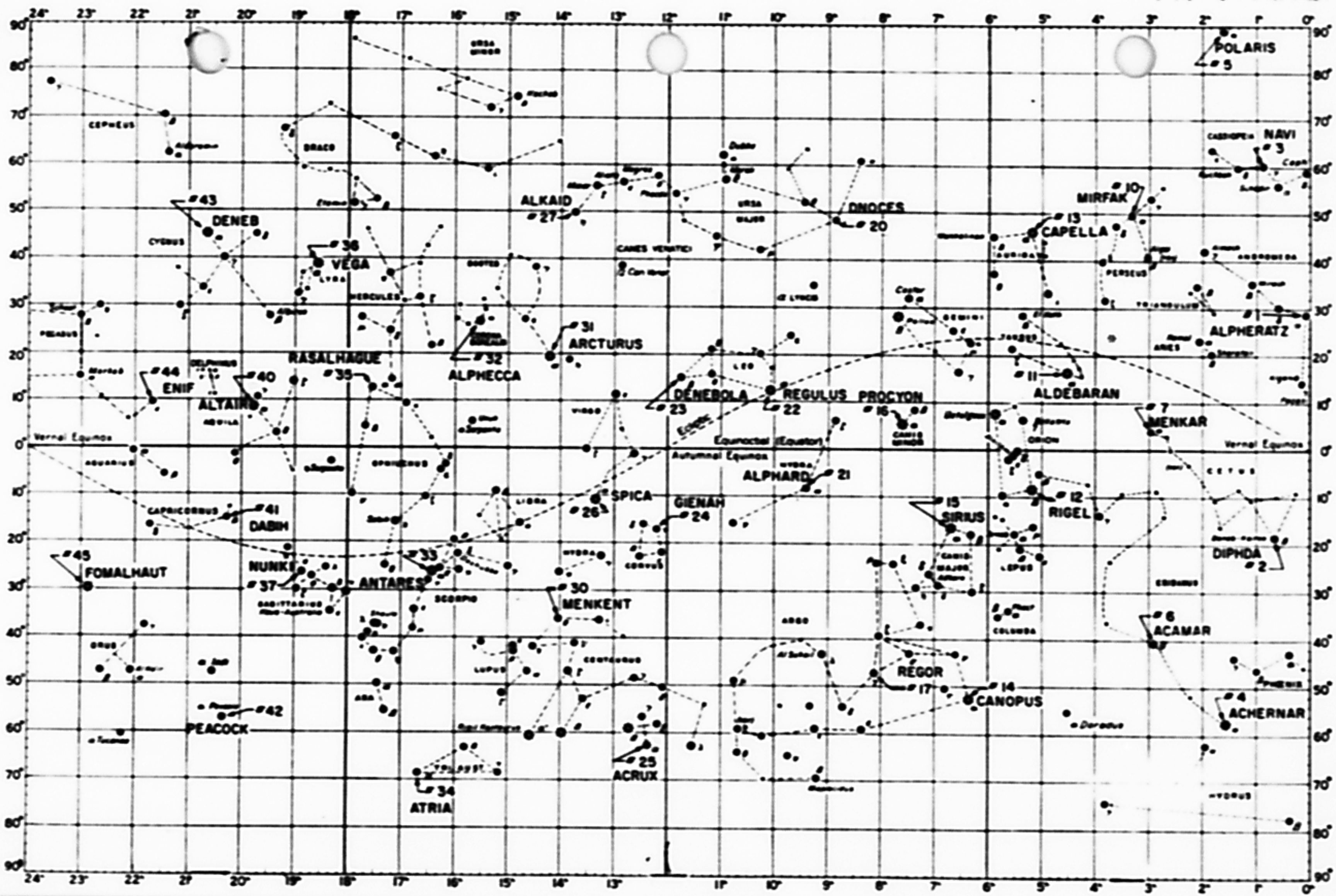
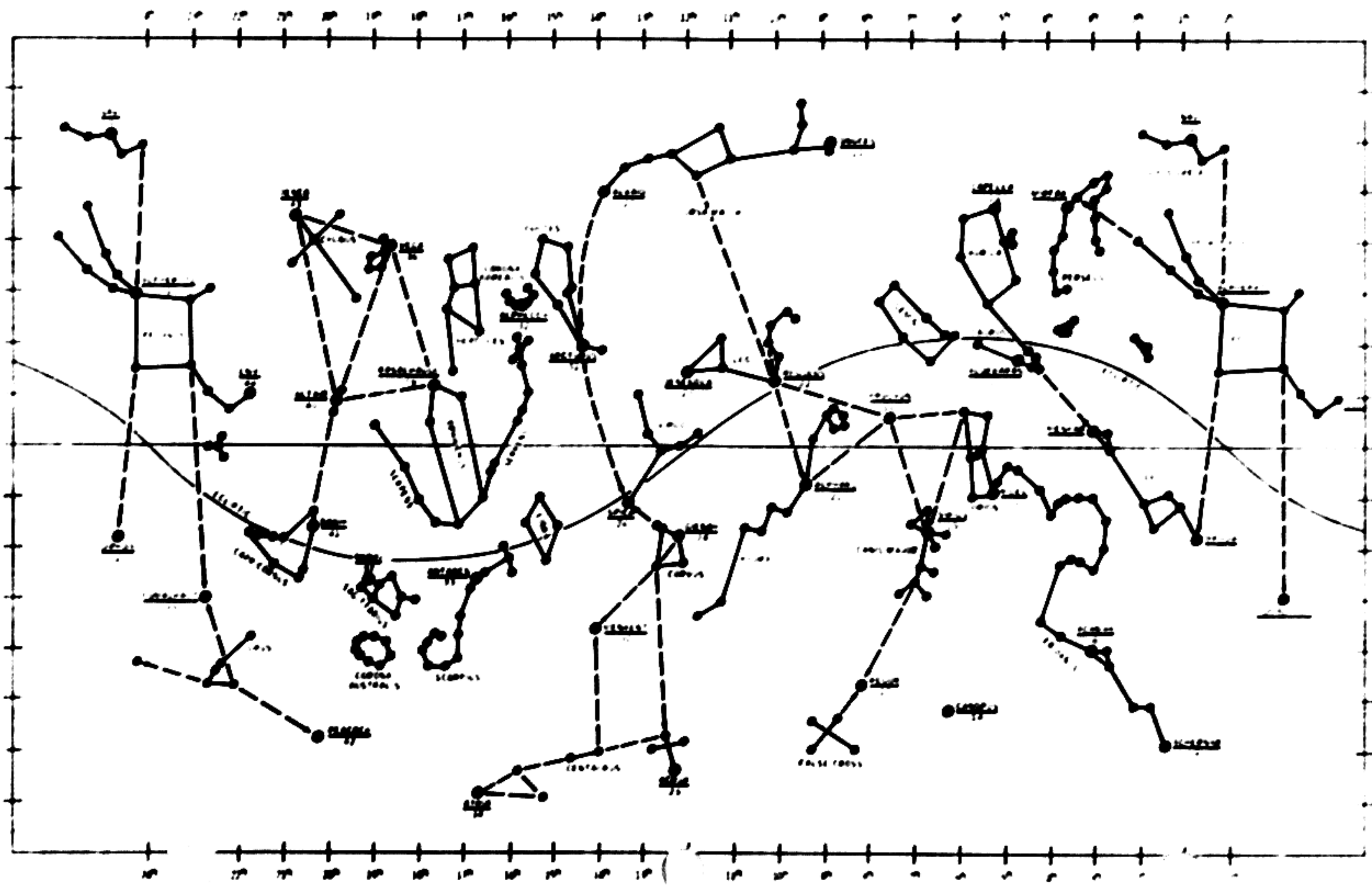


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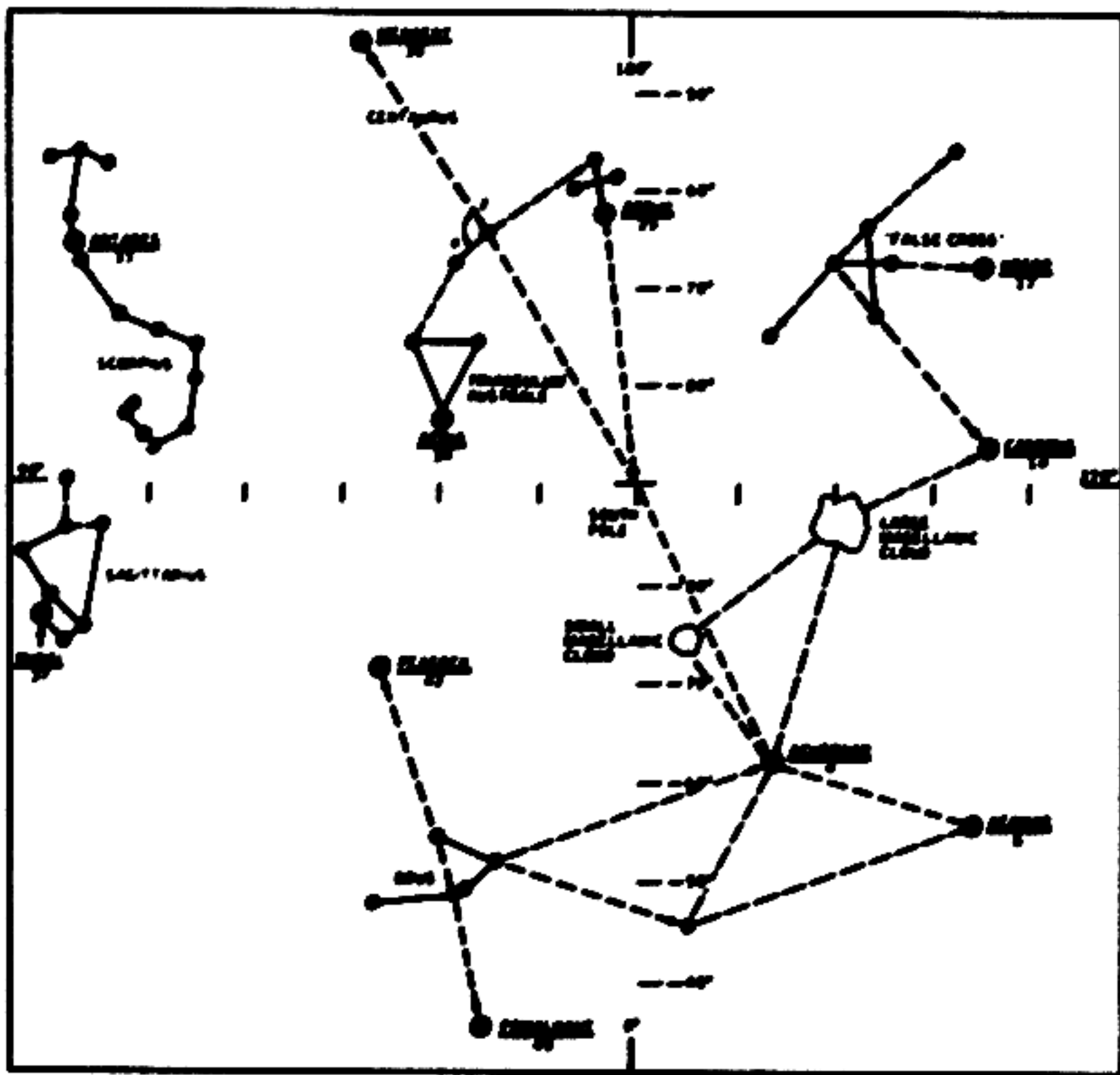
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LM G&N DICTIONARY	
PART NO	S/N
SKB32100075-361	1002



