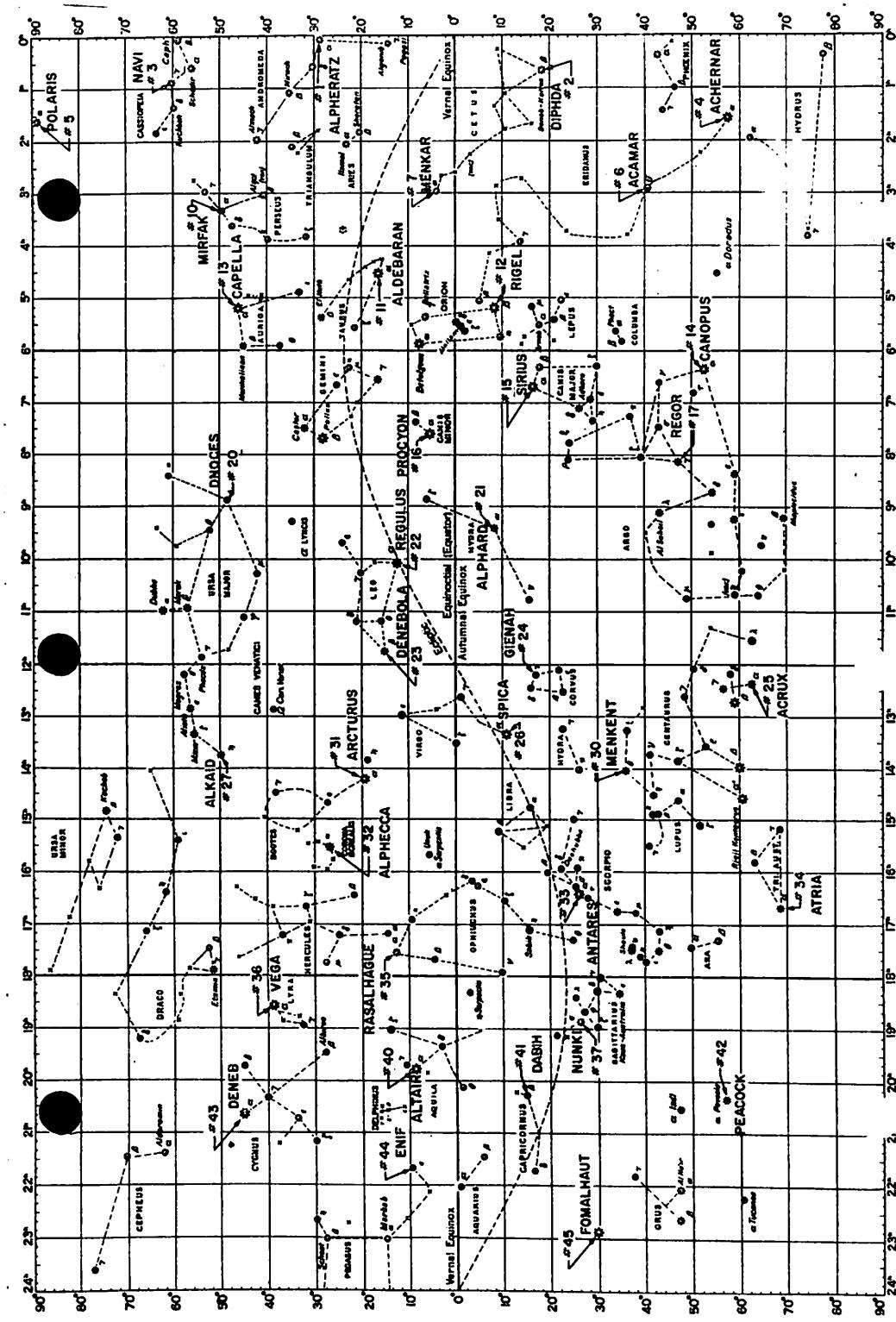


Apollo 10

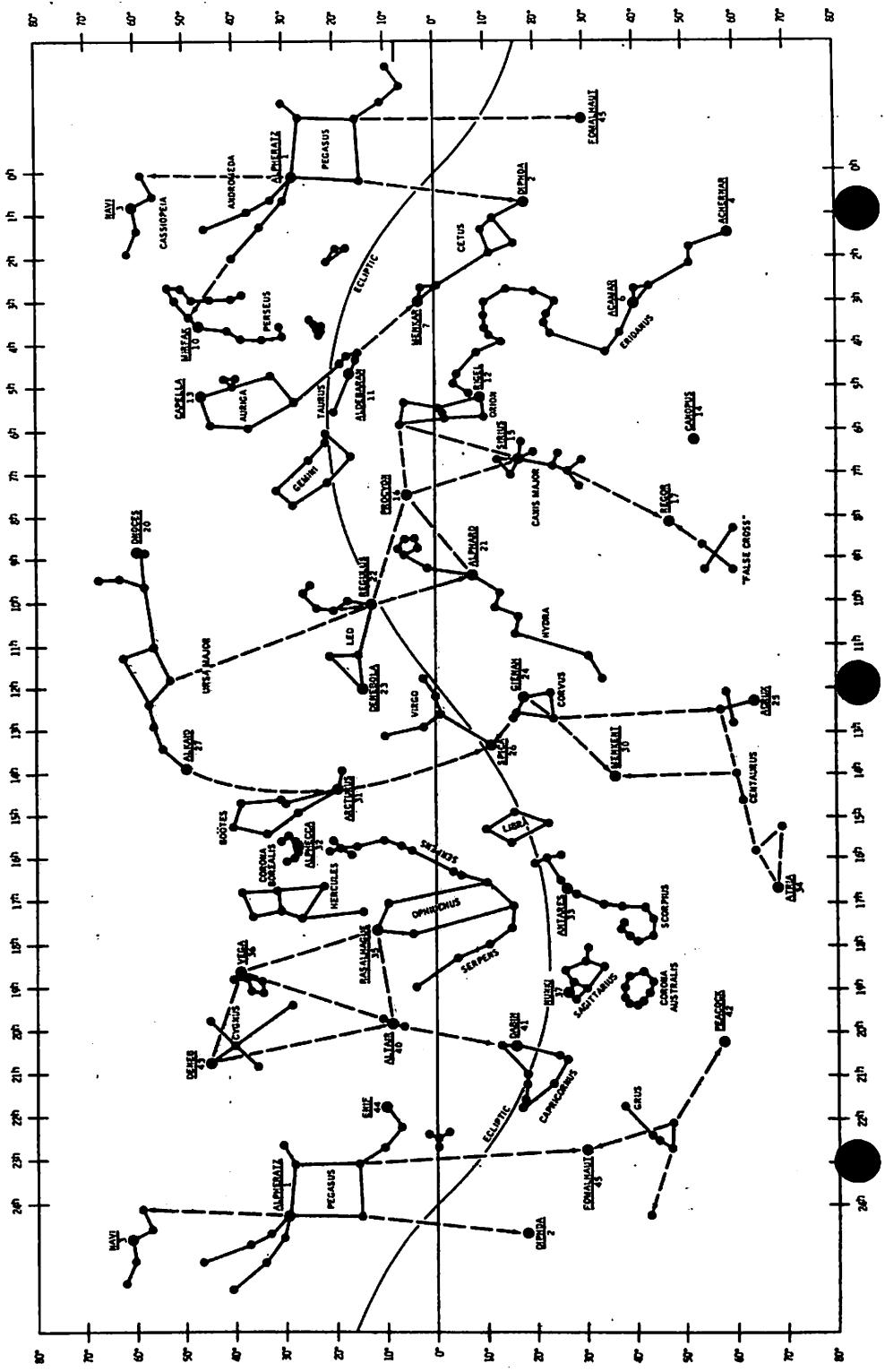
LM G&N DICTIONARY

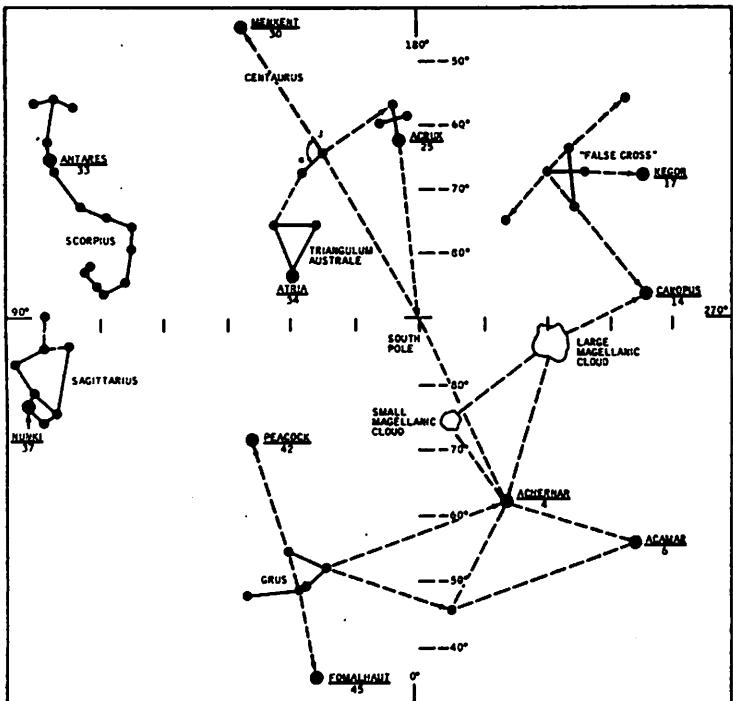
PART NO	S/N
SKB32100073-361	1002

STAR CHARTS

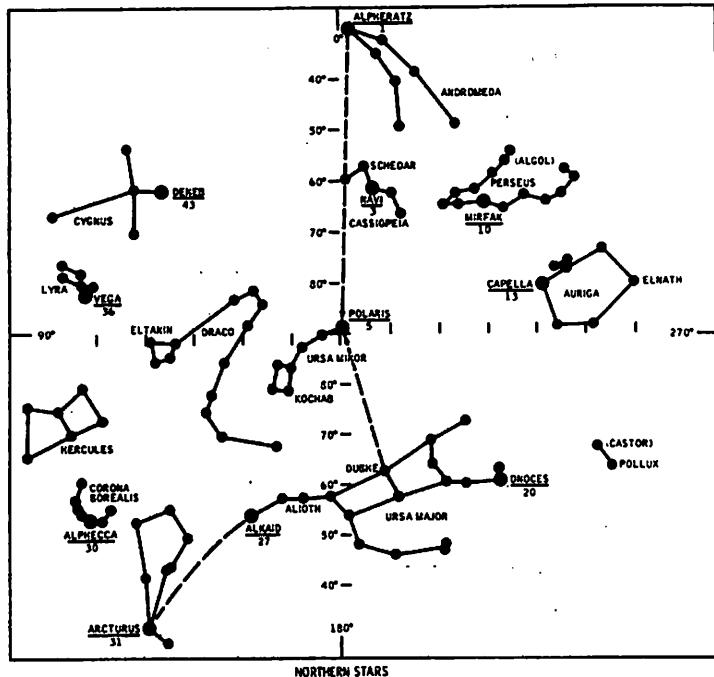


STAR CHARTS





SOUTHERN STARS



NORTHERN STARS

STAR LIST

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

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PROGRAMSNO.

00 LGC Idle
06 LGC Power Down
20 Rendezvous Navigation
21 Ground Track Determination
25 Preferred Tracking Attitude
27 LGC Update
30 External ΔV
31 Lambert Aim Point Guidance
32 CSI Pre-Thrust
33 CDH Pre-Thrust
34 TPI Pre-Thrust
35 TPM Pre-Thrust
38 Stable Orbit Rendezvous
39 Stable Orbit Midcourse
40 DPS
41 RCS
42 APS
47 ΔV Monitor
51 IMU Orientation Determination
52 IMU Realign
72 CSM CSI Targeting
73 CSM CDH Targeting
74 CSM TPI Targeting
75 CSM TPM Targeting
76 Target ΔV
78 CSM SOR Targeting
79 CSM SOM Targeting

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

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- 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 (POO Only)
 31 Request Waitlist (POO Only)
 32 Recycle
 33 Proceed
 34 Terminate
 35 Test Lights (POO Only)
 36 Request Fresh Start (Wait 20 Sec Before
 V37E XXE)
 (See Alarm Code 01107, PGNS-12)
 For Recovery Procedure)
 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 FDAO Error Needles :
 44 Terminate Continuous Designate
 (V41 N72 Option 2)
 47 Initialize AGS (R47)
 48 Load DAP Data (R03)
 49 Start Crew Defined Maneuver (R62)
 50 Please Perform
 52 Mark X-Reticle
 53 Mark Y-Reticle
 54 Mark X Or Y-Reticle
 55 Increment LGC Time (Decimal)
 56 Terminate Tracking (P20&P25)
 57 Permit LR Update
 58 Inhibit LR Update
 60 Command LR To Pos. 2
 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 Display W-Matrix RSS Errors
 68 Start P-64 Immediately (P63 Only)
 69 Cause Restart
 70 Update Liftoff Time (P27)
 71 Universal Update Load Block Addresses
 (P27)
 72 Universal Update Load Singular Addresses
 (P27)
 73 Update LGC Time (Octal) (P27)
 74 Initialize Erasable Dump Via Downlink
 75 Enable U,V Jets During DPS Burns
 76 Set Min Impulse Mode In DAP
 77 Set Rate Command/Attitude Hold Mode In
 DAP
 78 Start LR Spurious Test (R77)
 79 Stop LR Spurious Test (R77)
 80 Update LM State Vector
 81 Update CSM State Vector
 82 Request Orbit Parameter Display (R30)
 83 Rendevous Parameter Display (R31)
 85 Display RR LOS AZ And E1
 89 Start Rendezvous Final Attitude Maneuver
 (R63)
 90 Request Rendezvous Out Of Plane Display
 (R36)
 91 Display Banksun
 92 Start IMU Performance Test (P07)
 (Non-Flight)
 93 Enable W-Matrix Initialization
 95 Inhibit State Vector Update (P20 or P22)
 96 Interrupt Integration And Go To P00
 (Do Not Use During P20 Mark Processing,
 Or Before Program Light Changes
 following V37E XXE)
 97 Perform Engine fail Procedure (R40)
 99 Enable Engine Ignition

