APOLLO 15

FLIGHT CREW G&N DICTIONARY

PART NO.	S/N
SKB32100116-365	1001

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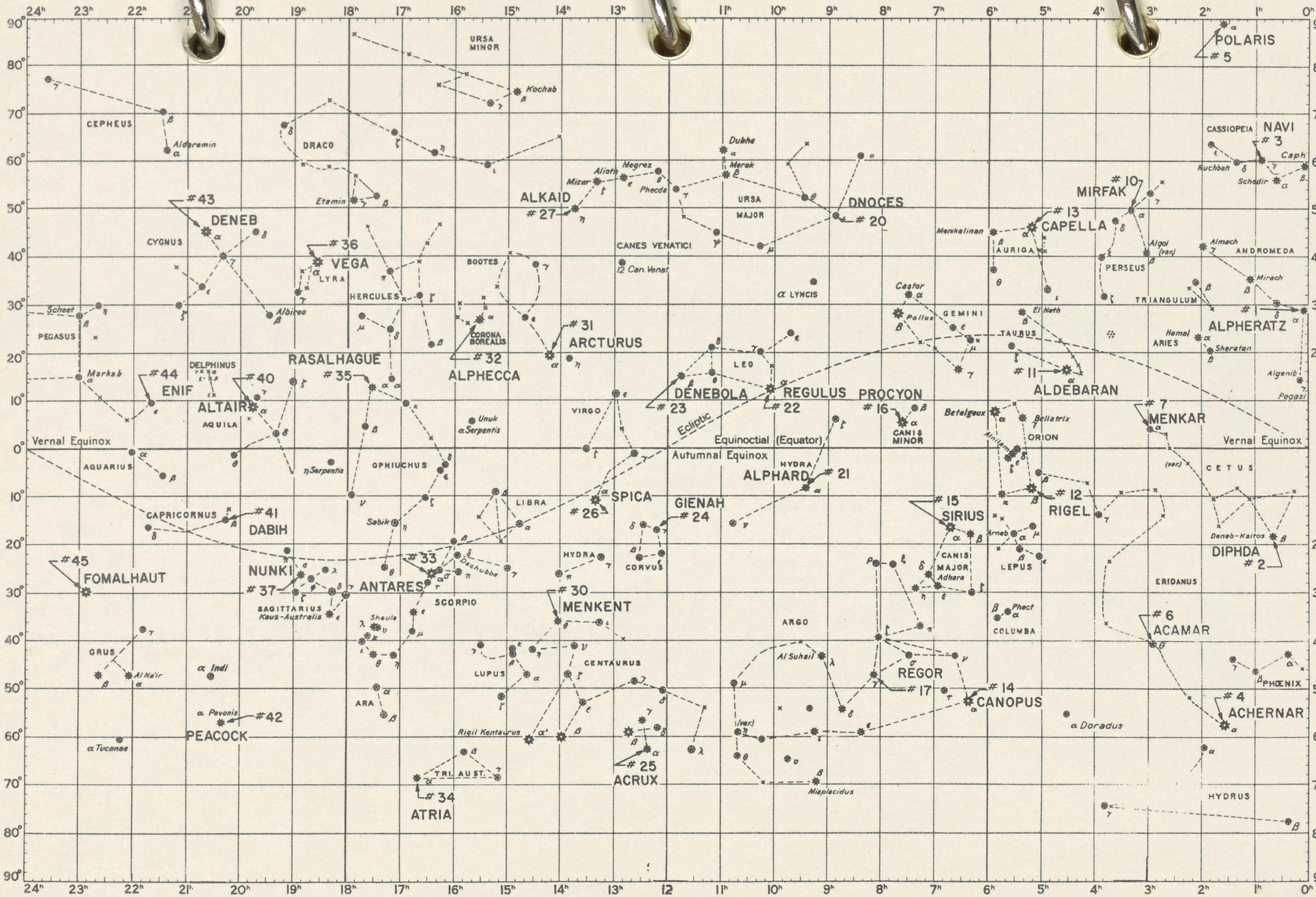
5. FLIGHT CREW G&N DICTIONARY PGNS/AGS
SUMMARY CARD



PRETHRUST
P3X/P7X

P06 - P27

OPT. & ALARM CODES
GEN. SYS. C/O

STARS, VERBS, NOUNS

STAR LIST

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

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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 (POO 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; POO Only)
44	Terminate Continuous Designate (V41N72 Option 2)
47	Initialize AGS
48	Load DAP Data
49	Start Crew Defined Maneuver (POO Only)
50	Please Perform

52 Mark Cursor
53 Mark Spiral
54 Mark X or Y
55 Increment LGC Time (Decimal)
56 Terminate 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 (POO Only)
90 Request Rendezvous Out of Plane Display (Non Ave G)
91 Display Banksum (POO 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 POO
97 Perform Engine Fail Procedure
99 Enable Engine Ignition

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

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	Digital Autopilot Configuration	Octal
	Switch Function Fail Code	Octal
47V	LM Weight	lbs
	CSM Weight	lbs
48V	Engine Gimbal Pitch Trim (+ Only)	.01°
	Engine Gimbal Roll Trim (+ Only)	.01°
49	ΔR	.01nm
	ΔV	.1fps
	Source Code (1:R,2:R,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)

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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	mps
	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
72V	RR Trunnion Angle (Reg's RR MODE-LGC)	.01°
	RR Shaft Angle	.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 LS)	.1nm

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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°

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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/SPL) 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	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

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42 63 70 71	[00203	Sel PGNS Auto]	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-DESCENT 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

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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
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, N07,77E,10000E,1E

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

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 (P63)
Continue

00525 I SV/RR LOS Angle >3°
PRO For Angle. Side Lobe, V32;
Main, Align COAS, PRO

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

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, P51E PRO POOE; If Recurs, LGC Failed

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

01406 I TGO Comp Fail (P64)
If Recurs, P66 Or GUID CONT - AGS

01407 P VG Increasing
GUID CONT - AGS Or Term Burn
01410 P/I DES Guid Eqn's Overflow (P64)
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
20430 I Orbit Integration Overflow
GUID CONT - AGS Or MSFN Uplink S.V.

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P40 - P47
P51 - P57
P06 - P27
PRETHRUST
P3X/P7X

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 Arguement
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

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

NOTE: All 2XXXX Codes (If AVE-G Is On) Leave AVE-G On But Discontinue Guidance. Also If 2XXXX Code Is Generated While An Ext. Verb (With Displays) Is Active, The Code Will ~~Appear~~ ACT As 3XXXX.

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:
a. V37E 00E
b. V96E
c. V36E (NO DAP Lt - On For 11 Sec)
Wait 11 sec, Then
V96E
d. Force A Hardware Restart By Simultaneously Pressing 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, 3000E, 2324E Sets HIACENT 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

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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
```

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

-1:00            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

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
```

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P40 - P47

P51 - P57

P63 - P68
P70 - P76/P77

PRETHRUST
P3X/P7X

```
(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
            If RR MODE - LGC Performed Here,
              wait 10 sec Before V37E20E
                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 Pointing Error <15°, To(3); 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(F 50 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)

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

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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) NO TRACK Lt - Off
RR MODE-LGC
PRO To ③
(NO LOCK) MNVR
ENTR To ②

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

⑥ F 50 72 TRUN, SHFT (.01°)
Confirm Main Lobe Lock-On
(ACQUIRE MAIN LOBE)
RR MODE - SLEW
Slew To Peak AGC
RR MODE - LGC
(ACCEPT) PRO To ⑦

⑦ NO TRACK LITE

<u>OUT</u> DSKY Blanks, RR Taking Marks
(RAW RR DATA) V16N78E R,RDOT,TFI
(.01nm,.1fps,m-s)

*F 05 09 00525 SV/RR LOS ∢ >3° *
* PRO *
*F 06 05 SV/RR LOS ∢ (.01°) *
*N05 Can Be Caused By S.V. Errors *
* or RR Bias Errors *
*Verify COAS Aligned & RR Needles *
* Nulled *

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P40 - P47
P51 - P57
P63 - P68
P70 - P76/P77
PRETHRUST
P3X/P7X