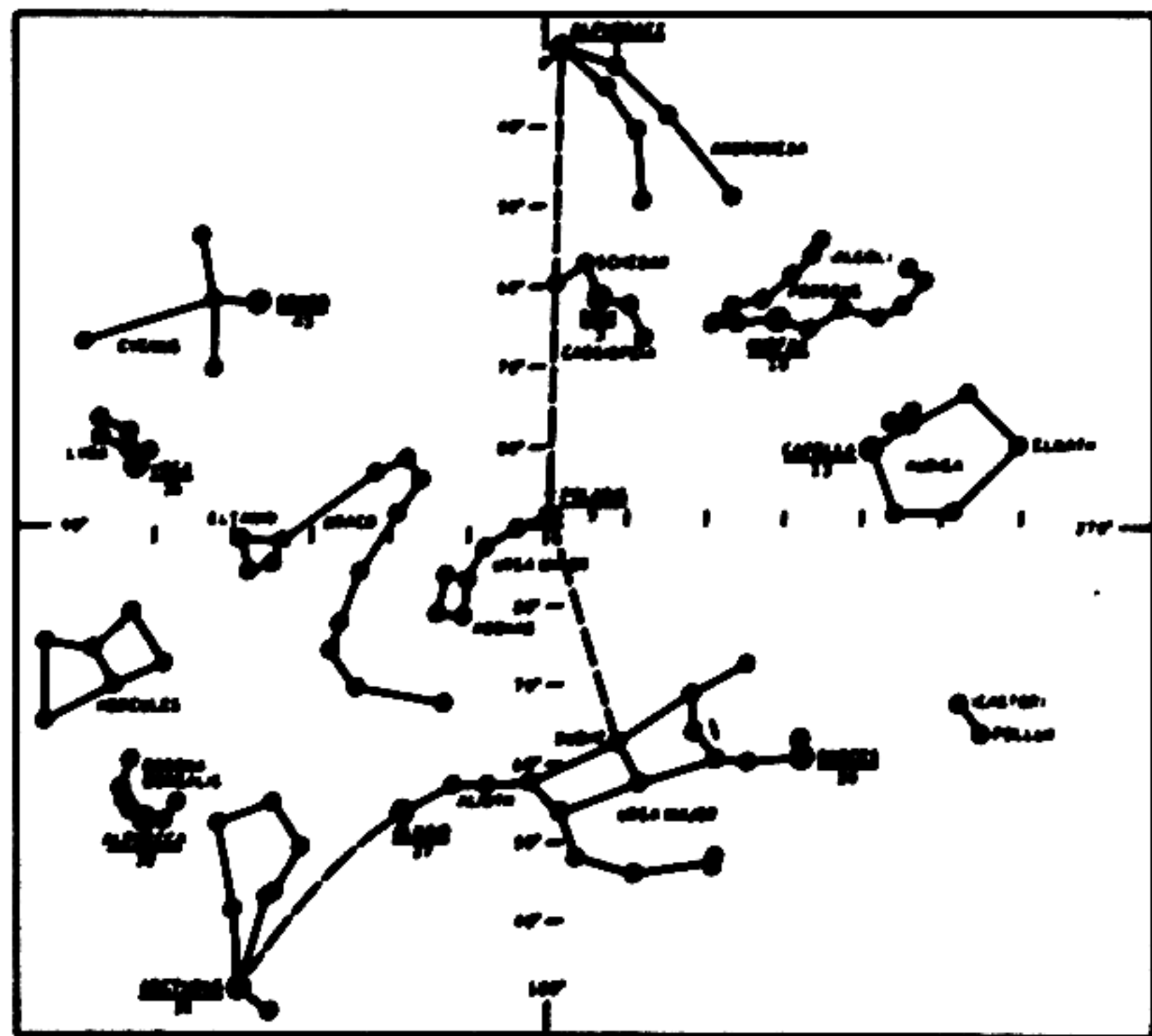


LM-6

Basic Date October 6, 1969
Changed _____



SOUTHERN STARS



NORTHERN STARS

PGNS-1

STAR LIST

	<u>STAR NAME</u> (Numerical)	<u>STAR NAME</u> (Alphabetical)	
<u>NO</u>			<u>NO</u>
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 October 6, 1969

Changed

PGNS-2

STARS, PROG

PROGRAMS

NO.

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 ΔV
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	ΔV Monitor
51	IMU Orientation Determination
52	IMU Realign
57	Lunar Surface Align
63	Braking Phase
64	Approach Phase
65	Landing Phase (Auto)
66	Landing Phase (ROD)
67	Landing Phase (MANUAL)
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 ΔV

Basic Date October 6, 1969

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

Basic Date October 6, 1969
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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 (Don't Use In Ave G)
- 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 Eraseable 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 Rend^{er})
- 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

Basic Date October 6, 1969

Changed _____

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	Flag Word Operator	ECADR	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

Basic Date October 6, 1969
 Changed

NOUNS

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

Basic Date October 6, 1969

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PGNS-7

60	V (Horizontal) (Always +)	.1fps
	H DOT (+ Increasing H)	.1fps
	H	ft
61	TG	min-sec
	TFI	min-sec
	Crossrange	.1nm
62	VI	.1fps
	TFI	min-sec
	ΔV Accumulated	.1fps
63	VI	.1fps
	H DOT (+ Increasing H)	.1fps
	H	ft
64	TR/LPD	Sec/deg
	H DOT (+ Increasing H)	.1fps
	H	ft
65V	Sampled LGC Time, Hrs	hrs
	Min	min
	Sec	.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 (Δ Alt)	ft
69	Ldg Site Correction Comp Z,X,Y	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	ΔH (CDH)	.1nm
	ΔT (CDH-CSI/TPI-CDH)(Modular 60)	min-sec
	ΔT (TPI-CDH/TPI-Nom TPI)(Modular 60)	min-sec
76	V (HOR)	.1fps
	V (VERT)	.1fps
	Crossrange	.1nm

Basic Date October 6, 1969
 Changed - October 17, 1969

PGNS-8

77	ΔT 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	ΔV_X (LV) (+ Fwd)		.1fps
	ΔV_Y (LV) (+ Rt)		.1fps
	ΔV_Z (LV) (+ Dn)		.1fps
82	ΔV_X (LV) (+ Fwd)		.1fps
	ΔV_Y (LV) (+ Rt)		.1fps
	ΔV_Z (LV) (+ Dn)		.1fps
83	ΔV_X (LM) (+ Up)		.1fps
	ΔV_Y (LM) (+ Rt)		.1fps
	ΔV_Z (LM) (+ Fwd)		.1fps
84	ΔV_X (Other Vehicle) + (RXV)XR		.1fps
	ΔV_Y (Other Vehicle) + (VXR)		.1fps
	ΔV_Z (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	.XXXXX
		Y	.XXXXX
		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°

Basic Date - October 6, 1969

Changed

PGNS-9

93	Δ Gyro Torquing Angles	X	.001°
		Y	.001°
		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 = REFSMAT 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 = REFSMAT + 1G 2 = 2 Bodies 3 = 1 Body + 1G

CHECKLIST CODES
ALARMS

Basic Date October 6, 1969
Changed

LM-6

PGNS-11

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 FINDCDUM 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

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, PRO
 LDG ANT - HOVER

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

00526 I Range >400 Miles.Terminate P20

Basic Date — October 6, 1969
 Changed — October 24, 1969

LM-6

PGNS-12

- 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 ΔV 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 N08 & Record For MSFN
- 21103 I **Unused CCS Branch Executed
Copy N08, 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 - October 6, 1969

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
 ΔT
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

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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 TIMES/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

October 6, 1969

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LM-6

RECOV-1

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
V21 N10E, 13E, 0E
V37E 00E
- 2 V37E 51E
PRO
V37E 00E
- 3 V25 N07E, 77E, 10000E, 1E

Basic Date October 6, 1969
Changed October 24, 1969

RECOV-2

P63

1 V37E 00E
V25 N07E, 102E, 200E, E

V30 OR V31

1 Record N26,
Notify MSFN
V74E
Perform General System Checkout

V36

1 If Unstaged V21 N01E 3000E, 2343E
Perform General System Checkout If Necessary

V92 (POO ONLY)

1 V37E 00E
V93E

GO JAM

1 V74 when Convenient (See V36)

STAR CODE >50

1 Perform General System Checkout

Basic Date. October 6, 1969
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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 To 8 *
 * (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 October 6, 1969
 Changed

