

APOLLO 13

G&N DICTIONARY

PART NO.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO XIII  
LM-7

# FLIGHT CREW G&N DICTIONARY

PREPARED BY

GUIDANCE AND CONTROL SECTION  
SPACECRAFT SYSTEMS BRANCH  
FLIGHT CREW SUPPORT DIVISION



MANNED SPACECRAFT CENTER  
HOUSTON, TEXAS

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APOLLO 13

G&N DICTIONARY

MARCH 25, 1970

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APOLLO FLIGHT DATA FILE  
FLIGHT CREW G&N DICTIONARY (LM-7)

BASIC DATE 1/5/70

**LIST OF EFFECTIVE PAGES**

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Cover Page	1/5/70	3/9/70
Signature Page	3/9/70	NONE
Table of Contents (v thru viii)	3/9/70	NONE
Star Maps	NONE	NONE
PGNS-1 thru 3	1/5/70	NONE
PGNS-4 & 5	1/5/70	3/9/70
PGNS-6	1/5/70	NONE
PGNS-7 & 8	1/5/70	3/9/70
PGNS-9 & 10	1/5/70	NONE
PGNS-11	1/5/70	3/9/70
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RECOV-1	1/5/70	1/18/70
RECOV-2	1/5/70	NONE
PGNS-15 & 16	1/5/70	NONE

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PGNS-22	1/5/70	NONE
PGNS-23 & 24	1/5/70	1/18/70
PGNS-25 thru 28	1/5/70	NONE
PGNS-29	1/5/70	3/9/70
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PGNS-38 & 41	1/5/70	3/25/70
PGNS-42	1/5/70	NONE
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PGNS-46	1/5/70	NONE
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 Changed \_\_\_\_\_

PADS

- P27 (4 pgs)
- P30 (4 pgs)
- AGS STATE VECTOR UPDATE (4 pgs)

HALF UNIT VECTORS

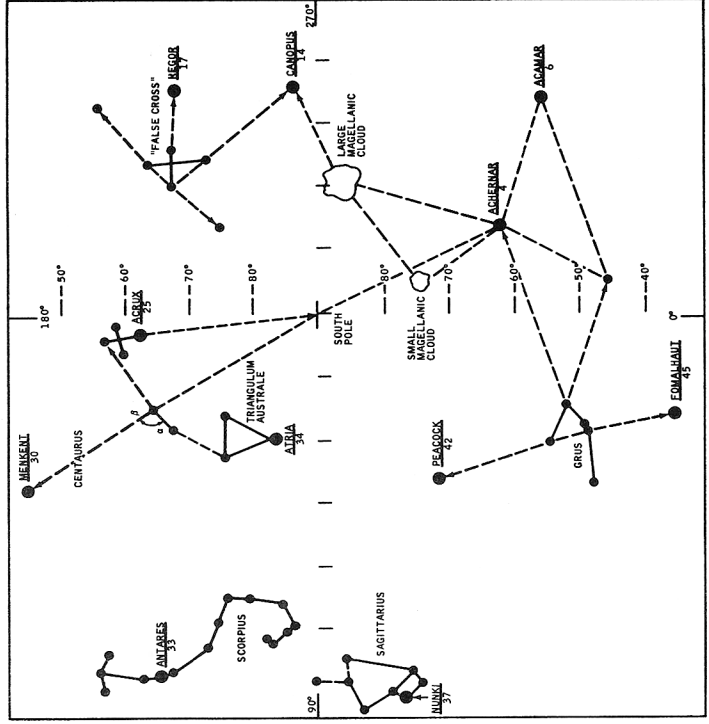
- PLANET VECTORS (MARS, JUPITER, SATURN,  
VENUS) . . . . . PV-1
- PLANET VECTORS (EARTH) . . . . . PV-2
- STAR VECTORS . . . . . PV-3/4

Basic Date 3/9/70  
 Changed

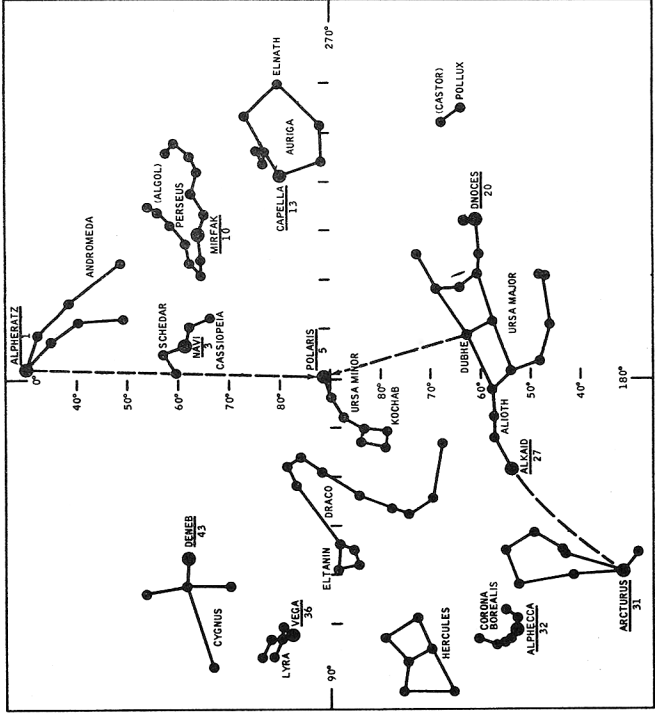




Basic Date \_\_\_\_\_  
 Changed \_\_\_\_\_



SOUTHERN STARS



NORTHERN STARS





## PGNS-1

STAR LIST

	<u>STAR NAME</u> (Numerical)	<u>STAR NAME</u> (Alphabetical)	
NO			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

STARS, PROG

Basic Date 1/5/70

Changed \_\_\_\_\_

LM-7

PROGRAMS

<u>STARS, PROG</u>	<u>NO.</u>	
	00	LGC Idle
	06	LGC Power Down
	12	Powered Ascent
	20	Rendezvous Navigation
	21	Ground Track Determination
	22	Lunar Surface Navigation
	25	Preferred Tracking Attitude
	27	LGC Update
	30	External $\Delta V$
	32	CSI Pre-Thrust
	33	CDH Pre-Thrust
	34	TPI Pre-Thrust
	35	TPM Pre-Thrust
	40	DPS Thrust
	41	RCS Thrust
	42	APS Thrust
	47	$\Delta V$ Monitor
	51	IMU Orientation Determination
	52	IMU Realign
	57	Lunar Surface Align
	63	Braking Phase
	64	Approach Phase
	66	Landing Phase (ROD)
	68	Landing Confirmation
	70	DPS Abort
	71	APS Abort
	72	CSM CSI Targeting
	73	CSM CDH Targeting
	74	CSM TPI Targeting
	75	CSM TPM Targeting
	76	Target $\Delta V$

Basic Date 1/5/70  
 Changed \_\_\_\_\_

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 (P00 only)
- 31 Request Waitlist (P00 only)
- 32 Recycle
- 33 Proceed
- 34 Terminate
- 35 Test Lights (P00 only)
- 36 Request Fresh Start
- 37 Change Program
- 40 Zero CDU's (Specify N20 or N72)
- 41 Coarse Align CDU's (Specify N20 or N72)
- 42 Fine Align IMU
- 43 Load FDAI Error Needles (test only)
- 44 Terminate Continuous Designate  
(V41N72 Option 2)
- 47 Initialize AGS (R47)
- 48 Load DAP Data (R03)
- 49 Start Crew Defined Maneuver (R62)
- 50 Please Perform
- 52 Mark X

VERBS

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 Changed \_\_\_\_\_

PGNS-4

VERBS

- 53 Mark Y
- 54 Mark X or Y
- 55 Increment LGC Time (Decimal)
- 56 Terminate Tracking (P20,P22,&P25)
- 57 Call 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
- 62 Display Total Attitude Error
- 63 Start RR/LR Self-Test
- 64 Start S-Band Antenna Routine (R05)
- 65 Disable U,V Jets During DPS Burns
- 66 Set LM State Vector into CSM State Vector
- 67 W-Matrix Monitor
- 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
- 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 (R77)
- 79 Stop LR Spurious Test (R77)
- 80 Update LM State Vector
- 81 Update CSM State Vector
- 82 Request Orbit Parameter Display (R30)
- 83 Rendezvous Parameter Display (R31)
- 85 Display RR LOS Az and El
- 89 Start Rendezvous Final Attitude Maneuver (R63)
- 90 Request Rendezvous Out of Plane Display (R36)  
(Non Ave G)
- 91 Display Banksum (P00 Only)
- 92 Start IMU Performance Test (P07) (non-flight)
- 93 Enable W-Matrix Initialization (Clear Rendflg)
- 95 Inhibit State Vector Update (P20 or P22)
- 96 Interrupt Integration and Go to P00
- 97 Perform Engine Fail Procedure (R40)
- 99 Enable Engine Ignition

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NOUN LIST V - Can Be Called At Any Time For Valid Data

01V	Address to be Specified (Frac)		.XXXXX
02V	Address to be Specified (Whole)		XXXXX.
03	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/Flag Word 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)	hrs,min,.	.01sec
12	Option Code (Extended Verbs Only)		Octal
	Desired Option		Octal
13	TIG CDH	hrs,min,.	.01sec
14	Checklist (Internal to LGC)		XXXXX.
15	Increment Address		Octal
16	Time of Event (Extended Verbs Only)		hrs,min,.
			.01sec
18	Desired Maneuver To FDAI RPY 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	hrs,min,.	.01sec
25	Checklist (Used With V50)		Octal
26	Prio/Delay, ADRES, BBCON		Octal
27V	Self Test ON/OFF		
32	Time From Perigee	hrs,min,.	.01sec
33	TIG	hrs,min,.	.01sec
34	Time of Event	hrs,min,.	.01sec
35	Time From Event	hrs,min,.	.01sec
36V	LGC Clock Time	hrs,min,.	.01sec
37	TIG TPI	hrs,min,.	.01sec
38	Time of State Being Integrated	hrs,min,.	.01sec
40	Time From Ignition/Cutoff		min-sec
	VG		.1fps
	ΔV (Accumulated)		.1fps

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NOUNS

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PGNS-6

41	Target Azimuth (Non-Flight)	.01°
	Elevation	.001°
42	Apogee	.1nm
	Perigee	.1nm
	ΔV (Required)	.1fps
43	Latitude (+North)	.01°
	Longitude (+East)	.01°
	Altitude	.1nm
44	Apogee	.1nm
	Perigee	.1nm
	TFF	min-sec
45V-R1	Marks	XXXXX.
	TFI Of Next/From Last Burn	min-sec
	MGA	.01°
46V	Digital Autopilot Configuration	Octal
47V	LM Weight	lbs
	CSM Weight	lbs
48V	Engine Gimbal Pitch Trim (+ Only)	.01°
	Engine Gimbal Roll Trim (+ Only)	.01°
49	ΔR	.1nm
	ΔV	.1fps
	Source Code	0000X.
51	S-Band Antenna	
	Pitch	.01°
	Yaw	.01°
52	Central Angle of Active Vehicle	.01°
54	Range	.01nm
	Range Rate	.1fps
	Theta	.01°
55	No. of Apsis Crossings (or Precision Offsets)	0000X.
	Elevation Angle	.01°
	Central Angle	.01°
56	RR LOS Azimuth	.01°
	Elevation	.01°
58	Perigee Alt. (Post TPI)	.1nm
	ΔV TPI	.1fps
	ΔV TPF	.1fps
59	ΔV LOS Fwd/Aft (+FWD)	.1fps
	ΔV LOS Rt/Left (+RT)	.1fps
	ΔV LOS Up/Dn (+DN)	.1fps

NOUNS

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60	V (Fwd) (+Along +Z)(Requires MODE SEL-PGNS)	.1fps
	H DOT (+ Increasing H)	.1fps
	H (+H>RLS)	ft
61	TG	min-sec
	TFI	min-sec
	Crossrange(+L.S. Is North of S/C)	.1nm
62	VI	.1fps
	TFI	min-sec
	$\Delta$ V Accumulated	.1fps
63	VI	.1fps
	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	hrs,min,.01sec
66V-R2	LR Slant Range	ft
	LR Position	00001/00002
67	LR VX	fps
	VY	fps
	VZ	fps
68	Slant Range to LS	.1nm
	TG Braking	min-sec
	LR Alt-Comp Alt ( $\Delta$ Alt)	ft
69	Ldg Site Correction Comp Z, Y, X	ft
70	AOT Detent/Star Code	Octal
71	AOT Detent/Star Code	Octal
72V	RR Trunnion Angle	.01°
	RR Shaft Angle	.01°
73	Desired RR Trunnion Angle	.01°
	Desired RR Shaft Angle	.01°
74	TFI	min-sec
	Yaw	.01°
	Pitch	.01°
75	$\Delta$ H (CDH)	.1nm
	$\Delta$ T (CDH-CSI/TPI-CDH)(Modular 60)	min-sec
	$\Delta$ T (TPI-CDH/TPI-Nom TPI)(Modular 60)	min-sec
76	V (HOR)	.1fps
	V (VERT)	.1fps
	Crossrange	.1nm

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PGNS-8

77	$\Delta T$ to Engine Cutoff	min-sec
	Velocity Normal To CSM Plane	.1fps
78	RR Range	.01nm
	RR Range Rate	fps
	TFI	min-sec
79	Cursor Angle	.01°
	Spiral Angle	.01°
	Detent Position	0000X
80	Data Indicator	XXXXX.
	Omega	.01°
81	$\Delta VX$ (LV) (+ Fwd)	.1fps
	$\Delta VY$ (LV) (+ Rt)	.1fps
	$\Delta VZ$ (LV) (+ Dn)	.1fps
82	$\Delta VX$ (LV) (+ Fwd)	.1fps
	$\Delta VY$ (LV) (+ Rt)	.1fps
	$\Delta VZ$ (LV) (+ Dn)	.1fps
83	$\Delta VX$ (LM) (+ Up)	.1fps
	$\Delta VY$ (LM) (+ Rt)	.1fps
	$\Delta VZ$ (LM) (+ Fwd)	.1fps
84	$\Delta VX$ (Other Vehicle) + (RXV)XR	.1fps
	$\Delta VY$ (Other Vehicle) + (VXR)	.1fps
	$\Delta VZ$ (Other Vehicle) + (-R)	.1fps
85	VGX (LM) (+ Up)	.1fps
	VGY (LM) (+ Rt)	.1fps
	VGZ (LM) (+ Fwd)	.1fps
86	VGX (LV) (+ Fwd)	.1fps
	VGY (LV) (+ Rt)	.1fps
	VGZ (LV) (+ Dn)	.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	Rendezvous Out of Plane Parameter Y	.01nm
	YDOT	.1fps
	PSI	.01°
91	Alt	10nm
	Vel	fps
	Flt Path Angle	.01°
92	LGC Guidance Throttle Command	%
	HDOT	.1fps
	H (+H>RLS)	ft

Basic Date 1/5/70  
 Changed 3/9/70



PGNS-9

93	Δ Gyro Torquing Angles X, Y, Z	.001°
97	System Test Inputs	XXXXX.
98	System Test Results	XXXXX. .XXXXX XXXXX.
99	W-Matrix: RMS Position	ft
	RMS Velocity	.1fps
	Radar Bias Angle	mr