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NOUN LIST

01	(V) Address To Be Specified (Frac)	.XXXXXX
02	(V) Address To Be Specified (Whole)	XXXXXX.
03	Address To Be Specified (Degree)	.01°
04	Gravity Error Angle	.01°
05	Angular Error/Difference	.01°
06	Option Code	Octal
	Desired Option	Octal
07	Flag Word Operator	Octal
	ECADR	Octal
	BIT ID	Octal
	ACTION	Octal
08	(V) Alarm Data	Octal
09	(V) Alarm Codes	Octal
10	(V) Channel To Be Specified	Octal
11	TIG CSI	hrs,min,.0lsec
12	Option Code (Extended Verbs Only)	Octal
	Desired Option	Octal
13	TIG CDH	hrs,min,.0lsec
14	Checklist (Internal To LGC)	.XXXXXX.
15	Increment Address	Octal
16	Time of Event (Extended Verbs Only)	hrs,min,.0lsec
18	Desired Maneuver To FDAI RPY Angles	.01°
20	(V) ICDU Angles (OG,IG,MG)	.01°
21	(V) PIPA PULSES	.XXXXXX.
22	New ICDU Angles (OG,IG,MG)	.01°
24	Delta Time For LGC Clock	hrs,min,.0lsec
25	Checklist (Used With V50)	Octal
26	PRI0 DELAY, ADRES, BBCON	Octal
27	(V) Self Test ON/OFF	.XXXXXX.
32	Time From Perigee	hrs,min,.0lsec
33	TIG	hrs,min,.0lsec
34	Time Of Event	hrs,min,.0lsec
35	Time From Event	hrs,min,.0lsec
36	(V) LGC Clock Time	hrs,min,.0lsec
37	TIG TPI	hrs,min,.0lsec
38	Time Of State Being Integrated	hrs,min,.0lsec
40	Time From Ignition/Cutoff VG ΔV (Accumulated)	min-sec .1fps .1fps
41	Target Azimuth (Non Flight) Elevation	.01° .001°

SNON

NOUNS

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
45(V-R1)	Marks	XXXXX.
	TFI Of Next Burn	min-sec
	MGA	.01°
46 (V)	DAP Configuration	Octal
47 (V)	LM Weight	lbs
	CSM Weight	lbs
48 (V)	Engine Gimbal Pitch Trim (+ Only)	.01°
	Engine Gimbal Roll Trim (+ Only)	.01°
49	ΔR	.1nm
	ΔV	.1fps
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	0000X.
	Elevation Angle	.01°
	Central Angle	.01°
56	RR LOS	
	Azimuth	.01°
	Elevation	.01°
57	ΔR	.1nm
58	Perigee Alt. (Post TPI/SOR)	.1nm
	ΔV TPI/SOR	.1fps
	ΔV TPF/SOR FINAL	.1fps
59	ΔV LOS Fwd/AFT (+FWD)	.1fps
	ΔV LOS Rt/Left (+RT)	.1fps
	ΔV LOS Up/Dn (+DN)	.1fps
60	V (Horizontal)	.1fps
	HDOT (+ Increasing H)	.1fps
	H	ft

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• 61	TG	min-sec
	TFI	min-sec
	Crossrange	.lnm
62	VI	.1fps
	TFI	min-sec
	ΔV (Accumulated)	.1fps
63	VI	.1fps
	HDOT (+Increasing H)	.1fps
	H	ft
64	TG/LPD	Sec B Deg
	HDOT (+Increasing H)	.1fps
	H	ft
65 (V)	Sampled LGC Time	hrs,min,.01sec
66(V-R2)	LR Slant Range	ft
	LR Position	00001/00002
67	LR VX	fps
	VY	fps
	VZ	fps
68	Slant Range To LS	.lnm
	TF Braking	min-sec
	LR Alt-Comp Alt	ft
70	AOT Detent/Star Code	Octal
71	AOT Detent/Star Code	Octal
72(V)	RR Trunnion Angle	.01°
	RR Shaft Angle	.01°
73	Desired RR Trunnion Angle	.01°
	Desired RR Shaft Angle	.01°
74	TF (TFI)	min-sec
	Yaw	.01°
	Pitch	.01°
75	ΔH (CDH)	.lnm
	ΔT (CDH-CSI/TPI-CDH)	min-sec
	ΔT (TPI-CDA/TPI-TPI NOM)	min-sec
76	Crossrange	.lnm
	Apo Alt	.lnm
77	T to Engine Cutoff	min-sec
	Velocity Normal To CSM Plane	.1fps
78	RR Range	.01nm
	RR Range Rate	fps
79	Cursor Angle	.01°
	Spiral Angle	.01°
	AOT Position Code	0000X
80	Data Indicator	XXXXX
	Omega	.01°

PGNS-8

81	ΔV_X (LV) (+FWD)	.1fps
	ΔV_Y (LV) (+RT)	.1fps
	ΔV_Z (LV) (+DN)	.1fps
82	ΔV_X (LV) (+FWD)	.1fps
	ΔV_Y (LV) (+RT)	.1fps
	ΔV_Z (LV) (+DN)	.1fps
83	ΔV_X (LM) (+UP)	.1fps
	ΔV_Y (LM) (+RT)	.1fps
	ΔV_Z (LM) (+FWD)	.1fps
84	ΔV_X (Other vehicle) (+RXV)XR	.1fps
	ΔV_Y (Other vehicle) (+VXR)	.1fps
	ΔV_Z (Other vehicle)+(-R)	.1fps
85	V_{GX} (LM) (+UP)	.1fps
	V_{GY} (LM) (+RT)	.1fps
	V_{GZ} (LM) (+FWD)	.1fps
86	V_{GX} (LV) (+FWD)	.1fps
	V_{GY} (LV) (+RT)	.1fps
	V_{GZ} (LV) (+ON)	.1fps
87	Backup Optics LOS Azimuth (+RT)	.01°
	Elevation (+UP)	.01°
88	Celestial Body Vector X	.XXXXXX
	Y	.XXXXXX
	Z	.XXXXXX
89	Latitude	.001°
	Longitude/2	.001°
	Altitude	.01nm
90	Rendezvous Out Of Plane Parameter Y	.01nm
	YDOT	.1fps
	PSI	.01°
93	Δ Gyro Torquing Angles X	.001°
	Y	.001°
	Z	.001°
97	System Test Inputs	.XXXXXX.
98	System Test Results & Inputs	.XXXXXX.
		.XXXXXX
99	W-MATRIX RSS Pos Error	.01nm
	W-MATRIX RSS Vel Error	.1fps

(V) Means: Can Be Called At Any Time For Valid Data

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V50 N25 CHECKLIST CODES

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

OPTION CODES

<u>Basic Date April 25, 1969 Changed</u>	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
	00005	Specify SOR Phase	1 = First 2 = Second
	00006	Specify RR Coarse Align Option	1 = Lock ON 2 = Continuous Designate

V05 N09 ALARM CODES

00105 P	**AOT Mark System In Use (Reselect P5X)
00107 P	More Than 5 Mark Pairs (Continue)
00111 P	Mark Missing (Start Mark Sequence Over)
00112 P	Mark or Mark Reject Not Being Accepted (Continue)

CHECKLIST, OPTION, ALARM CODES

- 00113 H No Inbits
(Continue)
- 00114 P Mark Made But Not Desired
(Mark Correct Axis (X or Y))
- 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 Reselect V40 N20)
- 00207 P/H ISS Turn On Request Not Present For 90 sec
(CB(11) PGNS: IMU OPR - OPEN & RECLOSE
If Alarm Recurs And No ISS Warning, Continue)
- 00210 P/H IMU Not Operating
(CB(11) PGNS: IMU OPR - OPEN & RECLOSE
Consult MSFN But Continue With V36E And
Recovery ~~(See 1107 PGNS 12)~~)
- 00211 H Coarse Align Error
(If P51 Or P52 In Progress, Record GYRO
Torquing Angles And Perform Fine Align
Check In P52
If V41 N20 In Progress,
Use V42 And Continue)
- 00212 H PIPA Fail, But PIPA Is Not Being Used
(Go to ISS MAL PROCEDURES)
- 00213 H IMU Not Operating With Turn-On Request
(See 00210 Above)
- 00214 P/H Computer Using IMU When Turned OFF
(Exit Routine)
- 00217 H Bad Return ISS MODE Switch Request
(Reinitiate Current Program
If Alarm Recurs, ISS MODE
Switching Failure)
- 00220 P IMU Not Aligned
(Align Or If Aligned V25 N07E, 77E
10000E, 1E)
- 00401 I Desired Gimbal Angles Yield Gimbal Lock
(Call N22, MNVR If MGA <85°, Or Realign IMU)
- 00402 P FINDCDUW Routine (TVC) Not Controlling Attitude
(Terminate Burn Or Go To AGS)
- 00405 I Two Stars Not Available
(See P52/6)

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- 00421 I W-Matrix Overflow
 (Notify MSFN, W-MATRIX Automatically
 Initialized At Next Mark)
- 00501 I RR Antenna Out Of Present Mode Limits
 (See P20/6)
- 00502 I Bad Radar Gimbal Angle Input
 (MNVR And Redo V41 N72)
- 00503 I Radar Antenna Designate Fail
 (See P20/7)
- 00510 P Radar Auto Descrete Not Present
 (RNDZ RDR - LGC Continue)
- 00511 P LR Not In Pos 2 Or Repositioning
 (LDG ANT - HOVER, V16 N66E, Verify R2+00002)
- 00514 P RR Goes Out Of Auto Mode While In Use
 (P20/5)
- 00515 H RR CDU Fail Discrete Present
 (P20/7)
- 00520 P/H RADARUPT Not Expected At This Time
 (Continue)
- 00521 I Could Not Read Radar
 (See P20/7)
- 00522 P LR Position Change
 (Continue)
- 00523 P LR Ant Not In Position 2
 (See 00511 Above)
- 00525 I SV/RR LOS >3°
 (See P20/7)
- 00526 I Range >400 Miles
 (Terminate P20 (V56E), Recall When R<400 nm)
- 00527 I LOS Not In Mode II Coverage While On
 On Lunar Surface, Or Vehicle Mnvr Required
- 00600 I Imaginary Roots On First Iteration
 (See P32/4)
- 00601 I Perigee Altitude(Post CSI):<35,000 ft
 (Lunar Orbit)
 :<85 NM
 (Earth Orbit)
 (See P32/4)
- 00602 I Perigee Altitude(Post CDH):<35,000 ft
 (Lunar Orbit)
 :<85 NM
 (Earth Orbit)
 (See P32/4)

- 00603 I CSI To CDH Time <10 MIN
(See P32/4)
- 00604 I CDH To TPI Time <10 MIN Or TIG CDH > TIG TPI
- 00605 I No Solution In 15 Tries
(See P32/4)
- 00606 I ΔV Exceeds 1000 fps
(See P32/4)
- 00611 I No TIG For Given Elevation Angle
(See P33/2, 34/3)
- 00701 I Illegal Option Code Selected (P57 Only)
- 00777 H PIPA Fail Caused The ISS Warning
(Go To ISS MAL Procedure)
- 01102 H LGC Self Test Error
(See PGNS TURN ON And SELF TEST/7)
- 01103 H Illegal Program Branch Executed
(Copy N08, Notify MSFN, Initiate V36 Recovery)
~~(See 01107 Below)~~
- 01104 H *Delay Routine Busy
(Reselect Extended Verb Or Continue With Program)
- 01105 H Downlink Too Fast
(If Alarm Recurs, DOWNLINK FAILURE)
- 01106 H Uplink Too Fast
(If Alarm Recurs, UPLINK FAILURE)
- 01107 H A Restart Failure Caused Fresh Start
(Perform: 1. ~~V37E-00E~~ Perform V36
2. ~~V74-LGG-DOWNLINK~~ Recovery
3. ~~P27 As Necessary~~ Procedure
4. ~~V48 As Necessary~~
5. ~~Reestablish REFSMMAT via P51~~
If FRESH START Recurs, LGC FAILURE)
- 01201 P *Executive Overflow - No Vac. Areas
(Reselect Extended Verb Or Continue Program)
- 01202 P *Executive Overflow - No Core Sets
(See 01201 above)
- 01203 P/I *Waitlist Overflow - Too Many Tasks
(See 01201 Above)
- 01204 P/I **Zero Or Negative WAITLIST CALL
(Reselect Program)
- 01206 P **Two Jobs Try To Use PINBALL
(Reselect Program)
- 01207 P *No Vac Area For Marks
(Reselect P51 or P52)

