

LM TRANSFER PHASE INITIATION (TPI)  
TARGETING PROGRAM (P74)

LOGIC REV 05 11/27/68

PURPOSE:

(1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE TRANSFER PHASE INITIATION MANEUVER, GIVEN:

(A) TIME OF IGNITION TIG (TPI) OR THE ELEVATION ANGLE (E) OF THE LM/CSM LOS AT TIG(TPI)

(B) CENTRAL ANGLE OF TRANSFER (CENTANG) FROM TIG(TPI) TO INTERCEPT TIME (TIG(TPF)).

(2) TO CALCULATE TIG (TPI) GIVEN E OR E GIVEN TIG (TPI).

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND CERTAIN DEPENDENT VARIABLES ASSOCIATED WITH THE MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

ASSUMPTIONS:

(1) THE PROGRAM MUST BE DONE OVER A TRACKING STATION FOR REAL TIME GROUND PARTICIPATION IN CMC DATA INPUT AND OUTPUT. CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME.

(2) 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.

(3) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.

THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETTING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.

(4) THE OPERATION OF THE PROGRAM UTILIZES THE FOLLOWING FLAGS:

ACTIVE VEHICLE FLAG - DESIGNATES THE VEHICLE WHICH IS DOING RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.

FINAL FLAG - SELECTS FINAL PROGRAM DISPLAYS AFTER CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION CYCLE.

(5) THERE IS NO REQUIREMENT FOR ISS OPERATION DURING THIS PROGRAM UNLESS AUTOMATIC STATE VECTOR UPDATING IS DESIRED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20).

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

PROG CMC GROUND CREW CHECKLIST TIME TOTAL  
 CNT

.CREW PROG.  
 .SELECTION  
 .  
 .  
 .  
 .

-----  
 START LM TRANSFER  
 PHASE INITIATION  
 TARGETING PROGRAM  
 (P74).  
 -----

-----  
 KEY IN LM TRANSFER  
 PHASE INITIATION  
 TARGETING PROGRAM  
 (P74)  
 V37E 74E  
 -----

++  
 +05  
 +  
 +  
 +  
 +  
 +

#10

-----  
 DISPLAY PROGRAM 74  
 -----

-----  
 MONITOR DSKY:  
 OBSERVE DISPLAY OF  
 PROGRAM 74  
 -----

+05  
 ++  
 EDIT

#20

-----  
 SET ACTIVE VEHICLE  
 FLAG TO LM  
 -----

"AN"

++  
 +05  
 ++  
 EDIT

#30

-----  
 RESFT COMP E FLAG  
 -----

#40

-----  
 SFT TRACK FLAG  
 (SEE P20)  
 -----

#50

P74/COLOSSUS  
 P74/LUMINARY

-----  
SET UPDATE FLAG  
(SEE P20)  
-----

"A"

HOLD . FLASH VERB-NOUN TO  
..... REQUEST RESPONSE AND  
SNAP . DISPLAY TIG(TPI):  
V06N37  
R1-TIG (TPI)-HRS  
R2-TIG (TPI)-MIN  
R3-TIG (TPI)-SEC

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

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

-----  
AM I SATISFIED WITH  
THIS VALUE?  
(NOTE: THIS PROGRAM  
ALWAYS REQUIRES AN  
INITIAL VALUE OF  
TIG(TPI) WHICH IS  
WITHIN 30 MINUTES  
OF THE ACTUAL VALUE  
EVEN IF TIG (TPI) IS  
TO BE CALCULATED  
FROM A SPECIFIED E.)  
-----

.Y N.  
.  
.

-----  
RECORD THIS  
VALUE FOR FUTURE  
TRANSMISSION TO  
THE LM.  
-----

#60

#70

#80

#90

#100

```

.....
-----
WAIT FOR KEYBOARD   ..... KEY IN PROCEED
ENTRY
    
```

#110

```

-----
TERMINATE FLASH UPON  ..... KEY IN V25E AND
RECEIPT OF PROCEED   ..... LOAD THE DESIRED
OR NEW DATA          TIG
    
```

#120

```

.P      . NEW
.R      . DATA
.C
.C      -----
.E      STORE DATA
.F      -----
.D
    
```

#130

```

HOLD . FLASH VERB-NOUN TO
..... REQUEST RESPONSE
SNAP . AND DISPLAY E AND
      CENTANG:
        V06 N55
        R1-BLANK
        R2-E
        R3-CENTANG
    
```

```

-----
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF E AND CENTANG:
-----
    
```

#140

```

E-ELEVATION ANGLE.
BETWEEN THE LM/
CSM LOS AND THE
LM LOCAL HORIZON-
TAL AT TIG (TPI)
REFERENCED TO THE
DIRECTION OF
FLIGHT (SEE SEC-
TION 5.4.4.2 OF
R577 FOR DETAILED
DESCRIPTION). FROM
J TO 360 IN DEG-
REES TO NEAREST
.01 DEGREE.
    
```

```

-----
DO I WISH THE CMC TO
CALCULATE F?
    
```

```

-----
.Y      .N
.       .
.       .
    
```

#150

```

-----
IS R2=00000?
    
```

#160

```

CENTANG-THE ORBIT-
    
```

++  
+05  
+  
+  
+  
+  
+  
+  
+ 382

AL CENTRAL ANGLE  
OF THE PASSIVE  
VEHICLE DURING  
TRANSFER FROM  
TIG(TPI) TO TIME  
OF INTERCEPT. IN  
DEGREES TO NEAREST  
.01 DEGREE.

-----  
Y.      .N  
.

#170

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

-----  
KEY IN V22E  
AND LOAD  
+00000E IN  
R2.  
-----

#180

++  
+05  
++  
EDIT

-----  
AM I SATISFIED WITH  
THE PRESENT VALUF  
OF E?  
-----

.Y      .N  
.

#190

-----  
KEY IN V22E  
AND LOAD THE  
DESIRED E IN  
R2.  
-----

#200

#210

+05  
++  
PCR  
206

RECORD THIS VALUE  
FOR FUTURE TRANS-  
MISSION TO THE LM.

#220

AM I SATISFIED WITH  
THE PRESENT VALUE OF  
CENTANG?

.Y .N

KEY IN V23E AND  
LOAD THE DESIRED  
CENTANG IN R3.

#230

RECORD THIS VALUE  
FOR FUTURE TRANS-  
MISSION TO THE LM.

#240

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

KEY IN PROCEED

#250

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

#260

IS F SPECIFIED TO  
BE +00000?

.N . Y.

. SET COMP E FLAG

..... "B"

++  
+05  
++  
EDIT

"B"

. RESET UPDATE  
. FLAG.

DID I SPECIFY E  
TO BE +00000?

. IS COMP E FLAG  
. SET?

.N . Y.

. COMPUTE E FOR  
. SPECIFIED  
. TIG(TPI)

. MONITOR DSKY:  
. OBSERVE  
. VERB-NOUN  
. FLASH TO RE-  
. QUEST RESPON-  
. SE AND DIS-  
. PLAY OF CAL-  
. CULATED E.

POSS  
HOLD .  
.....  
SNAP .

#270

#280

#290

#300

#310

(NOTE: FOR DE-  
FINITION SEE  
ABOVE).

RECORD THIS  
VALUE FOR  
FUTURE TRANS-  
MISSION TO  
THE LM.

#320

WAIT FOR KEY-  
BOARD ENTRY

KEY IN PRO-  
CEED.

#330

TERMINATE  
FLASH UPON  
RECEIPT OF  
PROCEED

#340

.P  
.R  
.Q  
.C  
.E  
.E  
.D

RESET FINAL  
FLAG

#350

++  
+05  
++  
EDIT

COMPUTE TIG  
(TPI) FOR THE  
SPECIFIED F.  
ESTABLISH  
ALARM IF NO  
SOLUTION CAN  
BE REACHED

#360

.N .A  
.D .L  
. .A  
.A .R  
.L .M  
.A .

#370

POSS  
HOLD .  
.....

M FLASH VERB-

MONITOR DSKY:





MISSION TO  
THE LM.

#430

-----  
WAIT FOR KEY-  
BOARD ENTRY

-----  
KEY IN  
PROCEED

TERMINATE  
FLASH UPON  
RECEIPT OF  
PROCEED.

#440

-----  
.P  
.R  
.C  
.C  
.E  
.E  
.D

#450

-----  
BASED ON STORED  
TARGET PARAMETERS  
COMPUTE THE PARA-  
METERS ASSOCIATED  
WITH TPI AND  
TPE AS DESCRIBED  
IN SECTION  
5.4.4.2 OF R577.

#460

++  
+05  
+  
+  
+05  
++  
PCN  
582

#470

POSS  
HOLD .  
.....  
SNAP .

.....  
-----  
. FLASH VERR-NCUN  
. TO REQURST RE-  
. SPONSE AND DIS-  
. PLAY CALCULATED  
. PER ALT, DELTA  
. V(TPI), AND DELTA  
. V(TPF):  
. V06N58  
. R1-PER ALT  
. R2-DELTA V(TPI)  
. R3-DELTA V(TPF)

-----  
. MONITOR DSKY:  
. OBSERVE VERB-  
. NOUN FLASH TO  
. REQUEST RESPONSE  
. AND DISPLAY OF  
. CALCULATED PER  
. ALT, DELTA  
. V(TPI), AND  
. DELTA V(TPF).

#480

.....  
. PER ALT-ALTITUDE  
. OF PERIGEE ABOVE  
. THE LAUNCH PAD  
. RADIUS (EARTH  
. ORBIT) OR ALTI-  
. TUDE OF PERILUNE  
. ABOVE THE LUNAR  
. RADIUS AT THE  
. MOST RECENTLY DE-  
. FINED LANDING  
. SITE (LUNAR  
. ORBIT). IN NAUTI-  
. CAL MILES TO  
. NEAREST .1 NM.

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. .

#490

.....  
. DELTA V(TPI)-RE-  
. QUIRED IMPULSIVE  
. DELTA V TO ACCOM-  
. PLISH TPI MANEU-  
. VER AT TIG(TPI).  
. IN FPS TO NEAREST  
. .1 FPS.

#510

.....  
. DELTA V(TPF)-RE-  
. QUIRED IMPULSIVE  
. DELTA V TO ACCOM-  
. PLISH TPF MANEU-  
. VER AT TIME OF  
. INTERCEPT. IN FPS  
. TO NEAREST .1 FPS.

-----  
. RECORD THESE  
. VALUES FOR  
. FUTURE TRANS-  
. MISSION TO THE  
. LM.

#520

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

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

TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED

#530

IS THE FINAL FLAG  
SET?

IS THIS THE  
FINAL PASS  
THROUGH THIS  
PROGRAM?

#540

.N .Y.

.Y .N.

PCN  
582  
++  
+  
+05  
+  
++

SFT UP-  
DATE  
FLAG  
{SEE  
P20}

#550

++  
+05  
+  
+05  
++  
EDIT

RESET  
NEW  
TARGET  
FLAG

#560

POSS  
HOLD .  
.....  
SNAP .

FLASH VERB-  
NOUN TO RE-  
QUEST RESPONSE  
AND DISPLAY  
CALCULATED  
COMPONENTS OF  
DELTA V(LV)  
FOR TPI:  
V06N81  
R1-DELTA  
VX(LV)  
R2-DELTA  
VY(LV)  
R3-DELTA  
VZ(LV)

MONITOR DSKY:  
OBSERVE  
VERB-NOUN  
FLASH TO RE-  
QUEST RES-  
PONSE AND  
DISPLAY OF  
DELTA V(LV)  
FOR TPI

#570

DELTA VX(LV)-  
COMPONENT OF  
IMPULSIVE  
DELTA V AT

AM I SATIS-  
FIED WITH  
THESE VALUES?  
(NOTE: CREW  
HAS THE OP-  
TION AT THIS

#580

TIG(TPI) ALONG  
(RXV)XP. IN  
FPS TO NEAREST  
.1 FPS.

DELTA VY(LV)-  
COMPONENT OF  
IMPULSIVE  
DELTA V AT  
TIG(TPI) ALONG  
VXR. IN FPS TO  
NEAREST .1 FPS

DELTA VZ(LV)-  
COMPONENT OF  
IMPULSIVE  
DELTA V AT  
TIG(TPI) ALONG  
-R. IN FPS TO  
NEAREST .1 FPS

WHERE R IS THE  
LM GEOCENTRIC  
(EARTH ORBIT)  
OR SELENOCENT-  
RIC (LUNAR  
ORBIT) RADIUS  
VECTOR AND V  
IS THE LM IN-  
ERTIAL VELO-  
CITY VECTOR AT  
TIG(TPI).

-----  
WAIT FOR KEY-  
BOARD ENTRY

TIME TO RE-  
DEFINE THE  
DELTA V(LV)  
COMPONENTS  
FOR THE SUB-  
SEQUENT THRU-  
STING MANEU-  
VER. THIS  
CAPABILITY  
WILL NORMALLY  
BE EXERCISED  
TO CORRECT  
OUT OF PLANE-  
NESS BY FIRST  
SELECTING THE  
RENDEZVOUS  
OUT OF PLANE  
DISPLAY ROU-  
TINE (R36)  
(V90E), AND  
THEN MODIFY-  
ING DELTA  
VY(LV).  
HOWEVER IT  
MUST BE RE-  
MEMBERED THAT  
THE R36 CALC-  
ULATION IS  
BASED UPON AN  
ACTIVE CSM.

-----  
.Y            N.  
-----

-----  
KEY IN V25E.  
AND LOAD  
THE DESIRED  
DELTA V  
VALUES.  
-----

#590

#600

#610

#620

#630

-----  
RECORD THESE  
VALUES FOR  
FUTURE TRANS-  
MISSION TO THE  
LM.  
-----

#640

TERMINATE  
FLASH UPON RE-  
CEIPT OF PRO-  
CEED OR NEW  
DATA

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

#650

-----  
.P .NEW  
.R .DATA  
.N .

.C  
-----  
.E STORE DATA

.E  
-----  
.D

-----  
SET NEW  
TARGET  
FLAG.  
-----

#660

-----  
IS THE NEW  
TARGET FLAG  
SET?  
-----

.N .Y  
. .  
. .

-----  
. CALCULATE  
. NEW TARGET  
. VECTOR  
. BASED ON  
. NEWLY  
. LOADED  
. DELTA  
. V(LV) FOR  
. TPI.

#680

#690

++  
+05  
++  
EDIT  
-----  
. . . . .  
. . . . .  
. . . . .  
. . . . .  
. . . . .  
. . . . .  
. . . . .  
. . . . .  
. . . . .

POSS  
HOLD .  
.....  
SNAP .  
-----  
. FLASH VERB-NOUN  
TO REQUEST RE-  
SPONSE AND DIS-  
PLAY DELTA V(LCS)  
FOR TPI:  
. V06N59  
. R1-DELTA V1(LCS)  
. R2-DELTA V2(LCS)  
. R3-DELTA V3(LCS)  
. . . . .

-----  
. MONITOR DSKY:  
OBSERVE VERB-  
NOUN FLASH TO  
REQUEST RESPONSE  
AND DISPLAY OF  
DELTA V(LCS).  
-----  
. . . . .

#700

++  
+05  
+  
+05  
++  
EDIT  
-----  
DELTA V(LCS) -  
LINE OF SIGHT  
COMPONENT IN FEET  
PER SECOND TO  
NEAREST .1 FPS  
-----  
(NOTE: FOR DEFINITION SEE SECTION 5.4.4.2 OF R577.)  
-----  
. . . . .

-----  
RECORD THESE VALUES  
FOR FUTURE TRANS-  
MISSION TO THE LM.  
-----  
. . . . .

#710

-----  
WAIT FOR KEYBOARD  
ENTRY  
-----  
TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED.  
-----  
. . . . .

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

#720

-----  
IS THE FINAL FLAG  
SET?  
-----

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

#730

#740

SET MGA DISPLAY  
IN R3(BELOW)  
= -00001.

SET MGA DIS-  
PLAY IN R3  
(BELOW) =  
-00002.

