Flown on Apollo 9
1st Flight of
Lunar Module
Jim McDivitt
Apollo 9 CDR

<table>
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<tr>
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</tr>
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</tr>
<tr>
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NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION

APOLLO IX LM-3
FINAL
FLIGHT CREW
G&N
DICTIONARY

PREPARED BY
GUIDANCE & CONTROL
SECTION
FLIGHT CREW SUPPORT
DIVISION

FEBRUARY 24, 1969

MANNED
SPACECRAFT CENTER
HOUSTON, TEXAS

| STAR MAP
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<td>6 Acamar</td>
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<td>45 Fomalhaut</td>
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<td>46 Sun</td>
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<td>47 Earth</td>
<td>Sun 46</td>
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<td>50 Moon</td>
<td>Vega 36</td>
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<td>LGC Power Down</td>
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<td>Rendezvous Navigation</td>
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<td>21</td>
<td>Ground Track Determination</td>
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<td>25</td>
<td>Preferred Tracking Attitude</td>
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<td>LGC Update</td>
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<td>External ΔV</td>
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<td>APS</td>
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<td>47</td>
<td>ΔV Monitor</td>
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<tr>
<td>51</td>
<td>IMU Orientation Determination</td>
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<td>52</td>
<td>IMU Realign</td>
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**VERBS**

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<th>Basic Date Changed</th>
<th>Display Octal Comp 1 in R1</th>
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<td>01</td>
<td>Display Octal Comp 2 in R1</td>
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<tr>
<td>02</td>
<td>Display Octal Comp 3 in R1</td>
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<tr>
<td>03</td>
<td>Display Octal Comp 1&amp;2 in R1&amp;R2</td>
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<td>04</td>
<td>Display Octal Comp 1,2&amp;3 in R1,R2&amp;R3</td>
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<td>Display Decimal Comp 1 or 1&amp;2 or 1,2,&amp;3 in R1 or R1&amp;R2 or R1, R2&amp;R3</td>
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<td>Display DP Decimal in R1&amp;R2</td>
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<td>Monitor Octal Comp 1 in R1</td>
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<td>Monitor Octal Comp 2 in R1</td>
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<td>Monitor Octal Comp 3 in R1</td>
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<tr>
<td>14</td>
<td>Monitor Octal Comp 1&amp;2 in R1&amp;R2</td>
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<td>15</td>
<td>Monitor Octal Comp 1,2&amp;3 in R1,R2&amp;R3</td>
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<tr>
<td>16</td>
<td>Monitor Decimal Comp 1 or 1&amp;2 or 1,2,&amp;3 in R1 or R1&amp;R2 or R1, R2&amp;R3</td>
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<td>Monitor DP Decimal in R1&amp;R2</td>
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<td>Load Component 1 in R1</td>
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<td>22</td>
<td>Load Component 2 in R2</td>
</tr>
<tr>
<td>23</td>
<td>Load Component 3 in R3</td>
</tr>
<tr>
<td>24</td>
<td>Load Component 1&amp;2 in R1&amp;R2</td>
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</table>
Load Component 1,2&3 in R1,R2&R3
Display Fixed Memory
Request Executive
Request Waitlist
Recycle
Proceed
Terminate
Test Lights
Request Fresh Start
Change Program
Zero CDU's (Specify N20 or N72)
Coarse Align CDU's (Specify N20 or N72)
Fine Align IMU
Load FDAI Error Needles
Terminate Continuous Designate (V41N72)
Display W-Matrix RMS Errors
Initialize AGS (R47)
Load DAP Data (R03)
Start Crew Defined Maneuver (R62)
Please Perform
Mark X-Reticile
Mark Y-Reticile
Mark X or Y-Reticile
Increment LGC Time (Decimal)
Terminate Tracking (P20&P25)
Mode I Attitude Error Display (DAP
Follow Error)
Command LR to Position 2
Start RR/LR Self Test (R04)
Mode II Attitude Error Display (Error
WRT N22)
Disable U,V Jets
Set LM State Vector into CSM State Vector
Cause Restart
Update Liftoff Time
Universal Update Load Block Addresses
Universal Update Load Singular Addresses
Update LGC Time (Octal)
Initiate Eraseable Dump via Downlink
Enable U,V Jets
Set Min Impulse Mode in DAP
Set Rate Command/Attitude Hold Mode in DAP
Start LR Spurious Test (R77)
Stop LR Spurious Test (R77)
Update LM State Vector
Update CSM State Vector
Request Orbit Parameter Display (R30)
Rendezvous Parameter Display (R31)
Start Target V (R32)
Start Rendezvous Final Attitude Maneuver (R63)
Request Rendezvous Out of Plane Display (R36)
Compute Banksum
Start IMU Performance Test (non-flight)
Enable W-Matrix Initialization
Inhibit State Vector Update (P20 or P22)
Interrupt Integration and Go to P00
Enable Engine Ignition

**NOUN LIST (v) - Can Be Called At Any Time For Valid Data**

<p>| 01(v) | Address to be Specified (Frac) | .XXXXX |
| 02(v) | Address to be Specified (Whole) | XXXXXX |
| 03(v) | Address to be Specified (Degree) | .01° |
| 05(v) | Angular Error/Difference | .01° |
| 06(v) | Option Code | Octal |
| 07(v) | Flag Word Operator | Octal |
| 08(v) | Alarm Data | Octal |
| 09(v) | Alarm Codes | Octal |
| 10(v) | Channel To Be Specified | Octal |
| 14(v) | Checklist (Internal to LGC) | XXXXXX |
| 15(v) | Increment Address | Octal |
| 16(v) | Time of Event | hrs,min,.01sec |
| 18(v) | Desired Maneuver to FDAO RPY Angles | .01° |
| 19(v) | Bypass Trim Maneuver to FDAO RPY Angles | .01° |
| 20(v) | ICDU Angles Y,P,R (OG,IG,MG) | .01° |
| 21(v) | PIPA Pulses | Pulses |
| 22(v) | New ICDU Angles Y,P,R,(OG,IG,MG) | .01° |
| 24(v) | Delta Time For LGC Clock | hrs,min,.01sec |
| 25(v) | Checklist (Used with V50) | Octal |
| 26(v) | Prio/Delay, ADRES, BBCON | Octal |
| 27(v) | Self Test ON/OFF | hrs,min,.01sec |
| 30(v) | TIG CSI | hrs,min,.01sec |
| 31(v) | TIG CDH | hrs,min,.01sec |</p>
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<td>Time Of Event</td>
<td>hrs:min:01sec</td>
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<td>35</td>
<td>Time To Go To Event</td>
<td>hrs:min:01sec</td>
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<td>LGC Clock Time</td>
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<td>Time From Ignition/Cutoff</td>
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<td>ΔV (Accumulated)</td>
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<td>Target Azimuth</td>
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<td>Engine Gimbal Pitch Trim (+ Only)</td>
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<td>VGZ (LM) (+ Fwd)</td>
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<td>Elevation (+ Up)</td>
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PGNS-7

90  Rendezvous Out of Plane Parameter Y
    YDOT
    PSI
    .01nm
    .1fps
    .001°

93  ΔGyro Torquing Angles X
    Y
    Z

97  System Test Inputs
    XXXXX.

98  System Test Results & Inputs
    XXXXX.
    XXXXX.

99  W-Matrix RMS Pos Error
    .01nm
    W-Matrix RMS Vel Error
    .1fps

V50 N25 CHECKLIST CODES

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<td>Recheck or Exit Fine Align Option</td>
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<td>Select Star Acquisition Mode</td>
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<td>Power Down LGC</td>
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<td>Select RR LGC Mode</td>
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<td>Select PGNS, AUTO, &amp; AUTO THROTTLE</td>
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<td>Enable Engine Gimbal Trim</td>
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<tr>
<td>00205</td>
<td>Slew RR for Manual Acquisition</td>
<td></td>
</tr>
</tbody>
</table>

VO4 NO6 OPTION CODES

<table>
<thead>
<tr>
<th>Options</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specify IMU Orientation</td>
<td>Preferred, Nominal, REFSSMAT, LM, CSM</td>
</tr>
<tr>
<td>Specify Vehicle</td>
<td>+Z Axis, +X Axis</td>
</tr>
<tr>
<td>Specify Tracking Attitude</td>
<td>RR, LR, Lock On, Continuous Designate</td>
</tr>
<tr>
<td>Specify Radar</td>
<td></td>
</tr>
<tr>
<td>Specify RR Function</td>
<td></td>
</tr>
</tbody>
</table>
V05 N09 ALARM CODES

