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G & C REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4 G&C REFERENCE DATA

4.4.1 LGC/DSKY RESTRICTIONS

The following restrictions apply to use of the LGC and DSKY:

a. For display verbs 01 through 07, monitor verbs 11 through 17, and load verbs 21 through 25, the number of components of the verb must not exceed the number of components of the noun being used. If this restriction is not observed, the OPR ERR lt goes on.

b. Mixing of octal and decimal data in multicomponent load verbs is not permitted. Data components must be all decimal or all octal.

c. Loaded machine addresses must be in octal form.

d. The magnitude of data being loaded should not exceed that of the noun being used. If this restriction is not observed, OPR ERR lt goes on.

e. Decimal data must be preceded by a sign (+ or -). Leading zeroes need not be loaded when loading decimal data.

f. When loading time-only nouns, three data words (three registers) must be loaded (for hours, minutes, and seconds).

g. All data loads must be verified before pressing ENTR pb for the last register being loaded. If any data are incorrect, the register can be cleared by pressing CLR pb. Each successive pressing of the CLR pb clears the preceding register. This backing-up action occurs only on components called by the load verb.

h. Only one of the following extended verbs can be running one at a time: 41, 42, 43, 47, 48, 49, 55, 57, 63, 64, 67, 70, 71, 72, 73, 82, 83, 85, 89, 90, 91, and 92. Each of these verbs call Extended Verb Interlock Routine (R76). If an extended verb from R76 is running when another is selected, OPR ERR lt will go on.

i. Flashing VERB/NOUN requires operator action. The program in process is halted until appropriate action is taken.

j. Nouns 40, 44, 45, 61, 62, 64, 66, 68, 74, 75, 77, and 78 cannot be loaded by V24 or V25 or have components that cannot be loaded. Channel No. 7 cannot be loaded via noun 07 or 10.

k. Most nouns contain useful data only when relevant computations are running. The following are exceptions: 1, 2, 8, 9, 10, 20, 21, 36, 46, 47, 48, 65, 72, and R2 of 66.

l. If verb 37 is attempted within approximately 15 seconds of a fresh start or ISS turn-on, a PIPA failure will go undetected. To correct this condition, select P00 and reset IMODES 30, bit 5 (key V37E 00E; key V25 N07E 1277E, 20E, E).

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.1 LGC/DSKY RESTRICTIONS (cont)

m. Final Automatic Request Terminate Routine (R00) is not executed if V37 is flashing, until a proper response is made keying in two digits (program number), then ENTR.

n. Performing ICDU Zero (para 4.6.1.21) during LM Rendezvous Navigation Program (P20) (para 4.8.2.1) may result in a bad mark or designate.

o. An efficient attitude hold/rate command mode is not provided when docked with the CSM.

p. KALCMANU maneuver rate >0.5°/sec should not be used when docked with the CSM.

q. A 1°/sec loss of attitude results if a +X-jet fails on or off and is undetected.

r. A hardware restart removes track enable. If LM Rendezvous Navigation Program (P20) is in process, P20 is forced back to the beginning of RR Designate Routine (R21) and calls Preferred Tracking Attitude Routine (R61).

s. Deleted

t. Deleted

u. V30 and V31 should not be used during P06, P12, P20, P21, P22, P40, P42, P51, P52, P57, P63, P70, P71, or R04.

v. Any program can be terminated as follows: (1) via V34E at any flashing display except at N60 in P66 or (2) via V37E XXE at any flashing or nonflashing display.

w. Deleted

x. Restarts will terminate automatic attitude maneuvers and cause RESTART lt or PROG lt to come on with FL V50 N18. To recover, key PRO and continue.

y. Deleted

z. Deleted

aa. If P20 or P22 is incorporating a mark, another program should not be selected via V37 until mark counter is incremented in V16 N45 display. If this is not desired, V95 can be used to stop updating. Wait 15 seconds before selecting another program. V80 or V81 must be entered to start state vector updating again.

ab. VG or ΔV displays in control coordinates, N85 or N83 are based on reading accelerometers every 2 seconds. Displays, however, are asynchronous one-second monitors; therefore, result is a possible 0.5- to 1.5-second delay between application of ΔV and visible result.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.1 LGC/DSKY RESTRICTIONS (cont)

ac. When loading decimal data, ENTR may change last digit of loaded data.

ad. During periods of high computer activity, selection of certain extended verbs (notably V67, V82, V83, V85, V90) may result in program alarms 31201 or 31202. Extended verb activity is lost and verb must be reselected.

ae. KEY REL lt remains on after V37 until new program is started. DSKY should not be used until KEY REL lt goes off and new program number is displayed.

af. VEC POINT routine may compute large OGA when +X-axis must be rotated approximately 180°. Sensitivity to such changes becomes greater as magnitude approaches 180°. If desired, maneuver manually in pitch approximately 30° and then have solution recomputed by keying PRO on FL V50 N18 while not in PGNCS automatic mode.

ag. No crew initiated verb/noun is restart protected.

ah. A restart will terminate extended verbs.

ai. PRO pb must be depressed for minimum of 120 milliseconds for proceed function. If PRO pb fails, use V33E for proceed functions.

aj. PRO pb is ignored when VERB ind displays V21, V22, or V23. To accomplish a proceed function in response to a flashing load verb, V PRO should be used.

ak. If V37E XXE, ABORT pb, or ABORT STAGE pb is used or if software restart occurs when RR/LR is being read, a 520 alarm may occur. Data that was being read is not used.

al. Deleted

am. If an extended verb has been selected during a mission program, with normal displays, the extended verb logic initially blanks the DSKY. Any response during the time the DSKY is blank would do one of the following; (1) respond to a normal mission program display underneath the extended verb or (2) respond to the first display in the extended verb, which could be initiated simultaneously with crew response. In general, do not key a response (PRO, ENTR, V32E, V33E, V34E) to either a blank DSKY or a nonflashing display.

an. Do not select P20 in the update mode before completion of P66. W-matrix initialization will destroy the erasable memory (E-memory) descent targets.

ao. V92, which calls IMU performance test program (P07), is for ground use only and is inhibited by the NODOP07 flag. The flag is set by V37 logic. If this restriction is not observed, the OPR ERR lt goes on.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.1 LGC/DSKY RESTRICTIONS (cont)

ap. To avoid computational errors in use of STAR/PLANET codes 46, 47, 50 (for sun, earth, moon respectively) (digits DE of R1 in N70, 71) if the sun, earth or moon are to be sighted on select code 00 (planet), and have MSFN uplink unit vectors.

4.4.2 AEA/DEDA RESTRICTIONS

The following restrictions apply to use of the AEA and DEDA:

a. The CLR pb must be pressed before every DEDA entry.

b. All addresses are in octal form. They must not be less than 26 (lowest numbered accessible address) nor greater than 704 (highest numbered accessible address).

c. A sign (+ or -) must be entered after the address when loading data.

d. An octal quantity with a digit greater than 7 or a number greater than the allowable range of the address must not be entered.

e. A DEDA entry of -00000 should not be made unless specified in a particular procedure.

f. If more than 4 hours elapse with the AGS operating and no thrust along the X-axis, perform one of the following to prevent overflow of the accumulated velocity counter:

Staged: Key DEDA C 404+00000E
Unstaged: Key DEDA C 404-12345E

g. If an accelerometer malfunctions, all AGS equations function properly and all guidance modes can be used as long as thrusting is performed orthogonal to the axis of the failed accelerometer, and the scale factor and bias compensation constant of the failed accelerometer are set to zero as follows:

X-axis: Key DEDA C 534+00000E
C 540+00000E
Y-axis: Key DEDA C 535+00000E
C 541+00000E
Z-axis: Key DEDA C 536+00000E
C 542+00000E

h. In attitude hold (400+00000) and guidance steering (400+10000), X-axis override can be accomplished through any desired angle. In Z-axis steering (400+20000), Z-axis override can be accomplished through any desired angle. If override of any other steering channel is desired, attitude excursion should be <90° from AGS-computed orientation.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.2 AEA/DEDA RESTRICTIONS (cont)

i. Do not enter +00000 into address 414. This is done automatically after completion of any navigation intialization. If this entry is made manually, it is treated as a +10000 and causes the program to search the PGNCS downlink for an identification word which, when located, could destroy LM and CSM state vectors. If +10000 is entered manually into address 414, PGNCS downlink search can be eliminated by keying DEDA C 563+00000E.

j. If lunar surface flag is inadvertently set during earth orbit, reset lunar surface flag as follows:
Key DEDA C 604+00000 (only the sign is significant)

k. DEDA quantities which are displayed in octal have a least quantization four times the internal computer scaling.

l. When keying DEDA, each pushbutton should be depressed to its limit of travel to ensure making good switch contact.

m. The scaling of certain DEDA values is mission-dependent. When these values appear in the DEDA listings of paragraphs 4.4.15, 4.4.16, and 4.4.17, quantization is given. When these values appear in the body of this document, quantization is defined with lunar scaling first, followed by earth scaling (e.g., 0.1/1 fps).

n. All thrusting under AGS control must be done using External ΔV guidance routine (410+50000), or Orbit Insertion guidance routine (410+00000).

o. To preclude any DEDA operation problem due to computer timing, the following rules should be observed:
1. At least 0.6 second shall elapse between the pressing of any two DEDA control pushbuttons (CLR, ENTR, READOUT, or HOLD), except when pressing the CLR pb to erase the previous operation.
2. After a DEDA entry, do not press the ENTR or READOUT pb within 1.5 seconds of the time the DEDA display has gone blank after pressing the ENTR pb.

p. DEDA address 277 is angle between Z body axis and local horizon projected into $\underline{U}1$-$\underline{V}1$ plane ($\underline{U}1$ is LM local vertical, $\underline{V}1$ is downrange and parallel to CSM orbit plane). This quantity will agree with PGNCS angle only when LM yaw angle is 0° or 180°.

q. DEDA should not be used to enter data while CB/AC BUS A: RNDZ RDR or CB/AC BUS A: GASTA is being opened or closed nor while LTG: OVERRIDE INTEGRAL sw is being operated.

r. The DEDA detects certain operator errors. The OPR ERR lt on the face of the DEDA goes on when these errors occur. False OPR ERR lt indications resulting from EMI on discrete lines may also occur. The light remains on until the CLR pb is pushed. The DEDA is then ready for a new instruction.

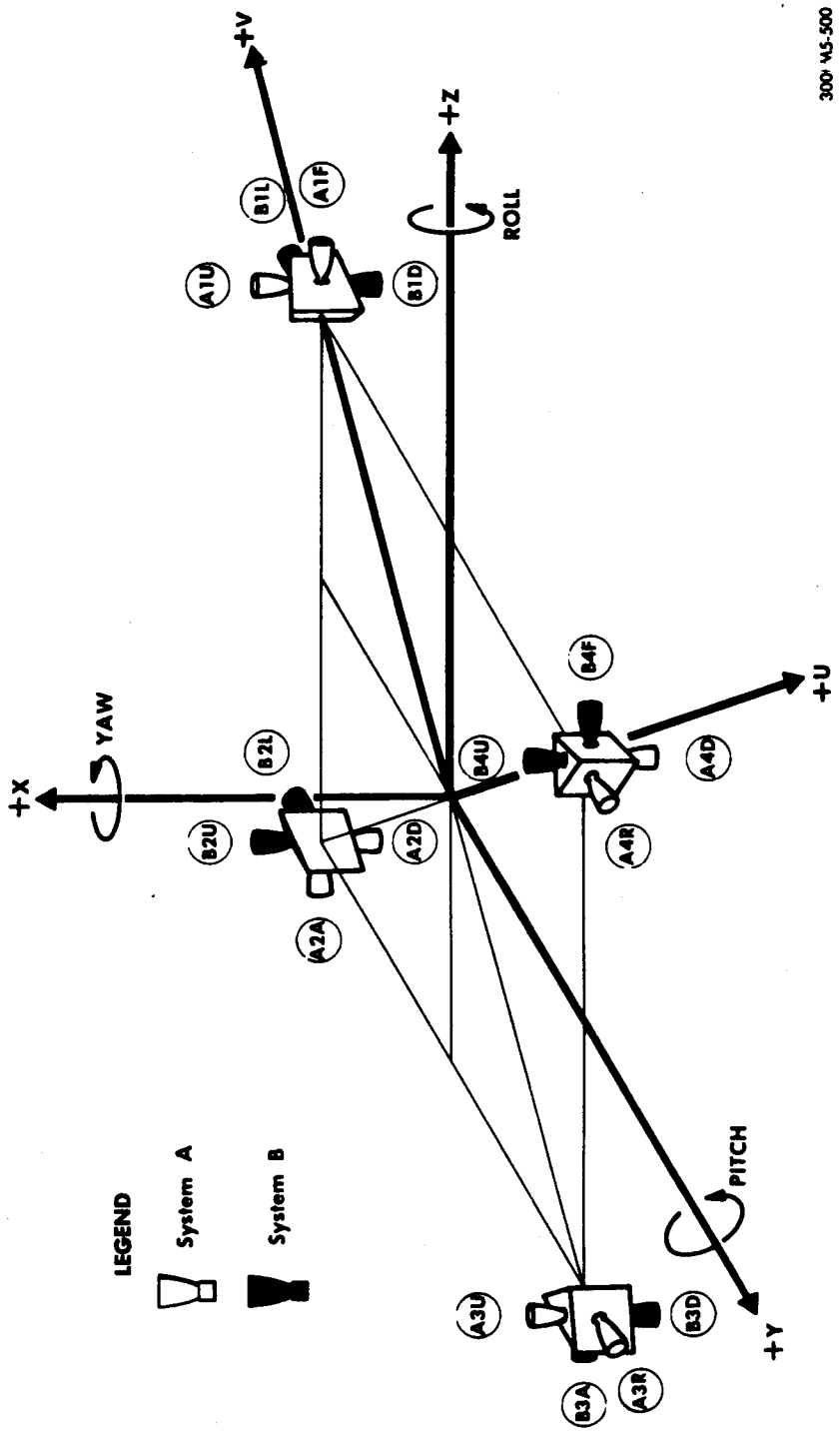

Figure 4-16. RCS Thruster Geometry

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.3 JET SELECT LOGIC

Table 4-1 is a general listing of the basic RCS engine logic for DAP-controlled translation and rotation maneuvers of the LM. Under DAP control, the jets selected for a particular maneuver are arranged so that the first entry is the optimum selection for the specified maneuver.

