) (.1fps)
452R ΔVZ CDH (.1fps)
370R ΔVG Magnitude CDH (.1fps)

6 623 +0 Z-axis Parallel To CSM Orbit Plane
+1 Z-axis Parallel To Specified Plane
If 623 +1, Specify Plane
514 +(X Component of Unit Vector)
515 +(Y Component of Unit Vector)
516 +(Z Component of Unit Vector)

DATE 6/15/72

7 400 +1 GUIDANCE STEERING (Z-Axis,400+2,507+1)

8 ATTITUDE CONTROL (3)-PULSE
MODE CONT (AGS) - AUTO
Maneuver To Burn Attitude
ATTITUDE CONTROL (3) - MODE CONT

9
500R ΔVGX (LM) (.1fps)
501R ΔVGY (LM) (.1fps)
502R ΔVGZ (LM) (.1fps)

10

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANSL	2 JET	2 JET	2 JET
TTCA(CDR)	THROT (MIN THRUST)	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT(STAGE)	PUSH	PUSH	-
ENG ARM	DES	ASC	-
MASTER ARM	ON(1st Burn Only)	ON(Un-Staged Only)	OFF
PRPLNT QTY MON	DES 1	OFF	OFF
PRPLNT TEMP/PRESS MON	DES 1	ASC	-
HELIUM MON	SUPCRIT PRESS	PRESS 2	-
ENGINE STOP	-	-	PUSH

DATE 6/15/72

11 -:30 For DPS Burns:
CB(11) DECA PWR-Close
CB(16) DES ENG OVRD-Close
ENG GMBL-ENABLE
For APS Burns:
CB(11 & 16) AELD (2) - Close

-:15 (X-Axis) 500R
(Z-Axis) 502R

12	-:10	Start Ullage	
	:00	IGN	
		(RCS Burn) When ΔVG <15fps, MODE CONTROL (AGS)-ATT HOLD	
13		When Burn Complete	
		ABORT(STAGE) - Reset	
		NULL 500,501,502	(.1 fps)
14		MASTER ARM -OFF	
		ENG ARM -OFF	
		BAL CPL -ON	
		TTCA (CDR) -JETS	
		DEADBAND -MAX	
		PRPLNT QTY MON -OFF	
		HELIUM MON -OFF	

TPI

1	MODE CONT (AGS) - ATT HOLD	
	GUID CONT - AGS	
2	If CFP TPI, Go To ③	
	Wait Until TIG - 136 min:	
	306R (+0) Node At TPF	(.01 min)
	312R (+0) Target Offset Time	(.01 min)
	307 (ΔT Rndz Trans)	(.01 min)
	373 (TIG TPI)	
	410 +4 TPI EXECUTE	
	616 +00005 (10 sec Ullage)	
	303R LOS Angle TPI	(.01°)
	Go To ⑤	
③	Wait Until TIG -136 min:	
	306 (+0) Node At TPF	(.01 min)
	307 + (ΔT Rndz Trans)	(.01 min)
	312 (+0) Target Offset Time	(.01 min)
	310 + (Target TFI TPI)	(.01 min)
	410 + 3 TPI Search	
	616 + 00005 (10 sec ullage)	

DATE 6/15/72

4 303R LOS ANGLE TPI (.01°)
410 + 4 TPI EXECUTE (When 303 is 26.6° Below), (28.3° Above)

(TO RETARGET 410 +3 And
310 (Target TFI TPI) Then
410 +4(When 303 Reads Desired Value)

⑤ 310R ΔT To TPI (.01 min)
DET - SET
371R ΔV Braking (.1fps)
(If +60000, Retarget)

6 If Time Available:
303R LOS Angle TPI (.01°)
306R Target Time of Node (.01min)
307R Desired Transfer Time (.01min)
311R Time To Rendezvous (.01min)
312R Target Offset Time (.01min)
373R TIG TPI (.1 min)
402R Hp TPI (.1nm)

7 For Comparison With LGC P34, N81:
450R ΔVX (LV) (.1fps)
451R ΔVY (LV) (.1fps)
452R ΔVZ (LV) (.1fps)

8 410 +5
370R ΔVG TPI

9 623 +0 Z-Axis Parallel To CSM Orbit Plane
+1 Z-Axis Parallel To Specified Plane
If 623 +1, Specify Plane:
514 +(X-Comp. of Unit Vector)
515 +(Y-Comp. of Unit Vector)
516 +(Z-Comp. of Unit Vector)

10 400 +1 GUIDANCE STEERING (Z Axis, 400+2,507+1)

11 ATTITUDE CONTROL (3) - PULSE
MODE CONT (AGS) - AUTO
Maneuver To Burn Attitude
ATTITUDE CONTROL (3) - MODE CONT

DATE 6/15/72

12 501R VGY (LM) (.1fps)
502R VGZ (LM) (.1fps)
500R VGX (LM) (.1fps)

13

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANS	2 JET	2 JET	2 JET
TTCA (CDR)	THROT	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT (STAGE) PB	PUSH	PUSH	-
ENG ARM	DES	ASC	OFF
MASTER ARM	ON(1st Burn Only)	ON(Un-Staged Only)	OFF
PRPLNT QTY MON	DES 1	OFF	-
PRPLNT TEMP/PRESS MON	DES 1	ASC	-
HELIUM MON	SUPCRIT PRESS	PRESS 2	-
ENGINE STOP	-	-	PUSH

14-:30 For DPS Burns:
CB(11) DECA PWR-Close
CB(16) DES ENG OVRD-Close
ENG GMBL-ENABLE
For APS Burns:
CB(11 & 16) AELD (2) - CLOSE

-:15 (X-Axis) 500R
(Z-Axis) 502R

15 -:10 Start Ullage
:00 IGN
(RCS Burn)When ΔVG <15fps,
MODE CONTROL (AGS)-ATT HOLD

16 When Burn Complete
ABORT(STAGE)PB - Reset
NULL 500, 501, 502 (.1fps)

DATE 6/15/72

17	MASTER ARM	-OFF
	ENG ARM	-OFF
	BAL CPL	-ON
	TTCA (CDR)	-JETS
	DEADBAND	-MAX
	PRPLNT QTY MON	-OFF
	HELIUM MON	-OFF

TPM

Retargeting (Same Rndz Time)

1	410 +4 TPI EXECUTE	
	373 (TPI + 15); (TPI + 30)	(.1min)
	307 +(ΔT Rndz Trans)	
	(+02800 For 1st MCC)	
	(+01300 For 2nd MCC)	
	310R ΔT To TPM	(.01min)
2	If Time Available:	
	311R ΔT Rendezvous	(.01min)
	277R THETA	(.01°)
3	410 +5	
	370R VG MDC	(.1fps)
4	Null 500, 501, 502	(.1fps)

EXTERNAL ΔV

1	MODE CONT (AGS) - ATT HOLD	
	GUID CONT - AGS	
2	Wait Until TIG-136 min	
	410 +5 EXT ΔV	
	373 + TIG	(.1 min)
	450 + ΔVX (LV)	(.1fps)
	451 + ΔVY (LV)	(.1fps)
	452 + ΔVZ (LV)	(.1fps)
	616 + 00005 (10 sec ullage)	(.01 min)
3	370R Total ΔV	
	310R ΔT To IGN	(.01 min)
	DET - SET	

DATE 6/15/72

4 400 +1 GUIDANCE STEERING (Z-Axis, 400+2, 507+1)

5 ATTITUDE CONTROL (3) - PULSE
MODE CONT (AGS) - AUTO
Maneuver To Burn Attitude
ATTITUDE CONTROL (3) - MODE CONT

6
501R ΔVGY (LM)	(.1fps)
502R ΔVGZ (LM)	(.1fps)
500R ΔVGX (LM)	(.1fps)

7

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANS	2 JET	2 JET	2 JET
TTCA(CDR)	THROT	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT(STAGE)	PUSH	PUSH	-
ENG ARM	DES	ASC	OFF
MASTER ARM	ON(1st Burn Only)	ON(Un-Staged Only)	OFF
PRPLNT QTY MON	DES 1	OFF	-
PRPLNT TEMP/PRESS MON	DES 1	ASC	-
HELIUM MON	SUPCRIT PRESS	PRESS 2	-
ENGINE STOP	-	-	PUSH

DATE 6/15/72

8 -:30 For DPS Burns:
CB(11) DECA PWR-Close
CB(16) DES ENG OVRD-Close
ENG GMBL-ENABLE
For APS Burns:
CB(11 & 16) AELD (2) - Close

-:15 (X-Axis) 500R
(Z-Axis) 502R

9	-:10	Start Ullage	
	:00	IGN	
		(RCS Burn) When ΔVG <15fps,	
		MODE CONTROL (AGS) - ATT HOLD	
10		When Burn Complete:	
		ABORT(STAGE) - Reset	
		NULL 500, 501, 502	(.1fps)
11		MASTER ARM	-OFF
		ENG ARM	-OFF
		BAL CPL	-ON
		TTCA(CDR)	-JETS
		DEADBAND	-MAX
		PRPLNT QTY MON	-OFF
		HELIUM MON	-OFF

DATE 6/15/72

AGS MANUAL THRUST

1	GUID CONT	-AGS
	MODE CONT (AGS)	-ATT HOLD
	ATTITUDE CONTROL (3)	- MODE CONT
	DEADBAND	-MIN
	TTCA/TRANSL	-ENABLE
	TTCA(CDR)	-JETS

2 Mnvr Vehicle To Desired Attitude (Align One Of The Spacecraft Body Axes In The Desired Thrust Direction)

3 400 +0
MODE CONT (AGS) - AUTO
404 +0
405 +0
406 +0

4 Perform Burn or Trim Residuals
X - 470R (.1fps)
Null (TTCA Up/Dn)
(If Thrust Axis, Acquire Desired ΔV)
Y - 471R (.1fps)
Null (TTCA Right/Left)
(If Thrust Axis, Acquire Desired ΔV)
Z - 472R (.1fps)
Null (TTCA In/Out)
(If Thrust Axis, Acquire Desired ΔV)

AGS ACTIVATION & SELF TEST

1 AGS STATUS - STBY
(AGS Warn Lt - On)
CB(11) AC BUS B: AGS-Close
CB(16) STAB/CONT: AEA-CTose
(AGS Warn Lt - Off)
AGS STATUS - OPERATE
(AGS Warn Lt - On)
02/H20 QTY MON - CWEA RESET
(AGS Warn Lt - Off)

2 000 +888888 (OPR ERR Lt - On)

DATE 6/15/72

3 123 -45679 (Do Not ENTR)

4 412 +0 To Reinitiate Test
412R +1 SELF TEST SATISFACTORY
+3 LOGIC TEST FAILURE
+4 MEMORY TEST FAILURE
+7 LOGIC AND MEMORY TEST FAILURE

5 574R DESCENT STAGE FLAG (+Not Staged)
604R LUNAR SURFACE FLAG (+Not On Lunar Surface)
612R STAGING SEQ COUNTER (+Att Hold At Abort Stage)

AGS CALIBRATION (INFLIGHT)

1 Verify AGS In Standby/Operate For 25 min

② Read And Record

540R X ACCEL BIAS	_____	(.001 ft/sec2)
541R Y	_____	(.001 ft/sec2)
542R Z	_____	(.001 ft/sec2)
544R X GYRO DRIFT COEFF	_____	(.01°/hr)
545R Y	_____	(.01°/hr)
546R Z	_____	(.01°/hr)

