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THIS LGC PROGRAM IS INTENDED FOR USE IN THE LM DURING THE MANNED LUNAR LANDING MISSION OR ANY SUBSET THEREOF.
THE DETAILS OF IMPLEMENTATION ARE SPECIFIED IN REPORT R-567, AS AMENDED.

GUIDANCE SYSTEM OPERATIONS PLAN
FOR MANNED LM EARTH ORBITAL AND LUNAR MISSIONS
USING PROGRAM LUMINARY

THIS PROGRAM AND R-567 HAVE BEEN PREPARED BY THE INSTRUMENTATION LABORATORY, MASSACHUSETTS INSTITUTE OF
TECHNOLOGY, 75 CAMBRIDGE PARKWAY, CAMBRIDGE, MASSACHUSETTS, UNDER PROJECT 55-238-70, SPONSORED BY THE MANNED
SPACECRAFT CENTER OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CONTRACT NAS 9-4065.

THIS PROGRAM IS REFERRED TO AS LUMINARY 1A

1412THE

TABLE OF LOG CARDS

ASSEMBLY AND OPERATION INFORMATION
TAGS FOR RELATIVE SETLOC AND BLANK BANK CARDS
CONTROLLED CONSTANTS
INPUT/OUTPUT CHANNEL BIT DESCRIPTIONS
FLAGWORD ASSIGNMENTS
SUBROUTINE CALLS

TABLE OF SUBROUTINE LOG SECTIONS

LUMERASE
ERASABLE ASSIGNMENTS
LNYAIDE
INTERRUPT LEAD INS
T4RUPT PROGRAM
RCS FAILURE MONITOR
DOWNLINK LISTS
AGS INITIALIZATION
FRESH START AND RESTART
RESTART TABLES
AOTMARK
EXTENDED VERBS
PINBALL NOUN TABLES
LEM GEOMETRY
IMU COMPENSATION PACKAGE
R63
ATTITUDE MANEUVER ROUTINE
GIMBAL LOCK AVOIDANCE
KALCMANU STEERING
SYSTEM TEST STANDARD LEAD INS
IMU PERFORMANCE TESTS 2
IMU PERFORMANCE TESTS 4
PINBALL GAMES BUTTONS AND LIGHTS
R60,R62
S-BAND ANTENNA FOR LM
LEMP20S
RADAR LEADIN ROUTINES
P20-P25
LEMP30S
P30,P37
P32-P35, P72-P75
GENERAL LAMBERT AIMPOINT GUIDANCE
KISSING
GROUND TRACKING DETERMINATION PROGRAM - P21
P34-P35, P74-P75
R31
P76
R30
STABLE ORBIT - P38-P39

FLY

BURN, BABY, BURN -- MASTER IGNITION ROUTINE

P40-P47

THE LUNAR LANDING

THROTTLE CONTROL ROUTINES

LUNAR LANDING GUIDANCE EQUATIONS

P70-P71

P12

ASCENT GUIDANCE

SERVICER

LANDING ANALOG DISPLAYS

FINDCDUW -- GUIDAP INTERFACE

LEMP50S

P51-P53

LUNAR AND SOLAR EPHEMERIDES SUBROUTINES

SKIPPER

DOWN-TELEMETRY PROGRAM

INTER-BANK COMMUNICATION

INTERPRETER

FIXED-FIXED CONSTANT POOL

INTERPRETIVE CONSTANTS

SINGLE PRECISION SUBROUTINES

EXECUTIVE

WAITLIST

LATITUDE LONGITUDE SUBROUTINES

PLANETARY INERTIAL ORIENTATION

MEASUREMENT INCORPORATION

CONIC SUBROUTINES

INTEGRATION INITIALIZATION

ORBITAL INTEGRATION

INFLIGHT ALIGNMENT ROUTINES

POWERED FLIGHT SUBROUTINES

TIME OF FREE FALL

AGC BLOCK TWO SELF-CHECK

PHASE TABLE MAINTENANCE

RESTARTS ROUTINE

IMU MODE SWITCHING ROUTINES

KEYRUPT, UPRUPT

DISPLAY INTERFACE ROUTINES

SERVICE ROUTINES

ALARM AND ABORT

UPDATE PROGRAM

RTB OP CODES

LMDAP

T6-RUPT PROGRAMS

DAP INTERFACE SUBROUTINES

DAPIDLER PROGRAM

P-AXIS RCS AUTOPILOT

Q,R-AXIS RCS AUTOPILOT

TJET LAW

1412THE

#	KALMAN FILTER
#	TRIM GIMBAL CONTROL SYSTEM
#	AOSTASK AND AOSJOB
#	SPS BACK-UP RCS CONTROL
#	
#	SYMBOL TABLE LISTING
#	UNREFERENCED SYMBOL LISTING
#	ERASABLE EQUALS CROSS-REFERENCE TABLE
#	SUMMARY OF SYMBOL TABLE LISTINGS
#	MEMORY TYPE AVAILABILITY DISPLAY
#	COUNT TABLE
#	PARAGRAPHS GENERATED FOR THIS ASSEMBLY
#	OCTAL LISTING
#	OCCUPIED LOCATIONS TABLE
#	SUBROS CALLED PROGRAM STATUS

VERB LIST FOR LUMINARY

REGULAR VERBS

00 NOT IN USE

01 DISPLAY OCTAL COMP 1 IN R1

02 DISPLAY OCTAL COMP 2 IN R1

03 DISPLAY OCTAL COMP 3 IN R1

04 DISPLAY OCTAL COMP 1,2 IN R1,R2

05 DISPLAY OCTAL COMP 1,2,3 IN R1,R2,R3

06 DISPLAY DECIMAL IN R1 OR R1,R2 OR R1,R2,R3

07 DISPLAY DP DECIMAL IN R1,R2 TEST ONLY

08

09

10

11 MONITOR OCTAL COMP 1 IN R1

12 MONITOR OCTAL COMP 2 IN R1

13 MONITOR OCTAL COMP 3 IN R1

14 MONITOR OCTAL COMP 1,2 IN R1,R2

15 MONITOR OCTAL COMP 1,2,3 IN R1,R2,R3

16 MONITOR DECIMAL IN R1 OR R1,R2 OR R1,R2,R3

17 MONITOR DP DECIMAL IN R1,R2 TEST ONLY

18

19

20

21 LOAD COMPONENT 1 INTO R1

22 LOAD COMPONENT 2 INTO R2

23 LOAD COMPONENT 3 INTO R3

24 LOAD COMPONENT 1,2, INTO R1,R2

25 LOAD COMPONENT 1,2,3 INTO R1,R2,R3

26

27 DISPLAY FIXED MEMORY

28

29

30 REQUEST EXECUTIVE

31 REQUEST WAITLIST

32 RECYCLE PROGRAM

33 PROCEED WITHOUT DSKY INPUTS

34 TERMINATE FUNCTION

35 TEST LIGHTS

36 REQUEST FRESH START

37 CHANGE PROGRAM MAJOR MODE

38

39

EXTENDED VERBS

40 ZERO CDU-S
41 COARSE ALIGN CDU-S
42 FINE ALIGN IMU
43 LOAD IMU ATT ERROR METERS
44 TERMINATE RR CONTINUOUS DESIGNATE V41N72 OPTION 2
45
46
47 INITIALIZE AGS R47
48 REQUEST DAP DATA LOAD ROUTINE R03
49 REQUEST CREW DEFINED MANEUVER ROUTINE R62
50 PLEASE PERFORM
51
52 MARK X-RETICLE
53 MARK Y-RETICLE
54 MARK X OR Y-RETICLE
55 INCREMENT AGC TIME DECIMAL
56 TERMINATE TRACKING P20 + P25
57 PERMIT LANDING RADAR UPDATES
58 INHIBIT LANDING RADAR UPDATES
59
60 COMMAND LR TO POSITON 2.
61 DISPLAY DAP FOLLOWING ATTITUDE ERRORS.
62 DISPLAY TOTAL ATTITUDE ERRORS WITH RESPECT TO NOUN 22.
63 SAMPLE RADAR ONCE PER SECOND 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 TO OTHER VEHICLE.
67 DISPLAY W MATRIX
68
69 CAUSE RESTART
70 UPDATE LIFTOFF TIME
71 UNIVERSAL UPDATE-BLOCK ADR
72 UNIVERSAL UPDATE-SINGLE ADR
73 UPDATE AGC TIME OCTAL
74 INITIALIZE ERASABLE DUMP VIA DOWNLINK
75 ENABLE U AND V JET FIRINGS DURING DPS BURNS.
76 MINIMUM IMPUSE COMMAND MODE.
77 RATE COMMAND AND ATTITUDE HOLD MODE
78 LR SPURIOUS RETURN TEST START R77
79 LR SPURIOUS RETURN TEST STOP
80 UPDATE LEM STATE VECTOR
81 UPDATE CSM STATE VECTOR
82 REQUEST ORBIT PARAM DISPLAY R30
83 REQUEST REND PARAM DISPLAY R31
84
85 DISPLAY RR LOS AZ AND ELEV
86
87

88
89 REQUEST RENDEZVOUS FINAL ATTITUDE ROUTINE R63
90 REQUEST RENDEZVOUS OUT OF PLANE DISPLAY ROUTINE R36
91 DISPLAY BANK SUM
92 OPERATE IMU PERFORMANCE TEST P07
93 ENABLE W MATRIX INITIALIZATION
94
95 NO UPDATE OF EITHER STATE VECTOR P20 OR P22
96 INTERRUPT INTEGRATION AND GO TO P00
97 PERFORM ENGINE FAIL PROCEDURE
98
99 PLEASE ENABLE ENGINE

IN THE FOLLOWING NOUN LIST THE NO LOAD RESTRICTION MEANS THE NOUN
CONTAINS AT LEAST ONE COMPONENT WHICH CANNOT BE LOADED, I.E. OF
SCALE TYPE L MIN/SEC , PP 2 INTEGERS OR TT LANDING RADAR POSITION .
IN THIS CASE VERBS 24 AND 25 ARE NOT ALLOWED, BUT VERBS 21, 22 OR 23
MAY BE USED TO LOAD ANY OF THE NOUN S COMPONENTS WHICH ARE NOT OF THE
ABOVE SCALE TYPES.

THE DEC ONLY RESTRICTION MEANS ONLY DECIMAL OPERATION IS ALLOWED ON
EVERY COMPONENT IN THE NOUN. NOTE THAT NO LOAD IMPLIES DEC ONLY .

#	NORMAL NOUNS	COMPONENTS	SCALE AND DECIMAL POINT	RESTRICTIONS
# 00	NOT IN USE			
# 01	SPECIFY MACHINE ADDRESS	FRACTIONAL	3COMP .XXXXX FOR EACH	
# 02	SPECIFY MACHINE ADDRESS	WHOLE	3COMP XXXXX. FOR EACH	
# 03	SPECIFY MACHINE ADDRESS	DEGREES	3COMP XXX.XX DEG FOR EACH	
# 04	ANGULAR ERROR/DIFFERENCE		1COMP XXX.XX DEG	
# 05	ANGULAR ERROR/DIFFERENCE		1COMP XXX.XX DEG	
# 06	OPTION CODE		3COMP OCTAL ONLY FOR EACH	
# 07	LOADING NOUN 07 WILL SET OR RESET SELECTED BITS IN ANY ERASABLE REGISTER			
# 07	ECADR OF WORD TO BE MODIFIED		3COMP OCTAL ONLY FOR EACH	
#	ONES FOR BITS TO BE MODIFIED			
#	1 TO SET OR 0 TO RESET SELECTED BITS			
# 08	ALARM DATA		3COMP OCTAL ONLY FOR EACH	
# 09	ALARM CODES		3COMP OCTAL ONLY FOR EACH	
# 10	CHANNEL TO BE SPECIFIED		1COMP OCTAL ONLY	
# 11	TIG OF CSI		3COMP 000XX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 12	OPTION CODE		2COMP OCTAL ONLY FOR EACH	
#	USED BY EXTENDED VERBS ONLY			
# 13	TIG OF CDH		3COMP 000XX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 14	CHECKLIST		3COMP XXXXX. FOR EACH	
#	USED BY EXTENDED VERBS ONLY			
#	NOUN 25 IS PASTED AFTER DISPLAY			
# 15	INCREMENT MACHINE ADDRESS		1COMP OCTAL ONLY	
# 16	TIME OF EVENT		3COMP 000XX. HRS	DEC ONLY
#	USED BY EXTENDED VERBS ONLY		000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 17	SPARE			
# 18	AUTO MANEUVER BALL ANGLES		3COMP XXX.XX DEG FOR EACH	
# 19	SPARE			
# 20	ICDU ANGLES		3COMP XXX.XX DEG FOR EACH	
# 21	PIPAS		3COMP XXXXX. PULSES FOR EACH	
# 22	NEW ICDU ANGLES		3COMP XXX.XX DEG FOR EACH	
# 23	SPARE			
# 24	DELTA TIME FOR AGC CLOCK		3COMP 000XX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	

# 25	CHECKLIST	3COMP	XXXXX. FOR EACH	
#	USED WITH PLEASE PERFORM ONLY			
# 26	PRIORITY/DELAY, ADRES, BBCON	3COMP	OCTAL ONLY FOR EACH	
# 27	SELF TEST ON/OFF SWITCH	1COMP	XXXXX.	
# 28	SPARE			
# 29	SPARE			
# 30	SPARE			
# 31	SPARE			
# 32	TIME FROM PERIGEE	3COMP	00XXX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 33	TIME OF IGNITION	3COMP	00XXX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 34	TIME OF EVENT	3COMP	00XXX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 35	TIME FROM EVENT	3COMP	00XXX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 36	TIME OF AGC CLOCK	3COMP	00XXX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 37	TIG OF TPI	3COMP	00XXX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 38	TIME OF STATE BEING INTEGRATED	3COMP	00XXX. HRS	DEC ONLY
#			000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 39	SPARE			

#	MIXED NOUNS	COMPONENTS	SCALE AND DECIMAL POINT	RESTRICTIONS
# 40	TIME FROM IGNITION/CUTOFF	3COMP	XXBXX MIN/SEC	NO LOAD, DEC ONLY
#	VG,		XXXX.X FT/SEC	
#	DELTA V ACCUMULATED		XXXX.X FT/SEC	
# 41	TARGET AZIMUTH	2COMP	XXX.XX DEG	FOR SYSTEM TEST
#	ELEVATION		XX.XXX DEG	
# 42	APOGEE,	3COMP	XXXX.X NAUT MI	DEC ONLY
#	PERIGEE,		XXXX.X NAUT MI	
#	DELTA V REQUIRED		XXXX.X FT/SEC	
# 43	LATITUDE,	3COMP	XXX.XX DEG	DEC ONLY
#	LONGITUDE,		XXX.XX DEG	
#	ALTITUDE		XXXX.X NAUT MI	
# 44	APOGEE,	3COMP	XXXX.X NAUT MI	NO LOAD, DEC ONLY
#	PERIGEE,		XXXX.X NAUT MI	
#	TFF		XXBXX MIN/SEC	
# 45	MARKS,	3COMP	XXXXX.	NO LOAD, DEC ONLY
#	TFI OF NEXT BURN,		XXBXX MIN/SEC	
#	MGA		XXX.XX DEG	
# 46	AUTOPILOT CONFIGURATION	1COMP	OCTAL ONLY	
# 47	LEM WEIGHT,	2COMP	XXXXX. LBS	DEC ONLY
#	CSM WEIGHT		XXXXX. LBS	
# 48	GIMBAL PITCH TRIM,	2COMP	XXX.XX DEG	DEC ONLY
#	GIMBAL ROLL TRIM		XXX.XX DEG	
# 49	DELTA R,	3COMP	XXXX.X NAUT MI	DEC ONLY
#	DELTA V,		XXXX.X FT/SEC	
#	RADAR DATA SOURCE CODE		XXXXX.	
# 50	SPARE			
# 51	S-BAND ANTENNA ANGLES	2COMP	XXX.XX DEG	DEC ONLY
#	PITCH		XXX.XX DEG	
#	YAW		XXX.XX DEG	
# 52	CENTRAL ANGLE OF ACTIVE VEHICLE	1COMP	XXX.XX DEG	
# 53	SPARE			
# 54	RANGE,	3COMP	XXX.XX NAUT MI	DEC ONLY
#	RANGE RATE,		XXXX.X FT/SEC	
#	THETA		XXX.XX DEG	
# 55	NO. OF APSIDAL CROSSINGS	3COMP	XXXXX.	DEC ONLY
#	ELEVATION ANGLE		XXX.XX DEG	
#	CENTRAL ANGLE OF PASSIVE VEHICLE		XXX.XX DEG	
# 56	RR LOS AZIMUTH	2COMP	XXX.XX DEG	
#	ELEVATION		XXX.XX DEG	
# 57	DELTA R	1COMP	XXXX.X NAUT MI	DEC ONLY
# 58	PERIGEE ALT POST TPI	3COMP	XXXX.X NAUT MI	DEC ONLY
#	DELTA V TPI		XXXX.X FT/SEC	
#	DELTA V TPF		XXXX.X FT/SEC	
# 59	DELTA VELOCITY LOS	3COMP	XXXX.X FT/SEC FOR EA.	DEC ONLY
# 60	HORIZONTAL VELOCITY	3COMP	XXXX.X FT/SEC	DEC ONLY
#	ALTITUDE RATE		XXXX.X FT/SEC	
#	COMPUTED ALTITUDE		XXXXX. FEET	
# 61	TIME TO GO IN BRAKING PHASE	3COMP	XXBXX MIN/SEC	NO LOAD, DEC ONLY
#	TIME FROM IGNITION		XXBXX MIN/SEC	

#	CROSS RANGE DISTANCE		XXXX.X NAUT MI	
# 62	ABSOLUTE VALUE OF VELOCITY	3COMP	XXXX.X FT/SEC	NO LOAD, DEC ONLY
#	TIME FROM IGNITION		XXBXX MIN/SEC	
#	DELTA V ACCUMULATED		XXXX.X FT/SEC	
# 63	ABSOLUTE VALUE OF VELOCITY	3COMP	XXXX.X FT/SEC	DEC ONLY
#	ALTITUDE RATE		XXXX.X FT/SEC	
#	COMPUTED ALTITUDE		XXXXX. FEET	
# 64	TIME LEFT FOR REDESIGNATION- LPD ANGLE	3COMP	XXBXX	NO LOAD, DEC ONLY
#	ALTITUDE RATE		XXXX.X FT/SEC	
#	COMPUTED ALTITUDE		XXXXX. FEET	
# 65	SAMPLED AGC TIME	3COMP	00XXX. HRS.	DEC ONLY
#	FETCHED IN INTERRUPT		000XX. MIN	MUST LOAD 3 COMPS
#			0XX.XX SEC	
# 66	LR RANGE	2COMP	XXXXX. FEET	NO LOAD, DEC ONLY
#	POSITION		+0000X	
# 67	LRVX	3COMP	XXXXX. FT/SEC	
#	LRVY		XXXXX. FT/SEC	
#	LRVZ		XXXXX. FT/SEC	
# 68	SLANT RANGE TO LANDING SITE	3COMP	XXXX.X NAUT MI	NO LOAD, DEC ONLY
#	TIME TO GO IN BRAKING PHASE		XXBXX MIN/SEC	
#	LR ALTITUDE - COMPUTED ALTITUDE		XXXXX. FEET	
# 69	SPARE			
# 70	AOT DETENT CODE/STAR CODE	3COMP	OCTAL ONLY FOR EACH	
# 71	AOT DETENT CODE/STAR CODE	3COMP	OCTAL ONLY FOR EACH	
# 72	RR 360 - TRUNNION ANGLE	2COMP	XXX.XX DEG	
#	SHAFT ANGLE		XXX.XX DEG	
# 73	NEW RR 360 - TRUNNION ANGLE	2COMP	XXX.XX DEG	
#	SHAFT ANGLE		XXX.XX DEG	
# 74	TIME FROM IGNITION	3COMP	XXBXX MIN/SEC	NO LOAD, DEC ONLY
#	YAW AFTER VEHICLE RISE		XXX.XX DEG	
#	PITCH AFTER VEHICLE RISE		XXX.XX DEG	
# 75	DELTA ALTITUDE CDH	3COMP	XXXX.X NAUT MI	NO LOAD, DEC ONLY
#	DELTA TIME CDH-CSI OR TPI-CDH		XXBXX MIN/SEC	
#	DELTA TIME TPI-CDH OR TPI-NOMTPI		XXBXX MIN/SEC	
# 76	DESIRED HORIZONTAL VELOCITY	3COMP	XXXX.X FT/SEC	DEC ONLY
#	DESIRED RADIAL VELOCITY		XXXX.X FT/SEC	
#	CROSS-RANGE DISTANCE		XXXX.X NAUT MI	
# 77	TIME TO ENGINE CUTOFF	2COMP	XXBXX MIN/SEC	NO LOAD, DEC ONLY
#	VELOCITY NORMAL TO CSM PLANE		XXXX.X FT/SEC	
# 78	RR RANGE	2COMP	XXX.XX NAUT MI	NO LOAD, DEC ONLY
#	RANGE RATE		XXXXX. FT/SEC	
# 79	CURSOR ANGLE	3COMP	XXX.XX DEG	DEC ONLY
#	SPIRAL ANGLE		XXX.XX DEG	
#	POSITION CODE		XXXXX.	
# 80	DATA INDICATOR,	2COMP	XXXXX.	
#	OMEGA		XXX.XX DEG	
# 81	DELTA V LV	3COMP	XXXX.X FT/SEC FOR EACH	DEC ONLY

# 82	DELTA V LV	3COMP	XXXX.X FT/SEC FOR EACH	DEC ONLY
# 83	DELTA V BODY	3COMP	XXXX.X FT/SEC FOR EACH	DEC ONLY
# 84	DELTA V OTHER VEHICLE	3COMP	XXXX.X FT/SEC FOR EACH	DEC ONLY
# 85	VG BODY	3COMP	XXXX.X FT/SEC FOR EACH	DEC ONLY
# 86	VG LV	3COMP	XXXX.X FT/SEC FOR EACH	DEC ONLY
# 87	BACKUP OPTICS LOS	2COMP	XXX.XX DEG	
#	ELEVATION		XXX.XX DEG	
# 88	HALF UNIT SUN OR PLANET VECTOR	3COMP	.XXXXX FOR EACH	DEC ONLY
# 89	LANDMARK	3COMP	XX.XXX DEG	DEC ONLY
#	LATITUDE		XX.XXX DEG	
#	LONGITUDE/2		XXX.XX NAUT MI	
# 90	Y	3COMP	XXX.XX NM	DEC ONLY
#	Y DOT		XXXX.X FPS	
#	PSI		XXX.XX DEG	
# 91	ALTITUDE	3COMP	XXXXXB. NAUT MI	
#	VELOCITY		XXXXX. FT/SEC	
#	FLIGHT PATH ANGLE		XXX.XX DEG	
# 92	SPARE			
# 93	DELTA GYRO ANGLES	3COMP	XX.XXX DEG FOR EACH	
# 94	SPARE			
# 95	SPARE			
# 96	SPARE			
# 97	SYSTEM TEST INPUTS	3COMP	XXXXX. FOR EACH	
# 98	SYSTEM TEST RESULTS AND INPUTS	3COMP	XXXXX.	
#			.XXXXX	
#			XXXXX.	
# 99	RMS IN POSITION	3COMP	XXXXX. FT	DEC ONLY
#	RMS IN VELOCITY		XXXX.X FT/SEC	
#	RMS IN BIAS		XX.XXX RADIANS	

REGISTERS AND SCALING FOR NORMAL NOUNS

# NOUN	REGISTER	SCALE TYPE
# 00	NOT IN USE	
# 01	SPECIFY ADDRESS	B
# 02	SPECIFY ADDRESS	C
# 03	SPECIFY ADDRESS	D
# 04	DSPTM1	H
# 05	DSPTM1	H
# 06	OPTION1	A
# 07	XREG	A
# 08	ALMCADR	A
# 09	FAILREG	A
# 10	SPECIFY CHANNEL	A
# 11	TCSI	K
# 12	OPTIONX	A
# 13	TCDH	K
# 14	DSPTMX	C
# 15	INCREMENT ADDRESS	A
# 16	DSPTMX	K
# 17	SPARE	
# 18	FDAIX	D
# 19	SPARE	
# 20	CDUX	D
# 21	PIPAX	C
# 22	THETAD	D
# 23	SPARE	
# 24	DSPTM2 +1	K
# 25	DSPTM1	C
# 26	DSPTM1	A
# 27	SMODE	C
# 28	SPARE	
# 29	SPARE	
# 30	SPARE	
# 31	SPARE	
# 32	-TPER	K
# 33	TIG	K
# 34	DSPTM1	K
# 35	TTOGO	K
# 36	TIME2	K
# 37	TTPI	K
# 38	TET	K
# 39	SPARE	

REGISTERS AND SCALING FOR MIXED NOUNS

# NOUN	COMP	REGISTER	SCALE TYPE
# 40	1	TTOGO	L
#	2	VGDISP	S
#	3	DVTOTAL	S
# 41	1	DSPTM1	D
#	2	DSPTM1 +1	E
# 42	1	HAP0	Q
#	2	HPER	Q
#	3	VGDISP	S
# 43	1	LAT	H
#	2	LONG	H
#	3	ALT	Q
# 44	1	HAP0X	Q
#	2	HPERX	Q
#	3	TFF	L
# 45	1	TRKMKCNT	C
#	2	TTOGO	L
#	3	+MGA	H
# 46	1	DAPDATR1	A
# 47	1	LEMMASS	KK
#	2	CSMMASS	KK
# 48	1	PITTIME	NN
#	2	ROLLTIME	NN
# 49	1	R22DISP	Q
#	2	R22DISP +2	S
#	3	WHCHREAD	C
# 50	SPARE		
# 51	1	ALPHASB	H
#	2	BETASB	H
# 52	1	ACTCENT	H
# 53	SPARE		
# 54	1	RANGE	JJ
#	2	RRATE	S
#	3	RTHETA	H
# 55	1	NN	C
#	2	ELEV	H
#	3	CENTANG	H
# 56	1	RR-AZ	H
#	2	RR-ELEV	H
# 57	1	DELTAR	Q
# 58	1	POSTTPI	Q
#	2	DELVTPI	S
#	3	DELVTPI	S
# 59	1	DVLOS	S
#	2	DVLOS +2	S
#	3	DVLOS +4	S
# 60	1	VHORIZ	S

#	2	HDOTDISP	S
#	3	HCALC	RR
# 61	1	TTFDISP	L
#	2	TTOGO	L
#	3	OUTOFPLN	QQ
# 62	1	ABVEL	S
#	2	TTOGO	L
#	3	DVTOTAL	S
# 63	1	ABVEL	S
#	2	HDOTDISP	S
#	3	HCALC1	RR
# 64	1	FUNNYDSP	PP
#	2	HDOTDISP	S
#	3	HCALC	RR
# 65	1	SAMPTIME	K
#	2	SAMPTIME	K
#	3	SAMPTIME	K
# 66	1	RSTACK +6	W
#	2	CHANNEL 33	TT
# 67	1	RSTACK	X
#	2	RSTACK +2	Y
#	3	RSTACK +4	Z
# 68	1	RANGEDSP	QQ
#	2	TTFDISP	L
#	3	DELTAH	RR
# 69	SPARE		
# 70	1	AOTCODE	A
#	2	AOTCODE +1	A
#	3	AOTCODE +2	A
# 71	1	AOTCODE	A
#	2	AOTCODE +1	A
#	3	AOTCODE +2	A
# 72	1	CDUT	WW
#	2	CDUS	D
# 73	1	TANG	WW
#	2	TANG +1	D
# 74	1	TTOGO	L
#	2	YAW	H
#	3	PITCH	H
# 75	1	DIFFALT	Q
#	2	T1TOT2	L
#	3	T2TOT3	L
# 76	1	ZDOTD	S
#	2	RDOTD	S
#	3	XRANGE	Q
# 77	1	TTOGO	L
#	2	YDOT	S
# 78	1	RSTACK	U
#	2	RSTACK +2	V
# 79	1	CURSOR	D

#	2	SPIRAL	D
#	3	POSCODE	C
# 80	1	DATAGOOD	C
#	2	OMEGAD	H
# 81	1	DEVLVLC	S
#	2	DEVLVLC +2	S
#	3	DEVLVLC +4	S
# 82	1	DEVLVLC	S
#	2	DEVLVLC +2	S
#	3	DEVLVLC +4	S
# 83	1	DELVIMU	S
#	2	DELVIMU +2	S
#	3	DELVIMU +4	S
# 84	1	DELVOV	S
#	2	DELVOV +2	S
#	3	DELVOV +4	S
# 85	1	VGBODY	S
#	2	VGBODY +2	S
#	3	VGBODY +4	S
# 86	1	DEVLVLC	S
#	2	DEVLVLC +2	S
#	3	DEVLVLC +4	S
# 87	1	AZ	D
#	2	EL	D
# 88	1	STARAD	B
#	2	STARAD +2	B
#	3	STARAD +4	B
# 89	1	LANDLAT	G
#	2	LANDLONG	G
#	3	LANDALT	JJ
# 90	1	RANGE	JJ
#	2	RRATE	S
#	3	RTHETA	H
# 91	1	P21ALT	Q
#	2	P21VEL	P
#	3	P21GAM	H
# 92	SPARE		
# 93	1	OGC	G
#	2	OGC +2	G
#	3	OGC +4	G
# 94	SPARE		
# 95	SPARE		
# 96	SPARE		
# 97	1	DSPTM1	C
#	2	DSPTM1 +1	C
#	3	DSPTM1 +2	C
# 98	1	DSPTM2	C
#	2	DSPTM2 +1	B
#	3	DSPTM2 +2	C
# 99	1	WWPOS	XX

MEMORY/100 TO DISPLAY TENS N.M.

NOUN SCALES AND FORMATS

# -SCALE TYPE-	PRECISION		
# UNITS	DECIMAL FORMAT	--	AGC FORMAT
# -----	-----	--	-----
# -A-			
# OCTAL	XXXXXX	SP	OCTAL
# -B-			
# FRACTIONAL	.XXXXX	SP	BIT 1 2 ⁻¹⁴ UNITS
#	MAX .99996		
# -C-			
# WHOLE	XXXXX.	SP	BIT 1 1 UNIT
#	MAX 16383.		
# -D-			
# CDU DEGREES	XXX.XX DEGREES	SP	BIT 1 360/2 ¹⁵ DEGREES
#	MAX 359.99		USES 15 BITS FOR MAGNI-
#			TUDE AND 2-S COMP.
# -E-			
# ELEVATION DEGREES	XX.XXX DEGREES	SP	BIT 1 90/2 ¹⁴ DEGREES
#	MAX 89.999		
# -F-			
# DEGREES 180	XXX.XX DEGREES	SP	BIT 1 180/2 ¹⁴ DEGREES
#	MAX 179.99		
# -G-			
# DP DEGREES 90	XX.XXX DEGREES	DP	BIT 1 OF LOW REGISTER
#			28
#			360/2 DEGREES
# -H-			
# DP DEGREES 360	XXX.XX DEGREES	DP	BIT 1 OF LOW REGISTER
#			28
#	MAX 359.99		360/2 DEGREES

# -K-				
# TIME	HR, MIN, SEC	00XXX. HR	DP	BIT 1 OF LOW REGISTER
#		000XX. MIN		-2
#		0XX.XX SEC		10 SEC
#		DECIMAL ONLY.		
#		MAX MIN COMP 59		
#		MAX SEC COMP 59.99		
#		MAX CAPACITY 745 HRS		
#		39 MINS		
#		14.55 SECS.		
#		WHEN LOADING, ALL 3		
#		COMPONENTS MUST BE		
#		SUPPLIED.		
# -L-				
# TIME	MIN/SEC	XXBXX MIN/SEC	DP	BIT 1 OF LOW REGISTER
#		B IS A BLANK		-2
#		POSITION, DECIMAL		10 SEC
#		ONLY, DISPLAY OR		
#		MONITOR ONLY. CANNOT		
#		BE LOADED.		
#		MAX MIN COMP 59		
#		MAX SEC COMP 59		
#		VALUES GREATER THAN		
#		59 MIN 59 SEC		
#		ARE DISPLAYED AS		
#		59 MIN 59 SEC.		
# -M-				-2
# TIME	SEC	XXX.XX SEC	SP	BIT 1 10 SEC
#		MAX 163.83		
# -N-				
# TIME	SEC DP	XXX.XX SEC	DP	BIT 1 OF LOW REGISTER
#				-2
#				10 SEC.
# -P-				
# VELOCITY	2	XXXXX. FEET/SEC	DP	BIT 1 OF HIGH REGISTER
#		MAX 41994.		-7
#				2 METERS/CENTI-SEC
# -Q-				
# POSITION	4	XXXX.X NAUTICAL MILES	DP	BIT 1 OF LOW REGISTER
#				2 METERS
# -S-				
# VELOCITY	3	XXXX.X FT/SEC	DP	BIT 1 OF HIGH REGISTER
#				-7
#				2 METERS/CENTI-SEC

# -T-			-2
# G	XXX.XX G	SP	BIT 1 10 G
#	MAX 163.83		
# -U-			
# RENDEZVOUS	XXX.XX NAUT MI	DP	LOW ORDER BIT OF LOW ORDER
# RADAR RANGE			WORD 9.38 FEET
# -V-			
# RENDEZVOUS	XXXXX. FEET/SEC	DP	LOW ORDER BIT OF LOW ORDER
# RADAR RANGE RATE			WORD -.6278 FEET/SEC
# -W-			
# LANDING RADAR	XXXXX. FEET	DP	LOW ORDER BIT OF LOW ORDER
# ALTITUDE			WORD 1.079 FEET
# -X-			
# LANDING RADAR	XXXXX. FEET/SEC	DP	LOW ORDER BIT OF LOW ORDER
# VELX			WORD -.6440 FEET/SEC
# -Y-			
# LANDING RADAR	XXXXX. FEET/SEC	DP	LOW ORDER BIT OF LOW ORDER
# VELY			WORD 1.212 FEET/SEC
# -Z-			
# LANDING RADAR	XXXXX. FEET/SEC	DP	LOW ORDER BIT OF LOW ORDER
# VELZ			WORD .8668 FEET/SEC
# -AA-			
# INITIAL/FINAL	XXXXX. FEET	DP	LOW ORDER BIT OF LOW ORDER
# ALTITUDE			WORD 2.345 FEET
# -BB-			
# ALTITUDE RATE	XXXXX. FEET/SEC	SP	LOW ORDER BIT .5
#	MAX 08191.		FEET/SEC
# -CC-			
# FORWARD/LATERAL	XXXXX. FEET/SEC	SP	LOW ORDER BIT .5571
# VELOCITY	MAX 09126.		FEET/SEC
# -DD-			
# ROTATIONAL HAND	XXXXX. DEG/SEC	SP	FRACTIONAL PART OF PI RAD
# CONTROLLER ANGULAR	MAX 00044.		4 SEC
# RATES			
# -EE-			
# OPTICAL TRACKER	XXX.XX DEG.	DP	LOW ORDER BIT OF LOW ORDER
# AZIMUTH ANGLE			WORD 360/2 ¹⁵ DEGREES
#			

# -JJ-			
# POSITION5	XXX.XX NAUT MI	DP	BIT 1 OF LOW REGISTER
#			2 METERS
# -KK-			
# WEIGHT2	XXXXX. LBS	SP	FRACTIONAL PART OF 2 ¹⁶ KG
# -NN-			
# TRIM DEGREES 2	XXX.XX DEG	SP	BIT 1 .01 SEC TIME
#	MAX 032.76		
# -PP-			
# 2 INTEGERS	+XXBY	DP	BIT 1 OF HIGH REGISTER
#	B IS A BLANK		1 UNIT OF XX
#	POSITION. DECIMAL		BIT 1 OF LOW REGISTER
#	ONLY, DISPLAY OR		1 UNIT OF YY
#	MONITOR ONLY. CANNOT		EACH REGISTER MUST
#	BE LOADED.		CONTAIN A POSITIVE INTEGER
#	MAX 99B99		LESS THAN 100
# -QQ-			
# POSITION7	XXXX.X NAUT MI	DP	BIT 1 OF LOW REGISTER
#	MAX 9058.9		-4
#			2 METERS
# -RR-			
# COMPUTED ALTITUDE	XXXXX. FEET	DP	BIT 1 OF LOW REGISTER
#			-4
#			2 METERS
# -SS-			
# DP DEGREES	XXXX.X DEGREES	DP	BIT 1 OF HIGH REGISTER
#			1 DEGREE
# -TT-			
# LANDING RADAR	+0000X		CHANNEL 33, BIT 6 NOT POSIT. 1
# POSITION	DECIMAL ONLY.		CHANNEL 33, BIT 7 NOT POSIT. 2
#	DISPLAY OR MONITOR	X	1 FOR LR POSITION 1
#	ONLY. CANNOT BE	X	2 FOR LR POSITION 2
#	LOADED.		
# -WW-			
# 360-CDU DEGREES	XXX.XX DEGREES	SP	BIT 1 360 - 360/2 ¹⁵
#	MAX 359.99		DEGREES
#			USES 15 BITS FOR MAGNI-
#			TUDE AND 2-S COMP.
# -XX-			
# POSITION 9	XXXXX. FEET	DP	BIT 1 OF LOW REGISTER
#			-9
#			2 METERS

# VELOCITY 4	XXXX.X FEET/SEC	DP	FRACTIONAL PART
#	MAX 328.0		METERS/CENTI-SEC

#	RADIANS	XX.XXX RADIANS	DP	BIT 1 OF HIGH REGISTER
#		MAX 31.999		-9
#				2 RADIANS.

THAT-S ALL ON THE NOUNS.

ALARM CODES FOR LUMINARY

# *9	*18	*60	COLUMN
# CODE	* TYPE	SET BY	
# 00105	** AOTMARK SYSTEM IN USE		
# 00107	MORE THAN 5 MARK PAIRS	AOTMARK	
# 00111	MARK MISSING	AOTMARK	
# 00112	MARK OR MARK REJECT NOT BEING ACCEPTED	AOTMARK	
# 00113	NO INBITS	AOTMARK	
# 00114	MARK MADE BUT NOT DESIRED	AOTMARK	
# 00115	NO MARKS IN LAST PAIR TO REJECT	AOTMARK	
# 00206	ZERO ENCODE NOT ALLOWED WITH COARSE ALIGN	IMU MODE SWITCHING	
# 00206	+ GIMBAL LOC		
# 00207	ISS TURNON REQUEST NOT PRESENT FOR 90 SEC	T4RUPT	
# 00210	IMU NOT OPERATING	IMU MODE SWITCH, IMU-2, RD2, P51, P57	
# 00211	COARSE ALIGN ERROR	IMU MODE SWITCH	
# 00212	PIPA FAIL BUT PIPA IS NOT BEING USED	IMU MODE SWITCH, T4RPT	
# 00213	IMU NOT OPERATING WITH TURN-ON REQUEST	T4RUPT	
# 00214	PROGRAM USING IMU WHEN TURNED OFF	T4RUPT	
# 00217	BAD RETURN FROM IMUSTALL	P51, P52, P57	
# 00220	IMU NOT ALIGNED - NO REFSMMAT	R02, R47	
# 00401	DESIRED GIMBAL ANGLE YIELDS GIMBAL LOCK	INF ALIGN, IMU-2,	
#		FINDCDUW	
# 00402	FINDCDUW NOT CONTROLLING ATTITUDE	FINDCDUW	
# 00404	TWO STARS NOT AVAILABLE IN ANY DETENT	R59, LUNAR SURFACE	
# 00405	TWO STARS NOT AVAILABLE	P52	
# 00421	W-MATRIX OVERFLOW	INTEGRV	
# 00430	** ACCELERATION OVERFLOW IN INTEGRATION	ORBITAL INTEGRATION	
# 00501	P RADAR ANTENNA OUT OF LIMITS	R23	
# 00502	BAD RADAR GIMBAL ANGLE INPUT	V41N72	
# 00503	P RADAR ANTENNA DESIGNATE FAIL	R21, NON-P IN V41N72	
# 00510	RADAR AUTO DESCRETE NOT PRESENT	R25	
# 00511	LR NOT IN POSITION 2 OR REPOSITIONING	SERVICER	
# 00514	P RR GOES OUT OF AUTO MODE WHILE IN USE	P20	
# 00515	RR CDU FAIL DISCRETE PRESENT	R25	
# 00520	RADAR RUPT NOT EXPECTED AT THIS TIME	RADAR READ	
# 00521	COULD NOT READ RADAR	P20	
# 00522	LANDING RADAR POSITION CHANGE	RADAR READ	
# 00523	P LR ANTENNA DIDN T ACHIEVE POSITION 2	SERVICER, V60 NON-P IN V60	
# 00525	P DELTA THETA GREATER THAN 3 DEGREES	R22	
# 00526	P RANGE GREATER THAN 400 NAUT. MILES	P20, P22	
# 00527	P LOS NOT IN MODE II COVERAGE WHILE ON	R21, R24	
#	LUNAR SURFACE		
#	OR VEHICLE MANEUVER REQUIRED	R24 20	
# 00530	P LOS NOT IN MODE2 COVERAGE	R21	
#	ON LUNAR SURFACE AFTER 600 SECS.		
# 00600	IMAGINARY ROOTS ON FIRST ITERATION	P32, P72	
# 00601	PERIGEE ALTITUDE CSI LT PMIN1	P32, P72.	

# 00602	PERIGEE ALTITUDE CDH LT PMIN2	P32, P72.
# 00603	CSI TO CDH TIME LT TMIN12	P32, P72, P33, P73
# 00604	CDH TO TPI TIME LT TMIN23	P32, P72,
#	OR COMPUTED CDH TIME GREATER THAN INPUT TPI TIME	
# 00605	NUMBER OF ITERATIONS EXCEEDS LOOP MAXIMUM	P32, P72
# 00606	DV EXCEEDS MAXIMUM	P32, P72
# 00607	** NO SOLN FROM TIME-THETA OR TIME-RADIUS	TIMETHET, TIMERAD
# 00611	NO TIG FOR GIVEN ELEV ANGLE	P34, P74
# 00701	ILLEGAL OPTION CODE SELECTED	P57
# 00777	PIPA FAIL CAUSED THE ISS WARNING	T4RUPT
# 01102	AGC SELF TEST ERROR	SELF CHECK
# 01103	** UNUSED CCS BRANCH EXECUTED	ABORT
# 01104	* DELAY ROUTINE BUSY	EXEC
# 01105	DOWNLINK TOO FAST	T4RUPT
# 01106	UPLINK TOO FAST	T4RUPT
# 01107	PHASE TABLE FAILURE. ASSUME	RESTART
#	ERASABLE MEMORY IS SUSPECT.	RESTART
# 01201	* EXECUTIVE OVERFLOW - NO VAC AREAS	EXEC
# 01202	* EXECUTIVE OVERFLOW - NO CORE SETS	EXEC
# 01203	* WAITLIST OVERFLOW - TOO MANY TASKS	WAITLIST
# 01204	** WAITLIST, VARDELAY, FIXDELAY, OR LONGCALL	WAITLIST ROUTINES
#	CALLED WITH ZERO OR NEGATIVE DELTA-TIME	
# 01206	** SECOND JOB ATTEMPTS TO GO TO SLEEP	PINBALL
# 01206	VIA KYBD AND DISPLAY PROGRAM	
# 01207	* NO VAC AREAS FOR MARKS	AOTMARK
# 01210	* TWO PROGRAMS USING DEVICE AT SAME TIME	MODE SWITCHING
# 01211	* ILLEGAL INTERRUPT OF EXTENDED VERB	AOTMARK
# 01301	ARCSIN-ARCCOS ARGUMENT TOO LARGE	INTERPRETER
# 01302	** SQRT CALLED WITH NEGATIVE ARGUMENT	INTERPRETER
# 01406	BAD RETURN FROM ROOTPSRS	DESCENT GUIDANCE EQS.
# 01406	** BAD RETURN FROM ROOTPSRS	IGNITION ALGORITHM
#	NOTE 1406 IS A POODOO DURING THE IGNITION ALGORITHM	
#	AND AN ALARM DURING THE ACTUAL GUIDANCE PHASE.	
#		
# 01407	VG INCREASING DELTA-V ACCUMULATED	S40.8
#	.GT. 90 DEGREES AWAY FROM DESIRED THRUST	S40.8
#	VECTOR.	S40.8
# 01410	UNINTENTIONAL OVERFLOW IN GUIDANCE	DESCENT GUIDANCE EQS.
# 01412	DESCENT IGNALG NOT CONVERGING	P63
# 01501	** KEYBOARD AND DISPLAY ALARM DURING	PINBALL
# 01501	INTERNAL USE NVSUB . ABORT	
# 01502	** ILLEGAL FLASHING DISPLAY	GOPLAY
# 01520	V37 REQUEST NOT PERMITTED AT THIS TIME	V37
# 01600	OVERFLOW IN DRIFT TEST	IMU 4
# 01601	BAD IMU TORQUE	OPT PRE ALIGN CALIB
# 01601		IMU 4 LEM
# 01703	IGNITION TIME SLIPPED	MIDTOAVE
# 01706	INCORRECT PROGRAM REQUESTED FOR VEHICLE	
#	CONFIGURATION	P40, P42

# 02000	* DAP STILL IN PROGRESS AT NEXT TIMES RUPT	DAP
# 02001	JET FAILURES HAVE DISABLED Y-Z TRANS.	DAP
# 02002	JET FAILURES HAVE DISABLED X TRANSLATION	DAP
# 02003	JET FAILURES HAVE DISABLED P-ROTATION	DAP
# 02004	JET FAILURES HAVE DISABLED U-V ROTATION	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, ICPU FAILS CAUSED THE ISS WARNING	T4RUPT
# 14777	IMU, ICPU, PIPA FAILS CAUSED THE ISS WARNING	T4RUPT
#		
#	* INDICATES AN ABORT CODE THAT RESULTS IN A SOFTWARE RESTART.	
#		
#	** INDICATES A MORE SERIOUS ABORT CODE THAT RESULTS IN THE	
#	PROGRAM GOING TO R00.	
#		
#	P INDICATES A PRIORITY ALARM.	
#		
#	ALL OTHERS ARE NON-ABORTIVE	

CHECKLIST CODES FOR LUMINARY

# *9	*17	*26	*9	COLUMN
# R1CODE		ACTION TO BE EFFECTED		PROGRAM
# 00013	KEY IN	NORMAL OR GYRO TORQUE COARSE ALIGN	P52	
# 00014	PROCEED	DO IMU FINE ALIGN ROUTINE	P51, P63, P57	
# 00014	ENTER	DO LANDING SITE DETERMINATION N89DISP	P57OPTION2	
# 00015	PERFORM	CELESTIAL BODY ACQUISITION	R51, P51	
# 00062	SWITCH	AGC POWER DOWN	P06	
# 00201	SWITCH	RR MODE TO AUTOMATIC	P20, P22, R04	
# 00203	SWITCH	GUID CONTROL TO GNC, MODE TO AUTO...	P12, P42, P71	
#		ALSO THR CONT TO AUTO	P40, P63, P70	
# 00205	PERFORM	MANUAL ACQUISITION OF RR	R23	
# 00500	SWITCH	LR ANTENNA TO POSITION 1	P63	

SWITCH DENOTES CHANGE POSITION OF A CONSOLE SWITCH
PERFORM DENOTES START OR END OF A TASK
KEY IN DENOTES KEY IN OF DATA THRU THE DSKY

OPTION CODES FOR LUMINARY

THE SPECIFIED OPTION CODES WIL BE FLASHED IN COMPONENT R1 IN
CONJUNCTION WITH V04N06 OR V04N12 FOR EXTENDED VERBS TO REQUEST THE
ASTRONAUT TO LOAD INTO COMPONENT R2 THE OPTION HE DESIRES.

# *9	*17	*52	*11	*25	COLUMN
# OPTION					
# CODE	PURPOSE	INPUT FOR COMPONENT 2	PROGRAM S	APPLICABILITY	
# 00001	SPECIFY IMU ORIENTATION	1 PREF 2 NOM 3 REFSMMAT	P52	ALL	
#		4 LAND SITE			
# 00002	SPECIFY VEHICLE	1 THIS 2 OTHER	P21,R30	ALL	
# 00003	SPECIFY TRACKING ATTITUDE	1 PREFERRED 2 OTHER	R63	ALL	
# 00004	SPECIFY RADAR	1 RR 2 LR	R04	SUNDANCE + LUMINARY	
# 00005	SPECIFY SOR PHASE	1 FIRST 2 SECOND	P38	COLOSSUS + LUMINARY	
# 00006	SPECIFY RR COARSE ALIGN OPTION	1 LOCKON 2 CONTINUOUS DESIG.	V41N72	SUNDANCE + LUMINARY	
# 00010	SPECIFY ALIGNMENT MODE	0 ANY TIME 1 REFSMMAT +G	P57	LUMINARY	
#		2 TWO BODIES 3 ONE BODY + G			
# 00012	SPECIFY CSM ORBIT OPTION	1 NO ORBIT CHANGE 2 CHANGE	P22	LUMINARY	
#		ORBIT TO PASS OVER LM			

TAGS FOR RELATIVE SETLOC AND BLANK BANK CARDS

COUNT BANKSUM

MODULE 1 CONTAINS BANKS 0 THROUGH 5

BLOCK 02

RADARFF EQUALS

FFTAG1 EQUALS

FFTAG2 EQUALS

FFTAG3 EQUALS

FFTAG4 EQUALS

FFTAG7 EQUALS

FFTAG8 EQUALS

FFTAG9 EQUALS

FFTAG10 EQUALS

FFTAG11 EQUALS

FFTAG12 EQUALS

FFTAG13 EQUALS

BNKSUM 02

BLOCK 03

FFTAG5 EQUALS

FFTAG6 EQUALS

BNKSUM 03

BANK 00

DLAYJOB EQUALS

BNKSUM 00

BANK 01

RESTART EQUALS

LOADDAP1 EQUALS

BNKSUM 01

BANK 04

R02 EQUALS

VERB37 EQUALS

PINBALL4 EQUALS

CONICS1 EQUALS

KEYRUPT EQUALS

R36LM EQUALS

UPDATE2 EQUALS

E/PROG EQUALS

AOTMARK2 EQUALS

BNKSUM 04

	BANK	05
FRANDRES	EQUALS	
DOWNTLM	EQUALS	
ABORTS1	EQUALS	
EPHEM1	EQUALS	
ASENT3	EQUALS	
	BNKSUM	05

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# MODULE 2 CONTAINS BANKS 6 THROUGH 13
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	BANK	06
IMUCOMP	EQUALS	
T4RUP	EQUALS	
RCSMONT	EQUALS	
MIDDGIM	EQUALS	
EARTHLOC	EQUALS	
	BNKSUM	06

AOTMARK1	BANK	07
MODESW	EQUALS	
ASENT2	EQUALS	
	BNKSUM	07

	BANK	10
RTBCODES	EQUALS	
DISPLAYS	EQUALS	
PHASETAB	EQUALS	
FLESHLOC	EQUALS	
SLCTMU	EQUALS	
	BNKSUM	10

ORBITAL	BANK	11
F2DPS*11	EQUALS	
INTVEL	EQUALS	
	BANKSUM	11

	BANK	12
CONICS	EQUALS	
ORBITAL1	EQUALS	

1				1
2	INTPRET2	EQUALS		2
3		BNKSUM	12	3
4				4
5		BANK	13	5
6	LATLONG	EQUALS		6
7	INTINIT	EQUALS		7
8	LEMGEOM	EQUALS		8
9	P76LOC	EQUALS		9
10	ORBITAL2	EQUALS		10
11	ABTFLGS	EQUALS		11
12		BNKSUM	13	12
13				13
14				14
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MODULE 3 CONTAINS BANKS 14 THROUGH 21

P50S1	BANK	14
STARTAB	EQUALS	
ASENT4	EQUALS	
	BNKSUM	14

P50S	BANK	15
EPHEM	EQUALS	
	BNKSUM	15

DAPS1	BANK	16
	EQUALS	
	BNKSUM	16

DAPS2	BANK	17
P40S3	EQUALS	
	BNKSUM	17

DAPS3	BANK	20
LOADDAP	EQUALS	
RODTRAP	EQUALS	
	BNKSUM	20

DAPS4	BANK	21
R10	EQUALS	
R11	EQUALS	
	BNKSUM	21

MODULE 4 CONTAINS BANKS 22 THROUGH 27

	BANK	22
KALCMON1	EQUALS	
KALCMON2	EQUALS	
R30LOC	EQUALS	
RENDEZ	EQUALS	
SERV2	EQUALS	
LANDCNST	EQUALS	
	BNKSUM	22

	BANK	23
POWFLITE	EQUALS	
POWFLIT1	EQUALS	
INFLIGHT	EQUALS	
AOPERI	EQUALS	
R61	EQUALS	
R62	EQUALS	
INTPRET1	EQUALS	
MEASINC	EQUALS	
MEASINC1	EQUALS	
EXTVB1	EQUALS	
P12A	EQUALS	
NORMLIZ	EQUALS	
ASENT7	EQUALS	
	BNKSUM	23

	BANK	24
PLANTIN	EQUALS	
P20S	EQUALS	
	BNKSUM	24

	BANK	25
P20S1	EQUALS	
P20S2	EQUALS	
RADARUPT	EQUALS	
RRLEADIN	EQUALS	
R29S1	EQUALS	
PLANTIN3	EQUALS	
	BNKSUM	25

	BANK	26
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1					1
2	P20S3	EQUALS			2
3	BAWLANGS	EQUALS			3
4	MANUVER	EQUALS			4
5	MANUVER1	EQUALS			5
6	PLANTIN1	EQUALS			6
7	PLANTIN2	EQUALS			7
8		BNKSUM	26		8
9					9
10		BANK	27		10
11	TOF-FF	EQUALS			11
12	TOF-FF1	EQUALS			12
13	P40S1	EQUALS			13
14	VECPT	EQUALS			14
15	ASENT1	EQUALS			15
16	SERV3	EQUALS			16
17		BNKSUM	27		17
18					18
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MODULE 5 CONTAINS BANKS 30 THROUGH 35

	BANK	30
LOWSUPER	EQUALS	
P12	EQUALS	
ASENT	EQUALS	
FCDUW	EQUALS	
FLOGSUB	EQUALS	
VB67A	EQUALS	
ASENT5	EQUALS	
	BNKSUM	30

	BANK	31
FTHROT	EQUALS	
F2DPS*31	EQUALS	
VB67	EQUALS	
	BNKSUM	31

	BANK	32
P20S4	EQUALS	
F2DPS*32	EQUALS	
ABORTS	EQUALS	
LRS22	EQUALS	
P66LOC	EQUALS	
R47	EQUALS	
SERV	EQUALS	
	BNKSUM	32

	BANK	33
SERVICES	EQUALS	
R29/SERV	EQUALS	
ASENT6	EQUALS	
	BNKSUM	33

	BANK	34
STBLEORB	EQUALS	
P30S1	EQUALS	
CSI/CDH1	EQUALS	
ASCFILT	EQUALS	
R12STUFF	EQUALS	
SERV4	EQUALS	
	BNKSUM	34

CSI/CDH	BANK	35
P30S	EQUALS	
GLM	EQUALS	
P40S2	EQUALS	

BNKSUM 35

MODULE 6 CONTAINS BANKS 36 THROUGH 43

P40S BANK 36
EQUALS
BNKSUM 36

P05P06 BANK 37
EQUALS
IMU2 EQUALS
IMU4 EQUALS
R31 EQUALS

IMUSUPER EQUALS
SERV1 EQUALS
BNKSUM 37

PINBALL1 BANK 40
EQUALS
SELSUPR EQUALS
PINSUPER EQUALS
R31LOC EQUALS
BNKSUM 40

PINBALL2 BANK 41
EQUALS
BNKSUM 41

SBAND BANK 42
EQUALS
PINBALL3 EQUALS
BNKSUM 42

EXTVERBS BANK 43
EQUALS
SELFCHC EQUALS
BNKSUM 43

HI6ZEROS EQUALS ZEROVECS # ZERO VECTOR ALWAYS IN HIGH MEMORY

LO6ZEROS EQUALS ZEROVEC # ZERO VECTOR ALWAYS IN LOW MEMORY

HIDPHALF EQUALS UNITX

LODPHALF EQUALS XUNIT

HIDP1/4 EQUALS DP1/4TH

LODP1/4 EQUALS D1/4 # 2DEC .25

HIUNITX EQUALS UNITX

HIUNITY EQUALS UNITY

HIUNITZ EQUALS UNITZ

LOUNITX EQUALS XUNIT # 2DEC .5

LOUNITY EQUALS YUNIT # 2DEC 0

LOUNITZ EQUALS ZUNIT # 2DEC 0

DELR SPL EQUALS SPLRET # COL PGM, ALSO CALLED BY R30 IN LUMINARY.

ROPE-SPECIFIC ASSIGNS OBVIATING NEED TO CHECK COMPUTER FLAG IN DETERMINING INTEGRATION AREA ENTRIES.

ATOPTHIS EQUALS ATOPLEM

ATOPOTH EQUALS ATOPCSM

OTHPREC EQUALS CSMPREC

MOONTHIS EQUALS LMOONFLG

MOONOTH EQUALS CMOONFLG

MOVATHIS EQUALS MOVEALEM

RMM LODPMAX

RME LODPMAX1

THISPREC EQUALS LEMPREC

THISAXIS EQUALS UNITZ

NB1NB2 EQUALS THISAXIS # FOR R31

ERASID EQUALS BITS2-10 # DOWNLINK ERASABLE DUMP ID

DELAYNUM EQUALS TWO

DPS AND APS ENGINE PARAMETERS

SETLOC P40S
BANK
COUNT* \$\$/P40

*** THE ORDER OF THE FOLLOWING SIX CONSTANTS MUST NOT BE CHANGED ***

FDPS	2DEC	4.3670 B-7	# 9817.5 LBS FORCE IN NEWTONS
MDOTDPS	2DEC	0.1480 B-3	# 32.62 LBS/SEC IN KGS/CS
DTDECAY	2DEC	-38	
FAPS	2DEC	1.5569 B-7	# 3500 LBS FORCE IN NEWTONS
MDOTAPS	2DEC	0.05135 B-3	# 11.32 LBS/SEC IN KGS/CS
ATDECAY	2DEC	-10	

FRCS4	2DEC	0.17792 B-7	# 400 LBS FORCE IN NEWTONS
FRCS2	2DEC	0.08896 B-7	# 200 LBS FORCE IN NEWTONS

SETLOC P40S1
BANK
COUNT* \$\$/P40

*** APS IMPULSE DATA FOR P42 *****

K1VAL	2DEC	124.55 B-23	# 2800 LB-SEC
K2VAL	2DEC	31.138 B-24	# 700 LB-SEC
K3VAL	2DEC	1.5569 B-10	# FAPS 3500 LBS THRUST

S40.136	2DEC	.4671 B-9	# .4671 M NEWTONS DPS
S40.136	2DEC	.4671 B+1	# S40.136 SHIFTED LEFT 10.

SETLOC ASENT1
BANK
COUNT* \$\$/P70

1/DV A	2DEC	15.20 B-7	# 2 SECONDS WORTH OF INITIAL ASCENT
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```
1
2                                     # STAGE ACCELERATION -- INVERTED M/CS
3                                     # 1 PREDICATED ON A LIFTOFF MASS OF
4                                     # 4869.9 KG SNA-8-D-027 7/11/68
5                                     # 2 PREDICATED ON A CONTRIBUTION TO VEH-
6                                     # ICLE ACCELERATION FROM RCS THRUSTERS
7                                     # EQUIV. TO 1 JET ON CONTINUOUSLY.
8
9 K 1/DV          2DEC    436.70 B-9      # DPS ENGINE THRUST IN NEWTONS / 100 CS.
10
11 AT A           2DEC    3.2883 E-4 B9    # INITIAL ASC. STG. ACCELERATION ** M/CS.
12                                     # ASSUMPTIONS SAME AS FOR 1/DV A.
13 TBUP A         2DEC    91902 B-17      # ESTIMATED BURN-UP TIME OF THE ASCENT STG.
14                                     # ASSUMPTIONS SAME AS FOR 1/DV A WITH THE
15                                     # ADDITIONAL ASSUMPTION THAT NET MASS-FLOW
16                                     # RATE 5.299 KG/SEC 5.135 APS +
17                                     # .164 1 RCS JET .
18
19 SETLOC ASENT
20 BANK
21 AT/RCS         COUNT* $$/ASENT
22                 2DEC    .0000785 B+10   # 4 JETS IN A DRY LEM
23
24 SETLOC SERVICES
25 BANK
26 COUNT* $$/SERV
27
28 # *** THE ORDER OF THE FOLLOWING TWO CONSTANTS MUST NOT BE CHANGED *****
29 APSVEX         DEC     -3030 E-2 B-5     # 9942 FT/SEC IN M/CS.
30 DPSVEX         DEC*    -2.95588868 E+1 B-05* # VE DPS +2.95588868E+ 3
31
32 # *****
33
34 SETLOC F2DPS*31
35 BANK
36 COUNT* $$/F2DPS
37
38 TRIMACCL       2DEC*    +3.50132708 E-5 B+08* # A T +3.50132708E- 1
39
40
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THROTTLING AND THRUST DETECTION PARAMETERS

SETLOC P40S
BANK
COUNT* \$\$/P40

THRESH1 DEC 24
THRESH3 DEC 12
HIRTHROT BIT13

SETLOC FFTAG5
BANK
COUNT* \$\$/P40

THRESH2 DEC 308

SETLOC FTHROT
BANK
COUNT* \$\$/THROT

FMAXODD DEC +3841 # FSAT +4.81454413 E+4
FMAXPOS DEC +3467 # FMAX +4.34546769 E+4
THROTLAG DEC +20 # TAU TH +1.99999999 E-1
SCALEFAC 2DEC* +7.97959872 E+2 B-16* # BITPERF +7.97959872 E-2

SETLOC F2DPS*32
BANK
COUNT* \$\$/F2DPS

DPSTHRSH DEC 36 # THRESH1 + THRESH3 FOR P63

LM HARDWARE-RELATED PARAMETERS

SETLOC RADARUPT
BANK
COUNT* \$\$/RRUPT

LVELBIAS DEC -12288 # LANDING RADAR BIAS FOR 153.6 KC.
RDOTBIAS 2DEC 17000 # BIAS COUNT FOR RR RANGE RATE.

SETLOC LRS22
BANK
COUNT* \$\$/LRS22

RDOTCONV 2DEC -.0019135344 B7 # CONVERTS RR RDOT READING TO M/CS AT 2 7
RANGCONV 2DEC 2.859024 B-3 # CONVERTS RR RANGE READING TO M. AT 2 -29

SETLOC SERVICES
BANK
COUNT* \$\$/SERV

HBEAMANT 2DEC -.4687018041 # RANGE BEAM IN LR ANTENNA COORDINATES.
2DEC 0
2DEC -.1741224271

HSCAL 2DEC -.3288792 # SCALES 1.079 FT/BIT TO 2 22 M.

***** THE SEQUENCE OF THE FOLLOWING CONSTANTS MUST BE PRESERVED *****

VZSCAL 2DEC +.5410829105 # SCALES .8668 FT/SEC/BIT TO 2 18 M/CS.
VYSCAL 2DEC +.7565672446 # SCALES 1.212 FT/SEC/BIT TO 2 18 M/CS.
VXSCAL 2DEC -.4020043770 # SCALES -.644 FT/SEC/BIT TO 2 18 M/CS.

KPIP DEC .0512 # SCALES DELV TO UNITS OF 2 5 M/CS.
KPIP1 2DEC .0128 # SCALES DELV TO UNITS OF 2 7 M/CS.
KPIP2 2DEC .0064 # SCALES DELV TO UNITS OF 2 8 M/CS.

ALTCONV	2DEC	1.399078846 B-4	# CONVERTS M*2 -24 TO BIT UNITS *2 -28 .
ARCONV1	2DEC	656.167979 B-10	# CONV. ALTRATE COMP. TO BIT UNITS
	SETLOC	R10	
	BANK		
	COUNT*	\$\$/R10	
ARCONV	OCT	24402	# 656.1679798B-10 CONV ALTRATE TO BIT UNIT
ARTOA	DEC	.1066098 B-1	# .25/2.345 B-1 4X/SEC CYCLE RATE.
ARTOA2	DEC	.0021322 B8	# .5 / 2.345 100
VELCONV	OCT	22316	# 588.914 B-10 CONV VEL. TO BIT UNITS.
KPIP1 5	DEC	.0512	# SCALES DELV TO M/CS*2 -5 .
MAXVBITS	OCT	00547	# MAX. DISPLAYED VELOCITY 199.9989 FT/SEC.
	SETLOC	DAPS3	
	BANK		
	COUNT*	\$\$/DAPAO	
TORKJET1	DEC	.03757	# 550 / .2 SCALED AT +16 64 / 180

PARAMETERS RELATING TO MASS, INERTIA, AND VEHICLE DIMENSIONS

SETLOC FRANDRES
BANK
COUNT* \$\$/START

FULLAPS DEC 5050 B-16 # NOMINAL FULL ASCENT MASS -- 2 16 KG.

SETLOC LOADDAP1
BANK
COUNT* \$\$/R03

MINLMD DEC -2850 B-16 # MIN. DESCENT STAGE MASS -- 2 16 KG.

MINMINLM DEC -2200 B-16 # MIN ASCENT STAGE MASS -- 2 16 KG.

MINCSM BIT11 # MIN CSM MASS OK FOR 1/ACCS 9050 LB

SETLOC DAPS3
BANK
COUNT* \$\$/DAPAD

LOASCENT DEC 2200 B-16 # MIN ASCENT LEM MASS -- 2 16 KG.

HIDESCNT DEC 15300 B-16 # MAX DESCENT LEM MASS -- 2 16 KG.

LODESCNT DEC 1750 B-16 # MIN DESCENT STAGE ALONE -- 2 16 KG.

PHYSICAL CONSTANTS TIME - INVARIANT

SETLOC IMU2
BANK
COUNT* \$\$/P07

OMEG/MS 2DEC .24339048

SETLOC R30LOC
BANK
COUNT* \$\$/R30

*** THE ORDER OF THE FOLLOWING TWO CONSTANTS MUST BE PRESERVED *****

1/RTMUM 2DEC* .45162595 E-4 B14*
1/RTMUE 2DEC* .50087529 E-5 B17*

SETLOC P40S1
BANK
COUNT* \$\$/S40.9

EARTHMU 2DEC* -3.986032 E10 B-36* # M 3 /CS 2

SETLOC ASENT1
BANK
COUNT* \$\$/P12

MUM -37 2DEC* 4.9027780 E8 B-37*
MOONRATE 2DEC* .26616994890062991 E-7 B+19* # RAD/CS.

SETLOC SERVICES
BANK
COUNT* \$\$/SERV

*** THE ORDER OF THE FOLLOWING TWO CONSTANTS MUST BE PRESERVED *****

-MUDT 2DEC* -7.9720645 E+12 B-44*
-MUDT1 2DEC* -9.8055560 E+10 B-44*

-MUDTMUN 2DEC* -9.8055560 E+10 B-38*
RESQ 2DEC* 40.6809913 E12 B-58*

1412THE

20J 2DEC 3.24692010 E-2
2J 2DEC 3.24692010 E-3

SETLOC P50S1
BANK
COUNT* \$\$/LOSAM

RSUBEM 2DEC 384402000 B-29
RSUBM 2DEC 1738090 B-29
RSUBE 2DEC 6378166 B-29
ROE 2DEC .00257125

SETLOC CONICS1
BANK
COUNT* \$\$/LT-LG

ERAD 2DEC 6373338 B-29 # PAD RADIUS
504RM 2DEC 1738090 B-29 # METERS B-29 EQUATORIAL MOON RADIUS

SETLOC CONICS1
BANK
COUNT* \$\$/CONIC

*** THE ORDER OF THE FOLLOWING CONSTANTS MUST BE PRESERVED *****

MUTABLE 2DEC* 3.986032 E10 B-36* # MUE
2DEC* .25087606 E-10 B+34* # 1/MUE
2DEC* 1.99650495 E5 B-18* # SQRT MUE
2DEC* .50087529 E-5 B+17* # 1/SQRT MUE
2DEC* 4.902778 E8 B-30* # MUM
2DEC* .203966 E-8 B+28* # 1/MUM
2DEC* 2.21422176 E4 B-15* # SQRT MUM
2DEC* .45162595 E-4 B+14* # 1/SQRT MUM

SETLOC INTINIT
BANK
COUNT* \$\$/INTIN
OMEGMOON 2DEC* 2.66169947 E-8 B+23*

SETLOC ORBITAL2
BANK
COUNT* \$\$/ORBIT

*** THE ORDER OF THE FOLLOWING CONSTANTS MUST NOT BE CHANGED *****

MUM 2DEC* 1.32715445 E16 B-54*
2DEC* 4.9027780 E8 B-30*
MUEARTH 2DEC* 3.986032 E10 B-36*
2DEC 0
J4REQ/J3 2DEC* .4991607391 E7 B-26*
2DEC -176236.02 B-25
2J3RE/J2 2DEC* -.1355426363 E5 B-27*
2DEC* .3067493316 E18 B-60*
J2REQSQ 2DEC* 1.75501139 E21 B-72*
3J22R2MU 2DEC* 9.20479048 E16 B-58*

SETLOC TOF-FF1
BANK
COUNT* \$\$/TFF
1/RTMU 2DEC* .5005750271 E-5 B17* # MODIFIED EARTH MU

SETLOC SBAND
BANK
COUNT* \$\$/R05

REMDIST 2DEC 384402000 B-29 # MEAN DISTANCE BETWEEN EARTH AND MOON.

PHYSICAL CONSTANTS TIME - VARIANT

SETLOC STARTAB
BANK
COUNT* \$\$/STARS

2DEC	+.8342971408 B-1	# STAR 37	X
2DEC	-.2392481515 B-1	# STAR 37	Y
2DEC	-.4966976975 B-1	# STAR 37	Z
2DEC	+.8139832631 B-1	# STAR 36	X
2DEC	-.5557243189 B-1	# STAR 36	Y
2DEC	+.1691204557 B-1	# STAR 36	Z
2DEC	+.4541086270 B-1	# STAR 35	X
2DEC	-.5392368197 B-1	# STAR 35	Y
2DEC	+.7092312789 B-1	# STAR 35	Z
2DEC	+.3201817378 B-1	# STAR 34	X
2DEC	-.4436021946 B-1	# STAR 34	Y
2DEC	-.8370786986 B-1	# STAR 34	Z
2DEC	+.5520184464 B-1	# STAR 33	X
2DEC	-.7933187400 B-1	# STAR 33	Y
2DEC	-.2567508745 B-1	# STAR 33	Z
2DEC	+.4537196908 B-1	# STAR 32	X
2DEC	-.8779508801 B-1	# STAR 32	Y
2DEC	+.1527766153 B-1	# STAR 32	Z
2DEC	+.2069525789 B-1	# STAR 31	X
2DEC	-.8719885748 B-1	# STAR 31	Y
2DEC	-.4436288486 B-1	# STAR 31	Z
2DEC	+.1217293692 B-1	# STAR 30	X
2DEC	-.7702732847 B-1	# STAR 30	Y

[illegible]

2DEC	-.4523440203 B-1	# STAR 21	X
2DEC	-.0493710140 B-1	# STAR 21	Y
2DEC	-.8904759346 B-1	# STAR 21	Z
2DEC	-.9525211695 B-1	# STAR 20	X
2DEC	-.0593434796 B-1	# STAR 20	Y
2DEC	-.2986331746 B-1	# STAR 20	Z
2DEC	-.9656605484 B-1	# STAR 19	X
2DEC	+.0525933156 B-1	# STAR 19	Y
2DEC	+.2544280809 B-1	# STAR 19	Z
2DEC	-.8608205219 B-1	# STAR 18	X
2DEC	+.4636213989 B-1	# STAR 18	Y
2DEC	+.2098647835 B-1	# STAR 18	Z
2DEC	-.7742591356 B-1	# STAR 17	X
2DEC	+.6152504197 B-1	# STAR 17	Y
2DEC	-.1482892839 B-1	# STAR 17	Z
2DEC	-.4657947941 B-1	# STAR 16	X
2DEC	+.4774785033 B-1	# STAR 16	Y
2DEC	+.7450164351 B-1	# STAR 16	Z
2DEC	-.3612508532 B-1	# STAR 15	X
2DEC	+.5747270840 B-1	# STAR 15	Y
2DEC	-.7342932655 B-1	# STAR 15	Z
2DEC	-.4118589524 B-1	# STAR 14	X
2DEC	+.9065485360 B-1	# STAR 14	Y
2DEC	+.0924226975 B-1	# STAR 14	Z
2DEC	-.1820751783 B-1	# STAR 13	X

[illegible]

2DEC	+.9998837600 B-1	# STAR 5	Z
2DEC	+.4917678276 B-1	# STAR 4	X
2DEC	+.2204887125 B-1	# STAR 4	Y
2DEC	-.8423473935 B-1	# STAR 4	Z
2DEC	+.4775639450 B-1	# STAR 3	X
2DEC	+.1166004340 B-1	# STAR 3	Y
2DEC	+.8708254803 B-1	# STAR 3	Z
2DEC	+.9342640400 B-1	# STAR 2	X
2DEC	+.1735073142 B-1	# STAR 2	Y
2DEC	-.3115219339 B-1	# STAR 2	Z
2DEC	+.8748658918 B-1	# STAR 1	X
2DEC	+.0260879174 B-1	# STAR 1	Y
2DEC	+.4836621670 B-1	# STAR 1	Z

CATLOG DEC 6970

SETLOC EPHEM1
BANK
COUNT* \$\$/EPHEM

KONMAT	2DEC 1.0 B-1	# *****
	2DEC 0	# *
	2DEC 0	# *
	2DEC 0	# *
	2DEC .91745 B-1	# K1 COS OBL *
	2DEC -.03571 B-1	# K2 SIN OBL SIN IM *
	2DEC 0	# *
	2DEC .39784 B-1	# K3 SIN OBL *

	2DEC	.082354 B-1	# K4 COS OBL SIN IM *	
CSTODAY	2DEC	8640000 B-33	#	* NOTE *
RCB-13	OCT	00002	#	* TABLES CONTAIN *
	OCT	00000	#	* CONSTANTS FOR *
RATESP	2DEC	.03660098 B+4	# LOMR	* 1969 - 1970 *
	2DEC	.00273779 B+4	# LOSR	
	2DEC	-.00014719 B+4	# LONR	
	2DEC	.815282336	# LOMO	
	2DEC	.274674910	# LOSO	
	2DEC	.986209499	# LONO	
VAL67	2DEC*	.01726666666 B+1*	# AMOD	
	2DEC	.530784445	# AARG	
	2DEC	.036291712 B+1	# 1/27	
	2DEC	.003505277 B+1	# BMOD	
	2DEC	.585365625	# BARG	
	2DEC	.03125 B+1	# 1/32	
	2DEC	.005325277 B+1	# CMOD	
	2DEC	-.01106341036	# CARG	
	2DEC	.002737925 B+1	# 1/365	
# *****				
SETLOC PLANTIN2				
BANK				
COUNT* \$\$/LUROT				
COSI	2DEC	.99964173 B-1	# COS 5521.5 SEC. B-1	
SINI	2DEC	.02676579 B-1	# SIN 5521.5 SEC. B-1	
NODDOT	2DEC	-.457335121 E-2	# REV/CSEC B+28	-1.07047011 E-8 RAD/SEC
FDOT	2DEC	.570863327	# REV/CSEC B+27	2.67240410 E-6 RAD/SEC

CONTROLLED CONSTANTS

BDOT	2DEC	-3.07500686 E-8	# REV/CSEC B+28	-7.19757301 E-14 RAD/SEC
NODIO	2DEC	.986209434	# REVS B-D	6.19653663041 RAD
FSUBO	2DEC	.829090536	# REVS B-D	5.20932947829 RAD
BSUBO	2DEC	.0651201393	# REVS B-D	0.40916190299 RAD
WEARTH	2DEC	.973561595	# REV/CSEC B+23	7.29211494 E-5 RAD/SEC

1412THE

*** CHANNEL DESCRIPTIONSF WORDS ARE ALLOCATED IN ERASABLE ASSIGNMENTS ***

CHANNEL 1 IDENTICAL TO COMPUTER REGISTER L 0001

CHANNEL 2 IDENTICAL TO COMPUTER REGISTER Q 0002

CHANNEL 3 HISCALAR INPUT CHANNEL MOST SIGNIFICANT 14 BITS FROM 33 STAGE BINARY COUNTER. SCALE FACTOR IS B23 IN CSEC, SO MAX VALUE ABOUT 23.3 HOURS AND LEAST SIGNIFICANT BIT 5.12 SECS.

CHANNEL 4 LOSCALAR INPUT CHANNEL NEXT MOST SIGNIFICANT 14 BITS FROM THE 33 STAGE BINARY COUNTER ASSOCIATED WITH CHANNEL 3. SCALE FACTOR IS B9 IN CSEC. SO MAX VAL IS 5.12 SEC AND LEAST SIGNIFICANT BIT IS 1/3200 SEC. SCALE FACTOR OF D.P. WORD WITH CHANNEL 3 IS B23 CSEC.

CHANNEL 5 PYJETS OUTPUT CHANNEL PITCH RCS JET CONTROL. REACTION CONTROL SYSTEM USES BITS 1-8.

CHANNEL 6 ROLLJETS OUTPUT CHANNEL ROLL RCS JET CONTROL. REACTION CONTROL SYSTEM USES BIT 1-8.

CHANNEL 7 SUPERBNK OUTPUT CHANNEL NOT RESET BY RESTART FIXED EXTENSION BITS USED TO SELECT THE APPROPRIATE FIXED MEMORY BANK IF FBANK IS 30 OCTAL OR MORE. USES BITS 5-7.

CHANNEL 10 OUTO OUTPUT CHANNEL REGISTER USED TO TRANSMIT LATCHING-RELAY DRIVING INFORMATION FOR THE DISPLAY SYSTEM. BITS 15-12 ARE SET TO THE ROW NUMBER 1-14 OCTAL OF THE RELAY TO BE CHANGED AND BITS 11-1 CONTAIN THE REQUIRED SETTINGS FOR THE RELAYS IN THE ROW.

CHANNEL 11 DSALMOUT OUTPUT CHANNEL REGISTER WHOSE BITS ARE USED FOR ENGINE ON-OFF CONTROL AND TO DRIVE INDIVIDUAL INDICATORS OF THE DISPLAY SYSTEM. BITS 1-7 ARE A RELAYS.

BIT 1 ISS WARNING

BIT 2 LIGHT COMPUTER ACTIVITY LAMP

BIT 3 LIGHT UPLINK ACTIVITY LAMP

BIT 4 LIGHT TEMP CAUTION LAMP

BIT 5 LIGHT KEYBOARD RELEASE LAMP

BIT 6 FLASH VERB AND NOUN LAMPS

BIT 7 LIGHT OPERATOR ERROR LAMP

[illegible]

#	CHANNEL 13	CHAN13	OUTPUT CHANNEL.
#			
#	BIT 1	RADAR C	PROPER SETTING OF THE A,B,C MATRIX
#	BIT 2	RADAR B	SELECTS CERTAIN RADAR
#	BIT 3	RADAR A	PARAMETERS TO BE READ.
#	BIT 4	RADAR ACTIVITY	
#	BIT 5	NOT USED	CONNECTS AN ALTERNATE INPUT TO UPLINK
#	BIT 6	BLOCK INPUTS TO UPLINK CELL	
#	BIT 7	DOWNLINK TELEMETRY WORD ORDER CODE BIT	
#	BIT 8	RHC COUNTER ENABLE	READ HAND CONTROLLER ANGLES
#	BIT 9	START RHC READ INTO COUNTERS IF BIT 8 SET	
#	BIT 10	TEST ALARMS, TEST DSKY LIGHTS	
#	BIT 11	ENABLE STANDBY	
#	BIT 12	RESET TRAP 31-A	ALWAYS APPEAR TO BE SET TO 0
#	BIT 13	RESET TRAP 31-B	ALWAYS APPEAR TO BE SET TO 0
#	BIT 14	RESET TRAP 32	ALWAYS APPEAR TO BE SET TO 0
#	BIT 15	ENABLE T6 RUPT	
#	CHANNEL 14	CHAN14	OUTPUT CHANNEL USED TO CONTROL COMPUTER COUNTER CELLS CDU,GYRO,SPACECRAFT FUNC.
#			
#	BIT 1	OUTLINK ACTIVITY	NOT USED
#	BIT 2	ALTITUDE RATE OR ALTITUDE SELECTOR	
#	BIT 3	ALTITUDE METER ACTIVITY	
#	BIT 4	THRUST DRIVE ACTIVITY FOR DESCENT ENGINE	
#	BIT 5	SPARE	
#	BIT 6	GYRO ENABLE POWER FOR PULSES	
#	BIT 7	GYRO SELECT B	PAIR OF BITS IDENTIFIES AXIS OF -
#	BIT 8	GYRO SELECT A	GYRO SYSTEM TO BE TORQUED.
#	BIT 9	GYRO TORQUING COMMAND IN NEGATIVE DIRECTION	

#	BIT 10	GYRO ACTIVITY
#	BIT 11	DRIVE CDU S
#	BIT 12	DRIVE CDU T
#	BIT 13	DRIVE CDU Z
#	BIT 14	DRIVE CDU Y
#	BIT 15	DRIVE CDU X
#	CHANNEL 15	MNKEYIN INPUT CHANNEL KEY CODE INPUT FROM KEYBOARD OF DSKY, SENSED BY PROGRAM WHEN PROGRAM INTERRUPT #5 IS RECEIVED. USES BITS 5-1
#	CHANNEL 16	NAVKEYIN INPUT CHANNEL OPTICS MARK INFORMATION AND NAVIGATION PANEL DSKY CM OR THRUST CONTROL LM SENSED BY PROGRAM WHEN PROGRAM INTERRUPT #6 IS RECEIVED. USES BITS 3-7 ONLY.
#	BIT 1	NOT ASSIGNED
#	BIT 2	NOT ASSIGNED
#	BIT 3	OPTICS X-AXIS MARK SIGNAL FOR ALIGN OPTICAL TSCOPE
#	BIT 4	OPTICS Y-AXIS MARK SIGNAL FOR AOT
#	BIT 5	OPTICS MARK REJECT SIGNAL
#	BIT 6	DESCENT+ CREW DESIRED SLOWING RATE OF DESCENT
#	BIT 7	DESCENT- CREW DESIRED SPEEDING UP RATE OF DESCENT
#	# NOTE ALL BITS IN CHANNELS 30-33 ARE INVERTED AS SENSED BY THE PROGRAM, SO THAT A VALUE OF ZERO MEANS THAT THE INDICATED SIGNAL IS PRESENT.	
#	CHANNEL 30	INPUT CHANNEL
#	BIT 1	ABORT WITH DESCENT STAGE
#	BIT 2	UNUSED
#	BIT 3	ENGINE ARMED SIGNAL
#	BIT 4	ABORT WITH ASCENT ENGINE STAGE
#	BIT 5	AUTO THROTTLE COMPUTER CONTROL OF DESCENT ENGINE

1				1
2	#	BIT 6	DISPLAY INERTIAL DATA	2
3	#	BIT 7	RR CDU FAIL	3
4	#	BIT 8	SPARE	4
5	#	BIT 9	IMU OPERATE WITH NO MALFUNCTION	5
6	#	BIT 10	LM COMPUTER NOT AGS HAS CONTROL OF LM	6
7	#	BIT 11	IMU CAGE COMMAND TO DRIVE IMU GIMBAL ANGLES TO 0.	7
8	#	BIT 12	IMU CDU FAIL MALFUNCTION OF IMU CDU,S	8
9	#	BIT 13	IMU FAIL MALFUNCTION OF IMU STABILIZATION LOOPS	9
10	#	BIT 14	ISS TURN ON REQUESTED	10
11	#	BIT 15	TEMPERATURE OF STABLE MEMBER WITHIN DESIGN LIMITS	11
12				12
13	#	CHANNEL 31	INPUT CHANNEL BITS ASSOCIATED WITH THE ATTITUDE CONTROLLER, TRANSLATIONAL CONTROLLER,	13
14	#		AND SPACECRAFT ATTITUDE CONTROL USED BY RCS DAP	14
15	#			15
16	#	BIT 1	ROTATION BY RHC COMMANDED IN POSITIVE PITCH DIRECTION MUST BE IN MINIMUM IMPULSE MODE.	16
17	#		ALSO POSITIVE ELEVATION CHANGE FOR LANDING POINT DESIGNATOR	17
18	#	BIT 2	AS BIT 1 EXCEPT NEGATIVE PITCH AND ELEVATION	18
19	#	BIT 3	ROTATION BY RHC COMMANDED IN POSITIVE YAW DIRECTION MUST BE IN MINIMUM IMPULSE MODE.	19
20	#	BIT 4	AS BIT 3 EXCEPT NEGATIVE YAW	20
21	#	BIT 5	ROTATION BY RHC COMMANDED IN POSITIVE ROLL DIRECTION MUST BE IN MINIMUM IMPULSE MODE.	21
22	#		ALSO POSITIVE AZIMUTH CHANGE FOR LANDING POINT DESIGNATOR	22
23	#	BIT 6	AS BIT 5 EXCEPT NEGATIVE ROLL AND AZIMUTH	23
24	#	BIT 7	TRANSLATION IN +X DIRECTION COMMANDED BY THC	24
25	#	BIT 8	TRANSLATION IN -X DIRECTION COMMANDED BY THC	25
26	#	BIT 9	TRANSLATION IN +Y DIRECTION COMMANDED BY THC	26
27	#	BIT 10	TRANSLATION IN -Y DIRECTION COMMANDED BY THC	27
28	#	BIT 11	TRANSLATION IN +Z DIRECTION COMMANDED BY THC	28
29	#	BIT 12	TRANSLATION IN -Z DIRECTION COMMANDED BY THC	29
30				30
31				31
32				32
33				33
34				34
35				35
36				36
37				37
38				38
39				39
40				40
41				41
42				42
43				43
44				44
45				45
46				46
47				47
48				48
49				49
50				50
51				51
52				52
53				53
54				54
55				55
56				56
57				57
58				58
59				59
60				60

BIT 13 ATTITUDE HOLD MODE ON SCS MODE CONTROL SWITCH
BIT 14 AUTO STABILIZATION OF ATTITUDE ON SCS MODE SWITCH
BIT 15 ATTITUDE CONTROL OUT OF DETENT RHC NOT IN NEUTRAL

CHANNEL 32 INPUT CHANNEL.

BIT 1 THRUSTERS 2 4 DISABLED BY CREW
BIT 2 THRUSTERS 5 8 DISABLED BY CREW
BIT 3 THRUSTERS 1 3 DISABLED BY CREW
BIT 4 THRUSTERS 6 7 DISABLED BY CREW
BIT 5 THRUSTERS 14 16 DISABLED BY CREW
BIT 6 THRUSTERS 13 15 DISABLED BY CREW
BIT 7 THRUSTERS 9 12 DISABLED BY CREW
BIT 8 THRUSTERS 10 11 DISABLED BY CREW
BIT 9 DESCENT ENGINE GIMBALS DISABLED BY CREW
BIT 10 APPARENT DESCENT ENGINE GIMBAL FAILURE
BIT 14 INDICATES PROCEED KEY IS DEPRESSED

CHANNEL 33 CHAN33 INPUT CHANNEL FOR HARDWARE STATUS AND COMMAND INFORMATION. BITS 15-11 ARE FLIP-FLOP BITS RESET BY A CHANNEL WRITE COMMAND THAT ARE RESET BY A RESTART BY T4RUPT LOOP.

BIT 1 SPARE
BIT 2 RR AUTO-POWER ON
BIT 3 RR RANGE LOW SCALE
BIT 4 RR DATA GOOD
BIT 5 LR RANGE DATA GOOD
BIT 6 LR POS1
BIT 7 LR POS2

[illegible]

FLAGWORDS 0-11 ARE DOWNLINKED AND CAN BE SET AND CLEARED BY UP-FLAG AND DOWN-FLAG INSTRUCTIONS IN THE INTERPRETER. THESE WERE PREVIOUSLY LISTED UNDER INTERPRETIVE SWITCH BIT ASSIGNMENTS IN THE ERASABLE LOG SECTION. FLAGWORDS 12 13 WERE PREVIOUSLY RADMODES AND DAPBOOLS AND ARE STILL DOWNLINKED UNDER THOSE NAMES.

ALPHABETICAL LIST OF FLAGWORDS

# FLAGWORD	DEC. NUMBER	BIT AND FLAG	BIT NAME
# ACCOKFLG	207	BIT 3 FLAG 13	ACCSOKAY
# ACC4-2FL	199	BIT 11 FLAG 13	ACC4OR2X
# ACMODFLG	032	BIT 13 FLAG 2	ACMODBIT
# ALTSCALE	186	BIT 9 FLAG 12	ALTSCBIT
# ANTENFLG	183	BIT 12 FLAG 12	ANTENBIT
# AORBSFLG	205	BIT 5 FLAG 13	AORBSYST
# AORBTFLG	200	BIT 10 FLAG 13	AORBTRAN
# APSESW	130	BIT 5 FLAG 8	APSESBIT
# APSFLAG	152	BIT 13 FLAG 10	APSFLBIT
# ASTNFLAG	108	BIT 12 FLAG 7	ASTNBIT
# ATTFLAG	104	BIT 1 FLAG 6	ATTFLBIT
# AUTOMODE	193	BIT 2 FLAG 12	AUTOMBIT
# AUTR1FLG	209	BIT 1 FLAG 13	AUTRATE1
# AUTR2FLG	208	BIT 2 FLAG 13	AUTRATE2
# AUXFLAG	103	BIT 2 FLAG 6	AUXFLBIT
# AVEGFLAG	115	BIT 5 FLAG 7	AVEGFBIT
# AVEMIDSW	149	BIT 1 FLAG 9	AVEMDBIT
# AVFLAG	040	BIT 5 FLAG 2	AVFLBIT
# CALCMAN2	043	BIT 2 FLAG 2	CALC2BIT
# CALCMAN3	042	BIT 3 FLAG 2	CALC3BIT
# CDESFLAG	180	BIT 15 FLAG 12	CDESBIT
# CMOONFLG	123	BIT 12 FLAG 8	CMOONBIT
# COGAFLAG	131	BIT 4 FLAG 8	COGAFBIT
# CSMDKFLG	197	BIT 13 FLAG 13	CSMDOCKD
# CULTFLAG	053	BIT 7 FLAG 3	CULTBIT
# DAPBOOLS		FLGWRD13	
# DBSELFLG	206	BIT 4 FLAG 13	DBSELECT
# DESIGFLG	185	BIT 10 FLAG 12	DESIGBIT
# DIDFLAG	016	BIT 14 FLAG	DIDFLBIT
# DIMOFLAG	059	BIT 1 FLAG 3	DIMOBIT
# DMENFLG	081	BIT 9 FLAG 5	DMENFBIT
# DRIFTDFL	202	BIT 8 FLAG 13	DRIFTBIT
# DRIFTFLG	030	BIT 15 FLAG 2	DRFTBIT
# DSKYFLAG	075	BIT 15 FLAG 5	DSKYFBIT

# D6OR9FLG	058	BIT 2 FLAG 3	D6OR9BIT	
# ENGONFLG	083	BIT 7 FLAG 5	ENGONBIT	
# ERADFLAG	017	BIT 13 FLAG 1	ERADFBIT	
# ETPIFLAG	038	BIT 7 FLAG 2	ETPIBIT	EQUIVALENT FLAG NAME DPTNSW
# FINALFLG	039	BIT 6 FLAG 2	FINALBIT	
# FLAGWRD0	000-014	STATE +0		
# FLAGWRD1	015-029	STATE +1		
# FLAGWRD2	030-044	STATE +2		
# FLAGWRD3	045-059	STATE +3		
# FLAGWRD4	060-074	STATE +4		
# FLAGWRD5	075-089	STATE +5		
# FLAGWRD6	090-104	STATE +6		
# FLAGWRD7	105-119	STATE +7		
# FLAGWRD8	120-134	STATE +8D		
# FLAGWRD9	135-149	STATE +9D		
# FLAP	142	BIT 8 FLAG 9	FLAPBIT	
# FLGWRD10	150-164	STATE +10D		
# FLGWRD11	165-179	STATE +11D		
# FLGWRD12	180-194	STATE +12D		
# FLGWRD13	195-209	STATE +13D		
# FLPC	138	BIT 12 FLAG 9	FLPCBIT	
# FLPI	139	BIT 11 FLAG 9	FLPIBIT	
# FLRCS	149	BIT 10 FLAG 9	FLRCSBIT	
# FLUNDISP	125	BIT 10 FLAG 8	FLUNDBIT	
# FLVR	136	BIT 14 FLAG 9	FLVRBIT	
# FREEFLAG	012	BIT 3 FLAG 0	FREEFBIT	
# FSPASFLG	005	BIT 10 FLAG 0	FSPASBIT	
# GLOKFAIL	046	BIT 14 FLAG 3	GLOKFBIT	
# GMBDRVSW	095	BIT 10 FLAG 6	GMBDRBIT	
# GUESSW	028	BIT 2 FLAG 1	GUESSBIT	
# HFLSHFLG	179	BIT 1 FLAG 11	HFLSHBIT	
# IDLEFLAG	113	BIT 7 FLAG 7	IDLEFBIT	
# IGNFLAG	107	BIT 13 FLAG 7	IGNFLBIT	
# IMPULSW	036	BIT 9 FLAG 2	IMPULBIT	
# IMUSE	007	BIT 8 FLAG 0	IMUSEBIT	
# INFINFLG	128	BIT 7 FLAG 8	INFINBIT	
# INITALGN	133	BIT 2 FLAG 8	INITABIT	
# INTFLAG	151	BIT 14 FLAG 10	INTFLBIT	
# INTYPFLG	056	BIT 4 FLAG 3	INTYPBIT	
# ITSWICH	105	BIT 15 FLAG 7	ITSWBIT	
# JSWITCH	001	BIT 14 FLAG 0	JSWCHBIT	
# LETABORT	141	BIT 9 FLAG 9	LETABBIT	
# LMOONFLG	124	BIT 11 FLAG 8	LMOONBIT	
# LOKONSW	010	BIT 5 FLAG 0	LOKONBIT	
# LOSCMFLG	033	BIT 12 FLAG 2	LOSCMBIT	
# LRALTFLG	190	BIT 5 FLAG 12	LRALTBIT	
# LRBYPASS	165	BIT 15 FLAG 11	LRBYBIT	
# LRINH	172	BIT 8 FLAG 11	LRINHBIT	
# LRPOSFLG	189	BIT 6 FLAG 12	LRPOSBIT	
# LRVELFLG	187	BIT 8 FLAG 12	LRVELBIT	
# PAGE63				
# LUNAFLAG	048	BIT 12 FLAG 3	LUNABIT	
# MANUFLAG	106	BIT 14 FLAG 7	MANUFBIT	
# MGLVFLAG	088	BIT 2 FLAG 5	MGLVFBIT	
# MIDAVFLG	148	BIT 2 FLAG 9	MIDAVBIT	
# MIDFLAG	002	BIT 13 FLAG 0	MIDFLBIT	
# MID1FLAG	147	BIT 3 FLAG 9	MID1BIT	
# MKOVFLAG	072	BIT 3 FLAG 4	MKOVBIT	
# MOONFLAG	003	BIT 12 FLAG 0	MOONBIT	

	#	MRKIDFLG	060	BIT 15	FLAG 4	MRKIDBIT
1	#	MRKNVFLG	066	BIT 9	FLAG 4	MRKNVBIT
2	#	MRUPTFLG	070	BIT 5	FLAG 4	MRUPTBIT
3	#	MUNFLAG	097	BIT 8	FLAG 6	MUNFLBIT
4	#	MWAITFLG	064	BIT 11	FLAG 4	MWAITBIT
5	#	NEEDLFLG	011	BIT 4	FLAG 0	NEEDLBIT
6	#	NEWIFLG	122	BIT 13	FLAG 8	NEWIBIT
7	#	NJETSFLG	015	BIT 15	FLAG	NJETSBIT
8	#	NODOFLAG	044	BIT 1	FLAG 2	NODOBIT
9	#	NOLRREAD	170	BIT 10	FLAG 11	NOLRRBIT
10	#	NORMSW	110	BIT 10	FLAG 7	NORMSBIT
11	#	NORRMON	086	BIT 4	FLAG 5	NORRMBIT
12	#	NOR29FLG	049	BIT 11	FLAG 3	NR29FBIT
13	#	NOTHROTL	078	BIT 12	FLAG 5	NOTHRBIT
14	#	NOUPFLAG	024	BIT 6	FLAG 1	NOUPFBIT
15	#	NRMNVFLG	067	BIT 8	FLAG 4	NRMNVBIT
16	#	NRMIDFLG	062	BIT 13	FLAG 4	NRMIDBIT
17	#	NRUPTFLG	071	BIT 4	FLAG 4	NRUPTBIT
18	#	NTARGFLG	102	BIT 3	FLAG 6	NTARGBIT
19	#	NWAITFLG	065	BIT 10	FLAG 4	NWAITBIT
20	#	OLDESFLG	014	BIT 1	FLAG 0	OLDESBIT
21	#	OPTNSW	038	BIT 7	FLAG 2	OPTNBIT
22	#	ORBWFLAG	054	BIT 6	FLAG 3	ORBWFBIT
23	#	ORDERSW	129	BIT 6	FLAG 8	ORDERBIT
24	#	OURRCFLG	198	BIT 12	FLAG 13	OURRCBIT
25	#	PDSPFLAG	063	BIT 12	FLAG 4	PDSPFBIT
26	#	PFRATFLG	041	BIT 4	FLAG 2	PFRATBIT
27	#	PINBRFLG	069	BIT 6	FLAG 4	PINBRBIT
28	#	PRECIFLG	052	BIT 8	FLAG 3	PRECIBIT
29	#	PRIODFLG	061	BIT 14	FLAG 1	PRIODBIT
30	#	PRONVFLG	068	BIT 7	FLAG 4	PRONVBIT
31	#	PSTHIGAT	169	BIT 11	FLAG 11	PSTHIBIT
32	#	PULSEFLG	195	BIT 15	FLAG 13	PULSES
33	#	P21FLAG	004	BIT 11	FLAG 0	P21FLBIT
34	#	P25FLAG	006	BIT 9	FLAG 0	P25FLBIT
35	#	P39/79SW	126	BIT 9	FLAG 8	P39SWBIT
36	#	QUITFLAG	145	BIT 5	FLAG 9	QUITBIT
37	#	RADMODES		FLGWRD12		
38	#	RASFLAG		FLGWRD10		
39	#	RCDUFAIL	188	BIT 7	FLAG 12	RCDUFBIT
40	#	RCDUOFLG	182	BIT 13	FLAG 12	RCDUOBIT
41	#	READLR	174	BIT 6	FLAG 11	READLBIT

EQUIVALENT FLAG NAME ETPIFLAG

# READRFLG	051	BIT 9 FLAG 3	READRBIT	EQUIVALENT FLAG NAME FOR R04FLAG
# READVEL	175	BIT 5 FLAG 11	READVBIT	
# REDFLAG	099	BIT 6 FLAG 6	REDFLBIT	
# REFSMFLG	047	BIT 13 FLAG 3	REFSMBIT	
# REINTFLG	158	BIT 7 FLAG 10	REINTBIT	
# REMODFLG	181	BIT 14 FLAG 12	REMODBIT	
# RENDWFLG	089	BIT 1 FLAG 5	RENDWBIT	
# REPOS MON	184	BIT 11 FLAG 12	REPOSBIT	
# RHCSCFLG	203	BIT 7 FLAG 13	RHCSCALE	
# RNDVZFLG	008	BIT 7 FLAG 0	RNDVZBIT	
# RNGEDATA	176	BIT 4 FLAG 11	RNGEDBIT	
# RNGSCFLG	080	BIT 10 FLAG 5	RNGSCBIT	
# RODFLAG	018	BIT 12 FLAG 1	RODFLBIT	
# ROTFLAG	144	BIT 6 FLAG 9	ROTFLBIT	
# RPQFLAG	120	BIT 15 FLAG 8	RPQFLBIT	
# RRDATAFL	191	BIT 4 FLAG 12	RRDATA BT	
# RRNBSW	009	BIT 6 FLAG 0	RRNB BIT	
# RRRSFLAG	192	BIT 3 FLAG 12	RRRSBIT	
# RVSW	111	BIT 9 FLAG 7	RVSWBIT	
# R04FLAG	051	BIT 9 FLAG 3	R04FLBIT	EQUIVALENT FLAG NAME READRFLG
# R10FLAG	013	BIT 2 FLAG 0	R10FLBIT	
# R61FLAG	020	BIT 10 FLAG 1	R61FLBIT	
# R77FLAG	079	BIT 11 FLAG 5	R77FLBIT	
# SCALBAD	177	BIT 3 FLAG 11	SCABBIT	
# SLOPESW	027	BIT 3 FLAG 1	SLOPEBIT	
# SNUFFER	077	BIT 13 FLAG 5	SNUFFBIT	
# SOLNSW	087	BIT 3 FLAG 5	SOLNSBIT	
# SRCHOPTN	031	BIT 14 FLAG 2	SRCHOBIT	
# STATEFLG	055	BIT 5 FLAG 3	STATEBIT	
# STEERSW	034	BIT 11 FLAG 2	STEERBIT	
# SURFFLAG	127	BIT 8 FLAG 8	SURFFBIT	
# SWANDISP	109	BIT 11 FLAG 7	SWANDBIT	
# S32.1F1	090	BIT 15 FLAG 6	S32BIT1	
# S32.1F2	091	BIT 14 FLAG 6	S32BIT2	
# S32.1F3A	092	BIT 13 FLAG 6	S32BIT3A	
# S32.1F3B	093	BIT 12 FLAG 6	S32BIT3B	
# TFFSW	119	BIT 1 FLAG 7	TFFSWBIT	
# TRACKFLG	025	BIT 5 FLAG 1	TRACKBIT	
# TURNONFL	194	BIT 1 FLAG 12	TURNONBT	
# ULLAGFLG	204	BIT 6 FLAG 13	ULLAGER	
# UPDATFLG	023	BIT 7 FLAG 1	UPDATBIT	
# UPLOCKFL	116	BIT 4 FLAG 7	UPLOCBIT	
# USEQRFLG	196	BIT 14 FLAG 13	USEQRJTS	
# VEHUPFLG	022	BIT 8 FLAG 1	VEHUPBIT	
# VELDATA	173	BIT 7 FLAG 11	VELDABIT	
# VERIFLAG	117	BIT 3 FLAG 7	VERIFBIT	
# VFLAG	050	BIT 10 FLAG 3	VFLAGBIT	
# VFLSHFLG	178	BIT 2 FLAG 11	VFLSHBIT	
# VINTFLAG	057	BIT 3 FLAG 3	VINTFBIT	
# VXINH	168	BIT 12 FLAG 11	VXINHBIT	

# V37FLAG	114	BIT 6 FLAG 7	V37FLBIT
# V67FLAG	112	BIT 8 FLAG 7	V67FLBIT
# V82EMFLG	118	BIT 2 FLAG 7	V82EMBIT
# XDELVFLG	037	BIT 8 FLAG 2	XDELVBIT
# XDSPFLAG	074	BIT 1 FLAG 4	XDSPBIT
# XORFLG	171	BIT 9 FLAG 11	XORFLBIT
# XOVINFLG	201	BIT 9 FLAG 13	XOVINHIB
# 3AXISFLG	084	BIT 6 FLAG 5	3AXISBIT
# 360SW	134	BIT 1 FLAG 8	360SWBIT

ASSIGNMENT AND DESCRIPTION OF FLAGWORDS

FLAGWRD0 STATE +0 # 000-014

SET RESET

BIT 15 FLAG 0 S

000D
BIT15

BIT 14 FLAG 0 S

JSWITCH
JSWCHBIT

001D
BIT14

INTEGRATION OF W INTEGRATION OF STATE
MATRIX VECTOR

BIT 13 FLAG 0 S

MIDFLAG

002D

INTEGRATION WITH INTEGRATION WITHOUT
SECONDARY BODY AND SOLAR PERTURBATIONS
SOLAR PERTURBATIONS

MIDFLBIT

BIT13

BIT 12 FLAG 0 L

MOONFLAG
MOONBIT

003D
BIT12

MOON IS SPHERE OF EARTH IS SPHERE OF
INFLUENCE INFLUENCE

BIT 11 FLAG 0

P21FLAG
P21FLBIT

004D
BIT11

USE BASE VECTORS 1ST PASS -- CALC-
ALREADY CALCULATED ULATE BASE VECTORS

BIT 10 FLAG 0

FSPASFLG
FSPASBIT

005D
BIT10

FIRST PASS THROUGH NOT FIRST PASS THRU
REPOSITION ROUTINE REPOSITION ROUTINE

FLAGWORD ASSIGNMENTS

# BIT 9 FLAG 0 S				
P25FLAG	006D	#	P25 OPERATING	P25 NOT OPERATING
P25FLBIT	BIT9			
# BIT 8 FLAG 0 S				
IMUSE	007D	#	IMU IN USE	IMU NOT IN USE
IMUSEBIT	BIT8			
# BIT 7 FLAG 0 S				
RNDVZFLG	008D	#	P20 RUNNING RADAR	P20 NOT RUNNING
RNDVZBIT	BIT7	#	IN USE	
# BIT 6 FLAG 0 S				
RRNBSW	009D	#	RADAR TARGET IN	RADAR TARGET IN
RRNBBIT	BIT6	#	NB COORDINATES	SM COORDINATES
# BIT 5 FLAG 0 S				
LOKONSW	010D	#	RADAR LOCK-ON	RADAR LOCK-ON NOT
LOKONBIT	BIT5	#	DESIRED	DESIRED
# BIT 4 FLAG 0 S				
NEEDLFLG	011D	#	TOTAL ATTITUDE	A/P FOLLOWING
NEEDLBIT	BIT4	#	ERROR DISPLAYED	ERROR DISPLAYED
# BIT 3 FLAG 0				
FREEFLAG	012D	#	USED BY P51-53 TEMP IN MANY DIFFERENT	
		#	ROUTINES BY LUNAR + SOLAR EPHEMERIDES	
FREEFBIT	BIT3			
# BIT 2 FLAG 0				
R10FLAG	013D	#	R10 OUTPUTS DATA TO	BESIDES OUTPUT WHEN
R10FLBIT	BIT2	#	ALTITUDE ALTITUDE	SET, R10 ALSO OUTPUT
		#	RATE METERS ONLY	TO FORWARD LATERAL
		#		VELOCITY CROSSPOINTER
# BIT 1 FLAG 0 L				
OLDESFLG	014D	#	R29 GYRO CMD LOOP	R29 GYRO CMD LOOP
OLDESBIT	BIT1	#	REQUESTED	NOT REQUESTED
FLAGWRD1	STATE +1	#	015-029	

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		#	SET	RESET
# BIT 15 FLAG 1 S				
NJETSFLG	015D	#	TWO JET RCS BURN	FOUR JET RCS BURN
NJETSBIT	BIT15			
# BIT 14 FLAG 1 L				
DIDFLAG	016D	#	INERTIAL DATA IS	PERFORM DATA DISPLAY
DIDFLBIT	BIT14	#	AVAILABLE	INITIALIZATION FUNCS
# BIT 13 FLAG 1 S				
ERADFLAG	017D	#	COMPUTE REARTH	USE CONSTANT REARTH
ERADFBIT	BIT13	#	FISCHER ELLIPSOID	PAD RADIUS
# BIT 12 FLAG 1				
RODFLAG	018D	#	IF IN P66, NORMAL	IF IN P66, RE-INIT-
RODFLBIT	BIT12	#	OPERATION CONTINUES.	IALIZATION IS PER-
		#	RESTART CLEARS FLAG	FORMED AND FLAG IS
# BIT 11 FLAG 1				
	019D			
	BIT11			
# BIT 10 FLAG 1 L				
R61FLAG	020D	#	RUN R61 LEM	RUN R65 LEM
R61FLBIT	BIT10			
# BIT 9 FLAG 1				
	021D			
	BIT9			
# BIT 8 FLAG 1 S				
VEHUPFLG	022D	#	CSM STATE-VECTOR	LEM STATE VECTOR
VEHUPBIT	BIT8	#	BEING UPDATED	BEING UPDATED
# BIT 7 FLAG 1 S				
UPDATFLG	023D	#	UPDATING BY MARKS	UPDATING BY MARKS
UPDATBIT	BIT7	#	ALLOWED	NOT ALLOWED
# BIT 6 FLAG 1 S				
NOUPFLAG	024D	#	NEITHER CSM	EITHER STATE
NOUPFBIT	BIT6	#	NOR LM STATE VECTOR	VECTOR MAY BE
		#	MAY BE UPDATED	UPDATED

# BIT 5 FLAG 1 S				
TRACKFLG	025D	#	TRACKING ALLOWED	TRACKING NOT ALLOWED
TRACKBIT	BIT5			
# BIT 4 FLAG 1				
	026D			
	BIT4			
# BIT 3 FLAG 1 S				
SLOPESW	027D	#	ITERATE WITH BIAS	ITERATE WITH REGULAR
		#	METHOD IN ITERATOR	FALSI METHOD IN
SLOPEBIT	BIT3	#		ITERATOR
# BIT 2 FLAG 1 S				
GUESSW	028D	#	NO STARTING VALUE	STARTING VALUE FOR
GUESSBIT	BIT2	#	FOR ITERATION	ITERATION EXISTS
# BIT 1 FLAG 1				
	029D			
	BIT1		# OH 2009-05-15 SCAN DOES NOT HAVE THIS LINE	
FLAGWRD2	STATE +2	#	030-044	
		#	SET	RESET
# BIT 15 FLAG 2 S				
DRIFTFLG	030D	#	T3RUPT CALLS GYRO	T3RUPT DOES NO GYRO
DRFTBIT	BIT15	#	COMPENSATION	COMPENSATION
# BIT 14 FLAG 2 S				
SRCHOPTN	031D	#	RADAR IN AUTOMATIC	RADAR NOT IN AUTO-
SRCHOBIT	BIT14	#	SEARCH OPTION R24	MATIC SEARCH OPTION
# BIT 13 FLAG 2 S				
ACMODFLG	032D	#	MANUAL ACQUISITION	AUTO ACQUISITION
ACMODBIT	BIT13	#	BY RENDEZVOUS RADAR	BY RENDEZVOUS RADAR
# BIT 12 FLAG 2 S				
LOSCMFLG	033D	#	LINE OF SIGHT BEING	LINE OF SIGHT NOT
		#	COMPUTED R21	BEING COMPUTED
LOSCMBIT	BIT12			

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# BIT 11 FLAG 2 S				
STEERSW	034D	#	SUFFICIENT THRUST	INSUFFICIENT THRUST
STEERBIT	BIT11	#	IS PRESENT	IS PRESENT
# BIT 10 FLAG 2 S				
	035D		# OH 2009-05-15 THESE TWO LINE DON T APPEAR IN SCAN	
	BIT10			
# BIT 9 FLAG 2 S				
IMPULSW	036D	#	MINIMUM IMPULSE	STEERING BURN NO
		#	BURN CUTOFF TIME	CUTOFF TIME YET
IMPULBIT	BIT9	#	SPECIFIED	AVAILABLE
# BIT 8 FLAG 2 S				
XDELVFLG	037D	#	EXTERNAL DELTAV VG	LAMBERT AIMPOINT
XDELVBIT	BIT8	#	COMPUTATION	VG COMPUTATION
# BIT 7 FLAG 2 S				
ETPIFLAG	038D	#	ELEVATION ANGLE	TPI TIME SUPPLIED
		#	SUPPLIED FOR	FOR P34,74 TO COMPUTE
ETPIBIT	BIT7	#	P34,74	ELEVATION
# BIT 7 FLAG 2 L				
OPTNSW	ETPIFLAG	#	SOI PHASE OF P38/78	SOR PHASE OF P38/78
OPTNBIT	BIT7			
# BIT 6 FLAG 2 S				
FINALFLG	039D	#	LAST PASS THROUGH	INTERIM PASS THROUGH
		#	RENDEZVOUS PROGRAM	RENDEZVOUS PROGRAM
FINALBIT	BIT6	#	COMPUTATIONS	COMPUTATIONS
# BIT 5 FLAG 2 S				
AVFLAG	040D	#	LEM IS ACTIVE	CSM IS ACTIVE
AVFLBIT	BIT5	#	VEHICLE	VEHICLE
# BIT 4 FLAG 2 S				
PFRATFLG	041D	#	PREFERRED ATTITUDE	PREFERRED ATTITUDE
PFRATBIT	BIT4	#	COMPUTED	NOT COMPUTED
# BIT 3 FLAG 2 S				

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1						1
2	CALCMAN3	042D	#	NO FINAL ROLL	FINAL ROLL IS	2
3	CALC3BIT	BIT3	#		NECESSARY	3
4						4
5	# BIT 2 FLAG 2 S					5
6	CALCMAN2	043D	#	PERFORM MANEUVER	BYPASS STARTING	6
7	CALC2BIT	BIT2	#	STARTING PROCEDURE	PROCEDURE	7
8						8
9	# BIT 1 FLAG 2 S					9
10	NODOFLAG	044D	#	V37 NOT PERMITTED	V37 PERMITTED	10
11	NODOBIT	BIT1				11
12						12
13	FLAGWRD3	STATE +3	#	045-059		13
14			#	SET	RESET	14
15						15
16						16
17	# BIT 15 FLAG 3					17
18		045D	#			18
19		BIT15	#	OH 2009-05-15 THIS LINE IS NOT IN SCANS		19
20						20
21	# BIT 14 FLAG 3 S					21
22	GLOKFAIL	046D	#	GIMBAL LOCK HAS	NOT IN GIMBAL LOCK	22
23	GLOKFBIT	BIT14	#	OCCURRED		23
24						24
25	# BIT 13 FLAG 3 *** PROTECTED FROM FRESH START ***					25
26	REFSMFLG	047D	#	REFSMMAT GOOD	REFSMMAT NO GOOD	26
27	REFSMBIT	BIT13				27
28						28
29	# BIT 12 FLAG 3 S					29
30	LUNAFLAG	048D	#	LUNAR LAT-LONG	EARTH LAT-LONG	30
31	LUNABIT	BIT12				31
32						32
33	# BIT 11 FLAG 3 L					33
34	NOR29FLG	049D	#	R29 NOT ALLOWED	R29 ALLOWED RR DES-	34
35	NR29FBIT	BIT11	#		IGNATED POWERED FLT	35
36						36
37	# BIT 10 FLAG 3 S					37
38	VFLAG	050D	#	LESS THAN TWO STARS	TWO STARS IN FIELD	38
39	VFLAGBIT	BIT10	#	IN FIELD OF VIEW	OF VIEW	39
40						40
41	# BIT 9 FLAG 3 S					41
42	R04FLAG	051D	#	ALARM 521	ALARM 521 ALLOWED	42
43			#	SUPPRESSED		43
44						44
45						45
46						46
47						47
48						48
49						49
50						50
51						51
52						52
53						53
54						54
55						55
56						56
57						57
58						58
59						59
60						60

R04FLBIT	BIT9		
# BIT 9 FLAG 3 L			
READRFLG	R04FLAG	#	READING RR DATA
READRBIT	BIT9	#	PURSUANT TO R29
			NOT READING RR DATA
			PURSUANT TO R29
# BIT 8 FLAG 3 S			
PRECIFLG	052D	#	NORMAL INTEGRATION
		#	ENGAGES 4-TIME STEP
PRECIBIT	BIT8	#	P00 LOGIC IN INTE-
			GRATION
# BIT 7 FLAG 3 S			
CULTFLAG	053D	#	STAR OCCULTED
CULTBIT	BIT7		STAR NOT OCCULTED
# BIT 6 FLAG 3 S			
ORBWFLAG	054D	#	W MATRIX VALID FOR
ORBWFBIT	BIT6	#	ORBITAL NAVIGATION
			W MATRIX INVALID FOR
			ORBITAL NAVIGATION
# BIT 5 FLAG 3 S			
STATEFLG	055D	#	PERMANENT STATE
STATEBIT	BIT5	#	VECTOR UPDATED
			PERMANENT STATE
			VECTOR NOT UPDATED
# BIT 4 FLAG 3 S			
INTYPFLG	056D	#	CONIC INTEGRATION
INTYPBIT	BIT4		ENCKE INTEGRATION
# BIT 3 FLAG 3 S			
VINTFLAG	057D	#	CSM STATE VECTOR
VINTFBIT	BIT3	#	BEING INTEGRATED
			LEM STATE VECTOR
			BEING INTEGRATED
# BIT 2 FLAG 3 S			
D6OR9FLG	058D	#	DIMENSION OF W IS 9
D6OR9BIT	BIT2	#	FOR INTEGRATION
			DIMENSION OF W IS 6
			FOR INTEGRATION
# BIT 1 FLAG 3 S			
DIM0FLAG	059D	#	W MATRIX IS TO BE
DIM0BIT	BIT1	#	USED
			W MATRIX IS NOT TO
			USED
FLAGWRD4	STATE +4	#	060-074

		#	SET	RESET
# BIT 15 FLAG 4 S				
MRKIDFLG	060D	#	MARK DISPLAY IN	NO MARK DISPLAY IN
MRKIDBIT	BIT15	#	ENDIDLE	ENDIDLE
# BIT 14 FLAG 4 S				
PRIODFLG	061D	#	PRIORITY DISPLAY IN	NO PRIORITY DISPLAY
PRIODBIT	BIT14	#	ENDIDLE	IN ENDIDLE
# BIT 13 FLAG 4 S				
NRMIDFLG	062D	#	NORMAL DISPLAY IN	NO NORMAL DISPLAY
NRMIDBIT	BIT13	#	ENDIDLE	IN ENDIDLE
# BIT 12 FLAG 4 S				
PDSPFLAG	063D	#	P20 SETS SO AS TO	LEAVE AS NORMAL DISP
		#	TURN A NORMAL DIS-	
PDSPFBIT	BIT12	#	PLAY INTO A PRIORITY	
		#	DISPLAY IN R60	
# BIT 11 FLAG 4 S				
MWAITFLG	064D	#	HIGHER PRIORITY	NO HIGHER PRIORITY
		#	DISPLAY OPERATING	DISPLAY OPERATING
MWAITBIT	BIT11	#	WHEN MARK	WHEN MARK DISPLAY
		#	DISPLAY INITIATED	INITIATED
# BIT 10 FLAG 4 S				
NWAITFLG	065D	#	HIGHER PRIORITY	NO HIGHER PRIORITY
		#	DISPLAY OPERATING	DISPLAY OPERATING
NWAITBIT	BIT10	#	WHEN NORMAL	WHEN NORMAL DISPLAY
		#	DISPLAY INITIATED	INITIATED
# BIT 9 FLAG 4 S				
MRKNVFLG	066D	#	ASTRONAUT USING	ASTRONAUT NOT USING
		#	KEYBOARD WHEN MARK	KEYBOARD WHEN MARK
MRKNVBIT	BIT9	#	DISPLAY INITIATED	DISPLAY INITIATED
# BIT 8 FLAG 4 S				
NRMNVFLG	067D	#	ASTRONAUT USING	ASTRONAUT NOT USING
		#	KEYBOARD WHEN	KEYBOARD WHEN
NRMNVBIT	BIT8	#	NORMAL DISPLAY	NORMAL DISPLAY
		#	INITIATED	INITIATED
# BIT 7 FLAG 4 S				
PRONVFLG	068D	#	ASTRONAUT USING	ASTRONAUT NOT USING

PRONVBIT	BIT7	#	KEYBOARD WHEN PRIORITY DISPLAY INITIATED	KEYBOARD WHEN PRIORITY DISPLAY INITIATED
# BIT 6 FLAG 4 S		#		
PINBRFLG	069D	#	ASTRONAUT HAS INTERFERED WITH EXISTING DISPLAY	ASTRONAUT HAS NOT INTERFERED WITH EXISTING DISPLAY
PINBRBIT	BIT6	#		
# BIT 5 FLAG 4 S		#		
MRUPTFLG	070D	#	MARK DISPLAY INTERRUPTED BY PRIORITY DISPLAY	MARK DISPLAY NOT INTERRUPTED BY PRIORITY DISPLAY
MRUPTBIT	BIT5	#		
# BIT 4 FLAG 4 S		#		
NRUPTFLG	071D	#	NORMAL DISPLAY INTERRUPTED BY PRIORITY OR MARK DISPLAY	NORMAL DISPLAY NOT INTERRUPTED BY PRIORITY OR MARK DISPLAY
NRUPTBIT	BIT4	#		
# BIT 3 FLAG 4 S		#		
MKOVFLAG	072D	#	MARK DISPLAY OVER NORMAL	NO MARK DISPLAY OVER NORMAL
MKOVBIT	BIT3	#		
# BIT 2 FLAG 4				
	073D			
	BIT2		# OH 2009-05-15 NOT IN SCAN.	
# BIT 1 FLAG 4 S				
XDSPFLAG	074D	#	MARK DISPLAY NOT TO BE INTERRUPTED	NO SPECIAL MARK INFORMATION
XDSPBIT	BIT1	#		
FLAGWRD5	STATE +5	#	075-089	
		#	SET	RESET
# BIT 15 FLAG 5 S				
DSKYFLAG	075D	#	DISPLAYS SENT TO DSKY	NO DISPLAYS TO DSKY
DSKYFBIT	BIT15	#		
# BIT 14 FLAG 5				
	076D			
	BIT14			

# BIT 13 FLAG 5 S,L				
SNUFFER	077D	#	U,V JETS DISABLED	U,V JETS ENABLED
		#	DURING DPS	DURING DPS
SNUFFBIT	BIT13	#	BURNS V65	BURNS V75
# BIT 12 FLAG 5 S				
NOTHROTL	078D	#	INHIBIT FULL	PERMIT FULL THROTTLE
NOTHRBIT	BIT12	#	THROTTLE	
# BIT 11 FLAG 5 S,L				
R77FLAG	079D	#	R77 IS ON,	R77 IS NOT ON.
		#	SUPPRESS ALL RADAR	
		#	ALARMS AND TRACKER	
R77FLBIT	BIT11	#	FAILS	
# BIT 10 FLAG 5 S				
RNGSCFLG	080D	#	SCALE CHANGE HAS	NO SCALE CHANGE HAS
		#	OCCURRED DURING	OCCURRED DURING
RNGSCBIT	BIT10	#	RR READING	RR READING
# BIT 9 FLAG 5 S				
DMENFLG	081D	#	DIMENSION OF W IS 9	DIMENSION OF W IS 6
DMENFBIT	BIT9	#	FOR INCORPORATION	FOR INCORPORATION
# BIT 8 FLAG 5 S				
	082D			
	BIT8			
# BIT 7 FLAG 5 S				
ENGONFLG	083D	#	ENGINE TURNED ON	ENGINE TURNED OFF
ENGONBIT	BIT7	#		
# BIT 6 FLAG 5 S				
3AXISFLG	084D	#	MANEUVER SPECIFIED	MANEUVER SPECIFIED
		#	BY THREE AXES	BY ONE AXIS R60
3AXISBIT	BIT6	#		CALLS VECPOINT.
# BIT 5 FLAG 5				
	085D			
	BIT5		# OH 2009-05-15 NOT IN SCAN	
# BIT 4 FLAG 5 S				

NORRMON	086D	#	BYPASS RR GIMBAL	PERFORM
NORRMBIT	BIT4	#	MONITOR	RR GIMBAL MONITOR
# BIT 3 FLAG 5 S				
SOLNSW	087D	#	LAMBERT DOES NOT	LAMBERT CONVERGES OR
		#	CONVERGE, OR TIME-RAD	TIME-RADIUS NON-
SOLNSBIT	BIT3	#	NEARLY CIRCULAR	CIRCULAR
# BIT 2 FLAG 5 S				
MGLVFLAG	088D	#	LOCAL VERTICAL	MIDDLE GIMBAL ANGLE
		#	COORDINATES	COMPUTED
MGLVFBIT	BIT2	#	COMPUTED	
# BIT 1 FLAG 5 S				
RENDWFLG	089D	#	W MATRIX VALID	W MATRIX INVALID
		#	FOR RENDEZVOUS	FOR RENDEZVOUS
RENDWBIT	BIT1	#	NAVIGATION	NAVIGATION
FLAGWRD6	STATE +6	#	090-104	
		#	SET	RESET
# BIT 15 FLAG 6 S				
S32.1F1	090D	#	DELTA V AT CSI TIME	DVT1 LESS THAN MAX
S32BIT1	BIT15	#	ONE EXCEEDS MAX	
# BIT 14 FLAG 6 S				
S32.1F2	091D	#	FIRST PASS OF	REITERATION OF
S32BIT2	BIT14	#	NEWTON ITERATION	NEWTON
# BIT 13 FLAG 6 S				
S32.1F3A	092D	#	BIT 13 AND BIT 12 FUNCTION AS AN ORDERED	
S32BIT3A	BIT13	#	PAIR 13,12 INDICATING THE POSSIBLE OC-	
		#	CURRENCE OF 2 NEWTON ITERATIONS FOR S32.1	
		#	IN THE PROGRAM IN THE FOLLOWING ORDER	
# BIT 12 FLAG 6 S		#	0,1 I.E. BIT 13 RESET, BIT 12 SET	
S32.1F3B	093D	#	FIRST NEWTON ITERATION BEING DONE	
S32BIT3B	BIT12	#	0,0 FIRST PASS OF SECOND NEWTON ITERATION	
		#	1,1 50 FT/SEC STAGE OF SECOND NEWTON ITERATION	
		#	1,0 REMAINDER OF SECOND NEWTON ITERATION	
# BIT 11 FLAG 6 S				
	094D	#		
	BIT11	#		

# BIT 10 FLAG 6 S				
GMBDRVSW	095D	#	TRIMGIMB OVER	TRIMGIMB NOT OVER
GMBDRBIT	BIT10	#		
# BIT 9 FLAG 6				
	096D	#		
	BIT9	#		
# BIT 8 FLAG 6 S				
MUNFLAG	097D	#	SERVICER CALLS	SERVICER CALLS
MUNFLBIT	BIT8	#	MUNRVG	CALCRVG
# BIT 7 FLAG 6 L				
	098D	#		
	BIT7	#		
# BIT 6 FLAG 6 L				
REDFLAG	099D	#	LANDING SITE	LANDING SITE
REDFLBIT	BIT6	#	REDESIGNATION	REDESIGNATION NOT
		#	PERMITTED	PERMITTED
# BIT 5 FLAG 6				
	100D	#		
	BIT5	#	OH 2009-05-15 NOT IN SCAN	
# BIT 4 FLAG 6				
	101D	#		
	BIT4	#	OH 2009-05-15 NOT IN SCAN	
# BIT 3 FLAG 6 S				
NTARGFLG	102D	#	ASTRONAUT DID	ASTRONAUT DID NOT
NTARGBIT	BIT3	#	OVERWRITE DELTA	OVERWRITE DELTA
		#	VELOCITY AT TPI	VELOCITY
		#	OR TPM P34,35	
# BIT 2 FLAG 6				
AUXFLAG	103D	#	PROVIDING IDLEFLAG	SERVICER WILL SKIP
AUXFLBIT	BIT2	#	IS NOT SET, SERV-	DVMON ON ITS NEXT
		#	ICER WILL EXERCISE	PASS EVEN IF THE
		#	DVMON ON ITS NEXT	IDLEFLAG IS NOT SET.
		#	PASS.	IT WILL THEN SET
		#		AUXFLAG.
# BIT 1 FLAG 6 L				
ATTFLAG	104D	#	LEM ATTITUDE EXISTS	NO LEM ATTITUDE
		#	IN MOON-FIXED	AVAILABLE IN MOON-

ATTFLBIT	BIT1	#	COORDINATES	FIXED COORDINATES
FLAGWRD7	STATE +7	#	105-119	
		#	SET	RESET
# BIT 15 FLAG 7 S				
ITSWICH	105D	#	R34 TPI TIME TO BE	TPI HAS BEEN
ITSWBIT	BIT15	#	COMPUTED	COMPUTED
# BIT 14 FLAG 7 S				
MANUFLAG	106D	#	ATTITUDE MANEUVER	NO ATTITUDE MANEUVER
MANUFBIT	BIT14	#	GOING DURING RR	DURING RR SEARCH
		#	SEARCH	
# BIT 13 FLAG 7 S				
IGNFLAG	107D	#	TIG HAS ARRIVED	TIG HAS NOT ARRIVED
IGNFLBIT	BIT13	#		
# BIT 12 FLAG 7 S				
ASTNFLAG	108D	#	ASTRONAUT HAS	ASTRONAUT HAS NOT
ASTNBIT	BIT12	#	OKAYED IGNITION	OKAYED IGNITION
# BIT 11 FLAG 7 L				
SWANDISP	109D	#	LANDING ANALOG	LANDING ANALOG
SWANDBIT	BIT11	#	DISPLAYS ENABLED	DISPLAYS SUPPRESSED
# BIT 10 FLAG 7 S				
NORMSW	110D	#	UNIT NORMAL INPUT	LAMBERT COMPUTES ITS
NORMSBIT	BIT10	#	TO LAMBERT	OWN UNIT NORMAL
# BIT 9 FLAG 7 S				
RVSW	111D	#	DO NOT COMPUTE	COMPUTE FINAL STATE
RVSWBIT	BIT9	#	FINAL STATE VECTOR	VECTOR IN TIME-THETA
		#	IN TIME-DELTA	
# BIT 8 FLAG 7 S				
V67FLAG	112D	#	ASTRONAUT OVERWRITE	ASTRONAUT DOES NOT
V67FLBIT	BIT8	#	W-MATRIX INITIAL	OVERWRITE W-MATRIX
		#	VALUES	INITIAL VALUES

# BIT 7 FLAG 7 S				
IDLEFLAG	113D	#	NO DV MONITOR	CONNECT DV MONITOR
IDLEFBIT	BIT7	#		
# BIT 6 FLAG 7 S				
V37FLAG	114D	#	AVERAGEG SERVICER	AVERAGEG SERVICER
V37FLBIT	BIT6	#	RUNNING	OFF
# BIT 5 FLAG 7 S				
AVEGFLAG	115D	#	AVERAGEG SERVICER	AVERAGEG SERVICER
AVEGFBIT	BIT5	#	DESIRED	NOT DESIRED
# BIT 4 FLAG 7 S				
UPLOCKFL	116D	#	K-KBAR-K FAIL	NO K-KBAR-K FAIL
UPLOCBIT	BIT4	#		
# BIT 3 FLAG 7 S				
VERIFLAG	117D	#	CHANGED WHEN V33E OCCURS AT END OF P27	
VERIFBIT	BIT3	#		
# BIT 2 FLAG 7 L,C				
V82EMFLG	118D	#	MOON VICINITY	EARTH VICINITY
V82EMBIT	BIT2	#		
# BIT 1 FLAG 7 S				
TFFSW	119D	#	CALCULATE TPERIGEE	CALCULATE TFF
TFFSWBIT	BIT1	#		
FLAGWRD8	STATE +8D	#	120-134	
		#	SET	RESET
# BIT 15 FLAG 8 S				
RPQFLAG	120D	#	RPQ NOT COMPUTED	RPQ COMPUTED
RPQFLBIT	BIT15	#	RPQ VECTOR BE-	
		#	TWEEN SECONDARY BODY	
		#	AND PRIMARY BODY	
# BIT 14 FLAG 8				
	121D	#		
	BIT14	#		

# BIT 13 FLAG 8 S				
NEWIFLG	122D	#	FIRST PASS THROUGH	SUCCEEDING ITERATION
NEWIBIT	BIT13	#	INTEGRATION	OF INTEGRATION
# BIT 12 FLAG 8 *** PROTECTED FROM FRESH START ***				
CMOONFLG	123D	#	PERMANENT CSM STATE	PERMANENT CSM STATE
CMOONBIT	BIT12	#	IN LUNAR SPHERE	IN EARTH SPHERE
# BIT 11 FLAG 8 *** PROTECTED FROM FRESH START ***				
LMOONFLG	124D	#	PERMANENT LM STATE	PERMANENT LM STATE
LMOONBIT	BIT11	#	IN LUNAR SPHERE	IN EARTH SPHERE
# BIT 10 FLAG 8 L				
FLUNDISP	125D	#	CURRENT GUIDANCE	CURRENT GUIDANCE
FLUNDBIT	BIT10	#	DISPLAYS INHIBITED	DISPLAYS PERMITTED
# BIT 9 FLAG 8 L				
P39/79SW	126D	#	P39/79 OPERATING	P38/78 OPERATING
P39SWBIT	BIT9	#		
# BIT 8 FLAG 8 *** PROTECTED FROM FRESH START ***				
SURFFLAG	127D	#	LM ON LUNAR SURFACE	LM NOT ON LUNAR
SURFFBIT	BIT8	#		SURFACE
# BIT 7 FLAG 8 S				
INFINFLG	128D	#	NO CONIC SOLUTION	CONIC SOLUTION
		#	CLOSURE THROUGH	EXISTS
INFINBIT	BIT7	#	INFINITY REQUIRED	
# BIT 6 FLAG 8 S				
ORDERSW	129D	#	ITERATOR USES 2ND	ITERATOR USES 1ST
ORDERBIT	BIT6	#	ORDER MINIMUM MODE	ORDER STANDARD MODE
# BIT 5 FLAG 8 S				
APSESW	130D	#	RDESIRED OUTSIDE	RDESIRED INSIDE
		#	PERICENTER-APOCENTER	PERICENTER-APOCENTER
APSESBIT	BIT5	#	RANGE IN TIME-RADIUS	RANGE IN TIME-RADIUS
# BIT 4 FLAG 8 S				
COGAFLAG	131D	#	NO CONIC SOLUTION --	CONIC SOLUTION
		#	TOO CLOSE TO RECTI-	EXISTS COGA DOES NOT

COGAFBIT	BIT4	#	LINEAR COGA OVERFLWS	OVERFLOW
# BIT 3 FLAG 8 S	132D BIT3	#	# OH 2009-05-15 LINE NOT IN SCAN	
# BIT 2 FLAG 8 L				
INITALGN	133D	#	INITIAL PASS THRU	SECOND PASS THRU P57
INITABIT	BIT2	#	P57	CHECK RESET-MILLARD
# BIT 1 FLAG 8 S				
360SW	134D	#	TRANSFER ANGLE NEAR	TRANSFER ANGLE NOT
360SWBIT	BIT1	#	360 DEGREES	NEAR 360 DEGREES
FLAGWRD9	STATE +9D	#	135-149	
		#	SET	RESET
# BIT 15 FLAG 9				
	135D BIT15	#		
# BIT 14 FLAG 9 L				
FLVR	136D	#	VERTICAL RISE	NON-VERTICAL RISE
FLVRBIT	BIT14	#	ASCENT GUIDANCE	
# BIT 13 FLAG 9				
	137D	#		
	BIT13	#	# OH 2009-05-15 LINE NOT IN SCAN	
# BIT 12 FLAG 9 L				
FLPC	138D	#	NO POSITION CONTROL	POSITION CONTROL
FLPCBIT	BIT12	#	ASCENT GUIDANCE	
# BIT 11 FLAG 9 L				
FLPI	139D	#	PRE-IGNITION PHASE	REGULAR GUIDANCE
FLPIBIT	BIT11	#	ASCENT GUIDANCE	
# BIT 10 FLAG 9 L				
FLRCS	140D	#	RCS INJECTION MODE	MAIN ENGINE MODE
FLRCSBIT	BIT10	#	ASCENT GUIDANCE	
# BIT 9 FLAG 9 L				

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LETABORT	141D	#	ABORT PROGRAMS	ABORT PROGRAMS
LETABBIT	BIT9	#	ARE ENABLED	ARE NOT ENABLED
# BIT 8 FLAG 9 L				
FLAP	142D	#	APS CONTINUED ABORT	APS ABORT IS NOT A
		#	AFTER DPS STAGING	CONTINUATION
FLAPBIT	BIT8	#	ASCENT GUIDANCE	
# BIT 7 FLAG 9 L				
	143D			
	BIT7		# OH 2009-05-15 LINE NOT IN SCAN	
# BIT 6 FLAG 9 L				
ROTFLAG	144D	#	P70 AND P71 WILL	P70 AND P71 WILL NOT
ROTFLBIT	BIT6	#	FORCE VEHICLE	FORCE VEHICLE
		#	ROTATION IN THE	ROTATION IN THE
		#	PREFERRED DIRECTION	PREFERRED DIRECTION
# BIT 5 FLAG 9 S				
QUITFLAG	145D	#	DISCONTINUE INTEGR.	CONTINUE INTEGRATION
QUITBIT	BIT5	#		
# BIT 4 FLAG 9				
	146D	#		
	BIT4	#		
# BIT 3 FLAG 9 L				
MID1FLAG	147D	#	INTEGRAT TO TDEC	INTEGRATE TO THE
MID1FBIT	BIT3	#		THEN-PRESENT TIME
# BIT 2 FLAG 9 L				
MIDAVFLG	148D	#	INTEGRATION ENTERED	INTEGRATION WAS
		#	FROM ONE OF MIDTOAV	NOT ENTERED VIA
MIDAVBIT	BIT2	#	PORTALS	MIDTOAV
# BIT 1 FLAG 9 S				
AVEMIDSW	149D	#	AVETOMID CALLING	NO AVETOMID W INTEGR
		#	FOR W.MATRIX INTEGR	ALLOW SET UP RM, VN
AVEMDBIT	BIT1	#	DON T WRITE OVER RN,	PIPTIME
		#	VN,PIPTIME	
RASFLAG	EQUALS	FLGWRD10	# WAS ONLY AN INSTALL-ERASTALL FLAG	

FLGWRD10	STATE +10D	# 150-164
		# SET RESET
# BIT 15 FLAG 10 S	150D BIT15	# OH 2009-05-15 LINE NOT IN SCAN
# BIT 14 FLAG 10 L,C INTFLAG INTFLBIT	151D BIT14	# INTEGRATION IN # PROGRESS INTEGRATION NOT IN PROGRESS
# BIT 13 FLAG 10 S,L APSFLAG APSFLBIT	152D BIT13	# ASCENT STAGE DESCENT STAGE # *** PROTECTED FROM FRESH START ***
# BIT 12 FLAG 10	153D BIT12	# OH 2009-05-15 LINE NOT IN SCAN
# BIT 11 FLAG 10	154D BIT11	# OH 2009-05-15 LINE NOT IN SCAN
# BIT 10 FLAG 10	155D BIT10	# OH 2009-05-15 LINE NOT IN SCAN
# BIT 9 FLAG 10	156D BIT9	# OH 2009-05-15 LINE NOT IN SCAN
# BIT 8 FLAG 10	157D BIT8	# OH 2009-05-15 LINE NOT IN SCAN
# BIT 7 FLAG 10 L,C REINTFLG REINTBIT	158D BIT7	# INTEGRATION ROUTINE INTEGRATION ROUTINE # TO BE RESTARTED NOT TO BE RESTARTED
# BIT 6 FLAG 10	159D BIT6	# OH 2009-05-15 LINE NOT IN SCAN
# BIT 5 FLAG 10	160D BIT5	# OH 2009-05-15 LINE NOT IN SCAN

BIT 4 FLAG 10

161D
BIT4

OH 2009-05-15 LINE NOT IN SCAN

BIT 3 FLAG 10

162D
BIT3

OH 2009-05-15 LINE NOT IN SCAN

BIT 2 FLAG 10

163D
BIT2

OH 2009-05-15 LINE NOT IN SCAN

BIT 1 FLAG 10

164D
BIT1

OH 2009-05-15 LINE NOT IN SCAN

FLGWRD11

STATE +11D

165-179

SET RESET

BIT 15 FLAG 11 L R12

LRBYPASS
LRBYBIT

165D
BIT15

BYPASS ALL LANDING DO NOT BYPASS LR
RADAR UPDATES UPDATES

BIT 14 FLAG 11

166D
BIT14

#

BIT 13 FLAG 11

167D
BIT13

#

BIT 12 FLAG 11 L R12

VXINH

168D

IF Z VELOCITY DATA UPDATE X AXIS
UNREASONABLE, VELOCITY
BYPASS X VELOCITY
UPDATE ON NEXT PASS

VXINHBIT

BIT12

BIT 11 FLAG 11 L R12

PSTHIGAT
PSTHIBIT

169D
BIT11

PAST HIGATE PREHIGATE
#

BIT 10 FLAG 11 L R12

NOLRREAD	170D	#	LANDING RADAR	LR NOT REPOSITIONING
		#	REPOSITIONING	
NOLRRBIT	BIT10	#	BYPASS UPDATE	
# BIT 9 FLAG 11 L R12				
XORFLG	171D	#	BELOW LIMIT	ABOVE LIMIT DO
		#	INHIBIT X AXIS	NOT INHIBIT
XORFLBIT	BIT9	#	OVERRIDE	
# BIT 8 FLAG 11				
LRINH	172D	#	LANDING RADAR UP-	LR UPDATES INHIBITED
LRINHBIT	BIT8	#	DATES PERMITTED	BY ASTRONAUT
		#	BY ASTRONAUT	
# BIT 7 FLAG 11 L R12				
VELDATA	173D	#	LR VELOCITY	LR VELOCITY MEASURE
VELDABIT	BIT7	#	MEASUREMENT MADE	NOT MADE
# BIT 6 FLAG 11 L R12				
READLR	174D	#	OK TO READ LR	DO NOT READ LR RANGE
READLBIT	BIT6	#	RANGE DATA	DATA
# BIT 5 FLAG 11 L R12				
READVEL	175D	#	OK TO READ LR	DO NOT READ LR
READVBIT	BIT5	#	VELOCITY DATA	VELOCITY DATA
# BIT 4 FLAG 11 L R12				
RNGEDATA	176D	#	LR ALTITUDE	LR ALTITUDE MEASURE
RNGEDBIT	BIT4	#	MEASUREMENT MADE	NOT MADE
# BIT 3 FLAG 11				
SCALBAD	177D	#	LR LOW SCALE DISP-	LS SCALE DISCRETE
SCABBIT	BIT3	#	CREATE NOT PRESENT	APPEARS OK
		#	WHEN IT SHOULD	
# BIT 2 FLAG 11 L R12				
VFLSHFLG	178D	#	LR VELOCITY FAIL	LR VEL FAIL LAMP
		#	LAMP SHOULD BE	SHOULDN T FLASH
VFLSHBIT	BIT2	#	FLASHING	
# BIT 1 FLAG 11 L R12				

HFLSHFLG	179D	#	LR ALTITUDE FAIL	LR ALTITUDE FAIL
HFLSHBIT	BIT1	#	LAMP SHOULD BE	LAMP SHOULD NOT BE
		#	FLASHING	FLASHING
RADMODES	EQUALS FLGWRD12	#	RADAR FLAG WORD	
FLGWRD12	STATE +12D	#	180-194	WAS RADMODES
		#	SET	RESET
# BIT 15 FLAG 12				
CDESFLAG	180D	#	CONTINUOUS DESIGNATE, LGC COMMANDS	LGC CHECKS FOR LOCK-ON WHEN ANTENNA
CDESBIT	BIT15	#	RR REGARDLESS OF	BEING DESIGNATED
		#	LOCK-ON	
# BIT 14 FLAG 12				
REMODFLG	181D	#	CHANGE IN ANTENNA	NO REMODE REQUESTED
REMODBIT	BIT14	#	MODE BEEN REQUESTED	OR OCCURRING
		#	I.E., REMODE	
# BIT 13 FLAG 12				
RCDUOFLG	182D	#	RR CDU S BEING	RR CDU S NOT BEING
RCDUOBIT	BIT13	#	ZEROED	ZEROED
# BIT 12 FLAG 12				
ANTENFLG	183D	#	RR ANTENNA MODE IS	RR ANTENNA IN MODE 1
ANTENBIT	BIT12	#	MODE 2	
# BIT 11 FLAG 12				
REPOSFLG	184D	#	REPOSITION MONITOR.	NO REPOSITION TAKING
REPOSBIT	BIT11	#	RR REPOSITION IS	PLACE
		#	TAKING PLACE	
# BIT 10 FLAG 12				
DESIGFLG	185D	#	RR DESIGNATE	RR DESIGNATE NOT
DESIGBIT	BIT10	#	REQUESTED OR IN	REQUESTED OR IN
		#	PROGRESS	PROGRESS
# BIT 9 FLAG 12				
ALTSCALE	186D	#	LR ALTITUDE READING	LR ALTITUDE READING
ALTSCBIT	BIT9	#	IS ON HIGH SCALE	IS ON LOW SCALE

BIT 8 FLAG 12

LRVELFLG 187D
LRVELBIT BIT8

LR VELOCITY DATA NO LR VELOCITY DATA
FAIL FAIL

BIT 7 FLAG 12

RCDUFAIL 188D
RCDUFBIT BIT7

RR CDU FAIL HAS RR CDU FAIL OCCURRED
NOT OCCURRED

BIT 6 FLAG 12

LRPOSFLG 189D
LRPOSBIT BIT6

LANDING RADAR LR POSITION 1
POSITION 2

BIT 5 FLAG 12

LRALTFLG 190D
LRALTBIT BIT5

LR ALTITUDE DATA NO LR ALTITUDE DATA
FAIL. COULD NOT BE FAIL
READ SUCCESSFULLY.