Table 4-1. RCS Jet Select Logic

Maneuver	B A B A 4 4 4 4 U D F R	A B B A 3 3 3 3 U D A R	B A A B 2 2 2 2 U D A L	A B A B 1 1 1 1 U D F L
A. DAP JET SELECTION - ROTATION				
+P (Yaw left), four-jet	X	X	X	X
two-jet	Alternating pulses between A4R, B2L & A1F, B3A			
-P (Yaw right), four-jet	X	X	X	X
two-jet	Alternating pulses between B4F, A2A & B1L, A3R			
+P (Alternative)*, two-jet		X		X
	X		X	
	X	X		
		X	X	
			X	X
	X			X
-P (Alternative)*, two-jet		X		X
	X		X	
		X	X	
			X	X
	X			X
	X	X		
+U (Pitch up, roll right)**, two-jet		X		X
-U (Pitch down, roll left)**, two-jet		X		X
+V (Pitch down, roll right)**, two-jet	X		X	
-V (Pitch up, roll left)**, two-jet	X		X	

* Alternative two-jet policies when a P rotational jet fails.
** If one U or V rotational jet fails, the other jet completes rotation.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.3 JET SELECT LOGIC (cont)

Table 4-1. RCS Jet Select Logic (cont)

Maneuver	B A B A 4 4 4 4 U D F R	A B B A 3 3 3 3 U D A R	B A A B 2 2 2 2 U D A L	A B A B 1 1 1 1 U D F L
B. DAP JET SELECTION - TRANSLATION				
+X-Translation, four-jet	X	X	X	X
two-jet	X		X	
		X		X
-X-Translation, four-jet	X	X	X	X
two-jet		X		X
	X		X	
+Y-Translation			X	X
-Y-Translation	X	X		
+Z-Translation		X	X	
-Z-Translation	X			X
+U (+Z & +Y) Translation		X	X X	X
-U (-Z & -Y) Translation	X X	X		X
+V (+Z & -Y) Translation	X	X X	X	
-V (-Z & +Y) Translation	X		X	X X
+Y-Tack Translation***	Alternating pulses between B2L, B4F & A2A, B2L Alternating pulses between B1L, A1F & B1L, B3A			
-Y-Tack Translation***	Alternating pulses between A4R, B4F & A4R, A2A Alternating pulses between A3R, B3A & A3R, A1F			
+Z-Tack Translation***	Alternating pulses between B3A, A3R & B3A, B1L Alternating pulses between A2A, B2L & A2A, A4R			
-Z-Tack Translation***	Alternating pulses between B4F, A4R & B4F, B2L Alternating pulses between A1F, A3R & A1F, B1L			

*** Y- and Z-tack translations are commanded when conventional Y or Z two-jet translations are not available (jet failure). Tacking alternations are done every 0.1 second.

G&C REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.4 LGC PROGRAMS

No.		Phase	Paragraph
00	LGC Idling	Service	4.6.1.6
06	LGC Power-Down	Service	4.6.1.2
12	Powered Ascent	Ascent	4.10.3.1
20	Rendezvous Navigation	Coast	4.8.2.1
21	Ground Track Determination	Coast	4.8.1.1
22	Lunar Surface Navigation	Coast	4.8.3.1
25	Preferred Tracking Attitude	Coast	4.6.1.19
27	LGC Update	Coast	4.6.1.7
30	External ΔV	Prethrust	4.7.1.1
32	Coelliptic Sequence Initiation (CSI)	Prethrust	4.7.1.2
33	Constant Δ Altitude (CDH)	Prethrust	4.7.1.3
34	Transfer Phase Initiation (TPI)	Prethrust	4.7.1.4
35	Transfer Phase Midcourse (TPM)	Prethrust	4.7.1.5
40	DPS Thrust	Thrust	4.10.1.1, 4.10.1.7
41	RCS Thrust	Thrust	4.10.1.3
42	APS Thrust	Thrust	4.10.1.2, 4.10.1.6, 4.12.9
47	Thrust Monitor	Thrust	4.10.1.4, 4.11.1, 4.12.8
51	IMU Orientation Determination	Alignment	4.9.1.1
52	IMU Realign	Alignment	4.9.1.2
57	Lunar Surface Align	Alignment	4.9.3.1
63	Braking Phase	Descent	4.10.2.1
64	Approach Phase	Descent	4.10.2.2
66	Landing Phase (ROD)	Descent	4.10.2.3
68	Landing Confirmation	Descent	4.10.2.4
70	DPS Abort	Abort	4.10.3.2
71	APS Abort	Abort	4.10.3.3
72	CSM Coelliptic Sequence Initiation Targeting	Backup	4.7.4.1
73	CSM Constant Δ Altitude Targeting	Backup	4.7.4.2
74	CSM Transfer Phase Initiation Targeting	Backup	4.7.4.3
75	CSM Transfer Phase Midcourse Targeting	Backup	4.7.4.4
76	Target ΔV	Backup	4.7.2.2

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.5 LGC ROUTINES

No.		Paragraphs	Crew Callable by Extended Verb
00	Final Automatic Request Terminate	4.6.1.36	V37
01	Erasable and Channel Modification	4.6.1.37	N/A
02	IMU Status Check	N/A	N/A
03	DAP Data Load	4.6.1.8	V48
04	RR/LR Self-Test	4.6.3.2, 4.6.3.8	V63
05	S-Band Antenna	4.6.1.30	V46
09	R10/R11/R12 Service	N/A	N/A
10	Landing Analog Displays	N/A	N/A
11	Abort Discretes Monitor	N/A	N/A
12	Descent State Vector Update	N/A	N/A
13	Landing Automatic Modes Monitor	N/A	N/A
20	LR/RR Data Read	N/A	N/A
21	RR Designate	N/A	N/A
22	RR Data Read	N/A	N/A
23	RR Manual Acquisition	N/A	N/A
24	RR Search	N/A	N/A
25	RR Monitor	N/A	N/A
26	Lunar Surface RR Predesignate	N/A	N/A
30	Orbit Parameter Display	4.8.1.2	V82
31	Rendezvous Parameter Display	4.6.1.11	V83
33	LGC/CMC Clock Synchronization	4.6.1.15	V55
36	Rendezvous Out-of-Plane Display	4.7.2.1	V90
40	DPS/APS Thrust Fail	N/A	N/A
41	State Vector Integration (MID to AVE)	N/A	N/A
47	AGS Initialization	4.6.1.18	V47
50	Coarse Align	N/A	N/A
51	In-Flight Fine Align	N/A	N/A
52	Automatic Optics Positioning	N/A	N/A
53	AOT Mark	N/A	N/A
54	Sighting Data Display	N/A	N/A
55	Gyro Torquing	N/A	N/A
56	Terminate Tracking	N/A	N/A
57	Markrupt	N/A	N/A
58	Celestial Body Definition	N/A	N/A
59	Lunar Surface Sighting Mark	N/A	N/A
60	Attitude Maneuver	N/A	N/A
61	Preferred Tracking Attitude	N/A	N/A
62	Crew-Defined Maneuver	4.6.1.9	V49
63	Rendezvous Final Attitude	4.6.1.10	V89
65	Fine Preferred Tracking Attitude	N/A	N/A
76	Extended Verb Interlock	N/A	N/A
77	LR Spurious Test	4.6.3.10	V78

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.6 VERB LIST

No.	Regular Verbs	REMARKS
01	Display octal component 1 in R1	
02	Display octal component 2 in R1	
03	Display octal component 3 in R1	
04	Display octal components 1, 2 in R1, R2	
05	Display octal components 1, 2, 3 in R1, R2, R3	
06	Display decimal in R1; or R1, R2; or R1, R2, R3	
07	Display double precision decimal in R1, R2	Test only
11	Monitor octal component 1 in R1	
12	Monitor octal component 2 in R1	
13	Monitor octal component 3 in R1	
14	Monitor octal components 1, 2 in R1, R2	
15	Monitor octal components 1, 2, 3 in R1, R2, R3	
16	Monitor decimal in R1; or R1, R2; or R1, R2, R3	
17	Monitor double precision decimal in R1, R2	Test only, ground use
21	Load component 1 into R1	
22	Load component 2 into R2	
23	Load component 3 into R3	
24	Load components 1, 2 into R1, R2	
25	Load components 1, 2, 3 into R1, R2, R3	
27	Display fixed memory	Ground use
30	Request executive	Ground use, use in P00 only
31	Request waitlist	Ground use, use in P00 only
32	Recycle	
33	Proceed without DSKY input	
34	Terminate function	
35	Test lights	Use in P00 only.
36	Request fresh start	
37	Change program	

	Extended Verbs	REMARKS	Paragraph
40	Zero CDU	Specify N20 or N72	4.6.1.21, 4.6.1.22
41	Coarse-align CDU	Specify N20 or N72	4.9.1.3, 4.6.3.3
42	Fine-align IMU		4.9.1.4
43	Load FDAI error needles	Test only	4.6.1.23
44	Terminate RR continuous designate	V41 N72, option 2	4.6.3.3
47	Initialize AGS (R47)		4.6.1.18
48	Start DAP Data Load Routine (R03)		4.6.1.8
49	Start crew-defined maneuver (R62)		4.6.1.9
50	Please perform		N/A
52	Mark X reticle		N/A

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.6 VERB LIST (cont)	

No.	Extended Verbs	Paragraph	Remarks
53	Mark Y reticle	N/A	
54	Mark X or Y reticle	N/A	
55	Increment LGC time (decimal)	4.6.1.24	
56	Terminate tracking (R56)	N/A	
57	Permit LR update	N/A	
58	Inhibit LR update	N/A	
59	Command LR to position 2	4.6.3.9	
60	Display LM attitude rates on FDAI error needles	N/A	
61	Display DAP attitude error	4.6.1.32	
62	Display total attitude error	4.6.1.33	
63	RR/LR self-test (R04)	4.6.3.2, 4.6.3.8	
64	Start S-band antenna routine (R05)	4.6.1.30	
65	Disable U & V jets during DPS burn	N/A	
66	Vehicles attached; move this vehicle state vector to other vehicle.	4.6.1.35	
67	W-matrix rms error display	4.6.1.34	
68	Bypass lunar terrain model computations	N/A	
69	Restart	4.6.1.29	
70	Update liftoff time	4.6.1.7	
71	Universal update, block address	4.6.1.7	
72	Universal update, single address	4.6.1.7	
73	Update LGC time (octal)	4.6.1.7	
74	Initialize erasable dump via downlink	4.6.1.25	
75	Enable U & V jets during DPS burn	N/A	
76	Minimum impulse command mode	N/A	
77	Rate command and attitude hold mode	N/A	
78	Start LR spurious return test (R77)	4.6.3.10	
79	Stop LR spurious return test (R77)	4.6.3.10	
80	Update LM state vector	N/A	
81	Update CSM state vector	N/A	
82	Request orbit parameter display (R30)	4.8.1.2	
83	Request rendezvous parameter display (R31)	4.6.1.11	
85	Display RR LOS azimuth & elevation	N/A	
89	Start rendezvous final attitude maneuver (R63)	4.6.1.10	
90	Request rendezvous out-of-plane display (R36)	4.7.2.1	
91	Show Banksum	4.6.1.12	
92	Start IMU performance tests	N/A	For ground use only.
93	Enable W-Matrix Initialization	4.6.1.26	

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.6 VERB LIST (cont) No. Extended Verbs 95 No update of either state vector 96 Interrupt integration and go to P00 97 Perform engine fail procedure 99 Enable engine ignition 4.4.7 NOUN LIST No. Description/Component Scale 01 Specify address (fraction) R1 .XXXXX R2 .XXXXX R3 .XXXXX 02 Specify address (whole) R1 XXXXX R2 XXXXX R3 XXXXX 03 Specify address (degree) R1 XXX.XX° R2 XXX.XX° R3 XXX.XX° 04 R1 Gravity error angle XXX.XX° R2 ----- R3 ----- 05 R1 Sighting angle difference XXX.XX° R2 ----- R3 -----	Ref para 4.6.1.31. Do not use during P20 when CSM state vector is being updated (V81) or after responding to FL V37 when leaving a program where average g was on.

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.7 NOUN LIST (cont)	

No.	Description/Component	Scale	
06	Option code		
	R1 Code	Octal	
	R2 Desired option	Octal	
	R3	-----	R3 contains DATCODE during P57.
07	Channel/Flagword/Erasable operator		
	R1 ECADR	Octal	
	R2 Bit Identification	Octal	
	R3 Action	Octal	
08	Alarm data		
	R1 Address	Octal	
	R2 BBCON	Octal	
	R3 ERCOUNT	Octal	
09	Alarm codes		
	R1 First	Octal	
	R2 Second	Octal	
	R3 Last	Octal	
10	Channel to be specified		All except channel 7.
	R1	Octal	
	R2	-----	
	R3	-----	
11	TIG (CSI)		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
12	Option code (used by extended verbs only)		
	R1 Code	Octal	
	R2 Desired option	Octal	
	R3	-----	
13	TIG (CDH)		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.7 NOUN LIST (cont)

No.	Description/Component	Scale
14	Checklist (used by extended verbs only)	
	R1	XXXXX
	R2	-----
	R3	-----
15	Increment address	
	R1	Octal
	R2	-----
	R3	-----
16	Time of event (used by extended verbs only)	
	R1	00XXX hr
	R2	000XX min
	R3	0XX.XX sec
18	Desired automatic maneuver FDAI angles	
	R1 Roll	XXX.XX°
	R2 Pitch	XXX.XX°
	R3 Yaw	XXX.XX°
20	Present ICDU angles	
	R1 Outer gimbal	XXX.XX°
	R2 Inner gimbal	XXX.XX°
	R3 Middle gimbal	XXX.XX°
21	PIPA's	
	R1 X	XXXXX pulses
	R2 Y	XXXXX pulses
	R3 Z	XXXXX pulses
22	Desired ICDU angles	
	R1 Outer gimbal	XXX.XX°
	R2 Inner gimbal	XXX.XX°
	R3 Middle gimbal	XXX.XX°

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.7 NOUN LIST (cont)	

No.	Description/Component	Scale	
24	ALGC clock time		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
25	Checklist reference code (used with V50)		
	R1 Code	XXXXX	
	R2	-----	
	R3	-----	
26	Priority/delay, address, BBCON		
	R1	Octal	
	R2	Octal	
	R3	Octal	
27	Self-test switch (on/off)		Ref para 4.6.1.13.
	R1	XXXXX	
	R2	-----	
	R3	-----	
32	Time from perigee		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
33	TIG		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
34	Time of event		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
35	Time from event		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.7 NOUN LIST (cont)	

No.	Description/Component	Scale	REMARKS
36	Time of LGC clock		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
37	TIG (TPI)		
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
38	State vector integration time (TET)		To monitor progress of state vector integration, time associated with progressing (regressing) state vector is available by keying V16 N38E. TET is time (GET) to which state vector integration process has presently calculated state vector.
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
40			
	R1 TFI/TFC	XXBXX min-sec	
	R2 VG	XXXX.X fps	
	R3 ΔV (Accumulated)	XXXX.X fps	
41	Navigation base		System test
	R1 Azimuth	XXX.XX°	
	R2 Latitude	XX.XXX°	
	R3	-----	
42			
	R1 Ha	XXXX.X nm	
	R2 Hp	XXXX.X nm	
	R3 ΔV	XXXX.X fps	
43			
	R1 Latitude	XXX.XX°	A + display indicates north
	R2 Longitude	XXX.XX°	A + display indicates east
	R3 Altitude	XXXX.X nm	
44			
	R1 Ha	XXXX.X nm	
	R2 Hp	XXXX.X nm	
	R3 TFF	XXBXX min-sec	

