APOLLO 13	
G&N DICTIONARY	
PART NO.	S / N
SKB32100076 – 361	

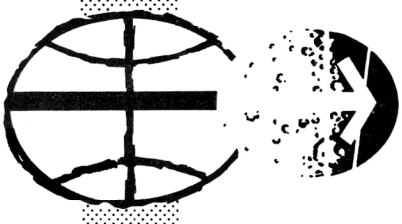
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO XIII
LM-7

FLIGHT CREW G&N DICTIONARY

PREPARED BY

GUIDANCE AND CONTROL SECTION
SPACECRAFT SYSTEMS BRANCH
FLIGHT CREW SUPPORT DIVISION



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

JANUARY 5, 1970
REVISED MARCH 25, 1970

APOLLO 13

G&N DICTIONARY

MARCH 25, 1970

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SPACECRAFT SYSTEMS BRANCH

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CHIEF, SPACECRAFT SYSTEMS BRANCH

It is requested that any organization having comments, questions, or suggestions concerning this document contact T. H. Kaiser, CF221, Building 4, Room 255, Telephone Number HU-3-3048.

This document is under the configuration control of the Crew Procedures Control Board (CPCB). All proposed changes should be submitted to the Apollo Flight Data File Manager, Mr. T. W. Holloway, CF34, Room 230, telephone HU3-4271.

Distribution of this document is controlled by Mr. J. W. O'Neill, Chief, Flight Planning Branch, Flight Crew Support Division.

APOLLO FLIGHT DATA FILE

FLIGHT CREW G&N DICTIONARY (LM-7)

BASIC DATE 1/5/70

LIST OF EFFECTIVE PAGES

PAGE NO.	BASIC DATE	CHANGE DATE
Cover Page	1/5/70	3/9/70
Signature Page	3/9/70	NONE
Table of Contents (v thru viii)	3/9/70	NONE
Star Maps	NONE	NONE
PGNS-1 thru 3	1/5/70	NONE
PGNS-4 & 5	1/5/70	3/9/70
PGNS-6	1/5/70	NONE
PGNS-7 & 8	1/5/70	3/9/70
PGNS-9 & 10	1/5/70	NONE
PGNS-11	1/5/70	3/9/70
PGNS-12 thru 14	1/5/70	NONE
RECOV-1	1/5/70	1/18/70
RECOV-2	1/5/70	NONE
PGNS-15 & 16	1/5/70	NONE

PAGE NO.	BASIC DATE	CHANGE DATE
PGNS-17 & 18	1/5/70	1/18/70
PGNS-19 & 20	1/5/70	NONE
PGNS-21	1/5/70	1/18/70
PGNS-22	1/5/70	NONE
PGNS-23 & 24	1/5/70	1/18/70
PGNS-25 thru 28	1/5/70	NONE
PGNS-29	1/5/70	3/9/70
PGNS-30	1/5/70	1/18/70
PGNS-31	1/5/70	NONE
PGNS-32	1/5/70	3/9/70
PGNS-33	1/5/70	1/18/70
PGNS-34 thru 37	1/5/70	NONE
PGNS-38 & 41	1/5/70	3/25/70
PGNS-42	1/5/70	NONE
PGNS-43	1/5/70	1/18/70
PGNS-44	1/5/70	3/9/70
PGNS-45	1/5/70	3/25/70
PGNS-46	1/5/70	NONE
PGNS-47 thru 49	1/5/70	3/9/70
PGNS-50 thru 57	1/5/70	NONE
PGNS-58	1/5/70	3/9/70

PAGE NO.	BASIC DATE	CHANGE DATE
PGNS-59	1/5/70	NONE
PGNS-60	1/5/70	2/13/70
PGNS-61	1/5/70	1/18/70
PGNS-62	1/5/70	NONE
PGNS-63 & 64	1/5/70	2/13/70
PGNS-65	1/5/70	3/9/70
PGNS-66	1/5/70	NONE
PGNS-67	1/5/70	3/25/70
PGNS-68	1/5/70	3/25/70
PGNS-69 thru 77	1/5/70	NONE
PGNS-78	1/5/70	1/18/70
AGS-1	1/5/70	NONE
AGS-2 thru 7	1/5/70	2/13/70
AGS-8 & 9	1/5/70	3/9/70
AGS-10	1/5/70	2/13/70
AGS-11 & 12	1/5/70	NONE
AGS-13	1/5/70	2/13/70
AGS-14	1/5/70	3/9/70
AGS-15	1/5/70	NONE
AGS-16 & 17	1/5/70	2/13/70
AGS-18 thru 22	1/5/70	NONE

PAGE NO.	BASIC DATE	CHANGE DATE
AGS-23	1/5/70	1/18/70
AGS-24	1/5/70	2/13/70
AGS-25	1/5/70	3/9/70
AGS-26 thru 28	1/5/70	NONE
P27 UPDATE (4 pgs)	1/5/70	NONE
P30 UPDATE (4 pgs)	1/5/70	NONE
AGS SV UPDATE (4 pgs)	1/5/70	NONE
PLANET VECTORS (PV-1 & 2)	2/13/70	NONE
STAR VECTORS (PV-3 & 4)	2/13/70	NONE

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PGNS

RECOVERY PROCEDURES

DETAILED PROGRAMS

EXTENDED VERBS

GENERAL PROCEDURES

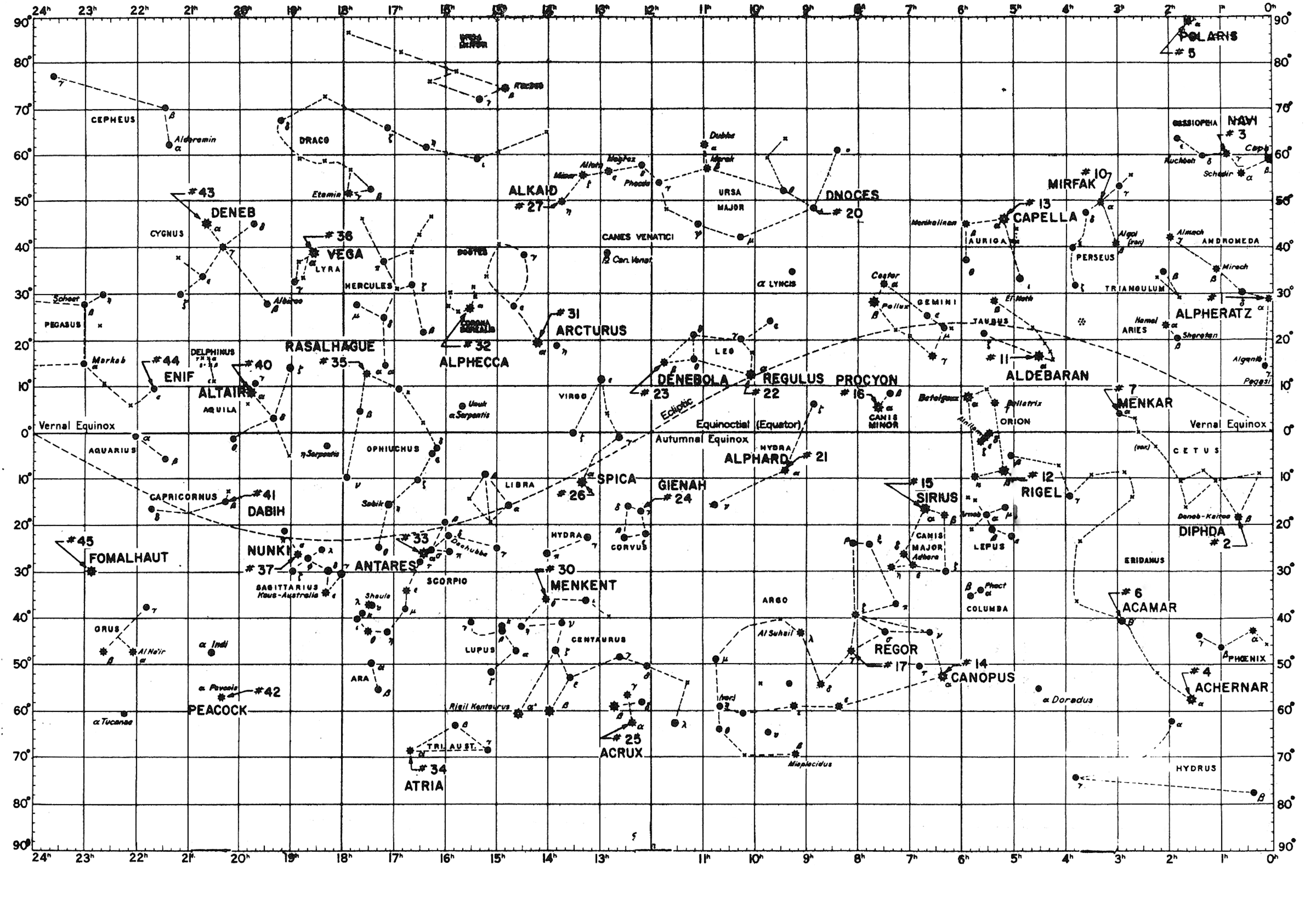
Basic Date 3/9/70
Changed

Basic Date 3/9/70
Changed

PADS

HALF UNIT VECTORS

Basic Date 3/9/70
Changed



POLARIS #5
NAVI #3
MIRFAK #10
CAPELLA #13
DNOCES #20
ALKAID #27
DENEB #43
VEGA #36
ARCTURUS #31
ALPHECCA #32
RASALHAGUE #35
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DENEBOLA #23
REGULUS #22
PROCYON #16
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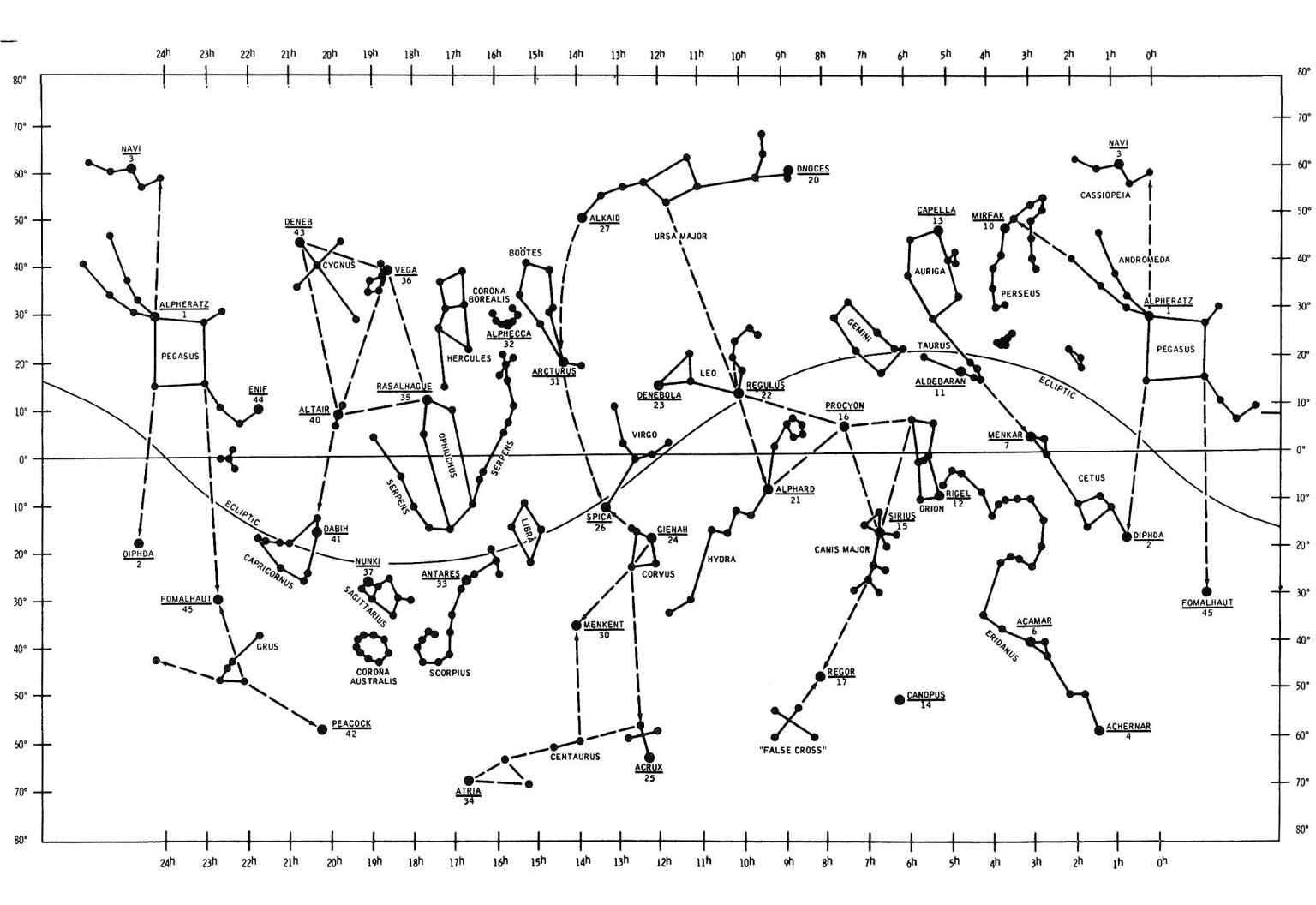
ALPHARD #21
SPICA #26
GIENAH #24
SIRIUS #15
RIGEL #12
DIPHDA #2
DABIH #41
FOMALHAUT #45
NUNKI #37
ANTARES #33
MENKENT #30
ACAMAR #6
REGOR #17
CANOPUS #14
ACHERNAR #4
PEACOCK #42
ATRIA #34
ACRUX #25
Vernal Equinox
Autumnal Equinox
Equinoctial (Equator)
Ecliptic
CEPHEUS
DRACO
CYGNUS
LYRA
HERCULES
BOOTES
CORONA BOREALIS
CANES VENATICI
URSA MAJOR
URSA MINOR
CASSIOPEIA
ANDROMEDA
PERSEUS
AURIGA
TRIANGULUM
ARIES
PEGASUS
DELPHINUS
AQUILA
AQUARIUS
OPHIUCHUS
VIRGO
LEO
GEMINI
TAURUS
ORION
CANIS MINOR
CETUS
HYDRA
LIBRA
CORVUS
CAPRICORNUS
SAGITTARIUS
SCORPIO
CANIS MAJOR
LEPUS
ERIDANUS
COLUMBA
ARGO
CENTAURUS
LUPUS
ARA
GRUS
TRI. AUST.
PHOENIX
HYDRUS
α Indi
α Tucanae
α Doradus
α Lyncis


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 3
ALPHERATZ 1
PEGASUS
ENIF 44
DIPHDA 2
FOMALHAUT 45
GRUS
PEACOCK 42
DENEB 43
CYGNUS
VEGA 36
ALTAIR 40
DABIH 41
CAPRICORNUS
NUNKI 37
SAGITTARIUS
CORONA AUSTRALIS
RASALHAGUE 35
OPHIUCHUS
SERPENS
HERCULES
CORONA BOREALIS
ALPHECCA 32
BOÖTES
ARCTURUS 31
ALKAID 27
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ECLIPTIC
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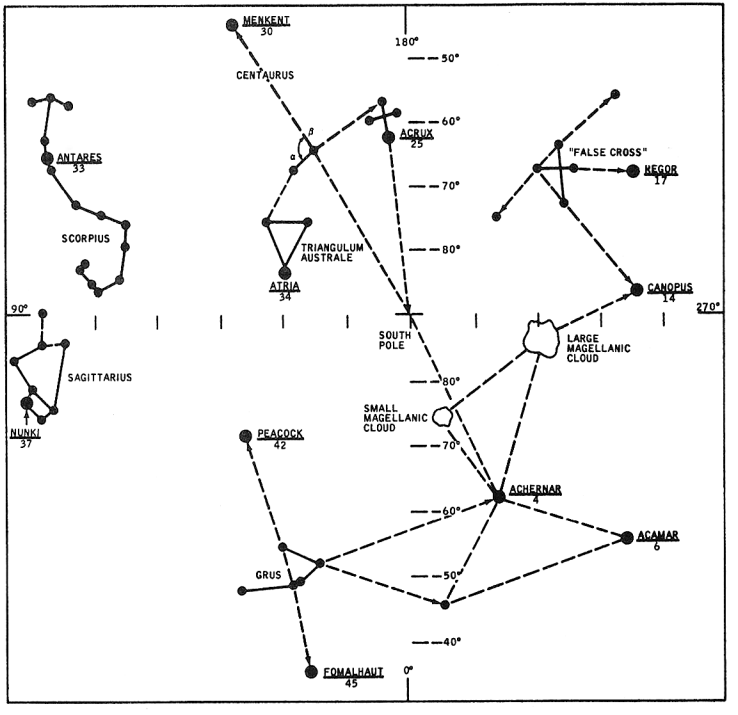
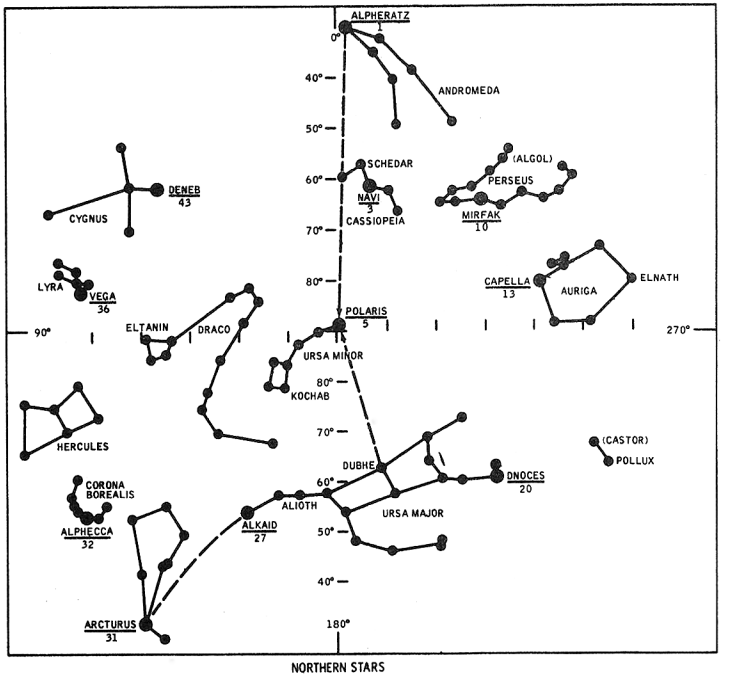
PERSEUS
MENKAR 7
CETUS
ACAMAR 6
ERIDANUS
ACHERNAR 4
NAVI 3
CASSIOPEIA
ANDROMEDA
ALPHERATZ 1
PEGASUS
DIPHDA 2
FOMALHAUT 45