BIT 4 FLAG 12

RRDATAFL 191D
RRDATAFT BIT4

RR DATA FAIL. NO RR DATA FAIL
DATA COULD NOT BE
READ SUCCESSFULLY

BIT 3 FLAG 12

RRRSFLAG 192D
RRRSBIT BIT3

RR RANGE READING RR RANGE READING ON
ON THE HIGH SCALE THE LOW SCALE

BIT 2 FLAG 12

AUTOMODE 193D
AUTOMBIT BIT2

RR NOT IN AUTO MODE. RR IN AUTO MODE
AUTO MODE DISCRETE
IS NOT PRESENT

BIT 1 FLAG 12

TURNONFL 194D
TURNONBT BIT1

RR TURN-ON SEQUENCE NO RR TURN-ON
IN PROGRESS. ZERO SEQUENCE IN PROGRESS
CDU S, FIX ANTENNA
MODE

DAPBOOLS EQUALS FLGWRD13 # DIGITAL AUTOPILOT FLAGWORD

FLGWRD13	STATE +13D	# 195-209	WAS DAPBOOLS
		#	SET RESET
# BIT 15 FLAG 13			
PULSEFLG	195D	#	MINIMUM IMPUSE
PULSES	BIT15	#	COMMAND MODE IN
		#	ATT HOLD V76
			NOT IN MINIMUM
			IMPULSE COMMAND MODE
			V77
# BIT 14 FLAG 13			
USEQRFLG	196D	#	GIMBAL UNUSABLE.
USEQRJTS	BIT14	#	USE JETS ONLY.
			TRIM GIMBAL MAY BE
			USED.
# BIT 13 FLAG 13			
CSMDKFLG	197D	#	CSM DOCKED. USE
CSMDOCKD	BIT13	#	BACKUP DAP
			CSM NOT DOCKED TO LM
# BIT 12 FLAG 13			
OURRCFLG	198D	#	CURRENT DAP PASS
OURRCBIT	BIT12	#	IS RATE COMMAND
			CURRENT DAP PASS IS
			NOT RATE COMMAND
# BIT 11 FLAG 13			
ACC4-2FL	199D	#	4 JET X-AXIS TRANS-
ACC4OR2X	BIT11	#	LATION REQUESTED
			2 JET X-AXIS TRANS-
			LATION REQUESTED
# BIT 10 FLAG 13			
AORBTFLG	200D	#	B SYSTEM FOR X-
AORBTRAN	BIT10	#	TRANSLATION
			A SYSTEM FOR X-
			TRANSLATION PREFER D
# BIT 9 FLAG 13			
XOVINFLG	201D	#	X-AXIS OVERRIDE
XOVINHIB	BIT9	#	LOCKED OUT
			X-AXIS OVERRIDE OKAY
# BIT 8 FLAG 13			
DRIFTDFL	202D	#	ASSUME 0 OFFSET
DRIFTBIT	BIT8	#	DRIFTING FLIGHT
			USE OFFSET ACCELERA-
			ION ESTIMATE
# BIT 7 FLAG 13			
RHCSCFLG	203D	#	NORMAL RHC SCALING
RHCSCALE	BIT7	#	REQUESTED
			FINE RHC SCALING
			REQUESTED

BIT 6 FLAG 13

ULLAGFLG

204D

#

ULLAGE REQUEST BY

NO INTERNAL ULLAGE

ULLAGER

BIT6

#

MISSION PROGRAM

REQUEST

BIT 5 FLAG 13

AORBSFLG

205D

#

P-AXIS COUPLES 7.15

P-AXIS COUPLES 4.12

AORBSYST

BIT5

#

AND 8.16 PREFERRED

AND 3.11 PREFERRED

BIT 4 FLAG 13

DBSELFLG

206D

#

MAX DB SELECTED

MIN DB SELECTED BY

DBSELECT

BIT4

#

BY CREW 5 DEG

CREW 0.3 DEG

BIT 3 FLAG 13

ACCOKFLG

207D

#

CONTROL AUTHORITY

RESTART OR FRESH ST.

ACCSOKAY

BIT3

#

VALUES FROM 1/ACCS

SINCE LAST 1/ACCS

USABLE

OUTPUTS SUSPECT.

BIT 2 FLAG 13

AUTR2FLG

208D

#

THESE FLAGS ARE USED TOGETHER TO INDICATE

AUTRATE2

BIT2

#

ASTRONAUT-CHOSEN KALCMANU MANEUVER RATES

0,0

BIT2,BIT1

0.2 DEG/SEC

0,1

0.5 DEG/SEC

1,0

2.0 DEG/SEC

1,1

10.0 DEG/SEC

- 1
- 2
- 3
- 4
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CONVENTIONS AND NOTATIONS UTILIZED FOR ERASABLE ASSIGNMENTS.

EQUALS IS USED IN TWO WAYS. IT IS OFTEN USED TO CHAIN A GROUP OF ASSIGNMENTS SO THAT THE GROUP MAY BE MOVED WITH THE CHANGING OF ONLY ONE CARD. EXAMPLE

X EQUALS START
Y EQUALS X +SIZE.X
Z EQUALS Y +SIZE.Y

X, Y, AND Z ARE CONSECUTIVE AND BEGIN AT START.
SIZE.X AND SIZE.Y ARE THE RESPECTIVE SIZES OF X AND Y.
USUALLY NUMERIC, IE. 1, 2, 6, 18D, ETC.

EQUALS OFTEN IMPLIES THE SHARING OF REGISTERS DIFFERENT NAMES AND DIFFERENT DATA . EXAMPLE

X EQUALS Y
MEANS THAT MULTIPLE NAMES HAVE BEEN GIVEN TO THE SAME DATA.
THIS IS LOGICAL EQUIVALENCE, NOT SHARING. EXAMPLE

X Y

THE SIZE AND UTILIZATION OF AN ERASABLE ARE OFTEN INCLUDED IN THE COMMENTS IN THE FOLLOWING FORM M SIZE N.

M REFERS TO THE MOBILITY OF THE ASSIGNMENT.
B MEANS THAT THE SYMBOL IS REFERENCED BY BASIC INSTRUCTIONS AND THUS IS E-BANK SENSITIVE.
I MEANS THAT THE SYMBOL IS REFERENCED ONLY BY INTERPRETIVE INSTRUCTIONS, AND IS THUS E-BANK INSENSITIVE AND MAY APPEAR IN ANY E-BANK.
SIZE IS THE NUMBER OF REGISTERS INCLUDED BY THE SYMBOL.
N INDICATES THE NATURE OF PERMANENCE OF THE CONTENTS.
PL MEANS THAT THE CONTENTS ARE PAD LOADED.
DSP MEANS THAT THE REGISTER IS USED FOR A DISPLAY.
PRM MEANS THAT THE REGISTER IS PERMANENT. IE., IT IS USED DURING THE ENTIRE MISSION FOR ONE PURPOSE AND CANNOT BE SHARED.
TMP MEANS THAT THE REGISTER IS USED TEMPORARILY OR IS A SCRATCH REGISTER FOR THE ROUTINE TO WHICH IT IS ASSIGNED. THAT IS, IT NEED NOT BE SET PRIOR TO INVOCATION OF THE ROUTINE NOR DOES IT CONTAIN USEFUL OUTPUT TO ANOTHER ROUTINE. THUS

1412THE

#		IT MAY BE SHARED WITH ANY OTHER ROUTINE WHICH
#		IS NOT ACTIVE IN PARALLEL
#	IN	MEANS INPUT TO THE ROUTINE AND IT IS PROBABLY
#		TEMPORARY FOR A HIGHER-LEVEL ROUTINE/PROGRAM.
#	OUT	MEANS OUTPUT FROM THE ROUTINE, PROBABLY
#		TEMPORARY FOR A HIGHER-LEVEL ROUTINE/PROGRAM.

SPECIAL REGISTERS.

A	EQUALS	0	
L	EQUALS	1	# L AND Q ARE BOTH CHANNELS AND REGISTERS
Q	EQUALS	2	
EBANK	EQUALS	3	
FBANK	EQUALS	4	
Z	EQUALS	5	# ADJACENT TO FBANK AND BBANK FOR DXCH Z
BBANK	EQUALS	6	# DTCB AND DXCH FBANK DTCF . # REGISTER 7 IS A ZERO-SOURCE, USED BY ZL.
ARUPT	EQUALS	10	# INTERRUPT STORAGE
LRUPT	EQUALS	11	
QRUPT	EQUALS	12	
SAMPTIME	EQUALS	13	# SAMPLED TIME 1 2.
ZRUPT	EQUALS	15	# 13 AND 14 ARE SPARES.
BANKRUPT	EQUALS	16	# USUALLY HOLDS FBANK OR BBANK.
BRUPT	EQUALS	17	# RESUME ADDRESS AS WELL.
CYR	EQUALS	20	
SR	EQUALS	21	
CYL	EQUALS	22	
EDOP	EQUALS	23	# EDITS INTERPRETIVE OPERATION CODE PAIRS.
TIME2	EQUALS	24	
TIME1	EQUALS	25	
TIME3	EQUALS	26	
TIME4	EQUALS	27	
TIME5	EQUALS	30	
TIME6	EQUALS	31	
CDUX	EQUALS	32	
CDUY	EQUALS	33	
CDUZ	EQUALS	34	
CDUT	EQUALS	35	# REND RADAR TRUNNION CDU
CDUS	EQUALS	36	# REND RADAR SHAFT CDU
PIPAX	EQUALS	37	
PIPAY	EQUALS	40	
PIPAZ	EQUALS	41	
Q-RHCCTR	EQUALS	42	# RHC COUNTER REGISTERS
P-RHCCTR	EQUALS	43	
R-RHCCTR	EQUALS	44	
INLINK	EQUALS	45	
RNRAD	EQUALS	46	
GYROCMD	EQUALS	47	
CDUXCMD	EQUALS	50	
CDUYCMD	EQUALS	51	
CDUZCMD	EQUALS	52	
CDUTCMD	EQUALS	53	
CDUSCMD	EQUALS	54	

THRUST	EQUALS	55
LEMONM	EQUALS	56
OUTLINK	EQUALS	57
ALTM	EQUALS	60

INTERPRETIVE REGISTERS ADDRESSED RELATIVE TO VAC AREA.

LVSQUARE	EQUALS	34D	# SQUARE OF VECTOR INPUT TO ABVAL AND UNIT
LV	EQUALS	36D	# LENGTH OF VECTOR INPUT TO UNIT.
X1	EQUALS	38D	# INTERPRETIVE SPECIAL REGISTER RELATIVE
X2	EQUALS	39D	# TO THE WORK AREA.
S1	EQUALS	40D	
S2	EQUALS	41D	
QPRET	EQUALS	42D	

INPUT/OUTPUT CHANNELS

*** CHANNEL ZERO IS TO BE USED IN AN INDEXED OPERATION ONLY. ***

LCHAN	EQUALS	L	
QCHAN	EQUALS	Q	
HISCALAR	EQUALS	3	
LOSCALAR	EQUALS	4	
CHAN5	EQUALS	5	
CHAN6	EQUALS	6	
SUPERBNK	EQUALS	7	# SUPER-BANK.
OUT0	EQUALS	10	
DSALMOUT	EQUALS	11	
CHAN12	EQUALS	12	
CHAN13	EQUALS	13	
CHAN14	EQUALS	14	
MNKEYIN	EQUALS	15	
NAVKEYIN	EQUALS	16	
CHAN30	EQUALS	30	
CHAN31	EQUALS	31	
CHAN32	EQUALS	32	
CHAN33	EQUALS	33	
DNTM1	EQUALS	34	
DNTM2	EQUALS	35	

END OF CHANNEL ASSIGNMENTS



INTERPRETIVE SWITCH BIT ASSIGNMENTS

** FLAGWORDS AND BITS NOW ASSIGNED AND DEFINED IN THEIR OWN LOG SECTION. **

GENERAL ERASABLE ASSIGNMENTS

SETLOC 61
INTERRUPT TEMPORARY STORAGE POOL. 11D

ITEMP1 THROUGH RUPTREG4

ANY OF THESE MAY BE USED AS TEMPORARIES DURING INTERRUPT OR WITH INTERRUPT INHIBITED. THE ITEMP SERIES
IS USED DURING CALLS TO THE EXECUTIVE AND WAITLIST -- THE RUPTREGS ARE NOT.

ITEMP1 ERASE
WAITEXIT EQUALS ITEMP1
EXECTEM1 EQUALS ITEMP1

ITEMP2 ERASE
WAITBANK EQUALS ITEMP2
EXECTEM2 EQUALS ITEMP2

ITEMP3 ERASE
RUPTSTOR EQUALS ITEMP3
WAITADR EQUALS ITEMP3
NEWPRIO EQUALS ITEMP3

ITEMP4 ERASE
LOCCTR EQUALS ITEMP4
WAITTEMP EQUALS ITEMP4

ITEMP5 ERASE
NEWLOC EQUALS ITEMP5

ITEMP6 ERASE
NEWLOC+1 EQUALS ITEMP6 # DP ADDRESS.

SETLOC 67
NEWJOB ERASE # MUST BE AT LOC 67 DUE TO WIRING.

RUPTREG1 ERASE
RUPTREG2 ERASE
RUPTREG3 ERASE
RUPTREG4 ERASE
KEYTEMP1 EQUALS RUPTREG4
DSRUPTM EQUALS RUPTREG4

FLAGWORD RESERVATIONS. 16D

STATE ERASE +15D # +15D FLAGWORD REGISTERS

P25 RADAR STORAGE. MAY BE UNSHARED IN E7 TEMP OVERLAY 2D OVERLAYS FLGWRD 14 15

LASTYCMD EQUALS STATE +14D # B 1 PRM THESE ARE CALLED BY T4RUPT
LASTXCMD EQUALS LASTYCMD +1 # B 1 PRM THEY MUST BE CONTIGUOUS, Y FIRST

EXEC TEMPORARIES WHICH MAY BE USED BETWEEN CCS NEWJOBS 32D INTB15+ THROUGH RUPTMXTM
INTB15+ ERASE # REFLECTS 15TH BIT OF INDEXABLE ADDRESSES

DSEXIT INTB15+ # RETURN FOR DSPIN
EXITEM INTB15+ # RETURN FOR SCALE FACTOR ROUTINE SELECT
BLANKRET INTB15+ # RETURN FOR 2BLANK

INTBIT15 ERASE # SIMILAR TO ABOVE.
WRDRET INTBIT15 # RETURN FOR 5BLANK
WDRET INTBIT15 # RETURN FOR DSPWD
DECRET INTBIT15 # RETURN FOR PUTCOM DEC LOAD
21/22REG INTBIT15 # TEMP FOR CHARIN

THE REGISTERS BETWEEN ADDRWD AND PRIORITY MUST STAY IN THE FOLLOWING ORDER FOR INTERPRETIVE TRACE.

ADDRWD ERASE # 12 BIT INTERPRETIVE OPERAND SUB-ADDRESS.
POLISH ERASE # HOLDS CADR MADE FROM POLISH ADDRESS.
UPDATRET POLISH # RETURN FOR UPDATNN, UPDATVB
CHAR POLISH # TEMP FOR CHARIN
ERCNT POLISH # COUNTER FOR ERROR LIGHT RESET
DECOUNT POLISH # COUNTER FOR SCALING AND DISPLAY DEC

FIXLOC ERASE # WORK AREA ADDRESS.
OVFIND ERASE # SET NON-ZERO ON OVERFLOW.

VBUF ERASE +5 # TEMPORARY STORAGE USED FOR VECTORS.
SGNON VBUF # TEMP FOR +,- ON
NOUNTEM VBUF # COUNTER FOR MIXNOUN FETCH
DISTEM VBUF # COUNTER FOR OCTAL DISPLAY VERB
DECTEM VBUF # COUNTER FOR FETCH DEC DISPLAY VERBS

SGNOFF VBUF +1 # TEMP FOR +,- ON
NVTEMP VBUF +1 # TEMP FOR NVSUB
SFTEMP1 VBUF +1 # STORAGE FOR SF CONST HI PART SFTEMP2-1
HITEMIN VBUF +1 # TEMP FOR LOAD OF HRS,MIN,SEC
 # MUST LOTEMIN-1.

CODE VBUF +2 # FOR DSPIN
SFTEMP2 VBUF +2 # STORAGE FOR SF CONST LO PART SFTEMP1+1
LOTEMIN VBUF +2 # TEMP FOR LOAD OF HRS,MIN,SEC
 # MUST HITEMIN+1

MIXTEMP VBUF +3 # FOR MIXNOUN DATA
SIGNRET VBUF +3 # RETURN FOR +,- ON

ALSO MIXTEMP+1 VBUF+4, MIXTEMP+2 VBUF+5

BUF ERASE +2 # TEMPORARY SCALAR STORAGE.

# VARIABLE ASSIGNMENTS				
2	BUF2	ERASE	+1	
3	INDEXLOC	EQUALS	BUF	# CONTAINS ADDRESS OF SPECIFIED INDEX.
4	SWWORD	EQUALS	BUF	# ADDRESS OF SWITCH WORD.
5	SWBIT	EQUALS	BUF +1	# SWITCH BIT WITHIN THE SWITCH WORD
6	MPTEMP	ERASE		# TEMPORARY USED IN MULTIPLY AND SHIFT
7	DMPNTEMP		MPTEMP	# DMPSUB TEMPORARY
8	DOTINC	ERASE		# COMPONENT INCREMENT FOR DOT SUBROUTINE
9	DVSIGN	EQUALS	DOTINC	# DETERMINES SIGN OF DDV RESULT
10	ESCAPE	EQUALS	DOTINC	# USED IN ARCSIN/ARCCOS.
11	ENTRET		DOTINC	# EXIT FROM ENTER
12				
13	DOTRET	ERASE		# RETURN FROM DOT SUBROUTINE
14	DVNORMCT	EQUALS	DOTRET	# DIVIDENT NORMALIZATION COUNT IN DDV.
15	ESCAPE2	EQUALS	DOTRET	# ALTERNATE ARCSIN/ARCCOS SWITCH
16	WDCNT		DOTRET	# CHAR COUNTER FOR DSPWD
17	INREL		DOTRET	# INPUT BUFFER SELECTION X,Y,Z, REG
18				
19	MATINC	ERASE		# VECTOR INCREMENT IN MXV AND VXM
20	MAXDVSW	EQUALS	MATINC	# +0 IF DP QUOTIENT IS NEAR ONE -- ELSE -1.
21	POLYCNT	EQUALS	MATINC	# POLYNOMIAL LOOP COUNTER
22	DSPMMTEM		MATINC	# DSPCOUNT SAVE FOR DSPMM
23	MIXBR		MATINC	# INDICATOR FOR MIXED OR NORMAL NOUN
24				
25	TEM1	ERASE		# EXEC TEMP
26	POLYRET		TEM1	
27	DSREL		TEM1	# REL ADDRESS FOR DSPIN
28				
29	TEM2	ERASE		# EXEC TEMP
30	DSMAG		TEM2	# MAGNITUDE STORE FOR DSPIN
31	IDADDTEM		TEM2	# MIXNOUN INDIRECT ADDRESS GARBLED
32				
33	TEM3	ERASE		# EXEC TEMP
34	COUNT		TEM3	# FOR DSPIN
35				
36	TEM4	ERASE		# EXEC TEMP
37	LSTPTR		TEM4	# LIST POINTER FOR GRABUSY
38	RELRET		TEM4	# RETURN FOR RELDSP
39	FREERET		TEM4	# RETURN FOR FREEDSP
40	DSPWDRET		TEM4	# RETURN FOR DSPSIGN
41	SEPSECRET		TEM4	# RETURN FOR SEPSEC
42	SEPMNRET		TEM4	# RETURN FOR SEPMIN
43				
44	TEM5	ERASE		# EXEC TEMP
45	NOUNADD		TEM5	# TEMP STORAGE FOR NOUN ADDRESS
46				
47	NNADTEM	ERASE		# TEMP FOR NOUN ADDRESS TABLE ENTRY
48	NNTYPTTEM	ERASE		# TEMP FOR NOUN TYPE TABLE ENTRY
49	IDAD1TEM	ERASE		# TEMP FOR INDIR ADDRESS TABLE ENTRY MIXNN
50				# MUST IDAD2TEM-1, IDAD3TEM-2
51	IDAD2TEM	ERASE		# TEMP FOR INDIR ADDRESS TABLE ENTRY MIXNN

IDAD3TEM ERASE # MUST IDAD1TEM+1, IDAD3TEM-1.
TEMP FOR INDIR ADDRESS TABLE ENTRY MIXNN

RUTMXTEM ERASE # MUST IDAD1TEM+2, IDAD2TEM+1.
TEMP FOR SF ROUT TABLE ENTRY MIXNN ONLY

AX*SR*T STORAGE. 6D
DEXDEX EQUALS TEM2 # B 1 TMP
DEX1 EQUALS TEM3 # B 1 TMP
DEX2 EQUALS TEM4 # B 1 TMP
RTNSAVER EQUALS TEM5 # B 1 TMP
TERM1TMP EQUALS MPAC +3 # B 2 TMP

DEXI DEX1

THE FOLLOWING 10 REGISTERS ARE USED FOR TEMPORARY STORAGE OF THE DERIVATIVE COEFFICIENT TABLE OF
SUBROUTINE ROOTPSRS. THEY MUST REMAIN WITHOUT INTERFERENCE WITH ITS SUBROUTINES WHICH ARE POWRSERS POLY .
DMP SUB, DMPNSUB, SHORTMP, DDV/BDDV, ABS, AND USPRCADR.

DERCOF-8 MPAC -12 # ROOTPSRS DER COF N-4 HI ORDER
DERCOF-7 MPAC -11 # ROOTPSRS DER COF N-4 LO ORDER
DERCOF-6 MPAC -10 # ROOTPSRS DER COF N-3 HI ORDER
DERCOF-5 MPAC -7 # ROOTPSRS DER COF N-3 LO ORDER
DERCOF-4 MPAC -6 # ROOTPSRS DER COF N-2 HI ORDER
DERCOF-3 MPAC -5 # ROOTPSRS DER COF N-2 LO ORDER
DERCOF-2 MPAC -4 # ROOTPSRS DER COF N-1 HI ORDER
DERCOF-1 MPAC -3 # ROOTPSRS DER COF N-1 LO ORDER
DERCOFN MPAC -2 # ROOTPSRS DER COF N, HI ORDER
DERCOF+1 MPAC -1 # ROOTPSRS DER COF N, LO ORDER

PWRPTR POLISH # ROOTPSRS POWER TABLE POINTER
DXCRIT VBUF +2 # ROOTPSRS CRITERION FOR ENDING ITERS HI
DXCRIT+1 VBUF +3 # ROOTPSRS CRITERION FOR ENDING ITERS LOW
ROOTPS VBUF +4 # ROOTPSRS ROOT HI ORDER
ROOTPS+1 VBUF +5 # ROOTPSRS ROOT LO ORDER
RETROOT BUF +2 # ROOTPSRS RETURN ADDRESS OF USER
PWRCNT MATINC # ROOTPSRS DER TABLE LOOP COUNTER
DERPTR TEM1 # ROOTPSRS DER TABLE POINTER

DYNAMICALLY ALLOCATED CORE SETS FOR JOBS

84D

MPAC	ERASE	+6	# MULTI-PURPOSE ACCUMULATOR.
MODE	ERASE		# +1 FOR TP, +0 FOR DP, OR -1 FOR VECTOR.
LOC	ERASE		# LOCATION ASSOCIATED WITH JOB.
BANKSET	ERASE		# USUALLY CONTAINS BBANK SETTING.
PUSHLOC	ERASE		# WORD OF PACKED INTERPRETIVE PARAMETERS.
PRIORITY	ERASE		# PRIORITY OF PRESENT JOB AND WORK AREA.

ERASE	+83D	# EIGHT SETS OF 12 REGISTERS EACH
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INCORP STORAGE R22 N29 SHARES WITH FOLLOWING SECTION 4D

R22DISP	EQUALS	TIME2SAV	# I 4 N49 DISPLAY OF DELTA R AND DELTA V
---------	--------	----------	--

STANDBY VERB ERASABLES. REDOCTR BEFORE THETADS. 14D

TIME2SAV	ERASE	+1	
SCALSAVE	ERASE	+1	
REDOCTR	ERASE		# CONTAINS NUMBER OF RESTARTS
THETAD	ERASE	+2	
CPHI		THETAD	# 0 DESIRED GIMBAL ANGLES
CTHETA		THETAD +1	# 1 FOR
CPSI		THETAD +2	# M MANEUVER
DELV	ERASE	+5	
DELVX		DELV	
DELVY		DELV +2	
DELVZ		DELV +4	

DOWNLINK STORAGE.

28D

DNLSTADR	EQUALS	DNLSTCOD
----------	--------	----------

DNLSTCOD	ERASE		# B 1 PRM DOWNLINK LIST CODE
DUMPCNT	ERASE		# B 1
LDATALST	ERASE	+25D	# 26D
DNTMGOTO	EQUALS	LDATALST +1	# B 1
TMINDEX	EQUALS	DNTMGOTO +1	# B 1
DUMPLOC	EQUALS	TMINDEX	# CONTAINS ECADR OF AGC DP WORD BEING DUMPED
			# AND COUNT OF COMPLETE DUMPS ALREADY
			# SENT.
DNQ	EQUALS	TMINDEX +1	# B 1
DNTMBUFF	EQUALS	DNQ +1	# B 22 PRM DOWNLINK SNAPSHOT BUFFER

UNSWITCHED FOR DISPLAY INTERFACE ROUTINES. 10D FIVE MORE IN EBANK 2.

```
1  RESTREG          ERASE          # B 1 PRM FOR DISPLAY RESTARTS
2  NVWORD           ERASE
3
4  MARKNV           ERASE
5  NVSAVE           ERASE
6  # RETAIN THE ORDER OF CADRFLSH TO FAILREG +2 FOR DOWNLINK PURPOSES
7  CADRFLSH         ERASE
8  CADRMARK         ERASE
9  TEMPFLSH         ERASE
10 FAILREG          ERASE    +2      # B 3 PRM 3 ALARM CODE REGISTERS
11
12 # VAC AREAS. -- BE CAREFUL OF PLACEMENT --      220D
13
14 VAC1USE           ERASE
15 VAC1              ERASE    +42D
16 VAC2USE           ERASE
17 VAC2              ERASE    +42D
18 VAC3USE           ERASE
19 VAC3              ERASE    +42D
20 VAC4USE           ERASE
21 VAC4              ERASE    +42D
22 VAC5USE           ERASE
23 VAC5              ERASE    +42D
24
25 # WAITLIST REPEAT FLAG.      1D
26 RUPTAGN           ERASE
27 KEYTEMP2          RUPTAGN      # TEMP FOR KEYRUPT, UPRUPT
28
29 # STARALIGN ERASABLES.      13D
30
31 STARCODE           ERASE          # 1
32 AOTCODE            STARCODE
33 STARALGN           ERASE    +11D
34 SINCDU             STARALGN
35 COSCDU             STARALGN +6
36
37 SINCDUX            SINCDU +4
38 SINCDUY            SINCDU
39 SINCDUZ            SINCDU +2
40 COSCDUX            COSCDU +4
41 COSCDUY            COSCDU
42 COSCDUZ            COSCDU +2
43
44 # PHASE TABLE AND RESTART COUNTERS      12D
45
46 -PHASE1            ERASE
```

PHASE1	ERASE		
-PHASE2	ERASE		
PHASE2	ERASE		
-PHASE3	ERASE		
PHASE3	ERASE		
-PHASE4	ERASE		
PHASE4	ERASE		
-PHASE5	ERASE		
PHASE5	ERASE		
-PHASE6	ERASE		
PHASE6	ERASE		
# A**SR*T STORAGE. 6D			
CDUSPOT	ERASE	+5	# B 6
CDUSPOTY		CDUSPOT	
CDUSPOTZ		CDUSPOT +2	
CDUSPOTX		CDUSPOT +4	
# VERB 37 STORAGE 2D			
MINDEX	ERASE	# B 1 TMP INDEX FOR MAJOR MODE	
MMNUMBER	ERASE	# B 1 TMP MAJOR MODE REQUESTED BY V37	
# PINBALL INTERRUPT ACTION 1D			
DSPCNT	ERASE	# B 1 PRM COUNTER FOR DSPOUT	
# PINBALL EXECUTIVE ACTION 44D			
DSPCOUNT	ERASE	# DISPLAY POSITION INDICATOR	
DECBRNCH	ERASE	# +DEC, -DEC, OCT INDICATOR	
VERBREG	ERASE	# VERB CODE	
NOUNREG	ERASE	# NOUN CODE	
XREG	ERASE	# R1 INPUT BUFFER	
YREG	ERASE	# R2 INPUT BUFFER	
ZREG	ERASE	# R3 INPUT BUFFER	
XREGLP	ERASE	# LO PART OF XREG FOR DEC CONV ONLY	
YREGLP	ERASE	# LO PART OF YREG FOR DEC CONV ONLY	
HITEMOUT		YREGLP	# TEMP FOR DISPLAY OF HRS,MIN,SEC
			# MUST LOTEMOUT-1.
ZREGLP	ERASE	# LO PART OF ZREG FOR DEC CONV ONLY	
LOTEMOUT		ZREGLP	# TEMP FOR DISPLAY OF HRS,MIN,SEC
			# MUST HITEMOUT+1
MODREG	ERASE	# MODE CODE	

```
1 DSPLOCK          ERASE          # KEYBOARD/SUBROUTINE CALL INTERLOCK
2 REQRET           ERASE          # RETURN REGISTER FOR LOAD
3 LOADSTAT         ERASE          # STATUS INDICATOR FOR LOADTST
4 CLPASS           ERASE          # PASS INDICATOR CLEAR
5 NOUT             ERASE          # ACTIVITY COUNTER FOR DSPTAB
6 NOUNCADR         ERASE          # MACHINE CADR FOR NOUN
7 MONSAVE          ERASE          # N/V CODE FOR MONITOR.      MONSAVE1-1
8 MONSAVE1         ERASE          # NOUNCADR FOR MONITOR MATBS1  MONSAVE+1
9 MONSAVE2         ERASE          # NVMONOPT OPTIONS
10 DSPTAB           ERASE    +11D  # 0-10D, DISPLAY PANEL BUFF. 11D, C/S LTS.
11 NVQTEM           ERASE          # NVSUB STORAGE FOR CALLING ADDRESS
12 NVBNKTEM         ERASE          # MUST NVBNKTEM-1.
13                 ERASE          # NVSUB STORAGE FOR CALLING BANK
14                 ERASE          # MUST NVQTEM+1
15 VERBSAVE         ERASE          # NEEDED FOR RECYCLE
16 CADRSTOR        ERASE          # ENDIDLE STORAGE
17 DSPLIST          ERASE          # WAITING REG FOR DSP SYST INTERNAL USE
18 EXTVBACT         ERASE          # EXTENDED VERB ACTIVITY INTERLOCK
19 DSPTM1           ERASE    +2    # BUFFER STORAGE AREA 1  MOSTLY FOR TIME
20 DSPTM2           ERASE    +2    # BUFFER STORAGE AREA 2  MOSTLY FOR DEG
21
22 DSPTMX           EQUALS  DSPTM2 +1  # B 2 S-S DISPLAY BUFFER FOR EXT. VERBS
23 NORMTEM1         EQUALS  DSPTM1    # B 3 DSP NORMAL DISPLAY REGISTERS.
24
25 # DISPLAY FOR EXTENDED VERBS  V82, R04 V62 , V41 N72      2D
26
27 OPTIONX          EQUALS  DSPTMX    # 2 EXTENDED VERB OPTION CODE
28
29 # TBASES AND PHSPRDT S.          12D
30
31 TBASE1           ERASE
32 PHSPRDT1         ERASE
33 TBASE2           ERASE
34 PHSPRDT2         ERASE
35 TBASE3           ERASE
36 PHSPRDT3         ERASE
37 TBASE4           ERASE
38 PHSPRDT4         ERASE
39 TBASE5           ERASE
40 PHSPRDT5         ERASE
41 TBASE6           ERASE
42 PHSPRDT6         ERASE
43
44 # UNSWITCHED FOR DISPLAY INTERFACE ROUTINES.      6D
45
46
47
48
49
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51
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58
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60
```


NVWORD1 ERASE # B 1 PROBABLY FOR DISPLAY DURING SERVICER

EBANKSAV ERASE

MARKEBAN ERASE

EBANKTEM ERASE

MARK2PAC ERASE

R1SAVE ERASE

IMU COMPENSATION UNSWITCHED ERASABLE. 1D

1/PIPADT ERASE

SINGLE PRECISION SUBROUTINE TEMPORARIES 2D

TEMK ERASE # 1

SQ ERASE # 1

UNSWITCHED RADAR ERASABLE

SAMPLIM ERASE

SAMPLSUM ERASE +3

TIMEHOLD ERASE +1

RRTARGET EQUALS SAMPLSUM # HALF U IT VECTOR IN SM OR NB AXES.

TANG ERASE +1 # DESIRE TRUNNION AND SHAFT ANGLES.

MODEA EQUALS TANG

MODEB ERASE +1 # DODES LOBBERS TANG +2.

NSAMP EQUALS MODEB

DESRET ERASE

OLDATAGD EQUALS DESRET # USED IN DATA READING ROUTINES.

DESCOUNT ERASE

***** P22 ***** 6D

RSUBC EQUALS RRTARGET # I 6 S-S CSM POSITION VECTOR.

UNSWITCHED FOR ORBIT INTEGRATION 21D

TDEC	ERASE	+20D	# I 2
COLREG	EQUALS	TDEC +2	# I 1
LAT	EQUALS	COLREG +1	# I 2
LONG	EQUALS	LAT +2	# I 2
ALT	EQUALS	LONG +2	# I 2
YV	EQUALS	ALT +2	# I 6
ZV	EQUALS	YV +6	# I 6

MISCELLANEOUS UNSWITCHED. 20D

P40/RET	ERASE	#	WILL BE PUT IN E6 WHEN THERE IS ROOM
GENRET	ERASE	# B 1	R61 RETURN CADR.
OPTION1	ERASE	# B 1	NOUN 06 USES THIS
OPTION2	ERASE	# B 1	NOUN 06 USES THIS
OPTION3	ERASE	# B 1	NOUN 06 USES THIS
LONGCADR	ERASE +1	# B 2	LONGCALL REGISTER
LONGBASE	ERASE +1		
LONGTIME	ERASE +1	# B 2	LONGCALL REGISTER
CDUTEMPX	ERASE	# B 1	TMP
CDUTEMPY	ERASE	# B 1	TMP
CDUTEMPZ	ERASE	# B 1	TMP
PIPATMPX	ERASE	# B 1	TMP
PIPATMPY	ERASE	# B 1	TMP
PIPATMPZ	ERASE	# B 1	TMP
DISPDEX	ERASE	# B 1	
TEMPR60	ERASE	# B 1	
PRIOTIME	ERASE	# B 1	

P27 UPDATE PROGRAM STORAGE 26D

UPVERBSV	ERASE	# B 1	UPDATE VERB ATTEMPTED.
UPTMP	ERASE +24D	# B 1	TMP SCRATCH
INTWAK1Q	EQUALS UPTMP	#	BORROWS UPTMP REGISTERS
# RETAIN THE ORDER OF COMPNUMB THRU UPBUFF +19D FOR DOWNLINK PURPOSES.			
COMPNUMB	EQUALS UPTMP +1	# B 1	TMP NUMBER OF ITEMS TO BE UPLINKED
UPOLDMOD	EQUALS COMPNUMB +1	# B 1	TMP INTERRUPTD PROGRAM MM
UPVERB	EQUALS UPOLDMOD +1	# B 1	TMP VERB NUMBER
UPCOUNT	EQUALS UPVERB +1	# B 1	TMP UPBUFF INDEX
UPBUFF	EQUALS UPCOUNT +1	# B 20D	

SPECIAL DEFINITION FOR SYSTEM TEST ERASABLE PGMS. 2D

EBUF2	EQUALS UPTMP	# B 2	FOR EXCLUSIVE USE OF SYSTEM TEST.
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PERM STATE VECTORS FOR BOOST AND DOWNLINK -- WHOLE MISSION -- 14D

RN	ERASE	+5	# B 6 PRM
VN	ERASE	+5	# B 6 PRM
PIPTIME	ERASE	+1	# B 2 PRM MUST BE FOLLOWED BY GDT/2

SERVICER -- MUST FOLLOW PIPTIME -- 19D

GDT/2	ERASE	+19D	# B 6 TMP	** MUST FOLLOW PIPTIME **
MASS	EQUALS	GDT/2 +6	# B 2	
WEIGHT/G		MASS		
ABDELV	EQUALS	MASS +2	#	KALCMANU STORAGE
PGUIDE	EQUALS	ABDELV +1	#	2
DVTHRUSH	EQUALS	PGUIDE +2	#	1
AVEGEXIT	EQUALS	DVTHRUSH +1	#	2
AVGEXIT		AVEGEXIT		
TEMX	EQUALS	AVEGEXIT +2	#	1
TEMY	EQUALS	TEMX +1	#	1
TEMZ	EQUALS	TEMY +1	#	1
PIPAGE	EQUALS	TEMZ +1	# B 1	
OUTROUTE	EQUALS	PIPAGE +1	# B 1	

PERMANENT LEM DAP STORAGE 12D

CH5MASK	ERASE		# B 1 PRM
CH6MASK	ERASE		# B 1 PRM JET FAILURE MASK.
DTHETASM	ERASE	+5	# 6
SPNDX	ERASE		# B 1
RCSFLAGS	ERASE		# AUTOPILOT FLAG WORD
			# BIT ASSIGNMENTS
			# 1 ALTERYZ SWITCH ZEROOR1
			# 2 NEEDLER SWITCH
			# 3 NEEDLER SWITCH
			# 4 NEEDLER SWITCH
			# 5 NEEDLER SWITCH
			# 9 JUST-IN-DETENT SWITCH
			# 10 PBIT -- MANUAL CONTROL SWITCH
			# 11 QRBIT -- MANUAL CONTROL SWITCH
			# 12 PSKIP CONTROL PJUMPADR
			# 13 1/ACCJOB CONTROL ACCSET
T5ADR	ERASE	+1	# GENADR OF NEXT LM DAP T5RUPT. * 2CADR *
			# BBCON OF NEXT LM DAP T5RUPT. 2CADR

ERASABLES FOR P64 OVERLAY OF DTHETASM, WHICH IS UNUSED 4D

ZERLINA	EQUALS	DTHETASM	# B 1 P64
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ERASABLE ASSIGNMENTS

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ELVIRA	EQUALS	ZERLINA +1	# B 1	P64
AZINCR1	EQUALS	ELVIRA +1	# B 1	P64
ELINCR1	EQUALS	AZINCR1 +1	# B 1	P64

RCS FAILURE MONITOR STORAGE 1

PVALVEST ERASE # B 1 PRM

KALCMANU/DAP INTERFACE 3D

DELPEROR ERASE # B 1 PRM COMMAND LAGS.

DELQEROR ERASE # B 1 PRM

DELREROR ERASE # B 1 PRM

MODE SWITCHING ERASABLE. 9D

RETAIN THE ORDER OF IMODES30 AND IMODES33 FOR DOWNLINK PURPOSES

IMODES30 ERASE # B 1

IMODES33 ERASE

MODECADR ERASE +2 # B 3 PRM

IMUCADR EQUALS MODECADR

OPTCADR EQUALS MODECADR +1

RADCADR EQUALS MODECADR +2

ATTCADR ERASE +2 # B 3 PRM

ATTPRIO ATTCADR +2

MARKSTAT ERASE

T4RUPT ERASABLE 2D

DSRUPTSW ERASE

LGYRO ERASE # 1

RENDEZVOUS RADAR TASK STORAGE 3D

RRRET ERASE +2D # B 1 TMP P20 S, PERHAPS R29 R12

RDES EQUALS RRRET +1 # B 1 TMP

RRINDEX EQUALS RDES +1 # B 1 TMP

MEASINC 4D

WIXA ERASE # B 1

WIXB ERASE # B 1

ZIXA ERASE # B 1

ZIXB ERASE # B 1

AGS DUMMY ID WORD. 1D

AGSWORD ERASE

SOME MISCELLANEOUS UNSWITCHED. 6D

RATEINDX ERASE # 1 USED BY KALCMANU

DELAYLOC ERASE +2

LEMMASS ERASE # KEEP CONTIGUOUS W. CSMMASS. 1 EACH

CSMASS ERASE

LESS IS MORE.

RENDEZVOUS AND LANDING RADAR DOWNLINK STORAGE. 7D

NORMALLY USED DURING P20, BUT MAY ALSO
BE REQUIRED FOR THE V62 SPURIOUS TEST.

PLEASE KEEP IN THIS ORDER

DNRRANGE ERASE +6 # B 1 TMP

DNRRDOT EQUALS DNRRANGE +1 # B 1 TMP

DNINDEX EQUALS DNRRDOT +1 # B 1 TMP

DNLRVELX EQUALS DNINDEX +1 # B 1 TMP

DNLRVELY EQUALS DNLRVELX +1 # B 1 TMP

DNLRVELZ EQUALS DNLRVELY +1 # B 1 TMP

DNLRALT EQUALS DNLRVELZ +1 # B 1 TMP

INCORPORATION UNSWITCHED 2D

W.IND EQUALS PIPAGE # B 1

W.INDI EQUALS W.IND +1 # I 1

SUBROUTINE BALLANGS OF R60.

BALLEXIT ERASE # B 1 SAVE LOCATION FOR BALLINGS SUBR EXIT

SOME LEM DAP STORAGE. 4D

DAPDATR1 ERASE # B 1 DSP DAP CONFIG.

TEVENT ERASE +1 # B 2 DSP

DB ERASE # B 1 TMP DEAD BAND.

NOUN 87 2D

AZ ERASE +1D # B 1 AZ AND EL MUST BE CONTIGUOUS

```
1 EL                      EQUALS  AZ +1D          # B 1
2
3
4 # P63, P64, P65, P66, AND P67.                  1D
5
6 WCHPHASE                ERASE                  # B 1
7
8 # ERASABLES FOR THE R2 LUNAR POTENTIAL MODEL    2D
9
10 E3J22R2M                ERASE                  # I 1
11 E32C31RM                ERASE                  # I 1
12
13
14 RADSKAL                 ERASE  +1              # LR ALT DOPPLER BIAS  2T/LAMBDA SCALED
15                                     # AT 1/ 2 7  M/CS
16 SKALSKAL                ERASE                  # LR ALT SCALE FACTOR RATIO  .2 NOM
17
18 END-UE                  EQUALS                  # NEXT UNUSED UE ADDRESS
19
20 # SELF-CHECK ASSIGNMENTS                        17D
21
22 SELFERAS                ERASE  1357 - 1377      # *** MUST NOT BE MOVED ***
23 SFAIL                   EQUALS  SELFERAS        # B 1
24 ERESTORE                EQUALS  SFAIL +1        # B 1
25 SELFRET                 EQUALS  ERESTORE +1      # B 1  RETURN
26 SMODE                   EQUALS  SELFRET +1      # B 1
27 ALMCADR                 EQUALS  SMODE +1        # B 2  ALARM-ABORT USER S 2CADR
28 ERCOUNT                 EQUALS  ALMCADR +2      # B 1
29 SCOUNT                  EQUALS  ERCOUNT +1      # B 3
30 SKEEP1                  EQUALS  SCOUNT +3      # B 1
31 SKEEP2                  EQUALS  SKEEP1 +1      # B 1
32 SKEEP3                  EQUALS  SKEEP2 +1      # B 1
33 SKEEP4                  EQUALS  SKEEP3 +1      # B 1
34 SKEEP5                  EQUALS  SKEEP4 +1      # B 1
35 SKEEP6                  EQUALS  SKEEP5 +1      # B 1
36 SKEEP7                  EQUALS  SKEEP6 +1      # B 1
```

EBANK-3 ASSIGNMENTS

SETLOC 1400

WAITLIST TASK LISTS.

26D

LST1	ERASE	+7	# B 8D PRM DELTA T S.
LST2	ERASE	+17D	# B 18D PRM TASK 2CADR ADDRESSES.

RESTART STORAGE.

2D

RSBBQ ERASE +1 # B 2 PRM SAVE BB AND Q FOR RESTARTS

MORE LONGCALL STORAGE. MUST BE IN LST1 S BANK. 2D

LONGEXIT ERASE +1 # B 2 TMP MAY BE SELDOM OVERLAYED.

PHASE-CHANGE LISTS PART II.

12D

PHSNAME1	ERASE	# B 1 PRM
PHSBB1	ERASE	# B 1 PRM
PHSNAME2	ERASE	# B 1 PRM
PHSBB2	ERASE	# B 1 PRM
PHSNAME3	ERASE	# B 1 PRM
PHSBB3	ERASE	# B 1 PRM
PHSNAME4	ERASE	# B 1 PRM
PHSBB4	ERASE	# B 1 PRM
PHSNAME5	ERASE	# B 1 PRM
PHSBB5	ERASE	# B 1 PRM
PHSNAME6	ERASE	# B 1 PRM
PHSBB6	ERASE	# B 1 PRM

IMU COMPENSATION PARAMETERS

22D

PBIASX	ERASE	# B 1 PIPA BIAS, PIPA SCALE FACTOR TERMS
PIPABIAS		# INTERMIXED.

PIPASCFX	ERASE	
PIPASCF		PIPASCFX

PBIASY	ERASE
PIPASCFY	ERASE
PBIASZ	ERASE
PIPASCFZ	ERASE

NBDX	ERASE	# GYRO BIAS DRIFT
NBDY	ERASE	
NBDZ	ERASE	

ADIAX ERASE # ACCELERATION SENSITIVE DRIFT ALONG THE
ADIAZ ERASE # INPUT AXIS

ADSRAX ERASE # ACCELERATION SENSITIVE DRIFT ALONG THE
ADSRAY ERASE # SPIN REFERENCE AXIS
ADSRAZ ERASE

GCOMP ERASE +5 # CONTAINS COMPENSATING TORQUES

COMMAND EQUALS GCOMP
CDUIND EQUALS GCOMP +3

GCOMPSW ERASE

STATE VECTORS FOR ORBIT INTEGRATION. 44D

DIFEQCNT THUR XKEP MUST BE IN THE SAME
EBANK AS RRECTCSM, RRECTLEM ETC
BECAUSE THE COPY-CYCLES ATOPCSM,
PTOACSM ETC ARE EXECUTED IN BASIC.
ALL OTHER REFERENCES TO THIS GROUP
ARE BY INTERPRETIVE INSTRUCTIONS.

DIFEQCNT ERASE +43D # B 1
UPSVFLAG...XKEP MUST BE KEPT IN ORDER

UPSVFLAG EQUALS DIFEQCNT +1 # B 1
RRECT EQUALS UPSVFLAG +1 # B 6
VRECT EQUALS RRECT +6 # B 6
TET EQUALS VRECT +6 # B 2
TDELTAV EQUALS TET +2 # B 6
TNUV EQUALS TDELTAV +6 # B 6
RCV EQUALS TNUV +6 # B 6
VCV EQUALS RCV +6 # B 6
TC EQUALS VCV +6 # B 2
XKEP EQUALS TC +2 # B 2

PERMANENT STATE VECTORS AND TIMES.

DO NOT OVERLAY WITH ANYTHING AFTER BOOST

RRECTCSM...XKEPCSM MUST BE KEPT IN THIS ORDER

RRECTCSM ERASE +5 # B 6 PRM CSM VARIABLES.
RRECTOTH RRECTCSM
VRECTCSM ERASE +5 # B 6 PRM

```
1  TETCSM          ERASE  +1          # B 2 PRM
2  TETOTHER        TETCSM
3
4  DELTACSM        ERASE  +5          # B 6 PRM
5  NUVCSM          ERASE  +5          # B 6 PRM
6  RCVCSM          ERASE  +5          # B 6 PRM
7  VCVCSM          ERASE  +5          # B 6 PRM
8  TCCSM           ERASE  +1          # B 2 PRM
9  XKEPCSM         ERASE  +1          # B 2 PRM
10
11 # RRECTLEM...XKEPLEM MUST BE KEPT IN THIS ORDER
12
13 RRECTLEM        ERASE  +5          # B 6 PRM LEM VARIABLES
14 RRECTHIS        RRECTLEM
15 VRECTLEM        ERASE  +5          # B 6 PRM
16 TETLEM          ERASE  +1          # B 2 PRM
17 TETTHIS        TETLEM
18 DELTALEM        ERASE  +5          # B 6 PRM
19 NUVLEM          ERASE  +5          # B 6 PRM
20 RCVLEM          ERASE  +5          # B 6 PRM
21 VCVLEM          ERASE  +5          # B 6 PRM
22 TCLEM           ERASE  +1          # B 2 PRM
23 XKEPLEM         ERASE  +1          # B 2 PRM
24
25 X789            ERASE  +5
26 TEPHEM          ERASE  +2
27 AZO             ERASE  +1
28 -AYO            ERASE  +1
29 AXO             ERASE  +1
30
31 # STATE VECTORS FOR DOWNLINK          12D
32
33 R-OTHER          ERASE  +5          # B 6 PRM POS VECT  OTHER VECH  FOR DNLINK
34 V-OTHER          ERASE  +5          # B 6 PRM VEL VECT  OTHER VECH  FOR DNLINK
35
36 T-OTHER          TETCSM          #          TIME  OTHER VECH  FOR DNLINK
37
38 # REFSMMAT.          18D
39
40 REFSMMAT         ERASE  +17D        # I 18D PRM
41
42 # ACTIVE VEHICLE CENTANG.  MUST BE DISPLAYED ANYTIME  ALMOST.    2D
43
44 ACTCENT          ERASE  +1          # I 2  S-S CENTRAL ANGLE BETWEEN ACTIVE
45                                     # VEHICLE AT TPI TIG AND TARGET VECTOR.
46
47 # **** USED IN CONICSEX  PLAN INERT ORIENT  ****
48
49
50
51
52
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ERASABLE ASSIGNMENTS

PAGE 112

TIMSUBO EQUALS TEPHEM # CSEC B-42 TRIPLE PRECISION

LPS20.1 STORAGE -- ALL ARE PRM -- 9D

LS21X ERASE # I 1

LOSVEL ERASE +5 # I 6

MLOSV ERASE +1 # I 2 MAGNITUDE OF LOS. METERS B-29

***** P22 ***** OVERLAYS LPS 20.1 STORAGE 6D

VSUBC EQUALS LOSVEL # I 6 S-S CSM VELOCITY VECTOR

PADLOADED ERASABLES FOR P20/P22 6D

RANGEVAR ERASE +1 # I 2 RR RANGE ERROR VARIANCE

RATEVAR ERASE +1 # I 2 RR RANGE RATE ERROR VARIANCE

RVARMIN ERASE # I 1 MINIMUM RANGE ERROR VARIANCE

VVARMIN ERASE # I 1 MINIMUM RANGE-RATE ERROR VARIANCE

P32-P33 STORAGE 2D

TCDH ERASE +1 # I 2 T2 CDH TIME IN CS. ALSO DOWNLINKED

END-E3 EQUALS 1777 # ** LAST LOCATION USED IN E3 **

1412THE

EBANK-4 ASSIGNMENTS

SETLOC 2000

E4 IS, FOR THE MOST PART RESERVED FOR PAD LOADED AND UNSHARABLE ERASE.

AMEMORY EQUALS

P20 STORAGE. -- PAD LOADED -- 6D

WRENDPOS	ERASE	# B 1 PL	KM*2 -7
WRENDVEL	ERASE	# B 1 PL	KM -1/2 *2 11
WSHAFT	ERASE	# B 1 PL	KM*2 -7
WTRUN	ERASE	# B 1 PL	KM*2 -7
RMAX	ERASE	# B 1 PL	METERS*2 -19
VMAX	ERASE	# B 1 PL	M/CSEC*2 -7

LUNAR SURFACE NAVIGATION 2D

WSURFPOS	ERASE	# B 1 PL
WSURFVEL	ERASE	# B 1 PL

P22 STORAGE. -- PAD LOADED -- 2D

SHAFTVAR	ERASE	# B 1 PL	RAD SQ*2 12
TRUNVAR	ERASE	# B 1 PL	RAD SQ*2 10

CONISEX STORAGE. -- PAD LOADED --

504LM ERASE +5 # I 6 MOON LIBRATION VECTOR

V47 R47 AGS INITIALIZATION STORAGE. -- PAD LOADED -- 2D

AGSK ERASE +1

LUNAR LANDING STORAGE. -- PAD LOADED -- 6D

RLS ERASE +5 # I 6 LANDING SITE VECTOR -- MOON REF

INTEGRATION STORAGE. 102D

PBODY ERASE +101D # I 1

```
1  ALPHAV      EQUALS  PBODY +1      # I 6
2  BETAV      EQUALS  ALPHAV +6      # I 6
3  PHIV       EQUALS  BETAV +6      # I 6
4  PSIV       EQUALS  PHIV +6       # I 6
5  FV         EQUALS  PSIV +6       # I 6  PERTURBING ACCELERATIONS
6  ALPHAM     EQUALS  FV +6         # I 2
7  BETAM     EQUALS  ALPHAM +2      # I 2
8  TAU.       EQUALS  BETAM +2      # I 2
9  DT/2      EQUALS  TAU. +2       # I 2
10 H          EQUALS  DT/2 +2       # I 2
11 GMODE      EQUALS  H +2          # I 1
12 IRETURN    EQUALS  GMODE +1      # I 1
13 NORMGAM    EQUALS  IRETURN +1    # I 1
14 RPQV       EQUALS  NORMGAM +1
15 ORIGEX     EQUALS  RPQV +6       # I 1
16 KEPRTN     EQUALS  ORIGEX        # I 1
17 RQVV       EQUALS  ORIGEX +1     # I 6
18 RPSV       EQUALS  RQVV +6       # I 6
19 XKEPNEW    EQUALS  RPSV +6       # I 2
20 VECTAB      EQUALS  XKEPNEW +2    # I 36D
21 VECTABND   EQUALS  VECTAB +35D   # END MARK
```

```
22 # THESE PROBABLY CAN SHARE MID-COURSE VARIABLES.      6D
```

```
23 VACX      EQUALS  VECTAB +6      # I 2
24 VACY      EQUALS  VACX +2        # I 2
25 VACZ      EQUALS  VACY +2        # I 2
```

```
26 # SERVICER STORAGE USED BY ALL POWERED FLIGHT PROGS.  18D
```

```
27 XNBPIP     EQUALS  VECTAB +12D   # I 6
28 YNBPIP     EQUALS  XNBPIP +6     # I 6
29 ZNBPIP     EQUALS  YNBPIP +6     # I 6
```

```
30 # SOME VERB 82 STORAGE      4D
```

```
31 HAPOX      EQUALS  RQVV +4       # I 2
32 HPERX      EQUALS  HAPOX +2      # I 2
```

```
33 # V82 STORAGE      6D
```

```
34 VONE      EQUALS  VECTAB +30D    # I T TMP NORMAL VELOCITY VONE / SQRT. MU
```

```
35 # R32 V83 STORAGE. -- SHARES WITH INTEGRATION STORAGE --  28D
```

```
1  BASETHV      EQUALS  RPQV      # I 6  BASE VEL VECTOR THIS VEH
2
3
4  BASETIME     EQUALS  RQVV      # I 2  TIME ASSOC WITH BASE VECs
5  ORIG         EQUALS  RQVV +2   # I 1  0 FOR EARTH      2 FOR MOON
6  STATEXIT     EQUALS  RQVV +3   # I 1  STQ ADDRESS FOR STATEXTP
7  BASEOTV      EQUALS  RQVV +4   # I 6  BASE VEL VECTOR OTHER VEH
8
9  BASEOTP      EQUALS  VECTAB +6  # I 6  BASE POS VECTOR OTHER VEH
10
11 BASETHP      EQUALS  VECTAB +30D # I 6  BASE POS VECTOR THIS VEH
12
13 # KEPLER STORAGE.  KEPLER IS CALLED BY PRECISION INTEGRATION AND 2D
14 # CONICS
15
16 EPSILONT      ERASE   +1       # I 2
17
18 # VERB 83 STORAGE                      18D
19
20 RANGE         ERASE   +17D     # I 2  DSP NOUN 54 DISTANCE TO OPTICAL SUBJ
21 RRATE         EQUALS  RANGE +2  # I 2  DSP NOUN 54 RATE OF APPROACH
22 RTHETA        EQUALS  RRATE +2  # I 2  DSP NOUN 54.
23 RONE          EQUALS  RTHETA +2 # I 6  TMP VECTOR STORAGE.  SCRATCH
24 VONE          EQUALS  RONE +6   # I 6  TMP VECTOR STORAGE.  SCRATCH
25
26 # VERB 67 STORAGE
27
28 WWPOS         RANGE    # NOUN 99  V67
29 WWVEL         RRATE    # NOUN 99  V67
30 WWBIAS        RTHETA   # NOUN 99  V67
31
32 # V82 STORAGE.  CANNOT OVERLAY RONE OR VONE    11D  TWO SEPARAT LOCATIONS
33
34 V82FLAGS      EQUALS  VECTAB +6  # 1  FOR V82 BITS.
35 TFF           EQUALS  V82FLAGS +1 # I 2
36 -TPER         EQUALS  TFF +2     # I 2
37
38 HPERMIN       EQUALS  RANGE      # I 2  SET TO 300KFT FOR SR30.1
39 RPADTEM       EQUALS  HPERMIN +2 # I 2  PAD OR LANDING RADIUS FOR SR30.1
40 TSTART82      EQUALS  RPADTEM +2 # I 2  TEMP TIME STORAGE VOR V82.
41
42 # VARIOUS DISPLAY REGISTERS          6D  NOUN 84  P76
43
44
45
46
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```



```
1 DELVOV          ERASE   +5D          #   6
2
3
4 # ALIGNMENT PLANETARY -- INERTIAL TRANSFORMATION STORAGE.      18D
5
6 #
7     UNSHARED WHILE LM ON LUNAR SURFACE.
8
9 GSAV            ERASE   +17D          # I  6
10 YNBSAV          EQUALS  GSAV +6       # I  6
11 ZNBSAV          EQUALS  YNBSAV +6     # I  6
12
13 # KALCMANU STORAGE, CAN OVERLAY GSAV.      18D
14
15 MFS             EQUALS  GSAV          # I 18
16 MFI             EQUALS  MFS           # I
17 KEL            EQUALS  MFS           # I 18
18 E01            EQUALS  MFS           # I  6
19 E02            EQUALS  E01 +6        # I  6
20
21 # LR VEL BEAM VECTORS.      26D
22
23 # CAN OVERLAY GSAV WITH CARE, USED DURING POWERED DESCENT ONLY.
24
25 VZBEAMNB        EQUALS  GSAV          # I  6  LR VELOCITY BEAMS IN NB COORDS.
26 VYBEAMNB        EQUALS  VZBEAMNB +6  # I  6
27 VXBEAMNB        EQUALS  VYBEAMNB +6  # I  6  PRESERVE Z,Y,X ORDER
28
29 LRVTIME          VXBEAMNB +6          # B  2  LR
30 LRXCDU           LRVTIME +2          # B  1  LR
31 LRYCDU           LRXCDU +1           # B  1  LR
32 LRZCDU           LRYCDU +1           # B  1  LR
33 PIPTM           LRZCDU +1           # B  3  LR
34
35 # P32-P35, P72-P75 STORAGE.      40D
36
37 T1TOT2          ERASE   +1           #   2  TIME FROM CSI TO CDH
38 T2TOT3          ERASE   +1           #   2
39 ELEV            ERASE   +1           #   2
40 UP1            ERASE   +5           #   6
41 DELVEET1        ERASE   +5           # I  6  DV CSI IN REF
42 DELVEET2        ERASE   +5           # I  6  DV CSH IN REF
43 RACT1           ERASE   +5           #   6  POS VEC OF ACTIVE AT CSI TIME
44 RACT2           ERASE   +5           #   6  POS VEC OF ACTIVE AT CDH TIME
45
46
47
48
49
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```

```
RTSR1/MU      ERASE  +1      # 2  SQ ROOT 1/MU STORAGE
RTMU          ERASE  +1      # 2  MU STORAGE
```

THE FOLLOWING ERASABLES OVERLAY PORTIONS OF THE PREVIOUS SECTION

```
+MGA          EQUALS  T1TOT2      # 2  S-S + MID GIM ANGL TO DELVEET3
```

```
UNRM          EQUALS  UP1         # I 6  S-S
```

```
DVLOS         EQUALS  RACT1       # I 6  S-S DELTA VELOCITY, LOS COORD-DISPLAY
```

```
ULOS          EQUALS  RACT2       # I 6  S-S UNIT LINE OF SIGHT VECTOR
```

```
NOMTPI        EQUALS  RTSR1/MU    # 2  S-S NOMINAL TPI-TIME FOR RECYCLE
```

SOME P30 STORAGE. 4D

```
HAPD          EQUALS  RTSR1/MU    # I 2
```

```
HPER          EQUALS  HAPD +2     # I 2
```

SOME P38-P39,P78-79 STORAGE # 6D

```
DELTAR        EQUALS  DVLOS       # I 2
```

```
DELTTIME      EQUALS  DELTAR +2   # I 2  TIME REPRESENTATION OF DELTAR
```

```
TARGETIME     EQUALS  DELTTIME +2 # I 2  TINT MINUS DELTTIME
```

```
TINTSOI       EQUALS  DELTAR      # I 2  TIME OF INTERCEPT FOR SOI PHASE
```

THE FOLLOWING ARE ERASABLE LOADS DURING A PERFORMANCE TEST.

```
TRANSM1       WRENDPOS          # E4,1400
```

```
ALFDK         TRANSM1 +18D
```

***** THE FOLLOWING SECTIONS OVERLAY V83 AND DISPLAY STORAGE *****

V47 R47 AGS INITIALIZATION PROGRAM STORAGE. OVERLAYS V83 14D

```
AGSBUFF       EQUALS  RANGE      # B 14D
```

```
AGSBUFFE      EQUALS  AGBUFF +13D # ENDMARK
```

R36 OUT-OF-PLANE RENDEZVOUS DISPLAY STORAGE. OVERLAYS V83 12D

RPASS36 EQUALS RONE # I 6 S-S
UNP36 EQUALS RPASS36 +6 # I 6 S-S

S-BAND ANTENNA GIMBAL ANGLES. DISPLAYED BY R05 V64 . OVERLAYS V83 10D
OPERATES DURING P00 ONLY

ALPHASB EQUALS RANGE # B 2 DSP NOUN 51. PITCH ANGLE.
BETASB EQUALS ALPHASB +2 # B 2 DSP NOUN 51. YAW ANGLE.
RLM EQUALS BETASB +2 # I 6 S S/C POSITION VECTOR.

**** USED IN S-BAND ANTENNA FOR LM ****

YAWANG EQUALS BETASB
PITCHANG EQUALS ALPHASB

NOUN 56 DATA -- COMPUTED AND DISPLAYED BY VERB 85.

RR-AZ EQUALS PITCHANG # I 2 ANGLE BETWEEN LOS AND X-Z PLANE
RR-ELEV EQUALS RR-AZ +2 # I 2 ANGLE BETWEEN LOS AND Y-Z PLANE

R04 V62 RADAR TEST STORAGE.
R04 IS RESTRICTED TO P00.

RSTACK EQUALS RANGE # B 8 BUFFER FOR R04 NOUNS.

INITVEL STORAGE. ALSO USED BY P31, P34, P35, P74, P75, P10, P11, MIDGIM, S40.1 AND S40.9. 18D

POSSIBLY RINIT VINIT CAN OVERLAY DELVEET1 2 ABOVE

RINIT ERASE +5 # I 6 ACTIVE VEHICLE POSITION
VINIT ERASE +5 # I 6 ACTIVE VEHICLE VELOCITY
VIPRIME ERASE +5 # I 6 NEW VEL REQUIRED AT INITIAL RADIUS.

VARIOUS DISPLAY REGISTERS. BALLANGS 3D

FDAIX ERASE # I 1
FDAIY ERASE # I 1
FDAIZ ERASE # I 1

P34-P35 STORAGE. DOWNLINKED. 2D

DELVTPIF ERASE +1 # I 2 DELTA V FOR TPIF

SOME R04 V63 -R77 RADAR TEST STORAGE. 6D

```
1  RTSTDEX      ERASE      # 1
2  RTSTMAX      ERASE      # 1
3  RTSTBASE     ERASE      # 1
4  RTSTLOC      ERASE      # 1
5  RSTKLOC      ERASE      RTSTLOC
6  RSAMPDT      ERASE      # 1
7  RFAILCNT     ERASE      # 1
8
9  # LPS20.1 STORAGE.          12D
10
11  LMPOS        EQUALS RTSTDEX      # I 6 TMP STORAGE FOR LM POS. VECTOR.
12  LMVEL        EQUALS LMPOS +6     # I 6 TMP STORAGE FOR LM VEL. VECTOR.
13
14  # INITVEL STORAGE.  ALSU USED BY P31,34,35,74,75,S40.1 AND DOWNLINKED.  6D
15
16  DELVEET3     EQUALS LMVEL +6     # I 6 DELTA V IN INERTIAL COORDINATES
17
18  END-E4       EQUALS              # FIRST UNUSED LOCATION IN E4
19
20  # SECOND DPS GUIDANCE LUNAR LANDING  OVERLAY P32-35, INITVEL          14D
21
22  VHORIZ       EQUALS PIPTM +3     # I 2 DISPLAY
23  ANGTERM      EQUALS VHORIZ +2    # I 6 GUIDANCE
24  HBEAMNB      EQUALS ANGTERM +6   # I 6 LANDING RADAR
25
26  # R12 DOWNLINK QUANTITIES          5D
27
28  LRXCDUDL     EQUALS /LAND/ +2    # B 1 LANDING RADAR DOWNLINK
29  LRYCDUDL     EQUALS LRXCDUDL +1  # B 1 LANDING RADAR DOWNLINK
30  LRZCDUDL     EQUALS LRYCDUDL +1  # B 1 LANDING RADAR DOWNLINK
31  LRVTIMDL     EQUALS LRZCDUDL +1  # B 2 LANDING RADAR DOWNLINK
32
33  # ASCENT GUIDANCE FOR LUNAR LANDING  54D
34
35  AT           EQUALS PIPTM +3     # I 2 TMP ENGINE DATA -- THRUST ACC*2 9
36  VE           EQUALS AT +2        # I 2 TMP EXHAUST VELOCITY * 2 7 M/CS.
37  TTO          EQUALS VE +2        # I 2 TMP TAILOFF TIME * 2 17 CS.
38  TBUP         EQUALS TTO +2       # I 2 TMP M/MDOT * 2 17 CS.
39  RDOTD        EQUALS TBUP +2      # I 2 TMP TARGET VELOCITY COMPONENTS
40  YDOTD        EQUALS RDOTD +2     # I 2 TMP SCALING IS 2 7 M/CS.
41  ZDOTD        EQUALS YDOTD +2     # I 2 TMP
42
43  /R/MAG       EQUALS ZDOTD +2     # I 2 TMP
44  LAXIS        EQUALS /R/MAG +2    # I 6 TMP
```

ZAXIS1		UHZP		
RDOT		HDOTDISP		
YDOT		LAXIS +6	# I 2	TMP VEL. NORMAL TO REF. PLANE*2 -7
ZDOT	EQUALS	YDOT +2	# I 2	TMP DOWN RANGE VEL * 2 -7
GEFF	EQUALS	ZDOT +2	# I 2	TMP EFFECTIVE GRAVITY
# THESE TWO GROUPS OF ASCENT GUIDANCE ARE SPLIT BY THE ASCENT-DESCENT SERVICER SECTION FOLLOWING THIS SECTION				
Y	EQUALS	/LAND/ +2	# I 2	TMP OUT-OF-PLANE DIST *2 24 M
DRDOT	EQUALS	Y +2	# I 2	TMP RDOTD - RDOT
DYDOT	EQUALS	DRDOT +2	# I 2	TMP YDOTD - YDOT
DZDOT	EQUALS	DYDOT +2	# I 2	TMP ZDOTD - ZDOT
PCONS	EQUALS	DZDOT +2	# I 2	TMP CONSTANT IN ATR EQUATION
YCONS	EQUALS	PCONS +2	# I 2	TMP CONSTANT IN ATY EQUATION
PRATE	EQUALS	YCONS +2	# I 2	TMP RATE COEFF. IN ATR EQUATION
YRATE	EQUALS	PRATE +2	# I 2	TMP RATE COEFF. IN ATY EQUATION
ATY	EQUALS	YRATE +2	# I 2	TMP OUT-OF-PLANE THRUST COMP. *2 9
ATR	EQUALS	ATY +2	# I 2	TMP RADIAL THRUST COMP. * 2 9
ATP	EQUALS	ATR +2	# I 2	TMP DOWN-RANGE THRUST COMP
YAW	EQUALS	ATP +2	# I 2	TMP
PITCH	EQUALS	YAW +2	# I 2	TMP
# SERVICER FOR LUNAR ASCENT AND DESCENT 14D				
G CSM	EQUALS	GEFF +2	# I 6	FOR UPDATE OF COMMAND MODULE STATE
R CSM	EQUALS	R-OTHER	#	VECTORS BY LEM ANALOGS OF GDT/2,
V CSM	EQUALS	V-OTHER	#	R, AND V, RESPECTIVELY OF THE CSM
WM	EQUALS	G CSM +6	# I 6	TMP -- LUNAR ROTATION VECTOR SM
/LAND/	EQUALS	WM +6	# B 2	LUNAR RADIUS AT LANDING SITE

EBANK-5 ASSIGNMENTS

SETLOC 2400

W-MATRIX. ESSENTIALLY UNSHARABLE. 162D

W ERASE +161D
ENDW EQUALS W +162D

***** OVERLAY NUMBER 1 IN EBANK 5 *****

#	W-MATRIX PADLOADS	124D
TLAND	EQUALS W	# I 2 NOMINAL TIME OF LANDING
RBRFG	EQUALS TLAND +2	# I 6 BRAKING
VBRFG	EQUALS RBRFG +6	# I 6 PHASE
ABRFG	EQUALS VBRFG +6	# I 6 TARGET
VBRFG*	EQUALS ABRFG +6	# I 2 PARAMETERS
ABRFG*	EQUALS VBRFG* +2	# I 2 HIGH
JBRFG*	EQUALS ABRFG* +2	# I 2 GATE
GAINBRAK	EQUALS JBRFG* +2	# B 2
TCGFBRAK	EQUALS GAINBRAK +2	# B 1
TCGIBRAK	EQUALS TCGFBRAK +1	# B 1
RAPFG	EQUALS TCGIBRAK +1	# I 6 APPROACH
VAPFG	EQUALS RAPFG +6	# I 6 PHASE
AAPFG	EQUALS VAPFG +6	# I 6 TARGET
VAPFG*	EQUALS AAPFG +6	# I 2 PARAMETERS
AAPFG*	EQUALS VAPFG* +2	# I 2 LOW
JAPFG*	EQUALS AAPFG* +2	# I 2 GATE
GAINAPPR	EQUALS JAPFG* +2	# B 2
TCGFAPPR	EQUALS GAINAPPR +2	# B 1
TCGIAPPR	EQUALS TCGFAPPR +1	# B 1
VIGN	EQUALS TCGIAPPR +1	# I 2 DESIRED SPEED FOR IGNITION
RIGNX	EQUALS VIGN +2	# I 2 DESIRED ALTITUDE FOR IGNITION
RIGNZ	EQUALS RIGNX +2	# I 2 DESIRED GROUND RANGE FOR IGNITION
KIGNX/B4	EQUALS RIGNZ +2	# I 2
KIGNY/B8	EQUALS KIGNX/B4 +2	# I 2
KIGNV/B4	EQUALS KIGNY/B8 +2	# I 2
LOWCRIT	EQUALS KIGNV/B4 +2	# B 1 HIGHCRIT MUST FOLLOW LOWCRIT
HIGHCRIT	EQUALS LOWCRIT +1	# B 1
V2FG	EQUALS HIGHCRIT +1	# I 6 DESIRED VELOCITY FOR P65.
TAUVERT	EQUALS V2FG +6	# I 2 TIME CONSTANT FOR P65 VEL. NULLING.
DELQFIX	EQUALS TAUVERT +2	# I 2 LR ALTITUDE DATA REASONABLE PARM.
LRALPHA	EQUALS DELQFIX +2	# B 1 POS1 X ROTATION * MUST *


```
1 LRBETA1      EQUALS  LRALPHA +1      # B 1  POS1 Y ROTATION      * BE *
2 LRALPHA2     EQUALS  LRBETA1 +1      # B 1  POS2 X ROTATION      * IN *
3 LRBETA2      EQUALS  LRALPHA2 +1     # B 1  POS2 Y ROTATION      * ORDER*
4 LRVMAX       EQUALS  LRBETA2 +1     # B 1  LR VEL WEIGHTING FUNCTIONS
5 LRVF         EQUALS  LRVMAX +1      # B 1  LR VEL WEIGHTING FUNCTIONS
6 LRWVZ        EQUALS  LRVF +1        # B 1  LR VEL WEIGHTING FUNCTIONS
7 LRWVY        EQUALS  LRWVZ +1       # B 1  LR VEL WEIGHTING FUNCTIONS
8 LRWVX        EQUALS  LRWVY +1       # B 1  LR VEL WEIGHTING FUNCTIONS
9 LRWVFZ       EQUALS  LRWVX +1       # B 1  LR VEL WEIGHTING FUNCTIONS
10 LRWVFY      EQUALS  LRWVFZ +1      # B 1  LR VEL WEIGHTING FUNCTIONS
11 LRWVFX      EQUALS  LRWVFY +1      # B 1  LR VEL WEIGHTING FUNCTIONS
12 LRWVFF      EQUALS  LRWVFX +1      # B 1  LR VEL WEIGHTING FUNCTIONS
13
14 ABVEL*       EQUALS  BUF            # B 1  LR TEMP
15 VSELECT*    EQUALS  BUF +1         # B 1  LR TEMP
16
17 RODSCALE     EQUALS  LRWVFF +1      # I 1  CLICK SCALE FACTOR FOR ROD
18 TAUROD       EQUALS  RODSCALE +1    # I 2  TIME CONSTANT FOR R.O.D.
19 LAG/TAU      EQUALS  TAUROD +2      # I 2  LAG TIME DIVIDED BY TAUROD P66
20 MINFORCE     EQUALS  LAG/TAU +2     # I 2  MINIMUM FORCE P66 WILL COMMAND
21 MAXFORCE     EQUALS  MINFORCE +2    # I 2  MAXIMUM FORCE P66 WILL COMMAND.
22 ABTCOF       EQUALS  MAXFORCE +2    # I 16 COEFFICIENTS FOR ABORT TFI POLYS.
23 VMIN         EQUALS  ABTCOF +16D    # I 2  MINIMUM VELOCITY FOR ABORT INJ.
24 YLIM         EQUALS  VMIN +2        # I 2  MAXIMUM CROSS-RANGE DIST. IN ABORTS
25 ABTRDOT      EQUALS  YLIM +2        # I 2  DESIRED RADIAL VEL. FOR ABORTS.
26 COSTHET1     EQUALS  ABTRDOT +2     # I 2  COS CONE 1 ANGLE FOR ABORTS.
27 COSTHET2     EQUALS  COSTHET1 +2    # I 2  COS OF CONE 2 ANGLE FOR ABORTS.
```

SOME VARIABLES FOR SECOND DPS GUIDANCE. 34D

```
31
32 CG           EQUALS  COSTHET2 +2    # I 18D GUIDANCE
33 RANGEDSP     EQUALS  CG +18D        # B 2  DISPLAY
34 OUTOFPLN     EQUALS  RANGEDSP +2    # B 2  DISPLAY
35 R60VSAVE     EQUALS  OUTOFPLN +2    # I 6  TMP SAVES VALUE OF POINTVSM THRU R51
36 RGU         EQUALS  R60VSAVE +6    # I 6  UNSHARED FOR DOWNLINK
37 VBIAS        EQUALS  R60VSAVE      # I 6  PIPA BIAS EQUIV. VELOCITY VECTOR.
38 L*WCR*T      BUF
39 H*GHCRT      BUF +1
```

ALIGNMENT/SYSTEST/CALCSMSC COMMON STORAGE 36D

```
41
42
43 XSM          EQUALS  ENDW            # B 6
44 YSM          EQUALS  XSM +6          # B 6
45 ZSM          EQUALS  YSM +6          # B 6
46
47 XDC          EQUALS  ZSM +6          # B 6
48 YDC          EQUALS  XDC +6          # B 6
49 ZDC          EQUALS  YDC +6          # B 6
```

XNB XDC
YNB YDC
ZNB ZDC

OVERLAYS WITHIN ALIGNMENT/SYSTEST/CALCSMSC COMMON STORAGE 4D

-COSB EQUALS XSM +2 # 2 TMP
SINB EQUALS -COSB +2 # 2 TMP

MORE OVERLAYS TO ALIGNMENT/SYSTEST THESE ARE P52 6D

LANDLAT EQUALS STARAD # 2 LATTITUDE, LONGITUDE
LANDLONG EQUALS LANDLAT +2 # 2 AND ALTITUDE
LANDALT EQUALS LANDLONG +2 # 2 OF LANDING SITE

ALIGNMENT/SYSTEST COMMON STORAGE. 31D

STARAD EQUALS ZDC +6 # 1 18D TMP
STAR EQUALS STARAD +18D # 1 6
GCTR EQUALS STAR +6 # 8 1
OGC EQUALS GCTR +1 # 1 2
IGC EQUALS OGC +2 # 1 2
MGC EQUALS IGC +2 # 1 2

P57 ALIGNMENT OVERLAY OF ALIGNMENT/SYSTEST COMMON STORAGE 12D

GACC STARAD # 6 SS
GOUT STARAD +6 # 6 SS

OVERLAYS WITHIN ALIGNMENT/SYSTEST COMMON STORAGE 24D

VEARTH EQUALS STARAD # 6 TMP
VSUN EQUALS VEARTH +6 # 6 TMP
VMOON EQUALS VSUN +6 # 6 TMP
SAX EQUALS VMOON +6 # 6 TMP

P50 S, R50 S Q STORES 2D

QMIN EQUALS MGC +2 # 8 1 TMP
QMAJ EQUALS QMIN +1 # 8 1 TMP

**** USED IN P50S **** SCATTERED OVERLAYS

XSCI EQUALS STARAD
YSCI EQUALS XSCI +6

ZSCI	EQUALS	YSCI			
CULTRIX	EQUALS	VEARTH	#	VEARTH, VSUN, VMOON	
VEC1	EQUALS	STARAD	+12D		
VEC2	EQUALS	STAR			
# ALIGNMENT STORAGE. 23D					
OGCT	EQUALS	QMAJ	+1	#	I 6
BESTI	EQUALS	OGCT	+6	#	I 1
BESTJ	EQUALS	BESTI	+1		
STARIND	EQUALS	BESTJ	+1		
# RETAIN THE ORDER OF STARSAV1 TO STARSAV2 +5 FOR DOWNLINK PURPOSES					
STARSAV1	EQUALS	STARIND	+1	#	I 6
STARSAV2	EQUALS	STARSAV1	+6	#	I 6
TALIGN	EQUALS	STARSAV2	+6	#	B 2 TIME OF IMU ALIGNMENT DOWNLINKED
# P32-35 + SERVICER					
RTX1	EQUALS	TALIGN	+2	#	I 1 X1 -2 EARTH, -10 MOON
RTX2	EQUALS	RTX1	+1	#	I 1 X2 0 EARTH, 2 MOON
ZPRIME		22D			
PDA		22D			
COSTH		16D			
SINTH		18D			
THETA		20D			
STARM		32D			

***** OVERLAY NUMBER 2 IN EBANK 5 *****

CONICS ROUTINE STORAGE. 85D

DELX	EQUALS	ENDW	# I 2 TMP
DELT	EQUALS	DELX +2	# I 2 TMP
URRECT	EQUALS	DELT +2	# I 6 TMP
RCNORM	EQUALS	34D	# I 2 TMP
XPREV	EQUALS	XKEP	# I 2 TMP
R1VEC	EQUALS	URRECT +6	# I 6 TMP
R2VEC	EQUALS	R1VEC +6	# I 6 TMP
TDESIRED	EQUALS	R2VEC +6	# I 2 TMP
GEOMSGN	EQUALS	TDESIRED +2	# I 1 TMP
UN	EQUALS	GEOMSGN +1	# I 6 TMP
VTARGETAG	EQUALS	UN +6	# I 1 TMP
VTARGET	EQUALS	VTARGETAG +1	# I 6 TMP
RTNLAMB	EQUALS	VTARGET +6	# I 1 TMP
U2	EQUALS	RTNLAMB +1	# I 6 TMP
MAGVEC2	EQUALS	U2 +6	# I 2 TMP
UR1	EQUALS	MAGVEC2 +2	# I 6 TMP
SNTH	EQUALS	UR1 +6	# I 2 TMP
CSTH	EQUALS	SNTH +2	# I 2 TMP
1-CSTH	EQUALS	CSTH +2	# I 2 TMP
CSTH-RHO	EQUALS	1-CSTH +2	# I 2 TMP
P	EQUALS	CSTH-RHO +2	# I 2 TMP
R1A	EQUALS	P +2	# I 2 TMP
RVEC	EQUALS	R1VEC	# I 6 TMP
VVEC	EQUALS	R1A +2	# I 6 TMP
RTNTT	EQUALS	RTNLAMB	# I 1 TMP
ECC	EQUALS	VVEC +6	# I 2 TMP
RTNTR	EQUALS	RTNLAMB	# I 1 TMP
RTNAPSE	EQUALS	RTNLAMB	# I 1 TMP
R2	EQUALS	MAGVEC2	# I 2 TMP
RTNPRM	EQUALS	ECC +2	# I 1 TMP
SGNRDOT	EQUALS	RTNPRM +1	# I 1 TMP
RDESIRED	EQUALS	SGNRDOT +1	# I 2 TMP
DELDEP	EQUALS	RDESIRED +2	# I 2 TMP
DEPREV	EQUALS	DELDEP +2	# I 2 TMP
TERRLAMB	EQUALS	DELDEP	# I 2 TMP
TPREV	EQUALS	DEPREV	# I 2 TMP
EPSILONL	EQUALS	DEPREV +2	# I 2 TMP
COGA	EQUALS	EPSILONL +2	# I 2 COTAN OF INITIAL FLIGHT PATH ANGLE.
INDEP	EQUALS	COGA	# USED BY SUBROUTINE ITERATOR .

***** OVERLAY NUMBER 3 IN EBANK 5 *****

INCORP STORAGE. 18D

ZI EQUALS ENDW # I 18D TMP

INCORP/L SR22.3 STORAGE. 21D

DELTAX EQUALS ZI +18D # I 18

VARIANCE EQUALS DELTAX +18D # I 3

MEASUREMENT INCORPORATION -R22- STORAGE. 49D

GRP2SVQ EQUALS VARIANCE +3 # I 1 TMP QSAVE FOR RESTARTS

OMEGAM1 EQUALS GRP2SVQ +1 # I 6

OMEGAM2 EQUALS OMEGAM1 +6 # I 6

OMEGAM3 EQUALS OMEGAM2 +6 # I 6

HOLDW EQUALS OMEGAM3 +6 # I 18

TDPOS EQUALS HOLDW +18D # I 6

TDVEL EQUALS TDPOS +6 # I 6

TRIPA EQUALS DELTAX # I 3 TMP

TEMPVAR EQUALS TRIPA +3 # I 3 TMP

INCORPORATION/INTEGRATION Q STORAGE. 1D

EGRESS EQUALS TDVEL +6 # I 1

P30/P31 STORAGE. 1D AND ONE OVERLAY

P30EXIT EQUALS EGRESS +1 # B 1 TMP

ORIGIN EQUALS P30EXIT # I 1 TMP INTX DURING INITVEL.

SYSTEM TEST ERASABLES. CAN OVERLAY W MATRIX. 127D

***** OVERLAY NUMBER 0 IN EBANK 5 *****

AZIMUTH	EQUALS	W	# 2
LATITUDE	EQUALS	AZIMUTH +2	# 2
ERVECTOR	EQUALS	LATITUDE +2	# 6
LENGTHOT	EQUALS	ERVECTOR +6	# 1
LOSVEC	EQUALS	LENGTHOT +1	# 6
NDXCTR	EQUALS	LOSVEC +1	# 1
PIPINDEX	EQUALS	NDXCTR +1	# 1
POSITON	EQUALS	PIPINDEX +1	# 1
QPLACE	EQUALS	POSITON +1	# 1
QPLACES	EQUALS	QPLACE +1	# 1
SOUTHDR	EQUALS	QPLACES +1	# 7
TEMPTIME	EQUALS	SOUTHDR +7	# 2
TMARK	EQUALS	TEMPTIME +2	# 2
GENPL	EQUALS	TMARK +2	
CDUTIMEI		GENPL	
CDUTIMEF		GENPL +2	
CDUDANG		GENPL +4	
CDUREADF		GENPL +5	
CDUREADI		GENPL +6	
CDULIMIT		GENPL +7	
TEMPADD		GENPL +4	
TEMP		GENPL +5	
NOBITS		GENPL +6	
CHAN		GENPL +7	

LOS1	GENPL +8D
LOS2	GENPL +14D

CALCDIR	EQUALS	GENPL +20D
CDFLAG	EQUALS	GENPL +21D
GYTOBETQ	EQUALS	GENPL +22D
OPTNREG	EQUALS	GENPL +23D
SAVE	EQUALS	GENPL +24D
SFCONST1	EQUALS	GENPL +27D
TIMER	EQUALS	GENPL +28D

THREE ONSEC LOC

DATAPL	EQUALS	GENPL +30D
RDSP	EQUALS	GENPL
MASKREG	EQUALS	GENPL +64D
CDUNDX	EQUALS	GENPL +66D
RESULTCT	EQUALS	GENPL +67D
COUNTPL	EQUALS	GENPL +70D

FIX LATER POSSIBLY KEEP1

CDUANG	EQUALS	GENPL +71D
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AINLA		GENPL	# 110 DEC OR 156 OCT LOCATIONS
WANGO	EQUALS	AINLA	# VERT ERATE
WANGI	EQUALS	AINLA +2D	# HORIZONTAL ERATE
WANGT	EQUALS	AINLA +4D	# T
TORQNDX		WANGT	
DRIFTT	EQUALS	AINLA +6D	
ALXIS	EQUALS	AINLA +8D	
CMPX1	EQUALS	AINLA +9D	# IND
ALK	EQUALS	AINLA +10D	# GAINS
VLAUNS	EQUALS	AINLA +22D	
WPLATO	EQUALS	AINLA +24D	
INTY	EQUALS	AINLA +28D	# SOUTH IP INTE
ANGZ	EQUALS	AINLA +30D	# EAST A IS
INTZ	EQUALS	AINLA +32D	# EAST P P I
ANGY	EQUALS	AINLA +34D	# SOUTH
ANGX	EQUALS	AINLA +36D	# VE
DRIFTO	EQUALS	AINLA +38D	# VERT
DRIFTI	EQUALS	AINLA +40D	# SOU
VLAUN	EQUALS	AINLA +44D	
ACCWD	EQUALS	AINLA +46D	
POSNV	EQUALS	AINLA +52D	
DPIPAY	EQUALS	AINLA +54D	# SOUTH
DPIPAZ	EQUALS	AINLA +58D	# NORTH IP INCREMENT
ALTIM	EQUALS	AINLA +60D	
ALTIMS	EQUALS	AINLA +61D	# INDEX
ALDK	EQUALS	AINLA +62D	# TIME ONSTAN
DELM	EQUALS	AINLA +76D	
WPLATI	EQUALS	AINLA +84D	
GEOCOMPS	EQUALS	AINLA +86D	
ERCOMP	EQUALS	AINLA +87D	
ZERONDX	EQUALS	AINLA +93D	
THETAN		ALK +4	
FILDELV	EQUALS	THETAN +6	# AGS ALIGNMENT STORAGE
INTVEC	EQUALS	FILDELV +2	
1SECXT		AINLA +94D	
ASECXT		AINLA +95D	
PERFDLAY	EQUALS	AINLA +96D	# B 2 DELAY TIME BEF. START DRIFT MEASURE
OVFLOWCK	EQUALS	AINLA +98D	# 1 SET MEANS OVERFLOW IN IMU PERF TEST
END-E5	EQUALS	STARSAV2 +6	# *** FIRST FREE LOCATION IN E5 ***

EBANK-6 ASSIGNMENTS.

SETLOC 3000

DAP PAD-LOADED DATA.

10D

ALL OF THE FOLLOWING EXCEPT PITTIME AND ROLLTIME ARE INITIALIZED IN FRESH START TO PERMIT IMMEDIATE USE OF DAP.

HIASCENT	ERASE	# 1	MASS AFTER STAGING, SCALE AT B16 KG.
ROLLTIME	ERASE	# 1	TIME TO TRIM Z GIMBAL IN R03, CSEC.
PITTIME	ERASE	# 1	TIME TO TRIM Y GIMBAL IN R03, CSEC.
DKTRAP	ERASE	# 1	DAP STATE POSSIBLE 77001
DKOMEGAN	ERASE	# 1	ESTIMATOR PARA- VALUES 00012
DKKAOSN	ERASE	# 1	METERS FOR THE 00074
LMTRAP	ERASE	# 1	DOCKED AND 77001
LMOMEGAN	ERASE	# 1	LEM-ALONE CASES 00000
LMKAOSN	ERASE	# 1	RESPECTIVELY 00074
DKDB	ERASE	# 1	WIDTH OF DEADBAND FOR DOCKED RCS
		#	AUTOPILOT DB 1.4DEG IN FRESH START
		#	DEADBAND PI/DKDB RAD.

PADLOADS FOR INITIALIZATION OF DAP BIAS ACCELERATION AT P12 IGNITION 2D

IGNAOSQ	ERASE	# B 1 PL
IGNAOSR	ERASE	# B 1 PL

AXIS TRANSFORMATION MATRIX -- GIMBAL TO PILOT AXES 5D

M11	ERASE	# SCALED AT 1
M21	ERASE	# SCALED AT 1
M31	ERASE	
M22	ERASE	# SCALED AT 1.
M32	ERASE	# SCALED AT 1.

ANGLE MEASUREMENTS

OMEGAP	ERASE	+4	# BODY-AXIS ROT. RATES SCALED AT PI/4 AND
OMEGAQ	EQUALS	OMEGAP +1	# BODY-AXIS ACCELERATIONS SCALED AT PI/8.
OMEGAR	EQUALS	OMEGAP +2	
# RETAIN THE ORDER OF ALPHAQ AND ALPHAR FOR DOWNLINK PURPOSES.			
ALPHAQ	EQUALS	OMEGAP +3	
ALPHAR	EQUALS	OMEGAP +4	
OMEGAU	ERASE	+1	
OMEGAV		OMEGAU +1	

TRAPEDP	ERASE	+5
TRAPEDQ		TRAPEDP +1
TRAPEDR		TRAPEDP +2
NPTRAPS		TRAPEDP +3

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1 NQTRAPS          TRAPEDP +4
2 NRTRAPS          TRAPEDP +5
3
4 EDOTP            EDOT
5 EDOTQ            ERASE  +1
6 EDOTR            EDOTQ +1      # MANY SHAREING NAMES
7 QRATEDIF         EQUALS EDOTQ   # ALTERNATIVE NAMES
8 RRATEDIF         EQUALS EDOTR   # DELETE WHEN NO. OF REFERENCES  0
9
10 URATEDIF         EQUALS OMEGAU
11 VRATEDIF         EQUALS OMEGAV
12 OLDXFORP         ERASE  +2      # STORED CDU READINGS FOR STATE
13 OLDYFORP         EQUALS OLDXFORP +1 # DERIVATIONS  SCALED AT PI RADIANS  2 S
14 OLDZFORQ         EQUALS OLDXFORP +2
15
16 # RATE-COMMAND AND MINIMUM IMPULSE MODES
17
18 CH31TEMP         ERASE
19 STIKSENS         ERASE
20 TCP              ERASE
21 DXERROR          ERASE  +5
22 DYERROR          EQUALS DXERROR +2
23 DZERROR          EQUALS DXERROR +4
24 PLAST            ERASE
25 QLAST            ERASE
26 RLAST            ERASE
27 TCQR             ERASE
28
29 # OTHER VARIABLES                                5D
30
31 OLDPMIN           ERASE          # THESE THREE USED IN MIN IMPUSE MODE
32 OLDQRMIN          ERASE
33 TEMP31            EQUALS DAPTEMP1
34
35 SAVEHAND          ERASE  +1
36 PERROR            ERASE
37 QERROR            EQUALS DYERROR
38 RERROR            EQUALS DZERROR
39
40 # JET STATE CHANGE VARIABLES -- TIME TOFJTCHG , JET BITS WRITTEN NOW  10D
41 # JTSONNOW , AND JET BITS WRITTEN AT T6 RUPT JTSATCHG .
42
43 NXT6ADR           ERASE
44 T6NEXT            ERASE  +1
45 T6FURTHA          ERASE  +1
46 NEXTP             ERASE  +2
47 NEXTU             NEXTP +1
48 NEXTV             NEXTP +2
49 -2JETLIM          ERASE  +1      # RATE COMMAND 4-JET RATE DIFFERENCE LIMIT
50 -RATEDB            EQUALS -2JETLIM +1 # AND RATE DEADBAND FOR ASCENT OR DESCENT
51
52 TARGETDB          EQUALS -RATEDB   # MAN. CONTROL TARGET DB COMPLEMENT.
53
54 # ***Q,R AXIS ERASABLES ***                3
```

PBIT	EQUALS	BIT10	
QRBIT	EQUALS	BIT11	
UERROR	EQUALS	DAPTREG5	# U,V-AXES ATT ERROR FOR RCS CONTROL LAWS.
VERROR		UERROR +1	
RETJADR	ERASE		
TEMPNUM	EQUALS	DAPTEMP4	
NUMBERT	EQUALS	DAPTEMP5	
ROTINDEX	EQUALS	DAPTEMP6	
ROTEMP1	EQUALS	DAPTEMP1	
ROTEMP2	EQUALS	DAPTEMP2	
POLYTEMP	EQUALS	DAPTEMP3	
SENSETYP	ERASE		
ABSTJ	EQUALS	DAPTEMP1	# ABS VALUE OF JET-FIRING TIME
ABSEDOTP	EQUALS	DAPTEMP1	
DPSBURN	EQUALS	DAPTREG4	# USED WITH SNUFFBIT. VERY TEMPORARY.

TRIM GIMBAL CONTROL LAW ERASABLES

11D

GTSTEMPS	EQUALS	DAPTEMP1	# GTS IS PART OF THE JASK.
SHFTFLAG	EQUALS	GTSTEMPS +2	# COUNT BITS FOR GTSQRT SHIFTING.
ININDEX	EQUALS	GTSTEMPS +5	# INDEX FOR SHIFT LOOP IN GTSQRT.
SAVESR	EQUALS	AXISCTR	# CANNOT BE A DAPTEMP -- GTS USES THEM ALL.
SCRATCH	EQUALS	GTSTEMPS +7	# ROOTCYCL ERASABLE.
HALFARG	EQUALS	GTSTEMPS +8D	# ROOTCYCL ERASABLE.
K2THETA	EQUALS	GTSTEMPS	# D.P., K*ERROR, NEGUSUM
KCENTRAL	EQUALS	GTSTEMPS +2	# S.P., K FROM KQ OR KRDP, AT PI/2 8
K2CNTRAL	EQUALS	GTSTEMPS +3	# D.P., GTS SCRATCH CELLS.
WCENTRAL	EQUALS	GTSTEMPS +4	# S.P., OMEGA, AT PI/4 RAD/SEC
ACENTRAL	EQUALS	GTSTEMPS +5	# S.P., ALPHA, AT PI/4 RAD/SEC 2
DEL	EQUALS	GTSTEMPS +6	# S.P., SGN FUNCTION VALUE.
A2CNTRAL	EQUALS	GTSTEMPS +7	# D.P., GTS SCRATCH CELLS.
QRCNTR	EQUALS	GTSTEMPS +9D	# S.P., INDEX FOR GTS LOOP THROUGH Q,R AXES
FUNCTION	EQUALS	GTSTEMPS +10D	# D.P., ARGUMENT FOR GRSQRT, SCRATCH FOR GTS.
NEGUQ	ERASE	+2	# NEGATIVE OF Q-AXIS GIMBAL DRIVE.
	EQUALS	NEGUQ +1	# DEFINED AND USED ELSEWHERE.
NEGUR	EQUALS	NEGUQ +2	# NEGATIVE OF R-AXIS GIMBAL DRIVE.
KQ	ERASE	+2	# S.P., JERK TERM FOR GTS, AT PI/2 8
AXISCTR	EQUALS	KQ +1	
KRDAP	EQUALS	KQ +2	# .3 ACCDOTR SCALED AT PI/2 8
ACCDOTQ	ERASE	+3	# Q-JERK SCALED AT PI/2 7 UNSIGNED
QACCDOT	EQUALS	ACCDOTQ +1	# Q-JERK SCALED AT PI/2 7 SIGNED
ACCDOTR	EQUALS	ACCDOTQ +2	# R-JERK SCALED AT PI/2 7 UNSIGNED
RACCDOT	EQUALS	ACCDOTQ +3	# R-JERK SCALED AT PI/2 7 SIGNED
QDIFF	EQUALS	QERROR	# ATTITUDE ERRORS
RDIFF	EQUALS	RERROR	# SCALED AT PI RADIANS.

TORQUE VECTOR RECONSTRUCTION VARIABLES

18D

JETRATE	EQUALS	DAPTREG1	
JETRATEQ	EQUALS	JETRATE +1	# THE LAST CONTROL SAMPLE PERIOD OF 100 MS.
JETRATER	EQUALS	JETRATE +2	# SCALED AT PI/4 RADIANS/SECOND
DOWNTORK	ERASE	+5	# ACCUMULATED JET TORQUE COMMANDED ABOUT
POSTORKP	EQUALS	DOWNTORK	# +,-P, +,-U, +,-V RESPECTIVELY.
NETTOTKP	EQUALS	DOWNTORK +1	# EMPLOYED EXCLUSIVELY FOR DOWNLIST.
POSTORKU	EQUALS	DOWNTORK +2	# NOT INITIALIZED PERMITTED TO OVERFLOW.

NEG TORKV EQUALS DOWNTORK +5

L,PVT-CG	ERASE			
1JACC	ERASE	+4		# ACCELERATIONS DUE TO 1 JET TORQUING
1JACCQ	EQUALS	1JACC	+1	# SCALED AT PI/4 RADIANS/SECOND
1JACCR	EQUALS	1JACC	+2	
1JACCU	EQUALS	1JACC	+3	# FOR U,V-AXES THE SCALE FACTOR IS DOFF
1JACCV	EQUALS	1JACC	+4	# SCALED AT PI/2 RADIANS/SECOND FOR ASC

SKIPU	ERASE	+1
SKIPV		SKIPU +1

AOSQ	ERASE	+5	# OFFSET ACC. ESTIMATES, UPDATED IN D.P.,
AOSR	EQUALS	AOSQ +2	# AND SCALED AT PI/2.
AOSU	EQUALS	AOSQ +4	# UV-AXES OFFSET ACC. FROMED BY VECTOR
AOSV	EQUALS	AOSQ +5	# ADDITION OF Q,R. AT PI/2 RAD/SEC 2 .

AOSQTERM	ERASE	+1	# .1-.05K AOS
AOSRTERM	EQUALS	AOSQTERM +1	# SCALED AT PI/4 RADIANS/SECOND.

#NUMBERT EQUALS DAPTEMP5 # DEFINED IN QRAxis.

EDOTSQ	EQUALS	DAPTEMP1	
ROTSENSE	EQUALS	DAPTEMP2	
FIREFCT	EQUALS	DAPTEMP3	# LOOKED AT BY PAXIS.

TTOAXIS	EQUALS	DAPTEMP4	
ADRSDIF2	EQUALS	DAPTEMP6	
HOLDQ	EQUALS	DAPTREG1	
ADRSDIF1	EQUALS	DAPTREG2	
HH	EQUALS	DAPTREG3	# DOUBLE PRECISION.
# HH +1	EQUALS	DAPTREG4	

E	EQUALS	DAPTREG6	# TIME SHARE WITH VERROR
EDOT	EQUALS	OMEGAV	

INPUT TO TJET LAW PERMANENT ERASABLES . 48D

TJETU		TJU	# EQUATE NAMES. INDEXED BY -1, 0, +1.
BLOCKTOP	ERASE	+47D	
1/ANET1		BLOCKTOP +16D	# THESE 8 PARAMETERS ARE SET UP BY 1/ACCS
1/ANET2		1/ANET1 +1	# FOR MINIMUM JETS ABOUT THE U-AXIS WHEN
1/ACOAST		1/ANET1 +4	# EDOT IS POSITIVE. TJETLAW INDEXES BY
ACCFCTZ1		1/ANET1 +6	# ADRSDIFF FROM THESE REGISTERS TO PICK UP
ACCFCTZ5		1/ANET1 +7	# PARAMETERS FOR THE PROPER AXIS, NUMBER
FIREDB		1/ANET1 +10D	# OF JETS AND SIGN OF EDOT. THERE ARE 48
COASTDB		1/ANET1 +12D	# REGISTERS IN ALL IN THIS BLOCK.
AXISDIST		1/ANET1 +14D	# FOUR NOT REFERENCED P-AXIS ARE FILLED
			# IN BY THE FOLLOWING
ACCSWU		BLOCKTOP	# SET BY 1/ACCS TO SHOW WHETHER MAXIMUM
ACCSWV		ACCSWU +1	# JETS ARE REQUIRED BECAUSE OF AOS.
FLAT		BLOCKTOP +6	# WIDTH OF MINIMUM IMPULSE ZONE.
ZONE3LIM		BLOCKTOP +7	# HEIGHT OF MINIMUM IMPULSE ZONE AT 4 SEC.

COEFFQ	ERASE	+1	# COEFFQ AND COEFFR ARE USED IN ROT-TOUV
COEFFR	EQUALS	COEFFQ +1	# TO REXOLVE Q,R COMPONENTS INTO U,V COMP.

VARIABLES FOR GTS-QRAXIS CONTROL EXCHANGE. 4

ALLOWGTS	EQUALS	NEGUQ +1	# INSERT INTO UNUSED LOCATION
COTROLER	ERASE		# INDICATES WHICH CONTROL SYSTEM TO USE.
QGIMTIMR	ERASE	+2	# Q-GIMBAL DRIVE ITMER, DECISECONDS.
INGTS	EQUALS	QGIMTIMR +1	# INDICATOR OF CURRENT GTS CONTROL.
RGIMTIMR	EQUALS	QGIMTIMR +2	# R-GIMBAL DRIVE TIMER, DECISECONDS.

PLEASE RETAIN THE ORDER OF CDUXD THRU CDUZD FOR DOWNLINK PURPOSES.

KALCMANU DAP INTERFACE 9D

CDUXD	ERASE	+2	# CDU DESIRED REGISTERS
CDUYD	EQUALS	CDUXD +1	# SCALED AT PI RADIANS 180 DEGREES
CDUZD	EQUALS	CDUXD +2	# STORE IN 2 S COMPLEMENT
DELCDUX	ERASE	+2	# NEGATIVE OF DESIRED 100MS CDU INCREMENT
DELCDUY	EQUALS	DELCDUX +1	# SCALED AT PI RADIANS 180 DEGREES
DELCDUZ	EQUALS	DELCDUX +2	# STORE IN 2 S COMPLEMENT

RETAIN THE ORDER OF OMEGAPD TO OMEGARD FOR DOWNLINK PURPOSES.

OMEGAPD	ERASE	+2	# ATTITUDE MANEUVER DESIRED RATES
OMEGAQD	EQUALS	OMEGAPD +1	# NOT EXPLICITLY REFERENCED IN GTS CNTRL
OMEGARD	EQUALS	OMEGAPD +2	# SCALED AT PI/4 RADIANS/SECOND

KALCMANU STORAGE. 24D

MIS	ERASE	+23D	# I 18D
-----	-------	------	---------

COF	EQUALS	MIS +18D	# I 6	
# KALCMANU STORAGE.				33D
BCDU	ERASE	+30D	# B 3	
KSPNDX	EQUALS	BCDU +3	# B 1	
KDPNDX	EQUALS	KSPNDX +1	# B 1	
TMIS	EQUALS	KDPNDX +1	# I 18	MUST BE IN SAME BANK AS RCS DAP
COFSKEW	EQUALS	TMIS +18D	# I 6	MUST BE IN THE SAME BANK AS RCS DAP
CAM	EQUALS	COFSKEW +6	# I 2	MUST BE IN THE SAME BANK AS RCS DAP
AM	ERASE	+1	# I 2	THIS WAS ONCE IN E5 OVERLAYING OGC
# FIRST-ORDER OVERLAYS IN KALCMANU				25D
KV1	EQUALS	TMIS	# I 6	
MFISYM	EQUALS	TMIS	# I	
TMFI	EQUALS	TMIS	# I	
NCDU	EQUALS	TMIS	# B	
NEXTIME	EQUALS	TMIS +3	# B	
TTEMP	EQUALS	TMIS +4	# B	
KV2	EQUALS	TMIS +6	# I 6	
BIASTEMP	EQUALS	TMIS +6	# B	
KV3	EQUALS	TMIS +12D	# I 6	
OGF	EQUALS	TMIS +12D	# I	
BRATE	EQUALS	COFSKEW	# B	
IG	EQUALS	COFSKEW	# I	
TM	EQUALS	CAM	# B	
# SECOND-ORDER OVERLAYS IN KALCMANU				24D
K1		KV1		
K2		KV2		
K3		KV3		
P21	EQUALS	KV1	# I 2	
D21	EQUALS	KV1 +2	# I 2	
G21	EQUALS	KV1 +4	# I 2	
C2SQP	EQUALS	KV2	# I 2	
C2SQM	EQUALS	KV2 +2	# I 2	
C2PP	EQUALS	KV2 +4	# I 2	
C2MP	EQUALS	KV3	# I 2	
C1PP	EQUALS	KV3 +2	# I 2	
C1MP	EQUALS	KV3 +4	# I 2	

VECQTEMP COFSKEW

DCDU CDUXD
DELDCDU DELCDUX
DELDCDU1 DELCDUY
DELDCDU2 DELCDUZ

* * * * *

STORAGE FOR FINDCDUW

OVERLAYING KALCMANU STORAGE 26D

ECDUW	EQUALS	MIS	
ECDUWUSR	EQUALS	ECDUW	# B 1 TMP
QCDUWUSR	EQUALS	ECDUWUSR +1	# I 1 TMP
NDXCUDW	EQUALS	QCDUWUSR +1	# B 1 TMP
FLAGOODW	EQUALS	NDXCUDW +1	# B 1 TMP
FLPAUTNO	EQUALS	FLAGOODW +1	# B 1 TMP
UNFC/2	EQUALS	FLPAUTNO +1	# I 6 IN
UNWC/2	EQUALS	UNFC/2 +6	# I 6 IN
UNFV/2	EQUALS	UNWC/2 +6	# I 6 S-S
UNFVX/2		UNFV/2	
UNFVY/2		UNFV/2 +2	
UNFVZ/2		UNFV/2 +4	
-DELGMB	EQUALS	UNFV/2 +6	# B 3 TMP

DEFINED IN THE WORK AREA 18D

UNX/2 0
UNY/2 6
UNZ/2 14

END OF FINDCDUW ERASABLES

* * * * *

THE FOLLOWING ARE THE DAP REPLACEMENTS FOR THE ITEMPS AND RUPTREGS, NEEDED BECAUSE DAP IS NOW A TOB,JASK,JAB,TOSK
... ANYWAY, THE DAP CAN NOW BE INTERRUPTED. 18D

DAPTEMP1	ERASE	+17D
DAPTEMP2	EQUALS	DAPTEMP1 +1
DAPTEMP3	EQUALS	DAPTEMP1 +2
DAPTEMP4	EQUALS	DAPTEMP1 +3
DAPTEMP5	EQUALS	DAPTEMP1 +4
DAPTEMP6	EQUALS	DAPTEMP1 +5
DAPTREG1	EQUALS	DAPTEMP1 +6
DAPTREG2	EQUALS	DAPTEMP1 +7
DAPTREG3	EQUALS	DAPTEMP1 +8D

DAPTREG4	EQUALS	DAPTEMP1 +9D	
DAPTREG5	EQUALS	DAPTEMP1 +10D	
DAPTREG6	EQUALS	DAPTEMP1 +11D	
DAPARUPT	EQUALS	DAPTEMP1 +12D	
DAPLRUPT	EQUALS	DAPARUPT +1	
DAPBQRPT	EQUALS	DAPARUPT +2	
DAPZRUPT	EQUALS	DAPARUPT +4	
# DAPZRUPT IS ALSO A JASK-IN-PROGRESS FLAG			
# NEEDLER ATTITUDE ERROR EIGHT BALL DISPLAY STORAGE. 6D			
T5TEMP	EQUALS	ITEMP1	
DINDX	EQUALS	ITEMP3	
AK	ERASE	+2	# NEEDLER ATTITUDE INPUTS, SCALED AT 180
AK1	EQUALS	AK +1	# DEGREES. P,Q,R AXES IN AK,AK1,AK2.
AK2	EQUALS	AK +2	
EDRIVEX	ERASE	+2	# NEEDLER DISPLAY REGS AT 1800 DEGREES.
EDRIVEY	EQUALS	EDRIVEX +1	# SO THAT 384 BITS REPRESENT 42 3/16 DEGREES.
EDRIVEZ	EQUALS	EDRIVEX +2	
# DOCKED JET INHIBITION COUNTERS 3D			
PJETCTR	ERASE	+2	
UJETCTR	EQUALS	PJETCTR +1	
VJETCTR	EQUALS	PJETCTR +2	
END-E6	EQUALS	VJETCTR	

EBANK-7 ASSIGNMENTS

SETLOC 3400

P35 CONSTANTS. -- PAD LOADED -- 4D

ATIGINC	ERASE	+1	# B 2 PL	*MUST BE AT 1400 FOR SYSTEMSTEST
PTIGINC	ERASE	+1	# B 2 PL	

AOTMARK STORAGE. -- PAD LOADED -- 12D

AOTAZ	ERASE	+5	# B 6 PL
AOTEL	ERASE	+5	# B 6 PL

LANDING RADAR -- PAD LOADED -- 2D

LRHMAX	ERASE	# B 1
LRWH	ERASE	# B 1

THROTTLE STORAGE. -- PAD LOADED -- 1D

ZOOMTIME ERASE # B 1 PL TIME OF DPS THROTTLE-UP COMMAND

P63 AND P64 CONSTANTS. -- PAD LOADED -- 4D

TENDBRAK	ERASE	# B 1	LANDING PHASE SWITCHING CRITERION.
TENDAPPR	ERASE	# B 1	LANDING PHASE SWITCHING CRITERION.
DELTTFAP	ERASE	# B 1	INCREMENT ADDED TO TTF/8 WHEN
		#	SWITCHING FROM P63 TO P64.
LEADTIME	ERASE	# B 1	TIME INCREMENT SPECIFYING HOW MUCH
		#	GUIDANCE IS PROJECTED FORWARD

LANDING RADAR. -- PAD LOADED -- 2D

RPCRTIME	ERASE	# B 1	REPOSITIONING CRITERION TIME
RPCRTQSW	ERASE	# B 1	REPOSITIONING CRITERION ANGLE

ASTEER. -- PAD LOADED -- 2D

TNEWA ERASE +1 # I 2 PL LAMBERT CYCLE PERIOD.