00105 P  AOT Mark System In Use  
           (Terminate Extended Verb & Reselect P5X)
00107 P  More Than 5 Mark Pairs  
           (Continue)
00111 P  Mark Missing  
           (Start Mark Sequence Over)
00112 P  Mark or Mark Reject Not Being Accepted  
           (Continue)
00113 H  No Inbits  
           (Continue)
00114 H  Mark Made But Not Desired  
           (Mark Correct Axis (X) or (Y))
00115 P  No Marks in Last Pair to Reject  
           (Continue)
00206 P  Zero Encode Not Allowed With Coarse  
           Align & Gimbal Lock  
           (Coarse Align To 0,0,0 Then Reselect V40N20)
00207 P/H ISS Turn on Request Not Present For 90 sec  
           (CB(11) PGNS: IMU OPR - OPEN & RECLOSE  
           If Alarm Recurs & NO ISS Warning, Continue)
00210 P/H IMU Not Operating  
           (CB(11) PGNS: IMU OPR - OPEN & RECLOSE  
           V36E, Consult MSFN, But Continue)
00211 H  Coarse Align Error  
           (If P51 or P52 in Progress, Record GYRO  
           Torquing Angles and Perform Fine Align  
           Check in P52;  
           If P51 or P52 Not In Progress, Reduce Space-  
           craft Drift, Continue)
00212 H  PIPA Fail, But PIPA is Not Being Used  
           (Go to ISS Malfunction Procedures)
00213 H  IMU Not Operating With Turn-On Request  
           (See 00210 Above For Procedure)
00214 P  Program Using IMU When Turn OFF  
           (Exit Program)
00215 P  Preferred Orientation Not Specified  
           (See P52/1)
00217 H  Bad Return From Stall (Computer Waiting  
           For IMU, Radar or AOT to be Used) Routine  
           (Reinitiate Current Program  
           If Alarm Recurs, ISS Mode  
           Switching Failure)
00220 P IMU Not Aligned  
   (Align Or Set REFSMMAT Flag If Aligned)
00401 I Desired Gimbal Angles Yield Gimbal Lock  
   (Call N22, Manually Mnvr If MGA<85° Or 
   Realign IMU)
00405 I Two Stars Not Available  
   (See P52/4)
00421 I W-Matrix Overflow (Matrix invalid,  
   scaling exceeded)  
   (Notify MSFN But Continue, W Matrix Is 
   Automatically Intialized At Next Mark)
00501 I RR Antenna Out of Present Mode Limits  
   (See P20/7 or 8)
00502 I LOS Outside Limits of Both RR Antenna Modes  
   (Mnvr & Redo V41N72)
00503 I Radar Antenna Designate Fail  
   (See P20/8)
00510 P Radar Auto Descrete Not Present  
   (RDZ RDR - LGC, Continue)
00511 H LR Not in Pos 2 or Repositioning  
   (LDG ANT - HOVER V16N66E, Verify R2+00002)
00514 P Radar Out of Auto Mode While in Use  
   (See P20/6)
00515 H RR CDU Fail Discrete Present  
   (See P20/8)
00520 H/P RADARUPT Not Expected at This Time  
   (Radar data is received during a time 
   when it is not expected)  
   (Continue)
00521 I RR Data Good Not Present  
   (See P20/8)
00522 P LR Position Change  
   (Continue)
00525 I SV/RR LOS > 3°  
   (See P20/8)
00526 I Range >400 Miles  
   (Terminate P20 (V56), Recall When 
   Range <400 mi)
00527 I LOS Outside of Antenna Mode Limits  
   (MNVR)
00600 I Imaginary Roots on First Iteration  
   (No solution found for CSI)  
   (See P32/1)
00601 I Perigee Altitude (Post CSI) < 85NM
   (See P32/1)
00602 I Perigee Altitude (Post CDH) < 85NM
   (See P32/1)
00603 I CSI to CDH Time < 10 MIN
   (See P32/1)
00604 I CDH to TPI Time < 10 MIN
   (See P32/1)
00605 I Number of Iterations Exceeds Loop Max
   (Program cannot converge on solution for CSI)
   (See P32/1)
00606 I $\Delta V$ Exceeds Maximum
   (See P32/1)
00611 I No TIG For Given Elevation Angle
   (See P33/2 Or P34/3)
00777 H PIPA fail caused the ISS Warning
   (Go To ISS Malf)
01102 H LGC Self Test Error
   (See PGNS TURN ON & SELF TEST/8)
01103 I *Unused CCS Branch Executed
   (Program has taken a wrong logic path)
   (Copy NO8, Notify MSFN, Continue)
01104 H *Delay Routine Busy
   (Routine is already being used & cannot process two requests)
   (Reselect Extended Verb Or Continue With Program)
01105 H Downlink Too Fast
   (Spurious noise on downlink)
   (If Alarm Recurs, Downlink Failure)
01106 H Uplink Too Fast (Spurious noise on uplink)
   (If Alarm Recurs, Uplink Failure)
01107 H Phase (Restart) Table Failure
   (Restart logic cannot determine the restart phase (point)).
   (Perform The Following:
    1. V74 LGC DOWNLINK
    2. P27 As Necessary
    3. V48 As Necessary
    4. Revalidate REFSMMAT via P51 or P27)
   If FRESH START Recurs, LGC FAILURE
01201 P  *Executive Overflow - No Vac. Areas
           (Too Many requests for LGC to process)
           (Reselect Extended Verb Or Continue
            With Program)
01202 P  *Executive Overflow - No Core Sets
           (Too many requests for LGC to process)
           (See Code 1201)
01203 I  *Waitlist Overflow - Too Many Tasks
           (Too many requests for LGC to process)
           (See Code 1201)
01206 P  *Two Jobs Try To Sleep in PINBALL
           (Too many display requests have been
            made at same time)
           (See Code 1201)
01207 P  *No Vac Area For Marks
           (More than 5 mark pairs have been
            accepted but there is not room for
            storage)
           (Reselect P51 or P52)
01210 P  *Two Routines Using Device at Same Time
           (Crewman attempted to use RR or IMU
            2 different ways (Ext. Verb, etc.)
            at same time)
           (Reselect Extended Verb When Indicated
            Device No Longer In Use)
01211 P  *Illegal Interrupt of Extended Verb
           (Reselect P51 Or P52)
01301 I  ARCSIN-ARCCOS Input Angle Too Large
           (Data computed by the program is
            unrealistic)
           (Copy NO8 Data, Notify MSFN, Continue)
01302 I  *SQRT Called With Negative Argument
           (Data computed by the program is
            unrealistic)
           (See Code 1301)
01407 P  VG Increasing
           (See P40/IGN Or P42/IGN)
01501 P  *Illegal Internal Use of PINBALL
           (See Code 1301)
01502 P  *Illegal Flashing Display
           (See Code 1301)
01520 P  V37 Request Not Permitted At This Time
           (Reselect V37)
01600 H Overflow In Drift Test (Gnd Only)
01601 H Bad IMU Torque (Gnd Only)
01703 P Less than 45 Secs to Ignition
   (See P40/3 or P42/3)
01706 P CSM Docked with Ascent Stage Only
   (See P40/1 or P42/1)
01711 I State Vector Integration Not Finished
   Prior to TIG-30 sec (Burn cannot be done
   at the desired TIG due to lengthy SV
   intergration)
   (See P4X/4)
02000 P *Previous DAP Computation Still in
   Progress at this T5RUPT
   (RSET, If Recurs GUID CONT - Cycle AGS
   Then PGNS; If Recurs, V36E)
02001 I Jet Failures Have Disabled Y-Z Trans
   (Change Thruster Pair Isol Value Or
   Use Alternate Control Mode)
02002 I Jet Failures Have Disabled X Trans
   (See Code 2001)
02003 I Jet Failures Have Disabled P Rotation
   (See Code 2001)
02004 I Jet Failures Have Disabled U-V Rotation
   (See Code 2001)
03777 H IC DU Fail Caused the ISS Warning
   (Go To ISS Malf)
04777 H IC DU, PIPA Fails Caused the ISS Warning
   (Go To ISS Malf)
07777 H IMU Fail Caused The ISS Warning
   (Go To ISS Malf)
10777 H IMU, PIPA Fails Caused The ISS Warning
   (Go To ISS Malf)
13777 H IMU, IC DU Fails Caused The ISS Warning
   (Go To ISS Malf)
14777 H IMU, IC DU, PIPA Fails Caused The ISS Warning
   (Go To ISS Malf)

*Generates Restart
P-Procedure Caused Alarm
I-Input Data Caused Alarm
H-Hardware Status Caused Alarm

Alarms for V05N09
R1 First Alarm to Occur
R2 Second Alarm to Occur
R3 Last Alarm to Occur (May Be of The
   Form 4XXXX or 5XXXX)

4XXXX Indicates More than 3 Alarms
5XXXX Indicates More Than 3 Alarms Including 1XXXX
SUNDANCE PROGRAM NOTES

1. Do not select another program (except P00) before terminating V41N72. (Antenna will wander).

   RECOVERY: Select P00 or V44.

2. Do not select V41N72 after initial failure of the RR to lock-on in the designate routine of P20, the LOSCMFLG (bit 12, flagword 2) should be reset prior to the V41N72 request. (Radar will be designated along computed LM-CSM LOS instead of to N72 input angles.)

   RECOVERY: V37E00E then 76E 04000E 0E.

3. Always complete the auto track maneuver when it is called for by the RR Auto Search Routine in P20 in the normal fashion; i.e., do not terminate the maneuver via V56 or V34. (Attempt to search pattern will not be generated if R24 is attempted again.)

   RECOVERY: Reselect the Search Routine via P20. When the V16N80 display comes up, do a V32E and allow the maneuver to take place.

4. If during the data load of the W matrix (N99) in V45 the display is interrupted by a priority display, the ENTER on the data load does not set the V45 flag. (VO6N99 does not appear on the DSKY after the ENTER on the data load, a priority display appears instead.)

   RECOVERY: Reload data completely when VO6N99 Returns or key V32 if correct data is displayed on DSKY.

5. During any CDU zero, DAP is inactive.

   RECOVERY: Wait 10 sec or switch out of PGNCS.
6  P00 integration will be lost if there is a restart during P00 following any P27 update. (Restart light in P00 after a P27, prior to another PXX selection out of P00.)

RECOVERY: Reselect P00.

7  A restart during execution of R00 (Program Change Routine) may cause inability to select a new program. (Unable to select new program following a program using AVE G.)

RECOVERY: Use V30 in the following manner:

V25N26E, 15001E, 2073E, 10003E
V30E

8  If a V05N09 2000 restart occurs without program recovery go to AGS until PGNCS can be reinitialized. (Restart with 2000 in FAILREG.)

RECOVERY: Confer with ground to determine possible erasable damage.

9  There exists in P40 and P42 a 5 ms window in which a response to the flashing V99N4X will cause anomalous program behavior. An ENTER or a V34 response in the time interval will cause a 1502 alarm code and hardware restart along with the termination of CLOKTASK (normal operation for an ENTER or V34 response is flashing V16N4X or flashing V37, respectively.)

RECOVERY: Key ENTR again (if restart occurred) key V5N9, then error reset when convenient.

10 If you use V96 then at some future time return to V37E00E and allow integration.

11 The W matrix should not be initialized to magnitudes greater than 325 ft/sec and 8.5 NM.
12 In P51 and P52 the permissible values of Ri of N70 and/or N71 are 0-508 for the star code. Anything else will cause indeterminate program transfer.

RECOVERY: Confer with ground, perform E memory dump to determine possible erasable memory damage.

13 If V37 is attempted within approximately 20 seconds of a fresh start, ISS turn-on, or restart with the IMUSE flag reset, a PIPA FAIL will go undetected.

RECOVERY: Perform extended verb V42E, E, E, E.

14 Marks should not be taken on the VO1N71 display in P51 & P52. (Flashing V54N71 with possible alarm 107, too many marks, after legitimate marking sequence.)

RECOVERY: Begin P51 & P52 again and mark only during request for marks (V54, V53, V52).

15 Use V55 (LGC clock align) only in PO0. (Restart.)

RECOVERY: Restart recovery procedure.

16 Do not select a mission program via V37 after selecting P20 until the first auto maneuver (V50N18) display in P20. (RR may acquire in Mode II due to the fact that an attitude maneuver was not performed.)

RECOVERY: Self recovery in 2-4 minutes; RR will reacquire in Mode I after auto attitude maneuver.

17 Noun 17 should not be loaded.

RECOVERY: Reload erasable cells that are invalidated; V21N01E, 1351E, 46761E.
A hardware restart removes track enable; if P20 is in progress, it will be forced back to the beginning of the designate and call auto track maneuver routine.

When a Fresh Start occurs, the REFSMFLG is reset. This flag should be manually set if it is desired to use the REFSMMAT that remains in the LGC after the Fresh Start.

Do not select V92 during P00. (a. 07 appears in program lights; b. the DAP is turned off for 10 seconds; c. the W matrix will be zero or overwritten; d. flashing VO6N41.)

RECOVERY: Select P00 via V37E00E, key V93.

Do not enter another program (except P00) before terminating V41N72 with a V44E.

Do not exit P20 with V34E or V56E on AUTO MANEUVER ROUTINE during the SEARCH ROUTINE.

Do not select another program after V37E20E until V50N18 complete.

Do not select another program during gimbal drive in V48.
PO6 PGNS PWR DOWN

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

P20 RENDZ NAV

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

2 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES
(AUTO) GUID CONT - PGNS
MODE CONT - AUTO
PRO
(MAN) ENTR To 4

3 06 18 AUTO MNVR TO FDAI RPY ANGLES

4 F 50 19 BYPASS TRIM MNVR TO FDAI RPY ANGLES
(TRIM) PGNS - AUTO
ENTR To 3
(BYPASS) PRO To 5 (RR Search To 9)
(Man Acq To 7)

5 RR MODE: LGC To 8
SLEW or AUTO To 6

6 F 50 25 00201 (or F 05 09 00514) RR ACQ MODE
(AUTO) RR MODE LGC (15 sec)
PRO To 5
(MAN) ENTR (NOT ALLOWED FOR 00514)

7 F 50 25 00205 SLEW RR For LOCK-ON
(LOCK) RR-LGC;
No Track Lt - OUT (15 sec)
PRO To 5
(NO LOCK) MNVR
ENTR To 2

*F 05 09 501 RR OUT OF MODE LIMITS*
* (REQUEST MNVR) V32E To 2*
8 NO TRACK LITE

OUT

DSKY BLANKS, RR TAKING MARKS

*F 05 09 00525 SV/RRΔ LOS >3° *
* PRO *
*F 06 05 SV/RRΔ LOS (.01)*
* (REJECT) CK SIDE LOBE *
* Rendz RR MODE LGC *
* V32E To 8 *
* (UPDATE) PRO To 5 or below *
*F 06 49 +ΔSVΔR, ΔV (.1NM,.1fps) *
* (UPDATE) PRO To 5 *
* (REREAD or MAN ACQ)V32E To 5 *
*F 50 18 (MNVR REQUEST) Go To 2 *

ON

NO LOCK

F 05 09 00503 RR NO DATA GOOD 42sec (or Desig. Fail)
(REDESIG) V32E To 5
(SEARCH) PRO To 9

*V05N09E 00521 (or 00515) DATA NOT GOOD*
* Key Rel To 8 *
* 00501 R25 LIMITS, RR To +Z *