Basic Date _____
Changed _____



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	Aldebaran	11
4	Achernar	Alkaid	27
5	Polaris	Alphard	21
6	Acamar	Alphecca	32
7	Menkar	Alpheratz	1
10	Mirfak	Altair	40
11	Aldebaran	Antares	33
12	Rigel	Arcturus	31
13	Capella	Atria	34
14	Canopus	Canopus	14
15	Sirius	Capella	13
16	Procyon	Dabih	41
17	Regor	Deneb	43
20	Dnoces	Denebola	23
21	Alphard	Diphda	2
22	Regulus	Dnoces	20
23	Denebola	Earth	47
24	Gienah	Enif	44
25	Acrux	Fomalhaut	45
26	Spica	Gienah	24
27	Alkaid	Menkar	7
30	Menkent	Menkent	30
31	Arcturus	Mirfak	10
32	Alphecca	Moon	50
33	Antares	Navi	3
34	Atria	Nunki	37
35	Rasalhague	Peacock	42
36	Vega	Planet	00
37	Nunki	Polaris	5
40	Altair	Procyon	16
41	Dabih	Rasalhague	35
42	Peacock	Regor	17
43	Deneb	Regulus	22
44	Enif	Rigel	12
45	Fomalhaut	Sirius	15
46	Sun	Spica	26
47	Earth	Sun	46
50	Moon	Vega	36

Basic Date 1/5/70
Changed

STARS, PROG

PROGRAMS

NO.	
00	LGC Idle
06	LGC Power Down
12	Powered Ascent
20	Rendezvous Navigation
21	Ground Track Determination
22	Lunar Surface Navigation
25	Preferred Tracking Attitude
27	LGC Update
30	External ΔV
32	CSI Pre-Thrust
33	CDH Pre-Thrust
34	TPI Pre-Thrust
35	TPM Pre-Thrust
40	DPS Thrust
41	RCS Thrust
42	APS Thrust
47	ΔV Monitor
51	IMU Orientation Determination
52	IMU Realign
57	Lunar Surface Align
63	Braking Phase
64	Approach Phase
66	Landing Phase (ROD)
68	Landing Confirmation
70	DPS Abort
71	APS Abort
72	CSM CSI Targeting
73	CSM CDH Targeting
74	CSM TPI Targeting
75	CSM TPM Targeting
76	Target ΔV

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VERBS

01	Display Octal Comp 1 in R1
02	Display Octal Comp 2 in R1
03	Display Octal Comp 3 in R1
04	Display Octal Comp 1&2 in R1&R2
05	Display Octal Comp 1,2&3 in R1,R2&R3
06	Display Decimal in R1 or R1,R2 or R1, R2,R3
07	Display DP Decimal in R1&R2
11	Monitor Octal Comp 1 in R1
12	Monitor Octal Comp 2 in R1
13	Monitor Octal Comp 3 in R1
14	Monitor Octal Comp 1&2 in R1&R2
15	Monitor Octal Comp 1,2&3 in R1,R2&R3
16	Monitor Decimal in R1 or R1,R2 or R1,R2,R3
17	Monitor DP Decimal in R1&R2
21	Load Component 1 in R1
22	Load Component 2 in R2
23	Load Component 3 in R3
24	Load Component 1&2 in R1&R2
25	Load Component 1&2&3 in R1&R2&R3
27	Display Fixed Memory
30	Request Executive (P00 only)
31	Request Waitlist (P00 only)
32	Recycle
33	Proceed
34	Terminate
35	Test Lights (P00 only)
36	Request Fresh Start
37	Change Program
40	Zero CDU's (Specify N20 or N72)
41	Coarse Align CDU's (Specify N20 or N72)
42	Fine Align IMU
43	Load FDAI Error Needles (test only)
44	Terminate Continuous Designate (V41N72 Option 2)
47	Initialize AGS (R47)
48	Load DAP Data (R03)
49	Start Crew Defined Maneuver (R62)
50	Please Perform
52	Mark X

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VERBS

53 Mark Y
54 Mark X or Y
55 Increment LGC Time (Decimal)
56 Terminate Tracking (P20,P22,&P25)
57 Call LR Update
58 Inhibit LR Update
59 Command LR To Pos. 2
60 Display Attitude Rates On Error Needles (NON AGS)
61 Display DAP Attitude Error
62 Display Total Attitude Error
63 Start RR/LR Self-Test
64 Start S-Band Antenna Routine (R05)
65 Disable U,V Jets During DPS Burns
66 Set LM State Vector into CSM State Vector
67 W-Matrix Monitor
69 Cause Restart
70 Update Liftoff Time (P27)
71 Universal Update Load Block Addresses (P27)
72 Universal Update Load Singular Addresses(P27)
73 Update LGC Time (Octal) (P27)
74 Initialize Erasable Dump via Downlink
75 Enable U,V Jets During DPS Burns
76 Set Min Impulse Mode in DAP
77 Set Rate Command/Attitude Hold Mode in DAP
78 Start LR Spurious Test (R77)
79 Stop LR Spurious Test (R77)
80 Update LM State Vector
81 Update CSM State Vector
82 Request Orbit Parameter Display (R30)
83 Rendevous Parameter Display (R31)
85 Display RR LOS Az and El
89 Start Rendezvous Final Attitude Maneuver (R63)
90 Request Rendezvous Out of Plane Display (R36) (Non Ave G)
91 Display Banksum (P00 Only)
92 Start IMU Performance Test (P07) (non-flight)
93 Enable W-Matrix Initialization (Clear Rendflg)
95 Inhibit State Vector Update (P20 or P22)
96 Interrupt Integration and Go to P00
97 Perform Engine Fail Procedure (R40)
99 Enable Engine Ignition

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

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

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41	Target Azimuth (Non-Flight)	.01°
	Elevation	.001°
42	Apogee	.1nm
	Perigee	.1nm
	ΔV (Required)	.1fps
43	Latitude (+North)	.01°
	Longitude (+East)	.01°
	Altitude	.1nm
44	Apogee	.1nm
	Perigee	.1nm
	TFF	min-sec
45V-R1	Marks	XXXXX.
	TFI Of Next/From Last Burn	min-sec
	MGA	.01°
46V	Digital Autopilot Configuration	Octal
47V	LM Weight	lbs
	CSM Weight	lbs
48V	Engine Gimbal Pitch Trim (+ Only)	.01°
	Engine Gimbal Roll Trim (+ Only)	.01°
49	ΔR	.1nm
	ΔV	.1fps
	Source Code	0000X.
51	S-Band Antenna	
	Pitch	.01°
	Yaw	.01°
52	Central Angle of Active Vehicle	.01°
54	Range	.01nm
	Range Rate	.1fps
	Theta	.01°
55	No. of Apsis Crossings (or Precision Offsets)	0000X.
	Elevation Angle	.01°
	Central Angle	.01°
56	RR LOS Azimuth	.01°
	Elevation	.01°
58	Perigee Alt. (Post TPI)	.1nm
	ΔV TPI	.1fps
	ΔV TPF	.1fps
59	ΔV LOS Fwd/Aft (+FWD)	.1fps
	ΔV LOS Rt/Left (+RT)	.1fps
	ΔV LOS Up/Dn (+DN)	.1fps

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60	V (Fwd) (+Along +Z)(Requires MODE SEL-PGNS)	.1fps
	H DOT (+ Increasing H)	.1fps
	H (+H>RLS)	ft
61	TG	min-sec
	TFI	min-sec
	Crossrange(+L.S. Is North of S/C)	.1nm
62	VI	.1fps
	TFI	min-sec
	ΔV Accumulated	.1fps
63	VI	.1fps
	H DOT (+ Increasing H)	.1fps
	H (+H>RLS)	ft
64	TR/LPD	sec/deg
	H DOT (+ Increasing H)	.1fps
	H (+H>RLS)	ft
65V	Sampled LGC Time	hrs,min,.01sec
66V-R2	LR Slant Range	ft
	LR Position	00001/00002
67	LR VX	fps
	VY	fps
	VZ	fps
68	Slant Range to LS	.1nm
	TG Braking	min-sec
	LR Alt-Comp Alt (Δ Alt)	ft
69	Ldg Site Correction Comp Z, Y, X	ft
70	AOT Detent/Star Code	Octal
71	AOT Detent/Star Code	Octal
72V	RR Trunnion Angle	.01°
	RR Shaft Angle	.01°
73	Desired RR Trunnion Angle	.01°
	Desired RR Shaft Angle	.01°
74	TFI	min-sec
	Yaw	.01°
	Pitch	.01°
75	ΔH (CDH)	.1nm
	ΔT (CDH-CSI/TPI-CDH)(Modular 60)	min-sec
	ΔT (TPI-CDH/TPI-Nom TPI)(Modular 60)	min-sec
76	V (HOR)	.1fps
	V (VERT)	.1fps
	Crossrange	.1nm

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77	ΔT to Engine Cutoff	min-sec
	Velocity Normal To CSM Plane	.1fps
78	RR Range	.01nm
	RR Range Rate	fps
	TFI	min-sec
79	Cursor Angle	.01°
	Spiral Angle	.01°
	Detent Position	0000X
80	Data Indicator	XXXXX.
	Omega	.01°
81	ΔVX (LV) (+ Fwd)	.1fps
	ΔVY (LV) (+ Rt)	.1fps
	ΔVZ (LV) (+ Dn)	.1fps
82	ΔVX (LV) (+ Fwd)	.1fps
	ΔVY (LV) (+ Rt)	.1fps
	ΔVZ (LV) (+ Dn)	.1fps
83	ΔVX (LM) (+ Up)	.1fps
	ΔVY (LM) (+ Rt)	.1fps
	ΔVZ (LM) (+ Fwd)	.1fps
84	ΔVX (Other Vehicle) + (RXV)XR	.1fps
	ΔVY (Other Vehicle) + (VXR)	.1fps
	ΔVZ (Other Vehicle) + (-R)	.1fps
85	VGX (LM) (+ Up)	.1fps
	VGY (LM) (+ Rt)	.1fps
	VGZ (LM) (+ Fwd)	.1fps
86	VGX (LV) (+ Fwd)	.1fps
	VGY (LV) (+ Rt)	.1fps
	VGZ (LV) (+ Dn)	.1fps
87	Backup Optics LOS Azimuth (+ Rt)	.01°
	Elevation (+ Up)	.01°
88	Celestial Body Vector X,Y,Z	.XXXXX
89	Latitude (+ North)	.001°
	Longitude/2 (+ East)	.001°
	Altitude	.01nm
90	Rendezvous Out of Plane Parameter Y	.01nm
	YDOT	.1fps
	PSI	.01°
91	Alt	10nm
	Vel	fps
	Flt Path Angle	.01°
92	LGC Guidance Throttle Command	%
	HDOT	.1fps
	H (+H>RLS)	ft

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93	Δ Gyro Torquing Angles X, Y, Z	.001°
97	System Test Inputs	XXXXX.
98	System Test Results	XXXXX. .XXXXX XXXXX.
99	W-Matrix: RMS Position RMS Velocity Radar Bias Angle	ft .1fps mr

V50 N25 CHECKLIST CODES

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

N06 or N12 OPTION CODES

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

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00012 Specify CSM Orbit Option

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

V05 N09 ALARM CODES

20105 P **AOT Mark System In Use
Reselect P5X

00107 P More Than 5 Mark Pairs (5 Marks On Surface)
Continue

00111 P Mark Missing
Restart Mark Sequence

00112 P Mark or Mark Reject Not Being Accepted
Continue

00113 H No Inbits
Continue

00114 P Mark Made But Not Desired
Mark Correct Axis (X or Y) Continue

00115 P No Marks in Last Pair to Reject
Continue

00206 P Zero Encode Not Allowed With Coarse Align & Gimbal Lock
Coarse Align To 0,0,0 Then V40N20E

00207 P/H ISS Turn On Request Not Present For 90 sec
CB(11) IMU OPR - Open, Wait 3 Min, & Reclose
If Alarm Recurs And No ISS Warning, Continue

00210 P/H IMU Not Operating
CB(11) IMU OPR - Open, Wait 3 Min, & Reclose
V36E, Consult MSFN, Continue

00211 H Coarse Align Error
If P51, P52, or P57 in Progress, Record Gyro Torquing Angles and Perform Fine Align
Check in P52, P57
If P51 or P52 Not In Progress
Reduce Spacecraft Drift, Continue

00212 H PIPA Fail, But PIPA is Not Being Used
Go to ISS MALFUNCTION PROCEDURES

00213 H IMU Not Operating With Turn-On Request
See 00210

00214 P/H Program Using IMU When Turned OFF
Terminate Program

Basic Date 1/5/70
Changed _____

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

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

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

00402 P FINDCDUW Routine Not Controlling Attitude
GUID CONT - AGS

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

00405 I Two Stars Not Available
See P52/6

00421 I W-Matrix Overflow
Notify MSFN

20430 I **Acceleration Overflow In Integration
Notify MSFN

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

00502 I Bad Radar Gimbal Angle Input
Redo V41N72

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

00510 P Radar Auto Descrete Not Present
RR Mode - LGC, Continue
CB(11) RR(2) - CLOSE

00511 P LR Not In Posl (P63) or 2(P64)
LDG ANT-DES (Hover) Wait 10 sec,AUTO
(P63) If Alarm Recurs, V59E

00514 P RR Out Of Auto Mode While In Use
RR MODE - LGC or V56E

00515 H RR CDU Fail Discrete Present
Notify MSFN, Continue

00520 P/H RADARUPT Not Expected At This Time
Continue

00521 I Could Not Read Radar, See P20/8

00522 P LR Position Change

00523 P LR Ant Not In Position 2, V58E,
LDG ANT-HOVER, PRO

00525 I ΔTHETA >3°
See P20/8 or P22/5

00526 I Range >400 Miles, Terminate P20

Basic Date 1/5/70
Changed 3/9/70

00527 I LOS Not In Mode II Coverage (P22) or Vehicle Mnvr Required (P20)
Terminate If P22
In P20, Mnvr

00530 I LOS Not In Mode II Coverage On Surface After 600 sec
Reselect P22

00600 I Imaginary Roots On First Iteration
See P32/4 or P72/4

00601 I Perigee Altitude (Post CSI) <35,000 ft (Lunar Orbit)
See P32/4 or P72/4

00602 I Perigee Altitude (Post CDH) <35,000 ft (Lunar Orbit)
See P32/4 or P72/4

00603 I CSI To CDH Time <10 Min
See P32/4 or P72/4

00604 I CDH To TPI Time <10 Min Or TIG CDH > TIG TPI
See P32/4 or P72/4

00605 I Number Of Iterations > 15
Program Cannot Converge On CSI Solution
See P32/4 or P72/4

00606 I ΔV Exceeds Max
See P32/4 or P72/4

20607 I **No Solution From Time-Theta or Time-Radius

00611 I No TIG For Given Elevation Angle
See P33/2, P34/3, P73/4, P74/2

00701 I Illegal Option Code Selected
V32E Reselect Option

00777 H PIPA Fail Caused The ISS Warning
Go To ISS Malfunction Procedure

01102 H LGC Self Test Error
Call N08 & Record For MSFN

21103 I **Unused CCS Branch Executed
Copy N08, Notify MSFN, Continue

31104 H *Delay Routine Busy
Reselect Extended Verb

01105 H Downlink Too Fast
If Alarm Recurs, Downlink Failure

01106 H Uplink Too Fast
If Alarm Recurs, Uplink Failure

Basic Date 1/5/70
Changed _____

01107 H Phase Table Failure
Perform:1. V74 LGC DOWNLINK
2. P27 As Necessary
3. V48 As Necessary
4. Reestablish REFSMMAT via P51
If FRESH START Recurs, LGC FAILURE

31201 P *Executive Overflow - No Vac. Areas
Reselect Extended Verb or Continue Program

31202 P *Executive Overflow - No Core Sets
See 31201

31203 P/I*Waitlist Overflow - Too Many Tasks
See 31201

21204 P/I**Waitlist, Var Delay, Fix delay, Longcall, Or Delay Job Called With Zero Or Negative ΔT
Copy NO8, Notify MSFN, Continue

31206 P *Two Jobs Try To Sleep in PINBALL
See 31201

31207 P *No Vac Area For Marks
Reselect P51 or P52

31210 P *Two Routines Using Device at Same Time
Reselect Extended Verb or Prog When Device No Longer In Use
Record NO8, Notify MSFN, Continue

