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Sugert

SECTION VI

FLIGHT OPERATION PROCEDURES

6.1 NORMAL AND BACKUP PROCEDURES

For normal procedures, refer to Guidance System Operation Plan for Manned CM Earth Orbital Mission Using Program Sundisk, Section 4 GNCS Operational Mode (GSOP) and/or Block II CSM Flight Crew Abbreviated Checklist.

The primary backup for ISS and CMC failures is to switch to SCS control. SCS procedures are contained in the Crew Abbreviated Checklist. Backup use of the COAS for an OSS failure is found in programs P53 and P54 in the GSOP. Some programs and routines (e.g., P47, R62) may be used for backup procedures in some instances. Some very short backup procedures are contained in the normal procedures in the GSOP; e.g., manual backup of lift-off discrete and manual backup of thrust off. The extended verb procedures in the GSOP can be considered as backup procedures. Backup procedures which do not appear in other documents are contained in this section.

6.1.1 CMC Self Check

The CMC self check consists of four tests which may be commanded individually or together. The latter is recommended for in flight use.

The first test is a check of control pulses. It consists of two parts.

Part "a" checks the control pulses for normal basic instructions. Part "b" checks control pulses for input-output channel read and write instructions.

Test 2 checks special and central processor registers. Test 3 checks the CMC ability to properly address and read into and out of each bit in erasable memory. Test 4 adds all the cells of each bank of fixed memory and compares the sum to the bank number. They must be the same to pass the test.

During performance of CMC self check it is recommended that certain erasable addresses be monitored. These include the following:

- One greater than the address which contains the instruction to go to the ERRORS routine. It is loaded only when an error is detected.
- 1365 (ERCOUNT) Number of errors since last time address was zeroed by self check or fresh start.
- 1366 (SCOUNT) Number of times one of the four tests of self check was begun since last time address was zeroed.
- 1367 (SCOUNT + 1) Number of times erasable memory was successfully tested in self check since last time address was zeroed.

The following procedure is recommended for in flight performance of self check:

1. Command P00:

Key: V37E 00E

2. Zero ERCOUNT, SCOUNT, and SCOUNT + 1:

Key: V25 N01E 1365E ENTR ENTR ENTR

3. Start monitor of ERCOUNT, SCOUNT, and SCOUNT + 1:

Key: V15 N01E 1365E

4. Command self check:

Key: V21 N27E 10E KEY REL 5. Monitor register R2 (SCOUNT):

Normal indication: 00001 for 35 to 45 milliseconds

00002 for about 20 seconds 00003 for about 7 seconds 00004 for about 43 seconds

00005 or greater (successful self check,

go to step 7)

Abnormal indication: PROG light comes on.

R2 stops before 00005.

(Go to step 6)

6. Record results:

Record R1 (ERCOUNT), R2 (SCOUNT), and R3 (SCOUNT + 1)

Key: V05 N09E

Verify alarm code 01102

Key: V05 N08E

Record R1 (ALMCADR)

7. Terminate self check:

Key: V21 N27E

OE

If PROG light is on, key RSET.

8. Use following table for diagnosis of failure.

Recorded SCOUNT	Action to take	Probable trouble		
00001	Transmit ALMCADR to MSFN.	CMC control problem.		
00002	Transmit ALMCADR to MSFN. Terminate use of CMC.	Special register or central problem. CMC not useable.		
00003	1. Key: V01 N01E 1374E	Erasable memory problem. Don't use CMC.		
	2. Record R1 (SKEEP 4)			
	3. Key: ENTR 1377E			
	4. Record R1 (SKEEP 7)			
	5. Transmit ALMCADR, SKEEP 4, and SKEEP 7 to MSFN			
	6. Terminate use of CMC			
00004	Perform SHOW BANKSUM (para. 6.1.2). Transmit bank number of failed bank to MSFN.	Fixed memory trouble. CN not useable.		

6.1.2 Fixed Memory Check (SHOW BANKSUM):

SHOW BANKSUM is a CMC routine which checks all the cells in each fixed memory bank. The test adds all the cells for each bank and displays the sum in R2. These values must be equal for a successful test. If they are not, the bank has an error in it.

Perform SHOW BANKSUM as follows:

1. Command P00:

Key: V37E 00E

2. Check first bank:

Key: V91E

Monitor: Flashing V05 N01

R1 - Sum of cells in bank

R2 - Bank number

- If R1 and R2 are the same, check next bank:Key: PRO
- 4. Repeat steps 2 and 3 for each succeeding bank until the last bank (43) has been checked.
- 5. If R1 and R2 differ for any bank, record bank number and transmit to MSFN. Terminate use of CMC after completion of test, until further notice by MSFN.
- 6. To terminate SHOW BANKSUM:
 Key: V34E

6.1.3 CMC Input-Output Channel Check

To determine the state of discretes to or from the CMC, the input and output channels can be checked. This is done as follows:

- 1. Key: V01 N10E
- 2. Key: XXE, where XX is the number of the channel desired.
- 3. Monitor R1, which contains the 15 binary bits of the channel in octal.

To determine the state of each bit, the octal number in the register must be converted to binary. This needn't be done for the entire register, but only for the octal digit that contains the bit in question. Bits 1, 2, and 3 of the channel word appear in digit position 1 (from the right) of R1; bits 4, 5, and 6...in digit position 2, bits 7, 8, and 9...position 3; bits 10, 11, and 12...position 4; and bits 13, 14, and 15...position 5. The following is an octal to binary conversion list:

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

Table 6-1 contains the bit assignment for the output channels and Table 6-2 for the input channels. The fourth column from the right gives the octal digit of R1 which contains the bit in column two. The last column contains those octal numbers which indicate that the bit is active. It should be noted that the output channels use positive logic; i.e., an active bit is a one and an inactive bit is a zero. The input channels use negative logic; i.e., an active bit is a zero and an inactive bit is a one.

