LM SOFTWARE

LUMINARY 1E
(REV 210 OF LUMINARY)
LM DSKY
COMPUTER PROGRAMS
COMPUTER ROUTINES
VERB CODES
NOUN CODES
ALARM CODES
OPTION CODES
CHECKLIST CODES
FLAGWORD BIT ASSIGNMENTS
IMODES30 AND IMODES33
CHANNEL BIT ASSIGNMENTS
COMPUTER PROGRAM DESCRIPTION

LM DSKY

UPLINK ACTY light — is energized by the first character of a digital UPLINK message received by the LGC.

NO ATT Light — is energized when the LGC is in the Operate mode and there is no inertial reference; that is, the ISS is off, caged, or in the Coarse Align mode.

STBY Light — is energized when the LGC is in the Standby mode and deenergized when the LGC is in the Operate mode.

KEY REL Light

1. Energized when:
   a. An internal display comes while the astronaut has the DSKY.
   b. An astronaut keystroke is made while an internal flashing display is currently on the DSKY.
   c. The astronaut makes a keystroke on top of (his own) Monitor Verb display.
2. Deenergized when:
   a. Astronaut relinquishes the DSKY by operating the KEY REL button.
   b. Astronaut terminates his current sequence normally, for example:
      (1) with final ENTR of a load sequence.
      (2) the ENTR of a response to a flashing display.
      (3) the ENTR of an extended verb request.

OPR ERR Light — is energized when the DSKY operator performs an improper sequence of key depressions.

DAP NOT IN CONTROL Light (unmarked) — The DAP NOT IN CONTROL light on the DSKY is a constant indication to the astronauts whether or not the PGNS digital autopilot is controlling the spacecraft attitude. It is lit whenever the autopilot is in the Idle, Off, or Minimum Impulse mode; it is extinguished in all other modes.

PRIORITY DISPLAY Light (unmarked) — The PRIORITY DISPLAY light will alert the astronaut that a priority display from P20, P22, and P25 is waiting to come up if he is using the DSKY over a foreground program and the KEY RELEASE light is already on.

1. The light is turned on when a priority display is put up.
2. The light will be turned off for:
   a. A response to the display of PROCEED, V33ENTER, V32ENTER, V34ENTER.
   b. A response of V37E (change Major Mode), V36E (Fresh Start), V56E (Terminate Tracking).

TEMP Light — The LGC receives a signal from the IMU when the stable member temperature is in the range 126.3° F to 134.3° F. In the absence of this signal, the TEMP lamp on the DSKY is acutated.

GIMBAL LOCK Light — is energized when the middle gimbal angle exceeds ± 70 degrees from its zero position. When the middle gimbal angles exceeds ± 85 degrees from its zero position the LGC automatically commands the Coarse Align mode in the ISS to prevent gimbal oscillation. The NO ATT light will then be energized.

PROG Light — Under a variety of situations a program alarm is generated. The program alarm actuates the PROG lamp on the DSKY.

RESTART Light — In the event of a RESTART during operation of a program, a latch is set in the LGC which illuminates the RESTART lamp on the DSKY until the latch is manually reset by pressing RSET.

TRACKER Light — When the Rendezvous Radar is on, the light is energized when:

1. a RR CDU failed with the RR in the Auto mode and RR CDU's not being zeroed.
2. when the RR Data Good bar discrete occurs during an LGC data read sequence.

ALT Light — When the Landing Radar is on, the light is energized (on steady or flashing) when:

1. LR Range Data Good discrete was not present before and after LR altitude sampling (STEADY).
2. LR Altitude Reasonability test was failed (FLASHING).

VEL Light — When the Landing Radar is on, the light is energized (on STEADY or FLASHING) when:

1. LR Velocity Data Good discrete was not present before and after LR velocity sampling (STEADY).
2. LR Velocity Reasonability test was failed (FLASHING).

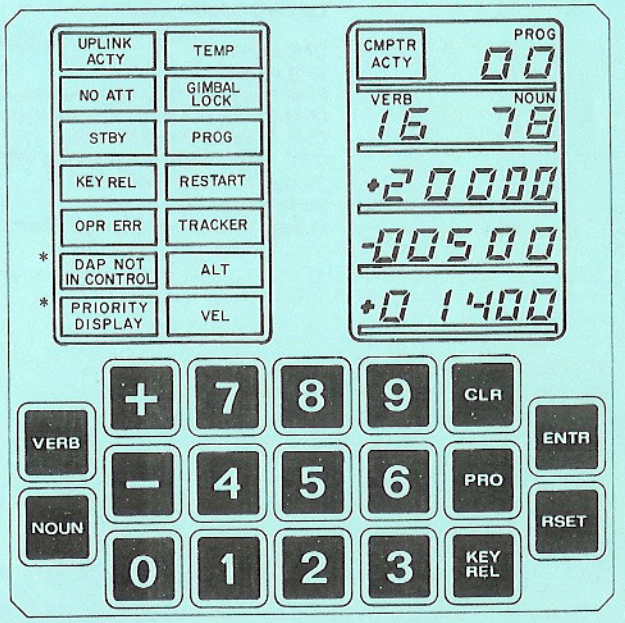
COMP ACTY Light — is energized when the LGC is occupied with an internal sequence.

Display Panel — consists of 24 electroluminescent sections. Each section is capable of displaying a decimal character or remaining blank, except the three sign sections. These display a plus sign, a minus sign, or a blank. The numerical sections are grouped to form three data display registers, each of five numerical characters; and three control display registers, each of two numerical characters. The data display registers are referred to as R1, R2, R3. The control display registers are known as VERB, NOUN, and PROGRAM.

At maximum activity, the complete display panel may be updated in 0.50 second.

Keyboard — contains the following buttons:

1. VERB — Pushing this button indicates that the next two numerical characters keyed are to be interpreted as the Verb Code.
2. NOUN — Pushing this button indicates that the next two numerical characters keyed are to be interpreted as the Noun Code.
3. + and - — are sign keys used for sign convention and to identify decimal data.
4. 0 - 9 — are numerical keys.
5. CLR — is used during a data loading sequence to blank the data display register (R1, R2, R3) being used. It allows the operator to reload the data word.
6. PRO — This pushbutton performs two functions:
   a. When the LGC is in the Standby mode, pressing this button will put the LGC in the Operate mode, turn off the STBY light, and automatically select Routine 00 in the LGC, after restoring the clock.
   b1. When the LGC is in the Operate mode but Program 06 is not selected, pressing the button will provide the "Proceed" function.
   b2. When the LGC is in the Operate mode and Program 06 is selected, pressing the button will put the LGC in the Standby mode and turn on the STBY light.
7. ENTR — is used in three ways:
   a. To direct the LGC to execute the Verb/Noun now appearing on the Verb/Noun lights.
   b. To direct the LGC to accept a data word just loaded.
   c. To respond to a "Please Perform" request.
8. RSET — turns off alarm indicator on the DSKY providing the alarm condition has been corrected.



* Labels shown are not on lights.

PROGRAMS FOR PROGRAM LUMINARY

PHASE	PROGRAM NUMBER	PROGRAM TITLE
Service	00	LGC Idling
	06	LGC Power Down
Ascent	12	Powered Ascent
Coast	20	Rendezvous Navigation
	21	Ground Track Determination
	22	Lunar Surface Navigation
	25	Preferred Tracking Attitude
	27	LGC Update
Pre-thrusting	30	External Delta V
	32	Coelliptic Sequence Initiation (CSI)
	33	Constant Delta Altitude (CDH)
	34	Transfer Phase Initiation (TPI)
	35	Transfer Phase Midcourse (TPM)
Thrusting	40	DPS
	41	RCS
	42	APS
	47	Thrust Monitor
Align-ments	51	IMU Orientation Determination
	52	IMU Realign
	57	Lunar Surface Align
Descent	63	Braking Phase
	64	Approach Phase
	66	Landing Phase (ROD)
	68	Landing Confirmation
Aborts and Backups	70	DPS Abort
	71	APS Abort
	72	CSM Coelliptic Sequence Initiation (CSI) Targeting
	73	CSM Constant Delta Altitude (CDH) Targeting
	74	CSM Transfer Phase Initiation (TPI) Targeting
	75	CSM Transfer Phase Midcourse (TPM) Targeting
	76	State Vector Update (CSM)
	77	State Vector Update (LM)
	99	Guided RCS Burn (Erasable Memory Program)

ROUTINES FOR PROGRAM LUMINARY

ROUTINE	ROUTINE TITLE
00	Final Automatic Request Terminate
01	Erasable Modification
02	IMU Status Check
03	DAP Data Load
04	Rendezvous Radar/Landing Radar Self-Test
05	S-Band Antenna
09	R10/R11/R12 Service
10	Landing Analog Displays
11	Abort Discretes Monitor
12	Descent State Vector Update
13	Landing Auto Modes Monitor
20	Landing Radar/Rendezvous Radar Read
21	Rendevzous Radar Designate
22	Rendezvous Radar Data Read
23	Rendezvous Radar Manual Acquisition
24	Rendezvous Radar Search
25	Rendezvous Radar Monitor
26	Lunar Surface RR Designate
30	Orbit Parameter Display
31	Rendezvous Parameter Display
33	LGC/AGC Clock Synchronization
36	Out-of-Plane Rendezvous Display
40	DPS/APS Thrust Fail
41	State Vector Integration (MIDTOAVE)
47	AGS Initialization
50	Coarse Align
51	In-Flight Fine Align
52	Auto Optics Positioning
53	AOT Mark
54	Sighting Data Display
55	Gyrotorquing
56	Terminate Tracking
57	MARKRUPT
58	Celestial Body Definition
59	Lunar Surface Sighting Mark
60	Attitude Maneuver
61	Preferred Tracking Attitude
62	Crew-Defined Maneuver
63	Rendezvous Final Attitude
65	Fine Preferred Tracking Attitude
76	Extended Verb Interlock
77	LR Spurious Test