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- 01210 P *Two Routines Using Device At Same Time
 (Reselect Extended Verb When Device No Longer
 In Use)
- 01211 P *Illegal Interrupt of Extended Verb
 (Reselect P51 or P52)
- 01301 I ARCSIN-ARCCOS Input Angle Too Large
 (Copy N08, Notify MSFN, Continue)
- 01302 I **SQRT Called With Negative Argument
 (Copy N08, Notify MSFN, Initiate
 V36 Recovery ~~See 00107 PGNS-12~~)
- 01406 I **Bad Return From ROOTPSRS (PGX Only)
- 01407 P VG Increasing
 (See P40/IGN Or P42/IGN)
- 01410 P/I Unintentional Overflow In Landing Guidance
 (P~~G~~X Only)
- 01412 I Descent Ignition Algorithm Non-Converging
 (P~~G~~X Only)
- 01501 P **Illegal Internal Use Of PINBALL
 (See 01103 PGNS-12)
- 01502 P **Illegal Flashing Display
 (See 01103 PGNS-12)
- 01520 P V37 Request Not Permitted At This Time
 (Reselect V37)
- 01600 H Overflow In Drift Test (Ground Only)
- 01601 H Bad IMU Torque (Ground Only)
- 01703 P TIG Slipped P40/3, 42/3)
- 01706 P P40 Selected But Staged
 P42 Selected But Not Staged
 (See P40/1 Or P42/1)
- 02000 P *DAP Still In Progress At Next TIME5/RUPT
 RSET, GUILD CONT - AGS Then PGNS; If Alarm
 Recurs, V36E And Recovery, ~~See 01107 PGNS-12~~
- 02001 I Jet Failures Have Disabled Y-Z Trans
 (Change Thruster Pair ISOL Valve Or Use
 Alternate Control Mode)
- 02002 I Jet Failures Have Disabled X Trans
 (See 02001 Above)
- 02003 I Jet Failures Have Disabled P Rotation
 (See 02001 Above)
- 02004 I Jet Failures Have Disabled U-V Rotation
 (See 02001 Above)
- 03777 H ICDU Fail Caused The ISS Warning
 (Go To ISS MAL Procedures)

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04777 H ICDU, PIPA Fails Caused The ISS Warning
(Go To ISS MAL Procedures)
07777 H IMU Fail Caused The ISS Warning
(Go To ISS MAL Procedures)
10777 H IMU, PIPA Fails Caused The ISS Warning
(Go To ISS MAL Procedures)
13777 H IMU, ICDU Fails Caused The ISS Warning
(Go To ISS MAL Procedures)
14777 H IMU, ICDU, PIPA Fails Caused The ISS Warning
(Go To ISS MAL Procedures)

*Generates Software Restart

**POODOO Code, Program Goes To R00.

(If This Occurs During Permanent Integration
V27 N07E, 77E, 20E, E
V37E 00E)

P - Procedure Caused Alarm

I - Input Data Caused Alarm

H - Hardware Status Caused Alarm

Alarms for V05N09

R1 First Alarm To Occur

R2 Second Alarm To Occur

R3 Last Alarm To Occur (May Be
Of The Form 4XXXX Or 5XXXX)

4XXXX - More Than 3 Alarms

5XXXX - More Than 3 Alarms Including 1XXXX

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LM-

RECOV-1

GENERAL SYSTEM CHECKOUT

1. Go To POO By One of the Following:
V37E 00E or
V96E or
V36E V96E or
CB(11) AC BUS A: AOT LAMP-CLOSE
AC BUS B: AOT LAMP-CLOSE

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
V25 N07E, 76E, 1E, 0E
2. V37E 51E
PRO
V37E 00E
3. V25 N07E, 77E, 10000E, 1E

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Changed May 9, 1969

P63

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

V30 OR V31

1. Record N26,
Notify MSFN
V74E
Perform General System Checkout

V36

1. V21 N01E, 333E, 10000E
If Unstaged V21 N01E 3000E, 1673E
Perform General System Checkout if necessary

V92 (POO ONLY)

1. V37E 00E
V93E

GO JAM

1. V74 when Convenient (See V36)

STAR CODE >50

1. Perform General System Checkout

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P06 PGNS PWR DOWN

- V37E 06E
00062 POWER DOWN LGC
PRO Until STBY Lt - ON

P20 RENDZ NAV

- 1 V37E 20E
(TO TERM-V56E Or V37E 00E)
(SV OPTION, V80E LM, V81E CSM, V95E NONE)

- 2 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(TO ADJUST ROLL)

MNVR

MODE CONT: PGNS - ATT HOLD

PRO TO 2

(AUTO) GUND CONT - PGNS

MODE CONT: PGNS - AUTO

PRO

MODE CONT: PGNS - ATT HOLD

MNVR

MODE CONT: PGNS - AUTO

PRO

(BYPASS) ENTR To 4 (To 8 If Entered From
8 Via V32E)
(To 6 If Entered From
6 via ENTR)

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

- 4 RR MODE: LGC To 7
 : SLEW Or AUTO To 5

- 5 F 50 25 00201 RR ACQ MODE
(Or F 05 09 00514 RR Out Of AUTO MODE
Reselect P20 If MAN ACQ Desired
Use AUTO Option, This Step, If Not)
(AUTO) RR MODE LGC (Wait 15 sec)
PRO To 4
(MAN) ENTR (Not Allowed For 00514 Alarm)

6 F 50 25 00205 SLEW RR For LOCK-ON

(LOCK) RR-LGC:

NO TRACK Lt - OFF (Wait 15 sec)

PRO To 4

(NO LOCK) MNVR

ENTER To 2

F 05 09 00501 RR Out Of mode limits

*(REQUEST MNVR) V32E To 2 *

NO TRACK LITE - OFF

DSKY BLANKS, RR TAKING MARKS

*F 05 09 00525 SV/RR LOS >3° *

* PRO *

* *

*F 06 05 SV/RR LOS (.01°) *

* (REJECT) CK SIDE LOBE *

* Rendz RR MODE-LGC *

* V32E To 4 *

* (UPDATE) PRO To 7 Or below *

* *

*F 06 49 ΔR,ΔV (.1nm,.1fps) *

* (UPDATE) PRO To 7 *

* (REREAD or MAN ACQ)V32E TO 4*

* *

*F 50 18 (MNVR REQUEST) Go To 2 *

NO TRACK LITE-ON

NO LOCK

F 05 09 00503 RR NO DATA GOOD 42 SEC(or Desig.
Fail)

(REDESIG) V32E To 4

(SEARCH) PRO To 8

*V05 N09E 00521 Could Not Read Radar *

* 00515 RR CDU FAIL DISCRETE *

* Present *

* KEY REL To 7 *

* 00501 RR Ant. Out Of Mode Limits *

* RR To + Z *

Basic Date Apr 25, 1969
 Changed May 3, 1969

8 F 16 80 RR AUTO SEARCH, SEARCH CODE,
 R1 O-SEARCH 42 sec/scan
 1-LOCK ON
 R2 OMEGA (.01°)
 (LOCK) PRO To 2
 (NO LOCK) (MAN ACQ) SLEW RR For LOCK-ON
 RR MODE-LGC, NO TRACK LITE-OFF - To 8
 (MNVR) V32E To 2

P21 GROUND TRACK DETERMINATION

Basic Date April 1 25, 1969
 Changed May 3, 1969

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)
 PRO

3 F 06 43 LAT, LONG, ALT (.01°,.1nm)
 V32E (Increment GET 10 Min) To 2
 PRO

4 F 37 P25 PREFERRED TRACKING ATT

1 MODE CONT: PGNS - AUTO
 V37E 25E
 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (TO ADJUST ROLL)
 MNVR
 MODE CONT: PGNS - ATT HOLD
 PRO To 1
 (AUTO) GUID CONT - PGNS
 MODE CONT: PGNS - AUTO
 PRO
 (MAN) MODE CONT: PGNS - ATT HOLD
 MNVR
 MODE CONT: PGNS - AUTO
 PRO
 (BYPASS) ENTR To 3

LM-4

2 06 18 AUTO MNVR TO FDAI RPY ANGLES
Monitor Auto Mnvr To 1

3 (TERMINATE) V56E
(NO TERMINATE) P25 Continues To Run
In Background

P27 LGC MANUAL UPDATECAUTION

- *For LOS Before Completion *
- *For AUTO UPDATE: *
- * If V33 N02 DISPLAYED, PRO *
- * If V21 N02 Or N01 DISPLAYED *
- * V34E *

2 V37E 00E

3 V70E Update Lift Off Time
or V71E Load Consec Data
or V72E Load Singular Data
or V73E Increment LGC Time

4 P27 Displayed

5 F 21 01 R3 UPDATE BUFFER ADD (Initially 1174)
R1 DATA E (R3 Increments)
Repeat Step 5 For All Data

6 F 21 02 R3 1167
(Verify Data) V01 N01E
R3 1174E
R1 Verify Data
N15E (R3 1175)
R1 Verify Data, Repeat ENTR For
Each Line Of Data (Note Octal
Identifier (01-24) For Each
Data To Be Changed)
KEY REL To 6

(CHANGE) LOAD OCTAL IDENTIFIER XXE
F 21 01 R3 DATA ADD (To Be Changed)
R1 DATA E GO TO 6
(ACCEPT) PRO TO 7

7 POO DISPLAYED

Basic Date April 25, 1969
Changed May 3, 1969

P30 EXTERNAL ΔV

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

F 37

P31 LAMBERT AIM POINT GUIDANCE

- V37E 31E
- 1 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
(TERMINATE) V34E To 5
- 4 F 16 45 M,TFI,MGA(-00002 If No REFSMMAT Set)
(marks,min-sec,.01°)
SET EVENT TIMER
PRO

F 37

P32 CSI PRETHRUST

- 1 F 06 11 V37E 32E (hrs,min,.01sec)
TIG (CSI)
PRO

Basic Date April 25, 1969
Changed

LM-4

Basic Date April 25, 1969
Changed _____

LM-4

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

9 F 37

P33 CDH PRE-THRUST

1	V37E 33E F 06 13 TIG (CDH) PRO	(hrs,min,.01sec)
2	F 16 45 M,TFI,MGA (-00001) (RECYCLE) V32E To 3 (TERMINATE MARKS) PRO	(marks,min-sec)

F 05 09 00611 NO TIG FOR SPECIFIED ANGLE
* PRO Use Last AT(CDH/TPI/TPI)To 3*
* (REDO)V32E To 1 *

Record YDOT _____
PRO
(Insert -YDOT In R2 Of ΔV CDH)

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

6 F 37

P34 TPI PRETHRUST

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

2 F 06 55 R2 ELEVATION ANGLE, R3 CENTRAL ANGLE
 (.01°)
 (COMP E) V22E +00000E
 PRO

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

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

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

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

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

9 F 37

Basic Date March 25, 1969
Changed

LM-4

P35 TPM PRETHRUST

1 V37E 35E
 F 16 45 M,ΔT,MGA (-00001) (marks,min-sec)
 ΔT =: Time From Previous IGN If P41
 : Time From Previous CUTOFF If P40/42
 : ATIGIMC If Recycling
 (RECYCLE) V32E To 3 (Do Not Use)
 (TERMINATE MARKS) PRO

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

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

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

5 F 37 PRO

P38 STABLE ORBIT RENDEZVOUS

1 F 06 33 V37E 38E (hrs,min.,.01sec)
 TIG
 PRO

2 F 06 55 R3,CENTANG (.01°)
 PRO

3 F 04 06 R1,00005, R2,0000X
 R2,00001 First Phase
 PRO
 R2,00002 Second Phase
 PRO To 8

4 F 06 57 ΔR (+Behind) (.1nm)
 PRO

Basic Date April 25, 1969
 Changed May 3, 1969

IN-4

PGNS-24

5 F 06 34 T (Intercept) (hrs,min,.01sec)
 RECORD _____ (hrs)

_____ (min)

PRO To 8 _____ (sec)

6 F 06 58 HP,ΔV(SOR),ΔV (SOR FINAL) (.1nm,.1fps)
 PRO

*V06 N52E R1, ACTCENT (.01°) *
 * IF ACTCENT BETWEEN 170° And*
 * 190°: *
 * V37E 38E RETARGET *

7 F 06 81 ΔV XYZ (.1fps)
 PRO

8 F 16 45 M,TFI,MGA (-00002 If No REFSMMAT Set)
 (marks,min-sec,.01°)
 (TERMINATE MARKS) PRO To 6
 (RECYCLE) V32 To 6
 (FINAL PASS Phase 1) COMPUTE TIG FOR Phase 2
 =f(TFI,T Intercept)

TIG= _____ : _____ : _____

PRO

(FINAL PASS Phase 2) SET EVENT TIMER
 PRO

9 F 37

P39 STABLE ORBIT MIDCOURSE

1 V37E 39E
 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)
 (RECYCLE) V32E
 (TERMINATE MARKS) PRO
 (FINAL PASS) SET EVENT TIMER
 PRO To 3

Basic Date May 25, 1969
 Changed May 3, 1969

*V06 N52E R1, ACTCENT (.01°)

*

* IF ACTCENT BETWEEN 170° and 190°*
 * V37E 39E RETARGET *

2 F 06 81 ΔV XYZ (.1fps)
 PRO To 1

3 F 37

P40 DPS THRUST

THRUST CONT	-AUTO
MAN THROTTLE	-CDR
BAL CPL	-ON
DAP	-SET
ENG GIMBAL	-ENABLE, TRIMMED
DES ENG CMD OVRD	-Verify OFF
THROTT/JETS (LMP)	-JETS
THROTT/JETS (CMP)	-THROTT(MIN SETTING)
PRPLNT QTY MON	-DES 1
PRPLNT TEMP/PRESS MON	-DES 1
HELIUM MON	-SUP CRIT PRESS

