



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 17

ALL LAUNCH DATES

CHANGE A

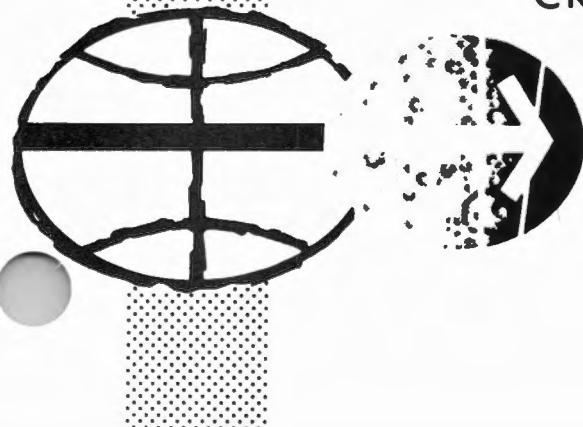
FLIGHT CREW
G&N DICTIONARY

PREPARED BY

FLIGHT PLANNING BRANCH
CREW PROCEDURES DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NOVEMBER 15, 1972



APOLLO 17
LM FLIGHT CREW G&N DICTIONARY

NOVEMBER 15, 1972

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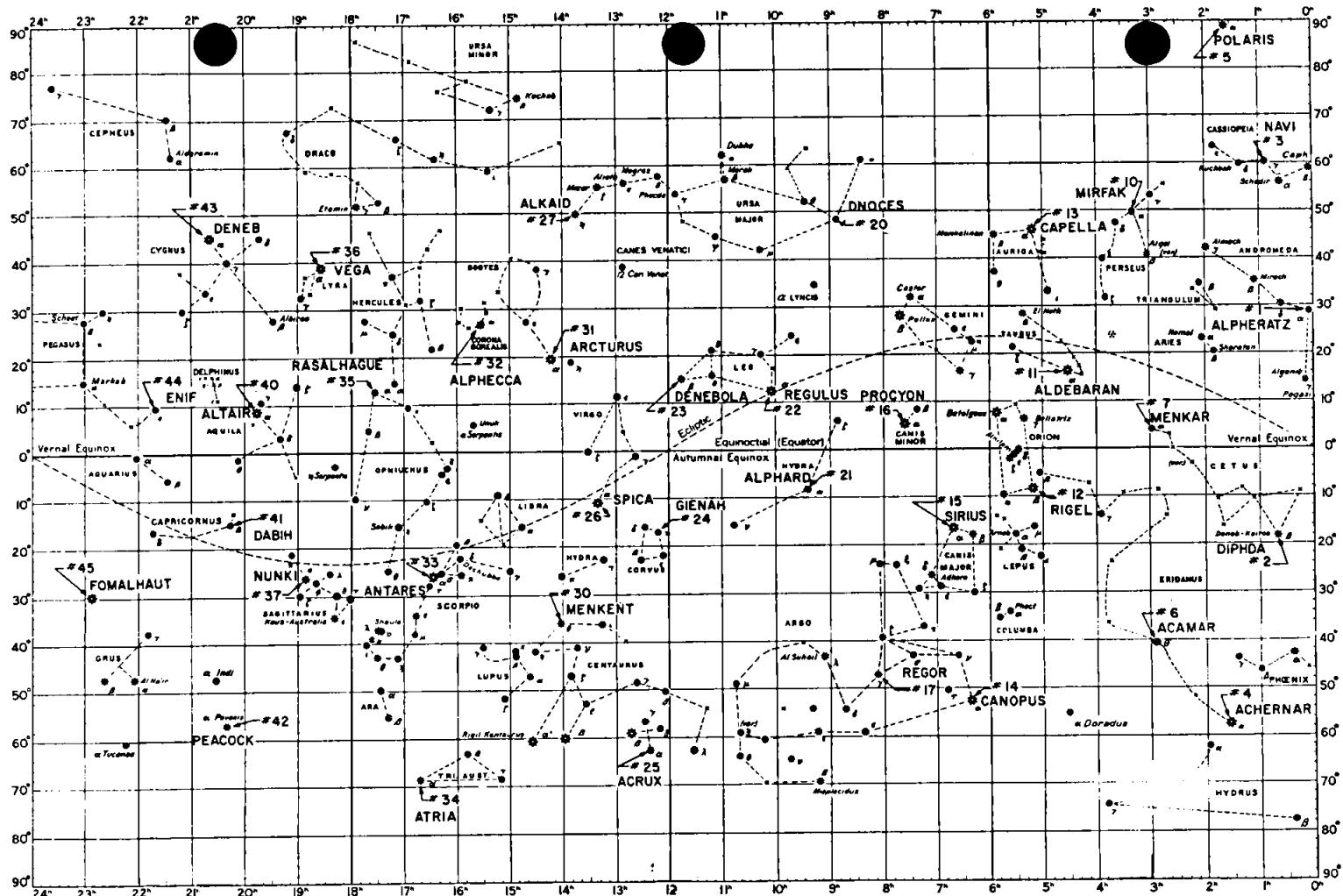
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STAR LIST

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

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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
31 Request Waitlist
32 Recycle
33 Proceed Without DSKY Inputs
34 Terminate
35 Test Lights (POO 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 FDAO Error Needles (Test; POO Only)
44 Terminate Continuous Designate
 (V41N72 Option 2)
47 Initialize AGS
48 Load DAP Data
49 Start Crew Defined Maneuver (POO Only)
50 Please Perform

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- 52 Mark Cursor
- 53 Mark Spiral
- 54 Mark X or Y
- 55 Increment LGC Time (Decimal)
- 56 Terminate RR Tracking (P20,P22,&P25)
- 57 Enable 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 (Mode 1)
- 62 Display Total Attitude Error (Mode 2)
- 63 Start RR/LR Self-Test
- 64 Start S-Band Antenna Routine
- 65 Disable U,V Jets During DPS Burns
- 66 Set LM State Vector Into CSM State Vector
- 67 W-Matrix RSS Error Display
- 68 Terminate LR Terrain Model
- 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 (42 sec)
- 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
- 79 Stop LR Spurious Test
- 80 Update LM State Vector
- 81 Update CSM State Vector
- 82 Request Orbit Parameter Display
- 83 Rendezvous Parameter Display
- 85 Display RR LOS Az and El
- 89 Start Rendezvous Final Attitude Maneuver (POO Only)
- 90 Request Rendezvous Out of Plane Display (Non Ave G)
- 91 Display Banksum (POO Only)
- 92 Start IMU Performance Test (non-flight) (OPR ERR)
- 93 Enable W-Matrix Initialization (Clear Rendwf1g)
- 95 Inhibit State Vector Update (via Navigation)
- 96 Interrupt Integration and Go To POO
- 97 Perform Engine Fail Procedure
- 99 Enable Engine Ignition

NOUNS V - Can Be Called At Any Time For Valid Or
Partially Valid Data

| | | |
|-----|--|----------|
| 01V | Address To Be Specified (Frac) | .XXXXX |
| 02V | Address To Be Specified (Whole) | XXXXX. |
| 03V | 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/E-Memory 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) | h,m,.01s |
| 12 | Option Code (Extended Verbs Only) | Octal |
| | Desired Option | Octal |
| 13 | TIG CDH | h,m,.01s |
| 15V | Increment Address | Octal |
| 16 | Time of Event (Extended Verbs Only) | h,m,.01s |
| 18 | Desired Maneuver To FDAI R,P,Y 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 | h,m,.01s |
| 25 | Checklist (Used With V50) (R2 Valid For Code 00016) | Octal |
| 26V | Prio/Delay, ADRES, BBCON | Octal |
| 27V | Self Test ON/OFF | Octal |
| 32 | Time From Perigee | h,m,.01s |
| 33 | TIG | h,m,.01s |
| 34 | Time of Event | h,m,.01s |
| 35 | Time From Event | h,m,.01s |
| 36V | LGC Clock Time | h,m,.01s |
| 37 | TIG TPI | h,m,.01s |
| 38V | Time of State Being Integrated | h,m,.01s |
| 40 | Time From Ignition/Cutoff | m-s |
| | VG | .1fps |
| | ΔV (Accumulated) | .1fps |

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| | | |
|--------|---|--------|
| 41 | Target Azimuth (V92 Only) | .01° |
| | Elevation | .001° |
| 42 | Pre-Burn Apogee | .1nm |
| | Pre-Burn Perigee | .1nm |
| | ΔV (Required) | .1fps |
| 43 | Latitude (+North) | .01° |
| | Longitude (+East) | .01° |
| | Altitude | .1nm |
| 44 | Apogee | .1nm |
| | Perigee | .1nm |
| | TFF | m-s |
| 45V-R1 | Marks | XXXXX. |
| | TFI Of Next/From Last Burn | m-s |
| | MGA | .01° |
| 46V-R2 | Digital Autopilot Configuration | Octal |
| | Switch Function Fail Code | Octal |
| 47V | LM Weight | 1bs |
| | CSM Weight | 1bs |
| 48 | Engine Gimbal Pitch Trim (+ Only) | .01° |
| | Engine Gimbal Roll Trim (+ Only) | .01° |
| 49 | ΔR | .01nm |
| | ΔV | .1fps |
| | Source Code (1:R,2:R,3:SHFT,4:TRUN) | 0000X. |
| 51 | S-Band Antenna: Pitch | .01° |
| | Yaw | .01° |
| 52 | Central Angle of Active Vehicle | .01° |
| 54 | Range (Calc From S.V.) | .01nm |
| | Range Rate | .1fps |
| | Theta | .01° |
| 55 | No. of Apsis Crossings P32/72 | |
| | Or Precision Offsets P34/74 | 0000X. |
| | Elevation Angle | .01° |
| | Central Angle of Passive Vehicle | .01° |
| 56 | RR LOS Azimuth | .01° |
| | Elevation | .01° |
| 58 | Perigee Alt. (Post TPI) | .1nm |
| | ΔV TPI | .1fps |
| | ΔV TPF | .1fps |
| 59 | ΔV1 LOS (+I) If Heads-up (+ Fwd) | .1fps |
| | ΔV2 LOS (+HXI)XI Facing Tgt, (+ Rt) | .1fps |
| | ΔV3 LOS (+HXI) Below, Behind (+ Dn) | .1fps |
| | (H=Orbital Momentum Vector of Active Vehicle) | |
| | (I=LOS Vector To Target) | |

| | | |
|--------|---|-------------|
| 60 | V (Fwd) (+Along +Z) | .1fps |
| | H DOT (+ Increasing H) | .1fps |
| | H (+H > RLS) | ft |
| 61 | TG Next Target | m-s |
| | TFI | m-s |
| | Crossrange (+ S/C Is South of L.S.) | .1nm |
| 62 | VI | .1fps |
| | TFI | m-s |
| | ΔV Accumulated | .1fps |
| 63 | ΔH (+LR > LGC) | ft |
| | 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 | h,m,.01s |
| 66V-R2 | LR Slant Range | ft |
| | LR Position | 00001/00002 |
| 67 | LR VX V63 Only | fps |
| | VY | fps |
| | VZ | fps |
| 68 | Ground Range to L.S. | .1nm |
| | TG Next Target | m-s |
| | VI | .1fps |
| 69 | Ldg Site Correction Comp Z (+ Dnrng) | ft |
| | Y (+ Rt of RLS) | ft |
| | X (+ Alt > RLS) | ft |
| 70 | AOT Detent/Star Code | Octal |
| 71 | AOT Detent/Star Code (R1 Only With V01) | Octal |
| | Mark X/Cur Cntr [Indicator A; Cntr E] | Octal |
| | Mark Y/Spir Cntr [(A000E) Max E=5] | Octal |
| 72 | RR Trunnion Angle [Req's. RR MODE-LGC] | .01° |
| | RR Shaft Angle [For Validity] | .01° |
| 73 | Desired RR Trunnion Angle | .01° |
| | Desired RR Shaft Angle | .01° |
| 74 | TFI | m-s |
| | Yaw | .01° |
| | Pitch | .01° |
| 75 | ΔH (CDH) | .1nm |
| | ΔT (CDH-CS1/TPI-CDH)(Modular 60) | m-s |
| | ΔT (TPI-CDH/TPI-Nom TPI)(Modular 60) | m-s |
| 76 | FINAL HORIZ VEL | .1fps |
| | FINAL H DOT | .1fps |
| | Crossrange(+ Post Insert Orb North of L.S.) | .1nm |

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| | | |
|----|---|--------|
| 77 | ΔT to Engine Cutoff (TFC) | m-s |
| | VGY (LM) (+Rt) | .1fps |
| | VI | .1fps |
| 78 | RR Range | .01nm |
| | RR Range Rate | .1fps |
| | TFI | m-s |
| 79 | Cursor Angle | .01° |
| | Spiral Angle | .01° |
| | Detent Position | 0000X. |
| 80 | Data Indicator (0:No Lock, 1:Lock) | XXXXX. |
| | Omega (} Between RR LOS & S/C +Z) | .01° |
| 81 | ΔV_x (LV) (+ Fwd) | .1fps |
| | ΔV_y (LV) (+ Rt) [N81 Is P30 ΔV Increment)] | .1fps |
| | ΔV_z (LV) (+ Dn) | .1fps |
| 82 | ΔV_x (LV) (+ Fwd) | .1fps |
| | ΔV_y (LV) (+ Rt) | .1fps |
| | ΔV_z (LV) (+ Dn) | .1fps |
| 83 | ΔV_x (LM) (+ Up) | .1fps |
| | ΔV_y (LM) (+ Rt) | .1fps |
| | ΔV_z (LM) (+ Fwd) | .1fps |
| 84 | ΔV_x (Other Vehicle) + (RXV)XR | .1fps |
| | ΔV_y (Other Vehicle) + (VXR) | .1fps |
| | ΔV_z (Other Vehicle) + (-R) | .1fps |
| 85 | VGX (LM) (+ Up) | .1fps |
| | VGY (LM) (+ Rt) | .1fps |
| | VGZ (LM) (+ Fwd) | .1fps |
| 86 | ΔV_x (LV) (+ Fwd) [N86 Is P40-42 ΔV After] | .1fps |
| | ΔV_y (LV) (+ Rt) [N81 Has Been Rotated] | .1fps |
| | ΔV_z (LV) (+ Dn) [By Half The Central }] | .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 | Rndz Out of Plane Param: | |
| | Y (+LM Rt of CSM) | .01nm |
| | YDOT (+ Increasing Y) | .1fps |
| | PSI (} Between S.V. LOS & L.V. Fwd) | .01° |
| 91 | Alt | 10nm |
| | Vel | fps |
| | Flt Path Angle | .01° |

| | | |
|----|---|-------------------------------|
| 92 | LGC Guidance Throttle Command H DOT (+ Increasing H) H (+H > RLS) | % .1fps ft |
| 93 | ΔGyro Torquing Angles X,Y,Z | .001° |
| 94 | VGX (LM) (+Up) H DOT (+Increasing H) H (+H > RLS) | .1fps ft |
| 97 | System Test Inputs (V92 Only) | XXXXXX. |
| 98 | System Test Results (V92 Only) | XXXXXX. .XXXXXX XXXXXX. |
| 99 | W-Matrix: Position Error Velocity Error Radar Bias Angle Error | ft .1fps mr |

V50 N25 CHECKLIST CODES

| <u>PROG</u> | <u>R1 CODE</u> | <u>DEFINITION</u> | <u>OPTIONS</u> |
|-----------------|----------------|------------------------------------|--|
| 52 | 00013 | C/A or Gyro Torque | (C/A) PRO (TORQ) PGNS-MIN IMP ENTR |
| 52 57 | 00014 | Check or Exit Align | (CHECK) PRO (EXIT) ENTR |
| 52 | 00015 | Align Type | (MAN) ENTR (PICAPAR) PRO (CUR/SPIR) V32E |
| 52 57 | 00016 | Unused Mark Sets (R2 Contains No.) | (REMARK) ENTR (ACCEPT) PRO |
| 06 | 00062 | Pwr Dn LGC | (STBY) PRO (OPR) V96E |
| 20 22 V63 | 00201 | RR Acq Mode | (MAN) ENTR (P20 Only) (LGC) RR MODE - LGC PRO |
| 12 40 | 00203 | Sel PGNS Auto | (BYPASS) ENTR (AUTO) GUID CONT - PGNS |

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42
63
70
71

MODE CONT (P) - AUTO
 THR CONT - AUTO
 (Unless Masked or
 P12, 42 , 71)
 PRO

- 20 00205 Perform RR Acq Manually (LOCK) Verify SIG STG
 NO TRACK Lt - Out
 RR MODE - LGC
 PRO
 (LGC MNVR) ENTR
 (Go To 00201)
- 63 00500 Position LR To DESCENT (DES) LDG ANT - DES
 Wait 10s,AUTO,PRO
 (BYPASS) ENTR

N06 or N12 OPTION CODES

| <u>R1 CODE</u> | <u>DEFINITION</u> | <u>R2 CODE</u> |
|----------------|--------------------------------|--|
| 00001 | Specify IMU Orientation | 1 = Preferred 2 = Nominal 3 = REFSMMAT 4 = Landing Site |
| 00002 | Specify Vehicle | 1 = LM 2 = CSM |
| 00003 | Specify Tracking Attitude | 1 = Preferred (+Z) 2 = Other (+X) |
| 00004 | Specify Radar | 1 = RR, 2 = LR |
| 00006 | Specify RR Coarse Align Option | 1 = Lock On 2 = Continuous Designate |
| 00010 | Specify Alignment Mode | 0 = REFSMMAT or Stored Att 1 = REFSMMAT + 1G 2 = 2 Bodies 3 = 1 Body + 1G |
| 00012 | Specify CSM Orbit Option | 1 = No Orbit Change 2 = Change Orbit To Pass Over LM |

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V05 N09 ALARM CODES

- 00111 P Mark Missing (Marks Lost)
Restart Mark Sequence
- 00112 P LGC Not Expecting Mark, Mark
Reject, or ROD Attempt
Cont Prog
- 00113 P/H Markrupt But No Inbits or Wrong Inbits
Cont Prog; If Recurs Notify MSFN
- 00115 P Mark Reject Ignored
Cont Prog
- 00206 P CDU Zero Not Allowed With Coarse
Align & Gimbal Lock
V41N20E, E,E,E; V40N20E
- 00207 P/H ISS Turn-On Request Not Present For
90 Sec
CB(11) IMU OPR - Open, Wait 3 Min,
Reclose; If Recurs and No ISS Warn,
Continue
- 00210 P/H IMU Off When Should Be On
CB(11) IMU OPR - Open, Wait 3 Min,
Reclose; If Recurs, V36E, Notify
MSFN
- 00211 H Coarse Align Error $>2^\circ$
If P52 or P57, Record N93, PRO On
V50N25 (00014), Recheck; If Other
Prog, Reduce S/C Drift And Cont
- 00212 H PIPA Fail But PIPA Not Being Used
Go to ISS Malf
- 00213 H Turn-On Request Present But IMU Pwr Off
CB(11) IMU OPR - Open, Wait 3 Min,
Reclose; If Recurs, V36E, Notify
MSFN
- 00214 P/H LGC Using IMU When Power Removed
See 00210 Or Term Prog
- 00217 H Coarse Align Or Pulse Torque
Difficulty Has Occurred
If Also 00211, Perform 00211 Only;
Reinitiate PROG, If Alarm Recurs
Terminate Use Of IMU
- 00220 P No Known REFSMMAT
Align Or If Aligned, V25N07E,77E,10000E,1E
- 00401 I Desired MGA Is Excessive
V06N22E, MNVR If MGA $<85^\circ$; Or Realign IMU