```
*Initially:                                  *
*  a) If <5°; Allow Update                   *
*  b) If >5° & S.V. Err Cause                *
*        V67E, Load N99                      *
*        10000, 10, 0                        *
*  c) If >5° & RR Bias Cause:                *
*        ~~Continue~~ ALLOW UPDATE           *
*NOT Initially:                              *
*  1) Perform RR BIAS INITIAL                *
*        (Pg 1-65)                           *
*  2) V67E, Load N99 10000,10,0              *
*        (Subsequent N05's Should            *
*         Decrease)                          *

*    (REJECT) If Side Lobe                   *
*             RR MODE-LGC                    *
*             V32E To 6                      *
*    (UPDATE) PRO To 7                       *

*F 06 49 ΔR,ΔV,Code(.01nm,.1fps,             *
*                    0000X)                  *
*          X=1, RANGE                        *
*          X=2, RDOT                         *
*          X=3, SHAFT ∡                      *
*          X=4, TRUN  ∡                      *
*N49 Can Be Expected If:                     *
*  (1) Initial Nav Updates(~10 min)*
*  (2) After Long "No Track" In-             *
*        tervals                             *
*  (3) After Mnvrs                           *
*  (4) After V93's (2-3 Marks)               *
*                                            *
*If (1) Only Reject 1st Mark If              *
*  >2nm & 12 fps, Then Check Value           *
*  With CSM                                  *
*If (2) Only Reject 1st Mark If              *
*  >2nm & 12 fps, Then Accept Sub-           *
*  sequent                                   *
*If (3) or (4) Only Reject If                *
*  >.8nm & 5 fps                             *
*In All Other Cases Reject 1st               *
*  Mark, Then Accept Up To .8nm &            *
*  5 fps                                     *
```

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```
*    (REJECT PART MARK)V32E To⑦      *
*    (REJECT TOTAL MARK) V34E To⑦    *
*    (MAN ACQ) RR MODE - SLEW        *
*                Acquire             *
*                RR MODE - LGC       *
*                V32E To③            *
*     (UPDATE) PRO To⑦               *
*(If Bad Mark Accepted, V93E, Cont)*

                *F 50 18 (MNVR REQUEST) Go To②    *

     ON   NO LOCK
F 05 09   00503 RR NO DATA GOOD 30 SEC(or Desig.
     (REDESIG)V32E To③                  Fail)
     (SEARCH) PRO To⑧

          *PROG Lt-On, V05 N09E                  *
          *  00515 RR CDU Failed                  *
          *        (P20 Will Not Update S.V.)     *
          *              KEY REL To⑥ or           *
          *              RR MODE - AUTO TRACK     *

          *TRACKER Lt(Only)Could Not Read RR,To⑥*

⑧    F 16 80   RR AUTO SEARCH, SEARCH CODE,      (.01°)
               R1    00000-SEARCH 42 sec/scan
                     11111-LOCK ON
               R2    LOS/+Z
          (LOCK)     PRO To②
          (NO LOCK OR MAN ACQ) SLEW RR For LOCK ON
               RR MODE - LGC
               NO TRACK Lt-Out, To⑧
          (MNVR) V32E To②
```

P21 GROUND TRACK DETERMINATION

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

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P40 - P47

P51 - P57

P63 - P68
P70 - P76/P77

PRETHRUST
P3X/P7X

```
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 To②
          (TERM) PRO

4    F 37
```

P22 LUNAR SURFACE NAV

```
LGC Start Sequence At ∿ 130 nm
NO TRACK Lt - Out ∿ 103 nm
MARKS Every 13 sec If V95E
NO TRACK Lt - On (After TCA) ∿ 80 nm
RR Antenna Designated 180,270

CB (11) RR (2) - Close, Wait 10 sec
If RR MODE - LGC Performed Here
  Wait 10 sec Before V37E22E
       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 Step②,Then Go To③)
     (OPT 2) PRO To②

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 Step③)

③    RR MODE - LGC To⑤
             - SLEW or AUTO TRACK To④
```

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                      *
*          (TERM) V56E                       *
```

⑤ NO TRACK Lt-OUT 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

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P40 - P47
P51 - P57
P63 - P68
P70 - P76/P77
PRETHRUST
P3X/P7X

```
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        *
```

P25 PREFERRED TRACKING 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(F 50 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

```
1         (NOTE: For Auto Update, If V33 N02
               Displayed Key ENTR; If V21 N02
               or N01 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 Procedure)

⑤ F 21 01 R3 ADDRESS (Initially 1173)
LOAD DATA IN R1 E (R3 Increments)

6 F 21 01 Repeat Step ⑤ For All Data

⑦ F 21 02 R3 Goes To 1166 When Data Load Complete

TO REVIEW DATA
V01 N01E, 1173E
R1 Data
N15E (R3 1174)
ENTR Verify Data For Remaining Comps.
KEY REL To ⑦

TO CHANGE DATA
Load Comp Identifier XX E
Correct Data E, Go To ⑦

TO ACCEPT UPDATE
V33E (or Key VERB Then PRO)

8 P00 Displayed

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)	
		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)
		PRO	
		If Zero, T (APOAPSIS) Displayed	
2	F 06 55	APSIS CROSSING (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	

```
*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)
               PRO                          (.1nm,m-s)

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 (-00002 If No REFSMMAT Set)
               SET DET TO TFI          (marks,m-s,.01°)
               PRO        (MGA = -00002 If P72)

9    F 37      P72 - Transmit Mnvr Parameters To CSM
```

P33 CDH PRETHRUST (P73 CSM)

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

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P40 - P47

P51 - P57

P63 - P68
P70 - P76/P77

V40 - V90

```
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 To①          *
                         *  (CONTINUE) PRO To③      *

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 (-00002 If No REFSMMAT Set)
               SET DET TO TFI              (marks,m-s,.01°)
               PRO        (MGA = -00002 If P73)

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   PRECISSION 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

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)
(ΔV LOS) N59E, KEY REL
PRO (If Recycling To ③)

7 F 16 45 MARKS,TFI,MGA (-00002 If No REFSMMAT Set)
SET DET TO TFI (marks,m-s,.01°)
PRO (MGA = -00002 If P74)

8 F 37 P74 - Transmit Mnvr Parameters To CSM

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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)
(ΔV LOS) N59E, KEY REL
PRO (If Recycling To ①)

3 F 16 45 MARKS,TFI,MGA (-00002 If No REFSMMAT Set)
SET DET TO TFI (marks,m-s,.01°)
PRO (MGA = -00002 If P75)

4 F 37 P75 - Transmit Mnvr Parameters To CSM

P40 - P47

P51 - P57

P63 - P68
P70 - P76/P77

V40 - V90

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, P40E*

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

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```
-: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)
```

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PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

P51 - P57

P63 - P68
P70 - P76/P77

V40 - V90

```
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 To②                    *

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                         *
```

```
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             *
                            *(TERMINATE) 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 3/29/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

P51 - P57

P63 - P68
P70 - P76/P77

V40 - V90

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

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

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

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)

DATE 3/29/71

```
        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))
```

P40 - P47

P51 - P57

P06 - P27

PRETHRUST
P3X/P7X

DATE 6/21/71

```
7A   F 01 70   R1 OOCDE (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 OOCDE (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 To 7
               After 2nd Star To 11
```

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P63 - P68
P70 - P76/P77
V40 - V90

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

(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 To (7A)
After 2nd Star 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)

(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*
```

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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

(REDEFINE STAR) V32E To ⑥
PRO

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

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 To ⑥ (If Opt 00003 To ⑫)
After 2nd Star 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|
Stars & 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 6/21/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS
FLGWD, CHAN LISTS
LM/CSM S.V.READOUT
P63 - P68
P70 - P76/P77
V40 - V90

(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) To (6))
(If A/T 1 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

1 V37E 63E
*PROG Lt-On *
*V05N09E 01412 BAD *
* RETURN FROM TIME *
* TO TGT ROUTINE *
* MSFN Uplink New *
* S.V. & 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

                        *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)

-1:00            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
```

DATE 6/21/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

P63 - P68
P70 - P76/P77

V40 - V90

-: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

*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) - ~~AUTO~~ ATT HOLD
~~Do Not~~ Throttle Up Manually
V37E 70E

(APS) ABORT STAGE - Push (or V37E 71E)

If Masked:
MODE CONT (P) - ~~AUTO~~ ATT HOLD
V37E 71E

~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 *

DATE ~~6/27/71~~ 7/12/71

(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

```
*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

DATE 6/21/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

MAN. BURN,AGS ACT.
& SELF TEST,CALIB.