3 If Docked, CSM Mnvr To AGS CAL Attitude
V16N20E
16 20 ICDU Angles O,I,M (All Angles Should Be Approx 22.5°,67.5°,112.5°,157.5°,202.5°,247.5°, 292.5°, or 337.5°)
Rates <.075°/sec
Disable CSM & LM Thrusters(Undocked,PGNS-MIN IMP)
V40N20E (Wait 20 sec Before Step ④)

④ 400 +6 CALIBRATE GYRO & ACCEL
Read And Record After 35 sec

540R X ACCEL BIAS	_____	(.001 ft/sec2)
541R Y	_____	(.001 ft/sec2)
542R Z	_____	(.001 ft/sec2)

Values Should Not Change From Step ②
By More Than (.039)ft/sec2 (.008nom)
(If Undocked, Enter Att Hold Mode For 2 min
Only If Rates >.075 Then Return To MIN IMP)

DATE 6/15/72

MAN BURN,AGS ACT & SELF TEST, CALIB

5 400R +0 GYRO & ACCEL CALIB COMPLETE (302 Sec)
Read And Record
544R X GYRO DRIFT COEFF _____(.01°/hr)
545R Y _____(.01°/hr)
546R Z _____(.01°/hr)
Values Should agree with Step ② Values
Within 2.0°/hr (Nominal 0.9)

AGS ACCEL CALIB/ISOL (INFLIGHT ONLY)

1 DET - Reset/UP
Zero Affected Axis:
(X) 404+0
(Y) 405+0 ENTR & Start DET Simultaneously
(Z) 406+0
(X) 470R
(Y) 471R
(Z) 472R
When DET = 30 sec: DEDA - HOLD

2 If Value < 00012:
Isolate RCS Jets
400 + 7E, Wait 35 sec, Then
400 + 0E, (+1E), or (+2E)
Re-enable RCS
(AGS Is Now Usable for Navigation & Burns)

3 If Value > 00012:
(X) 534 + 0E & 540 + 0E
(Y) 535 + 0E & 541 + 0E
(Z) 536 + 0E & 542 + 0E
Perform State Vector Updates Via
DEDA or V47
(AGS Is Now Usable for Navigation & Burns
Along Non-Affected Axis)

DATE 6/15/72

AGS GYRO CALIBRATION (SURFACE)

1 Verify AGS In Standby/Operate For 25 min &
413 + 10000 Has Been Performed

2 If PGNS Available: V40 N20E
400+3 (If PGNS Not Available 400+4 Then
Wait 30 sec Minimum Before Step ④)

③ Read And Record GYRO DRIFT COEFF
544R X _____ (.01°/hr)
545R Y _____ (.01°/hr)
546R Z _____ (.01°/hr)

④ 400+6 Calibrate Gyros

5 400R (+0 Calibration Complete In 302 sec)

6 Read And Record
544R X _____ (.01°/hr)
545R Y _____ (.01°/hr)
546R Z _____ (.01°/hr)
Values Should Agree With Step ③
Values Within 2.0°/hr (Nominal 0.9)

AGS RR AUTO S.V. UPDATE

1 GUID CONT - PGNS
* GUID CONT - AGS *
* 400+2 Acq. Steer *
* 507+0 Boresight *
* ATT CONT (3) - PULSE *
* MODE CONT (AGS) - AUTO *
* Null Error Needles *
* ATT CONT (3) - MODE CONT*

2 P20 Running & Proper Downlist Active
RR MODE - LGC
TLM - HI

3 417+1 (Initialize Radar Filter)

4 411+1 (Enables Update)
621R XXOYY; XX = No. of Rng Marks
YY = No. of Rng Rt Marks
317R (AEA Range) (.01nm)
440R (AEA Range Rate) (.1fps)
606R (+) Rng Next Update
(-) Rng Rt Next Update

5 To Disable Updating (Prior To Burn):
411+0

DATE 6/15/72

AGS RR MANUAL ACQUISITION AND UPDATE

1	GUID CONT	-AGS
	RNG/ALT MON	-RNG/RNG RT
	RATE/ERR MON	-LDR RDR/CMPTR
	ATT MON	-AGS
	SHFT/TRUN	-+5°
	RR MODE	-SLEW
	ATTITUDE CONTROL (3)	-PULSE
	MODE CONT (AGS)	-AUTO
	DEAD BAND	-MIN
2	400 +2 (Acq Steering) 507 +0 (Z Body Boresight)	
3	Manually Null FDAI	
4	RATE/ERR MON-RNDZ RADAR	
5	Slew Null FDAI, Then Search For Strongest Signal And Check For Side Lobe	
6	RR MODE - AUTO TRACK	
7	417 +1 (Initialize Radar Filter) Wait 16 sec Before Step ⑧	
⑧	415 +1 (Store Z-Axis Cosines) ENTR (When FDAI's Centered)	
9	316 +(RR Rng) (.01nm) (Must Be Entered Within 30 sec of Step ⑧) Wait 4 sec Before Step ⑩	
⑩	415 +1 Store Z Axis Cosines	
⑪	503 ± (RR Rng Rt) (.1fps) (Must Be Entered Within 30 sec of Step ⑩) (Wait 4 sec Before Next 415 Entry)	
12	Repeat Steps ⑧ thru ⑪	

DATE 6/15/72

AUTO,MAN RR UPDATE,
AGS MAN S.V. UPDATE

13 Pre-TPI Repeat Procedure For A Minimum of 6 Range Data Points Approximately 3 min Apart (6 Points, 2 min If Pre-MCC) (9 Points, 3 min if Pre-CSI & CDH)

AGS MANUAL STATE VECTOR UPDATE

NOTE: Insure 411 +0 & 563 +0 Prior To Loading LM or CSM S.V. via DEDA.

1	Record LM Data And Time	
2	240 +(LM X Position)	(100 ft)
	241 +(LM Y Position)	(100 ft)
	242 +(LM Z Position)	(100 ft)
3	260 +(LM X Velocity)	(.1fps)
	261 +(LM Y Velocity)	(.1fps)
	262 +(LM Z Velocity)	(.1fps)
4	254 +(LM Epoch Time)	(.1 min)
5	414 +20000E Update State Vector 414R (+00000 Update Complete)	
6	Record CSM Data And Time	
7	244 +(CSM X Position)	(100 ft)
	245 +(CSM Y Position)	(100 ft)
	246 +(CSM Z Position)	(100 ft)
8	264 +(CSM X Velocity)	(.1fps)
	265 +(CSM Y Velocity)	(.1fps)
	266 +(CSM Z Velocity)	(.1fps)
9	272 +(CSM Epoch Time)	(.1 min)
10	414 +30000E Update State Vector 414R (+00000 Update Complete)	

DATE 6/15/72

AUTO,MAN RR UPDATE,
AGS MAN S.V. UPDATE

RAPID IMU REALIGN

NOTE: This Procedure Assumes A Good AGS Alignment

1 Fly Spacecraft to 0°,0°,0° On AGS Inertial Ball

2 V41 N20E
E,E,E, (Coarse Align IMU To 0°,0°,0° Body)

3 V40 N20
Verify 0°,0°,0° On AGS Ball - ENTR
(Releases Platform and Recovers PGNS Control Modes After 11 sec)
Wait 11 sec Before Step ⑤

4 V25 N07E
77E, 10000E, 1E (Sets REFSMMAT Flag)

⑤ V37E 51E
PRO On First Display (Sets DRIFT Flag)
V37E 00E

6 Perform P52, Option 3 (Auto Optics Are Good)

NOTE: If Loss of Alignment is Due To Temporary Loss of CDR's BUS, Update LGC Clock With V55 To Complete Recovery.

DATE 6/15/72

AGS RNDZ ALIGN

1 Fly to 0° Roll, Z-Axis Toward CSM

2 400 +5E
400 +0 DO NOT ENTR

3 When Wings Level (Horiz Ref) And Z-Axis Toward CSM Key ENTR And Note GET ___:___:___

4 Coordinate with CSM To Adjust Ordeal (Pitch LM = 180° + Pitch CM)

5 Transmit GET of Align to MSFN

AGS STAR ALIGN

1 MODE CONT (AGS) - ATT HOLD

2 Mnvr To Place Star Set In AOT (Fwd Detent)

3 Position Prime Star In Center of Reticle

4 DEAD BAND - MIN

5 Rotate Reticle To Place Either +X,+Y Line on Star #2

6 400 +5E
400 +0E

7 Record & Report To MSFN Star Set, ID Line AOT Counter
_____ (Star #1)
_____ (Star #2)
_____ (ID Line)
_____ (AOT Counter)

8 Mnvr To FDAI Angles From MSFN

9 At New Attitude
400 +5E
400 +0E

DATE 6/15/72

ALIGN LM AGS TO CSM IMU/GDC

1 Verify: ATTITUDE CONTROL (3) - PULSE
MODE CONTROL (AGS) - ATT HOLD

2 Request CSM Mnvr To
R (CSM) = 300° + (RC)
P (CSM) = 180°
Y (CSM) = 0°

3 400 + 5E
400 + 0, When CSM At Proper Attitude, ENTR

4 Copy And Load State Vector From MSFN
If AGS Ext ΔV Routine Usage Desired

ALIGN LM IMU TO CSM GDC

1 Request CSM Go To MIN DB, ATT HOLD

2 Request And Copy CSM GDC (R,P,Y)

3 Calculate Gimbal Angles

OG	IG	MG
300.00°	180.00°	360.00°
+_____RC		
-_____CM(R)	-_____CM(P)	-_____CM(Y)
_____LM	_____LM	_____LM

4 V41N20E, Load Gimbal Angles
Wait Until Coarse Align Complete

5 V40N20, Verify CSM at GDC Attitude, ENTR
Notify CSM Att Hold No Longer Required
Wait 11 sec Before Step ⑦

6 V25N07E (Set REFSMMAT Flag)
77E, 10000E, 1E

DATE 6/15/72

⑦ V37E51E (Set DRIFT Flag)
PRO
V37E00E

8 Request MSFN Uplink REFSMMAT,
Then, If Desired, Do P52

ALIGN CSM IMU TO LM IMU

1 Configure For MIN DB, ATT HOLD
(Either PGNS or AGS)

2 Notify CSM That LM In MIN DB ATT HOLD

3 V06N20E
Read Gimbal Angles To CSM When Requested

4 Terminate ATT HOLD On CSM Cmd

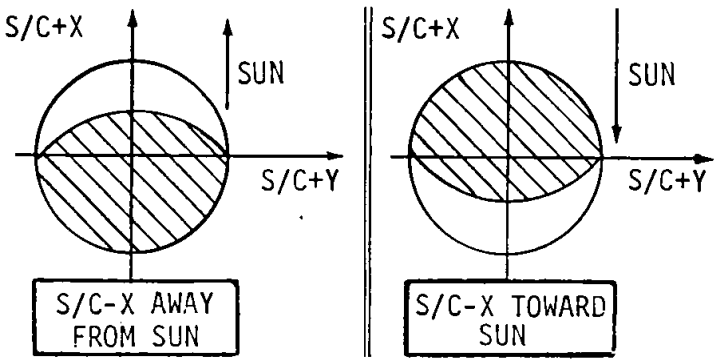
5 On CSM Request V06N20
On CSM Mark, Key ENTR

6 Copy Angles And Transmit To CM

DATE 6/15/72

CRESCENT ALIGN

1 Verify COAS or AOT Lighting
Mnvr To Acquire Earth In Optical System's Field-of-view.
Further Mnvr To Align Required Reference Line Along Earth's Crescent, Placing The Reference Line On The Points Of The Crescent.