P22 STORAGE -- OVERLAYS LANDING PADLOADS -- 5D


```
1 REPOSCNT      EQUALS  TENDBRK      # B 1 TMP COUNTS NUMBER OF PASSES THROUGH
2                                     # REPOSITION ROUTINE.
3
4 REPOSTM       EQUALS  REPOSCNT +1   # I 2 TMP PRESENT TIME PLUS INCREMENTS OF
5                                     # TEN SECONDS.
6 DELTATM       EQUALS  REPOSTM +2    # I 2 TMP TIME INTERVAL FOR RUNNING
7                                     # DESIGNATE TASK.
8
9 # *** RETAIN THE ORDER OF DELVSLV, TIG, RTARG, DELLT4 FOR UPDATE. ***
10
11 # P32-35 P72-75 STORAGE.           6D
12
13 DELVLVC       ERASE   +5            # I 6 DELTA VELOCITY -- LOCAL VERTICAL COO
14 DELVSLV       DELVLVC              # TEMP STORAGE OF SAME VECTOR    -RDINATE
15
16 # P30-P40 INTERFACE UNSHARED.      2D
17
18 TIG           ERASE   +1            # B 2
19
20 # INITVEL STORAGE.  ALSO USED BY P34,35,74,75,10,11 OTHERS      8D
21
22 RTARG         ERASE   +5            # I 6 TARGET VECTOR
23 DELLT4        ERASE   +1            # I 2 TIME DIFFERENCE
24
25 # P30-P40 INTERFACE UNSHARED.      3D
26
27 TTOGO         ERASE   +1            # B 2
28 TFI           EQUALS  TTOGO
29 WHICH         ERASE
30
31 # *** R21 ***                      1D
32
33 LOSCOUNT     ERASE                # B 1
34
35 # L SR22.3 RENDEZVOUS NAVIGATION STORAGE.      4D
36
37 # RETAIN THE ORDER OF AIG TO TRKMKCNT FOR DOWNLINK PURPOSES.
38
39 AIG           ERASE                # B 1 OUT GIMBAL ANGLES
40 AMG           ERASE                # B 1 OUT MUST BE
41 AOG           ERASE                # B 1 OUT CONSECUTIVE
42
43 TRKMKCNT      ERASE                # B 1 TMP TEMPORARY MARK STORAGE.
44 MARKCTR       TRKMKCNT
45
46
47
48
49
50
51
52
53
54
55
56
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58
59
60
```


P32-P35, P72-P75 STORAGE. -- PERMANENT -- 6

NORMEX	ERASE		# B 1 PRM SAVE FOR Q
QSAVED	ERASE		# B 1 PRM SAVE FOR Q
RTRN	ERASE		# B 1 PRM SAVE FOR Q
NN	ERASE	+1	# B 2
SUBEXIT	ERASE		# B 1 PRM SAVE Q

E7OVERLA	EQUALS		# START OF E7 OVERLAYS
WHOCARES	EQUALS	E7OVERLA	# DUMMY FOR EBANK INSENSITIVE 2CADRS.

LUNAR LANDING OVERLAYS 6D

/AFC/	EQUALS	NORMEX	# B 2 TMP THROTTLE
FCODD	EQUALS	/AFC/ +2	# B 2 TMP THROTTLE
FP	EQUALS	FCODD +2	# B 2 TMP THROTTLE

***** OVERLAY NUMBER 0 IN EBANK 7 *****

RENDEZVOUS GUIDANCE STORAGE --P32.....P35-- 89D

TSTRT	EQUALS	DELDV	# MIDCOURSE START TIME
TDEC2	EQUALS	DELVCSI	# TEMP STORAGE FOR INTEGRATION TIME INPUT
KT	EQUALS	DELVTPI	# TEMP STORAGE FOR MIDCOURSE DELTA TIME
VACT1	ERASE	+5D	# VELOCITY VECTOR OF ACTIVE AT CSI TIME
RPASS1	ERASE	+5D	# POSITION VECTOR OF PASSIVE AT CSI TIME
VPASS1	ERASE	+5D	# VELOCITY VECTOR OF PASSIVE AT CSI TIME
VACT2	ERASE	+5D	# VELOCITY VECTOR OF ACTIVE AT CDH TIME
RPASS2	ERASE	+5D	# POSITION VECTOR OF PASSIVE AT CDH TIME
VPASS2	ERASE	+5D	# VELOCITY VECTOR OF PASSIVE AT CDH TIME
RACT3	ERASE	+5D	# POSITION VECTOR OF ACTIVE AT TPI TIME
VACT3	ERASE	+5D	# VELOCITY VECTOR OF ACTIVE AT TPI TIME
RPASS3	ERASE	+5D	# POSITION VECTOR OF PASSIVE AT TPI TIME
VPASS3	ERASE	+5D	# VELOCITY VECTOR OF PASSIVE AT TPI TIME
VACT4	ERASE	+5D	# VELOCITY VECTOR OF ACTIVE AT INTERCEPT
UNVEC	EQUALS	VACT3	# CDHMVR UNIT VECTOR TEMP STORAGE.
DELVCSI	ERASE	+1D	# THRUST VALUE AT CSI
DELVTPI	ERASE	+1D	# THRUST VALUE AT TPI OR MID
DELMID	EQUALS	DELVTPI	
DIFFALT	ERASE	+1D	# ALT DIFFERENT AT CDH
POSTCSI	ERASE	+1	# PERIGEE ALTITUDE AFTER CSI MANEUVER
POSTCDH	ERASE	+1	# PERIGEE ALTITUDE AFTER CDH MANEUVER
POSTTPI	ERASE	+1	# PERIGEE ALTITUDE AFTER TPI MANEUVER
LOOPCT	EQUALS	POSTTPI	# CSI NEWTON ITERATION COUNTER
HAFFA1	EQUALS	POSTCDH	# HALF PERIOD
GAMPREV	ERASE	+1	# PREVIOUS GAMMA
DVPREV	EQUALS	DELVTPI	# PREVIOUS DELVCSI
DELDV	ERASE	+1D	
CSIALRM	ERASE	+1	# FIRST SOLUTION ALARM
VERBNOUN	ERASE		
TITER	EQUALS	CSIALRM	# ITERATION COUNTER
RDOTV	ERASE	+1	
VAPREC	EQUALS	VPASS1	# I 6 S-S PREC VEC FOR NOM TPI TIME ACTIVE
RAPREC	EQUALS	RPASS1	# I 6 S-S PREC VEC FOR NOM TPI TIME ACTIVE
VPPREC	EQUALS	VPASS2	# I 6 S-S PREC VEC FOR NOM TPI TIME PASSIVE
RPPREC	EQUALS	RPASS2	# I 6 S-S PREC VEC FOR NOM TPI TIME PASSIVE
DELEL	EQUALS	DELVTPI	# I 2 S-S
DELTEE	EQUALS	DELDV	# I 2 S-S
SECMAX	EQUALS	DELVCSI	# I 2 S-S MAX STOP SIZE FOR ROUTINE
DELTEEO	EQUALS	POSTTPI	# I 2 S-S BACK VALUES OF DELTA TIME
CENTANG	ERASE	+1	# I 2 CENTRAL ANGLE COVERED TPI-TPF

SOME P47 STORAGE

6D

DELVIMU ERASE +5 # I 6 DSP NOUN 83 FOR P47 DELTA V IMU

P30-P40 COMMON STORAGE.

3D

TPASS4 ERASE +1 # INTERCEPT TIME
QTEMP ERASE # I 1 TMP COMMON RETURN SAVE REGISTER.

P32,33,34 STORAGE.

6D

TCSI ERASE +1 # B 2 TMP CSI TIME IN CENTISECONDS
TTPI ERASE +1 # B 2 TMP TPI TIME IN CENTISECONDS
TTPIO ERASE +1 # B 2 TMP TTPI STORAGE FOR RECYCLE

P30,P40 INTERFACE.

21D

RTIG ERASE +19D # I 6 TMP
VTIG EQUALS RTIG +6 # I 6 TMP
DELVSIN EQUALS VTIG +6 # I 6 TMP
DELVSAB EQUALS DELVSIN +6 # I 2 TMP
VGDISP DELVSABQTEMP1 ERASE # I 1 TMP HOLDS RETURN.
RGEXIT EQUALS QTEMP1 # SAVE Q
SAVQR52 EQUALS QTEMP1# INITVEL STORAGE. IN OVERLAY 0 AND OVERLAY 1. 2D
CALLS LAMBERT, CONIC SUBROUTINESVTPRIME EQUALS VACT4 # TOTAL VELOCITY AT DESIRED RADIUS
ITCTR EQUALS RDOTV # ITERATION COUNTER
COZY4 ERASE +1 # COS OF ANGLE WHEN ROTATION STARTS
X1INPUT EQUALS DELDV # X1 TEMP STORAGE
INTIME EQUALS GAMPREV # TIME OF RINIT

PERIAPO STORAGE.

2D

XXXALT ERASE +1 # RADIUS TO LAUNCH PAD OR LANDING SITE
END-IN/M EQUALS XXXALT +2 # NEXT AVAIL ERASABLE AFTER INITVEL/MIDGIM

S40.1 STORAGE.

12D

UT	ERASE	+11D	# I 6 THRUST DIRECTION
VGTIG	EQUALS	UT +6	# I 6 OUT
VGPREV		VGTIG	

ASTEER STORAGE.

22D

VG	ERASE	+21D	# I 6
RMAG	EQUALS	VG +6	# I 2
MUASTEER	EQUALS	RMAG +2	# I 2
MU/A	EQUALS	MUASTEER +2	# I 2
RTMAG	EQUALS	MU/A +2	# I 2
R1C	EQUALS	RTMAG +2	# I 6
SS	EQUALS	R1C +6	# I 2

IC		DELVSIN	
TIGSAVE		P21TIME	
TIGSAVEP		SCAXIS	
MUSCALE		SCAXIS +2	

P40 STORAGE.

6D

F, MDOT, AND TDECAY MUST BE CONTIGUOUS FOR WLOAD

F	ERASE	+5	# I 2 TMP S40.1 GENERATES THIS FOR S40.3
MDOT	EQUALS	F +2	# I 2 TMP MASS CHNG RATE, KG/CS AT 2**3.
TDECAY	EQUALS	MDOT +2	# I 2 IN DELTA-T TAILOFF, 2**28 CS.
VEX	ERASE	+1	# I 2 EXHAUST VELOCITY FOR TGO COMPUTAT N

MIDTOAV1 2 STORAGE. CALLED BY P40,P41,P42

1D

IRETURN1	ERASE	# B 1 RETURN FROM MIDTOAV1 AND 2.
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***** OVERLAY NUMBER 1 IN EBANK 7 *****

INITVEL CALLED BY P34,35,38,39,10,11,S40.9,S40.1 6D

RTARG1 EQUALS VACT1 # I 6 S TEMP STORAGE OF RTARG

P35-P40 INTERFACE. 6D

VPASS4 EQUALS VPASS1 # I 6 TMP VELOCITY OF PASSIVE AT INTERCEPT

INITVEL OVERLAYS RENDESVOUS GUIDANCE LISTED IN OVERLAY 0

SOME P38-30,P78-79 STORAGE 2D
TINT EQUALS TPASS4 # I 2 TIME OF INTERCEPT

LAT-LONG TEMPORARIES. CAN OVERLAY WITH S40.1 3D

ERADM EQUALS UT # I 2
INCORPEX EQUALS ERADM +2 # I 1

LRS24.1 STORAGE. CAN SHARE WITH P30 S 40D

RLMSRCH EQUALS INCORPEX +1 # I 6 TMP LM POSITION VECTOR
VXRCH EQUALS RLMSRCH +6 # I 6 CM V X R VECTOR
LOSDESRD EQUALS VXRCH +6 # I 6 DESIRED LOS VECTOR
UXVECT EQUALS LOSDESRD +6 # I 6 X-AXIS SRCH PATTERN COORDS
UYVECT EQUALS UXVECT +6 # I 6 Y-AXIS SRCH PATTERN COORDS
DATAGOOD EQUALS UYVECT +6 # B 1 DSP FOR R1 -- ALL 1-S WHEN LOCKON
OMEGDISP EQUALS DATAGOOD +1 # B 2 ANGLE OMEGA DISPLAYED IN R2
OMEGAD OMEGDISP # PINBALL DEFINITION
NSRCHPNT EQUALS OMEGDISP +2 # B 1 TMP SEARCH PATTERN POINT COUNTER.
SAVLEMV EQUALS NSRCHPNT +1 # I 6 S-S SAVES LOSVEL

***** OVERLAY NUMBER 2 IN EBANK 7 *****

INCORP STORAGE IN E7. 47D

TX789	EQUALS	E7OVERLA	# I 6
GAMMA	EQUALS	TX789 +6	# I 3
OMEGA	EQUALS	GAMMA +3	# I 18
BVECTOR	EQUALS	OMEGA +18D	# I 18
DELTAQ	EQUALS	BVECTOR +18D	# I 2

AOTMARK STORAGE 3D

MARKCNTR	EQUALS	DELTAQ +2	# I 1
XYMARK	EQUALS	MARKCNTR +1	# B 1
MKDEX	EQUALS	XYMARK +1	# B 1 TMP INDEX FOR AOTMARK

PLANET STORAGE 8D

PLANVEC	EQUALS	MKDEX +1	# 6 REFER VECTOR OF PLANET
TSIGHT	EQUALS	PLANVEC +6	# 2 TIME OF MARK OR EST TIME OF MARK

LRS22.3 STORAGE. CAN SHARE WITH P30 S AND OVERLAY LRS24.1 30D

LGRET	EQUALS	RLMSRCH	# I 1 TMP
RDRET	EQUALS	LGRET	# B 1 TEMP RETURN.
IGRET	EQUALS	LGRET	# B 1 TEMP RETURN.
MX	EQUALS	RDRET +1	# I 6
MY	EQUALS	MX +6	# I 6
MZ	EQUALS	MY +6	# I 6
E0	EQUALS	MX	# I 2
E1	EQUALS	MX +2	# I 2
E2	EQUALS	MX +4	# I 2
E3	EQUALS	E2 +2	# I 2
SCALSHFT	EQUALS	MZ +6	# B 1 SCALE SHIFT FOR EARTH/MOON
RXZ	EQUALS	SCALSHFT +1	# I 2
ULC	EQUALS	RXZ +2	# I 6
SINTheta	EQUALS	ULC +6	# I 2

***** IN OVERLAY ONE *****

N49FLAG	EQUALS	RDOTMSAV	# B 1 S FLAG INDICATING V0649 RESPONSE
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LRS22.1 STORAGE. MUST NOT SHARE WITH P30 S 13D

OUTPUTS ARE TO LRS22.3


```
1 RRTRUN      EQUALS  SINTHETA +2      # B 2 OUT RR TRUNNION ANGLE
2 RRSHAFT     EQUALS  RRTRUN +2        # B 2 OUT RR SHAFT ANGLE
3 LRS22.1X    EQUALS  RRSHAFT +2      # B 1 TMP
4 RRBORSIT    EQUALS  LRS22.1X +1     # I 6 TMP RADAR BORESIGHT VECTOR.
5 RDOTMSAV    EQUALS  RRBORSIT +6     # B 2 S RR RANGE-RATE  FPS
```

```
6
7
8 # LRS22.1  SAME AS PREVIOUS SECTION  ALSO DOWNLINK FOR RR  R29          10D  CANNOT SHARE WITH L.A.D.
```

```
9
10 RDOTM      EQUALS  RDOTMSAV +2      # B 2 OUT RANGE-RATE READING
11 TANGNB     EQUALS  RDOTM +2        # B 2 TMP RR GIMBAL ANGLES
12 # RETAIN THE ORDER OF MKTIME TO RM FOR DOWNLINK PURPOSES
13 MKTIME     EQUALS  TANGNB +2      # B 2 OUT TIME OF RR READING
14 RM         EQUALS  MKTIME +2      # I 2 OUT RANGE READING
15 RANGRDOT   EQUALS  RM +2          # B 2  DOWNLINKED RAW RANGE AND RRATE
```

```
16
17 # R61LEM -- PREFERRED TRACKING ATTITUDE ROUTINE **IN OVERLAY ONE**
18 #  CALLED BY P20, R22LEM, LSR22.3          1D
```

```
19
20 R65CNTR     EQUALS  RRBORSIT +5     # B 1 SS COUNT NUMBER OF TIMES PREFERRED
21                                     #      TRACKING ROUTINE IS TO CYCLE
22 WHCHREAD    EQUALS  R65CNTR        # TELLS WHICH RR DATA TRIGGERED N49 DISPLAY
```

```
23
24 # P21 STORAGE          2D
```

```
25
26 P21TIME     EQUALS  RANGRDOT +2     # I 2 TMP
```

```
27
28 # KALCMANU, VECPOINT STORAGE.  CALLED BY R63, R61, R65.          12D
```

```
29
30 SCAXIS      EQUALS  P21TIME +2      # I 6
31 POINTVSM    EQUALS  SCAXIS +6      # I 6
```

***** OVERLAY NUMBER 3 IN EBANK 7 *****

SERVICER STORAGE

6D

ABVEL	EQUALS	E7OVERLA	# B 2	DISPLAY
HDOTDISP	EQUALS	ABVEL +2	# B 2	DISPLAY
TTFDISP	EQUALS	HDOTDISP +2	# B 2	DISPLAY

BURN PROG STORAGE.

2D

SAVET-30 EQUALS TTFDISP +2 # B 2 TMP TIG-30 RESTART

SERVICER STORAGE.

69D

VGBODY	EQUALS	SAVET-30 +2	# B 6	OUT SET BY S41.1 VG LEM, SC.COORDS
DELVCTL		VGBODY		
DVTOTAL	EQUALS	VGBODY +6	# B 2	DISPLAY NOUN
GOBLTIME	EQUALS	DVTOTAL +2	# B 2	NOMINAL TIG FOR CALC. OF GOBLATE.
ABDVCONV	EQUALS	GOBLTIME +2	# I 2	
DVCNTR	EQUALS	ABDVCONV +2	# B 1	
TGO	EQUALS	DVCNTR +1	# B 2	
R	EQUALS	TGO +2	# I 6	
UNITGOBL	EQUALS	R	# I 6	
V	EQUALS	R +6		
DELVREF	EQUALS	V	# I 6	
HCALC	EQUALS	DELVREF +6	# B 2	LR
UNIT/R/	EQUALS	HCALC +2	# I 6	

THE FOLLOWING SERVICER ERASABLES CAN BE SHARED WITH SECOND DPS GUIDANCE STORAGE

RN1	EQUALS	UNIT/R/ +6	# B 6	
VN1	EQUALS	RN1 +6	# I 6	IN ORDER
PIPTIME1	EQUALS	VN1 +6	# B 2	FOR
GDT1/2	EQUALS	PIPTIME1 +2	# I 6	COPY
MASS1	EQUALS	GDT1/2 +6	# I 2	CYCLE
R1S	EQUALS	MASS1 +2	# I 6	
V1S	EQUALS	R1S +6	# I 6	

ALIGNMENT/S40.2,3 COMMON STORAGE.

18D

XSMD	EQUALS	V1S +6	# I 6
YSMD	EQUALS	XSMD +6	# I 6
ZSMD	EQUALS	YSMD +6	# I 6

XSCREF	XSMD
YSCREF	YSMD

***** P22 ***** 24D

***** P21 ***** 18D

P21ORIG		DISPDEX				
P21BASER	EQUALS	RLMSRCH	#	I	6	TMP
P21BASEV	EQUALS	P21BASER +6	#	I	6	TMP
P21VEL	EQUALS	P21BASEV +6	#	I	2	TMP
P21GAM	EQUALS	P21VEL +2	#	I	2	TMP
P21ALT	EQUALS	P21GAM +2	#	I	2	TMP

***** OVERLAY NUMBER 4 IN EBANK 7 *****

VARIABLES FOR SECOND DPS GUIDANCE THE LUNAR LANDING 18D

THESE ERASABLES MAY BE SHARED WITH CARE

OURTEMPS	RN1	#	OVERLAY LAST PART OF SERVICER
LANDTEMP	OURTEMPS	# B 6	GUIDANCE
TTF/8TMP	LANDTEMP +6	# B 2	GUIDANCE
ELINCR	TTF/8TMP +2	# B 2	GUIDANCE
AZINCR	ELINCR +2	# B 2	GUIDANCE
KEEP-2	AZINCR +2	# B 2	TP PREVENT PIPTIME1 OVERLAY
TABLTTF	KEEP-2 +2	# B 2	GUIDANCE
TPIPOLD	TABLTTF +9D	# B 2	GUIDANCE
E2DPS	EQUALS OURPERMS		

THESE ERASABLES MUST NOT OVERLAY GOBLTIME OR SERVICER

PIFPSET	XSMD	# B 1	THROTTLE
RTNHOLD	PIFPSET +1	# B 1	THROTTLE
FWEIGHT	RTNHOLD +1	# B 2	THROTTLE
PIF	FWEIGHT +2	# B 2	THROTTLE
PSEUDO55	PIF +2	# B 1	THROTTLE DOWNLINK
FC	PSEUDO55 +1	# B 2	THROTTLE
TTHROT	FC +2	# B 1	THROTTLE
FCOLD	TTHROT +1	# B 1	THROTTLE

THESE ERASABLES SHOULD NOT BE SHARED DURING P63, P64, P65, P66, P67

OURPERMS	FCOLD +1	#	MUSTN T OVERLAY OURTEMPS OR SERVICER
WCHPHOLD	OURPERMS	# B 1	GUIDANCE
FILLER	WCHPHOLD +1		
FLPASS0	FILLER +1	# B 1	GUIDANCE
TPIP	FLPASS0 +1	# B 2	
VGU	TPIP +2	# B 6	GUIDANCE
LAND	VGU +6	# B 6	GUIDANCE CONTIGUOUS
TTF/8	LAND +6	# B 2	GUIDANCE CONTIGUOUS
ELIDUMMY	TTF/8 +2	# 1	DUMMY FOR ELINCR1
AZIDUMMY	ELIDUMMY +1	# 1	DUMMY FOR AZINCR1
ZERDUMMY	AZIDUMMY +1	# 1	DUMMY FOR ZERLINA
ELVDUMMY	ZERDUMMY +1	# 1	DUMMY FOR ELVIRA
LRADRET	ELVDUMMY +1	# B 1	LR
VSELECT	LRADRET +1	# B 1	LR
VMEAS	VSELECT +1	# B 2	LR
HMEAS	VMEAS +2	# B 2	LR
VN2	HMEAS +2	# B 6	LR

```
1 GNUR          VN2          # B 6  LR
2 GNUV          VN2          # B 6  LR
3 LRADRET1      VN2          # B 1  LR
4 DELTAH        VN2 +6       # B 2  DISPLAY
5 FUNNYDSP      DELTAH +2     # B 2  DISPLAY
6 OURPERM      EQUALS  FUNNYDSP +2  # NEXT AVAILABLE ERASABLE AFTER OURPERMS
```

ERASABLES WHICH OVERLAY THE ABOVE BLOCK

```
11 VDGVERT      ELIDUMMY      # B 2  P65,P66
12 NIGNLOOP     ZERDUMMY      # B 1  IGNALG
13 NGUIDSUB     ELVDUMMY      # B 1  IGNALG
14 WCHVERT      ELVDUMMY      # B 1  P65,P66,P67
15 FUELNEED     FUNNYDSP      # B 1  DISPLAY
16 TREDES       FUNNYDSP      # B 1  DISPLAY
17 LOOKANGL     FUNNYDSP +1   # B 1  DISPLAY
```

ERASABLES CONVENIENTLY DEFINABLE IN THE WORK AREA

```
21 PROJ        18D          # I 2  GUIDANCE
22 UNLRB/2      20D          # I 6  GUIDANCE DURING P64 ONLY
23 UNLR/2       20D          # I 6  GUIDANCE
```

THE END OF THE LUNAR LANDING ERASABLES

R12 FOR LUNAR LANDING 6D

```
29 LRLCTR      EQUALS  OURPERM      # B 1  LR DATA TEST
30 LRRCTR      EQUALS  LRLCTR +1     # B 1
31 LRMCTR      EQUALS  LRRCTR +1     # B 1
32 LRSCTR      EQUALS  LRMCTR +1     # B 1
33 STILBADH    EQUALS  LRSCTR +1     # B 1
34 STILBADV    EQUALS  STILBADH +1   # B 1
```

LANDING ANALOGS DISPLAY STORAGE. 40D

```
38 LATVMETR    EQUALS  STILBADV +1   # B 1  PRM LATVEL MONITOR METER AN ORDER
39 FORVMETR    EQUALS  LATVMETR +1    # B 1  PRM FORVEL MONITOR METER -ED PAIR
40 LATVEL      EQUALS  FORVMETR +1    # B 1  PRM LATERAL VELOCITY AN ORDER
41 FORVEL      EQUALS  LATVEL +1      # B 1  PRM FORWARD VELOCITY -ED PAIR
42 TRAKLATV    EQUALS  FORVEL +1      # B 1  PRM MONITOR FLG 4 LATVEL AN ORDER
43 TRAKFWDV    EQUALS  TRAKLATV +1    # B 1  PRM MONIT. FLAG FOR FORVEL ED PAIR
44 VHY         EQUALS  TRAKFWDV +1    # B 1  PRM VHY VMP.UHYP AN ORDER
```


VHZ	EQUALS	VHY +1	# B 1 PRM VHZ VMP.UHZP -ED PAIR
VVECT	EQUALS	VHZ +1	# B 3 PRM UPDATED S.P. VELOCITY VECTOR
ALTRATE	EQUALS	VVECT +3	# B 1 PRM ALTITUDE RATE IN BIT UNITS
ALTSAVE	EQUALS	ALTRATE +1	# B 2 PRM ALTITUDE IN BIT UNITS
LADQSAVE	EQUALS	ALTSAVE +2	# B 1 PARM SAVE Q IN LANDISP
DT	EQUALS	LADQSAVE +1	# B 1 PRM TIME 1 MINUS PIPTIME +1
DALTRATE	EQUALS	DT +1	# B 1 PRM ALTITUDE RATE ERROR CORRECTION
UHYP	EQUALS	DALTRATE +1	# B 6 PRM SM UNIT VECTOR
QAXIS		UHYP	
UHYP	EQUALS	UHYP +6	# B 6 PRM SM UNIT VECTOR
DELVS	EQUALS	UHYP +6	# B 6 PRM DELVS WMXR
ALTBITS	EQUALS	DELVS +6	# B 2 PRM ALTITUDE IN BIT UNITS. 2.34 FT/BIT
RUNIT	EQUALS	ALTBITS +2	# B 3 PRM SM HALF-UNIT R VECTOR
LASTLADW	EQUALS	RUNIT +2	# ONLY A TAG TO SIGNIFY LAST L.A.D. WORD

P66 ERASABLES R.O.D. 1D

RODCOUNT EQUALS RUNIT +3

P66 ERASABLES R.O.D. 14D

RODSCAL1	EQUALS	RM	# B 1
LASTTPIP	EQUALS	RODSCAL1 +1	# I 2
THISTPIP	EQUALS	LASTTPIP +2	# B 2
OLDPIPAX	EQUALS	THISTPIP +2	# B 1
OLDPIPAY	EQUALS	OLDPIPAX +1	# B 1
OLDPIPAZ	EQUALS	OLDPIPAY +1	# B 1
DELVROD	EQUALS	OLDPIPAZ +1	# B 6

NOUN 63 COMPONENT 2D

HCALC1 EQUALS DELVROD +6 # I 2

***** OVERLAY NUMBER 5 IN EBANK 7 *****

ASCENT GUIDANCE ERASABLES.

21D

RCO	EQUALS	END-ALIG	# I 2 TMP TARGET RADIUS AND OUT-OF-PLANE
YCO	EQUALS	RCO +2	# I 2 TMP DISTANCE, SCALED AT 2 24 .
1/DV1	EQUALS	YCO +2	# B 2 TMP ATMAG
1/DV2	EQUALS	1/DV1 +2	# B 2 TMP ATMAG
1/DV3	EQUALS	1/DV2 +2	# B 2 TMP ATMAG
XRANGE	EQUALS	1/DV3 +2	# B 2 TMP
ENGOFFDT	EQUALS	XRANGE +2	# B 1 TMP
VGVECT	EQUALS	ENGOFFDT +1	# I 6 OUT VELOCITY-TO-BE-GAINED.
TXO	EQUALS	VGVECT +6	# I 2 TMP TIME AT WHICH X-AXIS OVERRIDE
			# IS ALLOWED.

END OF THE ASCENT GUIDANCE ERASABLES

THE FOLLOWING CARDS KEEP THE ASSEMBLER HAPPY UNTIL THE SYMBOLS ARE DELETED FROM THE PINBALL NOUN TABLES.

END-E7.0	EQUALS	IRETURN1 +1	# FIRST UNUSED LOCATION IN E7 OVERLAY 0
END-E7.1	EQUALS	N49FLAG +1	# FIRST UNUSED LOCATION IN E7 OVERLAY 1
END-E7.2	EQUALS	POINTVSM +6	# FIRST UNUSED LOCATION IN E7 OVERLAY 2
END-E7.3	EQUALS	END-ALIG	# FIRST UNUSED LOCATION IN E7 OVERLAY 3
END-E7.4	EQUALS	3777	# ** LAST LOCATION USED IN E7 OVERLAY 4 **
END-E7.5	EQUALS	TXO +2	# FIRST UNUSED LOCATION IN E7 OVERLAY 5
END-E7	EQUALS	3777	# ** LAST LOCATION USED IN E7 **

SETLOC 4000

COUNT* \$\$/RUPTS # FIX-FIX LEAD INS
INHINT # GOCAF GOBB
XCH BBANK
TCF GOPROGDXCH ARUPT # T6RUPT
EXTEND
DCA T6ADR
DTCBDXCH ARUPT # T5RUPT - AUTOPILOT
EXTEND
DCA T5ADR
DTCBDXCH ARUPT # T3RUPT
CAF T3RPTBB
XCH BBANK
TCF T3RUPTDXCH ARUPT # T4RUPT
CAF T4RPTBB
XCH BBANK
TCF T4RUPTDXCH ARUPT # KEYRUPT1
CAF KEYRPTBB
XCH BBANK
TCF KEYRUPT1DXCH ARUPT # KEYRUPT2
CAF MKRUPTBB
XCH BBANK
TCF MARKRUPTDXCH ARUPT # UPRUPT
CAF UPRPTBB
XCH BBANK
TCF UPRUPTDXCH ARUPT # DOWNRUPT
CAF DWRPTBB
XCH BBANK
TCF DODOWNTMDXCH ARUPT # RADAR RUPT
CAF RDRPTBB

[illegible]

```
1
2      BANK      12
3      SETLOC    T4RUP
4      BANK
5
6      EBANK      M11
7      COUNT*    $$/T4RPT
8      TS        BANKRUPT
9
10
11      EXTEND
12      QXCH      QRUP
13
14      CCS        DSRUPTSW      # GOES 7 -1 0 AROUND AND AROUND
15      TCF        NORMT4 +1
16      TCF        NORMT4
17
18
19      TCF        QUIKDSP
20
21      NORMT4     CAF        SEVEN
22      TS        RUPTREG1
23      TS        DSRUPTSW
24
25
26      BLOCK      02
27      SETLOC    FFTAG10
28      BANK
29
30      COUNT*    $$/T4RPT
31      100MRUPT   OCT37766      # DEC 16374
32      # RELTAB IS A PACKED TABLE. RELAYWORD CODE IN UPPER 4 BITS, RELAY CODE
33      # IN LOWER 5 BITS.
34
35      RELTAB     OCT        04025
36      OCT        10003
37      OCT        14031
38      OCT        20033
39      OCT        24017
40      OCT        30036
41      OCT        34034
42      OCT        40023
43      OCT        44035
44      OCT        50037
45      OCT        54000
46      RELTAB11   OCT        60000
47
48
49
50
51
52
53
54
55
56
57
58
59
60
```

SWITCHED-BANK PORTION

BANK 12
SETLOC T4RUP
BANK

CDRVE COUNT* \$\$/T4RPT
CCS DSPTAB +11D
TC DSPOUT
TC DSPOUT

XCH DSPTAB +11D
MASK LOW11
TS DSPTAB +11D
AD RELTAB11
EXTEND
WRITE OUT0
TC HANG20

DSPOUT PROGRAM, PUTS OUT DISPLAYS

DSPOUTSB	TS	NOUT	
	CS	ZERO	
	TS	DSRUPTM	# SET TO -0 FOR 1ST PASS THRU DSPTAB
	XCH	DSPCNT	
	AD	NEGO	# TO PREVENT +0
	TS	DSPCNT	
DSPSCAN	INDEX	DSPCNT	
	CCS	DSPTAB	
	CCS	DSPCNT	# IF DSPTAB ENTRY +, SKIP
	TCF	DSPSCAN -2	# IF DSPCNT +, TRY AGAIN
	TCF	DSPLAY	# IF DSPTAB ENTRY -, DISPLAY
TABLNTH	OCT	12	# DEC 10, LENGTH OF DSPTAB
	CCS	DSRUPTM	# IF DSRUPTM +0, 2ND PASS THRU DSPTAB
120MRUPT	DEC	16372	# DSPCNT 0 . +0 INTO NOUT.
	TS	NOUT	
	TC	Q	
	TS	DSRUPTM	# IF DSRUPTM -0, 1ST PASS THRU DSPTAB
	CAF	TABLNTH	# DSPCNT 0 .+0 INTO DSRUPTM. PASS AGAIN
	TCF	DSPSCAN -1	
DSPLAY	AD	ONE	
	INDEX	DSPCNT	
	TS	DSPTAB	# REPLACE POSITIVELY
	MASK	LOW11	# REMOVE BITS 12 TO 15
	TS	DSRUPTM	
	CAF	HI5	
	INDEX	DSPCNT	
	MASK	RELTAB	# PICK UP BITS 12 TO 15 OF RELTAB ENTRY
	AD	DSRUPTM	
	EXTEND		
	WRITE	OUT0	
	TCF	Q+1	
DSPOUT	CCS	FLAGWRD5	# IS DSKY FLAG ON
	CAF	ZERO	# NO
	TCF	NODSPOUT	# NO
	CCS	NOUT	# YES
	TC	DSPOUTSB	
	TCF	NODSPOUT	# NO DISPLAY REQUESTS
HANG20	CS	14,11,9	
	ADS	DSRUPTSW	
	CAF	20MRUPT	
SETTIME4	TS	TIME4	


```

1  # THE STATUS OF THE PROCEED PUSHBUTTON IS MONITORED EVERY 120 MILLISECONDS VIA THE CHANNEL 32 BIT 14 INBIT.
2  # THE STATE OF THIS INBIT IS COMPARED WITH ITS STATE DURING THE PREVIOUS T4RUPT AND IS PROCESSED AS FOLLOWS.
3
4  # IF PREV ON AND NOW ON -- BYPASS.
5  # IF PREV ON AND NOW OFF -- UPDATE IMODES33.
6  # IF PREV OFF AND NOW ON -- UPDATE IMODES33 AND PROCESS VIA PINBALL.
7  # IF PREV OFF AND NOW OFF -- BYPASS.
8  # THE LOGIC EMPLOYED REQUIRES ONLY 9 MCT APPROX. 108 MICROSECONDS OF COMPUTER TIME WHEN NO CHANGES OCCUR.
9

```

```

10 PROCEEDE CA IMODES33 # MONITOR FOR PROCEED BUTTON
11

```

```

12 EXTEND

```

```

13 RXOR CHAN32

```

```

14 MASK BIT14

```

```

15 EXTEND

```

```

16 BZF T4JUMP # NO CHANGE

```

```

17 LXCH IMODES33

```

```

18 EXTEND

```

```

19 RXOR LCHAN

```

```

20 TS IMODES33 # UPDATE IMODES33

```

```

21 MASK BIT14

```

```

22 CCS A

```

```

23 TCF T4JUMP # WAS ON -- NOW OFF

```

```

25 CAF CHRPRIO # WAS OFF -- NOW ON

```

```

26 TC NOVAC

```

```

27 EBANK DSPCOUNT

```

```

28 2CADR PROCKEY

```

JUMP TO APPROPRIATE ONCE-PER SECOND 0.96 SEC ACTUALLY ACTIVITY

T4JUMP INDEX RUPTREG1
TCF +1

TC RCSMONIT
TCF RRAUTCHK
TCF IMUMON
TCF DAPT4S
TC RCSMONIT
TCF RRAUTCHK
TCF IMUMON
TCF DAPT4S

20MRUPT OCT37776 # DEC 16382

ADDITIONAL ROUTINES FOR 20MS. KEYBOARD ACTIVITY

NODSPOUT

EXTEND
WRITE OUT0CAF 120MRUPT #SET FOR NEXT CCRIVE
TCF SETTIME4

QUIKDSP

CAF BIT14
MASK DSRUPTSW
EXTEND

BZF QUIKOFF # WROTE LAST TIME, NOW TURN OFF RELAYS.

CCS NOUT

TC DSPOUTSB

TCF NODSPY

NOUT 0 OR BAD RETURN FROM DSPOUTSB

CS BIT14

GOOD RETURN WE DISPLAYED SOMETHING

QUIKRUPT

ADS DSRUPTSW

CAF 20MRUPT

TS TIME4

CAF BIT9

ADS DSRUPTSW

TC RESUME

NODSPY

EXTEND
WRITE OUT0

SYNCT4

CAF 20MRUPT
ADS TIME4CAF BIT9
ADS DSRUPTSW

CCS DSRUPTSW

TC RESUME

OCT37737

OCT 37737
TC SYNCT4
TC RESUME

QUIKOFF

EXTEND
WRITE OUT0CAF BIT14
TCF QUIKRUPT

RESET DSRUPTSW TO SEND DISPLAY NEXT PASS

14,11,9

OCT 22400

PROGRAM NAME IMUMON

FUNCTIONAL DESCRIPTION THIS PROGRAM IS ENTERED EVERY 480 MS. IT DETECTS CHANGES OF THE IMU STATUS BITS IN
CHANNEL 30 AND CALLS THE APPROPRIATE SUBROUTINES. THE BITS PROCESSED AND THEIR RELEVANT SUBROUTINES ARE

#	FUNCTION	BIT	SUBROUTINE CALLED
#	-----	---	-----
#	TEMP IN LIMITS	15	TLIM
#	ISS TURN-ON REQUEST	14	ITURNON
#	IMU FAIL	13	IMUFAIL SETISSW
#	IMU CDU FAIL	12	ICDUFAIL SETISSW
#	IMU CAGE	11	IMUCAGE
#	IMU OPERATE	9	IMUOP

THE LAST SAMPLED STATE OF THESE BITS IS LEFT IN IMODES30. ALSO, EACH SUBROUTINE CALLED FINDS THE NEW
VALUE OF THE BIT IN A, WITH Q SET TO THE PROPER RETURN LOCATION NXTIFAIL.

CALLING SEQUENCE T4RUPT EVERY 480 MILLISECONDS.

JOBS OR TASKS INITIATED NONE.

SUBROUTINES CALLED TLIM, TURNON, SETISSW, IMUCAGE, IMUOP.

ERASABELE INITIALIZATION

FRESH START OR RESTART WITH NO GROUPS ACTIVE C IMODES30 OCT 37411 .

RESTART WITH ACTIVE GROUPS C IMODES30 B IMODES30 AND OCT 00035 PLUS OCT 37400.

THIS LEAVES IMU FAIL BITS INTACT.

ALARMS NONE.

EXIT TNONTEST.

OUTPUT UPDATED IMODES30 WITH CHANGES PROCESSED BY APPROPRIATE SUBROUTINE.

IMUMON CA IMODES30 # SEE IF THERE HAS BEEN A CHANGE IN THE
EXTEND # RELEVANT BITS OF CHAN 30.

RXOR CHAN30
MASK 30RDMSK

EXTEND
BZF TNONTEST # NO CHANGE IN STATUS

TS RUPTREG1 # SAVE BITS WHICH HAVE CHANGED.
LXCH IMODES30 # UPDATE IMODES30.

EXTEND
RXOR LCHAN
TS IMODES30

CS ONE
XCH RUPTREG1
EXTEND

PROGRAM NAME TNONTEST.

FUNCTIONAL DESCRIPTION THIS PROGRAM HONORS REQUESTS FOR ISS INITIALIZATION. ISS TURN-ON CHANNEL 30 BIT 14
AND ISS OPERATE CHANNEL 30 BIT 9 REQUESTS ARE TREATED AS A PAIR AND PROCESSING TAKES PLACE .480 SECONDS
AFTER EITHER ONE APPEARS. THIS INITIALIZATION TAKES ON ONE OF THE FOLLOWING THREE FORMS

1 ISS TURN-ON IN THIS SITUATION THE COMPUTER IS OPERATING WHEN THE ISS IS TURNED ON. NOMINALLY,
BOTH ISS TURN-ON AND ISS OPERATE APPEAR. THE PLATFORM IS CAGED FOR 90 SECONDS AND THE ICDU S ZEROED
SO THAT AT THE END OF THE PROCESS THE GIMBAL LOCK MONITOR WILL FUNCTION PROPERLY.

2 ICDU INITIALIZATION IN THIS CASE THE COMPUTER WAS PROBABLY TURNED ON WITH THE ISS IN OPERATE OR
A FRESH START WAS DONE WIT THE ISS IN OPERATE. IN THIS CASE ONLY ISS OPERATE IS ON. THE ICDU S ARE
ZEROED SO THE GIMBAL LOCK MONITOR WILL FUNCTION. AN EXCEPTION IS IF THE ISS IS IN GIMBAL LOCK AFTER
A RESTART, THE ICDU S WILL NOT BE ZEROED.

3 RESTART WITH RESTARTABLE PROGRAM USING THE IMU IN THIS CASE, NO INITIALIZATION TAKES PLACE SINCE
IT IS ASSUMED THT THE USING PROGRAM DID THE INITIALIZATION AND THEREFORE T4RUPT SHOULD NOT INTERFERE.

IMODES30 BIT 7 IS SET 1 BY THE FIRST BIT CHANNEL 30 BIT 14 OR 9 WHICH ARRIVES. FOLLOWING THIS, TNONTEST IS
ENTERED, FINDS BIT 7 1 BUT BIT 8 0, SO IT SETS BIT 8 1 AND EXITS. THE NEXT TIME IT FINDS BIT 8 1 AND
PROCEEDS, SETTING BITS 8 AND 7 0. AT PROCTNON, IF ISS TURN-ON REQUEST IS PRESENT, THE ISS IS CAGED ZERO +
COARSE . IF ISS OPERATE IS NOT PRESENT PROGRAM ALARM 00213 IS ISSUED. AT THE END OF A 90 SECOND CAGE, BIT 2
OF IMODES30 IS TESTED. IF IT IS 1, ISS TURN-ON WAS NOT PRESENT FOR THE ENTIRE 90 SECONDS. IN THAT CASE, IF
THE ISS TURN-ON REQUEST IS PRESENT TEH 90 SECOD WAIT IS REPEATED. OTHERWISE NO ACTION OCURS UNLESS A PROGRAM
WAS WAITING FOR THE INITIALIZATION IN WHIC CASE TH PROGRAM IS GIVEN AN IMUSTALL ERROR RETURN. IF THE DELAY
WENT PROPERLY, THE ISS DELAY OUTBIT IS SENT AND THE ICDU S ZEROED. A TASK IS INITIATED TO REMOVE THE PIPA FAIL
INHIBIT BIT IN 10.24 SECONDS. IF A MISSION PROGRAM WAS WAITING IT IS INFORMED VIA ENDIMU.

AT PROCTNON, IF ONLY ISS OPERATE IS PRESENT OPONLY , THE CDU S ARE ZEROED UNLESS THE PLATFORM IS IN COARSE
ALIGN GIMBAL LOCK HERE OR A MISSIN PROGRAM IS USING THE IMU INUSEFLG 1 .

CALLING SEQUENCE T4RUPT EVERY 480 MILLISECONDS AFTER IMUMON.

JOBS OR TASKS INITIATED 1 ENDTNON, 90 SECONDS AFER CAGING STARTED. 2 ISSUP, 4 SECONDS AFTER CAGING DONE.
3 PFAILOK, 10.24 SECONDS AFTER INITIALIZATION COMPLETED. 4 UNZ2, 320 MILLISECONDS AFTER ZEROING
STARTED.

SUBROUTINES CALLED CAGESUB, CAGESUB2, ZEROICDU, ENDIMU, IMUBAD, NOATTOFF, SETISSW, VARDELAY.

ERASABLE INITIALIZATION SEE IMUMON.

ALARMS PROGRAM ALARM 00213 IF ISS TURN-ON REQUESTED WITHOUT ISS OPERATE.

EXIT ENDTNON EXITS TO C33TEST. TASKS HAVING TO DO WITH INITIALIZATION EXIT AS FOLLOWS MISSION PROGRAM
WAITING AND INITIALIZATION COMPLETE, EXIT TO ENDIMU, MISSION PROGRAM WAITING AND INITIALIZATION FAILED, EXIT TO
IMUBAD, IMU NOT IN USE, EXIT TO TASKOVER.

OUTPUT ISS INITIALIZED.

TNONTEST CS IMODES30 # AFTER PROCESSING ALL CHANGES, SEE IF IT


```
1
2      MASK    BIT7      # IS TIME TO ACT ON A TURN-ON SEQUENCE.
3      CCS     A
4      TCF     C33TEST   # NO -- EXAMINE CHANNEL 33.
5
6      CAF     BIT8      # SEE IF FIRST SAMPLE OR SECOND.
7      MASK    IMODES30
8      CCS     A
9      TCF     PROCTNON  # REACT AFTER A SECOND SAMPLE.
10
11     CAF     BIT8      # IF FIRST SAMPLE, SET BIT TO REACT NEXT
12     ADS     IMODES30  # TIME.
13     TCF     C33TEST
14
15     # PROCESS IMU TURN-ON REQUESTS AFTER WAITING 1 SAMPLE FOR ALL SIGNALS TO ARRIVE.
16
17     PROCTNON    CS     BITS7 8
18                MASK    IMODES30
19                TS      IMODES30
20                MASK    BIT14      # SEE IF TURN-ON REQUEST.
21                CCS     A
22                TCF     OPONLY      # OPERATE ON ONLY.
23
24                CS      IMODES30    # IF TURN-ON REQUEST, WE SHOUD HAVE IMU
25                MASK    BIT9        # OPERATE.
26                CCS     A
27                TCF     +3
28
29                TC      ALARM      # ALARM IF NOT
30                OCT     213
31
32     +3          TC      CAGESUB
33                CAF     90SECS
34                TC      WAITLIST
35                EBANK   M11
36                2CADR   ENDTNON
37
38                TCF     C33TEST
39
40     RETNON      CAF     90SECS
41                TC      VARDELAY
42
43     ENDTNON     CS      BIT2      # RESET TURN-ON REQUEST FAIL BIT.
44                MASK    IMODES30
45                XCH     IMODES30
46                MASK    BIT2      # IF IT WAS OFF, SEND ISS DELAY COMPLETE.
47                EXTEND
48                BZF     ENDTNON2
49
50                CAF     BIT14      # IF IT WAS ON AND TURN-ON REQUEST NOW.
51
52
53
54
55
56
57
58
59
60
```

	MASK	IMODES30	# PRESENT, RE-ENTER 90 SEC DELAY IN WL.
	EXTEND		
	BZF	RETNON	
	CS	FLAGWRD0	# IF IT IS NOT ON NOW, SEE IF A PROG WAS
	MASK	IMUSEBIT	# WAITING.
	CCS	A	
	TCF	TASKOVER	
	TC	POSTJUMP	
	CADR	IMUBAD	# UNSUCCESSFUL TURN-ON.
ENDTNON2	CAF	BIT15	# SEND ISS DELAY COMPLETE.
	EXTEND		
	WOR	CHAN12	
	TC	IBNKCALL	# TURN OFF NO ATT LAMP.
	CADR	NOATTOFF	
UNZ2	TC	ZEROICDU	
	CS	BITS4 5	# REMOVE ZERO AND COARSE.
	EXTEND		
	WAND	CHAN12	
	CAF	BIT11	# WAIT 10 SECS FOR CTRS TO FIND GIMBALS
	TC	VARDELAY	
ISSUP	CS	OCT54	# REMOVE CAGING, IMU FAIL INHIBIT BIT, AND
	MASK	IMODES30	# ICDUFail INHIBIT FLAGS.
	TS	IMODES30	
	CS	BIT6	# ENABLE DAP
	MASK	IMODES33	
	TS	IMODES33	
	CS	FLAGWRD2	# TEST DRIFTFLG IF ON DO NOTHING BECAUSE
	MASK	DRFTBIT	# IMUCOMP SHOUD BE ALL SET UP RESTART
	EXTEND		# WITH IMUSE DOWN . IF OFF, SET DRIFTFLG
	BZF	+4	# AND 1/PIPADT TO GET FREEFALL IMUCOMP
	ADS	FLAGWRD2	# GOING FRESH START OR ISS TURN-ON .
	CA	TIME1	
	XCH	1/PIPADT	# CANNOT GET HERE IF RESTART WITH IMUSE UP
	TC	SETISSW	# ISS WARNING MIGHT HAVE BEEN INHIBITED.
	CS	BIT15	# REMOVE IMU DELAY COMPLETE DISCRETE.
	EXTEND		
	WAND	CHAN12	
	CAF	4SECS	# DON T ENABLE PROG ALARM ON PIP FAIL FOR

	TC	WAITLIST	# ANOTHER 4 SECS.
	EBANK	CDUIND	
	2CADR	PFAILOK	
	TCF	TASKOVER	
OPONLY	CAF	BIT4	# IF OPERATE ON ONLY, AND WE ARE IN COARSE
	EXTEND		# ALIGN, DON T ZERO THE CDUS BECAUSE WE
	RAND	CHAN12	# MIGHT BE IN GIMBAL LOCK.
	CCS	A	
	TCF	C33TEST	
	CAF	IMUSEBIT	# OTHERWISE, ZERO THE COUNTERS.
	MASK	FLAGWRD0	# UNLESS SOMEONE IS USING TH IMU.
	CCS	A	
	TCF	C33TEST	
	TC	CAGESUB2	# SET TURNON FLAGS.
ISSZERO	TC	IBNKCALL	# TURN OFF NO ATT LAMP.
	CADR	NOATTOFF	# IMU CAGE OFF ENTRY.
	CAF	BIT5	# ISS CDU ZERO
	EXTEND		
	WOR	CHAN12	
	TC	ZEROICDU	
	CAF	BIT6	# WAIT 300 MS. FOR AGS TO RECEIVE SIGNAL.
	TC	WAITLIST	
	EBANK	M11	
	2CADR	UNZ2	
	TCF	C33TEST	

PROGRAM NAME C33TEST

FUNCTIONAL DESCRIPTION THIS PROGRAM MONITORS THREE FLIP-FLOP INBITS OF CHANNEL 33 AND CALLS THE APPROPRIATE
SUBROUTINE TO PROCESS A CHANGE. IT IS ANALOGOUS TO IMUMON, WHICH MONITORS CHANNEL 30, EXCEPT THAT IT READS
CHANNEL 33 WITH A WAND INSTRUCTION BECAUSE A WRITE PULSE IS REQUIRED TO RESET THE FLIP-FLOPS. THE BITS
PROCESSED AND THE SUBROUTINES CALLED ARE

BIT	FUNCTION	SUBROUTINE
13	PIPA FAIL	PIPFAIL
12	DOWNLINK TOO FAST	DNTMFAST
11	UPLINK TOO FAST	UPTMFAST

UPON ENTRY TO THE SUBROUTINE, THE NEW BIT STATE IS IN A.

CALLING SEQUENCE EVERY 480 MILLISECONDS AFTER TNONTEST.

JOBS OR TASKS INITIATED NONE.

SUBROUTINES CALLED PIPFAIL, DNTMFAST AND UPTMFAST ON BIT CHANGES.

ERASABLE INITIALIZATION C IMODES33 OCT 16000 ON A FRESH START OR RESTART, THEREFORE, THESE ALARMS WILL
REAPPEAR IF THE CONDITIONS PERSIST.

ALARMS NONE.

EXIT GLOCKMON.

OUTPUT UPDATED BITS 13, 12, AND 11 OF IMODES33 WITH CHANGES PROCESSED.

C33TEST	CA	IMODES33	# SEE IF RELEVANT CHAN33 BITS HAVE
	MASK	33RDMSK	
	TS	L	# CHANGED.
	CAF	33RDMSK	
	EXTEND		
	WAND	CHAN33	# RESETS FLIP-FLOP INPUTS
	EXTEND		
	RXOR	LCHAN	
	EXTEND		
	BZF	GLOCKMON	# ON NO CHANGE.
	TS	RUPTREG1	# SAVE BITS WHICH HAVE CHANGED.
	LXCH	IMODES33	
	EXTEND		
	RXOR	LCHAN	
	TS	IMODES33	# UPDATED IMODES33.
	CAF	ZERO	
	XCH	RUPTREG1	
	DOUBLE		

1					1
2		TCF	NXTIBT +1	# SCAN FOR BIT CHANGES.	2
3					3
4	-1	AD	ONE		4
5	NXTIBT	INCR	RUPTREG1		5
6	+1	DOUBLE			6
7		TS	A	# CODING IDENTICAL TO CHAN 30 .	7
8		TCF	NXTIBT		8
9					9
10		XCH	RUPTREG2		10
11		INDEX	RUPTREG1	# GET NEW VALUE OF BIT WHICH CHANGED.	11
12		CAF	BIT13		12
13		MASK	IMODES33		13
14		INDEX	RUPTREG1		14
15		TC	C33JMP		15
16	NXTFL33	CCS	RUPTREG2	# PROCESS POSSIBLE ADDITIONAL CHANGES.	16
17		TCF	NXTIBT -1		17
18					18
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59					59
60					60

PROGRAM NAME GLOCKMON

FUNCTIONAL DESCRIPTION THIS PROGRAM MONITORS THE CDUZ COUNTER TO DETERMINE WHETHER THE ISS IS IN GIMBAL LOCK
AND TAKES ACTION IF IT IS. THREE REGIONS OF MIDDLE GIMBAL ANGLE MGA ARE USED

1 ABS MGA LESS THAN OR EQUAL TO 70 DEGREES -- NORMAL MODE.

2 ABS MGA GREATER THAN 70 DEGREES AND LESS THAN OR EQUAL TO 85 DEGREES -- GIMBAL LOCK LAMP TURNED ON.

3 ABS MGA GREATER THAN 85 DEGREES -- ISS PUT IN COARSE ALIGN AND NO ATT LAMP TURNED ON.

CALLING SEQUENCE EVERY 480 MILLISECONDS AFTER C33TEST.

JOBS OR TASKS INITIATED NONE.

SUBROUTINES CALLED 1 SETCOARS WHEN ABS MGA GREATER THEN 85 DEGREES AND ISS NOT IN COARSE ALIGN.

2 LAMPTEST BEFORE TURNING OFF GIMBAL LOCK LAMP.

ERASABLE INITIALIZATION

1 FRESH START OR RESTART WITH NO GROUPS ACTIVE C CDUZ 0, IMODES30 BIT 6 0, IMODES33 BIT 1 0.

2 RESTART WITH GROUPS ACTIVE SAME AS FRESH START EXCEPT C CDUZ NOT CHANGED SO GIMBAL MONITOR
PROCEEDS AS BEFORE.

ALARMS 1 MGA REGION 2 CAUSES GIMBAL LOCK LAMP TO BE LIT.

2 MGA REGION 3 CAUSES THE ISS TO BE PUT IN COARSE ALIGN AND THE NO ATT LAMP TO BE LIT IF EITHER NOT
SO ALREADY.GLOCKMON CCS CDUZ
TCF GLOCKCHK # SEE IF MAGNITUDE OF MGA IS GREATER THAN
TCF SETGLOCK # 70 DEGREES.
TCF GLOCKCHK
TCF SETGLOCKGLOCKCHK AD -70DEGS
EXTEND
BZMF SETGLOCK -1 # NO LOCK.AD -15DEGS # SEE IF ABS MGA GREATER THAN 85 DEGREES
EXTEND
BZMF NOGIMRUNCAF BIT4 # IF SO, SYSTEM SHOULD BE IN COARSE ALIGN
EXTEND # TO PREVENT GIMBAL RUNAWAY.RAND CHAN12
CCS A
TCF NOGIMRUNTC IBNKCALL
CADR SETCOARSCAF SIX # ENABLE ISS ERROR COUNTERS IN 60 MS.
TC WAITLIST

	EBANK 2CADR	CDUIND CA+ECE	
NOGIMRUN	CAF TCF	BIT6 SETGLOCK	# TURN ON GIMBAL LOCK LAMP.
-1 SETGLOCK	CAF AD	ZERO DSPTAB +11D	# SEE IF PRESENT STATE OF GIMBAL LOCK LAMP
	MASK EXTEND	BIT6	# AGREES WITH DESIRED STATE BY HALF ADDING
	BZF	GLOCKOK	# THE TWO.
			# OK AS IS.
	MASK CCS	DSPTAB +11D A	# IF OFF, DON T TURN ON IF IMU BEING CAGED.
	TCF	GLAMPTST	# TURN OFF UNLESS LAMP TEST IN PROGRESS.
	CAF	BIT6	
	MASK CCS	IMODES30 A	
	TCF	GLOCKOK	
GLINVERT	CS MASK	DSPTAB +11D BIT6	# INVERT GIMBAL LOCK LAMP.
	AD	BIT15	# TO INDICATE CHANGE IN DSPTAB +11D.
	XCH MASK	DSPTAB +11D OCT37737	
	ADS TCF	DSPTAB +11D GLOCKOK	
GLAMPTST	TC TCF TCF	LAMPTST GLOCKOK GLINVERT	# TURN OFF UNLESS LAMP TEST IN PROGRESS.
-70DEGS	DEC	-.38888	# -70 DEGREES SCALED IN HALF-REVOLUTIONS.
-15DEGS	DEC	-.08333	

PROGRAM NAME TLIM.
#

FUNCTIONAL DESCRIPTION THIS PROGRAM MAINTAINS THE TEMP LAMP BIT 4 OF CHANNEL 11 ON THE DSKY TO AGREE WITH
THE TEMP SIGNAL FROM THE ISS BIT 15 OF CHANNEL 30 . HOWEVER, THE LIGHT WILL NOT BE TURNED OFF IF A LAMP TEST
IS IN PROGRESS.

CALLING SEQUENCE CALLED BY IMUMON ON A CHANGE OF BIT 15 OF CHANNEL 30.
#

JOBS OR TASKS INITIATED NON.

SUBROUTINES CALLED LAMPTEST.

ERASABLE INITIALIZATION FRESH START AND RESTART TURN THE TEMP LAMP OFF.
#

ALARMS TEMP LAMP TURNED ON WHEN THE IMU TEMP GOES OUT OF LIMITS.

EXIT NXTIFAIL.

OUTPUT SERVICE OF TEMP LAMP. IN A, EXCEPT FOR TLIM.

TLIM	MASK	POSMAX	# REMOVE BIT FROM WORD OF CHANGES AND SET
	TS	RUPTREG2	# DSKY TEMP LAMP ACCORDINGLY.

	CCS	IMODES30
	TCF	TEMPOK
	TCF	TEMPOK

	CAF	BIT4	# TURN ON LAMP.
	EXTEND		

	WOR	DSALMOUT
	TCF	NXTIFAIL

TEMPOK	TC	LAMPTEST	# IF TEMP NOW OK, DON T TURN OFF LAMP IF
	TCF	NXTIFAIL	# LAMP TEST IN PROGRESS.

	CS	BIT4	
	EXTEND		
	WAND	DSALMOUT	# TURN OFF LAMP
	TCF	NXTIFAIL	

PROGRAM NAME ITURNON.

#

FUNCTIONAL DESCRIPTION THIS PROGRAM IS CALLED BY IMUMON WHEN A CHANGE OF BIT 14 OF CHANNEL 30 ISS TURN-ON REQUEST IS DETECTED. UPON ENTRY, ITURNON CHECKS IF A TURN-ON DELAY SEQUENCE HAS FAILED, AND IF SO, IT EXITS. IF NOT, IT CHECKS WHETHER THE TURN-ON REQUEST CHANGE IS TO ON OR OFF. IF ON, IT SETS BIT7 OF IMODES30 TO 1 SO THAT TNONTEST WILL INITIATE THE ISS INITIALIZATION SEQUENCE. IF OFF, THE TURN-ON DELAY SIGNAL, CHANNEL 12 BIT 15, IS CHECKED AND IF IT IS ON, ITURNON EXITS. IF THE DEALY SIGNAL IS OFF, PROGRAM ALARM 00207 IS ISSUED, BIT 2 OF IMODES30 IS SET TO 1 AND THE PROGRAM EXITS.

THE SETTING OF BIT 2 OF IMODES30 ISS DELAY SEQUENCE FAIL INHIBITS THIS ROUTINE AND IMUOP FROM PROCESSING ANY CHANGES. THIS BIT WILL BE RESET BY THE ENDTNON ROUTINE WHEN THE CURRENT 90 SECOND DELAY PERIOD ENDS.

CALLING SEQUENCE FROM IMUMON WHEN ISS TURN-ON REQUEST CHANGES STATE.

JOBS OR TASKS INITIATED NONE.

SUBROUTINES CALLED ALARM, IF THE ISS TURN-ON REQUEST IS NOT PRESENT FOR 90 SECONDS.

ERASABLE INITIALIZATION FRESH START AND RESTART SET BIT 15 OF CHANNEL 12 AND BITS 2 AND 7 OF IMODES30 TO 0, AND BIT 14 OF IMODES30 TO 1.

ALARMS PROGRAM ALARM 00207 IS ISSUED IF THE ISS TURN-ON REQUEST SIGNAL IS NOT PRESENT FOR 90 SECONDS.

EXIT NXTIFAIL.

OUTPUT BIT 7 OF IMODES30 TO START ISS INITIALIZATION, OR BIT 2 OF IMODES30 AND PROGRAM ALARM 00207 TO INDICATE A FAILED TURN-ON SEQUENCE.

ITURNON	CAF	BIT2	# IF DELAY REQUEST HAS GONE OFF
	MASK	IMODES30	# PREMATURELY, DO NOT PROCESS ANY CHANGES
	CCS	A	# UNTIL THE CURRENT 90 SEC WAIT EXPIRES.

	TCF	NXTIFAIL
--	-----	----------

	CAF	BIT14	# SEE IF JUST ON OR OFF.
--	-----	-------	--------------------------

	MASK	IMODES30
--	------	----------

	EXTEND		
	BZF	ITURNON2	# IF JUST ON.

	CAF	BIT15
--	-----	-------

	EXTEND		# SEE IF DELAY PRESENT DISCRETE HAS BEEN
--	--------	--	--

	RAND	CHAN12	# SENT. IF SO, ACTION COMPLETE
--	------	--------	--------------------------------

	EXTEND	
--	--------	--

	BZF	+2
--	-----	----

	TCF	NXTIFAIL
--	-----	----------

	CAF	BIT2	# IF NOT, SET BIT TO INDICATE REQUEST NOT
--	-----	------	---

	ADS	IMODES30	# PRESENT FOR FULL DURATION.
--	-----	----------	------------------------------

	TC	ALARM
--	----	-------

	OCT	207
--	-----	-----

	TCF	NXTIFAIL
--	-----	----------



1					1
2	ITURNON2	CS	IMODES30	# SET BIT7 TO INDICATE WAIT OF 1 SAMPLE	2
3		MASK	BIT7		3
4		ADS	IMODES30		4
5		CAF	RRINIT		5
6		TS	RADMODES		6
7		TCF	NXTIFAIL		7
8					8
9	RRINIT	OCT	00102		9
10					10
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PROGRAM NAME IMUCAGE.

#

FUNCTIONAL DESCRIPTION THIS PROGRAM PROCESSES CHANGES OF THE IMUCAGE INBIT, CHANNEL 30 BITS 11. IF THE BIT
CHANGES TO 0 CAGE BUTTON PRESSED , THE ISS IS CAGED ICDU ZERO + COARSE ALIGN + NO ATT LAMP UNTIL THE
ASTRONAUT SELECTS ANOTHER PROGRAM TO ALIGN THE ISS. ANY PULSE TRAINS TO THE ICDU S AND GYRO S ARE TERMINATED,
THE ASSOCIATE OUTCOUNTERS ARE ZEROED AND THE GYRO S ARE DE-SELECTED. NO ACTION OCCURS WHEN THE BUTTON IS
RELEASED INBIT CHANGES TO 1 .

#

CALLING SEQUENCE BY IMUMON WHEN IMU CAGE BIT CHANGES.

#

JOBS OR TASKS INITIATED NONE.

#

SUBROUTINES CALLED CAGESUB.

#

ERASABLE INITIALIZATION FRESH START AND RESTART SET BIT 11 OF IMODES30 TO 1.

#

ALARMS NONE.

#

EXIT NXTIFAIL.

#

OUTPUT ISS CAGED, COUNTERS ZEROED, PULSE TRAINS TERMINATED AND NO ATT LAMP LIT.

IMUCAGE	CCS	A	# NO ACTION OF GOING OFF.
	TCF	ISSZERO	
	CS	OCT77000	# TERMINATE ICDU, RCDU, GYRO PULSE TRAINS
	EXTEND		
	WAND	CHAN14	
	CS	OCT272	# KNOCK DOWN DISPLAY INERTIAL DATA, IMU
	EXTEND		# ERROR COUNTER ENABLE, ZERO ICDU, COARSE
	WAND	CHAN12	# ALIGN ENABLE, RR ERROR COUNTER ENABLE.
	CS	ENGONBIT	# INSURE ENGONFLG IS CLEAR.
	MASK	FLAGWRD5	
	TS	FLAGWRD5	
	CS	PRI030	# TURN ENGINE OFF.
	EXTEND		
	RAND	DSALMOUT	
	AD	BIT14	
	EXTEND		
	WRITE	DSALMOUT	# FORCE BIT14 1, BIT13 0.
	TC	CAGESUB1	
	TC	IBNKCALL	# KNOCK DOWN TRACK, REFSMMAT, DRIFT FLAGS
	CADR	RNDREFDR	
	CS	ZERO	
	TS	CDUXCMD	
	TS	CDUYCMD	

CS	OCT740	# HAVING WAITED AT LEAST 27 MCT FROM
EXTEND		# GYRO PULSE TRAIN TERMINATION, WE CAN
WAND	CHAN14	# DE-SELECT THE GYROS.
TCF	NXTIFAIL	

PROGRAM NAME IMUOP.

#

FUNCTIONAL DESCRIPTION THIS PROGRAM PROCESSES CHANGES IN THE ISS OPERATE DISCRETE, BIT 9 OF CHANNEL 30.

IF THE INBIT CHANGES TO 0, INDICATING ISS ON, IMUOP GENERALLY SETS BIT 7 OF IMODES30 TO 1 TO REQUEST ISS

INITIALIZATION VIA TNONTEST. AN EXCEPTION IS DURING A FAILED ISS DELAY DURING WHICH BIT 2 OF IMODES30 IS SET

TO 1 AND NO FURTHER INITIALIZATION IS REQUIRED. WHEN THE INBIT CHANGES TO 1, INDICATING ISS OFF, IMUSEFLG IS

TESTED TO SEE IF ANY PROGRAM WAS USING THE ISS. IF SO, PROGRAM ALARM 00214 IS ISSUED.

#

CALLING SEQUENCE BY IMUMON WHEN BIT 9 OF CHANNEL 30 CHANGES.

#

JOBS OR TAKS INITIATED NONE.

#

SUBROUTINES CALLED ALARM, IF ISS IS TURNED OFF WHILE IN USE.

#

ERASABLE INITIALIZATION ON FRESH START AND RESTART, BIT 9 OF IMODES30 IS SET TO 1 EXCEPT WHEN THE GIMBAL LOCK

LAMP IS ON, IN WHICH CASE IT IS SET TO 0. THIS PREVENTS ICDU ZERO BY TNONTEST WITH THE ISS IN GIMBAL LOCK.

#

ALARMS PROGRAM ALARM 00214 IF THE ISS IS TURNED OFF WHILE IN USE.

#

EXIT NXTIFAIL.

#

OUTPUT ISS INITIALIZATION REQUEST IMODES30 BIT 7 OR PROGRAM ALARM 00214.

IMUOP	EXTEND	
	BZF	IMUOP2

CS	IMODES33	# DISABLE DAP
MASK	BIT6	
ADS	IMODES33	

TC	IBNKCALL	# KNOCK DOWN TRACK, REFSMMAT, DRIFT FLAGS
CADR	RNDREFDR	

CS	BITS7 8	# KNOCK DOWN RENDEZVOUS, IMUUSE FLAGS
----	---------	---------------------------------------

MASK	FLAGWRD0	
------	----------	--

XCH	FLAGWRD0	# IF GOING OFF, ALARM IF PROG USING IMU.
-----	----------	--

COM		
-----	--	--

MASK	IMUSEFLG	
------	----------	--

CCS	A	
-----	---	--

TCF	NXTIFAIL	
-----	----------	--

TC	ALARM	
----	-------	--

OCT	214	
-----	-----	--

TCF	NXTIFAIL	
-----	----------	--

IMUOP2	CAF	BIT2	# SEE IF FAILED ISS TURN-ON SEQ IN PROG.
--------	-----	------	--

MASK	IMODES30	
------	----------	--

CCS	A	
-----	---	--

TCF	NXTIFAIL	# IF SO, DON T PROCESS UNTIL PRESENT 90
-----	----------	---

TCF	ITURNON2	# SECONDS EXPIRES.
-----	----------	--------------------

PROGRAM NAME PIPFAIL

FUNCITONAL DESCRIPTION THIS PROGRAM PROCESSES CHANGES OF BIT 13 OF CHANNEL 33, PIPA FAIL. IT SETS BIT 10 OF
IMODES30 TO AGREE. IT CALLS SETISSW IN CASE A PIPA FAIL NECESSITATES AN ISS WARNING. IF NOT, I.E., IMODES30
BIT 1 1, AND A PIPA FAIL IS PRESENT AND THE ISS NOT BEING INITIALIZED, PROGRAM ALARM 0212 IS ISSUED.

CALLING SEQUENCE BY C33TEST ON CHANGES OF CHANNEL 33 BIT 13.

JOBS OR TASKS INITIATED NONE.

SUBROUTINES CALLED 1 SETISSW, AND 2 ALARM SEE FUNCITONAL DESCRIPTION .

ERASABLE INITIALZIZATION SEE IMUMON FOR INITIALIZATION OF IMODES30. THE RELEVANT BITS ARE 5, 7, 8, 9, AND 10.

ALARMS PROGRAM ALARM 00212 IF PIPA FAIL IS PRESENT BUT NEITHER ISS WARNING IS TO BE ISSUED NOR THE ISS IS
BEING INITIALIZED.

EXIT NXTFL33.

OUTPUT PROGRAM ALARM 00212 AND ISS WARNING MAINTENANCE.

PIPFAIL	CCS	A	# SET BIT10 IN IMODES30 SO ALL ISS WARNING
	CAF	BIT10	# INFO IS IN ONE REGISTER.

	XCH	IMODES30
	MASK	-BIT10
	ADS	IMODES30

	TC	SETISSW
--	----	---------

	CS	IMODES30	# IF PIP FAIL DOESN T LIGHT ISS WARNING, DO
	MASK	BIT1	# A PROGRAM ALARM IF IMU OPERATING BUT NOT
	CCS	A	# CAGED OR BEING TURNED ON.
	TCF	NXTFL33	

	CA	IMODES30	
	MASK	OCT1720	
	CCS	A	
	TCF	NXTFL33	# ABOVE CONDITION NOT MET.

	TC	ALARM
	OCT	212
	TCF	NXTFL33

PROGRAM NAMES DNTMFAST, UPTMFAST

FUNCTIONAL DESCRIPTION THESE PROGRAMS PROCESS CHANGES OF BITS 12 AND 11 OF CHANNEL 33. IF A BIT CHANGES TO A 0, A PROGRAM ALARM IS ISSUED. THE LAARMS ARE

#	BIT	ALARM	CAUSE
#	---	-----	-----
#	12	01105	DOWNLINK TOO FAST
#	11	01106	UPLINK TOO FAST

CALLING SEQUENCE BY C33TEST ON A BIT CHANGE.

SUBROUTINES CALLED ALARM, IF A BIT CHANGES TO A 0.

ERASABLE INITIALIZATION FRESH START OR RESTART, BITS 12 AND 11 OF IMODES33 ARE SET TO 1.

ALARMS SET FUNCTGIONAL DESCRIPTION.

EXIT NXTFL33.

OUTPUT PROGRAM ALARM ON A BIT CHANGE TO 0.

DNTMFAST	CCS	A	# DO PROG ALARM IF TM TOO FAST.
	TCF	NXTFL33	
	TC	ALARM	
	OCT	1105	
	TCF	NXTFL33	

UPTMFAST	CCS	A	# SAME AS DNLINK TOO FAST WITH DIFFERENT
	TCF	NXTFL33	# ALARM CODE.
	TC	ALARM	
	OCT	1106	
	TCF	NXTFL33	

PROGRAM NAME SETISSW

#

FUNCTIONAL DESCRIPTION THIS PROGRAM TURNS THE ISS WARNING LAMP ON AND OFF CHANNEL 11 BIT 1 1 FOR ON,
0 FOR OFF DEPENDING ON THE STATUS OF IMODES30 BITS 13 IMU FAIL AND 4 INHIBIT IMU FAIL, 12 ICDU FAIL AND
3 INHIBIT ICDU FAIL, AND 10 PIPA FAIL AND 1 INHIBIT PIPA FAIL. THE LAMP IS LEFT ON IF A LAMP TEST IS IN
PROGRESS.

#

CALLING SEQUENCE CALLED BY IMUMON ON CHANGES TO IMU FAIL AND ICDU FAIL. CALLED BY IFAILOK AND PFAILOK UPON
REMOVAL OF THE FAIL INHIBITS. CALLED BY PIPFAIL WHEN THE PIPA FAIL DISCRETE CHANGES. IT IS CALLED BY PIPUSE
SINCE THE PIPA FAIL PROGRAM ALARM MAY NECESSITATE AN ISS WARNING, AND LIKEWISE BY PIPFREE WHEN THE ALARM DEPARTS
AND IT IS CALLED BY IMUZERO3 AND ISSUP AFTER THE FAIL INHIBITS HAVE BEEN REMOVED.

#

JOBS OR TASKS INITIAZTED NONE.

#

SUBROUTINES CALLED NONE.

#

ERASABLE INITIALIZATION

#

1 IMODES30 -- SEE IMUMON.

2 IMODES33 BIT 1 0 LAMP TEST NOT IN PROGRESS .

#

ALARMS ISS WARNING.

#

THE FOLLOWING PROGRAM ALARMS WILL SHOW WHICH FAILURE CAUSED THE ISS WARN

PROGRAM ALARM 00777 PIPA FAIL

PROGRAM ALARM 03777 ICDU FAIL

PROGRAM ALARM 04777 ICDU, PIPA FAILS

PROGRAM ALARM 07777 IMU FAIL

PROGRAM ALARM 10777 IMU, PIPA FAILS

PROGRAM ALARM 13777 IMU, ICDU FAILS

PROGRAM ALARM 14777 IMU, ICDU, PIPA FAILS

#

EXIT VIA Q.

#

OUTPUT ISS WARNING LAMP SET PROPERLY.

SETISSW

CAF

OCT15

SET ISS WARNING USING THE FAIL BITS IN

MASK

IMODES30

BITS 13, 12, AND 10 OF IMODES30 AND THE

EXTEND

FAILURE INHIBIT BITS IN POSITIONS

MP

BIT10

4, 3, AND 1.

CA

IMODES30

EXTEND

ROR

LCHAN

0 INDICATES FAILURE

COM

MASK

OCT15000

CCS

A

TCF

ISSWON

FAILURE.

ISSWOFF

CAF

BIT1

DON T TURN OFF ISS WARNING IF LAMP TEST

MASK

IMODES33

IN PROGRESS.

	CCS	A	
	TC	Q	
	CS	BIT1	
	EXTEND		
	WAND	DSALMOUT	
	TC	Q	
ISSWON	EXTEND		
	QXCH	ITEMP6	
	TC	VARALARM	# TELL EVERYONE WHAT CAUSED THE ISS WARNING
	CAF	BIT1	
	EXTEND		
	WOR	DSALMOUT	
	TC	ITEMP6	
CAGESUB	CS	BITS6 15	# SET OUTBITS AND INTERNAL FLAGS FOR
	EXTEND		# SYSTEM TURN-ON OR CAGE. DISABLE THE
	WAND	CHAN12	# ERROR COUNTER AND REMOVE THE IMU DELAY COMP.
	CAF	BITS4 5	# SEND ZERO AND COARSE.
	EXTEND		
	WOR	CHAN12	
CAGESUB1	CS	DSPTAB +11D	# TURN ON NO ATT LAMP
	MASK	OC40010	
	ADS	DSPTAB +11D	
CAGESUB2	CS	IMODES30	# SET FLAGS TO INDICATE CAGING OR TURN-ON
	MASK	OCT75	# AND INHIBIT ALL ISS WARNING INFO
	ADS	IMODES30	
	CS	IMODES33	# DISABLE DAP AUTO AND HOLD MODES
	MASK	BIT6	
	ADS	IMODES33	
	TC	Q	
IMUFAIL	EQUALS	SETISSW	
ICDUFAIL	EQUALS	SETISSW	

JUMP TABLES AND CONSTANTS.

IFAILJMP TCF ITURNON # CHANNEL 30 DISPATCH.

TCF IMUFAIL

TCF ICDUFAIL

TCF IMUCAGE

30RDMSK OCT 76400 # BIT 10 NOT SAMPLED HERE .

TCF IMUOP

C33JMP TCF PIPFAIL # CHANNEL 33 DISPATCH.

TCF DNTMFAST

TCF UPTMFAST

SUBROUTINE TO SKIP IF LAMP TEST NOT IN PROGRESS.

LAMPTST CS IMODES33 # BIT 1 OF IMODES33 1 IF LAMP TEST IN

MASK BIT1 # PROGRESS.

CCS A

INCR Q

TC Q

33RDMSK EQUALS PRI016

OC40010 OCT 40010

OCT54 OCT 54

OCT75 OCT 75

OCT272 OCT 00272

BITS7 8 OCT 300

OCT1720 OCT 1720

OCT740 OCT 00740

OCT15000 EQUALS PRI015

OCT77000 OCT 77000

BITS6 15 OCT 40040

-BIT10 OCT -1000

90SECS DEC 9000

120MS OCT14

DEC12

GLOCKOK EQUALS RESUME

PROGRAM NAME RRAUTCHK

#

FUNCITONAL DESCRIPTION

RRAUTCHK IS THE RENDEZFOUS RADAR INBIT MONITOR. INITIALLY THE RR

POWER ON AUTO CHAN 33 BIT 2 INBIT IS CHECKED. IF NO CHANGE, THE

PROGRAM EXITS TO RRCDOCHK. IF A CHANGE, RADMOES IS UPDATED

AND A CHECK MADE IF RR POWER HAS JUST COME ON. IF JUST OFF, A CHECK

IS MADE TO SEE IF A PROGRAM WAS USING THE RR STATE BIT 7 . IF NO,

THE PROGRAM EXITS TO RRCDOCHK. IF YES, PROGRAM ALARM 00514

IS REQUESTED BEFORE EXITING TO RRCDOCHK. IF RR POWER HAS JUST COME

ON, A CHECK IS MADE TO SEE IF A PROGRAM WAS USING THE RR STATE BIT 7

SEQUENCE. IF NO, RADMODES IS UPDATED TO INDICATE RR CDU ZERO AND

RR TURN-ON SEQUENCE BITS 13, 1 . A 10 MILLISECOND WAITLIST CALL

IS THEN SET FOR RRTURNON BEFORE THE PROGRAM EXITS TO NORRGMON.

#

CALLING SEQUENCE

T4RUPT EVERY 480 MILLISECONDS

#

ERASABLE INITIALIZATION REQUIRED

RADMODES, STATE.

#

SUBROUTINES CALLED

WAITLIST.

#

JOBS OR TASKS INITIATED

RRTURNON

#

ALARMS PROGRAM ALARM 00514 -- RADAR GOES OUT OF AUTO MODE WHILE BEING

USED

#

EXIT RRCDOCHK, NORRGMON

RRAUTCHK CA RADMODES # SEE IF CHANGE IN RR AUTO MODE BIT.

EXTEND

RXOR CHAN33

MASK AUTOMBIT

EXTEND

BZF RRCDOCHK

LXCH RADMODES

EXTEND

UPDATE RADMODES.

RXOR LCHAN

MASK OCT05776

CLR CONT. DES., REMODE, REPOS, CDUZERO,

TS RADMODES

AND TURNON BITS.

MASK BIT2

SEE IF JUST ON.

CCS A

TCF RRCDOCHK -3

OFF. GO DISABLE RR CDU ERROR COUNTERS.

CA OCT10001

SET RRCDUZRO AND TURNON BITS.

ADS RADMODES

	CAF	ONE
	TC	WAITLIST
	EBANK	LOSCOUNT
	2CADR	RRTURNON
	TCF	NORRGMON
OCT05776	OCT	5776

PROGRAM NAME RRCDUCHK

#

FUNCTIONAL DESCRIPTION

RRCDUCHK CHECKS FOR RR CDU FAIL CHAN 30 BIT 7 . INITIALLY THE

RR CDU FAIL BIT IS SAMPLED CHAN 30 BIT 7 . IF NO CHANGE, THE

PROGRAM EXITS TO RRGIMON. IF A CHANGE, THE RR AUTO MODE

RADMODES BIT 2 BIT IS CHECKED. IF NOT IN RR AUTO MODE, THE

PROGRAM EXITS TO NORRGMOON. IF IN AUTO MODE, RADMODES BIT 7

RR CDU OK IS UPDATED AND IF P-20 IS OPERATING PROGRAM ALARM 00515 IS

REQUESTED. CONTROL IS TRANSFERRED TO SETTRKF TO UPDATE

THE TRACKER FAIL LAMP DSPTAB+11D BIT 8 . CONTROL RETURNS TO

RRGIMON.

#

CALLING SEQUENCE

EVERY 480 MILLISECONDS FROM RRAUTCHK VIA T4RUPT UNLESS A

TURN-ON SEQUENCE HAS JUST BE INITIATED.

#

ERASABLE INITIALIZATION REQUIRED

RADMODES

#

SUBROUTINES CALLED

SETTRKF

#

JOBS OR TASKS INITIATED

NONE

#

ALARMS

TRACKER FAIL

PROGRAM ALARM 00515 -- RRCDU FAIL DURING P-20

#

EXIT

RRGIMON, NORRGMON

-3 CS BIT2

EXTEND

WAND CHAN12

AT TURNON, DISABLE CDU ERROR COUNTERS.

RRCDUCHK CA RADMODES

LAST SAMPLED BIT IN RADMODES.

EXTEND

RXOR CHAN30

MASK RCDUFBIT

EXTEND

BZF RRGIMON

CAF AUTOMBIT

IF RR NOT IN AUTO MODE, DON T CHANGE BIT

MASK RADMODES

7 OF RADMODES. IF THIS WERE NOT DONE,

CCS A

THE TRACKER FAIL MIGHT COME ON WHEN

TCF NORRGMON

JUST READING LR DATA.

CAF RCDUFBIT

SET BIT 7 OF RADMODES FOR SETTRKF.

	LXCH	RADMODES	# UPDATE RADMODES.
	EXTEND		
	RXOR	L	
	TS	RADMODES	
	CA	RADMODES	# DID RR CDU FAIL
	MASK	RCDUFBIT	
	CCS	A	
	TCF	TRKFLCDU	# NO
	CS	FLAGWRDO	# RNDVFLG P20 OR P22 OPERATING
	MASK	RNDVZBIT	
	CCS	A	
	TCF	TRKFLCDU	# NO
	TC	ALARM	# YES
	OCT	00515	
TRKFLCDU	TC	SETTRKF	# UPDATE TRAKER FAIL LAMP ON DSKY.

PROGRAM NAME RRGIMON

#

FUNCTIONAL DESCRIPTION

RRGIMON IS THE RR GIMBAL LIMIT MONITOR. INITIALLY THE FOLLOWING IS

CHECKED REMOD, RR CDU S BEING ZEROED, REPOSITION, AND RR

NOT IN AUTO MODE RADMODES BITS 14, 13, 11, 2 . IF ANY OF THESE

EXIST THE PROGRAM EXITS TO GPMATRIX. IF NONE ARE PRESENT RRLIMCHK

IS CALLED TO SEE IF THE PRESENT RR CDU ANGLES OPTY, OPTX ARE WITHIN

THE LIMITS OF THE CURRENT MODE. IF WITHIN LIMITS, THE PROGRAM EXITS

TO NORRGMON. IF NOT WITHIN LIMITS, THE REPOSITION FLAG RADMODES

BIT 11 IS SET, THE RR AUTO TRACKER AND RR ERROR COUNTER

CHAN 12 BITS 14, 2 ARE DISABLED, AND A 20 MILLISECOND WAITLIST

CALL IS SET FOR DORREPOS AFTER WHICH THE PROGRAM EXITS TO NORRGMON.

#

CALLING SEQUENCE

EVERY 480 MILLISECONDS FROM RRCDUCHK VIA T4RUPT UNLESS TURN-ON

HAS JUST BEEN INITIATED VIA RRAUTCHK OR IF THERE HAS BEEN A CHANGE IN

THE RR CDU FAIL BIT CHAN 30 BIT 7 AND THE RR IS NOT IN THE AUTO MODE

RADMODES BIT 2 .

#

ERASABLE INITIALIZATION RADMODES

#

SUBROUTINES CALLED

RRLIMCHK, WAITLIST

#

JOBS OR TASKS INITIATED

DORREPOS

#

ALARMS

NONE

#

EXIT

NORRGMON

RRGIMON CAE FLAGWRD5 # IS NO ANGLE MONITOR FLAG SET

MASK NORRMBIT

CCS A

TCF NORRGMON # YES -- SKIP LIMIT CHECK

CS FLAGWRD7 # IS SERVICER RUNNING

MASK AVEGFBIT

CCS A

TCF +5 # NO. DO R25

CA FLAGWRD6 # YES. IS MUNFLAG SET

MASK MUNFLBIT

CCS A

TCF NORRGMON # YES. DON T DO R25

+5 CAF OCT32002 # INHIBIT BY REMODE, ZEROING, MONITOR.

MASK RADMODES # OR RR NOT IN AUTO.

CCS A

TCF NORRGMON

	TC	RRLIMCHK	# SET IF ANGLES IN LIMITS.
	ADRES	CDUT	
	TCF	MONREPOS	
	TCF	NORRGMON	# ADDITIONAL CODING MAY GO HERE .
MONREPOS	CAF	REPOSBIT	# SET FLAG TO SHOW REPOSITION IN PROGRESS.
	ADS	RADMODES	
	CS	OCT20002	# DISABLE TRACKER AND ERROR COUNTER.
	EXTEND		
	WAND	CHAN12	
	CAF	TWO	
	TC	WAITLIST	
	EBANK	LOSCOUNT	
	2CADR	DORREPOS	
	TCF	NORRGMON	
OCT32002	OCT	32002	
OCT20002	OCT	20002	
OCT02100	OCT	02100	# P20, P22 MASK BITS.


```
1 # PROGRAM NAME  GPMATRIX  DAPT4S  MCD. NO. 2 DATE  OCTOBER 27, 1966
2 #
3 #
4 # AUTHOR  JOHNATHAN D. ADDLELSTON  ADAMS ASSOCIATES
5 #
6 # MODIFIED  7FEB. 1968 BY P. S. WEISSMAN TO DELETE COMPUTATION OF MR12 AND MR13, WHICH ARE NO LONGER REQUIRED.
7 #
8 # THIS PROGRAM CALCULATES ALL THE SINGLE-PRECISION MATRIX ELEMENTS WHICH ARE USED BY LEM DAP TO TRANSFORM VECTORS
9 # FROM GIMBAL TO PILOT  BODY  AXES AND BACK AGAIN.  THESE ELEMENTS ARE USED EXCLUSIVELY BY BASIC LANGUAGE ROUTINES
10 # AND THEREFORE ARE NOT ARRAYED FOR USE BY INTERPRETIVE PROGRAMS.
11 #
12 # CALLING SEQUENCE  GPMATRIX IS TRANSFERRED TO FROM DAPT4S AND IS THUS EXECUTED 4 TIMES A SECOND BY T4RUPT.
13 # DAPT4S IS LISTED IN T4JUMP TABLE TWICE EXPLICITLY AND ALSO OCCURS AFTER RRAUTCHK  WHICH IS ALSO LISTED TWICE .
14 #
15 # SUBROUTINES CALLED  SPSIN, SPCOS.
16 #
17 # NORMAL EXIT MODE  TCF RESUME
18 #
19 # ALARM AND ABORT MODES  NONE.
20 #
21 # INPUT  CDUX, CDUY, CDUZ.
22 #
23 # OUTPUT  M11, M21, M32, M22, M32.
24 #
25 # AOG  CDUX, AIG  CDUY, AMG  CDUZ  MNEMONIC IS  OIM  XYZ
26 #
27 #          *      *      SING MG          0          1      *
28 #          M      *      COS MG COS OG      SIN OG          0      *
29 #          GP      *      -COS MG SIN OG      COS OG          0      *
30 #
31 #          *      *      0          COS OG /COS MG      -SIN OG /COS MG      *
32 #          M      *      0          SIN OG          COS OG          *
33 #          PG      *      1          -SIN MG COS OG /COS MG  SIN MG SIN OG /COS MG      *
34 #
35 #          EBANK  M11
36 DAPT4S      EQUALS  GPMATRIX
37
38 # T4RUPT DAP LOGIC
39
40 GPMATRIX    CAE    CDUZ      # SINGLE ENTRY POINT
41             TC     SPSIN      # SIN CDUZ      SIN MG
42             TS     M11        # SCALED AT 1
43
44             CAE    CDUZ
45             TC     SPCOS      # COS CDUZ      COS MG
46             TS     COSMG      # SCALED AT 1  ONLY A FACTOR
47
48             CAE    CDUX
49             TC     SPSIN      # SIN CDUX      SIN OG
50             TS     M22        # SCALED AT 1  ALSO IS MR22
51
52             CS     M22
```

```
1
2      EXTEND
3      MP      COSMG      # -SIN OG COS MG
4      TS      M31      # SCALED AT 1
5
6      CAE      CDUX
7      TC      SPCOS      # COS CDUX      COS OG
8      TS      M32      # SCALED AT 1      ALSO IS MR23
9
10     EXTEND
11     MP      COSMG      # COS OG COS MG
12     TS      M21      # SCALED AT 1
13
14     TC      RESUME
15
16     NORRGMON      EQUALS      DAPT4S
17     ENDDAPT4      EQUALS      RESUME
18
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PROGRAM DESCRIPTION

AUTHOR J S MILLER

MODIFIED 6 MARCH 1968 BY P S WEISSMAN TO SET UP JOB FOR 1/ACCS WHEN THE MASKS ARE CHANGED.

THIS ROUTINE IS ATTACHED TO T4RUPT, AND IS ENTERED EVERY 480 MS. ITS FUNCTION IS TO EXAMINE THE LOW 8 BITS OF CHANNEL 32 TO SEE IF ANY ISOLATION-VALVE CLOSURE BITS HAVE APPEARED OR DISAPPEARED THE CREW IS WARNED OF JET FAILURES BY LAMPS LIT BY THE GRUMMAN FAILURE-DETECTION CIRCUITRY THEY MAY RESPOND BY OPERATING SWITCHES WHICH ISOLATE PAIRS OF JETS FROM THE PROPELLANT TANKS AND SET BITS IN CHANNEL 32. IN THE EVENT THAT CHANNEL 32 BITS DIFFER FROM PVALVEST, THE RECORD OF ACTIONS TAKEN BY THIS ROUTINE, THE APPROPRIATE BITS IN CH5MASK CH6MASK, USED BY THE DAP JET-SELECTION LOGIC, ARE UPDATED, AS IS PVALVEST. TO SPEED UP SHORTEN THE ROUTINE, NO MORE THAN ONE CHANGE IS ACCEPTED PER ENTRY. THE HIGHEST-NUMBERED BIT IN CHANNEL 32 WHICH REQUIRES ACTION IS THE ONE PROCESSED.

THE CODING IN THE FAILURE MONITOR HAS BEEN WRITTEN SO AS TO HAVE ALMOST COMPLETE RESTART PROTECTION. FOR EXAMPLE, NO ASSUMPTION IS MADE WHEN SETTING A CH5MASK BIT TO 1 THAT THE PREVIOUS STATE IS 0, ALTHOUGH IT OF COURSE SHOULD BE. ONE CASE WHICH MAY BE SEEN TO EVADE PROTECTION IS THE OCCURRENCE OF A RESTART AFTER UPDATING ONE OR BOTH DAP MASK-WORDS BUT BEFORE UPDATING PVALVEST, COUPLED WITH A CHANGE IN THE VALVE-BIT BACK TO ITS FORMER STATE. THE CONSEQUENCE OF THIS IS THAT THE NEXT ENTRY WOULD NOT SEE THE CHANGE INCOMPLETELY INCORPORATED BY THE LAST PASS BECAUSE IT WENT AWAY AT JUST THE RIGHT TIME, BUT THE DAP MASK-WORDS WILL BE INCORRECT. THIS COMBINATION OF EVENTS SEEMS QUITE REMOTE, BUT NOT IMPOSSIBLE UNLESS THE CREW OPERATES THE SWITCHES AT HALF-SECOND INTERVALS OR LONGER. IN ANY EVENT, A DISAGREEMENT BETWEEN REALITY AND THE DAP MASKS WILL BE CURED IF THE MISINTERPRETED SWITCH IS REVERSED AND THEN RESTORED TO ITS CORRECT POSITION SLOWLY.

CALLING SEQUENCE

TCF RCSMONIT IN INTERRUPT MODE, EVERY 480 MS.

EXIT TCF RCSMONEX ALL PATHS EXIT VIA SUCH AN INSTRUCTION
RCSMONEX EQUALS RESUME

ERASABLE INITIALIZATION REQUIRED

VIA FRESH START PVALVEST +0 ALL JETS ENABLED
CH5MASK, CH6MASK +0 ALL JETS OK

OUTPUT CH5MASK CH6MASK UPDATED 1 S WHERE JETS NOT TO BE USED, IN CHANNEL 5 6 FORMAT
PVALTEST UPDATED 1.5 WHEN VALVE CLOSURES HAVE BEEN TRANSLATED INTO CH5MASK CH6MASK CHAN 32 FORMAT
JOB TO DO 1/ACCS.

DEBRIS A, L, Q AND DEBRIS OF NOVAC.

SUBROUTINE CALLED NOVAC.

EBANK CH5MASK

BANK 23
SETLOC RCSMONT
BANK

COUNT* \$\$/T4RCS

RCSMONIT EQUALS RCSMON

RCSMON CS ZERO

EXTEND

RXOR CHAN32

PICK UP + INVERT INVERTED CHANNEL 32.

MASK LOW8

KEEP JET-FAIL BITS ONLY.

TS Q

CS PVALVEST

- -

MASK Q

FORM PC + PC.

TS L

P PREVIOUS ISOLATION VALVE STATE,

CS Q

C CURRENT VALVE STATE CH 32 .

MASK PVALVEST

ADS L

RESULT NZ INDICATES ACTION REQUIRED.

EXTEND

BZF RCSMONEX

QUIT IF NO ACTION REQUIRED.

EXTEND

MP BIT7

MOVE BITS 8 - 1 OF A TO 14 - 7 OF L.

XCH L

ZERO TO L IN THE PROCESS.

-3 INCR L

DOUBLE

BOUND TO GET OVERFLOW IN THIS LOOP.

OVSK

SINCE WE ASSURED INITIAL NZ IN A.

TCF -3

INDEX L

CA BIT8 -1

SAVE THE RELEVANT BIT 8 - 1 .

TS Q

MASK PVALVEST

LOOK AT PREVIOUS VALVE STATE BIT.

CCS A

TCF VOPENED

THE VALVE HAS JUST BEEN OPENED.

CS CH5MASK

THE VALVE HAS JUST BEEN CLOSED.

INDEX L

MASK 5FAILTAB

ADS CH5MASK

SET INHIBIT BIT FOR CHANNEL 5 JET.

CS CH6MASK

INDEX L

MASK 6FAILTAB

ADS CH6MASK

SET INHIBIT BIT FOR CHANNEL 6 JET.

CA Q

ADS PVALVEST

RECORD ACTION TAKEN.

TCF 1/ACCFIX

SET UP 1/ACCJOB AND EXIT.

VOPENED	INDEX	L	# A VALVE HAS JUST BEEN OPENED.
	CS	5FAILTAB	
	MASK	CH5MASK	
	TS	CH5MASK	# REMOVE INHIBIT BIT FOR CHANNEL 5 JET.
	INDEX	L	
	CS	6FAILTAB	
	MASK	CH6MASK	
	TS	CH6MASK	# REMOVE INHIBIT BIT FOR CHANNEL 6 JET.
	CS	Q	
	MASK	PVALVEST	
	TS	PVALVEST	# RECORD ACTION TAKEN.
1/ACCFIX	CAF	PRI027	# SET UP 1/ACCS SO THAT THE SWITCH CURVES
	TC	NOVAC	# FOR TJETLAW CAN BE MODIFIED IF CH5MASK
	EBANK	AOSQ	# HAS BEEN ALTERED.
	2CADR	1/ACCJOB	
	TCF	RCSMONEX	# EXIT.
5FAILTAB	EQUALS	-1	# CH 5 JET BIT CORRESPONDING TO CH 32 BIT
	OCT	00040	# 8
	OCT	00020	# 7
	OCT	00100	# 6
	OCT	00200	# 5
	OCT	00010	# 4
	OCT	00001	# 3
	OCT	00004	# 2
	OCT	00002	# 1
6FAILTAB	EQUALS	-1	# CH 6 JET BIT CORRESPONDING TO CH 32 BIT
	OCT	00010	# 8
	OCT	00020	# 7
	OCT	00004	# 6
	OCT	00200	# 5
	OCT	00001	# 4
	OCT	00002	# 3
	OCT	00040	# 2
	OCT	00100	# 1

BANK 22
SETLOC DOWNTLM
BANK

EBANK DNTMBUFF

SPECIAL DOWNLINK OP CODES

#	OP CODE	ADDRESS	EXAMPLE	SENDS...	BIT 15	BITS 14-12	BITS 11-0
#	-----	-----	-----	-----	-----	-----	-----
#	1DNADR	TIME2		2 AGC WDS	0	0	ECADR
#	2DNADR	TEPHM		4 AGC WDS	0	1	ECADR
#	3DNADR	VGBODY		6 AGC WDS	0	2	ECADR
#	4DNADR	STATE		8 AGC WDS	0	3	ECADR
#	5DNADR	UPBUFF		10 AGC WDS	0	4	ECADR
#	6DNADR	DSPTAB		12 AGC WDS	0	5	ECADR
#	DNCHAN	30		CHANNELS	0	7	CHANNEL
#							ADDRESS
#	DNPTR	NEXTLIST		POINTS TO NEXT	0	6	ADRES
#				LIST			
#							

DOWNLIST FORMAT DEFINITIONS AND RULES --

- # 1. END OF A LIST -XDNADR X 1 TO 6 , -DNPTR, OR -DNCHAN.
2. SNAPSHOT SUBLIST LIST WHICH STARTS WITH A -1DNADR.
3. SNAPSHOT SUBLIST CAN ONLY CONTAIN 1DNADRS.
4. TIME2 1DNADR MUST BE LOCATED IN THE CONTROL LIST OF A DOWNLIST.
5. ERASABLE DOWN TELEMETRY WORDS SHOULD BE GROUPED IN SEQUENTIAL
LOCATIONS AS MUCH AS POSSIBLE TO SAVE STORAGE USED BY DOWNLINK LISTS.

	COUNT*	\$\$/DLIST	
ERASZERO	EQUALS	7	
UNKNOWN	EQUALS	ERASZERO	
SPARE	EQUALS	ERASZERO	# USE SPARE TO INDICATE AVAILABLE SPACE
LOWIDCOD	OCT	77340	# LOW ID CODE
NOMDNLIST	EQUALS	LMCSTADL	# FRESH START AND POST P27 DOWNLIST
AGSLIST	EQUALS	LMAGSIDL	
UPDNLIST	EQUALS	LMAGSIDL	# UPDATE PROGRAM P27 DOWNLIST

LM ORBITAL MANEUVERS LIST

#

----- CONTROL LIST -----

LMORBMDL	EQUALS		# SEND ID BY SPECIAL CODING
	DNPTR	LMORBM01	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	1DNADR	DELLT4	# DELLT4,+1
	3DNADR	RTARG	# RTARG,+1...+5
	1DNADR	ELEV	# ELEV,+1
	1DNADR	TEVENT	# TEVENT,+1
	6DNADR	REFSMMAT	# REFSMMAT +0...+11D
	1DNADR	TCSI	# TCSI,+1
	3DNADR	DELVEET1	# DELVEET1 +0...+5
	3DNADR	VGIG	# VGIG +0...+5
	1DNADR	DNLRVELZ	# DNLRVELZ,DNLRALT
	1DNADR	TPASS4	# TPASS4,+1
	DNPTR	LMORBM02	# COMMON DATA
	1DNADR	TIME2	# TIME2/1
	DNPTR	LMORBM03	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	DNPTR	LMORBM04	# COMMON DATA
	2DNADR	POSTORKU	# POSTORKU,NEGORKU,POSTORKV,NEGORKV
	1DNADR	SPARE	
	1DNADR	TCDH	# TCDH,+1
	3DNADR	DELVEET2	# DELVEET2 +0...+5
	1DNADR	TTPI	# TTPI,+1
	3DNADR	DELVEET3	# DELVEET3 +0...+5
	1DNADR	DNRRANGE	# DNRRANGE,DNRRDOT
	2DNADR	DNLRVELX	# DNLRVELX,DNLRVELY,DNLRVELZ,DNLRALT
	1DNADR	DIFFALT	# DIFFALT,+1
	1DNADR	LEMMASS	# LEMMASS,CSMASS
	1DNADR	IMODES30	# IMODES30,IMODES33
	1DNADR	TIG	# TIG,+1
	DNPTR	LMORBM05	# COMMON DATA
	DNPTR	LMORBM06	# COMMON DATA
	1DNADR	SPARE	# FORMERLY PIF
	-1DNADR	TGO	# TGO,+1

----- SUB-LISTS -----

LMORBM01	-1DNADR	R-OTHER +2	# R-OTHER +2,+3	SNAPSHOT
	1DNADR	R-OTHER +4	# R-OTHER +4,+5	
	1DNADR	V-OTHER	# V-OTHER,+1	
	1DNADR	V-OTHER +2	# V-OTHER +2,+3	
	1DNADR	V-OTHER +4	# V-OTHER +4,+5	
	1DNADR	T-OTHER	# T-OTHER,+1	
	-1DNADR	R-OTHER	# R-OTHER +0,+1	
LMORBM02	2DNADR	REDOCTR	# REDOCTR,THETAD,+1,+2	COMMON DATA

	1DNADR	RSBBQ	# RSBBQ,+1
	2DNADR	OMEGAP	# OMEGAP,OMEGAQ,OMEGAR,GARBAGE
	2DNADR	CDUXD	# CDUXD,CDUYD,CDUZD,GARBAGE
	2DNADR	CDUX	# CDUX,CDUY,CDUZ,CDUT
	6DNADR	STATE	# STATE +0...+11D FLAGWORDS
	-6DNADR	DSPTAB	# DSPTAB TABLES
LMORBM03	-1DNADR	RN +2	# RN +2,+3 SNAPSHOT
	1DNADR	RN +4	# RN +4,+5
	1DNADR	VN	# VN,+1
	1DNADR	VN +2	# VN +2,+3
	1DNADR	VN +4	# VN +4,+5
	1DNADR	PIPTIME	# PIPTIME,+1
	-1DNADR	RN	# RN,+1
LMORBM04	2DNADR	OMEGAPD	# OMEGAPD,OMEGAQD,OMEGARD,GARBAGE
	3DNADR	CADRFLSH	# CADRFLSH,+1,+2,FAILREG,+1,+2
	-1DNADR	RADMODES	# RADMODES,DAPBOOLS COMMON DATA
LMORBM05	2DNADR	OMEGAP	# OMEGAP,OMEGAQ,OMEGAR,GARBAGE
	2DNADR	CDUXD	# CDUXD,CDUYD,CDUZD,GARBAGE
	2DNADR	CDUX	# CDUX,CDUY,CDUZ,CDUT
	1DNADR	ALPHAQ	# ALPHAQ,ALPHAR COMMON DATA
	1DNADR	POSTORKP	# POSTORKP,NEGTORKP
	DNCHAN	11	# CHANNELS 11,12
	DNCHAN	13	# CHANNELS 13,14
	DNCHAN	30	# CHANNELS 30,31
	-DNCHAN	32	# CHANNELS 32,33
LMORBM06	1DNADR	PIPTIME1	# PIPTIME,+1 COMMON DATA
	-3DNADR	DELV	# DELV +0...+5

LM COAST AND ALIGNMENT DOWNLIST

#

----- CONTROL LIST -----

LMCSTADL	EQUALS		# SEND ID BY SPECIAL CODING
	DNPTR	LMCSTA01	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	1DNADR	AGSK	# AGSK,+1
	1DNADR	TALIGN	# TALIGN,+1
	2DNADR	POSTORKU	# POSTORKU,NEGORKU,POSTORKV,NEGORKV
	1DNADR	DNRRANGE	# DNRRANGE,DNRRDOT
	1DNADR	TEVENT	# TEVENT,+1
	6DNADR	REFSMAT	# REFSMAT +0...+11D
	1DNADR	AOTCODE	# AOTCODE,GARBAGE
	3DNADR	RLS	# RLS +0...+5
	2DNADR	DNLRVELX	# DNLRVELX,DNLRVELY,DNLRVELZ,DNLRALT
	DNPTR	LMCSTA06	# COMMON DATA
	DNPTR	LMCSTA02	# COMMON DATA
	1DNADR	TIME2	# TIME2/1
	DNPTR	LMCSTA03	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	DNPTR	LMCSTA04	# COMMON DATA
	DNPTR	LMCSTA07	# COMMON DATA
	2DNADR	DNLRVELX	# DNLRVELX,DNLRVELY,DNLRVELZ,DNLRALT
	2DNADR	CDUS	# CDUS,PIPAX,PIPAY,PIPAZ
	1DNADR	LASTYCMD	# LASTYCMD,LASTXCMD
	1DNADR	LEMMASS	# LEMMASS,CSMMASS
	1DNADR	IMODES30	# IMODES30,IMODES33
	1DNADR	TIG	# TIG,+1
	DNPTR	LMCSTA05	# COMMON DATA
	-6DNADR	DSPTAB	# DSPTAB +0...+11D TABLE

----- SUB-LISTS -----

LMCSTA01	EQUALS	LMORBM01	# COMMON DOWNLIST DATA
LMCSTA02	EQUALS	LMORBM02	# COMMON DOWNLIST DATA
LMCSTA03	EQUALS	LMORBM03	# COMMON DOWNLIST DATA
LMCSTA04	EQUALS	LMORBM04	# COMMON DOWNLIST DATA
LMCSTA05	EQUALS	LMORBM05	# COMMON DOWNLIST DATA
LMCSTA06	2DNADR	X789	# X789 +0...+3 COMMON DATA
	-1DNADR	LASTYCMD	# LASTYCMD,LASTXCMD
LMCSTA07	3DNADR	OGC	# OGC,+1,IGC,+1,MGC,+1 COMMON DATA
	1DNADR	BESTI	# BESTI,BESTJ
	3DNADR	STARSAV1	# STARSAV1 +0...+5
	-3DNADR	STARSAV2	# STARSAV2 +0...+5



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LM RENDEZVOUS AND PRE-THRUST DOWNLIST

#

----- CONTROL LIST -----

LMRENDDL	EQUALS		# SEND ID BY SPECIAL CODING
	DNPTR	LMREND01	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	DNPTR	LMREND07	# COLLECT SNAPSHOT
	4DNADR	DNTMBUFF	# SEND SNAPSHOT
	1DNADR	DELLT4	# DELLT4,+1
	3DNADR	RTARG	# RTARG +0...+5
	3DNADR	DELVSLV	# DELVSLV +0...+5
	1DNADR	TCSI	# TCSI,+1
	3DNADR	DELVEET1	# DELVEET +0...+5
	1DNADR	SPARE	
	1DNADR	TPASS4	# TPASS4,+1
	DNPTR	LMREND06	# COMMON DATA
	DNPTR	LMREND02	# COMMON DATA
	1DNADR	TIME2	# TIME2/1
	DNPTR	LMREND03	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	DNPTR	LMREND04	# COMMON DATA
	2DNADR	POSTORKU	# POSTORKU,NEGORKU,POSTORKV,NEGORKV
	1DNADR	SPARE	
	1DNADR	TCDH	# TCDH,+1
	3DNADR	DELVEET2	# DELVEET2 +0...+5
	1DNADR	TTPI	# TTPI,+1
	3DNADR	DELVEET3	# DELVEET3 +0...+5
	1DNADR	ELEV	# ELEV,+1
	2DNADR	CDUS	# CDUS,PIPAZ,PIPAY,PIPAZ
	1DNADR	LASTYCMD	# LASTYCMD,LASTXCMD
	1DNADR	LEMMASS	# LEMMASS,CSMASS
	1DNADR	IMODES30	# IMODES30,IMODES33
	1DNADR	TIG	# TIG,+1
	DNPTR	LMREND05	# COMMON DATA
	1DNADR	DELTAR	# DELTAR,+1
	1DNADR	CENTANG	# CENTANG,+1
	1DNADR	NN	# NN,+1
	1DNADR	DIFFALT	# DIFFALT,+1
	1DNADR	DELVTPF	# DELVTPF,+1
	-1DNADR	SPARE	

----- SUB-LISTS -----

LMREND01	EQUALS	LMORBM01	# COMMON DOWNLIST DATA
LMREND02	EQUALS	LMORBM02	# COMMON DOWNLIST DATA
LMREND03	EQUALS	LMORBM03	# COMMON DOWNLIST DATA

LMREND04	EQUALS	LMORBM04	# COMMON DOWNLIST DATA
LMREND05	EQUALS	LMORBM05	# COMMON DOWNLIST DATA
LMREND06	EQUALS	LMCSTA06	# COMMON DOWNLIST DATA
LMREND07	-1DNADR	AIG	# AIG,AMG
	1DNADR	AOG	# AOG,TRKMKCNT
	1DNADR	TANGNB	# TANGNB,+1
	1DNADR	MKTIME	# MKTIME,+1
	-1DNADR	RANGRDOT	# DNRRANGE,DNRRDOT

LM DESCENT AND ASCENT DOWNLIST

----- CONTROL LIST -----

LMDSASDL	EQUALS		# SEND ID BY SPECIAL CODING
	DNPTR	LMDSAS07	# COLLECT SNAPSHOT
	DNPTR	LMDSAS08	# SEND SNAPSHOT
	1DNADR	TEVENT	# TEVENT,+1
	3DNADR	UNFC/2	# UNFC/2 +0...+5
	3DNADR	VGVECT	# VGVECT +0...+5
	1DNADR	TTF/8	# TTF/8,+1
	1DNADR	DELTAH	# DELTAH,+1
	3DNADR	RLS	# RLS +0...+5
	1DNADR	SPARE	
	DNPTR	LMDSAS09	# COMMON DATA
	DNPTR	LMDSAS02	# COMMON DATA
	1DNADR	TIME2	# TIME2/1
	DNPTR	LMDSAS03	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	DNPTR	LMDSAS04	# COMMON DATA
	2DNADR	POSTORKU	# POSTORKU,NEGORKU,POSTORKV,NEGORKV
	3DNADR	RGU	# RGU +0...+5
	3DNADR	VGU	# VGU +0...+5
	3DNADR	LAND	# LAND +0...+5
	1DNADR	AT	# AT,+1
	1DNADR	TLAND	# TLAND,+1
	1DNADR	FC	# FC,GARBAGE
	1DNADR	LASTYCMD	# LASTYCMD,LASTXCMD
	1DNADR	LEMMASS	# LEMMASS,CSMASS
	1DNADR	IMODES30	# IMODES30,IMODES33
	1DNADR	TIG	# TIG,+1
	DNPTR	LMDSAS05	# COMMON DATA
	DNPTR	LMDSAS06	# COMMON DATA
	1DNADR	PSEUDO55	# PSEUDO55,GARBAGE
	-1DNADR	TTOGO	# TTOGO,+1

----- SUB-LISTS -----

LMDSAS02	EQUALS	LMORBM02	# COMMON DOWNLIST DATA
LMDSAS03	EQUALS	LMORBM03	# COMMON DOWNLIST DATA
LMDSAS04	EQUALS	LMORBM04	# COMMON DOWNLIST DATA
LMDSAS05	EQUALS	LMORBM05	# COMMON DOWNLIST DATA
LMDSAS06	EQUALS	LMORBM06	# COMMON DOWNLIST DATA
LMDSAS07	-1DNADR	LRZCDUDL	# LRZCDUDL,GARBAGE
	1DNADR	VSELECT	# VSELECT,GARBAGE
	1DNADR	LRVTIMDL	# LRVTIMDL,+1

SNAPSHOT

	1DNADR	VMEAS	# VMEAS,+1
	1DNADR	MKTIME	# MKTIME,+1
	1DNADR	HMEAS	# HMEAS,+1
	1DNADR	RM	# RM,+1
	1DNADR	AIG	# AIG,AMG
	1DNADR	AOG	# AOG,TRKMKCNT
	1DNADR	TANGNB	# TANGNB,+1
	1DNADR	MKTIME	# MKTIME,+1
	-1DNADR	LRXCDUDL	# LRXCDUDL,LRYCDUDL
LMDSAS08	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	-5DNADR	DNTMBUFF +12D	
LMDSAS09	EQUALS	LMCSTA06	# COMMON DOWNLIST DATA

LM LUNAR SURFACE ALIGN DOWNLIST

----- CONTROL LIST -----

LMLSALDL	EQUALS		# SEND ID BY SPECIAL CODING
	DNPTR	LMLSAL01	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SNAPSHOT
	DNPTR	LMLSAL07	# COLLECT SNAPSHOT
	4DNADR	DNTMBUFF	# SEND SHAPSHOT
	1DNADR	TALIGN	# TALIGN,+1
	6DNADR	REFSMMAT	# REFSMMAT +0...+11D
	6DNADR	YNBSAV	# YNBSAV +0...+5,SNBSAV +0...+5
	DNPTR	LMLSAL08	# COMMON DATA
	DNPTR	LMLSAL02	# COMMON DATA
	1DNADR	TIME2	# TIME2/1
	DNPTR	LMLSAL03	# COLLECT SNAPSHOT
	6DNADR	DNTMBUFF	# SEND SHAPSHOT
	DNPTR	LMLSAL04	# COMMON DATA
	DNPTR	LMLSAL09	# COMMON DATA
	3DNADR	GSAV	# GSAV +0...+5
	1DNADR	AGSK	# AGSK,+1
	1DNADR	LASTYCMD	# LASTYCMD, LASTXCMD
	1DNADR	LEMMASS	# LEMMASS,CSMMASS
	1DNADR	IMODES30	# IMODES30,IMODES33
	1DNADR	TIG	# TIG,+1
	DNPTR	LMLSAL05	# COMMON DATA
	DNPTR	LMLSAL06	# COMMON DATA
	1DNADR	SPARE	
	-1DNADR	SPARE	

----- SUB-LISTS -----

LMLSAL01	EQUALS	LMORBM01	# COMMON DOWNLIST DATA
LMLSAL02	EQUALS	LMORBM02	# COMMON DOWNLIST DATA
LMLSAL03	EQUALS	LMORBM03	# COMMON DOWNLIST DATA
LMLSAL04	EQUALS	LMORBM04	# COMMON DOWNLIST DATA
LMLSAL05	EQUALS	LMORBM05	# COMMON DOWNLIST DATA
LMLSAL06	EQUALS	LMORBM06	# COMMON DOWNLIST DATA
LMLSAL07	EQUALS	LMREND07	# COMMON DOWNLIST DATA
LMLSAL08	EQUALS	LMCSTA06	# COMMON DOWNLIST DATA
LMLSAL09	EQUALS	LMCSTA07	# COMMON DOWNLIST DATA



1	# -----	1
2		2
3		3
4		4
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8		8
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LM AGS INITIALIZATION AND UPDATE DOWNLIST

----- CONTROL LIST -----

LMAGSIDL	EQUALS	# SEND IO BY SPECIAL CODING
	3DNADR AGSBUFF +0	# AGSBUFF +0...+5
	1DNADR AGSBUFF +12D	# AGSBUFF +12D,GARBAGE
	3DNADR AGSBUFF +1	# AGSBUFF +1...+6
	1DNADR AGSBUFF +13D	# AGSBUFF +13D, GARBAGE
	3DNADR AGSBUFF +6	# AGSBUFF +6...+11
	1DNADR AGSBUFF +12D	# AGSBUFF +12D,GARBAGE
	3DNADR AGSBUFF +7	# AGSBUFF +7...+12D
	1DNADR AGSBUFF +13D	# AGSBUFF +13D,GARBAGE
	6DNADR COMPNUMB	# COMPNUMB,UPOLDMOD,UPVERB,UPCOUNT,
		# UPBUFF +0...+7
	6DNADR UPBUFF +8D	# UPBUFF +8D...+19D
	DNPTR LMAGSI02	# COMMON DATA
	1DNADR TIME2	# TIME2/1
	DNPTR LMAGSI03	# COLLECT SNAPSHOT
	6DNADR DNTMBUFF	# SEND SNAPSHOT
	DNPTR LMAGSI04	# COMMON DATA
	2DNADR POSTORKU	# POSTORKU,NEGTORKU,POSTORKV,NEGTORKV
	1DNADR SPARE	
	1DNADR SPARE	
	1DNADR AGSK	# AGSK,+1
	6DNADR UPBUFF	# UPBUFF +0...+11D
	4DNADR UPBUFF +12D	# UPBUFF +12D...+19D
	1DNADR LEMMASS	# LEMMASS,CSMASS
	1DNADR IMODES30	# IMODES30,IMODES33
	1DNADR SPARE	
	DNPTR LMAGSI05	# COMMON DATA
	-6DNADR DSPTAB	# DSPTAB +0...+11D

----- SUB-LISTS -----

LMAGSI02	EQUALS	LMORBM02	# COMMON DOWNLIST DATA
LMAGSI03	EQUALS	LMORBM03	# COMMON DOWNLIST DATA
LMAGSI04	EQUALS	LMORBM04	# COMMON DOWNLIST DATA
LMAGSI05	EQUALS	LMORBM05	# COMMON DOWNLIST DATA

DNTABLE	GENADR	LMCSTADL	# LM COAST AND ALIGN DOWNLIST
	GENADR	LMAGSIDL	# LM AGS INITIALIZATION/UPDATE DOWNLIST
	GENADR	LMRENDDL	# LM RENDEZVOUS AND PRE-THRUST DOWNLIST
	GENADR	LMORBMDL	# LM ORBITAL MANEUVERS DOWNLIST
	GENADR	LMDSASDL	# LM DESCENT AND ASCENT DOWNLIST



1	GENADR LMLSALDL		# LM LUNAR SURFACE ALIGN DOWNLIST	1
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4	#	-----		4
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59				59
60				60

1412THE

PROGRAM NAME AGS INITIALIZATION R47

#

WRITTEN BY RHODE/KILROY/FOLLETT

#

MOD NO. 0

DATE 23 MARCH 1967

MOD BY KILROY

#

MOD NO. 1

DATE 28 OCTOBER 1967

MOD BY FOLLETT

#

FUNCT. DESC. 1 TO PROVIDE THE AGS ABORT ELECTRONICS ASSEMBLY AEA WITH THE LEM AND CSM STATE VECTORS

POSITION,VELOCITY,TIME IN LEM IMU COORDINATES BY MEANS OF THE LGC DIGITAL DOWNLINK.

#

2 TO ZERO THE ICPU, LGC, AND AEA GIMBAL ANGLE COUNTER SIMULTANEOUSLY IN ORDER TO ESTABLISH A

COMMON ZERO REFERENCE FOR THE MEASUREMENT OF GIMBAL EULER ANGLES WHICH DEFINE LEM ATTITUDE

3 TO ESTABLISH THE GROUND ELAPSED TIME OF AEA CLOCK ZERO. IF AN AEA CLOCK ZERO IS

REQUESTED DURING THIS PROGRAM

#

LOG SECTION AGS INITIALIZATION

#

CALLING SEQ PROGRAM IS ENTERED WHEN ASTRONAUT KEYS V47E ON DSKY.

R47 MAY BE CALLED AT ANY TIME EXCEPT WHEN ANOTHER EXTENDED VERB IS IN PROGRESS

#

SUBROUTINES

CALLED

#

NORMAL EXIT ENDEXT

#

ALARM/ABORT ALARM -- BAD REFSMMAT -- CODE 220

OPERATOR ERROR IF V47 SELECTED DURING ANOTHER EXTENDED VERB.

#

ERASABLES

USED SAMPTIME 2 TIME OF ENTER KEYSTROKE

AGSK 2 GROUND ELAPSED TIME OF THE AEA CLOCK ZERO

AGSBUFF 14D CONTAINS AGS INITIALIZATION DATA SEE OUTPUT BELOW

AGSWORD 1 PREVIOUS DOWNLIST SAVED HERE

#

EBANK AGSBUFF

BANK 40

SETLOC R47

BANK

COUNT* \$\$/R47

AGSINIT

CAF REFSMBIT

MASK FLAGWRD3

CHECK REFSMFLG.

CCS A

	TC	REDSPTM	# REFSMMAT IS OK
	TC	ALARM	# REFSMMAT IS BAD
	OCT	220	
	TC	ENDEXT	
NEWAGS	EXTEND		
	DCA	SAMPTIME	# TIME OF THE ENTER KEYSTROKE
	DXCH	AGSK	# BECOMES NEW AEA CLOCK ZERO
REDSPTM	EXTEND		
	DCA	AGSK	
AGSDISPK	DXCH	DSPTMX	
	CAF	V06N16	
	TC	BANKCALL	# R1 00XXX. HRS., R2 000XX MIN.,
	CADR	GOMARKF	# R3 0XX.XX SEC.
	TC	ENDEXT	# TERMINATE RETURN
	TC	AGSVCALC	# PROCEED RETURN
	CS	BIT6	# IS ENTER VIA A V32
	AD	MPAC	
	EXTEND		
	BZF	NEWAGS	# YES, USE KEYSTROKE TIME FOR NEW AGSK
	EXTEND		# NO, NEW AGSK LOADED VIA V25
	DCA	DSPTMX	# LOADED INTO DSPTMX BY KEYING
	TC	REDSPTM -1	# V25E FOLLOWED BY HRS.,MINS.,SECS.
			# DISPLAY THE NEW K
AGSVCALC	TC	INTPRET	
	SET		
	SET	NODOFLAG	# DON T ALLOW V37
		EXIT	
		XDSPFLAG	
	CAF	V06N16	
	TC	BANKCALL	
	CADR	EXDSPRET	
	TC	INTPRET	# EXTRAPOLATE LEM AND CSM STATE VECTORS
	RTB		# TO THE PRESENT TIME
		LOADTIME	# LOAD MPAC WITH TIME2,TIME1
	STCALL	TDEC1	# CALCULATE LEM STATE VECTOR
		LEMPREC	
	CALL		# CALL ROUTINE TO CONVERT TO SM COORDS AND
		SCALEVEC	# PROVIDE PROPER SCALING
	STODL	AGSBUFF	# LEMPREC AND CSMPREC LEAVE TDEC1 IN TAT
		TAT	# TAT TIME TO WHICH RATT1 AND VATT1 ARE
	STCALL	TDEC1	# COMPUTED CSEC SINCE CLOCK START B-28 .
		CSMPREC	# CALCULATE CSM STATE VECTOR FOR SAME TIME
	CALL		
		SCALEVEC	

	STODL	AGSBUFF +6	
		TAT	
	DSU	DDV	# CALCULATE AND STORE THE TIME
		AGSK	
		TSCALE	
	STORE	AGSBUFF +12D	
	EXIT		
	CAF	LAGSLIST	
	TS	DNLSTCOD	
	CAF	20SEC	# DELAY FOR 20 SEC WHILE THE AGS
	TC	BANKCALL	# DOWNLIST IS TRANSMITTED
	CADR	DELAYJOB	
	CA	AGSWORD	
	TS	DNLSTCOD	# RETURN TO THE OLD DOWNLIST
	CAF	IMUSEBIT	
	MASK	FLAGWRDO	# CHECK IMUSE FLAG.
	CCS	A	
CKSTALL	TC	AGSEND	# IMU IS BEING USED -- DO NOT ZERO
	CCS	IMUCADR	# CHECK FOR IMU USAGE WHICH AVOIDS THE
	TCF	+3	# IMUSE BIT I.E., IMU COMPENSATION.
	TCF	+6	# FREE. GO AHEAD WITH THE IMU ZERO.
	TCF	+1	
+3	CAF	TEN	# WAIT .1 SEC AND TRY AGAIN.
	TC	BANKCALL	
	CADR	DELAYJOB	
	TCF	CKSTALL	
+6	TC	BANKCALL	# IMU IS NOT IN USE
	CADR	IMUZERO	# SET IMU ZERO DISCRETE FOR 320 MSECS.
	TC	BANKCALL	# WAIT 3 SEC FOR COUNTERS TO INCREMENT
	CADR	IMUSTALL	
	TC	AGSEND	
AGSEND	TC	DOWNFLAG	# ALLOW V37
	ADRES	NODOFLAG	
	CAF	V50N16	
	TC	BANKCALL	
	CADR	GOMARK3	
	TCF	ENDEXT	
	TCF	ENDEXT	
	TC	ENDEXT	
SCALEVEC	VLOAD	MXV	
		VATT1	
	VXSC	REFSMMAT	
		VSL2	
		VSCALE	

```
1      VAD      VAD      # THIS SECTION ROUNDS THE VECTOR, AND
2      AGSRND1  # CORRECTS FOR THE FACT THAT THE AGS
3      AGSRND2  # IS A 2 S COMPLEMENT MACHINE WHILE THE
4      RTB      # LGC IS A 1 S COMPLEMENT MACHINE.
5
6      VECSGNAG
7      STOVL    VATT1
8      RATT1
9      MXV      VXSC
10     REFSMMAT
11     RSCALE
12     VSL8     VAD      # AGAIN THIS SECTION ROUNDS. TWO VECTORS
13     AGSRND1  # ARE ADDED TO DEFEAT ALSIGNAG IN THE
14     VAD      RTB      # CASE OF A HIGH-ORDER ZERO COUPLED WITH
15     AGSRND2  # A LOW ORDER NEGATIVE PART.
16     VECSGNAG
17     LXA,1
18     VATT1
19     SXA,1    LXA,1
20     MPAC +1
21     VATT1 +2
22     SXA,1    LXA,1
23     MPAC +4
24     VATT1 +4
25     SXA,1    RVQ
26     MPAC +6
27
28     LAGSLIST  ONE
29     V01N14    VN      0114
30     V50N00A   VN      5000
31     V00N25    EQUALS  OCT31
32     V06N16    VN      0616
33     V00N34    EQUALS  34DEC
34     V50N16    VN      5016
35     TSCALE    2DEC    100 B-10      # CSEC TO SEC SCALE FACTOR
36     20SEC     DEC      2000
37     RSCALE    2DEC    3.280839 B-3  # METERS TO FEET SCALE FACTOR
38     VSCALE    2DEC    3.280839 E2 B-9 # METERS/CS TO FEET/SEC SCALE FACTOR
39     AGSRND1    2OCT    0000060000
40
41     2OCT    0000060000
42     AGSRND2    2OCT    0000037777
43     2OCT    0000037777
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20CT 0000037777

SBANK	LOWSUPER
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100	100

FOR SUBSEQUENT LOW 2CADRS.