P22 LUNAR SURFACE NAVIGATION

1

V95E
V37E22E
(To TERM-V56E)
(SV OPTION, V81E CSM, V95E NONE)
F 04 06 R1 00012 CSM ORBIT OPTION
R2 00001 CSM WILL NOT CHANGE
ORBIT
00002 CSM WILL CHANGE ORBIT

(OPT 1) To 3
(OPT 2) PRO To 2

2

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

3

V83E, Rng <400, PRO, PRO
V16N38E
When N38 = Present time and remains equal:
V24N01E, 3424E
Load MSFN supplied octal acq. time
RR MODE - LGC To 5
- SLEW or AUTO TRACK To 4

4

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

*PROG Lt-On *
F 05 09 00530 CSM NOT IN MODE II
* LIMITS YET *
* (WAIT FOR CSM) PRO *
* V37E 22E *
* (TERM) V56E *

5

NO TRACK Lt:
OUT DSKY BLANKS, RR TAKING MARKS
(P22 Continues To Run In Background)

Basic Date October 6, 1969
Changed October 23, 1969

LM-6

PGNS-22

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

Basic Date.) October 6, 1969

Changed _____

P25 PREFERRED TRACKING ATT

1 V37E 25E
 (To TERM - V56E)
 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 Mnv, To 1

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

P27 LGC MANUAL UPDATE

1 (NOTE: For Auto Update, If V33 N02
 Displayed Key PRO; If V21 N02
 or N01 Displayed Key V34E)

2 V37E 00E

3 IF AGS OPERATING, 563 + 00000E

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 October 6, 1969
 Changed

PGNS-24

- 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 1167 When Data Load Complete

TO REVIEW DATA

V01 NOTE, T173E

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 October 6, 1969

Changed

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 (.1rm,.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
REFSMAT 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 APGIS 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 October 6, 1969

Changed

P33 CDH PRETHRUST

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

Basic Date October 6, 1969
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 REFSHMT 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

Basic Date October 6, 1969
Changed

LM-6

P40-P47

PGNS-30

3 06 40 TFI, VG, VM (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
 ENG ARM - DES

-:30 06 40 (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-On *
 * 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 October 6, 1969
 Changed

LM-6

PGNS-31

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 Mmvr 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 October 6, 1969
 Changed

PGNS-32

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 1, Man Stage*
 * At -:30 *

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 1
 (BYPASS) ENTR To 3

3

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

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

4

06 40 TFI, VG, VM (min-sec, .1fps)
 EVENT TIMER-SET

-:35 DSKY BLANKS
 ENG ARM-ASC

-:30
 06 40 (AVE G ON)

-:15 Verify ΔVM (R3) <00005

Basic Date October 6, 1969
 Changed _____

-:05
 F 99 40 ENG ON ENABLE
 -:03.5 Verify +X ULLAGE
 (V34E NO ULLAGE, ENG ARM-OFF, To 5)
 (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 5 *

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

2 F 37

Basic Date October 6, 1969
 Changed _____

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 REFSMAT PRO To 6
 4 LANDING SITE PRO To 2

Basic Date October 6, 1969
 Changed _____

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 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 October 6, 1969
 Changed

RAPID IMU REALIGN

**NOTE: This Procedure Assumes A Good
AGS Alignment**

- 1 Fly Spacecraft to 0°,0°,0° On AGS Inertial Ball**
- 2 V41 N20E
E,E,E, (Coarse Align IMU To 0°,0°,0° Body)**
- 3 V40 N20
Verify 0°,0°,0° On AGS Ball - ENTR
(Releases Platform and Recovers PGNS
Control Modes)
Wait 15 sec**
- 4 V37E 51E
PRO On First Display (Sets Drift Flag)
V37E 00E**
- 5 V25 N07E
77E, 10000E, 1E (Sets REFSMAT 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 October 6, 1969
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
 (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 October 6, 1969
 Changed

PGNS-39

- 4 **Determination of Lunar Gravity**
ATTITUDE MON - PGNS
V16N20E Monitor Coarse Align (.01°)
 R1 +04200
 R2 +31800
 R3 +03525
NO ATT Lt - On Then Off (Twice)
 *PROG Lt - On *
 V05N09E 00211 & 00217
- KEY REL**
- 5 F 06 04 **(+) GRAVITY ERROR ANGLE (.01°)**
 (RECYCLE) V32E To 4
 (TERM) V34E, Select New Prog
 PRO (If A/T = 00001 or 00003
 Go To 13)
- 6 F 01 70 **R1 OOCDE (C) DETENT (DE) STAR CODE**
 (DETENT) 1-L, 2-F, 3-R, 4-RR, 5-CL, 6-LR
 PRO (Go to 8 If DE >45 or = 00)
- *PROG Lt - On *
 F 05 09 00404 Defined Star
 * Not Available In *
 * Any Detent *
 *(CREW SPECIFY) PRO To 8 *
 *(LGC CALC N79) V32E To 6 *
- 7 F 06 79 **CURSOR, SPIRAL, POSITION CODE (.01°)**
 (REDEFINE STAR) V32E To 6
 PRO
- *PROG Lt - On *
 *V05N09E *
 * 20105 AOT Mark System*
 * In Use *
 * 31207 No VAC Area *
 * For Marks *
 * 31211 Illegal *
 * Interrupt of *
 * Extended Verb *
 *V37E XXE *

Basic Date October 6, 1969

Changed

PGNS-40

- 8 F 01 71 R1 OOCDE (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 13a
(TERM) V34E

Basic Date October 6, 1969
Changed

P63-P68

PGNS-41

P63-P68

13 If Gyro Angles >5°
F 06 22 ICDU ANGLES 06,IG,MG (.01°)
PRO
NO ATT Lt - On Then Off
If Gyro Angles <5°

13a Monitor Gyro Torquing
V16N93E (.001°)
KEY REL
(If A/T 00002 OR 00003 & First Pass Through
Step 13) To 6
(If A/T 00001 & First Pass Through
Step 13) Go To 11, (If A/T 00000, Go To 14)

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,
ENTER 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 October 6, 1969

Changed

PGNS-42

2 F 06 61 T6,TFI (min-sec)
 R3, CROSSRANGE (-NORTH) (.1mm)
 SET EVNT TMR 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 Mnr 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 | October 6, 1969
 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 ΔVM (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, ΔH (LR-LGC)
(.1nm, min-sec, ft)
(UPDATE) PRO
(EXIT V57) V34E (To 06 63)

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

(MAN) MODE CONT:PGNS-ATT HOLD

October 6, 1969

Basic Date _____
Changed _____

PGNS-44

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 *

+08:30 P64 DISPLAYED

P64 APPROACH PHASE

1 P64 DISPLAYED

2 F 06 64 R1,TR/LPD, (sec-deg)
 R2 H DOT(-For Descent) (.1fps)
 R3 H(+ Landing Site Radius) (ft)

F 05 09 00523 LR DID NOT
 * ACHIEVE POS 2 *
 *(CONTINUE) PRO *
 * * *
 *(RECHECK) V32E *
 * * *
 *(TERM R12) V34E *

Monitor Attitude Change
 To Enable Landing Site
 Visibility.

(MAN) 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.

Basic Date October 6, 1969
 Changed

PGNS-45

4 Redesignate Landing Site
As Desired (+Pitch Redesignates
Landing Site Toward LM)

5 P65 DISPLAYED

P65 LANDING PHASE (AUTO)

1 P65 Displayed

2 F 06 60 V (HOR) (.1fps)
H DOT (-Descent) (.1fps)
H (+ >LANDING SITE RADIUS) (ft)

Monitor Attitude Maneuver To
Local Vertical Attitude
(+Z Downrange)

H DOT (R2)= -00030
MODE CONT: PGNS-ATT HOLD
or AUTO

(ROD LANDING) MODE CONT: PGNS-ATT HOLD
ROD - Activate
To P66

(MAN LANDING) TTCA - Advance Until:
THRUST: CMD=10%
THR CONT - MAN
To P67

(AUTO LANDING) To 3

3 H(actual)= 5.6 ft LUNAR CONTACT Lt - On
MODE CONTROL - ATT HOLD
ENGINE STOP - Push
PRO

TD+3:00

V37E 68E To P68

P66 LANDING PHASE (ROD)

1 P66 Displayed
(From P67)TTCA-Retard Gradually
THRUST IND(Left Side)-Monitor
(Maintain Constant Thrust/
Chamber Pressure)

Basic Date— October 6, 1969
Changed—

LM-f

PGNS-46

2 F 06 60 V(HOR) (.1fps)
H DOT(-Descent) (.1fps)
H(+ >Landing Site Radius) (ft)
ROD - Input ROD As Desired

(MAN LANDING) TTCA - Advance Until:
THRUST IND: CMD=10%
THR CONT - MAN
To P67

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

P67 LANDING PHASE (MANUAL)

1 P67 Displayed

2 F 06 60 V(HOR) (.1fps)
H DOT (-Descent) (.1fps)
H(+ >Landing Site Radius) (ft)
(ROD LANDING) THR CONT - AUTO
To P66

3 H(actual)=5.6 ft LUNAR CONTACT Lt - ON
ENGINE STOP - Push
TD+3:00 PRO
V37E 68E To P68

P68 LANDING CONFIRMATION

1 V37E 68E

2 F 06 43 LAT(+NORTH),LONG(+EAST),ALT (.01°, .1nm)
RECORD LAT _____ °
LONG _____ °
ALT _____ nm (Nominal zero)
PRO

3 F 37

Basic Date October 6, 1969
Changed _____

P70-P71

LM-6

PGNS-47

P70 DPS ABORT

1 ABORT-PUSH (From P63,64,65,66,67)
 *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-Monitor Attitude Mnr To
 Local Vertical With Windows
 Downrange. X-axis Override
 Inhibited.