MSFN Will Update X-axis Direction.
The COAS Or The AOT Detent 2, May Be Used

2 For AGS Only, Perform Step ⑦ Only
If LGC Not Available,
Verify CB(11) PGNS: IMU OPR - Open
Wait 5 min Then Go To Step ⑧

3 V41N20E, Load Desired Angles From MSFN or 0,0,0
Wait Until Coarse Align Complete (If Further Mnvr Required, Perform Via AGS)

4 V40N20, Verify Ref. Line Aligned With Crescent, ENTR
Wait 11 sec Before V37 In Step ⑤

⑤ V25N07E, 77E, 10000E, 1E
V37E51E, PRO, V37E00E
(Request MSFN Uplink REFSMMAT And Do P52 If Desired)

DATE 6/15/72

6 To Align AGS To PGNS Reference: 400 + 3E or Step ⑦

⑦ 400 + 5E
400 + 0, Verify Ref. Line Aligned With
Crescent, ENTR

⑧ CB(11) PGNS: IMU OPR - Close
Wait 90 sec
IMU CAGE - ON (Momentarily)

DATE 6/15/72 —ASA — MSC

VERB LIST

01-05 DISPLAY OCTAL
06 DISPLAY DECIMAL
07 DP DEC DSPLY (≤N38)
11-15 MONITOR OCTAL
16 MONITOR DECIMAL
17 DP DEC MON (≤N38)
21-25 LOAD DATA
27 01 DSPLY FIXED MEMORY
30 EXECUTIVE (PRE/L N26)
31 WAITLIST (PRE/L N26)
32 RECYCLE
33 PROCEED
(REQ W/ V21-V23)
34 TERMINATE
(EXCEPT N49,60,63,88)
35 TEST LITES (P00)
36 FRESH START
37 CHANGE PROGRAM
40 20 ZERO ICDU'S
40 72 ZERO RR CDU'S
41 20 IMU CRS ALN
41 72 RR CRS ALN
42 GYRO TORQ
43 LOAD FDAI ERROR NEEDLES (P00)
44 TERM RR DESIGNATE
47 INITIALIZE AGS
48 DAP DATA LOAD
49 CREW ATT MNVR (P00)
50 PLEASE PERFORM
52 REQST CURSOR MK
53 REQST SPIRAL MK
54 REQST X OR Y MK
55 INCRMT CLK (H,M,S)
56 TERM TRACKING
57 PERMIT LR UPDTS
58 INHIBIT LR UPDTS
59 CMD LR TO POSN 2
60 DAP ATT RTS (ERR NDLS)
61 DAP FOLLOW ATT ERROR (MODE 1 ERR NDLS)
62 TOTAL ATT ERR (N22-N20) (MODE 2 ERR NDLS)
63 RR/LR SELF-TEST
64 S-BAND ANT (06 51)
65 DISABLE U-V JETS
66 LM SV TO CSM SLOTS
67 DSPLY W-MATRIX RSS ERROR (06 99)
68 TERM TERRAIN MODEL
69 FORCE RESTART
70 LIFTOFF TIME UPDT (P27)
71 BLOCK ADRS UPDT (P27)
72 SINGLE ADRS UPDT (P27)
73 LGC CLK OCT UPDT (P27)
74 START ERASABLE DUMP
75 ENABLE U-V JETS
76 MINIMUM IMPULSE
77 RATE CMD/ATT HOLD
78 START LR SPURIOUS TEST
79 STOP LR SPURIOUS TEST
80 UPDT LM SV (P20)
81 UPDT CSM SV (P20,P22)
82 ORBIT PMTR DSPLY(16 44)
83 RDZ PMTR DSPLY (16 54)
85 DSPLY RR LOS AZ, ELEV ≠ (16 56)
89 RDZ FNL ATT MNVR(P00)
90 RDZ OUT-OF-PLANE DSPLY (06 90)
91 DSPLY BANKSUM (P00) (BK SUM,BK,BUGGER) (NEXT BANK-PRO TERM-V34E)
93 ENABLE W-MATRIX INITIALIZATION
95 INHIBIT SV UPDTS(P20,P22)
96 STOP SV INTEGRATION
97 PERFORM ENGINE FAIL PROCEDURE
99 ENABLE ENGINE IGN

ROUTINE CROSS-REF

R03/V48 R36/V90
R04/V63 R47/V47
R05/V64 R56/V56
R30/V82 R62/V49
R31/V83 R63/V89
R33/V06N65 R77/V78

NOUN LIST

* - LEGIT LOADABLE NOUN & DATA VALID ANYTIME NOUN CALLED
V - DATA VALID ANYTIME NOUN CALLED
L - LEGIT LOADABLE NOUN
X - LEGIT LOADABLE NOUN (HR, MIN, .01S) (IF LOAD, ENTR R1, R2, R3)

01,02,03 * SPECIFIED OCT ADRS

DSPY	OCT	DEC
N01	[OCT]	[.XXXXX]
N02	[OCT]	[XXXXX.]
N03	[OCT]	[.01°]

04 GRAVITY ERR ≠ [.01°(R1)]
05 SIGHT ≠ DIFF/SV-RR LOS ≠ [.01°(R1)]
06 L OPTION CODE [OCT] (SEE P21, P22, P52, P57)
07 L ADRS/CHNL, BIT ID, ACTION [OCT] (SEE "FLAGWRD/CHNL SET/RESET")
08 V ALARM DATA [OCT] (ALMCADR, "BBCON", ERCOUNT)
09 V ALARM CODES [OCT] (1ST, 2ND, MOST RECENT ALM)
10 * SPECIFIED CHNL [OCT(R1)]

CAN'T 34, READ 35	CAN'T 3, 4, 7,15 LOAD 16,30,31,32

(IF LOAD CH 33, RESETS BITS 15-11)

11 X T CSI OR T APOAPSIS [H, M, .01S] (0,0,0 = COMPUTE T APOAPSIS)
12 L OPTN CODE [OCT (0000X, 0000Y)]

	X (SPFY)	Y=1	Y=2
V82	2 (VEH)	LM	CSM
V89	3 (TK ATT)	+Z	+X
V63	4 (RADAR)	RR	LR
41 72	6 (RR FN)	LOCK	DESIG

13 X T CDH [H, M, .01S]
15 * INCREMENTED OCT ADRS [OCT(R1)]
16 X T EVENT [H, M, .01S] (AGSK = PRSNT T IF V32E (V47)) (0,0,0 = PRSNT T (V90)
18 AUTO MNVR FDAI ≠ ~R, P, Y [.01°]
20 V PRSNT ICDU'S ~ Y, P, R [.01°]
21 V PIPA PULSES X, Y, Z [XXXXX.]
22 L DSRD NEW ICDU'S ~ Y, P, R [.01°]
24 X LGC CLK ΔT [H, M, .01S]
25 SEE "V50 CHECKLIST" [OCT(R1,R2)]
26 * PRIO/DELAY, ADRES, "BBCON" [OCT] (SEE V30, V31)
27 * SELF-TEST ON/OFF SW [OCT(R1)] (START: 00010 (ALL) STOP: 00000; 00004(ERAS) ALSO; 00005(FIXED) V36, V91)
32 T FROM PERIGEE [H, M, .01S]
33 X TIG [H, M, .01S]
34 X T EVENT [H, M, .01S] (0,0,0 = PRSNT T)
35 TFI/TCO [H, M, .01S]
36 V LGC CLOCK TIME [H, M, .01S]
37 X T TPI [H, M, .01S]
38 V INTEG SV TIME TAG [H, M, .01S]
40 TFI/TCO, VG, ΔVM [M:S, .1FPS, .1FPS]
42 HA, HP, VG [.1NM, .1NM, .1FPS]
43 LAT, LON, ALT [.01°, .01°, .1NM] (+N, +E, + > RLS)
44 HA, HP, TFF [.1NM, .1NM, M:S] (TFF = ~59 59 IF HP > 35K FT)
45 V/R1 MKS, TFI, +MGA [X., M:S, .01°] (R3 = ~00001: NOT FINAL; R3 = ~00002: P7X OR FNL, NO ALN; R3 = +MGA: FNL, IMU ALN)
46 L DAP CONFIG, CHANBKUP [OCT(R1,R2)] (CONFG: SEE "DAP DATA LOAD"; CHANBKUP: IGNORE SPFY DSCRT; 00001 - ABORT/ABORT STAGE; 00010 - AUTO THRTL; 00011 - BOTH DSCRTS)
47 * LM WT, CSM WT ELBM (R1, R2)
48 L DPS P, R GMBL TRIM [.01°(R1, R2)]
49 ΔR, ΔV, SOURCE [.01NM, .1FPS, X.] (X=1 RANGE X=3 SHIFT; X=2 RNG RT X=4 TRUN)
51 DSRD S-BAND P, Y ≠ [.01°(R1, R2)]
52 ACT VEH CENTRL ≠ [.01°(R1)] (AVOID 170° - 190° REGION)
54 RANGE, RDOT (~ CLOSE), +Z/HORZ ≠ [.01NM, .1FPS, .01°]
55 L P32: APSIS, ELEV, CODE [X., .01°, Y] (Y=0: CDH AT APSIS SPFY BY R1) (Y≠0: CDH AT (R1)x(180°))
L P34: CODE, ELEV, TRANSFER ≠ [X., .01°, .01°] (X=0 CONIC ELEV=0 T OPTN; X≠0 ENCKE ELEV≠0 ≠ OPTN)
56 RR LOS AZ, ELEV [.01°(R1, R2)] (AZ +/LM Z, ELEV +/Y)
58 PREDICT POST-TPI HP, TPI ΔV, TPF ΔV [.1NM, .1FPS, .1FPS]
59 LOS ΔV VEC (FWD, RT, DN IF BORE ≠, IN-PLANE, HEADS-UP) [.1FPS]
60 V(+Z), HDOT(~/H1), H [.1FPS, .1FPS, FT]
61 TG (AIM PT), TFI, XR (+/LS N) [M:S, M:S, .1NM]
62 V1, TFI, ΔVM [.1FPS, M:S, .1FPS]
63 ΔH (LR~PGNS), HDOT(~/H1), H [FT, .1FPS, FT]
64 V TR: LPD, HDOT(~/H1), H [S:°, .1FPS, FT]
65 V SAMPLED LGC TIME [H, M, .01S] (IF LGC/CMC CLK SYNC, V06N65...E, SYNC W/ CMP; V55 ΔT = CSM T~LM T
66 V/R2 LR SR, ANT POSN [FT, X.(R1, R2)]
67 LR VX, VY, VZ [FPS]
68 RNG(+Z), TG(BRK), VI [.1NM, M:S, .1FPS]
69 L LS UPDT Z, Y, X (DN~R, XR, ALT) [FT]
70 L AOTCODE (00YXX) [OCT(R1)] (XX = STAR ID Y=DTNT; Y=0 COAS/LPD CAL (P52 ONLY); Y=1~6 AOT (L, F, R, RR, CL, LR); Y=7 COAS)
71 L AOTCODE, X/CRSR, Y/SPRL CTR [OCT] (R1 SAME AS N70 EXCPT NO DTNT 0; R2, R3 = POINTER: CTR (1~4 + LAST)
72 RR TRUN (↔), SHFT (1) [.01°(R1, R2)]
73 L DSRD RR TRUN, SHFT [.01°(R1, R2)]
74 TFI, PITCHOVR Y, P [M:S, .01°, .01°]
75 P32: CDH ΔH, CSI/CDH ΔT, CDH/TPI ΔT
P33: CDH ΔH, CDH/TPI ΔT, TPI SLIP [.1NM, M:S, M:S]
76 L DSRD VHORZ(FNL), HDOT(FNL), XR [.1FPS, .1FPS, .1NM]
77 TCO, VGY(BODY), VI [M:S, .1FPS, .1FPS]
78 RR RNG, RNG RT (~ CLOSE), TFI [.01NM, .1FPS, M:S]
79 L CRSR, SPRL, DTNT [.01°, .01°, X.] (X=1~6 AOT~L, F, R, RR, CL, LR)
80 RR SEARCH DATA IND, LOS/+Z ≠ [XXXXX., .01°(R1, R2)] (+00000=SEARCH; +11111=LOCK)
81 L ΔV(LV) VEC (FWD, RT, DN) [.1FPS]
82 CDH ΔV(LV) VEC (FWD, RT, DN) [.1FPS]
83 ΔV(BODY) VEC (UP, RT, FWD) [.1FPS]
84 L ΔV(CSM LV) VEC (FWD, RT, DN) [.1FPS]
85 VG(BODY) VEC (UP, RT, FWD) [.1FPS]
86 N86 = N81
87 L COAS AZ (+RT), EL (+ UP) [.01°(R1, R2)]
88 L CELEST BODY UNIT VEC [.XXXXX]
89 L LS LAT (+N), LON/2 (+E), ALT [.001°, .001°, .01NM]
90 Y, YDOT, PSI [.01NM, .1FPS, .01°] (Y, YDOT ≤ CSM PL; PSI = LOS/LM PL)
91 ALT, VI, FLT PATH ≠ [10NM, FPS, .01°]
92 THRTL, HDOT (~/H1), H [%, .1FPS, FT]
93 Δ GYRO TORQ ≠ X, Y, Z [.001°]
94 VGX(BODY), HDOT (+/H1), H [.1FPS, .1FPS, FT]
99 L W~MATRIX POSN, VEL, RR BIAS ERRS [FT, .1FPS, MILLI~RAD]