	BANK	10	
	SETLOC	FRANDRES	
	BANK		
	EBANK	LST1	
SLAP1	COUNT*	\$\$/START	# FRESH AND RESTART
	INHINT		# FRESH START. COMES HERE FROM PINBALL.
	TC	STARTSUB	# SUBROUTINE DOES MOST OF THE WORK
STARTSW	TCF	SKIPSIM	# PATCH....TCF STARTSIM FOR SIMULATION
STARTSIM	CAF	BIT14	
	TC	FINDVAC	
SIM2CADR	OCT	77777	# PATCH 2CADR AND EBANK DESIGNATION OF
	OCT	77777	# SIMULATION START ADDRESS.
SKIPSIM	CA	DSPTAB +11D	# TURN OFF ALL DSPTAB +11D LAMPS
	MASK	BITS4 6	# EXCEPT THE GIMBAL LOCK NO ATT ONLY ON
	AD	BIT15	# REQUESTED FRESH START.
	TS	DSPTAB +11D	
	CA	BIT12	# INITIALIZE DOWNLINK EASABLE MEMORY
	TS	DUMPCNT	# DUMP FOR ONE PASS
	CA	ZERO	
	TS	ERCOUNT	
	TS	FAILREG	
	TS	FAILREG +1	
	TS	FAILREG +2	
	TS	REDOCTR	
	CS	PRI012	
	TS	DSRUPTSW	
DOFSTART	CAF	BIT14	# INSURE ENGINE IS OFF.
	EXTEND		
	WRITE	DSALMOUT	
	CS	ZERO	
	TS	THRUST	
DOFSTRT1	CAF	FOUR	
	TS	RCSFLAGS	# INITIALIZE ATTITUDE ERROR DISPLAYS.
	CA	PRI030	
	TS	RESTREG	# SUPER BANK PRIORITY FOR DISPLAYS.
	CA	ZERO	
	TS	ABDELV	# DAP INITIALIZATION
	TS	NVSAVE	
	TS	EBANKTEM	


```
1
2      TS      CH5MASK
3      TS      CH6MASK
4      TS      PVALVEST      # FOR RCS FAILURE MONITOR
5      TS      ERESTORE      # ***** MUST NOT BE REMOVED FROM DOFSTART
6      TS      SMODE        # ***** MUST NOT BE REMOVED FROM DOFSTART
7      TS      DNLSTCOD      # SELECT P00 DOWNLIST
8      TS      AGSWORD       # ALLOW AGS INITIALIZATION
9      TS      UPSVFLAG      # ZERO UPDATE STATE VECTOR REQUEST FLAGWRD
10
11     EXTEND
12     WRITE    CHAN5         # TURN OFF RCS JETS.
13     EXTEND
14     WRITE    CHAN6         # TURN OFF RCS JETS.
15     EXTEND
16     WRITE    CHAN12
17     EXTEND
18     WRITE    CHAN13
19     EXTEND
20     WRITE    CHAN14
21     CS      DSPTAB +11D
22     MASK    BITS4 6
23     CCS     A
24     TC      +4
25     CA      BITS4 6
26     EXTEND
27     WOR     CHAN12         # THE IMU WAS IN COARSE ALIGN IN GIMBAL
28     TC      MR.KLEAN      # LOCK, SO PUT IT BACK INTO COARSE ALIGN.
29
30     CS      ZERO
31     TS      MODREG
32
33     CAF     IM30INIF      # FRESH START IMU INITIALIZATION
34     TS      IMODES30
35
36     CAF     MAXDB
37     TS      DB
38     CAF     FOUR
39     TS      RATEINDX      # INITIALZE KALCMANU RATE
40     CA      BOOLSTRT
41     TS      DAPBOOLS
42     CAF     EBANK6
43     TS      EBANK
44     EBANK   HIASCENT
45
46     CA      STIKSTRT
47     TS      STIKSENS
48     CA      RATESTRT
49     TS      -RATEDB
50     CAF     FULLAPS      # INITIALIZE MAXIMUM ASCENT MASS FOR USE
51     TS      HIASCENT     # BY 1/ACCS UNTIL THE PAD LOAD IS DONE.
52     CA      77001OCT     # LOAD DAP FILTER GAINS PAD LOAD.
```

```
1
2      TS      DKTRAP      #      TO BEST PRESENT ESTIMATE OF GOODIES
3      TS      LMTRAP      # .14 DEG
4
5      CA      60DEC
6      TS      DKKAOSN
7      TS      LMKAOSN      # 6 SEC GAIN FOR ALPHA
8
9      CA      ZERO
10     TS      LMOMEGAN      # UNITY GAIN
11     CA      TEN
12
13     TS      DKOMEGAN      # 1 SEC GAIN FOR OMEGA
14     CAF     BIT8          # SET DOCKED DB TO 1.4 DEG.  MAY OVERWRITE
15     TS      DKDB          #      WITH PAD LOAD.
16
17     CAF     IM33INIT
18     AD      BIT6          # KEEP BOTH DAP AND ERROR-NEEDLES DISPLAY
19     TS      IMODES33      #      OFF UNTIL ICDU ZERO IS FINISHED.
20
21
22     EXTEND
23     DCA      SWINIT      # INITIALIZE SWITCHES ONLY ON FRESH START.
24
25     DXCH     STATE
26     CA      SWINIT +2
27     TS      STATE +2
28
29     CA      REFSMBIT      # DO NOT ALTER REFSMFLG ON FRESH START.
30     MASK     STATE +3
31     AD      SWINIT +3
32
33     TS      STATE +3
34
35     EXTEND
36     DCA      SWINIT +4
37
38     DXCH     STATE +4
39
40     EXTEND
41     DCA      SWINIT +6
42
43     DXCH     STATE +6
44     CA      SURFFBIT      # DO NOT ALTER  SURFFLAG ON FRESH START.
45     AD      CMOONBIT      #      CMOONFLG
46
47     AD      LMOONBIT      #      LMOONFLG
48     MASK     STATE +8D
49     AD      SWINIT +8D
50
51     TS      STATE +8D
52     CA      SWINIT +9D
53     TS      STATE +9D
54
55     CA      APSFLBIT      # DO NOT ALTER APSFLAG ON FRESH START.
56     MASK     STATE +10D
57     AD      SWINIT +10D
58
59     TS      STATE +10D
60     CAF     SWINIT +11D
61     TS      STATE +11D
62
63
64     ENDRSTRT      TC      POSTJUMP      # NOW IN ANOTHER BANK.
65     CADR      DUMMYJOB +2      # PICKS UP AT RELINT.  DON T ZERO NEWJOB
66
67
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```
MR.KLEAN      INHINT
```

	EXTEND	
	DCA	NEGO
P00KLEAN	DXCH	-PHASE2
	EXTEND	
	DCA	NEGO
V37KLEAN	DXCH	-PHASE4
	EXTEND	
	DCA	NEGO
	DXCH	-PHASE1
	EXTEND	
	DCA	NEGO
	DXCH	-PHASE3
	EXTEND	
	DCA	NEGO
	DXCH	-PHASE5
	EXTEND	
	DCA	NEGO
	DXCH	-PHASE6
	TC	Q

COMES HERE FROM LOCATION 4000, GOJAM, RESTART ANY PROGRAMS WHICH MAY HAVE BEEN RUNNING AT THE TIME.

GOPROG EBANK LST1
 INCR REDOCTR # ADVANCE RESTART COUNTER.

LXCH Q
EXTEND
ROR SUPERBNK

DXCH RSBBQ
CA DSPTAB +11D
MASK BIT4

EXTEND
BZF +4
AD BIT6 # SET ERROR COUNTER ENABLE

 EXTEND
17 WOR CHAN12 # ISS WAS IN COARSE ALIGN SO GO BACK TO
18 TC LIGHTSET

ERASCHK TEMPORARILY STORES THE CONTENTS OF TWO ERASABLE LOCATIONS, X
AND X+1 INTO SKEEP5 AND SKEEP6. IT ALSO STORES X INTO SKEEP7 AND
ERESTORE. IF ERASCHK IS INTERRUPTED BY A RESTART, C ERESTORE SHOULD
EQUAL C SKEEP7, AND SHOULD BE A + NUMBER LESS THAN 2000 OCT. OTHERWISE
C ERESTORE SHOULD EQUAL +0.

CAF HI5
MASK ERESTORE

EXTEND
BZF +2 # IF ERESTORE NOT +0 OR +N LESS THAN 2K,
TCF NONAVKEY +3 # DO FRESH START -- E MEMORY MIGHT BE BAD

CS ERESTORE

EXTEND
BZF DORSTART # +0 CONTINUE WITH RESTART.

AD SKEEP7

EXTEND
BZF +2 # SKEEP7, RESTORE E MEMORY.

TCF NONAVKEY +3 # DO FRESH START -- E MEMORY MIGHT BE BAD

CA SKEEP4

TS EBANK # EBANK OF E MEMORY THAT WAS UNDER TEST.

EXTEND # NOT DXCH SINCE THIS MIGHT HAPPEN AGAIN

DCA SKEEP5

INDEX SKEEP7

DXCH 0000 # E MEMORY RESTORED

CA ZERO

TS ERESTORE

DORSTART TC STARTSUB # DO INITIALIZATION AFTER ERASE RESTORE.

SETINFL CS INTFLBIT

MASK FLGWRD10

TS FLGWRD10

CA	9,6,4	# LEAVE PROG ALARM, GIMBAL LOCK, NO ATT
MASK	DSPTAB +11D	# LAMPS INTACT ON HARDWARE RESTART
AD	BIT15	
XCH	DSPTAB +11D	
CAF	IFAILINH	# LEAVE IMU FAILURE INHIBITS INTACT ON
MASK	IMODES30	# HARDWARE RESTART, RESET ALL FAILURE
AD	IM30INIR	# CODES.
TS	IMODES30	
CA	AGSWORD	# BE SURE OF CORRECT DOWNLIST
TS	DNLSTCOD	
CA	BIT4	# TURN ON THROTTLE COUNTER
EXTEND		
WOR	CHAN14	# TURN ON THRUST DRIVE
CS	FLAGWRD5	
MASK	ENGONBIT	
CCS	A	
TCF	+5	
CAF	BIT13	
EXTEND		
WOR	DSALMOUT	# TURN ENGINE ON
TCF	GOPROG3	
CAF	BIT14	
EXTEND		
WOR	DSALMOUT	# TURN ENGINE OFF
TCF	GOPROG3	
ENEMA	INHINT	
TC	STARTSB1	
TCF	GOPROG2A	
TC	STARTSB2	
TC	LIGHTSET	
CS	RSFLGBTS	# CLEAR BITS 7 AND 14.
MASK	FLGWRD10	
TS	FLGWRD10	
CAF	NUMGRPS	# VERIFY PHASE TABLE AGREEMENTS
TS	MPAC +5	
DOUBLE		
EXTEND		
INDEX	A	
DCA	-PHASE1	# COMPLEMENT INTO A, DIRECT INTO L.
EXTEND		
RXOR	LCHAN	# RESULT MUST BE -0 FOR AGREEMENT.
CCS	A	
TCF	PTBAD	# RESTART FAILURE.
TCF	PTBAD	
TCF	PTBAD	

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1
2      CCS      MPAC +5      # PROCESS ALL RESTART GROUPS.
3      TCF      PCLOOP
4
5      TS      MPAC +6      # SET TO +0.
6      TC      MMDSPLAY    # DISPLAY MAJOR MODE
7
8      INHINT    # RELINT DONE IN MMDSPLAY
9
10     CS      DIDFLBIT    # CLEAR DIDFLAG IN ORDER TO FORCE R10 TO
11     MASK    FLAGWRD1    # RE-INITIALIZE ITSELF IF IT HAD BEEN
12     TS      FLAGWRD1    # OPERATION AT THE TIME OF THE RESTART.
13
14     CS      RODFLBIT    # CLEAR RODFLAG. IF P66 IS IN OPERATION
15     MASK    FLAGWRD1    # IT WILL RE-INITIALIZE ITSELF AND
16     TS      FLAGWRD1    # CONTINUE.
17
18     CS      P21FLBIT    # CLEAR P21 FLAG SO THAT P21 WILL COMPUTE
19     MASK    FLAGWRD0    # NEW BASE STATE VECTORS.
20     TS      FLAGWRD0
21
22     NXTRST    CAF      NUMGRPS      # SEE IF ANY GROUPS RUNNING.
23     TS      MPAC +5
24     DOUBLE
25     INDEX    A
26     CCS      PHASE1
27     TCF      PACTIVE      # PNZ -- GROUP ACTIVE.
28     TCF      PINACT       # +0 -- GROUP NOT RUNNING.
29
30     PACTIVE   TS      MPAC
31     INCR      MPAC      # ABS OF PHASE.
32     INCR      MPAC +6    # INDICATE GROUP DEMANDS PRESENT.
33     CA      RACTCADR
34     TC      SWCALL      # MUST RETURN TO SWRETURN.
35
36     PINACT    CCS      MPAC +5      # PROCESS ALL RESTART GROUPS.
37     TCF      NXTRST
38
39     CCS      MPAC +6      # NO, CHECK PHASE ACTIVITY FLAG
40     TCF      ENDRSTRT    # PHASE ACTIVE
41     CAF      BIT15      # IS MODE -0
42     MASK    MODREG
43     EXTEND
44     BZF      GOTOP00H    # NO
45     TCF      ENDRSTRT    # YES
46     PTBAD    TC      ALARM      # SET ALARM TO SHOW PHASE TABLE FAILURE.
47     OCT      1107
48
49     TCF      DOFSTRT1
50     ***** ***** *****
51
52
53
54
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```


DO NOT USE GOPROG2 OR ENEMA WITHOUT CONSULTING POOH PEOPLE.

OCT10000		BIT13	
OCT30000		PRI030	
OCT7777	OCT	7777	
STIKSTRT	DEC	0.825268	# 20 D/S MAXIMUM COMPANDED RATE
RATESTRT	DEC	-218	
RACTCADR	CADR	RESTARTS	
BOOLSTRT	OCT	21312	
77001OCT	OCT	77001	# .14 DEG SCALED AT 4.5 DEG
60DEC	DEC	60	
RSFLGBTS	OCT	20100	
MAXDB	OCTAL	03434	# 5 DEG ATTITUDE DEADBAND, SCALED AT 45.
LIGHTSET	CAF	BIT5	# CHECK FOR MARK REJECT AND ERROR RESET
	EXTEND		
	RAND	NAVKEYIN	
	EXTEND		
	BZF	NONAVKEY	# NO MARK REJECT
	EXTEND		
	READ	MNKEYIN	# CHECK IF KEYS 2M AND 5M ON
	AD	-ELR	# MAIN DSKY KEYCODE BITS 1-5
	EXTEND		
	BZF	+2	
NONAVKEY	TC	Q	
	TC	STARTSUB	
	TCF	DOFSTART	
+3	TC	STARTSUB	
	TCF	DOFSTRT1	# DO FRESH START BUT DON T TOUCH ENGINE

INITIALIZATION COMMON TO BOTH FRESH START AND RESTART.

STARTSUB	EBANK CAF TS	AOSQ LDNPHAS1 DNTMGOTO	# SET POINTER SO NEXT 20MS DOWNRUPT WILL # CAUSE THE CURRENT DOWNLIST TO BE # INTERRUPTED AND START SENDING FROM THE # BEGINNING OF THE CURRENT DOWNLIST.
	CAF EXTEND RAND AD TS	BIT6 CHAN33 RMODINIT RADMODES	
STARTSB1	CAF TS AD TS AD TS	POSMAX TIME3 MINUS2 TIME4 NEGONE TIME5	
	CAF TS	EBANK6 EBANK	
	CS MASK TS	BIT13 RCSFLAGS RCSFLAGS	# CAUSE DAPIDLER TO CALL 1/ACCS # ZERO BIT 13
	CAF TS EXTEND	POSMAX T6NEXT	# DISABLE TIME6 CLOCK. JUST IN CASE A T6 # RUPT IS ALREADY IN THE PRIORITY CHAIN, # ENSURE THAT ITS INPUTS WILL RENDER IT # INEFFECTUAL.
	WAND CAF TS TS	CHAN13 ZERO NXT6ADR NEXTP	
	CS MASK TS	ACCSOKAY DAPBOOLS DAPBOOLS	
	EXTEND DCA DXCH	IDLEADR T5ADR	# SET T5RUPT FOR DAPIDLER PROGRAM.
STARTSB2	CAF EXTEND WAND	OCT30001 DSALMOUT	# DURING SOFTWARE RESTART, DO NOT DISTURB # ENGINE ON, OFF AND ISS WARNING.
	CS MASK TS	READRBIT FLAGWRD3 FLAGWRD3	# CLEAR READRFLG FOR R29

CS	FLAGWRD3	# DURING SOFTWARE RESTART, CLEAR TURNON,
MASK	NR29FBIT	# REPOSITION, CDU ZERO AND REMODE BITS
EXTEND		# IN RADMODES, SINCE TASKS ASSOCIATED
BZF	+2	# WITH THESE BITS HAVE BEEN KILLED
CAF	BIT10	# ALSO IF R29 HAD BEEN REQUESTED.
AD	OCT32001	# NOR29FLG 0 CLEAR BIT 10 RADMODES
COM		# TO MAKE R29 FORGET IT HAD STARTED
MASK	RADMODES	# DESIGNATING
TS	RADMODES	
CAF	OCT27470	# DURING SOFTWARE RESTART, DO NOT DISTURB
EXTEND		# IMU FLAGS. COARSE ALIGN ENABLE, ZERO
WAND	CHAN12	# IMU CDUS, ENABLE IMU COUNTER AND GIMBAL
		# TRIM DRIVES. LEAVE RR LOCKON ENABLE
		# ALONE.
CS	NORRMBIT	# ENABLE R25.
MASK	FLAGWRD5	
TS	FLAGWRD5	
CS	R77FLBIT	# CLEAR R77FLAG
MASK	FLAGWRD5	
TS	FLAGWRD5	
CAF	OCT74160	# DURING SOFTWARE RESTART, DO NOT DISTURB
EXTEND		# TELEMETRY FLAGS, RESET TRAP FLAGS, AND
WAND	CHAN13	# ENABLE T6RUPT FLAG.
CAF	BIT12	# REENABLE RUPT10 RUPT QUICKLY
EXTEND		# RESUMES EXCEPT DURING P64
WOR	CHAN13	
CAF	BIT6	# DURING SOFTWARE RESTART, DO NOT DISTURB
EXTEND		# GYRO ENABLE FLAG.
WAND	CHAN14	
EBANK	LST1	
CAF	STARTEB	
TS	EBANK	# SET FOR E3
CAF	NEG1/2	# INITIALIZE WAITLIST DELTA-TS.
TS	LST1 +7	
TS	LST1 +6	
TS	LST1 +5	
TS	LST1 +4	
TS	LST1 +3	
TS	LST1 +2	
TS	LST1 +1	
TS	LST1	
CS	ENDTASK	
TS	LST2	

TS	LST2 +2	
TS	LST2 +4	
TS	LST2 +6	
TS	LST2 +8D	
TS	LST2 +10D	
TS	LST2 +12D	
TS	LST2 +14D	
TS	LST2 +16D	
CS	ENDTASK +1	
TS	LST2 +1	
TS	LST2 +3	
TS	LST2 +5	
TS	LST2 +7	
TS	LST2 +9D	
TS	LST2 +11D	
TS	LST2 +13D	
TS	LST2 +15D	
TS	LST2 +17D	
CS	ZERO	# MAKE ALL EXECUTIVE REGISTER SETS
TS	PRIORITY	# AVAILABLE.
TS	PRIORITY +12D	
TS	PRIORITY +24D	
TS	PRIORITY +36D	
TS	PRIORITY +48D	
TS	PRIORITY +60D	
TS	PRIORITY +72D	
TS	PRIORITY +84D	
TS	DSRUPTSW	
TS	NEWJOB	# SHOWS NO ACTIVE JOBS.
CAF	VAC1ADRC	# MAKE ALL VAC AREAS AVAILABLE.
TS	VAC1USE	
AD	LTHVACA	
TS	VAC2USE	
AD	LTHVACA	
TS	VAC3USE	
AD	LTHVACA	
TS	VAC4USE	
AD	LTHVACA	
TS	VAC5USE	
CAF	TEN	
DSPOFF	TS	MPAC # R1, R2, R3
	CS	BIT12
	INDEX	MPAC
	TS	DSPTAB
	CCS	MPAC
	TCF	DSPOFF

TS	DELAYLOC	
TS	DELAYLOC +1	
TS	DELAYLOC +2	
TS	R1SAVE	
TS	INLINK	
TS	DSPCNT	
TS	CADRSTOR	
TS	REQRET	
TS	CLPASS	
TS	DSPLOCK	
TS	MONSAVE	# KILL MONITOR
TS	MONSAVE1	
TS	VERBREG	
TS	NOUNREG	
TS	DSPLIST	
TS	MARKSTAT	
TS	EXTVBACT	# MAKE EXTENDED VERBS AVAILABLE
TS	IMUCADR	
TS	OPTCADR	
TS	RADCADR	
TS	ATTCADR	
TS	LGYRO	
TS	FLAGWRD4	# KILL INTERFACE DISPLAYS
CAF	NOUTCON	
TS	NOUT	
CS	ONE	
TS	SAMPLIM	
CAF	BIT6	
MASK	IMODES33	# LEAVE BIT 6 UNCHANGED
AD	IM33INIT	# NO PIP OR TM FAILS. BIT6 0 IN THIS WORD.
TS	IMODES33	
CAF	LESCHK	# SELF CHECK GO-TO REGISTER.
TS	SELFRET	
CS	VD1	
TS	DSPCOUNT	
TC	Q	
EBANK	AOSQ	
IDLEADR	2CADR	DAPIDLER
IFAILINH	OCT	435
LDNPHAS1	GENADR	DNPHASE1
LESCHK	GENADR	SELFCHK
VAC1ADRC	ADRES	VAC1USE
OCT32001	OCT	32001
LTHVACA	DEC	44

OCT27470	OCT	27470	
OCT74160	OCT	74160	
OCT30001	OCT	30001	
STARTEB	EQUALS	EBANK3	
NUMGRPS	EQUALS	FIVE	
-ELR	OCT	-22	# -ERROR LIGHT RESET KEY CODE.
IM30INIF	OCT	37411	# INHIBITS IMU FAIL FOR 5 SEC AND PIP ISSW
IM30INIR	OCT	37000	
IM33INIT		PRI016	# NO PIP OR TM FAIL SIGNALS.
9,6,4	OCT	450	
RMODINIT	OCT	00102	
SWINIT	OCT	0	
	OCT	0	
	OCT	0	
	OCT	02000	# BIT 11 NOR29FLG
	OCT	0	
	OCT	0	
	OCT	0	
	OCT	00100	
	OCT	0	
	OCT	0	
	OCT	0	
	OCT	40000	# BIT 15 LRBYPASS.

PROGRAM NAME GOTOPPOH ASSEMBLY SUNDANCE
LOG SECTION FRESH START AND RESTART

FUNCTIONAL DESCRIPTION

FLASH V 37 ON DSKY MM CHANGE REQUEST

INPUT/OUTPUT INFORMATION

A. CALLING SEQUENCE TC GOTOPPOH
B. ERASABLE INITIALIZATION NONE
C. OUTPUT FLASH V 37 ON DSKY
D. DEBRIS L

PROGRAM ANALYSIS

A. SUBROUTINES CALLED PRIODSPR, LINUS
B. NORMAL EXIT TCF ENDOFJOB
C. ALARM AND ABORT EXITS NONE

BLOCK 03
SETLOC FFTAG5
BANK

GOTOPPOH COUNT* \$\$/P00
CAF OCT33 # 4.33 SPOT FOR GOP00FIX
TS L
COM
DXCH -PHASE4

TC POSTJUMP
CADR GOP00FIX
OCT24 MM 20
OCT31 MM 25

BANK 20
SETLOC VERB37
BANK

GOP00FIX COUNT* \$\$/P00 # VERB 37 AND P00 IN BANK 4.
TC DOWNFLAG # ALLOW X-AXIS OVERRIDE
ADRES XOVINFLG
TC DOWNFLAG # INSURE THAT ULLAGE IS OFF
ADRES ULLAGFLG

TC CLEARMRK +2

TC	BANKCALL
1	1
2	2
3	3
4	4
5	5
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94	94
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99	99
100	100

TCF	-3
TCF	-4

TCF -5

V37N99	VN	3799
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PROGRAM NAME V37 ASSEMBLY SUNDANCE

LOG SECTION FRESH START AND RESTART

FUNCTIONAL DESCRIPTION

- # 1. CHECK IF NEW PROGRAM ALLOWED. IF BIT 1 OF FLAGWRD2 NODOFLAG IS SET, AN ALARM 1520 IS CALLED.
- # 2. CHECK FOR VALIDITY OF PROGRAM SELECTED. IF AN INVALID PROGRAM IS SELECTED, THE OPERATOR ERROR LIGHT IS SET AND CURRENT ACTIVITY, IF ANY, CONTINUE.
- # 3. SERVICER IS TERMINATED IF IT HAS BEEN RUNNING.
- # 4. INSTALL IS EXECUTED TO AVOID INTERRUPTING INTEGRATION.
- # 5. THE ENGINE IS TURNED OFF AND THE DAP IS INITIALIZED FOR COAST.
- # 6. TRACK AND UPDATE FLAGS ARE SET TO ZERO.
- # 7. DISPLAY SYSTEM IS RELEASED.
- # 8. THE FOLLOWING ARE PERFORMED FOR EACH OF THE THREE CASES.
- # A. PROGRAM SELECTED IS P00
- # 1. RENDEZVOUS AND P25 FLAGS ARE RESET. KILL P20 AND P25
- # 2. STATINT1 IS SCHEDULED BY SETTING RESTART GROUP 2.
- # 3. MAJOR MODE 00 IS STORED IN THE MODE REGISTER MODREG .
- # 4. SUPERBANK 3 IS SELECTED.
- # 5. NODOFLAG IS RESET.
- # 6. ALL RESTART GROUPS EXCEPT GROUP2 ARE CLEARED. CONTROL IS TRANSFERRED TO RESTART PROGRAM GOPROG2 WHICH CAUSES ALL CURRENT ACTIVITY TO BE DISCONTINUED AND A 9 MINUTE INTEGRATION CYCLE TO BE INITIATED.
- # B. PROGRAM SELECTED IS P20 OR P25.
- # 1. IF THE CURRENT MAJOR MODE IS THE SAME AS THE SELECTED NEWPROGRAM. THE PROGRAM IS RE-INITIALIZED VIA V37XEQ, ALL RESTART GROUPS, EXCEPT GROUP 4 ARE CLEARED.
- # 2. IF THE CURRENT MAJOR MODE IS NOT EQUAL TO THE NEW REQUEST, A CHECK IS MADE TO SEE IF THE REQUESTED MAJOR MODE HAS BEEN RUNNING THE BACKGROUND, AND IF IT HAS, NO NEW PROGRAM IS SCHEDULED, THE EXISTING P20 OR P25 IS RESTARTED TO CONTINUE, AND ITS MM IS SET.
- # 3. CONTROL IS TRANSFERRED TO GOPROG2.
- # C. PROGRAM SELECTED IS NEITHER P00, P20, NOR P25
- # 1. V37XEQ IS SCHEDULED AS A JOB BY SETTING RESTART GROUP 4
- # 2. ALL CURRENT ACTIVITY EXCEPT RENDEZVOUS AND TRACKING IS DISCONTINUED BY CLEARING ALL RESTART GROUPS. IF THE RENDEZVOUS OR THE P25 FLAG IS ON, GROUP 2 IS NOT CLEARED, ALLOWING THESE PROGRAMS TO CONTINUE.

INPUT/OUTPUT INFORMATION

A. CALLING SEQUENCE

CONTROL IS DIRECTED TO V37 BY THE VERBFAN ROUTINE.

VERBFAN GOES TO C VERBTAB+C VERBREG . VERB 37 MMCHANG.

MMCHANG EXECUTES A TC POSTJUMP , CADR V37.

B. ERASABLE INITIALIZATION NONE

C. OUTPUT

MAJOR MOD CHANGE

D. DEBRIS

MMNUMBER, MPAC +1, MINDEX, BASETEMP +C MINDEX , FLAGWRD0, FLAGWRD1, FLAGWRD2, MODREG, GOLOC -1,
GOLOC, GOLOC +1, GOLOC +2, BASETEMP, -PHASE2, PHASE2, -PHASE4

PROGRAM ANALYSIS

A. SUBROUTINES CALLED

ALARM, RELDSP, PINBRNCH, INTSTALL, ENGINOF2, ALLCOAST, V37KLEAN, GOPROG2, FALTON, FINDVAC, SUPERSW,
DSPMM

B. NORMAL EXIT

TC ENDOFJOB

C. ALARMS

1520 MAJOR MODE CHANGE NOT PERMITTED

V37 TS MMNUMBER # SAVE MAJOR MODE
CAF PRI030 # RESTART AT PINBALL PRIORITY
TS RESTREGCA IMODES30 # IS IMU BEING INITIALIZED
MASK BIT6
CCS A
TCF CANTRODCS MMNUMBER # IS P70 REQUESTED
AD DEC70EXTEND
BZF SETUP70 # YESAD ONE # IS P71 REQUESTED
EXTEND
BZF SETUP71 # YESCA MMNUMBER # IS NEW REQUEST P00
EXTEND

BZF ISSERVON # YES, CHECK SERVICER STATUS

CS FLAGWRD2 # NO, IS NODO V37 FLAG SET
MASK NODOBITCCS A
TCF CHECKTAB # NOCANTROD TC ALARM
OCT 1520

V37BAD TC RELDSP # RELEASES DISPLAY FROM ASTRONAUT

TC POSTJUMP # BRING BACK LAST NORMAL DISPLAY IF THERE
CADR PINBRNCH # WAS ONE. OTHERWISE DO AN EOJ.

CHECKTAB CA NOV37MM # INDEX FOR MM TABLES.

AGAINMM	TS	MPAC +1	
	NDX	MPAC +1	
	CA	PREMM1	# OBTAIN WHICH MM THIS IS FOR
	MASK	LOW7	
	COM		
	AD	MMNUMBER	
	CCS	A	
	CCS	MPAC +1	# IF GR, SEE IF ANY MORE IN LIST
	TCF	AGAINMM	# YES, GET NEXT ONE
	TCF	V37NONO	# LAST TIME OR PASSED MM
	CA	MPAC +1	
	TS	MINDEX	# SAVE INDEX FOR LATER
ISSERVON	CS	FLAGWRD7	# V37 FLAG SET -- I.E., IS SERVICER GOING
	MASK	V37FLBIT	
	CCS	A	
	TCF	CANV37	# NO
	TC	DOWNFLAG	# YES, TURN OFF THE AVERAGE FLAG AND
	ADRES	AVEGFLAG	# WAIT FOR SERVICER TO RETURN TO CANV37
	CAF	V37RETAD	
	TS	OUTROUTE	
	TCF	ENDOFJOB	
V37RET	CS	FLAGWRD0	# IS P20 OR P22 RUNNING
	MASK	RNDVZBIT	
	CCS	A	
	TCF	+2	# NO. CHECK FOR P25.
	TCF	2.7SPT	# YES. DO 2.7SPOT
	CS	FLAGWRD0	# IS P25 RUNNING
	MASK	P25FLBIT	
	CCS	A	
2.0SPT	CA	OCT37667	
2.11SPT	AD	BIT5	
2.7SPT	AD	OCT40072	
	TC	PHSCHNGA	
CANV37	CAF	ZERO	
	EXTEND		
	WRITE	SUPERBNK	
	CAF	ROOAD	
	TS	TEMPFLSH	
	TC	PHASCHNG	
	OCT	14	

R00	TC	INTPRET	
	CALL	INTSTALL	# WAIT FOR INTEGRATION TO FINISH
DUMMYAD	EXIT		
	TC	DOWNFLAG	
	ADRES	3AXISFLG	# RESET 3-AXIT FLAG
	CAF	LRBYBIT	# CLEAN UP THE R12 FLAGWORD.
	TS	FLGWRD11	
	TC	DOWNFLAG	# INSURE THAT THE R04FLAG IS CLEAR.
	ADRES	R04FLAG	
	TC	DOWNFLAG	# INSURE MUNFLAG IS CLEAR.
	ADRES	MUNFLAG	
	TC	DOWNFLAG	# ALLOW X-AXIS OVERRIDE.
	ADRES	XOVINFLG	
	CCS	MMNUMBER	# IS THIS A POOH REQUEST
	TCF	NOUVEAU	# NO, PICK UP NEW PROGRAM
POOH	TC	RELDSP	# RELEASE DISPLAY SYSTEM
	CAF	PRI05	# SET VARIABLE RESTART PRIORITY FOR
	TS	PHSPRDT2	# P00 INTEGRATION.
	TC	CLRADM0D	# CLRADM0D DOES AN INHINT.
	CS	NODOBIT	# TURN OFF NODOFLAG.
	MASK	FLAGWRD2	
	TS	FLAGWRD2	
	CA	FIVE	# SET RESTART FOR STATEINT1
	TS	L	
	COM		
	DXCH	-PHASE2	
	CS	OCT700	# TURN OFF P20, P25, IMU IN USE FLAG
	MASK	FLAGWRD0	
	TS	FLAGWRD0	# REMDFLG
	CAF	DNLADP00	
SEUDOP00	TS	DNLSTCOD	# SET UP APPROPRIATE DOWNLIST CODE
	TS	AGSWORD	# CURRENT LIST WILL BE COMPLETED BEFORE
			# NEW ONE IS STARTED
	TC	IBNKCALL	
	CADR	ENGNOF1	

	TC	IBNKCALL	# INSURE ALLCOAST.
	CADR	ALLCOAST	# DOES A RESTORDB.
	CS	OCT120	# TURN OFF TRACK, UPDATE FLAGS
	TS	EBANKTEM	
	MASK	FLAGWRD1	
	TS	FLAGWRD1	
	TC	IBNKCALL	# KILL GROUPS 1,3,5,6
	CADR	V37KLEAN	
GOMOD	CCS	MMNUMBER	# IS IT POOH
	TCF	RENDV00	# NO
	TC	IBNKCALL	# REDUNDANT EXCEPT FOR GROUP 4
	CADR	P00KLEAN	
	CA	MMNUMBER	
	TS	MODREG	
GOGOPROG	TC	POSTJUMP	
	CADR	GOPROG2	
RENDV00	CS	MODREG	# IS CURRENT PROGRAM 22
	AD	OCT26	
	EXTEND		
	BZF	RESET22	# YES -- CLEAR RENDEZVOUS FLAG
	CS	MMNUMBER	# IS NE PROGRAM P22
	AD	OCT26	
	EXTEND		
	BZF	RESET22	
	AD	NEG2	# IS NEW PROGRAM P20 OR P25
	EXTEND		
	BZF	RENDN00	# YES
	AD	FIVE	# 25
	EXTEND		
	BZF	RENDN00	# YES
	CA	OCT500	# NO, IS EITHER P20 OR P25 RUNNING
	MASK	FLAGWRD0	
	CCS	A	
	TCF	P00FIZZ	# YES, LEAVE GROUP 2 TO PICK UP P20 OR P25
RESET22	CS	OCT700	# CLEAR RENDEZVOUS, P25
	MASK	FLAGWRD0	# AND IMU IN USE FLAGS
	TS	FLAGWRD0	
	TC	CLRADM0D	

KILL2	EXTEND	# NO, KILL 2
	DCA	NEGO
	DXCH	-PHASE2
P00FIZZ	CAF	V37QCAD
	TS	TEMPFLSH
	TCF	GOGOPROG
RENDN00	CS	MODREG
	AD	OCT24
	EXTEND	
	BZF	KILL2
		# P20 OR P25 ON TOP OF P20 OR P25 --
	AD	FIVE
	EXTEND	
	BZF	KILL2
	CA	OCT500
	MASK	FLAGWRD0
	AD	MMNUMBER
	COM	
	AD	P20REG
	EXTEND	# IS IT 20 AND IS RENDEZVOUS FLAG ON
	BZF	STATQUO
		# YES
	AD	OCT305
	EXTEND	# IS IT 25 AND IS P25 BIT ON
	BZF	STATQUO
		# YES, LEAVE AS IS
	TCF	KILL2
STATQUO	CS	FLAGWRD1
	MASK	OCT120
	ADS	FLAGWRD1
		# SET TRACKFLAG
		# UPDATE FLAG
	TCF	GOMOD
NOUVEAU	CAF	OCT500
		# IS P20 OR P25 FLAG SET
	MASK	FLAGWRD0
	CCS	A
	TCF	+3
		# YES
	TC	DOWNFLAG
	ADRES	IMUSE
		# NO, RESET IMUINUSE FLAG
	INDEX	MINDEX
	CAF	DNLADMM1
		# OBTAIN APPROPRIATE DOWNLIST ADDRESS
	INHINT	
	TCF	SEUDOP00
V37NONO	TC	FALTON
		# COME HERE IF MM REQUESTED DOESN T EXIST

	TCF	V37BAD	
OCT00010	EQUALS	BIT4	
OCT500	OCT	500	# BITS 7 AND 9
OCT305	OCT	305	
OCT26	OCT	26	
P20REG	OCT	124	
V37XEQ	INHINT		
	INDEX	MINDEX	
	CAF	PREMM1	# OBTAIN PRIO, EBANK, AND MM
	TS	MMTEMP	
	TS	CYR	# SHIFT RIGHT TO BITS 14-10
	CA	CYR	
	MASK	PRI037	
	TS	PHSPRDT4	# PRESET GROUP 4 RESTART PRIORITY
	TS	NEWPRIO	# STORE PRIO FOR SPVAC
	CA	MMTEMP	# OBTAIN EBANK -- BITS 8, 9, 10 OF MMTEMP.
	EXTEND		
	MP	BIT8	
	MASK	LOW3	
	TS	L	
	INDEX	MINDEX	
	CAF	FCADRMM1	
	TS	BASETEMP	# MAKE BBCON BY ADDING HI5 OR FCADR
	MASK	HI5	
	ADS	L	
	CA	BASETEMP	# OBTAIN GENADR PORTION OF 2CADR.
	MASK	LOW10	
	AD	BIT11	
	TC	SPVAC	
V37XEQC	CA	MMTEMP	# UPON RETURN FROM FINDVAC PLACE THE
	MASK	LOW7	# NEW MM IN MODREG THE LOW 7 BITS OF
	TC	NEWMODEA	# PHSPRDT1
	TC	RELDSP	# RELEASE DISPLAY
	TC	ENDOFJOB	# AND EXIT
NEG7	EQUALS	OCT77770	
MMTEMP	EQUALS	PHSPRDT3	
BASETEMP	EQUALS	TBASE4	
V37QCAD	CADR	V37XEQ +3	
R00AD	CADR	DUMMYAD	

V37RETAD	CADR	V37RET
OCT37667	OCT	37667
OCT40072	OCT	40072
OCT700	OCT	700

SETUP71	CAF	THREE
SETUP70	TS	Q
	EXTEND	
	DCA	P70CADR
	AD	Q
	DTCB	

DEC70	DEC	70
	EBANK	R
P70CADR	2CADR	P70

FOR VERB 37 TWO TABLES ARE MAINTAINED. EACH TABLE HAS AN ETRY FOR EACH
MAJOR MODE THAT CAN BE STARTED FROM THE KEYBOARD. THE ENTRIES ARE PUT
INTO THE TABLE WITH THE ENTRY FOR THE HIGHEST MAJOR MODE COMING FIRST,
TO THE LOWEST MAJOR MODE WHICH IS THE LAST ENTRY IN EACH TABLE.

THE FCADRM TABLE CONTAINS THE FCADR OF THE STARTING JOB OF
THE MAJOR MODE. FOR EXAMPLE,

#	FCADRM1	FCADR	P79	# START OF P 79
#		FCADR	PROG18	# START OF P 18
#		FCADR	P01	# START OF P 01

NOTE THE FIRST ENTRY MUST BE LABELED FCADRM1.

FCADRM1	FCADR	P79
	FCADR	P78
	FCADR	P76
	FCADR	P75
	FCADR	P74
	FCADR	P73
	FCADR	P72
	FCADR	LANDJUNK
	FCADR	P63LM
	FCADR	P57
	FCADR	PROG52
	FCADR	P51
	FCADR	P47LM
	FCADR	P42LM
	FCADR	P41LM
	FCADR	P40LM
	FCADR	P39
	FCADR	P38

```
FCADR P35
FCADR P34
FCADR P33
FCADR P32
FCADR P31
FCADR P30
FCADR PROG25
FCADR PROG22
FCADR PROG21
FCADR PROG20
FCADR P12LM
FCADR P06
```

THE PREMM TABLE CONTAINS THE E-BANK, MAJOR MODE, AND PRIORITY
INFORMATION, IT IS IN THE FOLLOWING FORM,

PPP PPE EEM MMM MMM

WHERE THE 7 M BITS CONTAIN THE MAJOR MODE NUMBER
3 E BITS CONTAIN THE E-BANK NUMBER
5 P BITS CONTAIN THE PRIORITY AT WHICH THE JOB IS
TO BE STARTED

FOR EXAMPLE,

PREMM1	OCT	67213	# PRIORITY	33
			# E-BANK	5
			# MAJOR MODE	11
	OCT	25437	# PRIORITY	12
			# E-BANK	6
			# MAJOR MODE	31

NOTE THE FIRST ENTRY MUST BE LABELED PREMM1

PREMM1	OCT	27717	# MM 79	EBANK 7	PRIO 13
	OCT	27716	# MM 78	EBANK 7	PRIO 13
	OCT	27714	# MM 76	EBANK 7	PRIO 13
	OCT	27713	# MM 75	EBANK 7	PRIO 13
	OCT	27712	# MM 74	EBANK 7	PRIO 13
	OCT	27711	# MM 73	EBANK 7	PRIO 13
	OCT	27710	# MM 72	EBANK 7	PRIO 13
	OCT	27704	# MM 68	EBANK 7	PRIO 13
	OCT	27677	# MM 63	EBANK 7	PRIO 13
	OCT	27271	# MM 57	EBANK 5	PRIO 13
	OCT	27264	# MM 52	EBANK 5	PRIO 13
	OCT	27263	# MM 51	EBANK 5	PRIO 13
	OCT	27657	# MM 47	EBANK 7	PRIO 13
	OCT	27652	# MM 42	EBANK 7	PRIO 13
	OCT	27651	# MM 41	EBANK 7	PRIO 13
	OCT	27650	# MM 40	EBANK 7	PRIO 13
	OCT	27647	# MM 39	EBANK 7	PRIO 13
	OCT	27646	# MM 38	EBANK 7	PRIO 13

OCT	27643	# MM 35	EBANK 7	PRI0 13
OCT	27642	# MM 34	EBANK 7	PRI0 13
OCT	27641	# MM 33	EBANK 7	PRI0 13
OCT	27640	# MM 32	EBANK 7	PRI0 13
OCT	27637	#		
OCT	27636	# MM 30	EBANK 7	PRI0 13
OCT	27631	# MM 25	EBANK 7	PRI0 13
OCT	27626	# MM 22	EBANK 7	PRI0 13
OCT	27625	# MM 21	EBANK 7	PRI0 13
OCT	27624	# MM 20	EBANK 7	PRI0 13
OCT	27614	# MM 12	EBANK 7	PRI0 13
OCT	27006	# MM 06	EBANK 4	PRI0 13

NOTE THE FOLLOWING CONSTANT IS THE NUMBER OF ENTRIES IN EACH OF
----- THE ABOVE LISTS-1 I.E., THE NUMBER OF MAJOR MODES EXCEPT P00
THAT CAN BE CALLED FROM THE KEYBOARD MINUS ONE

NOV37MM DEC 29 # MM S -1

DNLADMM1	ADRES	RENDEZVU	# P79
	ADRES	RENDEZVU	# P78
	ADRES	RENDEZVU	
	ADRES	RENDEZVU	# P75
	ADRES	RENDEZVU	# P74
	ADRES	RENDEZVU	# P73
	ADRES	RENDEZVU	# P72
	ADRES	DESASCNT	# P68
	ADRES	DESASCNT	# P63
	ADRES	LUNRSALN	# P57
	ADRES	COSTALIN	# P52
	ADRES	COSTALIN	# P51
	ADRES	ORBMANUV	# P47
	ADRES	ORBMANUV	# P42
	ADRES	ORBMANUV	# P41
	ADRES	ORBMANUV	# P40
	ADRES	RENDEZVU	# P39
	ADRES	RENDEZVU	# P38
	ADRES	RENDEZVU	# P35
	ADRES	RENDEZVU	# P34
	ADRES	RENDEZVU	# P33
	ADRES	RENDEZVU	# P32
	ADRES	RENDEZVU	# P31LM
	ADRES	RENDEZVU	# P30
	ADRES	RENDEZVU	# P25
	ADRES	LUNRSALN	# P22
	ADRES	RENDEZVU	# P21
	ADRES	RENDEZVU	# P20
	ADRES	DESASCNT	# P12
	ADRES	COSTALIN	# P06

DNLADP00
COSTALIN ZERO

0


```
1 AGSUPDAT      1
2 RENDEZVU      2
3 ORBMANUV      3
4 DESASCNT      4
5 LUNRSALN      5
6
7
8 BANK      13
9 SETLOC    INTINIT
10 BANK
11
12 COUNT*    $$/INTIN
13
14 EBANK      RRECTCSM
15
16 # THIS ROUTINE DOES THE P00 INTEGRATION
17
18 STATEUP      SET      BOF          # EXTRAPOLATE CM STATE VECTOR
19             VINTFLAG
20             SURFFLAG          # ALSO 6X6 W-MATRIX IF LM ON LUNAR
21             DOINT            # SURFACE AND W-MATRIX VALID
22             BOF      SET          # FOR RENDEZVOUS NAVIGATION.
23             RENWFLG
24             DOINT
25
26 DOINT        CLEAR    DIMOFLAG
27             CALL          # ENGAGES 4-TIME STEP LOGIC IN INTEGRATION
28             PRECIFLG      # WHEN MODREG  0
29             INTEGRV
30
31             BON      DLOAD
32             SURFFLAG
33             NO-INT
34             TETCSM
35
36             STCALL    TDEC1
37             INTSTALL
38             CLEAR    CALL          # EXTRAPOLATE LM STATE VECTOR
39             VINTFLAG
40             SETIFLGS          # ALSO 9X9 W-MATRIX IF W IS VALID
41
42             RENWFLG
43             DOINT2
44             SET      SET
45
46 DOINT2        SET      DIMOFLAG
47             D6OR9FLG
48             CALL          # DISENGAGE 4 TIME STEP LOGIC IN INTEG.
49             PRECIFLG      INTEGRV
50
51 NO-INT        CLRGO
52             NODOFLAG
53             ENDINT
```



FRESH START AND RESTART

THISVINT IS CALLED BY MIDTOAV1 AND 2

THISVINT CLEAR RVQ
 VINTFLAG

1412THE

#	5.7SPOT	OCT	23000
#		2CADR	SOMEJOB
#			

#	5.5SPOT	OCT	-23000
#		2CADR	ANYJOB

```
# A LONGCALL HAS ITS GENADR OF ITS 2CADR STORED NEGATIVELY AND ITS BBCON STORED POSITIVELY.  IN ITS PRDITAB IS
# PLACED THE LOCATION OF A DP REGISTER THAT CONTAINS THE DELTA TIME THAT LONGCALL HAD BEEN ORIGINALLY STARTED
# WITH.  EXAMPLE,
```

#	3.6SPOT	GENADR	DELTAT
#		-GENADR	LONGTASK
#		BBCON	LONGTASK
#			
#		OCT	31000
#		2CADR	JOBAGAIN

```
# THIS WOULD START UP LONGTASK AT THE APPROPRIATE TIME, OR IMMEDIATELY IF THE TIME HAD ALREADY PASSED. IT SHOULD
# BE NOTED THAT IF DELTAT IS IN A SWITCHED E BANK, THIS INFORMATOIN SHOULD BE IN THE BBCON OFTHE 2CADR OF THE
# TASK.  FROM ABOVE, WE SEE THAT THE SECOND PART OF THIS PHASE WOULD BE STARTED AS A JOB WITH A PRIORITY OF 31.
```

```
# WAITLIST CALLS ARE IDENTIFIED BY THE FACT THAT THEIR 2CADR IS STORED NEGATIVELY. IF PRDTTAB OF THE PHASE SPOT
# IS POSITIVE, THEN IT CONTAINS THE DELTA TIME, IF PRDTTAB IS NEGATIVE THEN IT IS THE -GENADR OF AN ERASABLE
# LOCATION CONTAINING THE DELTA TIME, THAT IS, THE TIME IS STORED INDIRECTLY. IT SHOULD BE NOTED AS ABOVE, THAT
# IF THE TIME IS STORED INDIRECTLY, THE BBCON MUST CONTAIN THE NECESSARY E BANK INFORMATION IF APPLICABLE. WITH
# WAITLIST WE HAVE ONE FURTHER OPTION, IF -0 IS STORED IN PRDTTAB, IT WILL CAUSE AN IMMEDIATE RESTART OF THE
# TASK.  EXAMPLES,
```

#	OCT	77777	# THIS WILL CAUSE AN IMMEDIATE RESTART
#	-2CADR	ATASK	# OF THE TASK ATASK
#			
#	DEC	200	# IF THE TIME OF THE 2 SECONDS SINCE DUMMY
#	-2CADR	DUMMY	# WAS PUT ON THE WAITLIST IS UP, IT WILL BEGIN
#			# IN 10 MS, OTHERWISE IT WILL BEGIN WHEN
#			# IT NORMALLY WOULD HAVE BEGUN.

```
#          -GENADR  DTIME          # WHERE DTIME CONTAINS THE DELTA TIME
#          -2CADR   TASKTASK       # OTHERWISE THIS IS AS ABOVE
```

```
# ***** NOW THE TABLES THEMSELVES *****
```

```
BANK      01
SETLOC    RESTART
BANK
```

```
PRDTTAB    EQUALS  12000          # USED TO FIND THE PRIORITY OR DELTATIME
CADRTAB    EQUALS  12001          # THIS AND THE NEXT RELATIVE LOC CONTAIN
                                           # RESTART 2CADR
```

```
          COUNT*  $$/RSTAB        # TABLES IN BANK 1.
```

```
SIZE TAB   TC      1.2SPOT -12006
```

```
          TC      1.3SPOT -12004
```

```
          TC      2.2SPOT -12006
```

```
          TC      2.3SPOT -12004
```

```
          TC      3.2SPOT -12006
```

```
          TC      3.3SPOT -12004
```

```
          TC      4.2SPOT -12006
```

```
          TC      4.3SPOT -12004
```

```
          TC      5.2SPOT -12006
```

```
          TC      5.3SPOT -12004
```

```
          TC      6.2SPOT -12006
```

```
          TC      6.3SPOT -12004
```

```
1.2SPOT    OCT      21000          # A DUMMY EXAMPLE TO BE REPLACED AS SOON
```

```
          EBANK    STATE
```

```
          2CADR    ENDOFJOB        # AS THERE IS A LEGITIMATE 1.2SPOT
```

```
          DEC      100
```

```
          EBANK    STATE
```

```
          2CADR    TASKOVER
```

```
# ANY MORE GROUP 1.EVEN RESTART VALUES SHOULD GO HERE
```

```
1.3SPOT    -GENADR  SAVET-30
```

```
          EBANK    DVCNTR
```

```
          -2CADR   ULLGTASK
```

```
# ANY MORE GROUP 1.ODD RESTART VALUES SHOULD GO HERE
```

```
2.2SPOT    EQUALS  1.2SPOT
```

```
# ANY MORE GROUP 2.EVEN RESTART VALUES SHOULD GO HERE
```

```
2.3SPOT    GENADR  600SECS
```

```
          -GENADR  STATEINT
```

```
          EBANK    RRECTCSM
```

```
          BB CON   STATEINT
```

2.5SPOT OCT 05000
 EBANK RRECTCSM
 2CADR STATINT1

2.7SPOT DEC 1500
 EBANK LOSCOUNT
 -2CADR P20LEMC1

2.11SPOT OCT 14000
 EBANK P21TIME
 2CADR P25LEM1

2.13SPOT OCT 10000
 EBANK LOSCOUNT
 2CADR RELINUS

2.15SPOT OCT 26000
 EBANK LOSCOUNT
 2CADR R22RSTR

2.17SPOT OCT 77777
 EBANK VGPREV
 -2CADR RED02.17

2.21SPOT DEC 25
 EBANK DVCNTR
 -2CADR R10,R11

ANY MORE GROUP 2.ODD RESTART VALUES SHOULD GO HERE.

3.2SPOT EQUALS 1.2SPOT
ANY MORE GROUP 3.EVEN RESTART VALUES SHOULD GO HERE

3.3SPOT -GENADR ZOOMTIME
 EBANK DVCNTR
 -2CADR ZOOM

3.5SPOT OCT 20000
 EBANK TTOGO
 2CADR S40.13

ANY MORE GROUP 3.ODD RESTART VALUES SHOULD GO HERE

4.2SPOT DEC 2500
 EBANK TTOGO
 -2CADR TIG-5

OCT 77777
EBANK TTOGO

-2CADR RED04.2

ANY MORE GROUP 4.EVEN RESTART VALUES SHOULD GO HERE

4.3SPOT OCT 25000
EBANK DVCNTR
2CADR GOABORT

4.5SPOT DEC 50
EBANK TTOGO
-2CADR ULLAGOFF

4.7SPOT DEC 500
EBANK DVCNTR
-2CADR TIG-0

4.11SPOT -GENADR TGO +1
EBANK DVCNTR
-2CADR ENGOF TSK

4.13SPOT OCT 12000
EBANK TRKMKCNT
2CADR POSTBURN

4.15SPOT DEC 500
EBANK TTOGO
-2CADR TIG-30

4.17SPOT OCT 77777
EBANK DVCNTR
-2CADR TIG-5

4.21SPOT OCT 13000
EBANK STAR
2CADR R51.1 +1

4.23SPOT OCT 77777
EBANK DVCNTR
-2CADR IGNITION

4.25SPOT GENADR SAVET-30
-GENADR TIG-35
EBANK SAVET-30
BBCON TIG-35

4.27SPOT OCT 52777
EBANK DVCNTR
2CADR P70A

4.31SPOT OCT 52777
EBANK DVCNTR
2CADR P71A

4.33SPOT OCT 46777
EBANK DVCNTR
2CADR GOP00FIX

4.35SPOT OCT 46777
EBANK DVCNTR
2CADR GOP00DOO

4.37SPOT OCT 52777
EBANK WHICH
2CADR COMFAIL

ANY MORE 4.ODD RESTART VALUES SHOULD GO HERE.

5.2SPOT OCT 22000
EBANK DVCNTR
2CADR NORMLIZE

DEC 200
EBANK DVCNTR
-2CADR REREADAC

5.4SPOT DEC 200
EBANK DVCNTR
-2CADR REREADAC

OCT 20000
EBANK DVCNTR
2CADR SERVICER

ANY MORE GROUP 5.EVEN RESTART VALUES SHOULD GO HERE

5.3SPOT DEC 200
EBANK DVCNTR
-2CADR REREADAC

5.5SPOT OCT 77777
EBANK DVCNTR
-2CADR RED05.5

5.7SPOT OCT 77777
EBANK DVCNTR

-2CADR BIBIBIAS

ANY MORE GROUP 5.ODD RESTART VALUES SHOULD GO HERE

6.2SPOT EQUALS 1.2SPOT
6.3SPOT DEC 100
EBANK TIG
-2CADR CLOKTASK

6.5SPOT OCT 30000 # PROTECT INCREMENTING OF TIME2,TIME1 BY
EBANK TEPHEM # P27 UPDATE PROGRAM VIA V70 OR V73.
2CADR TIMEDIDR

6.7SPOT OCT 17000
EBANK VGPREV
2CADR RED06.7

	BANK	12	
	SETLOC	AOTMARK1	
	BANK		
	EBANK	XYMARK	
	COUNT*	\$\$/MARK	
AOTMARK	INHINT		
	CCS	MARKSTAT	# SEE IF AOTMARK BUSY
	TC	+2	# MARK SYSTEM BUSY -- DO ALARM
	TC	EXTVBCHK	
	TC	POOD00	
	OCT	00105	
EXTVBCHK	CAF	SIX	# SEE IF EXT. VERB WORKING
	MASK	EXTVBACT	
	CCS	A	
	TCF	MKABORT	# YES -- ABORT
	CAF	BIT2	# NO -- DISALLOW SOME EXTENDED VERB ACTION
	ADS	EXTVBACT	# BIT2 RESET IN ENDMARK
MKVAC	CCS	VAC1USE	# LOOK FOR A VAC AREAD -- DO ABORT IF
	TCF	MKVACFND	# NONE AVAILABLE
	CCS	VAC2USE	
	TCF	MKVACFND	
	CCS	VAC3USE	
	TCF	MKVACFND	
	CCS	VAC4USE	
	TCF	MKVACFND	
	CCS	VAC5USE	
	TCF	MKVACFND	
	DXCH	BUF2	
	TC	BAILOUT1	# ALL VAC AREAS OCCUPIED -- ABORT.
	OCT	01207	
MKVACFND	AD	TWO	
	TS	MARKSTAT	# STORE VAC ADR IN LOW 9 OF MARKSTAT
	CAF	ZERO	
	INDEX	MARKSTAT	
	TS	0 -1	# ZERO IN VACUSE REG TO SHOW VAC OCCUPIED
	CAF	PRI015	
	TC	FINDVAC	# SET UP JOB FOR GETDAT
	EBANK	XYMARK	
	2CADR	GETDAT	
	RELINT		
	TCF	SWRETURN	

1					1
2	MKABORT	DXCH	BUF2		2
3		TC	BAILOUT1	# CONFLICT WITH EXTENDED VERB	3
4		OCT	01211		4
5					5
6	MKRELEAS	CAF	ZERO		6
7		XCH	MARKSTAT	# SET MARKSTAT TO ZERO	7
8		MASK	LOW9	# PICK UP VAC AREA AOR	8
9					9
10					10
11					11
12					12
13					13
14					14
15					15
16					16
17					17
18					18
19					19
20					20
21					21
22					22
23					23
24					24
25					25
26					26
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44					44
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46					46
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48					48
49					49
50					50
51					51
52					52
53					53
54					54
55					55
56					56
57					57
58					58
59					59
60					60

KILLAOT	CAF TS	ZERO EXTVBACT	# TERMINATE AOTMARK -- ALLOW EXT VERB
GETDAT	TC CS MASK	GOTOPOOH MARKSTAT BIT12	# SET BIT12 TO DISCOURAGE MARKRUPT # BIT12 RESET AT GETMARK
	ADS	MARKSTAT	
	CAF TC CADR	V01N71 BANKCALL GOMARKF	# DISPLAY DETENT AND STAR CODE
ENTERDAT	TCF TCF TCF	KILLAOT DODAT GETDAT	# V34 -- DOES GOTOPOOH # V33 -- PROCEED -- USE THIS STAR FOR MARKS # ENTER -- REDISPLAY STAR CODE
DODAT	CAF MASK	HIGH9 AOTCODE	# PICK DETENT CODE FROM BITS7-9 OF AOTCODE # AND SEE IF CODE 1 TO 6
	EXTEND MP TS	BIT9 XYMARK	# STORE DETENT
	EXTEND BZMF	GETDAT	# COAS CALIBRATION CODE - NO GOOD HERE
	AD EXTEND BZF	NEG7 CODE7	# SEE IF DETENT 7 FOR COAS
	TCF	CODE1T06	
CODE7	CAF TC CADR	V06N87* BANKCALL GOMARKF	# CODE 7, COAS SIGHTING, GET OPTIC AXIS # AZ AND EL OF SIGHTING DEVICE FROM ASTRO
	TCF TCF TCF EXTEND	KILLAOT +2 CODE7	# V34 -- DOES GOTOPOOH # PROCEED # ON ENTER, RECYCLE
	DCA INDEX DXCH	AZ FIXLOC 8D	# PICK UP AZ AND EL IN SP 25 COMP # STORE IN 8D AND 9D OF LOCAL VAC
	CAF TCF	ZERO COASCODE	# BACKUP SYSTEM TO BE USED # ZERO APPARENT ROTATION
CODE1T06	INDEX CA INDEX TS	XYMARK AOTEL -1 FIXLOC 9D	# INDEX AOT POSITION BY DET CODE # STORE ELEVATION IN VAC+9D
	INDEX	XYMARK	# INDEX DET CODE 1,2 OR 3

1					1
2		CA	AOTAZ -1		2
3		INDEX	FIXLOC		3
4		TS	8D	# STORE AZIMUTH IN VAC +8D	4
5					5
6		CA	AOTAZ +1	# COMPENSATION FOR APPARENT ROTATION OF	6
7		EXTEND		# AOT FIELD OF VIEW IN LEFT AND RIGHT	7
8		INDEX	FIXLOC	# DETENTS IS STORED IN VAC +10D IN SP	8
9		MSU	8D	# PRECISION ONE S COMPLEMENT	9
10	COASCODE	INDEX	FIXLOC		10
11		TS	10D	# ROT ANGLE	11
12					12
13		TC	INTPRET	# COMPUTE X AND Y PLANE VECTORS	13
14					14
15					15
16					16
17					17
18					18
19					19
20					20
21					21
22					22
23					23
24					24
25					25
26					26
27					27
28					28
29					29
30					30
31					31
32					32
33					33
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60					60


```
1  # THE OPTAXIS SUBROUTINE COMPUTES THE X AND Y MARK PLANE VECs AND
2  # ROTATES THEM THRU THE APPARENT FIELD OF VIEW ROTATION UNIQUE TO AOT
3  # OPTAXIS USES OANB TO COMPUTE THE OPTIC AXIS
4  #
5  #
6  #      INPUT --      AZIMUTH ANGLE IN SINGLE PREC AT CDU SCALE IN 8D OF JOB VAC
7  #                      ELEVATION ANGLE IN SINGLE PREC AT CDU SCALE IN 9D OF JOB VAC
8  #                      ROTATION ANGLE IN SINGLE PREC IS COMP SCALED BY PI IN 10D OF VAC
9  #
10 #      OUTPUT --     OPTIC AXIS VEC IN NG COORDS IN SCAXIS
11 #                     X-MARK PLANE 1/4VEC IN NB COORDS AT 18D OF JOB VAC
12 #                     Y-MARK PLANE 1/4VEC IN NB COORDS AT 12D OF JOB VAC
```

```
13 OPTAXIS          CALL          # GO COMPUTE OA AN X AND Y PLANE VECs
14                      OANB
15                      SLOAD      SR1      # LOAD APP ROTATION IN ONES COMP
16                      10D        # RESCALE BY 2PI
17                      PUSH      SIN      # 1/2SIN ROT  0-1
18                      PDDL      COS
19                      PUSH      VXSC     # 1/2COS ROT  2-3
20                      18D
21                      PDDL      VXSC     # 1/4COS ROT UYP 4-9
22                      0
23                      24D      # 1/4SIN ROT UXP
24                      BVSU      STADR    # UP 4-9
25                      STODL     12D      # YPNB 1/4 COS ROT UYP-SIN ROT UXP
26                      VXSC      PDDL     # UP 2-3 UP 0-1 FOR EXCHANGE
27                      24D      # 1/4COS ROT UXP      PUSH 0-5
28                      VXSC      VAD      # 1/4SIN ROT UYP
29                      18D      # UP 0-5
30
31                      STADR
32                      STOVL     18D      # XPNB 1/4 COS ROT UXP+SIN ROT UYP
33                      L06ZEROS # INITIALIZE AVE STAR VEC ACCUMULATOR
34                      STORE     STARAD +6
35                      EXIT
36                      TCF      GETMKS
```

THE OANB SUBROUTINE COMPUTES THE OPTIC AXIS OF THE SIGHTING INSTRUMENT
FROM AZIMUTH AND ELEVATION INPUT FROM THE ASTRONAUT.

INPUT -- AZIMUTH ANGLE IN SINGLE PREC 2 S COMP IN 8D OF JOB VAC
ELEVATION ANGLE IN SINGLE PREC 2 S COMP IN 9D OF VAC

OUTPUT -- OPTIC AXIS IN NB COORDS. IN SCAXIS
X-PLANE 1/2VEC IN NB COORDS AT 24D OF VAC
Y-PLANE 1/2VEC IN NB COORDS AT 18D OF VAC

BANK 05
SETLOC AOTMARK2
BANK

COUNT* \$\$/MARK

OANB SETPD STQ
0
GCTR # STORE RETURN
SLOAD RTB
9D # PICK UP SP ELV
CDULOGIC
PUSH COS
PDDL SIN # 1/2COS ELV PD 0-1
STADR
STODL SCAXIS # OAX 1/2SIN ELV
8D

RTB
CDULOGIC
PUSH COS
STORE 20D # STORE UYP Y 20-21
PDDL SIN # 1/2COS AZ PD 2-3
PUSH DCOMP # PUSH 1/2S IN AZ 4-5
STODL 22D # STORE UYP Z 22-23
LO6ZEROS

STODL 18D # STORE UYP X 18-19
DMP SL1
0
STODL SCAXIS +2 # OAY 1/2COS ELV SIN AZ
DMP SL1 # UP 2-3
STADR # UP 0-1

STOVL SCAXIS +4 # OAZ 1/2COS ELV COS AZ
18D # LOAD UYP VEC
VXV UNIT

SCAXIS # UXP VEC UYP X OA
STORE 24D # STORE UXP
GOTO

GCTR

```
1 # SURFSTAR COMPUTES A STAR VECTOR IN SM COORDINATES FOR LUNAR
2 # SURFACE ALIGNMENT AND EXITS TO AVEIT TO AVERAGE STAR VECTORS.
3
4 #
5 #     GIVEN   X-MARK PLANE 1/4 VEC IN NB AT 18D OF LOCAL VAC
6 #           Y-MARK PLANE 1/4 VEC IN NB AT 12D OF LOCAL VAC
7 #           CURSOR SP 2COMP AT POSITION 1 OF INDEXED MARKVAC
8 #           SPIRAL SP 2COMP AT POSITION 3 OF INDEXED MARKVAC
9 #           CDUY,Z,X AT POSITIONS 0,2,4 OF INDEXED MARKVAC
10
11         BANK    15
12         SETLOC  P50S
13
14         BANK
15         COUNT*  $$/R59
16
17 SURFSTAR  VLOAD*
18           0,1          # PUT X-MARK CDUS IN CDUSPOT FOR TRG*NBSM
19         STORE  CDUSPOT
20         SLOAD* RTB
21           1,1          # PICK UP YROT
22         CDULOGIC
23         STORE  24D      # STORE CURSOR FOR SPIRAL COMP REVS
24         BZE
25           YZCHK        # IF YROT ZERO -- SEE IF SROT ZERO
26 JUSTZY    PUSH  COS
27           PDDL  SIN      # 1/2COS YROT    0-1
28           VXSC PDDL      # UP 0-1        1/8SIN YROT UXP 0-5
29           18D
30           VXSC VSU      # UP    0-5
31           12D      # UYP
32         UNIT  VXV
33         SCAXIS
34         UNIT  PUSH
35         SLOAD* RTB
36           3,1          # PICK UP SPIRAL
37         CDULOGIC
38         STORE  26D      # STORE SPIRAL REVS
39         DSU
40         DAD
41         24D
42         ABOUTONE
43         DMP
44         DP1/12
45         STORE  26D      # SEP 360 + SPIRAL -CURSOR /12
46         SIN    VXSC      # UP    0-5
47         VSL1   PDDL      # 1/2SIN SEP  UPP X OA  0-5
48         26D
49         COS    VXSC
50         SCAXIS
51 JUSTOA    VSL1  VAD      # UP    0-5
52         UNIT  CALL
53         TRG*NBSM
54         STCALL 24D      # STAR VEC IN SM
55         AVEIT   # GO AVERAGE
```

ABOUTONE	2DEC	.99999999	
DP1/12	EQUALS	DEG30	# .08333333
	BANK	7	
	SETLOC	AOTMARK1	
YZCHK	BANK		
	COUNT*	\$\$/MARK	
	SLOAD*	BZE	# YROT ZERO AND IF SROT ZERO FORCE STAR
		3,1	# ALONG OPTIC AXIS
	DLOAD	GOTO	
YSZERO	VLOAD	24D	
		JUSTZY	# SROT NOT ZERO -- CONTINUE NORMALLY
		GOTO	
		SCAXIS	
		JUSTOA	

THE GETMKS ROUTINE INITIALIZES THE SIGHTING MARK PROCEDURE

GETMKS	CAF	ZERO	# INITIALIZE MARK ID REGISTER AND MARK CNT
	TS	XYMARK	
	TS	MARKCNTR	
	CAF	LOW9	# ZERO BITS10 TO 15 RETAINING MKVAC ADR
	MASK	MARKSTAT	
	TS	MARKSTAT	
PASTIT	CAF	MKVB54*	# DISPLAY VB54 INITIALLY
	TC	BANKCALL	
	CADR	GOMARK4	
	TCF	KILLAOT	# V34 -- DOES GOTOP00H
	TCF	MARKCHEX	# VB33 -- PROCEED, GOT MARKS, COMPUTE LOS
	TCF	GETDAT	# ENTER -- RECYCLE TO V01N71
MARKCHEX	CS	MARKSTAT	# SET BIT12 TO DISCOURAGE MARKRUPT
	MASK	BIT12	
	ADS	MARKSTAT	
	MASK	LOW9	
	TS	XYMARK	# JAM MARK VAC ADR IN XYMARK FOR AVESTAR
	CAF	ZERO	
	TS	MKDEX	# SET MKDEX ZERO FOR LOS VEC CNTR
	CA	MARKSTAT	
	MASK	PRI03	# SEE IF LAST MK PART COMPLETE
	TS	L	
	CAF	PRI03	# BITS10 AND 11
	EXTEND		
	RXOR	LCHAN	
	EXTEND		
CNTCHK	BZF	AVESTAR	# LAST PAIR COMPLETE -- TO COMPUTE LOS
	CCS	MARKCNTR	# NO PAIR SHOWING -- SEE IF PAIR IN HOLD
	TCF	+2	# PAIR BURIED -- DECREMENT COUNTER
	TCF	MKALARM	# NO PAIR -- ALARM
	TS	MARKCNTR	# STORE DECREMENTED COUNTER
AVESTAR	CAF	BIT12	# INITIALIZE MKDEX FOR STAR LOS COUNTER
	ADS	MKDEX	# MKDEX WAS INITIALIZED ZERO IN MARKCHEX
	CS	MARKCNTR	
	EXTEND		
	MP	SIX	# GET C L -6 MARKCNTR
	CS	XYMARK	
	AD	L	# ADD -- MARK VAC ADR SET IN MARKCHEX
	INDEX	FIXLOC	
	TS	X1	# JAM -- CDU ADR OF X-MARK IN X1
	CA	FIXLOC	# SET PD POINTER TO ZERO
	TS	PUSHLOC	
	TC	INTPRET	

BON	VLOAD*		
	SURFFLAG		# IF ON SURFACE COMPUTE VEC AT SURFSTAR
	SURFSTAR		
	1,1		# PUT Y-MARK CDUS IN CDUSPOT FOR TRG*NBSM
STOVL	CDUSPOT		
	12D		# LOAD Y-PLANE VECTOR IN NG
CALL			
	TRG*NBSM		# CONVERT IT TO STABLE MEMBER
PUSH	VLOAD*		
	0,1		# PUT X-MARK CDUS IN CDUSPOT FOR TRG*NBSM
STOVL	CDUSPOT		
	18D		# LOAD X-PLANE VECTOR IN NB
CALL			
	TRG*NBSM		# CONVERT IT TO STABLE-MEMBER
VXV	UNIT		# UNIT XPSM * YPSM
STADR			
STORE	24D		
AVEIT	SLOAD	PDVL	# N NUMBER OF VECs IN 0-1
		MKDEX	
		24D	# LOAD CURRENT VECTOR
VSR3	V/SC		
	0		
STODL	24D		# VEC/N
	0		
DSU	DDV		
	DP1/8		# N-1 /N
VXSC	VAD		
	STARAD +6		# ADD VEC TO PREVIOUSLY AVERAGED VECTOR
	24D		# N-1 /N AVESTVEC + VEC/N
STORE	STARAD +6		# AVERAGE STAR VECTOR
STORE	STARSAV2		
EXIT			
CCS	MARKCNTR		# SEE IF ANOTHER MARK PAIR IN MKVAC
TCF	AVESTAR -1		# THERE IS -- GO GET IT -- DECREMENT COUNTER
ENDMARKS	CAF	FIVE	# NO MORE MARKS -- TERMINATE AOTMARK
	INHINT		
	TC	WAITLIST	
	EBANK	XYMARK	
	2CADR	MKRELEAS	
	TC	ENDMARK	
MKALARM	TC	ALARM	# NOT A PAIR TO PROCESS -- DO GETMKS
	OCT	111	
	TCF	GETMKS	
V01N71	VN	171	
V06N87*	VN	687	

MARKRUPT IS ENTERED FROM INTERRUPT LEAD-INS AND PROCESSES CHANNEL 16
CAUSED BY X,Y MARK OR MARK REJECT OR BY THE RATE OF DESCENT SWITCH

MARKRUPT	TS	BANKRUPT	
	CA	CDUY	# STORE CDUS AND TIME NOW -- THEN SEE IF
	TS	ITEMP3	# WE NEED THEM
	CA	CDUZ	
	TS	ITEMP4	
	CA	CDUX	
	TS	ITEMP5	
	EXTEND		
	DCA	TIME2	
	DXCH	ITEMP1	
	XCH	Q	
	TS	QRUPT	
	CAF	OCT34	# SEE IF X OR Y MARK OR MKREJECT
	EXTEND		
	RAND	NAVKEYIN	
	CCS	A	
	TCF	+2	# ITS A LIVE ONE -- SEE IF ITS WANTED
	TCF	SOMEKEY	# ITS SOME OTHER KEY
	CAF	BIT12	# ARE WE ASKING FOR A MARK
	MASK	MARKSTAT	
	CCS	A	
	TC	RESUME	# DON T WANT MARK OR MKREJECT -- DO NOTHING
	CCS	MARKSTAT	# ARE MARKS BEING ACCEPTED
	TCF	FINDKEY	# THEY ARE -- WHICH ONE IS IT
	TC	ALARM	# MARKS NOT BEING ACCEPTED -- DO ALARM
	OCT	112	
	TC	RESUME	
FINDKEY	CAF	BIT5	# SEE IF MARK REJECT.
	EXTEND		
	RAND	NAVKEYIN	
	CCS	A	
	TCF	MKREJ	# IT S A MARK REJECT
	CAF	BIT4	# SEE IF Y MARK
	EXTEND		
	RAND	NAVKEYIN	
	CCS	A	
	TCF	YMKRUPT	# IT S A Y MARK
	CAF	BIT3	# SEE IF X MARK
	EXTEND		
	RAND	NAVKEYIN	

	CCS TCF	A XMKRUPT	# IT S A X MARK
SOMEKEY	CAF EXTEND	OCT140	# NOT MARK OR MKREJECT -- SEE IF DESCENT BITS
	RAND EXTEND BZF	NAVKEYIN +3	# IF NO BITS
	TC CADR	POSTJUMP DESCBITS	# IF DESCENT BITS
	TC OCT	ALARM 113	# NO INBITS IN CHANNEL 16.
	TC	RESUME	
XMKRUPT	CAF TS CAF	ZERO RUPTREG1 BIT10	# SET X MARK STORE INDEX TO ZERO
YMKRUPT	TCF CAF TS	+4 ONE RUPTREG1	# SET Y MARK STORE INDEX TO ONE
	CAF TS	BIT11 XYMARK	# SET MARK IDENTIFICATION
	TC TCF	MARKTYPE SURFSTOR	# SEE IF SURFACE MARK # SURFACE MARK -- JUST STORE CDUS
	CAF MASK EXTEND	BIT14 MARKSTAT	# GOT A MARK -- SEE IF MARK PAIR MADE
	BZF CS AD	VERIFYMK MARKCNTR FOUR	# NOT A PAIR, NORMAL PROCEDURE # GO A PAIR, SEE IF ANOTHER CAN BE MADE # IF SO, INCREMENT POINTER, CLEAR BITS 10,11
	EXTEND BZMF INCR	5MKALARM MARKCNTR	# HAVE FIVE MARK PAIRS -- DON T ALLOW MARK # OK FOR ANOTHER PAIR, INCR POINTER
	CS MASK TS	PRI023 MARKSTAT MARKSTAT	# CLEAR BITS 10,11,14 FOR NEXT PAIR
VERIFYMK	CA MASK	XYMARK MARKSTAT	
	CCS TCF TCF	A +2 VACSTOR	# THIS MARK NOT DESIRED # MARK DESIRED -- STORE CDUS
	TC OCT TC	ALARM 114 RESUME	# RESUME -- DISPLAY UNCHANGED -- WAIT FOR ACTION



1	5MKALARM	TC	ALARM	# ATTEMPTING TO MAKE MORE THAN 5 MK PAIRS	1
2		OCT	107		2
3		TC	MARKTYPE	# SEE IF SURFACE MARK	3
4		TCF	DSPV6N79	# IT IS	4
5		TC	RESUME	# DON T CHANGE DISPLAY -- DO NOTHING	5
6					6
7					7
8					8
9					9
10					10
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MKREJ	TC TCF	MARKTYPE SURFREJ	# SEE IF SURFACE # SURFACE -- JUST CHECK MARK COUNTER
	CAF MASK	PRI03 MARKSTAT	# INFLIGHT -- SEE IF MARKS MADE
REJALM	CCS TCF TC	A REJECT ALARM	# MARKS MADE -- REJECT ONE # NO MARK TO REJECT -- BAD PROCEDURE -- ALARM
	OCT TC	115 RESUME	# DESIRED ACTION DISPLAYED
REJECT	CS MASK AD	PRI030 MARKSTAT BIT13	# ZERO BIT14, SHOW REJ., SEE IF MARK SINCE # LAST REJECT
	XCH MASK CCS	MARKSTAT BIT13 A	
	TCF	REJECT2	# ANOTHER REJECT SET BIT 10+11 TO ZERO
RENEWMK	CS MASK TS TCF	XYMARK MARKSTAT MARKSTAT REMARK	# MARK MADE SINCE REJECT -- REJECT MARK IN 1D # GO REQUEST NEW MARK ACTION
REJECT2	CS TCF	PRI03 RENEWMK	# ON SECOND REJECT -- DISPLAY VB53 AGAIN
SURFREJ	CCS TCF	MARKCNTR +2	# IF MARK DECREMENT COUNTER
	TCF TS TC	REJALM MARKCNTR RESUME	# NO MARKS TO REJECT -- ALARM

MARKTYPE TESTS TO SEE IF LEM ON LUNAR SURFACE. IF IT IS RETURN TO LOC+1

MARKTYPE CS FLAGWRD8 # SURFFLAG ***** TEMPORARY *****

MASK BIT8

CCS A

INCR Q

TC Q

IF SURFACE MARK RETURN TO LOC +1

IF INFLIGHT MARK RETURN TO LOC +2

SURFSTOR CAF ZERO # FOR SURFACE MARK ZERO MARK KIND INDEX

TS RUPTREG1

CS MARKSTAT

MASK PRI03

ADS MARKSTAT

SET BITS10,11 TO SHOW SURFACE MARK

FOR MARKCHEX

VACSTOR

CAF LOW9

MASK MARKSTAT

TS RUPTREG2

EXTEND

DCA ITEMP1

DXCH TSIGHT

CA MARKCNTR

EXTEND

STORE MARK VAC ADR IN RUPTREG2

PICK UP MARKTIME

STORE LAST MARK TIME

6 X MARKCNTR FOR STORE INDEX

MP SIX

XCH L

AD RUPTREG2

ADS RUPTREG1

TS MKDEX

CA ITEMP3

INDEX RUPTREG1

TS 0

CA ITEMP4

INDEX RUPTREG1

TS 2

CA ITEMP5

INDEX RUPTREG1

TS 4

TC MARKTYPE

TCF SURFJOB

GET INDEX FROM LOW ORDER PART

SET CDU STORE INDEX TO MARKVAC

INCREMENT VAC PICKUP BY MARK FOR FLIGHT

STORE HERE IN CASE OF SURFACE MARK

STORE CDUY

STORE CDUZ

STORE CDUX

IF SURFACE MARK -- JUST DO SURFJOB

CAF BIT13

AD XYMARK

COM

MASK MARKSTAT

AD XYMARK

TS MARKSTAT

MASK PRI03

TS L

CLEAR BIT13 TO SHOW MARK MADE

SET MARK ID IN MARKSTAT

SEE IF X, Y MARK MADE

- 1
- 2
- 3
- 4
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CA	PRI03	
EXTEND		
RXOR	LCHAN	
CCS	A	
TCF	REMARK	# NOT PAIR YET, DISPLAY MARK ACTION
CS	MARKSTAT	# MARK PAIR COMPLETE -- SET BIT14
MASK	BIT14	
ADS	MARKSTAT	
TCF	REMARK	# GO DISPLAY V54

REMARK	CAF MASK	PRI03 MARKSTAT	# BITS 10 AND 11
	EXTEND MP	BIT6	# SHIFT MARK IDS TO BE 0 TO 3 FOR INDEX
	TS	MKDEX	# STORE VERB INDEX
SURFJOB	CAF	PRI015	
	TC	NOVAC	# ENTER JOB TO CHANGE DISPLAY TO
	EBANK	XYMARK	# REQUEST NEXT ACTION
	2CADR	CHANGEVB	
	TC	RESUME	
CHANGEVB	TC	MARKTYPE	
	TCF	DSPV6N79	# SURFACE -- DISPLAY V 06 N 79
	INDEX	MKDEX	# INFLIGHT -- PICK UP MARK VB INDEX
	CAF	MKVB54	
	TC	PASTIT	# PASTE UP NEXT MK VERB DISPLAY
# THE FOUR MKVBS ARE INDEXED -- THEIR ORDER CANNOT BE CHANGED			
MKVB54	VN	5471	# MAKE X OR Y MARK
MKVB53	VN	5371	# MAKE Y MARK
MKVB52	VN	5271	# MAKE X MARK
MKVB54*	VN	5471	# MAKE X OR Y MARK
DP1/8	2DEC	.125	
OCT34	OCT	34	
V06N71	VN	671	
V06N79*	VN	679	

```
# ROUTINE TO REQUEST CURSOR AND SPIRAL MEASUREMENTS
COUNT*  $$/R59
```

```
DSPV6N79      CAF      V06N79*      # CURSOR -- SPIRAL DISPLAY
```

```
TC      BANKCALL
```

```
CADR      GOMARKF
```

```
TCF      KILLAOT      # V34 -- DOES GOTOP00H
```

```
TCF      SURFEND      # V33 -- PROCEED, END MARKING
```

```
CAF      BIT6      # IF V32 OCT40 IN MPAC DO RECYCLE
```

```
MASK      MPAC      # OTHERWISE IT IS LOAD VB ENTER SO
```

```
CCS      A      # RE-DISPLAY V06N79
```

```
TCF      SURFAGAN      # VB32 -- RECYCLE
```

```
TCF      DSPV6N79      # ENTER
```

```
SURFEND      CS      BIT14      # SET BIT14 TO SHOW MARK END
```

```
MASK      MARKSTAT
```

```
AD      BIT14
```

```
TS      MARKSTAT
```

```
SURFAGAN      CA      CURSOR
```

```
INDEX      MKDEX
```

```
TS      1      # HOLDS VAC AREA POINTER FOR SURF MARKING
```

```
TS      1      # STORE CURSOR SP 2COMP
```

```
CA      SPIRAL
```

```
INDEX      MKDEX
```

```
TS      3      # STORE SPIRAL
```

```
CS      MARKSTAT      # IF BIT 14 SET -- END MARKING
```

```
MASK      BIT14
```

```
EXTEND
```

```
BZF      MARKCHEX
```

```
CA      MARKCNTR      # THIS IS RECYCLE -- SEE IF 5 MARKS ALREADY
```

```
AD      ONE
```

```
COM
```

```
AD      FIVE
```

```
EXTEND      # CAN T RECYCLE -- TOO MANY MARKS -- ALARM
```

```
BZMF      5MKALARM      # OF FOR RECYCLE -- INCR COUNTER
```

```
INCR      MARKCNTR
```

```
TCF      GETMKS +3      # GO DISPLAY MARK VB
```

BANK 7
SETLOC EXTVERBS
BANK

EBANK OGC

COUNT* \$\$/EXTVB

FAN-OUT

GOEXTVB	INDEX	MPAC	# VERB-40 IS IN MPAC
	TC	LST2FAN	# FAN AS BEFORE.
LST2FAN	TC	VBZERO	# VB40 ZERO USED WITH NOUN 20 OR 72 ONLY
	TC	VBCOARK	# VB41 COARSE ALIGN USED WITH NOUN 20 OR 72 ONLY
	TC	IMUFINEK	# VB42 FINE ALIGN IMU
	TC	IMUATTCK	# VB43 LOAD IMU ATTITUDE ERROR METERS.
	TC	RRDESEND	# VB44 TERMINATE CONTINUOUS DESIGNATE
	TC	ALM/END	# VB45 SPARE
	TC	ALM/END	# VB46 SPARE
	TC	V47TXACT	# VB47 AGS INITIALIZATION
	TC	DAPDISP	# VB48 LOAD A/P DATA
	TCF	CREWMANU	# VB49 START AUTOMATIC ATTITUDE MANEUVER
	TC	GOLOADLV	# VB50 PLEASE PERFORM
	TC	ALM/END	# VB51 SPARE
	TC	GOLOADLV	# VB52 PLEASE MARK X -- RETICLE.
	TC	GOLOADLV	# VB53 PLEASE MARK Y -- RETICLE.
	TC	GOLOADLV	# VB54 PLEASE MARK X OR Y RETICLE
	TC	ALINTIME	# VB55 ALIGN TIME
	TC	TRMTRACK	# VB56 TERMINATE TRACKING -- P20 + P25
	TC	LRON	# VB57 PERMIT LANDING RADAR UPDATES
	TC	LROFF	# VB58 INHIBIT LANDING RADAR UPDATES
	TC	ALM/END	# VB59 SPARE
	TC	LRPOS2K	# VB60 COMMAND LR TO POSITION 2.
	TC	DAPATTER	# VB61 DISPLAY DAP ATTITUDE ERROR
	TC	TOTATTER	# VB62 DISPLAY TOTAL ATTITUDE ERROR
	TC	R04	# VB63 SAMPLE RADAR ONCE PER SECOND
	TC	VB64	# VB64 CALCULATE, DISPLAY S-BAND ANT ANGLES
	TC	SNUFFOUT	# VB65 DISABLE U,V JETS DURING DPS BURNS.
	TC	ATTACHED	# VB66 ATTACHED MOVE THIS TO OTHER STATE
	TC	V67	# VB67 W MATRIX MONITOR
	TC	ALM/END	# VB68 SPARE
VERB69	TC	VERB69	# VB69 FORCE A HARDWARE RESTART
	TC	V70UPDAT	# VB70 UPDATE LIFTOFF TIME.
	TC	V71UPDAT	# VB71 UNIVERSAL UPDATE -- BLOCK ADDRESS.
	TC	V72UPDAT	# VB72 UNIVERSAL UPDATE -- SINGLE ADDRESS.
	TC	V73UPDAT	# VB73 UPDATE AGC TIME OCTAL .
	TC	DNEDUMP	# VB74 INITIALIZE DOWN-TELEMETRY PROGRAM FOR ERASABLE DUMP.
	TC	OUTSNUFF	# VB75 ENABLE U,V JETS DURING DPS BURNS.

TC	MINIMP	# VB76 MINIMUM IMPULSE MODE
TC	NOMINIMP	# VB77 RATE COMMAND MODE
TC	R77	# VB78 START LR SPURIOUS RETURN TEST
TC	R77END	# VB79 TERMINATE LR SPURIOUS RETURN TEST
TC	LEMVEC	# VB80 UPDATE LEM STATE VECTOR
TC	CSMVEC	# VB81 UPDATE CSM STATE VECTOR
TC	V82PERF	# VB82 REQUEST ORBIT PARAM DISPLAY R30
TC	V83PERF	# VB83 REQUEST REND PARAM DISPLAY R31
TC	ALM/END	# VB84 SPARE
TC	VERB85	# VB85 DISPLAY RR LOS AZ AND ELEV
TC	ALM/END	# VB86 SPARE
TC	ALM/END	# VB87 SPARE
TC	ALM/END	# VB88 SPARE
TC	V89PERF	# VB89 ALIGN XORZ LEM AXIS ALONG LOS R63
TC	V90PERF	# VB90 OUT OF PLANE RENDEZVOUS DISPLAY
TC	GOSHOSUM	# VB91 DISPLAY BANK SUM.
TC	SYSTEST	# VB92 OPERAT IMU PERFORMANCE TEST.
TC	WMATRXNG	# VB93 CLEAR RENDWFLG
TC	ALM/END	# VB94 SPARE
TC	UPDATOFF	# VB95 NO STATE VECTOR UPDATE ALLOWED
TC	VERB96	# VB96 INTERRUPT INTEGRATION AND GO TO P00
TC	GOLOADLV	# VB97 PLEASE VERIFY ENGINE FAILURE
TC	ALM/END	# VB98 SPARE
TC	GOLOADLV	# VB99 PLEASE ENABLE ENGINE

END OF EXTENDED VERB FAN

TESTXACT	CCS	EXTVBACT	# ARE EXTENDED VERBS BUSY
	TC	ALM/END	# YES, TURN ON OPERATOR LIGHT
	CA	FLAGWRD4	# ARE PRIORITY DISPLAYS USING DSKY
	MASK	OC24100	
	CCS	A	
	TC	ALM/END	# YES
	CAF	OCT24	# SET 3, AND 5
SETXTACT	TS	EXTVBACT	# NO. SET FLAG TO SHOW EXT VERB DISPLAY
			# SYSTEM BUSY
	CA	Q	
	TS	MPAC +1	
	CS	TWO	# BLANK EVERYTHING EXCEPT MM AND VERB
	TC	NVSUB	
	TC	+1	
	TC	MPAC +1	
XACTALM	TC	FALTON	# TURN ON OPERATOR ERROR LIGHT.
	TC	ENDEXT	# RELEASE MARK AND EXT. VERB DISPLAY SYS.
TERMEXTV	EQUALS	ENDEXT	

1	ENDEXTVB	EQUALS	ENDEXT	
2				
3				
4	XACTO	CAF	ZERO	# RELEASE MARK AND EXT. VERB DISPLAY SYS.
5		TC	SETXTACT	
6				
7	ALM/END	TC	FALTON	# TURN ON OPERATOR ERROR LIGHT
8	GOPIN	TC	POSTJUMP	
9		CADR	PINBRNCH	
10				
11	CHKPOOH	CA	MODREG	# CHECK FOR P00 OR P00--.
12		EXTEND		
13		BZF	TCQ	
14		TC	ALM/END	
15				
16	OC24100	OCT	24100	
17				
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VBZERO VERB 40 DESCRIPTION

#

1. REQUIRE NOUN 20 ICDU ANGLES OR NOUN 72 RCDU ANGLES .

2. FOR N20, CHECK IMUCADR IN AN EFFORT TO AVOID A 1210 RESTART.

3. FOR N72, CHECK IF EITHER RADAR IS IN USE.

4. EXECUTE THE CDU ZERO.

5. STALL UNTIL THE ZERO IS DONE.

6. DON T DIFFERENTIATE BETWEEN A BAD OR GOOD RETURN.

7. EXIT, RE-ESTABLISHING THE INTERRUPTED DISPLAY IF ANY .

VBZERO TC OP/INERT

TC IMUZEROK # RETURN HERE IF NOUN ICDU 20

TC RRZEROK # RETURN HERE IF NOUN RCDU 72

IMUZEROK TC CKMODCAD

TC BANKCALL # KEYBOARD REQ FOR ISS CDUZERO

CADR IMUZERO

TC BANKCALL # STALL

CADR IMUSTALL

TC +1

TC GOPIN # IMUZERO

RRZEROK TC RDRUSECK

TC BANKCALL

CADR RRZERO

RWAITK TC BANKCALL

CADR RADSTALL

TCF +1

TC GOPIN # RRZERO

LRPOS2K VERB 60 DESCRIPTION

COMMAND LANDING RADAR TO POSITION 2

#

1. EXIT WITH OP ERROR IF SOMEONE IS USING EITHER RADAR.

2. ALARM WITH CODE 523 IF POS 2 IS NOT INDICATED WITHIN

3. THE PRESCRIBED TIME.

4. RE-ESTABLISH THE DISPLAYS.

LRPOS2K TC RDRUSECK

TC BANKCALL # COMMAND LR TO POSITION 2

CADR LRPOS2

TC BANKCALL

CADR RADSTALL

TC LRP2ALM

TC GOPIN

LRP2ALM TC ALARM

OCT 523

TC GOPIN

V61 VERB 61, DISPLAY DAP ATTITUDE ERRORS ON FDAI ATTITUDE ERROR NEEDLES.

DAPATTER	TC	DOWNFLAG
	ADRES	NEEDLFLG
	TC	GOPIN

V62 VERB 62, DISPLAY TOTAL ATTITUDE ERRORS ON FDAI ATTITUDE ERROR NEEDLES.

TOTATTER	TC	UPFLAG
	ADRES	NEEDLFLG
	TC	GOPIN

1412THE

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VBCOARK VERB 41 DESCRIPTION
COARSE ALIGN IMU OR RADAR

- # 1. REQUIRE NOUN 20 OR NOUN 72 OR TURN ON OPERATOR ERROR.
2. REQUIRE EXT VERB DISPLAY SYS AVAILABLE OR TURN ON OPERATOR ERROR LIGHT AND GO TO PINBRNCH.

- # CASE 1, NOUN 20 ICDU ANGLES
3. SET EXT VERB DISPLAY ACTIVE FLAG.
4. DISPLAY FLASHING V25,N22 LOAD NEW ICDU ANGLES .

RESPONSES

- A. TERMINATE
1. RELEASE EXT VERB DISPLAY SYSTEM
B. PROCEED
1. COARSE ALIGN TO THE EXISTING THETAD S ICORK2 .
C. ENTER
1. COARSE ALIGN TO THE LOADED THETAD S ICORK2 .

ICORK2

- # 1. RE-DISPLAY VERB 41.
2. EXECUTE IMUCCARS IMU COARSE ALIGN .
3. EXECUTE IMUSTALL ALLOW TIME FOR DATA TRANSFER .
4. RELEASE EXT VERB DISPLAY SYSTEM.
CASE 2, NOUN 72 RCDU ANGLES
EXIT WITH OP ERROR IF SOMEONE IS USING EITHER RADAD.
5. DISPLAY FLASHING V24, N73 LOAD NEW RR TRUNION ANGLE AND NEW SHAFT ANGLE .

RESPONSES

- A. TERMINATE
1. RELEASE EXT VERB DISPLAY SYS.
B. PROCEED OR ENTER
1. EXECUTE AURLOKON ASK OPERATOR FOR LOCK-ON REQUIREMENTS .
2. RE-DISPLAY VERB 41.
3. SCHEDULE RRDESK2 WITH PRIORITY 20.
4. RELEASE EXT VERB DISPLAY SYS.

AURLOKON

- # 1. FLASH V04 N12 R1 00006 R2 00002

RESPONSES

- A. TERMINATE
B. PROCEED
1. RESET LOCK-ON SWITCH
2. SET CONTINUOUS DESIGNATE FLAG
3. DISABLE R25
C. V22 E 1 E, R1 00001, PROCEED
1. SET LOCK-ON SWITCH

VBCOARK

TC OP/INERT

TC IMUCOARK

RETURN HERE IF NOUN ICDU 20

TC RRDESNBK

RETURN HERE IF NOUN RCDU 72

RETURNS TO L+1 IF IMU OR L+2 IF RR.

OP/INERT

CS OCT24

AD NOUNREG

EXTEND

	BZF	TCQ	# IF 20.
	AD	RRIMUDIF	# -52
	EXTEND		
	BZF	Q+1	
	TC	ALM/END	# ILLEGAL.
RRIMUDIF	DEC	-52	# THE IMU
IMUCOARK	TC	CKMODCAD	
	TC	TESTXACT	# COARSE ALIGN FROM KEYBOARD.
	CAF	VNLODCDU	# CALL FOR THETAD LOAD
	TC	BANKCALL	
	CADR	GOXDSPF	
	TC	TERMEXTV	
	TCF	+1	
ICORK2	CAF	IMUCOARV	# RE-DISPLAY COARSE ALIGN VERB.
	TC	BANKCALL	
	CADR	EXDSPRET	
	TC	BANKCALL	# CALL MODE SWITCHING PROG
	CADR	IMUCOARS	
	TC	BANKCALL	# STALL
	CADR	IMUSTALL	
	TC	ENDEXTVB	
	TC	ENDEXTVB	
VNLODCDU	VN	2522	
IMUCOARV	VN	4100	

DESIGNATE TO DESIRED GIMBAL ANGLES.

RRDESNBK	TC	RDRUSECK	
	TC	TESTXACT	
	CA	RNDVZBIT	# IS P20 RUNNING
	MASK	FLAGWRD0	
	CCS	A	
	TCF	XACTALM	# OPERADOR ERROR IF IN P20
	CS	OCT41000	# TERMINATE PRESENT DESIGNATION
	INHINT		# RELINT DONE IN GOXDSPF
	MASK	RADMODES	
	TS	RADMODES	
	CAF	VNLDRCDU	# ASK FOR GIMBAL ANGLES.
	TC	BANKCALL	
	CADR	GOXDSPF	
	TC	TERMEXTV	
	TCF	-4	# V33
	TC	BANKCALL	# ASK OP FOR LOCK ON REQUIREMENTS.
	CADR	AURLOKON	
	CAF	OPTCOARV	# RE-DISPLAY OUR OWN VERB
	TC	BANKCALL	
	CADR	EXDSPRET	
	CAF	PRI020	
	TC	FINDVAC	
	EBANK	LOSCOUNT	
	2CADR	RRDESK2	
	TCF	TERMEXTV	# FREES DISPLAY
VNLDRCDU	VN	2473	
OPTCOARV	EQUALS	IMUCOARV	# DIFFERENT NOUNS.
RRDESK2	TC	BANKCALL	
	CADR	RRDESNB	
	TC	+1	# DUMMY NEEDED SINCE DESRETRN DOES INCR
	CA	PRIORITY	
	MASK	LOW9	
	CCS	A	
	INDEX	A	
	TS	A	# RELEASE THIS JOB S VAC AREA.
	COM		# INSURE ENDOFJOB DOES A NOVAC END BZMF .
	ADS	PRIORITY	
	TC	BANKCALL	# WAIT FOR COMPLETION OF DESIGNATE
	CADR	RADSTALL	

	TC	+2	# BADEND -- NO LOCKON OR OUT OF LIMITS
	TC	ENDOFJOB	# GOODEND -- LOCKON ACHIEVED
	TC	ALARM	
	OCT	503	# TURN ON ALARM LIGHT -- 503 DESIGNATE FAIL
	TC	ENDOFJOB	
RRDESEND	CCS	RADMODES	# TERMINATE CONTINUOUS DESIGNATE ONLY
	TCF	GOPIN	
	TCF	GOPIN	
	TCF	+1	
	CS	OCT41000	# BEGDES GOES TO ENDRADAR
	INHINT		# RELINT DONE IN DOWNFLAG
	MASK	RADMODES	
	TS	RADMODES	
	TC	CLRADMOD	
	CAF	1SEC	
	TC	BANKCALL	
	CADR	DELAYJOB	
	TC	DOWNFLAG	# ENABLE R25 GIMBAL MONITOR
	ADRES	NORRMON	
	TCF	GOPIN	
OCT41000	OCT	41000	# CONTINUOUS DESIGNATE -- DESIGNATE

	BANK	23		
	SETLOC	EXTVB1		
	BANK			
	COUNT*	\$\$/EXTVB		
AURLOKON	TC	MAKECADR		
	TS	DESRET		
	CAF	TWO		
	TS	OPTIONX +1		
	CAF	SIX	# OPTION CODE FOR V04N12	
	TS	OPTIONX		
-5	CAF	V04N1272		
	TC	BANKCALL	# R2 00001 LOCK-ON	
	CADR	GOMARKFR		
	TCF	ENDEXT	# V34	
	TCF	+5	# V33	
	TCF	-5	# V32	
	CAF	BIT3		
	TC	BLANKET		
	TC	ENDOFJOB		
+5	CA	OPTIONX +1		
	MASK	BIT2		
	CCS	A		
	TCF	NOLOKON		
	TC	UPFLAG		
	ADRES	LOKONSW		
	TCF	AURLKON1		
NOLOKON	TC	DOWNFLAG	# IF NO LOCK-ON, SET BIT15 OF RADMADES TO	
	ADRES	LOKONSW	# INDICATE THAT CONTINUOUS DESIGNATION IS	
	TC	UPFLAG	# WANTED TO BE TERMINATED BY V44.	
	ADRES	CDESFLAG		
	TC	UPFLAG	# SET NO RR ANGLE MONITOR FLAG.	
	ADRES	NORRMON	# DISABLE R25 RR GIMBAL MONITOR IN T4RUPT	
AURLKON1	RELINT			
	CA	DESRET		
	TCF	BANKJUMP		
V04N1272	VN	412		
-LOKONFG	OCT	-20		
	BANK	43		
	SETLOC	EXTVERBS		
	BANK			
	COUNT*	\$\$/EXTVB		
LRON	TC	UPFLAG	# PERMIT INCORPORATION OF LR DATA	V57

OGC

IMUFINKEK VERB 42 DESCRIPTION

FINE ALIGN IMU

1. REQUIRE EXT VERB DISPLAY AVAILABLE AND SET BUSY FLAG OR TURN ON OPER ERROR AND GO TO PINBRNCH.

2. DISPLAY FLASHING V25,N93.....LOAD DELTA GYRO ANGLES.....

RESPONSES

A. TERMINATE

1. RELEASE EXT VERB DISPLAY SYSTEM.

B. PROCEED OR ENTER

1. RE-DISPLAY VERB 42

2. EXECUTE IMUFINKE IMU FIVE ALIGN MODE SWITCHING .

3. EXECUTE IMUSTALL ALLOW FOR DATA TRANSFER

A. FAILED

1. RELEASE EXT VERB DISPLAY SYSTEM.

B. GOOD

1. EXECUTE IMPULSE TORQUE IRIGS .

2. EXECUTE IMUSTALL AND RELEASE EXT VERB DISPLAY SYSTEM.

IMUFINKEK TC CKMODCAD

TC TESTXACT # FINE ALIGN WITH GYRO TORQUING.

CAF VNLODGYR # CALL FOR LOAD OF GYRO COMMANDS

TC BANKCALL

CADR GOXDSPF

TC TERMEXTV

TC +1 # PROCEED WITHOUT A LOAD

CAF IMUFINKEV # RE-DISPLAY OUR OWN VERB

TC BANKCALL

CADR EXDSPRET

TC BANKCALL # CALL MODE SWITCH PROG

CADR IMUFINKE

TC BANKCALL # HIBERNATION

CADR IMUSTALL

TC ENDEXTVB

FINEK2 CAF LGYROBIN # PINBALL LEFT COMMANDS IN OGC REGISTERS

TC BANKCALL

CADR IMPULSE

TC BANKCALL # WAIT FOR PULSES TO GET OUT.

CADR IMUSTALL

TC ENDEXTVB

TC ENDEXTVB

LGYROBIN ECADR OGC

VNLODGYR VN 2593

IMUFINKEV VN 4200

GOLOADLV VERB 50 DESCRIPTION

AND OTHER PLEASE

DO SOMETHING VERBS

PLEASE PERFORM, MARK, CALIBRATE, ETC.

- # 1. PRESSING ENTER ON DSKY INDICATES REQUESTED ACTION HAS BEEN PERFORMED, AND THE PROGRAM DOES THE
SAME RECALL AS A COMPLETED LOAD.
2. THE EXECUTION OF A VERB 33 PROCEED WITHOUT DATA INDICATES THE REQUESTED ACTION IS NOT DESIRED.

SBANK PINSUPER # FOR LOADLV1 AND SHOWSUM CADR S

GOLOADLV TC FLASHOFF

CAF PINSUPBT
EXTEND

WRITE SUPERBNK
TC POSTJUMP
CADR LOADLV1

VERB 47 -- AGS INITIALIZATION -- R47.

SEE LOG SECTION AGS INITIALIZATION FOR OTHER PERTINENT REMARKS.

V47TXACT TC TESTXACT # NO OTHER EXTVERB.

CAF PRI04
TC FINDVAC
SBANK LOWSUPER
EBANK AGSBUFF
2CADR AGSINIT

TC ENDOFJOB

CKMODCAD CA MODECADR

EXTEND

BZF TCQ
TC ALM/END # SOMEBODY IS USING MODECADR SO EXIT

ALINTIME VERB 55 DESCRIPTION

REQUIRE P00 OR P00--.

1. SET EXT VERB DISPLAY BUSY FLAG.
2. DISPLAY FLASHING V25,N24 LOAD DELTA TIME FOR AGC CLOCK.
3. REQUIRE EXECUTION OF VERB 23.
4. ADD DELTA TIME, RECEIVED FROM INPUT REGISTER, TO THE COMPUTER TIME.
5. RELEASE EXT VERB DISPLAY SYSTEM

ALINTIME TC TESTXACT
TC POSTJUMP # NO ROOM IN 43
CADR R33

BANK 42
SETLOC SBAND
BANK
COUNT* \$\$/R33

R33 CAF PRI07
TC PRIOCHNG
CAF VNLODDT
TC BANKCALL
CADR GOXDSPF
TC ENDEXT # TERMINATE
TC ENDEXT # PROCEED
CS DEC23 # DATA IN OR RESEQUENCE UNLIKELY
AD MPAC # RECALL LEFT VERB IN MPAC
EXTEND
BZF UPDATIME # GO AHEAD WITH UPDATE ONLY IF RECALL
TC ENDEXT # WITH V23 DATA IN .

UPDATIME INHINT # DELTA TIME IS IN DSPTM1, +1.
CAF ZERO
TS MPAC +2 # NEEDED FOR TP AGREE
TS L # ZERO T1 + 2 WHILE ALIGNING.

DXCH TIME2
DXCH MPAC
DXCH DSPTM2 +1 # INCREMENT
DAS MPAC

TC TPAGREE # FORCE SIGN AGREEMENT.
DXCH MPAC # NEW CLOCK.
DAS TIME2
RELINT

UPDTMEND TC ENDEXT

DEC23 DEC 23 # V 23

VNLODDT VN 2524 # V25N24 FOR LOAD DELTA TIME

SET UP FOR RADAR SAMPLING.

BANK 42
SETLOC EXTVERBS
BANK

EBANK RSTACK

COUNT* \$\$/R0477

R77 TC RDRUSECK # TRY TO AVOID THE 1210.

CA FLAGWRD3 # IS R04 RUNNING
MASK R04FLBIT
CCS A

TC ALM/END # YES.

TC UPFLAG

ADRES R77FLAG

TCF R04Z

R04 TC RDRUSECK # TRY TO AVOID THE 1210.

TC TESTXACT

TC UPFLAG

ADRES R04FLAG # SET R04FLAG FOR ALARMS

R04Z

CAF EBANK4

TS EBANK

CAF 1SEC+1 # SAMPLE ONCE PER SECOND

TS RSAMPDT

CAF ZERO

TS RTSTLOC

TS RFAILCNT # ZERO BAD SAMPLE COUNTER

INHINT

CS LRPOSCAL # INITIALIZE

MASK RADMODES # BIT 9 LR RANGE LOW SCALE 0

TS RADMODES # BIT 6 LR POS 1 0

CAF LRPOSCAL # BIT 3 RR RANGE LOW SCALE 0

EXTEND

RAND CHAN33

ADS RADMODES

RELINT

CS FLAGWRD3 # CHECK R04FLAG R04 1 R77 0

MASK R04FLBIT

CCS A

TCF R04K

CAF ONE # INDICATES RENDEZVOUS DESIRED

TS OPTIONX +1

R04A CAF BIT3 # OPTION CODE FOR V04N12

	TS	OPTIONX				
	CAF	V04N12X				
	TC	BANKCALL	#	R2	00001	RENDEZVOUS RADAR
	CADR	GOMARKFR	#		00002	LANDING RADAR
	TCF	R04END	#	V34		
	TCF	+5	#	V33		
	TCF	R04A +2	#	R2		
	CAF	BIT3				
	TC	BLANKET				
	TC	ENDOFJOB				
	CA	OPTIONX +1	#	SAVE DESIRED OPTION	RR 1	LR 2
	TS	RTSTDEX				
R04X	CAF	SIX	#	RR OR LR DESIRED		
	MASK	RTSTDEX				
	CCS	A				
	TCF	R04L	#	LANDING RADAR		
	TS	RTSTBASE	#	FOR RR	BASE 0, MAX 1	
R04B	CAF	BIT2	#	IS RR AUTO MODE DISCRETE PRESENT		
	EXTEND					
	RAND	CHAN33				
	EXTEND					
	BZF	R04C	#	YES		
	CAF	201R04	#	REQUEST SELECTION OF RR AUTO MODE		
	TS	DSPTM1				
	CAF	V50N25X				
	TC	BANKCALL				
	CADR	GOMARK4				
	TCF	R04END	#	V34		
	TCF	R04B	#	V33		
	TCF	-7	#	E		
R04C	CAF	BIT14	#	ENABLE RR AUTO TRACKER		
	EXTEND					
	WOR	CHAN12				
	CAF	TWO				
	TS	RTSTMAX	#	FOR SEQUENTIAL STORAGE		
	TC	WAITLIST				
	SBANK	PINSUPER				
	EBANK	RSTACK				
	2CADR	RADSAMP				
	RELINT					
	CS	FLAGWRD3	#	CHECK R04FLAG	R04 1	R77 0
	MASK	R04FLBIT				

	CCS	A		
	TCF	GOPIN	# R77	
	CAF	SIX	# RR OR LR	
	MASK	RTSTDEX		
	CCS	A		
	TCF	R04LR	# LR	
R04RR	CAF	V16N72	# DISPLAY RR CDU ANGLES 1/SEC	
	TC	BANKCALL	# R1 + XXX.XX DEG	TRUNNION
	CADR	GOMARKF	# R2 + XXX.XX DEG	SHAFT
	TCF	R04END	# V34 R3 BLANK	
	TCF	+2	# V33	
	TCF	R04RR	# V32	
	CAF	V16N78	# DISPLAY RR RANGE AND RANGE RATE 1/SEC	
	TC	BANKCALL	# R1 +- XXX.XX NM	RANGE
	CADR	GOMARKF	# R2 +- XXXXX. FPS	RANGE RATE
	TCF	R04END	# V34 R3 BLANK	
	TCF	R04Y	# V33	
	TCF	R04RR	# V32	
R04LR	CAF	V16N66	# DISPLAY LR RANGE AND POSITON 1/SEC	
	TC	BANKCALL	# R1 +- XXXXX, FT	LR RANGE
	CADR	GOMARKF	# R2 + 0000X.	POS. NO.
	TCF	R04END	# V34 R3 BLANK	
	TCF	+2	# V33	
	TCF	R04LR	# V32	
	CAF	V16N67	# DISPLAY LR VELX, VELY, VELZ 1/SEC	
	TC	BANKCALL	# R1 +- XXXXX. FPS	LR V X
	CADR	GOMARKF	# R2 +- XXXXX. FPS	LR V Y
	TCF	R04END	# V34 R3 +- XXXXX. FPS	LR V Z
	TCF	R04Y	# V33	
	TCF	R04LR	# V32	
R04Y	CAF	ZERO	# TO TERMINATE SAMPLING.	
	TS	RSAMPDT		
	CAF	2SECS	# WAIT FOR LAST RADARUP	
	TC	BANKCALL		
	CADR	DELAYJOB		
	CAF	1SEC+1	# SAMPLE ONCE PER SECOND	
	TS	RSAMPDT		
	CAF	ZERO	# FOR STORING RESULTS	
	TS	RTSTLOC		
	CAF	SIX		
	MASK	RTSTDEX		
	CCS	A		
	CS	ONE	# WAS LR	
	AD	TWO	# WAS RR	

	TCF	R04X -1	
R04K	CAF TS	250MS+1 RSAMPDT	# SAMPLE 4 LR COMPONENTS PER SECOND.
R04L	CAF TS	TWO RTSTBASE	# FOR LR BASE 2, MAX 3
	CAF	SIX	
	TCF	R04C +4	
R04END	CAF	ZERO	# ZERO RSAMPDT
	TS	RSAMPDT	# TO TERMINATE SAMPLING
	CAF	BIT8	# WAIT 1.28 SECONDS FOR POSSIBLE
	TC	BANKCALL	# PENDING RUPT.
	CADR	DELAYJOB	
	INHINT		
	CS	BIT14	# DISABLE RR AUTO TRACKER.
	EXTEND		
	WAND	CHAN12	
	TC	DOWNFLAG	
	ADRES	R04FLAG	# SIGNAL END OF R04.
	TC	ENDEXT	
R77END	CAF	EBANK4	# TO TERMINATE SAMPLING
	TS	EBANK	
	CAF	ZERO	
	TS	RSAMPDT	
	CAF	BIT6	# WAIT 320 MS FOR POSSIBLE
	TC	BANKCALL	# PENDING RUPT.
	CADR	DELAYJOB	
	TC	DOWNFLAG	
	ADRES	R77FLAG	
	TCF	GOPIN	
V16N72	VN	1672	
V16N78	VN	1678	
V16N66	VN	1666	
V16N67	VN	1667	
V04N12X	VN	412	
V50N25X	VN	5025	
201R04	OCT	00201	
1SEC+1	DEC	101	
250MS+1	EQUALS	CALLCODE	
LRPOSCAL	OCT	444	

RDRUSECK	CS	FLAGWRD3	# IS R29 ON
	MASK	NR29FBIT	
	CCS	A	
	TC	ALM/END	# YES
	CA	FLAGWRD5	# IS R77 RUNNING
	MASK	R77FLBIT	
	CCS	A	
	TC	ALM/END	# YES.
	CS	FLAGWRD7	# IS SERVICER RUNNING AND HENCE POSSIBLY
	MASK	V37FLBIT	# R12 USING THE LR
	CCS	A	
	TCF	CHECKRR	# NO
	CS	FLGWRD11	# YES, IS R12 ON
	MASK	LRBYBIT	
	CCS	A	
CHECKRR	TC	ALM/END	# YES
	CS	FLAGWRD1	# IS THE TRACK FLAG SET AND HENCE POSSIBLY
	MASK	TRACKBIT	# P20 USING THE RR
	CCS	A	
	TCF	CHECKP22	# NO, CHECK FOR P22.
CKRNDBIT	CA	FLAGWRD0	# YES, BUT IS IT P25
	MASK	RNDVZBIT	
	CCS	A	
CHECKP22	TC	ALM/END	
	CS	MODREG	
	AD	DEC22	
	EXTEND		
	BZF	ALM/END	
	TC	Q	
DEC22	DEC	22	
	COUNT*	\$\$/EXTVB	
VB64	TC	CHKPOOH	# DEMAND PROGRAM 00.
	TC	TESTXACT	# IF DISPLAY SYS. NOT BUSY MAKE IT BUSY.
	CAF	PRI04	
	TC	FINDVAC	
	EBANK	ALPHASB	
	2CADR	SBANDANT	# CALC., DISPLAY S-BAND ANTENNA ANGLES.
	TC	ENDOFJOB	

IMUATTCK VERB 43 DESCRIPTION
LOAD IMU ATTITUDE ERROR METERS

- #
1. REQUIRE P00 OR FRESH START.
2. REQUIRE COARSE ALIGN ENABLE AND ZERO ICDU BITS OFF.
3. REQUIRE THAT NEEDLES BE OFF.
4. REQUEST LOAD OF N22 VALUES TO BE DISPLAYED .
5. ON PROCEED OR ENTER RE-DISPLAY V43 AND SEND PULSES.

IMUATTCK TC CHKPOOH # VB 76 -- LOAD IMU ATT. ERROR METERS
CAF BITS4 5 # SEE IF COARSE ALIGN ENABLE AND ZERO IMU
EXTEND # CDUS BITS ARE ON
RAND CHAN12
CCS A
TCF ALM/END # NOT ALLOWED IF IMU COARSE OR IMU ZERO ON
CAF BIT13-14 # BOTH BITS 13 AND 14 MUST BE 1
EXTEND # INDICATING THE MODE SELECTED IS OFF.
RXOR CHAN31
MASK BIT13-14
EXTEND
BZF +2 # NEEDLES IS OFF.
TCF ALM/END # EXIT. NEEDLES IS ON.
TC TESTXACT
CAF VNLODCDU
TC BANKCALL
CADR GOXDSPF
TC ENDEXT # V34
TC +1
CAF V43K # REDISPLAY OUR VERB.
TC BANKCALL
CADR EXDSPRET
CAF BIT6
EXTEND
WOR CHAN12 # ENABLE ERROR COUNTERS.
CAF TWO
TC WAITLIST # PUT OUT COMMANDS IN .32 SECONDS.
EBANK THETAD
ZCADR ATTCK2
TCF ENDEXT
BANK 42
SETLOC PINBALL3 # SOMETHING IN B42.
BANK
COUNT* \$\$/EXTVB

ATTCK2 CAF TWO # PUT OUT COMMANDS.
 +1 TS Q # CDU WILL LIMIT EXCESS DATA.
 INDEX A
 CA THETAD
 EXTEND
 MP ATTSCALE
 INDEX Q
 XCH CDUXCMD
 CCS Q
 TCF ATTCK2 +1
 CAF 13,14,15
 EXTEND
 WOR CHAN14
 TCF TASKOVER # LEAVE ERROR COUNTERS ENABLED.

ATTSCALE DEC 0.1
 BANK 7
 SETLOC EXTVERBS
 BANK
 COUNT* \$\$/EXTVB

V43K VN 4300

V82PERF VERB82 DESCRIPTION
 # REQUEST ORBIT PARAMETERS DISPLAY R30
 #
 # 1. IF AVERAGE G IS OFF
 # FLASH DISPLAY V04N06. R2 INDICATES WHICH SHIP S STATE VECTOR IS
 # TO BE UPDATED. INITIAL CHOICE IS THIS SHIP R2 1. ASTRONAUT
 # CAN CHANGE TO OTHER SHIP BY V22EXE, WHERE X NOT EQ I.
 # SELECTED STATE VECTOR UPDATED BY THISPREC OTHPREC .
 # CALLS SR30.1 WHICH CALLS TFFCONMU + TFFRP/RA TO CALCULATE
 # RPER PERIGEE RADIUS , RAPO APOGEE RADIUS , HPER PERIGEE
 # HEIGHT ABOVE LAUNCH PAD OR LUNAR LANDING SITE , HAPO APOGEE
 # HEIGHT AS ABOVE , TPER TIME TO PERIGEE , TFF TIME TO
 # INTERSECT 300 KFT ABOVE PAD OR 35KFT ABOVE LANDING SITE .
 # FLASH MONITOR V16N44 HAPO, HPER, TFF . TFF IS -59M59S IF IT WAS
 # NOT COMPUTABLE, OTHERWISE IT INCREMENTS ONCE PER SECOND.
 # ASTRONAUT HAS OPTION TO MONITOR TPER BY KEYING IN N 32 E.
 # DISPLAY IS IN HMS, IS NEGATIVE AS WAS TFF , AND INCREMENTS
 # ONCE PER SECOND ONLY IF TFF DISPLAY WAS -59M59S.
 # 2. IF AVERAGE G IS ON
 # CALLS SR30.1 APPROX EVERY TWO SECS. STATE VECTOR IS ALWAYS
 # FOR THIS VEHICLE. V82 DOES NOT DISTURB STATE VECTOR. RESULTS
 # OF SR30.1 ARE RAPO, RPER, HAPO, HPER, TPER, TFF.
 # FLASH MONITOR V16N44 HAPO, HPER, TFF .
 # IF MODE IS P11, THEN CALL DELRSPL SO ASTRONAUT CAN MONITOR
 # RESULTS BY N50E. SPLASH COMPUTATION DONE ONCE PER TWO SECS.