V40 - V90

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

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 (Nominal zero)

PRO

(MIN IMP) MODE CONT(PGNS)-ATT HOLD

NO DAP Lt-On

P70 DPS ABORT

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

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

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 *
```

$\dot{H}$<25000 & $\dot{H}$<00400-Monitor Att. Mnvr To LV With Windows Downrange.

X-OVRD Inhibited. After $\dot{H}$>00400 Monitor Mnvr To Abort Att; X-OVRD Restored 12 sec After Initiation of Mnvr.

DATE 3/29/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

MAN. BURN,AGS ACT.
& SELF TEST,CALIB.

V40 - V90

H>25000-Monitor Att. Mnvr To
Abort Att. With Windows Down-
range. 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

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

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 ABORT STAGE -Push (From P63,64,66,70)
or V37E 71E
*F 50 25 R1 00203 *
* GUID CONT - PGNS *
* MODE CONT (PGNS) - AUTO*
* PRO *
*(BYPASS)ENTR *

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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)*

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

$\dot{H}$>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

DATE 3/29/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

MAN. BURN,AGS ACT.
& SELF TEST,CALIB.

V40 - V90

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

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) N84E
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

DATE 6/21/71

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

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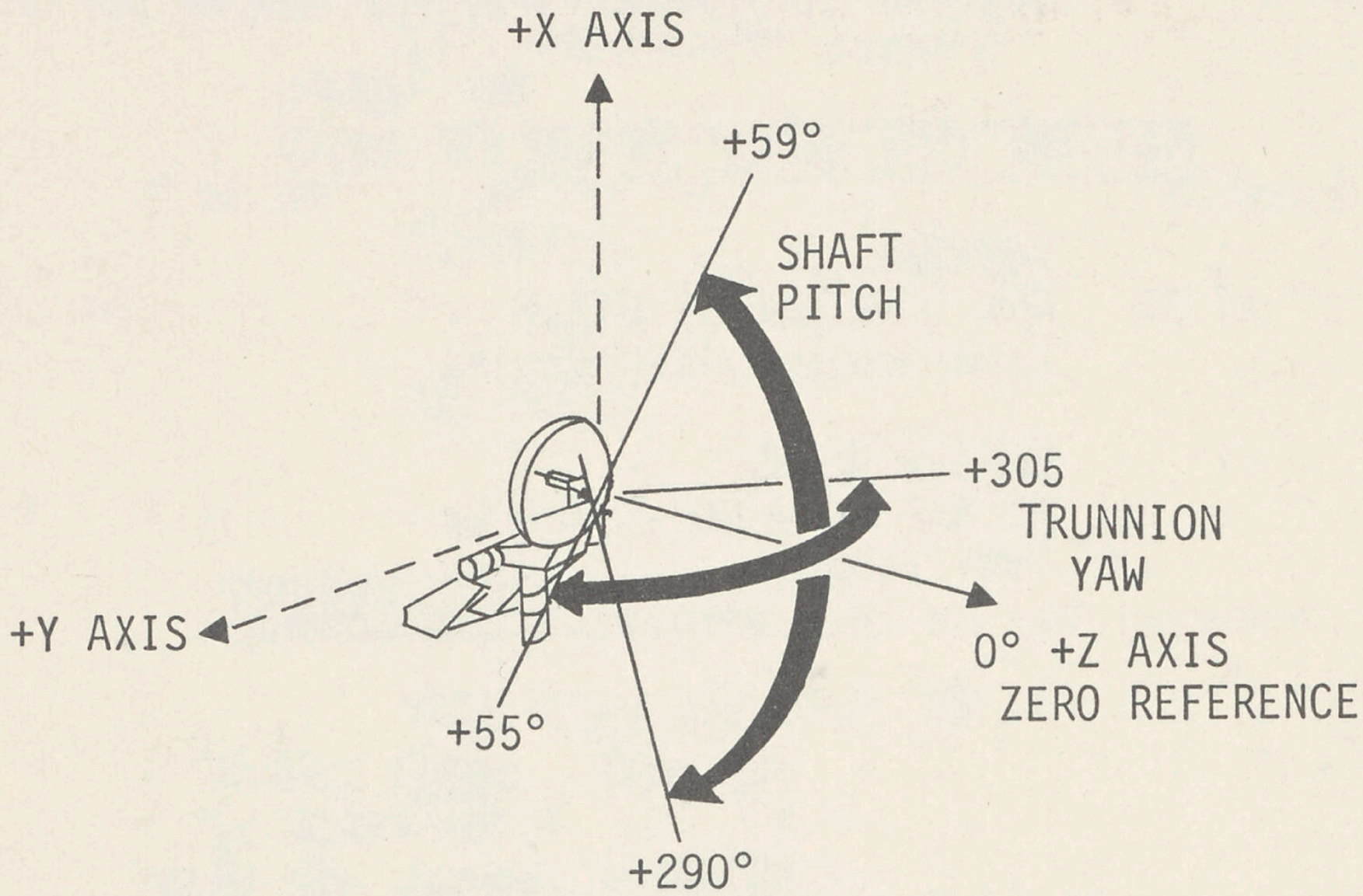
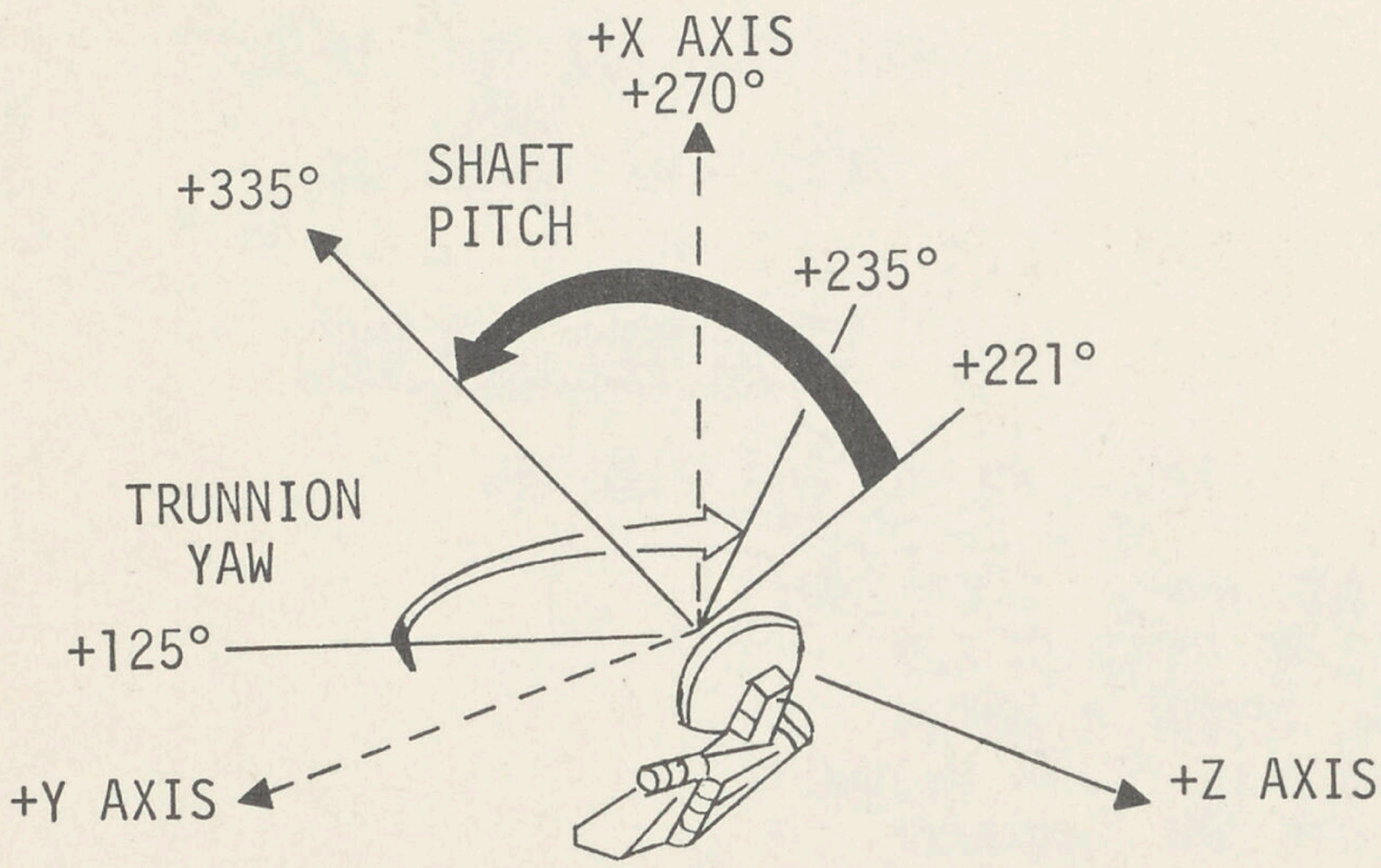


RR ANTENNA MODE I COVERAGE (OPERATIONAL LIMITS)
(IN N73 FORMAT)



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

P40 - P47
P51 - P57
P63 - P68
P70 - P76/P77
V40 - V90
DATE 6/21/71

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 6/21/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

MAN. BURN,AGS ACT.
& SELF TEST,CALIB.

AUTO, MAN RR UPDATE,
AGS MAN SV UPDATE

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		440R RANGE RATE (±1.0 fps)	(.1fps)
		PRO	

P40 - P47
P51 - P57
P63 - P68
P70 - P76/P77
V40 - V90

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V48 DAP CONFIG & DPS TRIM

