

PURPOSE:

- (1) TO PROVIDE A PROGRAM TO FULFILL THE FOLLOWING REQUIREMENTS:
  - (A) PROVIDE AN INDICATION TO THE CREW THAT THE CMC IS ENGAGED IN NO CONTROL OR COMPUTATIONAL OPERATIONS WHICH MIGHT REQUIRE CONSIDERATION FOR COORDINATION WITH OTHER CREW TASKS IN PROGRESS.
  - (B) TO MAINTAIN THE GNCS IN A CONDITION WHERE MANUAL ATTITUDE MANEUVERS CAN BE MADE BY THE CREW WITH MINIMAL CONCERN FOR THE GNCS (SFE ASSUMPTION 3).
  - (C) MAINTAIN THE CMC IN A CONDITION OF READINESS FOR ENTRY INTO OTHER PROGRAMS.
- (2) TO UPDATE THE CSM AND LM STATE VECTORS EVERY FOUR TIME STEPS.

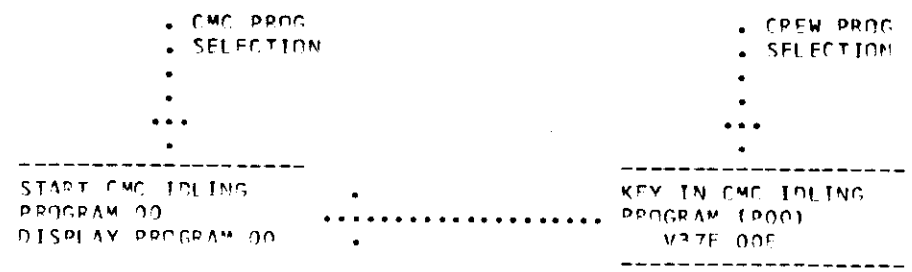
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 ASSUMPTIONS:  
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- (1) THE IMU MAY OR MAY NOT BE ON. IF ON, THE IMU IS INERTIALLY STABILIZED BUT NOT NECESSARILY ALIGNED TO AN ORIENTATION WHICH IS KNOWN TO THE CMC.
- (2) IF NON-GNCS CONTROLLED ATTITUDE MANEUVERS ARE MADE BY THE CREW CARE MUST BE TAKEN TO AVOID IMU GIMBAL LOCK. THE IMU GIMBAL ANGLES MAY BE MONITORED BY OBSERVING THE ICIDUS (V16 N20) OR BY MONITORING THE FPAI BALL.
- (3) DURING THIS PROGRAM THE CMC ERASABLE STORAGE MAY BE INITIALIZED BY KEYING IN V36E (FRESH START). THIS WOULD BE DONE ONLY AT INITIAL CMC STARTUP OR WHEN THE CONTENT OF THE CMC ERASABLE STORAGE IS IN QUESTION. IF THIS ENTRY IS PERFORMED, THE CMC'S KNOWLEDGE OF THE PRESENT STATE VECTOR AND THE PRESENT IMU ORIENTATION (PFSSMAT) IS INVALIDATED.
- (4) THE PROGRAM IS MANUALLY SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PCR  
 507  
 ++  
 +04 AND 05  
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 EDIT

- (5) THIS PROGRAM IS AUTOMATICALLY SELECTED BY V96E, WHICH MAY BE DONE DURING ANY PROGRAM. STATE VECTOR INTEGRATION IS PERMANENTLY INHIBITED FOLLOWING V96E. NORMAL INTEGRATION FUNCTIONS WILL RESUME AFTER SELECTION OF ANY PROGRAM OR EXTENDED VERB. POO INTEGRATION WILL RESUME WHEN POO IS RESELECTED. USAGE OF V96 CAN CAUSE INCORRECT W-MATRIX AND STATE VECTOR SYNCHRONIZATION.

PRG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
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EXIT R00  
AND GO TO  
PROGRAM  
SELECTED  
VIA R00

R00/COLLOSSUS  
R00/SUNDANCE  
R00/LUMINARY

#70

#80

CHANGE CONTROL NOTES

REV 03  
REV 04

PCR MIT 66  
PCR 507

#90

#100

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+04  
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WAIT ABOUT 10  
SECCNDS  
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TURN ON "NO ATT"  
LIGHT  
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.....  
-----  
OBSERVE "NO ATT"  
LIGHT ON  
-----

#40

.....  
-----  
COMMAND COARSE ALIGN  
IN ISS.  
COARSE ALIGN TO  
DESIRED PLATFORM  
ORIENTATION  
-----

#50

.....  
-----  
REMOVE COARSE ALIGN  
COMMAND (RELEASE  
PLATFORM).  
-----

#60

.....  
-----  
TURN OFF "NO ATT"  
LIGHT  
-----

.....  
-----  
OBSERVE "NO ATT"  
LIGHT OFF  
-----

#70

.....  
-----  
TERMINATE PROGRAM 01  
AND GO TO PRELAUNCH  
OR SERVICE - GYRO  
COMPASSING PROGRAM  
(P02)  
-----

.....  
-----  
MONITOR DSKY:  
OBSERVE TERMINATION  
OF P01 AND DISPLAY  
OF P02  
-----

.....  
EXIT P01

.....  
EXIT P01

#80

41

CHANGE CONTROL NOTES

REV 04 PCR 206

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DO VERTICAL  
ERECTION

#30

WAIT 0.5 SECONDS

#40

HAS TIMER  
REACHED 640  
SECS?

.N .Y

#50

DO GYRO COMPASS-  
ING

WAIT 0.5 SECONDS

#60

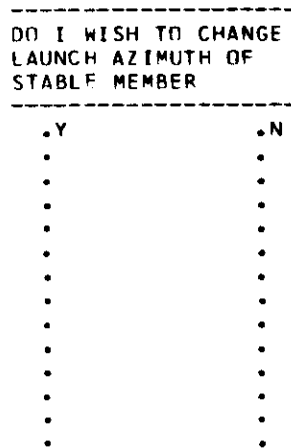
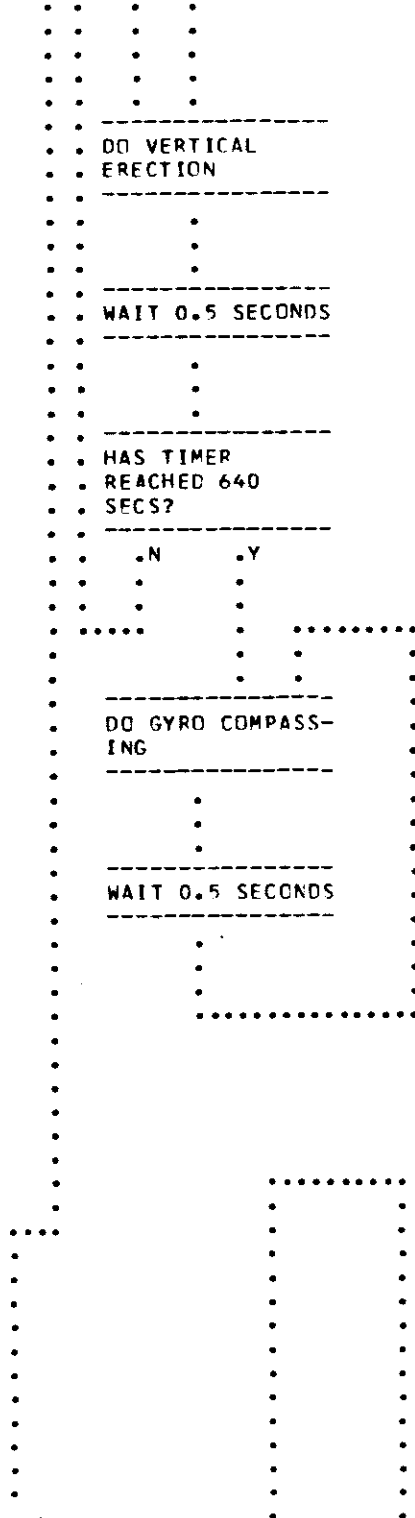
DO I WISH TO CHANGE  
LAUNCH AZIMUTH OF  
STABLE MEMBER

#70

.Y .N

++  
+04  
+  
+  
+  
+  
+04  
++  
EDIT

44



45

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HOLD .....
SNAP .....
FLASH VERB-NOUN TO
REQUEST PROCEED AND
DISPLAY STORED
LAUNCH AZIMUTH
V06 N29
R1-XSM LAUNCH AZIMUTH
R2-BLANK
R3-BLANK
XSM LAUNCH AZIMUTH
MEASURED CLOCKWISE
FROM TRUE NORTH IN
DEGREES TO NEAREST
.01 DEGREES
XSM LAUNCH AZIMUTH
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PROCEED AND DISPLAY
OF XSM LAUNCH
AZIMUTH
AM I SATISFIED
WITH XSM LAUNCH
AZIMUTH?
.Y .N
WAIT FOR KEYBOARD
ENTRY
KEY IN V21E AND
LOAD NEW LAUNCH
AZIMUTH
TERMINATE FLASH
UPON RECEIPT OF PRO-
CEED OR NEW DATA
KEY IN PROCEED
.P .NEW
.R .DATA
.O .
.C .
.E
.E STORE
.D NEW
DATA

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#80

#90

#100

#110

#120

#130

LD  
FROM  
SIVE  
IU

START MONITOR OF  
LIFT OFF DISCRETE

#140

.LD  
.OR  
.ENTER

AT T-2 MIN  
KEY IN  
V75

#150

.SEND NOTIFICATION OF LIFT-  
OFF

.WAIT FOR NOTIFICATION OF LIFTOFF  
FROM GROUND

#160

TERMINATE P02 AND GO  
TO EARTH ORBIT IN-  
SERPTION MONITOR  
PROGRAM (P11)

MONITOR DSKY:  
IS AGC RECEIPT OF  
LIFTOFF INDICATED BY  
DISPLAY OF P11?

#170

EXIT P02

.Y .N  
EXIT P02

#180

PRESS ENTER TO  
INITIATE P11

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·  
EXIT P02

CHANGE CONTROL NOTES

REV 04 EDITORIAL

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HOLD .  
 .....  
 SNAP .

FLASH VERB-NOUN TO  
 REQUEST PROCEED AND  
 DISPLAY STORED  
 TARGET 1 AZIMUTH AND  
 ELEVATION:  
 V06 N41  
 R1-TARG AZ  
 R2-TARG ELEV  
 R3-TARG ICFNT

TARG AZ-TARGET  
 AZIMUTH-ANGLE CLOCK-  
 WISE FROM TRUE NORTH  
 TO THE TARGET. IN  
 DEGREES TO NEAREST  
 .01 DEGREE

TARG ELEV-TARGET  
 ELEVATION-ANGLE FROM  
 THE LOCAL HCRIZONTAL  
 (OF NAV BASE) TO THE  
 TARGET. IN DEGREES  
 TO NEAREST .001  
 DEGREE

TARG IDENT-TARGET  
 IDENTIFIER-IDENTIFI-  
 ES AZIMUTH AND  
 ELEVATION FOR TARGET  
 1 OR 2

WAIT FOR KEYBOARD  
 ENTRY

MONITOR DSKY:  
 OBSERVE VERB-NOUN  
 FLASH TO REQUEST  
 PROCEED AND DISPLAY  
 OF TARGET 1 AZIMUTH  
 AND ELEVATION

AM I SATISFIED WITH  
 THE AZIMUTH AND  
 ELEVATION OF TARGET  
 1?

.Y .N

KEY IN PROCEED

#90

#100

#110

#120

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

KEY IN V21E,V22E, OP  
V24E AND LOAD NEW  
DATA

#130

.P .NEW  
.R .DATA  
.D .  
.C .

DISPLAY AND  
STORE NEW  
DATA

#140

SET TARG IDENT TO  
00002 IN R3 OF NOUN  
30

#150

++  
+08  
+  
+08  
++

PASTE V05N30 AND  
THEN V06N41 (DO NOT  
OVERWRITE R3)

#160

HOLD .  
.....  
SNAP .

FLASH VERB-NOUN TO  
REQUEST PROCEED AND  
DISPLAY STORED  
TARGET 2 AZIMUTH AND  
ELEVATION:  
V'6 N41  
R1-TARG AZ  
R2-TARG ELEV  
R3-TARG IDENT

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
PROCFED AND DISPLAY  
OF TARGET 2 AZIMUTH  
AND ELEVATION

#170

TARG AZ-TARGET  
 AZIMUTH-ANGLE CLOCK-  
 WISE FROM TRUE NORTH  
 TO THE TARGET. IN  
 DEGREES TO NEAREST  
 .01 DEGREE

-----  
 AM I SATISFIED WITH  
 THE AZIMUTH AND  
 ELEVATION OF TARGET  
 ??  
 -----

#180

TARG ELEV-TARGET  
 ELEVATION-ANGLE FROM  
 THE LOCAL HORIZONTAL  
 (OF NAV BASE) TO THE  
 TARGET. IN DEGREES  
 TO NEAREST .001  
 DEGREE

.Y .N

#190

TARG IDENT-TARGET  
 IDENTIFIER-IDENTIFI-  
 ES AZIMUTH AND  
 ELEVATION FOR TARGET  
 1 OR 2

#200

-----  
 WAIT FOR KEYBOARD  
 ENTRY

-----  
 KEY IN PROCEED  
 -----

#210

-----  
 TERMINATE FLASH UPON  
 RECEIPT OF PROCEED  
 OR NEW DATA

-----  
 KEY IN V21E,V22E,  
 OR V24E AND LOAD NEW  
 DATA  
 -----

P. NEW  
 R. DATA  
 O.  
 C.  
 E.  
 E. DISPLAY AND  
 D. STORE NEW  
 DATA

#220

COMPUTE LOS TO  
TARGET NUMBER ONE  
AND DRIVE OPTICS,  
IF ALLOWED.

#230

.....  
.....  
.....  
.....

#240

HOLD . . . . . FLASH VERB TO  
..... . . . . REQUEST PLEASE MARK  
SNAP . . . . . V5IN BLANK  
++ . . . . . R1-BLANK  
+07 . . . . . R2-BLANK  
+ . . . . . R3-BLANK

MONITOR DSKY:  
OBSERVE VERB  
FLASH TO REQUEST  
PLEASE MARK

+07  
++

#250

SELECT CMC OPTICS  
MODE, OBSERVE SXT  
DRIVE (OPTIONAL).