9 F 16 80 RR AUTO SEARCH, SEARCH CODE,
R1 0-SEARCH 42sec / scan
1-LOCK ON
R2 Ω - Angle between RR LOS & LM +Z (.01°)
(LOCK) PRO To 2
(NO LOCK) (MAN ACQ) RR-SLEW, Slew For LOCK-ON
RR MODE-LGC NO TRACK Out - To 9
(MNVR) V32E To 2
P21 GROUND TRACK DETERMINATION

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

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

3 F 06 43 LAT, LONG, ALT
    V32E (Increment GET 10 Min) To 2
    PRO

P25 PREFERRED TRACKING ATT

1 V37E 25E
    (TO TERM-V56E)
    F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
    AUTO) GUID CONT - PGNS
    MODE CONT - AUTO
    PRO
    (MAN) ENTR To 3

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

3 F 50 19 BYPASS TRIM MNVR TO FDAI RPY ANGLES (.01°)
    (TRIM) ENTR To 2
    (BYPASS) PRO (P25 Continues To Run In Background)
P27 LGC MANUAL UPDATE

1 (NOTE: For Auto Update: If V33N02 Displayed Key PRO
   If V21N02 or NO1 Displayed Key V34E)

2 V37E 00E

3 IF AGS OPERATING, DEDA 563 + 00000E

4 V70E LOAD LIFT OFF TIME
   or V71E LOAD CONSECUTIVE 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 Procedure)

5 F 21 01 R3 ADDRESS (Initially 306)
   LOAD DATA IN R1 E (R3 Increments)

6 F 21 01 Repeat Step 5 For All Data

7 F 21 02 R3 Goes To 301 When Data Load Complete

TO REVIEW DATA
   V0N0TE, 306E
   R1 Data
   N15E (R3 307)
   ENTR Verify Data For Remaining Comps.
   KEY REL Go To 7

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

TO ACCEPT UPDATE
   PRO

8 P00 Displayed
### P30 EXTERNAL ΔV

| 1 | F 06 33 | V37E 30E TIG PRO | (hrs, min, .01sec) |
| 2 | F 06 82 | ΔVXYZ(LV) PRO | (.1fps) |
| 3 | F 06 42 | HA, HP, ΔV PRO | (.1nm, .1fps) |
| 4 | F 16 45 | M, TFI, MGA PRO | (marks, min-sec, .01°) |
|    |         | DET - Set PRO (MGA Set To -00002 If No REFSMMAT Set) | |
| 5 | F 37   | CSI P32 PRETHRUST | |

| 1 | F 06 30 | V37E 32E TIG (CSI) PRO | (hrs, min, .01sec) |
| 2 | F 06 55 | APSIS CDH, TPI ELEVATION ANGLE PRO | (+0000X, .01°) |
| 3 | F 06 37 | TIG (TPI) PRO | (hrs, min, .01sec) |
| 4 | F 16 45 | M, TFI, -00001 DET - Set (RECYCLE) V32E To 5 (FINAL PASS) PRO (Terminate Marking) | (marks, min-sec) |
*F 05 09 00600 No Intersection on First Iteration
* 00601 hp+CSI<85 nm
* 00602 hp+CDH<85 nm
* 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 50 ΔH(CDH), ΔT(CDH-CSI), ΔT(TPI-CDH) (.1nm, min-sec)
PRO

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

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

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

9 F 37
P33 CDH PRE-THRUST

1  V37E 33E
   F 06 31  TIG (CDH)  
   PRO  
   (hrs, min, .01sec)

2  F 16 45  M, TFI, -00001  
    (RECYCLE) V32E To 3  
    (FINAL PASS) PRO (Terminate Marking)  
    
    *F 05 09 00611 NO TIG FOR SPECIFIED*  
    * (REDO) V32E To 1 ANGLE*  
    * PRO USE LAST ΔT(CDH/TPI/TPI) *  
    * To 3  

3  F 06 50  ΔH(CDH), ΔT(TPI-CDH), ΔT(TPI-NOMTPI)  
    PRO  
    (.1nm, min-sec)  

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

5  F 16 45  M, TFI, MGA  
    DET - Set  
    PRO (MGA Set To -00002 If No  
    REFSMMAT Set)  

6  F 37  

P34 TPI PRETHRUST

1  V37E 34E  
   F 06 37  TIG (TPI)  
   PRO  
   (hrs, min, .01sec)
2 F 06 55 R2 ELEVATION ANGLE, R3 wt. (.01°, .01°) (00000 In R2 To Calc Elevation Angle At TIG Time)

3 F 16 45 M, TFI, 00001 (marks, min-sec) (RECYCLE) V32E To 4 (FINAL PASS) PRO (Terminate Marking)

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

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

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

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

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

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

9 F 37
P35 TPM PRE-THRUSt

1 F 16 45 V37E 35E (marks, min-sec)
   M, TFI, -00001 (RECYCLE) V32E-To 3
   (FINAL PASS) PRO (Terminate Marking)

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

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

4 F 16 45 M, TFI, MGA (marks, min-sec, .01°)
   DET - Set
   PRO (MGA Set To -00002 If No
        REFSMMAT Set)

5 F 37
P40 DPS THRUST

THR CONT   -AUTO
MAN THROT  -CDR
BAL CPL    -ON
ENG GMBL   -Verify ENABLE
DES ENG CMD OVRD -Verify OFF
TTCA (LMP) -JETS
TTCA (CDR) -THROT (MIN SETTING)
PRPLNT QTY MON -DES 1
PRPLNT TEMP/PRESS MON -DES 1
HELIUM MON -SUPCRIT PRESS
DAP         -SET

1 V37E 40E
   *F 05 09 01706 *
   * P40 SELECTED *
   * BUT LM STAGED *
   *V34E(Select P42)*
F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (.01°)
   (AUTO) GUID CONT - PGNS
   MODE CONT - AUTO
   PRO
   (MAN) ENTR To 3

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

3 F 50 19 BYPASS TRIM MNVR TO FDAI RPY ANGLES (.01°)
   (TRIM) ENTR To 2
   (BYPASS) PRO

   *F 50 25 R1 00203 *
   * GUID CONT - PGNS *
   * MODE CONT - AUTO *
   * THR CONT - AUTO *
   * PRO *

   *F 05 09 01703 TFI<45 sec*
   *(TERMINATE) V34E *
   *(TIG IN 45 sec) PRO
4 06 40  TFI, VG, VM  (min-sec,.1fps)
   *F 05 09 01711 SV INTEGRATION NOT*
   * FINISHED PRIOR TO TIG - 30 *
   *(TERM P40) V34E
MASTER ARM-ON (1st Burn)
Verify DET - Set

-:35 DSKY BLANKS
   ENG ARM - DES

-:30 06 40  (AVE G ON)

-:15    VERIFY ΔVM (R3)<00005

-:07.5  Verify +X ULLAGE

-:05 F99 40 ENG ON ENABLE
   (AUTO) PRO (IGN WHEN TFI<00sec)
   (BYPASS) ENTR To DPS OFF

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

   *NO TIG or EARLY CUTOFF: *
   * To TIG-05 sec *
   *(For IGN) Correct Anomaly*  
   * PRO *
   *(BYPASS) ENTR To DPS OFF*

   *PROG Lt - ON *
   *VO5 NO9E 01407 VG *
   * INCREASING *
   *(Terminate Burn or Switch*  
   * To AGS)*

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

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

(.1fps)
6  F 37  MASTER ARM - OFF (Master Alarm - On)
  ENG GMBL - OFF
  PRPLNT QTY MON - OFF
  PRPLNT TEMP/PRESS MON - OFF
  HELIUM MON - OFF

P41 RCS THRUST

TTCA (CDR) - JETS
  DET - Set
  DAP - Set

1  V37E 41E
  F 50 18  REQUEST MNVR TO FDAI RPY ANGLES
     AUTO) GUID CONT - PGNS
           MODE CONT - AUTO
           PRO
     (MAN) ENTR To 3

2  06 18  AUTO MNVR TO FDAI RPY ANGLES
     (TRIM) ENTR To 2
     (BYPASS) PRO

3  F 50 19  BYPASS TRIM MNVR TO FDAI RPY ANGLES
     (TRIM) ENTR To 2
     (BYPASS) PRO

4  16 85  VG XYZ (LM)

   *F 05 09 01711 SV INTEGRATION*
   *NOT FINISHED PRIOR TO TIG-30*
   *(TERM P41) V34E*

   -:35 DSKY BLANKS

   -:30 16 85 (AVE G ON)

   -:00
     F 16 85  VG XYZ (LM)
            NULL COMPONENTS
            PRO

   5  F 37
P42 APS THRUST

LM - STAGED
HELIUM MON - ASC PRESS 1
PRPLNT TEMP/PRES MON - ASC
TTCA (CDR) - JETS
DAP - Set

1

V37E 42E
*F 05 09 01706 *
P 42 SELECTED *
* BUT NOT STAGED*
*V34E (Select P40)*
F 50 18 REQUEST MNVR TO FDAI RPY ANGLES
(AUTO) GUID CONT - PGNS
 Mode CONT - AUTO
 PRO
(MAN) ENTR To 3

2 06 18 AUTO MNVR TO FDAI RPY ANGLES

3 F 50 19 BYPASS TRIM MNVR TO FDAI RPY ANGLES
(TRIM) ENTR To 2
(BYPASS) PRO

*F 50 25 R1 00203 *
* GUID CONT - PGNS *
* MODE CONT - AUTO *
* PRO *

*F 05 09 01703 TFI < 45 sec *
*(TERMINATE) V34E *
*(TIG IN 45 sec) PRO *

4 06 40 TFI, VG ΔVM (min-sec, 1fps)
*F 05 09 01711 SV INTEGRATION *
* NOT FINISHED PRIOR TO TIG-30 *
*(TERM P42) V34E *
Verify DET - Set

- 35 DSKY BLANKS
ENG ARM-ASC
-:30 06 40 (AVG G ON)

-:15 Verify ΔVM (R3) < 00005

-:05 F99 40 ENG ON-ENABLE

-:03.5 Verify +X ULLAGE (V34E NO ULLAGE To 6)
(AUTO) PRO (IGN WHEN TFI ≤:00 sec)
(BYPASS) ENTR To APS OFF

IGN 06 40 TFI, VG, ΔVM (min-sec,.1fps)
*NO TIG OR EARLY CUTOFF: *
* TO TIG-05 sec *
*(FOR IGN) Correct Anomaly *
* PRO *
*(BYPASS) ENTR To APS OFF *

*PROG Lt - On *
* V05 NO9E 01407 *
* VG INCREASING *
*(Terminate Burn or Switch *
* To AGS) *

Feb. 24, 1969

Basic Date Changed

APS OFF

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

5 F 16 85 VG XYZ (LM)
NULL COMPONENTS
PRO
HELIELUM MON - OFF

6 F 37

P47 ΔV MONITOR

1 V37E 47E
(60 sec Delay)
F 16 83 ΔV XYZ (LM)
(EXIT) PRO
(RECYCLE) V32E

2 F 37
P51 IMU ORIENTATION

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

1

F 50 25
R1 00015 MNVR TO ACQ STARS
(To Coarse Align IMU To 0,0,0-ENTR 41 22 All Zeros)
PRO

2

F 01 71
R1 0OCDE (C)DETENT (DE)STAR CODE
(DETENT CODE) 1-L, 2-F, 3-R
4-RR(AZ+12000,EL+04500)
CL(AZ+18000,EL+04500)
LR(AZ+24000,EL+04500)
5-COAS(AZ+00000,EL+00000)

PRO
(For Detent Code 4 or 5
F 06 87 AZ,EL
PRO)

3

F 54 71
MARK X(52) and Y(53)

PRO
(For DE=00
F 06 88 CELESTIAL BODY VECTOR
Load Ground Values
PRO)
(After 1st Star) To 2
(After 2nd Star) To 4

4

F 06 05
R1 STAR ANGLE DIFFERENCE
(RECYCLE) V32E - To 1
PRO

(.01°)