V50 N25 CHECKLIST CODES

<u>RT Code</u>	<u>FUNCTION</u>
00013	Key In Normal Or Gyro Torque Coarse Align
00014	Recheck or Exit Fine Align Option
00015	Star Acquisition
00062	Power Down LGC
00201	Select RR LGC Mode
00203	Select PGNS, AUTO,&AUTO THROTTLE
00205	Slew RR For Manual Acquisition
00500	Switch LR Antenna to Position 1

N06 or N12 OPTION CODES

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 2 = Other
00004	Specify Radar	1 = RR, 2 = LR
00006	Specify RR Coarse Align Option	1 = Lock On 2 = Continuous Designate
00010	Specify Alignment Mode	0 = Anytime 1 = REFSMMAT + 1G 2 = 2 Bodies 3 = 1 Body + 1G

CHECKLIST CODES  
ALARMS

Basic Date 1/5/70  
Changed \_\_\_\_\_

LM-7



00217 H Bad Return From Stall Routine  
Reinitiate Current Program  
If Alarm Recurs, ISS Mode  
Switching Failure

00220 P IMU Not Aligned  
Align or If Aligned, Set REFSMMAT FLAG

00401 I Desired Gimbal Angles Yield Gimbal Lock  
Call N22, MNVR if MGA 85° or Realign IMU

00402 P FINDCDUW Routine Not Controlling Attitude  
GUID CONT - AGS

00404 I Defined Star Not Available In Any Detent  
See P57/6

00405 I Two Stars Not Available  
See P52/6

00421 I W-Matrix Overflow  
Notify MSFN

20430 I \*\*Acceleration Overflow In Integration  
Notify MSFN

00501 I RR Antenna Out of Present Mode Limits  
See P20/8

00502 I Bad Radar Gimbal Angle Input  
Redo V41N72

00503 I Radar Antenna Designate Fail  
See P20/8 or P22/5

00510 P Radar Auto Discrete Not Present  
RR Mode - LGC, Continue  
CB(11) RR(2) - CLOSE

00511 P LR Not In Pos1 (P63) or 2(P64)  
LDG ANT-DES (Hover) Wait 10 sec,AUTO  
(P63) If Alarm Recurs, V59E

00514 P RR Out Of Auto Mode While In Use  
RR MODE - LGC or V56E

00515 H RR CDU Fail Discrete Present  
Notify MSFN, Continue

00520 P/H RADARUPT Not Expected At This Time  
Continue

00521 I Could Not Read Radar, See P20/8

00522 P LR Position Change

00523 P LR Ant Not In Position 2, V58E,  
LDG ANT-HOVER, PRO

00525 I ΔTHETA >3°  
See P20/8 or P22/5

00526 I Range >400 Miles, Terminate P20

Basic Date 1/5/70  
Changed 3/9/70

00527 I LOS Not In Mode II Coverage (P22) or  
 Vehicle MnvR Required (P20)  
 Terminate If P22  
 In P20, MnvR  
 00530 I LOS Not In Mode II Coverage On Surface  
 After 600 sec  
 Reselect P22  
 00600 I Imaginary Roots On First Iteration  
 See P32/4 or P72/4  
 00601 I Perigee Altitude (Post CSI) <35,000 ft  
 (Lunar Orbit)  
 See P32/4 or P72/4  
 00602 I Perigee Altitude (Post CDH) <35,000 ft  
 (Lunar Orbit)  
 See P32/4 or P72/4  
 00603 I CSI To CDH Time <10 Min  
 See P32/4 or P72/4  
 00604 I CDH To TPI Time <10 Min Or TIG CDH > TIG TPI  
 See P32/4 or P72/4  
 00605 I Number Of Iterations > 15  
 Program Cannot Converge On CSI Solution  
 See P32/4 or P72/4  
 00606 I  $\Delta V$  Exceeds Max  
 See P32/4 or P72/4  
 20607 I \*\*No Solution From Time-Theta or Time-Radius  
 00611 I No TIG For Given Elevation Angle  
 See P33/2, P34/3, P73/4, P74/2  
 00701 I Illegal Option Code Selected  
 V32E Reselect Option  
 00777 H PIPA Fail Caused The ISS Warning  
 Go To ISS Malfunction Procedure  
 01102 H LGC Self Test Error  
 Call NO8 & Record For MSFN  
 21103 I \*\*Unused CCS Branch Executed  
 Copy NO8, Notify MSFN, Continue  
 31104 H \*Delay Routine Busy  
 Reselect Extended Verb  
 01105 H Downlink Too Fast  
 If Alarm Recurs, Downlink Failure  
 01106 H Uplink Too Fast  
 If Alarm Recurs, Uplink Failure

Basic Date 1/5/70  
 Changed \_\_\_\_\_

- 01107 H Phase Table Failure  
Perform:1. V74 LGC DOWNLINK  
2. P27 As Necessary  
3. V48 As Necessary  
4. Reestablish REFSMMAT via P51  
If FRESH START Recurs, LGC FAILURE
- 31201 P \*Executive Overflow - No Vac. Areas  
Reselect Extended Verb or Continue Program
- 31202 P \*Executive Overflow - No Core Sets  
See 31201
- 31203 P/I\*Waitlist Overflow - Too Many Tasks  
See 31201
- 21204 P/I\*\*Waitlist, Var Delay, Fix delay, Longcall,  
Or Delay Job Called With Zero Or Negative  
 $\Delta T$   
Copy N08, Notify MSFN, Continue
- 31206 P \*Two Jobs Try To Sleep in PINBALL  
See 31201
- 31207 P \*No Vac Area For Marks  
Reselect P51 or P52
- 31210 P \*Two Routines Using Device at Same Time  
Reselect Extended Verb or Prog When Device  
No Longer In Use  
Record N08, Notify MSFN, Continue
- 31211 P \*Illegal Interrupt of Extended Verb  
Reselect P51 or P52
- 01301 I ARCSIN-ARCCOS Input Angle Too Large  
Copy N08, Notify MSFN, Continue
- 21302 I \*\*SQRT Called With Negative Argument  
See 01301
- 01406 I Bad Return From Rootpsrs  
(\*\* 21406 - Occurs In P63 Ign Algorithm)
- 01407 P VG Increasing  
See P40/IGN or P42/IGN
- 01410 P/I Unintentional Overflow in Guidance,  
Contact MSFN
- 01412 I Descent Ignition Algorithm Non-Converging  
Consult MSFN
- 21501 P \*\*Illegal Internal Use of PINBALL  
See 01301
- 31502 P \*Illegal Flashing Display  
See 01301
- 01520 P V37 Request Not Permitted At This Time  
Reselect V37

Basic Date 1/5/70  
Changed \_\_\_\_\_

LM-7

PGNS-14

- 01600 H Overflow in Drift Test  
Perform V36E
- 01601 H Bad IMU Torque
- 01703 P TIG Slipped
- 01706 P P40 Selected But Staged  
P42 Selected But Not Staged  
See P40/1 or P42/1
- 32000 P \*DAP Still In Progress At Next TIME5/RUPT  
RSET, GUID CONT - AGS Then PGNS; If Alarm  
Rekurs, V36E, Reinitialize LGC
- 02001 I Jet Failures Have Disabled Y-Z Trans  
Change Quad Isol Valve or Use  
Alternate Control Mode
- 02002 I Jet Failures Have Disabled X Trans  
See 02001
- 02003 I Jet Failures Have Disabled P Rotation  
See 02001
- 02004 I Jet Failures Have Disabled U-V Rotation  
See 02001
- 03777 H ICDU Fail Caused the ISS Warning  
Go to ISS Malfunction Procedures
- 04777 H ICDU, PIPA Fails Caused the ISS Warning  
Go to ISS Malfunction Procedures
- 07777 H IMU Fail Caused The ISS Warning  
Go to ISS Malfunction Procedures
- 10777 H IMU, PIPA Fails Caused The ISS Warning  
Go to ISS Malfunction Procedures
- 13777 H IMU, ICDU Fails Caused The ISS Warning  
Go to ISS Malfunction Procedures
- 14777 H IMU, ICDU, PIPA Fails Caused The ISS Warning  
Go to ISS Malfunction Procedures

\*Generates Software Restart (3XXXX)

\*\*Abort Code, Program Goes To R00. (2XXXX)

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

Alarms for V05N09

- R1 First Alarm After RSET
- R2 Second Alarm After RSET
- R3 Most Recent Alarm

Basic Date 1/5/70  
Changed \_\_\_\_\_

GENERAL SYSTEM CHECKOUT

- 1 Go To P00 By One of the Following:  
     V37E 00E or  
     V96E or  
     V36E V96E (Wait 15 sec Before P00E)

    Simultaneously Press RSET And  
     MARK REJECT (GO JAM)

    V37E 00E

REASONABLENESS CHECK

- 1 V82 With Both Options
- 2 V83
- 3 P21 NAV CHECK
- 4 P52 Check Auto Optics Positioning  
     IF NOMINAL:  
         Continue  
     IF NOT NOMINAL:  
         Perform P27 Update
- 5 LGC SELF-TEST

P06 (F 50 25 00062)

- 1 PRO to STBY Then  
     PRO to F 37  
     or  
     V37E 00E
- 2 V37E 51E  
     PRO  
     V37E 00E
- 3 V25 N07E, 77E, 10000E, 1E

Basic Date 1/5/70  
 Changed 1/18/70

P63

1 V37E 00E

V30 OR V31

1 Record N26,  
Notify MSFN  
V74E  
Perform General System Checkout

V36

1 If Unstaged V21 N01E 3000E, 2324E  
Perform General System Checkout If Necessary

V92 (POO ONLY)

1 V37E 00E  
V93E

GO JAM

1 V74 when Convenient (See V36)

Basic Date 1/5/70  
Changed



PGNS-15

P06 PGNS PWR DOWN

1 F 50 25 V37E 06E  
00062 POWER DOWN LGC  
CB(11) IMU OPR - Open  
PRO Until STBY Lt - ON

P12 POWERED ASCENT

HELIUM MON - PRESS 2  
PRPLNT TEMP/PRESS MON - ASC  
SYS A&B ASC FEED 2 (2)- OPEN  
MAIN SOV (2) - CLOSE  
CRSFD - OPEN  
TTCA (Both) - JETS  
ATT/TRANSL - 4 JETS  
BAL CPL - ON  
DAP - Set

1 V37E 12E

\*PROG Lt - ON \*  
\*V05N09E 00210 IMU \*  
\* NOT OPERATING\*  
\* 00220 IMU \*  
\* NOT ALIGNED \*  
\* KEY REL \*  
\* RSET \*

2 F 06 33 TIG(ASC) (hrs,min,.01sec)  
PRO

3 F 06 76 V(HOR),V(VERT),CROSSRANGE (.1fps,.1nm)  
PRO

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

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

Record YAW \_\_\_\_\_ °

PITCH \_\_\_\_\_ °

Set EVENT TIMER To TFI

Basic Date 1/5/70  
Changed \_\_\_\_\_

PGNS-16

CMPTR ACTY Lt - ON

\*PROG Lt - On \*  
\*V05N09E,1703 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  
 ABORT STAGE - PUSH (min-sec,.01°)  
 ENG ARM - ASC

-:05  
 F 99 74 ENGINE ON ENABLE  
 (AUTO) PRO (Ign When TFI=:00)  
 (TERM) V37E 00E

5 06 74 TFI, FINAL FDAI YAW, PITCH ANGLES  
 (min-sec,.01°)

IGN 06 63 VI, HDOT, H (.1fps, ft)  
ENG START - PUSH  
Monitor Attitude Maneuver  
To Recorded Ball Angles

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

VI Increasing  
HDOT Increasing Then Decreasing  
H Increasing

V16 N77E (When VI  $\geq$  TBD fps)

P06-P27

Basic Date 1/5/70  
Changed \_\_\_\_\_

LM-7

6 16 77 TG,V(Y) (min-sec,.1fps)  
N85E

7 16 85 VG XYZ (LM) (.1fps)

VGX= 500fps SYS A MAIN SOV - OPEN  
SYS B MAIN SOV - OPEN  
SYS A ASC FEED 2-CLOSE  
SYS B ASC FEED 2-CLOSE  
CRSFD -CLOSE

VGX=200fps, ENG ARM - OFF

APS  
OFF

NULL COMPONENTS  
KEY REL

8 F 16 63 VI,HDOT,H (.1fps,ft)  
ABORT STAGE - Reset  
ENG STOP - Push Then Reset

Note VI \_\_\_\_\_  
HDOT \_\_\_\_\_  
H \_\_\_\_\_  
PRO \_\_\_\_\_

9 F 16 85 VG XYZ (LM) (.1fps)  
(DISPLAY ORB PARAM) V82E To 10  
(TERM) PRO To 11

10 F 16 44 APO ALT, PER ALT, TFF (.1nm,min-sec)

Note HA \_\_\_\_\_  
HP \_\_\_\_\_  
TFF \_\_\_\_\_  
PRO To 9

11 F 37

Basic Date 1/5/70  
Changed — 1/18/70

PGNS-18

P20 RENDZ NAV

- 1           V37E 20E  
           (TO TERM-V56E)  
           (SV OPTION, V80E LM, V81E CSM, V95E NONE)
  
- 2 (If Pointing Error <15°, To 4; 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  
           (MAN) MODE CONT: PGNS - ATT HOLD  
                   MNVR  
           PRO To 2  
           (BYPASS) ENTR To 4 (To 9 If Entered From  
                                   9 Via V32E)  
                                   (To 6 If Entered From  
                                   6 Via ENTR)
  
- 3       06 18   AUTO MNVR TO FDAI RPY ANGLES   (.01°)  
                   Monitor Auto Mnvr To 2
  
- 4                   RR MODE: LGC To 7  
                                   (To 8 If Entered From 6  
                                   or 9 via PRO)  
                   SLEW or AUTO To 5
  
- 5   F 50 25   00201 RR ACQ MODE  
           (AUTO)   RR MODE LGC  
                   PRO To 4  
           (MAN)   ENTR
  
- 6   F 50 25   00205 SLEW RR For LOCK-ON  
           (LOCK)   RR MODE-LGC:  
                   NO TRACK Lt - Off, Wait 10 sec  
                   PRO To 4  
           (NO LOCK) MNVR  
                   ENTR To 2

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

Basic Date 1/5/70  
 Changed — 1/18/70

LM-7

7 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

8 NO TRACK LITE

OUT DSKY BLANKS, RR TAKING MARKS  
 (RAW RR DATA) V16N78E R,RDOT,TFI  
 (.01nm, fps, min-sec)  
 KEY REL

```
*F 05 09 00525 SV/RR LOS >3° *
* PRO *
*f 06 05 SV/RR LOS (.01°) *
* (REJECT) CK SIDE LOBE *
* RR MODE-LGC *
* V32E To 7 *
* (UPDATE) PRO To 8 *
* *
*f 06 49 ΔR,ΔV,Code(.1nm,.1fps, *
* 0000X) *
* X=1, RANGE *
* X=2, RDOT *
* X=3, SHAFT } *
* X=4, TRUN } *
* (REJECT PARTIAL MARK)V32E To8*
* (REJECT TOTAL MARK) V34E To 8*
* (MAN ACQ) RR MODE - SLEW *
* Acquire *
* RR MODE - LGC *
* V32E To 4 *
* (UPDATE) PRO To 8 *
* *
*f 50 18 (MNVR REQUEST) Go To 2 *
```