V50 CHECKLIST

R1	PLEASE PERFM	"PRO"	"E"
00013	CRS ALN	NORM	PLS TORQ
00014	ALN RECHK	RECHK	EXIT
00015	P51~ACQ STAR	CONT	CRS ALN
	P52 PRO: PICAPAR, X/Y MK		
	SPFY E: MAN SPFY, X/Y MK		
	V32E: CRSR/SPRL MK; ROD BKUP		
00016	NOTE LGC REJ MK SETS (R2=REJ MK PRS)	CONT	REDO
00062	LGC PWR DN	CONT	
00201	RR SW ~ LGC	CONT	MAN ACQ (P20 ONLY)
00203	SW~PGNS/AUTO OR SW~AUTO THRTL (PGNS/AUTO, NOT STAGED)	CONT	MAN THRTL
00205	CSM ACQUIRE	LOCK	ATT MNVR
00500	SW LR ANT TO POSN 1 (DES, WT 10, AUTO)	CONT	LR AT POSN 1

PGNS/AGS SUMMARY CARD

(LUMINARY 210/FP~8)
REV: 1 DATE: 6/3/71

Prepared for FPRB/MSC by TRW Systems under Task ASPO 81C~3

N49 ACCPT CRITERIA

PRE~DIR RDZ/CSI W~MAT	ACCPT LMTS	POST~DIR RDZ/CSI W~MAT	ACCPT LMTS
+10000 +00100 +00015	ΔR < +00200 ΔV < +00120	+02000 +00020 +00005	ΔR < +00080 ΔV < +00050

- 06 49 IF ΔR > 2K FT (R1 > +00033) OR ΔV > 2 FPS (R2 > +00020)
- 06 49 SOURCE CODE SPFY BY R3 = +0000X: X=1 RNG, X=2 RNG RT, X=3 SHFT, X=4 TRUN
- REJ 1ST MK IF R1 OR R2 > ACCPT LMTS, BUT ACCPT 2ND MK IF IT AGREES W/ 1ST MK
- VFY DOWNWARD TREND IN MAG OF CORR (IF TREND NOT↓, CHK RR OPERATION)

P06

V37E06E
50 25 (00062)
IMU OPR~OPEN, PRO

P12

V37E12E
06 33, L, PRO
06 76, PRO
IF NOT PGNS, AUTO
50 25 (00203)
↓(AUTO BURN)
↓SET SW, PRO
↓(MAN BURN) E
06 74
99 74 (TIG~5), PRO
06 74 (T< TIG)
06 94, ...V16N77E
[16 77], KREL
06 94
16 94, PRO
16 85, NULL, V82E
[16 44], PRO
16 85, PRO
37
POSSIBLE
97 94 (NOT ON L/O)
PROG LITE/V05N09E
00210, 00220, 01703
AVAILABLE
X~AXIS OVERIDE OK AFTER P/OVR
N32(IF NO), N38, N76
N77; V60, V61, V62
V82, V83, V85(T< TIG)

P20

V37E20E
TK ATT MNVR
IF NOT PGNS, AUTO
BYPASS TK ATT (N18 = DSRD FDAI)
MNVR W/O DSPLY
IF POINT ERR < 15°
50 18
↓(AUTO) PRO
↓50 18, E
↓(MAN) MNVR, E
AUTO/SLEW/LGC SW GOVERNS LOGIC:
IF "LGC" → RR AUTO
OTHER → RR MAN
RR MAN ~ACQ
50 25(00201)
↓(AUTO ACQ)
RR SW ~ LGC, PRO
→ RR AUTO
↓(MAN ACQ) E
50 25 (00205)
↓(NO ACQ) E
→ TK ATT & RTN (LOCK~ON)
RR SW ~ LGC, PRO
→ UPDT
OR
RR AUTO ~ACQ
IF LOS > MODE 1, 2 LMTS → TK ATT
50 72, VFY ACQ, PRO
→ UPDT
IF NO LOCK~ON: 05 09 (00503)
(REDES) V32E
→ RR AUTO
↓(SEARCH) PRO
16 80 [VFY LOCK]
↓(NO ACQ) V32E
→ TK ATT & RTN (LOCK~ON) PRO
→ TK ATT → UPDT
UPDT ~SV
DSKY BLANKS OR OLD DSPLY RTNS IF P20 IN BKGRND
TAKE MKS OR SEL NEW PROG AS REQ
IF EXCESSIVE UPDT: 06 49
↓(PART REJ) V32E
↓(ACCPT MK) PRO
↓(TOTAL REJ) V34E
→ UPDT
IF SV/RR LOS > 3°: 05 09 (00525), PRO
06 05
(REDES) V32E
→ RR AUTO
(CONT) PRO
→ UPDT
IF SV/RR LOS > 30°: → TK ATT → UPDT

POSSIBLE/AVAILABLE SEE P20/P22 COMMON

P22

V37E22E
04 06 (00012, 0000X)
↓(X=1/SAME) PRO
↓(X=2/NEW) L, PRO
06 33, L, PRO
IF RNG > 400NM:
IF RDOT ~ 16 54 → IF RDOT + → F V37
IF MODE SW "SLEW" OR "AUTO": 50 25 (00201)
↓SEL "LGC", PRO
IF NO LGC~ON: 05 09 (00503)
↓(REDES) V32E
(SEARCH) PRO
↓16 80 (ACCQ), PRO
UPDT ~SV
DSKY BLANKS TRACK CSM AS REQ
IF EXCESSIVE UPDT: 06 49
↓(PART REJ) V32E
↓(ACCPT MK) PRO
↓(TOTAL REJ) V34E
→ UPDT
IF SV/RR LOS > 3°: 05 09 (00525), PRO
06 05
↓(REDES) V32E
(CONT) PRO
→ UPDT

POSSIBLE/AVAILABLE: SEE P20/P22 COMMON

P20/P22 COMMON

P20/P22 POSSIBLE
05 09(00503,00514,00525)
05 09(00501)(P20 ONLY)
05 09(00530)(P22 ONLY)
06 49
50 18 (P20 ONLY)
PROG LITE/V05N09E
00210, 00220, 00515
00520, 00527, 31210
00526 (P20 ONLY)
20607 (P22 ONLY)
P20/P22 AVAILABLE
N18, V80 (P20 ONLY)
N38, N45, N54, N72
N78; V56, V67, V81
V93, V95

RR SELF~TEST

IF SET "NORRMON": V25N07E 101E, 10E, 1E
V63E
04 12, PRO
IF NOT PGNS, AUTO
50 25 (00201)
↓RR SW ~ LGC, PRO
16 72, PRO
16 78
↓(TERM) V34E
(CONT) V32E
→16 72

P21

V37E21E
04 06 (00002, 0000X)
↓(X=1/LM) PRO
↓(X=2/CSM) L, PRO
06 34, L, PRO
06 43, N91E
[06 91], KREL
06 43
(RCYCL) V32E
(T=T + 10 MIN)
→ 06 34
↓(EXIT) PRO
37
AVAILABLE
N38, N91

P25

V37E25E
IF NOT PGNS, AUTO
NO ATT MNVR (N18)
MNVR W/O DSPLY
IF POINT ERR < 15°
50 18
↓(MAN) MNVR, E
(AUTO) PRO
↓50 18, E
[SELECT NEW PROG]
POSSIBLE
50 18
PROG LITE/V05N09E
00210, 00220
AVAILABLE
N18, N78; V56

P27

563+0 IF AGS ON
V37E00E
V7XE (X=0, 1, 2, 3)
21 01, L
21 02
↑(REVIEW) V01N01E
N15E, E...E, KREL
(CHANGE)
ID XXE → 21 01
↓(ACCPT) V33E
P00

P30

V37E30E
06 33, L, PRO
06 81, L, PRO
06 42, PRO
16 45, PRO
37
AVAILABLE
N52, N59; V56, V90

P32,P72

V37E32E/V37E72E
06 11
↑(T APO) PRO
ON 0, 0, 0
↓(T CSI) L, PRO
06 55, L, PRO
06 37, L, PRO
16 45
↑(RCYCL) V32E
06 75, PRO
06 81, PRO
06 82, PRO
↓(FINAL) PRO
06 75, PRO
06 81, V90E
[06 16], L, PRO
[06 90], PRO
06 81, L(~), PRO
06 82, PRO
16 45, PRO
37
POSSIBLE
05 09 (0060X)
X = 0 THRU 6
P20 IN BKGRND
05 09 (00525)
06 49
50 18
AVAILABLE
N13; V56, V90

P33,P73

V37E33E/V37E73E
06 13, L, PRO
16 45
↑(RCYCL) V32E
06 75, PRO
06 81, PRO
↓(FINAL) PRO
06 75, PRO
06 81, V90E
[06 16], L, PRO
[06 90], PRO
06 81, L(~), PRO
16 45, PRO
37
POSSIBLE
05 09 (00611)
P20 IN BKGRND
05 09 (00525)
06 49
50 18
AVAILABLE
N37; V56, V90