5

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

(.01°)
P52 IMU REALIGN

1

CB(11) AC BUS B: AOT LAMP - Close
V37E52E

F 04 06 R1 00001 IMU ALIGN OPT
R2 00001 PREF (0,0,0 Specified Attitude) PRO To 3
2 NOM (LV At Specified Time) PRO To 2
3 REFSMMAT PRO To 4
*F 05 09 00215 PREF ORIENT *
* NOT SPECIFIED *
*(PREF) Select P40,41,42 *
* To Define PREF *
*(NOM or REFS) V32E, Go To 1*

2 F 06 34 GET ALIGN
(0,0,0 For Present Time)
PRO

3 F 06 22 NEW ICDU ANGLES OG,IG,MG
(IF MGA > 75° Mnvr Then V32E To 3)
PRO NO ATT Lt-On Then Off

4 F 50 25 R1 00015 SELECT STAR ACQUISTION MODE
Mnvr If Necessary
(PICAPAR) PRO
*F 05 09 00405 NO PAIR *
*(CREW SPECIFY) PRO To 5*
*(PICAPAR) V32E To 4 *
(MAN ACQ) ENTR

5 F 01 70 R1 00015 DETENT (DE)STAR CODE
(DETENT CODE) 1-L, 2-F, 3-R
4-RR(AZ+12000,EL+04500)
CL(AZ+18000,EL+04500)
LR(AZ+24000,EL+04500)
5-COAS(AZ+00000,EL+00000)

(For Detent Code 4 or 5
F 06 87 AZ,EL
PRO)

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

Basic Date: Feb. 24, 1969
Changed: LM-3
6 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES
   (AUTO) GUID CONT - PGNS
   MODE CONT - AUTO
   PRO
   (MAN) ENTR To 8

7 06 18 AUTO MNVR TO FDAI RPY ANGLES

8 F 50 19 BYPASS TRIM MNVR TO FDAI RPY ANGLES
   (TRIM) ENTR To 7
   (BYPASS) PRO

9 F 01 71 R1 OOCDE (C)DETENT (DE) STAR CODE PRO
   (For Detent Code 4 or 5
    F 06 87 AZ,EL
    PRO)

10 F 54 71 MARK X(52) and Y(53) PRO
   (For DE=00
    F 06 88 CELESTIAL BODY VECTOR
    Load Ground Values
    PRO)
   (After 1st Star) To 5
   (After 2nd Star) To 11
   (Redefine Star) ENTR To 9

11 F 06 05 STAR ANGLE DIFFERENCE
   (REJECT) V32E To 13
   (ACCEPT) PRO

12 F 06 93 \(\Delta\)GYRO ANGLES X,Y,Z (TORQUE) V76E Then PRO
   (BYPASS) V32E

13 F 50 25 R1 00014 RECHECK or EXIT FINE ALIGN
   (RECHECK) PRO To 4
   (EXIT) ENTR

14 F 37 CB(11) AC BUS B: AOT LAMP - Open
LM DOCKED IMU ALIGNMENT

1 Verify CSM in MIN DB ATT HOLD Until Coarse Align Complete

2 Calculate LM Gimbal Angles:

\[\begin{align*}
\text{OG} & : 26 \quad \text{IG} : 090.00^\circ \\
\text{CM} & \quad \text{CM} \\
\text{LM} & \quad \text{LM} \\
\end{align*}\]

3 V41N20E COARSE ALIGN IMU LOAD ICDO ANGLES OG, IG, MG (NO ATT Lt - On, FDAI Torques)
   *PROG Lt - On*
   *V05N09E 00211 COARSE*
   *ALIGN ERROR, GO*
   *To 3*

4 V40N20E ZERO CDU (NO ATT Lt - OFF)
   Notify CSM ATT HOLD No Longer Required

5 V25N07E
   F 21 07
   SET REFSMFLG
   77E, 10000E, 1E
   V01N01E, 77E, Confirm Bit 13 Set

6 V37E51E, PRO, V37EOOE
On CSM MARK - ENTER
Copy OG, IG, MG, CSM & LM

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<thead>
<tr>
<th>OG</th>
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<th>MG</th>
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<tr>
<td>LM</td>
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Voice Angles to MSFN
Copy Ground Calculated Gyro Torquing Angles

X________, Y________, Z________

V42E FINE ALIGN IMU
LOAD GYRO TORQUING ANGLES X,Y,Z (.001°)

V16N93E
MONITOR TORQUING

* IF REF bu MMAT ARE TO BE MADE ALIKE USE 180°
V41N20 Coarse Align IMU

1. V41N20E
   F 21 22 LOAD NEW ICDU ANGLES 0, I, M (0.01°)

2. 41 COARSE ALIGN
   NO ATT Lt - ON
   FDAI Torques
   *PROG Lt - On *
   *V05N09E R1 00211 COARSE*
   *ALIGN ERROR *
   *Compare N22 With N20 *
   *Repeat V41N20 *

V41N72 Coarse Align RR

1. RNDZ RDR - LGC

2. (If P20 has failed to designate and
   V41N72 LOCKON option is desired,
   LOSCMFLG must be reset)

3. V41N72E
   F 21 73 LOAD RR TRUNNION, SHAFT ANGLES (0.01°)

4. F 04 06 R1 00006 SPECIFY RR FUNCTION
   R2 00002 LOCK ON CSM
   00002 CONT DESIG
   PRO
   (TERM CONT DESIG) V44E

V42 Gyro Torquing

1. V42E
   F 21 93 LOAD ΔGYRO ANGLES (XYZ) (0.001°)

2. Gyro Torquing (NO ATT Lt - OFF)

V43 FDAI Bias Check

1. MODE CONT - OFF

2. V37E00E
3  V43E
   F 21 22 LOAD NEW ICDU ANGLES YPR (.01°)
   FDAI Needles Deflect
   ENTR

4  F 21 22 LOAD (-) NEW ICDU ANGLES YPR (.01°)

5  43 FDAI Needles Return To 0,0,0

V45 W-MATRIX ERROR DISPLAY

1  V45E
   F 06 99 POS ERR, VEL ERR (.01nm,.1fps)
   (REINITIAL) V24E
   PRO

V47 AGS INITIALIZATION

1  V16N65E
   16 65 LGC TIME (hr,min,.01sec)
   377 + GET-PGNS/AGS BIAS TIME (.1min)
   ENTR-(At Correct PGNS Time)

2  V47E
   F 06 16 GET OF AGS CLOCK
   Load PGNS/AGS BIAS TIME

3  414 + 10000E

4  PRO (32 sec Elapse Before Step 6 Appears If
   CDU Zero Is Issued, otherwise 20 sec)

5  414R (+00000 Indicates Completion)

6  F 50 16 DOWNLINK COMPLETE
   PRO

7  400 + 30000E IMU ALIGN

8  RATE/ERR MON (LMP) - LDG RDR/CMPTR
   ATTITUDE MON (LMP) - AGS

9  V83E
   F 06 54 R,RDOT, THETA (.01nm,.1fps,.010)
10  440R RDOT (fps)
11  Compare DSKY/DEDA RDOT To Be Within 2.5 fps PRO

V48 DAP SET
1  V48E
   DAP CONFIGURATION (ABCDE)
      (CONFIG)  A  O-LM, 1-LM/CSM
      (X-TRANS) B  O-RCS A, 1-RCS B, 2-RCS A&B
      (SCALE)  C  O-Fine(4°/sec, 1-Normal(20°/sec)
      (ATTDB)  D  0-.3°, 1-5°
      (RATE)  E  0-.2°/sec, 1-.5°/sec, 2-2°/sec
               3-10°/sec

   PRO
      (TERM) V34E

2  LM WT, CSM WT  (1b)

3  ENGINE GIMBAL TRIM PITCH, ROLL  (.01°)
   R1 & R2 Must Be Positive
   Verify MSFN Contact
   ENG GMBL - ENABLE
   Verify MODE CONTROL - AUTO
   Verify MAN THROT - CDR
   TTCA (CDR)-THROT (Up) MIN
   ENG ARM - DES
      (TRIM) PRO (Master Alarm, GDA/RCCA Caution
               Lt-On When Gimbals Reach Limits)
      (EXIT) V34E

4  TRIM COMPLETE
   ENG ARM - OFF (GDA/RCCA Caution Lt-Off)
   PRO
   MSFN Verifies Final GDA Position (If Gimbal
   Angles Differ From Desired Values By more
   than 0.1° Repeat V48)

V49 CREW DEFINED MANEUVER
1  V37E00E
2  V49E
   NEW ICDU ANGLES YPR  (.01°)
3 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (0.01°)
(AUTO) GUID CONT - PGNS
MODE CONT - AUTO
PRO
(MAN) ENTR To 5

4 06 18 AUTO MNVR TO FDAI RPY ANGLES (0.01°)

5 F 50 19 BYPASS TRIM MNVR TO FDAI RPY ANGLES
(TRIM) ENTR To 4
(BYPASS) PRO

V74 E-MEMORY DUMP

1 . V21NO1E 333E
F 21 01 R3 333
R1 20000 E For 4 DUMPS (83.2 sec)
or 10000 E For 2 DUMPS (41.6 sec)
or 04000 E For 1 DUMP (20.8 sec)

2 . Verify MSFN Contact
V74E

V82 ORBIT PARAMETER DISPLAY

1 . V82E (GO To 2 If AVE G-On)
F 04 06 R1 00002 SPECIFY VEHICLE
R2 00001 LM
00002 CSM
PRO

2 F 16 44 HA,HP,TFF (.1nm, min-sec)
(UPDATE) V32E (Not Required If AVE G-On)
(TERM) PRO

V83 RNDZ PARAMETER DISPLAY

1 . V83E
F 06 54 R, RDOT, THETA (.01nm, .1fps, 0.01°)
PRO
V84 TARGET ΔV

1
F 06 84 ΔV XYZ (LV) PRO (.1fps)

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

3 If P20 Running V80E

V89 RENDEZVOUS FINAL ATTITUDE

1 V37E00E

2 F 04 06 R1 00003 SPECIFY TRACKING ATTITUDE
R2 00001 (+Z AXIS)
00002 (+X AXIS) PRO

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

4 F 50 18 REQUEST MNVR TO FDAI RPY ANGLES (AUTO) GUID CONT - PGNS
MODE CONT - AUTO PRO
(MAN) ENTR To 6 (.01°)

5 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)

6 F 50 19 BYPASS TRIM MNVR TO FDAI RPY ANGLES (.01°)
(TRIM) ENTR To 5
(BYPASS) PRO (.01°)

V90 OUT-OF-PLANE DISPLAY

1 V90E
F 06 16 GET EVENT (hrs, min, .01sec) PRO
2 F 06 90 Y, YDOT, PSI (.01nm, .1fps, .01°)
(RECYCLE) V32E To 1
(EXIT) PRO

V91 SHOW-BANKSUM

1 V37E00E

2 V91E
F 05 01 R1 SUM OF BANK
R2 BANK NUMBER
R3 BUGGER WORD

Verify R1 = R2 or Complement of R2, If
Not, Record For MSFN

R1
R2
R3

PRO For Next Bank
(TERM) V34E

Basic Date — Feb. 24, 1969
Changed

LM-3
LANDING RADAR SELF TEST

1. X-POINTER (Both) - HI MULT
   RATE/ERR MON-LDG RDR/CMPT
   TEMP MON - LDG (>49°) TBD
   RNG/ALT MON - ALT/ALT RT
   LDG ANT - DES
   MODE SEL - LDG RDR
   CB(11) PGNS: LDG RDR - Close
   (X-POINTER will oscillate then
   up and right off scale)

2. RADAR TEST - LDG (Alt and Alt Rt Tapes Drive)
   TEST MONITOR - ALT XMTR (2.1 To 5.0v) (3.6v)
   VEL XMTR (2.1 To 5.0v) (3.8v)
   ALT/ALT RT MON - +8094 To +8457 ft
   -433 To -465 fps (836/-450)