#260

SELECT MANUAL OPTICS  
MODE

WAIT FOR MARK  
TERMINATE FLASH UPON  
RECEIPT OF MARK

MARK

WHEN SIGHTING ON  
TARGET 1 IS SATIS-  
FACTORY PRESS MARK  
BUTTON

#270

STORE MARK DATA

#280

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-----
. FLASH VERB-NOUN TO
. REQUEST PLEASE PER-
. FORM TERMINATE MARK
. SEQUENCE
. V50 N25
. R1-00016
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-----
. MONITOR DSKY:
. OBSERVE FLASHING
. VERB-NOUN TO REQUEST
. PLEASE PERFORM TERM-
. INATE MARK SEQUENCE
-----

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. YES . NO
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.
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#290

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-----
. WAIT FOR KEYBOARD
. ENTRY
-----

```

REJECT

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-----
. PRESS MARK
. REJECT BUTTON
-----

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#300

```

. TERMINATE FLASH UPON
. RECEIPT OF
. PROCEED OR REJECT
-----

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-----
. KEY IN PROCEED
-----

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. .REJECT . PROCEED
.
.
.

```

#310

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-----
. ERASE LAST
. SET OF MARK
. DATA
-----

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#320

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-----
. COMPUTE LOS TO
. TARGET NUMBER
. TWO AND DRIVE
. OPTICS IF
. ALLOWED.
-----

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#330

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HOLD . . . . .  
 SNAP . . . . .  
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 +07 . . . . .  
 + . . . . .  
 +07 . . . . .  
 ++ . . . . .

FLASH VERB TO  
 REQUEST PLEASE MARK  
 V51N BLANK  
 R1-BLANK  
 R2-BLANK  
 R3-BLANK

MONITOR DSKY:  
 OBSERVE VERB  
 FLASH TO REQUEST  
 PLEASE MARK

#340

SELECT CMC OPTICS  
 MODE. OBSERVE SXT  
 DRIVE (OPTIONAL)

#350

SELECT MANUAL OPTICS  
 MODE

#360

WAIT FOR MARK  
 TERMINATE FLASH UPON  
 RECEIPT OF MARK

. MARK

WHEN SIGHTING ON  
 TARGET 2 IS SATIS-  
 FACTORY PRESS MARK  
 BUTTON

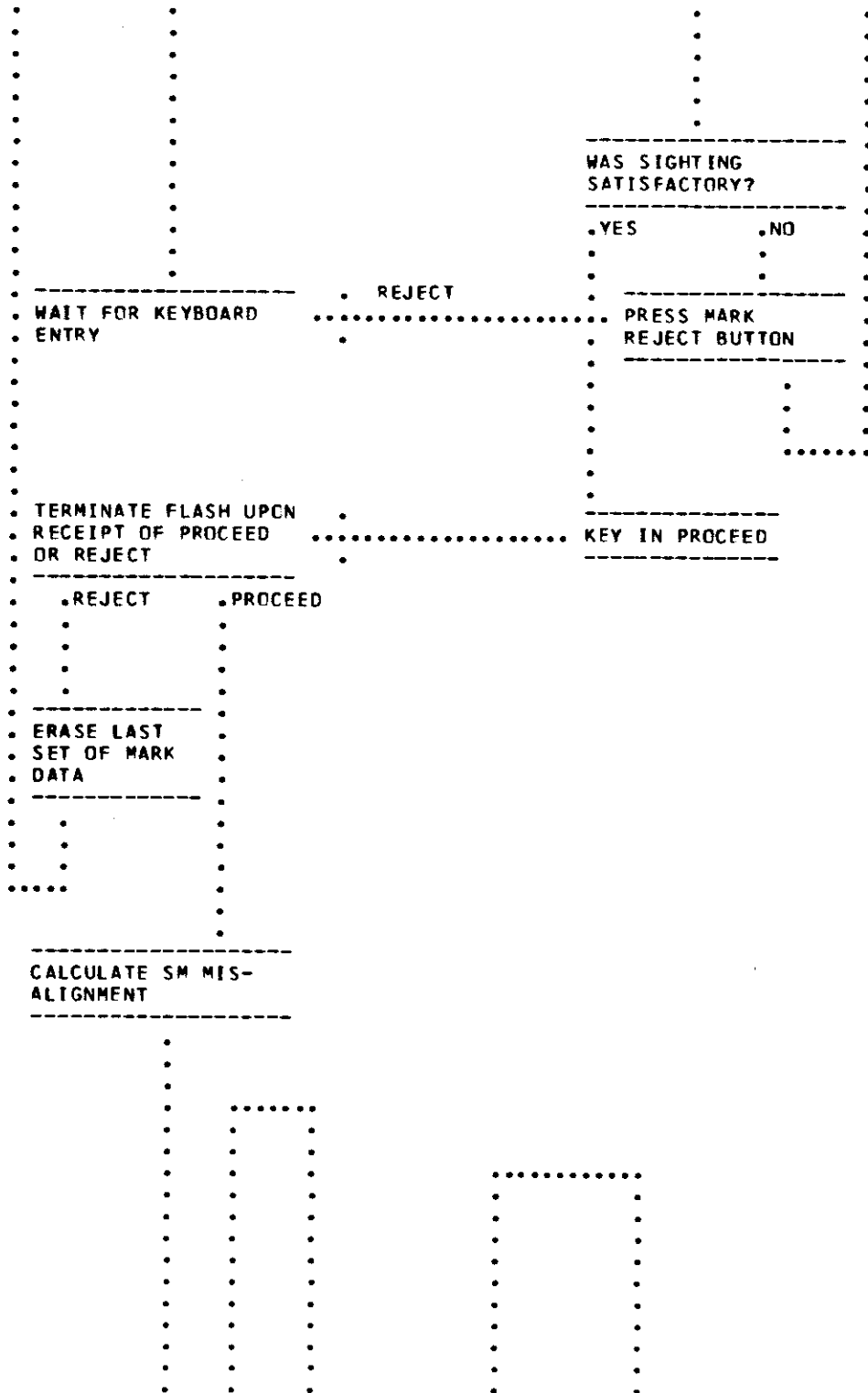
#370

STORE MARK DATA

FLASH VERB-NOUN TO  
 REQUEST PLEASE  
 PERFORM TERMINATE  
 MARK SEQUENCE  
 V50 N25  
 R1-00016

MONITOR DSKY:  
 OBSERVE FLASHING  
 VERB-NOUN TO REQUEST  
 PLEASE PERFORM  
 TERMINATE MARK  
 SEQUENCE

#380



#390

#400

#410

#420

#430

HOLD . FLASH VERB-NOUN TO  
 ..... REQUEST PROCFED AND  
 SNAP . DISPLAY DELTA GYRO  
 ANGLE:  
 V06 N93  
 R1-DELTA GYRO  
 ANGLE X  
 R2-DELTA GYRO  
 ANGLE Y  
 R3-DELTA GYRO  
 ANGLE Z

DELTA GYRO ANGLE-  
 ALIGNMENT ERROR IN  
 DEGREES TO NEAREST  
 .001 DEGREE

WAIT FOR KEYBOARD  
 ENTRY

MONITOR DSKY:  
 OBSERVE FLASHING  
 VERB-NOUN AND  
 DISPLAY MISALIGNMENT  
 ANGLES

#440

#450

#460

CONFER WITH GROUND.  
 ARE GYRO MISALIGN-  
 MENT ANGLES ACCEPT-  
 ABLE?

.N .Y

SHALL I CONTIN-  
 UE WITH BAD  
 DATA?

.NO .YES

KEY IN TER-  
 MINATE  
 V34E

EXIT

#470

#480



#490

.HAVE I  
 .ZEROED  
 .THE X  
 .AND Y  
 .GYRO  
 .ERROR?

#500

.KEY IN V24E AND  
 .LOAD R1 AND R2  
 .WITH ZEROES.

#510

.TERMINATE FLASH UPON  
 .RECEIPT OF TERMINATE  
 .OR PROCEED OR NEW  
 .DATA

.KEY IN PROCEED

#520

.P	.T	.NEW
.R	.E	.DATA
.D	.R	.
.C	.M	.
.E	.I	.
.E	.N	.
.D	.A	.
.	.T	.
.	.E	.

#530

.STORE NEW  
 .DATA

#540



PURPOSE: (1) TO TRANSFER THE CMC FROM THE OPERATE TO THE STANDBY CONDITION.

ASSUMPTIONS: (1) WHEN THIS PROGRAM IS TURNED ON THE ASTRONAUT MUST POWER DOWN THE CMC TO STANDBY.

(2) THE NORMAL CONDITION OF READINESS OF THE GNCS WHEN NOT IN USE IS STANDBY. ALL THE G/N CKT BKRS (PANEL 5) ARE CLOSED, THE IMU AND OPTICS G/N POWER SWITCHES (LEB PANEL 100) ARE OFF AND THE CMC STANDBY LIGHT (DSKY) IS ON. IN THIS CONDITION THE IMU IS IN STANDBY WITH ONLY HEATER POWER ON, OPTICS POWER IS OFF AND THE CMC IS IN STANDBY.

(3) A POSSIBLE CONDITION OF READINESS OF THE GNCS WHEN NOT COMPLETELY ON IS THE SAME AS STANDBY (2) ABOVE, EXCEPT THE CMC STANDBY LIGHT ON THE MAIN AND LEB DSKYS IS OFF. IN THIS CONFIGURATION THE CMC IS RUNNING FOR COMPUTATIONAL PURPOSES THAT DO NOT REQUIRE THE IMU OR OPTICS.

(4) IF THE COMPUTER POWER IS SWITCHED OFF IT WILL BE NECESSARY TO PERFORM A COMPUTER FRESH START (V36)E TO INITIALIZE THE ERASABLE STORAGE. THE CMC UPDATE PROGRAM (P27) WOULD HAVE TO BE DONE TO UPDATE THE STATE VECTOR AND COMPUTER CLOCK TIME.

(5) THE CMC IS CAPABLE OF MAINTAINING AN ACCURATE VALUE OF GROUND ELAPSED TIME (GET) FOR ONLY 23 HRS WHEN IN THE STANDBY MODE. IF THE CMC IS NOT BROUGHT OUT OF THE STANDBY CONDITION TO THE RUNNING CONDITION (SEE (3) ABOVE) AT LEAST ONCE WITHIN 23 HOURS THE CMC VALUE OF GET MUST BE UPDATED.

(6) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
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			<ul style="list-style-type: none"> <li>. CREW PROG</li> <li>. SELECTION</li> <li>.</li> <li>.</li> <li>...</li> <li>.</li> </ul>			
-----			-----			
START CMC POWER DOWN PROGRAM (P06) DISPLAY PROGRAM 06	.	.....	KEY IN CMC POWER DOWN PROGRAM (P06) V37E 06E			#10
	.		-----			
		.....	MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 06			
	.		-----			
	.					
	.					
	.					

RESET REFSMMAT FLAG

RESET RENDEZVOUS  
FLAG

++  
+08  
++

STORE CMC CLOCK TIME.

#30

#40

HOLD.  
.....  
SNAP.

FLASH VERB-NOUN TO  
REQUEST PLEASE PER-  
FORM CMC POWER DOWN:  
V50 N25  
R1-00062  
R2-BLANK  
R3-BLANK

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
PLEASE PERFORM CMC  
POWER DOWN

#50

WAIT FOR KEYBOARD  
ENTRY

#60

PRESS PROCEED  
BUTTON AND  
HOLD DEPRESS-  
ED UNTIL  
STANDBY LIGHT  
COMES ON.

#70



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- PURPOSE:
- (1) TO INDICATE TO THE ASTRONAUT THAT THE CMC HAS RECEIVED THE LIFTOFF DISCRETE.
  - (2) TO GENERATE AN ATTITUDE ERROR INDICATION ON THE F0A1 ERROR NEEDLES, SCALED FOR THE 50/15 SETTING; FROM LIFTOFF TO THE BEGINNING OF PITCHOVER/ROLLOUT THE ATTITUDE ERROR IS EQUAL TO THE DIFFERENCE BETWEEN THE CURRENT VEHICLE ATTITUDE AND THE ATTITUDE STORED AT LIFTOFF. DURING PITCHOVER/ROLLOUT THE ATTITUDE ERROR IS EQUAL TO THE DIFFERENCE BETWEEN THE CURRENT VEHICLE ATTITUDE AND THE CMC NOMINAL COMPUTATION OF VEHICLE ATTITUDE BASED ON THE STORED POLYNOMIALS IN PITCH AND ROLL.
  - (3) TO DISPLAY CMC COMPUTED TRAJECTORY PARAMETERS.
- ASSUMPTIONS:
- (1) THE PROGRAM IS NORMALLY AUTOMATICALLY SELECTED BY THE GYRO COMPASSING PROGRAM (P02) WHEN THE CMC RECEIVES THE LIFTOFF DISCRETE FROM THE SIVB. IN THE BACKUP CASE IT WOULD HAVE BEEN SELECTED BY KEYING IN V75 ENTER AS NOTED EARLIER IN P02.
  - (2) THE ORBIT PARAMETER DISPLAY ROUTINE IS AVAILABLE BY KEYING IN V82E.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
	. CMC PROG . SELECTION . ..... .					
	----- START ECI MONITOR PROGRAM (P11) DISPLAY PROGRAM 11 -----	.....	. MONITOR DSKY: . OBSERVE DISPLAY OF . PROGRAM 11	-----		#10
	. : .		. : .			
	----- SEND EFFECTIVE TIME OF LIFTOFF ON DOWNLINK -----		. VERIFY AUTOMATIC . START OF DIGITAL . EVENT TIMER	-----		#20
	. : .					
++ +06 ++	----- ZERO CMC CLOCK -----					
	. . . . . . .					

UPDATE TEPHEM TO  
TIME OF LIFTOFF

#30

CALL AVERAGE  
G INTEGRATION  
WITH DELTA V  
INTEGRATION

#40

TERMINATE GYRO-  
COMPASSING

#50

COMPUTE INITIAL  
STATE VECTOR

#60

COMPUTE REFSMMAT

SET REFSMMAT FLAG

#70

STORE LIFTOFF  
ATTITUDE



CALL ROUTINE TO  
 LOAD ICDU DACS WITH  
 PITCH, ROLL, AND YAW  
 ATTITUDE ERRORS DE-  
 RIVED FROM PRESENT  
 ATTITUDE AND STORED  
 LIFTOFF ATTITUDE  
 UNTIL PRESENT TIME  
 EQUALS TE1 (STORED  
 IN ERASABLE MEMORY)  
 AT WHICH TIME THE  
 STORED LIFTOFF ATT-  
 TUDE IS REPLACED BY  
 THE SOLUTION TO THE  
 STORED 6TH ORDER  
 BOOST POLYNOMIAL.

AT TIME TE1 + TE2  
 (TE2 IS STORED IN  
 ERASABLE MEMORY)  
 SHUT OFF BOOST POLY-  
 NOMIAL AND HOLD  
 ATTITUDE ERROR NEED-  
 LES CONSTANT AT  
 TERMINAL ERROR.

AT 163.84 SECS SHUT  
 OFF ROUTINE TO LOAD  
 ICDU DACS.

MONITOR:  
 (A) FDAI ATTITUDE  
 ERROR NEEDLES AS  
 INDICATION OF  
 CMC COMPUTATIONS  
 OF INSERTION.

BALL INDICATES  
 INITIAL VEHICLE  
 ROLLOUT AND THEN  
 GRADUAL PITCH-  
 OVER.

(B) DSKY:  
 R1-VI INCREASING  
 R2-H DOT FOLLOWS  
 NOMINAL HISTORY  
 R3-H INCREASING

#80

#90

#100

#110

HOLD .  
 ..... DISPLAY ON DSKY:  
 MON . V06 N62  
 R1 - VI  
 R2 - H DOT  
 R3 - H

VI-INERTIAL VELO-  
 CITY MAGNITUDE. IN  
 FPS TO NEAREST FPS

#120

H DOT - RATE OF  
 CHANGE OF VEHICLE  
 ALTITUDE ABOVE  
 LAUNCH PAD RADIUS.  
 IN FPS TO  
 NEAREST FPS

H-VEHICLE ALTITUDE  
ABOVE THE LAUNCH  
PAD RADIUS. IN NAUTI-  
CAL MILES TO  
NEAREST .1 NM

#130

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-----  
VERIFY SATURN  
SHUT DOWN  
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#140

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TERMINATE P11 AND GO  
TO PROGRAM SELECTED  
VIA ROO  
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-----  
KEY IN V37EXXE  
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#150

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EXIT P11

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EXIT P11

CHANGE CONTRCL NOTES

LOGIC REV 5    PCR 3  
LOGIC REV 6    PCR 206



TPI SEARCH PROGRAM (P17)

LOGIC REV 09 11/27/68

- PURPOSE:
- (1) TO ACCEPT A DESIRED TIME OF TRANSFER PHASE INITIATION (TIG(TPI)) AS A DSKY INPUT FROM THE ASTRONAUT, AND TO COMPUTE THEREFROM THE PARAMETERS ASSOCIATED WITH A MINIMUM ENERGY, SAFE PERIAPSIS TRANSFER MANEUVER AT TIG(TPI) AND THE RESULTANT RENDEZVOUS INTERCEPT.