ON NO LOCK  
 F 05 09 00503 RR NO DATA GOOD 30 SEC(or Desig.  
 Fail)  
 (REDESIG) V32E To 4  
 (SEARCH) PRO To 9

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

PGNS-20

```
* V05 N09E 00521 Could Not Read Radar *
*                               KEY REL To 7 *
*           00515 RR CDU FAIL DISCRETE *
*                               PRESENT *
*                               KEY REL To 7 *
*           00501 RR Ant. Out Of Mode Limits*
*                               RR To + Z *
```

```
9  F 16 80  RR AUTO SEARCH, SEARCH CODE,      (.01°)
      R1  00000-SEARCH 42 sec/scan
          11111-LOCK ON
      R2  LOS/+Z
      (LOCK) PRO To 2
      (NO LOCK OR MAN ACQ) SLEW RR For LOCK-ON
      RR MODE - LGC
      NO TRACK Lt-Out, To 9
      (MNVR) V32E To 2
```

P21 GROUND TRACK DETERMINATION

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

2  F 06 34  GET LAT, LONG          (hrs,min,.01sec)
      (Zero For Present Time)
      PRO

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

```
4  F 37
```

Basic Date 1/5/70  
 Changed



(RR TRUN, SHFT) V16N72E (.01°)  
KEY REL

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

ON

```
F 05 09 00503 RR DESIG FAIL
        (REDESIGN) ENTR To 3
        (SEARCH) PRO To 6
        (TERM) V56E
```

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

```
*PROG Lt-0n      *
*V05N09E 00527 CSM OUT *
*          OF MODE II LIMITS*
*          (TERM) V56E   *
```

Basic Date 1/5/70  
Changed \_\_\_\_\_



P25 PREFERRED TRACKING ATT

1 V37E 25E  
 (To TERM - V56E)  
 (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  
 (MAN) MODE CONT: PGNS - ATT HOLD  
 MNVR  
 PRO To 1  
 (BYPASS) ENTR To 3

2 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)  
 Monitor Auto MnvR, To 1

3 P25 Continues To Run  
 In Background Until Terminated  
 (RAW RR DATA) V16N78E R,RDOT,TFI  
 (.01nm,fps,min-sec)  
 KEY REL

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 Pro-  
 cedure)

Basic Date 1/5/70  
 Changed 1/18/70

- 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 NOTE, 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

8 P00 Displayed

Basic Date 1/5/70  
Changed 1/18/70

P30 EXTERNAL ΔV

1 F 06 33 V37E 30E (hrs,min,.01sec)  
TIG  
PRO

2 F 06 81 ΔV XYZ(LV) (.1fps)  
PRO

3 F 06 42 HA, HP, ΔV (.1nm,.1fps)  
PRO

4 F 16 45 M, TFI, MGA (marks,min-sec,.01°)  
SET EVENT TIMER TO TFI  
PRO (MGA Set To -00002 If No  
REFSMMAT Set)

5 F 37

P32 CSI PRETHRUST

1 F 06 11 V37E 32E (hrs,min,.01sec)  
TIG (CSI)/T(APOAPSIS)  
PRO  
If Zero, T (APOAPSIS) Displayed

2 F 06 55 APSIS CDH, TPI ELEVATION ANGLE, (+0000X,.01°)  
R3,0000Y  
For Y≠0,CDH At CSI+  
Multiple Of 180° Specified  
By R1(X)  
PRO

3 F 06 37 TIG (TPI) (hrs,min,.01sec)  
PRO

4 F 16 45 MARKS, TFI,-00001 (marks,min-sec)  
(RECYCLE) V32E To 5  
(TERM MARKING) PRO

P30-P35

Basic Date 1/5/70  
Changed \_\_\_\_\_

LM-7

PGNS-26

```

*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,min-sec)

6 F 06 81 ΔV XYZ (LV) CSI (.1fps)  
(For Out-of-Plane Corr In Final Comp ONLY)  
V90E  
F 06 16 GET EVENT (hrs,min,.01sec)  
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)  
PRO (If Recycling To 4)

8 F 16 45 MARKS,TFI,MGA (-00002 If No REFSMMAT Set)  
(marks,min-sec,.01°)  
SET EVENT TIMER TO TFI  
PRO

9 F 37

P30-P35

Basic Date 1/5/70  
Changed \_\_\_\_\_

P33 CDH PRETHRUST

1 F 06 13 V37E 33E (hrs,min,.01sec)  
TIG (CDH)  
PRO

2 F 16 45 MARKS,TFI, -00001 (marks,min-sec)  
(RECYCLE) V32E To 3  
(TERMINATE MARKING) PRO

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

3 F 06 75  $\Delta H$ (CDH), $\Delta T$ (TPI-CDH), $\Delta T$ (TPI-NOMTPI)  
PRO (.1mm,min-sec)

4 F 06 81  $\Delta V$  XYZ (LV) CDH (.1fps)  
(For Out-of-Plane Corr in Final Comp ONLY)  
V90E  
F 06 16 GET EVENT (hrs,min,.01sec)  
PRO  
F 06 90 Y,YDOT,PSI (.01mm,.1fps,.01°)  
Record YDOT  
PRO  
(Insert Neg YDOT in R2 of  $\Delta V$  CDH)  
PRO (If Recycling To 2)

5 F 16 45 MARK,TFI,MGA (-00002 If No REFSMMAT Set)  
(marks,min-sec,.01°)  
SET EVENT TIMER TO TFI  
PRO

6 F 37

P34 TPI PRETHRUST

1 F 06 37 V37E 34E (hrs,min,.01sec)  
TIG (TPI)  
PRO

Basic Date 1/5/70  
Changed \_\_\_\_\_

LM-7

PGNS-28

- 2 F 06 55 N, ELEVATION ANGLE, CENTRAL ANGLE  
 (0000X,.01°)  
 (00000 In R2 To Calc Elevation  
 Angle At TIG Time)  
 PRO
- 3 F 16 45 MARKS, TFI, -00001 (marks,min-sec)  
 (RECYCLE) V32E  
 (TERMINATE MARKINGS) PRO
- \*F 05 09 00611 NO TIG\*  
 \* FOR \*  
 \* SPECIFIED \*  
 \* ANGLE \*  
 \* PRO To 1 \*
- 4 F 06 37 TIG (TPI) (hrs,min,.01sec)  
 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 (If Recycling To 7)
- 6 F 06 81 ΔV XYZ (LV) TPI (.1fps)  
 PRO
- 7 F 06 59 ΔV XYZ (LOS) TPI (.1fps)  
 PRO (If Recycling To 3)
- 8 F 16 45 MARKS,TFI,MGA (-00002 If No REFSMMAT Set)  
 (marks,min-sec,.01°)  
 SET EVENT TIMER TO TFI  
 PRO
- 9 F 37
- P35 TPM PRETHRUST
- 1 F 16 45 V37E 35E  
 MARK, TFI, -00001 (marks,min-sec)  
 (RECYCLE) V32E To 3  
 (TERM MARKING) PRO

Basic Date 1/5/70  
 Changed

PGNS-29

- 2 F 06 81 ΔV XYZ (LV) TPM (.1fps)  
PRO
- 3 F 06 59 ΔV XYZ (LOS) TPM (.1fps)  
PRO (If Recycling To 1)
- 4 F 16 45 MARKS,TFI,MGA (-00002 If No REFSMMAT Set)  
(marks,min-sec,.01°)  
SET EVENT TIMER TO TFI  
PRO
- 5 F 37

P40 DPS THRUST

- GUID CONT -PGNS
- THR CONT -AUTO
- MAN THROT -CDR
- BAL CPL -ON
- ENG GMBL -ENABLE
- DES ENG CMD OVRD -OFF
- TTCA (Both) -THROT (Min)
- PRPLNT QTY MON -DES 1
- PRPLNT TEMP/PRESS MON -DES 1
- HELIUM MON -SUPCRIT PRESS
- DAP -Set

1

V37E 40E

\*F 05 09 01706 LM Staged\*  
\* (TERM) V37E42E, or \*  
\* Reload DAP \*

- F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)  
(AUTO or TRIM) GUID CONT - PGNS  
MODE CONT: PGNS - AUTO

PRO  
(MAN) MODE CONT: PGNS - ATT HOLD  
MNVR

PRO To 1  
(BYPASS) ENTR To 3

- 2 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)  
Mon Auto MNVR To 1

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

P40-P47

Basic Date 1/5/70  
Changed 3/9/70

PGNS-30

3 06 40 TFI, VG, ΔVM (min-sec, .1fps)  
 MASTER ARM - ON (1st BURN)  
 SET EVENT TIMER TO TFI

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

--:35 DSKY BLANKS

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

--:15 VERIFY ΔVM (R3) <00005

--: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 (min-sec, .1fps)

\*F 97 40 \*  
 \* (RECYCLE ΔV MON) PRO \*  
 \* (RECYCLE) ENTR To TIG -5 \*  
 \* (TERM) ENG ARM-OFF V34E To 5\*  
 \* \*  
 \* PROG Lt-0n \*  
 \* V05N 09E 01407 VG INCREAS- \*  
 \* \* ING \*  
 \* TERM BURN OR SWITCH \*  
 \* TO AGS \*

DPS  
 OFF F 16 40 TFC, VG, ΔVM (min-sec, .1fps)  
 ENG STOP - Push  
 ENG ARM - OFF  
 PRO

P40-P47

Basic Date 1/5/70  
 Changed 1/18/70

LM-7



4 F 16 85 VG XYZ (LM) (.1fps)  
 NULL COMPONENTS  
 PRO

5 F 37 MASTER ARM -OFF  
 ENG STOP -Reset  
 PRPLNT QTY MON -OFF  
 HELIUM MON -OFF

P41 RCS THRUST

TTCA (CDR) - JETS  
 EVENT TIMER- Set  
 DAP - Set

1 F 50 18 V37E 41E  
 REQUEST MNVR TO FDAI RPY ANGLES (.01°)  
 (AUTO or TRIM) GUID CONT - PGNS  
 MODE CONT: PGNS - AUTO

PRO  
 (MAN) MODE CONT: PGNS - ATT HOLD  
 MNVR

PRO To 1  
 (BYPASS) ENTR To 3

2 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)  
 Mon Auto Mnvr To 1

3 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

4 F 37

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

P42 APS THRUST

HELIUM MON -ASC PRESS 2  
 PRPLNT TEMP/PRESS MON -ASC  
 TTCA (CDR) -JETS  
 DAP -Set

1 V37E 42E  
 \*F 05 09 01706 LM NOT STAGED \*  
 \* (TERM) V34E \*  
 \* (BYPASS) PRO To 2, Man Stage\*  
 \* At -:10 \*

2 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)  
 (AUTO or TRIM) GUID CONT - PGNS  
 MODE CONT: PGNS - AUTO  
 PRO  
 (MAN) MODE CONT: PGNS - ATT HOLD  
 MNVR  
 PRO To 2  
 (BYPASS) ENTR To 4

3 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)  
 Mon Auto Mnv To 2  
 \*F 50 25 R1 00203 \*  
 \* GUID CONT-PGNS \*  
 \* MODE CONT (PGNS)-AUTO \*  
 \* PRO \*  
 \*(BYPASS) ENTR \*

4 06 40 TFI, VG, ΔVM (min-sec,.1fps)  
 \*PROG Lt - On \*  
 \*V05N 09E 01703 TIG SLIPPED\*  
 \* RSET, KEY REL \*  
 EVENT TIMER-SET  
 MASTER ARM-ON (Unstaged)

--:35 DSKY BLANKS  
 --:30 ENG ARM - ASC  
 06 40 (AVE G ON)  
 --:15 Verify ΔVM (R3) <00005  
 If Unstaged:

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

Basic Date 1/5/70  
 Changed 3/9/70

PGNS-33

--:05

F 99 40 ENG ON ENABLE

--:03.5 Verify +X ULLAGE

(V34E NO ULLAGE, ENG ARM-OFF, To 6)

(AUTO)PRO (IGN WHEN TFI=:00 sec)

(BYPASS) ENTR To APS OFF

IGN 06 40 TFI, VG,ΔVM (min-sec,.1fps)

\*F 97 40 \*

\*(RECYCLE ΔV MON) PRO \*

\*(RECYCLE) ENTR TO TIG -5 \*

\*(TERMINATE) ENG ARM-OFF \*

\* V34E To 6 \*

APS  
OFF F 16 40 TFC, VG,ΔVM (min-sec,.1fps)

ENG ARM - OFF

PRO

HELIUM MON - OFF

5 F 16 85 VG XYZ (LM) (.1fps)

NULL COMPONENTS

PRO

6 F 37

P47 ΔV MONITOR

1  
F 16 83 V37E 47E (20 sec Delay Minimum) ΔV XYZ (LM) (.1fps)

(EXIT) PRO

(RECYCLE) V32E (Zeroes N83 Display)

2 F 37

Basic Date 1/5/70  
Changed 1/18/70

P51 IMU ORIENTATION

CB(11) AC BUS B: AOT LAMP-Close

1 F 50 25 V37E 51E  
 (To Coarse Align IMU To 0,0,0-ENTR)  
 R1 00015 MNVR TO ACQ STARS  
 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 MARK X(52) and Y(53)  
 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

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

Basic Date 1/5/70  
 Changed \_\_\_\_\_

P51-P57

LM-7

PGNS-35

- 2 F 06 34 GET ALIGN (hrs,min,.01sec)  
 (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 Lt-On Then Off  
 (GYRO TORQUE) MODE CONT (PGNS)-ATT HOLD  
 V76E  
 ENTR
- 16 20 PRESENT ICDU ANGLES OG, IG, MG (.01°)  
 When Torquing Complete To 14
- 6 F 50 25 R1 00015 SELECT STAR ACQUISITION MODE  
 MNVR If Necessary  
 (PICAPAR) PRO
- \*F 05 09 00405 NO PAIR \*  
 \*(CREW SPECIFY) PRO To 7 \*  
 \*(PICAPAR) V32E To 6 \*
- (MAN ACQ) ENTR
- 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)

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

PGNS-36

- 8 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)  
 (AUTO OR TRIM) GUID CONT: PGNS  
 MODE CONT: PGNS - AUTO  
 PRO  
 (MAN) MODE CONT: PGNS - ATT HOLD  
 MNVR  
 PRO To 8  
 (BYPASS) ENTR To 10 (If COAS/LPD CALIB, Go to 7)
- 9 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)  
 Mon Auto MnvR To 8
- 10 F 01 71 R1 00CDE (C)DETENT (DE)STAR CODE  
 PRO  
 (For C=7  
 F 06 87 AZ,EL (.01°)  
 PRO)
- 11 F 54 71 MARK X(52) and Y(53)  
 (After 1st Star) PRO To 7  
 (After 2nd Star) PRO To 12  
 (Redefine Star) ENTER To 10  
 (For DE=00  
 F 06 88 CELESTIAL BODY VECTOR  
 Load Vector Values  
 PRO)
- 12 F 06 05 STAR ANGLE DIFFERENCE (.01°)  
 (REJECT) V32E To 14  
 (ACCEPT) PRO
- 13 F 06 93 GYRO ANGLES X,Y,Z (.001°)  
 (TORQUE) V76E  
 PRO  
 (NO TORQUE) V32E To 14
- 14 F 50 25 R1 00014  
 (RECHECK) PRO To 6  
 (EXIT) ENTR
- 15 F 37 CB(11) AC BUS B: AOT LAMP-Open

Basic Date 1/5/70  
 Changed \_\_\_\_\_

RAPID IMU REALIGN

NOTE: This Procedure Assumes A Good  
AGS Alignment

- 1 Fly Spacecraft to  $0^{\circ}, 0^{\circ}, 0^{\circ}$  On AGS Inertial Ball
- 2 V41 N20E  
E,E,E, (Coarse Align IMU To  $0^{\circ}, 0^{\circ}, 0^{\circ}$  Body)
- 3 V40 N20  
Verify  $0^{\circ}, 0^{\circ}, 0^{\circ}$  On AGS Ball - ENTR  
(Releases Platform and Recovers PGNS  
Control Modes)  
Wait 15 sec
- 4 V37E 51E  
PRO On First Display (Sets Drift Flag)  
V37E 00E
- 5 V25 N07E  
77E, 10000E, 1E (Sets REFSMMAT FLAG)
- 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.

Basic Date 1/5/70  
Changed \_\_\_\_\_





P57 LUNAR SURFACE ALIGNMENT

1 V37E57E

\*PROG Lt - On \*  
 \*V05N09E 00210 IMU \*  
 \* NOT ON \*  
 \*CB(11) PGNS: IMU OPR - Close\*  
 \*RSET & KEY REL, P57E \*

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 (hrs,min,.01sec)  
 (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 00CDO  
 C = 0 No REFSMMAT Defined  
 1 REFSMMAT Defined  
 D = 0 No Stored Attitude  
 1 Stored Attitude Available

(A/T 1 or 3) 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 13

\*PROG Lt - On \*  
 \*F 05 09 00701 REFSMMAT OR \*  
 \* ATTITUDE NOT AVAILABLE\*  
 \*(CHANGE A/T) V32E To 3 \*  
 \*(TERM) V34E, Select New Prog \*

Basic Date 1/5/70  
 Changed 3/25/70



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

9 F 54 71 MARK X OR Y  
(REDEFINE STAR) ENTER To 8  
MARK

10 F 06 79 CURSOR, SPIRAL, POSITION CODE (.01°)  
(TERM) V34E, Select New Prog  
(RECYCLE) V32E To 9  
(MARKS COMPLETE) PRO

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

(After First Star) To 6 (If Option 00003  
To 11)  
(After Second Star) To 11

11 F 06 05 STAR ANGLE DIFFERENCE (.01°)  
(REJECT) V32E To 14  
(ACCEPT) PRO  
(TERM) V34E

12 F 06 93 GYRO TORQUING ANGLES X,Y,Z (.001°)  
(REJECT) V32E To 14  
(ACCEPT) PRO To 14  
(TERM) V34E

Basic Date 1/5/70  
Changed 3/25/70

P63-P68

13 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 11)

14 F 50 25 R1 00014 RECHECK or EXIT FINE ALIGN  
 (RECHECK, A/T 00002 or 00003 Only) PRO To 6  
 (TERM) V34E To 16

Note: If Present A/T Is 00002 & A Previous  
 P57 Used A/T 00001 or 00003,  
 ENTR To Readout Present LM  
 Lunar Position (Step 15)

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

16 F 37

P63 BRAKING PHASE

1 V37E 63E  
 \*PROG Lt-On \*  
 \*V05N09E 01412 IGN \*  
 \* ALGORITHM NOT \*  
 \* CONVERGING \*  
 \* (TERM) V37E00E \*  
 \*

Basic Date 1/5/70  
 Changed 3/25/70

PGNS-42

- 2 F 06 61 TG,TFI (min-sec)  
 R3, CROSSRANGE (-NORTH) (.1mm)  
 SET EVNT THR TO 60-TFI  
 N33E
- F 06 33 TIG (hrs,min,.01sec)  
 KEY REL  
 PRO
- 3 F 50 25 R1 00014 PERFORM IMU FINE ALIGN  
 (ACCEPT) PRO - See P52/6  
 (BYPASS) ENTR
- 4 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)  
 (AUTO or TRIM) GUID CONT: PGNS  
 MODE CONT: PGNS - AUTO  
 PRO  
 (MAN) MODE CONT: PGNS - ATT HOLD  
 MNVR  
 PRO To 4  
 (BYPASS) ENTR To 6
- 5 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)  
 Mon Auto Mnvr To 4

