NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

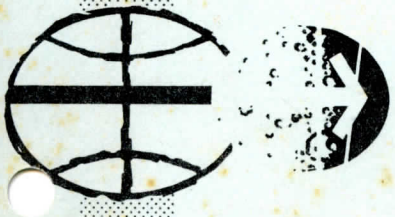
APOLLO XI
LM-5

FLIGHT CREW G&N DICTIONARY

PREPARED BY

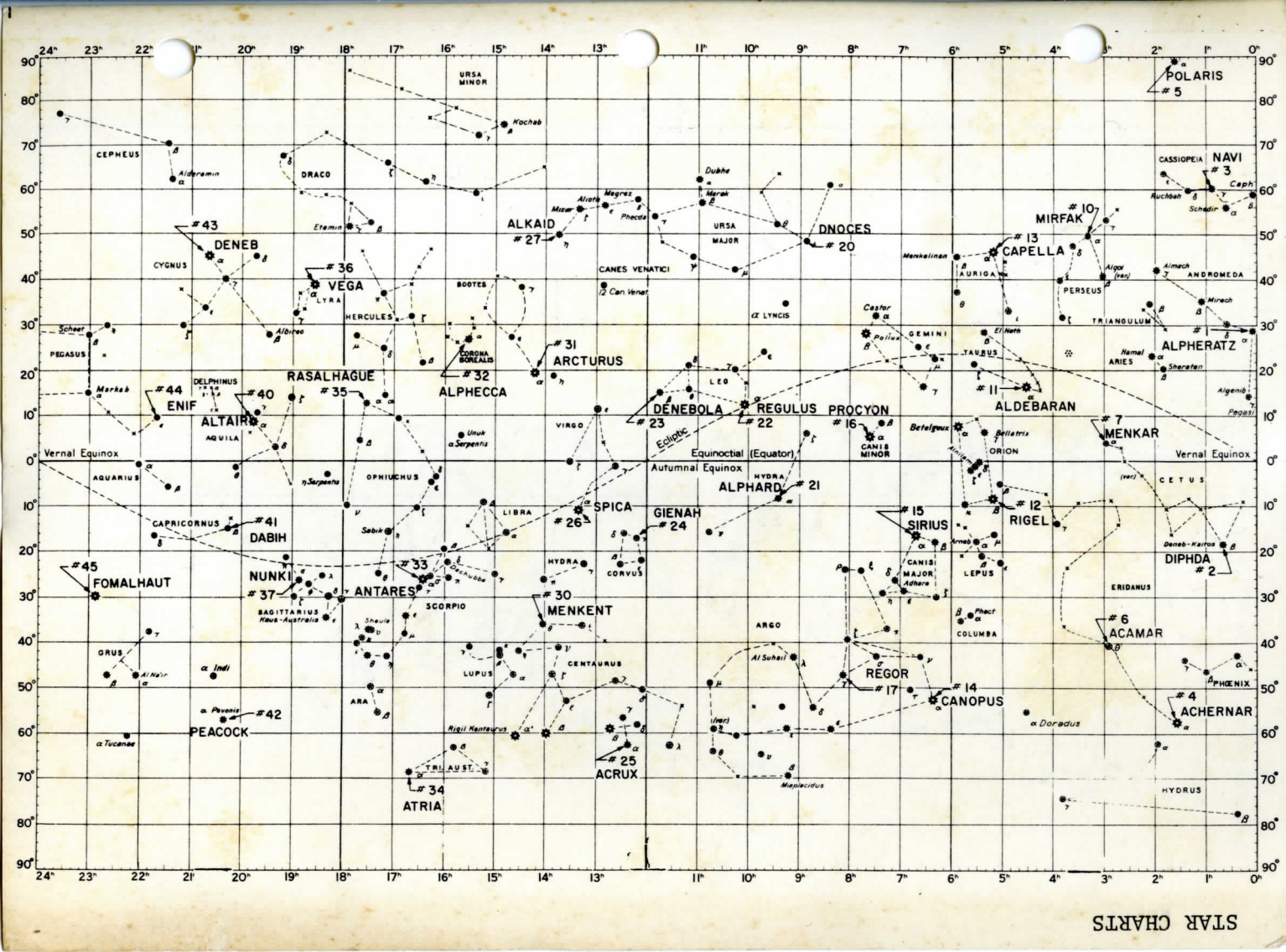
GUIDANCE AND CONTROL SECTION
SPACECRAFT SYSTEMS BRANCH
FLIGHT CREW SUPPORT DIVISION

(REPLACES PRELIMINARY
EDITION DATED APRIL 25, 1969)