- 00402 P DAP Steering Lost
Control Attitude Manually
- 00404 I Defined Star Not In Any AOT Detent
Crew Picked Star, PRO; LGC New Star,
V32E
- 00405 I Two Stars Not In Fwd Detent At
Present Attitude
Crew Specify, PRO; PICAPAR, Mnvr &
V32E
- 00421 I W-MATRIX Overflow
Automatically Reinitialized, Continue
- 00501 I RR Ant Out Of Mode Limits
V32E, Mnvr, Reacquire
- 00502 I Non-Valid N73 Input
Redo V41N72E
- 00503 I RR Ant Designate Fail
LGC Search, PRO;
Redesign, V32E; If V41, Redo
- 00510 P RR Auto Discrete Not Present For
V40 N72
CB(11) RR(2) - Close, RR-LGC,
Redo V40 N72
- 00511 H Both Or Neither LR Ant Pos Present
LDG ANT - Hover, No Δ H (N63)
Update (10 sec): LDG ANT - DES,
RSET
- 00514 P RR Auto Removed During Read Sequence
Check CB, RR MODE-LGC Or Terminate
(V56E)
- 00515 H RR CDU Failed (Non-Transient)
RR Mode - Auto Track; Use AGS Or
CSM For Delta V
- 00520 P/H Unexpected Radar Rupt
Continue
- 00522 P LR Ant Pos Changed After V63E
Continue
- 00523 P LR Ant Not In Pos 2 After V59E
Continue
- 00525 I SV/RR LOS Angle $>3^\circ$
PRO For Angle. Side Lobe, V32E;
Main, Align COAS, PRO
- 00526 I RNG To CSM >400 NM
V16N54E, RNG, RNG RT

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- 00527 I Mnvr Req In P20; LOS Not In Mode II
In P22
Mnvr If P20, Term If P22
- 00530 I P22 Called At Least 10 Min Early
PRO (F37); Recall 5 Min Prior To
Acq Time
- 00600 I No CSI Soln On First Iteration
V32E, Adjust Inputs
- 00601 I Post CSI HP <35,000 FT
V32E, Adjust Inputs
- 00602 I Post CDH HP <35,000 FT
V32E, Adjust Inputs
- 00603 I CSI To CDH Time <10 MIN
V32E, Adjust Inputs
- 00604 I CDH To TPI Time <10 MIN
V32E, Adjust Inputs
- 00605 I 15 Iterations And No CSI Soln
V32E, Adjust Inputs
- 00606 I CSI ΔV >1000 FPS
V32E, Adjust Inputs
- 00611 I No TIG For Given Elev Angle
P33, PRO Or V32E & Retarget; P34,
PRO & Reselect Option
- 00701 I Illegal Align Tech Selected
V32E & Reselect Align Tech
- 00777 H PIPA Fail Caused ISS Lt
Go To ISS Malf
- 01102 H LGC Self Test Error
Copy N08, Perform V91E; Notify MSFN
- 01105 H Downlink Too Fast
If Alarm Recurs, Downlink Failed
- 01106 H Uplink Too Fast
If Alarm Recurs, Uplink Failed
- 01107 H Phase Table Discrepancy (Fresh Start
Has Occurred)
If Time Critical, GUID CONT - AGS;
Notify MSFN Then V74E, P27 & V48 As
Necessary, V37E51E, PRO, V37E00E; If Recurs,
LGC Failed
- 01301 I Arcsine/Arcacos Input Too Large (> One)
Notify MSFN, Continue
- 01406 I TGO Comp Fail (P63/64)
If Recurs, P66 Or GUID CONT - AGS

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- 01407 P VG Increasing
 GUID CONT - AGS Or Term Burn
- 01410 P/I DES Guid Eqn's Overflow (P63/64/66)
 If Recurs, P66 Or GUID CONT - AGS
- 01412 I Non Converging PDI TIG (P63)
 MSFN Uplink New S.V. And Tgt
- 01466 P/I Insufficient Throt Servicing (P66)
 If Recurs, Man Thr + Att Hold (Or AGS)
- 01520 P V37 Not Presently Allowed
 Reselect V37
- 01703 P TIG Slip Due To Integration, Cont Or If PDI,
 Check For Blank DSKY At DET = +20s
 If Blanked, (Man Ign), TTCA Up At DET = +26s
 If Not Blanked, Slip PDI
- 01706 P Prog/Engine Mismatch
 Change Prog Or Reload DAP; If P42,
 PRO, Man Stage At T-10
- 02001 I Y/Z Trans Have Been Disabled
 Re-Enable Jets Or Use Alternate
 Cont Mode
- 02002 I X-Trans Has Been Disabled
 Re-Enable Jets Or Use Alternate
 Cont Mode
- 02003 I Yaw Has Been Disabled
 Re-Enable Jets Or Use Alternate
 Cont Mode
- 02004 I Pitch/Roll Have Been Disabled
 Re-Enable Jets Or Use Alternate
 Cont Mode
- 03777 H ICDU Fail Caused ISS Lt
 Go To ISS Malf
- 04777 H ICDU/PIPA Fail Caused ISS Lt
 Go To ISS Malf
- 07777 H IMU Fail Caused ISS Lt
 Go To ISS Malf
- 10777 H IMU/PIPA Fail Caused ISS Lt
 Go To ISS Malf
- 13777 H IMU/ICDU Fail Caused ISS Lt
 Go To ISS Malf
- 14777 H IMU/ICDU/PIPA Fail Caused ISS Lt
 Go To ISS Malf

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- 20430 I Orbit Integration Overflow
GUID CONT - AGS Or MSFN Uplink S.V.
- 20607 I No Soln From Conic Subroutine
In Rndz, Burn CSM Or AGS Soln
- 21103 I Unused CCS Branch Executed
If AVE-G On & F37, GUID CONT - AGS;
Otherwise Reselect Prog Or Ext Verb
- 21204 P/I Zero Or Neg Time Waitlist Call
If AVE-G On & F37, GUID CONT - AGS;
Otherwise Reselect Prog Or Ext Verb
- 21302 I Sqrt Called With Neg Argument
If AVE-G On & F37, GUID CONT - AGS;
Otherwise Reselect Prog Or Ext Verb
- 21406 I Bad Return From Time To Tgt Routine (P63)
MSFN Uplink New S.V. & Recall P63
- 21501 H LGC Attempt To Use Illegal Pinball
Info
If AVE-G On & F37, GUID CONT - AGS;
Otherwise Reselect Prog Or Ext Verb
- 31104 H Delay Routine Busy
Reselect Ext Vb, Notify MSFN
- 31201 P Exec Overflow (NO VAC)
Reselect Ext Vb, Notify MSFN
- 31202 P Exec Overflow (NO CORE)
Reselect Ext Vb, Notify MSFN
- 31203 P/I Waitlist Overflow (Too Many Tasks)
Reselect Ext Vb, Notify MSFN
- 31206 P Second Job Attempts To Sleep In
Pinball
Reselect Ext Vb, Notify MSFN
- 31207 P NO VAC Area For Marks
Continue
- 31210 P Two Routines Using AOT, IMU, Or
RDR At Same Time
Reselect Ext Vb Or Prog When Device
Not Being Used By LGC
- 31211 P Illegal Interrupt Of Ext Vb
Continue; Reselect Ext Vb After
Marks Complete
- 31502 P Illegal Flashing Display
Continue
- 32000 P DAP In Progress At Next DAP Request
Continue; If Recurs, Evaluate
Vehicle Dynamics, V36E

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3XXXX — Generates Software Restart
 2XXXX — Abort Code, Program Goes To R00 (F 37)

NOTE: All 2XXXX Codes (If AVE-G Is On) Leave
 AVE-G On But Discontinue Guidance (F 37). Also
 If 2XXXX Code Is Generated While An Ext.
 Verb (With Displays) Is Active, The Code
 Will Act As 3XXXX (No F 37).

| | |
|-----------------------------|----------------------------|
| P - Procedure Caused Alarm | Alarms For V05N09 |
| I - Input Data Caused Alarm | R1 First Alarm After RSET |
| H - Hardware Caused Alarm | R2 Second Alarm After RSET |
| | R3 Most Recent Alarm |

GENERAL SYSTEMS CHECKOUT

- 1 Go To POO By One Of The Following As Necessary:
 - a. V37E 00E
 - b. V96E
 - c. V36E (NO DAP Lt - On For 11 Sec)
Wait 11 sec, Then
V96E
 - d. Force A Freshstart By Simultaneously Pressing & Holding RSET And MARK REJECT Until Prog Register Blanks (Possible PROG Alarm 00115)
Wait 11 sec, Then
V37E 00E
Notify MSFN Then V74E (42 sec)
(If (c) or (d) Performed: V21 N01E, 3000E, 2324E Sets HIASCENT Back To Pad Value)
- 2 Perform State Vector Checks:
V82 (Both Options)
V83
P21
- 3 Check REFSMMAT Validity:
P52 (Check Auto Optics Positioning)
- 4 Perform LGC Self Test If Time Permits
- 5 If Steps 2 Or 3 Not Nominal, Perform P27 Update;
Otherwise Continue

P06 PGNS PWR DOWN

1 V37E 06E
F 50 25 00062 POWER DOWN LGC
(TO GO TO STBY)
CB(11) IMU OPR - Open (NO DAP Lt-On)
PRO, Hold In Until STBY Lt - On
(TO STAY IN OPR) V96E
If IMU Desired & CB(11) IMU OPR - Open:
CB(11) IMU OPR - Close (NO ATT - On For
90 sec)
V25N07E, 77E, 10000E, 1E
V37E51E, PRO, V96E

P12 POWERED ASCENT

DAP - Set (12102)

1 V37E 12E
F 06 33 TIG(ASC) (h,m,.01s)
PRO

2 F 06 76 FINAL VH, FINAL H DOT, CROSSRANGE
PRO (.1fps,.1nm)

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

3 06 74 TFI, FINAL FDAO YAW, PITCH ANGLES
(m-s, .01°)

Record YAW _____
PITCH _____

Set DET To TFI

CMPTR ACTY It - On

*PROG Lt - On *
V05N09E 01703 TIG SLIPPED
* RSET, KEY REL *

CMPTR ACTY Lt - Off

- 2:00 MASTER ARM - ON
- :35 DSKY Blanks
- :30 (AVE G ON)
06 74 TFI, FINAL FDAI YAW, PITCH ANGLES
(m-s,.01°)
- :10 ABORT STAGE - Push
ENG ARM - ASC
- (-:05) F 99 74 ENGINE ON ENABLE**
(AUTO) PRO (Ign When TFI=-:00)
(BYPASS) ENTR To **(APS OFF)**
- *F 97 74 ENGINE FAIL *
* (RECYCLE ΔV MON) PRO *
* (RECYCLE) ENTR To **TIG-5** *
- 4 06 74 TFI, FINAL FDAI YAW, PITCH ANGLES
(m-s,.01°)
- IGN 06 94 VGX, H DOT, H (.1fps, ft)
ENG START - Push
Monitor Attitude Maneuver
To Recorded Ball Angles
- X-axis override restored
at HDOT = 40 fps plus 12 sec
- VGX Decreasing
H DOT Increasing Then Decreasing
H Increasing
- 5 To Check FINAL VH, FINAL H DOT, & CROSSRANGE
N76E (.1fps,.1nm)
To Monitor TFC, VGY, & VI (m-s,.1fps)
V16 N77E
KEY REL

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- 6 06 94 VGX,H DOT,H (.1fps,ft)
 VGX=200fps, ENG ARM - OFF
- (APS OFF)** F 16 94 VGX,H DOT,H (.1fps,ft)
 ABORT STAGE - Reset
 ENG STOP - Push Then Reset
 PRO
- ⑦ F 16 85 VG XYZ (LM) (.1fps)
 Null Components
 (TERM) PRO
 (DISP ORB PARAM) V82E
- F 16 44 HA,HP,TFF (.1nm,m-s)
 Record HA _____
 HP _____
 TFF _____
 PRO To ⑦ _____
- 8 F 37
- P20 RENDZ NAV**
- 1 CB(11) RR (2) - Close, Wait 10 sec
 V37E 20E
 (TO TERM-V56E)
 (SV OPTION, V80E LM, V81E CSM, V95E NONE)
 *PROG Lt - On *
 *V05 N09E 00526 RNG > 400 nmi *
 * V16 N54E Rng, Rng Rt(.01nm,.1fps)*
 * N54 Is Updated Every 5 sec *
 * When Rng < 400nm, Go To Step ②*
- ② (If MODE CONT (P) - ATT HOLD, Go To ③)
 (If MODE CONT (P) - AUTO & Pointing Error <15°, To ③
 Auto 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(F50 18 Returns Upon Completion Of Mnvr)
 (MAN) MODE CONT (PGNS) - ATT HOLD
 MNVR
- (BYPASS) ENTR To ③ (To ⑧ If Entered From
 ⑧ Via V32E)
 (To ⑤ If Entered From
 ⑤ Via ENTR or 501 Alarm)

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③ RR MODE- LGC To ⑥
 (To ⑦ If Entered From ⑤
 or ⑧ via PRO)
 - SLEW or AUTO TRACK To ④

④ F 50 25 00201 RR ACQ MODE
 (AUTO) RR MODE-LGC
 PRO To ③
 (MAN) ENTR

⑤ F 50 25 00205 SLEW RR For Lock-On
 (LOCK) RR MODE-LGC
 NO TRACK Lt - Off In ~ 12 sec
 PRO To ③
 (NO LOCK) MNVR
 ENTR To ②

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

⑥ F 50 72 TRUN, SHFT (.01°)
 Confirm Main Lobe Lock-On
 (ACQ MAIN LOBE) RR MODE - SLEW
 Slew To Peak AGC
 RR MODE - LGC (NO TRACK Lt - Off In 12 sec)
 (ACCEPT) Align COAS On CSM
 Check FDAI/RR Needles
 PRO To ⑦ (If RR Needles Are Non-Zero
 Possible 00525 Alarm)

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⑦ NO TRACK Lt - Off
 DSKY BLANKS, RR Taking Marks
 (RAW RR DATA) V16 N78E R,RDOT,TFI
 (.01nm,.1fps,m-s)

- * F 05 09 00525 SV/RR LOS $\delta > 3^\circ$ *
- * PRO For Value *
- * F 06 05 SV/RR LOS δ (.01°) *
- * N05 Can Be Caused By S.V. or *
- * Radar Errors *
- * If P20 Just Called And: *
- * a) If S.V. Err Is Cause, *
- * V67E, Load N99 +10000,+100,+0,PRO *
- * b) If Radar Err Is Cause, *
- * Allow Update (See NOTE Below) *
- * If P20 Has Been Running (Assume S.V. *
- * Error) *
- * Perform RR BIAS INITIAL (pg 1-65) *
- * Then V67E, Load N99 +10000,+100,+0, *
- * PRO (Subsequently N05's Should *
- * Decrease) *
- * NOTE: If Radar Bias Is Known, Perform *
- * KNOWN RR BIAS LOADING(pg 1-65) *
- * Software Opts To N05 *
- * (REJECT) If Side Lobe *
- * RR MODE - LGC *
- * V32E To ⑥ *
- * (UPDATE) PRO To ⑦ *

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* F 06 49 ΔR,ΔV,CODE (.01nm,.1fps,0000X)*
 * X = 1 - Range; 2 - Range Rate *
 * 3 - Shaft }; 4 - Trunnion } *
 *
 * N49 Can Be Expected If: *
 * a) Initial Nav Updates (~ 10 min), *
 * Reject 1st Mark If >2nm or 12 fps*
 * Check Value With CSM, Thereafter *
 * If Agree Accept Update *
 * b) After Long No Track Intervals, *
 * Reject 1st Mark If >2nm or 12 fps,*
 * Then Accept Subsequent Updates,*
 * c) After Mnvrs or V93's (2-3 Marks), *
 * Reject If >0.8nm or 5 fps *
 * In All Other N49 Cases, Reject 1st *
 * Mark Then Accept Up to 0.8nm & *
 * 5 fps
 * Software Opts To N49 *
 * (REJECT PART MARK) V32E To ⑦ *
 * (REJECT TOTAL MARK) V34E To ⑦ *
 * (ALLOW UPDATE) PRO To ⑦ *
 * [If Bad Mark Accepted,
 * V93E, Cont.] *

* F 50 18 Mnvr Request, Go To ② *

NO TRACK LITE - On

F 05 09 00503 RR NO DATA GOOD 30 SEC(or Desig.
 (REDESIG)V32E To ③ Fail)
 (SEARCH) PRO To ⑧

*PROG Lt-On, V05 N09E *
 * 00515 RR CDU Failed *
 * (P20 Will Not Update S.V.) *
 * KEY REL To ⑥ or *
 * RR MODE - AUTO TRACK *

TRACKER Lt(Only) Could Not Read RR, To ⑥

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⑧ 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 ⑧
 (MNVR) V32E To ②

P21 GROUND TRACK DETERMINATION

- 1 V37E 21E
 F 04 06 R1 00002, SPECIFY VEHICLE
 R2 00001 LM
 00002 CSM
 PRO
- ② F 06 34 GET LAT, LONG (h,m,.01s)
 (Zero For Present Time)
 PRO
- 3 F 06 43 LAT, LONG, ALT (.01°,.1nm)
 (N91 CALL) N91E
 F 06 91 ALT, VEL, FLT PATH
 KEY REL (10nm,fps,.01°)
 (INCREMENT GET 10 min) V32E To ②
 (TERM) PRO
- 4 F 37

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P22 LUNAR SURFACE NAV

LGC Starts Sequence At ~ 130 nm
 NO TRACK Lt - Out ~ 103 nm
 MARKS Every 3.5 sec If V95E
 NO TRACK Lt - On (After TCA) ~ 80 nm
 RR Antenna Designated 180,270

- 1 CB(11) RR(2) - Close, Wait 10 sec
 V37E22E
 (To TERM-V56E)
 (SV OPTION, V81E CSM, V95E NONE)
- F 04 06 R1 00012 CSM ORBIT OPTION
 R2 00001 CSM WILL NOT CHANGE
 ORBIT
 00002 CSM WILL CHANGE ORBIT
 (OPT 1) PRO (Note Rng Check Step ②, Then Go To ③)
 (OPT 2) PRO To ②
- ~~②~~ F 06 33 TIG ASC (h,m,.01s)
 PRO
 (If Rng >400 nm & Rng Rt >0, Exit P22
 If Rng >400 nm & Rng Rt <0:
 16 54 Rng, Rng Rt (.01nm,.1fps)
 N54 Is Updated Every 5 Sec
 When Rng <400nm, Go To Step ③)
- 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 P22 Called At Least *
 * 10 Min Early *
 * (WAIT FOR CSM) PRO, Recall *
 * P22 5 Min Prior To P22 *
 * Acq. Time *

