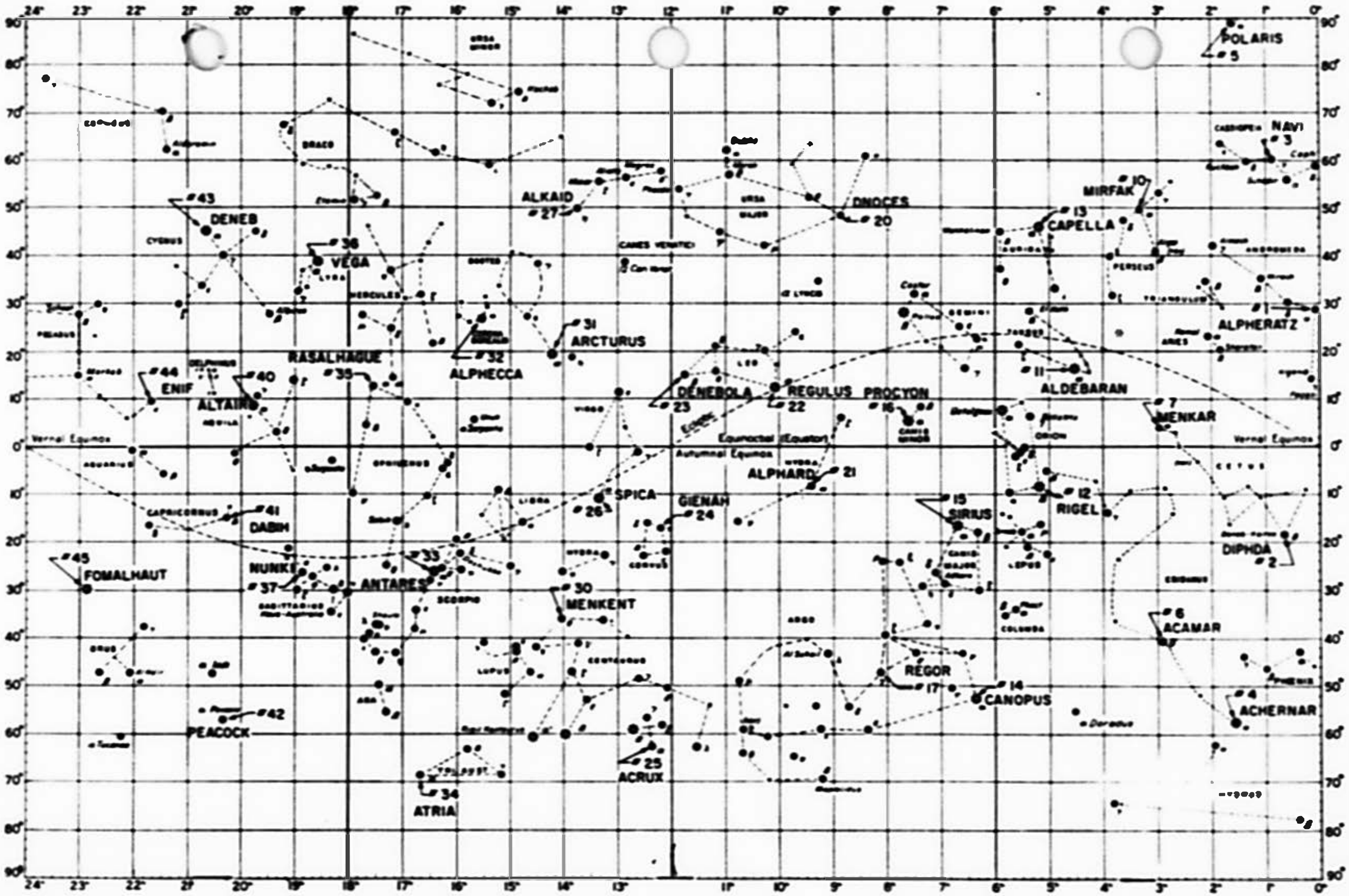
FAO

APOLLO 12	
LM G&N DICTIONARY	
PART NO	S/N
SKB32100075-361	1002


POLARIS
5
NAVI
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MIRFAK
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CAPELLA
13
DNOCES
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ALKAID
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DENEB
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VEGA
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ARCTURUS
31
ALPHECCA
32
RASALHAGUE
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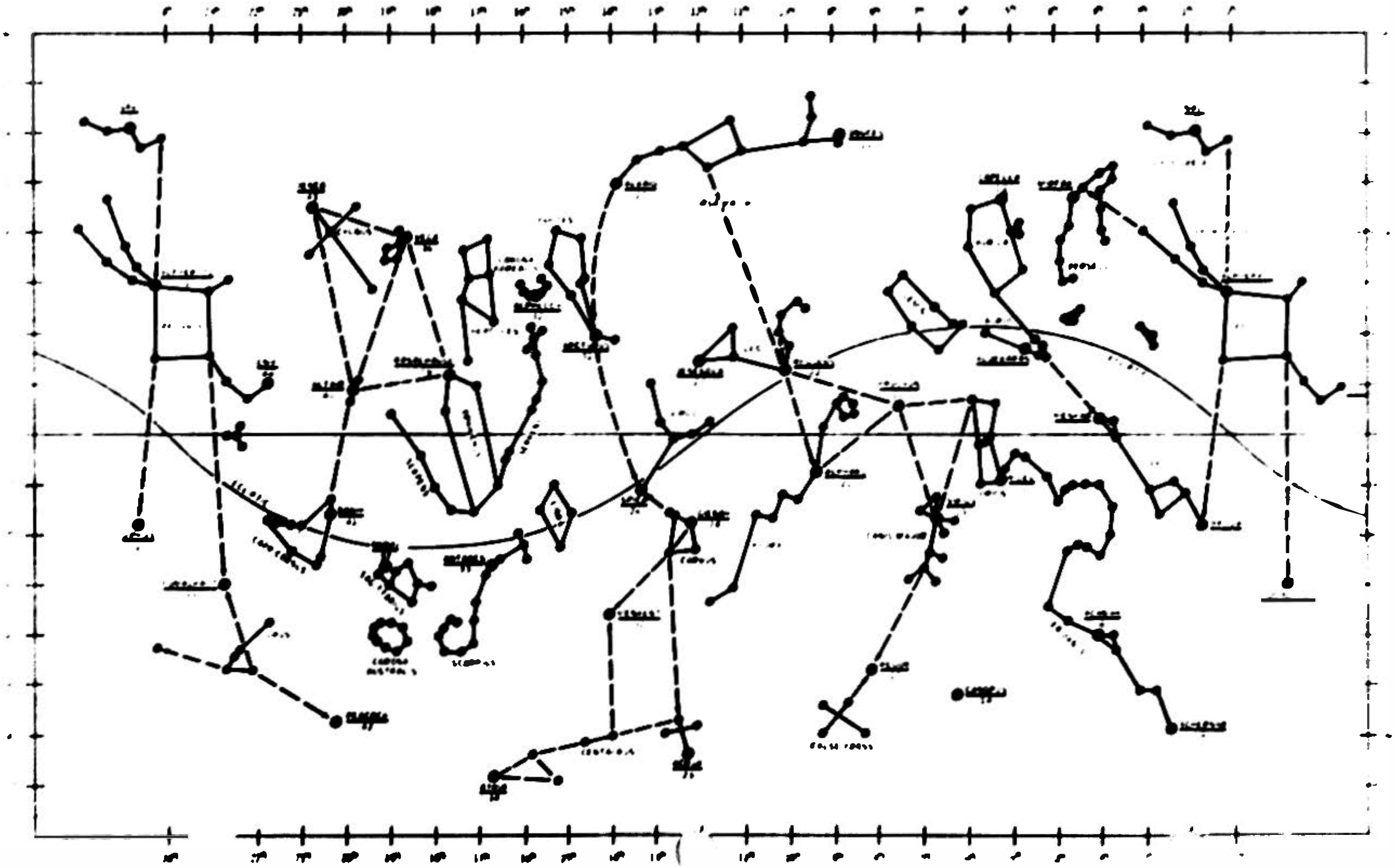
ENIF
44
ALTAIRB
40
DENEBOLA
23
REGULUS
22
PROCYON
16
ALDEBARAN
11
ALPHERATZ
1
MENKAR
7
ALPHARD
21
SPICA
26
GIENAH
24
SIRIUS
15
RIGEL
12
DIPHDA
2
DABIH
41
FOMALHAUT
45
NUNKI
37
ANTARES
33
MENKENT
30
ACAMAR
6
REGOR
17
CANOPUS
14
ACHERNAR
4
PEACOCK
42
ACRUX
25
ATRIA
34
Vernal Equinox
Equinoctial (Equator)
Autumnal Equinox