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

MAY 29, 1969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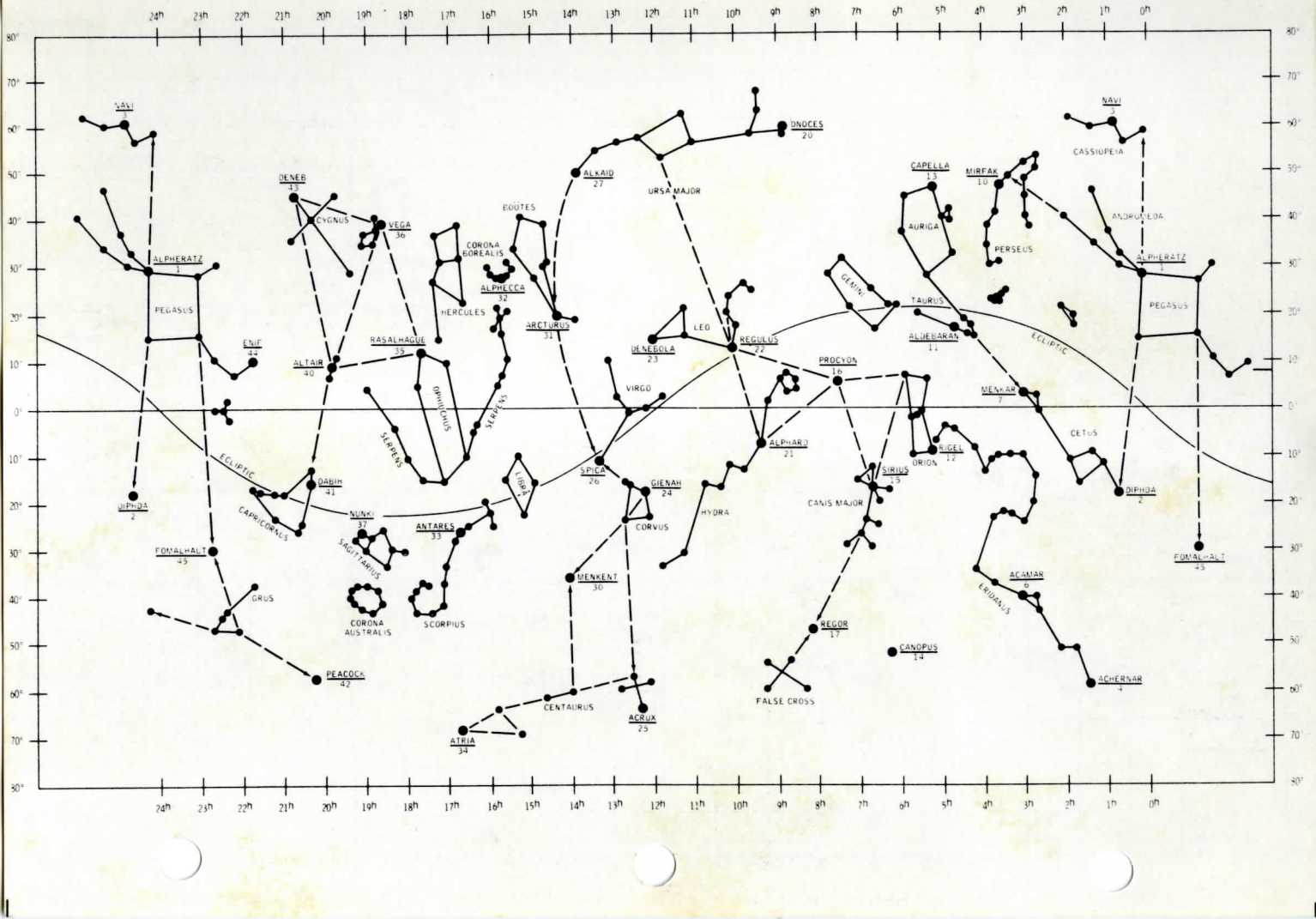
90° 80° 70° 60° 50° 40° 30° 20° 10° 0° 10° 20° 30° 40° 50° 60° 70° 80° 90°
URSA MINOR
Kochab
POLARIS
5
CEPHEUS
Alderamin
DRACO
Etamin
CASSIOPEIA
NAVI
3
Caph
Ruchbah
Schedir
43
DENEB
CYGNUS
Albireo
36
VEGA
LYRA
HERCULES
ALKAID
27
Alioth
Mizar
Megrez
Phecda
Dubhe
Merak
URSA MAJOR
DNOCES
20
CANES VENATICI
12 Can Venat
10
MIRFAK
13
CAPELLA
Menkalinan
AURIGA
Algol (var)
PERSEUS
ANDROMEDA
Almach
TRIANGULUM
Mirach
1
ALPHERATZ
Hamal
ARIES
Sheratan
Algenib
Pegasi
Scheat
PEGASUS
Markab
44
ENIF
DELPHINUS
40
ALTAIR
AQUILA
RASALHAGUE
35
CORONA BOREALIS
32
ALPHECCA
BOOTES
31
ARCTURUS
α LYNCIS
Castor
Pollux
GEMINI
El Nath
TAURUS
11
ALDEBARAN
DENEBOLA
23
REGULUS
22
PROCYON
16
CANIS MINOR
Betelgeux
Bellatrix
ORION
7
MENKAR
CETUS
Unuk
α Serpentis
VIRGO
Ecliptic
Equinoctial (Equator)
Autumnal Equinox
Vernal Equinox
Vernal Equinox
HYDRA
ALPHARD
21
AQUARIUS
η Serpentis
OPHIUCHUS
LIBRA
SPICA
26
GIENAH
24
15
SIRIUS
12
RIGEL
CAPRICORNUS
41
DABIH
Sabik
CANIS MAJOR
Adhara
LEPUS
Arneb
Deneb-Kaitos
DIPHDA
2
45
FOMALHAUT
NUNKI
37
33
ANTARES
SCORPIO
30
MENKENT
CORVUS
ERIDANUS
BAGITTARIUS
Kaus-Australis
Shaula
Rasalgethi
LUPUS
CENTAURUS
ARGO
Al Suhail
RIGOR
17
COLUMBA
Phact
6
ACAMAR
GRUS
Al Nair
α Indi
14
CANOPUS
PHOENIX
4
ACHERNAR
α Pavonis
42
PEACOCK
ARA
Rigil Kentaurus
α Doradus
α Tucanae
TRI AUST.
34
ATRIA
25
ACRUX
Miaplacidus
HYDRUS