1 V37E 40E

*F 05 09 01706 *

* P40 Selected With LM staged*

*V34E Select P42 *

F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (TO ADJUST YAW)

MNVR

MODE CONT: PGNS - ATT HOLD

PRO To 1

(AUTO) GUID CONT - PGNS

MODE CONT: PGNS - AUTO

PRO

(MAN) MODE CONT: PGNS - ATT HOLD

MNVR

MODE CONT: PGNS - AUTO

PRO

(BYPASS) ENTR To 3

Basic Date April 25, 1969
Changed

P40 - P47

LM-4

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

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

*PROG LT - ON *
V05 N09E 01703 TIG SLIPPED

-:35 DSKY BLANKS
ENG ARM - DES

-:30 06 40 CB(11) STAB CONT: DECA PWR-CLOSE
(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 THR FAIL MON) PRO *
*(CONTINUE BURN) ENTR To TIG-:05 *
*(TERMINATE) ENG ARM - OFF *
* V34E To 6 *

*PROG LT - ON *
*V05 N09E 01407 VG Increasing *
Terminate Burn Or Switch To AGS

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

Basic Date April 25, 1969
Changed

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

6 F 37 MASTER ARM -OFF (MASTER ALARM - On)
 ENG GMBL -OFF
 PRPLNT QTY MON -OFF
 PRPLNT TEMP/PRESS MON-OFF
 HELIUM MON -OFF

P41 RCS THRUST

THROTT/JET - JETS
 EVENT TIMER- SET
 DAP - SET

Basic Date April 25, 1969
 Changed ——————
 1 V37E 41E
 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (TO ADJUST: YAW (X),ROLL (Z))
 MNVR
 MODE CONT: PGNS - ATT HOLD
 PRO To 1
 (AUTO) GUID CONT - PGNS
 MODE CONT: PGNS - AUTO
 PRO
 (MAN) MODE CONT: PGNS - ATT HOLD
 MNVR
 MODE CONT: PGNS - AUTO
 PRO
 (BYPASS) ENTR To 3

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

3 16 85 VG XYZ (LM) (.1fps)

*PROG LT - ON *
 *V05 N09E 01703 TIG SLIPPED *

-:35 DSKY BLANKS

-:30 16 85 (AVE G ON)

4 -:00

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

5 F 37

P42 APS THRUST

LM	-STAGED
HELIUM MON	-ASC PRESS 1
PRPLNT TEMP/PRESS MON	-ASC
THROTT/JETS	-JETS
DAP	-SET

1

V37E 42E

*F 05 09 01706 *
 * P42 Selected But LM Not Staged*
 *V34E Select P40 *

F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (TO ADJUST YAW)

MNVR

MODE CONT: PGNS - ATT HOLD

PRO To 1

(AUTO) GUID CONT - PGNS

MODE CONT: PGNS - AUTO

PRO

(MAN) MODE CONT: PGNS - ATT HOLD

MNVR

MODE CONT: PGNS - AUTO

AUTO

(BYPASS) ENTR To 3

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

3 06 40 TFI,VG,ΔVM (min-sec,.1fps,.1fps)
 EVENT TIMER-SET

*PROG LT - ON *
 VO5 NO9E 01703 TIG SLIPPED

Basic Date April 25, 1969
 Changed

IM-

-:35 DSKY BLANKS
ENG ARM-ASC

-:30 CB(11) STAB CONT: AELD-CLOSE
CB(16) STAB CONT: AELD-CLOSE
06 40 (AVE G ON)

-:15 Verify ΔVM (R3) <00005

-:05 F 99 40 ENG ON-ENABLE

-:03.5 Verify +X ULLAGE
(NO ULLAGE) V34E To 5
(AUTO) PRO IGN WHEN TFI=-:00 sec
(BYPASS) ENTR To APS OFF

IGN 06 40 TFI,ΔVG,ΔVM (min-sec,.1fps)

*F 97 40 *
*(RECYCLE THR FAIL MON) PRO *
(CONTINUE BURN) ENTER TO TIG-:-05
*(TERMINATE) ENG ARM - OFF *
* V34E To 5 *

APS
OFF F 16 40 TFC,ΔVG,ΔVM (min-sec,.1fps)
ENG ARM - OFF
PRO
HELIUM MON - OFF

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

5 F 37

P47 ΔV MONITOR

1 V37E 47E (Wait 10 Sec)
F 16 83 ΔV XYZ (LM) (.1fps)
(EXIT) PRO
(RECYCLE) V32E (Zeroes N83 Display)

2 F 37

P51 IMU ORIENTATION

CB-AC AOT LAMP - CLOSE

- 1 V37E 51E
 (To TERM - V37EXXE)
- 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(AZ+12000,EL+04500)
 CL(AZ+18000,EL+04500)
 LR(AZ+24000,EL+04500)
 5-COAS(AZ+00000,EL+00000)
 PRO
 (For C=4 Or 5)
 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 Ground 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-AC AOT LAMP- OPEN

RECOV-~~13~~

RAPID IMU REALIGN

NOTE: This Procedure Assumes a good AGS Alignment

- 1 Fly Spacecraft to $0^\circ, 0^\circ, 0^\circ$ On AGS Inertial Ball
- 2 V41 N20E
E,E,E, (Coarse Align IMU To $0^\circ, 0^\circ, 0^\circ$ Body)
- 3 V40 N20
Verify $0^\circ, 0^\circ, 0^\circ$ On AGS Ball - ENTR
(Releases Platform And Recovers PGNS Control Modes)
- 4 V37E 51E
PRO On First Display
V37E 00E (Sets Drift Flag)
- 5 V25 N07E
77E, 10000E, 1E (Sets REFSMMAT FLAG)
- 6 Perform P52, Option 3 (AUTO OPTICS Are Good)

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

Basic Date April 25, 1969
Changed May 2, 1969

P52 IMU REALIGN

1

CB-AC AOT LAMP -CLOSE
 V37E 52E
 (To TERM - V37EXXE)

*PROG Lt - ON *
 V05 N09E 00220 IMU NOT ALIGNED
 *If REFSMMAT Good: V25 N07 E *
 * 77E 10000E, 1E *
 *V37E 52E *
 * Use Option 3 In Step 1 *
 * And MAN ACQ In Step 6 *

- Basic Date April 25, 1969
 Changed _____
- | | |
|-----------|---|
| F 04 06 | R1 00001 IMU ALIGN OPTION
R2 00001 PREF (0,0,0 Specified Attitude)
PRO To 4
2 NOM (LV At Specified Time)
PRO
3 REFSMMAT PRO To 6
4 LANDING SITE PRO |
| 2 F 06 34 | GET ALIGN (hrs,min,.01sec)
(0,0,0 For Present Time)
PRO (To 4 If Option 2) |
| 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) |
| 5 F 50 25 | R1 00013 COARSE ALIGN
(NORMAL) PRO To 6 NO ATT Lt-ON, Then OFF
(GYRO TORQUE) Disable Jets
ENTR |
| 16 20 | PRESENT ICDU ANGLES OG,IG,MG (.01°)
When Torquing Complete
To 14 |

6 F 50 25 R1 00015 SELECT STAR ACQUISTION MODE
MNVR If Necessary
(PICAPAR) PRO

*F 05 09 00405 NO PAIR *
(CREW SPECIFY) PRO To 7
*(PICAPAR) V32E To 6 *

(MAN ACQ) ENTR

7 F 01 70 R1 00CDE (C)DETENT (DE)STAR CODE
C 1-L, 2-F, 3-R
4-RR(AZ+12000,EL+04500)
CL(AZ+18000,EL+04500)
LR(AZ+24000,EL+04500)
5-COAS(AZ+00000,EL+00000)

PRO

(For C=4 Or 5)

F 06 87 AZ,EL (.01°)

PRO

(For DE=00)

F 06 88 CELESTIAL BODY VECTOR
Load Ground Values

PRO

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

PRO

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

PRO

(BYPASS) ENTR To 10

9 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
MON AUTO MNVR To 8

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

(For C=4 Or 5)

F 06 87 AZ,EL (.01°)
PRO)

Basic Date April 25, 1969
Changed LM

- 11 F 54 71 MARK X(52) And Y(53)
(After 1st Star) PRO To 7
(After 2nd Star) PRO To 12
(Redfine Star) ENTR To 10
(For DE=00
F 06 88 CELESTIAL BODY VECTOR
Load Ground Values
PRO)
- 12 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(REJECT) V32E To 14
(ACCEPT) PRO
- 13 F 06 93 ΔGYRO ANGLES X,Y,Z (.001°)
(TORQUE) V76E
PRO
(NO TORQUE) V32E
- 14 F 50 25 R1 00014
(RECHECK) PRO To 6
(EXIT) ENTR
- 15 F 37 CB-AC AOT LAMP - OPEN

Basic Date April 25, 1969
Changed May 3, 1969

P72 CSM CSI TARGETING

1 V37E 72E
F 06 11 TIG (CSI) (hrs, min, .01sec)

RECORD

(hrs)

(min)

(sec)

PRO

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

RECORD

(APSIS)

(E)

PRO

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

RECORD

(hrs)

_____ (min)

(sec)

PRO

4 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)
(RECYCLE) V32E
(TERMINATE MARKS) PRO

Basic Date April 25, 1969
Changed May 3, 1969

F 05 09 00600 No Intersection on First
 * Iteration *
 * 00601 hp+CSI < 35,000 ft *
 * 00602 hp+CDH < 35,000 ft *
 * 00603 TIG(CDH)-TIG(CSI)<10min *
 * 00604 TIG(TPI)-TIG(CDH)<10min *
 * Or TIG CDH>TIG TPI *
 * 00605 No SOL In 15 Tries *
 * 00606 ΔV (CSI) >1000 fps In 2 *
 * Iterations *
 *V32E To 1, Adjust Inputs *

- Basic Date April 25, 1969
 Changed _____
- 5 F 06 75 ΔH(CDH),ΔT(CDH-CSI),ΔT(TPI-CDH)
 PRO (.lnm,min-sec)
 (FINAL PASS) RECORD
 _____ (ΔH)
 _____ (ΔT CDH-CSI)
 _____ (ΔT TPI-CDH)
- PRO
- 6 F 06 81 ΔV XYZ (LV) (CSI) (.1fps)
 PRO
 (FINAL PASS) RECORD
 _____ (ΔVX)
 _____ (ΔVY)
 _____ (ΔVZ)
 PRO
 (To Correct Out-of-Plane Velocity)
 V90E
- F 06 16 T EVENT (hrs,min,.01Sec)
 RECORD
 _____ (hrs)
 _____ (min)
 _____ (sec)
 PRO

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

RECORD

_____ (Y)
 _____ (-YDOT)
 _____ (PSI)
 PRO

7 F 06 82 ΔV XYZ (LV) (CDH) (.1fps)

PRO (If Recycling, To 4)
 (FINAL PASS) RECORD

_____ (ΔVX)
 _____ (ΔVY)
 _____ (ΔVZ)

PRO

8 F 16 45 M,TFI,MGA (-00002) (marks,min-sec,.01°)

SET EVENT TIMER

PRO, TRANSMIT PARAMETERS TO CSM

9 F 37

P73 CSM CDH TARGETTING

1 V37E 73E

F 06 13 TIG CDH (hrs,min,.01sec)

RECORD

_____ (hrs)
 _____ (min)
 _____ (sec)
 PRO To 4

Basic Date April 25, 1969

Changed

M-4

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

 (ΔH)
 (ΔT TPI-CDH)
 (ΔT TIG TPI)
 PRO

3 F 06 81 ΔV XYZ (LV) (CDH) (.1fps)
 PRO
 (FINAL PASS) RECORD

 (ΔV_x)
 (ΔV_y)
 (ΔV_z)

PRO
 (To Correct Out-Of-Plane Velocity)
 V90E

F 06 16 T EVENT (hrs, min, .01sec)

RECORD
 (hrs)
 (min)
 (sec)
 PRO

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

 (Y)
 (-YDOT)
 (PSI)
 PRO

Basic Date
April 25, 1969
Changed

LM-4

4 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)
 (RECYCLE) V32E To 2
 (TERMINATE MARKS) PRO To 2
 (FINAL PASS) (MGA, -00002) SET EVENT TIMER
 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 F 06 37 V37E 74E
 TIG TPI (hrs,min,.01sec)
 PRO

2 F 06 55 R2 E,R3 CENTANG (.01°)
 PRO
 (COMP E) V22E +00000E To 2
 (FINAL PASS) RECORD

_____ E
 _____ CENTANG

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

Basic Date April 25, 1969
 Changed _____

- Basic Date April 25, 1969
 Changed
- 4 F 06 37 TIG TPI (hrs, min, .01sec)
 PRO
 (If E Computed, This Display
 Replaced By V06 N55 As In 2 Above)
 (FINAL PASS) RECORD
 _____ (hrs)
 _____ (min)
 _____ (sec)
- PRO
- 5 F 06 58 Hp, Δ V TPI, Δ V TPF (.1nm, .1fps)
 PRO To 7
 (FINAL PASS) RECORD
 _____ (Hp)
 _____ (Δ V TPI)
 _____ (Δ V TPF)
- PRO
- 6 F 06 81 Δ V XYZ (LV) (.1fps)
 RECORD
 _____ (Δ VX)
 _____ (Δ VY)
 _____ (Δ VZ)
 PRO
- 7 F 06 59 Δ V XYZ (LOS) (.1fps)
 PRO To 3
 (FINAL PASS) RECORD
 _____ (Δ V1)
 _____ (Δ V2)
 _____ (Δ V3)
 PRO To 3
- 8 F 37