#750

HOLD . . . . . FLASH VERB-NOUN TO  
MON . . . . . REQUEST RESPONSE AND  
DISPLAY MARK CTRS  
TFI AND MGA;  
V16N45  
R1 - MARK CTRS  
R2 - TFI  
R3 - MGA

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF MARK CTRS, TFI  
AND MGA.

#760

MARK CTRS - THE NUM-  
BER OF MARKS PROCES-  
SED BY THE RENDEZ-  
VOUS DATA PROCESSING  
ROUTINE (R22) (REFER  
TO ASSUMPTION (8) OF  
P20). THE REGISTER  
WILL DISPLAY XXBXX  
WHERE THE TWO MOST  
SIGNIFICANT DIGITS  
IS THE VHF RANGING  
MARK COUNTER AND THE  
TWO LEAST SIGNIFI-  
CANT DIGITS IS THE  
OPTICS MARK COUNTER.

NOTE: THE OPTICS  
MARK COUNTER DOES  
NOT DISTINGUISH BE-  
TWEEN BACK-UP AND  
PRIMARY MARKS.

#770

#780

#790



TFI-TIME FROM  
TIG(TPI). IN MIN AND  
SEC TO NEAREST SEC.  
MAX READING IS  
59R59. SIGN IS  
- BEFORE + AFTER  
TIG(TPI).

MGA-MIDDLE GIMBAL  
ANGLE DISPLAY IS NOT  
PERTINENT TO THIS  
PROGRAM. THEREFORE:  
(A) WHEN DISPLAY-  
ED AT ANY TIME  
OTHER THAN THE  
LAST PASS THROUGH  
THE PROGRAM THE  
VALUE IS -00001

(B) ON THE LAST  
PASS THE VALUE IS  
-00002.  
ANGLE IN DEGREES  
TO NEAREST .01  
DEGREE.

++  
+05  
++  
EDIT

-----  
WAS THIS THE LAST  
PASS THROUGH THE  
PROGRAM?  
-----

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

-----  
. DO I WISH TO  
. TERMINATE THE  
. MARKING PROCESS  
. AND DO THE FINAL  
. PASS THROUGH THE  
. PROGRAM?  
-----

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

#800

#810

-----  
WAIT FOR KEYBOARD  
ENTRY

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

#820

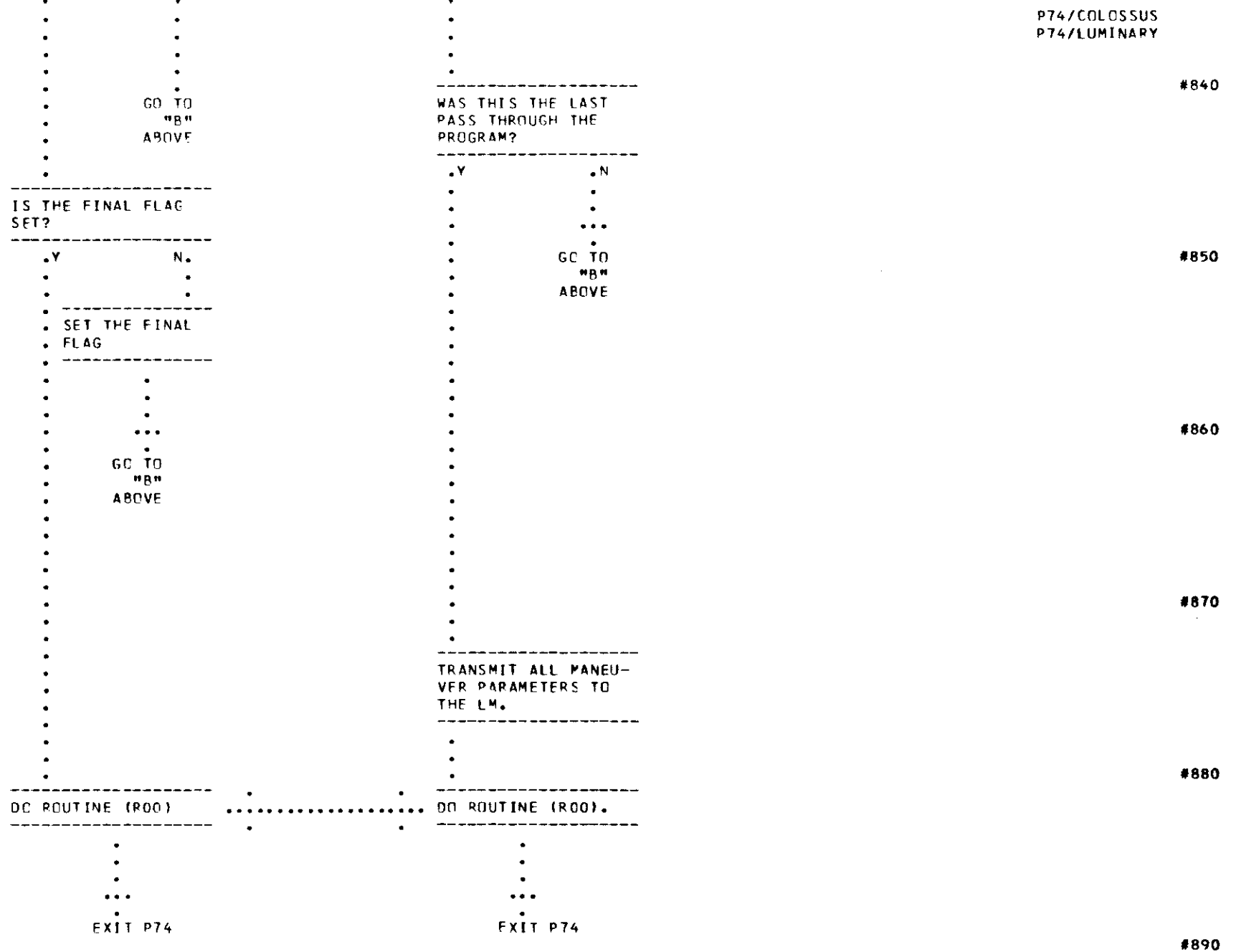
TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED OR RECYCLE

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

#830

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

GO TO  
"R"  
ABOVE



++  
+05  
++  
PCR  
206

397

CHANGE CONTROL NOTES

LOGIC REV 04 PCR MIT 66  
LOGIC REV 05 PCR 206 EDITORIAL  
PCN 582

01120000  
01120001  
01120002

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LM TRANSFER PHASE MIDCOURSE TARGETING PROGRAM (P75)

LOGIC REV 06 11/27/68

- PURPOSE: (1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE NEXT MIDCOURSE CORRECTION OF THE TRANSFER PHASE OF AN ACTIVE LM REND.
- 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) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.  
 THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETTING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.
- (3) THE OPERATION OF THIS PROGRAM UTILIZES THE FOLLOWING FLAGS:  
 ACTIVE VEHICLE FLAG - DESIGNATES THE VEHICLE WHICH IS DOING RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.  
 FINAL FLAG-SELECTS FINAL PROGRAM DISPLAYS AFTER ASTRONAUT HAS SELECTED THE FINAL MANEUVER COMPUTATIONS.
- (4) THE TIME OF INTERCEPT (T(INT)) WAS DEFINED BY PREVIOUS COMPLETION OF THE LM TRANSFER PHASE INITIATION (TPI) PROGRAM (P74) AND IS PRESENTLY AVAILABLE IN CMC STORAGE.
- (5) THERE IS NO REQUIREMENT FOR ISS OPERATION DURING THIS PROGRAM UNLESS AUTOMATIC STATE VECTOR UPDATING IS DESIRED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20).
- (6) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

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

			.CREW			
			.PROG			
			.SELECTION			
			.			
			...			
			.			
-----			-----			
START LM TRANSFER	.		KEY IN LM TRANSFER			
PHASE MIDCOURSE	.....		PHASE MIDCOURSE			
TARGETING (TPM)	.		TARGETING (TPM)			
PROGRAM (P75).			PROGRAM (P75)			#10
DISPLAY PROGRAM 75.			V37E 75E			
			-----			
			.			
			.			
			.			

•  
•  
•  
•  
•  
•

.....  
• MONITOR DSKY:  
• OBSERVE DISPLAY OF  
• PROGRAM 75

#20

•  
•  
•

-----  
SET ACTIVE VEHICLE  
FLAG TO LM  
-----

•  
•  
•

-----  
RESET FINAL FLAG  
-----

#30

•  
•  
•

-----  
SET TRACK FLAG (SEE  
P20)  
-----

#40

•  
•  
•

-----  
SET UPDATE FLAG  
(SEE P20)  
-----

#50

•  
•  
• "A"  
•  
•  
•  
•  
•  
•  
•

-----  
• RESET NEW TARGET  
• FLAG.  
-----

#60

•  
•  
•

-----  
• RESET UPDATE FLAG  
-----

•  
•  
•  
•  
•  
•  
•  
•

4100

#70

```
.
.
.
.
.
.
.
.
.
.
.
.
.-----
. DEFINE TIG(MID)=
. T + "B" MINUTES
. WHERE:
.
. "B" WILL BE
. STORED IN ERAS-
. ABLE STORAGE AND
. MAY BE CHANGED BY
. PRELAUNCH ERAS-
. ABLE LOAD OR CMC
. UPDATE BY P27.
. NOTE: THIS PARA-
. METER (P) IS NOT
. THE SAME AS THAT
. REFERRED TO IN
. P34 AS A.
```

#80

++  
+06  
++  
EDIT  
PCR  
206

```
.
.
.
.
.-----
. EXTRAPCLATE LM
. STATE VECTOR TO
. TIG(MID)
```

#90

```
.
.
.
.
.-----
. EXTRAPOLATE CSM
. STATE VECTOR TO
. T(INT) (NOTE:
. REFER TO ASSUMP-
. TION (4) ABOVE).
```

#100

```
.
.
.
.
.-----
. DO LAMBERT ROUT-
. INE TO CALCULATE
. THE REQUIRED VEL-
. OCITY FOR THE
. MIDCOURSE COR-
. RECTION.
```

#110

"A"

#120

IS THE FINAL FLAG  
SET?

.N .Y.

SET UPDATE  
FLAG

IS THIS THE FINAL  
PASS THROUGH THIS  
PROGRAM?

.Y .N.

#130

POSS  
HOLD .  
.....  
SNAP .

FLASH VERB-  
NOUN TO REQ-  
UEST RESPONSE  
AND DISPLAY  
CALCULATED  
COMPONENTS OF  
DELTA V(LV)  
FOR TPM;  
V06N81  
R1-DELTA  
VX(LV)  
R2-DELTA  
VY(LV)  
R3-DELTA  
VZ(LV)

MONITOR  
DSKY:  
OBSERVE  
VFRB-NCUN  
FLASH TO  
REQUEST RE-  
SPONSE AND  
DISPLAY OF  
DELTA V(LV)  
FOR TPM

#140

DELTA VX(LV)-  
COMPONENT OF  
IMPULSIVE  
DELTA V AT  
TIG(TPM)  
ALONG (RXV)  
XR. IN FPS TO  
NEAREST .1  
FPS.

AM I SATIS-  
FIED WITH  
THESE  
VALUES?  
(NOTE: CREW  
HAS THE OP-  
TION AT  
THIS TIME  
TO REDEFINE  
THE DELTA V  
(LV) COM-  
PONENTS FOR  
THE SUBSE-  
QUENT  
THRUSTING  
MANEUVER.  
THIS CAPA-  
BILITY WILL  
NORMALLY BE  
EXERCISED  
TO CORRECT

#150

DELTA VY(LV)-  
COMPONENT OF  
IMPULSIVE  
DELTA V AT  
TIG(TPM)  
ALONG VXR. IN  
FPS TO NEAR-  
EST .1 FPS

DELTA VZ(LV)-

#160

#170



++  
+06  
++  
EDIT  
PCR  
206

COMPONENT OF  
IMPULSIVE  
DELTA V AT  
TIG(TPM)  
ALONG -R. IN  
FPS TO NEAR-  
EST .1 FPS

WHERE R IS  
THE LM GEO-  
CENTRIC  
(EARTH ORBIT)  
OR SELENO-  
CENTRIC  
(LUNAR ORBIT)  
RADIUS VECTOR  
AND V IS THE  
LM INERTIAL  
VELOCITY  
VECTOR AT  
TIG(TPM).

-----  
WAIT FOR KEY-  
BOARD ENTRY

OUT OF  
PLANENESS  
BY FIRST SE-  
LECTING THE  
RENDEZVOUS  
OUT OF  
PLANE DIS-  
PLAY ROU-  
TINE (R36)  
(V90E), AND  
THEN MODIFY  
VY(LV).  
HOWEVER IT  
MUST BE RE-  
MEMBERED  
THAT THE  
R36 CALCU-  
LATION IS  
BASED UPON  
AN ACTIVE  
CSM.

-----  
.Y N.

-----  
KEY IN  
V25E  
AND  
LOAD  
THE DE-  
SIRED  
DELTA V  
VALUES.

-----  
RECORD  
THESE  
VALUES FOR  
FUTURE  
TRANSMISSION  
TO THE LM.

#180

#190

#200

#210

#220

#230

TERMINATE  
FLASH UPON  
RECEIPT OF  
PROCEED OR  
NEW DATA

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

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

#240

-----  
. SET NEW  
TARGET  
FLAG.  
-----

#250

-----  
IS THE NEW  
TARGET FLAG  
SET?  
-----

#260

.N .Y  
. .  
. .

-----  
. CALCULATE  
NEW TAR-  
GET VEC-  
TOR BASED  
ON NEWLY  
LOADED  
DELTA V  
(LV) FOR  
TPM.  
-----

#270

#280

405

POSS  
HOLD .  
.....  
SNAP .

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

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

-----  
FLASH VERB-NOUN .....  
TO REQUEST RE-  
SPONSE AND DIS-  
PLAY DELTA V (LOS)  
FOR TPM:  
V06N59  
R1-DELTA  
V1 (LOS)  
R2-DELTA  
V2 (LOS)  
V3-DELTA  
V3 (LOS)  
DELTA V (LOS) -  
LINE OF SIGHT  
COMPONENTS IN FPS  
TO NEAREST .1 FPS  
(NOTE: FOR DEFIN-  
ITION SEE SECTION  
5.4.4.3 OF R577.)  
-----

-----  
MONITOR DSKY:  
OBSERVE VERB-  
NOUN FLASH TO RE-  
QUEST RESPONSE  
AND DISPLAY OF  
DELTA V (LOS).  
-----

-----  
RECORD THESE  
VALUES FOR  
FUTURE TRANSMIS-  
SION TO THE LM.  
(NOTE: UNLIKE  
DELTA V(LV) FOR  
TPM ABOVE, THESE  
VALUES CANNOT BE  
WRITTEN OVER.  
-----

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

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

-----  
WAIT FOR KEYBOARD .....  
ENTRY  
TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED.  
-----

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

. P  
. R  
. C  
. C  
. F  
. E  
. D  
. .  
-----

IS THE FINAL FLAG  
SET?

-----  
. N . Y .  
. . . .  
. . . .  
. . . .  
. . . .  
. . . .

#290

#300

#310

#320

#330

SET MGA DISPLAY  
IN R3(BELCW)=  
-00001.

SET MGA DIS-  
PLAY IN R3  
(BELCW)=  
-00002.

#340

HOLD .  
.....  
MON .  
FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY OF MARK CTRS  
TFI AND MGA:  
V16N45  
R1-MARK CTRS  
R2-TFI  
R3-MGA

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF MARK CTRS, TFI  
AND MGA.

#350

MARK CTRS - THE  
NUMBER OF MARKS PRO-  
CESSED BY THE RENC-  
EZVOUS DATA PROCESS-  
ING ROUTINE (R22)  
(REFER TO ASSUMPTION  
(8) OF P20).  
THE REGISTER WILL  
DISPLAY XXXXX WHERE  
THE TWO MOST SIGNIF-  
ICANT DIGITS IS THE  
VHF RANGING MARK  
COUNTER AND THE TWO  
LEAST SIGNIFICANT  
DIGITS IS THE OPTICS  
MARK COUNTER  
NOTE : THE OPTICS  
MARK COUNTER DOES  
NOT DISTINGUISH BE-  
TWEEN BACK-UP AND  
PRIMARY MARKS.