P34,P74

V37E34E/V37E74E
06 37, L, PRO
06 55
↑(T OPTN) PRO
(≠OPTN)
↓L(R2), PRO
16 45
↑(RCYCL) V32E
↓(FINAL) PRO
IF ELEV ≠ OPTN 06 37, PRO
IF TIME OPTN 06 55, PRO
06 58, PRO
06 81, PRO/L, PRO
IF RCYCL → 16 45 (ABOVE)
16 45, PRO
37
POSSIBLE
05 09 (00611)
P20 IN BKGRND
05 09 (00525)
06 49
50 18
AVAILABLE
N52, N59; V56, V90

P35,P75

V37E35E/V37E75E
16 45, PRO
DON'T V32E(RCYCL) ON 16 45
06 81, PRO/ L, PRO
16 45, PRO
37
POSSIBLE
P20 IN BKGRND
05 09 (00525)
06 49
50 18
AVAILABLE
N52, N59; V56, V90

P40,P42

V37E40E/V37E42E
50 18
↓(AUTO) PRO
50 18, E
↓(MAN) MNVR, E
IF NOT PGNS, AUTO
50 25 (00203)
↓(AUTO BURN)
↓SET SW, PRO
↓(MAN BURN) E
→ 06 40
IF P40 BUT NOT AUTO THRTL
50 25 (00203)
↓(AUTO)
↓SET SW, PRO
↓(MAN) E
06 40
99 40 (TIG~5), PRO
06 40
16 40, PRO
16 85, NULL, PRO
37
POSSIBLE
05 09 (01706), 97 40
PROG LITE/V05N09E
00210, 00220, 01407
01703
AVAILABLE
V22N46E, 10E IF AUTO THRTL DSCRT FAIL
X~AXIS OVERRIDE OK
N18, N81, N86
V60, V61, V62, V82
V65, V75(DOCK ONLY)

P41

V37E41E
50 18
↓(AUTO) PRO
50 18, E
↓(MAN) MNVR, E
16 85
F16 85, NULL, PRO
37
POSSIBLE
PROG LITE/V05N09E
00210, 00220, 01703
AVAILABLE
IF 16 40 KEYED, 16 85
DSPLY RESTORED VIA:
• N85E
• LGC AT TIG~30
X~AXIS OVERRIDE OK
N18, N40, N81, N86
V60, V61, V62, V82

P47

V37E47E
16 83
↑(RCYCL) V32E
[RSET N83 = 0, 0, 0]
↓(EXIT) PRO
37
POSSIBLE
PROG LITE/V05N09E
00210, 00220
AVAILABLE
V82, V83

P51

V37E51E
50 25 (00015), MNVR
↑(CRS ALN) E
41 22 (0, 0, 0)
↓(CONT) PRO
→ X/Y MK
*06 05
(REDO) V32E
→ 50 25 (00015)
↓(ACCPT) PRO
37
POSSIBLE
SEE "ALN ALARMS"
AVAILABLE
V76, V77 ONLY

P52

V37E52E
04 06 (00001, 0000X)
↓(X=1/PREF) L, PRO
↓(X=2/NOM) L, PRO
06 34, L, PRO
(X=3/REFS) L, PRO
→ 50 25 (00015)
(X=4/LS) L, PRO
06 34, L, PRO
06 89, PRO
06 22 (V PRED MGA)
↑(REJ) MNVR, V32E
↓(ACCPT) PRO
50 25 (00013)
↓(NORM) PRO
(PLS TORQ)
V76E, E
16 20 (Y, Z, X)
50 25 (00014)
↓(CONT) PRO
↓(TERM/F V37) E
50 25 (00015)
(PICAPAR) PRO
→ AUTO OPTICS
(SPFY/NORM) E
→ AUTO OPTICS
(CRSR/SPRL) V32E
→ INFLT CRSR
SELECT V32 IF ROD BACKUP

AUTO OPTICS
01 70, L, PRO
IF COAS/LPD OR COAS (DTNTS 0, 7)
06 87, L, PRO
IF PLANET
06 88, L, PRO
50 18
↓(AUTO) PRO
50 18, E
↓(MAN) MNVR, E
IF COAS/LPD CAL
→ 01 70
→ X/Y MK

INFLT CRSR
01 70, L, PRO
IF PLANET
06 88, L, PRO
06 79
↓(RESEL) V32E
→ 01 70
↓(ACCPT) PRO
→ CRSR/SPRL MK

*06 05
↓(ACCPT) PRO
↓(REJ) V32E
→ 50 25 (00014)
06 93
↓(TORQ) PRO
↓(REJ) V32E
50 25 (00014)
↓(EXIT) E
IF A/T ≠ 2
↓06 89, PRO
IF A/T ≠ 2, #3
RECHK DSRD, PRO
W/REFS → 01 70
W/ NO REFS → CRSR/SPRL MK

37
POSSIBLE
05 09 (00404, 00405)
SEE "ALN ALARMS"
AVAILABLE
V76, V77 ONLY

STAR ID

00 PLANET	01~45 STAR	46 SUN	47 EARTH	50 MOON
1	ALPTZ	AKMAR	6	
2	DPHDA	AKNAR	4	
3	NAVI	ACRUX	25	
4	AKNAR	ALDBN	11	
5	POLRS	ALKAD	27	
6	AKMAR	ALFRD	21	
7	MNKAR	ALFKA	32	
10	MRFAK	ALPTZ	1	
11	ALDBN	ALTAR	40	
12	RIGEL	ANTRS	33	
13	CAPLA	ARCTS	31	
14	CNPUS	ATRIA	34	
15	SIRUS	CNPUS	14	
16	PRCYN	CAPLA	13	
17	REGOR	DABIH	41	
20	DNCES	DENEB	43	
21	ALFRD	DNBLA	23	
22	RGLUS	DPHDA	2	
23	DNBLA	DNCES	20	
24	GIENA	ENIF	44	
25	ACRUX	FMHLT	45	
26	SPICA	GIENA	24	
27	ALKAD	MNKAR	7	
30	MNKNT	MNKNT	30	
31	ARCTS	MRFAK	10	
32	ALFKA	NAVI	3	
33	ANTRS	NUNKI	37	
34	ATRIA	PECOK	42	
35	RSLHG	POLRS	5	
36	VEGA	PRCYN	16	
37	NUNKI	RSLHG	35	
40	ALTAR	REGOR	17	
41	DABIH	RGLUS	22	
42	PECOK	RIGEL	12	
43	DENEB	SIRUS	15	
44	ENIF	SPICA	26	
45	FMHLT	VEGA	36	

X/Y MK

01 71, L/VFY, PRO
IF COAS (DTNT 7)
06 87, L, PRO
54 71
↑(MKS) ANY ORDER (UP TO 5 MK SETS)
(SW REJ POINTER) E
(NEW STAR) V32E
→ 01 71
↓(DONE) PRO
IF PLANET
06 88, L, PRO
1ST STAR → X/Y MK
2ND STAR → *06 05

CRSR/SPRL MK

01 71, L/VFY, PRO
IF PLANET
06 88, L, PRO
XX 71 {XX = 52 (CRSR) XX = 53 (SPRL)}
↑(REVERSE XX) E
↑(MKS) X, Y MK/ROD (UP TO 5 MK SETS)
YY 79 {YY 21 CRSR; YY 22 SPRL}
06 79, PRO
(NEW STAR) V32E
→ 01 71
↓(DONE) PRO
IF LGC REJ MKS (R2): 50 25 (00016, 0000X)
↓(CONT) PRO
(REDO) E
→ 01 71
REDO IF ALL MK SETS REJ (29/28.5°)
IF PLANET
06 88, L, PRO
IF MK ON 2ND STAR REQ, → CRSR/SPRL MK
OTHERWISE → *06 05

P57

V37E57E
04 06 (00001, 0000X)
↓(X=1/PREF) L, PRO
(X=3/REFS) PRO
(X=4/LS) L, PRO
06 34, L, PRO
05 06 (00010, R2, R3)
↓L(R2), PRO
R2 = 0000X (A/T) X=0 REFS/STO ATT X=1 REFS + GRAV X=2 TWO STARS X=3 STAR + GRAV
R3 = 00RA0 (1 = YES/0 = NO) R = REFSMMAT A = STO ATT
A/T #0
IF TORQ ≠ > 5° 06 22, PRO
50 25 (00014), E
37
OR
A/T #1 OR #3
"NO ATT" LITE ON, OFF (TWICE)
IF MON CRS ALN V16N20E R1 = +04200 R2 = +31800 R3 = +03526
KREL
06 04
(REDO) V32E
→ "NO ATT"
↓(ACCPT) PRO
IF TORQ ≠ > 5° 06 22, PRO
IF A/T #1 ~ *06 05
IF A/T #3 ~ CRSR/SPRL MK
OR
A/T #2
IF REFS/STO ATT & IF TORQ ≠ > 5° 06 22, PRO
IF NO REFS CRSR/SPRL MK
01 70, L, PRO
IF PLANET
06 88, L, PRO
06 79
(RESEL) V32E
→ 01 70
↓(ACCPT)
CRSR/SPRL MK

*06 05
↓(ACCPT) PRO
↓(REJ) V32E
→ 50 25 (00014)
06 93
↓(TORQ) PRO
↓(REJ) V32E
50 25 (00014)
↓(EXIT) E
IF A/T ≠ 2
↓06 89, PRO
IF A/T ≠ 2, #3
RECHK DSRD, PRO
W/REFS → 01 70
W/ NO REFS → CRSR/SPRL MK

37
POSSIBLE
05 09 (00404, 00701)
SEE "ALN ALARMS"

ALN ALARMS
PROG LITE/V05N09E
00111, 00112, 00113
00115, 00210, 00211
00217, 31207, 31211
(P52: 00220, 00401)

P63

V37E63E
06 61, N33E
[06 33], KREL, PRO
50 18
↓(AUTO) PRO
50 18, E
↓(MAN) MNVR, E
IF NO POSN 1 DSCRT
50 25 (00500)
↓(AT POSN 1) E
(AT POSN 2)
LDG ANT~DES; WT 10 SEC, AUTO, PRO
IF NOT PGNS, AUTO
50 25 (00203)
↓(AUTO BURN)
↓SET SW, PRO
(MAN BURN) E
→ 06 62
IF NOT AUTO THRTL
50 25 (00203)
↓(AUTO)
↓SET SW, PRO
↓(MAN) E
06 62
99 62 (TIG~5), PRO
06 62 (T< TIG)
F06 63 ... V57E
06 63
LGC AUTO SEL P64 WHEN T ≈ HI~GATE

POSSIBLE
97 63
PROG LITE/V05N09E
00210, 00220, 00511, 00520
01406, 01410, 01412, 01703
21406
AVAILABLE
V22N46E, 10E IF AUTO THRTL DSCRT FAIL
V22N46E, 1E IF ABRT, ABRT~STG DSCRT FAIL
X~AXIS OVERRIDE OK IF H > 30K FT
40 20
N18, N33, N68, N69, N92
V47, V57, V58, V59, V60
V61, V62, V68

P64

P64 SELECT VIA LGC
F06 64 .... PRO (REDES)
06 64
P66 SELECT WHEN
• CREW SELECT A/H + ROD SW
• TR = 0 (REDES ΔT) (LGC AUTO SELECT)
POSSIBLE
PROG LITE/V05N09E
00511, 00520, 01406, 01410
AVAILABLE
NO X~AXIS OVERRIDE
N92; V47, V57, V58, V59
V60, V61, V62, V68