31211 P *Illegal Interrupt of Extended Verb
Reselect P51 or P52

01301 I ARCSIN-ARCCOS Input Angle Too Large
Copy NO8, Notify MSFN, Continue

21302 I **SQRT Called With Negative Argument
See 01301

01406 I Bad Return From Rootpsrs
(** 21406 - Occurs In P63 Ign Algorithm)

01407 P VG Increasing
See P40/IGN or P42/IGN

01410 P/I Unintentional Overflow in Guidance,
Contact MSFN

01412 I Descent Ignition Algorithm Non-Converging
Consult MSFN

21501 P **Illegal Internal Use of PINBALL
See 01301

31502 P *Illegal Flashing Display
See 01301

01520 P V37 Request Not Permitted At This Time
Reselect V37

Basic Date 1/5/70
Changed

01600 H Overflow in Drift Test
Perform V36E
01601 H Bad IMU Torque
01703 P TIG Slipped
01706 P P40 Selected But Staged
P42 Selected But Not Staged
See P40/1 or P42/1
32000 P *DAP Still In Progress At Next TIME5/RUPT
RSET, GUID CONT - AGS Then PGNS; If Alarm
Recurs, V36E, Reinitialize LGC
02001 I Jet Failures Have Disabled Y-Z Trans
Change Quad Isol Valve or Use
Alternate Control Mode
02002 I Jet Failures Have Disabled X Trans
See 02001
02003 I Jet Failures Have Disabled P Rotation
See 02001
02004 I Jet Failures Have Disabled U-V Rotation
See 02001
03777 H ICDU Fail Caused the ISS Warning
Go to ISS Malfunction Procedures
04777 H ICDU, PIPA Fails Caused the ISS Warning
Go to ISS Malfunction Procedures
07777 H IMU Fail Caused The ISS Warning
Go to ISS Malfunction Procedures
10777 H IMU, PIPA Fails Caused The ISS Warning
Go to ISS Malfunction Procedures
13777 H IMU, ICDU Fails Caused The ISS Warning
Go to ISS Malfunction Procedures
14777 H IMU, ICDU, PIPA Fails Caused The ISS Warning
Go to ISS Malfunction Procedures

*Generates Software Restart (3XXXX)
**Abort Code, Program Goes To R00. (2XXXX)

P - Procedure Caused Alarm
I - Input Data Caused Alarm
H - Hardware Status Caused Alarm

Alarms for V05N09
R1 First Alarm After RSET
R2 Second Alarm After RSET
R3 Most Recent Alarm

Basic Date 1/5/70
Changed

GENERAL SYSTEM CHECKOUT

1 Go To P00 By One of the Following:
V37E 00E or
V96E or
V36E V96E (Wait 15 sec Before P00E)

Simultaneously Press RSET And
MARK REJECT (GO JAM)

V37E 00E

REASONABLENESS CHECK

1 V82 With Both Options

2 V83

3 P21 NAV CHECK

4 P52 Check Auto Optics Positioning
IF NOMINAL:
Continue
IF NOT NOMINAL:
Perform P27 Update

5 LGC SELF-TEST

P06 (F 50 25 00062)

1 PRO to STBY Then
PRO to F 37
or
V37E 00E

2 V37E 51E
PRO
V37E 00E

3 V25 N07E, 77E, 10000E, 1E

Basic Date 1/5/70
Changed 1/18/70

P63

1 V37E 00E

V30 OR V31

1 Record N26,
Notify MSFN
V74E
Perform General System Checkout

V36

1 If Unstaged V21 N01E 30000E, 2324E
Perform General System Checkout If Necessary

V92 (P00 ONLY)

1 V37E 00E
V93E

GO JAM

1 V74 when Convenient (See V36)

P06 PGNS PWR DOWN

1		V37E 06E
	F 50 25	00062 POWER DOWN LGC CB(11) IMU OPR - Open PRO Until STBY Lt - ON

P12 POWERED ASCENT

HELIUM MON	- PRESS 2
PRPLNT TEMP/PRESS MON	- ASC
SYS A&B ASC FEED 2 (2)	- OPEN
MAIN SOV (2)	- CLOSE
CRSFD	- OPEN
TTCA (Both)	- 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(ASC) (hrs,min,.01sec) PRO
3	F 06 76	V(HOR),V(VERT),CROSSRANGE (.1fps,.1nm) PRO

```
*F 50 25 R1 00203 PGNS AUTO*
*        NOT SELECTED      *
*   (AUTO) GUID CONT - PGNS*
*       PGNS - 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 1/5/70
Changed ____

CMPTR ACTY Lt - ON

*PROG Lt - On *
V05N09E,1703 TIG SLIPPED
*RSET, KEY REL *

CMPTR ACTY Lt - OFF

-1:00 MASTER ARM - ON

-:35 DSKY BLANKS

-:30 (AVE G ON)
06 74 TFI, FINAL FDAI YAW, PITCH ANGLES
ABORT STAGE - PUSH (min-sec,.01°)
ENG ARM - ASC

-:05
F 99 74 ENGINE ON ENABLE
(AUTO) PRO (Ign When TFI=:00)
(TERM) V37E 00E

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

X-axis override restored
at HDOT = 40 fps plus 12 sec

VI Increasing
HDOT Increasing Then Decreasing
H Increasing

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

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

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

VGX=500fps SYS A MAIN SOV - OPEN
SYS B MAIN SOV - OPEN
SYS A ASC FEED 2-CLOSE
SYS B ASC FEED 2-CLOSE
CRSFD -CLOSE

VGX=200fps, ENG ARM - OFF

APS
OFF NULL COMPONENTS
KEY REL

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

Note VI _____
HDOT _____
H _____
PRO

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

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

Note HA _____
HP _____
TFF _____
PRO To 9

11 F 37

Basic Date 1/5/70
Changed — 1/18/70

P20 RENDZ NAV

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

2 (If Pointing Error <15°, To 4; Mnvr With No Display)
F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT: PGNS - AUTO
PRO
(MAN) MODE CONT: PGNS - ATT HOLD
MNVR
PRO To 2
(BYPASS) ENTR To 4 (To 9 If Entered From 9 Via V32E)
(To 6 If Entered From 6 Via ENTR)

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

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

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

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

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

Basic Date 1/5/70
Changed— 1/18/70

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

8 NO TRACK LITE

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

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

ON NO LOCK
F 05 09 00503 RR NO DATA GOOD 30 SEC(or Desig. Fail)

(REDESIG) V32E To 4
(SEARCH) PRO To 9

Basic Date 1/5/70
Changed

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

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

                P21 GROUND TRACK DETERMINATION

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

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

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

4    F 37
```

P22 LUNAR SURFACE NAVIGATION

1 V95E
V37E22E
(To TERM-V56E)
(SV OPTION, V81E CSM, V95E NONE)

F 04 06 R1 00012 CSM ORBIT OPTION
R2 00001 CSM WILL NOT CHANGE ORBIT
00002 CSM WILL CHANGE ORBIT
V83E, Rng <400, PRO
(OPT 1) PRO To 3
(OPT 2) PRO To 2

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

3 RR MODE - LGC To 5
- SLEW or AUTO TRACK To 4

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

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

5 NO TRACK Lt:

OUT DSKY BLANKS, RR TAKING MARKS
(P22 Continues To Run In Background)

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

Basic Date 1/5/70
Changed __ 1/18/70

(RR TRUN, SHFT) V16N72E (.01°)
KEY REL

```
*F 05 09 00525 SV/RR LOS >3°          *
*        PRO                          *
*F 06 05 SV/RR LOS (.01°)             *
*        (REJECT) CHECK SIDE LOBE     *
*                 RR MODE - LGC       *
*                 V32E To 5           *
*        (UPDATE) PRO To 3 or below   *
*F 06 49 ΔR,ΔV,Code(.1nm,.1fps,       *
*                          0000X)     *
*                  X=1, RANGE         *
*                  X=2, RDOT          *
*        (UPDATE) PRO To 5            *
*        (REREAD) V32E To 5           *
```

ON

F 05 09 00503 RR DESIG FAIL
(REDESIGN) ENTR To 3
(SEARCH) PRO To 6
(TERM) V56E

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

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

Basic Date 1/5/70
Changed _____

P25 PREFERRED TRACKING ATT

1 V37E 25E
(To TERM - V56E)
(If Pointing Error <15°, To 3; Mnvr With No Display)
F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT: PGNS - AUTO
PRO
(MAN) MODE CONT: PGNS - ATT HOLD
MNVR
PRO To 1
(BYPASS) ENTR To 3

2 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
Monitor Auto Mnvr, To 1

3 P25 Continues To Run
In Background Until Terminated

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

P27 LGC MANUAL UPDATE

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

2 V37E 00E

3 IF AGS OPERATING, 563 + 00000E
(Prevents Inadvertent Update of AGS
S.V From PGNS Downlink)

4 V70E Update Lift Off Time
or V71E Load Consec Data
or V72E Load Singular Data
or V73E Increment LGC Time
(Update Form Will Format Index Number,
Address, Data & Component Identifier
To Be Usable With The Following Pro-
cedure)

Basic Date 1/5/70
Changed 1/18/70

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

6 F 21 01 Repeat Step 5 For All Data

7 F 21 02 R3 Goes To 1166 When Data Load Complete

TO REVIEW DATA
V01 N01E, 1173E
R1 Data
N15E (R3 1174)
ENTR Verify Data For Remaining Comps.
KEY REL To 7

TO CHANGE DATA
Load Comp Identifier XX E
Correct Data E
Go To 7

TO ACCEPT UPDATE
V33E

8 P00 Displayed

Basic Date 1/5/70
Changed 1/18/70

P30 EXTERNAL ΔV

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

P32 CSI PRETHRUST

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

```
                    *F 05 09 00600 No Intersection On     *
                    *              First Iteration        *
                    *         00601 POST CSI ALT <35,000 ft*
                    *         00602 POST CDH ALT <35,000 ft*
                    *         00603 TIG(CDH)-TIG(CSI)<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)
               PRO                          (.1nm,min-sec)

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

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

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

9    F 37
```

P30-P35

Basic Date 1/5/70
Changed _____

P33 CDH PRETHRUST

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

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

*F 05 09 00611 NO TIG FOR *
* SPECIFIED ANGLE *
* (REDO)V32E To 1 *
* (CONTINUE) PRO To 3 *

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

4 F 06 81 ΔV XYZ (LV) CDH (.1fps)
(For Out-of-Plane Corr in Final Comp ONLY)
V90E
F 06 16 GET EVENT (hrs,min,.01sec)
PRO
F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
Record YDOT
PRO
(Insert Neg YDOT in R2 of ΔV CDH)
PRO (If Recycling To 2)

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

6 F 37

P34 TPI PRETHRUST

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

Basic Date 1/5/70
Changed

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

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

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

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

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

6 F 06 81 ΔV XYZ (LV) TPI (.1fps)
PRO

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

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

9 F 37

P35 TPM PRETHRUST

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

Basic Date 1/5/70
Changed

2 F 06 81 ΔV XYZ (LV) TPM (.1fps)
PRO

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

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

5 F 37

P40 DPS THRUST

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

1 V37E 40E

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

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

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

*F 50 25 R1 00203 *
* GUID CONT - PGNS *
* MODE CONT (PGNS)-AUTO*
* THR CONT-AUTO *
* PRO *
* (BYPASS) ENTR *

Basic Date 1/5/70
Changed 3/9/70

P40-P47

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

*PROG Lt - On *
V05 N09E 01703 TIG SLIPPED
* RSET,KEY REL *

-:35 DSKY BLANKS

-:30 ENG ARM - DES
06 40 (AVE G ON)

-:15 VERIFY ΔVM (R3) <00005

-:07.5 Verify +X ULLAGE

-:05
F 99 40 ENG ON ENABLE
(AUTO) PRO (IGN WHEN TFI=:00sec)
(BYPASS) ENTR To DPS OFF

IGN 06 40 TFC, VG,ΔVM (min-sec,.1fps)

*F 97 40 *
* (RECYCLE ΔV MON) PRO *
* (RECYCLE) ENTR To TIG -5 *
* (TERM) ENG ARM-OFF V34E To 5*
* *
* PROG Lt-On *
* V05N 09E 01407 VG INCREAS- *
* ING *
* TERM BURN OR SWITCH *
* TO AGS *

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

Basic Date 1/5/70
Changed 1/18/70

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

5 F 37 MASTER ARM -OFF
ENG STOP -Reset
PRPLNT QTY MON -OFF
HELIUM MON -OFF

P41 RCS THRUST

TTCA (CDR) - JETS
EVENT TIMER- Set
DAP - Set

1 V37E 41E
F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT: PGNS - AUTO
PRO
(MAN) MODE CONT: PGNS - ATT HOLD
MNVR
PRO To 1
(BYPASS) ENTR To 3

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

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

MODE CONT: PGNS - ATT HOLD

-:35 DSKY BLANKS

-:30
16 85 (AVE G ON)

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

4 F 37

Basic Date 1/5/70
Changed

P42 APS THRUST

HELIUM MON -ASC PRESS 2
PRPLNT TEMP/PRESS MON -ASC
TTCA (CDR) -JETS
DAP -Set

1 V37E 42E

```
*F 05 09 01706 LM NOT STAGED   *
*  (TERM) V34E                 *
*  (BYPASS) PRO To 2, Man Stage*
*    At -:10                   *
```

2 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT: PGNS - AUTO
PRO
(MAN) MODE CONT: PGNS - ATT HOLD
MNVR
PRO To 2
(BYPASS) ENTR To 4

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

```
*F 50 25 R1 00203          *
*  GUID CONT-PGNS          *
*  MODE CONT (PGNS)-AUTO   *
*  PRO                     *
*(BYPASS) ENTR              *
```

4 06 40 TFI,VG, ΔVM (min-sec,.1fps)

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

EVENT TIMER-SET
MASTER ARM-ON (Unstaged)

-:35 DSKY BLANKS

-:30 ENG ARM - ASC
06 40 (AVE G ON)

-:15 Verify ΔVM (R3) <00005
If Unstaged:

-:14 MANUAL ULLAGE

-:10 STAGE - FIRE
(MASTER ARM - OFF When Desired)

Basic Date 1/5/70
Changed 3/9/70

-:05
F 99 40 ENG ON ENABLE
-:03.5 Verify +X ULLAGE
(V34E NO ULLAGE, ENG ARM-OFF, To 6)
(AUTO)PRO (IGN WHEN TFI=:00 sec)
(BYPASS) ENTR To APS OFF

IGN 06 40 TFI, VG,ΔVM (min-sec,.1fps)

*F 97 40 *
*(RECYCLE ΔV MON) PRO *
*(RECYCLE) ENTR TO TIG -5 *
*(TERMINATE) ENG ARM-OFF *
* V34E To 6 *

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

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

6 F 37

P47 ΔV MONITOR

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

2 F 37

Basic Date 1/5/70
Changed 1/18/70

P51 IMU ORIENTATION

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

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

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

3 F 54 71 MARK X(52) and Y(53)
PRO
(For DE=00
F 06 88 CELESTIAL BODY VECTOR
Load Vector Values
PRO)
(After 1st Star) To 2
(After 2nd Star) To 4

4 F 06 05 R1 STAR ANGLE DIFFERENCE (.01°)
(RECYCLE) V32E To 1
PRO

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

P52 IMU REALIGN

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

Basic Date 1/5/70
Changed _____

2 F 06 34 GET ALIGN (hrs,min,.01sec)
(0,0,0 For Present Time)
(TLAND FOR OPT 4)
(OPT 2) PRO To 4
(OPT 4) PRO To 3

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

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

5 F 50 25 R1 00013 (COARSE ALIGN)
(NORMAL) PRO To 6 NO ATT Lt-On Then Off
(GYRO TORQUE) MODE CONT (PGNS)-ATT HOLD
V76E
ENTR

16 20 PRESENT ICDU ANGLES OG,IG,MG (.01°)
When Torquing Complete To 14

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

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

(MAN ACQ) ENTR

7 F 01 70 R1 00CDE (C)DETENT (DE)STAR CODE
C 0-COAS/LPD CALIBRATION 1-L, 2-F, 3-R
4-RR, 5-CL, 6-LR
7-COAS(+00000, +00000)FWD
(+00000, +09000)OVHD
(TERM) V34E
PRO
(For C=0 or 7
F 06 87 AZ,EL (.01°)
PRO)
(For DE=00
F 06 88 CELESTIAL BODY VECTOR
Load Vector Values
PRO)

Basic Date 1/5/70
Changed _____

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

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=7
F 06 87 AZ,EL (.01°)
PRO)

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

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

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

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

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

Basic Date 1/5/70
Changed

RAPID IMU REALIGN

NOTE: This Procedure Assumes A Good AGS Alignment

1 Fly Spacecraft to 0°,0°,0° On AGS Inertial Ball

2 V41 N20E
E,E,E, (Coarse Align IMU To 0°,0°,0° Body)

3 V40 N20
Verify 0°,0°,0° On AGS Ball - ENTR
(Releases Platform and Recovers PGNS Control Modes)
Wait 15 sec

4 V37E 51E
PRO On First Display (Sets Drift Flag)
V37E 00E

5 V25 N07E
77E, 10000E, 1E (Sets REFSMMAT FLAG)

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

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

Basic Date 1/5/70
Changed

P57 LUNAR SURFACE ALIGNMENT

1 V37E57E

```
*PROG Lt - On                    *
*V05N09E  00210 IMU              *
*         NOT ON                 *
*CB(11) PGNS:  IMU OPR - Close*
*RSET & KEY REL, P57E            *
```

F 04 06 R1 00001 IMU ALIGN OPT
R2 00001 PREF PRO To 3
3 REFSMMAT PRO To 3
4 LANDING SITE PRO To 2

2 F 06 34 T ALIGN (hrs,min,.01sec)
(LDG SITE) T ALIGN = 0,0,0 For Present Time
PRO

3 F 05 06 R1 00010 SPECIFY ALIGNMENT TECHNIQUE (A/T)
R2 0000X
X = 0 Stored Attitude or REFSMMAT
1 REFSMMAT & Gravity
2 Celestial Bodies (2)
3 Gravity & Celestial Body (1)
R3 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
(IMU ON & ALIGNED & A/T 0) PRO To 14
(IMU ON & ALIGNED & A/T 2) PRO To 6
(IMU NOT ALIGNED & 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 1/5/70
Changed 3/25/70

4 Determination of Lunar Gravity
ATTITUDE MON - PGNS
V16N20E Monitor Coarse Align (.01°)
R1 +04200
R2 +31800
R3 +03525
NO ATT Lt - On Then Off (Twice)
*PROG Lt - On *
V05N09E 00211 & 00217
KEY REL