6.1.4 Erasable Memory Verification and Update

The contents of any erasable memory address may be checked. This is useful in determining the condition of flags or the value of pertinent parameters.

Any address may be checked as follows:

- 1. Key: V01 N01E XXXXE, where XXXX is address desired
- 2. Monitor R1 for contents of address.

Table 6-1. CMC Output Channels Bit Assignment (sheet 1 of 3)

Channel	Bit	Description	DSKY Digit Position	Numerals with which Bit is Present
5		Channel 5 contains pitch and yaw RCS jet commands as follows:		v
	1	S/M Eng. 1 (+ θ , +X) C/M Eng. 1 (+ θ , -X, - ψ)	1	1, 5 1, 3, 5, 7
	2	S/M Eng. 4 ($-\theta$, $-X$) C/M Eng. 4 ($-\theta$, $+Z$)	1	2, 6 2, 3, 6, 7
	3	S/M Eng. 3 (+ θ , -X) C/M Eng. 3 (+ θ , -X, - ψ)	1	4, 5, 6 4, 5, 6, 7
	4	S/M Eng. 2 ($-\theta$, +X) C/M Eng. 2 ($-\theta$, +Z)	2	1, 3, 5 1, 3, 5, 7
	5	S/M Eng. 5 (+ ψ , +X) C/M Eng. 7 (+ ψ , -X, + θ)	2	2, 3 2, 3, 6, 7
	6	S/M Eng. 8 ($-\psi$, $-X$) C/M Eng. 8 ($-\psi$, $-X$, $+\theta$)	2	4, 5 4, 5, 6, 7
	7	S/M Eng. 7 (+ ψ , -X) C/M Eng. 5 (+ ψ , -X, + θ)	3	1,3 1,3
	8	S/M Eng. 6 ($-\psi$, +X) C/M Eng. 6 ($-\psi$, -X, + θ)	3	2, 3 2, 3
6		Channel 6 contains roll RCS jet commands as follows:		
	1	S/M Eng. 9 ($+\phi$, $+Z$) C/M Eng. 9 ($+\phi$, $+Z$, $+Y$)	1	1,5
	2	S/M Eng. 12 (- ϕ , -Z) C/M Eng. 12 (- ϕ , -Z, -Y)	1	2,6
	3	S/M Eng. 11 (+ ϕ , -Z) C/M Eng. 11 (+ ϕ , -Z, +Y)	1	4, 5, 6
	4	S/M Eng. 10 ($-\phi$, +Z) C/M Eng. 10 ($-\phi$, +Z, -Y)	2	1, 3, 5
	5	$S/M Eng. 13 (+\phi, -Y)$	2	2,3
	6	S/M Eng. 16 (- ϕ , -Y)	2	4,5
	7	S/M Eng. 15 (+ ϕ , -Y)	3	1
	8	$S/M Eng. 14 (-\phi, +Y)$	3	2

Table 6-1. CMC Output Channels Bit Assignment (sheet 2 of 3)

Channel	Bit	Description	DSKY Digit Position	Numerals with which Bit is Present
11	1	ISS warning	1	1, 3, 5, 7
	2	Computer activity	1	2, 3, 6, 7
	3	Uplink activity	1	4, 5, 6, 7
	4	Temperature caution	2	1, 3, 5, 7
	5	Key release flash	2	2, 3, 6, 7
	6	Verb-Noun flash	2	4, 5, 6, 7
	7	Operator error flash	3	1,5
	.8	Spare		
	9	Test connector outbit	3	4, 5
	10	Caution reset	4	1
	11	Spare		
	12	Spare		
	13	Engine on	5	1
,	14	Engine off	5	2
12	1	Zero OCDU's	1	1, 3
v.	2	Enable optics error counter	1	2,3
	3	Spare		
	4	Coarse align enable	2	1, 3, 5, 7
	5	Zero OCDU's	2	2, 3, 6, 7
	6	Enable IMU error counter	2	4, 5, 6, 7
	7	Spare		
	8	TVC enable	3	2,6
	9	SIVB takeover enable	3	4,6
	10	Zero optics	4	1
	11	Disengage optics DAC	4	2
	12	Spare		
	13	SIVB injection sequence start	5	1,5
	14	SIV B cutoff	5	2,6
	15	ISS turn on delay complete	5	4, 5, 6

Table 6-1. CMC Output Channels Bit Assignment (sheet 3 of 3)

Channel	Bit	Description	DSKY Digit Position	Numerals with which Bit is Present
13	1-4	Spare		
	5	Inhibit uplink	2	2, 6
	6	Block inlink	2	4,6
	7	Downlink word order	3	1, 3
	8	BMAG counter enable	3	2, 3
	9	Spare		
	10	Test alarms	4	1, 3, 5, 7
	11	Enable standby	4	2, 3, 6, 7
	12	Reset 31A trap	4	4, 5, 6, 7
*	13	Reset 31B trap	5	1, 3, 5, 7
	14	Reset 32 trap	5	2, 3, 6, 7
	15	Enable T6 rupt	5	4, 5, 6, 7
14	1	Outlink activity	1	1
	2	Spare		
	3	Spare		
	4	Spare		
	5	Entry velocity drive	2	2,6
	6	Gyro enable	2	4,6
	7	Gyro select A	3	. *
	8	Gyro select B	3	*
	9	Gyro minus sign	3	*
	10	Gyro activity	4	1, 3, 5, 7
	11	Drive shaft CDU	4	2, 3, 6, 7
	12	Drive trunnion CDU	4	4, 5, 6, 7
	13	Drive ICDU Z	5	1, 3, 5, 7
	14	Drive ICDU Y	5	2, 3, 6, 7
	15	Drive ICDU X	5	4, 5, 6, 7