```

*F 50 25 00500 LR *
* TO DESCENT POS *
*LDG ANT-DES, 10 sec, AUTO*
*PRO *
*F 50 25 00203 *
* GUID CONT - PGNS *
* MODE CONT(PGNS)-AUTO*
* THR CONT - AUTO *
* PRO *
* *
*PROG Lt - On *
*V05 N09E 01703 TIG *
* SLIPPED *
* V37E 00E EXIT P63 *
  
```

Basic Date 1/5/70  
 Changed

PGNS-43

6 06 62 VI,TFI, VM (.1fps,min-sec,.1fps)

59:25 DSKY BLANKS  
ENG ARM - DES

59:30 06 62 AVE G ON

59:45 Verify  $\Delta VM$  (R3) <00005

59:55  
F 99 62 ENG ON ENABLE  
VERIFY +X ULLAGE  
PRO  
(NO ULLAGE) V34E Exit P63

IGN 06 63 VI (.1fps)  
H DOT(-DESCENT) (.1fps)  
H(+ABOVE RLS) (ft)  
+:05 DES ENG CMD OVRD - ON

\*(DPS ABORT) ABORT - PUSH \*  
\*(APS ABORT) ABORT STAGE - PUSH\*

40,000 ft V57E  
F 06 68 SLANT RANGE, TG,  $\Delta H$ (LR-LGC)  
(.1nm, min-sec, ft)  
(UPDATE) PRO  
(EXIT V57) V34E (To 06 63)

F 50 68 SLANT RANGE, TG,  $\Delta H$  (LR-LGC)  
(.1nm, min-sec, ft)  
Verify  $\Delta H$  Decreasing  
(STOP UPDATE) ENTR (To 06 68)  
(CONTINUE UPDATE) PRO (To 06 63)

Basic Date 1/5/70  
Changed 1/18/70

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

\*ALT & VEL Lt - On\*  
\* RANGE/VELOCITY \*  
\* NOT GOOD \*  
\*PROGRAM Lt - On \*  
\* V05N09E \*  
\* 00511 LR Not in \*  
\* Pos 1 \*  
\*LDG ANT-DES,wait \*  
\* 10sec, Then AUTO \*  
\*If Alarm Recurs, \*  
\*V59E \*

+08:30 P64 Displayed

P64 APPROACH PHASE

1 P64 Displayed

2 F 06 64 R1 TR/LPD, (sec-deg)  
R2 H DOT(-For Descent) (.lfps)  
R3 H(+ H>RLS) (ft)

\*F 05 09 00523 LR DID NOT\*  
\* ACHIEVE POS 2 \*  
\* V58E \*  
\*(RECHECK POS 2) V32E \*  
\*(TERM R12) V34E \*  
\*(CONTINUE UPDATE) LR \*  
\* ANT-HOVER, PRO \*

Monitor Attitude Change  
To Enable Landing Site  
Visibility.

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

(To Return To Auto Throttle  
THR CONT - AUTO  
TTCA - Min  
KEY REL)

Basic Date 1/5/70  
Changed 3/9/70

PGNS-45

(MAN ATTITUDE CHECK) MODE CONT (PGNS)-ATT HOLD  
(TO USE LPD) PRO  
(Nominal Landing Site) To 5 When TR=0

3 06 64 Observe Nominal Landing Site  
Using LPD And N64 LPD Display.

4 Redesignate Landing Site  
As Desired (+Pitch Redesignates  
Landing Site Toward LM. Each ROLL In-  
put Changes The Landing Site Position  
By 2°Az; PITCH By .5°Elev.)

5 P66 Displayed

P66 LANDING PHASE (ROD)

1 P66 Displayed

2 F 06 60 V(FWD)(Requires MODE SEL-PGNS) (.lfps)  
H DOT(-Descent) (.lfps)  
H(+ >Landing Site Radius) (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:  
THRUST =10%  
THR CONT - MAN  
V16N92E

3 H(Actual)=5.6 ft LUNAR CONTACT Lt - On  
ENGINE STOP - Push  
PRO

TD+3:00 V37E 68E To P68

Basic Date 1/5/70  
Changed 3/25/70



P68 LANDING CONFIRMATION

V37E 68E

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

RECORD LAT \_\_\_\_\_ °

LONG \_\_\_\_\_ °

PRO ALT \_\_\_\_\_ nm (Nominal zero)

3 F 37

Basic Date 1/5/70  
Changed \_\_\_\_\_

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 \*

2 06 63 VI,H DOT,H (.1fps,ft)  
 VI Increasing  
 H DOT Remains Positive  
 H Increasing  
 H<25000 & H<00400-Monitor Att. Mnvr  
 To LV With Windows Downrange.  
 X-OVRD Inhibited. After H>00400  
 Monitor Mnvr To Abort Att;  
 X-OVRD Restored 12 sec After  
 Initiation of Mnvr  
 H>25000-Monitor Att. Mnvr To  
 Abort Att. With Windows Down-  
 range. X-OVRD Restored.

(To Monitor Time To Go And Crossrange Velocity)  
 V16 N77E

16 77 TG,V(Y) (min-sec,.1fps)  
 N85E

3 16 85 VG XYZ (LM) (.1fps)  
 (If Burn >400 sec,  
 PDI + 6:20  
 DES REG (2) - CLOSE  
 VGX = 100 fps  
 DES ENG CMD OVRD - OFF  
 ENG ARM - OFF)

DPS NULL COMPONENTS  
 OFF KEY REL

4 F 16 63 VI,HDOT, H (.1fps,ft)  
 ENG STOP - Push  
 ENG ARM-OFF  
 ABORT - Reset  
 PRO

P70 - P71

Basic Date 1/5/70  
 Changed 3/9/70

LM-7

5 F 16 85 VG XYZ (LM) (.1fps)  
 (DISPLAY ORB PARAM) V82E  
 (TERM) PRO To 7

6 F 16 44 APO ALT,PER ALT,TFF (.1nm,min-sec)  
 RECORD APO ALT \_\_\_\_\_ nm,  
 PER ALT \_\_\_\_\_ nm,  
 TFF \_\_\_\_\_ min-sec  
 PRO To 5

7 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 \*

APS  
 IGN 06 63 VI,H DOT,H (.1fps,ft)  
 ENG START - Push  
 ENG ARM - ASC  
 If ENG STOP Lt - On  
 ENG STOP - Reset  
 BAL CPL-ON  
 SYS A&B ASC FEED 2 (2) - OPEN  
 MAIN SOV(2)-CLOSE  
 CRSFD - OPEN

VI Increasing  
 H DOT Remains Positive  
 H Increasing

Basic Date 1/5/70  
 Changed 3/9/70

H<25000 & H<00400-Monitor Att. Mnvr  
To LV With Windows Downrange.

X-OVRD Inhibited. After H>00400  
Monitor Mnvr To Abort Att; X-OVRD  
Restored 12 sec After Initiation  
Of Mnvr.

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

(To Monitor Time To Go And Crossrange Velocity)  
V16 N77E

16 77 TG,V(Y) (min-sec,.1fps)  
N85E

2 16 85 VG XYZ (LM) (.1fps)  
VGX = 500 fps, CRSFD - CLOSE  
MAIN SOV (2) - OPEN  
SYS A&B ASC FEED 2(2)-CLOSE  
VGX = 200 fps,  
ENG ARM - OFF

\*NO Cutoff

\* ABORT STAGE - Push Then Reset\*

Basic Date 1/5/70  
Changed 3/9/70

APS NULL COMPONENTS  
OFF KEY REL

3 F 16 63 VI,H DOT,H (.1fps,ft)  
ENG STOP -Reset  
PRO

4 F 16 85 VG XYZ (LM) (.1fps)  
(DISPLAY ORB PARAM) V82E  
(TERM) PRO To 6

5 F 16 44 APO ALT,PER ALT,TFF (.1nm,min-sec)  
RECORD APO ALT \_\_\_\_\_ nm,  
PER ALT \_\_\_\_\_ nm,  
TFF \_\_\_\_\_ min-sec  
PRO To 4

6 F 37

P72 CSM CSI TARGETING

- 1      F 06 11      V37E 72E  
                  TIG (CSI)/T(APOAPSIS)      (hrs,min,.01sec)  
                  PRO  
                  If Zero, T (APOAPSIS) Displayed
  
- 2      F 06 55      APSIS (CDH), E      (+0000X,.01°)  
                  R3, 0000Y  
                  For Y ≠ 0, CDH At  
                  CSI + Multiple Of 180°  
                  Specified By R1(X)  
                  PRO
  
- 3      F 06 37      TIG TPI      (hrs,min,.01sec)  
                  PRO
  
- 4      F 16 45      M,TFI,MGA (-00001) (marks,min-sec,.01°)  
                  (RECYCLE) V32E  
                  (TERMINATE MARKS) 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) >1000 fps IN 2\*  
                  \*      Iterations      \*  
                  \*      V32E To 1 Adjust Inputs      \*
  
- 5      F 06 75      ΔH(CDH),ΔT(CDH-CSI),ΔT(TPI-CDH)  
                  PRO      (.1nm,min-sec)
  
- 6      F 06 81      ΔVXYZ (LV) (CSI)      (.1fps)  
                  PRO
  
- 7      F 06 82      ΔVXYZ (LV) (CDH)      (.1fps)  
                  PRO

Basic Date 1/5/70  
 Changed \_\_\_\_\_

P72-P76

8 F 16 45 M,TFI,MGA (-00002) (marks,min-sec,.01°)  
 (RECYCLE) V32E To 5  
 (TERMINATE) PRO To 9  
 (FINAL PASS) SET EVENT TIMER TO TFI  
 PRO, Transmit Parameters To CSM

9 F 37

P73 CSM CDH TARGETING

1 F 06 13 V37E 73E  
 TIG CDH (hrs,min,.01sec)  
 PRO To 4

2 F 06 75 ΔH(CDH),ΔT(TPI-CDH),ΔT(TIG TPI,P73-P72)  
 PRO (.1nm,min-sec)

3 F 06 81 ΔVXYZ (LV) (CDH) (.1fps)  
 (To Correct Out-Of-Plane Velocity)  
 V90E  
 F 06 16 T EVENT (hrs,min,.01sec)  
 PRO

F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)  
 (RECYCLE) V32E To (F 06 16)  
 PRO  
 PRO

4 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)  
 (RECYCLE) V32E To 2  
 (TERMINATE) PRO To 2  
 (FINAL PASS) SET EVENT TIMER TO TFI  
 PRO  
 Transmit Parameters To CSM

\*F 05 09 00611 NO TIG FOR EL ANGLE\*  
 \* (CONTINUE P73) PRO To 2 \*  
 \* (RECYCLE) V32E To 1 CHANGE TIG \*  
 \* (TERMINATE) V34E To 5 \*

5 F 37

P72-P76

Basic Date 1/5/70  
 Changed



P75 CSM TPM TARGETING

- 1 F 16 45 V37E 75E  
M,TFI,MGA (-00001) (marks,min-sec,.01°)  
(RECYCLE) V32E To 3  
(TERMINATE MARKS) PRO
- 2 F 06 81 ΔVXYZ (LV) (.1fps)  
PRO
- 3 F 06 59 ΔVXYZ(LOS) (.1fps)  
PRO
- 4 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)  
(RECYCLE)V32E TO 3  
(TERMINATE MARKS) PRO To 2  
(FINAL PASS) (MGA,-00002) SET EVENT TIMER,  
PRO, Transmit Parameters To CSM  
\*V06N52E R1, ACTCENT (.01°)  
\*If ACTCENT Between 170° And 190°\*\*  
\* V37E 75E Retarget
- 5 F 37

P76 TARGET ΔV

- 1 F 06 33 V37E 76E  
TIG (hrs,min,.01sec)  
PRO
- 2 F 06 84 ΔV(LV) XYZ (.1fps)  
PRO
- 3 F 37

Basic Date 1/5/70  
 Changed \_\_\_\_\_





PGNS-55

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

\*PROG Lt - On \*  
\*V05N09E 00502 BAD ANGLE INPUTS\*  
\* 00503 NO DATA GOOD IN \*  
\* 30 SEC DESIGN \*  
\* 00515 RR CDU FAIL \*  
\* DISCRETE \*  
\*(TERM CONT DESIGN) V44E \*

V42 GYRO TORQUING

1 V76E (If MODE CONT (PGNS) - ATT HOLD)  
V42E  
F 21 93 GYRO ANGLES (XYZ) (.001°)  
Load Desired Angles

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

V43 FDAI BIAS CHECK

1 MODE CONT: PGNS - OFF

2 V37E00E

3 V43E  
F 21 22 LOAD NEW ICDU ANGLES YPR (.01°)  
43 FDAI Needles Deflect

4 ENTR  
F 21 22 NEW ICDU ANGLES YPR (.01°)  
Load (-) New ICDU Angles

5 Verify FDAI Needles Return To 0,0,0

Basic Date 1/5/70  
Changed

V47 AGS INITIALIZATION

1 TLM-HI  
 V16N65E  
 16 65 LGC TIME (hr,min,.01sec)  
 377 + GET-PGNS/AGS BIAS TIME (.1min)  
 ENTR-(At Correct PGNS Time)

2 V47E  
 F 06 16 GET OF AGS CLOCK  
 Load PGNS/AGS TIME BIAS

3 414 +1

4 PRO (32 Sec Elapse Before Step 5  
 Appears If CDU Zero Is Issued,  
 Otherwise 20 Sec)

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 (+2.5 fps) (.1fps)  
 PRO

V48 DAP CONFIGURATION

1 V48E  
 F 01 46 DAP CONFIGURATION (ABCDE)  
 (CONFIG) A 1- ASCENT  
 2- DESCENT  
 3- DOCKED  
 (X-TRANS) B 0-2 JET RCS A, 1-2 JET RCS B,  
 2-4 JET RCS A, 3-4 JET 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°  
 (RATE) E 0-.2°/sec, 1-.5°/sec, 2-2°/sec  
 3-10°/sec  
 PRO

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

PGNS-57

- 2 F 06 47 LM WT, CSM WT (1b)  
PRO (Terminates If Staged)
- 3 F 06 48 ENGINE GIMBAL TRIM PITCH, ROLL (.01°)  
ENG GMBL - ENABLE  
ENG STOP - PUSH  
ENG ARM - DES  
(TRIM) PRO (ENG GMBL Lt - On  
When Gimbals Reach Limits)  
(EXIT) V34E
- 4 F 50 48 TRIM COMPLETE  
Continue Interrupted Program  
PRO  
ENG ARM - OFF (ENG GMBL Lt-OFF)  
ENG STOP - Reset

V49 CREW DEFINED MANEUVER

- 1 V37E00E
- 2 F 06 22 V49E  
NEW ICDU ANGLES YPR (.01°)  
PRO
- 3 F 50 18 REQUEST MNVR TO FDAI RPY (.01°)  
(AUTO OR TRIM) GUID CONT: PGNS  
MODE CONT: PGNS - AUTO  
PRO  
(MAN) MODE CONT: PGNS - ATT HOLD  
MNVR  
PRO To 3  
(BYPASS) ENTR (Exit V49)
- 4 06 18 AUTO MNVR TO FDAI RPY ANGLES  
Mon Auto Mnvr To 3

Basic Date 1/5/70  
Changed

V55 INCREMENT LGC TIME

1  
 F 21 24 V55E  
 ΔT  
 Record  
 \_\_\_\_\_ (hrs)  
 \_\_\_\_\_ (min)  
 \_\_\_\_\_ (sec)  
 Load ΔT

V64 S-BAND ANTENNA

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

V67 W-MATRIX ERROR DISPLAY

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