P66

CREW/LGC SELECT P66
06 60
↑(TOUCHDOWN) ENG STOP~PUSH PRO (OR V32E) ENG ARM~OFF
(EXIT) V37E68E
P68
POSSIBLE
PROG LITE/V05N09E
00511, 00520, 01410, 01466
AVAILABLE
NO AXIS OVERRIDE WHEN IN AUTO ATT
N92; V47

P68

V37E68E
06 43, A/H, PRO
37

P70,P71

IF DPS ABORT V37E70E OR ABORT PB
OR
IF APS ABORT V37E71E OR ABORT STAGE PB
NOT PGNS, AUTO
50 25 (00203)
↓(AUTO BURN)
↓SET SW, PRO
(MAN BURN) E
→ 06 94
IF P70 BUT NOT AUTO THRTL
50 25 (00203)
↓(AUTO)
↓SET SW, PRO
↓(MAN) E
06 94, V16N77E
[16 77], KREL
06 94
16 94, PRO
16 85, NULL, V82E
[16 44], PRO
16 85, PRO
37
POSSIBLE
97 94
AVAILABLE
X~AXIS OVERRIDE OK IF H > 25K FT OR HDOT > 40 FPS
V47, V60, V61, V62
V82, V83; N76, N77

P76

V37E76E
06 33, L, PRO
06 84, L, PRO
37

P77

V37E77E
06 33, L, PRO
06 81, L, PRO
37

IMU CRS ALN

V41N20E
21 22, L(O, I, M), PRO
41 (NO ATT LITE)

RR CRS ALN

V41N72E
21 73, L
04 12, (00006, 0000X)
↓(X=1/ACQ) L, PRO
(X=2/DESIG) PRO
41, V16N72E
[16 72]
(TERM DESIG) V1A V44E

LR SELF~TEST

V63E
04 12, L(R2=2), PRO
16 66, PRO
16 67
↓(TERM) V34E
(CONT) V32E
→ 16 66

RDZ FNL ATT MNVR (P00)

V89E
04 12 (00003, 0000X)
↓(X=1/+2) PRO
↓(X=2/+X) L, PRO
06 18
↓(REDO) V32E
↓(ACCPT) PRO
50 18
↓(AUTO) PRO
↓50 18, E
↓(MAN) MNVR, E

ALARM CODES

P - PROCEDURAL PH - PROCEDURAL/HARDWARE
I - INPUT DATA PI - PROCEDURAL/INPUT DATA
H - HARDWARE

00111	P	NO COMPLETE MK SET	REDO MK SEQUENCE
00112	P	MK, MK REJ, ROD (BKUP) NOT LEGAL AT PRSNT T	CONT
00113	PH	UNEXPECTED MK RUPT (NO CHNL 16 INBITS)	IF P52 ROD BKUP MK, RESEL P52 W/ CRSR, SPRL MK OPTN; CHNL FAIL IF RECURRING ALM - NOTIFY MSFN
00115	P	ILLEGAL MK REJ (NO SUCH MKS PRSNT)	CONT
00206	P	DON'T ZERO ICDU'S IF GMBL LOK + CRS ALN	CRS ALN TO 0,0,0 THEN V40N20E
00207	PH	ISS TURN-ON REQST NOT PRSNT 90 SEC	PNL 11 CB (IMU OPR)-OPEN; WT 3 MIN, THEN RECLOSE; IF ALM RECURS BUT NO ISS WARN, CONT
00210	PH	IMU NOT ON (TERM VIA F V37)	PNL 11 CB (IMU OPR)-OPEN; WT 3 MIN, THEN RECLOSE; V36E NOTIFY MSFN, CONT
00211	H	CRS ALN ERR > 2°	IF P51, 41 20, REDUCE S/C DRIFT & CONT; IF P52, P57, CONT (RECRD N93) THEN DO 50 25(00014) RECHK
00212	H	PIPA FAIL BUT PIPAS NOT BEING USED	SEE ISS MALFN PROCEDURES
00213	H	TURN-ON REQST BUT NO IMU-OPR SIGNAL	SEE ALM 00210
00214	PH	IMU TURNED OFF WHILE IN USE BY PROG	TERM PROG
00217	H	BAD RETURN FROM IMU STALL	RESEL PROG; IF ALM RECURS, ISS MODE SW FAIL; SEE ALM 00211
00220	P	BAD REFSMMAT (TERM VIA F V37)	ALN IMU; IF ALIGNED, SET REFSMMAT FLAG (N07: 77E, 10000E, 1E)
00401	I	APPROACH GMBL LOK (MGA >70°); OR DSRD MGA IS EXCESSIVE	CALL N22 & MNVR TO REDUCE MGA, OR REALN IMU
00402	P	DAP STEERING LOST	SW GUID CONT - AGS
00404	I	SPFY STAR NOT VISIBLE AT ANY AOT DTNT	PRO (SPFY CRSR/SPRL) OR V32E (DIFF STAR)
00405	I	PICAPAR FAIL - TWO STARS NOT VISIBLE IN AOT FOV (DTNT 2)	PRO (CREW SPFY STAR) OR MNVR & V32E (REDO PICAPAR)
00421	I	W-MATRIX OVERFLOW	CONT (LGC RE-INIT)
00501	I	RR OUT-OF-MODE LIMITS	V32E (TK ATT MNVR) OR V34E, V56E (TERM)
00502	I	BAD RR GMBL ⊀ INPUT	REPEAT 41 72
00503	I	RR ANT DESIGNATE FAIL	P20, P22: PRO(SEARCH) OR V32E(REDES); CHK MODE LMTS IF 41 72
00510	P	NO RR AUTO DSCRT DURING 40 72	RR MODE-LGC, CONT; PNL11 CB RR(2)-CLOSE
00511	PH	NEITHER/BOTH LR ANT POSN DSCRTS PRSNT 10 SEC (20 SEC HIGATE)	LDG ANT - HOVER, NOTIFY MSFN
00514	P	REMOVED RR AUTO DSCRT WHILE IN USE	RESET RR MODE SW-LGC, OR V34E, V56E
00515	H	RR CDU FAIL DSCRT	RR-AUTO TK, AGS RR MAN; P30 (CSM/AGS)
00520	PH	UNEXPECT RADAR RUPT	CONT
00522	P	LR ANT CHANGED DURING SELF-TEST	CONT
00523	P	LR NOT IN POSN 2 (V59)	CONT
00525	I	SV/RR LOS > 3 DEG	PRO(DSPLY ERR) OR V34E, V56E (TERM)
00526	I	PREDICT RR RANGE > 400 NM	TERM P20 OR V16N54E, WT FOR RNG<400NM
00527	I	MNVR REQ(P20); LOS OUT MODE 2 LMTS(P22)	IF P20, DO TK ATT MNVR; TERM P22
00530	I	NEXT 10 MIN LOS NOT IN MODE 2 COVERAGE	PRO (TERM); RESELECT P22 AT LATER TIME
00600	I	IMAGINARY ROOTS	V32E, ADJ INPT PMTRS
00601	I	POST CSI HP < 35K FT	SEE ALM 00600
00602	I	POST CDH HP < 35K FT	SEE ALM 00600
00603	I	CSI/CDH ΔT < 10 MIN	SEE ALM 00600
00604	I	CDH/TPI ΔT < 10 MIN	SEE ALM 00600
00605	I	15 ITER & NO SOLN	SEE ALM 00600
00606	I	CSI ΔV > 1000 FPS	SEE ALM 00600
00611	I	NO TIG FOR ELEV ⊀	IF P33, PRO(CONT) OR V32E (RETARG); IF P34, PRO & RESEL OPTN
00701	I	ILLEGAL ALN TECH	PRO & RESELECT A/T
00777	H	ISS WARN: PIPA FAIL	SEE ISS MALFN PROC
01102	H	LGC SELF-TEST ERROR	COPY N08, CONT
01105	H	DNLNK TOO FAST	ALM RECURS-TLM FAIL
01106	H	UPLNK TOO FAST	ALM RECURS-TLM FAIL
01107	H	RESTART FAILURE (PHASE TABLE)	DO V74, THEN P27 & V48 IF REQ; DO P51; IF ALM RECURS, LGC FAIL
01301	I	ARC SINE, ARC COSINE TOO LARGE	COPY N08, CONT
01406	I	BAD RTN-ROOTPSRS (DURING AVE-G)	CONSULT MSFN (ALM RECURS, SEL P66)
01407	P	VG INCREASING DURING BURN	TERM P40/P42 OR SW GUID CONT-AGS
01410	PI	G&N OVERFLOW	CONSULT MSFN
01412	I	NO IGN ALGORITHM	CONSULT MSFN
01466	PI	INSUFFICIENT THRTL SERVICING	SW GUID CONT-AGS SW THR CONT-MAN
01520	P	V37 NOT ALLOWED	RESELECT V37 (WT UNTIL CRS ALN, ICDU ZERO DONE)
01703	P	TIG SLIPPED	CONT; IF P63 & SMALL SLIP, MAN THRTL-UP; IF BIG SLIP, TERM PDI
01706	P	P40 SELECT BUT LM STAGED; P42 SELECT BUT LM NOT STAGED	SELECT CORR PROG IF INCORRECT; OR IF P40 RELOAD DAP (DPS); IF P42 PRO & MANUAL STAGE AT TIG-10 SEC
02001	I	JET FAIL: Y-Z TRANS	USE ALT CTRL MODE OR CHANGE QUAD ISOLATION SW
02002	I	JET FAIL: X TRANS	SEE ALM 02001
02003	I	JET FAIL: P ROTATE	SEE ALM 02001
02004	I	JET FAIL: U-V ROTATE	SEE ALM 02001
03777	H	ISS WARN: ICDU'S	SEE ISS MALFN PROC
04777	H	ISS WARN: ICDU'S, PIPAS	SEE ALM 03777
07777	H	ISS WARN: IMU	SEE ALM 03777
10777	H	ISS WARN: IMU, PIPAS	SEE ALM 03777
13777	H	ISS WARN: IMU, ICDU'S	SEE ALM 03777
14777	H	ISS WARN: IMU, PIPAS, AND ICDU'S	SEE ALM 03777

POODOO ALARMS (2XXXX)

20430	I	ORB INTEG-OVERFLOW	NOTIFY MSFN, CONT
20607	I	NO T-RADIUS OR T-THETA SOLN	RESELECT PROG
21103	I	ILLEGAL CCS BRANCH	COPY N08, CONT
21204	PI	WAITLIST-JOB/TASK W/ ZERO OR NEG ΔT	COPY N08, CONT
21302	I	SQ-ROOT W/ NEG ARG	COPY N08, CONT
21406	I	BAD RTN-ROOTPSRS (PRE-IGN ALGORITHM)	CONSULT MSFN
21501	P	ILLEGAL PINBALL	NOTIFY MSFN, CONT

BAILOUT ALARMS (3XXXX)

31104	H	DELAY ROUTINE BUSY	RESELECT EXT VERB
31201	P	EXEC-NO VAC AREAS	CONT PROG OR RESELECT EXT VERB
31202	P	EXEC-NO CORE SETS	SEE ALM 31201
31203	PI	WAITLIST-TOO MANY TASKS SCHEDULED	SEE ALM 31201
31206	P	TWO JOBS TRY TO SLEEP	SEE ALM 31201
31207	P	AOT MK-NO VAC AREAS	CONT
31210	P	TWO ROUTINES USING DEVICE AT SAME TIME (AOT, IMU, RADAR)	COPY N08; RESELECT PROG/EXT VB WHEN DEVICE NOT IN USE
31211	P	AOT MK-EXT VB ILLEGAL	CONT
31502	P	ILLEGAL FLASH DSPLY	NOTIFY MSFN, CONT
32000	P	DAP JASK STILL IN PROGRESS NEXT T5 RUPT	IF ALM RECURS, V36E, & REINITIALIZE LGC