  - (2) TO PROVIDE THE ASTRONAUT WITH THE OPTION OF DEFINING TO THE CMC THE INITIAL TRANSFER TRAJECTORY SEARCH SECTOR FOR CENTRAL ANGLES EITHER GREATER THAN OR LESS THAN 180 DEGREES FROM THE POSITION OF THE ACTIVE VEHICLE (CSM) AT TIG (TPI).
  - (3) TO DISPLAY TO THE ASTRONAUT THE PARAMETERS ASSOCIATED WITH THE TRANSFER (TPI AND INTERCEPT).
- ASSUMPTIONS:
- (1) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TURN ON THE RENDEZVOUS SIGHTING MARK ROUTINE (EITHER R21 OR R23) AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. SEE P20 FOR DETAILED DESCRIPTION.
  - (2) THE OPERATION OF THIS PROGRAM UTILIZES THE ACTIVE VEHICLE FLAG WHICH DESIGNATES THE VEHICLE WHICH IS DOING THE RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.
  - (3) TO EXECUTE THE TPI MANEUVER SELECT THE TRANSFER PHASE INITIATION (TPI) PROGRAM (P34).
  - (4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
			. CREW . PROGRAM ...SELECTION .			
						#10
START TPI SEARCH PROGRAM (P17).	.....	.....	----- KEY IN TPI SEARCH PROGRAM (P17) V37E17E ----- . . .			
						#20
DISPLAY PROGRAM 17	.....	.....	----- MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 17. ----- . . . . . . . .			

SET TRACK FLAG  
(SEE P20)

SET UPDATE FLAG  
(SEE P20)

SET ACTIVE VEHICLE  
FLAG TO CSM.

"A"

"A"

#30

#40

HOLD  
SNAP

FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY TIG(TPI):  
VO6N37  
R1-TIG(TPI)-HRS  
R2-TIG(TPI)-MINS  
R3-TIG(TPI)-SECS

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST RE-  
SPONSE AND DISPLAY  
OF TIG(TPI).

#50

TIG(TPI)-TIME OF TPI  
IGNITION (GET). IN  
HRS, MINS, SECS TO  
NEAREST .01 SEC.

AM I SATISFIED WITH  
THESE VALUES?

#60

.Y .N

RECORD THIS  
VALUE.

#70

WAIT FOR KEYBOARD  
ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

KEY IN V25E AND  
LOAD THE DESIR-  
ED TIG(TPI)

.PROCFED .NEW  
. .DATA  
.  
.  
-----  
STORE DATA  
-----  
.  
.  
.....  
.  
.

RESET UPDATE FLAG

COMPUTE VEHICLE  
POSITIONS AT  
TIG(TPI) AND SELECT  
NOMINAL SEARCH OP-  
TION AS FOLLOWS:  
IF ACTIVE VEHICLE IS  
ABOVE PASSIVE VEH-  
ICLE (NEGATIVE DELTA  
ALTITUDE) SELECT  
OPTION 00001.  
IF ACTIVE VEHICLE IS  
BELOW PASSIVE VEHICLE  
(POSITIVE DELTA ALT)  
SELECT OPTION 00002

SET UPDATE FLAG

#80

#90

#100

#110

#120

<p>HOLD . . . . .</p> <p>SNAP . . . . .</p>	<p>-----</p> <p>FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY TPI PARA- METERS: V06N72 R1-DELT ANG(TPI) R2-DELT ALT(TPI) R3-SEARCH OPTION</p> <p>DELT ANG(TPI)-CENT- RAL ANGLE AROUND THE EARTH OR MOON AT TIG (TPI) BETWEEN THE ACTIVE AND PASSIVE VEHICLES. POLARITY INDICATES ACTIVE VE- HICLE IS BEHIND (-) OR AHEAD OF (+) PASSIVE VEHICLE. IN DEGREES TO NEAREST .01 DEGREE.</p> <p>DELT ALT(TPI)-THE MAGNITUDE OF THE ALTITUDE DIFFERENCE BETWEEN THE POSITION VECTORS OF THE ACT- IVE AND PASSIVE VE- HICLES AT TIG(TPI). IN NAUTICAL MILES TO THE NEAREST .1 NM. POLARITY INDICATES THE PASSIVE VEHICLE IS ABOVE (+) OR BE- LOW (-) THE ACTIVE VEHICLE.</p> <p>SEARCH OPTION-AN OP- TION CODE TO CONTRL CMC SEARCH FOR TERM- INAL PHASE DEFINITION: 00001-CMC SEARCHES TO DEFINE A TERMINAL PHASE WHERE THE REN- DEZVOUS INTERCEPT OCCURS AT A CENTRAL ANGLE LESS THAN 180 DEGREES FROM THE ACTIVE VEHICLE PCS- ITION AT TIG(TPI). OR 00002-SAME AS 00001 EXCEPT CENTRAL</p>	<p>-----</p> <p>MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF TPI PARAMETERS.</p> <p>-----</p>	<p>#130</p> <p>#140</p> <p>#150</p> <p>#160</p> <p>#170</p> <p>#180</p>
---	---	---	---

ANGLE IS GREATER  
THAN 180 DEGREES.

-----  
.  
-----  
WAIT FOR KEYBOARD  
ENTRY.

-----  
DO I WISH TO  
CHANGE TIG(TPI)?

.N .Y

-----  
KEY IN RECY-  
CLE  
V32F

GO TO  
"A"  
ABOVE

-----  
DO I WISH TO  
CHANGE THE SEARCH  
OPTION DISPLAYED?

.N .Y

-----  
RECORD THESE  
VALUES

-----  
KEY IN PROCEED

#190

#200

#210

#220

#230

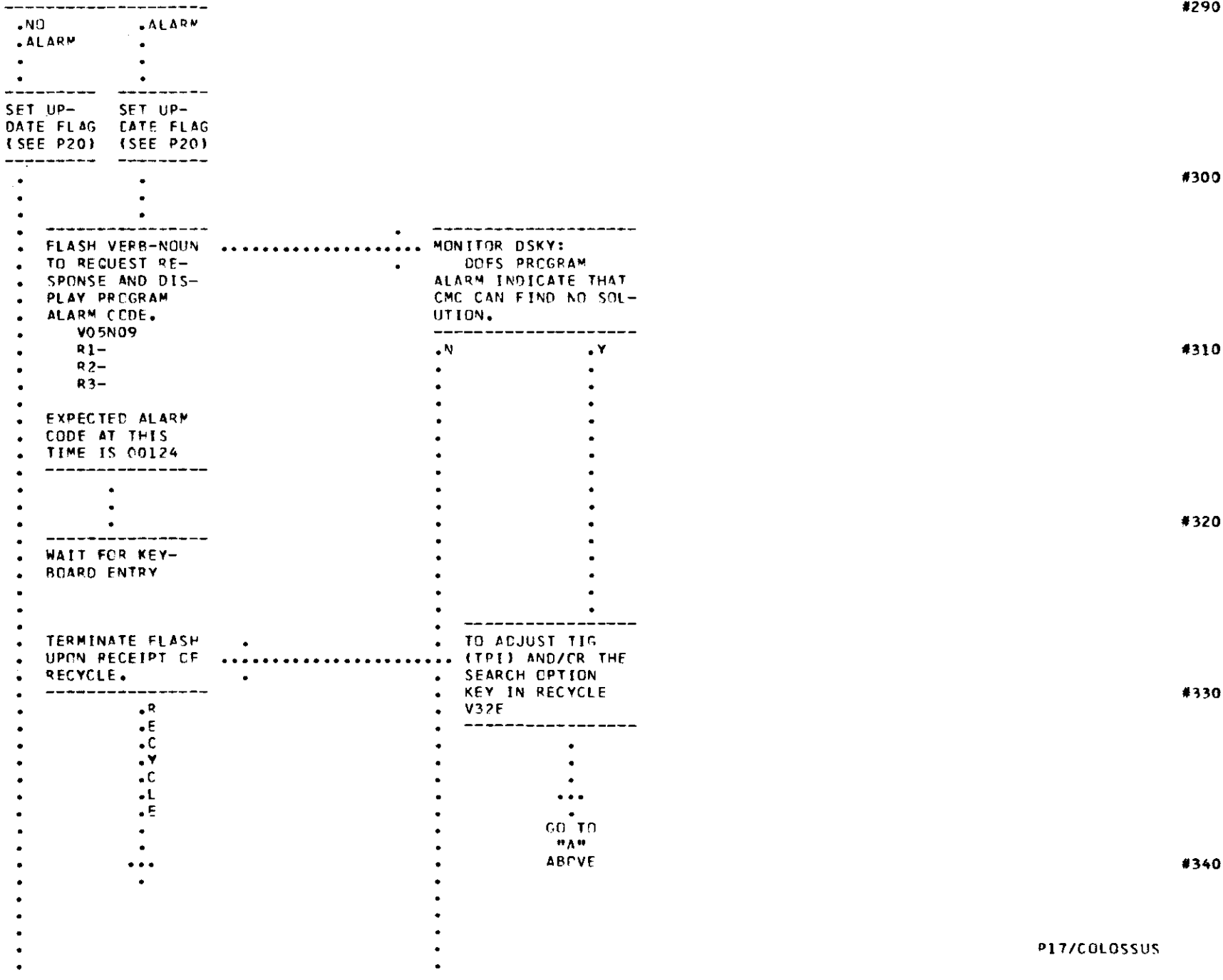
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GO TO  
"A"  
ABOVE

HOLD  
SNAP

FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY CALCULATED  
TERMINAL PHASE  
PARAMETERS:  
V06N58  
R1-PER ALT  
R2-DELTA V(TPI)  
R3-DELTA V(TPF)

PER ALT-ALTITUDE OF  
PERIGEE ABOVE LAUNCH  
PAD RADIUS (EARTH  
ORBIT) OR ALTITUDE  
OF PERILUNE ABOVE  
THE MOST RECENTLY  
DEFINED LANDING SITE  
RADIUS (LUNAR ORBIT)  
AFTER TPI MANEUVER  
IN NAUTICAL MILES TO  
NEAREST .1 NM.

DELTA V(TPI)-REQUIR-  
ED IMPULSIVE DELTA V  
TO ACCOMPLISH TPI  
MANEUVER AT TIG  
(TPI). IN FPS TO  
NEAREST .1 FPS.

DELTA V(TPF)-REQUIR-  
ED IMPULSIVE DELTA V  
TO ACCOMPLISH TPF  
MANEUVER AT TIME OF  
INTERCEPT. POLARITY  
INDICATES ACTIVE  
VEHICLE ASCENDING  
(+) OR DESCENDING  
(-) TO INTERCEPT.  
IN FPS TO NEAREST .1  
FPS.

WAIT FOR KEYBOARD  
ENTRY.

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF CALCULATED TER-  
MINAL PHASE  
PARAMETERS.

DO I WISH TO ADJUST  
TIG(TPI) AND/OR THE  
SEARCH OPTION?

.N	.Y
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RECORD THESE  
VALUES.

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KEY IN PROCEED

#350

#360

#370

#380

#390

TERMINATE FLASH UPON  
RECFPT OF PROCEED,  
OR RECYCLE.

-----  
KEY IN RECYCLE  
V32E  
-----

.P	.R
.R	.F
.D	.C
.C	.Y
.E	.C
.E	.L
.D	.E
.	.
.	.
.	...
.	.
.	GO TO
.	"A"
.	ABOVE
.	.

GO TO  
"A"  
ABOVE

#400

#410

HOLD .  
.....  
SNAP .

FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY CALCULATED  
PER CODE AND CENTANG:  
V06N55  
R1-PER CODE  
R2-BLANK  
R3-CENTANG

-----  
MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF PER CODE AND  
CENTANG.  
-----

#420

PER CODE-DEFINES  
WHEN PERIGEE/PERI-  
LUNE WILL OCCUR REL-  
ATIVE TO TIG(TPI)  
AND TIME OF INTER-  
CEPT.  
00001-INDICATES  
PERIGEE/PERILUNE  
WILL OCCUR BETWEEN  
TPI AND TPF.  
  
00002-INDICATES  
PERIGEE/PERILUNE  
WILL OCCUR AFTER  
INTERCEPT (BEYOND  
THE RENDEZVOUS  
PCINT).

#430

#440

CENTANG-THE ORBITAL  
CENTRAL ANGLE OF THE  
PASSIVE VEHICLE  
DURING TRANSFER FROM  
TIG(TPI) TO TIME  
OF INTERCEPT. IN  
DEGREES TO THE NEAR-  
EST .01 DEGREES.

DO I WISH TO ADJUST  
TIG(TPI) AND/OR THE  
SEARCH OPTION?

.N .Y  
:  
:

#450

RECORD THESE  
VALUES

:  
:  
:

#460

WAIT FOR KEYBOARD  
ENTRY.

KEY IN PROCEED

TERMINATE FLASH UPON  
RECEIPT OF PROCEED,  
OR RECYCLE.

KEY IN RECYCLE  
V32E

.P .R  
.R .E  
.D .C  
.C .Y  
.E .C  
.E .L  
.D .E

GO TO  
"A"  
ABOVE

#470

GO TO  
"A"  
ABOVE

#480

DO ROUTINE PGO

DO ROUTINE ROO

#490

EXIT

EXIT

CHANGE CONTRL NOTES

LOGIC REV 08 PCR MIT 66  
LOGIC REV 09 EDITORIAL

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## PURPOSE:

- (1) TO CONTROL THE CSM ATTITUDE AND OPTICS TO ACQUIRE THE LM IN THE SXT FIELD AND TO POINT THE CSM TRANSPONDER AT THE LM OR TO CONTROL THE CSM ATTITUDE TO ACQUIRE THE LM ALONG THE +X AXIS BASED ON THE OPTION CODE CHOSEN.
- (2) TO UPDATE EITHER THE LM OR CSM STATE VECTOR (AS SPECIFIED BY THE ASTRONAUT BY DSKY ENTRY) ON THE BASIS OF OPTICAL TRACKING DATA AND/OR VHF RANGE DATA.

## ASSUMPTIONS:

- (1) THE IMU MUST BE ON AND ALIGNED IN ORDER TO PERFORM THIS PROGRAM.
- (2) THE GNCS IS IN CONTROL OF THE VEHICLE IN THE AUTO MODE IN THE NOMINAL CASE. IF THE ASTRONAUT TAKES OVER CONTROL OF THE VEHICLE WITH RHC THE CSM WILL REMAIN AT THE ATTITUDE IT IS DRIVEN TO. REGARDLESS OF MODE SELECTION THE GNCS WILL CALCULATE THE PREFERRED TRACKING ATTITUDE AND THE +X-AXIS TRACKING ATTITUDE.
- (3) ROUTINE ROB HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM, IN ORDER FOR THE GNCS TO PERFORM THE AUTOMATIC ATTITUDE MANEUVERS THE ASTRONAUT SHOULD KEY IN V46E AT SOME TIME PRIOR TO THE FIRST MANEUVER.
- (4) THE LM IS MAINTAINING A PREFERRED TRACKING ATTITUDE TO CORRECTLY ORIENT THE OPTICAL BEACON.
- (5) THE OPERATION OF THE PROGRAM INCLUDES THE FOLLOWING FLAGS:

RENDEZVOUS FLAG- CONTROLS THE PERMANENT TERMINATION OF THE TOTAL RENDEZVOUS NAVIGATION PROCESS. THIS PROGRAM WILL ONLY RUN OR RESUME RUNNING WHEN THIS FLAG IS SET. SET BY P20 SELECTION. RESET BY SELECTION OF CMC IDLING PROGRAM(P00), CMC POWER DOWN PROGRAM(P06), THE ORBITAL NAVIGATION PROGRAM (P22), THE Cislunar NAVIGATION PROGRAM (P23), OR BY V56E. THE KEYING IN OF V56E WILL IMMEDIATELY TERMINATE P20 UNLESS A NAVIGATION MEASUREMENT IS BEING PROCESSED IN WHICH CASE IT WILL HOLD UNTIL COMPLETION OF THE INCORPORATION AND THEN TERMINATE P20.

TRACK FLAG- CONTROLS THE TEMPORARY TERMINATION OF THE TOTAL RENDEZVOUS NAVIGATION PROCESS. RESET OF THIS FLAG INTERRUPTS THE AUTOMATIC ATTITUDE MANEUVER/OPTICS POINTING PROCESS, AS WELL AS THE STATE VECTOR UPDATE PROCESS. THE SET OF THIS FLAG ENABLES ALL THESE PROCESSES. SET BY P17, 20, 30, 31, 34, 35, 38, 39, 74, 75, 76, 77, 78, 79 SELECTION. RESET BY AN V37EXXE

UPDATE FLAG- CONTROLS THE TEMPORARY TERMINATION OF THE STATE VECTOR UPDATE PROCESS ONLY. SET BY P17, 20, 30, 31, 34, 35, 38, 39, 74, 75, 77, 78, 79 SELECTION. RESET BY ANY V37EXXE AND IT IS ALSO RESET AND SET DURING THE PRETHRUST COMPUTATIONS TO PROTECT ERASABLE MEMORY.

PREFERRED ATTITUDE FLAG-DEFINES WHICH ATTITUDE THE SPACECRAFT IS TO BE ALIGNED TO BY R61. SET BY TURN ON OF P20, OR V76E. RESET BY V77E.

STICK FLAG - RESET BY EXECUTION OF A PROGRAM CHANGE VIA ROD AND BY V58E. SET BY TAKING RHC OUT OF DETENT WHEN THE SC CONTROL SWITCH IS CMC AND WHEN THE THO IS NOT CLOCKWISE. CPU RATE DRIVE IS NOT PERFORMED IF THE STICK FLAG IS SET.

STATE VECTOR FLAG - DEFINES WHICH STATE VECTOR WILL BE UPDATED BY SIGHTING MARKS AND VHF RANGING. SET TO LM BY P20 TURN ON AND V80E. SET TO CSM BY V81E.

**1A**

**1A**

PCR  
606  
++  
+22  