⑤ NO TRACK Lt-OFF DSKY Blanks, RR Taking Marks
(P22 Continues To Run In Background)

(RAW RR DATA) V16N78E R,RDOT,TFI
(.01nm,.1fps,m-s)
(RR TRUN, SHFT) V16N72E (.01°)

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

NO TRACK Lt-ON; If R > 80nm & R > 0, POOE

F 05 09 00503 RR ANT DESIG FAIL
(REDESIG) V32E 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 }
(NO LOCK) V56E
(LOCK) PRO To ③

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

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P25 PREF TRACK ATT

- 1 V37E 25E
 (To TERM - V56E)
 (If Pointing Error <15°, To ②, 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(F50 18 Returns Upon Completion Of Mnvr)
 (MAN) MODE CONT (PGNS)-ATT HOLD
 MNVR
 (BYPASS) ENTR To ②
- ② P25 Continues To Run
 In Background Until Terminated
 If RR On and Tracking
 (RAW RR DATA) V16N78E R,RDOT,TFI
 (.01nm,.1fps,m-s)

P27 LGC MANUAL UPDATE

■ (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)
- ⑤ F 21 01 R3 ADDRESS (Initially 1173)
 Load P27 PAD Data IN R1 E (R3 Increments)
 Repeat Step ⑤ For All PAD Data

(6) F 21 02 R3 Goes To 1166 When Data Load Complete

TO REVIEW DATA

V01 NOTE, 1173E

R1 Data

N15E (R3 1174)

ENTR Verify Data For Remaining
Comps.(Note COMP I.D. Containing
Erroneous Data)

KEY REL To (6)

TO CHANGE DATA

Load COMP I.D., XX E

Correct Data E, Go To (6)

TO ACCEPT UPDATE

V33E (or Key VERB Then PRO)

7 POO Displayed

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P30 EXTERNAL ΔV

- 1 F 06 33 V37E 30E (h,m,.01s)
TIG
PRO
- 2 F 06 81 ΔV XYZ(LV) (.1fps)
PRO
- 3 F 06 42 HA, HP, ΔV (.1nm,.1fps)
PRO
- 4 F 16 45 MARKS,TFI,MGA (-00002 If No REFSMMAT)
SET DET TO TFI (marks,m-s,.01°)
PRO
- 5 F 37

P32 CSI PRETHRUST (P72 CSM)

- ① F 06 11 V37E 32E (72E)
TIG (CSI)/T(APOAPSIS) (h,m,.01s)
To Calc T(APOAPSIS) Verify N11=0 (or Neg.)
PRO
- 2 F 06 55 APSIS CROSSINGS (CDH), TPI ELEV 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) (h,m,.01s)
PRO
- ④ F 16 45 MARKS, TFI,-00001 (marks,m-s)
(RECYCLE) V32E
(TERM MARKING) PRO

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PRETHRUST
P3X/P7X

*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) (.1nm,m-s)
 PRO
- 6 F 06 81 ΔV XYZ (LV) (CSI) (.1fps)
 (For Out-of-Plane Corr In Final Comp ONLY)
 V90E
 F 06 16 GET EVENT (h,m,.01s)
 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)
 (TIG CDH) N13E, KEY REL
 PRO (If Recycling To ④)
- 8 F 16 45 MARKS,TFI,MGA (marks,m-s,.01°)
 (MGA = -00002 If No REFSMMAT or If P72)
 SET DET TO TFI
 PRO
- 9 F 37 P72 - Transmit Mnvr Parameters To CSM
- ① P33 CDH PRETHRUST (P73 CSM)
- ① F 06 13 V37E 33E (73E)
 TIG (CDH) (h,m,.01s)
 PRO

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② F 16 45 MARKS,TFI, -00001 (marks,m-s)
(RECYCLE) V32E
(TERM MARKING) PRO

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

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

4 F 06 81 ΔV XYZ (LV) (CDH) (.1fps)
(For Out-of-Plane Corr in Final Comp ONLY)
V90E
F 06 16 GET EVENT (h,m,.01s)
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 MARKS,TFI,MGA (marks,m-s,.01°)
(MGA = -00002 If No REFSMMAT or If P73)
SET DET TO TFI
PRO

6 F 37 P73 - Transmit Mnvr Parameters To CSM

P34 TPI PRETHRUST (P74 CSM)

① F 06 37 V37E 34E (74E)
TIG (TPI) (h,m,.01s)
PRO

2 F 06 55 PRECISION OFFSETS, ELEV ȑ, CENTRAL ȑ
(+00000 In R2 To Calc Elev (0000X,.01°)
Angle At TIG Time)
PRO

③ F 16 45 MARKS, TFI, -00001 (marks,m-s)
(RECYCLE) V32E
(TERMINATE MARKING) PRO

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F 05 09 00611 NO TIG

* FOR SPECIFIED ANGLE*

* PRO To ① *

- 4 F 06 37 TIG (TPI) (h,m,.01s)
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
- 6 F 06 81 ΔV XYZ (LV) (TPI) (.1fps)
PRO (If Recycling To ③)
- 7 F 16 45 MARKS,TFI,MGA (marks,m-s,.01°)
(MGA = -00002 If No REFSMMAT or If P74)
(ΔV LOS) N59E, KEY REL
SET DET TO TFI
PRO
- 8 F 37 P74 - Transmit Mnvr Parameters To CSM
- P35 TPM PRETHRUST (P75 CSM)
- ① F 16 45 V37E 35E (75E) (marks,m-s)
MARKS, TFI, -00001
(RECYCLE) V32E
(TERM MARKING) PRO
- 2 F 06 81 ΔV XYZ (LV) (TPM) (.1fps)
PRO (If Recycling To ①)
- 3 F 16 45 MARKS,TFI,MGA (marks,m-s,.01°)
(MGA = -00002 If No REFSMMAT or If P75)
(ΔV LOS) N59E, KEY REL
SET DET TO TFI
PRO
- 4 F 37 P75 - Transmit Mnvr Parameters To CSM

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P40 DPS THRUST

ENG GMBL-ENABLE
DAP-Set Docked 32021; Undocked 22102: Typ

1

V37E 40E

F 05 09 01706 LM Staged
* (TERM) V34E, 42E or *
* Reload DAP, 40E *

F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO or TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion Of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR

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

2 06 40 TFI, VG, ΔVM (m-s,.1fps)
MASTER ARM - ON (1st DPS BURN)
DET - SET

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

-:35 DSKY Blanks

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

-:15 VERIFY ΔVM (R3) <00005

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P40-P47

-: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, Δ VM (m-s,.1fps)

- *F 97 40 ENGINE FAIL *
- * (RECYCLE Δ V MON) PRO *
- * (RECYCLE) ENTR To TIG-5 *
- * (TERM) ENG ARM-OFF, V34E To ④*

- * PROG Lt-On *
- * V05N 09E 01407 VG INCREAS- *
- * ING *
- * Term Burn or Switch To AGS *

(DPS OFF) F 16 40 TFC, VG, Δ VM (m-s,.1fps)
 ENG ARM - OFF
 PRO

3 F 16 85 VG XYZ (LM) (.1fps)
 Null Components
 PRO

④ F 37 MASTER ARM-OFF

P41 RCS THRUST

TTCA (2) - JETS
 DET - Set
 DAP - Set (11012) or (22102): Typ

1 V37E 41E
 F 50 18 (TFI Available via N40, 45, or 35)
 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (AUTO or TRIM) GUID CONT - PGNS
 MODE CONT (PGNS) - AUTO
 PRO(F50 18 Returns Upon Completion Of Mnvr)
 (MAN) MODE CONT (PGNS) - ATT HOLD
 MNVR
 (BYPASS) ENTR To ②

② 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

3 F 37

P42 APS THRUST

DAP - Set (11002): Typ

1 V37E 42E
 F 05 09 01706 LM NOT STAGED
 * (TERM) V34E *
 * (BYPASS) PRO To ② *

② F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (AUTO or TRIM) GUID CONT - PGNS
 MODE CONT (PGNS) - AUTO
 PRO(F50 18 Returns Upon Completion Of Mnvr)
 (MAN) MODE CONT (PGNS) - ATT HOLD
 MNVR
 (BYPASS) ENTR

*F 50 25 R1 00203 *
 * GUID CONT-PGNS *
 * MODE CONT (PGNS) - AUTO *
 * (If Step 1, BYPASS: *
 * THR CONT - AUTO) *
 * PRO *
 *(BYPASS) ENTR *

3 06 40 TFI, VG, Δ VM (m-s,.1fps)
 *PROG Lt - On *
 V05N 09E 01703 TIG SLIPPED
 * RSET, KEY REL *

DET - Set
 MASTER ARM - ON (Unstaged)

-:35 DSKY Blanks

-:30 06 40 (AVE G ON)

-:15 Verify Δ VM (R3) <00005

If Unstaged:
 -:14 MANUAL ULLAGE
 -:10 STAGE - FIRE
 (MASTER ARM - OFF When Desired)

-:10 ENG ARM - ASC

-:06 Verify +X ULLAGE

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

IGN 06 40 TFC, VG, Δ VM (m-s,.1fps)

*F 97 40 ENGINE FAIL *
 *(RECYCLE Δ V MON) PRO *
 *(RECYCLE) ENTR TO (TIG-5) *
 *(TERM) ENG ARM - OFF *
 * V34E To ⑤ *
 *PROG Lt - On *
 * V05 N09E 01407 VG *
 * INCREASING *
 * Term Burn Or Switch *
 * To AGS *

(APS OFF) F 16 40 TFC, VG, Δ VM (m-s,.1fps)
 ENG ARM - OFF
 PRO

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(.1fps)

4 F 16 85 VG XYZ (LM)
Null Components
PRO

⑤ F 37 MASTER ARM - OFF

P47 ΔV MONITOR

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

2 F 37

P51 IMU ORIENTATION

① CB(11) AC BUS B: AOT LAMP-Close
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 CODE, X, Y MARK COUNTERS (Octal)
(REDEFINE STAR) V32E To ②
(Last Mark Defined By Digit A=1 In R2/3)
(To Change A=1 From R2↔R3) ENTR
(MARK) Position Star, MARK X/Y
(TERM MARKS) PRO

(For DE=00
 F 06 88 CELESTIAL BODY VECTOR
 Load Vector Values
 PRO)

(After 1st Star) Go To ②
 (After 2nd Star) Go To ④

- ④ F 06 05 R1 STAR ANGLE DIFFERENCE (.01°)
 (RECYCLE) V32E To ①
 PRO (For Nom. N05 Values See P52/11)
- 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
- ② F 06 34 GET ALIGN (h,m,.01s)
 (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 & NO DAP Lts-On Then Off
 (GYRO TORQUE) MODE CONT (PGNS)-ATT HOLD, V76E
 ENTR (NO DAP Lt-On)

16 20 PRESENT ICDU ANGLES OG,IG,MG (.01°)
When Torquing Complete To ⑬

⑪ F 50 25 R1 00015 SELECT STAR ACQUISITION MODE
Mnvr To Place 2 Nav Stars In Fwd Detent
& Verify AOT $\delta = 0^\circ$
(MAN ACQ) ENTR
(PICAPAR) PRO
*F 05 09 00405 NO PAIR *
*(CREW SPECIFY) PRO To ⑦ *
*(PICAPAR) V32E To ⑥ *
(CUR/SPIR) V32E To ⑦A & 8A

⑦ ⑦ F 01 70 R1 00CDE (C)DETENT (DE)STAR CODE
C O-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)

8 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO OR TRIM) GUID CONT - PGNS
MODE CONT (PGNS) - AUTO
PRO(F50 18 Returns Upon Completion Of Mnvr)
(MAN) MODE CONT (PGNS) - ATT HOLD
MNVR
(BYPASS) ENTR To ⑨ (If COAS/LPD CALIB, Go to ⑦)

(7A) F 01 70 R1 00CDE (C) DETENT (DE) STAR CODE
 (DETENT) 1-L, 2-F, 3-R, 4-RR, 5-CL, 6-LR
 PRO

(For DE = 00
 F 06 88 CELESTIAL BODY VECTOR
 Load Vector Values
 PRO)

*PROG Lt - On *
 F 05 09 00404 DEFINED STAR
 * NOT AVAILABLE IN *
 * ANY DETENT *
 *(CREW SPECIFY) PRO To ⑨ *
 *(LGC CALC N79) V32E To (7A) *

(8A) F 06 79 CUR, SPIR, POSITION CODE (.01°,0000X)
 (REDEFINE STAR) V32E To (7A)
 PRO To ⑨

⑨ F 01 71 R1 00CDE (C)DETENT (DE)STAR CODE
 PRO

(For C=7
 F 06 87 AZ,EL (.01°)
 PRO)

(For DE=00 & CUR/SPIR Opt.
 F 06 88 CELESTIAL BODY VECTOR
 Verify Vector Values
 PRO)

10 (For CUR/SPIR Opt Go To (10A/B/C))
 F 54 71 CODE,X,Y MARK COUNTERS (Octal)
 (REDEFINE STAR) V32E To ⑨
 (Last Mark Defined By Digit A=1 In R2/3)
 (To Change A=1 From R2↔R3) ENTR
 (MARK) Position Star, MARK X/Y
 (TERM MARKS) PRO

(For DE=00
 F 06 88 CELESTIAL BODY VECTOR
 Verify Vector Values
 PRO)

(After 1st Star) Go To (7)
 (After 2nd Star) Go To (11)

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(10A) F 52/3 71 CODE, 52 CUR, 53 SPIR COUNTERS (Octal)
 (REDEFINE STAR) V32E To ⑨

(Last Mark Defined By Digit A=1 In R2/3)
 (To Change V52↔V53) ENTR

(V52) Position CUR, MARK X/Y/ROD

(V53) Position SPIR, MARK X/Y/ROD

(TERM MARKS) PRO

F 50 25 00016 Unused Mark Sets

* R2=Number Of Unused Sets *

* (CONT) PRO *

* (NEW MARKS) ENTR To ⑨ & *

* Repeat Marking *

(For DE = 00

F 06 88 CELESTIAL BODY VECTOR

Verify Vector Values

PRO)

(After 1st Star) Go To ⑦A

(After 2nd Star) Go To ⑪

(10B) F 21/2 79 LOAD CUR or SPIR (.01°)

(V21) Cur Data ENTR

(V22) Spir Data ENTR

(10C) F 06 79 CUR or SPIR ANGLES (.01°)

PRO To ⑩A (Mark Counter
Increments By 1)

(11) F 06 05 STAR ANGLE DIFFERENCE (.01°)

Nominal Values for N05:

AOT: Two Stars \leq |.12| COAS: Two Stars \leq |.71|

: Star & Planet \leq |.21| : Star & Planet \leq |.73|

(REJECT) V32E To ⑬

(ACCEPT) PRO

12 F 06 93 GYRO ANGLES X,Y,Z (.001°)

(TORQUE) MODE CONTROL (PGNS) - ATT HOLD

V76E (NO DAP Lt-On)

PRO

(NO TORQUE) V32E To ⑬

(13) F 50 25 R1 00014
 (RECHECK) PRO To ⑥
 (TERM) ENTR (V77E, NO DAP Lt-Off)

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

P57 LUNAR SURFACE ALIGNMENT

1 V37E57E
 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 (h,m,.01s)
 (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 00CDO
 C = 0 No REFSMMAT Defined
 1 REFSMMAT Defined
 D = 0 No Stored Attitude
 1 Stored Attitude Available

(A/T 1 or 3) ATT MON - PGNS, PRO To ④
 (IMU ON & ALIGNED & A/T 0) PRO To ⑯
 (IMU ON & ALIGNED & A/T 2) PRO To ⑥
 (IMU NOT ALIGNED & A/T 0 or 2) PRO To ⑯

*PROG Lt - On *
 *F 05 09 00701 ILLEGAL ALIGN *
 * TECH SELECTED *
 *(CHANGE A/T) V32E To ③ *
 *(TERM) V34E, Select New Prog *

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- (4) Monitor of Lunar Gravity Measurement
 V16N20E Monitor Coarse Align (.01°)
 R1 +04200
 R2 +31800
 R3 +03526
 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 (14)
- (For DE = 00
 F 06 88 CELESTIAL BODY VECTOR
 Load Vector Values
 PRO)
- *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 CUR, SPIR, POSITION CODE (.01°,0000X)
 Note: If This Star Is Also Visible In A
 Detent Adjacent To The One In R3
 & New Cur/Spir Are Desired:
 V21 N01E, 373E, 32533E, PRO To (7)
 (REDEFINE STAR) V32E To (6)
 PRO
- (8) F 01 71 R1 00CDE (C) DETENT (DE) STAR CODE
 PRO

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- ⑨ F 52/3 71 CODE, 52 CUR, 53 SPIR COUNTERS (Octal)
 (REDEFINE STAR) V32E To ⑧
 (Last Mark Defined By Digit A=1 In R2/3)
 (To Change V52→V53) ENTR
 (V52) Position CUR, MARK X/Y/ROD
 (V53) Position SPIR, MARK X/Y/ROD
 (TERM MARKS) PRO
- * F 50 25 00016 Unused Mark Sets *
 * R2=Number Of Unused Sets *
 * (CONT) PRO *
 * (NEW MARKS) ENTR To ⑧ & *
 * Repeat Marking *
- (For DE = 00
 F 06 88 CELESTIAL BODY VECTOR
 Verify Vector Values
 PRO)
- (After 1st Star) Go To ⑥ If Opt 00003, Go To ⑫
 (After 2nd Star) Go To ⑫
- 10 F 21/2 79 LOAD CUR or SPIR (.01°)
 (V21) Cur Data ENTR
 (V22) Spir Data ENTR
- 11 F 06 79 CUR or SPIR ANGLES (.01°)
 PRO To ⑨ (Mark Counter
 Increments By 1)
- ⑫ F 06 05 STAR ANGLE DIFFERENCE (.01°)
 Nominal Values For N05:
 Two Stars $\leq .10$ Grav. & Star $\leq .10$
 Star & Planet $\leq .21$ Grav. & Planet $\leq .13$
- (REJECT) V32E To ⑯
 (ACCEPT) PRO
 (TERM) V34E
- 13 F 06 93 GYRO TORQUING ANGLES X,Y,Z (.001°)
 (REJECT) V32E To ⑯
 (ACCEPT) PRO To ⑯
 (TERM) V34E

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- (14) (This Noun Only Displayed If Angle > 5.0°)
 F 06 22 ICDU ANGLES OG, IG, MG (.01°)
 PRO, NO ATT Lt - On Then Off
 (If A/T 2 or 3) Go To ⑥
 (If A/T 1) Go To ⑫
- (15) 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 ⑯ For L.S. Coordinates

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

- (17) F 37

P63 BRAKING PHASE

V37E 63E
 *PROG Lt-On *
 *V05N09E 01412 NON *
 * CONVERGING PDI TIG *
 * MSFN Uplink New S.V.*
 * & Target, Recall P63*