P75 CSM TPM TARGETING

- 1 V37E 75E (marks,min-sec,.01°)
F 16 45 M,TFI,MGA (-00001)
(RECYCLE) V32E To 3
(TERMINATE MARKS) PRO

2 F 06 81 ΔV XYZ (LV) (.1fps)
RECORD
_____ (ΔVX)
_____ (ΔVY)
_____ (ΔVZ)
PRO

3 F 06 59 ΔV XYZ (LOS) (.1fps)
PRO
(FINAL PASS) RECORD
_____ (ΔVX)
_____ (ΔVY)
_____ (ΔVZ)
PRO

4 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)
(RECYCLE)V32E To 3
(TERMINATE MARKS) PRO To 2
(FINAL PASS) (MGA, -00002) SET EVENT TIMER
PRO, TRANSMIT PARAMETERS TO CSM

*V06N 52E R1, ACTCENT (.01°) *
IF ACTCENT BETWEEN 170° AND 190°
* V37E 75E RETARGET *

5 F 37

Basic Date April 25, 1969
Changed _____

P76 TARGET ΔV

1 F 06 84 V37E 76E
 ΔV XYZ (LV) (.1fps)
 PRO

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

3 F 37

P78 CSM SOR TARGETING

1 F 06 33 V37E 78E
 TIG (hrs,min,.01sec)
 RECORD
 _____ (hrs)
 _____ (min)
 _____ (sec)
 PRO

2 F 06 55 R3 CENTANG (.01°)
 RECORD
 _____ (CENTANG)
 PRO

3 F 04 06 R1 00005
 R2 00001 (First Phase)
 00002 (Second Phase)
 (FIRST PHASE) PRO
 (SECOND PHASE) PRO To 6

4 F 06 57 ΔR (.1nm)
 RECORD
 _____ (ΔR)
 PRO

Basic Date April 25, 1969
 Changed _____

- 5 F 06 34 T(INTERCEPT) (hrs,min,.01Sec)
 RECORD
 _____ (hrs)
 _____ (min)
 _____ (sec)
 PRO
- 6 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 9 TRANSMIT PARAMETERS TO CSM
- 7 F 06 58 Hp,ΔV(SOR),ΔV(SOR FINAL) (.1nm,.1fps)
 PRO
 (FINAL PASS) RECORD
 _____ (Hp)
 _____ (ΔV SOR)
 _____ (ΔV SOR FINAL)
 PRO
- 8 F 06 81 ΔV XYZ (LV) (.1fps)
 PRO to 6
 (FINAL PASS) RECORD
 _____ (ΔVX)
 _____ (ΔVY)
 _____ (ΔVZ)
 PRO To 6
- 9 F 37

Basic Date April 25, 1969
 Changed _____

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P79 CSM SOM TARGETING

- 1 V37E 79E
 F 16 45 M,TFI,MGA, (-00001) (marks,min-sec,.01°)
 (RECYCLE) V32E
 (TERMINATE MARKS) PRO
 (FINAL PASS) MGA, (-00002) SET EVENT TIMER,
 Transmit Parameters To CSM
 PRO To 3
- 2 F 06 81 ΔV XYZ (LV) (.1fps)
 PRO To 1
 (FINAL PASS) RECORD
 _____ (ΔVX)
 _____ (ΔVY)
 _____ (ΔVZ)
 PRO To 1
- 3 F 37

Basic Date April 25, 1969
 Changed

V41 N20 COARSE ALIGN IMU

1 V41 N20E
F 21 22 LOAD NEW ICDU ANGLES OG,IG,MG (.01°)

2 41 COARSE ALIGN
NO ATT Lt - ON
FDAAI Torques

*PROG Lt - ON *
*V05 N09E 00211 COARSE *
* ALIGN ERROR *
*V16 N22E Compare N22 With *
N20 Reduce Spacecraft Drift
*Repeat V41 N20 *

V41 N72 COARSE ALIGN RR

1 RENDEZVOUS RADAR - LGC

2 V41 N72E
F 21 73 RR TRUNNION, 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 DESIGN MODE)

V16 N72E RR TRUNNION, SHAFT (.01°)

*PROG ALARM - ON *
V05 N09E 00502 BAD ANGLE INPUTS
* 00503 RR DESIGN FAIL *
*(Terminate CONT DESIGN) V44E *

Basic Date April 25, 1969
Changed

LM-

V42 GYRO TORQUING

- 1 V76E
 V42E
 F 21 93 ΔGYRO 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 V37E 00E
- 3 V43E
 F 21 22 LOAD NEW ICDU ANGLES YPR (.01°)
 FDAI Needles Deflect
 43 ENTR
- 4 F 21 22 NEW ICDU ANGLES YPR (.01°)
 Load (-) New ICDU Angles
- 5 43 Verify FDAI Needles Return To 0,0,0

V47 AGS INITIALIZATION

- 1 16 65 Verify TELEMETRY:PCM - HI
 V16 N65E
 LGC TIME (hr,min,.01sec)
 377 + GET-PGNS/AGS BIAS TIME (.1min)
 ENTR-(At Correct PGNS Time)
- 2 F 06 16 V47E
 GET OF AGS CLOCK
 Load PGNS/ACS TIME BIAS
- 3 *414 +1
- 4 PRO (32 Sec Elapse Before Step 6 Appears
 If CDU Zero Issued, Otherwise 20 Sec)
- 5 06 16 *414R +0

Basic Date April 25, 1969
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LM-4

- 6 F 50 16 DOWNLINK COMPLETE
PRO
- 7 *400 +3 AGS ALIGN
- 8 V83E
- F 16 54 R, RDOT, THETA (.01nm,.1fps,.01°)
- 9 *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-RCS A, 1-RCS B, 2-RCS A&B
(SCALE) C 0-Fine($4^\circ/\text{sec}$), 1-Normal ($20^\circ/\text{sec}$)
(ATTDB) D $0\text{--}.3^\circ$, 1- 5°
(RATE) E $0\text{--}.2^\circ/\text{sec}$, 1-. $5^\circ/\text{sec}$, 2- $2^\circ/\text{sec}$
3- $10^\circ/\text{sec}$
PRO
- 2 F 06 47 LM WT, CSM WT (1b)
PRO (TERMINATES IF STAGED)
- 3 F 06 48 ENGINE GIMBAL TRIM PITCH, ROLL (.01°)
(R1, R2 Must Be Positive)
ENG GMBL - ENABLE
ENG ARM - DES
(TRIM) PRO (Master Alarm, ENGINE GMBL Lt-ON)
(EXIT) V34E
- 4 F 50 48 TRIM COMPLETE
CONTINUE INTERRUPTED PROGRAM
PRO

Basic Date April 25, 1969
Changed

LM-

V49 CREW DEFINED MANEUVER

- 1 V37E OOE
- 2 V49E
- F 06 22 NEW ICDU ANGLES OG, IG, MG PRO (.01°)
- 3 F 50 18 REQUEST MNVR TO FDAI RPY (.01°)
 (AUTO) GUID CONT: PGNS
 MODE CONT: PGNS - AUTO
 PRO
 (MAN) MODE CONT: PGNS - ATT HOLD
 MNVR
 MODE CONT: PGNS - AUTO
 PRO
 (BYPASS) ENTR (Exit)
- 4 06 18 AUTO MNVR TO FDAI RPY ANGLES
 MON AUTO MNVR To 3
- V55 INCREMENT LGC TIME
- 1 F 21 24 V55E
 ΔT
 LOAD ΔT (hrs, min, .01 sec)

Basic Date April 25, 1969
 Changed

LGC CLOCK, RADAR TEST

LGC CLOCK INITIALIZATION

1 V06 N65
ON CSM MARK - ENTR
06 65 SAMPLED LGC TIME (hr,min,.01sec)
RECORD

(hrs)

(min)

(sec)

COMPUTE CSM/LM ΔT

(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	- LDG RDR $(+10^\circ \text{ To } +50^\circ \text{ F})$ $(\text{TBD})^{+50^\circ} \quad +145^\circ$
	RNG/ALT MON	- ALT/ALT RATE
	LDG ANT	- DES
	MODE SEL	- LDG RDR

2 RADAR TEST - LDG(Alt And Alt Rt Tapes
Drive)

TEST MONITOR - ALT XMTR (2.1 To 5.0)
(3.5V) (TBD)

- VEL XMTR (2.1 To 5.0)
(3.)

ALT/ALT RT MON - +8200 To +8350 ft/-445
To -453 fps

3 LDG ANT - HOVER (10sec)

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- 4 ALT/ALT RT - +7900 To +8350 ft/-445
To -453 fps
- 5 LDG ANT - DES (10sec)
- 6 V63E INITIATE RDR SELF TEST
F 04 12 R1 00004 SPECIFY RDR
R2 00001 RNDZ RDR
V22E 2E LDG RDR
PRO
- 7 F 16 66 SLANT RANGE, ANT POSITION (ft)
R1 +08195 To +08357
R2 +00001
V34E
- 8 LDG ANT - AUTO
- 9 V60E COMMAND ANT TO POS 2 (22 Sec)
ALT/ALT RT MON-+7818 To +8169 ft/-441
To -457 fps
- 10 F 04 12 V63E INITIATE RDR SELF TEST
R1 00004 SPECIFY RDR
R2 00001 RNDZ RDR
V22E2E LDG RDR
PRO
- 11 F 16 66 SLANT RANGE, ANT POSITION
R1 +8156 To +8418
R2 +00002
- 12 F 16 66 LDG ANT - DES (10 sec)
R2 +00001 (PROG LT ON, V05N09, 00522)
- 13 F 16 66 LDG ANT - AUTO
R2 +00001
V34E (Terminate)
- 14 RDR TEST - OFF
CB(11) PGNS: LDG RDR - OPEN

RNDZ RDR SELF TEST

1

VERIFY: CSM RCS THRUSTER B3 - OFF
 : RADAR X-PONDER - OFF
 RNDZ RDR ANT - RELEASED
 X-POINTERS (BOTH)-HI MULT
 RATE/ERR MON (BOTH) - RNDZ RADAR
 ATTITUDE MON (BOTH) - PGNS
 MODE SEL - LDG RDR
 RNG/ALT MON - RNG/RNG RATE
 SHFT/TRUN - +50°
 RNDZ RDR - SLEW
 TEMP MONITOR - RNDZ (+10° To +150°) (75°)
 SLEW RATE - HI +145°

2

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

3

Slew Right And Down, Left And Up
 (FDAI Needles Right And Dn, Left And Up)
 SLEW RATE - LO
 Slew Right And Dn Left And Up
 (FDAI Needles Right And Dn, Left And Up)

4

RNDZ RDR - AUTO TRACK (Master Alarm, RNDZ
 RDR Caut Lt - On)
 RADAR TEST - RNDZ RDR (Rng Rt Tape Drives,
 X-Pointers and FDAO Needles Vary Between
 Limits. After 12 sec, Rng Tape Drives,
 NO TRACK & RNDZ RDR Caut Lt - OFF)

5

TEST MON-AGC (1.0 To 1.5) (1.5)
 -XMTR PWR (2.9 To 4.1) (3.2)
 -SHAFT ERR (2.2 To 2.6 @1/2 cps)
 -TRUN ERR (2.0 To 3.0 @1/2 cps)
 -AGC (1.5)

Basic Date April 25, 1969

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- 6 F 21 07 V25 N07E
SET NORRMON FLAG
101E,10E,1E
RNDZ RDR - 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, TRACKER Lt - ON- OFF After 12 sec
- 8 F 16 72 RR TRUNNION AND SHAFT (.01°)
R1 Varying @1/2 cps
R2 Varying @1/2 cps
PRO
- 9 F 16 78 RANGE, RANGE RATE (.01nm, fps)
R1 +184 To +198 nm
R2 -00481 To -00521
RNG/RNG RT +196 nm/-478.5 fps
- 10 V34E
- 11 RADAR TEST - OFF (NO TRACK Lt - On,
X-Pntr-Center)
- 12 V40 N72E RRCDU ZERO (10 sec)
- 13 F 21 73 V41 N72E COARSE ALIGN RR CDU
LOAD TRUNNION AND SHAFT (.01°)
R1 +00000E
R2 +28300E
- 14 F 04 12 R1 00006 RR FUNCTION
R2 00002 CONT DESIG
PRO
- 15 V16 N72E MONITOR RR POSITION
16 72 CB(11) PGNS: RNDZ RDR - OPEN (.01°)
(NO TRACK Lt - OFF)
AC BUS A: RNDZ RDR - OPEN
V44E TERM CONT DESIG

EXT VERBS 64 - 90
PGNS T/O, ORDEAL,
PIPA BIAS

V64 S-BAND ANTENNA

1 V37E 00E

2 V64E

F 06 51 S-BD PITCH, YAW (.01°)
~~(AUTO)~~ PRO
~~(MAN)~~ MNVR
PRO

V67 W-MATRIX ERROR DISPLAY

1 V67E

F 06 99 POS ERR, VEL ERR (RSS) (.01nm,.1fps)
~~(TERM)~~ PRO
(REINITIALIZE) V24E

V74 E-MEMORY DUMP

1 V21 N01E 333E

F 21 01 R3 333
R1 20000 E For 4 DUMPS (83.2 sec)
Or 10000 E For 2 DUMPS (41.6 sec)
Or 04000 E For 1 DUMP (20.8 sec)