++

VHF RANGE FLAG - SET BY V87E, RESET BY V89E, AND BY ANY EXECUTION OF A PROGRAM CHANGE VIA R00. ALLOWS AUTOMATIC VHF RANGE DATA TO BE USED BY THE RENDEZVOUS DATA PROCESSING ROUTINE (P22).

(6) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY. IT MAY BE TERMINATED BY THE SELECTION OF THE CMC IDLING PROGRAM (P00), CMC POWER DOWN PROGRAM (P06), THE ORBITAL NAVIGATION PROGRAM (P22), THE Cislunar NAVIGATION PROGRAM (P23) OR BY V56F. R00 SELECTION WILL TERMINATE P20 AND ANY OTHER PROGRAM IN PROCESS AND ESTABLISH P00. ALL OTHER PROGRAMS SELECTED WILL CHANGE THE PROGRAM NUMBER DISPLAYED ON THE DSKY BUT WILL NOT TERMINATE P20. THIS PROGRAM IS DESIGNED TO OPERATE AUTOMATICALLY AND SIMULTANEOUSLY WITH ANOTHER PROGRAM WITHOUT REQUIRING USE OF THE DSKY UNLESS NON-NOMINAL CIRCUMSTANCES REQUIRE CMC COMMUNICATION WITH THE ASTRONAUT. IF V56F IS KEYED INTO THE DSKY AND P20 IS THE ONLY PROGRAM RUNNING, ROUTINE R00 WILL BE INITIATED.

(7) W MATRIX INITIALIZATION FOR RENDEZVOUS MAY BE ENABLED (RESET RENDWFLAG) IN ANY OF THE FOLLOWING WAYS:

- (A) KEYING IN OF VERR 93E
- (B) COMPUTER FRESH START (KEYING IN OF VERR 36E)
- (C) STATE VECTOR UPDATE FROM THE GROUND
- (D) STATE VECTOR CALCULATION MADE DURING ENTRANCE TO P22, OR P23.
- (E) CHANGES TO INITIALIZATION PARAMETERS IN V67

(8) THERE IS A RENDEZVOUS OPTICS MARK COUNTER USED IN THE CMC TO COUNT THE NUMBER OF OPTICS MARKS USED TO CHANGE EITHER STATE VECTOR AND THERE IS A RENDEZVOUS VHF RANGING MARK COUNTER USED IN THE CMC TO COUNT THE NUMBER OF VHF RANGING MARKS USED TO CHANGE EITHER STATE VECTOR.

THESE COUNTERS ARE ZEROED BY SEVERAL DISTINCT EVENTS, THEY ARE:

- (A) KEYING IN OF V37E20E (INITIATION OF (P20)).
- (B) COMPLETION OF THE TARGET DELTA V PROGRAM (P76).
- (C) SELECTION OF A NEW PROGRAM FROM A PROGRAM WHICH HAD TURNED ON AVERAGE G (SEE R00 LOGIC).
- (D) INITIALIZATION OF THE W MATRIX FOR RENDEZVOUS (FOR ANY REASON, SEE ASSUMPTION 7).
- (E) SELECTION OF RETURN TO EARTH PROGRAM (P37)

(9) SUMMARY OF EXTENDED VERRS ASSOCIATED WITH THE PROGRAM:

- V44E - SET SURFACE FLAG - CAUSES TRACKING OF THE LANDING SITE BASED ON THE STORED LANDING SITE
- V45E - RESET SURFACE FLAG - CAUSES TRACKING OF THE LM BASED ON THE LM STATE VECTOR
- V54E - DO R23 - ALLOWS BACK-UP MARKING ON THE LM.
- V56F - RESET THE RENDEZVOUS FLAG. CAUSES TERMINATION OF P20.
- V57E - DO R21 - ALLOWS OPTICS MARKING ON THE LM.
- V58E - RESET STICK FLAG - ALLOW AUTO MANEUVERS
- V67E - W-MATRIX RMS ERROR DISPLAY
- V76E - SET PREFERRED ATTITUDE FLAG - DRIVE TO PREFERRED ATTITUDE
- V77E - RESET PREFERRED ATTITUDE FLAG - DRIVE TO +X-AXIS ATTITUDE
- V80E - SET STATE VECTOR FLAG TO LM. DATA WILL UPDATE LM STATE VECTOR
- V81E - SET STATE VECTOR FLAG TO CSM. DATA WILL UPDATE CSM STATE VECTOR
- V87E - SET VHF RANGE FLAG - ALLOWS R22 TO ACCEPT RANGE DATA.
- V89E - RESET VHF RANGE FLAG - STOPS ACCEPTANCE OF RANGE DATA.
- V93E - RESET RENDWFLAG - CAUSE INITIALIZATION OF W MATRIX FOR RENDEZVOUS AT NEXT DATA INCORPORATION



INCOMPLETE SUMMARY OF ADDITIONAL DATA OR JOBS AVAILABLE WHILE THIS PROGRAM IS OPERATING:

- P17 - AVAILABLE BY KEYING IN V37E17E
- P30 - AVAILABLE BY KEYING IN V37E30E
- P31 - AVAILABLE BY KEYING IN V37E31E
- P34 - AVAILABLE BY KEYING IN V37E34E
- P35 - AVAILABLE BY KEYING IN V37E35E
- P38 - AVAILABLE BY KEYING IN V37E38E
- P39 - AVAILABLE BY KEYING IN V37E39E
- P74 - AVAILABLE BY KEYING IN V37E74E
- P75 - AVAILABLE BY KEYING IN V37E75E
- P76 - AVAILABLE BY KEYING IN V37E76E
- P77 - AVAILABLE BY KEYING IN V37E77E
- P78 - AVAILABLE BY KEYING IN V37E78E
- P79 - AVAILABLE BY KEYING IN V37E79E
- R03 - AVAILABLE BY KEYING IN V48E
- R30 - AVAILABLE BY KEYING IN V82E
- P31 - AVAILABLE BY KEYING IN V83E
- P34 - AVAILABLE BY KEYING IN V85E
- N09 - AVAILABLE BY KEYING IN V15N09E
- N20 - AVAILABLE BY KEYING V16N20E
- N22 - AVAILABLE BY KEYING V16N22E
- N36 - AVAILABLE BY KEYING V16N36E
- N91 - AVAILABLE BY KEYING V16N91E
- N92 - AVAILABLE BY KEYING V16N92E
- N95 - AVAILABLE BY KEYING V16N95E
- N96 - AVAILABLE BY KEYING V16N96E
- V46E- AVAILABLE BY KEYING IN V46E
- V60 - AVAILABLE BY KEYING V60E
- V61 - AVAILABLE BY KEYING V61E
- V62 - AVAILABLE BY KEYING V62E
- V63 - AVAILABLE BY KEYING V63E
- V96E- AVAILABLE BY KEYING V96E

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
--------------	-----	--------	------	-----------	------	---------------

.CREW  
.PROGRAM  
.SELECTION

...

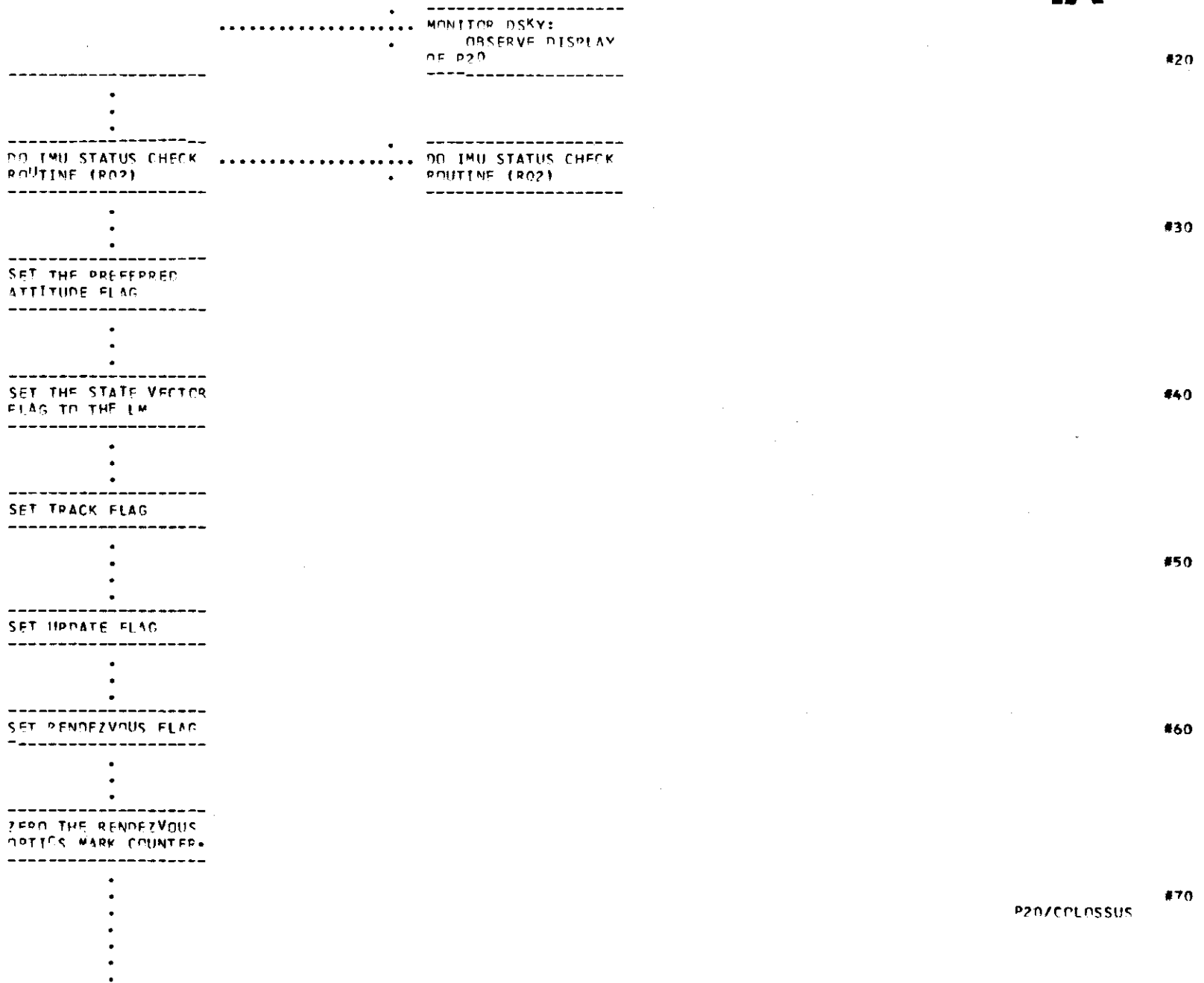
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-----  
START RENDEZVOUS  
NAVIGATION PROGRAM  
(P20).  
DISPLAY P20

.  
.....  
.

-----  
KEY IN RENDEZVOUS  
NAVIGATION PROGRAM  
(P20)  
V37E20E  
-----

# 1A



8

ZERO THE RENDEZVOUS  
VHF RANGING MARK  
COUNTER.

EXTRAPOLATE PERMA-  
NENT STATE VECTORS  
(LM AND OSM) TO THE  
PRESENT TIME USING  
PRECISION INTEGRA-  
TION.

REDD  
P20

IS TRACK FLAG SET?

.Y .N  
.  
.  
.  
.  
.  
EXIT

IS THE REFSMMAT FLAG  
SET?

.Y .N  
.  
.  
.  
.  
.  
EXIT

#80

#90

#100

#110

#120

**1A**

# 1A

CALL THE RENDEZVOUS  
DATA PROCESSING  
ROUTINE (R22)

THE RENDEZVOUS DATA  
PROCESSING ROUTINE  
IS NOW AUTOMATIC

#130

SET P61 COUNTER  
EQUAL TO ZERO.

#140

SET LM TARGET FLAG  
FOR USE BY AUTO  
OPTICS POSITIONING  
ROUTINE (R52).

#150

DO TRACKING ATTITUDE  
ROUTINE (R61) WHICH  
WILL CALL ATTITUDE  
MANEUVER ROUTINE  
(R60)

DO TRACKING ATTITUDE  
ROUTINE (R61) WHICH  
WILL CALL ATTITUDE  
MANEUVER ROUTINE  
(R60)

#160

++  
+22  
++  
PCR  
606

++  
+27  
++  
PCR  
606

CALL THE AUTO OPTICS  
POSITIONING ROUTINE  
(P52)

THE AUTO OPTICS POS-  
ITIONING ROUTINE  
(P52) AND THE TRACK-  
ING ATTITUDE ROUTINE  
(P61) ARE NOW AUTO-  
MATIC.

#170

DO I DESIRE TO  
TERMINATE P20?

.Y .N

#180

DO I DESIRE TO  
SELECT CMC IDLING  
PROGRAM(P00)?

.Y .N

#190

WAIT FOR KEYBOARD  
ENTRY.

SELECT CMC  
IDLING PROGRAM  
(P00).  
KEY IN  
V37E00F

#200

RESPONSE TO V56F  
OR V37E00E  
IMMEDIATELY.

KEY IN  
V56F

#210

.V	.V
.5	.3
.6	.7
.F	.F
.	.0
.	.0
.	F
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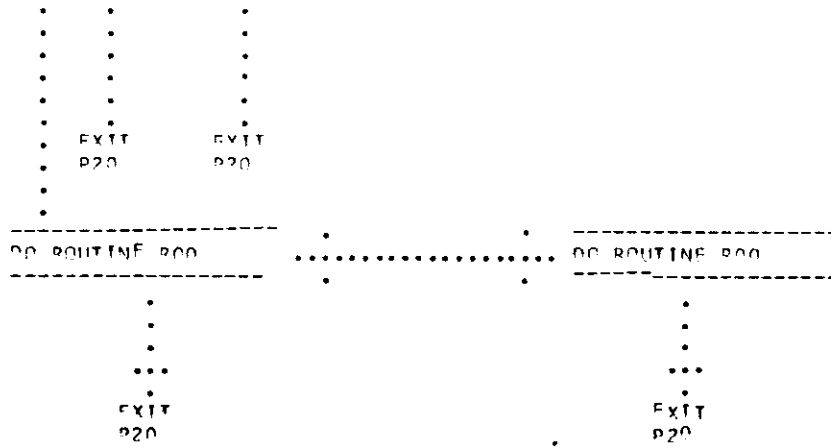
EXIT P20

#220

1A



13



020/00105516

#290

#290

CHANGE CONTROL NOTES

LOGIC REV 18	PCR NASA	147
LOGIC REV 19	PCR MIT	66
LOGIC REV 20	PCR	468
	PCR	206
	PCR	465
LOGIC REV 21	PCR	679
LOGIC REV 22	PCR	606

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## GROUND TRACK DETERMINATION PROGRAM (P21)

LOGIC REV C6 07/08/68

PURPOSE: (1) TO PROVIDE THE ASTRONAUT DETAILS OF HIS GROUND TRACK WITHOUT THE NEED FOR GROUND COMMUNICATION.

ASSUMPTIONS: (1) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(2) THIS PROGRAM MAY BE SELECTED WHILE THE CSM IS IN EITHER EARTH OR LUNAR ORBIT TO DEFINE THE GROUND TRACK OF EITHER THE LM OR CSM.

(3) THIS PROGRAM ASSUMES THE VEHICLE WHOSE GROUND TRACK PARAMETERS ARE CALCULATED TO REMAIN IN FREE FALL FROM THE PRESENT TIME UNTIL T LAT LONG.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
--------------	-----	--------	------	-----------	------	---------------

-----  
START GROUND TRACK  
DETERMINATION  
PROGRAM (P21).  
DISPLAY PROGRAM 21

.  
.....  
.

-----  
KEY IN GROUND TRACK  
DETERMINATION  
PROGRAM (P21)  
V37E21E  
-----

.CREW  
.PROGRAM  
.SELECTION  
.  
...  
.

.  
.  
.

.  
.....  
.

-----  
MONITOR DSKY:  
OBSERVE DISPLAY OF  
PROGRAM 21  
-----

#10

#20

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FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY OPTION CODE  
FOR ASSUMED VEHICLE  
(LM OR CSM)

V04 N06  
R1 00002  
R2 0000X  
R3 BLANK

R1 IS THE OPTION  
CODE FOR ASSUMED  
VEHICLE.

R2 IS THE ASSUMED  
OPTION:

00001 - THIS  
VEHICLE  
00002 - OTHER  
VEHICLE

WAIT FOR KEYBOARD  
ENTRY

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA.

.P .NEW  
.R .DATA  
.Q .  
.C  
.E STORE  
.E NEW  
.D DATA

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF OPTION CODE FOR  
ASSUMED VEHICLE  
(LM OR CSM).

IS THE ASSUMED  
OPTION CORRECT?

.Y .N

KEY IN  
PROCEED

KEY IN V22E  
AND LOAD THE  
DESIRED OPTION  
INTO R2

#30

#40

#50

#60

#70

#80

HOLD .....  
 SNAP .....  
 FLASH VERB-NOUN TO  
 REQUEST RESPONSE AND  
 DISPLAY T LAT LONG:  
 V06 N34  
 R1-T LAT LONG-HRS  
 R2-T LAT LONG-MIN  
 R3-T LAT LONG-SECS

T LAT LONG - TIME  
 (GET) AT WHICH LAT  
 AND LONG OF VEHICLE  
 POSITION IS DESIRED  
 IN HRS, MINS, SECS  
 TO NEAREST .01 SEC.

WAIT FOR KEYBOARD  
 ENTRY

TERMINATE FLASH UPON  
 RECEIPT OF NEW DATA  
 OR PROCEED

.NEW .P  
 .DATA .R  
 .C  
 -----  
 .C  
 STORE .E  
 NEW .E  
 DATA .C  
 -----

MONITOR DSKY:  
 OBSERVE VERB-NOUN  
 FLASH TO REQUEST  
 RESPONSE AND DISPLAY  
 OF T LAT LONG. AM I  
 SATISFIED WITH THIS  
 TIME?

.N .Y

KEY IN  
 PROCEED

KEY IN V25E AND LOAD  
 DESIRED T LAT LONG.

#90

#100

#110

#120

#130

-----  
CALCULATE LATITUDE,  
LONGITUDE AND ALTI-  
TITUDE OF VEHICLE AT  
T LAT LONG  
-----

#140

HOLD .. FLASH VERB-NOUN TO  
..... REQUEST RESPONSE AND  
SNAP .. DISPLAY LATITUDE,  
LONGITUDE AND  
ALTITUDE:  
V06 N43  
R1-LAT  
R2-LONG  
R3-ALT

-----  
MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF LATITUDE, LONGI-  
TITUDE AND ALTITUDE  
-----

#150

LAT-LATITUDE OF  
VEHICLE. + IS NORTH.  
IN DEGREES TO NEAR-  
EST .01 DEGREE.

LONG-LONGITUDE OF  
VEHICLE. + IS EAST.  
IN DEGREES TO NEAR-  
EST .01 DEGREE.

#160

ALT-ALTITUDE OF  
VEHICLE ABOVE THE  
LAUNCH PAD RADIUS  
(EARTH ORBIT) OR  
THE LUNAR RADIUS AT  
THE MOST RECENTLY  
DEFINED (SEE SECTION  
5 OF R577)  
LANDING SITE (LUNAR  
ORBIT). IN NAUTICAL  
MILES TO NEAREST .1  
NM.  
-----

#170

#180