```
1              V48E
     F 04 46   DAP CODE, FUNCTION FAIL CODE      (Octal)
          (CONFIG) A 1- ASCENT, 2- DESCENT, 3- DOCKED
       R1 (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                        (1b)
               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 6/21/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

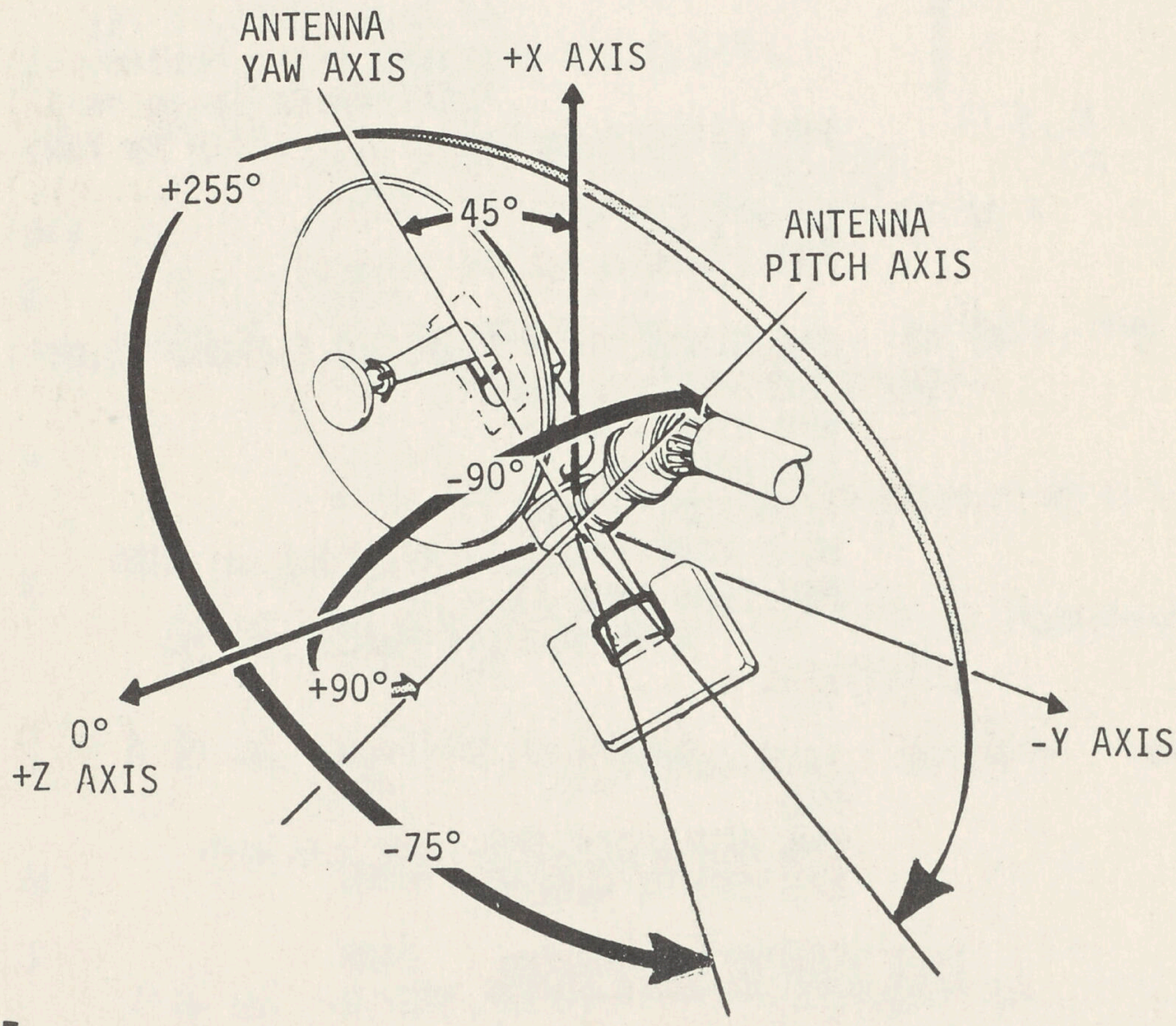
MAN. BURN,AGS ACT.
& SELF TEST,CALIB.

AUTO, MAN RR UPDATE,
AGS MAN SV UPDATE

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

P40 - P47
P51 - P57
P63 - P68
P70 - P76/P77
V40 - V90

V67 W-MATRIX ERROR DISPLAY

```
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 3/29/71

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

MAN. BURN,AGS ACT.
& SELF TEST,CALIB.

AUTO, MAN RR UPDATE,
AGS MAN SV UPDATE

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

PGNS TURN-ON AND SELF TEST

1 If STBY Lt - On, PRO (Hold In Until
STBY Lt - Off, RESTART Lt-On; Repeat
If Necessary M.A. & LGC Warn)
RSET

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 V25N01E 1365E
F 21 01 E,E,E

5 V15 N01E 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 _______________ *
```

7 V21 N27E 0E Terminate Self Test

8 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

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

3 F 16 44 HA,HP,TFF (.1nm,m-s)
(If AGS) 315R(HA);403R (HP) (.1nm)
Average HA & HP
ALT SET - Set
PRO

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PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

MAN. BURN,AGS ACT.
& SELF TEST,CALIB.