H>25000-or H DOT >00400-Monitor Atti-
 tude Mnr To Abort Attitude
 With Windows Downrange.
 X-axis Override 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

DPS NULL COMPONENTS
 OFF KEY REL

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

Basic Date October 6, 1969
 Changed October 31, 1969

LM-6

P70-P71

PGNS-47

P70 DPS ABORT

1 ABORT-PUSH (From P63,64,65,66,67)
 *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-Monitor Attitude Mnr To
 Local Vertical With Windows
 Downrange. X-axis Override
 Inhibited.

H>25000-or H DOT >00400-Monitor Atti-
 tude Mnr To Abort Attitude
 With Windows Downrange.
 X-axis Override 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

DPS NULL COMPONENTS
 OFF KEY REL

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

Basic Date - October 6, 1969
 Changed - October 31, 1969

LM-6

P70-P71

PGNS-48

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

9 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 P63,64,65,
66,67,70)

*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 October 6, 1969
Changed _____

PGNS-49

H<25000-Monitor Attitude Mnr To Local Vertical With Windows Downrange. X-axis Override Inhibited.
H>25000 or H DOT>00400-Monitor Attitude Mnr To Abort Attitude With Windows Downrange. X-axis Override 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 = 200 fps,
MAIN SOV (2) - OPEN
SYS A&B ASC FEED 2(2)-CLOSE
CRSFD-CLOSE
VGX - 100 fps,ENG ARM - OFF

***NO Cutoff ***
*** ABORT STAGE - Reset***

APS OFF

**NULL COMPONENTS
 KEY REL**

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

October 6, 1969
October 31, 1969
Basic Date Changed

M-6

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 RI(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 (.1mm,min-sec)

6 F 06 81 ΔVXYZ (LV) (CSI) (.1fps)
 PRO

7 F 06 82 ΔVXYZ (LV) (CDH) (.1fps)
 PRO

Basic Date October 6, 1969
 Changed

PGNS-51

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 (.1mm,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 (.01mm,.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 October 6, 1969

Changed _____

LM-6

P74 CSM TPI TARGETING

- 1 F 06 37 V37E 74E (hrs,min,.01sec)
TIG TPI
PRO
- 2 F 06 55 N,E,CENTANG (0000X,.01°)
PRO
(To Calculate E At TIG Time)
+00000 In R2

*(Calculate E Only) *
*F 05 09 00611 NO SOL *
* PRO To 1 Retarget*
- 3 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)
(RECYCLE) V32E
(TERMINATE MARKS) PRO
(FINAL PASS,MGA,-00002) SET EVENT TIMER
PRO To 8
Transmit Parameters To CSM
- 4 F 06 37 TIG TPI (hrs,min,.01sec)
PRO
(If E Computed, This Display
Replaced By V06N55 As In 2 Above)
- 5 F 06 58 HP,ΔV(TPI),ΔV(TPF) (.1mm,.1fps)
PRO To 7 (Final Pass To 6)
- 6 F 06 81 ΔVXYZ (LV) (.1fps)
PRO
- 7 F 06 59 ΔVXYZ(LOS) (.1fps)
PRO To 3
- 8 F 37

Basic Date — October 6, 1969
 Changed —

PGNS-53

P75 CSM TPM TARGETING

- 1 V37E 75E
F 16 45 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

V37E 76E

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

October 6, 1969

Basic Date
Changed

V40 N20 ICDU ZERO

1 V40 N20E
 *PROG Lt - On *
 *V05 N09E 00206 ISS IN *
 * COARSE ALIGN & GIMBAL *
 * LOCK *
 *Coarse Align To 0,0,0 Then *
 * Reselect V40 N20 *
 NO ATT Lt - OFF

2 Wait 15 sec Then Continue Program In Progress

V41N20 COARSE ALIGN IMU

1 F 21 22 V41N20E
 LOAD NEW ICDU ANGLES 0,I,M (.01°)

2 41 COARSE ALIGN
 NO ATT Lt - On
 FDAI Torques
 *PROG Lt - On *
 *V05N09E 00211 COARSE *
 * ALIGN ERROR *
 *V16N22E Compare N22 With *
 * N20 *
 *Repeat V41N20 *

V41N72 COARSE ALIGN RR

1 RR MODE - LGC

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

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

Basic Date October 6, 1969
 Changed _____

PGNS-55

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

*PR06 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°)
FDAI Needles Deflect

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

5 43 Verify FDAI Needles Return To 0,0,0

Basic Date October 6, 1969

Changed

V40-V49

LM-6

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), 1-Normal (20°/sec)
 (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 October 6, 1969
 Changed

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 Mnr To 3

Basic Date October 6, 1969
 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, .1fps,
 (REINITIAL) V25E, Load Values (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 (.1m,min-sec)
 (UPDATE) V32E (Not Required If AVE G-On)
 PRO

V83 RENDEZVOUS PARAMETER DISPLAY

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

Basic Date October 6, 1969
 Changed _____

V85 RR LOS, ELEV DISPLAY

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 Mvr To 4

V90 OUT-OF-PLANE DISPLAY

1 V90E
F 06 16 GET EVENT (hrs,min,.01sec)
(0, PRESENT TIME)
PRO

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

V55-V90

October 6, 1969

Basic Date

Changed

LM-6

PGNS-60

PGNS TURN-ON AND SELF-TEST

1 If STBY Lt - On, PRO

2 CB(11) PGNS: IMU OPR - Close
(NO ATT Lt - On 90 Sec)

3 F 88 88 V35E
DSKY LIGHT CHECK
(Master Alarm, LGC & ISS Warning,
And ALL DSKY Lts - On, 8's In All
Registers, Lts And DSKY Reset In 5 Sec)
NO ATT Lt - Off (Wait 20 Sec)
RSET

4 F 21 01 V25N01E 1365E
E,E,E

5 15 01 V15 N01E 1365E
R1, R2, R3 All Zero

6 15 01 V21 N27E 10E (Test Fixed And Erasable
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 _____ *

V21 N27E OE TERMINATE SELF TEST

Basic Date October 6, 1969
Changed

PGNS T/O, ORDEAL,
PIPA BIAS

PGNS-61

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 (.1mm,min-sec)
 Average HA & HP
 ALT SET - Set
 PRO

4 F 16 54 V83E
 R, RDOT, THETA (.01mm,.1fps,.01°)
 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 06 21 V06E
 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 October 6, 1969
Changed

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

06 65 V06N65
ON CSM MARK - ENTR
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 October 6, 1969
Changed October 23, 1969

LGC CLOCK INIT.
LR, RR SELF TEST

PGNS-64

- 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 +08277 To +08297
R2 +00002
- 11 F 16 66 LDG ANT - DES (10 sec)
R2 +00001 (PROG Lt-On, V05N09E,00522 RSET)
- 12 F 16 66 LDG ANT - AUTO
R2 +00001
V34E
- 13 RDR TEST - OFF
CB(11) PGNS: LDG RDR - Open

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 October 6, 1969
Changed NOVEMBER 5, 1969

PGNS-65

- 3 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 To
 -500fps, X-Pointers and FDAI Needles Vary
 Between +5°. After 12 sec, Rng Tape Drives
 To 194, NO TRACK Lt - Out)
- 5 TEST MONITOR - AGC (1.0 To 1.8) (1.5)
 - XMTR PWR (2.1 To 4.1) (3.7)
 - SHAFT ERR (2.2 To 2.6@1/2cps)
 - TRUN ERR (2.2 To 2.5@1/2cps)
 - AGC
- 6 Set NORRMON Flag
 V25 N07E
 101E, 10E, 1E
 RR MODE - LGC(NO TRACK Lt - On, Wait 10 sec)
- 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 (.01m, fps, min-sec)
 R1 +195.30 To +195.70 (TM Within +1.2 of R1)
 R2 -00480 To -00520 (TM=2 <R2)
 R3 00:00
- 10 V34E

Basic Date ~~October 6, 1969~~
 Changed ~~October 31, 1969~~

LM-6

PGNS-66

11 RADAR TEST - OFF (NO TRACK Lt - On,
X-Pntr-Center)

12 V40N72E RRCDU ZERO (10 sec)

13 SHFT/TRUN - $\pm 50^\circ$
V41N72E
N73 R1 +04000
R2 +04000
N12 R2 00002
V16N72E (Verify FDAI Needles Up & Right)
V44E

14 SHFT/TRUN - $\pm 5^\circ$
RR GYRO SEL - PRIM
V41N72E
N73 R1 -00400
R2 -00400
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

Basic Date October 6, 1969
Changed NOVEMBER 5, 1969

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

* CAUTION *
Affected Quad Valve Must
Be Open Before Next Step

2

1E

3

V48E
PRO
V34E

RR BIAS INITIALIZATION

1

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

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)E

Basic Date - October 6, 1969
Changed _____

THRUSTER INHIBIT,
RR BIAS, E-MEM

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

LOAD OUTPUT CHANNELS

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

FLAG WORD SET/RESET

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

RMAX - VMAX LOAD

V24 N01E
 2004E (RMAX)
 77776E
 77776E

Basic Date — October 6, 1969
 Changed — October 24, 1969

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

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

Basic Date October 6, 1969
 Changed _____

LM-6

Basic Date October 6, 1969
Changed

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

PGNS-70

FLAG LIST
CHANNEL LIST

**FLAG LIST
CHANNEL LIST**

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

PGNS-71

LM-6

Basic Date October 6, 1969
Changed _____

LM-6

Basic Date October 6, 1969
Changed

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

NON FLAGS

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

PGNS-73

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 RRCU
	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

Basic Date October 6, 1969
 Changed

PGNS-76

33 (INVERTED)	2	E=0,1,4,5	RR PWR ON/AUTO
	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