```

DO I WISH TO OBTAIN
NEW PARAMETERS FOR
A TIME 10 MIN.
LATER THAN THAT
WHICH APPLIES TO
PRESENT DISPLAY?

```

```

.N .Y

```

#190

```

WAIT FOR KEYBOARD
ENTRY

```

```

WHEN FINISHED
WITH DISPLAY
KEY IN
PROCEED

```

#200

++  
+06  
++

```

TERMINATE FLASH UPON
RECEIPT OF RECYCLE
OR PROCEED

```

```

WHEN FINISHED
WITH DISPLAY KEY
IN RECYCLE
V32E

```

#210

```

.R .P
.E .R
.C .O
.Y .C
.C .E
.L .E
.E .D

```

```

INCREMENT T-LAT-
LONG BY 10 MIN.

```

#220

```

DO ROUTINE R00

```

```

DO ROUTINE R00

```

#230

EXIT

EXIT

LOGIC REV 6 PCR 206

## PURPOSE:

- (1) TO LOCATE AND TRACK A LANDMARK SUITABLE FOR NAVIGATION PURPOSES.
- (2) TO OBTAIN SIGHTING MARKS ON THE CHOSEN LANDMARK.
- (3) TO CALCULATE THE ORBITAL PARAMETER CHANGES GENERATED BY THE LANDMARK SIGHTING MARKS.
- (4) TO DISPLAY THE ORBITAL PARAMETER CHANGES GENERATED BY THE FIRST SIGHTING MARK ON A LANDMARK, FOR DECISION BY THE NAVIGATOR/GROUND AS TO THE VALIDITY OF THE LANDMARK AND NAVIGATION PROCESS PRIOR TO INCORPORATION OF STATE VECTOR CHANGES AS A RESULT OF THE SIGHTING MARKS.
- (5) TO PROVIDE UPDATED COORDINATES OF THE KNOWN LANDMARKS.
- (6) TO PROVIDE COORDINATES OF UNKNOWN LANDMARKS.
- (7) TO TRACK A PRELOADED LANDING SITE.
- (8) TO PROVIDE COORDINATES OF A NEW LANDING SITE (TREATED AS AN UNKNOWN LANDMARK)
- (9) TO PROVIDE COORDINATES OF AN OFFSET LANDING SITE.
- (10) TO POINT THE OPTICS ALONG AN ADVANCED ORBIT GROUND TRACK FOR THE PURPOSE OF TRACKING AND MAPPING A NEW LANDING SITE.

## ASSUMPTIONS:

- (1) THERE ARE 25 KNOWN LUNAR LANDMARKS STORED IN FIXED MEMORY IN THE CMC AND ONE LANDMARK MAY BE STORED IN ERASABLE MEMORY IN THE CMC. THE LANDMARK STORED IN ERASABLE MEMORY IS REFERRED TO AS THE LANDING SITE AND IS DESIGNATED BY LANDMARK CODE NUMBER 01, THIS CODE IS AVAILABLE FOR LUNAR LANDMARK STORAGE ONLY.
- (2) THERE ARE TWO TYPES OF LANDMARK TRACKING METHODS:
  - (A) "KNOWN" LANDMARK TRACKING - THE TRACKING OF AN EARTH LANDMARK MADE KNOWN TO THE CMC BY LATITUDE, LONGITUDE OVER 2, AND ALTITUDE AND THE TRACKING OF A LUNAR LANDMARK MADE KNOWN TO THE CMC BY ITS LANDMARK CODE NUMBER OR BY LATITUDE, LONGITUDE OVER 2, AND ALTITUDE.
  - (B) "(UNKNOWN)" LANDMARK TRACKING - THE TRACKING OF A LANDMARK OR SURFACE FEATURE IDENTIFIED TO THE CMC AS AN UNKNOWN LANDMARK, ONE WHOSE COORDINATES ARE NOT KNOWN.
- (3) THERE ARE TWO TYPES OF LANDING SITE MAPPING METHODS, IN EITHER CASE THE LANDING SITE COORDINATES MAY BE STORED IN CMC MEMORY (REFER TO ASSUMPTION 1), THEY ARE:
  - (A) LANDING SITE DESIGNATION - TRACK AND MARK ON AN UNKNOWN LANDMARK. STORE THE RESULTING COORDINATES IN LANDMARK CODE 01. IF MAPPING ONLY IS DESIRED, I.E. NO STATE VECTOR CALCULATION OR CORRECTIONS, THE ASTRONAUT NEED TAKE ONLY ONE MARK.

++  
+10  
++  
PCN  
552

(B) LANDING SITE OFFSET - WHILE TRACKING AND MARKING ON A PRIMARY LANDMARK (KNOWN OR UNKNOWN), POINT THE OPTICS SLOS AT THE CHOSEN LANDING SITE AND MARK IT ONCE, (AT LEAST ONE MARK ON THE PRIMARY LANDMARK MUST HAVE BEEN MADE PRIOR TO THIS), THEN CONTINUE MARKING ON THE PRIMARY LANDMARK. STORE THE RESULTING COORDINATES OF THE OFFSET LANDING SITE IN LANDMARK CODE 01. THE ASTRONAUT HAS TWO WAYS OF DEFINING TO THE CMC WHICH MARK WAS MADE ON THE OFFSET LANDING SITE. THEY ARE:

1. KEY IN V52E AFTER MARKING ON THE OFFSET LANDING SITE. THIS WILL SET THE INDEX OF OFFSET DESIGNATOR EQUAL TO THE VALUE OF THE MARK COUNTER.
2. SIMPLY MARK ON THE OFFSET LANDING SITE BUT MAKE A MENTAL NOTE OF WHICH MARK IN THE SEQUENCE IT WAS AND THEN SET THE INDEX OF OFFSET DESIGNATOR TO THAT VALUE WHEN IT IS DISPLAYED FOLLOWING THE SIGHTING MARK ROUTINE.

(4) ACQUISITION OF A LANDMARK MAY BE AIDED BY THE CMC BY USE OF THE AUTOMATIC OPTICS POSITIONING ROUTINE (R52). CARE SHOULD BE EXERCISED WHEN AN UNKNOWN LANDMARK IS CHOSEN TO KEEP THE OPTICS OUT OF THE CMC MODE TO AVOID POSSIBLE PROGRAM ALARMS.

(5) ACQUISITION OF A PRELCADED LANDING SITE MAY BE AIDED BY KEYING LANDMARK CODE 01 INTO THE V05N70 DISPLAY FOR USE BY THE AUTOMATIC OPTICS POSITIONING ROUTINE (R52). TO IMPROVE THESE COORDINATES REFER TO ASSUMPTION 3.

(6) DURING LUNAR ORBIT WHILE IN THE CMC IDLING PROGRAM (P00) THE LUNAR LANDMARK SELECTION ROUTINE (R35) IS AVAILABLE TO AID THE CREW IN THE SELECTION OF APPROPRIATE LANDMARKS PRIOR TO THE SELECTION OF THIS PROGRAM.

(7) THE GROUND TRACK DETERMINATION PROGRAM (P21) IS AVAILABLE TO AID THE CREW IN CHOOSING APPROPRIATE LANDMARKS PRIOR TO SELECTION OF THIS PROGRAM.

(8) THE GROUND TRACK DETERMINATION PROGRAM (P21) IS AVAILABLE TO THE CREW FOLLOWING THIS PROGRAM TO PROVIDE UPDATED GROUND TRACK INFORMATION.

(9) POSSIBLE ATTITUDE CONTROL METHODS MIGHT BE AS FOLLOWS (IN ALL CASES CARE MUST BE TAKEN TO MONITOR POSSIBLE IMPENDING IMU GIMBAL LOCK).

(A) MANUAL CONTROL BY THE PILOT OR NAVIGATOR WITH THE ROTATIONAL HAND CONTROLLER.

(B) MANUAL RATE CONTROL BY THE NAVIGATOR WITH THE MINIMUM IMPULSE CONTROL IN THE GNC FREE MODE.

(10) THE PROGRAM MAY BE PERFORMED WITH SIVB ATTACHED IF THE LAUNCH VEHICLE GUIDANCE SWITCH IS PLACED IN THE CMC POSITION THEREBY PERMITTING SIVB ATTITUDE CONTROL WITH THE ROTATIONAL HAND CONTROLLER. GNC A/P CONTROL IS REQUIRED IN THIS CASE.

(11) THE IMU MUST BE ON AND ALIGNED IN ORDER TO COMPLETE THIS PROGRAM.

(12) SELECTION OF THIS PROGRAM WILL TERMINATE THE RENDEZVOUS NAVIGATION PROGRAM (P20).

(13) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
--------------	-----	--------	------	-----------	------	---------------

. CREW PROG.  
. SELECTION  
.  
.  
.

-----  
START ORBITAL  
NAVIGATION  
PROGRAM (P22)  
DISPLAY PROGRAM 22

.  
.....  
.

-----  
KEY IN ORBITAL  
NAVIGATION PROGRAM  
(P22)  
V37E22E  
-----

#10

.  
.  
.

.....  
.

-----  
MONITOR DSKY:  
OBSERVE DISPLAY  
OF PROGRAM 22  
-----

.  
.  
.

-----  
DO IMU STATUS CHECK  
ROUTINE (R02)

.  
.....  
.

-----  
DO IMU STATUS CHECK  
ROUTINE (R02)  
-----

#20

.  
.  
.

-----  
RESET THE RENDEZVOUS  
FLAG  
-----

#30

.  
.  
.

-----  
COMPUTE ANGLE BE-  
TWEEN Y AND V X R.  
-SM - -

THIS ANGLE IS THE  
MAGNITUDE OF THE  
MAXIMUM POSSIBLE  
MIDDLE GIMBAL ANGLE  
ASSUMING THE SC X  
AXIS IS KEPT IN THE  
ORBIT PLANE.  
-----

#40

.  
.  
.  
.  
.  
.

#50

++  
+11  
++  
PCN  
580

-----  
RESET RENCWFLAG  
(SEE P20)  
-----

-----  
FLASH VERR-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY MAGNITUDE OF  
MAX POSSIBLE MIDDLE  
GIMBAL ANGLE IF THE  
X AXIS IS HELD IN  
THE ORBIT PLANE.  
V06 N45  
R1:BLANK  
R2:BLANK  
R3:MGA  
IN DEG. TO NEAR-  
EST .01 DEG.  
-----

HOLD .  
.....  
SNAP .

-----  
MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST RE-  
SPONSE AND DISPLAY  
OF MAGNITUDE OF MAX  
POSSIBLE MIDDLE  
GIMBAL ANGLE IF THE  
SC X AXIS IS KEPT IN  
THE ORBIT PLANE  
-----

#60

#70

-----  
IS MGA GREATER THAN  
60 DEG? IF SO, IT IS  
ADVISABLE TO REALIGN  
THE IMU IF TIME PER-  
MITS.  
-----

#80

.Y .N  
.  
.  
.

-----  
HAS THE ISS BEEN  
ALIGNED IN THE  
PAST 3 HOURS?  
-----

#90

.N .Y  
.  
.  
.

-----  
ADVISE CREW  
ON ANTICI-  
PATED G+N  
ERRORS AND  
SUBSEQUENT  
PROCEDURES  
-----

-----  
SHALL I BYPASS  
IMU ALIGNMENT?  
-----

.N .Y  
.  
.  
.

#100