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.7 NOUN LIST (cont)	

No.	Description/Component	Scale	
45			
	R1 M	XXXXX marks	
	R2 TFI	XXBXX min-sec	
	R3 MGA	XXX.XX°	
46	DAP configuration		Ref para 4.6.1.8 (R03).
	R1	Octal	
	R2	-----	
	R3	-----	
47			
	R1 LM weight	XXXXX lb	
	R2 CSM weight	XXXXX lb	
	R3	-----	
48			
	R1 Gimbal pitch trim	XXX.XX°	
	R2 Gimbal roll trim	XXX.XX°	
	R3	-----	
49			
	R1 ΔR	XXXX.X nm	R3 indicates out-of-tolerance parameter
	R2 ΔV	XXXX.X fps	X = 1, RR range X = 3, RR shaft angle
	R3 Source Code	0000X	X = 2, RR range rate X = 4, RR trunnion angle
51	S-band antenna		
	R1 Pitch	XXX.XX°	
	R2 Yaw	XXX.XX°	
	R3	-----	
52			
	R1 Central angle of active vehicle	XXX.XX°	
	R2	-----	
	R3	-----	
54			
	R1 Range	XXX.XX nm	
	R2 Range rate	XXXX.X fps	
	R3 θ	XXX.XX°	

G&C REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.7 NOUN LIST (cont)

No.	Description/Component	Scale
55		
	R1 N (apsidal crossings)	XXXXX
	R2 E	XXX.XX°
	R3 CENTANG	XXX.XX°
56		
	R1 RR LOS azimuth	XXX.XX°
	R2 RR LOS elevation	XXX.XX°
	R3	-----
58		
	R1 Hp (Post-TPI)	XXXX.X nm
	R2 ΔV (TPI)	XXXX.X fps
	R3 ΔV (TPF)	XXXX.X fps
59	ΔV (LOS)	
	R1 LOS 1	XXXX.X fps
	R2 LOS 2	XXXX.X fps
	R3 LOS 3	XXXX.X fps
60		
	R1 V (Forward)	XXXX.X fps
	R2 H rate	XXXX.X fps
	R3 H	XXXXX ft
61		
	R1 TG	XXBXX min-sec
	R2 TFI	XXBXX min-sec
	R3 Crossrange	XXXX.X nm
62		
	R1 VI	XXXX.X fps
	R2 TFI	XXBXX min-sec
	R3 ΔV (Accumulated)	XXXX.X fps

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.7 NOUN LIST (cont)

No.	Description/Component	Scale	
63			
	R1 ΔH (LR alt minus LGC alt above landing site radius)	XXXX.X fps	
	R2 H rate	XXXX.X fps	
	R3 H	XXXXX ft	
64			
	R1 TR/LPD	XXBXX sec-deg	
	R2 H rate	XXXX.X fps	
	R3 H	XXXXX ft	
65	Sampled LGC time		Fetched in interrupt
	R1	00XXX hr	
	R2	000XX min	
	R3	0XX.XX sec	
66			
	R1 LR slant range	XXXXX ft	
	R2 LR position	0000X	X = 1 or 2
	R3	-----	
67	LR velocities		
	R1 X	XXXXX fps	
	R2 Y	XXXXX fps	
	R3 Z	XXXXX fps	
68			
	R1 Horizontal range to landing site	XXXX.X nm	
	R2 TG	XXBXX min-sec	
	R3 VI	XXXX.X fps	
69	ΔRLS		
	R1 ΔZ (downrange in SM coordinates)	XXXXX ft	
	R2 ΔY (crossrange in SM coordinates)	XXXXX ft	
	R3 ΔX (approx alt in SM coordinate)	XXXXX ft	

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.7 NOUN LIST (Cont)

NO.	Description/Component	Scale
70	R1 AOT detent/star code (before mark)	00CDE
	R2	-----
	R3	-----
71		
	R1 AOT detent/star code (after mark)	00CDE
	R2	-----
	R3	-----
72	RR angles	
	R1 Trunnion	XXX.XX°
	R2 shaft	XXX.XX°
	R3	-----
73	Desired RR angles	
	R1 Trunnion	XXX.XX°
	R2 Shaft	XXX.XX°
	R3	-----
74		
	R1 TFI	XXBXX min-sec
	R2 Yaw	XXX.XX°
	R3 Pitch	XXX.XX°
75		
	R1 ΔH (CDH)	XXXX.X nm
	R2 ΔT (CDH-CSI or TPI-CDH)	XXBXX min-sec
	R3 ΔT (TPI-CDH or TPI-nom TPI)	XXBXX min-sec
76		
	R1 Desired downrange velocity	XXXX.X fps
	R2 Desired radial velocity	XXXX.X fps
	R3 Crossrange	XXXX.X nm
77	R1 TG	XXBXX min-sec
	R2 Y	XXXX.X fps
	R3 VI	XXXX.X fps

R2 and R3 are modulerized to the hour; e.g. Modulo 60 minutes.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.7 NOUN LIST (cont)

No.	Description/Component	Scale
78		
	R1 RR range	XXX.XX nm
	R2 RR range rate	XXXXX fps
	R3 TFI	XXBXX min-sec
79		
	R1 Cursor angle	XXX.XX°
	R2 Spiral angle	XXX.XX°
	R3 Position code	0000X
80		
	R1 Data indicator	XXXXX
	R2 Ω	XXX.XX°
	R3	-----
81	ΔV (LV)	
	R1 X	XXXX.X fps
	R2 Y	XXXX.X fps
	R3 Z	XXXX.X fps
82	ΔV (LV)	
	R1 X	XXXX.X fps
	R2 Y	XXXX.X fps
	R3 Z	XXXX.X fps
83	ΔV (LM)	
	R1 X	XXXX.X fps
	R2 Y	XXXX.X fps
	R3 Z	XXXX.X fps
84	ΔV (CSM)	
	R1 X	XXXX.X fps
	R2 Y	XXXX.X fps
	R3 Z	XXXX.X fps
85	VG (LM)	
	R1 X	XXXX.X fps
	R2 Y	XXXX.X fps
	R3 Z	XXXX.X fps

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.7 NOUN LIST (cont)	

No.	Description/Component	Scale	
86	VG (LV)		
	R1 X	XXXX.X fps	
	R2 Y	XXXX.X fps	
	R3 Z	XXXX.X fps	
87	Backup optics LOS		
	R1 Azimuth	XXX.XX°	
	R2 Elevation	XXX.XX°	
	R3	-----	
88	Celestial body position		Celestial body unit vector
	R1 X	.XXXXX	
	R2 Y	.XXXXX	
	R3 Z	.XXXXX	
89			
	R1 Latitude	XX.XXX°	
	R2 Longitude/2	XX.XXX°	
	R3 Altitude	XXX.XX nm	
90	Rendezvous out-of-plane parameters		
	R1 Y	XXX.XX nm	
	R2 Y rate	XXXX.X fps	
	R3 ψ	XXX.XX°	
91			
	R1 Altitude	XXXXX nmX10	
	R2 V	XXXXX fps	
	R3 Flight path angle	XXX.XX°	
92	R1 Desired auto throttle	XXXXX%	
	R2 H rate	XXXX.X fps	
	R3 H	XXXXX ft	
93	Δ gyro angles		
	R1 X	XX.XXX°	
	R2 Y	XX.XXX°	
	R3 Z	XX.XXX°	

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.7 NOUN LIST (cont)

No.	Description/Component	Scale
94	R1 VGX (LM)	XXXX.X fps
	R2 H rate	XXXX.X fps
	R3 H	XXXXX ft
97	System test input	
	R1	XXXXX
	R2	XXXXX
	R3	XXXXX
98	System results and inputs	
	R1	XXXXX
	R2	.XXXXX
	R3	XXXXX
99		
	R1 RMS in position	XXXXX ft
	R2 RMS in velocity	XXXX.X fps
	R3 RMS in bias	XXXXX mrad

G & C REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.8 STAR/PLANET LIST

Alphabetical

		Octal Code	Vis Mag	Right Ascension hr	min	sec	Declination deg	min	sec
Acamar	(θ Eridani)	6	3.4	2	57	09.5	-40	25	13
Achernar	(α Eridani)	4	0.6	1	36	38.0	-57	23	02
Acrux	(α Crucis)	25	1.6	12	24	58.2	-62	56	19
Aldebaran	(α Tauri)	11	1.0	4	34	15.2	+16	27	08
Alkaid	(η Ursae Majoris)	27	1.9	13	46	23.8	+49	27	27
Alphard	(α Hydrae)	21	2.2	9	26	09.6	-08	31	56
Alphecca	(α Coronae Borealis)	32	2.3	15	33	27.5	+26	48	40
Alpheratz	(α Andromedae)	1	2.1	0	06	53.0	+28	55	49
Altair	(α Aquilae)	40	0.9	19	49	22.0	+08	47	26
Antares	(α Scorpii)	33	1.2	16	27	37.5	-26	22	09
Arcturus	(α Bootis)	31	0.2	14	14	20.1	+19	19	57
Atria	(α Trianguli Australis)	34	1.9	16	45	34.6	-68	58	37
Canopus	(α Carinae)	14	-0.9	6	23	18.5	-52	40	46
Capella	(α Aurigae)	13	0.2	5	14	32.5	+45	58	13
Dabih	(β Capricorni)	41	3.2	20	19	22.8	-14	52	27
Deneb	(α Cygni)	43	1.3	20	40	26.5	+45	10	34
Denebola	(β Leonis)	23	2.2	11	47	34.8	+14	44	03
Diphda	(β Ceti)	2	2.2	0	42	08.0	-18	08	44
Dnoces	(ι Ursae Majoris)	20	3.1	8	57	13.7	+48	09	24
Enif	(ε Pegasi)	44	2.5	21	42	45.5	+09	44	29
Fomalhaut	(α Piscis Austrini)	45	1.3	22	56	03.0	-29	44	35
Gienah	(γ Corvi)	24	2.8	12	14	18.6	-17	22	52
Menkar	(α Ceti)	7	2.8	3	00	45.5	+03	58	37
Menkent	(θ Centauri)	30	2.3	14	04	58.0	-36	13	42
Mirfak	(α Persei)	10	1.9	3	22	14.5	+49	45	34
Navi	(γ Cassiopeiae)	3	2.2	0	54	56.5	+60	33	36
Nunki	(σ Sagittarii)	37	2.1	18	53	28.0	-26	20	04
Peacock	(α Pavonis)	42	2.1	20	23	21.6	-56	49	47
Polaris	(α Ursae Minoris)	5	2.1	2	3	58.3	+89	07	52
Procyon	(α Canis Minoris)	16	0.5	7	37	47.0	+05	18	01
Rasalhague	(α Ophiuchi)	35	2.1	17	33	35.1	+12	34	47
Regor	(γ Velorum)	17	1.9	8	08	38.2	-47	15	02
Regulus	(α Leonis)	22	1.3	10	06	49.6	+12	06	34
Rigel	(β Orionis)	12	0.3	5	13	08.5	-08	14	02
Sirius	(α Canis Majoris)	15	-1.6	6	43	52.2	-16	42	32
Spica	(α Virginis)	26	1.2	13	23	39.6	-11	00	38
Vega	(α Lyrae)	36	0.1	18	35	57.2	+38	45	20
Planet		00							
Sun		46							
Earth		47							
Moon		50							

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.8 STAR/PLANET LIST (cont)

Octal Code	Numerical		Vis Mag	Right Ascension hr	min	sec	Declination deg	min	sec
1	Alpheratz	(α Andromedae)	2.1	0	06	53.0	+28	55	49
2	Diphda	(β Ceti)	2.2	0	42	08.0	-18	08	44
3	Navi	(γ Cassiopeiae)	2.2	0	54	56.5	+60	33	36
4	Achernar	(α Eridani)	0.6	1	36	38.0	-57	23	02
5	Polaris	(α Ursae Minoris)	2.1	2	3	58.3	+89	07	52
6	Acamar	(θ Eridani)	3.4	2	57	09.5	-40	25	13
7	Menkar	(α Ceti)	2.8	3	00	45.5	+03	58	37
10	Mirfak	(α Persei)	1.9	3	22	14.5	+49	45	34
11	Aldebaran	(α Tauri)	1.1	4	34	15.2	+16	27	08
12	Rigel	(β Orionis)	0.3	5	13	08.5	-08	14	02
13	Capella	(α Aurigae)	0.2	5	14	32.5	+45	58	13
14	Canopus	(α Carinae)	-0.9	6	23	18.5	-52	40	46
15	Sirius	(α Canis Majoris)	-1.6	6	43	52.2	-16	40	32
16	Procyon	(α Canis Minoris)	0.5	7	37	47.0	+05	18	01
17	Regor	(γ Velorum)	1.9	8	08	38.2	-47	15	02
20	Dnoces	(ι Ursae Majoris)	3.1	8	57	13.7	+48	09	24
21	Alphard	(α Hydrae)	2.2	9	26	09.6	-08	31	56
22	Regulus	(α Leonis)	1.3	10	06	49.6	+12	06	34
23	Denebola	(β Leonis)	2.2	11	47	34.8	+14	44	03
24	Gienah	(γ Corvi)	2.8	12	14	18.6	-17	22	52
25	Acrux	(α Crucis)	1.0	12	24	58.2	-62	56	19
26	Spica	(α Virginis)	1.2	13	23	39.6	-11	00	38
27	Alkaid	(η Ursae Majoris)	1.9	13	46	23.8	+49	27	27
30	Menkent	(θ Centauri)	2.3	14	04	58.0	-36	13	42
31	Arcturus	(α Bootis)	0.2	14	14	20.1	+19	19	57
32	Alphecca	(α Coronae Borealis)	2.3	15	33	27.5	+26	48	40
33	Antares	(α Scorpii)	1.2	16	27	37.5	-26	22	09
34	Atria	(α Trianguli Australis)	1.9	16	45	34.6	-68	58	37
35	Rasalhague	(α Ophiuchi)	2.1	17	33	35.1	+12	34	47
36	Vega	(α Lyrae)	0.1	18	35	57.2	+38	45	20
37	Numki	(σ Sagittarii)	2.1	18	53	28.0	-26	20	04
40	Altair	(α Aquilae)	0.9	19	49	22.0	+08	47	26
41	Dabih	(β Capricorni)	3.2	20	19	22.8	-14	52	27
42	Peacock	(α Pavonis)	2.1	20	23	21.6	-56	49	47
43	Deneb	(α Cygni)	1.3	20	40	26.5	+45	10	34
44	Enif	(ε Pegasi)	2.5	21	42	45.5	+09	44	29
45	Fomalhaut	(α Piscis Austrini)	1.3	22	56	03.0	-29	46	35
46	Sun								
47	Earth								
50	Moon								
00	Planet								