AUTO, MAN RR UPDATE,
AGS MAN SV UPDATE

4 V83E

F 16 54 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 V06E
06 21 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 V21N01E
F 21 01 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 3/29/71

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

DATE 6/21/71

4		V63E INITIATE RDR SELF TEST
	F 04 12	R1 00004 SPECIFY RDR
		R2 00001 RNDZ RDR
		V22E 2E LDG RDR
		PRO
5	F 16 66	SLANT RANGE, ANT POSITION (ft)
		R1 + 08276 To +08298 (+08287)
		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		V63E INITIATE RDR SELF TEST
	F 04 12	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		LDG ANT - DES (10 sec)
	F 16 66	R2 +00001 (PROG Lt-On, V05N09E,00522 RSET)
12		LDG ANT - AUTO
	F 16 66	R2 +00001
		V34E
13		RDR TEST - OFF
		CB(11) PGNS: LDG RDR - Open

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

P51 - P57

P63 - P68
P70 - P76/P77

V40 - V90

DATE 3/29/71

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)

5 TEST MONITOR - AGC (1.4 To 1.9)
- XMTR PWR (3.3 To 3.8)
- SHAFT ERR(2.2 To 2.6 @ 1/2 cps)
- TRUN ERR (2.2 To 2.5 @ 1/2 cps)
- AGC

DATE 6/21/71

DEDA ADDRESSES

FLGWD, CHAN LISTS LM/CSM S.V.READOUT

MAN. BURN,AGS ACT. & SELF TEST,CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

6		Set NORRMON Flag V25 N07E 101E, 10E, 1E RR MODE - LGC(NO TRACK Lt - On, Wait 10sec)
7	F 04 12	V63E START RNDZ RDR SELF TEST R1 00004 SPECIFY RADAR R2 00001 RNDZ RADAR PRO NO TRACK Lt - Out 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 +195.40 To +195.80 (TM Within±1.2 of R1) R2 -0480.0 To -0520.0 (TM=R2-2)
10		V34E
11		RADAR TEST - OFF (NO TRACK Lt - On, X-Pntr-Center)
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)

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

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

DATE 3/29/71

DEDA ADDRESSES
FLGWD, CHAN LISTS
LM/CSM S.V.READOUT
MAN. BURN,AGS ACT.
& SELF TEST,CALIB.
AUTO, MAN RR UPDATE,
AGS MAN SV UPDATE

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

2 Load New Value: (ie ± XXX.XXE)
New Value (AZBIAS) = -0.46 + 1.3 (Δ Az)
(+ΔAz =LPD is Right of L.S.)
(ELBIAS) = +0.18 + 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
	F 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

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

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DEDA ADDRESSES

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

MAN. BURN,AGS ACT.
& SELF TEST,CALIB.

AUTO, MAN RR UPDATE,
AGS MAN SV UPDATE

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

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

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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

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

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Rendwflg	101	1	W Matrix Valid For Flt Nav	E=1,3,5,7
		(1)	W Matrix Not Valid For Flt Nav	E=0,2,4,6
Attitude	102	1	LM Att Stored In LGC	E=1,3,5,7
		(1)	LM Att Not Stored In LGC	E=0,2,4,6
SURFFLAG	104	200	LM On Surface	C=2,3,6,7
		(8)	LM Not On Surface	C=0,1,4,5
FLT59FLG	105	10	Cur/Spir Marks Enabled In 52	D=1,3,5,7
(P52 Only)		(4)	Cur/Spir Marks Not Enabled In P52	D=0,2,4,6
Remode	110	20000	Remode Requested	A=2,3,6,7
		(14)	No Remode Requested	A=0,1,4,5
Antenna	110	4000	RR Ant In Mode 2	B=4,5,6,7
		(12)	RR Ant In Mode 1	B=0,1,2,3
Designate	110	1000	Designate Requested or In Progress	B=1,3,5,7
		(10)	Designate Not Requested or Not In Progress	B=0,2,4,6
ACA Mode	111	40000	Min Impulse Enabled (V76)	A=4,5,6,7
		(15)	Rate Command Enabled(V77)	A=0,1,2,3

CHANNEL LIST

CHANNEL	BIT	DSKY	FUNCTION
5 OUTPUT	1	E=1,3,5,7	JET 1 ON (4U)
	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 OUTPUT	1	E=1,3,5,7	JET 7 ON (3A)
	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 OUTPUT	1	E=1,3,5,7	ISS WARNING
	13	A=1,3,5,7	ENGINE ON
	14	A=2,3,6,7	ENGINE OFF
12 OUTPUT	1	E=1,3,5,7	ZERO RRCDU
	4	D=1,3,5,7	COARSE ALIGN ENABLE
	5	D=2,3,6,7	ZERO ICDU
	9	C=4,5,6,7	+PITCH GMBL TRIM CMD
	10	B=1,3,5,7	-PITCH GMBL TRIM CMD
	11	B=2,3,6,7	+ROLL GMBL TRIM CMD
	12	B=4,5,6,7	-ROLL GMBL TRIM CMD
	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 INPUT	3	E=4,5,6,7	MARK X
	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

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 FAILED (4D&R)
(INVERTED)	2	E=0,1,4,5	JETS 5,8 FAILED (3U&R)
INPUT	3	E=0,1,2,3	JETS 1,3 FAILED (4U&F)
	4	D=0,2,4,6	JETS 6,7 FAILED (3D&A)
	5	D=0,1,4,5	JETS 14,16 FAILED (1D&L)
	6	D=0,1,2,3	JETS 13,15 FAILED (1U&F)
	7	C=0,2,4,6	JETS 9,12 FAILED (2U&L)
	8	C=0,1,4,5	JETS 10,11 FAILED (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

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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
INPUT	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)

LM OR CSM S.V. READOUT

1 V83E

2 After integration: V05N01E

CSM S.V.		LM S.V.	
2130E		2160E	
E,2133E		E,2163E	
E,2171E		E,2103E	
E,2174E		E,2106E	
E,2112E		E,2112E	
PRO		PRO	

3 Transmit S.V. & Time Tag To CSM

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

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V40 - V90

P63 - P68
P70 - P76/P77

FLGWD, CHAN LISTS
LM/CSM S.V.READOUT

PGNS T/O,LR,RR TEST
RCS INHIB,LPD BIAS

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 Azimuth
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

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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

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)	

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CONTINGENCY ALIGNMENTS

O.I., CSI, CDH, TPI, TPM, EXT ΔV

MAN. BURN, AGS ACT. & SELF TEST, CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

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 Overflows	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.	