STAR CHARTS

STAR CHARTS


24h 23h 22h 21h 20h 19h 18h 17h 16h 15h 14h 13h 12h 11h 10h 9h 8h 7h 6h 5h 4h 3h 2h 1h 0h
80° 70° 60° 50° 40° 30° 20° 10° 0° 10° 20° 30° 40° 50° 60° 70° 80°
NAVI 2
ALPHERATZ 1
PEGASUS
ENIF 42
DIPHDA 2
FOMALHAUT 45
GRUS
PEACOCK 42
DABIH 41
CAPRICORNUS
NUNKI 37
SAGITTARIUS
CORONA AUSTRALIS
ANTARES 33
SCORPIUS
ATRIA 34
CENTAURUS
ACRUX 25
MENKENT 30
CORVUS
SPICA 26
GIENAH 24
VIRGO
LIBRA
SERPENS
OPHIUCHUS
SERPENS
RASALHAGUE 35
ALTAIR 40
DENEB 43
CYGNUS
VEGA 36
HERCULES
CORONA BOREALIS
ALPHECCA 32
BOÖTES
ARCTURUS 31
ALKAID 27
DNOCES 20
URSA MAJOR
DENEBOLA 23
LEO
REGULUS 22
ALPHARD 21
HYDRA
PROCYON 16
CANIS MAJOR
SIRIUS 15
REGOR 17
FALSE CROSS
CANOPUS 14
ECLIPTIC
GEMINI
TAURUS
ALDEBARAN 11
CAPELLA 13
AURIGA
MIRFAK 10
PERSEUS
ORION
RIGEL 12
MENKAR 7
CETUS
ACAMAR 6
ERIDANUS
ACHERNAR 1
NAVI 2
CASSIOPEIA
ANDROMEDA
ALPHERATZ 1
PEGASUS
DIPHDA 2
FOMALHAUT 45