5 F 06 04 (+) GRAVITY ERROR ANGLE (.01°)
(RECYCLE) V32E To 4
(TERM) V34E, Select New Prog
PRO To 13

6 F 01 70 R1 OOCDE (C) DETENT (DE) STAR CODE
(DETENT) 1-L, 2-F, 3-R, 4-RR, 5-CL, 6-LR
PRO (Go to 8 If DE >45 or = 00)

*PROG Lt - On *
F 05 09 00404 Defined Star
* Not Available In *
* Any Detent *
*(CREW SPECIFY) PRO To 8 *
*(LGC CALC N79) V32E To 6 *

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

*PROG Lt - On *
*V05N09E *
* 20105 AOT Mark System*
* In Use *
* 31207 No VAC Area *
* For Marks *
* 31211 Illegal *
* Interrupt of *
* Extended Verb *
*V37E XXE *

Basic Date 1/5/70
Changed 3/25/70

8	F 01 71	R1 OOCDE (C) DETENT, (DE) STAR CODE PRO
9	F 54 71	MARK X OR Y (REDEFINE STAR) ENTER To 8 MARK
10	F 06 79	CURSOR, SPIRAL, POSITION CODE (.01°) (TERM) V34E, Select New Prog (RECYCLE) V32E To 9 (MARKS COMPLETE) PRO (FOR DE = 00 F 06 88 CELESTIAL BODY VECTOR Load Vector Values PRO) (After First Star) To 6 (If Option 00003 To 11) (After Second Star) To 11
11	F 06 05	STAR ANGLE DIFFERENCE (.01°) (REJECT) V32E To 14 (ACCEPT) PRO (TERM) V34E
12	F 06 93	GYRO TORQUING ANGLES X,Y,Z (.001°) (REJECT) V32E To 14 (ACCEPT) PRO To 14 (TERM) V34E

Basic Date 1/5/70
Changed 3/25/70

P63-P68

13 F 06 22 ICDU ANGLES OG,IG,MG (.01°)
PRO
NO ATT Lt - On Then Off
(If A/T 2 or 3 To 6)
(If A/T 1 To 11)

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,
ENTR To Readout Present LM
Lunar Position (Step 15)

15 F 06 89 LAT, LONG/2, ALT (.001°,.01nm)
(TERM) V34E
(ACCEPT) PRO

16 F 37

P63 BRAKING PHASE

1 V37E 63E
*PROG Lt-On *
*V05N09E 01412 IGN *
* ALGORITHM NOT *
* CONVERGING *
* (TERM) V37E00E *
* *

Basic Date 1/5/70
Changed 3/25/70

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°)
(AUTO or TRIM) GUID CONT: PGNS
MODE CONT: PGNS - AUTO
PRO
(MAN) MODE CONT: PGNS - ATT HOLD
MNVR
PRO To 4
(BYPASS) ENTR To 6

5 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
Mon Auto Mnvr To 4

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

Basic Date 1/5/70
Changed

```
6       06 62   VI,TFI, VM          (.1fps,min-sec,.1fps)

    59:25       DSKY BLANKS
                ENG ARM - DES

    59:30
        06 62   AVE G ON

    59:45       Verify ΔVM (R3) <00005

    59:55
      F 99 62   ENG ON ENABLE
                VERIFY +X ULLAGE
                PRO
            (NO ULLAGE) V34E Exit P63

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

                        *(DPS ABORT) ABORT - PUSH       *
                        *(APS ABORT) ABORT STAGE - PUSH*

        40,000 ft V57E
        F 06 68   SLANT RANGE, TG, ΔH(LR-LGC)
                                  (.1nm, min-sec, ft)
             (UPDATE) PRO
             (EXIT V57) V34E (To 06 63)

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

Basic Date 1/5/70
Changed 1/18/70

(MAN ATTITUDE CHECK)
MODE CONT (PGNS) - ATT HOLD

ALT & VEL Lt - On
* RANGE/VELOCITY *
* NOT GOOD *
*PROGRAM Lt - On *
* V05N09E *
* 00511 LR Not in *
* Pos 1 *
*LDG ANT-DES,Wait *
* 10sec, Then AUTO *
*If Alarm Recurs, *
*V59E *

+08:30 P64 Displayed

P64 APPROACH PHASE

1 P64 Displayed

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

F 05 09 00523 LR DID NOT
* ACHIEVE POS 2 *
* V58E *
*(RECHECK POS 2) V32E *
*(TERM R12) V34E *
*(CONTINUE UPDATE) LR *
* ANT-HOVER, PRO *

Monitor Attitude Change
To Enable Landing Site
Visibility.

(MAN THROT) TTCA - Advance Until
Thrust = 10%
THR CONT - MAN
V16N92E
(To Return To Auto Throttle
THR CONT - AUTO
TTCA - Min
KEY REL)

Basic Date 1/5/70
Changed 3/9/70

(MAN ATTITUDE CHECK) MODE CONT (PGNS)-ATT HOLD
(TO USE LPD) PRO
(Nominal Landing Site) To 5 When TR=0

3 06 64 Observe Nominal Landing Site
Using LPD And N64 LPD Display.

4 Redesignate Landing Site
As Desired (+Pitch Redesignates Landing Site Toward LM. Each ROLL Input Changes The Landing Site Position By 2°Az; PITCH By .5°Elev.)

5 P66 Displayed

P66 LANDING PHASE (ROD)

1 P66 Displayed

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

(To Manually Null Forward & Lateral Velocities,
MODE CONTROL (PGNS) - ATT HOLD
Null Pitch (Fwd) & Roll (Lat)
Attitude Error Needles)

(MAN THROT) TTCA - Advance Until:
THRUST =10%
THR CONT - MAN
V16N92E

3 H(Actual)=5.6 ft LUNAR CONTACT Lt - On
ENGINE STOP - Push
PRO

TD+3:00 V37E 68E To P68

Basic Date 1/5/70
Changed 3/25/70

P68 LANDING CONFIRMATION

V37E 68E

2 F 06 43 LAT(+NORTH),LONG(+EAST),ALT (.01°,.1nm)

RECORD LAT _____°

LONG _____°

ALT _____nm (Nominal zero)

PRO

3 F 37

Basic Date 1/5/70
Changed _____

P70 DPS ABORT

1 ABORT-PUSH (From P63,64,66) or V37E 70E
*F 50 25 R1 00203 *
* GUID CONT - PGNS *
* MODE CONT: PGNS - AUTO*
* THR CONT - AUTO *
* PRO *

2 06 63 VI,H DOT,H (.1fps,ft)
VI Increasing
H DOT Remains Positive
H Increasing

H<25000 & $\dot{H}$<00400-Monitor Att. Mnvr To LV With Windows Downrange.

X-OVRD Inhibited. After $\dot{H}$>00400 Monitor Mnvr To Abort Att; X-OVRD Restored 12 sec After Initiation of Mnvr

H>25000-Monitor Att. Mnvr To Abort Att. With Windows Downrange. X-OVRD Restored.

(To Monitor Time To Go And Crossrange Velocity)
V16 N77E

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

3 16 85 VG XYZ (LM) (.1fps)
(If Burn >400 sec,
PDI + 6:20
DES REG (2) - CLOSE
VGX = 100 fps
DES ENG CMD OVRD - OFF
ENG ARM - OFF)

DPS OFF NULL COMPONENTS
KEY REL

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

P70 - P71

Basic Date 1/5/70
Changed 3/9/70

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

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

PER ALT _____ nm,

TFF _____ min-sec
PRO To 5

7 F 37

P71 APS ABORT

1 ABORT STAGE -Push (From P63,64 ,66,70)
or V37E 71E
*F 50 25 R1 00203 *
* GUID CONT - PGNS *
* MODE CONT: PGNS - AUTO *
* PRO *

APS
IGN 06 63 VI,H DOT,H (.1fps,ft)
ENG START - Push
ENG ARM - ASC
If ENG STOP Lt - On
ENG STOP - Reset
BAL CPL-ON
SYS A&B ASC FEED 2 (2) - OPEN
MAIN SOV(2)-CLOSE
CRSFD - OPEN

VI Increasing
H DOT Remains Positive
H Increasing

Basic Date 1/5/70
Changed 3/9/70

H<25000 & H<00400-Monitor Att. Mnvr To LV With Windows Downrange.

X-OVRD Inhibited. After H>00400 Monitor Mnvr To Abort Att; X-OVRD Restored 12 sec After Initiation Of Mnvr.

H>25000-Monitor Att. Mnvr To Abort Att. With Windows Downrange. X-OVRD Restored.

(To Monitor Time To Go And Crossrange Velocity)
V16 N77E

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

2 16 85 VG XYZ (LM) (.1fps)
VGX = 500 fps, CRSFD - CLOSE
MAIN SOV (2) - OPEN
SYS A&B ASC FEED 2(2)-CLOSE
VGX = 200 fps,
ENG ARM - OFF

*NO Cutoff *
* ABORT STAGE - Push Then Reset*

Basic Date 1/5/70
Changed 3/9/70

APS OFF NULL COMPONENTS
KEY REL

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

P72 CSM CSI TARGETING

1		V37E 72E
	F 06 11	TIG (CSI)/T(APOAPSIS) (hrs,min,.01sec) PRO If Zero, T (APOAPSIS) Displayed
2	F 06 55	APSIS (CDH), E (+0000X,.01°) R3, 0000Y For Y ≠ 0, CDH At CSI + Multiple Of 180° Specified By R1(X) PRO
3	F 06 37	TIG TPI (hrs,min,.01sec) PRO
4	F 16 45	M,TFI,MGA (-00001) (marks,min-sec,.01°) (RECYCLE) V32E (TERMINATE MARKS) PRO

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

5	F 06 75	ΔH(CDH),ΔT(CDH-CSI),ΔT(TPI-CDH) PRO (.1nm,min-sec)
6	F 06 81	ΔVXYZ (LV) (CSI) (.1fps) PRO
7	F 06 82	ΔVXYZ (LV) (CDH) (.1fps) PRO

Basic Date 1/5/70
Changed

P72-P76

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

9    F 37
```

P73 CSM CDH TARGETING

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

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

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

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

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

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

5    F 37
```

P74 CSM TPI TARGETING

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

2 F 06 55 N,E,CENTANG (0000X,.01°)
PRO
(To Calculate E At TIG Time)
+00000 In R2

*(Calculate E Only) *
*F 05 09 00611 NO SOL *
* PRO To 1 Retarget*

3 F 16 45 M,TFI,MGA (-00001) (marks,min-sec,.01°)
(RECYCLE) V32E
(TERMINATE MARKS) PRO
(FINAL PASS,MGA,-00002) SET EVENT TIMER
PRO To 8
Transmit Parameters To CSM

4 F 06 37 TIG TPI (hrs,min,.01sec)
PRO
(If E Computed, This Display
Replaced By V06N55 As In 2 Above)

5 F 06 58 HP,ΔV(TPI),ΔV(TPF) (.1nm,.1fps)
PRO To 7 (Final Pass To 6)

6 F 06 81 ΔVXYZ (LV) (.1fps)
PRO

7 F 06 59 ΔVXYZ(LOS) (.1fps)
PRO To 3

8 F 37

Basic Date 1/5/70
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

1 V37E 76E
F 06 33 TIG (hrs,min,.01sec)
PRO

2 F 06 84 ΔV(LV) XYZ (.1fps)
PRO

3 F 37

Basic Date 1/5/70
Changed

V40 N20 ICDU ZERO

1 V40 N20E

*PROG Lt - On *
*V05 N09E 00206 ISS IN *
* COARSE ALIGN & GIMBAL *
* LOCK *
*Coarse Align To 0,0,0 Then *
* Reselect V40 N20 *

NO ATT Lt - OFF

2 Wait 15 sec Then Continue Program In Progress

V41N20 COARSE ALIGN IMU

1 V41N20E

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

2 41 COARSE ALIGN
NO ATT Lt - On
FDAI Torques

*PROG Lt - On *
*V05N09E 00211 COARSE *
* ALIGN ERROR *
V16N22E Compare N22 With
* N20 *
*Repeat V41N20 *

V41N72 COARSE ALIGN RR

1 RR MODE - LGC

2 V41N72E

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

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

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

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

V42 GYRO TORQUING

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

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

V43 FDAI BIAS CHECK

1 MODE CONT: PGNS - OFF

2 V37E00E

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

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

5 Verify FDAI Needles Return To 0,0,0

Basic Date 1/5/70
Changed

V47 AGS INITIALIZATION

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

V48 DAP CONFIGURATION

1		V48E
	F 01 46	DAP CONFIGURATION (ABCDE)
	(CONFIG) A	1- ASCENT
		2- DESCENT
		3- DOCKED
	(X-TRANS)B	0-2 JET RCS A, 1-2 JET RCS B,
		2-4 JET RCS A, 3-4 JET RCS B
	(SCALE) C	0-Fine(4°/sec) (.4°/sec If Docked)
		1-Normal (20°/sec) (2°/sec If Docked)
	(ATTDB) D	0-.3°, 1-1°, 2-5°
	(RATE) E	0-.2°/sec, 1-.5°/sec,2-2°/sec
		3-10°/sec
		PRO

Basic Date 1/5/70
Changed

2 F 06 47 LM WT, CSM WT (lb)
PRO (Terminates If Staged)

3 F 06 48 ENGINE GIMBAL TRIM PITCH, ROLL (.01°)
ENG GMBL - ENABLE
ENG STOP - PUSH
ENG ARM - DES
(TRIM) PRO (ENG GMBL Lt - On
When Gimbals Reach Limits)
(EXIT) V34E

4 F 50 48 TRIM COMPLETE
Continue Interrupted Program
PRO
ENG ARM - OFF (ENG GMBL Lt-OFF)
ENG STOP - Reset

V49 CREW DEFINED MANEUVER

1 V37E00E

2 V49E
F 06 22 NEW ICDU ANGLES YPR (.01°)
PRO

3 F 50 18 REQUEST MNVR TO FDAI RPY (.01°)
(AUTO OR TRIM) GUID CONT: PGNS
MODE CONT: PGNS - AUTO
PRO
(MAN) MODE CONT: PGNS - ATT HOLD
MNVR
PRO To 3
(BYPASS) ENTR (Exit V49)

4 06 18 AUTO MNVR TO FDAI RPY ANGLES
Mon Auto Mnvr To 3

Basic Date 1/5/70
Changed

V55 INCREMENT LGC TIME

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

V64 S-BAND ANTENNA

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

V67 W-MATRIX ERROR DISPLAY

1 V67E
F 06 99 POS ERR, VEL ERR, RADAR BIAS ERR (ft,
(REINITIAL) V25E, Load Values .1fps,mr)
PRO

V74 LGC DOWNLINK

1 V74E (42 sec)

V82 ORBIT PARAMETER DISPLAY

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

2 F 16 44 HA,HP,TFF (.1nm,min-sec)
(UPDATE) V32E (Not Required If AVE G-On)
(If TFF = -59:59) N32E Time From Perigee
PRO (hr,min,.01sec)

V83 RENDEZVOUS PARAMETER DISPLAY

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

Basic Date 1/5/70
Changed 3/9/70

V85 RR LOS, ELEV DISPLAY

1 RR MODE - LGC

2 V85E
F 16 56 AZ, ELEV (.01)°
(TERM) PRO

V89 RENDEZVOUS FINAL ATTITUDE

1 V37E00E

2 V89E
F 04 12 R1 00003 SPECIFY TRACKING ATTITUDE
R2 00001 (+Z AXIS)
00002 (+X AXIS)
PRO

3 F 06 18 FINAL FDAI RPY ANGLES (.01°)
(AUTO MNVR) PRO
(RECALCULATE) V32E To 3

4 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO OR TRIM) GUID CONT: PGNS
MODE CONT: PGNS - AUTO
PRO
(MAN) MODE CONT: PGNS - ATT HOLD
MNVR
PRO To 4
(BYPASS) ENTR (EXIT V89)

5 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)
Mon Auto Mnvr To 4

V90 OUT-OF-PLANE DISPLAY

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

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

Basic Date 1/5/70
Changed

PGNS TURN-ON AND SELF-TEST

1 If STBY Lt - On, PRO

2 V35E
F 88 88 DSKY LIGHT CHECK
(Master Alarm, LGC & ISS Warning And ALL DSKY Lts - On, 8's In All Registers, Lts Reset In 5 sec)

3 CB(11) IMU OPR - Close
(NO ATT Lt - On For 90 sec)
Wait 20 sec After NO ATT Lt.-Off, Then V37E 00E

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

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

6 V21 N27E 10E (Test Fixed And Erasable Memory)
15 01 R1 Number Of Errors
R2 Number Of Tests Started
R3 Number Of Tests Successful
(Test Successful If R2≥3 Within 78 sec)

*PROG Lt - On		*
*	V05N09E 01102 SELF-	*
*	TEST ERROR	*
*N08E	Record For MSFN	*
*		*
*	R1 _____	*
*		*
*	R2 _____	*
*		*
*	R3 _____	*

7 V21 N27E 0E TERMINATE SELF TEST

Basic Date 1/5/70
Changed 2/13/70

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

PGNS ORDEAL INITIALIZATION

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

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

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

4 V83E
F 16 54 R, RDOT, THETA (.01nm,.1fps,.01°)
MODE - HOLD/FAST
SLEW - To THETA
MODE - OPR/SLOW
PRO

PIPA BIAS CHECK

1 EVENT TIMER - Zero
Rates <.1°/sec With No Thruster Firing

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

3 V06E
06 21 XYZ PIPA COUNTS (+XXXXX.)

4 At T+80sec - ENTR
T+80sec (X)R1___ (Y)R2 ___ (Z)R3 ___

5 Calculate XYZ Bias:
Take Last 3 Digits Of Displayed
Bias And Add 2 Zeroes

X _____

Y _____

Z _____

6 V06N01E, 1452E (Review X Bias) E
1454E (Review Y Bias) E
1456E (Review Z Bias)

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

LGC CLOCK INITIALIZATION

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

_____(min)

_____(sec)
COMPUTE CSM/LM ΔT

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

Basic Date 1/5/70
Changed _____

LANDING RADAR SELF TEST

1		CB(11) PGNS: LDG RDR - Close X-POINTERS(Both) - HI MULT TEMP MON - LDG RDR (50° - 70°F) RATE/ERR MON - LDG RDR/CMPTR RNG/ALT MON - ALT/ALT RATE LDG ANT - DES MODE SEL - LDG RDR
2		RADAR TEST - LDG(Alt And Alt Rt Tapes Drive) TEST MONITOR - ALT XMTR (2.1 To 5.0) (3.0v) - VEL XMTR (2.1 To 5.0) (3.0v) ALT/ALT RT MON - +7900 To +8100 ft/-478 To -482 fps
3		XPOINTER - UP, RT
4	F 04 12	V63E INITIATE RDR SELF TEST R1 00004 SPECIFY RDR R2 00001 RNDZ RDR V22E 2E LDG RDR PRO
5	F 16 66	SLANT RANGE, ANT POSITION (ft) R1 + 08276 To +08296 (+08286) R2 + 00001 PRO
6	F 16 67	VX,VY,VZ (fps) R1 -00495 (±2) R2 +01862 (±2) R3 +01331 (±2) V34E (If Antenna Not Commanded To HOVER, Go To 13)
7		LDG ANT - AUTO
8		V59E COMMAND ANT TO POS 2 (22 Sec) V37E00E

LGC CLOCK INIT.;
LR, RR SELF TEST

Basic Date 1/5/70
Changed 2/13/70

9 V63E INITIATE RDR SELF TEST
F 04 12 R1 +00004 SPECIFY RDR
R2 +00001 RNDZ RDR
V22E 2E LDG RDR
PRO

10 F 16 66 SLANT RANGE, ANT POSITION
R1 +08276 To +08296
R2 +00002

11 LDG ANT - DES (10 sec)
F 16 66 R2 +00001 (PROG Lt-On, V05N09E,00522 RSET)

12 LDG ANT - AUTO
F 16 66 R2 +00001
V34E

13 If Total Attitude Error Desired On FDAI:
V62E

14 RDR TEST - OFF
CB(11) PGNS: LDG RDR - Open

RNDZ RDR SELF TEST

1 VERIFY: CSM RCS THRUSTER B3 - OFF
: RADAR XPONDER - OFF
RNDZ RDR ANT - Released
X-POINTERS (Both)-HI MULT
RATE/ERR MON (Both) - RNDZ RADAR
ATTITUDE MON (Both) - PGNS
RNG/ALT MON - RNG/RNG RATE
SHFT/TRUN - +50°
RR MODE - SLEW
TEMP MONITOR - RNDZ (+10° To +145°)

2 CB(11) AC BUS A: RNDZ RDR - Close
: RNG/RNG RT/ALT/ALT RT-
Close(Wait 30 sec)
RR GYRO SEL - SEC
CB(11) PGNS: RNDZ RDR - Close
(NO TRACK Lt-On)
FLIGHT DISPLAYS: RNG/RNG RT/ALT/ALT RT-
Close

Basic Date 1/5/70
Changed 2/13/70

3		SLEW RATE - HI Slew Left To Mode I Region (18 sec) Slew Right, Down, Left, Up (FDAI Needles Right, Down, Left, Up) SLEW RATE - LO SHAFT/TRUN - ±5° Slew Right, Down, Left, Up (FDAI Needles Right, Down, Left, Up)
4		RR MODE - AUTO TRACK RADAR TEST - RNDZ RDR (Rng Rt Tape Drives, X-Pointers and FDAI Needles Vary Between ±5°. After 12 sec, Rng Tape Drives, NO TRACK Lt - Out)
5		TEST MONITOR - AGC (1.0 To 1.8) (1.6) - XMTR PWR (2.1 To 4.1) (2.4) - SHAFT ERR(2.0 To 2.8@1/2cps) - TRUN ERR (2.1 To 2.7@1/2cps) - AGC
6		Set NORRMON Flag V25 N07E 101E, 10E, 1E RR MODE - LGC (NO TRACK Lt - On, Wait 10 sec)
7	F 04 12	V63E START RNDZ RDR SELF TEST R1 00004 SPECIFY RADAR R2 00001 RNDZ RADAR PRO NO TRACK Lt - Out After 12 sec
8	F 16 72	RR TRUN, SHAFT (.01°) R1 Varying @1/2 cps R2 Varying @1/2 cps PRO
9	F 16 78	RNG, RNG RT, TFI (.01nm,fps,min-sec) R1 +195.39 To +195.79 (TM Within±1.2 of R1) R2 -00475 To -00517 (TM=2<R2)
10		V34E

Basic Date 1/5/70
Changed 3/9/70

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

12 V40N72E RRCDU ZERO (10 sec)

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

14 SHFT/TRUN - ±5°
RR GYRO SEL - PRIM
V41N72E
N73 R1 +35600
R2 +35600
N12 R2 00002
V16N72E (Verify FDAI Needles)
V44E

15 V41N72E
N73 R1 +00000
R2 +28300
N12 R2 00002
V16N72E

CB(11) PGNS: RNDZ RDR - Open
AC BUS A: RNDZ RDR - Open
V44E
Notify CSM To Enable Thruster B3 If Docked

Basic Date 1/5/70
Changed

LGC THRUSTER INHIBIT

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

A1U - 100E	B4U - 1E
B1D - 200E	A4D - 2E
A1F - 4E	B4F - 2E
B1L - 200E	A4R - 100E
B2U - 20E	A3U - 4E
A2D - 40E	B3D - 10E
A2A - 10E	B3A - 1E
B2L - 20E	A3R - 40E

2 1E

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

3 V48E,PRO,V34E

RR BIAS INITIALIZATION

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

LPD BIAS LOAD

1 V21 N01E, 3373E
(AZ BIAS - Octal) ENTR

2 ENTR, 1356E
(EL BIAS - Octal) ENTR

ALTERNATE LPD BIAS LOAD

1 V21 N03E, (ADD) E
ADD = 3373 For AZ BIAS
= 1356 For EL BIAS

Basic Date 1/5/70
Changed 3/25/70

2 Load New Value: (ie ±XXX.XXE)
New Value (AZ BIAS) = -4.20 + Δ Azimuth
(+ΔAzimuth =LPD is Right of L.S.)
(EL BIAS) = +.40 + ΔElevation
(+ΔElevation =LPD is Above L.S.)

3 To Verify New Value:
V06 N03E, (ADD) E, Verify R1

RMAX/VMAX LOAD

1 V24 N01E
2004E (RMAX)
77776E (Sets RMAX To -1)
77776E (Sets VMAX To -1)

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)

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

TO CHANGE DATA IN ERASABLE MEMORY

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

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

MONITOR OF INPUT/OUTPUT CHANNELS

1 V11N10E
F 11 10 Load Channel Add E
R1 Octal Contents Of Specified Channel

Basic Date 1/5/70
Changed 3/25/70

LOAD OUTPUT CHANNELS