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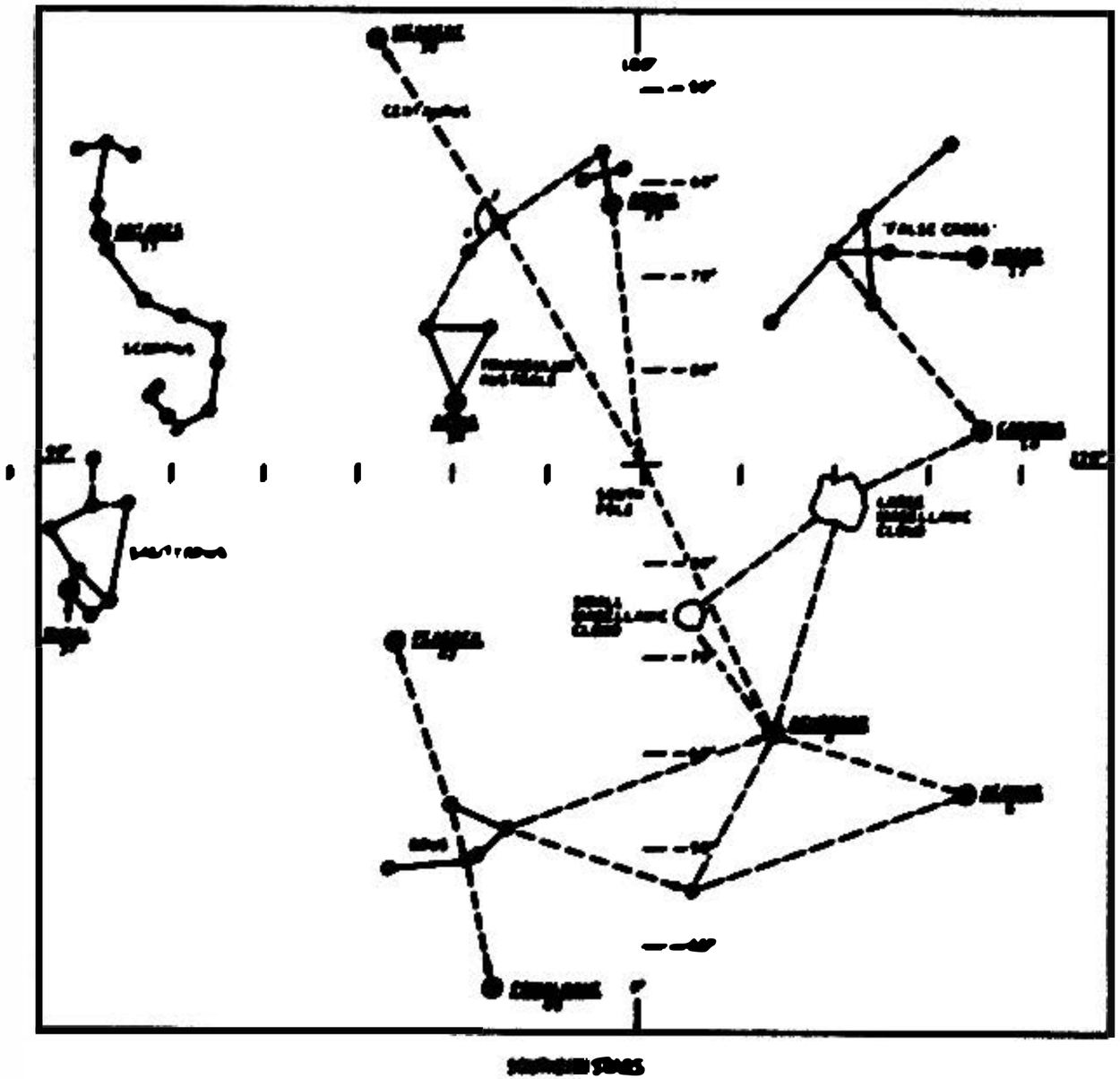
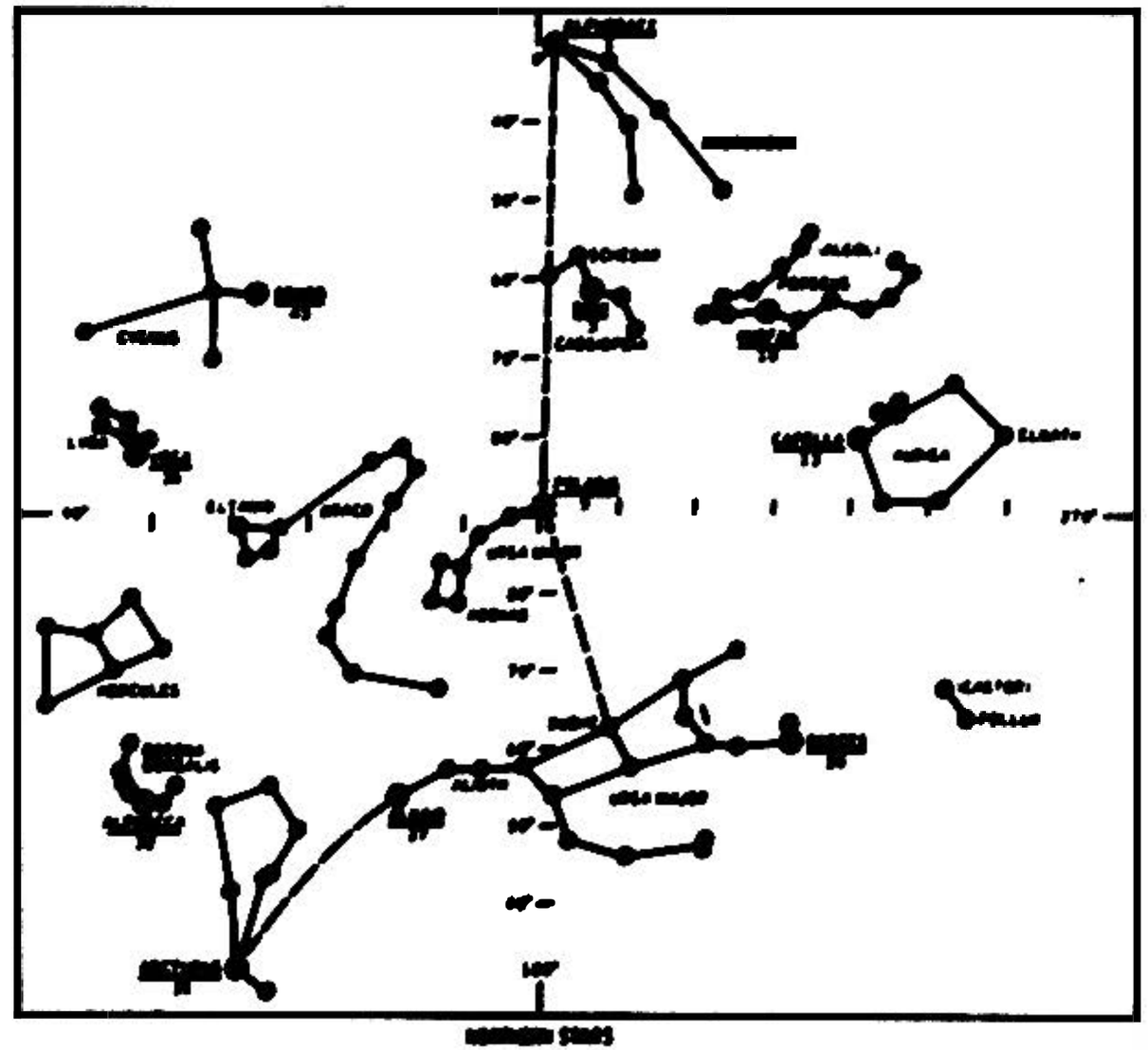
Changed





STAR LIST

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

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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

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VERBS

01	Display Octal Comp 1 in R1
02	Display Octal Comp 2 in R1
03	Display Octal Comp 3 in R1
04	Display Octal Comp 1&2 in R1&R2
05	Display Octal Comp 1,2&3 in R1,R2&R3
06	Display Decimal in R1 or R1,R2 or R1, R2,R3
07	Display DP Decimal in R1&R2
11	Monitor Octal Comp 1 in R1
12	Monitor Octal Comp 2 in R1
13	Monitor Octal Comp 3 in R1
14	Monitor Octal Comp 1&2 in R1&R2
15	Monitor Octal Comp 1,2&3 in R1,R2&R3
16	Monitor Decimal in R1 or R1,R2 or R1,R2,R3
17	Monitor DP Decimal in R1&R2
21	Load Component 1 in R1
22	Load Component 2 in R2
23	Load Component 3 in R3
24	Load Component 1&2 in R1&R2
25	Load Component 1&2&3 in R1&R2&R3
27	Display Fixed Memory
30	Request Executive (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

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	Rendevous 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 Rendezvous)
95	Inhibit State Vector Update (P20 or P22)
96	Interrupt Integration and Go to P00
97	Perform Engine Fail Procedure (R40)
99	Enable Engine Ignition

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

01V	Address to be Specified (Frac)		.XXXXX
02V	Address to be Specified (Whole)		XXXXX.
03	Address to be Specified (Degree)		.01°
04	Gravity Error Angle		.01°
05	Angular Error/Difference		.01°
06	Option Code		Octal
	Desired Option		Octal
	Data		Octal
07	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

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/On (+ON)	.1fps

NOUNS

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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 (ΔAlt)	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 (COH)	.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