ASCENT

VHORZ, HDOT(FNL), XR	N76
TCO, VGY(BODY), VI	N77
VGX(BODY), HDOT, H (+HDOT/H†)	N94

ORBIT/FLT PATH

HA, HP, TFF (V82)	N44
T PER (IF V82)	N32
LAT, LON, H (P21)	N43
H, VI, FLT PATH ⊀ (IF P21)	N91

RAPID IMU ALIGN

V41N20E, E, E, E (CRS ALN)	
FLY 0, 0, 0 ON AGS BALL	
V40N20E (RELEASE IMU)	
V37E51E, PRO (DFT FLG), P00	
V25N07E, 77E, 10000E, 1E (REF)	

RR ANTENNA

OPERATIONAL LMTS:

	MODE 1	MODE 2
TRUN(↔)	305°–55°	125°–235°
SHFT(↕)	290°–59°	41°–155°

RR CRS ALN	41 72
P52, P57 (0°, 283°)	
DOCK (0°, 320°)	
+X ACQ (180°, 270°)	
+Z-ACQ (0°, 0°)	
TERM RR DESIG	V44
RR LOS AZ, ELEV (V85) (+/Z, +/Y)	N56
PRSNT RR TRUN, SHFT ⊀	N72
DSRD RR TRUN, SHFT ⊀	N73

DESCENT

LS UPDT(DN-R, XR, ALT)	N69
RNG(+Z), TG(BRK), VI	N68
THRTL CMD, HDOT, H	N92
PERMIT LR UPDTS	V57
INHIBIT LR UPDTS	V58
CMD LR TO POSN 2	V59

THRUST

P40, P41, P42: TFI/TCO, VG, ΔVM	N40
VG(BODY)(UP,RT,FWD)	N85
P63, P64, P66: THRTL CMD, HDOT, H	N92
P12, P70, P71: VGX(BODY), HDOT, H	N94

ATTITUDE

PRSNT ICDU Y, P, R	N20
CREW MNVR DSRD Y, P, R	N22
DAP ATT RATES	V60
DAP FOLLOW ATT ERR	V61
TOTAL ATT ERR	V62
SET MIN IMPULSE	V76
SET RT CMD/ATT HOLD	V77
U-V JETS: YES/NO	V75/V65

RENDEZVOUS

	PGNS	AGS
RNG, RDOT, +Z/HORZ ⊀	N54	317,440,277
RR RNG, RNG RT, TFI	N78	---
CDH ΔH, ΔT'S (SEE TIMES)	N75	402,372 (CSI)
YDOT(TIG) (SIGN DIFF)	N90/R2	263
APSIS, ELEV ⊀, TRNSFR ⊀	N55	---
TPI HP, TPI ΔV, TPF ΔV	N58	402,370,371
ACT VEH CNTRL ⊀	N52	---
LOS VG X, Y, Z	N59	---

TIMES

TIG	N33	T CDH	N13
T CSI	N11	T TPI	N37
TFI/TCO			N35
T FROM PER (V82)			N32
T(SV INTEG)			N38
LGC CLK T			N65
RDZ ΔT'S (R2, R3)			N75

P32: CSI/CDH, CDH/TPI
P33: CDH/TPI, TPI SLIP

CHAN BKUP

N46/R2 LOAD ANY TIME (V48 NOT REQ)	
IGNORE SPFY DSCRT	L(R2) N46
ABORT OR ABORT STAGE	00001
AUTO THRTL	00010
BOTH DSCRTS	00011

NO IGN/ENG FAIL

TERM	V34E
IMPRPR CONFG	CORRECT PROBLEM (ENG STRTS), PRO
PRPR CONFG	E (REATMPT), THEN PRO (AUTO) OR E (MAN) ON F V99 ((P40, P42) (P12, P7X)) E→16 40 E→16 94

DAP DATA LOAD, PGNS-ATT DB/RATES

VEH	+X TRANS	ACA	ATT DB	RATES
1 ASC	0 2J/A	LM: 0 .4°/S, 1 20°/S	LM: 0 .3° .4, .4, .3; 1 1° 1.4, 1.4, 1.; 2 5° 7., 7., 5.	0 .2°/S
2 DSC	1 2J/B			1 .5°/S
3 DOK	2 4J			2 20°/S
	3 4J	DOK: 0 .4°/S, 1 2°/S	PWR 1°: 2., 2., 1. (APS); 1.5, 1.5, 1. (DPS)	3 10°/S
			DOK: 0,1,2: 1.4°; 2., 2., 1.4; PWR 1.4°: --, --, 1.4 (V65)	AVOID 10°/S IF DOK

* DAP P, R CTRL INDIRECT [CTRL AXES U'-V'(LM) OR U-V(DOK)]

ACCEL LEVELS (FT/SEC²)

PROPLNT LEFT (%)	DOCK/NON-STAGED FTP	40%	10%	4J/RCS	STAGED APS	4J/RCS
PRE LOI	3.1	1.3	.4	.1		
POST LOI	4.2	1.8	.6	.2		
100 %	9	3.7	1.2	.3	10	1.2
75 %	10	4.3	1.4	.4	12	1.3
50 %	12	5.0	1.6	.5	14	1.6
25 %	15	6.1	2.0	.6	16	1.8
0 %	19	7.9	2.6	.8	20	2.3

ACCEL AT 10% THRUST BASED UPON FMIN (≈ 13%)

FDAI

MONITOR	ERR NDLS
V60	1.25°/S
V61, V62	.5°
AGS - MAX	14.4°
AGS - MIN	1.7°
RR SHFT (P)	50° (HI)
TRUN (Y)	5° (LO)

AGS-ATT DB/RATES

VEH	DB SW	ACA (EA)	ATT DB (R, P, Y)	RATES (R, P, Y/EA)
ASC	MAX	7.5°/S	5., 5., 5.1°	30°/S
	MIN	20°/S	.3, .3, .4°	5, 10, 5°/S
DSC	MAX	17°/S	SAME	10°/S
	MIN	20°/S		5, 10, 5°/S

FLAGWRD/CHNL SET/RESET

V25N07E [OCT]
R1 = ADRS/CHNL (CHNL< 30, ≠ 7)
R2 = ABCDE
R3 (1=SET, 0=RSET)

*ADD L CODES IF MODIFY 2 OR 3 BITS PER DSKY DISPLAY

MODIFY BIT	R2 DIGIT A	B	C	D	E	R2 L* CODE
	15	12	9	6	3	→ 4
	14	11	8	5	2	→ 2
	13	10	7	4	1	→ 1
BIT NOT CHANGED						→ 0

ORDEAL

+Z/HORZ ⊀	277
RANGE	317
RDOT	440
LM ALT	337
HA, HP	315, 403

ALN/CAL

AGS/PGNS ALN	400+3
LUNAR ALN	+4
BODY-AXIS ALN (400+0, GO INERT)	+5
INFLT CAL (GYRO/ACCEL)	+6
SURF CAL (GYRO-ONLY)	+6
INFLT ACCEL CAL	+7

SELF-TEST

412+0 START TEST
412R=+1 SUCCESSFUL

ROUTINE MONITOR OF 412 NOT REQ

AGS CAUTION/WARN 412R (SELF-TEST FAIL)
+3 LOGIC
+4 MEMORY
+7 LOGIC, MEMORY

AGS READINESS √
574, 604, 507, 623, 612
IF 612R = +0 BUT STGD, ENTR +00020

ORB PMTRS

VI	433
H	337
HDOT	367
HA	315
HP	403

RR MAN

417 → 1
417R (+0, CONT)

RANGE
⊀, TM, N78, VHF, 415+1
316+RNG (< 30 SEC)

RDOT
TM OR N78, 415+1
503≠ RDOT (< 30 SEC)

WAIT AT LEAST 4 SEC BETWEEN UPDTS

LM/CSM

RANGE	317
RDOT (- CLOSING)	440
PREDICT TPI LOS	303
POST-TPI HP	402
LM+Z/HORZ ⊀	277
PRSNT Y ERR(+S)	211
PRSNT YDOT ERR(+S)	270
YDOT ERR (TIG)	263
CSI/CDH ONLY: POST-CDH ΔH	402
ΔH(TIG)	314
PHASE ⊀ (TIG)	303

TIMES

TIG	373
TFI	310
TRANSFER ΔT	307
T/RDZ [TPI]	311
NODE/RDZ ΔT	306
OFFSET ΔT (306, 312 NOM +0)	312
CSI/CDH ΔT	372
AGS CLK T	377

DESCENT

ALT UPDT
223 (SYNC W/ TM)

HDOT UPDT
360 (SYNC W/ TM)

BIAS UPDT IF ALT > 2000 FT

DEDA UPDT

411+0

LM
240, 241, 242 (POS)
260, 261, 262 (VEL)
254 (T)
414+2

CSM
244, 245, 246 (POS)
264, 265, 266 (VEL)
272 (T)
414+3

AGS/PGNS

SET AGS CLK
V16N65E
377+... (GET-BIAS)
(ENTR AT CORR T)

NAV UPDT
411+0
TLM PCM SW - HI
V47E, 414+1
06 16, L(BIAS), PRO
50 16, PRO

AGS/PGNS ALN
400+3
AFTER 414+1, NO AGS/PGNS ALN UNTIL 50 16

ATT/STEER

ATT HOLD
400+0

GUID STEER
400+1
623+0

IF YAW STEER, L
514+X, 515+Y, 516+Z
623+1

Z-AXIS STEER
400+2
507+ {0, CSM LOS; 1, THRUST VEC}

RR AUTO

TLM PCM SW - HI
VFY P20/P20 BKGND & PRE-THRST DNLST
VFY RR ⊀'S < 11.25°

417+1
417R/621R (/ +0)
411+1

FOR MAN UPDT, SET 411+0; TO RESUME AUTO, RESET 411+1

AVAILABLE
STOP AUTO 411+0
MK CTR (RRRR) 621
NEXT MK FLG 606
(+/RNG, -/RDOT)
RNG/RDOT 317, 440

ΔV MON

VG MAG 370

BURN VG'S
500, 501, 502
(UP, RT, FWD)

SENSED VG'S
470, 471, 472
(UP, RT, FWD)
RESET VIA
404, 405, 406

LV VG'S
450, 451, 452
(FWD, RT, DN)

DEDA ADDRESS

[OCTAL]
047, 053 SINE, COSINE (LAND AZ)

[100 FT]
211R PRSNT LM Y ERR (+/SOUTH)
223 ALT UPDT INPUT [PWR DSC]
224 TERM, TARG S-MAJ AXIS [OI]
225 TERM, S-MAJ AXIS LO LMT [OI]
226 RTARG FOR 224 IF PHASE ⊀ > PHASE LIMIT (305R) [OI]
231 LANDING SITE RADIUS
232 TARG ORBIT INSRT ALT [OI]
233R VERT STEER PITCHOVER H [OI]
240, 241, 242 LM EPHEMERIS POSN X, Y, Z (INERTIAL)
244, 245, 246 CSM EPHEMERIS POSN X, Y, Z (INERTIAL)

[.1 MIN]
254 LM EPOCH T (EPHEMERIS)