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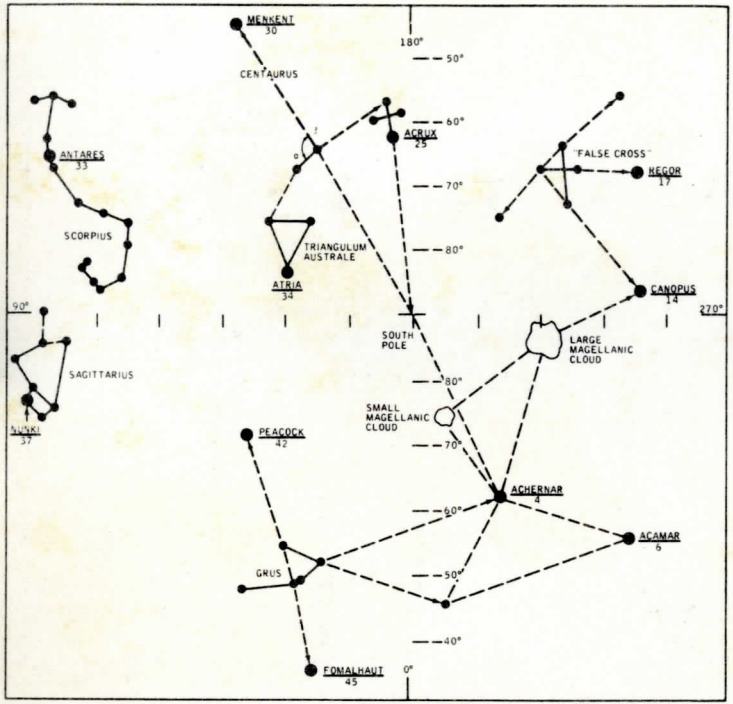
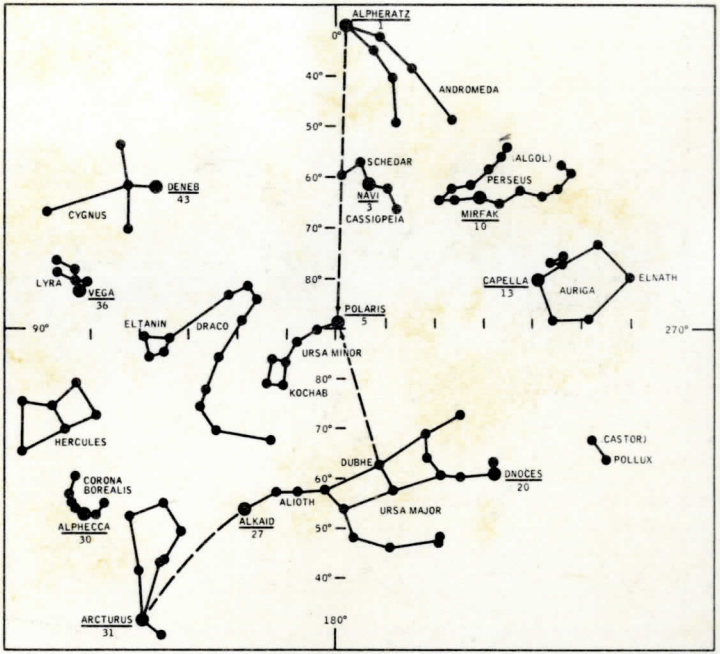


SOUTHERN STARS



NORTHERN STARS

STAR LIST

NO	STAR NAME (Numerical)	STAR NAME (Alphabetical)	NO
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

PROGRAMS

NO.	
00	LGC Idle
06	LGC Power Down
12	Powered Ascent
20	Rendezvous Navigation
21	Ground Track Determination
22	Lunar Surface Navigation
25	Preferred Tracking Attitude
27	LGC Update
30	External ΔV
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 Rendevous Parameter Display (R31)
85 Display RR LOS Az and El
89 Start Rendezvous Final Attitude Maneuver (R63)
90 Request Rendezvous Out of Plane Display (R36) (Non-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°

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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

61	TG	min-sec
	TF (TFI)	min-sec
	Crossrange	.1nm
62	VI	.1fps
	TF (TFI)	min-sec
	ΔVm	.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

R1 Code	FUNCTION
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

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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

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

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

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

00402 P FINDCDUW Routine Not Controlling Attitude

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 Descrete 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 ΔTheta >3°
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

Basic Date May 29, 1969
Changed

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

Basic Date May 29, 1969
Changed

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

02001 I Jet Failures Have Disabled Y-Z Trans
Change 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 ROO.
***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

Basic Date May 29, 1969
Changed

P06 PGNS PWR DOWN

1 V37E 06E

F 50 25 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

Basic Date May 29, 1969

Changed

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)

Basic Date May 29, 1969
Changed

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

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

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 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)
(NOUN 91) V06N 91E To 3
PRO To 4

3 06 91 ALT,VEL,FLT PATH ✗ (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-

```
                    *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 ΔLOS>3°        *
*        PRO                        *
*F 06 05 SV/RR ΔLOS (.01°)          *
*        (REJECT) CHECK SIDE LOBE   *
*                 RR MODE - LGC     *
*                 V32E To 6         *
*        (UPDATE) PRO To 3 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 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

MODE CONT: PGNS - AUTO

1 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

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

Basic Date May 29, 1969
Changed

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 - P39

P30 EXTERNAL ΔV

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

2 F 06 81 ΔV XYZ(LV) (.1fps)
PRO

3 F 06 42 HA, HP, ΔV (.1nm,.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

Basic Date May 29, 1969
Changed

LM-

P31 LAMBERT AIM POINT GUIDANCE

1		V37E 31E	
	F 06 33	TIG	(hrs,min,.01sec)
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 TO TFI	
		PRO	
5	F 37		

P32 CSI PRETHRUST

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	

Basic Date May 29, 1969
Changed

```
                *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)
                                (.1nm,min-sec,min-sec)
                PRO