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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	ΔVX (LV) (+ Fwd)	.1fps
	ΔVY (LV) (+ Rt)	.1fps
	ΔVZ (LV) (+ Dn)	.1fps
82	ΔVX (LV) (+ Fwd)	.1fps
	ΔVY (LV) (+ Rt)	.1fps
	ΔVZ (LV) (+ Dn)	.1fps
83	ΔVX (LM) (+ Up)	.1fps
	ΔVY (LM) (+ Rt)	.1fps
	ΔVZ (LM) (+ Fwd)	.1fps
84	ΔVX (Other Vehicle) + (RXV)XR	.1fps
	ΔVY (Other Vehicle) + (VXR)	.1fps
	ΔVZ (Other Vehicle) + (-R)	.1fps
85	VGX (LM) (+ Up)	.1fps
	VGY (LM) (+ Rt)	.1fps
	VGZ (LM) (+ Fwd)	.1fps
86	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°

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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

R1 Code	FUNCTION
00013	Key In Normal Or Gyro Torque Coarse Align
00014	Recheck or Exit Fine Align Option
00015	Star Acquisition
00062	Power Down LGC
00201	Select RR LGC Mode
00203	Select PGNS, AUTO,&AUTO THROTTLE
00205	Slew RR For Manual Acquisition
00500	Switch LR Antenna to Position 1

N06 or N12 OPTION CODES

00001	Specify IMU Orientation	1 = Preferred 2 = Nominal 3 = REFSMMAT 4 = Landing Site
00002	Specify Vehicle	1 = LM 2 = CSM
00003	Specify Tracking Attitude	1 = Preferred 2 = Other
00004	Specify Radar	1 = RR, 2 = LR
00006	Specify RR Coarse Align Option	1 = Lock On 2 = Continuous Designate
00010	Specify Alignment Mode	0 = Anytime 1 = REFSMMAT + 1G 2 = 2 Bodies 3 = 1 Body + 1G

00012 Specify CSM Orbit Option

1 = No Orbit Change
2 = Change Orbit To Pass Over LM

V05 N09 ALARM CODES

20105 P **AOT Mark System In Use
Reselect P5X
00107 P More Than 5 Mark Pairs (5 Marks On Surface)
Continue
00111 P Mark Missing
Restart Mark Sequence
00112 P Mark or Mark Reject Not Being Accepted
Continue
00113 H No Inbits
Continue
00114 P Mark Made But Not Desired
Mark Correct Axis (X or Y) Continue
00115 P No Marks in Last Pair to Reject
Continue
00206 P Zero Encode Not Allowed With Coarse Align & Gimbal Lock
Coarse Align To 0,0,0 Then V40N20E
00207 P/H ISS Turn On Request Not Present For 90 sec
CB(11) IMU OPR - Open, Wait 3 Min, & Reclose
If Alarm Recurs And No ISS Warning, Continue
00210 P/H IMU Not Operating
CB(11) IMU OPR - Open, Wait 3 Min, & Reclose
V36E, Consult MSFN, Continue
00211 H Coarse Align Error
If P51, P52, or P57 in Progress, Record Gyro Torquing Angles and Perform Fine Align
Check in P52, P57
If P51 or P52 Not In Progress
Reduce Spacecraft Drift, Continue
00212 H PIPA Fail, But PIPA is Not Being Used
Go to ISS MALFUNCTION PROCEDURES
00213 H IMU Not Operating With Turn-On Request
See 00210
00214 P/H Program Using IMU When Turned OFF
Terminate Program

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

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

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

00402 P FINDCDUW Routine Not Controlling Attitude
GUID CONT - AGS

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

00405 I Two Stars Not Available
See P52/6

00421 I W-Matrix Overflow
Notify MSFN

20430 I **Acceleration Overflow In Integration
Notify MSFN

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

00502 I Bad Radar Gimbal Angle Input
Redo V41N72

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

00510 P Radar Auto Descrete 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 ΔTHETA >3°
See P20/8 or P22/5

00526 I Range >400 Miles.Terminate P20

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

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

01600 H Overflow in Drift Test
Perform V36E
01601 H Bad IMU Torque
01703 P TIG Slipped
01706 P P40 Selected But Staged
P42 Selected But Not Staged
See P40/1 or P42/1
32000 P *DAP Still In Progress At Next TIME5/RUPT
RSET, GUID CONT - AGS Then PGNS; If Alarm
Recurs, 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, ICOU, 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

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

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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 (P00 ONLY)

1 V37E 00E
V93E

GO JAM

1 V74 when Convenient (See V36)

STAR CODE >50

1 Perform General System Checkout

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

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

VGX=200fps SYS A MAIN SOV - OPEN
SYS B MAIN SOV - OPEN
SYS A ASC FEED 2-CLOSE
SYS B ASC FEED 2-CLOSE
CRSFD -CLOSE

VGX=100fps, ENG ARM - OFF

APS
OFF NULL COMPONENTS
KEY REL

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

Note VI _____
HDOT _____
H _____
PRO

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

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

Note HA _____
HP _____
TFF _____
PRO To 9 _____

11 F 37

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P20 RENDZ NAV

```
1                V37E 20E
            (TO TERM-V56E)
            (SV OPTION, V80E LM, V81E CSM, V95E NONE)

2  (If Pointing Error <10°, To 4; Mnvr With No Display)
     F 50 18   REQUEST MNVR TO FOAI RPY ANGLES    (.01°)
            (AUTO or TRIM) GUID CONT - PGNS
                           MODE CONT:  PGNS - AUTO
                 PRO
            (MAN)  MODE CONT:  PGNS - ATT HOLD
                   MNVR
                 PRO To 2
            (BYPASS)  ENTR To 4 (To 9 If Entered From
                                    9 Via V32E)
                               (To 6 If Entered From
                                    6 Via ENTR)

3       06 18   AUTO MNVR TO FOAI RPY ANGLES       (.01°)
                Monitor Auto Mnvr To 2

4                    RR MODE: LGC To 7
                              (To 8 If Entered From 6
                               or 9 via PRO)
                     SLEW or AUTO To 5

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

6     F 50 25   00205 SLEW RR For LOCK-ON
            (LOCK)     RR MODE-LGC:
                       NO TRACK Lt - Off, Wait 10 sec
                 PRO To 4
            (NO LOCK) MNVR
                 ENTR To 2

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

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

8     NO TRACK LITE

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

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

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

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

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

P21 GROUND TRACK DETERMINATION

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

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

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

4     F 37
```

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)
```

```
(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, ROOT           *
*        (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         *
```

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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 Mnvr, To 1

3 P25 Continues To Run
In Background Until Terminated

(RAW RR DATA) V16N78E R,RDOT,TFI
(.01nm,fps,min-sec)
KEY REL

P27 LGC MANUAL UPDATE

1 (NOTE: For Auto Update, If V33 N02
Displayed Key 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 Procedure)

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

6 F 21 01 Repeat Step 5 For All Data

7 F 21 02 R3 Goes To 1167 When Data Load Complete

TO REVIEW DATA
VOT 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 POO Displayed

P30 EXTERNAL ΔV

1		V37E 30E	
	F 06 33	TIG	(hrs,min,.01sec)
		PRO	
2	F 06 81	ΔV XYZ(LV)	(.1fps)
		PRO	
3	F 06 42	HA, HP, ΔV	(.1nm,.1fps)
		PRO	
4	F 16 45	M, TFI, MGA	(marks,min-sec,.01°)
		SET EVENT TIMER TO TFI	
		PRO (MGA Set To -00002 If No REFSMMAT Set)	
5	F 37		

P32 CSI PRETHRUST

1		V37E 32E	
	F 06 11	TIG (CSI)/T(APOAPSIS)	(hrs,min,.01sec)
		PRO	
		If Zero, T (APOAPSIS) Displayed	
2	F 06 55	APSIS CDH, TPI ELEVATION ANGLE,	
		R3,0000Y	(+0000X,.01°)
		For Y≠0,CDH At CSI+	
		Multiple Of 180° Specified	
		By R1(X)	
		PRO	
3	F 06 37	TIG (TPI)	(hrs,min,.01sec)
		PRO	
4	F 16 45	MARKS, TFI,-00001	(marks,min-sec)
		(RECYCLE) V32E To 5	
		(TERM MARKING) PRO	

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

5     F 06 75   ΔH(C   ),ΔT (COH-CSI),ΔT(TPI-CDH)
                PRO                                (.1nm,min-sec)

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

7     F 06 82   ΔV XYZ (LV) CDH                        (.1fps)
                PRO (If Recycling To 4)

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

9     F 37
```

P33 CDH PRETHRUST

```
1                V37E 33E
     F 06 13     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     ΔH(CDH),ΔT(TPI-CDH),ΔT(TPI-NOMTPI)
                 PRO                          (.1nm,min-sec)

4    F 06 81     ΔV 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  (.01nm,.1fps,.01°)
                    Record YDOT
                    PRO
                 (Insert Neg YDOT in R2 of ΔV COH)
                 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                V37E 34E
     F 06 37     TIG (TPI)                    (hrs,min,.01sec)
                 PRO
```

```
2     F 06 55   N, ELEVATION ANGLE, CENTRAL ANGLE
                                          (0000X,.01°)
                (00000 In R2 To Calc Elevation
                 Angle At TIG Time)
                PRO

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

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

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

5     F 06 58    P,ΔV(TPI),ΔV(TPF)          (.1nm,.1fps)
                PRO (If Recycling To 7)

6     F 06 81   ΔV XYZ (LV) TPI                (.1fps)
                PRO

7     F 06 59   ΔV XYZ (LO ) TPI               (.1fps)
                PRO (If Recycling To 3)

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

9     F 37
```