```

.
.
.
.
-----
SELECT IMU
REALIGN (P52).
WHEN COMPLETE,
RESELECT THIS
PROGRAM.
-----

```

```

.
.
.
.
EXIT P22
.
.
.
.

```

#110

```

-----
TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW PROGRAM
-----

```

```

-----
KEY IN PROCEED
-----

```

```

.P          .NEW
.R          .PRCG
.O          .
.C          .
.E          .
.E          EXIT
.D          P22
.
.
.
.

```

```

-----
CONTROL ATTITUDE
FOR LANDMARK
ACQUISITION
-----

```

#120

```

.
.
.
.
" A "
SEE BELOW
.
.
.
.

```

#130

```

-----
SET THE INDEX OF
OFFSET DESIGNATOR
EQUAL TO ZERO.
-----

```

#140

```

-----
RESET MARK CATA
VALID BIT FOR INFOR-
MATION TO DOWNLINK.
-----

```

#150

```

.
.
" A "
SEE BELOW
.
.
.
.

```

IS THE SPACECRAFT  
IN LUNAR ORBIT?

.N .Y  
.  
.  
.  
GO TO  
"B"  
BELOW

IS THE SPACECRAFT  
IN LUNAR ORBIT?

.Y .N  
.  
.  
.  
GO TO  
"B"  
BELOW

#160

LUNAR ORBIT

#170

MONITOR DSKY:  
OBSERVE VERB NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
LMK CODE.  
TO HAVE THE AUTOMAT-  
IC OPTICS POSITION-  
ING ROUTINE (R52)  
POINT ALONG THE  
GROUND TRACK OF AN  
ADVANCED ORBIT AND  
60 DEGREES AHEAD OF  
THE SPACECRAFT  
CHANGE THE LANDMARK  
CODE TO PX (WHERE P  
>3 AND X DEFINES HOW  
MANY ORBITS AHEAD  
ARE DESIRED). THIS  
CODE IS USED ONLY BY  
THE AUTOMATIC OPTICS  
POSITIONING ROUTINE  
(R52) AT THIS TIME.

#180

#190

#200

POSS  
HOLD . . . FLASH VERB NOUN TO  
REQUEST RESPONSE AND  
SNAP . . . DISPLAY LMK CODE:

V05N70  
R1-BLANK  
R2 ABCDE  
R3-BLANK

A=1 IF KNOWN LMK  
A=2 IF UNKNOWN LMK.  
B= INDEX OF OFFSET  
DESIGNATOR  
C= NOT USED IN THIS  
PROGRAM  
DE-LMK ID NC N

++  
+11  
++  
PCN  
594

NOTE: THE PROBABLE  
OPTIONS ARE:  
A=1. DE=00-  
LANDMARK  
KNOWN BUT  
NOT STORED  
IN CMC  
MEMORY  
A=1. DE>00-  
LANDMARK  
KNOWN AND  
STORED

#210

++  
+11  
++  
FDIT

A=2. DE NOT  
MEANINGFUL:  
UNKNOWN  
LANDMARK.

DO I WISH TO NAVI-  
GATE ON AN UNKNOWN  
LANDMARK?

#220

.Y .N

DO I DESIRE THE  
USE OF THE AUTO-  
MATIC OPTICS  
POSITIONING  
ROUTINE (R52)  
TO AID IN ACQUI-  
SITION?

#230

.N .Y

DO I WISH TO  
NAVIGATE ON  
THIS LAND-  
MARK?

#240

.Y .N

SET OP-  
TICS  
MODE  
SWITCH  
TO MAN-  
UAL.

#250

WAIT FOR KEYBOARD  
ENTRY

.  
.....  
.

KEY IN  
V22E AND  
LOAD NEW  
LMK CODE

#260

#270

-----  
KEY IN  
PROCEED  
-----

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

.N .P  
.E .R  
.W .O  
.D .C  
.A .E  
.T .D  
.A

#280

-----  
STORE  
NEW DATA  
-----

#290

-----  
IS 0 < DE < 32?  
-----

"B"  
.  
.  
.  
.  
.

#300

.Y .N  
.  
.

-----  
EARTH ORBIT  
-----

#310

-----  
IS A = 1?  
(KNOWN LANDMARK)  
-----

.Y .N  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.

IS DE > 0?  
(STORED LANDMARK)

.N .Y

"B"

POSS . FLASH VERB-NOUN  
HOLD . TO REQUEST RESP-  
..... ONSE AND DISPLAY  
SNAP . LMK COORDINATES:  
V06 N89  
R1-LAT  
R2-LONG/2  
R3-ALT

R1-LAT IS LATI-  
TUDE OF LMK IN  
DEG TO NEAREST  
.001 DEGREE, +  
IS NORTH

R2-LONG/2 IS  
LONGITUDE OF  
LMK DIVIDED BY  
2. IN DEGREES  
TO NEAREST .001  
DEGREE, + IS  
EAST

R3-ALT IS ALTI-  
TUDE OF LMK  
ABOVE THE FISCH-  
ER ELLIPSOID  
IN EARTH ORBIT  
ABOVE THE MEAN  
LUNAR RADIUS FOR  
LUNAR ORBIT  
IN NAUTICAL  
MILES TO THE  
NEAREST .01 NM.

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
LMK COORDINATES FOR  
USE ONLY BY THE AUT-  
OMATIC OPTICS POSIT-  
IONING ROUTINE (R52)  
AT THIS TIME.

DO I WISH TO NAVI-  
GATE ON AN UNKNOWN  
LANDMARK?

.Y. .N

DO I DESIRE THE  
USE OF THE AUTO-  
MATIC OPTICS  
POSITIONING ROU-  
TINE (R52) TO AID  
IN ACQUISITION?

.N .Y

SET OPTICS  
MODE SWITCH  
TO MANUAL.

#320

#330

#340

#350

#360

#370

WAIT FOR KEY-BOARD ENTRY

AM I SATISFIED WITH THESE VALUES?

.Y .N

KEY IN PROCEED

KEY IN V25E AND LOAD LMK PARAMETERS:

TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA

.N	.P
.E	.R
.W	.O
.D	.C
.A	.E
.T	.E
.A	.D

STORE NEW DATA

SET SIGHTING FLAG TO LMK FOR USE BY SIGHTING MARK AND AUTO OPTICS POSITIONING ROUTINES.

#380

#390

#400

#410

#420





ZERO.

#480

MAKE SURE B RE-  
MAINS UNCHANGED  
IF A OR DE ARE  
CHANGED.

#490

IS THE DATA IN R2  
CORRECT FOR THIS  
SIGHTING?  
NOTE: IN EARTH ORBIT  
DE MUST BE SET EQUAL  
TO 00 BECAUSE LAND-  
MARK CODE 01 IS  
AVAILABLE FOR LUNAR  
LANDMARKS ONLY.

#500

.Y .N

WAIT FOR KEYBOARD  
ENTRY

.  
.....  
.

KEY IN V22E AND  
LOAD CORRECT  
DATA.

#510

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

.  
.....  
.

KEY IN PROCEED

#520

.N .P  
.E .R  
.W .C  
.D .C  
.A .F  
.T .F  
.A .D

#530

OR





POSS  
HOLD .. FLASH VERB-NOUN  
..... TO REQUEST RESP-  
SNAP .. ONSE AND DISPLAY  
..... LMK COORDINATES:  
..... V06 N89  
..... R1-LAT  
..... R2-LONG/2  
..... R3-ALT

#590

#600

#610

#620

#630

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
LMK COORDINATES

R1=LAT IS LATI-  
TUDE OF LMK IN  
DEG TO NEAREST  
.001 DEGREE,  
+ IS NORTH

R2=LONG/2 IS  
LONGITUDE OF LMK  
DIVIDED BY 2.  
IN DEGREES TO  
NEAREST .001  
DEGREE + IS EAST

R3=ALT IS ALTI-  
TUDE OF LMK  
ABOVE THE FIS-  
CHER ELLIPSGID  
FOR EARTH AND  
MEAN LUNAR RADI-  
US FOR MOON. IN  
NAUTICAL MILES  
TO THE NEAREST  
.01 NM.

AM I SATISFIED WITH  
THESE VALUES?

Y. N

WAIT FOR KEY-  
BOARD ENTRY

KEY IN PROCEED

III

TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED OR NEW  
DATA

.N	.P
.E	.R
.W	.C
.	.C
.D	.E
.A	.E
.T	.D
.A	.

STORE NEW  
DATA

SET THE DATA VALID  
BIT FOR INFORMATION  
TO DOWNLINK.

SET K = 0

SET J = 0

KEY IN V25E AND  
LOAD LMK PAPAMETERS:

P22/COLOSSUS

#640

#650

#660

#670

#680

++  
+11  
++  
PCN  
580

P22/COLOSSUS

#690

SET J = J+1

#700

IS J GREATER THAN THE MARK COUNTER?

.N .Y

#710

GET JTH MARK DATA FROM CMC STORAGE

#720

IS J = INDEX OF OFFSET DESIGNATOR?

.Y .N

#730

STORE MARK IN OFFSET DESIGNATOR LOCATION

IS THIS THE FIRST MARK?

.Y .N

++  
+11

112 )

)

)