G & C REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.9 CHECKLIST REFERENCE CODES (V50 N25) R1 Display 00013 Key in normal or gyro torque coarse align 00014 Key in fine alignment option 00015 Perform celestial body acquisition 00062 Switch LGC power down 00201 Switch RR mode to automatic (LGC) 00203 Switch to PGNCS automatic mode 00205 Perform manual acquisition of CSM with RR 00500 Switch LR antenna to position 1	"Switch" denotes position change of a panel switch. "Perform" denotes start or end of a task. "Key in" denotes data entry through DSKY. GUID CONT sw - PGNS; S/C: PGNS sw - AUTO; and ENG THR CONT: THR CONT sw - AUTO
		4.4.10 OPTION CODES (V04 N06, V04 N12, or V05 N06) R1 Display — R2 Load 00001 - Specify IMU orientation: 1 = Preferred; 2 = Nominal; 3 = REFSMMAT; 4 = Land site 00002 - Specify vehicle: 1 = LM; 2 = CSM 00003 - Specify tracking attitude: 1 = Preferred; 2 = Other 00004 - Specify radar: 1 = RR; 2 = LR 00006 - Specify RR coarse align option: 1 = Lock on; 2 = Continuous designation	Option code is displayed in R1 in conjunction with V04 N06, V04 N12, or V05 N06. Astronaut keys desired option into R2.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.10 OPTION CODES (V04 N06, V04 N12, or V05 N06) (cont)

R1 Display	R2 Load
00010 - Specify alignment mode	0 = Any time 1 = REFSMMAT and lunar-g determination 2 = 2 bodies (star/planet) 3 = 1 body and lunar-g determination
00012 - Specify CSM orbit option	1 = No orbit change 2 = Change orbit to pass over LM

4.4.11 ALARM CODES (V05 N09)

R1, R2, R3

		REMARKS
		Maximum of three alarm codes may be displayed simultaneously.
00107	More than five mark pairs in-flight; five marks on lunar surface	R1 is first alarm to occur after last reset, R2 is second alarm to occur after last reset, R3 is most recent alarm (not reset by RSET pb).
00111	Mark missing	
00112	Mark or mark reject not being accepted (V52, V53, V54 not flashing)	Alarms prefixed with 2 denote program goes into R00 (P00D0).
00113	No inbits	Alarms prefixed with 3 denote software restart is generated (Bailout).
00114	Mark made, but not desired	M indicates main alarm.
00115	No marks to reject	P indicates priority alarm.
00206	Zero encode not allowed with coarse-align + gimbal lock	
00207	ISS turn-on request not present for 90 sec	
00210	IMU not operating	
00211	Coarse align error	
00212	PIPA failed, but PIPA not in use	
00213	IMU not operating with turn-on request	
00214	Program using IMU when IMU turned off	
00217	Bad return from IMUSTALL	
00220	Bad REFSMMAT	
00401	Desired gimbal angles >X°	In-flight align, X = 60°; FINDCDUW, X = 70°.
00402	FINDCDUW routine not controlling attitude because of inadequate pointing vectors	

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.11 ALARM CODES (V05 N09) (cont)	
		R1, R2, R3	
		00404M Specified star not available in any detent	
		00405M Two stars not available	
		00421 W-matrix overflow	
		00501M,P Radar antenna out of limits	
		00502 Bad radar gimbal angle input	
		00503M,P Radar antenna designate fail	
		00510 Radar automatic discrete not present	
		00511 Neither or both LR antenna position discretes present for more than 10 sec (high gate, 20 sec)	
		00514M,P Radar goes out of automatic mode while in use	
		00515 RR CDU fail discrete present	
		00520 RADARUPT not expected at this time	Alarm 00520 may occur when V37E XXE is used during P20 or R04 (V77 or V63). To recover, key RSET and continue.
		00522 LR position change	
		00523 LR did not achieve position 2	Alarm occurs only with V59 in P00.
		00525M,P $\Delta\theta > 3°$	
		00526M,P Range >400 nm	
		00527 LOS not in mode-2 coverage on lunar surface or maneuver is required	
		00530P LOS not in mode 2 coverage on lunar surface after 600 sec	
		00600M Imaginary roots on first iteration	
		00601M Hp (CSI) <85 nm (earth orbit) or <35,000 ft (lunar orbit)	
		00602M Hp (CDH) <85 nm (earth orbit) or <35,000 ft (lunar orbit)	
		00603M CSI to CDH time <10 minutes	
		00604M CDH to TPI time <10 minutes or computed CDH time > input TPI time.	
		00605M Number of iterations exceeds loop maximum	
		00606M ΔV exceeds maximum	
		00611M No TIG for given elevation angle	
		00701M Illegal option code selected	
		00777 PIPA fail caused ISS warning	
		01102 LGC self-test error	
		01105 Downlink too fast	

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.11 ALARM CODES (V05 N09) (cont)	
		R1, R2, R3	
		01106 Uplink too fast	
		01107 Phase table failure. Assume erasable memory destroyed	
		01301 ARCSIN-ARCCOS input angle too large	
		01406 Bad return from ROOTPSRS	
		01407 VG increasing (ΔV accumulated at 90° from desired thrust vector)	
		01410 Unintentional overflow in guidance	
		01412 Descent ignition algorithm nonconverging	
		01466 <TOOFEW engine throttle commands computed since last omitted throttle computation.	
		01520 V37 request not permitted at this time	
		01600 Overflow in drift test	
		01601 Bad IMU torque	
		01703 Too close to ignition, slip TIG	
		01706M Incorrect program selected for vehicle configuration	
		02001 Jet failures disabled Y-Z translation	
		02002 Jet failures disabled X-translation	
		02003 Jet failures disabled P-rotations	
		02004 Jet failures disabled U-V rotations	
		03777 ICDU failure caused ISS warning	
		04777 ICDU, PIPA failure caused ISS warning	
		07777 IMU failure caused ISS warning	
		10777 IMU, PIPA failure caused ISS warning	
		13777 IMU, ICDU failure caused ISS warning	
		14777 IMU, ICDU, PIPA failure caused ISS warning	
		20105 AOT mark system in use	
		20430 Acceleration overflow in integration	
		20607 No solution from time - θ or time radius	
		21103 Unused CCS branch executed	
		21204 Waitlist, variable delay, fix delay, long call, or delay job called with zero or negative Δ time.	
		21302 SQRT called with negative argument	
		21406 Bad return from ROOTPSRS during ignition algorithm	
		21501 DSKY alarm during internal use	
		31104 Delay routine busy	
		31201 Executive overflow, no VAC areas	
		31202 Executive overflow, no core sets	

CREW-MAN	PNL	PROCEDURES	REMARKS
		4.4.11 ALARM CODES (V05 N09) (cont) 31203 Waitlist overflow, too many tasks 31206 Second job attempts to go to sleep via DSKY program. 31207 No VAC area for marks 31210 Two programs using device at same time 31211 Illegal interrupt of extended verb 31502 Illegal flashing display 32000 DAP still in progress at next T5RUPT	IMU mode switch
		4.4.12 AOT DETENT/LPD/COAS CODES (N70, N71) R1 LPD/COAS calibration 000DE Lf - Left front 001DE F - Front 002DE Rf - Right front 003DE Rr - Right rear 004DE CL - Close 005DE Lr - Left rear 006DE COAS 007DE Alternative LOS definition values N87 COAS (overhead window) R1 Azimuth 000.00° R2 Elevation 090.00° R3 ----- COAS (forward window) R1 Azimuth 000.00° R2 Elevation 000.00° R3 ----- LPD R1 Azimuth 000.00° R2 Elevation 320.00° R3 -----	Zero/zero values given are nominal. After realignment, using AOT, and possibly an alignment check, IMU Realign Program (P52) (para 4.9.1.2) can be used to calibrate COAS. (Calibration is valid until COAS is reinstalled.) Values given do not include ground test calibration values. After realignment, using AOT, and possibly an alignment check, IMU Realign Program (P52) (para 4.9.1.2) can be used to flight-calibrate LPD.

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4.4.13 FLAGWORDS

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Needle 2 flag	NEED2FLG	0074	0	15	Error needles are driven with LGC DAP computed body rates.	Error needles are driven with attitude errors.
J switch	JSWITCH	0074	0	14	Integration of W-matrix.	Integration of state vector.
MID flag	MIDFLAG	0074	0	13	Integration with secondary body & solar perturbations. (Should remain zero in luminary.)	Integration without solar perturbations.
Moon flag	MOONFLAG	0074	0	12	Moon is sphere of influence.	Earth is sphere of influence.
P21 flag	P21FLAG	0074	0	11	Use base vectors already calculated.	First pass, calculate base vectors.
First pass flag	FSPASFLG	0074	0	10	First pass	Succeeding pass
P25 flag	P25 FLAG	0074	0	9	P25 is operating (preferred tracking attitude)	P25 is not operating
IMUSE flag	IMUSE	0074	0	8	IMU is in use	IMU is not in use
Rendezvous flag	RNDVZFLG	0074	0	7	P20 or P22 is running (RR in use)	P20 or P22 is not running
Rendezvous radar NB switch	RRNBSW	0074	0	6	RR target is in navigation-base coordinates.	RR target is in stable-member coordinates.
Lock-on flag	LOKONSW	0074	0	5	Radar lock-on is desired	Radar lock-on is not desired
Needle flag	NEEDLFLG	0074	0	4	Total attitude error is displayed	DAP following error is displayed

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Free Flag	FREEFLAG	0074	0	3	Temporary flag used for utility purposes by P51 & P52 in many routines and by lunar and solar emphemerides.	Temporary flag used for utility purposes by P51 & P52 in many routines and by lunar and solar emphemerides.
R10 flag	R10FLAG	0074	0	2	R10 data output to ALT & ALT RATE ind only	R10 data output to ALT & ALT RATE ind and to forward & lateral velocity of X pointer ind
P66 PRO flag	P66PROFL	0074	0	1	P66 is entered for first time (in R13) as a directive to continue P66 horizontal nulling.	Proceed on flashing V06 N60 after touchdown (specifies stop to P66 horizontal nulling).
Number of jets flag	NJETSFLG	0075	1	15	Two-jet RCS burn	Four-jet RCS burn
DID flag	DIDFLAG	0075	1	14	Inertial data are available	Perform data display initialization functions
ERAD flag	ERADFLAG	0075	1	13	Compute earth radius for Fischer ellipsoid; use stored moon radius. (Never set in Luminary.)	Compute moon radius; use stored earth radius (pad radius) (latitude-longitude routines)
ROD flag	RODFLAG	0075	1	12	Rate-of-descent mode is in process; normal operation continues.	Rate-of-descent mode (P65) is not in process or, if in process, restart occurred.
No terrain flag	NOTERFLG	0075	1	11	Lunar terrain model computations inhibited.	Lunar terrain model computations permitted.
R61 flag	R61FLAG	0075	1	10	Run R61.	Run R65.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Vehicle update flag	VEHUPFLG	0075	1	8	CSM state vector being updated.	LM state vector being updated.
Update flag	UPDATFLG	0075	1	7	State vector updates from tracking allowed.	State vector updates from tracking not allowed.
No update flag	NOUPFLAG	0075	1	6	Neither CSM nor LM state vector may be updated.	Either CSM or LM state vector may be updated.
Track flag	TRACKFLG	0075	1	5	Tracking allowed.	Tracking not allowed.
Iterate	SLOPESW	0075	1	3	Iterate with bias method in iterator.	Iterate with regula falsi method in interator.
Iteration value	GUESSW	0075	1	2	No starting value for iteration.	Starting value for iteration exists.
Drift flag	DRIFTFLG	0076	2	15	T3RUPT calls gyro compensation.	T3RUPT does no gyro compensation.
Search flag	SRCHOPTN	0076	2	14	RR in automatic search option (R24).	RR not in automatic search option.
Acquisition mode flag	ACMODFLG	0076	2	13	Manual acquisition by RR.	Automatic acquisition by RR.
LOS compute flag	LOSCMFLG	0076	2	12	LOS is being computed.	LOS is not being computed.
Steering flag	STEERSW	0076	2	11	Powered flight steering is enabled (sufficient thrust is present).	Powered flight steering is off (insufficient thrust present).
Impulse flag	IMPULSW	0076	2	9	Minimum impulse burn (cutoff time specified.)	Steering burn (no cutoff) time available.)
External ΔV flag	XDELVFLG	0076	2	8	External ΔV VG computation.	Lambert (aimpoint) VG computation.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
E & TPI flag	ETPIFLAG	0076	2	7	Elevation angle supplied for P34 & P74.	TPI time supplied for P34 & P74 to compute elevation angle.
Final flag	FINALFLG	0076	2	6	Last pass through rendezvous program computations.	Interim pass through rendezvous program computations.
Active vehicle flag	AVFLAG	0076	2	5	LM is active vehicle.	CSM is active vehicle.
Preferred attitude flag	PFRATFLG	0076	2	4	Preferred attitude is computed.	Preferred attitude is not computed.
Calculate maneuver 3	CALCMAN3	0076	2	3	No final roll.	Final roll is necessary.
Calculate maneuver 2	CALCMAN2	0076	2	2	Perform maneuver starting procedure.	Bypass starting procedure.
Program select	NODOFLAG	0076	2	1	V37 is not permitted. (Do not allow major mode change.)	V37 is permitted. (Major mode change is enabled.)
P00 flag	POOHFLAG	0077	3	15	P00 integration 10-minute checks are running.	P00 integration 10-minute checks are disabled.
Gimbal lock fail	GLOKFAIL	0077	3	14	Gimbal lock has occurred.	Gimbal lock has not occurred.
REFSMMAT flag	REFSMFLG	0077	3	13	REFSMMAT valid (protected from fresh start).	Transformation matrix not valid.
Lunar flag	LUNAFLAG	0077	3	12	Lunar latitude & longitude.	Earth latitude & longitude.
NO DO P07 flag	NODOP07	0077	3	11	V37 logic	Manually, using flagword operator (N07)