V82PERF TC TESTXACT

CAF PRI07 # LESS THAN LAMBERT. R30,V82
 TC PRIOCHNG
 EXTEND

DCA V82CON
 TC SUPDXCHZ # V82CALL IN DIFF SUPERBANK FROM V82PERF

V82CON EBANK HAP0
 2CADR V82CALL

VB83PERF VERB 83 DESCRIPTION
 # REQUEST RENDEZVOUS PARAMETER DISPLAY R31
 #
 # 1. SET EXT VERB DISPLAY BUSY FLAG.
 # 2. SCHEDULE R31CALL WITH PRIORITY 5.
 # A. DISPLAY
 # R1 RANGE
 # R2 RANGE RATE
 # R3 THETA

V83PERF TC TESTXACT

CAF BIT2
 TC WAITLIST
 EBANK TSTRT
 2CADR R31CALL

TC ENDOFJOB

VERB 89 DESCRIPTION RENDEZVOUS FINAL ATTITUDE ROUTINE R63
 #
 # CALLED BY VERB 89 ENTER DURING P00. PRIO 10 IS USED. CALCULATES AND
 # DISPLAYS FINAL FDAI BALL ANGLES TO POINT LM +X OR +Z AXIS AT CSM.
 #
 # 1. KEY IN V 89 E ONLY IF IN PROG 00. IF NOT IN P00, OPERATOR ERROR AND
 # EXIT R63, OTHERWISE CONTINUE.
 #
 # 2. IF IN P00, DO IMU STATUS CHECK ROUTINE R02BOTH . IF IMU ON AND ITS
 # ORIENTATION KNOWN TO LGC,CONTINUE.
 #
 # 3. FLASH DISPLAY V 04 N 06. R2 INDICATES WHICH SPACECRAFT AXIS IS TO
 # BE POINTED AT CSM. INITIAL CHOICE IS PREFERRED +Z AXIS R2 1 .
 # ASTRONAUT CAN CHANGE TO +X AXIS R2 NOT 1 BY V 22 E 2 E. CONTINUE
 # AFTER KEYING IN PROCEED.
 #
 # 4. BOTH VEHICLE STATE VECTORS UPDATED BY CONIC EQS.
 #
 # 5. HALF MAGNITUDE UNIT LOS VECTOR IN STABLE MEMBER COORDINATES AND


```
1 # HALF MAGNITUDE UNIT SPACECRAFT AXIS VECTOR IN BODY COORDINATES
2 # PREPARED FOR VECPOINT.
3
4 #
5 # 6. GIMBAL ANGLES FROM VECPOINT TRANSFORMED INTO FDAI BALL ANGLES BY
6 # BALLANGS. FLASH DISPLAY V 06 N 18 AND AWAIT RESPONSE.
7
8 #
9 # 7. RECYCLE -- RETURN TO STEP 4.
10 # TERMINATE -- EXIT R63.
11 # PROCEED -- RESET 3AXISFLG AND CALL R60LEM FOR ATTITUDE MANEUVER.
```

```
12 V89PERF TC CHKPOOH
13 TC TESTXACT
14 CAF PRI010
15 TC FINDVAC
16 EBANK RONE
17 2CADR V89CALL
```

```
18 TC ENDOFJOB
```

```
21 # V90PERF VERB 90 DESCRIPTION
22 # REQUEST RENDEZVOUS OUT-OF-PLANE DISPLAY R36
23 #
24 # 1. SET EXT VERB DISPLAY BUSY FLAG.
25 # 2. SCHEDULE R36 CALL WITH PRIORITY 10
26 # A. DISPLAY
27 # TIME OF EVENT -- HOURS, MINUTES, SECONDS
28 # Y OUT-OF-PLANE POSITION -- NAUTICAL MILES
29 # YDOT OUT-OF-PLANE VELOCITY -- FEET/SECOND
30 # PSI ANGLE BTW LINE OF SIGHT AND FORWARD
31 # DIRECTION VECTOR IN HORIZONTAL PLANE -- DEGREES
```

```
32 V90PERF TC TESTXACT
33 CAF PRI07 # R36,V90
34 TC FINDVAC
35 EBANK RPASS36
36 2CADR R36
37
38 TCF ENDOFJOB
```

```
41 # MINIMP VERB 76 DESCRIPTION
42 # MINIMUM IMPULSE MODE
43 #
44 # 1. SET MINIMUM IMPULSE RHO MODE FLAG TO 1.
```

```
45 MINIMP INHINT
46 CS DAPBOOLS
47 MASK PULSES # PULSES 1 INDICATES MIN IMP MODE
48 ADS DAPBOOLS
49 TCF GOPIN # RETURN VIA PINBRNCH
```

```
52 # NOMINIMP VERB 77 DESCRIPTION
53 # RATE COMMAND MODE
```


1. SET MINIMUM IMPULSE RHO MODE FLAG TO 0. ZERO INDICATES NOT MINIMUM IMPULSE MODE. .
2. MOVE CDUX, CDUY, CDUZ INTO CDUXD, CDUYD, CDUZD.

NOMINIMP	INHINT	
	CS	PULSES
	MASK	DAPBOOLS
	TS	DAPBOOLS
	TC	IBNKCALL
	CADR	ZATTEROR
	TC	GOPIN

PULSES NOT IN MINIMUM UMPULSE MODE

1412THE

#	CREMANU	VERB 49	DESCRIPTION
#	START AUTOMATIC ATTITUDE MANEUVER		
#			
#	1.	REQUIRE PROGRAM 00 ACTIVE.	
#	2.	SET EXT VERB DISPLAY BUSY FLAG.	
#	3.	SCHEDULE R62DISP WITH PRIORITY 10.	
#	4.	RELEASE EXT VERB DISPLAY.	
#			
#	R62DISP		
#	1.	DISPLAY FLASHING V06,N22.	
#	RESPONSES		
#	A.	TERMINATE	
#		1.	GOTOPOOH
#	B.	PROCEED	
#		1.	SET 3AXISFLG TO INDICATE MANEUVER IS SPECIFIED BY 3 AXIS.
#		2.	EXECUTE R60LEM ATTITUDE MANEUVER .
#	C.	ENTER	
#		1.	REPEAT FLASHING V06,N22.
CREWMANU	TC	CHKPOOH	# DEMAND P00
	TC	TESTXACT	
	CAF	PRI010	
	TC	FINDVAC	
	EBANK	BCDU	
	2CADR	R62DISP	
	TC	ENDOFJOB	

```
1  # TRMTRACK      VERB 56      DESCRIPTION
2  #      TERMINATE TRACKING  P20 AND P25 .
3
4  #
5  #      1.      KNOCK DOWN RENDEZVOUS, TRACK, AND UPDATE FLAGS.
6  #      2.      REQUIRE P20 OR P25 NOT RUNNING ALONE OR GO TO GOGOPOOH  REQUEST PROGRAM 00 .
7  #      3.      SCHEDULE V56TOVAC WITH PRIORITY 30.
8  #
9  #      V56TOVAC
10 #      1.      EXECUTE INTSTALL  IF INTEGRATION IS RUNNING, STALL UNTIL IT IS FINISHED. .
11 #      2.      ZERO GROUP 2 TO HALT P20.
12 #      3.      TRANSFER CONTROL TO GOPROG2  SOFTWARE RESTART .
13
14 TRMTRACK      CA      BITS9+7      # IS REND OR P25 FLAG ON
15 MASK          FLAGWRD0
16
17 EXTEND
18 BZF          GOPIN      # NO
19
20 TC          DOWNFLAG
21 ADRES      RNDVZFLG
22
23 TC          DOWNFLAG
24 ADRES      P25FLAG
25
26 TC          DOWNFLAG      # ENSURE SEARCH FLAG IS OFF
27 ADRES      SRCHOPTN
28
29 CA          TRACKBIT      # IS TRACK FLAG ON
30 MASK      FLAGWRD1
31 EXTEND
32 BZF          GOPIN
33
34 TC          POSTJUMP
35 CADR      TRMTRAK1
36
37 BITS9+7      OCT      500
38
39 SETLOC      SBAND      # BANK 42
40 BANK
41
42 COUNT*     $$/EXTVB
43
44 TRMTRAK1     TC      DOWNFLAG
45 ADRES      UPDATFLG      # UPDATE FLAG DOWN
46 TC          DOWNFLAG
47 ADRES      TRACKFLG      # TRACK FLAG DOWN
48 TC          DOWNFLAG
49 ADRES      IMUSE
50
51 TC          INTPRET
52 CALL
53
54 INTSTALL      # DON T INTERRUPT INTEGRATION
55
56
57
58
59
60
```

EXIT

TC PHASCHNG
OCT 2 # KILL GROUP 2 TO HALT P20 ACTIVITY

INHINT
TC IBNKCALL # ZERO THE COMMANDED RATES TO STOP
CADR STOPRATE # MANEUVER

TC IBNKCALL
CADR RESTORDB

TC CLRADMOD # CLEAR BITS 10 + 15 OF RADMODES.

CS BIT14 # DISABLE LOCKON
EXTEND
WAND CHAN12

TC POSTJUMP
CADR GOPROG2 # CAUSE RESTART.

DNEDUMP VERB 74 DESCRIPTION
INITIALIZE DOWN-TELEMETRY PROGRAM FOR ERASABLE MEMORY DUMP.

1. SET EXT VERB DISPLAY BUSY FLAG.
2. REPLACE CURRENT DOWNLIST WITH ERASABLE MEMORY.
3. RELEASE EXT VERB DISPLAY.

SETLOC EXTVERBS
BANK

COUNT* \$\$/EXTVB

DNEDUMP EBANK 400
CAF LDNDUMPI
TS DNTMGOTO
TC GOPIN

V74 EQUALS DNEDUMP
LDNDUMPI REMADR DNDUMPI

LEMVEC VERB 80 DESCRIPTION
UPDATE LEM STATE VECTOR
RESET VHUPFLG TC 0

LEMVEC TC DOWNFLAG
ADRES VEHUPFLG # VB 80 -- VEHUPFLG DOWN INDICATES LEM

TC NOUPDOWN

CSMVEC VERB 81 DESCRIPTION
UPDATE CSM STATE VECTOR

#	UPDATOFF	VERB 95	DESCRIPTION
#	INHIBIT	STATE VECTOR	UPDATES BY INCORP
#		SET NOUPFLAG	TO 1

#	SYSTEST	VERB 92	DESCRIPTION
#	OPERATE	IMU PERFORMANCE TEST.	
#	1.	REQUIRE PROGRAM 00 OR TURN ON OPERATOR ERROR.	
#	2.	SET EXT VERB BUSY FLAG.	
	EBANK	QPLACE	
SYSTEST	TC	CHKPOOH	# DEMAND P00
	TC	TESTXACT	
	CAF	PRI022	
	TC	FINDVAC	
	EBANK	QPLACE	
	SBANK	IMUSUPER	
	2CADR	REDO	
	TC	ENDOFJOB	
# VERB 93		CLEAR RENDWFLG, CAUSES W-MATRIX TO BE RE-INITIALIZED.	
WMATRXNG	INHINT		
	CS	RENDWBIT	
	MASK	FLAGWRD5	
	TS	FLAGWRD5	
	TC	GOPIN	
GOSHOSUM	EQUALS	SHOWSUM	
SHOWSUM	TC	CHKPOOH	# *
	TC	TESTXACT	# *
	CAF	PRI07	# * ALLOW OTHER CHARINS.
	TC	PRI0CHNG	# *
	CAF	S+1	# *
	TS	SKEEP6	# * SHOWSUM OPTION
	CAF	S+ZERO	# *
	TS	SMODE	# * TURN OFF SELF-CHECK
	CA	SELFADRS	# *
	TS	SELFRET	# *
	TC	STSHOSUM	# * ENTER ROPECHK
SDISPLAY	LXCH	SKEEP2	# * BANK # FOR DISPLAY
	LXCH	SKEEP3	# * BUGGER WORD FOR DISPLAY
NOKILL	CA	ADRS1	# *
	TS	MPAC +2	# *
	CA	VNCON	# * 0501
	TC	BANKCALL	# *
	CADR	GOXDSPF	# *
	TC	+3	# *
	TC	NXTBNK	# *

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DAPDISP VERB 48 DESCRIPTION
LOAD AUTO PILOT DATA

1. REQUIRE EXT VERB DISPLAY AVAILABLE AND SET BUSY FLAG.
2. EXECUTE DAPDATA1, DAPDATA2, AND DAPDATA3.
3. RELEASE EXT VERB DISPLAY SYSTEM.

DAPDISP TC TESTXACT
CAF PRI07 # R03
TC PRIOCHNG
TC POSTJUMP
CADR DAPDATA1

BANK 34
SETLOC LOADDAP
BANK

COUNT* \$\$/R03

SBANK LOWSUPER # FOR SUBSEQUENT LOW 2CADR S

DAPDATA1 CAF BOOLSMSK # SET DISPLAY ACCORDING TO DAPBOOLS BITS.
MASK DAPBOOLS # LM
TS DAPDATR1 # LM
CS FLGWRD10 # SET BIT 14 TO BE COMPLEMENT OF APSFLAG.
MASK APSFLBIT

CCS A
CAF BIT14
ADS DAPDATR1
CHKDATA1 CAE DAPDATR1 # IF BITS 13 AND 14 ARE BOTH ZERO, FORCE
MASK BIT13-14 # A ONE INTO BIT 13.
EXTEND

BZF FORCEONE
CAE DAPDATR1 # ENSURE THAT NO ILLEGAL BITS SET BY CREW.
MSKDATR1 MASK DSPLYMSK
TS DAPDATR1
CAF V01N46 # LM
TC BANKCALL

CADR GOXDSPFR
TCF ENDEXT # V34E TERMINATE
TCF DPDAT1 # V33E PROCEED
TCF CHKDATA1 # E NEW DATA CHECK AND REDISPLAY
CAF REVCNT # BITS 2 3 BLANKS R2 R3.
TC BLANKET

FORCEONE TCF ENDOFJOB
CAF BIT13
ADS DAPDATR1
TCF MSKDATR1

DPDAT1 INHINT # INHINT FOR SETTING OF FLAG BITS AND MASS
CS APSFLBIT # ON BASIS OF DISPLAYED DAPDATR1.
MASK FLGWRD10
TS L # SET APSFLAG TO BE COMPLEMENT OF BIT 14.

CS	DAPDATR1	
MASK	BIT14	
CCS	A	
CAF	APSFLBIT	
AD	L	
TS	FLGWRD10	
CS	DAPDATR1	# SET BITS OF DAPBOOLS ON BASIS OF DISPLAY
MASK	BIT13-14	# MASK OUT CSMDOCKD BIT 13 UNLESS BOTH
CCS	A	# 13 AND 14 ARE SET.
CS	CSMDOCKD	
AD	BOOLSMSK	
MASK	DAPDATR1	
TS	L	
CS	BOOLSMSK	
MASK	DAPBOOLS	
AD	L	
TS	DAPBOOLS	
MASK	CSMDOCKD	# LOAD MASS IN ACCORDANCE WITH CSMDOCKD.
CCS	A	# MASS IS USUALLY OKAY, SO DO
CAE	CSMASS	# NOT TOUCH ITS LOW-ORDER PART.
AD	LEMASS	
TS	MASS	
CAE	DAPBOOLS	
MASK	ACC4OR2X	# 2 OR 4 JET X-TRANSLATION
EXTEND		# BIT ACC4OR2X 1 FOR 4 JETS
BZF	+5	
CS	BIT15	
MASK	FLAGWRD1	# CLEAR NJTSFLAG TO 0 FOR 4 JETS
TS	FLAGWRD1	
TCF	+4	
CS	FLAGWRD1	# SET NJTSFLAG TO 1 FOR 2 JETS
MASK	BIT15	
ADS	FLAGWRD1	
CA	DAPBOOLS	# SELECT DESIRED KALCMANU AUTOMATIC
MASK	THREE	# MANEUVER RATE
DOUBLE		# RATEINDX HAS TO BE 0,2,4,6 SINCE RATES
TS	RATEINDX	# ARE DP
TC	POSTJUMP	
CADR	STIKLOAD	
VO1N46	VN	0146
DSPLYMSK	OCT	33113
BOOLSMSK	OCT	13113
BANK	01	
SETLOC	LOADDAP1	
BANK		
COUNT*	\$\$/R03	
STIKLOAD	CAF	EBANK6

	TS	EBANK	
	EBANK	STIKSENS	
	CA	RHCSCALE	# SET STICK SENSITIVITY TO CORRESPOND TO A
	MASK	DAPBOOLS	# MAXIMUM COMMANDED RATE AT 42 COUNTS OF
	CCS	A	# 20 D/S NORMAL OR 4 D/S FINE , SCALED
	CA	NORMAL	# AT 45 D/S.
	AD	FINE	
	TS	STIKSENS	
	CA	-0.6D/S	
	TS	-RATEDB	# LM-ONLY BREAKOUT LEVEL IS .6 D/S.
	CA	CSMDOCKD	# IF CSM-DOCKED, DIVIDE STICK SENSITIVITY
	MASK	DAPBOOLS	# BY 10. NORMAL SCALING IS THEN 2 D/S AND
	EXTEND		# FINE SCALING IS 0.4 D/S
	BZF	+7	# BRANCH IF CSM IS NOT DOCKED.
	CA	STIKSENS	
	EXTEND		
	MP	1/10	
	TS	STIKSENS	
	CA	-0.3D/S	# CSM-DOCKED BREAKOUT LEVEL IS .3 D/S.
	TS	-RATEDB	
	RELINT		# PROCEED TO NOUN 47, MASS LOAD.
DAPDATA2	CAF	V0647	
	TC	BANKCALL	
	CADR	GOXDSPFR	
	TCF	ENDR03	# V34E TERMINATE. FIRST SET DB. DO 1/ACCS
	TCF	DAPDAT2	# V33E PROCEED
	TCF	DAPDATA2	# LOAD NEW DATA AND RECYCLE
	CAF	BIT3	# BLANKS R3
	TC	BLANKET	# LM
	TCF	ENDOFJOB	
ENDR03	INHINT		
	TC	IBNKCALL	
	CADR	RESTORDB	
	TCF	ENDEXT	# DOES RELINT
DAPDAT2	CS	FLGWRD10	# DETERMINE STAGE FROM APSFLAG
	MASK	APSFLBIT	
	CCS	A	
	CA	MINLMD	
	AD	MINMINLM	
	AD	LEMASS	# LEMASS MUST BE GREATER THAN EMPTY LEM
	EXTEND		
	BZMF	DAPDATA2	# ASK FOR NEW MASSES
	CAE	DAPBOOLS	
	MASK	CSMDOCKD	
	EXTEND		
	BZF	LEMALONE	# SKIP TEST ON CSMMASS IF NOT DOCKED.
	CS	MINCSM	# TEST CSM MASS
	AD	CSMASS	# CSMMASS MUST BE GREATER THAN EMPTY CSM

	EXTEND		
	BZMF	DAPDATA2	# ASK FOR NEW MASSES
LEMALONE	CAF	CSMMASS	# DOCKED MASS CSMMASS + LEMMASS
	AD	LEMASS	# LEM ALONE MASS LEMMASS
	ZL		
	DXCH	MASS	
	INHINT		
	TC	IBNKCALL	# SET DEADBANK AND COMPUTE MOMENTS OF
	CADR	RESTORDB	# INERTIA.
	RELINT		# PROCEED TO NOUN 48 OR END .
DAPDATA3	CS	FLGWRD10	
	MASK	APSFLBIT	
	EXTEND		# END ROUTINE IF LEM HAS STAGED.
	BZF	ENDEXT	
	CAF	V06N48	# DISPLAY TRIM ANGLES AND REQUEST RESPONSE
	TC	BANKCALL	
	CADR	GOXDSPFR	
	TC	ENDEXT	
	TCF	DPDAT3	# V33E GO DO TRIM WAITLIST TO TRIMGIMB
	TCF	-5	# LOAD NEW DATA AND RECYCLE
	CAF	BIT3	
	TC	BLANKET	# BLANK R3
DPDAT3	TCF	ENDOFJOB	
	CAF	BIT1	# GO TO TRIMGIMB VIA WAITLIST SO IT
	INHINT		# CAN USE FIXDELAY AND VARDELAY
	TC	WAITLIST	
	EBANK	ROLLTIME	
	2CADR	TRIMGIMB	
TRIMDONE	TCF	ENDOFJOB	# DOES A RELINT
	CAF	V50N48	
	TC	BANKCALL	# TRIM IS FINISHED PLEASE TERMINATE R03
	CADR	GOMARK3R	
	TC	ENDEXT	# V34E TERMINATE
	TC	ENDEXT	
	TC	ENDEXT	
	CAF	OCT24	# BIT5 TO CHANGE TO PERFORM, 3 TO BLANK 43
	TC	BLANKET	
	TCF	ENDOFJOB	
V0647	VN	0647	
V06N48	VN	0648	
V50N48	VN	5048	
NORMAL	DEC	.660214	
			# NORMAL SCALING IS 20 D/S
FINE	DEC	.165054	# FINE STICK SCALING 4 D/S .
1/10	DEC	.1	# FACTOR FOR CSM-DOCKED SCALING
-0.6D/S	DEC	-218	

-0.3D/S DEC -109

```
1  # VERB 66      VEHICLES ARE ATTACHED. MOVE THIS VEHICLE STATE VECTOR TO
2  #
3  #
4  #
5  # USE SUBROUTINE GENTRAN.
6
7      BANK      7
8      SETLOC    EXTVERBS
9      BANK
10
11      COUNT*    $$/EXTVB
12
13      EBANK      RRECTHIS
14
15  ATTACHED      CAF      PRI010
16                  TC      FINDVAC
17                  EBANK    RRECTHIS
18
19                  2CADR    ATTACHIT
20
21                  TC      ENDOFJOB
22
23  ATTACHIT      TC      INTPRET
24                  CALL
25
26                  SET      INTSTALL
27                          BON
28                          MOONOTH
29                          MOONTHIS
30                          +3
31                  CLEAR
32
33                  EXIT      MOONOTH
34                  CAF      OCT51
35                  TC      GENTRAN      # OUR STATE VECTOR INTO OTHER VIA GENTRAN
36                  ADRES    RRECTHIS
37                  ADRES    RRECTOTH
38
39                  RELINT
40                  TC      INTPRET
41                  CALL      # UPDATE R-OTHER, V-OTHER
42                  LXA,2    PTOALEM
43                          CALL
44                          PBODY
45                          SVDWN1
46                  EXIT
47
48                  CAF      TCPINAD
49                  INDEX    FIXLOC
50                  TS      QPRET
51                  TC      POSTJUMP      # FREE INTEGRATION AND EXIT.
52                  CADR    INTWAKE
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58
59
60
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1
2
3 TCPIN          RTB
4                PINBRNCH
5
6 OCT51          OCT    51
7 TCPINAD        CADR    TCPIN
8
9 # VERB 96      SET QUITFLAT TO STOP INTEGRATION.
10 #
11 #            GO TO V37 WITH ZERO TO CAUSE P00.
12 #            STATEINT WILL CHECK QUITFLAG AND SKIP 1ST PASS,
13 #            THUS ALLOWING A 10 MINUT PERIOD WITHOUT INTEGRATION.
14
15 VERB96         TC      UPFLAG      # QUITFLAG WILL CAUSE INTEGRATION TO EXIT
16              ADRES    QUITFLAG    #            AT NEXT TIMESTEP
17
18              CAF      ZERO
19              TC      POSTJUMP
20              CADR     V37          # GO TO P00
21
22 # VERB 67      DISPLAY OF W MATRIX
23
24 V67           TC      TESTXACT
25              CAF      PRI05
26              TC      FINDVAC
27              EBANK    WWPOS
28              2CADR    V67CALL
29
30              TC      ENDOFJOB
31
32 # VERB 65      DISABLE U,V JETS DURING DPS BURNS
33
34 SNUFFOUT       TC      UPFLAG
35              ADRES    SNUFFER
36              TC      GOPIN
37
38 # VERB 75      ENABLE U,V JETS DURING DPS BURNS
39
40 OUTSNUFF       TC      DOWNFLAG
41              ADRES    SNUFFER
42              TC      GOPIN
43
44 # VERB 85      DISPLAY RR LOS AZIMUTH AND ELEVATION.
45 #
46 # AZIMUTH IS THE ANGLE BETWEEN THE LOS AND THE X-Z NB PLANE, 0-90 DEG IN THE +Y HEMISPHERE,
47 # 360-270 DEG IN THE -Y HEMISPHERE.
48 #
49 # ELEVATION IS THE ANGLE BETWEEN +ZNB AND THE PROJECTION OF THE LOS INTO THE X-Z PLANE, 0-360 ABOUT +Y.
50
51              EBANK    RR-AZ
52 VERB85         TC      TESTXACT
53
54
55
56
57
58
59
60
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	TC	POSTJUMP	
	CADR	DSPRRLOS	
	SETLOC	PINBALL1	
	BANK		
	COUNT*	\$\$/EXTVB	
DSPRRLOS	CAF	PRI05	
	TC	FINDVAC	
	EBANK	RR-AZ	
	2CADR	RRLOSDSP	
	CAF	PRI04	
	TC	PRI0CHNG	
	CAF	V16N56	
	TC	BANKCALL	
	CADR	GOMARKFR	
	TC	B50FF	
	TC	B50FF	
	TC	B50FF	
	CAF	BIT3	
	TC	BLANKET	
	TC	ENDOFJOB	
RRLOSDSP	EXTEND		
	DCA	CDUT	
	DXCH	MPAC	
	TC	INTPRET	
	CALL		
		RRNBMPAC	# GET RR LOS IN BODY AXIS.
	STORE	0D	# UNIT LOS
	STODL	6D	
		HI6ZEROS	
	STOVL	8D	
		6D	
	UNIT		
	STORE	6D	# UNIT OF LOS PROJ IN X-Z PLANE
	DOT		
	STOVL	UNITZ	
		COSTH	# 16D
		UNITX	
	DOT		
		6D	
	STCALL	SINTH	# 18D
		ARCTRIG	
	BPL	DAD	# INSURE DISPLAY OF 0-360 DEG.
		+2	
		DPPOS MAX	# INTRODUCES AND ERROR OF B-28 REVS.

	STOVL	RR-ELEV	
		OD	
	DOT		
		UNITY	
	STOVL	SINTH	
		OD	
	DOT		
		6D	
	STCALL	COSTH	
		ARCTRIG	
	BPL	DAD	# INSURE DISPLAY OF 0-360 DEG.
		+2	
		DPPOSMAX	# INTRODUCES AN ERROR OF B-28 REVS.
	STORE	RR-AZ	
	EXIT		
	CA	1SEC	
	TC	BANKCALL	
	CADR	DELAYJOB	
	CA	BIT5	
	MASK	EXTVBACT	
	CCS	A	
	TC	RRLOSDSP	
	TC	ENDEXT	
V16N56	VN	1656	

THE FOLLOWING REFERS TO THE NOUN TABLES

COMPONENT CODE NUMBER INTERPRETATION

#	00000	1 COMPONENT
#	00001	2 COMPONENT
#	00010	3 COMPONENT
#	X1XXX	BIT 4 1. DECIMAL ONLY
#	1XXXX	BIT 5 1. NO LOAD

END OF COMPONENT CODE NUMBER

SF ROUTINE CODE NUMBER INTERPRETATION

#	00000	OCTAL ONLY
#	00001	STRAIGHT FRACTIONAL
#	00010	CDU DEGREES XXX.XX
#	00011	ARITHMETIC SF
#	00100	ARITH DP1 OUT MULT BY 2EXP14 AT END IN STRAIGHT
#	00101	ARITH DP2 OUT STRAIGHT IN SL 7 AT END
#	00110	LANDING RADAR POSITION +0000X
#	00111	ARITH DP3 OUT SL 7 AT END IN STRAIGHT
#	01000	WHOLE HOURS IN R1, WHOLE MINUES MOD 60 IN R2, SECONDS MOD 60 0XX.XX IN R3. *** ALARMS IF USED WITH OCTAL
#	01001	MINUTES MOD 60 IN D1D2, D3 BLANK, SECONDS MOD 60 IN D4D5 LIMITS TO 59B59 IF MAG EXCEEDS THIS VALUE. ALARMS IF USED WITH OCTAL ***** IN ALARM
#	01010	ARITH DP4 OUT STRAIGHT IN SL 3 AT END
#	01011	ARITH1 SF OUT MULT BY 2EXP14 AT END IN STRAIGHT
#	01100	2 INTEGERS IN D1D2, D4D5, D3 BLANK. ALARMS IF USED WITH OCTAL ***** IN ALARM
#	01101	360-CDU DEGREES XXX.XX

END OF SF ROUTINE CODE NUMBERS

SF CONSTANT CODE NUMBER INTERPRETATION

#	00000	WHOLE	USE ARITH
#	00000	DP TIME SEC XXX.XX SEC	USE ARITHDP1
#	00000	LR POSITION +0000X	USE LR POSITION
#	00001	SPARE	
#	00010	CDU DEGREES	USE CDU DEGREES
#	00010	360-CDU DEGREES	USE 360-CDU DEGREES
#	00011	DP DEGREES 90 XX.XXX DEG	USE ARITHDP3
#	00100	DP DEGREES 360 XXX.XX DEG	USE ARITHDP4
#	00101	DEGREES 180 XXX.XX DEG	USE ARITH
#	00101	OPTICAL TRACKER AZIMUTH ANGLE XXX.XXDEG	USE ARITHDP1
#	00110	WEIGHT2 XXXXX. LBS	USE ARITH1

#	00111	POSITION5	XXX.XX NAUTICAL MILES	
#				USE ARITHDP3
#	01000	POSITION4	XXXX.X NAUTICAL MILES	
#				USE ARITHDP3
#	01001	VELOCITY2	XXXXX. FT/SEC	USE ARITHDP4
#	01010	VELOCITY3	XXXX.X FT/SEC	USE ARITHDP3
#	01011	ELEVATION DEGREES	89.999 MAX	USE ARITH
#	01100	RENDEZVOUS RADAR RANGE	XXX.XX NAUT MI	
#				USE ARITHDP1
#	01101	RENDEZVOUS RADAR RANGE RATE	XXXXX.FT/SEC	
#				USE ARITHDP1
#	01110	LANDING RADAR ALTITUDE	XXXXX.FEET	
#				USE ARITHDP1
#	01111	INITIAL/FINAL ALTITUDE	XXXXX. FEET	
#				USE ARITHDP1
#	10000	ALTITUDE RATE	XXXXX.FT/SEC	USE ARITH
#	10001	FORWARD/LATERAL VELOCITY	XXXXX.FEET/SEC	
#				USE ARITH
#	10010	ROTATIONAL HAND CONTROLLER ANGLE RATES		
#		XXXXX.DEG/SEC		USE ARITH
#	10011	LANDING RADAR VELX	XXXXX.FEET/SEC	
#				USE ARITHDP1
#	10100	LANDING RADAR VELY	XXXXX.FEET/SEC	
#				USE ARITHDP1
#	10101	LANDING RADAR VELZ	XXXXX.FEET/SEC	
#				USE ARITHDP1
#	10110	POSITION7	XXXX.X NAUT MI	USE ARITHDP4
#	10111	TRIM DEGREES2	XXX.XX DEG	USE ARITH
#	11000	COMPUTED ALTITUDE	XXXXX. FEET	
#				USE ARITHDP1
#	11001	DP DEGREES	XXXX.X DEG	USE ARITHDP3
#	11010	POSITION9	XXXX.X FT	USE ARITHDP3
#	11011	VELOCITY4	XXXX.X FT/SEC	USE ARITHDP2
#	11100	RADIANS	XXX.XXX RADIANS	USE ARITHDP4

END OF SF CONSTANT CODE NUMBERS

FOR GREATER THAN SINGLE PRECISION SCALES, PUT ADDRESS OF MAJOR PART INTO
NOUN TABLES.

OCTAL LOADS PLACE +0 INTO MAJOR PART, DATA INTO MINOR PART.

OCTAL DISPLAYS SHOW MINOR PART ONLY.

TO GET AT BOTH MAJOR AND MINOR PARTS IN OCTAL , USE NOUN 01.

A NOUN MAY BE DECLARED DECIMAL ONLY BY MAKING BIT4 1 OF ITS COMPONENT
CODE NUMBER. IF THIS NOUN IS USED WITH ANY OCTAL DISPLAY VERB, OR IF
DATA IS LOADED IN OCTAL, IT ALARMS.# IN LOADING AN HOURS, MINUTES, SECONDS NOUN, ALL 3 WORDS MUST BE
LOADED, OR ALARM.

ALARM IF AN ATTEMPT IS MADE TO LOAD SPLIT MINUTES/SECONDS MMBSS .
THIS IS USED FOR DISPLAY ONLY.

THE FOLLOWING ROUTINES ARE FOR READING THE NOUN TABLES AND THE SF TABLES
WHICH ARE IN A SEPARATE BANK FROM THE REST OF PINBALL . THESE READING
ROUTINES ARE IN THE SAME BANK AS THE TABLES. THEY ARE CALLED BY DXCH Z.

LODNNTAB LOADS NNADTEM WITH THE NNADTAB ENTRY, NNTYPTTEM WITH THE
NNTYPTAB ENTRY. IF THE NOUN IS MIXED, IDADITEM IS LOADED WITH THE FIRST
IDADDTAB ENTRY, IDAD2TEM THE SECOND IDADDTAB ENTRY, IDAD3TEM THE THIRD
IDADDTAB ENTRY, RUTMXTEM WITH THE RUTMXTAB ENTRY. MIXBR IS SET FOR
MIXED OR NORMAL NOUN.

	BANK	6	
	SETLOC	PINBALL3	
	BANK		
	COUNT*	\$\$/NOUNS	
LODNNTAB	DXCH	IDAD2TEM	# SAVE RETURN INFO IN IDAD2TEM, IDAD3TEM.
	INDEX	NOUNREG	
	CAF	NNADTAB	

	TS	NNADTEM	
	INDEX	NOUNREG	
	CAF	NNTYPTAB	
	TS	NNTYPTTEM	
	CS	NOUNREG	
	AD	MIXCON	

	EXTEND		
	BZMF	LODMIXNN	# NOUN NUMBER G/E FIRST MIXED NOUN
	CAF	ONE	# NOUN NUMBER L/ FIRST MIXED NOUN
	TS	MIXBR	# NORMAL. +1 INTO MIXBR
	TC	LODNLV	
LODMIXNN	CAF	TWO	# MIXED. +2 INTO MIXBR.

	TS	MIXBR	
	INDEX	NOUNREG	
	CAF	RUTMXTAB -40D	# FIRST MIXED NOUN 40.
	TS	RUTMXTEM	
	CAF	LOW10	
	MASK	NNADTEM	

	TS	Q	# TEMP
	INDEX	A	
	CAF	IDADDTAB	

	TS	IDAD1TEM	# LOAD IDAD1TEM WITH FIRST IDADDTAB ENTRY
	EXTEND		
	INDEX	Q	# LOAD IDAD2TEM WITH 2ND IDADDTAB ENTRY
	DCA	IDADDTAB +1	# LOAD IDAD3TEM WITH 3RD IDADDTAB ENTRY.
LODNLV	DXCH	IDAD2TEM	# PUT RETURN INFO INTO A, L.
	DXCH	Z	

MIXCON		OCT50	# DEC 40
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GTSFOUT LOADS SFTEMP1, SFTEMP2 WITH THE DP SFOUTAB ENTRIES.

GTSFOUT	DXCH	SFTEMP1	# 2X SFCONUM ARRIVES IN SFTEMP1.
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	EXTEND			
	INDEX	A		
SFCOM	DCA	SFOUTAB		
	DXCH	SFTEMP1		
	DXCH	Z		
# GTSFIN LOADS SFTEMP1, SFTEMP2 WITH THE DP SFINTAB INTRIES.				
GTSFIN	DXCH	SFTEMP1	# 2X SFCOM	ARIVES IN SFTEMP1.
	EXTEND			
	INDEX	A		
	DCA	SFINTAB		
	TCF	SFCOM		
NNADTAB	OCT	00000	# NN	NORMAL NOUNS
	OCT	40000	# 00	NOT IN USE
	OCT	40000	# 01	SPECIFY MACHINE ADDRESS FRACTIONAL
	OCT	40000	# 02	SPECIFY MACHINE ADDRESS WHOLE
	OCT	40000	# 03	SPECIFY MACHINE ADDRESS DEGREES
	ECADR	DSPTM1	# 04	ANGULAR ERROR/DIFFERENCE
	ECADR	DSPTM1	# 05	ANGULAR ERROR/DIFFERENCE
	ECADR	OPTION1	# 06	OPTION CODE
	ECADR	XREG	# 07	ECADR OF WORD TO BE MODIFIED
			#	ONES FOR BITS TO BE MODIFIED
			#	1 TO SET OR 0 TO RESET SELECTED BITS
	ECADR	ALMCADR	# 08	ALARM DATA
	ECADR	FAILREG	# 09	ALARM CODES
	OCT	77776	# 10	CHANNEL TO BE SPECIFIED
	ECADR	TCSI	# 11	TIG OF CSI HRS,MIN,SEC
	ECADR	OPTIONX	# 12	OPTION CODE
			#	USED BY EXTENDED VERBS ONLY
	ECADR	TCDH	# 13	TIG OF CDH HRS,MIN,SEC
	ECADR	DSPTMX	# 14	CHECKLIST
			#	USED BY EXTENDED VERBS ONLY
	OCT	77777	# 15	INCREMENT MACHINE ADDRESS
	ECADR	DSPTMX	# 16	TIME OF EVENT HRS,MIN,SEC
	OCT	00000	# 17	SPARE
	ECADR	FDAIX	# 18	AUTO MANEUVER BALL ANGLES
	OCT	00000	# 19	SPARE
	ECADR	CDUX	# 20	ICDU ANGLES
	ECADR	PIPAX	# 21	PIPAS
	ECADR	THETAD	# 22	NEW ICDU ANGLES
	OCT	00000	# 23	SPARE
	ECADR	DSPTM2 +1	# 24	DELTA TIME FOR AGC CLOCK HRS,MIN,SEC
	ECADR	DSPTM1	# 25	CHECKLIST
			#	USED WITH PLEASE PERFORM ONLY
	ECADR	DSPTM1	# 26	PRIQ/DELAY, ADRES, BBCON
	ECADR	SMODE	# 27	SELF TEST ON/OFF SWITCH

OCT	00000	# 28	SPARE
OCT	00000	# 29	SPARE
OCT	0	# 30	SPARE
OCT	0	# 31	SPARE
ECADR	-TPER	# 32	TIME TO PERIGEE HRS,MIN,SEC
ECADR	TIG	# 33	TIME OF IGNITION HRS,MIN,SEC
ECADR	DSPTM1	# 34	TIME OF EVENT HRS,MIN,SEC
ECADR	TTOGO	# 35	TIME TO GO TO EVENT HRS,MIN,SEC
ECADR	TIME2	# 36	TIME OF AGC CLOCK HRS,MIN,SEC
ECADR	TTPI	# 37	TIG OF TPI HRS,MIN,SEC
ECADR	TET	# 38	TIME OF STATE BEING INTEGRATED
OCT	00000	# 39	SPARE

END OF NNADTAB FOR NORMAL NOUNS

		# NN	MIXED NOUNS
OCT	64000	# 40	TIME TO IGNITION/CUTOFF
		#	VG
OCT	02003	# 41	DELTA V ACCUMULATED TARGET AZIMUTH ELEVATION
OCT	24006	# 42	APOGEE PERIGEE
OCT	24011	# 43	DELTA V REQUIRED LATITUDE LONGITUDE
OCT	64014	# 44	ALTITUDE APOGEE PERIGEE
OCT	64017	# 45	TFF MARKS TTI OF NEXT BURN
OCT	00022	# 46	MGA AUTOPILOT CONFIGURATION
OCT	22025	# 47	LEM WEIGHT
OCT	22030	# 48	CSM WEIGHT GIMBAL PITCH TRIM GIMBAL ROLL TRIM
OCT	24033	# 49	DELTA R DELTA V RADAR DATA SOURCE CODE
OCT	0	# 50	SPARE
OCT	22041	# 51	S-BAND ANTENNA PITCH YAW
OCT	00044	# 52	CENTRAL ANGLE OF ACTIVE VEHICLE
OCT	00000	# 53	SPARE
OCT	24052	# 54	RANGE RANGE RATE THETA
OCT	24055	# 55	NO. OF APSIDAL CROSSINGS

		#	ELEVATION ANGLE
		#	CENTRAL ANGLE
OCT	02060	# 56	RR LOS AZIMUTH
		#	ELEVATION
OCT	20063	# 57	DELTA R
OCT	24066	# 58	PERIGEE ALT
		#	DELTA V TPI
		#	DELTA V TPF
OCT	24071	# 59	DELTA VELOCITY LOS
OCT	24074	# 60	HORIZONTAL VELOCITY
		#	ALTITUDE RATE
		#	COMPUTED ALTITUDE
OCT	64077	# 61	TIME TO GO IN BRAKING PHASE
		#	TIME TO IGNITION
		#	CROSS RANGE DISTANCE
OCT	64102	# 62	ABSOLUTE VALUE OF VELOCITY
		#	TIME TO IGNITION
		#	DELTA V ACCUMULATED
OCT	24105	# 63	ABSOLUTE VALUE OF VELOCITY
		#	ALTITUDE RATE
		#	COMPUTED ALTITUDE
OCT	64110	# 64	TIME LEFT FOR REDESIGNATION -- LPD ANGLE
		#	ALTITUDE RATE
		#	COMPUTED ALTITUDE
OCT	24113	# 65	SAMPLED AGC TIME HRS,MIN,SEC
		#	FETCHED IN INTERRUPT
OCT	62116	# 66	LR RANGE
		#	POSITION
OCT	04121	# 67	LRVX
		#	LRVY
		#	LRVZ
OCT	64124	# 68	SLANT RANGE TO LANDING SIGHT
		#	TIME TO GO IN BRAKING PHASE
		#	LR ALTITUDE -- COMPUTED ALTITUDE
OCT	00000	# 69	SPARE
OCT	04132	# 70	AOT DETENT CODE/STAR CODE
OCT	04135	# 71	AOT DETENT CODE/STAR CODE
OCT	02140	# 72	RR 360 -- TRUNNION ANGLE
		#	SHAFT ANGLE
OCT	02143	# 73	NEW RR 360 -- TRUNNION ANGLE
		#	SHAFT ANGLE
OCT	64146	# 74	TIME TO IGNITION
		#	YAWAFTER VEHICLE RISE
		#	PITCH AFTER VEHICLE RISE
OCT	64151	# 75	DELTA ALTITUDE CDH
		#	DELTA TIME CDH-CSI OR TPI-CDH
		#	DELTA TIME TPI-CDH OR TPI-NOMTPI
OCT	24154	# 76	DESIRED HORIZONTAL VELOCITY
		#	DESIRED RADIAL VELOCITY
		#	CROSS-RANGE DISTANCE

OCT	62157	# 77	TIME TO ENGINE CUTOFF
		#	VELOCITY NORMAL TO CSM PLANE
OCT	02162	# 78	RR RANGE
		#	RANGE RATE
OCT	24165	# 79	CURSOR ANGLE
		#	SPIRAL ANGLE
		#	POSITION CODE
OCT	02170	# 80	DATA INDICATOR
		#	OMEGA
OCT	24173	# 81	DELTA V LV
OCT	24176	# 82	DELTA V LV
OCT	24201	# 83	DELTA V BODY
OCT	24204	# 84	DELTA V OTHER VEHICLE
OCT	24207	# 85	VG BODY
OCT	24212	# 86	VG LV
OCT	02215	# 87	BACKUP OPTICS LOS AZIMUTH
		#	ELEVATION
OCT	24220	# 88	HALF UNIT SUN OR PLANET VECTOR
OCT	24223	# 89	LANDMARK LATITUDE
		#	LONGITUDE/2
		#	ALTITUDE
OCT	24226	# 90	Y
		#	Y DOT
		#	PSI
OCT	04231	# 91	ALTITUDE
		#	VELOCITY
		#	FLIGHT PATH ANGLE
OCT	00000	# 92	SPARE
OCT	04237	# 93	DELTA GYRO ANGLES
OCT	00000	# 94	SPARE
OCT	0	# 95	SPARE
OCT	0	# 96	SPARE
OCT	04253	# 97	SYSTEM TEST INPUTS
OCT	04256	# 98	SYSTEM TEST RESULTS
OCT	24261	# 99	RMS IN POSITION
		#	RMS IN VELOCITY
		#	RMS IN BIAS

END OF NNADTAB FOR MIXED NOUNS

		# NN	NORMAL NOUNS
NNTYPTAB	OCT	# 00	NOT IN USE
	OCT	# 01	3COMP FRACTIONAL
	OCT	# 02	3COMP WHOLE
	OCT	# 03	3COMP CDU DEGREES
	OCT	# 04	1COMP DPDEG 360
	OCT	# 05	1COMP DPDEG 360
	OCT	# 06	3COMP OCTAL ONLY
	OCT	# 07	3COMP OCTAL ONLY
	OCT	# 08	3COMP OCTAL ONLY

OCT	04000	# 09	3COMP	OCTAL ONLY
OCT	00000	# 10	1COMP	OCTAL ONLY
OCT	24400	# 11	3COMP	HMS DEC ONLY
OCT	02000	# 12	2COMP	OCTAL ONLY
OCT	24400	# 13	3COMP	HMS DEC ONLY
OCT	04140	# 14	3COMP	WHOLE
OCT	00000	# 15	1COMP	OCTAL ONLY
OCT	24400	# 16	3COMP	HMS DEC ONLY
OCT	0	# 17	SPARE	
OCT	04102	# 18	3COMP	CDU DEG
OCT	00000	# 19	SPARE	
OCT	04102	# 20	3COMP	CDU DEGREES
OCT	04140	# 21	3COMP	WHOLE
OCT	04102	# 22	3COMP	CDU DEGREES
OCT	00000	# 23	SPARE	
OCT	24400	# 24	3COMP	HMS DEC ONLY
OCT	04140	# 25	3COMP	WHOLE
OCT	04000	# 26	3COMP	OCTAL ONLY
OCT	00140	# 27	1COMP	WHILE
OCT	00000	# 28	SPARE	
OCT	00000	# 29	SPARE	
OCT	0	# 30	SPARE	
OCT	0	# 31	SPARE	
OCT	24400	# 32	3COMP	HMS DEC ONLY
OCT	24400	# 33	3COMP	HMS DEC ONLY
OCT	24400	# 34	3COMP	HMS DEC ONLY
OCT	24400	# 35	3COMP	HMS DEC ONLY
OCT	24400	# 36	3COMP	HMS DEC ONLY
OCT	24400	# 37	3COMP	HMS DEC ONLY
OCT	24400	# 38	3COMP	HMS DEC ONLY
OCT	00000	# 39	SPARE	

END OF NNTYPTAB FOR NORMAL NOUNS

		# NN	MIXED NOUNS
OCT	24500	# 40	3COMP MIN/SEC, VEL3, VEL3 NO LOAD, DEC ONLY
OCT	00542	# 41	2COMP CDU DEG, ELEV DEG
OCT	24410	# 42	3COMP POS4, POS4, VEL3 DEC ONLY
OCT	20204	# 43	3COMP DPDEG 360 , DPDEG 360 POS4 DEC ONLY
OCT	00410	# 44	3COMP POS4, POS4, MIN/SEC NO LOAD, DEC ONLY
OCT	10000	# 45	3COMP WHOLE, MIN/SEC, DPDEG 360 NO LOAD, DEC ONLY
OCT	00000	# 46	1COMP OCTAL ONLY
OCT	00306	# 47	2COMP WEIGHT2 FOR EACH DEC ONLY
OCT	01367	# 48	2COMP TRIM DEG2 FOR EACH

			#		DEC ONLY
			#		POS4, VEL3, WHOLE
	OCT	00510	# 49	3COMP	DEC ONLY
			#		DEC ONLY
	OCT	0	# 50	SPARE	
	OCT	00204	# 51	2COMP	DPDEG 360 , DPDEG 360
			#		DEC ONLY
	OCT	00004	# 52	1COMP	DPDEG 360
	OCT	00000	# 53	SPARE	
	OCT	10507	# 54	3COMP	POS5, VEL3, DPDEG 360
			#		DEC ONLY
	OCT	10200	# 55	3COMP	WHOLE, DPDEG 360 , DPDEG 360
			#		DEC ONLY
	OCT	00204	# 56	2COMP	DPDEG 360 , DPDEG 360
	OCT	00010	# 57	1COMP	POS4
			#		DEC ONLY
	OCT	24510	# 58	3COMP	POS4, VEL3, VEL3
			#		DEC ONLY
	OCT	24512	# 59	3COMP	VEL3 FOR EACH
			#		DEC ONLY
	OCT	60512	# 60	3COMP	VEL3, VEL3, COMP ALT
			#		DEC ONLY
	OCT	54000	# 61	3COMP	MIN/SEC, MIN/SEC, POS7
			#		NO LOAD, DEC ONLY
	OCT	24012	# 62	3COMP	VEL3, MIN/SEC, VEL3
			#		NO LOAD, DEC ONLY
	OCT	60512	# 63	3COMP	VEL3, VEL3, COMP ALT
			#		DEC ONLY
	OCT	60500	# 64	3COMP	2INT, VEL3, COMP ALT
			#		NO LOAD, DEC ONLY
	OCT	00000	# 65	3COMP	HMS DEC ONLY
	OCT	00016	# 66	2COMP	LANDING RADAR ALT, POSITION
			#		NO LOAD, DEC ONLY
	OCT	53223	# 67	3COMP	LANDING RADAR VELX, Y, Z
	OCT	60026	# 68	3COMP	POS7, MIN/SEC, COMP ALT
			#		NO LOAD, DEC ONLY
	OCT	00000	# 69	SPARE	
	OCT	0	# 70	3COMP	OCTAL ONLY FOR EACH
	OCT	0	# 71	3COMP	OCTAL ONLY FOR EACH
	OCT	00102	# 72	2COMP	360-CDU DEG, CDU DEG
	OCT	00102	# 73	2COMP	360-CDU DEG, CDU DEG
	OCT	10200	# 74	3COMP	MIN/SEC, DPDEG 360 , DPDEG 360
			#		NO LOAD, DEC ONLY
	OCT	00010	# 75	3COMP	POS4, MIN/SEC, MIN/SEC
			#		NO LOAD, DEC ONLY
			#		
	OCT	20512	# 76	3COMP	VEL3, VEL3, POS4
			#		DEC ONLY
	OCT	00500	# 77	2COMP	MIN/SEC, VEL3
			#		NO LOAD, DEC ONLY
	OCT	00654	# 78	2 COMP	RR RANGE, RR RANGE RATE
	OCT	00102	# 79	3COMP	CDU DEG, CDU DEG, WHOLE

		#		DEC ONLY
		# 80	2COMP	WHOLE, DPDEG 360
	OCT	00200		
	OCT	24512	# 81	3COMP VEL3 FOR EACH
			#	DEC ONLY
	OCT	24512	# 82	3COMP VEL3 FOR EACH
			#	DEC ONLY
	OCT	24512	# 83	3COMP VEL3 FOR EACH
			#	DEC ONLY
	OCT	24512	# 84	3COMP VEL3 FOR EACH
			#	DEC ONLY
	OCT	24512	# 85	3COMP VEL3 FOR EACH
			#	DEC ONLY
	OCT	24512	# 86	3COMP VEL3 FOR EACH
			#	DEC ONLY
	OCT	00102	# 87	2COMP CDU DEG FOR EACH
	OCT	0	# 88	3COMP FRAC FOR EACH
			#	DEC ONLY
	OCT	16143	# 89	3COMP DPDEG 90 , DPDEG 90 , POS5
			#	DEC ONLY
	OCT	10507	# 90	3COMP POS5, VEL3, DEPDEG 360
			#	DEC ONLY
	OCT	10450	# 91	3COMP POS4, VEL2, DPDEG 360
	OCT	00000	# 92	SPARE
	OCT	06143	# 93	3COMP DPDEG 90 FOR EACH
	OCT	00000	# 94	SPARE
	OCT	0	# 95	SPARE
	OCT	0	# 96	SPARE
	OCT	00000	# 97	3COMP WHOLE FOR EACH
	OCT	00000	# 98	3COMP WHOLE, FRAC, WHOLE
	OCT	71572	# 99	3COMP POS9, VEL4, RADIANS
			#	DEC ONLY

END OF NNTYPTAB FOR MIXED NOUNS

SFINTAB	OCT	00006	#	WHOLE, DP TIME SEC
	OCT	03240		
	OCT	00000	#	SPARE
	OCT	00000		
	OCT	00000	#	CDU DEGREES, 360-CDU DEGREES
	OCT	00000	#	SFCONS IN DEGINSF
	OCT	10707	#	DP DEGREES 90
	OCT	03435	#	UPPED BY 1
	OCT	13070	#	DP DEGREES 360 POINT BETWN BITS 11-12
	OCT	34345	#	UPPED BY 1
	OCT	00005	#	DEGREES 180
	OCT	21616		
	OCT	26113	#	WEIGHT2
	OCT	31713		
	OCT	00070	#	POSITION5
	OCT	20460		

	OCT	01065	# POSITION4
	OCT	05740	
	OCT	11414	# VELOCITY2 POINT BETWN BITS 11-12
	OCT	31463	
	OCT	07475	# VELOCITY3
	OCT	16051	
	OCT	00001	# ELEVATION DEGREES
	OCT	03434	
	OCT	00047	# RENDEZVOUS RADAR RANGE
	OCT	21135	
	OCT	77766	# RENDESVOUS RADAR RANGE RATE
	OCT	50711	
	2DEC*	.9267840599 E5 B-28*	# LANDING RADAR ALTITUDE
	OCT	00002	# INITIAL/FINAL ALTITUDE
	OCT	23224	
	OCT	00014	# ALTITUDE RATE
	OCT	06500	
	OCT	00012	# FORWARD/LATERAL VELOCITY
	OCT	36455	
	OCT	04256	# ROT HAND CONT ANGLE RATE
	OCT	07071	
	2DEC*	-1.552795030 E5 B-28*	# LANDING RADAR VELX
	2DEC*	.8250825087 E5 B-28*	# LANDING RADAR VELY
	2DEC*	1.153668673 E5 B-28*	# LANDING RADAR VELZ
	OCT	04324	# POSITION7
	OCT	27600	
	OCT	00036	# TRIM DEGREES2
	OCT	20440	
	OCT	00035	# COMPUTED ALTITUDE
	OCT	30400	
	OCT	23420	# DP DEGREES
	OCT	00000	
	2DEC	30480 B-19	# POSITION 9
	2DEC	30.48 B-7	# VELOCITY4
	2DEC	100 B-8	# RADIANS
			# END OF SFINTAB
SFOUTAB	OCT	05174	# WHOLE, DP TIME SEC
	OCT	13261	
	OCT	00000	# SPARE
	OCT	00000	
	OCT	00000	# CDU DEGREES, 360-CDU DEGREES

OCT	00000	#	SFCONS IN DEGOUTSF, 360 CDUO
OCT	00714	#	DP DEGREES 90 POINT BETWN BITS 7-8
OCT	31463		
OCT	13412	#	DP DEGREES 360
OCT	07534		
OCT	05605	#	DEGREES 180
OCT	03656		
OCT	00001	#	WEIGHT2
OCT	16170		
OCT	00441	#	POSITION5
OCT	34306		
OCT	07176	#	POSITION4 POINT BETWN BITS 7-8
OCT	21603		
OCT	15340	#	VELOCITY2
OCT	15340		
OCT	01031	#	VELOCITY3 POINT BETWN BITS 7-8
OCT	21032		
OCT	34631	#	ELEVATION DETREES
OCT	23146		
OCT	00636	#	RENDEZVOUS RADAR RANGE
OCT	14552		
OCT	74552	#	RENDEZVOUS RADAR RANGE RATE
OCT	70307		
2DEC	1.079 E-5 B14	#	LANDING RADAR ALTITUDE
OCT	14226	#	INITIAL/FINAL ALTITUDE
OCT	31757		
OCT	02476	#	ALTITUDE RATE
OCT	05531		
OCT	02727	#	FORWARD/LATERAL VELOCITY
OCT	16415		
OCT	00007	#	ROT HAND CONT ANGLE RATE
OCT	13734		
2DEC	-.6440 E-5 B14	#	LANDING RADAR VELX
2DEC	1.212 E-5 B14	#	LANDING RADAR VELY
2DEC	.8668 E-5 B14	#	LANDING RADAR VELZ
OCT	34772	#	POSITION7
OCT	07016		
OCT	01030	#	TRIM DEGREES2
OCT	33675		
OCT	01046	#	COMPUTED ALTITUDE
OCT	15700		
OCT	00321	#	DP DEGREES
OCT	26706		
2DEC	17.2010499 B-7	#	POSITION 9
2DEC	.032808399	#	VELOCITY4

2DEC .32

RADIANS

END OF SFOUTAB

NN SF CONSTANT SF ROUTINE

IDADDTAB

ECADR TTOGO

40

MIN/SEC

M/S

ECADR VGDISP

40

VEL3

DP3

ECADR DVTOTAL

40

VEL3

DP3

ECADR DSPTM1

41

CDU DEG

CDU

ECADR DSPTM1 +1

41

ELEV DEG

ARTH

OCT 0

41

SPARE COMPONENT

ECADR HAPO

42

POS4

DP3

ECADR HPER

42

POS4

DP3

ECADR VGDISP

42

VEL3

DP3

ECADR LAT

43

DPDEG 360

DP4

ECADR LONG

43

DPDEG 360

DP4

ECADR ALT

43

POS4

DP3

ECADR HAPOX

44

POS4

DP3

ECADR HPERX

44

POS4

DP3

ECADR TFF

44

MIN/SEC

M/S

ECADR TRKMKCNT

45

WHOLE

ARTH

ECADR TTOGO

45

MIN/SEC

M/S

ECADR +MGA

45

DPDEG 360

DP4

ECADR DAPDATR1

46

OCTAL ONLY

OCT

OCT 0

46

SPARE COMPONENT

OCT 0

46

SPARE COMPONENT

ECADR LEMMASS

47

WEIGHT2

ARTH1

ECADR CSMASS

47

WEIGHT2

ARTH1

OCT 0

47

SPARE COMPONENT

ECADR PITTIME

48

TRIM DEG2

ARTH

ECADR ROLLTIME

48

TRIM DEG2

ARTH

OCT 0

48

SPARE COMPONENT

ECADR R22DISP

49

POS4

DP3

ECADR R22DISP +2

49

VEL3

DP3

ECADR WHCHREAD

49

WHOLE

ARTH

OCT 0

50

SPARE

OCT 0

50

SPARE

OCT 0

50

SPARE

ECADR ALPHASB

51

DPDEG 360

DP4

ECADR BETASB

51

DPDEG 360

DP4

OCT 0

51

SPARE COMPONENT

ECADR ACTCENT

52

DPDEG 360

DP4

OCT 00000

52

SPARE COMPONENT

OCT 00000

52

SPARE COMPONENT

OCT 00000

53

SPARE

OCT 00000

53

SPARE

OCT 00000

53

SPARE

ECADR RANGE

54

POS5

DP1

ECADR	RRATE	# 54	VEL3	DP3
ECADR	RTHETA	# 54	DPDEG 360	DP4
ECADR	NN	# 55	WHOLE	ARTH
ECADR	ELEV	# 55	DPDEG 360	DP4
ECADR	CENTANG	# 55	DPDEG 360	DP4
ECADR	RR-AZ	# 56	DPDEG 360	DP4
ECADR	RR-ELEV	# 56	DPDEG 360	DP4
OCT	0	# 56	SPARE COMPONENT	
ECADR	DELTAR	# 57	POS4	DP3
OCT	0	# 57	SPARE COMPONENT	
OCT	0	# 57	SPARE COMPONENT	
ECADR	POSTTPI	# 58	POS4	DP3
ECADR	DELVTPI	# 58	VEL3	DP3
ECADR	DELVTPI	# 58	VEL3	DP3
ECADR	DVLOS	# 59	VEL3	DP3
ECADR	DVLOS +2	# 59	VEL3	DP3
ECADR	DVLOS +4	# 59	VEL3	DP3
ECADR	VHORIZ	# 60	VEL3	DP3
ECADR	HDOTDISP	# 60	VEL3	DP3
ECADR	HCALC	# 60	COMP ALT	DP1
ECADR	TTFDISP	# 61	MIN/SEC	M/S
ECADR	TTOGO	# 61	MIN/SEC	M/S
ECADR	OUTOFPLN	# 61	POS7	DP4
ECADR	ABVEL	# 62	VEL3	DP3
ECADR	TTOGO	# 62	MIN/SEC	M/S
ECADR	DVTOTAL	# 62	VEL3	DP3
ECADR	ABVEL	# 63	VEL3	DP3
ECADR	HDOTDISP	# 63	VEL3	DP3
ECADR	HCALC1	# 63	COMP ALT	DP1
ECADR	FUNNYDSP	# 64	2INT	2INT
ECADR	HDOTDISP	# 64	VEL3	DP3
ECADR	HCALC	# 64	COMP ALT	DP1
ECADR	SAMPTIME	# 65	HMS MIXED ONLY TO KEEP	CODE 65 HMS
ECADR	SAMPTIME	# 65	HMS	HMS
ECADR	SAMPTIME	# 65	HMS	HMS
ECADR	RSTACK +6	# 66	LANDING RADAR ALT	DP1
OCT	0	# 66	LR POSITION	LRPOS
OCT	0	# 66	SPARE COMPONENT	
ECADR	RSTACK	# 67	LANDING RADAR VELX	DP1
ECADR	RSTACK +2	# 67	LANDING RADAR VELY	DP1
ECADR	RSTACK +4	# 67	LANDING RADAR VELZ	DP1
ECADR	RANGEDSP	# 68	POS7	DP4
ECADR	TTFDISP	# 68	MIN/SEC	M/S
ECADR	DELTAH	# 68	COMP ALT	DP1
OCT	00000	# 69	SPARE	
OCT	00000	# 69		
OCT	00000	# 69		
ECADR	AOTCODE	# 70	OCTAL ONLY	OCT
ECADR	AOTCODE +1	# 70	OCTAL ONLY	OCT
ECADR	AOTCODE +2	# 70	OCTAL ONLY	OCT

ECADR	AOTCODE	# 71	OCTAL ONLY	OCT
ECADR	AOTCODE +1	# 71	OCTAL ONLY	OCT
ECADR	AOTCODE +2	# 71	OCTAL ONLY	OCT
ECADR	CDUT	# 72	360-CDU DEG	360-CDU
ECADR	CDUS	# 72	CDU DEG	CDU
OCT	0	# 72	SPARE COMPONENT	
ECADR	TANG	# 73	360-CDU DEG	360-CDU
ECADR	TANG +1	# 73	CDU DEG	CDU
OCT	0	# 73	SPARE COMPONENT	
ECADR	TTOGO	# 74	MIN/SEC	M/S
ECADR	YAW	# 74	DPDEG 360	DP4
ECADR	PITCH	# 74	DPDEG 360	DP4
ECADR	DIFFALT	# 75	POS4	DP3
ECADR	T1TOT2	# 75	MIN/SEC	
ECADR	T2TOT3	# 75	MIN/SEC	M/S
ECADR	ZDOTD	# 76	VEL3	DP3
ECADR	RDOTD	# 76	VEL3	DP3
ECADR	XRANGE	# 76	POS4	DP3
ECADR	TTOGO	# 77	MIN/SEC	M/S
ECADR	YDOT	# 77	VEL3	DP3
OCT	0	# 77	SPARE COMPONENT	
ECADR	RSTACK	# 78	RR RANGE	DP1
ECADR	RSTACK +2	# 78	RR RANGE RATE	DP1
OCT	00000	# 78	SPARE COMPONENT	
ECADR	CURSOR	# 79	CDU DEG	CDU
ECADR	SPIRAL	# 79	CDU DEG	CDU
ECADR	POSCODE	# 79	WHOLE	ARTH
ECADR	DATAGOOD	# 80	WHOLE	ARTH
ECADR	OMEGAD	# 80	DPDEG 360	DP4
OCT	0	# 80	SPARE COMPONENT	
ECADR	DELVLVC	# 81	VEL3	DP3
ECADR	DELVLVC +2	# 81	VEL3	DP3
ECADR	DELVLVC +4	# 81	VEL3	DP3
ECADR	DELVLVC	# 82	VEL3	DP3
ECADR	DELVLVC +2	# 82	VEL3	DP3
ECADR	DELVLVC +4	# 82	VEL3	DP3
ECADR	DELVIMU	# 83	VEL3	DP3
ECADR	DELVIMU +2	# 83	VEL3	DP3
ECADR	DELVIMU +4	# 83	VEL3	DP3
ECADR	DELVOV	# 84	VEL3	DP3
ECADR	DELVOV +2	# 84	VEL3	DP3
ECADR	DELVOV +4	# 84	VEL3	DP3
ECADR	VGBODY	# 85	VEL3	DP3
ECADR	VGBODY +2	# 85	VEL3	DP3
ECADR	VGBODY +4	# 85	VEL3	DP3
ECADR	DELVLVC	# 86	VEL3	DP3
ECADR	DELVLVC +2	# 86	VEL3	DP3
ECADR	DELVLVC +4	# 86	VEL3	DP3
ECADR	AZ	# 87	CDU DEG	CDU
ECADR	EL	# 87	CDU DEG	CDU

OCT	0	# 87	SPARE COMPONENT	
ECADR	STARAD	# 88	FRAC	FRAC
ECADR	STARAD +2	# 88	FRAC	FRAC
ECADR	STARAD +4	# 88	FRAC	FRAC
ECADR	LANDLAT	# 89	DPDEG 90	DP3
ECADR	LANDLONG	# 89	DPDEG 90	DP3
ECADR	LANDALT	# 89	POS5	DP1
ECADR	RANGE	# 90	POS5	DP1
ECADR	RRATE	# 90	VEL3	DP3
ECADR	RTHETA	# 90	DPDEG 360	DP4
ECADR	P21ALT	# 91	POS4	DP3
ECADR	P21VEL	# 91	VEL2	DP4
ECADR	P21GAM	# 91	DPDEG 360	DP4
OCT	00000	# 92	SPARE	
OCT	00000	# 92		
OCT	00000	# 92		
ECADR	OGC	# 93	DPDEG 90	DP3
ECADR	OGC +2	# 93	DPDEG 90	DP3
ECADR	OGC +4	# 93	DPDEG 90	DP3
OCT	00000	# 94	SPARE	
OCT	00000	# 94		
OCT	00000	# 94		
OCT	0	# 95	SPARE	
OCT	0	# 95	SPARE	
OCT	0	# 95	SPARE	
OCT	0	# 96	SPARE	
OCT	0	# 96	SPARE	
OCT	0	# 96	SPARE	
ECADR	DSPTM1	# 97	WHOLE	ARTH
ECADR	DSPTM1 +1	# 97	WHOLE	ARTH
ECADR	DSPTM1 +2	# 97	WHOLE	ARTH
ECADR	DSPTM2	# 98	WHOLE	ARTH
ECADR	DSPTM2 +1	# 98	FRAC	FRAC
ECADR	DSPTM2 +2	# 98	WHOLE	ARTH
ECADR	WWPOS	# 99	POS9	DP3
ECADR	WWVEL	# 99	VEL4	DP2
ECADR	WWBIAS	# 99	RADIANS	DP4

END OF IDADDTAB

		# NN	SF ROUTINES	
RUTMTAB	OCT	16351	# 40	M/S, DP3, DP3
	OCT	00142	# 41	CDU, ARTH
	OCT	16347	# 42	DP3, DP3, DP3
	OCT	16512	# 43	DP4, DP4, DP3
	OCT	22347	# 44	DP3, DP3, M/S
	OCT	24443	# 45	ARTH, M/S, DP4
	OCT	00000	# 46	OCT
	OCT	00553	# 47	ARITH1, ARITH1

OCT	00143	# 48	ARTH, ARTH
OCT	06347	# 49	DP3, DP3, ARTH
OCT	0	# 50	SPARE
OCT	00512	# 51	DP4, DP4
OCT	00012	# 52	DP4
OCT	00000	# 53	SPARE
OCT	24344	# 54	DP1, DP3, DP4
OCT	24503	# 55	ARTH, DP4, DP4
OCT	00512	# 56	DP4, DP4
OCT	00007	# 57	DP3
OCT	16347	# 58	DP3, DP3, DP3
OCT	16347	# 59	DP3, DP3, DP3
OCT	10347	# 60	DP3, DP3, DP1
OCT	24451	# 61	M/S, M/S, DP4
OCT	16447	# 62	DP3, M/S, DP3
OCT	10347	# 63	DP3, DP3, DP1
OCT	10354	# 64	2INT, DP3, DP1
OCT	20410	# 65	HMS, HMS, HMS
OCT	00304	# 66	DP1, LRPOS
OCT	10204	# 67	DP1, DP1, DP1
OCT	10452	# 68	DP4, M/S, DP1
OCT	00000	# 69	SPARE
OCT	0	# 70	OCT, OCT, OCT
OCT	0	# 71	OCT, OCT, OCT
OCT	00115	# 72	360-CDU, CDU
OCT	00115	# 73	360-CDU, CDU
OCT	24511	# 74	M/S, DP4, DP4
OCT	22447	# 75	DP3, M/S, M/S
OCT	16347	# 76	DP3, DP3, DP3
OCT	00351	# 77	M/S, DP3
OCT	00204	# 78	DP1, DP1
OCT	06102	# 79	CDU, CDU, ARTH
OCT	00503	# 80	ARTH, DP4
OCT	16347	# 81	DP3, DP3, DP3
OCT	16347	# 82	DP3, DP3, DP3
OCT	16347	# 83	DP3, DP3, DP3
OCT	16347	# 84	DP3, DP3, DP3
OCT	16347	# 85	DP3, DP3, DP3
OCT	16347	# 86	DP3, DP3, DP3
OCT	00102	# 87	CDU, CDU
OCT	02041	# 88	FRAC FOR EACH
OCT	10347	# 89	DP3, DP3, DP1
OCT	24344	# 90	DP1, DP3, DP4
OCT	24507	# 91	DP3, DP4, DP4
OCT	00000	# 92	SPARE
OCT	16347	# 93	DP3, DP3, DP3
OCT	00000	# 94	SPARE
OCT	0	# 95	SPARE
OCT	0	# 96	SPARE
OCT	06143	# 97	ARTH, ARTH, ARTH

OCT 06043 # 98 ARTH, FRAC, ARTH
OCT 24247 # 99 DP3, DP2, DP4

END OF RUTMXTAB

SBANK LOWSUPER


```
1 BANK 23
2 SETLOC LEMGEOM
3 BANK
4
5
6 SBANK LOWSUPER
7 EBANK XSM
8
9 # THESE TWO ROUTINES COMPUTE THE ACTUAL STATE VECTOR FOR LM,CSM BY ADDING
10 # THE CONIC R,V AND THE DEVIATIONS R,V. THE STATE VECTORS ARE CONVERTED TO
11 # METERS B-29 AND METERS/CSEC B-7 AND STORED APPROPRIATELY IN RN,VN OR
12 # R-OTHER , V-OTHER FOR DOWNLINK. THE ROUTINES NAMES ARE SWITCHED IN THE
13 # OTHER VEHICLES COMPUTER.
14 #
15 # INPUT
16 # STATE VECTOR IN TEMPORARY STORAGE AREA
17 # IF STATE VECTOR IS SCALED POS B27 AND VEL B5
18 # SET X2 TO +2
19 # IF STATE VECTOR IS SCALED POS B29 AND VEL B7
20 # SET X2 TO 0
21 #
22 # OUTPUT
23 # R T IN RN, V T IN VN, T IN PIPTIME
24 # OR
25 # R T IN R-OTHER, V T IN V-OTHER T IS DEFINED BY T-OTHER
26
27 COUNT* $$/GEOM
28 SVDWN2 BOF RVQ # SW 1 AVETOMID DOING W-MATRIX INTEG.
29 AVEMIDSW
30 +1
31 VLOAD VSL*
32 TDELTAV
33 0 -7,2
34 VAD VSL*
35 RCV
36 0,2
37 STOVL RN
38 TNUV
39 VSL* VAD
40 0 -4,2
41 VCV
42 VSL*
43 0,2
44 STODL VN
45 TET
46 STORE PIPTIME
47 RVQ
```

1				1
2	SVDWN1	VLOAD	VSL*	2
3			TDELTAV	3
4			0 -7,2	4
5		VAD	VSL*	5
6			RCV	6
7			0,2	7
8		STOVL	R-OTHER	8
9			TNUV	9
10		VSL*	VAD	10
11			0 -4,2	11
12			VCV	12
13		VSL*		13
14			0,2	14
15		STORE	V-OTHER	15
16		RVQ		16
17				17
18				18
19				19
20				20
21				21
22				22
23				23
24				24
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59				59
60				60

THE FOLLOWING ROUTINE TAKES A HALF UNIT TARGET VECTOR REFERRED TO NAV BASE COORDINATES AND FINDS BOTH
GIMBAL ORIENTATIONS AT WHICH THE RR MIGHT SIGHT THE TARGET. THE GIMBAL ANGLES CORRESPONDING TO THE PRESENT MODE
ARE LEFT IN MODEA AND THOSE WHICH WOULD BE USED AFTER A REMODE IN MODEB. THIS ROUTINE ASSUMES MODE 1 IS TRUNNION
ANGLE LESS THAN 90 DEGS IN ABS VALUE WITH ARBITRARY SHAFT, WITH A CORRESPONDING DEFINITION FOR MODE 2. MODE
SELECTION AND LIMIT CHECKING ARE DONE ELSEWHERE.

THE MODE 1 CONFIGURATION IS CALCULATED FROM THE VECTOR AND THEN MODE 2 IS FOUND USING THE RELATIONS

S 2 180 + S 1
T 2 180 - T 1

THE VECTOR ARRIVES IN MPAC WHERE TRG*SMNB OR *SMNB* WILL HAVE LEFT IT.

RRANGLES	STORE	32D	
	DLOAD	DCOMP	# SINCE WE WILL FIND THE MODE 1 SHAFT
		34D	# ANGLE LATER, WE CAN FIND THE MODE 1
	SETPD	ASIN	# TRUNNION BY SIMPLY TAKING THE ARCSIN OF
		0	# THE Y COMPONENT, THE ASIN GIVIN AN
	PUSH	BDSU	# ANSWER WHOSE ABS VAL IS LESS THAN 90 DEG
		LODPHALF	
	STODL	4	# MODE 2 TRUNNION TO 4.
		LO6ZEROS	
	STOVL	34D	# UNIT THE PROJECTION OF THE VECTOR
		32D	# IN THE X-Z PLANE
	UNIT	BOVB	# IF OVERFLOW, TARGET VECTOR IS ALONG Y
		LUNDESCH	# CALL FOR MANEUVER UNLESS ON LUNAR SURF
	STODL	32D	# PROJECTION VECTOR.
		32D	
	SR1	STQ	
		S2	
	STODL	SINTH	# USE ARCTRIG SINCE SHAFT COULD BE ARB.
		36D	
	SR1		
	STCALL	COSTH	
		ARCTRIG	

```

1
2      PUSH      DAD      # MODE 1 SHAFT TO 2.
3      LODPHALF
4      STOVL     6
5      4
6      RTB      # FIND MODE 2 CDU ANGLES.
7
8      2V1ST02S
9      STOVL     MODEB
10     0
11     RTB      # MODE 1 ANGLES TO MODE A.
12     2V1ST02S
13     STORE    MODEA
14     EXIT
15
16     CS      RADMODES    # SWAP MODEA AND MODEB IF RR IN MODE 2.
17     MASK    ANTENBIT
18     CCS     A
19     TCF     +4
20
21     DXCH     MODEA
22     DXCH     MODEB
23     DXCH     MODEA
24
25     TC      INTPRET
26     GOTO
27
28     S2
29
30
31
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```

GIVEN RR TRUNNION AND SHAFT T,S IN TANGNB,+1,FIND THE ASSOCIATED
LINE OF SIGHT IN NAV BASE AXES. THE HALF UNIT VECTOR, .5 SIN S COS T ,
-SIN T ,COS S COS T IS LEFT IN MPAC AND 32D.

SETLOC INFLIGHT
BANK

COUNT* \$\$/GEOM

RRNB SLOAD RTB
TANGNB
CDULOGIC
SETPD PUSH # TRUNNION ANGLE TO 0
0

SIN DCOMP
STODL 34D # Y COMPONENT

COS PUSH # .5 COS T TO 0
SLOAD RTB
TANGNB +1

RRNB1 PUSH COS # SHAFT ANGLE TO 2
DMP SL1
0
STODL 36D # Z COMPONENT

SIN DMP
SL1
STOVL 32D
32D

RVQ

THIS ENTRY TO RRNB REQUIRES THE TRUNNION AND SHAFT ANGLES IN MPAC AND MPAC +1 RESPECTIVELY

RRNBMPAC STODL 20D # SAVE SHAFT CDU IN 21.
MPAC # SET MODE TO DP. THE PRECEEDING STORE
MAY BE DP. TP OR VECTOR.

RTB SETPD
CDULOGIC
0

PUSH SIN # TRUNNION ANGLE TO 0
DCOMP
STODL 34D # Y COMPONENT
COS PUSH # .5COS T TO 0
SLOAD RTB # PICK UP CDU S.

21D
CDULOGIC

GOTO
RRNB1



LEM GEOMETRY

PAGE 325 EMPTY PAGE

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```
1 BANK 7
2 SETLOC IMUCOMP
3 BANK
4
5 EBANK NBDX
6
7
8 COUNT* $$/ICOMP
9 1/PIPA CAF LGCOMP # SAVE EBANK OF CALLING PROGRAM
10 XCH EBANK
11 TS MODE
12
13 CCS GCOMPSW # BYPASS IF GCOMPSW NEGATIVE
14 TCF +3
15 TCF +2
16 TCF IRIG1 # RETURN
17
18 1/PIPA1 CAF FOUR # PIPAZ, PIPAY, PIPAX
19 TS BUF +2
20
21 INDEX BUF +2
22 CA PIPASCF # P.P.M. X 2 -9
23 EXTEND
24 INDEX BUF +2
25 MP DELVX # PP X 2 +14 NOW PIPA PULSES X 2 +5
26 TS Q # SAVE MAJOR PART
27
28 CA L # MINOR PART
29 EXTEND
30 MP BIT6 # SCALE 2 +9 SHIFT RIGHT 9
31 INDEX BUF +2
32 TS DELVX +1 # FRACTIONAL PIPA PULSES SCALED 2 +14
33
34 CA Q # MAJOR PART
35 EXTEND
36 MP BIT6 # SCALE 2 +9 SHIFT RIGHT 9
37 INDEX BUF +2
38 DAS DELVX # PIPAI + PIPAI SFE
39
40 INDEX BUF +2
41 CS PIPABIAS # PIPA PULSES / CS X 2 -5 *
42 EXTEND
43 MP 1/PIPADT # CS X 2 +8 NOW PIPA PULSES X 2 +3 *
44 EXTEND
45 MP BIT4 # SCALE 2 +11 SHIFT RIGHT 11 *
46 INDEX BUF +2
47 DAS DELVX # PIPAI + PIPAI SFE - BIAS DELTAT
48
49 CCS BUF +2 # PIPAZ, PIPAY, PIPAX
50 AD NEG1
51 TCF 1/PIPA1 +1
```

PAGE 327	
# IMU COMPENSATION PACKAGE	
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NOOP

LESS THAN ZERO IMPOSSIBLE

1412THE

IRIGCOMP	TS TS	GCOMP SW BUF	# INDICATE COMMANDS 2 PULSES OR LESS. # INDEX COUNTER . IRIGX, IRIGY, IRIGZ.
	TC	IRIGX	# COMPENSATE ACCELERATION TERMS
	CS TC	NBDX DRIFTSUB	# GYRO PULSES / CS X 2 -5 # - NBOX DELTAT GYRO PULSES X 2 +14
	TC	IRIGY	# COMPENSATE ACCELERATION TERMS
	CS TC	NBDY DRIFTSUB	# GYRO PULSES / CS X 2 -5 # - NBDY DELTAT GYRO PULSES X 2 +14
	TC	IRIGZ	# COMPENSATE ACCELERATION TERMS
	CA TC	NBDZ DRIFTSUB	# GYRO PULSES / CS X 2 -5 # + NBDZ DELTAT GYRO PULSES X 2 +14
	CCS TCF	GCOMP SW +2	# ARE GYRO COMMANDS GREATER THAN 2 PULSES # YES SEND OUT GYRO TORQUING COMMANDS.
	TCF	IRIG1	# NO RETURN
	CA TC	PRI021 NOVAC	# PRI0 GREATER THAN SERVICER # SEND OUT GYRO TORQUING COMMANDS.
	EBANK 2CADR	NBDX 1/GYRO	
IRIG1	RELINT CA	MODE	# RESTORE CALLERS EBANK
	TS TCF	EBANK SWRETURN	

```
1  IRIGX          EXTEND
2  QXCH          MPAC +2          # SAVE Q
3
4  EXTEND
5  DCS          DELVX          # PIPA PULSES X 2 +14
6  DXCH          MPAC
7  CA          ADIAX          # GYRO PULSES / PIPA PULSE X 2 -6 *
8  TC          GCOMP SUB      # - ADIAX PIPAX GYRO PULSES X 2 +14
9
10 EXTEND          #
11 DCS          DELVY          # PIPA PULSES X 2 +14
12 DXCH          MPAC          #
13 CS          ADSRAX          # GYRO PULSES / PIPA PULSE X 2 -6 *
14 TC          GCOMP SUB      # + ADSRAX PIPAY GYRO PULSES X 2 +14
15
16 #             EXTEND          # ***
17 #             DCS          DELVZ          # *** PIPA PULSES X 2 +14
18 #             DXCH          MPAC          # ***
19 #             CA          ADOAX          # *** GYRO PULSES / PIPA PULSE X 2 -6 *
20 #             TC          GCOMP SUB      # *** - ADOAX PIPAZ GYRO PULSES X 2 +14
21
22 TC          MPAC +2
23
24 IRIGY          EXTEND
25 QXCH          MPAC +2          # SAVE Q
26 EXTEND
27 DCS          DELVY          # PIPA PULSES X 2 +14
28 DXCH          MPAC
29 CA          ADIAY          # GYRO PULSES / PIPA PULSE X 2 -6 *
30 TC          GCOMP SUB      # - ADIAY PIPAY GYRO PULSES X 2 +14
31
32 EXTEND
33 DCS          DELVZ          # PIPA PULSES X 2 +14
34 DXCH          MPAC
35 CS          ADSRAY          # GYRO PULSES / PIPA PULSE X 2 -6 *
36 TC          GCOMP SUB      # + ADSRAY PIPAZ GYRO PULSES X 2 +14
37
38 #             EXTEND          # ***
39 #             DCS          DELVX          # *** PIPA PULSES X 2 +14
40 #             DXCH          MPAC          # ***
41 #             CA          ADOAY          # *** GYRO PULSES / PIPA PULSE X 2 -6 *
42 #             TC          GCOMP SUB      # *** - ADOAY PIPAX GYRO PULSES X 2 +14
43
44 TC          MPAC +2
45
46 IRIGZ          EXTEND
47 QXCH          MPAC +2          # SAVE Q
48 EXTEND
49 DCS          DELVY          # PIPA PULSES X 2 +14
50 DXCH          MPAC
51 CA          ADSRAZ          # GYRO PULSES / PIPA PULSE X 2 -6 *
```

1	2
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GCOMP SUB	XCH EXTEND	MPAC	# ADIA OR ADSRA COEFFICIENT ARRIVES IN A
			# C MPAC PIPA PULSES X 2 +14
	MP	MPAC	# GYRO PULSES / PIPA PULSE X 2 -6 *
	DXCH	VBUF	# NOW GYRO PULSES X 2 +8 *
	CA EXTEND	MPAC +1	# MINOR PART OF PIPA PULSES
	MP	MPAC	# ADIA OR ADSRA
	TS	L	
	CAF	ZERO	
	DAS	VBUF	# NOW GYRO PULSES X 2 +8 *
	CA EXTEND	VBUF	# PARTIAL RESULT - MAJOR
	MP	BIT9	# SCALE 2 +6 SHIFT RIGHT *
	INDEX	BUF	# RESULT GYRO PULSES X 2 +14
	DAS	GCOMP	# HI ADIA PIPAI OR HI ADSRA PIPAI
	CA EXTEND	VBUF +1	# PARTIAL RESULT - MINOR
	MP	BIT9	# SCALE 2 +6 SHIFT RIGHT 6 *
	TS	L	
	CAF	ZERO	
	INDEX	BUF	# RESULT GYRO PULSES X 2 +14
	DAS	GCOMP	# ADIA PIPAI OR ADSRA PIPAI
	TC	Q	

DRIFTSUB	EXTEND		
	QXCH	BUF +1	
	EXTEND		# C A NBD GYRO PULSES / CS X 2 -5
	MP	1/PIPADT	# CS X 2 +8 NOW GYRO PULSES X 2 +3
	LXCH	MPAC +1	# SAVE FOR FRACTIONAL COMPENSATION
	EXTEND		
	MP	BIT4	# SCALE 2 +11 SHIFT RIGHT 11
	INDEX	BUF	
	DAS	GCOMP	# HI NBD DELTAT GYRO PULSES X 2 +14
	CA	MPAC +1	# NOW MINOR PART
	EXTEND		
	MP	BIT4	# SCALE 2 +11 SHIFT RIGHT 11
	TS	L	
	CAF	ZERO	
	INDEX	BUF	# ADD IN FRACTIONAL COMPENSATION
	DAS	GCOMP	# NBD DELTAT GYRO PULSES X 2 +14
DRFTSUB2	CAF	TWO	# PIPAX, PIPAY, PIPAZ
	AD	BUF	
	XCH	BUF	
	INDEX	A	
	CCS	GCOMP	# ARE GYRO COMMANDS 1 PULSE OR GREATER
	TCF	+2	# YES
	TC	BUF +1	# NO
	MASK	COMPCHK	# DEC -1
	CCS	A	# ARE GYRO COMMANDS GREATER THAN 2 PULSES
	TS	GCOMP SW	# YES - SET GCOMP SW POSITIVE
	TC	BUF +1	# NO

1/GYRO	CAF TS	FOUR BUF	# PIPAZ, PIPAY, PIPAX
	INDEX CA	BUF GCOMP +1	# SCALE GYRO COMMANDS FOR IMUPULSE # FRACTIONAL PULSES
	EXTEND MP INDEX	BIT8 BUF	# SHIFT RIGHT 7
	TS	GCOMP +1	# FRACTIONAL PULSES SCALED
	CAF	ZERO	# SET GCOMP 0 FOR DAS INSTRUCTION
	INDEX XCH EXTEND	BUF GCOMP	# GYRO PULSES
	MP INDEX	BIT8 BUF	# SHIFT RIGHT 7
	DAS	GCOMP	# ADD THESE TO FRACTIONAL PULSES ABOVE
	CCS AD	BUF NEG1	# PIPAZ, PIPAY, PIPAX
LGCOMP	TCF ECADR	1/GYRO +1 GCOMP	# LESS THAN ZERO IMPOSSIBLE
	CAF TC CADR	LGCOMP BANKCALL IMUPULSE	# CALL GYRO TORQUING ROUTINE
	TC CADR TCF	BANKCALL IMUSTALL ENDOFJOB	# WAIT FOR PULSES TO GET OUT # TEMPORARY
GCOMP1	CAF TS	FOUR BUF	# PIPAZ, PIPAY, PIPAX
	INDEX CA	BUF GCOMP +1	# RESCALE
	EXTEND MP INDEX	BIT8 BUF	# SHIFT MINOR PART LEFT 7 - MAJOR PART 0
	LXCH	GCOMP +1	# BITS 8-14 OF MINOR PART WERE 0
	CCS AD	BUF NEG1	# PIPAZ, PIPAY, PIPAX
COMPCHK	TCF DEC TCF	GCOMP1 +1 -1 ENDOFJOB	# LESS THAN ZERO IMPOSSIBLE

NBDONLY	CCS	GCOMP SW	# BYPASS IF GCOMP SW NEGATIVE
	TCF	+3	
	TCF	+2	
	TCF	ENDOFJOB	
	INHINT		
	CCS	FLAGWRD2	# PREREAD T3RUPT MAY COINCIDE
	TCF	ENDOFJOB	
	TCF	ENDOFJOB	
	TCF	+1	
	CA	FLAGWRD8	# IF SURFACE FLAG IS SET, SET TEM1
	MASK	BIT8	# POSITIVE SO THAT THE ACCELERATION TERMS
	TS	TEM1	# WILL BE COMPENSATED.
	EXTEND		
	BZF	+3	# ARE WE ON THE SURFACE
	TC	IBNKCALL	# ON THE SURFACE
	CADR	PIPASR +3	# READ PIPAS, BUT DO NOT SCALE THEM
	CA	TIME1	# CS X 2 +14
	XCH	1/PIPADT	# PREVIOUS TIME
	RELINT		
	COM		
	AD	1/PIPADT	# PRESENT TIME - PREVIOUS TIME
NBD2	AD	HALF	# CORRECT FOR POSSIBLE TIME1 TICK
	AD	HALF	
	XCH	L	# IF TIME1 DID NOT TICK, REMOVE RESULTING
	XCH	L	# OVERFLOW.
NBD3	EXTEND		# C A DELTAT CS X 2 +14
	MP	BIT10	# SHIFT RIGHT 5
	DXCH	VBUF +2	
	CA	ZERO	
	TS	GCOMP SW	# INDICATE COMMANDS 2 PULSES OR LESS.
	TS	BUF	# INDEX X, Y, Z.
	CCS	TEM1	# IF SURFACE FLAG IS SET,
	TC	IRIGX	# COMPENSATE ACCELERATION TERMS.
	EXTEND		
	DCA	VBUF +2	
	DXCH	MPAC	# DELTAT NOW SCALED CS X 2 +19
	CS	NBDX	# GYRO PULSES / CS X 2 -5
	TC	FBIASSUB	# - NBDX DELTAT GYRO PULSES X 2 +14
	CCS	TEM1	# IF SURFACE FLAG IS SET,
	TC	IRIGY	# COMPENSATE ACCELERATION TERMS.

```
EXTEND
DCS      VBUF +2
DXCH     MPAC      # DELTAT SCALED  CS  X 2 +19
CA       NBDY      #  GYRO PULSES / CS  X 2 -5
TC       FBIASSUB  # - NBDY  DELTAT    GYRO PULSES  X 2 +14

CCS      TEM1      # IF SURFACE FLAG IS SET.
TC       IRIGZ     # COMPENSATE ACCELERATION TERMS

EXTEND
DCS      VBUF +2
DXCH     MPAC      # DELTAT SCALED  CS  X 2 +19
CS       NBDZ      #  GYRO PULSES / CS  X 2 -5
TC       FBIASSUB  # + NBDZ  DELTAT    GYRO PULSES  X 2 +14

CCS      GCOMPSW   # ARE GYRO COMMANDS GREATER THAN 2 PULSES
TCF      1/GYRO    # YES
TCF      ENDOFJOB  # NO
```

FBIASSUB	XCH TS	Q BUF +1	
	CA EXTEND	Q	# NBD SCALED GYRO PULSES / CS X 2 -5
	MP INDEX DAS	MPAC BUF GCOMP	# DELTAT SCALED CS X 2 +19 # HI NBD DELTAT GYRO PULSES X 2 +14
	CA EXTEND	Q	# NOW FRACTIONAL PART
	MP TS CAF	MPAC +1 L ZERO	
	INDEX DAS	BUF GCOMP	# NBD DELTAT GYRO PULSES X 2 +14
	TCF	DRFTSUB2	# CHECK MAGNITUDE OF COMPENSATION
LASTBIAS	TC CADR	BANKCALL PIPUSE1	
	CCS	GCOMP SW	
	TCF	+3	
	TCF	+2	
	TCF	ENDOFJOB	
	CA MASK TS	FLAGWRD8 SURFFBIT TEM1	# IF SURFACE FLAG IS SET, SET TEM1 # POSITIVE SO THAT THE ACCELERATION TERMS # WILL BE COMPENSATED.
	CAF	PRI031	# 2 SECONDS SCALED CS X 2 +8
	XCH COM AD	1/PIPADT PIPTIME +1	
	TCF	NBD2	
GCOMPZER	CAF	LGCOMP	# ROUTINE TO ZERO GCOMP BEFORE FIRST
	XCH TS	EBANK MODE	# CALL TO 1/PIPA
	CAF	ZERO	
	TS	GCOMP SW	
	TS	GCOMP	
	TS	GCOMP +1	
	TS	GCOMP +2	
	TS	GCOMP +3	
	TS	GCOMP +4	



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1					1
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4	TS	GCOMP +5			4
5	TCF	IRIG1	# RESTORE EBANK AND RETURN		5
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```
1  # SUBROUTINE NAME      V89CALL
2
3  # MOD NO      0      DATE      9 JAN 1968
4  # MOD BY      DIGITAL DEVEL GROUP  LOG SECTION  R63
5
6  # FUNCTIONAL DESCRIPTION
7
8  # CALLED BY VERB 89 ENTER DURING P00.  PRI0 10 USED.  CALCULATES AND
9  # DISPLAYS FINAL FDAI BALL ANGLES TO POINT LM +X OR +Z AXIS AT CSM.
10
11 #
12 # 1. KEY IN V 89 E ONLY IF IN PROG 00.  IF NOT IN P00, OPERATOR ERROR AND
13 # EXIT R63, OTHERWISE CONTINUE.
14
15 #
16 # 2. IF IN P00, DO IMU STATUS CHECK ROUTINE  R02BOTH .  IF IMU ON AND ITS
17 # ORIENTATION KNOWN TO LGC, CONTINUE.
18
19 #
20 # 3. FLASH DISPLAY V 04 N 06.  R2 INDICATES WHICH SPACECRAFT AXIS IS TO
21 # BE POINTED AT CSM.  INITIAL CHOICE IS PREFERRED  +Z  AXIS  R2 1 .
22 # ASTRONAUT CAN CHANGE TO  +X  AXIS  R2 NOT  1  BY V 22 E 2 E.  CONTINUE
23 # AFTER KEYING IN PROCEED.
24
25 #
26 # 4. BOTH VEHICLE STATE VECTORS UPDATED BY CONIC EQS.
27
28 #
29 # 5. HALF MAGNITUDE UNIT LOS VECTOR  IN STABLE MEMBER COORDINATES  AND
30 # HALF MAGNITUDE UNIT SPACECRAFT AXIS VECTOR  IN BODY COORDINATES
31 # PREPARED FOR VECPOINT.
32
33 #
34 # 6. GIMBAL ANGLES FROM VECPOINT TRANSFORMED INTO FDAI BALL ANGLES BY
35 # BALLANGS.  FLASH DISPLAY V 06 N 18 AND AWAIT RESPONSE.
36
37 #
38 # 7. RECYCLE - RETURN TO STEP 4.
39 #   TERMINATE - EXIT R63.
40 #   PROCEED - RESET 3AXISFLG AND CALL R60LEM FOR ATTITUDE MANEUVER.
41
42 #
43 # CALLING SEQUENCE      V 89 E.
44
45 #
46 # SUBROUTINES CALLED      CHKPOOH, R02BOTH, GOXDSPF, CSMCONIC, LEMCONIC,
47 #                          VECPOINT, BALLANGS, R60LEM.
48
49 #
50 # NORMAL EXIT MODES      TC ENDEXT
51
52 #
53 # ALARMS      1. OPERATOR ERROR IF NOT IN P00.
54 #              2. PROGRAM ALARM IF IMU IS OFF.
55 #              3. PROGRAM ALARM IF IMU ORIENTATION IS UNKNOWN.
56
57 #
58 # OUTPUT      NONE
59
60 #
61 # ERASABLE INITIALIZATION REQUIRED      NONE
62
63 #
64 # DEBRIS      OPTION1, +1, TDEC1, PDINTVSM, SCAXIS, CPHI, CTHETA, CPSI,
```

```
1  #
2  3AXISFLG.
3
4  EBANK  RONE
5  BANK   32
6  SETLOC BAWLANGS
7  BANK
8
9  COUNT* $$/R63
10 V89CALL TC  BANKCALL      # IMU STATUS CHECK. RETURNS IF ORIENTATION
11        CADR  R02BOTH      # KNOWN. ALARMS IF NOT.
12        CAF   THREE        # ALLOW ASTRONAUT TO SELECT DESIRED
13        TS    OPTIONX      # TRACKING ATTITUDE AXIS.
14        CAF   ONE
15        TS    OPTIONX +1
16        CAF   VB04N12      # V 04 N 12
17        TC    BANKCALL
18        CADR  GOFLASH
19        TC    ENDEXT        # TERMINATE
20        TC    +2            # PROCEED
21        TC    -5            # DATA IN.  OPTION1+1  1 FOR Z AXIS
22 V89RECL TC    INTPRET      #
23        RTB   DAD           #
24        LOADTIME          # READ PRESENT TIME
25        DP1MIN
26        STORE TSTART82      # SAVE TIME FOR LEMCONIC CALL
27        STCALL TDEC1        # STORE TIME FOR CSMCONIC CALL
28        CSMCONIC          # CSM STATE VECTOR UPDATE
29        VLOAD             # CSMCONIC LEFT R VECTOR IN RATT
30        RATT
31        STODL RONE          # SAVE FOR LINE OF SIGHT  LOS  COMPUTATION
32        TSTART82
33        STCALL TDEC1        # STORE TIME FOR LEMCONIC CALL
34        LEMCONIC          # LEM STATE VECTOR UPDATE
35        VLOAD VSU          # CSM POSITION - LEM POSITION  LOS
36        RONE              # LOS VECTOR LEFT IN MPAC
37        RATT
38        MXV   RTB          # REFSMAT X LOS . TRANSFORMS LOS FROM
39        REFSMMAT          # REFERENCE COORD TO STAB MEMB COORD.
40        NORMUNIT
41        STORE POINTVSM     # STORE LOS FOR VECPOINT CALCULATION
42        EXIT
43        CS    OPTIONX +1    # 1 FOR Z AXIS.  2 FOR X AXIS.
44        AD    ONE
45        EXTEND
46        BZF   ALINEZ
47        TC    INTPRET      # X AXIS ALIGNMENT
48        VLOAD
49        UNITX              # READ  .5, 0, 0
```

1	V89CALL1	STCALL	SCAXIS	# STORE SELECTED ALIGNMENT AXIS
2			VECPOINT	# PUTS DESIRED GIM ANG OG,IG,MG IN TMPAC
3		STORE	CPHI	# STORE GIMBAL ANGLES FOR BALLANGS CALL.
4		EXIT		
5		TC	BANKCALL	
6		CADR	BALLANGS	# PUTS DESIRED BALL ANGLE IN FDAIX,Y,Z
7		CAF	VB06N18	# V 06 N 18
8		TC	BANKCALL	# NOUN 18 REFERS TO FDAIX,Y,Z
9		CADR	GOFLASH	
10		TC	ENDEXT	# TERMINATE
11		TC	+2	# PROCEED
12		TC	V89RECL	# RECYCLE
13		TC	DOWNFLAG	# RESET 3 AXIS FLAG
14		ADRES	3AXISFLG	# RESET BIT6 FLAG WORD 5
15		TC	BANKCALL	# PERFORMS LEM MANEUVER TO ALIGN SELECTED
16		CADR	R60LEM	# SPACECRAFT AXIS TO CSM.
17		TCF	ENDEXT	# TERMINATE R63
18	ALINEZ	TC	INTPRET	# Z AXIS ALIGNMENT
19		VLOAD	GOTO	
20			UNITZ	# READ 0, 0, .5
21			V89CALL1	
22	VB04N12	VN	412	
23	VB06N18	VN	0618	
24				
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R63

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1	DP1MIN			2DEC	6000	1
2						2
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5						5
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BLOCK 2 LGC ATTITUDE MANEUVER ROUTINE -- KALCMANU

MOD 2 DATE 5/1/67 BY DON KEENE

PROGRAM DESCRIPTION

KALCMANU IS A ROUTINE WHICH GENERATES COMMANDS FOR THE LM DAP TO CHANGE THE ATTITUDE OF THE SPACECRAFT DURING FREE FALL. IT IS DESIGNED TO MANEUVER THE SPACECRAFT FROM ITS INITIAL ORIENTATION TO SOME DESIRED ORIENTATION SPECIFIED BY THE PROGRAM WHICH CALLS KALCMANU, AVOIDING GIMBAL LOCK IN THE PROCESS. IN THE MOD 2 VERSION, THIS DESIRED ATTITUDE IS SPECIFIED BY A SET OF OF THREE COMMANDED CDU ANGLES STORES AS 2 S COMPLEMENT SINGLE PRECISION ANGLES IN THE THREE CONSECUTIVE LOCATIONS, CPHI, CTHETA, CPSI, WHERE

CPHI COMMANDED OUTER GIMBAL ANGLE
CTHETA COMMANDED INNER GIMBAL ANGLE
CPSI COMMANDED MIDDLE GIMBAL ANGLE

WHEN POINTING A SPACECRAFT AXIS I.E., X, Y, Z, THE AOT, THRUST AXIS, ETC. THE SUBROUTINE VECPOINT MAY BE USED TO GENERATE THIS SET OF DESIRED CDU ANGLES SEE DESCRIPTION IN R60 .

WITH THIS INFORMATION KALCMANU DETERMINES THE DIRECTION OF THE SINGLE EQUIVALENT ROTATION COF ALSO U AND THE MAGNITUDE OF THE ROTATION AM TO BRING THE S/C FROM ITS INITIAL ORIENTATION TO ITS FINAL ORIENTATION. THIS DIRECTION REMAINS FIXED BOTH IN INERTIAL COORDINATES AND IN COMMANDED S/C AXES THROUGHOUT THE

MANEUVER. ONCE COF AND AM HAVE BEEN DETERMINED, KALCMANU THEN EXAMINES THE MANEUVER TO SEE IF IT WILL BRING THE S/C THROUGH GIMBAL LOCK. IF SO, COF AND AM ARE READJUSTED SO THAT THE S/C WILL JUST SKIM THE GIMBAL LOCK ZONE AND ALIGN THE X-AXIS. IN GENERAL A FINAL YAW ABOUT X WILL BE NECESSARY TO COMPLETE THE MANEUVER. NEEDLESS TO SAY, NEITHER THE INITIAL NOR THE FINAL ORIENTATION CAN BE IN GIMBAL LOCK.

FOR PROPER ATTITUDE CONTROL THE DIGITAL AUTOPILOT MUST BE GIVEN AN ATTITUDE REFERENCE WHICH IT CAN TRACK. KALCMANU DOES THIS BY GENERATING A REFERENCE OF DESIRED GIMBAL ANGLES CDUXD, CDUYD, CDUZD WHICH ARE UPDATED EVERY ONE SECOND DURING THE MANEUVER. TO ACHIEVE A SMOOTHER SEQUENCE OF COMMANDS BETWEEN SUCCESSIVE UPDATES, THE PROGRAM ALSO GENERATES A SET OF INCREMENTAL CDU ANGLES DELDCDU TO BE ADDED TO CDU DESIRED BY THE DIGITAL AUTOPILOT. KALCMANU ALSO CALCULATES THE COMPONENT MANEUVER RATES OMEGAPD, OMEGAQD, OMEGARD , WHICH CAN

BE DETERMINED SIMPLY BY MULTIPLYING COF BY SOME SCALAR ARATE CORRESPONDING TO THE DESIRED ROTATIONAL RATE.

AUTOMATIC MANEUVERS ARE TIMED WTH THE HELP OF WAITLIST SO THAT AFTER A SPECIFIED INTERVAL THE Y AND Z DESIRED RATES ARE SET TO ZERO AND THE DESIRED CDU ANGLES CDUYD, CDUZD ARE SET EQUAL TO THE FINAL DESIRED CDU ANGLES CTHETA, CPSI . IF ANY YAW REMAINS DUE TO GIMBAL LOCK AVOIDANCE, THE FINAL YAW MANEUVER IS CALCULATED AND THE DESIRED YAW RATE SET TO SOME FIXED VALUE ROLLRATE + OR - 2 DEGREES PER SEC . IN THIS CASE ONLY AN INCREMENTAL CDUX ANGLE DELFROLL IS SUPPLIED TO THE DAP. AT THE END OF THE YAW MANEUVER OR IN THE EVENT THAT THERE WAS NO FINAL YAW, CDUXD IS SET EQUAL TO CPHI AND THE X-AXIS DESIRED RATE SET TO ZERO. THUS, UPON COMPLETION OF THE MANEUVER THE S/C WILL FINISH UP IN A LIMIT CYCLE ABOUT THE DESIRED GIMBAL ANGLES.

PROGRAM LOGIC FLOW

KALCMANU IS CALLED AS A HIGH PRIORITY JOB WITH ENTRY POINTS AT KALCMAN3 AND VECPOINT. IT FIRST PICKS UP THE CURRENT CDU ANGLES TO BE USED AS THE BASIS FOR ALL COMPUTATIONS INVOLVING THE INITIAL S/C ORIENTATION.


```
1 # IT THEN DETERMINES THE DIRECTION COSINE MATRICES RELATING BOTH THE INITIAL AND FINAL S/C ORIENTATION TO STABLE
2 #
3 # * * *
4 # MEMBER AXES MIS,MFS . IT ALSO COMPUTES THE MATRIX RELATING FINAL S/C AXES TO INITIAL S/C AXES MFI . THE
5 # ANGLE OF ROTATION AM IS THEN EXTRACTED FROM THIS MATRIX, AND TEST ARE MADE TO DETERMINE IF
6 #
7 # A AM LESS THAN .25 DEGREES MINANG
8 # B AM GREATER THAN 170 DEGREES MAXANG
9 #
10 # IF AM IS LESS THAN .25 DEGREES, NO COMPLICATED AUTOMATIC MANEUVERING IS NECESSARY. THEREFORE, WE CAN SIMPLY
11 # SET CDU DESIRED EQUAL TO THE FINAL CDU DESIRED ANGLES AND TERMINATE THE JOB.
12 #
13 # IF AM IS GREATER THAN .25 DEGREES BUT LESS THAN 170 DEGREES THE AXES OF THE SINGLE EQUIVALENT ROTATION
14 # *
15 # COF IS EXTRACTED FROM THE SKEW SYMMETRIC COMPONENTS OF MFI.
16 #
17 # IF AM GREATER THAN 170 DEGREES AN ALTERNATE METHOD EMPLOYING THE SYMMETRIC PART OF MFI MFSYM IS USED
18 #
19 # TO DETERMINE COF.
20 #
21 # THE PROGRAM THEN CHECKS TO SEE IF THE MANEUVER AS COMPUTED WILL BRING THE S/C THROUGH GIMBAL LOCK. IF
22 # SO, A NEW MANEUVER IS CALCULATED WHICH WILL JUST SKIM THE GIMBAL LOCK ZONE AND ALIGN THE S/C X-AXIS. THIS
23 # METHOD ASSURES THAT THE ADDITIONAL MANEUVERING TO AVOID GIMBAL LOCK WILL BE KEPT TO A MINIMUM. SINCE A FINAL
24 # P AXIS YAW WILL BE NECESSARY, A SWITCH IS RESET STATE SWITCH 31 TO ALLOW FOR THE COMPUTATION OF THIS FINAL
25 # YAW.
26 #
27 # AS STATED PREVIOUSLY, KALCMANU GENERATES A SEQUENCE OF DESIRED GIMBAL ANGLES WHICH ARE UPDATED EVERY
28 #
29 # SECOND. THIS IS ACCOMPLISHED BY A SMALL ROTATION OF THE DESIRED S/C FRAME ABOUT THE VECTOR COF. THE NEW
30 # DESIRED REFERENCE MATRIX IS THEN,
31 # * * *
32 # MIS MIS DEL
33 # N+1 N
34 # *
35 # WHERE DEL IS THE MATRIX CORRESPONDING TO THIS SMALL ROTATION. THE NEW CDU ANGLES CAN THEN BE EXTRACTED
36 # *
37 # FROM MIS.
38 #
39 # AT THE BEGINNING OF THE MANEUVER THE AUTOPILOT DESIRED RATES OMEGAPD, OMEGAQD, OMEGARD AND THE
40 # MANEUVER TIMINGS ARE ESTABLISHED. ON THE FIRST PASS AND ON ALL SUBSEQUENT UPDATES THE CDU DESIRED
41 # ANGLES ARE LOADED WITH THE APPROPRIATE VALUES AND THE INCREMENTAL CDU ANGLES ARE COMPUTED. THE AGC CLOCKS
42 # TIME1 AND TIME2 ARE THEN CHECKED TO SEE IF THE MANEUVER WILL TERMINATE BEFORE THE NEXT UPDATE. IF
43 # NOT, KALCMANU CALLS FOR ANOTHER UPDATE RUN AS A JOB WITH PRIORITY TBD IN ONE SECOND. ANY DELAYS IN THIS
44 # CALLING SEQUENCE ARE AUTOMATICALLY COMPENSATED IN CALLING FOR THE NEXT UPDATE.
45 #
46 # IF IT IS FOUND THAT THE MANEUVER IS TO TERMINATE BEFORE THE NEXT UPDATE A ROUTINE IS CALLED AS A WAIT-
47 # LIST TASK TO STOP THE MANEUVER AT THE APPROPRIATE TIME AS EXPLAINED ABOVE.
```


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SUCCESSFULLY, OR AT L+2 IF THE MANEUVER WAS ABORTED. THIS ABORT WOULD OCCUR IF THE INITIAL OR FINAL ATTITUDE

4

#

#

44

#

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#

#

44

```
1  #
2  #
3  # INDEX REGISTER X1 MUST BE LOADED WITH THE COMPLEMENT OF THE STARTING ADDRESS FOR M1, AND X2 MUST BE
4  #
5  # LOADED WITH THE COMPLEMENT OF THE STARTING ADDRESS FOR M2. THE ROUTINE USES THE FIRST 20 LOCATIONS OF THE PUSH
6  # DOWN LIST. THE FIRST ELEMENT OF THE MATRIX APPEARS IN PDO. PUSH UP FOR M .
7  #
8  # TRANSPOS
9  # -----
10 #
11 # THIS ROUTINE TRANSPOSES A 3X3 MATRIX AND LEAVES THE RESULT IN THE PUSH DOWN LIST, I.E.,
12 #
13 #      *      * T
14 #      M      M1
15 #
16 # INDEX REGISTER X1 MUST CONTAIN THE COMPLEMENT OF THE STARTING ADDRESS FOR M1. PUSH UP FOR THE FIRST AND SUB-
17 #
18 # SEQUENT COMPONENTS OF M. THIS SUBROUTINE ALSO USES THE FIRST 20 LOCATIONS OF THE PUSH DOWN LIST.
19 #
20 # CDU TO DCM
21 # -----
22 #
23 # THIS SUBROUTINE CONVERTS THREE CDU ANGLES IN T MPAC TO A DIRECTION COSINE MATRIX SCALED BY 2 RELATING
24 # THE CORRESPONDING S/C ORIENTATIONS TO THE STABLE MEMBER FRAME. THE FORMULAS FOR THIS CONVERSION ARE
25 #
26 #      M      COSY COSZ
27 #      0
28 #
29 #      M      -COSY SINZ COSX + SINY SINX
30 #      1
31 #
32 #      M      COSY SINZ SINX + SINY COSX
33 #      2
34 #
35 #      M      SINZ
36 #      3
37 #
38 #      M      COSZ COSX
39 #      4
40 #
41 #      M      -COSZ SINX
42 #      5
43 #
44 #      M      -SINY COSZ
45 #      6
46 #
47 #      M      SINY SINZ COSX + COSY SINX
48 #      7
49
50
51
52
53
54
55
56
57
58
59
60
```

```
#      M      -SINY SINZ SINX + COSY COSX
#      B
```

```
# WHERE      X      OUTER GIMBAL ANGLE
#            Y      INNER GIMBAL ANGLE
#            Z      MIDDLE GIMBAL ANGLE
```

THE INTERPRETATION OF THIS MATRIX IS AS FOLLOWS

```
# IF A , A , A REPRESENT THE COMPONENTS OF A VECTOR IN S/C AXES THEN THE COMPONENTS OF THE SAME VECTOR IN
# X Y Z
```

```
# STABLE MEMBER AXES B , B , B ARE
# X Y Z
```

```
#      B      A
#      X      X
```

```
#      B      *      A
#      Y      M      Y
```

```
#      B      B
#      Z      Z
```

```
# THE SUBROUTINE WILL STORE THIS MATRIX IN SEQUENTIAL LOCATIONS OF ERASABLE MEMORY AS SPECIFIED BY THE CALLING
# PROGRAM. TO DO THIS THE CALLING PROGRAM MUST FIRST LOAD X2 WITH THE COMPLEMENT OF THE STARTING ADDRESS FOR M.*
```

```
# INTERNALLY, THE ROUTINE USES THE FIRST 16 LOCATIONS OF THE PUSH DOWN LIST, ALSO STEP REGISTER S1 AND INDEX
# REGISTER X2.
```

DCM TO CDU

```
# THIS ROUTINE EXTRACTS THE CDU ANGLES FROM A DIRECTION COSINE MATRIX M SCALED BY 2 RELATING S/C AXIS TO
# STABLE MEMBER AXES. X1 MUST CONTAIN THE COMPLEMENT OF THE STARTING ADDRESS FOR M. THE SUBROUTINE LEAVES THE
# CORRESPONDING GIMBAL ANGLES IN V MPAC AS DOUBLE PRECISION 1 S COMPLEMENT ANGLES SCALED BY 2PI. THE FORMULAS
# FOR THIS CONVERSION ARE
```

```
#      Z      ARCSIN M
#            3
```

```
#      Y      ARCSIN -M /COSZ
#            6
```

```
# IF M IS NEGATIVE, Y IS REPLACED BY PI SGN Y - Y.
# 0
```

X ARCSIN -M /COSZ
5

IF M IS NEGATIVE, X IS REPLACED BY PI SGN X - X.
4

THIS ROUTINE DOES NOT SET THE PUSH DOWN POINTER, BUT USES THE NEXT 8 LOCATIONS OF THE PUSH DOWN LIST AND
RETURNS THE POINTER TO ITS ORIGINAL SETTING. THIS PROCEDURE ALLOWS THE CALLER TO STORE THE MATRIX AT THE TOP OF
THE PUSH DOWN LIST.

DELCOMP

THIS ROUTINE COMPUTES THE DIRECTION COSINE MATRIX DEL RELATING ON

IS ROTATED WITH RESPECT TO THE FIRST BY AN ANGLE, A, ABOUT A UNIT VECTOR U. THE FORMULA FOR THIS MATRIX IS

* * T *
DEL I COSA + U U 1 - COSA + V SINA
X

WHERE *
I 1 0 0
0 1 0
0 0 1

2
U U U U
X X Y X Z

U T
U U U 2
Y X Y Y Z

2
U U U
Z X Z Y Z

0 -U U
Z Y

*
V U 0 -U
X Z X

-U U 0
Y X

```
#
#          U          UNIT ROTATION VECTOR RESOLVED INTO S/C AXES.
#          A          ROTATION ANGLE
#
#          *
# THE INTERPRETATION OF DEL IS AS FOLLOWS
#
# IF A , A , A  REPRESENT THE COMPONENTS OF A VECTOR IN THE ROTATED FRAME, THEN THE COMPONENTS OF THE SAME
#   X   Y   Z
# VECTOR IN THE ORIGINAL S/C AXES  B , B , B  ARE
#                                     X   Y   Z
#
#          B          A
#          X          X
#
#          B          *          A
#          Y          DEL        Y
#
#          B          B
#          Z          Z
#
# THE ROUTINE WILL STORE THIS MATRIX  SCALED UNITY  IN SEQUENTIAL LOCATIONS OF ERASABLE MEMORY BEGINNING WITH
#
# THE LOCATION CALLED DEL.  IN ORDER TO USE THE ROUTINE, THE CALLING PROGRAM MUST FIRST STORE U  A HALF UNIT
# DOUBLE PRECISION VECTOR  IN THE SET OF ERASABLE LOCATIONS BEGINNING WITH THE ADDRESS CALLED COF.  THE ANGLE, A,
# MUST THEN BE LOADED INTO D MPAC .
#
# INTERNALLY, THE PROGRAM ALSO USES THE FIRST 10 LOCATIONS OF THE PUSH DOWN LIST.
#
# READCDUK
# -----
#
# THIS BASIC LANGUAGE SUBROUTINE LOADS T MPAC  WITH THE THREE CDU ANGLES.
#
# SIGNMPAC
# -----
#
# THIS IS A BASIC LANGUAGE SUBROUTINE WHICH LIMITS THE MAGNITUDE OF D MPAC  TO + OR - DPOS MAX ON OVERFLOW.
#
# PROGRAM STORAGE ALLOCATION
#
#   1      FIXED MEMORY      1059 WORDS
#   2      ERASABLE MEMORY    98
#   3      STATE SWITCHES     3
```

4 FLAGS 1

JOB PRIORITIES

1 KALCMANU TBD
2 ONE SECOND UPDATE TBD

SUMMARY OF STATE SWITCHES AND FLAGWORDS USED BY KALCMANU.

STATE SWITCH NO.	FLAGWRD 2 BIT NO.	SETTING	MEANING
* 31 14 0 MANEUVER WENT THROUGH GIMBAL LOCK 1 MANEUVER DID NOT GO THROUGH GIMBAL LOCK			
* 32 13 0 CONTINUE UPDATE PROCESS 1 START UPDATE PROCESS			
33 12 0 PERFORM FINAL P AXIS YAW IF REQUIRED 1 IGNORE ANY FINAL P-AXIS YAW			
34 11 0 SIGNAL END OF KALCMANU 1 KALCMANU IN PROCESS. USER MUST SET SWITCH BEFORE INITIATING			
* INTERNAL TO KALCMANU			

SUGGESTIONS FOR PROGRAM INTEGRATION

THE FOLLOWING VARIABLES SHOULD BE ASSIGNED TO UNSWITCH ERASABLE

CPHI
CTHETA
CPSI
POINTVSM +5
SCAXIS +5
DELDCDU
DELDCDU1
DELDCDU2
RATEINDX

THE FOLLOWING SUBROUTINES MAY BE PUT IN A DIFFERENT BANK

MXM3

#	TRANSPGS
#	SIGNMPAC
#	READCDUK
#	CDUTODCM

```
1 BANK 15
2 SETLOC KALCMON1
3 BANK
4
5 EBANK BCDU
6
7 # THE THREE DESIRED CDU ANGLES MUST BE STORED AS SINGLE PRECISION TWO S COMPLEMENT ANGLES IN THE THREE SUCCESSIVE
8 # LOCATIONS, CPHI, CTHETA, CPSI.
9
10
11 KALCMAN3 COUNT* $$/KALC
12 TC INTPRET # PICK UP THE CURRENT CDU ANGLES AND
13 RTB # COMPUTE THE MATRIX FROM INITIAL S/C
14 READCDUK # AXES TO FINAL S/C AXES.
15 STORE BCDU # STORE INITIAL S/C ANGLES
16 SLOAD ABS # CHECK THE MAGNITUDE OF THE DESIRED
17 CPSI # MIDDLE GIMBAL ANGLE
18 DSU BPL
19 LOCKANGL # IF GREATER THAN 70 DEG ABORT MANEUVER
20 TOOBADF
21 AXC,2 TLOAD
22 MIS
23 BCDU
24 CALL # COMPUTE THE TRANSFORMATION FROM INITIAL
25 CDUTODCM # S/C AXES TO STABLE MEMBER AXES
26 AXC,2 TLOAD
27 MFS # PREPARE TO CALCULATE ARRAY MFS
28 CPHI
29 CALL
30 CDUTODCM
31 SECAD AXC,1 CALL # MIS AND MFS ARRAYS CALCULATED $2
32 MIS
33 TRANSPOS
34 VLOAD STADR
35 STOVL TMIS +12D
36 STADR
37 STOVL TMIS +6
38 STADR
39 STORE TMIS # TMIS TRANSPOSE MIS SCALED BY 2
40 AXC,1 AXC,2
41 TMIS
42 MFS
43 CALL
44 MXM3
45 VLOAD STADR
46 STOVL MFI +12D
47 STADR
48 STOVL MFI +6
49 STADR
50 STORE MFI # MFI TMIS MFS SCALED BY 4
51 SETPD CALL # TRANSPOSE MFI IN PD LIST
```

```
1
2      18D
3      TRNSPSPD
4      VLOAD  STADR
5      STOVL  TMFI    +12D
6      STADR
7      STOVL  TMFI    +6
8      STADR
9      STORE  TMFI          # TMFI  TRANPOSE  MFI  SCALED BY 4
10
11 # CALCULATE COFSKEW AND MFISYM
12
13      DLOAD  DSU
14      TMFI    +2
15      MFI     +2
16      PDDL   DSU          # CALCULATE COF SCALED BY 2/SIN AM
17      MFI     +4
18      TMFI    +4
19      PDDL   DSU
20      TMFI    +10D
21      MFI     +10D
22      VDEF
23      STORE  COFSKEW      # EQUALS MFISKEW
24
25 # CALCULATE AM AND PROCEED ACCORDING TO ITS MAGNITUDE
26
27      DLOAD  DAD
28      MFI
29      MFI     +16D
30      DSU    DAD
31      DP1/4TH
32      MFI     +8D
33      STORE  CAM          # CAM  MF10+MF14+MF18-1 /2 HALF SCALE
34      ARCCOS
35      STORE  AM          # AM ARCCOS CAM      AM SCALED BY 2
36      DSU    BPL
37      MINANG
38      CHECKMAX
39      TLOAD          # MANEUVER LESS THAN .25 DEGREES
40      CPHI          # GO DIRECTLY INTO ATTITUDE HOLD
41      STCALL  CDUXD     # ABOUT COMMANDED ANGLES
42      TOOBADI     # STOP RATE AND EXIT
43
44 CHECKMAX      DLOAD  DSU
45               AM
46               MAXANG
47      BPL      VLOAD
48               ALTALC    # UNIT
49               COFSKEW   # COFSKEW
50      UNIT
51      STORE  COF        # COF IS THE MANEUVER AXIS
52
53
54
55
56
57
58
59
60
```

```
1      GOTO          # SEE IF MANEUVER GOES THRU GIMBAL LOCK
2
3      LOCASKIRT
4  ALTALC  VLOAD  VAD      # IF AM GREATER THAN 170 DEGREES
5          MFI
6          TMFI
7
8      VSR1
9      STOVL  MFISYM
10         MFI      +6
11
12         VAD      VSR1
13         TMFI     +6
14         STOVL  MFISYM +6
15
16         VAD      VSR1
17         TMFI     +12D
18
19         STORE  MFISYM +12D  # MFISYM  MFI+TMFI /2   SCALED BY 4
20
21  # CALCULATE COF
22
23      DLOAD  SR1
24      CAM
25
26      PDDL  DSU      # PDO CAM          $4
27      DPHALF
28      CAM
29
30      BOVB  PDDL      # PS2 1 - CAM      $2
31      SIGNMPAC
32      MFISYM +16D
33
34      DSU    DDV
35      0
36      2
37
38      SQRT  PDDL      # COFZ  SQRT MFISYM8-CAM / 1-CAM
39      MFISYM +8D      #          $ ROOT 2
40      DSU    DDV
41      0
42      2
43
44      SQRT  PDDL      # COFY  SQRT MFISYM4-CAM / 1-CAM  $ROOT2
45      MFISYM
46
47      DSU    DDV
48      0
49      2
50
51      SQRT  VDEF      # COFX  SQRT MFISYM-CAM / 1-CAM  $ROOT 2
52      UNIT
53
54      STORE  COF
55
56  # DETERMINE LARGEST COF AND ADJUST ACCORDINGLY
57
58  COFMAXGO  DLOAD  DSU
59             COF
60
61             COF      +2
62             BMN      DLOAD      # COFY G COFX
```

1		COMP12		
2		COF		
3				
4	DSU	BMN		
5		COF	+4	
6		METHOD3		# COFZ G COFX OR COFY
7	GOTO			
8		METHOD1		# COFX G COFY OR COFZ
9	COMP12	DLOAD	DSU	
10		COF	+2	
11		COF	+4	
12	BMN			
13		METHOD3		# COFZ G COFY OR COFX
14				
15	METHOD2	DLOAD	BPL	# COFY MAX
16		COFSKEW	+2	# UY
17		U2POS		
18	VLOAD	VCOMP		
19		COF		
20	STORE	COF		
21	U2POS	DLOAD	BPL	
22		MFISYM	+2	# UX UY
23		OKU21		
24	DLOAD	DCOMP		# SIGN OF UX OPPOSITE GARBLED
25		COF		
26	STORE	COF		
27	OKU21	DLOAD	BPL	
28		MFISYM	+10D	# UY UZ
29		LOCSKIRT		
30	DLOAD	DCOMP		# SIGN OF UZ OPPOSITE TO UY
31		COF	+4	
32	STORE	COF	+4	
33	GOTO			
34		LOCSKIRT		
35	METHOD1	DLOAD	BPL	# COFX MAX
36		COFSKEW		# UX
37		UIPOS		
38	VLOAD	VCOMP		
39		COF		
40	STORE	COF		
41	UIPOS	DLOAD	BPL	
42		MFISYM	+2	# UX UY
43		OKU12		
44	DLOAD	DCOMP		
45		COF	+2	# SIGN OF UY OPPOSITE TO UX
46	STORE	COF	+2	
47	OKU12	DLOAD	BPL	
48		MFISYM	+4	# UX UZ
49		LOCSKIRT		
50	DLOAD	DCOMP		# SIGN OF UZ OPPOSITE TO UY
51		COF	+4	
52				
53				
54				
55				
56				
57				
58				
59				
60				

1	2
---	---

MATRIX OPERATIONS

BANK 13
SETLOC KALCMON2
BANK

EBANK BCDU

MXM3 SETPD VLOAD* # MXM3 MULTIPLIES 2 3X3 MATRICES
0 # AND LEAVES RESULT IN PD LIST
0,1 # AND MPAC

VXM* PDVL*
0,2
6,1

VXM* PDVL*
0,2
12D,1

VXM* PUSH
0,2

RVQ

RETURN WITH MIXM2 IN PD LIST

TRANSPOS SETPD VLOAD* # TRANSPOS TRANSPOSES A 3X3 MATRIX
0 # AND LEAVES RESULT IN PD LIST
0,1 # MATRIX ADDRESS IN XR1

PDVL* PDVL*
6,1
12D,1

TRNSPSPD PUSH # MATRIX IN PD
EXIT # ENTER WITH MATRIX AT 0 IN PD LIST

INDEX FIXLOC

DXCH 12

INDEX FIXLOC

DXCH 16

INDEX FIXLOC

DXCH 12

INDEX FIXLOC

DXCH 14

INDEX FIXLOC

DXCH 4

INDEX FIXLOC

DXCH 14

INDEX FIXLOC

DXCH 2

INDEX FIXLOC

DXCH 6

INDEX FIXLOC

DXCH 2

```
1
2      TC      INTPRET
3      RVQ
4
5      BANK    15
6      SETLOC  KALCMON1
7      BANK
8
9      EBANK    BCDU
10
11     MINANG    2DEC    0.00069375
12
13     MAXANG    2DEC    0.47222222
14
15     # GIMBAL LOCK CONSTANTS
16
17     # D      MGA CORRESPONDING TO GIMBAL LOCK    60 DEGREES
18     #      NGL    BUFFER ANGLE  TO AVOID DIVISIONS BY ZERO    2 DEGREES
19
20     SD        2DEC    .433015      #    SIN D                $2
21
22     K3S1      2DEC    .86603      #    SIN D                $1
23
24     K4        2DEC    -.25        #    -COS D            $2
25
26     K4SQ      2DEC    .125        #    COS D COS D      $2
27
28     SNGLCD    2DEC    .008725     #    SIN NGL COS D    $2
29
30     CNGL      2DEC    .499695     #    COS NGL          $2
31
32     LOCKANGL  DEC      .388889     #    70 DEGREES
33
34     # INTERPRETIVE SUBROUTINE TO READ THE CDU ANGLES
35
36     READCDUK   CA      CDUZ      # LOAD T MPAC  WITH CDU ANGLES
37               TS      MPAC      +2
38               EXTEND
39               DCA      CDUX      # AND CHANGE MODE TO TRIPLE PRECISION
40               TCF      TLOAD     +6
41
42     CDUTODCM   AXT,1    SSP
43               OCT      3
44               S1
45               OCT      1          # SET XR1, S1, AND PD FOR LOOP
46               STORE    7
47               SETPD
48               0
49     LOOPSIN    SLOAD*   RTB
50               10D,1
51               CDULOGIC
```

```
1      STORE 10D      # LOAD PD WITH 0 SIN PHI
2      SIN   PDDL      #                2 COS PHI
3
4      COS   10D      #                4 SIN THETA
5      TIX,1 PUSH      #                6 COS THETA
6      DLOAD DLOAD      #                8 SIN PSI
7      LOOPSIN      #                10 COS PSI
8      6
9      DMP SL1
10
11     STORE 10D
12     DLOAD 0,2      # C0  COS THETA COS PSI
13     DMP
14     4
15     PDDL 0
16     DMP      # PD6 SIN THETA SIN PHI
17     6
18     DMP 8D
19     SL1
20     2
21     BDSU SL1
22     12D
23     STORE 2,2      # C1 -COS THETA SIN PSI COS PHI
24     DLOAD DMP
25     2
26     PDDL 4
27     DMP      # PD7 COS PHI SIN THETA  SCALED 4
28     6
29     DMP 8D
30     SL1
31     0
32     DAD SL1
33     14D
34     STORE 4,2      # C2 COS THETA SIN PSI SIN PHI
35     DLOAD
36     8D
37     STORE 6,2      # C3 SIN PSI
38     DLOAD
39     10D
40     DMP SL1
41     2
42     STORE 8D,2      # C4 COS PSI COS PHI
43     DLOAD DMP
44     10D
45     0
46     DCOMP SL1
47     STORE 10D,2      # C5 -COS PSI SIN PHI
48     DLOAD DMP
49     4
50     DCOMP 10D
51     STORE SL1      # C6 -SIN THETA COS PSI
52     12D,2
```

```
1      DLOAD
2      DMP      SL1      # PUSH UP 7
3
4      PDDL      8D
5      DMP      # PD7 COS PHI SIN THETA SIN PSI SCALE 4
6      6
7
8      DAD      SL1      # PUSH UP 7
9      STADR      # C7 COS PHI SIN THETA SIN PSI
10     STORE      14D,2    # +COS THETA SIN PHI
11     DLOAD
12     DMP      SL1      # PUSH UP 6
13     8D
14     PDDL      DMP      # PD6 SIN THETA SIN PHI SIN PSI SCALE 4
15     6
16
17     DSU      SL1      # PUSH UP 6
18     STADR
19     STORE      16D,2    # C8 -SIN THETA SIN PHI SIN PSI
20     RVQ      # +COS THETA COS PHI
```

CALCULATION OF THE MATRIX DEL.....

```
23 #
24 #      *      *      T      *
25 #      DEL      IDMATRIX COS A +UU 1-COS A +UX SIN A      SCALED 1
26 #
27 #      WHERE U IS A UNIT VECTOR DP SCALED 2 ALONG THE AXIS OF ROTATION.
28 #      A IS THE ANGLE OF ROTATION DP SCALED 2
29 #
30 #      UPON ENTRY, THE STARTING ADDRESS OF U IS COF, AND A IS IN MPAC
```

```
31
32 DELCOMP      SETPD      PUSH      # MPAC CONTAINS THE ANGLE A
33      0
34      SIN      PDDL      # PD0 SIN A
35      COS      PUSH      # PD2 COS A
36      SR2      PDDL      # PD2 COS A      $8
37      BDSU      BOVB
38      DPHALF
39      SIGNMPAC
40      PDDL      # PDA 1-COS A
```

COMPUTE THE DIAGONAL COMPONENTS OF DEL

```
43
44      DSQ      COF
45      DMP
46      4
47      DAD      SL3
48      2
49      BOVB
50      SIGNMPAC
```

```

1      STODL  KEL      # UX UX 1-COS A  +COS A      $1
2      COF      +2
3
4      DSQ    DMP
5      4
6      DAD    SL3
7      2
8      BOVB
9      SIGNMPAC
10     STODL  KEL      +8D  # UY UY 1-COS A  +COS A      $1
11     COF      +4
12     DSQ    DMP
13     4
14     DAD    SL3
15     2
16     BOVB
17     SIGNMPAC
18     STORE  KEL      +16D # UZ UZ 1-COS A  +COS A      $1

```

COMPUTE THE OFF DIAGONAL TERMS OF DEL

```

22     DLOAD  DMP
23     COF
24     COF      +2
25     DMP    SL1
26     4
27     PDDL   DMP      # D6      UX UY  1-COS A      $4
28     COF      +4
29     0
30     PUSH   DAD      # D8      UZ SIN A      $4
31     6
32     SL2    BOVB
33     SIGNMPAC
34     STODL  KEL      +6
35     BDSU   SL2
36     BOVB
37     SIGNMPAC
38     STODL  KEL      +2
39     COF
40     DMP    DMP
41     COF      +4
42     4
43     SL1    PDDL      # D6      UX UZ  1-COS A      $4
44     COF      +2
45     DMP    PUSH      # D8      UY SIN A
46     0
47     DAD    SL2
48     6
49     BOVB
50     SIGNMPAC
51     STODL  KEL      +4      # UX UZ  1-COS A  +UY SIN A

```

BDSU
BOVB

SL2

STODL

SIGNMPAC

KEL

+12D

UX UZ 1-COS A -UY SIN A

COF

+2

DMP

DMP

COF

+4

SL1

PDDL

D6

UY UZ 1-COS A

\$ 4

COF

DMP

PUSH

D8

UX SIN A

DAD

SL2

6

BOVB

STODL

SIGNMPAC

KEL

+14D

UY UZ 1-COS A +UX SIN A

BDSU

SL2

BOVB

SIGNMPAC

STORE

KEL

+10D

UY UZ 1-COS A -UX SIN A

RVQ

DIRECTION COSINE MATRIX TO CDU ANGLE ROUTINE

X1 CONTAINS THE COMPLEMENT OF THE STARTING ADDRESS FOR MATRIX SCALED 2 .