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- 1 F 06 61 TG NEXT TGT,TFI, CROSSRANGE
 SET DET TO TFI (m-s,.1nm)
 N33E
- F 06 33 TIG (h,m,.01s)
 KEY REL
 PRO
- 2 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
 (AUTO or TRIM) GUID CONT - PGNS
 MODE CONT (PGNS) - AUTO
 PRO(F50 18 Returns Upon Completion of Mnvr)
 (MAN) MODE CONT (PGNS) - ATT HOLD
 MNVR
 (BYPASS) ENTR

P63-P68
 P70-P76/P77

*F 50 25 00500 LR *
 * TO DESCENT POS *
 LDG ANT-DES, 10 sec, AUTO
 * PRO *
 *(BYPASS) ENTR *

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

*PROG Lt - On *
 *V05 N09E 01703 TIG SLIPPED *
 * Check For Blank DSKY At DET = +20s; *
 * If Has Blanked, (Man Ign), TTCA Up At*
 * DET = +26s; If Not Blanked, Slip PDI *

4 06 62 VI,TFI, Δ VM (.1fps,m-s,.1fps)

-2:00 MASTER ARM - ON
 (STAGE RELAY Lts (2) - On)

-:35 DSKY Blanks

-:30 06 62 ENG ARM-DES
 (AVE G ON)

-:15 Verify Δ VM (R3) <00005

-:07.5 VERIFY +X ULLAGE
 (NO ULLAGE) Apply Man. Ullage

(-:05) F 99 62 ENG ON ENABLE
 PRO

IGN F 06 63 Δ H (Initially +99999, + LR > LGC) (ft)
 H DOT(-Decreasing H) (.1fps)
 H(+H) RLS (ft)
 (NO IGN & AUTO ULLAGE) ENGINE START - Push
 (NO ULLAGE & NO IGN) - NO-GO PDI
 Release Manual Ullage

1-45

*F 97 63 ENGINE FAIL
* (RECYCLE ΔV MON) PRO
* (RECYCLE) ENTR To **TIG-5**

*
*
*

+:05 DES ENG CMD OVRD - ON
MASTER ARM - OFF

ABORTS:

(DPS) ABORT - Push (or V37E 70E)

If Masked:

MODE CONT (P) - ATT HOLD
Throttle Up Manually
V37E70E(or V22 N46E,E)

(APS) ABORT STAGE - Push (or V37E 71E)

If Masked:

MODE CONT (P) - ATT HOLD
V37E 71E(or V22 N46E, E)

~42,000 ft ALT Lt - Off
V57E (06 63)

~25,000 ft Verify ΔH Decreasing
VEL Lt - Off
(N68 On-Call Via N68E)
(STOP UPDATE) V58E (F 06 63)

*ALT &/or VEL Lt - On *
* RANGE/VELOCITY DATA NOT GOOD *

(MAN THROT) TTCA - Advance Until Cmd = 10%
THR CONT - MAN
V16 N92E
(To Return to Auto Throttle
THR CONT - AUTO
TTCA - Min
KEY REL)

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

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*PROG Lt - On *
 * V05N09E 00511 *
 * Neither or Both LR Ant *
 * Discretes Present *
 * LDG ANT - HOVER, If No ΔH *
 * Update In 10 sec *
 * LDG ANT - DES *

~+09:30 P64 Displayed

P64 APPROACH PHASE

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

Monitor Attitude Change
 To Enable Landing Site
 Visibility.

(MAN THROT) TTCA - Advance Until Cmd = 10%
 THR CONT - MAN

V16N92E

(To Return To Auto Throttle
 THR CONT - AUTO
 TTCA - Min
 KEY REL)

(MAN ATTITUDE CHECK) MODE CONT (PGNS)-ATT HOLD
 (TO USE LPD) Verify MODE CONT(PGNS)-AUTO
 PRO

(Nominal Landing Site) To ④ When TR=0
 (MAN ROD) MODE CONTROL (PGNS)-ATT HOLD
 Activate ROD, To P66 Step 1

2 06 64 Observe Nominal Landing Site
 Using LPD And N64 LPD Display.

3 Redesignate Landing Site
 As Desired (+Pitch Redesignates
 Landing Site Toward LM. Each ROLL/
 PITCH Input Changes The Landing Site
 Position By 1°Az/E1)

④ P66 Displayed

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P66 LANDING PHASE (ROD)

- ① F 06 60 V(FWD) (.1fps)
 H DOT(-Decreasing H) (.1fps)
 H(+ H > RLS) (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 Cmd = 10%
 THR CONT - MAN
 V16N92E
- 2 H(Actual)=5.6 ft LUNAR CONTACT Lt - On
 ENGINE STOP - Push
 PRO
 ENG ARM - OFF
- TD+3:00 V37E 68E To P68 Step 2

P68 LANDING CONFIRMATION

- 1 V37E 68E
- ② F 06 43 LAT(+NORTH),LONG(+EAST),ALT (.01°,.1nm)
 RECORD LAT _____ °
 LONG _____ °
 ALT _____ nm (Nominally zero)
 PRO
 (MIN IMP) MODE CONT(PGNS)-ATT HOLD
 NO DAP Lt-On

P70 DPS ABORT

- 1 From P63,64, or 66 via ABORT-Push or V37E 70E

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

2 06 94 VGX,H DOT,H (.1fps,ft)
 VGX Decreasing
 H DOT Remains Positive
 H Increasing
 *F 97 94 ENGINE FAIL *
 * (RECYCLE ΔV MON) PRO *
 * (RECYCLE) ENTR To F 99 63 *
 * *
 *F 99 63 ENG ON ENABLE *
 * (AUTO) PRO *
 * (BYPASS) ENTR To DPS OFF *

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 Down-
 range. X-OVRD Restored.

3 To Monitor TFC, VGY, VI (m-s,.1fps)
 V16 N7E
 KEY REL

If APS Desired:
 ABORT STAGE - Push (or V37E 71E)
 If Masked:
 MODE CONT (P) - AUTO
 V37E 71E (or V22 N46E, E)

06 94 When VGX = 100 fps:
 DES ENG CMD OVRD - OFF
 ENG ARM - OFF

DPS OFF F 16 94 VGX,H DOT,H (.1fps,ft)
 ENG STOP - Push
 ABORT - Reset
 PRO

(4) F 16 85 VG XYZ (LM) (.1fps)
 Null Components
 (TERM) PRO
 (DISP ORB PARAM) V82E
 F 16 44 HA,HP,TFF (.1nm,m-s)
 Record HA
 HP _____
 HP _____
 TFF _____
 PRO To (4)

5 F 37

P71 APS ABORT

1 From P63,64,66, or 70 via ABORT STAGE - Push or
 V37E 71E

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

APS 06 94 VGX,H DOT,H (.1fps,ft)
 IGN ENG ARM - ASC
 If ENG STOP Lt - On
 ENG STOP - Reset
 ENG START-Push

VGX Decreasing
 H DOT Remains Positive
 H Increasing

*F 97 94 ENGINE FAIL *
 * (RECYCLE ΔV MON) PRO *
 * (RECYCLE) ENTR To (F 99 63)*
 *
 *(F 99 63) ENG ON ENABLE *
 * (AUTO) PRO *
 * (BYPASS) ENTR To (APS OFF)*

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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.

- 2 To Monitor TFC, VGY, VI (m-s,.1fps)
V16 N77E
KEY REL
- 06 94 When VGX = 200 fps, ENG ARM - OFF
*No Cutoff *
* ABORT STAGE - Reset*
- (APS OFF)** F 16 94 VGX,H DOT,H PRO (.1fps,ft)
- ③ F 16 85 VG XYZ (LM) (.1fps)
Null Components
(TERM) PRO
(DISP ORB PARAM) V82E
- F 16 44 HA,HP,TFF (.1nm,m-s)
RECORD HA _____
HP _____
TFF _____
PRO To ③
- 4 F 37

[P76/P77 S.V. UPDATE]

- 1 V37E (CSM) 76E/(LM) 77E (h,m,.01s)
F 06 33 TIG
PRO
- 2 F 06 84 ΔV XYZ (LV) (CSM) [If from P72] (.1fps)
PRO [N84 Is ΔV CDH]
- or
F 06 81 ΔV XYZ (LV) (LM) (.1fps)
PRO
(TO RECALL ΔV) V06N84E
- 3 F 37

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V40 N20 ICDU ZERO

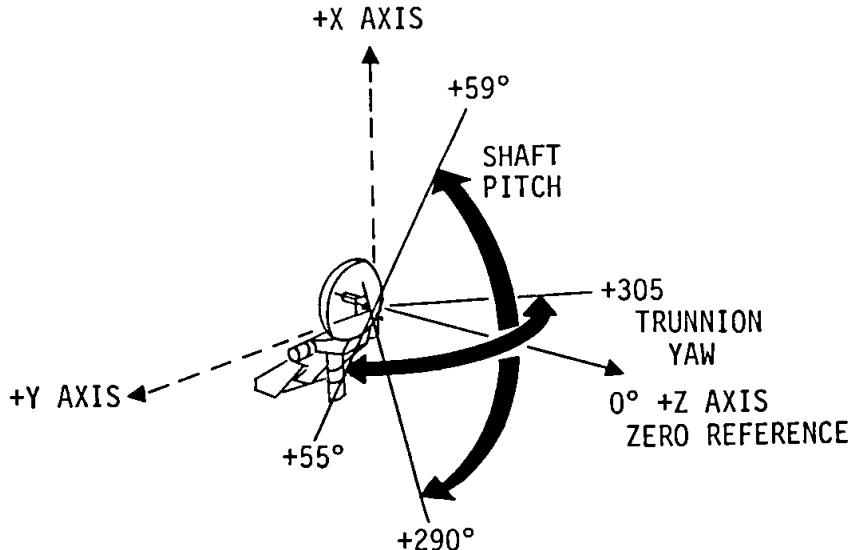
- 1 V40 N20E (NO DAP Lt - On) *
- *PROG Lt - On *
 - *V05 N09E 00206 CDU ZERO *
 - * NOT ALLOWED IN COARSE *
 - * ALIGN & GIMBAL LOCK *
 - *Coarse Align To 0,0,0 Then *
 - * Reselect V40 N20 *
- NO ATT Lt - Off
- 2 (NO DAP Lt-Off) Wait 11 sec Before V37 Attempt

V41 N20 ICDU COARSE ALIGN

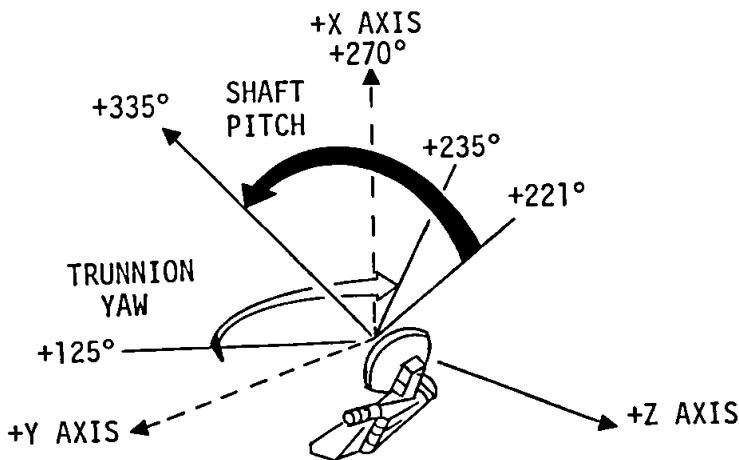
- 1 V41N20E
- F 21 22 NEW ICDU ANGLES 0,I,M (.01°)
Load Desired ICDU Angles
- 2 41 COARSE ALIGN
NO ATT & NO DAP Lts - On
FDIAI Torques
- Accuracy May Be Increased By V41N20E, V33E

- *PROG Lt - On *
- *V05N09E 00211 COARSE *
- * ALIGN ERROR >2° *
- *V16N22E Compare N22 With*
- * N20, Reduce S/C Drift & *
- * Repeat V41N20 *

To Release Platform, Perform ICDU Zero Above



RR ANTENNA MODE I COVERAGE (OPERATIONAL LIMITS)
(IN N73 FORMAT)



RR ANTENNA MODE II COVERAGE (OPERATIONAL LIMITS)
(IN N73 FORMAT)

V41 N72 RR CDU COARSE ALIGN

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

*PROG Lt - On *
 *V05N09E 00502 BAD N73 INPUT *
 * 00503 RR ANT DESIG *
 * FAIL *
 * V44E, Redo V41N72E *
 * 00515 RR CDU FAILED *
 * *(TERM) V44E *

V42 GYRO TORQUING

- 1 MODE CONT (PGNS) - ATT HOLD
V76E (NO DAP Lt-On)
V42E
- F 21 93 ΔGYRO ANGLES (XYZ) (.001°)
Load Desired Angles
- 2 42 FINE ALIGN
Gyro Torquing (NO ATT Lt - Off)
V77E (NO DAP Lt-Off)

V43 FDAI BIAS CHECK

- 1 MODE CONT (PGNS) - OFF
(NO DAP Lt-On)
- 2 V37E00E

- 3 V43E
 F 21 22 NEW ICDU ANGLES YPR (.01°)
 43 Load Desired ICDU Angles & Verify
 Needles Deflect
- 4 ENTR
 F 21 22 NEW ICDU ANGLES YPR (.01°)
 43 Load (-) New ICDU Angles & Verify
 FDAI Needles Return To Initial Pos.
- 5 MODE CONTROL (PGNS) - AUTO or ATT HOLD
 (NO DAP Lt-Off)

V47 AGS INITIALIZATION

- 1 TLM-HI
 V16N65E
 16 65 LGC TIME (h,m,.01s)
 377 + GET-PGNS/AGS BIAS TIME (.1min)
 ENTR-(At Correct PGNS Time)
- 2 V47E
 F 06 16 GET OF AGS CLOCK (h,m,.01s)
 Load PGNS/AGS TIME BIAS
- 3 414 +1
 414R (+0 Indicates AGS Acceptance Of S.V.)
- 4 PRO
 06 16 NO DAP Lt-On For 11 sec If Auto ICDU Zero
 Issued
- 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 Rng (317) Must Be <690.28 nm For Valid 440
 Readout
 440R RANGE RATE ($\Delta R \leq 1.0$ fps) (.1fps)
 PRO

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V48 DAP CONFIG & DPS TRIM

- 1 V48E
- F 04 46 DAP CODE, FUNCTION FAIL CODE (Octal)
 (CONFIG) A 1- ASCENT, 2- DESCENT, 3- DOCKED
 R1 (X-TRANS)B 0- 2JET,M.I/RCS A; 1-2JET,M.I/RCS B
 2- 4JET,M.I/RCS A; 3-4JET,M.I/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°, 3-5°
 (RATE) E 0-.2°/sec, 1-.5°/sec, 2-2°/sec
 3-10°/sec (Use 0 or 1 Docked)
- R2 A=B=C=0
 D=1,3,5,7 Bypasses Auto Thr Check
 of Code 00203, & P66
 E=1,3,5,7 Bypasses (R11) Monitor of
 Abort/Abort Stage Pb's
 PRO (R2 Can Be Changed Directly By V22)
- 2 F 06 47 LM WT, CSM WT (1b)
 PRO (Terminates If Staged)
- 3 F 06 48 ENG GIMBAL TRIM (+)PITCH,(+)ROLL (.01°)
 (TRIM)ENG GMBL - ENABLE
 ENG STOP - PUSH
 ENG ARM - DES
 GUID CONT - PGNS
 MODE CONT (PGNS) - ATT HOLD or AUTO
 PRO (ENG GMBL Lt - On
 When Gimbal Reach Limits)
 (EXIT)V34E
- 4 F 50 48 TRIM COMPLETE
 PRO
 ENG ARM - OFF (ENG GMBL Lt-Off)
 ENG STOP - Reset

V49 CREW DEFINED MNVR

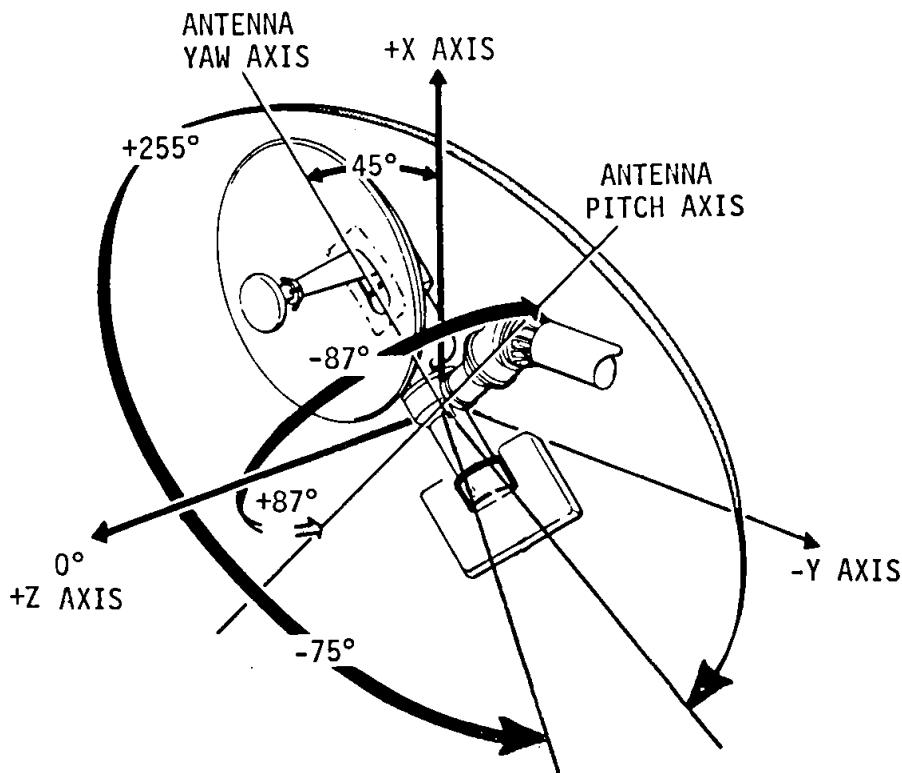
- 1 V37E00E
- 2 V49E
- F 06 22 NEW ICDU ANGLES YPR (.01°)
 PRO

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3 F 50 18 REQUEST MNVR TO FDAI RPY (.01°)
 (AUTO OR TRIM) GUID CONT - PGNS
 MODE CONT (PGNS) - AUTO
 PRO(F50 18 Returns Upon Completion of Mnvr)
 (MAN) MODE CONT (PGNS) - ATT HOLD
 MNVR
 (BYPASS) ENTR (Exit V49)

V64 S-BD ANT POINTING

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



S-BD STEERABLE OPERATIONAL LIMITS

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V67 W-MATRIX ERROR DISP

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

V82 ORB PARAM DISP

1 V82E (G0 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,m-s)
 (UPDATE) V32E (Not Required If AVE G-On)
 (If TFF= -59:59) N32E Time From Perigee
 PRO (h,m,.01s)