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

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CONTINGENCY ALIGNMENTS

O.I., CSI, CDH, TPI, TPM, EXT ΔV

MAN. BURN, AGS ACT. & SELF TEST, CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

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

613 (1K37)	Accel. Calibration Time	Octal
617 (1K30)	Gyro Calbration Time	(1 Ct=2sec)
622 (4K23)	Attitude Hold At Abort Staging Threshold	(1 Ct=40 millisec)
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

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CONTINGENCY ALIGNMENTS

O.I., CSI, CDH, TPI, TPM, EXT ΔV

MAN. BURN, AGS ACT. & SELF TEST, CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

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DEDA ADDRESSES
FLGWD, CHAN LISTS
LM/CSM S.V. READOUT
P63 - P68
P70 - P76/P77
V40 - V90

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°)
410+0 Orbit Insertion Routine
465+(Altitude Rate At Insertion) (.1fps)
616+0 Zero Ullage Counter Limit
662+(4K10) (100ft)
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
MASTER ARM	ON(1st Burn Only)	ON(Un-staged)	OFF

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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 -TBD 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

For Over Burns:
(Out-of-Plane Comp):
Null 263R ΔVY (.1fps)
373 [377] Tig (.1min)
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 3/29/71

CONTINGENCY ALIGNMENTS

MAN. BURN, AGS ACT. & SELF TEST, CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

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 - ENALBE
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

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)

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

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 3/29/71

CONTINGENCY ALIGNMENTS

MAN. BURN, AGS ACT. & SELF TEST, CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

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

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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 3/29/71

CONTINGENCY ALIGNMENTS

MAN. BURN,AGS ACT. & SELF TEST,CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

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	

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

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

DATE 3/29/71

CONTINGENCY ALIGNMENTS

MAN. BURN, AGS ACT. & SELF TEST, CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

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

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-Close
(AGS Warn Lt - Off)
AGS STATUS - OPERATE
(AGS Warn Lt - On)
O2/H2O QTY MON - CWEA RESET
(AGS Warn Lt - Off)

DATE 3/29/71

CONTINGENCY ALIGNMENTS

MAN. BURN, AGS ACT. & SELF TEST, CALIB.

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

2 000 +888888 (OPR ERR Lt - On)

3 123 -45679

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 +0 DESCENT STAGE FLAG (+NOT STAGED)

6 604R+0 LUNAR SURFACE FLAG (+NOT ON LUNAR SURFACE)

7 612R +0 STAGING SEQ COUNTER

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)

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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)

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 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)

DATE 6/21/71

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

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	-$\overline{\text{SLEW}}$
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

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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

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)

DATE 6/21/71

AGS MANUAL STATE VECTOR UPDATE

Note: Insure 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)	

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 3/29/71

AGS RNDZ ALIGNMENT

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 ALIGNMENT

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

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

DATE 3/29/71

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

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

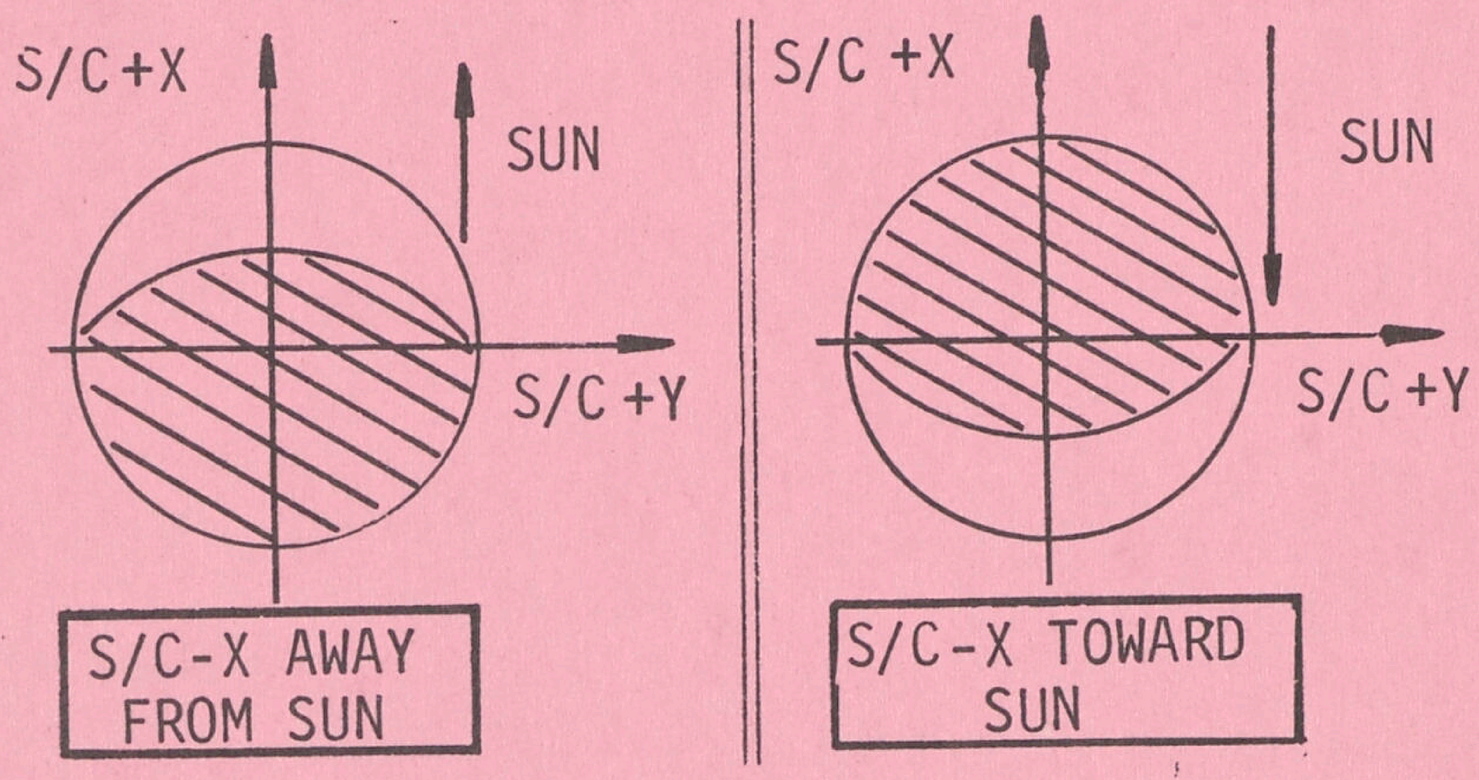
4 Terminate ATT HOLD On CSM Cmd

5 On CSM Request V06N20
On CSM Mark, Key ENTR

6 Copy Angles And Transmit To CM

CRESCENT ALIGN

1 Verity COAS or AOT LAMP Ltg
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 Mnv Req'd., 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 6/21/71

PLANET VECTORS JULY 26

PLANET VECTORS JULY 27

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 3/29/71

DATE 7/12/71

0 HR GET = 7:26:13:34 GMT
LO = 7:26:__:__

7/1/71 Final

Earth Unit Vectors

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	.76447	.54969	.33681
100.5	.76165	.55267	.33817
101.0	.75882	.55581	.33953
101.5	.75597	.55886	.34088
102.0	.75311	.56189	.34223
102.5	.75023	.56492	.34357
103.0	.74733	.56794	.34490
103.5	.74442	.57095	.34623
104.0	.74150	.57394	.34775
104.5	.73856	.57693	.34886
105.0	.73560	.57991	.35017
105.5	.73263	.58287	.35147
106.0	.72964	.58583	.35277
106.5	.72664	.58878	.35406
107.0	.72362	.59171	.35534
107.5	.72059	.59464	.35662
108.0	.71754	.59756	.35789
108.5	.71448	.60046	.35915
109.0	.71140	.60336	.36041
109.5	.70830	.60624	.36166
110.0	.70520	.60911	.36290
110.5	.70207	.61198	.36414
111.0	.69893	.61483	.36537
111.5	.69578	.61767	.36659
112.0	.69261	.62050	.36781
112.5	.68943	.62332	.36902
113.0	.68623	.62613	.37022
113.5	.68302	.62892	.37142
114.0	.67980	.63171	.37261
114.5	.67655	.63448	.37379
115.0	.67330	.63725	.37497
115.5	.67003	.64000	.37614
116.0	.66674	.64274	.37730
116.5	.66344	.64547	.37846
117.0	.66013	.64819	.37961
117.5	.65680	.65089	.38075
118.0	.65346	.65359	.38188
118.5	.65010	.65627	.38301
119.0	.64673	.65894	.38413