P35 TPM PRETHRUST

```
1               V37E 35E
      F 16 45   MARK, TFI, -00001           (marks,min-sec)
          (RECYCLE) V32E To 3
          (TERM MARKING)  PRO
```


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2 F 06 81 ΔV XYZ (LV) TPM (.1fps)
PRO

3 F 06 59 ΔV XYZ (LOS) TPM (.1fps)
PRO (If Recycling To 1)

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

5 F 37

P40 DPS THRUST

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

1 V37E 40E

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

F 50 18 REQUEST MNVR TO FOAI 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 FOAI RPY ANGLES (.01°)
Mon Auto MNVR To 1

```
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
```

```
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                V37E 41E
      F 50 18    REQUEST MNVR TO FOAI 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 FOAI RPY ANGLES                    (.01°)
                 Mon Auto Mnvr To 1

3       16 85    VG XYZ (LM)                                     (.1fps)
                             *PROG Lt - On                          *
                             *V05N 09E 01703 TIG SLIPPED*
                             *RSET, KEY REL                         *

                 MODE CONT: PGNS - ATT HOLD

        -:35     DSKY BLANKS

        -:30
            16 85  (AVE G ON)

         :00
          F 16 85  VG XYZ (LM)                                    (.1fps)
                   NULL COMPONENTS
                   PRO
4         F 37
```

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 FOAI 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 FOAI RPY ANGLES (.01°)
Mon Auto Mnvr 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

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```
-: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 83    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
```

P51 IMU ORIENTATION

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

1 V37E 51E
F 50 25 R1 00015 MNVR TO ACQ STARS
(To Coarse Align IMU To 0,0,0-ENTR)
41 22 All Zeroes
PRO

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

3 F 54 71 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 8: AOT LAMP-Open

P52 IMU REALIGN

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

```
2     F 06 34   GET ALIGN                          (hrs,min,.01sec)
                (0,0,0 For Present Time)
                (TLANO 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 SPECIF ) 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)F D
                           (+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)
```


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```
8     F 50 18   REQUEST MNVR TO FOAI RPY ANGLES    (.01°)
        (AUTO OR TRIM) GUID CONT:  PGNS
                       MODE CONT:  PGNS - AUTO
             PRO
        (MAN)          MODE CONT:  PGNS - ATT HOLD
                       MNVR
             PRO To 8
        (BYPASS)  ENTR To 10 (If COAS CALIB, Go to 7)

9       06 18   AUTO MNVR TO FOAI RPY ANGLES       (.01°)
                Mon Auto Mnvr To 8

10    F 01 71   R1 00CDE (C)DETENT (DE)STAR CODE
                PRO
                (For C=7
                 F 06 87 AZ,EL                     (.01°)
                 PRO)

11    F 54 71   MARK X(52) and Y(53)
        (After 1st Star) PRO To 7
        (After 2nd Star) PRO To 12
        (Redefine Star)  ENTER To 10
                (For DE=00
                F 06 88 CELESTIAL BODY VECTOR
                        Load Vector Values
                        PRO)

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

13    F 06 93   GYRO ANGLES X,Y,Z                  (.001°)
        (TORQUE) V76E
                 PRO
        (NO TORQUE) V32E To 14

14    F 50 25   R1 00014
        (RECHECK) PRO To 6
        (EXIT)    ENTR

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

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 REFSMMAT FLAG)

6 Perform P52, Option 3 (AUTO OPTICS Are Good)

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

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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)
                 (LOG 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 00C00
                      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        *
```

```
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 00CDE (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                 *
```

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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 (TERM) V34E, Select New Prog (RECYCLE) V32E To 9 (MARKS COMPLETE) PRO	(.01°)
		(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 OS	STAR ANGLE DIFFERENCE (REJECT) V32E To 14 (ACCEPT) PRO (TERM) V34E	(.01°)
12	F 06 93	GYRO TORQUING ANGLES X,Y,Z (REJECT) V32E To 14 (ACCEPT) PRO To 13a (TERM) V34E	(.001°)

P63-P68

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Basic Date ___
Changed ___

13 If Gyro Angles >5°
F 06 22 ICDU ANGLES 06,I6,M6 (.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    *
*                    *
```

```
2     F 06 61    T6,TFI                                  (min-sec)
                 R3, CROSSRANGE (-NORTH)                   (.1nm)
                 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 Mnvr To 4

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

```
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
```

```
*ALT. & VEL Lt - On*
* RANGE/VELOCITY    *
* NOT GOOD          *
*PROGRAM Lt - On    *
* V05N09E           *
*  00511 LR Not in  *
*            Pos 1  *
*LOG 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.

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
TD+3:00 PRO
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)

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

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 Mnvr To
                         Local Vertical With Windows
                         Downrange.  X-axis Override
                         Inhibited.
                 H>25000-or H DOT >00400-Monitor Atti-
                         tude Mnvr 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

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 Mnvr To
                                Local Vertical With Windows
                                Downrange.  X-axis Override
                                Inhibited.
                        H>25000-or H DOT >00400-Monitor Atti-
                                tude Mnvr 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,
                     POI+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

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

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

PER ALT _____ nm,

TFF _____ min-sec
PRO To 5

7 F 37

P71 APS ABORT

1 ABORT STAGE -Push (From P63,64,65,
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

H<25000-Monitor Attitude Mnvr To Local Vertical With Windows Downrange. X-axis Override Inhibited.

H>25000 or H DOT>00400-Monitor Attitude Mnvr 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 NULL COMPONENTS
OFF 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

Basic Date October 6, 1969
Changed October 31, 1969

P72 CSM CSI TARGETING

```
1                V37E 72E
     F 06 11     TIG (CSI)/T(APOAPSIS)    (hrs,min,.01sec)
                 PRO
                 If Zero, T (APOAPSIS) Displayed

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

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

4    F 16 45     M,TFI,MGA (-00001)  (marks,min-sec,.01°)
                (RECYCLE) V32E
                (TERMINATE MARKS) PRO
                        *F 05 09 00600 No Intersection On      *
                        *              First Iteration         *
                        *        00601 POST CSI ALT <35,000 ft*
                        *        00602 POST CDH ALT <35,000 ft*
                        *        00603 TIG(CDH)-TIG(CSI)<10min*
                        *        00604 TIG(TPI)-TIG(CDH)<10min*
                        *        00605 NO SOL IN 15 TRIES      *
                        *        00606 ΔV (CSI) >1000 fps IN 2*
                        *              Iterations              *
                        *        V32E To 1  Adjust Inputs      *

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

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

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

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

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

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

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

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

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

5     F 37
```

P74 CSM TPI TARGETING

```
1                V37E 74E
     F 06 37     TIG TPI                          (hrs,min,.01sec)
                 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)               (.1nm,.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
```

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
        |TE  INATE 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
```

Basic Date October 6, 1969
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          V41N20E
     F 21 22  LOAD NEW ICDU ANGLES O,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          V41N72E
     F 21 73  RR TRUN,SHAFT                       (.01°)
            Load Desired Trun and Shaft Angles

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

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

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

V42 GYRO TORQUING

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

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

V43 FDAI BIAS CHECK

1 MODE CONT: PGNS - OFF

2 V37E00E

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

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

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

Basic Date October 6, 1969
Changed

V47 AGS INITIALIZATION

		TLM-HI
1		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

2 F 06 47 LM WT, CSM WT (lb)
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 V49E
F 06 22 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 FOAI RPY ANGLES
Mon Auto Mnvr To 3

Basic Date October 6, 1969
Changed

V55 INCREMENT LGC TIME

```
1                V55E
     F 21 24     ΔT
                 Record
                 _________(hrs)
                 _________(min)
                 _________(sec)
                 Load ΔT
```

V64 S-BAND ANTENNA

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

V67 W-MATRIX ERROR DISPLAY

```
1                V67E
     F 06 99     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                V82E (GO To 2 If AVE G-On)
     F 04 12     R1 00002 SPECIFY VEHICLE
                 R2 00001 LM
                    00002 CSM
                 PRO

2    F 16 44     HA,HP,TFF                        (.1nm,min-sec)
                 (UPDATE) V32E (Not Required If AVE G-On)
                 PRO
```