V83 RENDZ PARAM DISP

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

V85 RR LOS DISP

1 RR MODE - LGC

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

V89 RENDZ FINAL ATI

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(F50 18 Returns Upon Completion of Mnvr)
 (MAN) MODE CONT (PGNS) - ATT HOLD
 MNVR
 (BYPASS) ENTR (Exit V89)

V90 OUT-OF-PLANE DISP

- ① F 06 16 V90E
 GET EVENT (TIG) (h,m,.01s)
 (0, PRESENT TIME)
 PRO
- 2 F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
 (RECYCLE) V32E To ①
 (EXIT) PRO

V91 SHOW BANKSUM

- 1 F 05 01 V37E00E (or V96E)
 V91E BANKSUM
 R1 SUM OF BANK
 R2 BANK NO.
 R3 BUGGER WORD
 (NEXT BANK) PRO (If R2 ≠ |R1|, Record For MSFN)
 (TERM) V34E

PGNS TURN-ON AND SELF TEST

- 1 If STBY Lt - On, PRO (Hold In Until
 STBY Lt - Off, Repeat If Necessary)
 Possible M.A., LGC Warn, RESTART, &
 PROG Lts-On; Code 1105 or 1106
 RSET

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- 2 V96E
V35E
- F 88 88 DSKY LIGHT CHECK
(M.A., LGC & ISS Warn, And ALL
DSKY Lts - On, 8's In All Registers,
Lts Reset In 5 sec Except NO DAP; LGC
Warn Resets Within 20 sec)
- 3 CB(11) IMU OPR - Close
(NO ATT Lt - On For 90 sec)
- 4 F 21 01 V25N01E 1365E
E,E,E
- 5 15 01 V15 N01E 1365E
R1, R2, R3 A11 Zero
- 6 15 01 V21 N27E 10E (Test Fixed & Erasable Memory)
R1 Number Of Errors
R2 Number Of Tests Started
R3 Number Of Erasable Tests Successful
Test Successful If $R2 \geq 3$ (Minimum 78 sec)

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

- 7 V21 N27E 0E Terminate Self Test

ORDEAL INITIALIZATION

- 1 CB(11) AC BUS B: ORDEAL - Close
FLIGHT DISPLAYS: ORDEAL - Close
FDAAI 1 or 2 - ORB RATE
EARTH/LUNAR - LUNAR
- 2 V82E
F 04 12 R1 00002 SPECIFY VEHICLE
R2 00001 LM
PRO

PGNS T/O,LR,RR TEST
RR BIAS, RCS INHIBIT

1-60

- 3 F 16 44 HA,HP,TFF (.1nm,m-s)
(If AGS) 315R(HA);403R (HP) (.1nm)
Average HA & HP
ALT SET - Set
PRO
- 4 F 16 54 V83E R, RDOT, THETA (.01nm,.1fps,.01°)
(If AGS) 277R (THETA) 0-360P (.01°)
MODE - HOLD/FAST
SLEW - To THETA
MODE - OPR/SLOW
PRO

PIPA BIAS CHECK

- 1 DET - Zero
Rates <.1°/sec With No Thruster Firing
- 2 V25N21E, E, E, E/DET - START
- 3 V06E 06 21 XYZ PIPA COUNTS (+XXXXXX.)
- ④ At T+80sec - ENTR
T+80sec (X)R1 ____ (Y)R2 ____ (Z)R3 ____
- 5 Calculate X,Y,Z 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 F 21 01 V21N01E
LOAD 1452E(Calc X BIAS)E,E
1454E(Calc Y BIAS)E,E
1456E(Calc Z BIAS)E
Same Sign As In Measured Bias of
Step ④

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LGC CLOCK INITIALIZATION

- 1 (Get Time From CSM, Mission Timer, or
MSFN)
V25 N36E
F 21 36 Load Hrs
F 22 36 Load Min
F 23 36 Load Sec (.01) Do Not ENTR
On Source's "Mark" - ENTR
- ② V06 N65
On Source's "Mark" - ENTR
Calculate LGC/Source Time Difference
____:____:____ (h,m,.01s)
- 3 V55E (h,m,.01s)
F 21 24 Load Difference From Step ②

LR SELF TEST

- 1 CB(11) PGNS: LDG RDR - Close
X-POINTERS(Both) - HI MULT
TEMP MON - LDG RDR(+60° to +95°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)
(3.5v)
- VEL XMTR (2.1 To 5.0)
(3.6v)
ALT/ALT RT MON - +7900 To +8100 ft/-478
To -482 fps
- 3 XPOINTER - UP, LFT
- 4 F 04 12 V63E INITIATE RDR SELF TEST
R1 00004 SPECIFY RDR
R2 00001 RNDZ RDR
V22E 2E LDG RDR
PRO

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- 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
- 7 LDG ANT - AUTO (If LR Ant Not Commanded
 To POS 2 via V59E, Go To ⑬)
- 8 V59E COMMAND ANT TO POS 2
 (11 sec, PROG Lt-On, 00523)
- 9 F 04 12 V63E INITIATE RDR SELF TEST
 R1 00004 SPECIFY RDR
 R2 00001 RNDZ RDR
 V22E 2E LDG RDR
 PRO
- 10 F 16 66 SLANT RANGE, ANT POSITION
 R1 +08276 To +08298
 R2 +00002
- 11 F 16 66 LDG ANT - DES (10 sec)
 R2 +00001 (PROG Lt-On, V05N09E,00522 RSET)
- 12 F 16 66 LDG ANT - AUTO
 R2 +00001
 V34E
- ⑬ RDR TEST - OFF
 CB(11) PGNS: LDG RDR - Open

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[RR SELF TEST]

- 1 VERIFY: CSM RCS THRUSTER B3 - OFF (Docked)
 : 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 +75°)
 RR GYRO SEL - SEC
- 2 CB(11) AC BUS A: RNDZ RDR - Close
 : RNG/RNG RT/ALT/ALT RT-
 Close(Wait 30 sec)
 CB(11) PGNS: RNDZ RDR - Close
 (NO TRACK Lt-On)
 FLIGHT DISPLAYS: RNG/RNG RT/ALT/ALT RT-
 Close
- 3 Slew Rate - HI
 Slew Left To Mode I Region (18 sec)
 Slew Right, Down, Left, Up (FDI Needles
 Right, Down, Left, Up)
 SLEW RATE - LO
 SHAFT/TRUN - +5°
 Slew Right, Down, Left, Up (FDI Needles
 Right, Down, Left, Up)
- 4 RR MODE - AUTO TRACK
 RADAR TEST - RNDZ RDR (Rng Rt Tape Drives,
 X-Pointers Oscillate and FDI Needles Vary
 Between +5°. After 12 sec, Rng Tape
 Drives, NO TRACK Lt - Out)
 (If Ant Mode II, No FDI Needles)
- 5 TEST MONITOR - AGC (1.5 To 1.9)
 - XMTR PWR (2.8 To 3.2)
 - SHAFT ERR(2.2 To 2.6@1/2cps)
 - TRUN ERR (2.2 To 2.6@1/2cps)
 - AGC

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- 6 Set NORRMON Flag
 V25 NO7E
 101E, 10E, 1E
 RR MODE - LGC(NO TRACK & Pwr Fail Lts - On)
- 7 F 04 12 V63E START RNDZ RDR SELF TEST
 R1 00004 SPECIFY RADAR
 R2 00001 RNDZ RADAR
 PRO (TRACKER Lt - On)
 (TRACKER, NO TRACK & Pwr Fail Lts - Off
 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,.1fps,m-s)
 R1 +195.10 To +195.50 (TM 193 To 197)
 R2 -0470.5 To -0510.5 (TM 478 To 528)
- 10 V34E (NO TRACK & Pwr Fail Lts - On,
 X-Pntr-Center)
- 11 RADAR TEST - OFF
- 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)
- 14 SHFT/TRUN - +5°
 RR GYRO SEL - PRIM
 V41N72E
 N73 R1 +35600
 R2 +35600
 N12 R2 00002
 V16N72E (Verify FDAI Needles)

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

16

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

RR BIAS INITIAL

1

V24N01E
 1700E
 E, E
 V24N01E
 1702E
 E, E
 V93E

KNOWN RR BIAS LOADING

1

V21 N01E
 (SHAFT) 1700E, XXXXXE (See Table)
 (TRUN) 1702E, XXXXXE (See Table)

(+) TRUN = Needle Left
 (+) SHAFT = Needle Up

| (+)_ DEG | (+) OCT | (-) OCT | (+)_ DEG | (+) OCT | (-) OCT |
|----------|---------|---------|----------|---------|---------|
| 0.5 | 22 | 77755 | 4.5 | 241 | 77536 |
| 1.0 | 44 | 77733 | 5.0 | 263 | 77514 |
| 1.5 | 66 | 77711 | 5.5 | 305 | 77472 |
| 2.0 | 107 | 77670 | 6.0 | 326 | 77451 |
| 2.5 | 131 | 77646 | 6.5 | 350 | 77427 |
| 3.0 | 153 | 77624 | 7.0 | 372 | 77405 |
| 3.5 | 175 | 77602 | 7.5 | 414 | 77363 |
| 4.0 | 217 | 77560 | | | |

LGC THRUSTER INHIBIT/RE-ENABLE

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 |
| <hr/> | <hr/> |
| B2U - 20E | A3U - 4E |
| A2D - 40E | B3D - 10E |
| A2A - 10E | B3A - 1E |
| B2L - 20E | A3R - 40E |

2 CAUTION
 Affected Quad Pair(s) Must Be
 *Enabled Before Next Step *
 1E (To Re-enable, OE This Step)

3 V48E, PRO, V34E

CREW DEFINED DOCKED DB

1 V21NOTE
 3011E
 (DB = 5.0°) 44E
 (DB = 1.4°) 200E

LPD BIAS LOAD

1 V21 N01E, 3373E
 (AZBIAS - Octal) ENTR

2 ENTR, 1353E
 (ELBIAS - Octal) ENTR

ALTERNATE LPD BIAS LOAD

1 V21 N03E, (ADD) E
 ADD = 3373 For AZBIAS
 = 1353 For ELBIAS

2 Load New Value: (ie + XXX.XXe)
 New Val (AZBIAS) = Old Val + 1.3 (ΔAz)
 (+ ΔAz = LPD is Right of L.S.)
 (ELBIAS) = Old Val + Δ Elev
 (+ Δ Elev = LPD is Above L.S.)

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

RMAX LOAD TO MINUS ONE

1 V21 N01E
 2004E (RMAX)
 77776E (Sets RMAX To -1 Which Forces N49
 For All MARKS)

RMAX/VMAX LOAD TO PAD VALUES

1 V24N01E
 2004E (RMAX)
 23E (Sets RMAX To 2,000 ft)
 1E (Sets VMAX To 2 fps)

REVIEW DATA IN E-MEMORY

1 V01 N01E, OCTAL ADD E
 01 01 R3 OCTAL ADD, R1 (DATA)
 2 N15E (For Next Succeeding Address)
 ENTR (For Each Succeeding Address)

CHANGE DATA IN E-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 V11N1OE
 F 11 10 Load Channel Add E
 R1 Octal Contents Of Specified Channel

LOAD OUTPUT CHANNELS

1 V21N1OE
 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

FLAGWORD SET/RESET

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

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

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4

1-69

To Verify Load:

V01N01E, FLAGWORD ADD ENTR

01 01 R3 FLAGWORD ADD

R1 FLAGWORD CONTENT (See Table Above)

BINARY-TO-OCTAL CONVERSION

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

OCTAL-TO-DECIMAL CONVERSION

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

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FL GWD, CHAN LIST
LM/CSM S.V. READ

FLAGWORD LIST

| <u>FLAG</u> | <u>ADD</u> | <u>CODE (BIT)</u> | <u>SET (1) RESET(0)</u> | |
|---------------|------------|-----------------------|--|--------------------------------------|
| P25 FLAG | 74 | 400 (9) | <u>P25 Operating</u> <u>P25 Not Oper.</u> | <u>C=4,5,6,7</u> <u>C=0,1,2,3</u> |
| IMU | 74 | 200 (8) | <u>IMU In Use</u> <u>IMU Not In Use</u> | <u>C=2,3,6,7</u> <u>C=0,1,4,5</u> |
| Rendezvous | 74 | 100 (7) | <u>P20 Or P22 Initiated</u> <u>P20 Or P22 Terminated</u> | <u>C=1,3,5,7</u> <u>C=0,2,4,6</u> |
| Lock On | 74 | 20 (5) | <u>RR Lock-ON Desired</u> <u>RR Lock-ON Not Desired</u> | <u>D=2,3,6,7</u> <u>D=0,1,4,5</u> |
| Terrain Model | 75 | 2000 (11) | <u>Terrain Model Inhibited</u> <u>Terrain Model Permitted</u> | <u>B=2,3,6,7</u> <u>B=0,1,4,5</u> |
| State Vector | 75 | 200 (8) | <u>CSM S.V. Updated (V81)</u> <u>LM S.V. Updated (V80)</u> | <u>C=2,3,6,7</u> <u>C=0,1,4,5</u> |
| Update | 75 | 100 (7) | <u>S.V. Update by Marks Allowed</u> <u>S.V. Update by Marks Not Allowed</u> | <u>C=1,3,5,7</u> <u>C=0,2,4,6</u> |

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| | | | | |
|----------------|-----|---------------|--|--------------------------------------|
| Track | 75 | 20 (5) | <u>Rndz Tracking Allowed</u> <u>Rndz Tracking Not Allowed</u> | <u>D=2,3,6,7</u> <u>D=0,1,4,5</u> |
| Manual Acquire | 76 | 10000 (13) | Enable man acq of CSM by RR Enable auto acq of CSM by RR | <u>A=1,3,5,7</u> <u>A=0,2,4,6</u> |
| Final | 76 | 40 (6) | Final Pass Through Rndz Prog Comp Interim Pass Through Rndz Prog Comp | <u>D=4,5,6,7</u> <u>D=0,1,2,3</u> |
| Active Veh | 76 | 20 (5) | <u>LM Active Veh</u> <u>CSM Active Veh</u> | <u>D=2,3,6,7</u> <u>D=0,1,4,5</u> |
| REFSMMAT | 77 | 10000 (13) | REFSMMAT Good REFSMMAT Not Good | <u>A=1,3,5,7</u> <u>A=0,2,4,6</u> |
| No Throttle | 101 | 4000 (12) | Inhibit Full Throttle Permit Full Throttle | <u>B=4,5,6,7</u> <u>B=0,1,2,3</u> |
| 3 Axis | 101 | 40 (6) | Mnvr Specified By 3 Axis Mnvr Specified By 1 Axis | <u>D=4,5,6,7</u> <u>D=0,1,2,3</u> |
| NORRMON | 101 | 10 (4) | Bypass RR Gmb1 Monitor Perform RR Gmb1 Monitor | <u>D=1,3,5,7</u> <u>D=0,2,4,6</u> |

| | | | | |
|-----------|-----|---------------|--|------------------------|
| Rendwflg | 101 | 1 (1) | <u>W Matrix Valid For Flt Nav</u> <u>W Matrix Not Valid For Flt Nav</u> | E=1,3,5,7 E=0,2,4,6 |
| Attitude | 102 | 1 (1) | <u>LM Att Stored In LGC</u> <u>LM Att Not Stored In LGC</u> | E=1,3,5,7 E=0,2,4,6 |
| SURFFLAG | 104 | 200 (8) | <u>LM On Surface</u> <u>LM Not On Surface</u> | C=2,3,6,7 C=0,1,4,5 |
| FLT59FLG | 105 | 10 (4) | <u>Cur/Spir Marks Enabled In P52</u> <u>Cur/Spir Marks Not Enabled In P52</u> | D=1,3,5,7 D=0,2,4,6 |
| Remode | 110 | 20000 (14) | <u>Remode Requested</u> <u>No Remode Requested</u> | A=2,3,6,7 A=0,1,4,5 |
| Antenna | 110 | 4000 (12) | <u>RR Ant In Mode 2</u> <u>RR Ant In Mode 1</u> | B=4,5,6,7 B=0,1,2,3 |
| Designate | 110 | 1000 (10) | <u>Designate Requested or In Progress</u> <u>Designate Not Requested or Not In Progress</u> | B=1,3,5,7 B=0,2,4,6 |
| ACA Mode | 111 | 40000 (15) | <u>Min Impulse Enabled (V76)</u> <u>Rate Command Enabled(V77)</u> | A=4,5,6,7 A=0,1,2,3 |

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CHANNEL LIST

| CHANNEL | BIT | DSKY | FUNCTION |
|-----------|-----|-----------|------------------------------|
| OUTPUT 5 | 1 | E=1,3,5,7 | JET 1 ON (4U) |
| | 2 | E=2,3,6,7 | JET 2 ON (4D) |
| | 3 | E=4,5,6,7 | JET 5 ON (3U) |
| | 4 | D=1,3,5,7 | JET 6 ON (3D) |
| | 5 | D=2,3,6,7 | JET 9 ON (2U) |
| | 6 | D=4,5,6,7 | JET 10 ON (2D) |
| | 7 | C=1,3,5,7 | JET 13 ON (1U) |
| | 8 | C=2,3,6,7 | JET 14 ON (1D) |
| OUTPUT 6 | 1 | E=1,3,5,7 | JET 7 ON (3A) |
| | 2 | E=2,3,6,7 | JET 3 ON (4F) |
| | 3 | E=4,5,6,7 | JET 15 ON (1F) |
| | 4 | D=1,3,5,7 | JET 11 ON (2A) |
| | 5 | D=2,3,6,7 | JET 12 ON (2L) |
| | 6 | D=4,5,6,7 | JET 8 ON (3R) |
| | 7 | C=1,3,5,7 | JET 4 ON (4R) |
| | 8 | C=2,3,6,7 | JET 16 ON (1L) |
| OUTPUT 11 | 1 | E=1,3,5,7 | ISS WARNING |
| | 13 | A=1,3,5,7 | ENGINE ON |
| | 14 | A=2,3,6,7 | ENGINE OFF |
| OUTPUT 12 | 1 | E=1,3,5,7 | ZERO RRCDU |
| | 4 | D=1,3,5,7 | COARSE ALIGN ENABLE |
| | 5 | D=2,3,6,7 | ZERO ICDU |
| | 9 | C=4,5,6,7 | GMBL TRIM CMD (S/C Pitch Up) |
| | 10 | B=1,3,5,7 | GMBL TRIM CMD (S/C Pitch Dn) |
| | 11 | B=2,3,6,7 | GMBL TRIM CMD (S/C Roll Rt) |
| | 12 | B=4,5,6,7 | GMBL TRIM CMD (S/C Roll Lt) |
| | 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 | E=4,5,6,7 | MARK X |
| | 3 | D=1,3,5,7 | MARK Y |
| | 4 | D=2,3,6,7 | MARK REJECT |
| | 5 | D=4,5,6,7 | +RATE OF DESCENT |
| | 6 | C=1,3,5,7 | -RATE OF DESCENT |