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
View flag	VFLAG	0077	3	10	Star pair is not in field of view	Star pair is in field of view
R04 flag	R04FLAG	0077	3	9	R04 is running	R04 is not running
Precision integration flag	PRECIFLG	0077	3	8	Normal integration in P00.	Engage 4-time step (P00) logic in integration.
Occult flag	CULTFLAG	0077	3	7	Star is occulted.	Star is not occulted.
W-matrix orbital flag	ORBWFLAG	0077	3	6	W-matrix valid for orbital navigation. (Not used in Luminary.)	W-matrix invalid for orbital navigation. (Not used in Luminary.)
State vector flag	STATEFLG	0077	3	5	Permanent state vector updated.	Permanent state vector not updated.
Integration type flag	INTYPFLG	0077	3	4	Conic integration.	Encke integration.
State vector integration flag	VINTFLAG	0077	3	3	CSM state vector being integrated.	LM state vector being integrated.
W-dimension flag	D60R9FLG	0077	3	2	Dimension of W is 9 for integration.	Dimension of W is 6 for integration.
W-matrix use flag	DIMOFLAG	0077	3	1	W-matrix is to be used.	W-matrix is not to be used.
Mark display flag	MRKIDFLG	0100	4	15	Mark display in ENDIDLE.	No mark display in ENDIDLE.
Priority display flag	PRIODFLG	0100	4	14	Priority display in ENDIDLE.	No priority display in ENDIDLE.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Normal display flag	NRMIDFLG	0100	4	13	Normal display in ENDIDLE.	No normal display in ENDIDLE.
Priority display flag	PDSPFLAG	0100	4	12	P20 set so as to turn normal display into priority display in R60.	Leave as normal display.
Mark display wait flag	MWAITFLG	0100	4	11	Higher priority display operating when mark display initiated.	No higher priority display operating when mark display initiated.
Normal display wait flag	NWAITFLG	0100	4	10	Higher priority display operating when normal display initiated.	No higher priority display operating when normal display initiated.
Mark NV flag	MRKNVFLG	0100	4	9	Astronaut using DSKY when mark display initiated.	Astronaut not using DSKY when mark display initiated.
Normal NV flag	NRMNVFLG	0100	4	8	Astronaut using DSKY when normal display initiated.	Astronaut not using DSKY when normal display initiated.
Priority NV flag	PRONVFLG	0100	4	7	Astronaut using DSKY when priority display initiated.	Astronaut not using DSKY when priority display initiated.
Existing display interfered	PINBRFLG	0100	4	6	Astronaut has interfered with existing display.	Astronaut has not interfered with existing display.
Mark display interrupt flag	MRUPTFLG	0100	4	5	Mark display interrupted by priority display.	Mark display not interrupted by priority display.
Normal display interrupt flag	NRUPTFLG	0100	4	4	Normal display interrupted by priority or mark display.	Normal display not interrupted by priority or mark display.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Mark display over normal display	MKOVFLAG	0100	4	3	Mark display over normal.	Priority display over mark or normal.
Mark display flag	XDSPFLAG	0100	4	1	Mark display not to be interrupted.	Mark display may be interrupted.
DSKY flag	DSKYFLAG	0101	5	15	Displays sent to DSKY.	No displays sent to DSKY.
U&V jets	SNUFFER	0101	5	13	U&V jets disabled during DPS burns (V65).	U&V jets enabled during DPS burns (V75).
No throttle flag	NOTHROTL	0101	5	12	Inhibit full throttle.	Permit full throttle.
R77 flag	R77FLAG	0101	5	11	R77 is on. Suppress all radar alarms and tracker failures.	R77 is not on.
RR range scale flag	RNGSCFLG	0101	5	10	Scale change occurred during RR reading.	No scale change occurred during RR reading.
Dimension flag	DMENFLG	0101	5	9	Dimension of W is 9 for incorporation.	Dimension of W is 6 for incorporation.
Zoom flag	ZOOMFLAG	0101	5	8	Throttle up and start guidance.	Prepare for throttle up.
Engine on flag	ENGONFLG	0101	5	7	Engine is turned on.	Engine is turned off.
3-axis flag	3AXISFLG	0101	5	6	Maneuver specified by three axes.	Maneuver specified by one axis; R60 calls vector point.
Yaw axis flag	AORBSFLG	0101	5	5	P-axis couples B3A, A1F and A3R, B1L RCS jets.	P-axis couples A4R, B2L and B4F, A2A RCS jets.

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CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
RR gimbal monitor	NORRMON	0101	5	4	Bypass RR gimbal monitor.	Perform RR gimbal monitor.
Lambert switch	SOLNSW	0101	5	3	Lambert does not converge or time-radius nearly circular.	Lambert converges or time-radius noncircular.
Middle gimbal local vertical flag	MGLVFLAG	0101	5	2	Local vertical coordinates computed.	Middle gimbal angle computed.
REND W flag	RENDWFLG	0101	5	1	W-matrix valid for rendezvous navigation.	W-matrix invalid for rendezvous navigation.
ΔV at CSI	S32.1F1	0102	6	15	ΔV at CSI T1 exceeds maximum	ΔV at CSI T1 is less than maximum of Newton reiteration.
Newton pass	S32.1F2	0102	6	14	First pass of Newton iteration.	Reiteration.
Newton Iteration order	S32.1F3A S32.1F3B	0102	6	13 12	Bits 13 & 12 of flagword 6 function as ordered pair in following order:	

Bit 13	Bit 12	
0 (reset)	1 (set)	= First Newton iteration being done
0	0	= First pass of second Newton iteration
1	1	= 50-fps stage of second Newton iteration
1	0	= Remainder of second Newton iteration

CREW-MAN	PNL	PROCEDURES					REMARKS	
		4.4.13 FLAGWORDS (cont)						
		Flag	Name	Register Address	Flagword	Bit	Set	Reset
		Gimbal drive switch	GMBDRVSW	0102	6	10	Gimbal trim over.	Gimbal trim not over.
		MUN FLAG	MUNFLAG	0102	6	8	Servicer calls MUNRVG.	Servicer calls CALCRVG.
		Redesignation flag	REDFLAG	0102	6	6	Landing site redesignation permitted.	Landing site redesignation not permitted.
		ΔV overwrite at TPI or TPM	NTARGFLG	0102	6	3	Astronaut did overwrite ΔV at TPI or TPM (P34, P35, P74, P75).	Astronaut did not overwrite ΔV at TPI or TPM.
		AUX flag	AUXFLAG	0102	6	2	If IDLEFLAG is not set, servicer will exercise DVMON on next pass.	Servicer will skip DVMON on its next pass even if IDLEFLAG is not set. It will then set AUXFLAG.
		Attitude flag	ATTFLAG	0102	6	1	LM attitude exists in moon-fixed coordinates.	No LM attitude exists in moon-fixed coordinates.
		TPI time	ITSWICH	0103	7	15	TPI time to be computed (P34).	TPI time has been computed.
		Maneuver flag	MANUFLAG	0103	7	14	Attitude maneuver during RR search. (Not used in Luminary.)	No attitude maneuver during RR search. (Not used in Luminary.)
		Ignition flag	IGNFLAG	0103	7	13	TIG has arrived.	TIG has not arrived.

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CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Astronaut flag	ASTNFLAG	0103	7	12	Astronaut has OK'd ignition.	Astronaut has not OK'd ignition.
Analog displays	SWANDISP	0103	7	11	Landing analog displays enabled.	Landing analog displays suppressed.
Normal switch	NORMSW	0103	7	10	Unit normal input to Lambert.	Lambert computes its own unit normal.
Compute state vector	RVSW	0103	7	9	Do not compute final state vector in time θ	Compute final state vector in time θ
V67 flag	V67FLAG	0103	7	8	Astronaut overwrites W-matrix initial values.	Astronaut does not overwrite W-matrix initial values.
ΔV Monitor flag	IDLEFLAG	0103	7	7	No ΔV monitor.	Connect ΔV monitor.
V37 flag	V37FLAG	0103	7	6	Average g (servicer) running.	Average g (servicer) off.
Average g flag	AVEGFLAG	0103	7	5	Average g (servicer) desired.	Average g (servicer) not desired.
Uplink flag	UPLOCK FL	0103	7	4	$\overline{KK}$K fail	No $\overline{KK}$K fail
VERI FLAG	VERIFLAG	0103	7	3	Inverted by V33 at end of P27.	
Orbit parameter flag	V82EMFLG	0103	7	2	Moon vicinity	Earth vicinity
TFF switch	TFFSW	0103	7	1	Calculate T-perigee.	Calculate TFF.
RPQ flag	RPQFLAG	0104	8	15	RPQ not computed (RPQ = vector between secondary body and primary body)	RPQ computed

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Integration flag	NEWIFLG	0104	8	13	First pass through integration	Succeeding iteration of integration
CSM moon flag	CMOONFLG	0104	8	12	Permanent CSM state vector in lunar sphere (protected from fresh start)	Permanent CSM state vector in earth sphere (protected from fresh start)
LM moon flag	LMOONFLG	0104	8	11	Permanent LM state vector in lunar sphere (protected from fresh start)	Permanent LM state vector in earth sphere (protected from fresh start)
Guidance display flag	FLUNDISP	0104	8	10	Current guidance displays inhibited	Current guidance displays permitted
Surface flag	SURFFLAG	0104	8	8	LM on moon (protected from fresh start)	LM not on moon (protected from fresh start)
Infinity flag	INFINFLG	0104	8	7	No conic solution (closure through infinity required)	Conic solution exists
Order switch	ORDERSW	0104	8	6	Integrator uses second-order minimum mode (not set in Luminary)	Integrator uses first-order standard mode (not set in Luminary)
Apocenter-pericenter range select switch	APSESW	0104	8	5	Range desired outside pericenter-apocenter range in time-radius	Range desired inside pericenter-apocenter range in time-radius
COGA flag	COGAFLAG	0104	8	4	No conic solution; too close to rectilinear (COGA overflows)	Conic solution exists (COGA does not overflow)
Initial align flag	INITALGN	0104	8	2	Initial pass through P57	Second pass through P57
360° switch	360SW	0104	8	1	Transfer angle near 360°	Transfer angle not near 360°

CREW-MAN	PNL	PROCEDURES					REMARKS	
		4.4.13 FLAGWORDS (cont)						
		Flag	Name	Register Address	Flagword	Bit	Set	Reset
		Vertical rise flag	FLVR	0105	9	14	Vertical rise (ascent guidance)	Nonvertical rise (ascent guidance)
		P70/P71 flag	P7071FLG	0105	9	13	Near beginning of P70 or P71	Not near beginning of P70 or P71 (Pad loaded)
		Position control	FLPC	0105	9	12	No position control (ascent guidance)	Position control (ascent guidance)
		Preignition	FLPI	0105	9	11	Preignition phase (ascent guidance)	Regular guidance
		RCS	FLRCS	0105	9	10	RCS injection mode (ascent guidance)	Main engine mode
		Abort enable flag	LETABORT	0105	9	9	Abort programs enabled	Abort programs not enabled
		APS abort continuation flag	FLAP	0105	9	8	APS continues abort after DPS staging (ascent guidance).	APS abort is not continuation.
		Abort targeting flag	ABTTGFLG	0105	9	7	J2 and K2 parameters will be used during P70 and P71. (For H-2 type CSM DOI missions, J2 and K2 are used when rendezvous does not require an extra revolution.)	J1 and K1 parameters will be used during P70 and P71. (For H-2 type CSM DOI missions, J1 and K1 are used when rendezvous requires an extra revolution.)
		Rotation flag	ROTFLAG	0105	9	6	P70 & P71 will force rotation in preferred direction	P70 & P71 will not force rotation in preferred direction
		Quit flag	QUITFLAG	0105	9	5	Discontinue integration.	Continue integration.
		Integrate time flag	MID1FLAG	0105	9	3	Integrate to TDEC.	Integrate to the then present time.
		MID to AV integration	MIDAVFLG	0105	9	2	Integration entered from one of MID to AV portals.	Integration was not entered via MID to AV.

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORD (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
AVE to MID W-matrix integration	AVEMIDSW	0105	9	1	AVE to MID calling for W-matrix integration. Do not write over RN, VN, or PIPTIME.	No AVE to MID W-matrix integration. Allow setup of RN, VN, and PIPTIME.
Integration flag	INTFLAG	0106	10	14	Integration in process	Integration not in process
Ascent/ descent stage flag	APSFLAG	0106	10	13	Ascent stage (protected from fresh start)	Descent stage (protected from fresh start)
Restart integration flag	REINTFLG	0106	10	7	Integration routine to be restarted	Integration routine not to be restarted
LR bypass	LRBYPASS	0107	11	15	Bypass all LR updates	Do not bypass LR updates
Velocity fail test flag	VFAILFLG	0107	11	14	When corresponding radar reading has failed LR data reasonability test.	When corresponding radar reading has passed LR data reasonability test.
Altitude fail test flag	HFAILFLG	0107	11	13	When corresponding radar reading has failed LR data reasonability test.	When corresponding radar reading has passed LR data reasonability test.
VX inhibit flag	VXINH	0107	11	12	If Z-velocity data unreasonable, bypass X-velocity update on next pass.	Update X-axis velocity.
Past high gate	PSTHIGAT	0107	11	11	Past high gate	Pre high gate
No LR read	NOLRREAD	0107	11	10	LR repositioning; bypass update.	LR not repositioning
X-axis override inhibit flag	XORFLG	0107	11	9	Below limit; inhibit X-axis override.	Above limit; do not inhibit X-axis override.