LIST OF VERBS USED IN PROGRAM LUMINARY

REGULAR VERBS

00	Not in use
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 DP decimal in R1, R2 (test only)
08-10	Spare
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 DP decimal in R1, R2 (test only)
18-20	Spare
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
26	Spare
27	Display Fixed Memory
28-29	Spare
30	Request EXECUTIVE
31	Request WAITLIST
32	Recycle program
33	Proceed without DSKY inputs
34	Terminate function
35	Test lights (P00 only)
36	Request FRESH START
37	Change program (major mode)
38-39	Spare

EXTENDED VERBS

40	Zero CDU's (specify N20 or N72)
41	Coarse align CDU's (specify N20 or N72)
42	Fine align IMU
43	Load IMU attitude error needles (P00 only)
44	Terminate RR continuous designate (V41N72 Option 2)
45-46	Spare
47	Initialize AGS (R47)
48	Request DAP Data Load routine (R03)
49	Request Crew Defined Maneuver routine (R62) (P00 only)
50	Please perform
51	Spare
52	Mark cursor
53	Mark spiral
54	Mark X or Y reticle
55	Increment LGC time (decimal)
56	Terminate tracking (P20, P22, and P25)
57	Permit Landing Radar updates
58	Inhibit Landing Radar updates
59	Command LR to Position 2
60	Display vehicle attitude rates on FDAI error needles

LIST OF VERBS USED IN PROGRAM LUMINARY

61	Display DAP following attitude errors (Mode 1)
62	Display total attitude errors with respect to N22 (Mode 2)
63	Start RR/LR Self-Test (R04)
64	Request S-Band Antenna routine (R05)
65	Disable U and V jet firings during DPS burns
66	Vehicles are attached. Move this vehicle state vector to other vehicle
67	Display W matrix RSS error
68	Cause Lunar Terrain model to be bypassed
69	Cause RESTART
70	Start LGC update, liftoff time (P27)
71	Start LGC update, block address (P27)
72	Start LGC update, single address (P27)
73	Start LGC update, LGC time (P27)
74	Initialize erasable dump via DOWNLINK (42 seconds)
75	Enable U and V jet firings during DPS burns
76	Minimum Impulse Command mode
77	Rate Command and Attitude Hold mode
78	Start LR spurious test (R77)
79	Stop LR spurious test
80	Enable LM state vector update
81	Enable CSM state vector update
82	Request Orbit Parameter display (R30)
83	Request Rendezvous Parameter display (R31)
84	Spare
85	Display Rendezvous Radar LOS azimuth and elevation
86-88	Spare
89	Request Rendezvous Final Attitude maneuver (R63) (P00 only)
90	Request Out of Plane Rendezvous display (R36) (Non-Average g)
91	Display BANKSUM (P00 only)
92	Start IMU performance tests (ground use) (OPR ERR)
93	Enable W matrix initialization (Clear REND W FLG)
94	Spare
95	No update of either state vector allowed (Via navigation)
96	Interrupt integration and go to P00
97	Perform Engine Fail procedure (R40)
98	Spare
99	Please Enable Engine Ignition

LIST OF NOUNS USED IN PROGRAM LUMINARY

00	Not in use	
01 V	Specify address (fractional)	.XXXXX fractional .XXXXX fractional .XXXXX fractional
02 V	Specify address (whole)	XXXXX. integer XXXXX. integer XXXXX. integer
03 V	Specify address (degree)	XXX.XX deg XXX.XX deg XXX.XX deg
04	Angular error/difference	XXX.XX deg
05	Angular error/difference	XXX.XX deg
06	Option code ID Option code Data code	Octal Octal Octal
07 V	Channel/E Memory operator	
	Identifier BIT ID Action	Octal Octal Octal
08 V	Alarm data	
	ADRES BBANK ERCOUNT	Octal Octal Octal
09 V	Alarm codes	
	First Second Last	Octal Octal Octal
10 V	Channel to be specified	Octal
11	TIG of CSI/T (APO APSIS)	00XXX. h 000XX. min 0XX.XX s
12	Option code (extended verbs only)	Octal Octal
13	TIG of CDH	00XXX. h 000XX. min 0XX.XX s
14	Not in use.	
15 V	Increment address	Octal
16	Time of event (used by extended verbs only)	00XXX. h 000XX. min 0XX.XX s
17	Spare	
18	Desired automaneuver FDAI ball angles	R XXX.XX deg P XXX.XX deg Y XXX.XX deg

NOUNS V — Can be called at any time for valid or partially valid data.

LIST OF NOUNS USED IN PROGRAM LUMINARY

19	Spare	
20 V	Present ICDU angles	OG XXX.XX deg IG XXX.XX deg MG XXX.XX deg
21 V	PIPA's	X XXXXX. pulses Y XXXXX. pulses Z XXXXX. pulses
22	Desired ICDU angles	OG XXX.XX deg IG XXX.XX deg MG XXX.XX deg
23	Spare	
24	Delta time for LGC clock	00XXX. h 000XX. min 0XX.XX s
25	CHECKLIST (used with V50) (R2 valid for 00016)	Octal
26	PRIO/DELAY, ADRES, BBCON	Octal Octal Octal
27 V	Self-test on/off switch	Octal
28-31	Spare	
32	Time from perigee	00XXX. h 000XX. min 0XX.XX s
33	Time of ignition	00XXX. h 000XX. min 0XX.XX s
34	Time of event	00XXX. h 000XX. min 0XX.XX s
35	Time from event	00XXX. h 000XX. min 0XX.XX s
36 V	Time of LGC clock	00XXX. h 000XX. min 0XX.XX s
37	Time of ignition (TPI)	00XXX. h 000XX. min 0XX.XX s
38 V	Time of state being integrated	00XXX. h 000XX. min 0XX.XX s
39	Spare	

NOUNS V — Can be called at any time for valid or partially valid data.

LIST OF NOUNS USED IN PROGRAM LUMINARY

40	*	Time from ignition/cutoff	XX b XX min/s
		VG	XXXX.X ft/s
		Delta V (accumulated)	XXXX.X ft/s
41		Target (V92 only)	
		Azimuth	XXX.XX deg
		Elevation	XX.XXX deg
42		Apocenter altitude	XXXX.X nmi
		Pericenter altitude	XXXX.X nmi
		Delta V (required)	XXXX.X ft/s
43		Latitude	XXX.XX deg (+ north)
		Longitude	XXX.XX deg (+ east)
		Altitude	XXXX.X nmi
44	*	Apocenter altitude	XXXX.X nmi
		Pericenter altitude	XXXX.X nmi
		TFF	XX b XX min/s
45	V-R1*	Marks	XXXXX.
		Time from ignition of next/last burn	XX b XX min/s
		Middle gimbal angle	XXX.XX deg
46	V-R2*	DAP configuration	Octal
		Switch function fail code	Octal
47	V	LM weight	XXXXX. lb
		CSM weight	XXXXX. lb
48		Gimbal pitch trim	XXX.XX deg
		Gimbal roll trim	XXX.XX deg
49		Delta R	XXX.XX nmi
		Delta V	XXXX.X ft/s
		Radar data source code	0000X
50		Spare	
51		S-band antenna angles	
		Pitch (Alpha)	XXX.XX deg
		Yaw (Beta)	XXX.XX deg
52		Central angle of active vehicle	XXX.XX deg
53		Spare	
54		Range	XXX.XX nmi
		Range rate	XXXX.X ft/s
		Theta	XXX.XX deg
55		Number of apsidal crossings	XXXXX.
		Elevation angle	XXX.XX deg
		Central angle of passive vehicle	XXX.XX deg
56		RR LOS	
		Azimuth	XXX.XX deg
		Elevation	XXX.XX deg
57		Spare	
58		Pericenter altitude (post TPI)	XXXX.X nmi
		Delta V (TPI)	XXXX.X ft/s
		Delta V (TPF)	XXXX.X ft/s

*Display cannot be changed via a data load (that is, V25 NXXE, and so forth)

NOUNS V — Can be called at any time with valid or partially valid data.