V83 RENDEZVOUS PARAMETER DISPLAY

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

V55-V90

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 Mnvr 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
```

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		V35E
	F 88 88	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		V25N01E 1365E
	F 21 01	E,E,E
5		V15 N01E 1365E
	15 01	R1, R2, R3 All Zero
6		V21 N27E 10E (Test Fixed And Erasable Memory)
	15 01	R1 Number Of Errors 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 0E TERMINATE SELF TEST

Basic Date ___October 6, 1969
Changed ___

PGNS T/O, ORDEAL,
PIPA BIAS

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

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		V82E
	F 04 12	R1 00002 SPECIFY VEHICLE
		R2 00001 LM
		PRO
3	F 16 44	HA,HP, TFF (.1nm,min-sec)
		Average HA & HP
		ALT SET - Set
		PRO
4		V83E
	F 16 54	R, RDOT, THETA (.01nm,.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		V06E
	06 21	XYZ PIPA COUNTS (+XXXXX.)
4		At T+80sec - ENTR
		T+80sec (X)R1___ (Y)R2 ___ (Z)R3 ___

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

LGC CLOCK INITIALIZATION

1 V06N65
ON CSM MARK - ENTR
06 65 SAMPLED LGC TIME (hr,min,.01sec)
RECORD
_____(hrs)

_____(min)

_____(sec)
COMPUTE CSM/LM ΔT

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

LANDING RADAR SELF TEST

1		CB(11) PGNS: LDG RDR - Close X-POINTERS(Both) - HI MULT TEMP MON - LOG RDR (50° - 70°F) RATE/ERR MON - LDG RDR/CMPTR RNG/ALT MON - ALT/ALT RATE LDG ANT - DES MODE SEL - LDG RDR
2		RADAR TEST - LDG(Alt And Alt Rt Tapes Drive) TEST MONITOR - ALT XMTR (2.1 To 5.0) (3.4v) - VEL XMTR (2.1 To 5.0) (3.3v) ALT/ALT RT MON - +7900 To +8100 ft/-478 To -482 fps
3		XPOINTER - UP, RT
4	F 04 12	V63E INITIATE RDR SELF TEST R1 00004 SPECIFY RDR R2 00001 RNDZ RDR V22E 2E LDG RDR PRO
5	F 16 66	SLANT RANGE, ANT POSITION (ft) R1 + 08277 To +08297 (+08287) R2 + 00001 PRO
6	F 16 67	VX,VY,VZ R1 -00494 (±2) R2 +01861 (±2) R3 +01331 (±2) V34E (If Antenna Not Commanded To HOVER, Go To 13)
7		LDG ANT - AUTO
8		V59E COMMAND ANT TO POS 2 (22 Sec)

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Changed

9		V63E INITIATE RDR SELF TEST
	F 04 12	R1 +00004 SPECIFY RDR
		R2 +00001 RNDZ RDR
		V22E 2E LDG RDR
		PRO
10	F 16 66	SLANT RANGE, ANT POSITION
		R1 +08277 To +08297
		R2 +00002
11		LDG ANT - DES (10 sec)
	F 16 66	R2 +00001 (PROG Lt-On, V05N09E,00522 RSET)
12		LDG ANT - AUTO
	F 16 66	R2 +00001
		V34E
13		RDR TEST - OFF
		CB(11) PGNS: LDG RDR - Open

RNDZ RDR SELF TEST

1	VERIFY: CSM RCS THRUSTER 83 - 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

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 (FOAI Needles Right, Down, Left, Up)
4		RR MODE - AUTO TRACK RADAR TEST-RNDZ RDR (Rng Rt Tape Drives To -500fps, X-Pointers and FOAI 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 NORRMDN 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 (.01nm,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

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

12 V40N72E RRCDU ZERO (10 sec)

13 SHFT/TRUN - ±50°
V41N72E
N73 R1 +04000
R2 +04000
N12 R2 00002
V16N72E (Verify FDAI Needles Up & Right)
V44E

14 SHFT/TRUN - ±5°
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

LGC THRUSTER INHIBIT

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

A1U - 100E	B4U - 1E
B1O - 200E	A4O - 2E
A1F - 4E	B4F - 2E
B1L - 200E	A4R - 100E
B2U - 20E	A3U - 4E
A2O - 40E	B3O - 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 V1 N1E OCTAL ADD E
F 01 01 R3 OCTAL ADD, R1 (DATA)E

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

TO CHANGE DATA IN ERASABLE MEMORY

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

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

MONITOR OF INPUT/OUTPUT CHANNELS

1 V11N10E
F 11 10 LOAD CHANNEL ADD E
R1 Octal Contents Of Specified Channel

LOAD OUTPUT CHANNELS

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

FLAG WORD SET/RESET

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

RMAX - VMAX LOAD

V24 N01E
2004E (RMAX)
77776E
77776E

2 F 22 07 (Load FLAGWORD BIT CODE)E

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

3 F 23 07 (Load 1-SET/0-RESET) E

4 To Verify Load:
V1N1E, FLAGWORD ADD ENTR
01 01 R3 FLAGWORD ADD
R1 FLAGWORD CONTENT (See Table Above)

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

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

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

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Changed _____

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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 Gmbl Monitor	D=1,3,5,7
		(4)	Perform RR Gmbl 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)	Use of Mark X or Y Use of Mark Reject	A=1,3,5,7 A=0,2,4,6
AOT Mark Y	1307	2000 (11)	After Use of Mark Y After Mark X & Y or Mark Reject	B=2,3,6,7 B=0,1,4,5
AOT Mark X	1307	1000 (10)	After Use of Mark X After Mark X & Y or Mark Reject	B=1,3,5,7 B=0,2,4,6

CHANNEL LISTING

CHANNEL	BIT	DSKY	FUNCTION
5	1	E=1,3,5,7	JET 1 ON (B4U)
OUTPUT	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	1	E=1,3,5,7	JET 7 ON (B3A)
OUTPUT	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	1	E=1,3,5,7	ISS WARNING
OUTPUT	13	A=1,3,5,7	ENGINE ON
	14	A=2,3,6,7	ENGINE OFF
12	1	E=1,3,5,7	ZERO RRCDU
OUTPUT	4	D=1,3,5,7	COARSE ALIGN ENABLE
	5	D=2,3,6,7	ZERO ICDU
	9	C=4,5,6,7	+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	3	E=4,5,6,7	MARK X
INPUT	4	D=1,3,5,7	MARK Y
	5	D=2,3,6,7	MARK REJECT
	6	D=4,5,6,7	+RATE OF DESCENT
	7	C=1,3,5,7	-RATE OF DESCENT

30	1	E=0,2,4,6	ABORT
(INVERTED)	2	E=0,1,4,5	STAGE VERIFY
INPUT	3	E=0,1,2,3	ENG ARM
	4	D=0,2,4,6	ABORT STAGE
	5	D=0,1,4,5	AUTO THROTTLE
	6	D=0,1,2,3	DISPLAY INERTIAL DATA
	7	C=0,2,4,6	RR CDU FAIL
	9	C=0,1,2,3	IMU OPERATE
	10	B=0,2,4,6	G&N CONTROL OF S/C
	11	B=0,1,4,5	IMU CAGE
	12	B=0,1,2,3	ICDU FAIL
	13	A=0,2,4,6	IMU FAIL
	14	A=0,1,4,5	ISS TURN ON REQUEST
	15	A=0,1,2,3	TEMP IN LIMITS
31	1	E=0,2,4,6	+PITCH MIN IMPULSE/+EL LPD
(INVERTED)	2	E=0,1,4,5	-PITCH MIN IMPULSE/-EL LPD
INPUT	3	E=0,1,2,3	+YAW MIN IMPULSE
	4	D=0,2,4,6	-YAW MIN IMPULSE
	5	D=0,1,4,5	+ROLL MIN IMPULSE/+AZ LPD
	6	D=0,1,2,3	-ROLL MIN IMPULSE/-AZ LPD
	7	C=0,2,4,6	+X TRANSLATION
	8	C=0,1,4,5	-X TRANSLATION
	9	C=0,1,2,3	+Y TRANSLATION
	10	B=0,2,4,6	-Y TRANSLATION
	11	B=0,1,4,5	+Z TRANSLATION
	12	B=0,1,2,3	-Z TRANSLATION
	13	A=0,2,4,6	ATTITUDE HOLD
	14	A=0,1,4,5	AUTO STAB
	15	A=0,1,2,3	ACA OUT OF DETENT
32	1	E=0,2,4,6	JETS 2,4 FAILED
(INVERTED)	2	E=0,1,4,5	JETS 5,8 FAILED
	3	E=0,1,2,3	JETS 1,3 FAILED
	4	D=0,2,4,6	JETS 6,7 FAILED
	5	D=0,1,4,5	JETS 14,16 FAILED
	6	D=0,1,2,3	JETS 13,15 FAILED
	7	C=0,2,4,6	JETS 9,12 FAILED
	8	C=0,1,4,5	JETS 10,11 FAILED
	9	C=0,1,2,3	GIMBAL NOT ENABLED
	10	B=0,2,4,6	GIMBAL FAILED
	14	A=0,1,4,5	PROCEED

33	2	E=0,1,4,5	RR PWR ON/AUTO
(INVERTED)	3	E=0,1,2,3	RR RNG SCALE LOW
	4	O=0,2,4,6	RR DATA GOOD
	5	O=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	8=0,1,4,5	UPLINK TOO FAST
	12	8=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

LM OR CSM S.V. READOUT

1 V83E

2 After intergration: V05N01E

CSM S.V.

2137E

E,2142E

E,2117E

E,2122E

E,2113E

PRO

LM S.V.

2167E

E,2172E

E,2104E

E,2107E

E,2113E

PRO

Basic Date November 3, 1969
Changed

3 Transmit S.V. & Time Tag
To CSM

LM OR CSM S.V. LOADING

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

AGS SELECTOR LOGIC LIST

Address	Entry	