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

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| | | | |
|---------------------------|----|-----------|---|
| 33 (INVERTED) INPUT | 2 | E=0,1,4,5 | RR PWR ON/AUTO |
| | 3 | E=0,1,2,3 | RR RNG SCALE LOW |
| | 4 | D=0,2,4,6 | RR DATA GOOD |
| | 5 | D=0,1,4,5 | LR ALT 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 |
| 77 OUTPUT | 1 | E=1,3,5,7 | ERASABLE OR FIXED MEMORY PARITY FAIL |
| | 2 | E=2,3,6,7 | ERASABLE MEMORY PARITY FAIL |
| | 3 | E=4,5,6,7 | TC TRAP |
| | 4 | D=1,3,5,7 | RUPTLOCK |
| | 5 | D=2,3,6,7 | NIGHT WATCHMAN |
| | 6 | D=4,5,6,7 | VOLTAGE FAIL |
| | 7 | C=1,3,5,7 | COUNTER FAIL |
| | 8 | C=2,3,6,7 | SCALAR FAIL |
| | 9 | C=4,5,6,7 | SCALAR DOUBLE FREQUENCY |

(Chan 77 is Reset By V36E, P27 S.V.Update, or via N10)

| |
|------------------------|
| LM OR CSM S.V. READOUT |
|------------------------|

| | | |
|---|-----------------|----------------------------|
| 1 | V83E | After integration: V05N01E |
| 2 | | |
| | <u>CSM S.V.</u> | <u>LM S.V.</u> |
| | 2130E | 2160E |
| | E,2133E | E,2163E |
| | E,2171E | E,2103E |
| | E,2174E | E,2106E |
| | E,2112E | E,2112E |
| | PRO | PRO |

3 Transmit S.V. & Time Tag To CSM

| |
|------------------------|
| LM OR CSM S.V. LOADING |
|------------------------|

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

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AGS SELECTOR LOGIC LIST

| <u>Address</u> | <u>Entry</u> | |
|----------------|--------------|--|
| 400 | +00000 | Attitude Hold |
| | +10000 | Auto Guidance Steering |
| | +20000 | Z-Body Axis Steering |
| | +30000 | IMU Align |
| | +40000 | Lunar Align |
| | +50000 | Body Axis Align |
| | +60000 | Gyro and Accelerometer Calibration (302 sec,35 sec) |
| | +70000 | Inflight Accelerometer Only Calibration (35 sec) |
| 410 | +00000 | Orbit Insertion Routine |
| | +10000 | CSI Routine |
| | +20000 | CDH Routine |
| | +30000 | TPI Search Routine |
| | +40000 | TPI Execute Routine |
| | +50000 | External ΔV |
| 411 | +00000 | Disables AGS Auto S.V. Updating via Radar Data |
| | +10000 | Enables AGS Auto S.V. Updating via Radar Data |
| 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 Az. & Set Surf. Flg. |
| 414 | +00000 | Navigation Initialization Complete (AUTO) |
| | +10000 | LM And CSM Navigation Initialization via PGNCS Downlink |
| | +20000 | LM Navigation Initial- ization via DEDA |
| | +30000 | CSM Navigation Initial- ization via DEDA |
| 415 | +00000 | Normal Value |
| | +10000 | Store Z-axis Direction Cosines & Rng/Rng Rt Data in RDR Filter |

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| | | |
|-----|--------|--|
| 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 Value |
| | +10000 | Initialize Radar Filter (Zeros 621) |
| 507 | +00000 | Z Body Points In Direction Of CSM When In Z-Body Axis Steering (400 set to +2) |
| | +10000 | Z Body Points To Desired Thrust Direction When 400 Set To +20000 |
| 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 De- fined By WB When In Guidance Steering (400 set To +1) |

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 ω_L Calculation (O.I.) | 100 ft |
| 225 | One Half of the Lower Limit of Apolune Radius (O.I.) | 100 ft |
| 226 | Retarget Value For Term In ω_L Calculation (O.I.) | 100 ft |
| 231 | Landing Site Radius | 100 ft |
| 232 | Targeted Orbit Insertion Altitude | 100 ft |
| 233 | Vertical Pitch Steering Altitude Threshold | 100 ft |

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| | | |
|-----|--|---------|
| 240 | X Position Comp (LM) | 100 ft |
| 241 | Y Position Comp (LM) | 100 ft |
| 242 | Z Position Comp (LM) | 100 ft |
| 244 | X Position Comp (CSM) | 100 ft |
| 245 | Y Position Comp (CSM) | 100 ft |
| 246 | Z Position Comp (CSM) | 100 ft |
| 254 | LM Ephemeris Data (Epoch Time) | .1 min |
| 260 | X Velocity Comp (LM) | .1fps |
| 261 | Y Velocity Comp (LM) | .1fps |
| 262 | Z Velocity Comp (LM) | .1fps |
| 264 | X Velocity Comp (CSM) | .1fps |
| 265 | Y Velocity Comp (CSM) | .1fps |
| 266 | Z Velocity Comp (CSM) | .1fps |
| 272 | CSM Ephemeris Data (Epoch Time) | .1 min |
| 275 | Desired Update Time For TIG TPI (For CSI Calc Only) | .1 min |
| 304 | Sine Of Central Angle Limit (TPI) | N/A |
| 305 | Retarget 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 (<136 min) | .01 min |
| 312 | TPI Rendezvous Offset Time (Stable Orbit Rendezvous) | .01 min |
| 316 | Radar Range (R) | .01 nm |
| 373 | AGS TIG CSI, CDH, TPI, TPM, EXT ΔV | .1 min |
| 377 | AGS Computer Time (T) | .1 min |
| 404 | Set +0 For 470 Readout | N/A |
| 405 | Set +0 For 471 Readout | N/A |
| 406 | Set +0 For 472 Readout | N/A |
| 450 | ΔVX (LV) (+Fwd) | .1fps |
| 451 | ΔVY (LV) (+Rt) | .1fps |
| 452 | ΔVZ (LV) (+Dn) | .1fps |
| 464 | Vertical Pitch Steering Altitude Rate Threshold | .1fps |
| 465 | Targeted Radial Rate at Insertion (Lower Limit) | .1fps |
| 503 | Radar Range Rate (RDOT) Input | .1fps |
| 514 | Components of Unit Vector (X,Y,Z) Used to Provide Yaw | Octal |
| 515 | Steering Out of CSM Orbit Plane (400 +10000;623 +10000) | |

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| | | |
|-----|---|--------------------------|
| 534 | Scale Factor for X Accelerometer | Octal |
| 535 | Scale Factor for Y Accelerometer | Octal |
| 536 | Scale Factor for Z Accelerometer | Octal |
| 540 | X Accel Bias Comp Coeff | .001 ft/sec ² |
| 541 | Y Accel Bias Comp Coeff | .001 ft/sec ² |
| 542 | Z Accel Bias Comp Coeff | .001 ft/sec ² |
| 544 | X Gyro Drift Comp Coeff | .01°/hr |
| 545 | Y Gyro Drift Comp Coeff | .01°/hr |
| 546 | Z Gyro Drift Comp Coeff | .01°/hr |
| 547 | Lunar Align Azimuth Correction | Octal |
| 574 | Staging Flag(+ Not Staged) | Octal |
| 575 | Attitude Hold Flag (-Is Att Hold) | 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 |
| 616 | Counts For Ullage | (1ct=2sec) |
| 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 | Retargeted Value For 4K10 When Central Angle Exceeds The Retarget Phase Angle Limit (See 305) | Octal |

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 |
| 270 | Present ΔV_y Out-of-CSM Orbit Plane Velocity (V_{yo}) | .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. | |

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| | | |
|-----|--|---------|
| 310 | Time To Next Maneuver (Except O.I.) | .01 min |
| 311 | Time To Rndz (TPI) | .01 min |
| 312 | Target Offset Time (TPI) | .01 min |
| 314 | ΔH At TIG CSI | .1 nm |
| 315 | Predicted Apogee Altitude Of Present LM Orbit | .1 nm |
| 317 | State Vector Range To CSM | .01 nm |
| 337 | LM Altitude (h) | .1 nm |
| 340 | X Comp of LM Position | 100 ft |
| 341 | Y Comp of LM Position | 100 ft |
| 342 | Z Comp of LM Position | 100 ft |
| 344 | X Comp of CSM Position | 100 ft |
| 345 | Y Comp of CSM Position | 100 ft |
| 346 | Z Comp of CSM Position | 100 ft |
| 347 | Predicted Altitude At TIG or Pre- dicted Altitude At Burnout For O.I. | 100 ft |
| 357 | Time To Burnout =[357]/160 sec) | .01 sec |
| 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 |
| 370 | ΔV Magnitude (Except O.I.) | .1fps |
| 371 | Braking Velocity TPI(+60000 Invalid) | .1fps |
| 372 | CSI To CDH ΔT (CSI) | .1 min |
| 402 | ΔH In Coelliptic Orbit (CSI,CDH) | .1nm |
| 402 | Predicted Hp (TPI) | .1nm |
| 403 | LM Perigee Altitude (Hp) | .1nm |
| 423 | Desired Final HDOT (Except EXT ΔV) | .1fps |
| 427 | Present LM HOR Velocity | .1fps |
| 433 | LM Total Velocity Magnitude | .1fps |
| 440 | State Vector Range Rate Between LM and CSM (-Closing) | .1fps |
| 470 | ΔV_X Measured (LM) (+ Up) (Use 404 to zero) | .1fps |
| 471 | ΔV_Y Measured (LM) (+ Rt) (Use 405 to zero) | .1fps |
| 472 | ΔV_Z Measured (LM) (+ Fwd) (Use 406 to zero) | .1fps |
| 477 | Predicted HDOT At CSI, CDH, TPI or Present HDOT O.I. | .1fps |

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| | | |
|-----|--------------------------------|-------|
| 500 | ΔV_{gx} (LM) (+Up) | .1fps |
| 501 | ΔV_{gy} (LM) (+Rt) | .1fps |
| 502 | ΔV_{gz} (LM) (+Fwd) | .1fps |
| 606 | Next Update Flag (R + or R -) | N/A |
| 612 | Staging Sequence Counter | Octal |
| 614 | Uillage Counter Duration | 2 sec |
| 621 | Radar Mark Counter R/R (XXOYY) | Cts |

DEDA ACCESSIBLE CONSTANTS LIST

Address

| | | |
|------------|---|--------|
| 216 (2K3) | Value of LM Pericynthian 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 |
| 267 (5K18) | Lower Limit Of Radial Jerk For Unstaged Vehicle (Orbit Insertion) | N/A |
| 274 (7K1) | TIG Time Bias (Ext ΔV) | .1 min |
| 313 (6K12) | Range Scale Factor (Auto) | N/A |
| 446 (4K25) | APS Tailoff ΔV | .1fps |
| 453 (2K20) | P Iterator Convergence Check (TPI) | .1 sec |
| 454 (4K26) | VG Engine Cutoff Threshold | .1fps |
| 466 (5K26) | Vgx Pseudo Attitude Hold Threshold | .1fps |
| 506 (4K12) | Acceleration Threshold for Radial Jerk Set (O.I.) | Octal |
| 517 (6K14) | Range Rate Bias (Auto) | Octal |
| 523 (5K20) | Lower Limit Of Radial Jerk For Staged Vehicle (O.I.) | Octal |
| 526 (2K11) | Set Value Of VF (TPI) | Octal |
| 527 (4K6) | Upper Limit Of Predicted Radial Rate At Insertion (O.I.) | Octal |
| 537 (1K14) | X-Axis Gyro Mass Unbalance Compensation Constant | Octal |
| 560 (5K14) | Upper Limit Of Radial Jerk (O.I.) | Octal |
| 561 (5K16) | Upper Limit Of Out-Of-Plane Jerk (O.I.) | Octal |
| 577 (6K13) | Range Rate Scale Factor (Auto) | Octal |
| 611 (5K17) | Lower Limit Of Out-Of-Plane Jerk (O.I.) | Octal |

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| | | |
|------------|---|-----------------|
| 613 (1K37) | Accel. Calibration Time | Octal |
| 617 (1K30) | Gyro Calibration Time | (1 Ct = 2sec) |
| 622 (4K23) | Attitude Hold At Abort | |
| | Staging Threshold | (1 Ct = 40msec) |
| 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 |
| 660 (4K34) | Lower Limit Of Thrust Acceleration | Octal |
| 661 (4K35) | Ullage Counter Threshold | Octal |
| 662 (4K10) | Factor In LM Desired Semi-Major Axis aL Calculation (O.I.) | Octal |
| 666 (4K21) | Limit For Attitude Error | Octal |

ADDRESS/DISCRETES

| <u>ADD</u> | <u>READOUT</u> | <u>DISC. DEF.</u> |
|------------|----------------|-----------------------------------|
| 533 | A = 1,3,5,7 | Follow-Up Disc. Present |
| | B = 4,5,6,7 | MODE CONT (A) - AUTO Disc.Present |
| | B = 2,3,6,7 | Descent Eng On |
| | B = 1,3,5,7 | Ascent Eng On |
| | C = 4,5,6,7 | Abort Disc. Present |
| | C = 2,3,6,7 | Abort Stage Disc. Present |

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ORBIT INSERTION

| | | | |
|---|---|---|--------------|
| 1 | MODE CONT (AGS) - AUTO GUID CONT - PGNS DET - SET | | |
| 2 | 224+(Semi-Major Axis Targeting Term) 225+(Apolune Radius/2) 226+(Retarget Value For Term In αL) 232+(Orbit Insertion Altitude) 305+(Phase Angle Limit) 373+(Load TIG LO or PDI) | (100ft) (100ft) (100ft) (100ft) (.01°) (.1min) | |
| | [Note: Present Time Must Be <136min Prior To TIG Loaded] | | |
| | 410+0 Orbit Insertion Routine 465+(Altitude Rate At Insertion) 616+0 Zero Ullage Counter Limit 662+(4K10) 673+(Retarget Value For 4K10) | (.1fps) (.1fps) (Octal) (Octal) | |
| 3 | 623+0 Z-AXIS PARALLEL TO CSM ORBIT PLANE +1 Z-AXIS PARALLEL TO SPECIFIED PLANE If 623+1; Specify Plane: 514+(X Comp. of Unit Vector) 515+(Y Comp. of Unit Vector) 516+(Z Comp. of Unit Vector) | | |
| 4 | 400+1 GUIDANCE STEERING 501R $\Delta VGY(LM)$ 502R $\Delta VGZ(LM)$ 500R $\Delta VGX(LM)$ | (.1fps) (.1fps) (.1fps) | |
| 5 | <u>CONFIGURATION</u> | DES | ASC |
| | THR CONT | MAN | - |
| | MAN THROT | CDR | - |
| | BAL CPL | ON | ON |
| | ATT/TRANSL | 4 JET | 4 JET |
| | TTCA (CDR) | THROT | JETS |
| | DEADBAND | MIN | MIN |
| | ABORT(STAGE)PB | Reset | Reset |
| | ENG ARM | DES | ASC |
| | ATT CONT(3) | MODE CONT | MODE CONT |

O.I.,CSI,CDH,TPI,
TPM,EXT AV

DATE
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| | | | |
|-------------------|-------------------------|-------------------|------|
| MASTER ARM | ON(1st Burn Only) | ON(Un- staged) | OFF |
| PRPLNT QTY MON | DES 1 | OFF | OFF |
| PRPLNT TEMP/PRESS | DES 1 | ASC | - |
| MON | | | |
| HELIUM MON | SUPCRIT PRESS | PRESS 2 | - |
| ENGINE STOP | - | - | PUSH |

6 - :30 For DPS Burns:

CB(11) DECA PWR - Close
CB(16) DES ENG OVRD - Close
ENG GMBL - ENABLE

For APS Burns:

CB(11&16) AELD (2)- Close

7 - :20 GUID CONT - AGS

8 :00 ABORT (STAGE) - Push
IGN ENGINE START - Push

9 When $\Delta VGX=200$ fps:
ENG ARM-OFF

When Burn Complete:
ABORT (STAGE) - Reset
ENG STOP - Push

For Over Burns:

(Out-of-Plane Comp):

Null 263R ΔVY

(.1fps)

410+5

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| | | |
|----|--|---------|
| 10 | NULL 500,501,502 | (.1fps) |
| | (Null 501 After 502 for Out-of-Plane Trim) | |
| | ENG STOP | - Reset |
| | MASTER ARM | - OFF |
| | ENG ARM | - OFF |
| | BAL CPL | - ON |
| | TTCA (CDR) | - JETS |
| | DEADBAND | - MAX |
| | PRPLNT QTY MON | - OFF |
| | HELIUM MON | - OFF |

CSI

- 1 MODE CONT (AGS) - ATT HOLD
GUID CONT - AGS
- 2 Wait until TIG-136 min
275 + (TIG TPI) (.1 min)
373 + (TIG CSI) (.1 min)
410 + 1 CSI Routine
416 + 1 CDH 1/2 Orbital Period After CSI
+ 3 CDH 3/2 Orbital Periods After CSI
451 + OE (Δ VY CSI)
605 + (COTAN LOS TPI) (Octal)
616 + 00005 (10 sec of ullage)
- 3 477R HDOT CSI (.1fps)
- 4 310R Δ T To CSI (.01 min)
DET - SET
- 5 If Time Available:
303R LM/CSM Phase Angle (.01°)
314R Δ H At TIG (.1nm)
372R Δ T CSI To CDH (.1 min)
402R Δ H CDH (.1nm)
477R Predicted HDOT (.1fps)
- 6 410 + 5 EXT Δ V
450R Δ VX CSI (.1fps)
263R Δ VY CSI (.1fps)
451 (Δ VY CSI) (Sign As 263) (.1fps)
452R Δ VZ CSI (.1fps)
370R Δ VG Magnitude CSI (.1fps)
- 7 623 +0 Z-Axis Parallel to CSM Orbit Plane
+1 Z-Axis Parallel to Specified Plane
If 623 +1, Specify Plane:
514 + (X Comp. of Unit Vector)
515 + (Y Comp. of Unit Vector)
516 + (Z Comp. of Unit Vector)
- 8 400 +1 GUIDANCE STEERING (Z Axis Mnvr, 400+2,
507+1)

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- 9 ATTITUDE CONTROL (3)-PULSE
 MODE CONT (AGS) - AUTO
 Maneuver To Burn Attitude
 ATTITUDE CONTROL (3)-MODE CONT
- 10 500R ΔVGX (LM) (.1fps)
 501R ΔVGY (LM) (.1fps)
 502R ΔVGZ (LM) (.1fps)
- 11 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 Only) | OFF |
| PRPLNT QTY MON | DES 1 | OFF | OFF |
| PRPLNT TEMP/PRESS | DES 1 | ASC | - |
| MON | | | |
| HELIUM MON | SUPCRIT PRESS | PRESS 2 | - |
| ENGINE STOP | - | - | PUSH |
- 12 -:30 For DPS Burns:
 CB(11) DECA PWR-Close
 CB(16) DES ENG OVRD-Close
 ENG GMBL - ENABLE
 For APS Burns:
 CB(11&16) AELD (2) - Close
- :15 (X-Axis) 500R
 (Z-Axis) 502R
- 13 -:10 Start Ullage
 :00 Ignition
 (RCS Burn) When ΔVG <15fps,
 MODE CONTROL (AGS)-ATT HOLD