LIST OF NOUNS USED IN PROGRAM LUMINARY

59		Delta V LOS 1	XXXX.X ft/s
		Delta V LOS 2	XXXX.X ft/s
		Delta V LOS 3	XXXX.X ft/s
60		Forward velocity	XXXX.X ft/s
		Altitude rate	XXXX.X ft/s
		Computed altitude	XXXXX. ft
61	*	Time to go in braking phase	XX b XX min/s
		Time from ignition	XX b XX min/s
		Crossrange distance	XXXX.X nmi
62	*	Absolute value of velocity	XXXX.X ft/s
		Time from ignition	XX b XX min/s
		Delta V (accumulated)	XXXX.X ft/s
63		Delta Altitude (+LR >LGC)	XXXXX. ft
		Altitude rate	XXXX.X ft/s
		Computed altitude	XXXXX. ft
64	*	Time left for redesignations (TR)/LPD	XX b XX seconds/deg
		Altitude rate	XXXX.X ft/s
		Computed altitude	XXXXX. ft
65	V	Sampled LGC time (fetched in interrupt)	00XXX. h
			000XX. min
			0XX.XX s
66	*	LR slant range	XXXXX. ft
	V	LR position	00001/00002
67		LR VX	XXXXX. ft/s
		LR VY	XXXXX. ft/s
		LR VZ	XXXXX. ft/s
68	*	Ground range to landing site	XXXX.X nmi
		Time to go in braking phase	XX b XX min/s
		Absolute value of velocity	XXXX.X ft/s
69		Landing site correction	Z XXXXX. ft
		Landing site correction	Y XXXXX. ft
		Landing site correction	X XXXXX. ft
70		AOT detent code/star code (before mark)	Octal
			Octal
			Octal
71		AOT detent code/star (after mark)	Octal
		Mark X/Cursor Counter (Max = 5)	Octal
		Mark Y/Spiral Counter (Max = 5)	Octal
72	V	RR trunnion angle (360 degrees — CDU trunnion angle)	XXX.XX deg
		RR shaft angle	XXX.XX deg
73		Desired RR trunnion angle (360 degrees — CDU trunnion angle)	XXX.XX deg
		Desired RR shaft angle	XXX.XX deg
74	*	Time from ignition	XX b XX min/s
		Yaw after vehicle rise	XXX.XX deg
		Pitch after vehicle rise	XXX.XX deg
75	*	Delta altitude (CDH)	XXXX.X nmi
		Delta time (CDH-CSI or TPI-CDH) (Modular 60)	XX b XX min/s
		Delta time (TPI-CDH or TPI-NOMTPI) (Modular 60)	XX b XX min/s

*Display cannot be changed via a data load (that is, V25 NXXE, and so forth)

NOUNS V — Can be called at any time for valid or partially valid data.

LIST OF NOUNS USED IN PROGRAM LUMINARY

76	Desired downrange velocity	XXXX.X ft/s
	Desired radial velocity	XXXX.X ft/s
	Crossrange distance	XXXX.X nmi
77 *	Time to engine cutoff	XX b XX min/s
	Velocity normal to CSM plane (LM) (+Rt)	XXXX.X ft/s
	Absolute value of velocity	XXXX.X ft/s
78 *	RR range	XXX.XX nmi
	RR range rate	XXXX.X ft/s
	Time from ignition	XX b XX min/s
79	Cursor angle	XXX.XX deg
	Spiral angle	XXX.XX deg
	Position code	0000X
80	Data indicator	XXXXX.
	Omega	XXX.XX deg
81	Delta VX (LV) (+Fwd)	XXXX.X ft/s
	Delta VY (LV) (+Rt)	XXXX.X ft/s
	Delta VZ (LV) (+Dn)	XXXX.X ft/s
82	Delta VX (LV) (+Fwd)	XXXX.X ft/s
	Delta VY (LV) (+Rt)	XXXX.X ft/s
	Delta VZ (LV) (+Dn)	XXXX.X ft/s
83	Delta VX (body) (+Up)	XXXX.X ft/s
	Delta VY (body) (+Rt)	XXXX.X ft/s
	Delta VZ (body) (+Fwd)	XXXX.X ft/s
84	Delta VX (LV of other vehicle) (+ (R x V) x R)	XXXX.X ft/s
	Delta VY (LV of other vehicle) (+ (V x R))	XXXX.X ft/s
	Delta VZ (LV of other vehicle) (+ (-R))	XXXX.X ft/s
85	VGX (body) (+ Up)	XXXX.X ft/s
	VGY (body) (+ Rt)	XXXX.X ft/s
	VGZ (body) (+ Fwd)	XXXX.X ft/s
86	VGX (LV) (+ Fwd)	XXXX.X ft/s
	VGY (LV) (+ Rt)	XXXX.X ft/s
	VGZ (LV) (+ Dn)	XXXX.X ft/s
87	Backup optics LOS	
	Azimuth (+ Rt)	XXX.XX deg
	Elevation (+ Up)	XXX.XX deg
88	Components of celestial body unit vector	X .XXXXX
		Y .XXXXX
		Z .XXXXX
89	Landmark latitude (+ North)	XX.XXX deg
	Landmark longitude/2 (+ East)	XX.XXX deg
	Landmark altitude	XXX.XX nmi
90	Rendezvous out of plane parameters	
	Y	XXX.XX nmi
	Y dot	XXXX.X ft/s
	PSI	XXX.XX deg
91	Altitude	XXXXXb. nmi
	Velocity	XXXXX. ft/s
	Flight path angle	XXX.XX deg

*Display cannot be changed via a data load (that is, V25 NXXE, and so forth)

LIST OF NOUNS USED IN PROGRAM LUMINARY

92	Percent of full thrust (10,500 lb)	00XXX %
	Altitude rate	XXXX.X ft/s
	Computed altitude	XXXXX. ft
93	Delta gyro angles	X XX.XXX deg
		Y XX.XXX deg
		Z XX.XXX deg
94	VGX (LM) (+Up)	XXXX.X ft/s
	Altitude Rate	XXXX.X ft/s
	Computed Altitude	XXXXX.ft
95	Spare	
96	Spare	
97	System test inputs	XXXXX.
		XXXXX.
		XXXXX.
98	System test results and input	XXXXX.
		.XXXXX
		XXXXX.
99	W Matrix Position error	XXXXX. ft
	Velocity error	XXXX.X ft/s
	Radar bias angle error	XX.XXX radians

LIST OF ALARM CODES USED WITH VERB 05 NOUN 09 FOR PROGRAM LUMINARY

CODE		PURPOSE	SET BY
00111		Mark missing	R53
00112		Mark or mark reject not being accepted/or ROD input and Average G off	R57
00113		No inbits	R57
00115		Mark reject entered but ignored	R57
00206		Zero Encode not allowed with Coarse Align plus Gimbal Lock	IMU mode switching V40 N20
00207		ISS turn-on request not present for 90 seconds	T4RUPT
00210		IMU not operating	IMU mode switching, R02
00211		Coarse Align error	IMU mode switching, P51, P57, R50
00212		PIPA fail but PIPA is not being used	IMU mode switching, T4RUPT
00213		IMU not operating with turn-on request	T4RUPT
00214		Program using IMU when turned off	T4RUPT
00217		Bad return from IMUSTALL	P51, P57, R50
00220		Bad REFSMMAT	R02, R47
00401		Desired gimbal angles yields Gimbal Lock	In-flight alignment, IMU-2, FINDCDUW
00402		FINDCDUW routine not controlling attitude because of inadequate pointing vectors	FINDCDUW
00404	*	Defined star not available in any detent	R59
00405	*	Two stars not available	R51
00421		W-matrix overflow	INTEGRV
00501	*	Radar antenna out of limits	R23
00502		Bad radar gimbal angle input	V41N72
00503	*	Radar antenna designate fail	R21, non-* in V41 N72
00510		Radar auto discrete not present	R25, V40 N72
00511		Neither or both LR antenna position bits present for 10 seconds or more	R12
00514	*	RR goes out of Auto mode while in use	P20, P22
00515		RR CDU Fail discrete present	R25
00520		RADARUPT not expected at this time	Radar read, P20, P22, R12
00522		LR position change	R04
00523		LR antenna did not achieve Position 2	V59
00525	*	Delta Theta greater than 3 degrees	R22
00526		Range greater than 400 nmi	P20
00527		LOS not in Mode 2 coverage in P22 or vehicle maneuver required in P20	R24 R24
00530	*	LOS not in Mode 2 coverage while on lunar surface after 600 seconds	R21
00600	*	Imaginary roots on first iteration	P32, P72
00601	*	Perigee altitude after CSI < 85 nmi earth orbit, <35,000 feet moon orbit	P32, P72
00602	*	Perigee altitude after CDH < 85 nmi earth orbit, <35,000 feet moon orbit	P32, P72
00603	*	CSI to CDH time less than 10 minutes	P32
00604	*	CDH to TPI time less than 10 minutes	P32, P72
00605	*	Number of iterations exceeds P32/P72 loop maximum (>15)	P32, P72
00606	*	DV exceeds maximum	P32, P72
00611	*	No TIG for given E angle	P33, P34, P73, P74
00701	*	Illegal option code selected	P57
00777		PIPA Fail caused ISS warning	T4RUPT
01102		LGC self-test error	SELFCHECK
01105		DOWNLINK too fast	T4RUPT
01106		UPLINK too fast	T4RUPT
01107		Phase table failure. Assume erasable memory is suspect.	RESTART

LIST OF ALARM CODES USED WITH VERB 05 NOUN 09 FOR PROGRAM LUMINARY

CODE		PURPOSE	SET BY
01301		ARCSIN-ARCCOS input angle too large	INTERPRETER
01406		Bad return from ROOTPSRS during descent guidance	P63, P64
01407		VG increasing (Delta V accumulated at 90 degrees from desired thrust vector)	P40, P42
01410		Unintentional overflow in guidance	P63, P64, P66
01412		Descent ignition algorithm not converging	P63
01466		Throttle servicing insufficient	P66
01520		V37 request not permitted at this time	R00
01600		Overflow in drift test	Ground Test
01601		Bad IMU torque	Ground Test
01703		Too close to ignition; slip time of ignition	R41
01706	*	Incorrect program selected for vehicle configuration	P40, P42
02001		Jet failures have disabled Y-Z translation	DAP
02002		Jet failures have disabled X translation	DAP
02003		Jet failures have disabled P rotations	DAP
02004		Jet failures have disabled U-V rotations	DAP
03777		ICDU fail caused the ISS warning	T4RUPT
04777		ICDU, PIPA fails caused the ISS warning	T4RUPT
07777		IMU fail caused the ISS warning	T4RUPT
10777		IMU, PIPA fails caused the ISS warning	T4RUPT
13777		IMU, ICDU fails caused the ISS warning	T4RUPT
14777		IMU, ICDU, PIPA fails caused the ISS warning	T4RUPT
20430		Acceleration overflow in integration	Orbital integration
20607		No solution from TIME-THETA or TIME-RADIUS	TIMETHET, TIMERAD
21103		Unused CCS branch executed	ABORT
21204		WAITLIST, VARDELAY, FIXDELAY, DELAYJOB, or LONGCALL called with zero or negative delta time	WAITLIST
21302		SQRT called with negative argument	INTERPRETER
21406		Bad return from ROOTPSRS during descent preignition	Ignition algorithm
21501		Keyboard and Display alarm during internal use (NVSUB)	PINBALL
31104		Delay routine busy	EXECUTIVE
31201		Executive overflow—no VAC areas	EXECUTIVE
31202		Executive overflow—no core sets	EXECUTIVE
31203		WAITLIST overflow—too many tasks	WAITLIST
31206		Second job attempts to go to sleep via Keyboard and Display program	PINBALL
31207		No VAC area for marks	R53
31210		Two programs using device at same time	IMU mode switching
31211		Illegal interrupt of extended verb	R53
31502		Two priority displays waiting	GOPLAY
32000		DAP still in progress at next T5RUPT	DAP