3. LDG ANT - HOVER (10 sec)
   ALT/ALT RT - +7818 To +8169/-441 To -457 fps
   (8000/-457)

4. LDG ANT - DES (Wait 10 sec)

5. V62E INITIATE RDR SELF TEST
   F 04 06
   R1 00004 SPECIFY RDR
   R2 00002 LDG RDR
   PRO

6. F 16 66
   SLANT RANGE, ANT POSITION
   (ft)
   R1 +08165 To +08418 (+08286)
   R2 +00001
   PRO

7. F 16 67
   LDR RDR VEL X,Y,Z
   (fps)
   R1 -00230 To -00264 (-00247)
   R2 +00924 To +00954 (+00930)
   R3 +00643 To +00689 (+00665)

8. V34E

9. LDG ANT - AUTO
10 V61E COMMAND ANT TO POS 2 (27sec)
ALT/ALT RT MON - +7818 To +8169 ft/-441
To -457 fps (8000/-450)

11 V62E INITIATE RDR SELF TEST
F 04 06 R1 00004 SPECIFY RADAR
R2 00002 LDG RDR
PRO

12 F 16 66 SLANT RNG, ANT POSITION 92 (ft)
R1 +08156 To +08418 (+08275)
R2 +00002

13 LDG ANT - AUTO
V34E

14 RADAR TEST - OFF
CB(11) PGNS: LDG RDR-Open (Master Alarm-ON)

RNDZ RDR SELF TEST

1 Verify CSM RCS Thruster B3 And Transponder-OFF
RDZ RDR ANT - Released
X-POINTERS (Both) - HI MULT
RATE/ERR MON (Both - RNDZ RADAR
ATTITUDE MON (Both) - PGNS
MODE SEL - LDG RADAR
RNG/ALT MON - RNG/RNG RATE
SHFT/TRUN - +50°
RDZ RDR - SLEW
TEMP MONITOR - RNDZ (+10° To +150°)

2 CB(11) AC BUS A: RNDZ RDR-Close(Wait 30 sec)
PGNS: RNDZ RDR-Close(NO TRACK Lt-On)

3 SLEW LEFT TO 0°, 0°
SLEW RATE - LO
SHFT/TRUN - +5°
SLEW ANTENNA UP, DOWN, LEFT, RIGHT TO VERIFY SLEW
4

RDZ RDR - AUTO TRACK (MASTER ALARM & RNDZ RDR Caut Lt-On)
RADAR TEST - RNDZ (Rng Rt Tape Drives X-Pointers And FDAI Needles Vary Between Limits. After 12sec, Rng Tape Drives, NO TRACK & RNDZ RDR Caut Lt - Out)

5

TEST MONITOR - AGC (0.7 To 3.5V)(1.5)
- XMTR PWR (2.1 To 4.8V)(2.8)
- SHAFT ERR(1.5 To 3.5V)(1.5-1.8)
- TRUN ERR (1.5 To 3.5V)(1.6-1.7)

RDZ RDR-SLEW
SLEW ANTENNA TO 0°, 0°
RDZ RDR-LGC(NO TRACK Lt-On)

6

V62E START RNDZ RDR SELF TEST
F 04 06
R1 00004 SPECIFY RADAR
R2 00001 RNDZ RADAR
PRO

*F 50 25 R1 00201 SELECT*
* LGC CONTROL *
* RNDZ RDR - LGC *
* PRO *

NO TRACK Lt - Out After 12 sec

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

8 16 78
RANGE, RANGE RATE (.01nm, fps)
R1 +189000 To +198000 (+19564)
R2 -00459 To -00541 (-00493)
RNG/RNG RT - +189 To +198nm/-459 To -541 fps
(196/489)

9

V34E

10

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

11

V40N72E RRCDU ZERO (10sec)
12
V41N72E
N73 R1+04000
R2+04000
N06 R2 00002
V16N72E (Verify FDAQ Needles Up & Right)
V44E (TERM DESIG)

13
V41N72E
N73 R1-00400
R2-00400
N06 R2 00002
V16N72E (Verify FDAQ Needles)
V44E (TERM DESIG)

14
V41N72E
N73 R1+00000
R2+00000
N06 R2 00002
V16N72E (VERIFY FDAQ NEEDLES)
V44E (TERM DESIG)

15
V41N72E
N73 R1+18000
R2+19400
N06 R2+00002
V16N72E
CB(11) PGNS: RNDZ RDR - Open
AC BUS A: RNDZ RDR - Open
V44E (TERM DESIG)
PGNS TURN ON & SELF TEST

1. CB(11) PGNS: LGC/DSKY - Close
   If STBY Lt-On, PRO
   V36E
   V21N01E, 3000E, 2176E,E
   3011E, 201E, E
   1642E, 37777E
   V66E

2. CB(11) PGNS: IMU OPR - Close
   (NO ATT Lt-On For 90 sec)

3. V35E
   F 88 88 DSKY LIGHT CHECK
   (Master Alarm, LGC, Iss Warning
   and all DSKY Lts-On for 5 sec)
   Key RSET
   When NO ATT Lt-OFF +20 sec, V37E00E

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

5. V16N01E, 1365E
   15 01 R1, R2, R3 All Zero

6. V21N27E 10E (Self Test Both Fixed And
   Erasable Memory)
   (4E Self Tests Erasable)
   (5E Self Tests Fixed)

7. KEY REL
   15 01 R1 Number of Errors
   R2 Number of Tests Started
   R3 Number of Tests Successful
   Test Successful When R2>3 (78 sec)
   *PROG Lt - On *
   *V05N09E 01102 SELF *
   * TEST ERROR *
   *NO8E Record For MSFN *
   * R1 ______________ *
   * R2 ______________ *
   * R3 ______________ *

8. V21N27E, OE (Terminate Self Test)
**PGNS-46**

**PIPA BIAS CHECK**

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

2. V25N21E, E, E/DET - START

3. VO6E 06 21 XYZ PIPA PULSE(Pulses)

4. At T+32 sec - ENTR  
   T+32 sec (X)R1 (Y)R2 (Z)R3 (+XXXAB)

5. VO6NO1E, 1452E(R1-Review X BIAS)E,E(+AB000)  
   1454E(Review Y BIAS) E  
   1456E(Review Z BIAS)

6. V21NO1E  
   F 21 01 LOAD 1452E(Calculated X BIAS)E,E(+AB000)  
   1454E(Calculated Y BIAS)E,E  
   1456E(Calculated Z BIAS)E

**PGNS ORDEAL INITIALIZATION**

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

2. V82E  
   F 04 06 R1 00002 SPECIFY VEHICLE  
   R2 00001 LM  
   PRO

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

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

1. V37E00E
2. V25N36E
   F 21 36 LOAD CSM TIME (hr,min,.01sec)
   ON CSM MARK - ENTR
3. V06N65
   ON CSM MARK - ENTR
   06 65 SAMPLED LGD TIME (hr,min,.01sec)
   COMPUTE CSM/LM ΔTIME
   PERFORM SEVERAL TIMES THEN
4. V55E
   F 21 24 LOAD ΔLGC CLOCK TIME (hr,min,.01sec)
REVIEWS DATA IN ERASABLE MEMORY

1 Perform During Any Flashing Display

2 0101E, OCTAL ADD E
   F 01 01 R3 OCTAL ADD, R1 DATA

3 N15E (For Next Succeeding Address)
   ENTR (For Each Succeeding Address)
   (TERM) KEY REL

TO CHANGE DATA IN ERASABLE MEMORY

1 V21 NO1E 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

MONITOR OF INPUT/OUTPUT CHANNELS

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

LOAD OUTPUT CHANNELS

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

FLAG WORD SET/RESET

1 V25 NO7E
   F 21 07 (Load FLAGWORD ADD) E
2  F 22 07  (Load Code For Bit To Be Changed) E

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3  F 23 07  (Load 1-SET/O-RESET) E

4  TO VERIFY LOAD

- VO1NO1E, FLAGWORD ADD ENTR
- 01 01  R3 FLAGWORD ADD
- R1 FLAGWORD CONTENT

**BINARY-TO-OCTAL CONVERSION**

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<td>010-2</td>
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<td>011-3</td>
<td>111-7</td>
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**OCTAL-TO-DECIMAL CONVERSION**

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<td>26-22</td>
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<td>20-16</td>
<td>30-24</td>
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<td>50-40</td>
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<tr>
<td>FLAG NAME</td>
<td>ADDRESS</td>
<td>BIT</td>
<td>WHEN SET</td>
<td>WHEN RESET</td>
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<td>----------------------------------------------</td>
<td>------------------------------------------------</td>
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<tr>
<td>P25FLAG</td>
<td>0074</td>
<td>9</td>
<td>P25 is operating</td>
<td>P25 is not operating</td>
</tr>
<tr>
<td>IMU</td>
<td>0074</td>
<td>8</td>
<td>IMU in use</td>
<td>IMU not in use</td>
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<tr>
<td>Rendezvous</td>
<td>0074</td>
<td>7</td>
<td>P20 initiated (Radar in use)</td>
<td>P20 terminated (Radar not in use)</td>
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<tr>
<td>Lock On</td>
<td>0074</td>
<td>5</td>
<td>RR Lock-ON desired</td>
<td>RR Lock-ON not desired</td>
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<tr>
<td>State Vector</td>
<td>0075</td>
<td>8</td>
<td>CSM State Vector Updated (V81 sets this flag)</td>
<td>LM State Vector Updated (V80 resets this flag)</td>
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<tr>
<td>Update</td>
<td>0075</td>
<td>7</td>
<td>State Vector updating by marks allowed</td>
<td>State vector updating by marks not allowed</td>
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<td>Track</td>
<td>0075</td>
<td>5</td>
<td>Rendezvous Tracking allowed</td>
<td>Rendezvous Tracking not allowed</td>
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<tr>
<td>LOS CM Flag</td>
<td>0076</td>
<td>12</td>
<td>LOS Being Computed (R21)</td>
<td>LOS not being computed (R21)</td>
</tr>
<tr>
<td>Manual Acquire</td>
<td>0076</td>
<td>13</td>
<td>Enable manual acquisition of CSM by RR</td>
<td>Enable auto acquisition of CSM by RR</td>
</tr>
<tr>
<td>Field</td>
<td>Code</td>
<td>Value</td>
<td>Description</td>
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<td>-----------------------------------------------------------------------------</td>
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<td>External Delta V</td>
<td>0076</td>
<td>8</td>
<td>External Delta V VG Computation</td>
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<tr>
<td>Final</td>
<td>0076</td>
<td>6</td>
<td>Final pass through rendezvous program computations</td>
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<td>Active vehicle</td>
<td>0076</td>
<td>5</td>
<td>LM Active Vehicle</td>
<td></td>
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<td>Preferred Attitude</td>
<td>0076</td>
<td>4</td>
<td>Preferred attitude Computed</td>
<td></td>
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<tr>
<td>Auto/manual</td>
<td>0077</td>
<td>15</td>
<td>Do maneuver manually</td>
<td></td>
</tr>
<tr>
<td>REFSMMAT</td>
<td>0077</td>
<td>13</td>
<td>REFSMMAT good</td>
<td></td>
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<tr>
<td>No throttle</td>
<td>0101</td>
<td>12</td>
<td>Inhibit full throttle</td>
<td></td>
</tr>
<tr>
<td>3 Axis</td>
<td>0101</td>
<td>6</td>
<td>Maneuver specified by 3 axes</td>
<td></td>
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<tr>
<td>W Matrix</td>
<td>0101</td>
<td>1</td>
<td>W Matrix valid for flight navigation</td>
<td></td>
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<tr>
<td>NTARGFLG</td>
<td>0102</td>
<td>3</td>
<td>Astronaut Loaded ΔV</td>
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Lambert VG Computations
Interim pass through rendezvous program computations
CSM active Vehicle
Preferred attitude not computed
Do maneuver using KALCMANU
REFSMMAT not good
Permit full throttle
Maneuver specified by 1 axis
W Matrix invalid for flight navigation
Astronaut Did Not Load ΔV