Basic Date October 6, 1969
 Changed

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)
407	+70000	Inflight Accelerometer Only Calibration (32 sec)
	+00000	Use Rotating External ΔV Reference Frame
410	+10000	Freeze External ΔV in Inertial Space And Allow ΔV 's To Count
	+00000	Orbit Insertion Routine
	+10000	CSI Routine
	+20000	CDH Routine
	+30000	TPI Search Routine
	+40000	TPI Execute Routine
411	+50000	External ΔV
	+00000	DPS or RCS Engine Select
412	+10000	APS Engine Selection
	+00000	Reinitiate Test
	+10000	Test Successful
	+30000	Logic Test Fail
	+40000	Memory Test Fail
	+70000	Logic & Memory Test Fail
	413	+00000
+10000		Store Lunar Azimuth
414	+00000	Navigation Initialization Complete (AUTO)
	+10000	LM And CSM Navigation Initialization via PGNCs Downlinks
	+20000	LM Navigation Initialization via DEDA
	+30000	CSM Navigation Initialization via DEDA

AGS LOGIC

Basic Date - October 6, 1969

Changed _____

AGS-2

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)
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)

Basic Date -- October 6, 1969
 Changed -- NOVEMBER 5, 1969

AGS LOGIC

DEDA INPUT/OUTPUT LISTAddress

047	Sine of Landing Azimuth Angle	Octal
053	Cosine of Landing Azimuth Angle	Octal
223	Attitude Update Input	100 ft
224	Term In LM Desired Semi-major Axis α_L (O.I.)	100 ft
225	Lower Limit of α_L (O.I.)	100 ft
226	Upper Limit of α_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
306	Target Time Of Node Prior To Rendezvous	.01 min
307	Time From TPI To Rendezvous	.01 min
310	Targeted TFI TPI (For TPI Search Routine)	.01 min
312	TPI Rendezvous Offset Time (Stable Orbit Rendezvous)	.01 min

DEDA INPUT/OUTPUT
CONSTANTSBasic Date October 6, 1969
Changed

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	ΔV_X (Use 470 For Readout)	Octal
405	ΔV_Y (Use 471 For Readout)	Octal
406	ΔV_Z (Use 472 For Readout)	Octal
450	ΔV_X (LV) (+Fwd)	.1fps
451	ΔV_Y (LV) (+Rt)	.1fps
452	ΔV_Z (LV) (+Dn)	.1fps
464	Vertical Pitch Steering, Attitude Rate Threshold	.1fps
465	Target Radial Rate at Insertion (Lower Limit)	.1fps
503	Radar Range Rate (RDOT) Input	.1fps
514	Components of Unit Vector	Octal
515	Used to PROVIDE Yaw	
516	Steering Out of CSM Orbit Plane (400,+10000;623,+10000)	Octal
534	Scale Factor for X Accelerometer	Octal
535	Scale Factor for Y Accelerometer	Octal
536	Scale Factor for Z Accelerometer	Octal
540	X Accel Bias Comp Coeff	.001 ft/sec ²
541	Y Accel Bias Comp Coeff	.001 ft/sec ²
542	Z Accel Bias Comp Coeff	.001 ft/sec ²
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 (TAN 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

DEDA INPUT/OUTPUT
CONSTANTS

Basic Date October 6, 1969

Changed

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	ΔV To Be Gained (Except CDH)	.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	ΔH 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 (Except 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	ΔV For CDH (Valid in CSI, Coast)	.1fps
371	ΔV Direct Trans + Braking (TPI)	.1fps

Basic Date October 6, 1969Changed

LM-6

AGS-6

372	CSI To CDH ΔT (CSI)	.1 min
402	ΔH 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	ΔV_X Measured (LM) (+ Up) (Use 404 to zero)	.1fps
471	ΔV_Y Measured (LM) (+ Rt) (Use 405 to zero)	.1fps
472	ΔV_Z Measured (LM) (+ Fwd) (Use 406 to zero)	.1fps
477	Predicted HDOT At CSI, CDH, or TPI Time	.1fps
500	ΔV_{gx} (LM) (+Up)	.1fps
501	ΔV_{gy} (LM) (+Rt)	.1fps
502	ΔV_{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 (4K10)	Factor In LM Desired Semi-major Axis a_L (Orbit Insertion)	100 ft
230 (2K19)	ΔP 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

Basic Date October 6, 1969

Changed _____

AGS-7

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
666	(4K21)	Scale Factor For Attitude Error	Octal

Basic Date — October 6, 1969
 Changed —

AGS-8

ORBIT INSERTION

1 MODE CONT: AGS - ATT HOLD
 GUID CONT - AGS
 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+(α Lower) (100ft)
 226+(α Upper) (100ft)
 227+(4K10) (100ft)
 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

	<u>DES</u>	<u>ASC</u>	<u>RCS</u>
<u>THR CONT</u>	<u>MAN</u>	-	-
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 October 6, 1969

Changed

AGS PROG

LM-6

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 MODE CONT: AGS - AUTO

- 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 ΔVY (.1fps)
 451 (ΔVY) (Same sign As 263)
 407+1
 NULL 501,502,500
 (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 October 6, 1969
 Changed

AGS-10

CSI

- 1 MODE CONT: AGS - ATT HOLD
 GUID CONT - AGS

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

- 3 477R HDOT CSI (.1fps)

- 4 310R TFI CSI (.01 min)
 EVENT TIMER - SET

- 5 If Time Available
 372R ΔT CSI To CDH (.1min)
 303R LM/CSM Phase Angle (.01°)
 371R ΔV CDH (.1fps)
 477R Predicted HDOT (.1fps)
 314R ΔH At TIG (.1nm)
 402R ΔH CDH (.1nm)

- 6 410 + 5 EXT ΔV
 450R ΔVX CSI (.1fps)
 263R ΔVY CSI (.1fps)
 451 (ΔVY CSI) (Same sign as 263) (.1fps)
 452R ΔVZ CSI (.1fps)
 267R ΔVG CSI (.1fps)

- 7 411 +0 DES ENG OR RCS BURN
 +1 ASC ENG BURN

- 8 623 +0 Z-Axis Parallel to CSM Orbit Plane
 +1 Z-Axis Parallel to Specified Plane

Basic Date — October 6, 1969
 Changed —

AGS-11

- 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

October 6, 1969
 Basic Date _____
 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 $\Delta VG < 15fps$,
MODE CONTROL (AGS)-ATT HOLD
- 18 When Burn Complete:
ABORT (STAGE) Reset
NULL 501,502,500
- 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 October 6, 1969
Changed

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 501, 502, 500 (fps)

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

Basic Date — October 6, 1969
 Changed —

AGS-17

- 8 623 +0 Z-Axis Parallel To CSM Orbit Plane
+1 Z-Axis Parallel To Specified Plane
- 9 If 623 +1, Specify Plane
514 +(X-Component of Unit Vector)
515 +(Y-Component of Unit Vector)
516 +(Z-Component of Unit Vector)
- 10 400 +1 GUIDANCE STEERING (Z Axis, 400+2,507+1)

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

12 407 +0

13 501R VGY (LM) (.1fps)
502R VGZ (LM) (.1fps)
500R VGX (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/TRANS	2 JET	2 JET	2 JET
	TTCA (CDR)	THROT	JETS	JETS
	DEADBAND	MIN	MIN	MIN
	ABORT PB	PUSH	PUSH	-
	ENG ARM	DES	ASC	OFF
	MASTER ARM	ON(1st Burn Only)	ON(Un- Staged Only)	OFF
	PRPLNT QTY MON	DES 1	OFF	-
	PRPLNT TEMP/PRESS MON	DES 1	ASC	-
	HELIUM MON	SUPCRIT PRESS	PRESS 2	-
	ENGINE STOP	-	-	DEPRESS

Basic Date October 6, 1969
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 501, 502, 500 (fps)
- 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 October 6, 1969

Changed

TPM

Retargeting (Same Rndz Time)

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

Basic Date October 6, 1969
 Changed

AGS-21

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

AGS MAN THRUST

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 $\Delta VG < 15\text{fps}$,
 MODE CONTROL (AGS) - ATT HOLD

13 When Burn Complete
 ABORT(STAGE) - Release
 NULL 501, 502, 500 (.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 — October 6, 1969
 Changed —

AGS MAN THRUST

AGS MANUAL THRUST

- | | | |
|---|--|---|
| 1 | GUID CONT
MODE CONT: AGS
ATT CONT RPY
DEADBAND
TTCA/TRANSL
TTCA(CDR) | -AGS
-ATT HOLD
-MODE CONT
-MIN
-ENABLE
-JETS |
| 2 | MNVR Vehicle To Desired Attitude (Align One
Of The Spacecraft Body Axes In The Desired
Thrust Direction) | |
| 3 | 400 +0
MODE CONT: AGS - AUTO
404 +0
405 +0
406 +0 | |
| 4 | Monitor ΔV Along Thrust Axis
X - 470R
Y - 471R
Z - 472R | (.1fps)
(.1fps)
(.1fps) |
| 5 | Thrust Residuals | |
| 6 | Trim Residuals | |
| | X - 470R
Null (TTCA Up/Dn)
(If Thrust Axis Acquire Desired ΔV) | (.1fps) |
| | Z - 472R
Null (TTCA In/Out)
(If Thrust Axis Acquire Desired ΔV) | (.1fps) |

Basic Date October 6, 1969
 Changed

AGS ACTIVATION & SELF TEST

1 AGS STATUS - STBY
 (AGS Warn Lt - On)
 CB(11) AC BUS B: AGS-Close
 CB(16) STAB/CONT: AEA-Close
 (AGS Warn Lt - Off)
 AGS STATUS - OPERATE
 (AGS Warn Lt - On)
 02/H2O QTY MON - CWEA RESET
 (AGS Warn Lt - Off)

2 000 +888888 (OPR ERR Lt - On)

3 123 -45679

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

5 574 +0 DESCENT STAGE FLAG (+NOT STAGED)

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

7 612R +0 STAGING SEQ COUNTER

AGS ACT, SELF-
 TEST, CALIBRATION

Basic Date October 6, 1969
 Changed

AGS CALIBRATION

- 1 Verify AGS In Standby/Operate For 25 min

- 2 Read And Record

540R X ACCEL BIAS		(.001 ft/sec ²)
541R Y		(.001 ft/sec ²)
542R Z		(.001 ft/sec ²)
544R X GYRO DRIFT COEFF		(.01°/hr)
545R Y		(.01°/hr)
546R Z		(.01°/hr)