NOTE: For V05 N09 displays:
R1—XXXXX (first alarm to occur after last RSET)
R2—XXXXX (second alarm to occur after RSET)
R3—XXXXX (alarm which occured last)

3XXXX indicates an Abort code that results in a software RESTART
2XXXX indicates a more serious Abort code that results in the program going to R00

*This alarm displayed without having to key in V05 N09E.
An astronaut response is required by this alarm.

LIST OF CHECKLIST REFERENCE CODES USED WITH VERB 50 NOUN 25 PROGRAM LUMINARY

R1 CODE	ACTION TO BE EFFECTED	PROGRAM
00013	Key in normal or gyro torque coarse align	P52
00014	Proceed: Do fine alignment option	R51, P63, P57
	Enter: Do landing site determination (N89)	P57 Option 2
00015	Perform celestial body acquisition	R51, P51
00016	Unprocessed mark sets (R2 contains the number of unused sets)	R53
00062	Switch LGC power down	P06
00201	Switch RR mode to automatic	P20, P22, R04
00203	Switch guidance control to PGNS, mode to Auto, and (for P40, P63, and P70) switch thrust control to Auto	P12, P42, P71, P40, P63, P70
00205	Perform manual acquisition of CSM with RR	R23
00500	Switch LR antenna to Position 1	P63

NOTES: Switch: denotes change position of a console switch
Perform: denotes start or end of a task
Key In: denotes key-in of data through the DSKY

LIST OF OPTION CODES DISPLAYED IN R1 IN CONJUNCTION WITH VERB 04/05 NOUN 06/12 TO REQUEST THE ASTRONAUT TO LOAD INTO R2 THE OPTION HE DESIRES FOR PROGRAM LUMINARY

CODE	PURPOSE	INPUT FOR R2	PROGRAM
00001	Specify IMU Orientation	1 = preferred, 2 = nominal 3 = REFSMMAT, 4 = landing site	P52, P57
00002	Specify vehicle	1 = this, 2 = other	P21, R30
00003	Specify tracking attitude	1 = preferred, 2 = other	R63
00004	Specify radar	1 = RR, 2 = LR	R04
00006	Specify RR coarse align option	1 = lockon, 2 = continuous designate	V41N72
00010	Specify alignment mode	0 = anytime, 1 = REFSMMAT + g 2 = two bodies, 3 = one body + g	P57
00012	Specify CSM orbit option	1 = no orbit change, 2 = change orbit to pass over LM	P22

FLAGWORD BIT ASSIGNMENTS (ALPHABETICAL) FOR LUMINARY

ABTTFLG	FW9	B7
ACCSOKAY	FW13	B3
ACC4-2FL	FW13	B11
ACC4OR2X	FW13	B11
ACMODFLG	FW2	B13
ALTSCALE*	FW12	B9
ANTENBIT	FW12	B12
AORBSYST	FW5	B5
AORBTFLG	FW13	B10
AORBTRAN	FW13	B10
APSESW	FW8	B5
APSFLAG	FW10	B13
APSFLBIT	FW10	B13
ASTNBIT	FW7	B12
ASTNFLAG	FW7	B12
ATTFLAG	FW6	B1
ATTFLBIT	FW6	B1
AUTOMBIT	FW12	B2
AUTR1FLG*	FW13	B1
AUTR2FLG*	FW13	B2
AUXFLBIT	FW6	B2
AVEGFBIT	FW7	B5
AVEGFLAG	FW7	B5
AVEMIDSW	FW9	B1
AVFLAG	FW2	B5
CALCMAN2	FW2	B2
CALCMAN3	FW2	B3
CDESBIT	FW12	B15
CDESFLAG	FW12	B15
CMOONFLG	FW8	B12
COGAFLAG	FW8	B4
CONTRLBT	FW10	B2
CSMDOCKD	FW13	B13
CULTFLAG	FW3	B7
DAPBOOLS	FW13	
DBSELECT	FW13	B4
DBSELECT2	FW13	B5
DESIGBIT	FW12	B10
DESIGFLG	FW12	B10
DIDFLBIT	FW1	B14
DIMOFLAG	FW3	B1
DMENFBIT	FW5	B9
DMENFLG	FW5	B9
DRFTBIT	FW2	B15
DRIFTBIT	FW13	B8
DRIFTDFL	FW13	B8
DRIFTFLG	FW2	B15
DSKYFBIT	FW5	B15
D6OR9FLG	FW3	B2
ENGONBIT	FW5	B7
ERADFLAG	FW1	B13
ETPIFLAG	FW2	B7
FINALFLG	FW2	B6
FLAP	FW9	B8
FLPC	FW9	B12
FLPI	FW9	B11
FLRCS	FW9	B10
FLRCSBIT	FW9	B10
FLT59BIT	FW9	B4
FLT59FLG	FW9	B4
FLUNDBIT	FW8	B10
FLUNDISP	FW8	B10
FLVR	FW9	B14
FREEFBIT	FW0	B3
FREEFLAG	FW0	B3
FRSTIME	FW1	B4
FRSTMBIT	FW1	B4
FSPASFLG	FW0	B10
GLOKFAIL	FW3	B14
GMBDRBIT	FW6	B10
GMBDRVSW	FW6	B10
GUESSW	FW1	B2
HFAILFLG	FW11	B13
HFLSHBIT	FW11	B1
HFLSHFLG	FW11	B1
IDLEFBIT	FW7	B7
IDLEFLAG	FW7	B7
IGNFLAG	FW7	B13
IGNFLBIT	FW7	B13
IMPULBIT	FW2	B9
IMPULSW	FW2	B9
IMUSE	FW0	B8
IMUSEBIT	FW0	B8
INFINFLG	FW8	B7
INITABIT	FW8	B2
INITALGN	FW8	B2
INTFLBIT	FW10	B14
INTYPFLG	FW3	B4
ITSWICH	FW7	B15
JSWITCH	FW0	B14
LETABBIT	FW9	B9
LETABORT	FW9	B9
LMOONFLG	FW8	B11
LOKONBIT	FW0	B5
LOKONSW	FW0	B5
LOSCMBIT	FW2	B12
LOSCMFLG	FW2	B12
LRALTBIT	FW12	B5
LRBYBIT	FW11	B15
LRBYPASS	FW11	B15
LRINH	FW11	B8
LRINHBIT	FW11	B8
LRPOSBIT	FW12	B6
LRVELFLG*	FW12	B8
LUNAFLAG	FW3	B12
MANUFLAG*	FW7	B14
MGLVFLAG	FW5	B2
MIDAVFLG	FW9	B2
MIDFLAG	FW0	B13
MID1FLAG	FW9	B3
MKOVBIT	FW4	B3
MOONFLAG	FW0	B12
MRKIDFLG*	FW4	B15
MRKNVBIT	FW4	B9
MRKNVFLG	FW4	B9
MRUPTFLG*	FW4	B5
MUNFLAG	FW6	B8
MUNFLBIT	FW6	B8
MWAITFLG*	FW4	B11
NEEDLBIT	FW0	B4
NEEDLFLG	FW0	B4
NEED2BIT	FW0	B15
NEED2FLG	FW0	B15
NEWIFLG	FW8	B13
NJETSFLG	FW1	B15
NODOBIT	FW2	B1
NODOFLAG	FW2	B1
NOLRRBIT	FW11	B10
NOLRREAD	FW11	B10
NOPO7BIT	FW3	B11
NORMSW	FW7	B10

*These switches are never called by name.