2 V74E

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

EXT VERBS 64 - 90
PGNS T/O, ORDEAL,
PIPA BIAS

Basic Date April 25, 1969
Changed _____
L

V85 DISPLAY RR LOS DATA

1 V85E
 F 16 56 RR LOS (.01°)
 R1 AZ
 R2 EL
 R3 BLANK
 PRO

V89 RENDEZVOUS FINAL ATTITUDE

1 V37E 00E
 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°)
 (TO ADJUST ROLL)
 MNVR
 PRO To 4
 (AUTO) MODE CONT: PGNS - ATT HOLD
 MODE CONT: PGNS - AUTO
 PRO
 (MAN) MODE CONT: PGNS - ATT HOLD
 MNVR
 MODE CONT: PGNS - AUTO
 PRO
 (BYPASS) ENTR (EXIT)
 5 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
 MON AUTO MNVR To 4

Basic Date April 25, 1969
 Changed May 7, 1969

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PGNS-54

V90 OUT-OF-PLANE DISPLAY

- 1 V90E
 F 06 16 GET EVENT (hrs,min.,.01sec)
 Load Zeroes R1,R2,R3 For Present Time)
 PRO
- 2 F 06 90 Y,YDOT,PSI (.01nm,.1fps,01^θ)
 (RECYCLE) V32E To 1
 (EXIT) PRO

PGNS TURN-ON AND SELF-TEST

- 1 If STBY Lt - ON, PRO
 V36E
 V21 N01E, 3000E, 1672E,E
 333E, 10000E
- 2 CB(11) PGNS: IMU OPR - CLOSE
 (NO ATT Lt - ON 90 Sec)
- 3 V35E
 F 88 88 DSKY LIGHT CHECK
 (Master Alarm, LGC Warning, 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)
- 4 KEY RSET
 V37E 00E
 F 21 01 V25 N01E, ~~136E~~ 1365E
 E,E,E
- 5 V15 N01E, 1365E
 15 01 R1, R2, R3, All Zero

Basic Date May 25, 1969
 Changed May 1, 1969

Basic Date April 25, 1969
 Changed May 3, 1969

LM-4

- 6 V21 N27E 77777E (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 *
 * V05 N09E 01102 SELF-*
 * TEST ERROR *
 *N08 E RECORD FOR MSFN *
 * R1 _____ *
 * R2 _____ *
 * R3 _____ *
- 7 V21 N27E OE TERMINATE SELF TEST
- 9 V91E BANKSUM
 F 05 01 R1 SUM OF BANK
 R2 BANK NUMBER = R
 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 Thrusters Firing

2 V25 N21E, E, E
 EVENT TIMER - START

3 V06E
 Q6 21 XYZ PIPA COUNTS (+XXXXX.)

4 At T+32sec - KEY ~~VERD~~ ENTER
 T+32sec (X)R1 _____ (Y)R2 _____
 (Z)R3 _____ (+XXXAB)

Calculate XYZ Bias:
 Take Last Two Digits of Displayed
 Bias And Add 3 zeroes (+AB000)

X _____

Y _____

Z _____

6 V21 NO1E
 F 21 01 LOAD 1452E(CALCULATED X BIAS)E,E
 1454E(CALCULATED Y BIAS)E,E
 1456E(CALCULATED Z BIAS)E
 Same Sign As In Measured Bias In
 Step 4

Basic Date May 25, 1969
 Changed May 1, 1969

LGC THRUSTER INHIBIT

1

V25 N07E

1262E Or 1263E
XXxE (See Codes Below)

* **CAUTION** *

Affected Quad Valve Must

Be Open Before Next Step

2

1E
V48E, PRO, V34E

<u>THRUSTER</u>	<u>ADDRESS</u>	<u>CODE</u>
B1D	1262	200
B2U		20
B3D		10
B4U		1
A1U		100
A2D		40
A3U		4
A4D		2
 B1L	1263	200
B2L		20
B2A <i>B3A</i>		1
B4F		2
A1F		4
A2A		10
A3R		40
A4R		100

RR BIAS INITIALIZATION

1

V21 N01E
1700E, E
N15E, E
E, E
E, E
V93EBasic Date April 25, 1969
Changed May 3, 1969

LM-4

REVIEW DATA IN ERASABLE MEMORY

1 Perform During Any Flashing Display

2 V01 N01E 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 V11 N10E
F 11 10 LOAD CHANNEL ADD E
R1 Octal Contents Of Specified Channel

LOAD OUTPUT CHANNELS

1 V21 N10E
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

2 F 22 07 (Load Code For Bit To Be Changed) E

Basic Date April 25, 1969
Changed May 3, 1969

LN

BIT	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
CODE	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	4	2	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	4	2	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	4	2	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	4	2	1

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

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

Basic Date April 25, 1969
 Changed _____

FLAG WORD LISTING

<u>FLAG NAME</u>	<u>ADDRESS</u>	<u>BIT</u>	<u>WHEN SET</u>	<u>WHEN RESET</u>
P25FLAG	0074	9	P25 Is Operating	P25 Is Not Operating
IMU	0074	8	IMU In Use	IMU Not In Use
Rendezvous	0074	7	P20 Initiated (Radar In Use)	P20 Terminated (Radar Not In Use)
Lock On	0074	5	RR Lock-ON Desired	RR Lock-ON Not Desired
State Vector	0075	8	CSM State Vector Updated (V81 Sets This Flag)	LM State Vector Updated (V80 Resets This Flag)
Update	0075	7	State Vector Updating By Marks Allowed	State Vector Updating By Marks Not Allowed
Track	0075	5	Rendezvous Tracking Allowed	Rendezvous Tracking Not Allowed
Manual Acquire	0076	13	Enable Manual Acquisition of CSM By RR	Enable Auto Acquisition Of CSM By RR
LOS CM Flag	0076	12	LOS Being Computed (R21)	LOS Not Being Computed (R21)

Basic Date April 25, 1969
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External Delta V	0076	8	External Delta V VG Computation	Lambert VG Computations
Final	0076	6	Final Pass Through Rendezvous Program Computations	Interim Pass Through Rendezvous Program Computations
Active vehicle	0076	5	LM Active Vehicle	CSM Active Vehicle
Preferred Attitude	0076	4	Preferred Attitude Computed	Preferred Attitude Not Computed
REFSMMAT	0077	13	REFSMMAT Good	REFSMMAT Not Good
No throttle	0101	12	Inhibit Full Throttle	Permit Full Throttle
3 Axis	0101	6	Maneuver Specified By 3 Axis	Maneuver Specified By 1 Axis
RR Monitor	0101	4	Bypass RR Gimbal Monitor	Perform RR Gimbal Monitor
W Matrix	0101	1	W Matrix Valid For Flight Navigation	W Matrix Invalid For Flight Navigation

NON FLAGS

RR Mode	0110	14	RR Remote Required	RR Remote Not Required
Designate	0110	10	Desired LOS Within Limits Of Present RR Mode. Drive CDU's.	Desired LOS Not Within The Limits Of The Present RR Mode. Do Not Drive CDU's.
ACA Mode (Min Imp)	0111	15	Minimum Impulse Mode Enabled (V76)	Rate Command Mode Enabled (V77)
AOT Mark Reject	1312	13	Use Of Mark Reject Button	Use Of Mark X Or Y
AOT Y Mark	1312	11	After Use Of Mark Y button	After both X&Y Marks Made Or A Mark Reject
AOT X	1312	10	After X Mark Made	After Both X&Y Marks Made Or A Mark Reject

14

Basic Date April 25, 1969
Changed _____

CHANNEL LISTING

CHANNEL	BIT	FUNCTION
5 OUTPUT	1	JET 1 ON
	2	JET 2 ON
	3	JET 5 ON
	4	JET 6 ON
	5	JET 9 ON
	6	JET 10 ON
	7	JET 13 ON
	8	JET 14 ON
6 OUTPUT	1	JET 7 ON
	2	JET 3 ON
	3	JET 15 ON
	4	JET 11 ON
	5	JET 12 ON
	6	JET 8 ON
	7	JET 4 ON
	8	JET 16 ON
11 OUTPUT	1	ISS WARNING
	13	ENGINE ON
	14	ENGINE OFF
12 OUTPUT	1	ZERO RRCDU
	4	COARSE ALIGN ENABLE
	5	ZERO ICDU
	9	+PITCH GMBL TRIM CMD
	10	-PITCH GMBL TRIM CMD
	11	+ROLL GMBL TRIM CMD
	12	-ROLL GMBL TRIM CMD
	13	LR POS CMD
	14	RR AUTO TRACK ENABLE
	15	ISS TURN ON DELAY COMPLETE
16 INPUT	3	MARK X
	4	MARK Y
	5	MARK REJECT
	6	+RATE OF DESCENT
	7	-RATE OF DESCENT

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

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

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AGS SELECTOR LOGIC LIST

<u>Address</u>	<u>Entry</u>	
400	+00000	Attitude Hold
	+10000	Auto Guidance Steering
	+20000	Acquisition Steering If 507+0 Z-Axis Guidance Steering If 507+1
	+30000	IMU Align
	+40000	Lunar Align
	+50000	Body Axis Align
	+60000	Gyro And Accelerometer Calibration (300 sec,30 sec)
	+70000	Accelerometer Only Calibration (30 sec)
	+00000	Use Rotating External ΔV
	+10000	Reference Frame
407	+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	DPS Or RCS Engine Select
	+10000	APS Engine Selection
412	+00000	Reinitiate Test
	+10000	Test Successful
	+30000	Logic Test fail
	+40000	Memory Test fail
413	+70000	Logic & Memory Test Fail
	+00000	Normal Position
414	+10000	Store Lunar Azimuth
	+00000	Navigation Initialization Complete (AUTO)
	+10000	LM And CSM Navigation Initialization Via PGNCS Downlink
	+20000	LM Navigation Initial- ization Via DEDA
	+30000	CSM Navigation Initial- ization Via DEDA

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415	+00000	Normal Position
	+10000	Store Z-axis Direction Cosines In RDR filter
416	+00000	For CSI Calculation Select CDH At First Apsidal Crossing
	+10000	For CSI Calculation Select CDH At Second Apsidal Crossing
	+20000	For CSI Calculation Select CDH At Third Apsidal Crossing
417	+00000	CDH At Apsidal Crossing Selected By Address 416
	+10000	CDH At 180° , 360° Or 540° From CSI Maneuver Based On Address 416
507	+00000	+Z Body Points In Direction Of CSM When 400 +2
	+10000	+Z Body Points To Thrust Direction When 400 +2
623	+00000	+Z Body Parallel To CSM Orbit Plane When 400+1
	+10000	+Z Body Parallel To Plane De- fined By WB When In Guidance Steering

DEDA INPUT/OUTPUT LISTAddress

047	Sine of Landing Azimuth Angle	Octal
053	Cosine Of Landing Azimuth Angle	Octal
231	Radial Distance Of Launch Site From Center Of Moon	100 ft
232	Orbit Insertion Altitude	100 ft
233	Vertical Pitch Steering Altitude Threshold	100 ft
237	Altitude Update Input For PDI	100 ft
240	X Position Comp (LM)	100 ft

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	Y Position Comp (LM)	100 ft
	Z Position Comp (LM)	100 ft
	X Position Comp (CSM)	100 ft
	Y Position Comp (CSM)	100 ft
	Z Position Comp (CSM)	100 ft
	LM Ephemeris Data (Epoch Time)	.1 min
	X Velocity Comp (LM)	.1fps
	Y Velocity Comp (LM)	.1fps
	Z Velocity Comp (LM)	.1fps
	X Velocity Comp (CSM)	.1fps
	Y Velocity Comp (CSM)	.1fps
	Z Velocity Comp (CSM)	.1fps
	CSM Ephemeris Data Epoch Time	.1 min
	Targeted AGS Time For CSI Maneuver (TIG CSI)	.1 min
	Absolute Time CDH (TIG CDH)	.1 min
	Targeted AGS Time For TPI Maneuver (TIG TPI)	.1 min
	TPI RNDZ OFFSET TIME	.01 min
	Time From TPI To RNDZ	.01 min
	Targeted TFI TPI (For TPI Search Routine)	.01 min
	Time From TPI To Rendezvous (TPI)	.01 min
	Time From CSI To CDH (CSI)	.01 min
	Target Time Of Node Prior To Rendezvous	.01 min
	Radar Range (R) (INPUT)	.1 nm
	AGS TIG TPI/TPM	.1 min
	CSI to CDH Coast Time (CSI)	.1 min
	AGS Computer Time (T)	.1 min
	ΔVX (Use 470 For Readout)	Octal
	ΔVY (Use 471 For Readout)	Octal
	ΔVZ (Use 472 For Readout)	Octal
	ΔVX (LV) (+Fwd)	.1fps
	ΔVY (LV) (+Left)	.1fps
	ΔVZ (LV) (+Dn)	.1fps
	Vertical Pitch Steering, Attitude Rate Threshold	.1fps
	Lower Limit Of Target Radial Rate At Insertion	.1fps