- 3 V16N20E

16	20	ICDU Angles 0,I,M
		CSM MNVR Until LM Angles: 292.5°
		338.0°
		337.0°

Rates <.075°/sec
 Disable CSM & LM Thrusters
 V40N20E

- 4 400 +6 CALIBRATE GYRO & ACCEL

Read And Record		
540R X ACCEL BIAS		(.001 ft/sec ²)
541R Y		(.001 ft/sec ²)
542R Z		(.001 ft/sec ²)

Values Should Not Change From Step 2
 By More Than (.039) ft/sec² (.008nom)

- 5 400R +0 GYRO & ACCEL CALIBRATE COMPLETE (302 Sec)

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

Values Should agree with Step 2 Values
 Within 2.0°/hr (Nominal 0.9)

AGS ACT, SELF TEST, CALIBRATION

Basic Date October 6, 1969
 Changed October 24, 1969

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 October 6, 1969
 Changed

LM-6

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

Basic Date October 6, 1969
Changed _____

AGS MAN S.V.:
BACK-UP ALIGN

Basic Date October 6, 1969

Changed

LM-6

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	
												22	
												23	
												24	
X	X	X				X	X	X				N34	HR
X	X	X	X			X	X	X	X				MIN
X	X					X	X					NAV	CHECK
	0						0					N43	LAT
													LONG
+	0					+	0						ALT

P27 UPDATE (LM)

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	
											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 October 6, 1969
 Changed _____

LM-6

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 October 6, 1969
 Changed

LM-6

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 October 6, 1969
 Changed _____

LM-b

P 30 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								•					•
AVR			+					•	+				•
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 October 6, 1969
 Changed _____

P30 UPDATE (LM)

P30 UPDATE (LM)

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								•					•
AVR			+					•	+				•
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 October 6, 1969
 Changed _____

LM-7

P 30 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							•					•
AVR			+				•		+			•
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 October 6, 1969
 Changed

P 30 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								•				•
AVR			+					•	+			•
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 October 6, 1969
 Changed _____

AGS STATE VECTOR UPDATE

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

REMARKS:

Basic Date October 6, 1969
 Changed

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 October 6, 1969

Changed _____

AGS STATE VECTOR UPDATE

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

REMARKS:

Basic Date October 6, 1969
 Changed

AGS STATE VECTOR UPDATE

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

REMARKS:

Basic Date October 6, 1969

Changed _____

AGS STATE VECTOR UPDATE

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

REMARKS:

Basic Date October 6, 1969
 Changed

Basic Date October 6, 1969
 Changed NOVEMBER 3, 1969

VENUS HALF-UNIT VECTORS

GMT M:D:H	GET Hr	X vector	Y vector	Z vector
11:14:16	0	-.40935	-.26799	-.10306
11:14:21	5	-.40806	-.26969	-.10383
11:15:02	10	-.40672	-.27138	-.10461
11:15:07	15	-.40539	-.27306	-.10538
11:15:12	20	-.40406	-.27474	-.10614
11:15:17	25	-.40271	-.27641	-.10691
11:15:22	30	-.40136	-.27807	-.10767
11:16:03	35	-.40000	-.27973	-.10843
11:16:08	40	-.39864	-.28138	-.10919
11:16:13	45	-.39726	-.28303	-.10994
11:16:18	50	-.39588	-.28467	-.11069
11:16:23	55	-.39449	-.28630	-.11144
11:17:04	60	-.39309	-.28793	-.11219
11:17:09	65	-.39168	-.28955	-.11294
11:17:14	70	-.39027	-.29116	-.11368
11:17:19	75	-.38885	-.29277	-.11442
11:18:00	80	-.38742	-.29437	-.11516
11:18:05	85	-.38598	-.29596	-.11589
11:18:10	90	-.38454	-.29755	-.11663
11:18:15	95	-.38309	-.29913	-.11736
11:18:20	100	-.38163	-.30071	-.11809
11:19:01	105	-.38016	-.30227	-.11881
11:19:06	110	-.37869	-.30384	-.11954
11:19:11	115	-.37720	-.30539	-.12026
11:19:16	120	-.37571	-.30694	-.12098
11:19:21	125	-.37422	-.30848	-.12169

GMT M:D:H	GET Hr	X vector	Y vector	Z vector
11:20:02	130	-.37271	-.31002	-.12241
11:20:07	135	-.37120	-.31154	-.12312
11:20:12	140	-.36968	-.31307	-.12383
11:20:17	145	-.36816	-.31458	-.12453
11:20:22	150	-.36662	-.31609	-.12524
11:21:03	155	-.36508	-.31759	-.12594
11:21:08	160	-.36353	-.31909	-.12664
11:21:13	165	-.36197	-.32058	-.12733
11:21:18	170	-.36041	-.32206	-.12803
11:21:23	175	-.35884	-.32353	-.12872
11:22:04	180	-.35726	-.32500	-.12941
11:22:09	185	-.35568	-.32646	-.13009
11:22:14	190	-.35408	-.32792	-.13078
11:22:19	195	-.35248	-.32937	-.13146
11:23:00	200	-.35087	-.33081	-.13214
11:23:05	205	-.34926	-.33224	-.13281
11:23:10	210	-.34764	-.33367	-.13349
11:23:15	215	-.34601	-.33509	-.13416
11:23:20	220	-.34437	-.33651	-.13483
11:24:01	225	-.34273	-.33792	-.13550
11:24:06	230	-.34107	-.33932	-.13616
11:24:11	235	-.33942	-.34071	-.13682
11:24:16	240	-.33775	-.34210	-.13748
11:24:21	245	-.33608	-.34348	-.13814
11:25:02	250	-.33440	-.34485	-.13879

* Planet is within 15 degrees of the sun

PLANET VECTORS
 NOV 14

PLANET VECTORS

NOV 14

MAJIB HALF-UNIT VECTORS

GMT M:D:H	GET Hr	X vector	Y vector	Z vector
11:14:16	0	.30172	-.35270	-.17244
11:15:02	10	.30387	-.35803	-.17172
11:15:12	20	.30601	-.35655	-.17100
11:15:22	30	.30814	-.35506	-.17027
11:16:08	40	.31026	-.35356	-.16953
11:16:18	50	.31237	-.35205	-.16879
11:17:04	60	.31448	-.35053	-.16805
11:17:14	70	.31657	-.34900	-.16730
11:18:00	80	.31866	-.34746	-.16655
11:18:10	90	.32073	-.34591	-.16579
11:18:20	100	.32280	-.34435	-.16503
11:19:06	110	.32485	-.34278	-.16427
11:19:16	120	.32689	-.34120	-.16350
11:20:02	130	.32892	-.33961	-.16273
11:20:12	140	.33094	-.33802	-.16195
11:20:22	150	.33295	-.33641	-.16118
11:21:08	160	.33495	-.33480	-.16039
11:21:18	170	.33693	-.33318	-.15961
11:22:04	180	.33891	-.33155	-.15882
11:22:14	190	.34087	-.32991	-.15803
11:23:00	200	.34282	-.32827	-.15724
11:23:10	210	.34476	-.32662	-.15644
11:23:20	220	.34668	-.32496	-.15564
11:24:06	230	.34860	-.32329	-.15484
11:24:16	240	.35050	-.32161	-.15403
11:25:02	250	.35239	-.31993	-.15322

JUPITER HALF-UNIT VECTORS

GMT M:D:H	GET Hr	X vector	Y vector	Z vector
11:14:16	0	-.45655	-.19071	-.07210
11:15:12	20	-.45595	-.19195	-.07263
11:16:08	40	-.45534	-.19318	-.07315
11:17:04	60	-.45474	-.19440	-.07367
11:18:00	80	-.45414	-.19562	-.07418
11:18:20	100	-.45353	-.19682	-.07469
11:19:16	120	-.45292	-.19802	-.07520
11:20:12	140	-.45232	-.19921	-.07570
11:21:08	160	-.45171	-.20039	-.07620
11:22:04	180	-.45110	-.20157	-.07670
11:23:00	200	-.45049	-.20274	-.07720
11:23:20	220	-.44988	-.20391	-.07769
11:24:16	240	-.44927	-.20507	-.07818

SATURN HALF-UNIT VECTORS

GMT M:D:H	GET Hr	X vector	Y vector	Z vector
11:14:16	0	.41333	.26061	.08988
11:16:18	50	.41408	.26558	.08948
11:18:20	100	.41480	.26459	.08910
11:20:22	150	.41549	.26363	.08874
11:23:00	200	.41616	.26269	.08840
11:25:02	250	.41680	.26179	.08807

Basic Date October 6, 1969
 Changed NOVEMBER 3, 1969

Basic Date October 6, 1969
 Changed NOVEMBER 3, 1969

VENUS HALF-UNIT VECTORS			
g.e.t., hr	X vector	Y vector	Z vector
108.5	-.37881	-.30370	-.11945
110.5	-.37822	-.30432	-.11974
112.5	-.37763	-.30494	-.12003
114.5	-.37704	-.30556	-.12031
116.5	-.37645	-.30618	-.12060
118.5	-.37585	-.30679	-.12088
120.5	-.37526	-.30741	-.12117
122.5	-.37467	-.30802	-.12145
124.5	-.37407	-.30863	-.12173
126.5	-.37347	-.30924	-.12202
128.5	-.37287	-.30985	-.12230
130.5	-.37227	-.31046	-.12258
132.5	-.37167	-.31107	-.12286
134.5	-.37107	-.31167	-.12315
136.5	-.37047	-.31228	-.12343
138.5	-.36986	-.31288	-.12371
140.5	-.36926	-.31349	-.12399
142.5	-.36865	-.31409	-.12427
144.5	-.36804	-.31469	-.12455