V74 LGC DOWNLINK

1  
 V74E (42 sec)

V82 ORBIT PARAMETER DISPLAY

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

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

V83 RENDEZVOUS PARAMETER DISPLAY

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

V55-V90

Basic Date 1/5/70  
 Changed 3/9/70

LM-7

V85 RR LOS, ELEV DISPLAY

V55-V90

1 RR MODE - LGC  
 2 V85E  
 F 16 56 AZ, ELEV (.01)°  
 (TERM) PRO

V89 RENDEZVOUS FINAL ATTITUDE

1 V37E00E  
 2 V89E  
 F 04 12 R1 00003 SPECIFY TRACKING ATTITUDE  
 R2 00001 (+Z AXIS)  
 00002 (+X AXIS)  
 PRO  
 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  
 (MAN) MODE CONT: PGNS - ATT HOLD  
 MNVR  
 PRO To 4  
 (BYPASS) ENTR (EXIT V89)  
 5 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01)°  
 Mon Auto Mnv To 4

V90 OUT-OF-PLANE DISPLAY

1 V90E  
 F 06 16 GET EVENT (TIG) (hrs,min,.01sec)  
 (0, PRESENT TIME)  
 PRO  
 2 F 06 90 Y, YDOT, PSI (.01nm,.1fps,.01)°  
 (RECYCLE) V32E To 1  
 (EXIT) PRO

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

PGNS TURN-ON AND SELF-TEST

- 1                    If STBY Lt - On, PRO
  
- 2                    V35E  
                   F 88 88    DSKY LIGHT CHECK  
    (Master Alarm, LGC & ISS Warning  
    And ALL DSKY Lts - On, 8's In All  
    Registers, Lts Reset In 5 sec)
  
- 3                    CB(11) IMU OPR - Close  
    (NO ATT Lt - On For 90 sec)  
    Wait 20 sec After NO ATT Lt.-Off, Then  
    V37E OOE
  
- 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 And Erasable  
                   15 01    R1 Number Of Errors                    Memory)  
    R2 Number Of Tests Started  
    R3 Number Of Tests Successful  
    (Test Successful If R2>3 Within 78 sec)
  
- \*PROG Lt - On    \*
- \*                    V05N09E 01102 SELF-\*
- \*    TEST ERROR                    \*
- \*N08E                    Record For MSFN                    \*
- \*    \*
- \*                    R1                    \_\_\_\_\_                    \*
- \*    \*
- \*                    R2                    \_\_\_\_\_                    \*
- \*    \*
- \*                    R3                    \_\_\_\_\_                    \*
  
- 7                    V21 N27E 0E TERMINATE SELF TEST

PGNS T/O, ORDEAL,  
PIPA BIAS

Basic Date 1/5/70  
Changed 2/13/70

LM-7

8 F 05 01 V91E BANKSUM  
 R1 SUM OF BANK  
 R2 BANK NO.  
 R3 BUGGER WORD  
 (NEXT BANK) PRO (If R2≠|R1| Record For MSFN)  
 (TERM) V34E

PGNS ORDEAL INITIALIZATION

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

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

3 F 16 44 HA,HP, TFF (.1nm,min-sec)  
 Average HA & HP  
 ALT SET - Set  
 PRO

4 F 16 54 V83E (.01nm,.1fps,.01°)  
 R, RDOT, THETA  
 MODE - HOLD/FAST  
 SLEW - To THETA  
 MODE - OPR/SLOW  
 PRO

PIPA BIAS CHECK

1 EVENT TIMER - Zero  
 Rates <.1°/sec With No Thruster Firing

2 V25N21E, E, E, E/EVENT TIMER - START

3 V06E  
 06 21 XYZ PIPA COUNTS (+XXXXX.)

4 At T+80sec - ENTR  
 T+80sec (X)R1 \_\_\_ (Y)R2 \_\_\_ (Z)R3 \_\_\_

PGNS T/O, ORDEAL,  
 PIPA BIAS

Basic Date 1/5/70  
 Changed 1/18/70

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PGNS-62

5

Calculate XYZ Bias:  
Take Last 3 Digits Of Displayed  
Bias And Add 2 Zeroes

X \_\_\_\_\_

Y \_\_\_\_\_

Z \_\_\_\_\_

6

V06N01E, 1452E (Review X Bias) E  
1454E (Review Y Bias) E  
1456E (Review Z Bias)

7

F 21 01 V21N01E  
LOAD 1452E(Calc X BIAS)E,E  
1454E(Calc Y BIAS)E,E  
1456E(Calc Z BIAS)E  
Same Sign As In Measured Bias In Step4

LGC CLOCK INITIALIZATION

1

V06N65  
ON CSM MARK - ENTR  
06 65 SAMPLED LGC TIME (hr,min,.01sec)  
RECORD  
\_\_\_\_\_(hrs)  
\_\_\_\_\_(min)  
\_\_\_\_\_(sec)  
COMPUTE CSM/LM ΔT

2

F 21 24 V55E  
LOAD ΔT (hr,min,.01sec)

Basic Date 1/5/70  
Changed \_\_\_\_\_

LGC CLOCK INIT.;  
LR, RR SELF TEST

LANDING RADAR SELF TEST

- 1                   CB(11) PGNS: LDG RDR - Close  
                   X-POINTERS(Both)     - HI MULT  
                   TEMP MON               - LDG RDR (50° - 70°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)  
   (3.0v)  
   - VEL XMTR (2.1 To 5.0)  
   (3.0v)  
                   ALT/ALT RT MON - +7900 To +8100 ft/-478  
   To -482 fps
  
- 3                   XPOINTER - UP, RT
  
- 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 +08296 (+08286)  
                                   R2 + 00001  
                                   PRO
  
- 6                   F 16 67     VX,VY,VZ                               (fps)  
                                   R1 -00495 (+2)  
                                   R2 +01862 (+2)  
                                   R3 +01331 (+2)  
                                   V34E (If Antenna Not Commanded  
   To HOVER, Go To 13)
  
- 7                   LDG ANT - AUTO
  
- 8                   V59E COMMAND ANT TO POS 2 (22 Sec)  
                   V37E00E

LGC CLOCK INIT.,  
 LR, RR SELF TEST

Basic Date 1/5/70  
 Changed 2/13/70

- 9 F 04 12 V63E INITIATE RDR SELF TEST  
R1 +00004 SPECIFY RDR  
R2 +00001 RNDZ RDR  
V22E 2E LDG RDR  
PRO
- 10 F 16 66 SLANT RANGE, ANT POSITION  
R1 +08276 To +08296  
R2 +00002
- 11 F 16 66 LDG ANT - DES (10 sec)  
R2 +00001 (PROG Lt-On, V05N09E,00522 RSET)
- 12 F 16 66 LDG ANT - AUTO  
R2 +00001  
V34E
- 13 If Total Attitude Error Desired On FDAI:  
V62E
- 14 RDR TEST - OFF  
CB(11) PGNS: LDG RDR - Open

RNDZ RDR SELF TEST

- 1 VERIFY: CSM RCS THRUSTER B3 - OFF  
: 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 +145°)
- 2 CB(11) AC BUS A: RNDZ RDR - Close  
: RNG/RNG RT/ALT/ALT RT-  
Close(Wait 30 sec)  
RR GYRO SEL - SEC  
CB(11) PGNS: RNDZ RDR - Close  
(NO TRACK Lt-On)  
FLIGHT DISPLAYS: RNG/RNG RT/ALT/ALT RT-  
Close

Basic Date 1/5/70  
Changed 2/13/70

PGNS-65

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 and FDAI Needles Vary Between  
 +5°. After 12 sec, Rng Tape Drives,  
 NO TRACK Lt - Out)

5 TEST MONITOR - AGC (1.0 To 1.8) (1.6)  
 - XMTR PWR (2.1 To 4.1) (2.4)  
 - SHAFT ERR (2.0 To 2.8@1/2cps)  
 - TRUN ERR (2.1 To 2.7@1/2cps)  
 - AGC

6 Set NORRMON Flag  
 V25 NO7E  
 101E, 10E, 1E  
 RR MODE - LGC (NO TRACK Lt - On, Wait 10 sec)

Basic Date 1/5/70  
 Changed 3/9/70

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,fps,min-sec)  
 R1 +195.39 To +195.79 (TM Within +1.2 of R1)  
 R2 -00475 To -00517 (TM=2-R2)

LM-7

10 V34E

- 11 RADAR TEST - OFF (NO TRACK Lt - On,  
X-Pntr-Center)
- 12 V40N72E RRCDU ZERO (10 sec)
- 13 SHFT/TRUN - +5°  
V41N72E  
N73 R1 +04000  
R2 +04000  
N12 R2 00002  
V16N72E (Verify FDAI Needles Up & Right)  
V44E
- 14 SHFT/TRUN - +5°  
RR GYRO SEL - PRIM  
V41N72E  
N73 R1 +35600  
R2 +35600  
N12 R2 00002  
V16N72E (Verify FDAI Needles)  
V44E
- 15 V41N72E  
N73 R1 +00000  
R2 +28300  
N12 R2 00002  
V16N72E  
  
CB(11) PGNS: RNDZ RDR - Open  
AC BUS A: RNDZ RDR - Open  
V44E  
Notify CSM To Enable Thruster B3 If Docked

Basic Date 1/5/70  
Changed \_\_\_\_\_

LGC THRUSTER INHIBIT

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

1E

\* CAUTION \*

\*Affected Quad Valve Must\*

\*Be Open Before Next Step\*

2

3

V48E,PRO,V34E

RR BIAS INITIALIZATION

1

V21N01E  
 1700E,E  
 N15E,E  
 E,E  
 E,E  
 V93E

LPD BIAS LOAD

1

V21 N01E, 3373E  
 (AZ BIAS - Octal) ENTR

2

ENTR, 1356E  
 (EL BIAS - Octal) ENTR

ALTERNATE LPD BIAS LOAD

1

V21 N03E, (ADD) E  
 ADD = 3373 For AZ BIAS  
 = 1356 For EL BIAS

Basic Date 1/5/70  
 Changed 3/25/70

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THRUSTER INHIBIT,  
 RR BIAS, LPD BIAS

2 Load New Value: (ie +XXX.XXE)  
 New Value (AZ BIAS) =  $-4.20 + \Delta \text{Azimuth}$   
 (+ $\Delta \text{Azimuth}$  = LPD is Right of L.S.)  
 (EL BIAS) =  $+0.40 + \Delta \text{Elevation}$   
 (+ $\Delta \text{Elevation}$  = LPD is Above L.S.)

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

RMAX/VMAX LOAD

1 V24 N01E  
 2004E (RMAX)  
 7777E (Sets RMAX To -1)  
 7777E (Sets VMAX To -1)

REVIEW DATA IN ERASABLE MEMORY

1 Perform During Any Flashing Display  
 2 F 01 01 V1 N1E, OCTAL ADD E  
 R3 OCTAL ADD, R1 (DATA)  
 3 N15E (For Next Succeeding Address)  
 ENTR (For Each Succeeding Address)

TO CHANGE DATA IN ERASABLE MEMORY

1 F 21 01 V21 N01E ADD E  
 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 F 11 10 V11N10E  
 Load Channel Add E  
 R1 Octal Contents Of Specified Channel

Basic Date 1/5/70  
 Changed 3/25/70

LOAD OUTPUT CHANNELS

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

or

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

FLAG WORD SET/RESET

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

2  
 F 22 07 (Load FLAGWORD BIT CODE)E

<u>BIT</u>	<u>CODE</u>	<u>SET</u>	<u>RESET</u>
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:  
 VIN1E, FLAGWORD ADD ENTR  
 01 01 R3 FLAGWORD ADD  
 R1 FLAGWORD CONTENT (See Table Above)

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 Changed \_\_\_\_\_

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PGNS-70

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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<u>FLAG</u>	<u>ADD</u>	<u>CODE</u> <u>(BIT)</u>	<u>SET (1)</u> <u>RESET(0)</u>	
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 Initiated P20 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
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 (5)	Rndz Tracking Allowed Rndz Tracking Not Allowed	D=2,3,6,7 D=0,1,4,5

Manual Acquire	76	10000 (13)	Enable man acq of CSM by RR <u>Enable auto acq of</u> CSM by RR	<u>A=1,3,5,7</u> <u>A=0,2,4,6</u>
LOS CM	76	4000 (12)	LOS Being Computed (R21) <u>LOS Not Being Computed</u> (R21)	<u>B=4,5,6,7</u> <u>B=0,1,2,3</u>
External V	76	200 (8)	Ext ΔV VG Computation <u>Lambert VG Computation</u>	<u>C=2,3,6,7</u> <u>C=0,1,4,5</u>
Final	76	40 (6)	Final Pass Through Rndz Prog Comp <u>Interim Pass Through</u> Rndz Prog Comp	<u>D=4,5,6,7</u> <u>D=1,2,3,4</u>
Active Veh	76	20 (5)	LM Active Veh <u>CSM Active Veh</u>	<u>D=2,3,6,7</u> <u>D=0,1,4,5</u>
Preferred Attitude	76	10 (4)	Preferred Att Computed <u>Preferred Att Not</u> Computed	<u>D=1,3,5,7</u> <u>D=0,2,4,6</u>
REFSMAT	77	10000 (13)	REFSMAT Good <u>REFSMAT Not Good</u>	<u>A=1,3,5,7</u> <u>A=0,2,4,6</u>
No Throttle	101	4000 (12)	Inhibit Full Throttle <u>Permit Full Throttle</u>	<u>B=4,5,6,7</u> <u>B=0,1,2,3</u>

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3 Axis	101	40 (6)	Mnvr Specified By 3 Axis <u>Mnvr Specified By 1 Axis</u>	D=4,5,6,7 <u>D=0,1,2,3</u>
