

JUN 11 1969



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO XI
LM-5

FLIGHT CREW G&N DICTIONARY

PREPARED BY

GUIDANCE AND CONTROL SECTION
SPACECRAFT SYSTEMS BRANCH
FLIGHT CREW SUPPORT DIVISION

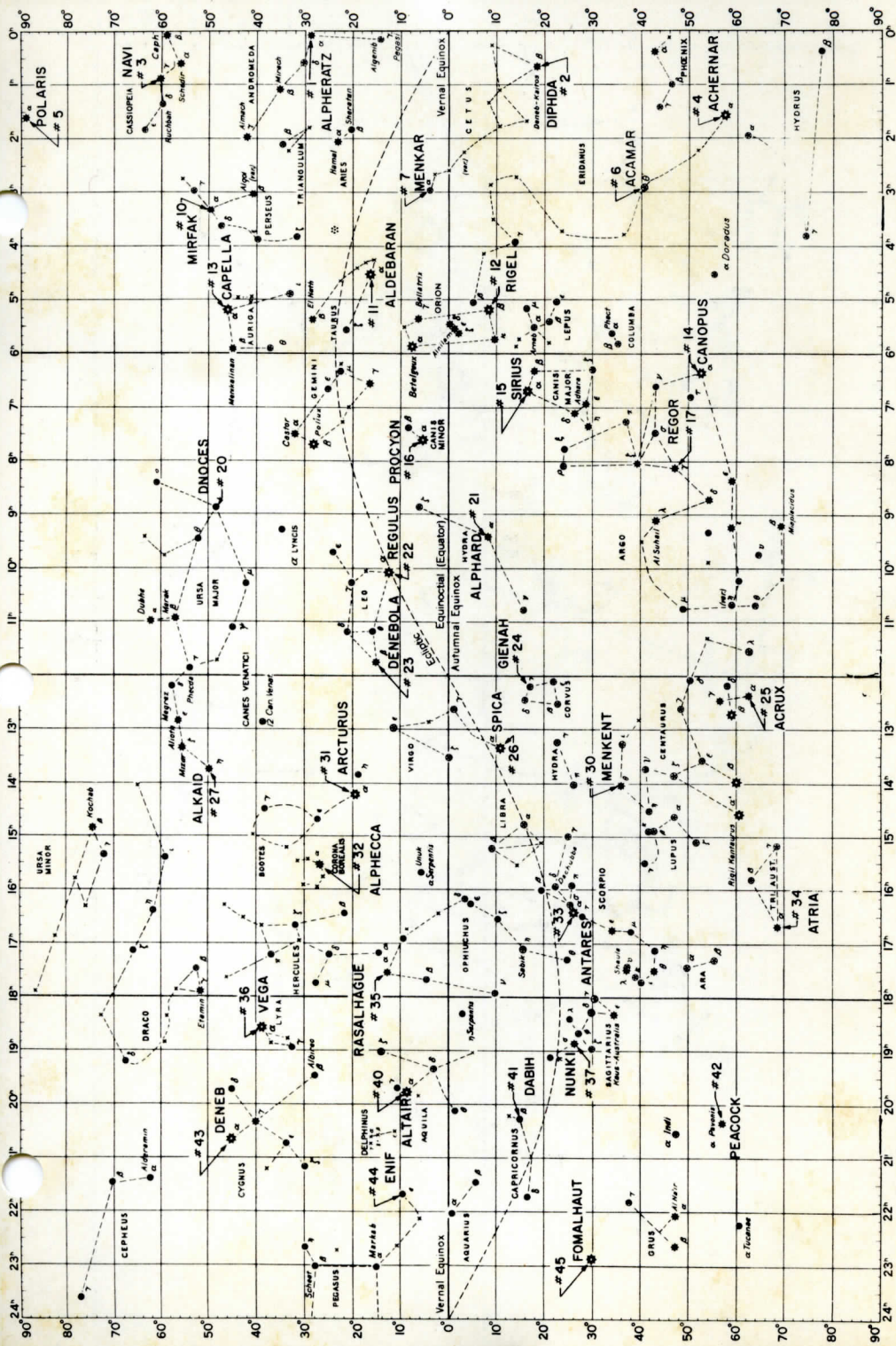
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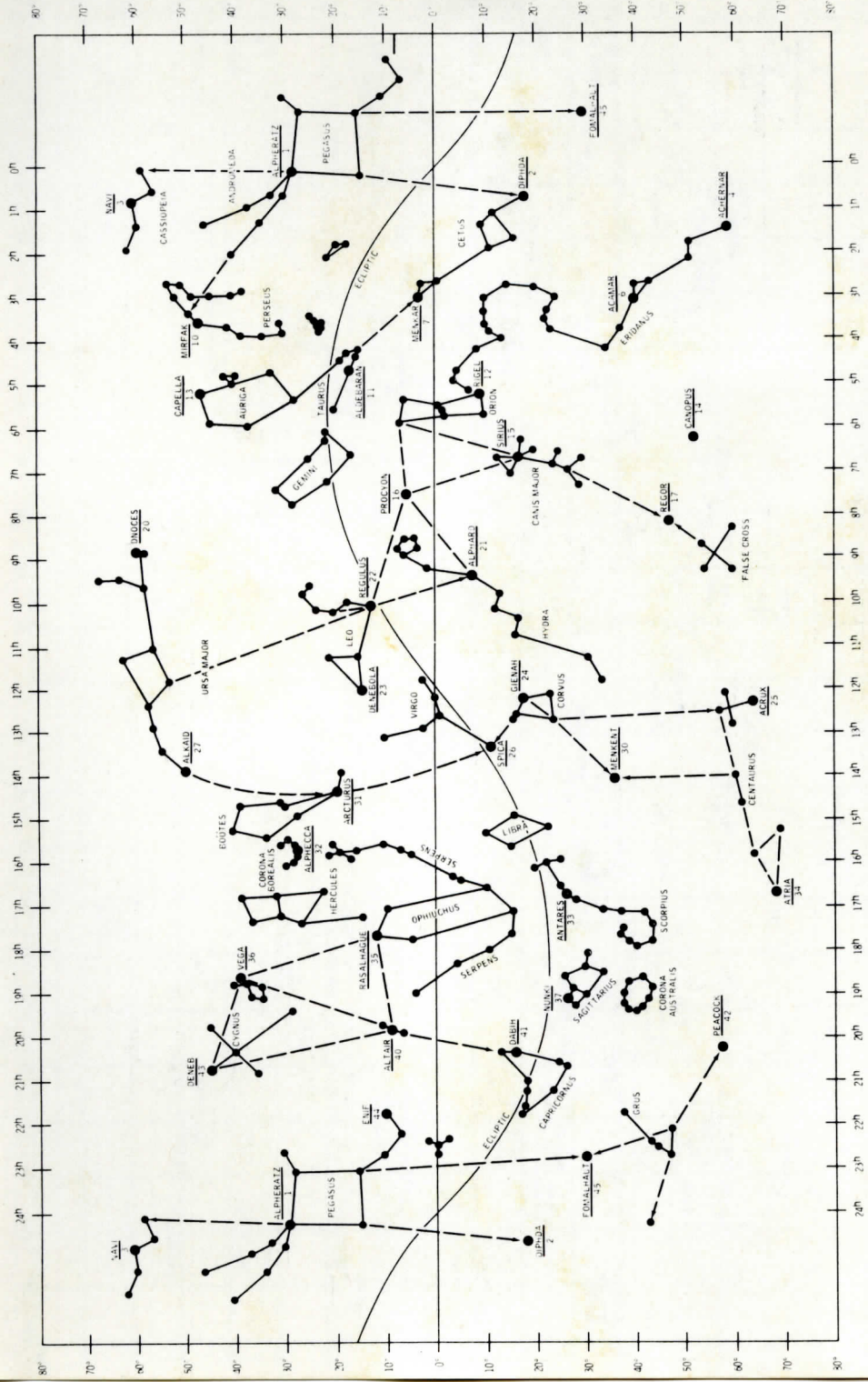
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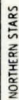
MAY 29, 1969

STAR CHARTS



STAR CHARTS





STAR LIST

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

STARS, PROGRAMS, VERBS

Basic Date May 29, 1969
 Changed

PROGRAMS

STARS, PROGRAMS, VERBS

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
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
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
78	CSM SOR Targeting
79	CSM SOM Targeting

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VERBS

00	Not in use
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-Reticle
53	Mark Y-Reticle

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54 Mark X or Y-Reticle
 55 Increment LGC Time (Decimal)
 56 Terminate Tracking (P20,P22,&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 W-Matrix Monitor
 69 Cause Restart
 70 Update Liftoff Time (P27)
 71 Universal Update Load Block Addresses (P27)
 72 Universal Update Load Singular Addresses (P27)
 73 Update LGC Time (Octal) (P27)
 74 Initialize Eraseable Dump via Downlink
 75 Enable U,V Jets During DPS Burns
 76 Set Min Impulse Mode in DAP
 77 Set Rate Command/Attitude Hold Mode in DAP
 78 Start LR Spurious Test (R77)
 79 Stop LR Spurious Test (R77)
 80 Update LM State Vector
 81 Update CSM State Vector
 82 Request Orbit Parameter Display (R30)
 83 Rendezvous Parameter Display (R31)
 85 Display RR LOS Az and El
 89 Start Rendezvous Final Attitude Maneuver (R63)
 90 Request Rendezvous Out of Plane Display (R36)
 (Non-P12)
 91 Display Banksum
 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
 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

01(V)	Address to be Specified (Frac)		.XXXXX
02(V)	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
08(V)	Alarm Data		Octal
09(V)	Alarm Codes		Octal
10(V)	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°
20(V)	ICDU Angles Y,P,R (OG,IG,MG)		.01°
21(V)	PIPA PULSES		.01°
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
27(V)	Self Test ON/OFF		Octal
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
36(V)	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°