JUPITER HALF-UNIT VECTORS			
GMT LO ____:____:____			
g.e.t., hr	X vector	Y vector	Z vector
108.5	-.45323	-.19739	-.07493
120.5	-.45288	-.19810	-.07523
132.5	-.45252	-.19881	-.07552
144.5	-.45216	-.19951	-.07582

EARTH HALF-UNIT VECTORS

G.e.t., hr	X vector	Y vector	Z vector	G.e.t., hr	X vector	Y vector	Z vector	G.e.t., hr	X vector	Y vector	Z vector
110.00	-.49993	.00176	-.00856	121.00	-.49676	-.04550	-.03409	132.00	-.48792	-.09192	-.05905
110.50	-.49991	-.00041	-.00973	121.50	-.49648	-.04764	-.03524	132.50	-.48739	-.09400	-.06016
111.00	-.49988	-.00256	-.01089	122.00	-.49619	-.04977	-.03638	133.00	-.48685	-.09608	-.06128
111.50	-.49984	-.00472	-.01206	122.50	-.49589	-.05189	-.03753	133.50	-.48629	-.09816	-.06239
112.00	-.49978	-.00688	-.01323	123.00	-.49557	-.05402	-.03868	134.00	-.48572	-.10023	-.06350
112.50	-.49972	-.00903	-.01439	123.50	-.49525	-.05615	-.03982	134.50	-.48515	-.10230	-.06461
113.00	-.49964	-.01119	-.01556	124.00	-.49491	-.05827	-.04096	135.00	-.48456	-.10437	-.06572
113.50	-.49955	-.01334	-.01672	124.50	-.49456	-.06039	-.04210	135.50	-.48396	-.10643	-.06683
114.00	-.49944	-.01549	-.01789	125.00	-.49420	-.06251	-.04324	136.00	-.48334	-.10849	-.06793
114.50	-.49933	-.01765	-.01905	125.50	-.49382	-.06462	-.04438	136.50	-.48272	-.11055	-.06903
115.00	-.49920	-.01980	-.02021	126.00	-.49344	-.06674	-.04552	137.00	-.48209	-.11261	-.07013
115.50	-.49907	-.02195	-.02138	126.50	-.49304	-.06885	-.04666	137.50	-.48144	-.11466	-.07123
116.00	-.49892	-.02409	-.02254	127.00	-.49263	-.07096	-.04779	138.00	-.48079	-.11670	-.07232
116.50	-.49875	-.02624	-.02370	127.50	-.49221	-.07307	-.04892	138.50	-.48012	-.11875	-.07342
117.00	-.49858	-.02839	-.02485	128.00	-.49178	-.07517	-.05005	139.00	-.47944	-.12079	-.07451
117.50	-.49839	-.03053	-.02601	128.50	-.49134	-.07728	-.05118	139.50	-.47875	-.12283	-.07560
118.00	-.49820	-.03268	-.02717	129.00	-.49089	-.07938	-.05231	140.00	-.47805	-.12486	-.07669
118.50	-.49799	-.03482	-.02832	129.50	-.49042	-.08147	-.05344	140.50	-.47734	-.12689	-.07777
119.00	-.49777	-.03696	-.02948	130.00	-.48994	-.08357	-.05456	141.00	-.47662	-.12892	-.07885
119.50	-.49753	-.03910	-.03063	130.50	-.48946	-.08566	-.05569	141.50	-.47589	-.13094	-.07994
120.00	-.49729	-.04123	-.03179	131.00	-.48896	-.08775	-.05681	142.00	-.47515	-.13296	-.08101
120.50	-.49703	-.04337	-.03294	131.50	-.48845	-.08984	-.05793	142.50	-.47439	-.13498	-.08209
								143.00	-.47363	-.13699	-.08316

Basic Date October 6, 1969
 Changed - NOVEMBER 3, 1969

Basic Date October 6, 1969
 Changed NOVEMBER 3, 1969

VENUS HALF-UNIT VECTORS

GHE M:D:H	GHE Hr	X vector	Y vector	Z vector
11:16:19	9	-.39559	-.29450	-.11095
11:17:00	5	-.39420	-.29363	-.11110
11:17:05	10	-.39280	-.28826	-.11234
11:17:10	15	-.39132	-.28984	-.11309
11:17:15	20	-.38994	-.29142	-.11383
11:17:20	25	-.38852	-.29310	-.11457
11:18:01	30	-.38713	-.29470	-.11531
11:18:06	35	-.38569	-.29629	-.11604
11:18:11	40	-.38424	-.29787	-.11678
11:18:16	45	-.38279	-.29945	-.11751
11:18:21	50	-.38133	-.30103	-.11824
11:19:02	55	-.37987	-.30259	-.11897
11:19:07	60	-.37838	-.30415	-.11968
11:19:12	65	-.37690	-.30571	-.12040
11:19:17	70	-.37541	-.30725	-.12112
11:19:22	75	-.37391	-.30880	-.12184
11:20:03	80	-.37240	-.31033	-.12255
11:20:08	85	-.37089	-.31186	-.12326
11:20:13	90	-.36937	-.31338	-.12397
11:20:18	95	-.36784	-.31489	-.12468
11:20:23	100	-.36631	-.31640	-.12538
11:21:04	105	-.36477	-.31790	-.12608
11:21:09	110	-.36321	-.31939	-.12678
11:21:14	115	-.36165	-.32088	-.12747
11:21:19	120	-.36009	-.32237	-.12817
11:22:00	125	-.35852	-.32383	-.12887

GHE M:D:H	GHE Hr	X vector	Y vector	Z vector
11:22:05	130	-.35694	-.32530	-.12955
11:22:10	135	-.35535	-.32674	-.13023
11:22:15	140	-.35375	-.32822	-.13092
11:22:20	145	-.35215	-.32966	-.13160
11:23:01	150	-.35054	-.33110	-.13228
11:23:06	155	-.34893	-.33254	-.13295
11:23:11	160	-.34730	-.33397	-.13363
11:23:16	165	-.34567	-.33539	-.13430
11:23:21	170	-.34403	-.33680	-.13497
11:24:02	175	-.34239	-.33820	-.13563
11:24:07	180	-.34074	-.33960	-.13630
11:24:12	185	-.33907	-.34100	-.13696
11:24:17	190	-.33741	-.34238	-.13762
11:24:22	195	-.33573	-.34376	-.13827
11:25:03	200	-.33405	-.34513	-.13892
11:25:08	205	-.33236	-.34650	-.13957
11:25:13	210	-.33067	-.34786	-.14022
11:25:18	215	-.32897	-.34921	-.14087
11:25:23	220	-.32725	-.35057	-.14151
11:26:04	225	-.32553	-.35192	-.14215
11:26:09	230	-.32381	-.35322	-.14279
11:26:14	235	-.32208	-.35454	-.14342
11:26:19	240	-.32034	-.35586	-.14406
11:27:00	245	-.31859	-.35717	-.14469
11:27:05	250	-.31684	-.35848	-.14531

* Planet is within 1° degree of the sun.

PLANET VECTORS

NOV 16

MARS HALF-UNIT VECTORS

GMT M:D:H	GMT Hr	X vector	Y vector	Z vector
11:16:19	0	.31259	-.35190	-.16872
11:17:05	10	.31469	-.35037	-.16797
11:17:15	20	.31679	-.34884	-.16722
11:18:01	30	.31887	-.34730	-.16647
11:18:11	40	.32095	-.34575	-.16571
11:18:21	50	.32301	-.34419	-.16495
11:19:07	60	.32506	-.34262	-.16419
11:19:17	70	.32710	-.34104	-.16342
11:20:03	80	.32913	-.33945	-.16265
11:20:13	90	.33115	-.33785	-.16187
11:20:23	100	.33316	-.33625	-.16110
11:21:09	110	.33515	-.33463	-.16031
11:21:19	120	.33714	-.33301	-.15953
11:22:05	130	.33911	-.33138	-.15874
11:22:15	140	.34107	-.32975	-.15795
11:23:01	150	.34302	-.32810	-.15715
11:23:11	160	.34495	-.32645	-.15636
11:23:21	170	.34688	-.32479	-.15556
11:24:07	180	.34879	-.32312	-.15475
11:24:17	190	.35069	-.32144	-.15395
11:25:03	200	.35258	-.31975	-.15314
11:25:13	210	.35446	-.31806	-.15232
11:25:23	220	.35633	-.31636	-.15151
11:26:09	230	.35818	-.31465	-.15069
11:26:19	240	.36003	-.31293	-.14987
11:27:05	250	.36186	-.31121	-.14904

JUPITER HALF-UNIT VECTORS

GMT M:D:H	GMT Hr	X vector	Y vector	Z vector
11:16:19	0	-.45501	-.19385	-.07343
11:17:15	20	-.45441	-.19507	-.07395
11:18:11	40	-.45380	-.19628	-.07446
11:19:07	60	-.45320	-.19748	-.07497
11:20:03	80	-.45259	-.19868	-.07548
11:20:23	100	-.45198	-.19986	-.07598
11:21:19	120	-.45138	-.20104	-.07648
11:22:15	140	-.45077	-.20222	-.07697
11:23:11	160	-.45015	-.20339	-.07747
11:24:07	180	-.44954	-.20455	-.07796
11:25:03	200	-.44893	-.20571	-.07845
11:25:23	220	-.44831	-.20686	-.07894
11:26:19	240	-.44769	-.20801	-.07943

SATURN HALF-UNIT VECTORS

GMT M:D:H	GMT Hr	X vector	Y vector	Z vector
11:16:19	0	.41410	.26556	.08948
11:18:21	50	.41482	.26457	.08910
11:20:23	100	.41551	.26361	.08874
11:23:01	150	.41617	.26267	.08839
11:25:03	200	.41681	.26177	.08805
11:27:05	250	.41743	.26088	.08773