*Digit 3 indicates gyro axis selected as follows:
0 - None 4 - None

0 - None 4 - None 1 - +X 5 - -X 2 - +Y 6 - -Y 3 - +Z 7 - -Z

Table 6-2. CMC Input Channels Bit Assignment (sheet 1 of 2)

Channel Bit		Description	DSKY Digit Position	Numerals with which Bit is Present
		Channel 15, bits 1 through 5, contain the keycode from the main panel DSKY. It appears in the first two digits of the register as an octal number (0 through 37).		
16	1-5	Keycode from navigation panel DSKY (see channel 15, above).		
•	6	Mark discrete	2	0
	7	Mark reject	3	6
30	1	Ullage present	1	0, 2, 4, 6
	2	SM separate	1	0, 1, 4, 5
	3	SPS ready	1	0, 1, 2, 3
	4	SIVB separate, abort	2	0, 2, 4, 6
	5	Liftoff	2	0, 1, 4, 5
6		Guidance reference release	2	0, 1, 2, 3
	7	OCDU fail	3	2,6
	8	Spare		
	9	IMU operate	3	2,3
	10	S/C control of Saturn	4	0, 2, 4, 6
	11	IMU cage	4	0, 1, 4, 5
	12	ICDU fail	4	0, 1, 2, 3
	13	IMU fail	5	0, 2, 4, 6
	14	ISS turn on request	5	0, 1, 4, 5
	15	IMU temperature within limits	5	0, 1, 2, 3
31	1	+Pitch manual rotation	1	2,6
	2	-Pitch manual rotation	. 1	1,5
	3	+Yaw manual rotation	1	1, 2, 3
	4	-Yaw manual rotation	2	2, 4, 6
	- 5	+Roll manual rotation	2	4,5
	6	-Roll manual rotation	2	2,3

Table 6-2. CMC Input Channels Bit Assignment (sheet 2 of 2)

Channel	Bit	Description	DSKY Digi t Position	Numerals with which Bit is Present
31	7	+X translation	3	2,6
(cont.)	8	-X translation	3	1,5
	9	+Y translation	3	1, 2, 3
	10	-Y translation	4	2, 4, 6
*	11	+Z translation	4	4,5
	12	-Z translation	4	2,3
	13	CMC attitude hold mode	5	6
	14	CMC free mode	5	5
	15	CMC automatic mode	5	3
32	1	+Pitch minimum impulse	1	2,6
	2	-Pitch minimum impulse	1	1,5
	3	+Yaw minimum impulse	1	1, 2, 3
	4	-Yaw minimum impulse	2	2, 4, 6
	5	+Roll minimum impulse	2	4,5
	6	-Roll minimum impulse	2	2,3
	7-10	Spare		
	11	LM attached	4	5
33	1-4	Spare		
	5	Zero optics	2	1,5
	6	CMC control	2	1,3
	7-9	Spare		
	10	Block uplink	4	2,6
	11	Uplink too fast	4	5
	12	Downlink too fast	4	2,3
	13	PIPA fail	5	0, 2, 4, 6
	14	Warning	5	0, 1, 4, 5
	15	OSC alarm	5	0, 1, 2, 3

The data displayed in R1 is in octal, to determine the state of an individual bit (such as when checking a flagword) an octal to binary conversion is necessary just as in checking the input-output channels (see para. 6.1.3).

The contents of erasable memory addresses can be changed; however, great care must be exercised to prevent destroying valid data by keying an incorrect address. Update erasable memory as follows:

1. Command P00:

Key: V37E 00E

2. Start update:

Key: V21 N01E

3. Load address:

Key: XXXXE, where XXXX is address to be loaded

4. Load data:

Key: XXXXXE, E, where XXXXXis data to be loaded in octal.

- 5. If more than one nonsequential address is to be loaded, repeat steps 3 and 4 until all addresses are loaded.
- 6. If a number of sequential addresses are to be loaded, after the first data load,

Key V15E

and repeat step 4 until all addresses are loaded.

After loading data verify data data word as follows:

1. Start data display:

Key: V01 N01E

2. Load address:

Key: XXXXE, where XXXX is address of data to be verified

- 3. Verify data word in R1.
- 4. If the data in a number of sequential addresses are to be verified,

Key: N15E

Verify second data word in R1

Key: ENTR

Verify third data word in R1

Key: ENTR

continue process until all data words are verified.

Table 6-3 gives the addresses and bit positions of all flags. Table 6-4 contains addresses of some important parameters.

6.1.5 PIPA Bias Check

The PIPA bias can be checked and updated as follows:

- 1. Set digital event timer (DET) to zero.
- 2. Obtain SC rates of less than 0.1 degrees per second.
- 3. Key: V25 N21E ENTR ENTR ENTR

ENTR V06 N21

- 4. Simultaneously key ENTR and start DET.
- 5. Record PIPA counts R1, R2, and R3.

R1 - X axis PIPA

R2 - Y axis PIPA

R3 - Z axis PIPA

- 6. When DET reads 04:16 key ENTR.
- 7. Record PIPA counts as in step 5.
- 8. Compute PIPA bias for each axis as follows:

$$\frac{N_F - N_I}{100} = PIPA bias$$

Table 6-3. Flagword List (sheet 1 of 7)