```
1                V21N10E
     F 21 10     LOAD CHANNEL ADD E
                 R1 Load Octal Data E
       or
1                V25 N07E
     F 21 07     (Load Channel Add) E
     F 22 07     (Load Bit Code) E
     F 23 07     (Load 1-Set/0-Reset) E
```

FLAG WORD SET/RESET

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

2    F 22 07     (Load FLAGWORD BIT CODE)E
```

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

```
3    F 23 07     (Load 1-Set/0-Reset) E

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

Basic Date 1/5/70
Changed

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

Basic Date 1/5/70
Changed

Basic Date 1/5/70
Changed _____

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

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

Basic Date 1/5/70
Changed _____

Basic Date 1/5/70
Changed _____

3 Axis	101	40 (6)	Mnvr Specified By 3 Axis Mnvr Specified By 1 Axis	D=4,5,6,7 D=0,1,2,3
No RR Mon	101	10 (4)	Bypass RR Gmbl Monitor Perform RR Gmbl Monitor	D=1,3,5,7 D=0,2,4,6
W Matrix	101	1 (1)	W Matrix Valid For Flt Nav W Matrix Not Valid For Flt Nav	E=1,3,5,7 E=0,2,4,6
Attitude	102	1 (1)	LM Att Stored In LGC LM Att Not Stored In LGC	E=1,3,5,7 E=0,2,4,6
Remode	110	20000 (14)	LOS Within Other RR Ant Mode RR Mode Set To 2	A=2,3,6,7 A=0,1,4,5
Antenna	110	4000 (12)	RR Ant In Mode 2 RR Ant In Mode 1	B=4,5,6,7 B=0,1,2,3
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	1307	10000 (13)	Use of Mark X or Y Use of Mark Reject	A=1,3,5,7 A=0,2,4,6
AOT Mark Y	1307	2000 (11)	After Use of Mark Y After Mark X & Y or Mark Reject	B=2,3,6,7 B=0,1,4,5
AOT Mark X	1307	1000 (10)	After Use of Mark X After Mark X & Y or Mark Reject	B=1,3,5,7 B=0,2,4,6

Basic Date 1/5/70
Changed _____

CHANNEL LISTING

CHANNEL	BIT	DSKY	FUNCTION
5	1	E=1,3,5,7	JET 1 ON (B4U)
OUTPUT	2	E=2,3,6,7	JET 2 ON (A4D)
	3	E=4,5,6,7	JET 5 ON (A3U)
	4	D=1,3,5,7	JET 6 ON (B3D)
	5	D=2,3,6,7	JET 9 ON (B2U)
	6	D=4,5,6,7	JET 10 ON (A2D)
	7	C=1,3,5,7	JET 13 ON (A1U)
	8	C=2,3,6,7	JET 14 ON (B1D)
6	1	E=1,3,5,7	JET 7 ON (B3A)
OUTPUT	2	E=2,3,6,7	JET 3 ON (B4F)
	3	E=4,5,6,7	JET 15 ON (A1F)
	4	D=1,3,5,7	JET 11 ON (A2A)
	5	D=2,3,6,7	JET 12 ON (B2L)
	6	D=4,5,6,7	JET 8 ON (A3R)
	7	C=1,3,5,7	JET 4 ON (A4R)
	8	C=2,3,6,7	JET 16 ON (B1L)
11	1	E=1,3,5,7	ISS WARNING
OUTPUT	13	A=1,3,5,7	ENGINE ON
	14	A=2,3,6,7	ENGINE OFF
12	1	E=1,3,5,7	ZERO RRCDU
OUTPUT	4	D=1,3,5,7	COARSE ALIGN ENABLE
	5	D=2,3,6,7	ZERO ICDU
	9	C=4,5,6,7	+PITCH GMBL TRIM CMD
	10	B=1,3,5,7	-PITCH GMBL TRIM CMD
	11	B=2,3,6,7	+ROLL GMBL TRIM CMD
	12	B=4,5,6,7	-ROLL GMBL TRIM CMD
	13	A=1,3,5,7	LR POS CMD
	14	A=2,3,6,7	RR AUTO TRACK ENABLE
	15	A=4,5,6,7	ISS TURN ON DELAY COMPLETE
16	3	E=4,5,6,7	MARK X
INPUT	4	D=1,3,5,7	MARK Y
	5	D=2,3,6,7	MARK REJECT
	6	D=4,5,6,7	+RATE OF DESCENT
	7	C=1,3,5,7	-RATE OF DESCENT

Basic Date 1/5/70
Changed

30	1	E=0,2,4,6	ABORT
(INVERTED)	2	E=0,1,4,5	STAGE VERIFY
INPUT	3	E=0,1,2,3	ENG ARM
	4	D=0,2,4,6	ABORT STAGE
	5	D=0,1,4,5	AUTO THROTTLE
	6	D=0,1,2,3	DISPLAY INERTIAL DATA
	7	C=0,2,4,6	RR CDU FAIL
	9	C=0,1,2,3	IMU OPERATE
	10	B=0,2,4,6	G&N CONTROL OF S/C
	11	B=0,1,4,5	IMU CAGE
	12	B=0,1,2,3	ICDU FAIL
	13	A=0,2,4,6	IMU FAIL
	14	A=0,1,4,5	ISS TURN ON REQUEST
	15	A=0,1,2,3	TEMP IN LIMITS

31	1	E=0,2,4,6	+PITCH MIN IMPULSE/+EL LPD
(INVERTED)	2	E=0,1,4,5	-PITCH MIN IMPULSE/-EL LPD
INPUT	3	E=0,1,2,3	+YAW MIN IMPULSE
	4	D=0,2,4,6	-YAW MIN IMPULSE
	5	D=0,1,4,5	+ROLL MIN IMPULSE/+AZ LPD
	6	D=0,1,2,3	-ROLL MIN IMPULSE/-AZ LPD
	7	C=0,2,4,6	+X TRANSLATION
	8	C=0,1,4,5	-X TRANSLATION
	9	C=0,1,2,3	+Y TRANSLATION
	10	B=0,2,4,6	-Y TRANSLATION
	11	B=0,1,4,5	+Z TRANSLATION
	12	B=0,1,2,3	-Z TRANSLATION
	13	A=0,2,4,6	ATTITUDE HOLD
	14	A=0,1,4,5	AUTO STAB
	15	A=0,1,2,3	ACA OUT OF DETENT

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

Basic Date 1/5/70
Changed

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

Basic Date 1/5/70
Changed _____

LM OR CSM S.V. READOUT

1 V83E

2 After integration: V05N01E

CSM S.V.

2137E

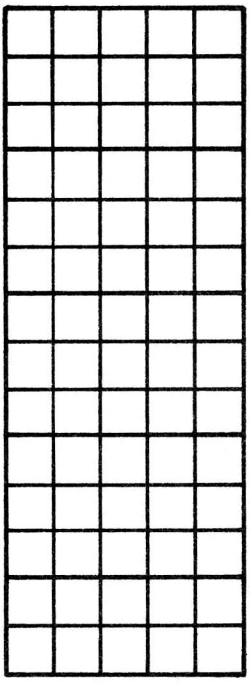
E,2142E

E,2117E

E,2122E

E,2113E

PRO



LM S.V.

2167E

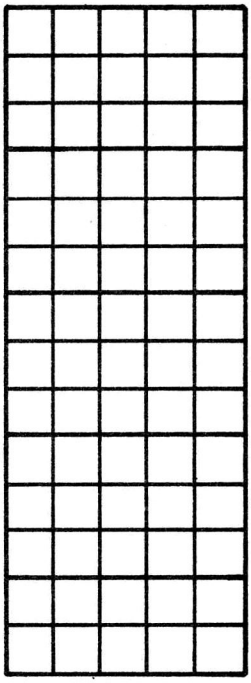
E,2172E

E,2104E

E,2107E

E,2113E

PRO



3 Transmit S.V. & Time Tag
To CSM

LM OR CSM S.V. LOADING

1 V37E00E
V71E
21E
15015E
(CSM S.V.) 00002E, Plus Xmited Pad
(LM S.V.) 77775E, Plus Xmited Pad
V33E

Basic Date 1/5/70
Changed 1/18/70

AGS SELECTOR LOGIC LIST

Address	Entry	
400	+00000	Attitude Hold
	+10000	Auto Guidance Steering
	+20000	Z-Body Axis Steering
	+30000	IMU Align
	+40000	Lunar Align
	+50000	Body Axis Align
	+60000	Gyro and Accelerometer Calibration (302 sec,32 sec)
	+70000	Inflight Accelerometer Only Calibration (32 sec)
407	+00000	Use Rotating External ΔV Reference Frame
	+10000	Freeze External ΔV in Inertial Space And Allow ΔV's To Count
410	+00000	Orbit Insertion Routine
	+10000	CSI Routine
	+20000	CDH Routine
	+30000	TPI Search Routine
	+40000	TPI Execute Routine
	+50000	External ΔV
411	+00000	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 Downlinks
	+20000	LM Navigation Initialization via DEDA
	+30000	CSM Navigation Initialization via DEDA

Basic Date 1/5/70
Changed

415	+00000	Normal Position
	+10000	Store Z-axis Direction Cosines & Rng/Rng Rt Data in RDR Filter
416	+10000	For CSI Calculation Select CDH At 1/2 Orbital Period Following CSI
	+30000	For CSI Calculation Select CDH At 3/2 Orbital Period Following CSI
417	+00000	Normal Position
	+10000	Initialize Radar Filter
507	+00000	Z Body Points In Direction Of CSM When In Z-Body Axis Steering (400 set to +2)
	+10000	Z Body Points To Thrust Direction When (400 set to +2)
563	+00000	Disables AGS Update via Downlink (To Reenable AGS Update via Downlink, 414+1E)
623	+00000	Z Body Parallel To CSM Orbit Plane When In Guidance Steering (400 set To +1)
	+10000	Z Body Parallel To Plane Defined By WB When In Guidance Steering (400 set To +1)

Basic Date 1/5/70
Changed 2/13/70

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 α L (O.I.)	100 ft
225	One Half of the Lower Limit of Apolune Radius (O.I.)	100 ft
226	Retarget Value For αL (O.I.)	100 ft
231	Radial Distance of Landing Site From Center of Moon	100 ft
232	Orbit Insertion Altitude	100 ft
233	Vertical Pitch Steering Altitude Threshold	100 ft
240	X Position Comp (LM)	100 ft
241	Y Position Comp (LM)	100 ft
242	Z Position Comp (LM)	100 ft
244	X Position Comp (CSM)	100 ft
245	Y Position Comp (CSM)	100 ft
246	Z Position Comp (CSM)	100 ft
254	LM Ephemeris Data (Epoch Time)	0.1 min
260	X Velocity Comp (LM)	.1fps
261	Y Velocity Comp (LM)	.1fps
262	Z Velocity Comp (LM)	.1fps
264	X Velocity Comp (CSM)	.1fps
265	Y Velocity Comp (CSM)	.1fps
266	Z Velocity Comp (CSM)	.1fps
272	CSM Ephemeris Data (Epoch Time)	0.1 min
274	Initial Update Time For Radar Filter	.1 min
275	Desired Update Time For TIG TPI (For CSI Calc Only)	.1 min
305	Retargeted Phase Angle Limit (O.I.)	.01°
306	Target Time Of Node Prior To Rendezvous	.01 min
307	Time From TPI To Rendezvous	.01 min
310	TFI of Next Mnvr	.01 min
312	TPI Rendezvous Offset Time (Stable Orbit Rendezvous)	.01 min

Basic Date 1/5/70
Changed 2/13/70

316	Radar Range (R)	0.1 nm
373	AGS TIG CSI, CDH, TPI, TPM	0.1 min
377	AGS Computer Time (T)	0.1 min
404	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, Altitude Rate Threshold	.1fps
465	Target Radial Rate at Insertion (Lower Limit)	.1fps
503	Radar Range Rate (RDOT) Input	.1fps
514	Components of Unit Vector (X,Y,Z)	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/sec2
541	Y Accel Bias Comp Coeff	.001 ft/sec2
542	Z Accel Bias Comp Coeff	.001 ft/sec2
544	X Gyro Bias Comp Coeff	.01°/hr
545	Y Gyro Bias Comp Coeff	.01°/hr
546	Z Gyro Bias Comp Coeff	.01°/hr
547	Lunar Align Azimuth Correction	Octal
574	Section Staging Flag(+ Not Staged)	Octal
604	Lunar Surface Flag(+ Not On Lunar Surface)	Octal
605	Desired cotangent of LOS at TPI (COTAN LOS TPI)	Octal
607	HDOT Display Scale Factor	Octal
613	Central Angle Limit On TPI	Octal
616	Ullage Counter Value For Ullage Completion	2 sec
640	X Comp of Lunar Rotation Vector	Octal
641	Y Comp of Lunar Rotation Vector	Octal
642	Z Comp of Lunar Rotation Vector	Octal
673	Retarget Value For 4K10 When Central Angle Overflows	Octal

DEDA INPUT/OUTPUT CONSTANTS

Basic Date 1/5/70
Changed 2/13/70

DEDA OUTPUT LIST

Address		
211	Present Out-of CSM Orbit Plane Position	100 ft
263	Predicted Out-Of-Plane Velocity At TIG (CSI, CDH, TPI), Present Out of Plane O.I.	.1fps
267	ΔV To Be Gained	.1fps
270	Present Vy Out-of-CSM Orbit Plane Velocity (Vyo)	.1fps
277	Angle Between Local Horizon & Z Body Axis (In Plane)	.01°
303	Predicted LOS At TIG TPI (TPI mode)	.01°
303	LM/CSM Phase Angle at TIG (CSI,CDH) Present O.I.	-
310	Time To Next Maneuver (CSI,CDH,TPI)	0.01 min.
311	Time To Rndz (TPI)	0.01 min.
312	Target Offset Time (TPI)	0.01 min.