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466	Target Horizontal Velocity At Insertion	.1fps
503	Radar Range Rate (RDOT) Input	.1fps
514	WBX Components Of Unit Vector Used To Provide Yaw	Octal
515	WBY Steering Out Of CSM Orbit Plane	
516	WBZ (400,+1;623,+1)	Octal
534	Scale Factor For X Accel	Octal
535	Scale Factor For Y Accel	Octal
536	Scale Factor For Z Accel	Octal
537	X Axis Gyro Mass Unbalance Compensation Constant	Octal
540	X Accel Bias Compensation Coeff	Octal
541	Y Accel Bias Compensation Coeff	Octal
542	Z Accel Bias Compensation Coeff	Octal
544	X Gyro Bias Compensation Coeff	.01°/hr
545	Y Gyro Bias Compensation Coeff	.01°/hr
546	Z Gyro Bias Compensation Coeff	.01°/hr
547	Lunar Align Azimuth Correction	Octal
574	DES Section Staging Flag(+ Not staged)	Octal
604	Lunar Surface Flag(+ Not On Lunar Surface)	Octal
605	Desired Tangent Of LOS At TPI (TAN LOS TPI)	Octal

DEDA OUTPUT LISTAddress

211	Present Out-Of CSM Orbit Plane Position	100 ft
263	VG Component For Out-Of-Plane Steering At CSI, CDH,(Vpy)	.1fps
267	Delta Velocity To Be Gained	.1fps
270	Present Out-Of-CSM Orbit Plane Velocity (Vyo)	.1fps
274	ΔT CDH -TPI	.1 min
303	Predicted LOS At tig C (TPI)	.01°
303	LM/CSM Central Angle At CDH (CSI/CDH)	.01°
304	Angle Between Local Horizon And Z body Axis	.01°

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306	TPI Rndz Offset Time	.01 min
307	Time From TPI To Rndz	.01 min
310	Time To Next Maneuver	.01 min
311	Time To Rndz	.01 min
312	Predicted Post-CSI LM Orbit Period (If 416 +2)	.01 min
313	Time To Pericynthion	.01 min
315	Predicted Altitude Of LM Apocynthion	1 nm
317	LM To CSM Range (R) (Computed)	.1 nm
337	LM Altitude (h)	.1 nm
340	X Comp Of LM Position	100 ft
341	Y Comp Of LM Position	100 ft
342	Z Comp Of LM Position	100 ft
344	X Comp Of CSM Position	100 ft
345	Y Comp Of CSM Position	100 ft
346	Z Comp Of CSM Position	100 ft
347	Predicted LM Burnout Altitude (Orbit Insertion)	100 ft
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 (HDOT)	.1fps
371	ΔV For CDH (CSI, Coast)	.1fps
371	ΔV Direct Trans + Braking (TPI)	.1fps
373	CSI To CDH ΔT (CSI)	.1 min
373	TIG TPI (TPI)	.1 min
402	LM Predicted ΔH (CSI)	.1 nm
402	TPI Transfer Orbit Pericynthion Altitude	.1 nm
403	LM Perigee Altitude (Hp)	.1nm
423	Predicted Burnout HDOT (Orbit Insertion)	.1fps
433	LM Velocity	.1fps
440	Range Rate Between LM And CSM (RDOT)	.1fps
456	ΔV CSI (VO)	.1fps
457	CSI Velocity Search Increment	.1fps
463	Predicted HDOT CSI	.1fps
470	ΔVX Measured (LM) (+ Up) (Use 404 To zero)	.1fps

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471	ΔVY Measured (LM) (+ RT) (Use 405 To Zero)	.1fps
472	ΔZ Measured (LM) (+ Fwd) (Use 406 To zero)	.1fps
500	Δvg_x (LM) (+Up)	.1fps
501	Δvg_y (LM) (+Rt)	.1fps
502	Δvg_z (LM) (+Fwd)	.1fps

DEDA ACCESSIBLE CONSTANTS LISTAddress

216	q Value Set If Overflow In Orbital Eccentricity	100 ft
217	Initial P Perturbation	100 ft
223	Nominal Burnout Altitude Expression For Orbit Insertion	100 ft
230	(Δp) Limiter	100 ft
271	Late Abort Hor. Vel Target Value	.1 fps
454	VG Threshold On Engine Cutoff Computations	.1fps
473	Descent Stage ΔV Capability (Vdx)	.1fps
522	Ullage Threshold For Orbit Insertion Retarget	Octal
523	Rd Jerk Lower Limit When LM Staged And Thrust Accel Is Small	Octal
526	Set Value of VT If Overflow	Octal
527	Upper Limit On Final Altitude Rate For Orbital Insertion	Octal
534	X Accel Scale Factor	Octal
535	Y Accel Scale Factor	Octal
536	Z Accel Scale Factor	Octal
537	X Axis Mass Unbalance Compensation	Octal
540	X Accel Bias Compensation	Octal
541	Y Accel Bias Compensation	Octal
542	Z Accel Bias Compensation	Octal
544	X Gyro Bias Compensation	.01 deg/hr
545	Y Gyro Bias Compensation	.01 deg/hr
546	Z Gyro Bias Compensation	.01 deg/hr
550	X Gyro Scale Factor Compensation	Octal
551	Y Gyro Scale Factor Compensation	Octal
552	Z Gyro Scale Factor Compensation	Octal

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554	Upper Limit Of rd Jerk	Octal
555	Upper Limit Of Derivative of Yaw Acceleration	Octal
557	Lower Limit Of Derivative Of Yaw Acceleration	Octal
564	Δ6 Lower Limit	Octal
565	Δ6 Upper Limit	Octal
566	Engine Cant Angle In Pitch Plane	Octal
602	Engine Cant Angle In Roll (X,Y) Plane	Octal
607	Scale Factor For HDOT	Octal
613	Sine Of Central Angle Limit In TPI	Octal
616	Ullage Counter Limit	Octal
617	Gyro Calibrate Duration	Octal
620	No. Of P Iterations - 3	Octal
621	Accelerometer Calibrate Time	Octal
622	Staging Time Delay	Octal
624	Altitude And Altitude Rate Constant, 200 msec Readout	Octal
625	FDAI Computation Singularity Threshold	Octal
626	X Axis Alignment Gain	Octal
627	Lunar Align Constant	Octal
630	Lunar Align Constant	Octal
631	Lunar Align Stop Criterion	Octal
632	Calibrate Gain	Octal
633	Calibrate Gain	Octal
634	Acceleration Bias Threshold	Octal
635	Accelerometer Calibrate Gain	Octal
636	Gravitational Constant	Octal
637	Gravitational Constant Reciprocal	Octal
640	rd Jerk Lower Limit When LM Not Staged Or Thrust Accel Is Large	Octal
641	Filter Velocity Uncertainty Term	Octal
642	Orbit Insertion Steering Constant	Octal
643	Coefficient In Evaluation of CSI Cost Function	Octal
644	Decrease Δ6 Factor	Octal
645	Increase Δ6 Factor	Octal
646	Error Term In Radar Filter	Octal

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647	Velocity To Be Gained Threshold	Octal
650	Cosine Of Angle Between Radar And AGS X-body Axis	Octal
651	Filter Initial Position Error Covariance	Octal
652	Filter Initial Velocity Error Covariance	Octal
653	Radar Error Model	Octal
654	TB Computation Factor	Octal
655	TB Computation Factor	Octal
656	Factor In VHF Computation In Orbit Insertion	Octal
657	Ascent Engine Cutoff Impulse Compensation	Octal
660	Thrust Accel Lower Limit	Octal
661	Ullage Threshold	Octal
662	Cosine Of Angle Between Radar And AGS Y-body Axis.	
666	Att Error Output Limit	Octal
673	Product Of Lunar Rotation Rate And 20 msec Compute Cycle Period	Octal
674	-(Gravitational Constant) Δt (Δ t= 2 sec)	Octal

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AGS PROGRAMS

***** CSI *****

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

2 *275 +(TIG CSI) (.1min)
*277 +(TIG TPI) (.1min)
*605 +(TAN LOS TPI (Octal)) +10006 for 26.6°
(Below),
+10472 for 28.3°
(Above)

*416 +0 CDH 1st Apsis (Or 180° From CSI If
417 +1)
+1 CDH 2nd Apsis (Or 360° From CSI If
417 +1)
+2 CDH 3rd Apsis (Or 540° From CSI If
417+1)

Wait Until TIG - 136 Min
*410 +1 CSI ROUTINE

3 *457 R ITERATION ERROR (.1fps) (If > +00010 Set
*410 + 0 And Retarget)

4 *463 R HDOT CSI (.1fps)
(If 463 < 00100 Set *417+1 For CDH At
CSI + 180°, 360°, Or 540° Per 416)

5 *310 R TFI CSI (.01min)
EVENT TIMER - SET
*456 R ΔV CSI (VO) (.1fps)

6 If Time Available
*371 R ΔV CDH (.1fps)
*402 R Δh CDH (.1nm)
*276 R TIG CDH (.1min)
*373 R ΔT CSI To CDH (.1min)
*274 R ΔT CDH To TPI (Must Be Positive) (.1min)

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7	*410 + 5 EXT ΔV *450 R ΔVX CSI *263 R ΔVY CSI *451 (ΔVY CSI) (Same Sign As 263) *452 R ΔVZ CSI *267 R Total ΔV	(.1fps) (.1fps) (.1fps) (.1fps) (.1fps) (.1fps)		
8	*411 +0 DES ENG OR RCS BURN +1 ASC ENG BURN			
9	*400 +1 X-AXIS GUIDANCE STEERING OR *400 +2,*507 +1 Z-AXIS GUIDANCE STEERING OR *400 +2,*507 +0 TO MAINTAIN RR LOCK-ON			
10	ATTITUDE CONTROL(3) - PULSE MODE CONT: AGS - AUTO MANEUVER TO BURN ATTITUDE ATTITUDE CONTROL (3) - MODE CONT			
11	*407+0			
12	*501 R ΔVGY(LM) *502 R ΔVGZ(LM) *500 R ΔVGX(LM)	(.1fps) (.1fps) (.1fps)		
13	<u>CONFIGURATION</u>	<u>DES</u>	<u>ASC</u>	<u>RCS</u>
	THR CONT	MAN	-	-
	MAN THROT	CDR	-	-
	BAL CPL	ON	ON	ON
	X-TRANSL	2 JET	2 JET	2 JET
	THROT/JET	THROT	JETS	JETS
	DEADBAND	MIN	MIN	MIN
	ABORT (STAGE) PB	PUSH	PUSH	-
	ENG ARM	DES	ASC	OFF
	MASTER ARM	ON(1st MON	ON(Un- staged)	OFF
	PRPLNT QTY MON	DES 1	OFF	-
	PRPLNT TEMP/PRESS MON	DES 1	ASC	-
	HELIUM MON	SUPCRIT PRESS	PRESS 1	-
	ENGINE STOP	OUT	OUT	IN

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- Basic Date April 25, 1969
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- 14 -1:00 For DPS Burns:
 CB(11) STAB/CONT: DECA PWR-Close
 CB(16) STAB/CONT: DES ENG OVRD - Close
 ENGINE GMBL-ENBL
For APS Burns:
 CB(11) STAB/CONT: AELD-Close
 CB(16) STAB/CONT: AELD-Close
- :15 *407 +1 (For RCS Burn Not +X LM)
- 15 - :06 Start Ullage
- 16 :00 IGNITION
- 17 When Burn Complete:
 ABORT(STAGE)PB - RELEASE
 NULL 501, 502, 500 (.1fps)
- 18 *410 +2 CDH ROUTINE
- 19 MASTER ARM - OFF
 ENG GMBL - OFF
 ENG ARM - OFF
 BAL CPL - ON
 THR/JET - JETS
 DEADBAND - MAX
 PRPLNT QTY MON - OFF
~~PRPLNT TEMP/PRESS MON~~ OFF
 HELIUM MON - OFF
- ***** CDH *****
- 1 MODE CONT: AGS - ATT HOLD
 GUID CONT - AGS
- 2 *410 +2 CDH ROUTINE
 *276 R TIG CDH (Adjust AGS TIG CDH)
 As Desired For New Solution (.1min)
- 3 *310 R TFI CDH (.01min)
 EVENT TIMER - SET
 *267 R AVG CDH (.1fps)

4 If Time Available Check The Following:

*402 R ΔH CDH (.1nm)
 *423 R HDOT CDH (.1fps)

5 *410 +5 EXT ΔV

*450 R ΔV_X CDH (.1fps)
 *263 R ΔV_Y CDH (.1fps)
 *451 (ΔV_Y CDH) (Same Sign As 263) (.1fps)
 *452 R ΔV_Z CDH (.1fps)

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

7 *400 +1 X-AXIS GUIDANCE STEERING OR

*400 +2,*507 +1 Z-AXIS GUIDANCE STEERING OR
 *400 +2,*507 +0 TO MAINTAIN RR LOCK-ON

8 ATTITUDE CONTROL(3) - PULSE
MODE CONT: AGS - AUTO
MANEUVER TO BURN ATTITUDE THEN
ATTITUDE CONTROL(3) - MODE CONT

9 *407+0

10 *501 R ΔV_{GY} (LM) (.1fps)
 *502 R ΔV_{GZ} (LM) (.1fps)
 *500 R ΔV_{GX} (LM) (.1fps)