Flagword (Address)	Bit	Flag	DSKY Dig- it Position	Set Condition*	Reset Condition*
	Not	te: Flagwords r by procedur	may be call	ed from erasable mem	ory
0 (0074)	1	ESCAPE SW	1	Hyperbolic orbit	Elliptic orbit
(001-1)	2	Spare			
	3	FREE FLAG	1	Temporary flag used routines	l in various
	4	TRUN FLAG	2	Trunnion drive allowed	Trunnion drive not allowed
	5	Spare			
	6	R53 FLAG	2	V51 initiated	V51 not initiated
	7	RNDVX FLG	3	P20 running	P20 not running
	8	IMUSE	3	IMU in use	IMU not in use
	9	NEEL FLG	3	Total attitude error displayed on FDAI error needles	Error needles under DAP control
	10	COAROFIN	4	Fine align mark	Coarse align mark
	11	Spare			
	12	Spare			
	13	Spare			
	14	J SWITCH	5	Integration of W matrix in process	Integration of state vector in process
	15	CPHI FLAG	5	Desired CDU angle stored in CPHIX (noun 96)	Desired angles stored in THETAD (noun 92)
1	1	AVE G FLAG	1	Continue average g	Stop average g
(0075)	2	GUESS SW	1	Starting value for iteration exists	Starting value for iteration does not exist
	3	ITER 1 SW	1	First Lambert iteration	Reiteration of Lambert
	4	Spare			
	5	TRACK FLAG	2	Tracking allowed	Tracking not allowed
	6	ON FLAG	2	Thrust detected	No thrust detected

^{*}Bits 1, 4, 7, 10, and 13 are set when appropriate octal digit is 1, 3, 5, or 7. Bits 2, 5, 8, 11, and 14 are set when appropriate octal digit is 2, 3, 6, or 7. Bits 3, 6, 9, 12, and 15 are set when appropriate octal digit is 4, 5, 6, or 7.

Table 6-3. Flagword List (sheet 2 of 7)

Flagword	1	T	DOKK Die		T
Flagword (Address)	Bit	Flag	DSKY Dig- itPosition	Set Condition	Reset Condition
1 (cont.)	7	UPDAT FLG	3	Updating by marking allowed	Updating by marking not allowed
	8	VEHUP FLG	3	CSM state vector being updated	LM state vector being updated
	9	TARG 2 FLG	3	Sighting landmark	Sighting star
	10	TARG 1 FLG	4	Sighting LM	Not sighting LM
	11	ENG 2 FLG	4	RCS burn	SPS burn
	12	R31 FLAG	4	R31 selected (V83)	R34 selected (V85)
	13	ERAD FLAG	5	Compute Fischer ellipsoid for radi- us of earth	Use constant pad radius for radius of earth
	14	STIK FLAG	5	RHC control	CMC control
	15	NJET FLG	5	Two jet RCS burn	Four jet RCS burn
2	1	NODO FLAG	1	V37 not permitted	V37 permitted
(0076)	2	CALCMAN 2	1	Perform maneuver starting procedure	Bypass maneuver starting procedure
	3	CALCMAN 3	1	No final roll re- quired	Final roll required
	4	PFRAT FLG	2	Preferred attitude computed	Preferred attitude not computed
	5	AV FLAG	2	LM is active ve- hicle	CSM is active ve- hicle
	6	FINAL FLAG	2	Last pass through rendezvous compu-	Not last pass through rendezvous computa-
	77	D DELAM EL C	2	tation	tion .
	7	RPEAT FLG (in P21 and P22)	3	Landmark stored	Landmark not stored
	7	FIRST FLG (in P40 thru P47)	3	Succeeding pass through VG calcula- tion	First pass through VG calculation
	7	ETPI FLAG (in P34 and P74)	3	Elevation angle sup- plied, CMC calcu- lates TPI	TPI supplied, CMC calculates elevation angle
	8	XDEL FLG	3	External delta V computation	Lambert VG computation
	9	IMPULSW	3	Minimum impulse burn	Steering burn

Table 6-3. Flagword List (sheet 3 of 7)

Flagword (Address)	Bit	Flag	DSKY Dig- it Position	Set Condition	Reset Condition
2 (cont.)	10	CYCLE SW	4	VG calculation to be done	No VG calculation to be done
(33331)	11	STEER SW	4	Steering to be done	No steering
	12	Spare		3	0
	13	Spare			
	14	R21 MARK	5	Radar in search markrupt routine	Radar not in search markrupt routine
	15	DRIFT FLG	5	T3RUPT calls for gyro compensation	Gyro compensation not called for
3					*
(0077)	1	DIMO FLAG	1	W matrix to be used	Do not use W matrix
	2	D6 OR 9 FLG	1	Dimension of W matrix is 9 by 9 for integration	Dimension of W matrix is 6 by 6 for integration
	3	VINT FLAG	1	CSM state vector being integrated	LM state vector being integrated
	4	INTYP FLG	2	Conic integration	Encke integration
	5	STATE FLG	2	Permanent state vector updated	Permanent state vector not updated
	6	ORBW FLAG	2	W matrix valid for orbital navigation	W matrix invalid for orbital navigation
	7	CULT FLAG	3	Star occulted	Star not occulted
, , , , , ,	8	Spare			
	9	ONMON FLG	3	Monitoring of PIPA's every 1/2 second during entry enabled	Monitoring of PIPA's every 1/2 second not enabled
	10	VFLAG	4	Two stars not in acquisition field of SXT	Two stars available in acquisition field of SXT
	11	STBY FLAG	4	CMC was in stand- by	CMC was not in stand- by
	12	Spare			
	13	REFSM FLG	5	REFSMMAT good	No REFSMMAT
	14	GLOKFAIL	5	Gimbal lock has occurred	Gimbal lock has not occurred
	15	AUTMANSW	5	Do manual maneu- ver	Do KALCMANU maneuver

Table 6-3. Flagword List (sheet 4 of 7)