LEAVE CDU ANGLES SCALED 2PI IN V MPAC .

COS MGA WILL BE LEFT IN S1 SCALED 1 .

THE DIRECTION COSINE MATRIX RELATING S/C AXES TO STABLE MEMBER AXES CAN BE WRITTEN AS

C COS THETA COS PSI

0

C -COS THETA SIN PSI COS PHI + SIN THETA SIN PHI

1

C COS THETA SIN PSI SIN PHI + SIN THETA COS PHI

2

C SIN PSI

3

C COS PSI COS PHI

4

C -COS PSI SIN PHI

5

C -SIN THETA COS PSI

6

C SIN THETA SIN PSI COS PHI + COS THETA SIN PHI

7

C -SIN THETA SIN PSI SIN PHI + COS THETA COS PHI

8


```
#
# WHERE PHI   OGA
#   THETA   IGA
#   PSI    MGA

DCMTOCDU      DLOAD*  ARCSIN
                6,1
                PUSH   COS          # PD +0          PSI
                SL1    BOVB
                SIGNMPAC
                STORE   S1
                DLOAD*  DCOMP
                12D,1
                DDV     ARCSIN
                S1
                PDDL*   BPL          # PD +2          THETA
                0,1      # MUST CHECK THE SIGN OF COS THETA
                OKTHETA # TO DETERMINE THE PROPER QUADRANT.
                DLOAD   DCOMP
                BPL     DAD
                SUHALFA
                DPHALF
                GOTO
SUHALFA      DSU     CALCPHI
                DPHALF
CALCPHI      PUSH
OKTHETA      DLOAD*  DCOMP
                10D,1
                DDV     ARCSIN
                S1
                PDDL*   BPL          # PUSH DOWN PHI
                8D,1
                OKPHI
                DLOAD   DCOMP          # PUSH UP PHI
                BPL     DAD
                SUHALFAP
                DPHALF
                GOTO
SUHALFAP      DSU     VECOFANG
                GOTO
                DPHALF
                VECOFANG
OKPHI         DLOAD
VECOFANG      VDEF    RVQ          # PUSH UP PHI
```

ROUTINES FOR TERMINATING THE AUTOMATIC MANEUVER AND RETURNING TO USER.

TOOBADF	EXIT		
	TC	ALARM	
	OCT	00401	
	TCF	NOGO	# DO NOT ZERO ATTITUDE ERRORS
	TC	BANKCALL	
	CADR	ZATTEROR	# ZERO ATTITUDE ERRORS
NOGO	TC	BANKCALL	
	CADR	STOPRATE	# STOP RATES
	CAF	TWO	
	INHINT		# ALL RETURNS ARE NOW MADE VIA GOODEND
	TC	WAITLIST	
	EBANK	BCDU	
	2CADR	GOODMANU	
	TCF	ENDOFJOB	
TOOBADI	EXIT		
	TCF	NOGO	

```
1 BANK 15
2
3
4 SETLOC KALCMON1
5 BANK
6
7 # DETECTING GIMBAL LOCK
8 LOCSKIRT EQUALS NOGIMLOC
9
10 NOGIMLOC SET
11
12 WCALC LXC,1 CALCMAN3
13 DLOAD*
14 RATEINDX # CHOOSE THE DESIRED MANEUVER RATE
15 ARATE,1 # FROM A LIST OF FOUR
16 SR4 CALL # COMPUTE THE INCREMENTAL ROTATION MATRIX
17 DELCOMP # DEL CORRESPONDING TO A 1 SEC ROTATION
18 # ABOUT COF
19
20 DLOAD* VXSC
21 ARATE,1
22 COF
23 STODL BRATE # COMPONENT MANEUVER RATES 45 DEG/SEC
24 AM
25 DMP DDV*
26 ANGLTIME
27 ARATE,1
28 SR
29 5
30 STORE TM # MANEUVER EXECUTION TIME SCALED AS T2
31 SETGO
32 CALCMAN2 # 0 OFF CONTINUE MANEUVER
33 NEWANGL +1 # 1 ON START MANEUVER
34
35 # THE FOUR SELECTABLE FREE FALL MANEUVER RATES SELECTED BY
36 # LOADING RATEINDX WITH 0,2,4,6, RESPECTIVELY
37
38 ARATE 2DEC .0088888888 # 0.2 DEG/SEC $ 22.5 DEG/SEC
39
40 2DEC .0222222222 # 0.5 DEG/SEC $ 22.5 DEG/SEC
41
42 2DEC .0888888888 # 2.0 DEG/SEC $ 22.5 DEG/SEC
43
44 2DEC .4444444444 # 10.0 DEG/SEC $ 22.5 DEG/SEC
45
46 ANGLTIME 2DEC .0001907349 # 1008-19 FUDGE FACTOR TO CONVERT
47 # MANEUVER ANGLE TO MANEUVER TIME
48
49
50
51
52
53
54
55
56
57
58
59
60
```

GENERATION OF STEERING COMMANDS FOR DIGITAL AUTOPILOT FREE FALL MANEUVERS

#

NEW COMMANDS WILL BE GENERATED EVERY ONE SECOND DURING THE MANEUVER

EBANK TTEMP

NEWDELHI TC BANKCALL # CHECK FOR AUTO STABILIZATION
CADR ISITAUTO # ONLYNEWANGL CCS A
TCF NOGO -2
TC INTPRETAXC,1 AXC,2
MIS # COMPUTE THE NEW MATRIX FROM S/C TO
KEL # STABLE MEMBER AXES

CALL

VLOAD MXM3
STADR STADR

STOVL MIS +12D # CALCULATE NEW DESIRED CDU ANGLES

STADR
STOVL MIS +6DSTADR
STORE MIS
AXC,1 CALLMIS
DCMTOCDU # PICK UP THE NEW CDU ANGLES FROM MATRIX

RTB

STORE V1STO2S
BONCLR NCDU # NEW CDU ANGLES
EXITCALCMAN2
MANUSTAT # TO START MANEUVER
TWO # +0 OTHERWISEINCRDCDU CAF
TS SPNDX
INDEX SPNDX
CA BCDU # INITIAL CDU ANGLES

EXTEND # OR PREVIOUS DESIRED CDU ANGLES

INDEX SPNDX
MSU NCDUEXTEND
SETLOC KALCMON1
BANKMP DT/TAU
CCS A # CONVERT TO 2S COMPLEMENT

AD ONE

TCF +2
COMINDEX SPNDX
TS DELDCDU # ANGLE INCREMENTS TO BE ADDED TO
INDEX SPNDX # CDUXD, CDUYD, CDUZD EVERY TENTH SECOND

```
1
2      CA      NCDU      # BY LEM DAP
3      INDEX   SPNDX
4      XCH      BCDU
5      INDEX   SPNDX
6      TS       CDUXD
7      CCS      SPNDX
8      TCF      INCRDCDU      # LOOP FOR THREE AXES
9
10     RELINT
11
12     # COMPARE PRESENT TIME WITH TIME TO TERMINATE MANEUVER
13
14     TMANUCHK      TC      TIMECHK
15                  TCF      CONTMANU
16
17     MANUSTAL      CAF      ONE
18                  INHINT    # END MAJOR PART OF MANEUVER WITHIN 1 SEC
19                  TC       WAITLIST      # UNDER WAITLIST CALL TO MANUSTOP
20                  EBANK    TTEMP
21                  2CADR    MANUSTOP
22
23     RELINT
24     TCF      ENDOFJOB
25
26     TIMECHK      EXTEND
27                  DCS      TIME2
28                  DXCH     TTEMP
29
30     EXTEND
31     DCA      TM
32     DAS      TTEMP
33     CCS      TTEMP
34     TC       Q
35     TCF      +2
36
37     TCF      2NDRETRN
38     CCS      TTEMP +1
39     TC       Q
40
41     TCF      MANUOFF
42     COM
43     MANUOFF   AD      ONESEK +1
44
45     EXTEND
46     BZMF      2NDRETRN
47     INCR      Q
48     2NDRETRN  INCR      Q
49     TC       Q
50
51     DT/TAU    DEC      .1
52
53     MANUSTAT   EXIT      # INITIALIZATION ROUTINE
54                  EXTEND  # FOR AUTOMATIC MANEUVERS
55     DCA      TIME2
```

	DAS	TM	# TM+TO	MANEUVER COMPLETION TIME
	EXTEND			
	DCS	ONESEK		
	DAS	TM	# TM+TO -1	
	INHINT			
RATEBIAS	CAF	TWO		
	TS	KSPNDX		
	DOUBLE			
	TS	KDPNDX		
	INDEX	A		
	CA	BRATE		
	INDEX	KSPNDX	# STORE MANEUVER RATE IN	
	TS	OMEGAPD	# OMEGAPD, OMEGAQD, OMEGARD	
	EXTEND			
	BZMF	+2	# COMPUTE ATTITUDE ERROR	
	COM		# OFFSET WX ABS WX /2AJX	
	EXTEND		# WHERE AJX 2-JET ACCELERATION	
	MP	BIASCALE	# -1/16	
	EXTEND			
	INDEX	KDPNDX		
	MP	BRATE		
	EXTEND			
	INDEX	KSPNDX		
	DV	1JACC	# AJX \$ 90 DEG/SEC-SEC	
	INDEX	KSPNDX		
	TS	DELPORR	# \$ 180 DEG	
	CCS	KSPNDX		
	TCF	RATEBIAS		
	CA	TIME1		
	AD	ONESEK +1		
	XCH	NEXTIME		
	TCF	INCRDCDU -1		
ONESEK	DEC	0		
	DEC	100		
BIASCALE	OCT	75777	# -1/16	
CONTMANU	CS	TIME1	# RESET FOR NEXT DCU UPDATE	
	AD	NEXTIME		
	CCS	A		
	AD	ONE		
	TCF	MANUCALL		
	AD	NEGMAX		
MANUCALL	COM		# CALL FOR NEXT UPDATE VIA WAITLIST	
	INHINT			
	TC	WAITLIST		
	EBANK	TTEMP		
	2CADR	UPDTCALL		

1		CAF	ONESEK +1	# INCREMENT TIME FOR NEXT UPDATE
2		ADS	NEXTIME	
3		TCF	ENDOFJOB	
4				
5				
6	UPDTCALL	CAF	PRI026	# SATELLITE PROGRAM TO CALL FOR UPDATE
7		TC	FINDVAC	# OF STEERING COMMANDS
8		EBANK	TTEMP	
9		2CADR	NEWDELHI	
10				
11		TC	TASKOVER	
12				
13				
14				
15				
16				
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60				

ROUTINE FOR TERMINATING AUTOMATIC MANEUVERS

MANUSTOP	CAF	ZERO	# ZERO MANEUVER RATES
	TS	DELDCDU2	
	TS	OMEGARD	
	TS	DELQEROR	
	TS	DELDCDU1	
	TS	OMEGAQD	
	TS	DELQEROR	
	CA	CPSI	# SET DESIRED GIMBAL ANGLES TO
	TS	CDUZD	# DESIRED FINAL GIMBAL ANGLES
	CA	CTHETA	
	TS	CDUYD	
ENDROLL	CA	CPHI	# NO FINAL YAW
	TS	CDUXD	
	CAF	ZERO	
	TS	OMEGAPD	# I.E. MANEUVER DID NOT GO THRU
	TS	DELDCDU	# GIMBAL LOCK ORIGINALLY
GOODMANU	TS	DELPEROR	
	CA	ATTPRIO	# RESTORE USERS PRIO
	TS	NEWPRIO	
	CA	ZERO	# ZERO ATTCADR
	DXCH	ATTCADR	
	TC	SPVAC	# RETURN TO USER
	TC	TASKOVER	

EBANK XSM

BANK 33
SETLOC E/PROG
BANK

COUNT* \$\$/P07

SPECIAL PROGRAMS TO EASE THE PANGS OF ERASABLE MEMORY PROGRAMS.

#

E/BKCALL FOR DOING BANKCALLS FROM AND RETURNING TO ERASABLE.

#

THIS ROUTINE IS CALLABLE FROM ERASABLE OR FIXED. LIKE BANKCALL, HOWEVER, SWITCHING BETWEEN S3 AND S4
IS NOT POSSIBLE.

#

THE CALLING SEQUENCE IS

#

TC BANKCALL
CADR E/BKCALL
CADR ROUTINE # WHERE TO WANT TO GO IN FIXED.

RETURN HERE FROM DISPLAY TERMINATE, BAD STALL OR TC Q.

RETURN HERE FROM DISPLAY PROCEED OR GOOD RETURN FROM STALL.

RETURN HERE FROM DISPLAY ENTER OR RECYCLE.

#

THIS ROUTINE REQUIRES TWO ERASABLES EBUF2, +1 IN UNSWITCHED WHICH ARE UNSHARED BY INTERRUPTS AND
OTHER EMEMORY PROGRAMS.

#

A + L ARE PRESERVED THROUGH BANKCALL AND E/BKCALL.

E/BKCALL	DXCH	BUF2	# SAVE A,L AND GET DP RETURN.
	DXCH	EBUF2	# SAVE DP RETURN.
	INCR	EBUF2	# RETURN +1 BECAUSE DOUBLE CADR.
	CA	BBANK	
	MASK	LOW10	# GET CURRENT EBANK. SBANK SOMEDAY
	ADS	EBUF2 +1	# FORM BBCON. WAS FBANK
	NDX	EBUF2	
	CA	0 -1	# GET CADR OF ROUTINE.
	TC	SWCALL	# GO TO ROUTINE, SETTING Q TO SWRETURN
			# AND RESTORING A + L.
	TC	+4	# TX Q, V34, OR BAD STALL RETURN.
	TC	+2	# PROCEED OR GOOD STALL RETURN.
	INCR	EBUF2	# ENTER OR RECYCLE RETURN.
	INCR	EBUF2	
E/SWITCH	DXCH	EBUF2	
	DTCB		

E/CALL FOR CALLING A FIXED MEMORY INTERPRETIVE SUBROUTINE FROM ERASABLE AND RETURNING TO ERASABLE.

THE CALLING SEQUENCE IS...

RTB

CADR E/CALL ROUTINE # THE INTERPRETIVE SUBROUTINE YOU WANT.
RETURNS HERE IN INTERPRETIVE.

E/CALL LXCH LOC # ADRES -1 OF CADR.

INDEX L

CA L

INCR L

INCR L

DXCH EBUF2

TC INTPRET

CALL

EXIT EBUF2

LXCH EBUF2 +1

TCF INTPRET +2

INDIRECTLY EXECUTE ROUTINE. IT MUST
LEAVE VIA RVQ OR EQUIVALENT.
PICK UP RETURN.
SET LOC AND RETURN TO CALLER.

```
# E/JOBWAK      FOR WAKING UP ERASABLE MEMORY JOBS.
#
# THIS ROUTINE MUST BE CALLED IN INTERRUPT OR WITH INTERRUPTS INHIBITED.
#
# THE CALLING SEQUENCE IS
#
#      INHINT
#      ...
#      CA      WAKEADR      # ADDRESS OF SLEEPING JOB
#      TC      IBNKCALL
#      CADR     E/JOBWAK
#      ...
#      RELINT      # RETURNS HERE
#                  # IF YOU DID AND INHINT.

      BANK      33
      SETLOC    E/PROG
      BANK

      COUNT*    $$/P07

E/JOBWAK      TC      JOBWAKE      # ARRIVE IWTH ADRES IN A.
              CS      BIT11
              NDX     LOCCTR
              ADS     LOC      # KNOCK FIXED MEMORY BIT OUT OF ADRES.
              TC      RUPTREG3   # RETURN
```

```

# NAME --      IMU PERFORMANCE TESTS 2
#
# DATE --      MARCH 20, 1967
#
# BY --        SYSTEM TEST GROUP 864-6900 EXT. 1274
#
# MODNO. --    ZERO
#
# FUNCTIONAL DESCRIPTION
#
# POSITIONING ROUTINES FOR THE IMU PERFORMANCE TESTS AS WELL AS SOME OF
# THE TESTS THEMSELVES.  FOR A DESCRIPTION OF THESE SUBROUTINES AND THE
# OPERATING PROCEDURES  TYPICALLY  SEE STG MEMO 685.  THEORETICAL REF. E-1973
#
# BANK 33
# SETLOC IMU2
# BANK
# EBANK POSITON
# COUNT* $$/P07
#
# REDO      TC      NEWMODEX
#           MM      07
#
# GEOIMUTT  TC      IMUZERR
# IMUBACK   CA      ZERO
#           TS      NDXCTR
#           TS      TORQNDX
#           TS      TORQNDX +1
#           TS      OVFLOWCK
#
# NBPOSPL   CA      DEC17
#           TS      ZERONDX
#           CA      XNBADR
#           TC      ZEROING
#           CA      HALF
#           TS      XNB
#
# GUESS     TC      INTERPRET
# LATAZCHK  DLOAD    SL2
#           LATITUDE
#           STODL    DSPTEM1 +1
#           AZIMUTH
#           RTB      EXIT
#           1ST02S
#           XCH      MPAC
#           TS      DSPTEM1
#           CAF      VN0641
#           TC      BANKCALL
#           CADR      GOFLASH
#           TC      ENDTEST1
#           TC      +2
#           TC      -5
    
```


	TC	INTPRET	
	SLOAD	RTB	
		DSPTM1	
		CDULOGIC	
	STORE	AZIMUTH	
	SLOAD	SR2	
		DSPTM1 +1	
	STORE	LATITUDE	
	COS	DCOMP	
	SL1		
	STODL	WANGI	
		LATITUDE	
	SIN	SL1	
	STODL	WANGO	
		AZIMUTH	
	PUSH	SIN	
	STORE	YNB	+2
	STODL	ZNB	+4
	COS		
	STORE	YNB	+4
	DCOMP		
POSGMBL	STCALL	ZNB	+2
		CALCGA	
	EXIT		
	TC	BANKCALL	
	CADR	IMUCOARS	
	CAF	BIT14	# IF BIT14 SET, GIMBAL LOCK
	MASK	FLAGWRD3	
	EXTEND		
	BZF	+2	
	INCR	NDXCTR	# +1 IF IN GIMBAL LOCK, OTHERWISE 0
	TC	DOWNFLAG	
	ADRES	GLOKFAIL	# RESET GIMBAL LOCK FLAG
	TC	IMUSLLL6	
	CCS	NDXCTR	# IF ONE GO AND DO A PIPA TEST ONLY
	TC	PIPACHK	# ALIGN AND MEASURE VERTICAL PIPA RATE
	TC	FINIMUDD	
	EXTEND		
	DCA	PERFDLAY	
	TC	LONGCALL	# DELAY WHILE SUSPENSION STABILIZES
	EBANK	POSITON	
	2CADR	GOESTIMS	
	CA	ESTICADR	
	TC	JOBSLEEP	
GOESTIMS	CA	ESTICADR	
	TC	JOBWAKE	
	TC	TASKOVER	
ESTICADR	CADR	ESTIMS	
TORQUE	CA	ZERO	

	TS	DSPTM2	
	CA	DRIFTI	
	TS	DSPTM2 +1	
	INDEX	POSITON	
	TS	SOUTHDR -1	
	TC	SHOW	
PIPACHK	INDEX	NDXCTR	# PIPA TEST
	TC	+1	
	TC	EARTH*	
	CA	DEC17	# ALLOW PIP COUNTER TO OVERFLOW 17 TIMES
	TS	DATAPL +4	# IN THE ALLOTTED TIME INTERVAL
	CA	DEC58	
	TS	LENGTHOT	
	CA	ONE	
	TS	RESULTCT	
	CA	ZERO	
	INDEX	PIPINDEX	
	TS	PIPAX	
	TS	DATAPL	
	TC	CHECKG	
	INHINT		
	CAF	TWO	
	TC	TWIDDLE	
	EBANK	XSM	
	ADRES	PIPATASK	
	TC	ENDOFJOB	
PIPATASK	EXTEND		
	DIM	LENGTHOT	
	CA	LENGTHOT	
	EXTEND		
	BZMF	STARTPIP	
	CAF	BIT10	
	TC	TWIDDLE	
	EBANK	XSM	
	ADRES	PIPATASK	
STARTPIP	CAF	PRI020	
	TC	FINDVAC	
	EBANK	XSM	
	2CADR	PIPJOB	
	TC	TASKOVER	
PIPJOB	INDEX	NDXCTR	
	TC	+1	
	TC	EARTH*	
	CA	LENGTHOT	

```
1
2      EXTEND
3      BZMF      +2
4      TC        ENDOFJOB
5
6      CA        FIVE
7      TS        RESULTCT
8      TC        CHECKG
9      CCS       DATAPL  +1
10     TC        +4
11     TC        CCSHOLE
12     CS        DATAPL  +4
13     TS        DATAPL  +4
14     EXTEND
15     DCS       DATAPL
16     DAS       DATAPL  +4
17
18     TC        INTPRET
19     DLOAD     DSU
20             DATAPL  +6
21             DATAPL  +2
22     BPL       CALL
23             AINGOTN
24             OVERFFIX
25     AINGOTN   PDDL   DDV
26             DATAPL  +4
27     DMPR      RTB
28             DEC585      # DEC585 HAS BEEN REDEFINED FOR LEM
29             SGNAGREE
30             DSPTM2
31     EXIT
32     CCS       NDXCTR
33     TC        COAALIGN      # TAKE PLATFORM OUT OF GIMBAL LOCK
34     TC        SHOW
35     CA        3990DEC      # ABOUT 1 HOUR VERTICAL DRIFT TEST
36     TS        LENGTHOT
37     INDEX     POSITON
38     CS        SOUTHDR -2
39     TS        DRIFTT
40     CCS       PIPINDEX      # OFFSET PLATFORM TO MISS PIP DEAD-ZONES
41     TCF       PON4          # Z-UP IN POS 4
42     PON2      CS        BIT5      # X-UP
43     ADS       ERCOMP  +2
44     CA        BIT5
45     ADS       ERCOMP  +4
46     TCF       PON
47     PON4      CS        BIT5
48     ADS       ERCOMP  +2
49     CA        BIT5
50     ADS       ERCOMP
51     PON       TC        EARTH*
52
53
54
55
56
57
58
59
60
```

ALLOW ONLY SOUTH GYRO EARTH RATE COMPENS

GUESS1

VALMIS

ENDTEST1

CA	ZERO
TS	ERVECTOR
TS	ERVECTOR +1
CAF	POSMAX
TS	TORQNDX
TS	TORQNDX +1
CA	CDUX
TS	LOSVEC
TC	ESTIMS
CA	DRIFT0
TS	DSPTM2 +1
CA	ZERO
TS	DSPTM2
TC	SHOW

TC	DOWNFLAG
ADRES	IMUSE
CS	ZERO
TC	NEWMODEA
TC	ENDEXT

OVERFFIX

DAD

DAD
DPPOS MAX
ONEDPP

RVQ

COAALIGN

EXTEND

COARSE ALIGN SUBROUTINE

QXCH

ZERONDX

CA

ZERO

TS

THETAD

TS

THETAD +1

TS

THETAD +2

ALIGNCOA

TC

BANKCALL

CADR

IMUCOARS

TC

BANKCALL

CADR

IMUSTALL

TC

SOMERR2

TC

ZERONDX

IMUSLLLG

EXTEND

QXCH

ZERONDX

TC

ALIGNCOA

FINIMUDD

EXTEND

QXCH

ZERONDX

TC

BANKCALL

CADR

IMU FINE

TC

ALIGNCOA

IMUZERR

EXTEND

QXCH

ZERONDX

TC

BANKCALL

CADR

IMUZERO

TC

ALIGNCOA

CHECKG

EXTEND

PIP PULSE CATCHING ROUTINE

QXCH

QPLACE

TC

+6

CHECKG1

RELINT

CA

NEWJOB

EXTEND

BZMF

+6

TC

CHANG1

INHINT

INDEX

PIPINDEX

CS

PIPAX

TS

ZERONDX

INHINT

	INDEX	PIPINDEX
	CA	PIPAX
	AD	ZERONDX
	EXTEND	
	BZF	CHECKG1
	INDEX	PIPINDEX
	CA	PIPAX
	INDEX	RESULTCT
	TS	DATAPL
	TC	FINETIME
	INDEX	RESULTCT
	TS	DATAPL +1
	INDEX	RESULTCT
	LXCH	DATAPL +2
ENDCHKG	RELINT	
	TC	QPLACE
ZEROING	TS	L
	TCF	+2
ZEROING1	TS	ZERONDX
	CAF	ZERO
	INDEX	L
	TS	0
	INCR	L
	CCS	ZERONDX
	TCF	ZEROING1
	TC	Q

ERTHRVSE	DLOAD	PDDL	SCHZEROS	# PD24	SIN	-COS	0	OMEG/MS
			LATITUDE					
	COS	DCOMP						
	PDDL	SIN						
			LATITUDE					
	VDEF	VXSC						
		OMEG/MS						
	STORE	ERVECTOR						
	RTB							
		LOADTIME						
	STOVL	TMARK						
		SCHZEROS						
	STORE	ERCOMP						
	RVQ							
EARTH	ITA	RTB						
		S2						
		LOADTIME						
	STORE	TEMPTIME						
	DSU	BPL						
		TMARK						
		ERTHR						
	CALL							
ERTHR	SL	OVERFFIX						
		VXSC						
		9D						
		ERVECTOR						
	MXV	VAD						
		XSM						
		ERCOMP						
	STODL	ERCOMP						
		TEMPTIME						
	STORE	TMARK						
	AXT,1	RTB						
	ECADR	ERCOMP						
		PULSEIMU						
	GOTO							
		S2						
EARTH*	EXTEND							
	QXCH	QPLACES						
	TC	INTPRET						
	CALL							
		EARTH						
	EXIT							
	TC	IMUSLLLG						
	TC	QPLACES						
SHOW	EXTEND							

SHOW1	QXCH CA	QPLACE POSITON	
	TS	DSPTM2 +2	
	CA	VB06N98	
	TC	BANKCALL	
	CADR	GOFLASH	
	TC	ENDTEST1	# V34
	TC	QPLACE	# V33
	TCF	SHOW1	
3990DEC	DEC	3990	
VB06N98	VN	0698	
VN0641	VN	0641	
DEC17		ND1	
DEC58	DEC	58	
OGCPL	ECADR	OGC	
1SECX		1SEC	
XNBADR	GENADR	XNB	
XSMADR	GENADR	XSM	
	BLOCK	2	
FINETIME	COUNT*	\$\$/P07	
	INHINT		# RETURNS WITH INTERRUPT INHIBITED
	EXTEND		
	READ	LOSCALAR	
	TS	L	
	EXTEND		
	RXOR	LOSCALAR	
	EXTEND		
	BZF	+4	
	EXTEND		
	READ	LOSCALAR	
	TS	L	
+4	CS	POSMAX	
	AD	L	
	EXTEND		
	BZF	FINETIME +1	
	EXTEND		
	READ	HISCALAR	
	TC Q		

```
# PROGRAM --      IMU PERFORMANCE TESTS 4
# DATE --        NOV 15, 1966
# BY --          GEORGE SCHMIDT IL7-146 EXT 1126
# MOD NO-ZERO
#
# FUNCTIONAL DESCRIPTION
#
# THIS SECTION CONSISTS OF THE FILTER FOR THE GYRO DRIFT TESTS.  NO COMPASS
# IS DONE IN LEM.  FOR A DESCRIPTION OF THE FILTER SEE E-1973.  THIS
# SECTION IS ENTERED FROM IMU 2.  IT RETURNS THERE AT END OF TEST.
#
# EARTH,OGC ZERO,ERTHRVSE
#
# NORMAL EXIT
#
# LENGTHOT GOES TO ZERO -- RETURN TO IMU PERF TESTS 2 CONTROL
#
# ALARMS
#
# 1600  OVERFLOW IN DRIFT TEST
# 1601  BAD IMU MODING IN ANY ROUTINE THAT USES IMUSTALL
#      OUTPUT
#
# FLASHING DISPLAY OF RESULTS -- CONTROLLED IN IMU PERF TESTS 2
#
# DEBRIS
#
# ALL CENTRALS -- ALL OF EBANK XSM
```

	BANK	33	
	SETLOC	IMU4	
	BANK		
	COUNT*	\$\$/P07	
	EBANK	XSM	
ESTIMS	INHINT		
	CAE	1SECXT	
	TC	TWIDDLE	
	EBANK	XSM	
	ADRES	ALLOOP	
	CAF	ZERO	# ZERO THE PIPAS
	TS	PIPAX	
	TS	PIPAY	
	TS	PIPAZ	
	RELINT		
	CA	77DECML	
	TS	ZERONDX	
	CA	ALXXXZ	
	TC	ZEROING	
	TC	INTPRET	
	SLOAD		
		SCHZEROS	
	STOVL	GCOMP SW -1	
		INTVAL +2	
	STOVL	ALXIS	
		SCHZEROS	
	STORE	DELVX	
	STORE	GCOMP	
	SLOAD		
		TORQNDX	
	DCOMP	BMN	
		VERTSKIP	
	CALL		
		ERTHRVSE	
VERTSKIP	EXIT		
	TC	SLEEPIE +1	

ALLOOP	CA	OVFLOWCK
	EXTEND	
	BZF	+2
	TC	TASKOVER
	CCS	ALTIM
	CA	A
	TS	ALTIMS
	CS	A
	TS	ALTIM
	CS	ONE
	AD	GEOCOMPS
	EXTEND	
	BZF	+4
	CA	LENGTHOT
	EXTEND	
	BZMF	+5
	CAE	1SECXT
	TC	TWIDDLE
	EBANK	XSM
	ADRES	ALLOOP
	CAF	ZERO
	XCH	PIPAX
	TS	DELVX
	CAF	ZERO
	XCH	PIPAY
	TS	DELVY
	CAF	ZERO
	XCH	PIPAZ
	TS	DELVZ
SPECSTS	CAF	PRI020
	TC	FINDVAC
	EBANK	XSM
	2CADR	ALFLT
	TC	TASKOVER

SHOULD NEVER HIT THIS LOCATION

START THE JOB

ALFLT	CCS	GEOCOMPS	
	TC	+2	
	TC	NORMLOP	
	TC	BANKCALL	
	CADR	1/PIPA	
NORMLOP	TC	INTPRET	
	DLOAD		
		INTVAL	
	STOVL	S1	
		DELVX	
	VXM	VSL1	
		XSM	
	DLOAD	DCOMP	
		MPAC +3	
	STODL	DPIPAY	
		MPAC +5	
	STORE	DPIPAZ	
	SETPD	AXT,1	
		0	
		8D	
	SLOAD	DCOMP	
		GEOCOMPS	
	BMN		
ALCGKK	SLOAD	PERFERAS	
		BMN	
		ALTIMS	
ALKCG	AXT,2	ALFLT3	
		LXA,1	# LOADS SLOPES AND TIME CONSTANTS AT RQST
		12D	
ALKCG2	DLOAD*	ALX1S	
		INCR,1	
		ALFDK	+144D,1
	DEC	-2	
	STORE	ALDK	+10D,2
	TIX,2	SXA,1	
		ALKCG2	
		ALX1S	
ALFLT3	AXT,1		
		8D	
DELMPL	DLOAD*	DMP	
		DPIPAY	+8D,1
		PIPASC	
	SLR	BDSU*	
		9D	
		INTY	+8D,1
	STORE	INTY	+8D,1
	PDDL	DMP*	
		VELSC	

		VLAUN	+8D,1
	SL2R		
	DSU	STADR	
	STORE	DELM	+8D,1
	STORE	DELM	+10D,1
	TIX,1	AXT,2	
		DELMLP	
		4	
ALILP	DLOAD*	DMPR*	
		ALK	+4,2
		ALDK	+4,2
	STORE	ALK	+4,2
	TIX,2	AXT,2	
		ALILP	
		8D	
ALKLP	LXC,1	SXA,1	
		CMPX1	
		CMPX1	
	DLOAD*	DMPR*	
		ALK	+1,1
		DELM	+8D,2
	DAD*		
		INTY	+8D,2
	STORE	INTY	+8D,2
	DLOAD*	DAD*	
		ALK	+12D,2
		ALDK	+12D,2
	STORE	ALK	+12D,2
	DMPR*	DAD*	
		DELM	+8D,2
		INTY	+16D,2
	STORE	INTY	+16D,2
	DLOAD*	DMP*	
		ALSK	+1,1
		DELM	+8D,2
	SL1R	DAD*	
		VLAUN	+8D,2
	STORE	VLAUN	+8D,2
	TIX,2	AXT,1	
		ALKLP	
		8D	
LOOSE	DLOAD*	PDDL*	
		ACCWD	+8D,1
		VLAUN	+8D,1
	PDDL*	VDEF	
		POSNV	+8D,1
	MXV	VSL1	
		TRANSM1	

```

1
2      DLOAD
3      MPAC
4      STORE POSNV +8D,1
5      DLOAD
6      MPAC +3
7      STORE VLAUN +8D,1
8      DLOAD
9      MPAC +5
10     STORE ACCWD +8D,1
11     TIX,1
12     LOOSE
13
14     AXT,2  AXT,1      # EVALUATE SINES AND COSINES
15           6
16           2
17 BOOP      DLOAD*  DMPR
18           ANGX +2,1
19           GEORGEJ
20
21     SR2R
22     PUSH  SIN
23     SL3R  XAD,1
24           X1
25     STORE 16D,2
26     DLOAD
27     COS
28     STORE 22D,2      # COSINES
29     TIX,2
30     BOOP
31
32 PERFERAS  EXIT
33           CA  EBANK7
34           TS  EBANK
35           EBANK ATIGINC
36           TC  ATIGINC      # GOTO ERASABLE TO CALCULATE ONLY TO RETN
37
38 #
39 # CAUTION
40 # THE ERASABLE PROGRAM THAT DOES THE CALCULATIONS MUST BE LOADED
41 # BEFORE ANY ATTEMPT IS MAKE TO RUN THE IMU PERFORMANCE TEST
42
43     EBANK  AZIMUTH
44     CCS    LENGTHOT
45     TC     SLEEPIE
46     CCS    TORQNDX
47     TCF    +2
48     TC     SETUPER1
49     CA     CDUX
50     TS     LOSVEC +1      # FOR TROUBLESHOOTING VD POSNS 2$4
51
52
53
54
55
56
57
58
59
60
```

SETUPER1	TC	INTPRET	
	DLOAD	PDDL	# ANGLES FROM DRIFT TEST ONLY
		ANGZ	
		ANGY	
	PDDL	VDEF	
		ANGX	
	VCOMP	VXSC	
		GEORGEJ	
	MXV	VSRI	
		XSM	
	STORE	OGC	
	EXIT		
	CA	OGCPL	
	TC	BANKCALL	
	CADR	IMUPULSE	
	TC	IMUSLLLG	
GEOSTRT4	CCS	TORQNDX	# ONLY POSITIVE IF IN VERTICAL DRIFT TEST
	TC	VALMIS	
	TC	INTPRET	
	CALL		
		ERTHRVSE	
	EXIT		
	TC	TORQUE	
SLEEPIE	TS	LENGTHOT	# TEST NOT OVER-DECREMENT LENGTHOT
	CCS	TORQNDX	# ARE WE DOING VERTDRIFT
	TC	EARTH*	
	TC	ENDOFJOB	
SOMEERRR	CA	EBANK5	
	TS	EBANK	
	CA	ONE	
	TS	OVFLOWCK	# STOP ALLOOP FROM CALLING ITSELF
	TC	ALARM	
	OCT	1600	
	TC	ENDTEST1	
SOMERR2	CAF	OCT1601	
	TC	VARALARM	
	TC	DOWNFLAG	
	ADRES	IMUSE	
	TC	ENDOFJOB	
OCT1601	OCT	01601	
DEC585	OCT	06200	# 3200 B+14 ORDER IS IMPORTANT
SCHZEROS	2DEC	.00000000	

	2DEC	.00000000	
ONEDPP	OCT	00000	# ORDER IS IMPORTANT
	OCT	00000	
	OCT	00001	
INTVAL	OCT	4	
	OCT	2	
	DEC	144	
	DEC	-1	
SOUPPLY	2DEC	.93505870	# INITIAL GAINS FOR PIP OUTPUTS
	2DEC	.26266423	# INITIAL GAINS/4 FOR ERECTION ANGLES
77DECML	DEC	77	
ALXXXZ	GENADR	ALX1S -1	
PIPASC	2DEC	.13055869	
VELSC	2DEC	-.52223476	# 512/980.402
ALSK	2DEC	.17329931	# SSWAY VEL GAIN X 980.402/4096
	2DEC	-.00835370	# SSWAY ACCEL GAIN X 980.402/4096
GEORGEJ	2DEC	.63661977	
GEORGEK	2DEC	.59737013	

```
1 # PROGRAM NAME -- KEYBOARD AND DISPLAY PROGRAM
2 # MOD NO -- 4          DATE -- 27 APRIL 1967          ASSEMBLY -- PINDANCE REV 18
3
4 # MOD BY -- FILENE
5 # LOG SECTION -- PINBALL GAME BUTTONS AND LIGHTS
6 #
7 # FUNCTIONAL DESCRIPTION
8 #
9 # THE KEYBOARD AND DISPLAY SYSTEM PROGRAM OPERATES UNDER EXECUTIVE
10 # CONTROL AND PROCESSES INFORMATION EXCHANGED BETWEEN THE AGC AND THE
11 # COMPUTER OPERATOR.  THE INPUTS TO THE PROGRAM ARE FROM THE KEYBOARD,
12 # FROM INTERNAL PROGRAM, AND FROM THE UPLINK.
13 #
14 # THE LANGUAGE OF COMMUNICATION WITH THE PROGRAM IS A PAIR OF WORDS
15 # KNOWN AS VERB AND NOUN.  EACH OF THESE IS REPRESENTED BY A 2 CHARACTER
16 # DECIMAL NUMBER.  THE VERB CODE INDICATES WHAT ACTION IS TO BE TAKEN, THE
17 # NOUN CODE INDICATES TO WHAT THIS ACTION IS APPLIED.  NOUNS USUALLY
18 # REFER TO A GROUP OF ERASABLE REGISTERS.
19 #
20 # VERBS ARE GROUPED INTO DISPLAYS, LOADS, MONITORS  DISPLAYS THAT ARE
21 # UPDATED ONCE PER SECOND , SPECIAL FUNCTIONS, AND EXTENDED VERBS  THESE
22 # ARE OUTSIDE OF THE DOMAIN OF PINBALL AND CAN BE FOUND UNDER LOG SECTION
23 # EXTENDED VERBS .
24 #
25 # A LIST OF VERBS AND NOUNS IS GIVEN IN LOG SECTION  ASSEMBLY AND
26 # OPERATION INFORMATION .
27 #
28 #
29 # CALLING SEQUENCES --
30 #
31 # KEYBOARD
32 # EACH DEPRESSION OF A KEYBOARD BUTTON ACTIVATES AN INTERRUPT KEYRUPT1
33 # AND PLACES THE 5 BIT KEY CODE INTO CHANNEL 15.  KEYRUPT1 PLACES THE KEY
34 # CODE INTO MPAC, ENTERS AN EXECUTIVE REQUEST FOR THE KEYBOARD AND DISPLAY
35 # PROGRAM AT CHARIN , AND EXECUTES A RESUME.
36 #
37 # UPLINK
38 # EACH WORD RECEIVED BY THE UPLINK ACTIVATES INTERRUPT UPRUPT, WHICH
39 # PLACES THE 5 BIT KEY CODE INTO MPAC, ENTERS AN EXECUTIVE REQUEST FOR THE
40 # KEYBOARD AND DISPLAY PROGRAM AT CHARIN  AND EXECUTES A RESUME.
41 #
42 # INTERNAL PROGRAMS
43 # INTERNAL PROGRAMS CALL PINBALL AT NVSUB WITH THE DESIRED VERB/NOUN
44 # CODE IN A LOW 7 BITS FOR NOUN, NEXT 7 BITS FOR VERB .  DETAILS
45 # DESCRIBED ON REMARKS CARDS JUST BEFORE NVSUB AND NVSBWAIT  SEE
46 # SYMBOL TABLE FOR PAGE NUMBERS .
47 #
48 # NORMAL EXIT MODES --
49 #
50 # IF PINBALL WAS CALLED BY EXTERNAL ACTION, THERE ARE FOUR EXITS
51 # 1 ALL BUT 2 , 3 , AND 4 EXIT DIRECTLY TO ENDOFJOB.
52 # 2 EXTENDED VERBS GO TO THE EXTENDED VERB FAN AS PART OF THE
```

```
1 #
2 # PINBALL EXECUTIVE JOB WITH PRIORITY 30000. IT IS THE
3 # RESPONSIBILITY OF THE EXTENDED VERB CALLED TO EVENTUALLY
4 # CHANGE PRIORITY IF NECESSARY AND DO AN ENDOFJOB.
5 # ALSO PINBALL IS A NOVAC JOB. EBANK SET FOR COMMON.
6 # 3 VERB 37. CHANGE OF PROGRAM MAJOR MODE CALLS V37 IN THE
7 # SERVICE ROUTINES AS PART OF THE PINBALL EXEC JOB WITH Prio
8 # 30000. THE NEW PROGRAM CODE MAJOR MODE IS LEFT IN A.
9 # 4 KEY RELEASE BUTTON CALLS PINBRNCH IN THE DISPLAY INTERFACE
10 # ROUTINES AS PART OF THE PINBALL EXEC JOB WITH Prio 30000 IF
11 # THE KEY RELEASE LIGHT IS OFF AND CADDRSTOR IS NOT +0.
12 #
13 # IF PINBALL WAS CALLED BY INTERNAL PROGRAMS, EXIT FROM PINBALL IS BACK
14 # TO CALLING ROUTINE. DETAILS DESCRIBED IN REMARKS CARDS JUST BEFORE
15 # NVSUB AND NVSWAIT SEE SYMBOL TABLE FOR PAGE NUMBERS .
16 #
17 # ALARM OR ABORT EXIT MODES --
18 #
19 # EXTERNAL INITIATION
20 # IF SOME IMPROPER SEQUENCE OF KEY CODES IS DETECTED, THE OPERATOR
21 # ERROR LIGHT IS TURNED ON AND EXIT IS TO ENDOFJOB .
22 #
23 # INTERNAL PROGRAM INITIATION
24 # IF AN ILLEGAL V/N COMBINATION IS ATTEMPTED, AN ABORT IS CAUSED
25 # WITH OCTAL 01501 .
26 # IF A SECOND ATTEMPT IS MADE TO GO TO SLEEP IN PINBALL, AN ABORT IS
27 # CAUSED WITH OCTAL 01206 . THERE ARE TWO WAYS TO GO TO SLEEP IN PINBALL
28 # 1 ENDIDLE OR DATAWAIT.
29 # 2 NVSWAIT, PRENVBSY, OR NVSUBUSY.
30 #
31 # CONDITIONS LEADING TO THE ABOVE ARE DESCRIBED IN FORTHCOMING MIT/IL
32 # E-REPORT DESCRIBING KEYBOARD AND DISPLAY OPERATION FOR 278.
33 #
34 # OUTPUT --
35 #
36 # INFORMATION TO BE SENT TO THE DISPLAY PANEL IS LEFT IN THE DSPTAB
37 # BUFFERS REGISTERS UNDER EXEC CONTROL . DSPOUT A PART OF T4RUPT
38 # HANDLES THE PLACING OF THE DSPTAB INFORMATION INTO OUTPUT CHANNEL 10
39 # IN INTERRUPT.
40 #
41 # ERASABLE INITIALIZATION --
42 #
43 # FRESH START AND RESTART INITIALIZE THE NECESSARY E REGISTERS FOR
44 # PINBALL IN STARTSUB . REGISTERS ARE DSPTAB BUFFER, CADDRSTOR,
45 # REQRET, CLPASS, DSPLOCK, MONSAVE, MONSAVE1, VERBREG, NOUNREG, DSPLIST,
46 # DSPCOUNT, NOUT.
47 #
48 # A COMPLETE LIST OF ALL THE ERASABLES BOTH RESERVED AND TEMPORARIES FOR
```


PINBALL IS GIVEN BELOW.

THE FOLLOWING ARE OF GENERAL INTEREST --

REMARKS CARDS PRECEDE THE REFERENCED SYMBOL DEFINITION. SEE SYMBOL
TABLE TO FIND APPROPRIATE PAGE NUMBERS.

NVSUB CALLING POINT FOR INTERNAL USE OF PINBALL.
OF RELATED INTEREST NVSBWAIT
NVSUBUSY
PRENVBSY

ENDIDLE ROUTINE FOR INTERNAL PROGRAMS WISHING TO TO SLEEP WHILE
AWAITING OPERATORS RESPONSE.

DSPMM ROUTINE BY WHICH AN INTERNAL PROGRAM MAY DISPLAY A DECIMAL
PROGRAM CODE MAJOR MODE IN THE PROGRAM MAJOR MODE LIGHTS.
DSPMM DOES NOT DISPLAY DIRECTLY BUT ENTERS EXEC REQUEST
FOR DSPMMJB WITH PRIO 30000 AND RETURNS TO CALLER.

BLANKSUB ROUTINE BY WHICH AN INTERNAL PROGRAM MAY BLANK ANY
COMBINATION OF THE DISPLAY REGISTERS R1, R2, R3.

JAMTERM ROUTINE BY WHICH AN INTERNAL PROGRAM MAY PERFORM THE
JAMPROC TERMINATE V 34 OR PROCEED V 33 FUNCTION.

MONITOR VERBS FOR PERIODIC 1 PER SEC DISPLAY.

PLEASE PERFORM, PLEASE MARK SITUATIONS
REMARKS DESCRIBING HOW AN INTERNAL ROUTINE SHOULD HANDLE
THESE SITUATIONS CAN BE FOUND JUST BEFORE NVSUB SEE
SYMBOL TABLE FOR PAGE NUMBER .

THE NOUN TABLE FORMAT IS DESCRIBED ON A PAGE OF REMARKS CARDS JUST
BEFORE DSPABC SEE SYMBOL TABLE FOR PAGE NUMBER .

THE NOUN TABLES THEMSELVES ARE FOUND IN LOG SECTION PINBALL NOUN
TABLES .

FOR FURTHER DETAILS ABOUT OPERATION OF THE KEYBOARD AND DISPLAY SYSTEM
PROGRAM, SEE THE MISSION PLAN AND/OR MIT/IL E-2129
DESCRIBING KEYBOARD AND DISPLAY OPERATION FOR 278.

THE FOLLOWING QUOTATION IS PROVIDED THROUGH THE COURTESY OF THE AUTHORS.

IT WILL BE PROVED TO THY FACE THAT THOU HAST MEN ABOUT THEE THAT
USUALLY TALK OF A NOUN AND A VERB, AND SUCH ABOMINABLE WORDS AS NO

CHRISTIAN EAR CAN ENDURE TO HEAR.

HENRY 6, ACT 2, SCENE 4

THE FOLLOWING ASSIGNMENTS FOR PINBALL ARE MADE ELSEWHERE

# DSPCOUNT	ERASE		# DISPLAY POSITION INDICATOR
# DECBRNCH	ERASE		# +DEC, -DEC, OCT INDICATOR
# VERBREG	ERASE		# VERB CODE
# NOUNREG	ERASE		# NOUN CODE
# XREG	ERASE		# R1 INPUT BUFFER
# YREG	ERASE		# R2 INPUT BUFFER
# ZREG	ERASE		# R3 INPUT BUFFER
# XREGLP	ERASE		# LO PART OF XREG FOR DEC CONV ONLY
# YREGLP	ERASE		# LO PART OF YREG FOR DEC CONV ONLY
# HITEMOUT		YREGLP	# TEMP FOR DISPLAY OF HRS, MIN, SEC
#			# MUST LOTEMOUT-1.
# ZREGLP	ERASE		# LO PART OF ZREG FOR DEC CONV ONLY
# LOTEMOUT		ZREGLP	# TEMP FOR DISPLAY OF HRS, MIN, SEC
#			# MUST HITEMOUT+1.
# MODREG	ERASE		# MODE CODE
# DSPLOCK	ERASE		# KEYBOARD/SUBROUTINE CALL INTERLOCK
# REQRET	ERASE		# RETURN REGISTER FOR LOAD
# LOADSTAT	ERASE		# STATUS INDICATOR FOR LOADTST
# CLPASS	ERASE		# PASS INDICATOR FOR CLEAR
# NOUT	ERASE		# ACTIVITY COUNTER FOR DSPTAB
# NOUNCADR	ERASE		# MACHINE CADR FOR NOUN
# MONSAVE	ERASE		# N/V CODE FOR MONITOR. MONSAVE1-1
# MONSAVE1	ERASE		# NOUNCADR FOR MONITOR MATBS MONSAVE+1
# MONSAVE2	ERASE		# NVMONOPT OPTIONS
# DSPTAB	ERASE	+13D	# 0-10, DISPLAY PANEL BUFFER, 11-13, C RELAYS
# CADRSTOR	ERASE		# ENDIDLE STORAGE
# NVQTEM	ERASE		# NVSUB STORAGE FOR CALLING ADDRESS
#			# MUST NVBNKTEM-1.
# NVBNKTEM	ERASE		# NVSUB STORAGE FOR CALLING BANK
#			# MUST NVQTEM+1
# VERBSAVE	ERASE		# NEEDED FOR RECYCLE
# DSPLIST	ERASE		# WAITING REG FOR DSP SYST INTERNAL USE
# EXTVBACT	ERASE		# EXTENDED VERB ACTIVITY INTERLOCK
# DSPTM1	ERASE		# BUFFER STORAGE AREA 1 MOSTLY FOR TIME
# DSPTM2	ERASE		# BUFFER STORAGE AREA 2 MOSTLY FOR DEG

END OF ERASABLES RESERVED FOR PINBALL EXECUTIVE ACTION

#

TEMPORARIES FOR PINBALL EXECUTIVE ACTION

# DSEXIT	INTB15+	# RETURN FOR DSPIN
# EXITEM	INTB15+	# RETURN FOR SCALE FACTOR ROUTINE SELECT
# BLANKRET	INTB15+	# RETURN FOR 2BLANK
# WRDRET	INTBIT15	# RETURN FOR 5BLANK.
# WDRET	INTBIT15	# RETURN FOR DSPWD
# DECRET	INTBIT15	# RETURN FOR PUTCOM DEC LOAD
# 21/22REG	INTBIT15	# TEMP FOR CHARIN
# UPDATRET	POLISH	# RETURN FOR UPDATNN, UPDATVB
# CHAR	POLISH	# TEMP FOR CHARIN
# ERCNT	POLISH	# COUNTER FOR ERROR LIGHT RESET
# DECOUNT	POLISH	# COUNTER FOR SCALING AND DISPLAY DEC
# SGNON	VBUF	# TEMP FOR +,- ON
# NOUNTEM	VBUF	# COUNTER FOR MIXNOUN FETCH
# DISTEM	VBUF	# COUNTER FOR OCTAL DISPLAY VERB
# DECTEM	VBUF	# COUNTER FOR FETCH DEC DISPLAY VERBS
# SGNOFF	VBUF +1	# TEMP FOR +,- ON
# NVTEMP	VBUF +1	# TEMP FOR NVSUB
# SFTEMP1	VBUF +1	# STORAGE FOR SF CONST HI PART SFTEMP2-1
# HITEMIN	VBUF +1	# TEMP FOR LOAD OF HRS, MIN, SEC
#		# MUST LOTEMIN-1.
# CODE	VBUF +2	# FOR DSPIN
# SFTEMP2	VBUF +2	# STORAGE FOR SF CONST LO PART SFTEMP1+1
# LOTEMIN	VBUF +2	# TEMP FOR LOAD OF HRS, MIN, SEC
#		# MUST HITEMIN+1
# MIXTEMP	VBUF +3	# FOR MIXNOUN DATA
# SIGNRET	VBUF +3	# RETURN FOR +,- ON
# ALSO MIXTEMP+1	VBUF+4, MIXTEMP+2	VBUF+5.
# ENTRET	DOTINC	# EXIT FROM ENTER
# WDCNT	DOTRET	# CHAR COUNTER FOR DSPWD
# INREL	DOTRET	# INPUT BUFFER SELECTOR X, Y, Z, REG
# DSPMMTEM	MATINC	# DSPCOUNT SAVE FOR DSPMM
# MIXBR	MATINC	# INDICATOR FOR MIXED OR NORMAL NOUN
# TEM1	ERASE	# EXEC TEMP
# DSREL	TEM1	# REL ADDRESS FOR DSPIN
# TEM2	ERASE	# EXEC TEMP
# DSMAG	TEM2	# MAGNITUDE STORE FOR DSPIN
# IDADDTEM	TEM2	# MIXNOUN INDIRECT ADDRESS STORAGE
# TEM3	ERASE	# EXEC TEMP
# COUNT	TEM3	# FOR DSPIN

```
1  # TEM4          ERASE          # EXEC TEMP
2  # LSTPTR          TEM4          # LIST POINTER FOR GRABUSY
3  # RELRET          TEM4          # RETURN FOR RELDSP
4  # FREERET         TEM4          # RETURN FOR FREEDSP
5  # DSPWDRET        TEM4          # RETURN FOR DSPSIGN
6  # SEPSCRET        TEM4          # RETURN FOR SEPSEC
7  # SEPMNRET        TEM4          # RETURN FOR SEPMIN
8
9  # TEM5          ERASE          # EXEC TEMP
10 # NOUNADD        TEM5          # TEMP STORAGE FOR NOUN ADDRESS
11
12 # NNADTEM        ERASE          # TEMP FOR NOUN ADDRESS TABLE ENTRY
13 # NNTYPTTEM      ERASE          # TEMP FOR NOUN TYPE TABLE ENTRY
14 # IDAD1TEM       ERASE          # TEMP FOR INDIR ADDRESS TABLE ENTRY MIXNN
15 #
16 #                # MUST IDAD2TEM-1, IDAD3TEM-2.
17 # IDAD2TEM       ERASE          # TEMP FOR INDIR ADDRESS TABLE ENTRY MIXNN
18 #                # MUST IDAD1TEM+1, IDAD3TEM-1.
19 # IDAD3TEM       ERASE          # TEMP FOR INDIR ADDRESS TABLE ENTRY MIXNN
20 #                # MUST IDAD1TEM+2, IDAD2TEM+1.
21 # RUTMXTEM       ERASE          # TEMP FOR SF ROUT TABLE ENTRY MIXNN ONLY
22
23 # END OF TEMPORARIES FOR PINBALL EXECUTIVE ACTION.
24 #
25 # ADDITIONAL TEMPORARIES FOR PINBALL EXECUTIVE ACTION
26 #
27 # MPAC, THRU MPAC +6
28 # BUF, +1, +2
29 # BUF2, +1, +2
30 # MPTEMP
31 # ADDRWD
32 #
33 # END OF ADDITIONAL TEMPS FOR PINBALL EXEC ACTION
34 #
35 # RESERVED FOR PINBALL INTERRUPT ACTION
36 #
37 # DSPCNT          ERASE          # COUNTER FOR DSPOUT
38 # UPLOCK          ERASE          # BIT1 UPLINK INTERLOCK ACTIVATED BY
39 #                # RECEPTION OF A BAD MESSAGE IN UPLINK
40 #
41 # END OF ERASABLES RESERVED FOR PINBALL INTERRUPT ACTION
42 #
43 # TEMPORARIES FOR PINBALL INTERRUPT ACTION
44 #
45 # KEYTEMP1        WAITEXIT      # TEMP FOR KEYRUPT, UPRUPT
46 # DSRUPTTEM       WAITEXIT      # TEMP FOR DSPOUT
47 # KEYTEMP2        RUPTAGN       # TEMP FOR KEYRUPT, UPRUPT
48 #
49 # END OF TEMPORARIES FOR PINBALL INTERRUPT ACTION
```


THE INPUT CODES ASSUMED FOR THE KEYBOARD ARE,

0 10000

1 00001

9 01001

VERB 10001

ERROR RES 10010

KEY RLSE 11001

+ 11010

- 11011

ENTER 11100

CLEAR 11110

NOUN 11111

2003 RSB -- THE PROCEED KEY HAS NO KEYCODE IT IS READ BY AN ALTERNATE MECHANISM.#
OUTPUT FORMAT FOR DISPLAY PANEL. SET OUTO TO AAAABCCCCCDDDDDD.# A S SELECTS A RELAYWORD. THIS DETERMINES WHICH PAIR OF CHARACTERS ARE
ENERGIZED.

B FOR SPECIAL RELAYS SUCH AS SIGNS ETC.

C S 5 BIT RELAY CODE FOR LEFT CHAR OF PAIR SELECTED BY RELAYWORD.

D S 5 BIT RELAY CODE FOR RIGHT CHAR OF PAIR SELECTED BY RELAYWORD.

THE PANEL APPEARS AS FOLLOWS,

MD1 MD2 MAJOR MODE

VD1 VD2 VERB ND1 ND2 NOUN

R1D1 R1D2 R1D3 R1D4 R1D5 R1

R2D1 R2D2 R2D3 R2D4 R2D5 R2

R3D1 R3D2 R3D3 R3D4 R3D5 R3

EACH OF THESE IS GIVEN A DSPCOUNT NUMBER FOR USE WITHIN COMPUTATION ONLY#
MD1 25 R2D1 11 ALL ARE OCTAL

MD2 24 R2D2 10

VD1 23 R2D3 7

VD2 22 R2D4 6

ND1 21 R2D5 5

ND2 20 R3D1 4

R1D1 16 R3D2 3

R1D2 15 R3D3 2

R1D3 14 R3D4 1

R1D4 13 R3D5 0

R1D5 12

THERE IS AN 11-REGISTER TABLE DSPTAB FOR THE DISPLAY PANEL.#
DSPTAB RELAYWD BIT11 BITS 10-6 BITS 5-1

RELADD

10 1011 MD1 25 MD2 24

9 1010 VD1 23 VD2 22

8 1001 ND1 21 ND2 20

7 1000 R1D1 16

# 6	0111	+R1	R1D2	15	R1D3	14
# 5	0110	-R1	R1D4	13	R1D5	12
# 4	0101	+R2	R2D1	11	R2D2	10
# 3	0100	-R2	R2D3	7	R2D4	6
# 2	0011		R2D5	5	R3D1	4
# 1	0010	+R3	R3D2	3	R3D3	2
# 0	0001	-R3	R3D4	1	R3D5	0
#	0000	NO RELAYWORD				

THE 5-BIT OUTPUT RELAY CODES ARE

BLANK 00000

0 10101

1 00011

2 11001

3 11011

4 01111

5 11110

6 11100

7 10011

8 11101

9 11111

OUTPUT BITS USED BY PINBALL

KEY RELEASE LIGHT - BIT 5 OF CHANNEL 11

VERB/NOUN FLASH - BIT 6 OF CHANNEL 11

OPERATOR ERROR LIGHT - BIT 7 OF CHANNEL 11

START OF EXECUTIVE SECTION OF PINBALL

BANK 40
SETLOC PINBALL1
BANK

CHARIN COUNT* \$\$/PIN
CAF ONE # BLOCK DISPLAY SYST
XCH DSPLOCK # MAKE DSP SYST BUSY, BUT SAVE OLD
TS 21/22REG # C DSPLOCK FOR ERROR LIGHT RESET.
CCS CADRSTOR # ALL KEYS EXCEPT ER TURN ON KR LITE IF
TC +2 # CADRSTOR IS FULL. THIS REMINDS OPERATOR
TC CHARIN2 # TO RE-ESTABLISH A FLASHING DISPLAY
CS ELRCODE1 # WHICH HE HAS OBSCURED WITH DISPLAYS OF
AD MPAC # HIS OWN SEE REMARKS PRECEDING ROUTINE
EXTEND # VBRELDSP .
BZF CHARIN2

CHARIN2 TC RELDSPON
XCH MPAC
TS CHAR

INDEX A
TC +1 # INPUT CODE FUNCTION
TC CHARALRM # 0
TC NUM # 1
TC NUM # 2
TC NUM # 3
TC NUM # 4
TC NUM # 5
TC NUM # 6
TC NUM # 7
TC 89TEST # 10 8
TC 89TEST # 11 9
TC CHARALRM # 12
TC CHARALRM # 13
TC CHARALRM # 14
TC CHARALRM # 15
TC CHARALRM # 16
TC CHARALRM # 17
TC NUM -2 # 20 0
TC VERB # 21 VERB
TC ERROR # 22 ERROR LIGHT RESET
TC CHARALRM # 23
TC CHARALRM # 24
TC CHARALRM # 25
TC CHARALRM # 26
TC CHARALRM # 27
TC CHARALRM # 30
TC VBRELDSP # 31 KEY RELEASE
TC POSGN # 32 +

```
1
2      TC      NEGSN      # 33      -
3      TC      ENTERJMP   # 34      ENTER
4
5      TC      CHARALRM   # 35
6      TC      CLEAR      # 36      CLEAR
7      TC      NOUN       # 37      NOUN
8
9  ELRCODE1    OCT      22
10 ENTERJMP    TC      POSTJUMP
11
12 89TEST      CCS      DSPCOUNT
13      TC      +4        # +
14      TC      +3        # +0
15      TC      ENDOFJOB   # - BLOCK DATA IN IF DSPCOUNT IS - OR -0
16      TC      ENDOFJOB   # -0
17      CAF      THREE
18      MASK     DECBRNCH
19
20      CCS      A
21      TC      NUM        # IF DECBRNCH IS +, 8 OR 9 OK
22      TC      CHARALRM   # IF DECBRNCH IS +0, REJECT 8 OR 9
```

```
23 # NUM ASSEMBLES OCTAL 3 BITS AT A TIME. FOR DECIMAL IT CONVERTS INCOMING
24 # WORD AS A FRACTION, KEEPING RESULTS TO DP.
25 # OCTAL RESULTS ARE LEFT IN XREG, YREG, OR ZREG. HI PART OF DEC IN XREG,
26 # YREG, ZREG. THE LOW PARTS IN XREGLP, YREGLP, OR ZREGLP.
27 # DECBRNCH IS LEFT AT +0 FOR OCT, +1 FOR + DEC, +2 FOR - DEC.
28 # IF DSPCOUNT WAS LEFT -, NO MORE DATA IS ACCEPTED.
```

```
29
30      CAF      ZERO
31
32 NUM          TS      CHAR
33      CCS      DSPCOUNT
34      TC      +4        # +
35      TC      +3        # +0
36      TC      +1        # -BLOCK DATA IN IF DSPCOUNT IS -
37      TC      ENDOFJOB   # -0
38
39      TC      GETINREL
40      CCS      CLPASS    # IF CLPASS IS + OR +0, MAKE IT +0.
41      CAF      ZERO
42      TS      CLPASS
43      TC      +1
44      INDEX    CHAR
45      CAF      RELTAB
46      MASK     LOW5
47      TS      CODE
48      CA      DSPCOUNT
49      TS      COUNT
50      TC      DSPIN
51      CAF      THREE
```

	MASK	DECBRNCH	
	CCS	A	# +0, OCTAL. +1, + DEC. +2, - DEC.
	TC	DECTOBIN	# +
	INDEX	INREL	# +0 OCTAL
	XCH	VERBREG	
	TS	CYL	
	CS	CYL	
	CS	CYL	
	XCH	CYL	
	AD	CHAR	
	TC	ENDNMTST	
DECTOBIN	INDEX	INREL	
	XCH	VERBREG	
	TS	MPAC	# SUM X 2EXP-14 IN MPAC
	CAF	ZERO	
	TS	MPAC +1	
	CAF	TEN	# 10 X 2EXP-14
	TC	SHORTMP	# 10SUM X 2EXP-28 IN MPAC, MPAC+1
	XCH	MPAC +1	
	AD	CHAR	
	TS	MPAC +1	
	TC	ENDNMTST	# NO OF
	ADS	MPAC	# OF MUST BE 5TH CHAR
	TC	DECEND	
ENDNMTST	INDEX	INREL	
	TS	VERBREG	
	CS	DSPCOUNT	
	INDEX	INREL	
	AD	CRITCON	
	EXTEND		
	BZF	ENDNUM	# -0, DSPCOUNT CRITCON
	TC	MORNUM	# - , DSPCOUNT G/ CRITCON
ENDNUM	CAF	THREE	
	MASK	DECBRNCH	
	CCS	A	
	TC	DECEND	
ENDALL	CS	DSPCOUNT	# BLOCK NUMIN BY PLACING DSPCOUNT
	TC	MORNUM +1	# NEGATIVELY
DECEND	CS	ONE	
	AD	INREL	
	EXTEND		
	BZMF	ENDALL	# IF INREL 0,1 VBREG,NNREG LEAVE WHOLE
	TC	DMP	# IF INREL 2,3,4 R1,R2,R3 , CONVERT TO FRAC
			# MULT SUM X 2EXP-28 IN MPAC, MPAC+1 BY
	ADRES	DECON	# 2EXP14/10EXP5, GIVES SUM/10EXP5 X2EXP-14
	CAF	THREE	# IN MPAC, +1, +2.
	MASK	DECBRNCH	
	INDEX	A	
	TC	+0	
	TC	+DECSGN	

```
1
2      EXTEND          # - CASE
3      DCS      MPAC +1
4      DXCH     MPAC +1
5      +DECSGN  XCH     MPAC +2
6      INDEX    INREL
7      TS       XREGLP -2
8      XCH      MPAC +1
9      INDEX    INREL
10     TS       VERBREG
11     TC       ENDALL
12     MORNUM   CCS      DSPCOUNT      # DECREMENT DSPCOUNT
13     TS       DSPCOUNT
14     TC       ENDOFJOB
15
16     CRITCON  OCT      22      # DEC 18
17             OCT      20      # DEC 16
18             OCT      12      # DEC 10
19             OCT      5
20             OCT      0
21
22     DECON    2DEC     1 E-5 B14      # 2EXP14/10EXP5   .16384 DEC
23
24     # GETINREL GETS PROPER DATA REG REL ADDRESS FOR CURRENT C DSPCOUNT AND
25     # PUTS IN INTO INREL. +0 VERBREG, 1 NOUNREG, 2 XREG, 3 YREG, 4 ZREG.
26
27     GETINREL  INDEX    DSPCOUNT
28             CAF      INRELTAB
29             TS       INREL      # A TEMP. REG
30             TC       Q
31
32     INRELTAB  OCT      4      # R3D5  DSPCOUNT  0
33             OCT      4      # R3D4
34             OCT      4      # R3D3
35             OCT      4      # R3D2
36             OCT      4      # R3D1
37             OCT      3      # R2D5
38             OCT      3      # R2D4
39             OCT      3      # R2D3
40             OCT      3      # R2D2
41             OCT      3      # R2D1
42             OCT      2      # R1D5
43             OCT      2      # R1D4
44             OCT      2      # R1D3
45             OCT      2      # R1D2
46             OCT      2      # R1D1
47             TC       CCSHOLE  # NO DSPCOUNT NUMBER 15D
48             OCT      1      # ND2
49             OCT      1      # ND1
```

	OCT	0	# VD2	18D
	OCT	0	# VD1	19D
VERB	CAF	ZERO		
	TS	VERBREG		
NVCOM	CAF	VD1		
	TS	DSPCOUNT		
	TC	2BLANK		
	CAF	ONE		
	TS	DECBRNCH	# SET FOR DEC V/N CODE	
	CAF	ZERO		
	TS	REQRET	# SET FOR ENTPAS0	
	CAF	ENDINST	# IF DSPALARM OCCURS BEFORE FIRST ENTPAS0	
	TS	ENTRET	# OR NVSUB, ENTRET MUST ALREADY BE SET	
			# TO TC ENDOFJOB	
NOUN	TC	ENDOFJOB		
	CAF	ZERO		
	TS	NOUNREG		
	CAF	ND1	# ND1, OCT 21 DEC 17	
	TC	NVCOM		
NEGSGN	TC	SIGNTEST		
	TC	-ON		
BOTHSGN	CAF	TWO		
	INDEX	INREL	# SET DEC COMP BIT TO 1 IN DECBRNCH	
	AD	BIT7	# BIT 5 FOR R1. BIT 4 FOR R2.	
FIXCLPAS	ADS	DECBRNCH	# BIT 3 FOR R3.	
	CCS	CLPASS	# IF CLPASS IS + OR +0. MAKE IT +0.	
	CAF	ZERO		
	TS	CLPASS		
	TC	+1		
	TC	ENDOFJOB		
POSGN	TC	SIGNTEST		
	TC	+ON		
	CAF	ONE		
	TC	BOTHSGN		
+ON	LXCH	Q		
	TC	GETINREL		
	INDEX	INREL		
	CAF	SGNTAB -2		
	TS	SGNOFF		
	AD	ONE		
SGNCOM	TS	SGNON		
	CAF	ZERO		
	TS	CODE		
	XCH	SGNOFF		

```
1
2      TC      11DSPIN
3      CAF      BIT11
4
5      TS      CODE
6      XCH      SGNON
7      TC      11DSPIN
8
9      -ON      TC      L
10     LXCH      Q
11     TC      GETINREL
12
13     INDEX      INREL
14     CAF      SGNTAB -2
15     TS      SGNON
16
17     AD      ONE
18     TS      SGNOFF
19     TC      SGNCOM
20
21     SGNTAB      OCT      5      # -R1
22                  OCT      3      # -R2
23                  OCT      0      # -R3
24
25     SIGNTST      LXCH      Q      # ALLOWS +,- ONLY WHEN DSPCOUNT R1D1,
26                  CAF      THREE      # R2D1, OR R3D1.  ALLOWS ONLY FIRST OF
27                  MASK      DECBRNCH  # CONSECUTIVE +/- CHARACTERS.
28                  CCS      A      # IF LOW2 BITS OF DECBRNCH NOT 0, SIGN
29                  TC      ENDOFJOB    # FOR THIS WORD ALREADY IN. REJECT.
30                  CS      R1D1
31                  TC      SGNTST1
32                  CS      R2D1
33                  TC      SGNTST1
34                  CS      R3D1
35
36     SGNTST1      TC      SGNTST1
37                  TC      ENDOFJOB    # NO MATCH FOUND. SIGN ILLEGAL
38                  AD      DSPCOUNT
39
40                  EXTEND
41                  BZF      +2      # MATCH FOUND
42                  TC      Q
43                  TC      L      # SIGN LEGAL
44
45     # CLEAR BLANKS WHICH R1, R2, R3 IS CURRENT OR LAST TO BE DISPLAYED PERTINENT
46     # XREG, YREG, ZREG IS CLEARED . SUCCESSIVE CLEARS TAKE CARE OF EACH RX
47     # L/ RC UNTIL R1 IS DONE. THEN NO FURTHER ACTION.
48     #
49     # THE SINGLE COMPONENT LOAD VERBS ALLOW ONLY THE SINGLE RC THAT IS
50     # APPROPRIATE TO BE CLEARED.
51     #
52     # CLPASS      +0 PASS0, CAN BE BACKED UP
53     #              +NZ HIPASS, CAN BE BACKED UP
54     #              -NZ PASS0, CANNOT BE BACKED UP
```


CLEAR	CCS	DSPCOUNT	
	AD	ONE	
	TC	+2	
	AD	ONE	
	INDEX	A	# DO NOT CHANGE DSPCOUNT BECAUSE MAY LATER
	CAF	INRELTAB	# FAIL LEGALTST.
	TS	INREL	# MUST SET INREL, EVEN FOR HIPASS.
	CCS	CLPASS	
	TC	CLPASHI	# +
	TC	+2	# +0 IF CLPASS IS +0 OR -, IT IS PASS0
	TC	+1	# -
	CA	INREL	
	TC	LEGALTST	
	TC	CLEAR1	
CLPASHI	CCS	INREL	
	TS	INREL	
	TC	LEGALTST	
	CAF	DOUBLK +2	# +3 TO - NUMBER, BACKS DATA REQUESTS.
	ADS	REQRET	
	CA	INREL	
	TS	MIXTEMP	# TEMP STORAGE FOR INREL
	EXTEND		
	DIM	VERBREG	# DECREMENT VERB AND RE-DISPLAY
	TC	BANKCALL	
	CADR	UPDATVB	
	CA	MIXTEMP	
	TS	INREL	# RESTORE INREL
CLEAR1	TC	CLR5	
	INCR	CLPASS	# ONLY IF CLPASS IS + OR +0.
	TC	ENDOFJOB	# SET FOR HIGHER PASS.
CLR5	LXCH	Q	# USES 5BLANK BUT AVOIDS ITS TC GETINREL
	TC	5BLANK +2	
LEGALTST	AD	NEG2	
	CCS	A	
	TC	Q	# LEGAL INREL G/ 2
	TC	CCSHOLE	
	TC	ENDOFJOB	# ILLEGAL INREL 0,1
	TC	Q	# LEGAL INREL 2
# 5BLANK BLANKS 5 CHAR DISPLAY WORD IN R1, R2, OR R3. IT ALSO ZEROES XREG,			
# YREG, OR ZREG. PLACE ANY + DSPCOUNT NUMBER FOR PERTINENT RC INTO DSPCOUNT.			
# DSPCOUNT IS LEFT SET TO LEFT MOST DSP NUMB FOR RC JUST BLANKED.			
	TS	DSPCOUNT	# NEEDED FOR BLANKSUB
5BLANK	LXCH	Q	
	TC	GETINREL	
	CAF	ZERO	
	INDEX	INREL	
	TS	VERBREG	# ZERO X, Y, Z, REG.

	INDEX	INREL	
	TS	XREGLP	-2
	TS	CODE	
	INDEX	INREL	# ZERO PERTINENT DEC COMP BIT.
	CS	BIT7	# PROTECT OTHERS
	MASK	DECBRNCH	
	MASK	BRNCHCON	# ZERO LOW 2 BITS.
	TS	DECBRNCH	
	INDEX	INREL	
	CAF	SINBLANK	-2 # BLANK ISOLATED CHAR SEPARATELY
	TS	COUNT	
5BLANK1	TC	DSPIN	
	INDEX	INREL	
	CAF	DOUBLK	-2
	TS	DSPCOUNT	
	TC	2BLANK	
	CS	TWO	
	ADS	DSPCOUNT	
	TC	2BLANK	
	INDEX	INREL	
	CAF	R1D1	-2
	TS	DSPCOUNT	# SET DSPCOUNT TO LEFT MOST DSP NUMBER
	TC	L	# OF REG. JUST BLANKED
SINBLANK	OCT	16	# DEC 14
	OCT	5	
	OCT	4	
DOUBLK	OCT	15	# DEC 13
	OCT	11	# DEC 9
	OCT	3	
BRNCHCON	OCT	77774	
# 2BLANK BLANKS TWO CHAR. PLACE DSP NUMBER OF LEFT CHAR OF THE PAIR INTO			
# DSPCOUNT. THIS NUMBER IS LEFT IN DSPCOUNT			
2BLANK	CA	DSPCOUNT	
	TS	SR	
	CS	BLANKCON	
	INHINT		
	INDEX	SR	
	XCH	DSPTAB	
	EXTEND		
	BZMF	+2	# IF OLD CONTENTS -, NOUT OK
	INCR	NOUT	# IF OLD CONTENTS +, +1 TO NOUT
	RELINT		# IF -, NOUT OK
	TC	Q	
BLANKCON	OCT	4000	

```
# ENTER PASS 0 IS THE EXECUTE FUNCTION. HIGHER ORDER ENTERS ARE TO LOAD
# DATA. THE SIGN OF REQRET DETERMINES THE PASS, + FOR PASS 0, - FOR HIGHER
# PASSES.
#
# MACHINE CADR TO BE SPECIFIED MCTBS NOUNS DESIRE AN ECADR TO BE LOADED
# WHEN USED WITH LOAD VERBS, MONITOR VERBS, OR DISPLAY VERBS EXCEPT
# VERB FIXED MEMORY DISPLAY, WHICH REQUIRES AN FCADR .
```

```
BANK 41
SETLOC PINBALL2
BANK
```

```
NVSUBB      COUNT*  $$/PIN
LOADLV1     TC      NVSUB1      # STANDARD LEAD INS. DONT MOVE.
            TC      LOADLV
            # END OF STANDARD LEAD INS.
```

```
ENTER       CAF      ZERO
            TS      CLPASS
            CAF      ENDINST
            TS      ENTRET
            CCS      REQRET
            TC      ENTPAS0      # IF +, PASS 0
            TC      ENTPAS0      # IF +, PASS 0
            TC      +1           # IF -, NOT PASS 0
ENTPASHI     CAF      MMADREF
            AD      REQRET      # IF L/ 2 CHAR IN FOR MM CODE, ALARM
            EXTEND             # AND RECYCLE DECIDE AT MMCHANG+1 .
```

```
BZF         ACCEPTWD
CAF         THREE      # IF DEC, ALARM IF L/ 5 CHAR IN FOR DATA,
MASK        DECBRNCH   # BUT LEAVE REQRET - AND FLASH ON, SO
            CCS        A      # OPERATOR CAN SUPPLY MISSING NUMERICAL
            TC         +2     # CHARACTERS AND CONTINUE.
            TC         ACCEPTWD # OCTAL. ANY NUMBER OF CHAR OK.
            CCS        DSPCOUNT
            TC         GODSPALM # LESS THAN 5 CHAR DEC DSPCOUNT IS +
            TC         GODSPALM # LESS THAN 5 CHAR DEC DSPCOUNT IS +
ACCEPTWD     TC         +1     # 5 CHAR IN DSPCOUNT IS -
            CS         REQRET  # 5 CHAR IN DSPCOUNT IS -
            TS         REQRET  # SET REQRET +.
            TC         FLASHOFF
            TC         REQRET
```

```
ENTEXIT     ENTRET
```

```
MMADREF     ADRES     MMCHANG +1      # ASSUMES TC REQMM AT MMCHANG.
```

LOWVERB	DEC	28	# LOWER VERB THAT AVOIDS NOUN TEST.
ENTPAS0	CAF	ZERO	# NOUN VERB SUB ENTERS HERE
	TS	DECBRNCH	
	CS	VD1	# BLOCK FURTHER NUM CHAR, SO THAT STRAY
TESTVB	TS	DSPCOUNT	# CHAR DO NOT GET INTO VERB OR NOUN LTS.
	CS	VERBREG	# IF VERB IS G/E LOWVB, SKIP NOUN TEST.
	TS	VERBSAVE	# SAVE VERB FOR POSSIBLE RECYCLE.
	AD	LOWVERB	# LOWVERB - VB
	EXTEND		
	BZMF	VERBFAN	# VERB G/ E LOWVERB
TESTNN	EXTEND		# VERB L/ LOWVERB
	DCA	LODNNLOC	# SWITCH BANKS TO NOUN TABLE READING
	DXCH	Z	# ROUTINE.
	INDEX	MIXBR	
	TC	+0	
	TC	+2	# NORMAL
	TC	MIXNOUN	# MIXED
	CCS	NNADTEM	# NORMAL
	TC	VERBFAN -2	# NORMAL IF +
	TC	GODSPALM	# NOT IN USE IF +0
	TC	REQADD	# SPECIFY MACHINE CADR IF -
	INCR	NOUNCADR	# AUGMENT MACHINE CADR IF -0
	TC	SETNADD	# ECADR FROM NOUNCADR, SETS EB, NOUNADD.
	TC	INTMCTBS +2	
REQADD	CAF	BIT15	# SET CLPASS FOR PASS 0 ONLY
	TS	CLPASS	
	CS	ENDINST	# TEST IF REACHED HERE FROM INTERNAL OR
	AD	ENTEXIT	# FROM EXTERNAL
	EXTEND		
	BZF	+2	# EXTERNAL MACH CADR TO BE SPECIFIED
	TC	INTMCTBS	
	TC	REQDATZ	# EXTERNAL MACH CADR TO BE SPECIFIED
	CCS	DECBRNCH	# ALARM AND RECYCLE IF DECIMAL USED
	TC	ALMCYCLE	# FOR MCTBS.
	CS	VD1	# OCTAL USED OK
	TS	DSPCOUNT	# BLOCK NUM CHAR IN
	CCS	CADRSTOR	
	TC	+3	# EXTERNAL MCTBS DISPLAY WILL LEAVE FLASH
	TC	USEADD	# ON IF ENDIDLE NOT +0.
	TC	+1	
USEADD	TC	FLASHON	
	XCH	ZREG	
	TC	SETNCADR	# ECADR INTO NOUNCADR. SET EB, NOUNADD.
	EXTEND		
	DCA	LODNNLOC	# SWITCH BANKS TO NOUN TABLE READING
	DXCH	Z	# ROUTINE.
	TC	VERBFAN	
	EBANK	DSPCOUNT	

LODNNLOC	2CADR	LODNNTAB	
NEG5	OCT	77772	
INTMCTBS	CA	MPAC +2	# INTERNAL MACH CADR TO BE SPECIFIED.
	TC	SETNCADR	# ECADR INTO NOUNCADR. SET EB. NOUNADD.
	CS	FIVE	# NVSUB CALL LEFT CADR IN MPAC+2 FOR MACH
	AD	VERBREG	# CADR TO BE SPECIFIED.
	EXTEND		
	BZF	VERBFAN	# DONT DISPLAY CADR IF VB 05.
	CAF	R3D1	# VB NOT 05. DISPLAY CADR.
	TS	DSPCOUNT	
	CA	NOUNCADR	
	TC	DSPOCTWO	
	TC	VERBFAN	
	AD	ONE	
VERBFAN	TC	SETNCADR	# ECADR INTO NOUNCADR. SETS EB, NOUNADD.
	CS	LST2CON	
	AD	VERBREG	# VERB LST2CON
	CCS	A	
	AD	ONE	# VERB G/ LST2CON
	TC	+2	
	TC	VBFANDIR	# VERB L/ LST2CON
	TS	MPAC	
	TC	RELDSP	# RELEASE DISPLAY SYST
	TC	POSTJUMP	# GO TO GOEXTVB WITH VB 40 IN MPAC.
LST2CON	CADR	GOEXTVB	
	DEC	40	# FIRST LIST2 VERB EXTENDED VERB
VBFANDIR	INDEX	VERBREG	
	CAF	VERBTAB	
	TC	BANKJUMP	
VERBTAB	CADR	GODSPALM	# VB00 ILLEGAL
	CADR	DSPA	# VB01 DISPLAY OCT COMP 1 R1
	CADR	DSPB	# VB02 DISPLAY OCT COMP 2 R1
	CADR	DSPC	# VB03 DISPLAY OCT COMP 3 R1
	CADR	DSPAB	# VB04 DISPLAY OCT COMP 1,2 R1,R2
	CADR	DSPABC	# VB05 DISPLAY OCT COMP 1,2,3 R1,R2,R3
	CADR	DECDSP	# VB06 DECIMAL DISPLAY
	CADR	DSPDPDEC	# VB07 DP DECIMAL DISPLAY R1,R2
	CADR	GODSPALM	# VB08 SPARE
	CADR	GODSPALM	# VB09 SPARE
	CADR	DSPALARM	# VB10 SPARE
	CADR	MONITOR	# VB11 MONITOR OCT COMP 1 R1
	CADR	MONITOR	# VB12 MONITOR OCT COMP 2 R1
	CADR	MONITOR	# VB13 MONITOR OCT COMP 3 R1
	CADR	MONITOR	# VB14 MONITOR OCT COMP 1,2 R1,R2

	CADR	MONITOR	# VB15 MONITOR OCT COMP 1,2,3 R1,R2,R3
	CADR	MONITOR	# VB16 MONITOR DECIMAL
	CADR	MONITOR	# VB17 MONITOR DP DEC R1,R2
	CADR	GODSPALM	# VB18 SPARE
	CADR	GODSPALM	# VB19 SPARE
	CADR	GODSPALM	# VB20 SPARE
	CADR	ALOAD	# VB21 LOAD COMP 1 R1
	CADR	BLOAD	# VB22 LOAD COMP 2 R2
	CADR	CLOAD	# VB23 LOAD COMP 3 R3
	CADR	ABLOAD	# VB24 LOAD COMP 1,2 R1,R2
	CADR	ABCLOAD	# VB25 LOAD COMP 1,2,3 R1,R2,R3
	CADR	GODSPALM	# VB26 SPARE
	CADR	DSPFMEM	# VB27 FIXED MEMORY DISPLAY
			# THE FOLLOWING VERBS MAKE NO NOUN TEST
	CADR	GODSPALM	# VB28 SPARE
	CADR	GODSPALM	# VB29 SPARE
REQEXLOC	CADR	VBRQEXEC	# VB30 REQUEST EXECUTIVE
	CADR	VBRQWAIT	# VB31 REQUEST WAITLIST
	CADR	VBRESEQ	# VB32 RESEQUENCE
	CADR	VBPROC	# VB33 PROCEED WITHOUT DATA
	CADR	VBTERM	# VB34 TERMINATE CURRENT TEST OR LOAD REQ
	CADR	VBTSTLTS	# VB35 TEST LIGHTS
	CADR	SLAP1	# VB36 FRESH START
	CADR	MMCHANG	# VB37 CHANGE MAJOR MODE
	CADR	GODSPALM	# VB38 SPARE
	CADR	GODSPALM	# VB39 SPARE

THE LIST2 VERBFAN IS LOCATED IN THE EXTENDED VERB BANK.

NNADTAB CONTAINS A RELATIVE ADDRESS, IDADDREL IN LOW 10 BITS , REFERRING
TO WHERE 3 CONSECUTIVE ADDRESSES ARE STORED IN IDADDTAB .
MIXNOUN GETS DATA AND STORES IN MIXTEMP,+1,+2. IT SETS NOUNADD FOR
MIXTEMP.

MIXNOUN	CCS	NNADTEM	
	TC	+4	# + IN USE
	TC	GODSPALM	# +0 NOT IN USE
	TC	+2	# - IN USE
	TC	+1	# -0 IN USE
	CS	SIX	
	AD	VERBREG	
	EXTEND		
	BZMF	+2	# VERB L/E 6
	TC	VERBFAN	# AVOID MIXNOUN SWAP IF VB NOT DISPLAY
MIXNN1	CAF	TWO	
	TS	DECOUNT	
	AD	MIXAD	
	TS	NOUNADD	# SET NOUNADD TO MIXTEMP + K
	INDEX	DECOUNT	# GET IDADDTAB ENTRY FOR COMPONENT K
	CA	IDADITEM	# OF NOUN.
	TS	NOUNTEM	
			# TEST FOR DP FOR OCT DISPLAY . IF SO, GET
			# MINOR PART ONLY.
	TC	SFRUTMIX	# GET SF ROUT NUMBER IN A
	TC	DPTEST	
	TC	MIXNN2	# NO DP
MIXNN2	INCR	NOUNTEM	# DP GET MINOR PART
	CA	NOUNTEM	
	MASK	LOW11	# ESUBK NO DP OR ESUBK +1 GARBLED FOR DP
	TC	SETEBANK	# SET EBANK, LEAVE EADRES IN A.
	INDEX	A	# PICK UP C ESUBK NOT DP
	CA	0	# OR C ESUBK +1 FOR DP MINOR PART
	INDEX	NOUNADD	
	XCH	0	# STORE IN MIXTEM + K
	CCS	DECOUNT	
	TC	MIXNN1	
	TC	VERBFAN	

MIXAD TC MIXTEMP

DPTTEST ENTER WITH SF ROUT NUMBER IN A.
RETURNS TO L+1 IF NO DP.
RETURNS TO L+2 IF DP.

DPTTEST	INDEX	A	
	TCF	+1	
	TC	Q	# OCTAL ONLY NO DP
	TC	Q	# FRACT NO DP

	TC	Q	# DEG NO DP
	TC	Q	# ARITH NO DP
	TCF	DPTEST1	# DP1OUT
	TCF	DPTEST1	# DP2OUT
	TC	Q	# LRPOSOUT NO DP DATA IN CHANNEL 33
	TCF	DPTEST1	# DP3OUT
	TC	Q	# HMS NO DP
	TC	Q	# M/S NO DP
	TCF	DPTEST1	# DP4OUT
	TC	Q	# ARITH1 NO DP
	TC	Q	# 2INTOUT NO DP TO GET HI PART IN MPAC
	TC	Q	# 360-CDU NO DP
DPTEST1	INDEX	Q	
	TC	1	# RETURN TO L+2
REQDATX	CAF	R1D1	
	TCF	REQCOM	
REQDATY	CAF	R2D1	
	TCF	REQCOM	
REQDATZ	CAF	R3D1	
REQCOM	TS	DSPCOUNT	
	CS	Q	
	TS	REQRET	
	TC	BANKCALL	
	CADR	5BLANK	
	TC	FLASHON	
ENDRQDAT	TC	ENTEXIT	
	TS	NOUNREG	
UPDATNN	XCH	Q	
	TS	UPDATRET	
	EXTEND		
	DCA	LODNNLOC	# SWITCH BANKS TO NOUN TABLE READING
	DXCH	Z	# ROUTINE.
	CCS	NNADTEM	
	AD	ONE	# NORMAL
	TCF	PUTADD	
	TCF	PUTADD +1	# MCTBS DONT CHANGE NOUNADD
	TCF	PUTADD +1	# MCTBI DONT CHANGE NOUNADD
PUTADD	TC	SETNCADR	# ECADR INTO NOUNCADR. SETS EB. NOUNADD.
	CAF	ND1	
	TS	DSPCOUNT	
	CA	NOUNREG	
	TCF	UPDAT1	
	TS	VERBREG	
UPDATVB	XCH	Q	
	TS	UPDATRET	
	CAF	VD1	

1					1
2		TS	DSPCOUNT		2
3		CA	VERBREG		3
4	UPDAT1	TC	POSTJUMP	# CANT USE SWCALL TO GO TO DSPDECVN, SINCE	4
5		CADR	GOVNUPDT	# UPDATVB CAN ITSELF BE CALLED BY SWCALL.	5
6		TC	UPDATRET		6
7					7
8	GOALMCYC	TC	ALMCYCLE	# NEEDED BECAUSE BANKJUMP CANT HANDLE F/F.	8
9					9
10	GODSPALM	TC	POSTJUMP		10
11		CADR	DSPALARM		11
12					12
13					13
14					14
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60					60

NOUN TABLES

NOUN CODE L/40, NORMAL NOUN CASE. NOUN CODE G/E 40, MIXED NOUN CASE.
FOR NORMAL CASE, NNADTAB CONTAINS ONE ECADR FOR EACH NOUN.
+0 INDICATES NOUN NOT USED. - ENTRY INDICATES MACHINE CADR E OR F TO
BE SPECIFIED. -1 INDICATES CHANNEL TO BE SPECIFIED. -0 INDICATES AUGMENT
OF LAST MACHINE CADR SUPPLIED.

FOR MIXED CASE, NNADTAB CONTAINS ONE INDIRECT ADDRESS IDADDREL IN LOW
10 BITS, AND THE COMPONENT CODE NUMBER IN THE HIGH 5 BITS.

NNTYPTAB IS A PACKED TABLE OF THE FORM MMMMMNNNNNPPPPP.

FOR THE NORMAL CASE, M S ARE THE COMPONENT CODE NUMBER.

N S ARE THE SF ROUTINE CODE NUMBER.

P S ARE THE SF CONSTANT CODE NUMBER.

MIXED-CASE, M S ARE THE SF CONSTANT3 CODE NUMBER 3 COMPONENT CASE

N S ARE THE SF CONSTANT2 CODE NUMBER

P S ARE THE SF CONSTANT1 CODE NUMBER

N S ARE THE SF CONSTANT2 CODE NUMBER 2 COMPONENT CASE

P S ARE THE SF CONSTANT1 CODE NUMBER

P S ARE THE SF CONSTANT1 CODE NUMBER 1 COMPONENT CASE

THERE IS ALSO AN INDIRECT ADDRESS TABLE IDADDTAB FOR MIXED CASE ONLY.
EACH ENTRY CONTAINS ONE ECADR. IDADDREL IS THE RELATIVE ADDRESS OF
THE FIRST OF THESE ENTRIES.

THERE IS ALSO A SCALE FACTOR ROUTINE NUMBER TABLE RUTMXTAB FOR MIXED
CASE ONLY. THERE IS ONE ENTRY PER MIXED NOUN. THE FORM IS,

QQQQRRRRRSSSSS

Q S ARE THE SF ROUTINE 3 CODE NUMBER 3 COMPONENT CASE

R S ARE THE SF ROUTINE 2 CODE NUMBER

S S ARE THE SF ROUTINE 1 CODE NUMBER

R S ARE THE SF ROUTINE 2 CODE NUMBER 2 COMPONENT CASE

S S ARE THE SF ROUTINE 1 CODE NUMBER

IN OCTAL DISPLAY AND LOAD OCT OR DEC VERBS, EXCLUDE USE OF VERBS WHOSE
COMPONENT NUMBER IS GREATER THAN THE NUMBER OF COMPONENTS IN NOUN.

ALL MACHINE ADDRESS TO BE SPECIFIED NOUNS ARE 3 COMPONENT.

IN MULTI-COMPONENT LOAD VERBS, NO MIXING OF OCTAL AND DECIMAL DATA
COMPONENT WORDS IS ALLOWED. ALARM IF VIOLATION.

IN DECIMAL LOADS OF DATA, 5 NUMERICAL CHARACTERS MUST BE KEYED IN
BEFORE EACH ENTER. IF NOT, ALARM.

DISPLAY VERBS

DSPABC	CS	TWO	
	TC	COMPTST	
	INDEX	NOUNADD	
DSPAB	CS	2	
	XCH	BUF	+2
	CS	ONE	
	TC	COMPTST	
	INDEX	NOUNADD	
	CS	1	
DSPA	XCH	BUF	+1
	TC	DECTEST	
	TC	TSTFORDP	
	INDEX	NOUNADD	
DSPCOM1	CS	0	
	XCH	BUF	
DSPB	TC	DSPCOM2	
	CS	ONE	
	TC	DCOMPTST	
	INDEX	NOUNADD	
	CS	1	
	TC	DSPCOM1	
DSPC	CS	TWO	
	TC	DCOMPTST	
	INDEX	NOUNADD	
	CS	2	
DSPCOM2	TC	DSPCOM1	
	CS	TWO	# A B C AB ABC
	AD	VERBREG	# -1 -0 +1 +2 +3 IN A
	CCS	A	# +0 +0 +0 +1 +2 IN A AFTER CCS
	TC	DSPCOM3	
	TC	ENTEXIT	
	TC	+1	
DSPCOM3	TS	DISTEM	# +0 +1 +2 INTO DISTEM
	INDEX	A	
	CAF	R1D1	
	TS	DSPCOUNT	
	INDEX	DISTEM	
	CS	BUF	
	TC	DSPOCTWO	
	XCH	DISTEM	
	TC	DSPCOM2	+2

COMPTST ALARMS IF COMPONENT NUMBER OF VERB LOAD OR OCT DISPLAY IS
GREATER THAN THE HIGHEST COMPONENT NUMBER OF NOUN.

COMPTST	TS	SFTEMP1	# VERB COMP
	LXCH	Q	
COMPTST1	TC	GETCOMP	
	TC	LEFT5	
	MASK	THREE	# NOUN COMP

	AD	SFTEMP1	# NOUN COMP	VERB COMP
	CCS	A		
	TC	L	# NOUN COMP	G/ VERB COMP
	TC	CCSHOLE		
	TC	GODSPALM	# NOUN COMP	L/ VERB COMP
NDCMPTST	TC	L	# NOUN COMP	VERB COMP
# DCOMPTST ALARMS IF DECIMAL ONLY BIT BIT4 OF COMP CODE NUMBER 1.				
# IF NOT, IT PERFORMS REGULAR COMPTST.				
DCOMPTST	TS	SFTEMP1	# - VERB COMP	
	LXCH	Q		
	TC	DECTEST		
	TC	COMPTST1		
DECTEST	EXTEND		# ALARMS IF DEC ONLY BIT 1	BIT4 OF COMP
	QXCH	MPAC +2	# CODE NUMBER .	RETURNS IF NOT.
	TC	GETCOMP		
	MASK	BIT14		
	CCS	A		
	TC	GODSPALM		
	TC	MPAC +2		
DCTSTCYC	LXCH	Q	# ALARMS AND RECYCLES IF DEC ONLY BIT 1	
	TC	GETCOMP	# BIT4 OF COMP CODE NUMBER .	RETURNS
	MASK	BIT14	# IF NOT. USED BY LOAD VERBS.	
	CCS	A		
	TC	ALMCYCLE		
	TC	L		
# NOUNTEST ALARMS IF NO-LOAD BIT BITS5 OF COMP CODE NUMBER 1.				
# IF NOT, IT RETURNS.				
NOUNTEST	LXCH	Q		
	TC	GETCOMP		
	CCS	A		
	TC	L		
	TC	L		
	TC	GODSPALM		
TSTFORDP	LXCH	Q	# TEST FOR DP. IF SO, GET MINOR PART ONLY.	
	CA	NNADTEM		
	AD	ONE	# IF NNADTEM -1, CHANNEL TO BE SPECIFIED	
	EXTEND			
	BZF	CHANDSP		
	INDEX	MIXBR		
	TC	+0		
	TC	+2	# NORMAL	

	TC	L	# MIXED CASE ALREADY HANDLED IN MIXNOUN
	TC	SFRUTNOR	
	TC	DPTEST	
	TC	L	# NO DP
	INCR	NOUNADD	# DP E+1 INTO NOUNADD FOR MINOR PART.
	TC	L	
CHANDSP	CA	NOUNCADR	
	MASK	LOW9	
	EXTEND		
	INDEX	A	
	READ	0	
	CS	A	
	TCF	DSPCOM1	
COMPICK	ADRES	NNTYPTM	
	ADRES	NNADTEM	
GETCOMP	INDEX	MIXBR	# NORMAL
	CAF	COMPICK -1	# ADRES NNTYPTM
			MIXED
	INDEX	A	ADRES NNADTEM
	CA	0	# C NNTYPTM
	MASK	H15	# GET H15 OF NNTYPTAB NORM C NNADTEM
			OF NNADTAB MIX
	TC	Q	
DECDSP	TC	GETCOMP	
	TC	LEFT5	
	MASK	THREE	
	TS	DECOUNT	# COMP NUMBER INTO DECOUNT
DSPDCGET	TS	DECTEM	# PICKS UP DATA
	AD	NOUNADD	# DECTEM 1COMP +0, 2COMP +1, 3COMP +2
	INDEX	A	
	CS	0	
	INDEX	DECTEM	
	XCH	XREG	# CANT USE BUF SINCE DMP USES IT.
	CCS	DECTEM	
DSPDCPUT	TC	DSPDCGET	# MORE TO GET
	CAF	ZERO	# DISPLAYS DATA
	TS	MPAC +1	# DECOUNT 1COMP +0, 2COMP +1, 3COMP +2
	TS	MPAC +2	
	INDEX	DECOUNT	
	CAF	R1D1	
	TS	DSPCOUNT	
	INDEX	DECOUNT	
	CS	XREG	
	TS	MPAC	
	TC	SFCONUM	# 2X SF CON NUMB IN A

```
1
2      TS      SFTEMP1
3      EXTEND
4      DCA      GTSFOUTL      # SWITCH BANKS TO SF CONSTANT TABLE
5      DXCH      Z      # READING ROUTINE.
6      INDEX      MIXBR      # LOADS SFTEMP1, SFTEMP2
7      TC      +0
8      TC      DSPSFNOR
9      TC      SFRUTMIX
10     TC      DECDSP3
11
12     DSPSFNOR      TC      SFRUTNOR
13                  TC      DECDSP3
14
15                  EBANK      DSPCOUNT
16     GTSFOUTL      ZCADR      GTSFOUT
17
18     DSPDCEND      TC      BANKCALL      # ALL SFOUT ROUTINES END HERE
19                  CADR      DSPDECWD
20                  CCS      DECOUNT
21                  TC      +2
22                  TC      ENTEXIT
23                  TS      DECOUNT
24                  TC      DSPDCPUT      # MORE TO DISPLAY
25
26     DECDSP3      INDEX      A
27                  CAF      SFOUTABR
28                  TC      BANKJUMP
29
30     SFOUTABR      CADR      PREDSPAL      # ALARM IF DEC DISP WITH OCTAL ONLY NOUN
31                  CADR      DSPDCEND
32                  CADR      DEGOUTSF
33                  CADR      ARTOUTSF
34                  CADR      DP1OUTSF
35                  CADR      DP2OUTSF
36                  CADR      LRPOSOUT
37                  CADR      DP3OUTSF
38                  CADR      HMSOUT
39                  CADR      M/SOUT
40                  CADR      DP2OUTSF
41                  CADR      AROUT1SF
42                  CADR      2INTOUT
43                  CADR      360-CDUO
44     ENDRTOUT      EQUALS
45
46     # THE FOLLOWING IS A TYPICAL SF ROUTINE. IT USES MPAC. LEAVES RESULTS
47     # IN MPAC, MPAC+1. ENDS WITH TC DSPDCEND
48
49
50
51
52
53
54
55
56
57
58
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60
```

SETLOC BLANKCON +1

COUNT* \$\$/PIN

DEGOUTSF SCALES BY .18 THE LOW 14 BITS OF ANGLE, ADDING .18 FOR
NUMBERS IN THE NEGATIVE AGC RANGE.

DEGOUTSF	CAF	ZERO	
	TS	MPAC +2	# SET INDEX FOR FULL SCALE.
	TC	FIXRANGE	
	TC	+2	# NO AUGMENT NEEDED SFTEMP1 AND 2 ARE 0
	TC	SETAUG	# SET AUGMENTER ACCORDING TO C MPAC +2
	TC	DEGCOM	

360-CDUD COMPUTES 360 - CDU ANGLE IN MPAC, STORES RESULT IN MPAC AND
GOES TO DEGOUTSF.

360-CDUD	TC	360-CDU	
	TC	DEGOUTSF	
360-CDU	CA	MPAC	
	MASK	POSMAX	# IF ANGLE IS 0 OR 180 DEGREES, DO NOTHING
	EXTEND		
	BZF	360-CDUE	
	CS	MPAC	# COMPUTE 360 DEGREES MINUS ANGLE
	AD	ONE	
	TS	MPAC	
360-CDUE	TC	Q	

LRPOSOUT DISPLAYS +0,1,2, OR 3 WHOLE FOR CHANNEL 33, BITS 7-6 11,10,
01,00 RESPECTIVELY

LRPOSOUT	EXTEND		
	READ	CHAN33	
	EXTEND		
	MP	BIT10	# BITS 7-6 TO BITS 2-1
	COM		
	MASK	THREE	
	TS	MPAC	
	TC	ARTOUTSF	# DISPLAY AS WHOLE

SETAUG	EXTEND		# LOADS SFTEMP1 AND SFTEMP2 WITH THE
	INDEX	MPAC +2	# DP AUGMENTER CONSTANT
	DCA	DEGTAB	
	DXCH	SFTEMP1	
	TC	Q	

FIXRANGE	CCS	MPAC	# IF MPAC IS + RETURN TO L+1
	TC	Q	# IF MPAC IS - RETURN TO L+2 AFTER
	TC	Q	# MASKING OUT THE SIGN BIT
	TCF	+1	

	CS	BIT15	
	MASK	MPAC	
	TS	MPAC	
	INDEX	Q	
	TC	1	
DEGCOM	EXTEND		# LOADS MULTIPLIER, DOES SHORTMP, AND
	INDEX	MPAC +2	# ADDS AUGMENTER.
	DCA	DEGTAB	
	DXCH	MPAC	# ADJUSTED ANGLE IN A
	TC	SHORTMP	
	DXCH	SFTEMP1	
	DAS	MPAC	
	TC	SCOUTEND	
DEGTAB	OCT	05605	# HI PART OF .18
	OCT	03656	# LOW PART OF .18
	OCT	16314	# HI PART OF .45
	OCT	31463	# LO PART OF .45
ARTOUTSF	DXCH	SFTEMP1	# ASSUMES POINT AT LEFT OF DP SFCON
	DXCH	MPAC	
	TC	PRSHRTMP	# IF C A -0, SHORTMP FAILS TO GIVE -0.
SCOUTEND	TC	POSTJUMP	
	CADR	DSPDCEND	
AROUT1SF	DXCH	SFTEMP1	# ASSUMES POINT BETWEEN HI AND LO PARTS OF
	DXCH	MPAC	# DP SFCON. SHIFTS RESULTS LEFT 14, BY
	TC	PRSHRTMP	# TAKING RESULTS FROM MPAC+1, MPAC+2.
	TC	L14/OUT	
DP1OUTSF	TC	DPOUT	# SCALES MPAC, MPAC +1 BY DP SCALE FACTOR
L14/OUT	XCH	MPAC +2	# IN SFTEMP1, SFTEMP2. THEN SCALE RESULT
	XCH	MPAC +1	# BY B14
	TS	MPAC	
	TC	SCOUTEND	
DP2OUTSF	TC	DPOUT	# SCALES MPAC, MPAC +1 BY DP SCALE FACTOR
	TC	SCOUTEND	
DP3OUTSF	TC	DPOUT	# ASSUMES POINT BETWEEN BITS 7-8 OF HIGH
	CAF	SIX	# LEFT BY 7, ROUNDS MPAC+2 INTO MPAC+1.
	TC	TPLEFTN	# SHIFT LEFT 7.
	TC	SCOUTEND	

```
1 MPAC+6          MPAC +6          # USE MPAC +6 INSTEAD OF OVFind
2
3
4 DPOUT          XCH      Q
5                TS      MPAC+6
6                TC      READLO      # GET FRESH DATA FOR BOTH HI AND LO.
7                TC      TPAGREE      # MAKE DP DATA AGREE
8                TC      DMP
9                ADRES    SFTEMP1
10               TC      MPAC+6
11
12 # THE FOLLOWING ROUTINE DISPLAYS TWO CONTIGUOUS SP POSITIVE INTEGERS
13 # AS TWO POSITIVE DECIMAL INTEGERS IN RXD1-RXD2 AND RXD4-RXD5  RXD3 IS
14 # BLANKED .  THE INTEGER IN THE LOWER NUMBERED ADDRESS IS DISPLAYED IN
15 # RXD1-RXD2.
16
17 2INTOUT        TC      5BLANK      # TO BLANK RXD3
18               TC      +ON         # TURN ON + SIGN
19               CA      MPAC
20               TC      DSPDECVN      # DISPLAY 1ST INTEGER  LIKE VERB AND NOUN
21               CS      THREE
22               INDEX    DECOUNT
23               AD      R1D1         # RXD4
24               TS      DSPCOUNT
25               TC      READLO      # GET 2ND INTEGER
26               CA      MPAC +1
27               TC      DSPDECVN      # DISPLAY 2ND INTEGER  LIKE VERB AND NOUN
28               TC      POSTJUMP
29               CADR     DSPDCEND +2
30
31 # READLO PICKS UP FRESHDATA FOR BOTH HI AND LO AND LEAVES IT IN
32 # MPAC, MPAC+1.  THIS IS NEEDED FOR TIME DISPLAY.  IT ZEROES MPAC+2, BUT
33 # DOES NOT FORCE TPAGREE.
34
35 READLO         XCH      Q
36               TS      TEM4
37               INDEX    MIXBR
38               TC      +0
39               TC      RDLONOR
40               INDEX    DECOUNT
41               CA      IDAD1TEM      # GET IDADDTAB ENTRY FOR COMP K OF NOUN.
42               MASK     LOW11        # E SUBK
43               TC      SETEBANK      # SET EB, LEAVE EADRES IN A.
44 READLO1        EXTEND      # MIXED          NORMAL
45               INDEX    A           # C ESUBK          C E
46               DCA      0           # C E SUBK +1        C E+1
47               DXCH     MPAC
48               CAF      ZERO
49               TS      MPAC      +2
50               TC      TEM4
51
52
53
54
55
56
57
58
59
60
```


RDONOR	CA	NOUNADD	# E
ENDRDLO	TC	READLO1	
	BANK	42	
	SETLOC	PINBALL3	
	BANK		
	COUNT*	\$\$/PIN	
HMSOUT	TC	BANKCALL	# READ FRESH DATA FOR HI AND LO INTO MPAC,
	CADR	READLO	# MPAC+1.
	TC	TPAGREE	# MAKE DP DATA AGREE.
	TC	SEPSECNR	# LEAVE FRACT SEC/60 IN MPAC, MPAC+1. LEAVE
			# WHOLE MIN IN BIT13 OF LOTEMOUT AND ABOVE
	TC	DMP	# USE ONLY FRACT SEC/60 MOD 60
	ADRES	SECON2	# MULT BY .06
	CAF	R3D1	# GIVES CENTI-SEC/10EXP5 MOD 60
	TS	DSPCOUNT	
	TC	BANKCALL	# DISPLAY SEC MOD 60
	CADR	DSPDECWD	
	TC	SEPMIN	# REMOVE REST OF SECONDS
	CAF	MINCON2	# LEAVE FRACT MIN/60 IN MPAC+1. LEAVE
	XCH	MPAC	# WHOLE HOURS IN MPAC.
	TS	HITEMOUT	# SAVE WHOLE HOURS.
	CAF	MINCON2 +1	
	XCH	MPAC +1	# USE ONLY FRACT MIN/60 MOD 60
	TC	PRSHRTMP	# IF C A -0, SHORTMP FAILS TO GIVE -0.
			# MULT BY .0006
	CAF	R2D1	# GIVE MIN/10EXP5 MOD 60
	TS	DSPCOUNT	
	TC	BANKCALL	# DISPLAY MIN MOD 60
	CADR	DSPDECWD	
	EXTEND		# MINUTES, SECONDS HAVE BEEN REMOVED
	DCA	HRCON1	
	DXCH	MPAC	
	CA	HITEMOUT	# USE WHOLE HOURS
	TC	PRSHRTMP	# IF C A -0, SHORTMP FAILS TO GIVE -0.
			# MULT BY .16384
	CAF	R1D1	# GIVES HOURS/10EXP5
	TS	DSPCOUNT	
	TC	BANKCALL	# USE REGULAR DSPDECWD, WITH ROUND OFF.
	CADR	DSPDECWD	
	TC	ENTEXIT	
SECON1	2DEC*	1.666666666 E-4 B12*	# 2EXP12/6000
SECON2	OCT	01727	# .06 FOR SECONDS DISPLAY
	OCT	01217	
MINCON2	OCT	00011	# .0006 FOR MINUTES DISPLAY
	OCT	32445	

MINCON1	OCT	02104	# .066..66 UPPED BY 2EXP-28
	OCT	10422	
HRCON1	2DEC	.16384	
	OCT	00000	
RNDCON	OCT	00062	# .5 SEC
M/SOUT	TC	BANKCALL	# READ FRESH DATA FOR HI AND LO INTO MPAC.
	CADR	READLO	# MPAC+1.
	TC	TPAGREE	# MAKE DP DATA AGREE
	CCS	MPAC	# IF MAG OF MPAC, MPAC+1 G/ 59 M 59 S.
	TC	+2	# DISPLAY 59B59, WITH PROPER SIGN.
	TC	M/SNORM	# MPAC +0. L/ 59M58.5S
	AD	M/SCON1	# - HI PART OF 59M58.5S +1 FOR CCS
	CCS	A	# MAG OF MPAC - HI PART OF 59M58.5S
	TC	M/SLIMIT	# G/ 59M58.5S
	TC	M/SNORM	# ORIGINAL MPAC -0. L/ 59M58.5S
	TC	M/SNORM	# L/ 59M58.5S
	CCS	MPAC +1	# MAG OF MPAC HI PART OF 59M58.5S
	TC	+2	
	TC	M/SNORM	# MPAC+1 +0. L/ 59M58.5S
	AD	M/SCON2	# - LO PART OF 59M58.5S +1 FOR CCS
	CCS	A	# MAG OF MPAC+1 - LO PART OF 59M58.5S
	TC	M/SLIMIT	# G/ 59M58.5S
	TC	M/SNORM	# ORIGINAL MPAC+1 -0. L/ 59M58.5S
	TC	M/SNORM	# L/ 59M58.5S
M/SLIMIT	CCS	MPAC	# 59M58.5S LIMIT
	CAF	M/SCON3	# MPAC CANNOT BE +/- 0 AT THIS POINT.
	TC	+LIMIT	# FORCE MPAC, MPAC+1 TO +/- 59M59.5S
	CS	M/SCON3	
	TS	MPAC	# WILL DISPLAY 59M59S IN DSPDECNR
	CS	M/SCON3 +1	
LIMITCOM	TS	MPAC +1	
	CAF	NORMADR	# SET RETURN TO M/SNORM+1.
	TC	SEPSECNR +1	
+LIMIT	TS	MPAC	
	CAF	M/SCON3 +1	
	TC	LIMITCOM	
M/SNORM	TC	SEPSEC	# LEAVE FRACT SEC/60 IN MPAC,MPAC+1. LEAVE
			# WHOLE MIN IN BIT13 OF LOTEMOUT AND ABOVE
	CAF	HISECON	# USE ONLY FRACT SEC/60 MOD 60
	TC	SHORTMP	# MULT BY .6 + 2EXP-14
	CS	THREE	# GIVES SEC/100 MOD 60
	ADS	DSPCOUNT	# DSPCOUNT ALREADY SET TO RXD1
	TC	BANKCALL	# DISPLAY SEC MOD 60 IN D4D5.
	CADR	DSPDC2NR	
	CAF	ZERO	
	TS	CODE	
	CS	TWO	

	INDEX	DECOUNT	
	AD	R1D1	# RXD3
	TS	COUNT	
	TC	BANKCALL	# BLANK MIDDLE CHAR
	CADR	DSPIN	
	TC	SEPMIN	# REMOVE REST OF SECONDS
	XCH	MPAC +1	# LEAVE FRACT MIN/60 IN MPAC+1
	EXTEND		# USE ONLY FRACT MIN/60 MOD 60
	MP	HIMINCON	# MULT BY .6 + 2EXP-7
	DXCH	MPAC	# GIVES MIN/100 MOD 60
	INDEX	DECOUNT	
	CAF	R1D1	# RXD1
	TS	DSPCOUNT	
	TC	BANKCALL	# DISPLAY MIN MOD 60 IN D1D2.
	CADR	DSPDC2NR	
	TC	POSTJUMP	
	CADR	DSPDCEND +2	
HISECON	OCT	23147	# .6 + 2EXP-14
HIMINCON	OCT	23346	# .6 + 2EXP-7
M/SCON1	OCT	77753	# - HI PART OF 59M58.5S +1
M/SCON2	OCT	41126	# - LO PART OF 59M58.5S +1
NORMADR	ADRES	M/SNORM +1	
M/SCON3	OCT	00025	# 59M 59.5S
	OCT	37016	
SEPSEC	CCS	MPAC +1	# IF +, ROUND BY ADDING .5 SEC
	TCF	POSEC	# IF -, ROUND BY SUBTRACING .5 SEC
	TCF	POSEC	# FINDS TIME IN MPAC, MPAC+1
	TCF	+1	# ROUNDS OFF BY +/- .5 SEC
	EXTEND		# LEAVES WHOLE MIN IN BIT13 OF
SEPSEC1	DCS	RNDCON -1	# LOTEMOUT AND ABOVE.
	DAS	MPAC	# LEAVES FRACT SEC/60 IN MPAC, MPAC+1.
	TCF	SEPSECNR	
POSEC	EXTEND		
	DCA	RNDCON -1	
	TCF	SEPSEC1	
SEPSECNR	XCH	Q	# THIS ENTRY AVOIDS ROUNDING BY .5 SEC
	TS	SEPSCRET	
	TC	DMP	# MULT BY 2EXP12/6000
	ADRES	SECON1	# GIVES FRACT SEC/60 IN BIT12 OF MPAC+1
	EXTEND		# AND BELOW.
	DCA	MPAC	# SAVE MINUTES AND HOURS
	DXCH	HITEMOUT	
	TC	TPSL1	
	TC	TPSL1	# GIVES FRACT SEC/60 IN MPAC+1, MPAC+2.
	CAF	ZERO	
	XCH	MPAC +2	# LEAVE FRACT SEC/60 IN MPAC, MPAC+1.

```

1
2      XCH      MPAC +1
3      XCH      MPAC
4      TC       SEPSCRET
5
6  SEPMIN      XCH      Q          # FIND WHOLE MINUTES IN BIT13
7              TS       SEPMNRET   # OF LOTEMOUT AND ABOVE.
8              CA       LOTEMOUT   # REMOVES REST OF SECONDS.
9              EXTEND    # LEAVES FRACT MIN/60 IN MPAC+1.
10             MP       BIT3       # LEAVES WHOLE HOURS IN MPAC.
11             EXTEND    # SR 12, THROW AWAY LP.
12             MP       BIT13      # SR 2, TAKE FROM LP.  SL 12.
13             LXCH     MPAC +1    # THIS FORCES BITS 12-1 TO 0 IF +.
14                                     # FORCES BITS 12-1 TO 1 IF -.
15             CA       HITEMOUT
16             TS       MPAC
17             TC       DMP        # MULT BY 1/15
18             ADRES    MINCON1    # GIVES FRACT MIN/60 IN MPAC+1.
19  ENDSPMIN    TC       SEPMNRET   # GIVES WHOLE HOURS IN MPAC.

```

```

20
21 # THIS IS A SPECIAL PURPOS VERB FOR DISPLAYING A DOUBLE PRECISION AGC
22 # WORD AS 10 DECIMAL DIGITS ON THE AGC DISPLAY PANEL.  IT CAN BE USED WITH
23 # ANY NOUN, EXCEPT MIXED NOUNS. IT DISPLAYS THE CONTENTS
24 # OF THE REGISTER NOUNADD IS POINTING TO.  IF USED WITH NOUNS WHICH ARE
25 # INHERENTLY NOT DP SUCH AS THE CDU COUNTERS THE DISPLAY WILL BE GARBAGE.
26 # DISPLAY IS IN R1 AND R2 ONLY WITH THE SIGN IN R1.