313	Time To Pericynthian	0.01 min.
314	ΔH Along LM Radial At TIG (CSI,CDH)	.1 nm
315	Predicted Altitude Of LM Apogee	0.1 nm
317	LM To CSM Range (R)	0.1 nm
337	LM Altitude (h)	0.1 nm
340	X Comp of LM Position	100 ft
341	Y Comp of LM Position	100 ft
342	Z Comp of LM Position	100 ft
344	X Comp of CSM Position	100 ft
345	Y Comp of CSM Position	100 ft
346	Z Comp of CSM Position	100 ft
347	Predicted Altitude At TIG or Predicted Altitude At Burnout For O.I.	100 ft
357	Time To Burnout	fps/16
360	X Comp of LM Velocity	.1fps
361	Y Comp of LM Velocity	.1fps
362	Z Comp of LM Velocity	.1fps
364	X Comp of CSM Velocity	.1fps
365	Y Comp of CSM Velocity	.1fps
366	Z Comp of CSM Velocity	.1fps
367	LM Altitude Rate (H DOT)	.1fps
371	ΔV For CDH (Valid in CSI, Coast)	.1fps
371	ΔV Direct Trans + Braking (TPI)	.1fps

Basic Date 1/5/70
Changed 2/13/70

LM-7

372	CSI To CDH ΔT (CSI)	.1 min
402	ΔH In Coelliptic Orbit (CSI,CDH)	.1nm
402	Predicted Hp (TPI)	.1nm
403	LM Perigee Attitude (Hp)	.1nm
423	Desired Final HDOT (Except TPI)	.1fps
427	Present LM HOR Velocity	.1fps
433	LM Velocity	.1fps
440	Range Rate Between LM and CSM (R DOT) (-Closing)	.1fps
470	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

Basic Date 1/5/70
Changed 2/13/70

DEDA ACCESSIBLE CONSTANTS LIST

Address		
216 (2K3)	Value of LM Pericynthion If Overflow In Orbital Eccentricity	100 ft
227 (4K5)	Constant In Expression For Altitude Rate At Cutoff (O.I.)	100 ft
230 (2K19)	ΔP Limiter	100 ft
453 (2K20)	P Iterator Convergence Check (TPI)	N.A.
454 (4K26)	VG Engine Cutoff Threshold	.1fps
466 (5K26)	Vgx Pseudo Attitude Hold Threshold	.1fps
473 (4K27)	Accumulated X-Velocity Bias	.1fps
506 (4K12)	Acceleration Threshold for Radial Jerk Set (Orbit Insertion)	Octal
523 (5K20)	Lower Limit Of Radial Jerk For Staged Vehicle (Orbit Insertion)	Octal

526 (2K11)	Set Value Of Transfer Velocity (VT) (TPI)		Octal
527 (4K6)	Upper Limit Of Perdocted Radial Rate At Insertion (Orbit Insertion)		Octal
560 (5K14)	Upper Limit Of Radial Jerk (Orbit Insertion)		Octal
561 (5K16)	Upper Limit Of Out-Of-Plane Jerk (Orbit Insertion)		Octal
564 (5K18)	Lower Limit Of Radial Jerk For Unstaged Vehicle (Orbit Insertion)		Octal
566 (4K7)	Ascent Engine Pitch Cant Angle		Octal
601 (5K17)	Lower Limit Of Out-Of-Plane Jerk (Orbit Insertion)		Octal
602 (4K8)	Ascent Engine Roll Cant Angle		Octal
617 (1K30)	Gyro Calbrate Time	1 Count	(2sec)
621 (1K37)	Accelerometer Calibrate Time	1 Count	(2sec)
622 (4K23)	Attitude Hold At Abort Staging Threshold	1 Count	(40 millisec)
627 (1K27)	Lunar Align Constant		Octal
630 (1K28)	Lunar Align Constant		Octal
631 (1K29)	Lunar Align Constant		Octal
634 (1K35)	Navigation Sensed Velocity Threshold		Octal
636 (2K1)	Lunar Gravitational Constant		Octal
637 (2K2)	Reciprocal Of Lunar Gravitational Constant		Octal
657 (4K25)	Vgx Engine Cutoff Threshold		Octal
660 (4K34)	Lower Limit Of Thrust Acceleration		Octal
661 (4K35)	Increment Ullage Counter Threshold		Octal
662 (4K10)	Factor In LM Desired Semi-Major Axis αL (O.I.)		Octal
666 (4K21)	Scale Factor For Attitude Error		Octal

Basic Date 1/5/70
Changed 2/13/70

ORBIT INSERTION

1 MODE CONT: AGS - AUTO
GUID CONT - PGNS
EVENT TIMER - SET

2 616+0 Zero Ullage Counter Limit
232+(Orbit Insertion Altitude) (100ft)
465+(Altitude Rate At Insertion) (.1fps)
224+(Semi-Major Axis Targeting Term) (100ft)
225+(Apolune Radius/2) (100ft)
226+(Retarget Value For αL) (100ft)
305+(Phase Angle Limit) (.01°)
662+(4K10) (Octal)
673+(Retarget Value For 4K10) (Octal)
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 JET	2 JET	2 JET
TTCA (CDR)	THROT	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT(STAGE)PB	RESET	RESET	RESET
ENG ARM	DES	ASC	OFF
MASTER ARM	ON(1st Burn Only)	ON(Unstaged)	OFF

Basic Date 1/5/70
Changed 3/9/70

	PRPLNT QTY MON	DES 1	OFF	OFF
	PRPLNT TEMP/PRESS MON	DES 1	ASC	-
	HELIUM MON	SUPCRIT PRESS	PRESS 2	-
	ENGINE STOP	-	-	PUSH

8 -30

FOR DPS BURNS
CB(11) STAB/CONT: DECA PWR - Close
CB(16) STAB/CONT: DES ENG OVRD - Close
ENG GMBL - ENABLE
FOR APS BURNS
CB(11) STAB/CONT: AELD - Close
CB(16) STAB/CONT: AELD - Close

9 -TBD

GUID CONT - AGS

10 00

ABORT (STAGE) - PUSH
IGNITION
When ΔV >50fps: BAL CPL - OFF

11

When Burn Complete
ABORT (STAGE) PB - RESET
407+0
410+5
451+0
(To Trim Out-of-Plane Comp)
263R ΔVY (.1fps)
451 (ΔVY)(Same sign As 263)
407+1
NULL 500, 501, 502 (.1fps)
(Null 501 After 502 for Out-of-Plane Trim)

12

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

13

616 + 00007

Basic Date 1/5/70
Changed 3/9/70

CSI

1	MODE CONT: AGS - ATT HOLD GUID CONT - AGS	
2	Wait until TIG-136 min 410 + 1 CSI Routine 373 + (TIG CSI) 275 + (TIG TPI) 605 + (COTAN LOS TPI) 451 + 0E (ΔVY CSI) 416 + 1 CDH 1/2 Orbital Period After CSI + 3 CDH 3/2 Orbital Periods After CSI	 (.1 min) (.1 min) (Octal)
3	477R HDOT CSI	(.1fps)
4	310R TFI CSI EVENT TIMER - SET	(.01 min)
5	If Time Available 372R ΔT CSI To CDH 303R LM/CSM Phase Angle 371R ΔV CDH 477R Predicted HDOT 314R ΔH At TIG 402R ΔH CDH	 (.1min) (.01°) (.1fps) (.1fps) (.1nm) (.1nm)
6	410 + 5 EXT ΔV 450R ΔVX CSI 263RΔVY CSI 451 (ΔVY CSI) (Same sign as 263) 452R ΔVZ CSI 267R ΔVG CSI	 (.1fps) (.1fps) (.1fps) (.1fps) (.1fps)
7	411 +0 DES ENG OR RCS BURN +1 ASC ENG BURN	
8	623 +0 Z-Axis Parallel to CSM Orbit Plane +1 Z-Axis Parallel to Specified Plane	

Basic Date 1/5/70
Changed 2/13/70

9 If 623 +1, Specify Plane
514 + (X Component of Unit Vector) (Octal)
515 + (Y Component of Unit Vector) (Octal)
516 + (Z Component of Unit Vector) (Octal)

10 400 +1 GUIDANCE STEERING (Z Axis Mnvr, 400+2, 507+1)

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

12 407 +0

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

14

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

Basic Date 1/5/70
Changed

15 -30 FOR DPS BURNS
CB(11) STAB/CONT: DECA PWR-Close
CB(16) STAB/CONT: DES ENG OVRD-Close
ENG GMBL - ENABLE
FOR APS BURNS
CB(11) STAB/CONT: AELD-Close
CB(16) STAB/CONT: AELD-Close

-15 407 +1 (For RCS Burn Not +X LM)
(X-Axis) 500R
(Z-Axis) 502R

16 - :14 Start Ullage

17 :00 Ignition
(RCS Burn) When ΔVG <15fps,
MODE CONTROL (AGS)-ATT HOLD

18 When Burn Complete:
ABORT (STAGE) Reset
NULL 500, 501, 502 (.1fps)

19 410 +2 CDH Routine

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

Basic Date 1/5/70
Changed

CDH

1	MODE CONT: AGS - ATT HOLD GUID CONT - AGS	
2	Wait Until TIG - 136 min 410 +2 CDH ROUTINE 373R TIG CDH (Adjust AGS TIG CDH As Desired For New Solution)	(.1 min)
3	310R TFI CDH EVENT TIMER - SET	(.01 min)
4	If Time Available Check The Following: 402R ΔH CDH 423R HDOT CDH (Final) 477R HDOT CDH	(.1nm) (.1fps) (.1fps)
5	410 +5 EXT ΔV 450R ΔVX CDH 263R ΔVY CDH 451 (ΔVY CDH) (Same Sign As 263) 452R ΔVZ CDH 267R ΔVG CDH	 (.1fps) (.1fps) (.1fps) (.1fps) (.1fps)
6	411 +0 DES ENG OR RCS BURN +1 ASC BURN	
7	623 +0 Z-axis Parallel To CSM Orbit Plane +1 Z-axis Parallel To Specified Plane	
8	If 623 +1, Specify Plane 514 +(X Component of Unit Vector) 515 +(Y Component of Unit Vector) 516 +(Z Component of Unit Vector)	

Basic Date 1/5/70
Changed 2/13/70

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

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

11 407 +0

12

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

13

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

Basic Date 1/5/70
Changed 3/9/70

14 -30 For DPS Burns
CB(11) STAB/CONT: DECA PWR-Close
CB(16) STAB/CONT: DES ENG OVRD-Close
ENG GMBL-ENBL
For APS Burns
CB(11) STAB/CONT: AELD-Close
CB(16) STAB/CONT: AELD-Close

-15 407 +1 (For RCS BURN Not Along +X)
(X-Axis) 500R
(Z-Axis) 502R

15 - :14 Start Ullage

16 00 IGNITION
(RCS Burn) When ΔVG <15fps,
MODE CONTROL(AGS)-ATT HOLD

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

18

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

Basic Date 1/5/70
Changed

TPI

1	MODE CONT: AGS - ATT HOLD GUID CONT: AGS	
2	Wait Until TIG - 136 min 410 +3 TPI SEARCH 307 +(ΔT RND TRANS) 306 +0 NODE AT TPF 310 +(TARGET TFI TPI)	 (.01 min) (.01 min) (.01 min)
3	303R LOS ANGLE TPI 410 +4 TPI EXECUTE (When 303 is 26.6° (Below), 28.3° (Above) (TO RETARGET 410 +3 And 310 (Target TFI TPI) Then 410 +4 (When 303 Reads Desired Value)	(.01°)
4	310R TFI TPI EVENT TIMER - SET 371R ΔVG to RNDZ (If +06000 Retarget)	(.01 min) (.1fps)
5	If Time Available: 303 LOS ANGLE TPI 373R TIG TPI 311R Time To Rendezvous 306R Target Time of Node 312R Target Offset Time 307R Desired Transfer Time 373R TIG TPI 402R Hp TPI	 (.01°) (.1 min) (.01min) (.01min) (.01min) (.01min) (.1min) (.1nm)
6	411 +0 DES ENG OR RCS +1 ASC ENG	
7	410 +5 267R ΔVG TPI	

Basic Date 1/5/70
Changed 2/13/70

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

9 If 623 +1, Specify Plane
514 +(X-Component of Unit Vector)
515 +(Y-Component of Unit Vector)
516 +(Z-Component of Unit Vector)