NOUNS

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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/From Last Burn	min-sec
	MGA	.01°
46(V)	Digital Autopilot 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
	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	0000X.
	Elevation Angle	.01°
	Central Angle	.01°
56	RR LOS Azimuth	.01°
	Elevation	.01°
57	ΔR (+ Behind)	.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
	H DOT (+ Increasing H)	.1fps
	H	ft

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61	TG	min-sec
	TF (TFI)	min-sec
	Crossrange	.1nm
62	VI	.1fps
	TF (TFI)	min-sec
	ΔV_m	.1fps
63	VI	.1fps
	H DOT	.1fps
	H	ft
64	TG/LPD	Sec/deg
	H DOT	.1fps
	H	ft
65(V)	Sampled LGC Time, Hrs	hrs
	Min	min
	Sec	.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	.1nm
	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	.1nm
	ΔT (CDH-CSI/TPI-CDH)	min-sec
	ΔT (TPI-CDH/TPI-Nom TPI)	min-sec
76	V (HOR)	.1fps
	V (VERT)	.1fps
	Crossrange	.1nm
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°
	Position Code	0000X

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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	.001°
	Longitude/2	.001°
	Altitude	.01nm
90	Rendezvous Out of Plane Parameter Y	.01nm
	YDOT	.1fps
	PSI	.01°
91	Alt	10nm
	Vel	fps
	Flt Path Angle	.01°
93	Δ Gyro Torquing Angles X	.001°
	Y	.001°
	Z	.001°
97	System Test Inputs	XXXXX.
98	System Test Results & Inputs	XXXXX.
		.XXXXX
		XXXXX.
99	RMS Position	ft
	RMS Velocity	.1fps
	Radar Bias Angle	mr

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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

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
00005	Specify SOR Phase	1 = First 2 = Second
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

00105 P **AOT Mark System in use
Reselect P5X

00107 P More Than 5 Mark Pairs
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)

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 V40N20

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
V36E, Consult MSFN But 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 Above For Procedure

00214 P/H Program Using IMU When Turned OFF
Exit 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 $<85^\circ$ or Realign IMU
 00402 P FINDCDUW Routine Not Controlling Attitude
 00404 I Two Stars Not Available In Any Detent
 See P57/6
 00405 I Two Stars Not Available
 See P52/6
 00421 I W-Matrix Overflow
 Notify MSFN
 00430 I **Acceleration Overflow In Integration
 00501 I RR Antenna Out of Present Mode Limits
 See P20/8
 00502 I Bad Radar Gimbal Angle Input
 MNVR And Redo V41N72
 00503 I Radar Antenna Designate Fail
 See P20/8
 00510 P Radar Auto Discrete Not Present
 RNDZ RDR - LGC Continue
 00511 P LR Not in Pos 2 or Repositioning
 LDG ANT - HOVER, Verify R2+00002
 00514 P RR Goes Out Of Auto Mode While In Use
 00515 H RR CDU Fail Discrete Present
 00520 P/H RADARUPT Not Expected at This Time
 00521 I Could Not Read Radar
 See P20/8
 00522 P LR Position Change
 00523 P LR Ant Not in Position 2
 00525 I $\Delta\theta >3^\circ$
 See P20/7
 00526 I Range >400 Miles
 Terminate P20 (V56)
 00527 I LOS Not in Mode II Coverage While On
 On Lunar Surface, or Vehicle Mnvr Required

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00530 I LOS Not In Mode II Coverage On Lunar Surface
After 600 sec

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
See P32/4

00605 I Number of Iterations Exceeds Loop Max
Program Cannot Converge on CSI Solution
See P32/4

00606 I ΔV Exceeds Max
See P32/4

00607 I **No Solution From Time - Theta or Time - Radius

00611 I No TIG For Given Elevation Angle
See P33/2

00701 I Illegal Option Code Selected

00777 H PIPA fail caused the ISS Warning
Go To ISS Malfunction Procedure

01102 H LGC Self Test Error
See PGNS TURN ON And SELF TEST/7

01103 I **Unused CCS Branch Executed
Copy N08, Notify MSFN, Continue

01104 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
If FRESH START Recurs, LGC FAILURE

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PGNS-13

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 **Waitlist, Var delay, Fix delay, Longcall,
 Or Delay Job Called With Zero Or Negative
 ΔT
 01206 P **Two Jobs Try To Sleep in PINBALL
 See 01201 above
 01207 P *No Vac Area For Marks
 Reselect P51 or P52
 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
 See 01301 above
 01406 I **Bad Return From Rootpsrs
 **-Occurs Only During P63 Ignition 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
 01501 P **Illegal Internal Use of PINBALL
 See 01301 above
 01502 P **Illegal Flashing Display
 See 01301 above
 01520 P V37 Request Not Permitted at This Time
 Reselect V37
 01600 H Overflow in Drift Test
 Perform Fresh Start V36E
 01601 H Bad IMU Torque
 01703 P TIG Slipped
 01706 P P40 Selected but Staged
 P42 Selcted but not Staged
 See P40/1 or P42/1

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PGNS-14

02000 P *DAP Still In Progress At Next TIME5/RUPT
RSET, GUID CONT - AGS Then PGNS; If Alarm
Recurr, V36E
Reinitialize LGC

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 Malfunction Procedures

04777 H ICDU, PIPA Fails Caused the ISS Warning
Go to ISS Malfunction Procedures

07777 H IMU Fail Caused The ISS Warning
Go to ISS Malfunction Procedures

10777 H IMU, PIPA Fails Caused The ISS Warning
Go to ISS Malfunction Procedures

13777 H IMU, ICDU Fails Caused The ISS Warning
Go to ISS Malfunction Procedures

14777 H IMU, ICDU, PIPA Fails Caused The ISS Warning
Go to ISS Malfunction Procedures

*Generates Software Restart

**Abort Code, Program Goes To R00.

***During P63 Ignition Algorithm Only

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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PGNS-15

P06 PGNS PWR DOWN

P06 - P27

1 F 50 25 V37E 06E
00062 POWER DOWN LGC
PRO Until STBY Lt - ON

P12 POWERED ASCENT

HELIUM MON - PRESS 2
PRPLNT TEMP/PRESS MON - ASC
APS/RCS PROPELLANT - INTERCONNECT
THROTT/JETS - JETS
ATT/TRANSL - 4 JETS
BAL CPL - ON
DAP - SET

1 V37E 12E

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

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

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

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

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

RECORD YAW _____°

PITCH _____°

SET EVENT TIMER TO TFI

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CMPTR ACTY Lt - ON

*PROG Lt - ON *

V05N09E,1703 TIG SLIPPED

*RSET *

CMPTR ACTY Lt - OFF

ENG ARM - ASC

-:35 DSKY BLANKS

-:30
06 74 TFI, FINAL FDAI YAW, PITCH ANGLES
(min-sec,.01°)
(AVE G ON)

-:05
F 99 74 ENGINE ON ENABLE
(AUTO) PRO (IGN WHEN TFI=:00sec)
(TERMINATE) V34E
ABORT STAGE-PUSH

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

IGN 06 63 VI, HDOT, H (.1fps, ft)
ENG START - PUSH
Monitor attitude maneuver
to recorded ball angles

BAL CPL - OFF (after pitch mnvr)

X-axis override restored
at HDOT = 40 fps plus 10 sec

VI increasing
HDOT increasing then decreasing
H increasing

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

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P06 - P27

PGNS-17

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

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

VGX=200fps MAIN SOV SYS A - OPEN
MAIN SOV SYS B - OPEN
SYS A ASC FEED 1&2-CLOSE
SYS B ASC FEED 1&2-CLOSE

VGX=50fps ENG ARM - OFF

APS
OFF NULL COMPONENTS
KEY RELEASE

8 F 16 63 VI,HDOT,H (.1fps,ft)
ABORT STAGE - RESET
ENG STOP - PUSH, RESET

NOTE VI _____ fps
HDOT _____ fps
H _____ ft
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 APO ALT _____ nm
PER ALT _____ nm
TFF _____ min-sec
PRO To 9

11 F 37

Basic Date May 29, 1969
Changed

P20 RENDZ NAV

- 1 V37E 20E
 (TO TERM-V56E)
 (SV OPTION, V80E LM, V81E CSM, V95E NONE)
- 2 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (TO ADJUST ROLL) MNVR
 ATT HOLD
 MODE CONT: PGNS - ATT HOLD
 PRO to 2
 (AUTO) GUID CONT - PGNS
 MODE CONT: PGNS - AUTO
 PRO
 (MAN) 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
 (AUTO) RR MODE LGC
 PRO To 4
 (MAN) ENTR
- 6 F 50 25 00205 SLEW RR for LOCK-ON
 (LOCK) RR-LGC:
 No Track Lt - OUT
 PRO To 4
 (NO LOCK) MNVR
 ENTR To 2

F 05 09 501 RR out of mode limits
 * (REQUEST MNVR) V32E To 2*

Basic Date. May 29, 1969
 Changed

LM-

7 F 50 72 SHFT, TRUN (.01°)
 Confirm main lobe lock-on
 (ACQUIRE MAIN LOBE)
 RR MODE - SLEW
 Slew to peak AGC
 RR MODE - LGC
 (ACCEPT) PRO

8 NO TRACK LITE

OUT DSKY BLANKS, RR TAKING MARKS

*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 7 *
 * (UPDATE) PRO To 7 or below *
 * *
 *F 06 49 + SV,ΔR,ΔV,Code(.1nm, *
 * .1fps,0000X) *
 * X=1, RANGE *
 * X=2, RDOT *
 * X=3, SHAFT ✕ *
 * X=4, TRUN ✕ *
 * UPDATE) PRO To 7 *
 * REREAD or MAN ACQ(V32E To 4 *
 * *
 *F 50 18 (MNVR REQUEST) go To 2 *

ON NO LOCK

F 05 09 00503 RR NO DATA GOOD 42 SEC(or Desig.
 Fail)
 (REDESIG) V32E To 4
 (SEARCH) PRO To 9