#360

#370

#380

TFI-TIME FROM TIG  
(TPM) IN MIN AND SEC  
TO NEAREST SEC. MAX  
READING IS 59859.  
SIGN IS - BEFORE +  
AFTER TIG(TPM).

MGA-MIDDLE GIMBAL  
ANGLE IS NOT PERTI-  
NENT TO THIS PROGRAM  
THEREFORE:

(A) WHEN DISPLAY-  
ED AT ANY TIME  
OTHER THAN THE  
LAST PASS THROUGH  
THE PROGRAM THE  
THE VALUE IS -  
00001

(B) ON THE LAST  
PASS WHEN THE IMU  
IS NOT ALIGNED  
THE VALUE IS  
-00002.  
IN DEGREES TO THE  
NEAREST .01  
DEGREES

.....  
-----  
WAS THIS THE LAST  
PASS THROUGH THE  
PROGRAM?  
-----

.Y                    N.

.  
-----  
. DO I WISH TO  
. TERMINATE THE  
. MARK PROCESS AND  
. DO THE FINAL PASS  
. THROUGH THE PRO-  
. GRAM?  
-----

.Y                    N.

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

#390

#400

#410

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

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

-----  
TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR RECYCLE

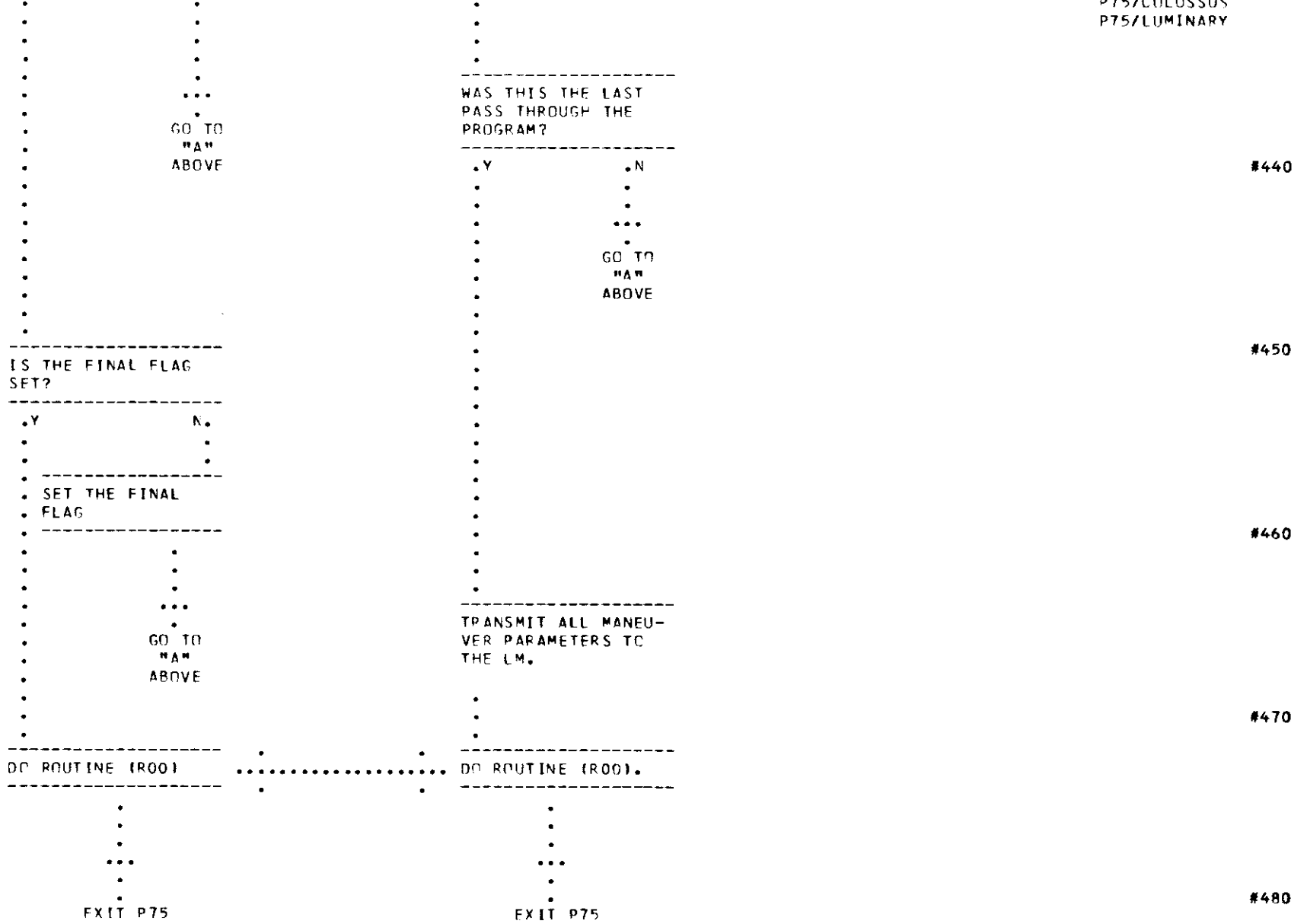
-----  
KEY IN RECYCLE  
V32E  
-----

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

.  
.  
.  
.....  
. GO TO  
. "A"  
. ABOVE  
.  
.  
.  
.  
.  
.  
.  
.  
.

#420

#430



409

CHANGE CONTROL NOTES

REV 04 PCR MIT 66  
REV 05 PCR 206  
REV 06 PCR 206 EDITORIAL

00637000  
00638000  
00638001

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PURPOSE: (1) TO PROVIDE A MEANS OF NOTIFYING THE CMC THAT THE LM HAS CHANGED ITS ORBITAL PARAMETERS BY THE EXECUTION OF A THRUSTING MANEUVER.

(2) TO PROVIDE TO THE CMC THE DELTA V APPLIED TO THE LM TO ENABLE AN UPDATING OF THE LM STATE VECTOR.

ASSUMPTIONS: (1) THE CSM CREW HAS THE DELTA V TO BE APPLIED BY THE LM IN LOCAL VERTICAL AXES AT A SPECIFIED TIG. THESE VALUES ARE DISPLAYED PRIOR TO TIG BY THE PRETHRUST TARGETING PROGRAM IN THE LM. NO PROVISION IS MADE IN THESE THRUSTING PROGRAMS TO DISPLAY THE RESULTS OF THE MANEUVER IN A FORM USABLE BY THIS ROUTINE. IF THE BURN IS NOT NOMINAL AND THIS DELTA V IS NOT AS SPECIFIED OR IF TIG IS NOT AS ORIGINALLY SPECIFIED CONSULT BACKUP PROCEDURES.

++ (2) CARE SHOULD BE EXERCISED TO INCORPORATE STATE VECTOR CHANGES VIA THIS PROGRAM IN LOGICAL ORDER WITH STATE VECTOR  
+05 CHANGES RESULTING FROM THE RENDEZVOUS NAVIGATION PROGRAM (P20). A SUGGESTED PROCEDURE WOULD BE TO STOP OPTICS  
+ MARKING, VERIFY DATA INCORPORATION BY REVIEWING NOUN 45 MARK COUNTERS, INCORPORATE STATE VECTOR CHANGES VIA THIS  
+ PROGRAM AND DO NOT TAKE OPTICS MARKS OR ENABLE VHF RANGE LINK UNTIL THE LM MANEUVER HAS TAKEN PLACE.  
+

+ (3) IN THE EVENT OF AN UPLINK FAILURE THE ASTRONAUT CAN CREATE A REASONABLE LM STATE VECTOR FOR LM INSERTION  
+ INTO ORBIT FROM THE LUNAR SURFACE BY KEYING IN THE EXPECTED LM THRUSTING MANEUVER FROM THE LUNAR SURFACE WHILE  
+ THE SURFACE FLAG IS SET. THIS WILL CAUSE THE COMPUTER TO TAKE THE POSITION VECTOR OF THE LANDING SITE AND ADD THE  
+ INPUTED DELTA V AND STORE THE RESULTS IN THE LM STATE VECTOR. THE LANDING SITE WILL NOT BE ALTERED.  
+

+05 (4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.  
++

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
			.CREW .PROGRAM .SELECTION ...			
++ +05 + + + + + + + +05 ++	----- START TARGET DELTA V PROGRAM (P76) DISPLAY P76 ----- . . . ----- SET THE TRACK FLAG ----- . . .	. ..... .	----- KEY IN V37E76E -----			#10
						#20

HOLD . . . FLASH VERB-NOUN  
 . . . . . TO REQUEST RESPONSE  
 SNAP . . . AND DISPLAY THREE  
 . . . . . COMPONENTS OF DELTA  
 . . . . . V(OV).  
 . . . . . V06N84  
 . . . . . R1-DELTA VX(OV)  
 . . . . . R2-DELTA VY(OV)  
 . . . . . R3-DELTA VZ(OV)

DELTA VX(OV)-  
 COMPONENT OF DELTA V  
 OF OTHER VEHICLE  
 APPLIED AT TIG  
 ALONG (RXV)XR. IN  
 FPS TO NEAREST .1  
 FPS.

DELTA VY(OV)-  
 COMPONENT OF DELTA V  
 OF OTHER VEHICLE  
 APPLIED AT TIG ALONG  
 VXR. IN FPS TO NEAR-  
 EST .1 FPS.

DELTA VZ(OV)-  
 COMPONENT OF DELTA V  
 OF OTHER VEHICLE  
 APPLIED AT TIG ALONG  
 -R. IN FPS TO NEAR-  
 EST .1 FPS.

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

MONITOR DSKY  
 OBSERVE VERR-NOUN  
 FLASH TO REQUEST  
 RESPONSE AND DISPLAY  
 THREE COMPONENTS OF  
 DELTA V APPLIED  
 ALONG LOCAL VERTICAL  
 AXES AT TIG.

-----  
 ARE THE VALUES  
 DISPLAYED THE  
 CORRECT ONES  
 EXECUTED OR TO BE  
 EXECUTED BY THE LM?  
 -----

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

#30

#40

#50

#60

#70

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

-----  
.PROCEED .NEW  
          .DATA  
-----

STORE DATA  
-----

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

-----  
KEY IN V25E  
AND LOAD THE  
CORRECT DELTA V.  
-----

#80

#90

HOLD . FLASH VERB-NOUN  
..... TO REQUEST RESPONSE  
SNAP . AND DISPLAY TIG  
          V06N33  
          R1-TIG-HRS  
          R2-TIG-MINS  
          R3-TIG-SECS

-----  
MONITOR DSKY  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF TIG.  
-----

#100

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

#110

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

-----  
IS THE VALUE  
DISPLAYED THE  
CORRECT TIME AT  
WHICH THE LM EXECUT-  
ED OR WILL EXECUTE  
THE MANEUVER?  
-----

#120

.Y                    .N  
.  
.  
.

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

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

..... KEY IN PROCEED

-----  
KEY IN V25E  
AND LOAD THE  
CORRECT TIG  
-----

#130

-----  
UPDATE LM STATE  
VECTOR TO REFLECT  
THE DELTA V ADDED.  
-----

.  
.  
.

-----  
ZERO THE RENDEZVOUS  
OPTICS MARK COUNTER.  
-----

.  
.  
.

-----  
ZERO THE RENDEZVOUS  
VHF RANGING MARK  
COUNTER.  
-----

.  
.  
.

-----  
DO ROUTINE R00  
-----

.  
.  
.  
.  
.  
.  
EXIT

..... DO ROUTINE R00

.  
.  
.  
.  
.  
.  
EXIT

#140

#150

#160

#170

#180

++  
+05  
++

415

CHANGE CONTROL NOTES

LOGIC REV 5    PCR 440  
                 PCR 468

00269000  
00270000

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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 RENDEZVUS INTERCEPT FOR AN ACTIVE LM.
- (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 (LM) 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 RENDEZVUS 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 RENDEZVUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVUS PRE-THRUSTING PROGRAM.
- (3) TO EXECUTE THE TPI MANEUVER SELECT THE LM TRANSFER PHASE INITIATION TARGETING (TPI) PROGRAM (74) AND TRANSMIT MANEUVER DATA TO THE LM.
- (4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
			<ul style="list-style-type: none"> <li>. CREW</li> <li>. PROGRAM</li> <li>...SELECTION</li> <li>.</li> </ul>			
-----			-----			
START LM TPI SEARCH PROGRAM (P77).	.	.....	KEY IN LM TPI SEARCH PROGRAM (P77) V37E77E			#10
	.		-----			
		.....	MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 77.			
DISPLAY PROGRAM 77	.		-----			
	.					
	.					
	.					
	.					#20

SET TRACK FLAG  
(SEE P20)

SET UPDATE FLAG  
(SEE P20)

SET ACTIVE VEHICLE  
FLAG TO LM

"A"

"A"

HOLD .  
SNAP .

FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY TIG(TPI):  
V06N37  
R1-TIG(TPI)-HRS  
R2-TIG(TPI)-MINS  
R3-TIG(TPI)-SECS

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

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

AM I SATISFIED WITH  
THESE VALUES?

.Y .N

RECORD THIS  
VALUE.

#30

#40

#50

#60

#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)

-----  
.PROCEED .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

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

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

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

.N .Y

-----  
KEY IN RECY-  
CLE  
V32E  
-----

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

TERMINATE FLASH UPON  
RCEIPT OF PROCEED,  
OR RECYCLE.

-----  
P      P NEW  
R      E DATA  
O      C  
C      Y  
E      C  
F      L  
D      E STORE  
      E DATA  
-----  
      GO TO  
      " A "  
      ABOVE  
-----

RESET UPDATE FLAG

.....  
.  
.  
.

SEARCH FOR A MINIMUM  
ENERGY, SAFE PERIA-  
PSIS TRANSFER TRAJ-  
ECTORY (TPI AND  
INTERCEPT) DEFINED  
BY THE STORED TIG  
(TPI) AND SEARCH  
OPTION.

IF SEARCH IS  
SUCCESSFUL CALCULATE  
MANEUVER PARAMETERS  
ASSOCIATED WITH THE  
RESULTANT TPI AND  
INTERCEPT MANEUVERS.

IF SEARCH IS UN-  
SUCCESSFUL, ESTAB-  
LISH A PROGRAM ALARM  
REFER TO SECTION  
5.4.4.4 OF R577 VOL  
I FOR A DETAILED  
DESCRIPTION OF THE  
COMPUTATION.

-----  
KEY IN V23E  
AND LOAD DES-  
IRED SEARCH  
OPTION IN R3.  
-----

#240

#250

#260

#270

#280



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)

++  
+04  
++  
FDIT  
PCR  
206

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.

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

#350

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

#360

.N .Y  
.  
.  
.  
.  
.

RECORD THESE  
VALUES.

#370

#380

#390

WAIT FOR KEYBOARD  
ENTRY.

KEY IN PROCEED

TERMINATE FLASH UPON  
RECEIPT OF PROCEED,  
OR RECYCLE.

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

-----  
 .P .R  
 .R .F  
 .O .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/PERIL-  
 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  
 POINT).