400	+00000	Attitude Hold
	+10000	Auto Guidance Steering
	+20000	Z-Body Axis Steering
	+30000	IMU Align
	+40000	Lunar Align
	+50000	Body Axis Align
	+60000	Gyro and Accelerometer Calibration (302 sec,32 sec)
	+70000	Inflight Accelerometer Only Calibration (32 sec)
407	+00000	Use Rotating External ΔV Reference Frame
	+10000	Freeze External ΔV in Inertial Space And Allow ΔV's To Count
410	+00000	Orbit Insertion Routine
	+10000	CSI Routine
	+20000	CDH Routine
	+30000	TPI Search Routine
	+40000	TPI Execute Routine
	+50000	External ΔV
411	+00000	OPS or RCS Engine Select
	+10000	APS Engine Selection
412	+00000	Reinitiate Test
	+10000	Test Successful
	+30000	Logic Test Fail
	+40000	Memory Test Fail
	+70000	Logic & Memory Test Fail
413	+00000	Normal Position
	+10000	Store Lunar Azimuth
414	+00000	Navigation Initialization Complete (AUTO)
	+10000	LM And CSM Navigation Initialization via PGNCS Downlinks
	+20000	LM Navigation Initialization via DEDA
	+30000	CSM Navigation Initialization via DEDA

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 Defined By WB When In Guidance Steering (400 set To +1)

Basic Date October 6, 1969
Changed NOVEMBER 5, 1969

DEDA INPUT/OUTPUT LIST

Address		
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 a_L (O.I.)	100 ft
225	Lower Limit of a_L (O.I.)	100 ft
226	Upper Limit of a_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

316	Radar Range (R)	0.1 nm
373	AGS TIG CSI, COH, TPI, TPM	0.1 min
377	AGS Computer Time (T)	0.1 min
404	ΔVX (Use 470 For Readout)	Octal
405	ΔVY (Use 471 For Readout)	Octal
406	ΔVZ (Use 472 For Readout)	Octal
450	ΔVX (LV) (+Fwd)	.1fps
451	ΔVY (LV) (+Rt)	.1fps
452	ΔVZ (LV) (+Dn)	.1fps
464	Vertical Pitch Steering, Attitude Rate Threshold	.1fps
465	Target Radial Rate at Insertion (Lower Limit)	.1fps
503	Radar Range Rate (ROOT) 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/sec2
541	Y Accel Bias Comp Coeff	.001 ft/sec2
542	Z Accel Bias Comp Coeff	.001 ft/sec2
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 OUTPUT LIST

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

372	CSI To COH 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	ΔVX Measured (LM) (+ Up) (Use 404 to zero)	.1fps
471	ΔVY Measured (LM) (+ Rt) (Use 405 to zero)	.1fps
472	ΔVZ Measured (LM) (+ Fwd) (Use 406 to zero)	.1fps
477	Predicted HDOT At CSI, COH, or TPI Time	.1fps
500	ΔVgx (LM) (+Up)	.1fps
501	ΔVgy (LM) (+Rt)	.1fps
502	ΔVgz (LM) (+Fwd)	.1fps
612	Staging Sequence Counter	Octal
614	Ullage Counter	2 sec

DEDA ACCESSIBLE CONSTANTS LIST

Address		
216 (2K3)	Value of LM Pericynthion If Overflow In Orbital Eccentricity	100 ft
227 (4K10)	Factor In LM Desired Semi major Axis αL (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

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 ____ ____

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) (.1f s)
224+(Semi-Major Axis Targeting Term) (100ft)
225+(a Lower) (100ft)
226+(a 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 (.1f s)

7

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	COR	-	-
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

PRPLNT QTY MON	DES 1	OFF	OFF
PRPLNT TEMP/PRESS MON	DES 1	ASC	-
HELIUM MON	SUPCRIT PRESS	PRESS 2	-
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 ΔV >50fps: 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 (COR) - JETS
DEADBAND - MAX
PRPLNT QTY MON - OFF
HELIUM MON - OFF

13 616 + 00007

CSI

1	MODE CONT: AGS - ATT HOLD GUID CONT - AGS	
2	Wait until TIG-136 min 410 + 1 CSI Routine 373 + (TIG CSI) 275 + (TIG TPI) 605 + (COTAN LOS TPI) 451 + OE 416 + 1 CDH 1/2 Orbital Period After CSI + 3 CDH 3/2 Orbital Periods After CSI	 (.1 min) (.1 min) (Octal)
3	477R HDOT CSI	(.1fps)
4	310R TFI CSI EVENT TIMER - SET	(.01 min)
5	If Time Available 372R ΔT CSI To CDH 303R LM/CSM Phase Angle 371R ΔV CDH 477R Predicted HDOT 314R ΔH At TIG 402R ΔH CDH	 (.1min) (.01°) (.1fps) (.1fps) (.1nm) (.1nm)
6	410 + 5 EXT ΔV 450R ΔVX CSI 263RΔVY CSI 451 (ΔVY CSI) (Same sign as 263) 452R ΔVZ CSI 267R ΔVG CSI	 (.1fps (.1fps (.1fps (.1fps (.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

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

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

Basic Date October 6, 1968
Changed

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 ΔVG <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(COR) - JETS
DEADBAND - MAX
PRPLNT QTY MON - OFF
HELIUM MON - OFF

CDH

1	MODE CONT: AGS - ATT HOLD GUID CONT - AGS	
2	410 +2 CDH ROUTINE 373R TIG CDH (Adjust AGS TIG CDH As Desired For New Solution)	(.1 min)
3	310R TFI CDH EVENT TIMER - SET	(.01 min)
4	If Time Available Check The Following: 402R ΔH CDH 423R HDOT CDH (Final) 477R HDOT CDH	 (.1nm) (.1fps) (.1fps)
5	410 +5 EXT ΔV 450R ΔVX CDH 263R ΔVY CDH 451 (ΔVY CDH) (Same Sign As 263) 452R ΔVZ CDH 267R ΔVG CDH	 (.1fps) (.1fps) (.1fps) (.1fps) (.1fps)
6	411 +0 DES ENG OR RCS BURN +1 ASC BURN	
7	623 +0 Z-axis Parallel To CSM Orbit Plane +1 Z-axis Parallel To Specified Plane	
8	If 623 +1, Specify Plane 514 +(X Component of Unit Vector) 515 +(Y Component of Unit Vector) 516 +(Z Component of Unit Vector)	

Basic Date October 6, 1969
Changed —

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

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

11 407 +0

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

13

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

Basic Date October 6, 1969
Changed

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 ΔVG <15fps,
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

TPI

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

2 410 +3 TPI SEARCH
307 +(ΔT RND TRANS) (.01 min)
306 +0 NODE AT TPF (.01 min)
310 +(TARGET TFI TPI) (.01 min)

3 303R LOS ANGLE TPI (.01°)
410 +4 TPI EXECUTE (When 303 is 26.6° (Below), 28.3° (Above)
(TO RETARGET 410 +3 And
310 (Target TFI TPI) Then
410 +4 (When 303 Reads Desired Value)

4 310R TFI TPI (.01 min)
EVENT TIMER - SET
371R ΔVG to RNDZ (.1fps)
(If +06000 Retarget)

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

6 411 +0 DES ENG OR RCS
+1 ASC ENG

7 410 +5
267R ΔVG TPI

Basic Date October 6, 1969
Changed

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

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANS	2 JET	2 JET	2 JET
TTCA (CDR)	THROT	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT 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

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 ΔVG <15fps,	
		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	(.01min)
	410 +4 TPI EXECUTE	
2	If Time Available:	
	311R ΔT RDZ	(.01 min)
	277R THETA	(.01°)
3	410 +5	
	407 +0 Ref Frame	(.1fps)
	267R VG MDC	
	407 +1 Freeze Ext ΔV	
4	Null 501, 502, 500	

EXTERNAL ΔV

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

2 410 +5 EXTERNAL ΔV
450 + ΔVX (LV) (.1fps)
451 + ΔVY (LV) (.1fps)
452 + ΔVZ (LV) (.1f s)

3 267R Total ΔV
EVENT TIMER - SET

4 411 +0 DES ENG OR RCS
+1 ASC ENG

5 400 +1 GUIDANCE STEERING (Z-Axis,400+2,507+1)

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

7 407 +0

8 501R ΔVGY (LM) .1fps
502R ΔVGZ (LM) .1f s
500R ΔVGX (LM) .1f s

9

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANS	2 JET	2 JET	2 JET
TTCA(CDR)	THROT	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT(STAGE)	PUSH	PUSH	-

Basic Date October 6, 1969
Changed

		ENG ARM	DES	ASC	OFF
		MASTER ARM	ON(1st Burn Only)	ON(Un-Staged Only)	OFF
		PRPLNT QTY MON	DES 1	OFF	-