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CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
LR permit flag	LRINH	0107	11	8	Permits LR data incorporation into state vector.	Inhibits LR data incorporation into state vector.
LR velocity data	VELDATA	0107	11	7	LR velocity measurement made	LR velocity measurement not made
LR altitude data	RNGEDATA	0107	11	4	LR altitude measurement made	LR altitude measurement not made
R12 read flag	R12RDFLG	0107	11	3	LR not being read. (Complete set of five velocity data readings for particular velocity beam are available.)	LR being read. (Complete set of five velocity data readings for particular velocity beam are not available.)
LR velocity fail lamp flash flag	VFLSHFLG	0107	11	2	LR velocity fail; VEL lt should be flashing	LR velocity has not failed; VEL lt should not flash
LR altitude fail lamp flash flag	HFLSHFLG	0107	11	1	LR altitude fail; ALT lt should be flashing	LR altitude has not failed; ALT lt should not flash
		RADMODES = Flagword 12				
Continuous designate flag	CDESFLAG	0110	12	15	LGC commands RR without lock-on	LGC checks for lock-on
Remode flag	REMODFLG	0110	12	14	Change in antenna mode was requested or is in process (remode)	Remode was not requested or is not in process.
RR CDU zero flag	RCDUOFLG	0110	12	13	RR CDU's are being zeroed.	RR CDU's are not being zeroed.
RR antenna mode flag	ANTENFLG	0110	12	12	RR antenna in mode 2	RR antenna in mode 1

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Reposition flag	REPOSMON	0110	12	11	RR reposition in process	No RR reposition in process
RR designate flag	DESIGFLG	0110	11	10	RR designate was requested or is in process	RR designate was not requested & is not in process
LR altitude scale	ALTSCALE	0110	12	9	LR altitude reading is on	LR altitude reading is on
LR velocity data fail flag	LRVELFLG	0110	12	8	LR velocity data fail	No LR velocity data fail
No RR CDU fail flag	RCDUFAIL	0110	12	7	No RR CDU fail	RR CDU fail
LR position flag	LRPOSFLG	0110	12	6	LR position 2 is desired	LR position 1 is desired
LR altitude data fail flag	LRALTFLG	0110	12	5	LR altitude data fail; cannot be read successfully	No LR altitude data fail
RR data fail flag	RRDATAFL	0110	12	4	RR data fail; cannot be read successfully	No RR data fail
RR range scale flag	RRRSFLAG	0110	12	3	RR range reading on high scale	RR range reading on low scale
RR automatic mode	AUTOMODE	0110	12	2	RR not in auto mode. Automatic mode discrete is not present.	RR in auto mode
RR turn-on flag	TURNONFL	0110	12	1	RR turn-on sequence in process.	No RR turn-on sequence in process.
			DAPBOOLS = Flagword 13			
Minimum impulse flag	PULSES	0111	13	15	Minimum impulse command mode in attitude hold (V76)	Not in minimum impulse command mode (V77)

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Gimbal flag	USEQRJTS	0111	13	14	Gimbal unusable; use RCS jets only.	Trim gimbal can be used
CSM docked flag	CSMDOCKD	0111	13	13	CSM docked to LM; use backup DAP.	CSM not docked to LM
Current rate command flag	OURRCBIT	0111	13	12	Current DAP pass is rate command.	Current DAP pass is not rate command.
4/2-jet X-axis translation flag	ACC4OR2X	0111	13	11	4-jet X-axis translation requested	2-jet X-axis translation requested
A/B system translation flag	AORBTRAN	0111	13	10	Use RCS system B for X-translation.	Use RCS system A for X-translation (preferred).
X-axis override flag	XOVINHIB	0111	13	9	X-axis override is locked out.	X-axis override is permitted.
Drift flight	DRIFTBIT	0111	13	8	Assume zero offset; drifting flight	Use offset acceleration estimate.
ACA scale flag	RHCSCALE	0111	13	7	Normal ACA scaling requested	Fine ACA scaling requested
Ullage flag	ULLAGER	0111	13	6	Ullage requested by program	No internal ullage request
Deadband select 2 flag	DBSLECT2	0111	13	5	Bits 5 and 4 of DAPBOOLS (flagword 13) are used together to indicate astronaut-selected deadband limits as follows:	
Deadband select flag	DBSELECT	0111	13	4		

Bit 5	Bit 4	DAP Deadband
0 (reset)	0 (reset)	± 0.3°
0	1	± 1.0°
1	0	± 5.0°
1	1	± 5.0°

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.13 FLAGWORDS (cont)

Flag	Name	Register Address	Flagword	Bit	Set	Reset
Accelerations OK flag	ACCSOKAY	0111	13	3	Computed accelerations are probably correct.	Computed accelerations are probably incorrect.
Automatic rate 2 flag	AUTRATE2	0111	13	2	Bits 2 & 1 of DAPBOOLS (flagword 13) are used together to indicate astronaut-selected KALCMANU maneuver rates, as follows:	
Automatic rate 1 flag	AUTRATE1	0111	13	1		

Bit 2	Bit 1	
0 (reset)	0 (reset)	= 0.2°/sec
0	1	= 0.5°/sec
1	0	= 2.0°/sec
1	1	= 10.0°/sec

4.4.14 AGS SELECTOR LOGIC

Address	Entry		
400	+00000	Attitude hold	Submodes of operation
400	+10000	Guidance steering	
400	+20000	Z-body-axis steering	
400	+30000	PGNCS-to-AGS align	Ref para 4.9.2.1
400	+40000	Lunar align	Ref para 4.9.3.2
400	+50000	Body-axis align	Ref para 4.9.2.2, 4.9.2.3
400	+60000	Gyro and accelerometer calibration	Ref para 4.6.2.5
400	+70000	Accelerometer only calibration	In-flight only. Ref para 4.6.2.13
407	+10000	Freeze external ΔV velocity-to-be-gained vector in inertial space	+00000 is selected when guidance routine (address 410) is switched out of external ΔV.
410	+00000	Orbit insertion	Guidance routines. Ref para 4.7.3.1
410	+10000	Coelliptic sequence initiation	Ref para 4.7.1.2
410	+20000	Constant Δh	Ref para 4.7.1.3
410	+30000	Terminal phase initiate search	Ref para 4.7.1.4
410	+40000	Terminal phase initiate execute	Ref para 4.7.1.4
410	+50000	External ΔV	Ref para 4.7.1.1
411	+00000	RCS or DPS selector	+00000 X-body-axis steering
411	+10000	APS selector	+10000 canted engine steering

CREW-MAN	PNL	PROCEDURES			REMARKS
		4.4.14 AGS SELECTOR LOGIC (cont)			
		Address	Entry		
		412	+00000	Reinitiate in-flight AGS self-test	Ref para 4.6.2.3. Self-test readouts: +00000 - Test not completed +10000 - Test successfully completed +30000 - Logic test failure +40000 - Memory test failure +70000 - Logic and memory test failure
		413	+10000	Any entry into 413 (+10000 is suggested) will store lunar azimuth and set lunar surface flag.	
		414	+00000	Navigation initialization complete	Readout only. A +00000 entry is treated as a +10000 entry.
		414	+10000	LM and CSM navigation initialization via PGNCS downlink	Ref para 4.6.1.18
		414	+20000	LM navigation initialization via DEDA	Ref para 4.6.2.7
		414	+30000	CSM navigation initialization via DEDA	Ref para 4.6.2.8
		415		Any entry in this cell causes Z-body axis direction cosines, time since last range input, and last computed range and range rate to be stored in appropriate cells for use in radar filter	A +10000 entry is suggested.
		416	+10000	Compute CSI maneuver with CDH maneuver occurring at 0.5 orbital period following CSI	
		416	+30000	Compute CSI maneuver with CDH maneuver occurring at 1.5 orbital periods following CSI	
		417	+00000	Normal value of radar initialization command	
		417	+10000	Initialize radar filter	Reset to +00000 after initialization.
		507	+00000	Orient Z-body-axis to direction of CSM (Z-body-axis steering commanded)	

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.14 AGS SELECTOR LOGIC (cont)

Address	Entry	
623	+00000	Orient Z-body-axis parallel to CSM orbit plane (guidance steering commanded)
623	+10000	Orient Z-body-axis parallel to plane defined by Wb vector (guidance steering commanded)

4.4.15 DEDA INPUT LIST

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
Sin δL	047	Octal		Sine of landing azimuth angle	1	1	1	1	1
Cosin δL	053	Octal		Cosine of landing azimuth angle	1	1	1	1	1
25J	223	100 ft	1000 ft	Manual altitude update to AEA during descent	1	1	1	1	1
7J	224	100 ft	1000 ft	Term in semi major axis computation, δL (OI)	1	1	1	1	1
8J	225	100 ft	1000 ft	One-half lower limit on apolune radius	1	1	1	1	1
10J	226	100 ft	1000 ft	Retarget value for 7J when central angle exceeds 12J (OI)	1	1	1	1	1
5J	231	100 ft	1000 ft	Radial distance of landing site from center of attracting body	1	1	1	1	1
16J	232	100 ft	1000 ft	Targeted injection altitude at orbit insertion	1	1	1	1	1
21J	233	100 ft	1000 ft	Vertical pitch steering altitude threshold	1	1	1	1	1
1J1	240	100 ft	1000 ft	X-component of LM position used in LM initialization	1	1	1	1	1
1J2	241	100 ft	1000 ft	Y-component of LM position used in LM initialization	1	1	1	1	1
1J3	242	100 ft	1000 ft	Z-component of LM position used in LM initialization	1	1	1	1	1
2J1	244	100 ft	1000 ft	X-component of CSM position used in CSM initialization	1	1	1	1	1
2J2	245	100 ft	1000 ft	Y-component of CSM position used in CSM initialization	1	1	1	1	1
2J3	246	100 ft	1000 ft	Z-component of CSM position used in CSM initialization	1	1	1	1	1

G & C REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.15 DEDA INPUT LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
1J7	254	0.1 min		Epoch time of LM ephemeris data used in LM navigation initialization. This time must be expressed in AGS computer time	1	1	1	1	1
1J4	260	0.1 fps	1 fps	X-component of LM velocity used in LM initialization	1	1	1	1	1
1J5	261	0.1 fps	1 fps	Y-component of LM velocity used in LM initialization	1	1	1	1	1
1J6	262	0.1 fps	1 fps	Z-component of LM velocity used in LM initialization	1	1	1	1	1
2J4	264	0.1 fps	1 fps	X-component of CSM velocity used in CSM initialization	1	1	1	1	1
2J5	265	0.1 fps	1 fps	Y-component of CSM velocity used in CSM initialization	1	1	1	1	1
2J6	266	0.1 fps	1 fps	Z-component of CSM velocity used in CSM initialization	1	1	1	1	1
2J7	272	0.1 min		Epoch time of CSM ephemeris data used in CSM navigation initialization. This time must be expressed in AGS computer time.	1	1	1	1	1
29J	274	0.1 min		Initial radar filter value for t1	1	1	1	1	1
1J	275	0.1 min		Desired TPI maneuver time for CSI computation	1	1	1	1	1
12J	305	0.01°		Phase angle limit for orbit insertion retargeting	1	1	1	1	1
4J	306	0.01 min		Time increment of node prior to nominal rendezvous	1	1	1	1	1
6J	307	0.01 min		Transfer time from beginning of direct transfer maneuver to rendezvous	1	1	1	1	1
TΔ	310	0.01 min		Time increment until TPI used in guidance TPI search routine	0	0	0	1	0
3J	312	0.01 min		TPI rendezvous offset time, as used in stable orbit rendezvous technique	1	1	1	1	1
18J	316	0.1 nm		Radar range	1	1	1	1	1
tig	373	0.1 min		Absolute time of next maneuver. Designations of tigA, tigB, and tigC (absolute times of CSI, CDH, and TPI maneuvers, respectively) are retained for procedural clarity.	1	1	1	1	1

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.15 DEDA INPUT LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
t	377	0.1 min		AGS computer time	1	1	1	1	1
Vdx	404	N/A		Accumulated ΔV in X-body-axis direction minus descent engine capability (updated every 0.040 sec)	1	1	1	1	1
28J1	450	0.1 fps	1 fps	Component of external ΔV input in direction parallel to CSM orbit plane. (Positive value indicates velocity to be added in posigrade direction.)	0	1	1	0	1
28J2	451	0.1 fps	1 fps	Component of external ΔV input in direction perpendicular to CSM orbit plane (positive value indicates velocity to be added opposite to LM angular momentum vector)	0	1	1	0	1
28J3	452	0.1 fps	1 fps	Component of external ΔV input in radial direction (positive value indicates velocity to be added toward attracting body)	0	1	1	0	1
22J	464	0.1 fps	1 fps	Vertical pitch steering altitude rate threshold	1	1	1	1	1
23J	465	0.1 fps	1 fps	Target radial rate at orbit insertion	1	1	1	1	1
17J	503	0.1 fps	1 fps	Radar range rate	1	1	1	1	1
Wbx	514	Octal		Guidance steering unit vector (X)	1	1	1	1	1
Wby	515	Octal		Guidance steering unit vector (Y)	1	1	1	1	1
Wbz	516	Octal		Guidance steering unit vector (Z)	1	1	1	1	1
1K18	534	Octal		X-accelerometer scale factor	1	1	1	1	1
1K20	535	Octal		Y-accelerometer scale factor	1	1	1	1	1
1K22	536	Octal		Z-accelerometer scale factor	1	1	1	1	1
1K19	540	0.001/0.01 fps sq		X-axis accelerometer bias compensation	1	1	1	1	1
1K21	541	0.001/0.01 fps sq		Y-axis accelerometer bias compensation	1	1	1	1	1
1K23	542	0.001/0.01 fps sq		Z-axis accelerometer bias compensation	1	1	1	1	1
1K1	544	0.01°/hr		X-gyro drift compensation constant	1	1	1	1	1
1K6	545	0.01°/hr		Y-gyro drift compensation constant	1	1	1	1	1
1K11	546	0.01°/hr		Z-gyro drift compensation constant	1	1	1	1	1
Δδ	547	Octal		Lunar align azimuth correction	1	1	1	1	1
2J	605	Octal		Desired cotangent of LOS angle between LM and CSM at desired TPI time used in CSI computation	1	1	1	1	1

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CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.15 DEDA INPUT LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
K55	607	Octal		h rate display scale factor	1	1	1	1	1
3K4	613	Octal		Sine of TPI interdict region	1	1	1	1	1
6J1	640	Octal		Negative of X inertial component of lunar rotation rate vector	1	1	1	1	1
6J2	641	Octal		Negative of Y inertial component of lunar rotation rate vector	1	1	1	1	1
6J3	642	Octal		Negative of Z inertial component of lunar rotation rate vector	1	1	1	1	1
4K10	662	Octal		Constant in linear expression for α_L (OI)	1	1	1	1	1
11J	673	Octal		Retarget values for 4K10 when central angle exceeds 12J (OI)	1	1	1	1	1

4.4.16 DEDA OUTPUT LIST

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
y	211	100 ft	1000 ft	Present LM out-of-plane distance	1	1	1	1	1
Vpy	263	0.1 fps	1 fps	Predicted out-of-plane velocity at tig in CSI, CDH, or TPI; present LM out-of plane velocity in OI	1	1	1	1	1
ΔVG	267	0.1 fps	1 fps	Magnitude of LM velocity to be gained	1	1	0	1	1
Vyo	270	0.1 fps	1 fps	Present LM out-of-plane velocity	1	1	1	1	1
1J	275	0.1 min		Nominal time of TPI maneuver	1	1	1	1	1
ξ	277	0.01°		In-plane angle between Z-body-axis and local horizontal	1	1	1	1	1
θ LOS	303	0.01°		Predicted LOS angle at TPI	0	0	0	1	0
θ f	303	0.01°		LM to CSM phase angle: valid for tig of CSI or CDH, present time in OI	1	1	1	0	0
4J	306	0.01 min		Time of node prior to nominal rendezvous time	0	0	0	1	0
6J	307	0.01 min		Time from TPI to rendezvous	1	1	1	1	1
TΔ	310	0.01 min		Time from present to CSI, CDH, or TPI maneuver	0	1	1	1	0
Tr	311	0.01 min		Time to go until rendezvous in TPI	0	0	0	1	0