*V0509E 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 May 29, 1969
 Changed

PGNS-20

9 F 16 80 RR AUTO SEARCH, SEARCH CODE,
 R1 00000-SEARCH 42 sec/scan
 11111-LOCK ON
 R2 LOS/+Z (.01°)
 (LOCK) PRO To 2
 (NO LOCK) (MAN ACQ) SLEW RR for LOCK-ON
 RR MODE-LGC No Track Out - to 8
 (MNVR) V32E To 2

P21 GROUND TRACK DETERMINATION

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

2 F 06 34 GET LAT, LONG (hrs,min,.01sec)
 (NOUN 91) V06N 91E To 3
 PRO To 4

3 06 91 ALT,VEL,FLT PATH X (10nm,fps,.01°)
 KEY REL To 2

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

5 F 37

P22 LUNAR SURFACE NAVIGATION

1 V37E22E
 (To TERM-V56E)

F 04 06 R1 00012 CSM ORBIT OPTION
 R2 00001 CSM WILL NOT CHANGE
 ORBIT
 00002 CSM WILL CHANGE ORBIT
 (OPT 1) PRO To 3
 (OPT 2) PRO To 2

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

Basic Date May 29, 1969
 Changed

LM-

PGNS-21

```
*PROG LT-ON *
*F 05 09 00526 Range >400nm*
*      (TERM) V56E *
*      (RECYCLE) Wait Until*
*      Range <400 nm *
*      V32E to 3 *

```

3 RR MODE: LGC TO 5
SLEW OR AUTO TRACK To 4

```
*F 05 09 00514 RR Mode*
*      not LGC *
*      RR MODE - LGC*
*      PRO TO 3 *

```

4 F 50 25 R1 00201 (or F 05 09 00514) 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 To 5 *
*      (TERM) V56E *

```

5 F 50 72 SHFT, TRUN (.01°)
Confirm main-lobe lock-on
(ACQUIRE MAIN LOBE)
RR MODE - SLEW
Slew to peak AGC
RR MODE - LGC
(ACCEPT) PRO

Basic Date _____ May 29, 1969
Changed _____

6

NO TRACK LT:

OUT DSKY BLANKS, RR TAKING MARKS
(P22 Continues to run in background)
*F 05 09 00525 SV/RR Δ LOS > 3° *
* PRO *
*F 06 05 SV/RR Δ LOS (.01°) *
* (REJECT) CHECK SIDE LOBE *
* RR MODE - LGC *
* V32E To 6 *
* (UPDATE) PRO To 3 or below*
*F 06 49 +SV, Δ R, Δ V, Code(.1nm, .1fps, *
* 0000X) *
* X=1, RANGE *
* X=2, RDOT *
* X=3, SHAFT ✕ *
* X=4, TRUN ✕ *
* (UPDATE) PRO To 3 *
* (REREAD) V32E To 3 *

ON

F 05 09 00503 RR DESIGN FAIL
(REDESIGN) V32E To 3
(SEARCH) PRO To 7
(TERM) V56E

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

*PROG LT-ON *
*V05N09E 00527 CSM OUT *
* OF MODE II LIMITS*
* (TERM) V56E *

Basic Date - May 29, 1969
Changed

LM-

P25 PREFERRED TRACKING ATT

1
 F 50 18 MODE CONT: PGNS - AUTO
 V37E 25E
 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

2 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
 Monitor Auto Mnvr to 1
 3
 (TERMINATE) V56E
 (NO TERMINATE) P25 Continues To Run
 In Background

P27 LGC MANUAL UPDATE

1 CAUTION
 *FOR LOS Before Completion *
 * of 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 Go To 6

(CHANGE) Load Comp Identifier XXXE
 F 21 01 R3 DATA ADD (To Be Changed)
 R1 DATA E Go To 6
 (ACCEPT) PRO To 7

7 POO Displayed

P30 EXTERNAL ΔV

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

2 F 06 81 ΔV XYZ(LV) (.1fps)
 PRO

3 F 06 42 HA, HP, ΔV (.1nm,.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

P30 - P39

Basic Date _ May 29, 1969
 Changed _

LM-

Basic Date

Changed

LM-5

```

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

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

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

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

```

```

*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*
*           00605 NO SOL IN 15 Tries       *
*           00606 ΔV(CSI)>1000fps in 2     *
*           Iterations                     *
*           V32E To 1 Adjust Inputs       *

```

```

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

6   F 06 81    ΔV XYZ (LV) CSI                (.lfps)
      (For Out-of-Plane Corr in Final Comp ONLY)
      V90E
      F 06 16 GET EVENT                (hrs,min,.0lsec)
      PRO
      F 06 90 Y,YDOT,PSI                (.0lnm,.lfps,.01°)
      Record YDOT_____
      PRO
      (Insert Neg YDOT in R2 of ΔV CSI)
      PRO

7   F 06 82    ΔV XYZ (LV) CDH                (.lfps)
      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

```

F 37

Basic Date — May 29, 1969
 Changed —

P33 CDH PRE-THRUST

- 1 F 06 13 V37E 33E
TIG (CDH) (hrs,min,.01sec)
PRO
- 2 F 16 45 MARKS,TFI, -00001 (marks,min-sec)
(RECYCLE) V32E To 3
(FINAL PASS)
(TERMINATE MARKING) PRO
- *F 05 09 00611 NO TIG FOR *
* SPECIFIED ANGLE *
* (REDO)V32E To 1 *
* PRO Use Last *
* ΔT (CDH/TPI/TPI)*
* 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)
PRO (If Recycling To 2)
(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 CDH)
- 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

Basic Date May 29, 1969
Changed —

P34 TPI PRETHRUST

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

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

3 F 16 45 MARKS, TFI, -00001 (marks,min-sec)
 (RECYCLE) V32E
 (FINAL PASS) SET EVENT TIMER TO TFI
 (TERMINATE MARKINGS) PRO

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

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

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

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

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

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

9 F 37

Basic Date - May 29, 1969

Changed -

LM-

P35 TPM PRETHRUST

1 V37E 35E
 F 16 45 MARK, TFI, -00001 (marks,min-sec)
 (RECYCLE) V32E To 3
 (FINAL PASS)
 (TERMINATE MARKING) 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)

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

P38 STABLE ORBIT RENDZVOUS

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

2 F 06 55 CENTANG (.01°)
 PRO

3 F 04 06 R1 00005 SPECIFY SOR PHASE
 R2 00001 First Phase
 PRO To 4
 00002 Second Phase
 PRO To 8

4 F 06 57 ΔR (.1nm)
 PRO

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

Basic Date May 29, 1969
 Changed

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

*V06N 52E 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 (-00001 If Recycling)
(marks,min-sec,.01°)

(TERMINATE) PRO To 6

(RECYCLE) V32 To 6

(FINAL PASS Phase 1) (COMPUTE TIG FOR
Phase 2)=f(TFI,T FINAL)

TIG=_____ : _____ : _____

PRO

(FINAL PASS Phase 2) SET EVENT TIMER TO TFI
PRO

9 F 37

P39 STABLE ORBIT MIDCOURSE

1 V37E 39E

F 16 45 M,TFI,MGA (-00002 If No REFSMAT Set)
(marks,min-sec,.01°)

(RECYCLE) V32E

(TERMINATE) PRO

(FINAL PASS) SET EVENT TIMER TO TFI
PRO To 3

V06E 52E 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

Basic Date May 29, 1969
Changed _____

LM.

P40 DPS THRUST

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

1 F 50 18 V37E 40E
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

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

3 F 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

P40 - P47

Basic Date May 29, 1969
Changed

-:35 DSKY BLANKS
ENG ARM - DES
V77E

-: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.,lfps,.lfps)

*F 97 40 *

* (RECYCLE THR FAIL MON) PRO *

* (CONTINUE BURN) ENTR To TIG*

* - 5 *

* (TERMINATE) V34E To 5 *

* PROG Lt-ON *

* V05N 09E 01407 VG INCREAS-*

* ING *

* TERMINATE BURN OR SWITCH *

* TO AGS *

DPS
OFF F 16 40 TFC, VG ΔVM (min-sec.,lfps,.lfps)
ENG STOP PB - PUSH
ENG ARM - OFF
PRO

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

5 F 37 MASTER ARM -OFF (MASTER ALARM - On)
ENG STOP PB -RESET
PRPLNT QTY MON -OFF

P40 - P47

Basic Date May 29, 1969

Changed

LM-

P41 RCS THRUST

THROTT/JET - JETS

EVENT TIMER- SET

DAP - SET

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 *

V05N 09E 01703 TIG SLIPPED

MODE CONT: PGNS - ATT HOLD

V77E

-:35 DSKY BLANKS

-:30

16 85 (AVE G ON)

:00

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

NULL COMPONENTS

PRO

4 F 37

Basic Date May 29, 1969
 Changed

LM-5

P42 APS THRUST

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

F 05 09 01706 LM NOT STAGED
 * (TERM) V34E *
 * (BYPASS) PRO To 1, Stage *
 * At -:30 *

- 1 V37E 42E
 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
 *PROG LT - ON *
 V05N 09E R1 01703 TIG SLIPPED
 * RSET *
- 3 06 40 TFI,VG,ΔVM (min-sec,.1fps,.1fps)
 EVENT TIMER-SET
- :35 DSKY BLANKS
 ENG ARM-ASC
- :30
 06 40 (AVE G ON)

Basic Date - May 29, 1969
 Changed

LM-

Basic Date May 29, 1969
Changed

LM-5

P51 - P57