```

+ 113 . . .
+ . . .
+ . . .
+ . . .
+ . . .
+ . . .

```

```

+11 . IS THE KNOWN FLAG .
++ . RESET? .
EDIT . .Y .N .
. . .
. . .

```

#740

```

. . .
. . .
. . .
. . .
. . .
. . .

```

#750

```

++ . . .
+11 . . .
++ . . .
EDIT . . .
. . .

```

```

. . .
. . .
. . .
. . .
. . .
. . .

```

#760

```

. . .
. . .
. . .

```

```

. . .
. . .
. . .
. . .
. . .
. . .

```

#770

```

POSS . . .
HOLD . . .
SNAP . . .
. . .
. . .
. . .

```

```

. . .
. . .
. . .
. . .
. . .
. . .

```

```

. . .
. . .
. . .
. . .
. . .
. . .

```

```

. . .
. . .
. . .
. . .
. . .
. . .

```

#780

```

. . .
. . .
. . .
. . .
. . .
. . .

```

#790

```

. . .
. . .
. . .
. . .
. . .
. . .

```

SIGHTING DATA IN  
N.M. TO NEAREST  
0.1 N.M.

DELTA V-MAGNI-  
TUDE OF THE  
DIFFERENCE BE-  
TWEEN THE VELO-  
CITY VECTOR BE-  
FORE AND AFTER  
INCORPORATION OF  
THE LANDMARK  
SIGHTING DATA IN  
FPS TO THE NEAR-  
EST .1 FPS.

-----  
WAIT FOR KEY-  
BOARD ENTRY

TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED OR RE-  
CYCLE.

-----  
.R .P  
.E .R  
.C .D  
.Y .C  
.C .E  
.L .E  
.E .D

GO TO  
"A"  
ABOVE

-----  
SET K = 1  
-----

.....  
.

.....  
.

-----  
KEY IN PROCEED  
-----

-----  
KEY IN RECYCLE  
V32E  
-----

GO TO  
"A"  
ABOVE

#800

#810

#820

#830

#840





R2=LONG/2 IS LONGI-  
TUDE OF LMK DIVIDED  
BY 2. IN DEGREES TO  
NEAREST .001 DEGREE  
+ IS EAST

R3=ALT IS ALTITUDE  
OF LMK ABOVE THE  
FISCHER ELLIPSOID  
FOR EARTH AND MEAN  
LUNAR RADIUS FOR  
MOON. IN NAUTICAL  
MILES TO THE NEAREST  
.01 NM.

-----  
.  
.  
.  
-----  
WAIT FOR KEY-  
BOARD ENTRY

MONITOR DSKY:  
OBSERVE VERB-  
NOUN FLASH TO  
REQUEST RESPONSE  
AND DISPLAY OF  
THE OFFSET LAND-  
ING SITE COORDI-  
NATES.

#910

#920

#930

-----  
SHALL THESE COORDIN-  
ATES BE STORED IN  
CMC MEMORY AND BE  
DEFINED AS THE LAND-  
ING SITE (LANDMARK  
CODE 01)?

#940

NOTE1: IF THESE CO-  
ORDINATES ARE STOR-  
ED, THE PREVIOUSLY  
STORED COORDINATES  
OF THE LANDING SITE  
WILL BE ERASED. IF  
THEY ARE NOT STORED  
THE PREVIOUSLY  
STORED LANDING SITE  
COORDINATES WILL BE  
SAVED IN THE LAND-  
MARK CODE 01  
LOCATION.

#950

NOTE2: THE CAPABIL-  
ITY OF STORING THE  
LANDING SITE IS ONLY  
AVAILABLE FOR LUNAR  
LANDMARKS. FOR THIS  
REASON THE ASTRONAUT

SHOULD ALWAYS KEY  
EITHER V32E OR V34E  
ON THIS DISPLAY  
WHEN IN EARTH ORBIT.

#960

.YES .NO

.  
.

..... KEY IN PROCEED

.  
.  
.

TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED OR  
RECYCLE

..... KEY IN RECYCLE  
V32E

#970

.R .P  
.E .R  
.C .C  
.Y .C  
.C .E  
.L .E  
.E .D

GO TO  
"A"  
ABOVE

GO TO  
"A"  
ABOVE

#980

GO TO  
"A"  
ABOVE

-----  
STORE THESE COORDIN-  
ATES AS UPDATED  
LANDING SITE  
PARAMETERS.  
-----

.  
.  
.  
.  
GO TO  
"A"  
ABOVE

#990

#1000

V34E

.  
.  
.  
.

#1010



- PURPOSE: (1) TO DO MIDCOURSE NAVIGATION BY INCORPORATION OF STAR/EARTH AND STAR/MOON OPTICAL MEASUREMENTS.
- ASSUMPTIONS: (1) THIS PROGRAM DOES NOT REQUIRE THAT THE IMU BE ON.
- (2) IF THE IMU IS NOT ALIGNED THE ASTRONAUT MUST ACQUIRE THE STAR/LMK OR STAR/HOR MANUALLY.
- (3) (A) IF THE IMU IS ALIGNED THE ASTRONAUT MAY ACQUIRE THE LMK/HOR AUTOMATICALLY.
- (B) IF THE IMU IS ALIGNED THE ASTRONAUT MAY ACQUIRE THE STAR AUTOMATICALLY.
- (C) IF THE IMU IS ON THE ASTRONAUT MUST TAKE APPROPRIATE PRECAUTIONS TO PREVENT POSSIBLE IMU GIMBAL LOCK.
- (4) PRIOR TO EACH MARK THE PROGRAM WILL CALL FOR AN OPTICS CALIBRATION WHICH MAY BE DONE OR BYPASSED DEPENDENT UPON THE STABILITY HISTORY OF THE CALIBRATION (SEE PURPOSES AND ASSUMPTIONS OF R57).
- (5) TO PERFORM THE MARK THE ASTRONAUT SHOULD FINALLY SELECT MINIMUM IMPULSE CONTROL (EITHER GNCS OR SCS) AND THE OPTICS SHOULD BE IN MANUAL IN ORDER TO MAINTAIN THE FIX.
- (6) THE OPTICS SHOULD BE ON FOR 15 MINUTES PRIOR TO MARKING.
- (7) THE CMC DOES NOT CHECK FOR MOON/EARTH OCCULTATION OR SUN BRIGHTNESS IN THIS PROGRAM
- (8) THIS PROGRAM IS DESIGNED FOR ONE MAN OPERATION WITHIN THE CONSTRAINTS OF MODE SWITCHING WHILE IN THE LEB.
- (9) THE SIGHTING IS ON THE BODY FOR WHICH THE STATE VECTOR IS DEFINED.
- (10) A STAR SERIAL 0 WILL GIVE PARITY FAILURE, AND LANDMARK SERIAL 01 WILL NOT WORK.
- (11) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

++  
+14  
++  
EDIT

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
--------------	-----	--------	------	-----------	------	---------------

.CREW PRG.  
.SELECTION

...  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.

-----  
START CISELUNAR MID-  
COURSE NAVIGATION  
PROGRAM (P23)  
DISPLAY P23

-----  
KEY IN CISELUNAR MID-  
COURSE NAVIGATION  
PROGRAM (P23)  
V37E 23E  
-----

#10

-----  
MONITOR DSKY:  
OBSERVE DISPLAY OF  
PROGRAM 23  
-----

#20

-----  
SET MARK INDEX TO 1  
FOR USE BY THE  
SIGHTING MARK  
ROUTINE R53  
-----

#30

-----  
RESET RENDEZVOUS FLAG  
-----

#40

-----  
SET TARGET FLAG TO  
STAR FOR USE BY THE  
SIGHTING MARK ROU-  
TINE (R53) AND BY  
THE AUTO OPTICS  
POSITIONING ROUTINE  
(R52)  
-----

#50

-----  
RESET V94 FLAG  
-----

"B"

++  
+13  
++  
EDIT  
PCR  
206



DO SIGHTING  
MARK ROUTINE,  
(R53).

DO THE SIGHTING  
MARK ROUTINE,  
R53.

GO TO  
"A"  
BELOW

MANUALLY MAN-  
EUVER THE  
VEHICLE UNTIL A  
SUITABLE LMK/  
HOR IS IN THE  
SXT FIELD OF  
VIEW. THEN,  
BY USE OF MIN-  
IMUM IMPULSE  
CONTROL (GNCS  
OR SCS) AC-  
QUIRE THE LMK  
AND BY USE OF  
OPTICS CONTROL-  
LER SUPERIMPOSE  
THE NAVIGATION  
STAR PER CHECK-  
LIST.

GO TO  
"A"  
BELOW

#110

#120

#130

#140

POSS  
HOLD .  
.....  
SNAP .

FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY MEASUREMENT  
IDENTIFICATION  
V05 N70  
R1-000DE (STAR ID)  
R2-ABCOE (LMK ID)  
R3-00CDO (HOR ID)

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF MEASUREMENT  
IDENTIFICATION

#150



STAR IDENTIFICATION-  
 R1=000XX FOR ID  
 NUM. OF STAR  
 USED

LANDMARK IDENTIFI-  
 CATION  
 R2=ABCDE WHERE

A AND B-NOT  
 USED

C=1 FOR EARTH  
 LMK

C=2 FOR MOON  
 LMK

DE-LANDMARK ID  
 NUMBER

R2=00000 FOR  
 HOR. MEAS.

HORIZON IDENTIFI-  
 CATION  
 R3=00CDO WHERE

C=1 FOR EARTH  
 HOR.

C=2 FOR MOON  
 HOR.

D=1 FOR NEAR  
 HORIZON

D=2 FOR FAR  
 HORIZON

R3=00000 FOR  
 LMK MEAS.

-----  
 DO I INTEND TO DO  
 THE SIGHTING  
 MANUALLY?  
 THIS DATA WILL BE  
 USED AT THIS TIME  
 FOR THE AUTOMATIC  
 TRACKING MANEUVER  
 AND BY THE AUTO-  
 MATIC OPTICS  
 POSITIONING ROUTINE  
 (R52) ONLY. IF IT IS  
 INTENDED TO DO MAN-  
 UAL ACQUISITION THIS  
 DISPLAY NEED NOT BE  
 REVIEWED. IT WILL BE  
 REDISPLAYED PRIOR TO  
 STATE VECTOR  
 CALCULATION.  
 -----

.Y .N

-----  
 SET OPTICS MODE  
 SWITCH TO MANUAL  
 -----

-----  
 AM I SATISFIED  
 WITH THIS DATA?  
 -----

.Y .N

-----  
 RECORD MEAS-  
 UREMENT IDEN-  
 TIFICATION  
 DATA IN  
 FLIGHT DATA  
 BOOK IF  
 DESIRED  
 -----

#160

#170

#180

#190

#200

#210

WAIT FOR KEYBOARD  
ENTRY

KEY IN  
PROCEED

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

KEY IN V25E AND  
LOAD NEW DATA

#220

.P .NEW  
.R .DATA  
.O .  
.C  
.E STORE NEW  
.E DATA  
.D

#230

WAS R3=0  
( LMK MEASUREMENT?)

#240

.N(HOR) .Y(LMK)

ARE R2(DE) NON-  
ZERO ( LMK IDENTIFIED )

#250

.Y .N

#260



TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED OR NEW  
DATA

.P .NEW  
.R .DATA  
.O .  
.C -----  
.E STORE NEW  
.E DATA  
.D -----

-----  
KEY IN  
V25E  
AND  
LOAD  
NEW  
DATA  
-----

#320

#330

POSS  
HOLD . FLASH VERB-NOUN TO  
..... REQUEST PLEASE  
SNAP . PERFORM GNCS AUTO-  
MATIC MANEUVER  
V50 N25

R1-00202  
R2-BLANK  
R3-BLANK

-----  
MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH REQUESTING  
PLEASE PERFORM AUTO-  
MATIC MANEUVER  
-----

#340

#350

-----  
DO I WISH TO HAVE  
THE GNCS COMPUTE THE  
SPACECRAFT ATTITUDE  
REQUIRED TO POINT  
THE LLOS AT THE  
CHOSEN LMK/HOR AND  
PERFORM THE ATTITUDE  
MANEUVER ROUTINE  
(R60)?  
THIS ATTITUDE WILL  
BE COMPUTED (VEC-  
POINT) TO POINT THE  
LLOS AXIS AT THE  
LMK/HOR BUT WILL NOT  
CONSTRAIN THE ORIEN-  
TATION ABOUT THAT  
VECTOR (THE ORIEN-  
TATION ABOUT THAT  
VECTOR COULD RESULT

#360



#430

DO THE ATTITUDE  
MANEUVER ROUTINE  
(R60)

DO THE  
ATTITUDE  
MANEUVER  
ROUTINE (R60)

#440

IS R57 FLAG SET?

.N .Y

#450

DO R57 OPTICS  
CALIBRATION  
ROUTINE

DO R57 OPTICS CALI-  
BRATION ROUTINE  
(WHEN LMK ACQUIRED)

++  
+14  
++  
PCN  
571

SET V94 FLAG

#460

SET R57 FLAG

DO THE AUTOMATIC  
OPTICS POSITIONING  
ROUTINE (R52) (CALLS  
R53)

DO R52 AUTOMATIC  
OPTICS POSITIONING  
ROUTINE. THE OPTICS  
POINTING PROCESS IS  
NOW AUTOMATIC AND  
WILL POINT THE SXT  
STAR LOS AT THE  
CHOSEN STAR UNTIL  
THE SIGHTING MARK  
ROUTINE (R53) IS

#470

.NORMAL .PREMATURE  
.EXIT .EXIT VIA  
.V94E

DO V94 LOGIC (AS

++  
+13  
+  
+  
+  
+



STAR IDENTIFICATION-  
R1=000XX FOR ID  
NUM. OF STAR  
USED

#530

LANDMARK IDENTIFI-  
CATION  
R2=ABCDE WHERE

-----  
IS THIS DATA CORRECT  
FOR THE MARK I MADE?  
-----

.Y .N

A AND B-NOT  
USED

#540

C=1 FOR EARTH  
LMK  
C=2 FOR MOON  
LMK

DE-LANDMARK ID  
NUMBER

R2=00000 FOR  
HOR. MEAS.

#550

HORIZON IDENTIFI-  
CATION  
R3=00C00 WHERE

C=1 FOR EARTH  
HOR.  
C=2 FOR MOON  
HOR.

#560

D=1 FOR NEAR  
HORIZON  
D=2 FOR FAR  
HORIZON

R3=00000 FOR  
LMK MEAS.

-----  
RECORD MEASURE-  
MENT IDENTIFIC-  
ATION DATA IN  
FLIGHT DATA  
BOOK IF DESIRED  
-----

#570

-----  
WAIT FOR KEYBOARD  
ENTRY

-----  
KEY IN  
PROCEED  
-----



TERMINATE FLASH UPON  
RECEIPT OF PROCFED  
OR NEW DATA

KEY IN V25E AND  
LOAD NEW DATA

#580

.P .NEW  
.R .DATA  
.D .  
.C  
.E STORE NEW  
.E DATA  
.D

#590

WAS R3=0  
(LMK MEASUREMENT?)

#600

.N(HOR) .Y(LMK)

ARE R2(DE) NON-  
ZERO (LMK IDENT-  
IFIED )

#610

.Y .N

#620

#630

POSS  
HOLD .  
.....  
SNAP .

FLASH VERB-NOUN  
TO REQUEST RE-  
SPONSE AND DIS-  
PLAY LMK DATA  
V06 N89

R1: LAT  
R2: LONG/2  
R3: ALT

LAT:-LATITUDE  
OF LMK IN DEG  
TO NEAREST .001  
DEG  
+ IS NORTH

LONG/2-LONGI-  
TUDE OF LMK DI-  
VIDED BY 2 IN  
DEG TO NEAREST  
.001 DEG  
+ IS EAST

ALT-ALT OF LMK  
IN NAUTICAL  
MILES TO NEAR-  
EST .01 N.M.  
(FOR EARTH  
ABOVE FISCHER  
ELLIPSCID) (FOR  
MOON ABOVE MEAN  
LUNAR RADIUS)