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.16 DEDA OUTPUT LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
3J	312	0.01 min		TPI rendezvous offset time	0	0	0	1	0
T perg	313	0.01 min		Time to go until LM orbit perifocus	1	1	1	1	1
δr	314	0.1 nm		Differential orbital altitude along LM radial at CSI time	0	1	1	0	0
qa	315	0.1 nm		Apofocus altitude of LM trajectory	1	1	1	1	1
R	317	0.1 nm		Range from LM to CSM	1	1	1	1	1
h	337	0.1 nm		LM altitude	1	1	1	1	1
rx	340	100 ft	1000 ft	X-component of LM position	1	1	1	1	1
ry	341	100 ft	1000 ft	Y-component of LM position	1	1	1	1	1
rz	342	100 ft	1000 ft	Z-component of LM position	1	1	1	1	1
rcx	344	100 ft	1000 ft	X-component of CSM position	1	1	1	1	1
rcy	345	100 ft	1000 ft	Y-component of CSM position	1	1	1	1	1
rcz	346	100 ft	1000 ft	Z-component of CSM position	1	1	1	1	1
rf	347	100 ft	1000 ft	Predicted LM orbit radial distance at tig (at burnout in OI)	1	1	1	1	0
Vx	360	0.1 fps	1 fps	X-component of LM velocity	1	1	1	1	1
Vy	361	0.1 fps	1 fps	Y-component of LM velocity	1	1	1	1	1
Vz	362	0.1 fps	1 fps	Z-component of LM velocity	1	1	1	1	1
Vcx	364	0.1 fps	1 fps	X-component of CSM velocity	1	1	1	1	1
Vcy	365	0.1 fps	1 fps	Y-component of CSM velocity	1	1	1	1	1
Vcz	366	0.1 fps	1 fps	Z-component of CSM velocity	1	1	1	1	1
ṙ	367	0.1 fps	1 fps	LM altitude rate	1	1	1	1	1
VT	371	0.1 fps	1 fps	Total velocity to rendezvous	0	0	0	1	0
VpO	371	0.1 fps	1 fps	ΔV for CDH maneuver	0	1	0	0	0
TAO	372	0.1 min		Time from CSI to CDH	0	1	0	0	0
tig	373	0.1 min		Absolute time of next maneuver. Designations tigA, tigB, and tigC (absolute times of CSI, CDH, and TPI maneuvers, respectively) are retained for procedural clarity.	1	1	1	1	1
t	377	0.1 min		AGS computer time	1	1	1	1	1
Δr	402	0.1 nm		Differential altitude in coelliptic orbit	0	1	1	0	0
q1D	402	0.1 nm		Perifocus altitude of predicted LM trajectory	0	0	0	1	0
qLT	403	0.1 nm		Perifocus altitude of LM trajectory	1	1	1	1	1
ṙf	423	0.1 fps	1 fps	Desired final value of altitude rate	1	1	1	1	0

G.E.C. REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.16 DEDA OUTPUT LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
V	433	0.1 fps	1 fps	Magnitude of LM velocity	1	1	1	1	1
Ṙ	440	0.1 fps	1 fps	Range rate between LM and CSM (negative value indicates LM closing on CSM)	1	1	1	1	1
VDX	470	0.1 fps	1 fps	ΔV expended in X-body-axis direction minus descent capability	1	1	1	1	1
VDY	471	0.1 fps	1 fps	ΔV expended in Y-body-axis direction	1	1	1	1	1
VDZ	472	0.1 fps	1 fps	ΔV expended in Z-body-axis direction	1	1	1	1	1
ṙA	477	0.1 fps	1 fps	Radial velocity at tig (at present in OI)	1	1	1	1	0
ΔVgx	500	0.1 fps	1 fps	Velocity to be gained in X-body-axis direction	1	1	1	1	1
ΔVgy	501	0.1 fps	1 fps	Velocity to be gained in Y-body-axis direction	1	1	1	1	1
ΔVgz	502	0.1 fps	1 fps	Velocity to be gained in Z-body-axis direction	1	1	1	1	1
1K18	534	Octal		X-accelerometer scale factor (fps/pulse)	1	1	1	1	1
1K20	535	Octal		Y-accelerometer scale factor (fps/pulse)	1	1	1	1	1
1K22	536	Octal		Z-accelerometer scale factor (fps/pulse)	1	1	1	1	1
1K19	540	0.001 fps sq 0.01 fps sq		X-accelerometer bias compensation	1	1	1	1	1
1K21	541	0.001 fps sq 0.01 fps sq		Y-accelerometer bias compensation	1	1	1	1	1
1K23	542	0.001 fps sq 0.01 fps sq		Z-accelerometer bias compensation	1	1	1	1	1
1K1	544	0.01°/hr		X-gyro drift compensation	1	1	1	1	1
1K6	545	0.01°/hr		Y-gyro drift compensation	1	1	1	1	1
1K11	546	0.01°/hr		Z-gyro drift compensation	1	1	1	1	1
52	574	N/A		Descent section staging flag	1	1	1	1	1
δ21	604	N/A		Lunar surface flag	1	1	1	1	1
μ6	612	Octal		Staging sequence counter	1	1	1	1	1
μ8	614	1 count		Ullage counter	1	1	1	1	1
1K9	616	1 count		Ullage counter value for ullage completion	1	1	1	1	1

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
C2	033		Octal	Rendezvous angle sine	0	0	0	1	0
V1X	034		Octal	In-plane horizontal unit vector at tig for CSI, CDH, and TPI; at present for OI & XDV (X)					
V1Y	035		Octal	In-plane horizontal unit vector at tig for CSI, CDH, and TPI; at present for OI & XDV (Y)	1	1	1	1	1
V1Z	036		Octal	In-plane horizontal unit vector at tig for CSI, CDH, and TPI; at present for OI & XDV (Z)	1	1	1	1	1
W1X	040		Octal	LM out-of-plane unit vector at tig for TPI; present for OI, CSI, CDH, & XDV (X)	1	1	1	1	1
W1Y	041		Octal	LM out-of-plane unit vector at tig for TPI; present for OI, CSI, CDH, & XDV (Y)	1	1	1	1	1
W1Z	042		Octal	LM out-of-plane unit vector at tig for TPI; present for OI, CSI, CDH, & XDV (Z)	1	1	1	1	1
A31S	044		Octal	Radar null direction cosine	1	1	1	1	1
A32S	045		Octal	Radar null direction cosine	1	1	1	1	1
A33S	046		Octal	Radar null direction cosine	1	1	1	1	1
Sin δL	047		Octal	Sine of azimuth angle	1	1	1	1	1
Cosin δL	053		Octal	Cosine of azimuth angle	1	1	1	1	1
Wcx	054		Octal	Out-of-CSM orbit plane unit vector (X)	1	1	1	1	1
Wcy	055		Octal	Out-of-CSM orbit plane unit vector (Y)	1	1	1	1	1
Wcz	056		Octal	Out-of-CSM orbit plane unit vector (Z)	1	1	1	1	1
U1X	060		Octal	Normal LM position vector at tig for CSI, CDH & TPI, present for OI & XDV (X)	1	1	1	1	1
U1Y	061		Octal	Normal LM position vector at tig for CSI, CDH, & TPI; present for OI & XDV (Y)	1	1	1	1	1
U1Z	062		Octal	Normal LM position vector at tig for CSI, CDH, & TPI; present for OI & XDV (Z)	1	1	1	1	1
AT	067		Octal	Thrust acceleration (fps sq)	1	1	1	1	1
Drx	104		Octal	LM position remainder (ft) (X)	1	1	1	1	1

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST (cont)

Symbol	Address	Quantization Lunar	Quantization Earth		0 = not available 1 = available OI	CSI	CDH	TPI	XDV
Dry	105		Octal	LM position remainder (ft) (Y)	1	1	1	1	1
Drz	106		Octal	LM position remainder (ft) (Z)	1	1	1	1	1
θP	107		Octal	PGNCS θ (pulses)	1	1	1	1	1
DIGX	110		Octal	Predicted change in integrated gravity (fps) (X)	1	1	1	1	1
DIGY	111		Octal	Predicted change in integrated gravity (fps) (Y)	1	1	1	1	1
DIGZ	112		Octal	Predicted change in integrated gravity (fps) (Z)	1	1	1	1	1
ψP	113		Octal	PGNCS ψ (pulses)	1	1	1	1	1
GXDT	114		Octal	Gravity times major cycle time (fps) (X)	1	1	1	1	1
GYDT	115		Octal	Gravity times major cycle time (fps) (Y)	1	1	1	1	1
GZDT	116		Octal	Gravity times major cycle time (fps) (Z)	1	1	1	1	1
ØP	117		Octal	PGNCS Ø (pulses)	1	1	1	1	1
Δvsx	120		Octal	Resolved sensed ΔV along inertial axis (fps) (X)	1	1	1	1	1
Δvsy	121		Octal	Resolved sensed ΔV along inertial axis (fps) (Y)	1	1	1	1	1
Δvsz	122		Octal	Resolved sensed ΔV along inertial axis (fps) (Z)	1	1	1	1	1
SIGA	123		Octal	Sine of FDAI γ	1	1	1	1	1
RRX	124		Octal	Computed LM-CSM range (ft) (X)	1	1	1	1	1
RRY	125		Octal	Computed LM-CSM range (ft) (Y)	1	1	1	1	1
RRZ	126		Octal	Computed LM-CSM range (ft) (Z)	1	1	1	1	1
COGA	127		Octal	Cosine of FDAI γ	1	1	1	1	1
A11	130		Octal	XB direction cosine	1	1	1	1	1
A12	131		Octal	XB direction cosine	1	1	1	1	1
A13	132		Octal	XB direction cosine	1	1	1	1	1
A31	134		Octal	ZB direction cosine	1	1	1	1	1
A32	135		Octal	ZB direction cosine	1	1	1	1	1
A33	136		Octal	ZB direction cosine	1	1	1	1	1
A21	140		Octal	YB direction cosine	1	1	1	1	1
A22	141		Octal	YB direction cosine	1	1	1	1	1
A23	142		Octal	YB direction cosine	1	1	1	1	1
T1	147		Octal	Time of last radar range update (sec)	1	1	1	1	1

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
A11D	160	Octal		XD direction cosine	1	1	1	1	1
A12D	161	Octal		XD direction cosine	1	1	1	1	1
A13D	162	Octal		XD direction cosine	1	1	1	1	1
A31D	164	Octal		ZD direction cosine	1	1	1	1	1
A32D	165	Octal		ZD direction cosine	1	1	1	1	1
A33D	166	Octal		ZD direction cosine	1	1	1	1	1
μ17	167	Octal		Filter cycle counter (2 sec counts)	1	1	1	1	1
α	171	Octal		Transfer orbit semimajor axis (ft)	0	0	0	1	0
R5X	174	100 ft	1000 ft	LM predicted position vector at CSI, CDH, or TPI burn time; present R in OI (X)	1	1	1	1	0
R5Y	175	100 ft	1000 ft	LM predicted position vector at CSI, CDH, or TPI burn time; present R in OI (Y)	1	1	1	1	0
R5Z	176	100 ft	1000 ft	LM predicted position vector at CSI, CDH, or TPI burn time; present R in OI (Z)	1	1	1	1	0
AL	177	100 ft	1000 ft	Predicted LM semimajor axis	1	1	1	0	0
REX	200	100 ft	1000 ft	CSM epoch position vector (X)	1	1	1	1	1
REY	201	100 ft	1000 ft	CSM epoch position vector (Y)	1	1	1	1	1
REZ	202	100 ft	1000 ft	CSM epoch position vector (Z)	1	1	1	1	1
RT	203	100 ft	1000 ft	Predicted CSM position magnitude	1	1	1	1	1
ROX	204	100 ft	1000 ft	Position vector input to orbit parameter subroutine (X)	1	1	1	1	1
ROY	205	100 ft	1000 ft	Position vector input to orbit parameter subroutine (Y)	1	1	1	1	1
ROZ	206	100 ft	1000 ft	Position vector input to orbit parameter subroutine (Z)	1	1	1	1	1
RO	207	100 ft	1000 ft	Predicted position magnitude	1	1	1	1	1
R	210	100 ft	1000 ft	LM present inertial position magnitude	1	1	1	1	1
Y	211	100 ft	1000 ft	LM out-of-plane position	1	1	1	1	1
POUTFS	213	100 ft	1000 ft	Maximum p displayable	1	1	1	1	1
2K3	216	100 ft	1000 ft	QL set on overflow	1	1	1	1	1
2K14	217	100 ft	1000 ft	Initial p perturbation	1	1	1	1	1
25J	223	100 ft	1000 ft	Entry for altitude update	1	1	1	1	1
7J	224	100 ft	1000 ft	Term in (OI) semimajor axis computation	1	1	1	1	1
8J	225	100 ft	1000 ft	One-half lower limit of apolune radius	1	1	1	1	1

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST (cont)

Symbol	Address	Quantization Lunar	Quantization Earth		0 = not available 1 = available OI	CSI	CDH	TPI	XDV
10J	226	100 ft	1000 ft	Retarget value for 7J	1	1	1	1	1
4K5	227	100 ft	1000 ft	Constant in linear expression for rf	1	1	1	1	1
2K19	230	100 ft	1000 ft	Δp limiter	1	1	1	1	1
5J	231	100 ft	1000 ft	Nominal lunar landing site radius	1	1	1	1	1
16J	232	100 ft	1000 ft	Targeted orbit insertion altitude	1	1	1	1	1
21J	233	100 ft	1000 ft	Vertical pitch steering altitude threshold	1	1	1	1	1
1J1	240	100 ft	1000 ft	LM ephemeris position (X-component)	1	1	1	1	1
1J1	241	100 ft	1000 ft	LM ephemeris position (Y-component)	1	1	1	1	1
1J3	242	100 ft	1000 ft	LM ephemeris position (Z-component)	1	1	1	1	1
2J1	244	100 ft	1000 ft	CSM ephemeris position (X-component)	1	1	1	1	1
2J2	245	100 ft	1000 ft	CSM ephemeris position (Y-component)	1	1	1	1	1
2J3	246	100 ft	1000 ft	CSM ephemeris position (Z-component)	1	1	1	1	1
1J7	254	0.1 min		LM epoch time	1	1	1	1	1
1J4	260	0.1 fps	1 fps	X-component of LM velocity used in LM initialization	1	1	1	1	1
1J5	261	0.1 fps	1 fps	Y-component of LM velocity used in LM initialization	1	1	1	1	1
1J6	262	0.1 fps	1 fps	Z-component of LM velocity used in LM initialization	1	1	1	1	1
Vpy	263	0.1 fps	1 fps	Out-of-plane velocity at tig; at present in OI	1	1	1	1	0
2J4	264	0.1 fps	1 fps	X-component of CSM velocity used in CSM initialization	1	1	1	1	1
2J5	265	0.1 fps	1 fps	Y-component of CSM velocity used in CSM initialization	1	1	1	1	1
2J6	266	0.1 fps	1 fps	Z-component of CSM velocity used in CSM initialization	1	1	1	1	1
ΔVG	267	0.1 fps	1 fps	Velocity to be gained	1	1	1	1	1
Vyo	270	0.1 fps	1 fps	LM present out-of-plane velocity	1	1	1	1	1
2J7	272	0.1 min		CSM epoch time	1	1	1	1	1
29J	274	0.1 min		Initial value of T1 for radar filter	1	1	1	1	1
1J	275	0.1 min		Desired time of TPI maneuver for CSI	1	1	1	1	1
ΔT	276	0.1 min		Time between radar range updates	1	1	1	1	1
ξ	277	0.01°		Angle between Z-body-axis and local horizon	1	1	1	1	1
θLOS	303	0.01°		Predicted LOS angle at TPI time (TPI only)	0	0	0	1	0