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 Changed May 3, 1969

- Basic Date April 25, 1969
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- 11 CONFIGURATION
- | | <u>DES</u> | <u>ASC</u> | <u>RCS</u> |
|-----------------------|---------------|---------------|------------|
| THR CONT | MAN | - | - |
| MAN THROT | CDR | - | - |
| BAL CPL | ON | ON | ON |
| X-TRANSL | 2 JET | 2 JET | 2 JET |
| THROT/JETS | THROT | JETS | JETS |
| | (MIN THRUST) | | |
| DEAD BAND | MIN | MIN | MIN |
| ABORT (STAGE) PB | PUSH | PUSH | - |
| ENG ARM | DES | ASC | - |
| MASTER ARM | ON(1st Burn) | ON(Un-staged) | OFF |
| PRPLNT QTY MON | DES | OFF | OFF |
| PRPLNT TEMP/PRESS MON | DES | ASC | - |
| HELIUM MON | SUPCRIT PRESS | PRESS 1 | - |
| ENGINE STOP | OUT | OUT | IN |
- 12 -1:00 For DPS Burns:
- CB(11) STAB/CONT: DECA PWR-Close
 CB(16) STAB/CONT: DES ENG OVRD -Close
 ENGINE GMBL-ENBL
- For APS Burns:
- CB(11) STAB/CONT: AELD-Close
 CB(16) STAB/CONT: AELD-Close
- 15 *407 +1 (For RCS BURN Not +X LM)
- 13 -:06 Start Ullage
- 14 :00 IGNITION
- 15 When Burn Complete
 ABORT(STAGE)PB - RELEASE
 NULL 501, 502, 500 (.1fps)

16	MASTER ARM	- OFF
	ENG GMBL	- OFF
	ENG ARM	- OFF
	BAL CPL	- ON
	THROT/JETS	- JETS
	DEAD BAND	- MAX
	PRPLNT QTY MON	- OFF
	PRPLNT TEMP/PRESS MON	- OFF
	HELIUM MON	- OFF

***** TPI *****

- 1 MODE CONT: AGS - ATT HOLD
GUID CONT - AGS
- 2 *410 +3 TPI SEARCH
*307 + (Δ T RND TRANS) (.01min)
*314 +0(NODE AT Prior To TPF) (.01min)
*310 + (TARGET TFI TPI) (.01min)
- 3 *303 R 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 *310 R TFI TPI (.01min)
EVENT TIMER - SET
*267 R Δ V TPI (.1fps)
- 5 If Time Available:
*304 R THETA (.1°)
*373 R TIG TPI (.1min)
*371 R Δ VG to RNDZ (.1fps)
(If +6 Retarget)
*402 R Hp TPI (.1nm)
- 6 *411 +0 DES ENG OR RCS
+1 ASC ENG
- 7 *410 +5

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8 *400 +1, X AXIS GUIDANCE STEERING OR
 *400 +2, 507 +1 Z-AXIS GUIDANCE STEERING OR
 *400 +2, 507 +0 TO MAINTAIN RR LOCK-ON

9 ATTITUDE CONTROL(3) - PULSE
 MODE CONT: AGS - AUTO

10 MANEUVER TO BURN ATTITUDE THEN
 ATTITUDE CONTROL(3) - MODE CONT

11 *407+0

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

13 CONFIGURATION DES ASC RCS
 THR CONT MAN - -
 MAN THROT CDR - -
 BAL CPL ON ON ON
 X-TRANSL 2 JET 2 JET 2 JET
 THROT/JET THROT JETS JETS
 DEAD BAND MIN MIN MIN
 ABORT PB PUSH PUSH -
 ENG ARM DES ASC OFF
 MASTER ARM ON(1st ON(Un OFF
 Burn Staged
 PRPLNT QTY MON DES OFF -
 PRPLNT TEMP/PRESS DES ASC -
 MON
 HELIUM MON SUPCRIT PRESS 1 -
 PRESS
 ENGINE STOP OUT OUT IN

14 -1:00 For DPS Burns:
 CB(11)STAB/CONT: DECA PWR-Close
 ENGINE 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)
 MODE CONT: AGS-ATT HOLD

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Changed July 3, 1969

15 -:06 Start Ullage

16 :00 IGNITION

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

18 *410+4 TPI EXECUTE

19 MASTER ARM - OFF
ENG GMBL - OFF
ENG ARM - OFF
BAL CPL - ON
THROTT/JETS - JETS
DEAD BAND - MAX
PRPLNT QTY MON - OFF
~~PRPLNT TEMP/PRESS MON~~ - OFF
HELIUM MON - OFF

***** TPM *****

No Retargeting

1 *410+4 TPI EXECUTE
*310R TFI TPM (.01min)
EVENT TIMER - SET
*267R ΔV TPM (.1fps)

2 If Time Available:
*304R THETA (.1°)
*373R TIG TPM (.1min)
*371R ΔVG To RNDZ (.1fps)
(If +6 Retarget)
*402R Hp TPM (.1nm)

3 *410+5 EXT ΔV
*407+0 REF FRAME

4 *407+1
NULL 501, 502, 500

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Changed May 3, 1969

Retargeting (Same Rndz Time)

- Basic Date April 25, 1969
 Changed May 3, 1969
- 1 *410 +3 TPI SEARCH
 *307 + (ΔT RNDZ TRANS)
 +00280 (TBD For 1st MCC)
 +00130 (TBD For 2nd MCC)
 *373 *310 +(TIG TPM) (.01min)
 *410 + 4 TPI EXECUTE
 - 2 *267 R VG MDC (.1fps)
 - 3 If Time Available:
 *311 R ΔT RDZ (.01min)
 *304 R THETA (.01°)
 - 4 *410 +5
 *407 +0 REF FRAME
 - 5 *407 +1
 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) (.1fps)
- 3 *267 R Total ΔV
 EVENT TIMER - SET
- 4 *411 +0 DES ENG OR RCS
 +1 ASC ENG
- 5 *400 +1 X-AXIS GUIDANCE STEERING OR
 *400 +2, *507 +1 Z-AXIS GUIDANCE STEERING OR
 *400 +2, *507 +0 TO MAINTAIN RR LOCK-ON

ATTITUDE CONTROL(3) - PULSE
MODE CONT: AGS - AUTO
MANEUVER TO BURN ATTITUDE THEN
ATTITUDE CONTROL(3) - MODE CONT

*407+0

*501 R ΔVGY(LM) (.1fps)

*502 R ΔVGZ(LM) (.1fps)

*500 R ΔVGX(LM) (.1fps)

<u>CONFIGURATION</u>	<u>DES</u>	<u>ASC</u>	<u>RCS</u>
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
X-TRANSL	2 JET	2 JET	2 JET
THROT/JETS	THROT	JETS	JETS
DEAD BAND	MIN	MIN	MIN
ABORT(STAGE)PG	PUSH	PUSH	-
ENG ARM	DES	ASC	OFF
MASTER ARM	ON(1st Burn)	ON(Un- staged)	OFF
PRPLNT QTY MON	DES	OFF	-
PRPLNT TEMP/PRESS	DES	ASC	-
MON			
HELIUM MON	SUPCRIT PRESS	PRESS 1	-
ENGINE STOP	OUT	OUT	IN

-1:00 For DPS Burns:

CB(11) STAB/CONT: DECA PWR-CLOSE

ENGINE GMBI-ENBI

For APS Burns:

CB(11) STAB/CONT: AEID=CLOSE

CB(16) STAB/CONT: AELD=CLOSE

-:15 *407 +1 (For RCS Burn Not +X LM)
MODE CONT: AGS-ATT HOLD

-:06 Start Ullage

:00 IGNITION

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

14 MASTER ARM - OFF
 ENG GMBL - OFF
 ENG ARM - OFF
 BAL CPL - ON
 THROT/JETS - JETS
 DEAD BAND - MAX
 PRPLNT QTY MON - OFF
~~PRPLNT TEMP/PRESS MON~~ - OFF
 HELIUM MON - OFF

***** AGS MANUAL THRUST *****

- 1 GUID CONT - AGS
 MODE CONT: AGS - ATT HOLD
 ATT CONT RPY - MODE CONT
 DEADBAND - MIN
 TTCA ENABLE - ENABLE
 THROTTLE/JETS - 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 - *470 R (.1fps)
 Y - *471 R (.1fps)
 Z - *472 R (.1fps)
- 5 Thrust Along Desired Axis Using TTCA

AGS ACT, CAL
 UPDATE, ALIGN

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Trim Residuals

X - *470 R (.1fps)
 Null (TTCA up/down)
 (If Thrust Axis Acquire Desired ΔV)

Y - *471 R (.1fps)
 Null (TTCA left/right)
 (If Thrust Axis Acquire Desired ΔV)

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

***** AGS ACTIVATION & SELF TEST *****

1

CB(11) AC BUS B: AGS - CLOSE
 AGS Status - STBY (Master Alarm, AGS
 Warning Lt - ON
 CB(16) STAB/CONT: AEA-CLOSE (AGS Warning
 Lt - OFF)
 AGS Status - Operate (Master Alarm, AGS
 Warning Lt-ON Momentarily)

2

6666 (OPR ERR Lt - ON)

3

000 +88888

4

123 -45679

5

*412R +1 SELF TEST SATISFACTORY
 +3 LOGIC TEST FAILURE
 +4 MEMORY TEST FAILURE
 +7 LOGIC AND MEMORY TEST FAILURE
 *412 +0 To reinitiate test

6

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

7

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

8

*612R +0 STAGING SEQ COUNTER

AGS ACT, CAL
 UPDATE, ALIGN

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LM-4

***** AGS CALIBRATION *****

- 1 Verify AGS In Standby/Operate For 25 min
- 2 Read And Record:
 *540R X ACCEL BIAS COEFF _____ Octal
- *541R Y _____ Octal
- *542R Z _____ Octal
- *544R X GYRO DRIFT COEFF _____ (.01°/hr)
- *545R Y _____ (.01°/hr)
- *546R Z _____ (.01°/hr)
- 3 V16 N2OE
- 16 20 ICDU ANGLES O,I,M
 CSM MNVR UNTIL ICDU's >11.25°
 And >5° From 0°, 45°, 90°, etc.
 Rates <.1°/sec
 Disable CSM & LM Thrusters
- 4 *400 + 6 CALIBRATE GYRO & ACCEL
 After 32 sec, Enable CSM Thrusters
 CSM Max Deadband Attitude Hold
 Read And Record:
 *540R X ACCEL BIAS COEFF _____ Octal
- *541R Y _____ Octal
- *542R Z _____ Octal
 Values Should Not Change From Step 1
 By More Than 20 Octal Digits In Least
 Significant Digit
- 5 *400R + 0 GYRO & ACCEL CALIBRATE COMPLETE
 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 2.5°/hr

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AGS RR MANUAL ACQUISITION AND UPDATE *****

GUID CONT	- AGS
RNG/ALT MON	- RNG/RNG RT
RATE/ERR MON	- LDR RDR/CMPTR
ATT MON	- AGS
SHFT/TRUN	- +5°
RENDEZVOUS RADAR	- SLEW
ATT CONT	- PULSE
MODE CONT: AGS	- AUTO
DB	- MIN

*507 +0
*400 +2 ACQUISITION STEERING

Manually Null FDAT

RATE/ERR MON-RNDZ RADAR

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

RNDZ RAD - AUTO TRACK

*415 +1 STORE Z AXIS COSINES
ENTR (When FDAI's centered)

*316 +(RADAR RANGE) (.lnm)
(Must Be Entered Within 30 sec
Repeat At 4 min Intervals For
5 Data Points)

*503 + (RADAR RANGE RATE) (.1fps)
(Enter Range Rate Only Once For
Each Set Of Updates)

Basic Date April 25, 1969
Changed May 2, 1969

***** AGS MANUAL STATE VECTOR UPDATE *****

- | | | |
|----|-----------------------------|----------|
| 1 | RECORD LM DATA AND TIME | |
| 2 | *240 +(LM X Position) | (100 ft) |
| 3 | *241 +(LM Y Position) | (100 ft) |
| 4 | *242 +(LM Z Position) | (100 ft) |
| 5 | *260 +(LM X Velocity) | (.1fps) |
| 6 | *261 +(LM Y Velocity) | (.1fps) |
| 7 | *262 +(LM Z Velocity) | (.1fps) |
| 8 | *254 +(LM Epoch Time) | (.1min) |
| 9 | *414 +2 Update State Vector | |
| 10 | *414R (+0=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) | (.1min) |
| 19 | *414 +3 Update State Vector | |
| 20 | *414R +0=Update Complete) | |

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~~*****AGS BACK-UP ALIGNMENT*****~~RNDZ ALIGN

- 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

STAR ALIGN

- 1 MODE CONT: AGS - ATT HOLD
- 2 MNVR To Place Star Set In AOT (FWD DETENT)
- 3 Position Prime Star In Center of Reticle
- 4 DEADBAND - MIN
- 5 Rotate Reticle To Place Either +X,+Y Line on Star #2
- 6 *400 + 5
*400 + 0

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LMA

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**RECORD & Report To MSFN Star Set, ID Line
AOT Counter**

(Star #1)

(Star #2)

(ID Line)

(AOT Counter)

8 MNVR To FDAO Angles From MSFN

9 At New Attitude

*400 + 5

*400 + 0

***** AGS ORDEAL INITIALIZATION *****

1 POWER = ON

FDAI 1 and/or 2 - ORB RATE
EARTH LUNAR - EARTH

2 *315R Ha LM (.1nm)
*403R Hp LM

3 ALT SET - Set To Average of HA & HP

4 Verify LM Pointed +Z In Direction Of Orbit Travel

5 *304R THETA (0° To 360°) (.01°)

6 MODE - HOLD/FAST
SLEW - Set To Theta
MODE - OPR/SLOW