FLAGWORD BIT ASSIGNMENTS (ALPHABETICAL) FOR LUMINARY

NORRMBIT	FW5	B4
NORRMON	FW5	B4
NOTERBT	FW1	B11
NOTERFLG	FW1	B11
NOTHRBIT	FW5	B12
NOTHROTL	FW5	B12
NOUPFBIT	FW1	B6
NOUPFLAG	FW1	B6
NPGNCSBT	FW10	B1
NPGNCSFL	FW10	B1
NRMNVFLG	FW4	B8
NRMIDFLG*	FW4	B13
NRUPTFLG*	FW4	B4
NTARGFLG	FW6	B3
NWAITFLG*	FW4	B10
ORBWFLAG	FW3	B6
ORDERSW	FW8	B6
OURRCBIT	FW13	B12
PDSPFBIT	FW5	B14
PDSPFLAG	FW5	B14
PFRATBIT	FW2	B4
PFRATFLG	FW2	B4
PINBRFLG	FW4	B6
POOHFLAG	FW3	B15
PRECIFLG	FW3	B8
PRIODBIT	FW4	B14
PRONVFLG	FW4	B7
PSTHIBIT	FW11	B11
PULSEFLG	FW13	B15
PULSES	FW13	B15
P21FLAG	FW0	B11
P21FLBIT	FW0	B11
P25FLAG	FW0	B9
P25FLBIT	FW0	B9
P66PROBT	FW0	B1
P66PROFL	FW0	B1
P7071FLG	FW9	B13
QUITFLAG	FW9	B5
RADMODES	FW12	
RCDUFBIT	FW12	B7
RCDU0BIT	FW12	B13
REDFLAG	FW6	B6
REDFLBIT	FW6	B6
REFSMBIT	FW3	B13
REFSMFLG	FW3	B13
REINTBIT	FW10	B7
REINTFLG	FW10	B7
REMODBIT	FW12	B14
RENDWBIT	FW5	B1
RENDWFLG	FW5	B1
REPOSBIT	FW12	B11
RHCSCALE	FW13	B7
RNDVZBIT	FW0	B7
RNDVZFLG	FW0	B7
RNGEDBIT	FW11	B4
RNGSCBIT	FW5	B10
RNGSCFLG	FW5	B10
RODFLAG	FW1	B12
RODFLBIT	FW1	B12
ROTFLAG	FW9	B6
RPQFLAG	FW8	B15
RRDATABT	FW12	B4
RRNBSW	FW0	B6
RRRSBIT	FW12	B3
RVSW	FW7	B9
R04FLAG	FW3	B9
R04FLBIT	FW3	B9
R10FLG	FW0	B2
R10FLBIT	FW0	B2
R12RDBIT	FW11	B3
R61FLAG	FW1	B10
R61FLBIT	FW1	B10
R77FLAG	FW5	B11
R77FLBIT	FW5	B11
SLOPESW	FW1	B3
SNUFFBIT	FW5	B13
SNUFFER	FW5	B13
SOLNSW	FW5	B3
SRCHOBIT	FW2	B14
SRCHOPTN	FW2	B14
STATEBIT	FW3	B5
STATEFLG	FW3	B5
STEERBIT	FW2	B11
STEERSW	FW2	B11
SURFFBIT	FW8	B8
SURFFLAG	FW8	B8
SWANDBIT	FW7	B11
SWANDISP	FW7	B11
S32.1F1	FW6	B15
S32.1F2	FW6	B14
S32.1F3A	FW6	B13
S32.1F3B	FW6	B12
TFFSW	FW7	B1
TRACKBIT	FW1	B5
TRACKFLG	FW1	B5
TURNONBT	FW12	B1
ULLAGER	FW13	B6
ULLAGFLG	FW13	B6
UPDATBIT	FW1	B7
UPDATFLG	FW1	B7
UPLOCBIT	FW7	B4
USEQRJTS	FW13	B14
VEHUPFLG	FW1	B8
VELDABIT	FW11	B7
VERIFBIT	FW7	B3
VFAILFLG	FW11	B14
VFLAG	FW3	B10
VFLSHBIT	FW11	B2
VFLSHFLG	FW11	B2
VINTFLAG	FW3	B3
VXINH	FW11	B12
VXINHBIT	FW11	B12
V37FLAG	FW7	B6
V37FLBIT	FW7	B6
V67FLAG	FW7	B8
V82EMFLG	FW7	B2
XDELVFLG	FW2	B8
XDSPBIT	FW4	B1
XDSPFLAG	FW4	B1
XORFLBIT	FW11	B9
XORFLG	FW11	B9
XOVINFLG	FW13	B9
XOVINHIB	FW13	B9
ZOOMBIT	FW5	B8
ZOOMFLAG	FW5	B8
3AXISBIT	FW5	B6
3AXISFLG	FW5	B6
360SW	FW8	B1

*These switches are never called by name.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 0, LOCATION 0074_8)

Bit	Name	1	0
1	P66PROFL P66PROBT	Continue P66 horizontal velocity nulling.	Stop P66 horizontal velocity nulling.
2	R10FLAG R10FLBIT	R10 outputs data to altitude and altitude rate meters only.	Besides outputs to altitude and altitude rates, when set, R10 also outputs data to forward and lateral velocity crosspointer
3	FREEFBIT FREEFLAG	Used by P51-P52 in many different routines and by lunar and solar ephemerides.	
4	NEEDLBIT NEEDLFLG	Total attitude error displayed.	A/P following error displayed.
5	LOKONBIT LOKONSW	Radar lock-on desired.	Radar lock-on not desired.
6	RRNBSW	Radar target in NB coordinates.	Radar target in SM coordinates.
7	RNDVZBIT RNDVZFLG	P20 or P22 running (radar in use).	P20 or P22 not running.
8	IMUSE IMUSEBIT	IMU in use.	IMU not in use.
9	P25FLAG P25FLBIT	P25 operating.	P25 not operating
10	FSPASFLG	First pass through reposition routine. Allow alarm 526.	Not first pass through reposition routine. Do not allow alarm 526.
11	P21FLAG P21FLBIT	Succeeding pass through P21; use base vectors already calculated.	First pass through P21; calculate base vectors.
12	MOONFLAG	Moon is sphere of influence.	Earth is sphere of influence.
13	MIDFLAG	Integration with secondary body and solar perturbations.	Integration without solar perturbations.
14	JSWITCH	Integration of W matrix.	Integration of state vector.
15	NEED2BIT NEED2FLG	Display DAP rates on FDAI needles.	Check Bit 4 of this FLAGWORD for display modes (1 or 2).

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 1, LOCATION 0075_8)

Bit	Name	1	0
1	Not Assigned		
2	GUESSW	No starting value for iteration.	Starting value for iteration exists.
3	SLOPESW	Iterate with bias method in iterator.	Iterate with Regula Falsi method in iterator.
4	FRSTIME FRSTMBIT	First time through reposition.	Not first time through reposition.
5	TRACKBIT TRACKFLG	Tracking allowed.	Tracking not allowed.
6	NOUPFBIT NOUPFLAG	Neither CSM nor LM state vector may be updated.	Either state vector may be updated.
7	UPDATBIT UPDATFLG	Updating by marks allowed.	Updating by marks not allowed.
8	VEHUPFLG	CSM state vector being updated.	LM state vector being updated.
9	Not Assigned		
10	R61FLAG R61FLBIT	Run R61 LM.	Run R65 LM.
11	NOTERBT NOTERFLG	LM Terrain Model inhibited.	LR Terrain Model permitted.
12	RODFLAG RODFLBIT	If in P66, normal operation continues. Restart clears flag.	If in P66, reinitialization is performed.
13	ERADFLAG	Compute REARTH Fischer ellipsoid.	Use constant REARTH pad radius.
14	DIDFLBIT	Inertial data is available.	Perform data display initialization functions.
15	NJETSFLG	Two-jet RCS burn.	Four-jet RCS burn.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 2, LOCATION 0076_8)

Bit	Name	1	0
1	NODOBIT NODOFLAG	V37 not permitted.	V37 permitted.
2	CALCMAN2	Perform maneuver starting procedure.	Bypass starting procedure.
3	CALCMAN3	No final roll.	Final roll is necessary.
4	PFRATBIT PFRATFLG	Preferred attitude computed.	Preferred attitude not computed.
5	AVFLAG	LM is active vehicle.	CSM is active vehicle.
6	FINALFLG	Last pass through rendezvous program computations.	Interim pass through rendezvous program computations.
7	ETPIFLAG	Elevation angle supplied for P34, P74.	TPI time supplied for P34, P74 to compute elevation.
8	XDELVFLG	External Delta V VG computation.	Lambert (aimpoint) VG computation.
9	IMPULBIT IMPULSW	Minimum impulse burn (cutoff time specified).	Steering burn (no cutoff time yet available).
10	Not Assigned		
11	STEERBIT STEERSW	Sufficient thrust is present.	Insufficient thrust is present.
12	LOSCMBIT LOSCMFLG	Line of sight being computed (R21).	Line of sight not being computed (R21).
13	ACMODFLG	Manual acquisition by Rendezvous Radar.	Auto acquisition by Rendezvous Radar.
14	SRCHOBIT SRCHOPTN	Radar in automatic search option (R24).	Radar not in automatic search option.
15	DRFTBIT DRIFTFLG	T3RUPT calls gyro compensation.	T3RUPT does no gyro compensation.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 3, LOCATION 0077_8)

Bit	Name	1	0
1	DIMOFLAG	W matrix is to be used.	W matrix is not to be used.
2	D6OR9FLG	Dimension of W is 9 for integration.	Dimension of W is 6 for integration.
3	VINTFLAG	CSM state vector being integrated.	LM state vector being integrated.
4	INTYPFLG	Conic integration.	Encke integration.
5	STATEBIT STATEFLG	Permanent state vector being updated.	Permanent state vector not being updated.
6	ORBWFLAG	W matrix valid for orbital navigation.	W matrix invalid for orbital navigation.
7	CULTFLAG	Star occulted.	Star not occulted.
8	PRECIFLG	Normal integration in P00.	Engages four-time step (P00) logic in integration.
9	R04FLAG R04FLBIT	R04 running.	R04 not running.
10	VFLAG	Less than two stars in the field of view.	Two stars in the field of view.
11	NOP07BIT	System tests not allowed.	System tests allowed.
12	LUNAFLAG	Lunar latitude-longitude.	Earth latitude-longitude.
13	REFSMBIT REFSMFLG	REFSMMAT good (protected from FRESH START).	REFSMMAT no good (protected from FRESH START).
14	GLOKFAIL	GIMBAL LOCK has occurred.	Not in GIMBAL LOCK.
15	POOHFLAG	Inhibit backwards integration.	Allow backwards integration.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 4, LOCATION 0100_8)