```

```

27
28      SETLOC   ENDRDLO +1
29
30      COUNT*   $$/PIN
31  DSPDPDEC    INDEX   MIXBR
32              TC      +0
33              TC      +2          # NORMAL NOUN
34              TC      DSPALARM
35              EXTEND
36              INDEX   NOUNADD
37              DCA     0
38              DXCH    MPAC
39              CAF     R1D1
40              TS      DSPCOUNT
41              CAF     ZERO
42              TS      MPAC +2
43              TC      TPAGREE
44              TC      DSP2DEC
45  ENDDPDEC    TC      ENTEXIT

```

```
1  # LOAD VERBS          IF ALARM CONDITION IS DETECTED DURING EXECUTE,
2  # CHECK FAIL LIGHT IS TURNED ON AND ENDOFJOB.  IF ALARM CONDITION IS
3  # DETECTED DURING ENTER OF DATA, CHECK FAIL IS TURNED ON AND IT RECYCLES
4  # TO EXECUTE OF ORIGINAL LOAD VERB.  RECYCLE CAUSED BY 1 DECIMAL MACHINE
5  # CADR 2 MIXTURE OF OCTAL/DECIMAL DATA 3 OCTAL DATA INTO DECIMAL
6  # ONLY NOUN 4 DEC DATA INTO OCT ONLY NOUN 5 DATA TOO LARGE FOR SCALE
7  # 6 FEWER THAN 3 DATA WORDS LOADED FOR HRS, MIN, SEC NOUN. 2 - 6 ALARM
8  # AND RECYCLE OCCUR AT FINAL ENTER OF SET. 1 ALARM AND RECYCLE OCCUR AT
9  # ENTER OF CADR.
```

```
11          SETLOC  ENDRTOUT
```

```
13
14          COUNT*  $$/PIN
15  ABCLOAD      CS      TWO
16              TC      COMPTST
17              TC      NOUNTEST      # TEST IF NOUN CAN BE LOADED.
18              CAF      VBSP1LD
19              TC      UPDATVB -1
20              TC      REQDATX
21              CAF      VBSP2LD
22              TC      UPDATVB -1
23              TC      REQDATY
24              CAF      VBSP3LD
25              TC      UPDATVB -1
26              TC      REQDATZ
27
28  PUTXYZ       CS      SIX      # TEST THAT THE 3 DATA WORDS LOADED ARE
29              TC      ALLDC/OC  # ALL DEC OR ALL OCT.
30              EXTEND
31              DCA      LODNNLOC  # SWITCH BANKS TO NOUN TABLE READING
32              DXCH      Z      # ROUTINE.
33              CAF      ZERO     # X COMP
34              TC      PUTCOM
35              INDEX    NOUNADD
36              TS      0
37              CAF      ONE      # Y COMP
38              TC      PUTCOM
39              INDEX    NOUNADD
40              TS      1
41              CAF      TWO      # Z COMP
42              TC      PUTCOM
43              INDEX    NOUNADD
44              TS      2
45              CS      SEVEN     # IF NOUN 7 HAS JUST BEEN LOADED, SET
46              AD      NOUNREG   # FLAG BITS AS SPECIFIED.
47              EXTEND
48              BZF      +2
49              TC      LOADLV
```

	CA	XREG	# ECADR OF FLAG WORD.
	TC	SETNCADR +1	# SET EBANK, NOUNADD.
	CA	ZREG	# ZERO TO RESET BITS, NON-ZERO TO SET BITS.
	INHINT		
	EXTEND		
	BZF	BITSOFF	
	INDEX	NOUNADD	
	CS	0	
	MASK	YREG	# BITS TO BE PROCESSED.
	INDEX	NOUNADD	
	ADS	0	# SET BITS.
BITSOFF	TC	BITSOFF1	
	CS	YREG	# BITS TO BE PROCESSED.
	INDEX	NOUNADD	
	MASK	0	
	INDEX	NOUNADD	
	TS	0	# RESET BITS.
BITSOFF1	RELINT		
	TC	LOADLV	
ABLOAD	CS	ONE	
	TC	COMPTST	
	TC	NOUNTEST	# TEST IF NOUN CAN BE LOADED.
	CAF	VBSP1LD	
	TC	UPDATVB -1	
	TC	REQDATX	
	CAF	VBSP2LD	
	TC	UPDATVB -1	
	TC	REQDATY	
PUTXY	CS	FIVE	# TEST THAT THE 2 DATA WORDS LOADED ARE
	TC	ALLDC/OC	# ALL DEC OR ALL OCT.
	EXTEND		
	DCA	LODNNLOC	# SWITCH BANKS TO NOUN TABLE READING
	DXCH	Z	# ROUTINE.
	CAF	ZERO	# X COMP
	TC	PUTCOM	
	INDEX	NOUNADD	
	TS	0	
	CAF	ONE	# Y COMP
	TC	PUTCOM	
	INDEX	NOUNADD	
	TS	1	
	TC	LOADLV	
ALOAD	TC	REQDATX	
	EXTEND		
	DCA	LODNNLOC	# SWITCH BANKS TO NOUN TABLE READING
	DXCH	Z	# ROUTINE.
	CAF	ZERO	# X COMP
	TC	PUTCOM	

	INDEX	NOUNADD	
	TS	0	
	TC	LOADLV	
BLOAD	CS	ONE	
	TC	COMPTST	
	CAF	BIT15	# SET CLPASS FOR PASS0 ONLY
	TS	CLPASS	
	TC	REQDATY	
	EXTEND		
	DCA	LODNNLOC	# SWITCH BANKS TO NOUN TABLE READING
	DXCH	Z	# ROUTINE.
	CAF	ONE	
	TC	PUTCOM	
	INDEX	NOUNADD	
	TS	1	
	TC	LOADLV	
CLOAD	CS	TWO	
	TC	COMPTST	
	CAF	BIT15	# SET CLPASS FOR PASS0 ONLY
	TS	CLPASS	
	TC	REQDATZ	
	EXTEND		
	DCA	LODNNLOC	# SWITCH BANKS TO NOUN TABLE READING
	DXCH	Z	# ROUTINE.
	CAF	TWO	
	TC	PUTCOM	
	INDEX	NOUNADD	
	TS	2	
	TC	LOADLV	
LOADLV	CAF	ZERO	
	TS	DECBRNCH	
	CS	ZERO	
	TS	LOADSTAT	
	TC	RELDSP	# RELEASE FOR PRIORITY DISPLAY PROBLEM.
	CS	VD1	# TO BLOCK NUMERICAL CHARACTERS AND
	TS	DSPCOUNT	# CLEARS AFTER A COMPLETED LOAD
	TC	POSTJUMP	# AFTER COMPLETED LOAD, GO TO RECALTST
	CADR	RECALTST	# TO SEE IF THERE IS RECALL FROM ENDIDLE.
VBSP1LD	DEC	21	# VB21 ALOAD
VBSP2LD	DEC	22	# VB22 BLOAD
VBSP3LD	DEC	23	# VB23 CLOAD
ALLDC/OC	TS	DECOUNT	# TESTS THAT DATA WORDS LOADED ARE EITHER
	CS	DECBRNCH	# ALL DEC OR ALL OCT. ALARMS IF NOT.
	TS	SR	


```
1
2      CS      SR
3      CS      SR      # SHIFTED RIGHT 2
4      CCS     A      # DEC COMP BITS IN LOW 3
5      TCF     +2     # SOME ONES IN LOW 3
6      TC      Q      # ALL ZEROS. ALL OCTAL. OK
7      AD      DECOUNT # DEC COMP 7 FOR 3COMP, 6 FOR 2COMP
8      EXTEND   # BUT IT HAS BEEN DECREMENTED BY CCS
9      BZF     +2     # MUST MATCH 6 FOR 3COMP, 5 FOR 2COMP.
10     TC      ALMCYCLE # ALARM AND RECYCLE.
11     GOQ     TC      Q      # ALL REQUIRED ARE DEC. OK
12
13     SFRUTNOR XCH     Q      # GETS SF ROUTINE NUMBER FOR NORMAL CASE
14             TS      EXITEM # CAN T USE L FOR RETURN. TSTFORDP USES L.
15             CAF      MID5
16             MASK     NNTYPTM
17             TC      RIGHT5
18             TC      EXITEM      # SF ROUTINE NUMBER IN A
19
20     SFRUTMIX XCH     Q      # GETS SF ROUTINE NUMBER FOR MIXED CASE
21             TS      EXITEM
22             INDEX    DECOUNT
23             CAF      DISPLACE   # PUT TC GOQ, TC RIGHT5, OR TC LEFT5 IN L
24             TS      L
25             INDEX    DECOUNT
26             CAF      LOW5      # LOW5, MID5, OR HI5 IN A
27             MASK     RUTMXTEM   # GET HI5, MID5, OR LOW5 OF RUTMXTAB ENTRY
28             INDEX    L
29             TC      0
30
31     # DO TC GOQ DECOUNT 0 , DO TC RIGHT5 DECOUNT 1 , DO TC LEFT5 DECOUNT 2 .
32     SFRET1   TC      EXITEM      # SF ROUTINE NUMBER IN A
33
34     SFCONUM  XCH     Q      # GETS 2X SF CONSTANT NUMBER
35             TS      EXITEM
36             INDEX    MIXBR
37             TC      +0
38             TC      CONUMNOR    # NORMAL NOUN
39             INDEX    DECOUNT   # MIXED NOUN
40             CAF      DISPLACE
41             TS      L      # PUT TC GOQ, TC RIGHT5, OR TC LEFT5 IN L
42             INDEX    DECOUNT
43             CAF      LOW5
44             MASK     NNTYPTM
45             INDEX    L
46             TC      0
47
48     # DO TC GOQ DECOUNT 0 , DO TC RIGHT5 DECOUNT 1 , DO TC LEFT5 DECOUNT 2 .
49     SFRET    DOUBLE   # 2X SF CONSTANT NUMBER IN A
50             TC      EXITEM
51
52     DISPLACE TC      GOQ
```

	TC	RIGHT5	
	TC	LEFT5	
CONUMNOR	CAF	LOW5	# NORMAL NOUN ALWAYS GETS LOW5 OF
	MASK	NNTYPTM	# NNTYPTAB FOR SF CONUM.
	DOUBLE		
	TC	EXITM	# 2X SF CONSTANT NUMBER IN A
PUTCOM	TS	DECOUNT	
	XCH	Q	
	TS	DECRET	
	CAF	ZERO	
	TS	MPAC+6	
	INDEX	DECOUNT	
	XCH	XREGLP	
	TS	MPAC +1	
	INDEX	DECOUNT	
	XCH	XREG	
	TS	MPAC	
	INDEX	MIXBR	
	TC	+0	
	TC	PUTNORM	# NORMAL NOUN
# IF MIXNOUN, PLACE ADDRESS FOR COMPONENT K INTO NOUNADD, SET EBANK BITS.			
	INDEX	DECOUNT	# GET IDADDTAB ENTRY FOR COMPONENT K
	CA	IDADITEM	# OF NOUN.
	MASK	LOW11	# ECADR SUBK FOR CURRENT COMP OF NOUN
	TC	SETNCADR	# ECADR INTO NOUNCADR. SETS EB, NOUNADD.
	EXTEND		# C NOUNADD IN A UPON RETURN
	SU	DECOUNT	# PLACE ESUBK -K INTO NOUNADD
	TS	NOUNADD	
	CCS	DECBRNCH	
	TC	PUTDECSF	# + DEC
	TC	DCTSTCYC	# +0 OCTAL
	TC	SFRUTMIX	# TEST IF DEC ONLY BIT 1. IF SO,
	TC	DPTEST	# ALARM AND RECYCLE. IF NOT, CONTINUE.
	TC	PUTCOM2	# NO DP
			# TEST FOR DP SCALE FOR OCT LOAD. IF SO,
			# +0 INTO MAJOR PART. SET NOUNADD FOR
			# LOADING OCTAL WORD INTO MINOR PART.
PUTDPCOM	INCR	NOUNADD	# DP ESUBK -K+1 OR E+1
	CA	NOUNADD	# NOUNADD NOW SET FOR MINOR PART
	ADS	DECOUNT	# ESUBK +1 OR E+1 INTO DECOUNT
	CAF	ZERO	# NOUNADD SET FOR MINOR PART
	INDEX	DECOUNT	
	TS	0 -1	# ZERO MAJOR PART ESUBK OR E
	TC	PUTCOM2	
PUTNORM	TC	SETNADD	# ECADR FROM NOUNCADR. SETS EB, NOUNADD.
	CCS	DECBRNCH	

```
1
2      TC      PUTDECSF      # + DEC
3      TC      DCTSTCYC      # +0 OCTAL
4
5      TC      SFRUTNOR      # TEST IF DEC ONLY BIT 1. IF SO,
6      TC      DPTST        # ALARM AND RECYCLE. IF NOT, CONTINUE.
7      TC      PUTCOM2 -4    # NO DP
8
9      CAF      ZERO        # DP
10     TS      DECOUNT
11     TC      PUTDPCOM
12
13
14     CA      NNADTEM
15     AD      ONE          # IF NNADTEM -1, CHANNEL TO BE SPECIFIED
16
17     EXTEND
18     BZF      CHANLOAD
19     XCH      MPAC
20     PUTCOM2
21     TC      DECRET
22
23
24     EBANK    DSPCOUNT
25     2CADR    GTSFIN
26     GTSFINLC
27
28     CHANLOAD    CS      SEVEN      # DONT LOAD CHAN 7. IT SUPERBANK .
29
30     AD      NOUNCADR
31     EXTEND
32     BZF      LOADLV
33
34     CA      NOUNCADR
35     MASK    LOW9
36     XCH      MPAC
37
38     EXTEND
39     INDEX    MPAC
40     WRITE    0
41     TC      LOADLV
42
43     # PUTDECSF FINDS MIXBR AND DECOUNT STILL SET FROM PUTCOM
44
45
46     PUTDECSF    TC      SFCONUM      # 2X SF CON NUMB IN A
47     TS      SFTEMP1
48
49     EXTEND
50     DCA      GTSFINLC      # SWITCH BANKS TO SF CONSTANT TABLE
51     DXCH      Z            # READING ROUTINE.
52     # LOADS SFTEMP1, SFTEMP2.
53
54     INDEX    MIXBR
55     TC      +0
56     TC      PUTSFNOR
57
58     TC      SFRUTMIX
59     TC      PUTDCSF2
60     TC      SFRUTNOR
61
62     PUTSFNOR
63
64     PUTDCSF2    INDEX    A
65     CAF      SFINTABR
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
```

```
1  SFINTABR      TC      BANKJUMP      # SWITCH BANKS FOR EXPANSION ROOM
2  CADR          CADR      GOALMCYC      # ALARM AND RECYCLE IF DEC LOAD
3                                     # WITH OCTAL ONLY NOUN.
4
5  CADR          CADR      BINROUND
6  CADR          CADR      DEGINSF
7  CADR          CADR      ARTHINSF
8  CADR          CADR      DPINSF
9  CADR          CADR      DPINSF2
10 CADR          CADR      DSPALARM      # LRPOSOUT CANT BE LOADED.
11 CADR          CADR      DPINSF      # SAME AS ARITHDP1
12 CADR          CADR      HMSIN
13 CADR          CADR      DSPALARM      # MIN/SEC CANT BE LOADED.
14 CADR          CADR      DPINSF4
15 CADR          CADR      ARTIN1SF
16 CADR          CADR      DSPALARM      # 2INTOUT CANT BE LOADED.
17 CADR          CADR      DEGINSF      # TESTS AT END FOR 360-CDU
18 ENDRUTIN      EQUALS
19
20 # SCALE FACTORS FOR THOSE ROUTINES NEEDING THEM ARE AVAILABLE IN SFTEMP1.
21 # ALL SFIN ROUTINES USE MPAC MPAC+1. LEAVE RESULT IN A. END WITH TC DECRET.
22
23      SETLOC      ENDDPDEC +1
24
25      COUNT*      $$/PIN
26 # DEGINSF APPLIES 1000/180      5.55555 10      5.43434 8
27
28 DEGINSF      TC      DMP      # SF ROUTINE FOR DEC DEGREES
29      ADRES      DEGCON1      # MULT BY 5.5 5 10 X2EXP-3
30      CCS      MPAC +1      # THIS ROUNDS OFF MPAC+1 BEFORE SHIFT
31      CAF      BIT11      # LEFT 3, AND CAUSES 360.00 TO OF/UF
32      TC      +2      # WHEN SHIFTED LEFT AND ALARM.
33      CS      BIT11
34      AD      MPAC +1
35      TC      2ROUND +2
36      TC      TPSL1      # LEFT 1
37 DEGINSF2      TC      TPSL1      # LEFT 2
38      TC      TESTOFUF
39      TC      TPSL1      # RETURNS IF NO OF/UF LEFT3
40      CCS      MPAC
41      TC      SIGNFIX      # IF +, GO TO SIGNFIX
42      TC      SIGNFIX      # IF +0, GO TO SIGNFIX
43      COM      # IF -, USE -MAGNITUDE +1
44      TS      MPAC      # IF -0, USE +0
45 SIGNFIX      CCS      MPAC+6
46      TC      SGNT01      # IF OVERFLOW
47      TC      ENDSCALE      # NO OVERFLOW/UNDERFLOW
48      CCS      MPAC      # IF UF FORCE SIGN TO 0 EXCEPT -180
49      TC      CCSHOLE
```

	TC	NEG180	
	TC	+1	
	XCH	MPAC	
	MASK	POSMAX	
	TS	MPAC	
ENDSCALE	INDEX	MIXBR	# IF ROUTINE NO. IS NOT CDU DEGREES,
	TC	+0	# THEN THIS IS 360 - CDU DEGREES
	TC	+3	# AND ANGLE IN MPAC MUST BE REPLACED
			# BY 360 DEGREES MINUS ITSELF.
MIXBACK	TC	SFMIXCAL	
	TC	+2	
	TC	SFNORCAL	
NORBACK	CS	A	
	AD	BIT2	
	EXTEND		
	BZF	+2	
ENDSCALE1	TC	360-CDU	
	TC	POSTJUMP	
	CADR	PUTCOM2	
SFMIXCAL	TC	BANKCALL	
	CADR	SFRUTMIX	
	TC	MIXBACK	
SFNORCAL	TC	BANKCALL	
	CADR	SFRUTNOR	
	TC	NORBACK	
NEG180	CS	POSMAX	
	TC	ENDSCALE -1	
SGNT01	CS	MPAC	# IF OF FORCE SIGN TO 1
	MASK	POSMAX	
	CS	A	
	TC	ENDSCALE -1	
DEGCON1	2DEC	5.55555555 B-3	
ARTHINSF	TC	DMP	# SCALES MPAC, +1 BY SFTEMP1, SFTEMP2.
	ADRES	SFTEMP1	# ASSUMES POINT BETWEEN HI AND LO PARTS
	XCH	MPAC +2	# OF SFCON. SHIFTS RESULTS LEFT BY 14.
	XCH	MPAC +1	# BY TAKING RESULTS FROM MPAC+1, MPAC+2
	XCH	MPAC	
	EXTEND		
	BZF	BINROUND	
BINROUND	TC	ALMCYCLE	# TOO LARGE A LOAD. ALARM AND RECYCLE.
	TC	2ROUND	
	TC	TESTOFUF	
	TC	ENDSCALE1	# RETURNS IF NO OF/UF

ARTIN1SF	TC	DMP	# SCALES MPAC, +1 BY SFTEMP1, SFTEMP2.
	ADRES	SFTEMP1	# ROUNDS MPAC+1 INTO MPAC.
	TC	BINROUND	
DPINSF	TC	DMP	# SCALES MPAC, MPAC +1 BY SFTEMP1,
	ADRES	SFTEMP1	# SFTEMP. STORES LOW PART OF RESULT
	XCH	MPAC +2	# IN E SUBK +1 OR E+1
	DOUBLE		
	TS	MPAC +2	
	CAF	ZERO	
	AD	MPAC +1	
	TC	2ROUND +2	
	TC	TESTOFUF	
	INDEX	MIXBR	# RETURNS IF NO OF/UF
	TC	+0	
	TC	DPINORM	
	CA	DECOUNT	# MIXED NOUN
DPINCOM	AD	NOUNADD	# MIXED NORMAL
	TS	Q	# E SUBK E
	XCH	MPAC +1	
	INDEX	Q	
	TS	1	# PLACE LOW PART IN
	TC	ENDSCAL1	# E SUBK +1 MIXED
DPINORM	CAF	ZERO	# E +1 NORMAL
	TC	DPINCOM	
DPINSF2	TC	DMP	# ASSUMES POINT BETWEEN BITS 7-8 OF HIGH
	ADRES	SFTEMP1	# PART OF SF CONST. DPINSF2 SHIFTS RESULTS
	CAF	SIX	# LEFT BY 7, ROUNDS MPAC+2 INTO MPAC+1
	TC	TPLEFTN	# SHIFT LEFT 7.
	TC	DPINSF +2	
DPINSF4	TC	DMP	# ASSUMES POINT BETWEEN BITS 11-12 OF HIGH
	ADRES	SFTEMP1	# PART OF SF CONST. DPINSF2 SHIFTS RESULTS
	CAF	TWO	# LEFT BY 3, ROUNDS MPAC+2 INTO MPAC+1.
	TC	TPLEFTN	# SHIFT LEFT 3.
	TC	DPINSF +2	
TPLEFTN	XCH	Q	# SHIFTS MPAC, +1, +2 LEFT N. SETS OV FIND
	TS	SFTEMP2	# TO +1 FOR OF, -1 FOR UF.
	XCH	Q	# CALL WITH N-1 IN A.
LEFTNCOM	TS	SFTEMP1	# LOOP TIME .37 MSEC.
	TC	TPSL1	
	CCS	SFTEMP1	
	TC	LEFTNCOM	


```
1
2      TC      SFTEMP2
3
4 2ROUND      XCH      MPAC      +1
5             DOUBLE
6             TS      MPAC      +1
7             TC      Q          # IF MPAC+1 DOES NOT OF/UF
8             AD      MPAC
9             TS      MPAC
10            TC      Q          # IF MPAC DOES NOT OF/UF
11            TS      MPAC+6
12 2RNDEND     TC      Q
13
14 TESTOFUF    CCS      MPAC+6    # RETURNS IF NO OF/UF
15            TC      ALMCYCLE    # OF      ALARM AND RECYCLE.
16            TC      Q
17            TC      ALMCYCLE    # UF      ALARM AND RECYCLE.
18
19            SETLOC  ENDSPMIN +1
20
21            COUNT*  $$/PIN
22 HMSIN       TC      ALL3DEC    # IF ALL 3 WORDS WERE NOT LOADED, ALARM.
23            TC      DMP        # XREG, XREGLP  HOURS  WERE ALREADY PUT
24            ADRES  WHOLECON    # INTO MPAC, MPAC+1.
25            TC      RND/TST    # ROUND OFF TO WHOLE HRS IN MPAC+1.
26            CAF    ZERO        # ALARM IF MPAC NON ZERO  G/ 16383 .
27            TS      MPAC      +2
28            CAF    HRCON
29            TS      MPAC
30            CAF    HRCON      +1
31            XCH      MPAC      +1
32            TC      SHORTMP
33            TC      MPACTST    # ALARM IF MPAC NON ZERO  G/ 745
34            DXCH    MPAC      +1 # STORE HOURS CONTRIBUTION
35            DXCH    HITEMIN
36            CA      YREG      # PUT YREG, YREGLP INTO MPAC, +1.
37            LXCH    YREGLP
38            DXCH    MPAC
39            TC      DMP
40            ADRES  WHOLECON
41            TC      RND/TST    # ROUND OFF TO WHOLE MIN IN MPAC+1
42            CS      59MIN      # ALARM IF MPAC NON ZERO  G/16383
43            TC      SIZETST    # ALARM IF MPAC+1 G/ 59MIN
44            XCH      MPAC      +1
45            EXTEND
46            MP      MINCON      # LEAVES MINUTES CONTRIBUTION IN A,L
47            DAS     HITEMIN    # ADD IN MINUTES CONTRIBUTION
48            EXTEND    # IF THIS DAS OVEFLOWS, G/ 745 HR, 39MIN
49
50
51
52
53
54
55
56
57
58
59
60
```

	BZF	+2	
	TC	ALMCYCLE	
	CA	ZREG	# PUT ZREG, ZREGLP INTO MPAC, +1.
	LXCH	ZREGLP	
	DXCH	MPAC	
	TC	DMP	
	ADRES	WHOLECON	
	TC	RND/TST	# ROUND OFF TO WHOLE CENTI-SEC IN MPAC+1
	CS	59.99SEC	# ALARM IF MPAC NON ZERO G/163.83 SEC
	TC	SIZETST	# ALARM IF MPAC+1 G/59.99 SEC
	DXCH	HITEMIN	# ADD IN SECONDS CONTRIBUTION
	DAS	MPAC	# IF THIS DAS OVERFLOWS,
	EXTEND		# G/ 745 HR, 39 MIN, 14.59 SEC.
	BZF	+2	
	TC	ALMCYCLE	# ALARM AND RECYCLE
	CAF	ZERO	
	TS	MPAC +2	
	TC	TPAGREE	
	DXCH	MPAC	
	INDEX	NOUNADD	
	DXCH	0	
	TC	POSTJUMP	
	CADR	LOADLV	
WHOLECON	OCT	00006	# 10EXP5/2EXP14 2EXP14
	OCT	03240	
HRCON	OCT	00025	# 1 HOUR IN CENTI-SEC
	OCT	37100	
MINCON	OCT	13560	# 1 MINUTE IN CENTI-SEC
59MIN	OCT	00073	# 59 AS WHOLE
59.99SEC	OCT	13557	# 5999 CENTI-SEC
RND/TST	XCH	MPAC +2	# ROUNDS MPAC+2 INTO MPAC+1.
	DOUBLE		# ALARMS IF MPAC NOT 0
	TS	MPAC +2	
	CAF	ZERO	
	AD	MPAC +1	
	TS	MPAC +1	
	CAF	ZERO	
	AD	MPAC	# CANT OVFLOW
	XCH	MPAC	
MPACTST	CCS	MPAC	# ALARM IF MPAC NON ZERO
	TC	ALMCYCLE	# ALARM AND RECYCLE.
	TC	Q	
	TC	ALMCYCLE	# ALARM AND RECYCLE.
	TC	Q	
SIZETST	TS	MPAC +2	# CALLED WITH - CON IN A
	CCS	MPAC +1	# GET MAG OF MPAC+1

	AD	ONE	
	TCF	+2	
	AD	ONE	
	AD	MPAC +2	
	EXTEND		# MAG OF MPAC+1 - CON
	BZMF	+2	
	TC	ALMCYCLE	# MAG OF MPAC+1 G/ CON. ALARM AND RECYCLE.
	TC	Q	# MAG OF MPAC+1 L/ CON
# ALL3DEC TESTS THAT ALL 3 WORDS ARE LOADED IN DEC FOR HMSIN .			
# ALARM IF NOT. TEST THAT BITS 3,4,5 OF DECBRNCH ARE ALL 1 .			
ALL3DEC	CS	OCT34BAR	# GET BITS 3,4,5 IN A
	MASK	DECBRNCH	# GET BITS 3,4,5 OF DECBRNCH IN A
	AD	OCT34BAR	# BITS 3,4,5 OF DECBRNCH MUST ALL 1
	CCS	A	
	TC	FORCEV25	
OCT34BAR	OCT	77743	
	TC	FORCEV25	
	TC	Q	
FORCEV25	CS	OCT31	# FORCE VERB 25 TO BE EXECUTED BY RECYCLE
	TS	VERBSAVE	# IN CASE OPERATOR EXECUTED A LOWER LOAD
	TC	ALMCYCLE	# VERB. ALARM AND RECYCLE.
ENDHMSS	EQUALS		

```
1 # MONITOR ALLOWS OTHER KEYBOARD ACTIVITY. IT IS ENDED BY VERB TERMINATE,
2 # VERB PROCEED WITHOUT DATA, VERB RESEQUENCE,
3 # ANOTHER MONITOR, OR ANY NVSUB CALL THAT PASSES THE DSPLOCK PROVIDED
4 # THAT THE OPERATOR HAS SOMEHOW ALLOWED THE ENDING OF A MONITOR WHICH
5 # HE HAS INITIATED THROUGH THE KEYBOARD .
6 #
7 # MONITOR ACTION IS SUSPENDED, BUT NOT ENDED, BY ANY KEYBOARD ACTION,
8 # EXCEPT ERROR LIGHT RESET. IT BEGINS AGAIN WHEN KEY RELEASE IS PERFORMED.
9 # MONITOR SAVES THE NOUN AND APPROPRIATE DISPLAY VERB IN MONSAVE. IT SAVES
10 # NOUNCADR IN MONSAVE1, IF NOUN MACHINE CADR TO BE SPECIFIED. BIT 15 OF
11 # MONSAVE1 IS THE KILL MONITOR SIGNAL KILLER BIT . BIT 14 OF MONSAVE1
12 # INDICATES THE CURRENT MONITOR WAS EXTERNALLY INITIATED EXTERNAL
13 # MONITOR BIT . IT IS TURNED OFF BY RELDSP AND KILMONON.
14 #
15 # MONSAVE INDICATES IF MONITOR IS ON + ON, +0 OFF
16 # IF MONSAVE IS +, MONITOR ENTERS NO REQUEST, BUT TURNS KILLER BIT OFF.
17 # IF MONSAVE IS +0, MONITOR ENTERS REQUEST AND TURNS KILLER BIT OFF.
18 #
19 # NVSUB IF EXTERNAL MONITOR BIT IS OFF , VB PROCEED WITHOUT DATA,
20 # VB RESEQUENCE, AND VB TERMINATE TURN KILL MONITOR BIT ON.
21 #
22 # IF KILLER BIT IS ON, MONREQ ENTERS NO FURTHER REQUESTS, ZEROS MONSAVE
23 # AND MONSAVE1 TURNING OFF KILLER BIT AND EXTERNAL MONITOR BIT .
24 #
25 # MONITOR DOESNT TEST FOR MATBS SINCE NVSUB CAN HANDLE INTERNAL MATBS NOW.
```

```
28 SETLOC ENDRUTIN
```

```
30 COUNT* $$/PIN
```

```
31 MONITOR
```

```
CS BIT15/14
```

```
32 MASK NOUNCADR
```

```
33 MONIT1
```

```
TS MPAC +1
```

```
# TEMP STORAGE
```

```
34 CS ENTEXIT
```

```
35 AD ENDINST
```

```
36 CCS A
```

```
38 BIT15/14
```

```
37 TC MONIT2
```

```
38 OCT 60000
```

```
39 TC MONIT2
```

```
40 CAF BIT14
```

```
# EXTERNALLY INITIATED MONITOR.
```

```
41 ADS MPAC +1
```

```
# SET BIT 14 FOR MONSAVE1.
```

```
42 CAF ZERO
```

```
44 MONIT2
```

```
43 TS MONSAVE2
```

```
# ZERO NVMONOPT OPTIONS
```

```
44 CAF LOW7
```

```
45 MASK VERBREG
```

```
46 TC LEFT5
```

```
47 TS CYL
```

```
48 CS CYL
```

```
49 XCH CYL
```

```
50 AD NOUNREG
```

```
51 TS MPAC
```

```
# TEMP STORAGE
```

```
52 CAF ZERO
```

	TS	DSPLOCK	# +0 INTO DSPLOCK SO MONITOR CAN RUN.
	CCS	CADRSTOR	# TURN OFF KR LITE IF CADRSTOR AND DSPLIST
	TC	+2	# ARE BOTH EMPTY. LITE COMES ON IF NEW
	TC	RELDSP1	# MONITOR IS KEYED IN OVER OLD MONITOR.
	INHINT		
	CCS	MONSAVE	
	TC	+5	# IF MONSAVE WAS +, NO REQUEST
	CAF	ONE	# IF MONSAVE WAS 0, REQUEST MONREQ
	TC	WAITLIST	
	EBANK	DSPCOUNT	
	2CADR	MONREQ	
	DXCH	MPAC	# PLACE MONITOR VERB AND NOUN INTO MONSAVE
	DXCH	MONSAVE	# ZERO THE KILL MONITOR BIT
	RELINT		# SET UP EXTERNAL MONITOR BIT
	TC	ENTRET	
MONREQ	TC	LODSAMPT	# CALLED BY WAITLIST
	CCS	MONSAVE1	# TIME IS SNATCHED N RUPT FOR NOUN 65
	TC	+4	# IF KILLER BIT 0, ENTER REQUESTS
	TC	+3	# IF KILLER BIT 0, ENTER REQUESTS
	TC	KILLMON	# IF KILLER BIT 1, NO REQUESTS.
	TC	KILLMON	# IF KILLER BIT 1, NO REQUESTS.
	CAF	MONDEL	
	TC	WAITLIST	# ENTER WAITLIST REQUEST FOR MONREQ
	EBANK	DSPCOUNT	
	2CADR	MONREQ	
	CAF	CHRPRI0	
	TC	NOVAC	# ENTER EXEC REQUEST FOR MONDO
	EBANK	DSPCOUNT	
	2CADR	MONDO	
	TC	TASKOVER	
KILLMON	CAF	ZERO	# ZERO MONSAVE AND TURN KILLER BIT OFF
	TS	MONSAVE	
	TS	MONSAVE1	# TURN OFF KILL MONITOR BIT.
	TC	TASKOVER	# TURN OFF EXTERNAL MONITOR BIT.
MONDEL	OCT	144	# FOR 1 SEC MONITOR INTERVALS
MONDO	CCS	MONSAVE1	# CALLED BY EXEC
	TC	+4	# IF KILLER BIT 0, CONTINUE
	TC	+3	# IF KILLER BIT 0, CONTINUE
	TC	ENDOFJOB	# IN CASE TERMINATE CAME SINCE LAST MONREQ
	TC	ENDOFJOB	# IN CASE TERMINATE CAME SINCE LAST MONREQ
	CCS	DSPLOCK	
	TC	MONBUSY	# NVSUB IS BUSY


```
1
2      CAF      LOW7
3      MASK     MONSAVE
4      TC       UPDATNN -1      # PLACE NOUN INTO NOUNREG AND DISPLAY IT
5      CAF      MID7
6      MASK     MONSAVE      # CHANGE MONITOR VERB TO DISPLAY VERB
7      AD       MONREF      # -DEC10, STARTING IN BIT8
8      TS       EDOP        # RIGHT 7
9      CA       EDOP
10     TS       VERBREG
11     CAF      MONBACK      # SET RETURN TO PASTEVB AFTER DATA DISPLAY
12     TS       ENTRET
13     CS       BIT15/14
14     MASK     MONSAVE1      # PUT ECADR INTO MPAC +2. INTMCTBS WILL
15     TS       MPAC +2      # DISPLAY IT AND SET NOUNCADR, NOUNADD,
16     ENDMONDO TC       TESTNN # EBANK.
17
18     BLOCK     2
19
20     SETLOC    FFTAG8
21     BANK
22
23     COUNT*    $$/PIN
24     PASTEVB   CAF      MID7
25     MASK     MONSAVE2      # NVMONOPT PASTE OPTION
26     EXTEND
27     BZF      +2
28     TC       PASTEOPT      # PASTE PLEASE VERB FOR NVMONOPT
29     CA       MONSAVE      # PASTE MONITOR VERB - PASTE OPTION IS 0
30     PASTEOPT TS       EDOP # RIGHT 7
31     CA       EDOP        # PLACE MONITOR VERB OR PLEASE VERB INTO
32     TC       BANKCALL     # VERBREG AND DISPLAY IT.
33     CADR     UPDATVB -1
34     CAF      ZERO        # ZERO REQRET SO THAT PASTED VERBS CAN
35     TS       REQRET      # BE EXECUTED BY OPERATOR.
36     CA       MONSAVE2
37     TC       BLANKSUB     # PROCESS NVMONOPT BLANK OPTION IF ANY
38     TC       +1
39     ENDPASTE TC       ENDOFJOB
40
41     MID7      OCT        37600
42
43     SETLOC    ENDMONDO +1
44     COUNT*    $$/PIN
45     MONREF    OCT        75377      # -DEC10, STARTING IN BIT8
46     MONBACK   ADRES     PASTEVB
47
48     MONBUSY   TC       RELDSPON      # TURN KEY RELEASE LIGHT
49     TC       ENDOFJOB
50
51
52
53
54
55
56
57
58
59
60
```



```
1 # DSPFMEM IS USED TO DISPLAY IN OCTAL ANY FIXED REGISTER.
2 # IT IS USED WITH NOUN MACHINE CADR TO BE SPECIFIED. THE FCADR OF THE
3 # DESIRED LOCATION IS THEN PUNCHED IN. IT HANDLES F/F FCADR 4000-7777
4 #
5 # FOR BANKS L/E 27, THIS IS ENOUGH.
6 #
7 # FOR BANKS G/E 30, THE THIRD COMPONENT OF NOUN 26 PRIO, ADRES, BBCON
8 # MUST BE PRELOADED WITH THE DESIRED SUPERBANK BITS BITS 5,6,7 .
9 #
10 # V23N26 SHOULD BE USED.
11 #
12 # SUMMARY
13 # FOR BANKS L/E 27, V27N01E FCADR E
14 # FOR BANKS G/E 30, V23N26E SUPERBITS E V27N01E FCADR E
15
16 DSPFMEM CAF RID1 # IF F/F, DATACALL USES BANK 02 OR 03.
17 TS DSPCOUNT
18 CA DSPTEM1 +2 # SUPERBANK BITS WERE PRELOADED INTO
19 TS L # 3RD COMPONENT OF NOUN 26.
20 CA NOUNCADR # ORIGINAL FCADR LOADED STILL IN NOUNCADR.
21 TC SUPDACAL # CALL WITH FCADR IN A, SUPERBITS IN L.
22 TC DSPOCTWO
23 ENDSPF TC ENDOFJOB
```

WORD DISPLAY ROUTINES

	SETLOC	TESTOFUF +4	
	COUNT*	\$\$/PIN	
DSPSIGN	XCH	Q	
	TS	DSPWDRET	
	CCS	MPAC	
	TC	+8D	
	TC	+7	
	AD	ONE	
	TS	MPAC	
	TC	-ON	
	CS	MPAC +1	
	TS	MPAC +1	
	TC	DSPWDRET	
	TC	+ON	
	TC	DSPWDRET	
DSPRND	EXTEND		# ROUND BY 5 EXP-6
	DCA	DECROUND -1	
	DAS	MPAC	
	EXTEND		
	BZF	+4	
	EXTEND		
	DCA	DPOSMAX	
	DXCH	MPAC	
	TC	Q	
# DSPDECWD CONVERTS C MPAC, MPAC+1 INTO A SIGN AND 5 CHAR DECIMAL			
# STARTING IN LOC SPECIFIED IN DSPCOUNT. IT ROUNDS BY 5 EXP-6.			
DSPDECWD	XCH	Q	
	TS	WDRET	
	TC	DSPSIGN	
	TC	DSPRND	
	CAF	FOUR	
DSPDCWD1	TS	WDCNT	
	CAF	BINCON	
	TC	SHORTMP	
TRACE1	INDEX	MPAC	
	CAF	RELTAB	
	MASK	LOW5	
	TS	CODE	
	CAF	ZERO	
	XCH	MPAC +2	
	XCH	MPAC +1	
	TS	MPAC	
	XCH	DSPCOUNT	
TRACE1S	TS	COUNT	
	CCS	A	# DECREMENT DSPCOUNT EXCEPT AT +0

	TS	DSPCOUNT
	TC	DSPIN
	CCS	WDCNT
	TC	DSPDCWD1
	CS	VD1
	TS	DSPCOUNT
	TC	WDRET

DECROUND	OCT	00000
	OCT	02476

DSPDECNR CONVERTS C MPAC,MPAC+1 INTO A SIGN AND 5 CHAR DECIMAL
STARTING IN LOC SPECIFIED IN DSPCOUNT. IT DOES NOT ROUND

DSPDECNR	XCH	Q
	TS	WDRET
	TC	DSPSIGN
	TC	DSPDCWD1 -1

DSPDC2NR CONVERTS C MPAC,MPAC+1 INTO A SIGN AND 2 CHAR DECIMAL
STARTING IN LOC SPECIFIED IN DSPCOUNT. IT DOES NOT ROUND

DSPDC2NR	XCH	Q
	TS	WDRET
	TC	DSPSIGN
	CAF	ONE
	TC	DSPDCWD1

DSP2DEC CONVERTS C MPAC AND C MPAC+1 INTO A SIGN AND 10 CHAR DECIMAL
STARTING IN THE LOC SPECIFIED IN DSPCOUNT.

DSP2DEC	XCH	Q
	TS	WDRET
	CAF	ZERO
	TS	CODE
	CAF	THREE
	TC	11DSPIN # -R2 OFF
	CAF	FOUR
	TC	11DSPIN # +R2 OFF
	TC	DSPSIGN
	CAF	R2D1
END2DEC	TC	DSPDCWD1

DSPDECVN DISPLAYS C A UPON ENTRY AS A 2 CHAR DECIMAL BEGINNING IN THE
DSP LOC SPECIFIED IN DSPCOUNT.
C A SHOULD BE IN FORM N X 2EXP-14. THIS IS SCALED TO FORM N/100 BEFORE
DISPLAY CONVERSION.

DSPDECVN	EXTEND		
	MP	VNDSPCON	# MULT BY .01
	LXCH	MPAC	# TAKE RESULTS FROM L. MULT BY 2EXP14 .
	CAF	ZERO	
	TS	MPAC +1	
	XCH	Q	
	TS	WDRET	
	TC	DSPDC2NR +3	# NO SIGN, NO ROUND, 2 CHAR
VNDSPCON	OCT	00244	# .01 ROUNDED UP
GOVNUPDT	TC	DSPDECVN	# THIS IS NOT FOR GENERAL USE. REALLY PART
	TC	POSTJUMP	# OF UPDATVB.
	CADR	UPDAT1 +2	
ENDECVN	EQUALS		
	SETLOC	ENDSPF +1	
	COUNT*	\$\$/PIN	
	# DSPOCTWD DISPLAYS C A UPON ENTRY AS A 5 CHAR OCT STARTING IN THE DSP		
	# CHAR SPECIFIED IN DSPCOUNT. IT STOPS AFTER 5 CHAR HAVE BEEN DISPLAYED.		
DSPOCTWO	TS	CYL	
	XCH	Q	
	TS	WDRET	# MUST USE SAME RETURN AS DSP2BIT.
	CAF	BIT14	# TO BLANK SIGNS
	ADS	DSPCOUNT	
	CAF	FOUR	
WDAGAIN	TS	WDCNT	
	CS	CYL	
	CS	CYL	
	CS	CYL	
	CS	A	
	MASK	DSPMSK	
	INDEX	A	
	CAF	RELTAB	
	MASK	LOW5	
	TS	CODE	
	XCH	DSPCOUNT	
	TS	COUNT	
	CCS	A	# DECREMENT DSPCOUNT EXCEPT AT +0
	TS	DSPCOUNT	
	TC	POSTJUMP	
	CADR	DSPOCTIN	
OCTBACK	CCS	WDCNT	
	TC	WDAGAIN	# +
DSPLV	CS	VD1	# TO BLOCK NUMERICAL CHARACTERS, CLEARS,
	TS	DSPCOUNT	# AND SIGNS AFTER A COMPLETED DISPLAY.

TC WDRET

DSPMSK SEVEN

DSP2BIT DISPLAYS C A UPON ENTRY AS A 2 CHAR OCT BEGINNING IN THE DSP
LOC SPECIFIED IN DSPCOUNT BY PRE CYCLING RIGHT C A AND USING THE LOGIC
OF THE 5 CHAR OCTAL DISPLAY

DSP2BIT TS CYR
XCH Q
TS WDRET
CAF ONE
TS WDCNT
CS CYR
CS CYR
XCH CYR
TS CYL
TC WDAGAIN +5

FOR DSPIN PLACE 0/25 OCT INTO COUNT, 5 BIT RELAY CODE INTO CODE. BOTH
ARE DESTROYED. IF BIT14 OF COUNT IS 1, SIGN IS BLANKED WITH LEFT CHAR.
FOR DSPIN1 PLACE 0,1 INTO BIT11 OF CODE, 2 INTO COUNT, REL ADDRESS OF
DSPTAB ENTRY INTO DSREL.

SETLOC ENDECVN

DSPIN COUNT* \$\$/PIN
XCH Q # CANT USE L FOR RETURN, SINCE MANYOF THE
TS DSEXIT # ROTINE CALLING DSPIN USE L AS RETURN.
CAF LOW5
MASK COUNT
TS SR
XCH SR
TS DSREL
CAF BIT1
MASK COUNT
CCS A
TC +2 # LEFT IF COUNT IS ODD
TC DSPIN1 -1 # RIGHT IF COUNT IS EVEN
XCH CODE
TC SLEFT5 # DOES NOT USE CYL
TS CODE
CAF BIT14
MASK COUNT
CCS A
CAF TWO # BIT14 1, BLANK SIGN
AD ONE # BIT14 0, LEAVE SIGN ALONE
TS COUNT # +0 INTO COUNT FOR RIGHT

+1 INTO COUNT FOR LEFT SIGN LEFT ALONE
+3 INTO COUNT FOR LEFT TO BLANK SIGN

DSPIN1

INHINT

INDEX

DSREL

CCS

DSPTAB

TC

+2

IF +

TC

CCSHOLE

AD

ONE

IF -

TS

DSMAG

INDEX

COUNT

MASK

DSMSK

EXTEND

SU

CODE

EXTEND

DFRNT

BZF

DSL

SAME

INDEX

COUNT

CS

DSMSK

MASK WITH 77740, 76037, 76777, OR 74037

MASK

DSMAG

AD

CODE

CS

A

INDEX

DSREL

XCH

DSPTAB

EXTEND

DSL

BZMF

DSL

DSPTAB ENTRY WAS -

INCR

NOUT

DSPTAB ENTRY WAS +

RELINT

TC

DSEXIT

DSMSK

OCT

37

OCT

1740

OCT

2000

OCT

3740

FOR 11DSPIN, PUT REL ADDRESS OF DSPTAB ENTRY INTO A, 1 IN BIT11 OR 0 IN
BIT11 OF CODE.

11DSPIN

TS

DSREL

CAF

TWO

TS

COUNT

XCH

Q

MUST USE SAME RETURN AS DSPIN

TS

DSEXIT

TC

DSPIN1

DSPOCTIN

TC

DSPIN

SO DSPOCTWO DOESNT USE SWCALL

CAF

+2

TC

BANKJUMP

ENDSPOCT

CADR

OCTBACK


```
1 # DSPALARM FINDS TC NVSUBEND IN ENTRET FOR NVSUB INITIATED ROUTINES
2 # ABORT WITH 01501.
3
4 #
5 # DSPALARM FINDS TC ENDOFJOB IN ENTRET FOR KEYBOARD INITIATED ROUTINES.
6 # DC TC ENTRET.
7
8 PREDSPAL      CS      VD1
9              TS      DSPCOUNT
10 DSPALARM      CS      NVSBENDL
11              AD      ENTEXIT
12              EXTEND
13              BZF     CHARALRM +2
14              CS      MONADR      # IF THIS IS A MONITOR, KILL IT
15              AD      ENTEXIT
16              EXTEND
17              BZF     +2
18              TC      CHARALRM
19              TC      KILMONON
20              TC      FALTON
21              TC      PASTEBV      # PUT MONITOR VERB BACK IN VERBREG
22 CHARALRM      TC      FALTON      # NO NVSUB INITATED. TURN ON OPR ERROR
23              TC      ENDOFJOB
24              TC      POODOO
25              OCT     01501
26 MONADR        GENADR PASTEBV
27 NVSBENDL      TC      NVSUBEND
28
29 # ALMCYCLE TURNS ON CHECK FAIL LIGHT, REDISPLAYS THE ORIGINAL VERB THAT
30 # WAS EXECUTED, AND RECYCLES TO EXECUTE THE ORIGINAL VERB/NOUN COMBINATION
31 # THAT WAS LAST EXECUTED. USED FOR BAD DATA DURING LOAD VERBS AND BY
32 # MCTBS. ALSO BY MMCHANG IF 2 NUMERICAL CHARACTERS WERE NOT PUNCHED IN
33 # FOR MM CODE.
34
35              SETLOC  MID7 +1
36              COUNT*  $$/PIN
37 ALMCYCLE      TC      FALTON      # TURN ON CHECK FAIL LIGHT.
38              CS      VERBSAVE     # GET ORIGINAL VERB THAT WAS EXECUTED
39              TS      REQRET       # SET FOR ENTPASO
40              TC      BANKCALL     # PUTS ORIGINAL VERB INTO VERBREG AND
41              CADR     UPDATVB -1   # DISPLAYS IT IN VERB LIGHTS.
42              TC      POSTJUMP
43 ENDALM        CADR     ENTER
44
45 # MMCHANG USES NOUN DISPLAY UNTIL ENTER. THEN IT USES MODE DISP.
46 # IT GOES TO MODROUT WITH THE NEW M M CODE IN A, BUT NOT DISPLAYED IN
47 # MM LIGHTS.
48 # IT DEMANDS 2 NUMERICAL CHARACTERS BE PUNCHED IN FOR NEW MM CODE.
49 # IF NOT, IT RECYCLES.
```

```
1
2      SETLOC  DSP2BIT +10D
3
4      COUNT*  $$/PIN
5  MMCHANG    TC      REQMM      # ENTPASHI ASSUMES THE TC REQMM AT MMCHANG
6                                     # IF THIS MOVES AT ALL, MUST CHANGE
7                                     # MMADREF AT ENTPASHI.
8      CAF      BIT5
9      AD      DSPCOUNT      # OCT20  ND2.
10                                     # DSPCOUNT MUST  -ND2.
11      EXTEND
12      BZF      +2
13      TC      ALMCYCLE      # DSPCOUNT NOT  -ND2. ALARM AND RECYCLE.
14      CAF      ZERO
15      XCH      NOUNREG
16      TS      MPAC
17      CAF      ND1
18      TS      DSPCOUNT
19      TC      BANKCALL
20      CADR      2BLANK
21      CS      VD1      # BLOCK NUM CHAR IN
22      TS      DSPCOUNT
23      CA      MPAC
24      TC      POSTJUMP
25      CADR      MODROUTB      # GO THRU STANDARD LOC.
26  MODROUTB
27  REQMM      CS      V37
28      TS      Q
29      TS      REQRET
30      CAF      ND1
31      TS      DSPCOUNT
32      CAF      ZERO
33      TS      NOUNREG
34      TC      BANKCALL
35      CADR      2BLANK
36      TC      FLASHON
37      CAF      ONE
38      TS      DECBRNCH      # SET FOR DEC
39      TC      ENTEXIT
40
41  # VBRQEXEC ENTERS REQUEST TO EXEC FOR ANY ADDRESS WITH ANY PRIORITY.
42  # IT DOES ENDOFJOB AFTER ENTERING REQUEST.  DISPLAY SYST IS RELEASED.
43  # IT ASSUMES NOUN 26 HAS BEEN PRELOADED WITH
44  # COMPONENT 1  PRIORITY  BITS 10-14  BIT1 0 FOR NOVAC, BIT1 1 FOR FINDVAC.
45  # COMPONENT 2  JOB ADRES  12 BIT
46  # COMPONENT 3  BBCON
47  VBRQEXEC    CAF      BIT1
48      MASK      DSPTM1
49      CCS      A
```

```
1
2      TC      SETVAC      # IF BIT1 1, FINDVAC
3      CAF      TCNOVAC     # IF BIT1 0, NOVAC
4  REQEX1      TS      MPAC      # TC NOVAC OR TC FINDVAC INTO MPAC
5      CS      BIT1
6      MASK     DSPTM1
7  REQUESTC    TS      MPAC +4    # PRIO INTO MPAC+4 AS A TEMP
8      TC      RELDSP
9      CA      ENDINST
10     TS      MPAC +3    # TC ENDOFJOB INTO MPAC+3
11     EXTEND
12     DCA      DSPTM1 +1    # JOB ADRES INTO MPAC+1
13     DXCH     MPAC +1    # BBCON INTO MPAC+2
14     CA      MPAC +4    # PRIO IN A
15     INHINT
16     TC      MPAC
17
18  SETVAC      CAF      TCFINDVC
19      TC      REQEX1
20
21  # VBRQWAIT ENTERS REQUEST TO WAITLIST FOR ANY ADDRESS WITH ANY DELAY.
22  # IT DOES ENDOFJOB AFTER ENTERING REQUEST. DISPLAY SYST IS RELEASED.
23  # IT ASSUMES NOUN 26 HAS BEEN PRELOADED WITH
24  # COMPONENT 1 DELAY LOW BITS
25  # COMPONENT 2 TASK ADRES 12 BIT
26  # COMPONENT 3 BBCON
27
28  VBRQWAIT    CAF      TCWAIT
29      TS      MPAC      # TC WAITLIST INTO MPAC
30      CA      DSPTM1    # TIME DELAY
31  ENDRQWT     TC      REQUESTC -1
32
33  # REQUESTC WILL PUT TASK ADRES INTO MPAC+1, BBCON INTO MPAC+2,
34  # TC ENDOFJOB INTO MPAC+3. IT WILL TAKE TIME DELAY OUT OF MPAC+4 AND
35  # LEAVE IT IN A, INHINT AND TC MPAC.
36
37      SETLOC   NVSBENDL +1
38      COUNT*   $$/PIN
39  VBPROC      CAF      ONE      # PROCEED WITHOUT DATA
40      TS      LOADSTAT
41      TC      KILMONON    # TURN ON KILL MONITOR BIT
42      TC      RELDSP
43      TC      FLASHOFF
44      TC      RECALTST    # SEE IF THERE IS ANY RECALL FROM ENDIDLE
45
46  VBTERM      CS      ONE
47      TC      VBPROC +1    # TERM VERB SETS LOADSTAT NEG
```

PROCKEY PERFORMS THE SAME FUNCTION AS VBPROC. IT MUST BE CALLED UNDER
EXECUTIVE CONTROL, WITH CHRPRIO.

PROCKEY	CAF	ZERO	# SET REQRET FOR ENTER PASS 0.
	TS	REQRET	
	CS	VD1	# BLOCK NUMERICAL CHARACTERS, SIGNS, CLEAR
	TS	DSPCOUNT	
	TC	VBPROC	

VBRESEQ WAKES ENDIDLE AT SAME LINE AS FINAL ENTER OF LOAD L+3 .
MAIN USE IS INTENDED AS RESPONSE TO INTERNALLY INITIATED FLASHING
DISPLAYS IN ENDIDLE. SHOULD NOT BE USED WITH LOAD VERBS, PLEASE PERFORM,
OR PLEASE MARK VERBS BECAUSE THEY ALREADY USE L+3 IN ANOTHER CONTEXT.

VBRESEQ	CS	ZERO	# MAKE IT LOOK LIKE DATA IN.
	TC	VBPROC +1	

FLASH IS TURNED OFF BY PROCEED WITHOUT DATA, TERMINATE, RESEQUENCE,
END OF LOAD.

KEY RELEASE ROUTINE

```
#
# THIS ROUTINE ALWAYS TURNS OFF THE UPACT LIGHT AND ALWAYS CLEARS DSPLOCK.
#
# THE HIGHEST PRIORITY FUNCTION OF THE KEY RELEASE BUTTON IS THE
# UNSUSPENDING OF A SUSPENDED MONITOR WHICH WAS EXTERNALLY INITIATED.
# THIS FUNCTION IS ACCOMPLISHED BY CLEARING DSPLOCK AND TURNING OFF
# THE KEY RELEASE LIGHT IF BOTH DSPLIST AND CADRSTOR ARE EMPTY.
#
# IF NO SUCH MONITOR EXISTS, THEN RELDSP IS EXECUTED TO CLEAR DSPLOCK
# AND THE EXTERNAL MONITOR BIT FREEING THE DISPLAY SYSTEM FOR INTERNAL
# USE , TURN OFF THE KEY RELEASE LIGHT, AND WAKE UP ANY JOB IN DSPLIST.
#
# IN ADDITION IF THERE IS A JOB IN ENDIDLE, THEN CONTROL IS TRANSFERRED
# TO PINBRNCH IN DISPLAY INTERFACE ROUTINE TO RE-EXECUTE THE SERIES OF
# NVSUB CALLS ETC. THAT PRECEDED THE ENDIDLE CALL STILL AWAITING RESPONSE.
# THIS FEATURE IS INTENDED FOR USE WHEN THE OPERATOR HAS BEEN REQUESTED TO
# RESPOND TO SOME INTERNAL ACTION THAT USED ENDIDLE, BUT HE HAS WRITTEN
# OVER THE INFORMATION ON THE DISPLAY PANEL BY SOME DISPLAYS OF HIS OWN
# INITIATION WHICH DO NOT SERVE AS RESPONSES. HITTING KEYRLSE WILL
# RE-ESTABLISH THE DISPLAYS TO THE STATE THEY WERE IN BEFORE HE OBSCURED
# THEM, SO THAT HE CAN SEE THE WAITING REQUEST. THIS WORKS ONLY FOR
# INTERNAL PROGRAMS THAT USED ENDIDLE THROUGH MARGARETS DISPLAY
# SUBROUTINES.
```

VBRELDSP	CS	BIT3	
	EXTEND		
	WAND	DSALMOUT	# TURN OFF UPACT LITE
	CCS	21/22REG	# OLD DSPLOCK
	CAF	BIT14	
	MASK	MONSAVE1	# EXTERNAL MONITOR BIT EMB
	CCS	A	
	TC	UNSUSPEN	# OLD DSPLOCK AND EMB BOTH 1, UNSUSPEND.
TSTLTS4	TC	RELDSP	# NOT UNSUSPENDING EXTERNAL MONITOR,
	CCS	CADRSTOR	# RELEASE DISPLAY SYSTEM AND
	TC	+2	# DO RE-ESTABLISH IF CADRSTOR IS FULL.
	TC	ENDOFJOB	
	TC	POSTJUMP	
	CADR	PINBRNCH	
UNSUSPEN	CAF	ZERO	# EXTERNAL MONITOR IS SUSPENDED,
	TS	DSPLOCK	# JUST UNSUSPEND IT BY CLEARING DSPLOCK.
	CCS	CADRSTOR	# TURN KEY RELEASE LIGHT OFF IF BOTH
	TC	ENDOFJOB	# CADRSTOR AND DSPLIST ARE EMPTY.
	TC	RELDSP1	
	TC	ENDOFJOB	
ENDRELDS	EQUALS		


```
1 # NVSUB IS USED FOR SUBROUTINE CALLS FROM WITHIN COMPUTER. IT CAN BE
2 # USED TO CALL THE COMBINATION OF ANY DISPLAY, LOAD, OR MONITOR VERB
3 # TOGETHER WITH ANY NOUN AVAILABLE TO THE KEYBOARD.
4 # PLACE OVVVVVVVNNNNNNNN INTO A.
5 # V S ARE THE 7-BIT VERB CODE. N S ARE THE 7-BIT NOUN CODE.
6 #
7 # IF NVSUB IS CALLED WITH THE FOLLOWING NEGATIVE NUMBERS RATHER THAN THE
8 # VERB-NOUN CODE IN A, THEN THE DISPLAY IS BLANKED AS FOLLOWS -
9 # -4 FULL BLANK, -3 LEAVE MODE, -2 LEAVE MODE AND VERB, -1 BLANK R S ONLY.
10 #
11 # NVSUB CAN BE USED WITH MACH CADR TO BE SPEC BY PLACING THE CADR INTO
12 # MPAC+2 BEFORE THE STANDARD NVSUB CALL.
13 #
14 # NVSUB RETURNS TO 2+ CALLING LOC AFTER PERFORMING TASK, IF DISPLAY
15 # SYSTEM IS AVAILABLE. THE NEW NOUN AND VERB CODES ARE DISPLAYED.
16 # IF V S 0, THE NEW NOUN CODE IS DISPLAYED ONLY RETURN WITH NO FURTHER
17 # ACTION. IF N S 0, THE NEW VERB CODE IS DISPLAYED ONLY RETURN WITH NO
18 # FURTHER ACTION.
19 #
20 # IT RETURNS TO 1+ CALLING LOC WITHOUT PERFORMING TASK, IF DISPLAY
21 # SYSTEM IS BLOCKED NOTHING IS DISPLAYED IN THIS CASE.
22 # IT DOES TC ABORT WITH OCT 01501 IF IT ENCOUNTERS A DISPLAY PROGRAM
23 # ALARM CONDITION BEFORE RETURN TO CALLER.
24 #
25 # THE DISPLAY SYSTEM IS BLOCKED BY THE DEPRESSION OF ANY
26 # KEY, EXCEPT ERROR LIGHT RESET.
27 # IT IS RELEASED BY THE KEY RELEASE BUTTON, ALL EXTENDED VERBS,
28 # PROCED WITHOUT DATA, TERMINATE, RESEQUENCE, INITIALIZE EXECUTIVE,
29 # RECALL PART OF RECALIST IF ENDIDLE WAS USED,
30 # VB REQUEST EXECUTIVE, VB REQUEST WAITLIST,
31 # MONITOR SET UP.
32 #
33 # THE DISPLAY SYSTEM IS ALSO BLOCKED BY THE EXTERNAL MONITOR BIT, WHICH
34 # INDICATES AND EXTERNALLY INITIATED MONITOR IS RUNNING SEE MONITOR.
35 #
36 # A NVSUB CALL THAT PASSES DSPLOCK AND THE EXTERNAL MONITOR BIT ENDS OLD
37 # MONITOR.
38 #
39 # DSPLOCK IS THE INTERLOCK FOR USE OF KEYBOARD AND DISPLAY SYSTEM WHICH
40 # LOCKS OUT INTERNAL USE WHENEVER THERE IS EXTERNAL KEYBOARD ACTION.
41 #
42 # NVSUB SHOULD BE USED TWICE IN SUCCESSION FOR PLEASE PERFORM SITUATIONS
43 # SIMILARLY FOR PLEASE MARK. FIRST PLACE THE CODED NUMBER FOR WHAT
44 # ACTION IS DESIRED OF OPERATOR INTO THE REGISTERS REFERRED TO BY THE
45 # CHECKLIST NOUN. GO TO NVSUB WITH A DISPLAY VERB AND THE CHECKLIST
46 # NOUN. GO TO NVSUB AGAIN WITH THE PLEASE PERFORM VERB AND ZEROS IN THE
47 # LOW 7 BITS. THIS PASTES UP THE PLEASE PERFORM VERB INTO THE VERB
48 # LIGHTS.
49 #
50 # NVMONOPT IS AN ENTRY SIMILAR TO NVSUB, BUT REQUIRING AN ADDITIONAL
```


PARAMETER IN L. IT SHOULD BE USED ONLY WITH A MONITOR VERB-NOUN CODE IN
A. AFTER EACH MONITOR DISPLAY A *PLEASE* VERB WILL BE PASED INT THE VERB
LIGHTS OR DATA WILL BE BLANKED OR BOTH ACCORDING TO THE OPTIONS
SPECIFIED IN L. IF BITS 8-14 OF L ARE OTHER THAN ZERO, THEN THEY WILL
BE INTERPRETED AS A VERB CODE AND PASTED IN THE VERB LIGHTS. THIS VERB
CODE SHOULD DESIGNATE ONE OF THE *PLEASE* VERBS. IF BITS 1-3 OF L ARE
OTHER THAN ZERO, THEN THEY WILL BE USED TO BLANK DATA BY BEING FED TO
BLANKSUB. IF NVMONOPT IS USED WITH A VERB OTHER THAN A MONITOR VERB,
THE PARAMETER IN L HAS NO EFFECT.

NVSUB IN FIXED-FIXED PLACES 2+CALLING LOC INTO NVQTEM, TC NVSUBEND INTO
ENTRET. THIS WILL RESTORE OLD CALLING BANK BITS

SETLOC ENDALM +1

NVSUB	COUNT*	\$\$/PIN	
	LXCH	7	# ZERO NVMONOPT OPTIONS
NVMONOPT	TS	NVTEMP	
	CAF	BIT14	
	MASK	MONSAVE1	# EXTERNAL MONITOR BIT
	AD	DSPLOCK	
	CCS	A	
	TC	Q	# DSP SYST BLOCKED, RET TO 1+ CALLING LOC
NVSBCOM	CAF	ONE	# DSP SYST AVAILABLE.
	AD	Q	
	TS	NVQTEM	# 2+ CALLING LOC INTO NVQTEM
	LXCH	MONSAVE2	# STORE NVMONOPT OPTIONS
NVSUBCOM	TC	KILMONON	# TURN ON KILL MONITOR BIT
	CAF	NVSBBBNK	
	XCH	BBANK	
	EXTEND		# SAVE OLD SUPERBITS
	ROR	SUPERBNK	
	TS	NVBNKTEM	
	CAF	PINSUPBT	
	EXTEND		
	WRITE	SUPERBNK	
	TC	NVSUBB	# GO TO NVSUB1 THRU STANDARD LOC
NVSBBBNK	EBANK	DSPCOUNT	
	BBCON	NVSUB1	
PINSUPBT		NVSBBBNK	# CONTAINS THE PINBALL SUPERBITS.
NVSUBEND	DXCH	NVQTEM	# NVBNKTEM MUST NVQTEM+1
	TC	SUPDXCHZ	# DTCB WITH SUPERBIT SWITCHING

SETLOC ENDRQWT +1

COUNT* \$\$/PIN

BLANKDSP BLANKS DISPLAY ACCORDING TO OPTION NUMBER IN NVTEMP AS FOLLOWS

-4 FULL BLANK, -3 LEAVE MODE, -2 LEAVE MODE AND VERB, -1 BLANK R S ONLY.

BLANKDSP	AD	SEVEN	# 7,8,9, OR 10 A HAD 0,1,2,OR 3
	INHINT		
	TS	CODE	# BLANK SPECIFIED DSPTABS
	CS	BIT12	
	INDEX	CODE	
	XCH	DSPTAB	
	CCS	A	
	INCR	NOUT	
	TC	+1	
	CCS	CODE	
	TC	BLANKDSP +2	
	RELINT		
	INDEX	NVTEMP	
	TC	+5	
	TC	+1	# NVTEMP HAS -4 NEVER TOUCH MODREG
	TS	VERBREG	# -3
	TS	NOUNREG	# -2
	TS	CLPASS	# -1
	CS	VD1	
	TS	DSPCOUNT	
	TC	FLASHOFF	# PROTECT AGAINST INVISIBLE FLASH
	TC	ENTSET -2	# ZEROS REQRET
NVSUB1	CAF	ENTSET	# IN BANK
	TS	ENTRET	# SET RETURN TO NVSUBEND
	CCS	NVTEMP	# WHAT NOW
	TC	+4	# NORMAL NVSUB CALL EXECUTE VN OR PASTE
	TC	GODSPALM	
	TC	BLANKDSP	# BLANK DISPLAY AS SPECIFIED
	TC	GODSPALM	
	CAF	LOW7	
	MASK	NVTEMP	
	TS	MPAC +3	# TEMP FOR NOUN CANT USE MPAC. DSPDECVN
	CA	NVTEMP	# USES MPAC, +1, +2 .
	TS	EDOP	# RIGHT 7
	CA	EDOP	
	TS	MPAC +4	# TEMP FOR VERB CANT USE MPAC+1. DSPDECVN
			# USES MPAC, +1, +2 .
	CCS	MPAC +3	# TEST NOUN
	TC	NVSUB2	# IF NOUN NOT +0, GO ON
	CA	MPAC +4	
	TC	UPDATVB -1	# IF NOUN +0, DISPLAY VERB, THEN RETURN
	CAF	ZERO	# XERO REQRET SO THAT PASTED VERBS CAN
	TS	REQRET	# BE EXECUTED BY OPERATOR.
ENTSET	TC	NVSUBEND	
NVSUB2	CCS	MPAC +4	# TEST VERB
	TC	+4	# IF VERB NOT +0, GO ON
	CA	MPAC +3	

```
1      TC      UPDATNN -1      # IF VERB  +0, DISPLAY NOUN, THEN RETURN
2      TC      NVSUBEND
3
4      CA      MPAC +2      # TEMP FOR MACH CADR TO BE SPEC.  DSPDECVN
5      TS      MPAC +5      #          USES MPAC, +1, +2
6      CA      MPAC +4
7
8      TC      UPDATVB -1      # IF BOTH NOUN AND VERB NOT +0, DISPLAY
9      CA      MPAC +3      # BOTH AND GO TO ENTPAS0.
10     TC      UPDATNN -1
11
12     CAF      ZERO
13     TS      LOADSTAT      # SET FOR WAITING FOR DATA CONDITION
14     TS      CLPASS
15
16     TS      REQRET      # SET REQRET FOR PASS 0.
17     CA      MPAC +5      # RESTORES MACH CADR TO BE SPEC TO MPAC+2
18     TS      MPAC +2      # FOR USE IN INTMCTBS  IN ENTPAS0 .
19
20     ENDNVSB1      TC      ENTPAS0
```

```
21
22 # IF INTERNAL MACH CADR TO BE SPECIFIED, MPAC+2 WILL BE PLACED INTO
23 # NOUNCADR IN ENTPAS0  INTMCTBS .
```

```
24     SETLOC  NVSUBEND +2
25     COUNT*  $$/PIN
26
27     KILMONON      CAF      BIT15      # FORCE BIT 15 OF MONSAVE1 TO 1.
28                                     #      THIS IS THE KILL MONITOR BIT.
29     TS      MONSAVE1      # TURN OFF BIT 14, THE EXTERNAL
30                                     #      MONITOR BIT.
31
32     TC      Q
```

```
33 # LOADSTAT      +0      INACTIVE  WAITING FOR DATA . SET BY NVSUB
34 #               +1      PROCEED NO DATA. SET BY SPECIAL VERB
35 #               -1      TERMINATE. SET BY SPECIAL VERB.
36 #               -0      DATA IN      SET BY END OF LOAD ROUTINE
37 #               OR      RESEQUENCE   SET BY VERB 32
```

```
38 #
39 # L TO ENDIDLE  FIXED FIXED
40 # ROUTINES THAT REQUEST LOADS THROUGH NVSUB SHOULD USE ENDIDLE WHILE
41 # WAITING FOR THE DATA TO BE LOADED. ENDIDLE PUTS CURRENT JOB TO SLEEP.
42 # ENDIDLE CANNOT BE CALLED FROM ERASABLE OR F/F MEMORY,
43 # SINCE JOB SLEEP AND JOBWAKE CAN HANDLE ONLY FIXED BANKS.
```

```
44 # RECALST TESTS LOADSTAT AND WAKES JOB UP TO,
45 #   L+1      FOR TERMINATE
46 #   L+2      FOR PROCEED WITHOUT DATA
47 #   L+3      FOR DATA IN, OR RESEQUENCE
48 # IT DOES NOTHING IF LOADSTAT INDICATES WAITING FOR DTA.
49 #
50 # ENDIDLE ABORTS  WITH CODE 1206  IF A SECOND JOB ATTEMPTS TO GO TO SLEEP
```

```
# IN PINBALL. IN PARTICULAR, IF AN ATTEMPT IS MADE TO GO TO ENDIDLE WHEN
# 1  CADRSTOR NOT +0. THIS IS THE CASE WHERE THE CAPACITY OF ENDIDLE IS
#    EXCEEDED. +-NZ INDICATES A JOB IS ALREADY ASLEEP DUE TO ENDIDLE.
# 2  DSPLIST NOT +0. THIS INDICATES A JOB IS ALREADY ASLEEP DUE TO
#    NVSUBUSY.
```

```
ENDIDLE      LXCH  Q      # RETURN ADDRESS INTO L.
              TC    ISCADR+0  # ABORT IF CADRSTOR NOT +0
              TC    ISLIST+0  # ABORT IF DSPLIST NOT +0
              CA    L      # DONT SET DSPLOC TO 1 SO CAN USE
              MASK  LOW10    # ENDIDLE WITH NVSUB INITIATED MONITOR.
              AD    FBANK    # SAME STRATEGY FOR CADR AS MAKECADR.
              TS    CADRSTOR
              TC    JOBSLEEP
```

```
ENDINST      TC    ENDOFJOB
```

```
ISCADR+0     CCS    CADRSTOR  # ABORTS CODE 01206 IF CADRSTOR NOT +0.
              TC    DSPABORT  # RETURNS IF CADRSTOR +0.
              TC    Q
              TC    DSPABORT
```

```
ISLIST+0     CCS    DSPLIST   # ABORTS CODE 01206 IF DSPLIST NOT +0.
              TC    DSPABORT  # RETURNS IF DSPLIST +0.
```

```
DSPABORT     TC    Q
              TC    POOD00
              OCT    01206
```

```
# JAMTERM ALLOWS PROGRAMS TO PERFORM THE TERMINATE FUNCTION.
# IT DOES ENDOFJOB.
```

```
JAMTERM      CAF    PINSUPBT
              EXTEND
              WRITE  SUPERBNK
              CAF    34DEC
              TS     REQRET    # LEAVE ENTER SET FOR ENTPASS0.
              CS     VD1
              TS     DSPCOUNT
              TC     POSTJUMP
              CADR   VBTERM
```

```
34DEC        DEC    34
```

```
# JAMPROC ALLOWS PROGRAMS TO PERFORM THE PROCEED/PROCEED WITHOUT DATA
# FUNCTION. IT DOES ENDOFJOB.
```

```
1 JAMPROC      CAF      PINSUPBT
2              EXTEND
3
4              WRITE    SUPERBNK
5              CAF      33DEC
6              TS       REQRET      # LEAVE ENTER SET FOR ENTPASS0.
7
8              CS       VD1
9              TS       DSPCOUNT
10             TC       POSTJUMP
11
12             CADR     VBPROC
13
14 33DEC        DEC      33
15
16 # BLANKSUB BLANKS ANY COMBINATION OF R1, R2, R3.
17 # CALL WITH BLANKING CODE IN A.
18 # BIT1 1 BLANKS R1, BIT2 1 BLANKS R2, BIT3 1 BLANKS R3.
19 # ANY COMBINATION OF THESE BITS IS ACCEPTED.
20 #
21 # DSPCOUNT IS RESTORED TO STATE IT WAS IN BEFORE BLANKSUB WAS EXECUTED.
22
23 BLANKSUB     MASK     SEVEN
24             TS       NVTEMP      # STORE BLANKING CODE IN NVTEMP.
25             CAF      BIT14
26             MASK     MONSAVE1    # EXTERNAL MONITOR BIT
27
28             AD       DSPLOCK
29             CCS      A
30             TC       Q           # DSP SYST BLOCKED. RET TO 1+ CALLING LOC
31             INCR     Q           # DSP SYST AVAILABLE
32                                     # SET RETURN FOR 2+ CALLING LOC
33
34             CCS      NVTEMP
35             TCF      +2
36             TC       Q           # NOTHING TO BLANK. RET TO 2+ CALLING LOC
37             LXCH     Q           # SET RETURN FOR 2 + CALLING LOC
38
39             CAF      BLNKBBNK
40             XCH      BBANK
41             EXTEND
42             ROR      SUPERBNK    # SAVE OLD SUPERBITS.
43             DXCH     BUF
44             CAF      PINSUPBT
45
46             EXTEND
47             WRITE    SUPERBNK
48             TC       BLNKSUB1
49
50 BLNKBBNK     EBANK     DSPCOUNT
51 ENDBLFF      BBCON     BLNKSUB1
52
53             SETLOC   ENDRELDS
54             COUNT*   $$/PIN
55 BLNKSUB1     CA       DSPCOUNT  # SAVE OLD DSPCOUNT FOR LATER RESTORATION
```



```
1
2      TS      BUF +2
3      CAF      BIT1      # TEST BIT1. SEE IF R1 TO BE BLANKED.
4
5      TC      TESTBIT
6      CAF      R1D1
7      TC      5BLANK -1
8
9      CAF      BIT2      # TEST BIT2. SEE IF R2 TO BE BLANKED.
10     TC      TESTBIT
11     CAF      R2D1
12     TC      5BLANK -1
13
14     CAF      BIT3      # TEST BIT3. SEE IF R3 TO BE BLANKED.
15     TC      TESTBIT
16     CAF      R3D1
17     TC      5BLANK -1
18     CA      BUF +2      # RESTORE DSPCOUNT TO STATE IT HAD
19
20     TS      DSPCOUNT    # BEFORE BLANKSUB.
21     DXCH    BUF          # CALL L+2 DIRECTLY.
22     TC      SUPDXCHZ +1   # DTCB WITH SUPERBIT SWITCHING
23
24     TESTBIT    MASK      NVTEMP      # NVTEMP CONTAINS BLANKING CODE.
25     CCS      A
26
27     TC      Q      # IF CURRENT BIT 1, RETURN TO L+1.
28     INDEX   Q      # IF CURRENT BIT 0, RETURN TO L+3.
29     TC      2
30
31     ENDBSUB1    EQUALS
32
33     # DSPMM DOES NOT DISPLAY MODREG DIRECTLY. IT PUTS IN EXEC REQUEST WITH
34     # PRIO 30000 FOR DSPMMJB AND RETURNS TO CALLER.
35     #
36     # IF MODREG CONTAINS -0, DSPMMJB BLANKS THE MODE LIGHTS.
37     #
38     # DSPMM MUST BE IN BANK 27 OR LOWER, SO IT CAN BE CALLED VIA BANKCALL.
39
40     BANK      7
41     SETLOC    PINBALL4
42     BANK
43
44     COUNT*    $$/PIN
45     DSPMM     XCH      Q
46     TS      MPAC
47     INHINT
48     CAF      CHRPRIO
49     TC      NOVAC
50     EBANK    DSPCOUNT
51     2CADR    DSPMMJB
52
53     RELINT
54     ENDSPMM   TC      MPAC
```


DSPMM PLACE MAJOR MODE CODE INTO MODREG

SETLOC ENDBSUB1

COUNT* \$\$/PIN

DSPMMJB

CAF

MD1

GETS HERE THRU DSPMM

XCH

DSPCOUNT

TS

DSPMMTEM

SAVE DSPCOUNT

CCS

MODREG

AD

ONE

TC

DSPDECVN

IF MODREG IS + OR +0, DISPLAY MODREG

TC

+2

IF MODREG IS -NZ, DO NOTHING

TC

2BLANK

IF MODREG IS -0, BLANK MM

XCH

DSPMMTEM

RESTORE DSPCOUNT

TS

DSPCOUNT

TC

ENDOFJOB

RECALTST IS ENTERED DIRECTLY AFTER DATA IS LOADED OR RESEQUENCE VERB IS

EXECUTED , TERMINATE VERB IS EXECUTED, OR PROCEED WITHOUT DATA VERB IS

EXECUTED. IT WAKES UP JOB THAT DID TC ENDIDLE.

#

IF CADRSTOR NOT +0, IT PUTS +0 INTO DSPLOCK, AND TURNS OFF KEY RLSE

LIGHT IF DSPLIST IS EMPTY LEAVES KEY RLSE LIGHT ALONE IF NOT EMPTY .

RECALTST

CCS

CADRSTOR

TC

RECAL1

RECAL1

TC

ENDOFJOB

NORMAL EXIT IF KEYBOARD INITIATED

CAF

ZERO

XCH

CADRSTOR

INHINT

TC

JOBWAKE

CCS

LOADSTAT

TC

DOPROC

+ PROCEED WITHOUT DATA

TC

ENDOFJOB

PATHOLOGICAL CASE EXIT

TC

DOTERM

- TERMINATE

RECAL2

CAF

TWO

-0 DATA IN OR RESEQUENCE

INDEX

LOCCTR

AD

LOC

LOC IS + FOR BASIC JOBS

INDEX

LOCCTR

TS

LOC

CA

NOUNREG

SAVE VERB IN MPAC, NOUN IN MPAC+1 AT

TS

L

TIME OF RESPONSE TO ENDIDLE FOR

CA

VERBREG

POSSIBLE LATER TESTING BY JOB THAT HAS

INDEX

LOCCTR

BEEN WAKED UP.

DXCH

MPAC

RECAL3

RELINT

TC

RELDSP

TC

ENDOFJOB



1412THE

1				1
2	DOTERM	CAF	ZERO	2
3		TC	RECAL2	3
4				4
5	DOPROC	CAF	ONE	5
6		TC	RECAL2	6
7				7
8				8
9				9
10				10
11				11
12				12
13				13
14				14
15				15
16				16
17				17
18				18
19				19
20				20
21				21
22				22
23				23
24				24
25				25
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27				27
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36				36
37				37
38				38
39				39
40				40
41				41
42				42
43				43
44				44
45				45
46				46
47				47
48				48
49				49
50				50
51				51
52				52
53				53
54				54
55				55
56				56
57				57
58				58
59				59
60				60

MISCELLANEOUS SERVICE ROUTINES IN FIXED/FIXED

SETLOC ENDBLFF

COUNT* \$\$/PIN

SETNCADR E CADR ARRIVES IN A. IT IS STORED IN NOUNCADR. EBANK BITS
ARE SET. E ADRES IS DERIVED AND PUT INTO NOUNADD.

SETNCADR TS NOUNCADR # STORE ECADR
TS EBANK # SET EBANK BITS
MASK LOW8
AD OCT1400
TS NOUNADD # PUT E ADRES INTO NOUNADD
TC Q

SETNADD GETS E CADR FROM NOUNCADR, SETS EBANK BITS, DERIVES
E ADRES AND PUTS IT INTO NOUNADD.

SETNADD CA NOUNCADR
TCF SETNCADR +1

SETEBANK E CADR ARRIVES IN A. EBANK BITS ARE SET. E ADRES IS
DERIVED AND LEFT IN A.

SETEBANK TS EBANK # SET EBANK BITS
MASK LOW8
AD OCT1400 # E ADRES LEFT IN A
TC Q

R1D1 OCT 16 # THESE 3 CONSTANTS FORM A PACKED TABLE.
R2D1 OCT 11 # DONT SEPARATE.
R3D1 OCT 4

RIGHT5 TS CYR
CS CYR
CS CYR
CS CYR
CS CYR
XCH CYR
TC Q

LEFT5 TS CYL
CS CYL
CS CYL
CS CYL
CS CYL

	XCH	CYL	
	TC	Q	
SLEFT5	DOUBLE		
	DOUBLE		
	DOUBLE		
	DOUBLE		
	DOUBLE		
	TC	Q	
LOW5	OCT	37	# THESE 3 CONSTANTS FORM A PACKED TABLE.
MID5	OCT	1740	# DONT SEPARATE.
HI5	OCT	76000	# MUST STAY HERE
TCNOVAC	TC	NOVAC	
TCWAIT	TC	WAITLIST	
TCTSKOVR	TC	TASKOVER	
TCFINDVC	TC	FINDVAC	
CHRPRI0	OCT	30000	# EXEC PRIORITY OF CHARIN
LOW11	OCT	3777	
B12-1	EQUALS	LOW11	
LOW8	OCT	377	
VD1	OCT	23	# THESE 3 CONSTANTS FORM A PACKED TABLE.
ND1	OCT	21	# DONT SEPARATE.
MD1	OCT	25	
BINCON	DEC	10	
FALTON	CA	BIT7	# TURN ON OPERATOR ERROR LIGHT.
	EXTEND		
	WOR	DSALMOUT	# BIT 7 OF CHANNEL 11
	TC	Q	
FALTOF	CS	BIT7	# TURN OFF OPERATOR ERROR LIGHT
	EXTEND		
	WAND	DSALMOUT	# BIT 7 OF CHANNEL 11
	TC	Q	
RELDSPON	CAF	BIT5	# TURN ON KEY RELEASE LIGHT
	EXTEND		
	WOR	DSALMOUT	# BIT 5 OF CHANNEL 11
	TC	Q	

LODSAMPT

EXTEND

DCA TIME2

DXCH SAMPTIME

TC Q

TPSL1

EXTEND

DCA MPAC +1

DAS MPAC +1

AD MPAC

ADS MPAC

TS 7

TC Q

TS MPAC+6

TC Q

SHIFTS MPAC, +1, +2 LEFT 1

LEAVES OVFIN D SET TO +/- 1 FOR OF/UF

TS A DOES NOT CHANGE A ON OF/UF.

NO NET OF/UF

MPAC +6 SET TO +/- 1 FOR OF/UF

IF MPAC, +1 ARE EACH +NZ OR +0 AND C A -0, SHORTMP WRONGLY GIVES +0.

IF MPAC, +1 ARE EACH -NZ OR -0 AND C A +0, SHORTMP WRONGLY GIVES +0.

PRSHRTMP FIXES FORST CASE ONLY, BY MERELY TESTING C A AND IF IT -0,

SETTING RESULT TO -0.

DO NOT USE PRSHRTMP UNLESS MPAC, +1 ARE EACH +NZ OR +0, AS THEY ARE

WHEN THEY CONTAIN THE SF CONSTANTS.

PRSHRTMP

TS

MPTMP

CCS

A

CA

MPTMP

TCF

SHORTMP +1

TCF

-2

CS

ZERO

TS

MPAC

TS

MPAC +1

TS

MPAC +2

TC

Q

C A +, DO REGULAR SHORTMP

C A +0, DO REGULAR SHORTMP

C A -, DO REGULAR SHORTMP

C A -0, FORCE RESULT TO -0 AND RETURN.

FLASHON

CAF

BIT6

EXTEND

WOR

DSALMOUT

TC

Q

TURN ON V/N FLASH

BIT 6 OF CHANNEL 11

FLASHOFF

CS

BIT6

EXTEND

WAND

DSALMOUT

TC

Q

TURN OFF V/N FLASH

INTERNAL USE OF KEYBOARD AND DISPLAY PROGRAM.

#

USER MUST SCHEDULE CALLS TO NVSUB SO THAT THERE IS NO CONFLICT OF USE OR
CONFUSION TO OPERATOR. THE OLD GRABLOCK INTERNAL/INTERNAL INTERLOCK
HAS BEEN REMOVED AND THE INTERNAL USER NO LONGER HAS THE PROTECTION THIS
OFFERED.

#

THERE ARE TWO WAYS A JOB CAN BE PUT TO SLEEP BY THE KEYBOARD + DISPLAY
PROGRAM. 1 BY ENDIDLE

2 BY NVSUBUSY

THE BASIC CONVENTION IS THAT ONLY ONE JOB WILL BE PERMITTED ASLEEP VIA
THE KEYBOARD + DISPLAY PROGRAM AT A TIME. IF A JOB ATTEMPTS TO GO TO
SLEEP BY MEANS OF 1 OR 2 AND THERE IS ALREADY A JOB ASLEEP THAT WAS
PUT TO SLEEP BY 1 OR 2, THEN AN ABORT IS CAUSED.

#

THE CALLING SEQUENCE FOR NVSUB IS

CAF V/N

L TC NVSUB

L+1 RETURN HERE IF OPERATOR HAS INTERVENED

L+2 RETURN HERE AFTER EXECUTION

#

A ROUTINE CALLED NVSUBUSY IS PROVIDED USE IS OPTIONAL TO PUT
YOUR JOB TO SLEEP UNTIL THE OPERATOR RELEASES THE KEYBOARD + DISPLAY
SYSTEM. NVSUBUSY ALSO TURNS ON THE KEY RELEASE LIGHT.
NVSUBUSY CANNOT BE CALLED FROM ERASABLE OR F/F MEMORY,
SINCE JOBSLEEP AND JOBWAKE CAN HANDLE ONLY FIXED BANKS.

#

THE CALLING SEQUENCE IS

CAF WAKEFCADR

TC NVSUBUSY

#

#

#

.

NVSUBUSY IS INTENDED FOR USE WHEN AN INTERNAL PROGRAM FINDS THE OPERATOR
IS NOT USING THE KEYBOARD + DISPLAY PROGRAM BY HIS OWN INITIATION . IT IS
NOT INTENDED FOR USE WHEN ONE INTERNAL PROGRAM FINDS ANOTHER INTERNAL
PROGRAM USING THE KEYBOARD + DISPLAY PROGRAM.

#

NVSUBUSY ABORTS WITH CODE 01206 IF A SECOND JOB ATTEMPTS TO GO TO
SLEEP IN PINBALL. IN PARTICULAR, IF AN ATTEMPT IS MADE TO GO TO NVSUBUSY

WHEN

1 DSPLIST NOT +0. THIS IS THE CASE WHERE THE CAPACITY OF THE DSPLIST
IS EXCEEDED.

2 CADDRSTOR NOT +0. THIS INDICATES THAT A JOB IS ALREADY USING

ENDIDLE. +-NZ INDICATE A JOB IS ALREADY ASLEEP DUE TO ENDIDLE.

PRENVBSY	CS	2K+3	# SPECIAL ENTRANCE FOR ROUTINES IN FIXED
	AD	Q	# BANKS ONLY DESIRING THE FCADR OF LOC
	AD	FBANK	# FROM WHICH THE TC PRENVBSY WAS DONE -2
NVSUBUSY	TC	POSTJUMP	# TO BE ENTERED.
	CADR	NVSUBSY1	
2K+3	OCT	2003	

NVSUBSY1 MUST BE IN BANK 27 OR LOWER, SO IT WILL PUT CALLER TO SLEEP
WITH HIS PROPER SUPERBITS.

	SETLOC	ENDSPMM +1	
	COUNT*	\$\$/PIN	
NVSUBSY1	TS	L	
	TC	ISCADR+0	# ABORT IF CADRSTOR NOT +0.
	TC	ISLIST+0	# ABORT IF DSPLIST NOT +0.
	TC	RELDSPON	
	CA	L	
	TS	DSPLIST	
ENDNVBSY	TC	JOBSLEEP	

NVSBWAIT IS A SPECIAL ENTRANCE FOR ROUTINES IN FIXED BANKS ONLY. IF
SYSTEM IS NOT BUSY, IT EXECUTES V/N AND RETURNS TO L+1 L LOC FROM
WHICH THE TC NVSBWAIT WAS DONE . IF SYSTEM IS BUSY, IT PUTS CALLING JOB
TO SLEEP WITH L-1 GOING INTO LIST FOR EVENTUAL WAKING UP WHEN SYSTEM
IS NOT BUSY.

	SETLOC	NVSUBUSY +3	
	COUNT*	\$\$/PIN	
NVSBWAIT	LXCH	7	# ZERO NVMONOPT OPTIONS
	TS	NVTEMP	
	CAF	BIT14	
	MASK	MONSAVE1	# EXTERNAL MONITOR BIT
	AD	DSPLOCK	
	CCS	A	
	TCF	NVSBWT1	# BUSY
	TCF	NVSB COM	# FREE. NVSUB WILL SAVE L+1 FOR RETURN
			# AFTER EXECUTION.
NVSBWT1	INCR	Q	# L+2. PRENVBSY WILL PUT L-1 INTO LIST AND
	TCF	PRENVBSY	# GO TO SLEEP.

RELDSP IS USED BY VBPROC, VBTERM, VBRQEXEC, VBRQWAIT, VBRELDSP, EXTENDED
VERB DISPATCHER, VBRESEQ, RECALIST.
RELDSP1 IS USED BY MONITOR SET UP, VBRELDSP.

RELDSP	XCH	Q	# SET DSPLOCK TO +0, TURN RELDSP LIGHT
	TS	RELRET	# OFF, SEARCH DSPLIST
	CS	BIT14	

	INHINT		
	MASK	MONSAVE1	
	TS	MONSAVE1	# TURN OFF EXTERNAL MONITOR BIT
	CCS	DSPLIST	
	TC	+2	
	TC	RELDSP2	# LIST EMPTY
	CAF	ZERO	
	XCH	DSPLIST	
RELDSP2	TC	JOBWAKE	
	RELINT		
	CS	BIT5	# TURN OFF KEY RELEASE LIGHT
	EXTEND		# BIT 5 OF CHANNEL 11
	WAND	DSALMOUT	
	CAF	ZERO	
	TS	DSPLOCK	
RELDSP1	TC	RELRET	
	XCH	Q	# SET DSPLOCK TO +0. NO DSPLIST SEARCH.
	TS	RELRET	# TURN KEY RLSE LIGHT OFF IF DSPLIST IS
			# EMPTY. LEAVE KEY RLSE LIGHT ALONE IF
			# DSPLIST IS NOT EMPTY.
	CCS	DSPLIST	
	TC	+2	# + NOT EMPTY. LEAVE KEY RLSE LIGHT ALONE.
	TC	RELDSP2	# +0 EMPTY. TURN OFF KEY RLSE LIGHT
	CAF	ZERO	# - NOT EMPTY. LEAVE KEY RLSE LIGHT ALONE
	TS	DSPLOCK	
	TC	RELRET	
ENDPINBF	EQUALS		



1412THE

PINTEST IS NEEDED FOR AUTO CHECK OF PINBALL.

PINTEST EQUALS LST2FAN

VBTSTLTS TURNS ON ALL DISPLAY PANEL LIGHTS. AFTER 5 SEC, IT TURNS
OFF THE CAUTION AND STATUS LIGHTS.

SETLOC ENDNVSBI +1

VBTSTLTS COUNT* \$\$/PIN
 INHINT
 CS BIT1 # SET BIT 1 OF IMODES33 SO IMUMON WONT
 MASK IMODES33 # TURN OUT ANY LAMPS.
 AD BIT1
 TS IMODES33

CAF TSTCON1 # TURN ON UPLINK ACTIVITY, TEMP, KEY RLSE,
EXTEND # V/N FLASH, OPERATOR ERROR.

WOR DSALMOUT
CAF TSTCON2 # TURN ON NO ATT, GIMBAL LOCK, TRACKER,
TS DSPTAB +11D # PROG ALM.

CAF BIT10 # TURN ON TEST ALARM OUTBIT
EXTEND

WOR CHAN13

TSTLTS1 CAF TEN
 TS ERCNT
 CS FULLDSP

INDEX ERCNT
TS DSPTAB
CCS ERCNT

TC TSTLTS1
CS FULLDSP1
TS DSPTAB +1 # TURN ON 3 PLUS SIGNS

TS DSPTAB +4
TS DSPTAB +6
CAF ELEVEN

TS NOUT

RELINT

CAF SHOLTS

INHINT

TC WAITLIST

EBANK DSPTAB

2CADR TSTLTS2

TC ENDOFJOB # DSPLOCK IS LEFT BUSY FROM KEYBOARD
 # ACTION UNTIL TSTLTS3 TO INSURE THAT
 # LIGHTS TEST WILL BE SEEN.

FULLDSP OCT 05675 # DISPLAY ALL 8 S
FULLDSP1 OCT 07675 # DISPLAY ALL 8 S AND +
TSTCON1 OCT 00175

UPLINK ACTIVITY, TEMP. KEY RLSE,
V/N FLASH, OPERATOR ERROR.

TSTCON2	OCT	40674	# DSPTAB+11D BITS 3,4,5,6,8,9 LR LITES, # NO ATT, GIMBAL LOCK, TRACKER, PROG ALM.
TSTCON3	OCT	00115	# CHAN 11 BITS 1, 3, 4, 7. # UPLINK ACITIVY, TEMP, OPERATOR ERROR.
SHOLTS	OCT	764	# 5 SEC
TSTLTS2	CAF TC	CHRPRI0 NOVAC	# CALLED BY WAITLIST
	EBANK 2CADR	DSPTAB TSTLTS3	
	TC	TASKOVER	
TSTLTS3	CS	TSTCON3	# CALLED BY EXECUTIVE
	INHINT EXTEND WAND	DSALMOUT	# TURN OFF UPLINK ACTIVITY, TEMP, # OPERATOR ERROR.
	CS EXTEND WAND	BIT10 CHAN13	# TURN OFF TEST ALARM OUTBIT
	CAF EXTEND RAND	BIT4 CHAN12	# MAKE NO ATT FOLLOW BIT 4 OF CHANNEL 12 # NO ATT LIGHT ON IF IN COARSE ALIGN
	AD TS CS	BIT15 DSPTAB +11D 13-11,1	# TURN OFF AUTO, HOLD, FREE, SPARE, # GIMBAL LOCK, SPARE, TRACKER, PROG ALM # SET BITS TO INDICATE ALL LAMPS OUT. TEST
	MASK AD TS	IMODES33 PRI016 IMODES33	# LIGHTS COMPLETE.
	CS MASK AD TS	OCT55000 IMODES30 PRI015 IMODES30	# 15000.
	CS MASK AD TS	RFAILS2 RADMODES RCDUFBIT RADMODES	
	RELINT		
	TC CADR	BANKCALL DSPMM	# REDISPLAY C MODREG
	TC TC TC CADR	KILMONON FLASHOFF POSTJUMP TSTLTS4	# TURN ON KILL MONITOR BIT. # TURN OFF V/N FLASH. # DOES RELDSP AND GOES TO PINBRNCH IF # ENDIDLE IS AWAITING OPERATOR RESPONSE.

13-11,1	OCT	16001	
RFAILS2	OCT	330	# RADAR CDU AND DATA FAIL FLAGS.
OCT55000	OCT	55000	
ENDPINS2	EQUALS		


```
1 # ERROR LIGHT RESET RSET TURNS OFF
2 # UPLINK ACTIVITY, AUTO, HOLD, FREE, OPERATOR ERROR,
3 # PROG ALM, TRACKER FAIL.
4 # LEAVES GIMBAL LOCK AND NO ATT ALONE.
5 # IT ALSO ZEROS THE TEST ALARM OUT BIT, WHICH TURNS OFF STBY, RESTART.
6 # IT ALSO SETS CAUTION RESET TO 1.
7 # IT ALSO FORCES BIT 12 OF ALL DSPTAB ENTRIES TO 1.
```

```
10 SETLOC DOPROC +2
11 COUNT* $$/PIN
12 ERROR XCH 21/22REG # RESTORE ORIGINAL C DSPLOCK . THUS ERROR
13 TS DSPLOCK # LIGHT RESET LEAVES DSPLOCK UNCHANGED.
14 INHINT
15 CAF BIT10 # TURN ON CAUTION RESET OUTBIT
16 EXTEND
17 WOR DSALMOUT # BIT10 CHAN 11
18 CAF GL+NOATT # LEAVE GIMBAL LOCK AND NO ATT INTACT,
19 MASK DSPTAB +11D # TURNING OFF AUTO, HOLD, FREE,
20 AD BIT15 # PROG ALARM, AND TRACKER.
21 TS DSPTAB +11D
22 CS PRI016 # RESET FAIL BITS WHICH GENERATE PROG
23 MASK IMODES33 # ALARM SO THAT IF THE FAILURE STILL
24 AD PRI016 # EXISTS, THE ALARM WILL COME BACK.
25 TS IMODES33
26 CS BIT10
27 MASK IMODES30
28 AD BIT10
29 TS IMODES30
30
31 CS RFAILS
32 MASK RADMODES
33 AD RCDUFBIT
34 TS RADMODES
35
36 CS BIT10 # TURN OFF TEST ALARM OUTBIT.
37 EXTEND
38 WAND CHAN13
39 CS ERCON # TURN OFF UPLINK ACTIVITY,
40 # OPERATOR ERROR.
41 EXTEND
42 WAND DSALMOUT
43 TSTAB CAF BINCON # DEC 10
44 TS ERCNT # ERCNT COUNT
45 INHINT
46 INDEX ERCNT
47 CCS DSPTAB
48 AD ONE
49 TC ERPLUS
50 ERMINUS AD ONE
51 CS A
52 MASK NOTBIT12
```

ERPLUS	TC	ERCOM	
	CS	A	
	MASK	NOTBIT12	
	CS	A	# MIGHT WANT TO RESET CLPASS, DECBRNCH,
ERCOM	INDEX	ERCNT	# ETC.
	TS	DSPTAB	
	RELINT		
	CCS	ERCNT	
	TC	TSTAB	+1
	CAF	ZERO	
	TS	FAILREG	
	TS	FAILREG	+1
	TS	FAILREG	+2
	TS	SFAIL	
	TC	ENDOFJOB	
ERCON	OCT	104	# CHAN 11 BITS 3,7.
			# UPLINK ACTIVITY, AND OPERATOR ERROR.
RFAILS	OCT	330	# RADAR CDU AND DATA FAIL FLAGS.
GL+NOATT	OCT	00050	# NO ATT AND GIMBAL LOCK LAMPS
NOTBIT12	OCT	73777	
ENDPINS1	EQUALS		
	SBANK	LOWSUPER	

```
1 # MOD NO 0          DATE 1 MAY 1968
2 # MOD BY DIGITAL DEVEL GROUP LOG SECTION R60,R62
3
4 #
5 # FUNCTIONAL DESCRIPTION
6 #
7 # CALLED AS A GENERAL SUBROUTINE TO MANEUVER THE LM TO A SPECIFIED
8 # ATTITUDE.
9 #
10 # 1. IF THE 3-AXIS FLAG IS NOT SET THE FINAL CDU ANGLES ARE
11 # CALCULATED VECPOINT .
12 #
13 # 2. THE FDAI BALL ANGLES NOUN 18 ARE CALCULATED BALLANGS .
14 #
15 # 3. REQUEST FLASHING DISPLAY V50 N18 PLEASE PERFORM AUTO MANEUVER.
16 #
17 # 4. IF PRIORITY DISPLAY FLAG IS SET DO A PHASECHANGE. THEN AWAIT
18 # ASTRONAUT RESPONSE.
19 #
20 # 5. DISPLAY RESPONSE RETURNS
21 #
22 #     A. ENTER - RESET 3-AXIS FLAG AND RETURN TO CLIENT.
23 #
24 #     B. TERMINATE - IF IN P00 GO TO STEP 5A. OTHERWISE CHECK IF R61 IS
25 #     THE CALLING PROGRAM. IF IN R61 AN EXIT IS MADE TO GOTOV56. IF
26 #     NOT IN R61 AN EXIT IS DONE VIA GOTOP00H.
27 #
28 #     C. PROCEED - CONTINUE WITH PROGRAM AT STEP 6.
29 #
30 # 6. IF THE 3-AXISFLAG IS NOT SET, THE FINAL CDU ANGLES ARE CALCULATED
31 # VECPOINT .
32 #
33 # 7. THE FDAI BALL ANGLES NOUN 18 ARE CALCULATED BALLANGS .
34 #
35 # 8. IF THE G+N SWITCH IS NOT SET GO BACK TO STEP 3.
36 #
37 # 9. IF THE AUTO SWITCH IS NOT SET GO BACK TO STEP 3.
38 #
39 # 10. NONFLASHING DISPLAY V06N18 FDAI ANGLES .
40 #
41 # 11. DO A PHASECHANGE.
42 #
43 # 12. DO A MANEUVER CALCULATION AND ICDU DRIVE ROUTINE TO ACHIEVE FINAL
44 #
45 # GIMBAL ANGLES GOMANUR .
46 #
47 # 13. AT END OF MANEUVER GO TO STEP 3.
48 #
49 #     IF SATISFACTORY MANEUVER STEP 5A EXITS R60.
50 #     FOR FURTHER ADJUSTMENT OF THE VEHICLE ATTITUDE ABOUT THE
51 #     DESIRED VECTOR, THE ROUTINE MAY BE PERFORMED AGAIN STARTING AT
```

STEP 5C.

CALLING SEQUENCE TC BANKCALL
CADR R60LEM# ERASABLE INITIALIZATION REQUIRED SCAXIS, POINTVSM FOR VECPOINT
3AXISFLG.# SUBROUTINES CALLED VECPOINT, BALLANGS, GOPERF2R, LINUS, GODSPER,
GOMANUR, DOWNFLAG, PHASCHNG, UPFLAG# NORMAL EXIT MODES CAE TEMPR60 CALLERS RETURN ADDRESS
TC BANKJUMP

ALARMS NONE

OUTPUT NONE

DEBRIS CPHI, CTHETA, CPSI, 3AXISFLG, TBASE2

BANK 34
SETLOC MANUVER
BANK

EBANK TEMPR60

R60LEM COUNT* \$\$/R06
TC MAKECADR
TS TEMPR60REDOMANN CAF 3AXISBIT
MASK FLAGWRD5 # IS 3-AXIS FLAG SETCCS A
TCF TOBALL # YES
TC INTPRETCALL
STORE VECPOINT # TO COMPUTE FINAL ANGLES
CPHI # STORE FINAL ANGLES - CPHI,CTHETA,CPSI
EXIT

TOBALL TC BANKCALL

CADR BALLANGS # TO CONVERT ANGLES TO FDAI

TOBALLA CAF V06N18
TC BANKCALLCADR GOPERF2R # DISPLAY PLEASE PERFORM AUTO MANEUVER
TC R61TEST
TC REDOMANC # PROCEED
TC ENDMANU1 # ENTER I.E. FINISHED WITH R60

	TC TC	CHKLINUS ENDOFJOB	# TO CHECK FOR PRIORITY DISPLAYS
REDOMANC	CAF MASK	3AXISBIT FLAGWRD5	# IS 3-AXIS FLAG SET
	CCS TCF TC	A TOBALLC INTPRET	# YES
	CALL		
	STORE	VECPOINT CPHI	# TO COMPUTE FINAL ANGLES # STORE ANGLES
	EXIT		
TOBALLC	TC	BANKCALL	
	CADR TC CCS	BALLANGS G+N,AUTO A	# TO CONVERT ANGLES TO FDAI # CHECK AUTO MODE
	TCF	TOBALLA	# NOT AUTO, GO REREQUEST AUTO MANEUVER.
AUTOMANV	CAF	V06N18	# STATIC DISPLAY DURING AUTO MANEUVER
	TC CADR TC	BANKCALL GODSPR CHKLINUS	# TO CHECK FOR PRIORITY DISPLAYS
STARTMNV	TC CADR	BANKCALL GOMANUR	# PERFORM MANEUVER VIA KALCMANU
ENDMANUV ENDMANU1	TCF TC	TOBALLA DOWNFLAG	# FINISHED MANEUVER. # RESET 3-AXIS FLAG
	ADRES CAE TC	3AXISFLG TEMPR60 BANKJUMP	
CHKLINUS	CS MASK	FLAGWRD4 PDSPFBIT	# IS PRIORITY DISPLAY FLAG SET
	CCS TC CA	A Q Q	# NO - EXIT
	TS CS AD	MPAC +2 THREE BUF2	# SAVE RETURN # OBTAIN LOCATION FOR RESTART # HOLDS Q OF LAST DISPLAY
	TS	TBASE2	
	TC OCT	PHASCHNG 00132	
	CAF TC TC	BIT7 LINUS MPAC +2	# GO SET BITS FOR PRIORITY DISPLAY

RELINUS	CAF TC	PRI026 PRIOCHNG	# RESTORE ORIGINAL PRIORITY
	CAF MASK	TRACKBIT FLAGWRD1	# DON T CONTINUE R60 UNLESS TRACKFLAG ON.
	CCS TCF	A RER60	
	CAF MASK CCS	RNDVZBIT FLAGWRD0 A	# IS IT P20
	TC TC OCT	+4 PHASCHNG 40112	# YES # NO, MUST BE P25, SET 2.11 SPOT
	TC	ENDOFJOB	
	TC OCT	PHASCHNG 40072	# SET 2.7 SPOT FOR P20
	TC	ENDOFJOB	
RER60	TC ADRES	UPFLAG PDSPFLAG	# SET PRIO DISPLAY FLAG AFTER RESTART
	TC	TBASE2	
R61TEST	CA EXTEND	MODREG	# IF WE ARE IN P00 IT MUST BE V49 OR V89
	BZF	ENDMANU1	# THUS WE GO TO ENDEXT VIA USER
	CA MASK EXTEND	FLAGWRD4 PDSPFBIT	# ARE WE IN R61 P20 OR P25
	BZF	GOTOP00H	# NO
	TC	GOTOV56	# YES
BIT14+7	OCT	20100	
OCT203	OCT	203	
V06N18	VN	0618	
# SUBROUTINE TO CHECK FOR G+N CONTROL. AUTO STABILIZATION			
#			
# RETURNS WITH C A + IF NOT SET FOR G+N, AUTO			
# RETURNS WITH C A +0 IF SWITCHES ARE SET			
G+N, AUTO	EXTEND		
	READ MASK CCS	CHAN30 BIT10 A	
	TC	Q	# NOT IN G+N C A +



1					1
2	ISITAUTO	EXTEND	# CHECK FOR AUTO MODE		2
3		READ	CHAN31		3
4		MASK	BIT14		4
5		TC	Q	# + NOT IN AUTO, +0 AOK	5
6					6
7					7
8					8
9					9
10					10
11					11
12					12
13					13
14					14
15					15
16					16
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51					51
52					52
53					53
54					54
55					55
56					56
57					57
58					58
59					59
60					60

```

1  # PROGRAM DESCRIPTION BALLANGS
2  # MOD NO.          LOG SECTION  R60,R62
3
4  #
5  # WRITTEN BY RAMA M.AIYAWAR
6  # FUNCTIONAL DESCRIPTION
7  #
8  # COMPUTES LM FDAI BALL DISPLAY ANGLES
9  # CALLING SEQUENCE
10 #
11 #          TC          BALLANGS
12 # NORMAL EXIT MODE
13 #
14 #          TC          BALLEXIT          #  SAVED Q
15 #
16 # ALARM OR EXIT MODE  NIL
17 # SUBROUTINES CALLED
18 #          CD*TR*G
19 #          ARCTAN
20 #
21 # INPUT
22 #
23 # CPHI,CTHETA,CPSI  ARE  THE ANGLES CORRESPONDING TO AOG,AIG,AMG. THEY ARE
24 # SP,2S COMPLIMENT SCALED TO HALF REVOLUTION.
25 # OUTPUT
26 #
27 # FDAIX,FDAIY,FDAIZ ARE THE REQUIRED BALL ANGLES SCALED TO HALF REVOLUTION
28 # SP,2S COMPLIMENT.
29 # THESE ANGLES WILL BE DISPLAYED AS DEGREES AND HUNDREDTHS. IN THE ORDER  ROLL, PITCH, YAW, USING NOUNS 18  19.
30 #
31 # ERASABLE INITIALIZATION REQUIRED
32 #
33 # CPHI,CTHETA,CPSI EACH A SP REGISTER
34 # DEBRIS
35 #
36 # A,L,Q,MPAC,SINCDU,COSCDU,PUSHLIS,BALLEXIT
37 #
38 #
39 # NOMENCLATURE  CPHI, CTHETA,  CPSI REPRESENT THE OUTER, INNER,  MIDDLE GIMBAL ANGLES, RESPECTIVELY OR
40 # EQUIVALENTLY, CDUX, CDUY,  CDUZ.
41 #
42 # NOTE  ARCTAN CHECKS FOR OVERFLOW AND SHOULD BE ABLE TO HANDLE ANY SINGULARITIES.
43
44          SETLOC  BAWLANGS
45          BANK
46
47          COUNT*  $$/BALL
48 BALLANGS      TC  MAKECADR
49              TS  BALLEXIT
50              CA  CPHI
51
52
53
54
55
56
57
58
59
60

```

TS	CDUSPOT +4	
CA	CTHETA	
TS	CDUSPOT	
CA	CPSI	
TS	CDUSPOT +2	
TC	INTPRET	
SETPD	CALL	
	OD	
	CD*TR*G	
DLOAD	DMP	
	SINCDUX	# SIN OGA
	COSCDUZ	# COS MGA
SL1	DCOMP	# SCALE
ARCSIN	PDDL	# YAW ARCSIN -SXCZ INTO 0 PD
STODL	SINCDUZ	
	SINTH	# SINTH 18D IN PD
	COSCDUZ	
DMP	SL1	# RESCALE
	COSCDUX	
STCALL	COSTH	# COSTH 16D IN PD
	ARCTAN	
PDDL	DMP	# ROLL ARCTAN SZ/CZCX INTO 2 PD
	SINCDUZ	
	SINCDUX	
SL2	PUSH	# SXSZ INTO 4 PD
DMP	PDDL	# SXSZCY INTO 4 PD
	COSCDUY	
DMP	PDDL	# SXSZSY INTO 6 PD
	SINCDUY	
	COSCDUX	
DMP	SL1	# CXCY
	COSCDUY	
DSU	STADR	# PULL UP FROM 6 PD
STODL	COSTH	# COSTH CXCY - SXSZSY
	SINCDUY	
DMP	SL1	
	COSCDUX	# CXSY
DAD	STADR	# PULL UP FROM 4 PD
STCALL	SINTH	# SINTH CXSY + SXSZCY
	ARCTAN	# RETURNS WITH D MPAC PITCH
PDDL	VDEF	# PITCH INTO 2 PD, ROLL INTO MPAC FROM 2PD
RTB		# VDEF MAKES V MPAC ROLL, PITCH, YAW
	V1STO2S	
STORE	FDAIX	# MODE IS TP
EXIT		
ENDBALL	CA	BALLEXIT

TC BANKJUMP

PROGRAM DESCRIPTION - VECPOINT

#

#

THIS INTERPRETIVE SUBROUTINE MAY BE USED TO POINT A SPACECRAFT AXIS IN A DESIRED DIRECTION. THE AXIS
TO BE POINTED MUST APPEAR AS A HALF UNIT DOUBLE PRECISION VECTOR IN SUCCESSIVE LOCATIONS OF ERASABLE MEMORY
BEGINNING WITH THE LOCATION CALLED SCAXIS. THE COMPONENTS OF THIS VECTOR ARE GIVEN IN SPACECRAFT COORDINATES.
THE DIRECTION IN WHICH THIS AXIS IS TO BE POINTED MUST APPEAR AS A HALF UNIT DOUBLE PRECISION VECTOR IN
SUCCESSIVE LOCATIONS OF ERASABLE MEMORY BEGINNING WITH THE ADDRESS CALLED POINTVSM. THE COMPONENTS OF THIS
VECTOR ARE GIVEN IN STABLE MEMBER COORDINATES. WITH THIS INFORMATION VECPOINT COMPUTES A SET OF THREE GIMBAL
ANGLES 2S COMPLEMENT CORRESPONDING TO THE CROSS-PRODUCT ROTATION BETWEEN SCAXIS AND POINTVSM AND STORES THEM
IN T MPAC BEFORE RETURNING TO THE CALLER.

THIS ROTATION, HOWEVER, MAY BRING THE S/C INTO GIMBAL LOCK. WHEN POINTING A VECTOR IN THE Y-Z PLANE,
THE TRANSPONDER AXIS, OR THE AOT FOR THE LEM, THE PROGRAM WILL CORRECT THIS PROBLEM BY ROTATING THE CROSS-
PRODUCT ATTITUDE ABOUT POINTVSM BY A FIXED AMOUNT SUFFICIENT TO ROTATE THE DESIRED S/C ATTITUDE OUT OF GIMBAL
LOCK. IF THE AXIS TO BE POINTED IS MORE THAN 40.6 DEGREES BUT LESS THAN 60.5 DEG FROM THE +X OR -X AXIS,
THE ADDITIONAL ROTATION TO AVOID GIMBAL LOCK IS 35 DEGREES. IF THE AXIS IS MORE THAN 60.5 DEGREES FROM +X OR -X
THE ADDITIONAL ROTATION IS 35 DEGREES. THE GIMBAL ANGLES CORRESPONDING TO THIS ATTITUDE ARE THEN COMPUTED AND
STORED AS 2S COMPLEMENT ANGLES IN T MPAC BEFORE RETURNING TO THE CALLER.

WHEN POINTING THE X-AXIS, OR THE THRUST VECTOR, OR ANY VECTOR WITHIN 40.6 DEG OF THE X-AXIS, VECPOINT
CANNOT CORRECT FOR A CROSS-PRODUCT ROTATION INTO GIMBAL LOCK. IN THIS CASE A PLATFORM REALIGNMENT WOULD BE
REQUIRED TO POINT THE VECTOR IN THE DESIRED DIRECTION. AT PRESENT NO INDICATION IS GIVEN FOR THIS SITUATION
EXCEPT THAT THE FINAL MIDDLE GIMBAL ANGLE IN MPAC +2 IS GREATER THAN 59 DEGREES.