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
θ	303	0.01°		LM-CSM phase angle: valid for tig of CSI or CDH, present time for OI	0	1	1	0	0
12J	305	0.01°		Phase angle limit for orbit insertion retargeting	1	1	1	1	1
4J	306	0.01 mi		Time of node prior to rendezvous	0	0	0	1	0
6J	307	0.01 min		Desired transfer time	1	1	1	1	1
TΔ	310	0.01 min		Time from present to CSI, CDH, or TPI	0	1	1	1	0
Tr	311	0.01 min		Time from present to rendezvous	0	0	0	1	0
3J	312	0.01 min		Target offset time	1	1	1	1	1
Tperg	313	0.01 min		Computed time to LM perifocus	1	1	1	1	1
Δrp	314	0.1 nm		LM-CSM differential altitude at tig	0	1	1	0	0
qa	315	0.1 nm		Apofocus altitude of LM trajectory	1	1	1	1	1
18J	316	0.1 nm		Radar range	1	1	1	1	1
R	317	0.1 nm		Computed range	1	1	1	1	1
h	337	0.1 nm		LM altitude	1	1	1	1	1
rx	340	100 ft	1000 ft	X-component of LM position	1	1	1	1	1
ry	341	100 ft	1000 ft	Y-component of LM position	1	1	1	1	1
rz	342	100 ft	1000 ft	Z-component of LM position	1	1	1	1	1
rcx	344	100 ft	1000 ft	X-component of CSM position	1	1	1	1	1
rcy	345	100 ft	1000 ft	Y-component of CSM position	1	1	1	1	1
rcz	346	100 ft	1000 ft	Z-component of CSM position	1	1	1	1	1
rf	347	100 ft	1000 ft	Predicted LM altitude at tig (at burnout in OI)	1	1	1	1	0
Vx	360	0.1 fps	1 fps	X-component of present LM inertial velocity	1	1	1	1	1
Vy	361	0.1 fps	1 fps	Y-component of present LM inertial velocity	1	1	1	1	1
Vz	362	0.1 fps	1 fps	Z-component of present LM inertial velocity	1	1	1	1	1
Vcx	364	0.1 fps	1 fps	X-component of present CSM inertial velocity	1	1	1	1	1
Vcy	365	0.1 fps	1 fps	Y-component of present CSM inertial velocity	1	1	1	1	1
Vcz	366	0.1 fps	1 fps	Z-component of present CSM inertial velocity	1	1	1	1	1
$\dot{h}$	367	0.1 fps	1 fps	LM altitude rate	1	1	1	1	1
VG	370	0.1 fps	1 fps	Magnitude of velocity to be gained	1	1	1	1	1
VT	371	0.1 fps	1 fps	Total velocity to rendezvous (direct intercept only)	0	0	0	1	0

G & C REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
Vpo	371	0.1 fps	1 fps	Predicted ΔV for CDH maneuver	0	1	0	0	0
TAO	372	0.1 min		Time from CSI to CDH	0	1	0	0	0
tig	373	0.1 min		Absolute time of next maneuver	1	1	1	1	1
TA1	377	0.1 min		AGS absolute time	1	1	1	1	1
SO	400	Octal		AGS function selector	1	1	1	1	1
DISC1C	401	Octal		Discrete word one	1	1	1	1	1
ΔH	402	0.1 nm		LM-CSM differential altitude after CDH	0	1	1	0	0
q1DEDA	402	0.1 nm		LM transfer orbit pericythion altitude	0	0	0	1	0
qLTELE	403	0.1 nm		LM present pericythion altitude	1	1	1	1	1
S7	407	Octal		Reference frame selector for ex-	0	0	0	0	1
S10	410	Octal		Guidance mode selector	1	1	1	1	1
S11	411	Octal		Cant angle correction selector	1	1	1	1	1
S12	412	Octal		In-flight self-test status indicator	1	1	1	1	1
S13	413	Octal		Store/no-store lunar azimuth selector	1	1	1	1	1
S14	414	Octal		Navigation initialization	1	1	1	1	1
S15	415	Octal		Radar gimbal null	1	1	1	1	1
S16	416	Octal		Number of LM half-orbits from CSI to CDH	1	1	1	1	1
S17	417	Octal		Radar filter initialization	1	1	1	1	1
Vex	420	0.1 fps	1 fps	CSM epoch velocity vector (X)	1	1	1	1	1
Vey	421	0.1 fps	1 fps	CSM epoch velocity vector (Y)	1	1	1	1	1
Vez	422	0.1 fps	1 fps	CSM epoch velocity vector (Z)	1	1	1	1	1
ẖf	423	0.1 fps	1 fps	Desired altitude rate	1	1	1	1	0
Vox	424	0.1 fps	1 fps	Velocity vector input to orbit parameter subroutine (X)	1	1	1	1	1
Voy	425	0.1 fps	1 fps	Velocity vector input to orbit parameter subroutine (Y)	1	1	1	1	1
Voz	426	0.1 fps	1 fps	Velocity vector input to orbit parameter subroutine (Z)	1	1	1	1	1
VH	427	0.1 fps	1 fps	Present LM horizontal velocity	1	1		1	1
V	433	0.1 fps	1 fps	Present LM velocity	1	1	1	1	1
ṘR	440	0.1 fps	1 fps	Estimated range rate between LM and CSM (negative value indicates LM closing on CSM)	1	1	1	1	1
Ṙ	441	0.1 fps	1 fps	Range rate at time of radar update	1	1	1	1	1
28J1	450	0.1 fps	1 fps	ΔV downrange (XDV input)	0	1	1	0	1
28J2	451	0.1 fps	1 fps	ΔV crossrange (XDV input)	0	1	1	0	1

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
28J3	452	0.1 fps	1 fps	ΔV radial (XDV input)	0	1	1	0	1
4K26	454	0.1 fps	1 fps	VG threshold	1	1	1	1	1
Vha	463	0.1 fps	1 fps	Horizontal velocity at tig; present horizontal velocity in OI	1	1	1	1	0
22J	464	0.1 fps	1 fps	Vertical pitch steering altitude rate threshold	1	1	1	1	1
23J	465	0.1 fps	1 fps	Target radial rate at orbit insertion	1	1	1	1	1
5K26	466	0.1 fps	1 fps	Threshold for freezing thrust direction	1	1	1	1	1
VDX	470	0.1 fps	1 fps	ΔV expended in X-body-axis direction minus descent capability	1	1	1	1	1
VDY	471	0.1 fps	1 fps	ΔV expended in Y-body-axis direction	1	1	1	1	1
VDZ	472	0.1 fps	1 fps	ΔV expended in Z-body-axis direction	1	1	1	1	1
4K27	473	0.1 fps	1 fps	Descent stage ΔV capability	1	1	1	1	1
VSmgx	474	0.1 fps	1 fps	X-component of velocity to be gained during burn	1	1	1	1	1
VSmgy	475	0.1 fps	1 fps	Y-component of velocity to be gained during burn	1	1	1	1	1
VSmgz	476	0.1 fps	1 fps	Z-component of velocity to be gained during burn	1	1	1	1	1
$\dot{r}a$	477	0.1 fps	1 fps	Radial velocity at tig (at present in OI	1	1	1	1	0
ΔVgx	500	0.1 fps	1 fps	Velocity to be gained in X-body-axis direction	1	1	1	1	1
ΔVgy	501	0.1 fps	1 fps	Velocity to be gained in Y-body-axis direction	1	1	1	1	1
ΔVgz	502	0.1 fps	1 fps	Velocity to be gained in Z-body-axis direction	1	1	1	1	1
17J	503	0.1 fps	1 fps	Radar range rate	1	1	1	1	1
$\dot{R}\dot{D}$	504	Octal		Desired radial jerk (fps cubed)	1	0	0	0	0
$\dot{Y}\dot{D}$	505	Octal		Desired out-of-plane jerk (fps cubed)	1	0	0	0	0
4K12	506	Octal		Acceleration check for RD3DTL in OI	1	1	1	1	1
S507	507	Octal		Orient Z-body-axis to thrust axis	1	1	1	1	1
C1	513	Octal		Rendezvous angle cosine	0	0	0	1	0
Wbx	514	Octal		Guidance steering unit vector (X)	1	1	1	1	1
Wby	515	Octal		Guidance steering unit vector (Y)	1	1	1	1	1
Wbz	516	Octal		Guidance steering unit vector (Z)	1	1	1	1	1
6K10	517	Octal		Radar filter range variance (ft sq)	1	1	1	1	1

G&C REF DATA

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST (cont)

0 = not available
1 = available

Symbol	Address	Quantization Lunar	Quantization Earth		OI	CSI	CDH	TPI	XDV
TE1	520	Octal		CSM epoch MS (sec)	1	1	1	1	1
TL1	521	Octal		LM epoch MS (sec)	1	1	1	1	1
6K6	522	Octal		Radar filter velocity weight (No units)	1	1	1	1	1
5K20	523	Octal		Lower limit of desired derivative of radial acceleration (1/sec)	1	1	1	1	1
TE2	524	Octal		CSM epoch LS (sec)	1	1	1	1	1
TL2	525	Octal		LM epoch LS (sec)	1	1	1	1	1
2K11	526	Octal		Set value of VT (fps)	1	1	1	1	1
4K6	527	Octal		Final upper limit of altitude rate at orbit insertion (fps)	1	1	1	1	1
Daxa	530	Octal		X-axis alignment error signal (rad)	1	1	1	1	1
Daya	531	Octal		Y-axis alignment error signal (rad)	1	1	1	1	1
Daza	532	Octal		Z-axis alignment error signal (rad)	1	1	1	1	1
DISC1	533	Octal		Discrete word one complement	1	1	1	1	1
1K18	534	Octal		X-accelerometer scale factor (fps/pulse)	1	1	1	1	1
1K20	535	Octal		Y-accelerometer scale factor (fps/pulse)	1	1	1	1	1
1K22	536	Octal		Z-accelerometer scale factor (fps/pulse)	1	1	1	1	1
1K14	537	Octal		X-axis mass unbalance compensation (rad/fps)	1	1	1	1	1
1K19	540	0.001 fps sq	0.01 fps sq	X-accelerometer bias compensation	1	1	1	1	1
1K21	541	0.001 fps sq	0.01 fps sq	Y-accelerometer bias compensation	1	1	1	1	1
1K23	542	0.001 fps sq	0.01 fps sq	Z-accelerometer bias compensation	1	1	1	1	1
1K1	544	0.01°/hr		X-gyro drift compensation	1	1	1	1	1
1K6	545	0.01°/hr		Y-gyro drift compensation	1	1	1	1	1
1K11	546	0.01°/hr		Z-gyro drift compensation	1	1	1	1	1
DΔ	547	Octal		Lunar align correction (rad)	1	1	1	1	1
1K3	550	Octal		X-gyro scale factor compensation	1	1	1	1	1
1K8	551	Octal		Y-gyro scale factor compensation	1	1	1	1	1
1K13	552	Octal		Z-gyro scale factor compensation	1	1	1	1	1
Hrf	553	Octal		High (+), low (-) angular rate scaling	1	1	1	1	1
5K14	560	Octal		Upper limit of desired derivative of radial acceleration (fps cubed)	1	1	1	1	1

CREW-MAN	PNL	PROCEDURES	REMARKS

4.4.17 DEDA ACCESSIBLE PARAMETERS LIST (cont)

Symbol	Address	Quantization Lunar	Quantization Earth		0 = not available 1 = available OI	CSI	CDH	TPI	XDV
P34	651		Octal	Radar filter VX-VZ covariance (ft sq/sec sq)	1	1	1	1	1
P43	652		Octal	Radar filter VZ-VX covariance (ft sq/sec sq)	1	1	1	1	1
P44	653		Octal	Radar filter VZ variance (ft sq/sec sq)	1	1	1	1	1
4K2	654		Octal	Time-to-burn computation factor (1/fps)	1	1	1	1	1
4K3	655		Octal	Time-to-burn computation factor (1/fps sq)	1	1	1	1	1
6K5	656		Octal	Filter Y weight (No. of units)	1	1	1	1	1
4K25	657		Octal	Engine cutoff compensation (fps)	1	1	1	1	1
4K34	660		Octal	Lower limit thrust acceleration (ft/sec sq)	1	1	1	1	1
4K35	661		Octal	Ullage threshold (ft/sec sq)	1	1	1	1	1
4K10	662		Octal	Constant in linear expression $\propto$ L (OI) (available in all guidance routines)	1	1	1	1	1
Vyofs	665		Octal	Maximum Vyo displayable (fps)	1	1	1	1	1
4K21	666		Octal	Scale factor for attitude error output (rad)	1	1	1	1	1
M25B16	667		Octal	Cycle counts to seconds factor	1	1	1	1	1
Dtb	670		Octal	One second plus DEDA time bias	1	1	1	1	1
ID1	671		Octal	Downlink code	1	1	1	1	1
11J	673		Octal	Retarget value for 4K10 (ft/rad)	1	1	1	1	1
2K4	674		Octal	-2(2K1) (ft cubed/sec)	1	1	1	1	1
KDT	675		Octal	ΔT/2 (sec)	1	1	1	1	1
				Conversion Scale Factors					
BACCSF	446		Octal	0.001/0.01 fps sq to fps/20 ms scaled at 1/3	1	1	1	1	1
BM13SF	676		Octal	0.01°/hr to rad/20 ms scaled at -13	1	1	1	1	1
B23SF	677		Octal	100/1000 ft to ft scaled at 23/25	1	1	1	1	1
B18SF	700		Octal	0.1 min to sec scaled at 18	1	1	1	1	1
B13VSF	701		Octal	0.1/1 fps to fps scaled at 13/15	1	1	1	1	1
B3SF	702		Octal	0.01° to rad scaled at 3	1	1	1	1	1
B23RSF	703		Octal	0.1 nm to ft scaled at 23/25	1	1	1	1	1
B13SF	704		Octal	0.01 min to sec scaled at 13	1	1	1	1	1

G&C REF DATA