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

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

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

     F 37
```

Basic Date May 29, 1969
Changed

P33 CDH PRE-THRUST

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

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

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 REFSMMAT 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 V37E 40E

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

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

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.,1fps,.1fps)

                        *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.,1fps,.1fps)
              ENG STOP PB - PUSH
              ENG ARM - OFF
              PRO

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

-:15 Verify ΔVM (R3) <00005

-:05
F 99 40 ENG ON-ENABLE
-:03.5 Verify +X ULLAGE
(V34E NO ULLAGE To 5)
(AUTO)PRO IGN WHEN TFI=:00 sec)
(BYPASS) ENTR To APS OFF

IGN 06 40 TFI, VG, ΔVM (min-sec,.1fps,.1fps)

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

APS
OFF F 16 40 TFC,ΔVG, ΔVM (min-sec,.1fps,.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
(20 sec Delay)
F 16 83 ΔV XYZ (LM) (.1fps)
(EXIT) PRO
(RECYCLE) V32E (Zeroes N83 Display)

2 F 37

Basic Date May 29, 1969
Changed

P51 IMU ORIENTATION

CB(11) AC: AOT LAMP-CLOSE

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

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

3 F 54 71 MARK X(52) and Y(53)
PRO
(For DE=00
F 06 88 CELESTIAL BODY VECTOR
Load 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

CB(11) AC: AOT LAMP-CLOSE

1 V37E 52E
F 04 06 R1 00001 IMU ALIGN OPT
R2 00001 PREF (0,0,0 Specified Attitude)
PRO To 4
2 NOM (LV At Specified Time)
PRO To 2
3 REFSMMAT PRO To 6
4 LANDING SITE PRO To 2

Basic Date May 29, 1969
Changed

P51 - P57

LM-

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 ACQUISTION 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)

Basic Date May 29, 1969
Changed

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,.01sec)
(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

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

```
*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

11	F 06 05	STAR ANGLE DIFFERENCE (REJECT) V32E To 14 (ACCEPT) PRO	(.01°)
12	F 06 93	GYRO TORQUING ANGLES X,Y,Z (REJECT) V32E To 14 (ACCEPT) PRO	(.01°)
13		If Gyro Angles >5° F 06 22 ICDU ANGLES OG,IG,MG PRO NO ATT Lt - On Then Off If Gyro Angles <5° Monitor Gyro Torquing V16N93E 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	(.01°) (.01°)
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 (TERM) V34E (ACCEPT) PRO	(.001°,.01nm)
16	F 37		

Basic Date— May 29, 1969
Changed—

P63 BRAKING PHASE

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

```
59:25          DSKY BLANKS
               ENG ARM - DES

59:30
       06 62   AVE G ON

59:45          Verify ΔVM (R3) <00005

59:55
     F 99 62   ENG ON ENABLE
               VERIFY +X ULLAGE
               PRO
          (NO ULLAGE) V34E Exit 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, ΔH (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 ΔH (LR/LGC)
                                    (.1nm,min-sec,ft)
               Verify ΔH converging
               KEY REL
          (MAN) MODE CONT:PGNS-ATT HOLD
               H=25,000 ft
```

Basic Date May 29, 1969
Changed

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) (.1fps)
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

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(acutal)=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 (.1fps,.1fps,ft)
VI increasing
H DOT remains positive
H increasing

H<25000-Monitor attitude mnvr to local vertical with windows downrange. X-axis override inhibited.
H>25000-or H DOT>00400-Monitor attitude mnvr to abort attitude with windows downrange. X-axis override restored.

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

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

3 16 85 VG XYZ (LM) (.1fps)
(If burn >400 sec,
VGY = 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,.1fps,ft)
ABORT PB - RESET
ENG STOP PB-PUSH
PRO

Basic Date May 29, 1969
Changed

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

Basic Date May 29, 1969
Changed ____

H<25000-Monitor attitude mnvr to local vertical with windows downrange. X-axis override inhibited.
H>25000 or H DOT>00400-Monitor attitude mnvr to abort attitude with windows downrange. X-axis override restored.
BAL CPL-OFF (After Pitch MNVR)

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

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

2 16 85 VG XYZ (LM) (.1fps)
VGX = 200 fps,
MAIN SOV (2) - OPEN
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,.1fps,ft)
ENG STOP PB-RESET
PRO