```

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

```

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

(BYPASS) ENTR TO APS OFF

*F 97 40 *

* (RECYCLE THR FAIL MON) PRO*

* (CONTINUE BURN) ENTR *

* TO TIG - 5*

* (TERMINATE) ENG ARM-OFF *

* V34E To 5 *

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

(20 sec Delay)

F 16 83 ΔV XYZ (LM) (.1fps)

(EXIT) PRO

(RECYCLE) V32E (Zeroes N83 Display)

2 F 37

P51 IMU ORIENTATION

CB(11) AC: AOT LAMP-CLOSE

- 1 F 50 25 V37E 51E
 (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 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(11) AC: AOT LAMP-OPEN

P52 IMU REALIGN

- 1 F 04 06 CB(11) AC: AOT LAMP-CLOSE
 V37E 52E
 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)
 (TLAND FOR OPT 4)
 (OPT 2) PRO To 4
 (OPT 4) PRO To 3

3 F 06 89 LAT, LONG/2, ALT (.001°, .01nm)
 PRO

4 F 06 22 NEW ICDU ANGLES OG, IG, MG (.01°)
 (IF MGA NEAR GIMBAL LOCK MNVR Then V32E To 4)
 PRO

5 F 50 25 R1 00013 (COARSE ALIGN)
 (NORMAL) PRO To 6 No ATT LT ON then OFF
 (GYRO TORQUE) 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 ACQUISITION MODE
 MNVR If Necessary
 (PICAPAR) PRO

*F 05 09 00405 NO PAIR *
 *(CREW SPECIFY) PRO To 5 *
 *(PICAPAR) V32E To 4 *
 (MAN ACQ) ENTR

7 F 01 70 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=0 or 7
 F 06 87 AZ, EL (.01°)
 PRO
 (For DE=00
 F 06 88 CELESTIAL BODY VECTOR
 Load Ground Values
 PRO)

May 29, 1969

Basic Date
Changed

LM-5

PGNS-38

- 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 OOCDE (C)DETENT (DE)STAR CODE
 PRO
 (For C=0 or 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 Ground 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: AOT LAMP-OPEN

Basic Date - May 29, 1969
 Changed

LM-

P57 LUNAR SURFACE ALIGNMENT

1 V37E57E

*PROG Lt - on *

*V05N09E 00210 IMU *

* NOT ON *

CB(11) PGNS: IMU OPR - Close

*RSET & KEY REL, 57E *

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,.0lsec)

(PREF) T ALIGN Must Be (-)

(LDG SITE) T ALIGN = 0,0,0 For Present Time
PRO

3 F 05 06 R1 00010 SPECIFY ALIGNMENT TECHNIQUE (A/T)

R2 0000X

X = 0 Stored Attitude or REFSMMAT

1 REFSMMAT & Gravity

2 Celestial Bodies (2)

3 Celestial Body (1) & Gravity

R3 00CD0

C = 0 No REFSMMAT Defined

1 REFSMMAT Defined

D = 0 No Stored Attitude

1 Stored Attitude Available

(A/T 1 or 3) PRO To 4

(A/T 0 or 2) PRO To 13

*PROG Lt - on *

*F 05 09 00701 REFSMMAT OR *

* ATTITUDE NOT AVAILABLE*

*(CHANGE A/T) V32E To 3 *

*(TERM) V34E, Select New Prog *

Basic Date May 29, 1969

Changed

LM-5

PGNS-40

4 Determination of Lunar Gravity
 ATTITUDE MON - PGNS
 V16N20E Monitor Coarse Align (.01°)
 R1 +04500
 R2 -04500
 R3 +04500
 NO ATT Lt - On Then Off (Twice)
 *PROG Lt - on *
 V05N09E 00211 & 00217
 KEY REL

5 F 06 04 (+) GRAVITY ERROR ANGLE (.01°)
 (RECYCLE) V32E To 4
 (TERM) V34E, Select New Prog
 PRO (If A/T = 00001 or 00003
 Go To 13)

6 F 01 70 R1 OOCDE (C) DETENT (DE) STAR CODE
 (DETENT) 1-L, 2-F, 3-R, 4-RR, 5-CL, 6-LR
 7-COAS (+00000, +00000) FWD
 (+00000, +09000) OVHD
 PRO
 *PROG Lt - on *
 F 05 09 00404 Defined Star
 Not Available In *
 Any Detent *
 *(CREW SPECIFY) PRO To 8 *
 *(LGC SPECIFY) V32E To 6 *

7 F 06 79 CURSOR, SPIRAL, POSITION CODE (.01°)
 (REDEFINE STAR) V32E To 6
 PRO

Basic Date May 29, 1969
 Changed

LM-

PGNS-41

*PROG Lt - on *

*V05N09E *

* 00105 AOT Mark System*

* In Use *

* 01207 No VAC Area *

* For Marks *

* 01211 Illegal *

* Interrupt of *

* Extended Verb *

*V37E XXE *

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

(For Detent Code 7

F 06 87 AZ, EL (.01°)
PRO)

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

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

(FOR DE = 00

F 06 88 CELESTIAL BODY VECTOR
Load Ground Values
PRO)

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

(After Second Star) To 11

Basic Date May 29, 1969
Changed

PGNS-42

- 11 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(REJECT) V32E To 14
(ACCEPT) PRO
- 12 F 06 93 GYRO TORQUING ANGLES X,Y,Z (.01°)
(REJECT) V32E To 14
(ACCEPT) PRO
- 13 If Gyro Angles >5°
F 06 22 ICDU ANGLES OG,IG,MG (.01°)
PRO
NO ATT Lt - On Then Off
If Gyro Angles <5°
Monitor Gyro Torquing
V16N93E (.01°)
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, otherwise 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

Basic Date — May 29, 1969
Changed —

P63 BRAKING PHASE

P63 - P68

1 V37E 63E

2 F 06 61 TG,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°)
 (TO ADJUST YAW)
 MNVR
 MODE CONT: PGNS - ATT HOLD
 PRO To 4
 (AUTO) GUID CONT: PGNS
 MODE CONT: PGNS - AUTO
 PRO
 (MAN) MODE CONT: PGNS - ATT HOLD
 MNVR
 MODE CONT: PGNS - AUTO
 PRO
 (BYPASS) Verify V77E
 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 THEN TO AUTO
 *PRO *
 *ENTR *
 *F 05 09 01703 TIG *
 * SLIPPED *
 * V34E EXIT P63 *

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

Basic Date May 29, 1969
 Changed —

LM-5

PGNS-44

P63 - P68

59:25 DSKY BLANKS
ENG ARM - DES

59:30 06 62 AVE G ON

59:45 Verify Δ VM (R3) <00005

59:55 F 99 62 ENG ON ENABLE
VERIFY +X ULLAGE
PRO
(NO ULLAGE) V34E Exit P 63

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

*(DPS ABORT) ABORT - PUSH *

(APS ABORT) ABORT STAGE - PUSH

(TO CHECK N68) N68E

06 68 SLNT RANGE, TG, Δ H (LR/LGC)
(.1nm,min-sec,ft)

KEY REL

+3:00 YAW TO WINDOW UP

+4:00 V57E Permit LR Update
V16N68E

16 68 SLNT RANGE, TG Δ H (LR/LGC)
(.1nm,min-sec,ft)

Verify Δ H converging
KEY REL
(MAN) MODE CONT:PGNS-ATT HOLD
H=25,000 ft

May 29, 1969

Basic Date

Changed

LM-

PGNS-45

TRACKER FAIL - ON
* RANGE/VELOCITY *
* NOT GOOD *
*PROGRAM LT - ON *
* V05N09E *
* 00511 LR Not in*
* Pos 2 *
*LDG ANT-DES,Wait *
* 10sec,then AUTO *

+08:30 P64 DISPLAYED

P64 APPROACH PHASE

1 P64 DISPLAYED

2 F 06 64 R1,TG/LPD, -XX B XX (sec-deg)
R2 H DOT-For Descent) (.lfps)
R3 H(+>Landing Site Radius) (ft)

Monitor Attitude Change
To Enable Landing Site
Visibility.

(MAN) MODE CONT:PGNS-ATT HOLD
(TO USE LPD) PRO
(Nominal Landing Site) To 5

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 -:03 P65 DISPLAYED

Basic Date May 29, 1969
Changed

LM-5

P65 LANDING PHASE (AUTO)

1 P65 DISPLAYED

2 06 60 V (.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 Sw - ACTIVATE

To P66

(MAN LANDING) TTCA - Advance Until:

THRUST: CMD=0

THROT CONT - MAN

TO P67

(AUTO LANDING) To 3

3 H(R3)=(TBD) TRACKER FAIL LT - ON

H(actual)= 4.4 ft LUNAR CONTACT LT - ON
 ENGINE STOP - DE-
 PRESS

V37E 68E To P68

P66 LANDING PHASE (ROD)

1 P66 DISPLAYED

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

Basic Date — May 29, 1969
 Changed —

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

(MAN LANDING) TTCA - Advance Until:
 THRUST IND: CMD=0
 THROT CONT - MAN
 To P67

3 H(R3)=(TBD) TRACKER FAIL-ON
 H(acute) = 4.4 ft LUNAR CONTACT - ON
 ENGINE STOP - DEPRESS
 V37E 68E To P68

P67 LANDING PHASE (MANUAL)

1 P67 DISPLAYED

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

3 H(R3)=(TBD) TRACKER FAIL-ON
 H(actual)=(4.4) LUNAR CONTACT-ON
 ENGINE STOP - DEPRESS
 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 pb-PUSH (From P63,64,65,66,67)