Basic Date: Feb. 24, 1969
Changed
<table>
<thead>
<tr>
<th>Code</th>
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<tr>
<td>V45 FLAG</td>
<td>0103</td>
<td>Astronaut Loaded Initial W Matrix Values</td>
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<td>Astronaut Did Not Load Initial W Maxtrix Values</td>
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<td>NON FLAGS</td>
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<tr>
<td>RR Mode</td>
<td>1101</td>
<td>LOS within limits of other RR Antenna mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RR mode set to 2</td>
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<tr>
<td>Designate</td>
<td>1101</td>
<td>Desired LOS within limits of present RR mode. Drive CDU's.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Desired LOS not within the limits of the present RR mode. Do not drive CDU's.</td>
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<td>ACA Mode (Min Imp)</td>
<td>1102</td>
<td>Minimum impulse mode enabled (V76)</td>
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<td></td>
<td>Rate Command mode enabled (V77)</td>
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<tr>
<td>AOT Mark Reject</td>
<td>1314</td>
<td>Use of Mark Reject button</td>
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<tr>
<td>AOT Y Mark</td>
<td>1314</td>
<td>After use of Mark Y button</td>
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<tr>
<td>AOT X Mark</td>
<td>1314</td>
<td>After X Mark Made</td>
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<tr>
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<td>After both X &amp; Y Marks made or a Mark Reject</td>
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## CHANNEL LISTING

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<td>JET B4U ON</td>
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<td>2</td>
<td>JET A4D ON</td>
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<td>3</td>
<td>JET A3U ON</td>
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<td>4</td>
<td>JET B3D ON</td>
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<td>JET B2U ON</td>
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<td>ZERO RRCDU</td>
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<td>COARSE ALIGN ENABLE</td>
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<td>+PITCH GMBL TRIM CMD</td>
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<td>-PITCH GMBL TRIM CMD</td>
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<td>+ROLL GMBL TRIM CMD</td>
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<td>-ROLL GMBL TRIM CMD</td>
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<td>RR AUTO TRACK ENABLE</td>
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<td>NBD X</td>
<td>1460</td>
<td>X GYRO DRIFT BIAS</td>
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<td>NBD Y</td>
<td>1461</td>
<td>Y GYRO DRIFT BIAS</td>
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<td>1462</td>
<td>Z GYRO DRIFT BIAS</td>
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<td>P BIAS X</td>
<td>1452</td>
<td>X PIPA BIAS</td>
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<td>Y PIPA BIAS</td>
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<td>P BIAS Z</td>
<td>1456</td>
<td>Z PIPA BIAS</td>
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<td>CH5 MASK</td>
<td>1264</td>
<td>Bits Of CH5 MASK Indicate Jet Failures In Pitch Or Roll</td>
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<tr>
<td>CH6 MASK</td>
<td>1265</td>
<td>Bits Of CH6 MASK Indicate Jet Failures In Yaw</td>
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<td>REDOCTR</td>
<td>1205</td>
<td>Contains Number of Restarts</td>
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<td>TEPHEM</td>
<td>1706</td>
<td>Ephemeris Time</td>
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<td>Starting Address For REFSSMMAT</td>
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<td>Docked Dead Band</td>
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<td>LM State Vector Time Log</td>
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<td>ALM CADR</td>
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<td>Contains Address Prior To Failure</td>
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<td>ALM CADR+1</td>
<td>1364</td>
<td>Contains Address of Failure</td>
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<td>ERCOUNT</td>
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<td>No of Errors Encountered</td>
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<td>RRECT LEM</td>
<td>1626</td>
<td>Starting Address of Permanent LM SV</td>
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<tr>
<td>RRECT CSM</td>
<td>1554</td>
<td>Starting Address of Permanent CSM SV</td>
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AGS-1

AGS BACK-UP ALIGNMENT

RNDZ ALIGN
(If CSM & Horizon In View At The Same Time, Go To Step 2)

1. Pitch Down To Horizon & Fly 0° Roll In Plane
   400+5E (Body Axis Align)
   400+0E (Release Align)

2. Pitch Up & Sight On CSM, 0° Roll
   400+5E (Body Axis Align)
   400+0E (Release Align)

3. Pitch Down To Horizon 0° Roll & Yaw
   400+5E (Body Axis Align)
   400+0E (Release Align)

4. Adjust ORDEAL
   120 nm - 345.5°
   130 nm - 344.5°
   140 nm - 344.0°
STAR ALIGN

1. Maneuver To Place Star Set In AOT (FWD DETENT)
   (Any 2 Apollo Nav Stars May Be Used)
2. Position Star In Center Of Reticle
3. ATT HOLD - Narrow DB
4. Rotate Reticle To Place Either $+X$, $+Y$ Line On Star #2
5. $400 + 50000\text{E}$
   $400 + 00000\text{E}$
6. Record & Report To MSFN Star Set Including Centered Star, ID Line, AOT Counter
7. Maneuver To FDAI Angles From MSFN
8. At New Attitude
   $400 + 50000\text{E}$
   $400 + 00000\text{E}$
AGS RR ACQUISITION AND STATE VECTOR UPDATE

1. GUID CONT - AGS
   RNG/ALT MON - RNG/RNG RT
   RATE/ERR MON - LDR RDR/CMPTR
   ATT MON - AGS
   SHFT/TRUN - +5°
   RDZ RDR - SLEW
   ATTITUDE CONT (3) - PULSE
   MODE CONTROL - AUTO
   DEAD BAND - MIN

2. 400 +2 ACQUISITION STEERING

3. Manually Null FDAI

4. RATE/ERR MON - RNDZ RADAR

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

6. RDZ RDR - AUTO TRACK

7. 415 +1 STORE Z-AXIS COSINES ENTR (When FDAI's centered)

8. 316 + (RADAR RANGE)E (.1nm)
   (Must Be Entered Within 30sec
    Repeat At 3min Intervals For
    5 Data Points)

9. 503 + (RADAR RANGE RATE)E (fps)
   (Enter Range Rate Only Once For
    Each Set Of Updates)
AGS MANUAL STATE VECTOR UPDATE

1. Record LM Data And Time
   240 + (LM X Position) (1000ft)
   241 + (LM Y Position) (1000ft)
   242 + (LM Z Position) (1000ft)

2. Update State Vector
   254 + (LM Epoch Time) (.1min)
   414 + 20000E Update State Vector
   414R (+00000 When Update Complete)

3. Record CSM Data And Time
   244 + (CSM X Position) (1000ft)
   245 + (CSM Y Position) (1000ft)
   246 + (CSM Z Position) (1000ft)

4. Update State Vector
   272 + (CSM Epoch Time) (.1min)
   414 + 30000E Update State Vector
   414R (+00000 When Update Complete)
AGS TURN-ON AND SELF TEST

1. AGS STATUS - STBY
   CB(16) STAB/CONT: AEA - Close
   AGS STATUS - OPERATE (Master Alarm & AGS Warning Lt On Then Off)

2. 6666 (OPR ERR Lt - On)

3. 000 +88888

4. 123 -45679

5. 412R +1 SELF TEST SATISFACTORY
   +3 LOGIC TEST FAILURE
   +4 MEMORY TEST FAILURE
   +7 LOGIC AND MEMORY TEST FAILURE
   (To Reinitiate Test Set 412+0)

6. 574R(+) DESCENT STAGE FLAG (+Not Staged)

7. 604R(+) LUNAR SURFACE FLAG (+Not On Lunar Surface)

8. 612R (+00000) STAGING SEQ COUNTER (+00000)
   For Att Hold At Abort Stage

AGS CALIBRATION

1. Read And Record
   540R X ACCEL BIAS COEFF _____ (Octal)
   541R Y ACCEL BIAS COEFF _____ (Octal)
   542R Z ACCEL BIAS COEFF _____ (Octal)
   544R X GYRO DRIFT COEFF _____ (.01°/hr)
   545R Y GYRO DRIFT COEFF _____ (.01°/hr)
   546R Z GYRO DRIFT COEFF _____ (.01°/hr)
Verify AGS In Standby/Operate For 25 min, PGNS-On, LM Thrusters Disabled, Rates 1°/sec, RPY ICDUs Torqued Beyond 11.25° And Will Not Pass Thru 0°, 45°, 90°, etc. (CSM O=82.5°, I=22.5°, MG=22.5° Will Give The Desired Starting Attitude)

CSM Establish AGS Calibration Attitude, Minimize Rates, Go CMC Mode-Free

V16N20E Monitor ICDU Angles (All Angles Should Be Approx. 22°, 67°, 112°, 157°, 202°, 247°, 292°, or 337°)
LM ICDUs: 
- R 112.5° 
- P 202.5° 
- Y 022.5°

FDAO ANGLES: 
- R 132.7° 
- P 339.8° 
- Y 301.4°

V40N20E ZERO ICDUS

400 +6E CALIBRATE GYRO & ACCEL
Read And Record After 32sec

540R X ACCEL BIAS COEFF (Octal)
541R Y ACCEL BIAS COEFF (Octal)
542R Z ACCEL BIAS COEFF (Octal)
(If BIAS Changes > 4 Counts, AGS Failed)

CSM Reset Wide Deadband Attitude Hold Monitor via V16N20E

If It Appears That The Gimbal Angles Will Pass Thru 0°, 45°, 90°, 135°, 180°, 225°, 270°, or 325°, Exit Calibration By 400 + 0E)

400R + 0 When GYRO & ACCEL CALIBRATE COMPLETE

Read And Record After 5 min 2 sec
544R X GYRO DRIFT COEFF (°/hr)
545R Y GYRO DRIFT COEFF (°/hr)
546R Z GYRO DRIFT COEFF (°/hr)
(If GYRO DRIFT > 2.5°/hr, AGS Failed)
AGS ORDEAL INITIALIZATION

1. POWER - ON
   FDAI 1 and/or 2 - ORB RATE
   EARTH/LUNAR - EARTH

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

3. ALT SET - Set To Ave Of Ha & Hp

4. Verify LM Pointed +Z In Direction Of Orbit Travel

5. 304R THETA (.01°)
   (THETA Reads (+) Pitching Up To 90°
    Then (+) Back Down To 0° (180° Actual THETA). Pitching Down THETA Reads Up
    (-) To 90° (270°) Then (-) Back Down To 0° (180°)

6. MODE - HOLD/FAST
   SLEW - Set To Theta
   MODE - OPR/SLOW
AGS ΔV MONITOR

1. GUID CONT - AGS
   MODE CONTROL - ATT HOLD
   ATTITUDE CONTROL (3) - MODE CONT
   DEADBAND - MIN
   TTCA (Both) - JETS

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

3. 400+00000E
   MODE CONTROL - AUTO
   404+0E
   405+0E
   406+0E

   Monitor ΔV Along Thrust Axis
   470 R ΔVX (fps)
   471 R ΔVY (fps)
   472 R ΔVZ (fps)

   Thrust Along Desired Axis Using TTCA

AGS EXTERNAL ΔV

1. MODE CONTROL - ATT HOLD
   GUID CONT - AGS

2. 410 +0E (Resets Guidance Mode Logic If previous Burn Was AGS EXT ΔV
   410 +5E EXTERNAL ΔV

   For Local Vertical Comps:
   450 + ΔVX(LV)E (fps)
   451 + ΔVY(LV)E (fps)
   452 + ΔVZ(LV)E (fps)
AGS-9

For Body Axis Comps:
404 +0E (Zeros 470)
405 +0E (Zeros 471)
406 +0E (Zeros 472)

3 (Inertial Attitude Must Be Maintained Throughout Burn)
267R VG
DET - Set

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

5 400 +1E GUIDANCE STEERING

6 ATTITUDE CONTROL (3) - PULSE
   MODE CONTROL - AUTO
   Maneuver To Burn Attitude Then
   ATTITUDE CONTROL (3) - MODE CONT
   407 +0E