Basic Date October 6, 1969
 Changed NOVEMBER 3, 1969

Basic Date October 6, 1969
 Changed NOVEMBER 3, 1969

VENUS HALF-UNIT VECTORS

g.e.t., hr	X vector	Y vector	Z vector
108.0	-.36437	-.31828	-.12622
110.0	-.36376	-.31887	-.12650
112.0	-.36314	-.31946	-.12677
114.0	-.36252	-.32005	-.12705
116.0	-.36191	-.32064	-.12733
118.0	-.36128	-.32123	-.12760
120.0	-.36066	-.32182	-.12788
122.0	-.36004	-.32241	-.12815
124.0	-.35942	-.32300	-.12842
126.0	-.35879	-.32358	-.12870
128.0	-.35817	-.32416	-.12897
130.0	-.35754	-.32475	-.12925
132.0	-.35691	-.32533	-.12952
134.0	-.35628	-.32591	-.12979
136.0	-.35565	-.32649	-.13006
138.0	-.35502	-.32707	-.13033
140.0	-.35439	-.32765	-.13061
142.0	-.35376	-.32823	-.13088
144.0	-.35313	-.32881	-.13115

JUPITER HALF-UNIT VECTORS

GMT LO ___:___:___

g.e.t., hr	X vector	Y vector	Z vector
108.0	-.45180	-.20021	-.07612
120.0	-.45144	-.20091	-.07641
132.0	-.45108	-.20161	-.07670
144.0	-.45072	-.20230	-.07700

EARTH HALF-UNIT VECTORS

G.e.t., hr	X vector	Y vector	Z vector	G.e.t., hr	X vector	Y vector	Z vector	G.e.t., hr	X vector	Y vector	Z vector
108.0	-.44449	-.19770	-.11556	119.0	-.41822	-.23757	-.13662	130.0	-.38762	-.27460	-.15605
108.5	-.44339	-.19956	-.11655	119.5	-.41692	-.23932	-.13754	130.5	-.38614	-.27621	-.15689
109.0	-.44229	-.20143	-.11754	120.0	-.41561	-.24106	-.13845	131.0	-.38464	-.27781	-.15773
109.5	-.44117	-.20329	-.11852	120.5	-.41429	-.24279	-.13937	131.5	-.38314	-.27941	-.15856
110.0	-.44005	-.20514	-.11950	121.0	-.41296	-.24452	-.14028	132.0	-.38163	-.28100	-.15939
110.5	-.43892	-.20699	-.12048	121.5	-.41163	-.24625	-.14118	132.5	-.38011	-.28258	-.16022
111.0	-.43777	-.20883	-.12145	122.0	-.41028	-.24797	-.14209	133.0	-.37859	-.28416	-.16104
111.5	-.43662	-.21067	-.12243	122.5	-.40893	-.24968	-.14298	133.5	-.37705	-.28573	-.16186
112.0	-.43546	-.21250	-.12339	123.0	-.40757	-.25138	-.14388	134.0	-.37551	-.28729	-.16267
112.5	-.43429	-.21433	-.12436	123.5	-.40620	-.25308	-.14477	134.5	-.37396	-.28885	-.16348
113.0	-.43311	-.21615	-.12532	124.0	-.40482	-.25478	-.14566	135.0	-.37240	-.29040	-.16429
113.5	-.43192	-.21796	-.12628	124.5	-.40343	-.25646	-.14655	135.5	-.37084	-.29194	-.16509
114.0	-.43072	-.21977	-.12724	125.0	-.40204	-.25814	-.14743	136.0	-.36927	-.29348	-.16589
114.5	-.42951	-.22158	-.12819	125.5	-.40063	-.25982	-.14831	136.5	-.36769	-.29501	-.16669
115.0	-.42829	-.22338	-.12914	126.0	-.39922	-.26149	-.14918	137.0	-.36610	-.29653	-.16748
115.5	-.42706	-.22517	-.13008	126.5	-.39780	-.26315	-.15005	137.5	-.36451	-.29804	-.16827
116.0	-.42583	-.22696	-.13103	127.0	-.39637	-.26480	-.15092	138.0	-.36290	-.29955	-.16905
116.5	-.42458	-.22874	-.13197	127.5	-.39493	-.26645	-.15178	138.5	-.36129	-.30105	-.16983
117.0	-.42333	-.23052	-.13290	128.0	-.39349	-.26810	-.15264	139.0	-.35968	-.30255	-.17061
117.5	-.42206	-.23229	-.13384	128.5	-.39203	-.26973	-.15350	139.5	-.35805	-.30403	-.17138
118.0	-.42079	-.23406	-.13477	129.0	-.39057	-.27136	-.15435	140.0	-.35642	-.30551	-.17215
118.5	-.41951	-.23582	-.13569	129.5	-.38910	-.27298	-.15520	140.5	-.35478	-.30698	-.17291
								141.0	-.35314	-.30845	-.17367

Basic Date October 6, 1969
 Changed NOVEMBER 3, 1969

Basic Date November 10, 1969
 Change November 11, 1969
 STAR HALF-UNIT VECTORS

Star number (octal)	X	Y	Z
46 HAMA	.392C4	.239C1	.19794
47	.29402	.32311	-.24320
50 POLLUX	-.19246	.394EA	.23951
51	-.130C:	.1141A	-.46462
52	-.22788	.059C5	.44112
53	-.32441	-.05489	-.37A1A
54 RIGEL	-.189C4	-.15521	-.426C9
55 BELLATRIX	.01396	.49564	.06442
56	-.214CA	-.12572	-.434C1
57 BELLATRIX	.07A77	.49068	.05507
60	.06794	.43377	.23922
61	.055C9	.494EA	-.01064
62	.04520	.4976A	-.01708
63	-.04431	.47362	-.15401
64	-.0749A	.47369	.14139
65	-.10A54	.42363	-.24187
66	-.12945	.42856	-.2218A
67 CASTOR	-.16693	.390C1	.76463
70	-.14764	.20720	-.42043
71	-.18991	.21871	-.40755
72	-.27046	-.334C9	-.4190A
73	-.24850	-.35C51	-.43093
74	-.27137	-.06354	.41511
75	-.04936	-.39581	-.20149
76	-.03957	-.36365	-.34088
77	.03986	-.41067	-.28249
100	.25750	.00A5C	.42A51
101	.36464	.33084	-.33756
102	.38943	.11914	.2570A
103	.31919	.18A1C	.33577
104	.06424	.49585	.08279
105	.02937	.497C1	-.084C7
106	.0C413	.3538A	.35322
107	-.15441	.40A04	-.24426
110	-.1954C	.32997	-.32084
111	-.26488	.24041	-.34298
112	-.19372	.16757	-.42925
113	-.26627	.77130	.41715
114	-.26777	-.10107	.48998
115	-.09958	-.39167	.48129
116	-.00554	-.31126	.39126

Star number (octal)	X	Y	Z
117	.22075	-.31191	.9224A
120	.29937	-.16193	-.36631
121	.32963	-.11530	-.36593
122	.27293	.04A65	.41A33
123	-.29470	.0095A	.4C380
124	-.23342	-.3904A	-.16165
125	-.12736	-.39323	-.28133
126	.48730	.32467	.12955
127	-.33317	-.387C4	-.31477
130	.23289	.38921	.43336
131	.41214	.22140	.17443
132	.25259	.38052	.20348
133	.22482	.36C63	.26345
134	.19772	.32A57	.22089
135	.11712	.407C5	.27320
136	.11547	.48443	-.04465
137	.06716	.46762	-.17741
140	.05923	.47225	-.15320
141	.05637	.49412	-.05164
142	.04906	.46391	.18021
143	.03A68	.41227	-.28C24
144	.00404	.39A18	.3023A
145	-.06763	.31023	-.38625
146	-.13007	.37730	-.30121
147	-.23871	.38853	-.2C510
150	-.22129	.18374	-.40899
151	-.42438	.20149	.17096
152	-.30920	.10425	-.37885
153	-.45775	.09A22	.17664
154	-.45476	-.06555	-.19722
155	-.17729	-.02759	-.46670
156	-.49223	-.08710	-.01122
157	-.38035	-.09741	.31112
160	-.47351	-.12839	.05643
161	-.37A0A	-.1355A	-.29780
162	-.27183	-.123A4	-.4C09A
163	-.41732	-.22483	.159C5
164	-.30980	-.23959	.31C84
165	-.291C9	-.23079	-.32474
166	-.26007	-.218C3	-.36722
167	-.33804	-.29128	.22855
170	-.35561	-.32363	-.13713

STAR HALF-UNIT VECTORS

**STAR HALF-UNIT
VECTORS**

Star number (octal)			
171	-.26736	-.25460	-.34109
172	-.32474	-.37156	-.08357
173	-.22537	-.30218	-.32847
174	-.27996	-.41034	.05477
175	-.22966	-.38619	-.21941
176	-.22874	-.41134	-.16875
177	-.09718	-.21720	.43975
200	-.17997	-.42840	.16369
201	-.16155	-.41017	-.22593
202	-.17717	-.45858	-.05118
203	-.14530	-.40004	.26241
204	-.10694	-.46934	-.12521
205	-.04576	-.27845	-.41708
206	-.05413	-.39414	-.30281
207	-.04275	-.31052	-.38720
210	-.04022	-.30255	.36573
211	-.03913	-.49687	.02951
212	.03605	-.43223	-.24881
213	.05134	-.44850	-.21478
214	.11344	-.41823	-.24043
215	.15488	-.31743	.35390
216	.21709	-.44103	.05145
217	.27376	-.31718	.27856
220	.17572	-.15026	.44334
221	.39955	-.26559	-.14003
222	.22212	-.10770	-.42479
223	.42788	-.11003	.23412
224	.46814	-.11832	.12977
225	.20630	.11651	-.44030
226	.41167	.28248	-.02715
227	.26013	.27462	.32658
230	-.21684	.16592	-.41887
231	-.20482	.07265	-.45030
232	-.31753	-.00942	-.28612
233	-.11849	-.19051	-.44684
234	.13389	-.46470	.11942
235	.13637	-.44619	-.17978
236	-.22905	-.44537	-.02155

Basic Date: November 10, 1969
 Changed _____