Earth Unit Vectors

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
119.5	.64334	.66160	.38524
120.0	.63994	.66425	.38635
120.5	.63653	.66688	.38745
121.0	.63310	.66951	.38854
121.5	.62966	.67212	.38962
122.0	.62620	.67472	.39070
122.5	.62273	.67731	.39177
123.0	.61924	.67988	.39283
123.5	.61575	.68244	.39389
124.0	.61223	.68499	.39493
124.5	.60871	.68753	.39597
125.0	.60517	.69006	.39701
125.5	.60161	.69257	.39803
126.0	.59804	.69507	.39905
126.5	.59446	.69755	.40006
127.0	.59087	.70003	.40106
127.5	.58726	.70249	.40206
128.0	.58364	.70494	.40305
128.5	.58000	.70737	.40403
129.0	.57635	.70980	.40500
129.5	.57269	.71221	.40596
130.0	.56901	.71460	.40692
130.5	.56532	.71699	.40787
131.0	.56162	.71936	.40881
131.5	.55791	.72171	.40974
132.0	.55418	.72406	.41067
132.5	.55044	.72639	.41158
133.0	.54668	.72870	.41249
133.5	.54291	.73100	.41339
134.0	.53913	.73329	.41429
134.5	.53534	.73557	.41517
135.0	.53153	.73783	.41605
135.5	.52771	.74008	.41692
136.0	.52388	.74231	.41778
136.5	.52003	.74453	.41864
137.0	.51618	.74674	.41948
137.5	.51230	.74893	.42032
138.0	.50842	.75111	.42115
138.5	.50453	.75327	.42197
139.0	.50062	.75542	.42278
139.5	.49670	.75755	.42358

AUTO, MAN RR UPDATE, AGS MAN SV UPDATE

M PLANET VECTORS JULY 26

O.I., CSI, CDH, TPI, TPM, EXT ΔV

CONTINGENCY ALIGNMENTS

0 HR GET = 7:26:13:34 GMT
LO = 7:26:__:__

7/1/71 Final

Earth Unit Vectors

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
140:0	.49277	.75967	.42438
140.5	.48882	.76178	.42516
141.0	.48486	.76387	.42594
141.5	.48089	.76595	.42671
142.0	.47691	.76801	.42748
142.5	.47292	.77005	.42823
143.0	.46891	.77209	.42897
143.5	.46490	.77410	.42971
144.0	.46087	.77611	.43044
144.5	.45683	.77809	.43116
145.0	.45277	.78007	.43187
145.5	.44871	.78202	.43257
146.0	.44463	.78397	.43326
146.5	.44054	.78589	.43395
147.0	.43644	.78780	.43463
147.5	.43233	.78970	.43529
148.0	.42821	.79158	.43595
148.5	.42408	.79345	.43660
149.0	.41993	.79529	.43724
149.5	.41578	.79713	.43787
150.0	.41161	.79895	.43850
150.5	.40743	.80075	.43911
151.0	.40324	.80254	.43972
151.5	.39904	.80431	.44031
152.0	.39483	.80606	.44090
152.5	.39061	.80780	.44148
153.0	.38637	.80952	.44205
153.5	.38213	.81123	.44261
154.0	.37788	.81292	.44316
154.5	.37361	.81459	.44370
155.0	.36934	.81625	.44423
155.5	.36505	.81789	.44475
156.0	.36075	.81952	.44527
156.5	.35645	.82113	.44577
157.0	.35213	.82272	.44627
157.5	.34780	.82429	.44676
158.0	.34347	.82585	.44723
158.5	.33912	.82739	.44770
159.0	.33476	.82892	.44816
159.5	.33040	.83042	.44861

Earth Unit Vectors

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
160.0	.32602	.83192	.44905
160.5	.32163	.83339	.44948
161.0	.31724	.83485	.44990
161.5	.31283	.83629	.45031
162.0	.30842	.83771	.45071
162.5	.30399	.83911	.45110
163.0	.29956	.84050	.45148
163.5	.29512	.84187	.45186
164.0	.29067	.84322	.45222
164.5	.28620	.84456	.45257
165.0	.28173	.84588	.45292
165.5	27725	.84718	.45325
166.0	.27277	.84846	.45357
166.5	.26827	.84972	.45389
167.0	.26376	.85097	.45419
167.5	.25925	.85220	.45449
168.0	.25473	.85341	.45477
168.5	.25020	.85460	.45505
169.0	.24566	.85578	.45531
169.5	.24111	.85694	.45557
170.0	.23655	.85807	.45581
170.5	.23199	.85920	.45605
171.0	.22742	.86030	.45627
171.5	.22284	.86138	.45649
172.0	.21825	.86245	.45669
172.5	.21365	.86349	.45689
173.0	.20905	.86452	.45707
173.5	.20444	.86553	.45725
174.0	.19982	.86652	.45741
174.5	.19519	.86749	.45757
175.0	.19056	.86845	.45771

DATE 7/12/71

DATE 6/21/71

LM 8-1.- Planet unit vectors (lunar referenced)
Venus, Mars, Jupiter, Saturn. (July 26 launch date)

3/7/71 Basic

0 HR GET = 7:26:13:34 GMT
LO = 7:26:__:__

VENUS UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	-.48921	.79491	.35886
104.0	-.49232	.79327	.35826
108.0	-.49542	.79161	.35765
112.0	-.49851	.78995	.35703
116.0	-.50159	.78827	.35641
120.0	-.50467	.78659	.35579
124.0	-.50774	.78490	.35516
128.0	-.51080	.78320	.35453
132.0	-.51385	.78148	.35389
136.0	-.51689	.77976	.35325
140.0	-.51993	.77803	.35261
144.0	-.52296	.77630	.35196
148.0	-.52598	.77455	.35131
152.0	-.52900	.77279	.35065
156.0	-.53200	.77102	.34999
160.0	-.53500	.76925	.34932
164.0	-.53799	.76746	.34866
168.0	-.54098	.76567	.34798
172.0	-.54395	.76387	.34731
176.0	-.54692	.76206	.34662
180.0	-.54988	.76024	.34594
184.0	-.55283	.75841	.34525
188.0	-.55578	.75657	.34456
192.0	-.55871	.75472	.34386
196.0	-.56164	.75286	.34316
200.0	-.56456	.75100	.34245

MARS UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	.75236	-.54892	-.36419
120.0	.75016	-.55105	-.36553
140.0	.74805	-.55308	-.36677
160.0	.74605	-.55502	-.36792
180.0	.74415	-.55686	-.36897
200.0	.74236	-.55861	-.36994

JUPITER UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	-.54982	-.77161	-.31986
140.0	-.54916	-.77197	-.32014
180.0	-.54838	-.77240	-.32044

SATURN UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	.43239	.84017	.32733
140.0	.43037	.84108	.32766
180.0	.42841	.84196	.32797

PLANET VECTORS
JULY 27

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DATE 7/12/71

LM 8-2.- Earth unit vectors. (July 27 launch date)

0 HR GET = 7:27:13:37
LO = 7:27:__:__

7/1/71 Final

Earth Unit Vector

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	.61188	.68525	.39504
100.5	.60835	.68778	.39608
101.0	.60481	.69031	.39711
101.5	.60126	.69282	.39814
102.0	.59769	.69532	.39915
102.5	.59410	.69780	.40016
103.0	.59051	.70028	.40116
103.5	.58690	.70274	.40216
104.0	.58327	.70518	.40314
104.5	.57964	.70762	.40412
105.0	.57599	.71004	.40509
105.5	.57232	.71245	.40606
106.0	.56865	.71484	.40701
106.5	.56495	.71722	.40796
107.0	.56125	.71959	.40890
107.5	.55753	.72195	.40983
108.0	.55380	.72429	.41076
108.5	.55006	.72662	.41168
109.0	.54630	.72893	.41258
109.5	.54253	.73123	.41348
110.0	.53875	.73352	.41438
110.5	.53496	.73580	.41526
111.0	.53115	.73806	.41614
111.5	.52733	.74030	.41701
112.0	.52349	.74253	.41787
112.5	.51965	.74475	.41872
113.0	.51579	.74696	.41956
113.5	.51192	.74915	.42040
114.0	.50803	.75132	.42123
114.5	.50414	.75348	.42205
115.0	.50023	.75563	.42286
115.5	.49631	.75777	.42366
116.0	.49237	.75988	.42446
116.5	.48843	.76199	.42524
117.0	.48447	.76408	.42602
117.5	.48050	.76615	.42679
118.0	.47651	.76821	.42755
118.5	.47252	.77026	.42830