Bit	Name	1	0
1	XDSPBIT XDSPFLAG	Mark display not to be interrupted.	No special mark information.
2	Not Assigned		
3	MKOVBIT	Mark display over normal.	No mark display over normal.
4	NRUPTFLG*	Normal display interrupted by priority or mark display.	Normal display not interrupted by priority or mark display.
5	MRUPTFLG*	Mark display interrupted by priority display.	Mark display not interrupted by priority display.
6	PINBRFLG	Astronaut has interferred with existing display.	Astronaut has not interferred with existing display.
7	PRONVFLG	Astronaut using keyboard when priority display initiated.	Astronaut not using keyboard when priority display initiated.
8	NRMNVFLG	Astronaut using keyboard when normal display initiated.	Astronaut not using keyboard when normal display initiated.
9	MRKNVBIT MRKNVFLG	Astronaut using keyboard when mark display initiated.	Astronaut not using keyboard when mark display initiated.
10	NWAITFLG*	Higher priority display operating when normal display initiated.	No higher priority display operating when normal display initiated.
11	MWAITFLG*	Higher priority display operating when mark display initiated.	No higher priority display operating when mark display initiated.
12	Not assigned		
13	NRMIDFLG*	Normal display in ENDIDLE.	No normal display in ENDIDLE.
14	PRIODBIT	Priority display in ENDIDLE.	No priority display in ENDIDLE.
15	MRKIDFLG*	Mark display in ENDIDLE.	No mark display in ENDIDLE.

*These switches are never called by name.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 5, LOCATION 0101_8)

Bit	Name	1	0
1	RENDWBIT RENDWFLG	W matrix valid for rendezvous navigation.	W matrix invalid for rendezvous navigation.
2	MGLVFLAG	Local vertical coordinates computed.	Middle gimbal angle computed.
3	SOLNSW	Lambert does not converge, or time-radius nearly circular.	Lambert converges or time-radius noncircular.
4	NORRMBIT NORRMON	Bypass RR gimbal monitor.	Perform RR gimbal monitor.
5	AORBSYST	Prefer P-axis jet pairs 7, 15 and 8, 16.	Prefer P-axis jet pairs 4,12 and 3, 11.
6	3AXISBIT 3AXISFLG	Maneuver specified by three axes.	Maneuver specified by one axis; R60 call VECPOINT.
7	ENGONBIT	Engine turned on.	Engine turned off.
8	ZOOMBIT ZOOMFLAG	Throttleup has occurred in P63.	Throttleup has not occurred in P63.
9	DMENFLG DMENFBIT	Dimension of W is 9 for incorporation.	Dimension of W is 6 for incorporation.
10	RNGSCBIT RNGSCFLG	Scale change has occurred during RR reading.	No scale change has occurred during RR reading.
11	R77FLAG R77FLBIT	R77 is on; suppress all radar alarms and tracker fails.	R77 is not on.
12	NOTHRBIT NOTHROTL	Inhibit full throttle.	Permit full throttle.
13	SNUFFER SNUFFBIT	U, V jets disabled during DPS burns (V65).	U, V jets enabled during DPS burns (V75).
14	PDSFLAG PDSPFBIT	R60 does priority display and is restart protected.	R60 does normal display and is not restart protected.
15	DSKYFBIT	Displays sent to DSKY.	No displays to DSKY.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 6, LOCATION 0102_8)

Bit	Name	1	0
1	ATTFLAG ATTFLBIT	LM attitude exists in moon-fixed coordinates.	No LM attitude available in moon-fixed coordinates.
2	AUXFLBIT	Providing IDLEFLAG is not set, SERVICER will exercise DVMON on its next pass.	SERVICER will skip DVMON on its next pass even if the IDLEFLAG is not set. It will then set AUXFLBIT.
3	NTARGFLG	Astronaut did overwrite Delta V at TPI or TPM (P34, P35).	Astronaut did not overwrite Delta V.
4	Not Assigned		
5	Not Assigned		
6	REDFLAG REDFLBIT	Landing site redesignation permitted.	Landing site redesignation not permitted.
7	Not Assigned		
8	MUNFLAG MUNFLBIT	SERVICER calls MUNRVG.	SERVICER calls CALCRVG.
9	Not Assigned		
10	GMBDRBIT GMBDRVSW	TRIMGIMB over.	TRIMGIMB not over.
11	Not Assigned		
12 13	S32.1F3B S32.1F3A	(Bits 12 and 13 function as an ordered pair (13, 12) indicating the possible occurrence of two Newton iterations for S32.1: (0, 0) — First pass of second Newton iteration, (0, 1) — First Newton iteration being done, (1, 0) — Remainder of second Newton iteration, (1, 1) — 50 ft/s stage of second Newton iteration.)	
14	S32.1F2	First pass of Newton iteration.	Reiteration of Newton.
15	S32.1F1	Delta V at CSI Time 1 exceeds maximum.	Delta V at CSI Time 1 less than maximum.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 7, LOCATION 0103_8)

Bit	Name	1	0
1	TFFSW	Calculate TPERIGEE.	Calculate TFF.
2	V82EMFLG	Moon vicinity.	Earth vicinity.
3	VERIFBIT	(Changed when V33E occurs at end of P27).	
4	UPLOCBIT	K-$\overline{K}$-K fail.	No K-$\overline{K}$-K fail.
5	AVEGFBIT AVEGFLAG	AVERAGEG (SERVICER) desired.	AVERAGEG (SERVICER) not desired.
6	V37FLAG V37FLBIT	AVERAGEG (SERVICER) running.	AVERAGEG (SERVICER) off.
7	IDLEFBIT IDLEFLAG	No Delta V monitor.	Connect Delta V monitor.
8	V67FLAG	Astronaut overwrites W-matrix initial values.	Astronaut does not overwrite W-matrix initial values.
9	RVSW	Do not compute final state vector in time-theta.	Compute final state vector in time-theta.
10	NORMSW	Unit normal input to Lambert.	Lambert computes its own normal.
11	SWANDBIT SWANDISP	Landing analog displays enabled.	Landing analog displays suppressed.
12	ASTNBIT ASTNFLAG	Astronaut has OKed ignition.	Astronaut has not OKed ignition.
13	IGNFLAG IGNFLBIT	TIG has arrived.	TIG has not arrived.
14	MANUFLAG*	Attitude maneuver going on during RR search.	No attitude maneuver during RR search.
15	ITSWICH	P34; TPI time to be computed.	TPI has been computed.

*These switches are never called by name.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 8, LOCATION 0104_8)

Bit	Name	1	0
1	360SW	Transfer angle near 360 degrees.	Transfer angle not near 360 degrees.
2	INITABIT INITALGN	Initial pass through P57.	Second pass through P57.
3	Not Assigned		
4	COGAFLAG	No conic solution, too close to rectilinear (COGA overflows).	Conic solution exists (COGA does not overflow).
5	APSESW	RDESIRED outside of PERICENTER-APOCENTER range in time-radius.	RDESIRED inside of PERICENTER-APOCENTER range in time-radius.
6	ORDERSW	Iterator uses second order minimum mode.	Iterator uses first order standard mode.
7	INFINFLG	No conic solution (closure through infinity required).	Conic solution exists.
8	SURFFBIT SURFFLAG	LM on lunar surface (protected from FRESH START).	LM not on lunar surface (protected from FRESH START).
9	Not Assigned.		
10	FLUNDBIT FLUNDISP	Current guidance displays inhibited.	Current guidance displays permitted.
11	LMOONFLG	Permanent LM state vector in lunar sphere (protected from FRESH START).	Permanent LM state vector in earth sphere (protected from FRESH START).
12	CMOONFLG	Permanent CSM state vector in lunar sphere (protected from FRESH START).	Permanent CSM state vector in earth sphere (protected from FRESH START).
13	NEWIFLG	First pass through integration.	Succeeding iteration of integration.
14	Not Assigned		
15	RPQFLAG	RPQ not computed. (RPQ = vector between secondary body and primary body.)	RPQ computed.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 9, LOCATION 0105_8)

Bit	Name	1	0
1	AVEMIDSW	AVETOMID calling for W-matrix integration. Do not overwrite RN, VN, PIPTIME.	No AVETOMID W-matrix integration. Allow setup of RN, VN, PIPTIME.
2	MIDAVFLG	Integration entered from one of MIDTOAV portals.	Integration was not entered via MIDTOAV.
3	MID1FLAG	Integrate to TDEC.	Integrate to the then-present time.
4	FLT59FLG FLT59BIT	Lunar surface mark procedure used during inflight alignment.	Normal marking to be used during inflight alignment.
5	QUITFLAG	Discontinue integration.	Continue integration.
6	ROTFLAG	P70 and P71 will force vehicle rotation in the preferred direction.	P70 and P71 will not force vehicle rotation in the preferred direction.
7	ABTTFLAG	J2, K2 parameters used for abort targeting.	J1, K1 parameters used for abort targeting.
8	FLAP	APS continued abort after DPS staging (ascent guidance).	APS abort is not a continuation.
9	LETABBIT LETABORT	Abort programs are enabled.	Abort programs are not enabled.
10	FLRCS FLRCSBIT	RCS injection mode (ascent guidance).	Main engine mode.
11	FLPI	Preignition phase (ascent guidance).	Regular guidance.
12	FLPC	No position control (ascent guidance).	Position control.
13	P7071BIT P7071FLG	P70 or P71 is using ascent guidance equations.	P12 is using ascent guidance equations.
14	FLVR	Vertical rise (ascent guidance).	Nonvertical rise.
15	Not Assigned		

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 10, RASFLAG, LOCATION 0106_8)