		PRPLNT TEMP/PRESS MON	DES 1	ASC	-
		HELIUM MON	SUPCRIT PRESS	PRESS 2	-
		ENGINE STOP	-	-	DEPRESS
10	-30	For DPS Burns CB(11) STAB/CONT: DECA PWR-Close CB(16) STAB/CONT: DES ENG OVRD-Close ENG GMBL-ENBL For APS Burns CB(11) STAB/CONT: AELD-Close CB(16) STAB/CONT: AELD-Close			
	-15	407 +1 (For RCS Burn Not Along +X)			
11	-:06	Start Ullage			
12	00	IGNITION (RCS Burn) When ΔVG <15fps, 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 MANUAL THRUST

1	GUID CONT	-AGS
	MODE CONT: AGS	-ATT HOLD
	ATT CONT RPY	-MODE CONT
	DEADBAND	-MIN
	TTCA/TRANSL	-ENABLE
	TTCA(CDR)	-JETS

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

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

4 Monitor ΔV Along Thrust Axis

X - 470R	(.1fps)
Y - 471R	(.1fps)
Z - 472R	(.1fps)

5 Thrust Residuals

6 Trim Residuals

X - 470R (.1fps)
Null (TTCA Up/Dn)
(If Thrust Axis Acquire Desired ΔV)

Z - 472R (.1fps)
Null (TTCA In/Out)
(If Thrust Axis Acquire Desired ΔV)

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)
O2/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 CALIBRATION

1 Verify AGS In Standby/Operate For 25 min

2 Read And Record

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

3 V16N20E

16 20 ICDU Angles O,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/sec2)
541R Y	_____	(.001 ft/sec2)
542R Z	_____	(.001 ft/sec2)

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

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)

Basic Date October 6, 1969
Changed October 24, 1969

AGS RR MANUAL ACQUISITION AND UPDATE

1	GUID CONT	-AGS
	RNG/ALT MON	-RNG/RNG RT
	RATE/ERR MON	-LDR RDR/CMPTR
	ATT MON	-AGS
	SHFT/TRUN	-+5°
	RR MODE	-SLEW
	ATT CONT (3)	-PULSE
	MODE CONT: AGS	-AUTO
	DB	-MIN

2 400 +2 ACQUISITION STEERING
507 +0 Z Body Boresight

3 Manually Null FDAI

4 RATE/ERR MON-RNDZ RADAR

5 Slew Null FDAI, Then Search For Strongest Signal And Check For Side Lobe

6 RR MODE - AUTO TRACK

7 417 +1 INITIALIZE RADAR FILTER

8 415 +1 STORE Z AXIS COSINES
ENTR (When FDAI's Centered)

9 316 +(RADAR RANGE) (.1nm)
(Must Be Entered Within 30 sec)
Wait 16 sec Before Step 10

10 415 +1 Store Z Axis cosines

11 503 ± (RADAR RANGE RATE) (.1fps)
(Must Be Entered Within 30 sec)
(Wait 16sec Before Next 415 Entry)

12 Repeat Steps 8 thru 11

13 Repeat Procedure For A Minimum of 6 Range Data Points Approximately 4 min Apart (9 Points if Pre CSI)

AGS ORDEAL INITIALIZATION

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

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

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

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

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							
X	X	X	X			X	X	X	X						
X	X					X	X								
	0						0								
+	0					+	0								

N34 HR
MIN
NAV CHECK SEC
N43 LAT
LONG
ALT

Basic Date October 6, 1969
Changed _____

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 ___

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

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							•						•
ΔVR		+					•	+					•
BT		X	X	X		•		X	X	X		•	
R	FDAI	X	X	X				X	X	X			
P	INER	X	X	X				X	X	X			
ΔVX	AGS N86						•						•
ΔVY	AGS						•						•
ΔVZ	AGS						•						•
BSS		X	X	X				X	X	X			
SPA		X	X				•	X	X				•
SXP		X	X	X			•	X	X	X			•

REMARKS:

Basic Date ____
Changed ____ October 6, 1969

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								•						•
ΔVR			+					•	+					•
BT			X	X	X		•		X	X	X		•	
R		FDAI	X	X	X				X	X	X			
P		INER	X	X	X				X	X	X			
ΔVX	AGS	N86						•						•
ΔVY	AGS							•						•
ΔVZ	AGS							•						•
BSS			X	X	X				X	X	X			
SPA			X	X				•	X	X				•
SXP			X	X	X			•	X	X	X			•

REMARKS:

P30 UPDATE (LM)

Basic Date October 6, 1969
Changed

LM-

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														
ΔVR		+						+						
BT		X	X	X				X	X	X				
R	FDAI	X	X	X				X	X	X				
P	INER	X	X	X				X	X	X				
ΔVX	AGS N86													
ΔVY	AGS													
ΔVZ	AGS													
BSS		X	X	X				X	X	X				
SPA		X	X					X	X					
SXP		X	X	X				X	X	X				

REMARKS:

Basic Date ____
Changed ____

October 6, 1969

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								•						•
ΔVR			+					•	+					•
BT			X	X	X		•		X	X	X		•	
R		FDAI	X	X	X				X	X	X			
P		INER	X	X	X				X	X	X			
ΔVX	AGS	N86						•						•
ΔVY	AGS							•						•
ΔVZ	AGS							•						•
BSS			X	X	X				X	X	X			
SPA			X	X				•	X	X				•
SXP			X	X	X			•	X	X	X			•

REMARKS:

Basic Date 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

LM-6

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

LM-6

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

LM-6

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 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	-.40804	-.26959	-.10383
11:14:02	10	-.40672	-.27138	-.10461
11:14:07	15	-.40539	-.27306	-.10538
11:14:12	20	-.40405	-.27474	-.10614
11:14:17	25	-.40271	-.27641	-.10691
11:14:22	30	-.40136	-.27807	-.10767
11:14:03	35	-.40000	-.27973	-.10843
11:14:08	40	-.39864	-.28138	-.10919
11:14:13	45	-.39726	-.28303	-.10994
11:14:18	50	-.39588	-.28467	-.11069
11:14:23	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
11:17:00	80	-.38742	-.29437	-.11516
11:17:05	85	-.38598	-.29596	-.11589
11:17:10	90	-.38454	-.29755	-.11663
11:17:15	95	-.38309	-.29913	-.11736
11:16:20	100	-.38163	-.30071	-.11809
11:19:01	105	-.38016	-.30227	-.11881
11:19:06	110	-.37869	-.30384	-.11954
11:19:11	115	-.37720	-.30539	-.12024
11:19:16	120	-.37571	-.30694	-.12095
11:19:21	125	-.37422	-.30846	-.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	-.13880

*Planet is within 15 degrees of the sun

PLANET VECTORS
NOV 14

PLANET VECTORS
NOV 14

MARS HALF-UNIT VECTORS

GMT M:D:H	GET Hr	X vector	Y vector	Z vector
11:14:16	0	.30172	-.35[illegible]0	-.17[illegible]
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	-.45[illegible]34	-.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	.26661	.08988
11:16:18	50	.41408	.26558	.08948
11:18:20	100	.41480	.26450	.08910
11:20:22	150	.41549	.26363	.08874
11:23:00	200	.41616	.26269	.08840
11:25:00	250	.41680	.26173	.08806

Basic Date _ ober 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	-.31348	-.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
110.00	-.49993	.00176	-.00856
110.50	-.49991	-.00041	-.00973
111.00	-.49988	-.00256	-.01089
111.50	-.49984	-.00472	-.01206
112.00	-.49978	-.00688	-.01323
112.50	-.49972	-.00903	-.01439
113.00	-.49964	-.01119	-.01556
113.50	-.49955	-.01334	-.01672
114.00	-.49944	-.01549	-.01789
114.50	-.49933	-.01765	-.01905
115.00	-.49920	-.01980	-.02021
115.50	-.49907	-.02195	-.02138
116.00	-.49892	-.02409	-.02254
116.50	-.49875	-.02624	-.02370
117.00	-.49858	-.02839	-.02485
117.50	-.49839	-.03053	-.02601
118.00	-.49820	-.03268	-.02717
118.50	-.49799	-.03482	-.02832
119.00	-.49777	-.03696	-.02948
119.50	-.49753	-.03910	-.03063
120.00	-.49729	-.04123	-.03179
120.50	-.49703	-.04337	-.03294

G.e.t., hr	X vector	Y vector	Z vector
121.00	-.49676	-.04550	-.03409
121.50	-.49648	-.04764	-.03524
122.00	-.49619	-.04977	-.03638
122.50	-.49589	-.05189	-.03753
123.00	-.49557	-.05402	-.03868
123.50	-.49525	-.05615	-.03982
124.00	-.49491	-.05827	-.04096
124.50	-.49456	-.06039	-.04210
125.00	-.49420	-.06251	-.04324
125.50	-.49382	-.06462	-.04438
126.00	-.49344	-.06674	-.04552
126.50	-.49304	-.06885	-.04666
127.00	-.49263	-.07096	-.04779
127.50	-.49221	-.07307	-.04892
128.00	-.49178	-.07517	-.05005
128.50	-.49134	-.07728	-.05118