No RR Mon	101	10 (4)	Bypass RR Gmb1 Monitor <u>Perform RR Gmb1 Monitor</u>	D=1,3,5,7 <u>D=0,2,4,6</u>
W Matrix	101	1 (1)	W Matrix Valid For Flt Nav <u>W Matrix Not Valid For Flt Nav</u>	E=1,3,5,7 <u>E=0,2,4,6</u>
Attitude	102	1 (1)	LM Att Stored In LGC <u>LM Att Not Stored In LGC</u>	E=1,3,5,7 <u>E=0,2,4,6</u>
Remode	110	20000 (14)	LOS Within Other RR Ant <u>RR Mode Set To 2</u>	A=2,3,6,7 <u>A=0,1,4,5</u>
Antenna	110	4000 (12)	RR Ant In Mode 2 <u>RR Ant In Mode 1</u>	B=4,5,6,7 <u>B=0,1,2,3</u>
Designate	110	1000 (10)	Desired LOS Within Mode Lim <u>Desired LOS Not Within Mode Lim</u>	B=1,3,5,7 <u>B=0,2,4,6</u>
ACA Mode	111	40000 (15)	Min Impulse Enabled (V76) <u>Rate Command Enabled(V77)</u>	A=4,5,6,7 <u>A=0,1,2,3</u>

NON FLAGS

Mark/Reject	1307	10000 (13)	Use of Mark X or Y <u>Use of Mark Reject</u>	<u>A=1,3,5,7</u> <u>A=0,2,4,6</u>
AOT Mark Y	1307	2000 (11)	After Use of Mark Y <u>After Mark X &amp; Y or</u> Mark Reject	<u>B=2,3,6,7</u> <u>B=0,1,4,5</u>
AOT Mark X	1307	1000 (10)	After Use of Mark X <u>After Mark X &amp; Y or</u> Mark Reject	<u>B=1,3,5,7</u> <u>B=0,2,4,6</u>

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CHANNEL LISTING

CHANNEL	BIT	DSKY	FUNCTION
5 OUTPUT	1	E=1,3,5,7	JET 1 ON (B4U)
	2	E=2,3,6,7	JET 2 ON (A4D)
	3	E=4,5,6,7	JET 5 ON (A3U)
	4	D=1,3,5,7	JET 6 ON (B3D)
	5	D=2,3,6,7	JET 9 ON (B2U)
	6	D=4,5,6,7	JET 10 ON (A2D)
	7	C=1,3,5,7	JET 13 ON (A1U)
	8	C=2,3,6,7	JET 14 ON (B1D)
6 OUTPUT	1	E=1,3,5,7	JET 7 ON (B3A)
	2	E=2,3,6,7	JET 3 ON (B4F)
	3	E=4,5,6,7	JET 15 ON (A1F)
	4	D=1,3,5,7	JET 11 ON (A2A)
	5	D=2,3,6,7	JET 12 ON (B2L)
	6	D=4,5,6,7	JET 8 ON (A3R)
	7	C=1,3,5,7	JET 4 ON (A4R)
	8	C=2,3,6,7	JET 16 ON (B1L)
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

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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
(INVERTED)	2	E=0,1,4,5	JETS 5,8 FAILED
	3	E=0,1,2,3	JETS 1,3 FAILED
	4	D=0,2,4,6	JETS 6,7 FAILED
	5	D=0,1,4,5	JETS 14,16 FAILED
	6	D=0,1,2,3	JETS 13,15 FAILED
	7	C=0,2,4,6	JETS 9,12 FAILED
	8	C=0,1,4,5	JETS 10,11 FAILED
	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
	4	D=0,2,4,6	RR DATA GOOD
	5	D=0,1,4,5	LR 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

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AGS SELECTOR LOGIC LIST

<u>Address</u>	<u>Entry</u>	
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,32 sec)
	+70000	Inflight Accelerometer Only Calibration (32 sec)
407	+00000	Use Rotating External $\Delta V$ Reference Frame
	+10000	Freeze External $\Delta V$ in Inertial Space And Allow $\Delta V$ 's To Count
410	+00000	Orbit Insertion Routine
	+10000	CSI Routine
	+20000	CDH Routine
	+30000	TPI Search Routine
	+40000	TPI Execute Routine
	+50000	External $\Delta V$
411	+00000	DPS or RCS Engine Select
	+10000	APS Engine Selection
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 Downlinks
	+20000	LM Navigation Initial- ization via DEDA
	+30000	CSM Navigation Initial- ization via DEDA

AGS LOGIC

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LM-7

## AGS LOGIC

415	+00000	Normal Position
	+10000	Store Z-axis Direction Cosines & Rng/Rng Rt Data in RDR Filter
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 Position
	+10000	Initialize Radar Filter
507	+00000	Z Body Points In Direction Of CSM When In Z-Body Axis Steering (400 set to +2)
	+10000	Z Body Points To Thrust Direction When (400 set to +2)
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 De- fined By WB When In Guidance Steering (400 set To +1)

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DEDA INPUT/OUTPUT LISTAddress

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 $\alpha$ L (O.I.)	100 ft
225	One Half of the Lower Limit of Apolune Radius (O.I.)	100 ft
226	Retarget Value For $\alpha$ L (O.I.)	100 ft
231	Radial Distance of Landing Site From Center of Moon	100 ft
232	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)	0.1 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)	0.1 min
274	Initial Update Time For Radar Filter	.1 min
275	Desired Update Time For TIG TPI (For CSI Calc Only)	.1 min
305	Retargeted 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	.01 min
312	TPI Rendezvous Offset Time (Stable Orbit Rendezvous)	.01 min

DEDA INPUT/OUTPUT  
CONSTANTSBasic Date 1/5/70  
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AGS-4

316	Radar Range (R)	0.1 nm
373	AGS TIG CSI, CDH, TPI, TPM	0.1 min
377	AGS Computer Time (T)	0.1 min
404	$\Delta V_X$ (Use 470 For Readout)	Octal
405	$\Delta V_Y$ (Use 471 For Readout)	Octal
406	$\Delta V_Z$ (Use 472 For Readout)	Octal
450	$\Delta V_X$ (LV) (+Fwd)	.1fps
451	$\Delta V_Y$ (LV) (+Rt)	.1fps
452	$\Delta V_Z$ (LV) (+Dn)	.1fps
464	Vertical Pitch Steering, Altitude Rate Threshold	.1fps
465	Target 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)	
534	Scale Factor for X Accelerometer	Octal
535	Scale Factor for Y Accelerometer	Octal
536	Scale Factor for Z Accelerometer	Octal
540	X Accl Bias Comp Coeff	.001 ft/sec <sup>2</sup>
541	Y Accl Bias Comp Coeff	.001 ft/sec <sup>2</sup>
542	Z Accl Bias Comp Coeff	.001 ft/sec <sup>2</sup>
544	X Gyro Bias Comp Coeff	.01°/hr
545	Y Gyro Bias Comp Coeff	.01°/hr
546	Z Gyro Bias Comp Coeff	.01°/hr
547	Lunar Align Azimuth Correction	Octal
574	Section Staging Flag(+ Not Staged)	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
613	Central Angle Limit On TPI	Octal
616	Ullage Counter Value For Ullage Completion	2 sec
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	Retarget Value For 4K10 When Central Angle Overflows	Octal

DEDA INPUT/OUTPUT  
CONSTANTS

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DEDA OUTPUT LISTAddress

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
267	$\Delta V$ To Be Gained	.1fps
270	Present $V_y$ Out-of-CSM Orbit Plane Velocity ( $V_{yo}$ )	.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 (CSI,CDH,TPI)	0.01 min.
311	Time To Rndz (TPI)	0.01 min.
312	Target Offset Time (TPI)	0.01 min.
313	Time To Pericynthian	0.01 min.
314	$\Delta H$ Along LM Radial At TIG (CSI,CDH)	.1 nm
315	Predicted Altitude Of LM Apogee	0.1 nm
317	LM To CSM Range (R)	0.1 nm
337	LM Altitude (h)	0.1 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	fps/16
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
371	$\Delta V$ For CDH (Valid in CSI, Coast)	.1fps
371	$\Delta V$ Direct Trans + Braking (TPI)	.1fps

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372	CSI To CDH $\Delta T$ (CSI)	.1 min
402	$\Delta H$ In Coelliptic Orbit (CSI,CDH)	.1nm
402	Predicted Hp (TPI)	.1nm
403	LM Perigee Attitude (Hp)	.1nm
423	Desired Final HDOT (Except TPI)	.1fps
427	Present LM HOR Velocity	.1fps
433	LM Velocity	.1fps
440	Range Rate Between LM and CSM (R DOT) (-Closing)	.1fps
470	$\Delta V_X$ Measured (LM) (+ Up) (Use 404 to zero)	.1fps
471	$\Delta V_Y$ Measured (LM) (+ Rt) (Use 405 to zero)	.1fps
472	$\Delta V_Z$ Measured (LM) (+ Fwd) (Use 406 to zero)	.1fps
477	Predicted HDOT At CSI, CDH, or TPI Time	.1fps
500	$\Delta V_{gx}$ (LM) (+Up)	.1fps
501	$\Delta V_{gy}$ (LM) (+Rt)	.1fps
502	$\Delta V_{gz}$ (LM) (+Fwd)	.1fps
612	Staging Sequence Counter	Octal
614	Ullage Counter	2 sec

DEDA ACCESSIBLE CONSTANTS LIST

Address

216 (2K3)	Value of LM Pericyynthion If Overflow In Orbital Eccentricity	100 ft
227 (4K5)	Constant In Expression For Altitude Rate At Cutoff (O.I.)	100 ft
230 (2K19)	$\Delta P$ Limiter	100 ft
453 (2K20)	P Iterator Convergence Check (TPI)	N.A.
454 (4K26)	VG Engine Cutoff Threshold	.1fps
466 (5K26)	Vgx Pseudo Attitude Hold Threshold	.1fps
473 (4K27)	Accumulated X-Velocity Bias	.1fps
506 (4K12)	Acceleration Threshold for Radial Jerk Set (Orbit Insertion)	Octal
523 (5K20)	Lower Limit Of Radial Jerk For Staged Vehicle (Orbit Insertion)	Octal

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526 (2K11)	Set Value Of Transfer Velocity (VT) (TPI)	Octal
527 (4K6)	Upper Limit Of Perdocted Radial Rate At Insertion (Orbit Insertion)	Octal
560 (5K14)	Upper Limit Of Radial Jerk (Orbit Insertion)	Octal
561 (5K16)	Upper Limit Of Out-Of-Plane Jerk (Orbit Insertion)	Octal
564 (5K18)	Lower Limit Of Radial Jerk For Unstaged Vehicle (Orbit Insertion)	Octal
566 (4K7)	Ascent Engine Pitch Cant Angle	Octal
601 (5K17)	Lower Limit Of Out-Of-Plane Jerk (Orbit Insertion)	Octal
602 (4K8)	Ascent Engine Roll Cant Angle	Octal
617 (1K30)	Gyro Calbrate Time	1 Count(2sec)
621 (1K37)	Accelerometer Calibrate Time	1 Count(2sec)
622 (4K23)	Attitude Hold At Abort Staging Threshold	1 Count(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
657 (4K25)	Vgx Engine Cutoff Threshold	Octal
660 (4K34)	Lower Limit Of Thrust Acceleration	Octal
661 (4K35)	Increment Ullage Counter Threshold	Octal
662 (4K10)	Factor In LM Desired Semi-Major Axis $\alpha L$ (O.I.)	Octal
666 (4K21)	Scale Factor For Attitude Error	Octal

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 Changed 2/13/70

ORBIT INSERTION

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1      MODE CONT:  AGS - AUTO
      GUID CONT - PGNS
      EVENT TIMER - SET

2      616+0 Zero Ullage Counter Limit
      232+(Orbit Insertion Altitude)           (100ft)
      465+(Altitude Rate At Insertion)        (.1fps)
      224+(Semi-Major Axis Targeting Term)    (100ft)
      225+(Apolune Radius/2)                 (100ft)
      226+(Retarget Value For αL)            (100ft)
      305+(Phase Angle Limit)                (.01°)
      662+(4K10)                             (Octal)
      673+(Retarget Value For 4K10)         (Octal)
      410+0 ORBIT INSERTION ROUTINE

3      411+0 DES ENG OR RCS BURN
      +1 ASC ENG BURN

4      623+0 Z-AXIS PARALLEL TO CSM ORBIT PLANE
      +1 Z-AXIS PARALLEL TO SPECIFIED PLANE

5      If 623+1, Specify Plane
      514+(X Component of Unit Vector)        (Octal)
      515+(Y Component of Unit Vector)        (Octal)
      516+(Z Component of Unit Vector)        (Octal)

6      400+1 GUIDANCE STEERING
      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/TRANSL                 2 JET          2 JET         2 JET
      TTCA (CDR)                 THROT          JETS          JETS
      DEADBAND                   MIN            MIN            MIN
      ABORT(STAGE)PB            RESET          RESET          RESET
      ENG ARM                    DES            ASC            OFF
      MASTER ARM                ON(1st Burn Only)  ON(Un-staged)  OFF
  