	,	The second section of the second seco	Dates Divi		
Flagword (Address)	Bit	Flag	DSKY Dig- it Position	Set Condition	Reset Condition
4	1	Spare			
(0100)	2	RET 1 FLG	1	Mark display has one return	Mark display has three recons
	3	MKOV FLG	1	Mark display over normal	No mark display over normal
	4	NRUPT FLG	2	Normal display in- terrupted by pri- ority or mark dis- play	Normal display not in- terrupted by priority or mark display
	5	MRUPT FLG	2	Mark display inter- rupted by priority display	Mark display not in- terrupted by priority display
	6	PINBR FLG	2	Astronaut has in- terfered with exist- ing display	Astronaut has not interfered with existing display
	7	PRONV FLG	3	Astronaut using keyboard when priority display initiated	Astronaut not using keyboard when pri- ority display initi- ated
	8 -	NRMNV FLG	3	Astronaut using keyboard when normal display initiated	Astronaut not using keyboard when nor-mal display initiated
	9	MRKNV FLG	3	Astronaut using keyboard when mark display initiated	Astronaut not using keyboard when mark display initiated
	10	NWAIT FLG	4	Higher priority display operating when normal display initiated	No higher priority display operating when normal display initiated
	11	MWAIT FLG	4	Higher priority display operating when mark display initiated	No higher priority display operating when normal display initiated
	12	NRMID FLG	4	Normal display in ENDIDLE routine	No normal display in ENDIDLE routine
-	13	ENDID FLG	5	GO PLAY (non- mark in ENDIDLE routine	NO GOPLAY in ENDIDLE routine

Table 6-3. Flagword List (sheet 5 of 7)

rable 6-5. Flagword List (sheet 5 of 1)							
Flagword (Address)	Bit	Flag	DSKY Dig	C - 1 C 1:1:	Reset Condition		
4 (cont.)	14	PROID FLG	5	Priority display in ENDIDLE routine	No priority display in ENDIDLE routine		
,	15	MRKID FLG	5	Mark display in ENDIDLE routine	No mark display in ENDIDLE routine		
5 (0101)	1	RENDW FLG	1	W matrix valid for rendezvous navigation	W matrix invalid for rendezvous navigation		
	2	MGLV FLAG	1.	ΔV in local vertical computed (passive vehicle doing computation)	Middle gimbal angle computed (active vehicle doing com- putation)		
	3	NOSO FLAG	1	No solution to conic integration	Conic solution exists		
	4	Spare					
δ.	5	GRRBK FLG	2	Back up guidance reference release discrete received	Back up guidance reference release discrete not received		
	6	3AXIS FLG	2	Maneuver specified by three axes	Maneuver specified by one axis		
	7	ENGON FLG	- 3	Engine on	Engine off		
	8	COMPUTER	3	Computer is CMC	Computer is LGC		
	9	DMEN FLG	3	Dimension of W matrix is 9 by 9 for incorporation	Dimension of W matrix is 6 by 6 for incorporation		
	10	Spare					
	11	INCOR FLG	4	First incorporation of update	Second incorporation of update		
	12	V59 FLAG	4	Mark for calibra- tion in P23	Normal marking in P23		
	13	INT FLAG 3	5	Phase change has occurred between INT STALL and INT WAKE	No phase change has occurred		
	14	INT FLAG 2	5	Integration in pro- cess	Integration not in pro- cess		
	15	DSKY FLAG	5	Displays sent to DSKY	No displays sent to DSKY		
		1					

Table 6-3. Flagword List (sheet 6 of 7)

1772					
Flagword (Address)	Bit	Flag	DSKY Dig- itr'osition	Set Condition	Reset Condition
6 (0102)	1	GYMDIFSW	1	CDU differences and body rates computed	CDU differences and body rates not computed
	2	CM/DSTBY	1	Entry DAP activated	Entry DAP not acti- vated
	3	.05GSW	1	0.05g detected during entry	0.05g not yet de- tected during entry
	4	LATSW	2	Downlift not inhib- ited	Downlift inhibited
	5	INRLSW	2	Initial roll attitude not held	Initial roll attitude held
	6	HIND	2	Iterating of HUN- TEST calculations to be done after range prediction	Iterating of HUNTEST calculations to be omitted after range prediction
	7	HUNTSW 1	3	Drag level initial- ized for constant drag	Drag level not yet initialized for constant drag
	8	KNOWN FLG (In P21 and P22)	3	Landmark known	Landmark unknown
	8	EGSW (during entry)	3	In final phase	Not in final phase
	9	REVEL SW	3	Targeting use earth- relative velocity	Targeting use iner- tial velocity
	10	GDNEPAST	4	Lateral control cal- cluations to be omit- ted	Lateral control cal- culations to be done
	11	GAMDIFSW	4	Calculate gamma dot	Do not calculate gamma dot
	12	CMDAPARM	. 4	Enable entry fir- ings and calcula- tions	Inhibit entry firings and control
,	13	LEWDSW (during entry)	5	Low velocity during initial roll	High velocity during initial roll
	13	DLBARFLG (burns not for entry)	5	Offset updates at end of burn allowed	Offset updates not allowed

Table 6-3. Flagword List (sheet 7 of 7)

Flagword (Address)	Bit	Flag	DSKY Dig- it Position	Set Condition	Reset Condition
6 (cont.)	14 15	DAPBIT 2 DAPBIT 1	5 5	Bits 14 & 15 designa as follows:	ate DAP configuration
				Bit 14 Bit 15	Configuration
				1 1 1 1 1 1 1 1 1 0 0 0 0	Saturn DAP TVC DAP RCS DAP No DAP
7 (0103)	1	TFFSW	1	Calculate time to perigee	Calculate TFF
	2	ATTCH FLG	1	LM attached	LM not attached
	3	VERI FLAG	1	Changed when V33E P27	occurs at end of
	4	UPLOCK FL	2	$\overline{ ext{KK}}$ K test failed	KKK test passed
	5	Spare			
	6	V37 FLAG	2	Average g on	Average g off
	7	IDLE FLAG	3	No delta V monitor	Connect delta V monitor
	8	GONEBY	3	Target passed	Target approaching
	9	TTMODESW	3	Compute state vector during time -	Do not compute state vector
	10	UNNORMSW	4	Unit normal com- puted	Unit normal not com- puted
	11	TIMR FLAG	4	Computation of time to ignition operating	Computation of time to ignition not operating
	12	ASTN FLG	4	Astronaut has okayed ignition	Astronaut has not okayed ignition
	13	IGN FLAG	5	TIG has arrived	TIG has not arrived
	14	Spare			
	15	TERMI FLAG	5	Terminate R21 and R 22	Do not terminate R21 and R22

where: $N_{
m F}$ is number of counts for an axis recorded in step 7. $N_{
m I}$ is number of counts for same axis recorded in step 5.