#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  
.O .C  
.C .Y  
.E .C  
.E .L  
.D .E

GO TO  
"A"  
ABOVE

#470

GO TO  
"A"  
ABOVE

#480

DO ROUTINE R00

DO ROUTINE R00

#490

EXIT

EXIT



427

CHANGE CONTROL NOTES

P77/C01 ESSUS

LOGIC REV 63    PCR MIT 66  
LOGIC REV 64    PCR 286 EDITORIAL

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LM STABLE ORBIT RENDEZVOUS TARGETING (SCPI)  
PROGRAM (P78)

LOGIC REV 07 12/26/68

- PURPOSE:
- (1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE FIRST PHASE OF THE STABLE ORBIT RENDEZVOUS MANEUVER, GIVEN:
    - (A) TIME OF IGNITION (TIG).
    - (B) CENTRAL ANGLE OF TRANSFER (CENTANG) FROM TIG TO INTERCEPT TIME.
    - (C) THE OFFSET OF THE STABLE ORBIT POINT SPECIFIED AS A DISTANCE ALONG THE PASSIVE VEHICLE ORBIT.
  - (2) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE SECOND PHASE OF THE STABLE ORBIT RENDEZVOUS MANEUVER, GIVEN:
    - (A) A RESPECIFICATION OF 1(A) ABOVE.
    - (B) AN OPTIONAL RESPECIFICATION OF 1(B) ABOVE.
  - (3) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE CMC BY THE ASTRONAUT.
  - (4) TO DISPLAY TO THE ASTRONAUT AND THE GROUND CERTAIN DEPENDENT VARIABLES ASSOCIATED WITH THE MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.
- ASSUMPTIONS:
- (1) THE STABLE ORBIT POINT IS DEFINED AS THE FINAL POSITION (AT COMPLETION OF SECOND PHASE) OF THE ACTIVE VEHICLE RELATIVE TO THE PASSIVE VEHICLE.
  - (2) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME EXCEPT FOR STABLE ORBIT RENDEZVOUS MANEUVER SEQUENCES.
  - (3) 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 P21 OR P23) AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. SEE P20 FOR DETAILED DESCRIPTION.
  - (4) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.  
THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETTING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.
  - (5) THE OPERATION OF THIS PROGRAM UTILIZES THE FOLLOWING FLAGS.  
ACTIVE VEHICLE FLAG- DESIGNATES THE VEHICLE WHICH IS DOING RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.  
FINAL FLAG- SELECTS FINAL PROGRAM DISPLAYS AFTER THE CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION CYCLE.
  - (6) THE SECOND PHASE OF THIS PROGRAM REQUIRES THE TIG INPUT BE BIASED AS A FUNCTION OF THE AND ANY MIDCOURSE CORRECTIONS PERFORMED IN THE LM STABLE ORBIT MIDCOURSE (TARGETING) PROGRAM (P79)

**1A**

**1A**

(7) THERE IS NO REQUIREMENT FOR ISS OPERATION DURING THIS PROGRAM UNLESS AUTOMATIC STATE VECTOR UPDATING IS DESIRED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20).

(8) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PRG CNT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
			CREW PROG SELECTION . . . .			
			----- START LM STABLE OR- BIT RENDEZVOUS TAR- GETING (SOP) PROGRAM (P78) DISPLAY P78	.		
		.....	KEY IN LM STABLE OR- BIT RENDEZVOUS TAR- GETING (SOP) PROGRAM (P78) V37E 78E -----			#10
			.....	MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 78 -----		
			----- SET ACTIVE VEHICLE FLAG TO LM. -----			
			----- SET TRACK FLAG. (SEE P20) -----			
			.....			#40

SET UPDATE FLAG.  
(SEE D20)

HOLD .  
.....  
SNMP .

FLASH VER-NDJIN  
TO REQUEST RESPONSE  
AND DISPLAY TIC.  
V06 N37  
R1-TIC HRS.  
R2-TIC MIN.  
R3-TIC SEC.

TIC - TIME OF IGNIT-  
ION (GFI). IN HOURS  
MIN AND SEC TO NEAR-  
EST .01 SEC.

MONITOR DSKY:  
OBSERVE VER-NDJIN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF TIC.

AM I SATISFIED WITH  
THIS VALUE?

RECORD THIS  
VALUE FOR FUTURE  
TRANSMISSION TO  
THE IM.

WAIT FOR KEYBOARD  
ENTRY.

KEY IN PROCEED

#50

#60

#70

#80

#90

1A

# 1A

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA.

-----  
KEY IN V250  
AND LOAD THE  
DESIRED TIG  
(SDP)  
-----

.P .NEW  
.R .DATA  
.D .  
.C .  
.F .  
.F .  
.D .  
-----  
STORE  
DATA  
-----

#100

#110

#120

#130

#140

HOLD .  
.....  
SNAP .

-----  
FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY CENTANG  
V06 N55  
R1-BLANK  
R2-BLANK  
R3-CENTANG

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

-----  
CENTANG- THE ORBITAL  
CENTRAL ANGLE OF THE  
PASSIVE VEHICLE DURING  
TRANSFER FROM  
TIG TO TIME OF IN-  
TERCEPT. IN DEGREES  
TO NEAREST .01  
DEGREES  
-----

-----  
AM I SATISFIED WITH  
THIS VALUE?  
-----

.Y .N

-----  
RECORD THIS  
VALUE FOR FUTURE  
TRANSMISSION TO  
THE LM.  
-----  
.

#150

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

-----  
KEY IN  
RECORDED.  
-----

#160

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

-----  
KEY IN M23C  
AND LOAD THE  
DESIRED  
CENTANG.  
-----

#170

-----  
P NEW  
P DATA  
C  
F  
F  
D  
-----  
STORE  
DATA  
-----

#180

-----  
HOLD . FLASH VERB-NOIN TO  
SNAP . REQUEST RESPONSE AND  
DISPLAY OF ASSUMED  
STABLE ORBIT RENEZ-  
VOUS PHASE OPTION:  
V04 N06  
01-00005  
02-0000X  
03-01 AXV  
-----

-----  
MONITOR DISK:  
OBSERVE VERB-NOIN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF ASSUMED STABLE  
ORBIT RENEZVOUS  
PHASE OPTION.  
-----

#190





113

PCN  
577

-----  
COMPUTE  
T(FINAL) GO TO  
-----  
"A"  
BELOW

GO TO  
"A"  
BELOW

#260

++  
+07'  
++  
PCN  
577

-----  
SFT UPDATE  
FLAG  
-----

#270

HOLD  
.....  
SNAP

FLASH VERR-NOUN  
TO REQUEST RES-  
PONSE AND DISPLAY  
DELTA R:

MONITOR DSKY:  
OBSERVE VERR-  
NOUN FLASH TO  
REQUEST RES-  
PONSE AND DIS-  
PLAY OF DELTA  
R.

#280

V06 N57  
R1-DELTA P  
R2-BLANK  
R3-BLANK

DELTA R- THE OFFSET  
OF THE STABLE  
ORBIT POINT, SPE-  
CIFIED AS THE DIS-  
TANCE ALONG THE  
PASSIVE VEHICLE  
ORBIT. REFER TO  
SECTION 5.4.4.5  
OF 2577, FOR  
DETAILED DESCIP-  
TION. IN NM TO  
THE NEAREST .1 NM  
(+ INDICATES STABLE  
ORBIT POINT BEHIND  
PASSIVE VEHICLE;  
- INDICATES AHEAD  
OF THE PASSIVE  
VEHICLE.)

-----  
AM I SATISFIED  
WITH THIS  
VALUE?  
-----

#290

#300

1A

# 1A

#310

RECORD  
THIS  
VALUE FOR  
FUTURE  
TRANSMIS-  
SION TO  
THE LM.

-----  
WAIT FOR KEYBOARD  
ENTRY

-----  
KEY IN  
PROCEED

#320

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

-----  
KEY IN  
V21F  
AND LOAD  
DESIRED  
DELTA P

#330

-----  
P  
R  
D  
STORE .C  
DATA .F  
-----  
F  
D

HOLD .  
.....  
SNAP .

-----  
FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY T(FINAL):

-----  
MONITOR DSKY:  
OBSERVE VERB-  
NOUN FLASH TO  
REQUEST RES-  
PONSE AND DIS-  
PLAY OF T  
(FINAL)

#340

V06N34  
R1-T(FINAL)HRS  
R2-T(FINAL)MIN  
R3-T(FINAL)SEC.

-----  
T(FINAL) - TIME OF  
ARRIVAL AT STABLE  
ORBIT (G.E.T.) IN  
HOURS, MIN SEC TO  
THE NEAREST .01 SEC-  
ONDS.  
-----

#350

•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•

-----  
RECORD THIS  
VALUE FOR  
FUTURE  
TRANSMIS-  
SION TO THE  
LM.  
-----

#360

-----  
WAIT FOR KEYBOARD  
ENTRY

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

#370

-----  
TERMINATE FLASH UPON  
RECEIPT OF RECEIVED  
PROCEED  
-----

#380

•••••

•  
•  
•  
•  
•

#390

-----  
RESET UPDATE FLAG.  
-----

•  
•

-----  
BASED ON STORED  
TARGET PARAMETERS  
COMPUTE THE  
TRANSFER TRAJECTORY,  
INITIAL CONDITIONS  
AND THE NECESSARY  
DEPENDENT VARIABLES  
FOR EVALUATION OF  
THE MANEUVER AS  
DESCRIBED IN SECTION  
S.4.4.6 OF DE77  
-----

#400

•  
•  
•  
•  
•  
•

**1A**

#410



#470

DELTA V (SOR)-  
REQUIRED IMPUL-  
SIVE DELTA V TO  
ACCOMPLISH SOR  
MANEUVER AT TIC  
IN EDS TO NEAREST  
.1 EDS.

DELTA V(SOR-FIN-  
AL) REQUIRED IM-  
PULSIVE DELTA V  
TO ACCOMPLISH SOR  
MANEUVER AT TIME  
OF INTERCEPT.  
IN EDS TO NEAREST  
.1 EDS.

#480

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

#490

TERMINATE FLASH  
UPON RECEIPT OF  
PROCEED

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

PROCEED

#500

HOLD .  
.....  
SNAP .

-----  
FLASH VERR NOUN TO  
REQUEST RESPONSE AND  
DISPLAY DELTA V(I,V):  
V06NR1  
R1-DELTA VX (I,V)  
R2-DELTA VY (I,V)  
R3-DELTA VZ (I,V)  
-----

-----  
MONITOR DSKY:  
OBSERVE VERR-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF DELTA V(I,V)  
COMPONENTS.  
-----

#510

DELTA VX - IMPULSIVE  
COMPONENT OF DELTA V  
AT TIC ALONG (RXY) X  
IN EDS TO NEAREST  
.1 EDS

1A

# 1A

DELTA VY IMPULSIVE  
COMPONENT OF DELTA V  
AT TIG ALONG VXP IN  
FPS TO NEAREST  
.1 FPS

#520

DELTA VZ IMPULSIVE  
COMPONENT OF DELTA V  
AT TIG ALONG -P IN  
FPS TO NEAREST  
.1 FPS

WHERE R IS THE LM  
GEOCENTRIC (EARTH  
ORBIT) OR SELENOCENTRIC  
(LUNAR ORBIT)  
RADIUS VECTOR AND V  
IS THE LM INERTIAL  
VELOCITY VECTOR AT  
TIG.

#530

-----  
RECORD THESE  
VALUES FOR  
FUTURE  
TRANSMISSION  
TO THE LM.  
-----

#540

-----  
WAIT FOR KEYBOARD  
ENTRY

#550

#560

799

TERMINATE FLASH FROM RECEIPT OF PROCESS	KEY IN PROCESS
. . . . . . . . . . . .	. . . . . . .
RESET FINAL FLAG	RESET EX- TERMINAL DELTA V FLAG
. . . . . . . . . . . .	. . . . . . . . . . . .
IS FINAL FLAG SET?	
.N . . . . . .	.Y . . . . . .
SET MCA DISPLAY IN R2 (BELOW) =-99991	. . . . . . .
. . . . . . .	. . . . . . .

#570

#580

#590

#600

#610

1A

# 1A

#620

```
-----  
SET MGA  
DISPLAY IN  
R3 (BELOW)=  
-00002  
-----
```

"A"

#630

```
HOLD . FLASH VERB-NOUN TO  
..... REQUEST RESPONSE AND  
MON . DISPLAY MARK CTRS,  
TEI, AND MGA.  
VIA N45  
R1 MARK CTRS  
R2 TEI  
R3 MGA
```

```
-----  
MONITOR DSKY:  
OBSERVE VERB-  
NOUN FLASH TO  
REQUEST RES-  
PONSE AND DISPLAY  
OF MARK CTRS,  
TEI, AND MGA.  
-----
```

#640

MARK CTRS - THE NUMBER OF MARKS PROCESSED BY THE PFMDFZ-VIOUS DATA PROCESSING ROUTINE (R22) (REFER TO ASSUMPTION (A1 OF P20). THE REGISTER WILL DISPLAY XXXX WHERE THE TWO MOST SIGNIFICANT DIGITS IS THE VHF RANGING MARK COUNTER AND THE TWO LEAST SIGNIFICANT DIGITS IS THE OPTICS MARK COUNTER.

NOTE: THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BETWEEN BACK-UP AND PRIMARY MARKS.

TEI-TIME FROM IGNITION IN MIN AND SEC TO NEAREST SEC. MAX READING IS 50R50. (-BEFORE, AND + AFTER T(G.)

#650

#660



10A-MIDDLE CIRCUM-  
ANGLE DISPLAY IS NOT  
PERTINENT TO THIS  
PROGRAM.

THEREFORE:

- (A) WHEN DISPLAYED  
AT ANY TIME OTHER  
THAN THE LAST  
PASS THROUGH THE  
PROGRAM THE  
VALUE IS -00001.
- (B) ON THE LAST PASS  
THE VALUE IS  
-00002. IN  
DEGREES TO THE  
NEAREST .01  
DEGREES.

-----

-----  
WAS THIS THE  
LAST PASS  
THROUGH THE  
PROGRAM?  
-----

.Y .N

-----  
DO I WISH  
TO TERMIN-  
ATE THE  
MARK PRO-  
CESS AND DO  
THE FINAL  
PASS THRO-  
UGH THE  
PROGRAM?  
-----

-----  
WAIT FOR KEYBOARD  
ENTRY

-----  
KEY IN  
DEGREE  
-----

#670

#680

#690

#700

#710

**1A**

# 1A

TERMINATE FLASH UPON  
RECEIPT OF RECYCLE  
OR PROCEED

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

GO TO  
"A"  
ABOVE

IS FINAL FLAG SET?

.N .Y

SET FINAL  
FLAG

GO TO  
"A"  
ABOVE

DO ROUTINE P00

KEY IN  
RECYCLE  
V32E

GO TO  
"A"  
ABOVE

WAS THIS THE LAST  
PASS THROUGH THE  
PROGRAM?

.Y .N

GO TO  
"A"  
ABOVE

TRANSMIT ALL MANEU-  
VER PARAMETERS TO  
THE LM.

DO ROUTINE P00

#770

#730

#740

#750

#760

13

.  
. .  
. .  
. .  
. .  
. .  
. .  
. .  
. .  
. .  
. .  
EXIT

.  
. .  
. .  
. .  
. .  
. .  
. .  
. .  
. .  
. .  
. .  
EXIT

078/00100515  
078/00100515

#770

CHANGE CONTROL NOTES

- REV 03 PCR MIT 45
- REV 04 PCR MIT 66
- REV 05 PCR 206
- REV 06 PCR 206 EDITORIAL
- REV 07 PCN 578
- REV 07 PCN 577

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## LM STABLE ORBIT MIDCOURSE TARGETING (SOM) PROGRAM (P79)

LOGIC REV 06 07/09/68

## PURPOSE:

- (1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR LM EXECUTION OF THE NEXT POSSIBLE MIDCOURSE CORRECTION OF THE STABLE ORBIT TRANSFER PHASE OF AN ACTIVE LM RENDEZVOUS.
- (2) TO COMPUTE AND DISPLAY SUITABLE INFORMATION TO ENABLE THE CREW TO ENTER THE FINAL RENDEZVOUS PHASE AT THE CORRECT TIME TO COMPLETE THE REQUIRED THRUSTING MANEUVER.

## ASSUMPTIONS:

- (1) THE ISS NEED NOT BE ON TO COMPLETE THIS PROGRAM.
- (2) 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.
- (3) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.  
THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETTING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.
- (4) THE OPERATION OF THIS PROGRAM UTILIZES THE FOLLOWING FLAGS.  
  
ACTIVE VEHICLE FLAG - DESIGNATES THE VEHICLE WHICH IS DOING RENDEZVOUS THRUSTING MANEUVERS TO THE PROGRAM WHICH CALCULATES THE MANEUVER PARAMETERS. SET AT THE START OF EACH RENDEZVOUS PRE-THRUSTING PROGRAM.  
  