Bit	Name	1	0
1	NPGNCSFL NPGNCSBT	Last active DAP. Pass done with an AGS indication.	Last active DAP. Pass done with a PGNCS indication.
2	CONTRLFL CONTRLBT	DAP controlling Vehicle attitude.	DAP not controlling Vehicle attitude.
3-6	Not Assigned		
7	REINTBIT REINTFLG	Integration routine to be RESTARTED.	Integration routine not to be RESTARTED.
8-12	Not Assigned		
13	APSFLAG APSFLBIT	Ascent stage (protected from FRESH START).	Descent stage (protected from FRESH START).
14	INTFLBIT	Integration in progress.	Integration not in progress.
15	Not Assigned		

(FLAGWORD 11, LOCATION 0107_8)

Bit	Name	1	0
1	HFLSHBIT HFLSHFLG	LR altitude fail lamp should be flashing.	LR altitude fail lamp should not be flashing.
2	VFLSHBIT VFLSHFLG	LR velocity fail lamp should be flashing.	LR velocity fail lamp should not be flashing.
3	R12RDBIT	Wait until velocity reads done before R12 processing.	Allow R12 processing of velocity data.
4	RNGEDBIT	LR altitude measurement made.	LR altitude measurement not made.
5-6	Not Assigned		
7	VELDABIT	LR velocity measurement made.	LR velocity measurement not made.
8	LRINH LRINHBIT	LR updates permitted by astronaut.	LR updates inhibited by astronaut.
9	XORFLBIT XORFLG	Below limit; inhibit X-axis override.	Above limit; do not inhibit.
10	NOLRRBIT NOLRREAD	LR repositioning; bypass update.	LR not repositioning.
11	PSTHIBIT	Posthigate.	Prehigate.
12	VXINH VXINHBIT	Since Z velocity data unreasonable, bypass X-axis velocity update on next pass.	Update X-axis velocity.
13	HFAILFLG	LR altitude reasonability test failed.	Passed LR altitude reasonability test.
14	VFAILFLG	LR velocity reasonability test failed	Passed LR velocity reasonability test.
15	LRBYBIT LRBYPASS	Bypass all LR updates.	Do not bypass LR updates.

*These switches are never called by name.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 12, RADMODES, LOCATION 0110_8)

Bit	Name	1	0
1	TURNONBT	RR turn-on sequence in progress (zero RR CDU's; fix antenna position).	No RR turn-on sequence in progress.
2	AUTOMBIT	RR not in Auto mode. Auto mode discrete is not present.	RR in Auto mode.
3	RRRSBIT	RR range reading on the high scale.	RR range reading on the low scale.
4	RRDATABT	RR data fail. Data could not be read successfully.	No RR data fail.
5	LRALTBIT	LR altitude data fail. Data could not be read successfully.	No LR altitude data fail.
6	LRPOSBIT	LR in Position 2.	LR in Position 1.
7	RCDUFBIT	RR CDU fail has not occurred.	RR CDU fail has occurred.
8	LRVELFLG*	LR velocity data fail.	No LR velocity data fail.
9	ALTSCALE*	LR altitude reading is on high scale.	LR altitude reading is on low scale.
10	DESIGBIT DESIGFLG	RR designate requested or in progress.	RR designate not requested or in progress.
11	REPOSBIT	Reposition monitor, RR reposition is taking place.	No RR reposition taking place.
12	ANTENBIT	RR antenna is in Mode 2.	RR antenna is in Mode 1.
13	RCDU0BIT	RR CDU's being zeroed.	RR CDU's not being zeroed.
14	REMODBIT	Change in antenna mode has been requested.	No remode requested or occurring.
15	CDESBIT CDESFLAG	Continuous designate. LGC commands RR regardless of lock-on.	LGC checks for lock-on when antenna being designated.

*These switches are never called by name.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

(FLAGWORD 13, DAPBOOLS, LOCATION 0111_8)

Bit	Name	1	0
1 2	AUTR1FLG* AUTR2FLG*	These bits (2, 1) are used together to indicate astronaut-chosen KALCMANU maneuver rates: (0, 0) = 0.2 deg/second (Bit 2, Bit 1), (0, 1) = 0.5 deg/second, (1, 0) = 2.0 deg/second, (1, 1) = 10.0 deg/second.	
3	ACCSOKAY	Control authority values from 1/ACCS usable.	RESTART or FRESH START since last 1/ACCS; outputs suspect.
4	DBSELECT	1-degree deadband selected by crew.	Minimum deadband selected by crew (0.3 degree).
5	DBSLECT2	5-degree deadband selected by crew (maximum deadband).	1- or 0.3-degree deadband selected by crew (See Bit 4).
6	ULLAGER ULLAGFLG	Ullage request by mission program.	No internal ullage request.
7	RHCSCALE	Normal RHC scaling requested.	Fine RHC scaling requested.
8	DRIFTBIT DRIFTDFL	Assume zero offset drifting flight.	Use offset acceleration estimate.
9	XOVINFLG XOVINHIB	X-axis override locked out.	X-axis override OK.
10	AORBTFLG AORBTRAN	B system for X-translation preferred.	A system for X-translation preferred.
11	ACC4-2FL ACC4OR2X	Four-jet X-axis translation requested.	Two-jet X-axis translation requested.
12	OURRCBIT	Current DAP pass is rate command.	Current DAP pass is not rate command.
13	CSMDOCKD	CSM docked; use backup DAP.	CSM not docked to LM.
14	USEQRJTS	Gimbal unusable; use jets only.	Trim gimbal may be used.
15	PULSEFLG PULSES	Minimum impulse command mode in "attitude hold" (V76).	Not in minimum impulse command mode (V77).

*These switches are never called by name.

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

IMODES30, a flag whose individual bits are used to control the monitoring of IMU functions associated with Channel 30 (and in a few cases Channel 33). LOCATION 1277_8.

Bit	Meaning
15	Last sampled value of Channel 30, Bit 15 (0 if IMU temperature within limits).
14	Last sampled value of Channel 30, Bit 14 (0 if ISS has been turned on or commanded to be turned on).
13	Last sampled value of Channel 30, Bit 13 (0 if an IMU fail indication has been produced).
12	Last sampled value of Channel 30, Bit 12 (0 if an IMU CDU fail indication has been produced).
11	Last sampled value of Channel 30, Bit 11 (0 if an IMU cage command has been produced by crew).
10	Last sampled value of Channel 33, Bit 10 (0 if a PIPA fail indication has been produced), having the same value as Bit 13 of IMODES33.
9	Last sampled value of Channel 30, Bit 9 (0 if IMU has been turned on and operating with no malfunctions).
8	Bit used to control the IMU turn-on sequencing.
7	Bit used to control the IMU turn-on sequencing.
6	Bit is set to 1 to indicate that IMU initialization is being carried out.
5	Bit is set to 1 to inhibit the generation of program alarm 0212_8 if a PIPA fail signal (Bit 13 of Channel 33) is produced.
4	Bit is set to 1 to inhibit generation of an ISS warning based on receipt of an IMU fail signal.
3	Bit is set to 1 to inhibit generation of an ISS warning based on receipt of an IMU CDU fail signal.
2	Bit is set to 1 to indicate failure of the turn-on delay sequence for IMU turn-on (alarm 0207_8 is also generated).
1	Bit is set to 1 to inhibit generation of an ISS warning based on receipt of a PIPA fail signal (Bit 13 of Channel 33).

FLAGWORD BIT ASSIGNMENTS FOR LUMINARY

IMODES33, a flag whose individual bits are used to control the monitoring of functions associated with Channel 33 (and other items). LOCATION 1300_8

Bit	Meaning
15	Not assigned.
14	Last sampled value of Channel 32, Bit 14 (0 if a Proceed command is given using the old "standby" button).
13	Last sampled value of Channel 33, Bit 13 (0 if an accelerometer fail signal, or PIPA fail, has been produced by hardware).
12	Last sampled value of Channel 33, Bit 12 (0 if a telemetry end pulse has been rejected because the downlink rate is too fast).
11	Last sampled value of Channel 33, Bit 11 (0 if an uplink bit has been rejected because the uplink rate is too fast).
10,9	Not assigned.
8	Bit is set to 1 when R10 is initialized during powered flight.
7	Not used.
6	Bit is set to 1 to indicate that IMU use for vehicle attitude information should not be attempted.
5	Bit is set to 1 in IMU Zeroing routine external to T4RUPT while zeroing is taking place (for an interval of about 10.56 seconds).
4-2	Not assigned.
1	Bit is set to 1 when a Verb 35 ("lamp test") is received, and reset to 0 about 5 seconds later.

CHANNEL BIT ASSIGNMENT (LM)

INPUT CHANNEL 3

The high order lists of the LGC scaler. The least significant bit is worth 5.12 seconds. The maximum value is equivalent to approximately 23.3 hours.

INPUT CHANNEL 4

The lower order bits of the LGC scaler. The least significant bit is worth 1 centisecond. The maximum value is equivalent to 5.12 seconds.

INPUT CHANNELS 3 AND 4

Channels 3 and 4 are sampled as Time 1 and Time 2 and provide the time tags for the downlink lists.