10 400 +1 GUIDANCE STEERING (Z Axis, 400+2,507+1)

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

12 407 +0

13

501R VGY (LM)	(.1fps)
502R VGZ (LM)	(.1fps)
500R VGX (LM)	(.1fps)

Basic Date 1/5/70
Changed 2/13/70

14

CONFIGURATION	DES	ASC	RCS
THR CONT	MAN	-	-
MAN THROT	CDR	-	-
BAL CPL	ON	ON	ON
ATT/TRANS	2 JET	2 JET	2 JET
TTCA (CDR)	THROT	JETS	JETS
DEADBAND	MIN	MIN	MIN
ABORT (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	-
PRPLNT TEMP/PRESS MON	DES 1	ASC	-
HELIUM MON	SUPCRIT PRESS	PRESS 2	-
ENGINE STOP	-	-	DEPRESS

15 -30 For DPS Burns
CB(11) STAB/CONT: DECA PWR-Close
CB(16) STAB/CONT: DES ENG OVRD-Close
ENG GMBL-ENBL
For APS Burns
CB(11) STAB/CONT: AELD-CLOSE
CB(16) STAB/CONT: AELD-CLOSE

-15 407 +1 (For RCS BURN Not In +X)
(X-Axis) 500R
(Z-Axis) 502R

16 -06 Start Ullage

17 00 IGNITION
(RCS Burn)When ΔVG <15fps,
MODE CONTROL (AGS)-ATT HOLD

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

19 410 +4 TPI EXECUTE

20

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

Basic Date 1/5/70
Changed

TPM

Retargeting (Same Rndz Time)

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

Basic Date 1/5/70
Changed

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

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

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

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

7 407 +0

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

9

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

Basic Date 1/5/70
Changed

		ENG ARM	DES	ASC	OFF
		MASTER ARM	ON(1st Burn Only)	ON(Un-Staged Only)	OFF
		PRPLNT QTY MON	DES 1	OFF	-
		PRPLNT TEMP/PRESS MON	DES 1	ASC	-
		HELIUM MON	SUPCRIT PRESS	PRESS 2	-
		ENGINE STOP	-	-	DEPRESS
10	-30	For DPS Burns CB(11) STAB/CONT: DECA PWR-Close CB(16) STAB/CONT: DES ENG OVRD-Close ENG GMBL-ENBL For APS Burns CB(11) STAB/CONT: AELD-Close CB(16) STAB/CONT: AELD-Close			
	-15	407 +1 (For RCS Burn Not Along +X)			
11	-:06	Start Ullage			
12	00	IGNITION (RCS Burn) When ΔVG <15fps, MODE CONTROL (AGS) - ATT HOLD			
13		When Burn Complete ABORT(STAGE) - Release NULL 500, 501, 502			(.1fps)
14		MASTER ARM		-OFF	
		ENG ARM		-OFF	
		BAL CPL		-ON	
		TTCA(CDR)		-JETS	
		DEADBAND		-MAX	
		PRPLNT QTY MON		-OFF	
		HELIUM MON		-OFF	

Basic Date 1/5/70
Changed

AGS MANUAL THRUST

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

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

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

4 Monitor ΔV Along Thrust Axis
X - 470R (.1fps)
Y - 471R (.1fps)
Z - 472R (.1fps)

5 Thrust Residuals

6 Trim Residuals

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

Y - 471R (.1fps)
Null (TTCA Right/Left)
(If Thrust Axis Acquire Desired ΔV)

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

Basic Date 1/5/70
Changed

AGS ACTIVATION & SELF TEST

1 AGS STATUS - STBY
(AGS Warn Lt - On)
CB(11) AC BUS B: AGS-Close
CB(16) STAB/CONT: AEA-Close
(AGS Warn Lt - Off)
AGS STATUS - OPERATE
(AGS Warn Lt - On)
O2/H2O QTY MON - CWEA RESET
(AGS Warn Lt - Off)

2 000 +888888 (OPR ERR Lt - On)

3 123 -45679

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

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

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

7 612R +0 STAGING SEQ COUNTER

Basic Date 1/5/70
Changed 1/18/70

AGS CALIBRATION (INFLIGHT)

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 If Docked, CSM Mnvr To AGS CAL Attitude
V16N20E
16 20 ICDU Angles O,I,M (All Angles Should Be Approx 22.5°,67.5°,112.5°,157.5°,202.5°,247.5°, 292.5°, or 337.5°
Rates <.075°/sec (Undocked, 0.1°/sec)
Disable CSM & LM Thrusters (Undocked, PGNS-MIN IMP)
V40N20E

4 400 +6 CALIBRATE GYRO & ACCEL
Read And Record After 35 sec

540R X ACCEL BIAS	_____	(.001 ft/sec2)
541R Y	_____	(.001 ft/sec2)
542R Z	_____	(.001 ft/sec2)

Values Should Not Change From Step 2 By More Than (.039)ft/sec2 (.008nom)
(If Undocked, Enter Attitude Hold Mode For 2 min Then Return To MIN IMP)

5 400R +0 GYRO & ACCEL CALIBRATE COMPLETE (302 Sec)
Read And Record

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

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

Basic Date 1/5/70
Changed 2/13/70

AGS GYRO CALIBRATION (SURFACE)

1 Verify AGS In Standby/Operate For 25 min & 413 + 10000 Has Been Performed

2 400+3 (If PGNS Not Available 400+4 Then Wait 35 sec Before Step 4)

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

4 400+6 Calibrate Gyros

5 400R (+0 Calibration Complete In 302 sec)

6 Read And Record
544R X _____ (.01°/hr)
545R Y _____ (.01°/hr)
546R Z _____ (.01°/hr)
Values Should Agree With Step 2
Values Within 2.0°/hr (Nominal 0.9)

AGS RR MANUAL ACQUISITION AND UPDATE

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

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

3 Manually Null FDAI

4 RATE/ERR MON-RNDZ RADAR

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

6 RR MODE - AUTO TRACK

Basic Date 1/5/70
Changed 3/9/70

AGS MAN ACQ, ORDEAL INITIAL

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) Wait 16 sec Before Step 10	(.1nm)
10	415 +1 Store Z Axis cosines	
11	503 ± (RADAR RANGE RATE) (Must Be Entered Within 30 sec) (Wait 16sec Before Next 415 Entry)	(.1fps)
12	Repeat Steps 8 thru 11	
13	Repeat Procedure For A Minimum of 6 Range Data Points Approximately 4 min Apart (9 Points if Pre CSI)	

AGS ORDEAL INITIALIZATION

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

AGS MAN ACQ, ORDEAL INITIAL

Basic Date 1/5/70
Changed

AGS MANUAL STATE VECTOR UPDATE

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

Basic Date 1/5/70
Changed

BACK-UP RNDZ ALIGNMENT

1 Fly to 0° Roll, Z-Axis Toward CSM

2 400 +5

3 400 +0 DO NOT ENTER

4 When Wings Level (HORIZ REF) And Z-Axis Toward CSM Key ENTER And Note GET _____.

5 Coordinate with CSM To Adjust Ordeal (PITCH LM = 180° + PITCH CM)

6 Transmit GET of Align to MSFN

BACK-UP STAR ALIGNMENT

1 MODE CONT: AGS - ATT HOLD

2 MNVR To Place Star Set In AOT (FWD DETENT)

3 Position Prime Star In Center of Reticle

4 DEADBAND - MIN

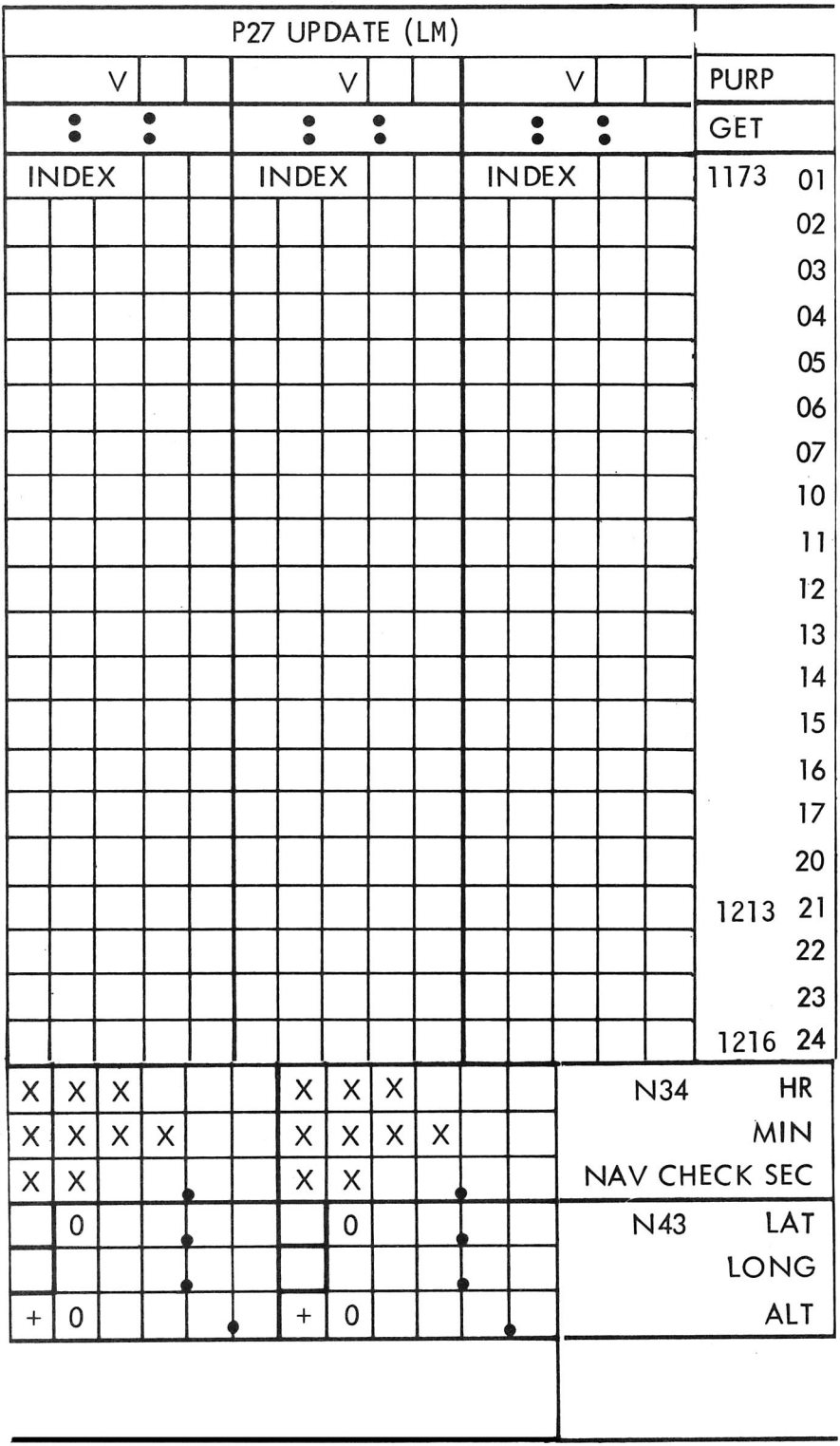
5 Rotate Reticle To Place Either +X,+Y Line on Star #2

6 400 +5E
400 +0E

7 RECORD & Report To MSFN Star Set, ID Line AOT Counter
_____ (Star #1)
_____ (Star #2)
_____ (ID Line)
_____ (AOT Counter)

8 MNVR To FDAI Angles From MSFN

9 At New Attitude
400 +5E
400 +0E



Basic Date 1/5/70
Changed

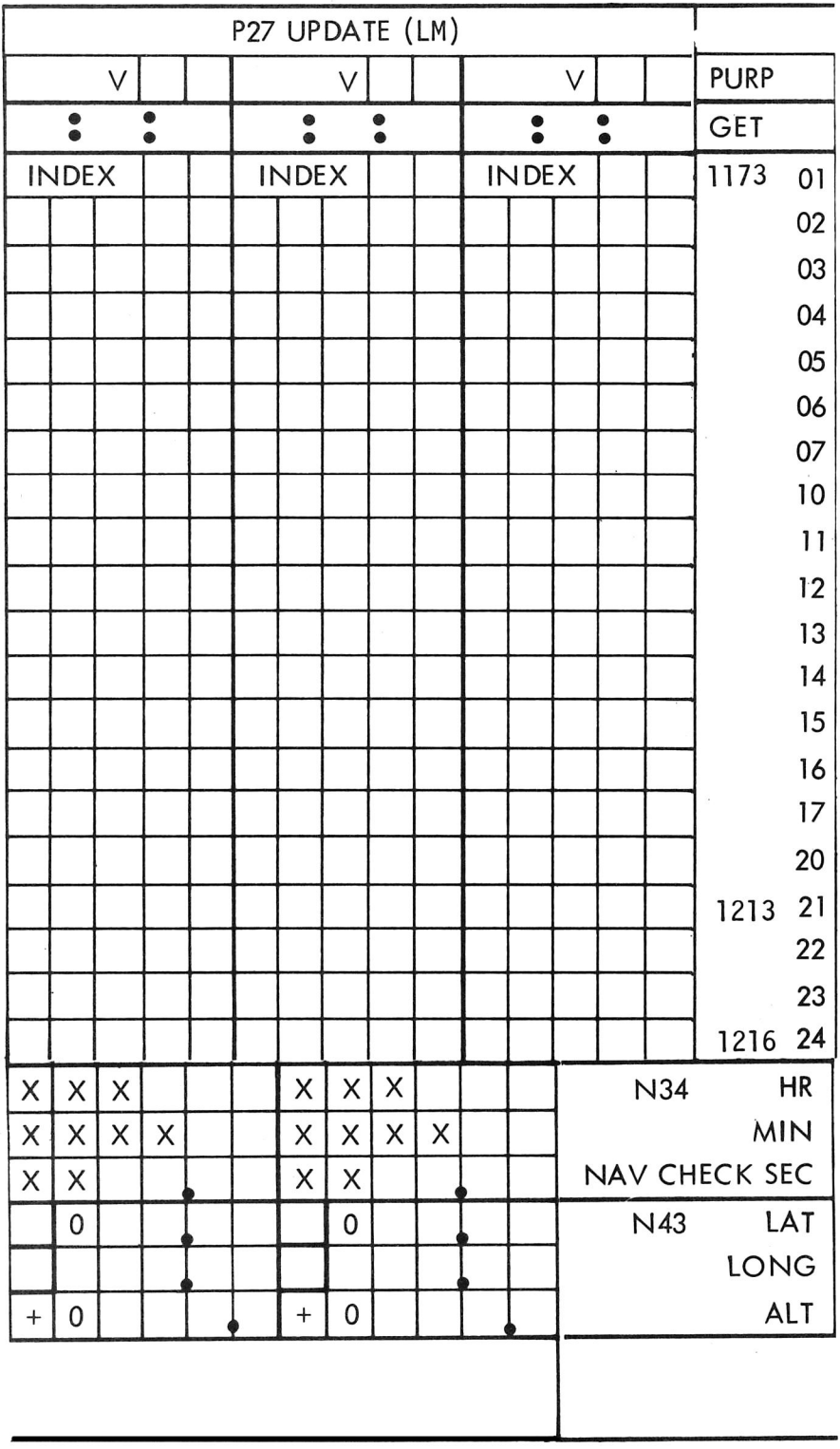
P27 UPDATE

P27 UPDATE (LM)

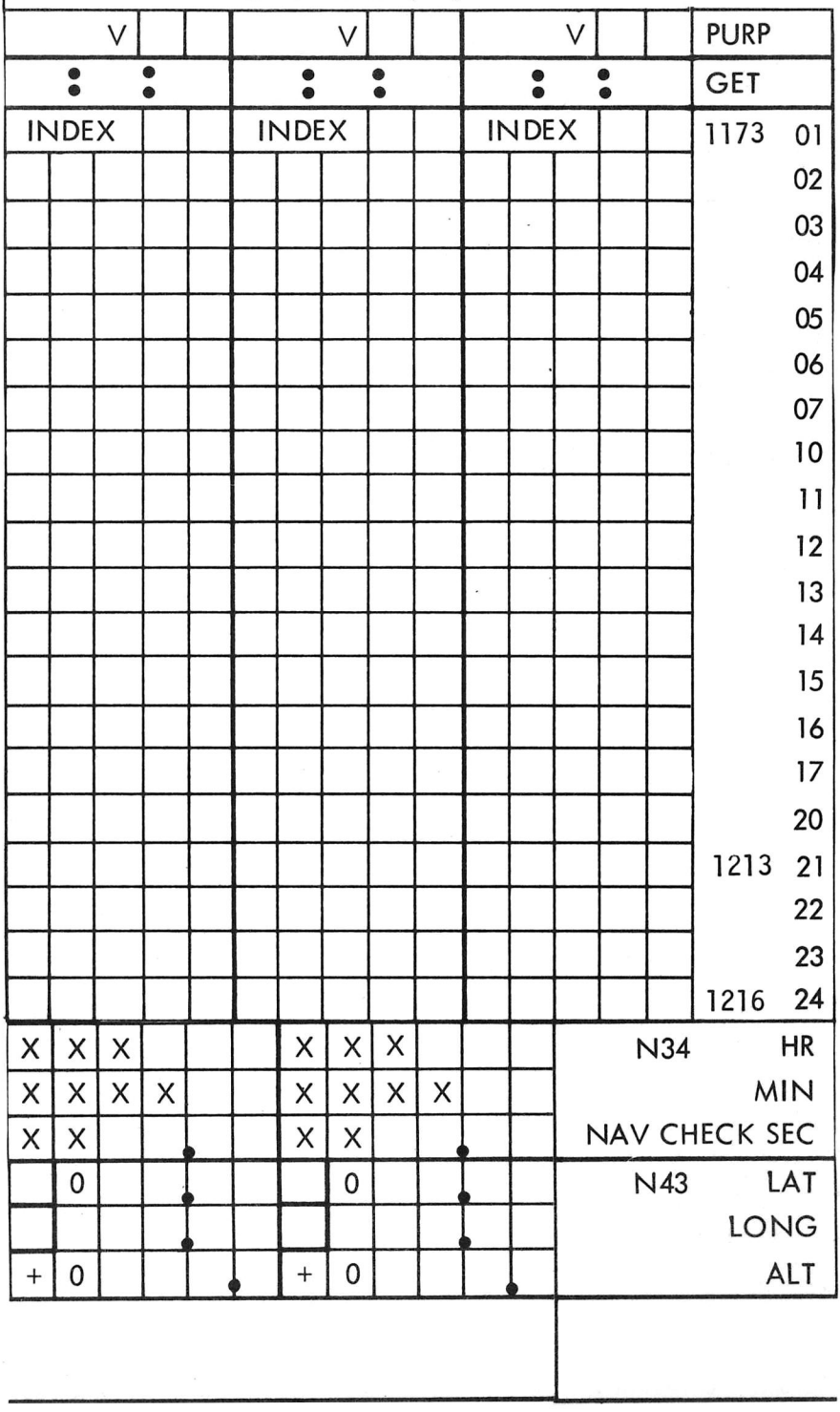
V			V			V			PURP	
:	:		:	:		:	:		GET	
INDEX			INDEX			INDEX			1173	01
										02
										03
										04
										05
										06
										07
										10
										11
										12
										13
										14
										15
										16
										17
										20
									1213	21
										22
										23
									1216	24

X	X	X				X	X	X				N34 HR
X	X	X	X			X	X	X	X			MIN
X	X					X	X					NAV CHECK SEC
	0						0					N43 LAT
												LONG
+	0					+	0					ALT

Basic Date 1/5/70
Changed _____



Basic Date 1/5/70
Changed



Basic Date 1/5/70
Changed

P30 LM MANEUVER

PURPOSE													
HR	N33	+	0	0				+	0	0			
MIN	TIG	+	0	0	0			+	0	0	0		
SEC		+	0			•		+	0			•	
ΔVX	N81						•						•
ΔVY	LOCAL						•						•
ΔVZ	VERT						•						•
HA	N42	+					•	+					•
HP							•						•
ΔVR		+				•	•	+				•	•
BT		X	X	X		•		X	X	X		•	
R	FDAI	X	X	X				X	X	X			
P	INER	X	X	X				X	X	X			
ΔVX	AGS N86						•						•
ΔVY	AGS						•						•
ΔVZ	AGS						•						•
BSS		X	X	X				X	X	X			
SPA		X	X				•	X	X				•
SXP		X	X	X			•	X	X	X			•

REMARKS:

Basic Date 1/5/70
Changed

P30 UPDATE (LM)

P30 LM MANEUVER

PURPOSE													
HR		N33	+	0	0				+	0	0			
MIN	TIG		+	0	0	0			+	0	0	0		
SEC			+	0			•		+	0			•	
ΔVX		N81						•						•
ΔVY		LOCAL						•						•
ΔVZ		VERT						•						•
HA		N42	+					•	+					•
HP								•						•
ΔVR			+					•	+					•
BT			X	X	X	•			X	X	X	•		
R		FDAI	X	X	X				X	X	X			
P		INER	X	X	X				X	X	X			
ΔVX	AGS	N86						•						•
ΔVY	AGS							•						•
ΔVZ	AGS							•						•
BSS			X	X	X				X	X	X			
SPA			X	X				•	X	X				•
SXP			X	X	X			•	X	X	X			•

REMARKS:

Basic Date 1/5/70
Changed _____

P30 LM MANEUVER

PURPOSE													
HR	N33	+	0	0				+	0	0			
MIN	TIG	+	0	0	0			+	0	0	0		
SEC		+	0			•		+	0			•	
ΔVX	N81						•						•
ΔVY	LOCAL						•						•
ΔVZ	VERT						•						•
HA	N42	+					•	+					•
HP							•						•
ΔVR		+					•	+					•
BT		X	X	X		••		X	X	X		••	
R	FDAI	X	X	X				X	X	X			
P	INER	X	X	X				X	X	X			
ΔVX	AGS N86						•						•
ΔVY	AGS						•						•
ΔVZ	AGS						•						•
BSS		X	X	X				X	X	X			
SPA		X	X				•	X	X				•
SXP		X	X	X			•	X	X	X			•

REMARKS:

Basic Date 1/5/70
Changed

P30 LM MANEUVER

PURPOSE													
HR	N33	+	0	0				+	0	0			
MIN	TIG	+	0	0	0			+	0	0	0		
SEC		+	0			•		+	0			•	
ΔVX	N81						•						•