9. Check presently stored bias as follows:

Key: V06 N01E 1716E

Record X axis PIPA bias from R1.

Key: 1720E

Record Y axis PIPA bias from R1.

Key: 1722E

Record Z axis PIPA bias from R1.

- 10. Compute difference between measured (step 8) and stored (step 9) values of PIPA bias for each axis. If the values differ by more than ±26400 perform step 11; if not, go to step 12.
- 11. Key: V21 N01E
 17XXE, where 17XX is address of applicable PIPA bias as indicated in step 9
 XXXXXE, where XXXXX is measured (step 8) value of PIPA bias
- 12. Key: V37E 00E

6.2 MALFUNCTION PROCEDURES

Table 6-4 lists GNCS caution and warning indications and the corrective action to be performed for each. To test the reliability of DSKY alarm indicators (GIMBAL LOCK, PROG, TRACKER, TEMP, and RESTART) key in V35E on the DSKY keyboard. This will also light the UPLINK ACT, KEY REL, OPR ERR, NO ATT, and STBY indicators and displays 8's and +'s on the numerical panel. After five seconds, these displays go out.

Table 6-5 lists the alarm codes which appear with program alarms (PROG indicator lighted). In most cases, the alarm code will not appear with the PROG alarm unless called for by keying V05 N09E. Alarm codes displayed without keying V05N09E are designated in table 6-5 by an asterisk. Some alarms

Table 6-6 Program Alarm Procedures (sheet 1 of 9)

Alarm Code	Description	Corrective Action
00110	Two mark rejects made without an intervening mark. Indicates that operator pressed MARK REJECT button unnecessarily.	Key RSET. Continue normal operation.
00112	Marks not being accepted. Indicates last mark was rejected.	Key RSET. Continue normal operation.
00113	No inbits in low seven bits of Channel 16. Not very likely to occur. Can only occur in markrupt program which is entered by mark, mark reject, or DSKY keycode, each of which sets one of the low seven bits of channel 16.	Key RSET. Reattempt the entry into mark- rupt program which failed (MARK, MARK REJECT, or keycode). If alarm recurs, desired entry is not possible.
00114	Mark made but not desired. Indicates that an unneeded mark was made (e.g., more marks than needed).	Key RSET. Continue normal operation.
00115	Optics torque request when optics is not in CMC mode.	Set OPTICS MODE switch to CMC. Key RSET. Continue normal operation.
00116	Optics switched from zero mode before 15 second zeroing time has elapsed.	Set OPTICS MODE switch to ZERO. Key RSET. Wait 15 seconds and continue normal operation.
00117	Optics torque request when optics not available. Occurs when V41 N91 is attempted while optics is in use.	Key RSET. (V41 N91 cannot be performed at this time.)

Note: Most alarm codes are not displayed on DSKY unless called for by keying VO5NO9E. Those that are displayed automatically are indicated by an asterisk.

Table 6-6 Program Alarm Procedures (sheet 2 of 9)

	Table 0-0 Flogram Alaim Flocedule	is (sheet 2 of 9)
Alarm Code	Description	Corrective Action
00120	Optics torque request with optics not zeroed.	Set OPTICS MODE switch to ZERO.
	•	Key RSET.
er indiglig version in		Wait 15 seconds and continue normal operation.
00122	Marking not called for.	Key RSET.
	Indicates a mark was made while CMC was not in the mark program.	Continue normal operation.
00205	PIPA saturated.	Switch to SCS control.
	Occurs during average g routine if a PIPA register exceeds 6400 pulses in two seconds. This is	Follow procedure for ISS warning light in Table 6-1.
Charles would be a second designation of the	equivalent to an acceleration of over 19 g's. Most likely will occur with an acceleration of over 19 g's.	IMU probably unuseable for velocity measurements.
00206	Zero encode not allowed during	Key RSET.
egite (AAF graph go annimalismus)	coarse align with gimbal lock. In this condition, zero encoding can only be done by first commanding coarse alignment to zero by V41.	Key V41 N20E and load 00000E 00000E 00000E
	Zelo by val.	Key V40 N20E.
00207	ISS turn-on not present for 90 seconds.	Wait for NO ATT light to go out then key RSET.
en entre procedo en estado		If alarm is still present reinitiate ISS turn on sequence (P05).
00210	IMU not operating.	Key RSET.
	Occurs when ICDU zeroing is attempted and IMU operate bit is not present.	Perform ISS turn-on sequence (P05).
00211	Coarse align error. Occurs when gimbal angles are not within two degrees of com-	To determine magnitude of error key V06 N20E for display of gimbal angles.
	manded position at completion of coarse alignment.	The operator may reattempt coarse alignment, continue with fine alignment, or terminate use of ISS.