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

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

PER ALT _____ nm,

TFF _____ min-sec
PRO To 4

6 F 37

Basic Date May 29, 1969
Changed

P72 CSM CSI TARGETING

1 V37E 72E

F 06 11 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*

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

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

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

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

9 F 37

Basic Date May 29, 1969
Changed

P72 - P79

P73 CSM CDH TARGETING

```
1                V27E 73E
     F 06 13     TIG CDH                          (hrs,min,.01sec)
                 PRO To 4

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

3    F 06 81     ΔVXYZ (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		V37E 74E	
	F 06 37	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

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

Basic Date— May 29, 1969
Changed———

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

Basic Date May 29, 1969
Changed

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

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

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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 V42E
F 21 93 GYRO ANGLES (XYZ) (.001°)
Load Desired Angles

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

V43 FDAI BIAS CHECK

1 MODE CONT: PGNS - OFF

2 V37E00E

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

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

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

Basic Date May 29, 1969
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V47 AGS INITIALIZATION

			TM-HI
1			V16N65E
	16	65	LGC TIME (hr,min,.01sec)
			377 + GET-PGNS/AGS BIAS TIME (.1min)
			ENTR-(At Correct PGNS Time)
2			V47E
	F 06	16	GET OF AGS CLOCK
			Load PGNS/AGS TIME BIAS
3			*414 +1
4			PRO (32 Sec Elapse Before Step 6 Appears If CDU Zero Is Issued, Otherwise 20 Sec)
5	F 50	16	Downlink Complete
			PRO
6			*400+3 AGS ALIGN
7			V83E
	F 16	54	R,RDOT,THETA (.01nm,.1fps,.01°)
8			*440R RANGE RATE (±2.5 fps) (.1fps)

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°/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
2	F 06	47	LM WT, CSM WT (lb)
			PRO (TERMINATES IF STAGED)

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LM-5

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
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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

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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

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PGNS TURN - ON

PGNS TURN - ON

PGNS TURN-ON AND SELF-TEST

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 DKSY 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

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Changed ____

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

LGC CLOCK INITIALIZATION

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

_____(min)

_____(sec)
COMPUTE CSM/LM ΔT

2 V55E
F 21 24 LOAD ΔT (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 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 06 54 R, RDOT, THETA (.01nm,.1fps,.01°)
MODE - HOLD/FAST
SLEW - To THETA
MODE - OPR/SLOW
PRO

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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	F 04 06	V63E INITIATE RDR SELF TEST 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

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10 V62E INITIATE RDR SELF TEST
F 04 06 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 LDG ANT - DES (10 sec)
F 16 66 R2 00001 (PROG LT ON, V05N09, 00522)

13 LDG ANT - AUTO
F 16 66 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

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3		Slew Left To Mode I Region (18 sec) Slew Right, Down, Left, Up (FDAI Needles Right, Down, Left, Up) SLEW RATE - LO SHAFT/TRUN - ±5° Slew Right, Down, Left, Up (FDAI Needles Right, Down, Left, Up)
4		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

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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

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PIPA BIAS CK,
THRUSTER INHIBIT

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 (±XXXXX.)

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 V21N01E
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

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

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MONITOR OF INPUT/OUTPUT CHANNELS

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

LOAD OUTPUT CHANNELS

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

FLAG WORD SET/RESET

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

2 F 22 07 (Load FLAGWORD BIT CODE

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