```

Basic Date 1/5/70  
 Changed 3/9/70

AGS PROG

LM-7

AGS-9

PRPLNT QTY MON            DES 1        OFF            OFF  
 PRPLNT TEMP/PRESS        DES 1        ASC            -  
                           MON  
 HELIUM MON                SUPCRIT    PRESS 2       -  
                           PRESS  
 ENGINE STOP               -            -            PUSH

8 -30    FOR DPS BURNS  
           CB(11) STAB/CONT: DECA PWR - Close  
           CB(16) STAB/CONT: DES ENG OVRD - Close  
           ENG GMBL - ENABLE  
           FOR APS BURNS  
           CB(11) STAB/CONT: AELD - Close  
           CB(16) STAB/CONT: AELD - Close

9 -TBD    GUID CONT - AGS

10 00    ABORT (STAGE) - PUSH  
           IGNITION  
           When  $\Delta V > 50\text{fps}$ : BAL CPL - OFF

11        When Burn Complete  
           ABORT (STAGE) PB - RESET  
           407+0  
           410+5  
           451+0  
           (To Trim Out-of-Plane Comp)  
                           263R  $\Delta VY$         (.1fps)  
                           451 ( $\Delta VY$ ) (Same sign As 263)  
           407+1  
           NULL 500, 501, 502                            (.1fps)  
           (Null 501 After 502 for Out-of-Plane Trim)

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

13        616 + 00007

Basic Date 1/5/70  
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LM-7



- 9 If 623 +1, Specify Plane  
 514 + (X Component of Unit Vector) (Octal)  
 515 + (Y Component of Unit Vector) (Octal)  
 516 + (Z Component of Unit Vector) (Octal)
- 10 400 +1 GUIDANCE STEERING (Z Axis Mnvr, 400+2,  
 507+1)
- 11 ATTITUDE CONTROL (3)-PULSE  
 MODE CONT: AGS - AUTO  
 Maneuver To Burn Attitude Then  
 ATTITUDE CONTROL (3)-MODE CONT
- 12 407 +0
- 13 501R ΔVGY (LM) (.1fps)  
 502R ΔVGZ (LM) (.1fps)  
 500R ΔVGX (LM) (.1fps)

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

Basic Date 1/5/70  
 Changed

AGS-12

- 15 -30 FOR DPS BURNS  
CB(11) STAB/CONT: DECA PWR-Close  
CB(16) STAB/CONT: DES ENG OVRD-Close  
ENG GMBL - ENABLE  
FOR APS BURNS  
CB(11) STAB/CONT: AELD-Close  
CB(16) STAB/CONT: AELD-Close
- 15 407 +1 (For RCS Burn Not +X LM)  
(X-Axis) 500R  
(Z-Axis) 502R
- 16 - :14 Start Ullage
- 17 :00 Ignition  
(RCS Burn) When  $\Delta VG < 15\text{fps}$ ,  
MODE CONTROL (AGS)-ATT HOLD
- 18 When Burn Complete:  
ABORT (STAGE) Reset  
NULL 500, 501, 502 (.1fps)
- 19 410 +2 CDH Routine
- 20 MASTER ARM - OFF  
ENG ARM - OFF  
BAL CPL - ON  
TTCA(CDR) - JETS  
DEADBAND - MAX  
PRPLNT QTY MON - OFF  
HELIUM MON - OFF

Basic Date 1/5/70  
Changed \_\_\_\_\_



AGS-14

9 400 +1 GUIDANCE STEERING (Z-Axis,400+2,507+1)

10 ATTITUDE CONTROL (3)-PULSE  
 MODE CONT: AGS - AUTO  
 Maneuver To Burn Attitude Then  
 ATTITUDE CONTROL (3) - MODE CONT

11 407 +0

12 501R ΔVGY (LM) (.1fps)  
 502R ΔVGZ (LM) (.1fps)  
 500R ΔVGX (LM) (.1fps)

13 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 JETS JETS  
 (MIN THRUST)  
 DEADBAND MIN MIN MIN  
 ABORT(STAGE) PUSH PUSH -  
 ENG ARM DES ASC -  
 MASTER ARM ON(1st ON(Un- OFF  
 Burn Staged  
 Only) Only)  
 PRPLNT QTY MON DES 1 OFF OFF  
 PRPLNT TEMP/PRESS DES 1 ASC -  
 MON  
 HELIUM MON SUPCRIT PRESS 2 -  
 PRESS  
 ENGINE STOP - - PUSH

Basic Date 1/5/70  
 Changed 3/9/70



AGS-15

- 14 -30 For DPS Burns  
 CB(11) STAB/CONT: DECA PWR-Close  
 CB(16) STAB/CONT: DES ENG OVRD-Close  
 ENG GMBL-ENBL  
 For APS Burns  
 CB(11) STAB/CONT: AELD-Close  
 CB(16) STAB/CONT: AELD-Close
- 15 407 +1 (For RCS BURN Not Along +X)  
 (X-Axis) 500R  
 (Z-Axis) 502R

15 - :14 Start Ullage

16 00 IGNITION  
(RCS Burn) When  $\Delta VG < 15\text{fps}$ ,  
MODE CONTROL(AGS)-ATT HOLD

17 When Burn Complete  
ABORT(STAGE) - Release  
NULL 500, 501, 502 (.1fps)

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

Basic Date 1/5/70  
Changed \_\_\_\_\_





AGS-18

- 15 -30 For DPS Burns  
 CB(11) STAB/CONT: DECA PWR-Close  
 CB(16) STAB/CONT: DES ENG OVRD-Close  
 ENG GMBL-ENBL  
 For APS Burns  
 CB(11) STAB/CONT: AELD-CLOSE  
 CB(16) STAB/CONT: AELD-CLOSE
  
- 15 407 +1 (For RCS BURN Not In +X)  
 (X-Axis) 500R  
 (Z-Axis) 502R
  
- 16 -06 Start Ullage
  
- 17 00 IGNITION  
 (RCS Burn)When  $\Delta VG < 15\text{fps}$ ,  
 MODE CONTROL (AGS)-ATT HOLD
  
- 18 When Burn Complete  
 ABORT(STAGE)PB - Release  
 NULL 500, 501, 502 (.1fps)
  
- 19 410 +4 TPI EXECUTE
  
- 20 MASTER ARM -OFF  
 ENG ARM -OFF  
 BAL CPL -ON  
 TTCA (CDR) -JETS  
 DEADBAND -MAX  
 PRPLNT QTY MON -OFF  
 HELIUM MON -OFF

Basic Date 1/5/70  
 Changed \_\_\_\_\_

TPM

Retargeting (Same Rndz Time)

- |   |  |                     |
|---|--|---------------------|
| 1 | 410 +3 TPI SEARCH<br>307 +(ΔT RNDZ TRANS)<br>(+02800 For 1st MCC)<br>(+01300 For 2nd MCC)<br>310 ΔT To TPM<br>410 +4 TPI EXECUTE | (.01min)            |
| 2 | If Time Available:<br>311R ΔT RDZ<br>277R THETA  | (.01 min)<br>(.01°) |
| 3 | 410 +5<br>407 +0 Ref Frame<br>267R VG MDC<br>407 +1 Freeze Ext ΔV  | (.1fps)             |
| 4 | Null 500, 501, 502   | (.1fps)             |

Basic Date 1/5/70  
 Changed \_\_\_\_\_



AGS-21

AGS MAN THRUST

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	-	-	DEPRESS

10 -30 For DPS Burns  
 CB(11) STAB/CONT: DECA PWR-Close  
 CB(16) STAB/CONT: DES ENG OVRD-Close  
 ENG GMBL-ENBL  
 For APS Burns  
 CB(11) STAB/CONT: AELD-Close  
 CB(16) STAB/CONT: AELD-Close

-15 407 +1 (For RCS Burn Not Along +X)

11 -:06 Start Ullage

12 00 IGNITION  
 (RCS Burn) When  $\Delta VG < 15fps$ ,  
 MODE CONTROL (AGS) - ATT HOLD

13 When Burn Complete  
 ABORT(STAGE) - Release  
 NULL 500, 501, 502 (.1fps)

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

Basic Date 1/5/70  
 Changed \_\_\_\_\_











- 7 417 +1 INITIALIZE RADAR FILTER
- 8 415 +1 STORE Z AXIS COSINES  
ENTR (When FDAI's Centered)
- 9 316 +(RADAR RANGE) (.1nm)  
(Must Be Entered Within 30 sec)  
Wait 16 sec Before Step 10
- 10 415 +1 Store Z Axis cosines
- 11 503 + (RADAR RANGE RATE) (.1fps)  
(Must Be Entered Within 30 sec)  
(Wait 16sec Before Next 415 Entry)
- 12 Repeat Steps 8 thru 11
- 13 Repeat Procedure For A Minimum of 6  
Range Data Points Approximately  
4 min Apart (9 Points if Pre CSI)

AGS ORDEAL INITIALIZATION

AGS MAN ACQ,  
ORDEAL INITIAL

- 1 POWER - ON  
FDAI 1 and/or 2 - ORB RATE  
EARTH LUNAR - LUNAR
- 2 315R Ha LM (.1nm)  
403R Hp LM
- 3 ALT SET - Set To Ave of HA & HP
- 4 Verify LM Pointed +Z In Direction Of  
Orbit Travel
- 5 277R THETA (0-360P) (.01°)
- 6 MODE - HOLD/FAST  
SLEW - Set To Theta  
MODE - OPR/SLOW

Basic Date 1/5/70  
Changed

AGS MANUAL STATE VECTOR UPDATE

1	RECORD LM DATA AND TIME	
2	240 +(LM X Position)	(100 ft)
3	241 +(LM Y Position)	(100 ft)
4	242 +(LM Z Position)	(100 ft)
5	260 +(LM X Velocity)	(.1fps)
6	261 +(LM Y Velocity)	(.1fps)
7	262 +(LM Z Velocity)	(.1fps)
8	254 +(LM Epoch Time)	(.1 min)
9	414 +20000E Update State Vector	
10	414R (+00000=Update Complete)	
11	RECORD CSM DATA AND TIME	
12	244 +(CSM X Position)	(100 ft)
13	245 +(CSM Y Position)	(100 ft)
14	246 +(CSM Z Position)	(100 ft)
15	264 +(CSM X Velocity)	(.1fps)
16	265 +(CSM Y Velocity)	(.1fps)
17	266 +(CSM Z Velocity)	(.1fps)
18	272 +(CSM Epoch Time)	(.1 min)
19	414 +30000E Update State Vector	
20	414R (+00000=Update Complete)	

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

AGS MAN S.V.,  
 BACK-UP ALIGN

BACK-UP RNDZ ALIGNMENT

- 1 Fly to 0° Roll, Z-Axis Toward CSM
- 2 400 +5
- 3 400 +0 DO NOT ENTER
- 4 When Wings Level (HORIZ REF) And Z-Axis  
Toward CSM Key ENTER And Note GET \_\_\_\_\_.
- 5 Coordinate with CSM To Adjust Ordeal  
(PITCH LM = 180° + PITCH CM)
- 6 Transmit GET of Align to MSFN

BACK-UP 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 DEADBAND - 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

AGS MAN S.V.;  
BACK-UP ALIGN

Basic Date      / 5 / 70  
Changed     

LM-7

P27 UPDATE (LM)

P27 UPDATE (LM)												PURP		
V			V			V						GET		
:			:			:						1173 01		
INDEX			INDEX			INDEX						02		
														03
														04
														05
														06
														07
														10
														11
														12
														13
														14
														15
														16
														17
														20
														1213 21
														22
														23
														1216 24
X	X	X				X	X	X				N34		HR
X	X	X	X			X	X	X	X					MIN
X	X					X	X					NAV CHECK		SEC
	0						0					N43		LAT
														LONG
+	0					+	0							ALT

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

P27 UPDATE

P27 UPDATE (LM)												
V			V			V			PURP			
• •			• •			• •			GET			
INDEX			INDEX			INDEX						
									1173	01		
										02		
										03		
										04		
										05		
										06		
										07		
										10		
										11		
										12		
										13		
										14		
										15		
										16		
										17		
										20		
										21		
									1213	22		
										23		
										24		
									1216			
X	X	X				X	X	X		N34	HR	
X	X	X	X			X	X	X	X		MIN	
X	X			•		X	X			NAV	CHECK	SEC
	0			•			0			N43	LAT	
				•							LONG	
+	0			•		+	0				ALT	

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7



P27 UPDATE (LM)

P27 UPDATE (LM)												PURP	
V			V			V					PURP		
:			:			:					GET		
INDEX			INDEX			INDEX					1173 01		
												02	
												03	
												04	
												05	
												06	
												07	
												10	
												11	
												12	
												13	
												14	
												15	
												16	
												17	
												20	
												1213 21	
												22	
												23	
												1216 24	
X	X	X				X	X	X				N34	HR
X	X	X	X			X	X	X	X				MIN
X	X					X	X					NAV	CHECK SEC
	0						0					N43	LAT
													LONG
+	0					+	0						ALT

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

P27 UPDATE (LM)

V			V			V			PURP			
•	•		•	•		•	•		GET			
INDEX			INDEX			INDEX						
									1173 01			
									02			
									03			
									04			
									05			
									06			
									07			
									10			
									11			
									12			
									13			
									14			
									15			
									16			
									17			
									20			
									1213 21			
									22			
									23			
									1216 24			
X	X	X				X	X	X			N34	HR
X	X	X	X			X	X	X	X			MIN
X	X			•		X	X			•	NAV CHECK	SEC
	0			•			0			•	N43	LAT
				•						•		LONG
+	0			•		+	0			•		ALT

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

# P30 LM MANEUVER

PURPOSE																			
HR	N33	+	0	0						+	0	0							
MIN	TIG	+	0	0	0					+	0	0	0						
SEC		+	0							+	0								
ΔVX	N81																		
ΔVY	LOCAL																		
ΔVZ	VERT																		
HA	N42	+								+									
HP																			
ΔVR		+								+									
BT		X	X	X						X	X	X							
R	FDAI	X	X	X						X	X	X							
P	INER	X	X	X						X	X	X							
ΔVX	AGS N86																		
ΔVY	AGS																		
ΔVZ	AGS																		
BSS		X	X	X						X	X	X							
SPA		X	X							X	X								
SXP		X	X	X						X	X	X							

REMARKS :

P30 UPDATE (LM)

Basic Date 1/5/70  
 Changed \_\_\_\_\_

P30 LM MANEUVER

P30 UPDATE (LM)

PURPOSE																	
HR	N33		+	0	0					+	0	0					
MIN	TIG		+	0	0	0				+	0	0	0				
SEC			+	0						+	0						
ΔVX	N81																
ΔVY	LOCAL																
ΔVZ	VERT																
HA	N42		+							+							
HP																	
ΔVR			+							+							
BT			X	X	X					X	X	X					
R	FDAI		X	X	X					X	X	X					
P	INER		X	X	X					X	X	X					
ΔVX	AGS	N86															
ΔVY	AGS																
ΔVZ	AGS																
BSS			X	X	X					X	X	X					
SPA			X	X						X	X						
SXP			X	X	X					X	X	X					

REMARKS:

Basic Date 1/5/70  
 Changed \_\_\_\_\_

P30 LM MANEUVER

PURPOSE														
HR	N33	+	0	0					+	0	0			
MIN	TIG	+	0	0	0				+	0	0	0		
SEC		+	0				.		+	0				.
ΔVX	N81						.							.
ΔVY	LOCAL						.							.
ΔVZ	VERT						.							.
HA	N42	+					.		+					.
HP							.							.
ΔVR		+					.		+					.
BT		X	X	X			.		X	X	X			.
R	FDAI	X	X	X					X	X	X			
P	INER	X	X	X					X	X	X			
ΔVX	AGS N86						.							.
ΔVY	AGS						.							.
ΔVZ	AGS						.							.
BSS		X	X	X					X	X	X			
SPA		X	X				.		X	X				.
SXP		X	X	X			.		X	X	X			.