Table 6-6 Program Alarm Procedures (sheet 3 of 9)

Alarm Code	Description	Corrective Action
00212	PIPA failure while PIPA's are not in use.	Key Rset.
	not in use.	Perform PIPA bias check (para. 6.1.5) If alarm persists GNCS TVC and entry capability may be lost.
00213	IMU not operating with turn on request.	Key RSET.
		Perform ISS turn on sequence (P05) and reinitiate desired program.
00214	ISS turned off while in use.	See alarm 00213.
00215*	IMU orientation not specified and preferred orientation has	Key RSET.
	been selected.	Perform either a or b:
		a) Key V32E and select nominal orientation or REFSMMAT option.
		b) Key V34E and perform pro- gram (P 22, P 40, or P 41) to define preferred orientation.
00217	Bad return from stall routines.	Key RSET.
		Reinitiate current program; if alarm recurs, terminate use of ISS.
00401	Desired gimbal angles yield	Key RSET.
	gimbal lock.	Either select new gimbal angles or maneuver spacecraft to avoid gimbal lock.
00404	Target out of view (90 degree test).	Perform one (a, b, or c) of the following:
	Occurs during auto optics positioning if the computed trunnion angles is greater than 90 degrees.	a) Manually maneuver space- craft until optics can acquire target.
		Key PRO
***		Key RSET.

^{*} Displayed automatically without keying V05N09E.

Table 6-6 Program Alarm Procedures (sheet 4 of 9)

•	Table 6-6 Program Alarm Proce	dure	es (sneet 4 of 9)
Alarm Code	Description		Corrective Action
00404 (cont.)		b)	Select new target which can be acquired.
			For star code, key V21N70E. For landmark code, key V22N70E. For landmark coordinates, key V25N89E.
			Key RSET.
		c)	Terminate auto-optics po-
			Set optics mode suited to MAN.
			Key RSET.
			Perform sighting mark routine (R53).
00405*	Two useable stars not available	Per	form a or b:
		a)	Maneuver spacecraft until two useable stars are manually acquired, then key PRO.
		b)	Maneuver spacecraft until two useable stars may be automatically acquired, then key V32E.
00406%	Rendezvous navigation program	Key	KEY REL.
	not operating. Occurs if rendezvous tracking data processing routine (R22) is reque ed when rendezvous navigation program (P20) is not running.	St-	RSET. (R22 cannot be performed.)
00407	Target out of view (38 degree test Occurs during auto optics positioning if computed trunnion angle exceeds 38 degrees.		During star or landmark track- ing either manually maneuver spacecraft until trunnion angle is less than 38 degrees or re- select target:
		For	star code, key V21 N70E.
		For	landmark code, key V22N70E.

^{*} Displayed automatically without keying V05 N09E.

Table 6-6 Program Alarm Procedures (sheet 5 of 9)

Alarm Code	Description	Corrective Action
00407 (cont.)		For landmark coordinates, key V25N89E.
		During LM tracking, either manually maneuver spacecraft back to preferred tracking attitude, or allow automatic maneuver by setting SC CONT switch to CMC and/or keying V58E.
00421	W matrix overflow.	Key RSET.
and the second s	Indicates that W matrix has been integrated forward without new navigation updates for so long a	Get state vector update from ground (P27).
The state of the s	time that terms in the matrix exceed their scale factors.	Perform orbital navigation program (P22).
00607*	Hyperbolic solution to Lambert routine or no solution to conic	If alarm occurs in P40 CMC will automatically entry P00:
	integration.	Key RSET and retarget with new parameters.
		If alarm occurs in P34 or P35:
		Key V32E.
		Key RSET.
		Adjust targeting parameters.
00611*	TIG (TPI) does not exist for	Key V32E and reload elevation.
	given elevation angle.	Key RSET.
00700	Change in state vector exceeds ΔV or ΔR threshold. Occurs in R22.	Either accept update by keying PRO, or reject by keying V32E.
01102	Self test error.	Reinitiate self test. If failure recurs self test has failed. CMC may not be useable (refer to para. 6.1.1).
01103	Unused CCS branch. Intended for program debugging; will not occur in flight. Causes restart.	Terminate and reinitiate program. Key RSET. If alarm recurs, perform CMC self check (para. 6.1.1).

^{*} Displayed automatically without keying V05 N09E.

	Table 6-6 Program Alarm Proce	dures (sheet 6 of 9)	
Alarm Code	Description	Corrective Action	
01104	Delay routine busy. Intended for CMC checkout; not likely to occur in flight. Causes restart.	See alarm 01103.	
01105	Down telemetry too fast.	Key RSET.	
	Occurs when end of word pulse rate of downlink exceeds 100pps.	Notify MSFN.	
01106	Up telemetry too fast. Locks out uplink when incoming	Request MSFN to retransmit up telemetry data.	
	bit rate exceeds 5000 bits per second.	Key RSET.	
	second.	If alarm recurs, perform CMC update by voicelink.	
	Note: Alarms 01107 through 0140 are intended for CMC testing and debugging. They are not likely to occur in flight.		
01107	2 11000	CMC does automatic fresh start.	
	restart.	Reinitialize erasable memory.	
01110	Restart with no active phase.	Key RSET.	
	Indicates CMC restart when CMC was not engaged in an active mission phase or rendezvous tracking. (See note preceding alarm 01107.)	No action necessary.	
01201	No vacant areas available.	Terminate and reinitiate program.	
	Occurs when more than five jobs requiring vacant areas are re-	Key RSET.	
	quested at the same time. Causes restart. (See note preceding alarm 01107.)	If alarm recurs, perform CMC self check (para. 6.1.1)	
01202	No core sets available. Occurs when more than seven jobs are requested at one time. Causes restart. (See note pre- ceding alarm 01107.)	See alarm 01201.	
01203	Waitlist overflow -too many tasks Occurs when more than seven tasks are requested at one time. Causes restart. (See note preceding alarm 01107.)	See alarm 01201.	