OUTPUT CHANNEL 5

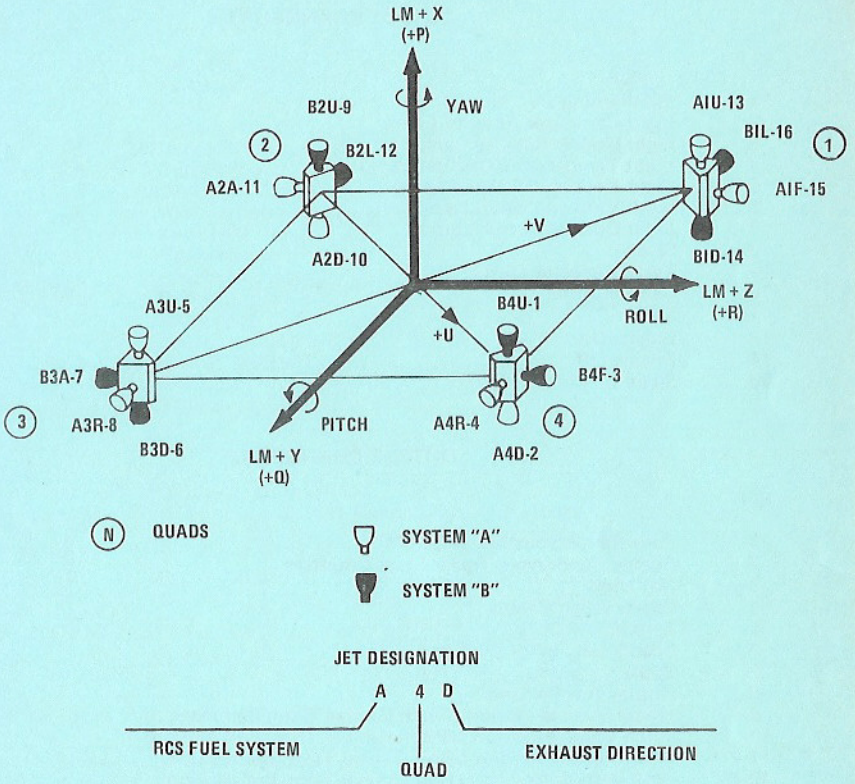
BIT	JET DESIGNATION	JET NO.	ROTATION EFFECT	(RCS JET FIRINGS) TRANSLATION EFFECT
1	B4U	1	+V	-X
2	A4D	2	-V	+X
3	A3U	5	+U	-X
4	B3D	6	-U	+X
5	B2U	9	-V	-X
6	A2D	10	+V	+X
7	A1U	13	-U	-X
8	B1D	14	+U	+X

Bits 9 - 15 not used

OUTPUT CHANNEL 6

BIT	JET DESIGNATION	JET NO.	ROTATION EFFECT	(RCS JET FIRINGS) TRANSLATION EFFECT
1	B3A	7	+P	+Z
2	B4F	3	-P	-Z
3	A1F	15	+P	-Z
4	A2A	11	-P	+Z
5	B2L	12	+P	+Y
6	A3R	8	-P	-Y
7	A4R	4	+P	-Y
8	B1L	16	-P	+Y

LM RCS JET CONTROL AXES



The P, Q & R axis designations are used with rotations and the X, Y & Z designations are used with translations. U & V are used with both.

The astronaut can disable jets on each QUAD only in pairs and according to RCS fuel systems.

CHANNEL BIT ASSIGNMENTS (LM)

OUTPUT CHANNEL 11

BIT	
1	ISS Warning
2	Light Computer Activity Lamp
3	Light Uplink Activity Lamp
4	Light Temperature Caution Lamp
5	Light Keyboard Release Lamp
6	Flash Verb and Noun Lamps
7	Light Operator Error Lamp
8	Spare
9	Test Connector Outbit
10	Caution Reset
11-12	Spare
13	Engine On
14	Engine Off
15	Spare

OUTPUT CHANNEL 12

BIT	
1	Zero Rendezvous Radar CDU's
2	Enable Rendezvous Radar Error Counters
3	Not Used
4	Coarse Align Enable
5	Zero IMU CDU's
6	Enable IMU Error Counters
7	Spare
8	Display Inertial Data
9	+Pitch Vehicle Motion (-Pitch Gimbal Trim, Bell motion)
10	-Pitch Vehicle Motion (+Pitch Gimbal Trim, Bell motion)
11	+Roll Vehicle Motion (-Roll Gimbal Trim, Bell motion)
12	-Roll Vehicle Motion (+Roll Gimbal Trim, Bell motion)
13	Landing Radar Position 2 Command
14	Rendezvous Radar Enable Auto Track
15	ISS Turn-on Delay Complete

CHANNEL BIT ASSIGNMENTS (LM)

OUTPUT CHANNEL 13

BIT	
1	Radar Select c
2	Radar Select b
3	Radar Select a
4	Radar Activity
5	Inhibit Uplink, Enable Crosslink (should not be set to 1)
6	Block Inlink
7	Downlink Word Order
8	RHC Counter Enable
9	Start RHC Read
10	Test Alarms
11	Enable Standby
12	Reset Trap 31-A
13	Reset Trap 31-B
14	Reset Trap 32
15	Enable T6RUPT

Channel 13 Radar Selections

a	b	c	Function
0	0	0	—
0	0	1	Rendezvous Radar range
0	1	0	Rendezvous Radar range rate
0	1	1	—
1	0	0	Landing Radar X velocity
1	0	1	Landing Radar Y velocity
1	1	0	Landing Radar Z velocity
1	1	1	Landing Radar range

OUTPUT CHANNEL 14

BIT	
1	Outlink Activity (should not be set to 1)
2	Altitude Rate Select
3	Altitude Meter Activity
4	Thrust Drive
5	Spare
6	Gyro Enable
7	Gyro Select b
8	Gyro Select a
9	Gyro Sign Minus
10	Gyro Activity
11	Drive CDU S
12	Drive CDU T
13	Drive CDU Z
14	Drive CDU Y
15	Drive CDU X

Channel 14-Gyro Selection

a	b	Gyro
0	0	—
0	1	X
1	0	Y
1	1	Z

CHANNEL BIT ASSIGNMENTS (LM)

INPUT CHANNEL 15

BIT

1-5	KEY codes from main DSKY
6-15	Spare

DSKY CHARACTER		KEY CODE CHANNEL 15 (BITS 5 THROUGH 1)
0		10000
1		00001
2		00010
3		00011
4		00100
5		00101
6		00110
7		00111
8		01000
9		01001
VERB		10001
NOUN		11111
ENTER	(ENTR)	11100
ERROR RESET	(RSET)	10010
CLEAR	(CLR)	11110
KEY RELEASE	(KEY REL)	11001
"+" (PLUS)		11010
"-" (MINUS)		11011
PROCEED	(PRO)	NONE (HARDWARE ONLY USE V33E)

CHANNEL BIT ASSIGNMENTS (LM)

INPUT CHANNEL 16

BIT

1-2	Spare
3	Mark X
4	Mark Y
5	Mark reject
6	Descent +
7	Descent -
8-15	Spare

INPUT CHANNEL 30

BIT

1	Abort with Descent Stage
2	Descent Stage Attached
3	Engine Armed
4	Abort with Ascent Stage
5	Auto Throttle
6	Display Inertial Data
7	Rendezvous Radar CDU Fail
8	Spare
9	IMU Operate
10	G/N Control of S/C
11	IMU Cage
12	IMU CDU Fail
13	IMU Fail
14	ISS Turn-On Request
15	Temp in Limits

NOTE:
All of the input signals in Channel 30 are inverted; that is, a ZERO bit indicates that the discrete is ON.

INPUT CHANNEL 31

BIT

1	+EL (LPD), + PMI
2	-EL (LPD), - PMI
3	+ YMI
4	-YMI
5	+AZ (LPD), +RMI
6	-AZ (LPD), -RMI
7	+X Translation
8	-X Translation
9	+Y Translation
10	-Y Translation
11	+Z Translation
12	-Z Translation
13	Attitude Hold
14	Auto Stabilization
15	Attitude Control Out of Detent

NOTE:
All of the input signals in Channel 31 are inverted; that is, a ZERO bit indicates that the discrete is ON.

CHANNEL BIT ASSIGNMENTS (LM)

INPUT CHANNEL 32

BIT	
1	Thruster 2 – 4 Disabled by Crew
2	Thruster 5 – 8 Disabled by Crew
3	Thruster 1 – 3 Disabled by Crew
4	Thruster 6 – 7 Disabled by Crew
5	Thruster 14 – 16 Disabled by Crew
6	Thruster 13 – 15 Disabled by Crew
7	Thruster 9 – 12 Disabled by Crew
8	Thruster 10 – 11 Disabled by Crew
9	Descent Engine Gimbals Disabled by Crew
10	Apparent Descent Engine Gimbal Fail
11-13	Spare
14	Proceed
15	Spare

NOTE:
All of the input signals in Channel 32 are inverted; that is, a ZERO bit indicates that the discrete is ON.

INPUT CHANNEL 33

BIT	
1	Spare
2	Rendezvous Radar Auto-Power On
3	Rendezvous Radar Range Low Scale
4	Rendezvous Radar Data Good
5	Landing Radar Range Data Good
6	Landing Radar Position 1
7	Landing Radar Position 2
8	Landing Radar Velocity Data Good
9	Landing Radar Range Low Scale
10	Block Uplink Input*
11	Uplink Too Fast
12	Downlink Too Fast
13	PIPA Fail
14	LGC Warning (repeated hardware or software alarms)
15	Oscillator Alarm

*This bit reads ONE when accept uplink signal is present at interface.

NOTE:
All of the input signals in Channel 33 are inverted; that is, a ZERO bit indicates that the discrete is ON. Bits 15-11 are flip-flop bits reset by a channel write command, restart, and T4RUPT loop.

INPUT CHANNEL 77

BIT	
15-10	Spare
9	Scaler Double Frequency
8	Scaler Fail
7	Counter Fail
6	Voltage Fail
5	Night Watchman
4	RUPT Lock
3	TC Trap
2	E Memory Parity Fail
1	E Memory or F Memory Parity Fail