- 14 When Burn Complete:
 ABORT (STAGE) - Reset
 NULL 500,501,502 (.1fps)
- 15 MASTER ARM - OFF
 ENG ARM - OFF
 BAL CPL - ON
 TTCA(CDR) - JETS
 DEADBAND - MAX
 PRPLNT QTY MON - OFF
 HELIUM MON - OFF
- CDH**
- 1 MODE CONT (AGS) - ATT HOLD
 GUID CONT - AGS
- 2 Wait Until TIG -136 min:
 373R TIG CDH (Adjust AGS TIG CDH
 As Desired For New Solution) (.1 min)
 410 + 2 CDH ROUTINE
 616 + 00005 (10 sec Ullage)
- 3 310R ΔT To CDH (.01 min)
 DET - SET
- 4 If Time Available Check The Following:
 402R ΔH CDH (.1nm)
 423R HDOT CDH (Final) (.1fps)
 477R HDOT CDH (.1fps)
- 5 410 +5 EXT ΔV
 450R ΔVX CDH (.1fps)
 263R ΔVY CDH (.1fps)
 451 (ΔVY CDH) (Sign As 263) (.1fps)
 452R ΔVZ CDH (.1fps)
 370R ΔVG Magnitude CDH (.1fps)
- 6 623 +0 Z-axis Parallel To CSM Orbit Plane
 +1 Z-axis Parallel To Specified Plane
 If 623 +1, Specify Plane
 514 +(X Component of Unit Vector)
 515 +(Y Component of Unit Vector)
 516 +(Z Component of Unit Vector)

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7 400 +1 GUIDANCE STEERING (Z-Axis ,400+2 ,507+1)

8 ATTITUDE CONTROL (3)-PULSE
 MODE CONT (AGS) - AUTO
 Maneuver To Burn Attitude
 ATTITUDE CONTROL (3) - MODE CONT

9 500R ΔVGX (LM) (.1fps)
 501R ΔVGY (LM) (.1fps)
 502R ΔVGZ (LM) (.1fps)

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

11 -:30 For DPS Burns:
CB(11) DECA PWR-Close
CB(16) DES ENG OVRD-Close
ENG GMBL-ENABLE
 For APS Burns:
CB(11 & 16) AELD (2) - Close

-:15 (X-Axis) 500R
 (Z-Axis) 502R

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12 -:10 Start Ullage
 :00 IGN
 (RCS Burn) When Δ VG <15fps,
 MODE CONTROL (AGS)-ATT HOLD

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

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

TPI

- 1 MODE CONT (AGS) - ATT HOLD
 GUID CONT - AGS
- 2 If CFP TPI, Go To ③
 Wait Until TIG - 136 min:
 306R (+0) Node At TPF (.01 min)
 312R (+0) Target Offset Time (.01 min)
 307 (Δ T Rndz Trans) (.01 min)
 373 (TIG TPI)
 410 +4 TPI EXECUTE
 616 +00005 (10 sec Ullage)
 303R LOS Angle TPI (.01°)
 Go To ⑤
- ③ Wait Until TIG -136 min:
 306 (+0) Node At TPF (.01 min)
 307 + (Δ T Rndz Trans) (.01 min)
 312 (+0) Target Offset Time (.01 min)
 310 + (Target TFI TPI)
 410 + 3 TPI Search
 616 + 00005 (10 sec ullage)

- 4 303R LOS ANGLE TPI (.01°)
 410 + 4 TPI EXECUTE (When 303 is 26.6° Below),
 (28.3° Above)
- (TO RETARGET 410 +3 And
 310 (Target TFI TPI) Then
 410 +4(When 303 Reads Desired Value)
- (5) 310R ΔT To TPI (.01 min)
 DET - SET
 371R ΔV Braking (.1fps)
 (If +60000, Retarget)
- 6 If Time Available:
 303R LOS Angle TPI (.01°)
 306R Target Time of Node (.01min)
 307R Desired Transfer Time (.01min)
 311R Time To Rendezvous (.01min)
 312R Target Offset Time (.01min)
 373R TIG TPI (.1 min)
 402R Hp TPI (.1nm)
- 7 For Comparison With LGC P34, N81:
 450R ΔVX (LV) (.1fps)
 451R ΔVY (LV) (.1fps)
 452R ΔVZ (LV) (.1fps)
- 8 410 +5
 370R ΔVG TPI
- 9 623 +0 Z-Axis Parallel To CSM Orbit Plane
 +1 Z-Axis Parallel To Specified Plane
 If 623 +1, Specify Plane:
 514 +(X-Comp. of Unit Vector)
 515 +(Y-Comp. of Unit Vector)
 516 +(Z-Comp. 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
 ATTITUDE CONTROL (3) - MODE CONT

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- 12 501R VGY (LM) (.1fps)
 502R VGZ (LM) (.1fps)
 500R VGX (LM) (.1fps)
- 13 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 | - | - | PUSH |
- 14-:30 For DPS Burns:
 CB(11) DECA PWR-Close
 CB(16) DES ENG OVRD-Close
 ENG GMBL-ENABLE
 For APS Burns:
 CB(11 & 16) AELD (2) - CLOSE
- :15 (X-Axis) 500R
 (Z-Axis) 502R
- 15 -:10 Start Ullage
 :00 IGN
 (RCS Burn) When Δ VG < 15fps,
 MODE CONTROL (AGS)-ATT HOLD
- 16 When Burn Complete
 ABORT(STAGE)PB - Reset
 NULL 500, 501, 502 (.1fps)

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| | | |
|----|----------------|-------|
| 17 | MASTER ARM | -OFF |
| | ENG ARM | -OFF |
| | BAL CPL | -ON |
| | TTCA (CDR) | -JETS |
| | DEADBAND | -MAX |
| | PRPLNT QTY MON | -OFF |
| | HELIUM MON | -OFF |

TPMRetargeting (Same Rndz Time)

- | | | |
|---|--|--------------------|
| 1 | 410 +4 TPI EXECUTE 373 (TPI + 15); (TPI + 30) 307 +(ΔT Rndz Trans) (+02800 For 1st MCC) (+01300 For 2nd MCC) 310R ΔT To TPM | (.1min) |
| 2 | If Time Available: 311R ΔT Rendezvous 277R THETA | (.01min) (.01°) |
| 3 | 410 +5 370R VG MDC | (.1fps) |
| 4 | Null 500, 501, 502 | (.1fps) |

EXTERNAL ΔVDATE 6/15/72

- | | | |
|---|---|--|
| 1 | MODE CONT (AGS) - ATT HOLD GUID CONT - AGS | |
| 2 | Wait Until TIG-136 min 410 +5 EXT ΔV 373 + TIG 450 + ΔVX (LV) 451 + ΔVY (LV) 452 + ΔVZ (LV) 616 + 00005 (10 sec ullage) | (.1 min) (.1fps) (.1fps) (.1fps) (.01 min) |
| 3 | 370R Total ΔV 310R ΔT To IGN DET - SET | (.01 min) |

- 4 400 +1 GUIDANCE STEERING (Z-Axis, 400+2, 507+1)
- 5 ATTITUDE CONTROL (3) - PULSE
 MODE CONT (AGS) - AUTO
 Maneuver To Burn Attitude
 ATTITUDE CONTROL (3) - MODE CONT
- 6 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/TRANS | 2 JET | 2 JET | 2 JET |
| TTCA(CDR) | THROT | JETS | JETS |
| DEADBAND | MIN | MIN | MIN |
| ABORT(STAGE) | 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 | - | - | PUSH |
- 8 -:30 For DPS Burns:
CB(11) DECA PWR-Close
CB(16) DES ENG OVRD-Close
ENG GMBL-ENABLE
 For APS Burns:
CB(11 & 16) AELD (2) - Close
- :15 (X-Axis) 500R
 (Z-Axis) 502R

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9 -:10 Start Ullage
 :00 IGN
 (RCS Burn) When ΔVG <15fps,
 MODE CONTROL (AGS) - ATT HOLD

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

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

AGS MANUAL THRUST

- DATE 6/15/72
- 1 GUID CONT -AGS
 MODE CONT (AGS) -ATT HOLD
 ATTITUDE CONTROL (3) - 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 Perform Burn or 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)

AGS ACTIVATION & SELF TEST

- 1 AGS STATUS - STBY
 (AGS Warn Lt - On)
 CB(11) AC BUS B: AGS-Close
 CB(16) STAB/CONT: AEA-CTose
 (AGS Warn Lt - Off)
 AGS STATUS - OPERATE
 (AGS Warn Lt - On)
 02/H2O QTY MON - CWEA RESET
 (AGS Warn Lt - Off)
- 2 000 +888888 (OPR ERR Lt - On)

MAIN BURN, AGS ACT &
SELF TEST, CALIB

MAN BURN,AGS ACI &
SELF TEST, CALIB

3 123 -45679 (Do Not ENTR)

- 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 DESCENT STAGE FLAG (+Not Staged)
 604R LUNAR SURFACE FLAG (+Not On
 Lunar Surface)
 612R STAGING SEQ COUNTER (+Att Hold At
 Abort Stage)

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 0,I,M (All Angles Should Be Approx
 $22.5^\circ, 67.5^\circ, 112.5^\circ, 157.5^\circ, 202.5^\circ, 247.5^\circ,$
 292.5° , or 337.5°)
 Rates $< .075^\circ/\text{sec}$
 Disable CSM & LM Thrusters (Undocked, PGNS-MIN IMP)
 V40N20E (Wait 20 sec Before Step ④)
- 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 Att Hold Mode For 2 min
 Only If Rates $> .075$ Then Return To MIN IMP)
- DATE 6/15/72

- 5 400R +0 GYRO & ACCEL CALIB 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)

AGS ACCEL CALIB/ISOL (INFLIGHT ONLY)

- 1 DET - Reset/UP
 Zero Affected Axis:
 (X) 404+0
 (Y) 405+0 ENTR & Start DET Simultaneously
 (Z) 406+0
 (X) 470R
 (Y) 471R
 (Z) 472R
 When DET = 30 sec: DEDA - HOLD
- 2 If Value < 00012:
 Isolate RCS Jets
 400 + 7E, Wait 35 sec, Then
 400 + 0E, (+1E), or (+2E)
 Re-enable RCS
 (AGS Is Now Usable for Navigation & Burns)
- 3 If Value > 00012:
 (X) 534 + 0E & 540 + 0E
 (Y) 535 + 0E & 541 + 0E
 (Z) 536 + 0E & 542 + 0E
 Perform State Vector Updates Via
 DEDA or V47
 (AGS Is Now Usable for Navigation & Burns
 Along Non-Affected Axis)

AGS GYRO CALIBRATION (SURFACE)

- 1 Verify AGS In Standby/Operate For 25 min &
 413 + 10000 Has Been Performed
- 2 If PGNS Available: V40 N20E
 400+3 (If PGNS Not Available 400+4 Then
 Wait 30 sec Minimum Before Step ④)

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- 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 ③
 Values Within 2.0°/hr (Nominal 0.9)

AGS RR AUTO S.V. UPDATE

- 1 GUID CONT - PGNS
 * GUID CONT - AGS *
 * 400+2 Acq. Steer *
 * 507+0 Boresight *
 * ATT CONT (3) - PULSE *
 * MODE CONT (AGS) - AUTO *
 * Null Error Needles *
 * ATT CONT (3) - MODE CONT*
- 2 P20 Running & Proper Downlist Active
 RR MODE - LGC
 TLM - HI
- 3 417+1 (Initialize Radar Filter)
- 4 411+1 (Enables Update)
 621R XX0YY; XX = No. of Rng Marks
 YY = No. of Rng Rt Marks
 317R (AEA Range) (.01nm)
 440R (AEA Range Rate) (.1fps)
 606R (+) Rng Next Update
 (-) Rng Rt Next Update
- 5 To Disable Updating (Prior To Burn):
 411+0

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AGS RR MANUAL ACQUISITION AND UPDATE**DATE**

6/15/72

- 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
 ATTITUDE CONTROL (3) -PULSE
 MODE CONT (AGS) -AUTO
 DEAD BAND -MIN
- 2 400 +2 (Acq Steering)
 507 +0 (Z Body Boresight)
- 3 Manually Null FDAI
- 4 RATE/ERR MON-RNDZ RADAR
- 5 Slew Null FDAI, Then Search For Strongest
 Signal And Check For Side Lobe
- 6 RR MODE - AUTO TRACK
- 7 417 +1 (Initialize Radar Filter)
 Wait 16 sec Before Step ⑧
- ⑧ 415 +1 (Store Z-Axis Cosines)
 ENTR (When FDAI's Centered)
- 9 316 +(RR Rng) (.01nm)
 (Must Be Entered Within 30 sec of
 Step ⑧)
 Wait 4 sec Before Step ⑩
- ⑩ 415 +1 Store Z Axis Cosines
- ⑪ 503 ± (RR Rng Rt) (.1fps)
 (Must Be Entered Within 30 sec of
 Step ⑩)
 (Wait 4 sec Before Next 415 Entry)
- 12 Repeat Steps ⑧ thru ⑪

- 13 Pre-TPI Repeat Procedure For A Minimum of 6
 Range Data Points Approximately 3 min Apart
 (6 Points, 2 min If Pre-MCC) (9 Points, 3 min
 if Pre-CSI & CDH)

AGS MANUAL STATE VECTOR UPDATE

NOTE: Insure 411 +0 & 563 +0 Prior To Loading
 LM or CSM S.V. via DEDA.

- 1 Record LM Data And Time
- 2 240 +(LM X Position) (100 ft)
 241 +(LM Y Position) (100 ft)
 242 +(LM Z Position) (100 ft)
- 3 260 +(LM X Velocity) (.1fps)
 261 +(LM Y Velocity) (.1fps)
 262 +(LM Z Velocity) (.1fps)
- 4 254 +(LM Epoch Time) (.1 min)
- 5 414 +20000E Update State Vector
 414R (+00000 Update Complete)
- 6 Record CSM Data And Time
- 7 244 +(CSM X Position) (100 ft)
 245 +(CSM Y Position) (100 ft)
 246 +(CSM Z Position) (100 ft)
- 8 264 +(CSM X Velocity) (.1fps)
 265 +(CSM Y Velocity) (.1fps)
 266 +(CSM Z Velocity) (.1fps)
- 9 272 +(CSM Epoch Time) (.1 min)
- 10 414 +30000E Update State Vector
 414R (+00000 Update Complete)

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RAPID IMU REALIGN

NOTE: This Procedure Assumes A Good AGS Alignment

- 1 Fly Spacecraft to $0^\circ, 0^\circ, 0^\circ$ On AGS Inertial Ball
- 2 V41 N20E
E,E,E, (Coarse Align IMU To $0^\circ, 0^\circ, 0^\circ$ Body)
- 3 V40 N20
Verify $0^\circ, 0^\circ, 0^\circ$ On AGS Ball - ENTR
(Releases Platform and Recovers PGNS
Control Modes After 11 sec)
Wait 11 sec Before Step ⑤
- 4 V25 N07E
77E, 10000E, 1E (Sets REFSMMAT Flag)
- ⑤ V37E 51E
PRO On First Display (Sets DRIFT Flag)
V37E 00E
- 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.

AGS RNDZ ALIGN

- 1 Fly to 0° Roll, Z-Axis Toward CSM
- 2 400 +5E
400 +0 DO NOT ENTR
- 3 When Wings Level (Horiz Ref) And Z-Axis
Toward CSM Key ENTR And Note GET ____:____
- 4 Coordinate with CSM To Adjust Ordeal
(Pitch LM = 180° + Pitch CM)
- 5 Transmit GET of Align to MSFN

AGS STAR ALIGN

- 1 MODE CONT (AGS) - ATT HOLD
- 2 Mnvr To Place Star Set In AOT (Fwd Detent)
- 3 Position Prime Star In Center of Reticle
- 4 DEAD BAND - 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

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ALIGN LM AGS TO CSM IMU/GDC

- 1 Verify: ATTITUDE CONTROL (3) - PULSE MODE CONTROL (AGS) - ATT HOLD
- 2 Request CSM Mnvr To
 R (CSM) = $300^\circ + (\text{RC})$
 P (CSM) = 180°
 Y (CSM) = 0°
- 3 $400 + 5E$
 $400 + 0$, When CSM At Proper Attitude, ENTR
- 4 Copy And Load State Vector From MSFN
 If AGS Ext ΔV Routine Usage Desired

ALIGN LM IMU TO CSM GDC

- 1 Request CSM Go To MIN DB, ATT HOLD
- 2 Request And Copy CSM GDC (R,P,Y)
- 3 Calculate Gimbal Angles

| <u>OG</u> | <u>IG</u> | <u>MG</u> |
|----------------|----------------|----------------|
| 300.00° | 180.00° | 360.00° |
| + _____ RC | | |
| - _____ CM(R) | - _____ CM(P) | - _____ CM(Y) |
| _____ LM | _____ LM | _____ LM |

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- 4 V41N20E, Load Gimbal Angles
 Wait Until Coarse Align Complete
- 5 V40N20, Verify CSM at GDC Attitude, ENTR
 Notify CSM Att Hold No Longer Required
 Wait 11 sec Before Step ⑦
- 6 V25N07E (Set REFSMMAT Flag)
 $77E, 10000E, 1E$

⑦ V37E51E (Set DRIFT Flag)

PRO

V37E00E

8 Request MSFN Uplink REFSMMAT,
Then, If Desired, Do P52

ALIGN CSM IMU TO LM IMU

1 Configure For MIN DB, ATT HOLD
(Either PGNS or AGS)

2 Notify CSM That LM In MIN DB ATT HOLD

3 V06N20E
Read Gimbal Angles To CSM When Requested

4 Terminate ATT HOLD On CSM Cmd

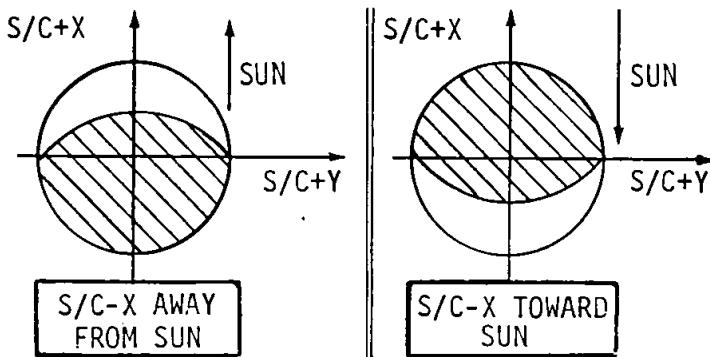
5 On CSM Request V06N20
On CSM Mark, Key ENTR

6 Copy Angles And Transmit To CM

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CRESCENT ALIGN

- 1 Verify COAS or AOT Lighting Mnvr To Acquire Earth In Optical System's Field-of-view. Further Mnvr To Align Required Reference Line Along Earth's Crescent, Placing The Reference Line On The Points Of The Crescent.