FINAL FLAG-SELECTS FINAL PROGRAM DISPLAYS AFTER CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION AND DISPLAY CYCLE.
- (5) THE TIME OF INTERCEPT (T(INT)) WAS DEFINED BY PREVIOUS COMPLETION OF THE LM STABLE ORBIT RENDEZVOUS TARGETING (SOR) PROGRAM (P78) AND IS PRESENTLY AVAILABLE IN CMC STORAGE.
- (6) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

.CREW  
.PROG  
.SELECTION  
.  
...  
.

-----  
START LM STABLE  
ORBIT MIDCOURSE  
TARGETING (SOM)  
PROGRAM (79).  
DISPLAY PROGRAM 79.  
-----

.  
.....  
.

-----  
KEY IN LM STABLE  
ORBIT MIDCOURSE  
TARGETING (SOM)  
PROGRAM (P79)  
V37E79E  
-----

#10

.  
.....  
.

-----  
MONITOR DSKY:  
OBSERVE DISPLAY OF  
PROGRAM 79  
-----

#20

.  
.  
.

-----  
SET ACTIVE VEHICLE  
FLAG TO LM  
-----

.  
.  
.

#30

-----  
RESET FINAL FLAG  
-----

.  
.  
.

-----  
SET TRACK FLAG (SEE  
P20)  
-----

.  
.  
.

#40

-----  
SET UPDATE FLAG  
(SEE P20)  
-----

.  
.  
.  
.  
.  
.  
.  
.  
.  
.

"A"

.  
.  
.  
.  
.  
.  
.

#50

P79/COLOSSUS  
P79/LUMINARY



```

. . .
. . .
. . .
-----
. DO LAMBERT
. ROUTINE TO CAL-
. CULATE THE
. REQUIRED VELOCITY
. FOR MIDCOURSE
. CORRECTION.
-----

```

#110

```

. . .
. . .
. . .
-----
. CALCULATE THRUST
. INITIAL CONDITION
. PARAMETERS REFER
. TO R577 SECTION
. 5.4.4.5, FOR
. DEFINITION OF
. CALCULATIONS
-----

```

#120

```

. . .
. . .
. . .
-----
. IS THE FINAL FLAG
. SET?
-----

```

#130

```

. .N      .Y
. .      .
. .      .
-----

```

```

. SET THE
. UPDATE
. FLAG.
-----

```

```

. "A"
.
.
.
.
.
.
.
.
.
.
.

```

#140

HOLD .  
.....  
SNAP .

```

. FLASH VERB-NCUN
. TO REQUEST RESP-
. ONSE AND DISPLAY
. THREE STORED
. COMPONENTS OF
. DELTA (LV):
. V06N81
. R1-DELTA VX(LV)
. R2-DELTA VY(LV)
. R3-DELTA VZ(LV)
. DELTA VX (LV):
. COMPONENT OF
. IMPULSIVE DELTA V
. AT TIG ALONG
. (RXV)XR. IN FPS
. TO NEAREST .1
-----

```

```

. MONITOR DSKY:
. OBSERVE VERB-NCUN
. FLASH TO REQUEST
. RESPONSE AND DISPLAY
. OF STORED COMPONENTS
. OF DELTA V(LV).
-----

```

#150





SET MGA DIS-  
PLAY IN R3  
(BELOW)  
= -00001.

#220

SET MGA  
DISPLAY IN  
R3 (BELOW)  
= -00002.

#230

HOLD .  
.....  
MON .  
FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY MARK CTRS  
TFI AND MGA:  
V16 N45  
R1-MARK CTRS  
R2-TFI  
R3-MGA

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF MARK CTRS, TFI,  
AND MGA

#240

MARK CTRS - THE NUM-  
BER OF MARKS PROCES-  
SED BY THE RENDEZ-  
VOUS DATA PROCESSING  
ROUTINE (P22) (REFER  
TO ASSUMPTION (8) OF  
P20). THE REGISTER  
WILL DISPLAY XXRX  
WHERE THE TWO MOST  
SIGNIFICANT DIGITS  
IS THE VHF RANGING  
MARK COUNTER AND  
THE TWO LEAST SIGNI-  
FICANT DIGITS IS THE  
OPTICS MARK COUNTER.

#250

NOTE: THE OPTICS  
MARK COUNTER DOES  
NOT DISTINGUISH BE-  
TWEEN BACK-UP AND  
PRIMARY MARKS.

#260

TFI - TIME FROM TIG.  
IN MIN AND SEC TO  
NEAREST SEC.  
MAXIMUM READING IS  
59859. (-BEFORE  
+ AFTER TIG.)

MGA-MIDDLE CIMBAL  
ANGLE IS NOT PERTIN-  
ENT IN THIS PROGRAM.  
THEREFORE:

(A)WHEN DISPLAYED  
AT ANY TIME OTHER  
THAN THE LAST PASS  
THROUGH THE PRO-  
GRAM THE VALUE IS  
-00001

(B)ON THE LAST  
PASS THE VALUE IS  
-00002 IN DEGREES  
TO THE NEAREST .01  
DEGREES

++  
+  
+06  
++

-----  
WAIT FOR KEYBOARD  
ENTRY

.....  
+

.....  
-----  
WAS THIS THE LAST  
PASS THROUGH THE  
PROGRAM?

.Y .N  
.  
.  
.  
.

-----  
. DO I WISH TO TER-  
. MINATE THE MARK  
. PROCESS AND DO  
. THE FINAL PASS  
. THROUGH THE  
. PROGRAM?  
.

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

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

.....  
GO TO  
"A"  
ABOVE

#270

#280

#290

#300

#310

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR RECYCLE

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

GO TO  
"A"  
ABOVE

IS THE FINAL  
FLAG SET?

.Y .N  
. .  
. .

SET THE  
FINAL FLAG.

GO TO  
"A"  
ABOVE

KEY IN PROCEED

WAS THIS THE LAST  
PASS THROUGH THE  
PROGRAM?

.Y .N  
. .  
. .  
GO TO  
"A"  
ABOVE

TRANSMIT ALL MANEU-  
VER PARAMETERS TO THE  
LM.

#320

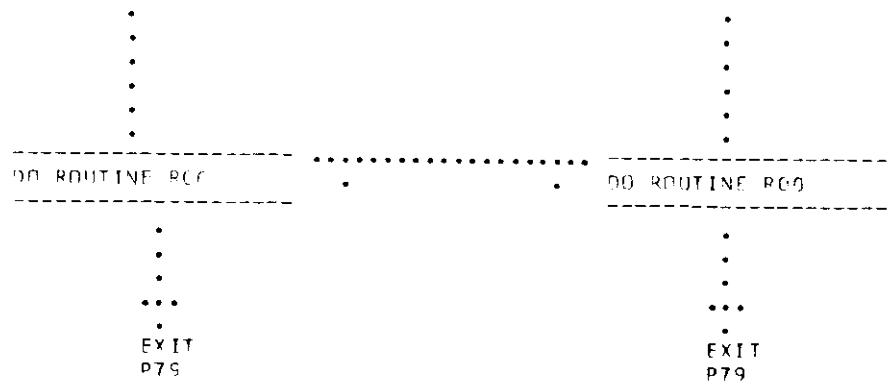
#330

#340

#350

#360

455



P79/COLOSSUS  
P79/LUMINARY

#370

CHANGE CONTROL NOTES

- REV 04 PCR MIT 45
- REV 05 PCR MIT 66
- REV 06 PCR 206

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FINAL AUTOMATIC REQUEST TERMINATE ROUTINE (P00)

LOGIC REV 09 11/29/68

- PURPOSE:
- (1) TO PROVIDE A STANDARD EXIT FOR PROGRAMS, AND AN OPTION TO SELECT ANY PROGRAM DESIRED.
  - (2) TO PROVIDE A GENERAL DESCRIPTION OF THE COMPUTER ACTIVITY FOLLOWING ANY V37EXXE.
- ASSUMPTIONS:
- (1) THE CALLING PROGRAM HAS SUCCESSFULLY COMPLETED ALL ITS FUNCTIONS OR THE OPERATOR HAS PREMATURELY TERMINATED THE PROGRAM.
  - (2) THE COMPUTER CHECKS ON THE RENDEZVOUS PROCESS FOLLOWING ANY V37EXXE IN THE FOLLOWING WAYS:
    - (A) IF P20 IS THE NEW PROGRAM KEYED IN AND IS NOT PRESENTLY RUNNING AND WAS NOT RUNNING IN THE BACKGROUND IT WILL BE STARTED AS A NEW PROGRAM.
    - (B) IF P20 IS THE NEW PROGRAM KEYED IN AND P20 IS PRESENTLY RUNNING (I.E. 20 DISPLAYED IN THE PROG LIGHTS) IT WILL BE STARTED AS A NEW PROGRAM (I.E. RE-INITIALIZED).
    - (C) IF P20 IS THE NEW PROGRAM KEYED IN AND IS NOT PRESENTLY THE ONLY PROGRAM RUNNING (I.E. A PROGRAM OTHER THAN P20 IS DISPLAYED IN THE PROG LIGHTS) AND P20 IS RUNNING IN THE BACKGROUND THE PROG LIGHTS WILL BE CHANGED TO 20 AND P20 WILL START AT REED P20 WITH THE FLAGS SET TO ALLOW TRACKING AND UPDATING.
    - (D) IF P00 IS SELECTED, THE RENDEZVOUS FLAG IS RESET (SHUTS OFF P20) AND P00 IS STARTED.
    - (E) IF A PROGRAM OTHER THAN P20 AND P00 IS KEYED IN, THE NEW PROGRAM WILL BE STARTED AND THE PROG LIGHTS WILL DISPLAY THE NEW PROGRAM. THE COMPUTER WILL THEN ATTEMPT TO RESTART P20 AND WILL BE SUCCESSFUL IF P20 WAS RUNNING IN THE BACKGROUND AND THE NEW PROGRAM WILL ALLOW TRACKING.

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

	. CMC . ROUTINE . SELECTION . . . .		CREW. ROUTINE SELECTION . . . . . . . . . . . . . . . . . .			#10
	----- IS MAX OR FLAG SET? -----					
	. N    . Y					
	. .					
	. .					
	. .					
	. .					
	. .					
	. .					
	. .					
	. .					
	. .					
	. .					
	. .					

#20

-----  
SET MAX  
DEAD-  
BAND IN  
RCS PAR.  
-----

-----  
SET MIN DEAD-  
BAND IN RCS PAR.  
-----

#30

HOI D .  
.....  
SNAP .  
-----  
FLASH VERB 27 TO  
REQUEST PLEASE PER-  
FORM CHANGE OF  
PROGRAM  
V27 M BLANK  
P1 BLANK  
P2 BLANK  
P3 BLANK  
-----

.....  
.  
.....

-----  
MONITOR DSKY:  
OBSERVE VERB 27  
FLASH TO REQUEST  
PLEASE PERFORM  
CHANGE OF PROGRAM.  
-----

#40

-----  
WAIT FOR KEYBOARD  
ENTRY TERMINATE  
FLASH ON RECEIPT OF  
OF XXF  
-----

.....  
.  
.....

-----  
KEY IN DESIRED  
PROGRAM:  
XXF  
-----

#50

-----  
RECEIVE V27XXF  
TO REQUEST NEW  
PROGRAM.  
-----

.....  
.  
.....

-----  
KEY IN DESIRED  
PROGRAM:  
V27XXF  
-----

#60

++  
+00  
++  
RCP  
507  
-----  
RAN ENTRY  
FROM V27  
WITH PROGRAM  
ROO SPECIFIED  
-----



459

```

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

```

IS THE IMU BEING  
INITIALIZED (IS IMU  
CDU ZERO IN  
PROCESS)?

```

.N .Y
. .
. .

```

TURN ON PROGRAM  
ALARM LIGHT AND  
STORE ALARM CODE  
1520

```

. .
. .
. .
. .
. .
EXIT

```

IS THE TVC DAP ON OR  
IS THE ENGINE ON?

```

.Y .N
. .
. .

```

TERMINATE THE  
ENGINE ON  
COMMAND.

TURN OFF TVC  
DAP

TURN OFF ALL  
RCS TRANSLATION  
AND ROTATION

```

. .
. .
. .

```

MONITOR DSKY:  
DOES PROGRAM  
ALARM LIGHT COME  
ON INDICATING THAT  
THE IMU IS STILL  
BEING INITIALIZED?

```

.N .Y
. .
. .

```

RESET ALARM  
LIGHT.

R00/COLOSSUS  
R00/SUNDANCE  
R00/LUMINARY

#70

#80

#90

#100

#110

#120

R00/COLOSSUS  
R00/SUNDANCE

.....  
-----  
WAIT ABOUT 3  
SECONDS  
-----  
.....

.....  
-----  
TURN ON PCS DAP  
-----  
.....

.....  
-----  
WRITE ZERO'S  
INTO NEW PROG-  
RAM SELECTION  
SO THAT REGARD-  
LESS OF THE  
SELECTED PROG-  
RAM, R00 WILL  
SELECT R00.  
-----  
.....

.....  
-----  
IS NEW PROGRAM R00?  
-----  
.....

.Y                                  .N  
.....

.....  
-----  
. IS STATE VECTOR  
EXTRAPOLATION  
BEING PERFORMED  
IN THE CMC IDLING  
PROGRAM R00 OR IS  
R05 ON?  
-----  
.....

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

#130

#140

#150

#160

#170





.....  
-----  
RESET STICK FLAG  
-----  
.....

.....  
-----  
SHUT OFF UPLINK ACTY  
LIGHT  
-----  
.....

.....  
-----  
PESET VHF RANGE  
FLAG  
-----  
.....

.....  
-----  
IS MAX DB FLAG SET?  
-----

.N .Y  
.....

.....  
-----  
SET MAX  
DEAD-  
BAND IN  
RCS DAP.  
-----  
.....

.....  
-----  
SET MIN DEAD-  
BAND IN RCS DAP  
-----  
.....

.....  
-----  
IS NEW PROGRAM P00?  
-----

.N .Y  
.....

ROO/COLOSSUS  
ROO/SUNDANCE  
ROO/LUMINARY

#290

#300

#310

#320

#330

ROO/COLOSSUS  
ROO/SUNDANCE

-----  
RESET  
THE REN-  
DEZVOUS  
FLAG.  
-----

-----  
IS NEW PROGRAM P20?  
-----

.Y .N  
.  
.  
.  
.  
.

-----  
IS THE CURRENT  
PROGRAM P20?  
-----

.N .Y  
.  
.  
.  
.  
.

-----  
RESET  
THE REN-  
DEZVOUS  
FLAG.  
-----

-----  
IS THE RENDEZVOUS  
FLAG SET?  
-----

.Y .N  
.  
.  
.  
.  
.

-----  
SET THE TRACK  
FLAG  
-----

.  
.  
.  
.  
.  
.  
.  
.  
.

#340

#350

#360

#370

#380

464

465

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

SET THE UPDATE  
FLAG

.  
. .  
. .

-----  
DISPLAY NEW PROGRAM

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

. DISPLAY NEW  
. PROGRAM AND  
. GO TO PROGRAM  
. SELECTED.

. .  
. .  
. .

-----  
PLEASE DISPLAY  
SYSTEM.

.  
. .  
. .

-----  
IS THE RENDEZVOUS  
FLAG SET?

.N .Y  
. .  
. .  
. .  
. .  
-----

. GO TO ADDR  
. P20 IN P20.

. .  
. .  
. .  
EXIT EXIT

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

-----  
MONITOR DSKY:  
OBSERVE DISPLAY OF  
NEW PROGRAM.

.  
.....  
. .

.  
.....  
. .

-----  
. .  
. .  
. .  
. .  
GO TO  
PROGRAM  
SELECTED

ROO/COLOSSUS  
ROO/SUNDANCE  
ROO/LUMINARY

#390

#400

#410

#420

#430

CHANGE CONTROL NOTES

REV 06	PCR 80.3	00510000
REV 07	PCR NASA 151	00511000
	PCR MIT 66	00512000
REV 08	PCR 465	00513000
	PCR 447	00514000
	PCR 492	00515000
	PCR 225	00516000
REV 09	PCR 507	00516001



IMU STATUS CHECK ROUTINE (R02)

LOGIC REV 03 04/12/68

PURPOSE: (1) TO CHECK WHETHER IMU IS ON AND IF ON WHETHER IT IS ALIGNED TO AN ORIENTATION KNOWN BY THE CMC.
(2) TO ESTABLISH A PROGRAM ALARM AND STORE AN ALARM CODE IF THE IMU IS OFF OR NOT ALIGNED TO AN ORIENTATION KNOWN BY THE CMC.