129.00	-.49089	-.07938	-.05231
129.50	-.49042	-.08147	-.05344
130.00	-.48994	-.08357	-.05456
130.50	-.48946	-.08566	-.05569
131.00	-.48896	-.08775	-.05681
131.50	-.48845	-.08984	-.05793

G.e.t., hr	X vector	Y vector	Z vector
132.00	-.48792	-.09192	-.05905
132.50	-.48739	-.09400	-.06016
133.00	-.48685	-.09608	-.06128
133.50	-.48629	-.09816	-.06239
134.00	-.48572	-.10023	-.06350
134.50	-.48515	-.10230	-.06461
135.00	-.48456	-.10437	-.06572
135.50	-.48396	-.10643	-.06683
136.00	-.48334	-.10849	-.06793
136.50	-.48272	-.11055	-.06903
137.00	-.48209	-.11261	-.07013
137.50	-.48144	-.11466	-.07123
138.00	-.48079	-.11670	-.07232
138.50	-.48012	-.11875	-.07342
139.00	-.47944	-.12079	-.07451
139.50	-.47875	-.12283	-.07560
140.00	-.47805	-.12486	-.07669
140.50	-.47734	-.12689	-.07777
141.00	-.47662	-.12892	-.07885
141.50	-.47589	-.13094	-.07994
142.00	-.47515	-.13296	-.08101
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

GMT M:D:H	GET Hr	X vector	Y vector	Z vector
11:16:19	[illegible]	-.39559	-.[illegible]00	-.110[illegible]
11:17:00	[illegible]	-.39[illegible]	-.[illegible]3	-.111[illegible]0
11:17:05	10	-.392[illegible]0	-.28826	-.1123[illegible]
11:17:10	1[illegible]	-.3913[illegible]	-.2[illegible]	-.11309
11:17:15	20	-.38[illegible]	-.29163	-.11383
11:17:20	25	-.388[illegible]	-.29310	-.11457
11:18:01	30	-.38713	-.29[illegible]70	-.11531
11:18:06	35	-.38569	-.29[illegible]29	-.11[illegible]
11:18:11	40	-.38[illegible]	-.29787	-.11678
11:18:16	45	-.38279	-.29[illegible]5	-.11751
11:18:21	50	-.38133	-.30103	-.11826
11:19:02	55	-.3798[illegible]	-.30259	-.11[illegible]
11:19:07	60	-.37838	-.30415	-.11968
11:19:12	65	-.37[illegible]90	-.30571	-.12040
11:19:17	70	-.37541	-.30725	-.12112
11:19:22	75	-.37391	-.30880	-.12184
11:20:03	80	-.37[illegible]	-.31033	-.12255
11:20:08	85	-.37[illegible]	-.31186	-.12326
11:20:13	90	-.[illegible]37	-.31338	-.12397
11:20:18	[illegible]	-.37[illegible]	-.31489	-.12468
11:20:23	100	-.3[illegible]31	-.31640	-.12538
11:21:04	105	-.3[illegible]	-.31790	-.12608
11:21:09	110	-.[illegible]21	-.31939	-.12[illegible]78
11:21:14	11[illegible]	-.3[illegible]	-.32[illegible]	-.12767
11:21:19	120	-.[illegible]	-.3223[illegible]	-.12817
11:22:00	125	-.[illegible]	-.32353	-.1[illegible]

GMT M:D:H	GET Hr	X vector	Y vector	Z vector
11:22:05	130	-.35656	-.32530	-.12955
11:22:10	135	-.35535	-.326[illegible]	-.13023
11:22:15	140	-.35375	-.32822	-.13092
11:22:20	145	-.35215	-.329[illegible]	-.13160
11:23:01	150	-.35056	-.33110	-.13228
11:23:06	1[illegible]5	-.34[illegible]93	-.332[illegible]4	-.1323[illegible]
11:23:11	[illegible]	-.34730	-.333[illegible]	-.133[illegible]3
*11:23:16	[illegible]	-.34[illegible]7	-.3353[illegible]	-.13630
*11:23:21	1[illegible]0	-.34403	-.33680	-.13697
*11:24:02	17[illegible]	-.34239	-.33520	-.13[illegible]3
*11:24:07	180	-.34076	-.33360	-.13[illegible]30
*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	21[illegible]	-.3289[illegible]	-.34921	-.140[illegible]
*11:25:23	220	-.32725	-.35[illegible]	-.14151
*11:26:04	22[illegible]	-.32553	-.35133	-.14215
*11:26:09	230	-.32381	-.35322	-.14279
*11:26:14	235	-.32208	-.35[illegible]	-.14342
*11:26:19	240	-.32036	-.35[illegible]96	-.14404
*11:27:00	24[illegible]	-.31859	-.35717	-.14469
*11:27:05	250	-.3168[illegible]	-.358[illegible]9	-.14531

*Planet is within 1° degree of the sun.

PLANET VECTORS
NOV 16

PLANET VECTORS
NOV 16

MARS HALF-UNIT VECTORS

GMT M:D:H	GET 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	GET 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	GET 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	[illegible]	[illegible]	-.13033
140.0	[illegible]	[illegible]	-.13061
142.0	[illegible]	[illegible]	-.13088
144.0	[illegible]	[illegible]	-.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	-.27860	-.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 ober 6, 1969
Changed NOVEMBER 3, 1969

NASA — MSC

Basic Date November 10, 1969

Change November 11, 1969

STAR HALF-UNIT VECTORS

Star number (octal)	X	Y	Z
46 Hamal	.39204	.23001	.18794
47	.29402	.32311	-.24320
50 Polaris	-.19246	.39468	.23951
51	-.13001	.11414	-.46962
52	-.22788	.35905	.44112
53	-.32441	-.05499	-.37418
54 Rigel Kent	-.18904	-.15521	-.43609
55 Dubhe	.01396	.49564	.06447
56	-.21408	-.12572	-.43461
57 Mizar	.07877	.49068	.05507
60	.06794	.43377	.23922
61	.05509	.49484	-.01084
62	.04520	.49766	-.01708
63	-.04431	.47302	-.15401
64	-.07498	.47349	.14139
65	-.10454	.42363	-.24187
66	-.12045	.42856	-.22184
67 Canopus	-.16693	.39001	.26463
70	-.14764	.20720	-.43043
71	-.18991	.21071	-.40755
72	-.27044	-.33469	-.41908
73	-.24850	-.35051	-.43393
74	-.27137	-.06394	.41511
75	-.04936	-.39581	-.20149
76	-.03957	-.30365	-.34088
77	.03984	-.41067	-.28740
100	.25750	.00850	.42851
101	.36464	.33044	-.33756
102	.38943	.11914	.25008
103	.31918	.18819	.33577
104	.06424	.49585	.08270
105	.02937	.49201	-.06407
106	.06413	.35348	.35322
107	-.15441	.40804	-.24426
110	-.19546	.32997	-.32084
111	-.26488	.24041	-.34298
112	-.19372	.16757	-.42925
113	-.26627	.07130	.41715
114	-.20777	-.19107	.48998
115	-.09958	-.39167	.48129
116	-.00554	-.31126	.39126

Star number (octal)	X		Z
117	.22075	-.31191	.92248
120	.29937	-.16183	-.34631
121	.32063	-.11530	-.36593
122	.27293	.04465	.41433
123	-.29470	.00968	.40380
124	-.23342	-.39048	-.16165
125	-.12736	-.39323	-.28133
126	.48230	.02462	.12055
127	-.33317	-.38704	-.31477
130	.23289	.38921	.49336
131	.41214	.22140	.17643
132	.29259	.38052	.30348
133	.22482	.36063	.28345
134	.19772	.32453	.32089
135	.11712	.40705	.27320
136	.11547	.48443	-.04465
137	.06716	.48762	-.17741
140	.05923	.47225	-.15329
141	.05637	.49412	-.05164
142	.04906	.46391	.18021
143	.03848	.41227	-.20624
144	.00404	.39818	.30238
145	-.06743	.31023	-.38625
146	-.13007	.37730	-.30121
147	-.23871	.30893	-.20510
150	-.22129	.18374	-.40899
151	-.42438	.20149	.17096
152	-.30920	.10425	-.37885
153	-.45779	.09422	.17684
154	-.45476	-.06555	-.19722
155	-.17729	-.02759	-.46670
156	-.49223	-.08710	-.01122
157	-.38035	-.09741	.31112
160	-.47351	-.12839	.06443
161	-.37808	-.13454	-.29780
162	-.27183	-.12344	-.40094
163	-.41732	-.22483	.29065
164	-.30980	-.23959	.31084
165	-.29104	-.23073	-.33474
166	-.26997	-.21803	-.34722
167	-.33604	-.29178	.22855
170	-.35561	-.32363	-.13713

STAR HALF-UNIT VECTORS

STAR HALF-UNIT VECTORS

Star number (octal)			
171	-.26236	-.25465	-.34169
172	-.32474	-.37156	-.08397
173	-.22537	-.30218	-.32947
174	-.27996	-.41034	.85477
175	-.22966	-.38815	-.23942
176	-.22874	-.41134	-.16475
177	-.09718	-.21720	.43975
200	-.17997	-.42840	.18369
201	-.18155	-.41017	-.23993
202	-.17717	-.45858	-.06118
203	-.14530	-.40004	.26241
204	-.10694	-.46934	-.13521
205	-.04576	-.27845	-.41708
206	-.05413	-.39414	-.30281
207	-.04275	-.31852	-.38920
210	-.04022	-.30255	.36573
211	-.03013	-.49687	.03951
212	.03605	-.43723	-.24481
213	.05134	-.44859	-.21478
214	.11344	-.41823	-.24943
215	.15488	-.31743	.35390
216	.21709	-.44103	.05145
217	.27376	-.31718	.27856
220	.17572	-.15026	.44334
221	.39955	-.26559	-.16003
222	.22212	-.10770	-.42479
223	.42786	-.11723	.23412
224	.46814	-.11832	.12977
225	.20630	.11651	-.44630
226	.41167	.28248	-.02715
227	.26013	.29462	.32458
230	-.21684	.16562	-.41887
231	-.20487	.07265	-.45330
232	-.31753	-.00942	-.28612
233	-.11849	-.19051	-.44684
234	.13389	-.40470	.11942
235	.13637	-.44619	-.17978
236	-.22505	-.44537	-.03155

Basic Date. November 10, 1969

Changed _____