WAIT FOR KEY-  
BOARD ENTRY

TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED OR NEW  
DATA

.P .NEW  
.R .DATA  
.C .  
.C -----  
.E STORE NEW  
.E DATA

MONITOR DSKY:  
OBSERVE VERB-  
NOUN FLASH TO  
REQUEST RESPONSE  
AND DISPLAY OF  
LMK DATA IF A  
NON-IDENTIFIED  
LANDMARK WAS  
CHOSEN

ARE THESE THE  
COORDINATES OF  
THE LANDMARK I  
MARKED ON?

.Y .N

KEY IN  
PROCEED

KEY IN  
V25E  
AND  
LOAD  
NEW  
DATA

#640

#650

#660

#670

#680



DELTA V- MAGNITUDE  
OF THE DIFFERENCE  
BETWEEN THE VELOCITY  
VECTOR BEFORE AND  
AFTER INCORPORATION  
OF THE STAR MEASURE-  
MENT DATA IN FEET/  
SEC TO NEAREST 0.1  
FPS

#740

ARE ORBITAL PARAMET-  
ER CHANGES ACCEPT-  
ABLE FOR INSERTION  
INTO CMC CALCULAT-  
IONS OF POSITION  
AND VELOCITY?

#750

. Y . N  
.  
.

WAIT FOR KEYBOARD  
ENTRY

KEY IN PROCEED

#760

TERMINATE FLASH ON  
RECEIPT OF PROCEED  
OR RECYCLE

KEY IN  
RECYCLE  
V32E

#770

.P .R  
.R .E  
.O .C  
.C .Y  
.E .C  
.E .L  
.D .E  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
GC TO  
"B"  
ABOVE

GO TO  
"B"  
ABOVE

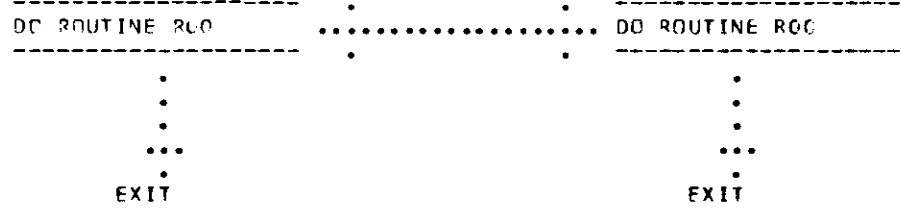
#780

UPDATE CMC  
STATE VECTOR

135

)  
.  
.  
.  
.  
.  
.

P23/COLOSSUS



#790

#800

CHANGE CONTRCL NOTES

- REV 10    PCR NASA 84
- REV 11    PCR MIT 66
- REV 12    PCR 206
- REV 13    PCN 520
- REV 14    PCN 571
- PCR 206 EDITORIAL

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CMC UPDATE PROGRAM (P27)

LOGIC REV 07 11/26/68

- PURPOSE: (1) TO INSERT INFORMATION INTO THE CMC VIA THE DIGITAL UPLINK BY TRANSMISSION FROM THE GROUND OR VIA THE DSKY KEYBOARD BY CREW MANUAL INPUT.
- ASSUMPTIONS: (1) THE CMC MUST BE IN THE OPERATE CONDITION. THE IMU MAY BE IN STANDBY OR OPERATE CONDITION.
- (2) CMC UPDATES ARE OF FOUR CATEGORIES:
- (A) PROVIDE AN UPDATE FOR CMC LIFTOFF TIME (V70).
- (B) PROVIDE AN OCTAL INCREMENT FOR THE CMC CLOCK ONLY (V73).
- (C) PROVIDE LOAD CAPABILITY FOR A BLOCK OF SEQUENTIAL ERASABLE LOCATIONS (1-18 INCLUSIVE LOCATIONS WHOSE ADDRESS IS SPECIFIED) (V71).
- (D) PROVIDE LOAD CAPABILITY FOR 1-9 INCLUSIVE INDIVIDUALLY SPECIFIED ERASABLE LOCATIONS (V72).
- (3) A COMPLETE DESCRIPTION OF THE CMC UPLINK FORMAT IS INCLUDED IN SECTION 2 OF R-577.
- (4) UPDATE IS ALLOWED IN THE CSM WHEN THE CMC IS IN P00 OR P02, AND IF THE DSKY IS AVAILABLE.
- (5) THE UPTEL ACCEPT/BLOCK SWITCH MUST BE IN ACCEPT FOR TELEMETRY UPDATE.
- (6) THE PROGRAM IS MANUALLY SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR BY THE GROUND BY UPLINK TRANSMISSION.
- (7) THE AUTOMATIC MODE OF UPDATE IS PROGRAM SELECTION AND UPDATE VIA THE GROUND BY UPLINK TRANSMISSION. THE ONLY DIFFERENCE BETWEEN THIS AND MANUAL SELECTION BY THE ASTRONAUT IS THAT THE DSKY RESPONSES ARE KEYED IN BY THE ASTRONAUT RATHER THAN TRANSMITTED.

PROC CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
--------------	-----	--------	------	-----------	------	---------------

-----						
NOTIFY CREW OF INTENTION TO UPDATE. SPEC- IFY PARAMETERS AND COORDINATE TIME.			-----	VERIFY THAT UPDATE WILL BE SATISFACTORY W.P.T. TIME, WORK IN PROGRESS AND CMC ACTIVITY.		
-----			-----	-----		

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410

P27/COLOSSUS  
P27/SUNDANCE  
P27/LUMINARY

-----  
SELECT THE DE-  
SIRED TYPE OF  
UPDATE:  
V70-LISTOFF  
TIME INCREMENT  
V71-CONTIGUOUS  
BLOCK UPDATE  
V72-SCATTER  
UPDATE  
V73-OCTAL TIME  
INCREMENT  
-----

-----  
INTERRUPT PRESENT  
PROGRAM AND TURN  
ON UPLINK ACTY LITE  
-----

..... TRANSMIT  
V7XF  
-----

-----  
START CMC UPDATE  
PROGRAM  
-----

-----  
IS ANOTHER EXTENDED  
VERB ACTIVE?  
-----

.N .Y  
.  
.  
.

-----  
TURN ON DPR ERR  
LITE  
-----

.....  
EXIT

-----  
IS ANOTHER EXTENDED  
VERB ACTIVE?  
-----

.V .N  
.  
.  
.

-----  
OBSERVE OPER-  
ATOR ERROR  
LITE ON, AND  
UPLINK ACTY  
LITE ON  
-----

.....  
EXIT

#20

#30

#40

#50

#60



IS PROGRAM P00 OR  
P02?

.Y .N

TURN ON OPR ERR  
LITE. TURN OFF  
UPLINK ACTY  
LITE

EXIT

MONITOR DSKY:  
IS PROGRAM P00 OR  
P02?

.N .Y

OBSERVE OPR  
ERR LITE ON  
AND UPLINK  
ACTY LITE OFF.

EXIT

SELECT UPDATE PRO-  
GRAM (P27) DOWNLIST  
FOR DOWNLINK TRANS-  
MISSION

DISPLAY PROGRAM 27

IS THIS A TIME IN-  
CREMENT UPDATE  
(V70 OR V73)?

.N .Y

"B"  
FROM  
BELOW

SET COMPNUMB  
EQUAL TO 2

MONITOR DSKY:  
OBSERVE DISPLAY  
OF PROGRAM 27

GO TO  
"A"  
BELOW

#70

#80

#90

#100

#110

FLASH VERB/NOUN TO  
REQUEST LOAD OF  
INDEX IN MACHINE  
ADDRESS SPECIFIED IN  
R3 AND DISPLAY:

POSS  
HOLD . . . . . V21 N01  
..... R1-BLANK  
SNAP . . . . . R2-UNCHANGED  
R3-AAAAA

MONITOR DOWN-  
LINK:  
OBSERVE VERB/  
NOUN FLASH AND  
DISPLAY OF  
AAAAA

AAAAA-MEMORY LOCA-  
TION IN WHICH THE  
INDEX VALUE WILL BE  
LOADED. THE INDEX  
VALUE REPRESENTS THE  
TOTAL NUMBER OF  
NUMERIC VALUES TO BE  
LOADED, INCLUDING  
THE INDEX VALUE IT-  
SELF. MINIMUM INDEX  
IS 3; MAXIMUM IS 20.

DO I WISH TO  
TERMINATE?

.Y .N

WAIT FOR KEYBOARD  
ENTRY

TRANSMIT  
TERMINATE  
V24F

GO TO "A"  
BELOW

TRANSMIT  
INDEX  
VALUE

#120

#130

#140

#150

#160



-----  
CALCULATE ADDRESS  
FOR STORAGE OF NEXT  
DATA LOAD  
-----

MCN  
FROM  
BELOW

#230

-----  
FLASH VERB/NCUN TO MONITOR DOWN-  
REQUEST LOAD OF DATA LINK:  
INTO CALCULATED OBSERVE VERB/  
ADDRESS SPECIFIED IN... NCUN FLASH TO  
R3 AND DISPLAY: REQUEST DATA  
LOAD  
-----

#240

HOLD .....  
SNAP .....  
V21 NOI  
R1 BLANK  
R2 UNCHANGED  
R3 AAAAA

-----  
DO I WISH TO  
TERMINATE?  
-----

#250

-----  
WAIT FOR KEYBOARD  
ENTRY  
-----

.Y .N

-----  
TRANSMIT  
TERMINATE  
V34F  
-----

#260

-----  
GO TO "A"  
BELOW  
-----

#270

-----  
TRANSMIT  
DATA  
-----

TERMINATE FLASH  
UPON RECEIPT OF  
TERMINATE OP DATA

#280

.T .D  
.E .A  
.R .T  
.M .A  
.I .  
.N .

.T DISPLAY DATA  
.E IN R1 AS IT  
. IS LOADED

#290

GO TO "A"  
BELOW

IS THIS THE LAST  
DATA LOAD? (UPLINK  
COMPONENT COUNTER =  
COMPNUMB)

#300

.N .Y

"D"  
FROM  
BELOW

#310

FLASH VERB/NOUN TO  
REQUEST LOAD OF  
OCTAL IDENTIFIER  
INTO MACHINE ADDRESS...  
SPECIFIED IN R3 AND  
DISPLAY:  
V21 N02  
R1 BLANK  
R2 UNCHANGED  
R3 AAAAA

MONITOR DOWN-  
LINK:  
OBSERVE VERB/  
NOUN FLASH TO  
REQUEST LOAD  
OF OCTAL  
IDENTIFIER

#320

HOLD .  
.....  
SNAP .

OCTAL IDENTIFIER -  
IDENTIFIES WHICH OF  
THE TRANSMITTED  
WORDS WILL BE  
CORRECTED.

#330

-----  
.  
.  
-----

DO I WISH TO  
TERMINATE?

WAIT FOR KEYBOARD  
ENTRY

.Y .N

#340

-----  
.  
DO I WISH  
TO COR-  
RECT ANY  
DATA?  
-----

.Y .N

#350

.  
-----  
.  
-----

TRANSMIT  
TERMIN-  
ATE V34E

#360

GO TO  
MAN  
BELOW

.  
-----  
.  
-----

TRANSMIT  
OCTAL  
IDENTIF-  
IER

#370

.  
-----  
.  
-----

TRANSMIT  
PROCEED

#380



TERMINATE FLASH UPON  
RECEIPT OF TERMIN-  
ATE, PROCEED, OR  
XXE.

-----  
.T .P .X  
.F .R .X  
.R .D .F  
.M .C .  
.I .E .  
.N .E .  
.A .D .  
.T .  
.F .

. . IS XX GRE-  
. . ATER THAN  
. . O AND EQU-  
. . AL TO OR  
GO TO . LESS THAN  
"A" . COMPNUMR  
BELOW .

. . Y .N  
. . .  
. . .  
. . .  
. . GO TO  
. . "D"  
. . ABOVE  
. .  
-----

. . CALCULATE  
. . ADDRESS OF  
. . DATA LOAD  
. . TO BE  
. . CORRECTED  
-----

. . .  
. . .  
. . .  
. . .  
. . GO TO "C"  
. . ABOVE  
. .  
-----

-----  
INVERT VERIFLAG . . . . .

-----  
MONITOR DOWN-  
LIST THAT PRO-  
CEED HAS BEEN  
SUCCESSFULLY  
RECEIVED  
-----

#399

#400

#410

#420

#430

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IS THIS AN ORBITAL  
TIME INCREMENT  
(V73)?

#440

.Y .N  
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WOULD THE INCRE-  
MENT CAUSE THE  
CMC CLOCK TO  
OVERFLOW?

#450

.Y .N  
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-----  
TURN ON  
OPERATOR  
ERROR LITE

-----  
MONITOR DSKY:  
OBSERVE OPER-  
ATOR LITE

#460

-----  
GO TO "A"  
BELOW

-----  
INCREMENT  
CMC CLOCK

-----  
GO TO "A"  
BELOW

#470

-----  
GO TO "A"  
BELOW

#480

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IS ORBITAL INTEGRA-  
TION IN PROGRESS?

.Y .N  
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DELAY TRANSFER  
OF DATA LOADS  
UNTIL INTEGRA-  
TION COMPLETED  
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STALL  
INTEGRATION  
UNTIL DATA  
TRANSFER  
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IS THIS A LIFTOFF  
TIME UPDATE  
(V70)?  
-----

.Y .N  
. .  
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WOULD UPDATE  
CAUSE THE CMC  
CLOCK TO OVER-  
FLOW?  
-----

.Y .N  
. .  
. .

-----  
TURN ON OP-  
ERATOR ERR-  
OR LITE  
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MONITOR DSKY:  
OBSERVE OPERA-  
TOR ERROR LITE  
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GO TO "A"  
BELOW

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GO TO "A"  
BELOW

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#490

#500

#510

#520

#530

#540

INCREM ENT TEPHEM  
AND DECREM ENT  
STATE VECTOR  
TIME TAGS AND  
CMC CLOCK

#550

GO TO "A" BELOW

#560

ARE ALL LOADED ADD-  
RESSES LEGAL?  
NOTE 1 - FOR V72  
COMPONENT MUST BE  
AN ODD NUMBER  
NOTE 2 - FOR V71 ALL  
ADDRESSES MUST BE  
IN THE SAME F-BANK.  
NOTE 3 - ERASABLE  
ADDRESSES LESS THAN  
OR EQUAL TO ENDSAFE  
ARE ILLEGAL.

#570

.N .Y  
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#580

TURN ON OPERA-  
TOR ERROR  
LITE

MONITOR DSKY:  
OBSERVE OPERA-  
TOR ERROR LITE

GO TO "A"  
BELOW

#590

-----  
TRANSFER DATA TO  
SPECIFIED BLOCK  
(V71) OR SPECIFIED  
ADDRESSES (V72)  
-----

"A"  
FROM  
ABOVE

"A"  
FROM  
ABOVE

"A"  
FROM  
ABOVE

-----  
TURN OFF UPTL ACT-  
IVITY LITE  
-----

... MONITOR DOWN-  
LINK:  
OBSERVE UPTL  
ACTIVITY LITE  
OUT, REVERSION  
TO ORIGINAL

-----  
MONITOR DSKY:  
SUCCESSFUL UPDATE IS  
INDICATED BY UPTL  
ACTIVITY LITE OUT,  
OPERATOR ERROR LITE  
OUT, AND RETURN TO  
P00 OR P02.  
-----

-----  
CHANGE DOWNLINK LIST  
TO ORIGINAL  
-----

... DOWNLINK LIST,  
TERMINATION OF  
P27, AND RE-  
TURN TO P00 OR  
P02.  
-----

-----  
TERMINATE P27 AND GO  
TO PROGRAM WHICH WAS  
INTERRUPTED (P00 OR  
P02)  
-----

.....  
EXIT P27

#600

#610

#620

#630

CHANGE CONTROL NOTES

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