7 If Local Vertical Comps Were Used:
   501R AVGY(LM) (fps)
   502R AVGZ(LM) (fps)
   500R AVGX(LM) (fps)

    If Body Axis Comps Were Used:
   470R AVX (fps)
   471R AVY (fps)
   472R AVZ (fps)

8

   CONFIGURATION  DES  ASC  RCS
   TTCA (CDR)  THROT  JETS  JETS
   THR CONT  MAN  -  -
   MAN THROT  CDK  -  -
   ENG ARM  DES  ASC  OFF
   X-TRANSL  2 JET  2 JET  2 JET
   BAL CPL  ON  ON  ON
   PRPLNT QTY MON  DES  OFF  -
   PRPLNT TEMP/PRESS DES  ASC  -
   HELIUM MON  SUPCRIT PRESS 1 -
   DEAD BAND  MIN  MIN  MIN
   ENGINE STOP  -  -  DEPRESS
   ABORT(STAGE)PB  PUSH  PUSH  PUSH
   ABORT PB  -  -  PUSH
   MASTER ARM  ON  ON  OFF
AGS-10

9  -15  407 +1E (For RCS Not Burn +X)

10  -06  Start Ullage
    ENG GMBL = ENABLE

11  00  IGNITION

12  When Burn Complete
    ABORT(STAGE)PB = RELEASE
    NULL 500, 501, 502

13  MASTER ARM - OFF
    ENG ARM - OFF
    ENG GMBL - OFF
    BAL CPL - ON
    TTCA (CDR) - JETS
    DEAD BAND - MAX
    PRPLNT QTY MON - OFF
    PRPLNT TEMP/PRESS MON - OFF
    HELIUM MON - OFF

AGS CSI

MODE CONT - ATT HOLD
GUID CONT - AGS

275 +(TIG CSI) E (.1min)
277 +(TIG TPI) E (.1min)
605 +(TAN LOS TPI)E(10250 For 27.5°)
416 +0 CDH 1st Apsis (or 180° From
   CDH If 417 +1)
   +1 CDH 2nd Apsis (or 360° From
   CDH If 417 +1)
   (CSI ROUTINE Not Usable Prior To TIG CSI
   - 20 min)
410 +1 CSI ROUTINE

457R ITERATION ERROR (If +00002 Set
   410 + OE And Retarget)
AGS-11

4  463R HDOT CSI
    (If 463 + 00010 Set 417+1E(CDH At
     CSI + 180 Per 416)

5  313R TFI CSI
    DET - Set
    267R ΔV CSI

6  If Time Available
    317R RANGE
    440R RDOT
    371R ΔV CDH
    402R Δh CDH
    276R TIG CDH
    373R ΔT CSI To CDH
    274R ΔT CDH To TPI (Must Be
    Positive)

7  410 +5 E EXT ΔV
    450R ΔVX CSI
    263R ΔVY CSI
    451R(ΔVY CSI)E(Same Sign As 263)
    452R ΔVZ CSI

8  411 +0 E DES ENG OR RCS BURN
    +1 E ASC ENG BURN

9  400 +1 E GUIDANCE STEERING

10 ATTITUDE CONTROL (3) - PULSE
    MODE CONTROL - AUTO
    Maneuver To Burn Attitude
    ATTITUDE CONTROL (3) - MODE CONT
    407 +0E:

11 501R ΔVGY(LM)
    502R ΔVgz(LM)
    500R ΔVGX(LM)
LM-3

Basic Date Changed
Feb. 24, 1969

CONFIGURATION

MASTER ARM = OFF
ENG GMBL = OFF
PRPLNT QTY MON = OFF
DEAD BAND = OFF
PRPLNT TEMP/PRESS MON = OFF
HELIUM MON = OFF

When Burn Complete:
ABORT (STAGE) PB = RESET
ENG GMBL = ENABLE
410-2E CDH ROUTINE
407 +1E (For RCS Burn Not +X(LM))
null 500, 501, 502

(fps)

When Burn Complete:
ABORT (STAGE) PB = RESET
ENG GMBL = ENABLE
AGS-13

AGS CDH

1. MODE CONTROL - ATT HOLD
   GUID CONT - AGS

2. 410 +2E CDH ROUTINE
   276R TIG CDH (Adjust AGS T CDH
   As Desired For New Solution) (.1min)

3. 313R TFI CDH
   DET - .Set
   267R ΔV CDH (fps)

4. If Time Available Check The Following:
   317R RANGE (.1nm)
   440R RDOT (fps)
   402R ΔH CDH (.1nm)
   423R HDOT CDH (fps)

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

6. 411 +0E DES ENG OR RCS BURN
   +1E ASC BURN

7. 400 +1E GUIDANCE STEERING

8. ATTITUDE CONTROL (3) - PULSE
   MODE CONTROL - AUTO
   Maneuver To Burn Attitude Then
   ATTITUDE CONTROL (3) - MODE CONT
   407 +0E

9. 501R ΔVGY(LM) (fps)
   502R ΔVGZ(LM) (fps)
   500R ΔVGX(LM) (fps)
### 10 CONFIGURATION

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<tr>
<th></th>
<th>DES</th>
<th>ASC</th>
<th>RCS</th>
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<td>TTCA (CDR)</td>
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<td>JETS</td>
<td>JETS</td>
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<tr>
<td>MAN THROT</td>
<td>CDR</td>
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<td>ENG ARM</td>
<td>DES</td>
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<tr>
<td>X-TRANSL</td>
<td>2 JET</td>
<td>2 JET</td>
<td>2 JET</td>
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<tr>
<td>BAL CPL</td>
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<td>ON</td>
<td>ON</td>
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<tr>
<td>PRPLNT QTY MON</td>
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<tr>
<td>PRPLNT TEMP/PRESS</td>
<td>DES</td>
<td>ASC</td>
<td>-</td>
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<tr>
<td>HELIUM MON</td>
<td>SUPCRIT</td>
<td>PRESS 1</td>
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<tr>
<td>DEAD BAND</td>
<td>MIN</td>
<td>MIN</td>
<td>MIN</td>
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<tr>
<td>ENGINE STOP</td>
<td>-</td>
<td>-</td>
<td>DEPRESS</td>
</tr>
<tr>
<td>ABORT STAGE PB</td>
<td>PUSH</td>
<td>PUSH</td>
<td>PUSH</td>
</tr>
<tr>
<td>MASTER ARM</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
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</table>

### 11 -15 407 +1E (For RCS BURN NOT +X(LM))

### 12 -08 Start Ullage

- ENG GMBL - ENABLE

### 13 -00 IGNITION

### 14 When Burn Complete

- ABORT(STAGE)PB - RESET
- NULL 500, 501, 502 (fps)

### 15

- MASTER ARM - OFF
- ENG ARM - OFF
- ENG GMBL - OFF
- BAL CPL - ON
- TTCA (CDR) - JETS
- DEAD BAND - MAX
- PRPLNT QTY MON - OFF
- PRPLNT TEMP/PRESS MON - OFF
- HELIUM MON - OFF
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</table>
| 1 | MODE CONTROL - ATT HOLD
   GUID CONT - AGS |
| 2 | 410 +3E TPI SEARCH
  311 +\(\Delta T \text{ RND TRANS}E\) (.01min)
  314 +00000E NODE AT TPF (.01min)
  313 +\(\text{TARGET TFI TPI}\)E (.01min) |
| 3 | 303R LOS ANGLE TPI (.01°)
  410 +4E TPI EXECUTE (When 303 Is 027.50°)
  (TO RETARGET 310 +3E And
  313 (Target TFI TPI) E Then
  410 + 4E When 303 Is Desired Value |
| 4 | 313R TFI TPI (.01min)
  DET - Set
  267R \(\Delta V\) TPI (fps) |
| 5 | If Time Available:
  317R RANGE (.1nm)
  440R RDOT (fps)
  304R THETA (.01°)
  373R TIG TPI
  371R \(\Delta V\)G To RNDZ (If +8 Retarget)
  402R Hp TPI (.1nm) |
| 6 | 411 +OE DES ENG OR RCS
   +1E ASC ENG |
| 7 | 400 +1E GUIDANCE STEERING |
| 8 | ATTITUDE CONTROL (3) - PULSE
   MODE CONTROL - AUTO |
| 9 | Maneuver To Burn Attitude Then
   ATTITUDE CONTROL (3) - MODE CONT |
| 10 | 501R \(\Delta V\)GY(LM) (fps)
  502R \(\Delta V\)GZ(LM) (fps)
  500R \(\Delta V\)GX(LM) (fps) |
To Execute A Burn Without AGS Steering
Perform The Following:

404 +0E
405 +0E
406 +0E

470R ΔVX(LM) (fps)
471R ΔVY(LM) (fps)
472R ΔVZ(LM) (fps)

Execute Burn Holding Constant Attitude

<table>
<thead>
<tr>
<th>CONFIGURATION</th>
<th>DES</th>
<th>ASC</th>
<th>RCS</th>
</tr>
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<tbody>
<tr>
<td>TTCA (CDR)</td>
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<tr>
<td>THROT</td>
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<td>JETS</td>
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<tr>
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<td>DES</td>
<td>ASC</td>
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</tr>
<tr>
<td>X-TRANSL</td>
<td>2 JETS</td>
<td>2 JETS</td>
<td>2 JETS</td>
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<tr>
<td>BAL CPL</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>PRPLNT QTY MON</td>
<td>DES</td>
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</tr>
<tr>
<td>PRPLNT TEMP/PRESS</td>
<td>DES</td>
<td>ASC</td>
<td></td>
</tr>
<tr>
<td>HELIUM MON</td>
<td>SUPCRIT</td>
<td>PRESS 1</td>
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<tr>
<td>ENGINE STOP</td>
<td>-</td>
<td>-</td>
<td>DEPRESS</td>
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<tr>
<td>ABORT PB</td>
<td>PUSH</td>
<td>PUSH</td>
<td>-</td>
</tr>
<tr>
<td>MASTER ARM</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

-15 407 + 1E MODE CONTROL - ATT HOLD
(For RCS BURN Not In +X)
ENG - ENABLE

-03 Start Ullage

00 IGNITION

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

MASTER ARM - OFF
ENG ARM - OFF
ENG GMBL - OFF
BAL CPL - ON
TTCA (CDR) - JETS
DEAD BAND - MAX
PRPLNT QTY MON - OFF
PRPLNT TEMP/PRESS MON - OFF
HELIUM MON - OFF

AGS TPM

1  No Retargeting
   Maintain TPI Conditions
   Burn Residuals When Desired

Retargeting (Same Rndz Time)

   410 +3E TPI SEARCH
   311 + (ΔT RNDZ TRANS)E
      (033.50 For 1st MCC)
      (010.50 For 2nd MCC)
   313 + (TFI TPM)E
   410 + 4E TPI EXECUTE

2  267R ΔVG MDC
   (fps)

3  If Time Available:
   306R ΔTRDZ
   (01min)
   304R THETA
   (01°)

4  To Execute A Burn Without AGS Steering
   Perform The Following:

   404 +0E
   405 +0E
   406+0E

   470R ΔVX(LM)
   (fps)
   471R ΔVY(LM)
   (fps)
   472R ΔVZ(LM)
   (fps)