Earth Unit Vector

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
119.0	.46851	.77229	.42905
119.5	.46449	.77430	.42978
120.0	.46046	.77631	.43051
120.5	.45642	.77829	.43123
121.0	.45237	.78026	.43194
121.5	.44830	.78222	.43264
122.0	.44422	.78416	.43333
122.5	.44013	.78608	.43402
123.0	.43603	.78799	.43469
123.5	.43192	.78989	.43536
124.0	.42780	.79177	.43602
124.5	.42366	.79363	.43666
125.0	.41952	.79548	.43730
125.5	.41536	.79731	.43794
126.0	.41119	.79913	.43856
126.5	.40701	.80093	.43917
127.0	.40282	.80271	.43978
127.5	.39862	.80448	.44037
128.0	.39441	.80624	.44096
128.5	.39018	.80797	.44153
129.0	.38595	.80969	.44210
129.5	.38171	.81140	.44266
130.0	.37745	.81309	.44321
130.5	.37318	.81476	.44375
131.0	.36891	.81642	.44428
131.5	.36462	.81806	.44481
132.0	.36032	.81968	.44532
132.5	.35602	.82129	.44582
133.0	.35170	.82288	.44632
133.5	.34737	.82445	.44680
134.0	.34303	.82601	.44728
134.5	.33869	.82755	.44775
135.0	.33433	.82907	.44820
135.5	.32996	.83057	.44865
136.0	.32558	.83206	.44909
136.5	.32120	.83354	.44952

PLANET VECTORS
JULY 27

LM 8-2.- Concluded.

0 HR GET = 7:27:13:37
LO = 7:27:__:__

7/1/71 Final

Earth Unit Vector

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
137.0	.31680	.83499	.44994
137.5	.31239	.83643	.45035
138.0	.30798	.83785	.45075
138.5	.30355	.83925	.45114
139.0	.29912	.84064	.45152
139.5	.29467	.84201	.45189
140.0	.29022	.84336	.45226
140.5	.28576	.84469	.45261
141.0	.28129	.84601	.45295
141.5	.27681	.84731	.45328
142.0	.27232	.84859	.45361
142.5	.26782	.84985	.45392
143.0	.26331	.85110	.45422
143.5	.25880	.85232	.45452
144.0	.25427	.85353	.45480
144.5	.24974	.85472	.45507
145.0	.24520	.85590	.45534
145.5	.24065	.85705	.45559
146.0	.23610	.85819	.45584
146.5	.23153	.85931	.45607
147.0	.22696	.86041	.45630
147.5	.22238	.86149	.45651
148.0	.21779	.86255	.45671
148.5	.21319	.86360	.45691
149.0	.20859	.86462	.45709
149.5	.20398	.86563	.45727
150.0	.19936	.86662	.45743
150.5	.19473	.86759	.45758
151.0	.19009	.86854	.45773
151.5	.18545	.86947	.45786
152.0	.18080	.87039	.45798
152.5	.17615	.87128	.45810
153.0	.17149	.87216	.45820
153.5	.16682	.87302	.45829
154.0	.16214	.87385	.45837
154.5	.15746	.87467	.45844
155.0	.15277	.87547	.45850
155.5	.14807	.87625	.45855

Earth Unit Vector

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
156.0	.14337	.87701	.45859
156.5	.13866	.87775	.45862
157.0	.13394	.87848	.45864
157.5	.12922	.87918	.45865
158.0	.12450	.87986	.45865
158.5	.11976	.88052	.45864
159.0	.11502	.88117	.45862
159.5	.11028	.88179	.45858
160.0	.10553	.88239	.45854
160.5	.10077	.88298	.45848
161.0	.09601	.88354	.45842
161.5	.09124	.88409	.45834
162.0	.08647	.88461	.45826
162.5	.08169	.88512	.43816
163.0	.07691	.88560	.45805
163.5	.07212	.88606	.45793
164.0	.06733	.88651	.45781
164.5	.06254	.88693	.45767
165.0	.05773	.88733	.45752
165.5	.05293	.88772	.45735
166.0	.04812	.88808	.45718
166.5	.04330	.88842	.45700
167.0	.03849	.88874	.45680
167.5	.03366	.88904	.45660
168.0	.02884	.88932	.45638
168.5	.02401	.88958	.45616
169.0	.01917	.88982	.45592
169.5	.01433	.89004	.45567
170.0	.00949	.89024	.45541
170.5	.00465	.89041	.45514
171.0	-.00021	.89057	.45486
171.5	-.00506	.89070	.45457
172.0	-.00992	.89082	.45427
172.5	-.01477	.89091	.45395
173.0	-.01963	.89098	.45363
173.5	-.02450	.89103	.45329
174.0	-.02936	.89106	.45294
174.5	-.03423	.89107	.45259
175.0	-.03910	.89106	.45222

DATE 7/12/71

DATE 6/21/71

LM 8-1.- Planet unit vectors (lunar referenced)
Venus, Mars, Jupiter, Saturn. (July 27 launch date)

6/7/71 Basic

0 HR GET = 7:27:13:37
LO = 7:27:__:__

VENUS UNIT VECTOR

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	-.50777	.78488	.35515
104.0	-.51084	.78317	.35452
108.0	-.51389	.78146	.35388
112.0	-.51693	.77974	.35324
116.0	-.51997	.77801	.35260
120.0	-.52300	.77627	.35195
124.0	-.52602	.77453	.35130
128.0	-.52904	.77277	.35064
132.0	-.53204	.77100	.34998
136.0	-.53504	.76923	.34932
140.0	-.53803	.76744	.34865
144.0	-.54101	.76565	.34797
148.0	-.54399	.76385	.34730
152.0	-.54696	.76203	.34662
156.0	-.54992	.76021	.34593
160.0	-.55287	.75838	.34524
164.0	-.55581	.75654	.34455
168.0	-.55875	.75470	.34385
172.0	-.56168	.75284	.34315
176.0	-.56460	.75097	.34244
180.0	-.56751	.74910	.34173
184.0	-.57042	.74722	.34102
188.0	-.57331	.74532	.34030
192.0	-.57620	.74342	.33957
196.0	-.57909	.74151	.33885
200.0	-.58196	.73959	.33812

MARS UNIT VECTOR

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	.74972	-.55147	-.36579
120.0	.74764	-.55348	-.36701
140.0	.74566	-.55540	-.36814
160.0	.74378	-.55723	-.36917
180.0	.74201	-.55896	-.37012
200.0	.74032	-.56060	-.37100

JUPITER UNIT VECTOR

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	-.54944	-.77182	-.32002
140.0	-.54870	-.77222	-.32031
180.0	-.54786	-.77269	-.32063

SATURN UNIT VECTOR

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
100.0	.43117	.84073	.32753
140.0	.42918	.84161	.32785
180.0	.42725	.84248	.32816

KNOWN RR BIAS LOADING

1 V21N01E
(SHAFT) 1700E, XXXXXE (See Table)
(TRUN) 1702E, XXXXXE

(±) 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	77671	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			