ASSUMPTIONS: (1) THE ROUTINE IS ONLY AUTOMATICALLY SELECTED.

PROG CMC GROUND CREW CHECKLIST TIME TOTAL
CONT

.CMC
.ROUTINE
.SELECTION
START IMU STATUS
CHECK ROUTINE (R02) #10

IS THE ISS ORIENTA-
TION KNOWN FLAG SET?
(CHECK REFSMMAT
FLAG) #20

.Y .N
IS THE ISS ON?

.Y .N
#30

```

-----
. TURN ON PROGRAM .
. ALARM LIGHT BUT .....
. DO NOT CHANGE .
. PRESENT DIS- .
. PLAY. (PROGRAM .
. ALARM DISPLAY .
. IF CALLED IS: .
.   V05N09 .
.   R1- .
.   R2- .
.   R3- .

```

```

-----
. MONITOR DSKY: .
.   DOFS PROGRAM .
. ALARM LIGHT INDICATE .
. THAT EITHER IMU IS .
. NOT ON OR NOT .
. ALIGNED? .

```

```

. EXPECTED ALARM .
. CODE IS 00210 .
-----

```

#40

```

-----
. TURN ON PROGRAM .
. ALARM LIGHT BUT .
. DO NOT CHANGE .
. PRESENT DISPLAY. .
. PROGRAM ALARM .....
. DISPLAY IF .
. CALLED IS: .
.   V05 N09 .
.   R1- .
.   R2- .
.   R3- .

```

```

. EXPECTED ALARM .
. CODE AT THIS .
. TIME IS 00220 .
-----

```

#50

#60

++  
+03  
++

```

-----
. Y . N .
. . . .
. . . .

```

#70

```

-----
. CALL PROGRAM ALARM .
. DISPLAY (V05N09) .
. TO IDENTIFY ABNOR- .
. MALITY. WHEN FIN- .
. IShed PUSH KEY .
. RELEASE. .
-----

```

#80



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DIGITAL AUTOPILOT DATA LOAD  
ROUTINE (R03)

LOGIC REV 06 07/09/68

- PURPOSE: (1) TO LOAD AND VERIFY CMC DIGITAL AUTOPILOT (DAP) DATA.  
 (2) TO PROVIDE THE CREW A MEANS FOR SELECTING APPROPRIATE CCAST AUTOPILOTS. AFTER COMPLETION OF THIS ROUTINE, WHICH IDENTIFIES THE VEHICLE CONFIGURATION, THE USE OF VERB 46 ENTER ("ESTABLISH GNC CONTROL") WILL CAUSE THE APPROPRIATE DAP TO BECOME ACTIVE.
- ASSUMPTIONS: (1) THE MOMENTS OF INERTIA AND OTHER PERTINENT PARAMETERS ARE STORED IN THE CMC AS A FUNCTION OF THE KEYED IN WEIGHTS.  
 (2) THE TVC DAP REDUCES THE VALUE FOR WEIGHT LINEARLY AS A FUNCTION OF SPS MANEUVER TIME DURING SPS THRUSTING PROGRAM (P40) MANEUVERS ONLY. ALL THRUSTING MANEUVERS THAT ARE PERFORMED WITHOUT USING P40 COULD CAUSE THE CMC'S KNOWLEDGE OF WEIGHT TO BE COMPROMISED.
- ++  
 +05 (3) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.  
 ++  
 (4) THIS ROUTINE IS NOT AVAILABLE IF UNDER THRUST VECTOR CONTROL.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
			.CREW .ROUTINE .SELECTION . ... .			
	START DAP DATA LOAD ROUTINE (R03)	.....	KEY IN V48E			#10
	.					
	.					
	.					
++ +06 +	IS ANOTHER EXTENDED VERB ACTIVE?					
+	.N .Y					
+	.					
+	.					
+	. TURN ON OPERATER ERROR LIGHT.					#20
+	.					
+	.					
+	.					
+	.					
+	.					
+	.					

```

+
+
+
+
+
+
+
+
+06
++

```

EXIT

#30

```

HOLD .
.....
SNAP .

```

```

-----
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY DAP CONFIG-
URATION DATA:
V04 N46
R1-ABCDE
R2-ABCDE
R3-BLANK

```

```

R1 DATA CODE:
A-VEHICLE CONFIG.
CODE:
0-NO DAP
1-CSM
2-CSM + LM
  (ASCENT PLUS
  DESCENT)
3-SIVB
6-CSM + LM
  (ASCENT ONLY)
B-QUAD AC FOR
+X TRANS CODE:
0-DON'T USE
QUAD
1-USE QUAD
C-QUAD BC FOR
+X TRANS CODE:
0-DON'T USE
QUAD
1-USE QUAD
D-DEADBAND CODE:
0-0.5 DEG
1-5.0 DEG
E (LSB)-MANEUVER
RATE CODE:
0-0.05 DEG/SEC
1-0.2 DEG/SEC
2-0.5 DEG/SEC
3-4.0 DEG/SEC
NOTE: IF BOTH B+C
DISPLAY ZERO
THIS MEANS 1-1

```

```

-----
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF DAP CONFIGURATION
DATA
-----

```

#40

```

-----
AM I SATISFIED WITH
THE STORED DAP CON-
FIGURATION DATA?
-----

```

#50

```

.Y .N

```

#60

#70

R2 DATA CODE:  
 A-QUAD AC OR RD  
 ROLL CODE  
 0-USE RD  
 1-USE AC  
 R-QUAD A CODE  
 0-DON'T USE  
 QUAD  
 1-USE QUAD  
 C-QUAD B CODE  
 0-DON'T USE  
 QUAD  
 1-USE QUAD  
 D-QUAD C CODE  
 0-DON'T USE  
 QUAD  
 1-USE QUAD  
 E-QUAD D CODE  
 0-DON'T USE  
 QUAD  
 1-USE QUAD

#80

#90

#100

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

-----  
 KEY IN PRO-  
 CEED  
 -----

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

-----  
 KEY IN V21E, V22E,  
 OR V24E AND LCAD DE-  
 SIRED DATA CODES IN  
 R1, R2  
 -----

#110

-----  
 .PROCEED .NEW DATA  
 .  
 .  
 .  
 .  
 .  
 .  
 -----

-----  
 .  
 .  
 .  
 -----  
 TRANSFER STORE DATA  
 DATA TO  
 DAP

#120

-----  
 .  
 .  
 .  
 -----  
 DID THE ASTRONAUT  
 SELECT MAXIMUM DEAC-  
 BAND (0 IN R1 = 1)?

#130

-----  
 .N .Y  
 .  
 .  
 .  
 .  
 .  
 .  
 -----

RESET  
MAX DB  
FLAG

#140

SET MAX DB  
FLAG

#150

HOLD .  
.....  
SNAP .

FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY CSM AND LM  
WEIGHTS:  
V06 N47  
R1-CSM WEIGHT  
R2-LM WEIGHT  
R3-BLANK

CSM WEIGHT-WEIGHT OF  
THE CSM IN POUNDS TO  
THE NEAREST POUND.

LM WEIGHT-WEIGHT OF  
THE LM IN POUNDS TO  
THE NEAREST POUND.

MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF CSM AND LM WEIGHT

#160

IS THE LM ATTACHED?

.Y .N  
. .  
. .

#170

ARE THE VALUES  
FOR CSM AND  
LM CORRECT?

.N .Y  
. .  
. .

IS THE CSM  
WEIGHT  
CORRECT?

#180

.Y .N



WAIT FOR KEYBOARD  
ENTRY

.....

KEY IN  
PROCEED

#190

KEY IN V21E,  
V22E, OR V24E  
AND LOAD  
CORRECT DATA

.....

#200

KEY IN V21E  
AND LOAD  
CORRECT DATA

.....

#210

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

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

#220

IS THE VEHICLE CON-  
FIGURATION CODE  
EQUAL TO 0 OR 3?

++  
+05

.Y .N

#230

.....

#240

05  
++

```
-----  
. IS VEHICLE CONFIGUR-  
+ ATION CODE EQUAL TO  
+ 2 OR 6?  
-----
```

.N .Y

```
-----  
TRANSFER TRANSFER  
CSM WEI- LM + CSM  
GHT TO WEIGHT TO  
DAP DAP  
-----
```

#250

HOLD .  
.....  
SNAP .

```
-----  
FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY GIMBAL ACTU-  
ATOR TRIM VALUES:  
V06 N48  
R1-PITCH TRIM  
R2-YAW TRIM  
R3-BLANK  
-----
```

```
-----  
PITCH TRIM AND YAW  
TRIM-SPS ENGINE BELL  
TRIM ANGLES AT  
IGNITION DATA  
TAKEN IN DEGREES  
TO NEAREST .01  
DEGREE.  
-----
```

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

```
-----  
MONITOR DSKY:  
OBSERVE VERB-NOUN  
FLASH TO REQUEST  
RESPONSE AND DISPLAY  
OF GIMBAL ACTUATOR  
TRIM VALUES  
-----  
.  
:  
.
```

```
-----  
DO THESE VALUES  
AGREE WITH MY CARRY  
ON DATA?  
-----
```

Y. .N  
.  
.  
.  
.

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

#260

#270

#280

417

R03/COLUSSUS

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR NEW DATA

-----  
KEY IN V21F, V22F,  
OR V24F AND LOAD THE  
CORRECT DATA  
-----

-----  
P. . NEW  
P. . DATA  
Q. .  
C. .  
E. .  
E. .  
D. .  
.  
.  
-----

STORE DATA

-----  
TRANSFER  
DATA TO DAP  
-----

.  
.  
...  
.  
EXIT R03

#290

#300

#310

CHANGE CONTROL NOTES

- REV 04 PCR 123
- PCR 151
- REV 05 PCR 423
- PCR 474
- REV 06 PCR 206

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479

S-BAND ANTENNA ROUTINE (R05)

LOGIC REV 10 11/27/68

PURPOSE: (1) TO COMPUTE AND DISPLAY THE TWO STEERABLE S-BAND ANTENNA GIMBAL ANGLES WHICH WILL POINT THE ANTENNA TOWARD THE CENTER OF THE EARTH.

ASSUMPTIONS: (1) THIS ROUTINE CAN BE INITIATED ONLY WHILE THE CMC IDLING PROGRAM (P00) IS IN OPERATION.

(2) THE IMU IS ON AND ALIGNED

(3) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROC CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
			.CREW .ROUTINE .SELECTION			
	----- START S-BAND ANTENNA ROUTINE (R05) -----		----- KEY IN V64E -----			#10
	----- IS THE CURRENT PROGRAM P00? -----					
	.Y .N					
++						
+10						
+						
+						
+10						
++						#20
EDIT	N. Y					

R05/COLOSSUS  
R05/LUMINARY

TURN ON  
OPERATOR  
ERROR  
LIGHT.

MONITOR DSKY:  
DOES OPERATOR ERROR  
LIGHT COME ON INDIC-  
ATING THAT THIS  
ROUTINE CAN NOT BE  
SELECTED AT THIS  
TIME?

#30

EXIT

.N .Y

IN ORDER  
TO TURN  
THIS ROU-  
TINE ON  
SELECT CMC  
IDLING  
PROGRAM  
(POO) BY  
KEYING IN  
V37E00F  
AND RESE-  
LECT THIS  
ROUTINE.

#40

EXIT

#50

#60

DO IMU STATUS CHECK  
ROUTINE (R02)

DO IMU STATUS CHECK  
ROUTINE (R02)

#70

EXTRAPOLATE CSM  
STATE VECTOR TO  
PRESENT TIME USING  
CONIC EQUATIONS

#80

481

R05/COLOSSUS  
R05/LUMINARY

•  
•  
•  
•  
•  
•  
•  
•

•-----•  
• CALCULATE VECTOR  
• FROM CSM TO EARTH  
• CENTER IN CSM BODY  
• AXIS  
•-----•

•  
•  
•  
•  
•  
•

•-----•  
• CALCULATE REQUIRED  
• S-BAND ANTENNA PITCH  
• AND YAW GIMBAL  
• ANGLES.  
•-----•

•  
•  
•  
•  
•  
•

HOLD •  
•-----•  
• FLASH VERB-NOUN TO  
• REQUEST RESPONSE AND  
• MON • DISPLAY REQUIRED S-  
• BAND ANTENNA GIMBAL  
• ANGLES.  
• V06N51  
• R1 RHO  
• R2 GAMMA  
• R3 BLANK

• RHO-S-BAND ANTENNA  
• PITCH GIMBAL  
• ANGLE-CORRE-  
• SPONDING TO  
• THE S-BAND  
• PITCH GIMBAL  
• DIAL IN DEGREES  
• TO THE NEAREST  
• .01 DEGREE.

• GAMMA-S-BAND ANTENNA  
• YAW GIMBAL ANGLE  
• CORRESPONDING TO  
• THE S-BAND YAW  
• GIMBAL DIAL IN  
• DEGREES TO THE  
• NEAREST .01  
• DEGREE.

• NOTE: FOR  
• DEFINITION OF  
• S-BAND DISPLAY  
• ANGLES REFER TO

•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•

•-----•  
• MONITOR DSKY:  
• OBSERVE VERB-NOUN  
• FLASH TO REQUEST RE-  
• SPONSE AND DISPLAY  
• OF THE REQUIRED S-  
• BAND ANTENNA PITCH  
• AND YAW GIMBAL ANG-  
• LES REQUIRED TO  
• POINT THE ANTENNA AT  
• EARTH CENTER WITH  
• THE CSM AT ITS PRE-  
• SENT POSITION AND  
• ATTITUDE.  
•-----•

•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•  
•

#90

#100

#110

#120

#130

R05/COLOSSUS  
R05/LUMINARY

R-577 CHAPTER V  
SECTION 5.6.6

++  
+09  
+  
+  
+  
+  
+  
+  
+  
+  
+  
+  
+  
+  
+  
+  
+09  
++

```
.....
NOTE:
THIS LOOP
WILL BE
PERFORM-
ED AT A
FREQUENCY
NOT LESS
THAN ONCE
EVERY 3
SECONDS.
.....
```

WAIT FOR KEYBOARD  
ENTRY

```
.....
.....
.....
```

CONSIDERING THE PRE-  
SENT POSITION AND  
ATTITUDE, DO THESE  
ANGLES YIELD AN UN-  
OBSTRUCTED ANTENNA  
LOS TO THE EARTH  
CENTER?

```
Y.        .N
.....
DO I WISH
TO MANEU-
VER THE
THE VEHI-
CLE AND
MONITOR
THE DIS-
PLAY TO
ACHIEVE
AN UNOBS-
TRUCTED
VIEW OF
THE FAR-
TH?
```

#140

#150

#160

#170

#180

#190



.N .Y

-----  
SET AN-  
TENNA TO  
THESE  
ANGLES  
-----

#200

-----  
USING  
THE RHC  
MANEU-  
VER THE  
VEHICLE  
UNTIL  
SATIS-  
FACTORY  
ANGLES  
ARE AC-  
HIEVED.  
-----

#210

#220

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

#230

EXIT  
R05

-----  
TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
-----

#240

.P  
.R  
.D  
.C  
.E  
.F  
.D  
. .  
. .

.  
. .  
. . .  
. . . .  
. . . . .  
EXIT  
R05

CHANGE CONTROL NOTES

LOGIC REV 09 PCR MIT 66  
REV 10 EDITORIAL

48-

PURPOSE: (1) TO PERFORM SIGHTING MARKS IN CONJUNCTION WITH THE RENDEZVOUS NAVIGATION PROGRAM (P20).

ASSUMPTIONS: (1) SIGHTINGS ARE MADE ON THE LM USING THE SXT.