MSFN Will Update X-axis Direction.
The COAS Or The AOT Detent 2, May Be Used

- 6/15/72 |
- 2 For AGS Only, Perform Step ⑦ Only
If LGC Not Available,
Verify CB(11) PGNS: IMU OPR - Open
Wait 5 min Then Go To Step ⑧
 - 3 V41N20E, Load Desired Angles From MSFN
or 0,0,0
Wait Until Coarse Align Complete (If Further
Mnvr Required, Perform Via AGS)
 - 4 V40N20, Verify Ref. Line Aligned With Crescent,
ENTR
Wait 11 sec Before V37 In Step ⑤
 - ⑤ V25N07E, 77E, 10000E, 1E
V37E51E, PRO, V37E00E
(Request MSFN Uplink REFSMMAT And Do P52
If Desired)

- 6 To Align AGS To PGNS Reference: 400 + 3E or Step ⑦
- ⑦ 400 + 5E
400 + 0, Verify Ref. Line Aligned With
Crescent, ENTR
- ⑧ CB(11) PGNS: IMU OPR - Close
Wait 90 sec
IMU CAGE - ON (Momentarily)

ASA — MSC

DATE 6/15/72

[EMP'S GENERAL]

START: V31E (TLM PCM-HI Required For All
EMPS)

STOP: V74E
V37EXXE

103A - See EMP 103A Step 5

[EMP 103A] Permits PGNS Operation With Static
CDUY (Pitch) and/or CDUZ (Roll) Failure

Control Modes: Coasting flight - V76 OK, DAP un-
stable at some attitudes. Powered
flight - see below

XPTRS: PGNS, LR Normal

Error Needles: Invalid

For PDI:

1. Fly AGS-ATT HOLD with PGNS MODE CONT-OFF
2. Manual ullage, manual start required
3. After throttle up, fly N87 and maintain
YAW = $0 \pm 5^\circ$

V16N87 R1 Desired Pitch (.01°)
R2 Desired Roll

4. Do not PRO on P64 (no redesignation)
5. If ABORT required because AGS control lost,
do following:

V36E (No DAP for 12 sec)
Select PGNS - ATT HOLD
Failed axis - DIR
Maintain YAW = $0 \pm 5^\circ$
After staging V48 (11002)

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EMPS FAIL P52
CDU

EMPS
CDU FAIL P52

3-8

EMP 103B Permits PGNS Operation With Static or Dynamic CDUX (Yaw) Failure

Control Modes: YAW must be DIRECT. PGNS-ATT HOLD or AUTO OK if YAW maintained = $0 \pm 5^\circ$

XPTRS: PGNS - DNRNG, XRNG
LR - Body

Error Needles: Pitch, Roll valid, Yaw invalid

For PDI:

1. Fly PGNS AUTO or ATT HOLD, YAW DIRECT
2. Maintain YAW = $0 \pm 5^\circ$
3. Redesignation possible
Downrange - Normal
Crossrange - Window Pointing Lost

EMP 107 Provides Display Of Raw LR H & HDOT On DSKY For Tape Meter Failure

- 1 V16N99 R1 SLANT LR ALT (ft)
(Good If ALT Lt-Off)
- R2 SLANT LR HDOT (.1fps)
(Good If VEL Lt-Off,
Updated Once/6 sec)
- R3 PGNS HDOT (.1fps)

- 2 EMP Must Be Activated After AVE G On

EMP 109 Allows P20 To Operate In Update Mode Under The Following Conditions

- 1 Static Or Runaway RR CDU (Maintain Bore-sight $\pm 0.5^\circ$ During MARKS; V41N72 Won't Work)
- Or 2 Presence Of RR CDU FAIL Discrete
- Or 3 RR MODE-LGC Discrete Failure

NOTE: Manual Acquisition Required In P20

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EMP 111 Detects CDU Transient and Stores Last Valid CDU Value

- 1 PROG Lt-On
V5 N9E, 15XXX CDUX
16XXX CDUY
17XXX CDUZ
- 2 V15N1E, 1373E
R1 15CDE (CDE=No. Of Failed
R2 16CDE Passes)
R3 17CDE
- 3 V40N20 & V41N20 Useable

NOTE: Max CDU Error Induced By Each Transient = $\pm 2.5^\circ$

CDU FAIL P52

- | | |
|--|---|
| <ol style="list-style-type: none"> 1 CB(11) AC BUS A: AOT LAMP - Close V37E52E F 04 06 R1 00001 R2 00003 PRO 2 F 50 25 R1 00015 V32E 3 F 01 70 R1 00CDE, Load Star Code DE PRO 4 F 06 79 CUR, SPIR PRO | DATE 11/15/72 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> If Adjacent Detent Desired: V21N01E, 373E, 32533E PRO To 4 </div> DATE |
|--|---|
- (.01°)
- 5 F 01 71 R1 00CDE Verify Detent & Star Code
PRO

3-10

- 6 F 52/3 71 NOTES: 1. INFLIGHT, Maintain FDAI=0 In Failed CDU Axis At Time Of Mark
2. SURFACE, CAGE IMU
3. Take 3 CUR & 3 SPIR Marks On Each Star

(V52) Position CUR, MARK

(V53) Position SPIR, MARK

F 21/2 79 Load CUR or SPIR (.01°)

F 06 79 CUR, SPIR

PRO To 6

NOTE: After Last MARK On Each Star,
DO NOT PRO On F 52/3 Until The
Following Has Been Performed:

V1 N1E, 1307E, Verify R1 (MARK VAC ADR)
(455)

V24 N1E, XXXE, E, E

V24 N1E, YYYE, E, E

V24 N1E, ZZZE, E, E

NOTE: XXX, YYY, & ZZZ Are Defined As:
MARK VAC ADR + ΔADR For Failed CDU
(OCTAL ADDITION)

| ΔADR & (XXX) | | ΔADR & (YYY) | ΔADR & (ZZZ) |
|--------------|---------|--------------|--------------|
| CDUY | 0 (455) | 10 (465) | 20 (475) |
| CDUZ | 2 (457) | 12 (467) | 22 (477) |
| CDUX | 4 (461) | 14 (471) | 24 (501) |

(After 1st Star) PRO To 3

(After 2nd Star) PRO To 7

7 F 06 05 Angle Difference (.01°)
PRO

8 F 06 93 Gyro Torquing Angles (.001°)
PRO

NOTE: PROG Alarm 00217 May Occur,
RSET & Ignore

9 F 50 25 R1 00014
ENTR

10 F 37

DATE

11/15/72

VERB LIST

01-05 DISPLAY OCTAL
06 DISPLAY DECIMAL
07 DP DEC DPLY (EN38)
11-15 MONITOR OCTAL
16 MONITOR DECIMAL
17 DP DEC MON (EN38)
21-25 LOAD DATA
27 OT DPLY FIXED MEMORY
30 EXECUTIVE (PRE/L N26)
31 WAITLIST (PRE/L N26)
32 RECYCLE
33 PROCEED
34 (REQ W/ V21-V23)
35 TEST LITES (P00)
36 FRESH START
37 CHANGE PROGRAM
40 20 ZERO ICDU'S
40 72 ZERO RR CDU'S
41 20 IMU CRS ALN
41 72 RR CRS ALN
42 GYRO TORQ
43 LOAD FDAT ERROR
NEEDLES (P00)
44 TERM RR DESIGNATE
47 INITIALIZE AGS
48 DAP DATA LOAD
49 CREW ATT MNVR (P00)
50 PLEASE PERFORM
52 REST CURSOR MK
53 REST SPIRAL MK
54 REGST X OR Y MK
55 INCRMNT CLK (H, M, S)
56 TERM TRACKING
57 PERMIT LR UPDTS
58 INHIBIT LR UPDTS
59 CMD LR TO POSN 2
60 DAP ATT RTA (RR NDLS)
61 DAP FOLLOW ATT ERROR
(MODE 1 ERR NDLS)
62 TOTAL ATT ERR (N22-N20)
(MODE 2 ERR NDLS)
63 R/R/LR SELF-TEST
64 S-BAND ANT (06 51)
65 DISABLE U-V JETS
66 LM SV TO CSM SLOTS
67 DPLY W-MATRIX
RSS ERROR (06 99)
68 TERM TERRAIN MODEL
69 FORCE RESTART
70 LIFTOFF TIME UDPT (P27)
71 BLOCK ADRS UPDT (P27)
72 SINGLE ADRS UDP (P27)
73 LGG CLK OCT UDP (P27)
74 START ERASABLE DUMP
75 ENABLE U-V JETS
76 MINIMUM IMPULSE
77 RATE CMD/ATT HOLD
78 START LR SPURIOUS TEST
79 STOP LR SPURIOUS TEST
80 UPDT LM SV (P20)
81 UPDT CMS SV (P20, P22)
82 ORBIT PMTR DPLY (16 44)
83 RDZ PMTR DPLY (16 54)
85 DPLY RR LOS AZ,
ELEV (16 56)
89 RDZ FNL ATT MNVR (P00)
90 RDZ OUT-OF-PLANE
DPLY (06 90)
91 DPLY BANKSUM (P00)
/BK SUM, BUGGER
(NEXT BANK-PRO)
TERM, V34E
93 ENABLE W-MATRIX
INITIALIZATION
95 INHIBIT SV UPDTS (P20, P22)
96 STOP SV INTEGRATION
97 PERFORM ENGINE
FAIL PROCEDURE
99 ENABLE ENGINE IGN

ROUTINE CROSS-REF

R03/V48 R36/V90
R04/V63 R47/V47
R05/V64 R56/V56
R30/V82 R62/V49
R31/V83 R63/V89
R33/V06N65 R77/V78

NOUN LIST

* LEGIT LOADABLE NOUN & DATA
VALID ANYTIME NOUN CALLED
V - DATA VALID ANYTIME NOUN CALLED
L - LEGIT LOADABLE NOUN
X - LEGIT LOADABLE NOUN (HR, MIN, .015)
(IF LOAD, ENTR RT, R2, R3)

01, 02, 03 * SPECIFIED OCT ADDRS
(DSPY OCT DEC)

| | | |
|-------|-------|----------|
| [NO1] | [OCT] | [XXXXXX] |
| [NO2] | [OCT] | [XXXXXX] |
| [NO3] | [OCT] | [.015] |

04 GRAVITY ERR, X = [.010(R1)]
05 SIGHT & DIFF/SV-RR LOS & [.010(R1)]
(SEE P21, P22, P52, P57)

06 L OPTION CODE(OCT)
(SEE "FLAGWRD/CHNL SET/RESET")

08 V ALARM DATA [OCT]
(ALMADC, "BBCON", ERCOUNT)

09 V ALARM CODES [OCT]
(1ST, 2ND, MOST RECENT ALM)

10 * SPECIFIED CHNL [OCT(R1)]
(CAN'T 34, I CAN'T 3, 4, 7, 15)
(READ 35) I GLENA 16, 30, 31, 32
[IF LOAD CH 33, RESETS BITS 15-11]

11 X T CSI OR T APOAPSIS [H, M, .01S]
(0, 0, 0 = COMPUTE 1 APOAPSIS)

12 L OPTCODE [OCT(0000X, 0000Y)]
(X (SPFY) Y=1 Y=2)

| | | |
|-----|-----------|------|
| V82 | LM | CSM |
| V89 | 2 (VEH) | CSM |
| V63 | +Z | +X |
| 41 | 4 (RADAR) | RR |
| 62 | 6 (RR FN) | LOCK |
| 71 | DESIG | |

13 X T CDM [H, M, .01S]

15 INCREMENTED OCT ADDRS [OCT(R1)]

16 T EVENT [H, M, .01S]
(AGSK = PRSN T IF V32E (V47))
(0, 0, 0 = PRSN T (V90))
AUTO MNVR FDAO = X - R, P, Y, [.01°]
PRSN T (CDU'S = Y, P, R, [.01°])

18 V PIPA PULSES X, Y, Z [XXXXXX]

21 V LSRD NEW [CDU'S = Y, P, R, [.01°]]

24 X LGC CLK AT [H, M, .01S]
SEE "V50 CHECKLIST" [OCT(R1, R2)]
(SEE V30, V31)

26 * PRI/O/DLAY, ADDRES, "BBCON" [OCT]
(SEE V30, V31)

27 * SELF-TEST ON/OFF SW [OCT(R1)]
(START: 00010 (ALL) STOP: 00000)
00004 (ERAS) (ALSO)
00005 (FIXED) (V36, V91)

28 T FROM PERIGEE [H, M, .01S]
TIC [H, M, .01S]

33 X T EVENT [H, M, .01S] (0, 0, 0 = PRSN T)
34 X T ALT, VFL PATH [10NM, .1FPS, .1FPS]

35 X TFI/TCO [H, M, .01S]

36 X LGC CLOCK TIME [H, M, .01S]

37 X T TBL [H, M, .01S]

38 INTEG SV TIME TAG [H, M, .01S]

40 TFI/TCO/GVAVM [M-S, .1FPS, .1FPS]

42 HA, HP, VEL [1NM, .1NM, .1FPS]

43 LAT, LON, ALT [1°, .01°, .1NM]
(+N, +E, +R, RLS)

44 HA, HP, TFL [1NM, .1NM, M-S]
(TFL = -59.59 IF HP > 35K FT)

45 V/R1 MKS, TFL +MGA [X, M-S, .01°]
(R3 = 00001: FINAL NOT)
(R3 = 00002: P7X QR, FNL, NO ALN)
(R3 = +MGA: FNL, IMU ALN)

46 L DAP CONFG, CHANBKUP [OCT(R1, R2)]
(CONFG: SEE "DAP DATA LOAD")
CHANBKUP: IGNORE SPFY DSCR
00001 - ABORT/ABORT STAGE
00010 - AUTO THRTL
00011 - BOTH DSCRTS

47 * LM WT, CSM WT [LBM (R1, R2)]

48 L DPS R, GMBL TRIM [01°(R1, R2)]
ΔR, ΔV, SOURCE [01NM, .1FPS, X]
(X=1 RANGE, X=2 SHFT)
(X=2 RNG RT, X=3 SHFT)
DSRD S-BAND P, Y, [01°(R1, R2)]

51 ACT VEH CENTRE [01°(R1, R2)]
(AVOID 170°, 190° REGION)

54 RANGE, RDT, (+CLOSE), +Z/HORZ &
[.01NM, .1FPS, .01°]

55 L P22: APSIS, ELEV, CODE [X, .01°, Y]
(Y=0: CDM AT APSIS SPFY BY R1)
(Y=0: CDM AT (R1)(180°))
L P24: CODE, ELEV, TRANSFER &
(X=0 CONIC | ELEV=0 T OPTN)
(X=0 ENCKE | ELEV=0 X OPTN)

RR LOS AZ, ELEV [01°(R1, R2)]
(AZ +/LM Z, ELEV +/Y)

PGNS/AGS SUMMARY CARD

(LUMINARY 210/FP-8)
REV: 1 DATE: 6/3/71

Prepared for FPBR/MSC by TRW Systems
under Task ASPO 81C-3

N49 ACCEPT CRITERIA

PRE-DIR RDZ/CS1
W-MAT ACCPT LMTS

POST-DIR RDZ/CS1
W-MAT ACCPT LMTS

+010000 ΔR < +000200

+001000 ΔR < +001200

+000015 ΔR < +000500

+000005

• 04 49 IF ΔR > 2 KFT (R1 > +0003) OR
ΔR > 2 FPS (R2 > +0002)

• 06 49 SOURCE CODE SPFY BY R3 = +0000X:

X=1 RNG, X=2 RNG RT, X=3 SHFT, X=4 TRUN

• REJ 1ST MK IF R1 OR R2 > ACCPT LMTS,

BUT ACCPT 2ND MK IF IT AGREES W/ 1ST MK

• VFY DOWNWARD TREND IN MAG OF CORR

(IF TREND NOT 1, CHK RR OPERATION)

P06

V37E06E
50 25 (00062)

IMU OPR - OPEN, PRO

P12

V37E12E

06 33, L, PRO

06 76, PRO

P20

V37E20E

TK ATT

MNVR

IF NOT PGNS, AUTO

05 25 (00203)

IMU BURN -

06 74

99 74 (TIG-5), PRO

06 74 (T < TIG)

06 94...V16N77E

[16 77], KREL

06 94

16 45, PRO

P22

V37E22E

04 06 (00012, 00000)

• (X=1/SAME) PRO

• (X=2/NEW) L, PRO

06 33, L, PRO

P20

V37E40E

TK ATT

MNVR

IF NOT PGNS, AUTO

05 25 (00203)

IMU BURN -

06 34, L, PRO

16 45, PRO

P21

V37E21E

DSKY BLANKS

TRACK CSM AS REQ

IF EXCESSIVE UPDT:

06 49

• (PART REJ) V32E

• (ACCEPT MK) PRO

• (TOTAL REJ) V34E

• UPDT

P20/P22 COMMON

P20/P22 POSSIBLE

05 09 (000503, 00002)

• (NO ACQ) E

• (SEARCH) PRO

16 80 (VFT, ACQ, PRO)

• UPDT

POSSIBLE/AVAILABLE:
SEE P20/P22 COMMON

P25

V37E25E

IF NO LOCK-ON:

05 09 (00503)

• (RED) V32E

• (RR AUTO)

• (MAN) MNVR, E

IF POINT ERR < 15°

50 18

P20/P22 POSSIBLE

05 09 (00503, 00205)

• (NO ACQ) E

• (SEARCH) PRO

16 80 (VFT, ACQ, PRO)

• UPDT

P27

V37E00E

SW-PGNS/AUTO

IF SW-AUTO THRTL

06 49

• (PART REJ) V32E

• (ACCEPT MK) PRO

• (TOTAL REJ) V34E

• UPDT

RR SW - LGC, PRO

P30

V37E30E

TK ATT

IMU OPR - OPEN, PRO

06 25 (00201)

IMU BURN -

06 49, PRO

16 78

• (TERM) V34E

• (CONT) V32E

• UPDT

POO

P35/P75

V37E35E/V37E75E

DON'T V32E(RCYCL)

ON 16 45

P51

V37E51E

50 25 (00015)

• (CRS ALN) E

• (1,2) PRO

• (X-4/5) L, PRO

• (0, 3, 4, 5, 6, 7) PRO

• (L/R) PRO

• (MNR) MNVR, E

• (REFS/STO) ATT

• (X=1/REFS) PRO

• (X=2/TWO STARS)

• (X=3 STAR + GRAV)

• (R=00RA)

• (I=0 YES-0-NO)

• (R= REFSMMAT)

• (A= STO) ATT

P52

V37E52E

04 06 (00001, 00000)

• (X=1/PREF) L, PRO

• (X=2/NOM) L, PRO

• (0, 34, 4, 5, 6, 7) PRO

• (REGON) PRO

• (DNEB) DNEB

• (DNL) DNL

• (DGL) DGL

• (DML) DML

• (DNN) DNN

• (DNR) DNR

• (DRL) DRL

• (DSC) DSC

• (DSCF) DSCF

• (DSCRT) DSCRT

• (DSCRT) DSCRT</p