ΔVY	LOCAL						•						•
ΔVZ	VERT						•						•
HA	N42	+					•	+					•
HP							•						•
ΔVR		+					•	+					•
BT		X	X	X	•	•		X	X	X	•	•	
R	FDAI	X	X	X				X	X	X			
P	INER	X	X	X				X	X	X			
ΔVX	AGS N86						•						•
ΔVY	AGS						•						•
ΔVZ	AGS						•						•
BSS		X	X	X				X	X	X			
SPA		X	X				•	X	X				•
SXP		X	X	X			•	X	X	X			•

REMARKS:

Basic Date 1/5/70
Changed ____

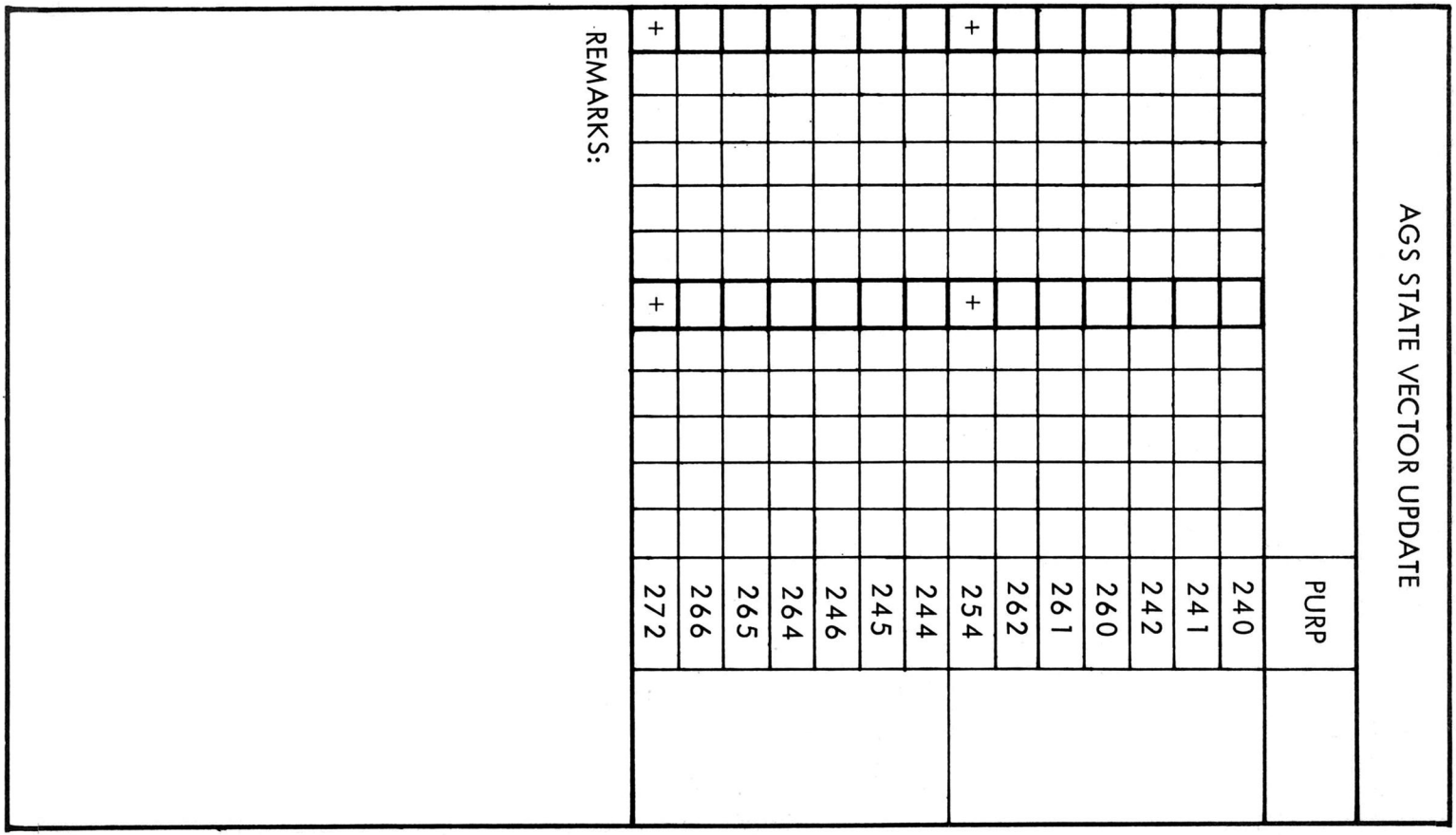
AGS STATE VECTOR UPDATE

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

REMARKS:

Basic Date 1/5/70
Changed _____

AGS STATE VECTOR



Basic Date 1/5/70
Changed _____

AGS STATE VECTOR UPDATE

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

REMARKS:

Basic Date 1/5/70
Changed _____

AGS STATE VECTOR UPDATE

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

REMARKS:

Basic Date 1/5/70
Changed _____

Basic Date 2/13/70
Changed _____

0 HR GET = 4:11:19:13 GMT
LO = 4:11:__:__

MARS HALF-UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
104.0	.26348	.38772	.17393
108.0	.26263	.33820	.17415
112.0	.26178	.38868	.17437
116.0	.26092	.38915	.17459
120.0	.26007	.38963	.17480
124.0	.25921	.39010	.17502
128.0	.25835	.39057	.17524
132.0	.25750	.39104	.17545
136.0	.25664	.39150	.17567
140.0	.25578	.39197	.17588
144.0	.25492	.39243	.17610

JUPITER HALF-UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
104.0	-.42493	-.24665	-.09271
124.0	-.42541	-.24594	-.09240
144.0	-.42589	-.24523	-.09210

SATURN HALF-UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
104.0	.38285	.30199	.11060
124.0	.38226	.30262	.11089
144.0	.38167	.30326	.11117

VENUS HALF-UNIT VECTORS

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
104.0	.34927	.32847	.14182
106.0	.34863	.32903	.14210
108.0	.34799	.32959	.14238
110.0	.34735	.33015	.14265
112.0	.34671	.33070	.14293
114.0	.34607	.33126	.14320
116.0	.34542	.33181	.14347
118.0	.34478	.33236	.14375
120.0	.34413	.33291	.14402
122.0	.34349	.33346	.14429
124.0	.34284	.33401	.14456
126.0	.34219	.33456	.14483
128.0	.34154	.33510	.14510
130.0	.34089	.33565	.14537
132.0	.34024	.33619	.14564
134.0	.33959	.33673	.14591
136.0	.33893	.33728	.14618
138.0	.33828	.33782	.14645
140.0	.33762	.33835	.14672
142.0	.33697	.33889	.14699
144.0	.33631	.33943	.14725

PLANET HALF UNIT VECTORS

EARTH HALF-UNIT VECTORS FOR LUNAR STAY

0 HR GET = 4:11:19:13 GMT LO = 4:11:__:__

TIME (GET) HOURS	X(R1)	Y(R2)	Z(R3)
104.0	.39753	-.27227	-.13358
104.5	.39884	-.27077	-.13273
105.0	.40013	-.26927	-.13188
105.5	.40142	-.26777	-.13102
106.0	.40271	-.26626	-.13017
106.5	.40398	-.26474	-.12931
107.0	.40525	-.26322	-.12844
107.5	.40651	-.26169	-.12758
108.0	.40776	-.26016	-.12671
108.5	.40901	-.25863	-.12584
109.0	.41024	-.25708	-.12496
109.5	.41147	-.25554	-.12409
110.0	.41270	-.25399	-.12321
110.5	.41391	-.25243	-.12233
111.0	.41512	-.25087	-.12144
111.5	.41632	-.24930	-.12056
112.0	.41751	-.24773	-.11967
112.5	.41870	-.24615	-.11878
113.0	.41988	-.24457	-.11789
113.5	.42105	-.24299	-.11699
114.0	.42221	-.24139	-.11609
114.5	.42336	-.23980	-.11519
115.0	.42451	-.23820	-.11429
115.5	.42565	-.23659	-.11338
116.0	.42678	-.23498	-.11248
116.5	.42790	-.23337	-.11157
117.0	.42902	-.23175	-.11066
117.5	.43013	-.23012	-.10974
118.0	.43123	-.22849	-.10883
118.5	.43232	-.22686	-.10791
119.0	.43340	-.22522	-.10699
119.5	.43448	-.22358	-.10606
120.0	.43555	-.22193	-.10514
120.5	.43661	-.22028	-.10421
121.0	.43766	-.21862	-.10328
121.5	.43870	-.21696	-.10235
122.0	.43974	-.21529	-.10142
122.5	.44077	-.21362	-.10048
123.0	.44179	-.21195	-.09954
123.5	.44280	-.21027	-.09860
124.0	.44380	-.20859	-.09766
124.5	.44480	-.20690	-.09671
125.0	.44579	-.20521	-.09577
125.5	.44677	-.20351	-.09482
126.0	.44774	-.20181	-.09387
126.5	.44870	-.20010	-.09292
127.0	.44965	-.19840	-.09196
127.5	.45060	-.19668	-.09101
128.0	.45154	-.19496	-.09005
128.5	.45247	-.19324	-.08909
129.0	.45339	-.19152	-.08812
129.5	.45430	-.18979	-.08716
130.0	.45521	-.18805	-.08619
130.5	.45610	-.18631	-.08523
131.0	.45699	-.18457	-.08426
131.5	.45787	-.18283	-.08328
132.0	.45874	-.18108	-.08231
132.5	.45960	-.17932	-.08134
133.0	.46046	-.17756	-.08036
133.5	.46130	-.17580	-.07938
134.0	.46214	-.17404	-.07840
134.5	.46297	-.17227	-.07741
135.0	.46379	-.17049	-.07643
135.5	.46460	-.16872	-.07544
136.0	.46540	-.16694	-.07446
136.5	.46619	-.16515	-.07347
137.0	.46698	-.16336	-.07248
137.5	.46775	-.16157	-.07148
138.0	.46852	-.15977	-.07049
138.5	.46928	-.15798	-.06949
139.0	.47003	-.15617	-.06849
139.5	.47077	-.15437	-.06749
140.0	.47150	-.15256	-.06649
140.5	.47222	-.15074	-.06549
141.0	.47294	-.14893	-.06448
141.5	.47364	-.14711	-.06348
142.0	.47434	-.14528	-.06247
142.5	.47503	-.14345	-.06146
143.0	.47570	-.14162	-.06045
143.5	.47637	-.13979	-.05944
144.0	.47703	-.13795	-.05843

Basic Date 2/13/70
Changed _____

Basic Date 2/13/70
Changed _____

STAR HALF UNIT VECTOR

STAR NUMBER	COMMON NAME	X(R1)	Y(R2)	Z(R3)
46	HAMAL	.39204	.23901	.19794
47		.29402	.32311	-.24320
50	POLLUX	-.19246	.39686	.23551
51	MIAPLACIDUS	-.13001	.11616	-.46862
52	DUBHE	-.22788	.05905	.44112
53		-.32441	-.05699	-.37618
54	RIGIL KENT	-.18904	-.15521	-.43609
55	BETELGEUSE	.01396	.49564	.06442
56	HADAR	-.21408	-.12572	-.43401
57	BELLATRIX	.07877	.49068	.05507
60	EL NATH	.06794	.43377	.23922
61	ALNI LAM	.05509	.49684	-.01064
62	ALNITAK	.04520	.49766	-.01708
63	MURZIM	-.04431	.47362	-.15401
64	ALHENA	-.07498	.47369	.14139
65	ADHERA	-.10854	.42393	-.24187
66	AL WAZOR	-.12945	.42896	-.22188
67	CASTOR	-.16693	.39001	.26463
70	AVIOR	-.14766	.20720	-.43043
71		-.18991	.21871	-.40755
72	GACRUX	-.27046	-.03500	-.41908
73	BECRUX	-.24850	-.05051	-.43093
74	ALIOTH	-.27137	-.06354	.41511
75	SHAULA	-.04936	-.39581	-.30149
76		-.03957	-.36365	-.34088
77	KAUS AUST	.03986	-.41062	-.28249
100	CAPH	.25750	.00850	.42851
101	ANKAA	.36666	.03984	-.33759
102	MIRACH	.38943	.11914	.29008
103	ALMACH	.31918	.18810	.33577

STAR NUMBER	COMMON NAME	X(R1)	Y(R2)	Z(R3)
104	MINTAKA	.06424	.49585	.00279
105	SAIPH	.02937	.49201	-.08407
106	MENKALINAN	.00413	.35386	.35322
107	ALUDRA	-.15441	.40804	-.24426
110		-.19540	.32997	-.32084
111	SUHAIL	-.26488	.24941	-.34298
112		-.19372	.16797	-.42925
113	MERAK	-.26627	.07130	.41715
114	MIZAR	-.26777	-.10107	.40998
115	KOCHAB	-.09958	-.09187	.48129
116	ELTANIN	-.00556	-.31126	.39126
117	SADR	.22075	-.31191	.32246
120	AL NA'IR	.29932	-.16193	-.36631
121		.32063	-.11530	-.36593
122	SCHEDAR	.27293	.04665	.41633
123	PHECDA	-.29470	.00996	.40380
124		-.23342	-.39848	-.19165
125		-.12736	-.39323	-.28133
126		.48230	.02462	.12955
127		-.03317	-.38706	-.31477
130		.23289	.08921	.43336
131		.41214	.22140	.17643
132		.25259	.38052	.20348
133		.22482	.36063	.26345
134		.19772	.32853	.32089
135		.11712	.40205	.27320
136		.11547	.48443	-.04465
137		.06716	.46262	-.17741
140		.05923	.47225	-.15320
141		.05637	.49412	-.05164

STAR HALF
UNIT VECTORS

STAR HALF
UNIT VECTORS

STAR HALF UNIT VECTOR

STAR NUMBER	COMMON NAME	X(R1)	Y(R2)	Z(R3)
142		.04906	.46381	.18021
143		.03868	.41227	-.28024
144		.00404	.39818	.30238
145		-.06763	.31023	-.38625
146		-.13007	.37730	-.30121
147		-.23871	.38853	-.20510
150		-.22129	.18374	-.40899
151		-.42438	.20169	.17096
152		-.30920	.10425	-.37885
153		-.45775	.09622	.17664
154		-.45476	-.06555	-.19722
155		-.17729	-.02759	-.46670
156		-.49223	-.08710	-.01122
157		-.38035	-.09241	.31112
160		-.47351	-.12839	.09643
161		-.37808	-.13556	-.29780
162		-.27183	-.12384	-.40096
163		-.41732	-.22483	.15905
164		-.30980	-.23959	.31084
165		-.29108	-.23070	-.33474
166		-.26002	-.21803	-.36722
167		-.33604	-.29128	.22855
170	ZUBEN'UBI	-.35561	-.32363	-.13713
171		-.26236	-.25460	-.34109
172		-.32474	-.37156	-.08057
173		-.22537	-.30218	-.32847
174		-.27996	-.41036	.05677
175		-.22966	-.38615	-.21941
176		-.22874	-.41134	-.16875
177		-.09718	-.21720	.43975

STAR NUMBER	COMMON NAME	X(R1)	Y(R2)	Z(R3)
200		-.17997	-.42880	.18369
201		-.16155	-.41017	-.23593
202		-.17717	-.45858	-.09118
203		-.14530	-.40004	.26241
204	SABIK	-.10694	-.46934	-.13521
205		-.04576	-.27945	-.41208
206		-.05413	-.39418	-.30281
207		-.04275	-.31952	-.38220
210		-.04022	-.30295	.39573
211		-.03913	-.49687	.03991
212		.03605	-.43220	-.24881
213		.05134	-.44859	-.21478
214		.11344	-.41823	-.24943
215		.15488	-.31743	.35390
216		.21709	-.44103	.09145
217		.27376	-.31218	.27856
220		.17572	-.15026	.44334
221		.39955	-.26599	-.14003
222		.22212	-.10779	-.43479
223		.42788	-.11003	.23412
224	MARKAB	.46814	-.11832	.12977
225		.20630	.11651	-.44030
226		.41167	.28248	-.02715
227		.26013	.27462	.32698
230		-.21684	.16592	-.41887
231		-.20482	.07265	-.45030
232		-.31753	-.00942	-.38612
233		-.11849	-.19051	-.44684
234		.13389	-.46670	.11942
235		.13637	-.44619	-.17978
236		-.22505	-.44537	-.03155

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