PCR (2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES 5 ANGLES (3 GCDUS AND 2 QCDUS) AND THE TIME OF MARK POSITION  
401 #1 AND MOVES PREVIOUS MARK DATA (IF ANY) TO POSITION #2. IF A MARK IS REJECTED (BY PRESSING MARK REJECT BUTTON) THE  
++ MARK DATA IN POSITION #1 IS ERASED.  
+08 THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) ATTEMPTS TO PROCESS THE MARK DATA (IF ANY) IN POSITION #2  
++ ONCE EVERY 4 SECONDS. IF DATA IS IN POSITION #2, IT IS MOVED TO POSITION #3 FOR PROCESSING BY (R22). IF NO DATA IS IN  
POSITION #2, R 22 INTERROGATES POSITION #2 AFTER 4 SECONDS.  
IF MARKS ARE MADE AT A GREATER FREQUENCY THAN R22 PROCESSES THEM THE OVERFLOW FROM POSITION #2 IS LOST.

(3) THE TRACKING ATTITUDE ROUTINE (R61) WILL AUTOMATICALLY HOLD RENDEZVOUS REFERENCE VECTOR AIMED AT THE LM, IF THE SC CONTROL SWITCH IS PLACED AT CMC, IF THE AUTOMODE IS SELECTED AND IF THE PREFERRED ATTITUDE FLAG IS SET. IF THE FREE MODE IS SELECTED THE ASTRONAUT MAY HOLD THE LM IN THE FIELD OF VIEW USING THE MINIMUM IMPULSE CONTROLLER. IF THE ATTITUDE HOLD MODE IS SELECTED THE ASTRONAUT MAY HOLD THE LM IN THE FIELD OF VIEW USING THE ROTATIONAL HAND CONTROLLER.

(4) THIS ROUTINE IS MANUALLY SELECTED BY THE ASTRONAUT BY KEYING IN V57E.

PROG            CMC            GROUND            CREW            CHECKLIST            TIME            TOTAL  
CONT

.CREW  
.ROUTINE  
.SELECTION  
.  
.  
...

-----  
START RENDEZVOUS  
TRACKING SIGHTING  
MARK ROUTINE (R21)  
-----



-----  
KEY IN V57E  
-----

#10

++  
+08  
+  
-----  
IS ANOTHER EXTENDED  
VEH ACTIVE?  
-----

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

#20

+  
+  
+  
+  
+  
+08  
++  
PCN  
586

. . .  
-----  
. TURN ON OPERATOR  
. ERROR LIGHT  
-----  
. . .  
. . .  
. . .  
. . .  
EXIT  
. . .

#30

-----  
IS RENDEZVOUS FLAG  
SET?  
-----  
.Y .N  
. . .  
. . .

#40

-----  
IS TRACK FLAG  
SET (SEE P201)?  
-----  
.Y .N  
. . .  
. . .

++  
+08  
+  
+  
+  
+  
+  
+08  
++  
EDIT  
PCR  
206

. . .  
-----  
. TURN ON PRO-  
. GRAM ALARM  
. LIGHT. NOTE:  
. ALARM CODE  
. IF CALLED BY  
. ASTRONAUT  
. IS:  
. V05N09  
. R1-  
. R2-  
. R3-  
. EXPECTED  
. ALARM CODE  
. AT THIS TIME  
. IS 406  
-----

-----  
MONITOR DSKY:  
DOES PROGRAM  
ALARM INDICATE  
THAT THE RENDEZVOUS  
NAVIGATION PROGRAM  
(P201) IS NOT IN  
PROCESS?  
-----

#50

.Y .N  
. . .  
. . .  
. . .  
. . .  
-----

#60

. . .  
. . .  
. . .  
. . .  
EXIT  
. . .

-----  
THIS ROUTINE  
MAY NOT BE SE-  
LECTED AT THIS  
TIME. PRESS  
ALARM RESET TO  
RESET PROGRAM  
ALARM  
-----

#70

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

#80

#90

#100

#110

#120

#130

HOLD..  
.....  
SNAP..

FLASH VERR TO  
REQUEST PLEASE MARK  
V51 N BLANK  
R1-BLANK  
R2-BLANK  
R3-BLANK

EXIT

MONITOR DSKY:  
OBSERVE VERR  
FLASH TO REQUEST  
PLEASE MARK.

SELECT MANUAL OPTICS  
MODE

WAIT FOR KEYBOARD  
ENTRY

MARK

WHEN LM IS AT  
CENTER OF RETICLE  
PRESS MARK BUTTON

WAS SIGHTING SATIS-  
FACTORY?

.N .Y

MARK REJECT.

PRESS MARK  
REJECT BUTTON

TERMINATE FLASH  
UPON RECEIPT  
OF MARK, MARK  
REJECT OR PROCEED

PROCEED

.M .M .P  
.A .A .R  
.R .R .D  
.K .K .C  
. . .F  
.R . .F  
. . .  
. . .  
. . .

.E  
.J  
.F  
.C  
.T

.D

-----  
ERASE  
MARK DATA  
IN POSI-  
TION #1  
(IF ANY)  
-----

-----  
DO I WISH TO  
MAKE MORE MARKS  
-----

.Y .N

#140

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

#150

-----  
TURN OPTICS MODE  
SWITCH TO CMC  
-----

#160

-----  
IS THERE  
MARK DATA  
IN POSI-  
TION #1?  
-----

.....  
EXIT R21

#170

-----  
TRANSFER  
MARK DATA  
FROM POSI-  
TION #1 TO  
POSITION  
#2  
-----

#180

488



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491

RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22)

LOGIC REV 16 11/27/68

PURPOSE: (1) TO PROCESS RENDEZVOUS SIGHTING MARK DATA TO UPDATE THE STATE VECTOR OF EITHER THE CSM OR LM AS DEFINED BY THE STATE VECTOR FLAG (SEE P20).

(2) TO PROCESS RENDEZVOUS VHF RANGING DATA TO UPDATE THE STATE VECTOR OF EITHER THE CSM OR LM AS DEFINED BY THE STATE VECTOR FLAG (SEE P20).

ASSUMPTIONS: (1) THIS ROUTINE IS AUTOMATICALLY SELECTED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20).

(2) V06N49 DISPLAYED IN THIS ROUTINE IS A PRIORITY DISPLAY AND WILL REMAIN UP A MINIMUM OF 2 SECONDS. RESPONSE AFTER 2 SECONDS WILL CAUSE THE PROGRAM TO CONTINUE AS DESCRIBED.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
	.CMC					
	.ROUTINE					
	.SELECTION					
	.					
	.					
	. . .					
	.					
	-----					
	START RENDEZVOUS					
	TRACKING DATA PROC-					
	ESSING ROUTINE (R22)					#10
	-----					
	.					
	.					
	.					
	.					
	-----					
	SET VHF TIMER					
	TO ZERO					#20
	-----					
	.					
	.					
	.					
	.					
	.					
	.					
	.					
	.					
	.	"R"				
	.	.				
	.	.				
	.	.				
	.	.				
	.	. . .				#30
	.	.				
	. . . . .	.				
.	.	.	.	.		
.	.	.	.	.		
.	.	.	.	.		



493

R22/COLOSSUS

```
. . .  
. . .  
. . .  
. . .  
. . .  
. . .  
. . .  
. . .  
.....
```

#90

++  
+16  
+  
++  
EDIT

```
. . .  
. EXIT "D"  
. .  
. .  
. .  
. . .  
. .  
. .
```

```
-----  
IS THERE DATA IN  
MARK DATA POSITION  
#2?
```

#100

```
.Y .N  
. .  
. .  
. . .  
. .  
. GO TO  
. "A"  
. .  
. .
```

#110

```
-----  
TRANSFER DATA OUT  
OF MARK DATA POSI-  
TION #2 AND INTO  
POSITION #3  
-----
```

#120

```
.  
.  
.  
-----  
CLEAR POSITION #2  
-----
```

```
.  
.  
.  
-----  
CALCULATE THE LCS TO  
THE LM  
-----
```

#130

```
.  
.  
.  
-----  
SET SOURCE  
CODE TO 1  
-----
```

#140

```
.  
.  
.  
.  
.  
.  
.  
.  
.
```

R22/COLOSSUS

GO TO  
"C"

#150

"C"  
.  
.  
.  
.  
.  
.  
.

#160

-----  
BASED ON THE DATA  
AND ITS SOURCE  
(OPTICS OR VHF ANC,  
IF OPTICS-PRIMARY OR  
BACK UP)  
CALCULATE THE RE-  
QUIRED CORRECTION  
TO UPDATE THE STATE  
VECTOR DESIGNATED BY  
THE STATE VECTOR  
FLAG (SEE P20).  
FOR DESCRIPTION  
OF UPDATE PROCESS  
REFER TO SECTION  
5.2.5.2.2 OF R577  
-----

#170

.  
.  
.

#180

-----  
IS THIS THE 2ND  
OPTICS CORRECTION  
FOR THIS MARK?  
-----

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

#190

494

495

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

-----  
IS THE MAGNITUDE  
OF THE STATE VECTOR  
CHANGE GREATER THAN  
THE TEST TOLERANCE  
STORED IN ERASABLE  
MEMORY?  
FOR DEFINITION  
OF TEST TOLFRANCE  
REFER TO ERASABLE  
LOAD FOR THE SPECI-  
FIC MISSION.  
-----

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

POSS  
PRIO  
HOLD  
.....  
SNAP

-----  
FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY EXCESSIVE  
UPDATE PARAMETERS.  
V06 N49  
R1-DELTA R  
R2-DELTA V  
R3-SOURCE CODE

DELTA R-MAGNITUDE  
OF THE DIFFERENCE  
BETWEEN THE POSITION  
VECTOR BEFORE AND  
AFTER INCORPORATION  
OF THIS MARK DATA.  
IN N.M. TO THE NEAR-  
EST .1 NM.

DELTA V-MAGNITUDE  
OF THE DIFFERENCE  
BETWEEN THE VELOCITY  
VECTOR BEFORE AND  
AFTER INCORPORATION  
OF THIS MARK DATA.  
IN FPS TO THE NEAR-  
EST .1 FPS.

SOURCE CODE-DEFINES  
SOURCE OF DATA:  
1 = OPTICS MARKS  
2 = VHF RANGING  
-----  
. .  
. .  
. .

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

-----  
MONITOR DSKY: DOES  
VERB NOUN FLASH TO  
REQUEST RESPONSE AND  
DISPLAY EXCESSIVE  
UPDATE PARAMETERS?  
-----

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

-----  
IS THE SOURCE CODE  
IN R3 = 1?  
-----

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

-----  
VERIFY THAT  
MARKING WAS DONE  
ON THE LM AND  
DISCUSS OUT OF  
TOLERANCE CON-  
DITION WITH THE  
GROUND, IF  
POSSIBLE.  
-----  
. .  
. .  
. .  
-----  
. .  
. .  
. .

#200

20001

#210

21001

#220

22001

#230

#240

++  
+16  
++  
EDIT

-----  
WAIT 2 SECONDS  
-----

VERIFY (TO BE  
DEFINED) AND  
DISCUSS OUT OF  
TOLERANCE CON-  
DITION WITH THE  
GROUND, IF  
POSSIBLE.

#250

-----  
SHALL I INCORPORATE  
THIS UPDATE?  
-----

#260

.Y .N

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

-----  
KEY IN RE-  
CYCLE V32E  
-----

#270

-----  
TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR RECYCLE  
-----

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

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

#280

-----  
IS SOURCE CODE =  
1?  
-----

#290

.N .Y

497

```

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

```

```

-----
EPASE
MARK DATA
FROM POS-
ITIONS 1,
2, AND 3
-----

```

#300

```

. . .
. . .
. . .

```

```

. . GO TO      GO TO
. . "RB"      "AB"

```

#310

```

-----
INCORPORATE STATE
VECTOR CORRECTION
INTO THE STATE
VECTOR DESIGNATED BY
THE STATE VECTOR
FLAG (SEE P20)
-----

```

#320

```

-----
IS SOURCE CODE = 1?
-----

```

```

. Y      . N
.         .
.         .

```

#330

```

. INCREMENT REND-
. EZVOUS VHF
. RANGING MARK
. COUNTER
-----

```

#340

++  
+16  
++  
EDIT

```

-----
IS THIS THE 2ND
OPTICS CORREC-
TION FOR THIS
MARK?
-----

```

```

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

```

#350





```

+ 499 . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+ . . . .
+16 .-----
++ . IS R60 OPERATING?
. Y. .N
. . . .
. . . .
PCN .....
570 . . . .

```

#410

```

-----
IS THE UPDATE FLAG
SET?
.Y .N
. . . .

```

#420

```

-----
. IS THE TRACK
. FLAG SET?
-----
. .N .Y .
. . . .
. . . .
. . . .
. . . .
. . . .
. EXIT
.

```

#430

```

-----
IS VHF RANGE FLAG
SET?
.Y .N
. . . .

```

#440

```

. . . .
. GO TO
. "D"
.

```

#450

```

++ HAS MORE THAN 1
+16 MINUTE ELAPSED ON
++ THE VHF TIMER SINCE
EDIT THE LAST VHF MARK
WAS PROCESSED?
-----
.Y .N
. . . .

```

#460



501

·  
·  
·  
·  
·  
·  
·  
·  
·  
·

GO TO  
"B"

-----  
SHUT OFF TRACKER  
FAIL LIGHT.  
-----

·  
·  
·

-----  
SET SOURCE CODE TO 2  
-----

·  
·  
·  
·  
·

GO TO  
"C"

R22/COLOSSUS

#520

#530

CHANGE CONTROL NOTES

LOGIC REV 13	PCR# MIT 54
LOGIC REV 14	PCR MIT 66
LOGIC REV 15	PCR MIT 465
	PCR 440
	PCR 468
	PCR 491
	PCR 226
LOGIC REV 16	PCN 570

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BACKUP RENDEZVOUS TRACKING SIGHTING MARK ROUTINE (R23) LOGIC REV 08 11/27/68

PURPOSE: (1) TO PERFORM SIGHTING MARKS IN CONJUNCTION WITH THE RENDEZVOUS NAVIGATION PROGRAM (P20) BY USE OF A BACKUP OPTICAL DEVICE.

ASSUMPTIONS: (1) THE ASTRONAUT KNOWS THE COORDINATES (OPTICS) OF THE ALTERNATE LOS HE MUST USE FOR THIS ROUTINE  
 EDIT  
 ++ (2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES THE 3 ICDU'S, THE CONTENTS OF NOUN 94 AND THE TIME OF MARK IN  
 +08 POSITION #1 AND MOVES PREVIOUS MARK DATA (IF ANY) TO POSITION #2. IF A MARK IS REJECTED BY KEYING IN V86E THE MARK  
 ++ DATA IN POSITION #1 IS ERASED.  
 PCR THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) ATTEMPTS TO PROCESS THE MARK DATA (IF ANY) IN  
 491 POSITION #2 ONCE EVERY 4 SECONDS. IF DATA IS IN POSITION #2, IT IS MOVED TO POSITION #3 FOR PROCESSING BY (R22). IF  
 ++ NO DATA IS IN POSITION #2, R22 INTERROGATES POSITION #2 AFTER 4 SECONDS.  
 +08  
 ++ (3) THIS ROUTINE IS MANUALLY SELECTED BY THE ASTRONAUT BY KEYING IN V54E.

PROG CONT	CMC	GROUND	CREW	CHECKLIST	TIME	TOTAL TIME
			.CREW .ROUTINE .SELECTION ...			
	----- START BACK UP REN- DEZVOUS TRACKING SIGHTING MARK ROU- TINE (R23) -----	.....	----- KEY IN V54E -----			#10
	. . .					
++ +08 + + + + + +08 ++	----- IS ANOTHER EXTENDED VERB ACTIVE? ----- N.                    Y. .                    . .                    . ----- . TURN ON OPERATOR . ERROR LIGHT -----					#20
PCN 586	. . . . . . . . . . .					

```

.
.
.
.
.
.
.
.
.
.
EXIT
.
.

```

#30

```

-----
IS THE RENDEZVOUS
FLAG SET?
-----

```

```

.Y           .N
.
.
.

```

#40

```

-----
IS TRACK FLAG
SET (SEE P20)?
-----

```

```

.Y           .N
.
.
.