```

      *F 50 26 R1 00203      *
      *   GUID CONT - PGNS   *
      *   MODE CONT: PGNS - AUTO*
      *   THR CONT - AUTO    *
      *   PRO                 *

```

2. 06 63 VI,H DOT,H (.lfps,.lfps,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,.lfps)
N85E

3. 16 85 VG XYZ (LM) (.lfps)

(If burn >400 sec,
VGX = 200 fps,
DES REG (2) - CLOSE)
VGX = 50 fps
ENG ARM - OFF

DPS NULL COMPONENTS
OFF KEY REL

4. F 16 63 VI,H DOT, H (fps,.lfps,ft)
ABORT PB - RESET
ENG STOP PB-PUSH
PRO

P70 - P71

Basic Date: May 29, 1969
Changed

LM-

5 F 16 85 VG XYZ (LM) (.1fps)
 (DISPLAY ORM 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 PB-PUSH (From P12,63,64,65,
 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, .1fps, ft)

ENG START - PUSH

ENG ARM - ASC

If ENG STOP Lt - ON,

ENG STOP - RESET

BAL CPL-ON

SYS A&B ASC FEED 1&2 (4)-OPEN

MAIN SOV(2)-CLOSE

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 over-
ride restored.

BAL CPL-OFF (After Pitch MNVR)

(To monitor time to go and crossrange velocity)
V16 N77E

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

2 16 85 VG XYZ (LM) (.lfps)
VGX = 200 fps,
MAIN SOV (2) - OPEN
ASC FEED 1&2 (4) - CLOSE
VGX = 50 fps,
ENG ARM - OFF
*NO Cutoff *
* ABORT STAGE - RESET *

APS NULL COMPONENTS
OFF KEY REL

3 F 16 63 VI,H DOT,H (fps,.lfps,ft)
ENG STOP PB-RESET
PRO

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

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

6 F 37

Basic Date May 29, 1969

Changed

LM-5

PGNS-51

P72 CSM CSI TARGETING

1 F 06 11 V37E 72E
TIG (CSI)/T(APOAPSIS) (hrs,min,.01sec)
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)
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 hp+CSI < 35,000 ft *
* 00602 hp+CDH < 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*
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

Basic Date — May 29, 1969

Changed —

P72 - P79

LM-5

P73 CSM CDH TARGETING

- 1 F 06 13 V27E 73E
TIG CDH (hrs,min,.01sec)
PRO To 4
- 2 F 06 75 $\Delta H(CDH), \Delta T(TPI-CDH), \Delta T(TIG TPI, P72-P73)$
PRO (.1nm,min-sec)
- 3 F 06 81 $\Delta VXYZ (LV) (CDH)$ (.1fps)
PRO
(To Correct Out-Of-Plane Velocity)
V90E
F 06 16 T EVENT (hrs,min,.01sec)
PRO
F 06 90 Y,YDOT,PSI (.1nm,.1fps,.01°)
(RECYCLE) V32E To (F 06 16)
PRO
- 4 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)
(RECYCLE) V32E To 2
(TERMINATE) PRO To 2
(FINAL PASS) SET EVENT TIMER TO TFI
PRO
TRANSMIT PARAMETERS TO CSM
- *F 05 09 00611 NO TIG FOR EL ANGLE*
* (CONTINUE P73) PRO To 2 *
* (RECYCLE) V32E To 1 CHANGE TIG *
* (TERMINATE) V34E To 5 *
- 5 F 37

P72 - P79

Basic Date - May 29, 1969
Changed

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°, .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 EVNT 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

Basic Date May 29, 1969

Changed

LM-5

P75 CSM TPM TARGETING

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

2 F 06 81 ΔVXYZ (LV) (.1fps)
 PRO

3 F 06 59 ΔVXYZ(LOS) (.1fps)
 PRO

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

*V06N52E R1, ACTCENT (.01°) *

IF ACTCENT BETWEEN 170° AND 190°

* V37E 75E RETARGET *

5 F 37

P76 TARGET ΔV

V37E 76E

1 F 06 84 ΔV(LV) XYZ (.1fps)
 PRO

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

3 F 37

P78 CSM SOR TARGETING

1 V37E 78E

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

May 29, 1969

Basic Date -
Changed

LM-5

2 F 06 55 R3 CENTANG (.01°)
PRO

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

4 F 06 57 ΔR (.1nm)
PRO

5 F 06 34 T(INTERCEPT) (hrs,min,.01Sec)
PRO

6 F 16 45 M,TFI,MGA (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

8 F 06 81 ΔVXYZ (LV) (.1fps)
PRO To 6

9 F 37

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 ΔVXYZ (LV)
PRO To 1

3 F 37

Basic Date May 29, 1969
Changed

LM-5

V40 - V48

V40 N20 ICDU ZERO

1 V40 N20E

*PROG Lt - ON *

*V05 N09E R1 00206 ISS *

* IN COARSE ALIGN & GIMBAL *

* LOCK *

*Coarse Align To 0,0,0 Then *

* Reselect V40 N20 *

NO ATT Lt - OFF

2 After 10 sec EXIT V40

V41N20 COARSE ALIGN IMU

1 V41N20E

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

2 41 COARSE ALIGN

NO ATT Lt - ON

FDAI Torques

*PROG Lt - ON *

*V05N09E R1 00211 COARSE *

* ALIGN ERROR *

V16N22E Compare N22 With

* N20 *

*Repeat V41N20 *

V41N72 COARSE ALIGN RR

1 RENDEZVOUS RADAR - LGC

2 V41N72E

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)

V16E72E RR TRUNNION, SHAFT (.01°)

*PRO G ALARM - ON *
 V05N09E 00502 BAD ANGLE INPUTS
 * 00503 NO DATA GOOD IN *
 * 30 SEC DESIGN *
 * 00515 RR CDU FAIL *
 * DISCRETE *
 *(Terminate CONT DESIGN) V44E *

V42 GYRO TORQUING

1 F 21 93 V42E
 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 F 21 22 V43E
 LOAD NEW ICDU ANGLES YPR (.01°)
 FDAI Needles Deflect
 ENTR

4 F 21 22 V43E
 NEW ICDU ANGLES YPR (.01°)
 Load (-) New ICDU Angles

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

Basic Date May 29, 1969
 Changed

V47 AGS INITIALIZATION

TM-HI

V16N65E

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

V47E

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

*414 +1

PRO (32 Sec Elapse Before Step 6
 Appears If CDU Zero Is Issued,
 Otherwise 20 Sec)

F 50 16 Downlink Complete
 PRO

*400+3 AGS ALIGN

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

*440R RANGE RATE (+2.5 fps) (.1fps)

V48 DAP CONFIGURATION

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°/sec), 1-Normal (20°/sec)

(ATTDB) D 0-.3°, 1-5°

(RATE) E 0-.2°/sec, 1-.5°/sec, 2-2°/sec
 3-10°/sec

PRO

F 06 47 LM WT, CSM WT (1b)
 PRO (TERMINATES IF STAGED)

Basic Date - May 29, 1969
 Changed

LM-5

PGNS-59

V49 - 67A

3 F 06 48 ENGINE GIMBAL TRIM PITCH, ROLL (.01°)
 ENG GMBL - ENABLE
 ENG ARM - DES
 (TRIM) PRO
 (EXIT) V34E

4 F 50 48 TRIM COMPLETE
 CONTINUE INTERRUPTED PROGRAM
 PRO

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) 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 V55E
 F 21 24 ΔT
 RECORD
 _____(hrs)
 _____(min)
 _____(sec)
 LOAD ΔT

Basic Date May 29, 1969

Changed

LM-5

V64 S-BAND ANTENNA

1 V37E00E
 2 V64E
 F 16 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,mr)
 (REINITIAL) V25E
 PRO

V74 LGC DOWNLINK

1 V21N01E 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 06 R1 00002 SPECIFY VEHICLE
 R2 00001 LM
 00002 CSM
 PRO
 2 F 16 44 HA,HP,TFF (.1nm,.1nm,min-sec)
 (UPDATE) V32E (Not Required If AVE G-On)
 PRO
 3 F 16 32 TFF (hrs,min,.01sec)
 PRO

V83 RENDEZVOUS PARAMETER DISPLAY

1 V83E
 F 16 54 R,RDOT,THETA (.01nm,.1fps,.01°)
 (RECYCLE) V32E
 (EXIT) PRO

Basic Date May 29, 1969
 Changed

V89 RENDEZVOUS FINAL ATTITUDE

1 V37E00E

2 V89E
F 04 06 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
MODE CONT: PGNS - ATT HOLD
PRO To 4
(AUTO) GUID CONT: PGNS
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

V90 OUT-OF-PLANE DISPLAY

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

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

PGNS TURN - ON

Basic Date May 29, 1969
Changed

PGNS TURN-ON AND SELF-TEST

PGNS TURN - ON

1 If STBY Lt - ON, PRO

2 V36E

3 CB(11) PGNS: IMU OPR - CLOSE
(NO ATT Lt - ON 90 Sec)

4 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)

5 KEY RSET
V37E00E
V25N01E 1365E
F 21 01 E,E,E

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

7 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>R3 Within 78 Sec)

*PROG Lt - ON	*
* V05N09E 01102 SELF-	*
* TEST ERROR	*
*05 08 RECORD FOR MSFN	*
* R1 _____	*
* R2 _____	*
* R3 _____	*

8 V21 N27E 0E TERMINATE SELF TEST

Basic Date. May 29, 1969
Changed _____

9
F 05 01 V91E BANKSUM
R1 SUM OF BANK
R2 BANK NO = R1
(NEXT BANK) PRO (If R2≠R1 Record For MSFN)
(TERM) V34E

LGC CLOCK INITIALIZATION

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

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

PGNS ORDEAL INITIALIZATION

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

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

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

4
F 06 54 V83E
R, RDOT, THETA (.01nm,.1fps,.01°)
MODE - HOLD/FAST
SLEW - To THETA
MODE - OPR/SLOW
PRO

Basic Date May 29, 1969
Changed

LM-5

LGC CLOCK, ORDEAL,
LR SELF TEST

LANDING RADAR SELF TEST

- 1 CB(11) PGNS: LDG RDR - CLOSE
 X-POINTERS(Both) - HI MULT
 TEMP MON - LDG RDR (TBD°F)
 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)
- 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 06 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

LGC CLOCK, ORDEAL,
 LR SELF TEST

Basic Date May 29, 1969
 Changed

PGNS-65

- 10 F 04 06 V62E INITIATE RDR SELF TEST
R1 +00004 SPECIFY RDR
R2 +00001 RNDZ RDR
V22E 2E 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
R 2 00001
- 14 RDR TEST - OFF
CB(11) PGNS: LDG RDR - OPEN
V34E

RNDZ RDR SELF TEST

- 1 VERIFY: CSM RCS THRUSTER B3 - OFF
: RADAR XPONDER - OFF
RNDZ RDR ANT - RELEASED
X-POINTERS (BOTH)-HI MULT
RATE/ERR MON (BOTH) - RNDZ RADAR
ATTITUDE MON (BOTH) - PGNS
RNG/ALT MON - RNG/RNG RATE
SHFT/TRUN - +50°
RNDZ RDR - 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)
CB(11) RR GYRO SEL - SEC
PGNS: RNDZ RDR - Close
(NO TRACK Lt-On)
FLIGHT DISPLAYS: RNG/RNG RT/ALT/ALT RT-
CLOSE

RR SELF TEST

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Changed 1

LM-5

PGNS-66

- 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 - $+5^{\circ}$
Slew Right, Down, Left, Up (FDAI Needles
Right, Down, Left, Up)
- 4 RNDZ RDR - AUTO TRACK
RADAR TEST - RNDZ RDR (Rng Rt Tape Drives
X-Pointers and FDAI Needles Vary Between
Limits. After 12 sec, Rng Tape Drives,