Table 6-6 Program Alarm Procedures (sheet 7 of 9)

Alarm Code	Description	Corrective Action
02106	Second job attempts to go to sleep via keyboard and display program. Causes restart. (See note preceding alarm 01107.)	See alarm 01201.
01207	No vacant areas available for marks. Occurs if a mark is received when all five mark areas are filled. Normally when more than five marks are made, the excessive ones are not accepted and alarm 00114 is set, alarm 01207 does not then get set. This alarm causes restart. (See note preceding alarm 01107.)	See alarm 01201.
01210	Two programs attempting to use the same device (ISS or OSS). Causes restart. (See note preceding alarm 01107.)	See alarm 01201.
01211	Illegal interrupt of extended verb. Occurs when an internal program requests marking while marking system is already in use or an extended verb is active. Causes restart. (See note preceding alarm 01107.)	See alarm 01201.
01301	Arcsine, arccosine input too large. Causes restart. (See note preceding alarm 01107.)	See alarm 01201.
01302	Square root routine called with a negative argument. Causes restart. (See note preceding alarm 01107.)	See alarm 01201.
01401	Test index too large in integrated test.	Terminate integrated test. V67 not intended for inflight use
01402	Illegal quantity loaded in jet task/or engine task.	See alarm 01401.

Table 6-6 Program Alarm Procedures (sheet 8 of 9)

1	Table 6-6 Program Alarm Proced	lures (sneet 8 of 9)
Alarm Code	Description	Corrective Action
01403	Illegal quantity loaded in SPS on Saturn steering task.	See alarm 01401.
01404	Integrated test please perform task 401, 402, or 403 failed.	See alarm 01401.
01405	ICDU's busy during Saturn steering test.	See alarm 01401.
01407	Velocity to be gained increasing.	Terminate thrusting.
		Check orbital parameters and re- initiate orbit change targeting and thrust as necessary.
01410	Thrust too low for cross product steering. Occurs when thrust decays too rapidly. (75% in 2 seconds.) TVC terminates.	See alarm 01407.
01411	IRIG scale factor test alarm. For ground test only.	Cannot occur in flight.
01412	CDUX out of limits.	Terminate and reinitiate program.
	Intended for ground test only.	Key RSET.
-		If alarm recurs, perform CMC self check (para. 6.1.1).
01413	CDUY out of limits.	See alarm 01412.
01414	CDUZ out of limits.	See alarm 01412.
01426*	IMU unsatisfactory.	Key RSET.
	Occurs during entry (P61 or P62) if the spacecraft +Y or -Y axis is not within 30 degrees of V X R. This condition may result in an excessive MGA during entry guidance causing a gimbal lock alarm.	If there is sufficient time, realign IMU. If not, the crew has the option to continue with GNCS entry or to switch to SCS or manual entry control.
01427*		Key RSET.
	Occurs during entry (P61 or P62) if the spacecraft -Y axis is within 30 degrees of V X R.	Continue normal operation but note that FDAI indication is inverted; i.e. 0 degrees roll is lift down and 180 degrees is lift up.

^{*} Displayed automatically without keying V05N09E.

Table 6-6 Program Alarm Procedures (sheet 9 of 9)

Alarm Code	Description	Corrective Action
01430	Computed angles yield gimbal	Terminate V92 routine.
	lock. Occurs only during systems test (V92). Causes restart.	V92 not intended for inflight use.
01501	Keyboard and display alarm during internal use. Intended for ground checkout; not likely to occur in flight. Causes restart.	Terminate and reinitiate program Key RSET. If alarm recurs, perform CMC self check (para. 6.1.1).
01502*	Illegal use of flashing display. Intended for ground checkout; not likely to occur in flight. Causes restart.	See alarm 01501.
01520	Verb 37 not allowed at this time.	Key RSET.
	Occurs when program change is attempted when it is not allowed.	Do not attempt to change programs until allowed.
01600	Overflow in drift test. For ground test only.	Cannot occur in flight.
01601	Bad IMU torque. For ground test only. Causes restart.	Cannot occur in flight.
01602	Bad optics verification. Occurs only during ground test optics verification. Causes re- start.	Cannot occur in flight.
01703*	Less than 45 seconds to ignition. Occurs in P40 at end of engine gimbal test if GETI is less than 45 seconds.	Either slip GETI to 45 seconds from time PRO is keyed and Key PRO.
		Key RSET. Or terminate program:
		Key V34E. Key RSET.
01704	DAP cannot operate unless auto mode is selected. Occurs in R61 if CMC auto mode has not been selected.	Set SC CONT switch to CMC. Set CMC MODE switch to AUTO. Key RSET.
01705	Stick flag set. Occurs in R61 if the stick flag is set. The stick flag disables the DAP.	Insure RHC is at null. Key V58E. Key RSET.

^{*} Displayed automatically without keying V05N09E.

also cause a restart, which returns CMC operation to a convenient prior point in the program. These alarms are noted as such in Table 6-5.

All alarms possible in the Sundisk program are included in Table 6-5; however, many of the alarms were intended only as aids to program debugging and ground checkout equipment. These alarms are very unlikely to occur in flight and are noted as such. Most of the alarms which cause restart are in this category.

6.3 EMERGENCY PROCEDURES

6.3.1 Tumbling IMU

- 1. Position and hold IMU CAGE switch to the (up) position until gimbals settle at the zero position (about 5 seconds).
- 2. Perform IMU orientation determination program (P51).

6.3.2 IMU Turn On When CMC Not Operating

- 1. Check that IMU and IMU/HTR circuit breakers are on.
- 2. Set G/N Power IMU switch to the on (up) position.
- 3. Wait 90 seconds.
- 4. Momentarily (about 5 seconds) hold IMU CAGE switch to on (up) position.

The IMU is then aligned to the spacecraft axes. To align the IMU to a particular inertial orientation:

Maneuver spacecraft to desired orientation and cage IMU (step 4 above).