```

```

++
+08
+
+
+
+
+08
++
EDIT
PCR
206

```

```

. TURN ON PRO-
. GRAM ALARM
. LIGHT. (NOTE:
. ALARM CODE
. IF CALLED BY
. ASTRONAUT
. IS:
. V05N09
. R1-
. R2-
. R3-
. EXPECTED
. ALARM CODE
. AT THIS TIME
. IS 406
-----

```

```

-----
MONITOR DSKY:
DOES PROGRAM
ALARM INDICATE
THAT THE RENDEZVOUS
NAVIGATION PROGRAM
(P20) IS NOT IN
PROCESS?
-----

```

#50

```

.Y           .N
.
.
.
.
.
.

```

#60

```

-----
THIS ROUTINE
MAY NOT BE SE-
LECTED AT THIS
TIME. PRESS
ALARM RESET TO
RESET PROGRAM
ALARM
-----

```

#70

```

.
.
.
.
.
.
EXIT
.
.

```

#80

```

.....
.
.
.
.
.
.

```

```

.....
.
.
.
.
.
.

```

HOLD .. FLASH VERB-NOUN TO  
 ..... REQUEST RESPONSE AND  
 SNAP .. DISPLAY ALTERNATE  
 LOS COORDINATES  
 VJ6 N94  
 R1 SHAFT  
 R2 TRUNNION  
 R3 BLANK

SHAFT-OPTICS SHAFT  
 ANGLE IN DEGREES TO  
 NEAREST .01 DEGREES  
 TRUNNION-OPTICS  
 TRUNNION ANGLE IN  
 DEGREES TO NEAREST  
 .001 DEGREES

WAIT FOR KEYBOARD  
 ENTRY:

TERMINATE FLASH  
 UPON RECEIPT OF NEW  
 DATA OR PROCEED

.NEW .PROCEED  
 .DATA .

MONITOR DSKY:  
 OBSERVE VERB-NOUN  
 FLASH TO REQUEST  
 RESPONSE AND DISPLAY  
 NEW OCDC ANGLES.

NOTE: THE VALUE OF  
 THESE REGISTERS  
 SHOULD CORRESPOND TO  
 THE CHOSEN ALTERNATE  
 LOS.

(THE NOMINAL ANGLES  
 TO BE USED FOR COAS  
 SIGHTINGS ARE:  
 R1-00000  
 R2-57470 )

ARE THE DISPLAYED  
 ANGLES CORRECT FOR  
 THE CHOSEN LOS?

.Y .N

KEY IN V24F  
 AND LOAD  
 ANGLES.

KEY IN  
 PROCEED

#90

#100

#110

#120

#130

STORE  
NEW DATA

#140

HOLD  
SNAP

FLASH VERB-TO  
REQUEST PLEASE PER-  
FORM ALTERNATE LOS  
SIGHTING MARK  
V53 N BLANK  
R1-BLANK  
R2-BLANK  
R3-BLANK

MONITOR DSKY:  
OBSERVE VERB  
FLASH TO REQUEST  
PLEASE PERFORM AL-  
TERNATE LOS SIGHTING  
MARK.

#150

WAIT FOR KEYBOARD  
ENTRY

USING THE ROTATIONAL  
HAND CONTROLLER PO-  
SITION THE SPACE-  
CRAFT SO THAT THE  
LM IS PRECISELY  
ALONG THE LOS  
CHOSEN.

#160

KEY IN ENTER

#170

WAS SIGHTING SATIS-  
FACTORY?

#180

.N .Y

#190



TERMINATE FLASH  
UPON RECEIPT  
OF ENTER, V86E  
OR PROCEED

. PROCEED

-----  
KEY IN V86E  
-----

-----  
.V .E .P  
.8 .N .R  
.6 .T .D  
.E .E .C  
. .R .E  
. . .E  
. . .D  
-----

ERASE  
MARK DATA  
IN POSI-  
TION #1  
(IF ANY)

-----  
DO I WISH TO  
MAKE MORE MARKS?  
-----

.Y .N

IS THERE  
MARK DATA  
IN POSI-  
TION #1?

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

.Y .N

.  
. .  
. .  
EXIT  
R23

-----  
TRANSFER  
MARK DATA  
FROM POSI-  
TION #1 TO  
POSITION  
#2  
-----

#200

#210

#220

#230

#240



PURPOSE: (1) TO PROVIDE THE ASTRONAUT PERTINENT ORBITAL PARAMETERS COMPUTED BY THE CMC TO SUPPLEMENT ORBITAL INFORMATION PROVIDED HIM BY THE GROUND.

ASSUMPTIONS: (1) THE COMPUTATIONS MADE DURING THIS ROUTINE ARE UPDATED ABOUT EVERY TWO SECONDS ONLY IF THE AVERAGE G ROUTINE IS ON WHEN THIS ROUTINE IS CALLED.

(2) THE VALUE OF TFF OR TF PER WILL BE MADE TO COUNT DOWN IF THE AVERAGE G ROUTINE IS NOT ON WHEN THIS ROUTINE IS CALLED.

(3) IF TFF IS NOT COMPUTABLE (PER ALT IS GREATER THAN 300,000 FT IN EARTH ORBIT OR GREATER THAN 35,000 FT IN LUNAR ORBIT) THE CMC WILL SET TFF EQUAL TO -59859 AND COMPUTE TF PER AND STORE IT IN N32. THE ASTRONAUT MAY CALL IT BY KEYING IN N32E.

(4) IF THIS ROUTINE IS CALLED WHILE THE EARTH ORBIT INSERTION PROGRAM (P11) IS ON OR WHEN IN CMC IDLE PROGRAM (P00), THE CMC WILL DISPLAY SPLERROR IN N50 BY KEYING IN N50E. IF THE APOGEE IS ABOVE 300,000 FT ALTITUDE AND THE PERIGEE IS BELOW 300,000 FT ALTITUDE ABOVE THE LAUNCH PAD, SPLERROR WILL BE DISPLAYED AS THE DISTANCE BETWEEN THE PREDICTED AND THE DESIRED ABORT TARGET. IF THESE CONDITIONS ARE NOT SATISFIED, SPLERROR WILL BE DISPLAYED AS THE DISTANCE BETWEEN THE PRESENT POSITION VECTOR AND THE DESIRED ABORT TARGET.

(5) REFER TO THE NOUN LIST IN THE BACK OF THIS DOCUMENT FOR DEFINITION OF THE CONTENTS OF NOUNS 32 AND 50.

(6) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG CMC GROUND CREW CHECKLIST TIME TOTAL

.CREW
.ROUTINE
.SELECTION
...
.

START ORBIT PARAMETER..... KEY IN V 82 E
DISPLAY ROUTINE (R30)

#10

IS ANOTHER EXTENDED
VEPB ACTIVE?
N. Y.

#20

+  
+  
+  
+  
+  
+  
+11  
++  
PCN  
586

-----  
TURN ON OPERATOR  
ERRCR LIGHT  
-----

EXIT

-----  
IS AVE G ROUTINE ON?  
-----

.Y     .N

-----  
IS AVE G ROUTINE ON?  
-----

.Y     .N

-----  
SET CMC ASSUMED  
OPTION TO 00001.  
-----

-----  
FLASH VERB-NOUN TO  
REQUEST RESPONSE AND  
DISPLAY OPTION CODE  
FOR ASSUMED VEHICLE  
V04 N12  
R1-00002  
R2-0000X  
R3-BLANK  
-----

-----  
R1 IS THE OPTION  
CODE FOR ASSUMED  
VEHICLE.  
-----  
R2 IS THE CMC ASSUM-  
ED OPTION:  
00001-THE VEHICLE  
00002-OTHER VEHICLE  
-----

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

HOLD  
.....  
SNAP

#30

#40

#50

#60

#70

-----  
IS THE VEHICLE (LM  
OR CSM) ASSUMPTION  
CORRECT?  
-----

.Y .N

-----  
KEY IN PRO-  
CEED  
-----

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

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

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

-----  
STORE CODE  
DATA  
-----

-----  
KEY IN  
V22F  
AND LOAD  
THE  
DESIRED  
VEHICLE  
(LM OR  
CSM)  
CODE IN-  
TO R2.  
-----

-----  
EXTRAPOLATE SELECTED  
VEHICLE STATE VECTOR  
TO PRESENT TIME  
USING PRECISION  
EQUATIONS.  
-----

#80

#90

#100

#110

#120



+ 513  
 +  
 +  
 +  
 +  
 +10  
 ++  
 PCR  
 509

R30/COLOSSUS  
 R30/SUNDANCE  
 R30/LUMINARY

-----  
 . COMPUTE  
 . SPLERROR  
 -----

#180

HOLD . . . . . FLASH VERB-NOUN TO  
 . . . . . REQUEST RESPONSE AND  
 MON . . . . . DISPLAY ORBIT PARA-  
 . . . . . METERS:  
 . . . . . V16 N44  
 . . . . . R1-APO ALT  
 . . . . . R2-PER ALT  
 . . . . . R3-TFF

-----  
 . MONITOR DSKY:  
 . OBSERVE VERB-NOUN  
 . FLASH TO REQUEST  
 . RESPONSE AND DIS-  
 . PLAY OF APO  
 . ALT, PER ALT  
 . AND TFF  
 -----

#190

. . . . . APO ALT-ALTITUDE  
 . . . . . OF APOGEE ABOVE  
 . . . . . THE LAUNCH PAD  
 . . . . . RADIUS (EARTH OR-  
 . . . . . BIT) OR ALTITUDE  
 . . . . . OF THE APOLUNE  
 . . . . . ABOVE THE LUNAR  
 . . . . . RADIUS AT THE MOST  
 . . . . . RECENTLY DEFINED  
 . . . . . LANDING SITE (LUN-  
 . . . . . AR ORBIT). IN NAU-  
 . . . . . TICAL MILES TO  
 . . . . . NEAREST .1 NM.

-----  
 . IS AVERAGE G ROUTINE  
 . ON?  
 -----

#200

. . . . . .N .Y

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

-----  
 . DO I WISH TO  
 . HAVE THE CAL-  
 . CULATIONS RE-  
 . PEATED? (SEE  
 . ASSUMPTION 1)  
 -----

#210

. . . . . .Y .N

#220

R30/COLOSSUS  
 R30/SUNDANCE  
 R30/LUMINARY

TFF-TIME OF FREE  
FALL TO 300,000 FT  
FOR EARTH ORBIT  
OR 35,000 FT FOR  
LUNAR ORBIT.  
ALTITUDE DEFINED  
ABOVE THE LAUNCH  
PAD RADIUS (EARTH  
ORBIT) AND ABOVE  
THE LUNAR RADIUS  
AT THE MOST RECENT-  
LY DEFINED LAND-  
ING SITE (LUNAR  
ORBIT).  
IN MIN, SEC TO  
NEAREST SEC. MAX  
READING IS -59859  
(IF PER ALT  
IS GREATER  
THAN 300,000/  
35,000 FT THE TFF  
DISPLAY WILL READ  
-59859.)

#230

++  
+10  
++  
PCR  
524

NOTE: IF PER ALT OR  
APO ALT EXCEEDS  
SCALE THE DISPLAY  
WILL BE 9999.9 NM.

#250

-----  
WAIT FOR KEYBOARD  
ENTRY

-----  
KEY IN  
RECYCLE  
V32F  
-----

#260

TERMINATE FLASH UPON  
RECEIPT OF PROCEED  
OR RECYCLE

NOTE:  
REFER TO ASSUMP-  
TIONS FOR DEFINI-  
TION OF ADDITIONAL  
DISPLAYS AVAILABLE  
IN THIS ROUTINE.  
WHEN FINISHED WITH  
THIS ROUTINE  
KEY IN PROCEED

#270

-----  
RECYCLE PROCEED  
OR AVE G  
AUTOMATIC  
RECYCLE  
.....

#280



515

.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
EXIT

.  
.  
.  
.  
.  
.  
.  
.  
.  
.  
EXIT

R30/COLOSSUS  
R30/SUNDANCE  
R30/LUMINARY

CHANGE CONTROL NOTES

REV 08 PCR MIT 66  
REV C9 PCR 206  
REV 09 PCR 490  
REV 10 PCR 524  
          PCR 505  
REV 11 PCN 586

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RENDEZVOUS PARAMETER DISPLAY ROUTINE NO 1 (R31)

LOGIC REV 08 11/27/68

PURPOSE: (1) TO DISPLAY AT ASTRONAUT REQUEST CMC CALCULATED RENDEZVOUS PARAMETERS (RANGE, RANGE RATE, THETA)

ASSUMPTIONS: (1) RANGE AND RANGE RATE ARE CALCULATED BY THE CMC ON THE BASIS OF THE STORED LM AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON. THE ISS MUST BE ON AND ALIGNED TO A "KNOWN" ORIENTATION IF A CORRECT DISPLAY OF THETA IS DESIRED. THE RANGE/RANGE RATE/ THETA DISPLAY IS NOT INHIBITED HOWEVER IF THE IMU IS NOT ON AND ALIGNED.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

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

.CRFW  
.ROUTINE  
.SELECTION  
.  
...  
.

-----  
START  
RENDEZVOUS PARAMETER  
DISPLAY ROUTINE (R31)  
-----

-----  
KEY IN V83E  
-----

#10

++  
+08  
+  
+  
+  
+  
+  
+  
+08  
++

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

N. Y.

-----  
TURN ON OPERATOR  
ERROR LIGHT  
-----

#20

PCN  
586

EXIT

#30

R31/COLOSSUS  
R31/SUNDANCE  
R31/LUMINARY

-----  
SET T = PRESENT  
TIME  
-----

-----  
EXTRAPOLATE CSM AND  
LM STATE VECTORS TO  
T USING COASTING  
INTEGRATION ROUTINE.  
-----

.....  
-----  
IS AVERAGE G RUN-  
NING?  
-----

-----  
N Y  
-----  
SET TF = PRESENT  
TIME  
-----

-----  
EXTRAPOLATE LM  
AND CSM STATE  
VECTORS TO TF  
FROM T USING  
KEPLER SUBROUTINE  
-----

-----  
SET TF = AVERAGE  
G TIME.  
-----

#40

#50

#60

#70

#80

519

R31/COLOSSUS  
R31/SUNDANCE  
R31/LUMINARY

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

-----  
. . .  
. . . EXTRAPOLATE LM  
. . . STATE VECTOR TO  
. . . TF FROM T USING  
. . . COASTING INTE-  
. . . GRATION ROUTINE.  
-----

#90

++  
+08  
++  
EDIT

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

#100

-----  
. . .  
. . . CALCULATE RANGE,  
. . . RANGE RATE AND  
. . . THETA  
-----

HOLD  
MON

. . .  
. . .  
. . .

-----  
. . .  
. . . FLASH VERB-NOUN TO  
. . . REQUEST RESPONSE AND  
. . . DISPLAY RENDEZVOUS  
. . . PARAMETERS:  
. . . V16 N54  
. . . R1-RANGE  
. . . R2-RANGE RATE  
. . . R3-THETA  
-----

. . .  
. . . RANGE-CALCULATED  
. . . RANGE TO LM. IN  
. . . NAUTICAL MILES TO  
. . . NEAREST .01 NM.  
-----

. . .  
. . . RANGE RATE-  
. . . CALCULATED RANGE  
. . . RATE BETWEEN CSM AND  
. . . LM. NEGATIVE SIGN  
. . . INDICATES CLOSING  
. . . IN FPS TO NEAREST  
. . . .1 FPS  
-----

-----  
. . .  
. . . MONITOR DSKY:  
. . . OBSERVE VERB-NOUN  
. . . FLASH TO REQUEST  
. . . RESPONSE AND DISPLAY  
. . . OF RENDEZVOUS  
. . . PARAMETERS.  
. . . (NOTE: THESE PARA-  
. . . METERS WILL BE  
. . . UPDATED EVERY TWO  
. . . SECONDS.  
-----

#110

#120

#130

R31/COLOSSUS  
R31/SUNDANCE  
R31/LUMINARY



521

CHANGE CONTROL NOTES

LOGIC REV 5 PCR MIT 66  
REV 6 PCR 495  
REV 7 PCR 511  
REV 8 PCN 586

00203000  
00204000  
00204001  
00204002

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