NO TRACK Lt - Out)
- 5 TEST MONITOR - AGC (1.0 To 1.8)
- XMTR PWR (2.1 To 4.1)
- SHAFT ERR (2.1 To 2.6
@1/2 cps)
- TURN ERR (2.2 To 2.6
@1/2 cps)
- AGC
- 6 If Antenna Stowed, Set NORRMON Flag
V25 N07E
F 21 07
101E, 10E, 1E
RNDZ RDR - LGC (NO TRACK Lt - ON, Wait 10
sec)
- 7 RR GYRO SEL - PRIM
V63E START RNDZ RDR SELF TEST
F 04 12 R1 00004 SPECIFY RADAR
R2 00001 RNDZ RADAR
PRO
NO TRACK Lt - Out After 12 sec

Basic Date May 29, 1969
Changed

RR SELF TEST

LM-5

PGNS-67

PIPA BIAS CK,
THRUSTER INHIBIT

8 F 16 72 RR TRUNNION AND SHAFT (.01°)
R1 Varying @1/2 cps (00667)(TBD)
R2 Varying @1/2 cps (00312)(TBD)
PRO

9 F 16 78 RANGE, RANGE RATE (.01nm,fps)
R1 +195.68 To +195.88 (TM Within 1.2 of R1)
R2 -00467 To -00507 (TM=2<R2)

10 V34E

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

12 V40N72E RRCDU ZERO (10 sec)

13 V41N72E COARSE ALIGN RR CDU
F 21 73 LOAD TRUNNION AND SHAFT (.01°)
R1 +04000E
R2 +04000E

14 F 04 12 R1 00006 RR FUNCTION
R2 00002 CONT DESIG
PRO

15 V16N72E MONITOR RR POSITION
16 72 V44E TERM CONT DESIGN (.01°)

16 Repeat 13,14,15 Twice Using -00400,
-00400 And +00000, -00400

17 CB(11) PGNS: RNDZ RDR - OPEN
(NO TRACK Lt - OFF)
AC BUS A: RNDZ RDR - OPEN

Basic Date May 29, 1969
Changed

LM-5

PIPA BIAS CHECK

1 EVENT TIMER - Zero
Rates .1°/sec

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

3 V16E
16 21 XYZ PIPA COUNTS (+XXXXXX.)

4 At T+32sec - KEY VERB
T+32sec (X)R1 ____ (Y)R2 ____ (Z)R3 ____

5 CALCULATE XYZ Bias:
TAKE LAST TWO DIGITS OF DISPLAYED
BIAS AND ADD 3 ZEROES

X ____

Y ____

Z ____

6 F 21 01 V21N01E
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

LGC THRUSTER INHIBIT

1 V25N07E
(VERTICAL JET) 1262E
(HORIZONTAL JET) 1263E
XXXE (See Codes Below)

AIU - 100E	B4U - 1E
BID - 200E	A4D - 2E
AIF - 4E	B4F - 2E
BIL - 200E	A4R - 100E
B2U - 20E	A3U - 4E
A2D - 40E	B3D - 10E
A2A - 10E	B3A - 1E
B2L - 20E	A3R - 40E

* CAUTION *

Affected Quad Valve Must

Be Open Before Next Step

2 1E

3 V48E
PRO
V34E

RR BIAS INITIALIZATION

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

REVIEW DATA IN ERASABLE MEMORY

1 Perform During Any Flashing Display

2 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

E-MEMORY, FLGWD SET

Basic Date May 29, 1969
Changed

MONITOR OF INPUT/OUTPUT CHANNELS

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

LOAD OUTPUT CHANNELS

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

FLAG WORD SET/RESET

1
F 21 07 V25 N07E
(Load FLAGWORD ADD) E
2 F 22 07 (Load FLAGWORD BIT CODE

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

E-MEMORY, FLGWD SET

Basic Date May 29, 1969

Changed

IM-5

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 May 29, 1969
 Changed

FLAG LIST

FLAG LIST

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

Manual Acquire	76	10000 (13)	Enable man acq of CSM by RR <u>Enable auto acq of</u> CSM by RR	<u>A=1,3,5,7</u> <u>A=0,2,4,6</u>
LOS CM	76	4000 (12)	<u>LOS Being Computed (R21)</u> <u>LOS Not Being Computed</u> (R21)	<u>B=4,5,6,7</u> <u>B=0,1,2,3</u>
External V	76	200 (8)	<u>Ext V VG Computation</u> <u>Lambert VG Computation</u>	<u>C=2,3,6,7</u> <u>C=0,1,4,5</u>
Final	76	40 (6)	<u>Final Pass Through Rndz</u> <u>Prog Comp</u> <u>Interim Pass Through</u> Rndz Prog Comp	<u>D=4,5,6,7</u> <u>D=1,2,3,4</u>
Active Veh	76	20 (5)	<u>LM Active Veh</u> <u>CSM Active Veh</u>	<u>D=2,3,6,7</u> <u>D=0,1,4,5</u>
Preferred Attitude	76	10 (4)	<u>Preferred Att Computed</u> <u>Preferred Att Not</u> Computed	<u>D=1,3,5,7</u> <u>D=0,2,4,6</u>
REFSMAT	77	10000 (13)	<u>REFSMAT Good</u> <u>REFSMAT Not Good</u>	<u>A=1,3,5,7</u> <u>A=0,2,4,6</u>

No Throttle	101	4000 (12)	<u>Inhibit Full Throttle</u> <u>Permit Full Throttle</u>	<u>B=4,5,6,7</u> <u>B=0,1,2,3</u>
3 Axis	101	40 (6)	<u>Mnvr Specified By 3 Axis</u> <u>Mnvr Specified By 1 Axis</u>	<u>D=4,5,6,7</u> <u>D=0,1,2,3</u>
No RR Mon	101	10 (4)	<u>Bypass RR Gmbl Monitor</u> <u>Perform RR Gmbl Monitor</u>	<u>D=1,3,5,7</u> <u>D=0,2,4,6</u>
W Matrix	101	1 (1)	W Matrix Valid For Flt Nav <u>W Matrix Not Valid For</u> Flt Nav	<u>E=1,3,5,7</u> <u>E=0,2,4,6</u>
Attitude	102	1 (1)	<u>LM Att Stored In LGC</u> <u>LM Att Not Stored In Lgc</u>	<u>E=1,3,5,7</u> <u>E=0,2,4,6</u>
Remode	110	20000 (14)	LOS Within Other RR Ant Mode <u>RR Mode Set To 2</u>	<u>A=2,3,6,7</u> <u>A=0,1,4,5</u>
Antenna	110	4000 (12)	<u>RR Ant In Mode 2</u> <u>RR Ant In Mode 1</u>	<u>B=4,5,6,7</u> <u>B=0,1,2,3</u>

LM-1

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LM-5 Basic Date May 29, 1969Changed

Desired LOS Within Mode

$$\frac{B=1,3,5,7}{B=0,2,4,6}$$
1000
(10)

110

Designate

Lim
Desired LOS Not Within
Mode Lim

$$\frac{A=4,5,6,7}{A=0,1,2,3}$$
40000
(15)

111

ACA Mode

Min Impulse Enabled (V76)
Rate Command Enabled (V77)

NON FLAGS

$$\frac{A=1,3,5,7}{A=0,2,4,6}$$
10000
(13)

1312

Mark/Reject

Use of Mark X or Y
Use of Mark Reject

$$\frac{B=2,3,6,7}{B=0,1,4,5}$$
2000
(11)

1312

AOT Mark Y

After Use of Mark Y
After Mark X & Y or
Mark Reject

$$\frac{B=1,3,5,7}{B=0,2,4,6}$$
1000
(10)

1312

AOT Mark X

After Use of Mark X
After Mark X & Y or
Mark Reject

CHANNEL LIST

CHANNEL LISTING

CHANNEL	BIT	DSKY	FUNCTION
5 OUTPUT	1	E=1,3,5,7	JET 1 ON
	2	E=2,3,6,7	JET 2 ON
	3	E=4,5,6,7	JET 5 ON
	4	D=1,3,5,7	JET 6 ON
	5	D=2,3,6,7	JET 9 ON
	6	D=4,5,6,7	JET 10 ON
	7	C=1,3,5,7	JET 13 ON
	8	C=2,3,6,7	JET 14 ON
6 OUTPUT	1	E=1,3,5,7	JET 7 ON
	2	E=2,3,6,7	JET 3 ON
	3	E=4,5,6,7	JET 15 ON
	4	D=1,3,5,7	JET 11 ON
	5	D=2,3,6,7	JET 12 ON
	6	D=4,5,6,7	JET 8 ON
	7	C=1,3,5,7	JET 4 ON
	8	C=2,3,6,7	JET 16 ON
11 OUTPUT	1	E=1,3,5,7	ISS WARNING
	13	A=1,3,5,7	ENGINE ON
	14	A=2,3,6,7	ENGINE OFF
12 OUTPUT	1	E=1,3,5,7	ZERO RRCDU
	4	D=1,3,5,7	COARSE ALIGN ENABLE
	5	D=2,3,6,7	ZERO ICDCU
	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

CHANNEL LIST

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 Changed

LM-5

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) INPUT	2	E=0,1,4,5	STAGE VERIFY
	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) INPUT	2	E=0,1,4,5	-PITCH MIN IMPULSE/-EL LPD
	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

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 Changed

32
(INVERTED) 1 E=0,2,4,6 JETS 2,4 FAILED
 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
(INVERTED) 2 E=0,1,4,5 RR PWR ON/AUTO
 3 E=0,1,2,3 RR RNG SCALE LOW
 4 D=0,2,4,6 RR DATA GOOD
 5 D=0,1,4,5 LR DATA GOOD
 6 D=0,1,2,3 LR POSITION 1
 7 C=0,2,4,6 LR POSITION 2
 8 C=0,1,4,5 LR VELOCITY DATA GOOD
 9 C=0,1,2,3 LR RNG SCALE LOW
 10 B=0,2,4,6 BLOCK UPLINK
 11 B=0,1,4,5 UPLINK TOO FAST
 12 B=0,1,2,3 DOWNLINK TOO FAST
 13 A=0,2,4,6 PIPA FAIL
 14 A=0,1,4,5 LGC WARNING
 15 A=0,1,2,3 OSCILLATOR ALARM

Basic Date - May 29, 1969
 Changed -

AGS SELECTOR LOGIC LIST

<u>Address</u>	<u>Entry</u>	
400	+00000	Attitude Hold
	+10000	Auto Guidance Steering
	+20000	Z-Body Axis Steering
	+30000	IMU Align
	+40000	Lunar Align
	+50000	Body Axis Align
	+60000	Gyro and Accelerometer Calibration (302sec,32sec)
	+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	DPS or RCS Engine Select
	+10000	APS Engine Selection
412	+00000	Reinitiate Test
	+10000	Test Successful
	+30000	Logic Test fail
	+40000	Memory Test fail
	+70000	Logic & Memory Test Fail
413	+00000	Normal Position
	+10000	Store Lunar Azimuth
414	+00000	Navigation Initialization Complete (AUTO)
	+10000	LM And CSM Navigation Initialization via PGNCS Downlink
	+20000	LM Navigation Initialization via DEDA
	+30000	CSM Navigation Initialization via DEDA

Basic Date May 29, 1969
 Changed

AGS-2

AGS LOGIC

415	+00000	Normal Position
	+10000	Store Z-axis Direction Cosines and range/range rate 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 +20000)
	+10000	Z Body Points to Thrust Direction when in Z-Body Axis Steering (400 set to +20000)
623	+00000	Z Body Parallel to CSM Orbit Plane When in Guidance Steering (400 set to +10000)
	+10000	Z Body Parallel to Plane Defined By WB When in Guidance Steering (400 set to +10000)

Basic Date May 29, 1969
 Changed _____

DEDA INPUT/OUTPUT LISTAddress

047	Sine of Landing Azimuth Angle	Octal
053	Cosine of Landing Azimuth Angle	Octal
223	Altitude Update Input	100 ft
224	Term in LM desired semi-major axis (O.I.)	100 ft
225	Lower limit of αL (O.I.)	100 ft
226	Upper limit of αL (O.I.)	100 ft
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
240	X Position Comp (LM)	100 ft
241	Y Position Comp (LM)	100 ft
242	Z Position Comp (LM)	100 ft
244	X Position Comp (CSM)	100 ft
245	Y Position Comp (CSM)	100 ft
246	Z Position Comp (CSM)	100 ft
254	LM Ephemeris Data (Epoch Time)	.1 min
260	X Velocity Comp (LM)	.1fps
261	Y Velocity Comp (LM)	.1fps
262	Z Velocity Comp (LM)	.1fps
264	X Velocity Comp (CSM)	.1fps
265	Y Velocity Comp (CSM)	.1fps
266	Z Velocity Comp (CSM)	.1fps
272	CSM Ephemeris Data (Epoch Time)	.1 min
274	Initial Radar Filter Value for t1	1 sec
275	Desired TIG TPI (for CSI calc only)	.1 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 rndz)	.01 min
314	Target Time of Node Prior to Rendezvous	.01 min
316	Radar Range (R)	.1 nm

DEDA INPUT/OUTPUT

Basic Date May 29, 1969

Changed

LM-5

AGS-4

DEDA INPUT/OUTPUT

373	AGS TIG CSI,CDH,TPI/TPM	.1 min
377	AGS Computer Time (T)	.1 min
404	ΔV_X (Use 470 For Readout)	Octal
405	ΔV_Y (Use 471 For Readout)	Octal
406	ΔV_Z (Use 472 For Readout)	Octal
450	ΔV_X (LV) (+Fwd)	.1fps
451	ΔV_Y (LV) (+Rt)	.1fps
452	ΔV_Z (LV) (+Dn)	.1fps
464	Vertical Pitch Steering, Attitude Rate Threshold	.1fps
465	Target Radial Rate at Insertion	.1fps
503	Radar Range Rate (RDOT) Input	.1fps