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

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FLAG LIST

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

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

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

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Designate	110	1000 (10)	Desired LOS Within Mode Lim / Desired LOS Not Within Mode Lim	B=1,3,5,7 / B=0,2,4,6
ACA Mode	111	40000 (15)	Min Impulse Enabled (V76) / Rate Command Enabled(V77)	A=4,5,6,7 / A=0,1,2,3

NON FLAGS

Mark/Reject	1312	10000 (13)	Use of Mark X or Y / Use of Mark Reject	A=1,3,5,7 / A=0,2,4,6
AOT Mark Y	1312	2000 (11)	After Use of Mark Y / After Mark X & Y or Mark Reject	B=2,3,6,7 / B=0,1,4,5
AOT Mark X	1312	1000 (10)	After Use of Mark X / After Mark X & Y or Mark Reject	B=1,3,5,7 / B=0,2,4,6

CHANNEL LIST

CHANNEL LISTING

CHANNEL	BIT	DSKY	FUNCTION
5	1	E=1,3,5,7	JET 1 ON
OUTPUT	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	1	E=1,3,5,7	JET 7 ON
OUTPUT	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	1	E=1,3,5,7	ISS WARNING
OUTPUT	13	A=1,3,5,7	ENGINE ON
	14	A=2,3,6,7	ENGINE OFF
12	1	E=1,3,5,7	ZERO RRCDU
OUTPUT	4	D=1,3,5,7	COARSE ALIGN ENABLE
	5	D=2,3,6,7	ZERO ICDU
	9	C=4,5,6,7	+PITCH GMBL TRIM CMD
	10	B=1,3,5,7	-PITCH GMBL TRIM CMD
	11	B=2,3,6,7	+ROLL GMBL TRIM CMD
	12	B=4,5,6,7	-ROLL GMBL TRIM CMD
	13	A=1,3,5,7	LR POS CMD
	14	A=2,3,6,7	RR AUTO TRACK ENABLE
	15	A=4,5,6,7	ISS TURN ON DELAY COMPLETE

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16	3	E=4,5,6,7	MARK X
INPUT	4	D=1,3,5,7	MARK Y
	5	D=2,3,6,7	MARK REJECT
	6	D=4,5,6,7	+RATE OF DESCENT
	7	C=1,3,5,7	-RATE OF DESCENT
30	1	E=0,2,4,6	ABORT
(INVERTED)	2	E=0,1,4,5	STAGE VERIFY
INPUT	3	E=0,1,2,3	ENG ARM
	4	D=0,2,4,6	ABORT STAGE
	5	D=0,1,4,5	AUTO THROTTLE
	6	D=0,1,2,3	DISPLAY INERTIAL DATA
	7	C=0,2,4,6	RR CDU FAIL
	9	C=0,1,2,3	IMU OPERATE
	10	B=0,2,4,6	G&N CONTROL OF S/C
	11	B=0,1,4,5	IMU CAGE
	12	B=0,1,2,3	ICDU FAIL
	13	A=0.2,4,6	IMU FAIL
	14	A=0,1,4,5	ISS TURN ON REQUEST
	15	A=0,1,2,3	TEMP IN LIMITS
31	1	E=0,2,4,6	+PITCH MIN IMPULSE/+EL LPD
(INVERTED)	2	E=0,1,4,5	-PITCH MIN IMPULSE/-EL LPD
INPUT	3	E=0,1,2,3	+YAW MIN IMPULSE
	4	D=0,2,4,6	-YAW MIN IMPULSE
	5	D=0,1,4,5	+ROLL MIN IMPULSE/-AZ LPD
	6	D=0,1,2,3	-ROLL MIN IMPULSE/-AZ LPD
	7	C=0,2,4,6	+X TRANSLATION
	8	C=0,1,4,5	-X TRANSLATION
	9	C=0,1,2,3	+Y TRANSLATION
	10	B=0,2,4,6	-Y TRANSLATION
	11	B=0,1,4,5	+Z TRANSLATION
	12	B=0,1,2,3	-Z TRANSLATION
	13	A=0,2,4,6	ATTITUDE HOLD
	14	A=0,1,4,5	AUTO STAB
	15	A=0,1,2,3	ACA OUT OF DETENT

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32	1	E=0,2,4,6	JETS 2,4 FAILED
(INVERTED)	2	E=0,1,4,5	JETS 5,8 FAILED
	3	E=0,1,2,3	JETS 1,3 FAILED
	4	D=0,2,4,6	JETS 6.7 FAILED
	5	D=0,1,4,5	JETS 14,16 FAILED
	6	D=0,1,2,3	JETS 13,15 FAILED
	7	C=0,2,4,6	JETS 9,12 FAILED
	8	C=0,1,4,5	JETS 10,11 FAILED
	9	C=0,1,2,3	GIMBAL NOT ENABLED
	10	B=0,2,4,6	GIMBAL FAILED
	14	A=0,1,4,5	PROCEED

33	2	E=0,1,4,5	RR PWR ON/AUTO
(INVERTED)	3	E=0,1,2,3	RR RNG SCALE LOW
	4	D=0,2,4,6	RR DATA GOOD
	5	D=0,1,4,5	LR DATA GOOD
	6	D=0,1,2,3	LR POSITION 1
	7	C=0,2,4,6	LR POSITION 2
	8	C=0,1,4,5	LR VELOCITY DATA GOOD
	9	C=0,1,2,3	LR RNG SCALE LOW
	10	B=0,2,4,6	BLOCK UPLINK
	11	B=0,1,4,5	UPLINK TOO FAST
	12	B=0,1,2,3	DOWNLINK TOO FAST
	13	A=0,2,4,6	PIPA FAIL
	14	A=0,1,4,5	LGC WARNING
	15	A=0,1,2,3	OSCILLATOR ALARM

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AGS SELECTOR LOGIC LIST

Address	Entry	
400	+00000	Attitude Hold
	+10000	Auto Guidance Steering
	+20000	Z-Body Axis Steering
	+30000	IMU Align
	+40000	Lunar Align
	+50000	Body Axis Align
	+60000	Gyro and Accelerometer Calibration (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

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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)

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DEDA INPUT/OUTPUT LIST

Address		
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

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373	AGS TIG CSI,CDH,TPI/TPM	.1 min
377	AGS Computer Time (T)	.1 min
404	ΔVX (Use 470 For Readout)	Octal
405	ΔVY (Use 471 For Readout)	Octal
406	ΔVZ (Use 472 For Readout)	Octal
450	ΔVX (LV) (+Fwd)	.1fps
451	ΔVY (LV) (+Rt)	.1fps
452	ΔVZ (LV) (+Dn)	.1fps
464	Vertical Pitch Steering, Attitude Rate Threshold	.1fps
465	Target Radial Rate at Insertion	.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

DEDA OUTPUT LIST

Address		
211	Present Out of CSM Orbit Plane Position	100 ft
263	Predicted out-of-plane velocity at TIG (CSI,CDH,TPI)	
	Present out-of-plane 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

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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	ΔVX Measured (LM) (+ Up) (Use 404 to Zero)	.1fps
471	ΔVY Measured (LM) (+ Rt) (Use 405 to Zero)	.1fps
472	ΔVZ Measured (LM) (+ Fwd) (Use 406 to Zero)	.1fps
477	Predicted HDOT at CSI,CDH, or TPI time	.1fps
500	ΔVgx (LM) (+ Up)	.1fps
501	ΔVgy (LM) (+ Rt)	.1fps
502	ΔVgz (LM) (+ Fwd)	.1fps
612	Staging sequence counter	Octal