#

CALLING SEQUENCE -

1 LOAD SCAXIS, POINTVSM

2 CALL

#

VECPOINT

#

RETURNS WITH

#

1 DESIRED OUTER GIMBAL ANGLE IN MPAC

2 DESIRED INNER GIMBAL ANGLE IN MPAC +1

3 DESIRED MIDDLE GIMBAL ANGLE IN MPAC +2

#

ERASABLES USED -

#

1 SCAXIS 6

2 POINTVSM 6

3 MIS 18

4 DEL 18

5 COF 6

6 VECQTEMP 1

7 ALL OF VAC AREA 43

#

TOTAL 99

#

SETLOC VECPT

BANK

	COUNT*	\$\$/VECPT	
	EBANK	BCDU	
VECPNT1	STQ	BOV	# THIS ENTRY USES DESIRED CDUS
		VECQTEMP	# NOT PRESENT-ENTER WITH CDUD S IN MPAC
VECPNT2	AXC,2	VECPT2	
		GOTO	
VECPOINT	STQ	MIS	
		STORANG	
		BOV	# SAVE RETURN ADDRESS
VECLEAR	AXC,2	VECQTEMP	
		VECLEAR	# AND CLEAR OVFIN
		RTB	
		MIS	# READ THE PRESENT CDU ANGLES AND
STORANG	STCALL	READCDUK	# STORE THEM IN PD25, 26, 27
		25D	
	VLOAD	CDUTODCM	# S/C AXES TO STABLE MEMBER AXES MIS
		VXM	
		POINTVSM	# RESOLVE THE POINTING DIRECTION VF INTO
		MIS	# INITIAL S/C AXES VF POINTVSM
	UNIT		
	STORE	28D	
			# PD 28 29 30 31 32 33
	VXV	UNIT	# TAKE THE CROSS PRODUCT VF X VI
		SCAXIS	# WHERE VI SCAXIS
	BOV	VCOMP	
		PICKAXIS	
	STODL	COF	# CHECK MAGNITUDE
		36D	# OF CROSS PRODUCT
DSU		BMN	# VECTOR, IF LESS
		DPB-14	# THAN B-14 ASSUME
		PICKAXIS	# UNIT OPERATION
	VLOAD	DOT	#
		SCAXIS	INVALID.
		28D	
COMPMATX	SL1	ARCCOS	
	CALL		# NOW COMPUTE THE TRANSFORMATION FROM
		DELCOMP	# FINAL S/C AXES TO INITIAL S/C AXES MFI
	AXC,1	AXC,2	
		MIS	# COMPUTE THE TRANSFORMATION FROM FINAL
		KEL	# S/C AXES TO STABLE MEMBER AXES
	CALL		# MFS MIS MFI
		MXM3	# IN PD LIST
	DLOAD	ABS	
		6	# MFS6 SIN CPSI \$2
DSU		BMN	
		SINGIMLC	# SIN 59 DEGS \$2
		FINDGIMB	# /CPSI/ LESS THAN 59 DEGS


```
1
2                                     # I.E. DESIRED ATTITUDE NOT IN GIMBAL LOCK
3
4      DLOAD  ABS      # CHECK TO SEE IF WE ARE POINTING
5      SCAXIS  # THE THRUST AXIS
6      DSU    BPL
7      SINVEC1 # SIN 49.4 DEGS $2
8      FINDGIMB # IF SO, WE ARE TRYING TO POINT IT INTO
9      VLOAD   # GIMBAL LOCK, ABORT COULD GO HERE
10
11     STADR
12     STOVL  MIS +12D
13     STADR
14     STOVL  MIS +6
15     STADR
16     STOVL  MIS
17     MIS +6 # INNER GIMBAL AXIS IN FINAL S/C AXES
18     BPL    VCOMP    # LOCATE THE IG AXIS DIRECTION CLOSEST TO
19     IGSAMEX IGSAMEX # FINAL X S/C AXIS
20
21     IGSAMEX VXV      # FIND THE SHORTEST WAY OF ROTATING THE
22     BMN      # S/C OUT OF GIMBAL LOCK BY A ROTATION
23     SCAXIS   # ABOUT +- SCAXIS, I.E. IF IG SGN MFS3
24     U SCAXIS # X SCAXIS . XF LESS THAN 0, U SCAXIS
25     # OTHERWISE U -SCAXIS
26
27     VLOAD  VCOMP
28     SCAXIS
29     STCALL COF
30     U SCAXIS VLOAD CHEKAXIS # ROTATE ABOUT -SCAXIS
31
32     STORE  SCAXIS
33     CHEKAXIS COF # ROTATE ABOUT + SCAXIS
34     DLOAD  ABS
35
36     DSU    SCAXIS # SEE IF WE ARE POINTING THE AOT
37     BPL    SINVEC2 # SIN 29.5 DEGS $2
38     PICKANG1 # IF SO, ROTATE 50 DEGS ABOUT +- SCAXIS
39     DLOAD   GOTO    # IF NOT, MUST BE POINTING THE TRANSPONDER
40     VECANG2 # OR SOME VECTOR IN THE Y, OR Z PLANE
41     COMPMFSN # IN THIS CASE ROTATE 35 DEGS TO GET OUT
42     PICKANG1 DLOAD  VECANG2 $360
43     COMPMFSN # 50 DEGS $ 360
44     CALL   DELCOMP
45     AXC,1  AXC,2 # COMPUTE THE ROTATION ABOUT SCAXIS TO
46     MIS    # BRING MFS OUT OF GIMBAL LOCK
47     KEL
48
49     CALL   # COMPUTE THE NEW TRANSFORMATION FROM
50     MXM3   # DESIRED S/C AXES TO STABLE MEMBER AXES
51           # WHICH WILL ALIGN VI WITH VF AND AVOID
52
53
54
55
56
57
58
59
60
```

```
1  # GIMBAL LOCK
2
3  FINDGIMB      AXC,1  CALL
4                  0      # EXTRACT THE COMMANDED CDU ANGLES FROM
5                  DCMTOCDU # THIS MATRIX
6                  RTB    SETPD
7                  V1STO2S # CONVERT TO 2 S COMPLEMENT
8                  0
9                  GOTO
10                 VECQTEMP # RETURN TO CALLER
11
12  PICKAXIS      VLOAD  DOT      # IF VF X VI  0,  FIND VF . VI
13                  28D
14                  SCAXIS
15                  BMN    TLOAD
16                  ROT180
17                  25D
18                  GOTO      # IF VF  VI, CDU DESIRED  PRESENT CDU
19                  VECQTEMP # PRESENT CDU ANGLES
20
21                  BANK    35
22                  SETLOC  MANUVER1
23                  BANK
24  ROT180        VLOAD  VXV      # IF VF, VI ANTIPARALLEL, 180 DEG ROTATION
25                  MIS      +6   # IS REQUIRED. Y STABLE MEMBER AXIS IN
26                  HIDPHALF # INITIAL S/C AXES.
27                  UNIT    VXV   # FIND Y SM  X X I
28                  SCAXIS   # FIND UNIT VI X UNIT Y SM  X X I
29                  UNIT    BOV   # I.E. PICK A VECTOR IN THE PLANE OF X I ,
30                  PICKX    # Y SM  PERPENDICULAR TO VI
31                  STODL    COF
32                  36D      # CHECK MAGNITUDE
33                  DSU      BMN  # OF THIS VECTOR.
34                  DPB-14   # IF LESS THAN B-14,
35                  PICKX    # PICK X-AXIS.
36                  VLOAD
37
38  XROT          STODL    COF
39                  COF
40                  HIDPHALF
41                  GOTO
42  PICKX          VLOAD  COMPMATX # PICK THE XAXIS IN THIS CASE
43                  GOTO
44                  HIDPHALF
45                  XROT
46  SINGIMLC       2DEC    .4285836003 # SIN 59          $2
47
48  SINVEC1        2DEC    .3796356537 # SIN 49.4        $2
49
50  SINVEC2        2DEC    .2462117800 # SIN 29.5        $2
51
52  VECANG1        2DEC    .1388888889 # 50 DEGREES      $360
53
54
55
56
57
58
59
60
```

VECANG2 2DEC .0972222222 # 35 DEGREES \$360

1BITDP OCT 0 # KEEP THIS BEFORE DPB -14 *****
DPB-14 OCT 00001
 OCT 00000

ROUTINE FOR INITIATING AUTOMATIC MANEUVER VIA KEYBOARD V49

BANK 34
SETLOC R62
BANK

EBANK BCDU

COUNT* \$\$/R62

R62DISP EQUALS R62FLASH

R62FLASH CAF V06N22 # FLASH V06N22 AND
TC BANKCALL # ICDU ANGLES
CADR GOFLASH

TCF ENDEXT # TERMINATE
TCF GOMOVE # PROCEED
TCF R62FLASH # ENTER

ASTRONAUT MAY LOAD NEW ICDUS AT THIS
POINT

GOMOVE TC UPFLAG # SET FOR 3-AXIS MANEUVER
ADRES 3AXISFLG

TC BANKCALL
CADR R60LEM
TCF ENDEXT # END R62

SUBROUTINE NAME R05 - S-BAND ANTENNA FOR LM

#

MOD0 BY T. JAMES

MOD1 BY P. SHAKIR

#

FUNCTIONAL DESCRIPTION

#

THE S-BAND ANTENNA ROUTINE, R05, COMPUTES AND DISPLAYS THE PITCH AND

YAW ANTENNA GIMBAL ANGLES REQUIRED TO POINT THE LM STEERABLE ANTENNA

TOWARD THE CENTER OF THE EARTH. THIS ROUTINE IS SELECTED BY THE ASTRO-

NAUT VIA DSKY ENTRY DURING COASTING FLIGHT OR WHEN THE LM IS ON THE MOON

SURFACE. THE EARTH OR MOON REFERENCE COORDINATE SYSTEM IS USED DEPENDING

ON WHETHER THE LM IS ABOUT TO ENTER OR HAS ALREADY ENTERED THE MOON

SPHERE OF INFLUENCE, RESPECTIVELY

#

TO CALL SUBROUTINE, ASTRONAUT KEYS IN V 64 E

#

SUBROUTINES CALLED-

R02BOTH

INTPRET

LOADTIME

LEMCONIC

LUNPOS

CDUTRIG

SMNB

BANKCALL

B500FF

ENDOFJOB

BLANKET

#

RETURNS WITH

PITCH ANGLE IN PITCHANG REV. B0

YAW ANGLE IN YAWANG REV. B0

#

ERASABLES USED

PITCHANG

YAWANG

RLM

VAC AREA

BANK 41

SETLOC SBAND

BANK

EBANK WHOCARES

COUNT* \$\$/R05

SBANDANT TC BANKCALL

```
1  CADR      R02BOTH      # CHECK IF IMU IS ON AND ALIGNED
2  TC        INTPRET
3
4  SETPD     RTB
5            OD
6            LOADTIME     # PICK UP CURRENT TIME
7
8  STCALL    TDEC1        # ADVANCE INTEGRATION TO TIME IN TDEC1
9            LEMCONIC      # USING CONIC INTEGRATION
10
11 SLOAD      BHIZ
12
13            X2            # X2  0 EARTH SPHERE, X2  2 MOON SPHERE
14            CONV4
15
16 VLOAD
17
18 STODL      RATT
19            RLM
20            TAT
21
22 CONV3      CALL
23            LUNPOS        # UNIT POSITION VECTOR FROM EARTH TO MOON
24            VLOAD
25            VXSC
26            VMOON
27            REMDIST      # MEAN DISTANCE FROM EARTH TO MOON
28
29 VSL1       VAD
30            RLM
31
32 GOTO       CONV5
33
34 CONV4      VLOAD
35
36 CONV5      RATT          # UE  -UNIT RATT  EARTH SPHERE
37            SETPD        # UE  -UNIT REM  UEM  + RL  MOON SPHERE
38            OD           # SET PL POINTER TO 0
39
40 VCOMP      CALL
41            CDUTRIG       # COMPUTE SINES AND COSINES OF CDU ANGLES
42
43 MXV        VSL1         # TRANSFORM REF. COORDINATE SYSTEM TO
44            REFSMMAT      # STABLE MEMBER  B-1 X B-1 X B+1  B-1
45            DLOAD        # 8D
46
47            HI6ZEROS
48
49 STORE      PITCHANG
50 STOVL      YAWANG        # ZERO OUT ANGLES
51 CALL
52
53 STODL      *SMNB*
54            RLM           # PRE-MULTIPLY RLM BY  NBSA  MATRIX B0
55            RLM          +2
56
57 PUSH       DSU
58            RLM
59
60 DMP
61
62 STODL      10VSQRT2
63            RLM          +2
64
65 DAD        DMP
66            RLM
67            10VSQRT2
68
69 STOVL      RLM           # R  B-1
70            RLM
71
72 UNIT       PDVL
```


	VPROJ	RLM VSL2	# PROJECTION OF R ONTO LM XZ PLANE
	BVSU	HIUNITY BOV RLM	# CLEAR OVERFLOW INDICATOR IF ON
COVCNV	UNIT	COVCNV BOV SBANDEX	# EXIT ON OVERFLOW
	PUSH	VXV	# URP VECTOR B-1
	VSL1	HIUNITZ VCOMP	# UZ X URP - URP X UZ
	STORE DOT	RLM PDVL HIUNITY	# X VEC B-1 # SGN X.UY UNSCALED
	ABVAL ASIN	RLM SIGN	# ASIN SGN X.UY ABV X REV B0
	STOVL DOT	PITCHANG URP BPL	
	DLOAD	HIUNITZ NOADJUST DSU	# YES, -90 TO +90
	STORE VLOAD	HIDPHALF PITCHANG PITCHANG VXV	
NOADJUST		UR URP	# Z UR X URP
	VSL1 STODL	RLM PITCHANG	# Z VEC B-1
	SIN PDDL	VXSC HIUNITZ COS	
	VXSC	PITCHANG VSU HIUNITX	# UX COS ALPHA - UZ SIN ALPHA
	DOT	PDVL RLM RLM	# YAW.Z
	ABVAL ASIN STORE	SIGN YAWANG	
SBANDEX	EXIT CA MASK	EXTVBACT BIT5	# IS BIT5 STILL ON
	EXTEND BZF CAF	ENDEXT PRI05	# NO

TC	PRI0CHNG		
CAF	V06N51	#	DISPLAY ANGLES
TC	BANKCALL		
CADR	GOMARKFR		
TC	B50FF	#	TERMINATE
TC	B50FF	#	PROCEED
TC	ENDOFJOB	#	RECYCLE
CAF	BIT3	#	IMMEDIATE RETURN
TC	BLANKET	#	BLANK R3
CAF	PRI04		
TC	PRI0CHNG		
TC	SBANDANT +2	#	YES, CONTINUE DISPLAYING ANGLES
V06N51	VN	0651	
10VSQRT2	2DEC	.7071067815	# 1/SQRT 2
UR	EQUALS	0D	
URP	EQUALS	6D	
SBANK	LOWSUPER		
# *** END OF LNYAIDE .001 ***			

```
1
2      BANK      25
3      SETLOC   RRLEADIN
4      BANK
5
6      EBANK     RSTACK
7
8  # RADAR SAMPLING LOOP.
9
10     COUNT*   $$/RLEAD
11     RADSAMP  CCS      RSAMPDT      # TIMES NORMAL ONCE-PER-SECOND SAMPLING.
12             TCF      +2
13             TCF      TASKOVER     # +0 INSERTED MANUALLY TERMINATES TEST.
14
15             TC       WAITLIST
16             EBANK    RSTACK
17             ZCADR    RADSAMP
18
19             CAF      PRI025
20             TC       NOVAC
21             EBANK    RSTACK
22             ZCADR    DORSAMP
23
24             CAF      BIT14        # FOR CYCLIC SAMPLING, RTSTDEX
25             EXTEND    # RTSTLOC/2 + RTSTBASE
26             MP       RTSTLOC
27             AD       RTSTBASE     # 0 FOR RR, 2 FOR LR.
28             TS       RTSTDEX
29             TCF      TASKOVER
30
31  # DO THE ACTUAL RADAR SAMPLE.
32
33     DORSAMP   TC       VARADAR      # SELECTS VARIABLE RADAR CHANNEL.
34             TC       BANKCALL
35             CADR     RADSTALL
36
37             INCR     RFAILCNT      # ADVANCE FAIL COUNTER BUT ACCEPT BAD DATA
38
39     DORSAMP2  INHINT
40             CA       FLAGWRD5     # DON T UPDATE RSTACK IF IN R77.
41             MASK     R77FLBIT
42             CCS      A
43             TCF      +4
44
45             DXCH     SAMPLSUM
46             INDEX    RTSTLOC
47             DXCH     RSTACK
48
49             CS       RTSTLOC      # CYCLE RTSTLOC.
50             AD       RTSTMAX
51             EXTEND
52
53
54
55
56
57
58
59
60
```

```
      BZF      +3
      CA       RTSTLOC
      AD       TWO      # STORAGE IS DP
      TS       RTSTLOC
      TCF      ENDOFJOB  # CONTINUOUS SAMPLING AND 2N TRIES - GONE.
```

VARIABLE RADAR DATA CALLER FOR ONE MEASUREMENT ONLY.

```
VARADAR      CAF      ONE      # WILL BE SENT TO RADAR ROUTINE IN A BY
              TS       BUF2     # SWCALL.
```

```
              INDEX    RTSTDEX
              CAF       RDRLOCS
              TCF      SWCALL    # NOT TOUCHING Q.
```

```
RDRLOCS      CADR     RRRANGE   # 0
              CADR     RRRDOT    # 1
              CADR     LRVELX    # 2
              CADR     LRVELY    # 3
              CADR     LRVELZ    # 4
              CADR     LRALT     # 5
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RENDEZVOUS NAVIGATION PROGRAM 20

PROGRAM DESCRIPTION

MOD NO -- 2
BY P. VOLANTE

FUNCTIONAL DESCRIPTION

THE PURPOSE OF THIS PROGRAM IS TO CONTROL THE RENDEZVOUS RADAR FROM
STARTUP THROUGH ACQUISITION AND LOCKON TO THE CSM AND TO UPDATE EITHER
THE LM OR CSM STATE VECTOR AS SPECIFIED BY THE ASTRONAUT BY DSKY ENTRY
ON THE BASIS OF THE RR TRACKING DATA.

CALLING SEQUENCE --

ASTRONAUT REQUEST THROUGH DSKY V37E20E

SUBROUTINES CALLED

#	R02BOTH	IMU STATUS CHECK	FLAGUP
#	GOFASH	PINBALL-DISPLAY	FLAGDOWN
#	R23LEM	MANUAL ACQUISITION	BANKCALL
#	LS201	LOS DETERMINATION	TASKOVER
#	LS202	RANGE LIMIT TEST	
#	R61LEM	PREFERRED TRACKING ATTITUDE	
#	R21LEM	RR DESIGNATE	ENDOFJOB
#	R22LEM	DATA READ	GOPERF1
#	R31LEM	RENDEZVOUS PARAMETER DISPLAY	
#	PRIOLARM	PRIORITY DISPLAY	

NORMAL EXIT MODES --

P20 MAY BE TERMINATED IN TWO WAYS -- ASTRONAUT SELECTION OF IDLING
PROGRAM P00 BY KEYING V37E00E OR BY KEYING IN V56E

ALARM OR ABORT EXIT MODES --

RANGE GREATER THAN 400 NM DISPLAY

OUTPUT

TRKMKCNT NO OF RENDEZVOUS TRACKING MARKS TAKEN COUNTER

ERASABLE INITIALIZATION REQUIRED

FLAGS SET + RESET

SRCHOPT, RNDVZFLG, ACMODFLG, VEHUPFLG, UPDATFLG, TRACKFLG

DEBRIS

CENTRALS -- A,Q,L

SBANK LOWSUPER # FOR LOW 2CADR S.

BANK 33
SETLOC P20S
BANK



1		EBANK	LOSCOUNT																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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	TC	ORBCHG0	# YES
	TC	PROG20A -2	# NO -- CONTINUE WITH P20
ORBCHG0	TC	UPFLAG	# SET VEHUPFLG -- CSM STATE
	ADRES	VEHUPFLG	# VECTOR TO BE UPDATED
	CAF	ONE	# SET R2 FOR OPTION CSM WILL NOT
	TS	OPTION2	# CHANGE PRESENT ORBIT
	CAF	OCT00012	
	TC	BANKCALL	# DISPLAY ASSUMED CSM ORBIT OPTION
	CADR	GOPERF4	
	TC	GOTOP00H	# TERMINATE
	TC	ORBCHG1	# PROCEED VALUE OF ASSUMED OPTION OK
ORBCHG1	TC	-5	# R2 LOADED THRU DSKY
	CS	P22ONE	
	AD	OPTION2	
	EXTEND		
	BZF	PROG20A	
	CAF	V06N33*	
	TC	BANKCALL	# FLASH VERB-NOUN TO REQUEST ESTIMATED
	CADR	GOFLASH	# TIME OF LAUNCH
	TC	GOTOP00H	# TERMINATE
	TC	ORBCHG2	# PROCEED VALUES OK
ORBCHG2	TC	-5	# TIME LOADED THRU DSKY
	TC	INTPRET	
	GOTO		
		ORBCHG3	
	BANK	32	
	SETLOC	P20S4	
	BANK		
	COUNT*	\$\$/P20	
ORBCHG3	CALL		
		INTSTALL	
	DLOAD		
		TIG	
	STORE	LNCHTM	
	STORE	TDEC1	# ESTIMATED LAUNCH TIME
	CLEAR	CLEAR	
		VINTFLAG	# LM INTEGRATION
		INTYPFLG	# PRECISION -- ENCKE
	CLEAR	CLEAR	
		DIM0FLAG	# NO W-MATRIX
		D60R9FLG	
	CALL		
		INTEGRV	# PLANETARY INERTIAL ORIENTATION
	CALL		
		GRP2PC	
	VLOAD		
		RATT1	
	STODL	RSUBL	# SAVE LM POSITION
		TAT	

1		STCALL	TDEC1	
2			INTSTALL	
3				
4		SET	CLEAR	
5			VINTFLAG	# CSM INTEGRATION
6			INTYPFLG	
7		CLEAR	BOFF	
8			DIM0FLAG	
9			RENDWFLG	# W MATRIX VALID
10			NOWMATX	# NO
11		SET	SET	# YES -- SET FOR W MATRIX
12			DIM0FLAG	
13			D6OR9FLG	
14	NOWMATX	CALL		
15			INTEGRV	# CSM INTEGRATION
16		CALL		
17			GRP2PC	
18		VLOAD		
19				
20		STOVL	VATT1	
21			VSUBC	# SAVE CSM POSITION
22			RATT1	
23		STORE	RSUBC	# SAVE CSM POSITION
24		VXV	UNIT	# COMPUTE NORMAL TO CSM ORBITAL PLANE
25			VSUBC	# NSUB1 UNIT R CM CROSS V CM
26		STOVL	20D	# SAVE NSUB1
27			RSUBL	# COMPUTE ESTIMATED ORBITAL
28		VXV	UNIT	# PLANE CHANGE
29			20D	# UCSM UNIT R LM CROSS NSUB1
30		STOVL	UCSM	
31			RSUBC	# COMPUTE ANGLE BETWEEN UCSM
32		UNIT	DOT	# AND RSUBC
33			UCSM	# COS A UCSM DOT UNIT R CM
34		SL1		
35		STORE	CSTH	# SAVE DOE TIME-THETA SUBROUTINE
36		DSQ	BDSU	# COMPUTE SINE A
37			ONEB-2	
38		SQRT		
39		STOVL	SNTH	# SAVE FOR TIME-THETA SUBROUTINE
40			RSUBC	# POSITION OF CSM AT EST. LAUNCH
41		STOVL	RVEC	# TIME FOR TIME-THETA B-27
42			VSUBC	# VELOCITY OF CSM AT EST. LAUNCH.
43		VCOMP		
44		STORE	VVEC	# TIME FOR TIME THETA B-5
45		CLEAR	CALL	
46			RVSW	
47			TIMETHET	
48		VCOMP		
49		STORE	NEWVEL	# TERMINAL VELOCITY OF CSM
50		DLOAD		
51			T	
52		STOVL	TRANSTM	# TRANSFER TIME
53				
54				
55				
56				
57				
58				
59				
60				

		NEWVEL	
	ABVAL		
	STOVL	20D	
		0D	
	STORE	NEWPOS	# TERMINAL POSITION OF CSM
	VXV	UNIT	# COMPUTE NORMAL TO SCM ORBITAL PLANE
		RSUBL	# NSUB2 UNIT NEWPOS CROSS R LM
	VXV	UNIT	# ROTATE TERMINAL VEL INTO DESIRED
		NEWPOS	# ORBITAL PLANE
	VXSC	VSL1	# VSUBC ABVAL NEWVEL \$ UNIT NSUB2
		20D	
	STCALL	NCSMVCL	# NEW CSM VELOCITY
		GRP2PC	
	CALL		
		INTSTALL	
	DLOAD	BDSU	
		TRANSTM	# LAUNCH TIME -- TRANSFER TIME
		LNCHTM	
	STOVL	TET	
		NEWPOS	
	STORE	RCV	
	STOVL	RRECT	
		NCSMVCL	
	STCALL	VRECT	
		MINIRECT	
	AXT,2	CALL	
		2	
		ATOPCSM	
	CALL		
		INTWAKE0	
	EXIT		
	TC	BANKCALL	
	CADR	PROG20A	
	BANK	24	
	SETLOC	P20S	
	BANK		
	COUNT*	\$\$/P20	
	TC	DOWNFLAG	# RESET VEHUPFLG -- LM STATE VECTOR
	ADRES	VEHUPFLG	# TO BE UPDATED
PROG20A	TC	BANKCALL	
	CADR	R02BOTH	
	TC	UPFLAG	
	ADRES	UPDATFLG	# SET UPDATE FLAG
	TC	UPFLAG	
	ADRES	TRACKFLG	# SET TRACK FLAG
	TC	UPFLAG	
	ADRES	RNDVZFLG	# SET RENDEZVOUS FLAG
	TC	DOWNFLAG	
	ADRES	SRCHOPTN	# INSURE SEARCH OPTION OFF

	TC	DOWNFLAG	# ALSO MANUAL ACQUISITION FLAG RESET
	ADRES	ACMODFLG	
	TC	DOWNFLAG	# TURN OFF R04FLAG TO ENSURE GETTING
	ADRES	R04FLAG	# ALARM 521 IF CAN T READ RADAR
	TC	DOWNFLAG	# ENSURE R25 GIMBAL MONITOR IS ENABLED
	ADRES	NORRMON	# RESET NORRMON FLAG
	TC	DOWNFLAG	# RESET LOS BEING COMPUTED FLAG
	ADRES	LOSCMFLG	
P20LEM1	TC	CLRADMOD	
	TC	PHASCHNG	
	OCT	04022	
	CAF	ZERO	# ZERO MARK COUNTER
	TS	MARKCTR	
	TC	INTPRET	# LOS DETERMINATION ROUTINE
	RTB		
		LOADTIME	
	STCALL	TDEC1	
		LPS20.1	
	CALL		
		LPS20.2	# TEST RANGE R/UTINE
	EXIT		
	INDEX	MPAC	
	TC	+1	
526ALARM	TC	P20LEMA	# NORMAL RETURN WITHIN 400 N M
	CAF	ALRM526	# ERROR EXIT -- RANGE 400 N. MI.
	TC	BANKCALL	
	CADR	PRIOLARM	
	TC	GOTOV56	# TERMINATE EXITS P20 VIA V56 CODING
	TC	-4	# PROC ILLEGAL
	TC	P20LEM1	# ENTER RECYCLE
	TC	ENDOFJOB	
P20LEMA	TC	PHASCHNG	
	OCT	04022	
	TC	LUNSFCHK	# CHECK LUNAR SURFACE FLAG P22 FLAG
	TC	P20LEMB	
	TC	BANKCALL	
	CADR	R61LEM	# PREFERRED TRACKING ATTITUDE ROUTINE
P20LEMB	TC	PHASCHNG	
	OCT	05022	# RESTART AT PRIORITY 10 TO ALLOW V37
	OCT	10000	# REQUESTED PROGRAM TO RUN FIRST
	CAF	PRI026	# RESTORE PRIORITY 26
	TC	PRI0CHNG	
	CA	FLAGWRD1	# IS THE TRACK FLAG SET
	MASK	TRACKBIT	
	EXTEND		
	BZF	P20LEMT	# BRANCH -- NO -- WAIT FOR IT TO BE SET
P20LEMB7	CAF	BIT2	# IS RR AUTO MODE DISCRETE PRESENT
	EXTEND		

	RAND EXTEND	CHAN33	
	BZF	P20LEMB3	# YES -- DO AUTOMATIC ACQUISITION R21
P20LEMB5	CS	OCT24	# RADAR NOT IN AUTO CHECK IF
	AD	MODREG	# MAJOR MODE IS 20
	EXTEND		
	BZF	P20LEMB6	# BRANCH -- YES -- OKAY TO DO PLEASE PERFORM
	AD	NEG2	# ALSO CHECK FOR P22
	EXTEND		
	BZF	P20LEMB6	# BRANCH -- YES OK TO DO PLEASE PERFORM
	CAF	ALRM514	# TRACK FLAG SET -- FLASH PRIORITY ALARM 514 --
	TC	BANKCALL	# RADAR GOES OUT OF AUTO MODE WHILE IN USE
	CADR	PRIOLARM	
	TC	GOTOV56	# TERMINATE EXITS VIA V56
	TC	P20LEMB	# PROCEED AND ENTER BOTH GO BACK
	TC	P20LEMB	# TO CHECK AUTO MODE AGAIN
P20LEMB6	TC	ENDOFJOB	
	CAF	OCT201	# REQUEST RR AUTO MODE SELECTION
	TC	BANKCALL	
	CADR	GOPERF1	
	TC	GOTOV56	# TERMINATE EXITS P20 VIA V56 CODING
	TC	P20LEMB	# PROCEED CHECKS AUTO MODE DISCRETE AGAIN
	TC	LUNSFCHK	# ENTER INDICATES MANUAL ACQUISITION R23
	TC	P20LEMB2	# YES -- R23 NOT ALLOWED -- TURN ON OPR ERROR
	TC	R23LEM	# NO -- DO MANUAL ACQUISITION
P20LEMB1	TC	UPFLAG	# RETURN FROM R23 -- LOCKON ACHIEVED
	ADRES	ACMODFLG	# SET MANUAL FLAG AND GO BACK TO CHECK
	TC	P20LEMB	# RR AUTO MODE
P20LEMB2	TC	FALTON	# TURNS ON OPERATOR ERROR LIGHT ON DSKY
	TC	P20LEMB	# AND GOES BACK TO CHECK AUTO MODE
P20LEMB3	CS	RADMODES	# ARE RR CDUS BEING ZEROED
	MASK	RCDU0BIT	
	EXTEND		
	BZF	P20LEMB4	# BRANCH -- YES -- WAIT
	CAF	BIT13-14	# IS SEARCH OR MANUAL ACQUISITION FLAG SET
	MASK	FLAGWRD2	
	EXTEND		
	BZF	P20LEMC3	# ZERO MEANS AUTOMATIC RR ACQUISITION
	TC	DOWNFLAG	# RESET TO AUTO MODE
	ADRES	SRCHOPTN	

	TC	DOWNFLAG	
	ADRES	ACMODFLG	
	TC	P20LEMT	# WAIT 2.5 SECONDS THEN GO TO RR DATA READ
P20LEMB4	CAF	250DEC	
	TC	BANKCALL	# WAIT 2.5 SECONDS WHILE RR CDUS ARE BEING
	CADR	DELAYJOB	# ZEROED -- THEN GO BACK AND CHECK AGAIN
	TC	P20LEMB3	
P20LEMC3	TC	INTPRET	
	RTB		
	STCALL	LOADTIME	
		TDEC1	
		UPPSV	
P20LEMC4	EXIT		
P20LEMC	TC	PHASCHNG	
	OCT	04022	
	CAE	FLAGWRD0	# IS THE RENDEZVOUS FLAG SET
	MASK	RNDVZBIT	
	EXTEND		
	BZF	ENDOFJOB	# NO -- EXIT P20
	CAE	FLAGWRD1	# IS TRACK FLAG SET BIT 5 FLAGWORD 1
	MASK	TRACKBIT	
	EXTEND		
P20LEMF	BZF	P20LEMD	# BRANCH -- TRACK FLAG NOT ON -- WAIT 15 SECONDS
	TC	R21LEM	
P20LEMT	CAF	250DEC	
	TC	TWIDDLE	# USE INSTEAD OF WAITLIST SINCE SAME BANK
	ADRES	P20LEMC1	# WAIT 2.5 SECONDS
	CAE	FLAGWRD1	# IS TRACK FLAG SET
	MASK	TRACKBIT	
	EXTEND		
P20LMWT1	BZF	ENDOFJOB	# NO -- EXIT WITHOUT DOING 2.7 PHASE CHANGE
	TC	PHASCHNG	
	OCT	40072	
	TC	ENDOFJOB	
P20LEMC1	CAE	FLAGWRD0	# IS RENDEZVOUS FLAG SET
	MASK	RNDVZBIT	
	EXTEND		
	BZF	TASKOVER	# NO -- EXIT P20/R22
	CAE	FLAGWRD1	# IS TRACK FLAG SET
	MASK	TRACKBIT	
	EXTEND		
	BZF	P20LEMC2	# NO -- DON T SCHEDULE R22 JOB

	CAF	PRI026	# YES -- SCHEDULE R22 JOB	RR DATA READ
	TC	FINDVAC		
	EBANK	LOSCOUNT		
	2CADR	R22LEM42		
	TC	TASKOVER		
P20LEMC2	TC	FIXDELAY	# TRACK FLAG NOT SET, WAIT 15 SECONDS	
	DEC	1500	# AND CHECK AGAIN	
	TC	P20LEMC1		
P20LEMD	CAF	1500DEC		
	TC	TWIDDLE	# WAITLIST FOR 15 SECONDS	
	ADRES	P20LEMD1		
	TC	ENDOFJOB		
P20LEMD1	CAE	FLAGWRD1	# IS TRACK FLAG SET	
	MASK	TRACKBIT		
	CCS	A		
	TCF	P20LEMD2	# YES -- SCHEDULE DESIGNATE JOB	
	TC	FIXDELAY	# NO -- WAIT 15 SECONDS	
	DEC	1500		
	TC	P20LEMD1		
P20LEMD2	CAF	PRI026	# SCHEDULE JOB TO DO R21	
	TC	FINDVAC		
	EBANK	LOSCOUNT		
	2CADR	P20LEMC3	# START AT PERM. MEMORY INTEGRATION	
	TC	TASKOVER		
250DEC	DEC	250		
ALRM526	OCT	00526		
OCT201	OCT	00201		
ALRM514	OCT	514		
MAXTRIES	DEC	60		
OCT00012	OCT	00012		
P22ONE	OCT	00001		
ONEB-2	2DEC	1.0 B-2		
V06N33*	VN	0633	# UPDATES PERMANENT STATE VECTORS	
UPPSV	STQ	CALL	#	TO PRESENT TIME
		LS21X		
		INTSTALL		
	CALL			

1			SETIFLGS	
2			SET	# IF W-MATRIX INVALID, DON T INTEGRATE IT
3		BOF		
4			RENDWFLG	
5			UPPSV1	
6			DIMOFLAG	# SET DIMOFLAG TO INTEGRATE W-MATRIX
7		BON	SET	
8			SURFFLAG	# IF ON LUNAR SURFACE W IS 6X6
9			UPPSV5	
10			D6OR9FLG	# OTHERWISE 9X9
11	UPPSV5	BOF		
12			VEHUPFLG	
13			UPPSV3	
14	UPPSV1	SET		
15			VINTFLAG	
16		CALL		
17			INTEGRV	
18		CALL		# GROUP 2 PHASE CHANGE
19			GRP2PC	# TO PROTECT INTEGRATION
20		CALL		
21			INTSTALL	
22		DLOAD	CLEAR	# GET TETCSM TO STORE IN TDEC FOR LM INT.
23			TETCSM	
24			VINTFLAG	
25	UPPSV4	CALL		# INTEGRATE OTHER VEHICLE
26			SETIFLGS	# WITHOUT W-MATRIX
27		STCALL	TDEC1	
28			INTEGRV	
29		BOFF	VLOAD	
30			SURFFLAG	
31			P20LEMC4	
32			RCVLEM	
33		VSR2		
34		STOVL	LMPOS	
35			VCVLEM	
36		VSR2		
37		STORE	LMVEL	
38		GOTO		
39			LS21X	
40				
41	UPPSV3	CLEAR	CALL	
42			VINTFLAG	
43			INTEGRV	
44		CALL		
45			GRP2PC	
46		CALL		
47			INTSTALL	
48		SET	DLOAD	
49			VINTFLAG	
50			TETLEM	# GET TETLEM TO STORE IN TDEC FOR CSM INT.
51				
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GOTO

UPPSV4

EBANK LOSCOUNT

COUNT* \$\$/P22

PROGRAM DESCRIPTION

PREFERRED TRACKING ATTITUDE PROGRAM P25
MOD NO -- 3
BY P. VOLANTE

FUNCTIONAL DESCRIPTION

THE PURPOSE OF THIS PROGRAM IS TO COMPUTE THE PREFERRED TRACKING
ATTITUDE OF THE LM TO CONTINUOUSLY POINT THE LM TRTACKING BEACON AT THE
CSM AND TO PERFORM THE MANEUVER TO THE PREFERRED TRACKING ATTITUDE AND
CONTINUOUSLY MAINTAIN THIS ATTITUDE WITHIN PRESCRIBED LIMITS.

CALLING SEQUENCE --

ASTRONAUT REQUEST THROUGH DSKY V37E25E

SUBROUTINES CALLED --

#	BANKCALL	FLAGUP
#	R02BOTH IMU STATUS CHECK	ENDOFJOB
#	R61LEM PREF TRK ATT ROUT	WAITLIST
#	TASKOVER	FINDVAC

NORMAL EXIT MODES --

P25 MAY BE TERMINATED IN TWO WAYS -- ASTRONAUT SELECTION OF IDLING
PROGRAM P00 BY KEYING V37E00E OR BY KEYING IN V56E

ALARM OR ABORT EXIT MODES --

NONE

OUTPUT

ERASABLE INITIALIZATION REQUIRED

FLAGS SET + RESET

TRACKFLG, P25FLAG

DEBRIS

NONE

	EBANK	LOSCOUNT	
	COUNT*	\$\$/P25	
PROG25	TC	2PHSCHNG	
	OCT	4	# MAKE GROUP 4 INACTIVE VERB 37
	OCT	05022	
	OCT	26000	# PRIORITY 26
	TC	BANKCALL	
	CADR	R02BOTH	# IMU STATUS CHECK
	TC	UPFLAG	
	ADRES	TRACKFLG	# SET TRACK FLAG
	TC	UPFLAG	
	ADRES	P25FLAG	# SET P25FLAG
P25LEM1	TC	PHASCHNG	



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OCT 04022
CAF P25FLBIT
MASK STATE # IS P25FLAG SET
EXTEND
BZF ENDOFJOB
CAF TRACKBIT # IS TRACKFLAG SET
MASK STATE +1
EXTEND

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2		BZF	P25LMWT1	# NO -- SKIP PHASE CHANGE AND WAIT 1 MINUTE	2
3		CAF	SEVEN	# CALL R65 -- FINE PREFERRED	3
4		TS	R65CNTR		4
5		TC	BANKCALL	# TRACKING ATTITUDE ROUTINE	5
6		CADR	R65LEM		6
7		TC	P25LEM1	# THEN GO CHECK FLAGS	7
8	P25LEMWT	TC	PHASCHNG		8
9		OCT	00112		9
10	P25LMWT1	CAF	60SCNDS		10
11		TC	TWIDDLE	# WAIT ONE MINUTE THEN CHECK AGAIN	11
12		ADRES	P25LEM2		12
13		TC	ENDOFJOB		13
14	P25LEM2	CAF	PRI014		14
15		TC	FINDVAC		15
16		EBANK	LOSCOUNT		16
17		2CADR	P25LEM1		17
18					18
19		TC	TASKOVER		19
20	60SCNDS	DEC	6000		20
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```
1 # DATA READ ROUTINE 22 LEM
2 # PROGRAM DESCRIPTION
3
4 #
5 #     MOD NO -- 2
6 #     BY P. VOLANTE
7
8 # FUNCTIONAL DESCRIPTION
9 #
10 #     TO PROCESS AUTOMATIC RR MARK DATA TO UPDATE THE STATE VECTOR OF EITHER
11 #     LM OR CSM AS DEFINED IN THE RENDEZVOUS NAVIGATION PROGRAM P20
12 #
13 # CALLING SEQUENCE --
14 #
15 #     TC      BANKCALL
16 #     CADR    R22LEM
17 #
18 # SUBROUTINES CALLED --
19 #
20 #     LSR22.1      GOFLASH      WAITLIST
21 #     LSR22.2      PRIOLARM     BANKCALL
22 #     LSR22.3      R61LEM
23 #
24 # NORMAL EXIT MODES --
25 #
26 #     R22 WILL CONTINUE TO RECYCLE, UPDATING STATE VECTORS WITH RADAR DATA
27 #     UNTIL P20 CEASES TO OPERATE RENDEZVOUS FLAG SET TO ZERO AT WHICH TIME
28 #     R22 WILL TERMINATE SELF.
29 #
30 # ALARM OR ABORT EXIT MODES --
31 #
32 #     PRIORITY ALARM
33 #     PRIORITY ALARM 525 LOS NOT WITHIN 3 DEGREE LIMIT
34 #
35 # OUTPUT
36 #
37 #     SEE OUTPUT FROM LSR22.3
38 #
39 # ERASABLE INITIALIZATION REQUIRED
40 #
41 #     SEE LSR22.1, LSR22.2, LSR22.3
42 #
43 # FLAGS SET + RESET
44 #
45 #     NOANGFLG
46 #
47 # DEBRIS
48 #
49 #     SEE LSR22.1, LSR22.2, LSR22.3
50
51 #
52 #     EBANK    LRS22.1X
53 #     COUNT*   $$/R22
54 #     TC       PHASCHNG
55 #     OCT      04022
56 #     CAF      RNDVZBIT      # IS RENDEZVOUS FLAG SET
57 #     MASK     STATE
58 #     EXTEND
59 #     BZF      ENDOFJOB      # NO -- EXIT R22 AND P20
60 #     CAF      TRACKBIT      # IS TRACKFLAG SET
61 #     MASK     STATE +1
```



1		EXTEND				1
2	R22LEM12	BZF	R22WAIT	# NO WAIT		2
3		CAF	BIT14	# IS RR AUTO TRACK ENABLE DISCRETE STILL		3
4		EXTEND		# ON A MONITOR REPOSITION BY R25 CLEARS IT		4
5		RAND	CHAN12			5
6		EXTEND				6
7		BZF	P20LEMA	# NO -- RETURN TO P20		7
8		CAF	BIT2	# YES		8
9		EXTEND		# IS RR AUTO MODE DISCRETE PRESENT		9
10		RAND	CHAN33			10
11						11
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EXTEND			
BZF	+2		# YES CONTINUE
TC	P20LEMB5		# NO -- SET IT
CS	RADMODES		# ARE RR CDUS BEING ZEROED
MASK	RCDU0BIT		
EXTEND			
BZF	R22LEM42		# CDUS BEING ZEROED
TC	PHASCHNG		# IF A RESTART OCCURS, AND EXTRA RADAR
OCT	00152		# READING IS TAKEN, SO BAD DATA ISN T USED
TC	BANKCALL		# YES READ DATA + CALCULATE LOS
CADR	LRS22.1		# DATA READ SUBROUTINE
INDEX	MPAC		
TC	+1		
TC	R22LEM2		# NORMAL RETURN GOOD DATA
TC	P20LEMC		# COULD NOT READ RADAR -- TRY TO REDESIGNATE
CAF	ALRM525		# RR LOS NOT WITHIN 3 DEGREES ALARM
TC	BANKCALL		
CADR	PRIOLARM		
TC	GOTOV56		# TERMINATE EXITS P20 VIA V56 CODING
TC	R22LEM1		# PROC DISPLAY DELTA THETA
TC	-5		# ENTER ILLEGAL OPTION
TC	ENDOFJOB		
R22LEM1	TC	PHASCHNG	
	OCT	04022	
	CAF	V06N05	# DISPLAY DELTA THETA
	TC	BANKCALL	
	CADR	PRIODSP	
	TC	GOTOV56	# TERMINATE EXITS P20 VIA V56 CODING
	TC	R22LEM2	# PROC OK CONTINUE
	TC	P20LEMC	# ENTER RECYCLE
R22LEM2	TC	PHASCHNG	
	OCT	04022	
	TC	LUNSFCHK	# CHECK IF ON LUNAR SURFACE P22FLAG SET
	TC	R22LEM3	# YES -- BYPASS FLAG CHECKS AND LRS22.2
	CA	FLAGWRD1	# IS TRACK FLAG SET
	MASK	TRACKBIT	
	EXTEND		
	BZF	R22WAIT	# NO -- WAIT
	TC	BANKCALL	# YES
	CADR	LRS22.2	# CHECKS RR BORESIGHT WITHIN 30 DEG OF +Z
	INDEX	MPAC	
	TC	+1	
	TC	R22LEM3	# NORMAL RETURN LOS WITHIN 30 OF Z-AXIS
	TC	BANKCALL	
	CADR	R61LEM	
	TC	R22WAIT	# NOT WITHIN 30 DEG OF Z-AXIS
R22LEM3	CS	FLAGWRD1	# SHOULD WE BYPASS STATE VECTOR UPDATE
	MASK	NOUPFBIT	# IS NO UPDATE FLAG SET

	EXTEND		
	BZF	R22LEM42	# BRANCH -- YES
	CA	FLAGWRD1	# IS UPDATE FLAG SET
	MASK	UPDATBIT	
	EXTEND		
	BZF	R22LEM42	# UPDATE FLAG NOT SET
	CAF	PRI026	# INSURE HIGH PRIO IN RESTART
	TS	PHSPRDT2	
	TC	INTPRET	
	GOTO		
		LSR22.3	
R22LEM93	EXIT		# NORMAL EXIT FROM LSR22.3
	TC	PHASCHNG	# PHASE CHANGE TO PROTECT AGAINST
	OCT	04022	# CONFLICT WITH GRP2PC ERASEABLE
	TCF	R22LEM44	
R22LEM96	EXIT		
	CAF	ZERO	# SET N49FLAG ZERO TO INDICATE
	TS	N49FLAG	# V06 N49 DISPLAY HASN T BEEN ANSWERED
	TC	PHASCHNG	
	OCT	04022	# TO PROTECT DISPLAY
	CAF	PRI027	# PROTECT DISPLAY
	TC	NOVAC	
	EBANK	N49FLAG	
	2CADR	N49DSP	
	TC	INTPRET	
	SLOAD		
		N49FLAG	
	BZE	BMN	# LOOP TO CHECK IF FLAG
		-3	# SETTING CHANGED -- BRANCH -- NO
		R22LEM7	# PROCEED
	EXIT		# DISPLAY ANSERED BY RECYCLE
	TC	LUNSFCHK	# ARE WE ON LUNAR SURFACE
	TC	R22WAIT	# YES -- 15 SECOND DELAY
	CA	ZERO	# NO -- SET R65COUNTER 0, DO FINE
	TC	R22LEM45	# TRACKING TAKE ANOTHER RADAR READING
R22LEM7	CALL		# PROCEED
		GRP2PC	# PHASE CHANGE AND
	GOTO		# GO TO INCOPORATE DATA.
		ASTOK	
R22LEM44	INCR	MARKCTR	# INCREMENT COUNT OF MARKS INCORPORATED.
	TC	LUNSFCHK	# ARE WE ON LUNAR SURFACE
	TC	R22LEM46	# YES -- WAIT 2 SECONDS
	CA	FIVE	# NOT ON LUNAR SURFACE
	TC	R22LEM45	# R65COUNTER 5
R22LEM42	TC	LUNSFCHK	# CHECK IF ON LUNAR SURFACE P22FLAG SET
	TC	R22LEM46	# YES -- WAIT 2 SECONDS
	CA	TWO	# NO -- SET R65COUNTER 2
R22LEM45	TS	R65CNTR	

```
1
2      TC      BANKCALL
3      CADR    R65LEM      # FINE PREFERRED TRACKING ATTITUDE
4
5      R22WAIT  TC      R22LEM
6      CAF     1500DEC
7      TC      P20LEMT +1
8
9      R22LEM46 CAF     2SECS
10     TC      BANKCALL    # WAIT 2 SECONDS AND TAKE ANOTHER MARK
11     CADR    DELAYJOB
12     TC      R22LEM
13
14     N49DSP   CAF     V06N49NB
15     TC      BANKCALL    # EXCESSIVE STATE VECTOR UPDATE -- FLASH
16     CADR    PRIODSP     # VERB 06 NOUN 49 R1 DELTA R, R2 DELTA V
17     TC      GOTOV56     # TERMINATE -- EXIT R22 AND P20
18     CS      ONE        # PROCEED -- N49FLAG -1
19     TS      N49FLAG     # RECYCLE -- N49FLAG + VALUE
20
21     R22RSTRT TC      ENDOFJOB
22     TC      PHASCHNG    # IF A RESTART OCCURS WHILE READING RADAR
23     OCT     00152       # COME HERE TO TAKE A RANGE-RATE READING
24     TC      BANKCALL    # WHICH ISN T USED TO PREVENT TAKING A BAD
25     CADR    RRRDOT      # READING AND TRYING TO INCORPORATE THE
26     TC      BANKCALL    # BAD DATA
27     CADR    RADSTALL    # WAIT FOR READ COMPLETE
28     TC      P20LEMC     # COULD NOT READ RADAR -- TRY TO REDISGNATE
29     TC      R22LEM      # READ SUCCESSFUL -- CONTINUE AT R22
30
31     ALRM525  OCT     00525
32     V06N05   VN      00605
33     V06N49NB VN      00649
34     1500DEC  DEC     1500
35
36     # LUNSFCHK -- CLOSED SUBROUTINE TO CHECK IF ON LUNAR SURFACE P22FLAG
37     # RETURNS TO CALLER +1 IF P22FLAG SET
38     # TO CALLER +2 IF P22FLAG NOT SET
39
40     LUNSFCHK COUNT*  $$/P22
41     CS      FLAGWRD8   # CHECK IF ON LUNAR SURFACE
42     MASK    SURFFBIT   # IS SURFFLAG SET
43     CCS     A          # BRANCH -- P22FLAG SET
44     INCR    Q          # NOT SET
45     TC      Q          # RETURN
```


RR DESIGNATE ROUTINE R21LEM
PROGRAM DESCRIPTION

MOD NO -- 2
BY P. VOLANTE

FUNCTIONAL DESCRIPTION

TO POINT THE RENDEZVOUS RADAR AT THE CSM UNTIL AUTOMATIC ACQUISITION
OF THE CSM IS ACCOMPLISHED BY THE RADAR. ROUTINE IS CALLED BY P20.

CALLING SEQUENCE --

TC BANKCALL
CADR R21LEM

SUBROUTINES CALLED --

#	FINDVAC	FLAGUP	ENDOFJOB	PRIOLARM
#	NOVAC	INTPRET	LPS20.1	PHASCHNG
#	WAITLIST	JOBSLEEP	JOBWAKE	FLAGDOWN
#	TASKOVER	BANKCALL	RADSTALL	RRDESSM

NORMAL EXIT MODES

WHEN LOCK-ON IS ACHIEVED, BRANCH WILL BE TO P20 WHERE R22 DATA READ
WILL BE SELECTED OR A NEED FOR A MANEUVER BRANCH TO P20LEMA

ALARM OR ABORT EXIT MODES --

PRIORITY ALARM 503 WHEN LOCK-ON HASN T BEEN ACHIEVED AFTER 30SECS --
THIS REQUIRES ASTRONAUT INTERFACE SELECTION OF SEARCH OPTION OF
ACQUISITION

OUTPUT

SEE LPS20.1, RRDESSM

ERASABLE INITIALIZATION REQUIRED

RRTARGET, RADMODES ARE USED BY LPS20.1 AND RRDESSM

FLAGS SET + RESET

LOSCMFLG LOKONSW

DEBRIS

SEE LPS20.1, RRSESSM

	EBANK	LOSCOUNT	
	COUNT*	\$\$/R21	
R21LEM	CS	BIT14	# REMOVE RR SELF TRACK ENABLE

	EXTEND	
	WAND	CHAN12
	TC	LUNSFCHK

	TC	R21LEM5	
	CAF	ZERO	# COMMAND ANTENNA TO MODE CENTER
	TS	TANG	# IF NOT ON SURFACE -- MODE 1 -- T 0,S 0



1		TS	TANG +1	1
2	R21LEM5	TC	R21LEM6	2
3		CAF	BIT12	3
4		MASK	RADMODES	4
5		CCS	A	5
6		TC	R21LEM10	6
7		CAF	BIT15	7
8		TS	TANG	8
9		CS	HALF	9
10		TS	TANG +1	10
11				11
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R21LEM6	TC	DOWNFLAG	
	ADRES	LOKONSW	
	TC	BANKCALL	
	CADR	RRDESNB	
	TC	+1	
	TC	BANKCALL	
	CADR	RADSTALL	
	TC	R21-503	# BAD RETURN FROM DESIGNATE -- ISSUE ALARM
R21LEM10	TC	UPFLAG	
	ADRES	LOSCMFLG	# EVERY FOURTH PASS THRU DODES
	CAF	MAXTRIES	# ALLOW 60 PASSES APPROX 45 SECONDS
R21LEM2	TS	DESCOUNT	# TO DESIGNATE AND LOCK ON
	CAF	THREE	
	TS	LOSCOUNT	
R21LEM1	TC	INTPRET	
	RTB	DAD	
		LOADTIME	
		HALFSEC	# EXTRAPOLATE TO PRESENT TIME + .5 SEC.
	STCALL	TDEC1	# LOS DETERMINATION ROUTINE
		LPS20.1	
R21LEM3	EXIT		
	TC	UPFLAG	# SET LOKONSW TO RADAR -- ON DESIRED
	ADRES	LOKONSW	
	TC	DOWNFLAG	
	ADRES	NORRMON	
	TC	INTPRET	
	CALL		# INPUT RRTARGET UPDATED BY LPS20.1
		RRDESSM	# DESIGNATE ROUTINE
	EXIT		
	TC	R21LEM4	# LOS NOT IN MODE 2 COVERAGE
			# ON LUNAR SURFACE
	TC	P20LEMA	# VEHICLE MANEUVER REQUIRED.
	TC	BANKCALL	# NO VEHICLE MANEUVER REQUIRED
	CADR	RADSTALL	# WAIT FOR DESIGNATE COMPLETE -- LOCKON OR
	TC	+2	# BAD END -- LOCKON NOT ACHIEVED IN 60 TRIES
R21-503	TC	R21END	# EXIT ROUTINE RETURN TO P20 LOCK-ON
	CAF	ALRM503	# ISSUE ALARM 503
	TC	BANKCALL	
	CADR	PRIOLARM	
	TC	GOTOV56	# TERMINATE EXITS P20 VIA V56 CODING
	TC	R21SRCH	# PROC
	TC	P20LEMC3	
	TC	ENDOFJOB	
R21END	TC	DOWNFLAG	
	ADRES	LOSCMFLG	# RESET LOSCMFLG
	TC	R21DISP	# PUT UP VERIFY MAIN LOBE LOCKON DISPLAY
R21SRCH	TC	PHASCHNG	
	OCT	04022	
	TC	R24LEM	# SEARCH ROUTINE
ALRM503	OCT	00503	

ALRM527	OCT	527	
R21LEM4	CAF	MAXTRIES	# SET UP COUNTER FOR
	TS	REPOSCNT	# 60 PASSES APPROX 600 SECS.
	TC	UPFLAG	
	ADRES	FSPASFLG	# SET FIRST PASS FLAG
	TC	DOWNFLAG	# RESET LOS BEING
	ADRES	LOSCMFLG	# COMPUTED FLAG
R21LEM12	TC	INTPRET	
	RTB	LOADTIME	
	DAD	TENSEC	# TIME T T + 10 SECS.
	STORE	REPOSTM	# SAVE FOR LONGCALL AND UPPSV
	STCALL	TDEC1	
		LPS20.1	# COMPUTE LOS AT TIME T
	CALL	RRDESSM	
	EXIT		
	TC	R21LEM13	# LOS NOT IN MODE 2 COVERAGE
	TC	ENDOFJOB	# VEHICLE MANEUVER REQUIRED
	TC	KILLTASK	
	CADR	BEGDES	
	TC	INTPRET	
	BOF		
		FSPASFLG	# FIRST PASS THRU REPOSITION
		R21LEMB	# NO -- GO TO CONTINUOUS DESIGNATE
	CLRGO		
		FSPASFLG	# YES -- RESET FIRST PASS FLAG
R21LEM13	CCS	R21LEM7 +1	
	TC	REPOSCNT	# HAVE WE TRIED 60 TIMES
		R21LEM7	# NO -- ADD 10 SECS. RECOMPUTE LOS
R21LEM7	TC	R21LEM11	# YES -- PUT OUT ALARM 530
	TS	REPOSCNT	
	TC	INTPRET	
	DLOAD	GOTO	
		REPOSTM	
		R21LEM12 +2	
R21LEMB	DLOAD		
		REPOSTM	
	STCALL	TDEC1	
		UPPSV	
	EXIT		
	TC	UPFLAG	# SET RADMODES BIT 15 FOR
	ADRES	CDESFLAG	# CONTINUOUS DESIGNATION
	TC	DOWNFLAG	
	ADRES	LOKONSW	
	TC	UPFLAG	
	ADRES	NORRMON	

	TC	BANKCALL	
	CADR	RRDESNB	
	TC	+1	
	TC	INTPRET	
	RTB	BDSU	
		LOADTIME	# COMPUTE DELTA TIME
		REPOSTM	# FOR LONGCALL
	STORE	DELTATM	
	EXIT		
	EXTEND		
	DCA	DELTATM	
	TC	LONGCALL	
	EBANK	LOSCOUNT	
	2CADR	R21LEM9	
R21LEM9	TC	ENDOFJOB	
	TC	KILLTASK	
	CADR	STDESIG	
	TC	CLRADM0D	
	CAF	PRI026	
	TC	FINDVAC	
	EBANK	LOSCOUNT	
	2CADR	R21LEM10	
R21LEM11	TC	TASKOVER	
	CAF	ALRM530	# ALARM 530 -- LOS NOT IN COVERAGE
	TC	BANKCALL	# AFTER TRYING TO DESIGNATE FOR
	CADR	PRIOLARM	# 600 SECS.
	TC	GOTOV56	
	TC	GOTOV56	
	TC	GOTOV56	
	TC	ENDOFJOB	
ALRM530	OCT	00530	
TENSEC	2DEC	1000 B-28	
HALFSEC	2DEC	50	
R21DISP	TC	PHASCHNG	
	OCT	04022	
	CAF	V06N72PV	# FLASH V 50 N 72 -- PLEASE PERFORM RR
	TC	BANKCALL	# MAIN LOBE LOCKON VERIFICATION
	CADR	GOPERF2R	
	TC	GOTOV56	# TERMINATE EXITS VIA V 56
	TC	P20LEMWT	# PROCEED CONTINUES TO R22
	TC	-5	# ENTER ILLEGAL
	CAF	BIT7	
	TC	LINUS	# SET BITS TO MAKE THIS A PRIORITY DISPLAY
	TC	ENDOFJOB	



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MANUAL ACQUISITION ROUTINE R23LEM
PROGRAM DESCRIPTION

MOD NO -- 2
BY P. VOLANTE

FUNCTIONAL DESCRIPTION

TO ACQUIRE THE CSM BY MANUAL OPERATION OF THE RENDEZVOUS RADAR

CALLING SEQUENCE --

TC R23LEM

SUBROUTINES CALLED

BANKCALL R61LEM
SETMINDB GOPERF1

NORMAL EXIT MODES --

IN RESPONSE TO THE GOPERF1, SELECTION OF ENTER WILL RECYCLE R23
SELECTION OF PROC WILL CONTINUE R23
SELECTION OF TERM WILL TERMINATE R23 + P20

ALARM OR ABORT EXIT MODES --

SEE NORMAL EXIT MODES ABOVE

OUTPUT

N.A.

ERASABLE INITIALIZATION REQUIRED --

ACMODFLG MUST BE SET TO 1 MANUAL MODE

	EBANK	GENRET	
	COUNT*	\$\$/R23	
R23LEM	TC	UPFLAG	# SET NO ANGLE MONITOR FLAG
	ADRES	NORRMON	

	INHINT		
	TC	IBNKCALL	# SELECT MINIMUM DEADBAND
	CADR	SETMINDB	

	RELINT		
R23LEM1	CAF	BIT14	# ENABLE TRACKER
	EXTEND		

	WOR	CHAN12	
	CAF	OCT205	
	TC	BANKCALL	

	CADR	GOPERF1	
	TC	R23LEM2	# TERMINATE
	TC	R23LEM11	# PROCEDE
	TC	R23LEM3	# ENTER -- DO ANOTHER MANEUVER

R23LEM11	INHINT		
	TC	RRLIMCHK	# YES -- CHECK IF ANTENNA IS WITHIN LIMITS

	ADRES	CDUT	
	TC	OUTOFLIM	# NOT WITHIN LIMITS
	TC	IBNKCALL	# RESTORE DEADBAND TO



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	CADR	RESTORDB	# ASTRONAUT SELECTED VALUE
1	RELINT		
2	TC	DOWNFLAG	# CLEAR NO ANGLE MONITOR FLAG
3	ADRES	NORRMON	
4	TC	P20LEMB1	# RADAR IS LOCKED ON CONTINUE IN P20
5	OUTOFLIM	RELINT	
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[illegible]

SEARCH ROUTINE R24LEM
PROGRAM DESCRIPTION

MOD NO -- 2
BY P. VOLANTE

FUNCTIONAL DESCRIPTION

TO ACQUIRE THE CSM BY A SEARCH PATTERN WHEN THE RENDEZVOUS RADAR HAS
FAILED TO ACQUIRE TEH CSM IN THE AUTOMATIC TRACKING MODE AND TO ALLOW
THE ASTRONAUT TO CONFIRM THAT REACQUISITION HAS NOT BEEN IN SIDELobe.

CALLING SEQUENCE

CAF PRIONN
TC FINDVAC
EBANK DATAGOOD
2CADR R24LEM

SUBROUTINES CALLED

FLAGUP FLAGDOWN BANKCALL
R61LEM GOFLASHR FINDVAC
ENDOFJOB NOVAC LSR24.1

NORMAL EXIT MODES --

ASTRONAUT RESPONSE TO DISPLAY OF OMEGA AND DATAGOOD. HE CAN EITHER
REJECT BY TERMINATING SEARCH OPTION AND RESELECTING P20 OR ACCEPT BY
PROCEEDING EXIT ROUTINE AND RETURN TO AUTO MODE IN P20

ALARM OR ABORT EXIT MODES --

SEE NORMAL EXIT MODES ABOVE

OUTPUT --

SEE OUTPUT FROM LSR24.1 + R61LEM

ERASABLE INITIALIZATION REQUIRED

SET INPUT FOR LSR24.1

FLAGS SET + RESET

SRCHOPT, ACMODFLG

R24LEM	EBANK	DATAGOOD	
	COUNT*	\$\$/R24	
	TC	UPFLAG	
	ADRES	SRCHOPTN	# SET SRCHOPT FLAG
	TC	DOWNFLAG	# RESET LOS BEING COMPUTED FLAG TO MAKE
	ADRES	LOSCMFLG	# SURE DODES DOESN T GO TO R21
R24LEM1	CAF	ZERO	
	TS	DATAGOOD	# ZERO OUT DATA INDICATOR
	TS	OMEGAD	# ZERO OMEGA DISPLAY REGS
	TS	OMEGAD +1	# ZERO OMEGA DISPLAY REGS
R24LEM2	TC	PHASCHNG	
	OCT	04022	



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CAF V16N80
TC BANKCALL
CADR PRIODSPR
TC GOTOV56
TC R24END # PROCEED EXIT R24 TO P20LEM1
TC R24LEM3 # RECYCLE -- CALL R61 TO MANEUVER S/C

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	TC	BANKCALL	
	CADR	LRS24.1	
R24END	TC	KILLTASK	
	CADR	CALLDGCH	
	TC	CLRADMOD	# CLEAR BITS 10 15 OF RADMODES.
	TCF	P20LEM1	# AND GO TO 400 MI. RANGE CHECK IN P20
	BLOCK	3	
	SETLOC	FFTAG6	
	BANK		
	COUNT*	\$\$/R24	
CLRADMOD	CS	BIT10+15	
	INHINT		
	MASK	RADMODES	
	TS	RADMODES	
	CS	BIT2	# DISABLE RR ERROR COUNTERS
	EXTEND		
	WAND	CHAN12	# USER WILL RELINT
	TC	Q	
BIT10+15	OCT	41000	
	BANK	24	
	SETLOC	P20S	
	BANK		
	COUNT*	\$\$/R24	
R24LEM3	TC	PHASCHNG	
	OCT	04022	
	TC	KILLTASK	
	CADR	CALLDGCH	# KILL WAITLIST FOR NEXT POINT IN PATTERN
	TC	CLRADMOD	# CLEAR BITS 10 + 15 OF RADMODES TO KILL
	RELINT		# HALF SECOND DESIGNATE LOOP
	CAF	.5SEC	
	TC	BANKCALL	# WAIT FOR DESIGNATE LOOP TO DIE
	CADR	DELAYJOB	
	TC	LUNSFCHK	# CHECK IF ON LUNAR SURFACE
	TC	R24LEM4	# YES -- DON T DO ATTITUDE MANEUVER
	TC	BANKCALL	# CALL R61 TO DO PREFERRED TRACKING
	CADR	R61LEM	# ATTITUDE MANEUVER
R24LEM4	CAF	ZERO	# ZERO OUT RADCADR WHICH WAS SET BY
	TS	RADCADR	# ENDRADAR WHEN DESIGNATE STOPPED SO THAT
			# RRDESSM WILL RETURN TO CALLER
	TC	R24LEM2	# AND GO BACK TO PUT UP V16 N80 DISPLAY
V16N80	VN	01680	

```

1  # PREFERRED TRACKING ATTITUDE ROUTINE R61LEM
2  # PROGRAM DESCRIPTION
3
4  #
5  #      MOD NO   3          DATE   4-11-67
6  #      MOD BY  P. VOLANTE, SDC
7
8  # FUNCTIONAL DESCRIPTION --
9  #
10 #      TO COMPUTE THE PREFERRED TRACKING ATTITUDE OF THE LM TO ENABLE RR
11 #      TRACKING OF THE CSM AND TO PERFORM THE MANEUVER TO THE PREFERRED
12 #      ATTITUDE.
13
14 # CALLING SEQUENCE --
15 #
16 #      TC      BANKCALL
17 #      CADR     R61LEM
18
19 # SUBROUTINES CALLED
20 #
21 #      LPS20.1      VECPOINT
22 #      KALCMAN3
23
24 # NORMAL EXIT MODES --
25 #
26 #      NORMAL RETURN IS TO CALLER + 1
27
28 # ALARM OR ABORT EXIT MODES --
29 #
30 #      TERMINATE P20 + R61 BY BRANCHING TO P20END IF BOTH TRACKFLAG +
31 #      RENDEZVOUS FLAG ARE NOT SET.
32
33 # OUTPUT --
34 #
35 #      SEE OUTPUT FOR LPS20.1 + ATTITUDE MANEUVER ROUTINE  R60
36
37 # ERASABLE INITIALIZATION REQUIRED
38 #
39 #      GENRET USED TO SAVE Q FOR RETURN
40
41 # FLAGS SET + RESET
42 #
43 #      3AXISFLG
44
45 # DEBRIS
46
47 #      SEE SUBROUTINES
48
49 #      SETLOC  R61
50 #      BANK
51 #      EBANK   LOSCOUNT
52 #      COUNT*  $$/R61
53 R61LEM      TC      MAKECADR
54             TS      GENRET
55             TC      UPFLAG          # SET R61 FLAG
56             ADRES   R61FLAG
57             TC      R61C+L01
58 R65LEM      TC      MAKECADR
59             TS      GENRET
60             TC      DOWNFLAG        # RESET R61 FLAG

```




1	R61C+L01	ADRES	R61FLAG	
2		CAF	TRACKBIT	# TRACKFLAG
3		MASK	STATE +1	
4		EXTEND		
5	R61C+L03	BZF	R65WAIT	# NOT SET
6		TC	INTPRET	
7		VLOAD		
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		HIUNITZ	
	STORE	SCAXIS	# TRACK AXIS UNIT VECTOR
R61LEM1	RTB	DAD	
		LOADTIME	# EXTRAPOLATE FORWARD TO CENTER
		3SECONDS	# SIX SECOND PERIOD.
	STCALL	TDEC1	
	VLOAD	LPS20.1	# LOS DETERMINATION + VEH ATTITUDE
	STORE	RRTARGET	
	RTB	POINTVSM	
		CALL	# GET DESIRED CDU S FOR VECPT1
		READCDUD	
		VECPNT1	# COMPUTES FINAL ANGLES FROM PRESENT CDUDS
	STORE	CPHI	# STORE FINAL ANGLES -- CPHI, CTHETA, CPSI
	EXIT		
	TC	PHASCHNG	
	OCT	04022	
	CAF	TRACKBIT	# IS TRACK FLAG SET
	MASK	FLAGWRD1	
	EXTEND		
	BZF	R65WAIT	
	TC	BANKCALL	
	CADR	G+N,AUTO	# CHECK FOR AUTO MODE
	CCS	A	
	TC	R61C+L04	# NOT IN AUTO
	TC	INTPRET	
	VLOAD	CALL	
		RRTARGET	
		CDU*SMNB	
	DLOAD	DSU	# GET PHI -- ARCCOS OF Z-COMPONENT OF LOS
		MPAC +5	
		COS15DEG	
R61LEM2	BMN	EXIT	# BRANCH -- PHI 15 DEGREES
		R61C+L05	# PHI GRE 10DEG
	EBANK	CDUXD	
	CAF	EBANK6	
	TS	EBANK	
	INHINT		
	EXTEND		
	DCA	CPHI	
	DXCH	CDUXD	
	CA	CPSI	
	TS	CDUZD	
	RELINT		
	EBANK	LOSCOUNT	
	CAF	EBANK7	
	TS	EBANK	
R61C+L05	TC	R61C+L06	
	EXIT		
	INHINT		

	TC	IBNKCALL	
	FCADR	ZATTEROR	
	TC	IBNKCALL	
	FCADR	SETMINDB	# REDUCE ATTITUDE ERROR
	TC	DOWNFLAG	
	ADRES	3AXISFLG	
	TC	UPFLAG	
	ADRES	PDSPFLAG	# SET PRIORITY DISPLAY FLAG
	TC	BANKCALL	
	CADR	R60LEM	
	INHINT		
	TC	IBNKCALL	
	FCADR	RESTORDB	
	TC	PHASCHNG	
	OCT	04022	
	TC	DOWNFLAG	
	ADRES	PDSPFLAG	# RESET PRIORITY DISPLAY FLAG
R61C+L06	CA	FLAGWRD1	
	MASK	R61FLBIT	
	CCS	A	
	TC	R61C+L4	
	CCS	R65CNTR	
	TC	+2	
	TC	R61C+L4	# R65CNTR 0 - EXIT ROUTINE
	TS	R65CNTR	
	CAF	06SEC	
	TC	TWIDDLE	
	ADRES	R61C+L2	
	TC	ENDOFJOB	
R61C+L2	CAF	PRI026	
	TC	FINDVAC	
	EBANK	LOSCOUNT	
	2CADR	R61C+L01	
	TC	TASKOVER	
R61C+L04	TC	BANKCALL	# TO CONVERT ANGLES TO FDAI
	CADR	BALLANGS	
	TC	R61C+L06	
R61C+L4	CAE	GENRET	
	TCF	BANKJUMP	# EXIT R61
R61C+L1	CAF	BIT7+9PV	# IS RENDEZVOUS OR P25FLAG SET
	MASK	STATE	
	EXTEND		
	BZF	ENDOFJOB	# NO -- EXIT ROUTINE AND PROGRAM.
	TC	R61C+L06	# YES EXIT ROUTINE
R65WAIT	TC	POSTJUMP	
	CADR	P20LEMWT	
BIT7+9PV	OCT	00500	

COS15DEG	2DEC	0.96593 B-1	
06SEC	DEC	600	
PHI	EQUALS	20D	
READCDUD	INHINT		# READS DESIRED CDU S AND STORES IN
	CAF	EBANK6	# MPAC TP EXITS WITH MODE SET TO TP
	XCH	EBANK	
	TS	RUPTREG1	
	EBANK	CDUXD	
	CA	CDUXD	
	TS	MPAC	
	EXTEND		
	DCA	CDUYD	
	DXCH	MPAC +1	
	CA	RUPTREG1	
	TS	EBANK	
	RELINT		
	TCF	TMODE	
	BLOCK	02	
	SETLOC	RADARFF	
	BANK		
	EBANK	LOSCOUNT	
	COUNT*	\$\$/RRSUB	

1412THE

THE FOLLOWING SUBROUTINE RETURNS TO CALLER +2 IF THE ABSOLUTE VALUE OF VALUE OF C A IS GREATER THAN THE
NEGATIVE OF THE NUMBER AT CALLER +1. OTHERWISE IT RETURNS TO CALLER +3. MAY BE CALLED IN RUPT OR UNDER EXEC.

MAGSUB	EXTEND		
	BZMF	+2	
	TCF	+2	
	COM		
	INDEX	Q	
	AD	0	
	EXTEND		
	BZMF	Q+2	# ABS A CONST GO TO L+3
	TCF	Q+1	# ABS A CONST GO TO L+2

PROGRAM NAME RRLIMCHK

FUNCTIONAL DESCRIPTION

RRLIMCHK CHECKS RR DESIRED GIMBAL ANGLES TO SEE IF THEY ARE WITHIN
THE LIMITS OF THE CURRENT MODE. INITIALLY THE DESIRED TRUNNION AND
SHAFT ANGLES ARE STORED IN ITEMP1 AND ITEMP2. THE CURRENT RR
ANTENNAE MODE RADMODES BIT 12 IS CHECKED WHICH IS 0 FOR
MODE 1 AND 1 FOR MODE 2.

MODE 1 -- THE TRUNNION ANGLE IS CHECKED AT MAGSUB TO SEE IF IT IS
BETWEEN -55 AND +55 DEGREES. IF NOT, RETURN TO L +2. IF WITHIN LIMITS,
THE SHAFT ANGLE IS CHECKED TO SEE IF IT IS BETWEEN -70 AND +59 DEGREES.
IF NOT, RETURN TO L +2. IF IN LIMITS, RETURN TO L +3.

MODE 2 -- THE SHAFT ANGLE IS CHECKED AT MAGSUB TO SEE IF IT IS
BETWEEN -139 AND -25 DEGREES. IF NOT, RETURN TO L +2. IF WITHIN
LIMITS, THE TRUNNION ANGLE IS CHECKED TO SEE IF IT IS BETWEEN +125
AND -125 +235 DEGREES. IF NOT, RETURN TO L +2. IF IN LIMITS, RETURN
TO L +3.

CALLING SEQUENCE

L TC RRLIMCHK WITH INTERRUPT INHIBITED
L +1 ADRES T,S DESIRED TRUNNION ANGLE ADDRESS

ERASABLE INITIALIZATION REQUIRED

RADMODES, MODEA, MODEB OR DESIRED TRUNNION AND SHAFT
ANGLES ELSEWHERE IN CONSECUTIVE LOCATIONS -- UNSWITCHED ERASABLE OR
CURRENT EBANK .

SUBROUTINES CALLED MAGSUB

JOBS OR TASKS INITIATED NONE

ALARMS NONE

EXIT L + 2 EITHER OR BOTH ANGLES NOT WITHIN LIMITS OF CURRENT MODE
L + 3 BOTH ANGLES WITHIN LIMITS OF CURRENT MODE

RRLIMCHK EXTEND
INDEX Q
INDEX 0
DCA 0
INCR Q
DXCH ITEMP1
LXCH Q # L CALLER +2 TO L.

CAF ANTENBIT # SEE WHICH MODE RR IS IN.
MASK RADMODES
CCS A
TCF MODE2CHK

CA ITEMP1 # MODE 1 IS DEFINED AS

[illegible]

PROGRAM NAME SETTRKF

FUNCTIONAL DESCRIPTION

SETTRKF UPDATES THE TRACKER FAIL LAMP ON THE DSKY.
 # INITIALLY THE LAMP TEST FLAG IMODES33 BIT 1 IS CHECKED.
 # IF A LAMP TEST IS IN PROGRESS, THE PROGRAM EXITS TO L +1.
 # IF NO LAMP TEST THE FOLLOWING IS CHECKED SEQUENTIALLY
 # 1 RR CDU S BEING ZEROED, RR CDU OK, AND RR NOT IN
 # AUTO MODE RADMODES BITS 13, 7, 2 .
 # 2 LR VEL DATA FAIL AND NO LR POS DATA RADMODES BITS
 # 8,5
 # 3 NO RR DATA RADMODES BIT 4
 # THE ABSENCE OF ALL THREE SIMULTANEOUSLY IN 1 , THE PRESENCE OF BOTH
 # IN 2 , AND THE PRESENCE OF 3 RESULTS IN EITHER THE TRACKER FAIL
 # LAMP DSPTAB +11D BIT 8 BEING TURNED OFF OR IS LEFT OFF. THEREFORE, THE
 # TRACKER FAIL LAMP IS TURN ON IF
 # A RR CDU FAILED WITH RR IN AUTO MODE AND RR CDU S NOT BEING ZEROED
 # B N SAMPLES OF LR DATA COULD NOT BE TAKEN IN 2N TRIES WITH
 # EITHER THE ALT OR VEL INFORMATION
 # C N SAMPLES OF RR DATA COULD NOT BE OBTAINED FROM 2N TRIES
 # WITH EITHER THE AL

CALLING SEQUENCE

L TC SETTRKF

ERASABLE INITIALIZATION REQUIRED IMODES33, RADMODES, DSPTAB +11D

SUBROUTINES CALLED NONE

JOBS OR TASKS INITIATED NONE

ALARMS TRACKER FAIL LAMP

EXIT L +1 ALWAYS

SETTRKF CAF BIT1 # NO ACTION IF DURING LAMP TEST

MASK IMODES33
 CCS A
 TC Q

RRTRKF CA BIT8
 TS L

CAF 13,7,2 # SEE IF CDU FAILED.
 MASK RADMODES

EXTEND
 BZF TRKFLON # CONDITION 3 ABOVE.

RRCHECK CAF RRDATA BT
 MASK RADMODES # SEE IF RR DATA FAILED.

1412THE

PROGRAM NAME RRTURNON

FUNCTIONAL DESCRIPTION

RRTURNON IS THE TURN-ON SEQUENCE WHICH, ALONG WITH
RRZEROSB, ZEROES THE CDU S AND DETERMINES THE RR MODE.
INITIALLY, CONTROL IS TRANSFERRED TO RRZEROSB FOR THE
ACTUAL TURN-ON SEQUENCE. UPON RETURN THE PROGRAM
WAITS 1 SECOND BEFORE REMOVING THE TURN-ON FLAG
RADMODES BIT1 SO THE REPOSITION ROUTINE WON T
INITIATE PROGRAM ALARM 00501. A CHECK IS THEN MADE
TO SEE IF A PROGRAM IS USING THE RR STATE BIT 7 . IF
SO, THE PROGRAM EXITS TO ENDRADAR SO THAT THE RR CDU
FAIL FLAG RADMODES BIT 7 CAN BE CHECKED BEFORE
RETURNING TO THE WAITING PROGRAM. IF NOT, THE PROGRAM EXITS
TO TASKOVER.

CALLING SEQUENCE WAITLIST TASK FROM RRAUTCHK IF THE RR POWER-ON AUTO
BIT CHAN 33 BIT 2 CHANGES TO 0 AND NO PROGRAM WAS USING
THE RR STATE BIT 7 .

ERASABLE INITIALIZATION REQUIRED

RADMODES, STATE

SUBROUTINES CALLED RRZEROSB, FIXDELAY, TASKOVER, ENDRADAR

JOBS OR TASKS INITIATED

NONE

ALARMS NONE SEE RRZEROSB

EXIT TASKOVER, ENDRADAR WAITING PROGRAM

BANK 24
SETLOC P20S1
BANK

EBANK LOSCOUNT
COUNT* \$\$/RSUB

RRTURNON TC RRZEROSB
TC FIXDELAY # WAIT 1 SEC BEFORE REMOVING TURN ON FLAG
DEC 100 # SO A MONITOR REPOSITION WON T ALARM.

CS TURNONBT
MASK RADMODES
TS RADMODES
TCF TASKOVER

PROGRAM NAME RRZEROSB

FUNCTIONAL DESCRIPTION

RRZEROSB IS A CLOSED SUBROUTINE TO ZERO THE RR CDU S,
DETERMINE THE RR MODE, AND TURN ON THE TRACKER FAIL
LAMP IF REQUIRED. INITIALLY THE RR CDU ZERO BIT CHAN 12
BIT 1 IS SET. FOLLOWING A 20 MILLISECOND WAIT, THE LGC
RR CDU COUNTERS OPTX, OPTX ARE SET 0 AFTER
WHICH THE RR CDU ZERO DISCRETE CHAN 12 BIT 1 IS
REMOVED. A 4 SECOND WAIT IS SET TO ALL THE RR CDU S
TO REPEAT THE ACTUAL TRUNNION AND SHAFT ANGLES. THE
RR CDU ZERO FLAG RADMODES BIT 13 IS REMOVED. THE
CONTENTS OF OPTX IS THEN CHECKED TO SEE IF THE TRUNNION
ANGLE IS LESS THAN 90 DEGREES. IF NOT, BIT 12 OF
RADMODES IS SET 1 TO INDICATE RR ANTENNA MODE 2.
IF LESS THAN 90 DEGREES, BIT 12 OF RADMODES IS SET 0 TO
INDICATE RR ANTENNA MODE 1. SETTRKF IS THEN CALLED TO
SEE IF THE TRACKER FAIL LAMP SHOULD BE TURNED ON.

CALLING SEQUENCE L TC RRZEROSB FROM RRTURNON AND RRZERO

ERASABLE INITIALIZATION REQUIRED

RADMODES BIT 13 SET , DSPTAB +11D

SUBROUTINES CALLED FIXDELAY, MAGSUB, SETTRKF

JOBS OR TASKS INITIATED

NONE

ALARMS TRAKCER FAIL

EXIT L +1 ALWAYS

RRZEROSB	EXTEND		
	QXCH	RRRET	
	CAF	BIT1	# BIT 13 OF RADMODES MUST BE SET BEFORE
	EXTEND		# COMING HERE.
	WOR	CHAN12	# TURN ON ZERO RR CDU
	TC	FIXDELAY	
	DEC	2	
	CAF	ZERO	
	TS	CDUT	
	TS	CDUS	
	CS	ONE	# REMOVE ZEROING BIT.
	EXTEND		
	WAND	CHAN12	
	TC	FIXDELAY	
	DEC	1000	# RESET FAIL INHIBIT IN 10 SECS. -- D.281
	CS	RCDU0BIT	# REMOVE ZEROING IN PROCESS BIT

[illegible]

PROGRAM NAME DORREPOS

FUNCTIONAL DESCRIPTION

DORREPOS IS A SEQUENCE OF TASKS TO DRIVE THE RENDEZVOUS RADAR TO A SAFE POSITION. INITIALLY SETRRECR IS CALLED WHERE THE RR ERROR COUNTERS CHAN 12 BIT 2 ARE ENABLED AND LASTYCMD AND LASTXCMD SET 0 TO INDICATE THE DIFFERENCE BETWEEN THE DESIRED STATE AND PRESENT STATE OF THE COMMANDS. THE RR TURN-ON FLAG RADMODES BIT 1 IS CHECKED AND IF NOT PRESENT, PROGRAM ALARM 00501 IS REQUESTED BEFORE CONTINUING. IN EITHER CASE, FOLLOWING A 20 MILLISECOND WAIT THE PROGRAM CHECKS THE CURRENT RR ANTENNA MODE RADMODES BIT 12. RRONLY IS THEN CALLED TO DRIVE THE TRUNNION ANGLE TO 0 DEGREES IF IN MODE 1 AND TO 180 DEGREES IF IN MODE 2. UPON RETURN, THE CURRENT RR ANTENNA MODE RADMODES BIT 12 IS AGAIN CHECKED. RRONLY IS THEN CALLED TO DRIVE THE SHAFT ANGLE TO 0 DEGREES IF IN MODE 1 AND TO -90 DEGREES IF IN MODE 2. IF DURING RRONLY OR RRONLY A REMODE HAS BEEN REQUESTED RADMODES BIT 14, AND ALWAYS FOLLOWING COMPLETION OF RRONLY, CONTROL IS TRANSFERRED TO REPOSRT. HERE THE REPOSITION FLAG RADMODES BIT 11 IS REMOVED. A CHECK IS THEN MADE ON THE DESIGNATE FLAG RADMODES BIT 10. IF PRESENT, CONTROL IS TRANSFERRED TO BEGDES. IF NOT PRESENT INDICATING NO FURTHER ANTENNA CONTROL REQUIRED, THE RR ERROR COUNTER BIT CHAN 12 BIT 2 IS REMOVED AND THE ROUTINE EXITS TO TASKOVER.

CALLING SEQUENCE

WAITLIST CALL FROM RRGIMON IF TRUNNION AND SHAFT CDU ANGLES NOT WITHIN LIMITS OF CURRENT MODE.

ERASABLE INITIALIZATION REQUIRED

RADMODES

SUBROUTINES CALLED

RRONLY, RRONLY, BEGDES EXIT

JOBS OR TASKS INITIATED

NONE

ALARMS NONE

EXIT TASKOVER, BEGDES

DORREPOS TC SETRRECR # SET UP RR CDU ERROR COUNTERS.

ALARM 501 DELETED IN DANCE 279 PER PCR 97.

TC FIXDELAY

DEC 2

CAF ANTENBIT # MANEUVER TRUNNION ANGLE TO NOMINAL POS.

	MASK	RADMODES	
	CCS	A	
	CAF	BIT15	# 0 FOR MODE 1 AND 180 FOR MODE 2.
	TC	RRONLY	
	CAF	ANTENBIT	# NOT PUT SHAFT IN RIGHT POSITION
	MASK	RADMODES	
	CCS	A	
	CS	HALF	# -90 FOR MODE 2.
	TC	RRONLY	
REPOS RPT	CS	REPOSBIT	# RETURNS HERE FROM RR1AXIS IN REMODE
			# REQUESTED DURING REPOSITION.
	MASK	RADMODES	# REMOVE REPOSITION BIT.
	TS	RADMODES	
	MASK	DESIGBIT	# SEE IF SOMEONE IS WAITING TO DESIGNATE.
	CCS	A	
	TCF	BEGDES	
	CS	BIT2	# IF NO FURTHER ANTENNA CONTROL REQUIRED,
	EXTEND		# REMOVE ERROR COUNTER ENABLE.
	WAND	CHAN12	
	TCF	TASKOVER	
SETRRECR	CAF	BIT2	# SET UP RR ERROR COUNTERS
	EXTEND		
	RAND	CHAN12	
	CCS	A	# DO NOT CLEAR LAST COMMAND IF
	TC	Q	# ERROR COUNTERS ARE ENABLED
	TS	LASTYCMD	
	TS	LASTXCMD	
	CAF	BIT2	
	EXTEND		
	WOR	CHAN12	# ENABLE RR CDU ERROR COUNTERS.
	TC	Q	

PROGRAM NAME REMODE

FUNCTIONAL DESCRIPTION

REMODE IS THE GENERAL REMODING SUBROUTINE. IT DRIVES THE TRUNNION ANGLE TO 0 DEGREES IF THE CURRENT MODE IS MODE 1, 180 DEGREES FOR MODE 2, THEN DRIVES THE SHAFT ANGLE TO -45 DEGREES, AND FINALLY DRIVES THE TRUNNION ANGLE TO -130 DEGREES, TO PLACE THE RR IN MODE 2, -50 DEGREES FOR MODE 1, BEFORE INITIATING 2-AXIS CONTROL. ALL REMODING IS DONE WITH SINGLE AXIS ROTATIONS RR1AXIS. INITIALLY THE RR ANTENNA MODE FLAG RADMODES BIT 12 IS CHECKED. CONTROL IS THEN TRANSFERRED TO RRONLY TO DRIVE THR TRUNNION ANGLE TO 0 DEGREES IF IN MODE 1 OR 180 DEGREES IF IN MODE 2. RRONLY IS THEN CALLED TO DRIVE THE SHAFT ANGLE TO -45 DEGREES. THE RR ANTENNA MODE FLAG RADMODES BIT 12 IS CHECKED AGAIN. CONTROL IS AGAIN TRANSFERRED TO RRONLY TO DRIVE THE TRUNNION ANGLE TO -130 DEGREES TO PLACE THE RR IN MODE 2 IF CURRENTLY IN MODE 1 OR TO -50 DEGREES IF IN MODE 2 TO PLACE THE RR IN MODE 1. RMODINV IS THEN CALLED TO SET RADMODES BIT 12 TO INDICATE THE NEW RR ANTENNA MODE. THE REMODE FLAG RADMODES BIT 14 IS REMOVED TO INDICATE THAT REMODING IS COMPLETE. THE PROGRAM THEN EXITS TO STDESIG TO BEGIN 2-AXIS CONTROL.

CALLIN SEQUENCE

FROM BEGDES WHEN REMODE FLAG RADMODES BIT 14 IS SET. THIS FLAG MAY BE SET IN RRDESSM AND RRDESNB IF RRLIMCHK DETERMINES THAT THE DESIRED ANGLES ARE WITHIN THE LIMITS OF THE OTHER MODE.

ERASABLE INITIALIZATION REQUIRED

RADMODES

SUBROUTINES CALLED

RRONLY, RRSONL, RMODINV ACTUALLY PART OF

JOBS OR TASKS INITIATED

NONE

ALARMS NONE

EXIT STDESIG

REMODE	CAF	ANTENBIT	# DRIVE TRUNNION TO 0 180
	MASK	RADMODES	# ERROR COUNTER ALREADY ENABLED
	CCS	A	
	CAF	BIT15	
	TC	RRONLY	
	CAF	-45DEGSR	
	TC	RRONLY	

[illegible]

PROGRAM NAMES RRONLY, RRONLY

FUNCTIONAL DESCRIPTION

RRONLY AND RRONLY ARE SUBROUTINES FOR DOING SINGLE AXIS
 # RR MANEUVERS FOR REMODE AND REPOSITION. IT DRIVES TO
 # WITHIN 1 DEGREE. INITIALLY, AT RR1AX2, THE REMODE AND REPOSITION
 # FLAGS RADMODES BITS 14, 11 ARE CHECKED. IF BOTH EXIST,
 # THE PROGRAM EXITS TO REPOSRPT SEE DORREPOS. THIS INDICATES
 # THAT SOMEONE POSSIBLY REQUESTED A DESIGNATE RADMODES BIT 10
 # WHICH REQUIRES A REMODE RADMODES BIT 14 AND THAT A
 # REPOSITION IS IN PROGRESS RADMODES BIT 11. IF NONE
 # OR ONLY ONE OF THE FLAGS EXIST, REMODE OR REPOSITION, MAGSUB
 # IS CALLED TO SEE IF THE APPROPRIATE ANGLE IS WITHIN 1 DEGREE. IF YES,
 # CONTROL RETURNS TO THE CALLING ROUTINE. IF NOT, CONTROL IS
 # TRANSFERRED TO RR0UT FOR SINGLE AXIS MANEUVERS WITH THE OTHER
 # ANGLE SET 0. FOLLOWING A .5 SECOND WAIT, THE ABOVE PROCEDURE IS
 # REPEATED.

# CALLING SEQUENCE	L-1	CAF	*ANGLE*	DESIRED ANGLE SCALED PI
#	L	TC	RRONLY	TRUNNION ONLY
#	RRONLY			SHAFT ONLY
#	RRONLY IS CALLED BY PREPOS29			
#	RRONLY AND RRONLY ARE CALLED BY DORREPOS AND REMODE			

ERASABLE INITIALIZATION REQUIRED

C A DESIRED ANGLE, RADMODES

SUBROUTINES CALLED

FIXDELAY, REPOSRPT, MAGSUB, RR0UT

JOBS OR TASKS INITIATED

NONE

ALARMS NONE

EXIT REPOSRPT REMODE AND REPOSITION FLAGS PRESENT -- RADMODES
 # BITS 14, 11
 # L+1 ANGLE WITHIN ONE DEGREE OR RR OUT OF AUTO MODE

RRONLY	TS	RDES	# DESIRED TRUNNION ANGLE.
	CAF	ZERO	
	TCF	RR1AXIS	
RRONLY	TS	RDES	# SHAFT COMMANDS ARE UNRESOLVED SINCE THIS
	CAF	ONE	# ROUTINE ENTERED ONLY WHEN T 0 OR 180.
RR1AXIS	TS	RRINDEX	
	EXTEND		
	QXCH	RRRET	
	TCF	RR1AX2	

NXTRR1AX	TC DEC	FIXDELAY 50	# 2 SAMPLES PER SECOND.
RR1AX2	CS MASK EXTEND BZF	RADMODES PRIO22 REPOSRT	# IF SOMEONE REQUESTS A DESIGNATE WHICH # REQUIRES A REMODE AND A REPOSITION IS IN # PROGRESS, INTERRUPT IT AND START THE # REMODE IMMEDIATELY.
	CA EXTEND INDEX MSU TS EXTEND	RDES RRINDEX CDUT ITEMP1	# SAVE ERROR SIGNAL.
	MP TS CA	RRSPGAIN L RADMODES	# TRIES TO NULL .7 OF ERROR OVER NEXT .5
	MASK XCH TC DEC	AUTOMBIT ITEMP1 MAGSUB -.00555	# STORE RR-OUT-OF-AUTO-MODE BIT. # SEE IF WITHIN ONE DEGREE. # SCALED IN HALF-REVS.
	CCS TC	ITEMP1 RRRET	# NO. IF RR OUT OF AUTO MODE, EXIT. # RETURN TO CALLER.
	CCS TCF XCH DXCH	RRINDEX +2 L TANG	# COMMAND FOR OTHER AXIS IS ZERO. # SETTING A TO 0.
	TC	RRROUT	
	TCF	NXTRR1AX	# COME BACK IN .5 SECONDS.
RRSPGAIN	DEC	.59062	# NULL .7 ERROR IN .5 SEC.

PROGRAM NAME RRROUT

FUNCTIONAL DESCRIPTION

RRROUT RECEIVES RR GYRO COMMANDS IN TANG, TANG +1 IN RR
ERROR COUNTER SCALING. RRROUT THEN LIMITS THEM AND
GENERATES COMMANDS TO THE CDU TO ADJUST THE ERROR COUNTERS
TO THE DESIRED VALUES. INITIALLY MAGSUB CHECKS THE MAGNITUDE OF
THE COMMAND SHAFT ON 1ST PASS TO SEE IF IT IS GREATER THAN
384 PULSES. IF NOT, CONTROL IS TRANSFERRED TO RRROUTLIM TO
LIMIT THE COMMAND TO +384 OR -384 PULSES. THE DIFFERENCE IS
THEN CALCULATED BETWEEN THE DESIRED STATE AND THE PRESENT STATE OF
THE ERROR COUNTER AS RECORDED IN LASTYCMD AND LASTXCMD.
THE RESULT IS STORED IN OPTXCMD 1ST PASS AND OPTYCMD 2ND
PASS. FOLLOWING THE SECOND PASS, FOR THE TRUNNION COMMAND, THE
OCDUT AND OCDUS ERROR COUNTER DRIVE BITS CHAN 14 BITS 12, 11
ARE SET. THIS PROGRAM THEN EXITS TO THE CALLING PROGRAM.

CALLING SEQUENCE

L TC RRROUT WITH RUPT INHIBITED RRROUT IS CALLED BY
RRONLY, RRONLY, AND DODES

ERASABLE INITIALIZATION REQUIRED

TANG, TANG +1 DESIRED COMMANDS, LASTYCMD, LASTXCMD
1ST PASS 0, RR ERROR COUNTER ENAGLE SET CHAN 12 BIT 2.

SUBROUTINES CALLED

MAGSUB

JOBS OR TASKS INITIATED

NONE

ALARMS NONE

EXIT L+1 ALWAYS

RRROUT	LXCH	Q	# SAVE RETURN
	CAF	ONE	# LOOP TWICE.
RRROUT2	TS	ITEMP2	
	INDEX	A	
	CA	TANG	
	TS	ITEMP1	# SAVE SIGN COMMAND FOR LIMITING.
-RRLIMIT	TC	MAGSUB	# SEE IF WITHIN LIMITS.
	DEC	-384	
	TCF	RRROUTLIM	# LIMIT COMMAND TO MAG OF 384.
SETRRCTR	CA	ITEMP1	# COUNT OUT DIFFERENCE BETWEEN DESIRED
	INDEX	ITEMP2	# STATE AND PRESENT STATE AS RECORDED IN
	XCH	LASTYCMD	# LASTYCMD AND LASTXCMD
	COM		

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ROUTINE TO ZERO THE RR CDUS AND DETERMINE THE ANTENNA MODE.

RRZERO CAF BIT11+1 # SEE IF MONITOR REPOSITION OR NOT IN AUTO
MASK RADMODES # IF SO, DON T RE-ZERO CDUS.
CCS A

TCF RADNOOP # IMMEDIATE TASK TO RGOODEND .

INHINT

CS RCDOUBIT # SET FLAG TO SHOW ZEROING IN PROGRESS.
MASK RADMODES
AD RCDOUBIT

TS RADMODES

CAF ONE
TC WAITLIST
EBANK LOSCOUNT
2CADR RRZ2

CS RADMODES # SEE IF IN AUTO MODE.
MASK AUTOMBIT

CCS A
TCF ROADBACK
TC ALARM # AUTO DISCRETE NOT PRESENT -- TRYING

ROADBACK OCT 510
RELINT
TCF SWRETURN

RRZ2 TC RRZEROSB # COMMON TO TURNON AND RRZERO.
TCF ENDRADAR

BIT11+1 OCT 02001

PROGRAM NAME RRDESSM

FUNCTIONAL DESCRIPTION

THIS INTERPRETIVE ROUTINE WILL DESIGNATE, IF DESIRED ANGLES ARE
WITHIN THE LIMITS OF EITHER MODE, TO A LINE-OF-SIGHT LOS VECTOR
HALF-UNIT KNOWN WITH RESPECT TO THE STABLE MEMBER PRESENT
ORIENTATION. INITIALLY THE IMU CDU S ARE READ AND CONTROL
TRANSFERRED TO SMNB TO TRANSFORM THE LOS VECTOR FROM STABLE
MEMBER TO NAVIGATION BASE COORDINATES SEE STG MEMO 699
RRANGLES IS THEN CALLED TO CALCULATE THE RR GIMBAL ANGLES,
TRUNNION AND SHAFT, FOR BOT THE PRESENT AND ALTERNATE MODE.
RRLIMCHK IS CALLED TO SEE IF THE ANGLES CALCULATED FOR THE
PRESENT MODE ARE WITHIN LIMITS. IF WITHIN LIMITS, THE RETUREN
LOCATION IS INCREMENTED, INASMUCH AS NO VEHICLE MANEUVER IS
REQUIRED, BEFORE EXITING TO STARTDES. IF NOT WITHIN THE LIMITS OF THE
CURRENT MODE, TRYSSW IS CALLED. FOLLOWING INVERTING OF THE RR
ANTENNA MODE FLAG RADMODES BIT 12, RRLIMCHK IS CALLED
TO SEE IF THE ANGLES CALCULATED FOR THE ALTERNATE MODE ARE WITHIN
LIMITS. IF YES, THE RR ANTENNA MODE FLAG IS AGAIN INVERTED,
THE REMODE FLAG RADMODES BIT 14 SET, AND THE RETURN LOCATION
INCREMENTED, TO INDICATE NO VEHICLE MANEUVER IS REQUIRED, BEFORE
EXITING TO STARTDES. IF THESE ANGLES ARE NOT WITHIN LIMITS
OF THE ALTERNATE MODE, THE RR ANTENNA MODE FLAG RADMODES
BIT 12 IS INVERTED BEFORE RETURNING DIRECTLY TO THE CALLING PROGRAM
TO INDICATE THAT A VEHICLE MANEUVER IS REQUIRED.

CALLING SEQUENCE

#	L	STCALL	RRTARGET	LOS HALF-UNIT VECTOR IN SM COORDINATES
#	L+1	RRDESM		
#	L+2	BASIC		VEHICLE MANEUVER REQUIRED
#	L+3	BASIC		NO VEHICLE MANEUVER REQUIRED

ERASABLE INITIALIZATION REQUIRED

RRTARGET, RADMODES

SUBROUTINES CALLED

READCDUS, SMNB, RRANGLES, RRLIMCHK, TRYSSW ACTUALLY
PART OF, RMODINV

JOBS OR TASKS INITIATED

NONE

ALARMS NONE

EXIT L+2 NEITHER SET OF ANGLES ARE WITHIN LIMITS OF RELATED MODE
STARTDES DESIGNATE POSSIBLE AT PRESENT VEHICLES ATTITUDE -- RETURNS
TO L+3 FROM STARTDES

RRDESSM	STQ	CLEAR
		DESRET

		RRNBSW	
	CALL		# COMPUTES SINES AND COSINES, ORDER Y Z X
		CDUTRIG	
	VLOAD	CALL	# LOAD VECTOR AND CALL TRANSFORMATION
		RRTARGET	
		SMNB	
	CALL		# GET RR GIMBAL ANGLES IN PRESENT AND
		RRANGLES	# ALTERNATE MODE.
	EXIT		
	INHINT		
	TC	RRLIMCHK	
	ADRES	MODEA	# CONFIGURATION FOR CURRENT MODE.
	TC	+3	# NOT IN CURRENT MODE
OKDESSM	INCR	DESRET	# INCREMENT SAYS NO VEHICLE MANEUVER REQ.
	TC	STARTDES	# SHOW DESIGNATE REQUIRED
	CS	FLAGWRD8	
	MASK	SURFFBIT	# CHECK IF ON LUNAR SURFACE SURFFLAG P22F
	EXTEND		
	BZF	NORDSTAL	# BRANCH -- YES -- CANNOT DESIGNATE IN MODE 2
	TC	TRYWS	
LUNDESCH	CS	FLAGWRD8	# OVERFLOW RETURN FROM RRANGLES
	MASK	SURFFBIT	# CHECK IF ON LUNAR SURFACE
	EXTEND		
	BZF	NORDSTAL	# BRANCH -- YES -- RETURN TO CALLER -- ALARM 527
	CA	STATE	
	MASK	RNDVZBIT	
	CCS	A	# TEST RNDVZFLG
	TC	NODESSM	# NOT ON MOON -- CALL FOR ATTITUDE MANEUVER
	TCF	ENDOFJOB	# ... BUT NOT IN R29.

PROGRAM NAME STARTDES

FUNCTIONAL DESCRIPTION

STARTDES IS ENTERED WHEN WE ARE READY TO BEGIN DESIGNATION.
BIT 14 OF RADMODES IS ALREADY SET IF A REMODE IS REQUIRED.
AT THIS TIME, THE RR ANTENNA MAY BE IN A REPOSITON
OPERATION. IN THIS CASE, IF A REMODE IS REQUIRED IT MAY HAVE
ALREADY BEGUN BUT IN ANY CASE THE REPOSITION WILL BE INTERRUPTED.
OTHERWISE, THE REPOSITION WILL BE COMPLETED BEFORE 2-AXIS
DESIGNATION BEGINS. INITIALLY DESCOUNT IS SET 60 TO INDICATE
THAT 30 SECONDS WILL BE ALLOWED FOR THE RR DATA GOOD INBIT
CHAN 33 BIT 4 IF LOCK-ON IS DESIRED STATE BIT 5 . BIT 10
OF RADMODES IS SET TO SHOW THAT A DESIGNATE IS REQUIRED.
THE REPOSITON FLAG RADMODES BIT 11 IS CHECKED. IF SET,
THE PROGRAM EXITS TO L+3 OF THE CALLING PROGRAM SEE RRDESSM
AND RRDESNB . THE PROGRAM WILL BEGIN DESIGNATING TO THE DESIRED
ANGLES FOLLOWING THE REPOSITON OR REMODE IF ONE WAS
REQUESTED. IF THE REPOSITON FLAG IS NOT SET, SETRRECR IS CALLED
WITH SETS THE RR ERROR COUNTER ENABLE BIT CHAN 12 BIT 2
AND SETS LASTYCMD AND LASTXCMD 0 TO INDICATE THE
DIFFERENCE BETWEEN THE PRESENT AND DESIRED STATE OF THE ERROR
COUNTERS. A 20 MILLISECOND WAITLIST CALL IS SET FOR BEGDES
AFTER WHICH THE PROGRAM EXITS TO L+3 OF THE CALLING PROGRAM.

CALLING SEQUENCE

FROM RRDESSM AND RRDESNB WHEN ANGLES WITHIN LIMITS.

ERASABLE INITIALIZATION REQUIRED

RADMODES, SEE DODES

SUBROUTINES CALLED

SETRRECR, WAITLIST

JOBS OR TASKS INITIATED

BEGDES

ALARMS NONE

EXIT L+3 OF CALLING PROGRAM SEE RRDESSM

L+2 OF CALLING PROGRAM SEE RRDESNB

STARTDES	INCR	DESRET	
	CS	RADMODES	
	MASK	DESIGBIT	
	ADS	RADMODES	
	MASK	REPOSBIT	# SEE IF REPOSITIONING IN PROGRESS.
	CCS	A	
	TCF	DESRETRN	# ECTR ALREADY SET UP.
	TC	SETRRECR	# SET UP ERROR COUNTERS.

1					1
2		CAF	TWO		2
3		TC	WAITLIST		3
4		EBANK	LOSCOUNT		4
5		2CADR	BEGDES		5
6					6
7	DESRETRN	CA	RADCADR	# FIRST PASS THRU DESIGNATE	7
8		EXTEND			8
9		BZF	DESRTN	# YES SET EXIT	9
10		TC	ENDOFJOB	# NO	10
11	DESRTN	RELINT			11
12		INCR	DESRET		12
13		CA	DESRET		13
14		TCF	BANKJUMP		14
15					15
16	NORDSTAL	CAF	ZERO	# ZERO RADCADR TO WIPE OUT ANYONE	16
17		TS	RADCADR	# WAITING IN RADSTALL SINCE WE ARE NOW	17
18		TCF	DESRTN	# RETURNING TO P20 AND MAY DO NEW RADSTALL	18
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SEE IF RRDESSM CAN BE ACCOMPLISHED AFTER A REMODE.

TRYAWS	TC	RMODINV	# NOTE RUPT INHIBIT
	TC	RRLIMCHK	# TRY DIFFERENT MODE.
	ADRES	MODEB	
	TCF	NODESSM	# VEHICLE MANEUVER REQUIRED
	TC	RMODINV	# RESET BIT12
	CAF	REMODBIT	# SET FLAG FOR REMODE.
	ADS	RADMODES	
	TCF	OKDESSM	
NODESSM	TC	RMODINV	# RE-INVERT MODE AND RETURN
	INCR	DESRET	# TO CALLER +2
	TCF	NORDSTAL	
MAXTRY5	DEC	60	

DESIGNATE TO SPECIFIC RR GIMBAL ANGLES INDEPENDENT OF VEHICLE MOTION . ENTER WITH DESIRED ANGLES IN
TANG AND TANG +1.

RRDESNB	TC	MAKECADR	
	TS	DESRET	
	TC	DOWNFLAG	# RESET FLAG TO PREVENT DODES FROM GOING
	ADRES	LOSCMFLG	# BACK TO R21
	CA	MAXTRYS	# SET TIME LIMIT COUNTER
	TS	DESCOUNT	# FOR DESIGNATE
	INHINT		# SEE IF CURRENT MODE OK.
	TC	RRLIMNB	# DO SPECIAL V41 LIMIT CHECK
	ADRES	TANG	
	TCF	TRYSWN	# SEE IF IN OTHER MODE.

OKDESNB	RELINT		
	EXTEND		
	DCA	TANG	
	DXCH	TANGNB	
	TC	INTPRET	
	CALL		# GET LOS IN NB COORDS.
		RRNB	
	STORE	RRTARGET	
	SET	EXIT	
		RRNBSW	

	INHINT		
TRYSWN	TCF	STARTDES +1	
	TC	RMODINV	# SEE IF OTHER MODE WILL DO.
	TC	RRLIMNB	# DO SPECIAL V41 LIMIT CHECK
	ADRES	TANG	
	TCF	NODESNB	# NOT POSSIBLE.
	TC	RMODINV	
	CAF	REMODBIT	# CALL FOR REMODE.
	ADS	RADMODES	
	TCF	OKDESNB	

NODESNB	TC	RMODINV	# REINVERT MODE BIT.
	TC	ALARM	# BAD INPUT ANGLES.
	OCT	502	
	TC	CLRADMOD	
	TC	ENDOFJOB	# AVOID 503 ALARM.

RRLIMNB	INDEX	Q	# THIS ROUTINE IS IDENTICAL TO RRLIMCHK
	CAF	0	# EXCEPT THAT THE MODE 1 SHAFT LOWER
	INCR	Q	# LIMIT IS -85 INSTEAD OF -70 DEGREES
	EXTEND		

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PROGRAM NAME BEGDES

FUNCTIONAL DESCRIPTION

BEGDES CHECKS VARIOUS DESIGNATE REQUESTS AND REQUESTS THE
ACTUAL RR DESIGNATION. INITIALLY A CHECK IS MADE TO SEE IF A
REMODE RADMODES BIT 14 IS REQUESTED OR IN PROGRESS. IF SO,
CONTROL IS TRANSFERRED TO STDESIG AFTER ROUTINE REMODE IS
EXECUTED. IF NO REMODE, STDESIG IS IMMEDIATELY CALLED WHERE
FIRST THE REPOSITION FLAG RADMODES BIT 11 IS CHECKED. IF
PRESENT, THE DESIGNATE FLAG RADMODES BIT 10 IS REMOVED
AFTER WHICH THE PROGRAM EXITS TO RDBADEND. IF THE REPOSITION
FLAG IS NOT PRESET, THE CONTINUOUS DESIGNATE FLAG RADMODES
BIT 15 IS CHECKED. IF PRESENT, AN EXECUTIVE CALL IS IMMEDIATELY
MADE FOR DODES AFTER WHICH A .5 SECOND WAIT IS INITIATED BEFORE
REPEATING AT STDESIG. IF THE RR SEARCH ROUTINE LRS24.1 IS DESIGNATING
TO A NEW POINT NEWPTFLG SET THE CURRENT DESIGNATE TASK IS TERMINATED.
IF CONTINUOUS DESIGNATE IS NOT WANTED, THE DESIGNATE FLAG RADMODES
BIT 10 IS CHECKED. IF NOT PRESENT, THE PROGRAM EXITS TO ENDRADAR TO
CHECK RR CDU FAIL BEFORE RETURNING TO THE CALLING PROGRAM. IF DESIGNATE
IS STILL REQUIRED, DESCOUNT IS CHECKED TO SEE IF THE 30 SECONDS HAS
EXPIRED BEFORE RECEIVING THE RR DATA GOOD CHAN 33 BIT 4
SIGNAL. IF OUT OF TIME, PROGRAM ALARM 00503 IS REQUESTED, THE
RR AUTO TRACKER ENABLE AND RR ERROR COUNTER ENABLE
CHAN 12 BITS 14,2 BITS REMOVED, AND THE DESIGNATE FLAG
RADMODES BIT 10 REMOVED BEFORE EXITING TO RDBADEND. IF
TIME HAS NOT EXPIRED, DESCOUNT IS DECREMENTED, THE
EXECUTIVE CALL MADE FOR DODES, AND A .5 SECOND WAIT INITIATED
BEFORE REPEATING THIS PROCEDURE AT STDESIG.

CALLING SEQUENCE

WAITLIST CALL FROM STARTDES
TCF BEGDES FROM DORREPOS
TC STDESIG RETURNING, FROM REMODE

ERASABLE INITIALIZATION REQUIRED

DESCOUNT, FINDVAC

JOBS OR TASKS INITIATED DODES

ALARMS PROGRAM ALARM 00503 30 SECONDS HAVE EXPIRED WITH NO RR DATA
GOOD CHAN 33 BIT 4 RECEIVED WHEN LOCK-ON STATE BIT 5 WAS REQUESTED.

EXIT TASKOVER SEARCH PATTERN DESIGNATING TO NEW POINT
ENDRADAR NO DESIGNATE -- RADMODES BIT 10
RDBADEND REPOSITION OR 30 SECONDS EXPIRED

BEGDES CS RADMODES

	MASK	REMODBIT	
	CCS	A	
	TC	STDESIG	
	TC	REMODE	
DESLOOP	TC	FIXDELAY	# 2 SAMPLES PER SECOND.
	DEC	50	
STDESIG	CAF	REPOSBIT	
	MASK	RADMODES	# SEE IF GIMBAL LIMIT MONITOR HAS FOUND US
	CCS	A	# OUT OF BOUNDS. IF SO, THIS BIT SHOWS A
	TCF	BADDES	# REPOSITION TO BE IN PROGRESS.
	CCS	RADMODES	# SEE IF CONTINUOUS DESIGNATE WANTED.
	TCF	+3	# IF SO, DON T CHECK BIT 10 TO SEE IF IN
	TCF	+2	# LIMITS BUT GO RIGHT TO FINDVAC ENTRY.
	TCF	MOREDES +1	
	CS	RADMODES	# IF NON-CONTINUOUS, SEE IF END OF
	MASK	DESIGBIT	# PROBLEM DATA GOOD IF LOCK-ON WANTED OR
	CCS	A	# WITHIN LIMITS IF NOT . IF SO, EXIT AFTER
	TCF	ENDRADAR	# CHECKING RR CDU FAIL.
STDESIG1	CCS	DESCOUNT	# SEE IF THE TIME LIMIT HAS EXPIRED
	TCF	MOREDES	
	CS	B14+B2	# IF OUT OF TIME, REMOVE ECR ENABLE + TRKR
	EXTEND		
	WAND	CHAN12	
BADDES	CS	DESIGBIT	# REMOVE DESIGNATE FLAG
	MASK	RADMODES	
	TS	RADMODES	
	TCF	RDBADEND	
MOREDES	TS	DESCOUNT	
	CAF	PRI026	# UPDATE GYRO TORQUE COMMANDS.
	TC	FINDVAC	
	EBANK	LOSCOUNT	
	2CADR	DODES	
	TCF	DESLOOP	
B14+B2	OCT	20002	

PROGRAM NAME DODES

FUNCTIONAL DESCRIPTION

DODES CALCULATES AND REQUESTS ISSUANCE OF RR GYRO TORQUE
COMMANDS. INITIALLY THE CURRENT RR CDU ANGLES ARE STORED AND
THE LOS HALF-UNIT VECTOR TRANSFORMED FROM STABLE MEMBER TO
NAVIGATION BASE COORDINATES VIA SMNB IF NECESSARY. THE
SHAFT AND TRUNNION COMMANDS ARE THEN CALCULATED AS FOLLOWS
+ SHAFT LOS . COS S , 0, -SIN S DOT PRODUCT
- TRUNNION LOS . SIN T SIN S , COS T , SIN T COS S
THE SIGN OF THE SHAFT COMMAND IS THEN REVERSED IF IN MODE 2
RADMODES BIT 12 BECAUSE A RELAY IN THE RR REVERSES THE
POLARITY OF THE COMMAND. AT RRSCALUP EACH COMMAND IS
SCALED AND IF EITHER, OR BOTH, OF THE COMMANDS IS GREATER THAN
.5 DEGREES, MPAC +1 IS SET POSITIVE. IF A CONTINUOUS DESIGNATE
RADMODES BIT 15 IS DESIRED AND THE SEARCH ROUTINE IS NOT OPERATING,
THE RR AUTO TRACKER ENABLE BIT CHAN 12 BIT 14 IS CLEARED AND RRROUT
CALLED TO PUT OUT THE COMMANDS PROVIDED NO REPOSITION RADMODES BIT 11
IS IN PROGRESS. IF A CONTINUOUS DESIGNATE AND THE SEARCH ROUTINE IS
OPERATING SRCHOPT FLAT SET THE TRACK ENABLE IS NOT CLEARED. IF NO
CONTINUOUS DESIGNATE AND BOTH COMMANDS ARE NOT LESS THAN .5 DEGREES AS
INDICATED BY MPAC +1, THE RR AUTO TRACKER ENABLE BIT CHAN 12 BIT 14 IS
CLEARED AND RRROUT CALLED TO PUT OUT THE COMMANDS PROVIDED NO REPOSITION
RADMODES BIT 11 IS IN PROGRESS. IF BOTH COMMANDS ARE LESS THAN .5
DEGREES AS INDICATED BY MPAC+1, THE RR AUTO TRACKER ENABLE BIT
CHAN 12 BIT 14 IS CLEARED AND RRROUT CALLED TO PUT OUT THE
COMMANDS PROVIDED NO REPOSITION RADMODES BIT 11 IS IN
PROGRESS. IF BOTH COMMANDS ARE LESS THAN .5 DEGREES, THE
LOCK-ON FLAG STATE BIT 5 IS CHECKED. IF NOT PRESETN, THE
DESIGNATE FLAG RADMODES BIT 10 IS CLEARED, AND ENDOFJOB
CALLED. IF LOCK-ON IS DESIRED, THE RR AUTO TRACKER CHAN 12
BIT 14 IS ENABLED FOLLOWED BY A CHECK OF THE RECEIPT OF THE
RR DATA GOOD CHAN 33 BIT 4 SIGNAL. IF RR DATA GOOD
PRESENT, THE DESIGNATE FLAG RADMODES BIT 10 IS CLEARED,
THE RR ERROR COUNTER ENABLE BIT CHAN 12 BIT 2 IS CLEARED,
AND ENDOFJOB CALLED. IF RR DATA GOOD IS NOT PRESENT, RRROUT
IS CALLED TO PUT OUT THE COMMANDS PROVIDED NO REPOSITION
RADMODES BIT 11 IS IN PROGRESS AFTER WHICH THE JOB IS TERMINATED
VIA ENDOFJOB.

CALLING SEQUENCE

EXECUTIVE CALL EVERY .5 SECONDS FROM BEGDES.

ERASABLE INITIALIZATION REQUIRED

RRTARGET HALF-UNIT LOS VECTOR IN EITHER SM OR NB COORDINATES ,
LOKONSW STATE BIT 5 , RRNSW STATE BIT 6 , RADMODES

SUBROUTINES CALLED

READCDUS, SMNB, CDULOGIC, MAGSUB, RRROUT

JOBS OR TASKS INITIATED

NONE

ALARMS NONE

EXIT ENDOFJOB ALWAYS

DODES EXTEND

DCA CDUT

DXCH TANG

TC INTPRET

SETPD VLOAD

0

BON RRTARGET

VXSC

RRNBSW

DONBRD

TARGET IN NAV-BASE COORDINATES

MLOSV

MULTIPLY UNIT LOS BY MAGNITUDE

VSL1 PDVL

LOSVEL

VXSC

ADD ONE SECOND RELATIVE VELOCITY TO LOS

VAD

MCTOMS

UNIT CALL

CDUTRIG

CALL

SMNB

DONBRD STODL

32D

RTB TANG +1

SHAFT COMMAND V 32D . COS S , 0,

PUSH

-SIN S .

CDULOGIC

SIN PDDL

SIN S TO 0 AND COS S TO 2.

COS PUSH

DMP PDDL

32D

36D

DMP BDSU

0

STADR

STORE TANG +1

SHAFT COMMAND

SLOAD

RTB

TANG

PUSH CDULOGIC

COS T TO 4.

PDDL

SIN

SIN T TO 6.

PUSH DMP

2

SL1	PDDL	# DEFINE VECTOR U	SIN T SIN S
	4	#	COS T
PDDL	DMP	#	SIN T COS S
	6		
	0		
SL1	VDEF		
DOT	EXIT	# DOT U WITH LOS TO GET TRUNNION COMMAND.	
	32D		

AT THIS POINT WE HAVE A ROTATION VECTOR IN DISH AXES LYING IN THE TS PLANE. CONVERT THIS TO A
COMMANDED RATE AND ENABLE THE TRACKER IF WE ARE WITHIN .5 DEGREES OF THE TARGET.

	CS	MPAC	# DOT WAS NEGATIVE OF DESREG ANGLE.
	EXTEND		
	MP	RDESGAIN	# SCALING ON INPUT ANGLE WAS 4 RADIANS.
	TS	TANG	# TRUNNION COMMAND.
	CS	RADMODES	# A RELAY IN THE RR REVERSES POLARITY OF
	MASK	BIT12	# THE SHAFT COMMANDS IN MODE 2 SO THAT A
	EXTEND		# POSITIVE TORQUE APPLIED TO THE SHAFT
	BZF	+3	# GYRO CAUSES A POSITIVE CHANGE IN THE
	CA	TANG +1	# SHAFT ANGLE. COMPENSATE FOR THIS SWITCH
	TCF	+2	# BY CHANGING THE POLARITY OF OUR COMMAND.
+3	CS	TANG +1	
	EXTEND		
	MP	RDESGAIN	# SCALING ON INPUT ANGLE WAS 4 RADIANS.
	TS	TANG +1	# SHAFT COMMAND FOR RR OUT
	TC	INTPRET	
	DLOAD	DMP	
		2	# COS S .
		4	# COS T .
	SL1	PDDL	# Z COMPONENT OF URR.
	DCOMP	PDDL	# Y COMPONENT -SIN T
		0	# SIN S .
	DMP	SL1	
		4	# COS T .
	VDEF	BON	# FORM URR IN NB AXES.
		RRNBSW	# BYPASS NBSM CONVERSION IN VERB 41
		+3	
	CALL		
		NBSM	# GET URR IN SM AXES.
	DOT	EXIT	
		RRTARGET	# GET COSIN OF ANGLE BETWEEN RR AND LOS
	EXTEND		
	DCS	COS1/2DG	
	DAS	MPAC	# DIFFERENCE OF COSINES, SCALED B-2.
	CCS	MPAC	
	CA	ZERO	# IF COS ERROR BIGGER, ERROR IS SMALLER
	TCF	+2	
	CA	ONE	
	TS	MPAC +1	# ZERO IF RR IS POINTED OK, ONE IF NOT.

SEE IF TRACKER SHOULD BE ENABLED OR DISABLED.

	CCS	RADMODES	# IF CONTINUOUS DESIGNATE WANTED, PUT OUT
	TCF	SIGNLCHK	# COMMANDS WITHOUT CHECKING MAGNITUDE OF
	TCF	SIGNLCHK	# ERROR SIGNALS

SIGNLCHK	TCF	DORROUT	
	CCS	MPAC +1	# SEE IF BOTH AXES WERE WITHIN .5 DEGS.
	TCF	DGOODCHK	

	CS	STATE	# IF WITHIN LIMITS AND NO LOCK-ON WANTED,
	MASK	LOKONBIT	# PROBLEM IS FINISHED.

	CCS	A	
	TCF	RRDESDUN	

	CAF	BIT14	# ENABLE THE TRACKER
--	-----	-------	----------------------

	EXTEND		
	WOR	CHAN12	

DGOODCHK	CAF	BIT4	# SEE IF DATA GOOD RECEIVED YET
	EXTEND		
	RAND	CHAN33	

	CCS	A	
	TCF	DORROUT	

RRDESDUN	CS	BIT10	# WHEN PROBLEM DONE, REMOVE BIT 10 SO NEXT
	MASK	RADMODES	# WAITLIST TASK WE WILL GO TO RGOODEND.
	INHINT		

	TS	RADMODES	
--	----	----------	--

	TC	DOWNFLAG	# RESET LOSCMFLG TO PREENT A
	ADRES	LOSCMFLG	# RECOMPUTATION OF LOS AFTER DATA GOOD
	CS	BIT2	# TURN OFF ENABLE RR ERROR COUNTER

	EXTEND		
	WAND	CHAN12	
	TCF	ENDOFJOB	# WITH ECTR DISABLED.

DORROUT	CA	FLAGWRD2	# IF BOTH LOSCMFLAG AND SEARCH FLAG ARE
	MASK	BIT12,14	# ZERO, BYPASS VELOCITY ADJUSTMENT TO LOS
	EXTEND		

	BZF	NOTP20	
	TC	INTPRET	
	VLOAD	VXSC	# MULTIPLY UNIT LOS BY MAGNITUDE

		RRTARGET	
		MLOSV	

	VSL1	PUSH	
	VLOAD	VXSC	# ADD .5 SEC. OF VELOCITY
		LOSVEL	# TO LOS VECTOR

		MCTOMS	
	VSR1	VAD	

	UNIT		
	STODL	RRTARGET	# STORE VELOCITY-CORRECTED LOS UNIT

	STORE	36D MLOSV	# AND STORE MAGNITUDE
NOTP20	EXIT INHINT CS	RADMODES	# PUT OUT COMMAND UNLESS MONITOR
	MASK CCS TC	REPOSBIT A RROUT	# REPOSITION HAS TAKEN OVER
	CA MASK	FLAGWRD2 LOSCMBIT	# IF LOSCMFLG NOT SET, DON T TEST
	EXTEND BZF	ENDOFJOB	# LOS COUNTER
	CCS TC	LOSCOUNT DODESEND	# TEST LOS COUNTER TO SEE IF TIME TO GET # A NEW LOS
	INHINT TC	KILLTASK	# YES -- KILL TASK WHICH SCHEDULES DODES
	CADR RELINT CCS	DESLOOP +2 NEWJOB	
	TC TC CADR	CHANG1 BANKCALL R21LEM2	
DODESEND	TS TC	LOSCOUNT ENDOFJOB	
RDESGAIN	DEC	.53624	# TRIES TO NULL .5 ERROR IN .5 SEC.
BIT12,14	EQUALS	PRI024	# OCT 24000
COS1/2DG	2DEC	.999961923 B-2	# COSINE OF 0.5 DEGREES.
MCTOMS	2DEC	100 B-13	

RADAR READ INITIALIZATION

#

RADAR DATA READ BY A BANKCALL FOR THE APPROPRIATE LEAD-IN BELOW.

LRALT TC INITREAD -1 # ONE SAMPLE PER READING.

ALLREAD OCT 17

LRVELZ TC INITREAD

OCT 16

LRVELY TC INITREAD

OCT 15

LRVELX TC INITREAD

OCT 14

RRRDOT TC INITREAD -1

OCT 12

RRRRANGE TC INITREAD -1

OCT 11

LRVEL IS THE ENTRY TO THE LR VELOCITY READ ROUTINE WHEN 5 SAMPLES ARE

WANTED. ENTER WITH C A 0,2,4 FOR LRVELZ,LRVELY,LRVELX RESP.

LRVEL TS TIMEHOLD # STORE VBEAM INDEX HERE MOMENTARILY

CAF FIVE # SPECIFY FIVE SAMPLES

INDEX TIMEHOLD

TCF LRVELZ

-1 INITREAD	CAF INHINT	ONE	# ENTRY TO TAKE ONLY 1 SAMPLE
	TS EXTEND	TIMEHOLD	# GET DT OF MIDPOINT OF NOMINAL SAMPLING # INTERVAL ASSUMES NO BAD SAMPLES WILL BE # ENCOUNTERED .
	MP DXCH	BIT3 TIMEHOLD	
	CCS TS AD	A NSAMP ONE	
# #	# INSERT FOLLOWING INSTRUCTION TO GET 2N TRIES FOR N SAMPLES. DOUBLE TS SAMPLIM		
	CAF EXTEND	DGBITS	# READ CURRENT VALUE OF DATA GOOD BITS.
	RAND TS	CHAN33 OLDATAGD	
	CS EXTEND WAND	ALLREAD CHAN13	# REMOVE ALL RADAR BITS
	INDEX CAF	Q 0	
	EXTEND WOR	CHAN13	# SET NEW RADAR BITS
	EXTEND DCA DAS	TIME2 TIMEHOLD	# TIME OF NOMINAL MIDPOINT
	CAF TS DXCH TCF	ZERO L SAMPLSUM ROADBACK	
DGBITS	OCT	230	

RADAR RUPT READER

#

THIS ROUTINE STARTS FROM A RADARUPT. IT READS THE DATA LOTS MORE.

SETLOC RADARUPT
BANK

COUNT* \$\$/RRUPT

RADAREAD EXTEND # MUST SAVE SBANK BECAUSE OF RUPT EXITS
ROR SUPERBNK # VIA TASKOVER BADEND OR GOODEND .
TS BANKRUPTEXTEND
QXCH QRUPT

CAF SEVEN

EXTEND

RAND CHAN13

TS DNINDEX

EXTEND # IF RADAR SELECT BITS ZERO, DO NOT STORE
BZF TRYCOUNT # DATA FOR DOWNLIST ERASABLE PROBLEMS

CA RNRAD

INDEX DNINDEX

TS DNRRANGE -1

TRYCOUNT CCS SAMPLIM

TCF PLENTY

TCF NOMORE

TC ALARM

OCT 520

TC RESUME

NOMORE CA FLGWRD11 # IS LRBYPASS SET

MASK LRBYBIT

EXTEND

BZF BADRAD # NO. R12 IS ON -- BYPASS 521 ALARM.

CS FLAGWRD3

MASK R04FLBIT

EXTEND

BZF BADRAD

TC ALARM # P20 WANTS THE ALARM.

OCT 521

BADRAD CS ONE

TS SAMPLIM

PLENTY TC RDBADEND -2

TS SAMPLIM

CAF BIT3

EXTEND

RAND CHAN13

EXTEND # TO FIND OUT WHICH RADAR

	BZF	RENDRAD	
LRPOSCHK	TC	R77CHECK	# R77 QUILTS HERE.
	CA	RADMODES	# SEE IF LR IN DESIRED POSITION
	EXTEND		
	RXOR	CHAN33	
	MASK	BIT6	
	EXTEND		
	BZF	VELCHK	
	TC	ALARM	
	OCT	522	
	TC	BADRAD	
VELCHK	CAF	BIN3	# 00003 OCT
	EXTEND		
	RXOR	CHAN13	# RESET ACTIVITY BIT
	MASK	BIN3	
	EXTEND		
	BZF	LRHEIGHT	# TAKE A LR RANGE READING
	CAF	POSMAX	
	MASK	RNRAD	
	AD	LVELBIAS	
	TS	L	
	CAE	RNRAD	
	DOUBLE		
	MASK	BIT1	
	DXCH	ITEMP3	
	CAF	BIT8	# DATA GOOD ISN T CHECKED UNTIL AFTER READ-
	TC	DGCHECK	# ING DATA SO SOME RADAR TESTS WILL WORK
			# INDEPENDENT OF DATA GOOD.
	CCS	NSAMP	
GOODRAD	TC	NOEND	
	CS	ONE	
	TS	SAMPLIM	
	CS	ITEMP1	# WHEN ENOUGH GOOD DATA HAS BEEN GATHERED,
	MASK	RADMODES	# RESET DATA FAIL FLAGS FOR SETTRKF.
	TS	RADMODES	
	TC	RADLITES	# LAMPS MAY GO OFF IF DATA JUST GOOD.
	TC	RGOODEND -2	
NOEND	TS	NSAMP	
RESAMPLE	CCS	SAMPLIM	# SEE IF ANY MORE TRIES SHOULD BE MADE.
	TCF	+2	
	TCF	DATAFAIL	# N SAMPLES NOT AVAILABLE.
	CAF	BIT4	# RESET ACTIVITY BIT.
	EXTEND		

	WOR TC	CHAN13 RESUME	# RESET ACTIVITY BIT
LRHEIGHT	CAF TS	BIT5 ITEMP1	# POSITION OF DATA GOOD BIT IN CHAN 33
	CAF TC	BIT9 SCALECHK -1	
RENDRAD	CAF MASK CCS TCF	REPOSBIT RADMODES A BADRAD	# MAKE SURE ANTENNA HAS NOT GONE OUT OF # LIMITS.
	CS MASK CCS TCF	RADMODES RCDUFBIT A BADRAD	# BE SURE RR CDU HASN T FAILED.
	CAF TS	BIT4 ITEMP1	# SEE IF DATA HAS BEEN GOOD. # POSITION OF DATA GOOD BIT IN CHAN 33
	CAF EXTEND RAND	BIT1 CHAN13	# SEE IF RR RDOT.
	TS CCS TCF	Q A +2	# FOR LATER TESTING.
	TCF CAF TS	RADIN BIT3 L	# NO SCALE CHECK FOR RR RDOT.
SCALECHK	EXTEND RAND	CHAN33	# SCALE STATUS NOW
	XCH MASK EXTEND	L RADMODES	# SCALE STATUS BEFORE
	RXOR CCS TC	LCHAN A SCALCHNG	# SEE IF THEY DIFFER # THEY DIFFER.
RADIN	CAF MASK TS	POSMAX RNRAD ITEMP4	
	CAE DOUBLE MASK TS	RNRAD BIT1 ITEMP3	

	CCS	Q	# SEE IF RR RDOT.
	TCF	SCALADJ	# NO, BUT SCALE CHANGING MAY BE NEEDED.
	EXTEND		# IF RR RANGE RATE, THROW OUT BIAS
	DCS	RDOTBIAS	
DASAMPL	DAS	ITEMP3	
DGCHECK2	CA	ITEMP1	# SEE THAT DATA HAS BEEN GOOD BEFORE AND
	TC	DGCHECK +1	# AFTER TAKING SAMPLE.
	TC	GOODRAD	
SCALCHNG	LXCH	RADMODES	
	AD	BIT1	
	EXTEND		
	RXOR	LCHAN	
	TS	RADMODES	
	CAF	DGBITS	# UPDATE LAST VALUE OF DATA GOOD BITS.
	EXTEND		
	RAND	CHAN33	
	TS	OLDATAGD	
	TC	UPFLAG	# SET RNGSCFLG
	ADRES	RNGSCFLG	# FOR LRS24.1
	TCF	BADRAD	
# R77 MUST IGNORE DATA FAILS SO AS NOT TO DISTURB THE ASTRONAUT.			
R77CHECK	CS	FLAGWRD5	
	MASK	R77FLBIT	
	CCS	A	
	TC	Q	# NOT R77
	CS	BITS5,8	# UPDATE LR DATA GOOD BITS IN RADMODES
	MASK	RADMODES	
	TS	L	
	CA	BITS5,8	
	EXTEND		
	RAND	CHAN33	
	AD	L	
	TS	RADMODES	
	TC	RGOODEND -2	
BITS5,8	OCT	220	

THE FOLLOWING ROUTINE INCORPORATES RR RANGE AND LR ALT SCALE INFORMATION AND LEAVES DATA AT LO SCALE.

SCALADJ	CCS	L	# L HAS SCALE INBIT FOR THIS RADAR.
	TCF	+2	# ON HIGH SCALE.
	TCF	DGCHECK2	
	CA	DNINDEX	
	MASK	BIT3	
	CCS	A	
	TCF	LRCK	
	DXCH	ITEMP3	
	DDOUBL		
	DDOUBL		
	DDOUBL		
	DXCH	ITEMP3	
	TCF	DGCHECK2	
LRCK	CCS	ITEMP3	
	TCF	+11	
	CS	ITEMP4	
	AD	HISCALIM	
	EXTEND		
	BZMF	+5	
	CS	FLGWRD11	
	MASK	SCABBIT	
	ADS	FLGWRD11	
	TCF	+4	
	CS	SCABBIT	
	MASK	FLGWRD11	
	TS	FLGWRD11	
	EXTEND		
	DCA	ITEMP3	
	DDOUBL		
	DDOUBL		
	TCF	DASAMPL	
HISCALIM	DEC	460	# 2481.7 FT *****

1					1
2	DGCHECK	TS	ITEMP1	# UPDATE DATA GOOD BIT IN OLDDATAGD AND	2
3		EXTEND		# MAKE SURE IT WAS ON BEFORE AND AFTER THE	3
4		RAND	CHAN33	# SAMPLE WAS TAKEN BEFORE RETURNING. IF	4
5		TS	L	# NOT, GOES TO RESAMPLE TO TRY AGAIN. IF	5
6		CS	ITEMP1	# MAX NUMBER OF TRIES HAS BEEN REACHED,	6
7		MASK	OLDDATAGD	# THE BIT CORRESPONDING TO THE DATA GOOD	7
8		AD	L	# WHICH FAILED TO APPEAR IS IN ITEMP1 AND	8
9		XCH	OLDDATAGD	# CAN BE USED TO SET RADMODES WHICH VIA	9
10		MASK	ITEMP1	# SETTRKF SETS THE TRACKER FAIL LAMP.	10
11		AD	L		11
12		CCS	A	# SHOULD BOTH BE ZERO.	12
13		TC	RESAMPLE		13
14		DXCH	ITEMP3	# IF DATA GOOD BEFORE AND AFTER, ADD TO	14
15		DAS	SAMPLSUM	# ACCUMULATION.	15
16		TC	Q		16
17					17
18	DATAFAIL	CS	ITEMP1	# IN THE ABOVE CASE, SET RADMODES BIT	18
19		MASK	RADMODES	# SHOWING SOME RADAR DATA FAILED.	19
20		AD	ITEMP1		20
21		TS	RADMODES		21
22					22
23		DXCH	ITEMP3	# IF WE HAVE BEEN UNABLE TO GATHER N	23
24		DXCH	SAMPLSUM	# SAMPLES, USE LAST ONE ONLY.	24
25		TC	RADLITES		25
26		TCF	NOMORE		26
27					27
28					28
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57					57
58					58
59					59
60					60

THIS ROUTINE CHANGES THE LR POSITION, AND CHECKS THAT IT GOT THERE.

SETLOC P20S1
BANK

LRPOS2

COUNT* \$\$/RSUB
INHINT

CS RADMODES
MASK LRPOSBIT # SHOW DESIRED LR POSITION IS 2
ADS RADMODES

CAF BIT7
EXTEND

RAND CHAN33 # SEE IF ALREADY THERE.
EXTEND
BZF RADNOOP

CAF BIT13
EXTEND

WOR CHAN12 # COMMAND TO POSITION 2
CAF 6SECS # START SCANNING FOR INBIT AFTER 7 SECS.
TC WAITLIST

EBANK LOSCOUNT
2CADR LRPOSCAN

TC ROADBACK

LRPOSNXT

TS SAMPLIM
TC FIXDELAY # SCAN ONCE PER SECOND 15 TIMES MAX AFTER
DEC 100 # INITIAL DELAY OF 7 SECONDS.

CAF BIT7 # SEE IF LR POS2 IS ON
EXTEND
RAND CHAN33

EXTEND
BZF LASTLRDT # IF THERE, WAIT FINAL SECOND FOR BOUNCE.

CCS SAMPLIM # SEE IF MAX TIME UP.
TCF LRPOSNXT

CS BIT13 # IF TIME UP, DISABLE COMMAND AND ALARM.
EXTEND
WAND CHAN12
TCF RDBADEND

RADNOOP

CAF ONE # NO FURTHER ACTION REQUESTED.
TC WAITLIST
EBANK LOSCOUNT
2CADR RGOODEND

1					1
2		TC	ROADBACK		2
3					3
4	LASTLRDT	CA	2SECS	# WAIT TWO SECONDS AFTER RECEIPT OF INBIT	4
5		TC	VARDELAY	# TO WAIT FOR ANTENNA BOUNCE TO DIE OUT.	5
6					6
7		CS	BIT13	# REMOVE COMMAND	7
8		EXTEND			8
9		WAND	CHAN12		9
10		TCF	RGOODEND		10
11					11
12	LRPOSCAN	CAF	FOURTEEN	# SET UP FOR 15 SAMPLES.	12
13		TCF	LRPOSNXT		13
14	6SECS	DEC	600		14
15					15
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60					60

SEQUENCES TO TERMINATE RR OPERATIONS.

ENDRADAR	CAF	RCDUFBIT	# PROLOG TO CHECK RR CDU FAIL BEFORE END.
	MASK	RADMODES	
	CCS	A	

	TCF	RGOODEND	
	TCF	RDBADEND	
-2	CS	ZERO	# RGOODEND WHEN NOT UNDER WAITLIST CONTROL
	TS	RUPTAGN	

RGOODEND	CAF	TWO	
	TC	POSTJUMP	
	CADR	GOODEND	

-2	CS	ZERO	# RDBADEND WHEN NOT UNDER WIATLIST.
	TS	RUPTAGN	
RDBADEND	CAF	TWO	
	TC	POSTJUMP	
	CADR	BADEND	

BIN3	EQUALS	THREE	
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```
# PROGRAM NAME      LPS20.1 VECTOR EXTRAPOLATION AND LOS COMPUTATION
# MOD. NO. 2        BY J.D. COYNE   SDC      DATE 12-7-66

#
# FUNCTIONAL DESCRIPTION
#      1      EXTRAPOLATE THE LEM AND CSM VECTORS IN ACCORDANCE WITH THE TIME REFERRED TO IN CALLER + 1.
#      2      COMPUTES THE LOS VECTOR TO THE CSM, CONVERTS IT TO STABLE MEMBER COORDINATES AND STORES IT IN RRTARGET.
#      3      COMPUTES THE MAGNITUDE OF TEH LOS VECTOR AND STORES IT IN MLOSV

# CALLING SEQUENCE      CALL
#                        LPS20.1

# SUBROUTINES CALLED
#      LEMPREC, CSMPREC

# NORMAL EXIT      RETURN TO CALLER + 2.

# ERROR EXITS      NONE

# ALARMS      NONE

# OUTPUT
#      LOS VECTOR  HALF UNIT  IN SM COORDINATES STORED IN RRTARGET
#      MAGNITUDE OF TEH LOS VECTOR  METERS SCALED B-29  STORED IN MSLOV
#      RRNBSW CLEARED.

# INITIALIZED ERASABLE
#      TDEC1 MUST CONTAIN THE TIME FOR EXTRAPOLATION
#      SEE ORBITAL INTEGRATION ROUTINE

# DEBRIS
#      MPAC DESTROYED BY THE ROUTINE
```

```
BANK      23
SETLOC    P20S
BANK
```


[illegible]