514	Components of Unit Vector	Octal
515	Used to Provide Yaw	
516	Steering Out of CSM Orbit Plane (400,+10000;623,+10000)	
534	Scale Factor for X Accelerometer	Octal
535	Scale Factor for Y Accelerometer	Octal
536	Scale Factor for Z Accelerometer	Octal
540	X Accel Bias Comp Coeff	.001 ft/sec 2
541	Y Accel Bias Comp Coeff	.001 ft/sec 2
542	Z Accel Bias Comp Coeff	.001 ft/sec 2
544	X Gyro Drift Comp	.01°/hr
545	Y Gyro Drift Comp	.01°/hr
546	Z Gyro Drift Comp	.01°/hr
547	Lunar Align Azimuth Correction	Octal
574	Section Staging Flag (+ not staged)	Octal
604	Lunar Surface Flag (+ not on Lunar Surface)	Octal
605	Desired Cotangent of LOS at TPI (COTAN LOS TPI)	Octal
607	HDOT Display Scale Factor	Octal
613	Sine of TPI Interdict Region	Octal
616	Ullage counter value for ullage completion	2 sec

May 29, 1969

Basic Date -

Changed

LM

DEDA OUTPUT LISTAddress

211	Present Out of CSM Orbit Plane Position	100 ft
263	Predicted out-of-plane velocity at TIG (CSI,CDH,TPI)	
	Present out-of-plane velocity in O.I.	.1fps
267	Delta Velocity To Be Gained	.1fps
270	Present Vy Out-of-CSM Orbit Plane Velocity (Vyo)	.1fps
277	Angle Between Local Horizon and Z body Axis	.01°
303	Predicted LOS at TIG TPI (TPI mode)	.01°
303	LM/CSM Central Angle at CDH (CSI,CDH, O.I.)	.01°
307	Time from TPI to Rndz	.01 min
310	Time to Next Maneuver (CSI,CDH,TPI)	.01 min
311	Time to Rndz (TPI)	.01 min
312	Predicted Post-CSI LM Orbit Period	.01 min
313	Time to Pericynthian	.01 min
315	Predicted Altitude of LM Apogee	.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
343	Present LM Pericynthian	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 Radius (Orbit Insertion)	100 ft
	Predicted Radius at TIG (CSI,CDH,TPI)	
357	Time To Burnout	
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

Basic Date - May 29, 1969
 Changed -

AGS-6

367	LM Altitude Rate (HDOT)	.1fps
371	ΔV for CDH (Valid in CSI, Coast)	.1fps
371	ΔV Direct Trans & Brak (TPI)	.1fps
372	CSI To CDH ΔT (CSI)	.1 min
373	TIG Next Maneuver	.1 min
402	ΔH in Coelliptic Orbit (CSI,CDH)	.1 nm
	Predicted Hp (TPI)	.1 nm
403	LM Perigee Altitude (Hp)	.1 nm
423	Desired Final HDOT	.1fps
433	LM Velocity	.1fps
440	Range Rate Between LM and CSM (RDOT) (- closing)	.1fps
470	ΔV_X Measured (LM) (+ Up)	.1fps
	(Use 404 to Zero)	
471	ΔV_Y Measured (LM) (+ Rt)	.1fps
	(Use 405 to Zero)	
472	ΔV_Z Measured (LM) (+ Fwd)	.1fps
	(Use 406 to Zero)	
477	Predicted HDOT at CSI,CDH, or TPI time	.1fps
500	ΔV_{gx} (LM) (+ Up)	.1fps
501	ΔV_{gy} (LM) (+ Rt)	.1fps
502	ΔV_{gz} (LM) (+ Fwd)	.1fps
612	Staging sequence counter	Octal
614	Ullage counter	2 sec

Basic Date May 29, 1969
 Changed

DEDA ACCESSIBLE CONSTANTS LIST

<u>Address</u>	(TBD)
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AGS PROGRAMS

ORBIT INSERTION

- 1 MODE CONT: AGS - ATT HOLD
GUID CONT - AGS
EVENT TIMER - SET

- 2 *616+0 ZERO ULLAGE COUNTER LIMIT
 *232+(ORBIT INSERTION ALTITUDE) (100ft)
 *465+(ALTITUDE RATE AT INSERTION) (.1fps)
 *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 ΔVGX(LM) (.1fps)
 *502R ΔVGZ(LM) (.1fps)
 *500R ΔVGX(LM) (.1fps)

AGS PROGRAMS

7	<u>CONFIGURATION</u>	<u>DES</u>	<u>ASC</u>	<u>RCS</u>
	THR CONT	MAN	-	-
	MAN THROT	CDR	-	-
	BAL CPL	ON	ON	ON
	ATT/TRANSL	2 JETT	2 JETT	2 JETT
	THROT/JETS	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
	PRPLNT QTY MON	DES 1	OFF	OFF
	PRPLNT TEMP/PRESS	DES 1	ASC	-
	MON			

Basic Date May 29, 1969
Changed

LM-5

HELIUM MON	SUPCRIT	PRESS 1	-
	PRESS		
ENGINE STOP	-	-	PUSH

8 -30 FOR DPS BURNS
 CB(11) STAB/CONT: DECA PWR - CLOSE
 CB(16) STAB/CONT: DES ENG OVRD - CLOSE
 ENGINE 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) PB - PUSH
 IGNITION

11 When Burn Complete
 ABORT (STAGE) PB - RESET
 NULL 501,502,500

12 MASTER ARM - OFF
 ENG GMBL - OFF
 ENG ARM - OFF
 BAL CPL - ON
 THROT/JETS - JETS
 DEADBAND - MAY
 PRPLNT QTY MON - OFF
 PRPLNT TEMP/PRESS MON - OFF
 HELIUM MON - OFF

13 *616 + 00003

AGS PROGRAMS

Basic Date - May 29, 1969

Changed -

1	MODE CONT: AGS - ATT HOLD		
	GUID CONT - AGS		
2	*373 + (TIG CSI)		(.1 min)
	*275 + (TIG TPI)		(.1 min)
	*605 + (COTAN LOS TPI)		(Octal)
	*416 + 1 CDH 1/2 Orbital Period After CSI		
	+ 3 CDH 3/2 Orbital Periods After CSI		
	Wait until TIG-20 min		
	*410 + 1 CSI Routine		
3	*477R HDOT CSI		(.1fps)
4	*310R TPI CSI		(.01 min)
	EVENT TIMER - SET		
	*267R ΔVG CSI		(.1fps)
5	If time available		
	*371R ΔV CDH	(.1fps)	(.1fps)
	*402R Δh CDH	(.1nm)	(.1nm)
	*373R TIG CDH		(.1 min)
	*372R ΔT CSI To CDH		(.1 min)
6	*410 + 5 EXT ΔV		
	*450R ΔVX CSI		(.1fps)
	*263R VY CSI		(.1fps)
	*451 (ΔVY CSI) (Same sign as 263)		(.1fps)
	*452R ΔVZ CSI		(.1fps)
7	*411 +0 DES ENG OR RCS BURN		
	+1 ASC ENG BURN		
8	*623 +0 Z-Axis Parallel to CSM Orbit Plane		
	+1 Z-Axis Parallel to Specified Plane		
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

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

12 *407 +0

13 *501R ΔVGY (LM) (.1fps)
*502R ΔVGZ (LM) (.1fps)
*500R ΔVGX (LM) (.1fps)

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

15 -30 FOR DPS BURNS

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

CB(16) STAB/CONT: DES ENG OVRD-Close

ENGINE 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)

Basic Date May 29, 1969
Changed

LM

16 TBD Start Ullage

17 00 Ignition

18 When Burn Complete:
ABORT (STAGE) PB-RESET
NULL 501,502,500

19 *410 +2 CDH Routine

20 MASTER ARM - OFF
ENG GMBL - OFF
ENG ARM - OFF
BAL CPL - OFF
THROT/JETS - 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 (.01 min)
EVENT TIMER - SET
*267R ΔVG CDH (.1fps)

4 If Time Available Check The Following:
*402R ΔH CDH (.1fps)
*423R HDOT CDH (final) (.1fps)
*477R HDOT CDH (.1fps)

Basic Date May 29, 1969
Changed

LM.

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

14 -30 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)

15 TBD Start Ullage

16 00 IGNITION

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

(fps)

Basic Date - May 29, 1969
 Changed -

AGS-14

18	MASTER ARM	-OFF	-OFF
	ENG GMBL		-OFF
	ENG ARM		-OFF
	BAL CPL		-ON
	THROT/JETS		-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)
	*314 +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°		
	(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		
	*267R ΔVG TPI		(.1fps)
5	If Time Available:		
	*303 LOS ANGLE TPI		(.01°)
	*373R TIG TPI		(.1 min)
	*371R ΔVG to RNDZ		(.1fps)
	(If +6000 Retarget)		
	*402R Hp TPI		(.1nm)
6	*411 +0 DES ENG OR RCS		
	+1 ASC ENG		
7	*410 +5		

Basic Date — May 29, 1969
Changed —

LM

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

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

12 *407 +0

13 *501R ΔVGY (LM) (.1fps)
*502R ΔVGZ (LM) (.1fps)
*500R ΔVGX (LM) (.1fps)

14	<u>CONFIGURATION</u>	<u>DES</u>	<u>ASC</u>	<u>RCS</u>
	THR CONT	MAN	-	-
	MAN THROT CDR	CDR	-	-
	BAL CPL	ON ON	ON	ON
	X-TRANSL	2 JET	2 JET	2 JET
	THROT/JET	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	OFF	-
	PRPLNT TEMP/PRESS MON	DES	ASC	-
	HELIUM MON	SUPCRIT PRESS	PRESS 1	-
	ENGINE STOP	-	-	DEPRESS

Basic Date May 29, 1969
Changed

15 -30 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 MODE CONT-ATT HOLD (For RCS BURN Not In +X)

16 -06 Start Ullage

17 00 IGNITION

18 When Burn Complete

ABORT(STAGE)PB - RELEASE

NULL 501, 502, 500 (fps)

19 *410 +4 TPI EXECUTE

20 MASTER ARM

-OFF

ENG GMBL

-OFF

ENG ARM

-OFF

BAL CPL

-ON

THROT/JETS

-JETS

DEADBAND

-MAX

PRPLNT QTY MON

-OFF

HELIUM MON

-OFF

TPM

No Retargeting

1 *410 +4 TPI EXECUTE

*310R TFI TPM

(.01 min)

EVENT TIMER - SET

*267R ΔV TPM

(.1fps)

Basic Date. May 29, 1969

Changed

LM-5

3 *267R Total ΔV
EVENT TIMER - SET

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

5 *400 +1 GUIDANCE STEERING

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) (fps)
*502R ΔVGZ (LM) (fps)
*500R ΔVGX (LM) (fps)

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

10 -30 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

Basic Date - May 29, 1969
Changed

LM

-15*407 +1 MODE CONT - ATT HOLD (For RCS)

11 TBD Start Ullage

12 00 IGNITION

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
	DEADBAND	-MAX
	PRPLNT QTY 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 - *470R
 Y - *471R
 Z - *472R

(.1fps)
 (.1fps)
 (.1fps)

AGS ACTIVATION

Basic Date May 29, 1969

Changed

LM-5

5 Thrust Residuals

6 Trim Residuals

X - *470R (.1fps)

Null (TTCA up/down)

(If thrust Axis Acquire Desired ΔV)

Z - *472R (.1fps)

Null (TTCA In/Out)

(If thrust Axis Acquire Desired ΔV)

AGS ACTIVATION & SELF TEST

1 AGS Status - STBY

AGS Status - Operate (Master Alarm On/
Reset)

2 6666 (OPR ERR Lt - ON)

3 000 +8888

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

Basic Date - May 29, 1969
Changed -

AGS ACTIVATION

LM

AGS CALIBRATION

- 1 Verify AGS in Standby/Operate For 25 min

- 2 Read And Record

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

- 3 V16N20E
 - 16 20 ICDU Angles 0,I,M
 CSM MNVR Until ICDU >11.25°
 and >4° from 0°, 45°, 90° etc.
 Rates <.1°/sec
 Disable CSM & LM Thrusters

- 4 *400 +6 CALIBRATE GYRO & ACCEL
 After 32 sec Enable Thrusters
 Min Deadband Att Hold (CSM)
 Max Deadband Att Hold (LM)
 Read And Record

*540R X ACCEL BIAS	_____	(.001 ft/sec ²)
*541R Y	_____	(.001 ft/sec ²)
*542R Z	_____	(.001 ft/sec ²)

Values Should Not Change From Step 1
 By More Than (TBD) ft/sec²

- 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 2.5°/hr

Basic Date May 29, 1969
 Changed _____

LM-5

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