614	Ullage counter	2 sec

DEDA ACCESSIBLE CONSTANTS LIST

Address (TBD)

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Changed

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

7

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANSL	2 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(Unstaged)	OFF
PRPLNT QTY MON	DES 1	OFF	OFF
PRPLNT TEMP/PRESS MON	DES 1	ASC	-

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Changed

AGS PROGRAMS

LM-5

		HELIUM MON	SUPCRIT PRESS	PRESS 1	-
		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

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CSI

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)

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LM-5

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

CONFIGURATION	DES	ASC	RCS
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)

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5 *410 +5 EXT ΔV
*450R ΔVX CDH (.1fps)
*263R VY CDH (.1fps)
*451 (ΔVY CDH) (Same Sign As 263) (.1fps)
*452R ΔVZ CDH (.1fps)

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

7 *623 +0 Z-axis parallel to CSM Orbit Plane
+1 Z-axis parallel to specified Plane

8 If 623 +1, Specify Plane
*514 +(X component of unit vector)
*515 +(Y Component of unit vector)
*516 +(Z component of unit vector)

9 *400 +1 GUIDANCE STEERING

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

11 *407 +0

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

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LM·

13	CONFIGURATION	DES	ASC	RCS
	THR CONT	MAN	-	-
	MAN THROT CDR	CDR	-	-
	BAL CPL	ON 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	ACS	-
	MASTER ARM	ON(1st Burn Only)	ON(Un-Staged Only)	OFF
	PRPLNT QTY MON	DES	OFF	OFF
	PRPLNT TEMP/PRESS MON	DES	ASC	-
	HELIUM MON	SUPCRIT PRESS	PRESS 1	-
	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)

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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

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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

CONFIGURATION	DES	ASC	RCS
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

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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)

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LM

2 If Time Available:
*207R THETA (.1°)
*373R TIG TPM (.1 min)
*371R ΔVG To RNDZ (.1fps)
(If +8 Retarget)
*402R Hp TPM (.1nm)

3 *410 +5 EXT ΔV
*407 +0 REF FRAME

4 *407 +1 Trim Residuals (Y,Z,X)

Retargeting (Same Rndz Time)

1 *410 +3 TPI SEARCH
*307 +(ΔT RNDZ TRANS)
(+00280 For 1st MCC)
(+00130 For 2nd MCC)
*310 ΔT TO TPM TPM) (.01 min)
*410 +4 TPI EXECUTE

2 *267R VG MDC (.1fps)

3 If Time Available:
*311R ΔT RDZ (.01 min)
*304R THETA (.01°)

4 *410 +5

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 *267R Total ΔV
EVENT TIMER - SET

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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

CONFIGURATION	DES	ASC	RCS
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

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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 (.1fps)
Y - *471R (.1fps)
Z - *472R (.1fps)

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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

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AGS ACTIVATION

LM

AGS CALIBRATION

1 Verify AGS in Standby/Operate For 25 min

2 Read And Record

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

3 V16N20E
16 20 ICDU Angles O,I,M
CSM MNVR Until 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/sec2)
*541R Y	_____	(.001 ft/sec2)
*542R Z	_____	(.001 ft/sec2)

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

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AGS RR MANUAL ACQUISITION AND UPDATE

1	GUID CONT	-AGS
	RNG/ALT MON	-RNG/RNG RT
	RATE/ERR MON	-LDR RDR/CMPTR
	ATT MON	-AGS
	SHFT/TRUN	-±5°
	RENDEZVOUS RADAR	-SLEW
	ATT CONT	-PULSE
	MODE CONT: AGS	-AUTO
	DB	-MIN
2	*400 +2 ACQUISITION STEERING	
3	Manually Null FDAI	
4	RATE/ERR MON-RNDZ RADAR	
5	Slew Null FDAI, Then Search For Strongest Signal And Check For Side Lobe	
6	RNDZ RAD - AUTO TRACK	
7	*417 +1 INITIALIZE RADAR FILTER	
8	*415 +1 STORE Z AXIS COSINES ENTR (When FDAI's centered)	
9	*316 +(RADAR RANGE) (Must Be Entered Within 30 sec)	(.1nm)
10	*415 +1 Store Z Axis cosines	
11	*503 ± (RADAR RANGE RATE) (Must Be Entered Within 30 sec)	(.1fps)

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LM

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 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

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AGS MANUAL STATE VECTOR UPDATE

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

AGS ORDEAL,SV UPDATE

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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

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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