[.1 FPS]
260, 261, 262 LM EPHEMERIS VEL X, Y, Z (INERTIAL)
263R PREDICT LM YDOT ERR AT TIG; PRSNT YDOT ERR [OI] (+/SOUTH)
264, 265, 266 CSM EPHEMERIS VEL X, Y, Z (INERTIAL)
270R PRSNT LM YDOT ERR (+/SOUTH)

[.1 MIN]
272 CSM EPOCH T (EPHEMERIS)
274 TIG BIAS T (NOM +00005) (TIG-30 SEC = "AVE-G")
275 TARG TPI TIME [CSI]

[.01°]
277R LM+Z/HORZ ⊀ (0°-360°)
303R PREDICT TPI LOS AT TIG [TPI]; PRSNT LM/CSM PHASE ⊀ [OI]; PREDICT LM/CSM PHASE ⊀ AT TIG [CSI, CDH]
305R RTARG PHASE ⊀ LIMIT [OI]

[.01 MIN]
306 NODE/INTCPT ΔT [TPI]
307 DSRD TRANSFER TIME [TPI]
310 T FROM TIG (TFI) (< 136 MIN)
311R ΔT TO INTERCEPT [TPI]
312 TARG OFFSET TIME [TPI]

[.1 NM]
314R PREDICT ΔH AT TIG [CSI, CDH]
315R PRSNT LM HA

[.01 NM]
316 RADAR RNG MANUAL INPUT (WT 4 SEC BEFORE RDOT UPDT)
317R COMPUTED RANGE (LM-CSM)

[.1 NM]
337R PRSNT LM ALT

[100 FT]
340R, 341R, 342R LM PRSNT POSN X, Y, Z (INERTIAL)
344R, 345R, 346R CSM PRSNT POSN X, Y, Z (INERTIAL)
347R PREDICT RADIUS AT TIG

[.1 FPS]
360R, 361R, 362R LM PRSNT VEL X, Y, Z (INERTIAL)
364R, 365R, 366R CSM PRSNT VEL X, Y, Z (INERTIAL)
367R PRSNT LM HDOT (-DECREASE)
370R ΔV TO BE GAINED (VG MAG)
371R PREDICT BRAKING ΔV [TPI] (NO TPI SOLN IF +60000)

[.1 MIN]
372R CSI/CDH AT [CSI]
373 TIG [XDV, CSI, CDH, TPI, MCC]
377 AGS CLOCK TIME

[SELECT LOGIC-OCTAL]
400+0 ATTITUDE HOLD
+1 GUIDANCE STEER (SPFY 623)
+2 Z-AXIS STEER (SPFY 507)
+3 AGS ALN TO PGNS (AFTER 414+1, WAIT FOR 50 16; AVOID CDU SW TRANSIENTS; CSM/X-Z PLANE DIFF < 10°)
+4 LUNAR ALN
+5 BODY-AXIS ALN
+6 INFLT CAL (GYRO/ACCEL) SURF CAL (GYRO-ONLY) (BAD PGNS-NO INFLT 400+6; NO 414+1 DURING SURF CAL)
+7 INFLT ACCEL-ONLY CAL

[.1 NM]
402R PREDICT POST-TPI HP [TPI] OR POST-CDH ΔH [CSI, CDH]
403R PRSNT LM HP

404, 405, 406 INITIALIZE 470, 471, 472 (SEP, PDI (NOM): -12345, +0, +0) (POST-OI (NOM): +0, +0, +0)

[SELECT LOGIC-OCTAL]
410+0 ORBIT INSERTION ROUTINE
+1 CSI ROUTINE
+2 CDH ROUTINE
+3 TPI SEARCH ROUTINE
+4 TPI EXECUTE ROUTINE
+5 EXTERNAL ΔV ROUTINE
411+0 STOP AUTO RADAR UPDATES
+1 START AUTO RADAR UPDATES
412+0 SEE "SELF-TEST"
413+1 STORE AZ & SET 604 (SURF FLG)
414+1 LM, CSM NAV UPDT VIA DNLK (SEE 400+6, 563+0, PGNS/AGS) (NO 414+1, +2, +3 IF RR AUTO)
+2 LM NAV UPDT VIA DEDA
+3 CSM NAV UPDT VIA DEDA
415+1 MANUAL RR UPDT (DIR COS)
416+1 CDH AT CSI+1/2 PERIOD [CSI]
+3 CDH AT CSI+3/2 PERIOD [CSI]
417+1 INITIALIZE RADAR FILTER [417R(+0) DONE (0-16 SEC)]

[.1 FPS]
423R DSRD FNL HDOT [OI, CSI, CDH]
427R PRSNT LM HORZ VEL
433R PRSNT LM TOTAL VEL MAG
440R COMPUTED RDOT (- CLOSING)
450, 451, 452 LOCAL VERT EXT ΔV X, Y, Z (FWD, RT, DN)
464R PITCHOVER STEER HDOT [OI]
465 TARG INSERTION HDOT [OI]
470R, 471R, 472R SENSED BODY ΔV X, Y, Z (UP, RT, FWD)
477R HDOT AT TIG; PRSNT HDOT [OI]
500R, 501R, 502R VG(BODY) X, Y, Z (UP, RT, FWD)
503 RADAR RDOT MANUAL INPUT (WT 4 SEC BEFORE RNG UPDT)

[IF 400+2, SELECT-OCTAL]
507+0 LM+Z ALONG CSM LOS VEC
+1 LM+Z ALONG THRUST VEC

[.1 NM]
514, 515, 516 YAW STEER UNIT X, Y, Z (INERTIAL) (SEE 623+1)
534, 535, 536 ACCEL SCALE FACTOR
537 X GYRO SPIN-AXIS MASS
UNBAL DRIFT COMPENSATE

[.001 FT/SEC²]
540, 541, 542 X, Y, Z ACCEL BIAS

[.01°/HR]
544, 545, 546 X, Y, Z GYRO DRIFT

[OCTAL]
547 LUNAR ALN AZ CORRECTION
550, 551, 552 X, Y, Z GYRO S. F. CORR
563+0 TERM NAV UPDT VIA DNLNK
574+0 NOT STAGED (STAGING) -X STAGED (FLAG)
575 A/H LOCK FLAG (ENTR 575+0 IN FOLLOW-UP DSCRT FAIL)
604+0 INFLT (LUNAR) -X SURFACE (SURF FLAG)
605 TARG COTAN (TPI LOS) [CSI]
606+0 RANGE NEXT (AUTO RADAR) -X RDOT NEXT (UPDT FLAG)
612R STAGING SEQUENCE TERM (+0 = NOT STGD; +00017 = STGD)

[COUNTS]
614R ULLAGE COUNTER (CNT/2 SEC)
616 ULL CTR LIMIT (CNT/2 SEC)
621R RADAR MK CTR (XX0YY) (XX = RNG MKS, YY = RDOT MKS)

[IF 400+1, SELECT-OCTAL]
623+0 LM +Z II TO CSM PLANE
+1 LM +Z II TO PLANE SPFY BY UNIT VEC (514, 515, 516)

[OCTAL]
634 SENSED ΔV BIAS THRESHOLD NOM: +00100 (.125 FPS/SEC) MAX: +77777 (64 FPS/SEC)
640, 641, 642 LUNAR ROT RATE VEC X, Y, Z (INERTIAL)
647R CAL CTR (RECRD TERM/C 00034)
662 CONST, TARG S-MAJ AXIS [OI]
673 RTARG FOR 662 IF PHASE ⊀ > PHASE LIMIT (305R) [OI]

DIR RDZ

306R, 312R (/ +0)
[START RR AUTO]
410+4
307+04300
373+TIG
310R [DET-SET]
450R, 451R, 452R
370R, 371R
MKS, -AUTO BURN

MCC

[START RR AUTO]
410+4
307+TRANSFER ΔT (+02800/+01300)
373+TIG
450R, 451R, 452R
370R, 371R
MKS, -AUTO BURN

EXT ΔV

410+5
373+TIG
450+VGX(LV)
451+VGY(LV)
452+VGZ(LV)
310R [DET-SET]
370R
-AUTO BURN
(ENTR AT 404+0)

CSI

[START RR AUTO]
410+1
451+0
373+T CSI
275+T TPI
605+COT(TPI ⊀) (NOM+00777)
416 ↓(1/2 PER) +1 ↓(3/2 PER) +3
310R [DET-SET]
MKS, -AUTO BURN

CDH

[START RR AUTO]
410+2
451+0
373R (ADJ IF REQ)
310R [DET-SET]
MKS, -AUTO BURN

TPI

[START RR AUTO]
410+3
306R, 312R (/+0)
307+TRANSFER ΔT (NOM +04300)
310+... TARG TPI
303R (NOM 26.6°)
410+4 (DSRD 303R)

IF RTARG REQ
410+3
310+... TARG TPI
303R (DSRD)
410+4 303R

310R [DET-SET]
370R, 371R, 277R
MKS, -AUTO BURN

D.R., MCC, TPI, CSI, CDH, XDV AVAILABLE

VG 450, 451, 452
ΔV MAG 370
HDOT(TIG) 477
+Z/HORZ ⊀ 277

D.R., MCC, TPI AVAILABLE

BRK ΔV 371
TPI LOS 303
POST-TPI HP 402
ΔT TO RDZ 311

CSI, CDH AVAILABLE

PHASE ⊀(TIG) 303
ΔH(TIG) 314
DSRD HDOT 423
POST-CDH ΔH 402
CSI/CDH ΔT 372

ORB INS

616+0
232+H(INSRT)
465+HDOT(INSRT)
224+S-MAJ AXIS
225+APO RAD/2
226+RTARG (224)
305-PHASE LIMIT
662-S-MAJ FACTR
673-RTARG (662)
410+0
623+0

IF S-BAND (YAW STEER) AFT P/OVR: 514+X, 515+Y, 516+Z
400+1
500R, 501R, 502R
SEE BURN √ LIST
L/O T: ABORT-STAGE
AFT P/OVR, S-BAND: 623+1
FOR NOM INSRT NULL RESIDUALS 500R, 501R, 502R (UP, RT, FWD)
IF EARLY APS C/O, CONT VIA RCS WHEN 500R<+00150
MODE CTRL - A/H
IF TWEAK/BAILOUT → "MAN BURN"
616+ ULL CTR LMT (NOM INS +00005)

AVAILABLE
Y-POSN ERR 211
Y-DOT ERR 270
H 337
HDOT 367
PHASE ⊀ 303
VI 433
HDOT(INS) 423

MAN BURN

SW - AGS, A/H
404+0, 405+0, 406+0
470R, 471R, 472R
(UP, RT, FWD)

AUTO BURN

AGS SOLN
IF RR AUTO ON 411+0
450R, 451R, 452R
IF YDOT (CSI, CDH): 263R (SAME) 451≥263R (SIGN)
370R
371R (D.R., MCC, TPI)
404+0, 405+0, 406+0

GUID (+X) | Z-AXIS
400+1 | 400+2
623+0 | 507+1

IF YAW STR 514, 515, 516
623+1
410+5

ENTR 410+5 PRIOR TO TIG-30 SEC

MAN/AUTO (MIN DB) MNVR TO BURN ATT
IF RCS BURN, SET MODE CTRL - A/H
IF PGNS BURN, LOAD BEFORE TIG - 30 SEC
373+TIG
450, 451, 452 (LV VG)
500R, 501R, 502R
SEE BURN √ LIST
NULL RESIDUALS 500R, 501R, 502R (UP, RT, FWD)