- ```

2 *400 +2 ACQUISITION STEERING
3
4 Manually Null FDAI
5
6 RATE/ERR MON-RNDZ RADAR
7
8 Slew Null FDAI, Then Search For Strongest
9 Signal And Check For Side Lobe
10
11 RNDZ RAD - AUTO TRACK
12
13 *417 +1 INITIALIZE RADAR FILTER
14
15 *415 +1 STORE Z AXIS COSINES
16 ENTR (When FDAI's centered)
17
18 *316 +(RADAR RANGE) (.1nm)
19 (Must Be Entered Within 30 sec)
20
21 *415 +1 Store Z Axis cosines
22
23 *503 + (RADAR RANGE RATE) (.1fps)
24 (Must Be Entered Within 30 sec)

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Basic Date May 29, 1969  
 Changed

AGS ORDEAL INITIALIZATION

AGS ORDEAL,SV UPDATE

- 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 Ave of HA & HP
- 4 Verify LM Pointed +Z In Direction Of  
Orbit Travel
- 5 \*304 THETA (.01°)  
(THETA Reads (+) Pitching Up To 90°  
Then (+) Back Down To 0° (180° Actual  
THETA). Pitching Down THETA Reads Up  
(-) To 90° (270°) Then (-) Back Down  
To 0° (180°)
- 6 MODE - HOLD/FAST  
SLEW - Set To Theta  
MODE - OPR/SLOW

Basic Date - May 29, 1969  
Changed -

AGS MANUAL STATE VECTOR UPDATE

AGS ORDEAL, SV 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 - May 29, 1969  
 Changed -

LM

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

BACKUP ALIGN

Basic Date - May 29, 1969  
Changed -



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 +5

\*400 +0

BACKUP ALIGN

Basic Date -- May 29, 1969

Changed --

LM