   Execute Burn Holding Constant Attitude
<table>
<thead>
<tr>
<th>Address</th>
<th>Entry</th>
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<tbody>
<tr>
<td>400</td>
<td>+00000 Attitude Hold</td>
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<tr>
<td></td>
<td>+10000 Auto Guidance Steering</td>
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<tr>
<td></td>
<td>+20000 Acquisition Steering</td>
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<tr>
<td></td>
<td>+30000 IMU Align</td>
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<tr>
<td></td>
<td>+40000 Lunar Align</td>
</tr>
<tr>
<td></td>
<td>+50000 Body Axis Align</td>
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<tr>
<td></td>
<td>+60000 Gyro And Accelerometer Calibration (300 sec, 30 sec)</td>
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<tr>
<td></td>
<td>+70000 Accelerometer Calibration Only (30 sec)</td>
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<tr>
<td>407</td>
<td>+00000 Use Rotating External ΔV Reference Frame</td>
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<tr>
<td></td>
<td>+10000 Freeze External ΔV In Inertial Space And Allow ΔV's To Count</td>
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<tr>
<td>410</td>
<td>+00000 Orbit Insertion Routine</td>
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<tr>
<td></td>
<td>+10000 CSI Routine</td>
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<tr>
<td></td>
<td>+20000 CDH Routine</td>
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<tr>
<td></td>
<td>+30000 TPI Search Routine</td>
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<tr>
<td></td>
<td>+40000 TPI Execute Routine</td>
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<tr>
<td></td>
<td>+50000 External ΔV</td>
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<tr>
<td>411</td>
<td>+00000 DPS Or RCS Engine Select</td>
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<td>+10000 APS Engine Selection</td>
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<td>412</td>
<td>+00000 Reinitiate Test</td>
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<td>+40000 Memory Test Fail</td>
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<td>413</td>
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<td>+10000 Store Lunar Azimuth</td>
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<td>414</td>
<td>+00000 Navigation Initialization Complete (AUTO)</td>
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<td></td>
<td>+10000 LM And CSM Navigation Initialization Via PGNCS Downlinks</td>
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<tr>
<td></td>
<td>+20000 LM Navigation Initialization Via DEDA</td>
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<tr>
<td></td>
<td>+30000 CSM Navigation Initialization Via DEDA</td>
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</tbody>
</table>
AGS-19

415 +00000 Normal Position
     +10000 Store Z-axis Direction
        Cosines In RDR Filter
416 +00000 For CSI Calculation Select
     +10000 CDH At First Apsidal Crossing
417 +00000 CDH At Apsidal Crossing
     +10000 CDH At Second Apsidal Crossing
     +20000 CDH At Third Apsidal Crossing
416 +00000 CDH At Apsidal Crossing
     Selected By Address 416
     +10000 CDH At 180°, 360° Or 540° From
     CSI Maneuver Based On Address
     416
507 +00000 +Z Body Points To CSM When 400
     Set To +20000
     +10000 +Z Body Points In Thrust Direction
     When 400 Set To +20000
563 +00000 Inhibit AGS Update Via PGNS Down-
     link
623 +00000 Z Body Parallel To CSM Orbit
     Plane When In Guidance Steering
     +00000 Z Body Parallel To Plane De-
     fined By WB When In Guidance
     Steering

DEDA INPUT/OUTPUT LIST

Address

<table>
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<th>Address</th>
<th>Description</th>
<th>Value</th>
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<td>Octal</td>
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<tr>
<td>053</td>
<td>Cosine Of Landing Azimuth Angle</td>
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<td>231</td>
<td>Radial Distance Of Launch Site From Center Of Earth</td>
<td>1000 ft</td>
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<tr>
<td>232</td>
<td>Orbit Insertion Altitude</td>
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<tr>
<td>233</td>
<td>Vertical Pitch Steering Altitude Threshold</td>
<td>1000 ft</td>
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<td>240</td>
<td>X Position Comp (LM)</td>
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<td>Y Position Comp (LM)</td>
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<td>Z Position Comp (LM)</td>
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<td>X Position Comp (CSM)</td>
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<td>LM Ephemeris Data (Epoch Time) .1 min</td>
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<td>X Velocity Comp (LM) fps</td>
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<td>Y Velocity Comp (LM) fps</td>
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<td>Targeted AGS Time For CSI Maneuver (TIG CSI) .1 min</td>
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<td>Absolute Time CDH (TIG CDH) .1 min</td>
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<td>Time From TPI To Rendezvous (ΔT RDZ Transfer) .01 min</td>
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<td>Targeted TFI TPI For TPI Search Routine .01 min</td>
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<td>Target Time Of Node Prior To Rendezvous .01 min</td>
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<td>AGS TIG TPI (Or TPM) .1 min</td>
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<td>CSI To CDH Coast Time (CSI Only) .1 min</td>
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<td>AGS Computer Time .1 min</td>
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<td>ΔVY Measured (Use 471 For Readout) Octal</td>
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<td>ΔVZ Measured (Use 472 For Readout) Octal</td>
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<td>Target Radial Rate At Insertion fps</td>
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<td>Target Horizontal Velocity At Insertion fps</td>
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<td>Radar Range Rate (RDOT) fps</td>
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<td>Components Of Unit Vector Octal</td>
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534 X Scale Factor For X Accelerometer Octal
535 Y Scale Factor For Y Accelerometer Octal
536 Z Scale Factor For Z Accelerometer Octal
537 X Axis Gyro Mass Unbalance Compensation Constant Octal
540 X Accel Bias Comp Coeff Octal
541 Y Accel Bias Comp Coeff Octal
542 Z Accel Bias Comp Coeff Octal
544 X Gyro Bias Comp Coeff .01°/hr
545 Y Gyro Bias Comp Coeff .01°/hr
546 Z Gyro Bias Comp Coeff .01°/hr
547 Lunar Align Azimuth Correction Octal
574 Section Staging Flag(+ Not Staged) Octal
604 Lunar Surface Flag(+ Not On Lunar Surface) Octal
605 Desired Tangent Of LOS At TPI (TAN LOS TPI) Octal

DEDA OUTPUT LIST

Address

211 Present Out-Of CSM Orbit Plane Position 1000 ft
263 VG Component For Out-Of-Plane Steering At CSI, CDH Or TPI VPY fps
267 Delta Velocity To Be Gained fps
270 Present VY Out-of CSM Orbit Plane Velocity (VYO) fps
274 ΔT (CDH - TPI) .1 min
303 Predicted LOS At tigC (TPI Mode) .01°
303 LM/CSM Central Angle At CDH (CSI/CDH Mode) .01°
304 Angle Between Local Horizon And Z Body Axis .01°
305 Minimum Value Of CSI Iteration Error For This Cycle .01°
| 306 | Time From CSI To CDH (CSI Mode) | .01 min |
| 312 | Predicted Time Of Peri Focus | .01 min |
| 313 | Time To CSI In CSI Mode, CDH In CDH Mode, TPI In TPI Mode (TIG) | .01 min |
| 315 | Predicted Altitude Of LM Apogee | .01 nm |
| 317 | LM To CSM Range (R) | \(\Delta l\) nm |
| 337 | LM Altitude (h) | .1 nm |
| 340 | X Comp Of LM Position | 1000 ft |
| 341 | Y Comp Of LM Position | 1000 ft |
| 342 | Z Comp Of LM Position | 1000 ft |
| 344 | X Comp Of CSM Position | 1000 ft |
| 345 | Y Comp Of CSM Position | 1000 ft |
| 346 | Z Comp Of CSM Position | 1000 ft |
| 347 | Predicted LM Burnout Altitude (Orbit Insertion) | 1000 ft |
| 360 | X Comp Of LM Velocity | fps |
| 361 | Y Comp Of LM Velocity | fps |
| 362 | Z Comp Of LM Velocity | fps |
| 364 | X Comp Of CSM Velocity | fps |
| 365 | Y Comp Of CSM Velocity | fps |
| 366 | Z Comp Of CSM Velocity | fps |
| 367 | LM Altitude Rate (R DOT) | fps |
| 370 | Total Velocity To Be Gained | fps |
| 371 | \(\Delta V\) For CDH (Valid In CSI, Coast) | fps |
| 371 | \(\Delta V\) Direct Trans + Braking (TPI) | fps |
| 373 | CSI to CDH \(\Delta T\) (CSI Only) | .1 min |
| 402 | LM Predicted Perigee Altitude (TPI) | .1 nm |
| 402 | LM Predicted \(\Delta H\) (CDH) | .1 nm |
| 403 | LM Perigee Attitude (Hp) | .1 nm |
| 423 | Predicted Burnout HDOT (Orbit Insertion) | fps |
| 433 | LM Velocity | fps |
| 440 | Range Rate Between LM And CSM (R DOT) | fps |
| 456 | \(\Delta V\) CSI | fps |
| 457 | CSI Velocity Search Increment | fps |
| 463 | Predicted HDOT CSI | fps |
| 470 | \(\Delta VX\) Measured (+Up) Use 404 To Zero | fps |
| 471 | \(\Delta VY\) Measured (+Rt) Use 405 To Zero | fps |
| 472 | \(\Delta VZ\) Measured (+Fwd) Use 406 To Zero | fps |
AGS -23

500 $\Delta VGX$ (LM) (+Up) fps
501 $\Delta VGY$ (LM) (+Rt) fps
502 $\Delta VGZ$ (LM) (+Fwd) fps
534 X Accelerometer Scale Factor Comp Octal
535 Y Accelerometer Scale Factor Comp Octal
536 Z Accelerometer Scale Factor Comp Octal

DEDATA ACCESSIBLE CONSTANTS LIST

Address

216 q Value Set If Over Flow In e 1000 ft
217 Initial P Perturbation 1000 ft
223 Nominal Burnout Altitude 1000 fps
Expression For Orbital Insertion
230 $\Delta p$ Limiter 1000 ft
447 Partial Derivitive, $\Delta T$ Protector fps
453 P-Iterator Converge Check Octal
454 VG Threshold On Engine fps
Cutoff Computations
473 Descent Stage $\Delta V$ Capability (VDX) fps
504 PGNCS/AGS Misalignment Corr Octal
505 PGNCS/AGS Misalignment Corr Octal
506 PGNCS/AGS Misalignment Corr Octal
526 Set Value Of VT If Overflow Octal
527 Upper Limit On Final Altitude Octal
Rate For Orbital Insertion
550 X Gyro Scale Factor Compensation Octal
551 Y Gyro Scale Factor Compensation Octal
552 Z Gyro Scale Factor Compensation Octal
554 Upper Limit Of rd Jerk Octal
555 Desired Derivative Of Octal
Yaw Acceleration
557 Desired Derivative Of Octal
Yaw Acceleration
564 Lower Limit On $\Delta 6$ Octal
565 $\Delta 6$ Upper Limit Octal
566 Engine Cant Angle In Pitch Plane Octal
602 Engine Cant Angle In Yaw Plane
607 Scale Factor For h DOT
613 Sine Of Central Angle Limit In TPI
616 Ullage Counter Limit Octal
617 Gyro Calibrate Duration Octal
620 No. Of P Iterations - 3 Octal
621 Accelerometer Calibrate Time Octal
622 Staging Time Delay Octal
624 Altitude And Altitude Rate Constant 200 msec Readout
625 FDAI Computation Singularity Threshold Octal
626 X Axis Alignment Gain Octal
627 Lunar Align Constant Octal
630 Lunar Align Constant Octal
631 Lunar Align Stop Criterion Octal
632 Calibrate Gain Octal
633 Calibrate Gain Octal
634 Acceleration Bias Threshold Octal
635 Accelerometer Calibrate Gain Octal
636 Gravitational Constant Octal
637 Gravitational Constant Octal Reciprocal
640 rd Jerk Lower Limit When LM Not Staged
641 Filter Velocity Uncertainty Term Octal
642 Orbit Insertion Steering Constant Octal
643 Coefficient In Evaluation Of Cost Octal
644 Decrease Δ6 Factor Octal
645 Increase Δ6 Factor Octal
646 Error Term In Radar Filter Octal
647 Velocity To Be Gained Threshold Octal
650 Cosine At Angle Between Radar And AGS X-Body Axis
651 Filter Initial Position Error Covariance Octal
652 Filter Initial Velocity Error Covariance Octal
AGS-25

653  Radar Error Model  Octal
654  TB Computation Factor  Octal
655  TB Computation Factor  Octal
657  Ascent Engine Cutoff  Octal
      Impulse Compensation
660  Lower Limit On aT  Octal
661  Ullage Threshold  Octal
662  Cosine At Angle Between Radar  Octal
      And AGS Y-Body Axis
666  Att Error Output Limit  Octal
673  Product Of Lunar Rotation  Octal
      Rate And 20 msec Compute  Octal
      Cycle Period (Not Used In  Octal
      FP-3)
674  (-2)Times(2K1)  Octal
      (2K1=Gravity Constant)
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