REMARKS :

Basic Date 1/5/70  
 Changed \_\_\_\_\_

# P30 LM MANEUVER

PURPOSE															
HR	N33		+	0	0					+	0	0			
MIN	TIG		+	0	0	0				+	0	0	0		
SEC			+	0						+	0				
ΔVX	N81														
ΔVY	LOCAL														
ΔVZ	VERT														
HA	N42		+							+					
HP															
ΔVR			+							+					
BT			X	X	X					X	X	X			
R	FDAI		X	X	X					X	X	X			
P	INER		X	X	X					X	X	X			
ΔVX	AGS	N86													
ΔVY	AGS														
ΔVZ	AGS														
BSS			X	X	X					X	X	X			
SPA			X	X						X	X				
SXP			X	X	X					X	X	X			

REMARKS :

Basic Date 1/5/70  
 Changed \_\_\_\_\_

# AGS STATE VECTOR UPDATE

											PURP	
											240	
											241	
											242	
											260	
											261	
											262	
+						+					254	
											244	
											245	
											246	
											264	
											265	
											266	
+						+					272	

REMARKS:

Basic Date 1/5/70  
 Changed \_\_\_\_\_

LM-7

AGS STATE VECTOR

# AGS STATE VECTOR UPDATE

											PURP	
											240	
											241	
											242	
											260	
											261	
											262	
+						+					254	
											244	
											245	
											246	
											264	
											265	
											266	
+						+					272	

REMARKS:

AGS STATE VECTOR

Basic Date 1/5/70  
 Changed \_\_\_\_\_



# AGS STATE VECTOR UPDATE

											PURP	
											240	
											241	
											242	
											260	
											261	
											262	
+						+					254	
											244	
											245	
											246	
											264	
											265	
											266	
+						+					272	

REMARKS:

Basic Date 1/5/70  
 Changed \_\_\_\_\_

# AGS STATE VECTOR UPDATE

										PURP	
										240	
										241	
										242	
										260	
										261	
										262	
+						+				254	
										244	
										245	
										246	
										264	
										265	
										266	
+						+				272	

REMARKS:

Basic Date 1/5/70  
 Changed \_\_\_\_\_

Basic Date 2/13/70  
 Changed \_\_\_\_\_

0 HR GET = 4:11:19.13 GMT  
 LO = 4:11:\_\_\_\_\_

MARS HALF-UNIT VECTORS

TIME (GET) HOURS	X (R1)	Y (R2)	Z (R3)
104.0	.26348	.38772	.17393
108.0	.26263	.33820	.17415
112.0	.26178	.38868	.17437
116.0	.26092	.38915	.17459
120.0	.26007	.38963	.17480
124.0	.25921	.39010	.17502
128.0	.25835	.39057	.17524
132.0	.25750	.39104	.17545
136.0	.25664	.39150	.17567
140.0	.25578	.39197	.17588
144.0	.25492	.39243	.17610

JUPITER HALF-UNIT VECTORS

TIME (GET) HOURS	X (R1)	Y (R2)	Z (R3)
104.0	-.42493	-.24665	-.09271
124.0	-.42541	-.24594	-.09240
144.0	-.42589	-.24523	-.09210

SATURN HALF-UNIT VECTORS

TIME (GET) HOURS	X (R1)	Y (R2)	Z (R3)
104.0	.38285	.30199	.11060
124.0	.38226	.30262	.11089
144.0	.38167	.30326	.11117

VENUS HALF-UNIT VECTORS

TIME (GET) HOURS	X (R1)	Y (R2)	Z (R3)
104.0	.34927	.32847	.14182
106.0	.34863	.32903	.14210
108.0	.34799	.32959	.14238
110.0	.34735	.33015	.14265
112.0	.34671	.33070	.14293
114.0	.34607	.33126	.14320
116.0	.34542	.33181	.14347
118.0	.34478	.33236	.14375
120.0	.34413	.33291	.14402
122.0	.34349	.33346	.14429
124.0	.34284	.33401	.14456
126.0	.34219	.33456	.14483
128.0	.34154	.33510	.14510
130.0	.34089	.33565	.14537
132.0	.34024	.33619	.14564
134.0	.33959	.33673	.14591
136.0	.33893	.33728	.14618
138.0	.33828	.33782	.14645
140.0	.33762	.33835	.14672
142.0	.33697	.33889	.14699
144.0	.33631	.33943	.14725

PLANET HALF  
UNIT VECTORS

PV-2

EARTH HALF-UNIT VECTORS FOR LUNAR STAY  
0 HR GET = 4:11:19.13 GMT LO = 4:11:\_\_\_

TIME (GET) HOURS	X (R1)	Y (R2)	Z (R3)
104.0	.39753	-.27227	-1.3358
104.5	.39884	-.27077	-1.3273
105.0	.40013	-.26927	-1.3188
105.5	.40142	-.26777	-1.3102
106.0	.40271	-.26626	-1.3017
106.5	.40398	-.26474	-1.2931
107.0	.40525	-.26322	-1.2844
107.5	.40651	-.26169	-1.2758
108.0	.40776	-.26016	-1.2671
108.5	.40901	-.25863	-1.2584
109.0	.41024	-.25708	-1.2496
109.5	.41147	-.25554	-1.2409
110.0	.41270	-.25399	-1.2321
110.5	.41391	-.25243	-1.2233
111.0	.41512	-.25087	-1.2144
111.5	.41632	-.24930	-1.2056
112.0	.41751	-.24773	-1.1967
112.5	.41870	-.24615	-1.1878
113.0	.41988	-.24457	-1.1789
113.5	.42105	-.24299	-1.1699
114.0	.42221	-.24139	-1.1609
114.5	.42336	-.23980	-1.1519
115.0	.42451	-.23820	-1.1429
115.5	.42565	-.23659	-1.1338
116.0	.42678	-.23498	-1.1248
116.5	.42790	-.23337	-1.1157
117.0	.42902	-.23175	-1.1066

TIME (GET) HOURS	X (R1)	Y (R2)	Z (R3)
117.5	.43013	-.23012	-1.0974
118.0	.43123	-.22849	-1.0883
118.5	.43232	-.22686	-1.0791
119.0	.43340	-.22522	-1.0699
119.5	.43448	-.22358	-1.0606
120.0	.43555	-.22193	-1.0514
120.5	.43661	-.22028	-1.0421
121.0	.43766	-.21862	-1.0328
121.5	.43870	-.21696	-1.0235
122.0	.43974	-.21529	-1.0142
122.5	.44077	-.21362	-1.0048
123.0	.44179	-.21195	-.9954
123.5	.44280	-.21027	-.9860
124.0	.44380	-.20859	-.9766
124.5	.44480	-.20690	-.9671
125.0	.44579	-.20521	-.9577
125.5	.44677	-.20351	-.9482
126.0	.44774	-.20181	-.9387
126.5	.44870	-.20010	-.9292
127.0	.44965	-.19840	-.9196
127.5	.45060	-.19668	-.9101
128.0	.45154	-.19496	-.9005
128.5	.45247	-.19324	-.8909
129.0	.45339	-.19152	-.8812
129.5	.45430	-.18979	-.8716
130.0	.45521	-.18805	-.8619
130.5	.45610	-.18631	-.8523

TIME (GET) HOURS	X (R1)	Y (R2)	Z (R3)
131.0	.45699	-.18457	-.8426
131.5	.45787	-.18283	-.8328
132.0	.45874	-.18108	-.8231
132.5	.45960	-.17932	-.8134
133.0	.46046	-.17756	-.8036
133.5	.46130	-.17580	-.7938
134.0	.46214	-.17404	-.7840
134.5	.46297	-.17227	-.7741
135.0	.46379	-.17049	-.7643
135.5	.46460	-.16872	-.7544
136.0	.46540	-.16694	-.7446
136.5	.46619	-.16515	-.7347
137.0	.46698	-.16336	-.7248
137.5	.46775	-.16157	-.7148
138.0	.46852	-.15977	-.7049
138.5	.46928	-.15798	-.6949
139.0	.47003	-.15617	-.6849
139.5	.47077	-.15437	-.6749
140.0	.47150	-.15256	-.6649
140.5	.47222	-.15074	-.6548
141.0	.47294	-.14893	-.6448
141.5	.47364	-.14711	-.6348
142.0	.47434	-.14528	-.6247
142.5	.47503	-.14345	-.6146
143.0	.47570	-.14162	-.6045
143.5	.47637	-.13979	-.5944
144.0	.47703	-.13795	-.5843

Basic Date 2/13/70  
Changed \_\_\_\_\_

Basic Date 2/13/70  
 Changed \_\_\_\_\_

STAR HALF UNIT VECTOR

STAR NUMBER	COMMON NAME	X(R1)	Y(R2)	Z(R3)
46	HAMAL	.39204	.23901	.19794
47		-.29402	.32311	-.24320
50	POLLUX	-.19246	.39686	.23551
51	MTAPLACIDUS	-.13001	.11616	-.46862
52	DUBHE	-.22788	.05905	.44112
53		-.32441	-.05699	-.37618
54	RIGIL KENT	-.18904	-.15521	-.43609
55	BETELGEUSE	.01396	.49564	.06442
56	HADAR	-.21408	-.12572	-.43401
57	BELLATRIX	.07877	.49068	.05507
60	EL NATH	.06794	.43377	.23922
61	ALMI LAM	.05509	.49684	-.01064
62	ALMITAK	.04520	.49766	-.01708
63	MURZIM	-.04431	.47362	-.15401
64	ALHERA	-.07498	.47369	.14139
65	ADHERA	-.10854	.42393	-.24187
66	AL WAZOR	-.12945	.42896	-.22188
67	CASTOR	-.16693	.39001	.26463
70	AVIOR	-.14766	.20720	-.43043
71		-.18991	.21871	-.40755
72	GACRUX	-.27046	-.03500	-.41908
73	BECRUX	-.24850	-.05051	-.43093
74	ALIOTH	-.27137	-.06354	.41511
75	SHAULA	-.04936	-.39581	-.30149
76		-.03957	-.36365	-.34088
77	KAUS AUST	.03986	-.41062	-.28249
100	CAPH	.25750	.00850	.42851
101	ANKAA	.36666	-.03984	-.33759
102	MIRACH	.38943	.11914	.29008
103	ALMACH	.31918	-.18810	-.33577

STAR NUMBER	COMMON NAME	X(R1)	Y(R2)	Z(R3)
104	MIHTAKA	.06424	.49585	.00279
105	SAIPH	.02937	.49201	-.08407
106	HEKALINAN	.00413	.35386	.35322
107	ALUDRA	-.15441	.40804	-.24426
110		-.19540	.32997	-.32084
111	SUHAIL	-.26488	.24941	-.34298
112		-.19372	.16797	-.42925
113	MERAK	-.26627	.07130	.41715
114	MIZAR	-.26777	-.10107	.40998
115	KOCHAB	-.09958	-.09187	.48129
116	ELTANIN	-.00556	-.31126	.39126
117	SAUR	.22075	-.31191	.32246
120	AL NA'IR	.29932	-.16193	-.36631
121		.32063	-.11530	-.36593
122	SCHEDAR	.27293	.04665	.41633
123	PHECDA	-.29470	-.00996	.40380
124		-.23342	-.39848	-.19165
125		-.12736	-.39323	-.28133
126		.48230	.02462	.12955
127		-.03317	-.38706	-.31477
130		.23289	.08921	.43336
131		.41214	.22140	.17643
132		.25259	.38052	.20348
133		.22482	.36063	.26345
134		.19772	.32853	.32089
135		.11712	.40205	.27320
136		.11547	.48443	-.04465
137		.06716	.46262	-.17741
140		.05923	.47225	-.15320
141		.05637	.48412	-.05164

STAR HALF  
UNIT VECTORS

# STAR HALF UNIT VECTORS

PV-4

STAR HALF UNIT VECTORS

STAR NUMBER	COMMON NAME	X (R1)	Y (R2)	Z (R3)
142		.04906	.46381	.18021
143		.03868	.41227	-.28024
144		.00404	.39818	.30238
145		-.06763	.31023	-.38625
146		-.13007	.37730	-.30121
147		-.23871	.38853	-.20510
150		-.22129	.18374	-.40899
151		-.42438	.20169	-.17096
152		-.30920	.10425	-.37885
153		-.45775	.09622	-.17664
154		-.45476	-.06555	-.19722
155		-.17729	-.02759	-.46670
156		-.49223	-.08710	-.01122
157		-.38035	-.09241	.31112
160		-.47351	-.12839	.09643
161		-.37808	-.13556	-.29780
162		-.27183	-.12384	-.40096
163		-.41732	-.22483	.15905
164		-.30980	-.23959	.31084
165		-.29108	-.23070	-.33474
166		-.26002	-.21803	-.36722
167		-.33504	-.29128	.22855
170	ZUBERHUBI	-.35561	-.32363	-.13713
171		-.26236	-.25460	-.34109
172		-.32474	-.37156	-.08057
173		-.22537	-.30218	-.32847
174		-.27996	-.41036	.05677
175		-.22966	-.38615	-.21941
176		-.22874	-.41134	-.16875
177		-.09718	-.21720	.43975

STAR NUMBER	COMMON NAME	X (R1)	Y (R2)	Z (R3)
200		-.17997	-.42880	.18369
201		-.16155	-.41017	-.23593
202		-.17717	-.45858	-.09118
203		-.14530	-.40004	.26241
204	SABIK	-.10694	-.46934	-.13521
205		-.04576	-.27945	-.41208
206		-.05413	-.39418	-.30281
207		-.04275	-.31952	-.38220
210		-.04022	-.30295	.39573
211		-.03913	-.49687	-.03991
212		.03605	-.43220	-.24881
213		.05134	-.44859	-.21478
214		.11344	-.41823	-.24943
215		.15488	-.31743	.35390
216		.21709	-.44103	.09145
217		.27376	-.31218	.27856
220		.17572	-.15026	.44334
221		.39955	-.26599	-.14003
222		.22212	-.10779	-.43479
223		.42788	-.11003	.23412
224	MARKAB	.46814	-.11832	.12977
225		.20630	.11651	-.44030
226		.41167	.28248	-.02715
227		.26013	.27462	.32698
230		-.21684	.16592	-.41887
231		-.20482	.07265	-.45030
232		-.31753	-.00942	-.36612
233		-.11849	-.19051	-.44684
234		.13389	-.46670	.11942
235		.13637	-.44619	-.17978
236		-.22505	-.44537	-.03155

LM-7

Basic Date 2/13/70  
Changed \_\_\_\_\_



